INTERNSHIP REPORT

NORTHERN RAILWAYS CARRIAGE AND WAGON WORKSHOP

ALAMBAGH , LUCKNOW

UTTAR PRADESH

Under the supervision of

Mr. BIPIN MISHRA SIR

(Head of B.T.C department C&W workshop Lucknow, Uttar Pradesh)

Submitted by :

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CANDIDATE DECLARATION

I **Harsh kumar (20BEI0088)** student of **B.Tech (Electronics And Instrumentation Engineering)** hereby declare that this Internship report at **"Carriage & Wagon workshop Alambagh Lucknow, Uttar Pradesh"** in partial fulfillment of the requirement for the award of the degree of Bachelor of Technology, is original and not copied from any source without proper citation.

Place : Lucknow

Harsh Kumar
(20BEI0088)

CERTIFICATE

I hereby certify that the project Dissertation titled **"Carriage & WagonWorkshop Lucknow, Uttar Pradesh"**, submitted by **Harsh Kumar (20BEI0088)**, student of **B.Tech (Electronics And Instrumentation Engineering)** of **Vellore Institute Of Technology, Vellore - 632014** in partial fulfillment of the requirement for the award of the degree of Bachelor of Technology, is a record of the project work carried out by the students under my supervision. To the best of my knowledge this work has not been submitted in part or full for any Degree or Diploma to this university or elsewhere.

Place : Lucknow

Mr. Bipin Mishra
(Head of B.T.C)
C&W workshop Lucknow, UP

ACKNOWLEDEGEMENT

It gives me immense pleasure to take this opportunity to acknowledgeour Project mentor & head of B.T.C department **Mr. BIPIN MISHRA SIR** of **"Carriage & Wagon workshop Alambagh Lucknow, Uttar Pradesh"**, who is providing me with his precious guidance. I thank him for his keen interest, moral support, valuable suggestions, and guidance.

I also appreciate the help of the Human Resources Development Centre and all the members along with the officials "C&W workshop Lucknow UP for assisting me in this training.

I am also thankful to all batchmates at the Training and other staff members for their support. I take the opportunity to thank my parentsand relatives for their moral support in successful completion of this project work.

Harsh Kumar
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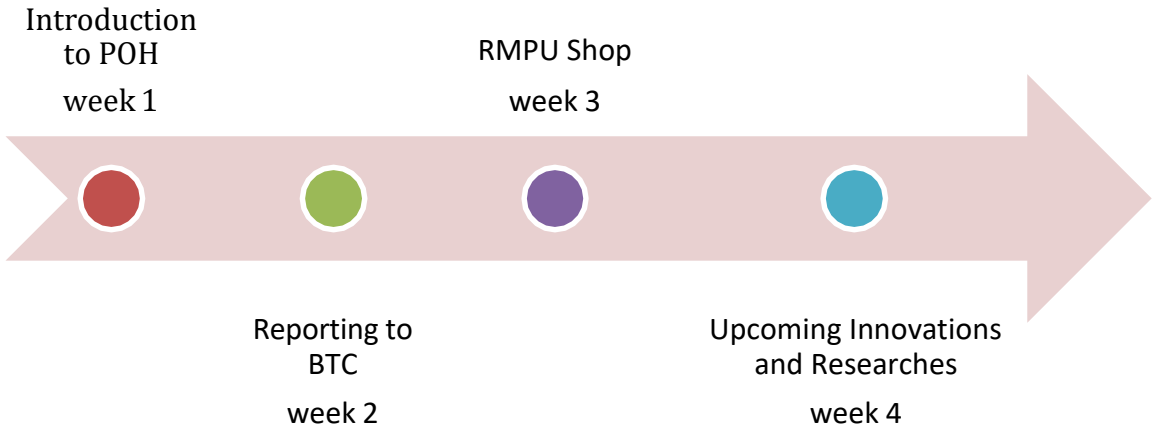
ABSTRACT

The aim of this report is to summarize the learnings, understandings and key findings of the Training achieved under the 'C&W workshop Lucknow UP". This report talks in detail about the C&W workshop, its workings & its manufacturing shop is situated in Lucknow. With special focus on the processes involved in the manufacturing of Coaches & Bogie for fulfilling the requirements of the Passengers and more.

TIMELINE WITH WEEKS



Week 1:- Introductory session on history of indian railways and the workshop, various departments, and prominent works done by the workshop. A small visit to various shops.

Week 2:- Reporting to BTC where we were guided through the industrial training like AC testing section and RMPU section.

Week 3:- Detailed overview of various maintenance processes involved the POH of RMPU section and the rectification of various issues like blockages,leakages etc along with testing of finalized RMPU unit.

Week 4:- We had seen new air brake digital technology which is in reasearch phase and are replacing manual testing system.
Additional Visit: Diesel locomotive Shed and Saloon shop in carriage workshop.

INTRODUCTION

Carriage and Wagon Workshop Alambagh, established in 1865 under Oudh & Rohilkhand Railway (O&RR), carries out the Periodical Overhauling (POH), Intermediate Overhauling (IOH) and Nominated POH(NPOH) of Rolling Stock of Carriage &Wagon and Locomotives. Apart from that, the shop also works in the field of converting outdated coaches.

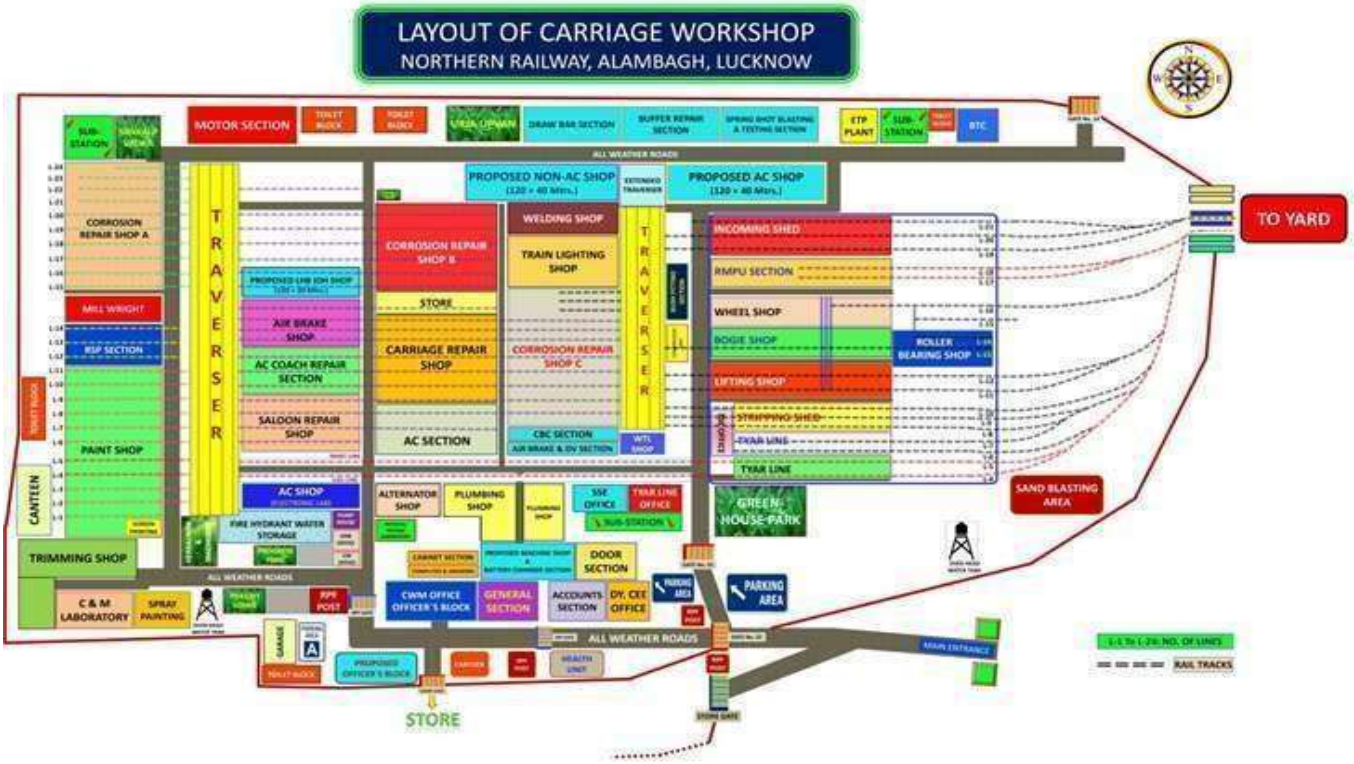
Sixty years later, in 1925, the O&RR was taken over by the Eastern Indian Railway (EIR) along with all the assets and liabilities. Thus, the Carriage & Wagon Workshop became the part and parcel of EIR. In 1952, the EIR got merged with Northern Railways. Periodic Overhauling of Goods stock was gradually reduced and totally stopped with effect from February-1995 onwards. The Workshop has since grown to become one of the premier Carriage Workshops of Indian Railways, to cater to the needs of Broad-Gauge Rolling Stock in the Northern Part of the Country.

Over the last 152 years, this workshop has witnessed lots of changesin the product mix. With the introduction of Steel Body Coaches and Wagons, the workload of Wagon POH kept on reducing and simultaneously there was increased requirement of coach POH capacity, reason being the steady increase in passenger services and enhanced number of Coaches in the system.

Main activity of this workshop is POH of BG Coaching stock with targeted outturn of 142 Coaches per month (AC-41&NAC-101). Total workforce of the shop is 5635 (Mech.3317, Elec.1062, Store 1086, Account 109& Personnel 61). Workshop is having total area of 2,04,684m^2out of which 72,959 m^2 is covered area. Energyconsumption is about 1.*8 lakh units per month* and total track length is about 8.306 Km. Total Budget of the Shop is Rs 386 Cr.

Being a 152 years old vintage Workshop, poor infrastructure conditions are evident. Modernization of the Workshop (Phase-I) has been sanctioned by Railway Board at estimated cost of Rs 77.47 Croresin *2010-11* and at a final revised estimate of Rs 91.7 Cr is being executed by MCF/RBL. This Modernization, upon complete execution, will result in reduced movement and offer enhanced flexibility in work,which will lead to increased shop productivity offering opportunity to undertake POH of LHB Coaches.

- **TOTAL AREA : 2,04,684 m^2**
- **COVERAGE AREA : 72,959 m^2 (35.6%)**
- **BERTHING CAPACITY : 121 COACHES**
- **TRACK LENGTH : 8.306 Km**
- **BUDGET/Yr. : 386 Cr.**



The Government of India plans to reduce the usage of ICF coaches to zero by 2025. In order to draw-out the cost and obtain profit from ICF coaches before they are eventually discarded (Life of ICF coach :21 Yrs.), the workshop also works in the field of converting these carriages into different bodies. Coaches are built in two parts: **1)** The upper Part called ***Body***: **2)** The lower part called ***Bogie***. The bodies of these obsolete coaches and converted to different forms which make them intodifferent carriages namely:

- **Parcel Van:** The windows and doors are sealed by welding them with metallic patches and only one door at the rear end is left to load the goods. India's First Parcel Van was produced by Carriage Workshop.
- **NMG (New Modified Goods):** Specially made for the Automobile Sector. Coaches are seal-packed and all the seating facility is replaced with partitions. Each coach can accommodate 6 to 8 cars

- **ART (Accident Relief Train):** Specially crafted coach with its noticeable Red and White colour which is used to clear the route and provide medical Assistance in case of any rail-accident. The coaches are equipped with proper medical equipment such as oxygen cylinders, etc and medical staff always stays on High Alert.

The deadline for the POH of coaches is generally 30 days, but in case if it exceeds, the presiding officer has to take permission from the Railway Board to lend more time due to specified issues.

After the POH has been finalised by the Workshop, the Railway Board and the Concerned Division who owns the carriage conduct an independent inspection based on the memo issued by the workshop's own inspection after its POH. The Officials who are in-charge are IOR (**Inspector of Rail**) (Division) and NTXR (**Neutral Train Examiner of Rail**) (Railway Board). Only after the carriages are approved by these officials, the are green-flagged to run for the day.

Role of C&W in Railways

- **Related with Open Line working:**
- To ensure and co-operate in safer running of rolling stock. • To attendrequired schedule maintenance & running repairs of rolling Stock till thestock are again due for P.O.H.
- To assist in time running of trains to maintain the punctuality.
- **Related with Work -Shop working:**
  - To attend Periodical Overhauling of Rolling Stocks.
  - To adopt required modifications.
  - To maintain proper records of all the rolling stock running in Indian Railways.

CLASSIFICATION OF ROLLING STOCK

- **Rolling Stock:** It is a term for the stocks of coaching, freight (Goods) & Locomotive.
- **Coaching Stock:** All Coaching vehicles including self-propelled units such as rail cars, electrical multiple units (luggage and brake van) fit to run with coaching stock are known as coaching stock.
- **Goods Stock:** All goods stock other than coaching stock whether attached to passenger or goods train is known as goods stock.
- **Coaching Stock (Vehicle):** It is a term used only for coaching stock.

There are two types of Coaching Stock:

1) ***Passenger Coaching Vehicles (PCV):*** A vehicle in which whole or partial portion is being utilized for carrying passengers.

2) ***Other Coaching Vehicles (OCV):*** It comprises salons, inspection cars, medical cars, tourist cars, parcel and horse vans, composite luggage Power Cars, Pantry Cars & brake van.

MAINTENANCE SCHEDULES OR OVERHAULING

The maintenance of the trains is an important criterion for facility and workshop. This is very much important to make the system run smoothly and to look after the passenger safety.

