MANUAL

INSTALLATION
OPERATION
MAINTENANCE

Double Skin Modular Air Handling Unit

MODELS	DM AHU
	DS AHU
	AHUR VRV AHU

VER: O-AHU01-DEC20-15

Table of Contents

1. General

1.1 Foreword

This installation, operation and maintenance manual is given as a guide to user of air handling units. The manual does not limit the users to add other necessary procedures or services for the continuous successful operation of this equipment.

1.2 Warning Notes

Warning and Important notes are appearing at appropriate places in this instruction manual. Follow the warning notes carefully to ensure correct operation of the equipment and personal safety. The manufacturer assumes no liability for installation, operation and maintenance undertaken by unqualified personnel.

1.3 Occupational, Health and Safety Practices

Connection and start-up of the unit should be done in conditions, which are in conformity with Local Codes and Regulations, especially in the field of operation of electrical devices.
The mains voltage must not be turned on before the unit is connected to the protective system. It is forbidden to make any repair and maintenance activities if the power supply of the unit is not turned off. Servicing person, who makes repair or maintenance of the unit must have proper qualifications resulting from the qualification certificate, which is determined by International, National or Local Codes and Regulation.
Place of service should be equipped with the necessary protective equipment, which provide safe maintenance.

1.4 Unit Decommissioning and Disposal

At the end of the unit's useful life, a suitably qualified engineer should decommission it. The parts/materials must be disposed of in a correct manner and comply with the local laws and regulations. The unit components shall be disposed of or recycled as appropriate in the correct manner.

2. Shipment

The items should be carefully checked against the bills of lading to ensure all crates have been received. All units should be carefully inspected for damage when received. Visible or concealed damage should be reported immediately to the carrier and filed damage claims.

WARNING

DAMAGE OR LOSS OF PARTS IN SHIPMENT OR AT THE JOB SITE IS NOT THE RESPONSIBILITY OF MANUFACTURER.

Air handling units are constructed with heavy-gauge steel or extruded aluminum and are thoroughly inspected before leaving the factory. Care must be taken during installation to prevent damage to units. Special care should be taken when handling the blower section. All fans are dynamically balanced before leaving the factory. Rough handling can cause misalignment or sprung shaft. Therefore, blower fan and shaft should be carefully checked before commissioning to avoid more damage cause by unbalance fan.
Screws, bolts, nuts, etc. for assembly of sections are supplied in a bag attached to each section. All necessary gaskets are fixed in the factory.

3. Handling / Rigging

Air handling units can be delivered as separate section or completely assembled.
To prevent damage to unit cabinet, a specific lifting method for offloading the units is recommended as shown in Figure 1. The spreader bars must be in position to prevent straps or cables from rubbing the frame panel. Ensure stability and balance when lifting the units and avoid twisting or uneven lifting. Uneven lifting may lead to accident or fatality which is out of factory responsibility. Care should be taken to prevent coil connections, drain pan connection, damper operators and accessory section from damage.
Do not push hard on the unit it self of on the metal base. Use large wooden beam to evenly distribute the force. Dropping the units will result in permanently damage of ball bearing, fan shaft or loosen coil from the mounting.

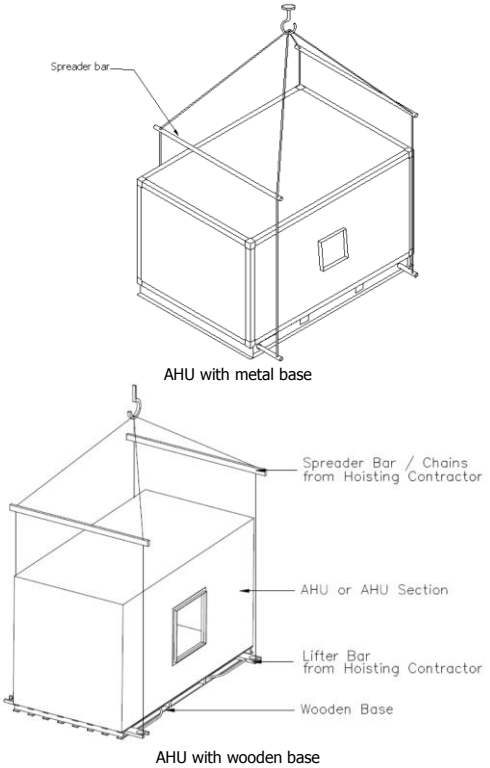


Figure 1 - Lifting method when offloading units

Transportation on the building site should be done using forklift truck or a crane (See Figure 2). The forks must only be applied under the unit base frame and not against the panel. In case when fork of the forklift is too short then suitable extensions should be used.

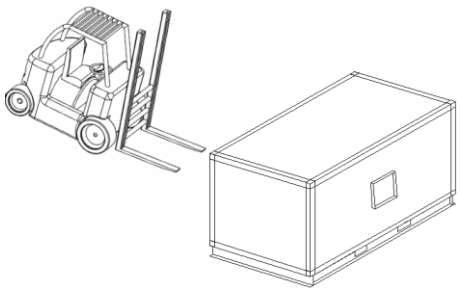


Figure 2 - Transportation by forklift truck

4. Storage

For external storage prior to installation, the units must be protected from dust, rain, constant sun exposure and rodents. Although covered in shrink-wrapped plastic sheeting, this is not intended for long-term storage and should be remove as soon as it is offloaded. Unit therefore should be more protected by tarpaulins or similar. Avoid exposed the units for coil connection damages by transient load.
The fan impeller or motor drive must be rotated once every month. Should the units be stored for a period of exceeding 6 months, then it is recommended that the drive belts be removed and store separately.

IMPORTANT

INSTALLATION AND MAINTENANCE ARE TO BE PERFORMED ONLY BY QUALIFIED AND EXPERIENCED PERSONNEL WHO ARE FAMILIAR WITH NATIONAL AND LOCAL CODES AND REGULATION.

5. Assembly and Installation

5.1 General

The system design and installation should follow accepted industrial practice, such as described in the ASHRAE Handbook.
These units are not designed to be weatherproof (unless equipped with canopy) and therefore should not be installed outdoors. Flexible connections should be used on the outlet and inlet duct connections for all units. A minimal amount of air leakage is normal on the cabinet and it will not affect unit performance. The air handling units are not design to be suspended from the top of the unit. Therefore, when the unit is ceiling hung, make sure unit is supported with a base rail of channel.

5.2 Foundation

Adequate space should be left around the unit for coils & drainage piping, filter replacement, and maintenance. (See Figure 3). If site access space for coil is not follow recommendation, AHU need to dismantle for coil replacement. The unit is installed at a height that allows the installation of condensate drain trap.

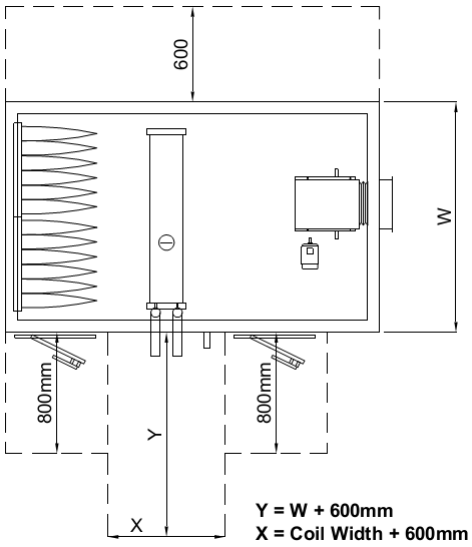


Figure 3 – Recommended minimum service clearances

To minimize noise transmission, insulation material (rubber pad) may be placed between the unit base and the foundation (See Figure 4)

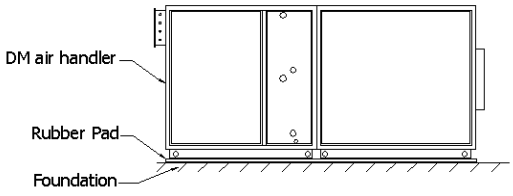


Figure 4 – Air handling unit Plinth Foundation

5.3 Section Joint

Units that shipped in sections must be carefully assembled to desired unit arrangement. The air handling units are design to use section joint brackets to combine two sections. Section joints for cabinet and base frame are shown in Figure 5 and Figure 6. (provided when cabinets are joined by intermediate-post to intermediate-post arrangement)

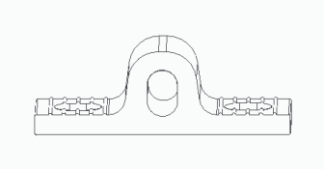


Figure 5 – Cabinet Section Joint

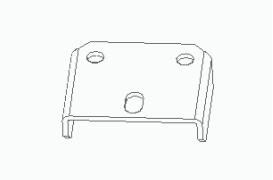


Figure 6 – Base Frame Section Joint

The section joints are pre-installed on cabinets and base frames as shown in Figure 7 (For AHU combination of 2 sections and above). The joint for side will located outside of AHU, joint for top bottom will be located inside of AHU.

