9 NEW DESIGN OF LHB COACHES

Version: **1.1**



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Amendment and Revisions

Version	Date	Corrections	Remarks
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9.1 General

Since the first use of LHB coach in 2000, this coach was widely adopted due to its lightweight construction and high safety and comfort standards. To match up the world standard many new features were introduced into the coach.

The introduced feature of LHB design coach focuses on future vehicle developments of the country, with its numerous technical innovations and intelligent solutions. The flexible and modular design represents a new innovative concept for long as well as short distance passenger traffic on high-speed lines of Indian Railways.

9.2 Coach Description

The vehicle is designed in such a way that it represents a strong and lightweight construction made from low-corrosive and stainless steels meeting all static and dynamic operational requirements. Thus, maintenance expenses are considerably reduced for the entire service life.

To increase the speed up to 200kmph changes have been made in the brake system. Bogie component have been changed as per load requirement. To provide futuristic looks vinyl wrapping with attractive graphics are used. To facilitate convenient inter coach movement sealed gangways have been provided. The new variants of LHB have been provided with modern amenities like automatic plug doors, automatic internal sliding doors, vacuum bio-toilet, electrically controlled opalescence on windows,GPS based PIS/PAS with digital speed indication, hot spot for infotainment, CCTV Cameras, mini pantry and numerous other technologies

Following coaches have been rolled out by Indian Railways. Each type of coach has their unique features which have been provided as per requirement.

Tejas: These coach are being used in Tejas Express, India's first semi-high speed fully air-conditioned train. It features modern onboard facilities such as sealed gangways, vacuum bio-toilet, motorized blinds for windows, internal automatic sliding door, Infotainment system , single leaf plug doors which are operated automatically and much more.

Humsafar: Humsafar Express is a premium service with AC-3 Tier Sleeper Class accommodation having all the modern facilities for long haul routes. It features onboard facilities such as CCTV, PIS, fire & smoke detection system, beverage vending machine, child protection seat & automatic urinals in toilet and much more.

Anubhuti: These type of coaches will be provided in the executive class of premium trains such as *Shatabdi* and *Rajdhani.* Plush upholstery, designer toilets, diffused lighting, better ergonomics, LCD screens, and personalisedpantries are some of its features.

Smart: With the use of *Smart Coach* ,Indian Railways aims to move to predictive maintenance instead of preventive maintenance. *Smart Coach* will provide world-class facilities to passengers with the help of an intelligent sensor-based system. Switch Cabinet Board, GPS based Public Announcement System, CCTV and RMPU monitoring, passenger talkback, digital destination board, energy harvester based sensor are some of its main features.

Uday: These are used in completely Double-Decker AC chair car trains, and will cater to the "busiest routes" and increase carrying capacity by 40%. These coaches

are lighter coach by virtue of monocoque design with a unique diamond shape under frame. Comfortable Shatabdi style seats, LCD screens with Wi-Fi, GPS based passenger information system, modular bio-toilets with soap dispensers, fire & smoke detection system, pantry and dining area in every third coach are some of its notable feature.

Antyodaya: Antyodaya Express is completely unreserved/general coaches. The trains have only general coaches designed by Indian Railways with features such as vestibule for inter-coach movement, improved sidewall and ceiling panels, wider sliding windows, improved Modular FRP toilets, cushioned luggage rack and fire extinguishers with anti-theft alarm.

AC 2T in 3 Tier Shell: Need for more head space for upper berth in AC 2 Tier type coach was always been felt and MCF has taken an initiative to useAC 3 Tier Roof profile with necessary design changes to mount seats and berths as per AC 2 Tier requirement. This development resulted 260 mm more headroom for upper berth passenger in compartment area.

High Capacity Parcel Van: This is the first ever High Capacity Parcel Van on LHB platform.It has total carrying capacity of 24 ton and total volume of 187 m^3 to facilitate transportation of wide goods, foldable 2-tier luggage racks have been provided. These coaches have three collapsible partitions and four numbers of sliding doors.The coach has complete stainless steel interior panelling and fitted with 140 KN air suspensions.

