



WE'LL TAKE YOU THERE / NOMA KANJANI

MANUAL FOR TRACK MAINTENANCE (2000)

METRORAIL

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CHAPTER 1

THE PURPOSE OF THIS MANUAL, IT'S APPLICATION AND ASSOCIATED PUBLICATIONS TO BE READ IN CONJUNCTION HEREWITH

1.1 PURPOSE OF THE MANUAL

This manual describes the responsibilities of all track maintenance personnel and is issued for their guidance. It supersedes the Permanent Way Instructions issued in 1984.

1.2 APPLICATION OF THE MANUAL

1.2.1 Track personnel who are supplied with copies of this manual must acquaint themselves with it and act in accordance with the manual in so far as it concerns them. They must ensure that their copy is updated with any amendments that may be issued from time to time.

1.2.2 except where provision is made for the contrary, this manual must be read in conjunction with, and not in lieu of the publications listed in **clause 1.3**.

1.3 ASSOCIATED PUBLICATIONS

Track personnel must be in possession of the publications listed hereunder (together with any amendments which may be issued), have knowledge of their contents and act in accordance therewith.

- Manual for Track Maintenance
- Train Working Rules
- General Appendix (parts I and II)/General Train Working Rules
- Construction Standards for Private Sidings (part B)
- Track data and curve lists
- Lists of structures, bridges and culverts, tunnels, level crossings and fouling points in relation to Track Structure gauge
- Safety Guidelines for Infrastructure
- Electrical Safety Instructions
- Latest updated section 53 'Perway Material/Price list'
- Applicable operating notices
- Manual for Managing Track Material, Tools and Equipment
- Applicable work codes and decision models/guidelines.
- Protection Manual
- Work Code for Fire Prevention
- Manual for Contingency Plan for Accidents/Derailments.
- Quick Reference for Building of Turnouts.
- Signing of Railway Crossings, chapter 7, SARTSM, Vol2
- Work Code for the Maintenance of Block joints.
- Specification for Track Welding.

CHAPTER 2

THE GOAL AND PERFORMANCE OBJECTIVES FOR TRACK MAINTENANCE. SPECIFIC AND GENERAL RESPONSIBILITIES OF MAINTENANCE PERSONNEL WITH RESPECT TO THE TRACK INFRASTRUCTURE

2.1 THE GOAL FOR TRACK MAINTENANCE

The goal for track maintenance is to strive for the most economical but safe balance between resource input, track condition and required levels of operational readiness.

2.2 THE PERFORMANCE OBJECTIVES FOR TRACK MAINTENANCE

- 2.2.1 Track personnel must ensure that railway lines and associated works are always maintained to a standard, which is safe for the passage of trains.
- 2.2.2 Employees must always regard the safety of the public, goods in transit and the safety and health of other employees as the first consideration.
- 2.2.3 Employees must not expose themselves to danger and must prevent other employees from exposing themselves and others to danger.
- 2.2.4 Service level agreements between Infrastructure-Maintenance, Service Execution and Service Planning must be met.
- 2.2.5 To continually strive for improved productivity to ensure an effectively and efficiently maintained rail network.
- 2.2.6 All departments involved must work together so as to ensure the long-term viability of the track infrastructure and associated works. Care must always be taken to ensure that over or under maintenance of the track structure does not take place.
- 2.2.7 Infrastructure-Maintenance teams must have regular communication with traffic controllers each day, in order to minimise delays to trains

2.3 RESPONSIBILITIES OF THE CHIEF ENGINEER (PERMANENT WAY AND STRUCTURES)

The Chief Engineer is responsible for

- 2.3.1 the long term viability of the track infrastructure and associated works,
- 2.3.2 maintaining and expanding the pool of knowledge and expertise,
- 2.3.3 ensuring that personnel are competent to perform their duties,
- 2.3.4 formulating policy and initiating strategies to meet objectives and taking corrective action when required,
- 2.3.5 performing certain services in respect of training, research and development, material, on-track machines and structures and
- 2.3.6 ensuring that the requirements of applicable legislation are complied with.

2.4 RESPONSIBILITIES OF THE INFRASTRUCTURE MANAGER

The Infrastructure Manager is responsible for:

- 2.4.1 determining and negotiating for required resources,
- 2.4.2 improving productivity on an ongoing basis,
- 2.4.3 monitoring safety and the quality of service continually and for initiating corrective actions,
- 2.4.4 identifying and utilising excess capacity,
- 2.4.5 ensuring that contingency planning has been done and will function smoothly if required,
- 2.4.6 ensuring that Regional Engineer is competent to perform his duties and
- 2.4.7 ensuring that the requirements of applicable legislation are complied with.

2.5 RESPONSIBILITIES OF THE REGIONAL ENGINEER (PERMANENT WAY AND STRUCTURES)

The Regional Engineer is responsible for

- 2.5.1 the safe passage of trains, the safety of the public as well as the safety and health of his personnel,
- 2.5.2 the quality of service and ensuring that all agreements in this regard are complied with,
- 2.5.3 the effective management of all maintenance activities and resources,
- 2.5.4 maintaining and operating reliable systems,
- 2.5.5 ensuring that adequate resources are available for all aspects of track maintenance including call-out and emergency procedures,
- 2.5.6 carrying out prescribed inspections,
- 2.5.7 ensuring that work is properly managed and undertaken in accordance with the relevant work codes and
- 2.5.8 ensuring that formal and on the job training takes place and that the requirements of applicable legislation are complied with.

2.6 RESPONSIBILITIES OF THE SECTION TRACK INSPECTOR

The Section Track Inspector focuses on the planning of track maintenance and is responsible for:

- 2.6.1 the safe passage of trains, the safety of the public as well as the safety and health of his personnel,
- 2.6.2 the effective maintenance of the track and associated works on his section,
- 2.6.3 inspections and the use of approved systems to plan, schedule and control all work and

- 2.6.4 ensuring that the requirements of applicable legislation are complied with.

2.7 RESPONSIBILITIES OF TRACK PERSONNEL IN CHARGE OF CONTRACT RELATED ACTIVITIES (See chapter 20)

The person in charge of the work site (Track master or Track inspector) is responsible for

- 2.7.1 the safe passage of trains, the safety of the public as well as the safety and health of his personnel at the work site,
- 2.7.2 ensuring that contractors comply with relevant safety measures and instructs their personnel accordingly,
- 2.7.3 ensuring that work codes are complied with,
- 2.7.4 ensuring that contract conditions are adhered to,
- 2.7.5 ensuring that resources are used efficiently,
- 2.7.6 ensuring that the quality of service is maintained and
- 2.7.7 that the requirements of applicable legislation are complied with.

2.8 RESPONSIBILITIES OF TRACK MANAGER

The Track Manager is responsible for

- 2.8.1 the safe passage of trains, the safety of the public and for the safety and health of his personnel at work sites,
- 2.8.2 using approved systems to manage all his work,
- 2.8.3 the efficient use of resources and
- 2.8.4 ensuring that all completed work complies with accepted norms and standards.
- 2.8.5 ensuring that the personnel under his control receive the necessary practical training in the correct use of and the efficient handling of material, tools and equipment. He must ensure that they are developed, coached and that they acquire sound experience in all aspects of track maintenance work,
- 2.8.6 performing any other duties assigned to him and
- 2.8.7 ensuring that the requirements of applicable legislation are complied with.

2.9 RESPONSIBILITIES OF THE ENGINEERING TECHNICIAN

The Engineering Technician is responsible for

- 2.9.1 performing all the duties assigned to him from time to time,
- 2.9.2 assisting with the improvement of the tools for the management of track maintenance,
- 2.9.3 assisting the Section Track Inspectors with the planning, scheduling and controlling processes of track maintenance,
- 2.9.4 assisting the Regional Engineer with the collection and processing of data
- 2.9.5 assisting in the determination of the long-term resource requirements.

2.10 RESPONSIBILITIES OF THE TRACK MASTER

Within his work area the Track master is responsible for:

- 2.10.1 the safe passage of trains, the safety of the public and for the safety and health of his personnel at the work site,
- 2.10.2 performing repair work in accordance with specific procedures and standards,
- 2.10.3 communicating regularly each day with Traffic controllers and his controlling office,
- 2.10.4 the efficient use of resources,
- 2.10.5 ensuring that the requirements of applicable legislation are complied with and
- 2.10.6 any additional duties assigned to him.

2.11 RESPONSIBILITIES OF THE TRACK WELDER

Within his work area the Track welder is responsible for

- 2.11.1 the safe passage of trains, the safety of the public and for the safety and health of his personnel at the work site,
- 2.11.2 performing work in accordance with specific procedures and standards,
- 2.11.3 the efficient use of resources,
- 2.11.4 ensuring that the requirements of applicable legislation are complied with and
- 2.11.5 performing any other duties assigned to him.

2.12 RESPONSIBILITIES OF THE TECHNICAL SUPERVISOR (WELDING)

Within their work area the Technical Supervisor (Welding) focuses on the execution of track welding and is responsible for:

- 2.12.1 the safe passage of trains, the safety of the public, and for the safety and health of their personnel at the work site,
- 2.12.2 using approved systems to manage all their work,
- 2.12.3 the efficient use of resources,
- 2.12.4 ensuring compliance with specific procedures and standards,
- 2.12.5 ensuring that material, tools and equipment are neatly kept and that the appropriate records are kept,
- 2.12.6 ensuring that the personnel under their control receive the necessary practical training in the correct use of and the efficient handling of material, tools and equipment and to help them in obtaining a comprehensive practical knowledge of track maintenance work.
- 2.12.7 ensuring that the requirements of applicable legislation are complied with.

2.13 RESPONSIBILITIES OF THE TRACK MANAGER AND THE TECHNICAL MANAGER (WELDING) IN THE HEAD OFFICE (See chapter 20)

The Track Manager and the Technical Manager (Welding) of the head office are responsible for

- 2.13.1 training, coaching and for transferring their knowledge and expertise to all involved in track maintenance work.
- 2.13.2 ensuring that formal and on the job training of personnel conforms to requirements and
- 2.13.3 ensuring that the requirements of applicable legislation are complied with.

2.14 GENERAL RESPONSIBILITIES OF INFRASTRUCTURE-MAINTENANCE PERSONNEL

2.14.1 Protection of trains and safeguarding of employees

- 2.14.1.1 Where protection of Infrastructure-Maintenance teams at work sites overlaps, all the parties involved must agree beforehand upon a Person in Control for the extended work site, who will be responsible for the protection arrangements in terms of the Protection Agreement. The supervisors involved must ensure that all personnel under their control are aware of the applicable protection arrangements at the extended work site.
- 2.14.1.2 Protection duties may only be undertaken by an employee who has been certified competent by an officially authorised competent person.
- 2.14.1.3 The names of employees competent to perform protection duties must be kept on record.

- 2.14.1.4 The Person in Control must ensure that work teams are adequately safeguarded. Special care must be taken when safeguarding work teams working in busy station yards, on curved tracks, in cuttings, on multiple tracks or where the view is restricted. Where work teams are working close to mechanised equipment, they must be warned of the approach of a train by means of a hooter, siren or other device, the sound of which must be audible above the noise of the machines.
- 2.14.1.5 When the track is not safe for the passage of trains the Person in Control must instruct the hand-signalman regarding the warning to be given to train drivers.
- 2.14.1.6 When the track is not safe for the passage of trains at normal speed, the Person in Control must instruct the hand-signalman regarding the warning to be given to train drivers.
- 2.14.1.7 In the event of maintenance work being done to or adjacent to the track and the safety of passing trains and/or personnel and equipment could be affected, the Person in Control must instruct the hand-signalman regarding the warning to be given to train drivers.
- 2.14.1.8 The Person in Control must show the hand-signalman where hand signals must be displayed and where detonators must be placed and he must ensure that the protection complies with the approved protection procedures.
- 2.14.1.9 When work on or adjacent to the track can affect the safety of trains, occupation of the track must be taken by the Track inspector or Track master.
- 2.14.2 Detonators
- 2.14.2.1 Under no circumstances may tests of detonators be arranged or undertaken by unauthorised persons.
- 2.14.2.2 In the event of a detonator failing to detonate when a rail vehicle moves over it at an estimated speed of 10 km/h or higher, a detailed report must be submitted to the Regional Engineer's office. This report must be submitted together with the defective detonator as well as the remaining detonators in the original container from which the defective one was taken.
- 2.14.2.3 Reports must include the type and estimated speed of the vehicle as well as track and weather conditions.
- 2.14.2.4 Where detonators are placed on the track, the person responsible must ensure that nobody comes within a 3m radius of the detonators.
- 2.14.2.5 Detonators may not be placed less than one metre from a block joint.
- 2.14.3 Safety precautions
- 2.14.3.1 Track personnel must take precautions to safeguard life and to protect property when working or handling equipment or material.
- 2.14.3.2 Track personnel are not allowed to have pets with them when they are on duty.
- 2.14.3.3 Highly visible clothing, reflective braces and/or other approved identification garments must be worn by patrolmen, hand-signalman, and all personnel that work alone on or alongside the track.

2.14.4 Safety precautions in stations and yards

2.14.4.1 On completion of the day's work, any tracks in a station or shunting yard which have not yet been filled in and the ballast levelled off or where released material has not yet been removed or where new material has been unloaded but not yet installed into the track, the Track master must advise the traffic controller or controlling office accordingly. In the interests of safety of yard officials and other employees, the Track master must, where required, provide white lights to indicate the obstruction.

2.14.4.2 When working at stations, crossing loops, inter sidings or private sidings, track teams must examine the points in the normal and reversed positions. The crossings, point's locks and bridles must also be examined. After the examination has been completed, care must be taken that the points are locked in the normal position.

2.14.5 Call outs

The Track master is responsible for attending promptly to defects communicated to him for repair via the Infrastructure-Maintenance fault control system. These faults can be reported by train drivers, track, signal or electrification personnel, the train control centre/traffic controllers, contractors, public etc.

2.14.6 Breaking of the line

Before breaking a line for alterations or repairs, the Track master must have authorisation for occupation of the track and must consult with the traffic controller in charge at each end of the section affected, the official in charge of the station/yard or the traffic controller in the train control centre, as the case may be. All relevant safety precautions required must be observed.

2.14.7 Breaking of track circuits

2.14.7.1 On electrified sections and/or where there are track circuits, a line must not be broken for alterations or repairs unless an authorised representative of Electrical and/or Signals is present or has been consulted. See clause 13.6.4.

2.14.7.2 Any two rails of a line which are track-circuited must not be short circuited, i.e. connected with metal objects such as track gauges, steel tapes or slewing bars.

2.14.8 Accidents and obstructions

2.14.8.1 Any accidents, irregularities or defects observed (of the track, passing trains, the signalling equipment or overhead track equipment) which are likely to interfere with the safe running of trains, must be reported immediately to the train control centre/traffic controller. The train control centre/traffic controller must ensure that the defect is reported to the official fault control system of Infrastructure-Maintenance. The person on duty at the official fault control system of Infrastructure-Maintenance must ensure that the appropriate Infrastructure-Maintenance teams are called out for the maintenance work. If telephone communication fails, the arrival of the first train must be awaited and the problem reported to the driver. If a Track master/Track inspector/Track manager is present then such person must instruct the driver of the actions to be taken. The driver will decide on the best course of action if none of these persons are available. Everything possible must be done to stop trains where immediate danger exists.

- 2.14.8.2 Track gangs must proceed promptly to the scene of the accident or obstruction and take the following actions:
- 2.14.8.2.1 Provide protection in accordance with the Protection Manual irrespective of any protection measures which may have already been provided by others. This must be maintained until the work is completed or alternative arrangements are implemented by the Person in Control.
 - 2.14.8.2.2 The Person in Control must ensure that correct protection is maintained until he is sure that the line can be re-opened to traffic.
 - 2.14.8.2.3 All lines that are not safe for the passage of trains must be protected on those sides of the obstruction from where a train might be expected.
 - 2.14.8.2.4 Track personnel may not interfere with, or give instructions or advice to a member of another department who is affording protection.
- 2.14.8.3 The primary object after an accident is to assist the injured and to get the train service back to normal as quickly as possible. Track personnel must assist wherever it may be necessary, in order to expedite repairs to the track so that normal working may be resumed as soon as possible. They are not to be used as a source of labour for other departments, especially if expeditious repairs to the track may be adversely affected.
- 2.14.8.4 The Track master must restore or assist in restoring normal working as soon as possible and report full particulars of the incident and of any additional assistance or material which may be required in order to re-open the line.
- 2.14.8.5 A **G140** form must be submitted after all accidents involving trains. A **T458** form must be submitted after any accident other than:
- a head-on, rear-end or side-on collision
 - an accident due to an obstruction
 - where a stopblock was hit or a train ran through a set's points or a wheel tyre/broken axle caused the accident
- and there is agreement, amongst all parties involved on site, that the track condition did not contribute to the cause of the accident. The exact cause of the accident must be determined on site, by consensus amongst all the parties involved. This information may not however be communicated to anybody outside Transnet.
- The most senior member of the track personnel present must ensure that the track measurements necessary to complete the **T458** form are taken before any work is done on the track. The form must be signed by every person who has a share in completing it.
- 2.14.8.6 When vehicles are to be re-railed by pulling or propelling, the Track master must take precautions to protect the track against avoidable damage.
- 2.14.8.7 When trucks conveying explosives or dangerous goods are involved in an accident, the Track master must not unload or interfere with these trucks except as instructed in writing by the responsible senior officer or his deputy. The responsible senior officer must decide as to the best and most effective action to be taken in accordance with instructions relating to the safe handling of explosive materials involved in accidents.

- 2.14.8.8 Once damage to the track is repaired and it is safe for the passage of trains (at normal or restricted speed), the person in control of repair work (Track master, Track inspector or Track manager) must advise the traffic controller at one of the adjacent stations or, if applicable, the train control centre/Traffic controller, accordingly.
- 2.14.8.9 Official inquiries into accidents must be conducted as set out in **Circular A.10-1**.
- 2.14.8.10 In the case of animals injured or killed by trains, the Track master must remove them from the track to a safe distance outside the structure gauge. If the owner(s) is/are known and reasonably available, he/they must be asked to take further responsibility and to remove the animal(s)/carcasses. In all other instances the personnel of Infrastructure-Maintenance must take care and dispose of the animal(s) in accordance with locally prescribed procedures. Any maintenance work that might be required on the track must be done and the track certified safe for the passage of trains.
- 2.14.8.10 The Track master must complete and sign form T502/SPOORNET410 and forward it to the Regional Engineer's office. This form must be completed only insofar as the apparent or known information is on hand at the place where the incident occurred and at the time of clearing the track.
- 2.14.8.11 Other Infrastructure-Maintenance work required at or in the vicinity where the incident occurred, e.g. repairs to fences, must be reported immediately to Infrastructure fault control.
- 2.14.8.12 Infrastructure fault control will arrange for all further maintenance work to be undertaken and for any subsequent investigations, administrative matters or claims procedures which may be required. The Track master shall, if called upon to do so, pass on any helpful information to these parties.
- 2.14.9 Reporting of track defects
- 2.14.9.1 Track defects that may affect the safe running of trains must be reported immediately to the train control centre/traffic controller as well as through the official fault control system of Infrastructure-Maintenance. Everything possible must be done to stop trains where immediate danger exists.
- 2.14.9.2 Track defects which do not affect the immediate safe running of trains, but which if left unattended could further deteriorate and present a danger to rail traffic over the short or medium term, must be reported to the Regional Engineer's organisation for purposes of planning of maintenance.
- 2.14.9.3 The person on duty at the fault control system of Infrastructure-Maintenance will ensure that Infrastructure-Maintenance personnel are contacted to undertake maintenance action.
- 2.14.9.4 The Track master must, at least three times every day (before starting work, at approximately midday and 15h00) establish if any track defects have been reported at the infrastructure fault control system. As soon as defects have been repaired, the Track master must notify the relevant party and advise him of the exact kilometre point where the defect was repaired as well as the nature of the repair work and the time it was done as well as further actions required.