There are normally seven kinds of maintenance schedules depending onthe condition of coaches and wagons. They are respectively:

1. **A-Schedule**: After 30 days of manufacturing or of periodic overhauling, repetitive.
2. **B-Schedule**: After 90 days of manufacturing or of periodic overhauling repetitive.
3. **C-Schedule**: After 180 days of manufacturing or of periodic overhauling, repetitive.
4. **Intermediate Overhauling**: After 9 months of manufacturing or ofperiodic overhauling.
5. **Periodic Overhauling**: After the returning date given by theworkshop after periodic overhauling.
6. **Non-Periodic Overhauling**: This is done after 12 months or 18 months after the Manufacturing date or the periodic overhaulingdate depending on the condition of the corresponding coach.

7. **Inter lifting schedule:** This is a special kind of maintenance done within the maintenance facility with lifted coach and parts.

➢ PERIODIC OVERHAULING

Periodic overhauling is the best available process of maintenance of coaches in India. This generally operated after 12 or 18 months after the manufacturing or the previous periodic overhauling done in any workshop.
This undergoes a huge process of lifting the coach, isolating the all parts, and changing or replacing the necessary or damaged parts. In other words, this is the process of renewing the coaches. Here are some varieties.

1. 12-month basis
2. 18-month basis

POH DATE AND RETURN DATE

POH date is that date on which its POH has been done previously in a workshop. This is written on the coach. And the return date is the date on which it is to be dropped off from the track and to be taken for another periodic overhauling. Generally, they have a 12 month or 18-month gap between them in accordance with the definition of the POH. Both of the dates should be given by the corresponding workshop where its POH has been done.

SIGNIFICANCE OF COACH NUMBER

Every coach has its own unique number attached to it which obviously carries some significant information to us. Generally, in India that is of five numbered. The first two digits represents the yearof manufacturing of the coach. And the rest three digits represent thelist of types of coaches. It represents of which type the coach is.

Last Three digits and the respective type of coach:

- 001-025: IST AC
- 026-050: Composite Coach
- 051-100: IIND AC
- 101-150: IIIRD AC
- 151-200: non-AC 3-Seater

ICF COACHES

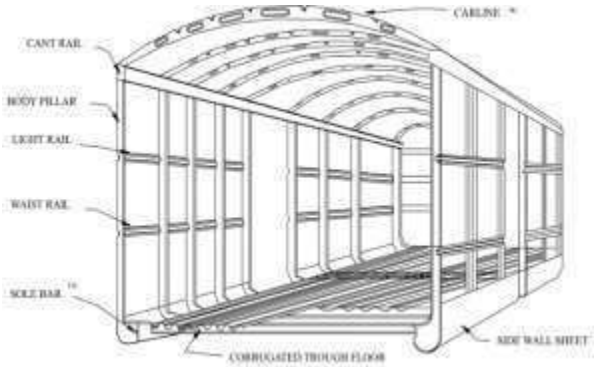
Integral Coach Factory (ICF) coaches are conventional passenger coaches developed by **Integral Coach Factory, Perambur, Chennai, India** in collaboration with the Swiss Car & Elevator Manufacturing Co, **Schlieren, Switzerland** in the 1950s. The design is also known as ***Schlieren design*** based on the location of the Swiss company. The 1st ICF coach had been flagged by the then Prime Minister Jawaharlal Nehru on 2 October, 1955. Indian Railways intends to discard the usage of ICF coaches and replace all of them with the newer LHB coaches by 2025.

ICF coaches have an Integral All Metal Design. They are equipped with air braking as well as vacuum braking system. The Bogie has Self aligning spherical Roller bearings. The coach has 4- 455 lt. water containment unit (installed below the shell) called UST-**Undersling Tank,** equipped with WRA (Water Raising Apparatus) to serve the sanitation need of the passengers. The toilets contain an additional 25 litre Auxiliary Tank to redirect unused water back to the Main unit.

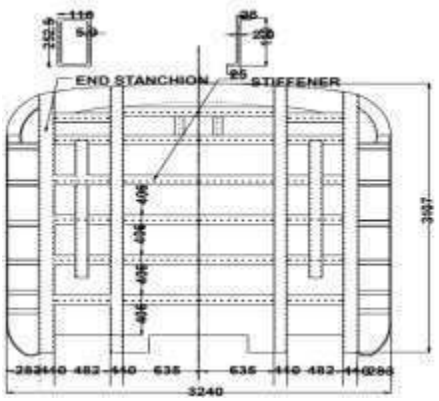
The weight of coach shell is reduced due to minimal use of wooden members, use of anti-corrosive Corten Steel (IRSM 41) of thickness 1.6mm for roof and 2mm thickness for corrugated floor, side panel and end panels during fabrication of coach body. The use of gusset plate, knee and rivets are also avoided in under frame. Hence weight of ICF shell is reduced by 26% to 32% compared to IRS coach shell which was used in the past.

The maximum speed is 140km/h but is restricted at 130 km/h for premium Coaches. These coaches are coupled by Screw Coupling, many are being retrofitted with CBC type couplers. These coaches are powered by two alternators connected to the wheels through a belt drive in SG-type vehicles. In EOG type vehicles, diesel is burnt to rotate the alternators which through a RRU (Rectifier cum Regulating Unit) supplies a continuous 110 V to the coach. HOG type vehicles directly provided the supply from overhead lines through panto (pantograph) which through a transformer gets stepped down from 25kV to 750 V 3-phase and further in the coach to 110V through an RRU which is then used for all the electrical needs.

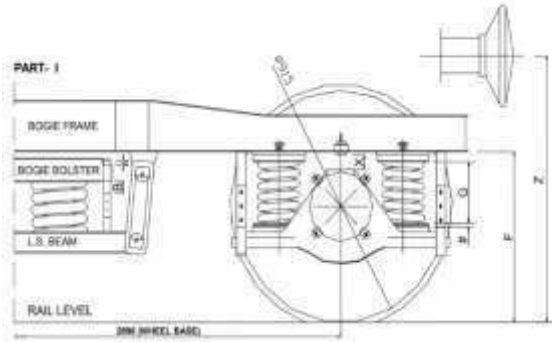
Fluorescent tubes are used for general lighting, vestibule, toilet, pantry and emergency working at 110V AC/DC with inverter and polycarbonate diffusers.



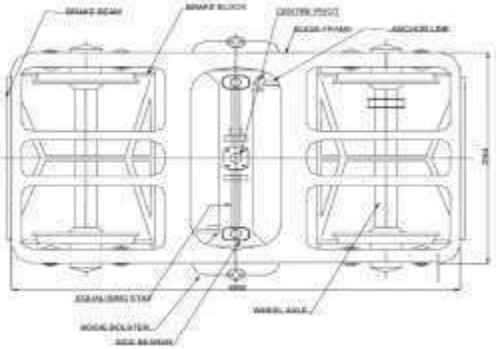
Cross-Sectional view of Shell of an ICF Coach



End-on View of an ICF Coach



Side View-Bogie

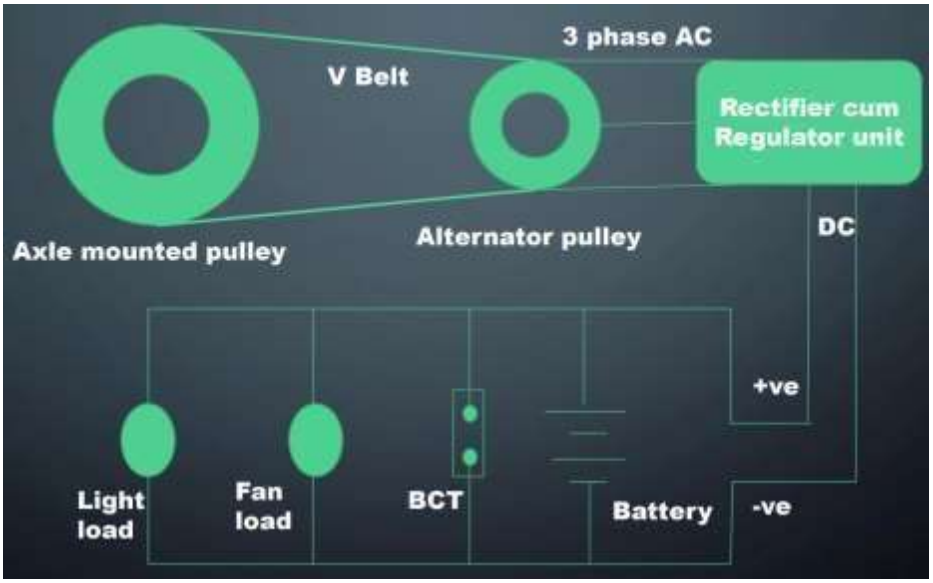


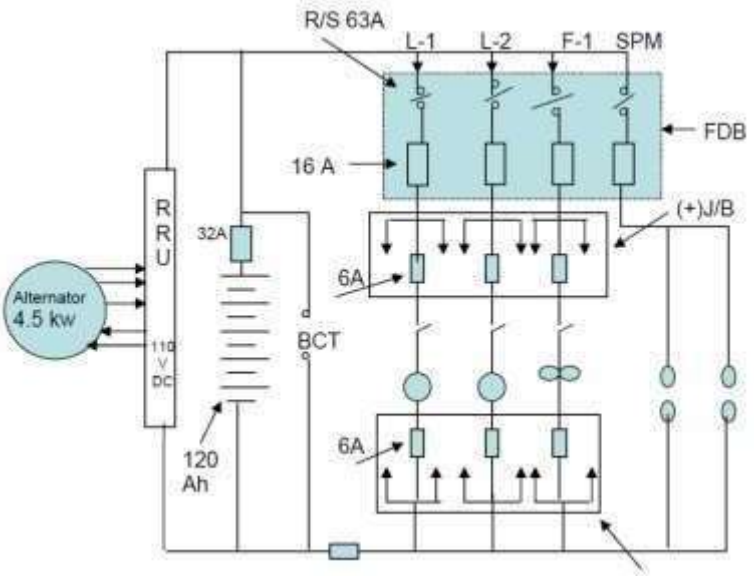
Upper View-Bogie

Self-Generating (SG) System

ICF coaches are self-generating type coaches, i.e., in these coaches, electricity required to run various electrical equipments including a.c.'s, is generated by underslung alternator sets fitted in coaches itself and which are driven by axle mounted pulleys with the help of belts.

DC generator is mechanically coupled with the wheel coach. Due to residual magnetic field and variable magnetic flux, voltage is induced in the generator. The volt generated is then sent to charge the dc batteries. Each coach is self-sufficient in Generation.





Schematic of 110 V DC System

SG NON-AC COACH

- Under slung alternator of 4.5 Kw, 37.5 Amp is driven by V-belts through axle and alternator pullies.
- Alternator generates 3 phase AC which is rectified and regulated through rectifier and regulator unit (RRU).
- Output of this RRU is given to electrical load through junction box. Lead acid batteries 110 V, 120 Ah arranged from 3 cell Monoblock units are in parallel with the alternator and feeds electrical loads when the alternator is not generating.
- For charging this battery, there is provision for battery charging terminal on the under frame of the coach. Fuses are provided for safety against excessive current for each component.
- 4 Emergency feeding terminals, located at each coach end, to give/take electrical power supply to/from adjoining coach in emergency through temporary connections (TC).
- At a junction box, rotary switches and MCBs are provided to switch ON and OFF power supply to light/fan and emergency feeding terminals (EFT).
- The load is fed through four rotating switches (RSW) and fuses connecting circuits L1, L2, F and SPM.
- L1 feeds the essential lighting load like lavatories, gangways, doorways and up-to 50% of light in each compartment/ bays corridor lights and night-lights.
- L2 feeds remaining lighting loads.
- F feeds the fan load and SPM feeds emergency feed terminals (EFT).

SG AC COACH

- For B.G AC coaches, 18 KW/25 KW brushless alternators are used, primarily to appropriately power the RMPUs and inverter.
- Two such alternators are used in AC-2T/AC-3T/chair cars and only an alternator is used in First AC Coach.
- • Batteries of 800/1100 Ah capacity at 10-hour rating are used in I AC/AC-2T/AC-3T/chair car of B.G coaches.
- Inverter.

COMPONENTS OF SG SYSTEM

Alternator

- Bi-directional and interchangeable.
- Rating:
  - ❖ 3/4.5 kW for non-AC coaches
  - ❖12 kW for MG AC/Jan Shatabdi Non-ac
  - ❖18 kW for under slung SG AC coaches
  - ❖25 kW for RMPU SG AC coaches (2 no. s)
- Output voltage - 97V, 3 phase AC
- Current 140/193 A (Max)
- Cut in speed - 550 rpm (30 KMPH with half worn wheels)
- Maxm. speed for full output 930 rpm for 135 A at 135 V- 51 KMPH
- Maxm. speed - 2800 rpm (156 KMPH)

RRU – RECTIFIER CUM REGULATOR UNIT

Functions:

• Rectification of 3 phase AC output of Alternator using full wave rectifier bridge.

• Regulation of voltage at set value for variable loads and speed.

• Regulating output current at set value for variable loads and speed.

ELECTRONIC RECTIFIER AND REGULATOR UNIT WITH UNIVERSAL VOLTAGE CONTROLLER (ERRU/UVC)

• High performance 16-bit microcontroller used to ensure real time response.

- Use of intelligent control algorithm for improved performance.
- Hall Effect sensors are used for sensing the output load current and battery charging current and further sets current limit.

• Modular construction.

• Fast and reliable switching devices.

• Less voltage and current ripple on Battery Charging current.

