MANUAL

INSTALLATION
OPERATION
MAINTENANCE

Double Skin Modular Air Handling Unit

MODELS	DM AHU
	DS AHU
	AHUR VRV AHU

VER: O-AHU01-July25-28

Table of Contents

1. General

1.1 Foreword

This installation, operation and maintenance manual is given as a guide to users 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 the 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 do any repair and maintenance activities if the power supply of the unit is not turned off. Servicing person, who do 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.

The place of service should be equipped with the necessary protective equipment, which provides 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 damage claims should be filed.

WARNING

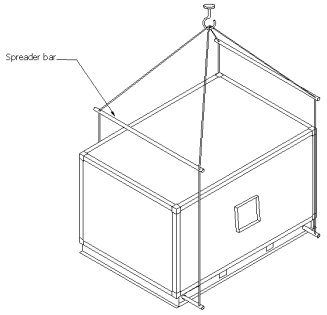
DAMAGE OR LOSS OF PARTS IN SHIPMENT OR AT THE JOB SITE IS NOT THE RESPONSIBILITY OF THE MANUFACTURER.

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, the blower fan and shaft should be carefully

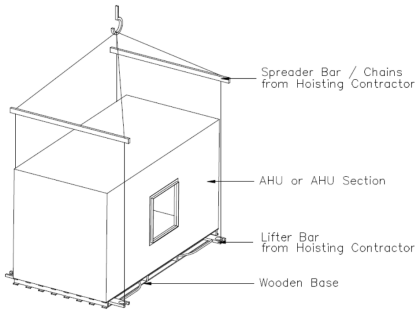
checked before commissioning to avoid more damage caused by unbalanced fan.
Screws, bolts, nuts, etc. for assembly of sections are supplied in a bag attached to each section. All necessary gaskets are fixed in the factory.

3. Handling / Rigging

Air handling units can be delivered as separate sections 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 connections, damper operators and accessory section from damage.
Do not push hard on the unit itself or on the metal base. Use large wooden beam to evenly distribute the force. Dropping the units will result in permanent damage of ball bearings, fan shaft or loosen coil from the mounting.



AHU with metal base



AHU with wooden base

Figure 1 - Lifting method when offloading units

For stacking unit, 2 methods are suggested below to lift the top cabinet without base frame. The top cabinet can be rigged using straps or slings (see Figure 2). Place wedges on top of the bottom cabinet. Fasten the strappings underneath the cabinet and lift onto the bottom cabinet and make sure it is aligned to the correct position. While the top cabinet is still supported by the wedges, first remove the strappings and then finally remove the wedges.

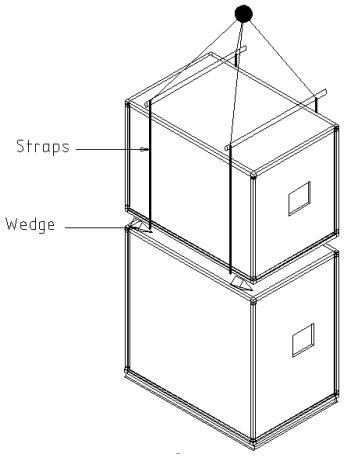


Figure 2 - Lifting method for top cabinet (using straps or slings)

An alternative method is to lift the top cabinet with the wooden base (see Figure 3) to the same level as the top of lower cabinet. Then push the upper cabinet to the required position. For larger or heavier top cabinets, rollers may be used to push the top cabinet into place. Then insert wedges to temporarily support the unit while taking out the rollers. Lastly, remove the wedges.

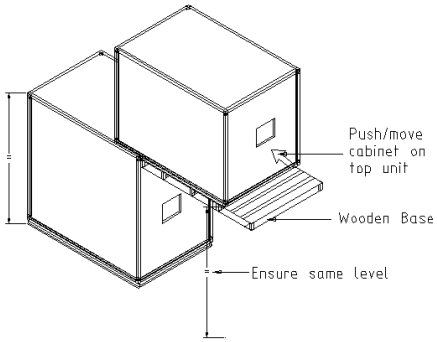


Figure 3 - Lifting method for top cabinet (using wooden base)

Transportation on the building site should be done using a forklift truck or a crane (See Figure 4). The forks must only be applied under the unit base frame and not against the panel. In case when the fork of the forklift is too short then suitable extensions should be used. Refer to Figure 5 for dimensions of base frame.

