Passenger Coach Design - Train Lighting, Airconditioning, Energy Efficiency

by

L C Sarser,

Sr. Professor,(Electrical Engg.)

TRAIN LIGHTING

TRAIN LIGHTING GENERAL

Initially lighting in trains was done using candles, oils and later on by gas lighting. To prevent fire accidents electric lighting was introduced by imposing stationary batteries. Train lighting by electricity on Indian Railways was introduced in 1897.

1. Axle generation system.

a. The 24v DC double battery parallel block (Remove Control)

b. The 24v DC modified train lighting.

c. The 110v DC simplified train lighting.

2. Mid on Generation.

3. End on Generation.

4. Supply from OHE.

a. 25k v AC single phase. (Hole line load).

b. 1.5 k v DC exclusively for DC EMU (Bombay Suburban Section)

c. 750 v DC in metro railway

The double battery, parallel block, 24v DC train lighting system was in vogue on the Indian Railways till 1968. The salient feature of the double battery system of train lighter is as follows:

WORKING OF 24 V DC (AXLE GENERATION SYSTEM)

The DC dynamos are being progressively replaced by Brushless alternators in view of their superior characteristics for both high and low speed trains apart from less maintenance.

Single or double sets of Lead acid batteries (each set consists of 12 cells) having standard capacity of 210 Ah. 320Ah. 400Ah. 525Ah are provided in each coach depending on the connected load of the coach.

Illumination;

Class of coach	Min level of illumination
I class	30 Lux
II class compartment	16 Lux
Postal compartment	40 Lux
Dinning compartment	30 Lux
Lavatories & corridor	16 Lux in I and II compartment.

The advantage of 110 v DC TL system will be obvious from the following comparison between 110V and 24V system.

24V DC TL system	110 V DC TL System
1. Higher weight -kw output	1. less weight -kw output
2. line working as possible	2. 110V can be fatal working is not possible (theft may the less)
3. It will not be possible to cater for Additional load.	3. additional load is possible
4. Current is higher hence cables, connectors etc. will be of higher size.	4. Current wall be smaller hence cables, connectors will be of smaller size.
5. Illumination level is more.	5. Better illumination level.
6. Comparative maintenance is more.	6. comparatively maintenance is less.
7. The capacity of TL batteries is 320Ah. Normal charging current is more.	7. The capacity of TL Batteries is one 120 Ah . Normal charging current is less.

Various Systems of TL

- Self generating– 24V/110V
- End-on-Generation (power cars) 415 V & 750 V (High capacity power car)
- Mid-on-Generation - 415/110V AC (30 KVA DG SET 2nos.)
- Head on generation- MA SET 110 AC, 15KW
- 25KV/141V

Train Lighting Equipments

- Alternator
- Rectifier cum regulator unit
- Battery
  - Lead Acid Battery
  - Valve Regulated Lead Acid Cell (VRLA)

Capacity of Batteries

Type of Coach	Capacity in Ah
110 V BG coaches	120
24 V MG coaches	210
24 V BG coaches	320
IInd AC BG coaches (Old)	800
IInd AC BG coaches (New)	1100
IIIrd AC BG coaches	1100

Self generating system of Train Lighting

- carriage fan (bedding of carbon brushes)
- emergency feed terminal
- Generation to non generation ratio
- Time taken to repair/replace various systems
  - Belt replacement 2 hours
  - Alternator replacement 3 hours
  - Battery charging 5 hours

RATINGS OF ALTERNATORS

- TRAINLIGHTING: 4.5 KW, 110 VOLTS, 4 V Belts on 1 pulley
- AIR-CONDITIONING: 18KW,22.5 KW or 25 KW,110 Volts, 6+6 V Belts on 2 pulleys

Construction :

- Lead Acid Cell container made of hard rubber, plates consists of conducting grid on which active material are incorporated. These grids serve to conduct the current to and from active material of positive and negative plates. For grids lead and antimony are used. In tubular construction of positive plate Pbo2 is held in tubes with a plastic bottom seal. The negative plate material is spongy lead pasted on lead structure. The chemical reaction, which takes place, is as under.

- $PbO_2 + Pb + 2H_2SO_4 \leftrightarrow 2PbSO_4 + 2H_2O$
- Separators are Porous to allow electrolyte pass and to separate plates from short circuit and are generally made up of wooden, rubber, glass and wool.
- Electrolyte is of Sulphuric acid mixed with distilled water to get required specific gravity. The positive plates are welded to a post to form a positive terminal and negative plates are welded to a post to form negative terminal.
- Float, which is provided on the top of the cell, indicates the electrolyte level.
- Vent plug to pass the gases if formed inside the cell and thus to protect the cell from damage. Filling cap is provided on the top of the cell for topping up as and when required.

Valve Regulated Lead Acid Cell (VRLA)

In a conventional flooded, towards the end of charge major part of the energy supplied by charging is dissipated by electrolyzing the water in the electrolyte generating oxygen at the positive plate and Hydrogen at negative plate. These gases are lost in a flooded system through the vent holes causing steady depletion of water and therefore requiring periodic topping up.

- In a VRLA system, the design is such that negative plates are never fully charged even when the positive plate is fully charged and hence almost no hydrogen gas generates from the negative plate although Oxygen is generated from positive plate. This oxygen gas generated at the positive plate migrates towards the negative plate and reacts with_the freshly formed spongy lead and turn into lead monoxide. The lead monoxide in turn reacts with the sulphuric acid to turn into lead sulphate resulting in the negative plate to be partially discharged. To summarize the Oxygen evolved at the positive plate is absorbed by the negative plate without being released outside. The negative plates being always in a state of partial

Parts Of VRLA Battery

Safety Valve

When the internal pressure increases abnormally the safety valve opens to release gas from the cell

- Container Lid

Made of Polypropylene Co- polymer impurities

- Separator

Made of high absorbent glass mat (AGM type)

- Positive plate

With Lead calcium- tin alloy grid

- Negative plate

With Lead-calcium-tin alloy grid

- Electrolyte

Dilute sulphuric acid with out any impurities

Comparison of VRLA cells with Flooded cells

Rating	Flooded type (Weight in Kilogram)	VRLA (weight in Kilogram)	Reduction in %
110 V- 800 AH	5250	3275	37%
110 V- 120	1050	680	35%
110V -1100 AH	-	4320	-

AIR CONDITIONING

Air-conditioning in its primitive stage

- Year 1900-1920
  - By providing Khus-Khus in mating
  - By providing ice container
- Introduction of first air-condition coach - in year 1936 at Matunga Workshop, Mumbai
- Introduction of first AC coach – manufactured by ICF, Chennai in 1965

Unit of Refrigeration

- Unit of Refrigeration – in ton
- It refers to the latent heat required to melt a ton of ice at 32 degree F in 24 hours
- 1 ton = 2000 lbs
- Latent heat of Water to freeze - 144 BTU/Lb

$$1\ TR = \frac{2000 \times 144}{24} = 12000\ BTU/Hr$$

$$= 3000\ k\ Cal/Hr$$

Type of Air- Conditioned Coaches

- Air-conditioned Coaches may be broadly classified as-
  - Self generating types
    - Power for AC equipments is met with axle driven alternators at 110V DC supply
  - End-on-generation types
    - Power from diesel generating sets (DG sets) at both ends at 750 V AC 3 phase 50 hz. Supply
    - AC equipments operate at 415 V 3 phase 50 hz. AC supply

Refrigerant

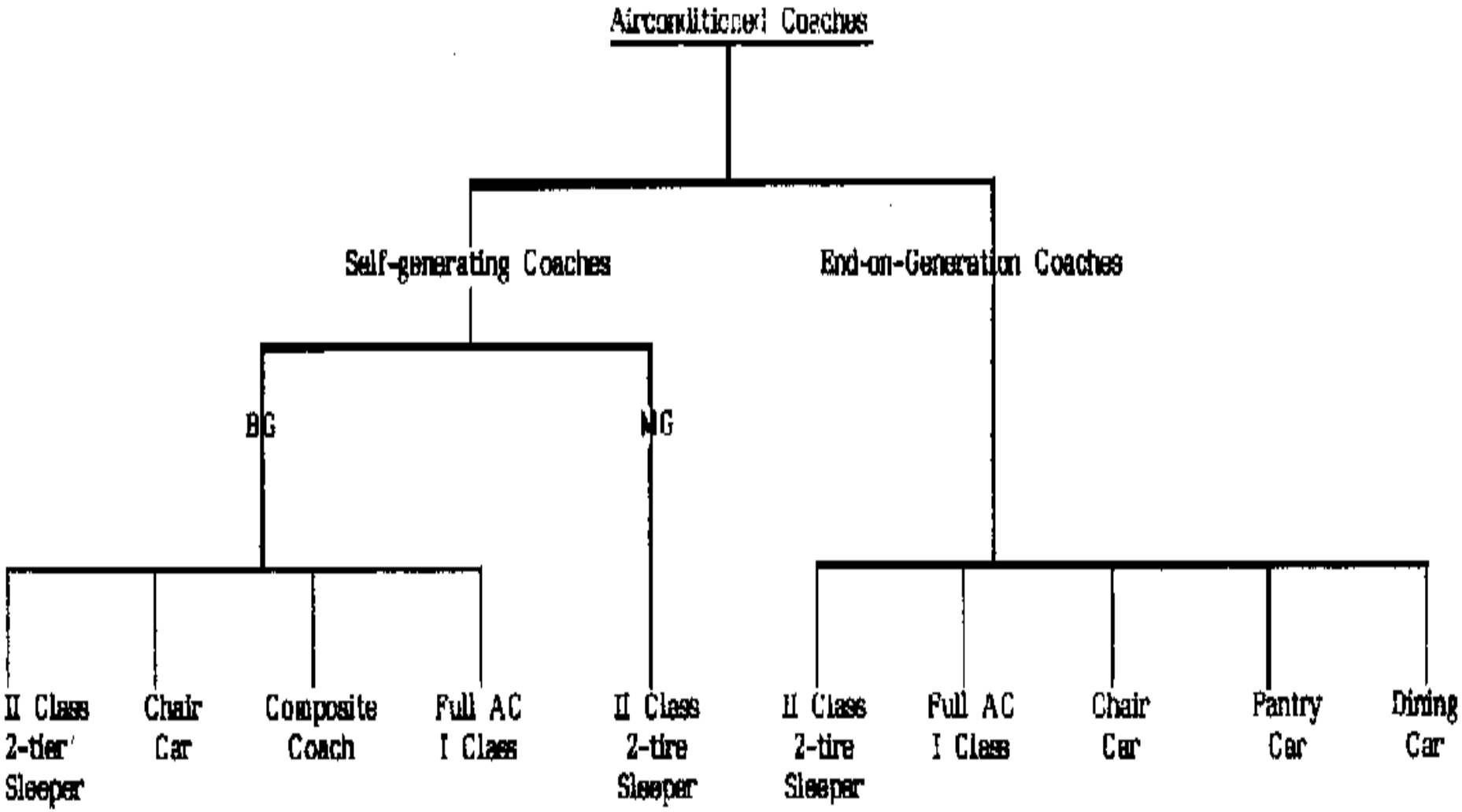
- Freon 12 or Freon 22
- These are chemical Compounds. Freon is the Trade name. In India the Trade name is Mafron. Manufactured by Navin Flurine Industries
- Freon 12– CCl_2F_2 Dichloro-difluoro methane
- Freon 22 - monochloro difluro methane $CHClF_2$

Passenger Conventional Coaches (BG)

Year	AC 1st Class	AC Sleeper	AC-3 Tier Sleeper	AC Chair Car	Composite Coaches	Total
2006	191	1, 519	2,104	493	612	4919
MG		57		4		61
Grand Total						4980

- Total Conventional Coaches- 3,8196 (excluding EMUs-5316 Nos. & DMUs-578 Nos.)

AIR CONDITIONED COACHES



Supply System in End-on-generation Coaches

- Power supply for air-conditioning, lights and fans is obtained by tapping from one of the two feeders of 750 V, 3 phase, 50 HZ emanating from the Power Car

  - Each coach is provided with 50KVA transformer which steps down voltage to 415 V 3 phase

  - All AC equipments I.e. compressor, condenser, evaporator, heater etc. works on 415V 3 phase

  - for supplying lights and fans, each coach Is provided with a step down transformer of capacity 3 KVA to Specification. This transformer steps down the voltage from 415 V. 3 phase to 190 V 3 phase.

  - 110 V a.c. supply is provided for lamps and fans by connecting them between line and neutral on the secondary side of under frame transformer

Contd….

Supply System in End-on-generation Coaches contd…

- 415 V 3 phase supply Is directly used for the compressor motors, the condenser fan motors and heaters installed in the evaporator.
- The evaporator blower motor is fed at 110 V a.c. 3 phase taken from a control transformer of 2.5 KVA capacity which steps down the voltage from 415 V 3 phase to 110 V 3 phase.
- A 24 V emergency battery of 90 Ah capacity has been provided on the under frame along with a battery charger. The battery supplies the emergency lights provided in the Coach *in* the event of a. c. power failure.

Battery Charging at the Terminal Stations

During pre-cooling, AC Coaches are provided with

- one 200A capacity battery charger
- The battery charger takes 415 V 3 phase supply through special battery charging sockets mounted diagonally one on each end wall.
- The battery charger consists of a transformer and a simple diode bridge rectifier.
- The secondary of the transformer is provided with tap changing arrangements, which enable control of d.c. output voltage from 104 V to 140 V dc.

Air-conditioning comforts factors

- Factors deciding comforts / discomforts level
  - temperature
  - humidity
  - draft (velocity of air)
  - purity of air
  - noise
- Humidity – ratio of the moisture contained in a given quantity to the quantity of moisture required to saturate that quantity. It is termed as Relative Humidity (RH)
- The difference between a dry and wet bulb temperature is the measurement of the humidity in the air
- Air-conditioning deals with the human comforts while refrigeration deals with preservation of perishable items.

Temperatures setting in AC coach

Controlled by mercury-in-glass thermostats with different settings :

		Low	Medium	High
First class AC coaches	Cooling	22^0C (72^0F)	24^0C (75^0F)	25.5^0C (78^0F)
	Heating	17^0C (62^0F)	19^0C (65^0F)	21.5^0C (68^0F)
Second class AC sleeper and other coaches	Cooling		24^0C (75^0F)	25.5^0C (78^0F)
	heating		19^0C (65^0F)	21.5^0C (60^0F)

Operation of cooling or heating takes place in accordance with ambient conditions.

