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IRISET

S 27

## SIGNALLING AND SAFETY



Indian Railways Institute of  
Signal Engineering and Telecommunications  
SECUNDERABAD - 500 017

# 27

## SIGNALLING & SAFETY

**VISION:** TO MAKE IRISET AN INSTITUTE OF INTERNATIONAL REPUTE, SETTING ITS OWN STANDARDS AND BENCHMARKS

**MISSION:** TO ENHANCE QUALITY AND INCREASE PRODUCTIVITY OF SIGNALLING & TELECOMMUNICATION PERSONNEL THROUGH TRAINING

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**INDIAN RAILWAYS INSTITUTE OF  
SIGNAL ENGINEERING & TELECOMMUNICATIONS  
SECUNDERABAD - 500 017**

**Issued in March 2014**

## **S-27** **SIGNALLING & SAFETY**

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Checked By	IOS1, SSE (D), LS2, PS2
No. of Pages	131
Date of Issue	March , 2014
Version	A3

In case of any suggestions please write to LS2/PS2 or mail to LS2/PS2 at email address  
[LS2@iriset.railnet.gov.in](mailto:LS2@iriset.railnet.gov.in)/[PS2@iriset.railnet.gov.in](mailto:PS2@iriset.railnet.gov.in)

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## CHAPTER-1: RAILWAY SAFETY

### 1.1 SAFETY

Safety is basically the product of good practices at all levels of functioning i.e. design, manufacturing, maintenance and operations. Safety is compromised only when the laid down 'Standard Practices' are infringed.

### 1.2 INDIAN RAILWAY - SAFETY SLOGANS

1. The best safety device is a careful man.
2. Make safe working a daily habit.
3. Always alert - accident avert.
4. Life is precious - be safety conscious.
5. Accident happens where safety ends.
6. A minor omission spells a major disaster.
7. Always vigilant - safe working.
8. Proper schedule maintenance- safe equipments working
9. Schedule inspections - safe equipments functioning
10. Train Safety Mission- Zero tolerance for Accident

### 1.3 RAILWAY SAFETY: HIGHEST PRIORITY

The Indian Railways comprises the world's fourth-largest rail network under a single management. The Indian Railways network transports about 18 million passengers and more than 2 million tons of bulk freight every day.

"Safety First" is the slogan of Indian Railways. Safety in train operation is prime concern for each railway man.

Safety on Indian Railways is a collective effort of men, materials and management observance of methods, rules, procedures, and performance of assets, machines, maintenance practices and Safety culture. Safety is of paramount importance for operational efficiency and to safeguard the lives of passengers, rail users & employees. Hence, highest priority is accorded to safety.

**CURRENT TREND OF ACCIDENTS:** - Though intensive efforts made since 1950s brought down accident rate, some accidents continue for various reasons. For Ex.

- Total : 131 in 2011-12
  - 90.84 %- human failure (due to: Rly staff - 43.5 %, other than Rly staff : 47.33 %)
  - 4.58 %-sabotage
  - Combination of factors + incidental : 0.76 + 1.53 %
- (Ref: Year book 2011-12)

From time to time, Indian Railways have been periodically getting its safety preparedness reviewed by expert committees headed by eminent personalities, mostly retired judges/chief justice of Supreme Court of India.

Following 4 committees have scrutinised IR safety in last five decades:

- Railway Accident Committee-1962 (Kunzru Committee)
- Railway Accident Inquiry Committee-1968 (Wanchoo Committee)
- Railway Accident Inquiry Committee 1978 (Sikri Committee)
- Railway Safety review Committee-1998 (Khanna Committee)

## **1.4 CORPORATE SAFETY PLAN**

With view to accelerating the pace of the safety drive Indian Railways formulated a 10-year Corporate Safety Plan. This plan envisages achieving following broad objectives:-

- (a) To achieve reduction in rate of accidents per million train kilometres from the present level of 0.44 to 0.17
- (b) Implement measures to reduce chances of passenger fatalities substantially in consequential train accidents
- (c) Focus on development of manpower through major improvements in working environment and training to reduce the accidents attributable to human failure by 40%.
- (d) Achieve safety culture on all fronts including maintenance depots, worksites, stations, controls etc.
- (e) Progressively achieve an environment of "Fail-proof" from the present "Failsafe" system of asset failures by upgrading the systems
- (f) Prioritization of safety related projects
- (g) Implementation of accepted recommendations of Railway Safety Review Committee 1998 at an accelerated pace.

To ensure that financial constraints do not inhibit the implementation of the Plan, fund requirement for the Safety enhancement works, as outlined in the Plan, has been identified as Rs.318 billion including Rs.170 billion Special Railway Safety Fund (SRSF) already committed.

## **1.5 INDIAN RAILWAYS' VISION 2020 & WHITE PAPER**

Unprecedented thrust on safety related issues was given during the year, particularly to enhance Safety at Level Crossings, Interlocking and Manning, provision of Limited Height Subways, Normal Height Subways, Road Under Bridges (RUBs), Road Over Bridges (ROBs), Expenditure on Road Safety Works, Catch Sidings etc, Safety aspects of Signals and their back-up power supply, etc

### **1.5.1 IMPROVEMENT AND MODERNISATION OF SIGNALLING SYSTEM**

In order to increase efficiency and enhance safety in train operations, Electrical and Electronic Interlocking system in replacement of over-aged mechanical/multi cabin signalling system, has been provided.

To improve reliability and visibility of signals, out dated filament type signals have been replaced with long life, highly durable LED signals. Stations have been provided with Data Logger for predictive maintenance and intensive supervision of Signalling system.

Auto Block Signalling to increase line capacity has been provided. On Board Train Protection Warning System (TPWS) has been commissioned on Chennai Central - Gummidipundi suburban section (50 RKMs) of Southern Railway as a pilot project. This system prevents 'Signal Passing at Danger' cases and enforces implementations of speed restriction. Second pilot project of Train Protection Warning System on main line (Delhi-Agra section of Northern/North Central Railway) is under way.

Automatic clearance of Block Section has been provided through use of axle counters. This will reduce dependence on human element & enhance safety.

Level crossing gates have been interlocked with signals to enhance safety. Track Circuiting for enhancing safety by reducing human dependence, has been provided at various station-sections.

### **1.5.2 IMPROVING COMMUNICATION SYSTEM ON RAILWAYS**

Optic Fibre Cable (OFC) cable laid by RailTel Corporation of Indian Limited. A total of around 37,000 Route Kms of OFC has so far been laid on Indian Railway system alongside railway track for improving communications. Works for laying 9,000 Kms of OFC further are under progress. Mobile Train Radio Communication system for communication among Train Driver, Guard, Station Master, Control Office and field maintenance staff during run of the train has been commissioned at about 700 Route Kms on Howrah – Dhanbad, Guwahati – New Bongaigaon and Mathura – Jhansi sections. Works are under progress for another 2700 Kms. Walkie-Talkie VHF communication between Guard, Driver & Stations has been provided.

\* \* \*

## CHAPTER-2: RAILWAY ACCIDENTS

### 2.1 RAILWAY ACCIDENT

As per accident manual the definition of 'Railway Accident' is as below:

For the purpose of Railway working, accident is an occurrence in the course of working of Railway which does or may affect the safety of the Railway, its engine, rolling stock, permanent way and works, fixed installations, passengers or servant or which affect the safety of others or which does or may cause delay to train or loss to the Railway.

Failures of 'Railway Equipment' are also treated as technical and potential 'accidents' for the purposes of managing the assets safely. Asset failures are continuously monitored and efforts made to oversee that they do not lead to actual accidents.

### 2.2 DUTY OF RAILWAY SERVANT

#### 2.2.1 The IR General Rule (GR 2.11) Duty for securing safety

(a) Every railway servant shall -

- (i) see that every exertion is made for ensuring the safety of the public,
- (ii) promptly report to his superior any occurrence affecting the safe or proper working of the railway which may come to his notice, and
- (iii) render on demand all possible assistance in the case of an accident or obstruction.

(b) Every railway servant who observes -

- (i) that any signal is defective,
- (ii) any obstruction, failure or threatened failure of any part of the way or works,
- (iii) anything wrong with a train, or
- (iv) any unusual circumstances likely to interfere with the safe running of trains, or the safety of the public, shall take immediate steps, such as the circumstances of the case may demand, to prevent accident and where necessary, advise the nearest Station Master by the quickest possible means.

### 2.3 CLASSIFICATION OF ACCIDENTS

Classifications of accidents are done as per Railway Board letter no; letter No: 2000/Safety (A&R)/19/20 dated 13.12.2000.

Accidents are broadly divided into 5 categories and further classified into 16 categories from 'A' - 'R' excludes 'I' & 'O'

I : Train Accidents	Class A,B,C,D,E
II : Yard Accidents	Class A5,B7,C9,D6 ( train is not involved )
III : Indicative Accidents	Class F,G,H
IV : Equipment Failure	Class J,K,L,M
V : Unusual Incidents	Class N,P,Q,R

### 2.3.1 DETAILED CLASSIFICATION OF RAILWAY ACCIDENTS

Sl.No.	Category	Class	Type
I	Train accidents	Class A(A1 – A4)	All types of collisions
		Class B(B1 – B6)	Cases of fire and blasts
		Class C(C1 – C8)	LC gate accidents
		Class D(D1 – D5)	All types of derailments
		Class E(E1-- E2)	Collision on obstruction or passing over obstruction but safe
II	Yard accidents	Class A5	All above related cases with concerned classes in yard, But Train is not involved
		Class B7	
		Class C9	
		Class D6	
III	Indicative accidents	Class F (F1 – F4)	Averted collisions cases
		Class G (G1 – G4)	Cases of breach of block rules
		Class H (H1 – H2)	Signal passing at danger (SPAD cases)
IV	Equipment failures	Class J (J1 – J10)	C&W, Loco failures
		Class K (K1 – K7)	Engg. department failures
		Class L (L1– L4)	Electric department failures
		Class M (M1– M7)	S&T department failures
V	Abnormal incidents	Class N (N1– N3)	Intentionally damages to Rail, train, stations
		Class P (P1 – P3)	Human run over cases
		Class Q (Q1 – Q6)	Natural human death, murder, suicide, theft, fire, blasts in railway area
		Class R (R1– R5)	Cattle run over cases, Other natural incidents

### 2.3.2 Train accidents are further classified under two types

- (a) Consequential Train Accidents – these accidents involves anyone or more of following criteria
- (i) Death of passenger or railway worker
  - (ii) Serious injuries to passenger or railway worker
  - (iii) Loss of railway property more than ₹ 2 crore.
  - (iv) Obstruction in rail traffic more than 24 hours

In this type of accident the classes of accidents involved are as below

Class (A1 to A4), Class (B1 to B4), Class (C1 to C4), Class (D1 to D4), Class E1 (Serious accidents).

- (b) Other Train Accidents -

These accidents includes those which are not included in above classes.

### 2.3.3 Class M (M1 to M7) S&T department failures

- (a) Class M1 – Total failure of interlocking
- (b) Class M2 – Track circuit/axle counter failure
- (c) Class M3 – Block instrument failure
- (d) Class M4 – Point machine failure
- (e) Class M5 – Signal/point failure
- (f) Class M6 – Failure of communication in between station master and section controller more than 15 minutes
- (g) Class M7 – Failure of communication in between station master and gateman of LC gate more than 15 minutes



Accident of category Class A1

.....



Accident of category Class B1



Accident of category Class C1



Accident of category Class D1  
Due to sabotage



Accident of category Class D1  
due to flood



Accident of category Class D2  
In block section



Accident of category Class D2  
in station yard

\* \* \*

## CHAPTER 3: DISASTER, DISASTER MANAGEMENT

### 3.1 ABBREVIATIONS

DM	Disaster Management
DDMP	Divisional Disaster Management Plans
DM ACT, 2005	Disaster Management Act, 2005
NCDM	National Committee on Disaster Management
NDMA	National Disaster Management Authority
NDMRCs	National Disaster Mitigation Resource Centres
NDRF	National Disaster Response Force
SDMA	State Disaster Management Authority
SEC	State Executive Committee
SOPs	Standard Operating Procedures
ATIs	Administrative Training Institutes
IAT	Instant Action Team
FR	First Responders
DMT	Disaster Management Team
SPART	Self Propelled Accident Relief Train

### 3.2 DISASTER MANAGEMENT ACT 2005

As per The Disaster Management Act, 2005 "Ministries of Government of India shall be responsible for proper action for prevention, mitigation, and to respond effectively to any disaster in accordance with the guidelines of the National Disaster Management"

Disaster is an unusual occurrence characterised by: "Sudden calamitous event, having great material damage, life loss and distress".

#### Disaster is classified under two main heads

- (a) Natural disaster (examples: Earth quake, Flood, Cyclone, Volcanoes, Tsunami)
- (b) Man made disaster (examples: Gas leakage, Nuclear leakage, Terrorist activity, Plane crash, Rail accidents)

Definition of Railway Disaster as per Railway Bd's letter No: 2003/safety (DM)/6/2 Pt dt; 06.01.09. "*Railway disaster is a serious train accident or untoward event of grave nature either on causes that may lead to loss of many lives and/or grievous injuries to a large number of people and/or severe disruption of traffic, necessitating large scale help from other Government / Non Government and private Organisations*"

COM is the authorised officer to declare an accident as a Disaster. Such declaration will be issued to all concerned with the approval of General Manager.

If the accident is declared as a Disaster, all instructions as contained in **Disaster Management Plan** would automatically come into force, and officers, staff of all departments should take action as laid down in this book without violation of any rule in G&SR, SWR, and Accident Manual.

**Railway Board's Safety Directorate vide their letter No. 2003/Safety-I/6/2 dated 29<sup>th</sup> September 2003 laid down the requirement of Zonal Railway's Disaster Management Plan as follows:**

- (a) Disaster Management Plan: – All Divisions and Zonal Railway Head quarters (including Metro Rail Corporation) must prepare their own disaster management plan
- (b) Zonal Railways Disaster Management Plan should integrate all divisions and also adjacent railway's framework.
- (c) The Disaster Management Plan must include 'who is responsible for what activities' in detail
- (d) Preparation and implementation of 'Disaster Management Plan' is the responsibility of concerned General Manager/ Divisional Railway Manager.

### **3.3 AIMS OF THE DISASTER MANAGEMENT PLAN**

- (a) Prevent all avoidable loss of lives.
- (b) Expedite Rescue, Relief and Rehabilitation.
- (c) Minimise human agony due to accident.
- (d) Protect Railways property and that of its users.
- (e) Preserve clues and evidence.
- (f) Speed up restoration of traffic.
- (g) Ensure post accident care of injured passengers and their relatives
- (h) Ensure proper communication system.
- (i) Ensure proper arrangement of light at site.
- (j) Protection to dead bodies.

#### **3.3.1 The Divisional Disaster Management Plan - DDMP**

- (a) It is available in the form of booklet duly signed by DRM/ADRM.
- (b) This booklet is kept at control room, all depots, railway hospital and railway stations.
- (c) Aim of booklet is to inculcate safety habits in day to day working
- (d) DRM/ADRM & all safety officers are responsible for dissemination of DDMP
- (e) DMP must be reviewed and updated in month of JAN of every year.

#### **3.3.2 Resources available in case of a major accident have grouped into 4 different units. These are as follows:**

- (a) Resource Unit I - Railway and non-railway resources available on the train, and at nearby surroundings
- (b) Resource Unit II - Railway resources available at ARME/ART depots and elsewhere within the division.
- (c) Resource Unit III - Railway resources available at ARME/ART depots and elsewhere on adjoining Zones and Divisions
- (d) Resource Unit IV- Non-railway resources available within or outside the division.

**3.3.3 Action plan of DDMP**

- (a) Prompt transmission of information about accident
- (b) Manning of control room
- (c) Setting of emergency control
- (d) Guide lines to site workers
- (e) Nominating nearby station as 'Nominated station'.

**3.3.4 Golden Hour:**

If a critical trauma patient is not given definite medical care within one hour from the time of accident, chances of his ultimate recovery reduces drastically, even with the best of Medical attention thereafter.

This one-hour period is generally known as 'The Golden Hour'.

**The Golden Hour must be consider at high priority level during preparation of disaster management plan**

During this Golden Hour period to save time, Concerned Staff must reach at spot in time, for this each and every staff should know siren codes (details of these siren codes are given in next chapter)

\* \* \*

## CHAPTER - 4: ACCIDENT RELIEF MEASURES & DUTIES

### 4.1 ACCIDENT RELIEF TRAIN



- (a) The 'Breakdown Trains', 'ARME,' 'SPART' 'Tower wagon' these all are 'Accident Relief Trains'
- (b) At home stations these trains are normally stabled on siding having two exit ends such sidings are meant for 'this purpose only'. The Breakdown trains are stabled with the 'Crane and Vehicles' coupled together on such type of sidings.
- (c) Where siding is with two exit ends, there 'Shunting Method' shall be in such way that at one end 'Medical Van' will be the first vehicle and at other end 'Crane' will be the first vehicle. So that at the time of emergency, dispatching of both vehicles will become very easy and fast without delay of time.
- (d) In case only one exit available , the medical van and the crane should be stabled nearest to the point of exit, so that if necessary the medical van can be moved out without any delay, in advance of the rest train.
- (e) In 'Disaster Management Plan' booklet the locations (station/division/headquarter) of the 'Break Down Trains' are given with the telephone numbers of its 'Incharges'.
- (f) The In-charge of a Break Down train / Tower wagon is responsible for that 'the train is fully equipped with necessary tools and is in running order'. He is also responsible for that 'these trains are marshalled (shunted) properly and kept stabled in a convenient siding and ready to move out without delay of time'.
- (g) Engineering tool vans are also available for use in emergencies.



#### **4.1.1 INSPECTION AND MAINTENANCE OF BREAKDOWN TRAINS AND ARMES**

All Safety and other concerned Officers must inspect breakdown trains and ARME, when visiting the stations / yards and must make a thorough inspection at least once in three months.

An Inspection Register must be maintained in the break- down train, in which inspecting officials, shall sign on each inspection and enter their remarks. The in-charge of the break down trains and ARME will report these remarks to the Controlling Officer for necessary action.

Rule books to be provided in relief trains are given below, and these books shall be checked during inspection by concerned officers.

- (a) General and Subsidiary Rules. (G & SR)
- (b) Accident Manual.
- (c) Rules for the working of crane.
- (d) Conference rules Part III.
- (e) Instructions Manual Sheets relating to Breakdown operation.
- (f) Working Time Table.

#### **4.1.2 SOUNDING OF ACCIDENT ALARM SIREN / HOOTER**

Alarm sirens are provided at home stations, yards and control room where Accident Relief Train/Medical Van is stabled. The accident alarm siren must be sounded immediately after notice of accident is received 'requiring Medical Van(ARME)/Break down train/Tower wagon'.

Following codes are prescribed for sounding the Accident alarm siren: Circumstances Code (As per accident manual chapter IV, Para 405, sub Para 2)

<b>Sl. No.</b>	<b>Accident site</b>	<b>Requirement</b>	<b>Sounding of accident alarm/Hooter</b>
1	Home station / marshalling yard	Medical relief <u>not</u> required	Hooter will sound for 45 seconds <u>two</u> times with a gap of 5 seconds
2	out of home station	Medical relief <u>not</u> required	Hooter will sound for 45 seconds <u>three</u> times with a gap of 5 seconds
3	Home station / marshalling yard	Medical relief <u>is</u> required	Hooter will sound for 45 seconds <u>four</u> times with a gap of 5 seconds
4	out of home station	Medical relief <u>is</u> required	Hooter will sound for 45 seconds <u>five</u> times with a gap of 5 seconds
5	-----	Cancellation of ARMV / ART	Hooter will sound for 90 seconds <u>one</u> time only.

#### **4.1.3 ACTION TO BE TAKEN WHEN ACCIDENT ALARM SIREN IS SOUNDED**

- (a) Immediately after the accident alarm siren / hotter is sounded, all staff earmarked (staff nominated for break down working) for accident relief train shall report at the nominated place and others at the station.
- (b) All officials concerned shall report at the Medical Van if ordered, and proceed with the medical van or to undertake any other duty that might be assigned to them.

- (c) The Loco Foreman /Lobby In-Charge/TPC/TLC on duty shall immediately take action to
- (i) Arrange for locomotive. Any locomotive available should be utilized, preferably Diesel Locomotive, in OHE Territory.
  - (ii) Call the locomotive crew and accident train relief staff.
  - (iii) Turn out the accident relief train quickly to be despatched to the accident site.

#### **4.1.4 TARGET TIME FOR TURNING OUT THE MEDICAL VAN**

Single exit siding - 20 Minutes

Double exit siding - 15 Minutes

The time is reckoned from the time of ordering to the time of despatch

#### **4.1.5 TARGET TIME FOR TURNING OUT THE BREAK DOWN TRAINS/TOWER WAGON**

- (a) During Day 30 Minutes
- (b) During Night 45 minutes.
- (c) The time is reckoned from the time of ordering to the time of leaving the shed/siding. For SPV (Self Propelled Vehicle) 15 minutes less in each case.

### **4.2 REPORTING OF ACCIDENTS AND OTHER UNUSUAL OCCURENCES**

Every Railway servant shall report immediately every accident or unusual occurrence in the course of working the railway which may come to his notice, to the nearest Station Master, or section controller or divisional HQ office by any possible means given below

- (a) Portable control telephone/ walkie-talkie set/VHF set/mobile phone;
- (b) Phone provided at level crossing gates;
- (c) By stopping train / Loco / trolleys or other vehicle passing on adjacent Line.
- (d) By BSNL/ MTNL phone/mobile phone, if available near by the accident site.
- (e) By sending message through a railway servant to the nearest SM.
- (f) Sending the light engine of the train.
- (g) By road transport, if available.

### **4.3 FIRST INFORMATION FROM THE ACCIDENT SITE**

This information must include following details

- (a) Time and date of accident.
- (b) Train No. and description of Train/Trains involved in the accident.
- (c) Block section / Station;
- (d) Location – Kilo meterage of the accident site.
- (e) General description of accident site including visibility, curve, Gradient, speed restriction or any other special feature.

- (f) Whether Medical van and Break Down train are required?
- (g) Brief description of accident, nature of accident.
- (h) Whether there is any casualty/ injury number of persons injured / killed, whether injury is to passengers, Railway staff or others.
- (i) Whether any derailment has occurred? In case of wagons derailed /capsized, whether loaded or empty, whether fouling adjacent track or not? If not fouling, whether required any speed restriction for passage of any train on adjacent line and any other information which is readily available.
- (j) Track condition: - Track length (Approximate) damaged (from km to km). Extent of damage i.e. damage to sleepers, track fittings, bridge, tunnel, fixtures etc.
- (k) OHE - Damage to Mast/Portal cantilever, wires, insulation etc.
- (l) S&T - Damage to signal posts, S&T gears, signals, points &crossings, track circuits.
- (m) Rolling Stock - Damage to loco, wagons, coaches or any other vehicle.
- (n) Prima facie cause of the accident, if known.
- (o) Any other relevant information.

#### **4.4 ADDITIONAL INFORMATION**

##### **4.4.1 FOR LEVEL CROSSING ACCIDENT**

- (a) The type of road vehicle such as Tractor or Bus etc. involved and number of persons injured / dead and the nature of injuries.
- (b) Whether the engine is disabled and whether any derailment has taken place.
- (c) Whether road vehicle is entangled / obstructing the track.

##### **4.4.2 FOR FIRE ACCIDENTS**

- (a) Coach or wagon no.
- (b) Material involved in fire, if known.
- (c) What was used to extinguish fire?
- (d) Time the fire extinguished.

#### **4.5 THE SM'S/SECTION CONTROLLERS DUTY**

The SM/section controller on receiving information of any accident shall immediately take action for:

- (i) Not allowing any movement in the affected block section;
- (ii) Informing SM of the other end to ensure the same.
- (iii) Informing local or nearest RPF and GRP officials to provide protection to the accident site and render assistance to the injured and stranded passengers.

## 4.6 ACCIDENTS REPORT

### 4.6.1 ACCIDENTS REPORTABLE TO RAILWAY ZONAL HEADQUARTER

Sr. DSO/DSO shall advise to CSO or other Safety Officer nominated by CSO, on telephone immediately after the accident in case of following categories of accidents:

- (a) All train Accidents.
- (b) Any yard accident having serious repercussion on movement of traffic on through line resulting in dislocation of traffic more than the threshold period.
- (c) Land slides, breaches, OHE breakdown etc. which result in dislocation of traffic more than the threshold period.
- (d) Averted collisions.
- (e) Driver passing signal at danger.
- (f) Breach of Block rules.
- (g) Untoward incidents.
- (h) Unusual incidents.

All accidents, equipment failures and unusual incidents classified, should be reported to Central Control by Divisional control. Central Control should record all the relevant information in the accident/unusual register for information of all concerned.

Central Control shall send a daily summary of the accidents/unusual to CSO, COM and other PHODs concerned for information and necessary action.

### 4.6.2 ACCIDENT REPORT TO RAILWAY BOARD

Following system will be followed for reporting of accident to Railway Board:-

- (i) Accidents shall be reported by Divisional Control to Central Control at Headquarter. The Central Control shall in turn inform concerned officers at Headquarters office.
- (ii) CSO or other Safety Officer nominated by CSO, should there after inform nominated officer of Safety Directorate of Railway Board. At board's level, safety directorate shall issue the message and take follow up action.
- (iii) In case of land slide, breaches, OHE break down etc. which result in dislocation of traffic more than threshold period and also cases due to public agitation shall be reported by Headquarters Control Office to Punctuality Cell of Railway Board and dealt with by the Coaching Directorate.
- (iv) Cases falling under N, P and Q except Q-6 i.e.; blocking of train services due to public agitation; shall be dealt with by Security Directorate.

In case of an accident an "All concerned" telegram is invariably issued.

### 4.6.3 DISASTER MANAGEMENT CELL AT HQS AND DIVISIONS.

The disaster management cell shall be operated at Head Quarters and division to be attended by nominated officers as under:-

In all cases of accident Involving passenger carrying train and other accidents where through communication is blocked JA Grade/Sr. Scale Officer of Safety, Operating, Medical, and Comml. Mech. Engg., Elect. & and S&T Dept. shall attend Disaster Management Cell within the minimum time to operate the Disaster Management Cell till restoration.

## 4.7 DUTIES OF CONCERNED OFFICIALS IN CASE OF ACCIDENTS

### 4.7.1 'BREAK DOWN' - NOMINATED STAFF

- (a) When an accident is reported, it is the bound duty of every JE/SSE (Signal), to proceed to the accident site by the quickest possible means.
- (b) In case of serious accident involving injury and loss of life, medical van is ordered which has to leave the station within 15 minutes after the accident siren is sounded. and breakdown train is required to be turned within 45 minutes during night time and 30 minutes day time. Nominated signal staff and officers shall be ready to move within these specified time which is in minutes.
- (c) All 'Break Down' staff shall maintain the record (log of events) in their diary after this, so that there may not be any difficulty in recollecting the sequence of events at a later date.

### 4.7.2 SECTION STAFF TO PROCEED TO SITE OF ACCIDENT

- (a) On receipt of the information of the occurrence of an accident, the JE/SSE (S&T) shall proceed by the quickest available means to the scene of the accident, with staff and tools and portable control telephones and establish immediate communication with the control.
- (b) He shall make a special note of the exact time of the accident; besides other important details. The JE/SSE shall check his watch, if available with Guard's time, station time and control time, as the exact time of an accident is often an important clue in determining the cause of the accident.

### 4.7.3 DUTIES OF RAILWAY OFFICIALS REACHING FIRST AT AN ACCIDENT SITE

The following duties are in priority sequence

- (a) Protection of adjacent running lines;
- (b) Protection of the accident site;
- (c) Save life and alleviate suffering;
  - (i) Allot duties to Police, Military and the Railway Security staff.
  - (ii) Assist other railway staff and the Medical Team to identify the dead and in rendering first-aid to the injured passengers. Arrange for medical aid to the injured taking the help of medical practitioners, if available.
  - (iii) Organize relief with the assistance of volunteers and Railway men
  - (iv) Be prompt in providing relief, re-assurance and comfort to the affected passengers.
  - (v) Seek assistance of Doctors travelling on the train to attend the injured.
  - (vi) Arrange for refreshments and drinking water free of charge to the affected passengers.
  - (vii) Give timely information to the passengers.
  - (viii) Collect details of the dead/injured passengers.
  - (ix) Record evidence of passengers with their names and addresses.
  - (x) Arrange for safeguard of Railway and Passengers property.
  - (xi) Transportation of stranded passengers.

#### **4.7.4 PRESERVATION OF CLUES & ASCERTAIN THE CAUSE OF THE ACCIDENT**

- (a) It is necessary to preserve all clues for the CRS/accident enquiry committee
- (b) Even an apparently unimportant clue can give some useful information as to the likely cause of accident.
- (c) In any individual case where the circumstances compel the removal of debris, in part or whole, complete and detailed notes should be recorded by the senior most Officer present, of the observations made by the various officers, before issuing such orders. This note should be given to the accident enquiry committee.
- (d) All sleepers, rails, S&T gears and other fittings removed from the site should be carefully preserved for inspection by the accident enquiry committee. and
- (e) Restoration time and date of through Traffic.

#### **4.7.5 DUTIES OF OFFICER-IN-CHARGE AT THE SITE**

The DRM or ADRM and in their absence, the senior most Officer at the accident site shall be the Officer-in-Charge at site. On arrival at the site he shall immediately

- (a) Make an immediate assessment of
  - (i) The number of passengers killed, grievously injured and simple injured.
  - (ii) Extent of damage.
  - (iii) Probable detention to traffic, and forecast of restoration.
  - (iv) Assistance required, and relay this information to the Officer-in-Charge of the control office.
  - (v) Prima-facie cause of accident & repeat to Divisional Control Office /HQ Central Control as early as possible & not later than 24 hrs in any case.
- (b) Depute officers and/or staff for specific duties in
  - (i) Assisting in rescue operation.
  - (ii) Noting down particulars of persons sent to hospitals/given first aid.
  - (iii) Assisting in preservation of clues.
  - (iv) Maintaining a log of events at site.
  - (v) Assisting in transhipment work.
  - (vi) Assisting in Railway security work.
- (c) Arrange for ex-gratia payment,
- (d) Arrange to operate Mobile Control Office provided with Control phone/Satellite phone /Railway Subscriber phone, BSNL/Public phone with STD/FAX facilities at accident site duly manned.
  - (i) The site telephones should be continuously manned by a responsible supervisor who should log the events and progress of restoration in the register and also give the latest information to Divisional Control, Central Control and Disaster management cell at HQ.
- (e) Catering arrangements such as food, drinking water etc. to passengers, injured or otherwise.
- (f) Security of luggage of the involved passenger and protection of the area around.
- (g) Transhipment of passengers and arrangements of road vehicles for clearing stranded passengers.

#### **4.7.6 DUTIES OF OFFICER-IN-CHARGE OF THE DIVISIONAL CONTROL OFFICE**

The Sr.DOM and in his absence, the DOM/AOM shall take charge of the control office and he will be responsible for:-

- (a) Keeping in touch with the Officer-in-charge at the site of accident to ascertain any assistance that is required at the site and making arrangements for it.
- (b) Passing on any supplementary information regarding the accident or clearing operations to the Head Quarters Office; including particulars of the dead and injured.
- (c) Maintaining constant liaison with the HQ with latest information and obtain general guidance.
- (d) Ensuring that food and tea/coffee etc. is sent to the accident site, and making arrangements for evacuation of stranded passengers.
- (e) Maintaining a chronological log of all events and action taken connected directly or indirectly with the accident.
- (f) Conveying detailed information regarding the causalities/injuries including names, identification, ticket Nos. etc. to the originating/destination stations as also to all the stations where the train had scheduled halts over his division as also to the stations nearest to the site of accident
- (g) The Officer in-charge of the control office will convey the same to Central Control/ Disaster Management Cell for passing it on to other Divisions/Zones of concerned, Railways and Railway Board.
- (h) Regulating traffic by diverting/cancelling the trains, running duplicate trains or restricting booking or arranging for transhipment as circumstances may require after obtaining reliable information from the site with regard to probable detention to traffic.

#### **4.8 NOMINATION OF AN OFFICIAL IN CASE OF SERIOUS ACCIDENTS TO DISSEMINATE INFORMATION TO PRESS AND ELECTRONIC MEDIA**

- (a) In case of serious accident, the senior most official at site will nominate a responsible railway officer at the site of accident to disseminate the information to press and electronic media about the accident.
- (b) Even casual remarks from staff such as Guards, Drivers and Station Masters are likely to be quoted in media. So, Staff should not speak or air their views publicly regarding the loss of property, estimates of casualties and cause of the accident to avoid creating panic among public.
- (c) If any person from press or electronic media or any Public Body approaches the Station Master or any other Railway official at any Station the request should be communicated to the officer in charge in the Control office / Central Control office and his instructions should be obtained.
- (d) At head quarters CPRO shall disseminate such information to the press and electronic media.

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## CHAPTER- 5: INVESTIGATION AND EXAMINATION

### 5.1 PRELIMINARY DUTIES OF SENIOR MOST OFFICIAL AFTER RESTORATION

- (a) The senior most Official at site of the accident shall ensure that Investigation & examination is started only after restoration of accident site.
- (b) The senior most Official at site of the accident shall, after initiating measures for restoring traffic, submit a briefing note to the DRM giving the particulars of the accident.
- (c) The senior most Official at site of the accident shall ensure that the 'SKETCH' drawn is showing important dimensions, position of vehicles, tracks made by derailed vehicles, marks on rails, particulars of condition of track for an adequate distance in the rear of the point of derailment and any other information likely to be of use in elucidating the cause of the accident and he has to submit this 'SKETCH' with the preliminary report.
- (d) Arrangements for photographs and videography with all essential features shall be done at the time of examination and investigation.
- (e) The senior most Railway Officer at the site of accident shall be responsible for the general appraisal of the situation and to co-ordinate all works.

### 5.2 EXAMINATION OF S&T GEARS

Examine the entire site inclusive of the track over which the train has passed immediately before derailing, noting down any unusual features observed, especially any parts of vehicles or other materials lying on or near the track.

After getting permission to restore signalling, every effort shall be made to complete the restoration as expeditiously as possible. Ensure that action specified above has been effectively covered by the Inspector. Prepare and submit a report to the DRM/ Sr. DSTE.

**Furnish a 'PRELIMINARY REPORT' to Sr. D.S.T.E by the quickest possible means.**

Preliminary Report should be followed with a '**DETAILED REPORT**' with complete drawing and track particulars. The detailed report should be submitted within a week of the occurrence.

#### 5.2.1 '**DETAILED REPORT**' SHALL INCLUDE

- (a) List of damaged gears ,replaced gears,
- (b) List of requirements.
- (c) Probable cause of failure in case of S&T involvement.
- (d) Any deficiency noticed in S&T installation
- (e) Any deficiency noticed in maintenance.
- (f) Any deficiency noticed in operation.
- (g) Outside interference if any.
- (h) History of particular gear which is responsible for the failure.
- (i) List of S&T checks and joint examinations done immediate after accident.
- (j) Inspection details.

**5.2.2 FOLLOWING DETAILS SHOULD BE RECORDED AND CONSIDERED -  
ACCIDENT INVOLVING S&T**

- (a) If the station is interlocked, standard and system of interlocking and classification of station?
- (b) Are the signals concerned visible from the place of operation? If not, are repeaters provided both in cabin and in Station Masters office and what was the condition of repeaters at the time of accident?
- (c) Is the outer visible from the required distance? What is the approach like?
- (d) Is the Home Signal visible while approaching the outer? If so, at what distance before the outer?
- (e) Lighting of signal lamps or indicators and the condition of lamps.
- (f) Were the signals, points, repeaters, slots tested by the committee concerned and what were their observations?
- (g) Recent History of signal concerned.
- (h) Are other points worked from a cabin or a ground frame? Whether rod operated or power operated?
- (i) Method of locking the points. Are points provided with point indicator or governed by starting signals whether FPL, Lock Bar or Track Circuit provided for route holding?
- (j) Method of controlling the reception and departure signal.
- (k) Were the rules and instructions complied with ?
- (l) Did the Lever man feel an obstruction while operating points or signal lever?
- (m) When did the maintenance staff last attended for the maintenance of the apparatus?
- (n) In case of double wire signalling, was the "Auxiliary Lever sealed and was it in safe custody of the station Master?
- (o) When was the "Auxiliary Lever" last used and for what purpose?
- (p) Were the points found correctly housed and set and what is the condition of the switches? Are they worn out or chipped?
- (q) Were the lever collars provided & used as per instructions in force?
- (r) Were the points found correctly set and locked and what is the condition of the switches? Are they worn out or chipped?
- (s) Was the Relay Room properly locked and Operating Key is in possession of SM/ ASM?
- (t) Were the Relays properly sealed?
- (u) When was the crank handle last used and for what purpose?
- (v) Was the Crank Handle sealed?
- (w) Was the Block Instrument properly sealed and locked?
- (x) Were Motor points in intact position and no tampering has been done?
- (y) Was Panel sealed and all the counters reading were properly recorded for last operation?
- (z) Whatever indications are shown on the panel (viz. Routes, Sub-routes, Signal aspects indications etc. should be recorded as shown on the panel).

## **COLLISION AND AVERTED COLLISION**

- (a) The position of the signal levers, point levers and block instruments should be immediately checked and recorded jointly with at least one dept.
- (b) The train Register Books should be signed so as to indicate the last entry made and then seized.
- (c) If Line admission books are in force, these should be seized immediately record them, in whose possession they were last found.
- (d) If Line Badges are in force, the disposition of the Line Badges should be recorded.
- (e) The position of the two trains or train and obstruction should be marked on the sleepers. The distance between the two should be measured in meters in the case of averted collision.
- (f) A rough sketch should be drawn showing their position vis-a-vis signals, station platform, turnouts and other fixed land marks.
- (g) If the Driver complaints regarding vacuum trouble, arrangements must be made to take necessary tests by Inspectors/Loco. Foreman at the nearest Loco changing or Carriage examining point.

## **DERAILMENTS**

- (a) Track measurements should be taken and a sketch should be prepared in accordance with instructions
- (b) Measurements of rolling stock should be taken as per C & W Manual.
- (c) For Locomotives derailments, Examination of locomotives should be done
- (d) The rail fittings and the point ridings including the locking arrangement should be examined. It should be seen whether there was any obstruction resulting in a gap in the points. Marks on the rails and sleepers should be observed and recorded.
- (e) In cases of derailments during shunting operations, it should be noted as to who was actually supervising the shunting. The position of the shunt signals, if any, point levers, point/track indicators concerned should be recorded.

