



USER MANUAL RMPU15 TR EMU COACHES



Sphere Thermal Systems Pvt. Ltd.

Factory Address: - Plot No. B-22 & 23, Ecotech-1 Extension, Greater Noida, Gautam Buddha Nagar UP-201306

Registered Office : 410, 4th Floor, Kirti Mahal Building 19 Rajendra Place New Delhi-110008 India

www.spheretherm.com

connect@spheretherm.com

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Published by Sphere Thermal Systems Pvt. Ltd.

Plot No. B-22 & 23, Ecotech-1 Extension, Greater Noida Gautam Buddha Nagar UP-201306

For restricted circulation only, Not for sale.

1. Warnings

FOR YOUR PERSONAL SAFETY THIS MANUAL MUST BE READ COMPLETELY PRIOR TO COMMENCING WORK ON THE HVAC SYSTEM.

ENSURE THE HVAC POWER SUPPLY PLUGS ARE DISCONNECTED BEFORE WORKING ON THE SYSTEM.

TECHNICAL PERSONNEL WHO HAVE EXPERIENCE IN REFRIGERATION AND ELECTRICAL EQUIPMENT SHOULD MAINTAIN THE AIR-CONDITIONING SYSTEM. IT'S MANDATE THAT THE HVAC SERVICE SHOULD BE HANDLED BY TRAINED/CERTIFIED REFRIGERTION TECHNICIAN ONLY.

Throughout this manual, warnings, cautions, and notes are given. It is important that the significance of each category is thoroughly understood by the personnel using this manual.

Their definitions are as follows:

WARNING:	Indicates a procedure, practice, etc. that, if not strictly observed, could result in personnel injury or loss of life.
CAUTION:	Indicates a procedure, practice, etc. that, if not strictly observed, could result in damage or destruction of equipment
NOTE:	Indicates special details

Revision	Date (dd-mm-yyyy)	Description of Changes
00	22-05-2026	First Issue

TABLE OF CONTENTS

Contents

<i>About this manual</i>	3
<i>ABBREVIATION AND DEFINITION</i>	6
1. <i>INTRODUCTION</i>	7
2. <i>USER SAFETY INFORMATION</i>	7
3. <i>UNIT SPECIFICATION</i>	8
3.1 <i>GENERAL</i>	8
3.2 <i>UNIT DIMENSION & WEIGHT</i>	8
3.3 <i>SYSTEM OVERVIEW</i>	9
3.4 <i>PRE-START CHECKS</i>	10
3.5 <i>WORKING PRINCIPAL SCHEMATIC:</i>	10
4. <i>ELECTRICAL DRAWING</i>	11
5. <i>ROUTINE MAINTENANCE SCHEDULE</i>	13
6. <i>SAFETY DEVICES & PROTECTIONS</i>	13
7. <i>TROUBLESHOOTING GUIDE</i>	14
8. <i>MICROPROCESSOR CONTROLLER (HVAC CONTROLLER)</i>	16
8.1 <i>CONTROLLER MAIN FUNCTIONS</i>	16
8.2 <i>IMPORTANT PRE-CHECKS BEFORE CONTROLLER START</i>	16
8.3 <i>DATA RECORDING & DOWNLOADING</i>	16
8.3.1 <i>EVENT LOG</i>	16
8.3.2 <i>FAULT LOG</i>	17
8.4 <i>FAULT REPORTING</i>	17
9. <i>MICROPROCESSOR FAULT TROUBLESHOOTING</i>	18
10. <i>LIFTING INSTRUCTION</i>	22
11. <i>TIGHTING INSTRUCTION</i>	23
12. <i>TIGHTENING TORQUE PARAMETERS FOR SS304 FASTNERS</i>	24
13. <i>SPARE PARTS</i>	25
14. <i>PROTECT THE ENVIRONMENT FROM E-WASTE</i>	29
15. <i>DO's AND DON'Ts</i>	29

ABBREVIATION AND DEFINITION

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

1. INTRODUCTION

This booklet contains the installation, operation and service instruction for self-contained air conditioning packaged unit supplied to Indian Railways for > 15 TR EMU coaches. This Roof Mounted Air-Conditioning Unit is based on RDSO Specification No. RDSO SPEC NO. RDSO/PE/SPEC/AC/D/0168- 2012 (Rev 0).