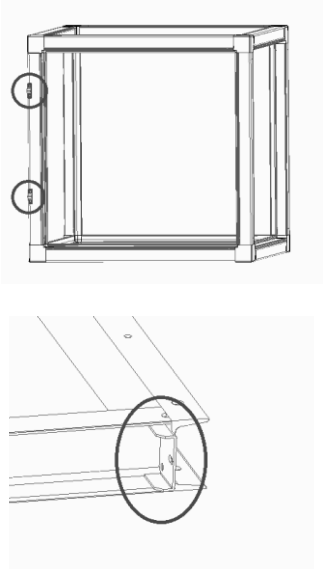
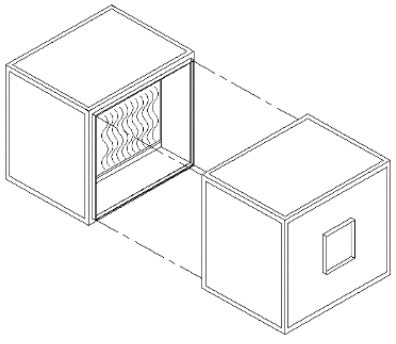
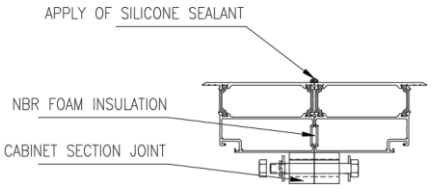
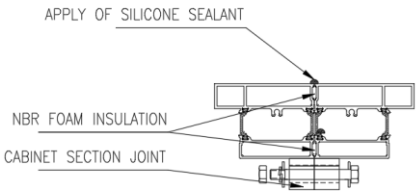


Figure 7 – Pre-installed section joints

To join two sections, install and level the first section in position, then push the second section close to the first section after the alignment is correct as shown in Figure 8.







Intermediate to intermediate post joining

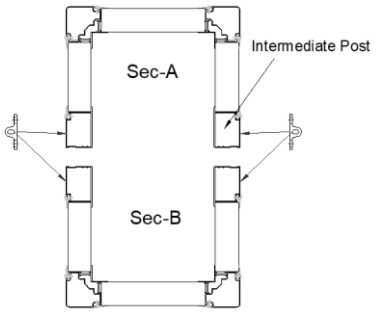


Figure 8 – Combine cabinets

Base frame section joints need to join with bolts and nuts as shown in Figure 9.

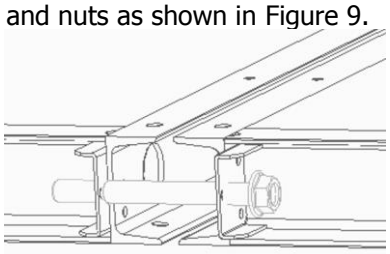


Figure 9 – Tighten the base frame section joint

After base frame being joined, further tighten the external cabinet section joint. After the external section joints being connected, then only followed by internal section joints. Make sure all joint brackets provided are tighten with bolt and nut as shown in Figure 10. All the bolts and nuts for the joining are provided and packed with the unit.

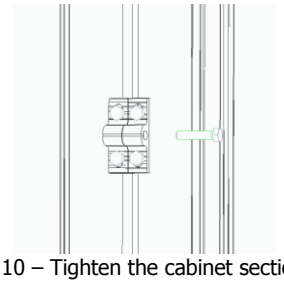
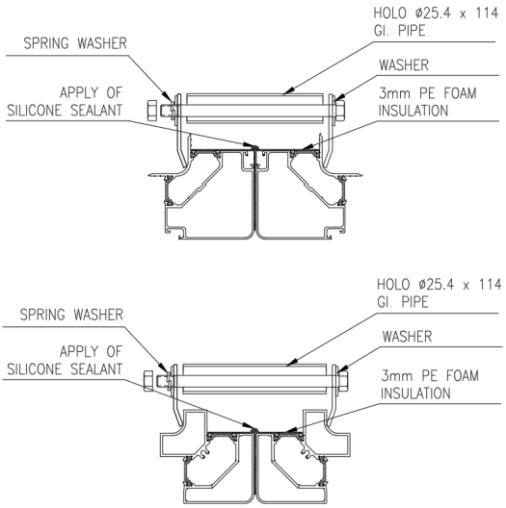


Figure 10 – Tighten the cabinet section joint

WARNING

CABINET SECTION JOINTS ARE NOT INTENDED FOR LIFTING PURPOSE AND PULLING CABINET FROM A DISTANCE TO JOIN SECTION TOGETHER.

When the cabinets are penta-post to penta-post arrangement or joining two sections with different cabinet width, then below type of section joints will be provided. (See Figure 11)



Pentapost to pentapost joining

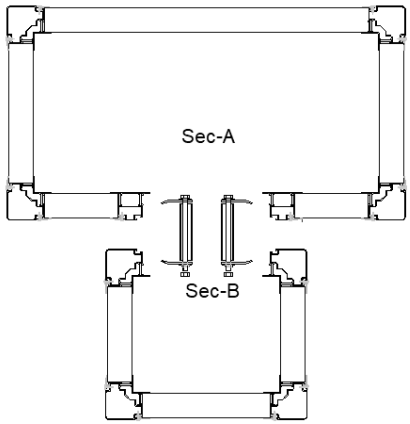


Figure 11 – Section Joint for pentapost to pentapost or different width cabinets

Lastly, silicone sealant need to apply to in-between section to seal the gap.

5.4 Vibration Isolator

Air handling unit fans are supplied with internal vibration isolators.

5.4.1 Spring Vibration Isolator

For model with spring isolators, temporary transport brackets are fitted to prevent damage during shipment. All transport brackets must be removed after

installation and before commissioning. (See Figure 12)
After removing the transport bracket, adjust the spring's height accordingly to ensure the frame is level before commissioning. Before turning the adjustment nut, the locking bolt must be loosened. Turn the adjustment nut bolt clockwise or anti-clockwise to decrease or increase the spring's height. Tighten the locking bolt after completing the adjustment. (See Figure 13)

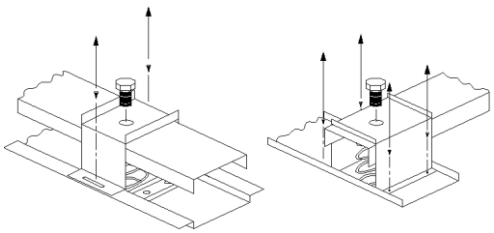


Figure 12 – Removing of transport bracket

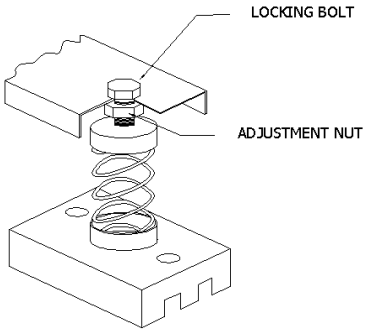


Figure 13 – Spring Isolator Adjustment

5.4.2 Restrained Vibration Isolator

The following is applied for plenum or other fan which is using restrained spring isolator. (See Figure 14). 20mm U-shaped plates are inserted between top plate and base plate when shipped out from factory. (See Figure 15).