2.14.9.5 Any deviation from **clauses 2.14.9.1 to 2.14.9.4** must be recorded in **Chapter 20**.

2.14.10 Goods found next to the track

2.14.10.1 Any luggage, goods or equipment observed on Transnet property must be reported to the nearest Client Service Centre who will arrange for the articles to be picked up. Details of time and place where luggage or goods were observed must be given.

2.14.10.2 When approaching or handling any luggage, goods or equipment found on Transnet or SARCC property, the instructions set out in the Hazardous Materials Handbooks, must be observed and applied. See also Clause 2.14.15.

2.14.10.3 When approaching or handling asbestos found on Transnet or SARCC property, the instructions as outlined in the Spoornet Procedure for Handling of Asbestos, must be adhered to.

2.14.11 Taking over a length

2.14.11.1 When a Track inspector or a Track master takes over a section, he should be shown over the length by his predecessor.

2.14.11.2 Places requiring attention must be pointed out and details of the current programme of maintenance work must be given.

2.14.11.3 The Track inspector or Track master must systematically examine every feature of the track so that he may become familiar with the types, quantities and condition of the track materials and with the types and condition of bridges and culverts and other structures. He must acquaint himself with the physical features of his section.

2.14.11.4 He must check the stock of track material, tools and equipment. Any shortages must be reported to the controlling office.

2.14.12 Possession of a reliable watch

The Track master and the Track inspector must be in possession of reliable watches and must periodically check that their watches show the correct time.

2.14.13 Communication means

The Track master and the Track inspector must be in possession of effective communication means for contacting the train control centre/traffic controller and their controlling office. Cellphone charges are expensive and discretion must be exercised when making calls.

2.14.14 Absence from section

Before leaving his place of residence outside working hours, the standby Track master/Track inspector must advise his controlling officer, who will then be responsible for making the necessary relief arrangements.

2.14.15 Dangerous substances

2.14.15.1 Dangerous substances being transported are identified by a sign in the form of a diamond. The colour of the sign indicates the substance and action(s) to be taken in case of an emergency:

2.14.15.2 Orange indicates explosives and that the area must be evacuated to a safe distance.

- 2.14.15.3 Green indicates compressed gas and that the area must be evacuated to a safe distance and that confined spaces are to be avoided.
- 2.14.15.4 Red indicates flammable substances and that evacuation to at least a distance of 500m is required if burning should occur.
- 2.14.15.5 White indicates poison and that contact must be avoided and that the gas must not be inhaled.
- 2.14.15.6 Black and white indicates corrosive substances and that contact must be avoided.
- 2.14.15.7 Blue indicates that the substance is dangerous when wet, is flammable and must be stayed clear of.
- 2.14.15.8 Yellow indicates oxidisers, which may be flammable and must be avoided.
- 2.14.15.9 Yellow and white indicates that the substance is radioactive and that no persons must come within 40m of the substance.

CHAPTER 3

EARTHWORKS, THE FORMATION, DRAINAGE, TUNNELS, BRIDGES, CULVERTS AND TEMPORARY TRACK SUPPORTS

3.1 INSPECTION

The inspection of earthworks, the formation, drainage, tunnels, bridges and culverts as well as temporary track supports must be carried out as set out in **clauses 4.1.5 and 4.1.6**.

3.2 EARTHWORKS

3.2.1 Banks and cuttings must be observed for cracks, landslides and rock falls.

3.2.2 Excavations must be carried out to safe batters. Shoring must be provided if it is impractical to work to safe batters. Shoring must always be provided in trenches and similar restricted excavations where the depth exceeds 1,5m, except when the presence of homogeneous solid rock causes the excavations to be absolutely safe without shoring.

3.2.3 Where excavations are carried out in soft material and the vibration of passing trains may cause caving in of earth, safety precautions must be taken and a temporary speed restriction imposed if necessary.

3.2.4 The formation must be maintained at the width and shape shown in **Annexure 4**.

3.2.5 When embankments are being constructed, material must not foul the structure gauge or obstruct the drainage.

3.2.6 Material to be used and the method of compacting must be approved by the Regional Engineer.

3.2.7 Borrow pits must be made on the lower side of the track if practical. The top of the borrow pit must be at least 3m from the toe of an embankment or from the boundary line, and the borrow pit wall must have a batter. Borrow pits must be drained and fenced if necessary.

3.3 THE FORMATION

3.3.1 A dry formation is a pre-requisite for a stable track structure.

3.3.2 Storm and ground water must be quickly and effectively drained away from the formation.

3.3.3 Competent guidance is required when repairs to the formation are undertaken.

3.4 DRAINAGE

3.4.1 All drains must be kept clean to allow water to flow freely.

3.4.2 Vegetation must not be removed from drains on steep inclines unless precautions are taken to prevent erosion.

3.4.3 Steps provided on slopes of banks and cuttings to gain access to the formation must not interfere with drainage.

- 3.4.4 Drains and catchwater mounds must be built to divert stormwater where necessary. The Regional Engineer must give his approval before work is started.
- 3.4.5 The top edge of a catchwater drain or the toe of a catchwater mound must, if possible, be at least 3m from the boundary of the right of way.
- 3.4.6 Material excavated from catchwater drains must be deposited on the low side of drains to increase the effective depth of the drains.
- 3.4.7 The Regional Engineer must be advised if SARCC's property might be affected where:
 - 3.4.7.1 storm-water from adjoining land has been diverted from its natural course
 - 3.4.7.2 new drains are being constructed
 - 3.4.7.3 dams are being constructed that could cause erosion or flooding
 - 3.4.7.4 soil erosion is taking place on adjoining land
 - 3.4.7.5 stormwater run-off is increasing.

3.5 TUNNELS

- 3.5.1 When working in tunnels particular care must be taken, because of the dangers involved, to adequately safeguard all personnel. Adequate lighting is essential.
- 3.5.2 Interiors of refuges and a 1m surround must be painted white.
- 3.5.3 Attention must be given to the drainage of tunnels and approach cuttings. Any obstruction in the drains must be removed.
- 3.5.4 In tunnels with ballasted track, reference pegs must be inserted at 20m intervals in both walls, so that a line, which is stretched over the tops of the pegs, will touch both rails when the track is at the correct level and cant. A list of offsets from the ends of the pegs to the track centre line must be supplied. The track must be lifted and aligned in accordance with these reference marks.
- 3.5.5 In the case of tunnels longer than 1000m, the letter 'P' must be painted with white paint on a black background at both tunnel portals. This must be clearly visible to indicate that protection may be encountered within that tunnel at the protection distance. These letters must be 600mm high by 400mm wide, positioned at a height of 2500mm above rail level.

3.6 BRIDGES AND CULVERTS

- 3.6.1 Track personnel must look out for the following defects:
 - 3.6.1.1 Scour under piers or abutments and at inlets and outlets of culverts.
 - 3.6.1.2 Structural damage, cracks, loose rivets or bolts, corrosion and movement of bedplates.
 - 3.6.1.3 Loose or ineffective handrails and/or walkways and where bridge or culvert openings are inadequate.
- 3.6.2 See **clauses 6.7.2** and **6.9.3** for laying of rails on unballasted bridges.

- 3.6.3 Safety rails, shown in **Annexure 6**, must be provided on unballasted bridges longer than 10m. In other cases the Regional Engineer will decide whether they are necessary. Each safety rail must be fastened by two coach screws to every sleeper.
- 3.6.4 Only approved sleepers may be used on unballasted bridges. Sleeper spacing may not be more than 610mm.
- 3.6.5 The distance between the centre lines of the sleepers behind and in front of ballast walls must not be more than 700mm. Cases where this is not possible must be reported to the Regional Engineer. He will arrange for the rails to be supported directly on the ballast walls, in accordance with **drawing BE 75-22**.
- 3.6.6 The Regional Engineer must be advised where it is necessary to adjust cant or to eliminate camber on bridges. Loose plates or tapered sleepers must not be used, nor may the track be raised by placing sleepers on top of one another.
- 3.6.7 Fastening of sleepers on bridges must be in accordance with **Annexure 8**.
- 3.6.8 Parapets, ballast walls, copings and handrails on bridges and culverts, in areas where shunting is done, must be painted white.
- 3.6.9 Competent guidance is required when steelwork is repaired and painted.
- 3.6.10 Culvert entrances and outlets must be cleaned annually before the onset of summer rains (or winter rains in the Western Cape) of all shrubs, bushes and trees to allow for an unrestricted flow of water through the culvert opening.
- 3.6.11 When constructing a maintenance road through a culvert opening it must be done in such a manner so as not to restrict the flow of water during sudden down pours.

3.7 TEMPORARY TRACK SUPPORTS

- 3.7.1 Should a line require temporary support, this can be provided by sleeper cribs, steel bridging cribs, trestles or rail girders. Details are shown in **Annexure 7**.
- 3.7.2 A speed restriction of 15 km/h must be imposed on a track with temporary supports.
- 3.7.3 Temporary track supports must be inspected at frequent intervals. All fastenings must be kept tight.
- 3.7.4 Rail girders
 - 3.7.4.1 The track must be fitted with wood sleepers, placed at 600mm centres.
 - 3.7.4.2 Top-rail girders are used principally when excavations are to be made under open lines. Bolts and rail girder clamps must not project above the top of the running rails. Girders must be laid on sleeper cribs.
 - 3.7.4.3 Bottom-rail girders are principally used in emergencies. They are built on top of sleeper or bridging cribs and provide a working platform on which a new track can be built.

3.7.5 Cribs

- 3.7.5.1 All sleepers must be sound, square and straight. Wood wedges must be used to eliminate any movement. Wedges must be anchored.
- 3.7.5.2 The bottom layer of sleepers in cribs must be close-laid and parallel to the track centre line.
- 3.7.5.3 Rails used with double stack cribs must have the same height (size) and must be sound and free of defects.

CHAPTER 4

INSPECTIONS AND TRACK GEOMETRY

4.1 Inspections general

Inspections of the track and associated infrastructure are used as a safety measure and also to determine the annual and long-term workload.

The responsibilities of individual track maintenance personnel are to ensure that:

- inspections are carried out by competent personnel, at the required frequencies, and in accordance with the available work codes.
- written inspection reports are prepared and systems are used to ensure action is taken and appropriate records are kept. It must be seen against the specific and general responsibilities described in chapter 2 and elsewhere in this manual.

4.1.1 Patrolling

4.1.1.1 Each region's patrolling process must be submitted to and approved by the Chief Engineer and recorded in **chapter 20**.

4.1.1.2 The Section Track Inspector must ensure that the approved process of patrolling and defect reporting is carried out.

4.1.1.3 If a track defect or damage to the track, which may affect the safety of trains, is observed, patrolling must be abandoned and protection afforded according to laid down instructions, first on the side from which the first train is expected and then on the other side. The defect/damage must be reported in accordance with clause 2.14.8. and 2.14.9.

4.1.1.4 In addition to telephonically reporting defects or damage in accordance with **clause 4.1.1.3**, a report must be submitted to the Regional Engineer's organisation, recording information gathered for each day on which patrolling was done. This report must be used as an input for planning track maintenance work.

4.1.1.5 During stormy weather, special patrols must be carried out to ensure that the track, earthworks, formation, drainage and associated structures remain safe for the passage of trains. The maximum flood water level must be recorded (on both sides of the track) during wash-aways.

4.1.2 Trolley Inspections

4.1.2.1 During trolley inspections, individual responsibilities must be focused on, as set out in **Chapter 2**.

4.1.2.2 The Chief Engineer and Infrastructure Manager must inspect all SARCC lines once annually.

4.1.2.3 The Assistant General Manager (Infrastructure Maintenance) Spoornet should be allowed to inspect all SARCC lines annually.

4.1.2.4 The Chief Engineer (Permanent Way) must inspect Spoornet lines that carry SARCC traffic once annually.

- 4.1.2.5 The Regional Engineer or his deputy must inspect SARCC every month.
- 4.1.2.6 The Section Track Inspector must inspect SARCC lines every second week.
- 4.1.2.7 Trolley inspections must be pre-planned on an annual basis.
- 4.1.2.8 Inspections should be carried out at the probable speed of a typical train traversing the section.
- 4.1.2.9 Footplate inspections may be substituted for trolley inspections.
- 4.1.2.10 Deviations from the above must be approved by the Chief Engineer, and the method(s) adopted and inspection frequencies must be recorded in chapter 20
- 4.1.2.11 Track personnel must also be encouraged to take part in trolley inspections at other depots as the process will speed up training and the transfer of skills.
- 4.1.3 Footplate inspections
- 4.1.3.1 Attention must be afforded to those aspects that will not emerge from other inspections.
- 4.1.3.2 The Regional Engineer must inspect all lines twice annually with at least one inspection being undertaken during night-time.
- 4.1.3.3 The inspection trip should be undertaken on a commuter train.
- 4.1.3.4 The driver should be requested to indicate over which sections he usually reduces speed due to poor track conditions. On such sections the reaction of the locomotive must be afforded special attention.
- 4.1.3.5 The driver's special knowledge of track conditions must be fully utilised.
- 4.1.3.6 Deviations from the above must be approved by the Chief Engineer and must be recorded in **chapter 20**.
- 4.1.4 Inspections by the track-measuring car
- 4.1.4.1 The track-measuring car is used to measure the geometric condition of the track.
- 4.1.4.2 These track measurements must be used to ensure compliance with responsibilities as set out in **clause 4.1** and **chapter 2**.
- 4.1.4.3 The Section Track Inspector must accompany the car, take note of defects and if necessary initiate urgent repairs.
- 4.1.4.4 The responsible Engineer or Engineering Technician must accompany the car to ensure that contract conditions are met.

- 4.1.4.5 Measuring frequencies will be determined by the Chief Engineer.
- 4.1.5 Inspection of structures
 - 4.1.5.1 Bridges, culverts and lined tunnels must be inspected at least once per year. Unlined tunnels must be inspected monthly by the Section Track Inspector.
 - 4.1.5.2 Coal stages, turn tables, pits, retaining walls and water towers must be inspected annually.
 - 4.1.5.3 See **clause 3.7** re temporary track supports.
- 4.1.6 Inspection of earthworks, the formation and drainage

Earthworks, the formation and drainage must be inspected at least once per year.
- 4.1.7 Ultrasonic and x-ray inspections

The frequency of inspections is determined by the Regional Engineer, in consultation with the Chief Engineer. Deviation from the work code must be approved by the Chief Engineer. Measurement frequencies and deviations must be recorded in **chapter 20**.
- 4.1.8 Inspection of track material (condition assessment)
 - 4.1.8.1 Track material is inspected annually by the Regional Engineer's organisation.
 - 4.1.8.2 Inspections must be carried out in accordance with the latest work code.
 - 4.1.8.3 Deviations from the work code or inspection frequency must be approved by the Chief Engineer, and recorded in **chapter 20**.
- 4.1.9 Inspection of turnouts, slips and diamond crossings ('sets') (safety inspections)
 - 4.1.9.1 These inspections are the responsibility of the Section Track Inspector.
 - 4.1.9.2 Sets on SARCC lines must be inspected at least once a month. The frequency of inspections in yards must not exceed 6 months.
 - 4.1.9.3 Deviations from the work code or inspection frequency must be approved by the Chief Engineer, and recorded in **chapter 20**.
- 4.1.10 Inspection of signs, level crossings and fences (safety inspections)
 - 4.1.10.1 Monthly inspections of road and track signs, level crossings and fences is the responsibility of the Section Track Inspector.
 - 4.1.10.2 In addition, the items mentioned in clause 4.1.10.1 should be regularly observed by track personnel that work in the area in order to arrange for urgent repairs to be undertaken.
 - 4.1.10.3 Deviations from the work code or inspection frequency must be approved by the Chief Engineer, and recorded in **chapter 20**.

4.1.11 Inspection of clearances

- 4.1.11.1 The Regional Engineer must ensure that annual inspections are carried out and that the conditions set out in **chapter 8** are complied with.
- 4.1.11.2 Deviations from the work code or inspection frequency must be approved by the Chief Engineer, and recorded in **chapter 20**.

4.2 TRACK GEOMETRY

4.2.1 Standards

- 4.2.1.1 The geometric condition of the track has an important influence on the life cycle of the track structure and the cost of track maintenance.
- 4.2.1.2 As a result of this influence on costs and the relative ease with which geometry can be measured, general standards have been developed to assist in the process of defining work priorities.
- 4.2.1.3 The general standards
 - 4.2.1.3.1 When track work is done, the work must conform to the A-standard.
 - 4.2.1.3.2 Repair work should be considered when the B-standard is reached.
 - 4.2.1.3.3 On SARCC lines work should preferably be done when the C-standard is reached.
 - 4.2.1.3.4 On SARCC lines urgent inspection of track below the C-standard is required; and
 - 4.2.1.3.5 When the C-standard is exceeded, repair work must be given a higher priority
- 4.2.1.4 Numerical values for geometric parameters:

(The standards show permissible deviation from design values, except for twist, which are absolute values.)

- 4.2.1.4.1 Horizontal alignment:- straight track
 - A: - 1:2000
 - B: - 1:500 and
 - C: - 1:360.
- 4.2.1.4.2 Horizontal alignment:- curves and on transition curves
 - A: - $(5\% \times H) + 2.5\text{mm}$
 - B: - $(20\% \times H) + 2.5\text{mm}$
 - C: - $(30\% \times H) + 2.5\text{mm}$

H being the mid-ordinate, in millimetres, measured with a 10m cord.
- 4.2.1.4.3 Vertical alignment: -
 - A: - 1:1000
 - B: - 1:250 and
 - C: - 1:180.

4.2.1.4.4 For twist the standards are:

Straights and circular curves

A: - 1:1000
 B: - 1:400 and
 C: - 1:288.

Transition curves

A: - 1:500
 B: - 1:400
 C: - 1:288

4.2.1.5 For specific application of these standards reference must be made to the work code for geometric track evaluation.

4.2.1.6 Deviations **from clauses 4.2.1.1 to 4.2.1.3** must be approved by the Regional Engineer and recorded in **chapter 20**.

4.2.2 Transition curves

4.2.2.1 A transition curve is a curve of varying radius such that the centrifugal force generated on the track by a train travelling at a constant speed, increases uniformly from the end of the tangent track to the beginning of the circular portion of the curve.