## **ACCIDENT AT MANNED LEVEL CROSSING**

- (a) Location and number of the gate.
- (b) Whether engineering or traffic?
- (c) Whether interlocked or non-interlocked?
- (d) Gate working instructions validity
- (e) Visibility of signals.
- (f) Visibility for road users.
- (g) Condition of the road surface and approaches of the level crossing.
- (h) Duty roster of the Gateman
- (i) Competency certificate of the Gateman
- (j) Last census date and TVU
- (k) Length of cleanliness of the check rails.
- (l) Availability of the safety equipment.
- (m) Frequency of inspections and last inspection by officers/supervisors.
- (n) Availability of Whistle boards, Road signs, Speed breakers and Stop boards etc.

### **SIGNALS PASSED AT DANGER (SPAD)**

- (a) In order to avoid any dispute later, the fact that a Driver has passed a signal at danger should be formally brought to his notice.
- (b) The Cabin man/SM/SS must confront the Driver and Guard with regard to the position of the signal arm and position of the lever concerned.
- (c) The distance by which the train has passed the signal should be recorded in bogie lengths and telegraph posts, and by measuring the actual distance.
- (d) In the night time, the brightness of the signal lamps should be noted. The weather condition and visibility should also be recorded.
- (e) If the driver is required to use glasses (this can be ascertained from the driver himself) it should be checked whether he was in possession of them in duplicate and using them
- (f) If the Driver complains of vacuum trouble, arrangements must be made to take the necessary tests by Inspectors/ Loco foreman at the nearest Loco changing or Carriage Examination point.
- (g) The Driver must be replaced immediately on relief being made available and sent for medical examination.

## **5.3 EXAMINATION OF LOCOMOTIVE**

### **5.3.1 CHECK LIST FOR LOCOMOTIVE INVESTIGATION**

- (a) Weight distribution on the wheels of the engine and the tender.
- (b) Buffer heights and difference in level, if any, between the front and back of Locomotive and tender separately.
- (c) The clearance between the axle box and the horn stay.
- (d) Particulars of the last weightment of the engine and the tender and the weights.
- (e) Wheel gauge of the derailed axles, whether these axles were bent or straight (wheel to be gauged at the four quarters).
- (f) Thickness of type and gauge of all the wheels. In case where the tread or the flag is usually worn, the profile to be recorded.
- (g) Camber of bearing springs of engine or tender or both if both are derailed under load and free.
- (h) Conditions of the bearing spring, i.e., normal, plates broken old fracture, broken new fracture.
- (i) Any signs to indicate jamming of tender spring pillars.
- (j) Thickness of bearings.
- (k) Thickness of sole plates. The condition of the lips of the sole plates and the axle box grooves. Any indication of the sole plate having over-ridden.
- (l) Side play of bearings.
- (m) Side play of boxes in horns.
- (n) Any signs of axle boxes coming in contact with the horn stay.
- (o) Condition of bogie slide and pivot, clearance between bogie pivot and bush, whether bogie slide stops show signs of repeated impacts.

- (p) Condition of control springs - Normal, broken old fractures, broken old fractures, broken new fractures, settled.
- (q) Inter draw bar- Normal, rigid or slack.
- (r) The date when the Locomotive had been last scheduled for repairs and the class of the repairs done. Mileage done by the Locomotive since last P.O.H.
- (s) Any previous bookings for repairs which have a bearing upon the case. It should particularly be recorded whether the engine had been booked as "Riding rough" prior to the accident.

### **5.3.2 FOLLOWING DETAILS SHOULD BE RECORDED AND CONSIDERED**

- (a) Buffer height and difference in level if any, between the front and back of the engine, and tender separately.
- (b) Clearance between axle boxed and horn-stays and also between the top of the axle boxes and the frame.
- (c) Particulars of the last weightment of the engine and tender.
- (d) If a weighing Bridge is available, the weight distribution on the wheels should be recorded.
- (e) Wheel Gauge of the derailed axle to check whether these axles are bent or straight (wheels should be gauged at four quarters).
- (f) Thickness and profile of the tyres. The profile of the tyres of every pair of derailed wheels must invariably be recorded.
- (g) Camber of bearings - springs, under load of the engine or tender or both, if both are derailed and condition of bearing springs, i.e., normal, broken plates of buckle, now breakages or old markings fracture.
- (h) Any signs of jammed spring pillars, hangers and compensating beams.
- (i) Condition of bogie and pony control springs and dumbbell rods and also the measurement of the control springs both in the free and the compressed position.
- (j) Condition of bogie slide and pivot, clearance between bogie pivot and bush, whether bogie slide shown sign of jamming or bogie slide stops show signs of repeated impacts.
- (k) Thickness of tender and radial axle brass bearing. Any signs of seizure or bearings in case of engines fitted with roller bearings on carrying wheels.
- (l) Thickness of sole plates. The condition of the lips of sole plates and axle box grooves. Any indication of the sole plates having over-ridden.
- (m) Total side play on carrying and coupled wheels e.g. side play of boxes in horns and between the hub and collar liners.
- (n) Any sign of axle boxes coming in contact with the horn stays.
- (o) Any signs of wheels binding against the frame or horn rivets.
- (p) Condition of intermediate draw bar e.g., normal, rigid or slack and condition of buffing gear.

- (q) Particulars of recent replacement of bearing, springs and wheels, etc.
- (r) Date of last POH of the Locomotive in shed and kilometres run by the Locomotive since last POH.
- (s) Any previous booked repair that may have a bearing upon the case. It should particularly be recorded whether the engine had been booked as 'riding rough" prior to the accident (say in the previous fortnight),
- (t) Any other mechanical defect on the Locomotive or tender which might have contributed to or caused the derailment.
- (u) In all cases, where a defect on the Locomotive is found, attempts should be made to explain when it developed and, if necessary, enquiries should be pursued further to determine the cause. Defective or broken material should be sent for testing, if necessary. Tender details should be examined only if the tender is involved in derailment

## **5.4 EXAMINATION OF ROLLING STOCK**

### **5.4.1 REMOVAL OF UNDAMAGED ROLLING STOCK**

Rolling stock which remains on track undamaged may be taken away after the written permission of the Senior Police Official at the site. These should be taken and stabled at the nearest convenient station where further examination of the fittings can be done under the supervision of the Sr. DME/DME/ADME.

### **5.4.2 FOLLOWING DETAILS SHOULD BE RECORDED AND CONSIDERED**

- (a) A detailed examination of the engine and vehicles damaged due to accident must be made by the Sr.DME/DME (along with the Sr. Police Official in case of passenger Train accident involving casualty or sabotage).
- (b) All damages and deficiencies must be carefully noted down and particular comments made with regard to damages and deficiencies likely to cause accident and whether these appear to be old or fresh and the signature of the police official obtained on the note. These notes should be utilised for the purpose removal of making the final note in the joint examination. After this Break-down operation only, remove these vehicles then it should be started.

#### **Wheel checks**

- (a) wheel gauge
- (b) Tyre boxes play parallel to the rail; play parallel to the sleepers, and play of journals in their brassies bent axles, restriction of free movement of axle on hot axles.
- (c) Axle Guard bent or broken. Horn check wedges adjusted or displaced

#### **SPRINGS CONDITION**

- (a) Camber, conditions of individual plates, fit of the plate, gaping plates, loaded and unloaded plates.
- (b) Fastenings, buckles, hangers, links, shackles, shoes breakages, cracks or defective fittings.

**BUFFERS CONDITION**

- (a) Variation in the height of buffers indicating twisted under frames.
- (b) Buffers interlocked and defective
- (c) Examination of bogie control springs: - Marking on the bogie frames of the control springs Buffers to indicate whether the springs have settled condition of bogie pivot.

**BRAKES WORKING**

- (a) Vacuum brakes, examination of cylinders
- (b) Vacuum records on engine and brake van
- (c) Hand Brakes
- (d) Examination of records at last examination station.

**VEHICLE MAINTENANCE**

- (a) Shopping schedule and P.O.H. records of Examination.
- (b) Breakage or dropping out of any parts prior to derailment
- (c) Position of derailed vehicle with respect to the train.

**THE LOAD SHARING**

- (a) Unequal, uneven loading
- (b) Light Loading
- (c) Over Loading
- (d) Shifting of Loads.

**OPERATION MISTAKES**

- (a) Sudden opening of the regulator
- (b) Sudden application of brakes
- (c) Costing
- (d) Evidence of train staff regarding lurches prior to derailment
- (e) Train out of control on Ghats Section.
- (f) Defective vision, in oxidation or sleeping due to exhaustion of train Crew.  
Speed in excess of the authorised maximum.

## 5.5 EXAMINATION OF TRACK COMPONENTS AND TRACK GEOMETRY



### 5.5.1 ENGINEERING MANUAL CHAPTER – 7: PARA 707

**Examination of site and preparation of sketches** - The first Engineering representative to arrive at site shall attend to the following:-

- (a) He should examine the entire site inclusive of track over which the train has passed immediately before derailing, noting down any unusual features observed, especially any parts of vehicles or other material lying on or near the track.
- (b) A dimensioned sketch should be prepared covering the entire site of accident, showing all relevant features inclusive of track leading up to point of derailment, showing position of derailed vehicles, point of mount and drop and other relevant details. All the details given in **Annexure 7/1** should be incorporated in the sketch.
- (c) He should record the particulars as detailed in **Para 708(1)**.
- (d) An examination of the derailed vehicle/ vehicles for defects not caused by the derailment but which may have been the cause of the derailment should be made. He should make out notes for inclusion in the joint report.
- (e) He should examine the gang-charts/diary books to ascertain the date when track was last attended, details of engineering works in progress, if any, at the site of accident, caution orders in force and nature of protection should be noted.

### 5.5.2 FOLLOWING DETAILS SHOULD BE RECORDED AND CONSIDERED

#### FAILURES OF BALLAST

- (a) Ballast material
- (b) Size
- (c) Shape of ballast particle
- (d) Ballast profile
- (e) State of consolidation

## FAILURES OF SLEEPER

- (a) Sleeper conditions
- (b) Sleeper spacing & density
- (c) sleeper Connections
- (d) sleepers packing
- (e) sleeper level

## FAILURES OF RAIL

- (a) Fractures
- (b) Abnormal bend
- (c) Vertical wear
- (d) Lateral wear
- (e) Angular wear

## FAILURE OF TRACK GEOMETRY

- (a) Gauge
- (b) Cross level / Twist
- (c) Creep
- (d) Radius of curvature
- (e) Super elevation

## 5.6 EXAMINATION OF WORKING OF STATIONS

### 5.6.1 ACCORDING TO OPERATING MANUAL CHAPTER 1 PARA I

#### Duties of station master

- (a) Station Master is responsible for the efficient discharge of duties by different members of staff at his Station. (**General Rules 5.01**)
- (b) Ensuring that the general working of the Station is being carried out in strict accordance with the current rules, procedures and instructions.
- (c) Availability, helpfulness and good conduct of station porters
- (d) He shall be responsible for keeping the safety and operating literature including circulars, pamphlets, gazette etc. up to date and these must be explained to the staff working under him and got noted by them.
- (e) He shall be responsible for maintaining Accident register and Accident charts and keeping these up to date.
- (f) He shall promptly attend all accidents, assume charge of the site to and assist in relief measures ensuring prompt evacuation of injured & stranded passengers. He shall take note of all the information available and protect the clues/evidence, which may be helpful in the enquiry. He shall intimate the control office at regular interval for current information and ask for the required assistance i.e., Relief Train, Medical van etc. He shall investigate yard accidents, obtain statements of the staff responsible and submit his report with conclusions and joint note to the Divisional office.

## **INVESTIGATION AND EXAMINATION**

- (g) He shall ensure that fire fighting equipments at the station such as fire extinguisher, fire buckets etc. are in fine fettle and ready for use.
- (h) The Station Master should regularly test and record in the charge book, the working of Points, Signals and Track Circuit to ensure that:
  - (i) The Signals are back to 'ON' position when the relevant slide/button/ lever is put back or intended train movement has been completed.
  - (ii) It is not possible to take 'OFF' conflicting signals at the same time.
  - (iii) Signals are not taken 'OFF' until all points are correctly set and facing points locked.
  - (iv) Any other manner of testing prescribed by the Authorised Officer.
  - (v) Panel testing: Normal/Abnormal by Station Master.
  - (vi) At stations provided with continuous track circuits or at stations having solid state interlocking the method of testing shall be prescribed jointly by Signalling and Operating Branch which shall be described in the Station Working Rules to be followed by station masters.
- (i) He shall see that train signal register, station Diary, Inspection Note Book, reference books and other station record is properly maintained and preserved for a minimum period as prescribed later in this chapter.
- (j) He shall be responsible to ensure that all the operating staff working under him are relieved in time for their periodical NVT/ Competency/ Safety camp and special competency programmes. No one, overdue NVT/Competency shall be allowed to perform his normal duties.

### **5.6.2 FOLLOWING DETAILS SHOULD BE RECORDED AND CONSIDERED**

- (a) Actions taken by on duty station master after accident.
- (b) Entry in TSR (which is in custody of on duty station master)
- (c) Last date of medical examination of on duty station master and his staff
- (d) Panel competency certificate of on duty station master
- (e) Block competency certificate of on duty station master
- (f) Duty roster of station staff
- (g) Entries from crank handle register
- (h) Entries from ASM cancellation operation register.
- (i) Entries from Emergency cancellation register.
- (j) Last date of resetting of axle counter section if any
- (k) Entries from S&T failure register
- (l) Any interference to S&T gears in station office.
- (m) On duty station masters and his staff's behaviour with passengers after accident.
- (n) All safety equipments at station office
- (o) Last date and content of safety meeting with all departments from that station
- (p) Last date of renewing of first aid box

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## CHAPTER- 6: ENQUIRIES

### 6.1 OBJECT OF ENQUIRY

- (a) To ascertain the root cause of accident.
- (b) To fix the staff responsible
- (c) To Suggest remedial measures

### 6.2 LEVELS OF INQUIRY

- (a) All 'Serious Accidents' shall be enquired by the CRS.
- (b) In case CRS or CCRS is not in a position to enquire into 'Serious Accident' cases, the enquiry should be done at least by a committee of JA grade Officers, formed in consultation with CRS/CCRS.
- (c) All cases of 'Collisions' must be enquired into by a committee of SA Grade Officers unless the same is being enquired into by CRS.
- (d) All other 'Consequential Train Accidents' except unmanned level crossing accidents shall be enquired into by a committee of JA Grade Officers and in its absence by Branch officers. Consequential unmanned level crossing accidents shall be enquired into by a committee of Junior Scale Officers.
- (e) All other 'Train Accidents' shall be enquired into by a committee of Senior or Junior scale Officers as decided by respective DRMs.
- (f) All 'Yard Accidents' shall be enquired into by a committee of Senior Supervisors.
- (g) All cases of 'Indicative Accidents' shall be enquired into by a committee of JA Grade Officers.
- (h) Safety Officer shall be one of the members of all Departmental Enquiry Committee. In case Safety officer in same grade as of the Enquiry Committee is not available in the Division, Safety Officer of one grade below may be nominated for the inquiry committee.
- (i) All cases of 'Equipment Failures' shall be enquired into by senior supervisors of the respective department.

### 6.3 TIME LIMIT

**Revised Item No. 9 to replace the existing item 9 at pages 6-7 of letter No. 2000/Safety (A&R)/ 19/20, dated 13.12.2000 regarding levels of accident inquiries to be conducted in various accidents:**

#### **Accident Inquiry by the Railways:**

- (a) All 'Serious Accident' shall be inquired into by the Commissioner of Railway Safety.
- (b) In case Commissioner of Railway Safety or Chief Commissioner of Railway Safety is not in a position to inquire into serious accident cases the Inquiry shall be done by JA Grade Inquiry Committee **with DRM as the accepting authority subject to the review by CSO.**
- (c) All cases of 'Collisions' falling under A1 to A4 categories shall be inquired into by a committee of SAG officers with General Manager as the accepting authority unless the same is being inquired into by CRS.

**ENQUIRIES**

- (d) All other 'Consequential Train Accidents' except Unmanned Level Crossing Accidents shall be inquired into by a committee of JA grade officers and in its absence by Branch Officers. **DRM shall be the accepting authority for these inquiries subject to the review by CSO.**
- (e) 'Consequential Unmanned Level Crossing accidents' and all other train accidents shall be inquired into by a committee of Senior Scale or Junior Scale Officers as decided by respective DRMs **with DRM as the accepting authority.**
- (f) All 'Yard Accidents' shall be inquired into by a Committee of Senior Supervisors **with Senior DSO/ DSO as accepting authority.**
- (g) All cases of 'Indicative Accidents' shall be inquired into by a Committee of Senior or Junior Scale Officers **with DRM as the accepting authority.**
- (h) General Manager or DRM can have the inquiry conducted by a committee of higher levels of officers than the above mentioned levels depending upon the seriousness of accident.
- (i) In accident cases wherein the Inquiry Committee determines responsibility on the Staff of Foreign Railway, the Inquiry Report should be put up to the Principal Head of the Department of the concerned department of the Railway on which the accident took place through CSO after which such inquiry report shall be accepted by the AGM (instead of DRM). Finalization of Inter-railway DAR cases arising out of such inquiry reports be followed up by the Principal Head of the Department of the concerned department of the Railway on which the accident took place. If suitable response is not received from the respondent railway at General Managers' level, then the case should be referred to Railway Board.
- (j) All cases of equipment failure shall be inquired into by Senior Supervisors/Supervisors of respective departments.
- (k) All inquiries will be ordered by the concerned DRM except for inquiries into collisions as per item (iii) as above wherein General Manager will order the inquiries.

**As per railway board letter No.2005/Safety (A&R)/6/4 New Delhi, dated 02.02.2006**

**Sub: Procedure for completion of Departmental accident inquiries.**

<b>Sl. No.</b>	<b>Model Time</b>	<b>Remarks</b>
1	D	Date of Accident
2	D+1	DRM /GM* shall order the inquiry, if no particular department accepts the responsibility.
3	D+3	Committee shall convene the inquiry into the accident.
4	D+7	Committee shall submit the inquiry report to DRM/GM*.
5	D+10	Acceptance of inquiry report by the DRM/GM* /Sr.DSO (only for yard accident) +
6	D+15	Inquiry reports will be finalized by CSO/AGM.
7	D+20	Submission of inquiry report to CRS for the section of the Railways on which the accident occurred with the remarks. A copy of findings of the Inquiry Report to be sent to Railway Board.
8	D+90	DAR action against responsible officials to be completed

\* For SAG Level Inquiries

+ Slightly Modified Under letter No.2005/Safety (A&R)/6/4 New Delhi dated. 24.02.2006.

## 6.4 PRELIMINARY ENQUIRY

An Officer or Sr. Subordinate conducting a Preliminary Enquiry is authorised to examine and take the deposition of employees of all departments. These depositions must be produced at any subsequent enquiry, and must be included in the general evidence.

- (a) Staff alleged found to be guilty of offences, which in the opinion of the DRM or the concerned Divl. Officer, would if proved, result in their removal from service or dismissed, must be placed under suspension, pending the result of the enquiry.
- (b) In the case of Driver passing Engineering stop Indicators or passing Fixed Signal at danger or running into Banner flags if there are grounds for suspecting that the accident may be due to defective vision, the Driver must be placed under suspension and immediate arrangements made to have his vision tested. If the result of the test is satisfactory, the Driver may be allowed to resume duty.
- (c) When any member of the staff is placed under suspension in consequence of an accident the usual procedure regarding suspension of a staff must be observed.

## 6.5 DETAILED ENQUIRY

Normally the 'DRM' shall order these Enquiries for accidents, GM or on his behalf, the CSO may order an enquiry into serious accidents, as deemed fit.

### 6.5.1 CLASSIFICATION OF INQUIRIES

- (a) **Commission of Enquiry:** - Central government may appoint a Commission of enquiry under the Commission of Enquiry Act, 1952 (LX of 1952) in a very serious accident.
- (b) **Commissioner of Railway Safety Enquiry:** - CRS may order and personally conduct an enquiry into an accident. CRS shall inform the GM/CSO of his intention to hold an enquiry and shall at the same time, fix and communicate the date, time and place of the enquiry.
- (c) **Magisterial Enquiry:** - In case of reportable train accident, the District magistrate or any other magistrate he may make an enquiry or depute subordinate magistrate or direct investigation to be made by the police.
- (d) **Joint Enquiry:** - When a reportable train accident has occurred, a joint enquiry shall be held for thorough investigation of the causes which led to the accident.
- (e) **Departmental Enquiries**
  - (i) **Officers Enquiry:** - When a Joint Enquiry / Magisterial Enquiry / CRS Enquiry into a reportable train accident is dispensed with, departmental Enquiry consisting of railway officers shall be held to determine the cause and / or responsibility for the accident.
  - (ii) **Sr. Supervisors Enquiry:** - All yard accidents shall be enquired into by a committee of Sr. Supervisors as decided by the DSO/ Sr. DSO/DRM.
- (f) When loss or damage to Mail Vans and Mails forms the subject to inquiry, the Superintendent, R.M.S. concerned shall be intimated. He may be present at the inquiry, but will take no part therein.
- (g) Where military personnel property are involved, the Headquarters of the Military Command should be advised of the date, time and place of enquiry so that the Headquarters may send a Military representative to attend the enquiry if they so desire. The Military representative so deputed will only be an observer to watch the proceedings and not to act as a Member of the Inquiry.

- (h) If accident is occurred in a private siding and for which the owner of the siding or his employees may be in any way responsible, opportunity should be given for the owner of the siding to attend the inquiry, but he will take no part there in.

## **6.6 COMPOSITION OF ENQUIRY COMMITTEE**

- (a) Enquiry committee will normally consist of 3 officers from Safety, Electrical, Signalling, Operating, Mechanical and Engineering Department. Other departments may also be represented if necessary.
- (b) When crew of Locomotive of another division is involved, representative of that division may also be included in the enquiry committee.
- (c) In case of fire accident the representative of RPF should also be associated.
- (d) No officer or a Subordinate official whose evidence is required to be recorded before an enquiry committee should be appointed as a Member of that committee except when allowed only under the personal orders of the CSO/DRM.

### **6.6.1 PRESIDENT OF ENQUIRY**

- (a) At a joint or Officers inquiry, the senior most officer in the highest grade among those present at the enquiry will preside, seniority in the same grade among Officers belonging to different departments being reckoned on the total length of service and among officers of the same department, from the date of appointment to the grade.
- (b) At a Sr. Supervisors enquiry, the senior most subordinate in the highest-grade among those present at the enquiry will preside, seniority as between Sub-ordinates belonging to different departments in the same grade being reckoned on the total length of service, and as between subordinates belonging to the same department, the respective seniority in the Department.

### **6.6.2 TIME AND PLACE OF ENQUIRY**

An enquiry must be held either at the place where the accident took place or at the nearest station, unless the Committee unanimously agrees that the holding of the enquiry elsewhere will best suit the circumstances of the case and the convenience of the witnesses.

### **6.6.3 OFFICER'S DUTIES IN CONNECTION WITH ENQUIRY**

Whenever an enquiry has been ordered, it will be the duty of the Divisional Officer of each Department to advise all persons concerned under his charge or any other witnesses whom the committee may require to give evidence to be present at the place and on the date and time fixed for the enquiry, and he will also be responsible for seeing that all documents necessary for conducting the enquiry are available and any information required is readily given.

Enquiry Committee should Endeavour not to call unnecessary witnesses. Other information required is readily given. Enquiry Committee should Endeavour not to call unnecessary witnesses.

## **6.7 TO FIX RESPONSIBILITY FOR THE ACCIDENT**

- (a) The responsibility should be fixed at higher level and should be specific i.e. primary, secondary and blameworthy. In fixing individual responsibility, if there are any extenuating circumstances, these should be mentioned
- (b) To formulate proposals for preventing a recurrence, practical feasibility of the recommendations should be borne in mind; the repercussion of the proposals should also be examined.

- (c) To determine whether there was a general laxity in working to which the accident could also be attributed.
- (d) To suggest improvement in system, practices and procedures. Some guidelines for the members of enquiry committees: - Following guide line for the members of enquiry committee. Strict impartiality must be observed by all members of the committee.
- (e) Findings shall be drawn unanimously, as far as possible dissent note should not be given.
- (f) Different technical data as well as evidence bearing on the accident have to be collected and sifted and an attempt should be made as far as possible to reconstruct the sequence of events leading to the accident,
- (g) Unless the cause of accident is evident, each of the factors that could result in the accident should be examined and its contribution, if any assessed.
- (h) The sequence of events prior to and after the accident should be brought out in the proceedings.
- (i) To check general laxity in working or ineffective supervision the relevant record should be examined over some period to check whether the irregularities that have come to light relating to the accident had been repeated previously. The inspection notes of supervisory staff should be perused and it should be determined whether the irregularities could have been detected earlier and set right and effective supervision had been exercised.
- (j) The following points should also be examined when relevant:-
  - (i) Whether the staff has passed the prescribed medical examination. In case of staff that are required to use glasses whether they were using them at the time of the accident, or not.
  - (ii) Hours of work and previous rest of the staff concerned and whether it complied with the rostered duties and the hours of employment regulations,
  - (iii) Whether the staff was acquainted with the rules pertaining to their duties and possessed the necessary competency certificates,
  - (iv) Whether the staffs was in possession of the prescribed Rule Books.

## 6.8 ENQUIRY BY CRS

- (a) One of the important functions of the CRS is to enquire into serious accidents. Notices of Statutory Investigation into Rly. Accidents Rules, 1973. The relevant portions of rules relating to the enquiries into serious accidents are reproduced below: -
- (b) Every Accident to a train carrying passengers which is attended with loss of human life or grievous hurt as defined in the Indian penal code to a passenger or passenger in the train or with serious damage to Rly. Property of the value exceeding ₹ 2 crores. and any other accident which in the opinion of the Chief Commissioner of Rly. Safety or the Commissioner of Rly. Safety requires the holding of an Enquiry shall be deemed to be an accident of such a serious nature as to require the holding of an enquiry.
- (c) Where the Chief Commissioner of Railway Safety considers the holding of an Enquiry into an accident necessary, he may either hold the enquiry himself or direct the Commissioner of Railway Safety to do so.

- (i) He shall submit a confidential report in writing to the Chief Commissioner of Railway Safety and shall forward copies of the report to:-
  - Railway Board;
  - Railway Administration of all the Zonal Railways;
  - In the case of a railway under the control of a State Government or Local Administration to such Government or Administration if the accident has occurred in that Railway;
  - Other Commissioners of Railway Safety;
- (d) Director, Intelligence Bureau, Ministry of Home affairs, Government of India, if the Commissioner of Railway safety finds that the accident was caused due to sabotage or train wrecking.

## **6.9 PREPARATION OF PLAN FOR CRS ENQUIRY**

A dimensional plan should be prepared for the CRS or Judicial enquiry, which should be a reproduction of the original sketch. Copies of recorded note signed by the Railway and the police representatives should form an appendix to the statement made by the senior most official in his evidence at the enquiry. Notes and sketches are to be carefully preserved.

All notes and sketches recording observations of the various officials who attend the site of suspected sabotage or train wrecking must be carefully preserved for future use in case evidence of such officers and officials is required at later enquiries, subsequent investigations or in court trials.

### **6.9.1 INTER-DEPARTMENTAL ENQUIRY ORDERED BY GM (MAJOR JOINT ENQUIRY)**

Even if the CRS does not hold an enquiry, the Railway will hold an Enquiry under following circumstances.

- (a) If the accident is classified as serious and if a passenger train is involved.
- (b) If the system of working is suspected to be defective.
- (c) If the GM considers Joint Enquiry is necessary.

### **6.9.2 MAJOR JOINT ENQUIRY NOT NECESSARY AS UNDER**

- (a) When an enquiry is held by CRS or when commission of enquiry appointed or any other authority appointed by the Central Government.
- (b) When there is no reasonable doubt as to the cause of the accident.
- (c) If any department of the Railway Administration concerned intimate that it accepts all responsibility in the matter.

### **6.9.3 MAJOR JOINT ENQUIRIES ARE OF 3 KINDS**

- (a) By Administrative Officers
- (b) By Divisional Officers
- (c) By Assistant Officers.

### **6.9.4 MINOR JOINT ENQUIRY**

It is an enquiry held under the orders of DSO by a committee of Supervisory officials to enquire into an Accident.

## 6.10 PROCEDURE FOR CONDUCTING JOINT ENQUIRIES

- (a) The Sr. Officers in all cases shall preside.
- (b) The Enquiry must be held at the station nearest to the site of the accident and within three days after the accident.
- (c) The date once fixed may not be changed except in case of absolute necessity.
- (d) The representative of each department shall be responsible for summoning and arranging for the attendance at the Enquiry of the staff of his own department may be able to give evidence in the case.
- (e) The Presiding Officer must arrange for the attendance of any other witness whose presence he considers desirable or whom any other member of the committee wishes to have examined.
- (f) Before starting the Enquiry, issues must be framed and the evidence confined to settling these issues as far as possible.
- (g) Witness must not be permitted to make oblong irrelevant statements, but from the outset must be asked questions relevant to the point at issue, after which their evidence, as recorded, must be read over to them and they must be asked if they have anything that witnesses must be cross-examined and re-examined if necessarily to elicit important details.
- (h) Irrelevant matter must be excluded as much as possible.
- (i) If a witness has given a statement prior to the Enquiry, the statement must first be read over to him and recorded as his deposition.
- (j) The Witness must also be specifically asked to state whether he has anything to depose in addition to, or in modification of that statement and his reply recorded and his signature obtained.
- (k) Any further evidence on the part of the witness must be the outcome of cross-examination and no fresh independent statement must be recorded. The questions put to the witness in the cross-examinations and the answers therefore, must be recorded then and there.
- (l) If a witness in his statement gives evidence of facts which have occurred and which are contrary to the rules and regulations an which render him culpable of neglect or violation of the rules and regulations, it must be elicited from the witness, during his examination, whether he is aware that the facts said by him are contrary to the rules and regulations in force.
- (m) The evidence of any officer (including a member of the Committee) who may have been present when the accident occurred must be recorded.
- (n) The Enquiry Officer or Committee shall not be satisfied merely with the determination of the immediate cause or causes of the accident, but must look for, elicit necessary evidence and ascertain the contributory factors if any, which have led the staff to commit the breach of rules and must also go fully into the matter of the extenuating circumstances, if any, which have a bearing on the accident.
- (o) Inadequacy of signalling and interlocking equipment or other safety devices (such as, interlocking key box, Point Indicators, etc.) inadequacy or absence of communication equipment (such as, telephones, key transmitters, etc.) resulting in frequency trips on the part of the station staff over long distances, impossibility,

especially at peak periods of carrying out all the operations and duties laid down for the staff, absence of the minimum staff required to perform all the duties and operations laid down impracticability of complying with the station working Instructions, staff working overtime owing to want to timely relief, etc., considerable care must be exercised in assessing the extenuating circumstances.

- (p) The standards considered desirable must be co-related to the workload at the station and shall be comparable to the standards obtaining at other similar stations.
- (q) The Enquiry Officer or Committee must also duly note matters brought to light in the course of the Enquiry, which, though not having a direct bearing on the accident, are such as might lead to accidents of any other description as it is essential that such potential dangers must be taken note of and must be eradicated without delay.
- (r) In the case of joint enquiries, it is necessary for the members of the Magistrate and the police to attend the deliberations in regard to the Finding or to sign the joint Enquiry proceedings, but they may ask any questions while the examinations of witnesses is going on and the answers given to such questions must be recorded as a part of the proceedings.

#### **6.10.1 PROCEEDINGS OF JOINT ENQUIRIES**

A report of the Proceedings must be written by the president or by someone deputed by him for this duty. The report may be typed in the prescribed forms and any correction in it must be initialed by the President. The signature of the witness must be obtained then and there, all corrections being attested by the witness. It must be in the following sequence.

#### **6.10.2 SUMMARY**

List of members of the Committee and of other officials attending Descriptive Account of the accident, which must be a brief record of the actual facts and must, interalia, contain the following information :-

- (a) Grades, Curves, Type of Signalling and Interlocking,
- (b) Type and condition of permanent way,
- (c) Weight of engine and weight of each wheel,
- (d) Marshalling of train,
- (e) Brakes and number of branded wheels,
- (f) Conditions of rolling stock, time train was due, and if late,
- (g) Time lost and reason therefore,
- (h) Extract from the Train Register Book or Train message Book at the Stations at both ends of the Block Section concerned, if the running time, speed, departure or arrival time is in dispute, whether train was booked to cross, or was crossing, out of course, whether train was booked to run through or stop,
- (i) Weight on each wheel of vehicle concerned in a derailment.
- (j) List of Witnesses examined with their names, designation and staff members.
- (k) Deposition of Witness Reasons for finding Joint Finding Matters brought to light during the Enquiry Relief Measures, etc.

#### **6.10.3 DESCRIPTIVE ACCOUNT**

The Descriptive Account shall be confined to a brief, but clear description of the accident and must contain a reference to the evidence. The evidence shall be left to speak for itself.

#### **6.10.4 WITNESSES**

Each Witness must be assigned a number which, in addition to being entered after the name of the witness at the commencement of the statement must be repeated after the signature at the end, as 'Witness No.' and in the proceeding wherever he is referred to. All particulars required by the Enquiry Proceedings must be given in the case of each witness, the nationality of witnesses being recorded thus - Indian. In the case of witnesses belonging to train or station staff, the hours of duty and rest must also be recorded.

#### **6.10.5 MATTERS BROUGHT TO LIGHT DURING THE ENQUIRY**

Matters brought to light during the enquiry which, though not having a direct hearing on the accident, indicate irregularities in working which might lead to accidents or any other description, must be mentioned. In the absence of any such matter, a 'NIL' entry must be made and submitted.

#### **6.10.6 PROCEEDINGS**

The proceedings of an inquiry will consist of the following documents:-

- (a) A list of members composing the Committee;
- (b) A description and summary of the accident;
- (c) A list of witnesses in the order examined;
- (d) The evidence of each witness with his name, designation and length of Service;
- (e) The findings arrived at by the Committee;
- (f) The reasons for the Findings;
- (g) A statement showing the cost of damage, if any to :-
  - (i) Permanent Way or Works;
  - (ii) Locomotive;
  - (iii) Rolling Stock,
  - (iv) S&T gears;
  - (v) Overhead Equipment;
  - (vi) Luggage, parcels and goods.
- (h) List of passengers or Railway servants, killed or injured, if any, with the Nature of the injuries sustained;
  - (i) Extract of relevant documents, if necessary;
  - (j) Rules violated;
- (k) Service particulars of staff held responsible giving brief particulars of Accidents if any, in which they were involved during the past 3 years with punishment awarded;
- (l) A sketch of the site of accident. The sketch should show the North point and the direction of the terminal station.
- (m) Recommendations;
- (n) Suggestions for system improvements; and
- (o) Other matters brought to light.

## 6.11 THE DESCRIPTION, SUMMARY OF THE ACCIDENT AND THE LOCALITY

This shall be a record of the actual facts and will include such of the following items, as may be relevant to the accident

### (a) Description of the accident

- (i) Date and time of the accident;
- (ii) Nature and summary of the accident;
- (iii) Kilometerage;
- (iv) Nearest station;
- (v) District and state.
- (vi) Terminal stations at either end;
- (vii) Single or double line;
- (viii) Electrified or non-electrified.
- (ix) Number and class of the train;
- (x) Load in tons and vehicles;
- (xi) Marshalling order of the train;
- (xii) Condition of Rolling Stock;
- (xiii) Brake power of the train;
- (xiv) Whether the train was booked to run through or stop;
- (xv) Train lights and headlight whether lit;
- (xvi) System of working at the time and
- (xvii) Weather and visibility conditions;

### (b) Description of the locality

- (i) Type and condition of formation;
- (ii) Type of Permanent Way i.e. sleepers, rails, ballast used;
- (iii) Condition of Permanent Way
- (iv) Grades and Curves;
- (v) Gauge and Cross-levels;
- (vi) Cant and Super elevation,
- (vii) Description of signals;
- (viii) Sighting of signals from approaching train and from the point from which they are worked;
- (ix) System of interlocking and when no interlocking is provided, method of setting and locking of points and controlling of signals.

### 6.11.1 FINDINGS

- (a) The findings should consist of a simple statement of the opinion of the Committee as to what caused the accident, mentioning the staff responsible, if any, and the rules violated or the offence committed by them. It should also be mentioned under which of the following categories the accident falls-
  - (i) Failure of Railway staff;
  - (ii) Failure of other than Railway staff;
  - (iii) Failure of locomotive or Rolling Stock;
  - (iv) Failure of permanent way;
  - (v) Failure of electrical, signalling and other equipment;
  - (vi) Fires;
  - (vii) Accidental or act of God;
  - (viii) Not definitely determinable.
- (b) **Dissent, reasons:** - If a Member does not agree with the findings, he must record his note of dissent and reasons thereof, the note of the dissent must be drawn up on the spot. This document must accompany the proceedings.
- (c) **Reasons For Findings:** - In the Reasons for findings, the Committee must state fully the reasons which have led them to arrive at their findings. The Committee should bear in mind that the proceedings have to be considered by those who have not had the advantage of hearing the evidence and reviewing the circumstances on the spot.

The description of the accident and the remarks of the Committee should, therefore, be as complete as possible, and knowledge on the part of others, who have to peruse the proceeding, of the conditions obtaining at the time and place of occurrence should not be assumed.

The value of the evidence of each witness should be commented upon, and it should be stated, in the case of doubtful witness, whether the witness is impartial or whether he is one to whom the decision is mattering indifference, or whether he is likely to be interested in securing a particular decision.

### 6.11.2 ACCIDENT INVESTIGATION REPORT

#### 1. Short Title and Commencement

- (a) These rules may be called the Railway Notices and Enquiries into one on the date of their publication in the Official Gazette.
- (b) The notices mentioned in Section-113 of the Railways Act, 1989 (24 of 1989) (hereinafter referred to as the Act), shall contain the following particulars, namely-
  - (i) Kilometerage, or station or both, at which the accident occurred;
  - (ii) Time and date of the accident;
  - (iii) Number and description of the train; or trains;
  - (iv) Nature of the accident;
  - (v) Number of people killed or injured, as far as is known;
  - (vi) Cause of the accident, as far as is known; and
  - (vii) Probable detention to traffic.