2. USER SAFETY INFORMATION

- *Disconnect 415 VAC and 110 VDC supply before maintenance.*
- *Only trained/certified HVAC technicians should service the unit.*
- *Use PPE: gloves, helmet, safety glasses, harness for roof work.*
- *Ensure OHE shutdown and safe access during roof maintenance.*



3. UNIT SPECIFICATION

3.1 GENERAL

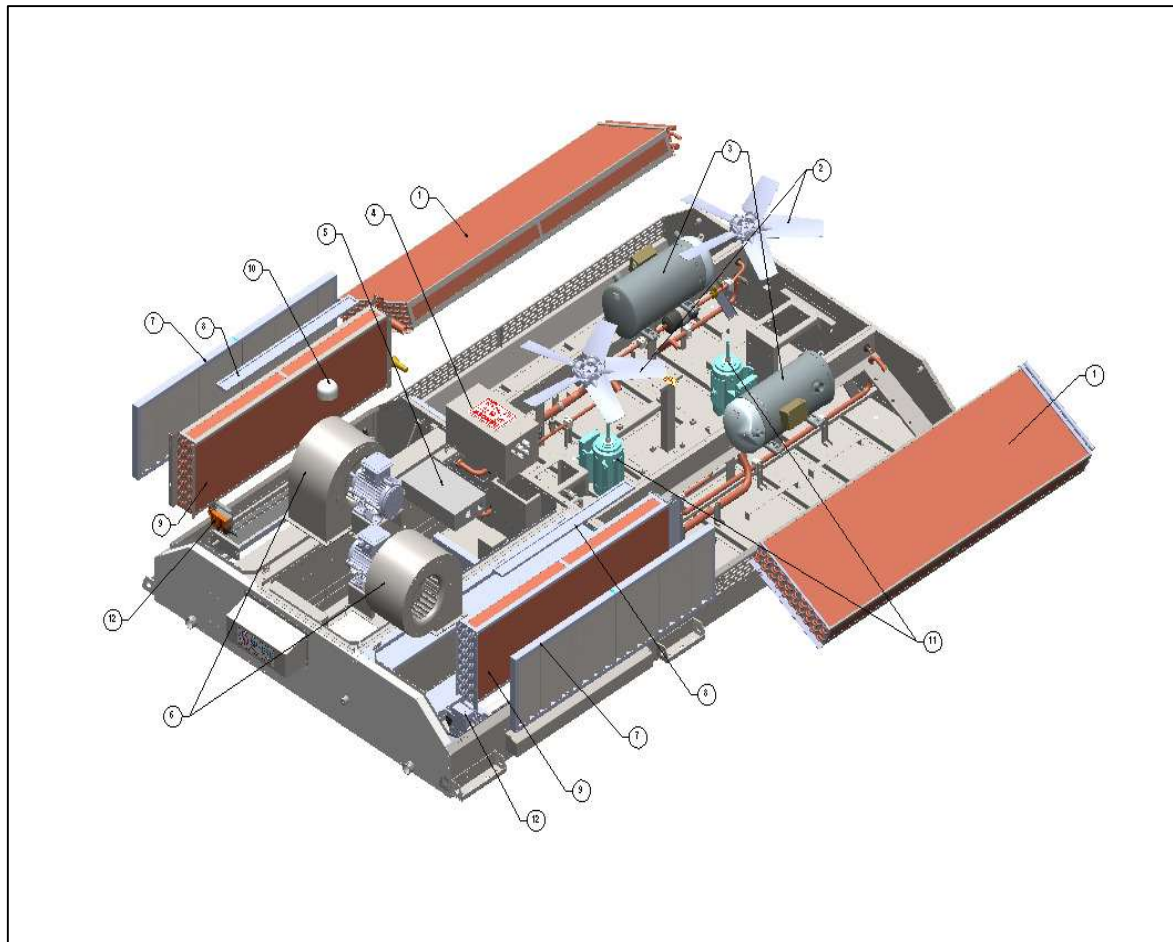
The packaged unit supplied by Sphere Thermal System PVT LTD is Roof mounted type which has the following characteristics.

Parameter	Value
Cooling Capacity	15 TR (52.8 kW)
Power Supply	415 VAC, 3 Ph, 50 Hz
Control Voltage	110 VDC / 24 VDC
Refrigerant	R407C (12.2 kg)
Compressor	2 Scroll Type Compressors
Supply Air	8000 CMH $\pm 5\%$
Dimensions	3400 x 2065 x 405 mm
Weight	987 kg