Air-conditioning system working

- System used is vapour compressor system using Freon as refrigerant
- Equipments used in air-conditioning system
  - Compressor – compresses & delivers gas into condensers at a high pressure & high temperature
  - Condenser – it cools the hot gas and liquidities under pressure
  - Expansion Valve – It controls and regulates the rate of flow of liquid freon under high pressure
  - Evaporator – This constitutes the cooling unit in which liquid freon under low pressure evaporates & in-doing so takes away the latent heat thereby cooling the medium surrounding the cooling coil

Air-conditioning system in conventional type Coaches

- In conventional type – AC equipments provided on under-frame except evaporator coil and expansion valve
- Operates on 110 V DC supply through 18/25 KW alternators
- Thermostat senses the inside temperature of the coach
- Battery charger is provided under-frame for charging the batteries
- Pre-cooling sockets are provided on either side of the coach for pre-cooling purpose

Drawbacks of Conventional AC system

- Open type compressor causes problems such as –
  - Refrigerant leakage from pipes and joints
  - Heavy weight
  - Large space of occupation by the equipments
  - More maintenance problems
  - Consuming more power
  - Less energy efficient

Salient Features of Roof-mounted Air-cooled Modular A.C. Package. Units for Rail Coaches:

- Light in weight, saves fuel for hauling. Total weight of both Units is 900 kg (as compared to 2700 kg for Conventional A.C.) saves more than Rs.20,000/- per year per coach in diesel fuel consumption. Thus it saves precious foreign exchange.

- Keeping in view the low price and fight weight, the unit pays for itself in one-year operation. In the Rajdhani Express e.g. the total weight reduction of 20 coaches (i.e. 8 x 20 = 36 MT) equals the weight of one coach. Therefore, one additional coach can be hauled which brings revenue of Rs.1.75 crore per year. The cost of 21 A.C. Units for *the* entire rake is less than this amount.

- Low cost of installation at the coach building factory since the system is factory made, assembled, gas charged and tested for performance prior to delivery.

- The installation requires simply to lower the unit in the false ceiling above the toilets on both ends of the coach and connection of wiring drain nine and flexible duct
- In case of failure replacement of the unit with now unit can be, done in less than two hours by simply lifting the defective units by a crane and lowering the new one in place.

- The A.C. unit remains outside the partition wall and therefore no chance of water leakage on passengers.
- Fresh air is taken from the roof through condenser area which gives a relatively clean air free of the smells of toilets which are common in conventional A.C. coaches.
- Hermetically scaled system with no fitting of openings, thus it presents little potential of gas leakages and break downs.
- The unit is almost maintenance free since it uses 3 phase AC motors which have no commutators or brushes to wear out.
- Uses more environment friendly Refrigerant R-22 and very small quantity less than 3 kg.
- Mounted on the roof, thus dirt or dust collection in condensers is negligible and therefore, requires practically no maintenance *or* water spraying on condenser coils.
- No chance of damage due to flash floods during the monsoons.
- No chance of damage due to cattle ran.
- Energy efficient - uses less electricity, saves fuel for generation.
- Humidity control in monsoons possible through use of Microprocessor based Control System. It will also provide optimum use of all equipments and even wear to compressors through rotation of operation.

Roof-Mounted Packaged Unit (RMPU)

- To overcome drawbacks of under-frame open type AC systems – RMPU of 5.2 TR each was introduced in the year 1992 with 25 KW alternator
- Now a days two high capacity packaged air-conditioning unit of 7.0 TR for AC II tier & AC III tier coach
- For Ist AC 1 unit of 7 TR is used
- Mounted above the toilets on both ends supplying conditioned air in the tapered duct to serve the coach end to end
- These units are
  - Energy efficient
  - Light weight & reliable

Comparison of RMPU with Conventional under-frame AC system

	RMPU	Conventional AC
Weight	900 Kgs (2 units)	2700 kgs
Installation time	4 hrs	4 days
Refrigerant	R – 22	R – 12
Refrigerant charge	2.85 Kgs	15 Kgs
Danger due to cattle run over / flood	Nil	Heavy
Down time for repairs	4 hrs.	Very long time

Linke Hoffman Busch (LHB) coaches

- Latest state of the art coaches provided in Rajdhani / Shatabdi Exp. With modern passenger amenities
- Technology transfer from M/s Alstom – LHB of Germany
- Being manufactured at Rail Coach Factory, Kapurthala from year 2003 onwards

INTRODUCTION TO LHB COACHES

GENERAL FEATURES OF LHB COACHES

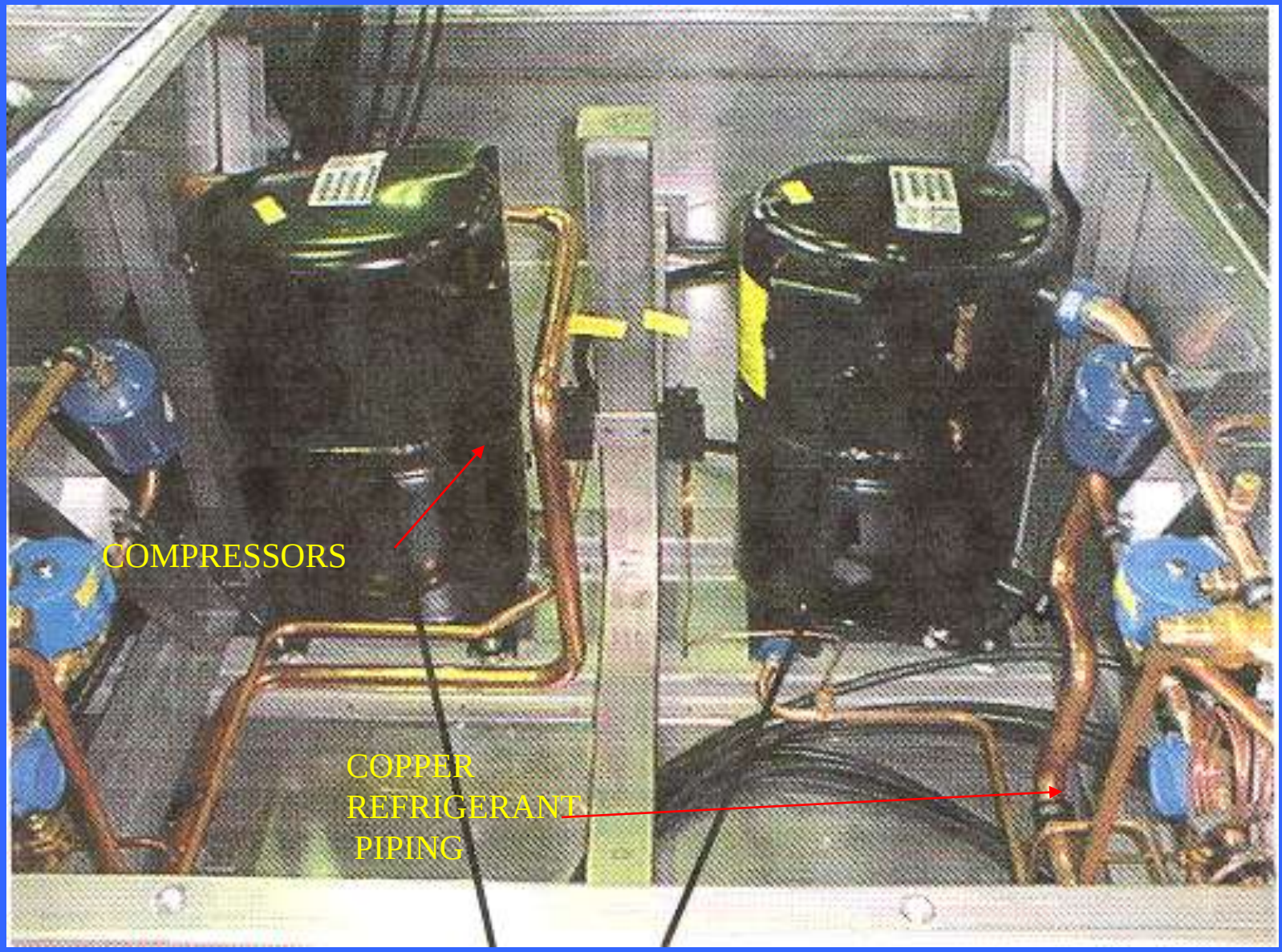
GENERAL FEATURES OF LHB COACH

- PROVISION OF IGBT BASED BATTERY CHARGER
- MICRO-CONTROLLER BASED AC PACKAGE WITH LOW NOISE LEVEL AND PUMP CONTROL
- INTEGRATED , MODULAR SINGLE SWITCH BOARD WITH CONTROLS OF AC , LIGHTING & PANTRY ETC.
- LIGHT WEIGHT EPOXY MOULDED TRANSFORMER
- MODULAR AND ELEGANT INTERIOR LIGHT FITTINGS AND READING LIGHTS
- INTEGRATED MODULAR PANTRY UNIT
- PROVISION OF RADOX TYPE FRLS CABLES
- ONLINE INSULATION MONITORING
- UNIFORMITY OF ILLUMINATION AS PER UIC

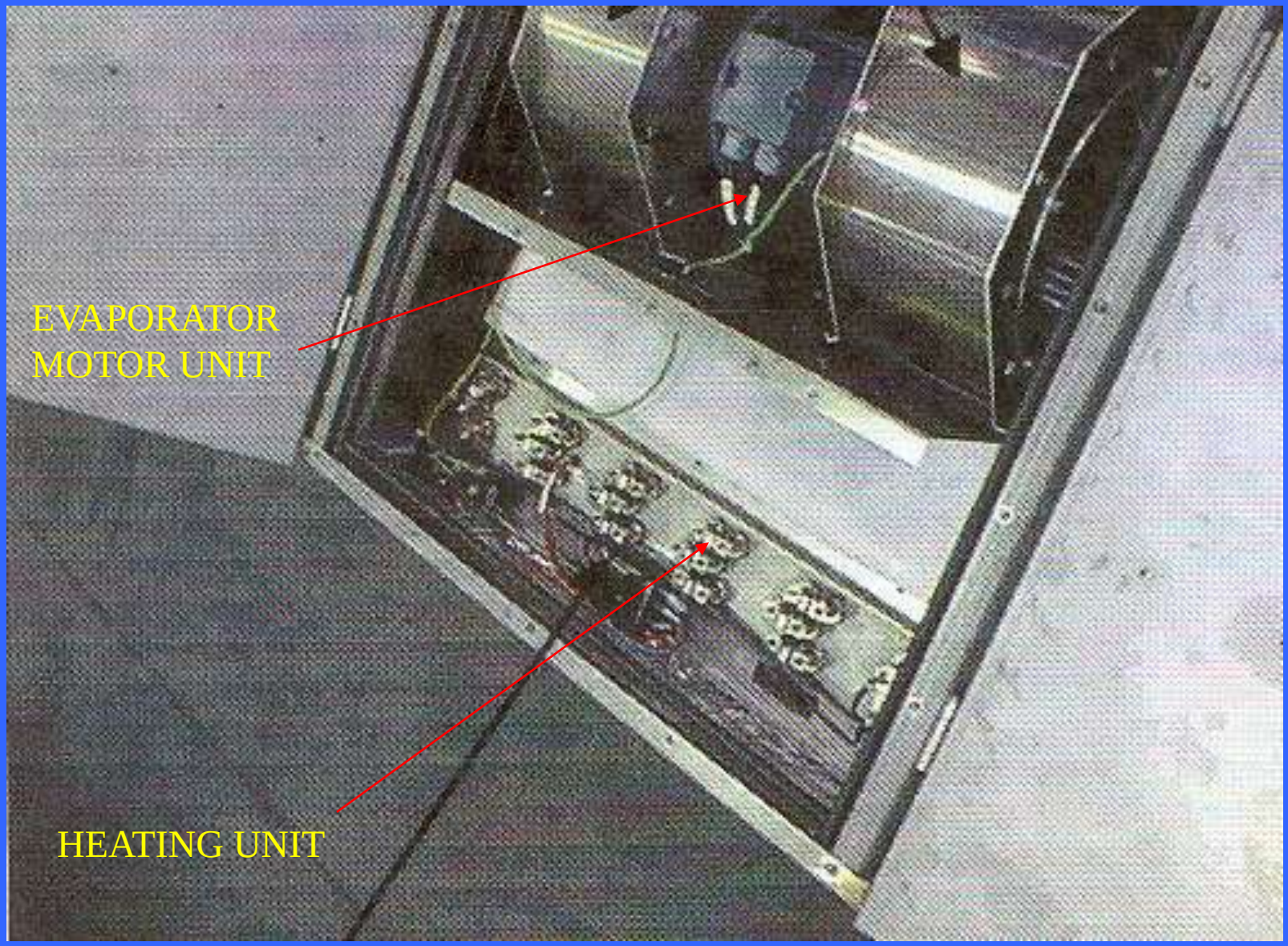
DEVELOPMENTAL ITEMS

- MICRO-PROCESSOR BASED AC PACKAGE
- INTEGRATED SWITCH BOARD CABINET
- INTERVEHICULAR COUPLER (IVC)
- PANTRY EQUIPMENTS
- IGBT BASED BATTERY CHARGER
- EPOXY COATED TRANSFORMER
- VARIOUS LIGHT FITTINGS
- MICR-PROCESSOR BASED PUMP UNIT
- WHEEL SET EARTHING DEVICE
- SMF BATTERIES
- FEEDER JUNCTION BOX
- DC-DC CONVERTERS

