RMPU & AC in LHB

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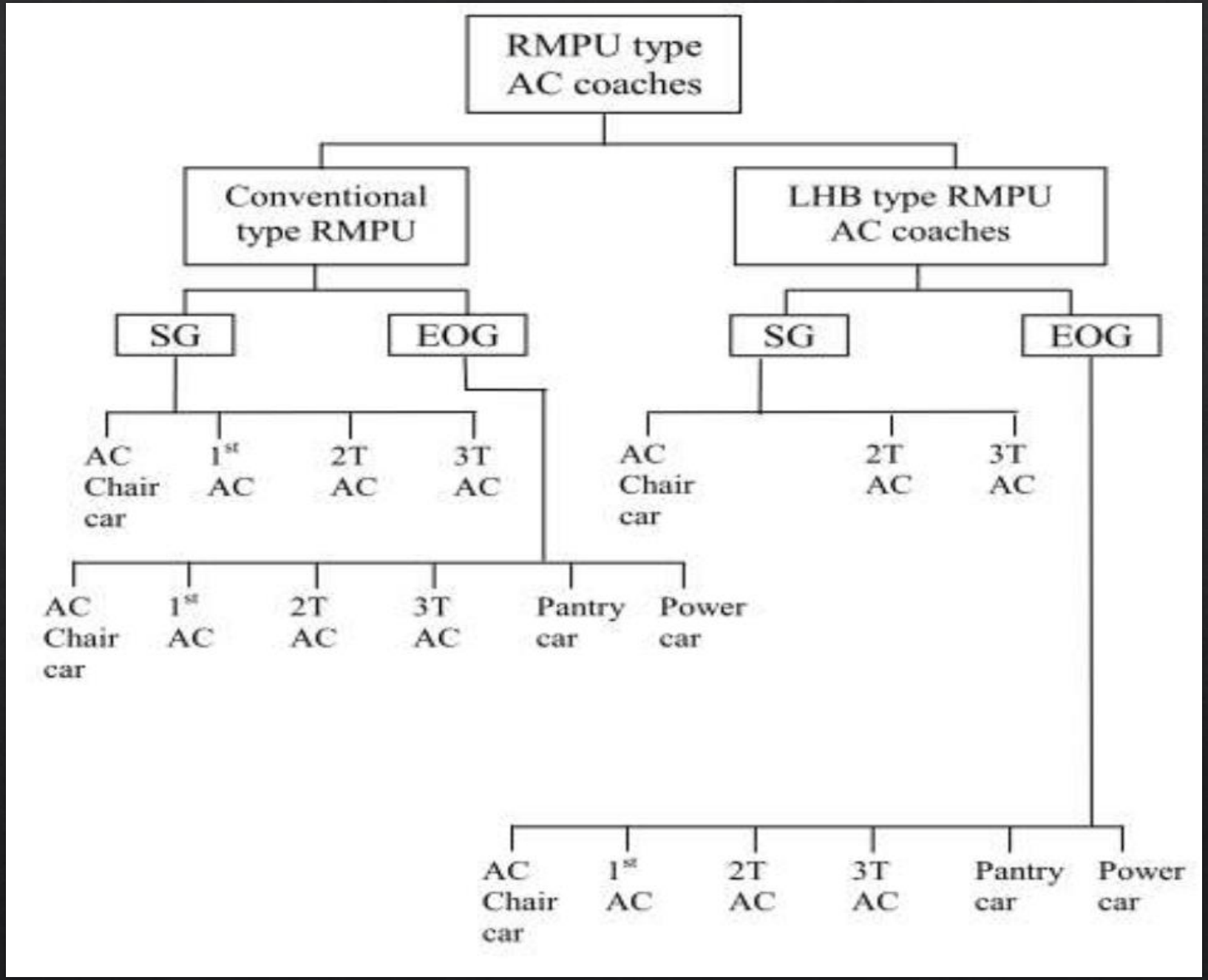
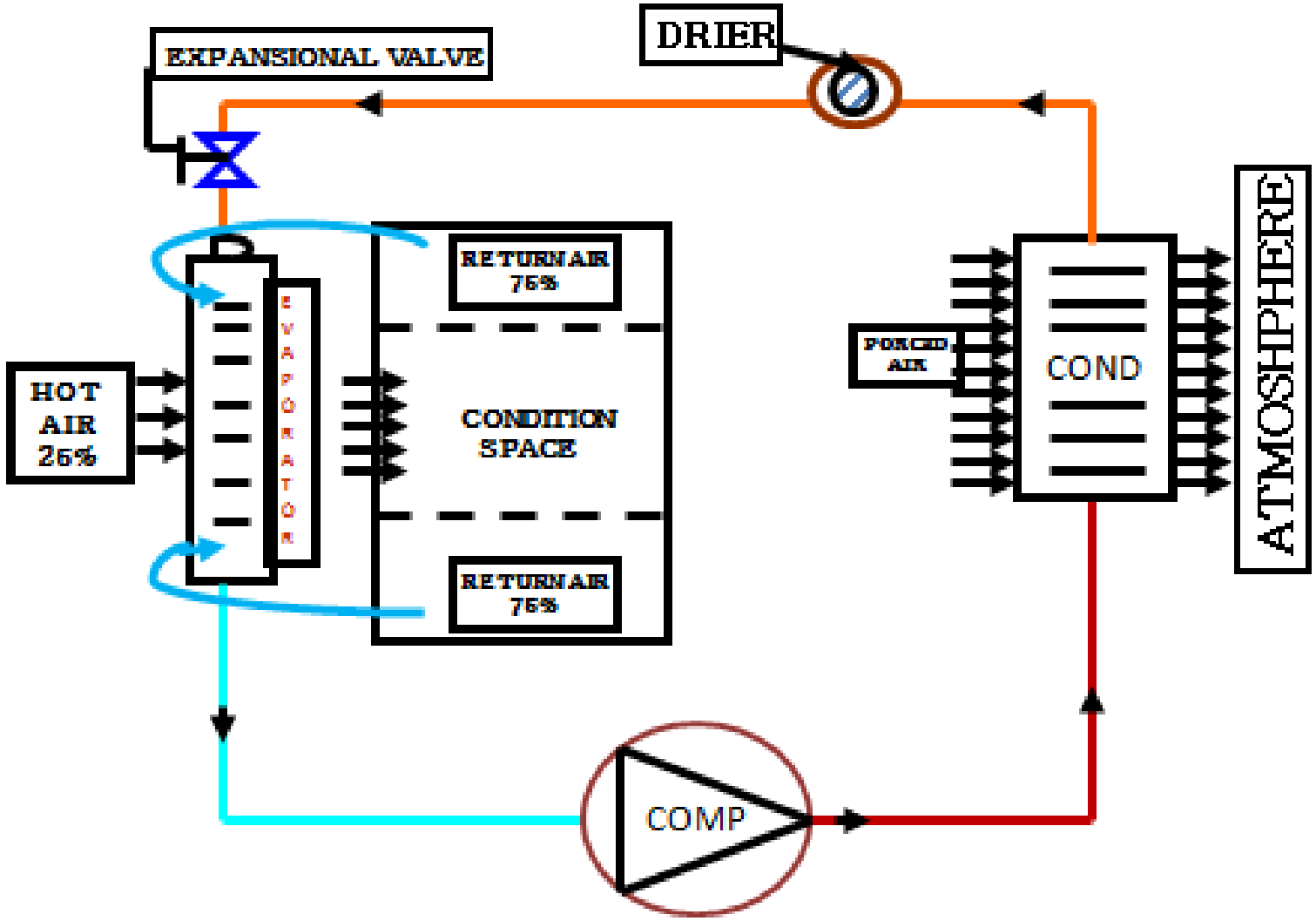
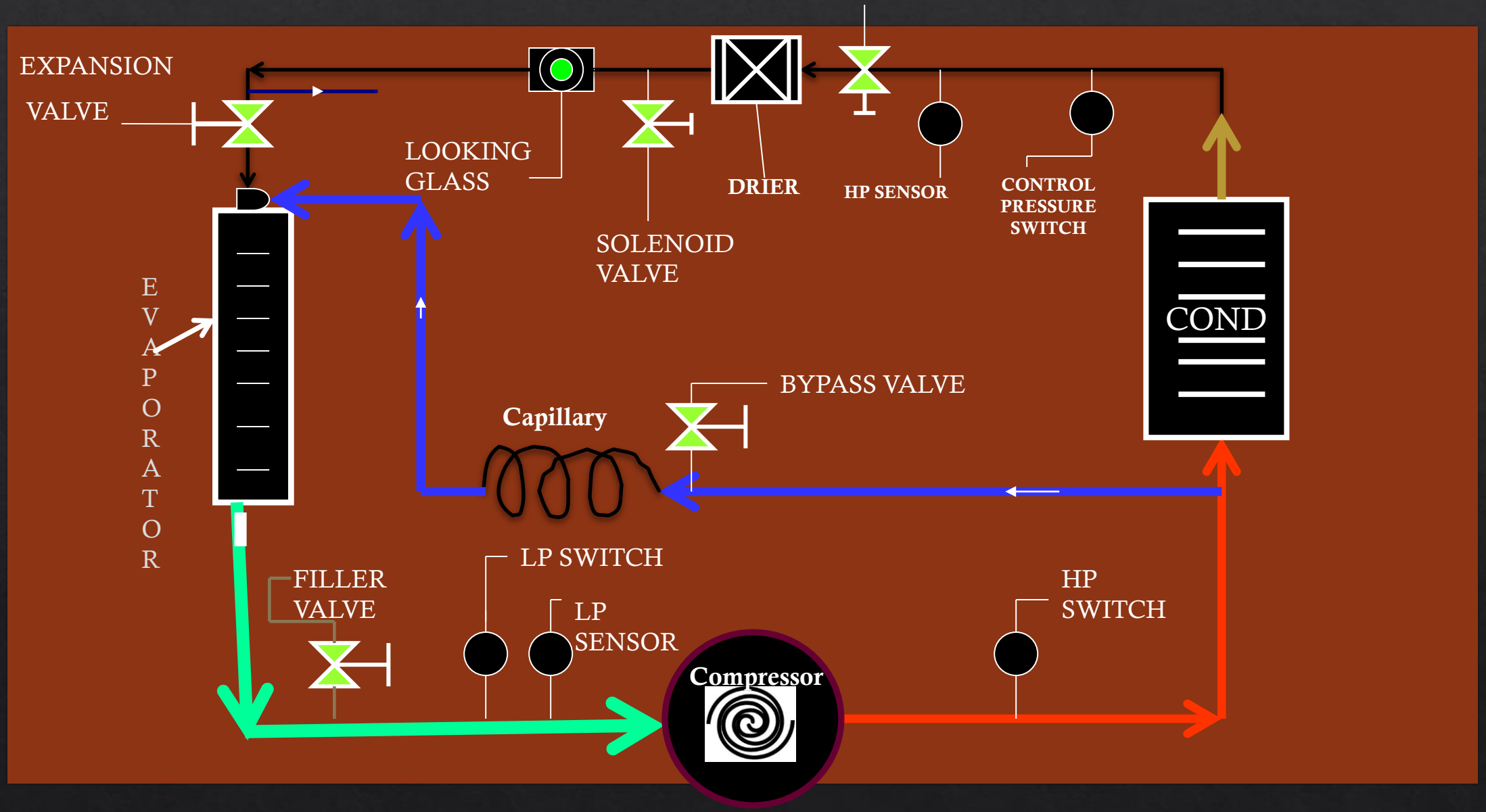
AP/WMT/IRIMEE


RMPU type AC coaches
Conventional type RMPU
LHB type RMPU AC coaches
SG
EOG
SG
EOG
AC Chair car
1st AC
2T AC
3T AC
AC Chair car
2T AC
3T AC
AC Chair car
1st AC
2T AC
3T AC
Pantry car
Power car
AC Chair car
1st AC
2T AC
3T AC
Pantry car
Power car