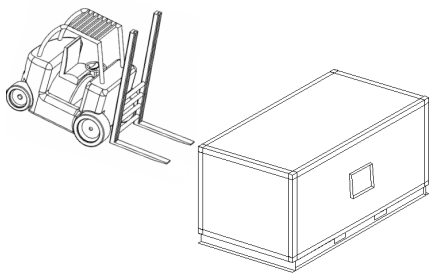


Figure 4 - Transportation by forklift truck

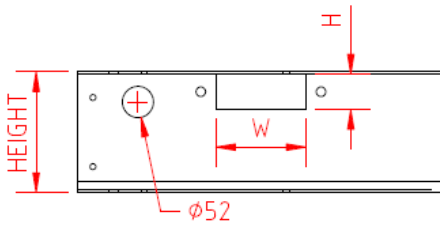


Figure 5 – Base frame dimensions

GI material,
For Height= 80mm, H=50mm, W=150mm
For Height> 80mm, H=60mm, W=150mm

C-Channel material,
For model 17xx and below, H=66mm, W=150mm
For model 18xx and above, H=66mm, W=200mm

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 removed as soon as it is offloaded. Therefore, units should be more protected by tarpaulins or similar. Avoid exposed to 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 stored separately.

IMPORTANT

IF LOOSE SECTIONS ARE LEFT UNATTENDED FOR ANY PERIOD OF TIME BEFORE ASSEMBLING, THEY NEED TO BE STRAPPED TO A FIXED LOCATION TO PREVENT THEM FROM FALLING OVER.

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 designed to be suspended from the top of the unit. Therefore, when the unit is ceiling hung, make sure the unit is supported with a base rail of channel.
During installation, due care and diligence should be exercised to ensure that any possible gaps or joints are sealed up with sealant. Cabinet section joints, ducting joints and any holes in the AHU for pipes, cables or wires should be properly sealed to minimize leakages. For units placed outdoors where the unit is exposed to the outdoor environment, any connections made into the unit (ducts, pipes, cables, etc.) should be properly sealed with sealant on the external side of the connection.
For CKD or SKD units, refer to the CKD/SKD manual for detailed installation instructions.

5.2 Foundation

Adequate space should be left around the unit for coils & drainage piping, filter replacement, and maintenance. (See Figure 6). If site access space for coil is not following recommendation, AHU needs to dismantle for coil replacement. The unit is installed at a height that allows the installation of condensate drain traps.

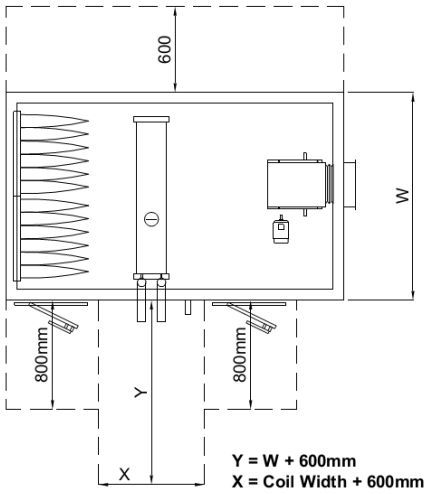


Figure 6 – Recommended minimum service clearances

To minimize noise transmission, insulation material (rubber pad) may be placed between the unit base and the foundation (See Figure 7)

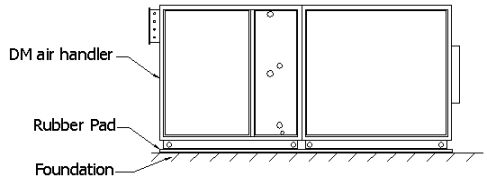


Figure 7 – Air handling unit Plinth Foundation

5.3 Section Joint

Units that are shipped in sections must be carefully assembled to the desired unit arrangement. The air handling units are designed to use section joint brackets to combine two sections. Section joints for cabinet and base frame are shown in Figure 8 and Figure 9. (provided when cabinets are joined by intermediate-post to intermediate-post arrangement)

