

NORTHWESTERNRAILWAY





TECHNICAL GUIDE FOR MECHANICAL SUPERVISORS (REFRESHERS) OF INDIAN RAILWAYS

SUPERVISOR TRAINING CENTRE, NEAR DRM OFFICE, AJMER

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UNIT-1: LHB COACHES

Indian Railways has entered in a contract (no.95/RSF/142/2 (GP-122)) with M/s.LHB, Germany for supply of modern light weight high speed coaches. The coaches are of air-conditioned type chair car and generator car, which are fit for operation at speed of 160 kmph. Coaches shall have a speed potential of 200 kmph with suitable additions.

The coaches shall have the satisfactory performance means that Sprelling RI shall be preferably below 2.5 but not exceeding 2.75. The coaches shall be designed to conform to the principal dimension/ requirement given hereunder:

1.	Track gauge	=	1676mm.
2.	SOD, IRSOD	=	1676mm gauge of 1939 (Reprinted 1973).
3.	Sharpest curve to negotiate	=	175m.
4.	Super elevation	=	165mm max.
5.	Min. Clearance above rail level	=	102mm.
6.	Pay load on AC coach	=	8.0 T.

1.1 BENEFIT FROM LHB COACHES:-

- 1. Higher carrying capacity- these coaches are about two meter longer than ICF coaches. This extra length means two additional rows of chairs in chair cars of one additional way in sleeper coaches.
- 2. Better pay to tare ratio- LHB coaches shall weight approximately 40.3 tonnes. This weight is less than ICF coaches even with 2meter extra length.
- 3. Low corrosion- these shall be low corrosion on LHB coaches due to extreme usage of stainless steel better design and manufacturing techniques.
- 4. Low maintenance- Replacement or removal of sub-system shall be required only after one million kilometres. These are no door handles projecting outside the coach and mechanised car washing in facilitated.
- 5. LHB coaches have authentically superior interior with GRP panels for side wall and roof panelling. They can be removed easily for maintenance, resist water seepage and are wear resistance.
- 6. These are no visible screws inside the passenger compartments.
- 7. Higher passenger comfort- Ride index of 2.5 (not exceeding 2.75) has been specified.
- 8. LHB coach offers better passenger safety due to- □Use of fire retardant material for furnishing.
 - Provision of emergency open able windows.
 - Centre buffer couplers, vertically interlocked. Uvisible door have thermal locking.
- 9. LHB coach offers better passenger amenities due to- A)More space for pantry.
 - B) Individual reading light in the chair car.
 - C) Ergonomically designed chairs with reclining back rest (seat bottom sliding feature provided additionally for executive class chairs).

1.2 LHB COACH PARAMETRES

1.	Gauge	1676mm
2.	Length over body	23540mm
3.	Buffer centres	1956mm
4.	Maximum width over body	3240mm
5.	Height of the centre line of coupler from rail level under tare condition	1105mm
6.	Height of compartment floor coupler from rail level under tare condition.	1303mm
7.	Maximum distance between innerwheels	12345mm
	Maximum buffer drop under gross load worn condition	75mm
8.	Maximum height of the centre line of side buffer above rail level for empty vehicles	1105mm
9.	Minimum height of centre Line of side buffer above Rail level for loaded vehicle	1030mm
10.	Maximum height of centre of screw coupling above rail level for empty vehicles	1055mm
11.	Maximum axle load Permissible	16 tonne

1.3 MAJOR FEATURES OF LHB COACHES

1.3.1 DOOR

- The LHB coach uses four body side doors. The body side door is a swing steel door of sandwich construction. It has a self-closing flap to cover the footsteps when the door is in closed position.
- The LHB coach uses two compartment doors. AC compartment door unit is a single leaf, stainless steel sandwich construction, sliding door unit consisting of door leaf and ups and lows guides. The move mechanism is with manual opening and automatic closing. The modular door unit is about 65 kgs.
- The LHB coach uses 3 lavatory doors. Lavatory doors unit has space saving double leaf, hinged folding doors with ups and lows guides and square key locking arrangement. The two folds of the door leaf are joined by a continues stainless steel hinge. The door leaf when open is folded in to a compact space. The weight of the assembly is 26 kgs.
- The LHB coach uses two vertical sliding doors. It is a self-contained module consisting of two sliding door leaves, a move mechanism with manual opening and auto closing ups and lows guides a frame into which this integral unit is assembled. Weight of the modular assembly is 94 kgs.

1.3.2 RMPU:- The air conditioning units for coach are provided with ducting for air intake and exhaust. A fresh air intake of $21m^3$ /hr for person shall be provided at a train speed of 160kmph. Heat generated in the pantry and switch cabinet is also extracted via exhaust air. Humidity control shall also be provided to ensure that it is less than 60% LHB is purchasing the RMPU from M/s Hagenuk Faively, Germany.Technical data for RMPU as under:-

1	. Cooling capacity	22.5KW
2	. Heating capacity	6.0 KW
3	. Compressor motor	10KVA (Nominal power)
	12.6KVA (Max. power)	
4	. Fan motor axial(for condenser)	3.3KVA
5	. Fan motor radial(for evaporator)	1.1KVA
6	. Required air supply	3000 m ³ /hr
	(Fresh air- 820 m ³ /hr)	
7	. Maximum power input, cooling	17KVA
8	. Maximum power input for heating	7.1KVA
9	. Maximum power input dehumidification	16.7KVA
1	0. Refrigerant	R-134a
1	1. Weight	630kg
1	2. Exhaust fan dimension	2200x2000x500mm

1.3.3 SEALED WINDOW GLASS UNIT

Three types of windows have been used in the chair car of ALSTOM -LHB coach.

- 1. Fixed window unit with sealed glass, 12 per coach.
- 2. Emergency open able window, 4 per coach.
- 3. Hooper type windows for the lavatory, 3 per coach.

The sealed unit consists of outs 8.4 mm laminated glass and inner 4mm tampered safety glass with 6 mm air gap with krypton gas filling. Glasses are held by an aluminium extrusion frame with rubber profile. The aluminium frame is design to the coach shell with adhesive replacement of window glass unit shell not required removal of between corsshell and aluminium frame.

Emergency window is similar to the fixed unit four units are provided in each coach to allow emergency of passengers. A handle is connected to the rubber profile to open the glass unit of emergency window. The breakage of glass unit while opening is prevented by a restraining chain.

1.3.4 CDTS UNIT

LHB coaches are fitted with controlled discharge toilet unit to avoid swelling of track in station and inhabited areas. Waste is stored in to an intermediate tank which is closed by a slide wall controlled by a microprocessor. The slide wall opens automatically at speed above 30KMPH. Toilet units are fitted with button operated flush valves, which flush with pre water using compressed air. Tanks have a capacity of storage of material for fifteen flushes and need to be before it can be used further.

Lavatory ventilation system is to coach AC system of the coach through grills and exhaust fan. Exhaust fan opens in end wall to avoid suction of the soul smell in AC systems.

1.3.5 FLEXIBLE FOAM PADDED CHAIRS

There 78 chairs in the second AC chair cars and 56 chairs in executive class arranged in rows of 2 and 3 chairs weight of a single chair for second AC chair car is approximately 21 kg against 28 kg in existing IR coaches. The chairs have lightweight aluminium frame seat cushion and back rest are made of fire retardant PU foam.

1.3.6 LUGGAGE RACKS:-

In LHB coaches, the luggage racks are made foam aluminium extrusion lengths. Framing houses a pane of tampered safety glass. Aluminium alloy cast side cheeks suspend the rack end bear the load reading light fit. Aluminium extrusion is used in the anodised finish. Side cheeks of cast aluminium alloy are provided with powder coated finish.

1.3.7 COMPOSITE WOOD FLOORING PANELS

For flooring, LHB is using 16mm composite board made from cork panels to "makore" wood. Flooring panels are light weight, strong, warp resistant and also resistant to vibration/impact forces. These boards are specially treated for the fire resistance as per DIN 5510/2 these are also resistant to moisture, cigarette burns, staining, ageing etc.

1.3.8 INSULATION MATERIAL

The LHB coaches are sound insulated and heat insulated. The heat insulated material as under:-

- a) Glass wool
- b) Resonaflex, now moniflux is used.

1.3.9 PANTRY

A sub pantry comprising of a hot case bottle coolers a 20 litres capacity hot water boils and 11 litres sup-warms shall be provided in each chair car. A serving trolley shall also be provided.

1.3.10 BRAKE SYSTEM

- a) Axle mounted disc brake with 2 disc per axle are used. This shall laid down maintenance requirements of brake systems.
- b) 640mm*110mm discs.
- c) Condemning wheel dia of 845mm (New 915mm).
- d) Microprocessor controlled wheel slide protection device with all four axle controlled.
- e) Braking distance of 18 coach double headed train from a speed of 160 kmph is 1200 meter.
- f) Bogie level isolation for brake systems.
- g) EP brakes.
- h) Indicators to show that brakes are applied.
- i) Hand brakes only in power cars.
- j) All brake components are mounted in brake system.
- k) Cutting ring type of pipe fittings for air tightness.
- 1) Stainless steel pipes for corrosion resistance.
- m) Independent brake cylinder for each disc.
- n) Asbestos free composition brake pads.

1.3.11 PASSANGER ALARM SYSTEMS

- a) Emergency brake application in the event of ACD.
- b) Air exhaust through 19mm chokes as per UIC.
- c) UIC pull handle.
- d) Pull handles are located on both the entrance walls of the passenger compartment and also lavatories.
- e) Coupler forces are required to be within limit of the coupler strength.

1.3.12 DRAW AND BUFFING GEAR

The coaches shall be provided with tight lock centre buffer coupler and anti-climbing feature and be capable with AAR type coupler fitted on locomotive to IR Specification 56-BD-92.

1.4 SALIENT FEATURES OF LHB COACHES

- 1.4.1 These coaches are longer by 1.7 meters than the ICF coaches and hence more number of passengers can be accommodated in a given coach. As the length of the coach is longer the number of coaches required to form a formation is reduced and hence overall cost of maintenance becomes less.
- 1.4.2 These coaches are fitted with Axle Mounted Disc brakes to have an effective brake power to stop the train within the emergency braking distance. As the brake forces are acting on the Discs which are mounted on the Axles, the wear on the wheel tread caused due to tread brake is eliminated and hence the life of the wheels are considerably increased.
- 1.4.3 These coaches are fitted with Wheel slide protection device to prevent the wheel from getting skid. Due to various reasons it is possible for any one of the wheel to have lesser speed when compared to the other three wheels and in such a case it releases the air from the brake cylinder of the affected wheel automatically to prevent the wheels from getting skid
- 1.4.4 These coaches are fitted with Brake accelerator in the Brake pipe to bring BP pressure to zero during emergency brake application. The brake accelerator connects the Brake pipe with exhaust during emergency application to facilitate faster releasing of air from the brake pipe.
- 1.4.5 These coaches are provided with FIAT bogies, which are designed to run at a speed of 160 KMPH.
- 1.4.6 These coaches are fitted with Controlled discharge Toilet system designed to discharge the human waste when the speed reaches above 30 KMPH after completion of 15 flushing. The objective of this toilet system is to keep the station premises clean and hygienic.
- 1.4.7 These are fitted with tight lock AAR centre buffer coupler with anti-climbing feature to prevent the climbing of one coach over another in case of accidents.
- 1.4.8 The wheelbase of Bogie is 2560 mm.
- 1.4.9 These coaches are fitted with earthling device to prevent damages to the Roller bearings.

- 1.4.10 These coaches are fitted with roof mounted AC package units.
- 1.4.11 The following equipment's are operated by electronically operated control system (Computer)
 - a. Wheel slide protection device.
 - b. Controlled discharge toilet system.
 - c. Water pumping device.
 - d. Roof mounted AC package units
- 1.4.12 The riding index of LHB coach is 2.75 when compared to 3.25 in case of ICF Coaches
- 1.4.13 The passenger emergency alarms signal devices are provided inside passenger compartment. This is to avoid operation of PEASD by unauthorized persons from outside. There is no mechanical linkage like a chain and this handle directly operates the PEASD valve for venting the brake pipe pressure.



2.1 DESIGN FEATURES OF BOGIE

The bogie frame consists of two side members of Y-shaped longitudinal beam connected by two tubular steel members. These members are connected by two channel shaped longitudinal members. The Y-shaped side members consist of structural steel sheet and welding is done to form box sections. Minimum strength of the structure is 52 Kg/mm² with class D weld. This is a two-stage suspension bogie. The car body directly rests on the secondary stage helical springs which rest on Y-shaped side beam. The bogie frame rests on primary stage helical spring which are resting above the axle box crown. The traction and braking force from axle to bogie frame is transferred through articulated control arm system of primary suspension and traction and braking from bogie to body is transferred through rocker arm device. Dimensional parameters and weight particulars are given below:

1	Bogie wheel base	= 2560mm.
2	Width of the bogie frame	= 2240mm.
3	Height from rail level to top of bogie frame	= 925mm
	(under tare load condition)	
4	Mass of total bogie	= 6330 Kg.
5	Secondary spring mass/bogie	= 942 Kg.
6	Primary spring mass/bogie	= 2611 Kg.
7	Un sprung mass/bogie	= 3100 Kg.
8	Bogie Length	= 3534 mm
9	Bogie Width	= 3030 mm
10	D_{1}^{1}	14000

10 Distance between bogie centres' of the coach= 14900mm.

Features	FIAT	ICF	IR20
Speed Potential (kmph)	160	140	160
Ride Index (max.)	2.75 at	3.5 at	3.0 at
	180kmph	140kmph	160kmph
Bogie Weight (t)	6.33	6.5(16.25t)	6.8
Wheel base(mm)	2560	2896	2440
Inner axle distance (m)	12.34	11.89	12.33
Wheel dia new (mm)	915	915	890
Wheel dia worn (mm)	845	814	814
Axle box guidance	Articulated	Rigid	Articulated
Dampers – Primary	Hydraulic damper	Dashpot	Hydraulic damper
Deflection ratio S/P	67/33	50/50	66/34
Bogie frame	Without headstock	With headstock	Without headstock.
Lateral stop	Rubber	Metal	Rubber

2.2 COMPARISON OF FIAT BOGIE, ICF BOGIE AND IR-20 BOGIE

Rubber compounds	Many	Very few.	Less than Fiat, but more than ICF
Brake	Axle mounted disc.	Conventional	Axle mounted disc.
Bearing	Taper	Spherical	Taper
Length over body (m)	23.54	21.34	21.77
Length over buffer	24.00	22.28	22.10
Seat capacity – I class	52	46	48
II class	78	67	70
No. of toilets	3	4	4

2.3 DESCRIPTION OF BOGIE COMPONENTS

2.3.1 PRIMARY SUSPENSION:-

It consists of an articulated control arm, nested helical coil spring and vertical damper. The traction and braking force from axle to bogie frame is transferred through the control arm. Part of the load on primary suspension is absorbed by elastic connection provided between control arm and bogie frame. Primary suspension characteristics are given below:

		Outer spring	Inner spring
۶	Mean coil dia (mm)	219	138
۶	Wire dia (mm)	38	26
۶	Free height (mm)	324	324.5
	Vertical stiffness (N/mm)	47505%	280□5%
\triangleright	No. of active coils	4.1	6.1
\succ	Total no. of coils	5.6	7.6
\triangleright	Radial stiffness Cx (N/mm)	= 40000.00	
۶	Torsional stiffness Ct (Nm/rad)	= 22800.00	

2.3.2 SECONDARY SUSPENSION:

It consists of nested flexi coil steel spring, rubber spring (both sides) and progressive rubber bellow spring. Progressive rubber is provided in parallel to coil spring for reduction of stresses in secondary spring in loaded condition in vertical direction. Secondary vertical damper connected with bogie frame and bolster to cushion the vertical movement. Secondary suspension characteristics are given below:

	Outer spring Inner spring		
Mean coil dia (mm)	368	246	
≻Wire dia (mm)	50	34	
➢No. of active coils	5.1	6.8	
≻Total no. of coils	6.6	8.3	
≻Free height (mm)	707	663	
≻Vertical stiffness (N/mm)	241.105%	129.5□5%	
Lateral stiffness (N/mm)(gross)	164.5	31.1	
≻Lateral stiffness of both rubber springs	180 N/mm.		

Lateral deflection of helical spring	28mm (gross)

≻Total lateral deflection of sec. suspension

≻Total lateral stiffness of sec. suspension

≻Total lateral spring deflection

Stiffness of minor pillow (each)

50mm (gross) 79.2 N/mm. 28mm under gross load condition. 180 N/mm.

2.3.3 The characteristics of Rubber Pad and Rubber Bellow are given below:

\triangleright	Rubber Pad:	Free height	= 90 to 95 mm.
		Inner dia.	= 152 to 158mm
		Outer dia.	= 225 to 238mm.
		Av. Ver. Stiffness	= 9.4 kN/mm for installed ht. of 48mm.

Rubber Bellow: This rubber element having a progressive type characteristics whose average value may be defined as 20 Kg/mm.

Max. vertical load capacity	= 3200 kg.
Max. vertical deflection	= 115mm.

2.3.4 <u>Anti-roll bar</u> :

This is again a type of suspension achieved through the torsional movement of torsion bar. The stiffness of torsion bar supplement the secondary spring during the galloping/rolling movement of coach. This torsion bar arrangement is used between bogie frame and coach body. The anti-roll bar used in Fiat bogie is designed for tilting co-efficient of 0.3 with 50mm cant. The stiffness per half of the torsion bar = 1389.7 N/mm at 1330mm base. Vertical stiffness ratio of Anti-roll bar and helical spring is 0.546 and 0.454, at a base of 2240mm.

2.3.5 Rocker device :

The traction and braking force between bogie and body is transferred through a rocker device located at the centre of the bogie approximately in the plane of axle, in order to decouple the various vibratory movements consisting of rocker and a pair of thrust rod.

2.3.6 **Body-bogie connection:**

A special type of body-bogic connection between coach body and bolster has been provided. This connection consists of disc spring, hemispherical ball, swinging link pin, link pin etc. This connection is capable to cater for the acceleration value upto 0.25g in lateral and longitudinal direction. Beyond that value, a bracket capable to take 5g. Acceleration comes into action between bogic bolster and coach body.

2.3.7 Brakes:

The bogie is fitted with axle-mounted disc brakes (2 per axle). The disc size is selected in such a way that wheels can be used upto max. Worn condition of 845mm dia. The size of the disc is 640mm dia, with pads (both sides of disc) and pad holders with brake linkage. 10" dia brake cylinder is used with built-in automatic slack adjusters. Different parameters of brakes applicable for Generator coach and Passenger coach are given below:

*	Brake cylinder pressure for empty/loaded:	3.8 bar	having built up time of 4 seconds
*	Brake cylinder piston force	:	17857 N.
*	No. of brake cylinders per vehicle	:	8

* Effective piston area	:	510.7 cm ² .
* No. of brake pads per vehicle	:	16
* Effective brake pad area	:	400 cm ² .
* Cylinder volume (each)	:	9.75 litre.
* Volume of auxiliary reservoir /vehicle	:	125 litre.
* Co-efficient of friction between brake pad & disc.	:	0.35
* Brake calliper ratio (for Gen. Coach)	:	2.48
(for Pass. Coach)	:	2.17

2.3.8 <u>Dampers</u> :

- Four primary vertical dampers are used on each bogie between axle box and bogie frame. The capacity of the vertical damper is 4250 N \pm 640 at the rate of 0.30 m/sec; frequency = 115/min.
- Two secondary vertical dampers per bogie between bogie frame and bolster is used to cushion the vertical movement. The capacity of damper = 3500 ± 1200 N at 0.2 m/sec.; frequency 115/minute.
- > Two lateral shock absorbers between bogie frame and bolster is used to cushion the lateral movement. The capacity of the damper = 8000 ± 520 N at 0.3m/sec; frequency 76/minute.
- Two yaw dampers have been used between bogie frame and car body to cushion the yaw and longitudinal movement. Capacity of the damper = 11000 ± 1650 N at 0.1 m/sec.; frequency- 7.6/minute.

2.3.9<u>Bump stops</u>

- Primary Bump stop: The vertical clearance is 13mm all coaches except Gen car 08mm and the lug clearance is 37.5mm and 45mm has been provided for vertical displacement of bogie frame during off-loading and on-loading from tare condition respectively.
- Secondary bump stop: The vertical Secondary bump stop has been provided between the supports connected with bolster and bogie frame (at secondary suspension stage). The supports on bolster are provided with synthetic plate.
- Lateral bump stop: Lateral bump stops having conical shaped rubber element are provided to prevent the excessive movements of secondary suspension. The lateral bump stop is provided between bolster and the cross member. The lateral gap between them is 25mm each side.
- Longitudinal bump stop: Longitudinal bump stop has been provided between bolster and the cross member on both the sides. The clearance in longitudinal direction is 8mm between bolster and cross member on both the sides.

2.4 OTHER SPECIAL FEATURES OF BOGIE

- 2.4.1 Bogie is capable to permit the coach body to negotiate curve of 175m radius at min. speed potential of 40 kmph and 1 in 8¹/₂ turnout in either direction at 30 kmph.
- 2.4.2 Buffer height adjustment is possible for every 20mm of wheel dia wear up to 845mm of condemning limit of wheel diameter.
- 2.4.3 Material of bogie frame = St 52.3, equivalent to European standards EN-10025 : 1990 A/1993; mechanical properties are given below:
- > Yield point = 355 for plate thickness <16mm. = 345 for plate thickness >16mm.
- > UTS = 490.63 for plate thickness range >3 < 100mm.
- Chemical composition of St.52.3 is given below:
 C = 0.23% by weight, Mn= 1.7%, Si= 0.6%, P= 0.045%, S= 0.045%
- 2.4.4 Permanent earthing connection has been provided to avoid the passage of operational current through roller bearing.
- 2.4.5 Wheel slip protection devices have been used to protect against skidding of wheels.
- 2.4.6 Tapered roller bearing has been used with min. life rating = 2×10^6 km, computed as per ISO practice. The axle box is made in two parts to permit axle dis-assembly without removing the suspension.
- 2.4.7 Wheel is IRS R19 and axle is IRS R16, wear adopted profile have been adopted.

2.4.8	New whe	el condition	. =	915mm.

2.4.9 Condemning limit = 845mm.

UNIT-3: SHELL CONSTRUCTION OF LHB COACH.

The entire shell is made from stainless steel and low corrosion steel. All the structural elements with section thickness above 5mm and more are made from Corten steel. Trough floor and roof panels are made from members and sidewall panels are made from 1.25mm Austenitic stainless steel. Other structural members and sidewall panels are lightweight design of the coach. The shell design eliminates turn-under other pockets causing corrosion in conventional coaches.



3.1 The various types of steels used in construction of LHB Coaches.

Shell Assemblies	Steels Used	Composition
Side Wall, End Wall	Ferritic Steel	C03%, Cr-10 to12%
And Roof structure	X2 Cr8	Si-1%, Mn-1.5%
Roof Sheet and Trough floor	Austenitic Steel	C07%, Cr-18%
	X5 CrNi18-10	Ni-10%, Si-1%, Mn-2%
Under Frame	Corten Steel	C01%, Cr35 to.6%
	IRS-M-41	Ni-2 to 4 %,Si-0.3to0.7%
		Mn-0.25%

3.2 COMPARISON THE CROSS SECTION OF SOLE BAR OF LHB COACHES WITH ICF COACHES.

The C – Shaped section Sole bar is used in the LHB coaches when compared to Z-shaped



in ICF Coaches at the joint between the side wall and the under frame.

3.3 Necessity of providing of Tight Lock CBC in LHB Coaches :

The LHB coaches are provided with Tight lock CBC with anti-climbing feature. Whenever there is an accident, the Screw coupling of conventional coach first breaks which will result in climbing of one coach over another. This will affect the extrication work very badly in case of accident. This tight lock CBC will not break in the event of the accident, which in turn does not allow the climbing of coaches, thus makes extrication works become easy.

3.4 **Description of the flooring of LHB coaches.**

Flooring: 16mm composite board made from cork panels are glued to "Makore" wood is used. The intermediate cork layer imparts nice insulation characteristics to the floor panel. Flooring panels are lightweight, strong, warp resistant and also resistant to vibrant/impact forces, moisture, cigarette burns, staining, ageing, etc. The "floating" floor is supported by rubber- metal decoupling elements, for absorption of structural vibrations.

- 3.5 The advantages of LHB coaches.
- > Up-gradation in design for passenger comfort.
 - 1. Improved ride comfort.
 - 2. Ergonomically designed seats as per Indian anthropometrics data.
 - 3. Large windows with good visibility.
 - 4. Luggage racks with in-built reading lamps.
 - 5. Insulation against noise. \geq No visible screws in the interior.
- > Up-gradation in design for passenger safety.
 - 1. Anti climbing feature in coupler.
 - 2. Wheel slide protection.
 - 3. Use of fire retardant materials.
 - 4. Hand safe feature in all automatic sliding doors.
 - 5. Anti skid PVC flooring.
 - 6. UIC vestibules and auto closing vestibule door.

3.6 Benefits from the overall system design.

- 1. Higher carrying capacity of 78 in chair car.
- 2. Better payload to tare ratio.
- 3. Better safe guards for corrosion.
- 4. Increased coach availability due to reduced maintenance.
- 5. Functionally designed pantry area.
- 6. Easily accessible AC unit controls.
- 7. Controlled discharge toilets for cleanliness in stations and yards.
- 3.7 Objectives of introducing the Controlled Discharge Toilet System (CDTS) in LHB coaches are.
 - 1. To keep the station premises clean and hygiene.
 - 2. To release the human discrete away from the station limits.
 - 3. To decrease water consumption during flushing.
 - 4. To keep toilets clean, odourless and aesthetic.
 - 5. To pressurize the water during flushing cycle.

Controlled discharge toilet units are fitted to avoid soiling of track in station and inhabited areas. Waste is stored into an immediate tank, which is closed off by microprocessor-controlled slide valves. The slide valve for waste tank outlet opens automatically at speeds above 30 kmph. The toilet units are fitted with button operated flush valves that flush with water, which is pressurized using compressed air. The tanks have a capacity of storage of material for 15 flushes and must be emptied before use.

3.7.1 Working of Controlled Discharge Toilet System with diagram below.



3.8.1 The system comprises the following:

1.	Control module	Having a programmable logic controller (PLC) used for counting the number of cycle as well as the speed sensing.
2.	Water pressuriser	A pressure pump used for pumping water from overhead tank with high pressure to clean the toilet bowl.
3.	Retention tank	A cylindrical tank with 40 Ltrs. capacity connected below the toilet bowl with two sliding valves each one at top & bottom.
4.	Slide valves	Two numbers of electro- operated by the control module during flushing cycle and discharge.
		Top valve is designed to open and close in every flushing cycle with the cycle time of 15 Sec. (can be adjustable) Bottom valve is designed to open and close after completion of 15 flushing cycles and also when the vehicle speed is above 30 KMPH.

- 5. Water check valve An electrically operated magnetic solenoid valve, used for opening and closing pressurised water during flushing cycle. It admits 2.5 Ltrs. For Indian water closet and 1.5 Ltrs. for European water closet in 12 Sec.
- 6. **Bye-pass valve** A hand operated push cock which bye passes the water Circuit during emergency situation i.e. in case of electricity failure and failure of CDTS.
- 7. Pressure switch A fail-safe system, which opens the top slide valve of the retention tank in case of failure of air supply/ electric supply to use the toilet as an ordinary toilet.
- 3.8.2 **Function**: The flushing cycle is explained as follows:
 - 1. Flush button is pressed (Soft press)
 - 2. Water pressures starts working
 - 3. Water check valve opens.
 - 4. Pressurised water flows from the circuit to the toilet bowl and flushing takes place.
 - 5. Top slide valve opens and flushed water goes to the retention tank.
 - 6. Water pressurise closes.
 - 7. Water check valve closes.
 - 8. Top sliding valve closes.

At the end of every 15th cycle and if the speed of the vehicle is equal to or above 30 KMPH. The bottom discharge valve will be opened and discharges take place. The speed is sensed from the wheel slide protection device, in which the signal from every axle is obtained by a phonic wheel electromagnetic mechanism. The explanation of necessity for providing the Wheel Slide Protection device in LHB Coaches and the working of WSP with diagram below.

Wheel Slide Protection Device (WSP):

In LHB coaches Air brake System with Disc brakes is used. During brake application, factors like variation of co-efficient of friction (due to composition of brake blocks and disc) and adhesion between rail and wheels may cause difference in rotation of axles on the same coach. This may lead to wheel skidding/ flat tyres. To prevent this, a Wheel Slide Protection (WSP) device is provided in these coaches.



3.8.3 Main Components and their functions:

PART No	NAME	QTY	FUNCTIONS
1.	Micro Computer	1Per Coach	Gets input from speed sensors, compares with reference speed and gives output signal to Rapid Discharge Valve to open or close in case of variations.
G-I & G-2	Speed Sensor	1Per Axle	It consists of a fixed Magnetic Resistor (MR) and a Phonic Wheel (P) having 80 teeth, fitted on the axle. It gives tachometric pulse signal to Micro Computer due to variation in air gap (A and A $+X$) between the phonic wheel and the magnetic resistor.
3.	Rapid discharge valve (dump valve)	1Per Axle	It is an Electro-Pneumatic Valve which is connected in series with the Brake Cylinder (BC). It regulates the BC (Part No-4) Pressure by disconnecting the DV from BC and also by connecting the BC with atmosphere when the output signal is received from Micro Computer.

3.8.4 **Principle:**

The rotation of each axle is constantly measured and compared with a reference speed for that coach. (The rotation of the fastest axle of the coach). In case there is a variation in rotation among the axles, WSP automatically releases or applies the brakes accordingly, so that the speeds of all the axles become uniform.

3.8.5 Working:

The limit of variation of speed and acceleration are defined as threshold values. The Micro Computer constantly compares the signals from the speed sensor mounted on each axle with the reference speed. If the speed/ acceleration of any axle is crossing the present threshold values, it gives signal to the respective Rapid Discharge Valve to vary the BC pressure accordingly, thus maintaining the speed/acceleration within the threshold level

Schedule D1, D2, D3 should be carried out in depots as per following periodicity

Trip Schedule D1,Every Trip/ WeeklyMonthly Schedule D2,30 Days ± 3 daysSix Monthly Schedule/ D3180 Days ±15 days

Check visually the following for any damages/defects/deficiencies, it is to be done in D1 and D2 both:

- 1. Destination board brackets.
- 2. Body panels.
- 3. End walls
- 4. Windows walls
- 5. Body side doors
- 6. Condition of head stock, sole bar and other under frame members.

D-3 (Periodicity D3 Schedule 180 days± 15 days)

- In addition to Schedule D1 & D2 do the following.
- Examine trough floor and other under frames from underneath for corrosion.

The detailed items to be carried out have been covered in chapter 12 of this manual.

Examination of Trains

The examination is to be carried out as per RPC IV as amended from time to time. Examination of Originating Trains

- i) All trains must be examined by the mechanical train examining staff before dispatch to ensure that all coaches on the train are in fit condition and without reject able defects. On formation of a rake and after its placement for examination, washing, cleaning and watering, the Station Master (SM) shall pass necessary memo to the Engineer (C&W). After carrying out all necessary work, the Engineer (C&W) shall communicate fitness of the train to Station Master. Normally, Railways have standard forms for the use of Station Masters and Engineers for this purpose. Railways, where such forms are not used, should also start using these forms as uniform practice for the guidance of both Engineer (C&W) and Station Master. The Station Master shall not dispatch the train unless the fitness certificate, in the prescribed form, is received from the Engineer (C&W).
- ii) The level of the air pressure on the train engine and the brake van gauges and the percentage of operative cylinders should be recorded on a prescribed 'Brake Power Certificate' and signatures of the driver and the guard of the train should be obtained by the Engineer (C&W) as per the procedure laid down by each Railway. A suggested standard format for the certificate is placed at Annexure 'C'. No train should be allowed to leave with an inoperative/defective brake cylinder on any coach after pit attention. Trains which have been attended on pit line should have 100% brake power.

Enroute/Terminating Examination of Passenger Trains

- i) Sr.DME/DME in charge shall nominate the site for carrying out rolling in/rolling out examination after personal inspection of site. While nominating the site following should be kept in view:
 - a) Site shall provide unobstructed view of under gear from both sides
 - b) Speed of the train shall not be more than 30 KMPH.
 - c) It should cover the entire length of train.
 - d) Should have adequate space for fixing the lighting arrangement and for staff.

- ii) For rolling in examination of train it has to be ensured that proper lighting arrangement is provided on both the sides of the track at nominated spots for examination of under gear parts during night. Focusing of lights shall be done by keeping a coach on the line and adjusting the angle of light to illuminate under gear and bogie. Use of fixed lights as indicated in figure 1.4 is preferable.
- iii) C&W staff should take position at nominated rolling in place on both the sides of the track before the arrival of train.
- iv) As the train passes the nominated point, C&W staff should watch out vigilantly for loose/hanging/broken under gear parts of the coaches, any unusual sound coming from the coaches or any other abnormality in the coaches.
- v) After train comes to halt, it should be ensured that the train is protected from both the sides (with the stop board/red flag during day time and red lamp during night time) before commencing the examination of the train. It should be ensured that a suitable indication board is placed at conspicuous location visible to the driver indicating that C&W staff is at work.
- vi) Temperature of the axle boxes should be measured preferably with the help of the electronic temperature measuring device.
- Brake release shall be checked physically. However, in case where train locomotive has to be changed, brakes of all coaches shall be manually released after attachment of loco.
- Other under gear parts should be examined visually to ensure that the train is safe to run further. During night the lamps/search light shall be used for illumination.
- vii) Repairs if required should be carried out promptly to avoid detention to train to the extent possible.
- viii) Lavatories of the coaches should be properly cleaned using High pressure water jet machine provided at nominated stations during halt of the train. Any complaint from passengers should be attended promptly to the satisfaction of the passenger.
- ix) After attending to any required repairs stop board/red flag should be removed.
- x) Carriage controller (CCR) should be informed about any out of course work done.
- xi) CCR shall repeat the out of course work done to the Primary Maintenance (PM) depot after corrective action.
- xi) At the train examination stations where locomotives are changed on through trains, the level of air pressure created on the locomotive and brake van gauges should be recorded on the certificate to be issued to the guard and driver on prescribed form. The inoperative/blanked cylinders, if any, should also be written in the certificate for their information. This certification should be an endorsement on the original brake power certificate; no fresh brake power certificate needs to be issued.

3.9 AIR BRAKE RAKE TESTING PROCEDURE (LHB COACHES)

- 1. On arrival of the rake on pit line, completely drain the AR tank (125 litres & 75 litres) of all the coaches by opening the drain cock, to remove the water in air.
- 2. Initially, couple the BP hose of the test rig with the BP hose of the rake & then charge the BP pressure to 5.0 kg/cm². Keep the FP angle cock of both end power cars in close position. Check the FP gauge fitted in the power car, if the gauge does not show any pressure, the NRV of all the coaches are ok. If, FP gauge shows any pressure, the NRV of any coach in the rake is defective. In this condition, check the rake for NRV defective by taking the coaches in parts. NRV found defective in particular coach should be replaced.

- 3. Open all the four cocks of rake, couple BP & FP hose pipe of test rig with the BP & FP hose pipe of the rake. Charge the BP & FP to 5.0 kg/cm² & 6.0 kg/cm² respectively. After building of pressure in BP & FP, disconnect the test rig BP & FP hose pipe from the rake Hose pipes & open both the angle cocks, due to which air pressure will be exhausted in atmosphere & brake will be applied. Wait for 20 to 25 minutes.
- 4. After 20 to 25 minutes, check the complete rake from one end. Note down the coach nos. found with release brake cylinder. Check whether, AR tank of the coach is charged or empty. If AR tanks found empty, write down Empty AR on the respective coach. If found charge, pull manual release of DV to check whether CR tank is charged / empty. If CR found empty, write down Empty CR on respective coach. With this, all the defects in the rake can be checked.
- 5. Again, connect BP & FP hose pipe of the rake & test rig & then charge BP to 5.0 kg/cm² & FP to 6.0 kg/cm². Connect BP & FP gauges with dummy on free end of other power car.
- 6. Check the BP & FP pressure gauges in front power car, BP pressure should show 5.0 kg/cm² & FP pressure should show 6.0 kg/cm². If there is any difference in any pressure, check by fitting master gauge if still the pressure is not showing 5.0 kg/cm² in BP & 6.0 kg/cm² in FP, check for leakage & attend.
- 7. Close the BP & FP angle cock of test rig for 03 minutes. Monitor the leakage in both BP & FP. The leakage should not be more than 0.6 kg/cm² in 03 minutes.
- 8. Attend the coaches in which AR empty & CR empty are found. Check the AR tank & pipe line from the back of the brake panel for leakage. Similarly, check CR tank & pipe line & dummy plug on the brake panel. If defect is still noticed after attending the leakage, than mark the coach sick for detailed investigation & single car testing in sick line.
- 9. Start the pressure & charge the BP to 5.0 kg/cm² & FP to 6.0 kg/cm². Drop the BP pressure by 1.6 kg/cm², brake should apply in all coaches. Start the leakage checking with the help of soap solution from one end. During soap solution testing, check all the BP & FP hose pipe, all hose pipe connectors, Main pressure pipe line, Angle cocks, Brake cylinder pipe line, CDTS pipe line. Similarly, check & attend leakage in components on Brake panel like DV, FP & BP filter, NRV, all isolating cock, brake indicator, brake accelerator & brake cylinder with soap solution.
- 10. Isolate the isolating cock on Brake panel & check all brake callipers& brake pad of all cylinders. In isolated condition, all brake pads should be released simultaneously. Similarly, on opening of isolating cock all Brake cylinder should operate & brakes should apply.
- 11. Check the brake indicator when brakes are applied, indicator should display red colour. However, when the brakes are released from isolating cock the brake indicator should display green colour. If on brake release condition, brake indicator is not showing green or on brake applied condition brake indicator is not showing red, then the brake indicator is defective. Repair / replace the brake indicator.
- 12. The BP & FP pressure gauges in the others end power car should show pressure 3.4 kg/cm² & 5.8 6.0 kg/cm² respectively. If any difference in above pressure is noticed that means there is any cross connection in BP & FP connection. Attend the same & ensure BP pressure 3.4 kg/cm² & FP pressure 5.8 6.0 kg/cm².
- 13. Charge the BP & FP pressure to 5.0 kg/cm² & 6.0 kg/cm² respectively. Check the brake indicator of complete rake, all coaches should be in released condition. If any coach is not released, it means that the CR of that particular coach may be overcharged & there is an internal defect in DV. Mark the coach sick for detailed investigation.

- 14. Check PEASD of at least 03 coaches. During PEASD checking, brakes should apply in all coaches & the brake accelerator should operate. Coach numbers should be noted in maintenance dairy.
- 15. Now closed the pressure supply from the test rig. Operate the emergency guard van valve of front power car guard van. BP pressure should become 0.0 kg/cm² in approx. 25 to 30 sec in front power car & approx. 40 to 50 sec in rear power car. Open the pressure supply & charge BP & FP to 5.0 kg/cm² & 6.0 kg/cm² respectively. Now again closed the pressure supply from the test rig. Operate the emergency guard van valve of rear power car guard van. BP pressure should become 0.0 kg/cm² in approx. 25 to 30 sec in rear power car guard van. BP pressure should become 0.0 kg/cm² in approx. 25 to 30 sec in rear power car & approx. 40 to 50 sec in front power car.

Check for any significant difference in time for droppage of BP pressure to 0.0 kg/cm^2 between front & rear power cars. If any, there may be blockage in BP line of any coach. If found, attend the same. Continuity test of the rake is now completed.

- 16. In both the power cars, check the condition & mounting of hand brake cables fitted on both the brake cylinders. Rotate the hand wheel fitted in guard van clockwise to apply the brakes, after full rotation brake should apply in both the brake cylinders & hand brake indicator should show red. Rotate the hand wheel anti clockwise, now brakes of both the cylinders should get release & hand brake indicator should show green.
- 17. Charge the BP & FP to 5.0 kg/cm² & 6.0 kg/cm² respectively. Close the BP & FP angle cock of test rig for 03 minute. Monitor the leakage in both BP & FP. The leakage should not be more than 0.6 kg/cm² in 03 minutes.
- 18. Isolate the isolating cock of BP & FP of the test rig & angle cock of BP & FP of the cock. Uncouple both hose pipes & open both the angle cocks of coach. After draining of pressure from both the BP & FP hose, release the complete rake by pulling the manual release handle of the DV of each coach & ensure the brake indicator of all coaches should display green color. Ensure that all BP, FP & BC gauges fitted in power car are calibrated & showing correct reading.

3.10 WSP Testing

- 1. Initially with no pressure, the WSP processor in all the coaches should be OFF. If any processor is in ON condition, there is problem in any of pressure switch, wiring or K-05 relay. Attend the same.
- 2. Start the BP & FP pressure. The processor should automatically ON when BP pressure reaches 1.6 to 2.0 kg/cm² in M/s KNORR WSP system & when FP pressure reaches in M/s FTIL WSP system.
- 3. Check & attend for loose/proper fitment of WSP components like speed sensor, junction box, dump valve, dump valve connector & pressure switch.
- 4. Drop the BP pressure by 1.6 kg/cm², brake should apply in all the coaches. Now check the WSP processor for correct reading '99' on the electrical panel inside the coach. If the reading shows '99', it means that the WSP system is OK. Operate the test button on the processor to check the proper working of dump valves. The dump valve should operate in a sequence & pressure should be exhausted from brake cylinder. If the dump valve is not operated in proper sequence attend the same. Similarly, check & attend the WSP system of all the coach. All the WSP system should be in operating condition in the rake.

3.11 PERT CHART: FOR POH OF LHB COACHES



PERT (Program evaluation and review technique) for POH of LHB coaches.

Details of activities:

 $A \rightarrow$ Stripping of partition and ceiling of pantry, pantry door etc. - (01 day).