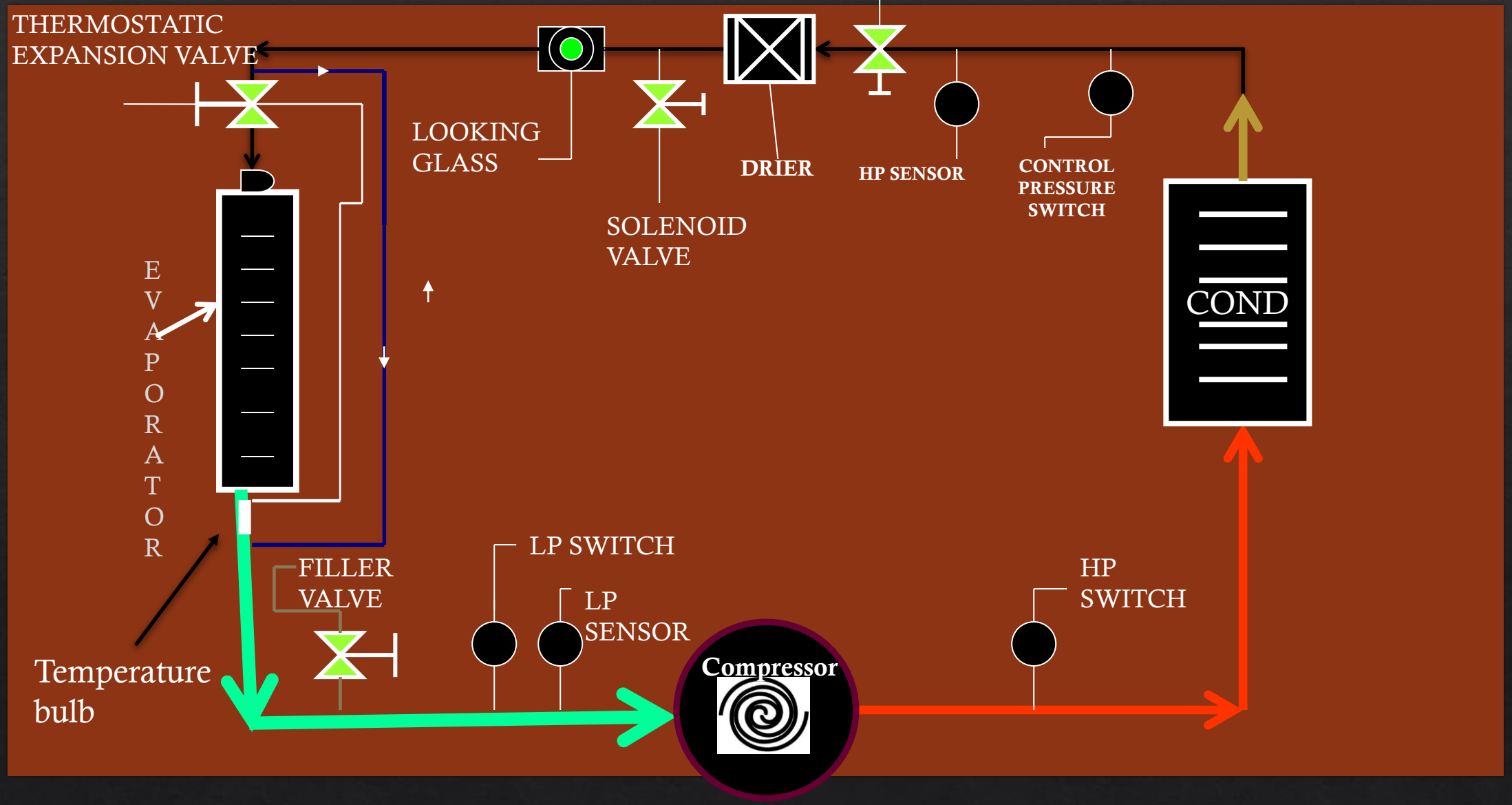
CIRCUIT DIAGRAM OF REFRIGERATION CYCLE OF AC COACHES



Conventional RMPU schematic



LHB RMPU schematic



Limitation of conventional RMPU

- The temperature in the air-conditioned space is controlled based on fixed selected thermostat settings without any relationships with humidity or requirement of air conditioning during different hours of day and night journey. Such arrangements do not ensure desired comfort level throughout the journey.
- The thermostats provided for the purpose of temperature control have only three fixed settings which cannot be changed and have to be selected manually by operating a rotary switch
- In the existing system, there is no provision to monitor the energy consumption in the coach to monitor the energy efficiency of the AC plant.
- The fault diagnostic assistance for the operator is not available in the existing system for efficient trouble shooting and isolation of fault/defect.
- The existing system does not have a data logging system for recording various faults and defects towards their subsequent analysis and for initiating corrective measures.

LHB TYPE RMPU	CONVENTIONAL RMPU
Working with micro-processor	Conventional panel
SCROLL TYPE compressor WITH AUTOMATIC THERMAL EXPANSION VALVE.	Maneurope – mg52 compressor with capillary tube
Flap motor to control thermal load	No such provision.
Control pressure	
Cut out for condensor	No such provision
Motor operation	

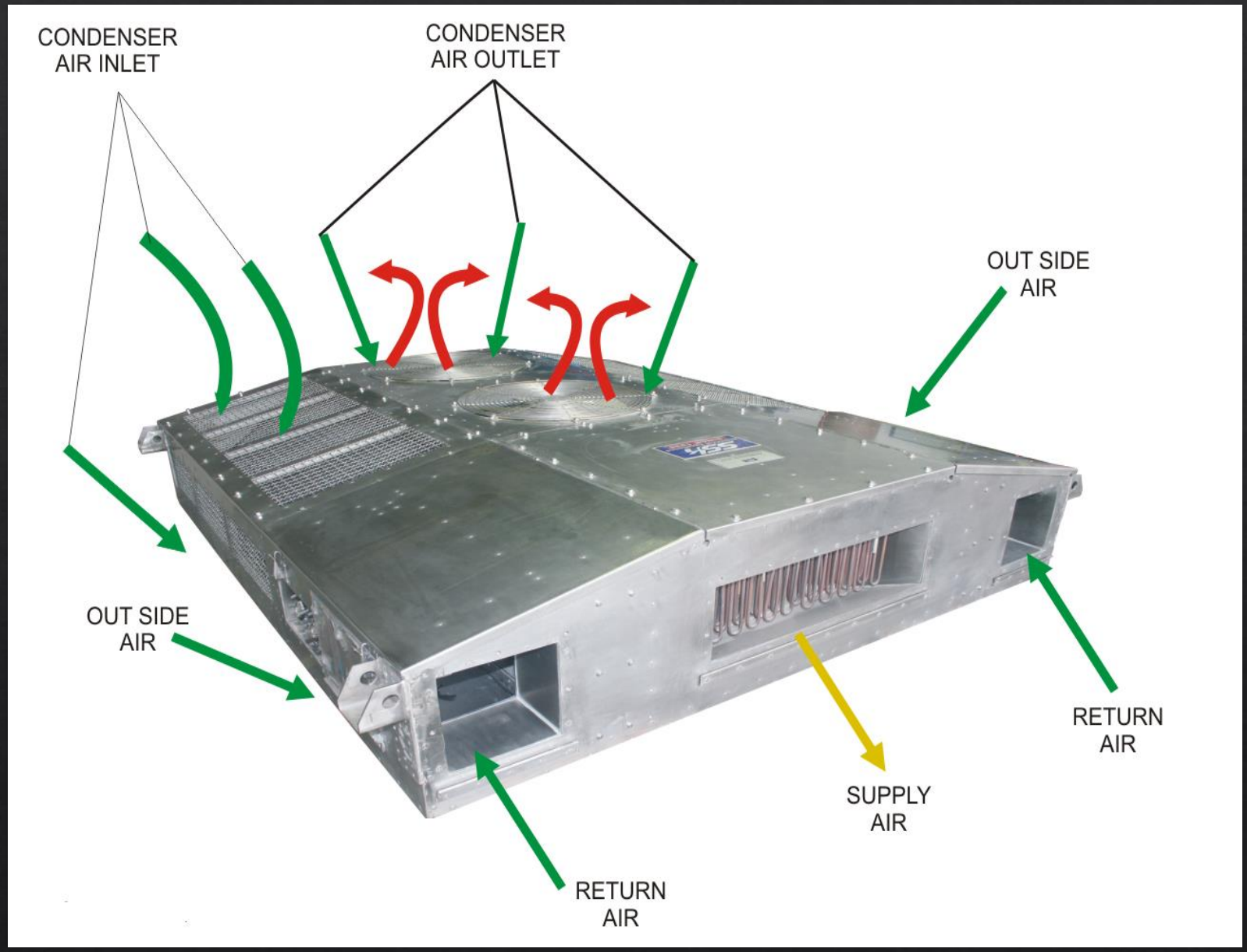
Fault logging is possible	No such provisoin
NTC type temperature sensor	Mercury / electronic type
Pressure transmitter with analog bar gauge	No such provisoin

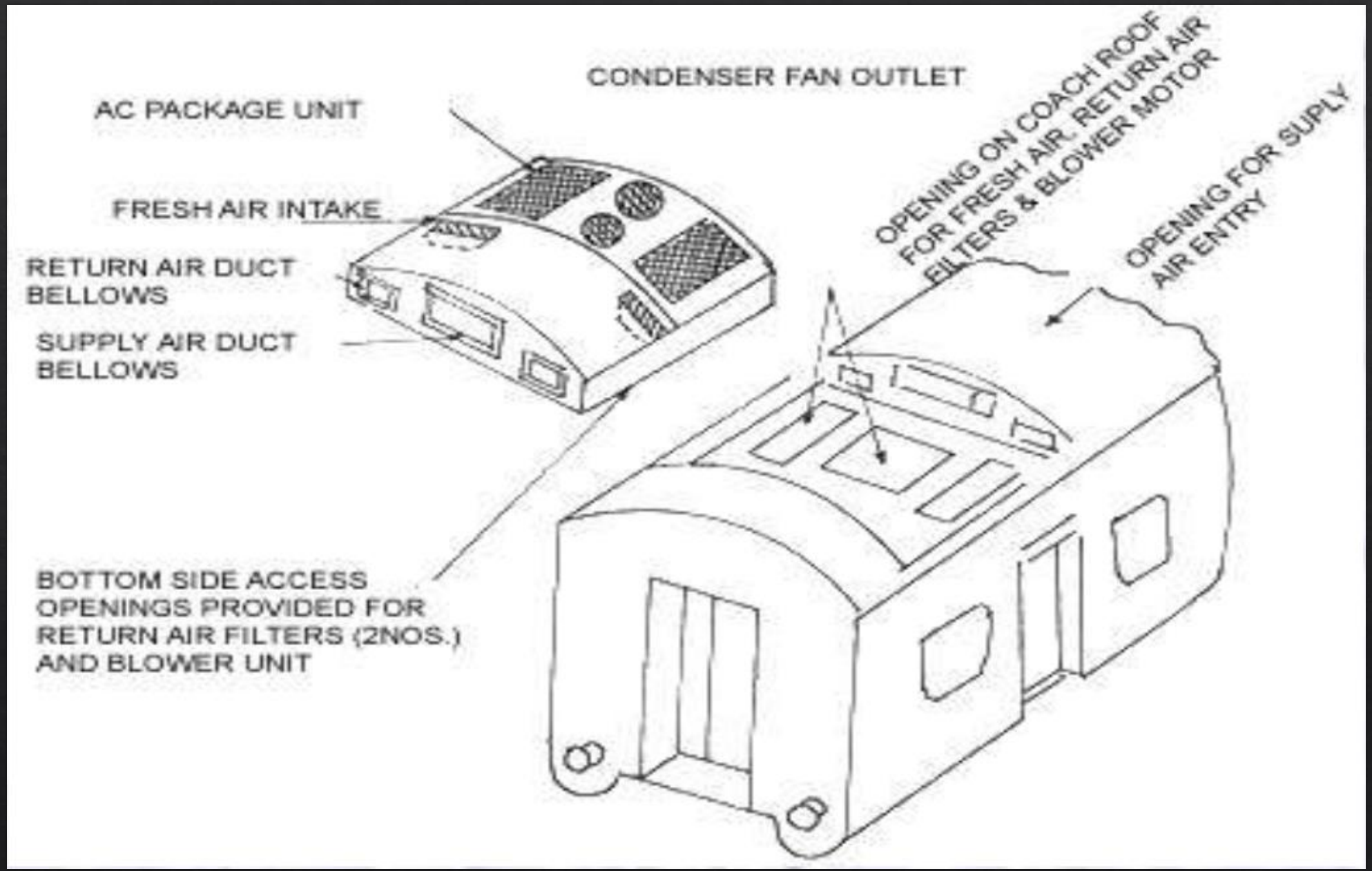
Salient features

- Power supply- 415 +/-5% V , 3 ph, 50 Hz+- 3%
- Control supply 110V ac, Single phase
- Two distinct refrigeration circuits
- Made of SS-304 (1.6 mm)
- Self supporting type
- Weight < 700 Kg
- Evaporator unit water-tight
- Noise level < 60 db
- Capacity 7 TR at service conditions
- Power input < 16 KVA
- Coils- Copper grooved tubes with Al fins