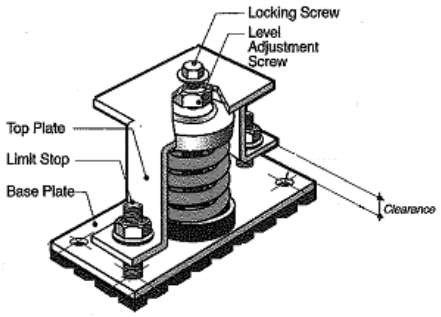


Figure 14 – Restrained Spring Isolator

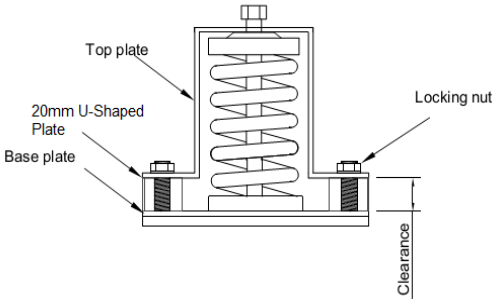


Figure 15 – Removing of U-Shaped Plate

5.5 Arrangement (VRV AHU)

Control box and expansion valve kit are installed on the air handling unit. Figure 16 and Figure 17 show the proposed arrangement of component. Item 2, 3, 5, 8 and 10 in Figure 16 and Item 2, 3, 6, 9 in Figure 17 will be supply by factory.
Refer to Installation and Operation manual of "EKEQMCBAV3 / EKEQFCBA – Option kit for combination of Daikin condensing units with air handling units" for further instructions.
Standard Air Series VRV AHU

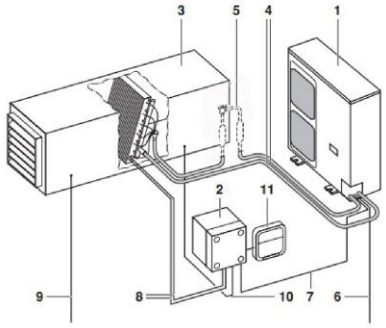


Figure 16 - Standard Air Series VRV AHU Unit

1. Outdoor unit
2. Control box
3. Air Handling unit
4. Field piping (field supply)
5. Expansion valve kit
6. Outdoor unit power supply
7. Control box wiring
8. Air handling unit thermistors
9. Power supply and control wiring for air handling unit and controller
10. Air thermistor control for AHU
11. Remote controller

Outdoor Air Series VRV AHU

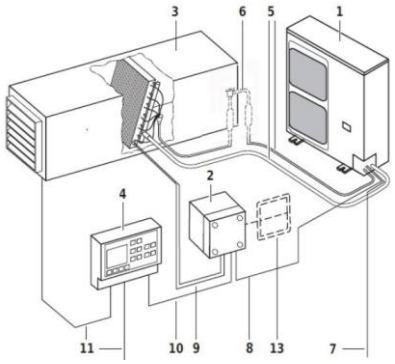


Figure 17- Outdoor Air Series VRV AHU Unit

1. Outdoor unit
2. Control box
3. Air Handling unit
4. Microtech III
5. Field piping (field supply)
6. Expansion valve kit
7. Outdoor unit power supply
8. Control box wiring
9. Air handling unit thermistors
10. Control wiring for control box and Microtech III
11. Power supply and control wiring for air handling unit and controller
12. Remote controller

5.6 Coil Installation/ Pipe Connection

5.6.1 General

The coil will perform as per rating only if the airflow is uniformly pass-through the coil surface.

IMPORTANT

HIGH VELOCITY SPOTS ON THE COIL MAY CAUSE MOISTURE CARRY OVER. THEREFORE, UNIFORM AIRFLOW ACROSS COIL SURFACE IS CRUCIAL.

External pipe-work must be adequately supported to ensure load-free towards coil connections. Swing joints or flexible fittings are to be provided in all piping connections, particularly those adjacent to heating source, to absorb expansion and contraction strains. Failure to comply will result in damage to the coils & headers.

IMPORTANT

TO AVOID DAMAGING THE COIL CONNECTIONS AT COIL HEADER, IT IS ESSENTIAL TO HOLD THE CONNECTOR / PIPE WITH TOOLS WHILST APPLYING COUNTER FORCE TO TIGHTEN THE JOINT. (See Figure 18)

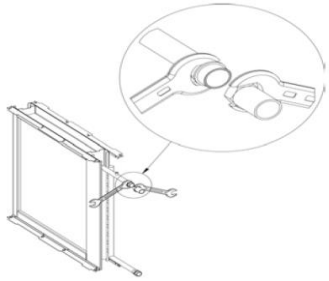


Figure 18 – Coil header connection method

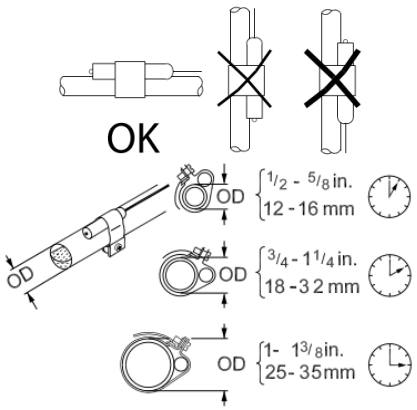


Figure 19 – Bulb orientation and position

Figure 19 shows the correct mounting method and the position of TXV sensing bulb according to the piping size.

IMPORTANT

*WRAP WET CLOTH AROUND PIPE BEFORE PERFORM BRAZING TO PREVENT OVERHEAT PIPE AND DAMAGE COMPONENT AT PIPING. (*Figure 20*)*

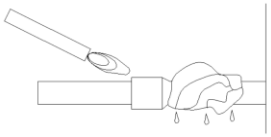


Figure 20 – wrap wet cloth before brazing

AFTER PIPE-WORK DONE, SITE INSTALLER MUST WRAP THE PIPE CONNECTION WITH INSULATION AND SEAL THE HOLES BETWEEN PIPE CONNECTIONS AND PANEL.

5.6.2 Water Coil

Water supply, water return, drains and vents connections are extending through

the end panel of the coil section. All connections are labeled on the end panel. For control equipment, follow recommendations from the manufacturer regarding the types, sizing and installation of equipment. Hot water coils are not recommended to be used with entering air below 40°F (4.4°C). Refer appendix 9.2 for water quality.

5.6.3 Winterizing Water Coils

Coil freeze-up may occur due to air stratification, failure of outdoor air dampers and/or preheat controls. Routine draining of water coils for winter shutdown cannot guarantee zero freeze-up incidents, which may result in coil damage. It is recommended to completely drain the coil and treated with anti-freeze solution.
Fill each coil independently with an anti-freeze solution by using a small circulating pump follow by complete draining. Check the freezing point of anti-freeze before proceed in each coil. Diluted effect normally occurred due to a small amount of water always remaining in each coil. Therefore, ensure sufficient amount of anti-freeze solution be remained in coil to prevent freeze-up.

5.6.4 Direct Expansion Coils

For each coil, individual expansion devices must be provided for header suction connection. If the air flow through two or more coils in parallel or stacked coil bank, the suction piping must be installed in such a way that refrigerant from one coil suction header cannot reach another coil suction header. The bulb for the control valve must be attached to the header or the coil or section of coil fed by valve and not to a common header. When two or more coils are connected to a common suction line, never place the bulb on the common line.
Thermostatic expansion valve is to be equipped with external equalizer tubes that are field connected to the suction line. The valve should be in accordance to the manufacturer recommendations, allowing approximately 35-psi pressure drop through the coil and distributor at full load. Do not oversize the valve, proper expansion valve operation is necessary in order to realize the rated coil capacity.