 $B \rightarrow pre-inspection of deficiency (electrical) - (01day)$

C₁→testing and analysing of coach defects, panel equipment, AC plant, water pump, transformers

- etc. (01day) $C_2 \rightarrow$ Stripping of equipment. (01day)
- $D_1 \rightarrow$ Before lifting of the coach dismantling of bogie components under pit such as traction lever, anti-roll bar, control arm etc. (01day)
- $D_2 \rightarrow$ Lifting of coach and washing of bogie. (01day)
- $D_3 \rightarrow Repairing of bogie control arm fitting on wheel and lowering of coach. (01day)$
- D₄→reparing of air brake components on panel, fitting of silent blocks, fitting of bogie components, under pit and air brake testing. (01day)
- $D_5 \rightarrow CBC$ and WSP system repair. (01 day)
- $E_1 \rightarrow Cleaning$ of the CDTS intermediate water tank before lifting coach on stripping line. (01day)
- $E_2 \rightarrow$ Washing of intermediate water tank, branch testing of CDTS panels, valves etc. in CR/L

Shop. $-(01 \text{day}) \to Fitting of intermediate water tank in the coach in lifting shop. <math>-(01 \text{day})$

- F→ Stripping of lavatory ceiling, repair of lavatory door, repairing vestibule door, cushion stripping, repair of recycling gear, foot rest, snack table, stripping of the fittings viz. bottle holder, mirrors etc. –(4days)
- $G_1 \rightarrow$ Loading of all equipment except RMPU. (02days)
- $G_2 \rightarrow RMPU$ loading, loading of pantry equipment etc. –(02days)
- $G_3 \rightarrow$ Complete testing, fault diagnosis and their remedy. –(2days)
- $H_1 \rightarrow$ Stripping and fitting of window glasses, flooring work etc. –(01day)
- $H_2 \rightarrow$ Repair and fitment of salon sliding door, roller blinds etc. –(01day)
- $H_3 \rightarrow Repair and fitment of entrance door, electrical panel door etc. -(01day)$
- H₄→Fitting of pantry partition, ceiling, pantry doors, lavatory ceiling, other fittings etc.–(01day)
- $I_1 \rightarrow Washing with suitable detergent -(01day)$
- I₂ \rightarrow Application of putty –(01day)
- I₃ \rightarrow Rubbing down putty and application of surface. –(01day)
- I₄→Window masking, roof painting, end painting and painting of side panels leaving down side area. –(01day)
- I₅ \rightarrow Masking of upper area and down side painting.–(01day)
- $I_6 \rightarrow$ Removal of masks, touch tip, lettering, cleaning and other works.-(01day)

- $J \rightarrow$ Internal painting
- $K \rightarrow$ Body panel repair, stripped body repair, repair of inner members like partition frames, chair angles and seat supports etc. –(02days)
- $L_1 \rightarrow$ Stripping of curtains in stripping line. –(01day)
- $L_2 \rightarrow$ Stripping of seats in carriage AC shop.-(01day)
- $L_3 \rightarrow$ Fitting of seats and curtains in coach.-(01day)
- $L_4 \rightarrow$ Cleaning of seats and other activity.-(01day)
- $M_1 \rightarrow$ Testing of under slung/Overhead water tank in CR body/CR AC section.-(01day)
- $M_2 \rightarrow$ Repair and testing of water tank in plumbing shop.-(01day)
- $M_3 \rightarrow$ Fitting of water tank in coach.–(01day)
- M₄→Fitting of CDTS panel in coach in CR body/CR AC shop.-(01day)
- $N \rightarrow$ Final Inspection and Despatch.–(01day)
- $O \rightarrow$ Final Air Brake testing.-(01day)

3.12 POH Chart for ICF Coaches:-



Activity Description:

- A. Verification of deficiencies.–(01day)
- B. Pre-Inspection and lifting.–(01day)
- C. Stripping.–(02days)
- D. Body repair, modification and alteration.–(03days)
- E. Painting.–(09days)
- F. Fitting of water tank, plumbing and leakage testing.–(03days)
- G. Repair of interior panels.–(03days)
- H. Fitment of shutters.–(02days)
- I. Fitment of doors.–(01day)
- J. Fitment of berths and seats. –(03days)
- K. Vacuum/Air Brake testing and final works.-(01day)
- L. Final Inspection and Dispatch.–(01day)
- M. Fitment of axel pulley, tension rod and testing of coach wiring. –(01day) N. Testing of branch wiring and fitment of electrical equipment.–(09days)

UNIT-4: PNEUMATIC SUSPENSION

Why needed---in sub urban trains the number of passenger entering into the coach cannot be controlled and due to this the payload of the coach increased from 18 tonnes to 34 tonnes, this abnormal increased in pay load creates following problems for safe running of trains-

Riding clearance between coach body and wayside platforms reduces and this may cause grazing of coach body, or wheel flange touching coach under frame.

Buffer height and buffer height of the coach also reduces considerably. These defects may cause derailment or serious accident

These trains runs with huge nos. of passengers during morning & evening whereas in daytime they runs with minimum nos. of passengers. If we provide spring suspension according to morning load the passengers feel discomfort during daytime whereas if we provide spring suspension according to daytime load the cases of breakage of spring will be more during morning run.so we need an effective suspension system for varying conditions of loads.

In coaching stock coaches load is classified as under –

Dense crush load (DCL)= seated capacity+200% of sitting as standing

Practical dense crush load (PDCL) ------ seated capacity + standing load@ 12 person per sqmtr.

Super dense crush load (SDCL)------ seated capacity + standing load@ 16 person per sqmtr.

Due to SDCL the bolster spring becomes solid, which inturn damages, breaks the coil spgs. resulting in discomfort to passengers.

Pneumatic suspension or air spring has been invented to resolve this problem.

Air spring- Air spring is a rubber bellow containing pressurised compressed air with an emergency rubber spring providing various suspension characteristics to maintain a constant buffer height and floor height irrespective of loading conditions.

Pneumatic suspension has been provided in secondary suspension in coaching stock. Presently

Indian Railway is using four types of air springs namely

- 180 k N for EMU/DMU/MEMU Motor coach
- 150 k N for EMU/DMU/MEMU Trailer Coach
- 140 k N for Main Line, Rajdhani, and Double Decker Coaches 130 k N for hybrid coaches 120 k N – for LHB fiat bogies.

4.1Main parts of pneumatic suspensions

- Air spring with emergency rubber spring 04 nos
- \blacktriangleright Levelling value 04 nos:- with ±2.5 degree dead band region
- ➢ Installation levers 04 nos
- Duplex valve 02 nos
- Main reservoir 150 ltrs capacity
- Additional reservoirs 04 nos
- Isolating cocks
- ➢ Air filters
- ➢ Non return valve
- Wireless failure indication cum brake application (WFIBA) valve





SCHEMATIC DIAGRAM OF AIR SUSPENSION EQUIPMENTS



4.2Advantages of pneumatic suspension

- Capable to sustain SDCL in suburban traffic at high speed.
- Maintains constant buffer height and floor height.
- Safe running due to excellent air damping.
- > Double decker coaches with RMACPU could be possible due to low design height

Working of Pneumatic Suspension: Equalization in sick line we maintain buffer height, floor height and air spring inflating height and according to it the position of installation lever has been set in this condition of the rotation arm of levelling valve remain in horizontal position and the pressure in air bellow should be minimum 5kg/cm²



Loading during run when the coach is super dense crush loaded the position of installation lever remains same, the floating bolster comes down so the rotation arm of levelling valve rotates and open the way to entre pressure from MR to Air Spring through levelling valve up to 5.8kg/cm². Due to this the floating bolster is lifted and the rotation arm of the levelling valve will come in horizontal position and buffer height and floor height of the coach will be maintained.



Again during run when the passengers will alight the floating bolster will lift due to pressure the rotation arm of levelling valve will again rotate in opposite direction and open the way to exhaust the pressure of air spring and till the rotation arm come in the horizontal position.



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UNIT-5: INJURY FREE FEATURE

5.1 INTRODUCTION

"CRASH-WORTHINESS" is achieved by making the interior parts of the coach in such a way that injury to passengers is minimized in the event of a minor collision or derailment or any other type of accident. When the passengers are thrown about, they hit the interior parts of the coach. At that point of time, the sharp corners and edges of the fittings and upholstery of the coach cause grievous injury to th4e passengers. They are also injured by falling luggage. In an effort to minimize the risk of such injuries many features are provided in the interior fittings of coaches.

Following injury -free features will be adopted in coaches:-

5.2 ACCOACHES

5.2.1 Lavatory Area:

- Tray below mi9rror in lavatory to be eliminated and soap tray above wash basin relocated to partition side above the wash basin.
- Shelf at the side wall side in lavatory –To be sunk inside the side wall.
- ➢ Flushing valve to be re-oriented by turning 90 degrees. Press type flush valve to be standardized.
- Flushing Valve in Western Type Toilet –Plumbing arrangement shifted from side wall to corner.
- > Toilet paper Holder to be sunk inside the end wall with flap cover.
- Coat hook on the lavatory door-design modified to swivelling type and re-locate on the door above louver.
- Coat hook above the outside wash basin to be replaced by ring type towel holder. Mouldings in the toilet entrance bay-rounded aluminium mouldings to be provided.

5.3 Passenger compartments

- Berth reading lights existing box type berth reading light to be replaced by focusing type and re-located and sunk inside the side wall
- coat hook at longitudinal upper berth-swivelling type coat hook to be provided and located at a higher level.
- > Diffuser- modified design of diffuser duly with sunk in arrangement to be used.
- ➢ Foldable table −To be sunk inside the side wall so that the table will flush with the side wall in the folded condition.
- Fluorescent light fittings the existing protruding type fitting to be replaced by sunk in type arrangement.
- Mirror –The existing rectangular mirror to be replaced by mirror with round corner with SS frame.
- Seats & Berths The sharp corners to be rounded off with adequate padding.
- Side Berths locking latch The projecting knob in the existing side Berth latch to be eliminated by using T-type latch arrangement.
- Side lower berth holding arrangement to be shifted from centre to sidewall corner.
- Bracket for holding side upper berth –Transverse and side upper berths shall be of fixed type as these are seldom folded by passengers. This will also eliminate the necessity for providing a Bracket for holding the berth in the folded condition. Provide reading light for lower berth.

- Ladder for upper berth –Moulded PU foam type ladder to be used.
- Berth holding bracket to be replaced by Tower Bolt with minimum projection.
- Upper berth holding Bracket –the protruding bolt heads to be replaced with counter sunk studs.
- Headrest for upper berth provision of cushion pad on sidewall at upper berth locations to avoid head injuries.

5.4 NON AC COACHES

5.4.1 Lavatory Area

- Coat hook on lavatory door and partition swivelling type coat hooks to be provided and relocated on the door above the louver.
- Flushing Valve To be re-oriented by turning by 90 degree press type flush valve to be standardized.
- Soap Tray below the mirror in toilets to be eliminated and a small sunk in type shelf to be provided in the sidewall above the Wash Basin.
- Banjo Shutter arrangement –This arrangement to be replaced by sealed window arrangement with powder coated venture type exhaust arrangement as provided by ICF IN ac coaches.
- ➤ Handles for water tank cover panel –The existing protruding handles to be replaced by swivelling and press in type handles.

5.4.2 Passenger Compartment

- Coat Hook on the compartment partition Swivelling type coat hooks to be provided and relocated towards sidewall.
- Bracket for middle berth suspension –Bracket to re-located from the bottom of upper berth to upper berth strap.
- Headrest for upper berth –Provision of cushion pad on side wall at upper berth location to avoid head injuries.
- Upper Berth –Provision of PU foam moulded safety railing similar to the one provided in I AC coaches to prevent accidental falling of passenger or luggage.
- Footstep for climbing upper berth PU foam moulded type ladder to provided.
- Middle berth suspension Middle berth suspension re-designed eliminating the eye.
- Side upper berth suspension arrangement –Suspension chain eye to be flushed with berth to avoid lifting in case of derailment. As an alternative, the side upper berth can be fixed type with strap suspension.
- Side berth locking latch –Latch to be re-designed elimination the projection knob by providing T-type latch.
- ➢ Side berth seat retaining bracken −To be replaced by tower bolt at side wall corner with minimum projection.
- Suspension strap for berths –The sharp edges to be removed by rounding off.
- Snack table To be flushed with side wall.
- Wire rope for luggage locking –To be replaced by foldable pull-up handles below the seat.
- All mouldings-Steel mouldings to be replaced by FRP protruded mouldings with rounded corners.
- Luggage Rack of GS coaches –Modified Luggage rack with increased slope and depth by providing adequate projection all around the luggage rack.

UNIT-6: DRDO-BIO-TOILET SYSTEM

6.1 **INTRODUCTION**

During kargil war there was a extreme difficulty to bio-degrade due to human waste at a temperature below 0^{0} C, for it DRDO has developed an anaerobic bacteria to bi-degrade due human excreta. As for as in due trains of Indian Railways the discharge on trade creates environmental problems as well as problems in working to railway workmen. So there is a urgent requirement of an effective bio-toilet system.

Rivanchal Express which runs between NDLS & Reevan jn. has been provided with bio toilets having aerobic bacteria. The aerobic bacteria digest the human excreta in the presence of sunlight and oxygen and the converts the fecal matter into bio-mass. The disposal of bio-mass is then an environmental problems.

AFTER kargil war IR has signed MOU with DRDO for joint technology development for the bio-toilet. DRDO gas used anaerobic bacteria which bio-degrade the human excreta even in absence of sunlight and oxygen.

It bio-degrade and converts its into gases and Odorless effluent.

The first rake with bio-toilet having anaerobic bacteria developed by DRDO was introduced in Bundelkhand Express since 18th January 2011. During year 2011-2012, 5 max rakes has been provided with DRDO technology toilets having anaerobic bacteria 2500 more coaches are fitted with DRDO bio-toilet during the year 2012-2013, Now the supreme court of India has ordered to provide bio-toilet having anaerobic bacteria in all the coaches of IR.

In the system a retention tank has been mounted below the squatting pan of coach toilet with the help of mounting brackets, safety ropes, U brackets hexagonal bolts and spring washers. A D type commode chutes with a ball value with operating handle has been provided in between the squatting pan and retention tank which was a failsafe mode.

This bio-digester tank is made off stain less steel and having size 1150x 720x 540mm. its volumetric capacity 400 liters, effective volume capacity is 300 liters. The weight of this tank in empty condition is 110kg and full tank weight is 410kg.

The tank has seven chambers having wall which are made off poly grass matfor formation of bacteria in due side walls. The strong bonding of colonized rubber mats has been provided in vertical walls of this tank. In the side of this tank the outlet part for effluent and sample port has been provided through a container having chlorine tablets.

The whole retention tank has been charged with 120 ltrs of anaerobic bacteria and rest of water .the bacteria flows from chamber 1 to chamber 2 and then to chamber 3 through the openings and pipes with the help of water. The human excreta which comes from D type commode chutes by flushing, the bacteria converts the whole matter in to $CO_2 + CH_4$ and odourless effluents flows to chamber 4, 5, 6 and 7. The polygrass mat of partition walls does not permit the bacteria to flow with effluent. The effluent flows through chlorine container in which chlorine tablets are provided so the effluent is chlorinated in chlorine chamber outside due retain tank and drain out through outlet ports. The sample has been collected through a sample port provided in chlorine container. A gas CH_4+CO_2 exhaust through a blow pipe provided in chamber 1,2 and3.

6.2 Working of anaerobic system

Human waste

↓

Anaerobic bacteria- CO2+CH4 Release to atoms

(Liquid bacteria)

↓

Liquid waste (effluent)

↓Chlorination

Disinfected odour lessliquid discharge on track

N.B:- System doesn't require oxygen and also doesn't require regular cleanings

- 6.3 Advantages of IR DRDO-Bio-Toilets
 - No bad smell in the toilets from the tank
 - No infestation of cockroaches and flies
 - ➢ Focal matter in the tank is not visible
 - > No clogging of digester
 - Effluent is free from odour and solid waste
 - ➢ No maintenance required
 - Reduction in organic matter by 90%
 - No requirement of adding bacteria/enzyme
 - No need of removal of solid waste
 - Simple design and easier retro fitment
 - Can process doubling its population within 6 to 8 hrs

6.4 Anaerobic bacteria

- Dominates and decompose matter in to liquid and gases
- Can be kept for 2-3 months at ambient temperature
- Can withstand sub zero temperature as well as upto 60 degree centigrade >Cold temperature would not affect the inside processing because:
- ➤ Anaerobic process is exothermic in nature thus, in cold regions heat will be available inside the chamber because of chemical process.

Per performance Parameters of Effluent

S. No	Parameter (as per APHA Test	Recommended Values	Targeted value(Max.)
	Method).	for next six months	
1	рН	6 to 9	6 to 9
2	Total Solids	Max 750mg/100 ml	750mg/100ml
3	Total Volatile solids	Max 500 mg/100 ml	500 mg/100 ml
4	Total Dissolved solids	Max 350mg/100ml	350mg/100ml
5	COD levels	Max 2000	Max 2000 MgO2/Lts
	Fecal Coli	MgO2/Lts99%	

Information about IR-DRDO Bio-digester Tank

- 1. Length 1150 mm
- 2. Width 720 mm
- 3. Height 540 mm
- 4. Total Volume of Tank 400 lt.
- 5. Effective Volume of Tank 300 it.
- 6. Empty Tank weight 110 Kg.
- 7. Full Tank Weight 410 Kg.





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UNIT-7: CENTER BUFFER COUPLER ("AAR", Type 'H' Tight lock Coupler)



- The coupler provides a means of mechanically connecting individual adjacent vehicles to make a train. The coupler is located at both ends of each vehicle. When connected to a coupler of an adjacent vehicle, it allows the vehicles to move independently to accommodate track curvature and elevation change while remaining connected together.
- > Couplers are AAR-H type and have anti-climbing features because of vertical interlocking.
- Couplers have adequate strength for:
- Satisfactory hauling of a train of 26 coaches at 110 kmph.
- Satisfactory hauling of a train of 18 coaches at 160 kmph

- The coupler is opened manually using the coupler operating rod and is closed automatically when the couplers on adjacent vehicles are mated. The coupler automatically locks when fully mated.
- LHB coaches have been provided with tight lock centre buffer couplers instead of screw coupling.
- Coupling is possible under angular misalignment both horizontally and vertically. The coupler permits coupled trains to negotiate vertical and horizontal curves and allows rotational movements. The draw gear ensures cushioning effective in both buff and draft.

7.1 COUPLER BODY PARTS



7.2 TIGHT LOCK COUPLER HEAD TYPE "H"

Coupler head is a standard AAR "H" type tight lock coupler, made of alloy steel & heat treated with a manual un-coupling device that can be easily operated from outside the coach end. Parts

like knuckle, knuckle thrower, lock, rotary lock lifting assembly, cotter pin , support pin , pivot pin etc. which enable coupling & uncoupling of the CBC assembly.

- The coupler head tail end is provided with a UIC *stabilizing link* and is connected to the draft gear through central pin.
- ▶ Height between center of shank and bottom of CBC pocket in head stock 260 mm

7.3 DRAFT GEAR

- ➤ The draft gear is a double acting device. This device absorbs energy during coupling & during service. This device is fitted in to the pocket of the coach where it absorbs the dynamic energy in both draw & buff modes.
- The stroke in tensile (draw) direction is limited to 58⁻⁵ mm while that in the compressive (buff) direction is 80 mm (max).



7.4 SUPPORTING DEVICE

- The supporting device comprises of four preloaded compression springs. This device is fitted below the draw bar in the coach pocket & is bolted on to the body of the coach. The coupler head rests on the top wear plate of the supporting device. The complete weight of the coupler is taken by this supporting device.
- \blacktriangleright Height of supporting device including wear plate = 187.5 mm




7.5 MANUAL UNCOUPLING DEVICE

The manual uncoupling device is mounted on one side near end wall of coach. This device is connecting the uncoupling mechanism on coupler head through the sliding rod.

For un-coupling the coupler, the handle of the coupler is unlocked, lifted and then rotated in clockwise direction. Ensure proper locking of handle for preventing unauthorized /accidental uncoupling



7.6 COUPLING & UNCOUPLING PROCEDURE

1. COUPLING:

- ➤ Keep the knuckle of coupler of coach to be attached in closed position.
- > Bring the vehicle at a distance of one meter approximately.
- > The position of coupler centers of both the coaches to be coupled should be aligned.
- ➢ If required pull the couplers manually towards each other & make sure that they are in the gathering range of the coupler geometry.
- Now push vehicle together slowly (approx. 3 kmph) for coupling two coaches.
- > Ensure the position of tell-tale device for proper coupling.
- > Also make sure that the manual uncoupling device is locked properly.
- > Reverse the engine to pull the vehicles apart. This pull test is to ensure positive coupling.

2. UN- COUPLING:

- > For un-coupling of the coupler manual uncoupling device is provided.
- ➢ First unlock the lock of the handle.
- > Lift & turn the handle in clockwise direction (minimum 90°), if required.
- > Then pull the vehicles apart.

7.7 CBC & BUFFER PARAMETERS

Items		Parameter	
Gathering range of	Horizontal	<u>+</u> 110 mm	
Coupler	Vertical	<u>+</u> 90 mm	
CBC height under tare cond	1105 mm		
Permissible CBC height under tare condition		1090 mm	
Permissible CBC height un	1030 mm		
Permissible knuckle differe knuckle by measuring Tape	75 mm		
Maximum projection of sid	le buffers	650 mm	

7.8 SCHEDULE OF CBC

CBC	Interval	Attention
Calculate	inter var	Attention
Schedule		
I.	Every Trip	Visual examination of all components for proper working, loosening and damage. Greasing of sliding rod once in 3 months (in rake)
II.	18 Months	All items of Schedule- I Cleaning, gauging for wear and distortion. Anti -creep test. Height of CBC. (in workshop)
III.	72 Months	All items of Schedule - I & II. Dismantling, checking, gauging, reconditioning, reassembling of all components. Greasing of coupler head with Molycot /graphite grease. (in workshop)

7.9 CBC HEIGHT ADJUSTMENT

- > By adding or removing shims from body/bogie connections
- Max 35 mm shims can be provided (05 mm shim per 10 mm diameter reduction)
- > If still height is not adjusted Secondary Spring and miner pad to be checked and adjusted.

7.10 DIMENSION OF MINER PAD IS

- $\blacktriangleright \text{ Free height} = 90 \text{ to } 95 \text{ mm}$
- \blacktriangleright Inner Dia = 152 to 158 mm
- \blacktriangleright Outer Dia = 225 to 238 mm
- Manganese wear plate of CBC shank and supporting device is to be checked and maintained.
- Shims will not be added/removed in Primary and Secondary Suspension for wheel wear compensation or buffer height adjustment.

7.11 PROFILE GAUGE



7.12 JAW GAP GAUGE



7.13 ANTI-CREEP CHECK



7.14 MAINTENANCE OF COUPLER HEAD

Monthly	Check tell tale of couplers. Visual check for external damage, condition of wear plate on shank. Replace wear plate if necessary.
Quarterly	Repeat above checks. Coat bare steel areas of coupler head body and knuckle with Molycot D321R (or equivalent) dry spray. CAUTION: Do not spray on the knuckle locking surface and internal parts like lock etc.
Annually	Repeat above checks. Check gap between coupler head and knuckle with Jaw gap gauge (NO-GO). If wear out is not acceptable replace knuckle etc., as advised in the maintenance manual. Check by profile gauge (GO). Conduct anti-creep check.
6 – 8 years	Repeat above checks. Overhaul coupler head. Check parts for wear out. Replace if necessary.

MAINTENANCE OF SUPPORTING DEVICE

Monthly	Visual check for external damage. Check height 187.5 mm both sides near the bolts. Tighten the M16 nut to set specified height. Apply grease on wear plate. Check condition of wear plate. Replace wear plate if necessary.
Quarterly	Repeat above checks.
Annually	Repeat above checks.
6 – 8 years	Repeat above checks. Check compression spring for loss of pre-load. Replace if necessary.

7.15 MAINTENANCE OF MANUAL UNCOUPLING DEVICE

Monthly	Visual check for external damage, loose bolts etc. Apply grease on the slide and slide rods.
Quarterly	Repeat above checks.
Annually	Repeat above checks. Check wear on slide, slide rods and bearings. Replace if wear is excessive.
6 – 8 years	Repeat above checks.

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UNIT-8: REVISED MAINT. PATTERN OF COACHING TRAINS POLICY CIRCULAR NO-4

Rpc-4 it is maintenance pattern which is based on round trip kms. It has been introduced in Indian railway in October 2001 for 2500 round trip kms with some conditions, and amended in Jan 2007 for 3500 round trip kms with some more conditions. These conditions are related with maintenance, infrastructure, time, safety, manpower and of supervision, this pattern of examination is not applicable for meter gauge.

Following approved condition should be fulfilled prior to introduction of rpc-4 in a coaching depot,

8.1 **PRIMARY END**:-the attentions during primary maintenance should be made more intensive with special emphasis on the following aspects.

8.1.1The brake block should be changed in bogie sets

- ➤ The brake gearing should be properly adjusted including the slack adjuster A dimensions and e dimensions & the brake cylinder stroke to ensure 100% brake power
- > Dashpot oil level must be ckd and maintained
- All missing passenger amenity fittings must be replaced and rake must be turned out as Zero missing fittings rake.
- Intensive cleaning of coach toilets
- No coach should run overdue schedule
- 8.1.2Clear maintenance time of 6 hours on the pit as per train schedule. Any exception to be jointly decided by COM/CME of the railways.
- 8.1.3Provisions of proper washing cum maintenance pit line facility with adequate testing equipment and high pressure water cleaning arrangements
- 8.1.4Adequate gang strength with proper supervision.
- 8.1.5Whenever the lie over is more than two hrs at the platform or rake is stabled in yard the rake should be locked and +ve security should be provided.
- 8.1.6Amenity &cleaning attention is carried out at washing line as for as possible, if not feasible they can be returned from platform yards, the minimum infrastructure on that platform should be as under---
- > One storages room for essential safety and passenger amenity item.
- Road transportation facility for ferrying material from the main depot to platform.
- Adequate numbers of mobile high pressure water pipe line running around the platform/yard line
- Washable apron on the plate form lines with covered drains to facilitate movement of maintenance staff
- Walkie-talkie/ mobile telephones for quick and easy communications > Standard watering hydrants
- ➢ Flood light at the platform ends for rolling −in − examinations at night and 110 volt. Inspection lights along the side of the track for night examination of the under gear.
- the decision regarding whether such trains may be shunted for working on pit line or may be attended at platform has to be taken after weighing these factors by mechanical and traffic HODS
- RPC-4 status of implementation should be reviewed every year in the month of June by mechanical and operating branches at divisional level.
- 8.2 In January 2007 the round trip kilo meter of RPC4 have been enhanced with following more conditions:

- 1. CME of the railway on which base depot of the rake is located will personally satisfy that mandatory condition applicable to primary end is fully satisfied.
- 2. CME of the railway which the base depot of the rake is located shall not permit 3500km round trip operation without first obtaining a certificate from the CME of the railway where terminal attention is proposed in place of pit examination.

S. No.	Category of train	Preventive maintenan ce schedule	Under gear examination and brake system maintenance at pit line	Internal cleaning, passenger amenity and watering	External cleaning on nominated line with proper facilities	Enroute/ Terminating examination	Brake system check prior to start at platform at the other end
1	Mail/Exp one-way run> 3500kms	Primary end	Both End	Both end	Both end	At every 250 to 350km and	Fresh BPC issue
2	Mail/Exp one-way run< 3500kms but round trip					point	
3a	Mail/Exp round trip run upto 3500kms		Primary end	Both end	Primary end		Only continuity check if stable in
3b	Shuttles interconnected mail/express round trip run upto 3500kms		At primary end after 3500km or 96hrs. whichever is earlier	At primary end or as per CME instructions	At primary end once a day		yard otherwise brake power check with endorsement on original BPC
4	Passenger trains with toilet		At primary end after 3500km or 4 days whichever is earlier	As per CME instructions	Primary end		
5	Passenger trains without toilet		At primary end after 3500km or 7 days whichever is earlier	Once a day	Primary end	Once a day	

3. Functions assigned to CME's in 1 and 2 above shall not be dedicated

UNIT-:9 FREIGHT STOCK

The term freight stock means all rolling stock other than coaching stock and locomotives irrespective of contents and whether attached to a passenger or goods train. The term wagon is applicable only to freight stock. Indian railways have different types of wagons to transport different commodities like coal, cement, fertilizers, ores, food grains, petroleum products, iron and steel and other finished products. To cater for the transportation requirements various types of freight stocks having different features in use are classified as under.

- ✤ According to it's Under Gear
 - Four Wheeled wagon
 - Bogie stock wagon
- ✤ According to Its Utility
 - Open wagon
 - Covered Wagon
 - ➢ Flat Wagon
 - Hopper Wagon
 - ➢ Well Wagon
 - Container Wagon
 - Tank Wagon
 - Explosive Wagon
 - ➢ Brake Van

9.1 BOGIES:-

- 9.1.1 Diamond frame bogie Used in BOB wagons
- 9.1.2 Cast steel bogie Used in BWT wagons
- 9.1.3 UIC fabricated bogie Used in VAC. Brake Bogie Stock
- 9.1.4 CASNUB Bogie Used in Air Brake Bogie Stock
- 9.2 LCCF-20(C) Bogie for BLC stock
- 9.3 Swing Motion Bogie-used in air brake stock
- 9.4 CAST STEEL CASNUB BOGIES

9.4.1 INTRODUCTION :

The Cast Steel CASNUB Bogies comprise of two cast side frames and a floating bolster. The bolster is supported on the side-frames through two groups of spring, which also incorporate the load proportional friction damping. The side-frames are connected by a fabricated mild steel spring plank to maintain the bogie square. The various bogie versions developed are as under:-

- ➢ CASNUB-22W
- CASNUB-22W (Retrofitted)
- ≻ CASNUB-22W (M)
- ➢ CASNUB-22NL
- ➢ CASNUB-22NL M
- CASNUB-22NLB
- ➢ CASNUB-22HS
- ➢ CASNUB-22NLC

9.4.2 HISTORY : The CASNUB Bogie was first tested in 1972 under BOI Wagon and was found safe to run at test speeds up to 110 km/h. Test results have been published in RDSO's Mechanical Engineering Report No. M-265. In 1981, trials were again undertaken on this bogie under 'BOXN' Wagon on track maintained to mainline standards and its behaviour was well within safety limits up to 90 Km/h speed. This bogie was first fitted under open BOXN wagons and was designated as Casnub 22W. This was modified as Casnub 22 W(M). Mainly to take care of high wheel wear reported on earlier version. Subsequently Casnub 22 NL (Narrow jaw) and Casnub 22 NLB (Narrow jaw with fish belly bolster) versions were introduced. Casnub 22 HS bogies have been developed for high speed operation with maximum permitted speed upto 100Km/h.

Sl. No.	ITEMS	DESCRIPTION
1	Gauge	1676 mm
2	Axle load	22.9 T to all except, CASNUB –NLC up to 25 t axle load with K type CTRB
3	Wheel diameter	1000 mm new, 956 mm new for 22W (retrofitted) 906 mm condemnation
4	Wheel base	2000 mm
5	Type of roller bearing	Slandered AAR cartridge bearing
6	journal centers	2260 mm
7	Distance between side bearer	1474 mm
8	Type of side bearer	 *) Roller type clearance for CASNUB 22 W. a) Spring loaded constant contact for LCCF-20(c). b) Constant Contact type (metal bonded rubber pads for others. c) P U pad for CASNUB 22HS
9	Anti rotation feature	Anti rotation lugs have been provided between bogie bolster and side frame.
10	Type of brake beam	Unit type cast steel brake beam slide in pocket in all bogies except hanger type brake beam suspended from side frames bracket in CASNUB 22 W (M)
11	Center pivot	 IRS spherical type for 22W only. Spherical type for others. Flat type in BLC wagons
12	Suspension details	4) Long travel Helical Springs.
13	Elastomeric Pad	Elastomeric Pad has been provided between adopters and side frames pedestal roof to reduce wheel flange wear.

7.4.5 STILLINI I LITTORES. The sufferit reatures of the bogie are	9.4.3	SALIENT	FEATURES:	The	salient	features	of the	e bogie	are	:
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9.4.4 Nominal Clearance: The nominal clearance are as under:-

S.N.	Description				
		Type of Casnub	Bogies		
		22W,22W(R)	22W(M)	22NL,NLB	22HS
1.	Lateral clearance between side frame bolster	18mm	18mm	18mm	25mm
2.	Lateral clearance between side frame and axle box/adapter	25mm	25mm	16mm	16mm
3.	Longitudinal clearance between side freame & axle box/adapter	2mm	10mm	9mm	9mm
4.	Longitudinal clearance between side freame and bolster	6mm	6mm	6mm	6mm
5.	Clearance between anti-rotation lug & bolster.	4mm	4mm	4mm	4mm

9.4.5 BOGIE COMPONENTS: The Casnub bogie assembly consists of the following components:-

- ➢ Wheel set with CTRB bearing.
- Axle box/adapter, & side frame key assembly and retainer bolt in wide jaw adaptor.
- ➢ Side frame with friction wear plates.
- ➢ Bolster with wear liners.
- Spring plank, fit bolts & rivets.
- Load bearing springs and snubber springs.
- Friction shoe wedge.

Centre Pivot arrangement comprising of centre pivot top, centre pivot bottom, centre pivot pin, centre pivot retainer & locking arrangement in all bogie except 22WR.

- Side bearers/PU pad.
- ➢ Elastomeric pads.
- ➢ Bogie brake gear.
- ➢ Brake beam.

9.4.6 The springs are condemned on the basis of free height. Springs should replace if minimum spring height is at or less than shown below:

Bogie	Springs	Free height nominal (mm)	Recommended free condemning height (mm)
All versions	Outer	260	245
Except Casnub	Inner	262	247
22113	Snubber	294	279
Casnub 22HS	Outer	260	245
Bogies	Inner	243	228
	Snubber	293	278

- 9.4.7 Grouping: Matching of both, load and snubber springs, is important. It is recommended that springs having not more than 3 mm free height variation should be assembled in the same group. Mixing of new & old springs should be avoided. The 'Casnub' bogie springs are manufactured out of Silico Manganese Steel to IS:3195 Gr.60 Si 7, Gr. 60Cr4V2, IRS Specification R2 & RDSO Specification WD-01-HLS-94 (Rev.1).
- 9.4.8 ELASTOMERIC PADS: If the top or the bottom plates or intermediate plate in case of side bearer pads show any crack in service.
 - (a) If any crack of more than 50 mm is developed at any surface of rubber.

(b) If a bond failure giving way more than 40 mm in any direction is developed in service.

(c) When in free condition, the pad has taken a permanent set of the order given below: -

Type of Pad	Nominal Dimension	Dimensions after
		permanent set
Elastomeric pad	46 mm	42 mm
Side Bearer Rubber Pad	114 mm	109mm

9.4.9 ADJUSTMENT OF CBC/BUFFER HEIGHT: To maintain CBC/Buffer Height within

Permissible limits following packing's shall be provided as described below for different versions of Casnub Bogies:

Sr.	Type of Bogie	Wheel Dia	Type of Bogie	Wheel Dia
No.				
1.	12 mm thick packing Casnub 22W (R) Casnub-22W(M) Casnub-22NL Casnub-22NLB Casnub-22HS	910 954 954 954 954 954	37mm thick special packing Casnub-22W(M) Casnub-22NL Casnub-22NLB Casnub-22HS	930 930 930 930 930
1			1	

NOTE: 37 MM Thick special packing is not required for Casnub-22W Retrofitted) Bogie due to use of worn out wheel from initial stage.

9.5 NEW WAGON NUMBERING SYSTEM:

The new wagon numbering system is being done as per railway board's instruction issued vide letter vide letter Number. 2000/M (N)/60/2/wagon census dated 4th July 2003. The wagon number shall consist of 11 digits. First two digits will indicate types of wagon, next two digits will indicate owning railway, next two digits will indicate year of manufacture, and next four digits will indicate individual wagon number and the last digit will be a check digit. Brief is as under:

C1 C2C3 C4C5 C6C7 C8 C9 C10C11Type of stockOwning Rly Yr. of Mfg.Ind. Wagon no.Check digit

9.5.1 Procedure of Check digit is calculated as under:

- Step-1. Add all the character in the even number (S1)=C2+C4+C6+C8+C10
- Step-2. Multiply S1 by 3 = 3 S1

Step-3. Add all the character in the odd number (S2)=C1+C3+C5+C7+C9 (Except check digit)

- > Step-4. Add 3S1 + S2 = S4
- Step-5. Round this total up to next multiple of 10.

Now Check digit is the number required to be added to roundup to the next multiple of 10. If the total in S4 is already a multiple of 10, then the check digit will be Zero.

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UNIT-10: BOGIE MOUNTED BRAKE SYSTEM FOR FREIGHT STOCK

10.1 INTRODUCTION

In the air brake system, a lot of developments have taken place such as bogie mounted Air brake system, Twin pipe air brake system, Automatic load sensing device etc,.

Recently, Bogie mounted Brake System (BMBS) has been introduced for freight stock. The details and maintenance of BMBS are given in this handbook.

10.2 **DESCRIPTION OF BMBS**

The Bogie Mounted Brake system (BMBS) equipment consists of a transversely mounted pneumatic Brake Cylinder with a self-contained, double acting slack adjuster, two brake beams, and two bell crank levers and interconnecting push rods. The hand brake arrangement is available as a mechanical model with two flexible handbrake cables. The pneumatic Brake Cylinder is 10" in diameter for application with high friction brake shoe (K type) on casnub type bogies. The system consists of a unique design with two pneumatic Brake Cylinder (one per bogie) to deliver reliable braking performance and is light in weight. It fits into CASNUB bogie and uses 58 mm thick brake shoes.

Brake cylinder contains an integral double acting slack adjuster, which provides optimal braking force and minimizes shoe & wheel wear. The design is with high strength and minimal brake beam deflection.



FIGURE -1

10.3 WORKING DESCRIPTION OF BMBS

During application, the air is introduced into the brake cylinder, which forces out the piston along the ram assembly. The brake cylinder is floating in nature, as result the brake cylinder extends equally on both the sides. This extension of brake cylinder causes the rotation of the bell crank levers on their pivot (which is on primary brake beam) and forces the push rod to move towards the secondary beam. This movement causes the secondary brake beam to move towards the wheels and apply force on the wheels. Simultaneously a reaction force is developed which causes the primary brake beam (along with levers and brake cylinder) to move towards the wheels. The primary brake beam continues to move until it touches the wheels and apply force on the wheels.







When the brakes are released, the air from the brake cylinder is exhausted to the atmosphere through the Distributor valve. The return spring inside the brake cylinder pushes the piston along with the ram assembly back to its original position. The bell crank levers rotate back, causing the beams to move back to their earlier positions. The brake cylinder is equipped with a double acting slack adjuster. If there is any wear (Brake Shoe/Wheel) or any slackness in the structure, it will be automatically compensated by the built in slack adjuster which pays out to fill the gap.

10.4 SALIENT FEATURES

More Safety

Two nos. of 10" brake cylinders with inbuilt double acting slack adjuster have been used per wagon. Along with this an automatic load-sensing device has been used for two stage braking (empty / loaded). This delivers optimum braking performance and hence increases safety parameters.

Reliability

Instead of one 14" cylinder, two 10" cylinders have been provided per wagon (one per bogie)., This increases the system reliability as in case of failure of one cylinder the wagon can be moved on another cylinder with the isolation of failed cylinder.

10.5 Advantages of BMBS:-

1.1.1Low Maintenance cost

- **1.1.2 Low Fitment cost**
- 1.1.3 Low Pay load cost
- **1.1.4 Easy Retro fitment**
- **1.1.5 Simplified Hand Braking Installation**
- **1.1.6 Replaceable Brake Heads**
- 1.1.7 Integral Double Acting Slack Adjuster
- **1.1.8 Patented Beam Design**

1.1.9 Under Bolster Design

> BMBS is reduces bending loads in the beams, enabling the use of lighter structure with no sacrifice in the performance. The brake cylinder is mounted parallel to the brake beams and transfers forces through the bell cranks. This parallelogram design improves the efficiency and aligns the braking forces with the wheels, which reduces the shoe and wheel wear.

> The system delivers optimum braking performance while minimizing weight.

> The system can be easily fitted on any IR standard casnub bogie without making any modifications. This is a drop in fit system and does not require any special tools and training for installation/assembly.

> To achieve uniform wheel loading, the loads are applied to the ends of the brake beam instead of center.

The system uses IR standard 58 mm thick K type brake blocks.

A replaceable brake head design permits the reuse of the beam in the event that the brake heads gets damaged. Replacement of the brake head is quickly accomplished by removal of only one pin.

 \geq The push rods are positioned under the bolster. With this system the track clearance has been increased, as there is nothing under the spring plank of the bogie.

> Instead of one 14" cylinder, the system uses 2 nos. of 10" brake cylinders per wagon, one per bogie. This increases the system reliability as in case of failure of one brake cylinder, the wagon

> can be moved on with other brake cylinder with the isolation of failed brake cylinder.

> The integral double acting slack adjuster of the brake cylinder maintains a constant piston stroke resulting in uniform brake performance even as the brake shoes and wheels wear. The slack adjuster has a total make-up capacity of 500 mm, which will compensate for total combination of shoe wear, wheel wear and clearance.

➤ Re-screwing of slack adjuster is automatic and can be done from the side of the wagon by a pry bar.

> All cylinders are equipped with an automatic piston stroke indicator.

> The hand brake systems uses two steel hand brake cables pulled through standard hand brake rigging as a means to apply the hand brakes. The cables provide a flexible and lightweight interface to the hand brake actuator.

Simplified installation and even shoe wear helps extend the turn round time between wagon maintenance intervals.

The system also has an automatic pressure modification (APM) device (EL-60 valve) for two stage braking (empty / loaded). It is fitted between wagon under frame and the bogie side frame.

10.6 SINGLE PIPE GRADUATED RELEASE AIR BRAKE SYSTEM



10.7 WORKING PRINCIPLE OF BMBS HAVING APM VALVE

The brake system provided on the wagons with BMBS is single / twin pipe graduated release system with automatic two stage braking. Its operating principle is as follows.

Schematic layout of single / twin pipe graduated release air brake system as provided on the wagons is shown in figures 6 &7. Brake pipe / Feed pipe runs through the length of wagon. Brake pipes / Feed pipes on consecutive wagons in a train are coupled to one another by means of hose coupling to form a continuous air passage from the locomotive to the rear end of the train. Brake pipe is charged to 5 kg/cm² through the compressor of the locomotive. Brake pipe is charged to 5 kg/cm².

The wagons are, provided with automatic pressure modification (APM) device EL-60 valve to cater for higher brake power in loaded condition instead of the conventional manual empty load device.

With the provision of this, brake cylinder pressure of $2.2 \pm 0.25 \text{ kg/cm}^2$ is obtained in empty condition and $3.8 \pm 0.1 \text{ kg/cm}^2$ is obtained in the loaded condition.

To obtain this a change over mechanism, APM under-frame and side frame of the bogie. The mechanism gets actuated at a pre-determined change over weight of the wagon and changes the pressure going to the brake cylinder from $2.2 \pm 0.25 \text{ kg/cm}^2$ to $3.8 \pm 0.1 \text{ kg/cm}^2$ in case of changeover from empty to loaded and vice versa

10.8 BRAKE CYLINDER - 10"DIA.:-



The built-in slack adjuster compensates for the wear of brake blocks during the brake application through equivalent pay-out. For paying-in, a pry bar is applied between the brake shoe and wheel and the rigging is pushed in.