AC 3-Tier Economy: The AC 3-tier economy is touted to be the Railways' most affordable class of air-conditioned travel. The design of the coach includes a redesigned AC duct to provide individual vents for each berth. The coach also has an improved and modular design of seats and berths, foldable snack tables in both longitudinal and transverse bays, injury-free spaces and holders for water bottles, mobile phones and magazines. Additional berths have been provided in the coach as the number of berths in the new coach has been increased from 72 to 83

9.3 Carbody Part

9.3.1 Carbody Shell

Economical light weight steel construction with interlocking technique. Roof of beaded sheet construction with roof arches. Corrugated sheet floor and roof sheeting are made of stainless steel.Roof framework, sidewall and end-wall complete are made of semi stainless steel.

Monocoque Shell Design

The *Uday* coach has unique design not only because of double decker design, but it relies on unique diamond shape under frame to carry the UIC standard 2000kN compressive load also. Besides, the design has been simulated for crashworthiness to take an impact load of over 5 Mega Joule. Shell design comply UIC 566 for static load condition and GMRT 2100 for crashworthiness design. Coach body structure is of stainless steel except for under frame which is fabricated with Corten steel.

Vinyl Wrapping on the Exterior

Vinyl wrapping with aesthetically pleasing design has been provided on the exterior of the coach. Such can be observed in coaches of *Tejas ,Humsafar, Uday, Antyodaya* etc.

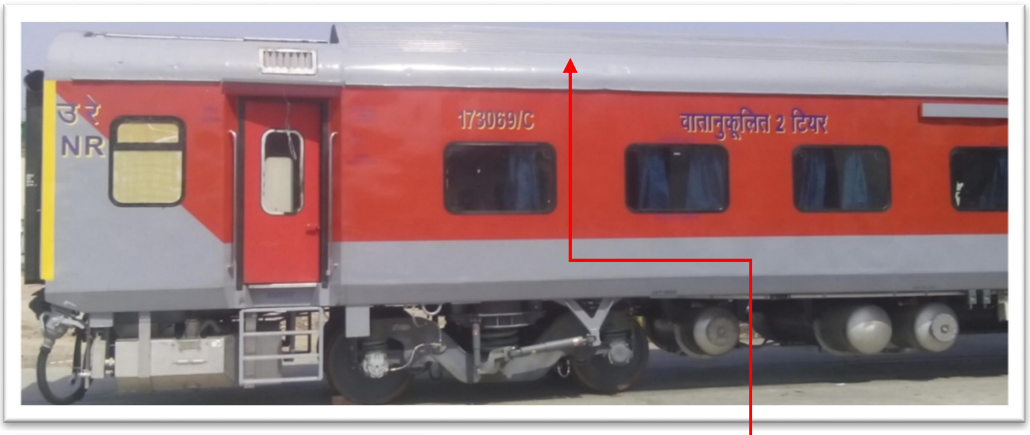


Vinyl wrapping in Tejas Coach

AC-2T Coach using of LHB AC-3T Roof Profile

Need for more head space for upper berth in LHB AC – 2 Tier coach was always been felt. MCF has usedLHB AC – 3 TierRoof profile with necessary design changes to mount seats and berths as per AC – 2 Tier requirement.

- This development resulting in 260mm more headroom for upper berth passenger in compartment area.
- This has also given flexibility to produce both variants on single shell design.