- Motors with built-in thermal protection
- Capacity with one condenser- 75%
- Protective mesh of 3 mm SS over condenser fans
- Refrigerant R22 or R 407c (3Kg per RMPU)
- Compressor- hermetically sealed scroll type
- Motors RPM- 1400

Roof Mounted Package Unit (RMPU)




CONDENSER FAN OUTLET
AC PACKAGE UNIT
FRESH AIR INTAKE
RETURN AIR DUCT BELLOWS
SUPPLY AIR DUCT BELLOWS
OPENING ON COACH ROOF FOR FRESH AIR, RETURN AIR FILTERS & BLOWER MOTOR
OPENING FOR SUPLY AIR ENTRY
BOTTOM SIDE ACCESS OPENINGS PROVIDED FOR RETURN AIR FILTERS (2NOS.) AND BLOWER UNIT

Fresh air intake grill

Supply air duct

WHY RMPU?

1. HIGH SAVINGS –

- Less Haulage charges as light in weight
- 615 kg instead of 1400 kg.
- Increase in availability of coaches
- Low maintenance cost

2. ENVIRONMENT FRIENDLY—

- R22 Ref.is used instead of R12.
- Very less quantity.- 3 kg / circuit. (conventional system- 8 kg)
- Very less chances of ref. leakage due Compact
- Piping –very long in conventional system.
- Hermatically sealed compresssors have no fittings & shaft seals hence major breakdowns due to gas leakage are avoided.

3. EASY INSTALLATION

   As compact, pre-charged, pre-tested for performance & plug in type connections. Installation time 04 hours/coach instead of 04 days.

4. LOW POH TIME-- It reduces each POH time period by18 days.
5. LOW DOWN TIME - Replacement can be done within 04 hrs.
6. LOW MAINTENANCE
7. BETTER PASSENGER COMFORT

- Clean fresh air is taken from roof, no toilet smell.
- System works with fresh air only (return air closed) during emergency mode (Micro Processor Failure), through Servo Motor. Low noise level & noiseless uniform conditioned air distribution through perforated deflectors. (lower duct)
- More comfortable as humidity is well controlled.

8. SAFE OPERATION --

- No chance of damage due to floods (flash over), cattle run-over, flying ballast etc.
- No derailment due to falling of compr./condensers etc.

9. ENERGY EFFICIENT—

- Capacity loss due to long ref. piping is avoided.
- 25%-100% capacity control is achieved by using 04 compressors.
- Compressors Start through TDR one by one to avoid simultaneous drawal of heavy starting current.
- Fresh air entry is completely closed during pre-cooling & pre-heating modes.
- Humidity control features are provided.

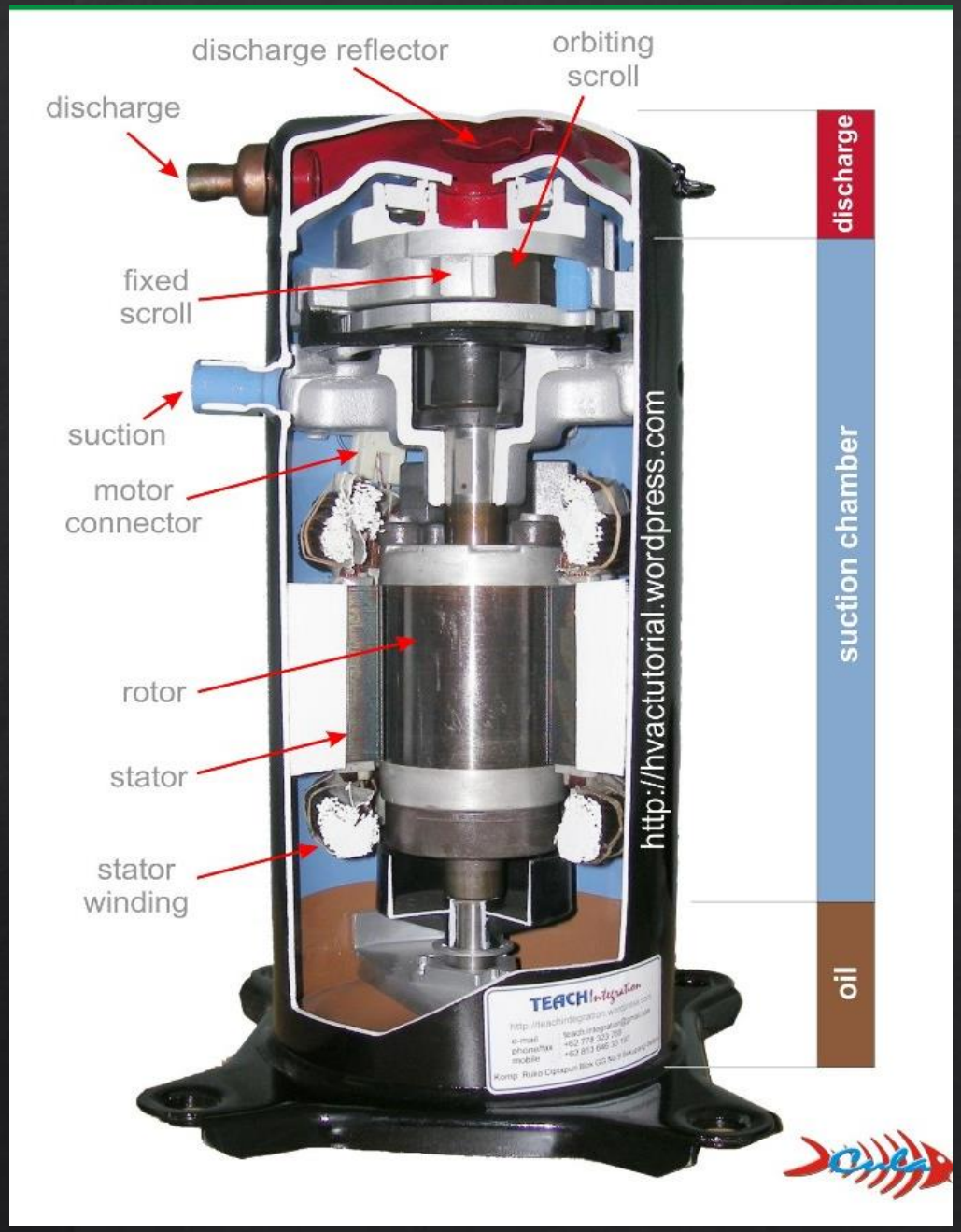
Each air conditioning package unit has two separate cooling circuits consisting of following components:

- Refrigeration compressors - Two (nos)
- Condensers with Copper pipes and copper fins - Two (nos)
- Axial fans for cooling the condensers - Two (nos)
- Evaporators - Two (nos)
- Heating assembly - One (no)
- Twin-sucking radial fans for supply air (driven by single motor) - One (no)
- Maintenance covers - Six (nos)
- Air inlets for circulating air - Two (nos)
- Air inlets for fresh air - Two(nos)
- Mixed air filters & Fresh air filter - Two (nos) each
- Air outlet for supply air - One (no)
- Control and safety devices
- Pipelines/fittings

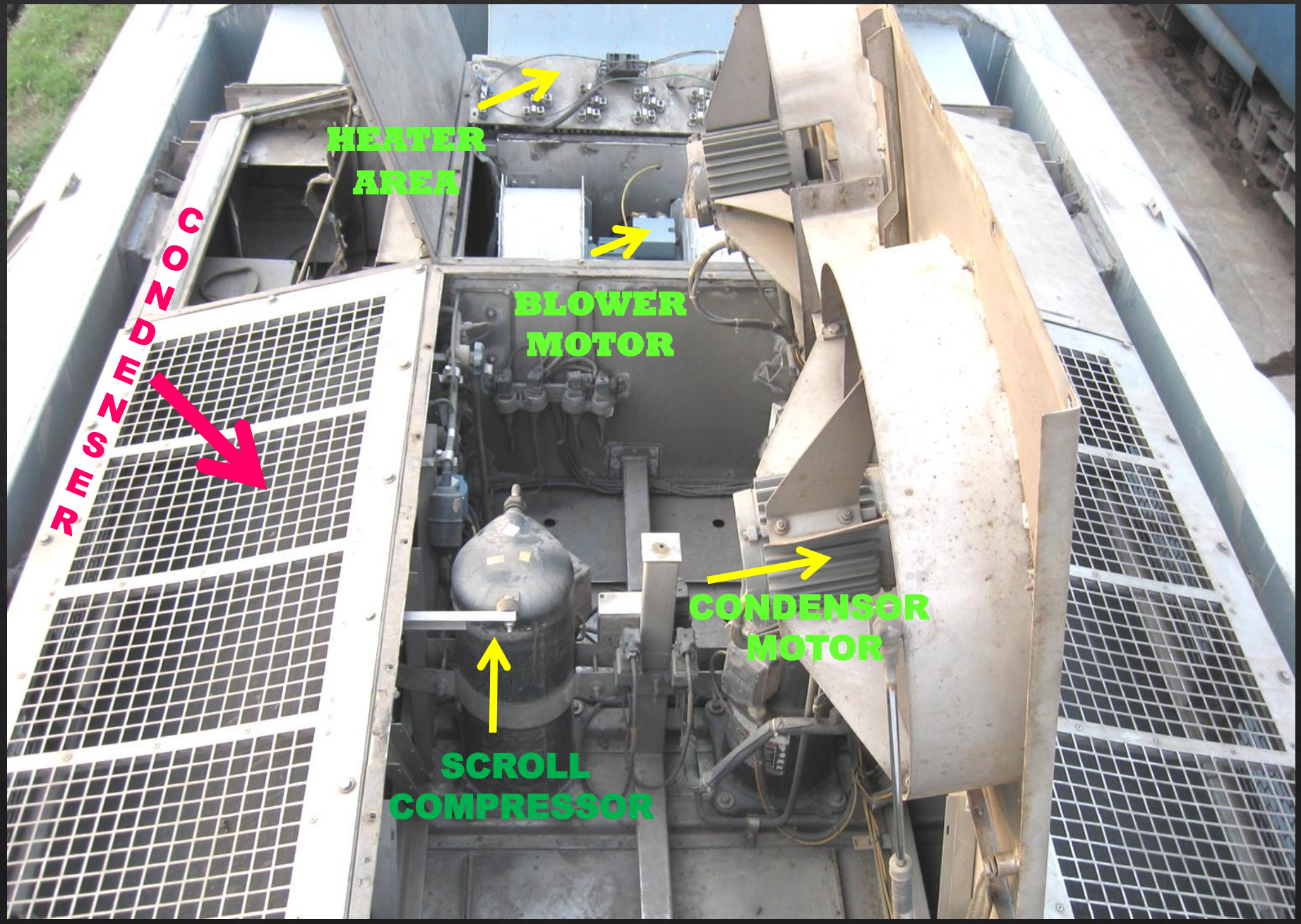
MAJOR EQUIPMENTS IN THE RMPU OF LHB AC COACHES

- SCROLL COMPRESSOR (6.5KVA)
- CONDENSER MOTOR (0.75KW 1HP)
- BLOWER MOTOR (1.5 HP 1.1KW)
- CONDENSER COIL
- EVAPORATOR (COOLING) COIL

