AMIT ENGINEERS

Smart Solution for Better Future

OPERATION & MAINTENANCE MANUAL FOR ROOF MOUNTED PACKAGED AIR-CONDITIONING UNITS SUPPLIED FOR TRAIN 18 EMU COACHES

AMIT ENGINEERS

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ABOUT US

Amit Engineers is an IRIS (International Railway Industry Standards) certified company based on ISO/TS 22163:2017, established in 2001. Its manufacturing unit is situated at Baddi (Himachal Pradesh). It has state-of-the-art Design & Manufacturing facilities to ensure product quality for greater customer satisfaction. It is one of the leading manufacturers of Rail Coach Components. It also provides PAN India Services Support to Indian Railways for the HVAC, Mechanical, Electro-Mechanical and Electrical & Electronics products.

It has developed a Roof Mounted Saloon HVAC Unit with capacity of 7.5TR as per the requirements of the Indian Railways. The Roof Mounted Packaged Air Conditioning unit design is reliable, which gives low-maintenance operations and keeps the atmosphere of Saloon passenger area under control, hence this product is a long-term asset to Indian Railways.

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ABBREVIATION AND DEFINITION

ABBREVIATION	DEFINATION
AC	Alternating Current
AIP	Analog Input
AVM	Anti-Vibration Mounting
DC	Direct Current
DDU	Driver Desk Unit
DIP	Digital Input
DOP	Digital Output
EMU	Electric Multiple Unit
HP	High Pressure
HVAC	Heating Ventilation & Air-Conditioning
LP	Low Pressure.
MCB	Miniature Circuit Breaker
MPCB	Motor Protection Circuit Breaker
NC	Normally Closed
OHP	Over Heat Protection
RDSO	Research Designs and Standards Organization, Lucknow
RMPU	Roof Mounted Packaged Unit.
Unit	Air Conditioning Unit.
UV	Ultraviolet
VFD	Variable Frequency Drive
VVVFD	Variable Voltage Variable Frequency

1 INTRODUCTION

This booklet contains the Installation, operation and service instruction manual for self-contained air conditioning packaged unit supplied to Indian Railways for Train 18 EMU coaches. This Unit is based on RDSO specification no. RDSO/PE/SPEC/D/EMU/0196-2019 (Rev. 0). There are a few precautions that should be taken to derive maximum satisfaction and healthy lifecycle of the equipment. Improper installation can result in unsatisfactory operation or dangerous conditions.

Read this booklet and any instructions packaged with separate equipment required to make up the system prior to installation. Give this booklet to the owner and explain its provisions. The owner should retain this booklet for future reference.

2 UNIT SPECIFICATION

2.1 GENERAL

The packaged unit supplied by Amit Engineers is roof mounted ducted type. It has nominal cooling capacity > 7 TR and having heating capacity of 9 kW. The Conditioned air is supplied from an end of the unit whereas return air from conditioned space is sucked from bottom of unit. Fresh air is sucked and filtered from the opening provided on both side of the unit.

Two identical units are installed on either side of the coach complimenting each other for maintaining the comfort condition for passengers in car. Unit is weatherized for mounting in outside ambient and has designed to survive and perform at its full capacity under the traction environment even in worst ambient conditions.

2.2 MAJOR COMPONENTS

The unit includes Two hermetically-sealed scrolled refrigerant compressors, two fin-tube type air cooled condensers, two direct expansion type evaporators, Thermostatic expansion valve. Unit also consist of a centrifugal type fan as blower, a propeller type fan for forced condensation, and all necessary components in refrigerant tubing for control and regulation along with internal electrical wiring.

The cooling system of unit is factory-evacuated, charged and performance tested and provided in ready to install condition. Refrigerant amount and type are indicated on rating plate.

SL.NO	PART NAME	QTY
1	Condenser Coil	2
2	Condenser Fan	2
3	Fixed Speed Compressor	1
4	Variable Speed Compressor	1
5	Emergency Fan Inverter	1
6	Compressor VFD	1
7	Pressure Differential Sensor	2
8	Blower Assembly	1
9	Return Air Filter	2
10	Fresh Air Filter	2
11	Evaporator Coil	2

SL.NO	PART NAME	QTY
12	Smoke Detector	1
13	Heater Assembly	1
14	Condenser Motor	2
15	Fresh Air Sensor	1
16	Actuator Return Air	2
17	CO_2 Sensor	1
18	Actuator Fresh Air	2
19	Supply Air Sensor	1
20	Return Air Sensor	1
21	Hygrostat	1
22	UV Lamp	2

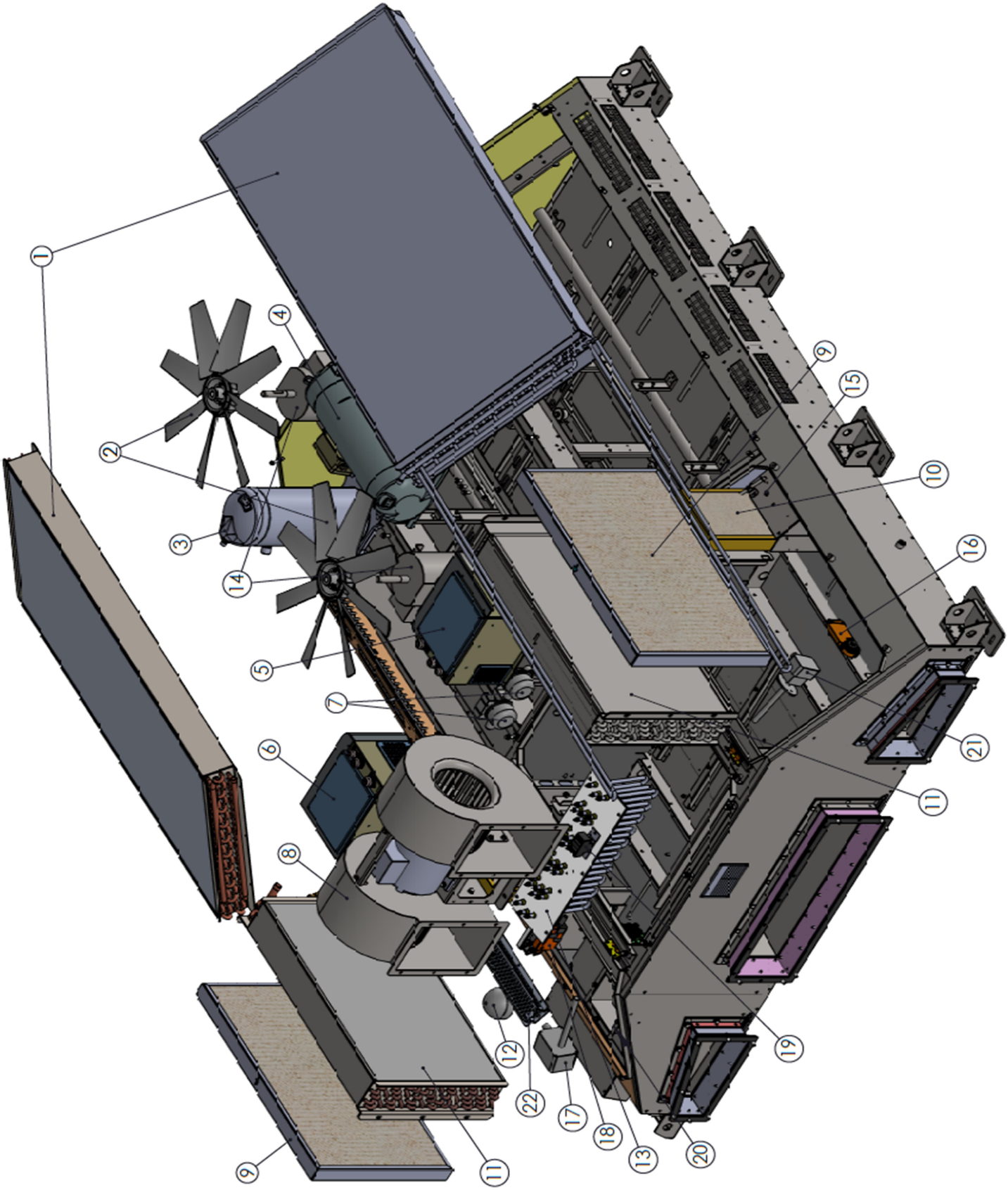
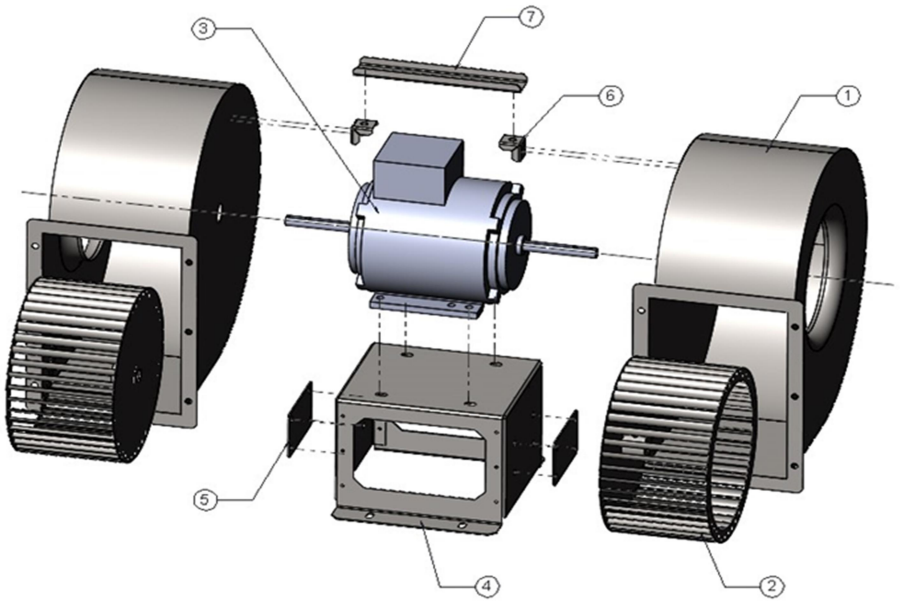
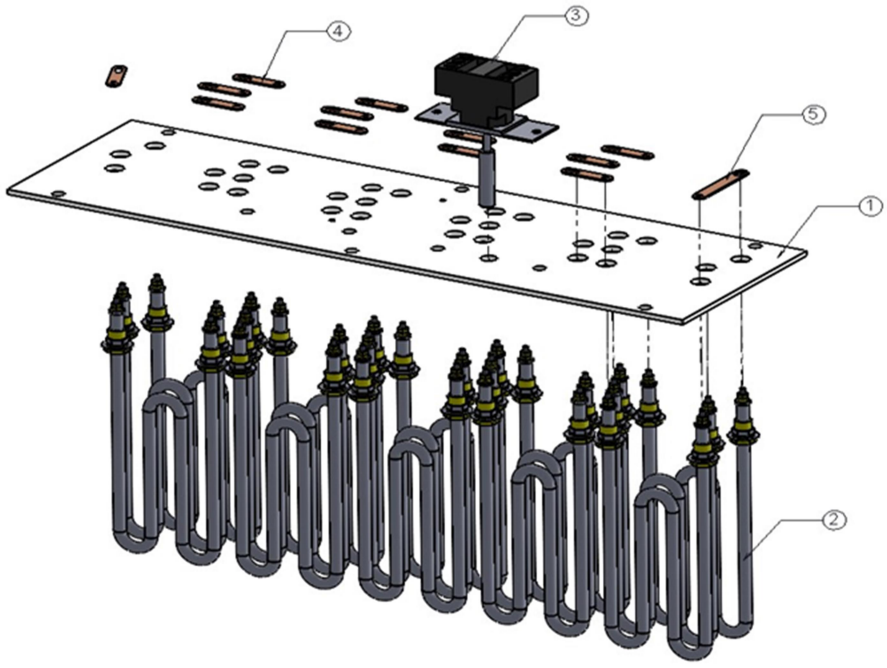