The brake cylinder has got a double acting slack adjuster as a result the actuator of brake cylinder will continue to move out till all the slack in the system is take care off and reaction force of the wheels is encountered. This ensures that every time every time the brake application takes place, sufficient brake force is delivered on the wheels.

The brake cylinder compensates for any change in gap between brake block and wheel through the inbuilt slack adjuster. Therefore it maintains a constant gap between the shoe and wheel and hence a constant piston strike. The slack adjuster works in both the condition whether there is an increase or decrease in gap. Since the brake cylinder maintains a constant piston stroke, there is no need to measure the piston stroke time and again.

There is an indicator on the brake cylinder to show the "APPLIED" or "RELEASED" condition of the Brake Cylinder. Don't hit the indicator, it may retract slowly. Hitting can bend / damage the indicator.

The brake cylinder has slack adjustment of 500 mm which could compensate of brake block wear of 48 mm (From 58 to 10 mm) and wheel wear of 47 mm (i.e., wheel dia reduce from 1000 mm to 906 mm).

The brake cylinders used on the bogic mounted brake system are of two types; with hand brake cables and without hand brake cables. The brake cylinder with hand brake cables are used for interface with the hand brake arrangement on the wagons.

10.9 APM Device (El-50 valve)

APM device is interposed between bogie side frame of casnub bogie and the under frame of the wagon. It is fitted for achieving 2-stage load braking with automatic changeover of brake power. Only one APM is required per wagon. It restricts the brake cylinder pressure coming from the Distributor valve to 2.2 ± 0.25 kg/cm2 in empty condition of the wagon and allows the brake cylinder pressure of 3.8 ± 0.1 kg/cm2 in loaded condition of the wagon. The sensor arm of the APM device comes down for sensing only during the brake application.



The complete movement of the sensor point is 104 mm. The first 80 mm of the sensor point is for the loaded zone and the balance is for the empty zone. The deflection of the bogie from tare to changeover weight is added to 80 mm to arrive at the total movement of the sensor point to be adjusted on the wagon. The gap between the sensor point and the bogie is to be measured at the point it touches the top surface of the side frame. Also ensure that the sensor point touches in the middle of the side frame.

It has an indicator to show the empty or loaded position. Whenever the indication is "ON" i.e., it is showing the orange colour, it is indicating the empty condition with brake cylinder pressure of 2.2 ± 0.25 kg/cm². When there is no indication in the indicator, it is loaded condition with 3.8 ± 0.1 kg/cm² going to the brake cylinder. It has a quick connect socket to connect the gauge to the check the pressure through the pressure gauge.

UNIT-11: SWING MOTION BOGIE

11.1 INTRODUCTION

CASNUB bogie as freight truck is introduced in Indian Railways in the year 1981 under BOXN Wagon. Before this, it was tested in 1972 under BOI wagon. Since then casnub types bogies are used as freight trunk in Indian Railways for enhancement of speed, improve mention pay to tare ratio and low maintenance.

A contract between M/s ASF KEYSTONE Inc. USA and Indian Railways has been made to supply of track friendly bogie with transfer of technology. This is a two axle three piece cast steel bogie. The bogie is designed in such a manner that pivoting at two place to provide swing motion feature. The side frame, Bolster and transom are design for 32.5 t axel load. They will apply 25 t axle load bogies its capacity can be elevated to 32.5 t axle load by changing its spring nest of suspension.

11.2 SALIENT FEATURE OF SWING MOTION BOGIE:-

- 11.2.1 Two axle three piece cast steel bogie.
- 11.2.2 Swing motion feature.
- 11.2.3 Maximum swing of bolster 32mm in two stages.
- 11.2.4 Speed 110 KMPH.
- 11.2.5 Pivoted surface between the pedestal and adopter.
- 11.2.6 Pivoted surface between the spring seal and rocker assembly.
- 11.2.7 Bogie Mounted brake system.
- 11.2.8 Spring loaded constant contact side bearers.
- 11.2.9 Wheel base 1880 mm.
- 11.2.10 Journal centre 2248 mm.
- 11.2.11 Diameter of wheel 965 mm (new) & 920 mm (old).
- 11.2.12 Bottom of centre pivot height from rail level 635.7 mm.
- 11.2.13 Height of Side Bearer from rail level 774.3 mm
- 11.2.14 Bogie Stiffness 715.16 kg/mm.

11.3 Axle and Bearing

- 11.3.1 Type of Bearing AAR Std. class "M" 7' x9"
- 11.3.2 Axle Aar M 101 Grade
- 11.3.3 Journal size 165.2 mm Dia.
- 11.3.4 Journal Centre 2248 mm
- 11.3.5 Adapter a type Class M

11.4 **Wheel**

- 11.4.1 Diameter of the wheel 965 mm.
- 11.4.2 Condemning diameter 920 mm.
- 11.4.3 Wheel profile WWP.
- 11.4.4 Rim thickness 127 mm.
- 11.4.5 Flange thickness 28.5mm.
- 11.4.6 Condemning flange thickness 23.8 mm.

11.5 Swing motion mechanism

- 11.5.1 Swing motion bogie design has two stage lateral suspensions.
- 11.5.2 Pivoting surface between the pedestal and the adopter.
- 11.5.3 Pivoting surface between the spring sheet and the rocker assembly.
- 11.5.4 In this arrangement the wheel gets decoupled from the mass of the wagon and ven flange heats the rail, the mask behind the contact is the mass of the wheel and not the mass of hole wagon.
- 11.5.5 Lateral force between wheel and rail also wheel and rail wear get reduce considerably.
- 11.5.6 Point of application of lateral forces is lowered from the height of conventional bolster gives to the height of spring sheet, reducing the wheel uploading considerably.

11.6 Advantages of Swing Motion Bogie.

- 11.6.1 Improves Curving Performance.
- 11.6.2 Improves Ride Quality.
- 11.6.3 High speed Stability and Axle-to-Rail alignment.
- 11.6.4 Reduces Rolling resistance.
- 11.6.5 It provides a longer bogie and rail life.
- 11.6.6 Excellent wheel load equalizing ability.
- 11.6.7 Increase Velocity.
- 11.6.8 Reduce Wheel Wear.
- 11.6.9 Prevent Hunting.
- 11.6.10 Reduce Track wear.
- 11.6.11 Reduce Component wear.

11.7 Extra earning per wagon per year due to increase in pay load.

Parameter.	BOXN 25M with ASF Bogies
Addition pay load compared to BOXNHL (In tonnes)	7.022
Load KM/Wagon per day.	184.5
Increase in NTKM per day per wagon.	1296
Increase in NTKM per year per wagon.	473040
Earning per NTKM of Revenue earning traffic (In	0.939
Rs.)	
Extra earning per year per Wagon (In Rs.)	444185

Total earning/saving for IR if Weight of all wagons is increased by 7.022 t

11.8 BOLSTER

Particulars.	ASF	CASNUB
Weight of Bolster.	720 Kg.	565 Kg.
Centre Pivot Bottom.	Integrated	Riveted
Material.	M-201 Grade B+	Annexure-VIII of WD-17- casnub-22HSBogie.
UTS.	552 Mpa .	500 Mpa
Yield Stress.	345 Mpa.	300 Mpa

11.9 SIDE FRAME

Particulars.	ASF	CASNUB
Weight of Each Frame.	420	430
Jaw	M Class	E Class
Material.	M-201 Grade B+	Annexure-VIII of WD-17-
		CASNUB-22HS-Bogie.
UTS.	552 Mpa	500 Mpa
Yield Stress	345 Mpa	300 Mpa.





UNIT-12: BLCWAGONS

12.1 DESIGN FEATURES OF LOW PLATFORM CONTAINER FLAT

The design of flat car for carriage of ISO Containers has been developed carefully since the containers are geometrically awkward loads and maximum speed of the linear trains is an important factor unlike the normal freight trains. It is important that the size of container. It is seen that height and length of the containers have been continuously increasing in the last two decades and are likely to increase further. Therefore, the flat car design should cater for such changes. At present container flats type BFKI are being used for the Inland Movement of ISO containers on B.G system of Indian Railways one of the difficulties with the movement of series ISO containers of 8' 6" height is that it infringes the standard moving dimensions on the B.G system. However, special dispensation has been obtain to permit unrestricted movement of these containers. Meanwhile International Organization for the standardization (ISO) adopted 9'6" height containers for International movements. A detailed study of the implication of carrying these size containers reveal that:-

It infringes the max moving dimensions of standard 'X' class engine by 254 mm vertically 533 horizontally. It is not permitted to run at speeds more than 75 kmph. It will be treated as on Over Dimensional Consignment (ODC).In addition to above shortcomings this flat is not of optimum design and not energy efficient and has been payload to tare ration of 2.24.It was therefore considered necessary to design of low platform container flat to remove the disability caused by classification of such wagons as ODC. The low platform container flat being manufactured by M/S. Hindustan Development Corporation of India Ltd. 'CONCOR' has following salient features:

- Minimum platform height of 1009 mm for carriage of maximum height/ISO container of 2896 mm.
- Pay load to tare ratio of 3.37.
- A new hybrid design of bogie frame and bolster in order to bring down the platform height of container flat.
- ▶ Use of 840 mm dia wheel to achieve low platform height.
- ≻Use of new concept of bogie suspension design to achive 100 kmph operational speed.
- ≻Use of spring loaded side bearers sharing 90% of the load under air condition to avoid things.
- ≻Use of air brake system.
- ➤Use of multiple car units each having 'A' and 'B' cars with AAR 'E' type center buffer coupler o raised ends of 'A' cars and use of slack less draw bar system on the inner ends of 'A' cars and on all 'B' cars.
- ➤Use of modular design of 5 cars unit will also ensure flexibility of operation and result in substantial saving in energy with improved pay load to tare ratio.

12.2 SPECIAL FEATURES OF BLC WAGONS:-

- These wagons are designed to carry ISO containers with a height of 2896 mm as Non-ODC load.
- These wagons are manufactured in multiple units. Each multiple units consist of two A– CARS and three B-CARS.



≻The buffer height of Outer end of A-CAR is 1105mm and at the inner end is 845mm.



▶ Both the ends of B-CARS are having a buffer height of 845mm.



- The overall slack in Slack less couplers between the two wagons is only 1 ¹/₂", When compared to a slack of 7 ¹/₂" in the standard AAR CBCs between the two wagons.
- ➤ These wagons provided with automatic twisting locks. These locks are designed to lock the containers with the wagons with a force of 600 kgs. It unlocks the container from the wagon with a force of 1000 kgs.



A formation can be formed with 9 multiple units with 45 wagons. The length of each unit is 69 meters approximately.

12.3 **UNDERFRAME DESIGN**: The underframe is a light weight all welded skeletal design for an optimum tare to pay load ratio. In order to reduce the tare weight and optimize the design of container copper bearing high tensile steel to IS:8500 Fe570B is used.

COUPLER : If single car unit of low platform container flats have to be built the two ends of underframe will have to be raised for accommodating the coupler with specified coupling height of 1105 mm. The space required to accommodate the couplers of 1105 mm will thus be not available for accommodating the ISO containers. Consequently the length of the wagon will increase by 3000mm. This will turn reduce the no. of wagons on a loop line from 42 for existing BFKI flats of 38 resulting in loss of capacity. Due to extra length tare weight of the wagon also will increase considerably which will turn result in extra energy consumption. Further use of individual wagons having their two ends raised is technically not desirable, because of the eccentricity between the draft line and the centre of the underframe momentary of loading of certain wheels would take place, when the tractive effort is applied suddenly by the locomotive and this would happen on all the wagons. In order to overcome these draw backs, concept of multiple car units using standards CBC at a height of 1105mm at the two ends of each unit to facilate coupling with the locomotive and slack free draw bar system at lower level in between intermediate cars was the only acceptable solution.

The basic object of using this system is to reduce the amount of slack within the train as compared to normal CBC coupling mechanism. The reduction of this free slack provides many benefits over a conventional coupling.

- Reduction of accelerations, decelerations and impact loading that act upon the loading. This helps to minimize lading damage.
- Reduction of impact forces that act upon the 3 car structure as a result of this free slacks.

 \succ Reduced car maintenance cost as result of induced impact loading on the car structure and components.

- Greatly increased riding quality, lesser damages to the track.
- Elimination of free slack reduces abuse on the car structure.
- Slack free draw bar system comprises of key stone. Mini gear, Mc Conway & trolley drawer, Standard AAR Yoke and indigenously developed striker casting.

12.5 **BOGIE DESIGN**: Cast steel bogie design for low platform container flats, is basically a three piece planked bogie with secondary coil spring suspension and load proportional friction damping and AAR Cartridge bearing.

I. **BOGIE FRAME DESIGN:**

Adoption of 840 mm dia wheel became necessary to bring down the height of Container flat as far as possible. This has brought down the height of the platform by 80mm in comparison to the wheel diameter of 1000mm provided on the existing BFKI Container flats. Critical problems such as minimum clearance between the bottom most point of the bogie and rail level permitted under worst condition i.e. 102mm, and height of the bolster ect, have been taken care of. A design of bogie frame with 2000 wheel base and completely new design of bolster is used. All these exercises have resulted in reduction in the height of the centre pivot from the rail level from 932mm on the existing BFKI container flats to 729mm on the low platform container flat, thus saving 203 mm in the vertical direction. The design thus ensures a vertical clearance of 17mm with the maximum moving dimensions of standard 'X' class locomotive when 9'6'' (2896mm) and height 8'00' (2438mm) wide ISO container are loaded.

II. **SUSPENSION DESIGN**: New concept of suspension design softer under tare and suffer under gross loaded condition has been adopted. The two stages vertical suspension was necessary to provide higher static deflection in empty condition, so that spring off-loading in the empty condition lies within limits. Vertical suspension in loaded condition is stiffer on account of the constrain of limit of buffer height variation. Keeping in mind the space available for accommodating the springs, the design in such that the stress level in the spring in the dynamic condition is within limits, beside sufficient residual deflection. In addition, load proportional friction damping arrangement with sufficient damping force is provided. To achieve this snubber springs are made stiffer but at the same time the stress level under dynamic load are not high and also sufficient residual deflection is available. Which gives better fatigue life of the spring. As result vertical damping factor is increased to 0.25 as compared to that of BFKI Container wagon which is 0.15. This optimization of suspension design lead to higher safety margin against derailment.

III. ELASTOMERIC PADS:

- Elastomeric pads basically provide flexibility in lateral mode at the axel box level and this reduces wheel wear tendency.
- A stiffer elastomeric pad reduces the uncontrolled lateral vibration at primary level which eliminates the hunting tendency.
- Elastomeric pads are made stiffer without increasing the hardness of rubber so that the fatigue life do not deteriorate.
- The extent of stiffening is kept as low as possible so that wheel wear is not affected as much,
- The longitudinal clearance between elastomeric pads and axle box crown is eliminated for effective functioning of the pads.
- IV) LOAD DISTRIBUTION: The weight distribution between centre pivot and side bearer has been optimized to avoid hunting 90% of the load under tare condition is borne of the two side bearer of spring loaded design. The spring loaded side bearer arrangement (refer figure 2) is having a distinct advantage of retaining the load distribution between centre pivot and the side bearer irrespective of manufacturing inaccurate as well as condition of the wagons (new or old) only 10% of the tare weight will be borne of the centre pivot which will also transfer the full pay load under taken condition.

12.6 AUTOMATIC LOAD SENSING DEVICE

Low platform container flat is fitted with two stage automatic load sensing device in each of the bogie. Initial pressure of 2.2 kg/ cm^2 is set under the condition. Clearance between operating value and buffer is adjusted such that it operates when gross weight crosses 40 tonnes. At this changeover weight pressure in the brake cylinder raises to 3.8 kg/cm^2 .

The Brake system of BLC wagons are designed in such a way that:

- The DV admits the maximum of 2.2 Kg/cm2 air pressure to Brake cylinder when the wagon is in Empty condition and the Maximum of 3.8 Kg/cm2 in Load condition.
- There is a provision of Load sensing devise duly eliminating the mechanical devise of Load Empty Box. This purpose is serving by two stage DV(C3W2)

- BLC wagons are provided with special type of DV which admits the maximum BC pressure of 2.2 kg/cm2 during the application of brake,
- In the absence of the provision of additional pipe line connection from Auxiliary Reservoir to Common Pipe Bracket.



- This special type DV admits the maximum BC pressure of 3.8 kg/cm2 during application(Loaded train), when the air is admitted from Auxiliary Reservoir to DV through additional port of Common Pipe Bracket, apart from the normal connection from DV to AR.
- This is achieved by introducing the additional pipe line from Auxiliary Reservoir to Common Pipe Bracket of DV.



• From the above it is understood that :

- To obtain the maximum of 3.8 kg/cm2 of pressure in BC, the DV requires an additional input pressure of air from AR to DV to sense the DV in such a way to admit the maximum of 3.8 Kg/cm2 BC pressure.
- And the Maximum BC pressure can be reduced from 3.8 to 2.2 by cutting off the additional input air from AR to DV.
- Load sensing devise (LSD) is introduced in the additional pipe line and it acts as a switch to admit/cut-off the input air from AR to DV depends upon the condition of wagon.
- POSITION OF LSD when the wagon is in EMPTY
- There are three ports available in LSD (i.e. inlet port, outlet port & Exhaust port)
- Inlet-port is isolated from outlet port

• Outlet port is connected to Exhaust port



POSITION OF LSD when the wagon is in LOAD

- In-port is connected to outlet port
- Out port is dis-connected from Exhaust port



Necessity of EXHAUST PORT in LSD

- When the containers are unloaded, the wagon becomes empty and the plunger of LSD gets released and the in-let port is dis-connected from out-let port, thereby further supply of air from inlet is cut-off.
- But the air which was admitted earlier in the outlet pipe when the plunger was in lifted condition (on load) remains in the outlet pipe and which may still sense the DV to admit the maximum BC pressure of 3.8 instead of 2.2 kg/cm2 even in the plunger is in released position.

• To exhaust the available air in the outlet pipe, exhaust port is necessary when the wagon gets emptied (i.e. when plunger of LSD gets released)



As there are two CASNUB bogies in each BLC wagon, both the bogies are provided with LSD duly securing the LSD by bolt & nuts at the Top bolster.



Necessity of DOUBLE CHECK VALVE

- It is possible to load two containers on one BLC wagon.
- There are possibilities to one of the LSD plunger to get applied due to the load on one side container and this LSD may supply the air from AR to CPB of DV.
- Since the outlets pipes of both the LSDs are commonly connected, the air in the one of the LSD's outlet pipe is sent out through the exhaust port of other LSD as the other

LSD's plunger is in released condition and causes for pressure drop in loco.



- To overcome the said problem, one Double check valve is provided at the common junction point to admit the air only from the LSD which is in applied condition duly isolating the path of the other LSD which is in released condition (i.e. one LSD functions on load and one LSD functions on Empty)
- In the Double check valve, there is a floating plug inside the housing which moves horizontally and it closes one of the end due the air pressure on the other end.



Necessity of Pressure Reducing Valve:

- Double check valve admits air to DV only because of difference of air pressure acting on the floating plug.
- When two containers are loaded, both the LSDs start function on load criteria and admits the air of 5 kg/cm2 on both the end of the double check valve.

• Double check valve prevents sending of air pressure to DV as the position of floating plug will be in neutral condition.



- To overcome the said problem, one pressure reducing valve is provided in between the double check valve & the out let of any one of the LSD.
- This pressure valve is set to the output pressure of 4 kg/Cm2.
- It means that the air received from one side of the LSD to Double check valve will be 5 Kg/cm2 and the other side of the LSD to Double check valve will be 4 kg/cm2.
- This causes the pressure difference over the floating plug and the 5 kg/cm2 air will be admitted into the CPB of DV.



12.7 AUTOMATIC TWIST LOCK

In order to minimize the manual operation automatic twist locks of M/s Holland and co. USA is fitted on low platform container flat for securing the containers. (Unique feature of this lock is its locking and unlocking is automatic). Radii of spindle head are so designed that while lowering the container, lock automatically operates the moment of force of 600 kg is exerted by the container. For fitting the container from the container flat a force of 1000 kg is required for the lock to operate.

S.NO	FEATURES	BLC	BFKI	
01	Wagon Unit	Consist of 5 wagon 2 Nos. A-CAR+3Nos. B-CAR	Single Wagon	
02	Platform Height from RL	1009mm	1269 Wagon	
03	Unit of Wagon Length over Head Stock	A-CAR 13625 mm B-CAR 12212mm	13716mm	
04	Tare	A-CAR 19.1t B-CAR 18.1t	20.5t	
05	Pay Load	61.t	48.t	
06	Wheel dia	840/780mm	1000/906mm	
07	Type of bearing	Tapered two row Cartridge bearing	Tapered two row cartridge bearing	
08	Speed	100kmph	75kmph	
09	Coupling	CBC & Slack less Draw bar	CBC	
10	Twist Lock	Automatic	Manual	
11	Empty/Load Device	Two stage automatic pneumatically operated	Manually leverage	
12	Side Bearer Arrangement	Spring loaded side bearer arrangement	Rubber bonded	
13	Suspension	Two stage suspension	Single suspension	
14	Rake carrying capacity/Rake Length	45 Wagons	42 Waggons	
15	Brake System	Air Brake	Vacuum Brake	
16	Brake Cylinder Pressure	3.8 Kg/CM Sq. in loaded 2.2 Kg/CM Sq. in empty		

12.8 COMPARTIVE FEATURES OF BLC-BFKI

12.9 CAST STEEL "LCCF-20(C) " BOGIE

12.9.1 INTRODUCTION

The cast steel low platform container flat bogie comprises of two cast steel side frames and floating bolster. The bolster is supported on the side frame through two nest of spring, which also incorporate a load proportional friction damping. The side frames are connected by a fabricated mild steel spring plank to maintain a bogie square. T he general arrangement of the bogie fitted with tapered cartridge bearing

12.9.2 SALIENT FEATURES : The salient features of the bogie are:

➢ Gauge	1676mm
➤ Axle load	20.3T
➢ Wheel diameter	840mm (new) &780mm(condemning)
➤ Wheel base	2000mm

Type of bearing	American association of railroad		
	Cartric	lge tapered roller bearing	
➢ Jaw	(6"*11	") wide jaw	
Distance between Journal ce	entres	2260 mm	
Distances between Side Bearers		1750mm	
> Type of side Bearer		Spring loaded	
➤ Type of pivot		Flat	

Anti-rotation features Anti-rotation lugs have been provided between bogie Bolster and side frame.

> Type of Brake Beam Unit type fabricated Brake Beam

SPRINGS: The bogie is fitted with two groups of long travel helical springs nests. The spring groups per bogie are as under: 20.3t 14 Outer 12 Inner 4 Snubber

12.9.3 **DAMPING**: The suspension is provided with load proportional frictional damping arrangement with the help of a cast steel wedge supported on the snubber springs.

12.9.4 **SIDE BEARERS**: The bogie is fitted with spring loaded side bearers having 90% of the

load under tare condition to avoid hunting.

12.9.5 **BRAKE BEAM**: The bogie is fitted with unit type brake beam. The brake heads are integral part of the Brake Beam which slide in the guide cavity of the Side Frame. A spring steel wear liner is provided in this with a centralizing feature.

UNIT-13: FREIGHT TRAIN EXAMINATION

उत्तर पश्चिम रेलवे NORTH WESTERN RAILWAY

L No.NWR/HQ/Mech/C&W/Frt./8 T-2/Goods/216/12 प्रधान कार्यालय,जयपुर HQ Office, Jaipur Fax No. +91-141-2725903 Date 23.07.2015

<u>Joint Procedure Order</u> Pattern of Freight Train Examination on North Western Railway

This JPO supersedes all earlier versions and come into force with effect from 23:0.7:2015

1. GENERAL

1.1 Types of examination

The following types of examination of freight trains will be conducted in North Western Railway

- (i) Intensive End to End Examination
- (ii) BPC revalidation
- (iii) Premium Examination
- (iv) Close Circuit Examination.
- (v) Departmental Train Examination.

1.2 Train Examination Points on NWR.

SL	Div.	Station	Stock	Type of examination	Circuit
1.	AII	MD	BCN	CC, Premium, Intensive	
			BCNHL	CC, Intensive, BPC Revalidation,	
			BLC,BLL	CC, BPC Revalidation	
		•	Others	Intensive, BPC Revalidation	
		BOBYN	DMT Examination	•	
2.	JP	ICD/KIIP/PALI	BLC	CC, BPC Revalidation	
3.		ICD/ALIK/MNDV	BLC	CC, BPC Revalidation	•
4.]	FL	BOBYN	DMT examination	
5.	BKN	SOG	BOBYN	DMT examination	
6.	JU	MTD	BOBYN	DMT examination	

- **1.3** MD depot will do ROH of BCN, BCNHL and BOBYN from the stock examined at the yard and that received from other points. POH marked from the same stock will go to Ajmer Workshop.
- 1.4 SBI/WR will do ROH of all type of BLC and BLL from the stock examined at MD, PALI & MNDV and POH marked from the same stock will go to KOTA workshop.



For CC rakes (BLC/BLL 6000km/30 days)

This BPC is valid up to(mention date) Rake should be moved toward to

(Rake should be moved towards base depot before laps of validity)

2. GDR Check

- 2.1 GDR check will be done of only that rake which is due for examination and the next TXR point is still 250-300 kms away with endorsement in BPC. (Rly.Bd No.2000/safety (A&R)/19 /35 dt. 28.07.09)
- 2.2 GDR check is not required when the Premium/End to End rake has a valid BPC or in case of an invalid BPC, when the next TXR point is less than 250 kms away.
- 2.3 GDR time should be restricted to 30-45 minutes.
- 2.4 Normally no rake should run with open doors. However in case of BCNHL rake, proper closing of doors must be ensured before starting the train.

3. INTENSIVE END TO END EXAMINATION

- 3.1 The rakes should normally be intensively examined in empty condition except when back loading of rake has to be done at station/siding.
- 3.2 The BPC of empty rake may have no destination mentioned, but after loading the empty rake, the Operating staff (Commercial staff, if no operating staff is posted at that station) will ensure that the destination of the loaded trains is clearly mentioned on the BPC and the same will then become valid up to such destination.
- 3.3 Driver will not move the loaded train from the loading point unless the destination is clearly mentioned on the BPC.
- 3.4 The BPC of a loaded train without destination mentioned on it will be considered as invalid.
- 3.5 The movement of empty rake/back loaded rake from the unloading point to the first freight train examination point will be permitted on GDR certificate for which the following instructions should be followed.
 - 3.5.1 Driver and Guard must ensure air pressure continuity before starting.
 - **3.5.2** Guard and Driver will ensure that there are no loose or missing fittings in the under gear (such as brake blocks, safety brackets, draw gear pins/brake gear pins etc.) which may endanger the safe running of the train.
 - 3.5.3 Driver and Guard will then prepare the memo jointly on a plain sheet in triplicate and both Driver and Guard will sign it. The Driver and Guard will retain one copy each and third copy will be handed over to Station Master.

Esc

3.6 Brake power certificate shall become invalid if the rake is stabled in an examination yard for more than 24 hrs.

4. BPC REVALIDATION

4.1 In case offered rake is CC rake of any other base depot, only intensive examination is to be conducted on such rake for one trip (maximum 7 days from date of such examination or date of expiry of original BPC, whichever is earlier) for loading to specified destination and onward movement as empty to the CC base depot.

MAR

- **4.2** A rake at other than its nominated mother CC base, it is essential that in case of sick marking, the examination point have to try for in-situ repair and as far as possible also replenish the sick wagons.
- **4.3** Instead of issuing fresh End to End BPC, endorsement on the original BPC is to be made as under:

"The rake is intensively examined and BPC is revalidated for one trip for Loading/ Unloading and after unloading the rake should be moved to Base Depot......"

Station:	3	Date:	Signature of SSE/JE(C&W)

- **4.4** After revalidation of BPC loading unloading in such rake will be confined to the destinations mentioned in para 4.3 above. Else, the rake shall lose its CC character.
- 4.5 All the conditions shall applicable mentioned in Para-3 except issue of fresh BPC.

5. PREMIUM EXAMINATION

Premium examination is to be carried out on BOXN & BCN variant rakes. The following instructions will apply to premium examination:

- 5.1 Premium rakes will be examined in empty condition only on Madar depot.
- 5.2 Premium rakes will be turned out with minimum 95% brake power.
- 5.3 BPC issued for such premium rakes will be valid for 12 days from the date of issue. During this 12 days period, the rake will be allowed multiple loading/unloading.
- 5.4 After each loading/unloading, the rake will be examined by Guard and Driver before commencement of journey and observation will be recorded under the relevant columns of brake power certificate.
- 5.5 After the lapse of 12 days, the rakes should be offered for next intensive examination at the first examination point in the direction of movement. To avoid examination in loaded condition, a grace period of 3 days be permitted.
- 5.6 After expiry of the grace period i.e. after a lapse of 15 days after the date of issue of BPC, even a loaded premium rake shall be offered for examination at the first TXR point in the direction of movement.
- 5.7 In no case Premium rake shall be offered for loading through bypass routes or through yards which are not nominated for examination.
- 5.8 Any breakage of rake integrity by more than 4 vehicles should be brought to the notice of control immediately for examination at the next C&W point in the direction of movement.

6. CLOSED CIRCUIT EXAMINATION

- 6.1 BLC/ Container Rakes
- 6.1.1 In the Close Circuit pattern, multiple trips are permitted with only one examination, for which the following instructions are issued:-
- 6.1.2 The air brake Close Circuit rakes shall be offered for periodical maintenance examination (PME) in empty condition at the CC base depot only who formed the CC rake originally.
- 6.1.3 The BPC validity for Close Circuit rake is 6000km/30days which ever earlier.
- 6.1.4 In case the record of the distance covered by the rake is discontinuous or not mentioned properly, the BPC will be deemed to be valid for only 15 days from the date of issue.
- 6.1.5 CC rakes will be turned out with 100 % brake power.
- 6.1.6 It is the responsibility of the crew to check that entries regarding distance are clearly and continuously recorded.
- 6.1.7 To avoid losses of CC rake Operating Deptt. will arrange to trace and offer the CC rakes to reexamination to base depot before laps of BPC validity.
- 6.1.8 After each loading unloading, the rake will be examined by Guard and Driver before commencement of journey and observations will be recorded under relevant column of the Brake Power Certificate.
- 6.1.9 It is absolutely essential that integrity of close circuit examined rake is ensured during the multiple/round trip. However, up to 1 unit (5 wagons) may be replaced by good examined wagons in the entire run between two PMEs.

6.2 BCNHL RAKES

- 6.2.1 In the Close Circuit pattern, multiple trips are permitted with only one examination, for which the following instructions are issued:-
- 6.2.2 The air brake Close Circuit rakes shall be offered for periodical maintenance examination (PME) in empty condition at the CC base depot only who formed the CC rake originally i.e MD.
- 6.2.3 The BPC validity for Close Circuit rake is 7500km/35days which ever earlier.
- **6.2.4** In case the record of the distance covered by the rake is discontinuous or not mentioned properly, the BPC will be deemed to be valid for only 20 days from the date of issue.
- 6.2.5 CC rakes will be turned out with 100 % brake power.
- 6.2.6 It is the responsibility of the crew to check that entries regarding distance are clearly and continuously recorded.
- 6.2.7 To avoid losses of CC rake Operating Deptt. will arrange to trace and offer the CC rakes to reexamination to base depot before laps of BPC validity.
- **6.2.8** After each loading unloading, the rake will be examined by Guard and Driver before commencement of journey and observations will be recorded under relevant column of the Brake Power Certificate.
- **6.2.9** It is absolutely essential that integrity of close circuit examined rake is ensured during the multiple/round trip. However, 4 wagons may be replaced by good examined wagons in the entire run between two PMEs.

7. EXAMINATION OF DMT RAKES

- 7.1 Examination of DMT rakes shall be conducted at locations given in Para-1.2. The BPC will be valid for a period of one month from the date of issue subject to GDR check or examination by C&W flying squad wherever feasible after each loading/unloading or stabling.
- 7.2 It is the duty of the owning department to ensure regular examination and maintenance of DMT rakes.
- 8. This joint circular does not in any way amend any stipulation of IRCA, G&SR

Chief Freight Traffic Manager North Western Railway

Chief Rolling Stock Engineer North Western Railway

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UNIT-14 :TRAIN PARTING

- 1. **DEFINATION**: Train parting is unforeseen division of a train into two or more portions while the train is on run or just about to move. Train Parting is a common unusual occurrence affecting train movement adversely. Freight train operation by crew and maintenance of wagons are the two major activities involved in train parting. There are many contributing factors towards train parting such as inadequate maintenance, material failure, improper driving & improper marshalling etc.
- 2. **TYPES OF TRAIN PARTING:**Train parting is classified under two main heads.
- 1.1 **Vertical Parting:** Vertical parting takes place due to excessive CBC height variation. The main reasons for variation in CBC height are;
- 1.1.1 Loose/ low rail joints
- 1.1.2 Mud pumping under the rail joints
- 1.1.3 CBC drooping– excessive wear and tear of coupler shanks and striker casting/ bearing piece.
- 1.1.4 Excessive over loading in the wagons.
- 1.2 **Horizontal Parting** :- Horizontal train parting takes place due to following reasons:
- 1.2.1 Uncoupling of CBC.
- 1.2.2 Breakage/ wear of CBC components due to inherent defects.
- 1.2.3 Failure of draft gear.
- 1.2.4 Bad engineman ship
- 3. **UNCOUPLING OF CBC**: The most common causes of train parting are, uncoupling of CBC on run (without any breakage of any parts), breakage of knuckle failure of draft gear and working out of CBC. The reasons of uncoupling and preventive measures taken to avoid uncoupling are described as under -
- 3.1 Lock not properly engaged In most of the cases, the lock does not drop down to the full locked position inside the coupler head. This may result in slipping up of the lock during run causing uncoupling.
- 3.2 Ineffective anti-creep device Lock may slip up due to jerking and jolting during run if the anti-creep feature is not effective.
- 3.3 Operating handle dropping on run This is caused by breakage of supporting bracket resulting in operating handle falling down on run and hitting the ballast. This tends to turn the handle leading to lifting of the lock piece and uncoupling.
- 3.4 Excessive play between anti–rotation lug and bearing piece slot: Due to excessive play between anti-rotation lug and bearing piece slot, operating handle can operate on run due to jerks and can cause uncoupling. Anti-rotation lug is made out of square cross section MS bar with standard dimensions of 16 mm x 16 mm and slot width in bearing piece of 17.5 mm.
- 3.5 Unauthorized tempering with operating handle This is believed to be a common incidence by many Railways. Since, uncoupling lever is situated alongside the wagon and is easily accessible, it is easily prone to unauthorized and mischievous manipulation.
- 3.6 Uncoupling due to vertical slipping out of knuckle This may occur due to abnormal relative vertical movement between the two coupler heads causing slippage of one knuckle out of the other. This situation is very unlikely to arise but there may be a possibility in the event of combination of number of adverse factors like maximum difference in coupler heights & unevenness on rail joints.

4. **GUIDELINES FOR PREVENTING CBC UNCOUPLING:** - The cases of uncoupling of freight trains on the Railways have increased. On thorough analysis, it came to light that required attention is not being paid during ROH and Yard examinations. It is also observed that, the knowledge of the technicians is not sufficient. It is therefore necessary to impart training to technicians on the subject matter in the C&W BTCs. The following guidelines with pictorials of the defective parts of CBCs are given for ready references:-

4.1 **Operating Handle:**

4.1.1 The correct geometry of the operating handle is very essential. The operating handle should not be bent. The photograph of proper and improper (bent) operating handle is given as under.



4.1.2 The length of the operating handle are different for different types of wagons. The length of the operating handle wagon wise are given as under.

S.No.	Type of wagon	Standard length in MM
1	BOXN/BCN	1414
2	BLCA/BLCB	1063
3.	BTPN	1414
4	BVZI	1414
5	BVZC	1450

ANTI ROTATION LUG:

- 4.2.1 There should be no excessive wear in **Anti rotation lug**. The lug length and all the dimensions of the lugs are very important as there should not be any excessive play between the bearing piece and anti-rotation lug. The standard section of the anti-rotation lug is **16 mm x 16 mm**.
- 4.2.2 The circular section on anti-rotation lug should not be permitted at all. The operating handle provided with the photograph of operating handle with circular section lug is given as under.

Photograph of new rotation lug Photograph of circular section of rotation lug



- **4.2** Bearing Piece Slot:
 - 4.3.1 There should not be any excessive wear in the **bearing piece** slot. The standard width of the slot is 17.5 mm. The photographs of the bearing pieces with standard slot width and worn out width are given as under.
 - 4.3.2 The bearing piece pin should be properly welded to hanger bracket. The photograph of the correctly welded bearing pin is given as under.





- 4.4 Articulated Lock Lift Assembly:
- 4.4.1 The components of Lock Lift Assembly such as **toggle, lever connector and lever hook** should be properly riveted. The photograph of Lock Lift Assembly is given as under.
- 4.4.2 Ensure that anti creep lug of the lever connector is not excessively worn out. There is no gauge specified for measuring the wear. However it should be checked with worn sample which can serve as a comparator.



Worn out sample of anti-creep



UNIT-15: CORROSION

The corrosion chemical phenomenon of oxidation of steel surfaces which result of loss of section and thereby the loss of strength oxidation takes place only when steel surfaces are exposed to atmosphere in the presence of moisture due to formation of ferrous oxide. The places of corrosion on coaching stock have been divided in two groups depending upon the importance of the place and rapidity of corrosion for destroying the structure and place.

(a) Vulnerable

(b) Non Vulnerable

Vulnerable places are those which may cause concern and even accident due to rapidity of corrosion

Non-vulnerable place are those which may not cause concern and accident due to less importance of the place and less rapidity of corrosion.Normally the places mentioned are prone to corrosion:

- Turn under of side walls
- \succ Sole bar
- Lavatories
- Trough floor
- Under frame parts
- Vacuum air reservoirs
- Side doors
- Door bottom channels and side panels
- Brake gear fittings
- Window seals
- Draw bar housing
- Distribution pipes

Box Wagons

- Sole plates at doorway
- Flap door hinges
- Flap door (inside surface)
- Vertical side stanchions

Tank Wagons

- The dome:- manhole cover manhole flange, bolts barrel, surface near the manhole and safety valves
- Perished rubber lining
- Underframe members
- Master valves and control valves and its body
- > Welded joints of the saddle plates with the tank barrel

15.1 Causes of corrosion due to short coming at the various places

15.1.1Wagon Builder

- Storage of plane plates, angles and channels in open.
- Storage for very long period.

- > No pre-treatment such as pickling or phosphating before fabrication.
- ▶ Use of rusty panel plates, channels and angles in sub-assemblies.
- Surface preparation like shot blasting or mechanical cleaning not proper.
- Application of primer coat on surface of panels without adequate removal of rust.
 Welded joints, rough edges not ground before applying primer.

15.1.2 At Railway Workshops and Sick Line

- Rusty panels plates used for patching work.
- > Panel plates not cleaned/free of rust before painting.
- Portion, where plates are lap jointed, not painted with anti-corrosive paints before riveting.
- Welding is not continuous in case of patching.
- > Surface preparation not adequate before painting of coaches.

15.1.3 Preventive measures are as below:

- Use of copper bearing steel
- Anti-corrosion bath to fittings
- Anti-corrosion paint
- > Carrying out modification for corrosion prevention
- Carrying out corrosion examination and repairs
- Introduction of carbon steel, considered more anti-corrosive than copper bearing steel
- 15.2 Following modification have been done in ICF Coaches for corrosion prevention
- 15.2.1 **Turn Under**: The turn under get corroded due to violent movement of the dust and Dirtduring running of coach and this dust and dirt block the drain holes of turn under Resulting the accumulation of water takes place which leads to corrosion, for this Following steps have been taken:
 - > The thickness of sheet, which is increased from 2.2mm to 5mm.
 - > The dimensions of drain holes have been increased and these have been elongated for ensuring proper cleaning.
 - ➤ A coat of zinc-chromate red oxide primer is applied, then three coats of bituminous emulsion and four coats of bituminous solution should be applied.
- 15.2.2 Sole bar

It gets corroded due to chemical reaction of discharge from lavatories. Apply anticorrosion paints after cleaning it thoroughly.

- 15.2.3 Lavatories
 - > Following modification have been done in lavatories to prevent corrosion.
 - Tubular structure has been fitted (pipes) in place of trough sheet to avoid accumulation of water.
 - > The decolite flooring height has been increased to 306mm.
- 15.2.4S.S. In-lay:
 - -A S.S (stainless steel) in-lay has been provided in the toilet floor which contains squatting pen, lota cock, flush drain holes and pvc have been pasted over it leaving squatting pen.
- 15.2.5 Provision of modular toilets:

15.2.6 Trough floor:

- > The drain holes of trough floor have been increased from 13mm to 19mm.
- If there is corrosion in trough floor it should be scraped to bare metal and two coats of zinc-chromate red oxide and then three coats of bituminous emulsion and four coats of bituminous solution should be applied.

15.2.7 Under frame parts:

Under frame parts which get corroded should be replaced and same treatment of primer and emulsion and solution should be done on underframe parts.

15.2.8 Side doors:

Side doors of ICF coaches have been modified by providing large openings at the bottom to avoid accumulation of water at side door.

15.2.9 Battery box frame:

- > It should be hot galvanized prior to lifting of aluminium sheet.
- 15.2.10 Window sills/ventilators:

Lingo rite packing should be provided at windows sills.

- 15.2.11 Brake gear fittings /draw bar housing
 - Same treatment should be done as m case of underframe parts
 - During rainy season the ventilators should be provided with roof holes for prevention of ingress of water
- 15.3.12 Following other measures are suggested to prevent corrosion in ICF coaches
 - 1. Design point of view
 - Change in construction design should be such that no water stagnation , prevention of ingress of moisture , overlapping of steel plates should be avoided , there should be no crevice
 - Use of anti-corrosion material
 - Better manufacturing techniques
 - Superior quality paints which should be able to withstand rust, sunrays, ultraviolet rays, wind, salt, sulphuric acid fumes, washing chemicals etc.

2. In workshop

- Maintenance, custody and control of steel materials
- Surface preparation before painting
- Technical training
- Butt welding should be used for patching work and their joints should be perfectly fitted with putty or some sealing materials

UNIT-16: WHEEL IMPACT LOAD DETECTOR



16.1 Why is WILD needed?

- > Defective rolling stock produce high impact loads.
- These loads over a prolonged period of time leads to Rail/Wagon failure, wheel bearing failure etc..
- WILD measures the impact load independent of the cause.
- WILD system assists the railway engineer to attend to the defective rolling stock immediately.
- Reduces Service Failures and Unplanned Maintenance Cost of Rolling Stocks & Tracks.
- WILD is used to catch the defects in the early stage and thereby protecting Rail Infrastructure & avoids Catastrophic Failures.