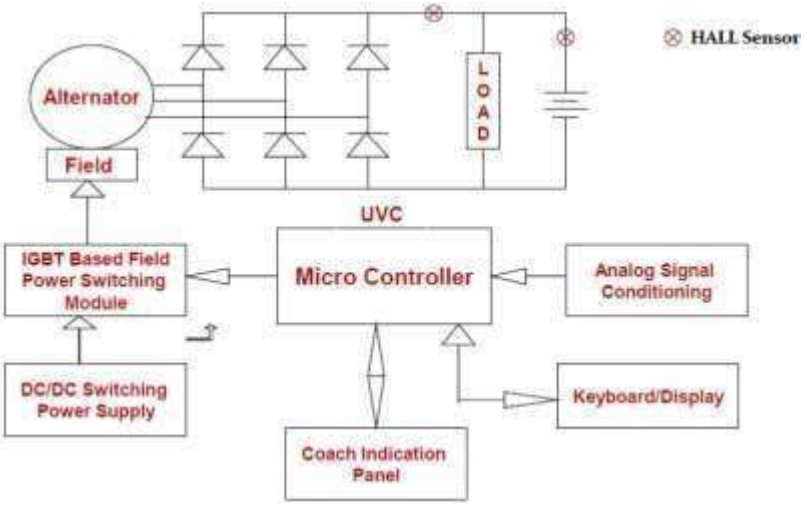
• Controlled Battery charging current to have longer life of batteries.

• Alternator identifying facilities (4.5, 18 or 25 KVA)

• Auto setting of parameters such as output DC voltage, battery current, load current, which in turn increase the life of battery and the alternator itself.

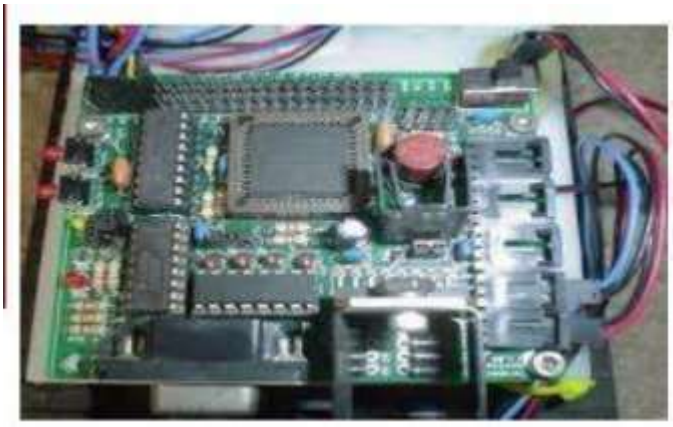
• Monitoring real time value of alternator voltage, load current, battery AH (IN), AH (OUT) etc. through interface fitted inside. Data logger and downloading unit available.

• This interface also has Emergency unit. In case of failure of one control unit, the other control unit will take care of both regulators.



Flowchart and Schematic of Overall System

- Reduction of the ripple content in the controlled DC output content as compared to the conventional system.
- Better current regulation and current ripple.



ERRU MODULE

INVERTER

- 25 KVA, 3 phase underslung inverter.
- IGBT based power circuit.
- Converts 110 DC from battery to 415V, 3 phase AC at 50 Hz.
- Output used to feed air conditioning load of coaches.
- Supplies power to RMPUs.

Battery

Ratings:

❖ 120 Ah for BG non-ac coaches.

❖ 800 Ah for under slung SG AC coaches.

❖ 1100 Ah (VRLA) for RMPU AC coaches.

Battery Charging Terminal (BCT)

Battery Charging Terminal (BCT) is provided centrally at the both sides of the under-frame of the coaches for external charging of the batteries at stations or maintenance lines.

UNDER FRAME TERMINAL BOX

All the cables coming from underframe equipment like regulator-rectifier, batteries and battery charging sockets are terminated at the terminal board mounted inside this box. Supply to the junction box inside the coach is taken from this box.

ROTARY JUNCTION BOX

Rotary Junction Box is provided inside the coach. It is used to arrange and control the power supply to various circuits of the coach (e.g., light, fan etc.) with the help of rotary switches.

EMERGENCY FEED TERMINAL (EFT)

Each coach is provided with four emergency feed terminal boards on end panels, one each at the four corners of the coach at lower level to enable emergency connection to be made between adjacent coaches.

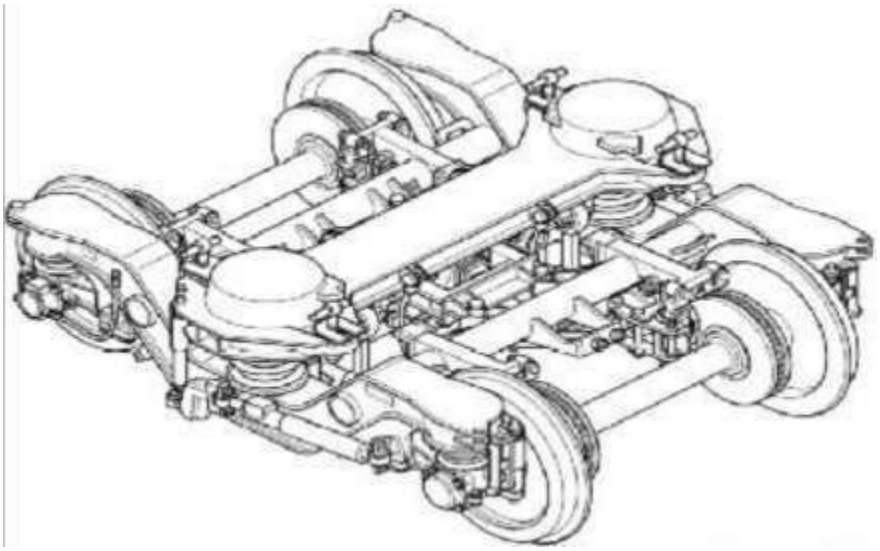
LHB COACHES

LHB coaches are the passenger compartments of Indian Railways that have been developed by Linke-Holfmann-Busch of Germany. The coaches are designed for an operating speed up to 160 km/h and could go up to 200 km/h. However, they have been tested up to 180km/h.

Features of LHB Coach

- Speed potential 160kmph can be raised to 200kmph.
- Noise and heat insulation.
- Two microprocessor-based roof-mounted air-conditioned unit (RMPU).
- Modular design interior.
- Hygienic toilets with controlled discharge.
- Cartridge Trapped Roller Bearing.
- Longer as compared to ICF coaches, hence can accommodate 8 to 9 more passengers.
- Aesthetic design.
- Enhanced corrosion-protection.
- Bio-Tanks.

FIAT Bogie



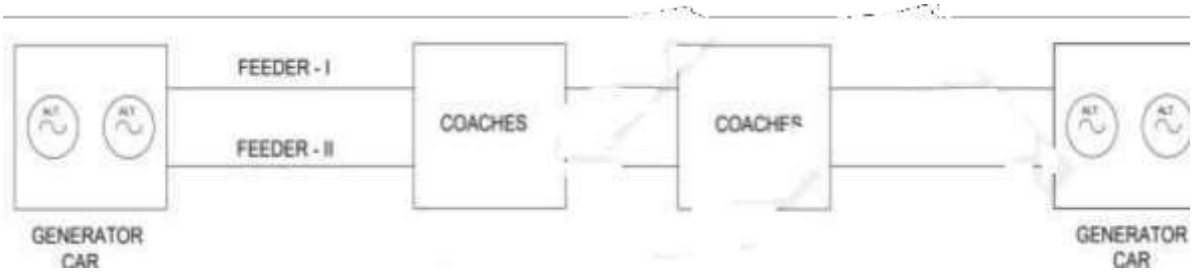
The FIAT (Fabrica Italina de Automobil Torino) bogie is an adoption of EUROFIMA design. This bogie belongs to the two-axle type, with a primary and a secondary suspension The bogie frame consists of two side members of Y-shaped longitudinal beam connected by two tubular steel members. The Y shaped side members consist of structural steel and welding is done to form box sections. Minimum strength of the structure is 52 kg/mm2 with D class weld. Bogie is designed for maximum operating speed of 160 kmph

and has potential for operation upto 200 kmph. Axle guidance is provided by an articulated control arm through a resilient bush. This is a two-stage suspension bogie. The car body directly rests on the secondary stage helical springs, which rests on Y shaped side beam. The bogie frame rests on primary stage helical spring which are resting above the axle box crown. The tracking and braking force from axle to bogie frame is transferred through articulated control arm system of primary suspension. Bogie is capable to permit the coach body to negotiate curve of 175 m radius at maximum speed potential of 40 kmph and 1 in 8 1/2 turn out in either direction at 30 kmph.

END ON GENERATION (EOG) SYSTEM

End on generation (EOG) system envisages the equipment of the power car in the front and rear end of a rake with diesel generating sets generating power at 750 V, 3 phase, 50 Hz ac supply with appropriate arrangement for the control and distribution to the entire rake composition through two sets 3 phase, 4 wire, 750 volts feeders. Feeders are taken to each coach in the rake composition with the help of inter locked electrical couplers.

LHB variant non-AC EOG coaches are equipped with 9/15 kVA step down transformers for stepping down 750 V, 3 Φ AC, 4 wire, 50 Hz supply to 415 V/ 190V, 3 Φ AC, 4 wire, 50 Hz supply. Power cars at both ends take entire load of whole rake, which includes air conditioning (if AC coaches in rake), light and fan circuit, and regulated battery charger circuit and mini pantry equipment (if chair cars in rake). Each power car has two DG sets (normally out of which one DG set is standby).



End-On Generation System

The neutral point of the 3-phase winding of the generator is solidly earthed in the power cars. The neutral conductor of the 750 volts, 3 phase, 4 wire system shall not be earthed at any other point in the rake composition.

ELECTRICAL FEATURES OF EOG NON-AC COACHES

- Constant voltage regulated battery charger.
- Onboard Switch Board panel with controls of lighting and fan and their fuses.

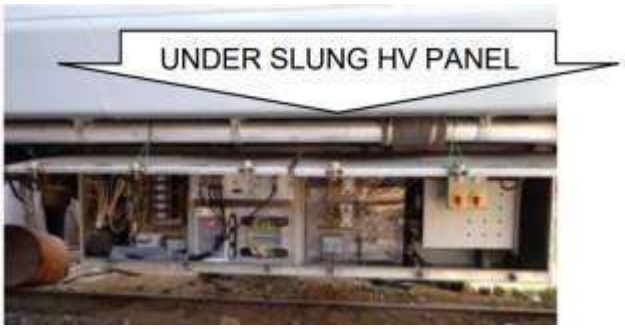
- Under slung panel for 750 volt and 415/ 190-volt supply.
- Onboard supply only 110-volt dc and 190/110 V ac for mobile charging sockets.
- Provision of Dry type Transformer without encapsulation.
- Elegant interior light fittings.
- Integrated modular mini pantry unit in Chair cars.
- Provision of Measuring and Monitoring relays in Feeder circuit.
- Wheel set earthing equipment for high life of axle bearings
- Provision of under slung mounted earthing and disconnecting device
- Provision of under slung mounted water raising pump with pump controller (in 3 tier sleeper coaches only).
- Cable protection system with IP-67 protection and UL-94 V0 fire retardancy.
- Provision of Emergency Feed Terminal (EFT) in future coaches and the same is to be implemented during POH in existing coaches.
- Provision of Battery Charging Terminal (BCT) in future coaches and the same is to be implemented during POH in existing coaches.

A Brief description of various electrical equipment fitted in different types of non-AC LHB EOG coaches are described here:

Set of Electrical Panels:

The set of panels comprises of the various cubicles consisting of power and control switchgear as mentioned below. Provision of halogen free electron beam irradiated cables conforming to RDSO specification no. ELRS/SPEC/ELC/0019 Rev-2.

1. **High Voltage Cubicle (under-slung mounted)**
   This cubicle is made of stainless-steel fabrication and mounted in underslung in the coach. This panel houses the disconnecting and earthing device, switchgear and fuses for 750 V, 415 V, 190 V, 110 V, Pump controller, Anti-skid device, MMR, RCBO (Residual Circuit Breaker with Overload), rotary switches for feeder selection etc. From the front of the panel all the equipment can be access for maintenance. For these front covers are provided with hinges and locking arrangement. The box is earthed with two earthing terminals on top and bottom on diagonally opposite ends.



2. Regulated Battery Charger

The under-slung mounted cubicle (as per RCF drg. no. LS 71104/EDTS 355) houses the regulated battery charger along-with connectors. This cubicle is totally enclosed and IP 53 ingress protection. Constant Voltage Regulated Battery Charger (Ref: RDSO/PE/SPEC/AC/0129-2009, REV-1) is provided for rectifying ac supply into dc for providing power supply in the coach at 110 V dc and at the same time to charge the VRLA batteries provided in the coach. The battery charger is forced air cooled, IGBT based and DSP (digital signal processor) controlled working on a nominal input supply of 415 V, 3 phase, 50 Hz fed from 750/415 V transformer.

3. Transformer 9/15 kVA 750/415 /190 V AC

This is a 3-phase dry type distribution transformer designed for LHB type non-AC EOG coaches for providing power to coaches from 750 V supply of power cars. There are two types of transformers i.e., type I- 9 kVA for general IIND class and 3 tier sleeper coaches (train lighting load 6.5 kVA-415V + 2.5 kVA -190V AC) and Type II for chair cars (pantry load and train lighting load 12.5 kVA- 415V+ 2.5 kVA 190V AC). Both types of the transformers are star- star-star connected, dry type and air cooled. The class of insulation of winding is class ‘H’. Transformer is fitted under slung with 4 nos. anti-vibration mountings.

4. **<u>Valve Regulated Lead Acid (VRLA) Battery110 V (9 modules of 12-volt, 70 Ah)</u>**

   VRLA battery requires no topping up under normal working conditions and minimal maintenance during lifetime of battery. It has self-sealing safety valve, which normally does not open out during service. These coaches are provided with 9 modules of 12-volt 70Ah, VRLA battery in series in one battery box mounted in under-slung. The auxiliary power required for charging is supplied by a regulated battery charger at constant voltage based as required by the battery. Current limit for battery charging is 20 Amp at constant voltage with the voltage setting at 122.0 ± 1.0 volt.