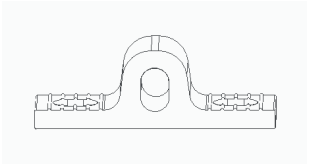


Figure 8 – Cabinet Section Joint

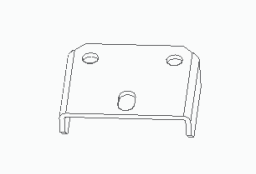
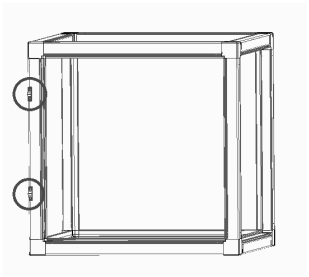


Figure 9 – Base Frame Section Joint

The section joints are pre-installed on cabinets and base frames as shown in Figure 10 (For AHU combination of 2 sections and above). The joint for side will be located outside of AHU, joint for top bottom will be located inside of AHU.



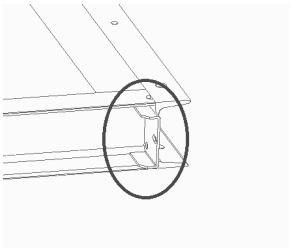
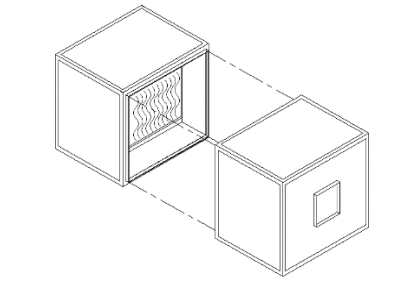
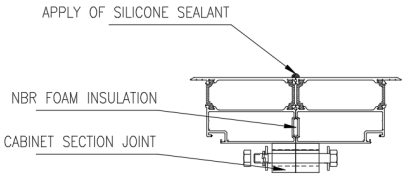
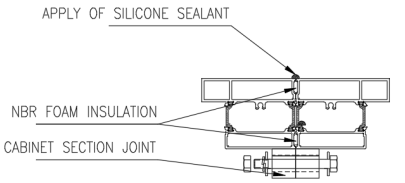


Figure 10 – pre-installed section joints

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 11.







Intermediate to intermediate post joining

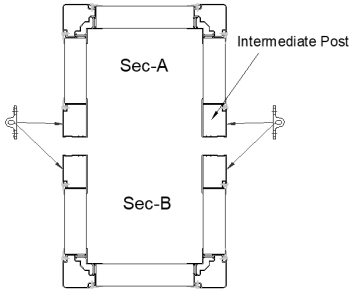


Figure 11 – Combine cabinets

Base frame section joints need to join with bolts and nuts as shown in Figure 12. When using SSTL fasteners, it is recommended to apply appropriate anti-seize lubricant on the fastener threads. Avoid excessive tightening or fastening too quickly else it may cause the fasteners to lock and be unable to remove.

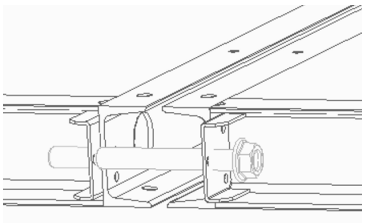


Figure 12 – Tighten the base frame section joint

After the 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 tightened with bolt and nut as shown in Figure 13. All the bolts and nuts for the joining are provided and packed with the unit. It is recommended to apply appropriate anti-seize lubricant on the fastener threads. Avoid excessive tightening or fastening too quickly else it may cause the fasteners to lock and be unable to remove.

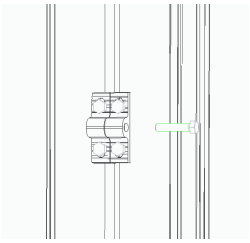
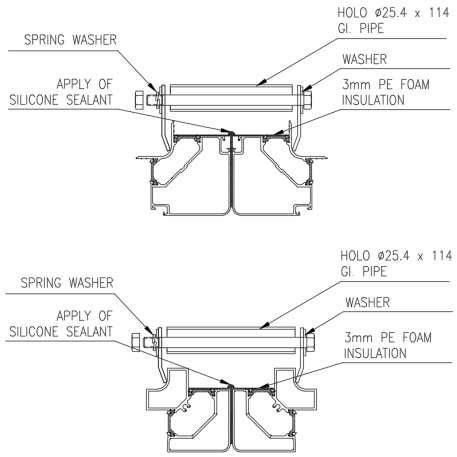