Hermetically sealed Scroll Compressor




English 3D Animation


HEATER
AREA
BLOWER
MOTOR
CONDENSER
CONDENSOR
MOTOR
SCROLL
COMPRESSOR

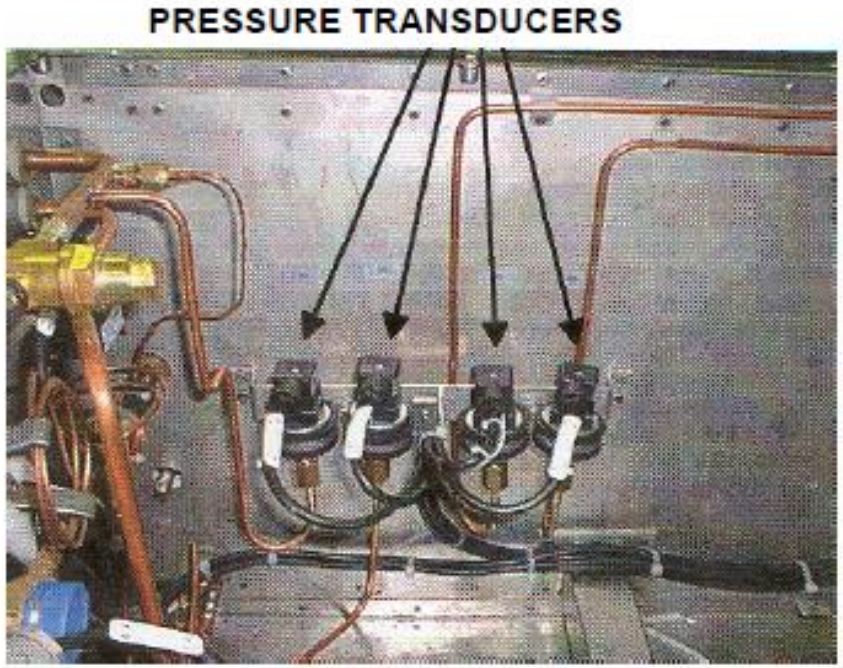
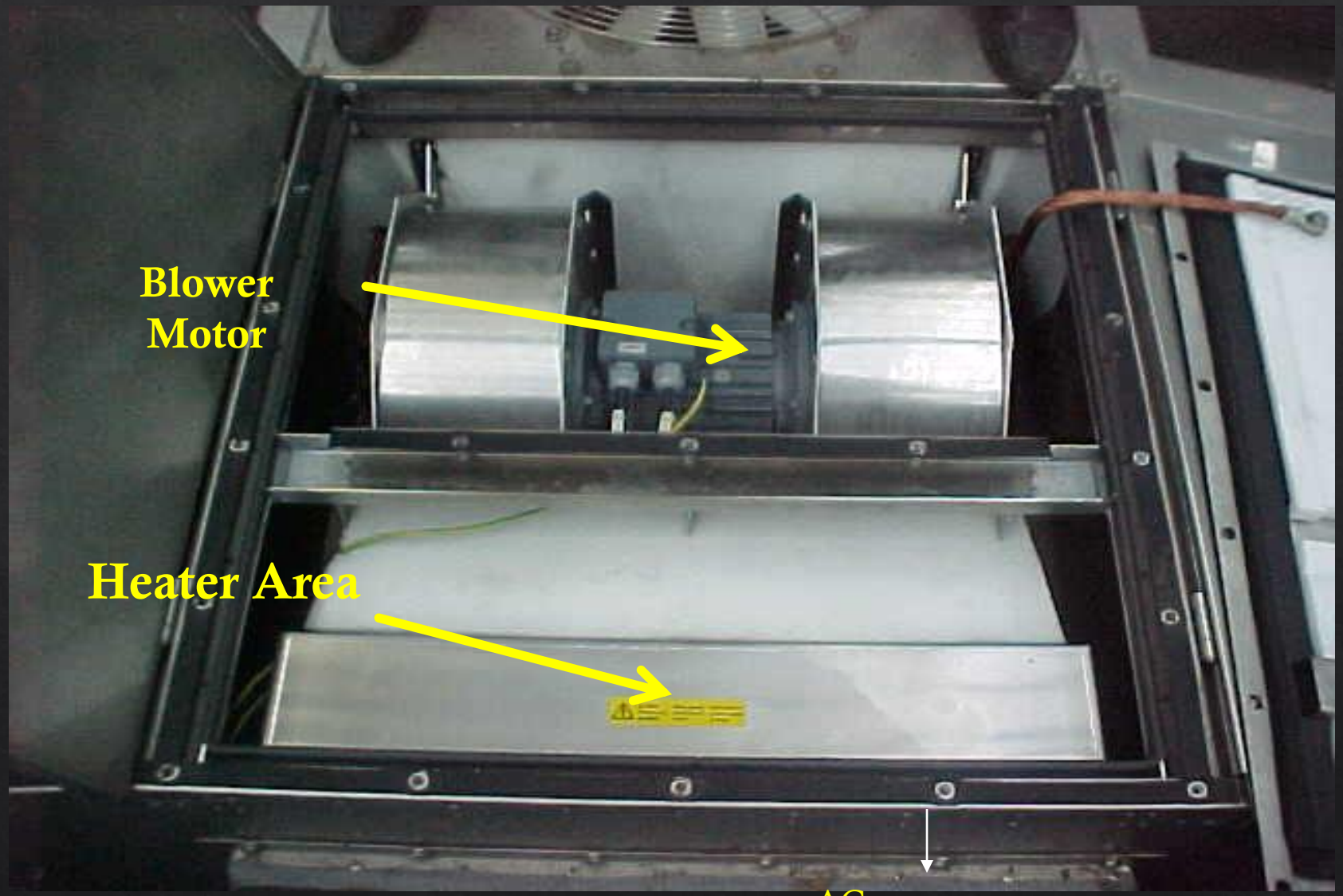