IMPORTANT

CAREFULLY READ THROUGH MANUFACTURING INSTRUCTION FOR APPLING ANTI-FREEZE SOLUTION. SOME PRODUCTS WILL HAVE DIFFERENT FREEZING POINT IN ITS NATURAL STATE WHEN MIXED WITH WATER. COIL FREEZE-UP IS NOT THE RESPONSIBILITY OF MANUFACTURER

It is not recommended to operate DX coil for air-conditioning purpose at below freezing suction temperature, 0°C which will result frost build-up at fins surface. If the full load operating point for the coil is selected at a "safe" temperature, a system analysis is required to check for the lowest probable suction temperature at light load condition.

5.6.5 Piping Diagram (VRV AHU)

For piping diagram of VRV AHU model, please refer to the VRV ED or refer to manufacturer for advices.

5.6.6 Drain Pan Trap

Drain pipes and traps must be at least same diameter as the drain pan connection. Drain pan must be level to permit condensation from coil drain freely for the recommended depth and distance of drain trap installation. (See Figure 21)
Drain pan are not designed to be walked on.

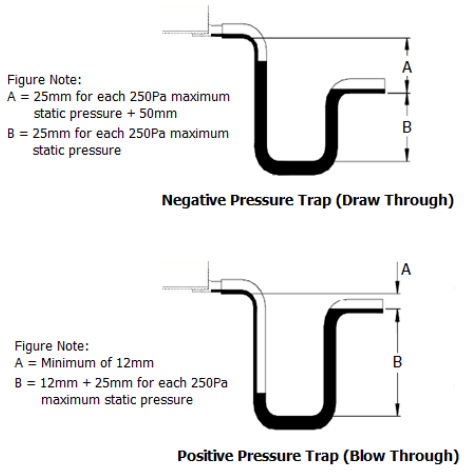


Figure 21 – Drain Trap Arrangement

5.7 Electrical Installation

Electric connecting should be compliant with relevant local laws and regulations.

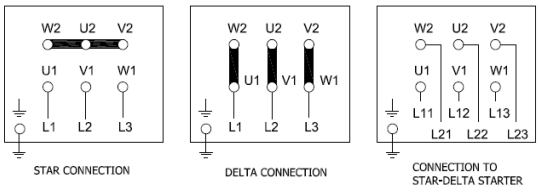
All installation and management activities must be carried out by qualified personnel. Refer to the specific wiring diagram and electrical component manual are attached with the product before electrical installation. Site contractor shall do termination at site for wiring connection between components that located at different AHU sections and delivered separately.

IMPORTANT

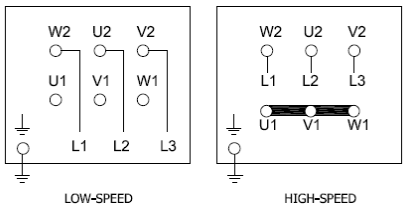
MAKE SURE ALL THE ELECTRIC POWER DISCONNECT AND SECURE FROM SWITCH ON BEFORE DOING WIRING CONNECTION

5.7.1 Motor Connection

The electric supply to the motor must correspond to the rated voltage stated in motor nameplate and be in conformance with the National and Local Electric Code and Regulations. Motor supplied able to operate within 10% tolerance from the nameplate voltage. Motor connection details are contained in the cover of the motor terminal box. (See Figure 22). The fan section metal frame must be grounded. Suitable electrical protection isolator should be installed to protect the motor and other electrical equipment.
Flexible conduit must be used when wiring up fan motors to allow the fan motor to move freely on its anti-vibration mounts. Cables passing through panels must be made with gland or grommet.
For inverter control, refer to the VFD manual for wire size and requirements.



MULTI-SPEED MOTOR CONNECTION
(TAPPED WINDING)



MULTI-SPEED MOTOR CONNECTION
(DUAL WINDING)

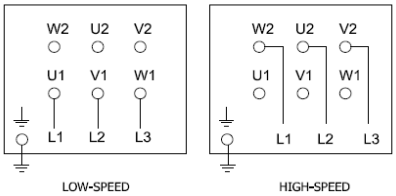


Figure 22 – 3 phases motor connection diagram

5.7.2 Motor Cabling

Motor wiring must go downward from motor terminal box to prevent condensation water flowing into motor and lead to a failure. (See Figure 23)

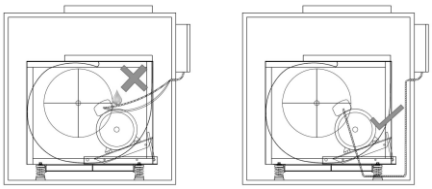


Figure 23 – Motor Cabling

5.8 Drive Belt & Sheave

Improper sheave alignment and belt tension can cause excessive vibration, premature failure of belts and bearings. See Figure 24 for correct motor sheave and fan sheave alignment.
Tensioning of the drive belt is achieved by moving the motor in relation to the fan (See Figure 25). When inserting new belts, do not force belts over grooves, Loosen the adjusting screw at motor base until belt can slide smoothly over the grooves. When all belts are in position, proceed to adjust belt tension using the adjusting screw and nuts on the motor base.
Use recognized belt tension gauge to check the belt tension by apply a force large enough at the center of the belt to deflect the belt by 16mm per meter (See Figure 26). The deflection force for any belt should be within the minimum and maximum force shown in table 1. Readjust the tension to maximum value when it drops to min. value. The deflection force of factory setting is based on "Initial Fitting", re-tensioning as "Retension" after the unit has run for 24 hours.

WARNING

OVER TENSION TOWARD DRIVE BELT WILL CAUSE PREMATURE FAILURE OF BELT AND BEARING DAMAGE.

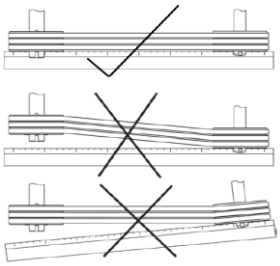


Figure 24 – Alignment of belt pulley

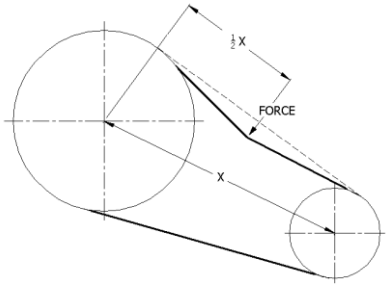


Figure 26 – Belt deflection distance

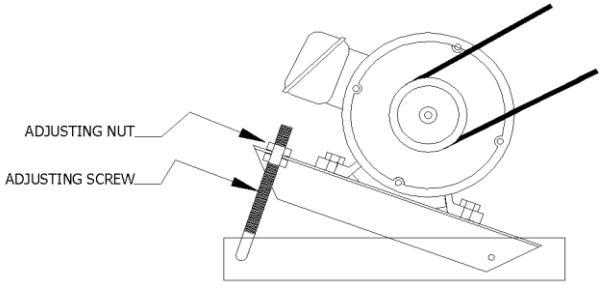


Figure 25 – Belt tensioning

Table 1 - Belt Tensioning Force

Belt Section	Pulley Diameter	Deflection Force (N)			
		Initial Fitting		Retension	
		Min	Max	Min	Max
SPZ	<70	12	17	12	16
	71-90	15	22	15	19
	91-125	19	27	19	24
SPA	<100	20	29	20	25
	101-140	27	39	27	34
	141-200	32	47	32	40
SPB	<160	36	54	36	46
	161-224	46	67	46	58
	225-355	53	79	53	69

Refer to factory specifications for tension values that are not included
Refer to the diameter of smaller pulley