### 6.11.3 RESPONSIBILITY

The responsibility of ensuring correct reporting of accidents shall be with the Divisional Railway Manager (DRM) at Divisional level and the General Manager (GM) at the Zonal level.

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## CHAPTER- 7: PUNISHMENTS PRESCRIBED IN ACCIDENT CASES

### 7.1 NOTE:

- (a) 'D' Staff: Staff directly held responsible for the accident.
- (b) 'S' Staff: Staff who are found to have secondary responsibility. In their case
- (c) The penalty imposed will depend on the degree of their contribution to the accident/engine failure and the Disciplinary authority will use its discretion in the matter.
- (d) The Disciplinary authority must impose the minimum penalty if the responsibility of staff is clear. Factors like the employee's past record of service may be taken into account by the Appellate authority if and when an appeal is made to it. The disciplinary authority should deal with the case solely with regard to the facts and circumstances of the accident itself.

### 7.2 NATURE OF ACCIDENT & MINIMUM PENALTY

As per railway board letter number No.99/Safety (A&R)/6/11, Dt 23.4.1999

**Sub: Punishment to be imposed in case of accident.**

Item No of letter	Nature of Accident		Minimum Penalty
1	Collisions involving a train	Involving loss of human life.	'D' Staff - Dismissal.  'S' Staff - Major penalties (v), (vi) or (vii)
		Not Involving loss of human life.	'D' Staff - Dismissal.  'S' Staff - Major penalties (v), (vi)
	Averted collisions involving a train.		'D' Staff - Removal from Service.  'S' Staff - Major penalty (v) or (vi)
	Train passing signal at danger.		Removal or compulsory retirement where entirely due to neglect of driver; reduction to a lower grade if there are contributory factors like loss of brake power on the run which he could not have detected when he took charge of the engine.
4. Over-speeding by drivers (in cases other than collisions, averted collisions and passing signals at danger)			
Sub Item No	Nature of Accident	Minimum Penalty	Sub Item No
(i)	Resulting in derailment of passenger train	Involving loss of human life.	Dismissal if there are no other contributory factors like track or rolling stock defects; Removal if there are such contributory factors.
(ii)	Resulting in derailment of passenger train	Not Involving loss of human life.	Removal, if there are no other contributory factors like track or rolling stock defects;-- reduction to 'C' grade for 3 years if working substantively in 'C' or 'B' grade and reduction to Shunter for 3 years if working substantively in 'C' grade with loss of seniority in both cases. If there are such contributory factors.

<b>Sub Item No</b>	<b>Nature of Accident</b>	<b>Minimum Penalty</b>	<b>Sub Item No</b>
(iii)	Resulting in derailment of goods trains on the main line in mid-section or within station limits.		Reduction to grade of shunter for one to three years with loss of seniority
(iv)	Resulting in derailment of goods train in station yard on other than main line		Reduction to Shunter for one to three years, depending on the extent of damage, without loss of seniority on being restored to 'C' grade driver
7	Station derailments while shunting: Due to Driver's fault.		WIT for 2 years
8	Breach of Block Rules (which do not result in collision or averted collision)		Reduction to a lower stage in the time scale.

## 9. Accidents at Manned Level Crossings.

<b>Sub Item No</b>	<b>Nature of Accident</b>	<b>Minimum Penalty</b>	<b>Sub Item No</b>
(i)	Failure of Gateman to close the gate.	Involving loss of human life.	Dismissal.
		Not Involving loss of human life.	Removal
(ii)	Failure of SM/ASM to ensure closure of level crossing gates before allowing any movement where rules provide		Reduction to a lower grade or post with loss of seniority (WIP 3 years in case in the lowest grade).
(iii)	Failure of Driver in observing rules before passing a gate signal in danger		Reduction to a lower grade with loss of seniority
(iv)	Where no breach of rules is proved but lack of vigilance on the part of driver /guard of other staff is proved		WIT upto 2 years 11 months.

## 12. Locomotive defects

<b>Sub Item No</b>	<b>Nature of Accident</b>	<b>Minimum Penalty</b>
(i)	Negligence in repairs or maintenance in shops or shed resulting in accidents	Reduction to a lower stage in the time scale with loss of seniority for the first offence, reduction to a lower grade with loss of seniority for the second offence and removal for the third offence
(ii)	Negligence in repairs or maintenance in shops or sheds or bad engine man ship by Driver resulting in Engine Failure	For the first offence stoppage of Passes and PTOs for 1 year; the second offence WIT 1year and for the third offence reduction to a lower grade for years.

14. Signal & interlocking failures, Signal & interlocking defects for which maintenance staff are held responsible resulting.				
Item No of letter	Nature of Accident			Minimum Penalty
(a)	Accidents of passenger train	(i) If due to causes where interlocking' has been shorted circulated/made inoperative	Involving loss of human life	D. Staff - Dismissal S. Staff - Major penalties under item (v), (vi) or (vii)
		(ii) If due to causes where 'interlocking' has deteriorated due to bad maintenance repairs	Involving loss of human life	D. Staff - Removal S. Staff - Penalties under item (v) or (vi)
(b)	Accidents of passenger or goods train	where interlocking' has been shorted circulated/made inoperative	Not involving loss of human life	D. Staff- Removal S. Staff- Penalties under item (v) or (vi)
		where 'interlocking' has deteriorated due to bad maintenance repairs	Not involving loss of human life	D. Staff - Penalties under item (vi) S. Staff - Penalties under item (v)
(c)	Derailment of goods train on the main line, in mid-section or within station limits			D. Staff - Penalties under item (vi) S. Staff - Penalties under item (iv) or (v)
(d)	Derailment of goods train within station yard other than main line			D. Staff - Penalties under item (v) S. Staff - Penalties under item (iv)
13. Traffic Staff failure, resulting in accidents other than collisions or averted collisions.				
Sub Item No	Nature of Accident			Minimum Penalty
(i)	Wrong setting/manipulation of points.			Reduction to a lower grade with loss of seniority
(ii)	Incorrect signaling			WIP upto three years.
(iii)	Wrong marshalling			Reduction to a lower stage in a time scale of pay.
(iv)	Excessive/uneven loading or improper securing of loads			WIT upto three years.

Engg department - Major track defects such as buckling, worn-out switches and crossings and spread of gauge			
Sub Item No	Nature of Accident		Minimum Penalty
(i)	Resulting in derailment of passenger trains	Involving loss of human life.	<p>D. Staff – Dismissal</p> <p>S. Staff - Reduction to a lower grade for a period of 3 years with loss of seniority. If any staff such as PWI/Gr.II are in the lowest grade reduction by 3 stages in the scale of pay with loss of seniority. If the staff are in the lowest stage of pay where reduction by 3 stages is not possible, WIT for 3 years with loss of seniority</p>
		Not Involving loss of human life.	<p>D. Staff – Removal</p> <p>S. Staff - Reduction to a lower grade for a period of 3 years with loss of seniority. If any staff such as PWI/Gr.II are in the lowest grade reduction by 3 stages in the scale of pay with loss of seniority. If the staff are in the lowest stage of pay where reduction by 3 stages is not possible, WIT for 3 years with loss of seniority</p>

Engg department - Major track defects such as buckling, worn-out switches and crossings and spread of gauge			
Sub Item No	Nature of Accident		Minimum Penalty
(iii)	Resulting in derailment of goods train in station yards on other than main line.		<p>D Staff -</p> <p>Reduction to a lower stage in time scale of pay for a period of 2 years without the effect of postponing future increment.</p> <p>S Staff –</p> <p>WIT up to 2 years 11 months or with-holding of Pass/PTOs for 2 years where the staff has reached the maximum of the grade</p>

### 7.3 MAJOR PENALTY NORMS

Item number of major penalty	Penalty
v	Reduction to lower stage in time scale of Pay for a period not exceeding 3 years, without cumulative effect.
vi	Reduction to a lower timescale of Pay, Grade, Post or Service.
vii	Compulsory retirement.
viii	Removal from Service
ix	Dismissal from Service

\* \* \*

## CHAPTER- 8: FEW ACCIDENT CASES

### DETAILS OF SOME MORE ACCIDENT CASES:

#### 8.1 CASE-1

##### HEAD-ON COLLISION OF 9112 JAMMU TAWI EXPRESS WITH 1 JMP DIESEL MULTIPLE UNIT PASSENGER TRAIN ON 14.12.2004.

###### INCIDENT

Block instruments and block phones failed (Quad cable got damaged due to construction works) between stations Mirthal and Bhangala on a single line section of Ambala Division of Northern Railway about 24 hours prior to the accident.

Under block failure conditions, Trains were to be worked on paper line clear (PLC) by exchanging PN number through VHF sets. But the two Station Masters of these stations did not do so and dispatched trains in the same block section from opposite directions resulting in Head-on collision of 9112 Jammu Tawi Headband Express with 1 JMP Diesel Multiple Unit Passenger train on 14.12.2004 at 11.53 hrs.

###### 8.1.1 POINTS TO NOTE

- (a) Block is vital safety critical equipment. Its working must be ensured. All care must be taken to prevent cable damages by properly altering others doing trending / earth moving in the Vicinity of cables.
- (b) Cable route markers shall be provided at every 200 Mts. and at every change of alignment/direction and Cable route plan to be kept updated to enable quick restoration of cable faults.
- (c) Cable route plan must be prepared updated (whenever required) and all precautions must be taken during cable laying for ensuring its life.

#### 8.2 CASE-2

##### COLLISION OF 9168 UP SABARMATI EXPRESS WITH STABLED GOODS TRAIN AT SAMLAYA JUNCTION STATION OF WESTERN RAILWAY ON 21.4.05 AT 03.10 HRS.

###### INCIDENT

Samlaya station has end cabins with lever frame and CLS. It's up Main home signal failed as facing point failed for Normal setting. Station Master advised ESM on VHF (instead of sending the written advice). BRC Divn. / W.Rly. reg. Failure ESM opened the Cabin Relay Room without making an entry in the Relay Room registers. ESM also picked up HR relay of Up Home signal by false feed, without verification of physical setting of the facing point and 9168 Up Sabarmati Express was then given run through signal on main line but facing point continued to be in reverse condition. i.e., set for the loop line. Thus Sabarmati express entered the loop line and collided with another stabled goods train causing serious casualties.

###### POINTS TO NOTE:-

- (a) False energisation of HR Relay by ESM, (ignoring Point Failure) caused the accident. So no short cut to be adopted for passing train in case of failure.
- (b) A written advice is to be sent by the Station Master to the ESM regarding signal failure and signal is to be restored only after the receipt of written advice back from the ESM.
- (c) Relay room must be opened only after entering in the SM's Relay room key register.

### 8.3 CASE-3

#### 2841 UP CORAMANDEL EXPRESS ENTERING THE UP LOOP LINE AT NELLORE STATION ON 14/2/2005 WHILE SIGNALLED FOR RUN-THROUGH.

##### INCIDENT:-

On 14/02/2005, facing Point No. 16 of Nellore station of BZA divn in S.C.Rly connecting Up main to Up/Common loop failed in Normal and was attended by ESM/A/NLR along with SSE/PW/NLR at about 03-11 Hrs .

At about 14-40 hrs Up 2841 Coramandel express was signalled for run-through on Up mainline. The train passed Up Home at 14-45 hrs. entered Up Loop as facing point No 16 was in Reverse position.

By driver's alertness, the train was brought to a stop soon after entering the loop line.

Investigation revealed that the Point No- 16 at site remained in reverse condition while train was signalled for run through due to direct Energisation of 16 NWKR in the Relay room by ESM by false feed.

##### 8.3.1 POINTS TO NOTE:

- (a) ESM/NLR station attended the failure of Point No.16 without following proper procedure (G&SR 3.68) and falsely energised 16 NWKR.
- (b) Dy.SS/NLR also failed to follow the procedure prescribed by the Para 3.68 of G&SR and Appendix XI/6(a) page 303 of G&SR and allowed ESM into the Relay room without any Entries in the Relay Room Key Register.

### 8.4 CASE - 4:

#### REAR END COLLISION OF LOCAL TRAIN NO. 439 ON DN LOCAL LINE WITH ANOTHER LOCAL EMU TRAIN NOS. 437 DN AT MAHIM STATION IN AUTO SECTION OF MUMBAI DIVISION ON 9TH AUGUST 2009.

##### INCIDENT:-

Train nos. 437 Dn was waiting for signal on Mahim platform no.1 439 Dn local passed Auto Signal A386 in danger & collided with train no. 437 was waiting for signal. Motorman of 439 Dn claimed that the signal A386 was yellow.

Data logger reports showed that the train no. 437 passed signal A386 at 13.05.10.078 hrs (A386T TP1R occupied) causing the signal to go to danger at 13.05.10.172 hrs (A386 RE(Mn) CPR UP) & occupied A386AT (PF no. 1 Berthing track) at 13.05.36.750 hrs(A386AT TP1R occupied) and cleared the rear track A386T at 13.06.06.828 hrs.

After the above events the status of relay A386 RE (Mn) CPR and that of relay A386AT TP1R had not changed. The next train no. 439 Dn passed the signal S-11 (rear to A386) at 13.08.11.031 hrs (11T TP1R occupied) and progressed towards A 386 & passed the same as seen by sequential occupation of tracks 101T & 386T at 13.08.21.203 hrs & 13.08.33.266 hrs respectively (The status of relay RE (Mn) CPR was still UP and that of relay A386AT TP1R still occupied) .It proved that the motorman of 439 Dn has passed the signal A 386 at ON (danger).

**8.4.1 POINTS TO NOTE:**

**Data Logger-As Investigation Tool**

Data logger is a microprocessor based data acquisition system which logs the field events, various signal status and analog voltages are continuously monitored and acquires by the system. The Data thus acquired is processed to give on line and off line reports with the help of software this it is possible to periodically monitor the health of the signalling system besides fault analysis. Many accident cases / unusual cases have been investigated through use of data loggers.

**IMPORTANT WORKS OF DATA LOGGER**

**JE/SSE (signal/telecom)**

- (a) Validation work of data logger
- (b) Regular observation of data logger
- (c) Keep PC and printer ready at all time.
- (d) Ensure communication of data logger with S&T control room.
- (e) If any alteration work is carried out, it shall be updated in data logger software.

**ADSTE/DSTE/ Sr. DSTE**

- (a) All S&T officers inspecting the station shall inspect data logger working.
- (b) Any deficiency noticed shall be taken up.

**8.5 CASE - 5:**

**CASE REFERRED BY NTSB (NATIONAL TRANSPORTATION SAFETY BOARD)  
WASHINGTON, USA.**

**COLLISION OF WMATA METRO RAIL TRAIN 112 TO THE REAR END OF METRO RAIL  
TRAIN 214 ON JUNE 22, 2009.**

**INCIDENT:-**

Post accident testing showed that the track circuit at the accident site lost detection of train 214 when it stopped at the location where the collision occurred. Because the automatic train protection (ATP) system was not detecting train 214 location, the following train 212 did not receive a command to slow or stop in order to maintain train separation.

An unintended signal path was created between track circuit modules that resulted in the associated track relay remaining energised even though train 214 was occupying the track circuit.

Testing found that spurious high-frequency modulated signal was being created by parasitic oscillation from the power output transistors in the track circuit module transmitter. This spurious signal propagated through the power transistor heat sink, through the metal rack structure and through a shared power source into the associated module receiver, thus establishing an unintended signal path. The peak amplitude of the spurious signal appeared at the correct time interval and was large enough to be sensed by the module receiver as a valid track circuit signal which energised the track relay.

Maintenance records show that an impedance bond was replaced 5 days before the accident, and after replacement signal strength was not adjusted.

**8.5.1 POINTS TO NOTE:**

After any replacement or any change in AFTC track circuit, gain adjustment and checking of TSR is essential and compulsory.

**SOME MORE ACCIDENTS & ACTION TAKEN**

<b>Sl. No.</b>	<b>Details of accidents</b>	<b>Action taken by railways</b>	<b>Additional measures to be taken</b>
1	On 09.04.09 in Kharsaliya - Derol section of WR, Up BCN/E dashed Auto Rickshaw at interlocked LC gate due to malfunctioning of gate signal	SSE/SIGNAL has been removed from service.  Spl drive launched for testing the integrity of interlocking of LC gate Spl safety course conducted for signal maintainers.	System integrity test to be done periodically as laid down in Para of IR SEM.
2	On 26.5.09 at Takari station of CR, 1029 Koyan express derailed at point 109 while leaving from station due to point operation under the wheel due to incorrect wiring by S&T staff.	SE/SIGNAL & ESM were held responsible.  Reduction to lower stage by two stages: for the period of six months. A safety drive was launched for S&T staff	Disconnection to be taken as per rule & same procedure shall be monitored at divisional level.  System integrity and corresponding test to be done after restoration and before reconnection.
3	On 29.6.09 at Balugaon station of ECoR, three wagons of goods train derails at point 17B while starting from station due to two road of point due to interference by S&T staff.	ESM has been permanently reverted to the post of Tech III. A drive has been launched to counsel S&T staff.	System integrity test to be ensured  Strict action to be taken against staff adopting short cut
4	On 6.08.09 at Leharia Sarai station of ECR, Engine & SLR of Ex.0589A Jasidis – Darbhanga Spl derailed while entering due to two Road of Point No. 17B due to interlocking failure.	SF-5 issued to SE/Signal & MCM. DAR enquiry is yet to be finalised.	1. System Integrity Test to be ensured.  2. Data logger to be provided.
5	On 21-10-09 at Mathura NCR station express 2779 Goa dashed to express 2964 on rear side- malfunctioning to S&T gears.	ESM has been removed from service.  Local resetting of axle counter has been prohibited.  Replacement of old analog axle counter by MSDAC  Monitoring of opening and closing of auto relay hut through data logger	Strict action to be taken against staff adopting short cut  Dual detection of track circuit to be provided
6	On 9.02.11 at Jaipur station of NWR, SLR & GS 12462 Mandore Exp. Derailed while entering station due to operation of point under wheel due to premature clearance of track circuit.	1. Track bonding was not intact. 2. Track bonding modified. 3. ESM and JE are taken up for poor maintenance. 4. Double bonding on crossings.	1. Track Bonding to be checked for all major stations having more than 200 routes in next 15 days. 2. RDSO to view the design of bonding plan to eliminate the possibility of dead zones 3. Track circuit having more than 2 point shall be bifurcated.

**FEW ACCIDENT CASES**

7	On 21-2-11 at Panipat of NR, 12471 up express derailed while leaving the station due to operation of point under the wheel due to premature clearance of track circuit.  Short cut method by S&T staff and Optg staff.	Operating staff and S&T staff taken up.  No failure entry in register by operating department.  Track circuit locally picked by S&T staff	Boosting of track relay voltage shall not be done under poor ballast condition.  Relay room entry to be monitored by data logger
8	On 8.03.11 at Juhi Yard of NCR, Six BOX/N wagons (5 <sup>th</sup> to 10 <sup>th</sup> ) PIC Up Goods Special (Coal) derailed at Point no.22 at about 9.40 hrs. While leaving from Holding line.	1. In case of single track, Route release is given with 2" time delay. 2. Bonding of track circuit modified. 3. Double bonding is ensured.	1. Relay & Feed end to be kept as far as possible. 2. Series bonding on negative rail also to be planned. 3. Minimum two track circuits be used for route release.
9	On 11.3.11 at Suchi Pind yard of NR, 13152 Dn express derailed at point no 135b due to operation of point under the wheel due to defective interlocking.	ASM applied emergency route release before complete arrival of train  ESM key for emergency route release facility was with ASM permanently.  Installation defect found later on.	A total system failure  System integrity test of panel to be done.  All inputs of relays to be wired in data logger.

Ref: RB letter No: 2011/SIG/Safety Performance/1

dt: 28-04-2011

**Some issues requiring attention (Ref: - RB letter no 2011/SIG/Safety performance/1 DT: 28.04.11) :-**

- (a) Signal technician and JE/SSE are the backbone of S&T. They shall be given proper rest to avoid stress and strain. Qualification of Technician shall be revised.
- (b) Signal staff shall be created as per yard stick to avoid overburden of work.
- (c) Bad maintenance can be controlled through effective inspections at all levels. Any shortcut in signalling can lead to major mishap.
- (d) Comprehensive AMC for modern signalling equipments.
- (e) Alteration in existing relay wiring involving frequent relay room opening is potential danger. A new relay wiring along with panel is to be planned in case alteration is involving more than 10% of total relay wired, so that change over can be done with 100% testing without resorting to disconnections.

Various Circulars are issued by Railway Board following the different accidents in parts of Indian Railways. Some of the Circulars are kept in the Annexure I to IV.

\* \* \*

## CHAPTER- 9: FIRST AID, EX-GRATIA PAYMENT, COMMUNICATION

### 9.1 INJURIES

Injuries are classified as 'Grievous' and 'Simple'.

#### 9.1.1 GRIEVOUS INJURIES

Injuries for purpose of these statistics should be taken as injuries as defined in Section 320 of Indian Penal Code reproduced below for ready reference. (Section 320, Indian Penal Code 45 of 1860) The following kinds of hurt only are designated as grievous :-

- (a) Emasculation.
- (b) Permanent privation of the sight of either eye.
- (c) Permanent privation of the hearing of either ear.
- (d) Privation of any member of joint.
- (e) Destruction or permanent impairing of the powers of any member or joint.
- (f) Permanent disfigurement of head or face.
- (g) Fracture or dislocation of a bone or tooth.
- (h) Any hurt which endangers life, or which causes the sufferer to be, during the period of twenty days, in severe bodily pain or unable to follow his ordinary pursuits.

#### 9.1.2 SIMPLE INJURIES

- (a) A person will be considered to have incurred simple injuries if these injuries incapacitate the injured person to follow his customary vocation during 48 hours after the occurrence of the accident.
- (b) A Railway servant is considered to have been injured if he / she are prevented from returning to work as a result of injuries for a period of 48 hours after the occurrence of the accident.
  - (i) Bleeding may vary in intensity from severe to slight.

#### 9.1.3 SEVERE HAEMORRHAGE

It comes from a torn artery or torn vein or both combined. Many large arteries and veins lie close together and are frequently injured together. Blood from an artery in the systemic circulation is bright red. If the injured artery is near the skin, the blood spurts out in jets corresponding to the pulsation of the heart. Blood from a vein is dark red. It flows in a steady continuous stream. Arterial and venous haemorrhage combined usually gushes out from the depth of the wound. Slight Haemorrhage: Comes usually from injured capillaries and may flow briskly in a continuous stream or merely ooze from all parts of the wound. This type of bleeding is much more easily controlled than severe haemorrhage.

#### 9.1.4 GENERAL RULES FOR TREATMENT OF WOUNDS ACCOMPANIED BY SEVERE HAEMORRHAGE

- (a) PLACE THE PATIENT in a suitable position i.e. in reclined position;
- (b) Elevate the bleeding part, except in the case of a fractured limb;
- (c) Expose the wound; removing only whatever clothing may be necessary;

- (d) Do not disturb any blood clot already formed;
- (e) Remove any foreign bodies which are visible and can be easily removed;
- (f) Apply direct pressure with the thumb or thumbs over a pad, if available, to the part of the wound from which the blood is coming, when a foreign body or projecting broken bone is present in the wound; press alongside it and not over it. If the bleeding point is not readily visible, grasp the whole wound area and squeeze it tightly. This will nearly always control the bleeding for a time, and by relaxing the grasp slowly, the bleeding points will be found so enabling pressure to be applied with the thumb.
- (g) Apply an antiseptic;
- (h) For thumb pressure substitute pressure as following:-

- (i) When there is no foreign body or projecting broken bone- Apply a suitable sized dressing and pad over the wound, press them firmly down and bandage them firmly in position. Deep wound may need further pads on top of the first, thus pressing the dressing into the depth of the wound. Ensure that pads projects well above the level of the skin in order to

Provide adequate pressure on the torn ends of the blood vessels.

- (ii) When foreign body which cannot be easily removed or a projecting broken bone is present in a wound:-

- When gauze or flint dressing are being used, cover the wound with the dressing and build up the pads around the wound to a sufficient heights to allow for pressure to be applied by the bandage without pressing on the foreign body or rejecting bones.
- When prepared sterile dressings and pads are being used, build them up in cone fashion around the wound to sufficient height to cover the wound and to allow for pressure to be applied by the diagonal bandage referred to in Sub-clause 2

- (i) Without pressing on the foreign body or projecting bone.
- (j) In the case of wound involving fracture of the dome of the skull a ring pad must be used.
- (k) Bandage the pads firmly in position. When a foreign body or projecting broken bone is present in a wound, it may be advantageous to apply the bandage diagonally to prevent pressure on the foreign body or projecting broken bone. The bandage should not be applied more tightly than is sufficient to stop the bleeding. If blood still soaks through, apply further pads on top with a fresh bandage, but do not remove the original bandage and Pads.
- (l) If bleeding is not controlled by the application of direct pressure, apply a firm bandage round the limb few inches above the wound. It is preferable to use rubber bandage about four feet long and about 2 inches wide with a tape attachment at the end for fastening. At the end of every 20 minutes, the bandage must be relaxed. If bleeding has not ceased, the bandage must be re-tightened. A note must be made of the application and time applied.
- (m) Where a limb has been amputated, no time should be wasted in attempting to apply direct pressure, but a constrictive bandage should be immediately applied a few inches above the stump wound.

- (n) When it is impossible to apply direct pressure successfully for the arrest of arterial haemorrhage as in the case of wound in the throat, tigh up in the arm, and tigh up in the thigh, it is necessary to apply indirect pressure to carotid, sub clavian, or femoral pressure points. Immobilize the injured part; when the wound is near a joint, immobilize the joint when bleeding has stopped: - Keep the patient warm; give him plenty of fluids especially warm tea sweetened with sugar.
- (o) In the limb fractures, to maintain some extension and give the maximum amount of immobilization, the method of choice is the well-padded splint or splints and when available, they should be used. If a leg is fractured, steady the limb by holding the Ankle and place it in its natural position along with its fellow and do not let go until the splints have been fixed. Apply splints on the outer and inner sides of the leg reaching from above the knee to beyond the foot. If only one splint is available, place it on the outer side. Secure splints by bandages (a) above, (b) below the fracture (c) immediately above the knee, (d) round the ankles and feet as figures of a broad bandage round both the knees.

## **9.2 EX-GRATIA PAYMENT**

### **9.2.1 EX- GRATIA**

**It is a Latin word** - Means grace or favour rather than from legal right, literal meaning of ex-gratia is a relief to the person involved in train accident or untoward incidents as an immediate help to the kith and kin of those died and to the injured on humanitarian grounds, with the sole purpose to perform the last rites for the dead and medical aid to the injured.

### **9.2.2 DEFINITION OF SECTION 124 & 124-A OF RAILWAY ACT 1989 REGARDING ACCIDENT CLAIM COMPENSATION CLAIM**

#### **SECTION 124:**

When in the course of working a railway, **an accident occurs**, being either a collision between trains of which one is a train carrying passengers or the derailment of or other accident to train or any part of train carrying passengers, then whether or not there has been any wrongful act, neglect or default on the part of the railway administration such as would entitle a passenger who has been injured or has suffered a loss to maintain an action and recover damages in respect thereof, the railway administration shall, notwithstanding any this contained in any other law, be liable to pay compensation to such extent as may be prescribed and to that extent only for loss occasioned by the death of a passenger dying as a result of such accident, and for personal injury and loss, destruction, damage or deterioration of goods owned by the passenger and accompanying him in his compartment or on the train, sustained as a result of such accident.

For the purpose of this section “passenger” includes a railway servant on duty.

#### **SECTION 124 A:**

When in the course of working a railway, **an untoward incident occurs**, then whether or not there has been any wrongful act, neglect or default on the part of the railway administration such as would entitle a passenger who has been injured or the dependant of a passenger who has been killed to maintain an action and recover damages in respect thereof, the railway administration shall, notwithstanding anything contained in any other law be liable to pay compensation to such extent as may be prescribed and to that extent only for loss occasioned by the death of, or injury to, a passenger as a result of such untoward incident:

Provided that no compensation shall be payable under this section by the railway administration if the passenger dies or suffers injury due to:

- (a) Suicide or attempted suicide by him;
- (b) Self – inflicted injury;
- (c) His own criminal act;
- (d) Any act committed by him in a state of intoxication or insanity;
- (e) Any natural cause or disease or medical or surgical treatment unless such treatment becomes necessary due to injury caused by the said untoward incident.

For the purposes of this section, “passenger” includes –

- (i) A railway servant on duty; and
- (ii) Person who has purchased a valid ticket for travelling, by a train carrying passengers, on any date or a valid platform ticket and becomes a victim of an untoward incident.

“Untoward incident” means –

- (a) A The commission of a terrorist act within the meaning of sub-section (1) of sec. 3 of the Terrorist and Disruptive Activities (Prevention) Act, 1987 (28 of 1987), or

The making of a violent attack or the commission of robbery or dacoit; or

The indulging in rioting, shoot-out or arson, by any person in or on any train carrying passengers, or in a waiting hall, cloak room or reservation or booking office or on any platform or in any other place within the precincts of a railway station; or

- (b) The accidental falling of any passenger from a train carrying passengers.

### **9.2.3 LIABILITY OF THE RAILWAYS FOR GRANTING OF THIS RELIEF TO THE PERSONS INVOLVED IN TRAIN ACCIDENT OR UNTOWARD INCIDENT OR LEVEL CROSSING GATE ACCIDENTS IS GIVEN BELOW:**

**No ex-gratia is admissible to the trespassers, person electrocuted and road users at unmanned level crossing. Ex-gratia is also payable to the rail servants killed or injured by the moving train while performing their duty as is payable to the dead or injured passenger during accident.**

#### **EX-GRATIA PAYMENT TO VICTIMS OF TRAIN ACCIDENT (Railway Board's Letter No. 2006/ TC- III/27/2 dated 20/ 12/ 2006)**

- (a) *Amount of ex-gratia for train accidents/untoward accidents:- The amount paid as ex-gratia relief payable to the dependants of dead or injured passengers involved in train accidents or untoward incidents as defined under section 124 and 124-A should be as under:-*
  - (i) *In case of death - Rs. 15,000/-*
  - (ii) *In case of grievous injury*
    - *hospitalisation up to 30 days- 5000 Rs*
    - *hospitalisation up to 6 months -1000 Rs*
    - *hospitalisation up to further 6 months- 500 Rs*
    - *max period - 13 months*

- (b) In case of LC gate accidents
  - (i) In case of death - Rs. 4000/-
  - (ii) In case of grievous injury - Rs 1500
  - (iii) Simple injury -nil

The Ex-gratia payment should be sanctioned /arranged preferably on the spot by an officer not less than a senior scale nominated by the G.M of Railway after making reasonable inquiry on the spot.

### **9.3 COMMUNICATION**

STD equipped telephone should be made available to passengers to communicate with their relatives.

Rly. Board's letter No. 93/Safety-I/6/1, dt. 2.11.93)

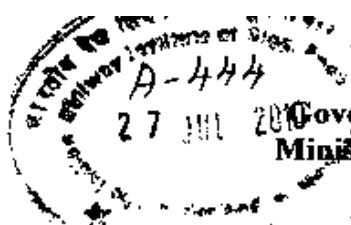
Station Masters can hire a few cellular phones in case of passenger train accidents to meet the needs of stranded passengers, wherever cellular phone connectivity is available. The stranded passengers should be permitted to use these phones free of charge.

Rly. Board's letter No. 2002/Tele/TN/1, dt. 12.5.03

Sr. DSTE should prepare a map of the division showing the areas where cell phone is operative/ available.

Sr. DSTE should set up machinery to hire sufficient number of cell phones for emergencies.

\* \* \*

**ANNEXURE - I****DATA LOGGERS FOR SIGNALLING - Timely extraction  
of Reports, procedure for taking printout**

339/2

No. 2010/Sig./SGF/12(Data Logger)

New Delhi., Dt. 22<sup>nd</sup> July, 2010.

**General Managers**  
**All Indian Railways**  
**Metro Rail Kolkata,**  
**Managing Director MRVC**  
**Director General RDSO, RSC**  
**Director IRISET**

**Sub: Data Loggers for Signalling – Timely extraction of Reports**

- Ref: i) Board's letter No. 2005/SIG/SGF/12(Datalogger) dtd 25.06.2005  
 ii) Board's letters No.2006/SIG/SGF/12(Datalogger) dtd 14.12.2006,  
 31.10.2008, 19.01.2009, 12.02.2009 & 07.10.2009  
 iii) RDSO's letter No. STS/E/DATALOGGER dtd 24.11.2009  
 iv) Board's Letter No. 2009/SIG/A/NCR/1 dtd 02.12.2009.

Instructions have been issued in the past vide above references in connection with provision, installation, configuration, maintenance, regular checking and extracting reports from Data Loggers. The performance, utilization and response from the system is still not very satisfactory. Recently, in few of unusual incidences/accidents, it has been observed that Officers and Supervisors have not been able to extract the required reports at all or in time for one reason or the other. Even for investigation of signal incidences, the system is not being used as regularly and effectively as is required. Use of Data Logger as a predictive maintenance tool is yet to get firmly ingrained in the maintenance organization.

2. Some of the major reasons for such a situation are incomplete or inadequate wiring/configuration of all relevant parameters, lack of involvement of S&T field staff, inadequate understanding of the procedures, improper upkeep of Data Logger (DL) hardware & software, interfaces & accessories like Laptop PCs & Printers & related documents (User Manuals), absence of fortnightly checks & Annual Maintenance Contracts (AMCs) with OEMs, poor follow up in case of DL failure and insufficient monitoring by SrDSTEs/SrDSOs & CSE/DRM/CSO/CSTE.

3. While reiterating the earlier instructions it is further directed that urgent action is required to be taken to ensure effective use of this extremely important sub-system

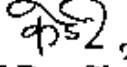
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- 2 -

monitoring signalling functions & train operations, for which following additional guidelines be followed:

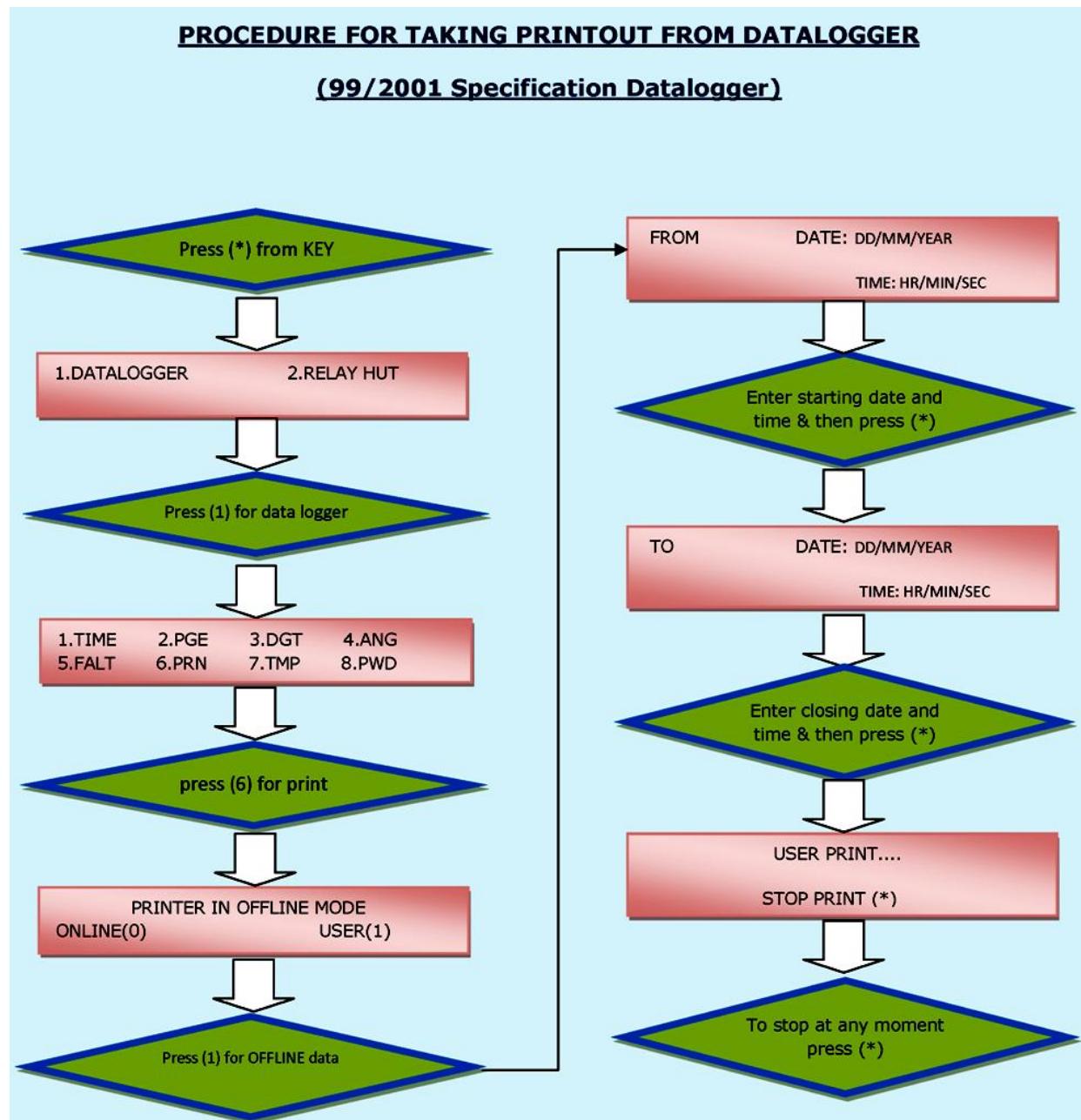
- i) Correct configuration & design of Data Logger and wiring diagram to be approved by CSE. This will include specific approval to the functions or parameters to be logged. Verification & validation of the system at site by ASTE or DSTE.
- ii) Training in use of Data Logger be imparted to all Technicians Gr I & MCM & JE/SE(Sig) of the section & be refreshed every time the system is changed or at the time of refresher course, whichever is earlier.
- iii) SE/SSE(Sig) & ASTEs of the section should also be trained to extract reports for a specific period. They should do this on each trip to the installation/station and enclose it along with their inspection report.
- iv) Regular drills should be conducted by Inspecting officials for extraction of reports at site and it should be ensured that the same is printed out within shortest possible time after reaching the site.
- v) Provision of printers as stipulated by RDSO and/or OEM be ensured at each station to optimize on the time for taking a print out. One printer duly tested and in working order should also be kept either with the SSE incharge of the section or in the ART for use at site.