3.2 UNIT DIMENSION & WEIGHT

Length	Width	Height	Weight
3400 mm	2065 mm	405 mm	987 Kg

3.3 SYSTEM OVERVIEW



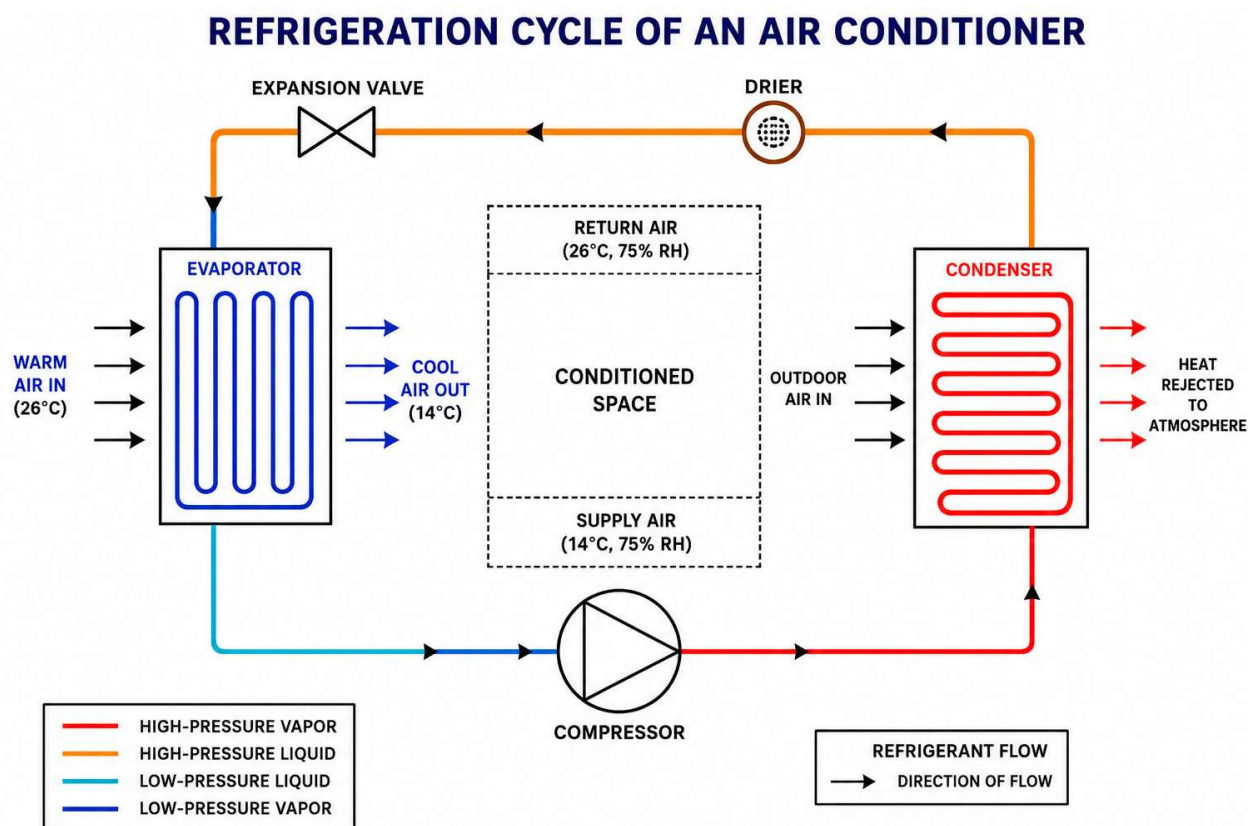
Sr. No.	Item Name	Article Code	UOM	Quantity
1	Condenser Coil	STA222107	Nos.	02
2	Condenser Fan	STA220103	Nos.	02
3	Fixed Speed Compressor	STA220095	Nos.	02
4	Emergency Inverter	STA220100	Nos.	01
5	Blower Motor	STA220176	Nos.	01
6	Return Air Filter	STA220195	Nos.	02
7	Fresh Air Filter	STA220096	Nos.	02
8	Evaporator Coil	STA222110	Nos.	02
9	Smoke Sensor	STA30226	No.	01
10	Condenser Motor	STA220019	No.	02
11	FAD Actuator Motor	STE00191	No.	02
12	Hygrostat	STE00111	No.	01

The HVAC unit consists of: Air Handling Section – evaporator, blower, filters, fresh air damper. Compressor-Condenser Section – compressors, condenser coils, condenser fans. Controller Section – microprocessor-based automatic control and fault monitoring.

3.4 PRE-START CHECKS

- Check 110V DC healthy and no earth leakage.
- Check 415V AC availability.
- Verify HP/LP switches and MPCBs are healthy.
- Ensure all connectors and earthing are properly connected.

3.5 WORKING PRINCIPAL SCHEMATIC:



Working Summary

1. **Compressor** compresses refrigerant gas.
2. **Condenser** rejects heat to atmosphere.
3. **Drier** removes moisture and impurities.
4. **Expansion Valve** drops pressure and temperature.
5. **Evaporator** absorbs heat from coach and cools air.
6. Refrigerant returns to compressor and cycle repeats.

4. ELECTRICAL DRAWING



5. ROUTINE MAINTENANCE SCHEDULE

Frequency	Activity	Remarks
<i>Trip/Weekly</i>	<i>Clean fresh & return air filters; visual inspection</i>	<i>Check abnormal sound/vibration</i>
<i>Monthly</i>	<i>Tighten terminals; clean condenser; inspect leakage</i>	<i>Check fan and blower condition</i>
<i>6 Monthly</i>	<i>Insulation resistance; refrigerant inspection</i>	<i>Megger test and motor health</i>
<i>IOH/POH</i>	<i>Major overhaul and replacement</i>	<i>As per railway maintenance plan</i>

6. SAFETY DEVICES & PROTECTIONS

- **High Pressure (HP) protection:**

The compressor should be switched OFF/tripped, if the discharge pressure of compressor rises beyond limit of 425 ± 15 psig. Once the compressor has been switched OFF, it shall not be started before 5 second even it is required. If the compressor tripped three times in one hour, the fault shall be indicated to TCMS through RS485 networking. In case both the compressors of any unit are switched OFF at a time, first compressor shall be started after 30 seconds and other one after 5 seconds from start of first compressor. The provision shall be there to restart the unit in case both the compressors have been tripped three times in one hour.