Table 2 - Adjusted Pitch Diameter

Model	VPT100Z1	VPT120A1 / A2	VPT139A1 / A2	VPT156A1 / A2	VPT177A1 / A2	VPT178B2
Max. Pitch Ø (mm)	96	114.4	133.4	150.4	171.4	171
Min. Pitch Ø (mm)	82.9	96	115	132	152.5	146.5
Adjusting Factor(mm)	1.089	1.227	1.089	1.089	1.452	1.635
No. of Turning	Adjusted Ø (mm)	Adjusted Ø (mm)	Adjusted Ø (mm)	Adjusted Ø (mm)	Adjusted Ø (mm)	Adjusted Ø (mm)
0.25	94.91	113.17	132.31	149.31	169.95	169.37
0.5	93.82	111.95	131.22	148.22	168.50	167.73
0.75	92.73	110.72	130.13	147.13	167.04	166.10
1	91.64	109.49	129.04	146.04	165.59	164.46
1.25	90.56	108.27	127.96	144.96	164.14	162.83
1.5	89.47	107.04	126.87	143.87	162.69	161.19
1.75	88.38	105.81	125.78	142.78	161.24	159.56

2	87.29	104.58	124.69	141.69	159.78	157.92
2.25	86.20	103.36	123.60	140.60	158.33	156.29
2.5	85.11	102.13	122.51	139.51	156.88	154.65
2.75	84.02	100.90	121.42	138.42	155.43	153.02
3	82.93	99.68	120.33	137.33	153.98	151.38
3.25	-	98.45	119.24	136.24	152.52	149.75
3.5	-	97.22	118.15	135.15	-	148.11
3.75	-	-	117.07	134.07	-	-
4	-	-	115.98	132.98	-	-

5.9 Accessory Items

5.9.1 Filter

Air handling units can be supplied with flat filters and/or bag filters. There are 2 types of filter frame, sliding frame or universal clip. Insert the filter into the frame by following airflow arrow indicated.

5.9.2 Mixing Box

Fresh air and return air dampers can be linked together and drives by the same actuator if both are same size. Care must be taken to ensure dampers are in open position while the fan is running whether they are integral with central plant control or associated ductwork under negative pressure condition.

5.9.3 Variable Pitch Pulley

Modifications of the pulley diameter must be done when stationery by moving the adjustable flange. Each complete rotation of one of the two disks results in a variation of the pulley diameter. (See Table 2 & Figure 27) When the required diameter is obtained, adjustable flange is locked by tighten the four clamp screws. To get the same diameter in the two grooves of pulleys, screw the two mobile flanges on the central flange. Then unscrew the two mobile flanges by the same number of turnings to get the required diameter.
Note that the belt centre line shifts when diameter changes. Driven pulley may need realignment.

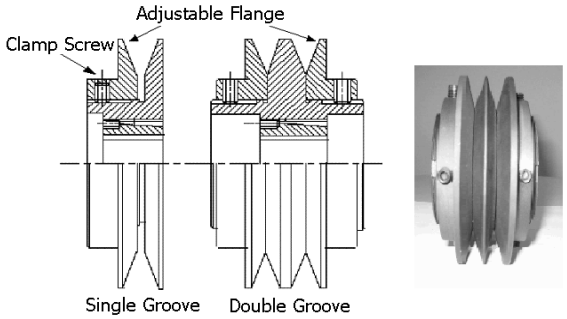


Figure 27 – Variable Pitch Pulley

5.9.4 Heat Wheel

Follow Heat Wheel manufacturer recommendations for proper installation procedure. Apply silicone to air leak spots at baffle plates. (If applicable)
Refer to assembly of heat wheel baffle plates at Appendix 9.1 when the heat wheel section not able to ship in complete build up.

5.9.5 Heat Pipe

After installation of Heat Pipe with refers to manufacturer recommendations, site installer to install heat pipe baffle plates at site, this is to avoid air bypass heat pipe/main cooling coil from top and side. (If applicable)

5.9.6 Electric Heater

Power supply to electric heater and electric connection is in accordance with wiring diagram in terminal box of electric heater.
The rated voltage of electric heater is 240V, single phase.

IMPORTANT

IT IS ADVICED TO INTERLOCK ELECTRICAL HEATER WITH BLOWER TO ENSURE HEATER IS NOT ENERGIZED WHEN THERE IS NO AIR FLOW.

5.10. Ductwork

Connections to unit cabinet are made by site drilling into the frame on the unit inlet or fan discharge collar. This should be load-free toward cabinet collar when initial positioned.

Compliance with the Codes of Practice in duct assembly and acoustic layout are necessary to ensure the best possible performance of the unit whilst avoiding excessive pressure loss in the duct system and minimize undue air stream noise. Duct connections to and from units should allow straight, smooth airflow. Sharp turns in the fan discharge should be avoided, particularly turns opposed to wheel rotation. Turning vanes should be used. Discharge plenums or any abrupt change in duct should be avoided.

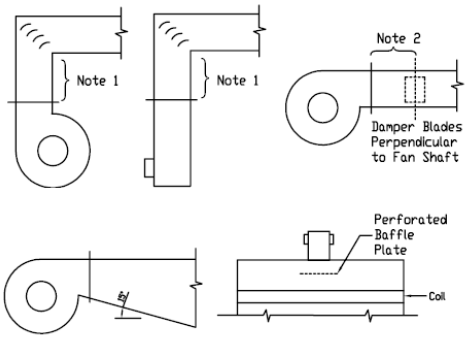


Figure 28 – Discharge duct layout

Notes:

1. Elbows should not be closer than 2-1/2 times the Duct Equivalent Diameter. (Refer to Formula 1)
2. Dampers should be placed at least fan diameters downstream of the fan discharge.

$$D_e = \frac{1.30(ab)^{0.625}}{(a+b)^{0.250}}$$

where

D_e = circular equivalent of rectangular duct for equal length, fluid resistance, and airflow, mm
a = length one side of duct, mm
b = length adjacent side of duct, mm

Formula 1 - Duct Equivalent Diameter

All duct joints, edges, opening area of top roof (example: top discharge, top damper and top roof with opening), must have skirting and fully sealed to avoid leakage and rain water seepage into the unit (if unit is placed outdoor).

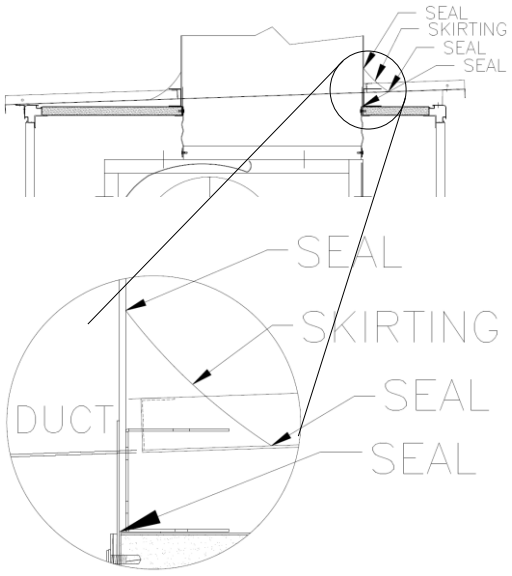


Figure 29 – Site to seal gap between roof and duct

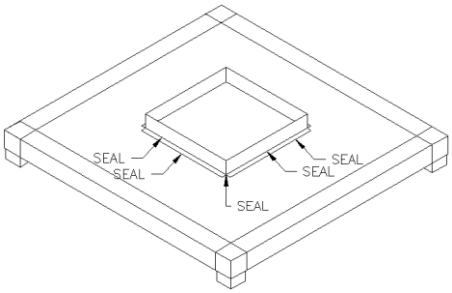


Figure 30 – All edge to be seal by site if the flange was sent separately / unit is CKD

For outdoor unit, the return duct should be large enough to cover the exposed area of AHU to prevent rain water from seeping into the unit.

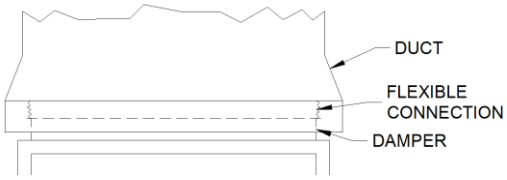


Figure 31 – Front view of Return duct to be large enough to cover exposed area

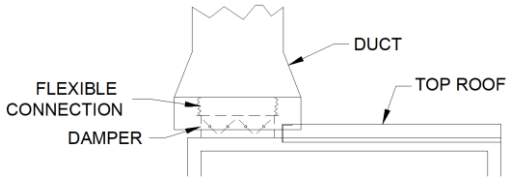


Figure 32 – Side view of Return duct to be large enough to cover exposed area

IMPORTANT

Top roof are not intended for people to step on.