4.2.2.2 On running lines the most appropriate transition curve lengths are 60m for curves sharper than 300m and 80m for curves flatter than 300m.

4.2.3 Gauge

4.2.3.1 On straight track the gauge for broad gauge track is 1 065mm and 610mm for narrow gauge track.

4.2.3.2 The gauge for track on curves and the maximum permissible gauge due to wear, is

Standard gauge track (1 065 mm gauge)

Radius (m)	Without check rails Gauge (mm)	
	Normal	Maximum
< 135	1 085	1 105
135 – 150	1 080	1 105
151 – 175	1 075	1 100
176 – 200	1 070	1 095
> 200, tangent track	1 065	1 090
With check rails Gauge (mm)		
< 135	1 090	1 105
135 – 150	1 085	1 105

Narrow gauge track (610mm gauge)

Radius (m)	Without check rails Gauge (mm)	
	Normal	Maximum
< 200	620	630
200 – 300	615	625
> 300, tangent track	610	620

- 4.2.3.3 Steel and wood sleeper fastenings, with clips and bolts, are designed to allow gauge adjustments in steps of 5mm. The gauge can vary from 1 065mm to 1 090mm with new rails.
- 4.2.3.4 Gauge widening must take place in accordance with **Annexure 9, sheets 2 and 3**.
- 4.2.3.5 When laying track with wood sleepers, the initial gauging should provide widening at a uniform rate.
- 4.2.3.6 Where rails are laid on wood sleepers with sole plates, or cast iron chairs with keys, re-gauging must not be resorted to. The high leg rails must be renewed before the maximum permissible track gauge has been reached.
- 4.2.3.7 Where rails are held with clips, re-gauging by changing the clip combination must be undertaken if the limit of gauge is reached before the limit of rail wear. Refer to **Annexure 11** and **clause 17.2.4**.
- 4.2.3.8 Any deviations from these standards must be documented, approved by the Chief Engineer and included in chapter 20 of this manual.
- 4.2.4 Cant
- 4.2.4.1 Cant must be provided in accordance with **Annexure 9, sheet 4**. When temporary speed restrictions are introduced on curves, cant must also be adjusted according to Annexure 9, sheet 4. See clause 13.5.2 for electrified lines.
- 4.2.4.2 The cant of curves in yard tracks must not exceed 10mm.
- 4.2.4.3 On curves without transitioned ends, two-thirds of the full cant must be applied at the beginning and end of the curve. The cant must be increased to the full amount towards the middle of the curve and decreased to zero into the straight at a rate not exceeding 10mm in 5m (i.e. 1:500, the maximum permissible twist in transitions).
- 4.2.4.4 On curves with transitioned ends, application of cant must commence at the point where the transition curve joins the straight. Cant must be uniformly applied over the transition to reach the required value at the point where the transition curve joins the circular curve. Should this not be possible without exceeding the rate of 10mm in 5m, cant must be uniformly applied at the maximum rate over the transition and into the circular curve.
- 4.2.4.5 On reverse curves where the intervening straight is less than 40m, both rails of the track must be at the same level for a distance of 6m between the two curves.
- 4.2.4.6 At or near mainline points and crossings and wherever the rate of wear on rails indicates that it is advisable, the specified cant may, on the authority of the Regional Engineer, be increased or decreased by up to 20mm for 1 065mm and 10mm for 610mm gauge lines.
- 4.2.4.7 When a turnout is situated on a curve, no cant is to be provided over the turnout but a permanent speed restriction of 30 km/h must be imposed.

CHAPTER 5

SETS (TURNOUTS, SLIPS AND DIAMOND CROSSINGS)

5.1 INTRODUCTION

- 5.1.1 Turnouts, slips and diamond crossings (collectively called 'sets') are expensive to replace, costly to maintain and are weak links in the track structure.
- 5.1.2 Unused sets must be removed in collaboration with relevant parties following the prescribed process.
- 5.1.3 Before sets are replaced, Operating, Electrical and Signals should be consulted to establish whether the layout could be simplified.
- 5.1.4 Sets must preferably be pre-assembled in a workshop according to the latest Quick Reference for Building of Turnouts. The process must be guided by competent track personnel.
- 5.1.5 Sets must be built, inspected, evaluated and maintained in accordance with the latest work codes. Before a set is put into the track it must be checked in every detail by the Track inspector, to ensure that it is correctly built.
- 5.1.6 Maximum allowable speed over and speed restrictions applicable to sets are prescribed in the General Appendix/General Train Working Rules.

5.2 GENERAL

- 5.2.1 If unavoidable, one exothermic joint or one flash-butt welded joint is permitted in lead and closure rails, provided the joint positions comply with **Annexure 18 sheet 1**.
- 5.2.2 Turnouts of 1:6 angle to **drawings E7051, E7075 and E7078** must be built only as equal-split turnouts.
- 5.2.3 On split 1:12 and 1:9 turnouts (i.e. through line is not straight), 5m and 4,88m guard-rails respectively, must be used on both legs of the turnouts.
- 5.2.4 Where the guard rail projects beyond the end of the guard stock rail, and there is insufficient clearance for the inner 100% fishplate at the stock rail's joint, a flat or angle fishplate must be paired with the outer 100% fishplate.
- 5.2.5 The alteration of stock rails and points blades from one hand to the other by bending or straightening the stock rail at the vertex is only allowed as follows:

<u>Location</u>	<u>Rail weight</u>	<u>Type of set</u>
Yards and Sidings only	30 kg/m and 40 kg/m	1:8 to 1:12
All lines	30-kg/m and 40-kg/m	1:5 to 1:7
All lines	22-kg/m	All

- 5.2.6 Gauge for sets must be in accordance with the work code for the building of turnouts, slips and diamond crossings.

- 5.2.7 Where turnouts are on curves, the gauge must be adjusted (forward from the extreme end of the guard rail and backward from the stock rail joint of the turnout), by 5mm every 6 sleepers, until it matches the gauge of the curve.
- 5.2.8 The gauge at the obtuse crossing of diamond crossings must be checked at least every six months, and if less than 1 065mm or more than 1 075mm, must be adjusted to 1070mm.
- 5.2.9 Working parts must move freely, fit correctly and be kept clear of obstructions. Nuts and bolts securing components must be kept tight. Broken bolts must be replaced.
- 5.2.10 Whenever any component of a turnout is replaced, the mismatch of the rail running surfaces must be rectified by welding and/or grinding without delay.
- 5.2.11 Welding and grinding must be performed in accordance with the latest work code.
- 5.2.12 Heel and crossing bolts must be greased over their full length to prevent rusting.

5.3 MAINTENANCE OF STOCK AND POINTS RAILS

5.3.1 General

- 5.3.1.1 To reduce the wear on switch-lades, switch lubricators must be installed. Alternatively lubrication may be affected by applying grease or graphite by hand.
- 5.3.1.2 Bolts and/or cotter pins holding stock rails to chairs must be securely in position.
- 5.3.1.3 Heel bolts must be tightened to prevent undue movement, but without interrupting the easy operation of the points blade. Ferrules must be in position and replaced when worn.
- 5.3.1.4 Point's blades must fit the stock rail closely and accurately with full bearing against the head.
- 5.3.1.5 Point's blades must rest on the slide chair. Should the point's blade show a tendency to rise off the sliding surface, the cause must be ascertained and the fault rectified.
- 5.3.1.6 Burrs, which interfere with the fit of switchblades against stock rails or with the operation of locking bars, must be removed by grinding. Burrs must further be kept in check in order to prevent breakouts on switchblades and stock rails. Grinding must be done in accordance with the Specification for Track Welding.
- 5.3.1.7 All point's blades must be black-leaded over the first 1,25m. Slide chairs (except where Teflon slide plates are fitted on concrete sleepers) must be cleaned and black-leaded. Lubricating oil may not be used.
- 5.3.1.8 Unusual wear of points blades must be reported to the controlling officer, in order to decide on protective measures.
- 5.3.1.9 Point's blades must be renewed (with welding where permitted) before they become worn to an extent likely to affect safe working.

5.3.2 Hinged points blades

- 5.3.2.1 Hinged points blades must be replaced under the following conditions:
 - 5.3.2.1.1 Before 300mm of the point's blade is worn to a knife-edge.

- 5.3.2.1.2 Before wear creates a knife-edge that is more than 15mm below the rail level of the stock rail at any position. (Measured with the points blade well seated on the slide chairs)
- 5.3.2.1.3 If chips occur that are more than 25mm long or 10mm below rail level of the stock rail (welding repairs can be done in the first metre of the points rail).
- 5.3.2.1.4 Before side-cutting occurs on the point's stock rail.
- 5.3.2.1.5 If black spots appear on the head of the point's blade, or shelling or mushrooming occurs.
- 5.3.2.2 Where heavy crown wear occurs on the stock rail and little or no wear on the corresponding points blade, the stock rail must be renewed with welding and/or grinding, where permitted. Alternatively, the points rail must be ground to fit, before the vertical gap between the running edge of the stock rail and the top of the points blade exceeds:
- 8mm in the area where crown wear is caused by hollow wheels' false flanges
 - 2mm at the machined end of the point's blade.
- 5.3.2.3 Point' blades and/or stock rails must be replaced (together, if a matching piece is not available) when the crown wear of either exceeds 10mm.
- 5.3.2.4 Points blade protectors (reversible web-mounted block or lead guard rail) may be used to limit wear of points blades in yards and running lines with low speeds.
- 5.3.3 Flexible type point's blades and undercut stock rails
- Flexible type points blades and undercut stock rails must be replaced together under the following conditions:
- 5.3.3.1 Before wear creates a knife edge over a distance of:
- 1 000mm for 1:9 turnouts
 - 1 100mm for 1:12 turnouts
 - 1 300mm for 1:20 turnouts,
- measured from the tip of the point's blade.
- 5.3.3.2 Before the top of the points blade, at any position further than 1 000mm from the tip, is worn more than 15mm below rail level of the stock rail (measured with the points blade well seated).
- 5.3.3.3 If chips occur that are more than 25mm long or 10mm below rail level of the stock rail.
- 5.3.3.4 Before side-cutting occurs on the point's stock rail.
- 5.3.3.5 If black spots appear on the head of the points rail or shelling or mushrooming occurs.
- 5.3.3.6 If side-cutting occurs on the stock rail but not on the point's blade. The point's blade and stock rail must be replaced before the point's blade chips or bends over.
- 5.3.3.7 Before the crown wear of the point's blade or stock rail exceeds 10mm.

5.4 **MAINTENANCE OF FROGS**

5.4.1 **Rail manufactured frogs**

Frogs should be replaced when the top wear (of the point- or splice rail) measured from a straight edge placed across the wing rails one metre from the nose of the frog, reaches:

5.4.1.1 In running lines: - 5mm (for all rail sections).

The frogs' use may be extended by:

- welding and grinding of the frog and the throat-area of the wing rails
- grinding of the throat-area of the wing rails (to relieve wheel hammer).

The permissible wear may then be increased as indicated in **clause 5.4.1.3**.

5.4.1.2 In loops, sidings and yards the frogs may be allowed to wear until wheel flanges touch the bottom of the flange-way (spacer blocks). This should normally only occur when top (crown) wear exceeds that shown in clause 5.4.1.3.

5.4.1.3 Allowable crown wear of crossing frogs

Rail profile	Running lines	Loops, sidings, yards
≥48 kg	10mm	15mm
40kg	8mm	10mm
≤30kg	5mm	6mm

5.4.1.4 Guard stock rails must be replaced together with frogs if the components' sleeper spacing require it.

5.4.2 Cast 14% manganese frogs (Railbound and Mono-block)

5.4.2.1 Maintenance welding and grinding work must be performed in accordance with the Welding Specification sections SSS13 and SSS14.

5.4.2.2 The wing rails of the movable V-type frogs are to be ground before the wear (measured as in clause 5.4.1) exceeds 3mm. The moveable V piece is to be replaced before the wear exceeds 10mm.

5.4.2.3 The overlap that forms on frogs must be removed by grinding before chips form in the overlap.

5.4.2.4 Components must be replaced before the maximum clearance between the guardrail and the guard stock rail opposite the frog is 50mm (57mm for old type 1:7 turnouts).

5.5 **POINTS LOCKS AND KEYS**

5.5.1 Where signalling gear is not installed, track personnel must replace defective points locks.

5.5.2 Provided the lock itself is sound, a key which cannot open a lock or which can be withdrawn from an open lock must be scrapped.

5.5.3 Defective locks and keys must be returned to the Regional Engineer's office for repair or replacement.

5.5.4 Missing points locks must be replaced and the circumstances reported to the officer in charge.

- 5.5.5 Point's locks must be black-leaded internally.
- 5.5.6 Patrick locks are used in accordance with operating instructions at some sets, including those at fuel sidings.

5.6 BRIDLE-LOCKED POINTS

- 5.6.1 The amount of slack in bridles or bridle chains of locked tumbler levers must not exceed 15mm.
- 5.6.2 At interloops where there is no signalling, counter weight arms must be provided with two bridles, one on each side of the arm. The lock must be placed so that the tumbler may be locked when set for the main line.

5.7 POINTS BOXES

- 5.7.1 Fitting points boxes with retaining mechanisms (Racor, Henry Williams, or as shown in **Annexure 27 sheet 4**), will improve safety of train movements over sets.
- 5.7.2 On running lines, the counter weights or the indicator plates must be painted half white and half red. The white half must be uppermost when the points are set for the main line.
- 5.7.3 Counter weights of points boxes not on running lines must be painted white. If the points must be kept locked in a specific position, the centre recess on both sides of the counter weight must, on direction of the yard official in charge, be painted black.
- 5.7.4 The clearance of the counter weight arm to the track centre line is 2 000mm. Depending on track centres, a points box with arm working parallel to the track may be required.
- 5.7.5 The Track master must ensure that the throw of the stiff-arm type points box is equal for both settings of the points.
- 5.7.6 The pins of the levers must be lubricated when the turnouts are cleaned and lubricated.
- 5.7.7 Points box components must be renewed before they become so worn that either the tumbler is not easily thrown over, or the points remain partially open.
- 5.7.8 The Track master must ensure that switchblades lock properly, both in the turnout and mainline setting.
- 5.7.9 Where derailments tend to occur on sets in yards, the switch boxes must be replaced with a Tumbler (stokstyf) with spring loaded linking mechanism. Refer Annexure 27 sheet 4.

5.8 SPIKED POINTS

If it is necessary to restrict movements through a turnout to one track, the points blades must be set for that track and secured with an adjustable points clamp and private lock or with a fishplate and two 'A' coach screws. The Train control centre/Traffic controller must be notified accordingly.

CHAPTER 6

RAILS

6.1 THE TRANSPORT AND HANDLING OF RAILS

- 6.1.1 Rails must be handled with care.
- 6.1.2 Rails must be off-loaded as close as possible to the time that they are required, and exactly as planned. Special care must be taken to match adjoining rails when re-conditioned, re-profiled and second hand rails are offloaded.
- 6.1.3 Offloaded rails must be kept clear of the track, electrical and signal equipment and must not be covered with soil or ballast.
- 6.1.4 Rails must be offloaded clear of level crossings.

6.2 BENDING AND STRAIGHTENING OF RAILS

- 6.2.1 Because of the danger of fracture, rails must not be straightened or curved in cold weather.
- 6.2.2 Before rails are placed in the track, all kinks must be removed.
- 6.2.3 On all curves, rails must be uniformly curved to true radius, as follows:
- 6.2.3.1 All 36m and shorter rails, throughout their length.
- 6.2.3.2 Continuous welded rail:
- curve radius < 500m: - curved throughout their length.
 - curve radius ≥ 500m: - 10m at each end must be curved.
- 6.2.4 The correct size jim-crow must be used for the mass of rail concerned.
- 6.2.5 If a mechanical jim-crow is used, the last metre of the rail must be curved with a hand type jim-crow.
- 6.2.6 When a hand type jim-crow is used, it must be moved by approximately half its length at a time.

6.3 RAIL USAGE

- 6.3.1 Consideration must be given to transpose the high leg rail to the low leg rail in order to optimise the wear life of rails. Consideration should also be given to exchange the rails on tangent track with rails on curves. Refer decision models clause 16.4.8.
- 6.3.2 Only class C and better rails may be used.
- 6.3.3 When another type and/or class of rail other than that mentioned in **Annexure 3** is considered for use, it must comply with the requirements of an equivalent rail as indicated below and with **clause 10.4.1.1.3**.

RAIL TYPE AND CLASS	EQUIVALENT RAIL
---------------------	-----------------

60 New 60 Class A 60 Class B 60 Class C	57 New 57 Class A
57 New 57 Class A 57 Class B 57 Class C	60 Class B 60 Class C 48 New 48 Class A
48 New 48 New 48 Class A 48 Class B 48 Class C	57 Class B 60 Class C 57 and 60 Class C 57 and 60 Class C 57 and 60 Class C

- 6.3.4. When rails are chosen for a specific application, the price and remaining life as well as sleeper compatibility must be taken into account.

6.4 **JUNCTION RAILS**

- 6.4.1 Junction rails are used for joining rails of different sections, spanning either two, or alternatively three, rail masses.
- 6.4.2 Junction fishplates may only be used when the use of junction exothermic welds or junction rails is not possible.
- 6.4.3 Wherever possible junction exothermic welds must be used instead of junction rails or fishplates.

6.5 **CLOSURE RAILS**

- 6.5.1 Closure rails may not be less than 4,2m in length and must be secured to all supporting sleepers.
- 6.5.2 Closure rails and the adjoining rail ends must be curved as in **clause 6.2.3**.
- 6.5.3 During rerailling work closure rails may be fastened with fishplates and with two G clamps, or with fishbolts in the outer holes of the fishplates. This is only a temporary measure to allow trains to pass through until the Track master leaves the work site at the end of a workday. **This measure is not applicable to heavy-haul lines.**
- 6.5.4 When rerailling work stretches over more than one day, closure rails may be fastened with fishplates and with four G clamps, or with fishbolts in all the holes of the fishplates. This is only a temporary measure to allow trains to pass through during the absence of the Track master from the work site in between shifts. This allowance is only valid for a period up to 48hours. **This measure is not applicable to heavy-haul lines.**
- 6.5.5 When closure rails are installed in track and left temporarily before exothermic welding the joints, both rail ends must be joined to the adjacent rails by fishplates and four fishbolts.
- 6.5.6 When closure rails are welded into the track all four rail ends must be free from dipped ends and fishbolt holes. Rails must be cropped and a longer closure used if necessary.

6.5.7 In the case of continuous rails the closure rail must be welded in within the destressing range (**clause 6.11.8**), and the rails on both legs must be destressed over at least 80 sleepers either side of each weld position. Where a break was caused by tensile stress, both rails must be destressed over a distance of at least 500m on either side.

6.5.8 All fastenings and rail off-cuts must be removed from site.

6.5.9 On electrified lines, jumper cables must be applied before starting work. (See **clauses 2.14.6 and 2.14.7 and 13.6.4.**)

6.6 CHECK RAILING

6.6.1 Checkrails are provided to prevent excessive wear on the high legs of curves and to prevent derailments. See **Annexure 9, sheet 3.**

6.6.2 Checkrails must start and end where the gauge of the track is 1 075mm.

6.6.3 Where new rails are used as checkrails they provide a flange-way of 63mm. The maximum permissible flange-way is 83mm.