- **Low Pressure (LP) protection:**

The compressor should be switched off/tripped; if the suction pressure of compressor goes down beyond limit of 35 ± 15 psig. Once the compressor has been switched OFF, it shall not be started before 5 second even it is required. If the compressor tripped three times in one hour, the fault shall be indicated to TCMS through RS485 networking. In case both the compressors of any unit are switched OFF at a time, first compressor shall be started after 30 seconds and other one after 5 seconds from start of first compressor. The provision shall be there to restart the unit in case both the compressors have been tripped three times in one hour.

- **Motor thermal overload protection:**

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

- **Smoke detection system:**

A smoke detector is mounted at fresh air entry to the HVAC. So in case smoke is detected from out-side the car, The fresh air dampers shall immediately be closed within 10 seconds under any mode of operation of the unit. The unit shall run with 100% re-circulation air (Return air damper shall remain open).

7. TROUBLESHOOTING GUIDE

Problem / Fault	Possible Cause	Corrective Action
No Cooling	HP trip due to high discharge pressure LP trip due to low suction pressure Compressor OFF due to protection logic and temp. setting Insufficient refrigerant charge expansion valve malfunction evaporator icing	Check HP/LP trip status on controller Verify refrigerant suction/discharge pressure Inspect compressor operation Check for refrigerant leakage Inspect expansion valve operation and its sensor is properly fixed on suction line and covered with insulation. Reset fault after rectification
Compressor Not Running	Check 415V AC supply to compressor Check MPCB tripping low/high pressure protection active or permanently trip Compressor contactor not working loose terminals wiring	Verify 415V AC incoming supply Inspect MPCB condition and reset if tripped Check compressor contactor Verify controller compressor command signal Inspect terminal connections and power wiring continuity from electrical box to compressor
Blower Motor Not Working	Blower motor TOP (thermal overload protection) activated MPCB tripped motor winding fault loose terminal connection blower jammed mechanically controller output failure	Check blower motor current and insulation Inspect motor terminals and wires are properly connected Reset TOP/MPCB Ensure blower runner rotates freely Verify motor supply voltage and controller signal
Condenser Fan Not Working	Fan motor failure motor winding damaged Contactor not getting hold Reverse phase sequence causing wrong rotation loose electrical connection fan blade damaged or obstructed	Verify motor voltage and current Check phase sequence and rotation direction Inspect motor terminals and wiring Remove mechanical obstruction and replace fan if damage Repair/replace faulty fan motor
Low Airflow	Dirty return air filter evaporator coil blockage blower motor running at low speed blower runner damage or not tightened properly duct blockage	Clean or replace filters Inspect evaporator coil and wire mesh chocking and cleanliness Check power supply 415 VAC Verify blower motor RPM/current Inspect blower assembly and ducting Check for air leakage or obstruction in ducts

Problem / Fault	Possible Cause	Corrective Action
	<i>air leakage</i>	
<i>HP Trip</i>	<i>Dirty condenser coil reducing heat rejection Condenser fan failure Reverse fan rotation Refrigerant overcharge Blocked condenser airflow</i>	<i>Clean condenser coil thoroughly with the pressurized water Inspect condenser fan motor and airflow direction Verify fan rotation and phase sequence Check refrigerant charge qty as per spec.</i>
<i>LP Trip</i>	<i>Refrigerant gas leakage Evaporator coil blockage Clogged air filters reducing airflow Expansion valve restriction Low ambient condition</i>	<i>Check leakage with soap solution and repair Recharge refrigerant as required Clean evaporator coil, filters and wire mesh Inspect suction pressure and expansion valve condition</i>
<i>Return Air Sensor Fault</i>	<i>Loose terminal wiring Sensor cable open circuit Damaged sensor incorrect resistance value controller input fault</i>	<i>Check sensor resistance with multimeter Check wiring continuity and connection in connector Replace faulty sensor Verify sensor value in controllers</i>
<i>Supply Air Sensor Fault</i>	<i>Loose terminal wiring Sensor cable open circuit Damaged sensor incorrect resistance value controller input fault</i>	<i>Check sensor resistance with multimeter Check wiring continuity and connection in connector Replace faulty sensor Verify sensor value in controllers</i>
<i>Humidity Sensor Fault</i>	<i>Check Hygrostat wiring Dust and moisture comes over the sensor probes Signal from controller not received</i>	<i>Verify sensor signal and wiring continuity Clean humidity sensor Check controller input Replace faulty sensor</i>
<i>Smoke Detector Alarm</i>	<i>False alarm due to dust/moisture Check wires connected properly Smoke Detector malfunction</i>	<i>Inspect coach for actual smoke/fire source Clean smoke detector Reset alarm & verify detector wiring and signal Replace faulty detector if repeated alarm occurs</i>
<i>Emergency Inverter not working</i>	<i>Check power supply to inverter Check Battery too low signal Overload condition Inverter overheating Loose power connection</i>	<i>Check inverter supply voltage and status indication Check all connectors are connected properly Inspect input/output terminals replace faulty inverter if required</i>