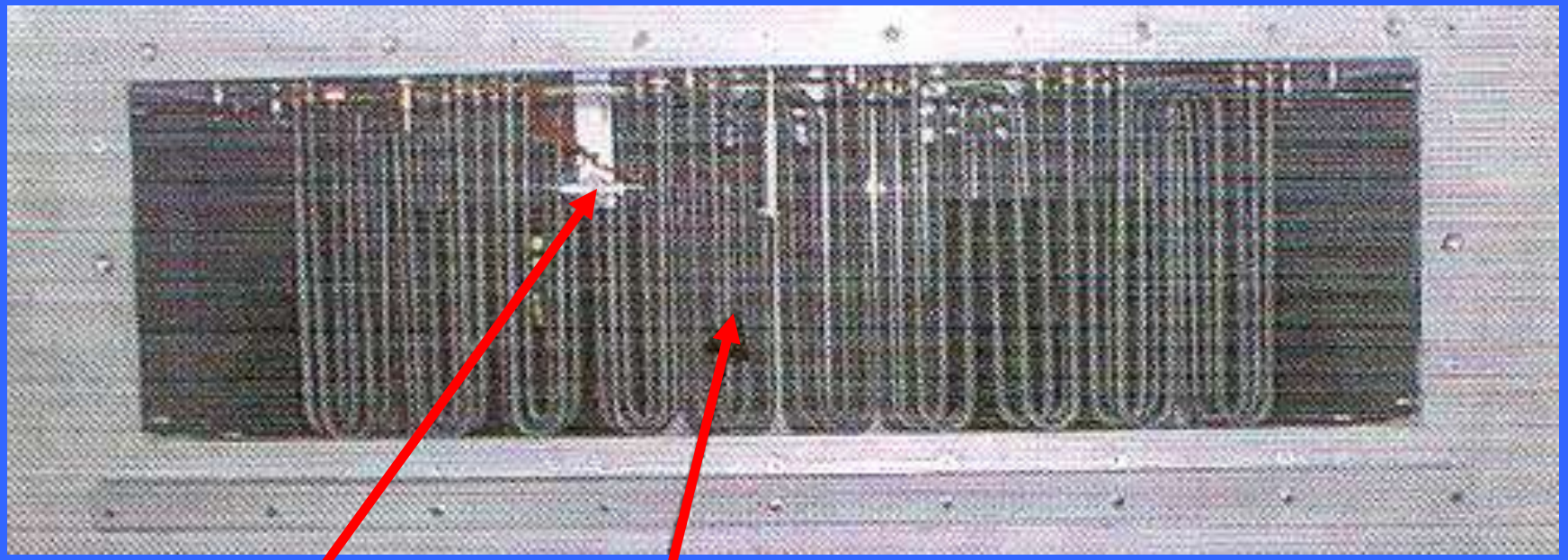
LOOK ONTO THE COMPRESSORS



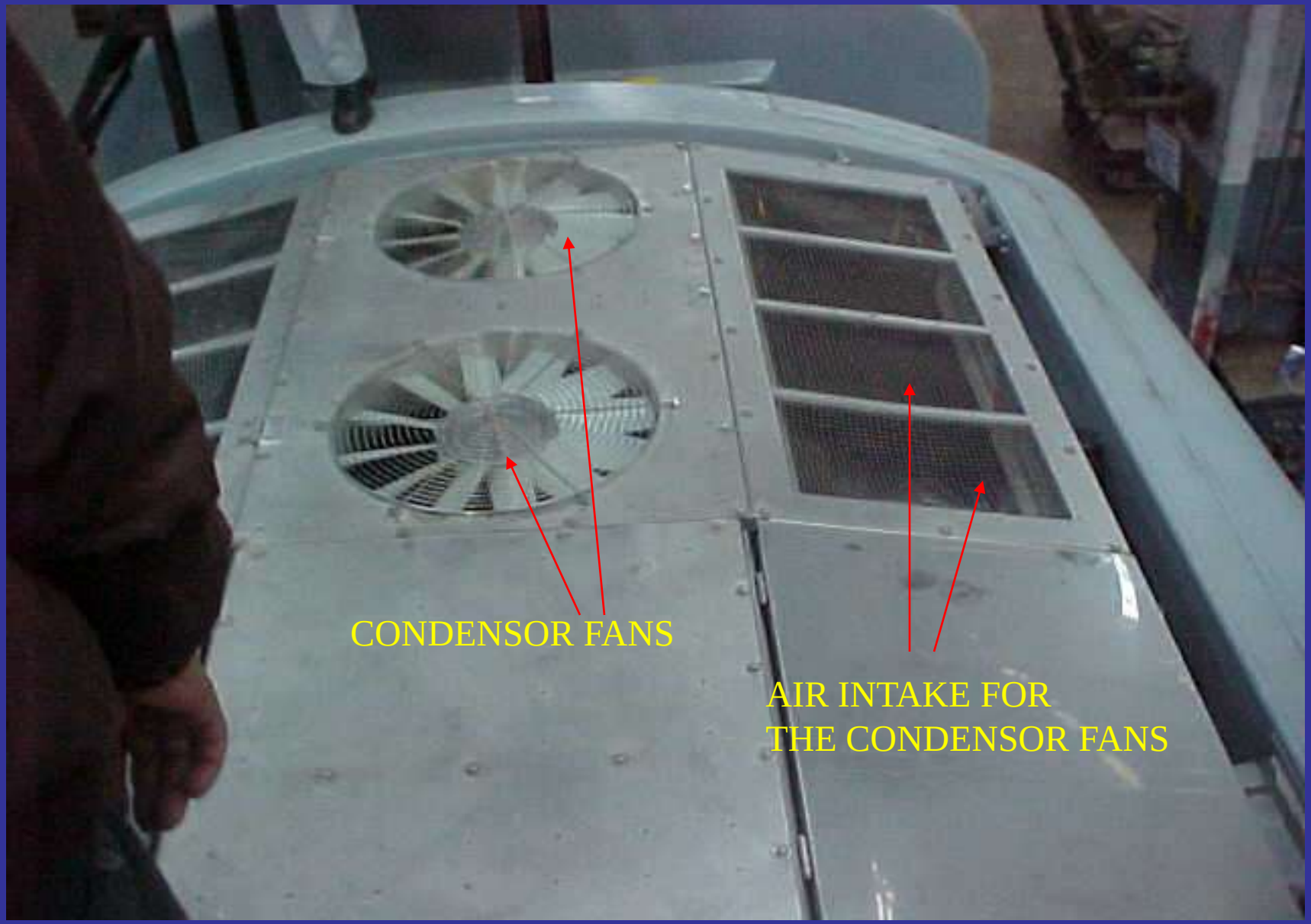
HEATING UNIT



HEATING UNIT ELEMENTS



ROOF MOUNTED AC PACKAGE UNIT



VIEW WITH SIDE COVER OPEN

CONDENSER AIR INTAKE GRILL

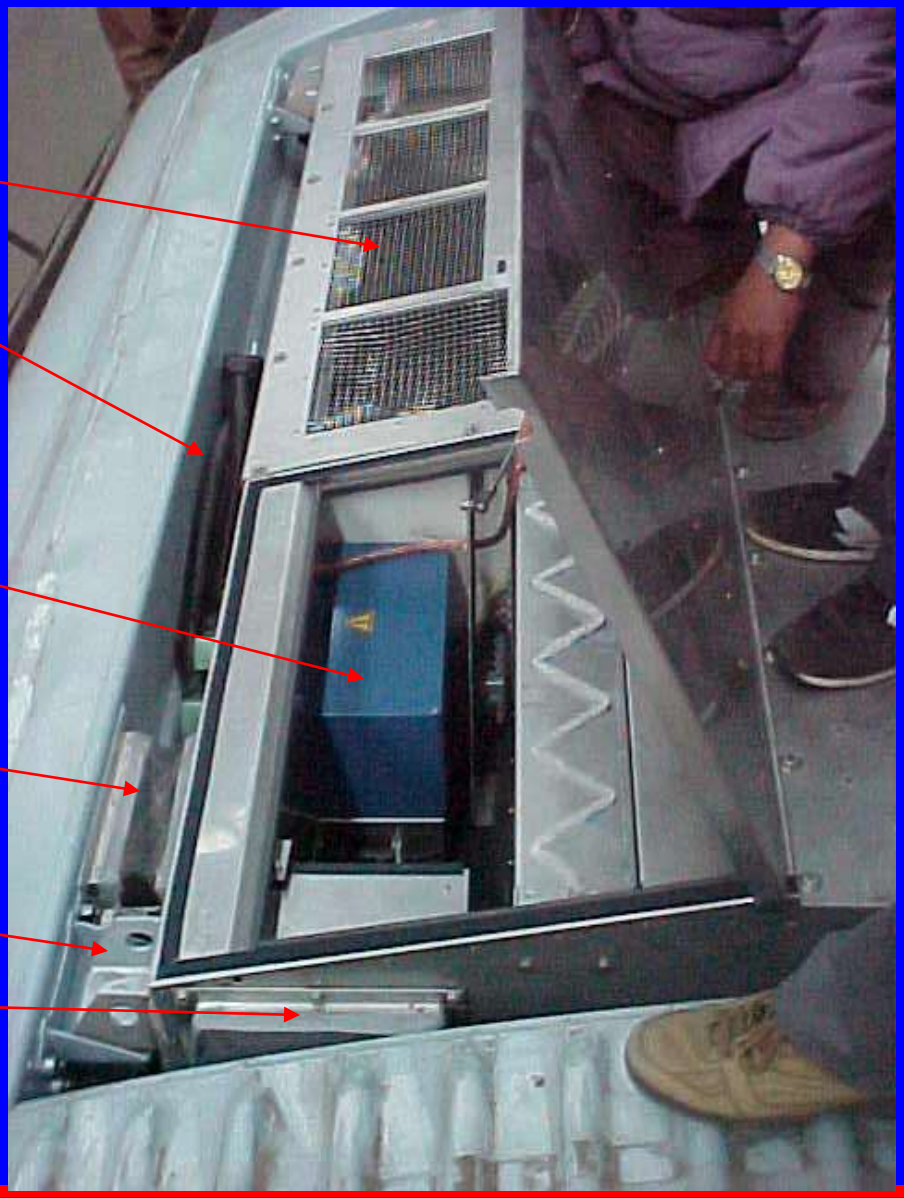
FLEXIBLE CONDUITS FOR ELECT. CONNECTIONS TO THE UNIT

ELECTRICAL JUNCTION BOX (ONE ON EACH SIDE)

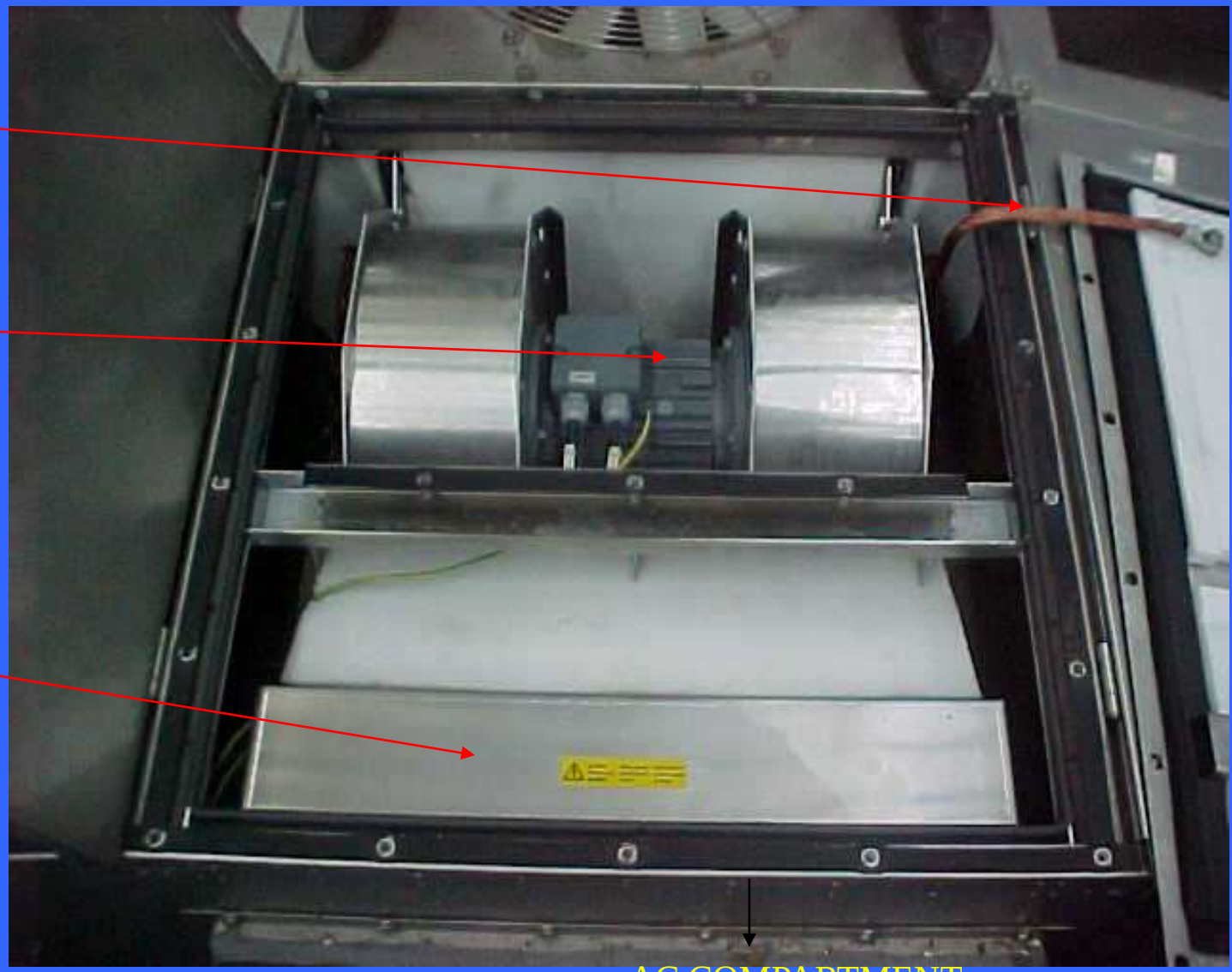
FRESH AIR DUCT (CANVAS)

MOUNTING BRACKET

RETURN AIR DUCT



EVAPORATOR MOTOR



AC PACKAGE MICROPROCESSOR CONTROLLER

CONTROLLER

CABLES
(FOR
CONTROL
OF THE
AC PKG.)

ROOF MOUNTED AC PACKAGE UNIT

CAPACITY

COOLING - 22.5KW (6.4 TON)

HEATING - 6.1KW

- POWER INPUT - 17KVA
- OPERATING VOLTAGE - 3 PHASE,415V,50HZ
- WEIGHT - 630KG
- DIMENSIONS - 2330X2000X500
- COMPRESSOR - BRISTOL MAKE TYPE H23A 563 DBE

SALIENT FEATURES

- NTC TYPE TEMP. SENSORS
- SERVO MOTOR CONTROLLED FRESH AIR DAMPERS
- MICRO-PROCESSOR CONTROL (WITH RS232 PORT)
- HARTING CONNNECTORS
- HUMIDITY CONTROL
- CAPACITY CONTROL THROUGH BYPASS SOLENOID VALVE
- MOTORS ARE PROTECTED WITH THERMAL SWITCHES
- ANALOGUE LP/HP DATA DISPLAY

COMPACT AIR CONDITIONING UNIT

COMPRESSOR

•TYPE	BRISTOL H23A563 DBEA R22
•VOLTAGE	415 VOLTS -3 - 5- Hz
•MAXIMUM POWER	6.5 KVA
•MOTOR PROTECTION DEVICE	EMBEDDED THERMISTORS

CONDENSOR FAN UNIT

• POWER	0.75 KW
•REVOLUTIONS	1380 r.p.m.
•AIR VOLUME	13804 CMPH

EVAPORATOR UNIT

• POWER	0.8 KW
•REVOLUTIONS	1440 r.p.m.
•AIR VOLUME	2800 Cubic M. AT 200 Pa.