AC-2Tier with AC-3Tier Roof profile

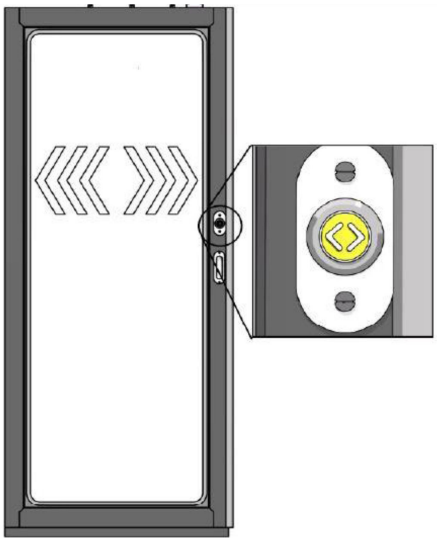
9.3.2 Doors

Automatic Internal Sliding Doors

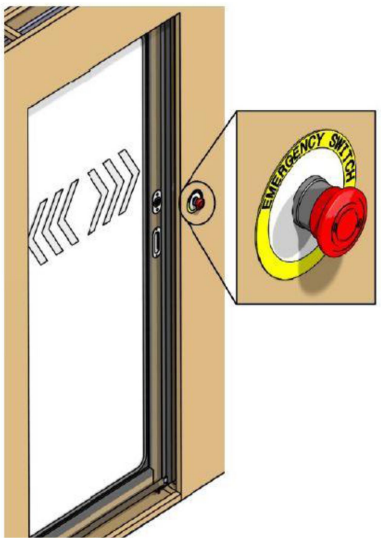
Interior sliding doors serve to separate the boarding area of the vehicle from the seating area with advantages of the solution: reliability and comfort of operation. The interior door can be controlled either by a radar signal when the person approaches or by pressing a button on the door.In case of power failure, the doors are freely movable manually or in case of emergency, the door is disconnected from the power supply when emergency button is pressed and is freely movable manually.



Automatic Internal Sliding Door



Press button for opening the door



Emergency button

Automatic Single Leaf Plug Doors

Automatic single leaf plug doors facilitate alighting boarding of passenger into the trains. The Automatic sliding Single Leaf Plug doors installed in the rake are controlled by centralized door control equipments via hardwired train lines installed in Guard's compartment. Guard panel have push buttons to activate the doorfunctional commands. Emergency door opening switch is also provided on the door. Train moves only after all the entrance doors are closed and entrance doors open only when train comes to a halt. In case the train starts operation, all doors (independently

which one) will automatically close when the speed is greater than 5 km/h. These doors enhance the safety of the passengers.



Automatic Plug Door in Tejas Coach

Automatic Hinged Door

Automatic door locking and opening mechanism in coach access doors is a sophisticated hinged type system in which train will only able to run from Railway station when the coach doors are in closed condition. Similarly these doors remain closed till the train stops at the next station and eliminate chances of passengers detraining from the moving train. These doors can be locally opened by pulling Emergency pulling chain and by pressing Door emergency button when train get stopped in emergency condition. All doors of one side (Left or Right depends upon platform side) of train can be opened by pressing push buttons available in door controller, will decided by guards. When the doors are open, the train should not be able to start. Controls of these doors will be available at guards/ Train crew.



Automatic Hinged Type Doors

Pocket Sliding Doors

High Capacity Parcel Van has four pocket sliding main door for easy & rapid loading unloading.

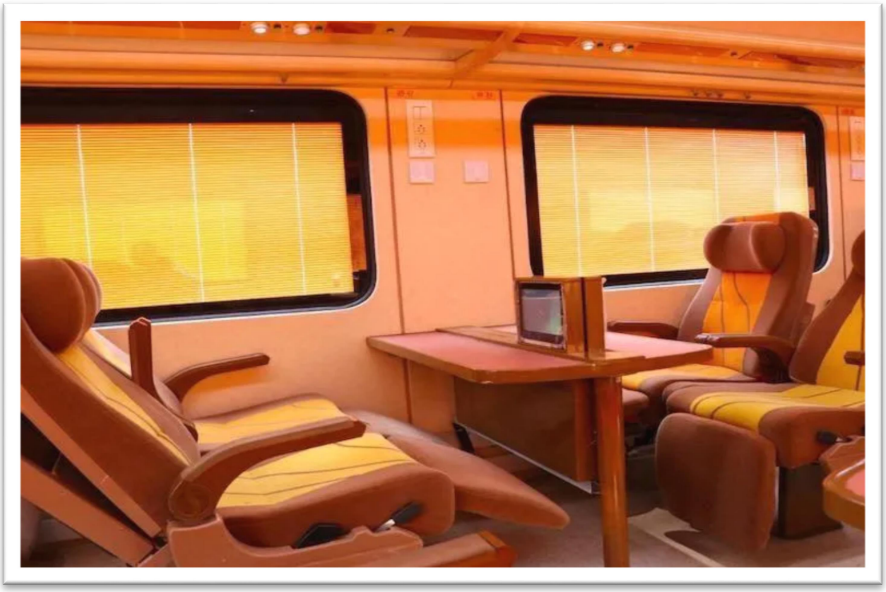


High Capacity Parcel Van with Sliding Main Doors

9.3.3 Windows

Motorized Blinds

The windows of the new coaches have motorized blinds. Initially provided in *Tejas* Coach passengers are provided with a button next to the window, which can be used to roll the blinds up and down.