5. **<u>Battery Fuse Box +ve and –ve</u>**

   Battery fuse boxes (+ve and –ve) are provided in under frame supported on brackets by fixing bolts. These boxes are properly earthed by earth cable. These are totally covered and locked by hinged bolts.

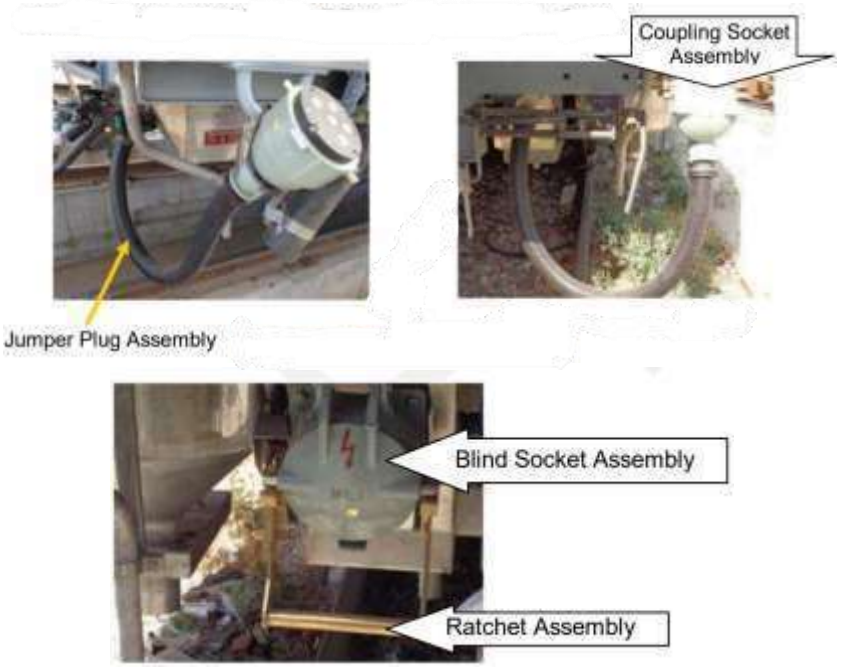
Battery Fuse Box (+ve)

Battery Fuse Box (-ve)

- Fuse Rating +ve 40 Amp/ 660 V = 01 no.
- Fuse Rating -ve 40 Amp/ 660 V = 02 nos.

6. ZS Coupling, 400A, 750V, 3-PH, 50HZ

Under-frame mounted Inter-vehicular coupler unit are used for transmission of 3 phase, 5 wire, 750 V, 50 Hz power supply from power cars to rake/ coaches (LHB type) working on End-on Generation (EOG) system.



7. Feeder Junction Box

Two types of feeder junction boxes are provided on the LHB coaches as given under:

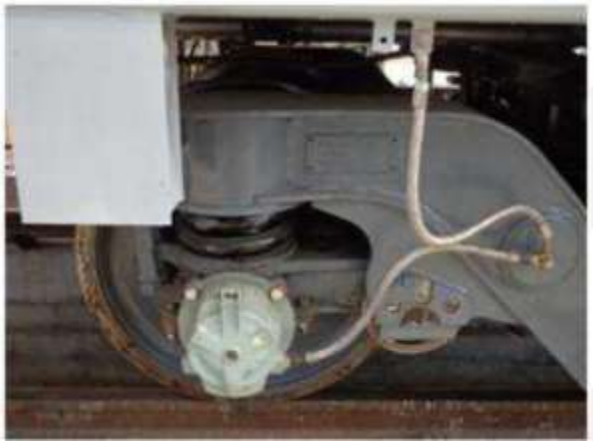
i. Feeder junction box- plug side – RCF Drg. no. LW 71006 – 2 nos.

ii. Feeder junction box- socket side – RCF Drg. no. LW 71007 – 2 nos.

8. Wheel Set Earthing Equipment

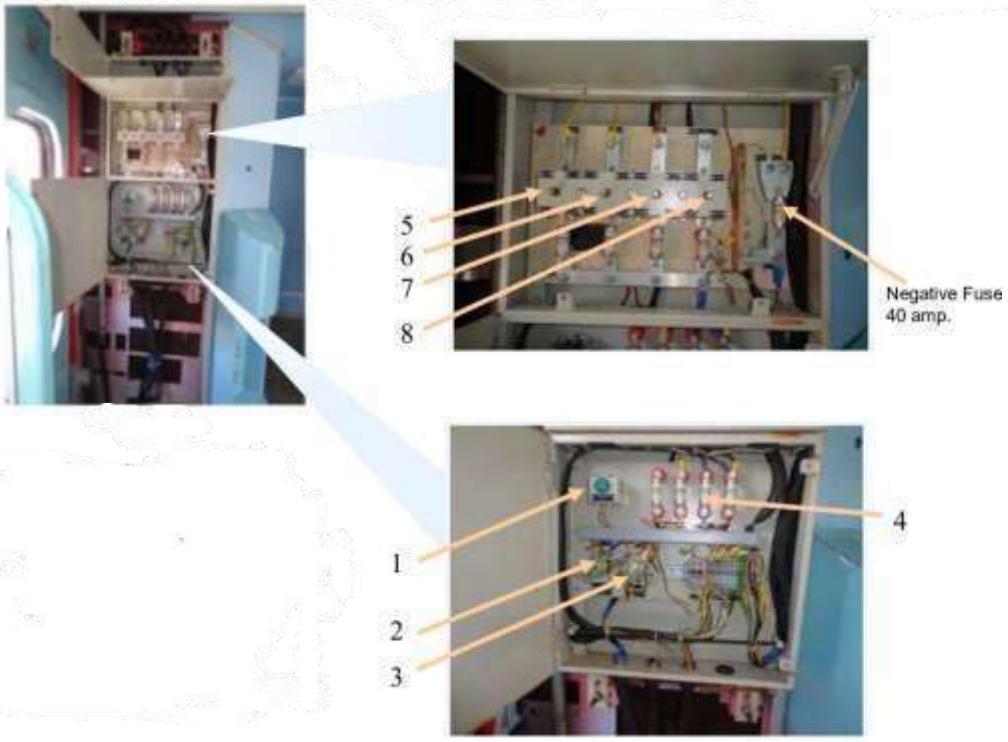
Wheel set earthing equipment for the wheel set is provided to prevent return current flow through the axle bearings and likely damage. Thus, the earthing contact system acts as a current bridge

that creates a connection by means of wiper contact (brush) from the stationary bogie frame to the rotating wheel set.
This set comprises following subassemblies per bogie:
i. Wheel set earthing equipment with stainless steel braided earthing cable: RCF
drawing no. LW 71231 – 1 set
ii. Earthing resistor assembly 0.1 Ohm (RCF drawing no. LW 71246) with mounting bracket (RCF drawing no. LW 71247) and grounding cable (RCF drawing no. LW 71248) – 3 sets.
Resistances are provided to restrict the return current from certain bogie parts and providing return current path through pre-determined low resistance path.



9. On Board Rotary Switch Panel

The on-board panel houses the rotary switch panel as used in conventional coaches for distribution of light and fan. This also houses rotary switch for feeder selection to select the feeders as provided in the under-slung HV cubicle and rotary switch for mobile charging socket along-with connectors, push button for testing AEL is also provided in this box. This cabinet is made of CRCA (Cold Rolled Close Annealed) sheet of thickness 2 mm and powder coated to Siemens grey shade.

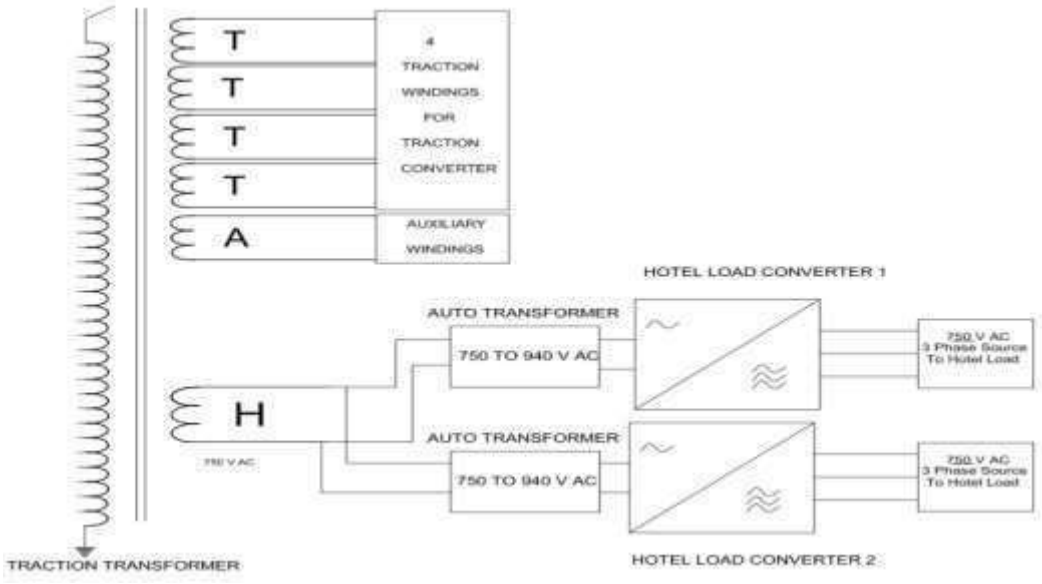


1. Test push button for ELU
2. RSW for feeder selection
3. RSW for charging socket
4. HRC fuse for charging socket
5. Rotary switch for L1
6. Rotary switch for LII
7. Rotary switch for fan
8. Rotary switch for SPM I, II

Head On Generation (HOG) System

HoG is a clean technology that taps power supply from overhead power lines and distributes it to train coaches after stepping down the voltage through the transformer.

The new technology doesn't create noise pollution and helps to save diesel costs besides making it environment-friendly. In HOG system, power is fed from the electric locomotive to the train to cater for the Hotel Load of the train. In electric locomotives, power is taken from the OHE through pantograph to traction transformer of the locomotive which is provided with a hotel load winding of 945 kVA, at nominal voltage of 750 V single-phase, which varies with the OHE voltage variations. This 750 Volts single-phase supply is fed to Hotel Load Converter, which gives 750 Volts 3- phase 50 Hz supply as output, for feeding the hotel load of the train.



Schematic Of HOG System

The three-phase output supply of the hotel load converter i.e., HOG system is transmitted to both the feeder of the existing EOG train through IV coupler.

Power for the hotel load of the train is taken directly from the Overhead line through a separate pantograph mounted on a power car, or through a special separate hotel load winding tap provided in the main transformer of the locomotive. Locomotives such as the WAP-5 series already have the provision for the hotel load tap. A separate power car is still needed when taking the locomotive tap for hotel load power, because a transformer must still step down the power drawn for distribution to the coaches.

If using a separate power car with a pantograph, the placement of the power car within the rake is likely to be at the rear to ensure safe inter-pantograph distance between it and the pantograph(s) of the locomotive and simultaneously to minimize coach shunting for forming the rake. Mechanisms like Locotrol need to be used to raise and lower the pantograph remotely from the locomotive cab.

Whether the power is drawn from the Overhead line or from the locomotive tap, it still needs to be further converted to 415V 3-phase / 110V 1-phase as required for the coach air-conditioning (RMPU) and lighting systems. This can be done in a Bulk Coach Converter in the power-car, or in individual coach converters provided in each coach (or in every two or three coaches).

OTHER PASSENGER AMINITIES

LAVATORIES

LHB coaches have both Oriental and European type of lavatories with controlled discharge toilet system. The salient features of LHB modular toilets are illustrated below:

WATER TANKS

3 types of water tanks are provided in LHB coach.

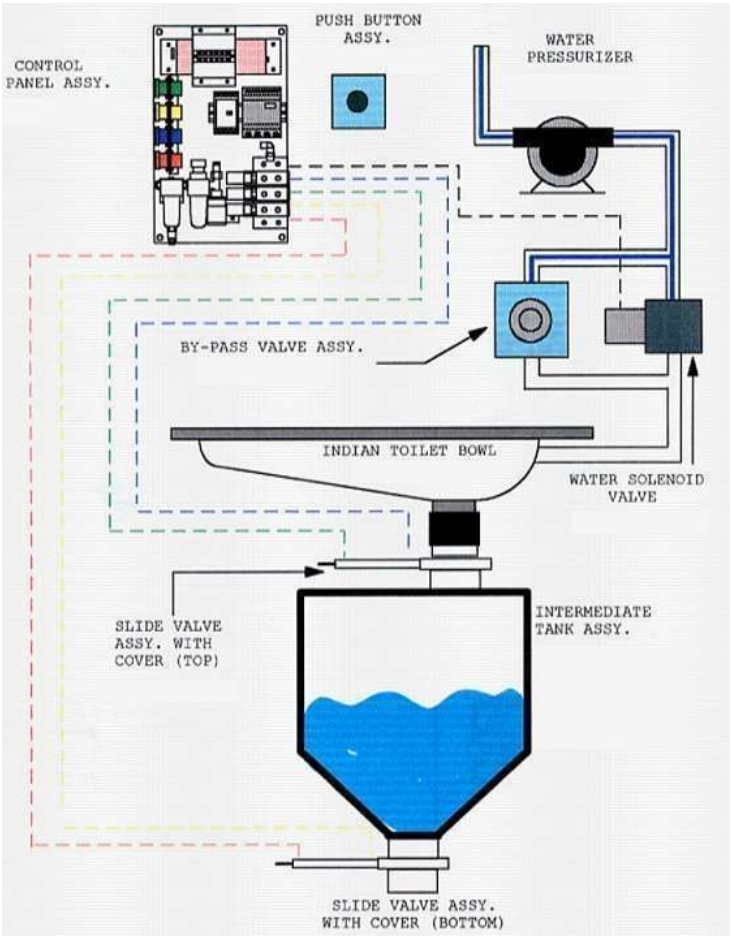
2 stainless steel water tanks of 685 liters capacity each. These tanks are installed in under frame in twos, are fixed with frames and are secured by safety belts. These tanks constitute the fresh water reserve in the passenger coaches. Water level indicator have been provided in these tanks.