16.2 Defects that can cause High Impact Load

- Uneven loading
- ➢ Coil spring weak
- ➤ Shell Tread
- Friction liner broken
- Snubber spring broken
- Axle box canting
- > PU/CC/EM Pad Shifted/Pressed/Perished
- CC housing broken
- S/Bearer roof/Friction Liner welding open
- Bolster tilted one side
- Defect in suspension
- Broken spring
- Skid mark, etc.

16.3 Components of WILD

- \triangleright Instrumented Tracks
- \triangleright Signal conditioning unit
- \triangleright Train Trigger Sensor
- \triangleright Real time Embedded controller
- \geq Impact Load Analyzer Software
- \geq Wireless data transfer
- \geq Power back up
- \triangleright **Calibration Setup**

WILD Block Diagram: -

- 16.4 Measuring concept of WILD
 - \triangleright WILD uses instrumented rails.
 - \triangleright The spaces between sleepers are instrumented using strain gauges and any load that appears in the effective zone is considered.



- Various such measuring zones are formed along the track.
- \triangleright The maximum load measured in the entire instrumented portion is treated as the impact load.
- As wheel of rolls over the rail various portions of the wheel fall in the effective \geq zone and dead zone (sleepers).
- As a result various diameters of wheel have different coverage. \geq
- \geq The instrumented portions can be determined and prepositioned to give best coverage for the wheels of interest.
- Once installed the system's wheel coverage pattern does not change. \triangleright

WILD System Architecture



16.6 How does WILD system flag defects



- WILD system flags the defects purely based on the impact load measured.
- > The limits are set by the RDSO/Railway Board
- Current limits

>/=20T Maintenance alarm or ILF >/=2.0 ~ <4.5

>/=35T Critical alarm or ILF >/=4.5

> The system however features a facility for the end user to set the limits as well.

Left	Load (Tor	ı) Ri	ght I	Load (Ton)		Left	Load (Ton)	Right	Load Ton)
L1	3.5	R1	3.4	1		L1	3.5	R1	3.4
L2	3.2	R2	3.3	3		L2	3.2	R2	3.3
L3	2.8	R3	2.9)		L3	9.8	R3	2.9
L4	2.7	R4	3			L4	2.7	R4	3
L5	3.1	R5	3.2	2		L5	3.1	R5	3.2
L6	2.9	R6	3			L6	2.9	R6	3
L7	3.1	R7	3.2		L7	3.1		R7	3.2
L8	3.4	R8	3.3		L8	3.4		R8	3.3
L9	17.1	R9	11.2		L9	17.1		R9	11.2
L10	6.1	R10	4.7		L10	6.1		R10	4.7
L11	3.1	R11	3.2		L11	3.1		R11	3.2

15.7 Calculation:-

L12	2.9	R12	3.1	L12	2.9	R12	3.1
L13	12.4	R13	10.8	L13	12.4	R13	10.8
L14	2.4	R14	2.5	L14	2.4	R14	2.5
L15	3.1	R15	3.2	L15	3.1	R15	3.2
L16	2.9	R16	3.1	L16	2.9	R16	3.1
L17	3.4	R17	3.3	L17	3.4	R17	3.3
L18	3.2	R18	3.1	L18	3.2	R18	3.1

Left	Load (Ton)	Right	Load (Ton)					
L1	3.5	R1	3.4					
L2	3.2	R2	3.3					
L3	9.8	R3	2.9					
L4	2.7	R4	3					
L5	3.1	R5	3.2	LD)-II Ver. 3	86chann	el)	
L6	2.9	R6	3					
L7	3.1	R7	3.2		Left Maximum Dy W	heel Load = 17.1		
τQ	3.4	DQ	2.2		Left Average Dy Wh	eel Load = 3.27		
Lo	5.4	Ко	5.5			Left Maximum Dy	Wheel Load (17	.1)
L9	17.1	R9	11.2	Left I	mpact Load Factor =	Left Average Dy W	heel Load (3.27)	_
L10	6.1	R10	4.7			(Avg. Of Lowest fift	teen readings)	
L11	3.1	R11	3.2	Rig	ht Maximum Dy Wh	eel Load = 11.2		
L12	2.9	R12	3.1	R	ight Average Dy Who	eel Load = 3.49		
L13	12.4	R13	10.8	Right	Impact Load Factor	Left Maximum [=	Dy Wheel Load (11.2)
T 14	2.4	D14	2.5		•	Left Average Dy (Avg. Of Lowest	Wheel Load (3.2 ten readings)	21)
L14	2.4	K14	2.5	Rig	ht Impact Load Facto	r(RIF) = 3.49	con readings,	
L15	3.1	R15	3.2		in input Loud ruck	5.45		
L16	2.9	R16	3.1					
				L18	3.2		R18	3.1
L17	3.4	R17	3.3					

16.8 System capabilities

- Counts number of axles from various measurement channels.
- Measures Average Dynamic Wheel Load for all wheels.
- > Determines Maximum Dynamic Wheel Load (WA) for all points of contact.
- Calculates speed of each axle and the average speed of train.
- Identifies and counts defective wheels as per specified thresholds and rates them according to the severity of defect.
- > Points out exact position of defective wheel from loco for easy examination.
- Has solar panel providing a power backup.

16.9 Automation Features

- Automatic Diagnosis of faulty channels and switching them off to avoid erroneous data at every start.
- Automatic start of Data Acquisition (DAQ) on the arrival of train in response to the start trigger switch.
- Automatic stop of DAQ after the passage of train by intelligently identifying the event.
- Uploads analyzed data to remote server.

16.10 Reports in WILD

- > The WILD system offers the end user to generate various reports.
- Month wise, Year wise, Train wise & wheel wise standard reports available.
- Provision for new standard reports.
- Summary reports can be drawn out based on
- ➤ Wheel loads
- Rolling stock (Engine, Wagon, Tanker etc...)
- Defective rolling stock

UNIT-17: DIESEL LOCOMOTIVES

17.1 CLASSIFICATION CODES OF DIESEL LOCO: <u>GUAGE</u>

Y	Meter Gauge	YDM4,YDM4A
W	Broad Gauge	WDM2,WDM2c,WDM3c
Z	Narrow Gauge (2' 6'')	ZDM4,
		ZDM4A,ZDM1,ZDM2,ZDM3
N	Narrow Gauge (2')	NDM1,NDM5,NDM6

POWER

D	Diesel
С	DC Traction
А	AC Traction
CA	Dual Traction (AC/DC Traction)

LOAD

М	Mixed Traffic	YDM4, WDM2, ZDM4
Р	Passenger	WDP1,WDP2,WDP4
G	Goods	WDG2,WDG3C,WDG4
S	Shunting	WDS4,WDS6
U	Multiple Units	(EMU/DEMU)
R	Rail Car	

SERIES

Is a digit identifying the model number of locomotives?

SUBTYPES

Is an optional letter or number that indicates some small verification in the basic model or series.

SUFFIX

Is an optional indication that indicates some things special about loco, such as different gearing ratio or brake system than usual?

17.2 TYPES OF BRAKE SYSTEM IN DIESEL LOCOMOTIVE



17.4 INDEPENDENT BRAKE SYSTEM (LOCO BRAKE)

Loco brake system is provided to stop the locomotive whenever it runs light engine. It is purely compressed air brake system, for which a separate air circuit is provided in 28 LAV-1 & IRAB-1 brake systems independent to other air circuits. SA9 independent brake valve is provided in driving control stand for application & release of loco brake. This valve has two positions i.e. release and application. Complete independent brake system consists of SA9 independent brake valve, double check valve and C2-Relay valve.

17.5 DESCRIPTION OF LOCO BRAKE (INDPENDENT BRAKE) SYSTEM

The SA9 valve handle is kept normally in release position (right side).MR air is always available at port no.30 of SA9 valve. When handle is brought in application position (left side),then SA9 port 30connects port 20 an starts supplying pilot air to C2-Relay air valve. The pilot air pressure through MU2B valve port no.2&20 and enters C2-Relay valve at port no.2. The pilot air pressure depends upon the handle position, at maximum it is 3.5kg/cm2. C2-Relay air valve actuates after getting pilot air and connects MR pressure to break cylinders of locomotives through port no.1 &3. The brake cylinder pressure depends upon pilot air pressure, supplied into C2Relay chamber through port no.2. For full brake application SA9 handle is moved to maximum travel position. When SA9 handle is placed in release position, loco brakes are released. A gauge line is taken from front truck of locomotive to driver's cabin control stand for indicating brake cylinder pressure.

Loco brake can be applied any desired pressure between the minimum& maximum. This pressure will automatically be maintained in the locomotive brake cylinders against their normal leakage .The locomotive brake can be graduated on and off with either the automatic (A9) or the independent brake valves (SA9).it is always possible to release the locomotive brakes with the SA9 valve.



17.6 PROPORTIONATE BRAKE SYSTEM

In proportionate brake system locomotive brake works in proportion to train brake. If train brake is partially applied to slow down the train, loco brake will be applied proportionately through a proportionate brake valve.

Proportionate brake system consists of SA9 valve, MU2B valve, proportionate brake valve, C2 relay valve and double check valve. This system also known as synchronizing brake system, is designed for locomotive brake application during train brake application through A9 handle.

In this system proportionate valve is connected to vacuum pipe and MR pipe. When vacuum is dropped to zero for train brake application, vacuum of proportionate valve chamber A also drops to zero at the same time. Then proportionate valve supplies control / pilot air pressure to C2 relay air valve and loco brakes are applied. To avoid loco brake, Quick Release position is provided in SA9 valve. By moving the handle to quick release position loco brake does not take place. Prop / valve have two vacuum chambers, which are connected to SA9 valve port no.1 & No.7.

At quick release position both ports are connected thus equalizing both chambers of proportionate valve. In IRAB-1 brake system C3W distributor valve is provided in place of proportionate brake valve, which senses the BP pressure.

17.7 A-9 AUTOMATIC BRAKE VALVE

The A-9 valve is also provided on both the control stands, just above the SA-9 valve. This valve is also a pressure reducing, pressure maintaining and self-lapping type. It is used to apply and release loco and train brakes.

A-9 valve position	Amount of BP dropping in	Amount of BP maintained in
	kg/cm2	kg/cm2
Release	0	5.0
Minimum reduction	0.5	4.5
Full service	1.5	3.5
Over reduction	2.5	2.5
Emergency	5.0	0

17.8 SA-9 brake valve

The SA-9 valve is also provided on both the control stands, just below the A-9 valve. This valve is also a pressure reducing, pressure maintaining and self lapping type. It is used to apply and release loco brakes. The valve has got two positions as follows

- ➢ Release
- Application

17.9 MU2B valve

The MU2B valve is located on the right control stand just above HS4 valve. This valve has got two positions-

- ➤ Lead
- ➤ Trail /dead

This valve should be in lead position on single locomotive or on leading loco motive in multiple unit operations. On trailing locomotives this valve should be in trail position.

C-2 RELAY VALVE

The C-2 relay valve is just located above R-2 wheel on the under truck frame. On SA-9 application this valve gets operated and gives pressure for the break cylinders for the application of the loco brakes.

F-1 SELECTOR VALVE

The F-1 selector valve is located inside the right control stand. This valve has got two positions lead and trail. This position is changed automatically with MU2B valve positions. This valve helps in charging BC pressure in BC equalizing pipe.

At this time of multiple unit i.e.MU parting, this valve helps in application of trailing loco brakes in conjunction working due to drop in main reservoir i.e. MR pressure.

UNIT-18: "AAR" CLASSIFICATION

AAR CLASSIFICATION Arrangement of Wheel in Classification/Codification of Wheel Locomotive Rigid Frame Bogie Type Locomotive Carrying Wheel Driving Wheel 1. Carrying the weight of Locomotive 2. Don't have driving power Carrying wheel of locomotive as well as driving locomotive They are donated number Denoted by "A" "B" "C" 1: One set of carrying wheel 2: Two set of carrying wheel 3: Three set of carrying wheel Coupled driving wheel Independent driving wheel Denoted by adding suffix "O" with Denoted by super scrubbing dash to denoted letter the denoting letter AO: One set of driving wheel A"-One set of coupled driving BO: Two set of driving wheel B"-Two set of coupled driving CO: Three set of driving wheel C"- Three set of coupled driving

(ASSOCIATION OF AMERICAN RAIL ROAD CLASSIFICATION BASED ON WHEEL ARRANGEMENT)

UNIT-19: SAILENT FEATURE OF GT46MAC GM LOCOMOTIVE

AC-AC locomotives hitherto manufactured by GM have been only for the North American market which does not import any major constraint on the layout primarily because axel loads are in region of 30t are permitted on North American Railroads. Development of the layout for GT46MAC the axel load for which is restricted to around 20.5 t , was therefore, a major exercise in locomotive design.

The locomotive has been designed on the 'platform' concept i.e. the layout and the mounting of equipment is arranged in such a manner that retro fitment of equipment developed in future on existing locomotives as wells as equipment changes/up gradation of the existing design of the locomotive can be implemented without any major change in the under frame, superstructure and even layout. GT46MAC is provided with the following special feature:

19.1 PERFORMANCE SPECIFICATIONS

- ➤ 4000 TCV locomotive
- Higher tractive and braking effort capability-540 kn starting TE and 270 kn braking effort
- > 11% improvement in fuel efficiency over existing WDM2 locos.

19.2 PERFORMANCE IMPACT

- The GT46MAC provides unit reduction, fuel saving and additional revenue tonnage capability
- Operation of fewer units results in significant maintenance and operating savings.

19.3 RELAIBILITY ANDSERVICEABILITY

▶90-day maintenance intervals

- AC motors double traction motor life
- > No running maintenance required on traction motors
- 1. No brushes, commutator, nor rotor insulation
- 2. No flashover/ground relays

► Bogie Inverter Control

- 1. High level of reliability with fewer parts
- Million kilometer (1 Million mile) overhaul with HTSC bogie >6year engine overhaul period

19.4 COMPUTER CONTROL, A 32 BIT COMPUTER CONTROL FOR LOCOMOTIVE CONTROLS HAVING FOLLOWING FEATURES

- Trouble Shooting and self Diagnostics
- Alpha numeric display
- Archive memory and data logging
- Radar based super series Wheel Slip /Slide Control system

19.5 ENGINE

- ➤ 4000 TCV 16-710G3B
- High efficiency turbocharger
- > Unit fuel injector which eliminate the problematic HP tube.
- ➢ Low emissions
- Laser hardened cylinder liners.
- Inconel valves and hydraulic valve adjuster.
- Durable crankcase and piston structure.

19.6 AC Traction Technologies

- Simple, robust motor design
- Higher efficiency- lower temperatures
- Doubles motor overhaul interval
- > Utilizes bogie- controlled AC Traction invertors for higher inherent reliability
- ➢ All weather adhesion of 32%
- High adhesion and tractive effort
- Maintenance- free traction motors
- ➢ No limitations of minimum continuous speed
- ➢ High reliability and availability
- Lower rolling resistance and higher energy efficiency

19.7 HTSC (HIGH TENSILE STEEL CASTING) Bogie–Basic

- No wearing surfaces extend bogie overhaul intervals to 1.6 million kilometres(one million miles)
- Dual high adhesion and high speed
- > Available gear ratios for heavy haul and passenger operation
- Reduced wear of components extends bogie overhaul intervals to1.6 million kilometres(one million miles)
- \triangleright

19.8 IMPROVED MECHANICAL SYSTEMS, THE NOTABLE BEING

- Microprocessor based engine cooling system
- ➢ High lube oil sump capacity
- Self-cleaning inertial type primary filter
- Efficient secondary air filtration

19.9 IMPROVED MISCELLOUNES ELECTRICAL SYSTEMS, THE NOTABLE BEING

- Wide range Dynamic brakes effective down to near standstill
- Maintenance-free roller suspension bearing having lower rolling resistance efficient filtration for electronic cabinet.

19.10 CAB FEATURES

- Desk style console
- Air operated window shield wipers
- Multi-resettable vigilance controls (optional)

19.11 AIR SYSTEM

- ➢ Knorr CCB I Electronic Air Brake system
- Direct drive WLN air compressor

19.12 SAFETY ASPECTS

- Increased crashworthiness requirements
- Cab design and overall car body configuration provides improved visibility >Anti-climber available

DIFFERENCE BETWEEN WDG4 AND WDP4 LOCOMOTIVES

SN.	Description	WDG4	WDP4
1	Service	Goods	Passengers
2	Max. Speed	100kmph	160kmph
3	Weight	129 Tones	115.8 Tones
4	No. of Axles	6	6
5	No. of Traction Motors	6 (each bogie 3 drivers)	6 (each bogie 3 drivers)
6	TM Pinion and Bull Gear Ratio	17:90	17:77
7	Batteries	Lead Acid	Nickel Cadmium
8	No. of Batteries	2	10
9	NO. of Cells	32	50
10	Cell Voltage	2.1	1.5
11	Total Voltage	68	75
12	Engine Starting Switch	Located in engine starting room	Located in engine control panel
13	Lube oil filter drum	Only by pass valve	Bye pass valve with gauge (like fuel oil primary filter)
14	Blended Brake	Not provided	Provided
15	Low Water Level Switch	Not provided	Provided

<i>a</i>	D11			
S No	Description	WDM2	WDM2C	WDG4
1	Service	Goods /Coaching	Goods /Coaching	Goods
2	Length in meters	17.12	17.12	21.24
3	Weight in Tonnes	112.8	112.8	128.5
4	Max. speed in KMPH	110	120	100
5	Engine RPM in Idle	400	400	269
6	Engine RPM(8notch)	1000	1050	904
7	OSTA Tripping RPM	1110-1150	1160-1200	960-1045
8	Air Filtration	Panel type/ Cyclonic with paper type secondary filter	Cyclonic with Bigger size filter and paper type secondary filter	Cyclonic type primary and baggy type secondary filter
9	Brake system	IRAB-1	IRAB-1	CCB-KNORR
10	Lube oil sump capacity	910	1150	950
11	Fuel oil tank capacity	5000	5000	6000
12	Horse Power under idle condition	2600	3100	4000
13	Input to Traction	2400 HP	2750 HP	3726 HP
14	Adhesion (Max. Tractive effort adhesive weight	24.5% / 30.4 T	24.5%/30.4 T	43% / 55.1 T
15	Weight transfer	Centre pivot 60%	Centre pivot 60%	Side rubber
	to wheels through	Side bearer 40%	Side bearer 40%	Resilient pads 100%
16	Axle load (Tonnes)	18.6	18.6	21.42
17	Bogie	Cast/Fabricated	Cast/Fabricated	High speed steel cast
18	Gear Ratio (Pinion: Bull gear)	18:65	18:65	17:90
19	Traction motor arrangements	LLR/LRR	LLR/LRR	LLL/RRR
20	Electrical transmission type	DC/DC	AC/DC	AC/AC
21	Cranking done by	Generator working as motor	Exciter and aux. Gen. working as motor	Two starter Motor AC
22	Master Controller	Alco model	UIC model with	Reverser handle
			throttle wheel and	throttle / DB
			reverser handle	Handle
23	Transition	3 with field shunting	1 (No field shunting)	No transition
24	In case of TN	Will not function	Will not function	Will function for

SAILENT FEATURES OF WDM2, WDM2C, WDG4

	Isolation D.B.			working truck
25	TM Isolation	Defective TM can be	Defective TM can be	Particular truck to
		isolated	isolated	be isolated.
26	Type of Engine	4-Stroke V-16 Turbo	4-Stroke V-16 Turbo	2-Stroke V-16
		super charge super	super charge super	Turbo super charge
		engine	engine	super engine
27	Type of Turbo	Exhaust Gas Driven	Exhaust Gas Driven	Gear/ Exhaust Gas
	used	Turbo	Turbo	Driven Turbo
28	Type of truck	Tri mount Co-Co	Tri mount Co-Co	Side load pads
		type	type	centre pivot Co-Co
				type
29	Type of Air	Air compressor	Air compressor	Air compressor
	compressor	directly driven by	directly driven by	directly driven by
		engine	engine	engine through
				clutch type
•	~			coupling
30	Compressor cooling	Air cooled	Air cooled	Water cooled
31	Fuel Injection	Through separate	Through separate	Direct fuel injection
	system	fuel injection pump	fuel injection pump	by unit injectors.
		and injector	and injector	
32	Engine lube oil	One lube oil pump,	One lube oil pump,	Four lube oil pumps
	system	gear driven for entire	gear driven for entire	1. Scavenging oil
		lube oil system	lube oil system	pump gear driven.
				2. Piston cooling oil
				pump gear driven.
				3. Main lube oil
				pump gear driven.
				4. Soak back pump
				for turbo, electric
				motor driven.
33	Cooling water	One water pump	One water pump	Two water pump
	system	gear driven, one	gear driven, one	gear driven, two
		radiator fan and	radiator fan and	radiator fans driven
		drive from engine	drive from engine	by computer
		inrough ECC	through ECC	controlled electric
24	I OC par avany	1 5 1+-	1 5 1+-	$\frac{1101018}{0.5.1tr}$
54	100 ltrs Of Evol	1.5 IU.	1.5 IU.	0.5 Itr.
	oil consumption			
35	Minimum radius	73.2	73.2	64.92
55	of curvature	10.4	13.2	UT.72
	(Meters)			
36	Minimum	18	28.2	14 72 / 14 88
50	continuous speed	10	20.2	11.74/17.00
	(kmnh)			
37	Displacement /	668.25 Cu in	668.25 Cu in	710 Cu in
57	cylinder	(10950.66 cc)	(10950.66 cc)	(11634.82 cc)
		((· · · · · · · · · · · · · · · · · · ·

<u>AC – AC TRANSMISSION IN DIESEL LOCOMOTIVE</u>

From the very beginning the traction were dreaming of using three phase technology in railway vehicles using brush less AC machines. With such electrical machines, step less motor control was practically impossible apart from complexity in the system of control. The development of Gate Turn Off (GTO) thyristor and high capacity power diodes enabled the traction engineers to introduce AC-AC Transmission in Diesel Locomotive.

Basic Structure

The principle structure of the main system is the 710 G3B 16 cylinder diesel engine acting as source of power. A twin wound three phase alternator which is misnamed as main generator is coupled to the diesel engine for converting energy into electrical. Both the outputs of main generator are separately rectified to DC and then connected in series so as to get double voltage in the tune of 2000 - 2200 volts for supply to the DC link. The DC link operates as supply voltage to the two converters, provided for supply to the traction motor of front truck and rear truck. Traction controls computers, for necessary supply frequency to the traction motors. The locomotive is equipped with three computers namely EM 2000 for having total control over the diesel engine performance including safety aspects and self-diagnostic function, Siemens computers to have control over the converters are interfaced for communication. However, EM – 2000 can impose control over other computers. EM 2000 computer is the only computer that gas got a screen and the other KNOR computer displays only digits for understanding faults in the system.

AC vs DC Traction Systems

Why does the rail road industry give such high acclaim to AC traction systems? Perhaps the simplest way to answer such a question is to computer the power generating circuits on both DC and AC locomotives. On conventional DC locomotives, a diesel engine is used to turn a generator. This generator then produces power that is passed on to traction motors to drive the wheels. On today's existing locomotives, the generator is either a DC generator or a three phase AC alternator whose input is rectified to DC. This DC power is used to drive the wheels DC traction motors.

With the AC traction locomotives, the same basic principle is used. A diesel drives an alternator and the output is rectified to DC. This DC output (referred to as DC link) is passed on to inverters which convert the power back in to an AC from which can be used by AC traction motors. The DC and AC sides of the circuit are in sense decoupled by the inverter. This means that operating efficiencies of the generator and motors can be chosen independently. In other words, the generator can operate at some certain throttle position at which it is most efficient while the motors operate at some power, which is most efficient for them. It is entirely possible to operate the generator at its maximum output while operating the motors at zero volts. This is the first benefit of AC traction systems. Let us take a look not at some of the more tangible benefits of AC traction systems.

Nearly, all these advantages are a direct result of the AC traction motor. The motor used is a squirrel cage, 4-pole, 3 phase, AC induction motor. The four poles referred to are magnetic poles. The motor actually has 12 physical poles on the stator (3 phases per magnetic pole). The advantages gained by using the AC motor are more pulling power, elimination of stall

burns, low maintenance requirements and elimination of short time ratings. Another advantage to thr AC traction system is than an AC induction motor is in a sense "self-correcting". That is, the wheel will tend not to slip dramatically. This characteristic is inherent in the concept of an induction motor. With an induction motor, a magnetic field is set up inside the motor which is a rotating field. The more the rotor lags behind the field, the harder it gets "pulled". The more the rotor catches up to the field, the less it gets pulled. If the rotor actually begins to turn faster than the field, the rotor is retarded by the field. (This is the case in Dynamic Braking operation.) So, we see now the rotor will tend not to exceed the rotating speed of the field. Taking into account the fact that under most conditions, field frequency does not exceed rotor frequency by more than I Hz. It becomes clear how the induction motor when used in this system is self-correcting. A prime example of this characteristic of the motor occurred when one of the prototype units of general motor locomotive encountered a slipped motor pinion. The detection software failed to recognize the faulty motor condition. Since a slipped pinion means that there is no longer a stable mechanical connection to the axle, the rotor of a DC motor would almost instantly spin out of control until self-destruction. But with an AC motor, the rotor will just coast along at the speed as the rotating field. Since the maximum continuous speed of the AC motor is 4000 RPM and the inverters will not create a field that rotates faster than 3600 RPM, the motor is well within its non-destructive operating range. In fact, when the slipped pinion happened, it went undetected for more than a day even though system engineers were riding the locomotive at that time.

When the wheel slip occurs on a DC powered locomotive, the Main Generator excitation is reduced in order to reduce the generator output. This reduction limits power in to the slipping motor. The drawback here is that all motors not just the slipping motor, see a power reduction.

Internally, an AC induction traction motor contains no electrical connections for commutation. Commutation is carried out through the principle of Electromagnetic induction, as the name suggests. Since no commutator or brushes exit within the motor, stall burns are no longer possible and short time ratings have been eliminated.

Let us take this opportunity to clarify the elimination of short time ratings, as with any electrical machine, these AC traction motors can overheat. However, unlike earlier motors, these have temperature sensors built in to the field windings that provide feedback in to each inverter computer, If the temperature of a motor gets too high, the inverter computer automatically reduces power to that truck. The operator does not have to worry about overheating motors on these AC traction units as they will protect themselves.

Maintenance requirements on the AC motors are virtually non-existent. Brush maintenance is no longer required and commutator need not be stoned simply because the component does not exist in an AC motor. Also, traction motor flashover cannot occur, meaning a dramatic reduction in the amount pf ground relay trips, hence less road failure. This means great advantages in high speed operation. The AC motor is an entirely sealed case with no inspection doors. In fact, visual inspection of the motor, connections in cabling and gear case oil level are the only 90 day maintenance items as recommended by SIEMENS.

Several factors combine to give an AC motor "pulling power" than its DC counterparts. First an AC motor produces higher starting torque providing superior performance "out of the hole". Second, AC motors are rated higher in terms of peak RPM meaning the gear ratio at the bull gear/pinion interface can be altered to provide higher torque without sacrificing ground speed. Firstly, an AC motor can squeeze the same amount of horse power in to a remarkably smaller package that its DC counterpart. On modern DC units, larger motors occupy much of the

available space in the truck. This makes maintenance of the DC motors difficult. Since comparable AC motors are smaller in size, higher horsepower can now be achieved with more reasonable sized motors.

From an operational standpoint, a major variation must be noted under low speed and heavy pull operation. AC motors on EMD Locomotives do not require the high currents for low speed pulling that a DC motor do. Consequently, much less heat builds in the AC motor on an EMD AC locomotive at low speeds, virtually eliminating short time ratings. Third, because brushes and commutator do not exist in an AC motor, stall burns cannot occur. Last, loading times when moving the reverser from centre position to forward or reverse will be longer as "Flux" or magnetism must build up in the motors before operation can continue. Loading times, when changing throttle positions, however, will not be slower, in fact they may even be faster than on a Conventional DC traction unit.

Electric Braking

The traction motors, which are practically asynchronous motors, immediately begin to work as generators when the synchronous speed drops below motor's rotor speed. Hence, there is no need of contractors or transfer switches for changeover from motoring to braking. Same inverter can successfully function for imposing control on braking mode too. This system provides same characteristic as motoring during braking. The actual braking curve is always above the traction curve because of the losses. However, from safety consideration, the locomotives are designed to have braking effort at much lower value to avoid loss of adhesion. In order to avoid jerk when stopping, the braking effort is reduced gradually, just before stand still. However, the electrical brake can brake the train to halt.

S.No.	CONVENTIONAL	AC – AC		
1.	TRACTIVE EFFORT			
	Does not permit high TE for extended	High TE can be achieved continuously –		
	period – Driver is expected to observe	Traction motor torque depends on Slip		
	overload range. Torque is proportional to	and thereby on Frequency.		
	square of the current.			
2.	SUPPLY CURRENT			
	Always high during starting and at low	Always low and within safe value during		
	speed – Risk of overloading.	entire operation – Traction Motors are de-		
		coupled from Alternators by Inverters.		
	TRANSITION			
	There are peaks during transitions, which	No transition is involved. Frequency is		
	may lead to Flashover.	increased to have higher loco speed.		
	REVERSING			
	Necessitates contacts to reverse TM field	No switching is involved – sequence of		
	current, which call for frequent	phases defined by GTOs' firing order		
	maintenance.	decides the direction of rotation.		
	ELECTRIC BRAKING			
	Involves switching to convert Traction	Only electronic change over to redefine		
	Motors to Generators and for connection	supply frequency - Braking energy can		
	of Braking Grids.	be suitably utilized.		
	BRAKING EFFORT			
	Ineffective low speed – demands	Enables maximum braking effort right		
	conventional brake application.	down to sand still.		

ADVANTAGES OF AC - AC

TRACTION GENERATOR	
Always over dimensioned for higher	Dimensioned according to power rating.
current rating.	
RELIABILITY	
DC machines are less reliable and are	AC machines are more reliable.
trouble prone.	
MAINTAINABILITY	
DC machines call for frequent	Brush less machines are practically
maintenance. Carbon brushes require	maintenance free.
regular replacement.	
BULL GEAR LUBRICATION	
Use of heavy grease inside non leak proof	Oil lubrication ensures longer gear life.
gear box reduces gear life.	
POWER CIRCUIT WIRING	
Involves expensive thick cable of more	Involves thin cables (1/8th) as the system
length for reversing and braking.	has higher voltage and three phases.
TRANS. EFFICIENCY	
Low comparing to AC-AC	More than Conventional.

UNIT-20: DEMU

INTRODUCTION

DEMU is a self-propelled electric vehicle/coach used for urban transport. The lighter Coaches faster speeds and higher load carrying capability have made DEMUs very economic and passenger popular. It is economical for short rake information (3-car/ 6-car, 9 –car rake). It is also advantageous for running train in either direction without changing the loco position. This is almost similar to EMU. In EMU the source of power is overhead electricity, whereas in case of DEMU the source of power is the diesel engine. In 1994- 1995 they are first introduced in Indian Railways.

The benefits obtained from DEMUs are:

- Fast and frequent service
- No need for reversal at the terminals as it can be driven from either end
- High acceleration
- Ergonomically designed coaches
- Low capital and maintenance cost
- Efficient use of rolling stock

In Indian Railways DEMUs are available both of 700 HP and 1400 HP. In addition, 9 units of DHMUs (Diesel Hydraulic Multiple Units) are also operating in SC Railways.

2. 700 HP DEMU

2.2

2.1 **OPERATING PARAMETER**

1.	Track Gauge	:	1676 mm (broad)
2.	Composition of unit	:	1 DPC - 1 TC + 1 DTC
	-	(DP	C: Driving Power Car,
		TC	: Trailer Car,
		DTC	C: Driving Trailer Car)
3.	Passenger Capacity	:	DPC – 79, TC/DTC – 108
4.	Estimated Service weight	:	188 Tones
5.	Maximum Axle Load	:	17 T (DPC), 15 T (TC/DTC)
6.	Wheel Arrangement	:	ВО-Во
7.	Wheel dia	:	952(New),
		877	mm (Fully worn)
		914.	5 mm (Half worn)
8.	Effective traction power output	:	610 HP
9.	Transmission	:	Electric AC/DC
10.	Max operating speed	:	100 KMPH
11.	Clearance above rail level	:	Minimum of 102 mm with Coaches
fully	y		
		Load	led and wheels fully worn
EQUI	PMENT SPECIFICATIONS		
1.	Manufacturer of equipment	:	ICF
2.	Engine Make	:	KCL
3.	Engine Model	:	VTA -1710 - L
4.	Transmission	:	Electric (AC/DC)
5.	Brake	:	Air
6.	Cooling system	:	Hydrostatic Fan Drive
7.	Installed Power	:	700 HP

	 Input to Traction Traction Motor Make Traction Motor rating Max cruising speed Compressor Make Compressor Model Lighting Generator Make 		 : 630 HP : BHEL : 167 KW : 110 kmph : ELGI : TRC 1000 : KELA 16122 FM
	15. Net Weight Tare weight Pay Load	:	60 Tons 9.49 Tons
2.3	ENGINE SPECIFICATIONS Engine Make	:	Kirloskar Cummins Limited, Pune
	Engine Model	:	VTA -1710 – L
	Displacement Volume	:	1710 Cubic Inches (28 Litres)
	Туре	:	45 Cycle, VEE type, 12 cylinders
	Bore & Stroke in Cu. In. (mm)	:	5.5 (140) x 6.0 (152)
	Compression Ratio	:	14.5:1
	Aspiration	:	Turbo charged & After cooled
	Firing Order	:	1L-6R-2L-5R-4L-3R 6L-1R-5L-2R-3L-4R
	Governor	:	LCC
	Rating Max allowable intake restriction (Dirty element)	:	705 BHP @ 1800 RPM 25 inches of Hg
	Engine coolant capacity	:	85 litres

3. 1400 HP DEMU

The success and popularity of DEMU and to meet the increased demand of traffic it was decided to develop high HP DEMU (1400 HP) with more seating capacity, higher acceleration and higher speed potential to serve both suburban and intercity traffic. To achieve these objectives, following upgradations have been carried out.

- 1400 HP type KTA 50 –L engine of Cummins
- High capacity Alternator type 7303 and Traction Motor type 4303 of BHEL
- Air springs on bogies to give better riding comfort and speed potential up to 100 kmph
- Capable to run 4 car units consisting of 1 power car, 2 trailer cars and 1 driving trailer car. Thus provides 37.8% extra passenger capacity per unit, as compared to 700 HP cars and still run at higher speed.

ITEM	D	DEMU TYPE		
	700 HP	1400 HP		
Acceleration	0.40 m/sec^2	0.56 m/sec^2		
Max Speed	95 kmph	100 kmph		
Passenger carrying	Seating : 228	Seating : 384		
capacity per unit	Standing : 504	Standing : 708		
	Total : 792	Total : 1092		
Input to Traction	610 HP	1310 HP		
Time to pick up	130 Secs	61 secs		
speed from 0 to 60				
kmph				
Time to pick up	310 Secs	115 secs		
speed from 0 to 80				
kmph				
Max tractive effort	11.9 tons	15.2 tons		
Secondary	Coil springs	Air springs		
suspension				

3.1 COMPARISON OF 700 HP DEMU VS. 1400 HP DEMU

3.2 PERFORMANCE COMPARISON WITH EMUs

ITEM	1400 HP DEMU		EMU	
	60	80	60	80
	KMP	KMP	KMP	KMP
	Н	Н	Н	Н
Time taken in	61	115	76	300
secs				
Distance taken	632	1693	778	5293
in Mtrs				

Each unit containing 4 Cars (1 DPC + 3 TC)

Each unit containing 3 Cars (1 DPC + 2 TC)

ITEM	1400 HP DEMU		EMU	
	60	80	60	80
	KMP	KMP	KMP	KMP
	Н	Н	Н	Н
Time taken in	46	83	55	172
secs				
Distance taken	467	1208	565	2890
in Mtrs				

UNIT – 21: TRACK PARAMETRES AT A GLANCE

1) Gauge	BG	a) Straightb) On curve with radiusMore than 440 mtrs.c) On curve with radius less 16 than 440 mtrs.	1676±6 mm 1676+15 mm -06 mm 76 +20 mm – 0 mm
	MG&NG	a) Straight	1000+6 mm -3 mm
		 b) On curve with radius than 1000 than 290 +03 m Mtrs. And more than 175 mtrs NG c) On curve with radius Less than 290 mtrs. And less than 175 mtrs. For NG 	+15 mm more m for 1000+20 mm

- 2) Unevenness of rail joint depression (low joint) Permissible 10mm measured on a chord of 3.5 mtrs.
- 3) Twist- a) 2.78 mm/mtrs. For straight and curved track.

b) 1mm/ mtrs. For transition of curve.

- 4) Alignment defects 5mm for a straight track.
- 5) Versine BG speed at curve in excess of 100 km/hrs, the station to station variation of versine a station 10mtrs apart should not exceed 15mm, for speed of 100 km/hrs and less, the variations should not exceed 20 mm or 20% of the average versine of circular portion whichever is more.

MG –On curves which permit speed in excess of 75 km/hrs, the station to station variation the versine ata station 10 mtrs apart should not exceed 15 mm, for speed of 75 km/ hrs and fewer variations should not exceed 20 mm or 20% of average versine of circular portion whichever is more.

- 6) Check rails on Curves Check rails are provided on gauge face side of inner Rail on curves shaper than 8° on BG, 10° on MG and 14° on NG.
- 7) Wear on wing rail and the nose of crossing
 - a) On CMS crossing 5.5mm for Rajdhani and Shatabdi Routes - 7.5mm for all other Routes.
 - b) On fabricated crossing 4mm for Rajdhani and Shatabdi Routes

6mm for all other Routes

9)

8) Condition of Tongue Rail - The Tongue rail should not be twisted cracked on broken up to length of 20 mm from its toe, should not have knife edge and have more than 5mm gap in applied condition. The maximum permitted vertical wear in 6mm.

Throw of the switch-	Max.	Min.	
BG	11	5mm	95mm
MG	10)0mm	89mm

10) Check rail clearance	Max.	Min.
BG	48mm	44mm
MG	44mm	41mm
	11 / 1	

11) Gauge and cross level at switch assembly (point)-

- 1) 305 mm ahead toe and switch
- 2) 150 mm behind the toe of the switch
- 3) Middle of tongue rail
- 4) Heal of the switch for straight and turn out. These should be correct at all place except heal block where it can be 6mm slack.
- 12) Gauge and cross level of crossing assembly-

The gauge and cross level should be checked at following locations and should always be correct

- 5) 1mtrs. ahead of nose on straight and turn out.
- 6) 150 mm behind the ANC on straight and turn out.
- 7) 1 mtr. Behind the ANC on straight and turn out.
- 13) Breathing length of SEJ \pm 60mm

14) Pandrol clip (MK –III) toe load – 900- 1000 kgs load exert for a nominal deflection of 13.5 mm

15) Service life of rail and UST of Rails.

/	C	D '1 ('	
	Gauge	Rail section	on Service life in GMT (with test free peri
	BG	60kg/mtrs	8. 800 GMT with 25% Test free period
	52kg/mtrs.	525 GMT	with 25% Test free period
		90R	375 GMT with 25% Test free period
	MG	75R	225 GMT with 25% Test free period
-			

16)Frequency of UST on all BG Routes

Up to 8 GMT	12 Months	
8 to less than 12	9 Months	
12 to less than 16	06 Months	
16 to less than 24	04 Months	
24 to 40 GMT	03 Months	
More than 40GMT	02 Months	
17) Ballast cushion		
Route	Ballast cushion	Speed
A class	300 mm	160 kmps
B&C (suburban) class	250mm	130 kmps
D class	200 mm	100 kmps
E class		

UNIT-22: WELDING

- **22.1 Introduction:** Welding is the process of joining two pieces of metals by application of heat. The heat may be developed in several ways, along with this application of heat; in some ways pressure is also applied in order to have better action of joining. For additional strength, sometimes filler material is also used. It is very old and this started with joining of metals by heating them to very high temperature and then hammering. The various ways of applying pressure in order to effect welding are hammering and rolling. In welding without the application of pressure, the metals are brought to fluid state and joined by some filler material. This is the most rapid and easiest way of fabrication and assembly of metal parts. The research carried out in this field has given various ways and method to weld practically all metals. Devices have also been found out to weld dissimilar metals. One beauty of welding on comparison to other process of joining metal is that by this process we can have more than 100% strength of joint and it is very easy process.
- 22.2 Classification of welding:-It is divided in two main sub classes:-
 - 1. Plastic / Pressure welding
 - 2. Fusion / without pressure welding
- **22.2.1 Plastic welding**:-In this process, the pieces of metals to be joined are heated up to the plastic state and then forced together by external pressure without the addition of filler material. Forge welding, resistance welding and Thermit welding with pressure are examples of this class.
- **22.2.2 Fusion welding:**-In this case, the metal at the joint is heated to molten state and allowed to solidify. In this case filler material is used during welding process. This includes gas welding, ARC welding and Thermit welding.



22.3 Advantages of welding

- 1. A good weld is as strong as base metal.
- 2. General welding equipment is not very costly.
- 3. Portable welding equipment is available.
- 4. Welding permit considerable freedom in design.
- 5. A large no. of metal/alloys both similar and dissimilar can be joined by welding.
- 6. Welding can join work piece through spots as continuous pressure tight seams end to end and in no. of other configuration.
- 7. Welding can be mechanised.

22.4 Disadvantages of welding

- 1. Welding create harmful radiation (light), fumes and spatters.
- 2. Welding results in residual stresses and distortion of work pieces.
- 3. Jigs and fixtures are generally required to hold and position the parts to be welded.
- 4. Edge preparation of the work pieces is generally required before welding them.
- 5. A skilled welder is a must to produce a good welding job.
- 6. Welding heat produces metallurgical changes.
- 7. A welded joint for many reasons needs stress relief heat treatment.

22.5 POINTS FOR HOW TO START THE WELDING JOB: (MANUAL METAL ARC WELDING)

- 1. Put on the protective clothes i.e. Apron, hand gloves, shoes guard, arm sleeves, welding screen etc.
- 2. In arc AC welding connect the holder to holder point and work (job) to work terminal.
- 3. Clean the work piece from paint, dust, grease, oil and moisture.
- 4. Select the diameter of the electrode as per job thickness.
- 5. Select the current according to the diameter of electrode.
- 6. In case of welding of thin section to thick section select the parameter of thin section basis.
- 7. Keep the work piece in easy welding position.
- 8. Strike the electrode on job and maintain the arc length i.e. equal to diameter of electrode.
- 9. Keep the electrode angle 60 degree with weld line and 90 degree with job surface.
- 10. Maintain the steady travel speed of electrode to form the bead.
- 11. Remove weld slag and clean each bead prior to making the next bead.