SWITCHBOARD CABINET

SALIENT FEATURES

- CAPABLE OF SWITCHNING , CONTROLLING , ADJUSTING AND MONITORING OF AIR CONDITIONING , PANTRY , LIGHTING , PUMP , SANITARY & ANTI-SKID PROTECTION .
- DIMENSIONS 1850 (H) x 1280 (W) x 1040 (D)
- EASY FRONT ACCESS FOR MAINTENANCE WITH SEPARATE HOUSING FOR BATTERY CHARGER , DISCONNECTING AND EARTHING DEVICES
- SEGREGATION FOR DIFFERENT VOLTAGE LEVELS
- EXTERNALLY VENTILATED

SWITCHBOARD WITH OPEN DOORS

MCB'S

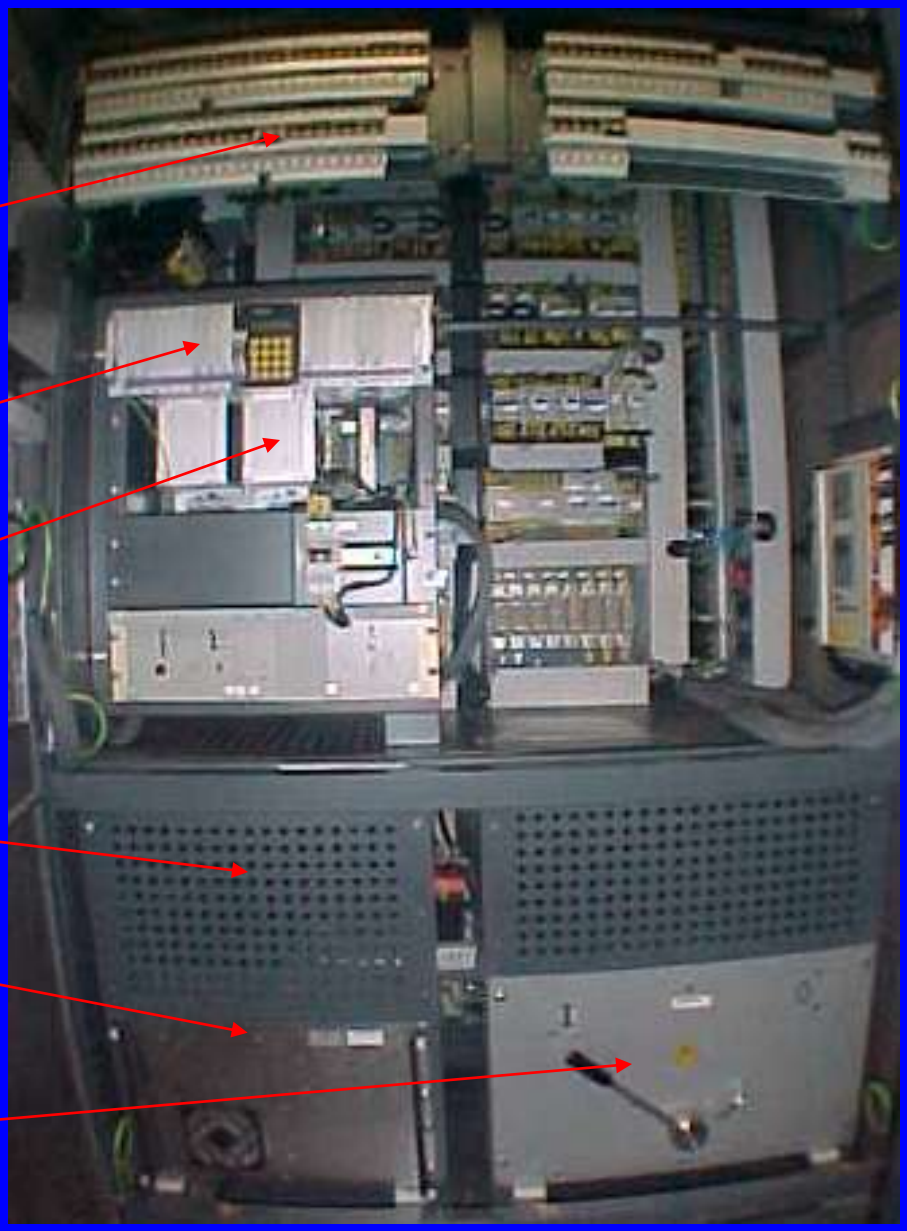
ANTI-SKID DEVICE

DC DC CONVERTERS

SPACE FOR THE
MAIN CONTACTORS

BATTERY CAHRGER

DISCONNECTING AND
EARTHING DEVICE



SWITCHBOARD WITH OPEN DOORS

MCB'S

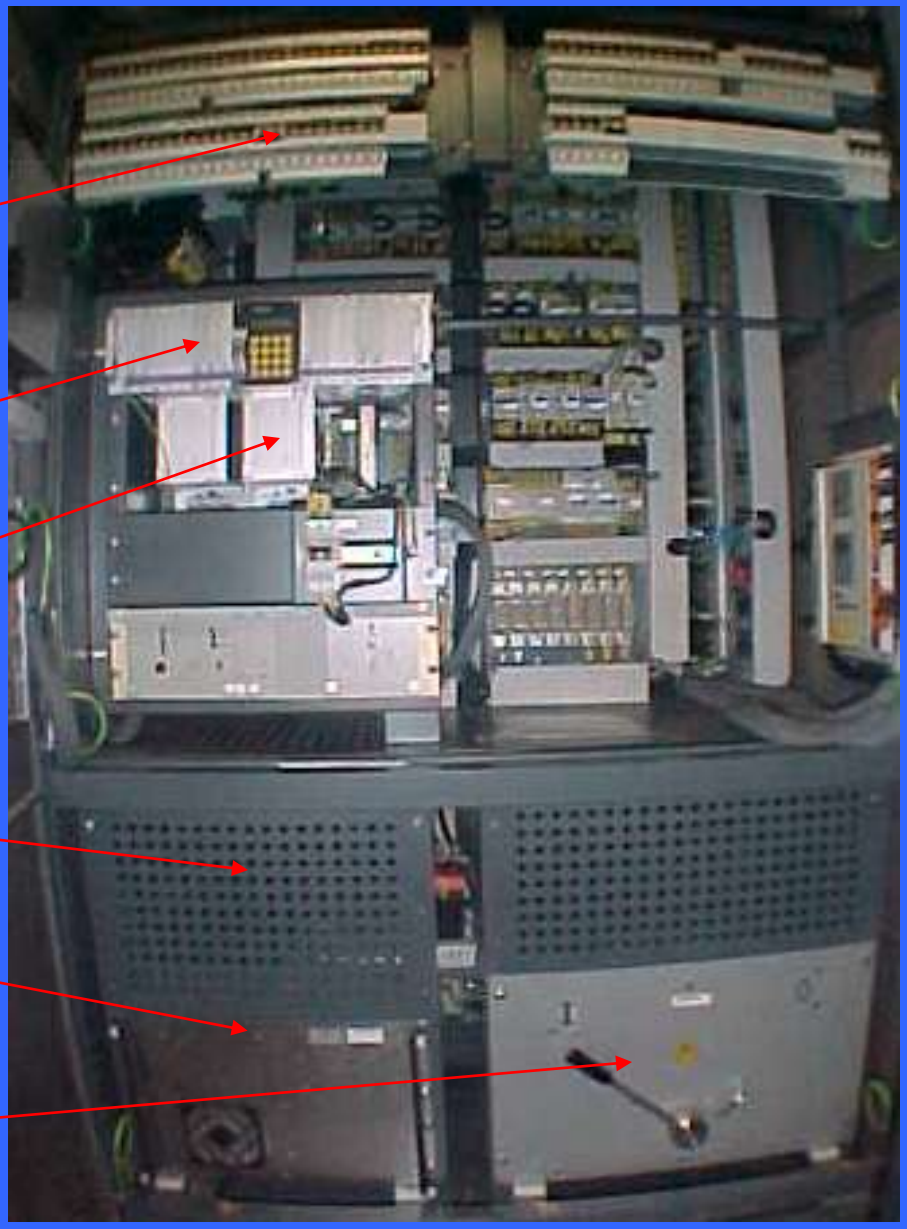
ANTI-SKID DEVICE

DC DC CONVERTERS

SPACE FOR THE
MAIN CONTACTORS

BATTERY CAHRGER

DISCONNECTING AND
EARTHING DEVICE



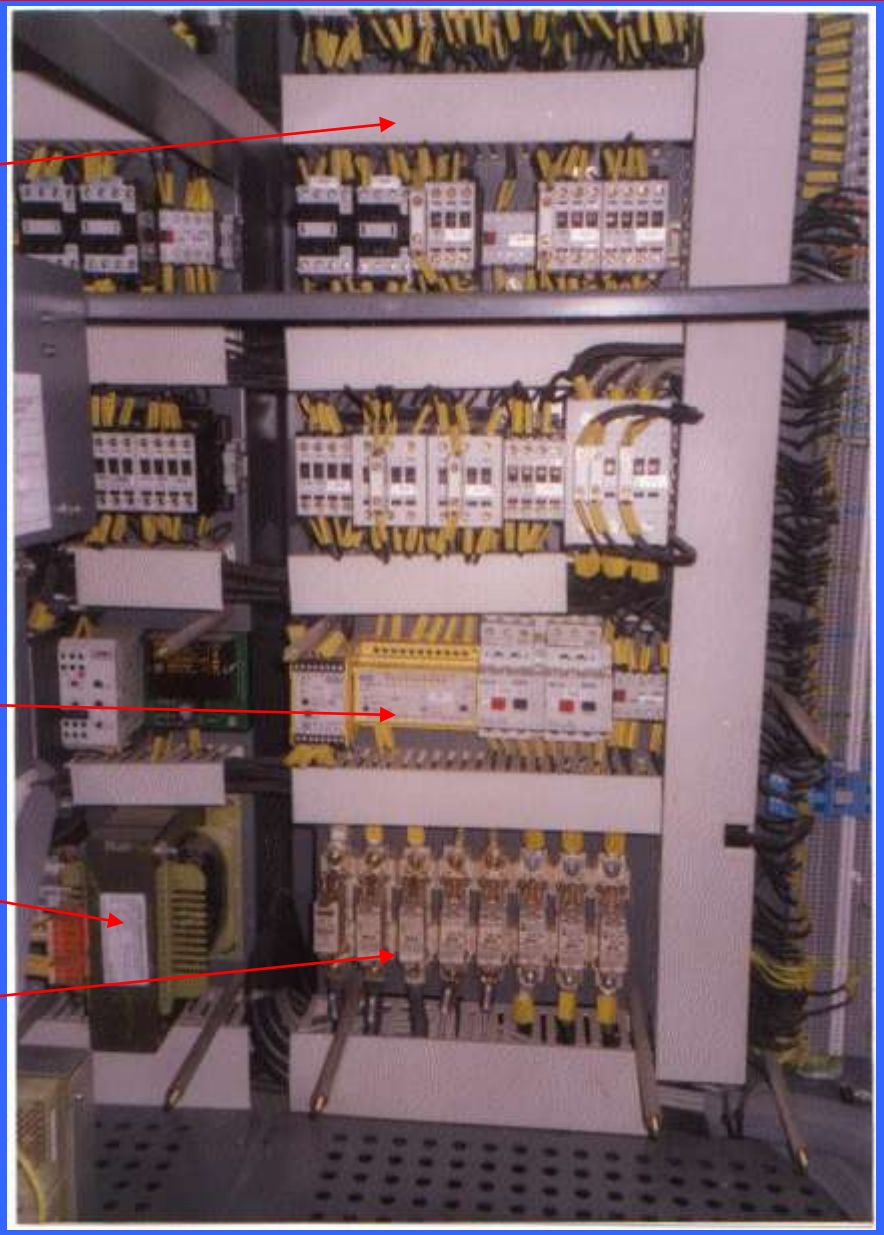
SWITCHBOARD VIEW WITH TOP RIGHT DOOR OPEN

CABLE ALLEYS

INSULATION
MONITORING DEVICE

1 KVA TRANSFORMER

LV FUSES (TRANSFORMER)