One stainless steel water tank of 450 liters capacity installed in under frame, fixed with frames and is secured by safety belts. This tank installed in the under frame constitute the fresh water reserves for the generator car.

3 stainless steel auxiliary water tanks of 30 liters capacity installed one in each lavatory in the roof and are continuously fresh-water-fed by means of pumps. They maintain the good running of water supply of the barometrical capacitor at each station. These tanks are installed alone and are fixed with 2 supports which are equipped with belts.

CONTROLLED DISCHARGE TOILET SYSTEM (CDTS)

LHB coaches are fitted with controlled discharge toilet units to avoid soiling of track in station and inhabited areas. The toilet system is designed to operate with a pressurized water bowl wash that covers 100% of the toilet bowl area. The waste is removed from the toilet bowl and transferred to a retention tank with minimal amount of water. Water consumption is only 2.5 liters per flush cycle for the Indian style toilet bowl and 1.5 liters for the European style toilet bowl. In future, Bio toilet tanks will be provided in the LHB coaches in place of CDTS.



SCHEMATIC DIAGRAM OF CDTS

IR-DRDO BIO-DIGESTER TANK FOR COACHES

These tanks are made of stainless steel and having following constructional features:

1. The size of the tank is 540 X 1150 X 720 MM with the provision of 04 nos mounting brackets at both the sides along the length of the tank.

2. Each bracket is with the provision of 02 nos. M16 Size bolts which are tighten in the under slung on mounting brackets.

Main parts of the Bio digester tank:

1. Stainless steel tank with 06 partition walls inside the tank.

2. Poly grass mats for protection of bacteria inside the walls.

3. Ball valve with handle for operation during emergency for making toilet direct discharge in case of chocking

4. SS fasteners in place of MS on tank covers.

5. Stronger bonding of Colonized rubber mat with vertical walls.

TOTAL VOLUME OF TANK: 400 Lt.

EFFECTIVE VOLUME: 300 Lt.

EMPTY TANK WEIGHT: 110 Kg.

FULL TANK WEIGHT: 410 Kg.

HEIGHT FROM RAIL LEVEL: 225 mm

AIR CONDITIONING

1.1 INTRODUCTION :

Air-conditioning in coaches was first introduced in India in 1936. The first air conditioned coach employing electromechanical air-conditioning system was constructed in the workshop at Matunga nearMumbai. The first AC coach was manufactured by ICF, chennai in 1965. The present AC coaches are very much modified and light weight coaches in comparison to the older models.

Air-conditioning of railway coaches is a priority passenger amenity for the maximum comfort and well- being of passengers in a railway travel. Microprocessor controlled, two air conditioning package units **(RMPUs)** are provided on roof of each LHB coach and they are controlled by single microcomputer basedcontroller. These air conditioning units work in fully automatic mode. Depending on ambient temperature, available modes of heating, ventilating, cooling and dehumidifying are selected and controlled. These units can work satisfactorily on End On Generation (EOG) and Head On Generation (HOG) type AC coaches. The generator car is provided only with one air conditioning unit. Each RMPU comprises two distinct refrigeration circuits i.e. two compressors, two condensers, two cooling coils, oneheater etc.

1.2 REQUIREMENT OF AIR CONDITIONING IN RAILWAY COACHES :

- ✓ Passengers are adversely affected by the air infiltrated in coaches laden with dust and smokeduring travel especially in the long routes high speed train .
- ✓ Air conditioning is necessary to maintain the comfort and leisure of passengers travelling inrailway,
- ✓ Also , for tropical country like India , where temperature vary from 48^{o}C in summer to 2^{o}Cduring winter AC coaches are necessary .

Fig. LHB AC coach

2 RMPU (ROOF MOUNTED PACKAGING UNIT) :

This **Controller for Roof Mounted AC Package Unit** of LHB Coaches and Double Decker Coaches is a Microcontroller based unit developed to control the sub-systems of the RMPU automatically accordingto the Heating, Ventilation and Air-Conditioning (HVAC) algorithm to provide accurate control thus resulting in comfort to passengers.

In 1 Coaches two units are installed at the both end of coaches .

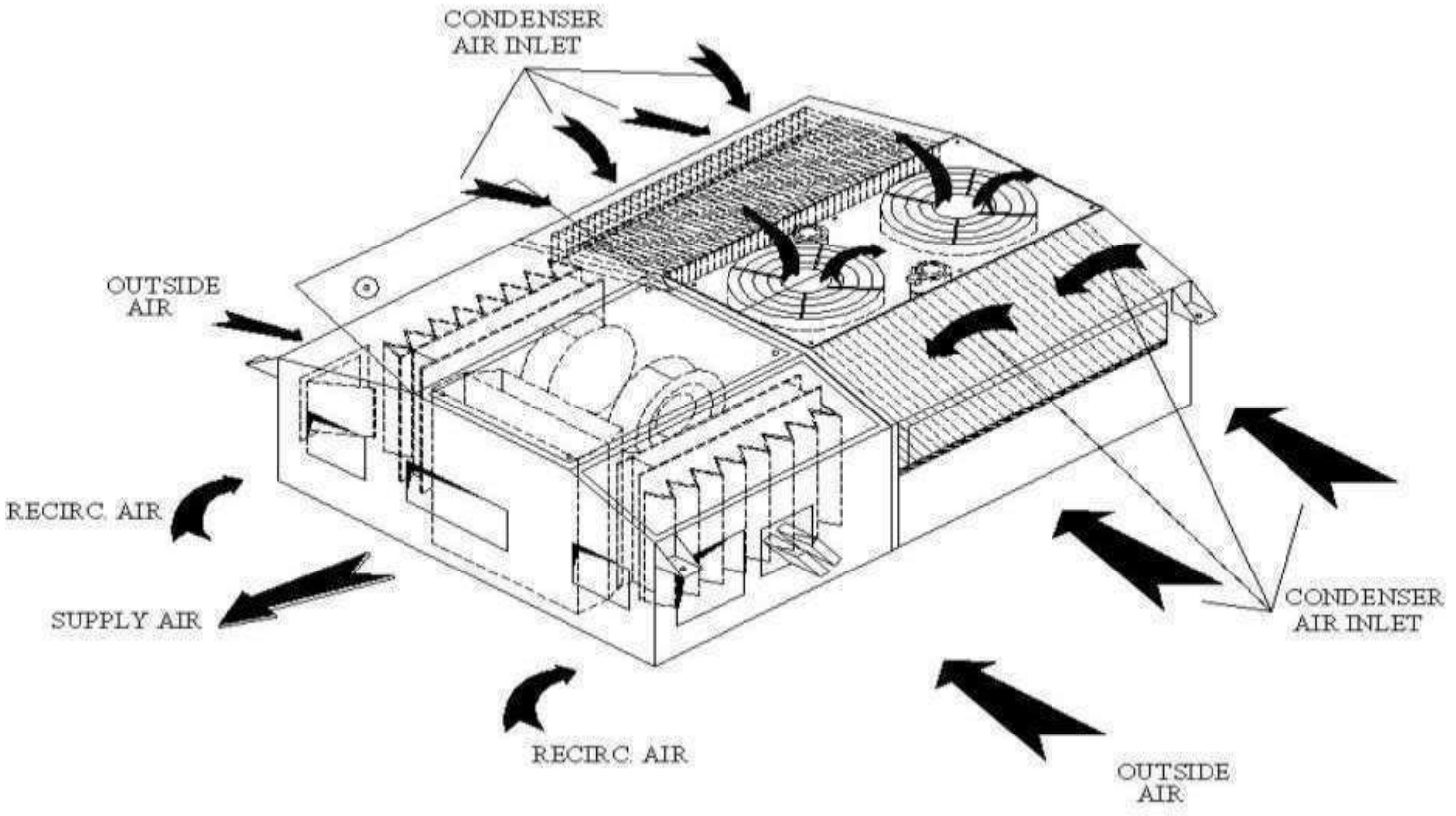


Fig 1: <u>RMPU (ROOF MOUNTED PACKAGING UNIT)</u>

2.1 FEATURES OF RMPU(LHB COACHES) :

- Micro-Controller based AC Package unit. Control and regulation function of air conditioning system (twonos. RMPU) are performed by single Microprocessor controller unit with software installed in it.
- The refrigeration system comprises two distinct refrigeration circuits i.e. two compressors, twocondensers, two cooling coils, one heater etc.
- Servo-Motor Controlled Fresh Air Damper for automatic Pre-cooling / Pre-heating.
- Micro-Processor Control (with RS 232 Port) with fault Diagnostics and Data acquisition system.
- Motors protected with Thermal switches.
- Pressure transducers for LP/ HP measurement
- NTC type temperature sensor
- Humidity Control through Hygrostat.
- Condenser Fan of Fire Retardant Plastic Blades.

- Compressor- hermetically sealed scroll type.
- Automatic temperature setting based on ambient temperature sensor and switch over to Pre-cooling
- Pre- Heating mode.
- Improved air duct design for better air flow and cooling.
- Connections through Harting connectors (plug & socket)
- Protective mesh of 3 mm SS over condenser fans
- Suck through type arrangement
- Light in weight
- Low cost of installation
- Power supply- 415 +/-5% V , 3 ph, 50 Hz+- 3%
- Capacity with one condenser- 75%

Fig.2 Open RMPU

2.2 TECHNICAL DETAILS : (LHB COACH)

S.NO	DESCRIPTION	DETAILS
1.	Application	LHB Coaches & power cars
2.	Cooling capacity	7.0 TR
3.	Heating capacity	6.0 kW
4.	Compressor capacity	3.5TR (two nos.)
5.	Maximum power consumption	16.5 kVA
6.	Supply voltage	415V,3Ø AC, 50Hz

7.	Operating voltage	415V,3Ø AC, 50Hz
9.	Control voltage	110±30% V DC
10.	Fan motor axial (for condenser)	1HP , 415V , 3Ø
11.	Fan motor radial (for evaporator)	1.5HP , 415V , 3Ø
12.	Fresh air supply (m^3/hr)	820 (m^3/h)
13.	Supply air flow	4000 (m^3/h) ± 10%
14.	Condenser fan	0.75 kW, 415 V, 3 Ø AC, 50 Hz, 1400 RPM (two nos.)
15.	Supply air fan(Blower motor)	1.1 kW, 415 V, 3 Ø, AC, 50 Hz, 1400 RPM (one no.)
16.	Refrigerant	R 407C
17.	Weight(Kg)	(620 to 710)kg approx.
18.	Dimensions(mm) (L*W*H)	2220*2200*500
19.	Material of enclosure	Stainless steel (UNPAINTED)

❖ Formula for calculating cooling capacity :

$$\textbf{Cooling Capacity(TR)} = \frac{(\boldsymbol{Enthalpy\ Difference})*(\boldsymbol{Air\ Delivery})}{(\boldsymbol{Specific\ Volume})*(\mathbf{3024})}$$

- Range for Cooling Capacity is 18°C to 22°C .

2.3 DETAILS OF AIR CONDITIONING SYSTEM IN LHB AC COACH :

The AC system for the LHB coaches consists of the following assemblies:

- Compact air conditioning unit
- Duct system
- Exhaust air system (Exhaust air unit, WC/WC exhaust fan, WC/ Switch cabinet exhaust fan)
- Fresh air screen
- Open/closed-loop control devices & Sensor

2.4 COMPACT AIR CONDITIONING UNIT :

Each compact air conditioning unit (RMPU) has two separate cooling circuits consisting of the followingmajor components:

- Two hermetic sealed scroll compressors.
- Two condensers with Cu pipes and pre coated Aluminium fins.
- Two axel fans (condenser fans) with motors for cooling the condensers.
- Two evaporators (cooling units)
- Two twin-sucking radial fans for the supply air (driven by the Evaporator blower motor)
- Three maintenance covers
- Two air inlets for circulating air
- One air outlet for supply air
- Control and safety devices
- Pipelines/fittings
- Two mixed air filters

2.4.1 COMPRESSOR

Two hermetic sealed scroll compressors along with Cu pipe lines are provided for two cooling circuits in each RMPU. They are fixed with anti-vibration mounting pads for reliable operation. Each compressor of minimum 3.5 TR capacity at 60 Degree C condensing and 5 Degree C evaporatingtemperature, making total rating of AC package unit 7 TR.