Motorized Blinds in Tejas Coach

Electrically Controlled Roof Opalescence Glass Unit

This is a important feature provided in *Vistadome* Coach. The Opalescence feature plays a vital role in controlling the incoming sun light by electrically controlling its transparent feature to opaque. Totally 10 (5 Left Hand and 5 Right Hand) opalescence glass units are provided in the roof and they are controlled by a single control box unit fitted inside the Service station.



Electrically Controlled Roof Opalescence Glass Unit in Vistadome Coach

Observation Lounge

A dedicated Observation lounge is provided in *Vistadome* Coach with panoramic viewing windows and a Utility table.



Observation Lounge of Vistadome Coach

Wider Sliding Windows

Wider sliding type glass windows with aluminum frame(which is glued to the sidewall like in AC LHB coaches) have been provided. These windows has wide viewing angle for passengers and better aesthetics. Such windows have been used in *Antyodaya* Coaches.



Wider Sliding Windows in Antyodaya Coach

9.3.4 Improved Sidewall and Ceiling Panels

In Antyodaya Coach the complete interior furnishing has been upgraded by providing FRP sidewall panels in quad coloration color scheme and FRP ceiling panels with two tone colorfinish in place of blue color LP sheet and white color NFTC respectively.







Ceiling Sheets



Sidewall Panels

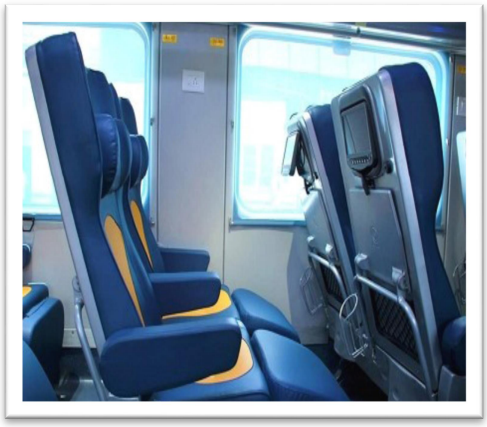
9.4 Interior Equipment

9.4.1 Seats

Improved chair with *E-leather* (eco leather) as upholstery material has been provided in *Tejas* coaches. In executive class chair cars, leg support has also been provided which are controlled by gas spring.

E-Leather is a unique, sustainable upholstery material. It is known for its longevity without the need for frequent and invasive deep-cleaning.





E Leather seats in Tejas Coach

180 Deg. Rotatable Reclining Passenger Seats

Vistadome coach is the 180 degree Rotatable Double seater offers a panoramic view of the surroundings to the passengers. Like in other elite coaches, these seats also have reclining operation, charging socket under each seat, Snack tables can be unfolded from arm rest, Bottle and Magazine holder in the back rest of each front seat. Additionally each pair of seats are mounted to the floor by a single shaft mechanism that allows the seat to be rotated on any direction as per the passengers wish. A Push button beneath the Arm rest will allows the back rest to be reclined. A 3

step adjustable foot rest for each seat is given below the front seat of each seat.



180 degree Rotatable Seats in Vistadome Coach

Cushioned Luggage Rack

Cushioned luggage racks have been provided in Antyodaya coaches for use as seats during rush time.