6.6.4 Re-gauging must not be carried out on check-railed track. Check rails must be renewed at the same time as high leg rails.

6.6.5 Reconditioned rails, classes B and C may be used for check rails. Side-worn rails used as check rails must be placed so that wheel flanges of vehicles bear against the unworn edge.

6.6.6 Joints in checkrails must be located between sleepers at least 3m from joints in low leg rails.

6.6.7 A gap 25mm wide must be left in the checkrail opposite an insulating joint in the low leg running rail. The wearing edge must be chamfered 5mm over a length of 50mm on both sides of the gap.

6.6.8 Trains must not be allowed to pass over a curve from which a portion of the check railing has been removed, unless the remaining portion of the checkrail has been fitted with tapered end pieces at both ends.

6.7 LAYING RAILS IN TRACK

6.7.1 General

6.7.1.1 Rail temperatures must be measured by placing the thermometer on the flange or web of the rail and shading it from direct sunlight. The thermometer should remain in contact with the rail for at least ten minutes before readings are taken.

6.7.1.2 Rails must be cut square and vertical and with a saw or a disc-cutter.

6.7.1.3 All rails in tunnels must be welded into continuous lengths.

6.7.1.4 Track circuit and other bonds should preferably be bolted to the rails. The Cad-method of welding may not be used with Cr.Mn.-rails.

6.7.1.5 Exothermic welds must as close as possible be positioned halfway between sleepers.

6.7.2 Jointed track (fishplated rails)

6.7.2.1 Rails must be laid within the temperature ranges specified in **Annexure 16**. Correct expansion gaps must be provided by using shims, which must be removed before trains are permitted to pass.

6.7.2.2 If 36m rails are laid outside the temperature ranges specified, the expansion gaps must be adjusted within the specified rail temperature ranges as soon as possible.

6.7.2.3 Rails must be laid with square joints. If stagger develops to more than 60mm owing to variations in rail lengths or track curvature, the rail must be cut.

6.7.2.4 Should jointed rails occur on unballasted bridges in a section of track with continuous rails, permanent splice joints must be provided:

- At both ends of multiple-span bridges.
- At both ends of bridges having a single span greater than 25m.
- At the free end of a bridge having a single span of 25m or less.

The splice joint must be at least 9m from the back of the ballast wall and clear of any safety rail.

6.7.2.5 Rail joints must not be placed less than 3m from deck supports or ballast walls. There must be no rail joints on spans of less than 7m.

6.8 CONTINUOUS RAILS

6.8.1 General

6.8.1.1 Continuous rails are rails longer than 36m.

6.8.1.2 Continuous rails must be 40kg/m or heavier, depending on permitted axle loads.

6.8.1.3 Concrete, wood or 40kg steel sleepers may be used.

6.8.1.4 Ballast must be sufficient and of acceptable standards.

6.8.1.5 In this clause the term 'rerailing' includes final jointing of rails, by exothermic welding or otherwise. Destressing of rails within the appropriate temperature range forms part of the laying of continuously welded rails.

6.8.1.6 'The destressing range' means the appropriate temperature range, as per clause 6.11.7.

6.8.1.7 The laying and destressing of continuous rails must be managed by an Engineer or an Engineering Technician.

6.8.1.8 A complete record must be kept on form T1286 (M) when destressing and/or welding is carried out.

6.8.1.9 On continuous railed track the geometry should be maintained to a standard equal or better than the B standard.

6.8.2 Track structure for running lines

6.8.2.1 Crossing loops are classified as running lines.

- 6.8.2.2 Continuous rails may be used on tangent track and curved track down to 800m radius, provided that the sleeper spacing is not more than 800mm.
- 6.8.2.3 For concrete sleepered track the radii of curves on which continuous welded rails are used may be reduced to 600m radius provided that the sleeper spacing does not exceed 700mm and 400m radius provided that the ballast profile is at least 3000mm or the sleeper spacing is not more than 600mm.
- 6.8.2.4 In the case of steel and wood sleepers the radii may be reduced to 600m provided that the sleeper spacing does not exceed 700mm.
- 6.8.2.5 With special written permission from the Chief Engineer continuous rails may be used on curves with sharper radii than 400m (see clause 6.8.9).
- 6.8.2.6 Wood sleepers must be fitted with type E3131 chairs.
- 6.8.3 Track structure for yard tracks
- 6.8.3.1 Continuous rails may be used on tangent track and curved track down to 600m radius, provided that sleeper spacing is not more than 800mm.
- 6.8.3.2 Concrete sleepers with FIST fastenings may be used under locking and safety bars. The open end of the clip must be on the outside of the rail.
- 6.8.3.3 Steel sleepers of 40 kg may be used at 800mm spacing under continuous rails down to and including 400m radius but 80 sleepers at the turnout ends of the continuous rails must be at 700mm spacing. Steel sleepers may not be used under locking and safety bars.
- 6.8.3.4 Fishplated joints on turnouts may be exothermic welded if the points blades do not require frequent replacement and the rail mass is 40kg/m or greater.
- 6.8.4 Laying continuous rails within the destressing range
- 6.8.4.1 While rerailing, trains may be allowed to pass at 30 km/h if every fourth sleeper is fully fastened and temporary rail joints are made with joggle fishplates secured with two clamps, provided the Track master is present on site. Refer clause 6.5.3. and 6.5.4. The speed of 30 km/h must apply until all the sleepers have been secured and permanent rail joints have been completed. Temporary expansion gaps must be set to facilitate final jointing.
- 6.8.4.2 Rails must at least be fastened to alternate sleepers within the limits of the destressing range, and the fastenings on all the other sleepers must be tightened before the limit of range B is reached. Rerailing that was not completed as above must proceed as in **clause 6.8.5**.
- 6.8.4.3 The left and right-hand rails must be fastened down simultaneously.
- 6.8.4.4 The last 80 sleepers of previously laid track must again be destressed before rerailing is resumed.
- 6.8.4.5 Short track lengths may be destressed at a time, provided the procedures set out herein are adopted.
- 6.8.4.6 Rerailing more than 20m inside a tunnel is not subject to destressing temperature considerations.

6.8.5 Laying of continuous rails outside the destressing range

- 6.8.5.1 Rerailing may proceed within the limits of temperature range B. Refer clause 6.8.1.5.
- 6.8.5.2 While rerailing, trains may be allowed to pass at 30 km/h, if every fourth sleeper is fully fastened and temporary rail joints are made with joggle fishplates secured with four clamps.
- 6.8.5.3 After rerailing, all sleeper fastenings and all fishbolts must be tightened and a speed restriction of 30 km/h must be imposed until the track has been destressed.

6.8.6 Laying of continuous rails on new formation

- 6.8.6.1 The new formation must be approved by an Engineer before track laying is commenced.
- 6.8.6.2 Traffic may only run on newly laid track after the sleepers have been packed sufficiently to ensure adequate and even bearing and to provide a uniform running top.
- 6.8.6.3 To ensure the safe use of the track during ballast consolidation, the rails must be destressed after the track has been fully ballasted, packed and aligned. Prior to destressing a speed restriction of 30 km/h must be applied to construction trains.
- 6.8.6.4 After the ballast has been consolidated the rails must again be destressed. A speed restriction of 50 km/h must be applied from the first destressing up to this point.

6.8.7 Laying of continuous rails on unballasted bridges

Continuous rails may be laid over unballasted single and multiple-span bridges of any length and the splice joints omitted provided that:

- 6.8.7.1 Type E3131 chairs are fitted on all the sleepers and that all the chairs except those on 5 consecutive sleepers at the fixed end of each span are fitted with type E3205 washers.
- 6.8.7.2 When laying new rails, exothermic welds on bridges must be avoided, and must be kept as far off the bridge as possible - preferably more than 20m.
- 6.8.7.3 If exothermic welds cannot be avoided, rail ends must be cropped to eliminate all fishbolt holes.
- 6.8.7.4 On completion of all exothermic welding of joints on the bridge, the rails must be destressed before commencing with the nearest welds off the bridge. On completion of destressing, the clip bolts of the anchoring sleepers at the fixed end(s) of the bridge span(s) must be firmly tightened.

6.8.8 Slacks, kinks and kick-outs

- 6.8.8.1 Should slacks, kinks or kick-outs occur in continuous rails, prompt protective measures must be taken.
- 6.8.8.2 Kick-outs in track with continuous rails must be eased to prevent further deterioration, provided the track is not pulled out from under the traction contact wire. Electrical must be called out when a kick-out occurs on an electrified section. Trains may be allowed to pass over the affected portion of the track if this can be done with safety. Depending on the seriousness of the situation, a temporary speed restriction must be imposed.

- 6.8.8.3 The track alignment must be restored only when the rail temperature is within the destressing ranges.
- 6.8.8.4 In all cases where kick-outs occur the rails must be cut and destressed for at least 500m on either side of the kick-out point.
- 6.8.8.5 The track (both rails) must be destressed over a distance of 500m on either side of where the track has been disturbed i.e. long slacks repaired, track lifted, re-alignment was done or sleepers replaced.
- 6.8.9 Continuous rails on sharp curves (see clauses 6.8.1. and 6.8.2.)
- 6.8.9.1 Special destressing temperature ranges (other than those in Annexure 16), specific conditions for tamping and ballast cleaning, as well as specific conditions that apply to each curve, must be recorded in **chapter 20**.

6.9 RAIL JOINTS

6.9.1 Fishplated joints

- 6.9.1.1 At least once a year, fishplated joints on running lines must be inspected. Where necessary the fishplates must be removed, cleaned, lubricated and reversed before being replaced. The fishplates and rail ends must be examined for cracks.
- 6.9.1.2 Except for destressing and exothermic welding, fishplates on rails 36m and longer must only be removed when the rail temperature is within the ranges specified in clause 6.11.7.
- 6.9.1.3 The fishing surfaces of fishplates and rails must be cleaned and greased, and the threads of fishbolts must be oiled, before being used.
- 6.9.1.4 Where rails are bonded for electrical track circuits, the nuts of the fishbolts must at all times be on the inside of the track. Reversal must be effected by transferring the fishplates from one rail to the opposite rail.
- 6.9.1.5 Fishplated joints must at all times be bolted with all its bolts in place and firmly tightened.
- 6.9.1.6 Fishbolts must be fitted with spring washers or self-locking nuts.
- 6.9.1.7 Rail fastenings must be kept uniformly tight. Lengthening bars must not be used on fishbolt spanners.
- 6.9.1.8 Pressed-to-parallel fishplates may be used with new rails and reconditioned second hand rails. They are stamped "P-P".
- 6.9.1.9 Enlarged fishplates stamped "E" are for replacing fishplates where the wear of the rail fishing surface justifies their use. They must not be used with new or reconditioned rails.
- 6.9.1.10 Worn fishplates are not to be used in the track.
- 6.9.1.11 Fishplate holes must be drilled and sharp edges must be removed.
- 6.9.1.12 The sleepers on either side of fishplated joints must be of the same type and special attention must be afforded to the tamping of these sleepers.
- 6.9.1.13 The use of a template is recommended when drilling fishbolt holes.

6.9.2 Insulating joints / block joints

- 6.9.2.1 An insulating joint (commonly called a block joint) is used to insulate one rail from the next for either signalling or electric traction purposes. Signals or Electrical will indicate where block joints are required. The Track master must fit and replace block joints. If possible, Signals or Electrical should be present. If Signals was not present, the Track master must inform the train control centre/traffic controller, as the case may be, once the block joint has been renewed.
- 6.9.2.2 Block joints for traction purposes are those insulating non-electrified track from electrified track and those provided on sidings on which flammable liquids are handled.
- 6.9.2.3 When block joints are inserted in curves, **clause 6.2.3** applies. With prefabricated block joints the jim-crow must not be allowed to span the joint. See **clause 6.6.7** for the installation of block joints in check railed curves.
- 6.9.2.4 The installation of block joints on open lines involves breaking the track. (See **clauses 2.14.6 and 2.14.7**)
- 6.9.2.5 Work on block joints may only be performed within the appropriate destressing or working temperature ranges (see **clause 6.11.7**).
- 6.9.2.6 Renewal and maintenance of block joints must be performed in accordance with the latest work code.
- 6.9.2.7 New block joints must be shortened to the minimum length before installation in order to eliminate the need for additional closures during subsequent block joint replacements. Refer clause 6.5.1.
- 6.9.2.8 The block joint gap must be limited to between 4mm and 6mm by using one T-piece only.
- 6.9.2.9 Worn ballast must be screened out and replaced. Fastenings and block joint bolts must be firmly tightened before thorough tamping of the block joint.

6.9.3 Splice joints

- 6.9.3.1 Splice joints must be provided at unballasted bridges, as set out in **clause 6.7.2.4**.
- 6.9.3.2 Splice joints may be used to protect sets and curves, if authorised by the Regional Engineer. In cases where the conditions for continuously welded rails cannot be adhered to safely, splice joints must be used.
- 6.9.3.3 Splice joints must be renewed before crown wear exceeds 6mm.
- 6.9.3.4 Splice joints must be installed and set as follows:
- Before welding of the continuous rail has taken place the gap at the point must be adjusted to 25mm.
 - The gap must be set immediately before welding to the continuous rail. It must be increased or decreased from the mean setting (which is 50mm from the closed position) by 1mm for every 2°C by which the temperature is lower or higher than the lower limit of the destressing temperature range.
 - Welding of splice joints to adjoining rails after final setting of the gap must be completed within the destressing temperature range.

6.10 RAIL CREEP

- 6.10.1 Fastenings securing rails to sleepers must be kept tight. This will help to prevent creep.
- 6.10.2 Development of creep must be kept under observation and reported to the Regional Engineer.
- 6.10.3 If creep develops to such an extent as to disturb sleepers and cause wide or tight joints, the rails must be pulled back and expansion gaps adjusted. Sleepers must be adjusted and fastenings replaced if necessary.
- 6.10.4 Tapered keys must be driven in the direction in which the forces on the rails appear to predominate, or in the direction of obvious creep. Where there is a tendency for keys to work loose, they must be reversed.

6.11 RAIL DESTRESSING

- 6.11.1 Because of the length of continuous rails, the stresses building up in them as a result of changes in temperature are very high. The lifting frame must be used to measure the stress free temperature. If the stress free temperature is found to be outside the limits of the A range, destressing must be carried out.
- 6.11.2 Destressing should also be considered after replacing sleepers, after ballast cleaning, when kick-outs have occurred, when the rail breaks or is cut, or when rail creep is observed. Refer to the decision guidelines and relevant work codes for rail destressing.
- 6.11.3 In all instances that destressing is called for, measuring of the rails' stress free temperature with the lifting frame should be considered. If the stress free temperature of both rails is within the destressing range, and also within 5°C of one another, the track may be considered as sufficiently stress free. In those areas where the lifting frame indicates excessive or unbalanced rail stress, destressing must be done.
- 6.11.4 Whenever the stress free temperature of the rail is known to be or is expected to be outside the destressing temperature range, a temporary speed restriction of 30km/h must be applied until the rails are destressed or shown to be safe by the use of the rail stress-lifting frame.
- 6.11.5 The stress free temperature is always at mid-point of the destressing temperature range. When destressing, the aim should be to have stress free rails. Depending on local conditions (e.g. rails' susceptibility to breaks resulting from tension stress, actual ballast profiles and sleeper spacing) and with written approval of the Regional Engineer, destressing may be aimed at other temperatures - but always within the destressing temperature range.
- 6.11.6 If that part of the day when the rail temperature is within the destressing range is uneconomically short, rail tensors must be used. Rail tensors provide excellent control over the destressing process.
- 6.11.7 When laying, destressing or welding continuous rails, the rail temperature must be taken and recorded every half hour.
- 6.11.8 Destressing temperature ranges are shown in **Annexure 16**.
- 6.11.8.1 Where the laying of continuous rails on sharper radii was approved (see **clauses 6.8.2.5** and **6.8.9**) special conditions will apply to each individual curve.

6.12 EXOTHERMIC WELDING OF RAIL JOINTS

- 6.12.1 Approximately half of all rail breaks occur in exothermic welded joints.
- 6.12.2 The work code for track welding must be followed conscientiously.
- 6.12.3 All preparatory, finishing and destressing instructions must be complied with.
- 6.12.4 Occupation time required to complete an exothermic weld in accordance with specification for normal (grade 700 or 900A) rails, is approximately 45minutes. Additional time is required for the preparation and finishing of the joint. For Cr.Mn (grade 1100) rails more time would be needed.
- 6.12.5 On electrified sections electrical continuity must first be provided as described in **clause 13.6.4.**
- 6.12.6 Welding personnel must inspect every exothermic welded joint and keep a record of the following:
- Location of joint.
 - Manufacturer's portion number.
 - Temperature before work is commenced and on completion of rough grinding.
 - Welder's code and joint number
 - Date welded
- 6.12.7 When exothermic joints fail, the whole joint must be removed and replaced with a wide gap joint where possible.
- 6.12.8 Sleepers on both sides of an exothermic weld must be of the same type and should receive special attention during tamping.

6.13 REPAIR OF BATTERED AND MISMATCHED RAIL ENDS AND CARE OF WELDED JOINTS

- 6.13.1 Effective and efficient joint maintenance will reduce battered rail ends.
- 6.13.2 Battered rail ends must be repaired as soon as possible.
- 6.13.3 The cropping and repositioning of rails must always be considered.
- 6.13.4 Rail-end batter must not be welded if boltholes have deformed.
- 6.13.5 Block joint rails must not be welded with the insulating fishplates in position.
- 6.13.6 Once work has been completed joint maintenance must be improved.
- 6.13.7 The work code for track welding must be followed conscientiously; and
- 6.13.8 all preparatory, finishing and destressing instructions must be complied with.
- 6.13.9 Mismatched joints will be reduced if re-conditioned and second hand rails are selected with the aim of improved matching.
- 6.13.10 Engineers must pay special attention to the maintenance of flash-butt joints on Cr.Mn. - rails.
- 6.13.11 Cad welds may not be used with Cr.Mn.-rails. Instead huckbolted connections must be used for cable bond connections.

6.14 REPAIR OF WHEEL SPIN DAMAGE

- 6.14.1 Severe wheel spin damage must be treated with the same urgency as a rail break.
- 6.14.2 Wheel spin damage will be reduced if drivers, Operating, Signals and Locomotive and Truck maintenance are involved in solving the problem.
- 6.14.3 Where wheel spin damage occurs repeatedly the use of reconditioned or second hand rails must be considered.
- 6.14.4 The work code for track welding work must be followed conscientiously.
- 6.14.5 All preparatory, fettling, finishing and destressing instructions must be complied with.
- 6.14.6 If repair of wheel spin damage cannot be effected immediately, the use of special absorbent rubber pads to minimise damage to the track structure must be considered as an interim measure.
- 6.14.7 Wheel spin burns up to 1mm deep can be repaired by grinding. Wheel spin burns deeper than 1mm but less than 6mm must be repaired by welding and grinding. Wheel spin burns deeper than 6mm must be repaired by cutting the effected rail and replacing it with a closure rail. Wheel spin burns must be repaired in accordance with the welding specification SSS7. Nests of wheel spin burns must be evaluated by the Regional Engineer to determine the most productive repair method.