Figure 6.14 Pressure Transducers in RMPU

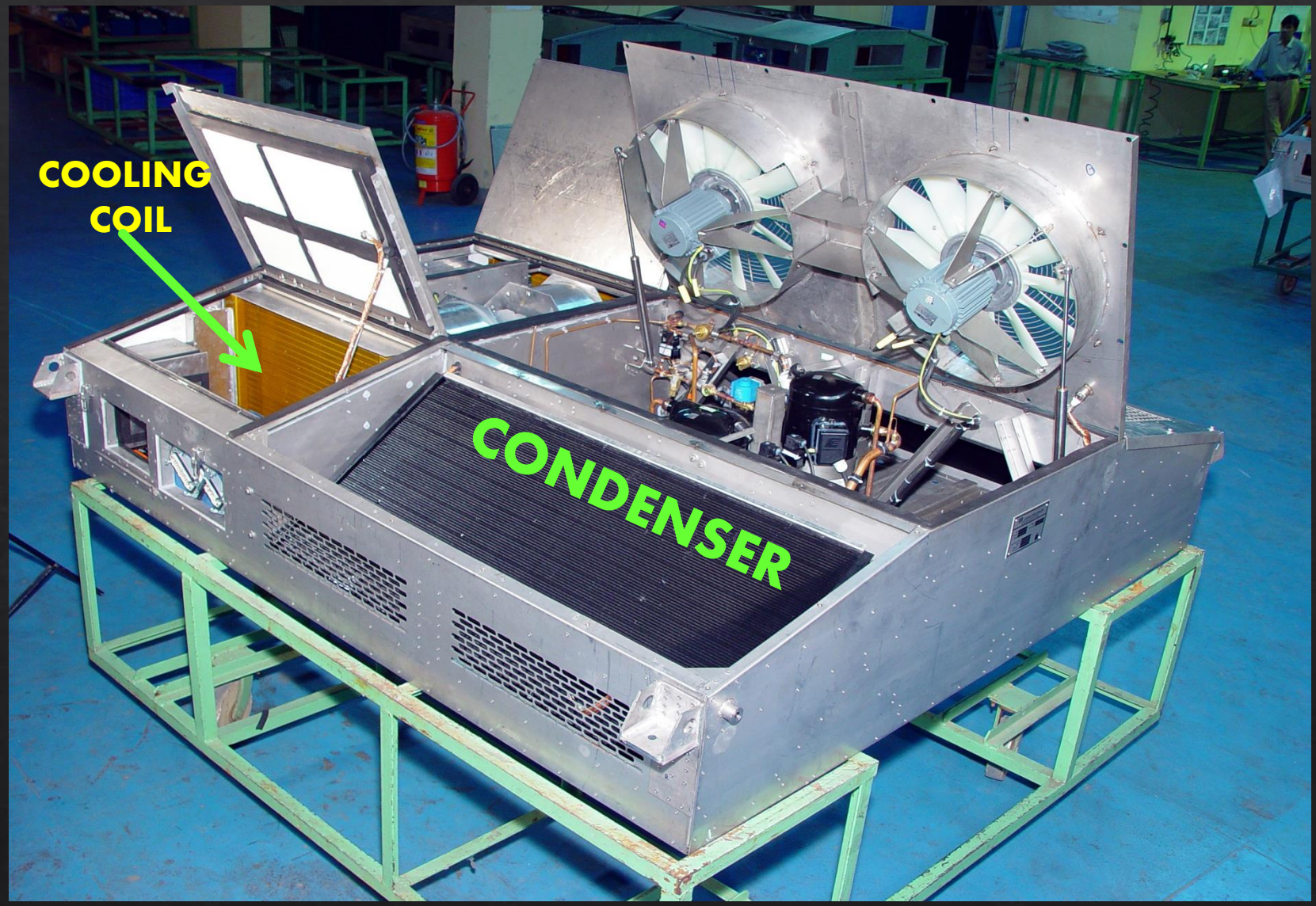

CONDENSOR MOTOR

Condenser fan

BLOWER MOTOR ASSEMBLY



CONDENSER

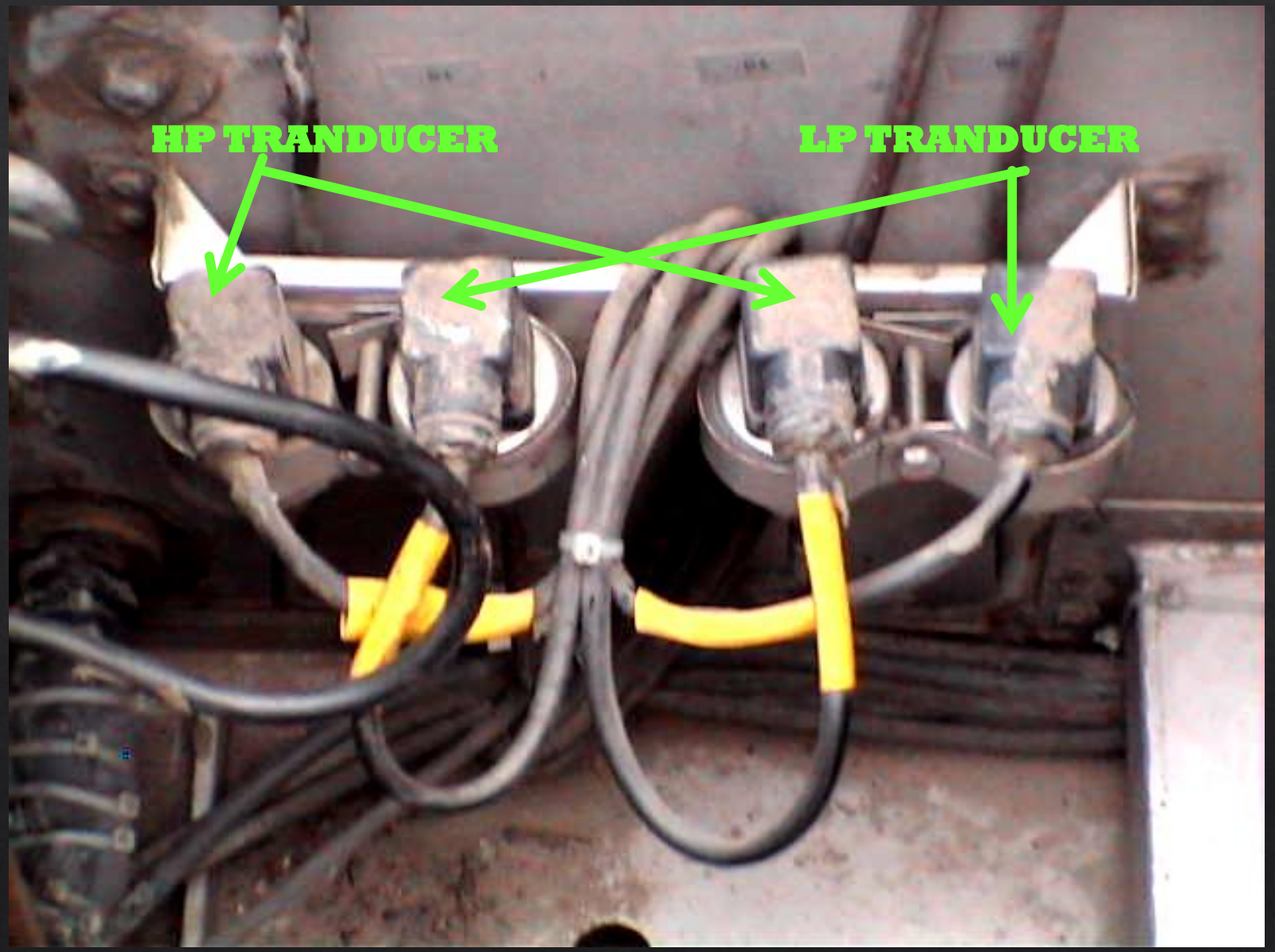


COOLING COIL

MAJOR EQUIPMENTS IN THE RMPU OF LHB AC COACHES

- TRANSDUCER FOR LP & HP GAUGE
- HP CUT-OUT SWITCH
- LP CUT-OUT SWITCH

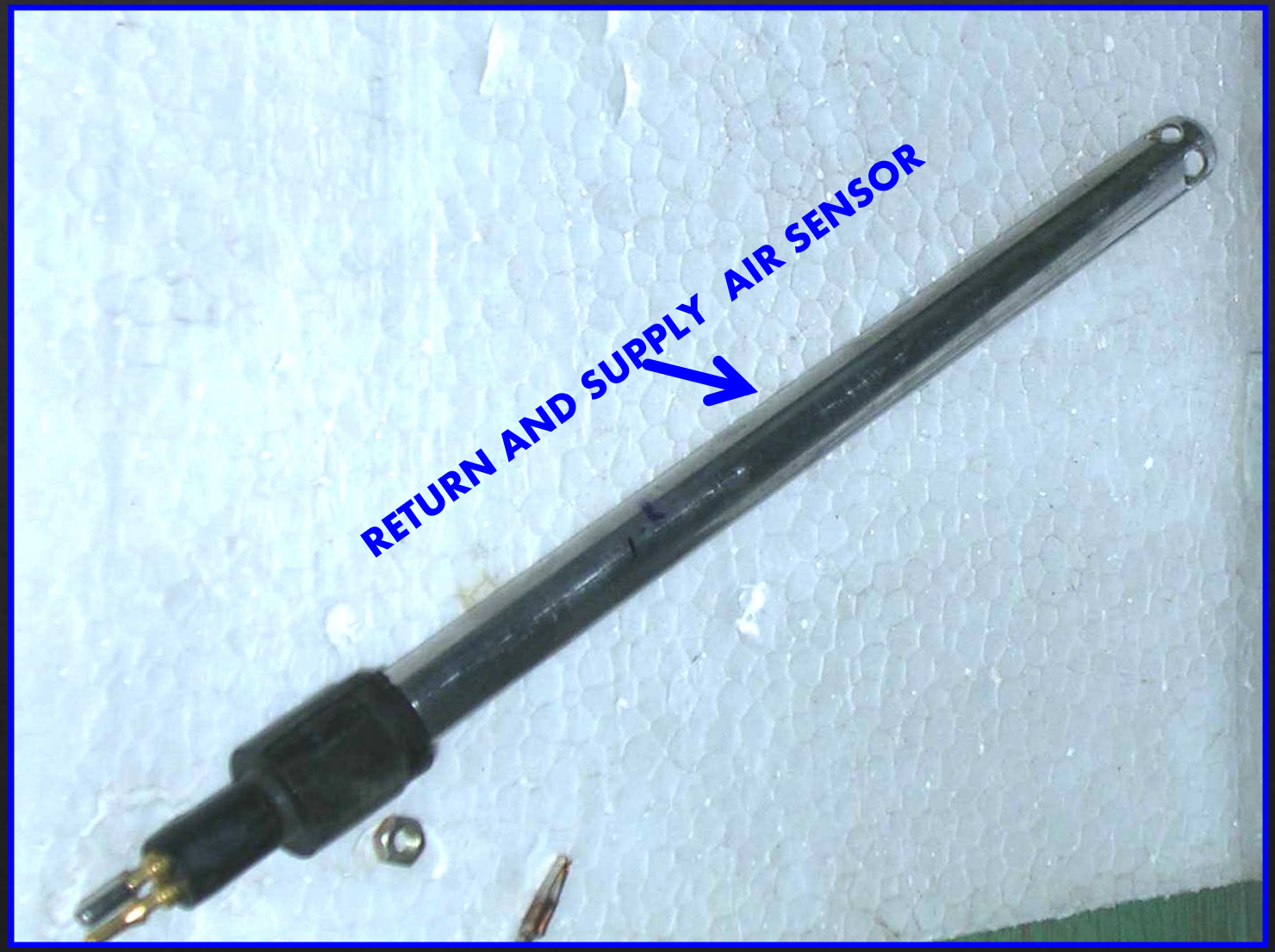
GAS PRESSURE TRANSDUCER



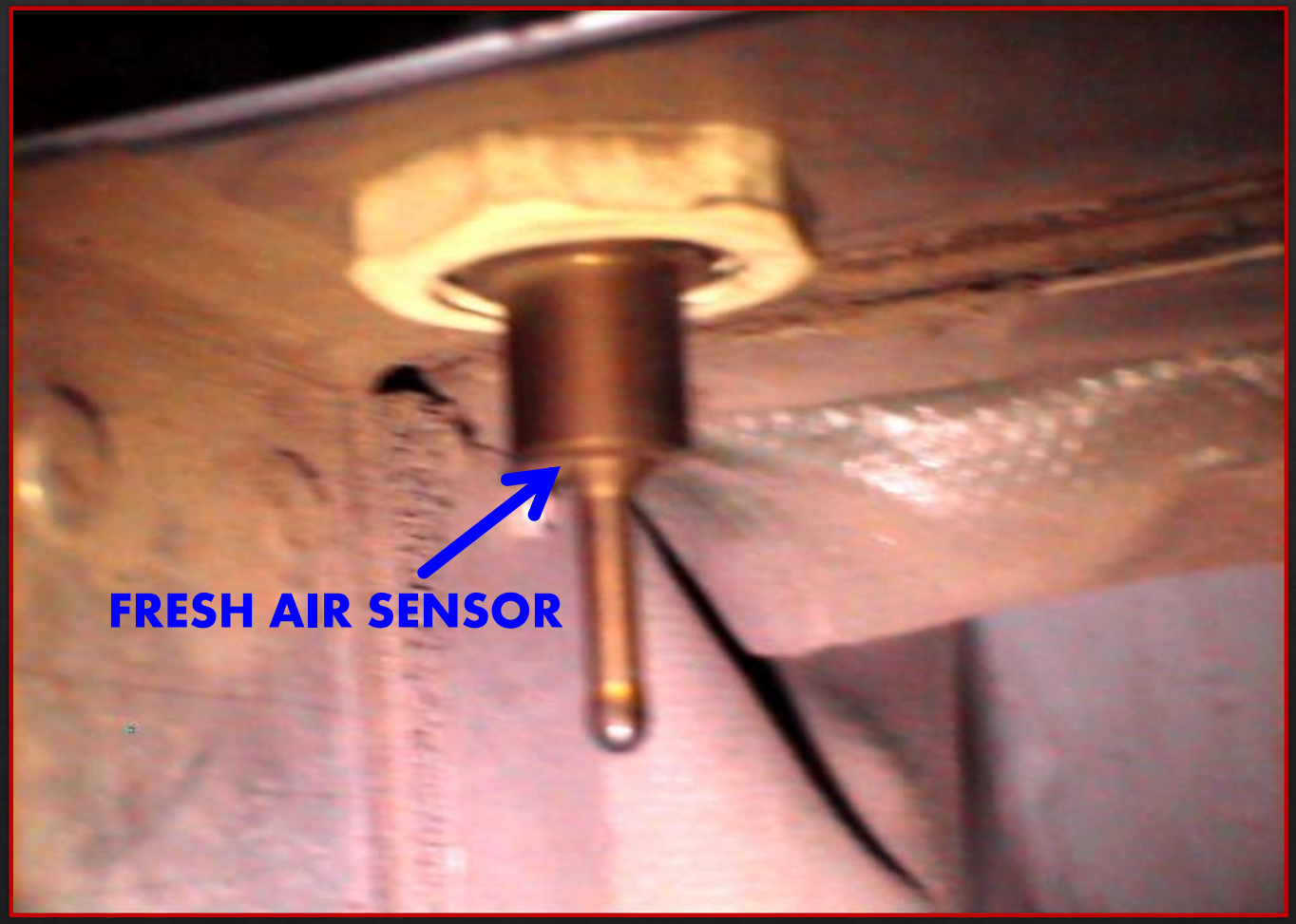
MAJOR EQUIPMENTS IN THE RMPU OF LHB AC COACHES

- TEMPERATURE SENSOR FOR RETURN AIR, FRESH AIR AND SUPPLY AIR
- HYGROSTAT FOR HUMIDITY CONTROL
- SERVO MOTOR FOR CONTROLLING QUANTITY OF FRESH AIR REQUIRED