Cushioned Luggage Racks in Antyodaya Coach

Modular Seats/Berths and Amenities

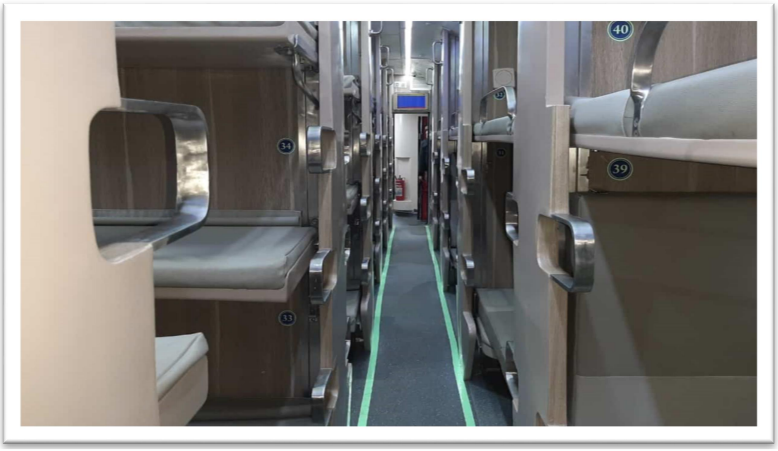
The design for *AC 3 Tier Economy Coach* includes a redesigned AC duct to provide individual vents for each berth. The coach also has an improved and modular design of seats and berths, foldable snack tables in both longitudinal and transverse bays, injury-free spaces and holders for water bottles, mobile phones and magazines.Individual reading lights and mobile charging points are provided for each berth in addition to standard sockets.



Side Berth of AC 3T Economy Coach



Modular Berth of AC 3T Economy Coach

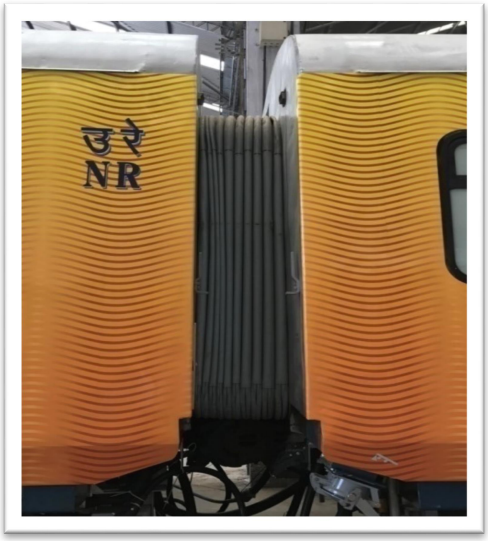


View of Aisle in AC 3T Economy Coach

9.4.2 Gangway

In *Tejas* Coach the gangways are fixed between two coaches as a single unit instead of conventional gangway vestibule where two separate units are fixed on adjacent coaches. Due to this, it has better sound levels, reduced dirt, sand and water ingress and better passenger safety and comfort.





Sealed Gangway in Tejas Coach

9.4.3 Collapsible Partitions& Foldable Luggage Racks

In High Capacity Parcel Van three collapsible partitions with four compartments is provided for modular use. These coaches have foldable 2 tire luggage racks. These facilitate transportation of wide goods.





Inside View of High-Capacity Parcel Van

9.5 Pantry

Pantry compartment for storing, preparingand serving of precooked food,snacks andbeverages with equipment like refrigerator,hot case,beverage vending machine, waterpurifier and microwave oven. Such minipantry is available in *Vistadome* Coach. For other coach where mini pantry is not available, equipment such as chiller, hot case andbeverage vending machines have been provided.



Mini-Pantry in Vistadome Coach

9.6 Toilet

Improved toilet system with touch-less fittings for water tap and soap dispensershave been provided for clean experience. Also the interior aesthetics have beenimproved substantially by marble paint finish with anti graffiti coating, gel coated wash basin

shelf, new design dustbin, door latch activated light and lavatoryengagement display.