5.11 Assembly of Complete Knock Down Unit (CKD)

Due to container size constrain, some air handling units are packed in unassembled condition - CKD method. All parts required are packed in section by section. It is recommended to open one section at a time to avoid confusion when assembly. For CKD, additional drawing will be provided for assembly at site.

5.12 Component Removal and Replacement

5.12.1 Panel Removal

To remove side or top panel, simply unscrew the fasteners located along the aluminum clip on the frame of Air Handling unit cabinet. Once the aluminum clips are removed, lift the panel off.

5.12.2 Fan / Motor

The fan shaft, motor and drive components can be removed and replace through the access door opening or side panel removal if additional access required. For fan replacement, the entire fan assembly can be pulled out from side or front (for top discharge) of the cabinet. Dismantle the intermediate fan supports and canvas follow by loosening bolts & nuts at motor and drive belts. Then remove the belts and nuts from Fan mounting frame. Take out the fan and replace with new fan with care. Re-connect the shaft and bearings and fan assembly.

5.12.3 Coil

The coil can be pulled out from side or top of cabinet. The coil is fastened with bolts and nuts on the coil support bracket at the end plate and baffle plate. Before removal of coil, ensure the piping connections at header are disconnected. In case where two coils are stacking, remove the drip pan and join brackets which holding the two coils together.
For DX coils, it is advisable that the refrigerant is to be pumped into the condenser. If this is not possible, refrigerant shall be purged out.

WARNING

DO NOT HEAT ANY PART ON DX COIL IF REFRIGERANT STILL IN THE SYSTEM. HEATING UP WILL CAUSE DANGER OF HIGH PRESSURE INSIDE THE COILS.

6. Commissioning and Operation

6.1 Pre-run Check

6.1.1 Preparation

The complete air handling unit and all accessory components should be thoroughly cleaned and all dust & debris completely removed.
Make sure that all transport brackets and packing have been removed.
Ensure all screws, bolts and nuts on AHU are secured tightly (not loose during AHU transportation or handling).
Ensure all panel and belt drive settings are secured due to change during shipment or installation.
In case additional equipment is installed at site, ensure air leaking spots are being seal with additional baffle plates or seal with silicone to prevent air bypassing.

WARNING

ISOLATE THE ELECTRICAL & MECHANICAL ENERGY SOURCE AND PADLOCK THE SWITCH BEFORE SERVICING THE FANS AND MOTORS.

6.1.2 Fan / Motor

Make sure the fan impeller can rotate freely by hand. Check the tension and alignment of the belt drive.
Check motor connections and make sure correct voltage is supplied. If standby motor is available, make sure only one motor to power source.
Seal end of fan motor conduit (if applicable) and the motor terminal box with silicon sealant.
VFD/Frequency Inverter for TEFC motor can only vary the frequency within **30 to 60 Hz** in order to control the motor rotation speed. For VFD setup, make sure the VFD settings according to recommendations at VFD manual.
When multiple fan with multiple VFDs, fans must set up to always start simultaneously and with same speed.

6.1.3 Fan Array

Fan array is available for EC plug fan. Ensure all fans are control to run simultaneously and with same speed.
Fans running at unequal speeds can result uneven airflow that cause performance, sound, vibration problems that lead to failure.
In case one of the fan is down, blank off plate shall be temporarily installed on the nonfunctional fan to prevent air re-circulation while waiting fan replacement (See Figure 33). If present of differential pressure controller, ensure the pressure tube of nonfunctional fan is capped and amend the setting of controller accordingly.

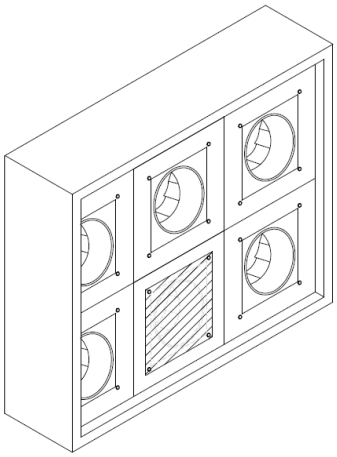


Figure 33 - Fan Array with Blank-off Plate

6.1.4 Vibration Isolator Mount

Ensure the vibration isolator mounts and flexible connections allow the fan and motor to move freely without constrain.
For the fan with Restrained Spring Isolator, ensure that the Alu Angle plates are removed from the restrained spring isolator before commissioning.

IMPORTANT

The clearance between flanges of "Top plate" and "Base plate" for restrained spring isolator should be approximately 10-20mm.

6.1.5 Coils

Check the pipe-work to coil is correctly connected and the fins are free from foreign matter or damage.
Check that the condensate drain is trap.
Ensure good sealing of silicon around the coil headers and drain pipe.

6.1.6 Damper & Filters

Check all dampers are operating correctly as per design.
Make sure all filter media are installed in correct airflow direction.

6.1.7 Panel & Section

Ensure all access panels are in position and secure. Make sure all necessary section joints are in place.

6.1.8 Electric Heater

Electric Heater – Before starting-up, ensure that the air flow through the heater should not be lower than **2.0 m/s** to avoid overheating heater.

WARNING

FOR 380-415V/3PH, STAR CONNECTION WITHOUT NEUTRAL (Figure 34), UNBALANCED PHASE VOLTAGE MAY CAUSE DAMAGE ON THE ELECTRIC HEATER.

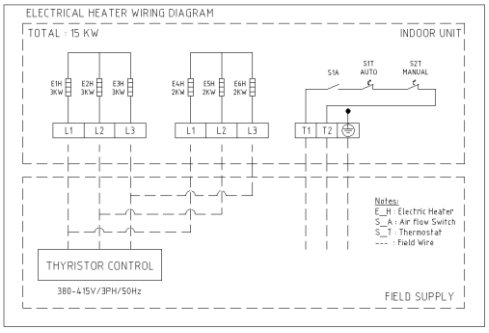


Figure 34 - Wiring Diagram without Neutral

FOR 380-415V/3PH, STAR CONNECTION WITH NEUTRAL (Figure 35), NEUTRAL POINT MUST BE CONNECTED IN ACCORDANCE WITH WIRING DIARGRAM IN ORDER TO CARRY CURRENT DUE TO UNBALANCED PHASE VOLTAGE.

IMPORTANT

SAFETY THERMOSTAT IS FOR OVERHEATING PROTECTION ONLY, NOT FOR CONTROL PURPOSE. DEFAULT SETPOINT IS 60˚C.
IT MUST BE CONNECTED TO CONTACTOR (WHETHER SUPPLIED BY FACTORY OR SITE) TO CUT-OFF HEATER IN CASE OF OVERHEATING HEATER.

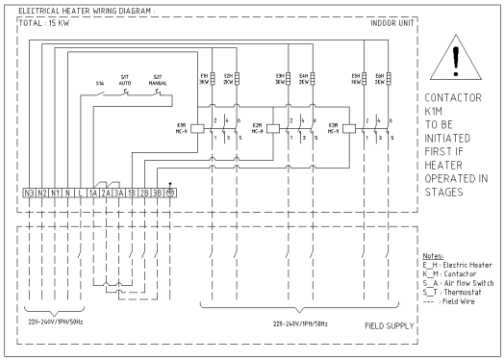


Figure 35 - Wiring Diagram with Neutral

Heat Wheel – Ensure the heat wheel can rotate freely by hand.
Heat Pipe – Ensure installations are as per manufacturer recommendation.

6.2 Start-up Check

Competent, well-trained personnel must be employed in the following operations to ensure Safety Rules and Regulation being adhered to at all time.