Problem / Fault	Possible Cause	Corrective Action
Battery Too Low Alarm	Low DC battery voltage loose battery terminal	Check power supply 110 VDC in panel. Check wire continuity of battery too low input of the controller
No Communication with TCMS/DDU	RS485 communication cable fault Loose terminal connection Incorrect communication settings controller communication failure Address mismatch	Inspect RS485 cable continuity and termination Check controller communication parameters (baud rate, node ID), Verify connectors and shielding of cables Restart communication system and controller

8. MICROPROCESSOR CONTROLLER (HVAC CONTROLLER)

The HVAC controller is a fully automatic microprocessor-based system used to monitor and control the RMPU from TCMS/DDU. It controls compressors, blower motors, condenser fans, humidity and temperature while monitoring safety protections.

8.1 CONTROLLER MAIN FUNCTIONS

- Automatic temperature and humidity control.
- 50% and 100% cooling operation based on TCMS command.
- Monitoring of HP/LP pressure, smoke detection, voltage status and motor protections.
- Fault logging and event recording through USB interface.
- Automatic shutdown during critical faults.

8.2 IMPORTANT PRE-CHECKS BEFORE CONTROLLER START

- Check 110V DC control supply healthy.
- Verify 415V AC power available.
- Ensure compressor, blower and condenser motor MPCBs are healthy.
- Check HP/LP switch status normal.
- Verify all connectors and sensor wiring.

8.3 DATA RECORDING & DOWNLOADING

There will be two type of data will be recorded in Microprocessor which can be downloaded by connecting Laptop or Pen-drive through USB port provided on the Microprocessor.

8.3.1 EVENT LOG

Micro-processors will record all the major events like all inputs & outputs status, other system performance parameters, change in auto/manual operation, instant status of various parameters like temperature

- 415V AC Failure
- Blower Motor 1 TOP/MPCB fault
- Blower Motor 2 TOP/MPCB fault
- Condenser Motor 1 TOP/MPCB fault
- Condenser Motor 2 TOP/MPCB fault
- Compressor 1 LP fault
- Compressor 1 HP fault
- Compressor 2 LP fault
- Compressor 2 HP fault
- RT (Return Air Temperature sensor) Failure
- AT (Ambient Air Temperature sensor) Failure
- ST (Supply Air Temperature sensor) Failure
- Hygrostat (Humidity Sensor) Failure
- Compressor 1 MPCB fault
- Compressor 2 MPCB fault
- Outside smoke detection fault
- Inside smoke detection fault
- Battery too low fault

9. MICROPROCESSOR FAULT TROUBLESHOOTING

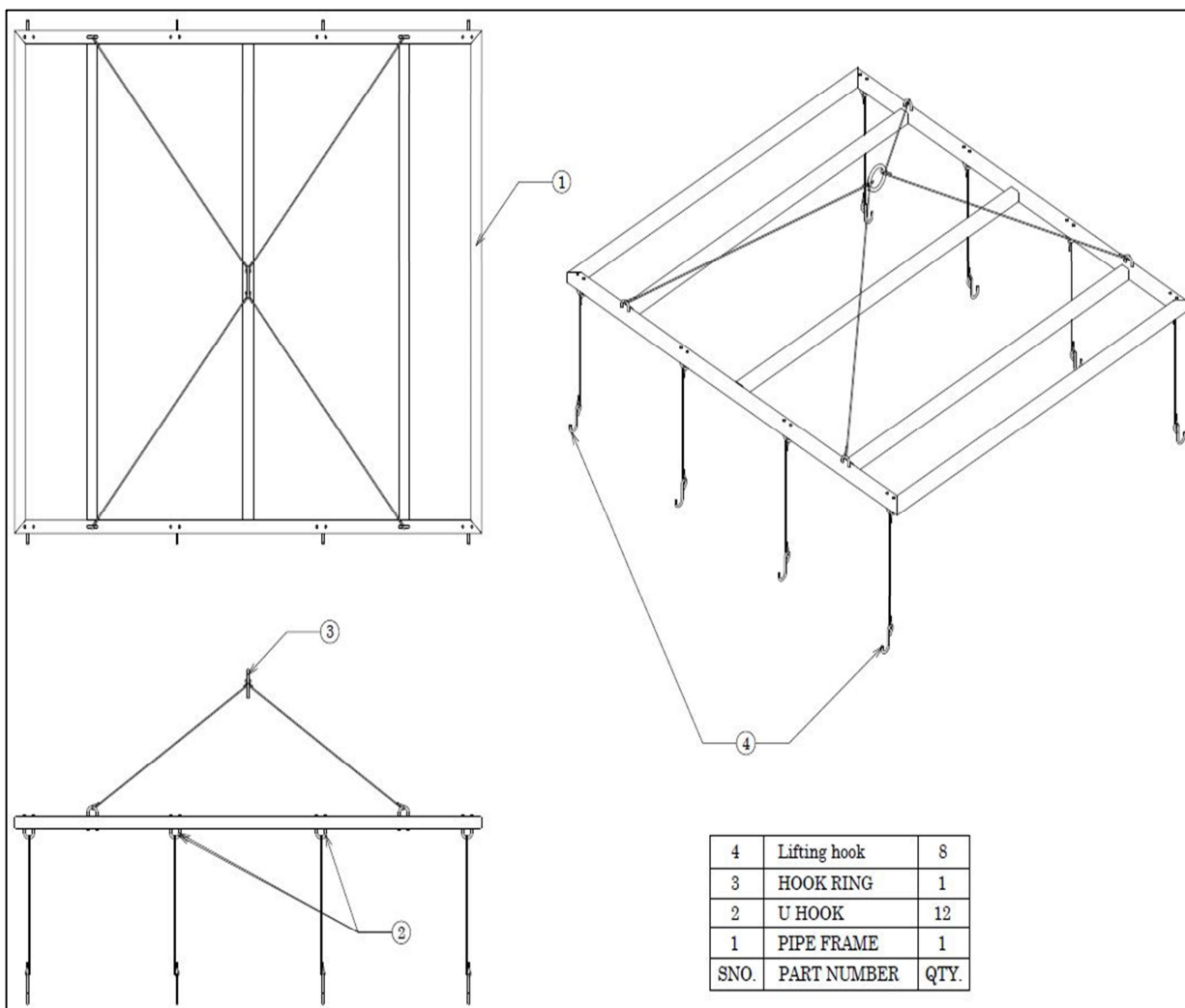
Controller Fault / Alarm	Indication	Possible Cause	Corrective Action
Controller OFF / No Indication	All LEDs OFF	110V DC supply missing Fuse blown MCB OFF Loose terminal connection Reverse polarity Internal SMPS failure wiring harness damage	Check 110V DC control supply with multimeter Check fuse and MCB condition Verify polarity and terminal tightness Check control wiring continuity