FIGURE 2-1: Extruded Unit View



SL.	PART NAME	QTY.
1	Blower Housing	1L+1R
2	Blower Runner	1L+1R
3	Blower Motor	1
4	Motor Base	1
5	Motor Base Plate	2
6	Angle for Blower Support	2
7	Blower Support	1

FIGURE 2-2 : Blower Assembly



SL.	PART NAME	QTY.
1	Heater Plate	1
2	Heater Element	15
3	ESTI (OHP)	1
4	Heater Cu Strip 1	13
5	Heater Cu Strip 2	1

FIGURE 2-3 : Heater Assembly

The HVAC unit is mainly divided into three main sections, Air Handling Section, Compressor-Condenser Section and Air-Conditioning Control Section. Followings are the list of component consists by each section along with their quantity and article code#.

2.2.1 AIR HANDLING SECTION

Sr. No.	Item Name	Article Code	UOM	Quantity
01	Evaporator Coil	T18 186	Nos.	02
02	Heater Assembly	LHB 007	Set	01
03	Supply Air Blower Motor	LHB 002	No.	01
04	Supply Air Blower runner with Housing (L+R)	T18 166	Nos	02
05	Thermostatic Expansion Valve	RVC 006	Nos	02
06	Fresh Air Filter	T18 164	Nos	02
07	Return Air Filter	T18 165	Nos	02
08	Fresh Air Damper with actuator	EMU 031	Nos	02
09	Return Air Damper with actuator (Right)	T18 018	No	01
10	Return Air Damper with actuator (Left)	T18 019	No	01
11	Smoke Detector	T18 009	No	01
12	NTC -Temperature sensors	LHB 013	Nos	03
13	Hygrostat	LHB 026	No	01
14	ESTI Cartridge	LHB 011	No	01
15	CO_2 Sensor	T18 017	No	01
16	UV Lamp	T18 007	Nos	02
17	Emergency Inverter With VFD	T18 343	No	01
18	Programmable Logic Controller	-	No	01
19	Compressor VVVFD	T18 344	No	01

2.2.2 COMPRESSOR CONDENSOR SECTION

Sr. No.	Item Name	Article Code	UOM	Quantity
01	Variable speed compressor	ACR 029	No.	01
02	Fixed speed compressor	ACR 033	No.	01
03	Condenser coil	T18 185	Nos.	02
04	Condenser motor	LHB 001	Nos.	02
05	Condenser fan	T18 010	Nos.	02
06	Refrigerant filter drier	T18 003	Nos.	02
07	Sight glass	T18 162	Nos.	02
08	High pressure switch	EMU 010	Nos.	02
09	High pressure transducer	LHB 015	Nos.	02
10	Low pressure switches	LHB 124	Nos.	02
11	Low pressure transducer	LHB 014	Nos.	02

for parts placement during maintenance, the article code shall be provided.

2.2.3 UNIT DIMENSION AND WEIGHT

Length	Width	Height	Weight
2565 mm	2100 mm	545 mm	690 kg

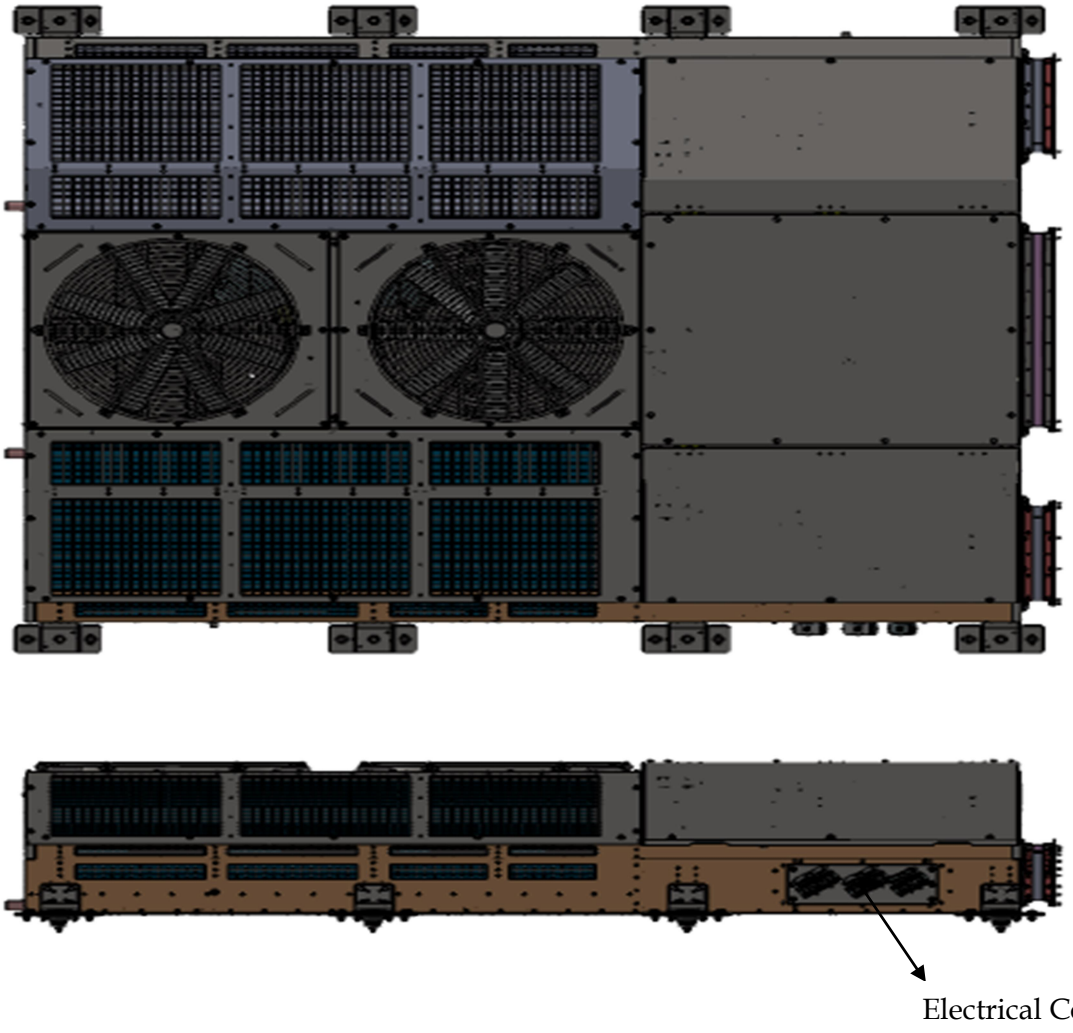
2.2.4 OPERATING VOLTAGE

Variable Speed Compressor	150-380V, 3 Ph, 30-60 HZ
Fixed Speed Compressor	415V AC, 3 Ph, 50 Hz
Condenser Motors	415V AC, 3 Ph, 50 Hz
Blower Motors	415V AC, 3 Ph, 50 Hz
Electric Heaters	415V AC, 3 Ph, 50 Hz
Control Voltages	110V DC, 24V DC

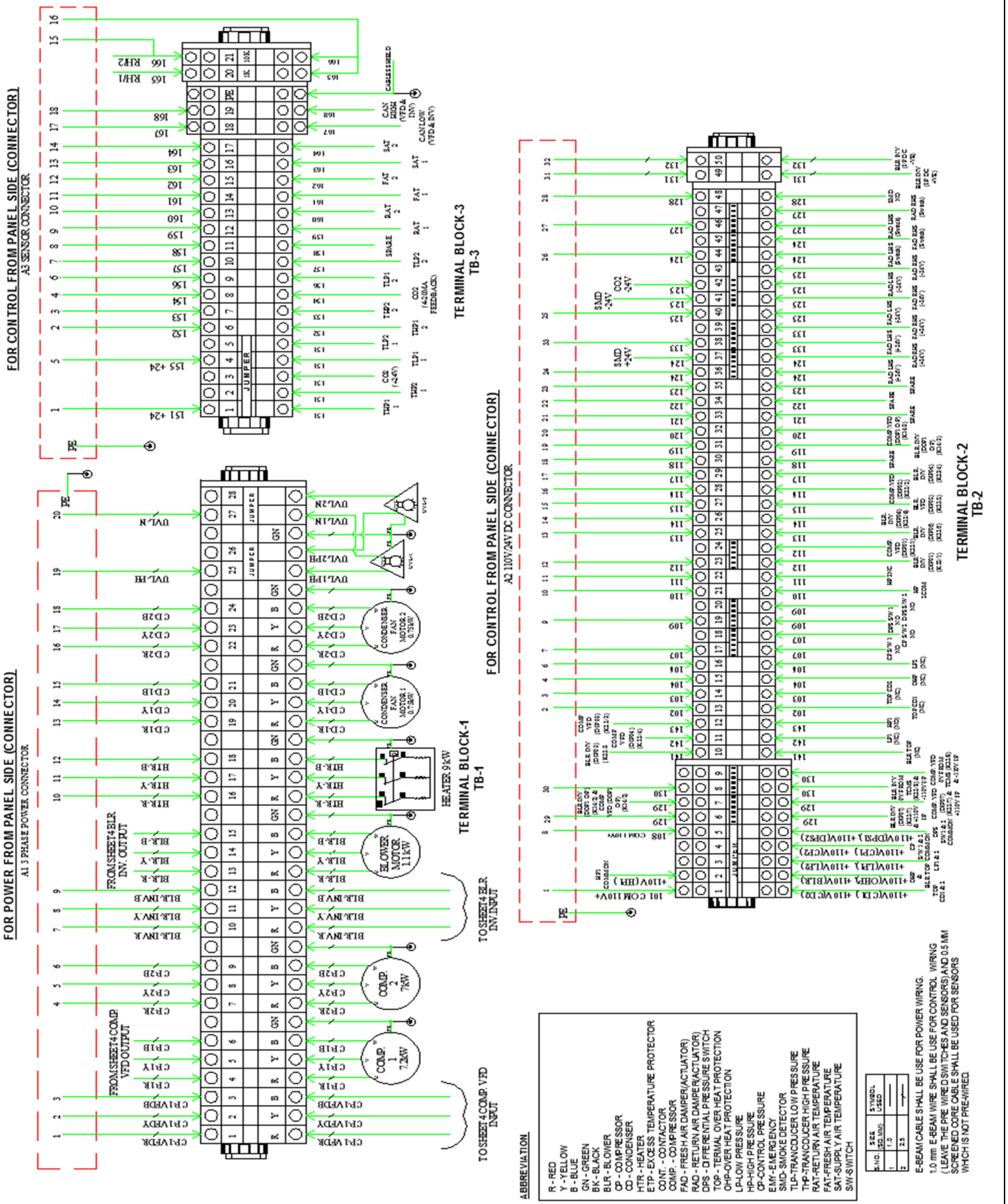
2.2.5 ELECTRICAL CONNECTOR

TYPE	PART NUMBER	PART NAME	UOM	QTY
A1 Connector	T18 142	Crimp terminal male	No.	1
	T18 138	Housing	No.	1
	LHB 149	Crimp contacts male 2.5 mm^2	No.	32
	EMU 008	Guide pin	No.	2
	EMU 089	Guide bush	No.	2
A2	T18 144	Crimp terminal male	No.	1
	LHB 142	Housing	No.	1