IMPORTANT

FAILURE TO PROVIDE MOTOR OVERLOAD PROTECTION COULD RESULT IN MOTOR DAMAGE. CONNECT THE MOTOR TO AN OVERLOAD PROTECTIVE DEVICE THAT IS RATED IN COMPLIANCE WITH THE APPLICABLE CODE.

a. Check the rotation of the fan impeller. If the fan rotates in opposite direction from desire, reverse any two phase connection at motor terminal.
b. Check that there is no unusual noise or vibration. Stop and investigate if found. (refer to section 8)
c. Measure the voltage and drawn current of the motor. The drawn current must not exceed the full load current mentioned at motor nameplate.

6.3 After first 48 hours of operation

a. Make sure complete isolate the Electrical source.
b. Re-check and Re-tension the drive belts due to stretch.
c. Check and adjust the pulley alignment to ensure the motor fixing is properly secure.
d. Check all bearing, wheel bolts & nuts and sheave set screws (or cap screw) are in secure position.

CAUTION

HIGH AIR TEMPERATURE IN FAN SECTION CAN CAUSE MOTOR OVERHEAT AND DAMAGE. ON DRAW-THROUGH AIR HANDLERS, ADJUST THE DISCHARGE AIR TEMPERATURE OF THE HEATING SECTION NOT TO EXCEED 104°F (40°C).

6.4 Fan Operating Limits

The fan operating limits for forward curve and airfoil fan are shown on the Table 3. Total static pressure should be limited to 1000 Pa for forward curve and 1500 Pa for backward curve/airfoil fan.

Table 3 - Fan Operating limits

Blower Size	Forward Curved		Backward Curve/Airfoil	
	Max. RPM	Max. kW	Max. RPM	Max. kW
200	3800	3	5700	2
225	3400	4	5400	3
250	2600	4	4400	3
280	2400	6	3900	4
315	2100	6	3500	5
355	1900	8	3100	6
400	1700	8	2700	8
450	1400	10	2500	11
500	1200	11	2200	11
560	1100	15	1900	15
630	900	15	1700	15
710	850	25	1500	30
800	750	25	1350	30
900	650	30	1150	35
1000	600	30	1050	35

6.5 Installation of VRV AHU Control Box (EKEQ)

For installation VRV AHU Control Box, please refer to the Installation And Operation Manual in VRV ED or refer to manufacturer for advices.

6.6 MicroTech III Commissioning

MicroTech III is an option. For commissioning of MicroTech III, please refer to the MicroTech III Commissioning Manual in VRV ED or refer to manufacturer for advices.

7. Maintenance

7.1 Fan / Motor

Check for soiling, corrosion, damage and tendency of excessive vibration.
Check that all bolts and nuts and flexible connections are securely fixed.

Check that vibration isolator mounts are functioning well.
Inspect for any obstructions or blockages at air intakes and discharges.
Check fan bearings are secured and no undue noise by observe/listen using metal bar as a conductor.
If unit equipped with belt guard, check that it is fitted correctly and secure.
If there is any undue noise or knocking from bearing, replace both bearings. Fan bearing are grease for life, but larger units with standard bearing require semi-annual or annual lubrication at bearing greasing nipple. Recommended lubricants are Standard Din 51823, K3N or ISO XM2.

7.2 Drive Belt

Belts that are split or have frayed edges or any other sign of damage (rubber shred on floor) must be replaced in full set.

IMPORTANT

DURING MAINTENANCE AND SERVICING, UNIT MUST BE COMPLETELY ISOLATED AND PRECAUTIONS TAKEN TO PREVENT ACCIDENT FROM HAPPENING.

Check the belt tension and alignment, re-tension and re-align if necessary. Refer to Section 5.7 for belt tensioning procedure. New belt drive must be re-tensioned after the first 48 hours of operation.
For replacement of belts, remove the belt guard before starting work. To change the belts, first loosen the adjusting screw and move the motor towards the fan to enable old belts to be taken off and put on of new belts. (Matched belts must be used) Tension the belts by following instruction at Section 5.7.

7.3 Coil Section

Periodic cleaning of coils is required. Dirty coils have tendency to increase airside pressure drops and reduce cooling/heating efficiency. Dry cleaning is done by using a powerful vacuum cleaner on the dust-accumulated side. If coil is very dirty, coils need to be removed for wet cleaning by trained personnel. Ensure coil fins are not damage when performing dry/wet cleaning. In the event that fin edges have been bent, treat with aid of a coil comb.
Check that frost protection is working before starting of each winter season. Ensure the frost sensor is correctly installed and working within desired temperature range.
For direct expansion coils, do not use hot water or steam to clean these coils. During normal operation, the fin block must not be ice up. If this occurs, check the refrigeration system.
Check that drain pan and drain trap are free from blockage and water accumulation at pan.

7.4 Filter Section

During system start up, filters are likely to become rapidly blocked.

Disposable filters and bag filters must be replaced each time when pressure drop reaches the indicated dirty condition by D.M. Manometer. Washable filters must be cleaned periodically.

7.5 Dampers

Check for dirt accumulation, damage and sign of corrosion. Clean with cloth or high pressure air. Check damper blade turning manually or central control for smooth operation.

Table 4 - Recommended Maintenance intervals (based on 12 hours operating time per day)

Component	Description	Action	Maintenance interval				
			Weekly	Monthly	3 Monthly	6 Monthly	Yearly
Fan / Motor	Fan in general	Check / Clean	●				
	Fan bearing	Check / Replace / Greasing				●	
	Motor in general	Check / Clean		●			
	Motor bearing	Check				●	
	Motor temperature	Check / Repair / Replace fan				●	
	Belt drive tension	Check / Re-tension		●			
	V-Belt condition	Check / Replace		●			
	Corrosion	Check / Treat / Repair		●			
	Bolt & nut secure	Check / Tighten				●	

	Excessive vibration	Check / Resolve	●				
	Flexible connection	Check / Tighten	●				
	Vibration isolator	Check / Tighten			●		
	Intake air not obstruct	Check / Clear				●	
Coil Section	Fin block	Check / Clean					●
	Frost protection	Check / Apply				●	
	Drain trap clog	Check / Clear			●		
	Corrosion	Check / Treat / Repair					●
	Leakage	Check / Repair				●	
	Bolts & nuts secure	Check / Tighten				●	
Filter	Resistance (Washable)	Check / Clean		●			
	Resistance (Disposable)	Check / Replace			●		
Damper	Dirt accumulation	Check / Clean				●	
	Sign of damage	Check / Repair / Replace				●	
	Turning torque	Check / Repair				●	
Electrical Control	Control box & wiring	Check / Repair / Replace					●
	Protection breaker	Check / Calibrate					●
	Internal lighting	Check / Replace					●
Electric Heater	Dirt accumulation	Check / Clean				●	
	Safety cut out	Check					●
	Functionality	Refer Manufacturer Recommendation					●
Heat Wheel / Heat Pipe	Functionality	Refer Manufacturer Recommendation					●
Moisture Eliminator	Dirt accumulation	Check / Clean				●	

7.6 Electric Heater

Check for dirt accumulation and clean if necessary with a soft brush. Check the safety control, cables and connections operation.

IMPORTANT

AIR VELOCITY SHOULD NOT BE LOWER THAN 2.0 m/s.

7.7 Heat Wheel & Heat Pipe

The unit should be maintained in line with the manufacturer recommendation. Please refer installation and maintenance manual for details.

7.8 Moisture Eliminator

Check the dirt accumulation at the blades, remove and clean the blades if necessary. Ensure the blades are correctly positioned and not distorted.

7.9 Maintenance Plan for Air Handling Units

The schedule provided in Table 4 gives recommended maintenance intervals for the AHU unit (Guideline only).
Intervals are based upon normal running conditions, in a moderate climate and assuming 12-hour running. Units operating outside these guidelines may require shorter or longer maintenance intervals.

8. Trouble Shooting

Use Table 5 to assist in trouble-shoot the malfunction in Air Handling Unit operation.