6.15 BROKEN AND DEFECTIVE RAILS

- 6.15.1 Typical rail defects and fractures are illustrated in Annexure 17, sheets 1, 2 and 3.
- 6.15.2 Broken or defective rails are potentially dangerous and must be thoroughly examined immediately. Trains may, except in the case of heavy-haul lines, be allowed to pass over broken or defective rails under the conditions set out in Annexure 17, sheet 4.
- 6.15.3 On heavy-haul lines with Cr.Mn rails, temporary remedial measures require special conditions, which must be recorded in chapter 20. (Also see clause 13.6.4.)
- 6.15.4 Before permanent repairs are undertaken on track-circuited sections or electrified lines, Electrical or Signals must be advised.
- 6.15.5 A T447-report, in respect of each broken or defective rail removed from the track, must be sent to the controlling office each month. If no such rails were removed during the month, a nil return must be submitted. An effective system of control, which will ensure that T447-reports are submitted for all rail fractures, must be introduced in conjunction with Operating.
- 6.15.6 When broken rails, frogs and points cause derailments, the broken sections must be despatched to the Track Testing Centre, where arrangements will be made for the required analysis.
A sample of approximately 0,5m on either side of the break is required. To facilitate identification, a copy of the T447 report must accompany the sample.
- 6.15.7 Rails in running lines in which defects are detected ultrasonically, must be marked and dealt with as set out in Annexure 17, sheet 5. Defective rails must be cut out and replaced in accordance with Annexure 18.

6.15.8 Any clean vertical break in a rail, a flash-butt weld or an exothermic weld can be repaired by exothermic welding, provided that all existing welding material is removed. Such breaks can be repaired as a temporary measure (except in the case of heavy haul lines) by using joggled fishplates, which are kept in place with four firmly tightened bolts, to permit the passage of trains. In such cases a temporary speed restriction of 30 km/h must be introduced. All other broken and defective rails must be cut out and replaced in accordance with Annexure 18.

6.15.9 All defective rails that are removed from the track, must be rendered unfit for further service by burning or cutting grooves across the crown at intervals of not more than two metres. The rail ends must be painted red.

6.16 RAIL WEAR

6.16.1 The maximum permissible wear for all types of rail is as for class C rail according to Annexure 15 sheet 2.

6.16.2 All approved rail wear gauges may be used. The method of using a rail wear gauge is shown in Annexure 15 sheet 1.

6.16.3 The Section track inspector must take measurements and keep a progressive record to establish the rate of wear of rails. This will enable corrective maintenance measures to be taken where necessary and new rails to be ordered in good time.

6.17 RAIL LUBRICATORS

6.17.1 Refer to the latest work code and decision guidelines for the positioning, installation and maintenance of rail lubricators.
For additional information refer to Annexure 19, circular 50161 and drawings E1051, E3212, E3213 and E3243.

6.17.2 The exact location of lubricators must be determined by an Engineer or Engineering Technician.

6.17.3 All curves up to a radius of 1 200m should be lubricated.

6.17.4 Lubricators should be placed on a curve where the offset on a 10m chord is 10 to 15mm, or just before the point on the rail where there are signs of contact between wheel flanges and the rail.

6.17.5 Lubricators should not be placed at roll marks or where heavy sanding takes place.

6.17.6 Checkrails must be extended to the straight track (where the gauge is 1 065mm) for installation of checkrail lubricators.

6.17.7 Rail and flange lubricators or special points lubricators must be used for the lubrication of point's blades of turnouts in yards.

6.17.8 Lubricant must not be deposited on the crown of the rail. The greasing plates must be adjusted to 20mm to 22mm below the top surface of the rail.

6.17.9 Rail lubricators must be maintained and adjusted by qualified personnel.

6.17.10 Repairs must be undertaken in a workshop and by qualified personnel.

- 6.17.11 The Track inspector must arrange for the filling and cleaning of lubricators.
- 6.17.12 Lubricators must be checked where on-track machines have worked, to ensure that they have been correctly replaced, properly filled and are in good working order.

6.18 STOP BLOCKS

- 6.18.1 The back end of a sliding stop block should be approximately 3m from the end of the running rail.
- 6.18.2 Stop blocks must be painted white.
- 6.18.3 The use of a single leg stop block is not permitted.

6.19 DERAILING DEVICES

- 6.19.1 Scotch blocks, derailleurs, run-away points, catch points and derail points (collectively called derailing devices), must be fitted at least 2m outside the clearance mark (away from the turnout), to derail vehicles to the side, away from the more important track and clear of any important structures such as electrification masts and signals. Also see clause 8.4.1.5.
- 6.19.2 Hand operated hinged derailleurs must be installed in accordance with drawing E853.
- 6.19.3 Scotch blocks and derailleurs must be painted white.
- 6.19.4 Scotch blocks must be fitted on the outside rail with the hinge on the same side as the track, which it is required to protect and lie with the point's lock one sleeper nearer to the turnout.
- 6.19.5 Non-compounded derailing devices must be equipped with chains and points locks.

CHAPTER 7

SLEEPERS AND BALLAST

7.1 SLEEPERS AND FASTENINGS

7.1.1 General

- 7.1.1.1 Sleepers must be off-loaded as close as possible to the time that they are required and in accordance with the maintenance plan.
- 7.1.1.2 Sleepers must be laid square to the rails.
- 7.1.1.3 Sleepers must be tamped to the same extent.
- 7.1.1.4 All sleeper fastenings must be in place and at all times properly fastened.
- 7.1.1.5 The contact areas of clips and rail flanges must be kept free of lubricant.
- 7.1.1.6 Proprietary fastenings and those using multi-coil spring washers must be tightened in accordance with the relevant instructions.
- 7.1.1.7 Anti-vandal clips must be fitted where necessary.
- 7.1.1.8 Mixing of different types of sleepers in the same sub-section must be avoided.

7.1.2 Inspections

Refer to clauses 4.1.1, 4.1.2 and 4.1.8.

7.1.3 Wood sleepers

- 7.1.3.1 Hardwood sleepers must be laid with the heart down. Laminated wood sleepers may be laid either side down.
- 7.1.3.2 Sleepers must be handled with care so that the outer layer of treated wood is not punctured or damaged.
- 7.1.3.3 The diameter of holes for coach screws must be 15mm for softwoods and 17mm for hardwoods.
- 7.1.3.4 Holes for coach screws must be drilled square to the sleeper surface. Holes must go right through the sleeper (in which case 25mm long dowels must be inserted and driven to the bottom of the holes). Alternatively the drill must be fitted with a depth indicator/stopper that will ensure that holes are 15mm deeper than the selected coach screw to be inserted. Newly drilled holes or holes still in good condition, must be filled with creosote before the coach screws are inserted. In the case of existing worn holes either epoxy or 'Vortok' coils may be used.
- 7.1.3.5 If sole plates or chairs with tapered keys are to be used and where gauge widening has to be applied, the holes at one end only of the sleeper may be drilled before the sleeper is placed into the track. The holes at the other end of the sleeper must be drilled after the rails have been laid to the correct gauge.
- 7.1.3.6 If chairs with clip fastenings are to be used, all holes may be drilled by using templates before the sleepers are put into the track.

- 7.1.3.7 Old holes that will not be used again must be plugged with dowels, 125mm long, dipped in oil or creosote. 'Vortok' coils should be used to regain holding-down force.
- 7.1.3.8 Coach screws must be screwed home tightly by means of a box spanner or a coach-screwing machine.
- 7.1.3.9 In curves on running lines and in sets and splice joints, all anchor points of each rail seat must be provided with coach screws. In all other instances two coach screws (placed diagonally) must be provided per rail seat.
- 7.1.3.10 Different types of coach screws are used as follows:

Type	Shank length	Used with
H	160mm	Concrete slabs and with nylon inserts, on E3282 chairs and concrete sleepers
HC	192mm	do. With nylon inserts, on E3338 chairs
F	158mm	Hardwood Chairs with ≥ 30 mm base thickness, with double-coil spring washers
A	146mm	do. Chairs with ≥ 30 mm base thickness
B	130mm	do. Sole plates and chairs with base < 30 mm
D	130mm	do. Locking bars
AL	186mm	Softwood (195mm) All chairs/sole plates

- 7.1.3.11 Released wood sleepers must be classified as follows and marked with a paint spot of the appropriate colour (50mm in diameter) on both ends of each sleeper.

Class	Colour	Application
2	White	Suitable for running lines
3	Blue	Suitable for yards
4	Red	Unsuitable for use

- 7.1.3.12 Sound sleepers must not be removed because of the number of coach screw holes. Worn holes must be restored. Broken coach screws that cannot be removed must be cut off and the open holes must be plugged. The sleepers must be used with an offset of about 75mm (alternatively to left and right).
- 7.1.3.13 The combined use of different thickness wooden sleepers in the same turnout set must not be allowed as it leads to uneven support and tamping of the set as a whole.
- 7.1.3.14 All cast iron and sliding chairs must be fitted as near as possible to the centre of the sleeper over its width. Coach screw holes must not be drilled within 50mm from the sleeper edge.
- 7.1.4 Steel sleepers
- 7.1.4.1 On electrified sections, ballast must consist of stone and must be kept clean.
- 7.1.4.2 Instructions regarding the installation of insulating pads must be implicitly followed.
- 7.1.4.3 Clip bolts must be fitted with spring washers or self-locking nuts.
- 7.1.4.4 Clip bolts must be lubricated before they are tightened.

7.1.4.5 The ballast bed at the end of steel sleepers must be opened up to expose the sleeper ends and the ballast must be loosened before re-alignment is attempted. The sleepers must not be packed until the track has been pulled to true alignment.

7.1.4.6 Released steel sleepers must be classified as follows and marked with paint spot of the appropriate colour (50mm in diameter) on both ends of each sleeper.

<u>Colour</u>	<u>Application</u>
Green	Useable
Yellow	Repairable
Red	Scrap

7.1.4.7 Steel sleepers must not be used within 10 km of the coast.

7.1.5 Concrete sleepers

7.1.5.1 Concrete sleepers may be used on curves with a radius flatter than 150m.

7.1.5.2 Concrete sleepers must be off-loaded as described in the work code, and may not be thrown from trucks or tipped out of tip trucks. After completion of off-loading, track personnel must make sure that all sleepers are clear of the structure gauge.

7.1.5.3 Within 10km of the coast and inside tunnels, sleeper fastenings must be galvanised. Sleepers with Fist fastenings should only be used with stone ballast, and not in yards where moist conditions resulting from infill material can cause rust.

7.1.5.4 Pandrol and Fist clips must only be applied by means of Panpuller or Fist-levers. The use of the incorrect tools leads to a reduction in the clamping force life of the clips. The clamping force life of the Fist clip expires after 7 cycles of loosening and fastening. The unnecessary loosening and fastening of Fist and Pandrol clips must therefore be avoided.

7.1.5.5 Where wheel spin burns cause damage to concrete sleepers with Fist fastenings, the HDPE pads on four consecutive sleepers must be temporarily replaced with rubber pads. The HDPE pads must be replaced as soon as the rail is repaired,

7.1.5.6 Before traffic is permitted over track laid on newly inserted concrete sleepers, the sleepers must be packed sufficiently to ensure adequate and even bearing.

7.1.5.7 Dual-block sleepers' tie bars are to be left exposed for easy inspection. In running lines all sleepers with cracked or broken tie bars must be replaced. In yards it is adequate to replace every fourth sleeper with a sound sleeper to hold the track true to gauge.

7.1.5.8 Where concrete sleepers are damaged to the extent that they cannot maintain gauge, the track may be temporarily repaired by installing wood sleepers, steel sleepers or gauge straps. On sections where track circuits exist only wood sleepers, mono-block concrete sleepers or isolated gauge straps may be used. For purposes of temporary repair every fourth sleeper may be replaced in this way. A temporary speed restriction must be applied until permanent repairs are effected.

7.1.5.9 Sufficient quantities of gauge straps must be kept in stock at strategic locations for emergency use.

7.1.5.10 The re-use of second hand concrete sleepers must be done in accordance with circular number IM/L01 of 11 March 1999.

7.1.6 Resleepering under continuously welded rails (by hand)

- 7.1.6.1 During resleepering, the speed of trains must be restricted to 30 km/h.
- 7.1.6.2 After resleepering has been completed, a speed restriction of 50 km/h must be applied until the ballast has consolidated.
- 7.1.6.3 At least 8 sleepers on both sides of any sleeper being removed must be fully packed and boxed in. Each replacement sleeper must be well packed and boxed in before an adjacent sleeper is removed.
- 7.1.6.4 When resleepering, the ballast under the sleeper and in the adjacent cribs must be completely removed, cleaned, replaced and tamped before adjacent sleepers are disturbed.
- 7.1.6.5 In tunnels (to within 20m of tunnel portals), sleepers may be replaced consecutively, at any temperature.
- 7.1.6.6 On track with continuous rails, resleepering with wood or steel sleepers can take place at any temperature below the maximum of range B. Resleepering with concrete sleepers can be undertaken up to the maximum of temperature range C in accordance with Annexure 16.

7.2 BALLAST

7.2.1 General

- 7.2.1.1 Ballast must comply with the latest specification.
- 7.2.1.2 Worn ballast must be replaced without delay.
- 7.2.1.3 Ballast from quarries must be checked at the source and loading point, and must be tested from time to time, to ensure that specified standards are complied with.
- 7.2.1.4 The volume of ballast in each truck must be measured before offloading to ensure that specified quantities are loaded at quarries.
- 7.2.1.5 Equal volumes must be off-loaded simultaneously from both sides of trucks. Ballast trucks that have been loaded or off-loaded disproportionately may derail and must not be sent off.
- 7.2.1.6 Dimensions and quantities must be in accordance with **Annexures 3 and 4**.
- 7.2.1.7 Ballast must be clear of the rail flange and sleeper fastenings (except at level crossings). When off-loading, or whilst cleaning ballast, the top of the ballast must not be left higher than the underside of the crown of the running rail.
- 7.2.1.8 The flange ways between running rails and guard or check rails and between running rails and points rails, must be kept clear of ballast.

7.2.2 Ballast cleaning

- 7.2.2.1 The decision guidelines must be used to determine cleaning priorities. On track-circuited sections ballast must be kept clean.
- 7.2.2.2 All track, including sets, must be regraded when ballast is cleaned.

- 7.2.2.3 Special attention must be given to vertical and horizontal clearances.
- 7.2.2.4 No ballast screening work must be undertaken before level and line pegs have been provided. On completion, the vertical profile and clearances must be checked to ensure that work has been executed according to plan.
- 7.2.2.5 On track with continuous welded rail with:
- wood or steel sleepers, cleaning of ballast can take place when rail temperature is below the maximum of range B
 - concrete sleepers, the work may continue until the maximum temperature of range C is reached.
 - Special care must be taken against kick-outs when the temperature falls outside destressing range (range A).
- 7.2.2.6 A speed restriction of 30km/h must be imposed for the duration of the ballast work (including replenishment, tamping and profiling of ballast). The speed restriction may be increased to 50km/h after the work has been completed. The speed restriction must be maintained until the ballast has consolidated.
- 7.2.2.7 After the ballast has consolidated and tamping has been completed, the gaps at fishplated joints must be adjusted and continuous welded rails must be destressed.
- 7.2.3 Ballast cleaning by hand
- 7.2.3.1 **Clause 7.2.2** applies.
- 7.2.3.2 Cleaning of ballast 'between trains' (i.e. removing, cleaning and replacing the ballast) must be carried out under and adjacent to one sleeper at a time in a batch of 8 sleepers. The ballast must be tamped before work under the next sleeper is commenced.
- 7.2.3.3 If work cannot proceed as in **clause 7.2.3.2**, cleaning must be done under total occupation.
- 7.2.4 Ballast cleaning by machine
- 7.2.4.1 Clause 7.2.2 applies.
- 7.2.4.2 Work must be done under total occupation.
- 7.2.4.3 The track must be lifted sufficiently before screening commences if there is a possibility that the cutting chain might cut into the formation.
- 7.2.4.4 Boxing in of ballast must be done immediately behind the ballast-cleaning machine. Additional ballast must be provided if necessary. The track must then be tamped, followed by a final tamp at a later stage, unless a stabiliser is used as part of the ballast screening process.
- 7.2.5 Ballast tamping
- Track laid with continuous rails may only be tamped by the heavy ballast-tamping machine within temperature range B. The full ballast profile must be maintained at all times when tamping is done above the upper limit of temperature range A.

CHAPTER 8

CLEARANCES AND DIMENSIONS

8.1 MINIMUM CLEARANCES BETWEEN TRACK AND STRUCTURES

- 8.1.1 Structures next to 1 065mm gauge track must be clear of the limits indicated by the full lines in Annexure 1, sheets 1 to 3, except in the case of tunnels, workshop areas and temporary works. These clearances allow additional space for handling of material, for electrification purposes and for reducing the risk to persons working in close proximity to moving trains. These clearances may only be reduced in exceptional circumstances, with the approval of the Regional Engineer.
- 8.1.2 Structures next to 610mm gauge track must be clear of the limits indicated by the full lines in Annexure 1, sheets 3 and 5.
- 8.1.3 Structures clear of the limits indicated by the dashed lines shown in Annexure 1, sheets 1 and 2 and clear of the full lines where no dashed lines are shown (i.e. platform level and below), are safely clear of passing trains. Temporary structures, tunnels and structures in workshop areas must not be closer to the track.
- 8.1.4 Horizontal clearances to the dashed lines in Annexure 1, sheet 1 are 300mm less than the tabulated values for horizontal clearance.
- 8.1.5 A structure, or any part of it which is adjacent to 1 065mm gauge track and which is not clear of the limits indicated by the dashed lines or full lines where no dashed lines are shown in Annexure 1, sheets 1 and 2, must be regarded as foul. Those parts of the structure, which are foul, must be painted as described in clause 8.2. The same action must be taken in the case of a structure or any portion of a structure, which is adjacent to a 610mm track and not clear of the full lines described in clause 8.1.2.
- 8.1.6 A list of structure gauge fouling points must be obtained from the Regional Engineer. The list will show the kilometre distances and measured clearances and heights of fouling points. The listed clearances may not be reduced.
- 8.1.7 Wires crossing non-electrified railway tracks must not be less than 6m above rail level.
- 8.1.8 Clearances for new structures are greater than those tabulated in Annexure 1. Details may be obtained from the Regional Engineer.
- 8.1.9 The distances from platform edge to track centre line as shown in Annexure 1, sheet 3 are minimum distances and may be exceeded by up to 50mm.
- 8.1.10 The height indicated for high level platforms is the maximum allowable. Platforms may be no more than 40mm lower than this height. See Annexure 1, sheet 3.
- 8.1.11 Clauses 8.1.1 to 8.1.6 are also applicable to objects such as rocks protruding from the sides of cuttings.
- 8.1.12 Movement of rail traffic which could involve any exceedance of the Structure Gauge must be handled strictly in accordance with the Procedure for Approval of Abnormal Loads.