Connector	T18 147	Crimp contacts male 1.00sqmm, With 50 Meting cycle	No.	38
	LHB 149	Crimp contacts male 2.5 mm^2	No.	2
	EMU 088	Guide pin	No.	2
	EMU 089	Guide bush	No.	2
A3 Connector	T18 140	Crimp terminal male	No.	1
	T18 138	Housing	No.	1
	T18 150	Crimp contacts male 0.5sqmm, with 500 Mating Cycle	No.	16
	T18 149	Crimp contacts male 0.75sqmm, Silver Plated , 500 Meting cycle	No.	2
	EMU 008	Guide pin	No.	2
	EMU 089	Guide bush	No.	2



2.2.6 ELECTRICAL DRAWING:



3 MICROPROCESSOR CONTROLLER FOR HVAC UNIT

- HVAC Controller is a fully automated microprocessor based control system which is used to monitor and operate the HVAC system from DDU.
- The system incorporates a self- diagnostic check in order to keep a track of its own performance. In case of critical failure, the system shuts down itself.
- It regulates the temperature and humidity conditions inside the coach using temperature sensor and humidity sensor and helps to obtained desired temperature level by switching on and switching off the compressors.
- It monitors the Parameters like high pressure, low pressure, voltage, high temperature, CO_2 level, smoke contains etc.

3.1 PRE–SEQUENCE CHECKING

Before switching the, Power ON the Microprocessor Controller, the following points are to be checked:

a) Continuity between 110V DC.
   - -ve & earth should not be there.
   - +ve & earth should not be there.
   - Also check for any leakage current between microprocessor controller box & 24V DC.

b) External connections of all connectors specially –ve one must show 110V DC with +ve.

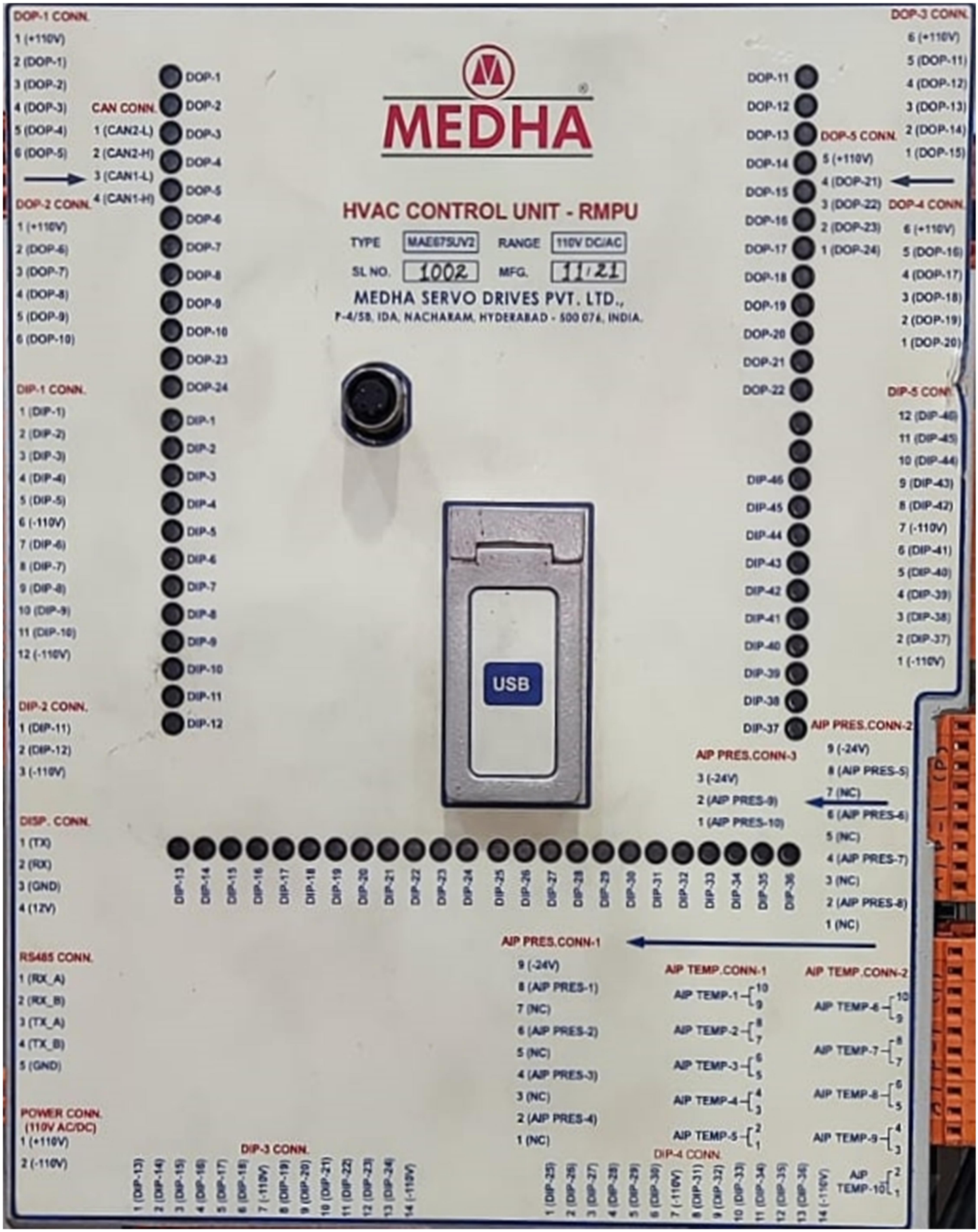
c) Check all motors TOP and both circuit LP, HP in healthy condition. Check all breakers input are in healthy condition.

Now, if all above conditions (a, b, c & d) are fulfilled then microprocessor controller is in healthy condition and ready to start.

3.2 OPERATING SEQUENCE OF MICROPROCESSOR CONTROLLER

1. Switch Air-CO Turned ON.
2. Blower 1 ON.
3. After 30 sec. Condenser fan 1/1 ON.
4. After 120 sec. Compressor 1/1 ON.
5. After 30 sec. Compressor 1/2 ON.
6. If Control Pressure switch gets energized then only Cond 1/2 gets ON.

3.3 SYSTEM DIGITAL INPUTS, OUTPUTS & ANALOG INPUT WIRING DETAILS



3.3.1 ANALOG INPUTS (AIP) PRESSURE (X204)

SL. NO.	CHANNEL	FUNCTION
1	--	NC
2	AIP-0	High Pressure Sensor-1/2
3	--	NC
4	AIP-1	High Pressure Sensor-1/1
5	--	NC
6	AIP-2	Low Pressure Sensor-1/2
7	--	NC
8	AIP-3	Low Pressure Sensor-1/1
9	-24VDC	Common -24VDC

3.3.2 ANALOG INPUTS (AIP) PRESSURE (X205)

SL. NO.	CHANNEL	FUNCTION
1	--	NC
2	AIP-4	High Pressure Sensor-2/1
3	--	NC
4	AIP-5	Low Pressure Sensor-2/2
5	--	NC
6	AIP-6	Low Pressure Sensor-2/1
7	--	NC
8	AIP-7	CO2-1
9	-24VDC	Common -24VDC

3.3.3 ANALOG INPUTS (AIP) PRESSURE (X206)

SL. NO.	CHANNEL	FUNCTION
1	AIP-19	CO2-2
2	AIP-18	High Pressure Sensor-2/2
3	-24VDC	Common -24VDC

3.3.4 ANALOG INPUTS (AIP) NTC (X207)

SL. NO.	CHANNEL	FUNCTION
1	AIP-12	Room Temperature Sensor (RT1)
2		
3	AIP-14	Outdoor / Ambient Temperature Sensor (AT1)
4		
5	AIP-16	Duct / Supply Temperature Sensor (ST1)
6		
7	AIP-8	Hygrostat 1 (HGS)
8		
9	AIP-10	Spare-01
10		

3.3.5 ANALOG INPUTS (AIP) NTC (X208)

SL. NO.	CHANNEL	FUNCTION
1	AIP-13	Room Temperature Sensor (RT2)
2		
3	AIP-15	Outdoor / Ambient Temperature Sensor (AT2)
4		
5	AIP-17	Duct / Supply Temperature Sensor (ST2)
6		
7	AIP-9	Hygrostat 2 (HGS)
8		
9	AIP-11	Spare-02
10		

3.3.6 DIGITAL INPUTS (DIP) (X210)

SL. NO.	CHANNEL	FUNCTION
1	DIP-01	AC-On Unit
2	DIP-02	Manual IN (RLY)-1
3	DIP-03	Temp Condenser Motor 1/1 OK
4	DIP-04	Temp Condenser Motor 1/2 OK
5	DIP-05	Spare-1
6	0V BN	Common- 110 VDC
7	DIP-06	Temp Heater 1 OK
8	DIP-07	Spare-3
9	DIP-08	LP 1/2 OK
10	DIP-09	CP 1/1 & ½ OK
11	DIP-10	Auto SW ON 1
12	0V BN	Common-110 VDC

3.3.7 DIGITAL INPUTS (DIP) (X211)

SL. NO.	CHANNEL	FUNCTION
1.	DIP-11	Spare-5
2.	DIP-12	Blower VFD 1 Status
3.	0V BN	Common- 110V DC

3.3.8 DIGITAL INPUTS (DIP) (X212)

SL. NO.	CHANNEL	FUNCTION
1	DIP-13	Earth Leakage fault 1
2	DIP-14	Blower 1 MPCB Fault
3	DIP-15	Condenser 1/1 MPCB Fault
4	DIP-16	Condenser 1/2 MPCB Fault