INSIDE VIEW OF THE CONTROL PANEL

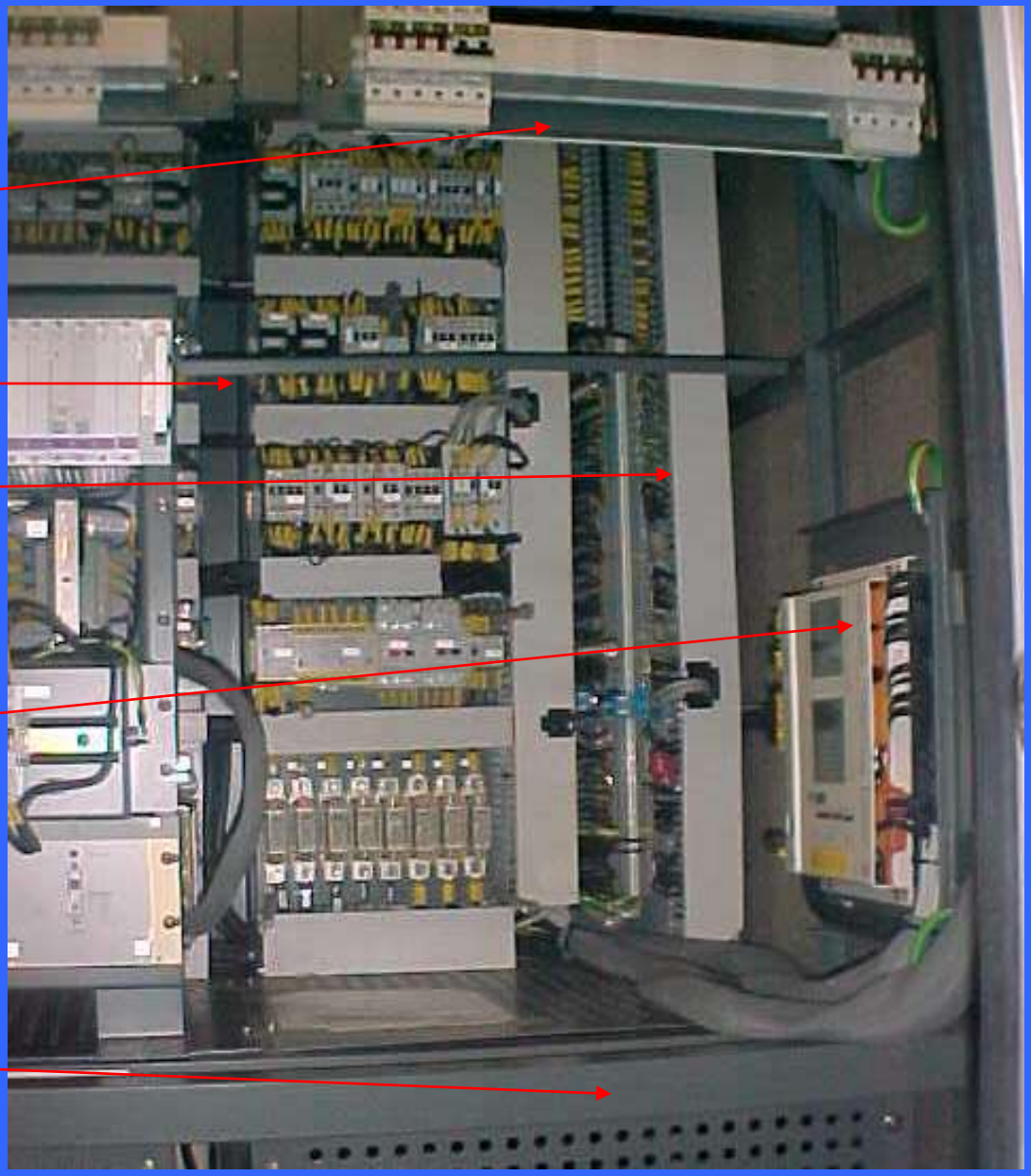
MCB'S FOR THE LIGHTING AND THE PUMP / SANITARY EQUIPMENT

ANTI SKID DEVICE

WAGO CONNECTOR S FOR CABLE TERMINATIONS

MICROPROCESSOR CONTROLLER FOR THE AC PACKAGE UNIT (ROTATING FRAME)

SPACE FOR THE DISCONNECTING AND EARTHING DEVICE



DISCONECTING AND EARTHING DEVICE

IN ONE SWITCHING OPERATION 2- INDEPENDENT 4- CABLE BUS BAR (4x750 VOLTS AC) ARE ISOLATED AND EARTHED

- DIM 600X500X670mm
- CURRENT RATING 125 A

HAND LEVER

PAD LOCK

WHEEL SET EARTHING EQUIPMENT

WHEEL SET EARTHING EQUIPMENT

- PREVENTS RETURN CURRENT FLOW THROUGH THE AXLE BEARING AND CREATES A CONNECTION BY MEANS OF CONTACT BRUSH TO THE ROTATING WHEEL
- EARTHING BRUSH

ALLOWABLE CURRENT	- 400 A
MAX. CURRENT	- 600 A
NO. OF BRUSHES	- 2

- EARTHING RESISTOR

EARTHING RESISTOR	- 0.1 Ohms
WEIGHT	-1.3 Kgs

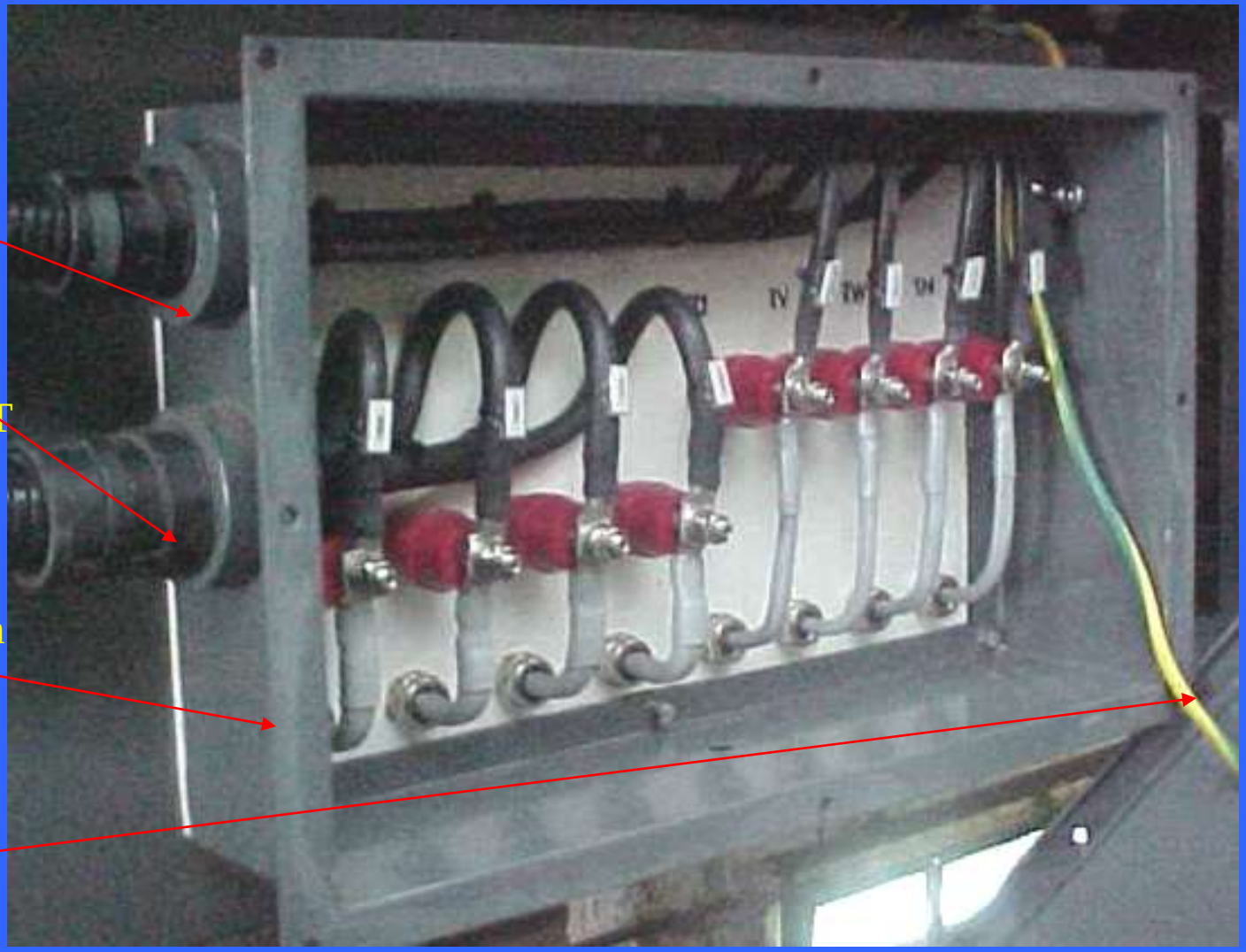
TRANSFORMER TERMINAL BOARD

CABLE INLET

CABLE OUTLET

CABLE BOX HOUSING 1.5 mm SS 304 GRADE

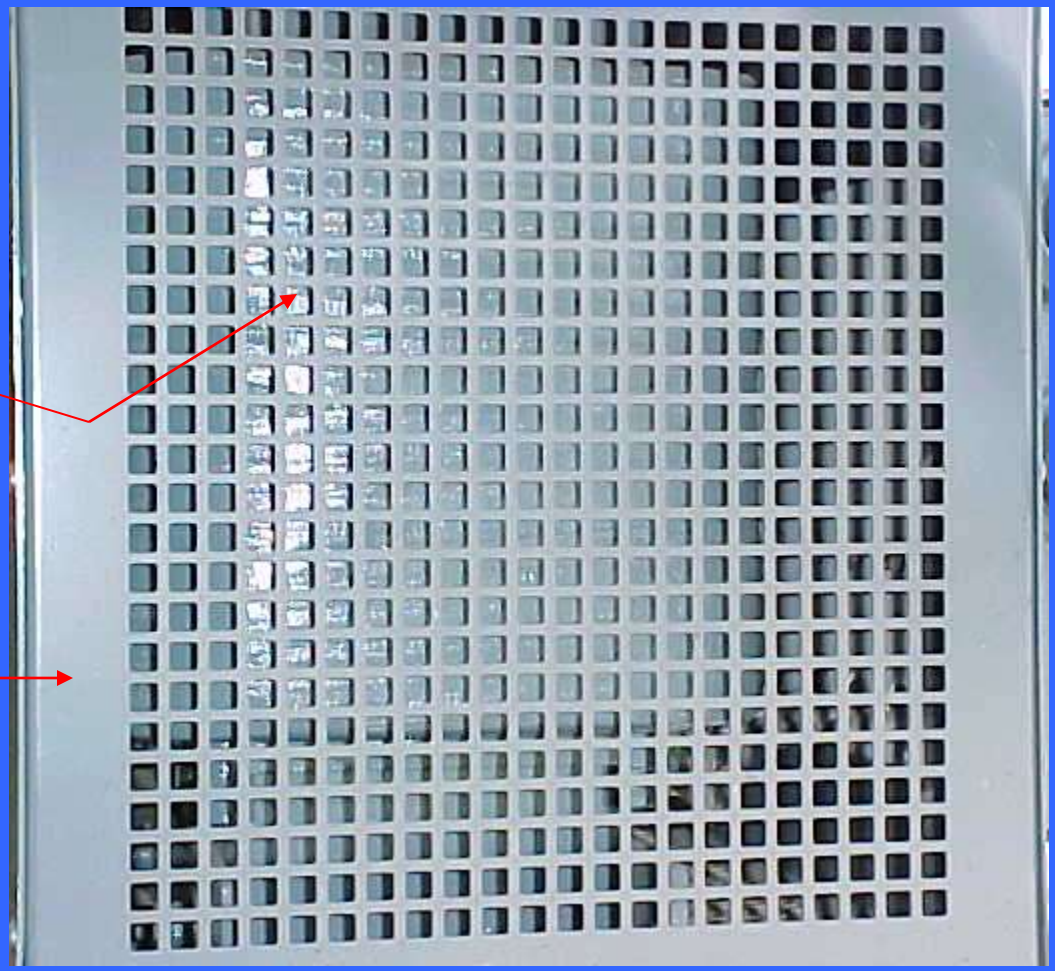
EARTHING CABLE



SIDE VIEW OF TRANSFORMER HOUSING

EPOXY COATED RESIN BONDED ENCAPSULATED WINDING

PERFORATED HOUSING FOR NATURAL AIR COOLING



110V,70AH VRLA LIGHT WEIGHT BATTERIES

BATTERY MODULE DETAILS

CLAMPING ARRGT.

END CELL CONNECTOR

110 V , 70 Ah , VRLA BATTERY MAIN FEATURES

CONSTRUCTIONAL FEATURES

- PURE LEAD -TIN PLATE (THIN)
- 12 VOLTS BATTERY MODULE
- UL 94 V-O NORYL PLASTIC CONTAINER WITH METAL JACKET
- M6 (F) NO MAINTENANCE TERMINALS
- CAN BE MOUNTED IN ANY ORIENTATION

PERFORMANCE FEATURES

- WIDE TEMPERATURE RANGE : -40 Deg.C to +55 Deg.C
- 400 + FULL DEPTH OF DISCHARGE CYCLES
- 8+ YEARS FLOAT LIFE @ 25 Deg C
- 2 YEARS SHELF LIFE
- HIGH DISCHARGE RATE @ 25 Deg C
- RAPID RECHARGE
- DEEP DISCHARGE RECOVERY

WATER PUMP WITH MICRO-CONTROLLER AND SENSOR

- SELF PRIMING MONO BLOCK TYPE MICR-CONTROLLER BASED WITH INFRA-RED SENSOR FOR DRY RUN PROTECTION

PUMP

• OPERATING VOLTAGE	: 3 PHASE,415V+/-5%,50HZ
• POWER RATING	: 200W (MAX.)
• RPM	: 2700
• DISCHARGE CAPACITY	: 10 LPM
• WEIGHT	: 6.5 KG
• PROTECTION	: IP-54

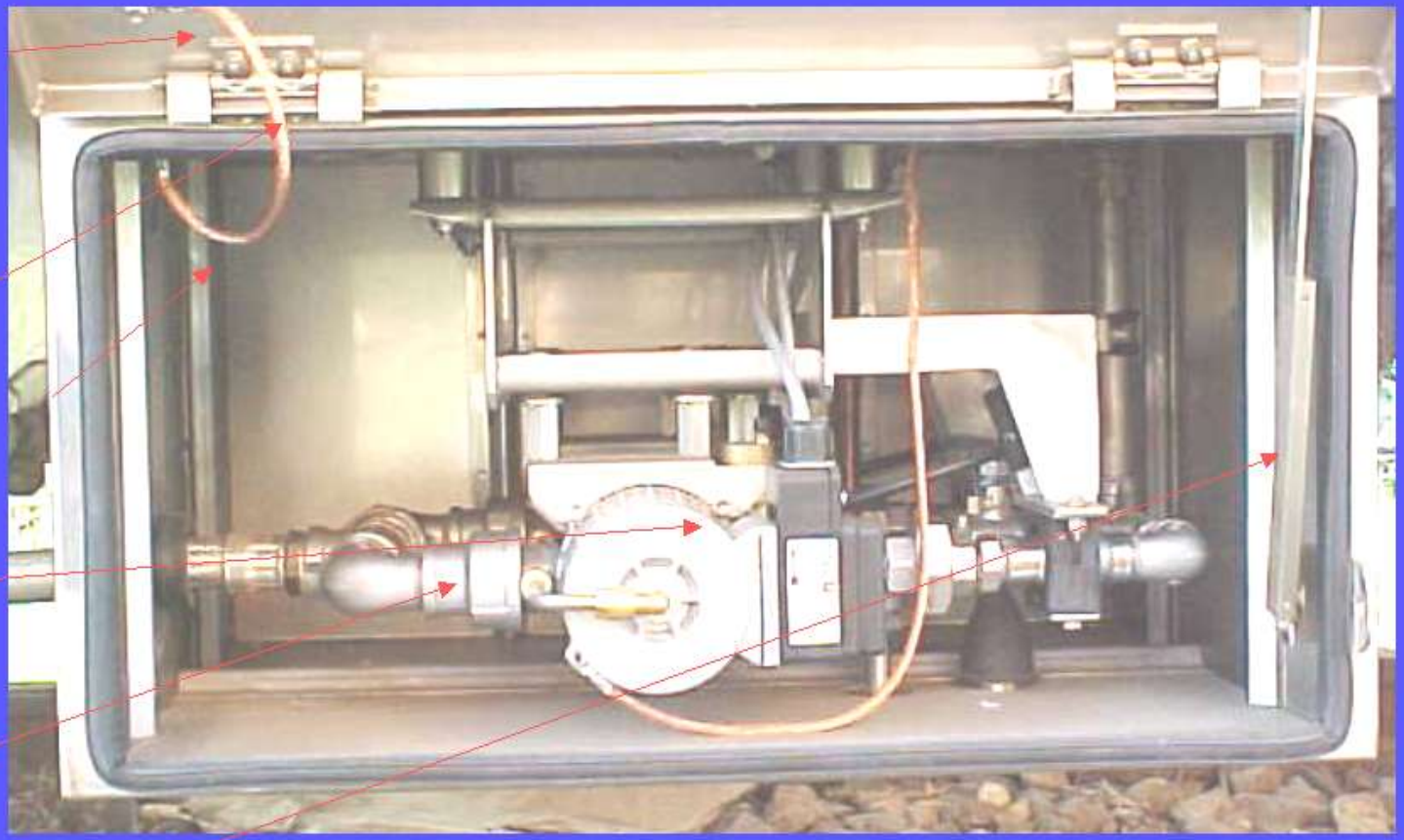
MICRO-CONTROLLER

• INPUT SUPPLY	: 24V DC +/-10%

WATER LEVEL SENSOR

• TYPE	: OPTICAL LEVEL SENSOR WITH UNMODULATED INFRA-RED TYPE, 24V DC 20 mA HOUSED IN POLYSULPHANE ENCUMBENT
• OTHER DETAILS	: OPERATING AT 0-100 LUX AT 30HZ WITH PRESSURE WITHSTANDING AT 10 BAR AT 60ºC INTERFACE PIPE THREADING 3/8”