Receipt of this letter may please be acknowledged with a compliance statement on the above items within ten days.

  
 22.7.10  
 (Kapil Dev Sharma)  
 Additional Member (Signal)  
 Railway Board

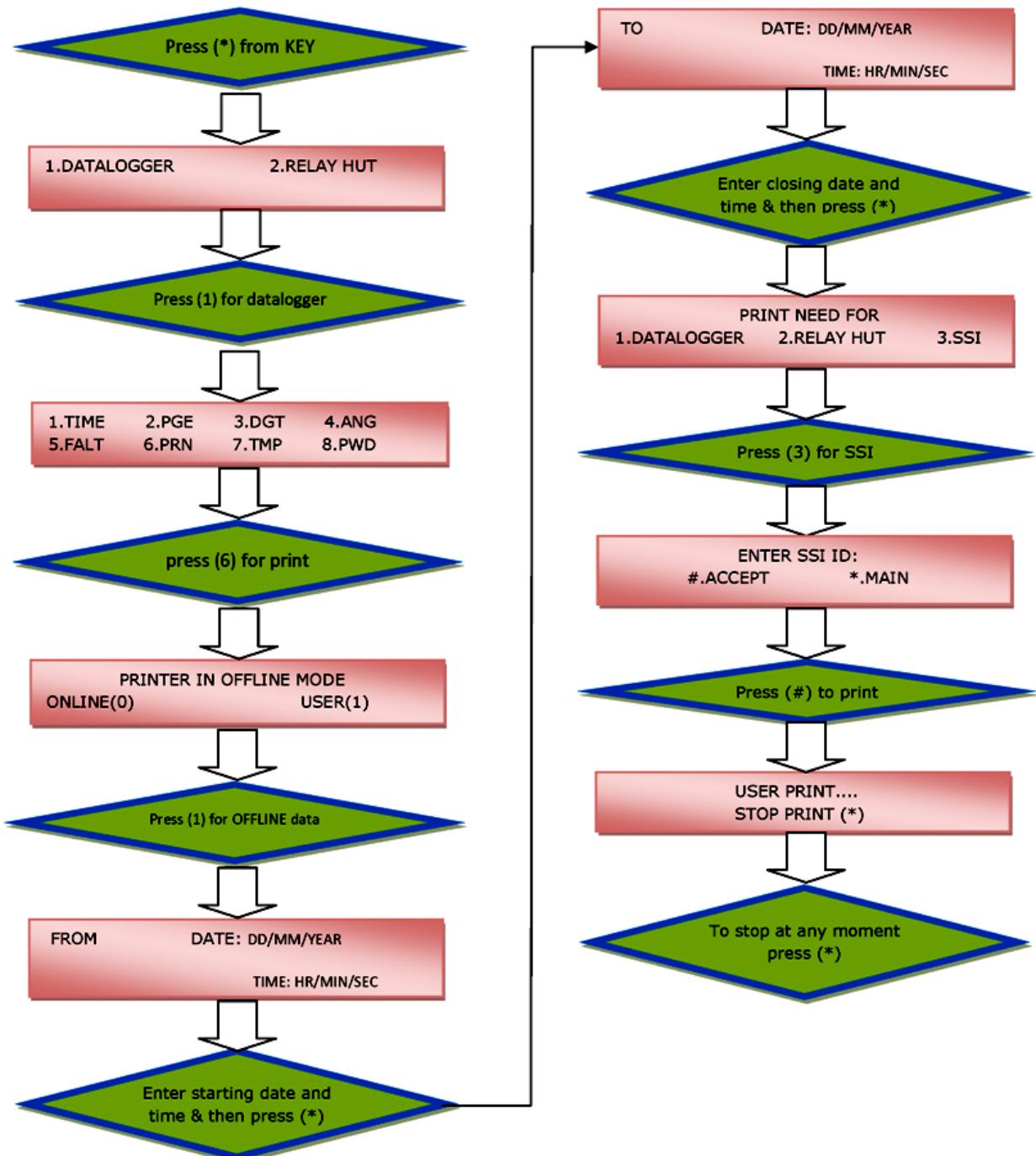
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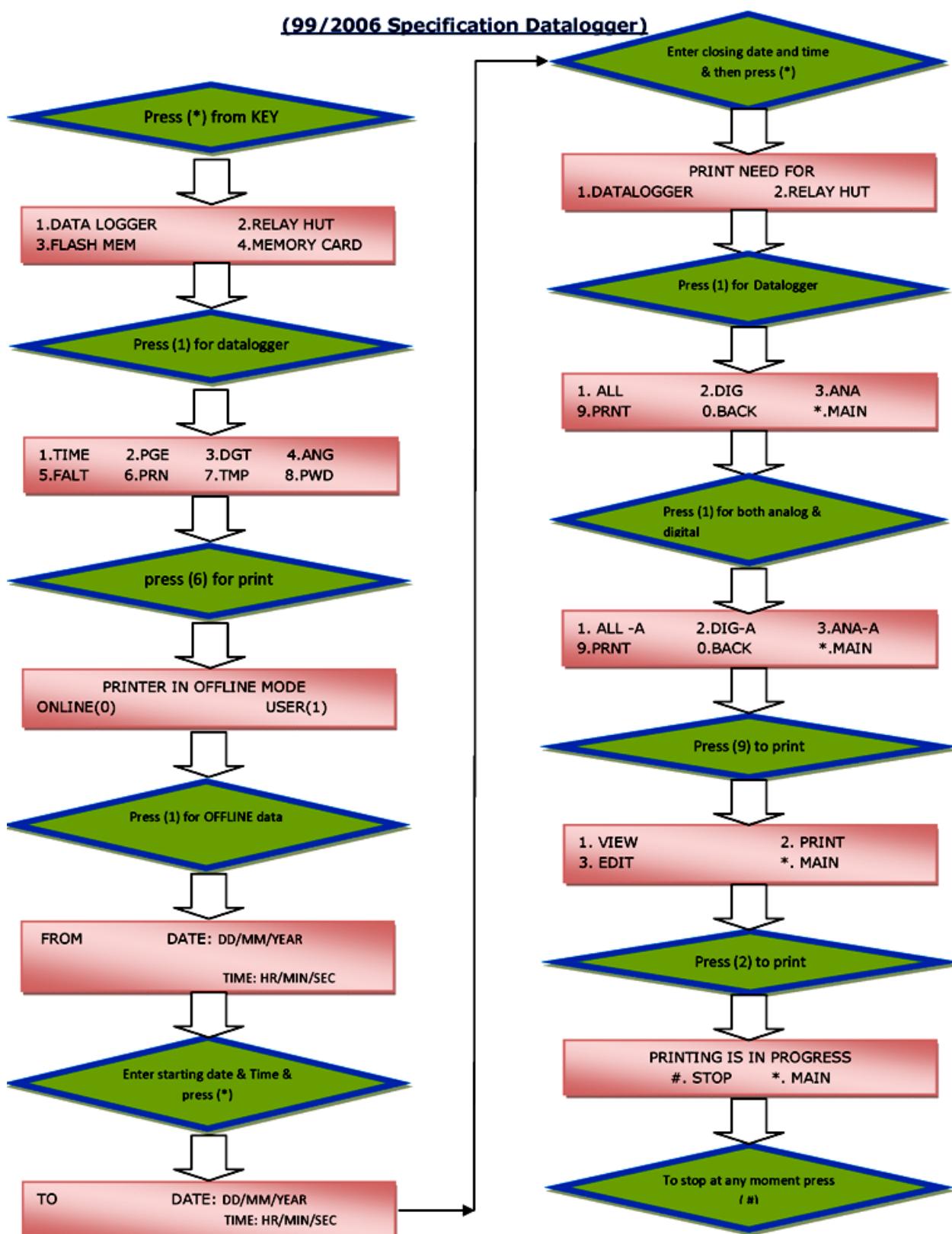
**Addl. Members (CE), (Elect.), (ME), (Traffic), Adviser (Safety)**  
**Chief Signal & Telecom Engineers, All Indian Railways**  
**Chief Safety Officers, All Indian Railways**



**PROCEDURE FOR TAKING PRINTOUT FROM SSI DATALOGGER**

**(99/2001 Specification Datalogger)**



**PROCEDURE FOR TAKING PRINTOUT FROM DATALOGGER****(99/2006 Specification Datalogger)**

## ANNEXURE - II

### Shifting of Starter Signal to the boundary of the track circuit mitigate ahead to the risk.



GOVERNMENT OF INDIA (भारत सरकार)  
MINISTRY OF RAILWAYS (रेल मंत्रालय)  
RAILWAY BOARD (रेलवे बोर्ड)

पत्र सं० 2012/Sig/SEM-II/Misc.

नई दिल्ली, दिनांक: 10.10.2012

General Manager,  
All Indian Railways.

Director General,  
R.D.S.O., Manak Nagar,  
Luckow.

**Sub:** Shifting of Starter Signal to the boundary of the Track Circuit ahead to mitigate the risk.

**Ref:** (i) CSTE/SER's No. S&T/S/315/Pt.III/2194, dated 22.05.2012.  
(ii) GM/SER's D.O. No. OPS/50/S&T/Pt.I, dated 28.06.2012.

As per extant practice, the boundary of the Track Circuit ahead of the Starter Signal (Insulated Block Joint or Detection Point (DP) of Axle Counter), is located 13 mtrs ahead of the Starter to cater for the requirement of Signal not going to danger with Long Hood Leading Diesel Loco Train Operations. South Eastern Railway vide letters referred to above, has requested to allow shifting of Signal near the Block Joint so as to allow increase in the CSL. With the introduction of Electrical & Electronic Interlocking, the Lock Bars, which were 13 mtrs long, have been removed and Track Circuit locking has been provided. There is no need to maintain a distance of 13 mtrs between the insulated Block Joint or Detection Point and the same can be reduced from 13 mtrs to 3 mtrs for Signaled movements.

The issue has been examined based on the stipulations in GR and IRSEM and feedback received from CR and WR and the following directives are issued for Starter Signals with the approval of ML, MT & CRB:

S.No.	Section	Diesel/Traction Operation	Directives issued
1(a)	Non Suburban not having AFTC	No Long Hood Diesels	Shift Signal to the Block Joint and in no case beyond 3 Meters for meeting technical & local requirements.
1(b)	Non Suburban not having AFTC	With Long Hood Diesel	Shift Signal to the Block Joint and in no case beyond 3 Meters for meeting technical & local requirements with 5 second delay in HR Circuit.
2(a)	Suburban – Provided with DC/AC Circuit	AC Locos EMU	Shift Signal to the Block Joint and in no case beyond 3 Meters for meeting technical & local requirements.
2(b)	Suburban – with Track Provided DC/AC Circuit	AC Locos, EMU & some Diesel/DEMUs	Shift Signal to the Block Joint and in no case beyond 3 Meters for meeting technical & local requirements with 5 second delay in HR Circuit.

While executing the changes at stations for Starter, following shall be ensured:-

- (i) The following instructions may be incorporated in Subsidiary Rules under GR 3.36 in addition to the existing one:-
- a) If in an emergency, a signal has to be put back to the 'ON' position before the movement of the train for which it was taken 'OFF', no points or lock shall be moved until train has come to stand except to prevent accident.
- b) In case Starter and Advanced Starter taken 'OFF' for departing trains i.e. trains starting from station after coming to stop are required to be put back for purpose of movement of another train (precedence or crossing), the following precautions must be taken:
- Relevant Starter and Advanced Starter may be replaced to 'ON' position. Then the Loco Pilot of the train for which the Signal had been taken 'OFF' should be advised by on duty ASM/Dy.SS through a secured means of communication (MTRC, etc.) to the effect that his signal has been replaced to 'ON' and he should not start.
  - Wherever secured means of communication in the form of MTRC, etc. is not available and in case of diesel long hood leading loco, the Loco Pilot shall be advised through a written memo that his signal has been replaced to 'ON' and he should not start.
  - Till the Loco Pilot has been advised through a secured means of communication or through a written memo and his acknowledgment received, the route set should not be altered except to avert an accident.
- (ii) With this, the IRSEM Para 17.13.3.3 shall also stand modified for starter signals as under:-  
"The Insulated Rail/Block Joint or Device of Axle Counters or Joint Less Track Circuit shall be so fixed that their boundary shall be within zero to 3 meters in advance of the Signal." Correction slip to the IRSEM will be issued separately
- (iii) Whenever a diversion is to be Signaled cutting across running lines, additional Flank Protection Circuits as deployed on Multiple Line Sections and Junction Stations on various Railways should be incorporated in the Signal Circuit, by providing the concerned infringing Track Circuits ahead of the opposite direction signal in the Signal Clearance Circuits.

Instructions for suburban sections having AFTCs and/or MSDACs will be finalized after assessing the trial changes made on Western Railway at 5 stations.

Railways are advised plan the work of shifting Signaling on contiguous sections to derive full benefits in consultation with COM and CME of the Railway and execute this work progressively.

Please acknowledge receipt of this letter.

  
11.10.2012  
(राजमल श्रीवाल)  
निदेशक (सिग्नल)

**ANNEXURE - III**

Safe installation Maintenance and certification of Signalling System.



No. 2012/Sig/Safety Performance/1

New Delhi, Dt. 22.10.2012

The General Manager  
All Indian Railways

Sub: Safe Installation Maintenance and Certification of Signaling System.  
Ref: (a) ML's DO letter No. 2012/Sig/Safety Performance/1 dt. 19.9.12  
(b) Rly. Bd's XXR Message No. 2012/Safety-1/3/5 dt. 26.4.12  
(c) MT's DO letter No. 2012/Safety(A&R)/19/9 dt. Oct. 03, 2012  
(d) CRB's XXR Message No. 2012/Safety(A&R)/19/9 dt. 4<sup>th</sup> Oct, 2012

After the Safety Drive launched vide Board's XXR message referred to above, CSTEs were advised vide Board's letter No. 2012/Sig/Safety Performance/1 dt. 19.9.12 to strictly follow safe maintenance procedures and take safety precautions at the time of maintenance, repair and execution of works.

In spite of regular drives and instructions, ground situation has not improved and another unfortunate collision took place at Dagori Station of SECR on 2.10.2012, where JE/Signal along with Signal Technicians was carrying out work of replacement of insulation of cross over point 36 B end without giving Disconnection Notice and adopted short cut to provide normal indication of cross over point No. 36 A, which lies on the Up Main Line. Home Signal was lowered for Main Line but the train entered the loop Line as this point 36 A was in reverse condition at site, whereas indication on panel was available for normal setting. Two Railway staff i.e. JE (Sig) and Khalasi were hit by the train and LP and ALP of goods train got grievously injured due to the impact of the collision.

While reiterating the instructions given in the D.O. letter no. 2012/Sig/Safety/Performance/1 dated. 19.9.12 addressed to CSTEs, following additional instructions are given for immediate compliance:

- (a) Signal Maintenance and repair works should be done only under Disconnection Notice as per provisions contained in para 11.4 of IRSEM (Part-II). The Signal Maintenance staff should indicate duration of requirement of disconnection to SM on duty. Disconnection for durations upto one hour should normally be allowed by the ASM/Dy.SS on duty depending upon trains in the section. If disconnection Notice is not allowed by Station Master, it should be requisitioned again by S&T maintenance staff and allowed by Control depending upon flow of traffic on the section. Otherwise, the available slot may be indicated by the Control to the S&T staff.
- (b) In extreme emergencies, if the maintenance/repair of S&T gears is urgently required to avoid an accident, the same may be suspended with the approval of Sr. DSTE.

Contd/....2

- (c) For works requiring disconnection of more than one hour, a Disconnection Schedule jointly signed by Sr. DSTE, Sr. DOM, Sr. DEN & Sr. DEE/TRD should be issued and notified to all concerned. The progress of the joint Schedule should be reviewed periodically by the DRMs.
- (d) For Disconnections/Maintenance likely to last for more than a day –
  - (i) Temporary Working Instructions must be issued.
  - (ii) The Station Master on duty shall be responsible for ensuring that all the points over which the train is to pass are correctly set, facing points are clamped and pad-locked and trailing points are correctly set. However, in case of motor operated points, trailing points must also be clamped and pad-locked.
  - (iii) S&T staff may restrict the aspect of signals to give only yellow aspect as permitted in Temporary Working Instructions. Thereafter, the Station Master may take off the signals after ensuring correct setting and locking of points, as per para (ii) above.
  - (iv) Temporary Engineering Indicators with speed indicator of 15 kmph may be placed at the site.

Railways are advised to ensure that instructions are followed in letter and spirit and no shortcuts are allowed under any circumstances. Requisite resources and inputs may be ensured to improve the level of safety during repair and maintenance of signaling gear.

**This issues with the approval of ML and MT.**

*He 22/12*  
(Arun Saksena)  
Adviser (Signal)

Copy to:

As per List enclosed.

## ANNEXURE - IV

### Situations which positively require the issue of a disconnection Memo

#### a) SITUATIONS WHICH POSITIVELY REQUIRE THE ISSUE OF A DISCONNECTION MEMO.

1. Opening up of the back cover or the front cover of a Block / Token / Tablet / Tokenless instrument for making any adjustments or change of wiring or disconnection of the instrument.
2. Disconnection of a rod from the corresponding lever of the lever frame for any purpose whatsoever; or from the unit the port lock etc to which it is connected.
3. Disconnection of signal transmission wire.
4. Removal of the slides of mechanical / electrical point detector (both point slides, Lock slides as well as signal slides).
5. Disconnection of a lock bar or a facing point lock plunger or the switch extension piece or the rod to the detector
6. Addition / alteration / replacement in the internal wiring of a relay room;
7. Disconnection of a circuit controller or a lever lock-cum-circuit controller from the lever to which it is connected
8. Removal of a key lock from the lever to which it is fixed;
9. Opening of a key transmitter or local release of its key.
10. Disconnection of an arm circuit controller from the semaphore arm
11. Disconnection of ARLR circuit from the Semaphore arm.
12. Any work on an Electric point Machine / Signal Machine / detector excluding the cleaning of contacts and other parts of the machine and excluding lubrication /Greasing.
13. Insulation Test of Cables by disconnecting the cores from the terminals.
14. Changing of Booms and Wire Ropes of a Lifting Barrier (except of the case where Swing Gates as a stand by are available).
15. Any soldering work of a plug in relay
16. Adjustment of stroke of point / lockbar
17. Changing of any part of a Reverser.
18. Disconnection of Station Master's slide.
19. Overhauling of Lever Frames

**b) SITUATION IN WHICH DISCONNECTION MEMO MAY NOT BE GIVEN**

1. Work on Track Circuit
2. Replacement of Fuses (One at a time)
3. Replacement of Subs of Colour Light Signals, panel indication lamps.
4. Cleaning of Colour light lens and focusing.
5. Cleaning of terminals / contacts of Circuit Controllers and Lever locks
6. Cleaning of Locking by opening of TOP cover only.
7. Greasing of Levers with grease gun.
8. Testing of Lock bar without disconnecting the Lock bar.
9. Cleaning and lubrication of Cranks & Compensators.
10. Graphiting, Coiling of connecting pins
11. Replacement of split pins without removing pins.
- 12 Lubrication of Signal wheels/Pins of rod runs.
13. Removal and refixing of pulleys
14. Maintenance of reverser.
15. Change of Batteries (subject to conditions in para 7b)
16. Tightening of Terminals (subject to condition in para 7a).
17. Removal and Re-insertion of Plug-in-relays
18. Testing of points including Motor operated points, (not revolving any adjustment)
20. Removal / refitting of roundels, signal lamps and tamp brackets of Semaphore Signals n daytime.
21. Testing of Signals.

N.B:- Although disconnection in such cases may not be given, it is necessary that the maintenance staff & supervisors carrying on with the work should take necessary precautions for working of trains during the period of works.

## ANNEXURE - V

### DERAILMENTS- TYPES AND REASONS

#### 1) THE FACTORS FOR A DERAILMENT

- (a) Abnormal Track condition
- (b) Abnormal Vehicle condition
- (c) Abnormal Loading condition
- (d) Abnormal Running Speed, etc

#### 2) VEHICLE OSCILLATIONS

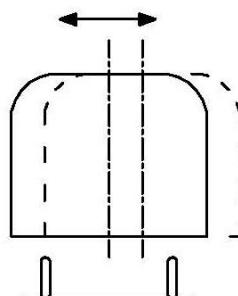
Motion of a Vehicle on a track is a complex phenomenon. A very large no. of factors will contribute on safety and stability of track, vehicle and movements. Only when one or more factors cross the safety limits, then an accident occurs.

While vehicles pass over a track, they are subjected to three types of motions.

- (a) Lurching motion:** Vehicle when moving, it oscillates from side to side because of the clearances available between the flanges and gauge faces of the rails.
- (b) Bouncing motion:** Vehicle when moving, it oscillates vertically up and down on the track due to unevenness of springs, unevenness in track and unevenness of loading.
- (c) Shuttling motion:** Vehicle when being started/stopped the movement is backward / forward in the direction of the movement of vehicle mainly generated from acceleration and retardation of the train.

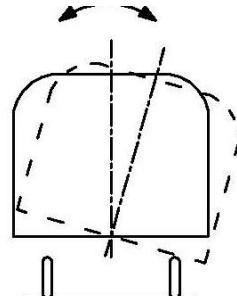
A vehicle while travelling over track, does not move smoothly, but due to various reasons, executes a variety of oscillations. These are called 'parasitic' oscillations, as, like parasites, they feed themselves on the forward motion of the vehicle on track i.e. their energy is derived from the energy of forward motion of the vehicle. The moment the vehicle stops, the oscillations also cease.

For convenience of reference and analysis, it is customary to classify these oscillations according to the 3-axis coordinate system. In reference to any axis, an oscillation can be linear or rotational.



(a)

(a) Linear oscillation



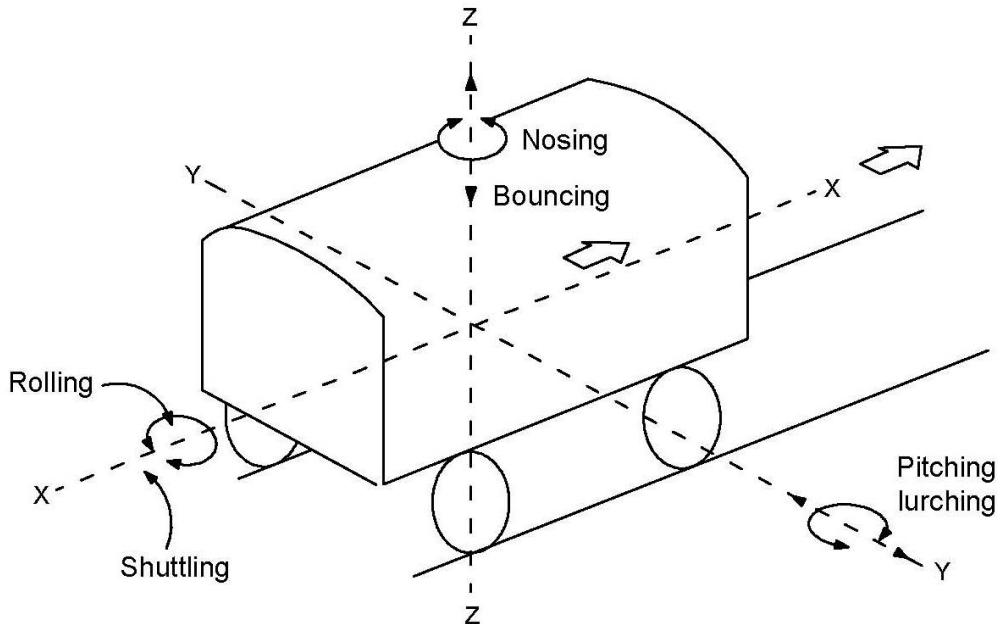
(b)

(b) Rotational oscillation

Considering the 3 axes viz

X axis :	along the track
Y axis :	lateral to the track
Z axis :	vertical direction

And that there are 2 modes pertaining to each axis Via, linear and rotational, there are in all 6 modes of oscillation,



**The six modes of oscillation**

Axis	Motion Type	
	Linear	Rotational
X	Shuttling	Rolling
Y	Lurching	Pitching
Z	Bouncing	Nosing (also called 'yaw')

The combined oscillation of rolling and nosing when violent is called hunting.

Cause-wise, there are two broad categories of oscillations:

- (a) Self excited: these are due to wheel conicity.
- (b) Other than self excited: These are due to
  - (i) Track irregularities
  - (ii) Varying elastic characteristics of track
  - (iii) Suspension Characteristics of the vehicle
  - (iv) Disposition of load on the vehicle
  - (v) Vehicle operation features

There are two main types of derailments. 1) Sudden derailment 2) Gradual derailment

### **3) SUDDEN DERAILMENT**

Where wheel set suddenly jumps the rails. Such derailment indicates that the derailing forces were high enough to suddenly force the wheel off the rails.

In case of sudden derailment a short mark across the rail table or just a scratch on the rail head edge or no mark at all but drop mark on the Rail flange, sleepers, ballast, fittings etc. It indicates that the derailing forces were high enough to suddenly force the wheel off the track. Therefore we must look for features that would cause sudden development of wheel flange forces.

**REASONS ARE:**

- (a) Sudden shifting of loads
- (b) Improper loading
- (c) Excess speed
- (d) Sudden variation in draw bar forces due to improper acceleration and braking.
- (e) Broken wheels,
- (f) Failure of track & vehicle parts
- (g) Obstruction on the track.
- (h) Loose fittings of Track & vehicle parts.

**4) GRADUAL DERAILMENT BY FLANGE MOUNTING ON RAIL**

Such derailments occur due to wheel mounting on the rail table in a 'relatively gradual manner'. In this, the derailing forces were powerful enough to overcome the normal stabilising forces, yet not sufficient enough to cause sudden derailment.

In case of sudden derailment it is relatively easier to know the cause of the derailment than the derailment occurred by flange/wheel climbing on rails.

Gradual derailment by flange climbing:

- (a) A long mark may be as long as 10 meters are ever more on the rail table indicates a gradual derailment. In this case it may be relatively more difficult to know the cause.
- (b) The following are some of the areas to look into are
  - (i) Identification & examination of wheel mark on rail head, rail flange, sleeper, ballast, fastenings
  - (ii) Recordings of defects, condition and history of travel of concerned vehicles.
  - (iii) Track particulars & Track Geometry
  - (iv) Operating feature of rolling stock.
  - (v) Condition of track and vehicle components etc.
  - (vi) Condition of loads/loading

**5) POINT OF MOUNT AND POINT OF DROP**

Upon reaching the site the first important thing is to locate and examine the point of mounting mark (POM) or mark of initial point of derailment (POD) in derailment.

Precise measurements and detailed examination of the wheel mounting marks should be made. The wheel mounting marks length, nature, whether straight or curved, strong or faint, broken or continuous, single or multiple, etc, to be seen.

In many cases after the initial derailment more vehicles, will derail before the train stops.

This creates multiple wheel mounting marks and it becomes necessary to find out which wheel set first derailed.

This involves matching of the length and nature of the various wheel trail marks, with the position and orientation of the derailed vehicles, marks on the wheel treads and flanges, damage to the vehicles and wheel sets and corresponding signs on the track e.g. Spill of wagon contents, point marks etc.

\* \* \*

## **ANNEXURE - VI** **S&T DEPARTMENT**

### **1) ROLE OF S&T OFFICERS**

- (a) The resources of all Departments are men and material. They should be promptly made available, when required for rendering assistance to passengers and restoration work.
- (b) All Railway men whether on duty or otherwise, to involve in rescue and relief operations.
- (c) Utmost speed in rushing medical and other relief to the site of accident to be ensured.
- (d) Utmost care, consideration and courtesy towards the passengers involved in the accident to be performed.
- (e) Preservation of clues must be done.
- (f) Proper planning of restoration operations and proper execution thereof to be followed.
- (g) The responsibilities of employees for restoration at the site to be clearly defined to avoid any confusion.
- (h) Record the statement of staff and take steps necessary to record or preserve evidence which subsequently may not be available. This shall be done by an officer or Sr. supervisor present at the site of the accident even if he is off duty. Evidence shall be collected and recorded with due care and attention, and later submitted to the Enquiry Committee.
- (i) Preserve all clues and record the character and relative position of marking to enable reconstruction of the scene of the accident. Where immediate repairs are necessary to pass trains, only such parts of the interlocking gear shall be disconnected as are necessary to carry out the repairs to the respective line road.
- (j) Scrutinise and initial joint with the concerned officials noting time and date on the Train Signal Register or Train Message Books, Private Number Books, Caution Orders, S & T forms concerned and any other relevant records.
- (k) Secure and seal immediately the records directly connected with the cause of the accident.
- (l) Special care and attention must be taken in the collection and recording of evidence as prescribed and in submitting the evidence with all details to the Enquiry Committee.
- (m) Position of levers, Station Master's Control Slides, indication of various points, track circuits, routes, slot indicators, etc., position of Block instrument handles and indications, aspects of the concerned signals, readings of the counters where provided and conditions of seals of appliances which are normally kept sealed and any other information relevant to the accident.
- (n) Adequate and swift arrangements for supply of food, drinking water etc. to the affected passengers to be arranged.
- (o) Quick transmission of information, particularly details of dead and injured to their relatives & others to be carried out.
- (p) Proper preservation and care of the dead to be carried out.
- (q) Security of passenger's luggage and Railway property must be ensured.
- (r) No S&T staff shall be permitted to leave the accident site without the permission of senior most S&T officer.

## 2) FORMAT FOR REPORTING OF ACCIDENTS TO HEAD QUARTER AND RAILWAY BOARD

(Ref: Rly. B d. s letter no. 2000/ Safety (A& R)/ 3/ 5 dated 23.3.2000)

\_\_\_\_\_ of \_\_\_\_\_ Train on \_\_\_\_\_ Railway.

Information received from \_\_\_\_\_ at \_\_\_\_\_ hrs. on date.

1. Date and Time of Accident:
2. Division:
3. Section:
4. Station/Block section:
5. Gauge/Track/Electrified/Route:
6. System of Working (Absolute/Automatic/ One train only etc.)
7. Train particulars
  - (i) Train No. /Name:
  - (ii) Engine No. :
  - (iii) Load:
8. Location:
9. Brief particulars:
10. Rolling Stock involved:
11. Causality
  - (i) Dead:
  - (ii) Grievous:
  - (iii) Simple:
12. ARMV/MFD/ART:
13. Officers visiting site:
14. Relief arrangements:
15. Repercussions:
16. Prima Facie cause:
17. State/Headquarter Civil District:
18. Any other information:
  - (a) The Pro-forma given in this appendix are required to be filled at the site by the supervisors of the respective department in presence of the TI/Representative of traffic department and signed jointly by them and countersigned by the senior most Officer present at the site.
  - (b) The Pro-forma should form a part of the proceedings of the inquiry.

**3) S&T OFFICERS SHALL INSPECT THE FOLLOWING LIST**

**List of minimum essential Telecom equipments to be kept in Accident Relief Trains (ART's)**

**I. Common for RE as well as non RE areas**

- (a) Inspection Book 1 No.
- (b) (i) Magneto Telephone 4 Nos.
  - (ii) Dry Cells Large 6-I, 1.5 volts each for Magneto phones 12 Nos.
- (c) PVC insulated, PVC Sheathed twin core cable 500 meters
- (d) Microphone for cordless PA system 2 Nos.
- (e) Loud Speaker Horn type 5/10 Watts. 2 Nos.
- (f) (i) Amplifier of minimum 20 watts power output (having interface for cordless Microphones) and operating voltage of 12 V DC 2 Nos.
  - (ii) 12 volt 'Storage Battery' along with appropriate 'Battery Chargers'- 2 Sets
- (g) Megaphones Transistorised (minimum 10 watts each) 3 Nos.
- (h) Portable stand for loud speaker with adjustable height from 1.5 Mts. to 3 Mts. 2 Nos.
- (i) Field Service Telephone cable PVC insulated (D-8) 2 drums of 500 Mts. each)
- (j) Push Button Auto Telephone with Tone/pulse switching facility 4 Nos.
- (k) Portable Generator set, Petrol started and Kerosene run (HONDA-750 watt or equivalent) along with sufficient Petrol and Kerosene etc. 2 Nos.
- (l) VHF sets (Simplex) of 25 watts each along with accessories including telescopic pole/mast, Antenna –YAGI as well as GP and battery 2 Nos.
- (m) VHF sets (Duplex) with interface for telephones, accessories including telescopic pole/mast, Antennae-YAGI as well as GP and battery (Under areas where mobile train radio system exists) 2 Nos.
- (n) Walkie-Talkie sets (2 watts – VHF) with 100% spare batteries 8 Nos. \*14 (b) Battery chargers 100%.
- (o) Folding Table 1 No.
- (p) Folding Chairs 4 Nos.
- (q) Beach Umbrella 1 No.
- (r) Tent Kabuli (Medium) 1 No.
- (s) Bell Hailer 9 V DC 4 Nos.
- (t) Multimeter – MOTWANI (Major) Model or equivalent 1 No.
- (u) Extension Boards for power supply (Mains) 4 Nos.
- (v) Hand held Torch of 3 cells complete with dry cells 4 Nos.
- (w) Jointing Kit & material for cables and overhead wires – This is required to be decided by the Railways themselves according to their local needs for different ARTs.

## II. Tool Box

- (a) Soldering Iron – 10 W/12 Volts, 10 W/220 V & 65 W/220 V 1 No. each
- (b) Long Nose Pliers 200 mm 1 No.
- (c) Cutter Diagonal 200 mm 1 No.
- (d) Box Spanner 6, 5.5 and 5 mm 1 No. each
- (e) Hammer Steel 750 grams 1 no.
- (f) Hammer Wooden 1 No.
- (g) Adjustable Spanner 300 mm 1 No.
- (h) Screw Driver – 200 mm 1 No.
- (i) Screw Driver – 250 mm 1 No.
- (j) Mams tester (230 volts) 1 No.
- (k) Electrical Insulation Tape 12 mm x 15 meter 1 no.
- (l) Resine core 500 Gms.
- (m) Tape Recorder (Cassette type) 2 Nos.
- (n) Control Way station equipment DTMF type 2 Wire & 4 Wire with telephone and suitable Nicad cells-2 Nos.

*Note:* Half of these Walkie-Talkie sets along with charges are advised to be kept with Sectional Engineer/Telecom.

## III. Specific Equipments required for ARTs in non-RE area

- (a) 2 Wire portable control phone in a suitable box with dry cells, 2 sets
- (b) Telescopic pole of minimum 6 meters height with its bracket opening space at least 350 mm - 2 Nos.
- (c) Overhead control alignment charts. 1 Set

## IV. Specific Equipments required for ARTs having beats in RE area

- (a) 4 wire emergency portable control telephone with dry cells 2 Sets
- (b) Tapping transformers (1120:1120, 1120:600) 2 Nos. each
- (c) Terminating transformers (1120: 470) 2 Nos.

## V. Desirable Equipments

- (a) Satellite phone which supports video, audio & text features.1 no.
- (b) FAX machine (Plain paper) 1 No.
- (c) Video Camera & Recorder 1 No.

**4) ACCIDENT MANAGEMENT - S&T JE/SSE**

- (a) It is necessary to proceed to the site quickly not only to save life, protect property and restoration but also to ascertain the cause of the accident and to save all possible clues and evidences before they are tampered wilfully or otherwise.
- (b) When you are first railway supervisor reaching at accident site , after a rapid survey of the position, send brief particulars to the nearest Station Master to enable him to issue the all concerned message;
- (c) Establish communication with controller as early as possible
- (d) Send information to control room, Sr. DSTE by any means.
- (e) Arrange for protection to affected line and adjacent line as early as possible
- (f) The JE/SE/SSE shall along with the other officials at site seal up affected interlocking gear such as lever frames, cabins, relay rooms, signal location boxes etc., immediately when accident occurs in order that these equipments are not interfered with, until necessary tests have been carried out. The seals shall not be removed until authorised by the Senior most official present at site after conducting necessary tests and recording all necessary.
- (g) Make a preliminary list of damaged S&T gears and list of requirements and send to Sr. DSTE by any means.
- (h) Arrange sufficient technician staff at site as per requirement.

\* \* \*

## ANNEXURE - VII

### LOCO - DEPARTMENT

#### **LOCOMOTIVE (DIESEL & ELECTRICAL): -**

S&T officials must know all formats of this department.

'Pro-forma' is given below which is to be filled by 'Loco department' in case of accident when 'Loco' is involved in derailment.

#### **1) BASIC INFORMATION:**

- (a) Date of Accident:
- (b) Train No.
- (c) Loco Class:
- (d) Loco Numbers:
- (e) Loco manufacturing Year and Place:
- (f) Base Shed of Loco:
- (g) Date & Place last POH.
- (h) Kilometres earned after last POH.
- (i) Date and Place of last major inspection.
- (j) Date and Place of last schedule inspection.
- (k) Whether any schedules are overdue?

#### **2) GIVE BRIEF PARTICULARS OF THE SAFETY ITEMS NOT PROVIDED OR PROVIDED BUT MISSING/NOT WORKING.**

Safety Fittings	Provided	Working
Head Light		
Speedometer		
Speed Recorder		
Flasher Light		
Horn		
Brake system		

#### **3) PARTICULARS OF ELECTRICAL PROTECTION (For electric loco in case of fire only)**

Relay	Working / Not working / Isolated
Earth fault in auxiliary circuit (QOA)	
Over current in power circuit (QLM)	
Over circuit in rectifier block (QRSI)	
Earth fault in power circuit (QOP)	
Time lag relay (Q44)	

**4) DAMAGE**

- (a) Damage to the loco (brief description).
- (b) Cost of damage to the loco (in Rs.).

**5) CHECK & RECORD THE OBSERVATIONS AS FOLLOWS**

1. Position of control handles, cut out cocks etc. after the accident.
2. Functioning of brake synchronising valve – Whether working or not.
3. Position of brake blocks after the accident – whether applied or not.
4. Condition of cattle guard.
5. Any sign of seizure of roller bearing in axle box.
6. Comments if any coil spring is broken or displaced.
7. Any other observation in respect to mechanical defect of the locomotive, which might have any bearing on safe running of loco.

