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Track Lateral Stability

Section 6

Applicability

ARTC Network Wide SMS

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2.6	12 Mar 21	Standards	Stakeholders	Manager Standards	General Manager Technical Standards 15/03/2021

This ARTC CoP has drawn on the Rail Industry Safety and Standards Board (RISSB) National Code of Practice Volume 4, Track and Civil Infrastructure, but is not identical. The ARTC CoP has been subject to Risk Assessment as required by the National Rail Safety Regulator. The results of these risk assessments have made it necessary to deviate from the RISSB CoP in some areas. ARTC maintains traceability of the differences.

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Amendment Record

Amendment Version #	Date Reviewed	Clause	Description of Amendment
2.0	25 Nov 09		Implementation draft of network wide document which is an amalgamation of the CoP for SA/WA & Vic and NSW requirements.
2.1	18 Jun 10		Banner added regarding mandatory requirements in other documents and alternative interpretations.
2.2	08 Nov 11		Banner added regarding elements of RISSB National CoP being incorporated
2.3	29 Jun 12		Terminology adjusted for consistency with AS 7643 and Work Instructions. Some content from Engineering Instructions incorporated. Also minor editorial changes.
2.4	05 Sep 12	6.2.1	Added measurement of stress free temperature as an alternative to monitoring rail creep.
2.5	19 Jul 13	6.3.3	Inclusion of general inspection information removed from ETM-06-06 Managing Track Stability – Concrete Sleepered Track.
2.6	12 Mar 21	6.1	Add General information.
		6.2	Clarification on requirements for Design Stress Free Temperature.
		Various	Editorial and reference updates.

Table of Contents

6 Section 6: Track Lateral Stability

6.1 General

This section applies to tracks constructed on sleepers in open ballasted track with rails which are continuously welded or mechanically jointed. This procedure provides requirements on the management of track stability to ensure the reliability and safety of the track structure throughout the asset lifecycle.

6.1.1 Reference Documents

The following documents support this Standard:

- ARTC CoP Section 1 Rail
- ARTC CoP Section 2 Sleeper and Fastenings
- ARTC CoP Section 4 Ballast
- ARTC CoP Section 5 Track Geometry
- ETM-06-08 Managing Track Stability
- ETM-06-10 Stressing Plain Line CWR
- ETW-06-10 Adjusting Plain Line Jointed Rail

6.1.2 Definitions

The following terms and acronyms are used within this document:

TERM OR ACRONYM	DESCRIPTION
ARTC	Australian Rail Track Corporation Ltd.
Continuously Welded Rail (CWR)	Rail lengths welded end to end into strings greater than 400m without rail joints.
Stress free	Rail which has no axial thermal forces, it is neither in compression nor in tension.
Stress free temperature (SFT)	The temperature at which the rail in CWR is stress free. If the rail were to be cut, the gap created would remain constant. It would neither close nor would it widen unless the rail temperature were to change.
Design SFT (DSFT)	The SFT to which CWR is to be adjusted during stressing. On the ARTC network it is typically 38°C.

6.2 Design

6.2.1 Design Stress Free Temperature in Track with CWR

The design rail stress free temperature is 38°C. Procedures for the stress adjustment of rail to achieve the design stress free temperature must be approved by ARTC. An alternate SFT may be considered in areas prevailing conditions of track features warrant, such as areas of tight curves with consistent track inward pulling.

The following locations have an approved alternate SFT

- 21.249km Belair - 96.000km Murray Bridge - 35°C

New locations shall be approved by Manager Standards.

6.3 Construction and Maintenance

6.3.1 Creep Monitoring Points

6.3.1.1 Timber/Steel Sleepered Track

Tracks welded into CWR should be provided with creep monitoring facilities located at every kilometre and half kilometre post and at other significant points of the track that ARTC considers appropriate.

Where required, monitoring points are to be provided as punch marks on the outer sides of both rail heads and are to be recovered by means of a nail or punch marks in suitable fixtures such as posts or overhead structures on each side of the track in such locations that a check string can be stretched above the rails between the recovery points.

Where creep monuments are not installed, the direct measurement of stress free temperature may be used to monitor the track buckling forces.

6.3.1.2 Concrete Sleepered Track

Track construction types that are known to provide very good resistance to longitudinal rail movement (e.g. CWR track with concrete sleepers and resilient fastenings) will not usually necessitate rail creep monitoring and control measures.

Practices for the measurement of rail creep should be considered and take into account the influence of fixed points in the track.

6.4 Inspection and Assessment

6.4.1 Management of Special Locations

Track sections prone to (i.e. with a history of) lateral track instability or pull-apart failures shall be identified and managed as special locations.