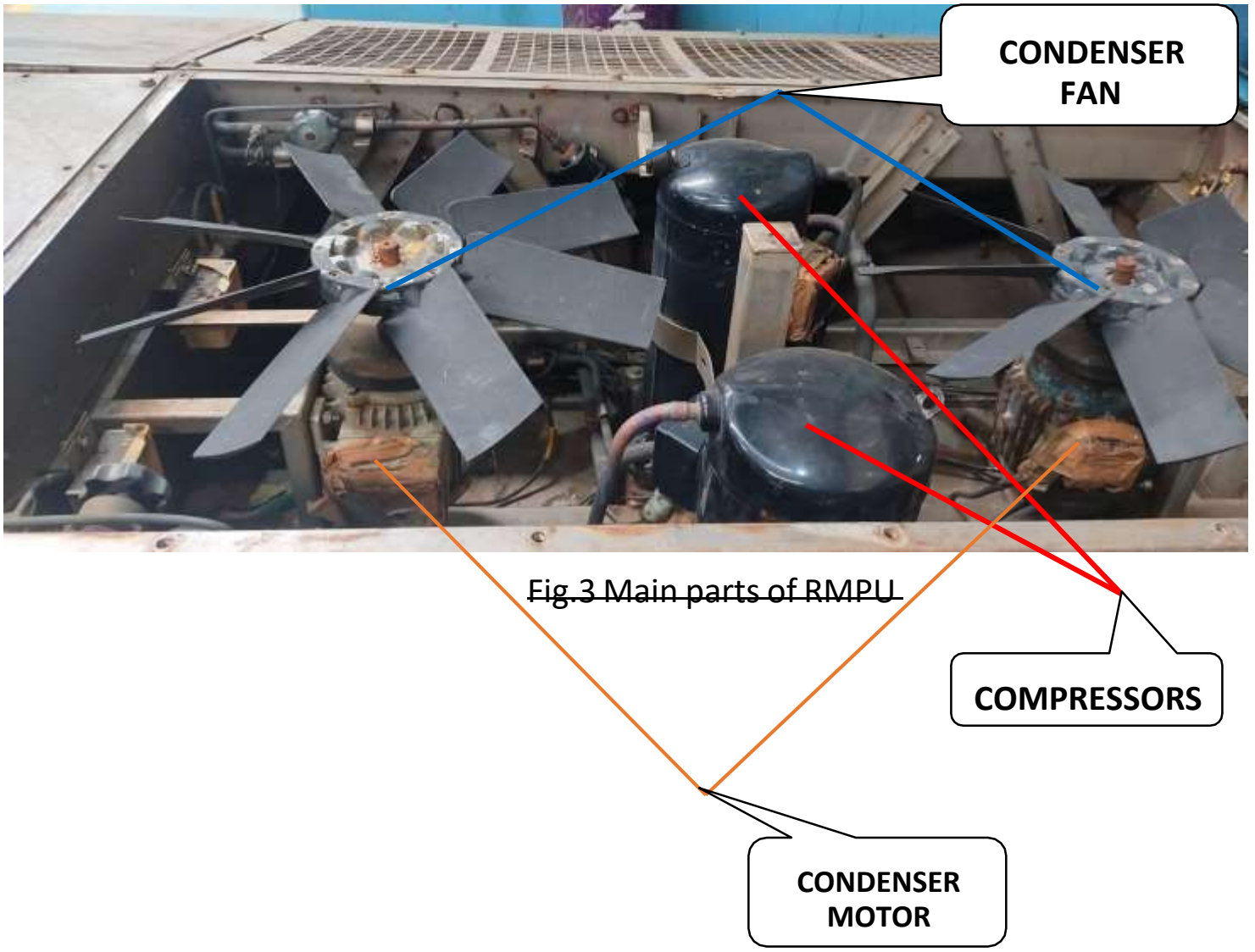


Fig.3 Main parts of RMPU

Fig.4 Compressor

Compressors circulate the filled refrigerant gases in the system under pressure .Two types of refrigerant gasesare used : R22 and R407 C . For all the LHB coaches R407 C is used. Earlier R12 was also used as a coolant but due to its contribution in global warming this gas was replaced withmore safer and suitable gases.

Refrigerant cycle :

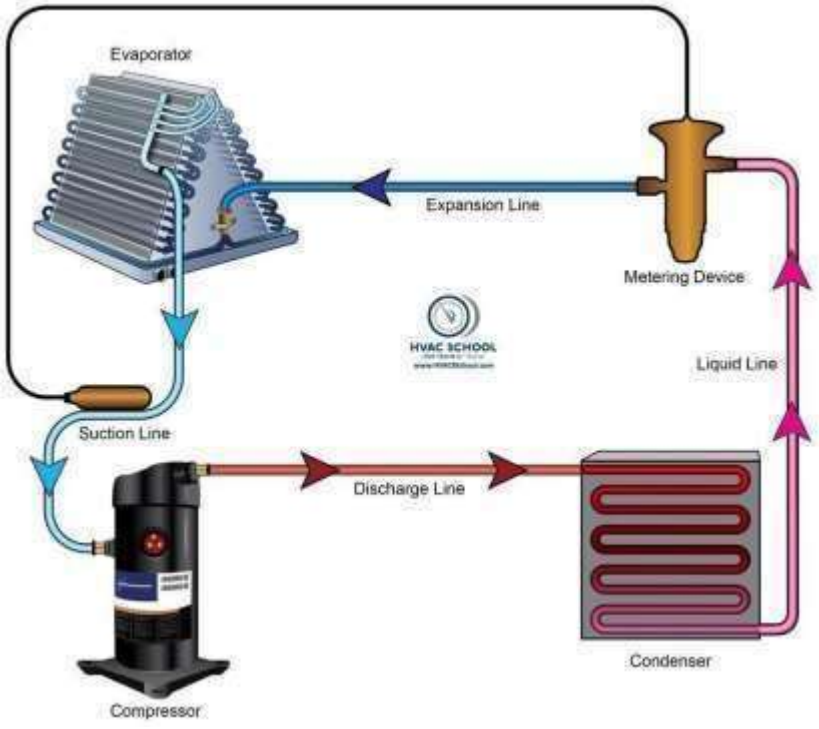


Fig.5 Basic refrigerant cycle

2.4.2 CONDENSER & CONDENSER FANS

Two Condensers with Cu tubes and pre coated Aluminium fins are provided for two cooling circuits in eachRMPU. These are air cooled and two axle fan (condenser fans) along with motors are also provided in eachunit for the cooling of the condenser fins. They are fixed with anti-vibration mounting pads for reliable operation.

Fig.6 Condenser unit in RMPU

2.4.3 EVAPORATORS :

Fig. 7 Evaporator units in RMPU

Two evaporators units with Cu pipes and pre coated Aluminium fins are provided for two cooling circuits ineach RMPU.

2.4.4 SUPPLY AIR FAN AND BLOWER MOTOR :

Two twin-sucking radial fans for the supply air (driven by single Evaporator blower motor) are also provided in each unit for the supply of cooling air.

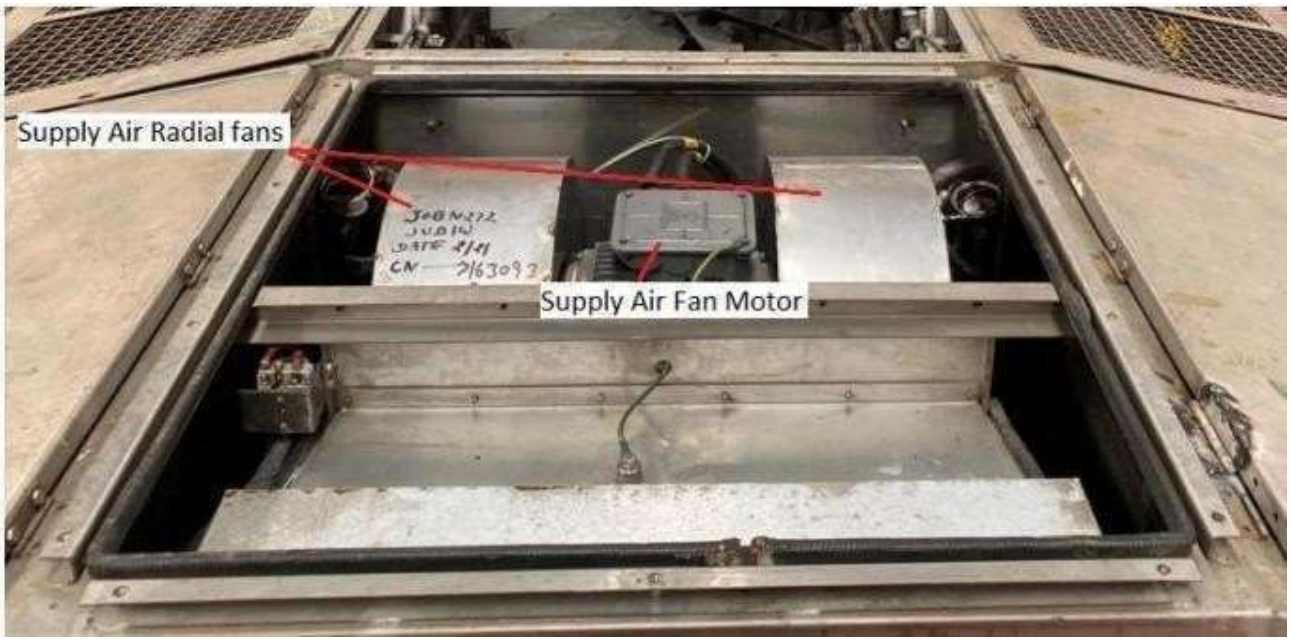


Fig.8 Twin-sucking radial fans for the supply air in RMPU

2.4.5 HEATING ASSEMBLY :

Each RMPU also has one three phase stainless steel heater element (one set) without fins of 6 kW capacity.The heating coil is supplied with 415V-3~50Hz supply. Heater has following protections:

a) Over heat protection switch for heater - one
b) ESTI-1 cartridge + 130 degree C for ultimate disconnection of power supply – one

Fig.9 Heating Assembly

2.4.6 AIR FILTERS AND FRESH AIR SCREENS :

- Air filters are provided in RMPU for the filtration of air at various locations while working of RMPU. They ensure clean air supply.
- Fresh air filters - two
- Mixed (supply) air filters - two
- Return air filters - two
- In each coach/ generator car four air screens are installed at the coach ends parallel to the airconditioning unit. These screens are fitted with exchangeable air filters.

Fig. 10 Fresh air screens

2.4.7 NTC TYPE SENSORS :

Three NTC type temperature sensors for each RMPU (total 06 nos. per coach) are provided to control the temperatureinside the LHB AC coach. The location of temperature sensors are :

- 1 Return Air
- 1 supply air
- 1 Air duct (in one RMPU)
- The temperature settings can be maintained inside the air conditioned compartment by means of sevenpositions of the stepped rotary switch provided on the Switch Board Cabinet.

Fig.11 NTC type sensor

Fig.12 Humidity sensor

2.4.8 HUMIDITY CONTROL :

Relative humidity is controlled inside coach by RMPU and is monitored by one Hygrostat (Range: 30-100% RH) located at return air duct. It restricts the relative humidity level inside the air conditioning compartment to a maximum of 60 % under any circumstances. Desired temperature is achieved by switching on heaters (50%) as per logic, such that the combined power consumption does not exceed the permissible power under cooling capacity.

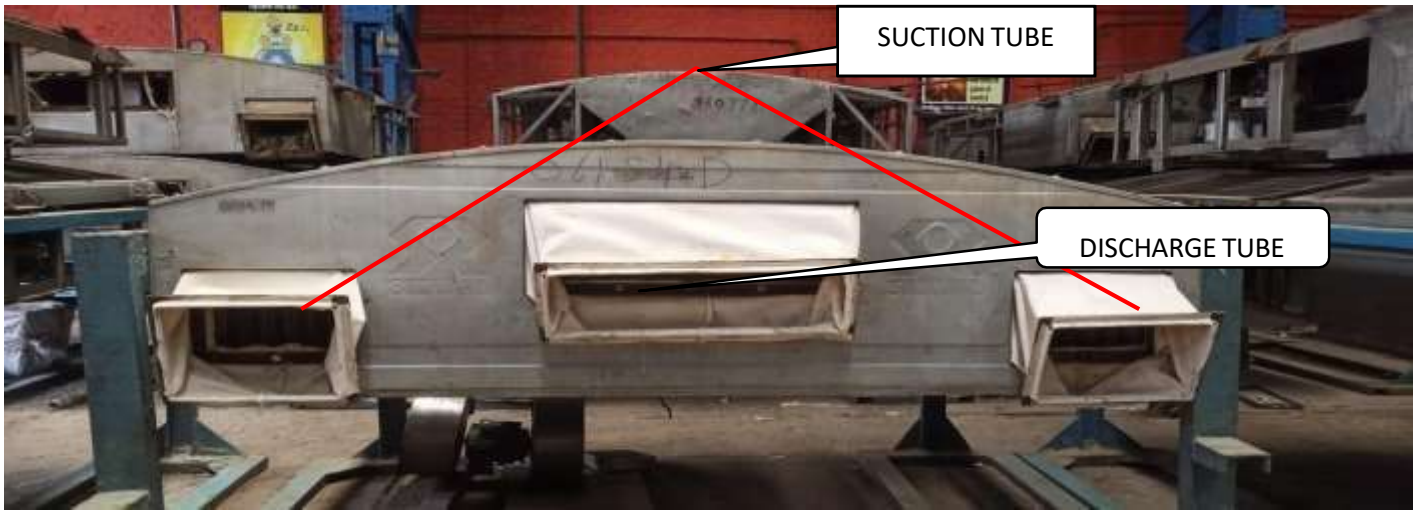


Fig. 12 Front face of RMPU

3. ELECTRICAL CONTROL PANELS :

Fig. 13 Electrical Control cabinet .

4. MICROPROCESSOR BASED CONTROLLER FOR RMPU :

Fig. 14 Automated RMPU testing and Data Acquisition system

With the changing era and modern innovations Indian railway also trying to modernise their techniquesand proceeding in the same manner the sensors used for testing the RMPU units are replaced with microcontrollers with the help of these controllers all data are collected and present on the screen which make the testing work easier and more accurate.

The control and regulation of both RMPUs is performed by one microprocessor controller, which is located in switch board cabinet and fed from battery net. This is designed as per RDSO specification no.RDSO/PE/SPEC/AC/0139- 2009 (Rev.1) effective from December, 2011.

The salient features of microprocessor based controller are given below:

- It is a fully automated control and monitoring system for all capacity RMPU units.
- The controller has fault diagnostic facility for continuous storage of various electrical faults inthe system, in time sequence manner.
- The fault data can be downloaded from the controller for analysis purpose.
- This unit works on 110 ± 30% V DC/AC.
- A Real Time Clock (RTC) is provided to determine the date and time at which the fault hasoccurred.
- Controller read the position of the Set Point Generator (7 positions) installed inside.