PUMP AND ACCESSORIES WITH PUMP BOX



IVC PLUG

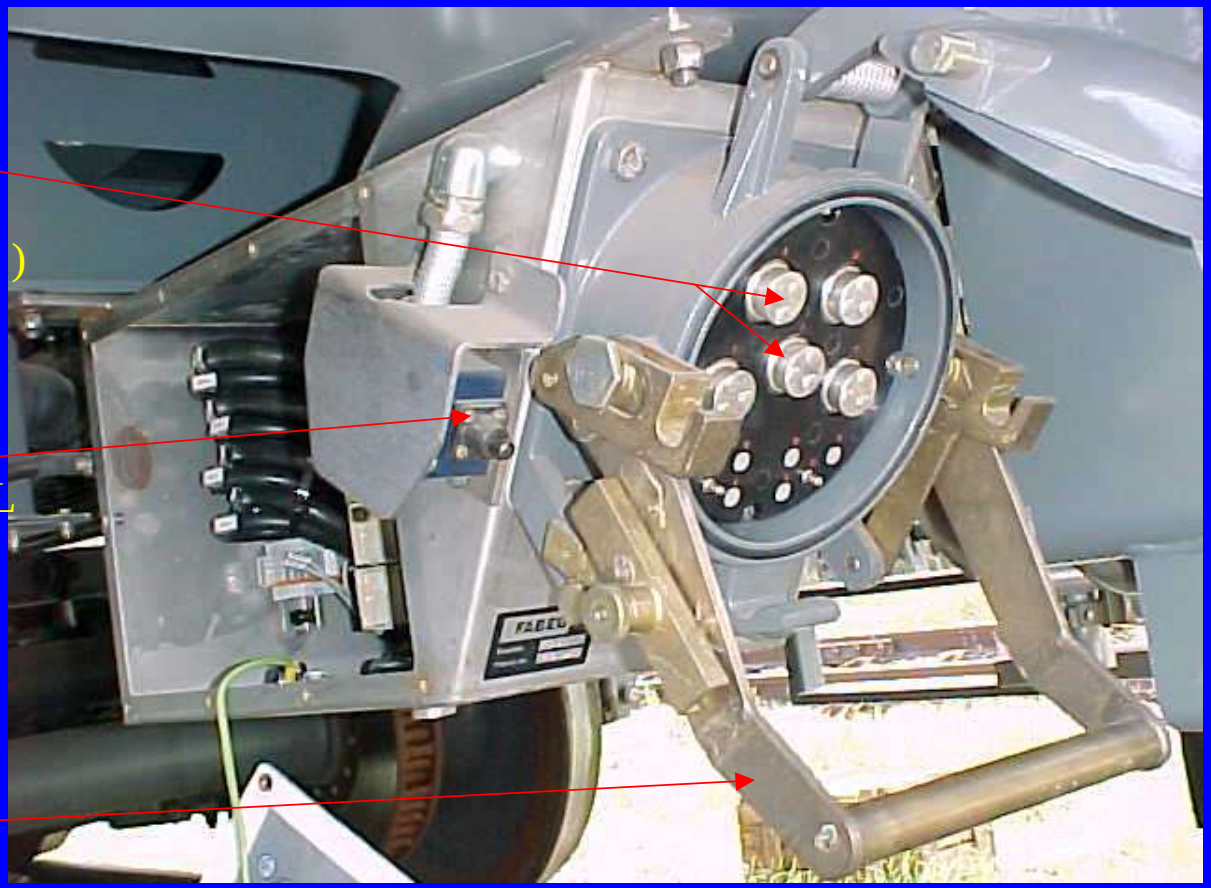

MAIN
CONTACTS
(400 AMPS)
CONTROL PINS
(25 AMPS)
IVC PLUG
HOUSING
(AL. DIE CAST)

IVC SOCKET WITH RATCHET ARRANGEMENT

MAIN PINS
(PRESSURE
CONTACT TYPE)

LIMIT SWITCH
(FOR CONTROL
PINS / SAFETY
LOOP)

RATCHET ASSY
FOR HOLDING
THE PLUG



EXTERNAL SUPPLY SOCKET

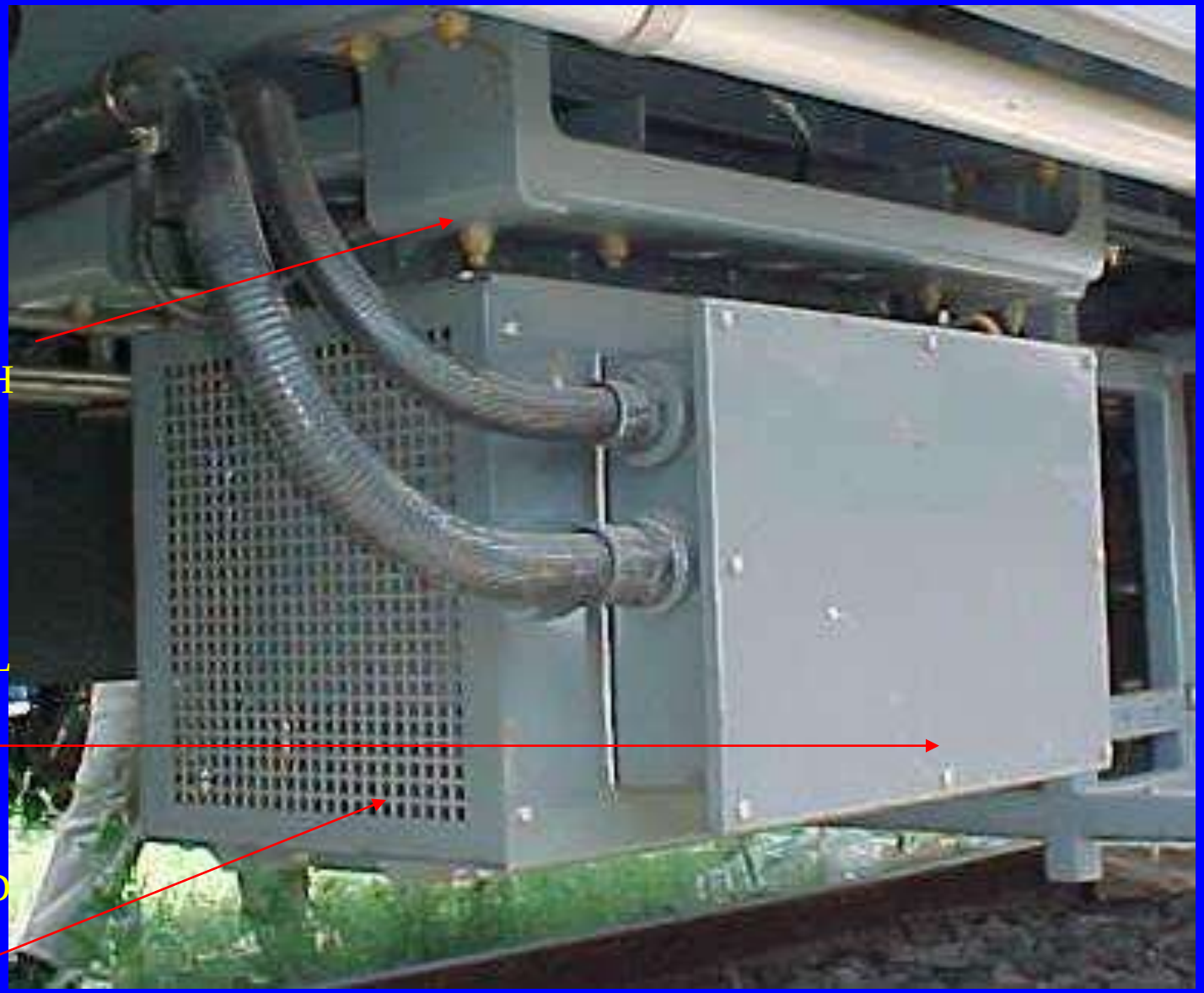
EXTERNAL SUPPLY SOCKET

END WALL ENCLOSURE

5-PIN SOCKET

MOUNTING SCREWS

60 KVA TRANSFORMER WITH EPOXY ENCAPSULATION



60 KVA TRANSFORMER

- TYPE - EPOXY COATED ENCAPSULATED , WATER PROOF WINDING
- RATING- 3ø , 50Hz , 60KVA, 750/415V
- INSULATION - CLASS H
- NATURAL AIR COOLED
- WEIGHT - 335KG (Max.)
- DIMENSIONS - 600X530X626
- DEGREE OF PROTECTION -

  IP-21 HOUSING

  IP-65 TERMINAL BOX & WINDING

RMPU Top View

WATER BOILER

CAPACITY :15LITRES

POWER :230V AC,+/-10%

HEATING ELEMENT : 2KW

THERMOSTAT : 0-100 DEG. C

DIM. :525X300X285MM

REFRIGERATING UNIT

BOTTLE COOLER

REFRIGERATING UNIT

DIMENSIONS :1157X595X1195MM

POWER :800W

VOLTAGE :230V+/-10%,50HZ

THERMOSTAT RANGE : a) DEEP FREEZER -18 TO -25 DEG. C

b) BOTTLE COOLER 0 TO +10 DEG.C

c) COOLING COMPT. 0 TO +10 DEG.C

REFRIGERATION CAPACITY : 560 Kcl/Hr

REFRIGERANT : R22

COOLING : FAN

COMPRESSOR : CSIR , 4.50 CC

HOT CASE

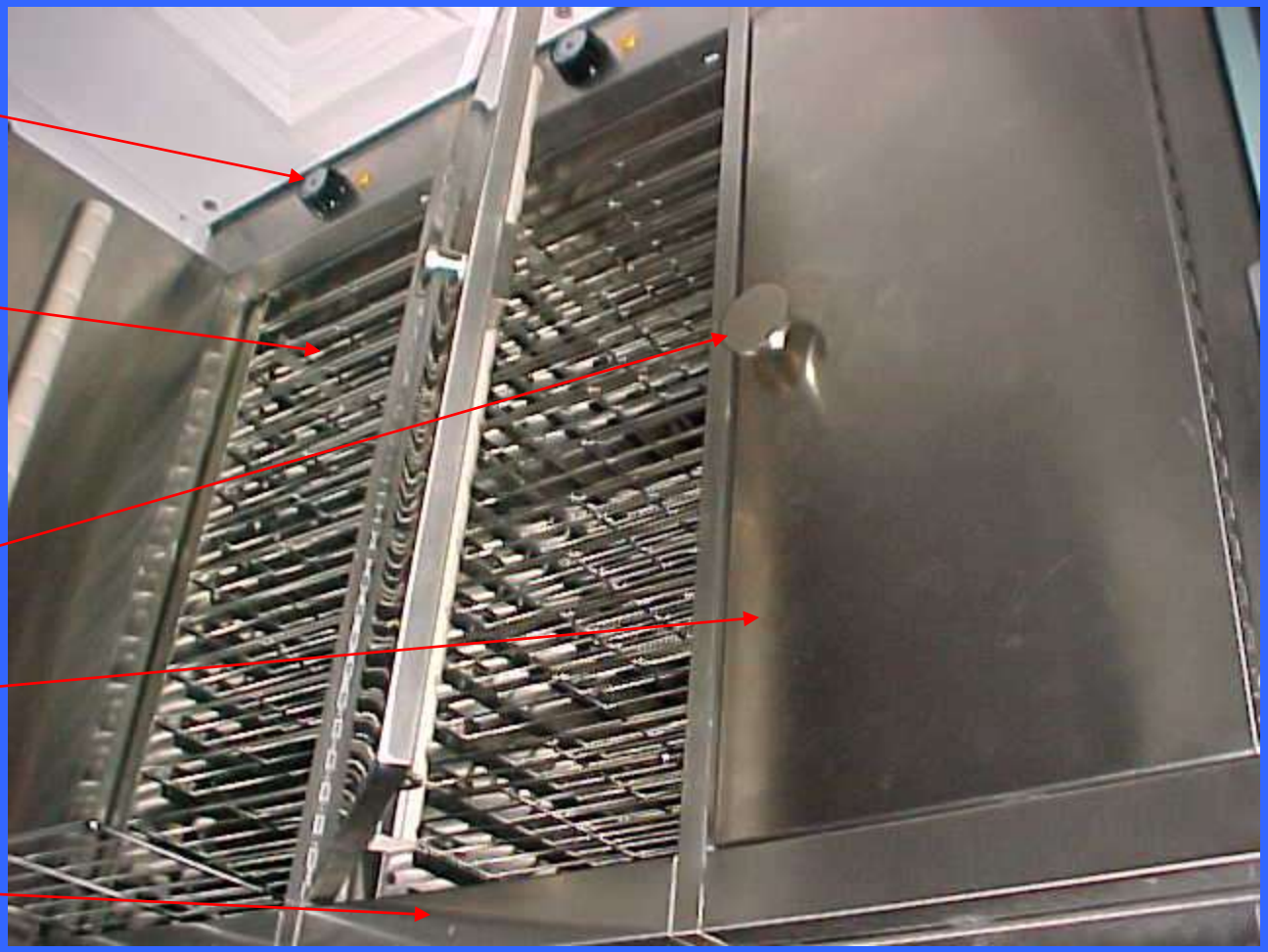
THERMOSTAT

TRAYS

KNOB WITH LOCKING ARRANGEMENT

DOOR

CABINET



HOT CASE

DIMENSIONS	: 910X1092X600MM
POWER	: 230V+/-10%,50HZ
HEATING ELEMENT	: 3 x 500W
HOT AIR BLOWER	: 230V+/-10%,50HZ, CLASS-H
OPERATING TEMPERATURE	: 80 DEG.C
THERMOSTAT	: 30 - 80 DEG.C
THERMAL INSULATION	: BONDED MINERAL WOOL
TRAYS	: 84 NOS. 3ØX280mmX250mm STAINLESS STEEL WIRE MESH