6.4.2 Scheduled Track Lateral Stability Inspections

6.4.2.1 Patrol inspection

The interval between track patrol inspections shall not exceed 7 days in the high temperature season appropriate to the area or as specified otherwise by ARTC e.g. in an approved Technical Maintenance Plan. These inspections shall keep a lookout for defects and conditions (i.e. indicators of a defect) that may affect, or indicate problems with the lateral stability of the track (e.g. evidence of excessive rail creep, degraded ballast conditions, longitudinal sleeper movement) including:

1. Lateral misalignments including "kicks" in tangent track.
2. Curved track sections with sharp or flat curvature.
3. Rail breaks (i.e. excessive local tensile rail stresses contributing to pull-aparts).
4. Indications of incorrect rail stress, for example:
    a. Twists and wriggles in the rail at temperatures well below design stress free, which may indicate the rail is in compression.
    b. (Marks on the rail indicating longitudinal movement of the rail (creep) through the fastening assemblies.
    c. Track movement indicated by for example:
        - Gaps between sleepers and ballast (laterally and longitudinally)
        - Heaped ballast
        - Skewed sleepers
5. Other obvious defects or conditions that may affect lateral track stability.

In addition, track patrol inspections leading up to and during the high temperature season must particularly check curves that:

- Have a history of winter pull-in.
- Have been disturbed by resleepering or resurfacing.
- Appear to have pulled in.

Sections of track with suspected defects that may contribute to inadequate lateral track stability should be subject to general inspection.

The speed at which the inspection is carried out should be consistent with the local conditions and the full scope of the inspection being carried out (e.g. the type and number of other infrastructure elements being inspected).

Particular attention should be paid to conditions at special locations such as fixed points.

6.4.2.2 General inspections

Scheduled general inspections shall be of sufficient detail to observe the track conditions and changes in condition that affect the vulnerability of the track to future high (and low) temperature events.

The inspections should include identification of defects and conditions as described for patrol inspections. They should also determine the condition of the general track structure in terms of its contribution to any reduced lateral strength including for example:

- Poor track geometry;
- Rail, weld and joint misalignment;
- Frozen joints and joint regulation for mechanically jointed track;
- Track structure changes particularly where the interface between two types of track structure may cause a significant change in restraint against rail creep, buckling strength or the temperature stresses induced in the track (e.g. a change from timber sleepers to concrete sleepers, a change in rail size, a change from plain track to a turnout, a change of fastening systems);
- Poor or deficient ballast profile;
- Poorly consolidated ballast;
- Wet and contaminated ballast/formation conditions;
- Generally poor ballast quality (rounded, degraded, broken down);
- Pumping sleepers or other signs of poor track support;
- Poor sleeper/fastening condition;
- Presence of fixed points;
- Recent track maintenance activity;
- Light track structure for alignment and traffic conditions.

General inspections shall be scheduled at an interval appropriate to each location, dependent on its nature and condition, and other seasonal factors but should not exceed twelve (12) months or as specified otherwise in an ARTC approved Technical Maintenance Plan.

General inspections should be supplemented where appropriate by detailed inspections for the measurement of rail stress, or rail movement relative to creep or alignment monuments.

General inspections shall be carried out prior to the high temperature season to enable appropriate actions to be taken (e.g. re-stressing or rail joint adjustment). General inspections carried out for other track infrastructure elements such as ballast, sleepers and fastenings shall also identify work that needs to be carried out to maintain track lateral stability.

Sections of track where reduced lateral stability has been identified shall be nominated and managed as special locations until rectification or strengthening work can be carried out. Detailed inspections may be necessary for this purpose.

6.4.2.2.1 Further Guidelines for General Inspections

Consideration is to be given as to whether the impact on the lateral stability posed at these locations, is due to buckling force or buckling resistance issues. This will impact on the way the location will be assessed, and hence the actions that may be recommended as a result.

- Locations where the “rail out = rail in” process has been undertaken and the balance of steel has been changed and must be listed as defects in the WMS and the location adjusted. This work shall be programmed before the onset of any warmer weather.
- Locations where the rail has been restressed due to track construction, reconditioning or re-railing etc. and still awaiting stress free temperature checks (in accordance with ETM-06-10 and ETM-06-11), will impact on buckling force management and should be scheduled for detailed inspection of stress free temperature.
- Locations where it has been identified that curves have pulled in or where there are indications that longitudinal creep will impact on buckling force management, should be scheduled for detailed inspection of either stress free temperature, curve alignment or creep.
- Locations where the ballast profile is non-compliant with the nominal ballast profile dimensions specified in ARTC Track & Civil Code of Practice Section 4 – Ballast, will impact on buckling resistance management and should be scheduled for rectification.
- Locations where the track has been disturbed by tamping etc. will impact on buckling resistance management and should be closely monitored or protected by TSR until a minimum 100,000 tonnes have passed over to consolidate it. Alternatively, the ballast should be compacted with a shoulder ballast compaction machine. Even after consolidation, these locations are still to be monitored during hot weather inspections until the end of the high temperature season.
- All special locations are to be assessed during the scheduled inspections to determine if there are additional conditions present that will increase that locations vulnerability to instability.