5	DIP-17	Compressor 1/1 MPCB Fault
6	DIP-18	Compressor 1/2 MPCB Fault
7	0V BN	Common- 110 VDC
8	DIP-19	Heater 1 MPCB Status
9	DIP-20	Air Pressure Switch 1
10	DIP-21	Smoke Detector 1
11	DIP-22	Compressor 1 VFD Status
12	DIP-23	AC-Off Unit
13	DIP-24	Manual IN (RLY)-2
14	0V BN	Common- 110V DC

3.3.9 DIGITAL INPUTS (DIP) (X213)

SL. NO.	CHANNEL	FUNCTION
1	DIP-25	Temp Condenser Motor 2/1 OK
2	DIP-26	Temp Condenser Motor 2/2 OK
3	DIP-27	Spare-2
4	DIP-28	Temp Heater 2 OK
5	DIP-29	Spare-4
6	DIP-30	LP 2/2 OK
7	0V BN	Common-110V DC
8	DIP-31	CP 2/1 & 2/2 OK
9	DIP-32	Auto SW ON 2
10	DIP-33	Spare-6
11	DIP-34	Blower VFD 2 Status
12	DIP-35	Earth Leakage fault 2
13	DIP-36	Blower 2 MPCB Fault
14	0V BN	Common- 110V DC

3.3.10 DIGITAL INPUTS (DIP) (X214)

SL. NO.	CHANNEL	FUNCTION
1	DIP-37	Condenser 2/1 MPCB Fault
2	DIP-38	Condenser 2/2 MPCB Fault
3	DIP-39	Compressor 2/1 MPCB Fault
4	DIP-40	Compressor 2/2 MPCB Fault
5	DIP-41	Heater 2 MPCB Status
6	0V BN	Common -110V DC
7	DIP-42	Air Pressure Switch 2
8	DIP-43	Smoke Detector 2
9	DIP-44	Compressor 2 VFD Status
10	DIP-45	Spare-7
11	DIP-46	Spare-8
12	0V BN	Common- 110V DC

3.3.11 DIGITAL OUTPUTS (DOP) (X215)

SL. NO.	CHANNEL	FUNCTION
1	110V BN	Common +110V DC
2	DOP-01	RMPU Controller OK
3	DOP-02	RMPU1 Fault
4	DOP-03	Spare-1
5	DOP-04	Compressor 1/2 Cont
6	DOP-05	Condenser 1/1 Cont

3.3.12 DIGITAL OUTPUTS (DOP) (X216)

SL. NO.	CHANNEL	FUNCTION
1	110V BN	Common +110 DC
2	DOP-06	Condenser 1/2 Cont.
3	DOP-07	Heater-1 Cont
4	DOP-08	UV-1 Relay
5	DOP-09	FA-1 Close
6	DOP-10	RA-1 Close

3.3.13 DIGITAL OUTPUTS (DOP) (X217)

SL. NO.	CHANNEL	FUNCTION
1	DOP-15	Spare-2
2	DOP-14	RMPU Status Relay
3	DOP-13	VFD Compressor-1 ON Command
4	DOP-12	RMPU2 Fault
5	DOP-11	Blower-1 ON Command
6	110V BN	Common +110V DC

3.3.14 DIGITAL OUTPUTS (DOP) (X218)

SL. NO.	CHANNEL	FUNCTION
1	DOP-20	UV-2 Relay
2	DOP-19	Heater-2 Cont.
3	DOP-18	Condenser 2/2 Cont.
4	DOP-17	Condenser 2/1 Cont.
5	DOP-16	Compressor 2/2 Cont.
6	110V BN	Common +110V DC

3.3.15 DIGITAL OUTPUTS (DOP) (X219)

SL. NO.	CHANNEL	FUNCTION
1	DOP-24	VFD Compressor-2 ON Command
2	DOP-23	Blower-2 ON Command

3	DOP-22	RA-2 Close
4	DOP-21	FA-2 Close
5	110V BN	Common +110V DC

3.3.16 SUPPLY 110V AC / DC (X201)

SL. NO.	CHANNEL	FUNCTION
1	110V BN	Power Supply (110V+)
2	0V BN	Ground (110V-)

4 MAINTENANCE

Maintenance work on the refrigerating circuit should be completed before the summer season.

CAUTION

- *Before starting any inspection or maintenance work on components working with power supply, turn off the main power supply and ensure against turning on.*
- *If the coach is running in servicing areas with heavy air pollution, the filter requires more frequent inspection i.e. cleaning etc.*
- *The shutdown of over headline should be ensured during operation, maintenance, repairs etc.*

Most components of the packaged air conditioner unit will be replaced when defective.

SR. NO.	EQUIPMENT	MAINTENANCE PROCEDURE
01	Condenser fan motor	• Open center top cover of compressor-condenser motor unit. • Remove Condenser fan blade. • Remove electrical connection. • Open mounting nuts & bolts. • Change motor with same rating.
02	Fixed Speed Compressor	• Open center top cover of compressor-condenser motor unit. • Loosen compressor clamp • Remove power connection • Drain refrigerant. • De-braze refrigerant piping and cap them properly to avoid entering of moisture and foreign particles inside the system. • Open mounting base nut. • Change compressor as per recommended procedure. • Use same rating of compressor.
03	Variable Speed Compressor	• Open center top cover of compressor-condenser motor unit. • Loosen compressor clamp • Remove power connection • Drain refrigerant. • De-braze refrigerant piping and cap them properly to avoid entering of moisture and foreign particles inside the system. • Open mounting base nut. • Change compressor as per recommended procedure. Use same rating of compressor.
04	Filter Drier	• Open condenser coil side cover. • Pump down system using service valve provided in liquid line of refrigeration circuit. • DE braze filter drier and cap refrigerant pipelines properly to avoid entering of moisture and foreign particles inside the system. • Change filter drier with same size.
05	Return air filter	• Open right-hand & left-hand side maintenance covers of evaporator section. • Take out filter. Clean filter media, replace if necessary.

06	Fresh air filter	• Visual inspection for dirt accumulation. Remove the accumulated dirt by air blower.
07	Blower motor	• Open evaporator center top cover. • Remove blower runners. • Open electrical connections. • Open mounting base nut & bolts. • Change blower motor with same rating.
08	Electric Heater	• Open evaporator center top cover • Take out heater bank. Inspect the safety element as per clause 4.2
09	Fresh Air Damper Actuator	• Remove RHS & LHS cover of evaporator section. • Remove the electric connection. • Remove flapper shaft of the FA damper actuator. • Remove the Fasteners. • Replace the FA damper Actuator with same rating of actuator.
10	Fresh Air Damper Actuator	• Remove RHS & LHS cover of evaporator section. • Remove the electric connection. • Remove flapper shaft of the RA damper actuator. • Remove the Fasteners. • Replace the RA damper Actuator with same rating of actuator.
11	Differential Pressure Switch	• Ensure setting 120 Pascal, if not adjust to 120 Pascal. • Open evaporator center top cover. • Remove electrical connections. • Remove adaptor tubes connected for reading points. • Loose and remove the Fasteners. • Remove the DP switch. • Replace it with new DP switch of same rating
12	Smoke Detector	• Open evaporator Left hand side top cover. • Remove smoke detector Box Shield. • Open the upper lid of Smoke Detector. • Remove electrical connections. • Loose and remove the Fasteners. • Remove the Smoke Detector. • Replace it with new smoke detector of same rating
14	UV Lamp	• Open LHS & RHS maintenance cover of Evaporator Section. • Open Aluminum Shield cover. • Remove electrical connection • Remove UV lamp.
15	Hygrostat	• Open evaporator section Right hand side cover. • Remove Electrical connections. • Loose and Remove fasteners. • Remove the Hygrostat. • Replace with new one with same rating.
16	Heater OHP	• Open Evaporator center cover. • Remove OHP thermostatic bulb form front of heater. • Open the upper lid of OHP. • Remove the electrical connections. • Loose and remove the fasteners.

		• Remove the OHP. • Replace with new one having same rating.
17	CO_2 Sensor	• Open evaporator section Left hand side cover. • Remove the electrical connections. • Loose and remove the fasteners. • Remove the CO_2 Sensor. • Replace the sensor with new one having same rating.
18	Emergency Inverter	• Remove evaporator section center top cover. • Remove the electrical connections. • Loose and remove the fasteners • Remove and replace the inverter having same rating.
19	VVVF Drive	• Remove evaporator section center top cover. • Remove the electrical connections. • Loose and remove the fasteners. • Remove and replace the drive having same rating.
20	Pressure Transducer	• Open Condenser center roof. • Remove electrical connections. • De-Braze the copper lines. • Loose & remove the fastness. • Remove the Transducer. • Replace with new one having same rating.
21	SA. Temperature Sensor	• Open Evaporator center roof. • Loose & Remove the bolts and heater cover. • Remove electrical connections. • Loose & remove nut of sensor. • Remove the Temperature sensor. • Replace with new one having same rating.
22	RA. Temperature Sensor	• Open Evaporator left hand side roof. • Remove electrical connections. • Loose & remove nut of sensor. • Remove the Temperature sensor. • Replace with new one having same rating.
23	FA Temperature Sensor	• Open Evaporator left hand side roof. • Remove electrical connections. • Loose & remove nut of sensor. • Remove the Temperature sensor. • Replace with new one having same rating.

4.1 SAFETY DEVICES

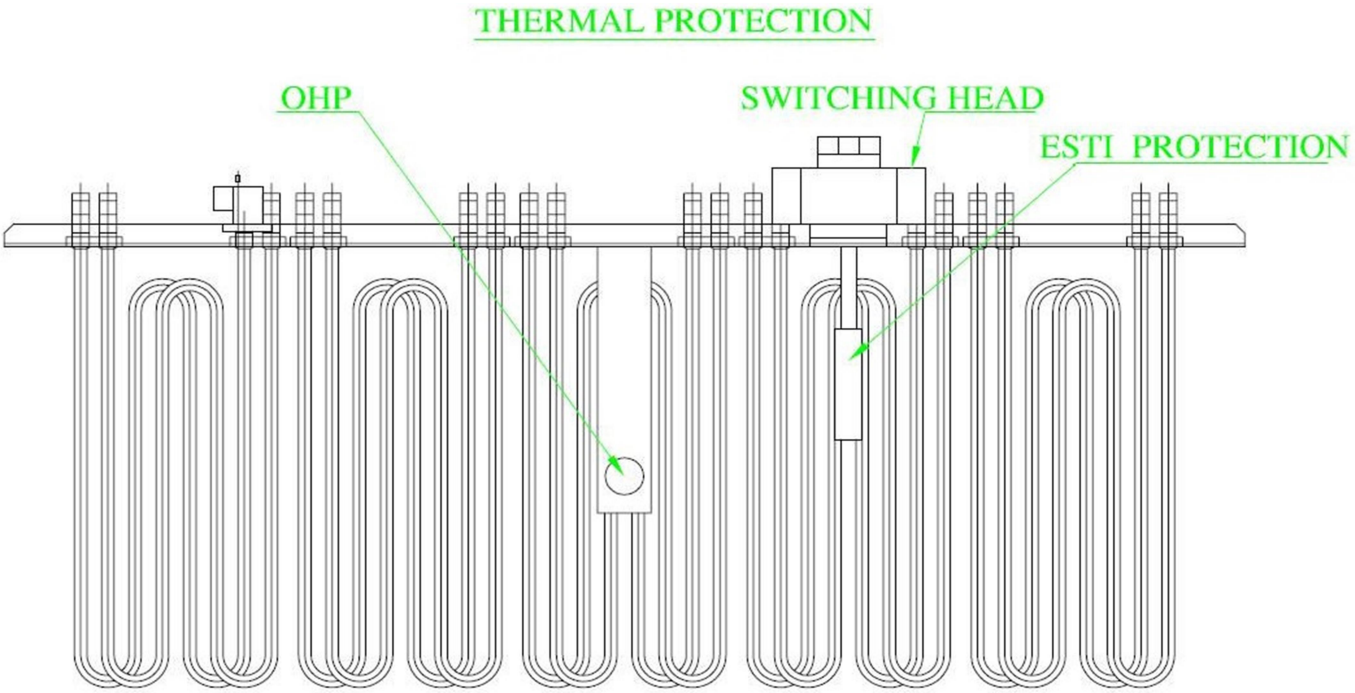
All current carrying components such as motors, heaters and compressors are positively earthed

4.1.1 THERMAL PROTECTION OF MOTORS

All motors are provided with thermal protection device. If a motor heats up impermissibly, the thermal protection system switches the motor off via the controller.