RETURN AND SUPPLY AIR SENSOR

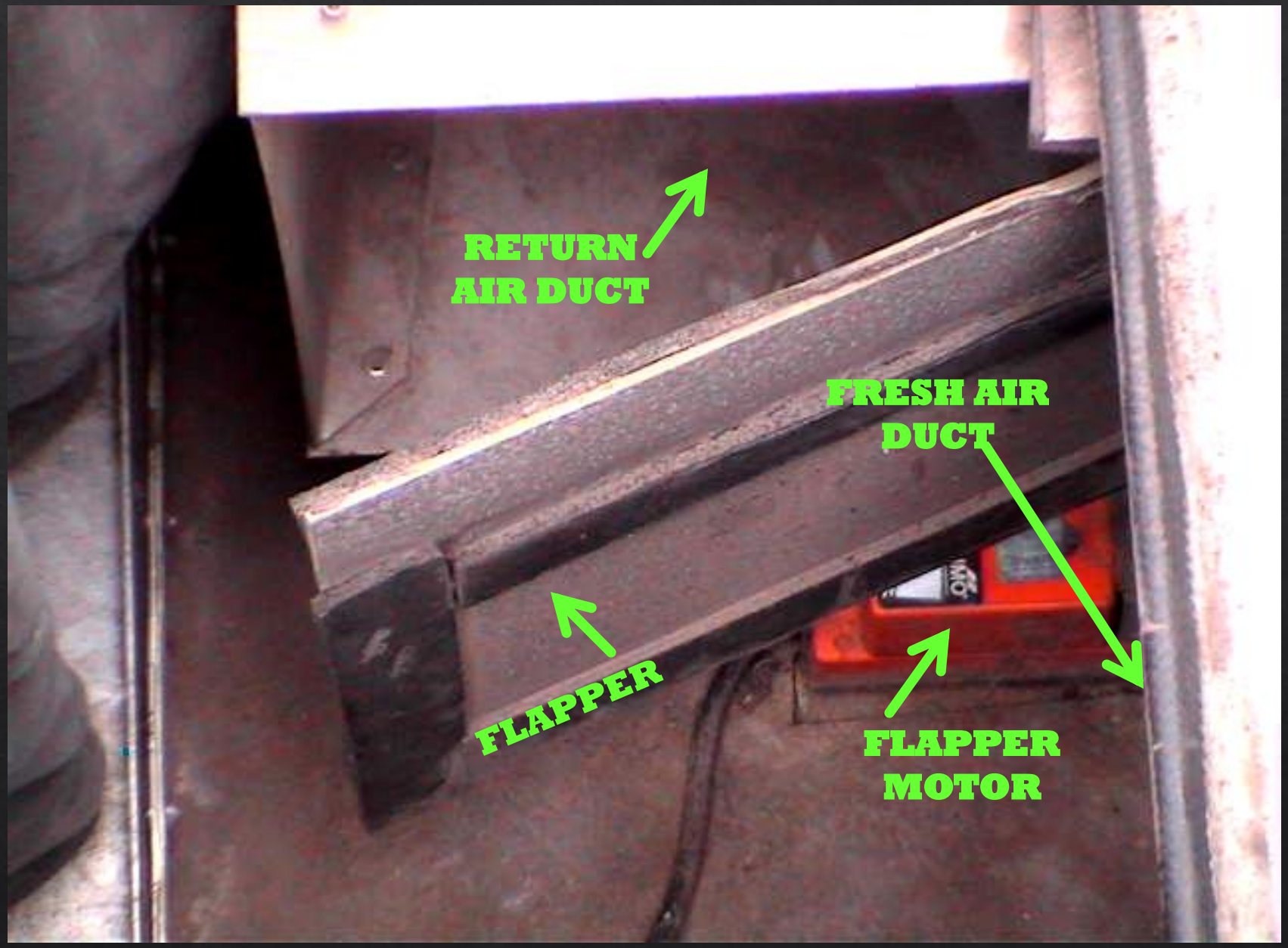


FRESH AIR SENSOR



HIGROSTAT (Humidity Sensor)

SERVO FLAPPER MOTOR



SERVO FLAPPER MOTOR

Servo motor control during Pre-Cooling Mode

- If the Ambient Temperature & Room Temperature is greater than 28°C , the controller decides to operate in Pre-cooling mode.
- In this mode the fresh air/re-circulating air flap set to 100% re-circulation air and exhaust fans are turned off.
- Both Compressor are turned ON for maximum Cooling
- This cycle runs for 30 minutes, after that depending on temperature, mode changed to Cooling / Heating.

Servo motor control Pre-Heating Mode

- If the Ambient Temperature & Room Temperature is less than 14°C , the controller decides to operate in Pre- Heating mode.
- In this mode the fresh air/re-circulating air flap set to 100% re-circulation air and exhaust fans are turned off.
- Heaters are operated at its maximum duty cycle (55 seconds ON and 5 seconds OFF)
- This cycle runs for 30 minutes, after that depending on temperature, mode changed to Cooling/Heating.

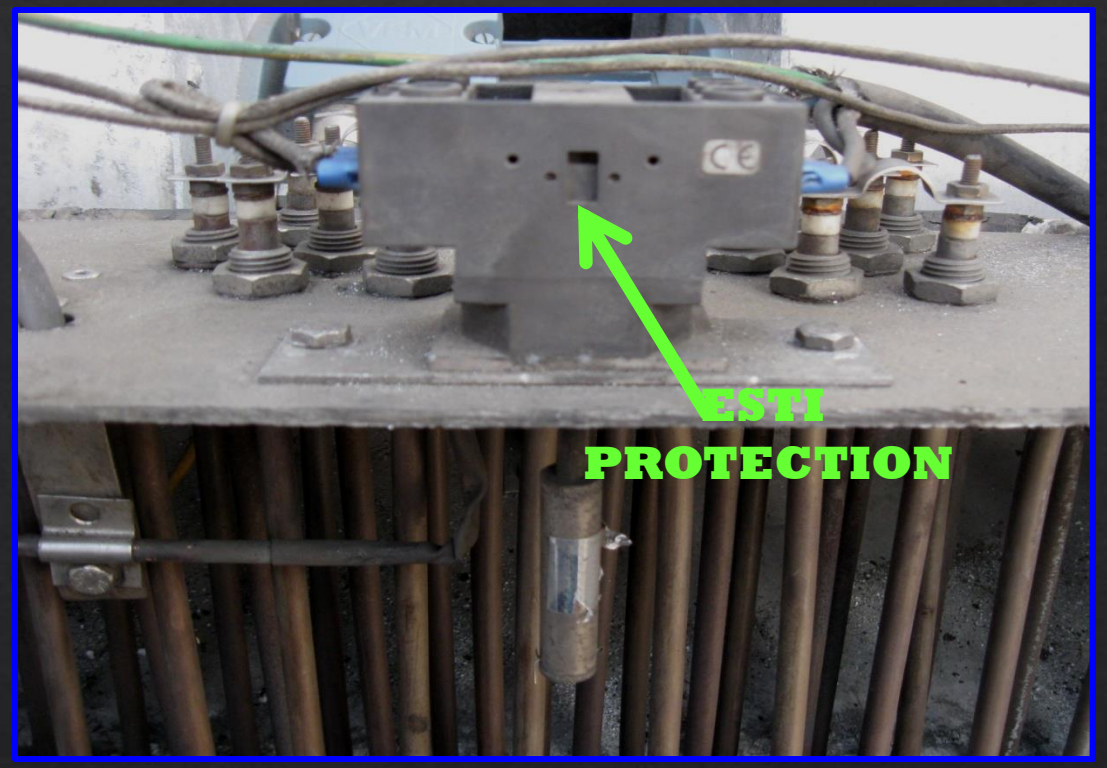
SERVO FLAPPER MOTOR

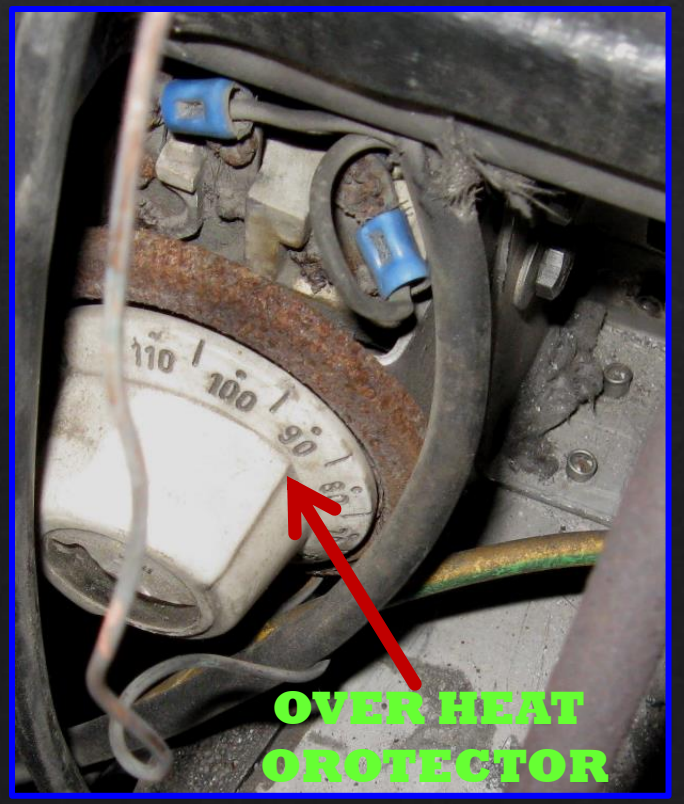
MAJOR EQUIPMENTS IN THE RMPU OF LHB AC COACHES

- HEATER COIL WITH Temperature Over heat protector .
- EXPANSION VALVE
- DRIER
- LOOKING GLASS
- RETURN AIR AND FRESH AIR FILTER