22.6 Essential for proper welding process

- 1. Correct electrode size
- 2. Correct current
- 3. Correct arc length
- 4. Correct travel speed
- 5. Correct electrode angle
- **22.7 Quality of welding**:- Beside the steady frying and cracking sound that a correct arc produces. The shape of the molten pool and the movement of the metal at near the pool serve as guide in checking welding quality. In a correctly made deposit the ripples produces on the bead will be uniform and the bead will be smooth with no overlap or undercut.

Correct electrode size: The correct choice of electrode size involves consideration of a variety of factors such as the type, position and preparation of the joint, the variety of the electrode to carry high current values without injury to the welding metal or less of deposition efficiency. The mass of work and its ability to maintain its original properties after welding. The characteristics of the assembly with reference to effect to strain set up heat application. The practicability of heat treatment before and / or after welding the specific requirement as to quality and cost of achieving the desired results.

Correct current: If current on machine is too high or low, you are certain to be disappointed in your welding. If too high, the electrodes melt too fast and your molten pool is large and irregular. If too low, there is not enough heat to melt the base metal and your molten

pool will be too small, will pile up, and look irregular. So select proper current according to job thickness and electrode size.

Correct arc length: If the arc is too long, the metal melts off the electrode in large globules which wobble from side as the arc wavers, giving a wide spattered and irregular bad with poor fusion between metal and deposited metal.

22.8 WELDING PROCESS FOR STEEL IRSM44: Both Manual Metal Arc welding (MMAW)and Gas Metal Arc Welding (GMAW)welding processes can be used can be used on IRS: M44. Tungsten inert gas (TIG) welding is usually used to weld the thinner plate thickness e.g. 1.0-3.0mm. The use of combined processes, e.g. TIG root followed by MIG/MAG filler and cap is considered as a means of improving both quality and productivity and shall preferably be employed. The Submerged Arc Welding (SAW) process should be used with great care keeping in view the high heat input and slow cooling rate associated with the process which can cause excessive loss of toughness in the heat affected zone.

Manual Metal Arc Welding (SMAW or MMAW):

- Electrical Characteristics:- D.C.E.P. (Direct Current Electrode Positive)
- Consumables:- Electrodes having rutile or basic flux coating are generally preferred as they reduce the likelihood of slag inclusions. The electrode pre-heat and storage requirements (recommended by the electrode manufacturer) must be strictly adhered to technique:
- ➤ A short arc length must be maintained together with normal welding speeds to ensure that good penetration occurs with negligible alloy losses and no electrode overheating.
- > Weaving and back stepping must be avoided to reduce the heat input.
- A stringer bead technique must be employed.
- Current setting should be minimum as required but with the range recommended by the electrode manufacturers.
- Lead angles must be as small as possible to obtain optimum penetration.

Adjust	ELECTRODE		VOLTAGE (V)	CURRENT	for
positional In all	TYPE	DIA.(mm)			cases
the		1.6	19-21	30-40	
	Rutile	2.0	20-22	40-55	
		2.5	20-22	60-75	
		3.25	21-23	95-115	
		4.0	21-23	120-140	
		1.6	24-30	35-45	
	Basic	2.0	24-30	45-60	
		2.5	24-30	65-80	
		3.2	24-30	100-120	
		4.0	24-30	130-150	

Typical voltages and currents for different types and diameters of electrodes (Horizontal Welding)

manufacturers' recommendations should be followed.

1. CO₂ WELDING

INTRODUCTION:-MAG / CO2 (carbon-dioxide) is a variation of the standard MIG process. In MIG process, generally argon, helium or their mixtures are used for shielding the molten weld pool. Where as in co_2 welding process, carbon dioxide is used as the shielding gas.

- CO₂ being an active gas, this process is known as MAG process.
- CO₂ welding is used for the welding of carbon and low alloy sheets from 16 gauge (0.059 inch) to .25inch (6 mm) or heavier.
- It produces deeper penetration than argon or argon mixtures with slightly more spatter.
- CO₂ have become widely popular for arc shielding or the welding of sheets.
- CO₂ is basically a semi-automatic process, in which the arc length and the feeding of the electrode wire into the arc automatically controlled.
- Less skilled welder is required in compare to TIG & SMAW process.
- CO₂ welding may also be used in mechanised and automatic forms where producing is to be increased and consistent quality in welding object is demanded.

WELDING EQUIPMENT :

- A D.C. power source and contracts.
- A wire feeder which contain of DC motor, speed reducing gear box,2/4 roll drive, gas solenoid valve, potential meter.
- The welding gun.
- Shielding gas.
- Flow meter.
- Control cables.
- Welding cables.
- Hoses for gas and water.
- Gas preheater.
- Welding helmet. \Box Glows.
- Apron
- Anti-spatter silicon spray etc.

WELDING PROCEDURE:-

- Correct edge preparation and joint fit up.
- Joint surfaces to be cleaned of rust, scale, grease or any other foreign matter.
- Assembling the welding equipment and setting the welding parameters.
- Selecting correct gun nozzle size.
- Setting electrode extension on the basic whether short circuiting or spray type welding is to be done.
- Passing on the carbon dioxide gas supply to remove air from the hoses and then setting Co2 flow rate as per base metal and joint design.
- It is easy to weld in the down hand position.
- Fillet, vertical, horizontal and overhead welds can also be made using Co2 welding.
- After the weld is complete, the end crater should be filled.

ADVANTAGES:-

- Higher welding speeds.
- Better and deep joint penetration with good bead control and little tendency to undercut as compound to argon.
- Sound welds deposits which can be made consistently.
- Lower associated cost as Co2 is relatively less expensive.
- Despite the oxygen in Co2, porosity is not a issue when a suitably deoxidized wire (electrode) and reasonably short arc used.
- Good mechanical properties of weld metal.

DISADVANTAGES:-

- Co2 produces a rather harsh arc.
- Spatter is expensive unless a very short, uniform arc length is maintained, keeping the tip of the electrode below the surface of the work properly adjusting the power supply inductance setting also minimises spatter.
- High impact properties in weld metals can't be achieved.

2. METAL INERT GAS ARC WELDING (MIG)/ GASMETAL ARC WELDING (GMAW)

PRINCIPLE OF OPERATION: - It is an arc welding process where in coalescence is produced by heating the job with an electric arc establishment between continuously fed metal electrode and the job. No flux is used but the arc and molten metal arc shielded by an inert gas, which may be argon, helium,Co₂ or a gas mixture. Before igniting the arc, gas flow is checked. Proper current and wire feed is set and the electrical connections are ensured. The arc is struck by any one of the two methods. In the first method, current and shielding gas flow is switched ` on' the electrode is scratched against the job as usual practice for striking the arc. In the second method, electrode is made to touch the job, is retracted and then moved forward to carry out welding, but before striking the arc, shielding gas, and current is switched on. About 15mm length of the electrode is protecting from the torch before striking the arc. During welding torch remains about 10-12mm away from the job and arc length is kept between 1.5 to 4mm. Arc length is maintained constant by using the principle of self-adjusted arc and controlled arc in semi-automatic (manually operated) and automatic welding sets respectively. MIG welding is very versatile in that a wide range of material thickness and positions can be accommodated. Weld quality and weld speeds that can be achieved are with high with MIG/MAG welding. Lack of side wall fusion problems commonly associated with process must be guarded against by providing proper angle to the arc.

EQUIPMENT:-

- Welding power source and cables.
- Welding torch and wire electrode coiled on a spool.
- Wire feed mechanism and controls consisting of a pair of driving rolls, electric motor etc.
- Shielding gas cylinder, pressure regulator and flow meter.
- Controls for switching on and off the currents, electrode wire and inert gas.

Electrical characteristics:-D.C.E.P. (Direct Current Electrode Positive)

- Consumables:-Filler wire:-
- The austenitic stainless steel consumable wires are recommended.
- Typical Welding Parameters for MIG Short Arc and Spray Arc Welding.

Type of	Position	Wire	Current	Voltage (V)	Speed
Arc		Diameter	(A)		(mm/sec)
		(mm)			
	Flat	0.8	130-140	22-24	3.0-4.5
Short Arc	Vertical	0.8	110-130	20-22	3.0-4.5
Spray Arc	Flat	1.6	325-375	25-28	3.0-4.5

It is recommended that the mechanical properties achieved by welding with this process be carefully evaluated in terms of the joint requirements. The welding should be in any case being carried out in accordance with an approved welding procedure.

Shielding Gas:-The shielding gas should be an argon 1 to 2% oxygen mixture. Argon based shielding gases containing a maximum of 5% carbon dioxide has been successfully used. Gases containing higher carbon dioxide concentration will require procedure testing.Gas flow rate under shielded welding conditions must be at least 14 litre/min. higher gas flow rates will be required if welding is being carried out in draughty or exposed conditions(too much is too bad as too low).

MIG/ GMAW WELDING DIAGRAM



ADVANTAGES:-

- Because of continuously fed electrode, MIG welding process is much faster as compared to TIG or stick electrode welding.
- Produce joints with deep penetration.
- Thick and thin type of work pieces can be welded effectively.
- Large metal deposition rates are achieved by MIG weld process.
- The process can be easily mechanised.
- No flux is used, MIG welding produces smooth, neat clean and spatter free welded surfaces which require no further cleaning, welding cost reduces.
- Higher arc travel speed associated with MIG welding reduces distortion considerably.

DISADVANTAGES:-

- The process is slightly more complex as compared to TIG or stick electrode welding because no of variable like- electrode stick out, torch angle, welding power etc. are required to be controlled effectively to achieve good results.
- Welding equipment is more complex, more costly, and less portable.

- Since air drafts may disperse the shielding gas, MIG welding may not work well in outdoor welding applications.
- Weld metal cooling rates higher than with the process that deposit slag over the weld metal.

3. TUNGSTEN INERT GAS ARC WELDING (TIG) OR GAS TUNGSTEN ARC WELDING (GTAW)

PRINCIPLE OPERATION: - It is an arc welding process where in coalescence is produced by "Heating the job with an electric arc between a tungsten electrode and a job. A Shielding gas is used to avoid atmospheric contamination of the molten weld pool. A filler metal may be added, if required. Welding current, water and inert gas supply are turned on. The arc is struck either by torching the electrode with a scrap metal tungsten piece or using a high frequency unit. In the first method arc is initially struck on a scrap metal piece and then broken by increasing the arc length. This procedure repeated twice or thrice warms up tungsten electrode. The arc is then struck between the electrode and pre-cleaned job to be welded. This method avoids breaking electrode tip, job contamination and tungsten loss. Weld puddle is developed due to arc action on the job.

- Welding torch is moved back.
- Filler rod is moved ahead and filler metal is added to the weld puddle.
- Filler rod is withdrawn.
- Torch is moved to the leading edge of the puddle.

NOTE:- Job before welding is cleaned off all air ,grease, paint, rust, etc. either mechanically or chemically.

EQUIPMENT:-

- Welding torch, Tungsten electrode, filler materials.
- Welding power source, high frequency unit, DC supply unit, Cables.
- Inert gas cylinder, pressure regulator and flow meter.
- Cooling water supply.
- Water and gas solenoid valves.
- This process is generally limited to sheet up to 2.5mm. TIG welding is also used for fusion of the root run on heavy gauge weldments. In order to ensure adequate ductility in the world, a suitable austenitic filler wire should be used.
- Electrical characteristics:-D.C.E.P.(Direct Current Electrode Positive)
- Electrode-1-2% throated tungsten using a 30-60 vertex angle (pointed tip) for optimum welding penetration for the least current used.
- Gas:-Pure argon must be used as the shielding gas typical flow rates are between 8 and 14 l/min.

APPLICATIONS:-

- Welding Aluminium, Mg ,Copper ,Nickel and their alloy Carbon alloy or stainless steel, inconel, high temp and hard surfacing alloys like Zirconium, titanium etc.
- Welding sheet metal and thinner sections.
- Welding of expansion bellows, transistor cases, instrument diaphragms and cansending joints.
- Precision welding in atomic energy, air craft, chemical and instrument industries. Rocket motor chamber fabrication in launch vehicle.

ADVANTAGES:-

- No flux is used, hence is no danger of flux entrapment. When welding refrigerator and air conditioner components.
- Because of clear visibility of the arc and the job, the operator can exercise.
- This process can weld in all positions and produces smooth and sound welds with less spatter.
- TIG welding is very much suitable for high quality welding of thin materials (As thin as 0.125mm).
- It is very good process for welding nonferrous metals and stainless steel.

DISADVANTAGES:-

- Under similar applications, MIG welding is a much faster process as compared to TIG welding, since TIG welding requires a separate filler rod.
- Tungsten if it transfers to molten weld pool can contaminate the same. Tungsten inclusions are hard and brittle.
- Filler rod end of it by chance comes out of the inert gas shield can cause weld metal contamination.
- Equipment costs are higher than that for flux shielded metal arc welding.

PLASMA ARC CUTTING

WHAT IS PLASMA: One common description of plasma is that it is the fourth state of matter. We normally think of the three state of the matter as Solid, Liquid & Gas.

- For the most commonly known substance water, these states are ice, water and steam.
- If you add heat energy, the ice will change from a solid to a liquid and if more heat is added it will change to a gas (steam). When substantial heat added to a gas, it will change from gas to plasma the forth state of matter.
- If you boost a gas to extremely high temperature you get plasma. The energy begins to break apart the gas molecules and atom begins to split. Normally atom is made up of proton and neutrons in the nucleus.
- In plasma the electrons separates from the nuclease. Once the energy of heat releases the electrons from the atom, the electrons begin to move around quickly.
- The electrons are negatively charged and they leave behind their positively charged nuclei. These positively charge nuclei are known as ions.
- By adding energy to water it separates into hydrogen and oxygen, further addition of more energy the ionization of gases takes place and creation of free electrons and ions takes place. This is called plasma and it is conductive of electricity due to availability of free electrons.



PLASMA ARC CUTTING



What is plasma cutting?

This is a cutting system utilizing heat generated by arc discharge between the cutting object material and the electrode inside the torch. Arc discharge heat forms working gas into the plasma state of high temperature; the plasma jet of high temperature and high-speed is blown out from the nozzle; and the cutting object material is fused to be cut.

Process

A plasma torch requires you to start an arc between the electrode in the torch and the work you intend to cut. To start this arc there are various methods used, commonly High Frequency or Blow Back. HF (High Frequency) is used in most modern industrial plasma systems and in many older systems. The second common method is known as blow back, or short circuit start.

In a high frequency plasma system there are no moving parts in the torch. The electrode is connected to the power source's negative output and the work connected to the positive. The electrode is the conductor from which the arc starts and travels to the work piece. To start the arc the plasma initially connects the nozzle to positive. The nozzle is responsible for directing the gas flow, it wraps around the electrode and has a small output hole inwhich the gas flow and the plasma arc is directed. A DC potential between the nozzle and electrode is established and the HF circuit is turned on. The high frequency, high voltage causes a small low current arc to transfer between the nozzle and electrode in the torch. The low HF current creates a path of ionized gas allowing the lower voltage DC output to conduct. The current established between the nozzle and electrode in the torch is known as a Pilot Arc.

In the blow back method the arc is started with the plasma torch's electrode and nozzle initially touching. The power source draws a current from the nozzle to the electrode. After the current is established the power source will turn on the gas flow. Due to the design of the torch when gas begins to flow the electrode will pull away from the nozzle. As the electrode retracts the current draw between it and the nozzle will create a spark. With this ionized path of gas, lower voltage DC current is allowed flow and once again has a Pilot Arc.

In both methods above you achieve a pilot arc, which is an ionized path of gas between the electrode and nozzle in the torch. Once this pilot arc is brought close to the work, which is at the

same potential as the nozzle, current will transfer directly from the electrode to the work. The plasma source will detect the current into the work and disconnect the nozzle (in most cases) allowing full current flow from the electrode to nozzle.

Plasma is an effective means of cutting thin and thick materials alike. Hand-held torches can usually cut up to 38mm thick steel plate, and stronger computer-controlled torches can cut steel up to 150 mm thick. Since plasma cutters produce a very hot and much localized "cone" to cut with, they are extremely useful for cutting sheet metal in curved or angled shapes. Through a small channel pressurized gas such as argon, nitrogen, air is sent. At the centre of channel there is a negatively charged electrode. As the gas passes through spark is produced in channel and the gas is converted to plasma. The temperature of this plasma is upto 17,000 ⁰C and speed at which it travel 20,000 feet per second. The plasma is sufficiently hot to melt the metal being cut and moves sufficiently fast to blow molten metal away from the cut. The plasma itself conducts electrical current. The cycle of creating the arc is continuous as long as power is supplied to the electrode and the plasma stays in contact with the metal that is being cut.



TYPES OF PLASMA ARC CUTTING 1. AIR PLASMA CUTTING

Air is used as plasma forming gas. The electrode material is hafnium or zirconium, which is mounted on copper holder. Air for cooling the torch is also used. It is used because it is cheaper. The disadvantage is erosion at a faster rate of electrode material.



DUAL FLOW PLASMA ARC CUTTING

2. WATER SHIELD PLASMA CUTTING

It is similar to dual flow except that for shielding purpose water is used. It improves cooling effect.

3. WATER INJECTION CUTTING

UNDERWATER WELDING:-Underwater welding can be classified as:-

(1) Wet Welding (2) Dry Welding

In wet welding the welding is performed underwater, directly exposed to the wet environment. In dry welding, a dry chamber is created near the area to be welded and the welder does the job by staying inside the chamber.

WET WELDING

Wet Welding indicates that welding is performed underwater, directly exposed to the wet environment. A special electrode is used and welding is carried out manually just as one does in open air welding. The increased freedom of movement makes wet welding the most effective, efficient and economical method. Welding power supply is located on the surface with connection to the diver/welder via cables and hoses. In wet welding MMA (manual metal arc welding) is used.

Hyperbaric Welding (dry welding)

Hyperbaric welding is carried out in chamber sealed around the structure to bewelded. The chamber is filled with a gas (commonly helium containing 0.5 bar of oxygen) atthe prevailing Pressure. The habitat is sealed onto the pipeline and filled with a breathable mixture of helium and oxygen, at or slightly above the ambient pressure at which the welding is to take place. This method produces high-quality weld joints that meet X-ray and code requirements. The gas tungsten arc welding process is employed for this process. The area under the floor of the Habitat is open to water. Thus the welding is done in the dry but at the hydrostatic pressure of the sea water surrounding the Habitat.

Principle of operation of Wet Welding

The process of underwater wet welding takes in the following manner: The work to be welded is connected to one side of an electric circuit, and a metal Electrode to the other side. These two parts of the circuit are brought together, and then separated slightly. The electric current jumps the gap and causes a sustained spark (arc), which melts the bare metal, forming a weld pool. At the same time, the tip of electrode melts, and metal droplets are projected into the weld pool. During this operation, the flux covering the electrode melts to provide a shielding gas, which is used to stabilize the arc column and shield the transfer metal. The arc burns in a cavity formed inside the flux covering, which is designed to burn slower than the metal barrel of the electrode.

THINGS TO BE NOTICED FOR GOOD PLASMA CUTTING OPERATION

- **1.** A clean compressed air supply, without water or oil.
- 2. The nozzle and electrode are correctly in place.
- 3. A good connection of the work lead to a clean portion of the work.
- 4. Correct air pressure, this can be checked by looking at the gauges on the unit.
- 5. Don't touch the nozzle to the work piece.
- 6. Proper cutting speed should be maintained.
- 7. Maintain a constant work distance.
- 8. Travel in the direction which gives you the best finished work.

PLASMA ARC CUTTING SET

Input Power -415V, 50-60Hz, 3 PH, 10KVA O/P CURRENT-10-50A OCV= 250V Duty Cycle-100@40% Size- 490' 270'375 Quality cut- 8mm Gas - compressed air

Advantages of Plasma Arc cutting:

- 1. It cuts carbon steel upto 10 times faster than Oxy-fuel cutting, with equal quality more economically.
- 2. It leaves a narrower kerf.
- 3. Plasma cutting being primarily a melting process, can cut any metal.
- 4. Arc Plasma torches give the highest temperature available from many practicable sources. The energy seems to be unlimited in this method.

Disadvantages of Plasma Arc cutting:

1. High initial cost of the equipment.

Applications of plasma arc cutting:

- i) Plasma cutting is used to cut particularly those nonferrous and stainless metal that cannot be cut by the usual rapid oxidation induced by ordinary flame torches
- ii) Plasma cutting can be used for stack cutting ,plate bevelling, shape cutting and piercing
- iii) With some modifications, plasma arc cutting can be used under water.
- iv) Plasma arc cutting finds application in many industries such as ship-yards, chemical, nuclear and pressure vessels.
- v) It is used for removing gates and risers in foundry.
- vi) It cuts hot extrusions to desired length.
- vii) It is used to cut any desired pipe contour.
- viii) It is also employed for gouging applications.
- ix) It finds use in the manufacture automotive and rail road components.

IGBT- Insulated Gate Bipolar Transistor

Working Principle of IGBT

The Insulated Gate Bipolar Transistor (IGBT) is a minority-carrier device with high input impedance and large bipolar current-carrying capability. Many designers view IGBT as a device with MOS input characteristics and bipolar output characteristic that is a voltage-controlled bipolar device. To make use of the advantages of both Power MOSFET and BJT, the IGBT has been introduced. It's a functional integration of Power MOSFET and BJT devices in monolithic form. It combines the best attributes of both to achieve optimal device characteristics.

The IGBT is suitable for many applications in power electronics, especially in Pulse Width Modulated (PWM) servo and three-phase drives requiring high dynamic range control and low noise. It also can be used in Uninterruptible Power Supplies (UPS), Switched-Mode Power Supplies (SMPS), and other power circuits requiring high switch repetition rates. IGBT improves

dynamic performance and efficiency and reduced the level of audible noise. It is equally suitable in resonant-mode converter circuits. Optimized IGBT is available for both low conduction loss and low switching loss.



The main advantages of IGBT over a Power MOSFET and a BJT are:

1. It has a very low on-state voltage drop due to conductivity modulation and has superior onstate current density. So smaller chip size is possible and the cost can be reduced.

2. Low driving power and a simple drive circuit due to the input MOS gate structure. It can be easily controlled as compared to current controlled devices (thermistor, BJT) in high voltage and high current applications.

3. Wide SOA. It has superior current conduction capability compared with the bipolar transistor. It also has excellent forward and reverse blocking capabilities.

The main drawbacks are:

1. Switching speed is inferior to that of a Power MOSFET and superior to that of a BJT. The collector current tailing due to the minority carrier causes the turn-off speed to be slow.

2. There is a possibility of latch up due to the internal PNPN thermistor structure.

Electric resistance welding (ERW)

Electric resistance welding (ERW) refers to a group of welding processes such as spot and seam welding that produce coalescence of faying surfaces where heat to form the weld is generated by the electrical resistance of material combined with the time and the force used to hold the materials together during welding. Some factors influencing heat or welding temperatures are the proportions of the work pieces, the metal coating or the lack of coating, the electrode materials, electrode geometry, electrode pressing force, electrical current and length of welding time. Small pools of molten metal are formed at the point of most electrical resistance (the connecting or "faying" surfaces) as an electrical current (100–100,000 A) is passed through the metal. In general, resistance welding methods are efficient and cause little pollution, but their applications

are limited to relatively thin materials and the equipment cost can be high (although in production situations the cost per weld may be low)

Spot welding

Spot welding is a resistance welding method used to join two or more overlapping metal sheets, studs, projections, electrical wiring hangers, some heat exchanger fins, and some tubing. Usually power sources and welding equipment are sized to the specific thickness and material being welded together. The thickness is limited by the output of the welding power source and thus the equipment range due to the current required for each application. Care is taken to eliminate contaminants between the faying surfaces. Usually, two copper electrodes are simultaneously used to clamp the metal sheets together and to pass current through the sheets. When the current is passed through the electrodes to the sheets, heat is generated due to the higher electrical resistance where the surfaces contact each other. As the electrical resistance of the material causes a heat build-up in the work pieces between the copper electrodes, the rising temperature causes a rising resistance, and results in a molten pool contained most of the time between the electrodes. As the heat dissipates throughout the work piece in less than a second (resistance welding time is generally programmed as a quantity of AC cycles or milliseconds) the molten or plastic state grows to meet the welding tips. When the current is stopped the copper tips cool the spot weld, causing the metal to solidify under pressure. The water cooled copper electrodes remove the surface heat quickly, accelerating the solidification of the metal, since copper is an excellent conductor.Resistance spot welding typically employs electrical power in the form of direct current, alternating current, medium frequency half-wave direct current, or highfrequency half wave direct current.

The advantages of the method include efficient energy use, limited work piece deformation, high production rates, easy automation, and no required filler materials. When high strength in shear is needed, spot welding is used in preference to more costly mechanical fastening, such as riveting. While the shear strength of each weld is high, the fact that the weld spots do not form a continuous seam means that the overall strength is often significantly lower than with other welding methods, limiting the usefulness of the process. It is used extensively in the automotive industry— cars can have several thousand spot welds. A specialized process, called shot welding, can be used to spot weld stainless steel.

Seam welding

Resistance seam welding is a process that produces a weld at the faying surfaces of two similar metals. The seam may be a butt joint or an overlap joint and is usually an automated process. It differs from butt welding in that butt welding typically welds the entire joint at once and seam welding forms the weld progressively, starting at one end. Like spot welding, seam welding relies on two electrodes, usually made from copper, to apply pressure and current. The electrodes are disc shaped and rotate as the material passes between them. This allows the electrodes to stay

in constant contact with the material to make long continuous welds. The electrodes may also move or assist the movement of the material.

A transformer supplies energy to the weld joint in the form of low voltage, high current AC power. The joint of the work piece has high electrical resistance relative to the rest of the circuit and is heated to its melting point by the current. The semi-molten surfaces are pressed together by the welding pressure that creates a fusion bond, resulting in a uniformly welded structure. Most seam welders use water cooling through the electrode, transformer and controller assemblies due to the heat generated. Seam welding produces an extremely durable weld because the joint is forged due to the heat and pressure applied. A properly welded joint formed by resistance welding is typically stronger than the material from which it is formed.

A common use of seam welding is during the manufacture of round or rectangular steel tubing. Seam welding has been used to manufacture steel beverage cans but is no longer used for this as modern beverage cans are seamless aluminium.

Thermit welding

Thermite is a pyrotechnic composition of metal powder fuel and metal oxide. When ignited by heat, thermite undergoes an exothermic reduction (redox) reaction. Most varieties are not explosive but can create brief bursts of high temperature in a small area. Its form of action is similar to that of other fuel-oxidizer mixtures, such as black powder.

Thermites have diverse compositions:

Fuels include aluminium, magnesium, titanium, zinc, silicon, and boron. Aluminium is common because of its high boiling point and low cost. Oxidizers include bismuth(III) oxide, boron(III) oxide, silicon(IV) oxide, oxide, manganese, iron(III) oxide, iron(II,III) oxide, copper(II) oxide, and lead(II,IV) oxide.[1]

The reaction is used for thermite welding, often used to join rail tracks. Thermites have also been used in metal refining, demolition of munitions, and in incendiary weapons. Some thermite-like mixtures are used as pyrotechnic initiators in fireworks.

Process





Tracks being joined

Typically, the ends of the rails are cleaned, aligned flat and true, and spaced apart 25 mm (1 in).[9] This gap between rail ends for welding is to ensure consistent results in the pouring of the molten steel into the weld mould. In the event of a welding failure, the rail ends can be cropped to a 75 mm (3 in) gap, removing the melted and damaged rail ends, and a new weld attempted with a special mould and larger thermite charge. A two or three piece hardened sand mould is clamped around the rail ends, and a torch of suitable heat capacity is used to preheat the ends of the rail and the interior of the mould. The proper amount of thermite with alloying metal is placed in a refractory crucible, and when the rails have reached a sufficient temperature, the thermite is ignited and allowed to react to completion (allowing time for any alloying metal to fully melt and mix, yielding the desired molten steel or alloy). The reaction crucible is then tapped at the bottom. Modern crucibles have a self-tapping thimble in the pouring nozzle. The molten steel flows into the mould, fusing with the rail ends and forming the weld. The slag, being lighter than the steel flows last from the crucible and overflows the mould into a steel catch basin, to be disposed of after cooling. The entire setup is allowed to cool. The mould is removed and the weld is cleaned by hot chiselling and grinding to produce a smooth joint. Typical time from start of the work until a train can run over the rail is approximately 45 minutes to more than an hour, depending on the rail size and ambient temperature. In any case, the rail steel must be cooled to less than 370 °C (700 °F) before it can sustain the weight of rail locomotives.

When a thermite process is used for track circuits – the bonding of wires to the rails with a copper alloy, a graphite mould is used. The graphite mould is reusable many times, because the copper alloy is not as hot as the steel alloys used in rail welding. In signal bonding, the volume of molten copper is guite small, approximately 2 cm3 (0.1 cu in) and the mould is lightly clamped to the side of the rail, also holding a signal wire in place. In rail welding, the weld charge can weigh up to 13 kg (29 lb). The hardened sand mould is heavy and bulky, must be securely clamped in a very specific position and then subjected to intense heat for several minutes before firing the charge. When rail is welded into long strings, the longitudinal expansion and contraction of steel must be taken into account. British practice sometimes uses a sliding joint of some sort at the end of long runs of continuously welded rail, to allow some movement, although by using a heavy concrete sleeper and an extra amount of ballast at the sleeper ends, the track, which will be pre stressed according to the ambient temperature at the time of its installation, will develop compressive stress in hot ambient temperature, or tensile stress in cold ambient temperature, its strong attachment to the heavy sleepers preventing buckling or other deformation. Current practice is to use welded rails throughout on high speed lines, and expansion joints are kept to a minimum, often only to protect junctions and crossings from excessive stress. American practice appears to be very similar, a straightforward physical restraint of the rail. The rail is pre stressed, or considered "stress neutral" at some particular ambient temperature. This "neutral" temperature will vary according to local climate conditions, taking into account lowest winter and warmest summer temperatures. The rail is physically secured to the ties or sleepers with rail anchors, or anti-creepers. If the track ballast is good and clean and the ties are in good condition, and the track geometry is good, then the welded rail will withstand ambient temperature swings normal to the region.

Electrode Identification

The American Welding Society (AWS) numbering system can tell a welder quite a bit about a specific stick electrode including what application it works best in and how it should be used to maximize performance. With that in mind, let's take a look at the system and how it works.

The prefix "E" designates an arc welding electrode. The first two digits of a 4-digit number and the first three digits of 5-digit number indicate minimum tensile strength. For example, E6010 is a 60,000 psi tensile strength electrode while E10018 designates a 100,000 psi tensile strength electrode.

Е	60	1	10
Electrode	Tensile Strength	Position	Type of Coating and Current

The next to last digit indicates position. The "1" designates an all position electrode, "2" is for flat and horizontal positions only; while "4" indicates an electrode that can be used for flat, horizontal, vertical down and overhead. The last 2 digits taken together indicate the type of coating and the correct polarity or current to use. See chart below:

Digit	Type of Coating	Welding Current
0	High cellulose sodium	DC+
1	High cellulose potassium	AC, DC+ or DC-
2	High titania sodium	AC, DC-
3	High titania potassium	AC, DC+
4	Iron powder, titania	AC, DC+ or DC-
5	Low hydrogen sodium	DC+
6	Low hydrogen potassium	AC, DC+
7	High iron oxide, iron powder	AC, DC+ or DC-
8	Low hydrogen potassium, iron powder	AC, DC+ or DC-

COMMON DEFECTS WELDING- CAUSES AND REMEDIAL MEASURES

WELDING DEFECT-welding is said to be defective if it not as per specifications or it is not fulfilling the customer requirements. The defect and their remedial measures for welds made by the GMAW, MMAW and other similar welding process are as follows.

DEFECTS	CAUSES	REMEDIAL ACTION
1.Lack of penetration	1.Too little heat input	1. Increase the current and
	in the weld area	Reduce stick out.
	2.Excessive welding speed	2. Reduce strike out
	3. Improper edge penetration	3. Follow the specified edge penetration
	4. Poor arc manipulation	4. Use proper techniques
	5.Excessive arc gap	5. Maintain the correct arc gap
	6.No root gap or less root gap	6. Maintain the correct root gap

2.Excessive	1. Too much heat in the weldarea.	1. Reduce the current area increase the speed of travel
(or burn through)	2 Too parrow root opening or no	2 Make sure that the root opening
	Root opening.	and root face are correct.
	3. Narrow arc gap or stick out.	3. Increase the stick out weaving of the welding gun.
	4. Improper electrode selection.	4. Pick up the correct electrode or filler wire diameter.
3.Lack of fusion	1. Improper torch handing	1. Direct the arc that it covers all areas of the joint the arc, not the puddle should do the fusion.
	2. Low heat and high travel speed.	2. Keep the electrode at the leading Edge of penetration.
	3. Arc is being directed at the base.	3. Check current values properly.
	4. Improper electrode/ filler wire Selection.	4. Select the filler metal as per base Metal specifications.
4.Spratters	1. High current	1. Use correct current
	2.Long arc	2. Maintain low and stable arc.
	3.Irregular and stable arc	3. Maintain low and stable arc.
	4.Excessive weaving	4. Avoid excessive weaving.
5.Undercut	1. Faulty electrode manipulation.	1. Use a uniform weave in welding.
	2. Improper electrode angle.	2. Maintain the proper electrode angle.
	3.Faulty electrode usage	3.Avoid excessive weaving
	4. Current too high.	4.Use moderate current and weld Slowly.
6.Blow holes/porosity	1. Contamination by the atmosphere and other materials i.e. oil, dirt, rust and paint etc.	1. Clean the job well before the Welding.
	2.Change in the physical qualities of The filler wire due to excessive current.	2. Use proper filler rod.
	3.Entrapment of the gas evolved during weld metal solidification.	3. Use proper speed of travel.
	4.Loss of shielding gas because of too fast travel.	4.Use proper flow rate of shielding Gas.
	5.Shielding gas flows rate too low, not providing full protection.	5.Proper welding technique and Shielding gas.
	6.Shielding gas flow rate too high, drawing air in to the arc area.	6. Adjust accurate gas flow rate.
	7.Wrong type of shielding gas being used.	7.Control the impurities percentage in gas as per specification.
	8.Gas shield blow away by wind/storms.	8.Do not weld in the wind or under The fan.
7.CRACK	1. Low temperature of base metal.	1.Raise the temperature of base Metal.
	2.Sudden cooling of the weld by water or other means.	2. Avoid such type of operation.
	3. Less throat thickness.	3. Maintain specified throat thickness.
	4. Crack generation due to crater.	4. Fill up the crater.

8.OVER LAPPING	1.Low current in butt joint and high current in tjoint/fillet joints.	1.Maintain the specified current as per joint.
	2. Too low welding speed.	2. Increase the welding speed.
	3.Improper filler wire/electrode angle.	3. Maintain the proper angle.
9.SLAG INCLUSION	1.Moisture content in the filler metal/ flux.	1. Preheat the filler metal/flux.
	2. Wrong arc manipulation.	2. Maintain uniform and stable arc.
	3. Improper cleaning in multi-layer welding in MMAW.	3. Clean the previous bead from the slag before depositing next layer.
10. CRATER	It occurs due to end of the bead or consumption of electrode in MMAW.	1.Fill up the crater at the end of the bead/ electrode finishing point by just moving the electrode in backward direction.
11.POOR	1. Faulty filler road.	1. Use proper weld techniques.
APPEARANCE	2. Overheating.	2. Avoid overheating.
	3. Wrong arc/current and voltage.	3. Use moderate parameters.
	4. Wrong arc manipulation.	4. Use a uniform weave and speed.
12.DISTORTION	1. Shrinkage welds metal.	1. Weld rapidly.
	2. Faulty clamping.	2. Clamping properly.
	3. Faulty preparation.	3. Adopt a welding procedure.
	4. High heat input at weld joint.	4. Use moderate current and voltage.
	5. Improper welding sequence.	5. Adopt correct welding sequence.
		6. Use post heating or peening to rectify the distortion effect.
		7.Use pre-bending technique to control the distortion.

SAFETY RECOMMONDATION FOR INSTALLATION AND OPERATION OF GAS WELDING AND CUTTING EQUIPMENT

- 1. Acetylene cylinders must always be kept upright.
- 2. A cap must be fitted on the cylinder while it is not in use
- 3. Cylinders should not be used as supports for heavy loads or as rollers for moving materials.
- 4. Cylinders should be stored in a well-protected, well ventilated, dry location, well away from highly combustible materials such as oil and excelsior.
- 5. Cylinders containing Acetylene and Oxygen should be stored separately or quite for apart from each other.
- 6. Do not use a hammer or wrench to open any valve on a cylinder.
- 7. One should not smoke at the place where gas cylinders have been stored.
- 8. Water, dirt, oil and grease should not be permitted to come in contact with oxygen cylinders, valves, regulators, hose or fittings. Do not handle oxygen cylinders with oily hands or oily gloves.
- 9. Cylinders valve shall be closed when worked is finished.
- 10. Do not tamper with the safety devices provide in cylinders or valves.
- 11. Never use acetylene or oxygen without proper pressure regulators.
- 12. Before connecting to pressure regulators to cylinder valve, the valve shall be opened slightly and closed immediately. This action which is termed as Cracking clears the valve of dirt or dusts that otherwise enters the pressure regulators. Stand to one side of the outlets while cracking.

- 13. Open cylinder valve slowly and let the cylinder key for opening valve remain on valve stem so that cylinders may be quickly turned off it an emergency arises.
- 14. To test for leaks a solution of soap and water may be brushed on the valve socket and gland nut. Bubbles indicate leakage.

SAFETY RECOMMONDATION FOR INSTALLATION AND OPERATING OF ARC WELDING AND CUTTING EQUIPMENT ARC

Welding Machines

- 1. Arc welding machines should be of suitable quality.
- 2. Arc welding machine should be properly grounded (earthed).
- 3. Proper terminals should be used on the arced welding machines for the power line voltage connection.
- 4. One should not work on the wiring of an arc welding machines unless qualified to do so.

In the case of AC arc welding machines:

- 1. In transformers, the secondary circuit shall be thoroughly insulated from the primary.
- 2. Welding (secondary) terminals shall be so arranged that current carrying parts arenot exposed to accidental contact.
- 3. In a transformer the welding circuit should be quite separate from the power circuit, so that there is no risk of worker suffering serious shocks or burns through power voltage appearing across the electrode holder.
- 4. Control apparatus provided with the welding machines shall be enclosed except for the operating wheels, levers etc.
- 5. Transformer welding be suction or compressed air cleaned periodically.
- 6. Greasing points need attention periodically.
- 7. Switch contacts should be cleaned periodically.
- 8. Before under taking any maintenance work on welding machines, disconnect them from the main supply.

OTHER ARC WELDING EQUIPMENTS:

1. Electrode Holder-

A. Electrode holder should be soundly connected to the welding lead. They should be of adequate rating for the maximum welding currents to prevent them from heating up and becoming too hot to handle.

B. Insulation of all metallic and current carrying parts, including the jaws which grip the electrodes, is recommended.

- 2. <u>Welding Cables</u> Welding Cables shall be of completely insulated, flexible type.
- 3. The body or the frame of the welding machine shall be efficiently earthed.
- 4. Earthing cable should be connected to the job as nearest as possible.
- 5. Avoid earthing cable connection at rail lines, wheels, bearings, CBC and other Sensitive parts of coach & wagon.

PROTECTION OF WORKERS: Workers need to be protected from:-

- 1. The welding rays.
- 2. Flying sparks, metal globules (spatter), hot slag particles and hot electrode stubs.
- 3. Fumes and gases when welding in confined space.
- 4. Falling when welding at a height from the ground.

So workers should wear personnel protective equipments (PPE) to protect from hazardous happenings.

What type of PPE is available when welding?

The chart below summarizes the types of personal protective equipment that can be used when welding. Welding - Personal Protective Equipment

Body Part	Equipment	Illustration	Reason
Eyes and face	Welding		Protects from:
	helmet, hand		□ radiation
	shield, or		\Box hot slag,
	goggles		sparks
		Helmet	□ intense light
			\Box irritation and
			chemical burns
			Wear fire
			resistant head
			coverings
			under the
			helmet where
			appropriate
Lungs	Respirators		Protects
(breathing)	-		against:
			\Box fumes and
			oxides
Exposed skin	Fire/Flame		Protects
(other than	resistant	1.7.4	against:
feet, hands,	clothing and		\Box heat, fires
and head)	aprons		□ burns
			Notes: pants
		HL Will	should not have
		No suffs Heat resistant jacket	currs, snirts
		No cuis /	should have
			naps over
			pockets of be
Eara	Ear muffs oor		Drotacts
Eals -	Ear muns, ear		Protects
nearing	plugs	\bigcirc	against. \Box noise
			Use fire
			resistant ear
		Ear protection	plugs where
		Ear protection	sparks or
			splatter may
Track and 1	D	2	enter the ear.
Feet and	Boots, gloves	Insulated Rubber-sol	Protects
nands		gloves safety sho	against:
			\square electric shock \square heat
			\Box burns
		Steel	□ fires
1			

UNIT-23: RAIL BUDGET

The word Budget means BOUGETTE from French language which means a leather bag. First of all in 1733 British finance minister Sir Robert Volpoul presented financial proposal in front of British Parliament and he used a leather bag for this purpose. Since then the financial proposal are called 'Budget'.

Budget is a statement of the estimates for the receipts and expenditure for a fixed period, both on capital as well as on revenue transition of an organisation. It is the process of planning and reviewing the activities of an organisation.

Rail Budget is presented for a period of one year commence from 1st April to31stmarch. This period is called "financial year". Railway being a department of government of India, Earlier the receipts and payments of the system were manage in the general budget. As a result of the recommendation of Acworth committee in 1921. It was decided to separate the rail budget from the general budget. The main objective was to bring flexibility in Railway budget. This is generally known as 'Separation Convention of 1924'. Since then the Railway budget is submitted in advance of general budget. These statements are submitted to both the houses of parliament i.e. Lok Sabha & Rajya Sabha.

The expenditure of the railway is of two types:-

- 1. Voted Expenditure
- 2. Charged Expenditure

The former category requires the approval of the Parliament. In respect of charged expenditure, the sanction of the president is conveyed and this is not submitted for the vote of parliament.

Approval of parliament is mandatory except for charged expenditure (which must however be included in the budget for information). Charged items means railway items under the head of salary & allowances, sum of money required to meet expenditure, to satisfy court decree/awards of arbitration of tribunals which are pronounced through judicial system.

Article 112(1) of the resolution provides that the rail budget should be presented in the houses of parliament. The voted part of the expenditure along with charged appropriation is presented to the parliament in the form of demands for grants.

Budget is presented to parliament during February of previous financial year. Generally the presentation takes place on 26^{th} Feb (rail budget) and 28^{th} Feb for general budget.

The expenditure of Railways is grouped in various categories and these categories are made for grant. There are 16 demand of grant in all.