8.2 **MARKING OF FOULING POINTS**

A fouling point as defined in clause 8.1.5 must be painted with alternate black and yellow diagonal stripes each 200mm wide. The markings should cover an area of approximately 1 000 x 200 mm where practical, and be in the most conspicuous position when seen from an approaching train. In cases such as in tunnels, where the fouling point may be somewhere inside the tunnel, the entrance portals must be painted with stripes on the same side and at the same height as the fouling points.

Where the fouling point is an object such as a rock protruding from the side of a cutting and painting with stripes is impractical, it must be painted white.

8.3 **ELECTRIFIED SECTIONS: HEIGHT OF CONTACT WIRE**

8.3.1 The minimum height of the contact wire above rail level on 3kV sections is 4,22m. This may occur through old tunnels and at old bridges.

8.3.2 The minimum contact wire height on 25kV and 50kV sections is 4,5m.

8.3.3 At points where the contact wire is at or near minimum height, permanent reference pegs must be provided. The track must not be raised above peg level.

8.3.4 At level crossings the minimum height of the contact wire above rail level and the minimum clearances to be provided by height gauges are: -

Line Voltage KV	Minimum contact wire height Metre	Minimum clearance Mm
3	4,5	300
25	5,0	300
50	6,0	500

8.3.5 Measurement of the contact wire height is the responsibility of Electrical.

8.3.6 Before implementation of any deviation from the above standards, such intended deviation must be documented and approved by the Chief Engineer. After approval it must then be included in chapter 20 of this manual.

8.4 **TRACK CENTRES**

8.4.1 1 065mm gauge

8.4.1.1 Minimum distance between centres of parallel tracks 4m

8.4.1.2 Minimum distance between centres of parallel tracks with traction masts, telegraph poles, water columns, signal poles or parachute tanks 5,5m

8.4.1.3 In yards, up to 4 adjacent tracks may be at 4m centres. Distance to the next track 5,5m

8.4.1.4 Centres of tracks at clearance marks 3,45m

8.4.1.5 Minimum track centres at derailling devices 3,65m

8.4.2 610mm gauge

8.4.2.1 Minimum distance between centres of parallel tracks 3,4m

- | | | |
|---------|--|-------|
| 8.4.2.2 | Minimum distance between centres of parallel tracks with telegraph poles, water columns, signal poles or parachute tanks | 5m |
| 8.4.2.3 | Centres of tracks at clearance marks | 2,75m |
| 8.4.3 | Also refer to circulars 50102 and 50118. | |

8.5 CLEARANCE MARKS

- 8.5.1 Clearance marks are placed between converging tracks to indicate where rail vehicles may safely pass.
- 8.5.2 The track personnel are responsible for providing and placing clearance marks.
- 8.5.3 Clearance marks must be at least 1m in length and must be painted white. Scrapped concrete sleepers may, where practical, be used for this purpose. Clearance markers must be installed in such a way that the safety of walkways is not adversely affected.
- 8.5.4 The webs of adjoining rails opposite the clearance mark as well as the upper surface of the first 'clear' sleepers must be painted white to serve as points of reference.

8.6 USEFUL DIMENSIONS

8.6.1 1 065mm gauge

- 8.6.1.1 The distance between wheel flanges varies from 992mm to 990mm. (The smaller dimension will be changed to 987mm in due course).
- 8.6.1.2 The distance between the two contact points for a new wheel-set on new rails (and on straight track) is 1 137mm. This distance will be changed to 1 151mm in due course.
- 8.6.1.3 Wheel width varies from 127mm to 135mm.
- 8.6.1.4 Wheel diameter can vary from 762mm to 1829mm.
- 8.6.1.5 Wheel flange projection (below rail level) may vary from 35mm to 29mm.
- 8.6.1.6 The average floor height of loaded trucks (above rail level) is 1 030mm.
- 8.6.1.7 The available length in a DZ-truck is 13 800mm and 19 200mm in a DA-truck.
- 8.6.1.8 The distance between rail level and coupler centre line may vary from 910mm to 825mm.

8.6.2 610mm gauge

- 8.6.2.1 Distance between wheel flanges is 540mm.
- 8.6.2.2 Wheel diameter is 805mm.
- 8.6.2.3 The permissible wheel flange projection (below rail level) varies from 32mm to 25mm.
- 8.6.2.4 The average floor height of loaded trucks (above rail level) is 685mm.
- 8.6.2.5 The distance between rail level and coupler centre-line (for empty trucks) is 560mm.

8.6.3 Permissible axle loads

- 8.6.3.1 The Chief Engineer sets the permissible axle loads per line. Allowable axle loads is a function of train speed, the track structure and the bridge structures of the line.
- 8.6.3.2 Before the maximum permissible axle loads on a section is exceeded, the approval of the Chief Engineer must first be obtained.

CHAPTER 9

ASSOCIATED WORKS

9.1 TRACK SIGNS

Track signs must not foul the structure gauge and should, if possible, be placed further than the minimum distance from the centre line of the track.

9.2 GRADE AND KILOMETRE POSTS

9.2.1 Grade and kilometre posts should preferably be placed on the left-hand side of the line facing in the direction of increasing kilometre distance. Grade posts should be placed so that the figures can be seen by the driver of a locomotive. Posts should be placed approximately 3m from the centre line of the outermost track.

9.2.2 The kilometre through distance must be displayed on overhead mast poles on those sections where the maintenance of kilometre posts is a problem.

9.2.3 Where vertical curves are longer than 120m, grade signs must be placed at the beginning and end of the vertical curve. The arm of the sign pointing to the line gradient must indicate this gradient, and the arm pointing to the vertical curve must be marked with a curved line indicating the direction of the curve.

9.3 PERMANENT SPEED RESTRICTION BOARDS

9.3.1 The fronts of the boards must be painted reflective yellow and indicate the permitted speed in black figures. Where there is doubt in regard to which track a board refers to, a black arrow pointing to the relevant track must be painted on the board. The back of the board must be painted reflective white, indicating the end of the speed restriction in the opposite direction. Where the back of a board cannot be clearly seen, it must be painted black and an additional (white) cancellation board must be provided.

9.3.2 Speed restriction boards must be erected as follows:

9.3.2.1 Different methods of displaying track signage (e.g. fixing to electrification masts and placing boards on poles next to the track) may not be combined in one specific track section.

9.3.2.2 Sections where a specific method will be applied must be selected in consultation with Operating.

9.3.2.3 On single lines boards may be fixed to masts on the left or right hand side of the track section.

9.3.2.4 On double lines, boards must be displayed on both sides of the track section and fixed to masts or poles, where no masts exist.

9.3.2.5 Boards must be fixed to the nearest electrification mast and at least 30m from where the speed restriction begins.

9.3.2.6 Boards must be fixed between 2m and 3m above rail level.

- 9.3.2.7 Electrical must supervise the fixing process.
- 9.3.3 On sections where boards cannot be fixed to electrification masts, they must be placed 30m before the speed restriction begins and on the right hand side of the track, as seen from approaching trains.
- 9.3.4 Grouping of speed restrictions on curved track over short distances are permissible, provided that the number of grouped curves does not exceed five, the distance over which the speed restriction applies does not exceed two kilometres, the lowest speed of the group is made applicable and speed restriction boards are erected only at each end of the group.
- 9.3.5 Where it is necessary to restrict the speed of trains through a station or a yard, or over a considerable distance, a rectangular notice board which should indicate or describe the extent to which the restriction applies, should be positioned adjacent to the permanent speed restriction board. The face of this notice board must be painted yellow and the back white. All lettering and figuring must be black. The normal cancellation board must be erected at the end of the restricted length.
- 9.3.6 Where turnouts are situated on curves and a speed restriction is necessary or where an unequal split turnout exists in a running line, two speed restriction boards must be erected on the same post 30m from the points. The upper board will indicate the maximum permissible speed over the through line, and the lower board the maximum permissible speed for the turnout. In the case of an equal split turnout in a through line, a single speed restriction board must be erected. In the outgoing direction one board must be provided for each line. The backs of the boards must be painted black.
- 9.3.7 Where permanent speed restriction boards applicable to a station or yard have been erected as laid down in clause 9.3.5 hereof, speed restriction boards for turnouts may be unnecessary.
- 9.3.8 Where it is impractical to place permanent speed restriction boards 30m outside the points or place where the speed restriction begins, the boards should be erected in such a position as to give maximum visibility to the driver of an approaching train.
- 9.3.9 For further details refer to Annexure 10, sheet 1.

9.4 TEMPORARY TRACK SIGNS

- 9.4.1 Temporary speed restriction boards and associated boards indicating the start of the danger zone must comply with Annexure 10, sheet 2 and must be placed as shown in Annexure 10, sheet 3.
- 9.4.2 Except on the Coal Line where speed restrictions of 40 km/h may also be used, speed restrictions of 15, 30, 50 and 65 km/h only may be used.
- 9.4.3 In the case of tandem temporary speed restrictions only 30km/h and 50km/h boards are permitted.
- 9.4.4 When temporary speed restrictions are introduced on curves, super-elevation must be adjusted according to Annexure 9, sheet 4. See clause 13.5.2 for electrified lines.
- 9.4.5 Where tamping machines off-track to enable train crossings or stage in section after work (on off-track platforms), tamping machine warning and crossing boards (see Annexure 10, sheet 2) must be used.
- 9.4.6 When temporary track signs are erected or removed, the train control centre/traffic controller must be informed in writing.

- 9.4.7 Temporary speed restriction boards which apply only during hours of duty must be completely removed at the end of each shift.

9.5 DISTANCE AND WARNING BOARDS

Distance and warning boards must be sited to give maximum visibility to the personnel of approaching trains. They should be approximately at right angles to the track, clear of the structure gauge and at distances as laid down in the rules applicable to the boards concerned.

9.6 WARNING SIGNS AT LEVEL CROSSINGS

- 9.6.1 Road warning signs at level crossings must be in accordance with the code, Signing for Railway Crossings, chapter 7, SARTSM, Vol. 2.
- 9.6.2 Track warning signs at level crossings must be erected in accordance with Clauses 9.3.2 and 9.3.3. The placement of the warning signs relative to the level crossing must be in accordance with Annexure 10 sheet 4.
- 9.6.3 The signs are ineffective if placed too high or not at the correct angle to the road. Their positions should therefore be checked by personal observation.

9.7 LEVEL CROSSINGS

- 9.7.1 Level crossings may not be constructed without the necessary authorisation.
- 9.7.2 At public level crossings, METRORAIL is responsible for the condition of the track(s) and the Roads Authority for the condition of roads over the track(s). (Also see clause 9.7.6 and 9.7.7)
- 9.7.3 In the case of pedestrian crossings, private crossings, obligatory private crossings, cattle crossings, unproclaimed or unnumbered public roads or unsurfaced private roads which are not controlled by a roads authority, METRORAIL is responsible for the maintenance of the section of road within the right of way.
- 9.7.4 Track at level crossings must be opened up and maintained whenever necessary and at least every two years. Prior arrangements must be made with the Roads Authority.
- 9.7.5 Unobstructed visibility must be maintained for both road and rail traffic at level crossings.
- 9.7.6 Where defects on the road surface at a level crossing are considered dangerous to rail or road traffic and require immediate attention, the Section Track Inspector must inform the Roads Authority concerned and his controlling office immediately. Only if the Roads Authority is unable to undertake the required repairs without delay, must the Section Track Inspector arrange for the repairs to be done and inform the Roads Authority as soon as possible thereafter of the remedial action taken.
- 9.7.7 No repairs to the road surface (except emergency work) may be undertaken without suitable prior arrangements. Repairs to the road surface within 3m of the centre line of track may be under taken by the Road Authorities, provided that the work does not affect the flange ways and that prior arrangements have been made with the Regional Engineer's office. Whenever machinery (as opposed to hand tools) is to be used within 3m of the track centre line, prior arrangements must be made with the Regional Engineer's office.
- 9.7.8 When maintenance to level crossings is to be undertaken, the supervisory personnel must ensure that all relevant parties involved are in attendance. Each party will bear its own costs.

- 9.7.9 When work is carried out on the track at a level crossing, care must be taken to interfere as little as possible with the use of the crossing.
- 9.7.10 Section Track Inspectors must be supplied with the following information in respect of level crossings:
- Railway route,
 - Kilometre distance,
 - Name and/or number and status of road,
 - Road Authority involved,
 - Grades, office addresses and telephone numbers of personnel directly responsible for maintenance.
- 9.7.11 Roads crossing straight railway tracks should be level with the tops of the rails for a minimum distance of 3m from the outer rails.
- 9.7.12 The gradient of a road crossing a single curved railway track should follow the cant of the track (but not steeper than 1 in 15) for a minimum distance of 3m beyond the rails on both sides of the track.
- 9.7.13 Where a road crosses two or more curved railway tracks, the grading of the road approaches will depend on local conditions, and should be decided upon on site.
- 9.7.14 Notwithstanding the provisions of clauses 9.7.12 and 9.7.13, the grading of a road over a level crossing must be altered to suit road traffic patterns.
- 9.7.15 In no case may the width of the road at any level crossing be less than the width of the road, which it serves.
- 9.7.16 Fishplated joints are not permitted on or within 6m of level crossings.
- 9.7.17 New level crossings must not be provided with guardrails. Where guardrails are not necessary at existing level crossings, they must be removed.
- 9.7.18 Timbered or precast concrete decks may be provided as a road surface.
- 9.7.19 The track over level crossings must be laid with rails of at least 48 kg/m and on either timber sleepers with E3131 cast iron chairs or concrete sleepers.
- 9.7.20 If any loaded vehicle comes into contact with a height gauge, the vehicle must not proceed before the load is lowered sufficiently to clear the height gauge.

9.8 SERVICE ROADS

- 9.8.1 Roads for maintenance purposes may be constructed as a working charge. Scrap concrete sleepers may be used for building causeways.
- 9.8.2 The Chief Engineer must sanction the construction of bridges, culverts and concrete drains.
- 9.8.3 Service roads must be maintained in good condition.
- 9.8.4 Track personnel may carry out minor repairs.

9.9 FENCING

- 9.9.1 Fences must be built and maintained according to the METRORAIL Fencing Strategy. New fences must be as per Annexure 29. Existing 6-wire fences must not be changed to 8-wire fences without approval.
- 9.9.2 Approved pre-fabricated fencing may be used.
- 9.9.3 Fence posts between cattle guards and the main fence must be of 6kg or 8kg standards.
- 9.9.4 Barbed wire must not be used where it may cause injury to persons.
- 9.9.5 Track personnel must close any gate that is found open at private level crossings and report the circumstances to the controlling office.
- 9.9.6 Damage to fences and gates must be reported to Infrastructure Fault Control, giving the names and addresses of the responsible persons whenever possible.

9.10 CATTLE GUARDS

- 9.10.1 Cattle guards must be built to plan type I 124/1. They must be painted white and kept free of silt and vegetation.
- 9.10.2 Only hardwood sleepers may be used under cattle guards.
- 9.10.3 On track-circuited and electrified sections there must be no metallic contact between the cattle guards and the running rails. A minimum clearance of 50mm must be maintained between possible points of contact.

9.11 BEACONS

- 9.11.1 The law provides for severe penalties for interference with any land beacon.
- 9.11.2 Beacons on boundary lines or within the property of Transnet and SARCC must not be moved or destroyed without the necessary authority.
- 9.11.3 Fence posts or fence anchors must not be placed less than 1m from a beacon. Where practical, fencing at corners should be splayed within the property of Transnet and SARCC.
- 9.11.4 Excavations must not be closer than 1m to any beacon.

9.12 UNDERGROUND SERVICES

- 9.12.1 Track personnel must be careful not to damage underground services alongside or beneath railway tracks.
- 9.12.2 Care must be exercised when digging in the vicinity of buried electric cable routes. These are indicated by cable markers.
- 9.12.3 Cable markers may not be removed without authorisation.
- 9.12.4 Cables running parallel to the track must not be buried in the formation or ballast without the authority of the Infrastructure Manager.

- 9.12.5 Where there is danger of washouts, cables crossing streams may be buried in the bank behind wing walls and head walls of culverts.
- 9.12.6 Cables must return at right angles to the formation to serve telephones and signals.
- 9.12.7 New cables will be buried between 400mm and 750mm below the ground surface within a 4,5m wide strip along the fence and will be indicated by cable markers approximately 15m apart and fixed to the fence.
- 9.12.8 Pegs must not be driven within the cable reserve. Firebreaks and access roads may be made within the reserve. Scrap concrete sleepers must not be left within the cable reserve.
- 9.12.9 Where cables are required to cross service roads and are to be buried less than 800mm deep, they must be placed in pipes of galvanised iron ducting. At other road crossings the cables will pass through conduits.
- 9.12.10 Cables may be laid where necessary in station areas.
- 9.12.11 If a cable is taken through a tunnel, it must be in a conduit and clear of refuges.

9.13 COMMUNICATION ROUTES

If a telegraph pole is found in an unsafe condition, the Track master must take whatever remedial measures are practical.
Unsafe poles, broken or slack wires and exposed underground cables must be reported without delay.

9.14 COMMUNICATIONS

- 9.14.1 Track teams must be supplied with the necessary radios, telephones and special keys to be able to communicate with station personnel, the train control centre or the traffic controller, as the case may be.
- 9.14.2 Track Inspectors must ensure that their personnel can operate the equipment.

9.15 BLASTING

- 9.15.1 When blasting is to be undertaken within 500m of a railway line the Track inspector or his representative must be present and consult with the person responsible for the blasting work. He must carry out instructions in the notice and be prepared to stop trains and effect any repairs to the track, which may be necessary.
- 9.15.2 If a Track inspector becomes aware that blasting is to take place within 500m of a railway line and he has not been officially advised, he must investigate and take appropriate measures including the stopping of blasting as he considers necessary to protect the property of Transnet and SARCC.

9.16 FIRES

- 9.16.1 Track personnel must at all times take effective precautions against the outbreak of fire in accordance with this instruction, the Specification for Track Welding, the Work code for Prevention of Fires and any other relevant instruction.
- 9.16.2 They must assist in extinguishing uncontrolled fires.
- 9.16.3 They must report sparks and cinders coming from locomotives.