Controller Fault / Alarm	Indication	Possible Cause	Corrective Action
		Check Connectors are plugged properly	Replace faulty controller if required
Controller ON but HVAC Not Running	Display healthy but no operation	No command from DDU/TCMS AIR.CO switch OFF Emergency interlock active wrong operating mode software parameter mismatch compressor lockout timer active	Verify AIR.CO switch status Check communication from DDU/TCMS confirm cooling enable command Verify operating mode and parameter settings Restart system if required
Communication Failure	No response from DDU/TCMS	Loose or broken RS485 cable for communication incorrect baud rate/address setting controller communication module failure Ethernet/TRDP/MVB/WTB communication failure	Inspect communication cable continuity and connectors Verify baud rate/node ID/IP settings Inspect communication LEDs/status Restart controller and communication network
High Pressure (HP) Alarm	HP fault shown	Dirty condenser coil Condenser fan not working Reverse fan rotation Blocked condenser airflow Refrigerant overcharge	Clean condenser coil Check fan motor and airflow direction Inspect refrigerant charge level Verify discharge pressure Reset Controller after work
Low Pressure (LP) Alarm	LP fault shown	Refrigerant leakage Gas shortage Evaporator icing Blocked evaporator airflow Expansion valve choke dirty filters	Perform refrigerant leak testing Check Evaporator coil and filters Check suction pressure and expansion valve Clean airflow path
Return Air Sensor Fault	Temperature abnormal	Check Sensor open circuit/short circuit Sensor fills with dust & dirt Check Damaged cable Check moisture ingress controller analog input failure	Measure sensor resistance and compare with standard values Inspect cable continuity Tighten connections & Clean sensor Replace faulty sensor

Controller Fault / Alarm	Indication	Possible Cause	Corrective Action
Supply Air Sensor Fault	Wrong supply temperature	Check Sensor open circuit/ short circuit Sensor fills with dust & dirt Check Damaged cable Check moisture ingress	Measure sensor resistance and compare with standard values Inspect cable continuity Tighten connections & Clean or replace faulty sensor
Fresh Air Sensor Fault	Incorrect fresh air reading	Check Sensor open circuit/ short circuit Sensor fills with dust & dirt Check Damaged cable Check moisture ingress controller analog input failure	Measure sensor resistance and compare with standard values Inspect cable continuity Tighten connections & Clean sensor Replace faulty sensor
Humidity Sensor Fault	Humidity control not working	Hygrostat defective loose signal cable Sensor fills with dust & dirt controller analog input failure	Check sensor signal output and wiring continuity. Clean or replace humidity sensor Inspect controller input
Smoke Detector Alarm	Smoke fault on controller	Actual smoke/fire detected Detector contamination by dust & Moisture effect Wiring fault Detector malfunction & false triggering	Inspect coach area for actual smoke/fire Clean smoke detector Verify detector signal and wiring Replace faulty detector if repeated fault occurs
Emergency Inverter Fault	Emergency mode not available	Inverter supply failure DC input low overload condition & inverter overheating Loose input/output terminal, internal inverter fault	Check inverter input/output voltage Inspect fuse and wiring, Reset inverter & verify Emergency ventilation condition replace faulty inverter if needed
Memory/Data Logging Error	Log not stored	USB/memory failure controller storage full corrupted memory, software glitch controller firmware issue	Restart controller & check USB or memory module Clear storage if full Reload firmware if required Replace Controller
Multiple Sensor Failure	HVAC locked	Common wiring harness issue, Sensor supply failure	Inspect wiring harness and common power supply