Table 5 - Trouble shooting analysis

Symptom	Probable Cause	Recommended Action
Motor fail to start	a) Blown fuse or open circuit breaker. b) Improper wiring. c) Mechanical Failure.	a) Replace fuse or reset circuit breaker. b) Check wiring with diagram supplied. c) Check motor & drive rotate freely & bearing lubricant.
Motor stall	a) Short circuit or phase to earth.	a) Check line phases and terminal block

	b) Overload motor. c) Low line voltage. d) Over tensioned belts. e) Misalign drive.	connection. b) Reduce system load. c) Check supplied voltage within motor voltage range. d) Adjust belt tension. e) Re-align drive.
Motor overheats	a) Overloaded motor. b) Motor Fan dirty/ damage.	a) Reduce load or replace larger motor. b) Clean/ replace motor fan.
Low air volume after start up	a) Fan rotating in wrong direction. b) Air damper not properly set. c) Pressure drop by filter above recommended level.	a) Reverse any two phase connection at motor terminal. b) Ensure system correctly balance & set. c) Change filters – (complete bank).
Excessive motor noise	a) Motor mounting bolt loosen. b) Worn motor bearing.	a) Tighten motor mounting bolt. b) Replace bearing and seals.
Excessive noise from unit	a) Worn fan or motor bearing. b) Fan impeller rubbing on inlet cone or cover. c) Incorrect drive belts tension.	a) Replace bearing and seals. b) Check clearance or remove for repair. c) Check tension.
Excessive vibration	a) Fan impeller out of balance. b) Transport bracket not remove. c) Improper pulley alignment. d) Over-tensioned belts. e) Vibration isolator damaged. f) Motor shaft bend. g) Bad bearings. h) Loosen bearing hold down bolt i) Fan & motor section not evenly supported on foundation. j) Fan assembly's tolerance is out of range.	a) Consult manufacturer. b) Remove transport bracket. c) Check pulley alignment. d) Re-tension belts. e) Replace vibration isolator. f) Send the motor for repair. g) Replace bearing and seals. h) Tighten hold down bolt. i) Re-adjust and tighten. j) Conducts dynamic balancing.
Bearing excessively hot	a) Over-tensioned belts. b) No lubricant. c) Over-lubricant. d) Misaligned bearing.	a) Re-tension belts. b) Apply lubricant c) Purge and clean surface. d) Check & re-align shaft.
Water present in cooling coil drain pan or overflow	a) Drain trap clog. b) Incorrect hydraulic trapping.	a) Clean & clear clog. b) Resize trap and check air break arrangement.
Premature drive belts failure	a) Improper tension or alignment. b) Incorrect belt being fitted. c) Dirt or grease on belts. d) Belt rubbing. e) Worn sheaves.	a) Check tension and alignment. b) Replace with full set. c) Clean belt & pulley, check for grease leak. d) Remove obstruction. e) Replace sheaves.
Belt swelling or softening	a) Excessive contamination by oil, certain cutting fluids or rubber solvent.	a) Replace with full set. Isolate the source of contaminate.
Belt whipping during running	a) Incorrect tensioning.	a) Re-tension belts.
Filter collapsing	a) Filter block with dirt. b) Air velocity too high.	a) Replace at advised dirty condition. b) Check unit running conditions.

Note: The table is intended as a diagnostic aid.

9. Appendix

9.1 Assembly of heat wheel

1. Heat wheel unit bottom section has already assembled with heat wheel support assembly and heat wheel baffle bottom when delivered.

2. Placed the baffle centre to the penta-post / centre-post or panel.

3. Placed the heat wheel on the heat wheel support assembly in the bottom section from opening on top/side, depends on the design.

4. Screw the heat wheel to the heat wheel support assy. by using self-drilling screws.

5. screwed the heat wheel baffle left/right and centre

6. Assemble the top cabinet section to the bottom section. If required, remove some panel to facilitate assembly work of heat wheel. Screw the baffle left/right and centre to top section cabinet.

7. Assemble the heat wheel baffle top.

8. Assembled back the remaining panels.

9.2 AHU Water Quality

Water quality requirements: Water softening treatment must be given in advance to prevent scaling in the heat exchanger which may affect heat exchange effect. Moreover, water without softening treatment may form scale in the pipe to increase water resistance which will affect water flow and pump work efficiency.

Table 6 – Water Quality Requirements

Item			Baseline Value	Tendency	
				Corrosion	Scaling
Benchmark items	pH (25°C)	-	7.5 ~ 9.0	O	O
	Conductivity (25°C)	µS / cm	<800	O	O
	Chloride Ion Cl^-	mg (Cl^-) / L	<200	O	
	Sulfate Ion SO_4^{2-}	mg(SO_4^{2-}) / L	<200	O	
	Acid Consumption (pH=4.8)	mg($CaCO_3$) / L	<100		O
	Total Harness	mg($CaCO_3$) / L	<200		O
Reference items	Ferrum Fe	mg(Fe) / L	<1.0	O	O
	Sulphion S^{2-}	mg(S^{2-}) / L	0	O	
	Ammonium Ion NH_4^+	mg(NH_4^+) / L	<1.0	O	
	Silicon Oxide SiO_2	mg(SiO_2) / L	<50		O
Note : O - factor related to the tendency of corrosion or scaling					

9.3 AHU Commissioning Check Sheet

AHU Commissioning Check Sheet

General Information

Project :

Unit Name :

Unit Model :

Unit Serial Number :

Installation Date :

Commissioning Date :

Initial Checking (Pre-start Up)

A) Fan Section

1. Are all fasteners tightened?
   Answer: *Yes* *No*

2. Motor winding Resistances.
   U1-U2: _____ *V1-V2:* _____ *W1-W2:* _____

3. Motor Megger Test.
   U-Ground: _____ *V-Ground:* _____ *W-Ground:* _____

4. Are all electrical connections tight and of correct wiring?
   Answer: *Yes* *No*

5. Correct incoming voltage that supplied to motor
   L1-L2: _____ *L2-L3:* _____ *L3-L1:* _____

6. Rotate fan wheel whether it can rotate freely and without abnormal noise.
   Answer: *Yes* *No*

7. Are pulleys aligned?
   Answer: *Yes* *No*

8. Is belt tensioning correct?
   Answer: *Yes* *No* *Value:*_____

9. Are lock blower bases (blower base shipment bracket) removed?
   Answer: *Yes* *No*

10. Are spring isolators adjusted to be same height?
    Answer: *Yes* *No*

11. Ensure no construction debris or foreign material left inside AHU.
    Answer: *Yes* *No*

12. Correct duct turning elbow direction and sufficient effective duct length.
    Answer: *Yes* *No*
    **Please attach duct layout from reference.*

B) Coil Section

1. No construction debris or foreign material left inside AHU.
   Answer: *Yes* *No*

2. Is the condensate drain trapped properly?
   Answer: *Yes* *No*

3. Are pipe connections to coil header correct?
   Answer: *Yes* *No*

4. Ensure good sealing around the coil header and drain pipe externally.
   Answer: *Yes* *No*

C) Others

1. Make sure all dampers in AHU or ducting (if applicable) are in open position.
   Answer: *Yes* *No*

2. Are filters installed in correct airflow direction?
   Answer: *Yes* *No*

3. Are the AHU sections joined with section joint properly?
   Answer: *Yes* *No*

4. Are the joining between AHU sections sealed properly?
   Answer: *Yes* *No*

Start Up Checking

1. Is fan rotated in correct direction?
   Answer: *Yes* *No*

1. Voltage that supplied to motor
   L1-L2: _____ *L2-L3:* _____ *L3-L1:* _____

2. Motor current drawn per phase
   L1: _____ *L2:* _____ *L3:* _____

3. Any abnormal noise?
   Answer: *Yes* *No*

4. Any abnormal vibration?
   Answer: *Yes* *No* *Value:*_____

5. Measure and record total static pressure.
   *Value:*_____

6. Measure and record airflow.
   *Value:*_____

7. Measure and record fan RPM.
   *Value:*_____

Remark: Please refer IOM for details.