LIGHT FITTINGS

COACH LIGHTING

TYPES

- FLOURESCENT TUBES 18 WATTS
- INCANDESCENT LAMPS 10 WATTS (FOR NIGHT LIGHT AND PANTRY)
- HALOGEN LAMPS 10 WATTS (READING LIGHTS)

FLOURESCENT TUBES USED AS GENERAL LIGHTING , VESTIBULE , TOILET , PANTRY AND EMERGENCY WORKING AT 110 VOLTS AC/DC WITH INVERTER AND WITH POLYCARBONATE DIFFUSERS

TECHNICAL DATA OF THE INVERTER FOR FLOURESCENT LAMP (SIZE - 48x36x252)

NOMINAL INPUT VOLTAGE 110 V AC/ 50 Hz (88 -138 V RANGE)

TECHNICAL DATA OF THE INVERTER FOR READING LIGHTS (SIZE - 36x31x296)

NOMINAL INPUT /OUTPUT VOLTAGE 110 V DC / 12 V DC

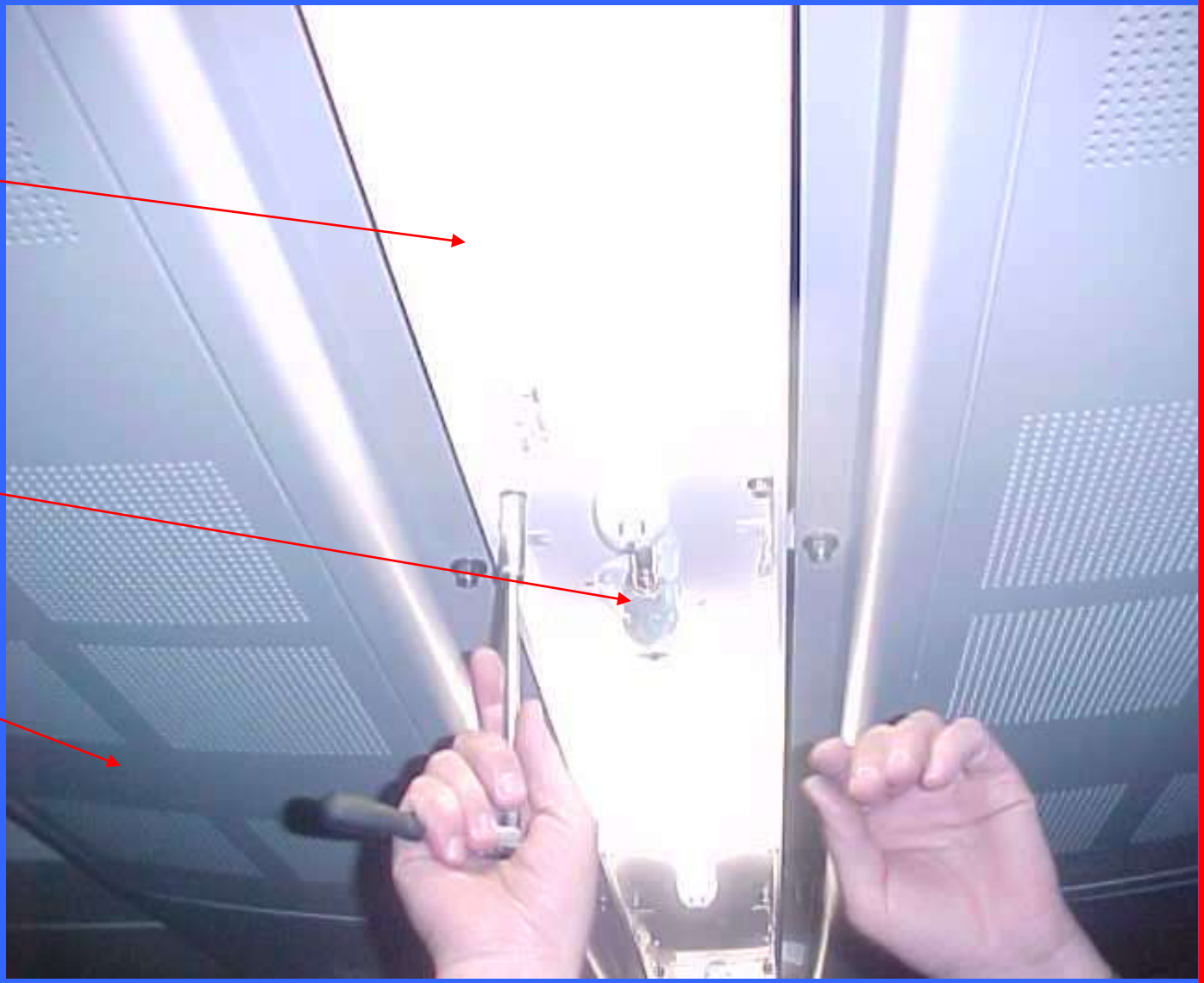
POWER 0 - 60 W / 12 V

COMPARTMENT LIGHT INSIDE VIEW

CENTRE RIBBON FITTINGS

INCANDESCENT LAMP

AC DUCT PANNELING

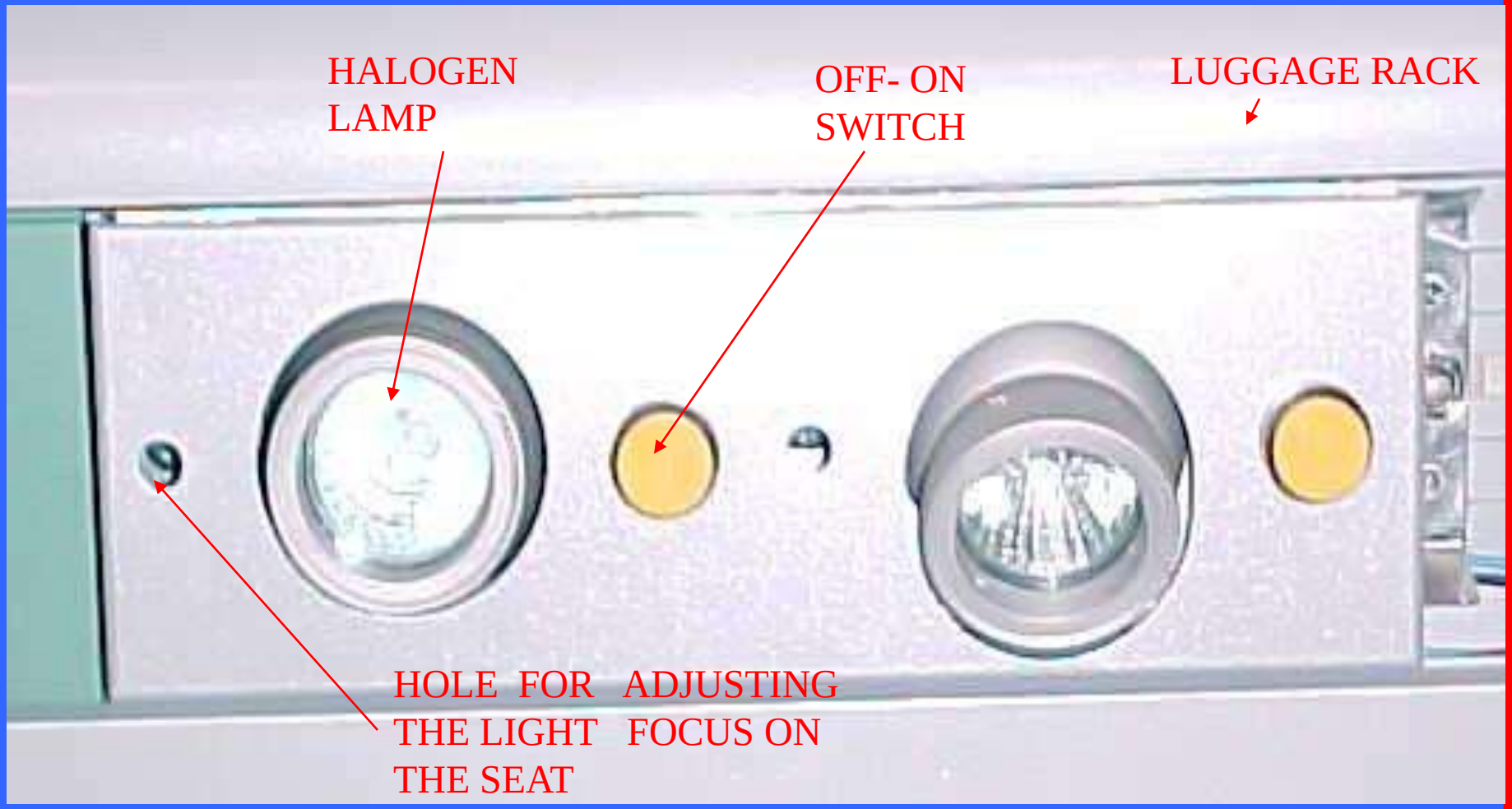


DIFFUSER PROFILE WITH SELF CLAMPING ARRGT.

POLYCARBONATE
DIFFUSER

ANTIDUST
AND VIBRATION
FOAM INSERTS

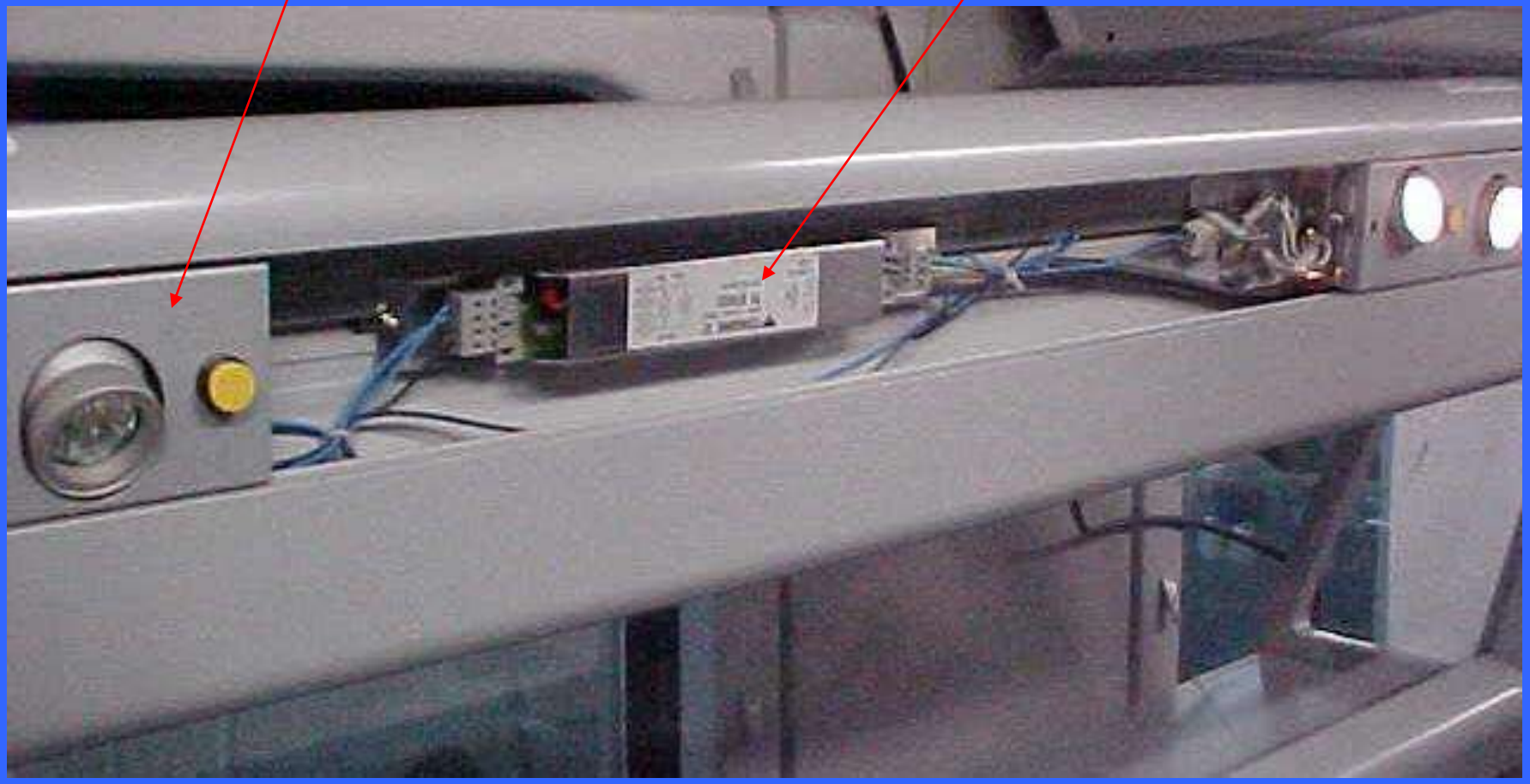
READING LIGHTS



READING LIGHT INVERTER / BALLAST

READING LIGHT ASSY.