4.1.2 THERMAL PROTECTION FOR HEATERS

The electric heaters are protected in two ways against over temperature. If the supply air temperatures reach an impermissible level, O.H.P. switches the heater off via the control system. If this safety feature fails, the heater is finally switched off by a fusible link (ESTI).

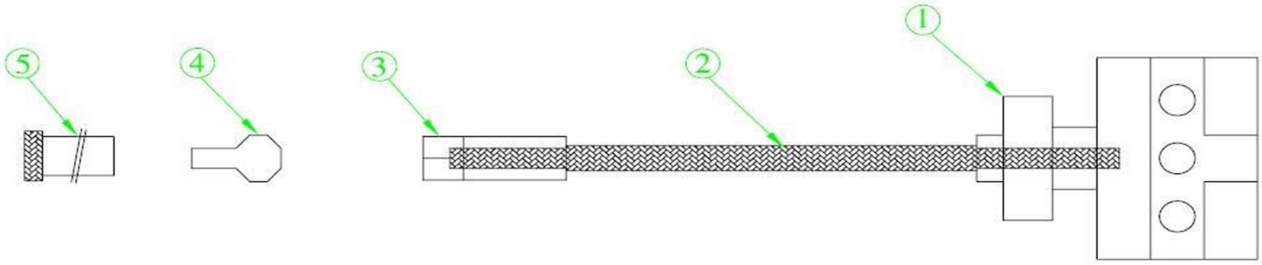


a) OHP & ESTI PROTECTIONS ONE EACH FOR HEATER BANK.

Cause of OHP tripping of heater is less air flow through heater due to:

- Blower motor defective or blower motor running in reverse direction.
- Air Filter or evaporator coils clogged with dirt, dust or any other obstruction in evaporator compartment.

b) INSPECTING AND MAINTENANCE OF ELECTRIC HEATER SAFETY ELEMENTS



The heater bank is controlled by a thermostat (O.H.P.) and protected from overheating by a temperature protection switch (ESTI)

c) FAILURE OF THE SAFETY ELEMENTS

- If the temperature of the heating element is too high more than 65 deg. C the thermostat (O.H.P) send a signal to the controller, which turns off the heater bank.
- If O.H.P. fail and the temperature continuous to rise, fusible link interrupts the power supply mechanically.
- The temperature protection switch (ESTI) contains fusible link (a small glass ball with a liquid), the glass ball bursts at a certain temperature (above 130 ^{O}C). This releases a spring-loaded pin which opens the three phase power supply contacts of heaters.
- The broken glass ball must be removed before installing a new ball in the fusible link switch. The cause of the overheating must be located and repaired.

d) REPLACEMENT OF FUSIBLE LINK

- Remove split pin '3' screw out cartridge holders '5'.
- Remove the broken glass pieces of the old ball (fusible link) and install a new ball '2' of the same type in the cap inspect the motion of the spring loaded release rod '1'. (If it is reluctant to move, install a new temperature switch).
- Slowly screw in cap '5' (the release rod is pressed down when the cap is screwed in place) and secure with split pin.

,

When the cartridge bursts, carefully remove all glass pieces from the cartridge before a new cartridge is installed.

Cartridge carrier with the installed cartridge must be secured with a split pin.

4.1.3 COOLING CIRCUIT PRESSURE PROTECTION

To prevent from high pressure or low pressure in the two parallel connected refrigerant circuits of an air conditioning unit, high, low and control pressure switches are used.

Pressure transducers are connected in the high pressure and low pressure line to determine refrigerant pressures. Transducers give current signal equivalent to pressure in refrigeration line to bar meters/gauges provided in switch panel of air conditioner.

CAUSE OF HP TRIPPING IN REFRIGERATION CIRCUIT

a) Condenser motor defective/not working.
b) Condenser fan motor running in reverse direction. Air should be sucked through condenser coils.
c) Condenser fan blade defective/ broken.
d) Condenser coil clogged with dirt & dust.

e) Cause of LP tripping in refrigeration circuit.
f) Blower motor defective/not working.
g) Blower motor running in reverses direction. Air should be sucked through Evaporator coils.
h) Blower runner defective/broken.
i) Evaporator coil clogged with dirt & dust.
j) Air filters clogged with dirt, dust or any other obstructions in evaporator Section.
k) Less refrigerant or leakage in the refrigeration circuit.
l) Drier filter or capillary chocked.

NOTE: Proper quantity of gas refrigerant (6.55 kg/circuit) should be charged in the system.

5 CHECK PRODUCT RECEIVED

Upon receiving the unit, inspect it for any damage from shipment. Claims for damage, either shipping or concealed, should be filed immediately with the shipping company with proper image proof of damage. Check the unit model number, electrical characteristics, and accessories to determine if they are correct. Also check the loose item packing box for damage and quantity.

6 SHIPMENT, STORAGE & INSTALLATION

6.1 TRANSPORTATION / SHIPMENT

Roof Mounted Package Air Conditioners are supplied preassembled on truck frame. The air conditioning units are fastened with bolts to the truck frame. All assemblies are carefully tested and packed prior to shipment (With refrigerant charged).

6.2 STORAGE & PACKING

The system components shall be stored in their undamaged transport skids. Do not store them in the open. Make sure that they cannot become damaged.

6.3 INSTALLATION

Install RMPU above in the roof space at both extreme ends of the coach. The duct connections for the supply air and re-circulating air point in the direction of the coach.

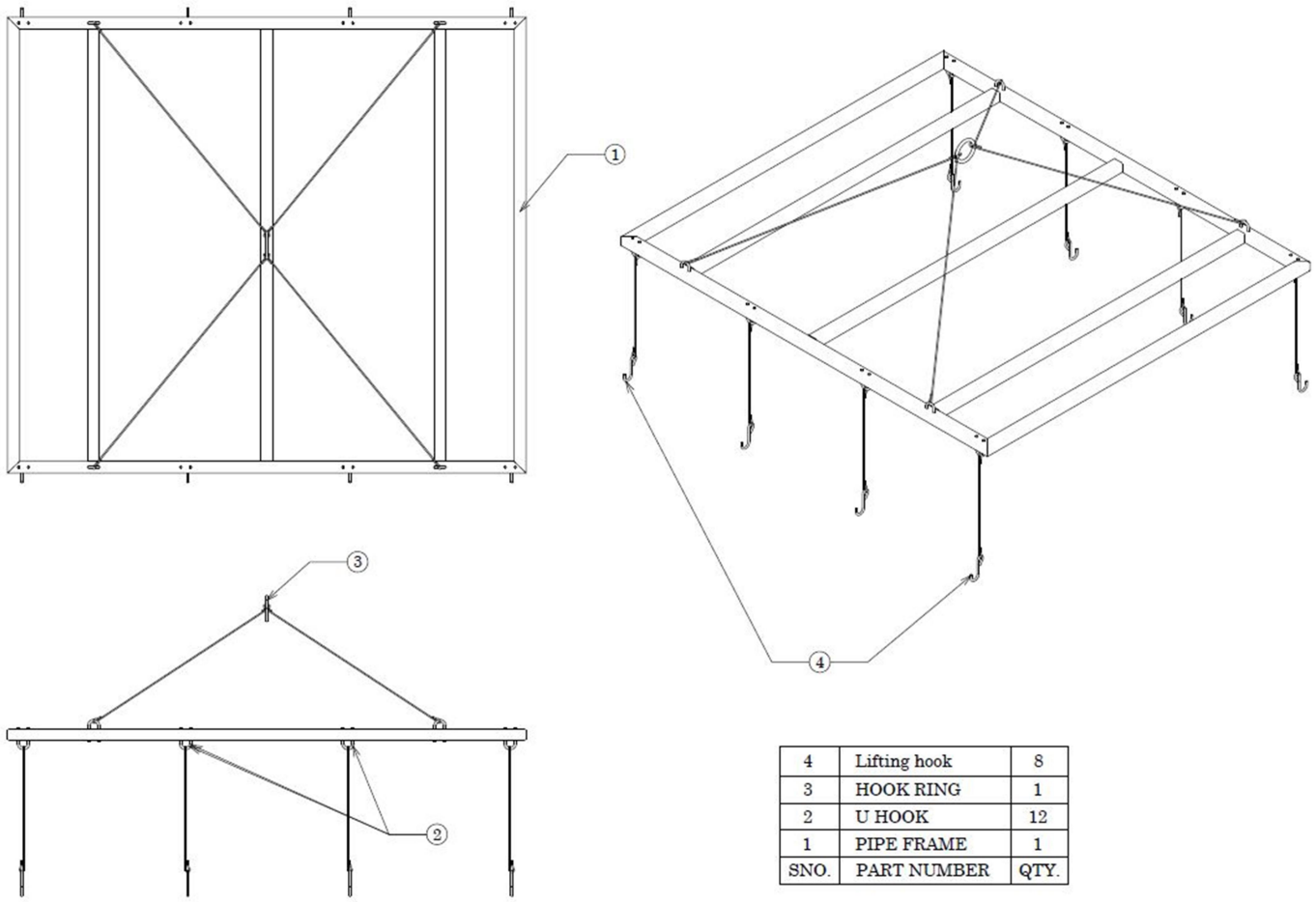
CAUTION

For transporting the air conditioning unit to the coach for the purpose of installation, overhead crane shall be used and Lift the air conditioner for the specified lifting points gently.