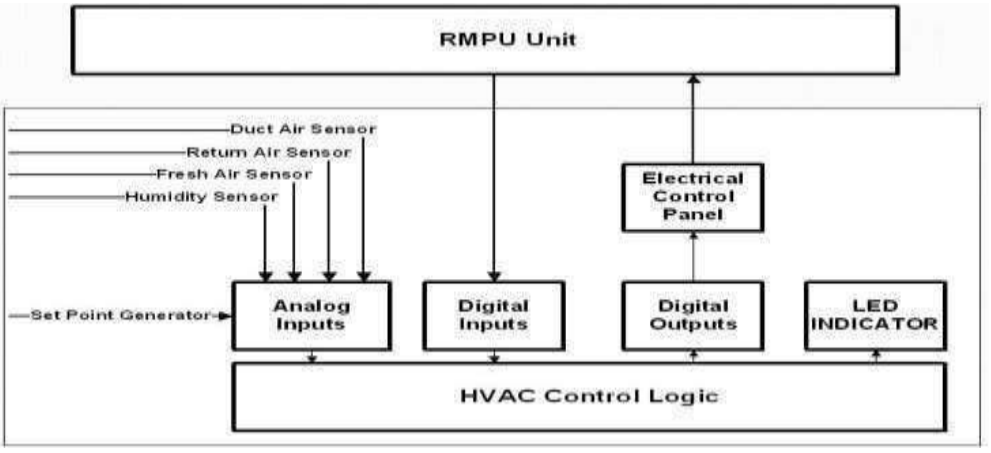


Fig. 15 Block Diagram of Control system of RMPU

- There are (8) Analog inputs designated X402 & X403. Of these eight inputs, 6 nos. are temperature sensors (NTC type) and there is 1 no. of humidity sensor for measuring humidity level. 1 no. of set point generator for temperature adjustment inside the coach.
- There are (20) digital inputs designated as X701 & X702.
- The external voltage is + 110V, Digital input returns must be tied to an external return (Inputcommon).
- There are 20 Digital Outputs designated as X301, X302, X501 and X502. Digital outputs areexternally sourced solid-state switches.
- Digital outputs are groups into four: each group requires one output common.

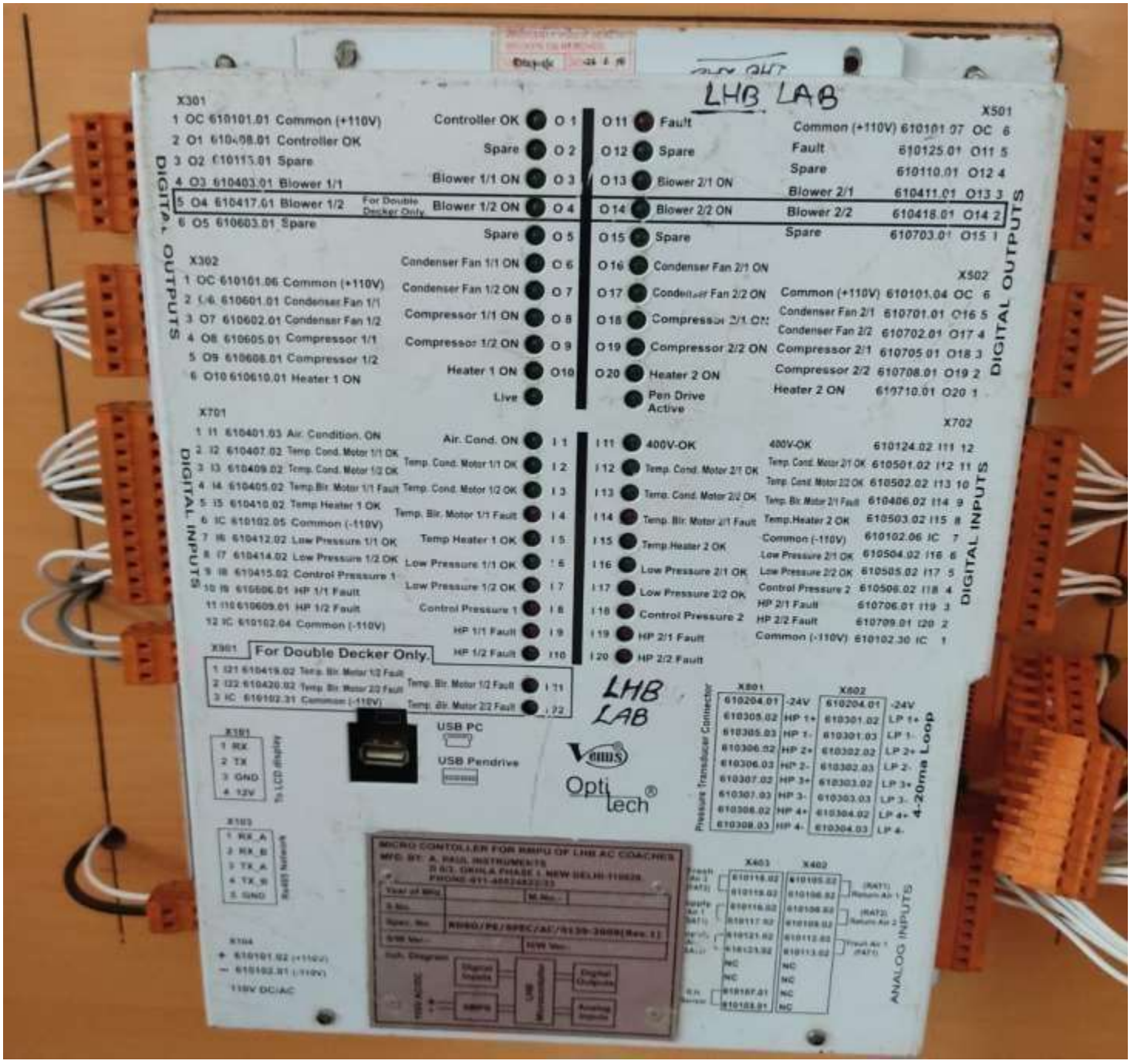


Fig. Microprocessor Based Controller for RMPU

5. FUNCTIONS AND MODES OF OPEARATION OF RMPU :

- The outside air (fresh air) is sucked in via the two fresh air screens and their air filters on the carriage side wall. It is mixed in the unit with the outside air/ recirculating air ratio can be set bymeans of air dampers, the positions of which are controlled by the controller of the air conditioning system.
- The temperature inside the coach is maintained as per the temperature setting selected by the operator. It is possible to alter the assigned value of temperature (in step of 0.1° C.) through key-board on display unit.
- The difference between cut in and cut out temperature shall be 2°C. The difference of 2°Creduces the duty cycle of compressor & eventually the failures of compressors.

System monitors supply voltage and current and record the power consumption.

The Heating, Ventilation and Air Conditioning unit work in different modes depending upon the temperatures SENSORS & Humidity level. The following are the main modes of operation:

i. **Pre-heating Mode:**
   - If the Ambient Temperature & Room Temperature is less than 14-degree C, thecontroller decides to operate in Pre- Heating mode.
   - In this mode the fresh air/re-circulating air flap set to 100% re-circulation air andexhaust fans are turned off.
   - Heaters are operated at its maximum duty cycle (55 seconds ON and 5 seconds OFF).

ii. **Pre-cooling Mode :**
   - If the Ambient Temperature & Room Temperature is greater than 28-degree C, the controllerdecides to operate in Pre-cooling mode.
   - In this mode the fresh air/re-circulating air flap set to 100% re-circulation air and exhaustfans are turned off.
   - Both Compressor are turned ON for maximum Cooling.

iii. **Normal Operating Mode :**
   - Depending on the Ambient Temperature, controller selects Heating or Cooling mode.
   - If the Ambient Temperature is less than the SET temperature, then Heating mode isselected. Ex: SET=20-degree C, AT= 18-degree C, HGS = Normal .
   - If the Ambient Temperature is greater than SET Temperature, then Cooling mode isselected. Ex: Ex: SET= 20-degree C, AT= 23-degree C, HGS = Normal

iv. Cooling Mode:

- During Cooling mode, the controller selects depending on the difference intemperature between SET temperature and Room Temperature.
- If the difference in temperature is less than 5-degree C and greater than 2-degree C,Condenser & one compressor turns ON.
- If the difference in temperature is greater than 5-degree C, Condenser with bothcompressors ON.

v. Heating Mode :

- During Heating mode, the controller selects depending on difference in temperature between SET temperature and Room Temperature for one of the 3 Heating cycle dutycycles.
- Minimum duty cycle - 5 sec ON & 55 sec OFF.
- Medium duty cycle - 30 sec ON & 30 sec OFF.
- Maximum duty cycle - 55 sec ON & 5 sec OFF.

vi. Dehumidification Mode :

- Dehumidification process starts, if the relative humidity of return air is more than60%.
- During 5 min cycle in this process, first compressor and heater are ON, while Secondcompressor remains in OFF position.
- The heater Duty Cycle is 30 sec ON and 30 sec OFF.
- After 5 minutes the Relative Humidity is again monitored, and if still it is more than60%, the cycle repeats till the RH is reached less than 60%.

vii. Shut -Down mode :

- Air Conditioning system will be shut down when the Air-Con switch is turned OFF orwhen there is no 400 V level supply.

viii. Manual mode :

- The Manual mode can only be activated through serial interface and application software with the help of laptop. This Mode makes testing of the individual outputs ofthe system.

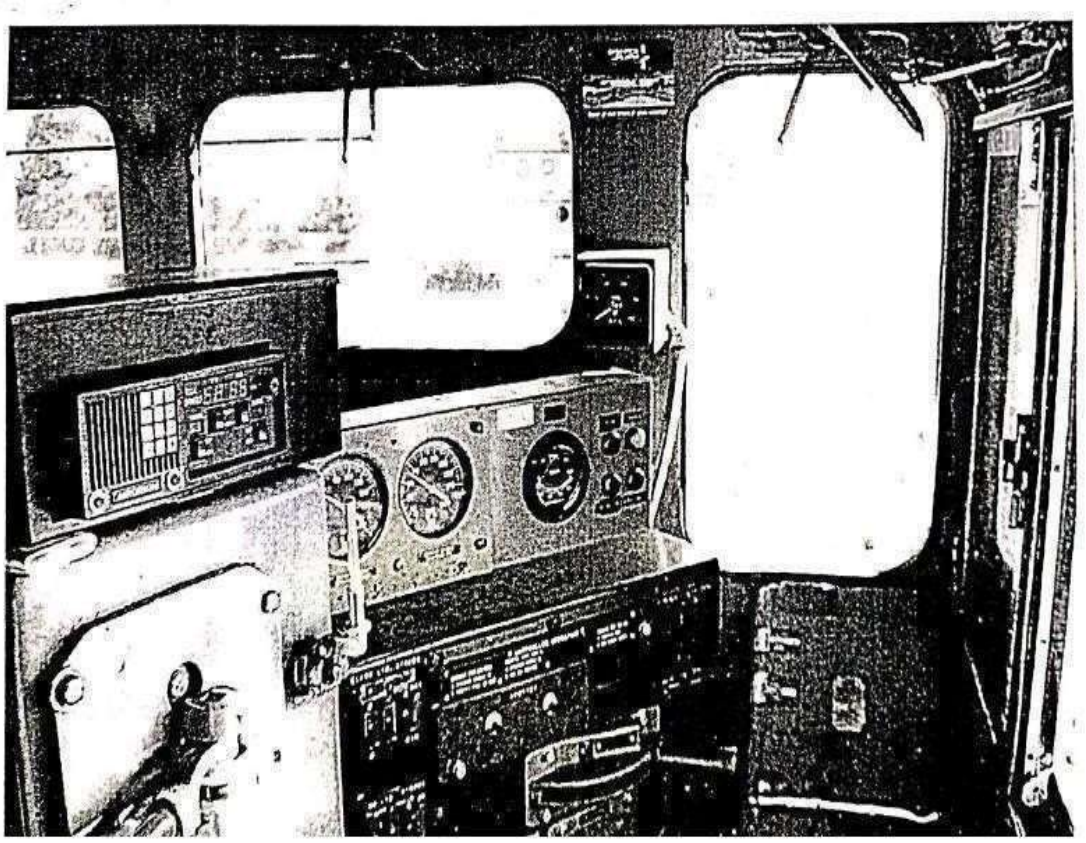
5.1 OTHER FUNCTIONS OF CONTROLLER :

- The controller will continuously monitor the duty cycle of compressors. If duty cycle of both the compressors is recorded to be less than 40% for four consecutive cycles, only one of the compressors will be worked alternatively. Again if one compressor is not able to achieve the desired temperaturewithin 10 minutes, both the compressors will start working simultaneously.
- Once the compressors are switched off, the first compressor starts after a time delay of 2 minutes and the second compressor starts after 30 seconds of starting of first compressor in order to controlinitial inrush of current.
- During winter season when the coach temperature reaches 2°C below the set value, the heaters areswitched ON. The heaters will remain ON till the set temperature is achieved.
- In the event of any defect, malfunction or abnormality, the unit isolates the equipment of RMPU orshuts down the system, depending upon the nature of defect to prevent any unsafe operating condition for the RMPU.