The following steps are involved while preparing rail budget during budget:

- a) Preparation of rail budget
- b) Voting of budget
- c) Execution of budget
- d) Review of executing budget

The 16 demands of grants are as said further:

S.NO.	GROUP	DEMAND	NAME OF DEMANDS
		NO.	
1.	Policy formation	1	Expenditure on railway board
	and service	2	Miscellaneous expenditure (general) like
	(common to all		expenditure on RDSO, survey railway inspectors
	railway)		attached to CBI and stationary audits.
	Q 1	2.4	
2.	General	3A	General superintendence and services railways.
	superintendence and		ragional offices
3	Repairs and	/B	Repair and maintenance of permanent way and
5.	maintenance	40	works.
	munitentitee	5C	Repair and maintenance of motive power (diesel
			loco, electrical loco, rail car, ferry
			services and other locos)
		6D	Repair and maintenance of carriage and wagons.
			Repair and maintenance of plants and equipments
		7E	(machine and plant, mechanical, electrical, civil, telecom department etc.)
4.	Operation	8F	Operating expenses- Rolling stock and
			equipments like signal, electrical, telecom
			equipments etc.
		9G	operating expenses – Irainc (trainc
			Operating and commercial)
		1011	oil loco electric energy charges for traction
		IUH	freight charges including fuelling of energy sale
			tax, excise and coal also accommodated.
5.	Staff wale fare,	11J	Staff wale fare amenities (Educational, Medical,
	Retirement benefits		health wale fare services, other facilities like
	and Misc.		canteen, quarter, colony etc.
			branch compensation claim for goods lost/
		12K	damaged and also payment arising out of
			workmen compensation act.
			Cost of training to staff of all department.
			Provident fund, pensions and another retirement
		13L	benefits, gratuity etc.
6.	Railway funds and	14M	Appropriation to funds (Depreciation reserve
	payments to general		rund, development rund, capital rund etc.)
	revenues		Dividends to general revenues, repayments of
		15N	loan taken from general revenues.
		1311	
7.	Assets acquisition	16	Assets acquisition construction and replacement.
	construction and		It is also known as works grant. Acquisition of
	replacement (work		new assets, construction of new lines,
	expenditure)		replacements of existing assets RSP, M&P and
			works programme.

23.1 DEMANDS OF GRANT

RSP- Rolling Stock Programme, M&P- Machines and Plant

23.2 Estimated Earning-

This is assessed based on the quantum of traffic anticipated fares and freight. Structure are reviewed. These are also assessed on the basis of last year earnings.

The budget estimate for the ensuring year is compiled during November each year. The budgeting assessed should originate from grass root level.

23.3 RAIL BUDGET TO BE PRESENTED IN PARLIAMENT

The rail budget is presented in the parliament in the following booklet-

- a) Budget speech of rail minister & working of Railway of last Financial year: Yellow Book
- b) Demands of grants in: Blue Book
- c) Description memorandum in : White Book
- d) Proposal expenditure on railway stock programme, M & P programme and work programme for each zonal railway: - Pink Book

23.4 IMPLEMNTATION OF BUDGET:-

This means allotment of sanctioned expenditure after sanction of parliament and approval from President, the budget is distributed by railway board to various zonal headquarter and other railway organization. This procedure is called allotment of budget.

23.5 APPROPRIATION BILL

According to article 114(1) of the constitution, after the demands for grant have been voted by the parliament and appropriations sanctioned by the President, an appropriation bill will be introduced in the parliament to provide for the appropriation out of consolidated fund of India of all the money required to meet the grants made by the parliament and the charged expenditure as sanctioned by the President.

23.6 BUDGET REVIEW:-

Objectives:-

- 1. August Review:- First review of the budget is known as 'August Review' because it is to be sent to railway board at the end of August. In this statement of figures shown are actual for the months April to June and approximate for the month of July. For each grant data is prepared separately for first four months and remaining as months. No additional funds are demanded in this review. This is only formal review and does not authorise the railways to enter into additional commitment. Railway board have to be approached for any in explainable expenditure. Thus it is to review the expenditure in order to see whether any modifications are necessary in the allotments placed at the disposal of various zones/divisions/railways. Form F.383 is to be used for this purpose.
- 2. Revised Estimate and Budget Estimate:- Second review of the budget is done in the month of November. In this actual expenditure up to September and anticipated expenditure for the month of October is given revised estimate are made for current financial year. If additional fund are required or change in earlier estimate necessitated, then the proposal with full detail and for each grant is to be sent to the financial advisor and chief accounts officer which will send it to railway board through GM. The budget estimate for coming year is also submitted to railway board which is based on current year trend.

- **3. First Modification:-** This modification is submitted to the railway board in the last week of January each year duly explaining the reasons for any addition or reduction required in the estimate.
- **4. Final Modification:-** Based on the trend of expenditure incurred till January necessary revision is made and railway board is approached for any additional provision required or any surrender to be made as per following time table-

20th Feb. - Ordinarily 1st March- Telegraphically / Fax 20th March- Under Do letter from GM

The modification made by the board in voted/ charged expenditure under each head of appropriation are called final modification and the allotments then sanctioned are known as the final grants for the financial year.

23.7 PARLIAMENTRY CONTROL OVER RAILWAY FINANCE/ BUDGET

India is a democratic country. Article 114(3) of the constitute on lay down that parliament is supreme authority and no money can be spent out of consolidate fund of India without the vote of parliament.

Railway finance was separated from general finance in 1924 to secure economy in the expenditure of public money and for proper development of railways. Therefore both the budgets are presented separately it is therefore, necessary that a control over railway budget by the parliament is exercised. In view of the above, the parliamentary control over railway finance is exercised by the following committees either before submission of demands to parliament for voting or after the expenditure is incurred on the annual accounts are closed as indicated.

- 1. RAILWAY CONVENTION COMMITTEE(RCC):- Based on the recommendation of Acworth committee in 1920-21, a convention commonly known as 'Separation Convention ' was adopted by a resolution on 20th sep 1924 under which this committee was formed, for periodical examination of railway finance, working and also to review the rate of dividend payable by railway to general revenue. This committee normally must after every five years to review the railway finance and recommend the changes to be made in railway finance/suggests measures for improvement.
- 2. ESTIMATE COMMITTEE:-This is a parliamentary committee for examination on of various estimates as it may deem fit or are specially referred to it by the parliament or the speaker. This committee has:-
 - To report what economies, improvements is organisation, efficiency or administrative reforms, consistent with the policy underlying the estimates may be effected;
 - To suggest alternative policies in order to bring about efficiency and economy in the administration.
 - ➤ To examine whether the money is well paid out within the limits of policy complied in the estimates, and
 - To suggest the form in which the estimates shall be presented to Parliament. There are 30 members and are elected by LOK SABHA every year. No minister is elected.
- **3. PUBLIC ACCOUNTS COMMITTEE:-**PAC examines the appropriation account of railway and takes in to consideration the report of comptroller and auditor general of India (CAG). In other words this committee examines the accounts of sum granted by Parliament for expenditure, to satisfy:

- ➤ The money shown in the accounts as having been disbursedwerelegally available for and applicable to the service or purpose to which they have been charged.
- > The expenditure conforms to the authority which governs it; and
- That every re-appropriation has been made in accordance with the provisions made in this behalf under rules framed by competent authority.

This committee consist of not more than 22 members to be elected by both house of parliament every year from amongst their members according to the principle of proportional representation by means of single transferable votes. A minister is not elected and if a member, after his election committee is appointed as minister he shall cease to be a member of committee from the state of such appointment.

The term of office of members shall not be exceeding one year. The Chairman of the committee is appointed by the speaker and if Dy. Speaker is a member, he shall be appointed as chairman. The committee has its own programme and procedure. The committee takes up examination of the Audits Report and Appropriation accounts they have been duly placed before parliament with approval of President. 15 from Lok Sabha and 47 from Rajay Sabha. Rajay Sabha members of committee have no power to vote, they may give only suggestions. The findings of committee have are presented to parliament in form of report.

4. National Railway users Consultative Council (NRUCC):- 70 Secure better representation of railway users and afford more frequent opportunities for consultation between railway and railway users on matters relating to service rendered by railway, NRUCC was formed in 1953. The member of council holds office not exceeding 2 years. The council consist of about 70 persons appointed by ministry of railways from various ministries including ministry of railway, committee, organisation and eminent persons who take interest in railway problems. The council meet at least once in year. The minister railways will decide at the meeting of council. It controls railway finance by means of interpretation, resolution and discussion on budget votes of various demands of grants.

The council have to consider-

- Such matters related to the services and facilities provide by railways.
- Matters within the scope of functions of Zonal committees as are referred to it, and
- Questions relating to staff discipline and appointment will not be brought before council.
- **5.** Committee on subordinate legislation:-It scrutinises and report to Parliament, that power to make regulations, rules, sub rules, bye laws etc. Conferred by the constitution or delegated by parliament are being properly exercised.

6. Committee on Government assurance:-It scrutinises weather the assurance, promises, undertakings given by ministers from time to time, or the floor on Lok Sabha and Rajay Sabha have been implemented within minimum time.

7. Discussion on Railway Budget:- During the period on discussion of rail budget, any MP may ask question for the purpose of obtaining information on a matter of public importance or issues concerning to railway working. The budgets critically examined by the MP's and after discussion expenditure on some projects may be cut down and then it can be passed by the Parliament. MP's may address the minister of railways or rail administrator on any matter concerning to railway working on any time. They raise questions of various kinds viz. starred

questions, unstarred questions, short notice questions in Lok Sabha and Rajay Sabha and railway minister has to answer there suitably.

8. Member of Parliament:- As said earlier, any MP may address Ministry of Railway or Rail Administrator on any matter concerning Railway Working. Member may also ask questions in both the houses of Parliament on issues concerned with Railway Working.

23.8 CANONS/STANDARDS OF FINANCIAL PROPRIETY

In the exercise of financial powers, the sanctioning authorities must pay due regard to the following principles;

- The expenditure should not prima facia be more than the occasion demands, and that every government servant should exercise the same vigilance in respect of expenditure incurred from public money as a person of ordinary presence would exercise in respect of the expenditure of his own money.
- No authority should exercise its powers of sanctioning expenditure to pass an order which will directly or indirectly be to its own advantages.
- Public money should not be utilised for the benefit of a particular person or section of the community unless;
- The amount of expenditure involved is insignificant.
- A claim for the amount could be enforced is a court of law; or
- The expenditure is in pursuance of a recognised policy or custom.
- The amount of allowances, such as travelling allowances, granted to meet expenditure of a particular type, should be so regulated that the allowances are not on the whole a source of profit to the recipients.

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UNIT-24: RULES OF ALLOCATION

Railway Expenditure is mainly divided into eight heads of Allocation viz. Capital, Depreciation Reserve Fund (DRF), Development Fund (DF), Open Line Works Revenue (OLWR), Capital Fund (CF), Revenue Special Safety Fund (SRSF) and Railway Safety Fund (RSF). Expenditure is debited or credited to one or more of these heads.

The above heads of accounts are financed from:-
CapitalLoan from General RevenueDRF, DF & CF-Internal ResourcesOLWR & Revenue-Current RevenuesSRF & SRSF-General Revenue

It would be observed that Funds for Capital and SRF & SRSF are financed from General Revenues (Loan) while funds for other Heads of Accounts are generated from general resources either from surplus or from Revenue.

Capital:

Expenditure normally incurred for acquisition of assets created for the purpose of earnings or possession is known as "Capital Expenditure". In other words, this expenditure helps the Railways to increase its assets such as cost of new constructions, cost of land other than land required for quarrying and mining purpose."

As a matter of fact funds for Capital Expenditure are borrowed from Central Govt. and the Railway is liable to pay dividend to General Revenue at the prevailing rate as decided by PAC.

DEPRECIATION RESERVE FUND (DRF):

In order to meet the cost of replacement of assets, the normal life of which is over due to wear and tear and require replacement. DRF has been created from revenue. Annual contribution is made to this fund as decided by the Convention Committee from time to time. It bears the cost of replacement including improvement and inflationary element of assets, the original cost of which has been borne by the Capital. The replacement and renewals at debit of DRF fall under one of the following categories:-

- (i) Renewals including casual renewals of rails, Sleepers & Fastenings such as rails, sleepers, fish plates, spikes, points, crossings and long rails.
- (ii) Whole sale renewal or strengthening of bridges and girders.
- (iii) Renewals of rails, boilers, carriages & Wagons.
- DRF is credited with:-
- (i) The amount of annual contribution from Railway Revenue.
- (ii) The amount realised from the disposal of Assets. (At the debit of Capital, DF &AC SPF).
- (iii) The amount of interest earned on the balance of fund.

DEVELOPMENT FUND (DF):

This fund was instituted w.e.f. 1st April 1950 incorporating the existing Railway Betterness Fund which was started from 1st April 1996.

In order to arrest over capitalization of Railway undertaking (Convention Committee 1949), the government along with the other factors have decided that all enumerative new lines,

works for Passenger amenities, staff quarters for non-gazetted staff and operational improvement work which cost over 03 lakhs (now 10 lakhs) should be charged to DF.

To start with, a sum of Rs. 12 Crores is transferred to the fund from the Railway Reserve Fund and further credits to the fund consists of annual contribution from surplus as may be fixed by Railway Board and voted by the Parliament.

Development Fund is credited with:-

- (i) Amount transferred from Revenue Reserve Fund.
- (ii) The amount appropriate to it each year from surplus.

CAPITAL FUND:

The existing Revenue Reserve Fund has been established w.e.f. 1992-92, in order to reduce over capitalization and to enable Railways to raise internal resources for meeting their increasing requirements for Capital Expenditure, a new fund "Capital Fund" has been credited. This fund is credited with the existing (insignificant) balance in RRF and also through appropriations of the balance of Railway surplus available after appropriation to Development Fund, Payment of interest on loan to Development Fund and repayment of loan to Development Fund.

OPEN LINE WORKS REVENUW (OLWR):

This head is financed from Revenue (Miscellaneous expenditure) and bears the cost of the following categories of work.

- (i) Cost of all works other than related to Passenger and other amenity works chargeable to Development Fund, whether new additional improvements and replacements when cost is less than Rs. 1,00,000 (One lakh) i.e within the limit of new minor works.
- (ii) Cost of such replacement and renewals less than Rs.1,00,000 when not charged to capital, CF, DRF, DF & Revenue.
- (iii) The cost of all unremunerated works for improving the operational efficiency when the cost is less than Rs. 10 Lakhs.
- (iv) The cost of dismantling, handling and shifting including freight to stores depot.
- (v) The expenditure on investment in the share capital of Railway Men's consumer's cooperative societies up to Rs. 2500 per society.

It is credited with the amount realised from disposal of an asset without being replaced the original cost of which was charged to OLWR and amount realised from the disposal of the asset replaced at the cost of OLWR.

REVENUE:

Revenue Expenditure is that which keeps the Railway in operational condition. All such working expenditure is debited to this head. This expenditure is broadly as under:-

- (i) The Wages of staff including DA and contingency office expenditure.
- (ii) Day to Day repair and maintenance.
- (iii) Operating expenditure.
- (iv) The contribution made to DRF to meet the cost of replacement and renewals of assets chargeable to Capital and DF.
- (v) Contribution made to Pension Fund.
- (vi) The cost of additional pitching stores laid in training works and protective works after their contribution completion.
- (vii) All other day to day expenses such as rent, rates, taxes and legal expenditure.

There are certain classified Heads under abstract (अनुलग्न) which bear the cost of all items incorporated under Demand No 3 to 15 as per revised classification.

SPECIAL RAILWAY SAFETY FUND (SRSF):

Pursuant to the recommendation of the Railway Safety Review Committee (1998) a Special Railway Safety Fund with a corpus of 17,000 Crores has been set up in the year 2001-02 to wipe out arrears of replacement and renewals of overaged railway assets within a fixed time frame of 06 years, For this purpose, as approved by the Government, Rs. 12,000 Crores will be provided by the Ministry of Finance and the balance Rs. 5,000 Crores will be mobilised by the Railways through levy of Safety charges on passenger fares. The allocation of fund will be intimated by Railway Board to Zonal Railways and appropriation to fund will be made. This fund has been created under Demand No. 16. This is in addition to the expenditure met from DRF.

The main objectives of creation of this fund are as under:-

- (i) Replacement of age old assets.
- (ii) Liquidation of arrears of Track renewals.
- (iii) Rebuilding and Rehabilitation of bridges under distress.
- (iv) Replacement of overaged signalling of Telecommunication equipment.

This fund bears expenditure on aforesaid works. Such works are incorporated in a separate book of projects to be funded from SRSF called "Green Book". This fund is credited with:-

- (i) Special surcharge levied by Railways on Passenger fares for this fund.
- (ii) Additional budgetary support as investment in Railways from the General Revenues provided as Divident Free Capital.
- (iii) Appropriation from Railway Surplus.

In order to strengthen safety and minimise accidents at level crossing, construction of Road Over/Under Bridges and conversion of unmanned level crossing to manned ones as necessary. To ensure adequate funding and focus and greater attention to such works, two new plan heads namely:

Road Safety Works- Conversion of level crossing into Road Over/Under bridges and

Road Safety Works- Conversion of unmanned level crossing into manned crossing have already been created. To cater to these plan heads exclusively a new allocation head namely, the "Railway Safety Fund" has been created.

This fund is credited with:-

- (i) Railway revenue out of excess left in the financial results after payment of dividend to general revenue.
- (ii) Transfer of funds by Central Government from Central Road Fund; and
- (iii) The present 20% contribution which is made by the Ministry of Railways to the existing Railway Safety Works. Fund out of the dividend paid to the general revenues.

This is a non-interest bearing fund.

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UNIT-25: STOCK VERIFICATION

The object of stock verification is to ensure that:-

- (i) The materials in stock accord with the description & specification shown in Numerical ledger (Bin Card).
- (ii) Actual balance of such stocks agrees with the balance appearing in the books.
- (iii) Excess or deficiencies, if any, noticed during such verification are properly investigated and accounted for.

As per stores code, FA&CAO has to record the above certificate in annual statement of transactions and submit the same to Railway Board before 1st November of the succeeding year.

In order to facilitate the issue of such a certificate he has a set of staff who carries out the verification work. This is called Accounts Stock Verification. The staff who does the above job are called "Stock Verifiers" who work under the direction and guidance of a senior Inspector of stores and accounts.

The duties of accounts verification staff in general comprise of not only the correct physical verification of stores and inspection of its accounts, but also the intelligent and efficient scrutiny of the different types of store transactions and the relevant accounts which are built up on the basis of admissible vouchers.

The stocks in the Stores Depot are verified as said further:

- (i) 'A' Value items Once in six months
- (ii) 'B' Value items Once in a year
- (iii) 'C' Value items Once in two years
 - 'D' Value items Once in three years

(That had no issue for last 12 months and over)

- (v) All T&) (Tool & Plant) items Once in three years
- (vi) All charged off stores Once in a year
- (vii) All imprest stores Once in two years
- (viii) Types in Printing press and other Once in three years
 - Printed forms in forms depot.

REGISTERS MAINTAINED BY STOCK VERIFIER:

Stock Verifiers maintain the following registers:

- (i) Verification Register
- (ii) Stock Sheet

(iv)

- (iii) Register of Stock Sheet, Account Notes & Inspection Reports
- (iv) Register of Field books.
- (v) Register of recoveries.
- (vi) Register of serious irregularities and important irregularities.

DUTIES OF STOCK VERIFIERS:

- (i) Routine verification of stores and T&P items art Stores, depots, online as per approved programmes.
- (ii) Surprise verification of stores.
- (iii) Witnessing of auction sale and delivery of materials sold.
- (iv) Survey of depots and yards for unaccounted stores as contemplated in para 9319 S.

PROCEDURE OF STOCK VERIFICATION OF STORES AT STORES LEVEL

On recipe of verification programme, one day's prior notice in writing should be given to Depot Store keeper/custodian of the group of stores that is to be taken up for verification.

The verification of the stock should be conducted strictly in the order of group concerned. The code number and description of the item proposed to be verified should be copied down in the field book from the standard nomenclature list of stores. The items of store subjected to stock verification should be carefully compared with the respective description in nomenclature list. Specific marks of identification, sizes, and dimensions, the proprietary and other particulars in the description should be particularly checked & compared with the store under verification. Discrepancies, is any, should be carefully investigated.

As and when necessary, the stock verifier should make appropriate use of testing, gasaging, measuring and other equipment. To ensure guidance for identification the ascertainment of exact location of stores and for expeditious completion of work undertaken, the continuous association of the custodian in comparative. At no stage, the stock verification should be conducted without the representative of the Stores Department. The Stock verifier is personally responsible for the accuracy of the verification. Care should be taken to locate all the stocks and assess the correct ground balance of stores. Storage Bins, Racks, Godowns & sites of stacks should be carefully searched to include the possibility of left over materials. As a result of stock verification, when cases of substitution mix up and other irregularities are detected, these should be carefully sorted out and separated and restored to their respective bins.

METHODS:

The methods adopted by the Stock Verifier are explained in the following paragraphs:

The stock taking is either by count, weight or measurement suiting the items of stock; under verification. These methods should be intelligently applied, ensuring maximum out turn at the minimum cost of time and labour.

- Heavy stock balances should be dealt with by Average methods such as weight versus count, measurement vs weight vides Code Para 0237-S and 3238-S.
- Costly items viz. Ingots, Copper, Tin, Brass, Gun Metal, Anti friction and Antimony etc. should be actually weighed on the beam scale irrespective of the stock & time involved.
- Items of stocks in the original packing from reliable firms need not be opened but their contents as marked in the packing from the voucher be accepted with appropriate remarks in the field book and in the verification report. However, in cases of doubt, a complete verification should be undertaken.
- Items of equal dimension and comprising identical stocks in orderly stacks and in wellarranged condition need not be disturbed. Such stocks can be easily counted at the site. Before accepting such a stock, precaution should be taken to inspect the formation of stack and unless thoroughly satisfied as to the accuracy of the content, the ground stocks should not be stuck.
- While verifying steel sections under group 90, Stock Verifier should pay particular attention whether colour marking to distinguish the different class of steel is adopted.

Stock Verifier should particularly examine and report that:-

- (a) Proper arrangements exist for safe custody & storage of materials against unnecessary deterioration from whether or any other factor/cause.
- (b) Proper arrangement exists for locking the Gowdown and keeping keys in safe custody.
- (c) Adequate arrangement exists for fire protection i.e. fire extinguishers etc. and are kept full and serviceable. Drums of water and/or sand are always kept full where inflammable articles/stores are stacked/kept.

At the end of verification, the stock verifier records the details in his field bool and obtains the signature of the custodian as a token of his acceptance of the correctness of the entries therein. He should also get custodians certificate that all the stocks has been presented to the stock verifier.

Stock sheets are prepared by the stock verifier for each item/items as soon as the verification of such item/items is completed. Each Stock sheet is signed by Stock Verifier as well as by the custodian/ representative of the custodian who has witnessed the verification. The stock verifier adjust Bin card so as to tally with ground stock. One copy of stock sheet is sent to EDPM (Computer) through Stores Accounts for adjusting/updating the price ledger as well as printing out of the stock sheets. This adjustment is debited/credited to stock Adjustment Account.

Then a copy of the stock sheet is sent to the custodian through Depot Store Keeper for explaining the discrepancy.

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UNIT-26: MISCELLANEAOUS SHORT NOTES ON FINANCIAL TERMS FINANCIAL COMMISSIONER:

The Financial Commissioner Railways is the professional head of Railways is the professional head of Railway Financial Organization and represents Government of India, Finance Department on the Railway Board. In his capacity as ex-officio secretary to Govt. of India in the Ministry of Railways on Financial matters, he is vested with full powers of GOO to sanction railway expenditure subject to the general control of Finance Minister. This arrangement is intended to ensure that financial control over operations of the Railway Department is exercised from within the Organization by an Officer who shares with members of Railway Board and the chairman, the managerial responsibility as a senior partner in the common enterprise of different and economic working of the Railway undertaking. In event of a difference of opinion between the financial commissioner and other members of the board, the former has right to refer the matter to the Finance Minister.

In the discharge of his responsibilities as head of Railway finance organization, the fc, Railways may issue or cause to be issued instructions to the FA&CAO on all accounting and administrative matters. These instructions will be communicated to the General Manager and it is the duty of the FA&CAO to give effect to them. The later should, however, keep the GM in touch with such correspondence as may be exchanged by him direct with Financial Commissioner, Railways, or Officers in the Railway Board working under him.

LIABILTY REGISTER:

It is the responsibility of Railway Administration to ensure that the requirement of funds are realistically assessed and suitably provided for in the budget. It is also the duty of Railway Administration to see that the funds provided for in the budget and voted by the Parliament are spent correctly without causing either excess or saving beyond permissible limit.

This means that Railway Administration is responsible for accuracy in the budgeting and control over expenditure as well.

Liability Register is, therefore, one of the important documents through the instrumentality of which budgeting and expenditure control is exercised. In short, the liability register is an instrument of expenditure and budgetary control. This is maintained primality at the executive level. It is a progressive record of commitments and liability interest into and liquidation made thereon from time to time. With the help of these registers, the executives are able to watch the commitments and incurrence of expenditure from time to time enabling the administration to suitably assess the requirements of funds at various Budget stages. This register is also helpful to regulate commitments in accordance with sanctioned grants. Liability Registers are to be maintained for Revenue and Works grant.

Another advantage of maintenance of liability register is the correctness of allocation and accountal of charges it ensures. All commitments, all requisitions, work orders, estimates and also the proposals are routed through Budget cell where transactions ar subject to check the reference to availability of funds and also allocation for recording these transactions in the liability registers.

The Liability Registers mainly serve the following purpose:

- (i) Accuracy of Budgeting
- (ii) Effective Control over Expenditure
- (iii) Correctness of allocation
- (iv) Correct booking of expenditure

- (v) Check on spending
- (vi) Economy in expenditure

OPERATING RATIO:

The "Operating ratio" represents the percentage of working expenses to gross earnings. In other words, the Operating ratio indicates how much the Organization should be spent to earn one rupee. The Operating ratio has been regarded as a important financial statistics of railway performance and is regarded as an index of operating efficiency and financial viability of Zonal Railways.

In case the percentage of operating ratio is less than hundred, it means that the particular zonal Railway is making profit and if percentage is more than hundred the Zonal Railway us making losses. The comparison of operating ratio within the same railway from year to year may reveal the efficiency and as performance index. The improvement in the operating ratio definitely indicates that wastages are plugged and Zonal Railway is financially more viable as compared with earlier years.

IRFC (INDIAN RAILWAY FINANCE CORPORATION):

The IRFC is wholly owned Government Company managed by Railway Ministry. IRF WGS set up for mobilising resources by floating Railway Bonds. The sole proceeds of the bonds are utilised for acquiring rolling stocks required by the railways. The Railway Administration is required to pay leasing charges. The payment of leasing charges are booked under Demand No.9, operating expense traffic. The main objective of LRFC is to borrow funds from the market and lease assets procured with such funds (Wagon) for use of Railways. IRFC was established in 1986 and up to March 1998. It has arranged 10323 crores of Rupees from Market through Bonds.

SUPPLIMENTARY GRANTS:

When the amount of grants or appropriation in the Budget is found insufficient for the purpose of current year, an estimate if supplementary grants or appropriation is submitted to the parliament or to the President as the way of original demand. It should be voted by the parliament or sanctioned by the president prior to 31st March as the way of original demand or grant. Excess demand is based on recommendation of PAC and to be presented after getting recommendation of President like in the case of Original demands.

VOTE ON ACCOUNT (ON ACCOUNTS BUDGET):

Budget should be passed by the Parliament within 75 days of its presentation in the Parliament. If it is not possible to get approval of Parliament in time, in such cases the Lok Sabha has power to make any grant in advance during the completion of procedure. This is known as "Vote On Account".

In a year, in which it is not possible to complete the procedure of passing the Budget before 31st March due to some reasons like convening of new Parliament after general elections, the outgoing parliament if presented with an "Account Budget" asking for sanction of appropriation from consolidated fund of India sufficient for few months. By which time the new parliament would consider in detail and pass the full Budget.

ZERO BASED BUDGET:

Zero based budget was first introduced in USA in 1969. Union Finance Minister of India has introduced it in India from the FY 1986-87. It is used as a tool for Planning, Budgeting and Controlling. It is prepared at grass root level. As the name implies budgeting under this system is done taking the base as zero for each year. (Budgeting for each year has to be done from scratch

under this system). In other words budgeting without any reference to what has gone before. Zero Based Budget is based on fundamental reappraisals for proposed method and resources & purposes.

Zero Based Budgeting has been variously defined as:-

- (a) An operating, planning and budgeting process which requires each manager to justify his entire budget request in details, and shifts the burden of proof to each manager to justify why he should spend any money. This procedure requires that all the activities and operation be identified in decision packages which will be evaluated and ranked in order of importance by systematic analysis.
- (b) Zero Based Budget is a management process that provides for systematic consideration for all programmes & activities in conjunction with formulation of budget requests and programme planning.
- (c) Zero Based Budget is a system where by each government programme, regardless of whether it is new or existing programme must be justified entirely each time a new budget is formulated.'
- (d) Zero Based Budget is a management tool which provides a systematic method for evaluating all operations and programmes current or new, allows for budget reductions and expenses in a rational manner and allows the re-allocation of resources from low to high priority programmes.

Steps:

- (i) Identification of goals, objectives, structure, management and "decision units".
- (ii) Analysis of existing structure, functions and activities.
- (iii) Identification of "decision making" units in the Organization.
- (iv) Formulation and development of "decision packages" am their review.
- (v) Decide priorities and ranking of all "decisions packages" using unanalytical technique.
- (vi) Allocation of resources from the chosen "decisions packages" i.e. preparation of Budget.

Zero based budget thus requires a complete re-examination of all programmes and activities ZBB requires a highly skilled and professional staff who are well conversant with planning tools and analytical techniques.

CONSOLIDATED FUND OF INDIA:

As per the Constitution of India, it is treated as reservoir to which all the revenues received by the government (Wages and means of advances, loans raised by Govt., repayment of loans etc.) are accredited and for which the expenditure of government is incurred by withdrawal when so authorised by the parliament. The consolidated fund of India can be divided into 03 classes:-

- (a) **Revenue:** It means all the receipts and expenditure that ultimately affect the budget and make it a budget of deficient or profit.
- (b) **Capital:** Fixed assets, it includes all types of fixed assets which are under the Indian Government.
- (c) Loan: The repayment of loan, their interest and all the receipts related to loan.

Not a single paisa from the consolidated fund of India can be used without approval or sanction from president, this fund has been constituted under Article -266(1).

AUDIT& AUDIT INSPECTION

The responsibility of the Comptroller and Auditor General for audit of Railway accounts is discharged through Dy. C&AG of India (Railways) who conducts the audit on behalf of and under the direction of CAG. In other words Dy. CAG (Railways) posted in Railway Board works according to the direction of CAG and for CAG. He is assisted by the Principal Director of Audit posted at HQ on each of the Zonal Railways and Production Units.

One important object of statutory audit for the Railways is to ensure that the system of accounts adopted and used in the Accounts Department of the Railway is suitable and that the check by the internal check mechanism is sufficient, that the accounts are maintained and the checks applied with accuracy ant that arrangement exists in the Railway Accounts Offices to ensure attention to the financial interests of Railway. This object is secured by a test check applied to vouchers and connected accounts records of the Accounts Department and by the inspections on the spot of initial records and documents in the Officers in which transactions originate. The Railway Officer should afford all facilities to statutory Audit Officers in the discharge of their duty.

The duties and the power of CAG are described in the Article149-151 of Indian Constitution. CAG is not responsible for collecting the data but he is empowered to sanction or to approve the head of Accounts on which the expenditure will be booked.

The Dy. C&CAG of India (Railways), is responsible for scrutinizing the adequacy and suitability of all instructions governing compilation of the accounts of Railways and the internal check procedure, whether those instructions be in the form of code or otherwise. He is to satisfy himself that all such instructions and consistent with the relevant statutory rules and facilitate conduct of an effective audit thereof.

He (Dy. C&CG) is also responsible for scrutinising the Railway portion of the Finance Accounts of the Union Govt. including Annual Review of Balance compiled by Railway Board (Accounts). He also examines the Appropriation Accounts prepared by the Railway Board for certifying their accuracy and prepares the Audit Report (Union Govt. Railways) of CAG of India.

Communications from Audit: Communication from Audit is through special letter inspection report. During the Inspection of Executive Department, if the head of Office is not able to offer satisfactory clarification, it issues objections in the form of Audit Notes, Audit Inspection Reports, Special Letters and Draft Paras as the case may be. Rough Audit Note, Preliminary fact report are also part of communication.

Ordinarily, the results of satisfactory Audit are communicated through:-

- a) Specific reports of more important and serious irregularity discovered in the course of audit.
- b) Audit Notes detailing minor irregularities detected.
- c) Inspection reports showing the results of Audit.

Responsibilities of Auditors:

- a) To check all types of expenditures related to the department directly or indirectly.
- b) To check all types of receipts related to department directly or indirectly.

Objects of Auditing or Periodical Auditing:

- a) To check mathematical accuracy of Accounts Department that means to check whether all additions, subtractions etc. are carried out in a proper way or not. It is also to ensure that all the receipts & vouchers of payment made by department is available or not.
- b) To ensure that all the expenditures & receipts are booked in proper Account Head and the expenditures made by the authority are within his competency.
- c) It is used as a part of Parliamentary Control over Budget i.e. to ensure that the Organization has made expenditure as per sanction of Demands of Grant.'

DRAFT PARA & AUDIT REPORT:

The results of Audit are as under:-

- a) During the Audit of a particular station/workplace, the major errors and nonconformities are detected and Special Audit Para is prepared accordingly.
- b) Minor errors of non-conformities /objections should be detected and an Audit Note must be prepared accordingly.
- c) Preparation of Preliminary Inspection report for the final inspection of records of Station,
- d) Workshop etc.
- e) All the objections raised by the Auditor must be replied immediately by the Accounts Officer, Accounts Officer may reply directly or in consultation with concerned executive Officer. It is not necessary for Accounts Officer to inform all the objections to executive department. But if objection is of such a nature and category in which consultancy of executive department is mandatory, it will be done accordingly.

Communication from Audit is through Special Letter, Inspection Report Part –I, Inspection Report Part – II, Audit Notes, Audit Inspection Reports, Inspection letters, Draft Para etc.

Inspection Report Part – I is generally for major and important subjects:

However, Inspection Report Part - II is for Minor objections. Similarly, Audit Note in which the results of monthly text audit are recorded, is prepared in two parts.

It is the duty of Accounts Officer to prepare proper reply of Audit Notes and Inspection Report Part-I. He should also indicate the action taken by him for these irregularities.

Generally the Audit Officers are satisfied with the reply of Accounts Officer but if the matter is very serious and irregularities are ofserious nature and they cannot be rectified /overcome by the ordinary reply or by notes, then, a Draft Para is prepared by the Chief Audit Officer to include aforesaid serious irregularities in the Railway Audit Reports.

Audit Department submits to the PAC (Public Accounts Committee) of parliament and for inclusion into Annual Railway Audit Report. Thus the serious irregularities which are intended to be included in Railway Audit Reports a reported to PAC are called "Draft Paras". The paragraph in dispute are normally finalized after discussions with Railway Board.

Objections brought by statutory Audit are reported to Railway Administration through special letters, factual statements etc. and replies of Railway Administration to the objections from the basis of material to be included in the Annual Report of CAG through different paragraphs. Prior to such an inclusion, the director of Audit sends draft para to the GM endorsing advance copy with connected correspondence. Simultaneously for FA&CAO, HOD concerned, Dy. Comptroller & Auditor General & Executive Director Acts of Railway Board.

To facilitate detailed examination of points brought out in the Draft Para the General Manager is required to send reply to each Draft Para to the Director of Railway Audit duly approved by Minister of Railways within 08 weeks. It is not disposed off by then, it is put before the Parliament & necessary actions as per recommendation of PAC are taken. Executive Officer (Acts) should send Draft Para wits explanation to Railway Board within 05 weeks.

The Draft Para related to Railway Board are directly sent to Railway Board & accordingly they are disposed off by the Board.

The following information must be included in the replay of Draft Para along with main

- a) History of Care
- b) Remedial action taken to prevent reoccurrence of such irregularity in future.
- c) 'Disciplinary actions that has been taken up.

DELEGATION OF POWERS

Railway is a vast Organization. All the works performed by Railway are done for the President of India and on his behalf. The President delegates his power to General Manager of Zonal Railways through Railway Board to efficiently run the Railways. The Powers accorded to GM are of two types. In one case they are empowered to take decisions themselves. In other cases, GM has to take permission of Railway Board before taking decisions.

GM also delegates some of the powers on many subjects to Officers subordinate to him. Some subjects are such, that GM delegates his power to subordinate officers with the note that they can also delegate these powers to the Officers/Staff subordinate to them. GM has to take advice of FA&CAO while delegating such powers to his subordinate officers, additionally, in this regard the rules and regulations available are also kept in mind.

If there exists difference of opinion between GM & FA&CAO, the matter is sent to Railway Board for its decision. This whole process is called "Delegation of Powers". It decentralize the powers so that Railways ate operated, managed, directed and controlled efficiently. Responsibility is fixed at every stage.

SOP – Schedule of Powers

Part A	-	Establishment Matters
Part B	-	Miscellaneous Matters
Part C	-	Commercial Matters
Part D	-	Medical Matters
Part E	-	Works Matters
Part F	-	Material Management Matters
Part G	-	Disaster Management Matters
Part H	-	Publicity Matters
Part I	-	Electronic Data Processing Matters

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UNIT-27: Integrated Management System

What is an Integrated Management System

An Integrated Management System (IMS) integrates all of an organization's systems and processes in to one complete framework, enabling an organization to work as a single unit with unified objectives.

Organizations often focus on management systems individually, often in silos and sometimes even in conflict. A quality team is concerned with the QMS, often an EHS manager handles both Environmental and Health and Safety issues, etc.

Integrated Management Systems:



QMS - Quality Management System

A quality management system (QMS) is a set of policies, processes and procedures required for planning and execution (production/development/service) in the core business area of an organization. (i.e. areas that can impact the organization's ability to meet customer requirements.) ISO 9001:2008 is an example of a Quality Management System.

EMS - Environmental Management System

An Environmental Management System (EMS) determines and continuously improves an organizations' environmental position and performance.

ISO 14001 Environmental Management Systems

SMS - Safety Management System

An OHSMS determines and continually improves an organizations Health and Safety position and performance. It follows an outline and is managed like any other facet of a business, such as with marketing or engineering functions.

OHSAS 18001 Occupational Health and Safety Management Systems

EnMS - Energy Management System

An EnMS determines and continually improves and organizations' energy usage and impact.

ISO 50001 Energy Management System
Quality management system

ISO 9000: 2008 defines "Quality management system" as system to established quality policy and quality objectives and to achieve those objectives. ISO 9000 family of standard distinguish between requirements for quality management systems and requirements for products. Requirement for quality management system are specified in ISO 9000. These are generic and could apply to any organisation regardless of nature of product or service. ISO 9000 itself does not establish requirements for products.

27.1 Why do we need Quality management system: –In today's competitive environment, it is not quality at any cost, instead it is quality of competitive cost. In this context Quality management system provides the right framework for organisation to harness there capabilities and basis the efforts to achieve the intended business result and serve as a basis for long term group and survival.

27.2 Key objects for Quality management system to have effective management of internal process to – Enhance costumer/stack holder satisfaction to sustain business competitiveness. Increase bottom line result and profitability with optimum use of resource.



27.3 International organisation for standardisation (ISO)-: The International organisation for standardisation is a worldwide federation national standards bodies, one from each of approximately 130 countries. ISO was duly formed and began its official function on 23rd February 1947.ISO is a non-governmental organisation which now sees its mission as the promotion of the development of standardisation and related activities in the world with a view to facilitating the international exchange of goods and services and developing corporations in the sphere of intellectual, scientific, technological and economic activity. Its work results in international agreements, which are international standards.

27.4 Structure of ISO-9000:2008 –As previously stated, under ISO protocols all international standard are required to be reviewed every five years. To determine if they should be confirmed, revised or with-draw. To this in the 1990, ISO/176 adopted a two phase revision process. The first to allow limited changes which were completed in 1994, the second reaffirmed in1996 and a more through revision, for year 2000. Now ISO 9000:2008 are implemented.A further element to the background was the intention that the 1994 models for quality assurance, ISO9001, 9002 and 9003, to be consolidated into a single revise standard ISO9000:2008 with tailoring, as appropriate.

Till recently there were some 20 standards in the ISO 9000 family. This revised series has only four core standards-

ISO 9000 is for concept and terminology.

ISO 9001 is for requirement of quality management.

ISO 9004 is for guidance of quality management of organisations. ISO 19011

guidelines on quality and environmental auditing.

27.5 Advantages of ISO 9000:2008-Adopting ISO 9000 series of standards offer number of advantage to all stakeholders including suppliers, customers, employees of the organisation etc. some of these advantages are stated below: It helps in setting house in order; it brings clarity in all operation that is what is to be done, by whom, how and established criteria for all processes. There is less of fire-fighting and employees are encouraged to be proactive. The costumers feel more confident, with the organisation having quality management system, as it provides them with visibility and verifiability about the organisation, its system and even products. The certified organisation gets mention in important product guides, directories and attracts more business. This is more so with oversees client, who for the obvious reasons, insist on ISO 9000 certificate.Documented quality system, based on requirements of ISO 9000, as a minimum helps organisation in being consistence. Infact threw measurement and maintaining the costumer's satisfaction, regular internal audits, monitoring of measuring process and products and management reviews, there is all-round improvement. Once system sets in, it institutionalises the process of continual improvement in real business terms. Like in any good dynamic quality management system, the employees' of ISO 9000 organisation has greater opportunities of learning and contributing, this helps them to satisfy their esteem needs, bringing positive and enjoying work culture in the organisation.

27.6 Some abbreviation in QMS:-

- ➢ ISO- International Organisation for Standardisation
- QMS- Quality Management System
- EMS Environmental Management System
- CEO Chief Executive officer
- MR- Management Representative
- ➢ QU − Quality Unit

- ➢ FU − Functional Unit
- MRM Management Review Meeting
- ➢ IQA − Internal Quality Audit
- ➤ CA & PA Corrective Action & Preventive Action
- ➢ QM − Quality Manual
- > QSP Quality Standard Procedure
- QP Quality Plan
- ➢ WI − Work Instruction
- IMPTE Inspection Measuring & Testing Equipment
- FMEA Failure Mode & Effective Analysis
- ➢ HRD − Human Resource Development
- > TQM Total Quality Management
- ➢ FIPO − For Indication Purpose Only
- ➢ NO − Non Conforming
- 27.7 Genesis of ISO 9001: 2008 is described in the flow chart given below:-
 - ≻Plan what you do
 - Defining scope of business in term of products & services & related supportive functions
 - > Defining process for realising the scope.
 - ➢ Justify what you plan
 - Organisation should look into process in terms of 7 M's (men, method, machine, material, measurement, milieu, money) their sequence and interaction and documents then as process maps. All process is based on respective criteria to minimised subjectivity, requirements of ISO 9001:2008 are designed for this very purpose. Ensure that these requirements are addressed within the documented system.
 - ➢ Do what you planned
 - Process and their interaction, need to be communicated to all process owners. Documented system are established and implemented at all levels.
 - ▶ Have evidence that you have been doing, as planned.
 - Organisation needs to demonstrate compliance of documentation system through objective evidence or quality records.
 - Review what you did
 - Management to review the effectiveness of system vice-versa quality objectives.
 - Modify what you should
 - Based on the management review, planned for corrective and preventive actions, bring modification in the procedure, process and system.
 - ➢ Go back to step-1
 - > Institutionalise the process of continuous improvement.