<i>Controller Fault / Alarm</i>	<i>Indication</i>	<i>Possible Cause</i>	<i>Corrective Action</i>
		<i>Controller analog input failure</i> <i>Connector loose or short circuit in cable harness</i>	<i>check sensor resistance value and compare</i> <i>verify connector condition, repair damaged wiring, replace faulty controller module</i>
<i>Auto Mode Not Working</i>	<i>Unit in manual only</i>	<i>Wrong parameter setting</i> <i>TCMS/DDU command unavailable</i> <i>Communication issue</i> <i>faulty selector switch</i> <i>Controller logic error</i>	<i>Verify parameter setting of controller</i> <i>Check AUTO/MANUAL selector switch and communication.</i> <i>Restart controller</i> <i>Reload settings/software if required</i>

10. LIFTING INSTRUCTION



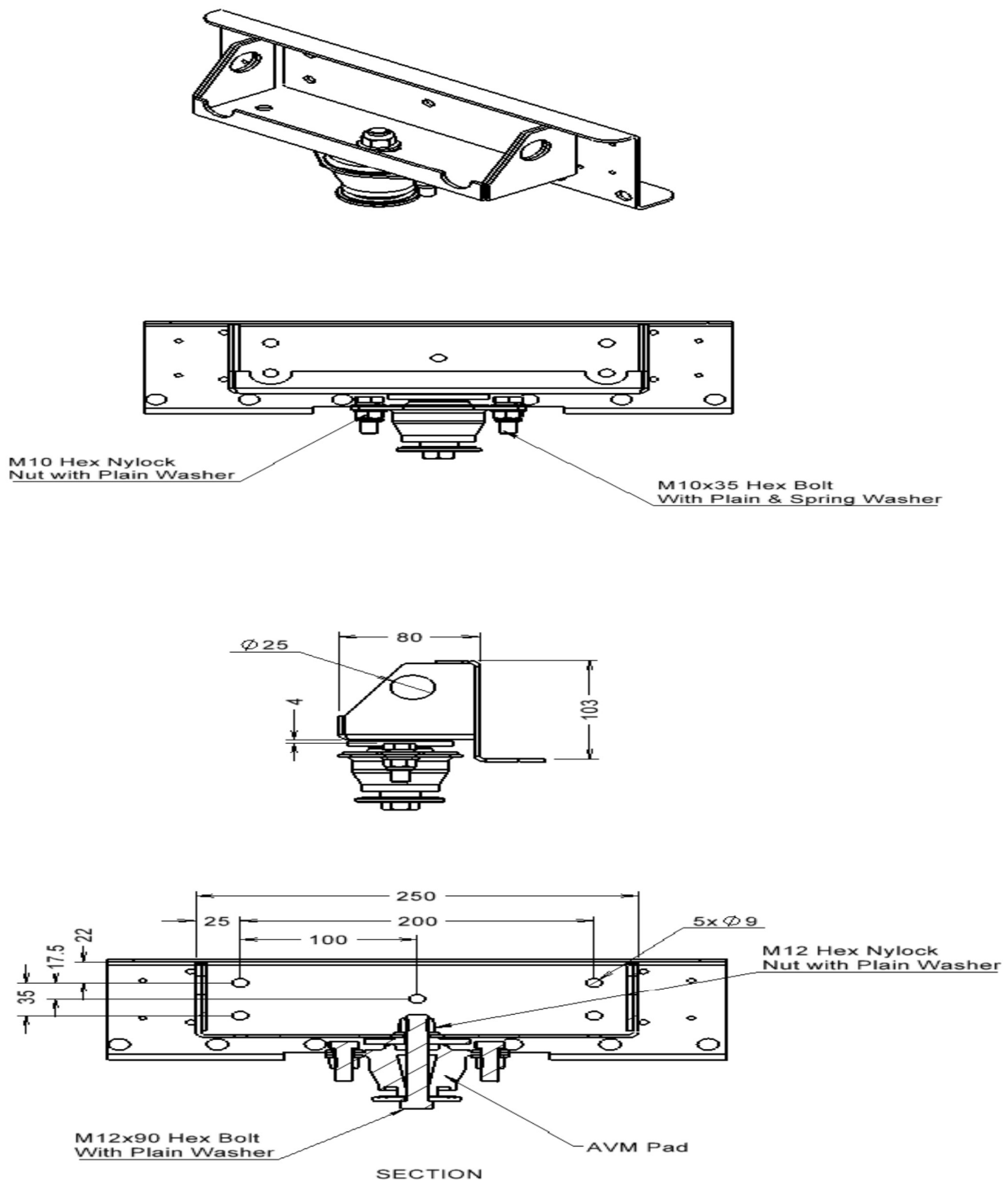
The following instructions shall be followed while lifting the Saloon HVAC Unit.