Figure 13 – Tighten the cabinet section joint

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, the type of section joints as below will be provided. (See Figure 14)



Pentapost to pentapost joining

Figure 14 – Section Joint for pentapost to pentapost or different width cabinets

Lastly, it is a must to apply silicone sealant to in-between sections to seal the gap. For Hygienic and clean AHU, please ensure that any sealant used does not pose a microbiological risk according to the VDI 6022 standard. The VDI 6022 compliant sealant provided along with the unit should be used for section joint sealing, otherwise an equivalent sealant should be used.

5.4 Joining Plate and Corner Guide

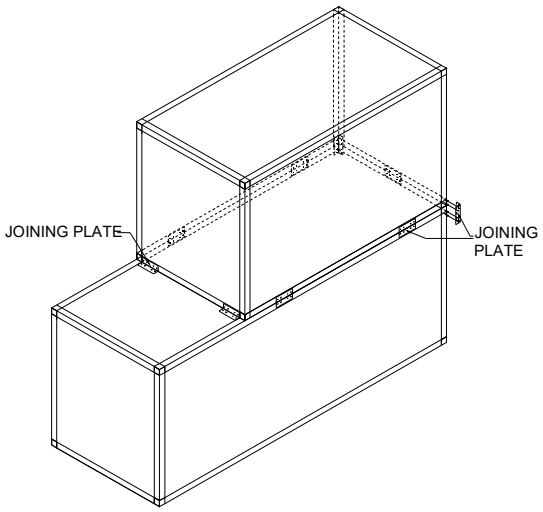


Figure 15 Joining Plate on Stacking Unit

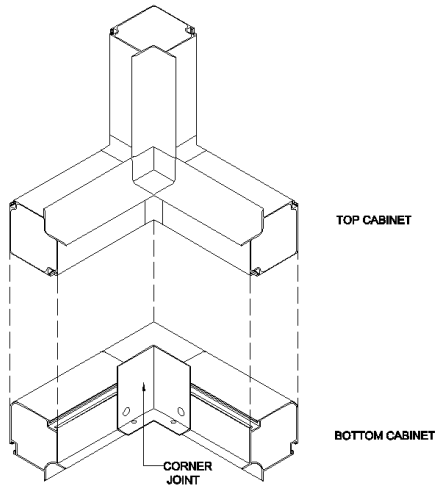


Figure 16 Corner Guide

For stacking unit, joining plates and corner guide are required to screwed in to secure the connection between top and bottom cabinets (see Figure 15 and Figure 16), if such joining plates and corner guide are provided. This helps to prevent cabinet dislocation.

5.5 Vibration Isolator

Air handling unit fans are supplied with internal vibration isolators.

5.5.1 Spring Vibration Isolator

For models 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 17)
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 anticlockwise to decrease or increase the spring's height. Tighten the locking bolt after completing the adjustment. (See Figure 18)

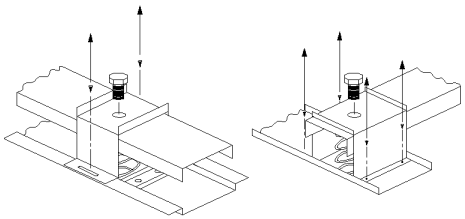


Figure 17 – Removing of transport bracket

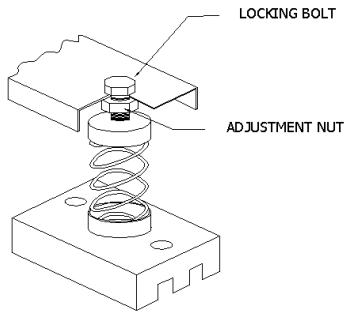


Figure 18 – Spring Isolator Adjustment

5.5.2 Restrained Vibration Isolator

The following is applied for plenum or other fan which is using restrained spring isolator. (See Figure 19). 20mm U-shaped plates are inserted between the top plate and base plate when shipped out from factory. (See Figure 20).