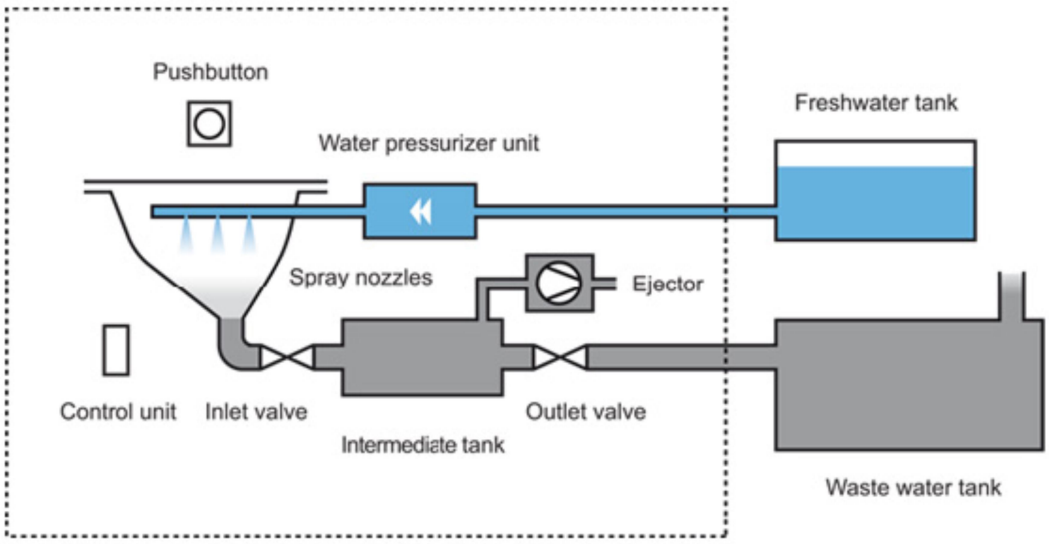
Modular Toilet Fittings



Toilet Engagement Indictor

9.6.1 Vacuum Assisted Flushing with Bio-Toilets

Due to vacuum assisted flushing, water consumption per flush is less and effectiveness of flushing is higher resulting in cleaner and more hygienic toilets.



Working of Vacuum Assisted Toilet

9.6.2 Child Protection Seat

Toilets are provided with Child Protection seats for holding toddlers travelling with single parent for the convenience of using toilets. Such seats are available in *Humsafar* Coach



Child Protection Seat in Humsafar Express

9.6.3 Odour Control Dispensers in the Aisle and Toilet

Odour control dispensers have been provided in the aisle and toilet.



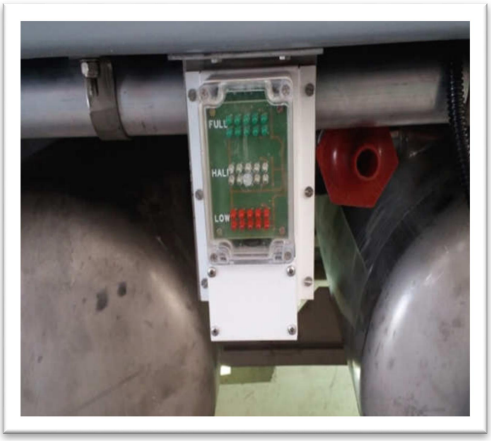
Odour Control System

9.7 Water Level Indicator

Water level indicator is used to indicate the level of water in the tank at convenient place from where the level of water in tank can be seen in trains during journey. It helps railway staff in taking decision to fill up the tank at coach watering station.



Primary Display/Controller Unit



Sec. Display Unit Installation Position

9.8 Brake

To increase the maximum speed up to 200kmph, existing Axle mounted discbrake system has been upgraded with:

- Steel brake disc (in lieu of grey cast iron brake discs)
- Sintered brake pads (in place of composite brake pads)
- Additional EP assist brake system



Organic Pad



Sintered Pad

9.9 Fire and Smoke Detection and Supression

9.9.1 Passenger Coach

The complete rake has been provided with fire and smoke detection system. The system has smoke sampling points provided at various locations in the compartment area (8 nos), doorway area (2 nos.) and electrical panel area (1 no.) Heat activated sensors are provided in all the 3 lavatories. On sensing of smoke/heat, depending upon the level of smoke, the system activates audio visual alarm and passenger announcement activation. After certain level/time automatic application of brake is initiated. A central monitoring system (CMS) is provided in each coach and a central monitoring unit (CMU) is mounted inside crew room of power car. The CMU displays the status of each coach of the rake.