<b>To be jointly signed</b>		
Supervisor (Loco)	Supervisor (Traffic)	Supervisor(P.Way)

**6) MEASUREMENT OF WHEELS**

<b>5. Measurement of wheels for all class of locomotives</b>					
Sl.	Description	Observed value (in MM)			Remarks
			Left	Right	
1	Diameter of wheel at tread	1			Wheel size below condemning limit is relevant only in case of wheel breakage due to lesser rim thickness.
		2			
		3			
		4			
		5			
		6			
2	Wheel flange thickness	1			Information is normally relevant in case of two road case.
		2			
		3			
		4			
		5			
		6			
3	Wheel root wear	1			
		2			
		3			
		4			
		5			
		6			

Sl.	Description	Observed value (in MM)			Remarks
			Left	Right	
4	Tread wear	1			Tread wear should be measured from tread at 63.5 mm from wheel gauge face (from back face of flange) in BG and at 57 mm from wheel gauge face (from back face of flange) in MG
		2			
		3			
		4			
		5			
		6			
5	Wheel root wear	1			Information is relevant in case of axle breakage
		2			
		3			
		4			
		5			
		6			
6	<u>Wheel Gauge :</u> For checking wheel gauge, average of three measurements at equal spacing on the inner periphery of the two wheels on the same axle is to be recorded.	1			All measurements shall be taken on a level tangent un canted track. These measurements are for un loaded wheels, should be taken in workshop after dismantling information is relevant in case of wheel disc sliding / bent axle only. For Safety, similar limit.
		2			
		3			
		4			
		5			
		6			

**Note:**

- (1) Wheel number one is the outer end axle of truck under the Short hood and wheel count increases towards the Long hood the Long hood on diesel loco, where as Electric loco, wheel number one is the outer end side under Cab-1 (Cab 1 is the side of the loco which has the compressors and Cab-2 to that side of the loco which has the ARNO converter) and wheel count increases towards the Cab-2.
- (2) The measurements of wheels are to be done using wheel gauges to RDSO drawing No. SK.DL.3592 for all BG locomotives except WAG, except WAP5 locos. For WAM locos RDSO drawing No. DKDL 4446 and SKDL 4447 may be followed.
- (3) All measurements are to be taken in shed on a level, un-canted track.
- (4) Service limits given in the Maintenance Manual are for good maintenance practice and these are not safety limits.

<b>To be jointly signed</b>		
Supervisor (Loco)	Supervisor (Traffic)	Supervisor(P.Way)

**7) PRO-FORMA FOR MEASUREMENT OF ELECTRIC AND DIESEL LOCOMOTIVES AFTER ACCIDENT (Locomotives which are not mentioned in this pro-forma, may be measured in similar manner)**

Sl. No.	Description		Observed Value (in mm)	Remarks
1	Buffer Height			All measurement shall be taken on a level tangent un-canted track. This measurement is required to be taken only in case of trailing stock is with buffers.
2	Lateral clearance	End Axles (1,3,4 & 6)		Applicable for WDM2, WDM2c, WDG4, WDS6, WAM4, WCG2, YDM4, WCAM1, WCAM2, YDM4A, WDG2, WCAM3, WAG5, WAG9, WAG7, WAP1, WCAG1 & WAP4 Locomotives only.
		Middle Axles (2 & 5)		Applicable for WDM2, WDM2c, WDG4, WDS6, WAM4, WCG2, YDM4, WCAM1, WCAM2, YDM4A, WDG2, WCAM3, WAG5, WAG7, WAG9, WAP1, WAP4, WDP2, WAP3, WAP6, WAP1 & WCAG1 locomotives only.
3	Lateral clearance	End Axles (1,3, & 4&6)		Applicable for WDP1 & WAP5 locomotives only.
4	Longitudinal clearance between axle box and pedestal liner (for all axles)			Applicable for WDM2, WDM2c, WDM5, WDS6, WAM4, WCG2, WAG5, YDM4, YDM4A, WDG2, WCAM3, WAG7, WAP4, WDP1, WCAG1 and WAP1 locomotives only.
5	Longitudinal clearance between axle box and pedestal liner (for middle axle)			Applicable for WAP3, WAP6, WDP2 locomotives only.
6	Height of Rail Guard from rail level			

To be jointly signed		
Supervisor (Loco)	Supervisor (Traffic)	Supervisor(P.Way)

## 8) BAD RIDING OF ENGINES

### ANNEXURE-B

On the locomotive

- (1) Engine No.
- (2) Train No.
- (3) Approximate speed when lurching or swaying occurred
- (4) Condition of bogie control springs
- (5) Condition bogie slides
- (6) Clearances in all axle boxes
- (7) Intermediate friction gear, if any
- (8) Whether Ferodo Liners are fitted to hind truck or bogie
- (9) Condition of tyre flanges

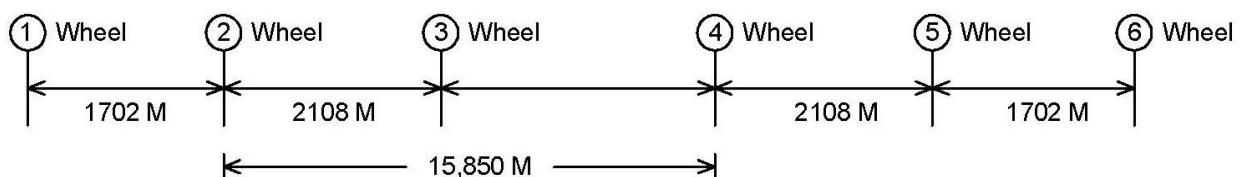
## 9) ENGINE PARAMETERS

Engine Parameters		
Axe Box: Side Clearance :		(1/16" to 3/16") (1.6mm – 4.8 mm)
Lateral Clearance:	Between 2 <sup>nd</sup> & 4 <sup>th</sup> Wheels –	(1" – 1 ¼ ") (25.4m-32m)
	Between 1 <sup>st</sup> , 3 <sup>rd</sup> , 5 <sup>th</sup> , & 6 <sup>th</sup> wheels	(1/4" – ½") (6m – 13m)

### Lateral Clearance:

Between 2<sup>nd</sup> & 4<sup>th</sup> Wheels – (1" – 1 ¼") (25.4 m – 32 m)

Between 1<sup>st</sup>, 3<sup>rd</sup>, 5<sup>th</sup>, & 6<sup>th</sup> Wheels – (1/4" – ½") (6 m – 13 m)



B. Buffer Height. (From R/L to centre of Buffer)	Not Less than 1030 mm Not more than 1105 m
C. Wheel Gauge Distance	(1596 + 0.5)m
D. Wheel Dia :	Not more than 1092 m (For a new Wheel)
	Not less than 1016 ( in service ) (1010 Dia is condemn size)
E. Difference of Dia between Wheel of same axle	Between:0.5 mm – 2.5mm
F. Difference of Dia between Wheels of same Trolley	Between: 3 mm – 8 mm
G. Difference Dia between Wheel of same Loco	Between 15 mm – 25 mm

\* \* \*

## ANNEXURE - VIII

### CARRIAGE & WAGON- DEPARTMENT

#### INSPECTION OF ROLLING STOCK IN CASE OF AN ACCIDENT

The rolling stock involved in accident must be inspected in the presence of nominated team of supervisors and results should be recorded in the prescribed format. The main items of inspection are as under:

##### **1) WHEEL GAUGE**

Wheel gauge is the distance between inside faces of the flange on the right and left side wheels of an axle. There should be no variation in the values of wheel gauge - measured at four points 90 degrees apart on a wheel set.

However the actual value of the wheel gauge can vary as per - tolerances given

- Standard 1600 mm 930 mm
- Maximum 1602 mm 932 mm
- Minimum 1599 mm 929 mm

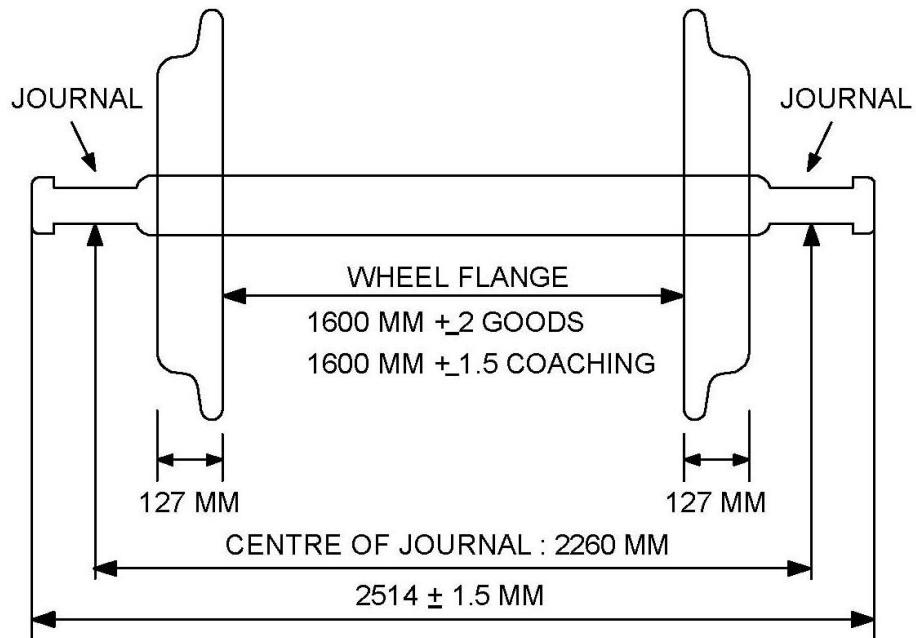
<b>WHEEL GAUGE</b>	
For Goods	: 1600 (+ 2) mm
For coaching	: 1600 (+ 1.5) mm

It has to be measured at 4 quadrants

All readings shall be same.

If the readings are not same then

- Axle is bent
- Wheel might have shifted (If a wheel shifts by 10 mm),



## 2) MEASUREMENT OF WHEEL GAUGE

The wheels are required to be gauged at three or four - quarters (as per possibility) and recorded duly indicating the following:

Tightness or slackness of gauge whether any indication exists about shifting of wheel on the axle.

*Note: It must be ensured that the back surface of wheels is cleaned thoroughly before measuring the wheel gauge in order to avoid erroneous readings.*

If the wheel gauge is more than permissible limit, there exists a possibility gauge is one of the parameters affecting the clearance at check rail opposite the Nose of crossing.

If the Wheel gauge is less than minimum value, there is a possibility of wheel hitting at the back of a tongue rail while passing through the switch and thus damaging the Tongue rail.

The variation in 'wheel gauge' after lowering the coach body on wheels was examined by RDSO/ Lucknow and circulated to all Railways vide letter no. MC/WA/GENL, Dated 27.06.88 as follows:

*The question of variation in the wheel gauge under no load and loaded Condition has been examined by RDSO.*

*The calculations for the 15 ton BG axle under tare load condition indicates that a variation of about 3 mm in the wheel gauge when measured at the top, at bottom location in the vertical plane is likely to take place due to bending of axle under coach load.*

*This variation in wheel gauge under loaded condition, however, has no bearing on the safety of coach operation. However, if the measurements for wheel gauge are done in horizontal plane passing through the axle then the effect of bending of the Axle will not be there.*

*It is therefore clarified that the wheel gauge tolerances of  $1600 \pm 2$  mm as laid down in IRCA rule book is required to be checked under No- load conditions.*

## 3) BENT AXLE

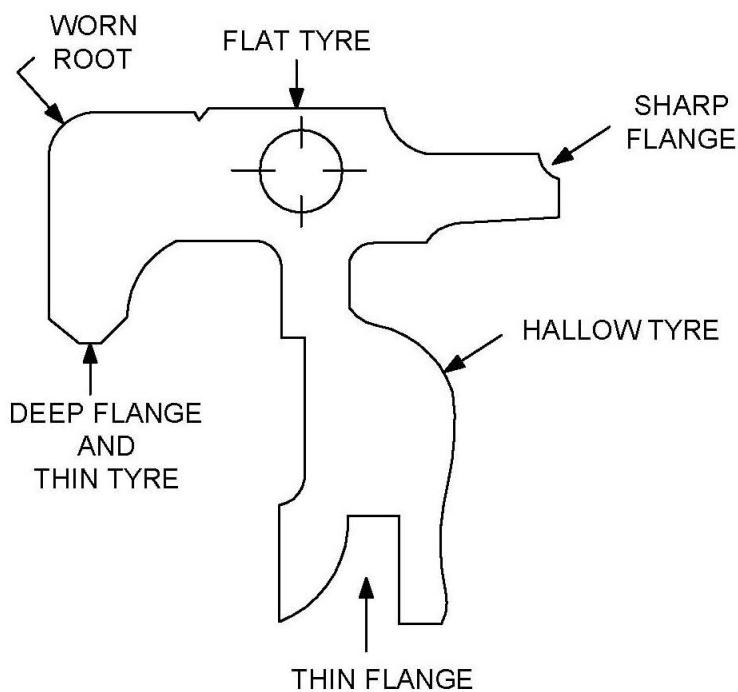
A bent axle starts wobbling during motion causing severe vibrations. In order to confirm whether an axle is bent or not, it must be checked carefully on a sensitive machine or measuring table.

## 4) WHEEL DEFECTS

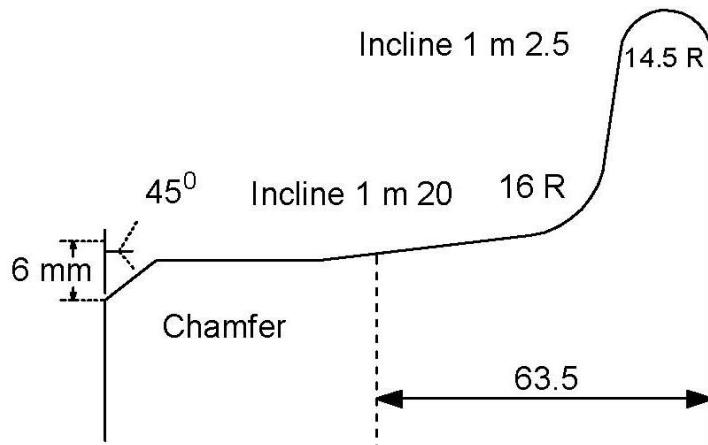
The following aspects should be checked on the suspected Wheels

- (a) Condemning limits
- (b) Flat places on tyre/skidding
- (c) Flanges sharp/deep/thin
- (d) Radius too small at the root of the flange
- (e) Gauge slack/tight
- (f) Cracks

The above Mentioned defects can be detected with the help of '**Tyre defect gauge**' and Wheel gauge meant for this purpose.



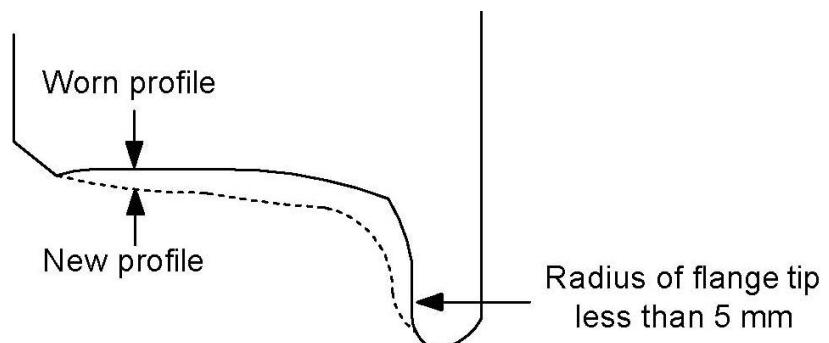
### TYRE DEFECT GAUGE



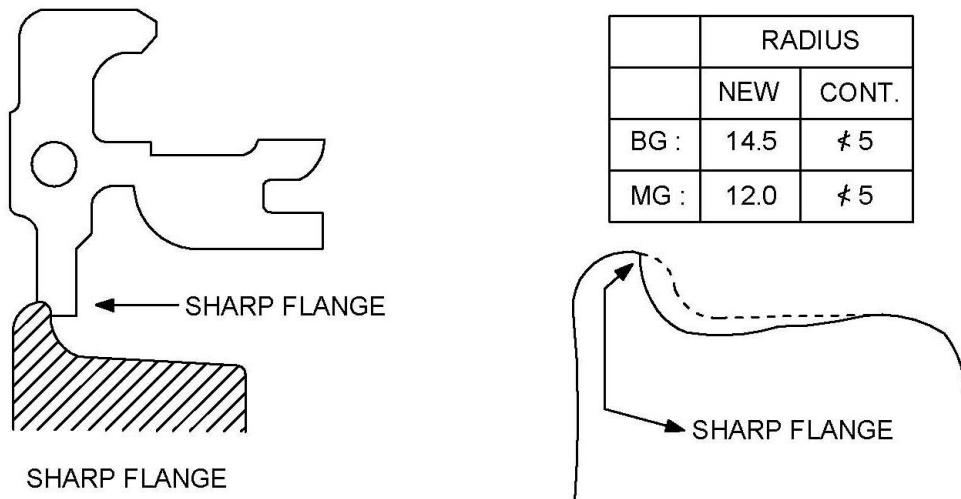
### STANDARD DIMENSION OF WHEEL

#### (i) SHARP FLANGE:

This occurs when the flange wears in such a way that radius at the tip of the flange becomes less than 5 mm. The flange forms a fine sharp edge. Due to this, the wheel set can take two roads at slightly gaping point or wheel may ride over the chipped tongue rail.



- Flange of the wheel sometimes wears to form a knife edge which becomes unsafe when radius of the flange at the tip is less than 5mm
- A wheel with sharp flange has biting action particularly while negotiating a curve. Sharp flange may split open a slightly gaping points.
- While travelling in facing direction it may even mount the tongue rail. Co-Efficient of Friction increases leading to unsafe/unstable condition.
- Rejection limit for flange tip radius is less than 5 mm for BG/MG

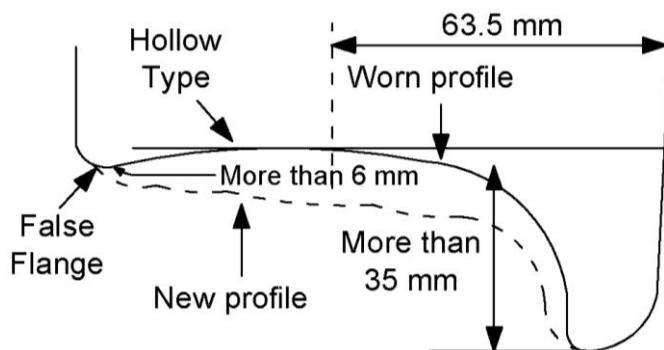


"Wheel gauge" should not house. If so, it is "sharp flange"

When Radius of Flange Tip reduces to 5 mm then it is "sharp Flange"

## (ii) FALSE FLANGE/HOLLOW TYRE

When the projection of outer edge of the wheel tread below the hollow of the tyre exceeds 5 mm, the outer edge of the wheel forms a False flange and the worn tread is called hollow tyre.



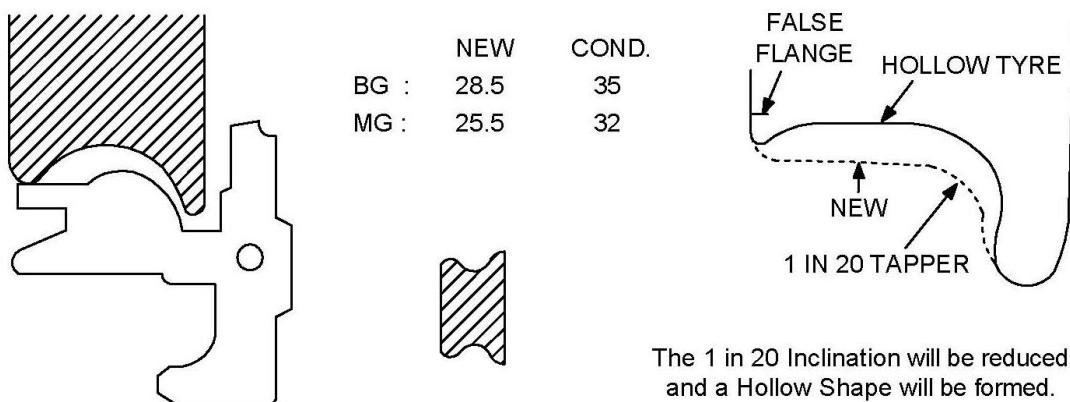
The hollow tyre has the danger of developing a false flange. There is no effect on angularity or eccentricity but wear on tyres has the effect of increasing the conicity of the wheel tyre. This reduces the critical speed of the rolling stock beyond which excessive hunting and oscillations take place thereby - increasing the flange force 'Y' and the chances of derailment.

A false flange may split open the points while travelling in trailing direction while negotiating the crossing. It may tend to get wedged in between the tongue rail and the stock rail. The wheel going across the wing rail would then get lifted as instead of travelling on the tread portion, it would be travelling on the false flange. This will make the wheel to suddenly lift up and drop down near the nose of the crossing.

Excessively worn-out tyre on tread is a hallow tyre and have developed a false flange. The false Flange formed may force open the switches when the vehicle runs in the trailing direction on points and crossing.

False flange can be dangerous at the wings of crossing as it may ride over the wing rail. Thus lifting the wheels and greating conditions favourable to derailment.

The 1 in 20 inclinations will be reduced and a Hollow shape will be formed. If the HOLLOWNESS is more than 5 mm with Hollow tyre then it results in difference of wheel dia. with (+ve) angularity and the wheel may ride over the rails.



If the HOLLOWNESS is more than 5mm with hollow tyre, then it results in difference in wheel dia. with (+ ve) angularity and the wheel may ride over the rails.

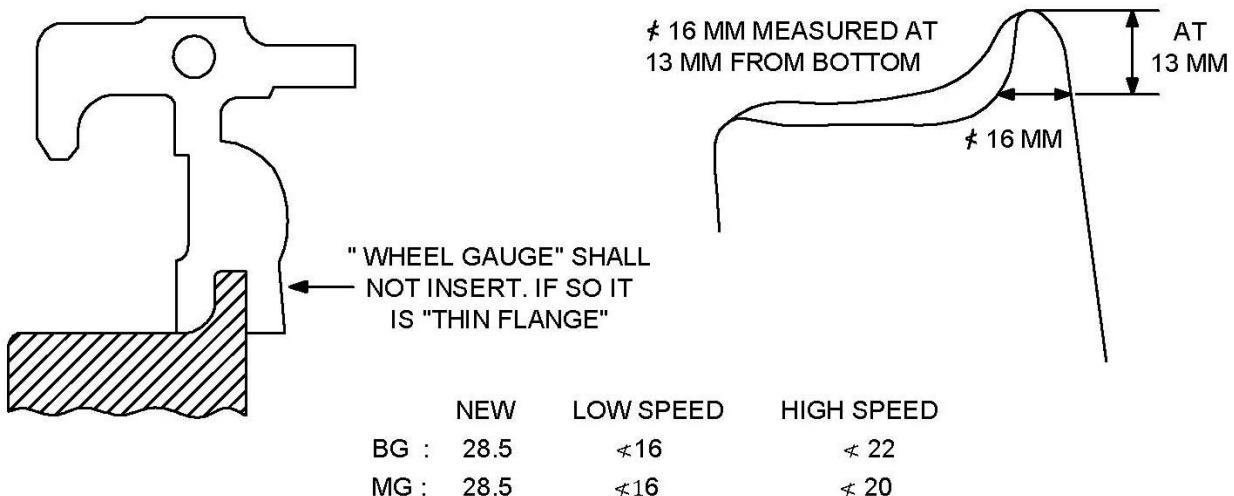
### (iii) THIN FLANGE:

When the flange thickness reduces to less than 16 mm for B.G., the flange is called a thin flange. It should be measured at the distance of 13 mm below the flange tip.

A thin flange increases lateral play between the wheel set and track and increases

- Lateral oscillations adversely affecting Y/Q and
- Angularity of wheel set on run

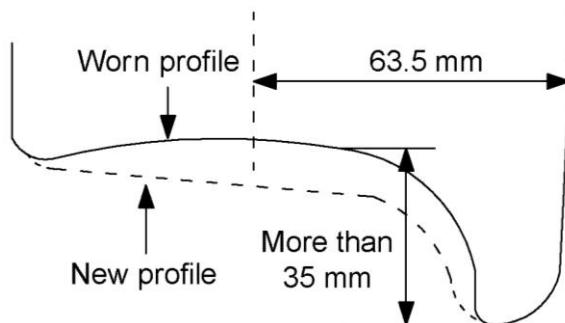
- (a) Flange becomes thin by wear and tear of the tyre and flange and becomes unsafe when it is less than 16 mm.
- (b) This increases clearance between wheel flange and rail, Which increases the derailment proneness
- (c) Oscillations increase due to greater play between wheel set and track resulting in greater in-stability of the vehicle.
- (d) Angularity of the axle increases
- (e) Rejection limit is 16 mm BG/MG measured at 13 mm from the flange tip.
- (f) It also damages tongue rails due to less gap and more play.



#### (iv) DEEP FLANGE:

When the depth of flange, measured from the flange top to a point on the wheel tread (63.5 mm away from the back of B.G. wheel), becomes greater than 35 mm, it is called a deep flange ( $35 - 28.5 = 6.5$  mm) as shown in Fig. 3.6.

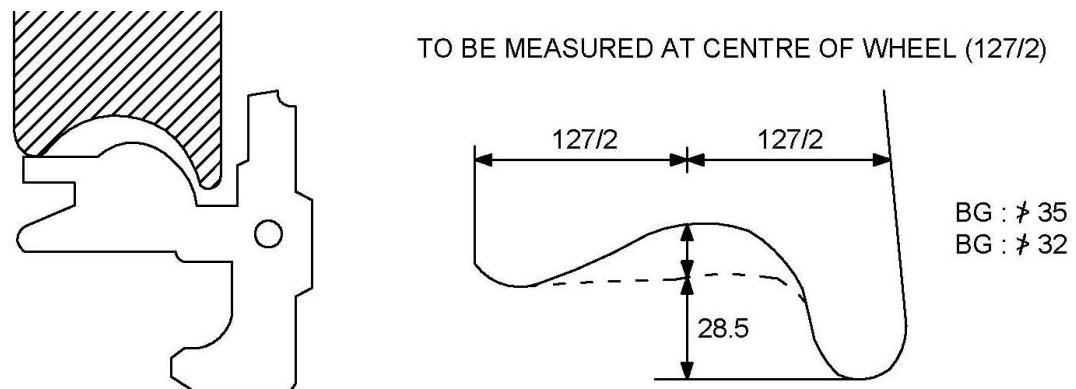
Under this condition, the wheel flange would tend to ride on the fish plate and check-block-and may damage the track components.



Deep Flange may hit track fittings like fishplate joints, lock bars, point and distance blocks.

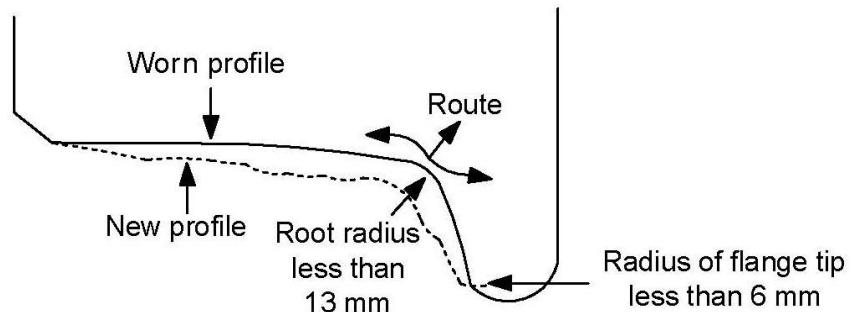
A deep flange tends to ride on fishplate and distant or check blocks and damage the track, particularly if there is vertical wear on railhead.

Rejection limit in depth of flange greater than 35mm (BG), 32mm (MG) measured at 63.5 for BG and 57 mm for MG away from back of wheel.



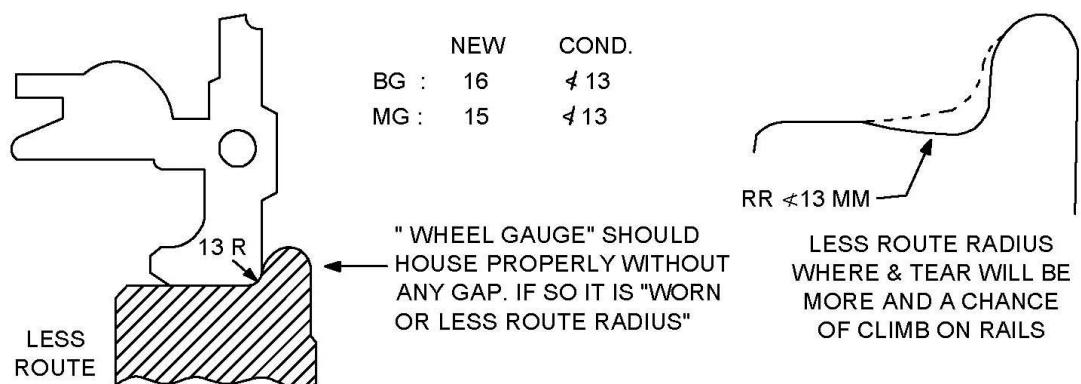
## (v) WORN OUT FLANGE:

When radius at the root of the flange becomes less than 13 mm, it is called worn out flange.



When the radius of the root of the tyre is excessively worn and radius at root of flange is less than 15 mm then it is called worn root and it may contribute to unsafe condition.

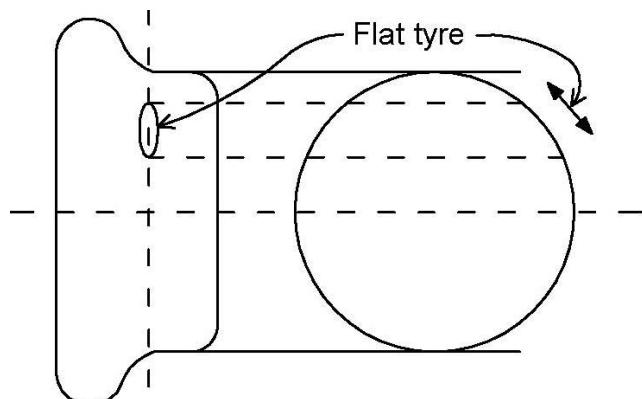
Worn-out Root increases the flange angle and increases the derailment proneness. Rejection limit is to get radius of the root curve between the thread and flange.



## (vi) FLAT PLACES ON TYRE

The maximum permissible value of flatness on B.G. wheel tyres is as under

- Goods Stock IRS - 60 mm
- Coaching Stock - 50 mm
- FLAT TYRE  $\leftarrow$

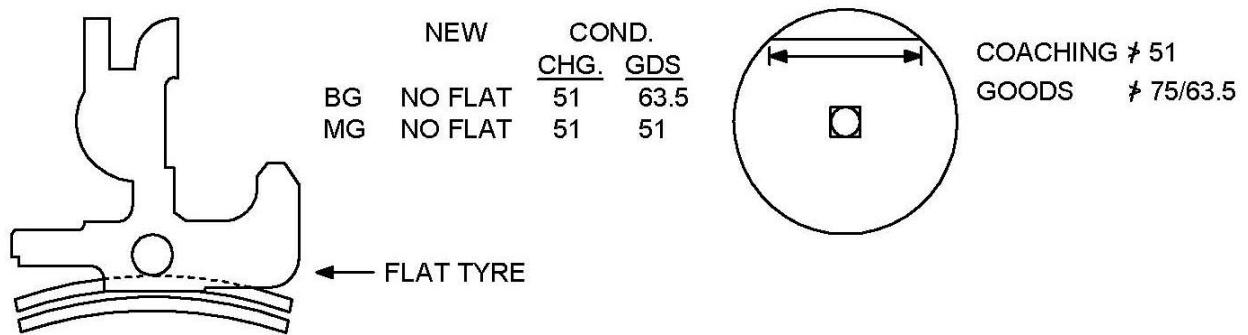


This may cause rail fracture leading to derailments.

### (vii) FLAT TYPE/SKIDDED WHEEL

It may occur due to continuous brake binding, skidding, and brake block tilting and jamming against the tyre.

- (a) Flat of more than 2" (MG), 3" BG will cause passenger discomfort and may become unsafe.
- (b) Flat tyre causes greater hammering action on the rail/rail fractures.
- (c) Rejection limit is 75 mm (goods stock), 51 mm ( ) MG all stock =51 mm.

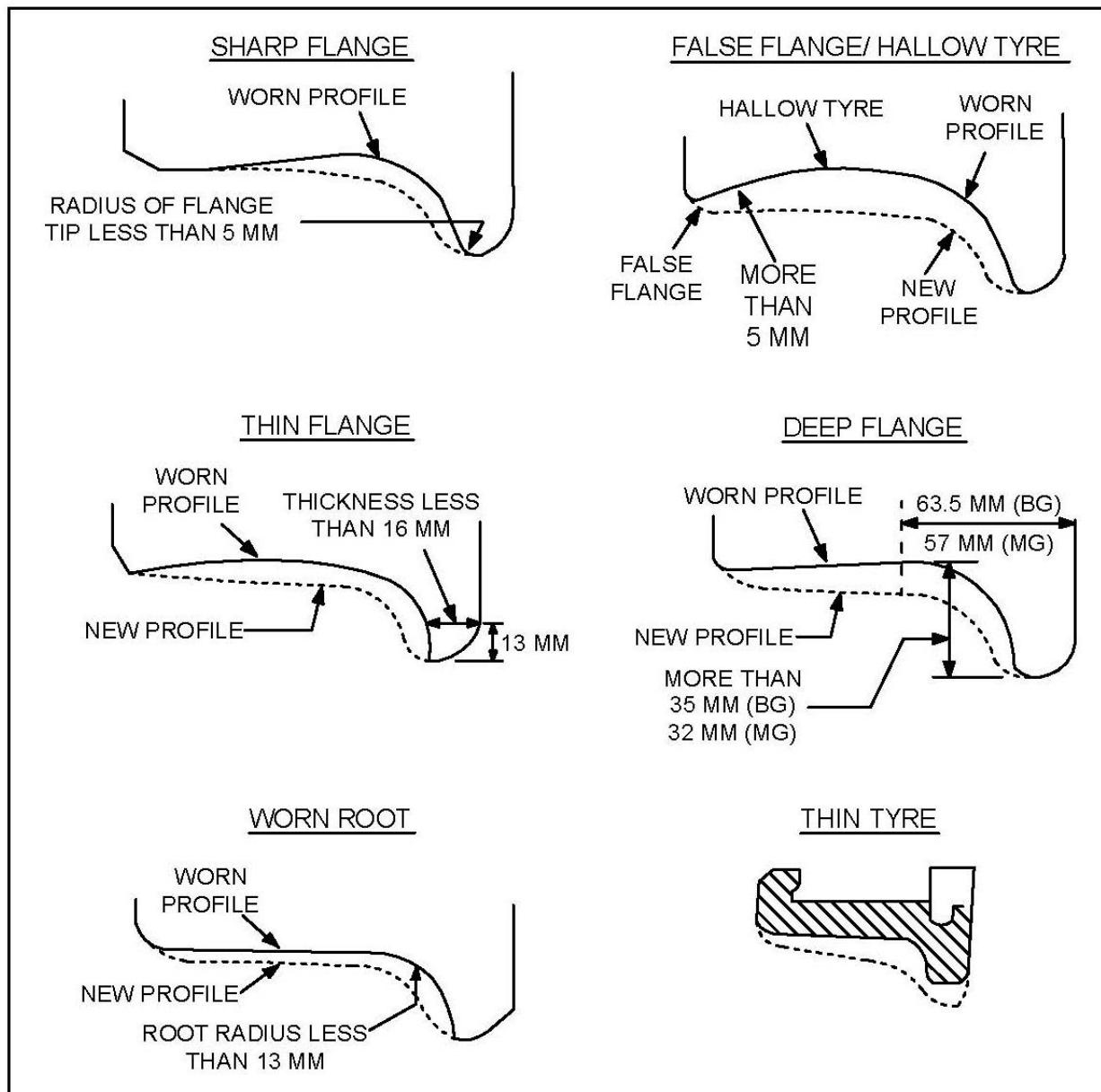


### (viii) THIN TYRE

- (a) When Thickness of the Tyre has gone below condemning size, there is a chance of bursting/cracking of tyre through out the periphery, resulting in derailment.