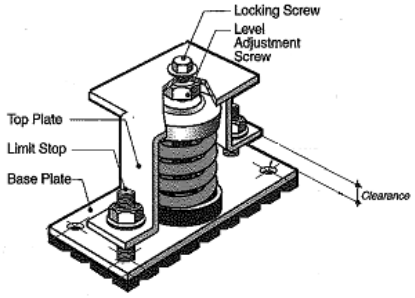


Figure 19 – Restrained Spring Isolator

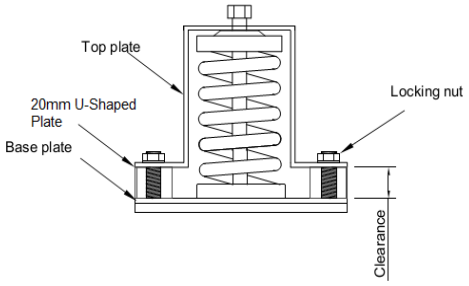


Figure 20 – Removing of U-Shaped Plate

5.6 Arrangement (VRV AHU)

Control box and expansion valve kit are installed on the air handling unit. Figure 21 and Figure 22 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 supplied by the 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

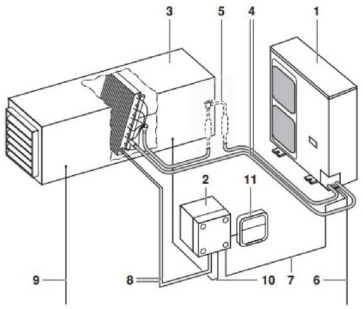


Figure 21 - Standard Air Series VRV AHU Unit

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

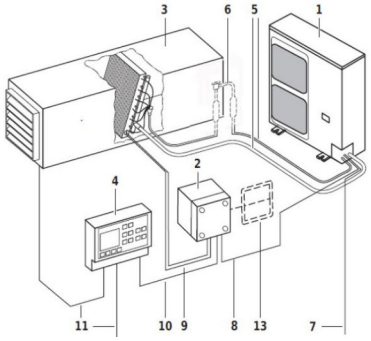


Figure 22- Outdoor Air Series VRV AHU Unit

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

5.7 Coil Installation/ Pipe Connection

5.7.1 General

The coil will perform as per rating only if the airflow is uniformly passing 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 pipework 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 the 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 23)

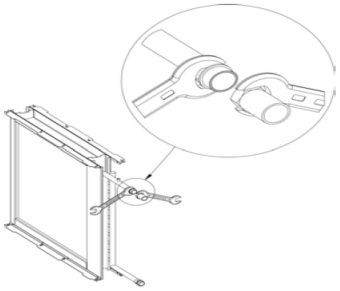
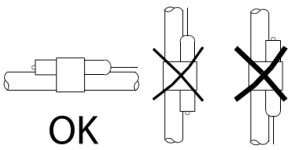


Figure 23 – Coil header connection method



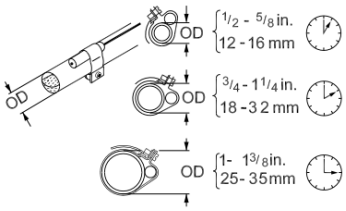


Figure 24 – Bulb orientation and position

Figure 24 shows the correct mounting method and the position of TXV sensing bulb according to the piping size.

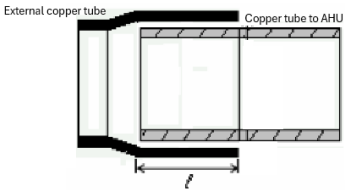


Figure 25 Copper Piping Connections

For copper piping connections, it is important to ensure proper insertion length between the tube and fitting to achieve leak-free joint.
It is recommended to fully insert the tube into the connection socket or, with a minimum insertion length for each copper tube size (see Table 1).
Table 1 is recommended insertion length by factory. Consult relevant local and national regulations to ensure compliance.