9.17 FIREBREAKS

- 9.17.1 The Infrastructure Manager will lay down policy in respect of the removal of flammable material and the provision and maintenance of firebreaks.
- 9.17.2 After a fire has occurred, no work must be done on the firebreak, until the Claims Examiner has completed his investigation.
- 9.17.3 Subject to the statutes of applicable legislation, the necessity for the provision and maintenance of a firebreak outside the boundaries of SARCC is left entirely to the discretion of the owner or occupier of the property.
- 9.17.4 The following precautions must be taken when firebreaks are provided on the property of SARCC:
 - 9.17.4.1 A two metre wide strip, within boundary fences, must be cleared by burning. Where burning is impractical or inadvisable, the strips may be scoffed and if necessary mounds may be built across the strips to prevent soil erosion.
 - 9.17.4.2 Young trees must be protected from damage. The lower branches of pine trees should be cut off to a height of at least 2,5m as soon as they can stand the cutting.
 - 9.17.4.3 Firebreaks must not be burnt on both sides of the railway line at the same time.
 - 9.17.4.4 Firebreaks must not be burnt when a strong wind is blowing. Burning must be done on the side of the line from which the wind is blowing and towards the line.
 - 9.17.4.5 Employees must not leave the site until the fire is completely extinguished.
 - 9.17.4.6 Grass, which did not burn when first fired, must be burnt as soon as it is sufficiently dry.
 - 9.17.4.7 Combustible material adjacent to or under telegraph or telephone lines and cables, must not be burnt if there is a possibility of the fire damaging poles, wires or cables. Grass and other combustible material must be removed and burnt at a safe distance from a pole or cable route.
 - 9.17.4.8 Every endeavour must be made to prevent the view of road users being obscured by smoke.
 - 9.17.4.9 When firebreaks are burnt, fire beaters must be supplied to each member of the gang.

9.18 PLANTS ON OR NEAR THE PROPERTY OF SARCC

- 9.18.1 Vegetation growing on the property of SARCC must be removed or trimmed where it:
 - 9.18.1.1 prevents locomotive drivers from obtaining a clear view of track signs, level crossings and/or signals,
 - 9.18.1.2 prevents the public from obtaining a clear view of approaching trains at level crossings,
 - 9.18.1.3 obstructs the visibility of signals from signal cabins.
- 9.18.2 Where growth obstructing the visibility is situated on adjacent private property, permission must be obtained from the owner to trim or remove the obstruction(s).

9.19 ERADICATION OF NOXIOUS WEEDS

Competent guidance is required with the identification and control of noxious weeds.

9.20 RODENTS

Track personnel must report the presence of animals burrowing in or near the formation, so that steps may be taken for their eradication.

CHAPTER 10

TRACK MATERIAL, TOOLS AND EQUIPMENT

10.1 SAFE KEEPING

- 10.1.1 Track material, tools and equipment must be managed according to the latest manual.
- 10.1.2 Track Masters are responsible for the security of material, tools, and equipment issued to them. When not in use, tools must be kept under lock and key.
- 10.1.3 Track Masters must report any loss of material, tools and equipment. Any theft must be reported to the South African Police Services and Asset Protection Services.
- 10.1.4 Track material must not be left in the section any longer than necessary. It should be stored at an emergency camp or at a depot.
- 10.1.5 Property of SARCC must not be used for private purposes.
- 10.1.6 Track personnel must not buy or borrow any goods or property on behalf of SARCC, nor may they dispose of or lend any goods or property belonging to SARCC without written authority from the Infrastructure Manager.

10.2 STORAGE AND CARE OF MATERIAL

- 10.2.1 Material must be placed clear of the structure gauge, and must not be stacked within 3 metres of the centre line of the track. Stacking methods are described in SI (SMT) 16/3/3B of October 1995.
- 10.2.2 To discourage theft, sleepers must be stacked as far away as practical from level crossings and roads.
- 10.2.3 With the exception of wood sleepers, track material should not come into direct contact with ash when stacked.
- 10.2.4 The ground within 6m of a stack of wood sleepers must be cleared of all grass and weeds and the storage area must be well drained.
- 10.2.5 Wood sleepers, irrespective of condition, must be stacked in lots of no more than 50 and in accordance with Annexure 12. Different methods of stacking apply to hardwood sleepers, softwood sleepers and crossing timbers. The stacks must be at least 3m apart.
- 10.2.6 Steel sleepers must be stacked clear of the ground, with alternate layers at right angles to each other. They must be stacked with bottoms facing down, in lots of no more than 100. To prevent the layers from rocking, two sleepers must be nested into one another at both ends of each layer.
- 10.2.7 Rails must be positioned upright on an even bed clear of traction bonds and supported to prevent kinking, bending and twisting.
- 10.2.8 Bags containing rail and sleeper fastenings must be stacked clear of the ground and if possible, under cover. Bolts and nuts must be oiled to prevent rust.

10.3 INVENTORY

- 10.3.1 Material and tool stock levels will vary according to local conditions and must be approved by the Infrastructure Manager.
- 10.3.2 The Regional Engineer will arrange to order material for planned works and emergencies.
- 10.3.3 When taking over a length of track, the Track master must check the material, tools and equipment taken over by him, and send a list of these to the Regional Engineer's Office.
- 10.3.4 Each Track master must control the material, tools and equipment issued to him and check his stock at least once a month.
- 10.3.5 When a Track master relinquishes a length he must check, the material, tools and equipment on hand, and send a list to the Regional Engineer's office, explaining any discrepancies. A duplicate of this list must be left for the supervisor taking over the length.
- 10.3.6 Wood or steel sleepers or tie bars must be kept for emergencies. Insulation must be maintained on track-circuited lines.
- 10.3.7 Special emergency material and equipment must be provided for tunnels with track slabs. (See circular No. 50271).

10.4 RELEASED TRACK MATERIAL

10.4.1 Rails

10.4.1.1 Classification

- 10.4.1.1.1 Used or second hand rails released from the track and to be reconditioned in workshops for re-use must comply with the rail classification requirements in Annexure 15, sheet 2. The class of rail is determined by the lowest classification indicator in this Annexure.
- 10.4.1.1.2 Before rails are removed from the section, they must be cut in accordance with Annexure 15 sheet 3 or longer if need be.
- 10.4.1.1.3 Second hand rails (other than reconditioned rails) may be used in running lines provided that:
- They have been ultrasonically tested and are found to be sound in all respects.
 - They match existing rails for wear or will match after grinding and/or welding.
 - The ends of the rails are cropped, by 300mm, to eliminate the old fishbolt holes.
 - New or pressed to parallel fishplates are used if the joints are not welded.
- 10.4.1.1.4 Rails which are removed from the track because of the existence (or suspected existence) of transverse fissures, piping and rails with rail marks BB COS JAX 2496, 2297, 2497 must not be re-used.
- 10.4.1.1.5 The quality of reconditioned rails is the responsibility of the welding workshops.
- 10.4.1.2 Rails intended for re-use must be transported in the longest possible lengths (or as required by the recipient) and cut accordingly. Depending on their intended future use, rails:
- 10.4.1.2.1 must be cut at every exothermic welded joint - the cut must be made adjacent to the edge of the weld collar.

10.4.1.2.2 rails consisting of 12m lengths joined by flash-butt welding must be cut through the flash-butt welded joints.

10.4.1.2.3 of 36m or long welded rails must be cut in accordance with Annexure 18, sheet 1.

10.4.1.2.4 may be flame cut only when they are released to welding depots for reconditioning or are scrapped.

10.4.1.3 Rails not required for re-use must be consigned as instructed by a representative of the Materials Logistics section and as follows:

10.4.1.3.1 No other material may be loaded into trucks with second handrails.

10.4.1.3.2 The rails loaded into any truck should as far as possible be of the same nominal length. Pieces of rail less than 6,5m long must not be loaded into trucks containing longer rails.

10.4.1.3.3 Scrap rails must be loaded separately.

10.4.2 Wood sleepers

Refer to clauses 7.1.3.12 to 7.1.3.14.

10.4.3 Steel sleepers

Refer to clauses 7.1.4.6 to 7.1.4.7.

10.5 **TRACK GAUGES**

10.5.1 Track gauges must be checked every six months. The gauge must be checked against a steel tape, and the bubble adjustment checked by reversing the gauge over two points. Geismar and other special track gauges must be checked every time before being used. Defective gauges must be replaced.

10.5.2 Only insulated types of track gauges may be used on electrified and track-circuited lines.

CHAPTER 11

TROLLEYS AND ON-TRACK MACHINES

11.1 NON SELF-PROPELLED TROLLEYS

- 11.1.1 A non self-propelled trolley is any hand-propelled device designed for the conveyance by rail of workmen, tools, material or equipment and includes push trolleys, trestle trolleys, rail transporters, light rail girders and other light machines or equipment that can easily be removed from the line by hand.
- 11.1.2 The person in charge of a trolley must be certified competent.
- 11.1.3 The person in charge of a trolley must arrange work so as not to unnecessarily delay trains.
- 11.1.4 When a trolley is carrying a heavy load, which cannot be easily removed from the track, permission must first be obtained from the train control centre/traffic controller before the trolley may be placed on a running line. In such a case the person in charge of the trolley must obtain authority for an occupation from the train control centre/traffic-controller before placing the trolley on a running line.
- 11.1.5 Non self-propelled trolleys must not be operated at speeds higher than ordinary walking pace.
- 11.1.6 Before a trolley is used, it must be in a track worthy condition and the full serviceability of the handbrake must be ascertained.
- 11.1.7 The person in charge of a non self-propelled trolley must ensure that the hand-signalmen providing the protection for the trolley, is well conversant with their protection duties and capable of executing them correctly.
- 11.1.8 A trolley must not be hauled or propelled by a train, except in an emergency. See clauses 11.3.8 and 11.3.13.
- 11.1.9 The person in charge of a trolley must have it under control at all times. He must warn personnel not to board a moving trolley from the front or the side and to watch for obstructions that may catch their feet.
- 11.1.10 The number of employees travelling on a trolley must not exceed the actual seating accommodation.
- 11.1.11 Employees must not stand on a trolley whilst it is in motion. This does not apply to employees operating a pump trolley.
- 11.1.12 The maximum load is 1 800kg for broad gauge and 1 400kg for narrow gauge trolleys and trailers.
- 11.1.13 Only trolleys with insulated wheels may be used on track-circuited sections. Insulated trolleys must be periodically tested by Signals.
- 11.1.14 Trolleys not in use must be placed clear of the track structure gauge and adequate precautions must be taken to prevent it from being placed back within the structure gauge by unauthorised persons.

11.1.15 Coupling of trolleys

11.1.5.1 Coupling of trolleys is undesirable and should only be done when essential. Not more than two trolleys may be coupled together.

11.1.5.2 Two trolleys must not be run independently under the control of one person. They must be securely coupled.

11.1.6 Trolleys, level crossings, bridges and tunnels

11.1.6.1 Before attempting to cross a level crossing with a non self-propelled trolley, the person in charge of that trolley must ensure that the level crossing is clear and that it will remain clear for the safe passing of the trolley and its load.

11.1.6.2 Before crossing a bridge by trolley, the person in charge must satisfy himself that a train is not approaching.

11.1.6.3 When a trolley is used through a tunnel, the person in charge of the trolley must, in addition to the prescribed protection measures, observe special precautions, which are contained in clauses 11.1.1 to 11.1.14.

11.2 **SELF-PROPELLED TROLLEYS**

11.2.1 Self-propelled trolleys include motor trolleys and all on-track machines. The operating of self-propelled trolleys, excluding Road-rail vehicles, is covered in the General Trains Working rules/General Appendix.

11.2.2 The person in charge of a self-propelled trolley must be in possession of effective means of communication for communicating with the train control centre/train traffic controller.

11.2.3 The person in charge of a self-propelled trolley being used on a running line must be qualified and certificated in train operating as applicable to a train driver and he must be the holder of a valid Road Knowledge Certificate for that section of track.

11.2.4 A person must first be afforded an opportunity to re-acquaint himself with a section of line if he hasn't operated, piloted or worked a trolley or on-track machine for a period exceeding 6 months over that section of line. After he has acquainted himself with the section of line and before he is placed in charge of a trolley or on-track machine on that section of line, he must record and certify this acquired familiarity in the road knowledge book.

11.2.5 A self-propelled trolley equipped with an approved towage may be used to tow a trailer.

11.2.6 Trolleys must be maintained so that the requirements of clause 4.1.2 can be met.

11.2.7 The maintenance of each trolley must be entrusted to a specific individual.

11.2.8 The monthly inspection of trolleys must be carried out in accordance with MTV-21.

11.2.9 Trolleys must be inspected before each trip. An inspection manual is provided in the cabin of each trolley.

11.2.10 Trolleys must be fitted with an independent emergency brake.

- 11.2.11 A back marker must be attached to the rear of each trolley and a yellow flashing light must be displayed continuously on its roof while it is operated.
- 11.2.12 A self-propelled trolley runs on a running line as a train and is therefore operated in accordance with the specific train working rules as applicable to the operation of trains.
- 11.2.13 Before attempting to cross a level crossing with a self-propelled trolley, the person in charge of that trolley must ensure that the level crossing is clear and that it will remain clear for the safe passing of the trolley.
- 11.2.14 A self-propelled trolley may only be turned around after authority has been obtained from the train control centre/Traffic controller. The trolley must be turned at a safe place, which is free from obstructions, preferably on straight sections of track. The person in charge of that trolley must ensure that adequate protection is provided on all running lines of which the structure profile might be fouled during the turning process.
- 11.2.15 When a self-propelled trolley is used, by day or night, on a running line, the headlights of the trolley must be switched on.

11.3 OPERATING OF ROAD-RAIL VEHICLES

- 11.3.1 Before a road-rail vehicle (which can also be classified as an on-track machine) may occupy a running line, that section of line must be clear of trains.
- 11.3.2 For a road-rail vehicle to be used on a running line, the person in charge of that vehicle must be qualified in trains operating as applicable to a train driver and he must be the holder of a valid Road Knowledge Certificate for that section of track.
- 11.3.3 The person in charge of a road-rail vehicle must be in possession of effective means of communication for communicating with the train traffic controller.
- 11.3.4 On sections where Colour Light Signalling or the Radio Train Order system or the Track Warrant system is used, a road-rail vehicle may be placed on, or be taken off a running line, at a level crossing or any other suitable place within that section of track.
- 11.3.5 Before the vehicle is placed on a running line, the person in charge of that vehicle must first obtain authorisation from the train control centre/train traffic controller. In the case of colour light signalling, he must then proceed strictly in accordance with the signal indications whilst in the case of the latter two train operating systems, he must be in possession of a valid token for that section of track. Such a token must be arranged between the train control centre/traffic controller and the person in charge of the road-rail vehicle.
- 11.3.6 In cases of any other trains operating system not mentioned in the preceding clause, the person in charge of the vehicle must obtain a valid token from the station or token-station as the case may be, before he may occupy a running line in that section of track.
- 11.3.7 Every time a road-rail vehicle is placed on a running line, the person in charge must obtain an instruction from the train traffic controller, which must indicate the time at which the road-rail vehicle must vacate the running line.
- 11.3.8 A road-rail vehicle fitted with an approved coupler may be used to tow a trailer on a running line.

- 11.3.9 A trailer/trolley may not be propelled (as opposed to being towed) except in an emergency, in which case special care must be taken. For this reason, a coupler must also be available on the front of the road-rail vehicle (see clause 11.3.13)
- 11.3.10 When a trailer is towed on a running line by a road-rail vehicle, the total mass of the trailer (inclusive of its load) may not exceed 95% of the licensed gross vehicle mass of the road-rail vehicle. When the total vehicle mass of a trailer (inclusive of its load), exceeds 50% of the road-rail vehicle's licensed gross vehicle mass, then the trailer may only be towed by the road-rail vehicle on a running line, provided that the trailer is equipped with a braking system which is operationally integrated with the braking system of the road-rail vehicle.
- 11.3.11 Unless otherwise specified inside the vehicle, the maximum allowable speed for a road-rail vehicle on a running line is 80km/h. The maximum allowable speed for a road-rail vehicle towing a trailer on a running line is 60km/h. Where a road-rail vehicle is used to tow a trailer on a running line of which the gradients are steeper than 1:100, additional safety precautions must be taken and the maximum speed further reduced.
- 11.3.12 A back marker must be attached to the rear of a road-rail vehicle or its trailer and a yellow flashing light must be displayed continuously on its roof while it is operated.
- 11.3.13 An emergency tow bar must be available on every road-rail vehicle at all times. This tow bar must be suitable for either towing or pushing the road-rail vehicle by a locomotive or other rail/road-rail vehicle in the event of an emergency.

11.4 RAIL TRANSPORTERS

- 11.4.1 Rail transporters must be protected and secured in the same manner as non self-propelled trolleys.
- 11.4.2 Loaded rail transporters may only be placed on a running line after authority has been obtained from the train control centre/traffic controller. The train control centre/traffic controller must ensure that the section of line is clear and remain clear of trains until the rail transporters are clear of the track.
- 11.4.3 For economic reasons, rail transporters should not be worked over long distances.
- 11.4.4 No person may ride on rail transporters or on the rails being transported.
- 11.4.5 Rail transporters must be manually propelled at walking pace.
- 11.4.6 On sections with colour light signalling, only insulated rail transporters may be used.
- 11.4.7 When two-axle type rail transporters are used:
- 11.4.7.1 each unit must be examined by the Track master before use, to ensure that it is in working order and that the brakes are operating efficiently.
- 11.4.7.2 the load on a single transporter must not exceed 7 250kg.
- 11.4.7.3 the rail stops provided must be inserted in the cross bearers before the rails are transported.

- 11.4.7.4 on gradients of 1 in 66 and steeper, all units must be equipped with hand brakes. On gradients flatter than 1 in 66, at least one unit in each set must be equipped with hand brakes.
- 11.4.7.5 rails must be centrally loaded on the cross bearer so that the brake handle is easily accessible.
- 11.4.8 Transporting 18m rails
- 11.4.8.1 Two rail transporters must be used at approximately one quarter of the rails' length from each rail end.
- 11.4.8.2 Not more than two layers of rails may be loaded on rail transporters. The rails in the bottom layer must be upright.
- 11.4.9 Transporting 36m rails
- 11.4.9.1 The distance between rail transporters must not exceed 9m and the end overhang must not exceed 4,5m.
- 11.4.9.2 Only one layer of rails may be loaded on rail transporters.
- 11.4.10 One-axle rail transporters
- 11.4.10.1 One rail may be transported at a time.
- 11.4.10.2 The approval of the Regional Engineer must be obtained before rails longer than 158m are transported.
- 11.4.10.3 Transporters must not be more than 15m apart when conveying a rail.
- 11.4.10.4 Four employees with rail tongs must be posted between all adjacent rail transporters, to control the movement of the rail. They must move with the rail and the tongs must be attached to the rail at all times.

11.5 ON-TRACK MACHINES

- 11.5.1 The person in charge (Track inspector or Track master) must have passed the appropriate theoretical and practical examinations and must be certified competent.
- 11.5.2 Where a Track inspector/Track master has not worked in charge of the operation of an on-track machine for a period exceeding 1 year, he must first pass the appropriate practical on site re-test in as far as machine working, safe working responsibility and contract specifications are concerned, before he may be put in control of such an on-track machine.
- 11.5.3 A Track inspector/Track master in charge of an on-track machine must be practically re-tested on site, every 2 years, in so far as the machine working, safe working responsibility and contract specifications for that machine are concerned. The Regional Engineer, in co-operation with the Chief Engineer, must arrange for these tests.

- 11.5.4 On-track machines must be managed by competent engineering personnel.
- 11.5.5 Productivity targets must be set for all on-track machines or groups of machines.
- 11.5.6 The use of these machines must be frequently discussed with all relevant departments.

CHAPTER 12

SIGNALS

12.1 INTRODUCTION

Track personnel must be acquainted with the functions and working of signalling equipment on their sections.