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.

11. 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

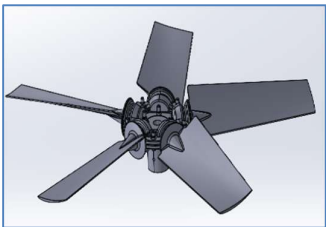
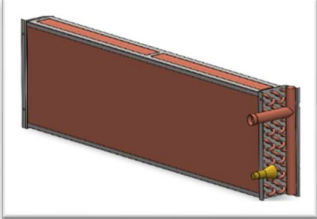
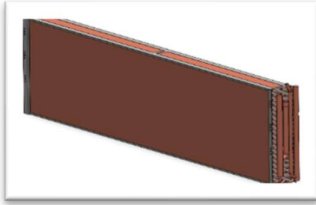


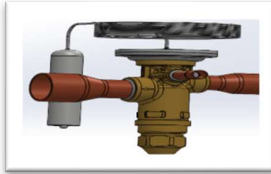
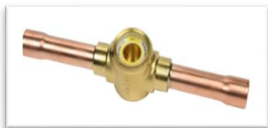
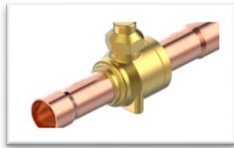
12. TIGHTENING TORQUE PARAMETERS FOR SS304 FASTNERS

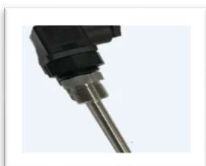
S No.	Size	Quality Class	Torque Required (Nm)		Ratchet Wrench Knob Setting
			Dry	Lubricant	
1	M04	A2-70	04±1	NA	3
2	M05	A2-70	07±1	NA	3
3	M06	A2-70	12±1	NA	0
4	M08	A2-70	29±1	26±1	3
5	M10	A2-70	59±1	53±1	3
6	M12	A2-70	99±1	89±1	3

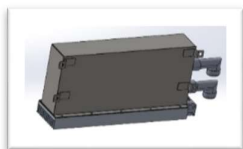
Note: Tightening Torque value for SS A2-70 as per ISO 3506-1.

13. SPARE PARTS

Sr. No.	Name	Part Code	Component Photograph
1	Fixed Speed Compressor	STA220095	
2	Condenser motor	STA220019	
3	Blower motor	STA220176	
4	Condenser fan	STA220084	
5	Evaporator coil	STA222110	
6	Condenser coil	STA222107	

7	Filter drier	STA220094	
8	Expansion valve	STA220097	
9	Mixed air filter	STA220195	
10	High pressure switch (auto)	STE00119	
11	LOW PRES. CUTOUT SWITCH	STE00120	
12	Refrigerant Sight Glass	STA220093	
13	BLOWER RUNNER	STA220200	
14	GBC VALVE	STM0078	

15	HP Transducer	STE0067	
16	LP Transducer	STE0066	
17	AVM Pads	STM00049	
18	RH Sensor	STE00111	
19	Fresh Air Filter	STA220096	
20	Return Air Temp Sensor	STE00088	
21	Supply Air Temp Sensor	STE00088	
22	Fresh Air Sensor	STE00088	

24	Inverter	STA220100	
26	Fresh air Actuator	STE00191	
27	Control Pressure Switch	STE00152	
28	Pin Valve ¼"	STE00156	
29	Smoke Sensor	STA30226	
30	Microprocessor Controller	STA22-0749	
31	Gaskets	STA220009	

14. PROTECT THE ENVIRONMENT FROM E-WASTE

This product at the end of its 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.



E-WASTE RESPONSIBLE DISPOSAL FOR A BETTER TOMORROW

-  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.
-  This product 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**.

DO NOT MIX WITH HOUSEHOLD OR GENERAL WASTE



HOUSEHOLD / GENERAL WASTE

STORE SEPARATELY AND DISPOSE OF THROUGH AN AUTHORIZED E-WASTE RECYCLER



1. STORE SEPARATELY 2. HAND OVER TO AUTHORIZED RECYCLER 3. ENVIRONMENTALLY SOUND DISPOSAL AND RECYCLING



As a responsible citizen of India, we request your cooperation in helping conserve the environment for future generations.

RECYCLE E-WASTE. PROTECT NATURE. SECURE OUR FUTURE.



15. 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*

16. Technical Query & Support

For technical enquiry or technical support, kindly contact or write a mail.

Office

Sphere Thermal System Pvt. Ltd.

Address: Plot No. B-22 & 23, Ecotech-1 Extension, Greater Noida Gautam Buddha Nagar UP-201306

India

connect@spheretherm.com

Email: chandrashekhar.rai@spheretherm.com

Mobile: +91 9147998960

Works

Sphere Thermal System Pvt. Ltd.

Address: Plot No. B-22 & 23, Ecotech-1 Extension, Greater Noida Gautam Buddha Nagar UP-201306