27.8 Quality management principles: Quality management system based on ISO 9001:2008, should have good look at those principles, to achieve best results:-

Customer focused organisation

- ➢ Leadership
- Involvement of people
- Process approach
- System approach To management
- Continual improvement

- ➢ Factual approach to decision making
- Mutually beneficial supplier relationship

Principle 1. Customer focused organisation:-

This principle calls for building customer oriented organisation. This is largely possible through empowerment. Front line employees are to be empowered mostly as they are dealing with the external customers on one basis. Organisation should deploy means to understand present and futuristic needs of customers in respect of products, delivery, price etc. these needs should get communicated through organisation. In short the organisation becomes functionally a customer driven organisation. To close the loop, customer satisfaction is measured and taken as feedback to improve upon and even exceed the customer expectation.

Principle 2. Leadership:-

Quality initiatives will succeed only in case these are led by top management. Leadership is to be developed through "knowledge & charisma". Organisation should be lay emphasis on developing leadership among senior management who are expected to be a role model of the employees. CEO should build shared vision, which could be own by all employees. Leadership in natural p process builds team work, trust and believe among people. Leader should empower, facilitate, inspire and recognise people to achieve challenging goals and targets which motivate people to take ownership of processes.

Principle 3. Involvement of people:-

In quality organisation, people are always in learning mode. They use learning as value addition of process and of their own. Leadership and costumer orientation coupled with learning environment are time tested ingredients for people to take ownership. These are the people, enjoy the same and are proud to be part of the organisation.

Principle 4. Process approach:-

Process are not set of procedures and work instructions, the organisation should define the process in terms of 7 Ms (Men, Method, Machine, Material, Milieu, Measurement, Money) this would mean designing and making available these Ms.

It is important that organisation identify interference of internal processes for smooth integration and achieving efficiency and effectiveness. This calls for identifying internal costumer, their needs, similarly as done for external costumers.

Principle 5. System approach to management:-

It's important to understand and dependencies among the processes of the system or system approach means; looking in to inter-relation of processes rather than linear cause effect chains. "The essential properties that describe any system are properties of the whole which none of its parts have, for e.g. The essential property of an automobile is that it can take you from one place to another. No single part of an automobile- a wheel, an axle, and carburettor can do that. An automobile is not the sum of its parts; it's the product of their interactions."

Principle 6. Continual improvement:-

QMS have in- build clauses which call for continuous improvement through corrective/prevention actions, internal audits and management review. These at times look at improvement on piece-metal basis. Continual improvement on other hand call for improvement process to become Norm that is institutionalised where organisation promote prevention based

activities, provide every member with appropriate education & training on the methods and tools of continual improvement.

Principle 7. Factual approach to decision making:-

This principle requires organisation to manage the information, making decisions and taking actions, based on the results of logical analysis. Organisation should make of use appropriate statistical techniques to monitor product characteristics and process capability. Competitive process benchmarking, measuring cost of quality, measuring customer satisfaction and similar interventions can help organisation to have factual approach to decision making.

Principle 8. Mutually beneficial supplier relationship:-

This also means, creating and managing supplier relationship to ensure reliable, on time, defect free delivery of supplies, this principle calls for identification and selection of suppliers based on sound principles of quality management system i.e. by accessing their capabilities for short term gains and long term considerations.

Organisation should encourage supplier to implement continual improvement programmes.

ISO 14001 - Environmental Management System

The **ISO 14001 Certification** is an Environmental Management System (EMS) Standards – This standard provided the requirement of EMS and guideline for use. The ISO 14001 standard is a specific standard for Environmental Management system. The ISO 14001 (EMS) is applicable to any organization that wishes to demonstrate sound environmental performance of the organization by controlling the impacts of their activities, products and services on the environment, consistent with their environmental policy and objectives and Complying with applicable legal and regulatory requirements.

The summarized requirement details of ISO 14001 are given below :

General Requirements of Environmental Management System

Which include the requirement of – development, documentation, implementation of organization Environmental Management System as per ISO 14001 requirement.

Environmental Policy

The organization shall develop the environmental policy, which includes the top management commitments to continual improvement, prevention of pollution, comply with applicable legal requirements and other requirements to which the organization subscribes which relate to its environmental aspects. The organization's environmental policy is being communicated to all stake holders and is available to public.

Planning

Which include the requirement of – identification of Environmental aspects and their impacts and determination of significant environmental aspects, applicable legal and other requirements, objectives, targets and programme(s).

Implementation and Operation

Which include the requirement of – setting up of Resources, roles, responsibility and authority in relation with EMS requirements, determination of Competence, providing training and

awareness on Environmental management system requirements, Communication, Documentation, Control of documents, setting up of the Operational control to reduce the environmental impact, determination of potential emergency situations and establishing the Emergency preparedness and response.

Checking

Monitoring and measurement of environmental performance (significant aspects and EMS objectives & targets), Evaluation of compliance, Nonconformity, corrective action and preventive action, Control of records, internal audit.

Management Review

Which include the requirement of - conduct the Management review meeting on environmental management system, at planned intervals, to ensure its continuing suitability, adequacy and effectiveness. And assessing opportunities for continual improvement identify any need for changes to the environmental management system, environmental policy and environmental objectives and targets.

Benefits of ISO 14001 Certification

- Improve the environmental performance of the organization.
- Environmental pollution reduced.
- Compliance with Legal and regulatory requirements related to Environment.
- Awareness about preparedness of potential Emergency situation.
- Improve the business potential among the competitor.
- Reduce wastage of Energy, natural resources, Raw materials.
- Operation control over the process shall improve.
- Commitment to Nation towards reduction pollution and compliance with legal regulatory requirement shall improve.

Applicant organization shall ensure the followings prior to ISO 14001 Certification (Environmental Management System Certification)

- Implementation of Environmental Management System in the organization. Established the Quality Manual, relevant procedures and SOP's
- Conducted one complete cycle Environmental Management System Internal Audit.
- Conducted at least one Management review meeting on Environmental Management System.
- Applicable Legal requirements related to Environmental management system have been identified and compliance has been established.
- Significant Environmental Aspects has been identified and its operational control has been implemented.
- Potential Environmental emergency situation has been identified and its preparedness has been established.

ISO 14001 - Environmental Management System Certification Process

- Application review and contract Sign up between OSS and applicant organization.
- Stage-1 Audit.
- Stage-2 Audit.

- Certification decision.
- Issue of certificate.
- Surveillance audit (annually or Half yearly as finalized during application review process and agreed by client).
- Re-Certification Audit (within three years before expiry of certificate).

OCCUPATIONAL HEALTH AND SAFETY MANAGEMENT SYSTEM

OHSAS 18001 has been developed to be compatible with ISO 9001:2008 (Quality) and ISO 14001:2004 (Environmental) management systems standards, in order to facilitate the integration of quality, environmental and occupational health and safety management systems by organisations, should they wish to do so.

Organisations of all kinds are increasingly concerned with achieving and demonstrating sound occupational health and safety (OH&S) performance by controlling their OH&S risks, consistent with their policy and objectives. They do so in the context of increasingly stringent legislation, the development of policies and other measures that foster good OH&S practices.

The advantages of an effective OHSAS management system:

- >• Provides a structured approach for managing OH&S
- >• Establishes and maintains a commitment to occupational health and safety
- >• Demonstrates strong commitment to safety excellence
- >• Organisational structures in place with clear roles and responsibilities
- >• Existence of a continuous improvement culture
- >• Strong levels of trust and communication
- >• Reduction in incident levels with increased measures of performance.
- >• Contributes to business performance by reducing cost and liabilities.

Occupational Health and Safety is based on:

Hazard identification

- The process of recognizing that a hazard exists (source or situation with the potential to cause harm in terms of human injury or ill-health)

Risk assessment

– The process of evaluating the risk arising from the hazard (combination of the likelihood of a hazardous event or exposure and the severity of injury or ill health that can be caused by the event of exposure)

Determination of applicable controls

– Measures relevant to eliminate or reduce risk to an acceptable level. Measures are based on the hierarchy of control measures.

In order to achieve an effective health and safety system it is vital for organizations to handle these with greater significance. The three aspects above provide the ever important foundation for implementing OHSAS 18001 and without them, the overall system would surely fail. They are, theoretically, considered a part of the 'PLAN' step (explained later), but most auditors and consultants agree that these aspects should be dealt with before designing the system as a whole.

OHSAS 18001 Occupational Health and Safety Standard uses a management approach tool called the PDCA cycle. PDCA is an ongoing process that enables an organisation to establish, implement andmaintain its health and safety policy based on top management leadership and commitment to the safety management system. It consists of the following:

Plan – establish the objectives and processes necessary to deliver results in accordance with the organisation's OH&S policy

Do – implement the process

Check –monitor and measure performance against OH&S policy, objectives, legal and other requirements, and report results



Act - take actions to continually improve OH&S performance

The standard can be implemented to your whole organization or to just a part of it. The best results though come when the whole organization is working on the same system and OH&S policy is integrated into other management systems and into the culture of the organization.

<u>Plan</u>

The planning stage of the process requires the organization to:

- >• Devise an OH&S policy
- >• Plan for hazard identification, risk assessment and determination of controls
- >• Identify relevant legal requirements
- >• Plan for emergencies and responses
- >• Manage change effectively
- >• Devise procedures for performance measuring, monitoring and improvement
- >• Provide and ensure the appropriate use of safety equipment
- >• Train in order to introduce an OH&S culture and establish the importance of organization's safety statement, policies and objectives
- >• Consult employees and communicate

At first, the management has to be consulted in order for them to feel confident in supporting the new system and constantly driving it forward. Then the workforce has to be consulted. It is very likely that the lower level employees have valuable insight, ideas and feedback about the new system. Since they are the ones that are going to be most affected by it, it is logical to ensure they believe and understand the need for change. Failure to realize this could result into much resistance throughout your organization and thus result in a system that is impractical to operate.

Do

The implementation stage should be the easiest part of this process. If the planning stage is done the right way then it is just a matter of following the documentation and procedures that have

been created. In order to ensure smooth implementation a lead senior manager should be in charge of the new OH&S system and at the same time each element of the process should have an 'owner' or a person that looks after that part of the system. This ensures the appropriate structure at your organization and effectively minimizes risk.

It is advisable to start the implementation by breaking the system down into specific elements rather than tackling it as a whole. Concentrating on specific elements in a logical order creates a solid foundation for the whole system to work efficiently.

Another important aspect of health and safety is having employees do the jobs that are suited to their competencies. A matrix should be created showing all groups of personnel, their required competencies, training and status of each. These formal procedures should instil the required awareness within your organization.

Check

The third step of the PDCA cycle consists of the following:

- >• Conducting internal audits
- >• Evaluation of legal compliance
- >• Identifying non-conformities and addressing them
- Thorough analysis of incidents and incidental data
- > •Measuring performance and monitoring

The failure to conduct internal audits periodically will most likely result in the breakdown of the system as a whole. It often happens that where there is no control, risks tend to arise especially quickly.

Any arising non-conformities should be tackled instantly using the devised corrective actions. The most effective and robust systems ensure that this process runs smoothly at all times. This means that the performance of this process should be measured as well and any non-conformities have to be dealt with. It is not only the arising non-conformities that your organization needs to think about. It's crucial for your organization to identify any possible emergencies and develop relevant response procedures, this is called preventative action.

When devising controls and measuring performance it is important to strike a balance between being overly bureaucratic and overly light on certain elements of the system. The OHSAS 18001 Occupational Health and Safety Management Specification is not supposed to hinder the performance of your organization but improve it.

Act

The final step is the management review, it is a vital part of the continuous improvement process and so the standard itself outlines what should be included in such a review.

Management review is done by the senior management and involves reviewing the suitability, adequacy and effectiveness of the system. It should also include assessing opportunities for improvement and the necessity to change the OH&S policy and the OH&S objectives. If changes are needed, the senior management should also provide the necessary resources for their

implementation. Providing resources is a way of presenting commitment to the new health and safety system.

ISO-50001:2011 : ENERGY MANAGEMENT SYSTEM

Introduction

The purpose of this International Standard is to enable organizations to establish the systems and processes necessary to improve energy performance, including energy efficiency, use and consumption. Implementation of this International Standard is intended to lead to reductions in greenhouse gas emissions and other related environmental impacts and energy cost through systematic management of energy. This International Standard is applicable to all types and sizes of organizations, irrespective of geographical, cultural or social conditions. Successful implementation depends on commitment from all levels and functions of the organization, and especially from top management.

This International Standard is based on the Plan - Do - Check - Act (PDCA) continual improvement framework and incorporates energy management into everyday organizational practices, as illustrated in Figure 1.

NOTE In the context of energy management, the PDCA approach can be outlined as follows:

- — Plan: conduct the energy review and establish the baseline, energy performance indicators (EnPIs), objectives, targets and action plans necessary to deliver results that will improve energy performance in accordance with the organization's energy policy;
- — Do: implement the energy management action plans;
- — Check: monitor and measure processes and the key characteristics of operations that determine energy performance against the energy policy and objectives, and report the results;
- — Act: take actions to continually improve energy performance and the EnMS.



Figure 1 — Energy management system model for this International Standard

Worldwide application of this International Standard contributes to more efficient use of available energy sources, to enhanced competitiveness and to reducing greenhouse gas emissions

and other related environmental impacts. This International Standard is applicable irrespective of the types of energy used.

This International Standard can be used for certification, registration and self-declaration of an organization's EnMS. It does not establish absolute requirements for energy performance beyond the commitments in the energy policy of the organization and its obligation to comply with applicable legal requirements and other requirements. Thus, two organizations carrying out similar operations, but having different energy performance, can both conform to its requirements.

This International Standard is based on the common elements of ISO management system standards, ensuring a high level of compatibility notably with <u>ISO 9001</u> and <u>ISO 14001</u>.

NOTE <u>Annex B</u> shows the relationship between this International Standard and <u>ISO 9001:2008</u>, <u>ISO 14001:2004</u> and <u>ISO 22000:2005</u>.

1 Scope

This International Standard specifies requirements for establishing, implementing, maintaining and improving an energy management system, whose purpose is to enable an organization to follow a systematic approach in achieving continual improvement of energy performance, including energy efficiency, energy use and consumption.

This International Standard is applicable to any organization wishing to ensure that it conforms to its stated energy policy and wishing to demonstrate this to others, such conformity being confirmed either by means of self-evaluation and self-declaration of conformity, or by certification of the energy management system by an external organization.

2 Normative references

No normative references are cited. This clause is included in order to retain clause numbering identical with other ISO management system standards.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1 boundaries

physical or site limits and/or organizational limits as defined by the organization

3.2 continual improvement

recurring process which results in enhancement of energy performance and the energy management system

3.3 correction

action to eliminate a detected **<u>nonconformity (3.21)</u>**

3.4 corrective action

action to eliminate the cause of a detected **nonconformity** (3.21)

3.5 energy

electricity, fuels, steam, heat, compressed air, and other like media

3.6 energy baseline

quantitative reference(s) providing a basis for comparison of energy performance

3.7 energy consumption

quantity of energy applied

3.8 energy efficiency

ratio or other quantitative relationship between an output of performance, service, goods or energy, and an input of energy

EXAMPLE:

Conversion efficiency; energy required/energy used; output/input; theoretical energy used to operate/energy used to operate.

3.9 energy management system

EnMS

set of interrelated or interacting elements to establish an energy policy and energy objectives, and processes and procedures to achieve those objectives

3.10 energy management team

person(s) responsible for effective implementation of the energy management system activities and for delivering energy performance improvements

3.11 energy objective

specified outcome or achievement set to meet the organization's energy policy related to improved energy performance

3.12 energy performance

measurable results related to <u>energy efficiency (3.8)</u>, <u>energy use (3.18)</u> and <u>energy</u> <u>consumption (3.7)</u>

3.13 energy performance indicator

EnPI

quantitative value or measure of energy performance, as defined by the organization

Note 1 to entry: EnPIs could be expressed as a simple metric, ratio or a more complex model.

3.14 energy policy

statement by the organization of its overall intentions and direction of an organization related to its energy performance, as formally expressed by top management

3.15 energy review

determination of the organization's energy performance based on data and other information, leading to identification of opportunities for improvement

3.16 energy services

activities and their results related to the provision and/or use of energy

3.17 energy target

detailed and quantifiable energy performance requirement, applicable to the organization or parts thereof, that arises from the energy objective and that needs to be set and met in order to achieve this objective

3.18 energy use

manner or kind of application of energy

EXAMPLE:

Ventilation; lighting; heating; cooling; transportation; processes; production lines.

3.19 interested party

person or group concerned with, or affected by, the energy performance of the organization

3.20 internal audit

systematic, independent and documented process for obtaining evidence and evaluating it objectively in order to determine the extent to which requirements are fulfilled

3.21 nonconformity

non-fulfilment of a requirement

[SOURCE: ISO 9000:2005, definition 3.6.2]

3.22 organization

company, corporation, firm, enterprise, authority or institution, or part or combination thereof, whether incorporated or not, public or private, that has its own functions and administration and that has the authority to control its energy use and consumption

3.23 preventive action

action to eliminate the cause of a potential **<u>nonconformity</u>** (3.21)

3.24 procedure

specified way to carry out an activity or a process

3.25 record

document stating results achieved or providing evidence of activities performed

3.26 scope

extent of activities, facilities and decisions that the organization addresses through an EnMS, which can include several boundaries

3.27 significant energy use

energy use accounting for substantial energy consumption and/or offering considerable potential for energy performance improvement

3.28 Top management

person or group of people who directs and controls an organization at the highest level

31.1 HOW TO PREPARE:

Use Form S-1302 (three copies)

- 1. Give correct details of Indenter.
- 2. Give correct details of the consignee (who is to physically receive the material) and consignee code number.
- 3. Give correct code no. (Group sub Group no.)
- 4. Give correct Description.
- 5. Give correct specification/ Drawing with latest amendments if any.
- 6. Give correct quantity in unit of accountable as shown in Nomenclature is (e: Number01, Pair-02, Set-03, Kg.-13, Meter-22, Liter-51)
- 7. Give correct Head of account chargeable and confirm availability of funds and finance concurrence as necessary (If items have value more than Rs. 1.0 Lakh require vetting from finance department.
- 8. Give particulars of last purchase with rate (To justify item current rate)
- 9. Give correct rate of the item.
- 10. Give value of the item (Total qty. X Rate)
- 11. Give end use of the item.
- 12. Attach essential certificate signed by JAG Officer with form no. S 1302 and submit 02 copies of S 1302 with essential certificate to Store deptt. for procurement.

31.2 Non Stock Indents - Signing Authority: - As per Railway Board letter no.

2005/RS(G)/779/7 dated 28.5.2007 (As per SOP Part 'F' item no. 1.0)

		Level of signing of Non-stock requisitions/indents for		
		procurement through		
S	Value of Non-	Local purchase/	Tenders	Tenders as HQ
No	requisition*	Spot Purchase	divisional/depo	level **
			t level	
1	Non-stock requisition	JS Officers SS Offic	cers in absence of	JS officer.
	valuing up to Rs. 10000/-			
	only			
2	Non stock requisition	SS Officer. JAG/SC	G Officers in abser	nce of SS Officer.
	exceeding Rs. 10000/- but			
	not exceeding Rs. 50000/-			
	only in value			
3	Non stock requisition	JAG/SG Officer ***	*	
	exceeding Rs. 50000/- but			
	not exceeding Rs. 2 Lakhs.			
4	Non stock requisition	Should be countersi	gned by CWM/A	DRM/SAG Officer of
	exceeding Rs. 2 Lakhs but	the user department	•	
	not exceeding Rs. 10 Lakhs.			
5	Non-stock requi	Should be counters	signed by CWM/	ADRM/SAG Officer
	exceeding Rs. 10 Lakhs	&the same show	uld be person	ally approved by
		PHOD/CHOD of th	e user department	t in HQ.

* Non stock requisition will require vetting as per extant instructions.

** All Non Stock purchase at HQ will require consolidation & essentiality of purchase to be certified by at least SAG level officer of consuming department in Headquarter & by ADRM for divisional requirements & CWM for workshops requirements.

*** In case JAG/SG Officer is not posted then non stock requisition to be signed by ADRM for divisional requirements. CWM for workshop requirements and SAG Officer for construction and other requirements.

**** The Essentiality Certificate is to be signed by DRM/ADRM for divisional requirements & CWM for workshop's requirements in case of Local Purchase at Depots/Divisions.

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		include the indents for closely similar iter	ms.) *	(町)(D)			
	6.	दरों संहित बकाया कय-आदेशों का ब्यौरा (इर	में पूर्णतया एक	(帝) (A)			
		समान मदों के लिए क्रय आदेश सं. शामिल वि	ন্যা जाना चाहिए)*	(ख) (B)			
		Details of outstanding purchase orders wi	th rates. (This	(町)(C)			20
		similar items)*	rclosely	(4)(D)			
	7.	संभावित आपूर्तिकर्ता (यदि कोई हो)Likely	supplier (If any)	•			~
	8.	क्या स्वामित्व वस्तु प्रमाण-पत्र संलग्न है ?	Is proprietary arti	cle certificate enclosed	1 ?		· · ·
	9.	gen weie o ole Reason for urgent pu	rchase :-				-
	10				·····		
	10.	Certificates : Certified that no/adequate	stock of the same	en closely similar its	/ uulua velas sua	नब्ध नहाह।	
3		(ii)वर्ष के	दौरान	or elosely standard	रुपये की ध	नराशि उपलब्ध है।	
		Funds are available for Rs		dur	ing the year		×
		(iii)माँगा गया पुर्जा/मांगे गये पुर	र्ने मांगकर्ता की देख	रेख में वास्तव में उपयोग	में परिसम्पत्तियों के	अनुरक्षण के लिए अपेक्षित है।	
•		Part (s) indented here is/ar	e required for mai	ntenance of assets act	tually in use under	the charge of the indentor.	
	मांग	कर्ता अधिकारी Indenting Officer	नियंत्रण अधिव	त्रारी Controlling Offic	er :	अनुमोदक अधिकारी Approving (Officer
20	केवल	न भरण डिपों के इस्तेमाल के लिए for use of	feeding Depot onl	у.	20 aprove 1676	72	
	· (2	॥द स्थान अपयाप्त हा तो अलग से कागज सं भाषात किया जाता है कि इस विवर्ष में स्टब्स	नग्न कर/Attach s	eparate sheet if space	ce insufficient)	1.1. 4. 1.	
	(ii)	गानित किया जाता है कि अधिशेष / विकल्प न	। स्टाक नहा रखा सामग्री से मांग परी	गया रु Centified tha नहीं की जासकली (t the item is not sto Certified that the de-	icked in this depot.	his/alternate material
					the same are de	and subject of met out of sup	and a contract material,
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	NWE	P, All. No. 424-1000x100-10-04				अध्यकारा Depot Officer	

UNIT 29: TL & RAC

1.0 DESCRIPTION ABOUT ELECTRICAL GENRATION IN ROLLING STOCK:

Based on the type of generation, there are two systems are being used over IR. These are Self Generating System (SG) & End on Generation System (EOG). However, efforts are being done for adoption of more efficient, more economical and more reliable Head On Generation System (HOG).

1.1 SELF GENERATING SYSTEM:

In this system, power supply is generated in individual coach through alternators propelled by axles. Power generated during run supplies coach supply and also charges the battery bank provided in each coach, which in turn supplies power to the coach while the coach is stationary. The alternators are fitted in the under frame driven by the axle through V-belts. These alternators generate 110V, AC, 3Ø, which is rectified and regulated by Rectifier cum Regulator Units (RRU). The RRU further passes 110V DC for coach supply and battery charging. This system is used for Air Conditioned coaches and Non AC coaches of Mail/Express/Passenger trains.





1.2 END ON GENERATING SYSTEM:

End on generation system envisages equipping of luggage cum brake vans in front and rear end of rake & coaches in between them. Presently on IR three types of coaches are being in use as per voltage i.e. 415 V, 750 V & dual Volt 415 V coaches are available in low capacity rakes, these coaches are not equipped with 50 kVA step down transformer & rating of Inter vehicular coupler of these coaches is lower therefore in future all coaches will be converted into 750 V, 3 Φ AC by equipping 50 kVA step down transformer. Dual volt & 750 V coaches are equipped with 50 kVA step down transformers for stepping down 750 V, 3 Φ AC, 4 wire, 50 Hz supply to 415 V, 3 Φ AC, 4 wire, 50 Hz supply. Supply to entire rake is fed through two feeders running on both sides of coaches along length of rake. Generator cars take entire load of rake, which includes air conditioning unit, light/fan circuit, emergency battery charger circuit and pantry equipments. This system is used for Air Conditioned coaches of Rajdhani/ Shatabdi/ Duronto/ Garib Rath trains.





110 v 3 Ø Lightning load

1.3 HOG TL SYSTEM:

To get electrical power supply from electric or diesel loco is known as HOG TL system.

Hog scheme with bulk converter with one on board DA set

Existing one DA set shall be removed (Right now both the DA sets are retained for extended trial purposes). Input supply of hotel load converter is single phase 750 V AC from locomotive transformer. The output of hotel load converter is three phase 750 V Sine wave AC.

Two converters feed power to two feeders independently and share load of the rake. In case of non availability of HOG loco or failure of converters/OHE, power shall be fed by DA sets from front or rear or both power cars.

HOG SCHEME WITH CONVERTER ANDONE ON BOARD DA SET



1.4 TYPES OF COACHES WORKING WITH SG SYSTEM:



i) Under slung type AC coaches

ii) Roof Mounted Package Unit type AC coaches





1.5 TYPES OF COACHES WORKING WITH EOG SYSTEM:

- i) Under slung type AC coaches
- ii) Roof Mounted Package Unit type AC coaches
- iii) LHB type AC coaches
- iv) Generator Cars
- v) AC Pantry Cars

2.0 LHB COACHES

2.1 INTRODUCTION:

Air conditioning equipment in coaches is mounted either under slung (conventional type under slung) or on the roof (RMPU type). RMPU type AC coaches can be classified on the basis of mode of power supply and type of accommodation.

2.2 SALIENT FEATURES OF LHB TYPE RMPU ACCOACHES:

- i) Provision of IGBT based battery charger.
- ii) Microprocessor based AC package with low noise level.
- iii) Integrated modular single switch board with controls of AC & lighting etc.
- iv) Lightweight epoxy molded transformer.
- v) Modular and elegant interior light fittings and reading lights.
- vi) Provision of radox type FRLS cables.
- vii) Uniformity of illumination.
- viii) Microprocessor based pump line.
- ix) Antiskid protection.
- x) Microprocessor controlled disc brake system with wheel slip control device.
- xi) Centre buffer coupler with anti-climbing features.

2.3. AIR CONDITIONING SYSTEM:

The coach is equipped with two compact air conditioning units installed in the roof area at the coach tails above false ceiling. These units are supplied by three phase mains.

Control and regulation are carried out by a common controller, mounted in switch cabinet S1 and fed from battery net. The operating and display elements of the air condition control are equally contained in the switch cabinet S1.

2.4 MAIN ELECTRICAL EQUIPMENTS:

- i) Microprocessors controlled package unit.
- ii) Switch board cabinet S1.
- iii) 60 KVA transformer.
- iv) Battery charger.
- v) Disconnecting and earthing device.
- vi) 110V, 70AH VRLA battery.
- vii) Fuse box.
- viii) Pump box.
- xi) NTC type temp sensor.

3.0 ACTION TO BE TAKEN IN CASE OF FIRE IN TRAIN:

- i) Immediately isolate the affected coach/coaches electrically.
- ii) Use fire extinguisher to extinguish fire to the extent possible.
- iii) Immediately check lights in the coaches and provide light in dark coaches.
- iv) Provide light at accident site.

v) Take necessary actions as a man of common prudence will take not only to help the stranded passengers but also to arrange such helps as would be Demanded by the circumstances.

vi) Help in extricating the trapped passengers/bodies.

4.0 ELECTRIC SHOCK:

Electric shock occurs when an electric current flows through the body. The human body is made up of 60% to 70% water. This makes it a good conductor of electricity. Burns, damage to internal organs, heart rhythm problems, and death can result from electric shock.

What to do when a person received an electric shock:

- i) Switch off the current, if possible, by removing the fuse or switching off the circuit breaker.
- ii) Do not touch / remove the victim from the electric source until the power source has been shut off.

iii) Separate the person from the source of electric current using a dry broom handle or other type of non-conducting material such as wood or rubber.

iv) Do not touch the victim with your bare hands, as electric current will pass through you as well.

v) Let his head be slightly lower than the rest of the body, and raise his legs.

vi) Inform TTE/conductor and call any Doctor, if available in the

coach/train to attend the injured person. Inform this incidence to electrical control.

5.0 WRA: Water raising apparatus (WRA) provided in AC coaches are of two types:

1. Air Compressor type

In air compressor type WRA one of two air compressors feeds air in to bottom tank to raise the water. These compressors are controlled by pressure operated switch.



2. Pump type.

In pump type WRA one of the two pumps feeds the water from bottom tank. These pumps may be controlled by timer, microprocessor or manually.

UNIT-30: ENERGY CONSERVATION

Energy conservation refers to reducing energy consumption through using less of an energy source/ service. In other words energy must be used when it actually required. It has also effect on nature .Energy conservation reduces the atmospheric pollution as it reduces the usage of energy Considering the necessity of energy conservation, 14th, December of every year is celebrated as Energy Conservation day. If we do not reduce / regulate the utilization of energy sources, it will be end up within few years & will cause huge energy crisis.

1. ENERGY SAVING TIPS:

1.1 AT HOME:

30% Energy needs of a country is for domestic usage .So energy saving should begin at home. Below mentioned are common techniques.

- i) While building home proper ventilation and use of natural light should be ensured.
- ii) Windows should be provided in such a way that the natural light illuminate inside of house.
- iii) Use light colored paint inside the house.
- iv) Use light colored curtain on windows.
- v) Switch off all electric equipment when not in use.
- vi) Clean up all the illuminating equipment.
- vii)Use energy saving CFL instead of incandescent lamp.
- viii) Always procure energy efficient equipment's (star rated)
- ix) Use solar water heater, solar light and solar cooker.

x)Saving of water.

xi) Applying efforts for Saving of LPG gas & electricity in Kitchen.

1.2. SAVING ENERGY IN TRANSPORTATION:

i) Accurate speed	vii) Route plan.
ii) Engine health	viii) Avoid unnecessary load.
iii) Correct gear	ix) Car/Bike sharing.
iv) Driving habits	x) Trip planning.
v) Stop at signals	xi) Proper air in tires.
vi) Good quality of fuel &automobile oil.	

1.3 ENERGY SAVING IN INDUSTRY:

i)	Use of solar heater instead of heater/geyser.	vi) Recycling of water.
ii)	Regular energy auditing	vii) DG set, Pump.
iii)	Efficiency testing of machines	viii)Compressor
iv)	Skill in handling of furnaces	ix) Welding
v)	Boiler maintenance	x) Refrigeration.

1.4 ENERGY SAVING IN AGRICULTURE:

- i) Know your tractor/vehicle.
- ii) Prevent fuel/oil/water leakage
- iii) Match the capacity
- iv) Solar pump/light
- v) Efficient pump ,machines& motor

1.5ENERGY SAVING IN COMMERCIAL COMPLEX: (MALL/HOSPITAL/CINEMA etc.)

- i) Lighting with luminaries of adequate wattage & star ratting
- ii) Lift / Escalators with smart operating system
- ii) Hot & cold water at lesser temperature setting
- iii) Geyser/Heater at lesser temperature setting
- iv) RAC at lesser temperature setting
- v) Provision of Water harvesting system
- vi) Using small speakers, earphones in Music/entrainment
- vii) Using solar plants for lighting and heating
- viii) Atomization in Pumping

2. GOVERNMENT EFFORTS: 2.1 FOR ELECTRICAL ENERGY:

- i) Energy conservation act (ECA-2001) applied on consumers having connected load of 500 kilowatt or more. The aim of this act to control over wastage of energy in industries.
- ii) Energy conservation building code (ECBC-2007) applied on the buildings having connected load of 100 kilowatt or more to control wastage of energy in buildings and to permot natural sources of energy.
- iii) Establishing Bureau of Energy Efficiency (**BEE**) under Ministry of power to monitor, setting up guidelines, training & recommendations to govt. of India regarding energy conservation

2.2 FOR PETROLUIM PRODUCTS:

i) Petroleum conservation and research association PCRA-1976

: It works for energy conservation in petroleum products

3. ROLE OFTECHNICAL SUPERVISORS OF RAILWAYS IN ENERGY CONSERVATION:

- i) Instruction to subordinates & artisan staff.
- ii) To prevent fuel/oil/water/air/gas/electricity leakage
- iii) Using energy efficient equipment/machines

- vi) Stop diesel/oil leakage.
- vii) off the vehicle at stop.
- viii) Keep engine healthy.
- ix) Preplanning.

- iv) Updating process/maintenance technology
- v) Energy conservation measures in Transportation
- vi) Using non-conventional energy resources
- vii) Optimum use of light/ac/fans
- viii) Motivation/management/discipline
- ix) Scrap disposal
- x) Stop misuse of light and fans and A/C
- xi) Adopting latest maintenance technology
- xii) Skill in welding ,cutting ,machining, painting
- xiii) Optimum use compressor, yard lights/shed lights, etc.
- xiv) Review the machine and plants for their capacity & efficiency

4. ENERGY MANAGEMENT POLICY ON NWR:

- i) Adopt cleaner and Eco –friendly renewable energy sources on railways.
- ii) Striving to reduce specific energy consumption by continuously taking energy efficiency improvement measures and minimizing energy wastages.
- iii) In corporate energy efficient designs and technology in all future projects compile with energy conservation building code 2007.
- iv) To carry out internal and external energy audits on regular basis to identify areas for improvement.
- v) Involvement of employees at all level (Zonal/Div/WS) in the energy conservation efforts.
- vi) Extensive use of three star (***) and above labeled electrical products/equipment.
- vii) Implementation of energy conservation act 2001.
- viii) Extensive use of LED based lighting product both in coaches and stationary applications.
- ix) Use of non-conventional energy resources.
- x) Providing solar light panels on roof of coaches
- xi) Installing wind power mill of 25 MW at Jaisalmer

5. INTERNET SITES FOR ENERGY CONSERVATION TIPS:

i) www.bee-india.nic.in (for electrical energy conversation) and

ii) <u>www.pcra.org</u>(for petroleum product -conservation)

6. ADVANTAGES OF ENERGY CONSERVATION:

- i) Help to environment
- ii) Costly fuel saving
- iii) Money saving
- iv) Increasing efficiency/productivity
- v) Relief in tension
- vi) Health improvement

- vii) Fast development of nation
- viii) Saving for future needs

33.2 ECBC CODE:

This code is applied to ensure the provision of energy conservation measures in buildings.

The code is being made mandatory for commercial buildings or building complexes that have a connected Load of 500 KW or greater or a contract demand of 600 KVA or greater. The code is also applicable to all buildings with a conditioned floor area of 1000 m2 (10,000 ft 2) or greater. In Amendment to the code issued in 2010, the buildings with contract demand of 120 KVA or 100 KW is stipulated as the criteria. The code is not mandatory for residential buildings with three or fewer storey's and single family buildings.

STAR RATING

It is the measure of energy efficiency of an equipment, machine or any building. Top rating under this classification is 5-star, which shows the most efficient equipment, machine or a building and 1-star equipment is the least efficiency for a particular category. Efficiency of any equipment does not stands in any range of star ratting belongs to the product of non-star ratting.



UNIT-31: LEAVE RULES

KINDS OF LEAVE:

1. LEAVE ON AVERAGE PAY: An employee permanent/ temporary other than in

school shall be entitled to 30 days leave in a calendar year credit in advance of a uniform rate of 15 days, on 1st January and 1 st July every year.

- \blacktriangleright Credit 2 ¹/₂ days per month maximum accumulation 300 days.
- > 1/10 period of extra ordinary leave / LWP to be debited.
- > Maximum LAP can be granted at a time = 180 day.
- > Joining period of transfer credited in LAP.
- > One month leave salary if 1 month or more LAP sanctioned.
- Benefit of carry-forward is allowed if selected in other central Govt. service on viceversa.
- Supervisors in scale Rs. 4200(GP) and above in charge can sanctioned 15 days.

2. LHAP:

- > 20 days earned after 1 year accumulation No limit.
- \blacktriangleright LHAP credit w.e.f.1.1.86. ie. 1 st January = 10 days and 1st July = 10 days.
- ➤ LHAP of 24 months irrespective of its combined with other leave.
- > During this, salary be $\frac{1}{2}$ of basic pay but full on commute.
- > 180 days can be availed without medical certificate for entire service. If used for study in the interest of public service.
- LHAP maximum of 120 days as commute/ leave without medical certificate in continuation of maternity leave.

3. COMMUTED LEAVE: Commuted leave is allowed without any limit on medical ground provided:

- > Competent authority is satisfied.
- Twice the amount of HLAP is debited.
- Resignation, Voluntary retirement without returning to duty commuted period be treated as LHAP and recovery of ½ salary be affected.
- But in case of compulsory retirement/ ill health no recovery.

4. LEAVE NOT DUE: Leave not due may be granted to an employee in permanent employment as in advance subject to:

- > LND shall be limited to LHAP likely to earn subsequently.
- Maximum 360 days for entire service on medical ground.
- > LND to be debited from LHAP likely to earn.
- During LND resignation/ voluntary retirement without returning to duty shall be cancelled and recovery be done.
- > No recovery of salary compulsory retired on disciplinary rule or ill health.
- > May be granted without medical certificate. Only in continuation of medical leaves.
- > LND may be sanctioned up to 90 days at a time on LHAP only.

5. EXTR ORDINARY LEAVE: To be granted only in special circumstances.

- ➢ No other leave is admissible.
- Admissible but employee applied for E.O.L.

- Not debited against leave account.
- No leave salary admissible.
- ▶ Not to be sanctioned exceeding 5 years in continuation.
- **6. SPL. DIABLITY LEAVE:** May be granted to temporary/ permanent staff Gazetted/ non- gazetted who is disabled by injury intentionally on duty.
 - ➢ Ceiling limit 24 months.
 - ➢ Injury − infest within 3 months.
 - First 4 months full pay, rest of $\frac{1}{2}$ pay.
 - > Intentionally inflicted by another person during the course of duty- by enemies.
- **7. HOSPITAL LEAVE:** Hospital leave granted to non- gazetted Rly. Servant while injured on duty. The maximum limit of hospital leave is 28 months.
- **8. STUDY LEAVE:** Can be granted with due regards to the exigencies of public service higher studies on specialized training or professional having direct close connection with the sphere of his duties.
 - > Not to be granted for studies in academic, semi- academic or literary subjects.
 - > Foreign ministry requires agreeing to the release of foreign exchange involved.
 - > Shall not be sanctioned who is on deputation.
 - Who has completed probation period and put in not less than 5 year's service including probation.
 - Should have remain still 3 years' service and such undertaking be done on bond papers.
 - Months at a spell and not more than 24 months of whole service.
 - After returning, if quitting service within 3 years shall pay the total amount of leave salary, study allowance, cost of fees traveling expense etc.

9. MATERNITY LEAVE:

- Female employee including an apprentice with less than 2 surviving children can be granted up to 180 days.
- Miscarriage or abortion ML may also be granted in case of miscarriage or abortion subject to following condition:
- > The leave should not exceed six weeks.
- Supported by medical certificate from the authorized medical attendant.
- ➢ Not debited to leave account.
- ➢ Granted on full pay.
- May be combined with any kind of leave.
- > ML as admissible may be granted to unmarried female employees.
- Leave of any kind due & admissible that can be granted in confirmation with maternity leave is increased from One year to Two years
- **10. PATERNITY LEAVE:** Male Rly. Servant with less than two surviving children may be granted paternity leave for a period of 15 days during the confinement of his wife.

11. CASUAL LEAVE;

CL is a leave admissible in all group (i.e. A,B,C, and D) for sudden / unforeseen needs requirement. It is not recognized as leave under leave rule.

- ▶ It is admissible for 8/11 days in different office set up workshop etc.
- Public holiday closed Saturday, Sunday, and weekly off falling in CL will not be counted as CL prefix/ suffix.
- \blacktriangleright 1/2 day CL should be debited to the CL for each late attendance.
- \blacktriangleright 1/2 day either for pre or post lunch session can be sanctioned.
- Late attendance can be condoned up to an hour and not more than 2 occasions, in a month with full justification.
- > Leaving office early be treated as par with late attendance also.
- In addition to 8 days casual leave, additional benefit of 4 days in a calendar year has been granted to Railway employees with disabilities as defined in the persons with Disabilities Act 1995(Effective from 1st Sept. 2008)

12. SPECIAL CASUAL LEAVE: Spl. Casual leave is granted to Rly. Employees on basis of the following occasions.

- ➢ For participation in sports events.
- ➢ For promoting small family norms.
- > For attending meeting of Rly. Men's co-operative societies.
- ➤ Attending meeting of trade union.
- Scout and guides works.
- Participation in cultural activities.
- ➢ Spl. occasions like:
- (a) Blood donation (b) flood. (c) Curfew (d) Participation in Republic Day

(e)Territorial army (f) DAR inquiry (g) Election.

13. Child care leave:

- > To look after only two eldest children during service max. 730 days.
- > Under 18 year child to look after or education or sickness purpose can be taken
- Not debited in leave account.
- Record maintained in service sheet accordingly.
- Pre sanction require like LAP
- Can be taken with other kind of leave.
- > During leave Saturday, Sunday, holiday etc. is countable.
- ➢ In a year can be availed 3 times.
- > At a time minimum 15 days leave should be granted.

14. Child adoption leaves:

- (a) Child Adoption Leave which was earlier available for 135 days has been enhanced to 180 days.
- (b) Railway Servant (incl. App) with less than 2 surviving children, on valid adoption of a Child below the age of one year may be sanctioned. Paternity Leave for a period of 15 Days within six months from the date of valid adoption.