Process of Installation for the Roof mounted air conditioning unit

a) Remove Packing
b) Perform visual check for any transit damage
c) Undo transport screws used for fixing unit to frame
d) Lift unit with crane into coach (refer lifting instructions given in section 6.3.1)
e) Lower down unit into installation trough
f) Adjust unit in position with AVM
g) Tighten fastening screws (refer tightening instruction in section 6.3.2 for torque values)
h) Connect earthling connections
i) Establish plug-and-socket connections for power, Control & Sensors supply
j) Connect duct system.

6.3.1 LIFTING INSTRUCTION



SNO.	PART NUMBER	QTY.
1	PIPE FRAME	1
2	U HOOK	12
3	HOOK RING	1
4	Lifting hook	8

Figure 6-1: LIFTING FRAME

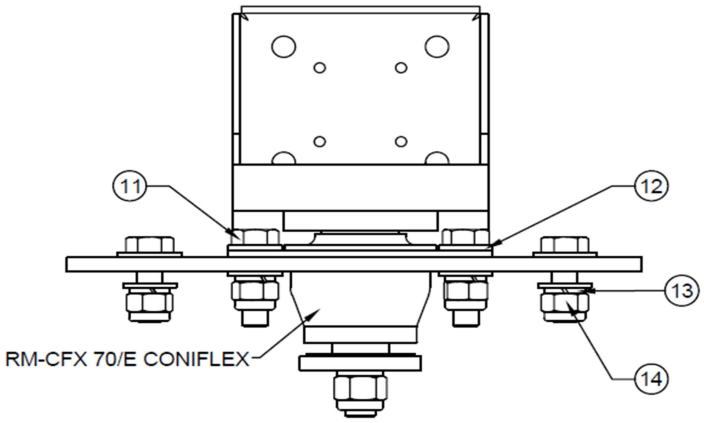
The following instructions shall be followed while lifting the Saloon HVAC Unit.

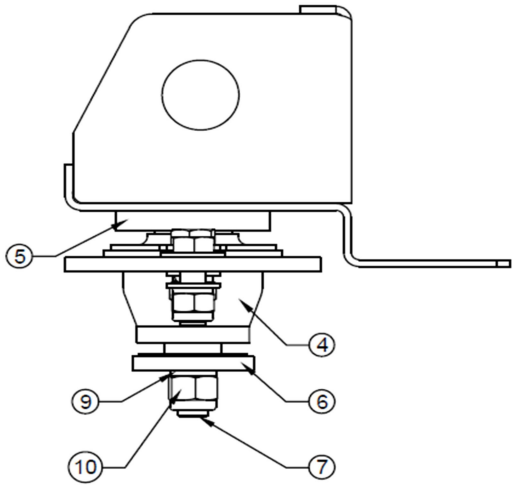
1. 8 hooks should be used to lift the machine.
2. Ensure sufficient strength of rope/belt supporting the hook.
3. Avoid slack lifting members.
4. Ensuring sufficient marching/transit space shall be available
5. Ensure no person shall be positioned underneath the load.

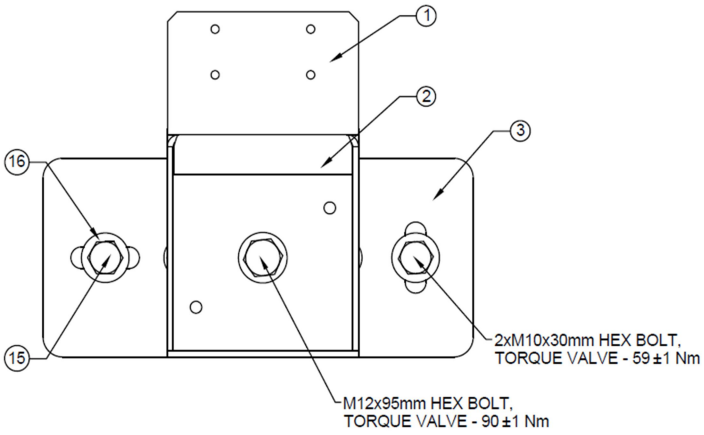
6.3.2 TIGHTING INSTRUCTION

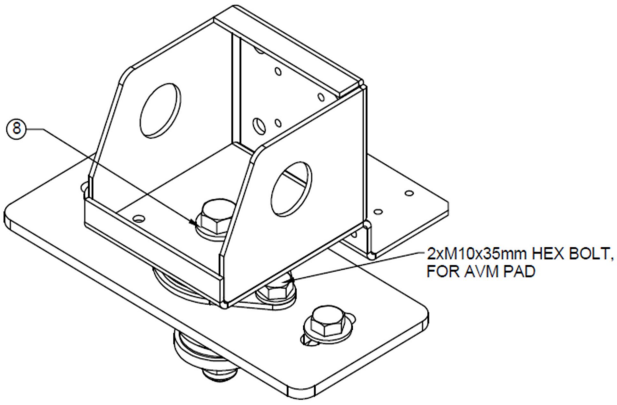
Proper tightening of bolts at is important as under torqued bolt will deform and be unable to provide as much fastening force as needed. An over torqued bolt will break.

A. MOUNTING DETAILS









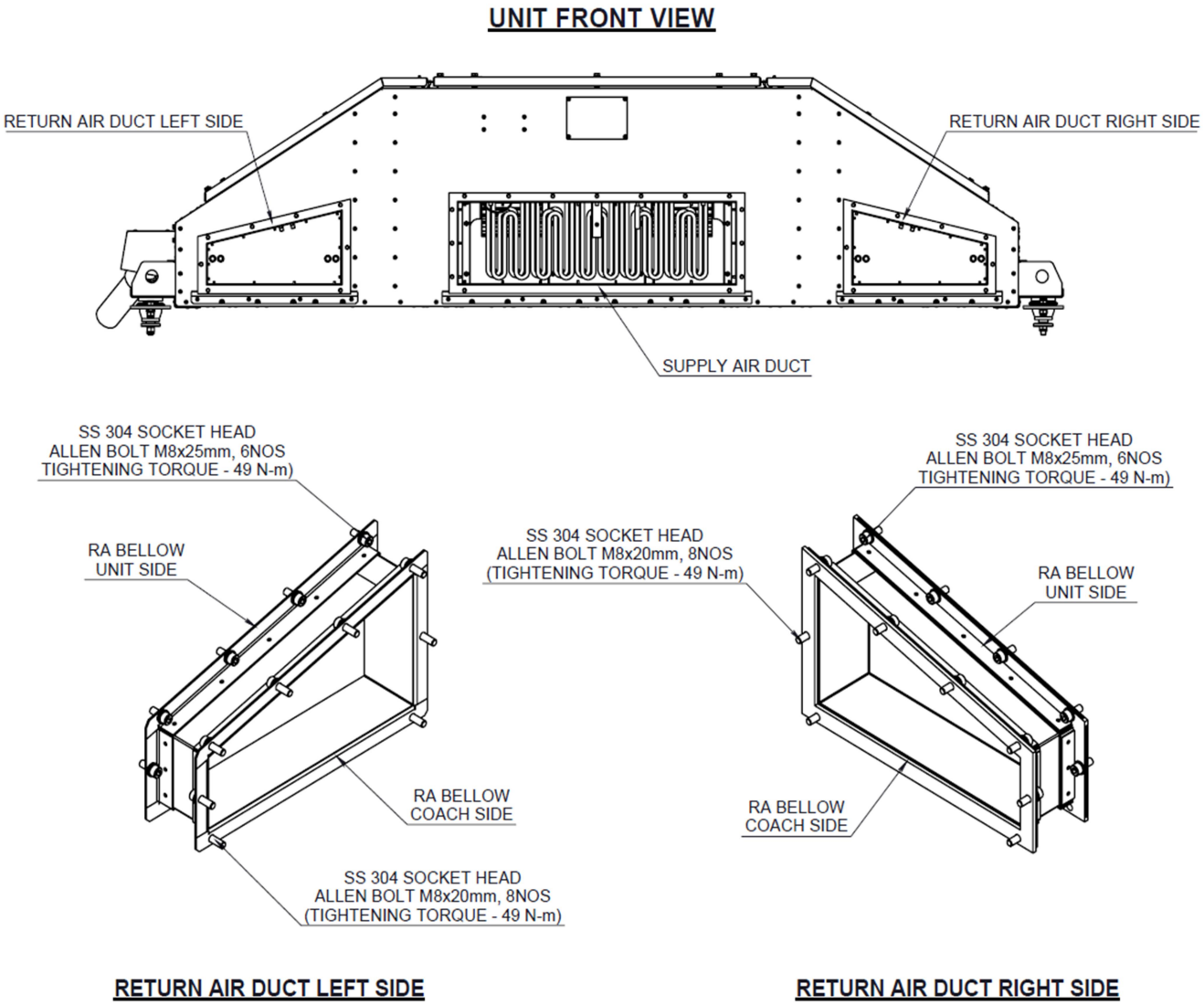
Sr. No.	Part Name	Qty	Sr. No.	Part Name	Qty
1	Base Mounting Bracket	1	9	SS 304 Spring Washer M12	1
2	Main Mounting Bracket	1	10	SS 304 Nylock Nut M12	1
3	Main Holding Plate	1	11	SS 304 Hexagon head Bolt M10 x 35mm	2
4	AVM Pad	1	12	SS 304 M10 Plain Washer	6
5	SS Upper Washer	1	13	SS 304 M10 Spring Lock Washer	4
6	SS Lower Washer With Rubber Coating	1	14	SS 304 Nylock Nut M10	4
7	SS 304 Hexagon head Bolt M12 x 95mm	1	15	SS 304 Hexagon head Bolt M10 x 30mm	2
8	SS304 Plain Washer M12	1	16	SS 304 Plan Washer M10 (Customised)	2

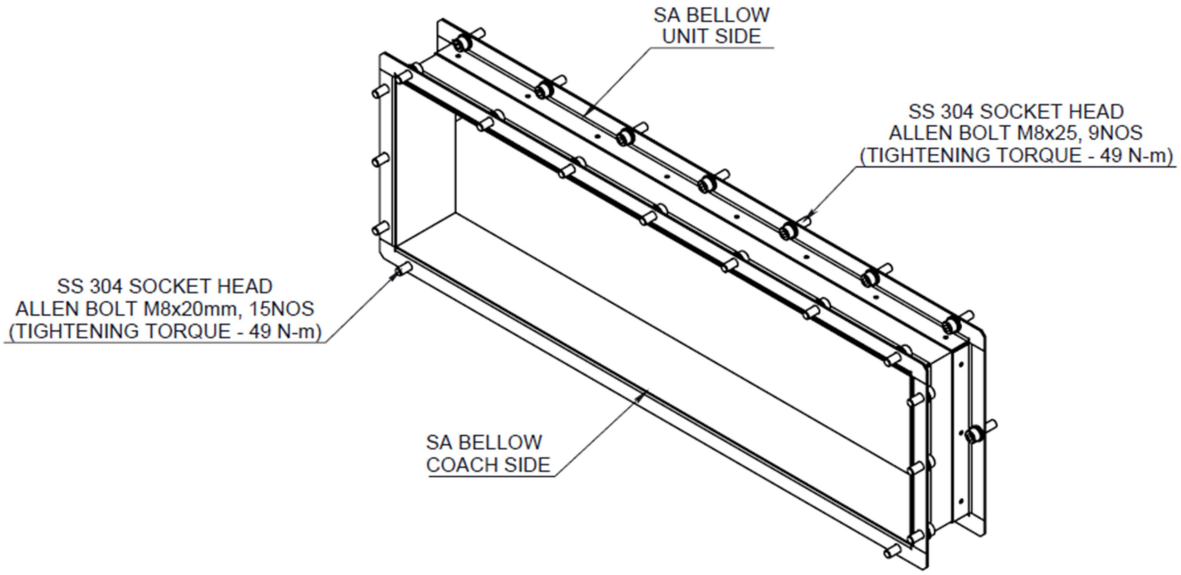
TIGHTENING TORQUE PARAMETERS FOR *SS304 FASTNERS*

S No.	Size	Quality Class	Torque Required (Nm)		Ratchet Wrench Knob Setting
			Dry	Lubricant	
1	M04	A2-70	04±1	NA	3
2	M05	A2-70	07±1	NA	3
3	M06	A2-70	12±1	NA	0
4	M08	A2-70	29±1	26±1	3
5	M10	A2-70	59±1	53±1	3
6	M12	A2-70	99±1	89±1	3

Note: Tightening Torque value for SS A2-70 as per ISO 3506-1.