Fire Detection System Installed in Coaches

9.9.2 Fire Suppression System in Power Cars

All the power cars in the rake have been provided with smoke detection and fire suppression system. The system consists of one number high pressure Nitrogen cylinder and 2 nos. water cylinders which are connected with 10 nos. of nozzles provided inside the generator room to disperse water mist. Heat and smoke detectors

are installed above the generators. The detector control panel is provided inside the crew room. In case of smoke/fire, the alarm/buzzer is sounded and on detecting the fire, crew members are needed to operate a manually operated trigger valve for initiating suppression. Operating of trigger valve releases the high pressure nitrogen with water and water mist is discharged in engine compartment.





Water and Nitrogen Cylinders in Power Car

9.9.3 Fire Extinguishers with Anti-Theft Alarm

Fire extinguishers with anti-theft alarm have been provided in *Antyodaya* coaches. A buzzer sounds whenever fire extinguisher is taken out from housing which also alerts passengers.



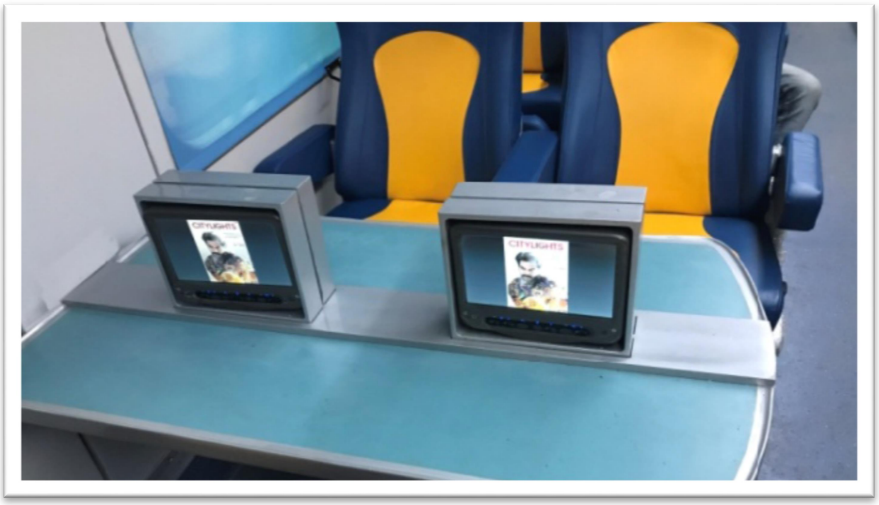
Fire Extinguisher with Anti-Theft Alarm

9.10 Electrical Equipment

9.10.1 Passenger Information System Integrated With the Infotainment System

The coaches are provided with infotainment system in the form of LCDscreens mounted on the back of chairs. The infotainment system has featuresfor displaying of recorded content like entertainment media, advertising, safety instructions etcand can

also be upgraded for live TV viewing. This infotainmentsystem has also been provided with integrated GPS based passengerinformation system. For this, LCD screen has one separate channel fordisplaying the data from GPS based passenger information system. Moreover,USB charging facility has also been provided with each screen.





PIS Integrated Infotainment System

Passenger Information System

Such technology is included in several coaches which include *Humsafar*, *Uday* etc.PIS system comprising of Master Board Unit, GPS receiver and LCD screendisplay panel above the passenger compartment doors has been provided ineach coach to display the Welcome/farewell messages and information regardingcurrent time, current station, next stations, remaining distance and late runningstatus in Hindi, English and Regional Language. The safety slogans are alsodisplayed intermittently**.**



PIS in Humsafar Coach

9.10.2 Public Address System

PA system comprising PA Amplifier and speakers in each coach has been provided which are connected to the main amplifier with the help of PA Couplers for interconnection of the coaches in the rake along with a speech unit which is used for Public address as per the requirement.



Public Address System

9.10.3 Emergency Talk Back System

This facility is provided in *Smart Coach*. Incaseofamedical or securityemergency,apassengerwillbeabletogenerateacallregisterforthetrainsupervisor. Thisfeaturewill Improveresponsetimeofstaffandalsoreducechainpullingsignificantly.