Diesel Locomotive shed

- **Diesel-electric control**

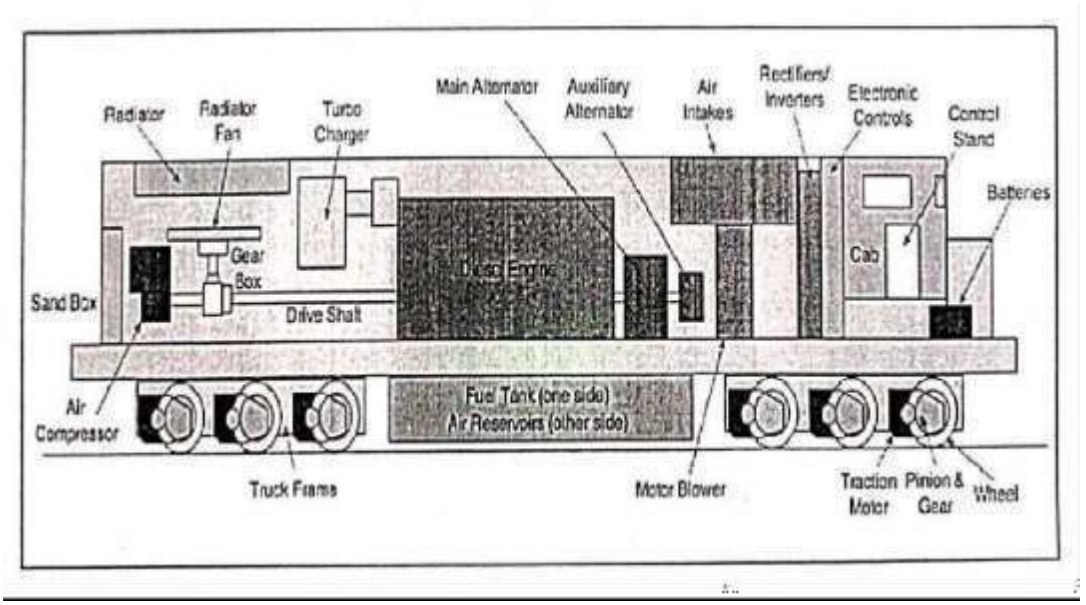
A Diesel-electric locomotive's power output is independent of roadspeed, aslong as the unit's generator and voltage limits are not exceeded. Therefore, the unit's ability is to develop tractive effort (also referred to as drawbar pullor tractive force, which is what actually propels the train) will tend to inversely vary with speed within these limits. (see power curve below). Maintaining acceptable operating parameters was one of the principal designconsiderationsthat had to be solved in early Diesel-electric locomotive development and ultimately, led to the complex control systems in place on modern units.



- **The Modern Diesel Locomotive**

The modern diesel locomotive is a self contained version of the electric locomotive. Like the electric locomotive, it has electric drive, in the form of traction motors during the axlesand controlled with electronic controls. It alsohas many of the same auxiliary systems for cooling, lighting, heating, braking and hotel power (if required) for the train. It can operate over the same routes (usually) and can be operated by the same drivers. It differs principally in that it carries its own generating station around with it, instead of being connected to a remote generating station through overhead wires or a third rail. The generating station consists of a largediesel engine coupled to an alternator producing the necessary electricity. A fuel tank is also essential. It isinteresting to note that the modern diesel locomotive produces about 35% of the power of a electric locomotive ofsimilar weight.

- **Main parts of a Diesel-Electric Locomotive**



- **Diesel Engine**

This is the main power source for the locomotive.

It comprises a large cylinder block, with the cylinders arranged in a straight lineor in a V. The engine rotates the drive shaft at upto 1000rpm and this drives the various items needed to power the locomotive. As the transmission is electric, the engine is used as the power source for the electricity generator or alternator, as it is callednowadays.

- **Traction Motor**

Since the diesel-electric locomotive uses electric transmission, traction motors are provided on the axles to give the final drive. These motors were traditionally DC but the development of modernpower and control electronics has led to the introduction of 3-phaseAC motors. There are between four and six motors on most diesel- electric locomotives. A modernAC motor with air blowing can provide upto 1000 hp.

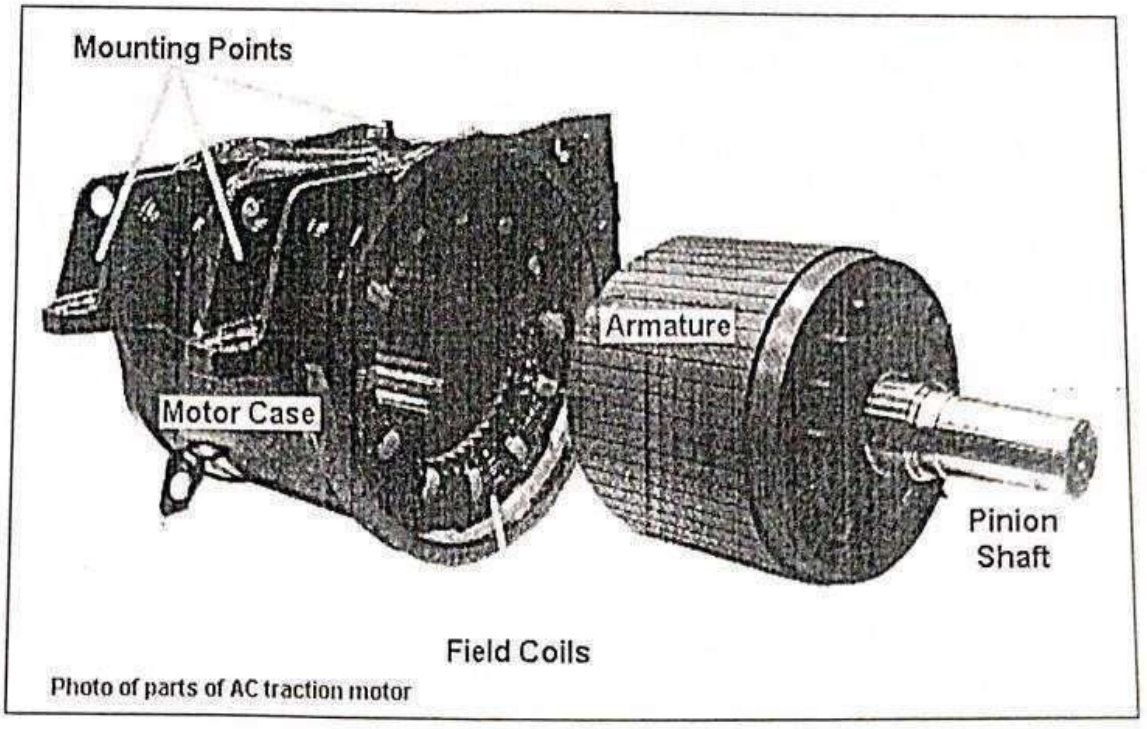


Photo of parts of AC traction motor

- **Fuel Tank**

A diesel locomotive has to carry its own fuel around with it and therehas to be enough for a reasonable length of trip. The fuel tank is normally under the loco frame and will have a capacity of say 1000 imperial gallons or 5000 US gallons in a General Electric AC4400CW 4400 hp locomotive. The new AC6000s have 5500 gallon tanks. In addition to fuel, the locomotive will carry around, typically about 300 US gallons of cooling water and 250 gallons of lubricating oil for the diesel engine.

Saloon Shop in Indian Railway

- The Railway Saloon (also known as RA coach) is special coach assigned to high ranking Indian railway officials for work-duty inspection related duties.
- Railway Saloon has facilities such as kitchen, drawing cum dining, separate bathrooms and a wide inspection windows atthe back of the coach.
- It has 6 berth capacity divided into 3 rooms.
- Apart from that there are 4 berth with attached bathroom inthe service kitchen area.
- Family of the high ranking officials can accompany them onthe official duty work as well.
- Saloon coaches can be attached from all major stations inmost Mail/Express trains subject to technical feasibility.

Bed rooms

Service Gallery to the rooms

Coach from outside

Drawing cum Dining room

Inspection window

AIR BRAKE SYSTEM OF TRAINS

INTRODUCTION:

In the air brake system, a lot of developments have taken place such as bogie mounted Air brake system, Twinpipe air brake system, Automatic load sensing device etc. As a result, the maintenance and requirements have changed considerably.

Classification of Air Brake System:

On the basis of type of release, air brake system is classified as:

- Direct release air brake system
- Graduated release air brake system

Both Direct and Graduated release are further available in two forms:

- Single Pipe and
- Twin Pipe

Currently most used system in carriage is Graduated Release Twin pipe system.

TWIN PIPE GRADUATED RELEASE AIR BRAKE SYSTEM:

Some of the Air Brake goods stock is fitted with Twin pipe graduated release air brake system. In Twin pipe, brake pipesand feed pipes of all wagons are connected. Auxiliary reservoir is charged to 6.0 Kg/cm2 through the feed pipe.

A. **Charging stage:**
   During this stage, brake pipe is charged to 5 kg/cm2 pressure and feed pipe is charged to 6 kg/cm2pressure which in turn charges control reservoir and auxiliary reservoir to 6 kg/cm2 pressure.
B. **Application stage :**
   For application of brakes, the pressure in brake pipe has to be dropped. This is done by venting air from driver'sbrake valve. Reduction in brake pipe pressure positions the distributor valve in such a way that the control reservoir gets disconnected from brake pipe and auxiliary reservoir gets connected to brake cylinder. This results in increase in air pressure in brake cylinder resulting in application of brakes.
C. **Release Stage:**
   For releasing brakes, the brake pipe is again charged to 5 kg/cm2 pressure by compressor through driver's brakevalve. This action positions distributor valve in such a way that auxiliary reservoir gets isolated from brake cylinder and brake cylinder is vented to atmosphere through distributor valve and thus brakes are released.

Indian Railway is very much concern about passenger's safety and in order to ensure the safety to greaterextent new machine is under trial for checking components of Air brake system with the help of microcontroller and digital machines .

AIR BRAKE TESTING BENCH MACHINE

Fig. Testing bench for AIR BRAKING DEVICES.

This Bench machine is just used to check the performance of small components which play role in stopping the train. Here each component is mounted on a bench and then with the help of controller pressure is applied as input and output is recorded and this process is repeated for number of times and then the result is analyzed that whether the device's output lies in the accurate range or not if not, then the device will be sent of repairing.

This machine display the result on the screen and prepare a report for each device as below.

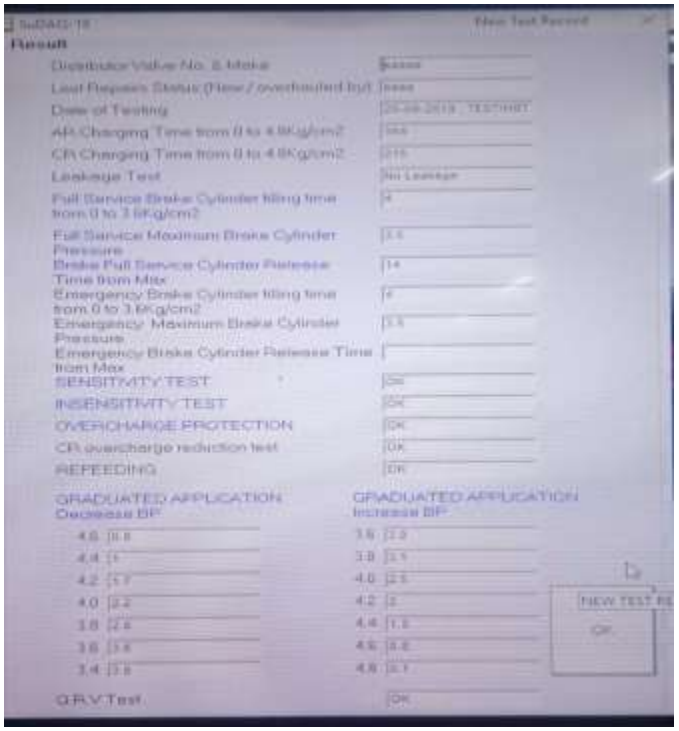


Fig. Sample result of Air brake testing bench machine.

DISTRIBUTED VALVE (DV) TEST BENCH MACHINE:

Automatic DV test bench are suitable for railway distributor valve. This system tests all the parameters of DV like Graduated application, re-feeding test, sensitivity test, insensitivity test, breaking application, Control Reservoir(CR) pressure, Auxillary Reservoir(AR) pressure, Main Reservoir(MR) pressure, Break Cylinder(BC) pressure etc.

A pressure sensor is a device for pressure measurement of gases or liquids. Pressure is an expression of the force required to stop a fluid from expanding, and is usually stated in terms of force per unit area. A pressure sensor usually acts as a transducer; it generates a signal as a function of the pressure imposed. In this test bench machine , signal generated is electrical.

Pressure sensors can also be used to indirectly measure other variables such as fluid/gas flow, speed, water level, and altitude. Pressure sensors can alternatively be called **pressure transducers, pressure transmitters, pressure senders, pressure indicators, piezometers and manometers.**

In this testing bench machine sensors used are :

- MAIN RESERVOIR SENSOR
- AUXILLARY SENSOR
- CONTROL RESERVOIR SENSOR
- BREAK PIPE SENSOR
- BREAK CYLINDER SENSOR

Pressure is measured at input and output with the help of the above mentioned sensor and report is prepared digitally based on the instruction given to the controller .

Fig. Stop cock test running on testing bench machine.

CONCLUSION

Successfully completed 4-week internship under the guidance of capable engineersand workers of **"C&W workshop, Alambagh Lucknow, Uttar Pradesh**", and special thanks to **Mr.Manoj Srivastav sir (AEE), Mr. Ravi Verma sir (SSE),** and **Head of BTC department Mr. Bipin Mishra sir and Mr. Shakir Ali sir.**

The training was specialized under BTC department, working under the departmentI was introduced to the Indian railway its organizational structure, this workshop, basics of Coaches, Bogie and different shops working under this workshop and thenin electrical department I was introduced to the RMPU section, electrical lab of AC shop where each component is tested. I also got know how these machines are operated and how current is supplied in each coach of train.

I also learnt about the different types of components used in coaches & Bogie andhow it is assembled. Along with this I also came to know about the different risks and dangers involved in industry and how caution one need to be working there especially in Railways where a small mistake can risk hundreds of lives.

The training brought to my knowledge is the various components, installation, their maintenance, cleaning, repairing, fabrication and safety devices.

Overall, this training cum internship has been a quite a unique experience with a huge gain in my knowledge both theoretically and practically and provided me withright tools and steps to understand and connect better with the industries.

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