B. BELLOW BOLTING





SUPPLY AIR DUCT

6.3.3 INSTALLATION PARTS

Sr. No.	Name	Quantity	Shape
1	Crimp terminal Female for A1 Connector , Part No. 09 32 032 3101	1	
2	Hood Side entry for A1 Connector, Part No. 19 30 016 0537	1	
3	Crimp contacts female for A1 & A2 Connector, Part No. 09 33 000 5202	34	
4	Guide bush for A1, A2 & A3 Connector, Part No. 09 33 000 9909	12	
5	Crimp terminal Female for A2 Connector, Part No. 09 32 040 3101	1	
6	Hood Side entry, With M50 for A2 Connector, Part No. 19 30 0160 529	1	
7	Crimp contacts female 1.00 mm^2, with 50 Meting cycle for A2 Connector, Part No. 09 33 000 5205	38	
8	Crimp terminal Female for A3 Connector, Part No. 09 32 018 3101	1	
9	Hood Side entry for A3 Connector, Part No. 19 30 010 0537	1	
10	Crimp contacts female 0.5mm^2, with 500 Mating Cycle for A3 Connector, Part No. 09 33 000 6220	16	

11	Crimp contacts female 0.75sqmm, Silver Plated , 500 Meting cycle for A3 Connector, Part No. 09 33 000 6214	2	
12	Fitting of Conduit M32 ,SQFR-M32B23	1	
13	Fitting of Conduit M50, SQFR-M50B48	1	
14	Conduit fitting SQFR-M32B29 M32 x 1.5	1	
15	SS Hex Bolt M10 X 30	16	
16	SS Hex Nylock Nut M10	32	
17	SS Plain washer M10	48	
18	SS Spring washer M10	16	
19	Anti-Vibration Mounting Pad	8	
20	SS M12 Nylock Nut	8	
21	SS Plain washer M12	8	

22	SS Spring washer M12	8	
23	SS Hex Bolt M10 × 35 mm	16	
24	Air Bellow	1	
25	SS Washer, OD- 60mm, ID- 13mm, Length- 9mm	8	
26	SS Washer, OD- 47.5mm, ID- 12mm, Length- 4mm	8	
27	SS Hex Bolt M12 x 95mm	8	
28	SS Washer M10, OD 25 mm, ID 11 mm	8	

7 TROUBLESHOOTING

Sr. No	Trouble	Trouble Shooting
1	110V DC main MCB of RMPU Control supply 'ON', but, HVAC Unit does not work.	• Check availability of 110V DC at MCB • Check AIR.CO. Switch 'ON' status on DDU (Driver Desk Unit). • Check availability of 415V AC at MCB
2	Controller 'ON', But AC not working.	
a	No cooling	• Check AIR.CO. Switch 'ON' status on DDU (Driver Desk Unit). • Check availability of 415V AC at MCB • Check HP fault status on DDU (Driver Desk Unit).
b	Compressors not working	1. Refer clause no. 4.1.3 for causes of HP tripping. • Check LP fault status on DDU (Driver Desk Unit). 2. Refer clause no. 4.1.3 for causes of LP tripping. • Check supply air fan 1 or 2 thermal protection for tripping. • All measuring sensors failed. • Check working of Blower motor. • Check 415V AC, 3 Ph. Available at Compressors terminals.
c	No Heating	• Check AIR.CO. Switch 'ON' status on DDU (Driver Desk Unit). • Check availability of 415V AC at MCB • Check OHP cut for tripping. In healthy condition LED indications in controller DIP-06 & DIP-28 should glow. • Refer clause no.6.2 for causes of OHP tripping. • Check supply air fan 1 or 2 thermal protection for tripping. • Check EST1 cartridge fusible link is not broken. • Check working of Blower motor. • Check 415VAC, 3 Phase available at Heater terminals.
3	In cooling mode Condenser motor does not work.	• Check thermal protection inside motor for tripping. In healthy condition LED indications in controller DIP-03, DIP-04, DIP-25, DIP-26 should glow. • Check supply air fans thermal protection for tripping. • All measuring sensors failed. • Check 415V AC, 3 Ph. available at Condenser motor terminals.
4	Supply air fan motors not working.	• Check AIR.CO. Switch 'ON' status on DDU (Driver Desk Unit). • Check availability of 415V AC at MCB • Check supply air fans thermal protection for tripping. • Check 415V AC, 3 Ph. available at Blower motor terminals.

8 PROTECT THE ENVIRONMENT FROM E-WASTE

This product at its end of usable life should not be mixed with household domestic waste or any general waste. It must be stored separately and disposed of through an authorized recycler of electrical and electronic appliance waste since it is categorized under Schedule I of E-Waste Management Rules promulgated by the Government of India.

As guided by these rules, this product needs to be disposed of after its useful life in a scientific and prescribed manner. As a responsible citizen of India, we request your cooperation in helping conserve the environment for future generations.

9 DO's AND DON'Ts

DO's:

- Run and Maintain machine as per instructions given in the User Manual.
- Engage only an authorized person to attend to repairs of your machine.
- Engage only an authorized person for DE-INSTALLATION.

DON'Ts:

- Do not try to repair/dismantle your machine by yourself.
- Do not engage any unauthorized person to repair/dismantle your machine or any of its parts.
- Do not sell or dispose of your machine or its parts to a local scrap dealer.
- Do not dispose of E-Waste in landfills or leave it outside unattended.
- Do not put the air conditioner to any other use post its end-of-life

10 MAINTENANCE SCHEDULE

Sr. No.	Equipment /Fittings	Activities	Trip / Weekly	Monthly	Six Monthly	IOH 18 Months	POH 36 Months
1.	General	a) Check the log sheet maintained in each Air-Conditioning coach and attained the defects recorded by escorting staff during run.	√	√	√	√	√
		b) Clean all dust by vacuum or compressed air from the switch board cabinet and tighten the cable terminals, if found loose.	√	√	√	√	√
		c) Replace/connect defective/by passed components.	√	√	√	√	√
		d) Remove fresh and return air filters by opening the access doors of the unit. Clean these filters with vacuum or compressed air taking out the filters and place them gently in their place or replace with pre-cleaned/new filter/filter media and close the doors properly. A cleaning jig should be available with AMC holder/Railways for this activity. Note: After this activity, the service doors shall be latched properly in case of return air filter.	√	√	√	To be replaced	To be replaced
		e) Check working of rotary switches by rotating forward and backward, provided on switch panel for temperature selection and Air. Co. ON. Replace if required.	√	√	√	√	√
		f) Check working of set point generator rotary switch provided for temperature setting.	√	√	√	√	√
		g) Check the tripping of Heaters i.e., OHP. The OHP setting is 65°C. The testing of OHP setting shall be done by			√	√	√

		switching off the blower. During testing, the probe of digital thermometer shall be placed near the sensor of OHP & the display shall be kept outside. NOTE: It shall be checked twice a year. In addition, it shall also be checked as a pre-winter precaution before the onset of winter season.					
		h) Run the HVAC for half an hour and then check the current drawn by various equipment's with the help of clamp tester (tongue tester) duly calibrated. Normal currents for various equipment's and mode of operation are as under: • Cooling mode • Heating Mode NOTE: The current also depends on the ambient temperature.			√	√	√
		i) Check visually condenser fan blade and ensure that there is no crack on the blade or hub.		√	√	√	√
		j) Check and tighten mountings of blower, compressor and blower motor and ensure that they are in good condition.			√	√	√
		k) Ensure that no capillary tubes are in hanging position.		√	√	√	√
		l) Check capillary tubes provided for HP/LP cutout for proper support/clamping. Their nuts should be properly tightened.		√	√	√	√
		m) Check for proper tightening of cover provided over evaporator compartment.			√	√	√
		n) Check the earthing shunts in HVAC are provided. Earthing shunts should be earthed with coach body.			√	√	To be replaced

		o) If less cooling is noticed, check the leakage of refrigerant from the system by using soap solution or leak detector. If leak is detected, it should be attended and re-charging of refrigerant in the system shall be made as per RDSO SMI No. ELPS/AC/SMI/14. Filter drier must be replaced during this activity.	√	√	√	√	√
		p) Check insulation resistance of all the motors & compressors by the duly calibrated 1000 V megger, Attend the motors, if insulation resistance of motor is found less than 2 M ohm. IMPORTANT: Disconnect control devices during this activity.				√	√
		q) Check for physically damaged/jointed cables. Replaced if needed.				√	√
		r) Check for the physically damaged conduits. Replace them, if needed.				√	To be replaced
2.	Refrigerant pipe line/capillary checks	a) Check for proper clamping/support				√	√
		b) Rubbing of capillary with SS sheet/channel or other parts of Train 18				√	√
		c) Leakage from the flare nut of HP/LP conduits with soap solution			√	√	√
		d) Leakage from Feeler tube of OHP				√	√
3.	Compressors checks	a) Holding clamps from top are properly tightened.			√	√	√
		b) Mounting fasteners are properly tightened.			√	√	√
		c) Leakage from suction and discharge port.			√	√	√
		d) Accumulators holding/mounting, if provided.			√	√	√