  Attention is to be paid to potential localised initiators, such as:

  - Poor rail/weld alignment arising from incorrect crowing, rail end alignment, poor rail profile matching, straight closures in curves, track alignment (including gauge), and glued insulated joints;
  - Rail surface and track geometry defects including poor top, twists, dipped welds, wheel burns and corrugations, and pumping sleepers;
  - Rail bunching at fixed points, i.e. bridges, turnouts and level crossings;
  - Rail bunching due to trains stopping at signals, or to changes in grade;
  - Loose/failed fastening assemblies with reduced toe load, causing rail creep; and
  - Local disturbances due to under-track crossings, bridges or culverts.

  Particular attention must be paid to those locations on curves less than 400m radius, as tight radius curves have higher buckling risk.

6.4.3 Un-scheduled Track Lateral Stability Inspection

6.4.3.1.1 Very hot weather inspections

Particular attention shall be paid to special locations such as [see Note 1]:

- Those nominated from general inspections;
- Those with a history of temperature induced track misalignments; or
- Where there is reduced track resistance to buckling, for example areas where maintenance of the track may have significantly disturbed ballast consolidation (e.g. slewing, ballast cleaning, construction).

At these locations rail temperature should be treated as a defined event until rectification or strengthening work is carried out. Ambient air temperature limits [see Note 3] should be set at the rail temperature which is estimated to be the minimum requiring an un-scheduled patrol inspection to be carried out. Standing or temporary operating restrictions may also be appropriate for some track structures and conditions at some locations.

Very hot weather inspections should keep a lookout for defects and conditions including those defined in Clause 6.3.2 and be carried out as near as possible to the time of the peak temperature for the day. Consideration should be given to the following:

- The need for additional patrol inspections on any given day prior to or following the onset of the peak temperature.
- Unscheduled very hot weather patrol inspections on days where the forecast temperature is significantly in excess of any daily temperature recorded since the last cool season [see Note 4].
- Patrol inspections may also be necessary at times of extreme low temperatures in areas prone to pull-aparts (break-aways), curve pull-ins and mechanical joint failures. Such special locations should be treated in a similar way to buckle prone sections of track.

Notes:

1. *A patrol inspection or a general inspection may be carried out in response to a defined temperature event, but it will usually be a patrol inspection in the first instance. Sections of track with suspected defects identified from any patrol inspection should be further inspected by a general inspection.*
2. *Special locations may extend over significant lengths of track particularly in the early part of the high temperature season.*
3. *The temperatures that trigger very hot weather patrol inspections, and the special locations requiring them should be reviewed as the high temperature season progresses. For example, consideration may be given to increasing the temperature limit as the high temperature season progresses.*
4. *It should be noted that often a significant number of track kinks and buckles occur in the earlier part of the high temperature season where temperatures have risen significantly but may not have reached the expected maximum for the season. Advantage should be taken of such situations to help identify areas that may be more prone to track buckling.*

6.4.3.1.2 General Unscheduled Inspections

These inspections shall be carried out to confirm the presence of suspected defects identified from track patrol inspections or in response to reported track buckles, track shift or rail pull-apart defects (e.g. by drivers, train controllers where track circuits indicate rail failure, or from high temperature patrol inspections) to allow actions to be determined. The condition of the general track structure shall be determined in terms of its contribution to the track lateral stability. Sections of track with identified reduced lateral stability shall be recorded and managed as special locations until rectification or strengthening work can be carried out. Detailed inspections may be necessary for this purpose.

Traffic may need to be restricted until the suspected defect or failure is inspected and the necessary actions assessed.

6.4.4 Assessment and Actions

Following inspections, including those following a defined event, the track shall be assessed to verify its capacity to provide adequate lateral stability. Where it is considered the track is inadequate, actions shall be determined to manage the risk. This shall occur at special locations prone to track lateral stability failure, where significant changes in the condition of the track have been identified (i.e. its ability to deal with events up to the defined event shall be assessed).

Track elements and conditions affecting lateral track stability should be controlled in accordance with the practices described in the following sections of this document:

Stress control of rail	Section 1
Sleepers/fastening assemblies	Section 2
Ballast profile	Section 4
Track geometry	Section 5

Rail stress assessment and, if necessary, adjustment should be carried out when one of the following occurs:

- Track buckle or significant heat misalignment.
- Mechanical joint failure.
- Identification of excessive creep.

Where such defects and failures are detected the operation of trains should, as a minimum, be consistent with the guidelines for defects detailed in other Sections of this Code. Trains should be piloted through the site where necessary, taking into account factors including the following:

- Clearances with respect to structures and other running lines.
- Track support conditions, in particular where the track has shifted.
- Track geometry.