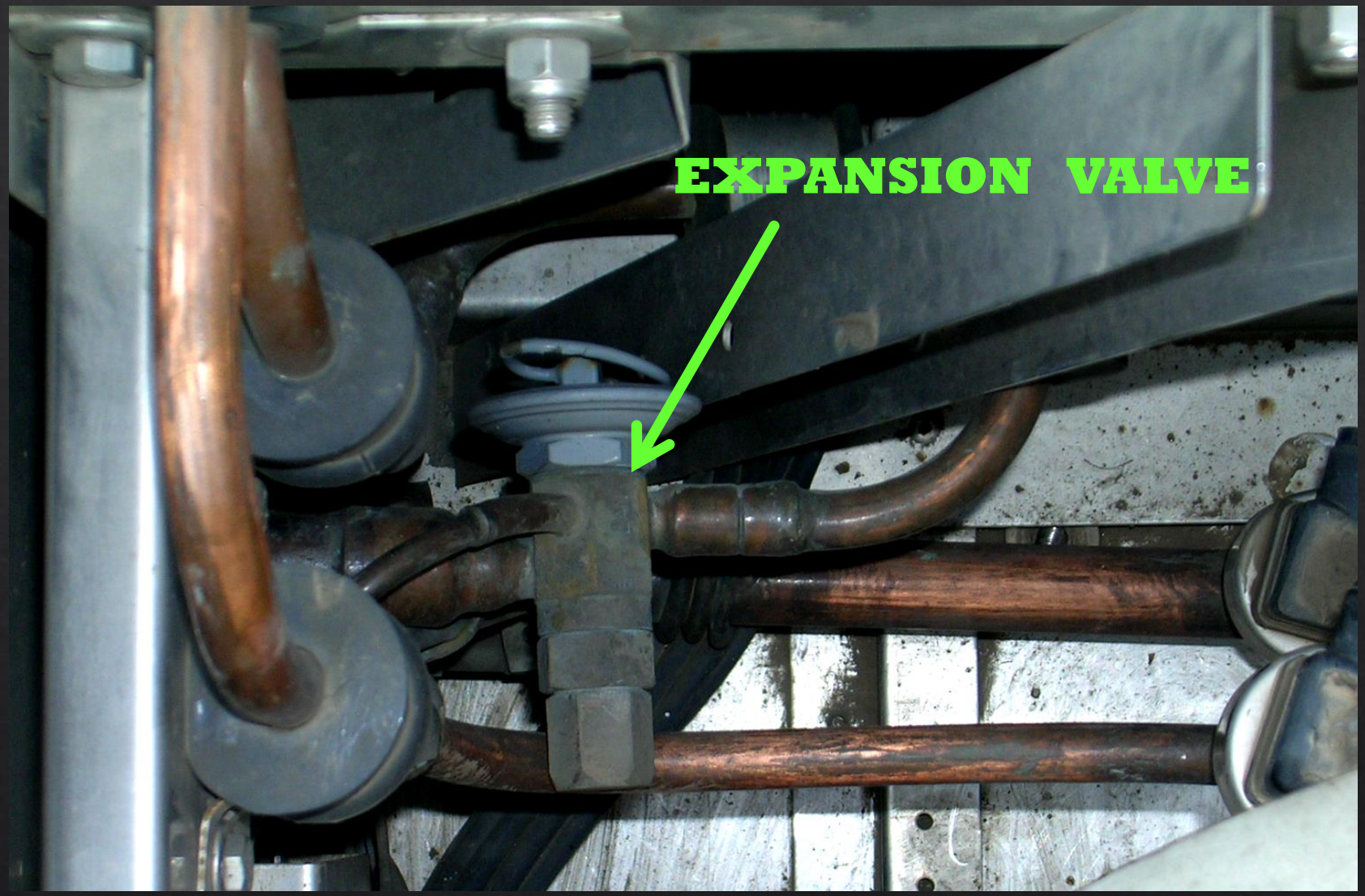
Heater Coils

ESTI PROTECTION & OVER HEAT POROTECTOR



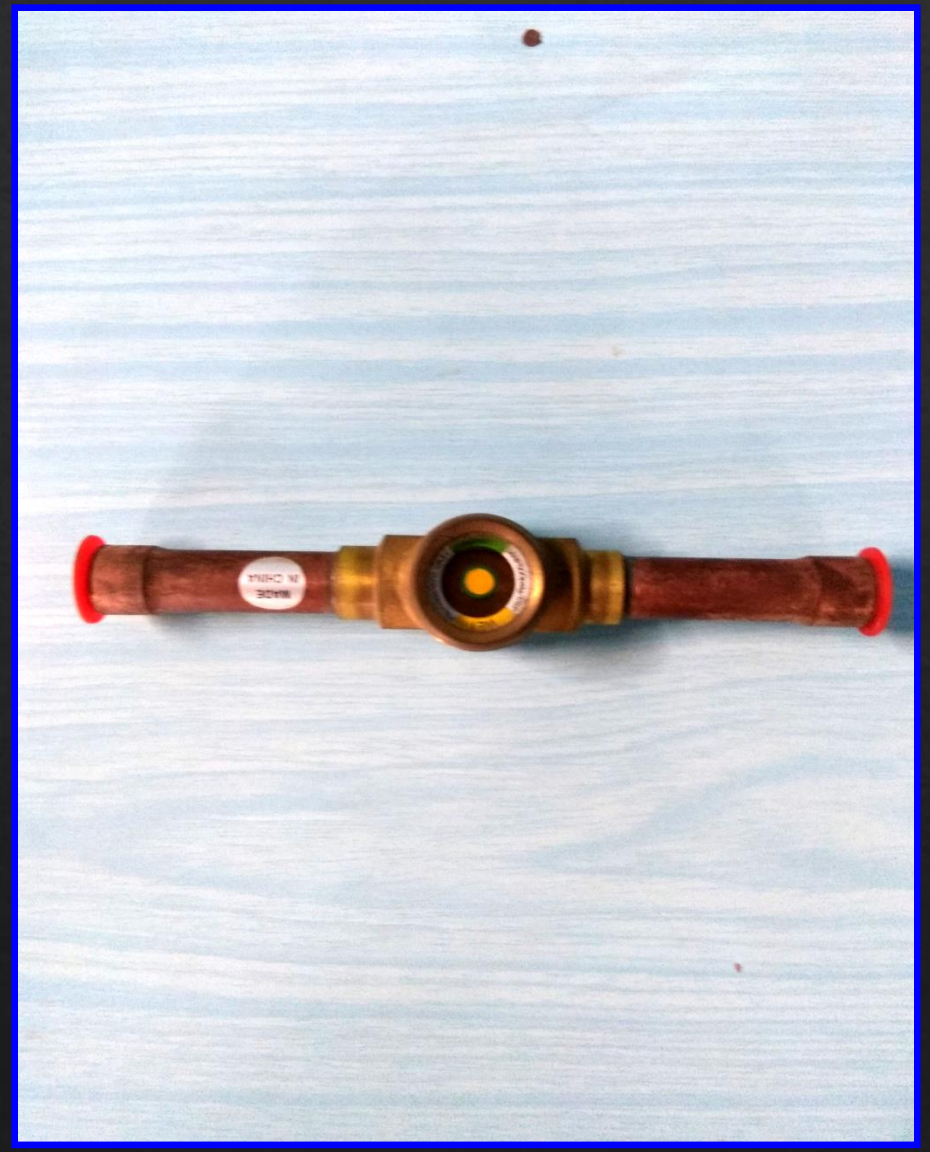


Expansion Valve



DRIER

LOOKING GLASS



RETURN AIR FILTER

FRESH AIR FILTER

Microprocessor based RMPU system

- Controls temperature and humidity through temperature sensors and humidity sensors.
- System is suitable for maximum ambient temperature of 55°C, minimum ambient temperatures of 5°C, average ambient temperature of 35°C and maximum relative humidity of 100% .
- 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°C reduces the duty cycle of compressor & eventually the failures of compressors.
- Sleep Mode Operation: The controller automatically enters the sleep mode operation during predefined night hours.

- The controller monitors duty cycle of compressors.
- Fault storage/diagnostics system: Faults are recorded automatically. Faults can be downloaded by Laptop.
- Display Unit is available.
- Trouble shooting instructions are displayed on the screen.
- System will monitor supply voltage and current and record the power consumption.

Sleep mode operation

- The controller automatically enters the sleep mode operation during pre-defined night hours which can be changed to suit the requirement for different seasons and places.
- At the start of sleep mode operation, controller gradually increases the coach temperature in equal steps to a predefined value within specified time period and maintains the same during the night hours.
- At the end of night hours, the processor gradually reduces the coach temperature to selected value within pre-defined time period.
- The set temperature during night hour as well as its time period can be altered by the maintenance staff.

RMPU Control system

- 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 temperature within 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 control initial inrush of current.
- During winter season when the coach temperature reaches 2°C below the set value, the heaters are switched 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 or shuts down the system, depending upon the nature of defect to prevent any unsafe operating condition for the RMPU.

Fault storage/ Self diagnostics

- A fault storage system records various tripping and faults of the RMPU along with the instant status of various parameters like temperature setting, LP & HP pressure and relative humidity.
- The fault messages along with trouble shooting instructions are displayed during various fault conditions.
- The system monitors supply voltage and current and records the power consumption of units.

Microprocessor system Display unit

- One display unit for each control unit is mounted on the left door of the control panel.
- The control display unit functions as an interface between operator and system. Display unit have necessary keys for the purpose.

The following functions are possible through key board.

- Setting of time, date, train no. and RMPU no.
- Clearing of the fault on display.
- Viewing of the stored faults.
- Display of digital inputs and outputs.
- Display of status of the system.
- Setting various parameters for controller by maintenance staff.

FUNCTIONAL DESCRIPTION

- Sucking of fresh air is controlled by the computer through air flap rotated by servo motor to maintained it to 21 cubic m /hr./Person during normal operation mode.
- Pre-heating / pre-cooling---- fresh air entry is closed for quick heating/ cooling
- In case of emergency / mpc failure servo motor closes entry of return air & system operates exclusively with fresh air.

1. Test mode
2. Emergency mode
3. Control mode

Test mode

A laptop is connected to the controller through the serial port. Software of the firm will be required. It will switch off all out puts & enter into test mode for 02 hours. In test mode each equipment can be checked individually i.e. Evaporator, condenser, comp, heater, exhaust fan, servomotor, by-pass solenoid valve etc.

EMERGENCY-MODE

- If a measuring sensor fails the system adopts emergency mode automatically
- Outdoor temp. SENSOR defective

  Step 1- works on value of other unit sensor.

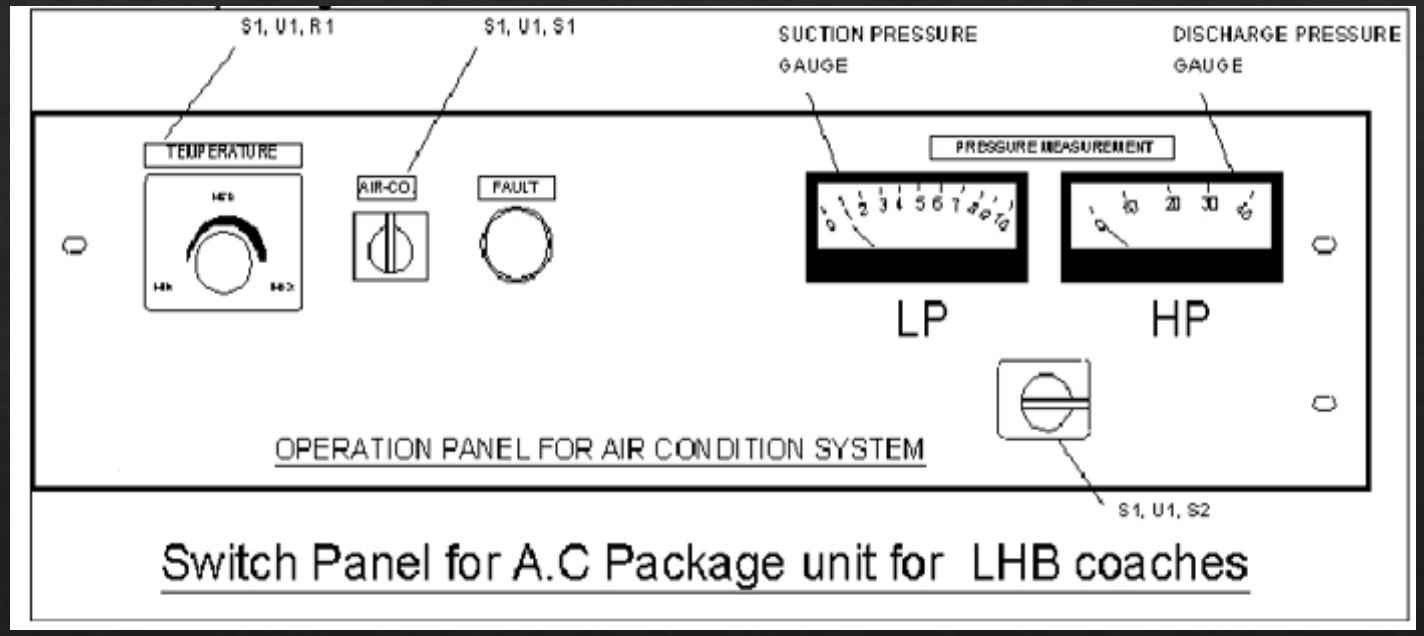
  Step 2- works on 20 degree Fixed value.
- Return air temp. Sensor defective

  Step 1-works on value of other unit sensor.