12.2 PROTECTION

When personnel from Track or Signals or Electrical have to work together, the Person in Charge shall decide on who will be responsible for protection when it becomes necessary.

12.3 GENERAL

Special forums must be created to co-ordinate long, medium and short term planning of maintenance activities.

12.4 INSULATING FASTENINGS

All instructions pertaining to the installation of insulating pads and fastenings must be followed implicitly. Care must be taken not to damage insulating materials.

12.5 SIGNALLING EQUIPMENT

12.5.1 Track Masters must keep the working parts of signalling equipment clear of obstructions and ensure that the area is well drained.

12.5.2 Track personnel must not interfere with signalling equipment (e.g. axle counters, hot box detectors etc), which has been fastened to the track unless they have been trained to maintain or to service it.

12.5.3 Track masters must ensure that the routes of surface cables are kept clear of long grass and combustible material.

12.5.4 Defective signalling equipment must be reported without delay. Also see clauses 6.1.3 and 6.7.1.4.

CHAPTER 13

ELECTRICAL

13.1 DANGER OF COMING IN TO CONTACT WITH ELECTRICAL EQUIPMENT

- 13.1.1 Persons working closer than 3m to live overhead track equipment must be trained to be aware of the dangers involved as well as in the safe working procedures to be applied and the clearance distances they should observe. (Courses PWP 1 and PWP 2 are available).
- 13.1.2 All electrical equipment and all electric wires may be live and dangerous and must not be touched. Even loose or broken wires lying on the ground may still be live and must not be approached.
- 13.1.3 No person may climb any pole or structure which supports live overhead wires or electrical equipment.
- 13.1.4 No person may climb, ride or work on the roof or on top of any load or equipment carried on any rail or road vehicle (or any machine) under live overhead equipment.
- 13.1.5 Track personnel working on, above or near the track must take precautions to prevent tools, plant or any implements coming into contact with any portion of the overhead equipment or its connections, or making contact between the traction rail and the signal rail simultaneously.

13.2 RESCUE AND TREATMENT OF PERSONS SUFFERING FROM ELECTRIC SHOCK

- 13.2.1 Persons working near high voltage equipment should be trained to apply first aid in the event of shock cases.
- 13.2.2 The procedure to be followed in regard to the rescue and treatment of persons suffering from electric shock is contained in clause 103.9 and Annexure 1.1 of the Electrical Safety Instructions.
- 13.2.3 Personnel trained in the application of artificial respiration are stationed at strategic points throughout electrified areas. The positioning of these artificial respiration posts are indicated by a silver triangular sign with a blue centre.
- 13.2.4 It is recommended that all track personnel employed in areas where high-voltage electrical equipment is installed, take the first opportunity of qualifying in first-aid.

13.3 WORK UNDER “DEAD” CONDITIONS

- 13.3.1 Persons working near high voltage equipment must be aware of what work must be done under dead conditions, i.e. within a siding or under the cover of a work permit.
- 13.3.2 The responsible person in charge of work near high voltage equipment must understand and follow the correct procedures with regard to work permits.

13.4 WORK WHICH MAY BE DONE WHILE ELECTRICAL EQUIPMENT IS “LIVE” AND THE PRECAUTIONS TO BE TAKEN

- 13.4.1 Persons working near live high voltage equipment must be aware of the dangers and implement the necessary precautions.
- 13.4.2 Specific precautions are covered in the training courses PWP 1 and PWP 2 and are required for:
 - 13.4.2.1 Handling of rigid material and wires.
 - 13.4.2.2 Erecting of poles.
 - 13.4.2.3 Use of cranes and machinery.
 - 13.4.2.4 Use of measuring devices.
 - 13.4.2.5 Work on the outside of rolling stock.
 - 13.4.2.6 Handling of tarpaulins and
 - 13.4.2.7 supervision of contractors.
- 13.4.3 The electrical officer (in charge) must always be consulted on all these matters.

13.5 TRACK/MAST ALIGNMENT

- 13.5.1 Reference plates on electrification masts should be used to record the correct mast to rail distance. Track personnel must maintain the track in its correct alignment.
- 13.5.2 Before a track in an electrified section is lifted, lowered or slewed, or before the cant is altered, the responsible electrical officer or his authorised deputy must be notified.

13.6 TRACTION RETURN RAIL CIRCUIT

- 13.6.1 General caution
 - 13.6.1.1 Unauthorised alterations to the traction bonding can result in high voltages, which will be dangerous to personnel working on or near the track.
 - 13.6.1.2 Connecting bonds must not be tampered with or disconnected. They must be kept clear of ballast, metal objects and tools. Track personnel must report any defect of or damage to electrical track equipment.
- 13.6.2 Rail bonds
 - 13.6.2.1 A traction rail-to-rail joint bond consists of a length of bare flexible cable fixed to each rail at a joint.
 - 13.6.2.2 Parallel tracks are connected at intervals by cross bonds.
 - 13.6.2.3 On electrified sections the mast to rail bonds are part of the return circuit and must not be disconnected by unauthorised personnel, otherwise dangerous conditions may result.

13.6.3 Other bonds

- 13.6.3.1 These bonds (or parts of them) are normally painted red (except stray current drainage connectors - which are blue, and impedance bonds - which are not painted).
- 13.6.3.2 A spark gap, consisting of a red-painted dome bolted to a flat steel base plate, occurs at numerous points along an electrified line, (e.g. at steel footbridges, road bridges, water columns, goods sheds, station roof structures and certain traction masts). Spark gaps are connected to structures and to the traction rail by means of bonds.
- 13.6.3.3 At all substations large conductors connect the power supply to the rails.
- 13.6.3.4 On some AC-electrified sections the booster transformer's return conductor is carried on the track equipment masts on insulators and is connected to the rail at intervals of about 4km.
- 13.6.3.5 Stray current drainage connections connect buried pipes and other services to the negative return for electrical protection purposes.
- 13.6.3.6 Impedance bonds for signalling purposes are sometimes provided on electrified tracks. They are part of the traction return circuit.

13.6.4 Breaking of track circuits

- 13.6.4.1 No work on the track which involves interference with the traction return rail circuit either by cutting or removing the rails, or by removal of bonds may be done unless Electrical is consulted. Electrical will take such precautions as may be necessary to ensure continuity of the return circuit before permitting the work to commence. Track personnel who have been suitably instructed may apply approved jumpers as permitted in clause 2.14.7 and described herein.
- 13.6.4.2 Should it be necessary to break the track or disconnect any type of bond, the Regional Engineer (Electrical) or his authorised deputy, must be advised in advance of this intention. Such work must not be started until an authorised employee of Electrical is available to supervise the work, or until this employee indicates that the work may proceed.
- 13.6.4.3 Because of the danger of electric shock on electrified sections, electrical continuity must first be provided. Electrical continuity is provided by means of a jumper cable between broken or fishplated rail ends, or by means of two jumper cables connecting the two ends of the closure rail to the running rail. It must be ensured that the jumper cables remain tight, because the return current can be lethal. (See Annexure 20).
- 13.6.4.4 In emergencies, if no representatives from Electrical or Signals are available or can be consulted, temporary electrical continuity jumper cables must be fixed across the break where a rail has broken, where fishplates or track bonds must be removed or where a closure must be inserted. This must be done strictly in accordance with Annexure 20. Also see clause 2.14.6. and 2.14.7.

13.7 PREVENTION OF STRAY RETURN CURRENTS

- 13.7.1 Metallic objects must not be placed in contact with point's rods, track equipment structures or any other metal structure attached to the running rails.
- 13.7.2 No metallic object or equipment in contact with the ground, e.g. fences, water pipes, etc. may be attached or connected to the overhead track equipment structures, to any metallic equipment associated with the track or to the rails.

CHAPTER 14

TRAIN OPERATING

14.1 INTRODUCTION

In order to render a safe, affordable, dependable and predictable service, track personnel must ensure that the railway lines and associated works are always safe for the passage of trains.

14.2 PLANNING

14.2.1 Infrastructure must establish forums to co-ordinate short, medium and long term planning with interested departments.

14.2.2 Over exploitation must be prevented and the creation of excess capacity must not be allowed.

14.3 IRREGULARITIES/DEFECTS

14.3.1 Prompt action must be taken by track personnel when irregularities / defects are reported to them or come to their attention, in order to ensure the safety of trains, of clients, the public, co-workers and the environment.

14.3.2 The procedures for reporting/recording of irregularities/defects must be followed conscientiously by all concerned.

14.4 COMMUNICATION

Regular communication is necessary between track personnel and other employees involved with the running of trains. Track supervisors must ensure that adequate communication is maintained.

CHAPTER 15

WORK CODES TO BE USED BY TRACK PERSONNEL

15.1 BALLAST

- 15.1.1 Machine cleaning.
- 15.1.2 Hand cleaning

15.2 INSULATING JOINTS

- 15.2.1 Positioning and maintenance.
- 15.2.2 In-situ assembly

15.3 BRIDGES AND CULVERTS

- 15.3.1 Bridge code.
- 15.3.2 Handbook.
- 15.3.3 Inspection.

15.4 EARTHWORKS, FORMATION AND DRAINAGE

- 15.4.1 Inspection.
- 15.4.2 Drainage maintenance

15.5 CIVIL ENGINEERING

- 15.5.1 Handbook (Green-book).

15.6 TRACK

- 15.6.1 Geometric evaluation.
- 15.6.2 Manual for Managing Track Material.
- 15.6.3 Evaluation of material and track condition.
- 15.6.4 Tamping.
- 15.6.5 Screening machine.

15.7 RAILS

- 15.7.1 Repair of breaks.
- 15.7.2 Classification (ANNEXURE 15 Sheet 1, 2 and 3)
- 15.7.3 Destressing.
- 15.7.4 Welding.
- 15.7.5 Ultrasonic and X-ray inspections.

15.8 SIGNS, LEVEL CROSSINGS AND FENCES

- 15.8.1 Inspection

15.9 TURNOUTS, SLIPS AND DIAMOND CROSSINGS

- 15.9.1 Construction manual.
- 15.9.2 Inspection.
- 15.9.3 Tamping.
- 15.9.4 Welding.
- 15.9.5 Condition evaluation.

15.10 CLEARANCES

- 15.10.1 Inspection.

CHAPTER 16

DECISION MODELS/GUIDELINES TO BE USED BY TRACK PERSONNEL

16.1 BALLAST

16.1.1 Determining cleaning priorities.

16.2 CONCRETE SLEEPERS

16.2.1 Treatment of alkaline aggregate reaction.

16.2.2 Replacing of pads.

16.3 TRACK

16.3.1 Determining of tamping cycles.

16.4 RAILS

16.4.1 Rail usage.

16.4.2 Re-use of second hand rails.

16.4.3 Workshop re-profiling.

16.4.4 In-track re-profiling.

16.4.5 Life of rails.

16.4.6 Destressing.

16.4.7 Replacing.

16.4.8 Transposing.

16.5 Set Maintenance Model

16.6 Formation Decision Model

16.7 Sleeper Replacement Model

CHAPTER 17

RAIL / WHEEL INTERACTION

17.1 INTRODUCTION

- 17.1.1 As a result of the complex nature and high cost attributable thereto, the management of rail/wheel interaction has been placed under the joint management of senior Rolling Stock and Infrastructure personnel.
- 17.1.2 This chapter must be read in conjunction with relevant clauses in other chapters of this manual.
- 17.1.3 A few of the factors that influence rail/wheel interaction are briefly discussed in this chapter.

17.2 GEOMETRY

17.2.1 General

An improvement in the condition of track geometry will improve bogie tracking and will reduce the long-term costs associated with the maintenance and relaying of the track.

17.2.2 Ballast

The dimensions shown in **Annexure 4** must be regarded as a minimum for critical points, such as the high legs of sharp curves, on bridges, tunnel entrances and sags of vertical curves.

17.2.3 Super-elevation / cant

To reduce unbalanced lateral forces that affect the track structure, it is necessary to apply super-elevation to the track. It must be applied in accordance with **Annexure 9, sheet 4** and **clause 4.2.4**.

17.2.4 Gauge

The tracking ability of bogies is reduced exponentially as gauge (due to wear) increases. Action must thus be taken well before maximum allowable gauge is reached. See clause 4.2.3

17.3 LUBRICATION

Lubrication is successful when the gauge corner of the high leg is sufficiently covered with an even layer of grease throughout the curve so that the rate at which rail side-wear occurs is reduced and that it takes place evenly over the whole length of a curve.

17.4 TRACKING

- 17.4.1 As vertical and horizontal irregularities are the main cause of bogie oscillation, special attention must be given to joint maintenance and all work must be performed in accordance with the latest work codes.
- 17.4.2 Forces transmitted to the track by rolling stock must be measured regularly when high rail wear and bogie oscillation occurs.

17.5 MOTIVE POWER AND SPEED

Although dynamic forces decrease as train speed is reduced, longitudinal forces transmitted to the track structure by locomotives are increased. Speed restrictions must be managed accordingly.

17.6 PROFILING

17.6.1 Rail profiling reduces surface defects and improves bogie tracking which in turn reduces flange contact and internal rail stresses.

17.6.2 A dramatic increase in rail life can be achieved when rail profiling, track geometry, lubrication, tracking and speed are managed optimally.

17.6.3 The rail profiling process is complex and must be managed by experts in this field. The latest decision guidelines / models must be used.

CHAPTER 18

PRIVATE SIDINGS

18.1 BACKGROUND

- 18.1.1 Seventy percent of Spoornet's income can be linked directly to private sidings. The service to these important clients must be managed accordingly.

18.2 INTRODUCTION

- 18.2.1 Engineers and Engineering Technicians must acquaint themselves with the latest Manual for the **Provision and Maintenance of Private Sidings**.
- 18.2.2 Track Inspectors concerned with private sidings must acquaint themselves with **part B** of the document and must be enabled to deliver the required level of service.

18.3 DEFINITIONS

- 18.3.1 A private siding is a railway track owned by the local authority, a company or a private person and is connected to track of Spoornet or the SARCC.
- 18.3.2 A siding is that portion of a private siding, which is situated on land belonging to Spoornet or the SARCC.
- 18.3.3 A siding extension is that portion of a private siding that is situated on land not belonging to Spoornet or the SARCC.

18.4 AGREEMENTS

- 18.4.1 Each private siding is covered by an agreement between Spoornet and the owner.
- 18.4.2 Location, ownership as well as construction and maintenance details are shown on the agreement plan which forms part of the private siding agreement.
- 18.4.3 An agreement between Spoornet and the SARCC is required for private sidings connected to the SARCC's lines.
- 18.4.4 Track personnel who are involved with private sidings must be aware of the above and act accordingly.

18.5 MAINTENANCE

- 18.5.1 If the take-off turnout is leased, Spoornet bears the cost of maintenance and the renewal of the turnout.
- 18.5.2 Where Spoornet is responsible for maintenance, the responsible track personnel must ensure that the private siding is adequately maintained.

18.6 MATERIAL

- 18.6.1 Private siding owners must provide material for the maintenance of their sidings.
- 18.6.2 Spoornet will supply track material if it is necessary and can be supplied.

- 18.6.3 Material released from private sidings must be handed over to the siding owner in accordance with the stipulations of the Private Siding Agreement. A receipt is to be obtained and forwarded to the Regional Engineer's office for official record keeping.

18.7 EMERGENCY WORK

Track personnel must complete all relevant documentation pertaining to emergency work undertaken on private sidings and forward it to the Regional Engineer's Office.

18.8 INSPECTIONS

- 18.8.1 The inspection of private sidings for renewal of right of access must be undertaken by the Track inspector.
- 18.8.2 Private sidings over which locomotives of Spoornet operate must be inspected annually.
- 18.8.3 Private sidings over which locomotives of Spoornet do not operate must be inspected every five years, prior to the renewal of the private siding agreements, unless -
- 18.8.3.1 Spoornet is relieved of all obligations in respect of any portion of a private siding (this will be shown on the agreement plan);
- 18.8.3.2 A private siding owner furnishes an annual certificate signed by a Professional Engineer that the portion of the private siding not covered by the preceding paragraph is safe for the passage of vehicles, including locomotives, of Spoornet.
- 18.8.4 The track personnel of Spoornet may at all times inspect private sidings to satisfy themselves that they are safe for the passage of trains. Comprehensive inspections must be undertaken in accordance with a pre-determined programme and as far as possible be carried out in co-operation with the siding owner or his representative.

18.9 RAIL WEAR

- 18.9.1 Maximum permissible rail wear is as shown for class C rails in **Annexure 15, sheet 2**.
- 18.9.2 Rails must be replaced when the maximum track gauge is reached and the gauge cannot be adjusted.

18.10 SLEEPERS

- 18.10.1 Thosti BBRV, Pandrol (mark 2) and Thosti BBRV, Fist (mark 3) may be used.
- 18.10.2 Concrete sleepers may be used in curves on private sidings as follows:
- 18.10.2.1 In running lines exceeding 1 km in length - minimum radius 240m and in running lines less than 1 km in length - minimum radius 140m.
- 18.10.2.2 In staging and shunting lines, minimum radius 140m.
- 18.10.2.3 On curves of radius less than 200m the appropriate gauge widening must be provided.

CHAPTER 19

RECOMMENDED READING FOR TRACK PERSONNEL

19.1 BOOKS

- 19.1.1 Selig, E.T. and Waters, J.M. (1994). Track Geotechnology and Substructure Management. Thomas Telford Services, London.
- 19.1.2 Esveld, Coenraad (1989). Modern Railway Track. MRT Productions, Germany.

19.2 CONFERENCES

- 19.2.1 Conference papers (1987). Related Problems on Wheel/Rail Interface and Railway Systems Capacity. International Heavy Haul Conference, Perth, Australia.
- 19.2.2 Conference papers (1989). Railways in Action. International Heavy Haul Conference, Brisbane, Australia.
- 19.2.3 Conference papers (1992). Meeting the Challenge of Increased Tonnage. International Heavy Haul Conference. Colorado Springs U.S.A.
- 19.2.4 Conference papers (1993). Efficiency and Safety of Heavy Haul Railways. International Heavy Haul Conference, Beijing, China.

19.3 SIMPOSIUMS, LECTURES AND COURSES

- 19.3.1 Post graduate course (1990). Track Maintenance. University of Pretoria.
- 19.3.2 Symposium (1991). Mechanised Track Maintenance. University of Pretoria.
- 19.3.3 Special postgraduate course (1992) Fundamentals of Track Structure Design and Maintenance. University of Pretoria.
- 19.3.4 Special course (1993). Rail/Wheel Interaction. University of Pretoria.
- 19.3.5 Lectures (1999). Introduction to Multi Disciplinary Concepts in Railway Engineering. University of Pretoria.

CHAPTER 20

RESPONSIBILITIES AND WORK METHODS APPLICABLE TO SPECIFIC SECTIONS

- 20.1 (2.7) Project managers, Technical officers and Technical officer's deputies must be appointed for each contract. The duties of these person are defined in the E5 and E160 documents.
- 20.2 (2.13) The Track manager and the Technical manager (welding) in the head office may be officers contracted in on a Buy-in service agreement by Metrorail, and will reports to the Chief engineer.
- 20.3

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