Talk Back Unit in Smart Coach

9.10.4 CCTV

The coaches like *Humsafar* have CCTV installedat both the ends.06 nos. of high

resolution cameras (2 in passengerarea, 2 nos. in each doorway area) have beenprovided. Cameras has night vision capability andfacial recognition in low light condition. A networkvideo recorder (NVR) has been provided in eachcoach with 2 TB hard disc capacity. The systemhas 30 days loop recording provision and works 24hours per day. Additional 32GB SD card has alsobeen provided to work as stand by to hard disk. Incase of failure of camera/hard disc, indication isshown on NVR. Real time tagging of videos withspeed, location and time through GPS antenna canalso be done.



CCTV Camera Unit in LHB Coach

Analytics

CCTV Analytics module (facial recognition system) is capable of capturing, andidentifying a person from a digital image or a video frame. Such a system is provided in *Smart Coach*.



Analytics used for Facial Recognition in Smart Coach

Blacklisted person face images can be saved. In case the blacklisted person appears and gets detected in front of camera. Check will be generated in alert window.

9.10.5 Energy Harvester Based Diagnostic

The Energy harvester based sensor monitors the condition of wheel, bearing and hard spots on the Track. The same is fed to the data concentrator and transmitted via GPS/GPRS to a remote server. The data can be used for diagnosis.Wheel defects, bearing defects are both reported up to 6months prior to their becoming critical, giving sufficient time to schedule maintenance time. This technology has been used *in Smart Coach.*



Vibration Energy Harvester in Smart Coach

9.10.6 Digital Destination Board

In Smart Coach, LED Digital Destination Board has been installed. This has been done by reducing the Display board size by splitting the displayed data in to two rows:

Row1: Train number and Coach Type

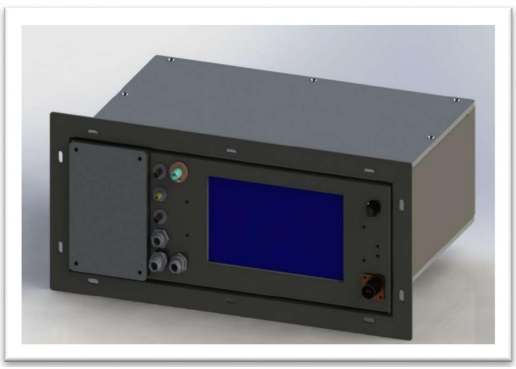
Row2: Scrolling text display of destination and intermediate station in multiple languages. Optimizing character height to 80mm for rationally arrived at 25m visibility.



Digital Destination Board in Smart Coach

9.10.7 Passenger Information and Coach Computing Unit (PICCU)

Smart Coach has a Passenger Information and Coach Computing Unit (PICCU) a CPU that is a similar to an industrial grade computer. This has been provided with GSM network which sends execution reports to the remote server. PICCU will monitor important areas of coach maintenance and passenger interface.





Passenger Information and Coach Computing Unit (PICCU)

It is a powerful expandable computing device based on Open Source Technologies that integrates all Control Systems related to Passenger Comfort or coach performance to a single web interface. Using industry standard Apps that may come from the PICCU OEM (pre-installed applications) or may be developed by third parties using the API documents provided by the OEM, PICCU performs an expandable platform. Its key feature is:

- Fan-less and Fully Sealed
- Best in-Class processor
- Capacitive 7" touch Screen
- Anti vandal Touch Panel
- Inbuilt GPS
- Inbuilt GSM/GPRS modem
- Wi-fi enabled
- Expandable
- Highly Rugged design

Note:- Please refer link for other detail of Cleaning, Maintenance Schedules, Tools and Spares, Maintenance, Drawing Index, General Information & Troubleshooting etc.
https://rdso.indianrailways.gov.in/uploads/LHB_Tech_Development_Volume_2_Complete(2).pdf of Hand Book on Maintenance Instructions for New Technological Developments in LHB Coaches published by CAMTECH in July 2021.