UNIT-32: DISCIPLINE & APPEAL RULES, 1968

CONDUCT RULES, 1966:-There are 26 rules & these rules are concerning to the conduct and behavioural attitude of the railway men to whom applicable. They shall come into force on the 1st day of October, 1968. In exercise of the powers conferred by the proviso to Article 309 of the Constitution, the President hereby makes the following rules:-The following officers are in DAR

- Appointing authority
- Disciplinary authority
- Enquiry officer
- Presenting officer
- Defence council

There are total eleven penalties, in which six are minor and five are major penalty

Minor Penalties:-

i	Censure;
ii	Withholding of his promotion for a specified period;
iii	Recovery from his pay of the whole or part of any pecuniary loss caused by him to the Government or Railway Administration by negligence or breach of orders
iii-a	Withholding of the Privilege Passes or Privilege Ticket Orders or both;
iii-b	Reduction to a lower stage in the time scale of pay for a period not exceeding three years, without cumulative effect and not adversely affecting his pension. Reduction to lower stage in the time scale of pay by one stage for a period not exceeding 3 years, without cumulative effect and not adversely affecting his pension.
iv	Withholding of increments of pay for a specified period with further directions as to whether on the expiry of such period this will or will not have the effect of postponing the future increments of his pay.

Major Penalties-

v	Save as provided for in clause (iii-b), reduction to a lower stage in the time-scale of pay for a specified period, with further directions as to whether on the expiry of such period, the reduction will or will not have the effect of postponing the future increments of his pay;		
vi	Reduction to a lower time scale of pay, grade, post, or service, with or without further directions regarding conditions of restoration to the grade or post or service from the which the Railway Servant was reduced and his seniority and pay on such restoration to that grade, post or service;		
vii	Compulsory retirement;		
viii	Removal from service which shall not be a disqualification for future employment under the		
	Government or Railway Administration;		
xi	Dismissal from service which shall ordinarily be a disqualification for future employment under the Government or Railway Administration.		

STANDARD FORMS for use in disciplinary proceeding:

- ➢ SF 1- Suspension
- ➢ SF 2-Deemed to be suspended
- SF 3-Demand for subsistence allowance by employee
- ➢ SF 4- Revoke
- SF 5- Charge sheet for major penalty
- SF 6-Refused to inspect/supply the documents to employee/defence council
- ➢ SF 7-Appointment of Inquiry officer
- SF 8- Appointment of presenting officer
- ➢ SF 9-Deleted
- SF 10-Common Proceedings
- SF 10A- Appointment of Inquiry officer in Common Proceedings
- SF 10B- Appointment of presenting officer in Common Proceedings
- ▶ SF 11- Charge sheet for minor penalty
- ➤ SF 11A- Convert Minor penalty to major penalty
- SF 11B- Conduct Inquiry in Minor penalty charge sheet
- ▶ SF 11C- Convert major penalty to minor penalty
- SF 12- Memorandum where action is proposed under Rule-14 (i)
- SF 13- Permission from president for action taking against the retire Rly. Employee.
- SF 14- Charge sheet for retired Railway employee

Effects of Penalties on promotion are as under:

	=		
Sr.	Penalties	For selection	Promotion
No.			
1-	Censure	May be called	Can be promoted
2-	Withholding of promotion	Will not be called	Will not be promoted
3-	Recovery of pecuniary losses	Will be called	Will be Promoted
4-	Withholding of Pass /PTO	Will be called	Will be Promoted
5	Withholding of Increment	Will be called	Promotion will not be given during penalty period
6-	Reduction to a lower one stage	Will be called	Promotion will not be given during penalty period
7-	Reduction to a lower time scale of pay	Will not be called	Promotion will not be given during penalty period

Procedure for imposition of Minor and Major penalties.

Preliminary consideration by D.A to determine whether there is prima facie ground to contemplate DAR action.

Minor penalties: - Charge memorandum (SF-11) is issued. Along with the Charge sheet, imputation of misconduct should be mentioned.

- On receipt of the Charge Sheet, the charged official should submit defence statement within 10 days.
- D A should consider the defence statement and should record whether he accepts the defence or not.
- If the defence statement is not submitted in time, the case can be dealt ex-parte.
- If the defence statement is not accepted, reasons in the form of speaking order is recorded and a particular minor penalty is also specified for imposition.
- Penalty advise in the prescribed form is served to the charged official duty incorporating the speaking order and specifying the appellate authority and time allowed for the appeal (45 days).

Major Penalties:-

- 1. The charged official is given a copy of the charge sheet in the prescribed proforma along with a statement of imputations of misconduct, list of documents relied upon to prove the charges and a list of witnesses by whom the charges are proposed to be sustained.
- 2. The charged official is given reasonable time to submit his defence.
- 3. On receipt of the defence, an enquiry is held in respect of the charge not admitted.
- 4. The DA himself may inquire or may appoint an Inquiry Officer to inquire the charges.
- 5. Presenting officer is appointed in important vigilance or CBI or SPE cases for presenting the case on behalf of the administration.
- 6. The charged official may be permitted to avail the assistance of another Railway servant serving or retired from the same Railway or a recognized trade union official to present the case on his behalf.
- 7. The charged official is also permitted to inspect the documents specified in the list of annexure to the charge sheet, and any other document relevant to the case.
- 8. In the inquiry the witness of both sides is examined, cross-examined and if necessary re examined.
- 9. After the examination of witnesses the charged official may state his defence orally or in writing. Oral defence should be recorded and got signed. A copy of the defence should be given to the Presenting officer.
- 10. If the charged official has not examined himself, the Inquiry officer should generally examine him to enable him to explain the circumstances appearing in the evidence against him.
- 11. The entire proceedings should be recorded and got signed at every page by all concerned, (i.e) the charged official, Inquiry officer and the witnesses involved.

12. If the charged official does not attend the enquiry it should be conducted ex-parte and all the stages of the enquiry have to be passed through.

13. The Inquiry Officer should hear the arguments of both sides or permit them to file written briefs. He should first take the brief from the presenting officer, supply a copy of the same to the charged employee to take the reply brief of the latter.

14. On completion of the inquiry, the enquiry officer should send copy of enquiry proceedings in the form of a report along with his findings.

15. The enquiry report should contain:

- The articles of charge and the statement of imputations of misconduct or misbehavior.
- The defence of the Railway servant in respect of each article of charge.
- Assessment of the evidence in respect each article of charge and;
- The findings on each article of charge and the reasons thereof.

16. The DA may accept the findings of the Inquiry Officer or disagree and record his findings on the basis of the evidence on record and make a final order as deems fit.

If the DA is Competent to impose only any one of the minor penalties, having regard to his decision and the findings, is of the opinion that a major penalty is to be imposed, the records of the Inquiry are forwarded to the higher competent Disciplinary Authority for taking a decision.

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UNIT-33: INDUSTRIAL RELATIONS MACHINARY

ADMINISTRATION

EMPLOYEES NATIONAL LEVEL ORGANIZATIONS

- a) Indian National Trade Union Congress (INTUC)
- b) Bhartiya Mazdoor Sangh (BMS)
- c) Hind Mazdoor Sabha (HMS)
- d) Centre of Indian Trade Union (CITU)
- e) All Indian Trade Union Congress (AITUC)
- These are recognized by the Ministry of Labour

PERMANENT NEGOTIATING MACHINERY (PNM): Founded by Shri V.V. Giri in 1951 when Shri Lal Bahadur Shastri was Rly. Minister with a view to maintain contact with organized labour & resolve disputes & differences arising between organized labour & the administration.

RAILWAY LEVEL ORGANIZATIONS

A.I.R.F. (All India Rly men's Federation) Affiliated to HMS (EU)36.6.2 N.F.I.R. (National Federation of Indian Rly. men) Affiliated to INTUC (MS)



ABBREVIATION DETAILS:

NRMU	-	(NORTHERN RAILWAY MENS UNIONS)
URMU	-	(UTTAR RAILWAY MAZDOOR UNION)
NWREU	-	(NORTH-WESTERN RAILWAY EMPLOYEES UNION)
UPRMS	-	(UTTAR PASCHIM RAILWAY MAZDOOR SANGH)

ZONAL LEVEL ORGANIZATIONS:

N.R.	N.W.R.	W.R.
NRMU	NWREU	WREU
URMU	UPRMS	WRMS

These unions are recognized by the general manager.



PNM MEETING

- ➢ BOARD LEVEL -- QUARTERLY
- > ZONAL LEVEL -- QUARTERLY
- DIVISIONAL LEVEL—BIMONTHLY

MAXIMUM ITEMS OF PNM

- ➢ BOARD LEVEL 30X4= 120 ITEMS
- ➢ ZONAL LEVEL 30X4= 120 ITEMS
- DIVISIONAL LEVEL- 30X6= 180 ITEMS

KINDS OF MEETING

- > PNM (PERMANENT NEGOTIATING MACHINERY)
- > NPM (NON PAYMENT MEETING)
- INFORMAL MEETING

LEVEL OF MEETING

NPM : ASSTT.GRADE OFFICERS OF ACCOUNTS & PERSONNEL ARE TO ATTEND

- ➢ INFORMAL MEETING: SR.SCALE OFFICERS ARE TO ATTEND
 - > PNM: HODs /DRMs ARE TO ATTEND
 - ➢ IN ONE MEETING, MAXIMUM 20 UNION DELEGATES ATTEND (15 AT WORKSHOP LEVEL)
 - RLY. PROVIDES THESE DELEGATES SPECIAL PASS, SPECIAL LEAVE FOR ATTENDING THE MEETING
- > THE AGENDA IS FURNISHED 21 DAYS BEFORE THE DATE OF MEETING.
- ADHOC TRIBUNAL: DISAGREEMENT WITH THE RAILWAY BOARD AND UNIONS. THE MATTER MAY BE PLACED BEFORE TRIBUNAL ADDED BY CHAIRMEN ARE RETIRED JUSTICE OF HIGH COURT OR SUPREME COURT AND EQUAL NUMBER OF REPRESENTATIVE OF BOTH ADMINISTRATION AND EMPLOYEE. >DECISION ACCEPTED/NOT ACCEPTED OR MODIFIED BY BOARD.

JOINT CONSULTATIVE MACHINERY

IT WAS FOUNDED IN 1966 WITH A VIEW TO HAVE HARMONIOUS RELATION BETWEEN THE GOVT.(EMPLOYER) & ITS EMPLOYEES IN THE MATTER OF COMMON CONCERN & WITH THE OBJECT OF FURTHER INCREASING THE EFFICIENCY.

NATIONAL COUNCIL

- > ALL CENTRAL GOVT. EMPLOYEES' MATTERS ARE DISCUSSED
- > CABINET SECRETARY IS THE CHAIRMAN
- > ADMINISTRATIVE SIDE 24 MEMBERS
- ▶ UNION SIDE 60 MEMBERS

DEPARTMENTAL COUNCIL

- ➢ IT WAS FOUNDED IN 1966
- > ALL RAILWAY EMPLOYEES' MATTERS ARE DISCUSSED
- > MEMBER STAFF IS THE CHAIRMAN
- ► ADMINISTRATIVE SIDE 10 MEMBERS
- ➢ UNION SIDE-30 MEMBERS

UNIT-34: भारतीय रेलवे में विकलांगो को मिलने वाली सुविधाएं

1. विकलांग व्यक्तियो की भर्तीः—

- कुल रिक्तियो का 3 प्रतिषत विकलांगो के लिये आरक्षित होगा। इस वर्ग में बहरे, नेत्रहीन तथा शारीरिक रुप से विकलांग सम्मिलित है।
- ग्रुप सी व डी में कोटा कुल काडर का नेत्रहीन–1 प्रतिषत, मूक बधिर–1प्रतिषत, शारीरिक रुप से विकलांग–1प्रतिषत
- 3. ग्रुप ए व बी में यह उन पदों का 3 प्रतिषत होगा जो इसके लिये चिन्हित किये गये है।
- नेत्रहीन की नियुक्ति केवल चिन्हित नेत्रहीन पदो पर ही होगी किसी ओर की नियुक्ति बोर्ड से स्वीकृति के पश्चात् होगी।
- 5. यथा संभव उनकी नियुक्ति उनके मूल स्थान के करीब की जाएगी।
- 6. यदि पद खाली हो तो दो वर्ष तक रिक्ति आगे बढाई जा सकती है।
- सीधी भर्ती में सामान्य योग्यता पर सामान्य रिक्तियों में समायोजित किया जाएगा यह नियम सीधी भर्ती पर लागू होगा।
- 8. टाईपिंग योग्यता के लिये उन्हें दो साल का समय दिया जाएगा।
- 9. आय सीमा में 10 वर्ष की छूट है। अनुसूचित जाति, जनजाति के लिये 5 वर्ष की अतिरिक्त छूट।
- 10. कर्मचारियों के विकलांग पुत्र / निकट आश्रित ग्रुप डी पदों पर भर्ती के लिये सूचनाओं के उत्तर में रेल प्रषासन को सीधे आवेदन कर सकते है। अन्य आवेदनों के साथ इन पर भी विचार किया जाएगा।
- स्थानांतरण:--बहरे या बहुविधिक रूप से अषक्त बच्चो वाले सरकारी कर्मचारियों की तैनाती जहां सम्भव हो उसी राज्य में रखने का प्रयत्न करना चाहिये।
- 3. छुट्टी:-
 - 1. विषेष निषक्तता छुट्टी– ड्यूटी के दौरान शारीरिक क्षति जिससे वह निषक्त हो गए हो प्राधिकृत डॉक्टरी प्रमाण पत्र पर दी जाएगी।
 - (i) किसी भी हालत में 24 माह से अधिक नहीं होनी चाहिये।
 - (ii) इसे किसी भी छुट्टी के साथ जोडा जा सकता है।
 - (iii) एक से अधिक बार दुबारा बीमारी उभरने पर स्वीकृत की जा सकती है।
 - (iv) इस छुट्टी के दौरान वेतन- पहले 120 दिनो के लिये औसत वेतन छुट्टी के बराबर होगा शेष अवधि के लिये आधे वेतन की छुट्टी के बराबर होगा। विकल्प पर 120 से अधिक छुट्टी का वेतन ले सकता है लेकिन एसी स्थिति में आधे वेतन की छुट्टी उसके खाते में डाली जाएगी।
 - (v) यदि कोई कर्मचारी श्रमिक हरजाने के कानून के अंतर्गत आता है तो उसका छुट्टी वेतन उसे देय हर्जाने की पाक्षिक भुगतानो के बराबर कम कर दिया जाएगा।
 - 2. आकस्मिक अवकाष निषक्तजन को 4 अतिरिक्त आकस्मिक अवकाष दिये जाते है।

4. रेलवे पास:--

- (i) नेत्रहीन कर्मचारियो को अकेले यात्रा करने पर उसी दर्जे में एक परिचर की अनुमति मिलेगी।
- (ii) मण्डल चिकित्सा अधिकारी के प्रमाण पत्र पर सुविधा पास पर व्हील चेयर या तीन पहिया साईकिल ले जाने की अनुमति होगी।
- (iii) कर्मचारी की नौकरी के दौरान डॉक्टर की सिफारिष पर उसे पहले दर्जे का पास तथा उसी दर्जे में साथी दिया जा सकता है। यह केवल 1सैट सालाना होगा। (यह अषक्तता होगी एक या दोनो हाथ, घुटने के उपर या नीचे एक टांग, दोनो टांगे न होना या टांगो का इस्तेमाल लायक न होना)
- (iv) आवासीय कार्ड पास पहले दर्जे का दिया जाता है। जब तक वह खुद इसका हकदार न हो जाए।

5. विकलांग भत्ता—

- (i) अषक्त महिलाओं को बच्चो की देखभाल के लिये विषेष भत्ता दो बच्चो पर जन्म से 2 साल तक ओर कर्मचारियो के अषक्त बच्चो की षिक्षा के लिये षिक्षण भत्ता 1000 रुपये मासिक दिया जाएगा। अषक्तता 40 प्रतिषत से कम नही होनी चाहिये। महंगाई भत्ता 50 प्रतिषत होने पर 25 प्रतिषत की वृद्धि की जाएगी।
- 6. परिवहन भत्ता– शारीरिक रुप से विकलांग कर्मचारी सामान्य दरो से दुगुनी दरो पर इस भत्ते को लेते रहेंगे जोकि 1000 / – रु. प्रतिमाह + महंगाई भत्ते की दर होगा।
- 7. कर्मचारी हित निधि— कर्मचारियो के शारीरिक / मानसिक रुप से अपंग बच्चो खासतौर पर लडकियो की रोजगार कुषलता के विकास के लिये प्रषिक्षण हेतु सुविधाएं।
- 8. पेंषन- यदि अषक्तता सेवा के दौरान हुई हो तो -
 - (i) 100 प्रतिषत अषक्तता होने पर मूल वेतन के 30 प्रतिषत के बराबर ।
 - (ii) यदि 100 प्रतिषत से कम है तो नियमानुसार अनुपात में कम की जाएगी।
 - (iii) किन्तु यदि अषक्तता 60 प्रतिषत से कम न हो तो कुल पेंषन मूल वेतन की 60 प्रतिषत या 7000 रुपये से कम नही होगी।
 नोट- मूल वेतन से तात्पर्य संषोधित वेतन में बैण्ड में वेतन + ग्रेड पे
- 9. **आयकर में छूट** डॉक्टरी प्रमाण पत्र पर 40 प्रतिषत या अधिक अषक्तता होने पर कर्मचारी या उनके बच्चों की अषक्तता पर 50000 रुपये की छूट प्रदान की जाती है।
- 10. **कार्यस्थल पर उपस्थिति** कार्यस्थल पर उपस्थिति हेतु विकलांग कर्मचारियो को 30 मिनट की छूट दी जाती है।

UNIT-35: सूचना का अधिकार

परिचय— भारतीय संविधान द्वारा लोकतंत्र के अंतर्गत सूचित नागरिक वर्ग तथा सूचना में पारदर्षिता की आवष्यकता एवं कार्य संचालन के लिये सूचना का अधिकार कानून बनाया गया। इसमें भ्रष्टाचार को रोकने तथा सरकारो एवं करणत्वों द्वारा किये गये शासन के प्रति जवाबदेही ठहराने की आवष्यकता होती है। जिससे कार्य कुषलता, राजकोषीय संसाधनो का इष्टतम उपयोग तथा संवेदनषील सूचनाओं की गोपनीयता की हिफाजत करना आदि शामिल है। उपरोक्तानुसार भारत सरकार ने सूचना का अधिकार विधेयक 2005 की प्रस्तावना की । 15 जून 2005 को राष्ट्रपति जी की मंजूरी प्राप्त हुई।

उद्देष्य— एक व्यवहारिक शासन प्रणाली की स्थापना करना ताकि नागरिक सार्वजनिक प्राधिकरणों की नियंत्रणा की सूचना तक पहुंच प्राप्त कर सके और जिससे पारदर्षिता तथा उनके कार्य के प्रति जवाबदेही को बढावा मिल सके (जिसमें सरकारी कर्मचारी भी शामिल है)। यह पूर्ण अधिकार नहीं है परन्तु इस अधिनियम के उपबंधो के अधीन है।

अनुप्रयोग— यह अधिनियम जम्मु एवं कष्मीर राज्य को छोडकर सम्पूर्ण भारत में लागू है। और यह आसूचना तथा सुरक्षा संगठन को छोडकर सभी सार्वजनिक प्राधिकरणों में लागू है। (धारा 2 एच)

प्रभावी होना- यह अधिनियम 12 अक्टूबर 2005 से लागू है ।

महत्वपूर्ण परिभाषाएं-

सूचना का अभिप्राय है किसी सामग्री चाहे वह किसी भी रुप में हो जिसमें रिकार्ड, दस्तावेज, ज्ञापन, ई मेल, रॉय, सलाह, प्रेस विज्ञप्तियां, परिपत्र, आदेष, लॉग बुक, करार, रिपोर्ट, कागजात, नमूना, किसी इलैक्ट्रोनिक रुप में रखी गई डाटा सामग्री तथा किसी प्राईवेट निकाय से संबंधित सूचना सम्मिलित है जिसे इस समय लागू किसी अन्य कानून के अंतर्गत किसी सार्वजनिक प्राधिकरण द्वारा प्राप्त किया जा सकता है।(धारा2एफ)

रिकॉर्ड– रिकॉर्ड के अंतर्गत कोई दस्तावेज, पाण्डुलिपि तथा फाईल, कोई माइको फिल्म तथा प्रतिकृति प्रतिलिपि, माईको फिल्म के प्रतिरुपो की किसी भी तरह से प्रतिकृति तैयार करना तथा किसी कम्प्युटर अथवा किसी अन्य उपकरण द्वारा प्रतिपादित कोई अन्य सामग्री शामिल है। (धारा 2 आई)

सूचना का अधिकार– सूचना के अधिकार में कार्य, दस्तावेजों, रिकॉर्डो का निरीक्षण करने, दस्तावेजो अथवा रिकॉर्डो को नोट करना, सार लेने या इनकी प्रमाणित प्रतियां प्राप्त करने, सामग्री का प्रमाणित नमूना लेने, डिस्केट, फ्लापी, टेपो, विडियो कैसेट या किसी अन्य इलैक्ट्रानिक साधन के रुप में या प्रिन्ट आउट के माध्यम से सूचना प्राप्त करने का अधिकार शामिल है। (धारा 2 जे)

तीसरा पक्ष— जिसका अभिप्राय सूचना का अनुरोध करने वाले नागरिक के अलावा किसी अन्य व्यक्ति से है ओर इसमें सार्वजनिक प्राधिकरण भी शामिल है। (धारा 2 एल)

सूचना प्राप्त करना– नागरिक सूचना प्राप्त करने के लिये जनसूचना अधिकारी को हिन्दी या अंग्रेजी या उस क्षेत्र की सरकारी भाषा में लिखित या इलैक्ट्रोनिक साधनो के माध्यम से मांगी गई सूचना का ब्यौरा निर्दिष्ट करते हुए आवेदन कर सकते है।

सूचना मांगने का कारण इंगित करना उसमें अपेक्षित नही है।

जनसूचना अधिकारी आवेदन की तारीख से 30 दिन के भीतर सूचना उपलब्ध कराएगा। (धारा एस 8 ओर 9 की सूचनाएं जो प्रकट न की जा सकने वाली सूचनाएं है को छोडकर)

तीसरे पक्ष की सूचना की समय सीमा 40 दिन होगी।

किसी व्यक्ति के जीवन एवं स्वतंत्रता से संबंधित सूचना के लिये समय सीमा केवल 48 घंटे है।

सहायक जन सूचना अधिकारी को आवेदन किया जाता है तो समय सीमा में 5 दिन ओर जोड दिये जाएंगे।

जनसूचना अधिकारी द्वारा निर्दिष्ट अवधि के भीतर सूचना उपलब्ध कराने की विफलता को मनाही माना जाएगा।

शुल्क—

- सूचना प्राप्त करने के आवेदन के साथ 10 रुपये का शुल्क संलग्न किया जाना है।
- प्रति पृष्ठ ए–4 अथवा ए–3 साईज का शुल्क दो रुपये।
- नमूनों अथवा मॉडल की वास्तविक कीमत ।
- दस्तावेजो की जांच करने के लिये प्रथम घंटे कोई शुल्क नहीं। और इसके बाद प्रत्येक 15 मिनट की समयावधि के लिये 5 रुपये शुल्क लिया जाएगा।
- डिस्केट अथवा फ्लॉपी के लिये 50 रु का शुल्क लिया जाएगा।
- मुद्रित फार्म में सूचना मुहैया करवाने के लिये निर्धारित कीमत अथवा फोटोकॉपी करवाने के 2 रुपये प्रति पृष्ठ।

अपील– निर्दिष्ट समय में सूचना न पाने पर या निर्णय से असंतुष्ट व्यक्ति 30 दिन की अवधि के भीतर जनसूचना अधिकारी से वरिष्ठ अधिकारी को अपील कर सकता है। आवेदकर्ता को अन्य बातों के साथ अपीलीय प्राधिकारी का विवरण सूचित करने का दायित्व जनसूचना अधिकारी पर डाला है।

अपीलीय प्राधिकारी के निर्णय के विरुद्ध 90 दिन के भीतर केन्द्रीय / राज्य सूचना आयोग के समक्ष दूसरी अपील करने का अधिकार है। इस संबंध में आयोग का निर्णय बाध्यकारी होगा। आयोग के समक्ष अपील कार्यवाही में यह सिद्ध करने की जिम्मेदारी कि किसी अनुरोध को अस्वीकार करना औचित्यपूर्ण था यह जन सूचना अधिकारी की होगी जिसने अनुरोध को अस्वीकार किया हो।

शास्तियां— किसी षिकायत अथवा अपील पर फैसला करते समय यदि आयोग का यह मत है कि बिना जायज वजह से जनसूचना अधिकारी ने अर्जी को प्राप्त करने से इन्कार अथवा सूचना मुहैया नही कराई है अथवा कुंठित मन से जानबूझकर, गलत, अधूरी अथवा गुमराह वाली सूचना दी है।

निष्कर्ष– सरकारी प्राधिकारियों से सूचना मांगने वाले नागरिको को निष्चित सूचना मुहैया करवाने में पारदर्षिता सुनिष्चित करना और अधिक से अधिक सूचनाएं उपलब्ध करवाना जिससे प्राधिकारियों को अपने कामकाज में सतर्क रहना पडेगा और दायित्व निभाने में तत्पर रहना चाहिये जिससे लोकतांत्रिक आदर्षो एवं जनता के व्यापक हितो में सामंजस्य हो सके।

UNIT-36: राजभाषा नियम - 1976

संघ की राजभाषा से संबन्धित विभिन्न सांविधिक और कानूनी उपबन्धों को कार्यरूप देने के उदेष्य से केन्द्रीय सरकार ने 1976 में राजभाषा नियम बनाये थे। इन नियमों की बडी विषेषता यह है कि इनमें पहली बार इनके उपबन्धों का सही अनुपालन करने की जिम्मेदारी प्रत्येक कार्यालय व प्रषासनिक प्रधान पर डाली गयी है। इनका विस्तार तमिलनाडू राज्य के अलावा सम्पूर्ण भारत में है।

राजभाषा अधिनियम 1963 (1963 का 19) की धारा 3 की उपधारा 4 के साथ पठित धारा 8 द्वारा प्रदत्त षक्तियो का प्रयोग करते हुए केन्द्रीय सरकार निम्नलिखित नियम बनाती है –

- 1. संक्षिप्त नाम, विस्तार और प्रारम्भ-
- क. इन नियमों का संक्षिप्त नाम राजभाषा (संघ के षासकीय प्रयोजनों के लिये प्रयोग) नियम 1976 है।
- ख. इनका विस्तार , तमिलनाडु राज्य के सिवाय सम्पूर्ण भारत पर है।
- ग. ये राजपत्र में प्रकाषन की तारीख को प्रवृत्त होंगे।
- 2. परिभाषाएं– इन नियमों में, जब तक कि संदर्भ से अन्यथा अपेक्षित न होः–
- क. 'अधिनियम'से राज्यभाषा अधिनियम,1963 (1963 का 19) अभिप्रेत हैः
- ख. 'केन्द्रीय सरकार के कार्यालय' के अंतर्गत निम्नलिखित भी है अर्थात–
 - क. केन्द्रीय सरकार का कोई मंत्रालय, विभाग या कार्यालयः
 - ख. केन्द्रीय सरकार द्वारा नियुक्त किसी आयोग,समिति या अधिकरण का कोई कार्यालयः और
 - ग. केन्द्रीय सरकार के स्वामित्व में या नियंत्रण के अधीन किसी निगम या कम्पनी का कोई कार्यालय कर्मचारी से केन्द्रीय सरकार के कार्यालय में नियोजित कोई व्यक्ति अभिप्रेत हैः
- ग. कर्मचारी से केन्द्रीय सरकार के कार्यालय में नियोजित कोई व्यक्ति अभिप्रेत हैः
 घ. 'अधिसूचित कार्यालय' से नियम 10 के उपनियम 4 के अधीन अधिसूचित कार्यालय, अभिप्रेत है।
- ड. हिन्दी में प्रवीणता से नियम 9 में वर्णित प्रवीणता अभिप्रेत है।
- च. क्षैत्र क से बिहार, हरियाणा, हिमाचल प्रदेष, मध्यप्रदेष, छत्तीसगढ, झारखण्ड, उत्तराखण्ड, राजस्थान और उत्तर प्रदेष राज्य तथा अण्डमान और निकोबार द्वीप समूह, दिल्ली संघ राज्य क्षैत्र अभिप्रेत है।
- छ. क्षेत्र ख से गुजरात, महाराष्ट्र और पंजाब राज्य तथा चण्डीगढ, दमन और दीव तथा दादरा और नागर हवेली संघ राज्य क्षेत्र अभिप्रेत है।
- ज. क्षेत्र ग से खण्ड (च और छ) में निर्दिष्ट राज्यो और संघ राज्य क्षेत्रो से भिन्न राज्य तथा संघ राज्य क्षेत्र अभिप्रेत है।
- झ. 'हिन्दी का कार्यसाधक ज्ञान'से नियम 10 में वर्णित कार्यसाधक ज्ञान अभिप्रेत है।

नियम 3/1:केन्द्रीय सरकार के कार्यालयों से पत्रादि हिन्दी भाषी राज्यों के लिए जिन्हें ''क'' क्षेत्र के राज्य कहा गया है या ऐसे राज्यों में किसी अन्य कार्यालयों या अन्य व्यक्ति को हिन्दी में भेजे जायेंगें। यदि किसी खास मामलें में कोई पत्र इन्हें अंगेजी भाषा में भेजा जाता है तो उसका अनुवाद भी साथ भेजा जायेगा।

नियम 3/2(क):केन्द्रीय कार्यालयों से पत्रादि पंजाब, गुजरात और महाराष्ट्र व चंडीगढ क्षेत्रों के प्रषासनों को जिन्हें ''ख'' क्षेत्र में शामिल किया गया है, सामान्यतः हिन्दी में भेजे जायेगें। यदि उन्हें कोई पत्र अंग्रेजी में भेजा जाता है तो उसका हिन्दी अनुवाद भी साथ भेजा जायेगा।

(ख)ः लेकिन इन राज्यों में किसी व्यक्ति को भेजे जाने वाले पत्रादि हिन्दी या अंग्रेजी दोनों में से किसी एक भाषा में भेजे जा सकते हैं।

नियम 3/3ः अन्य अहिन्दी भाषी राज्यों जिन्हें ''ग'' क्षेत्र कहा गया है, के कार्यालयों या व्यक्तियों को पत्र अंग्रेजी में भेजे जा सकते है। नियम 3/4:इन ''ग'' राज्यों में स्थित केन्द्र सरकार के कार्यालयों से ''क'' अथवा ''ख'' क्षेत्र की सरकारों उनके कार्यालयों आदि को पत्रादि हिन्दी अथवा अंग्रेजी में भेजे जा सकते है। नियम 4: (क) केन्द्रीय सरकार के एक मंत्रालय या विभाग और दूसरे मंत्रालय या विभाग के बीच पत्र व्यवहार हिन्दी या अंग्रेजी में हो सकता है। (ख) केन्द्रीय सरकार के मंत्रालय या विभाग और दूसरे मंत्रालय या विभाग के बीच पत्र व्यवहार हिन्दी या अंग्रेजी में हो सकता है। (ग) ''क'' क्षेत्र में स्थित अन्य केन्द्रीय सरकार के कार्यालयों के बीच पत्र व्यवहार हिन्दी में होगा। नियम 5ःहिन्दी में प्राप्त प्रत्रादि के उत्तर हिन्दी में ही दिये जायेगें। नियम 6 : राजभाषा अधिनियम की धारा 3/3 में निर्दिष्ट सभी दस्तावेजों के लिए हिन्दी और अंग्रेजी दोनों भाषाएं प्रयोग में लाई जायेगी और सुनिष्चित करने की जिम्मेदारी ऐसे दस्तावेजों पर हस्ताक्षर करने वाले की होगी। नियम 7 ः 1.कोई कर्मचारी आवेदन (Application), अपील, अभ्यावेदन(Representation)हिन्दी / अंग्रेजी में कर सकता है। 2. हिन्दी में हस्ताक्षर किये गये आवेदन या अभ्यावेदन का उत्तर हिन्दी में दिया जायेगा। 3.यदि कोई कर्मचारी सेवा संबंधी नियमों से संबंधित कोई आदेष या सूचना यथास्थिति हिन्दी/अंग्रेजी में चाहता हैतो उसे उसी भाषा में दी जायेगी। नियम 8 : 1. केन्द्रीय सरकार का कोई कर्मचारी फाईलों में हिन्दी या अंग्रेजी में टिप्पणी प्रारूप लिख सकता है और उससे यह अपेक्षा नहीं की जायेगी किवह उसका अनुवाद दूसरी भाषा में प्रस्तुत करें। 2. विषिष्ट दस्तावेज विधिक या तकनीकी प्रवृति का है अथवा नहीं, इसका विनिष्चय विभाग या कार्यालस का प्रधान करेगा । 3. अधिसूचित कार्यालयों में से कुछ को पूरी तरह या उनके कार्य की कुछ मदों को विनिदिष्ट / स्पेसीफाईड/ किया जा सकता है ताकि उनमें काम करने वाले हिन्दी में प्रवीण कर्मचारियों को नोटिंग / ड्राफ़िटंग आदि में केवल हिन्दी का इस्तेमाल करने के लिए कहा जा सके। नियम 10 : जिन कार्यालयों में 80 प्रतिषत या उससे अधिक लोगों को हिन्दी का कार्यसाधक ज्ञान प्राप्त है उन्हें अधिसूचित किया जा सकता है। नियम 11 : 1 / केन्द्रीय सरकार के कार्यालयों से संबंधित सभी नियमावली संहिताएं और अन्य प्रक्रिया संबंधि साहित्य हिन्दी व अंग्रेजी दोनों में द्विभाषिक (डिगलट) रूप से तैयार किये जायेगें। 2 व 3 : सभी फार्मों और रजिस्टरों के शीर्ष नामपटट, सूचनापटट, स्टेषनरी आदि की मदें तथा रबर की मोहरें, धातू सीलें, पत्र शीर्ष, लैटर हैड, विजिटिंग कार्ड हिन्दी और अंग्रेजी (द्विभाषी) में होगें। नियम 12 : प्रत्येक कार्यालय के प्रषासनिक प्रधान का यह उत्तरदायित्व होगा कि वह यह सुनिष्चित करे कि राजभाषा अधिनियम और नियमों का समुचित रूप से अनुपालन किया जाता है तथा इनके अनुपालन के लिए प्रभावी जॉच बिन्दु बनायें। राजभाषा नियमों के अनुपालन की दृष्टि से राज्यों का विभाजनः 1. (RegionA) पूर्णतः हिन्दी भाषी क्षेत्र (''क'' क्षेत्र) बिहार, झारखण्ड, उत्तर प्रदेष, उत्तरांचल, मध्य प्रदेष, छत्तीसगढ, हरियाणा, हिमाचल प्रदेष, राजस्थान, दिल्ली तथा अंडमान निकोबार द्वीप समूह⁄संघ शासित क्षेत्र (''ख'' क्षेत्र) (Region B) ऐसे राज्य जिन्होनें हिन्दी को विधिवत रूप से अपना लिया है। गुजरात, महाराष्ट्र, पंजाब तथा चंडीगढ / संघ शासित क्षेत्र ऐसे राज्य जिन्होनें अभी तक कानूनी रूप से हिन्दी को अपनायाहै। (''ग'' क्षेत्र) क्षेत्र क व ख में उल्लेखित राज्यों को छोडकर सभी राज्य व संघ शासित क्ष

UNIT-37: योगासन



पीठ और गर्दन की मांसपेशियां मजबूत होती हैं सिर एवं हृदय क्षेत्र में रक्त संचार बढ़ाता है। हृदय रोगियों के लिए अत्यंत लाभदायक है।

> 4. उष्ट्रासन (ऊंट जैसी शारीरिक स्थिति) लाभ –



दृष्टिदोष में अत्यंत लाभदायक है।

- यह पीठ और गले के दर्द से आराम दिलाता है।
- यह उदर और नितंब की चर्बी को कम करने में सहायक है।

5. शशांकासन

शारीरिक स्थिति : वज्रासन

लाभ –



6. उत्तानमंडूकासन

शारीरिक स्थिति- उर्ध्व दिशा में मेढ़क जैसा

लाभ

यह फेफड़े की कार्यक्षमता में वृद्धि करता है। पीठ दर्द और ग्रीवा की तकलीफ से छुटकारा दिलाता है।

7. मरीच्यासन/वक्रासन



कब्ज एवं अग्निमांद्य (डिस्पैप्सिया) को दर करता है।

उदर के बल लेटकर किए जाने वाले आसन

1. मकरासन - स्थिति : अधोमुख लेटकर शिथिल स्थिति लाभ -

कटि प्रदेश के निचले भाग के लिए लाभदायक है। पीठ संबंधी समस्याओं को दूर करने में उपयोगी है। तनाव व चिंता से संबंधित समस्याओं को नियंत्रित करता है।

यांगासन खड़े होकर किए जाने वाले आसन

1. ताड़ासन (ताड़वृक्ष की स्थिति में) लाभ - शरीर को सुदृढ़ करता है। लंबाई बढाने में सहायक है। मेरुदण्ड में रक्त संचय को ठीक करता है।

> 2. वृक्षासन (वृक्ष की स्थिति में) लाभ -

शरीर को संतुलित बनाता है। सहनशीलता एवं जागरुकता बढा़ता है। पैरों की मांसपेशियों को गठीला बनाता है



3.पादहस्तासन

लाभ - मेरुदण्ड को लचीला बनाता है। जठराग्नि प्रदीप्त करता है।

कब्ज तथा मासिक धर्म से संबंधित समस्याओं से बचौता है।

4. अर्धचक्रासन

- लाभ मेरुदण्ड लचीला बनता है।
- ग्रीवा की मांसपेशियों को मजबूत बनाता है।
- सर्वाइकल स्पॉन्डिलाइटिस में लाभकारी है।



5. त्रिकोणासन

लाभ - फेफड़ों की कार्य क्षमता को बढ़ाता है। पैर के तलवों से सम्बन्धित विसंगतियों से बचाता है पिण्डिका, जांघों और कटि भाग की मांसपेशियों मैजबूत बनाता है।

बैटकर किए जाने वाले आसन

1.भद्रासन - शारीरिक स्थिति : बैठी हुई स्थिति (विश्रामासन) लाभ –

उदर के अंगों को क्रियाशील करता है। घुटनों का दर्द कम करने में मदद करता है।

2. वज्रासन/वीरासन

लाभ -

- जांघ और पिंडली की मांसपेशियां मजबूत होती हैं।
- यह आसन पाचनशक्ति बढाने में सहायक है।
 - - यह मेरुदंड को सुदृढ़ता प्रदान करता है।

















* कपालभाति - शारीरिक स्थिति : कोई भी ध्यानात्मक आसन जैसे सुखासन/पद्मासन/वज्रासन आदि लाभ -यह जुकाम, साइनोसाइटिस, अस्थमा एवं श्वास नली संबंधी संक्रमणों में लाभदायक हैं॥ कपाल को शुद्ध करता है कफ विकारों को समाप्त करता है।

* प्राणायाम- 1. नाड़ी शोधन / अनुलोम विलोम प्राणायाम

शारीरिक स्थिति : कोई भी ध्यानात्मक आसन । लाभ – पूरे शरीर का पोषण करता है । एकाग्रता बढ़ाने में सहायक है । जीवन शक्ति बढ़ाता है और तनाव एवं चिंता के स्तर को कम करता है ।



2. शीतली प्राणायाम

लाभ-यह भूख और प्यास का शमन करता है। रक्त को शुद्ध करता है व शरीर में शीतलता प्रदान करता है। उच्च रक्तचाप वाले व्यक्तियों के लिए-यह-विशेष-लाभप्रद है।

भ्रामरी प्राणायाम शारीरिक स्थिति :

कोई भी ध्यानात्मक आसन। लाभ

तनाव से मुक्त करता है और चिंता, क्रोध एवं अतिसक्रियता को घटाता है। भौरे जैसी आवाज का प्रतिध्वनिक

प्रभाव मस्तिष्क एवं तंत्रिकातंत्र पर लाभकारी प्रभाव डालता है। यह महत्वपूर्ण शांतिकारक अभ्यास है, जो तनाव संबंधी विकारों को दूर करने में लाभकारी होता है।

यह एकाग्रता और ध्यान की आरंभिक अवस्था में उपयोगी है।

8. ध्यान - शारीरिक स्थिति : कोई भी ध्यानात्मक आसन। लाभ -सकारात्मक भावनाएं विकसित करता है। मस्तिष्क को शांत और निश्चल रखता है। ध्यान योगाभ्यास का सबसे महत्वपूर्ण खुट्का हो।

एकाग्रता, स्मृति, विचारों की स्पष्टता और मनोबल को बढ़ावा शान्ति पाठ

> ॐ सर्वे भवन्तु सुखिनः, सर्वे सन्तु निरामयाः। सर्वे भद्राणि पश्यन्तु, मा कश्चिद्दुःखभाग्भवेत्।। ॐ शान्तिः शान्तिः शान्तिः।।



भुजंगासन - शारीरिक स्थिति: मकरासन लाभ -

यह उदर के अतिरिक्त वसा को घटाता है। तनाव प्रबंधन के लिए यह आसन सर्वश्रेष्ठ है। पीठ दर्द और श्वास नली से संबंधित समस्याओं में लाभ।

3. शलभासन - स्थिति : मकरासन

- लाभ साइटिका के दर्द को समाप्त करता है।
 - पाचन में सहायता करता है।
- शरीर के वजन को नियंत्रित बनाए रखता है।

पीट के बल लेटकर किए जाने वाले आसन



1. सेतुबंधासन

लाभ – पाचन क्षमता बढ़ाता है। कब्ज से छुटकारा दिलाता है। अवसाद एवं चिंता से मुक्त करता है।

2. उत्तानपाद आसन

लाभ –

फेफड़े की क्षमता में वृद्धि करता है। यह आसन नाभि केंद्र

(नाभिमणिचक्र) में संतुलन स्थापित करता है।

यह उदर पीडा़, उदर-वायु, अपच और दस्त को दूर करता है।

3. अर्धहलासन

लाभ –

गहरे तनाव से ग्रस्त व्यक्तियों के लिए लाभदायक है। बदहज़मी और कब्ज़ियत से छुटकारा है। 🍂 मधुमेह, बवासीर और गले की समस्याओं से छुटकारा।

4. पवनमुक्तासन

लाभ-उदर के फुलाव को कम करना। यह पीठ की मांसपेशियों और मेरु के स्नायुओं को सुगठित बनाता है। जयत दर करता है वात से राइत दिलाता है।



कब्जियत दूर करता है वात से राहत दिलाता है।

5. शवासन - शारीरिक स्थिति: निष्क्रिय शिथिल स्थिति।

लाभ -

सभी प्रकार के तनावों से मुक्त। शरीर तथा मस्तिष्क दोनों को आराम प्रदान करता है। पूरे मन तथा शरीर तंत्र को विश्राम प्रदान करता है।

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