READING LIGHT INVERTER INTEGRATED IN THE LUGGAGE RACK



VESTIBULE LIGHT FITTING

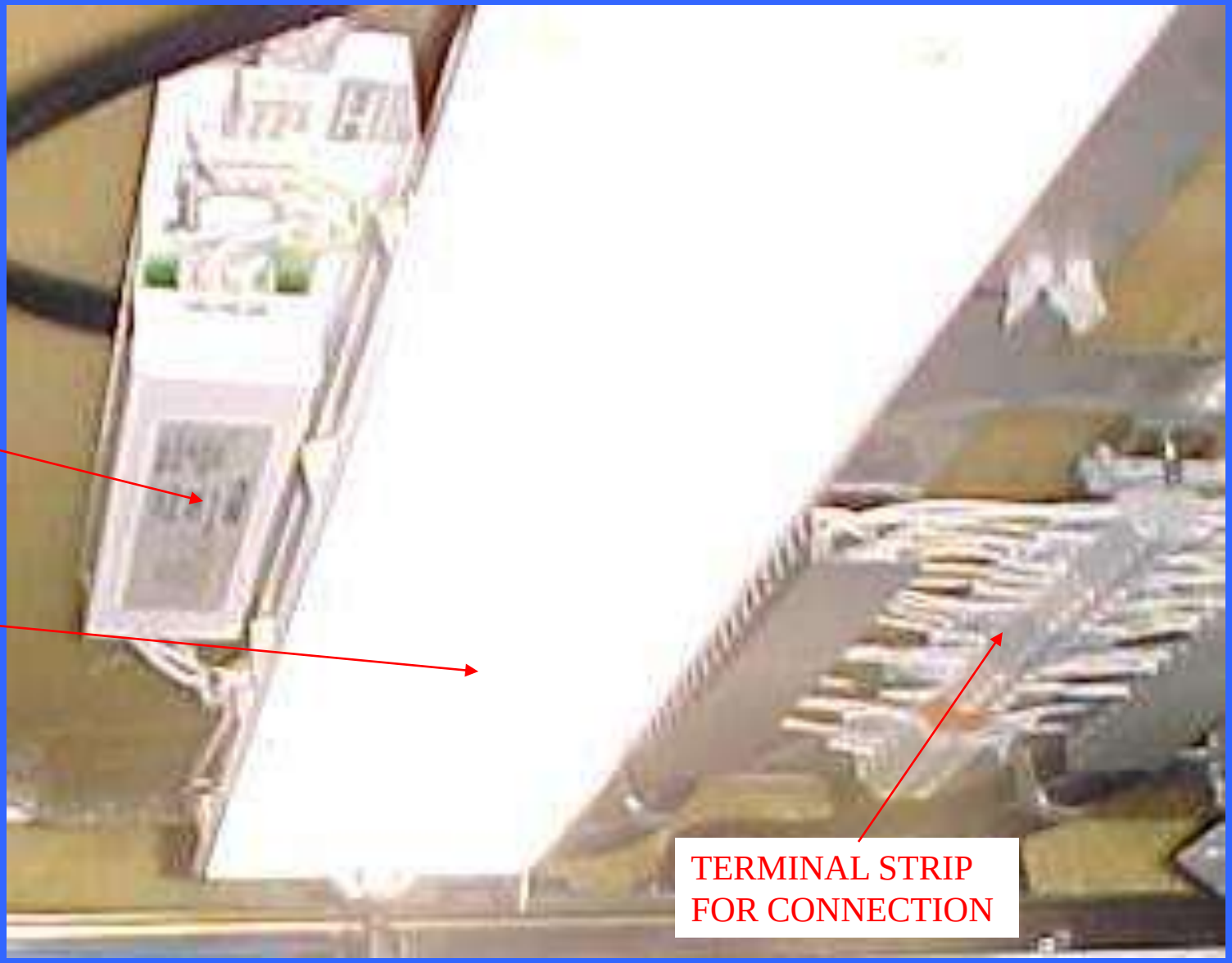
POLYCARBONATE DIFFUSER

VESTIBLUE DOOR

DIFFUSER FOR VESTIBULE LIGHT

POLYCARRBONATE DIFFUSER FOR THE VESTIBULE LIGHT

FLOURESCENT LIGHT FITTING INVERTER




सामान ब्रेक और जेनरेटर क
LUGGAGE BRAKE & GENERATOR C


I V COUPLER

BOMBAY

S. INTERNATIONALS

GARIB RATH

(2909 DN / 2910 UP)

Sleeper coaches are manufactured by Rail Coach Factory, Kapurthala and are having 75 berths (in place of 67 in Rajdhani Sleeper Coaches). New version of sleeper coaches having 81 berths has also just arrived at BDTS. Chair Cars are manufactured by integral Coach Factory, Perambur and are having 102 chairs (in place of 72 in other A.C. Chair Cars)

Power Cars are equipped with 02 nos. D.G.Sets each having 490 BHP engine & 500 KVA, 750 volts alternator. An independent A.C. Unit of 1.5 ton capacity is provided in Guard compartment. Four berths are provided in each Power Car for handicapped passengers. Luggage portion, however, is not available in these power cars.


21866
WCAM2

All Garib Rath Coaches are equipped with 02 nos. each non-LHB type RMPUs with different makes, like Sidwal, Fedders Lloyd, LEEL, Amit etc. Each RMPUs is having two nos. sealed compressors of 3.75 ton capacity and uses vapour compression system to achieve cooling effect in the coach.

Electronic Temperature Controllers are used in these coaches with temperature settings as 25^0 C to 27^0 C during summer and 19^0 C to 21^0 C during winter. Temperature setting for summer in other A.C. Coaches is 23^0 C to 25^0 C and higher temperature setting of 25^0 C to 27^0 in Garib Rath coaches is adopted due to more heat load in the coach because of increased accommodation while using existing type / capacity RMPUs to avoid increase in inventory.

Instead of using two transformers - one for 415 volts power circuit and another for 110 volts lighting circuit, Garib Rath coaches are equipped with a single transformer of 50 KVA having one 47 KVA tapping of 415 volts and another 3 KVA tapping of 110 volts.

Deccan Odyssey

The train has 21 coaches, out of which 13 are passenger cars accommodating 8 people per coach (11 passenger Cars, 4 coupes per coach - 2 Presidential Suite Cars, 2 coupes per coach), 1 Conference Car, 2 Dinning Cars, 2 Generator Cars with Luggage Store, 1 Staff, spare Car, 1 Spa Car, 1 Bar Car. The train has on-board facilities like T.V., Cable connection with central audio disc player, cell phones, Channel Music, Foreign exchange facilities, etc. The present capacity of the train is 80 pax.

The route has been fixed as Mumbai - Ratnagiri - Sindhudurg - Goa - Kolhapur - Pune - Nashik - Aurangabad (Ajanta - Ellora) - Nasik and Mumbai. It will be a seven days round trip starting on every Wednesday from Mumbai. The itinerary of the tour is broadly as follows:

1st Day - Mumbai

2nd Day- Ratnagiri-Ganapatipule-Jaigad

3rd Day - Sindhudurg-Tarkarli-Sawantwadi

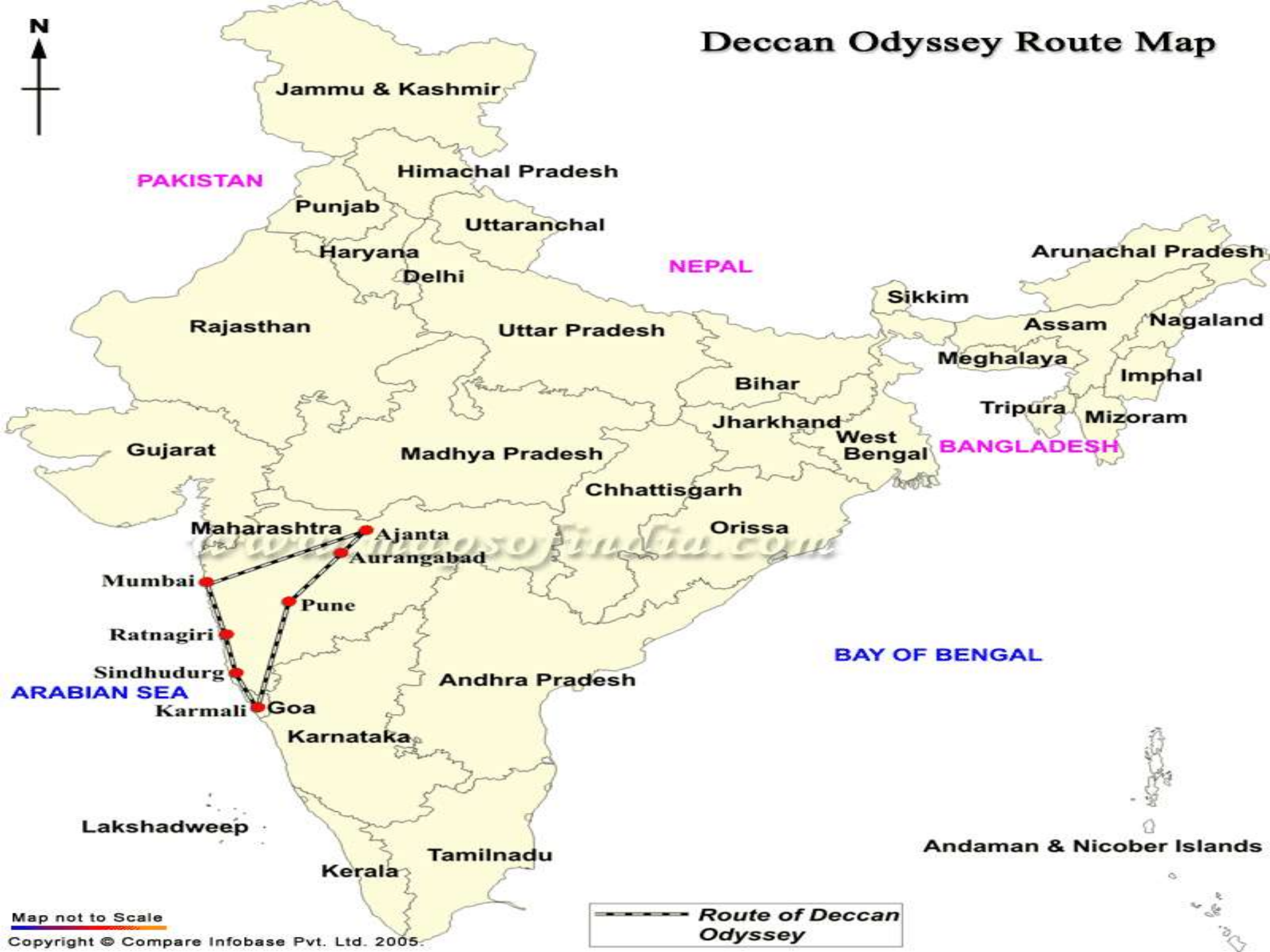
4th Day - Goa

5th Day - Kolhapur- New Palace, Museum, Bhavani Mandap Mahalaxmi Temple - Shalini Palace. Pune-Raja Kelkar Museum.

6th Day - Aurangabad-Daulatabad-Ellora Caves-Bibi-ka-Maqbara

7th Day - Jalgaon Ajanta Caves-Nasik-Panchawati Ghat

8th Day -Mumbai



Deccan Odyssey

Thus the train takes you through various facets of tourism attractions of Maharashtra ranging from the entire coastline of 720 kms of Maharashtra dotted with beautiful and unspoiled palm-fringed beaches, supplemented by ancient temples, coastal forts and sea forts that remind you of the naval power of the Maratha empire.

The coasts of Ganapatipule and Sindhudurg are also known for its natural beauty and greenery as well as a special kind of folk arts and cuisine, which is predominantly based on seafood and spices locally known as Malvani or Konkani cuisine. It touches Goa, an already established tourist destination.

Next day train reaches Kolhapur, a city of many great attractions. This city is a unique blend of culture, history, nature - industry. Most of the venues Bhavani Mandap, Mahalaxmi Temple, Shalini Palace etc. speak for themselves.

The Deccan Odyssey luxury train having 21 EOG AC coaches including two high capacity power cars. The details are as under.

1. Two high capacity power cars.
2. Five common service coaches, which includes,

- 2 restaurant-cum-kitchen,
- 1 spa plumeria
- 1 conference hall-cum-business centre
- 1 Bar

1. Two executive suite cars each coach having two suites.
2. Eleven deluxe cars, each coach having four cabins of 2 bed.
3. One AC 2 tier for service boys and kitchen staff.

The Power Cars.

No. - CR 03851, 03852
Engine : Cummins make

(PPR) Capacity : 1) 450 BHP/336 KW at 1500 rpm
2) 525 BHP /391 KW at 1800 rpm.

Fixing Order : 1-5, 3-6, 2-5

Alternator : CR 03851, KEL/03852 KEL

AC Coaches

All five common service coaches and staff car i.e AC 2 tier are having two RMPU's. All cabin cars and suite cars are having one RMPU.

The formation of rake is as under: -

SN	Coach No.	Name of the coaches	Plant make No.	Load (KW)
1	03851	Power Car I	F/L 1	43.45 KW
2	03891	Staff Car ACCW	F/L 2	37.65 KW
3	03876	AJNERI/C/Car	F/L 1	37.65 KW
4	03877	RATNAGIRI C/Car	F/L 1	37.65 KW
5	03878	RAIGAD C/Car	F/L 1	37.65 KW
6	03879	SINHAGAD C/Car	F/L 1	37.65 KW
7	03880	SINDUDURG C/Car	F/L 1	37.65 KW
8	03881	MAHIM C/Car	F/L 1	37.65 KW
9	03887	AJANTA Suite	SD-1	23.95 KW
10	03889	SPA-PLUMERIA	SD-2	58.45 KW
11	03890	SAMVAD - Conf	SD-2	59.95 KW
12	03802	PESHWA II - Restaurant	SD-2	83.37 KW
13	03801	PESHWA I - Restaurant	SD-2	83.37 KW
14	03803	MUMBAI HIGH - BAR	SD-2	56.35 KW
15	03888	VERUL -Suite	SD-1	23.95 KW
16	03882	NALDURG - C/Car	F/L 1	37.65 KW
17	03883	GAURGAD -C/Car	F/L 1	37.65 KW
18	03884	DAULATABAD- C/Car	F/L 1	37.65 KW
19	03885	VIJAYDURG -C/Car	F/L 1	37.65 KW
20	03886	AMBAGAD -C/Car	F/L 1	37.65 KW
21	03852	POWER CAR - II	F/L 1	43.45 KW

The coaches are named after famous forts of Maharashtra and world heritage sites.


THE DECCAN ODYSSEY


PESHWA-I


PALACE
ON
WHEELS

THANK YOU