## (ix) DIFFERENT SHAPES OF WHEELS WITH DEFECTS



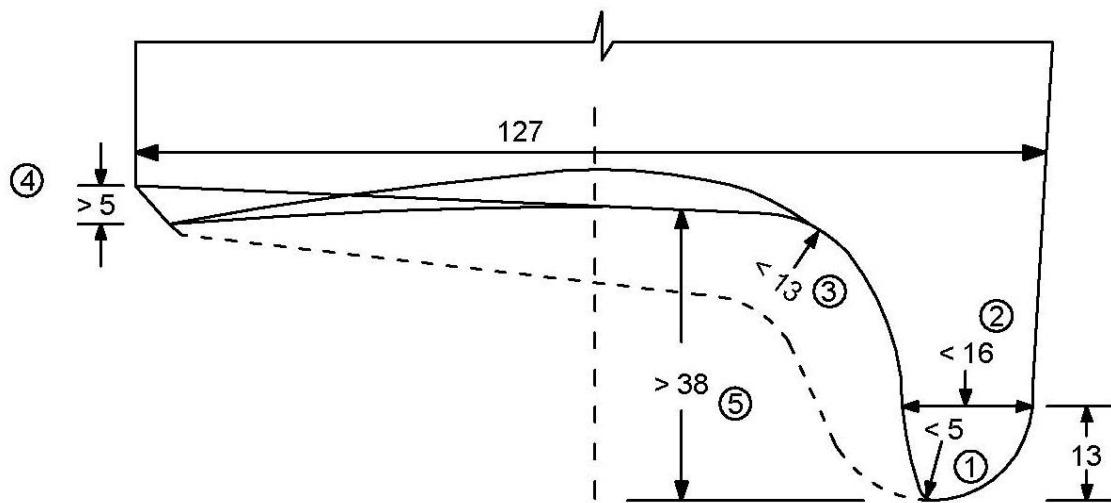
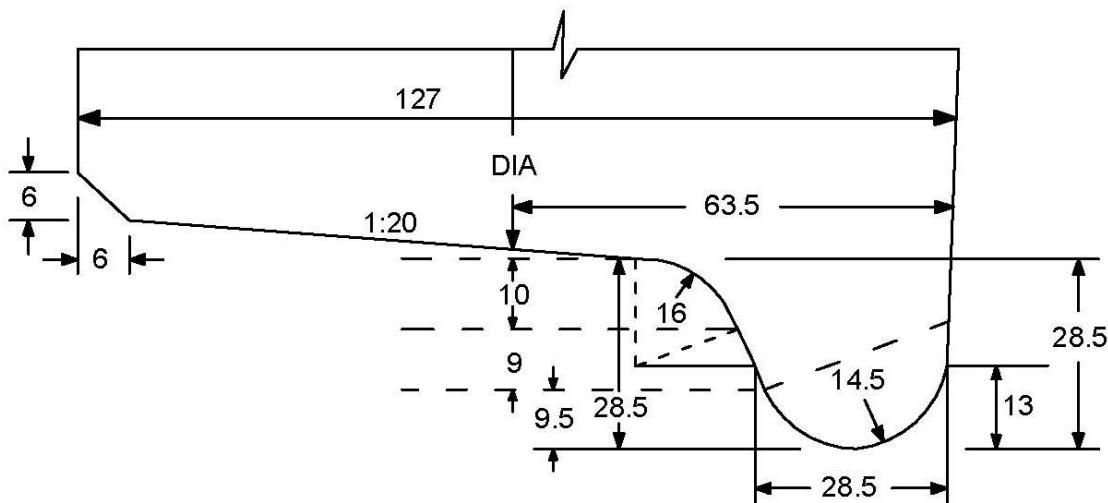
Sharp Flange: Radius < 5 mm

Thin Flange: Thickness < 16 mm

Worn Root: Root Radius < 13mm

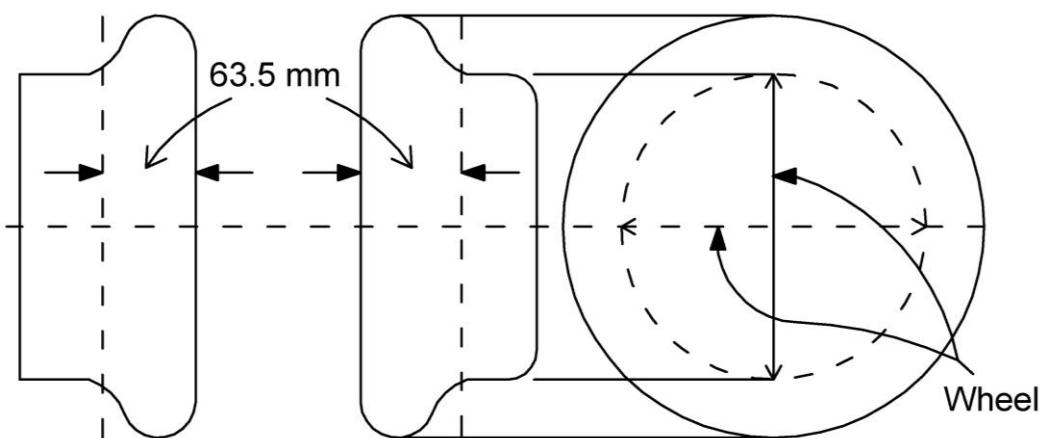
Deep Flange: > 35 mm

False Flange: > 5 mm



#### (x) DIFFERENCE OF WHEEL DIAMETER ON TREAD

Wheel diameter is measured on the Tread at a distance of 63.5 mm from the inside face of the wheel in case of B.G. Two measurements 180 degrees apart should be taken for each wheel.

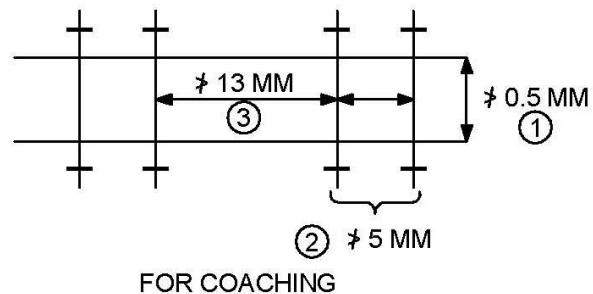
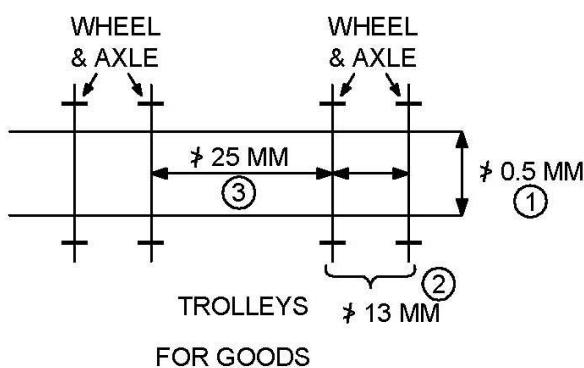
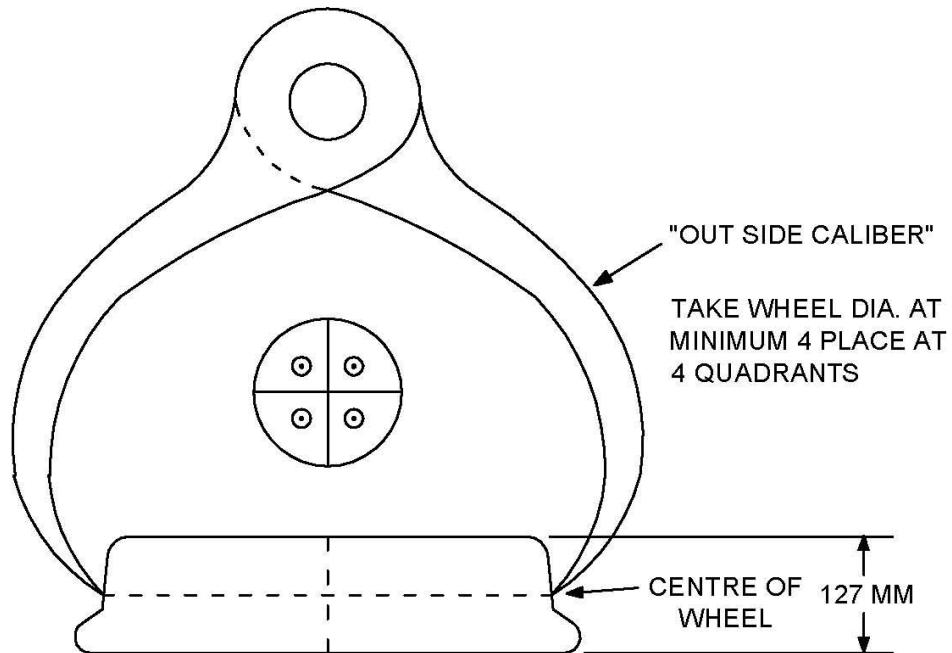


The limit of variation of wheel diameters on the same axle during service is 1.5 max, vide Rly. Bd. letter No.86/M/ (N)/960/8 Dated. 22-8-86. the workshop leaving limits for the difference in dia.

## Workshop Leaving Limits for Wheel Diameter on BG (All Dimension in mm)

Type of Wagon/Trolley	On same Axle	On same trolley	On same wagon
Four Wheeled Trolleys	0.5	13	13
Six Wheeled Trolleys	0.5	6	6
Six Wheeled Units	0.5	6	6
Four Wheeled Units	0.5	6	6

## METHOD OF MEASURING WHEEL DIAMETER



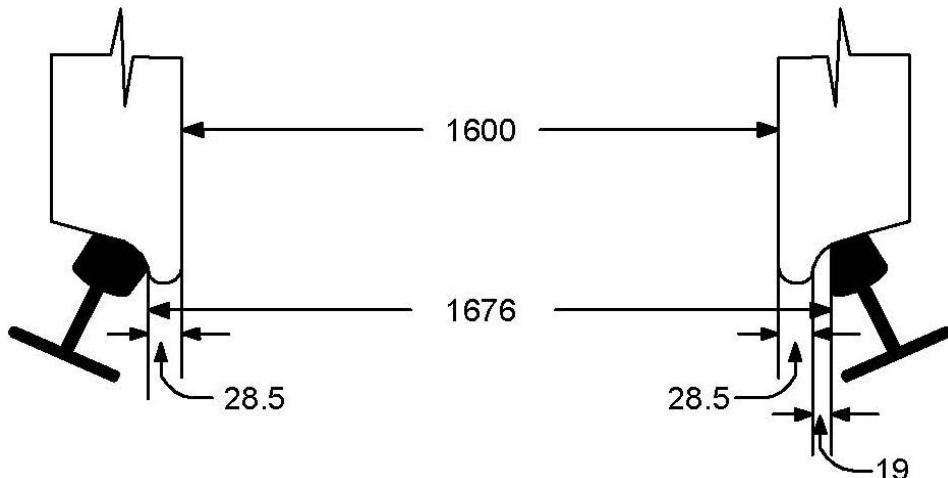
Type	Type of Wagon	Wheel Diameter in mm		Variation in Wheel Diameter in mm	
		New	Cond.	With in Trolley	On Coach / Wagon
Goods	I.C.F. coach	915	813	5	13
	B.E.M.L coach	914	812	5	13
	IRS Wagon	1090	990	13	25
	CRC Wagon	1000	860	-	25
	BOXN/BCN	1000	906	13	25

Difference of wheel diameter between wheels of	Goods	Coaching
Same axle	0.5mm	0.5mm
Two adjacent axles of the same trolley	13 mm	5 mm
Different trolleys of the Bogies	25 mm	13 mm

Due to difference in wheel dia., there will be angular motion of the wheels.

- Wheel with Less dia. will have (+) Positive angularity motion and will mount over rails and derail
- Wheel with more dia. will have (-) negative angularity motion will increase wear and tear.

## 5) EFFECT OF PLAY BETWEEN WHEEL SET & TRACK



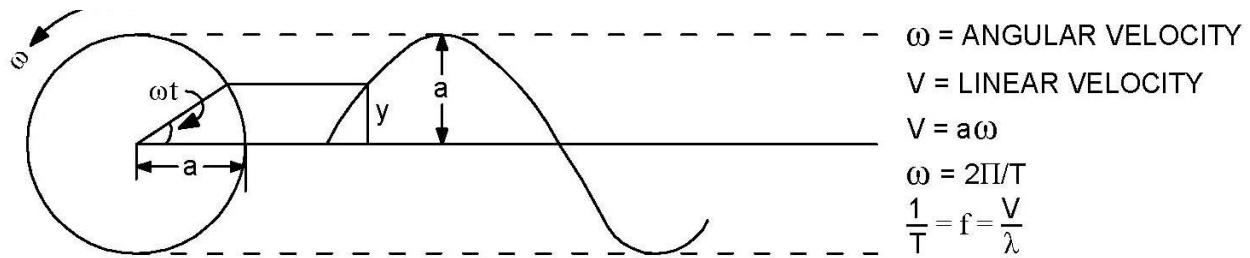
**Wheel Flange Depth 28.5 mm can go up to 32 mm (Due to wear & Tear)**

- Standard Play = 19 mm
- This will increase with wear of wheel flange & wear of rail
- With max. worn wheel flange, the play becomes  $2 \times 12.5 + 19 = 44$  mm
- Amplitude of lateral oscillation =  $44/2 = 22$  mm
- As against 9.5 mm with standard play.

The lateral Acceleration & Y would increase in direct proportion.

With slack gauge effect would be enhanced increase in play

- Increases lateral & vertical acceleration
- Increases flange force and
- Decreases speed potential



$dy/dt = a \omega \cos \omega t$ . = lateral velocity at time  $T$  lateral acceleration.

Wheel Defects and Parameters

All measurements in mm

Dotted lines: new profile. Full line: worn out profile.

## 6) AXLE BOX

### (a) Bearing

- (i) Plain Bearing
- (ii) Roller Bearing.

### (b) Play of Bearings at Journal



	Trolley	4 Wheels
BG	5mm - 10mm	5mm - 10mm
MG	3mm - 6mm	3mm - 10mm

If the play is excessive,

- (i) Lateral Oscillations will increase
- (ii) Angularity of the axle increases

In General, in axle boxes there shall be

- (i) No cracks,
- (ii) No breakages,
- (iii) No Hot axle,
- (iv) All rivets should be intact.

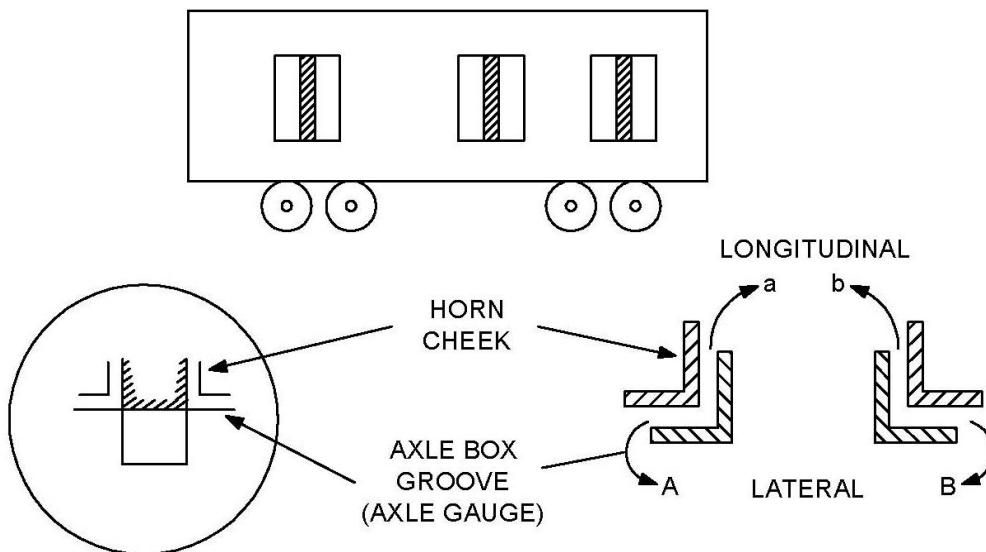
**(c) Clearance between Axle Box Groove and Axle Ground (Horn Cheek)**

**Lateral Clearance**

Goods & Coaching Bogies & 4 wheels ---	6 mm    10 mm (BG & MG)
Box Wagons -	20 mm 25 mm (BG & MG)

**Longitudinal Clearance**

Coaching Bogies & 4 Wheels	3 mm    10 mm (BG & MG)
Goods Stock.	Not specified but should be in good condition
Box Wagons	12 mm    18 mm ( BG & MG)



a+ b should be between 12-18 mm (or) 3+10 mm

A+B should be between 20-25mm (or) 12-18 mm.

Horn Cheek is attached to the carriage frame axle guard is attached to the axle box.

**(d) Spring Gear**

- (i) Leaf/Laminated Bearings.

(Provided for CRC /BOX/BCX/BCXT/BRH/IRS Wagons & 4 wheeler Tanks)

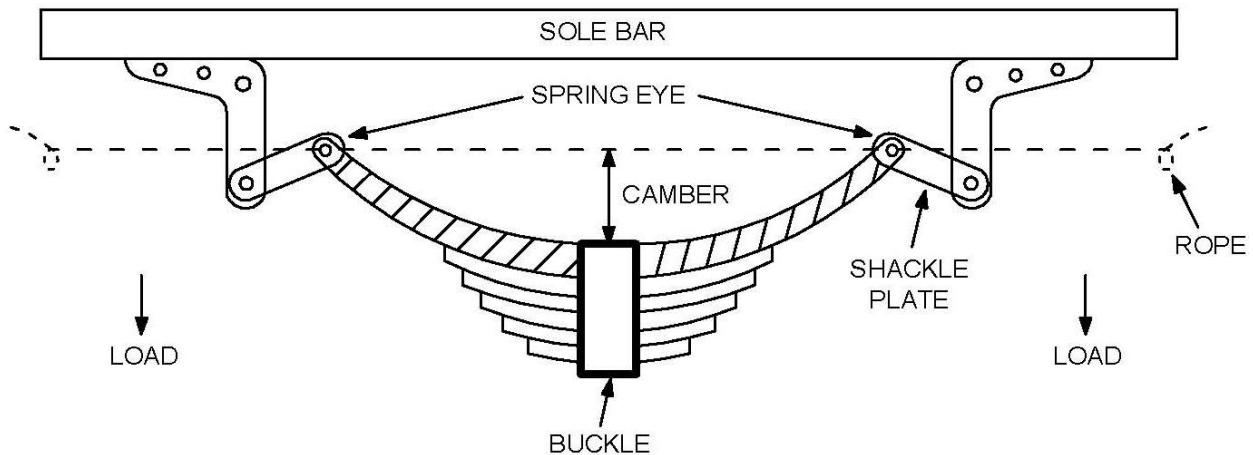
- (ii) Helical springs.

(Provided for all coaching, BOXN, BCN, BCRH)

**(e) Leaf/Laminated Bearing Springs**

**Camber:** It is the vertical distance between ropes drawn through centre of spring eyes and top of the buckle.

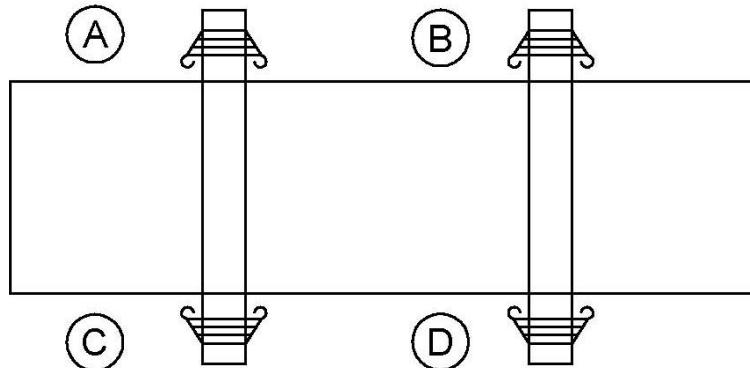
**Free Camber:** The distance measured when the spring is on the ground and new and not mounted. It shall be 58 mm.



The Tolerances allowed are :	
For Loco & Carriage	: 0 + 3
Goods Stock BG	: 0 + 6
Goods Stock MG	: 0 + 5

**Working Camber** The distance measured when the spring is mounted on the vehicle and with full load shall be 47 mm.

Also the difference between free camber and working camber measured between any 2 springs out of 4 fitted on the vehicle shall not be more than 13mm.



Difference of Free camber and working camber between any two springs-13 mm

Working camber can be measured as it is free camber can be measured after releasing the springs.

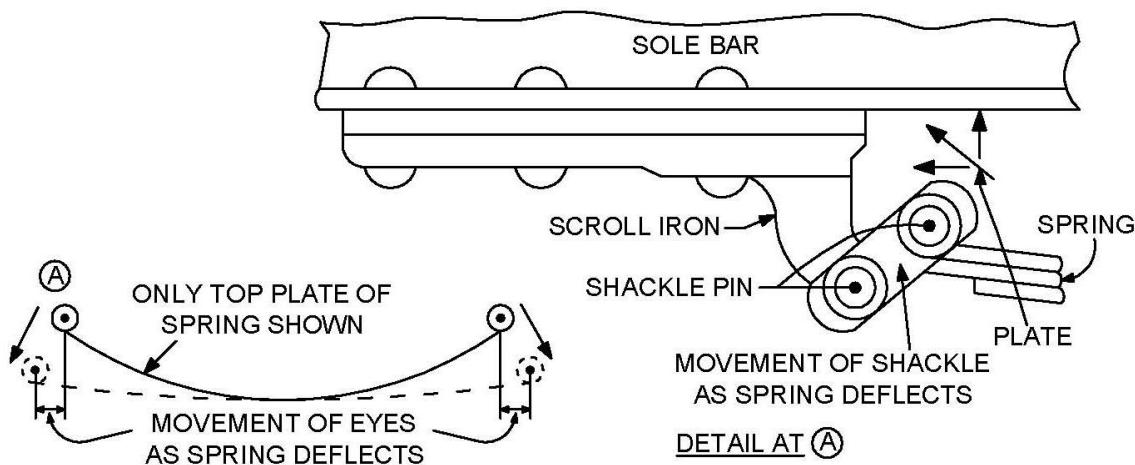
#### Spring and spring gear Defects – Rejections

#### Goods and Coaching stock (BG and MG)

There shall not be any damage to the spring gear or to any part of it. Spring eye, shackle plate shall not touch the bottom of sole bar even with load or even while running check up for any marks below the sole bar. All the springs should be intact and they shall not be shifted.

- (i) Any plate of a laminated bearing spring or any coiled bearing spring cracked or broken. Bearing spring buckle loose, broken and cracked and / or packing plate loose or deficient.
- (ii) Any plate or buckle loose and / or displaced from its central position by 13 mm or more.

- (iii) Bearing spring buckle not sitting square in the axle box housing or crown packing where fitted.
- (iv) Flange of any wheel within 25 mm of the bottom of a wagon. Incorrect type of bearing spring for the particular design of wagon. Scroll iron fractured, deficient of a rivet or fitted with a loose or wrong size rivet. Scroll iron shifted or out of alignment by more than 25 mm.
- (v) Shackle or pin cracked, deficient, broken or of wrong size. Bearing spring hanger cracked or broken or nut or jib cotter deficient or defective. Bearing spring shackle pin not fitted with a split cotter.
- (vi) On Meter Gauge wagon bearing spring shoe fractured or with a rivet, bolt or stud broken or deficient or bolt or stud of wrong size.
- (vii) Bearing spring eye or shackle plate touching the sole bar (in static or dynamic condition).
- (viii) This defect in dynamic condition can be confirmed by the presence of rubbing marks at the bottom surface of the sole bar. When a laminated spring deflects, it elongates, thereby causing the shackle plate to move up, as illustrated In Fig.11.
- (ix) Thus if movement of shackle plate is prevented, it in effect, prevents the deflection of the spring and renders it ineffective and hence derailment-prone.



Under load spring eyes move outwards. For such movement of spring eye to be possible, shackle plate has to move, arcing outwards which results in vertical component of movement.

#### **(f) Helical spring**

##### **Common Defects**

- (i) No crack or no breakage
- (ii) Springs shall be intact and not shifted
- (iii) It shall have spring action and not fully compressed
- (iv) It should not lose its elasticity.

## **7) BUFFER**

To be measured from R/L

- (a) Empty : 1105 mm (Both for goods and coaching)
- (b) Loaded : 1030 mm (Both for goods and coaching)

### **Common Defects**

Buffer should be rigidly fitted. The Height of buffer changes due to wear and tear of wheel set and when ever wheel set is replaced to maintain the height, Packing pieces are provided. If the 'packing piece' is missing then the height of buffer will get change and there by the buffers of adjacent vehicles may get entangle or CBC coupling may get disconnect resulting in derailment.

## **8) BUFFING GEAR**

Buffer projection limits from head stock

<b>For long case buffers</b>	<b>For short case buffers</b>
Max. 635 mm	456 mm
Min. 584 mm	406 mm

- (a) Buffer projection for POH stock should not be less then 625 mm for long Case and 445 mm for short case buffers.
- (b) No dead buffers shall be permitted from the sick line, the buffers shall be considered dead when the projection is below the prescribed minimum Limits.
- (c) Buffer heights in BG Stock shall be within the limits and it should be measured on level track.

Note:

- 1) The measurement should be taken from the centre of the buffer socket to the top of the rail head. The buffer height should never be taken from the centre of the buffer face because it will not give correct value.
- 2) While recording buffer height, it should be ensured that buffer bolts are in tight condition and buffer is not drooping. If it is drooping, the amount of drooping should be measured and recorded.

To make up buffer heights to maximum permissible limits, a packing piece of required design and size may be inserted. For goods stock: between axle box crown & bearing spring buckles. For ICF coaching stock: between lower spring (Dash pot spring) & axle box wing.

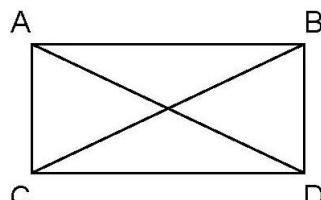
## **9) DISPLACED BUFFER**

If Buffer displaced 35 mm in any direction from its normal positioning case of goods stock and 38 mm for coaching stock are called displaced buffers. If buffers of adjacent stock are not in the same level due to different conditions off loading or spring characteristics, the buffer draw gear takes an inclined position.

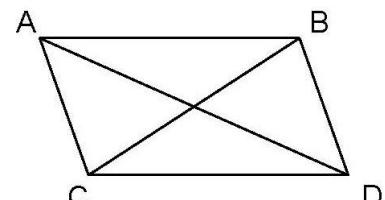
In case of sag on the track or brake application on a down gradient, the buffers exert compressive forces. It makes the lighter vehicle prone to derailment due to lifting, because of vertical component of the buffering force.

## 10) TWIST IN UNDER FRAME OF WAGON/BOGIES

### LONGITUDINAL TWIST



NO TWIST



TWIST

Normally  $AD=BC$ . If  $AD \neq BC$  then longitudinal twist is present. It would cause the axles to remain persistently angular to which may increase the derailment proneness.

### VERTICAL TWIST

A vertical twist is detected by measuring the height of sole bar at the 4 corners of the under frame above rail level. All 4 readings should be equal. A vertical twist of 20 mm can appreciably increase the derailment chances. It is equal to a twist in track. When both combined the chances are further more.

\* \* \*

**ANNEXURE - IX**  
**PERMANENT WAY (Engg.) - DEPARTMENT**

**1) REPORT ON TRACK**

- (a) SM's Wire No. and Station and date rough riding was experienced
- (b) Kilometrage and Section of Railway (Up or Down Track)
- (c) Train No. Engine No. and Type
- (d) Speed of the train
- (e) Date & Time of inspection by Sectional PWI / PWI – III
- (f) Rails
  - (i) Type & Weight
  - (ii) Length
  - (iii) Age
  - (iv) Condition
- (g) Sleepers
  - (i) Type
  - (ii) Age
  - (iii) No. per rail
  - (iv) Spacing
  - (v) Condition
- (h) Ballast
  - (i) Width at top
  - (ii) Deficiency of full Boxing Section
  - (iii) Depth below bottom of sleeper
  - (iv) Type
  - (v) Condition of ballast as regards Cleanliness and drainage
- (i) Formation
  - (i) Level or grade
  - (ii) Height of Bank
  - (iii) Depth of cutting
  - (iv) Class of soil
  - (v) Condition of drainage
- (j) Alignment Straight & Curve (Degree of curvature )
- (k) Type of Bridge
- (l) Last date of
  - (i) Through packing
  - (ii) Slack packing
  - (iii) Machine packing

- (m) Details of any defects in track, ballast or formation
- (n) Action taken to rectify defects in the track, ballast or formation
- (o) Any special features, Such as rainfall etc.

## 2) PREScribed FORMS

<b>SOIL</b>		
Sl. No.	Type e.g. Sandy, loam Clay, Moorum, Black Cotton etc.	Condition Firm, wet, Slushy etc.
1	2	3

<b>BALLAST</b>					
Type Stone, Moorum, Sand, Ash etc.	Depth below sleeper bottom in cms. Stating whether cleaned or chocked.	Width of shoulder in cm. From outside of			
		Rail		Sleeper	
		Left	Right	Left	Right
4	5	6	7	8	9
<b>SLEEPER</b>			<b>RAILS</b>		
Type Wooden CST 9, steel trough etc.	Condition New second hand damaged unserviceable etc.	Density	Square or not	Weight	Condition of wear (attach rail profile if wear is large)
					10

<b>Rail fastenings like dog spikes keys, tie-bars, cotters, loose jaws etc.</b>			<b>Rail Joints</b>
Number per sleeper seat	Condition : tight or loose		Condition: Hogged, Battered, low etc.
16	17		18

**ANNEXURE-IX**

General remarks about cracks or fracture of fish plates, fish bolts and other components	Description of anti sabotage measures like reversed jaws welded rails etc.	Location of point of mount		Location of point of Derailment	
		Whether on straight, curve or transition	Whether on a falling grade, level or rising grade & on sag	Whether on straight, curve or transition	Whether on a falling grade, level or rising grade & on sag
19	20	21	22	23	24

**To be jointly signed by Supervisor (Loco), Supervisor (Traffic), Supervisor (P.Way)**

<b>Track Measurements</b>								
Station No.	Distance apart in Mts.	Gauge slack or tight from the exact, correct to 3 mm	Cross level in mm (+) High (-) Low		Marks on sleepers or rail top	Grinding or rubbing marks on rails	On 62 ft. chord or 31 ft. chord.	Remarks regarding length of transition degree of curve and specified super
			Under no load condition	Under load condition				
1	2	3	4	5	6	7	8	9

<b>Details of Turnouts</b>	<b>Permissible Speeds in Kmph</b>		
	<b>With Straight Switch</b>	<b>With Curved Switch</b>	
<b>1 in 8 ½</b>	<b>BG MG</b>	<b>10 10</b>	<b>25 (15) 15</b>
<b>1 In 8 ½ Symmetrical Split</b>		<b>15</b>	<b>40 (30)</b>
<b>1 In 12</b>	<b>BG MG</b>	<b>15 * 15</b>	<b>40 (30) 25</b>
<b>1 In 16</b>	<b>BG MG</b>	<b>- -</b>	<b>50 OR 60+ 30</b>
<b>1 In 16 Symmetrical Split</b>		<b>-</b>	<b>75</b>
<b>1 In 20 Turnout</b>		<b>-</b>	<b>50</b>
<b>1 In 24 Turnout</b>		<b>-</b>	<b>100</b>

\* In special cases this may be relaxed upto 25 kmph on interlocked sections where train may pass on 1 in 12 turnouts throughout the section and locomotives are fitted with speedometers.

+ 60 kmph permitted only on high speed turnout

### 3) PREPARATION OF SKETCH AT SITE OF ACCIDENT

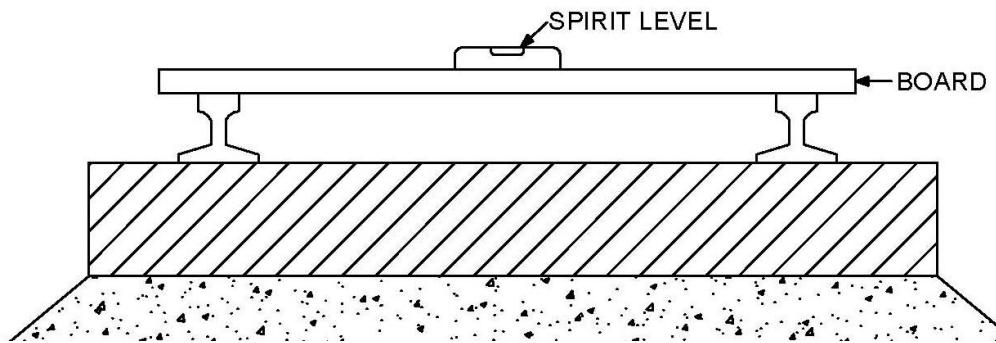
- (a) The point of mount should be marked station No. 0 and the stations numbered serially as (+) for measurements ahead of site of derailment and (-) for measurements in rear.
- (b) The cross level will be measured on the left rail only as determined from the direction of movement.
- (c) Normally, measurements will be taken at stations 3 Mts. Apart for a distance of 45 Mts. On either side of 0 station. They may be taken for col. (3) (4) and (5) may in addition be taken at individual sleepers for a length of 9 Mts. In the rear of 0 station. They may be taken for a distance of 90 Mts. in rear where the cause of derailment is not obvious.
- (d) This pro-forma need not be filled when the cause of derailment is obviously established as due to major obstruction on track, broken, axle, and / or spring having fallen off prior to point of derailment.
- (e) If the track is on a curve versine must be measured in mm in terms of Annexure 7/2 of Indian Railway Permanent Way Manual.
- (f) Additional data regarding vertical track profile of one of the rails should be taken if the point of derailment / mount is within 200 Mts. of the theoretical change of grade point and the change of grades is 0.5% or more. These levels should be taken 20 Mts. apart and should extend for at least 200 Mts. in rear of the point of derailment. They may be taken as early as possible after the accident site has been cleared.

### 4) DIAGRAM OF PERMANENT WAY DEFECTS

Where the course of derailment is not apparent, it is desirable to make a diagram of P.Way defects to appreciate the contribution made by defective P.way to derailment. The diagram shows the following to an exaggerated scale: -

- (a) Gauge: - As measured on each sleeper. Slack gauge being shown above and tight gauge below the datum.
- (b) Cross Level: - Is shown on each sleeper. Where the traffic is level the line should coincide with the datum. Any difference in X level is shown above datum for right rail and below datum for left rail. The same graph will indicate the cant if any and variation thereof
- (c) Void left Rail: This shows the voids under sleepers on left rail taken from void meter readings under load. This shows up hanging sleepers and state of packing.
- (d) Void right rail: - This shows the voids under sleepers on right side taken from void meter readings.
- (e) Alignment Line: - This line shows the correctness of alignment on the straight track, the alignment is checked by the versine on a chord of 20 ft long. If the track is in true alignment the versine should be zero. On curved track also the versines are measured at 10 ft intervals with a 20 ft. long chord and plotted.
- (f) From the above graphs, it is possible to see if P.way defects of voids left and right rail combined with alignment and gauge may give a different picture. Where derailments occur on transitions it is necessary to plot the lines showing rates of change of can't deficiency to check if they are excessive.

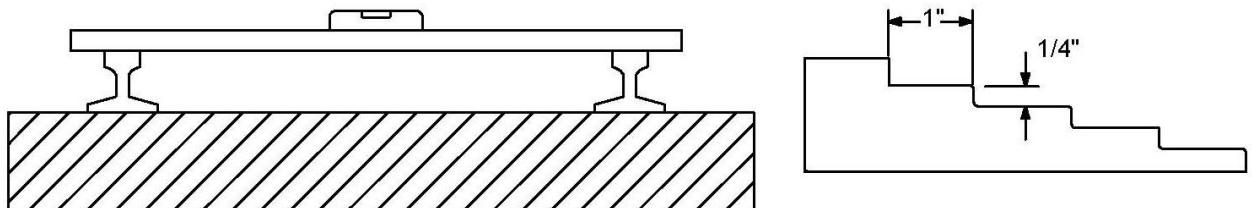
The two rails of the track should have the same level to measure levels, a level board (a mild steel flat of approx. X'1/2" X 6 ft. size is used) and spirit level are used. The board is placed as shown in the sketch on the track and spirit level placed on the top of it and if level is out the rail which is at lower level (or unpacked rail ) is lifted by packing or the rail which is at higher level is lowered by loosening the ballast under the sleeper.



When checking cross levels over a curve a small stepped piece of wood, known as a cant board is placed under the level board at the inner or lower rail as shown in the sketch. On curve the inner rail is first levelled and outer rail given the necessary super-elevation with cant and level boards.

Permanent reference pillars are invariably provided at a fixed distance on the inner side of the curve particularly at the tangent point. Such a pillar usually consists of a piece of rail embedded in concrete and with a notch cut in it. The depth of the notch is made equal to the super - elevation and the bottom of the notch is kept at the same level as that of the inner rail.

Gauge of the track is measured by standard Gauge shown in the sketch.



## 5) PARTICULARS OF TRACK TO BE EXAMINED IN CONNECTION WITH DERAILMENT:

### (a) The road bed

- (i) The Formation: Nature and condition of formation, any change in the formation, such as level crossing or bridge in the vicinity of the derailment, drainage rainfall date, subsidence softening of bank.
- (ii) Ballast: Types of Ballast, Width and depth of ballast from the point of view of drainage, condition of packing (Observations of movement of Track under load).

Alignment:

Lateral distortion and kinks in the vicinity of derailment.

### (b) Levels

- (i) Longitudinal Levels
- (ii) Theoretical and actual gradients. A normal change in gradients due to subsidence in dangerous working.
- (iii) Cross Levels.
- (iv) Low Joints.

**(c) Gauge**

On a straight track gauge is not a factor associated with derailment as vehicles can negotiate straight track safely within wide tolerance of gauge. It should, however, be noted that wide gauge encourages hunting and tight gauge increases the strain on the track fastening and creates a tendency for the wheels to be linked off the rail.

**(d) Track structure**

- (i) Rails: Rolling Marks, Rail profiles, defects such as, flaw on the rail; tables, kinks or fractures,
- (ii) Rail Joints: Type, condition of fish plates and fish bolts, low or high joints, square joints or staggered joints, pitch of stagger.
- (iii) Sleepers: Type, packing and condition (sleepers out of square)
- (iv) Rail and sleeper fastening: Type and condition, incidence of creep records, creep adjustments.
- (v) Track structure: Any change of structure in the vicinity of derailment with respect to rails and sleepers
- (vi) Track Maintenance: Date of last through packing, date of last spot packing examination of gang charts, records of track maintenance of staff. Dates and notes of engineers and SSE/SE/JE (P.Way) last trolley and engine inspection examination of track recorder graphs for persistent defects.

**(e) Obstructions**

- (i) Sabotage: Deliberate removal of rails, and sleepers, or distortion of track, placing of large boulders with intent to hold up train for looting.
- (ii) Natural causes; bolder drops, land slide
- (iii) Breaches, subsidence and wash ways.
- (iv) Casual obstructions, subsidence and wash ways.
- (v) Road Traffic: Animal drawn or motor transport collisions at level crossings.

**6) TRACK AND VEHICLE – MEASUREMENTS AND READINGS**

**(a) Track Readings at Accident Site**

Gauge should be checked at the following locations in case of points and crossings.

- (i) 305MM(1Foot) in advance of Toe of T/Rail
- (ii) 152MM inside Toe of T/Rail for straight and turn out.
- (iii) At middle of T/Rail for straight & T/Out
- (iv) At Heel of T/Rail for straight & T/Out

**Note:** Gauge should be correct at all locations. Tolerance at Toe is as follows-

**(b) Gauge at Crossings**

- (i) 610 mm (2Feet) in advance of nose of crossing on straight & T/Out
- (ii) 152 mm behind of more of crossing on straight & T/Out
- (iii) 76 mm behind of more of crossing on straight & T/Out.
- (iv) The gauge should be correct

**(c) Check Rail (Wing Rail) Clearance: On Crossings**

BG: 44 mm to 48 mm

MG: 41 mm to 44 mm

- (i) Ensure check rail clearance should be between the values mentioned above
- (ii) Measure vertical wear of stock and tongue rails.
- (iii) Maximum permissible vertical wear
  - On wing rails or nose of crossings: - 10mm
  - At the tip as shown below.