		e) Condensing area covers are properly tightened & not touching top of compressor body.			√	√	√
		f) Electrical terminal box is properly tightened & cables are terminated with lugs.			√	√	√
4.	Condenser fans motor/ blades and Blower motor/ impeller checks	a) Mounting fasteners are properly tightened.			√	√	√
		b) Electrical terminal box of motors is properly tightened & cables are terminated with lugs.			√	√	√
		c) Double earthing shunts are provided.			√	√	To be replaced during POH
		d) Condition of blade for its fixing/cracking/damage or touching with its cover. Rectify/replace, if needed.			√	√	√
		e) Ensure proper clamping of cable conduits.			√	√	√
		f) Overhauling of Blower and condenser fan motors shall include the following during POH. • The incoming motors shall be checked for abnormal noise and vibration. • Check bearing make and replace with specified make, if found defective. • The IR value of Motor stator shall be measured between motor terminal and frame before and after overhauling. The value of IR shall not be less than 10 M ohm, when measured with 1000-volt megger. • Winding resistance of motors shall be measured between RY, YB & BR phases. The winding resistance shall be ±10% of resistance declared by OEM in cold condition. • Check closely terminal block and connecting lead for any					√

		physical damage or any flash mark over it. Replace the same, if not satisfactory. • Perform HV (Di-electric test) on stator by applying 1.5 kV ac supply for one minute. During test the leakage current shall not be more than 1.0 mA. • Run motor on no load for 15 minutes and check for following: I. Bearing noise – Normal noise II. Bearing temperature rise above ambient - 10°C III. SPM reading - 20 dBN max. (Green zone)					
		• Measure starting current of motors on no load. It shall not be more than 10 times of normal running current. Similarly, the running current of motors shall be measured and it shall not be more than 1.1 A.					√
		• Ensure that impellers are properly tightened.			√	√	√
		• Electrical terminal box is properly tightened & cables are terminated with lugs.			√	√	√
5.	A) Return Air filters	a) Ensure that filters are not damaged.	√	√	√	√	√
		b) Ensure that there is a provision to avoid wrong fitment in the filter as well as in CAB AC.				√	√
	B) HP/LP/OHP cutout switch	a) Check that the mounting fasteners are properly tightened.			√	√	√
		b) Ensure proper clamping/support of capillary tube connected to HP/LP/OHP cutout switch.			√	√	√
		c) Ensure that flare nuts are properly tightened.			√	√	√

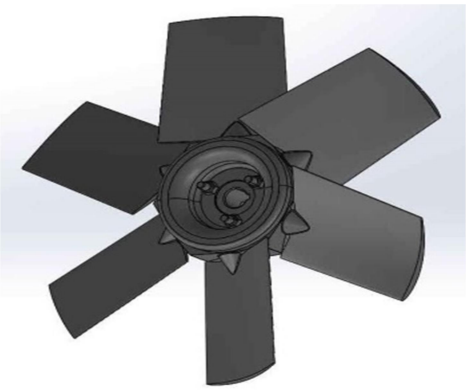
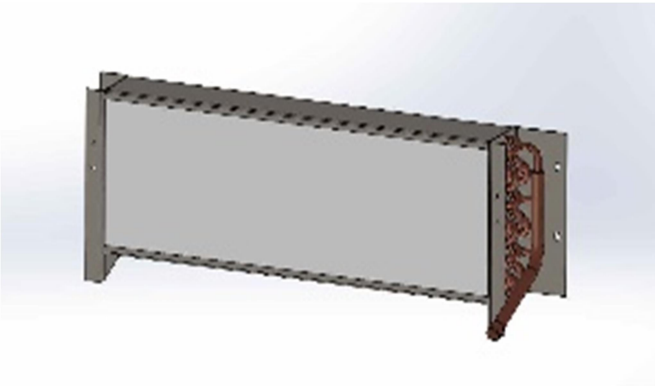
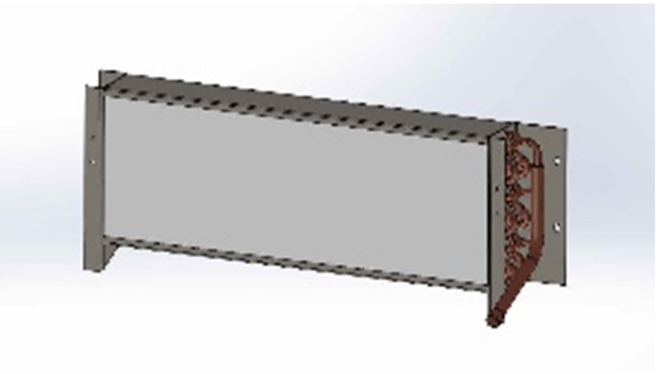
		d) Ensure that control wires to HP/LP/OHP cutout switches are properly clamped.			√	√	√
		e) Ensure that covers of these HP/LP/OHP cutouts switches are properly screwed.	√	√	√	√	√
		f) Ensure proper clamping of feeler tube of OHP switch.				√	√
		g) Remove the accumulated dust over feeler tube of OHP switch.			√	√	√
		h) There should be cover (canopy) on top HP/LP switch (provided with capillary tubes) to prevent water entry.		√	√	√	√
	C) Heater	a) Ensure proper mounting of heater.			√	√	√
		b) Ensure proper clamping of electrical wires to heater.			√		√
		c) Check dust accumulation on heating element. Remove gently, if required.			√	√	√
	D) NTC sensors	a) Ensure that the sensors provided at return air path and supply air are firmly mounted.			√	√	√
		b) Ensure sensor wires are properly clamped.			√	√	
		c) Remove the dust accumulated over sensor gently.			√	√	√
	E) Expansion Valve/capillary tubes	a) Ensure that the bulb is mounted in the suction line just after evaporator coil and in a position corresponding to between 1 O'clock and 4 O'clock. Ensure that it is properly insulated.		√	√	√	√
		b) Ensure that the equalizing line is connected in the suction line immediately after the bulb.			√	√	√
		c) Ensure that the bulb is not connected at the bottom of the pipe line.			√	√	√

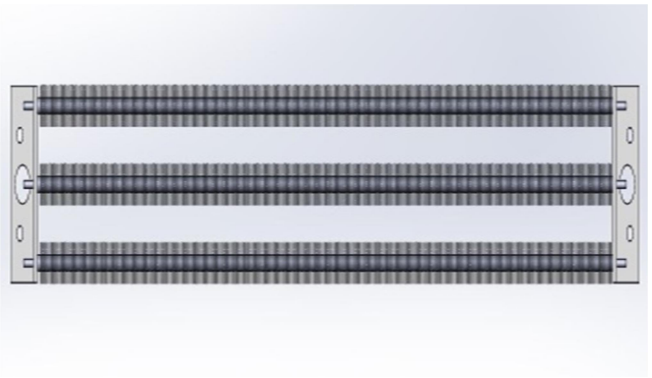
		d) Ensure that bulb/equalizing line/capillary tubes are not chocked.		√	√	√	√
	H) Evaporator coil	a) Ensure that there is no damage to fins.				√	√
		b) Ensure that capillaries of distributors to evaporator coil are not having any sharp bend or kinks. They should also be clamped properly.				√	√
		c) Ensure that air passes only through evaporator coils and no air is bypassed directly to blower chamber.				√	√
		d) Clean the coil, if found dirty.				√	√
		e) Check that the mounting fasteners are properly tightened.				√	√
	I) Filter drier & sight glass	a) Ensure that drier is installed with flow in the direction of the arrow marked on the filter drier label. NOTE: 1) Never use 'antifreeze liquids' like methyl alcohol together with a filter drier. Such liquid can damage the filter. 2) Never re-use a filter drier.			√	√	√
		3) To avoid chances of moisture ingress in the system. Filter drier & compressor should be installed immediately after evacuation and charging the system.			√	√	√
	J) Access Doors	a) Insulate service doors, lower portion and side wall from inside of the evaporator compartment.				√	√
		b) Ensure that latches to lock the service doors are not defective/ damaged.	√	√	√	√	√
	K) Drip tray	a) Ensure that there is no leakage of condensate water			√	√	√

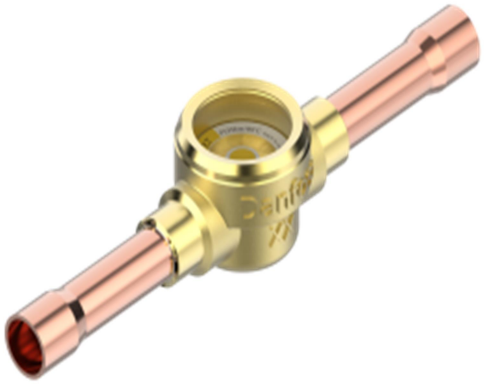
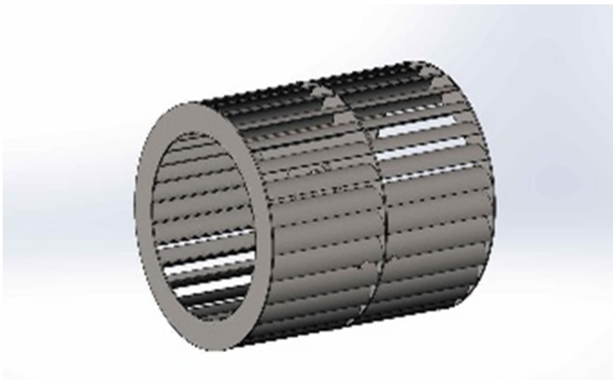
		from drip tray to electrical box & blower housing area.					
		b) Ensure free flow of condensate water		√	√	√	√
	L) Condenser area	a) Clean the condenser coil from inside with compressed air/water jet after opening the cover of condenser area.		√	√	√	√
		b) Ensure that there is no damage to fins			√	√	√
		c) Check that the mounting fasteners are properly tightened.				√	√
		d) Provide fire retardant thermal insulation over suction line.				√	√
		e) Ensure that there is no damage/crack in structure frame of RMPU.				√	√
		f) Ensure proper clamping of electrical conduit.				√	√

11 SPARE PART LIST

Sr. No.	Name	Part Code	Component Photograph
1	Fixed Speed Compressor	ACR 033	
2	Variable Speed Compressor	ACR 029	
2	Condenser motor	LHB 001	
3	Blower motor	LHB 002	

4	Condenser fan	T18 185	
5	Evaporator coil	T18 186	
6	Condenser coil	T18 185	
7	Filter drier	T18 003	

8	Expansion valve	RVC 006	
9	Heater	LHB 007	
10	Return air filter	T18 165	
11	High pressure switch (auto)	EMU 010	

12	LOW PRES. CUTOUT SWITCH	LHB 124	
13	THERMOSTAT SWITCH (OHP)	LHB 010	
14	Refrigerant Sight Glass	T18 162	
15	BLOWER RUNNER	T18 166	

16	Hand Shut Valve 1/4"	ACH 086	

12 INSTRUCTION TO USERS

SAFETY CONSIDERATIONS

Installing, starting up, and servicing air-conditioning equipment can be hazardous due to system pressures, electrical components and equipment location. Only trained, qualified installers and service technicians should install, start up, and service this equipment. When working on air-conditioning equipment, observe precautions in the literature, on tags, stickers, and labels attached to the equipment. Follow all safety codes. Wear safety glasses and work gloves. Use care in handling equipment.