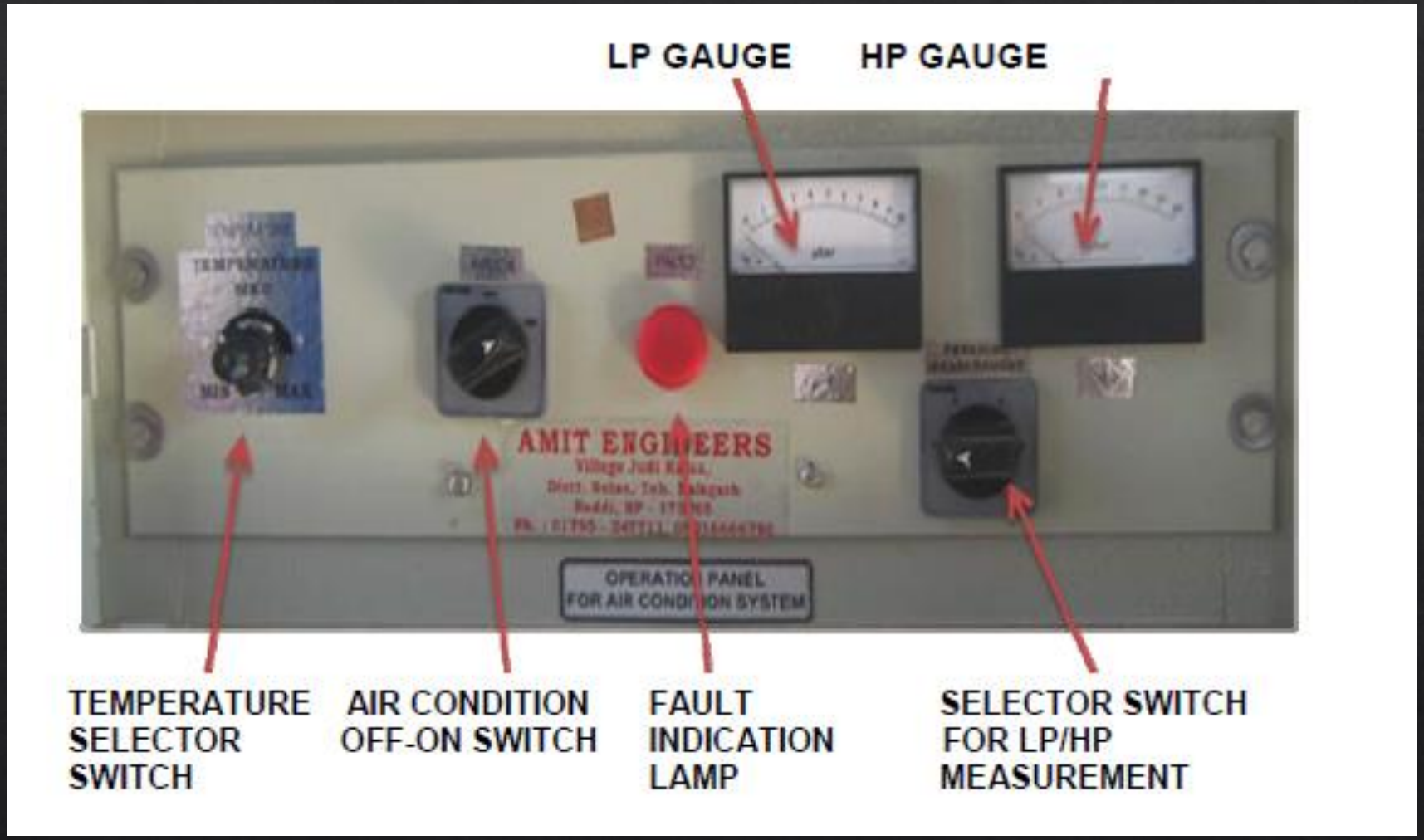
  Step 2-works according to supply & Fresh air temp.
- Supply air temperature Sensor defective- control together with return air temp.
- Set point generator defective - Works at 23 degree
- Supply & return air sensor defective- Turns off heating /cooling. Ventilation remains possible .

CONTROL MODE

- Heating , ventilating , cooling & dehumidifying are controled automatically as per the ambient temp.
- A.C. CONTROL



AC PACKAGE MICROPROCESSOR CONTROLLER DISPLAY PANEL



Temperature settings are achieved by rotary switch provided on the Switch Board Cabinet

Position of switch	Temperature	
	Cooling	Heating
1	20.0 Deg C	17.0 Deg C
2	20.5 Deg C	17.5 Deg C
3	21.2 Deg C	18.2 Deg C
4	21.9 Deg C	18.9 Deg C
5	22.6 Deg C	19.6 Deg C
6	24.3 Deg C	20.3 Deg C
7	25.0 Deg C	21.0 Deg C

HEATING

- 3phase 415v. 6kw heating set (400w*15) is provided in each unit.
- Several safety requirement must be met before switching the heater.
- Supply air fan must be running , monitoring thermostat & ohp (ESTI) must set.
- It stops working if supply air duct temperature increases above 65 deg. C, if an error message of supply air fan/heating coil thermostat is received.

DEHUMIDIFICATION

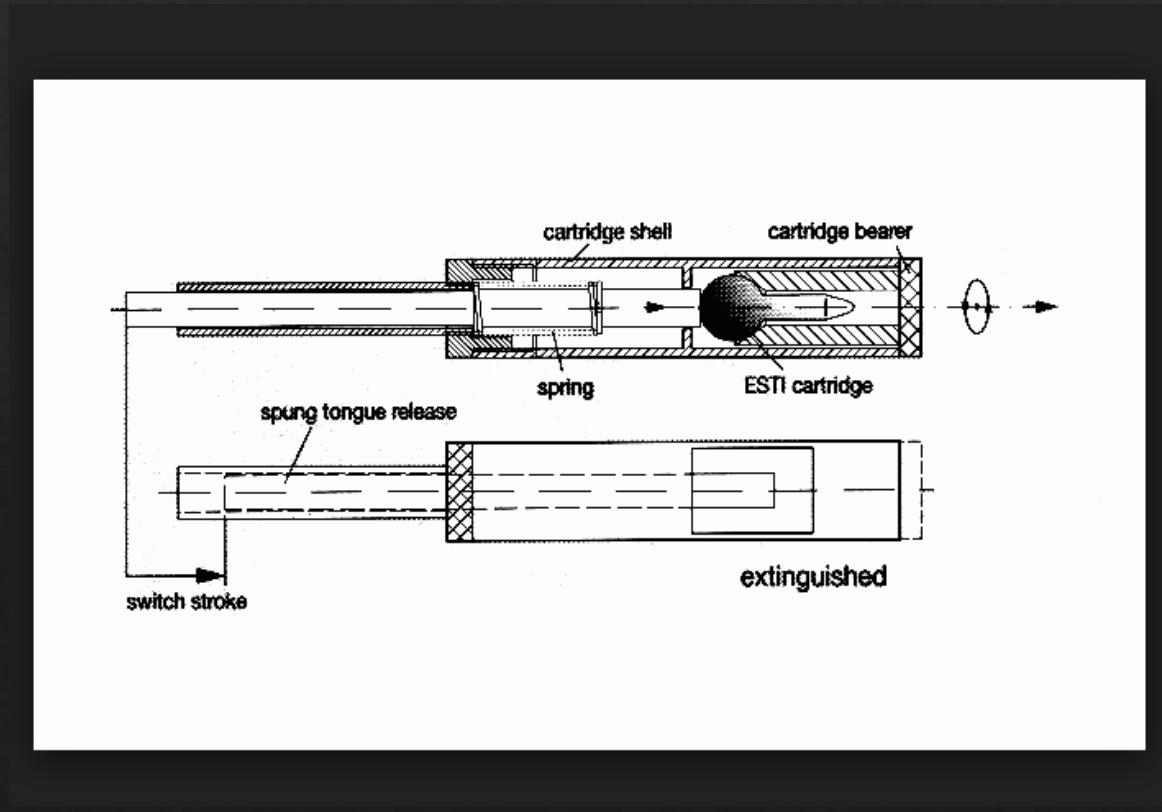
Relative humidity is sensed by hygrostat provided in the return air duct entrance. If it is above 60% and the cooling power is not sufficient to maintain the room temp. At maximum output, the heaters are cycled (1min on, 1min. Off) till the humidity is controlled.

Protections

- LP, HP cut outs have been provided in the refrigerant circuit
- Overheat protector has been provided in the heater circuit
- ESTI protection has been provided in the heater circuit to operate at 130°C in case of failure of overheat protector for ultimate disconnection of power supply to heater.
- Individual electrical protection has been provided by MCB's
- In-built overheat protection has also been provided in the motors windings, which are interlocked with microprocessor.

ESTI PRINCIPLE

- Self-destructing type, High Temp. Protection Device
  - Uses the ESTI Cartridge- A Glass Bulb filled with chemically inactive and insulating Fluid
  - Bursts with absolute certainty at a particular Temp. due to internal Pressure
  - Advantages
    - No Age
    - No Corrosion
    - No Adjustment
    - No Impact of Shocks



Advantages of Scroll compressor

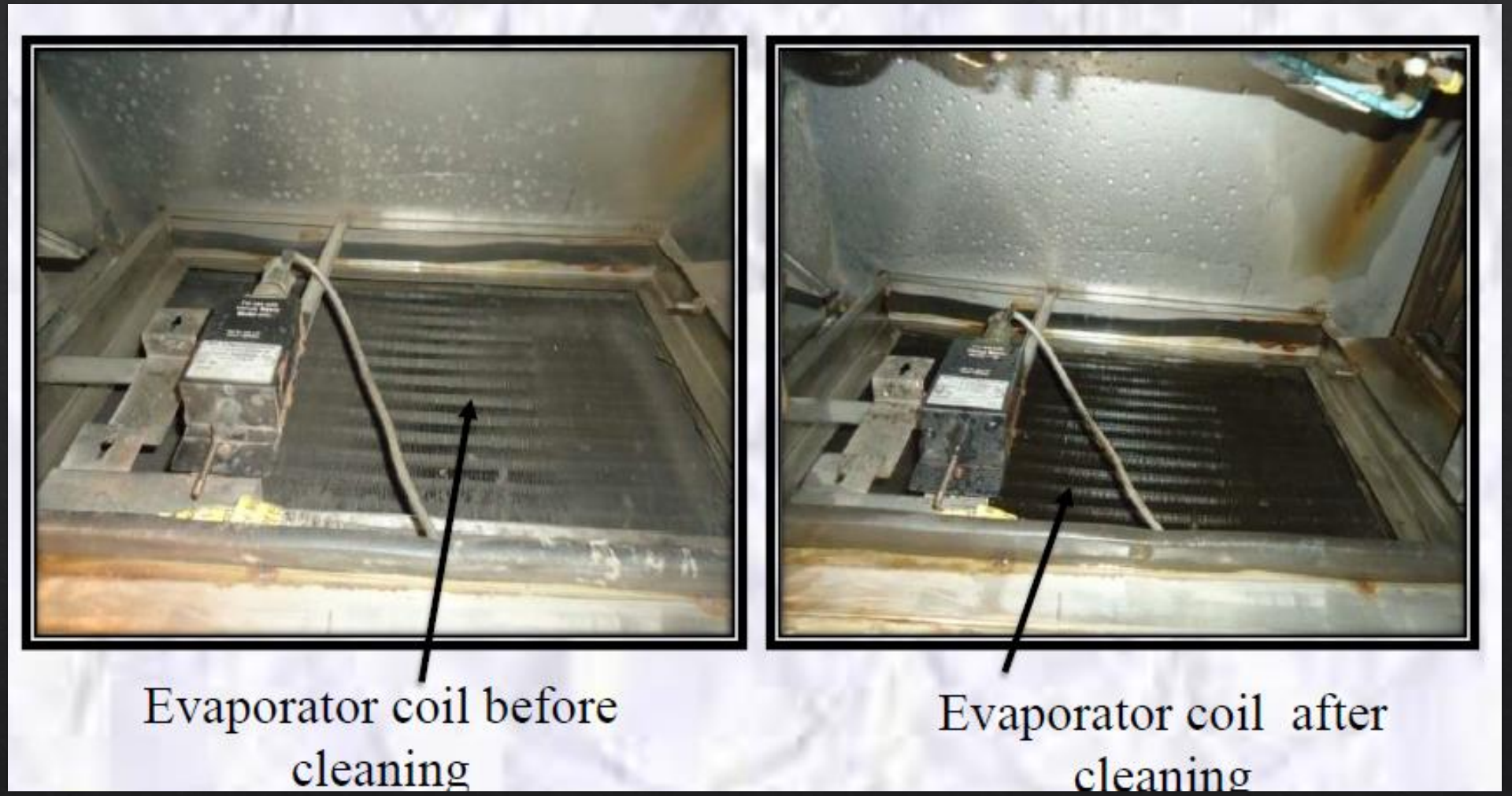
- Excellent full and part load efficiency
- Very few moving parts (3)
- Proven reliability
- Very quite operation
- Very low vibration
- Non-compliant (no contact between scrolls) have low friction
- Less wear and tear
- Low condenser temperatures
- Can handle liquid to some extent
- Continuous compression process with almost no pulsation or vibration
- Compact design

Causes of less cooling

- Inefficient working of RMPU results in more working hours of RMPU, leading to avoidable burden on battery/ alternator.
- Efficient working of RMPU results in less working hours of RMPU, which reduces burden on battery and alternators

How to avoid less cooling in AC coaches ?

- Ensure effective working of RMPU.
- Ensure working of both alternators.
- Ensure the healthiness of battery.
- Free flow of cool air and air dissipation (evaporator & condenser).
- Regular cleaning of return air filters & fresh air filters.
- Regular cleaning of condenser & evaporator coils with water jet.



Evaporator coil before cleaning

Evaporator coil after cleaning

Condensor coil before cleaning

Condensor coil after cleaning