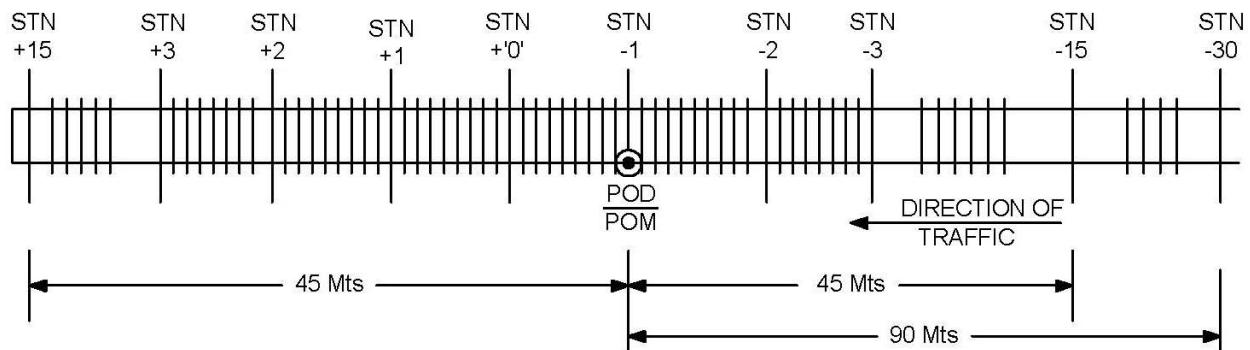
Rail	Section	BG	MG
Stock/Rail (wing rail also)	60Kg	13 mm	-
	52 Kg	8 mm	-
	90 R	5 mm	6 mm
	75 lbs	-	4.55mm
	60 lbs	-	3.0 mm
Tongue/Rail 1	60 Kg.	8 mm	-
2	52 Kg/90R	5 mm	-
3	75 R/60R	3 mm	-

**(d) Measure Lateral Wear of Stock and Tongue Rail**

Stock/Rail	8 m/10 m	for A,B/Other routes in Straight line
	6 mm/8 mm	for A,B/Other route in curve
Tongue/Rail	60 Kg to 8 mm	-
	52 Kg/90R – 6 mm	-
	75 R/60R – 5 mm	-

- (i) Measure both wears on T/rail at a point with 13 mm head width and at the point where T/Rail and S/Rail are at the same level (Refer Annexure "A" for level location for different rail section )
- (ii) Measure Angular Wear of Stock rail  $25^0$  Measured at 18 mm below Rail Head.
- (iii) Measure chipping of Tongue Rail within/1000 mm (1Mts.) from Toe 200 mm in Total 10 mm x 10 mm Depth size.
- (iv) Measure Knife Edge of T/Rail with in 1 Mts. from Toe: - 2 mm for 100 mm.

## (e) Measure 'Track Readings' (Gauge, Cross level, Versine etc) jointly



- Identify and mark Point of Drop (POD)/Point of Mount (POM) as Stn '0'. In case both POD/POM are available then take whichever is first to come as Stn. '0'
- Mark 15 Stations at 3 Meters apart in rear of POM/POD up to 45 Meters Stn ahead are marked +1, +2 etc, and rear are marked -1, -2, etc.
- Note: In case of any doubt of POM/POD then mark another 15 stns in rear from the suspected POM/POD at 3 Meters up to 90 Meters. i.e. total 30 stns in rear because clues for the cause of the accident are available mostly in rear portion.
- Take the reading at every sleeper up to 3 stns (i.e. up to 9 Meters) on both sides of POD/POM.
- Measure the gauge, cross level (with and without load). And versine in mm with 6 Meters Chord at 3 Meters All the measurements to be taken for both Straight Line and curve (cross over) in Point zone.
  - $V = C^2 / 8R$
  - $C = \text{length of cord} = 6 \text{ Mts.}$
  - $R = \text{Radius of curvature}$

Radius of Curvature	For 1 in $8\frac{1}{2}$ st. sw	-	222 Mts.
	For 1 in 12 st. sw	-	442 Mts.
	For 1 in 12 curved	-	458.12 Mts.
	For 1 in $8\frac{1}{2}$ curved	-	

## (f) Determination of Radius of Curvature

The radius of curvature is determined by measuring the versine on a chord of known length from the equation  $R = 125 C^2/V$ , Where  $C$  = Length of chord,  $V$  = Versine  $R$  = Radius of that curve.

*Note: For measuring  $V$ , take a 20 Mts. cord and measure at 10 Mts. interval. For turnout, take 6 Mts. chord and measure at 1.5 Mts.*

By putting the values we get versine on track. This is compared with the standard design versine value for the layout, and the values shall be as follows.

- The versine variation between the Standard value and the recorded value at every point shall not be more than + 4 mm.

- (ii) The difference between any two recorded values shall not be more than + 3 mm

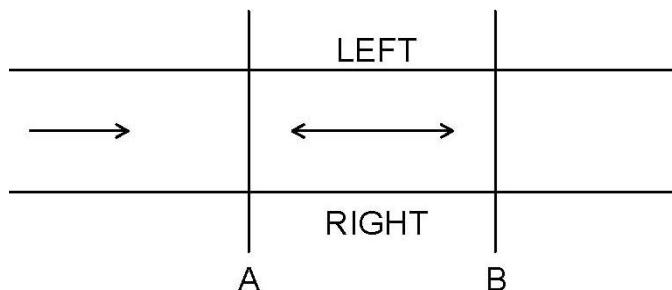
If the versine variation is not within the limits of + 4 mm between standard value and any recorded value and/or within + 3 mm between any two readings then the track curvature is defective.

**Note:** A cross-over point is a track in curvature, but without any super elevation. Hence all the parameters shall be maintained correctly.

### (g) Track Twist

It is an important parameter having crucial impact on safety.

The rate of change of cross levels is called 'TWIST' cross level means difference of lever of rails. Cross levels are measured on left rail as seen in the direction of train involved in derailment.



- (i) Track Twist = Algebraic difference of Cross Level at A & B in (mm) Distance between A & B in (Mts.)

**Ex.:** Cross level at 'A' = +5 mm (Left rail is higher than Right Rail by 5 mm)

Cross level at 'B' = -7 mm (Left rail is lower than Right Rail by 7 mm)

The distance between A & B = 3 Mts.

- (ii) Track Twist =  $(+5) - (-7) = 12/3 = 4 \text{ mm/Mts.}$

The track Twist is 12 mm over a length of 3 Mts.

### (h) Permitted cross level (twist)

For a new Track cross level difference Permitted is 1 in 720

i.e. in 720 mm length track the twist can be 1 mm

i.e. in 1 Mts. , the twist permitted is 1.4 mm/ Mts.

For an old track it can be 2.8mm/Mts.

A.		At 1 & 2 – Level At 3 & 4 – Level	$\therefore \text{TWIST} = 0$
B.		At 1 & 2 – Level At 3 & 4 – +5	$\therefore \text{TWIST} = +5$
C.		At 1 & 2 – Level At 3 & 4 – DIP/Level	$\therefore \text{TWIST} = 0$
D.		At 1 & 2 – (+5) At 3 & 4 – (+5)	$\therefore \text{TWIST} = 0$
E.		At 1 & 2 – (-5) At 3 & 4 – (+5)	$\therefore \text{TWIST} = 0$ $= -5 - (+5)$ $= -10$ $= 10 \text{ mm/Mtr.}$

(Distance between 1, 2 and 3, 4 is 1 Meters).

A vehicle with defective spring gear travelling on a track with twist leads to derailment. If there is improper loading then the chances are further increased.

### (i) Super elevation

In curvature, the rail outside the curve is raised than the rail inside the curve is termed as 'SE'. The SE provided on a curved track should be within the prescribed and calculated values, applicable for that curvature.

Super Elevation:	BG Route		MG
Max. SE Permissible (For 100 Kmph)	165 mm (A/B/C route)	140 mm (D & E route)	100 mm

For a train running above 100 Kmph, if the SE is less, then the train is running with 'Cant. Deficiency'. For a train running below 100 Kmph, if the SE is more, then the train is running with 'Excess cant'.

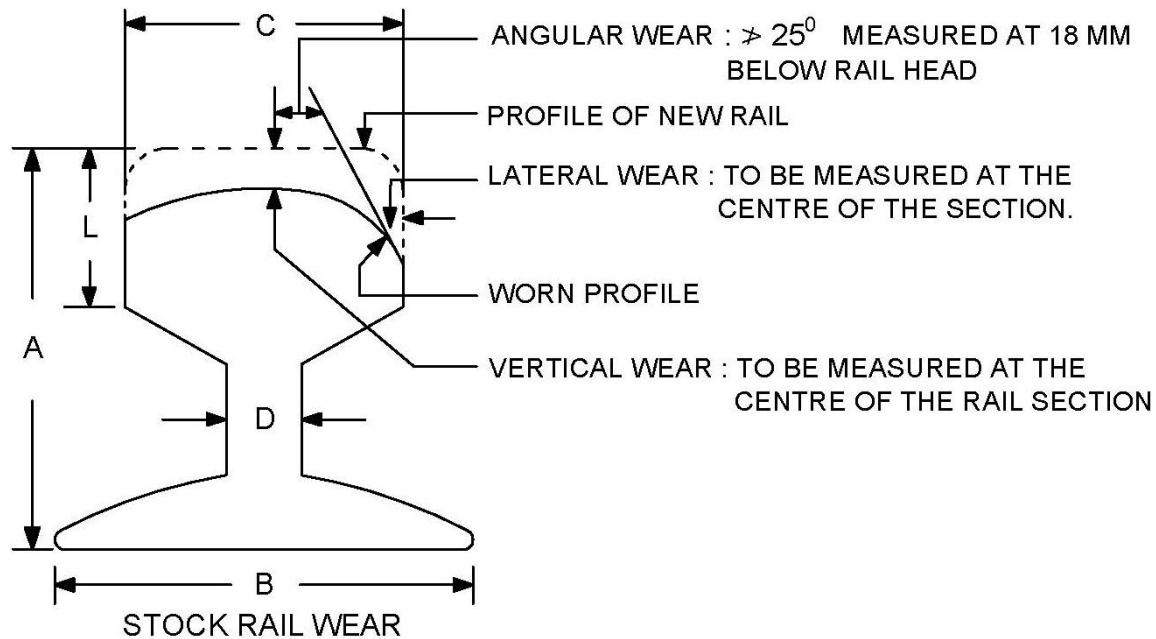
Gauge	Permitted Cant. Excess	Permitted Cant. Differing
BG	75 mm	75 mm (Speeds upto 100 Kmph) 100 mm (Speeds above 100 Kmph)
MG	65 mm	50 mm

Normally average cant is provided at all sections, taking the average speed of train of that section. Hence,

- (a) For a train moving faster than the average speed the SE will be less i.e. can't deficiency.
- (b) For a train moving slowly than the average speed, the SE will be more i.e. cant excess.

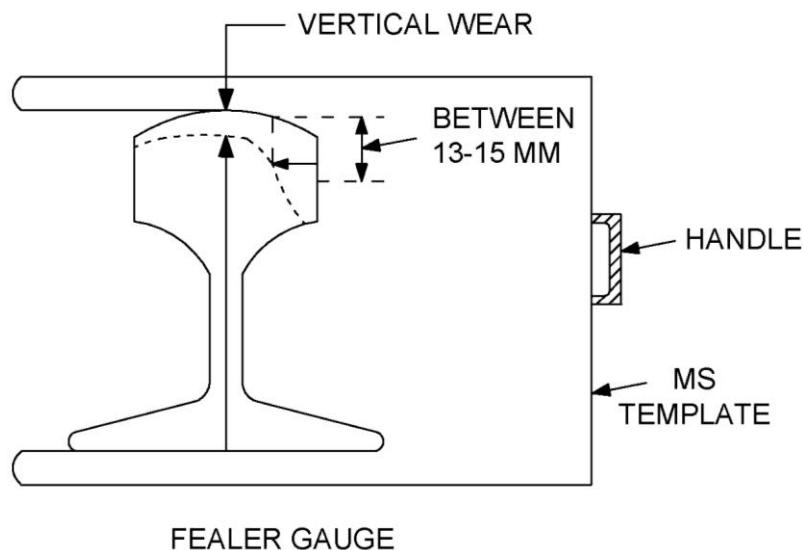
(Where necessary special restrictions will be imposed to follow to compensate for the Cant excess/deficiency).

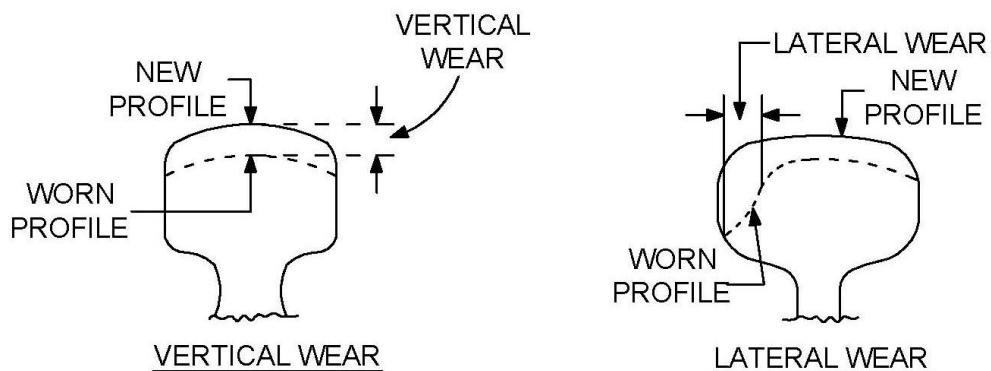
## (j) Rail profile



Rail Section	A	B	C	D	L
52 KG's	156	136	67	15.5	38.82
60 KG's	172	150	74.3	16.5	37.5
90 R	112.83	136.5	66.68	13.89	32.53
75 Lbs.	128.59	122.24	61.91	13.10	29.37
60 Lbs.	114.30	109.59	57.15	11.10	-

- (a) If vertical wear is Excess, A Deep Flange may ride over the fish plates, distance blocks, and over damaged track components. With excessive lateral wear, the play between the wheel set and the track increases oscillations and greater angularity is resulted.
- (b) Of all the above, the angular wear is most crucial. Angular wear is invariably encountered on the outer rail of a curve as well as on turnouts. If angular wear is more, then the rail represents on inclined plane, up which the wheel may slide. Gauge face lubrication of outer rail which is normally beneficial in reducing the wear & tear also increases the safety margin by reducing the flange friction.



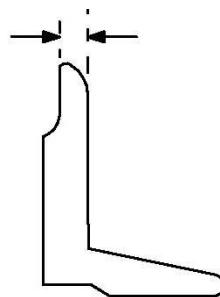


#### Limits of Permitted Wear on Stock Rail

	Section	BG	MG		
a. Vertical	60 Kg	13 mm	-		
	52 Kg	8 mm	-		
	90 Lbs	5 mm	6.0 mm		
	75/60 R	4.5/3 mm	4.5 mm		
	60 R	-	3.0 mm		
Note: Vertical wear to be measured at the centre of the rail.					
b. Lateral :	A/B routes	Other Routes			
	BG: Curve	8 mm	10 mm		
	Straight	6 mm	8 mm		
MG : Curve	Q/R routes				
	9 mm				
	Straight				
	6 mm (‘Q’ Route)				
	8 mm (‘R’ Route)				
Note: Lateral wear to be measured at 13-15 mm below the rail Top table.					
C. Angular Wear: Not more than 25° measured at 18 mm below rail Head.					

#### (k) Tongue rail

Section of T/Rail



Thickness of Tongue Rail

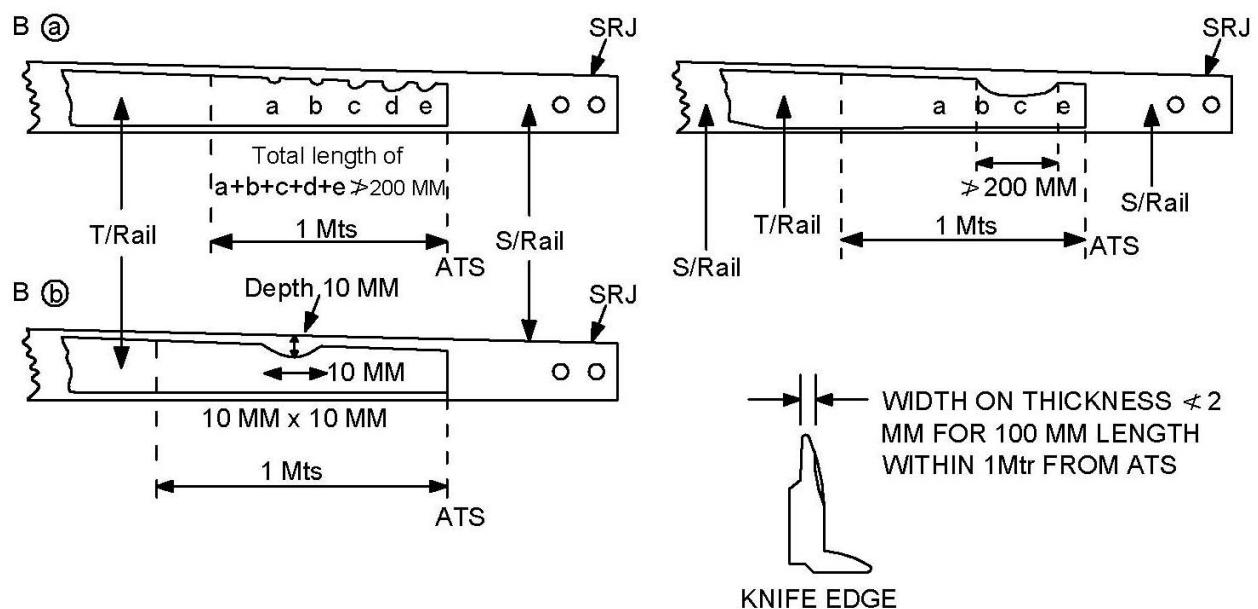
6 mm for Ordinary and 15 mm for Fan Shaped Curved Tongue Rails

Minimum at Tip of the Toe

## (I) Wear on tongue rails

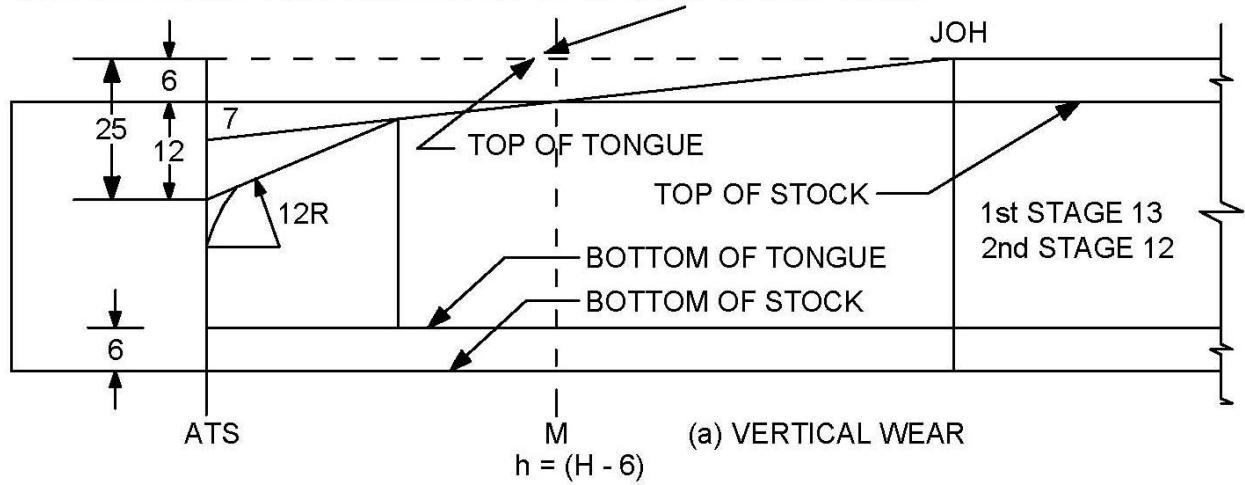
Permitted Wear	75 R/60 R	90R/52 Kg	60 Kg
Vertical Wear	3 mm	5 mm	8 mm
Lateral Wear	5 mm	6 mm	8 mm
Chipped/Broken T/Rails			
Length Wise: If the total length of broken piece or pieces is more than 200 mm in 1 Meter Length from ATS			
Depth Wise: 10 mm Depth with 10 mm Length i.e., 10 mm X 10 mm size Pieces is broken. Then the T/Rail is said to be chipped/broken.			
Knife edged T/Rails.			
If the thickness of the T/Rail is less than 2 mm continuous for 100 mm (10 cms) anywhere within 1 meter from ATS then it is K/edged.			

It has to be measured at a point with 13 mm head width and at the point where Tongue Rail and Stock Rail are at the same level.



## 7) SWITCH DESIGN

### SWITCH DESIGN Vs MEASUREMENT OF WEAR OF SWITCH RAILS



RAIL SECTION

52 KG

90 R

h = (H - 6)

50 MM

136.88 MM

RAIL SECTION

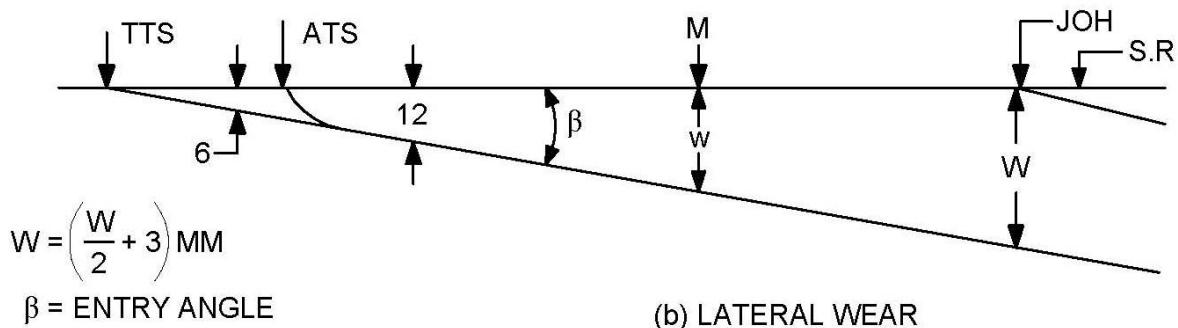
75 R

60 R

h = (H - 6)

122.59 MM

108.30 MM



RAIL SECTION

52 Kg

90 R

75 R

60 R

(W)

36.5MM

36.34 MM

33.95 MM

31.57 MM

**8) PARTICULARS OF TONGUE RAILS SHOWING LOCATION AND HEAD THICKNESS AT LEVEL POINT OF STOCK AND TONGUE RAIL**

Sl. No.	Description of Switches	Drg. No. of tongue rails	Location of 13 mm head from ATS mm	Location of JOH from ATS mm	Location of level point of stock & tongue rail from ATS mm	Head thickness of tongue rail at level point mm
1.	6400 mm c/s on w/s BG 52 kg TA-20197	TA-20197/1	464	3005	1503	31.6
2.	6400 mm c/s on s/s BG 52 kg TA-20836	TA-20197/1	464	3005	1503	31.6
3.	6400 mm c/s on PSC BG 52 kg RT-4866	RT-4866/2	476.5	3023	1512	31.6
4.	6400 mm c/s on PSC BG 60 kg RT-4966	RT-4966/1	476.5	3229	2348	48.25
5.	7135 mm c/s on w/s BG 60 kg RT-3011	RT-3011/1	1046	3900	2836	50.54
6.	7730 mm c/s on w/s BG 52 kg TA-20172	TA-20172/1	814	4669	2335	30.50
7.	7730 mm c/s on s/s BG 52 kg TA-20832	TA-20832/1	814	4669	2335	30.50
8.	10125 mm c/s on w/s BG 60 kg RT-2581	RT-2581/1	1682	5840	4247	43.40
9.	10125 mm c/s on PSC BG 60 kg RT-4219	RT-4325/1	1682	5836	4244	43.40
10.	10125 mm c/s on PSC BG 52 kg RT-4733	RT-4733/1	1682	5540	4029	40.34

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## ANNEXURE - X

### THE SKETCH OF THE ACCIDENT SITE

#### **1) SPECIAL POINTS FOR SKETCH**

The engineering representative should prepare dimensioned sketches adequate for the preparation of a scale plan covering the entire site of the accident. In preparing the sketch due care should be paid to the following instructions:

- (a) The sketch giving train number, date, kilometerage of the site of accident should be properly labelled.
- (b) The north point should be indicated.
- (c) It should indicate prominently the direction of movement and also the names of stations in rear and advance of the accident site.
- (d) It should cover a length of about 300 Mts. behind the point of mount and almost an equal distance in front.
- (e) A pair of the lines must denote each track of the P. way.
- (f) The position of the level crossing, Telegraph post/OHE Masts, Bridges, tunnels, gradient, post with gradient symbols, curves, de-marking the beginning and end
- (g) Length of transitions should be indicated. It should also indicate
  - (i) The position of all derailed vehicles and the marks left by them either on sleepers, rails or ballast.
  - (ii) Point of mount with position of rail joints on either side.
  - (iii) Point of drop.
  - (iv) The pair of the wheels of the first derailed vehicle.
  - (v) The position in which every displaced rail/wagon or part of a rail/wagon and Detachable components were found.
  - (vi) In all cases dimension from nearest kilometre post and centre line of track should be given.
- (g) In case of accident within station limit, sufficient details about the station layout should be shown in order to fully explain the movement of the affected train in relation to the topography of the place. The signal aspects at the time of accident should be correctly depicted.
- (h) The distance of the site of accident from a permanent structure to fix the site of accident precisely should be indicated.
  - (i) The distances should be indicated to show the extent of the disturbance caused in the P. way or train composition on account of the accident.
  - (j) A good sketch should always accompany the proceedings duly signed by the President. If necessary, more than one sketch should be enclosed, one clarifying the yard layout and the system of working it and the other giving details, such as, position of wheels, wheel marks, etc. In the former, one line should be used to represent both rails of a track and as such portion of the station yard (In case of accident within station limit) should be covered as may be necessary.

- (k) All necessary details relevant to the accident issue must be mentioned in the sketch. The terminal station on the Down direction should be mentioned on the right extremity of the sketch, the terminal station on the up direction being mentioned on the left extremity.
- (l) If the accident takes place within station limits the shorter sketch should be based on the SWR diagram.

**2) SPECIAL POINTS FOR EXAMINING THE SITE AND FOR PREPARATION OF NOTE AND DRAWINGS**

- (a) Examining the site of suspected sabotage
- (b) The exact position in which engines and vehicles came to rest and also where loose component parts were found.
- (c) The exact position in which rails and component parts, such as Sleepers, Fishplates, Bolts, Nuts, Dog spikes, etc. were found.
- (d) Wheel marks and other damage to Sleepers, Rails and other fittings in the accident
- (e) The examination of rail ends at the displaced point or points for any dents or burrs and whether burrs are vertical or horizontal.
- (f) The position of wheels in relation to any displaced rail, its normal alignment and the landing rail.
- (g) State of the track in rear for at least 800 Mts.
- (h) If the nature of the accident so requires:
  - (i) The position and condition of signals, point and signal levers and block instruments should be inspected.
  - (j) Functioning of interlocking provided at the station should be tested.
  - (k) Train passing records including Train Signal Register, private number sheets, line nomination book should be seized and carefully
  - (l) Preserve. Where line badges are in use, it should be recorded in whose possession each line badge was concerned. Statements of staff should be recorded

\* \* \*

## ANNEXURE - XI

### CENELEC

**CENELEC:** European Committee for Electro technical Standardisation

#### **1) CENELEC STANDARDS AS APPLICABLE TO FAIL SAFETY IN ELECTRONICS SIGNALLING SYSTEMS FOR RAILWAYS**

##### **(a) Risk Management**

Risk Management broadly co-relates with the application, maintenance, and assessment. The process of analysis to determine whether the design authority and the validate have achieved a product that meets the specified requirements and to form a judgement as to whether the product is fit for its intended purpose.

The proactive identification of hazards of an undertaking, product, system or process and assessment of their consequent risks is indispensable in the fulfilment of the professional and legal duty of care for the duty holders.

A systematic framework is therefore required in order to ensure that irrespective of the depth and breadth of an analysis, a number of key processes are applied and important assumptions are explicitly stated and documented.

The systematic assessment process entails a number of principal stages -

- (i) Identification and ranking of significant hazards
- (ii) Identification and modelling of causal factors leading to each hazard
- (iii) Analysis of escalation scenarios associated with the realisation of each hazard
- (iv) Assessment of the losses associated with each undesirable consequent event
- (v) Identification and ranking of key risk mitigation and control options and associated costs
- (vi) Assessment of the impact of each mitigation and control option on the total loss
- (vii) Implementation of the cost effective mitigation and control measures, optimisation of safety strategy and subsequent demonstration of ALARP and compliance with the industry benchmarks.

A systematic risk based approach to the engineering of products, systems, processes and undertakings been devised and developed at Rail track. This entails a seven stage process for identification of causality followed by determination and assessment of consequences arising from design, realisation and application stages culminating in selection of safety optimising strategies.

The systematic assessment process comprises seven key principles.

##### **(b) Hazard Identification**

This key stage focuses on the identification and ranking of hazards arising from failure of assets, business activities and external factors. Hazard in this context pertains to actions and circumstances with a potential to cause harm to people, damage to the environment or commercial detriment to the business.

Prudent identification of hazards often entails employing empirical/historical knowledge (e.g. Check-Lists, Walk-through, Inspections) in conjunction with creative, divergent analysis (FMEA10, Brain-storming and HAZOP21,22) as appropriate.

It is imprudent to constrain the scope of analysis a prior based on the physical or perceived boundaries of the problem domain. The true boundary for the analysis should emerge through consideration of the domain of influence of various factors involved. This may, and indeed often does, transcend the real physical boundaries by a considerable margin as in the case of Radio Frequency Interference (RFI) conducted and radiated by electronic equipment.

### **(c) Causal Analysis**

This relates to the need for identification, modelling and potentially quantification of basic causes of failure including human error and component/sub-system failures. The tools of Causal Analysis primarily originate from the reliability assessment domain and employ graphical notations for demonstration of the logical relationship of the causative factors to the hazard or failure.

These are employed to generate a qualitative logic or quantitative forecast for the probability or frequency of each potential failure or hazard.

A host of other metrics are also generated by the computer based causal analysis tools which assist in identification accident.

An Unintended events or series of events that results in death, injury, loss of a system / service or environmental damage are Significant contributory factors to the hazardous situation thus enabling a more effective implementation of mitigation measures.

### **(d) Consequence Analysis**

Failures of resources, assets and processes invariably lead to a number of consequences which could potentially comprise Safety, Commercial and Environmental implications .This mode of analysis is poorly understood and rarely applied, leading to the abuse of Causal Analysis tools in the Consequence domain. A defensive knowledge is elicitation and modelling technique.

### **(e) Loss Analysis**

The consequences of a hazard (incidents and accidents) are often associated with a measure of loss which may manifest in financial terms or various degrees of harm to people or the environment. Loss analysis is often a subjective and unsystematic process which does not readily lend itself to audit, correction and improvement. Loss analysis within the context of this frame work comprises systematic fore-casting of the extent of harm to people exposed to the hazards of an undertaking, product or process, harm to the environment or other business detriment expressed in financial terms.

### **(f) Options Analysis**

This mode of analysis employs a portfolio of empirical knowledge, expert opinion and creative techniques akin to those employed in stage I, to identify and rank potential options aimed at reliability enhancement or damage/loss containment. The costs associated with each option are assessed in order to enable prudent decision making at a later stage. The option portfolio comprises two broad categories of Reduction and containment options (RO & CO types) respectively.

The Reduction (RO) type options are aimed at prevention or reduction in the rate of occurrence of hazards, often through enhancement of reliability and availability of assets and other resources. The Containment (CO) type options on the other hand serve to limit the disruption and consequent loss which follows the realisation of a hazard. The

CO options are further classed into Retention (COR) and Transfer (COT) categories when viewed from the ownership perspective. The Retention (COR) options aim at loss containment within the business through exploitation of extra resource and preparedness. The Transfer (COT) options on the other hand endeavour to limit or contain losses arising from the realisation of a hazard through transfer of liability or responsibility to a third party. Outsourcing and insurance against adversities are typical examples of COT options.

### **(g) Impact Analysis**

This mode of analysis is aimed at systematic assessment of the overall effect of each identified option on the three potential loss components associated with each failure or hazard. This is mainly achieved through the incorporation of the likely effects into the Causal and Consequence models and re-assessment of the potential losses and gains through an iteration of Loss Analysis.

## **2) THE SAFETY CASE**

CENELEC standard defines the conditions that shall be satisfied in order that a safety-related electronic railway system/sub-system/equipment can be accepted as adequately safe for its intended application.

The conditions for safety acceptance are presented in this standard under three headings, namely

- (a) Evidence of quality management;
- (b) Evidence of safety management;
- (c) Evidence of functional and technical safety.

All of these conditions shall be satisfied, at equipment, sub-system and system levels, before the safety-related system can be accepted as adequately safe.

The documentary evidence that these conditions have been satisfied shall be included in structured safety justification document, known as the Safety Case.

The Safety Case forms part of the overall documentary evidence to be submitted to the relevant safety authority in order to obtain safety approval for a generic product, a class of application or a specific application. The Safety Case contains the documented safety evidence for the system/subsystem/equipment, and shall be structured as follows:

### **I. Part 1: Definition of System (or sub-system/equipment)**

This shall precisely define or reference the system/sub-system/equipment to which the Safety Case refers, including version numbers and modification status of all requirements, design and application documentation.

### **II. Part 2: Quality Management Report**

This shall contain the evidence of quality management, as specified in sub-clause of this standard.

### **III. Part 3: Safety Management Report**

This shall contain the evidence of safety management, as specified in sub-clause.

### **IV. Part 4: Technical Safety Report**

This shall contain the evidence of functional and technical Safety, as specified in sub clause.

## **V. Part 5: Related Safety Cases**

This shall contain references to the Safety Cases of any sub-systems or equipment On which the main Safety Case depends.

### **3) EVIDENCE OF QUALITY MANAGEMENT**

The first condition for safety acceptance that shall be satisfied is that the quality of the system, sub-system or equipment has been, and shall continue to be, controlled by an effective quality management system throughout its life-cycle. Documentary evidence to demonstrate this shall be provided in the Quality Management Report, which forms part 2 of the Safety Case.

The purpose of the quality management system is to minimise the incidence of human errors at each stage in the life-cycle, and thus to reduce the risk of systematic faults in the system, sub-system or equipment.

The quality management system shall be applicable throughout the system /subsystem/equipment life cycle, as defined in EN 50126.

### **4) SYSTEM LIFE-CYCLE (FROM EN 50126)- EVIDENCE OF SAFETY MANAGEMENT**

Process for RAMS described in EN 50126. The purpose of this process is to further reduce the incidence of safety-related human errors throughout the life-cycle, and thus minimise the residual risk of safety-related systematic faults. Documentary evidence to demonstrate compliance with all elements of the safety management process throughout the life-cycle shall be provided in the Safety Management

However, the depth of the evidence presented and the extent of the supporting documentation should be appropriate to the Safety Integrity Level of the system/sub-system/equipment under scrutiny.

### **5) SAFETY LIFE-CYCLE**

The safety management process shall consist of a number of phases and activities, which are linked to form the safety life-cycle; this should be consistent with the system life-cycle defined in EN 50126,

### **6) SAFETY VERIFICATION AND VALIDATION**

The Safety Plan shall include or reference plans for verifying that each phase of the life-cycle satisfies the specific safety requirements identified in the previous phase, and for validating the completed system/sub-system/equipment against its original Safety Requirements Specification.

These activities shall be carried out and fully documented, including appropriate testing and safety analyses. They shall be repeated as appropriate in the event of any subsequent modification or addition to the system/sub-system/equipment.

The degree of independence necessary for the verifier and the validator shall be in accordance with the Safety Integrity Level of the system/sub-system/equipment under scrutiny. Guidance on verification and validation techniques/measures for each Safety Integrity Level at the discretion of the safety authority, the assessor may be part of the supplier's organisation or of the customer's organisation but, in such cases, the assessor shall

- Be authorised by the safety authority
- Be totally independent from the project team
- Report directly to the safety authority.

## 7) SAFETY APPROVAL PROCESS

Before an application for Safety approval can be considered, an independent safety assessment of the system/sub-system/equipment and its Safety Case shall be carried out, to provide additional assurance that the necessary level of safety has been achieved. Its results should be presented in a Safety Assessment Report.

The report should explain the activities carried out by the safety assessor to determine how the system/sub-system/equipment, (hardware and software) has been designed to meet its specified requirements, and possibly specify some additional conditions for the operation of the system/sub-system/equipment.

The depth of the safety assessment, and the degree of independence with which it is carried out, are based on the results of the risk classification, as explained in EN 50126. Specific tests may be required by the safety assessor in order to increase confidence.

(a) The System (or sub-system/equipment) Requirements Specification;

(b) The Safety Requirements Specification;

(c) The Safety Case includes:

Part 1: Definition of System/Sub-system/Equipment;

Part 2: Quality Management Report (evidence of Quality Management);

Part 3: Safety Management Report (evidence of Safety Management);

Part 4: Technical Safety Report (evidence of Functional/Technical Safety);

Part 5: Related Safety Cases (if applicable);

Part 6: Conclusion;

## 8) THE SAFETY ASSESSMENT REPORT

Provided all the conditions for safety acceptance have been satisfied, as demonstrated by the Safety Case, and subject to the results of the independent safety assessment, the system/sub-system/equipment may be granted safety approval by the relevant safety authority. Approval may be subject to the fulfilment of additional conditions (temporary or permanent) imposed by the safety assessor.

The safety approval process is same for all three categories of Safety Case.

## 9) ASSURANCE OF CORRECT HARDWARE FUNCTIONALITY

This shall describe the system/sub-system/equipment hardware architecture, and explain how the design achieves the required integrity, as laid down by the requirements specification and any relevant standards, in respect of

- Reliability;
- Availability;
- Maintainability;
- Safety.

Consideration of safety may be limited to fault-free conditions, because effects of faults are dealt with elsewhere (see section B.3 of this annex).

## **10) ASSURANCE OF CORRECT SOFTWARE FUNCTIONALITY**

The Software Validation Report and the Software Assessment Report in addition, the interaction between hardware and software shall be explained.

The overall documentary evidence shall consist of

- Software Development Plan (SDP)
- Plan for Software Aspects of Certification (PSAC)
- Software Test Plan (STP)
- Software Verification Plan (SVP)
- Software Test Description (STD)
- Software Verification Cases & Procedures (SVCP)
- Software Test Report (STR)
- Software Requirements Specification (SRS)
- Interface Requirements Specification (IRS).
- Software Design Document (SDD)
- Design Description (DD)
- Software Accomplishment Summary (SAS)
- Software Configuration Index (SCI)
- Version Description Document (VDD)

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## **ANNEXURE - XII**

### **CENELEC GLOSSARY**

#### **1) CAUSAL ANALYSIS**

Analysis of the reasons how and why a particular hazard may come into existence.

#### **2) CONSEQUENCE ANALYSIS**

Analysis of events which are likely to happen after a hazard has occurred configuration the structuring and interconnection of the hardware and software of a system for its intended application.

#### **3) CROSS-ACCEPTANCE**

The status achieved by a product that has been accepted by one authority to the relevant European Standards and is acceptable to other authorities without the necessity for further assessment.

#### **4) DESIGN AUTHORITY**

The body which is responsible for the formulation of a design solution to fulfil the specified requirements and for overseeing the subsequent development and 'Setting-To-Work' of system in its intended environment is called 'Design Authority'.

#### **5) DIVERSITY**

Diversity is a means of achieving all or part of the specified requirements in more than one independent and dissimilar manner.

#### **6) FAIL-SAFE**

Fail safe is a concept which is incorporated into the design of a product such that, in the event of a failure, it enters or remains in a safe state.

#### **7) HAZARD ANALYSIS**

This is the process of analysing the causes of hazards and of identification of requirements to limit the likelihood of hazards to a tolerable level.

#### **8) HAZARD LOG**

This is the document in which all 'Safety Management Activities', 'Hazards Identified', 'Decisions Made and Solutions Adopted', are recorded or referenced.

#### **9) IMPLEMENTATION**

The activity applied in order to transform the specified designs into their physical realisation.

#### **10) INDIVIDUAL RISK**

It is a 'risk' which is related to a single 'Individual' only.

#### **11) MAINTAINABILITY**

The probability that a given active maintenance action, for an item under given conditions can be carried out within a stated time interval when the maintenance is performed under stated conditions and using stated procedures and resources.

**12) RANDOM FAILURE INTEGRITY**

It is the degree to which a system is free from hazardous random faults.

**13) RANDOM FAULT**

The occurrence of a fault based on probability theory and previous performance.

**14) RELIABILITY**

It is the ability of an item to perform required function under given conditions for a given period of time.

**15) SAFETY ACCEPTANCE**

It is the safety status given to a product by the final user.

**16) SAFETY APPROVAL**

It is the safety status given to a product by the requisite authority when the product has fulfilled a set of pre-determined conditions.

**17) SAFETY AUTHORITY**

The body which is responsible for certifying that a safety-related system is fit for service and complies with relevant statutory and regulatory safety requirements.

**18) SAFETY CASE**

It is the case in which the documented demonstration that the product complies with the specified safety requirements.

**19) SAFETY INTEGRITY**

The likelihood of a safety-related system achieving its required safety features under all the stated conditions within a stated operational environment and within a stated period of time.

**20) SAFETY INTEGRITY LEVEL**

It is the level at which 'Freedom' from any mechanism which can affect the correct operation of more than one system/sub-system/equipment as a result of random failures.

**21) SAFETY LIFE-CYCLE**

The additional series of activities carried out in conjunction with the system life-cycle for safety-related systems.

**22) SAFETY MANAGEMENT**

It is the management structure which ensures that the safety process is properly implemented.

**23) SAFETY PROCESS**

Safety process means the series of procedures that are followed to enable all safety requirements of a product to be identified and met.

**24) STRESS PROFILE**

Stress profile means the degree and number of external influences which a product can withstand whilst performing its required functionality. It is a set of sub-systems which interact according to a design.

**25) SYSTEMATIC FAILURE INTEGRITY**

The degree to which a system is free from non-identified hazardous errors and the causes thereof is a 'Systematic Failure Integrity'.

**26) SYSTEMATIC FAULT**

An inherent fault in the specification, design, construction, installation, operation or maintenance of a system, sub-system or equipment is a Systematic fault.

**27) SYSTEM LIFE-CYCLE**

The series of activities occurring during a period of time that starts when a system is conceived and ends at de-commissioning.

**28) VALIDATION**

The activity applied to demonstrate, by test and analysis, that the product meets in all respects its specified requirements.

\* \* \*

## ANNEXURE XIII

### CENELEC STANDARDS FOR RAILWAY SIGNALLING SAFETY

**1. Safety Integrity Level (SIL):-** To what extent can a process be expected to perform safety? And, in the event of a failure, to what extent can the process be expected to fail safely? These questions are answered through the assignment of a target **Safety Integrity Level(SIL)**. SILs are measures of the safety risk of a given process.

**2. Four Levels of Integrity:-** Historically, safety thinking categorized a process as being either safe or unsafe. For the new standards, however, safety isn't considered a binary attribute; rather, it is stratified into four discrete levels of safety. Each level represents an order of magnitude of risk reduction. The higher the SIL level, the greater the impact of a failure and the lower the failure rate that is acceptable.

**3. Relationship between SIL and safety targets:-** This standard is based on the assumption that safety relies both on adequate measures to avoid or tolerate faults (as safeguards against systematic failure) and on adequate measures to control random failures. Measures against both causes of failure should be balanced in order to achieve the optimum safety performance of a system. To achieve this the concept of Safety Integrity Levels(SIL) is used. SILs are used as a means of matching the qualitative approaches (to avoid systematic failures) with the quantitative approach (to control random failures), as it is not feasible to quantify systematic failures.

Like in many other standards this balance is expressed in a table, which consists of a list of Safety Integrity Levels 0, 1, 2, 3, 4 and a list of corresponding intervals or bands for tolerable hazard rates  $I_0, \dots, I_4$ .

#### 4. SIL – TABLE

Tolerable Hazard Rate THR per hour and per function	Safety Integrity Level
$10^{-9} \leq \text{THR} < 10^{-8}$	4
$10^{-8} \leq \text{THR} < 10^{-7}$	3
$10^{-7} \leq \text{THR} < 10^{-6}$	2
$10^{-6} \leq \text{THR} < 10^{-5}$	1

**5. Railway sector:-** In the railway sector, and more specifically in the area of signalling and control, four standards prepared by the European Committee for Electro technical Standardisation (CENELEC) are expected to have a decisive impact on certification.

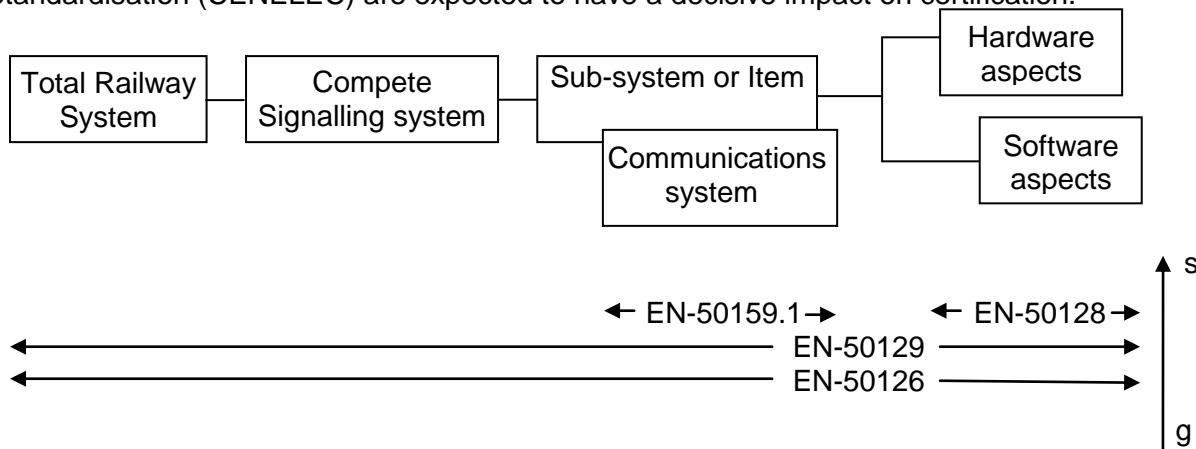


Figure above: Application scope of the Railway specific CENELEC standards

- 1) EN 50124: Railway applications - Insulation coordination.
- 2) EN 50126: Railway applications - The specification and demonstration of reliability, availability, maintainability and safety (RAMS).
- 3) EN 50128: Railway applications - Signalling and Communications – software for railway control and protection systems.
- 4) EN 50129: Railway applications - Communications, signalling and processing systems - Safety related electronic systems for signalling.
- 5) EN 50130: Alarm systems - Electromagnetic compatibility and Environmental test methods.
- 6) EN50159-1&2: Railway applications - Signalling and Communication Safety related communication in closed and open transmission system.
- 7) EN61000.4.2: Electromagnetic compatibility (EMC) – testing and measurement techniques electrostatic discharge immunity test and basic EMC.
- 8) EN610004.4: Electromagnetic compatibility – testing and measurement techniques - electrostatic fast transient/burst immunity test and basic EMC.
- 9) EN61000.4.5: Electromagnetic compatibility – testing and measurement techniques - surge and immunity test.
- 10) IEC529/EN60529: Specification for degree of protection provided by enclosures, (IP code).

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## ANNEXURE XIV

### REPORTS FROM DATA LOGGER FOR ACCIDENT INVESTIGATION

RDSO approved -Fault logics, unusual incidences, unusual sequences for assistance in investigating any Accident.

Reports required from data logger after any accident/unusual incident for investigation are

<b>SL. No</b>	<b>Reports from station data logger</b>	<b>Details</b>
1	Analog status report	Different supplies status
2	Digital status report / Selected relays report	All Interlocking relays status/ Interlocking relays status of particular route
3	Fault summary report	With all intermittent failures
4	Modem link status report	Modem working condition
5	Off line track simulation report With text display	Signal clearance operation and actual train movement at given time.

**With the help of above reports following lapses can be investigated.**

- (i) Signal passing at Danger - TPR1 Down, RECR UP and TPR2 Down, TPR1 and TPR2 are in sequence.
- (ii) Train Detained – after signal
- (iii) Train Speed
- (iv) Train speed in Loop line
- (v) Train Stop
- (vi) Un-Signal Movement
- (vii) Driver Entering into Block Section without Line Clear
- (viii) Operation of More than one point at a time
- (ix) Point operated with repeated operations
- (x) Late Start
- (xi) Late Operation
- (xii) Premature Operation
- (xiii) Route Cancellation
- (xiv) Point Maintenance
- (xv) Time difference between Timer Relays in case of Route Cancellation – with the help of Log-Off Reports

From control room also generate same reports and compare them with those of station data logger and compare both of them with train charting data to derive valuable insights in to the case.

Sl. No.	Reports from control room data logger	Details
1	Analog status report	Different supplies status
2	Digital status report / Selected relays report	All Interlocking relays status/ Interlocking relays status of particular route
3	Fault summary report	With all intermittent failures
4	Modem link status report	Modem working condition
5	Off line track simulation report With text display	Signal clearance operation and actual train movement at given time.
6	Punctuality report	Planning of controller and actual train movement
7	Trains List	Trains on board with time
8	Caution order report	Caution orders actually issued to related trains
9	Blocks report	Block nature and timing
10	Prediction report	Preplanning of controller
11	Vector model graph	Distance Vs. Time

## SCREEN PRINTS OF SOME REPORTS

- 1) Analog status report

Report Taken on : 26/May/03		ANALOG REPORT FOR KONDAPALLI	
SINo	Channel name	Voltage	Time
42	230V AC AT SUPP	211.2	17/05/2003 06:27:52:469
43	24VDC EXT-II	33.6	17/05/2003 06:28:13:969
44	24VDC EXT-I	35.04	17/05/2003 06:28:13:969
45	110V AC DISTANT	3.264	17/05/2003 06:28:14:469
46	110VAC SIG BZA	5.168	17/05/2003 06:28:14:469
47	110VAC SIG KZJ	6.528	17/05/2003 06:28:14:469
48	230V AC AT SUPP	1.584	17/05/2003 06:28:14:469
49	110VAC TRACKS	4.08	17/05/2003 06:28:14:719
50	24VDC EXT-II	31.04	17/05/2003 06:28:14:969
51	24VDC EXT-I	33.52	17/05/2003 06:28:14:969
52	110V AC DISTANT	1.088	17/05/2003 06:28:15:469
53	110VAC SIG BZA	1.36	17/05/2003 06:28:15:469
54	110VAC SIG KZJ	1.632	17/05/2003 06:28:15:469
55	230V AC AT SUPP	5.28	17/05/2003 06:28:15:469
56	110VAC TRACKS	1.36	17/05/2003 06:28:15:719
57	24VDC EXT-I	32.4	17/05/2003 06:28:15:969
58	110V AC DISTANT	102.272	17/05/2003 06:28:17:469
59	110VAC SIG BZA	102.816	17/05/2003 06:28:17:469
60	110VAC SIG KZJ	106.624	17/05/2003 06:28:17:469

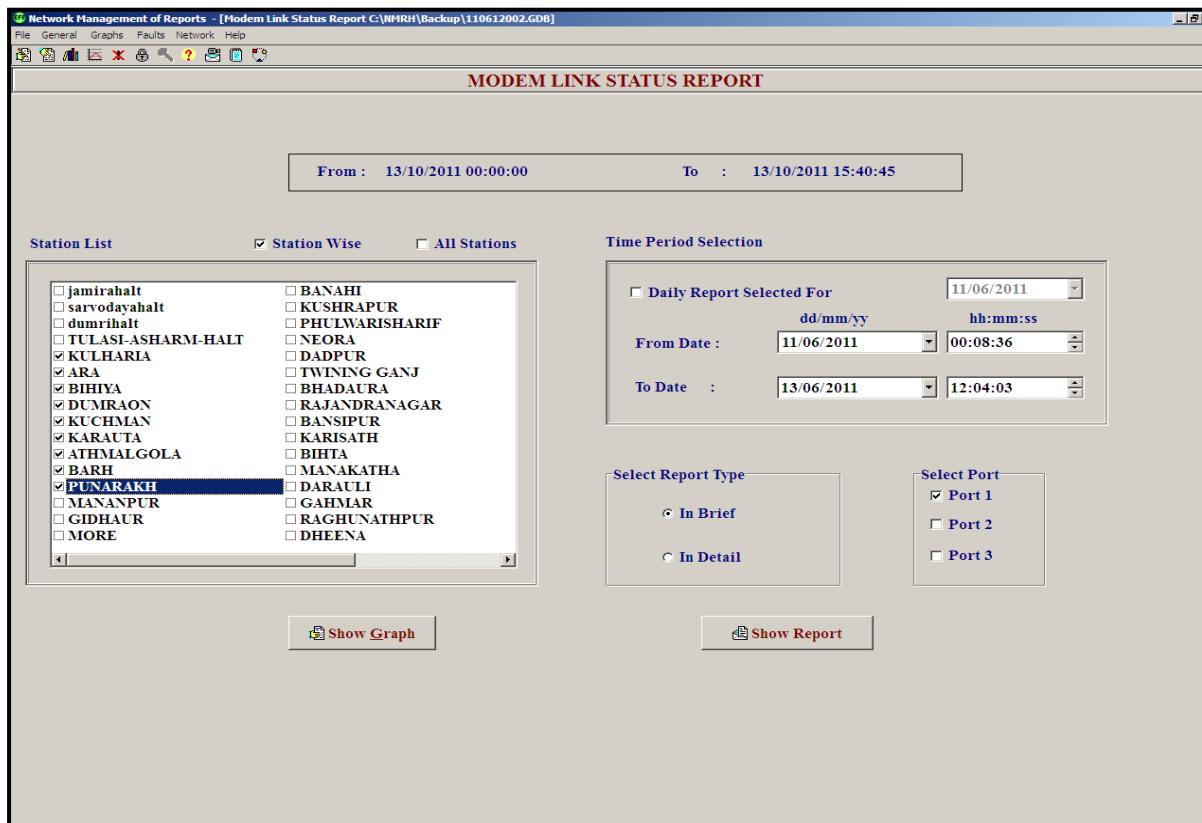
## 2) Digital status report

DIGITAL REPORT FOR RRI(MTJ)			
Report Taken on : 16/May/03		DIGITAL REPORT FOR RRI(MTJ)	
SLNo	Signal name	Signal Status	Signal Time
1	113Z1WR	Up	26/02/2003 00:12:18:422
2	113WKR1	Down	26/02/2003 00:12:18:641
3	113Z1WR	Down	26/02/2003 00:12:18:641
4	113WKR1	Up	26/02/2003 00:12:24:531
5	113W(R)LR	Up	26/02/2003 00:12:24:562
6	113RWKR	Up	26/02/2003 00:12:24:594
7	113RWKR	Down	26/02/2003 00:17:41:906
8	113W(R)LR	Down	26/02/2003 00:17:41:922
9	WNCR(N/Z)	Down	26/02/2003 00:22:39:641
10	WNCR(N/Z)	Up	26/02/2003 00:22:40:750
11	113Z1WR	Up	26/02/2003 00:25:06:281
12	113WKR1	Down	26/02/2003 00:25:06:516
13	113Z1WR	Down	26/02/2003 00:25:06:516
14	113WKR1	Up	26/02/2003 00:25:12:438
15	113W(R)LR	Up	26/02/2003 00:25:12:469
16	113NWKR	Up	26/02/2003 00:25:12:500
17	113NWKR	Down	26/02/2003 00:34:57:562
18	113W(R)LR	Down	26/02/2003 00:34:57:562
19	113W(R)LR	Up	26/02/2003 00:48:18:250
20	113NWKR	Up	26/02/2003 00:48:18:281
21	113NWKR	Down	26/02/2003 00:57:50:141
22	113W(R)LR	Down	26/02/2003 00:57:50:141
23	113W(R)LR	Up	26/02/2003 01:16:44:922

## 3) Fault summary report

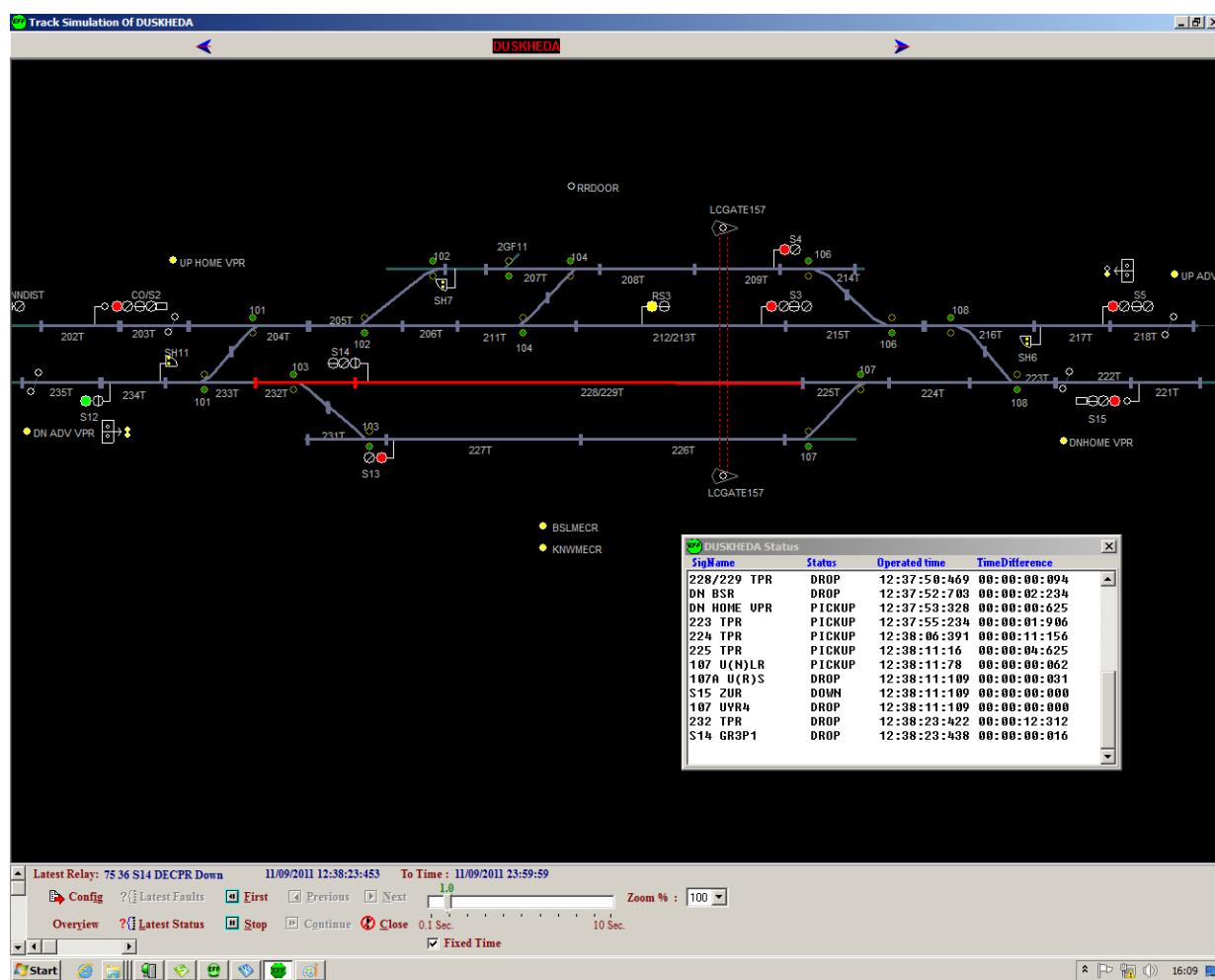
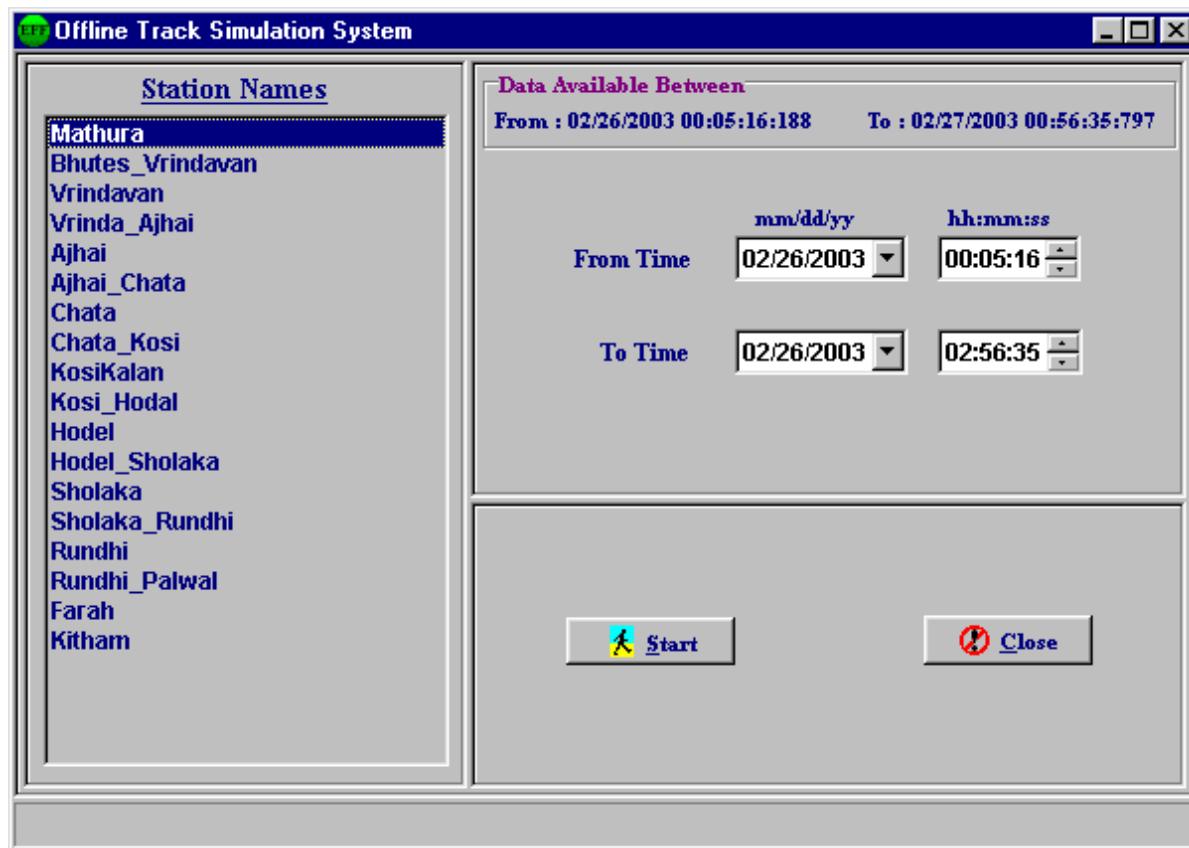
FAULTS SUMMARY REPORT						
Report Taken on : 16/Nov/01			FAULTS SUMMARY REPORT			From : 23/Apr/00 09:41:21
SL.No	Station	FLevel	FCount	Fault Message	First Occured	Last Occured
1	CHENNAI CENTRAL	I	9	109AT Bobbing	23/04/2000 15:11:40:766	02/05/2000 06:40:30:641
2	CHENNAI CENTRAL	I	4	109AT Bobbing	02/04/2001 11:22:45:266	04/04/2001 09:22:59:078
3	CHENNAI CENTRAL	M	6	109AT Down>10minutes	02/04/2001 17:29:04:000	04/04/2001 06:53:58:453
4	CHENNAI CENTRAL	I	1	109BT Bobbing	02/05/2000 02:50:04:812	02/05/2000 02:50:04:812
5	CHENNAI CENTRAL	I	1	109BT Bobbing	04/04/2001 05:51:38:469	04/04/2001 05:51:38:469
6	CHENNAI CENTRAL	I	3	110T Bobbing	24/04/2000 16:52:16:094	28/04/2000 07:34:03:469
7	CHENNAI CENTRAL	M	2	110T Down>10minutes	24/04/2000 02:39:04:266	01/05/2000 10:37:50:562
8	CHENNAI CENTRAL	M	2	112A Track Failed	30/04/2000 21:43:00:594	30/04/2000 21:43:05:703
9	CHENNAI CENTRAL	I	1	112AT Bobbing	25/04/2000 11:07:22:391	25/04/2000 11:07:22:391
10	CHENNAI CENTRAL	M	6	112B Track Failed	23/04/2000 15:46:02:750	30/04/2000 10:33:37:922
11	CHENNAI CENTRAL	I	24	112BT Bobbing	23/04/2000 13:16:06:922	03/05/2000 05:23:52:359
12	CHENNAI CENTRAL	M	2	114T Down>10minutes	30/04/2000 15:47:23:156	01/05/2000 05:54:45:938
13	CHENNAI CENTRAL	M	9	114T Track Failed	25/04/2000 20:17:21:688	26/04/2000 12:17:32:000
14	CHENNAI CENTRAL	M	2	11T Down>10minutes	23/04/2000 20:38:25:688	24/04/2000 05:40:32:000
15	CHENNAI CENTRAL	M	2	11T Down>10minutes	04/04/2001 00:13:50:438	04/04/2001 08:24:58:672
16	CHENNAI CENTRAL	M	2	122B Track Failed	28/04/2000 00:07:28:000	28/04/2000 00:07:36:750
17	CHENNAI CENTRAL	M	1	124 Track Failed	27/04/2000 21:23:00:844	27/04/2000 21:23:00:844
18	CHENNAI CENTRAL	M	2	126 Track Failed	26/04/2000 23:54:47:609	26/04/2000 23:54:56:672
19	CHENNAI CENTRAL	M	3	127 Track Failed	28/04/2000 01:13:10:531	28/04/2000 01:52:51:000
20	CHENNAI CENTRAL	M	3	130B Track Failed	27/04/2000 10:59:38:328	28/04/2000 00:37:02:516
21	CHENNAI CENTRAL	M	6	131BT Down>10minutes	25/04/2000 16:06:27:188	01/05/2000 05:56:45:375
22	CHENNAI CENTRAL	M	2	131BT Down>10minutes	02/04/2001 14:21:20:625	03/04/2001 23:26:24:438
23	CHENNAI CENTRAL	M	16	132A Track Failed	25/04/2000 18:39:35:281	26/04/2000 13:20:20:234
24	CHENNAI CENTRAL	M	2	132A Track Failed	27/04/2000 00:09:44:250	28/04/2000 00:51:29:172

## 4) Modem link status report

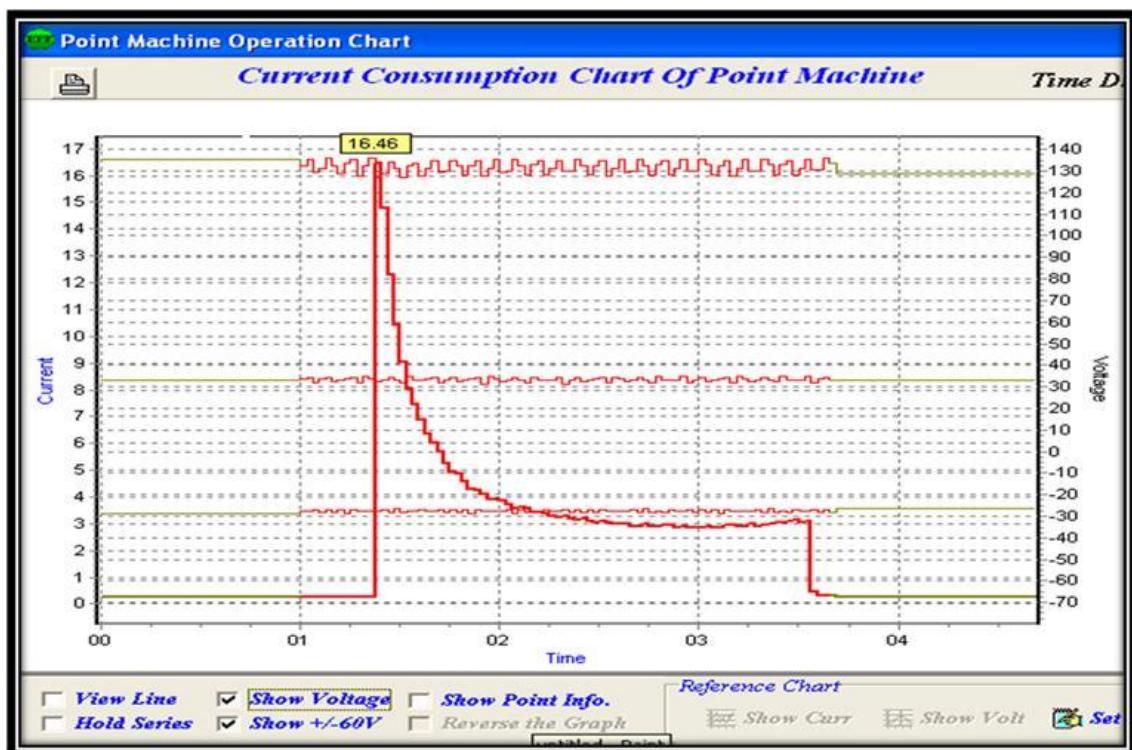


MODEM LINK STATUS REPORT						
<span style="margin-right: 20px;">FontSize</span> <span style="margin-right: 20px;">Save</span> <span style="margin-right: 20px;">Open</span> <span style="margin-right: 20px;">Preview</span> <span style="margin-right: 20px;">SetUp</span> <span style="margin-right: 20px;">Print</span> <span>Save To BMP</span>						
<span style="margin-right: 20px;">From: 11/Jun/11 00:08:36</span> <span style="margin-right: 20px;">To: 13/Jun/11 12:04:03</span>						
<b>Report Taken on : 13/Oct/11 16:10:48</b>						
SLNO	STATION	PORT NO	RESTORE COUNT	BREAK COUNT	Avg. Break Time	% Break Time
1	KULHARIA	1	3	3	00:02:14.656	00.19
2	ARA	1	4	4	00:01:32.500	00.17
3	BIHIYA	1	7	7	00:11:07.281	02.17
4	DUMRAON	1	3	1	00:00:00.000	00.00
5	KARAUTA	1	1238	41	1 day(s) 14:31:03.547	2635.24
6	ATHMALGOLA	1	4	4	00:00:22.250	00.04
7	PUNARAKH	1	496	494	00:00:44.672	10.23

## 5) Off line track simulation report with text display



## 6) Current consumption chart of point machine



**FAULTS REGISTERED IN THE DATABASE FOR CHENNAI CENTRAL**

SL No	FLevel	Information	Fault Message	Occured Time	Shown Time
1	M	132ATPR/DOWN 09:56:32:109	132AT Down>10minutes	23/04/2000 10:06:32:953	23/04/2000 10:09:33:234
2	M	134ATPR/DOWN 09:57:13:62	134AT Down>10minutes	23/04/2000 10:07:16:094	23/04/2000 10:10:17:016
3	M	29TPR/DOWN 10:00:10:484	29T Down>10minutes	23/04/2000 10:10:21:297	23/04/2000 10:13:23:922
4	I	120RWKR/DOWN 10:28:16:875 120RWKR/UP 10:28:16:891 00:00:00:16	Pt.120R Bobbing	23/04/2000 10:28:16:891	23/04/2000 10:31:16:516
5	M	33TPR/DOWN 10:28:14:781	33T Down>10minutes	23/04/2000 10:38:20:000	23/04/2000 10:41:19:203
6	L	70BLR/UP 11:34:04:672 70BHR/UP 11:36:16:219 70BHECR/UP 11:36:16:984	Sig.70B Calling On Operation	23/04/2000 11:36:16:984	23/04/2000 11:39:12:688
7	M	C70TPR/DOWN 11:26:20:484	C70T Down>10minutes	23/04/2000 11:36:20:688	23/04/2000 11:39:16:766
8	I	01TPR/DOWN 10:47:21:172 1RECR/UP 10:33:04:203 28HR/DOWN 09:48:06:906 112BTPR/DOWN 11:39:12:297 112ATPR/UP 11:23:06:656 114TPR/UP 11:24:41:953	PF.01 Sig.Passing at Danger	23/04/2000 11:39:15:625	23/04/2000 11:42:11:250
9	M	29TPR/DOWN 11:51:03:312	29T Down>10minutes	23/04/2000 12:01:06:469	23/04/2000 12:04:00:188
10	I	01TPR/DOWN 12:05:28:531 1RECR/UP 10:33:04:203 28HR/DOWN 12:09:29:47 112BTPR/DOWN 12:16:19:47 112ATPR/UP 12:13:35:891 114TPR/UP 12:10:54:953	PF.01 Sig.Passing at Danger	23/04/2000 12:16:20:938	23/04/2000 12:19:13:156
11	M	29TPR/DOWN 12:34:42:641	29T Down>10minutes	23/04/2000 12:44:43:000	23/04/2000 12:47:33:312
12	I	112BTPR/DOWN 13:16:06:31 112BTPR/UP 13:16:06:922 00:00:00:891	112BT Bobbing	23/04/2000 13:16:06:922	23/04/2000 13:18:55:125
13	I	120TPR/DOWN 13:23:52:172 120RWKR/UP 13:21:30:703 120RWKR/DOWN 13:24:13:422	Pt.120 Loose Packing	23/04/2000 13:24:13:422	23/04/2000 13:27:01:703
14	I	120RWKR/DOWN 13:24:13:422	Pt.120R Bobbing	23/04/2000 13:24:13:594	23/04/2000 13:27:01:766

## **ANNEXURE XV**

### **DO's & DON'Ts FOR S&T STAFF**

#### **1) DO's**

- Take pride in providing safe & Reliable Signalling System.
- Remember that you are vital and every action of yours has safety implications either directly / indirectly.
- Follow Maintenance schedules as given in Signal Engineering manual / Zonal Railways
- Follow G&SR rules in dealing with failures and replacements.
- Check station SWR and ensure its correctness.
- Ensure that completion drawings are available and all the alterations incorporated.
- Ensure testing of panel or lever frame is done properly.
- Check train shunt resistance of all track circuits and see that they shunt properly with light vehicle/motor trolley.
- Ensure double lock and sealing arrangements in all signalling system like Block Instruments, Relay room , locking Trough
- Ensure overhauling schedules for Block instruments, Relays are adhered to.
- Ensure Data logger Time is synchronised to operating time and also ensure the inputs and outputs are validated.
- Ensure the micro switch used for checking Relay room opening and closing is properly working.
- Ensure that proper tools are available and Maintainers have proper knowledge of the gear, he has to attend.
- Data logger reports to be used for analysis of failures –both for predictive and preventive measures.
- Ensure proper disconnection and Reconnection of gears at all time including failures.
- Ask for failure memo and put up disconnection before attending a failure.
- Ensure force drop of mechanical locks through entire travel of lever.
- Ensure all installations adhering to schedule of dimensions.
- Ensure joint inspections of points and crossings done religiously with all correctness in readings and defects are promptly attended.
- Ensure all replacement schedules are properly carried out.
- If a gear is not working safely it may be suspended and replaced at earliest.
- While disconnecting a point ensure that feed and detections also disconnected.
- Check regularly for Earth fault in any circuits. Install Earth Leakage Detector.
- Be vigilant at all times, particularly during working with field gears.
- Maintenance staff and construction staff should work in co-operation.
- Reduce Non –interlocked period during commissioning of signalling systems.
- Make elaborate planning while carrying out any signalling work.

- Train the staff for improved working methods.
- Make sure periodical remarks of the S&T equipment e.g. batteries, ground connection of points, Block joints etc.
- Develop a safety culture. Be calm & composed during failures.
- Be Professional in your work
- Ensure proper working Block Instruments e.g. commutator lock cks. For their integrity.

## **2) DON'Ts**

- Don't work in haste; don't be panic at the time of failure.
- Don't adopt any short cut methods.
- Don't attend to any failure or carryout any work involving safety without proper disconnection
- Don't infringe any gear or installation with schedule of dimensions
- Don't attend any gear without adequate knowledge of circuitry.
- Don't compromise with safe working rules.
- Don't bypass any contact in any circuit.
- Don't neglect any problem. Try to go to the root cause and prevent recurrence.
- Don't hide failures.
- Don't open the coding holes in base of relays, to make it possible to plug a different configuration relay.

\* \* \*