Table 1 Minimum Insertion Length for Copper Tube

Copper Outer Diameter, OD (mm)	Minimum insertion length, ℓ (mm)
6.4	6
7.9	6
9.5	7
12.7	8
15.9	8
19.1	10
22.2	10
25.4	12
31.8	12
38.1	14
44.5	14
50.8	17
63.5	19
76.2	22
101.6	27

IMPORTANT

WRAP WET CLOTH AROUND PIPE BEFORE PERFORM BRAZING TO PREVENT OVERHEAT PIPE AND DAMAGE COMPONENT AT PIPING. (Figure 26)

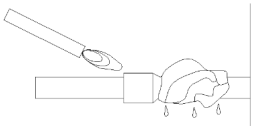


Figure 26 – wrap wet cloth before brazing

AFTER PIPE-WORK DONE, SITE INSTALLER MUST WRAP THE PIPE CONNECTION WITH INSULATION AND SEAL THE HOLES BETWEEN PIPE CONNECTIONS AND PANEL. THIS IS TO PREVENT AMBIENT AIR FROM COMING INTO CONTACT WITH LOW-TEMPERATURE PIPES, WHICH WOULD HELP TO AVOID CONDENSATION.
BEFORE PERFORM BRAZING, PLEASE ENSURE THERE ARE NO REFRIGERANT PRESENT IN THE PIPELINE.

5.7.2 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.

5.7.3 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 be treated with an anti-freeze solution.
Fill each coil independently with an anti-freeze solution by using a small circulating pump followed by complete draining. Check the freezing point of anti-freeze before proceeding in each coil. Diluted effects normally occur due to a small amount of water always remaining in each coil. Therefore, ensure sufficient amount of anti-freeze solutions remain in coil to prevent freeze-up.

5.7.4 Direct Expansion Coils

For each coil, individual expansion devices must be provided for a header suction connection. If the air flows 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 suction header cannot reach another 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 equipped with external equalizer tubes that are field connected to the suction line. The valve should be in accordance with the manufacturer's recommendations, allowing approximately 35-psi pressure to drop through the coil and distributor at full load. Do not oversize the valve, proper expansion valve operation is necessary 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 purposes at below freezing suction temperature, 0°C which will result in 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.

5.7.5 Piping Diagram (VRV AHU)

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

5.7.6 Steam Coil

All field brazing and welding should be performed using high quality materials and an inert gas purge, such as nitrogen, to reduce oxidation of the internal surface of the coil. All piping must be fully supported at locations other than the coil. The piping should be flexible enough to provide no forces on the coils due to thermal expansion. Do not support piping from coil or headers. Vent each coil at its highest location to ensure the exit of gases and to promote proper drainage. Piping should be the same size as the inlet and outlet connections. For threaded pipe connections, use only good quality fittings with tapered threads. Use of liquid Teflon pipe joint compound is recommended. Threaded piping hook-ups should always be made using two wrenches. Manual service valves should be installed to isolate the coil for service.

The flange or union is located to facilitate coil removal. Flash traps may be used if pressure differential between steam and condensate return exceeds 5 psi. Dirt leg may be replaced with a strainer. If so, tee in drop can be replaced by a reducing elbow. The petcock is not necessary with a bucket trap or any trap which has provision for passing air. The great majority of high or medium pressure returns end in hot wells or deaerators which vent air. All coils in a system should be piped separately. It is not recommended to put multiple coils on a

common trap. Vacuum breakers and air vents should be piped to a drain or other suitable location where discharged steam cannot lead to personal injury.

Steam piping and related components must be installed in accordance with all national and local codes, and in accordance with the local authorities having jurisdiction.

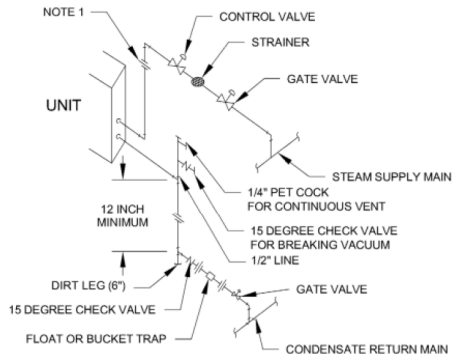


Figure 27 – Standard steam pipe layout for horizontal coil arrangement

IMPORTANT

ENSURE THAT THE SYSTEM IS OFF OR THE COMPONENTS ARE ISOLATED BEFORE WORK BEGINS. EVEN AT LOW PRESSURE, STEAM CAN CAUSE SERIOUS BODY INJURY THAT MAY RESULT IN DEAD.

5.7.7 Drain Pan Trap

Drainpipes and traps must be at least the 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 28)

Drain pan is not designed to be walked on.

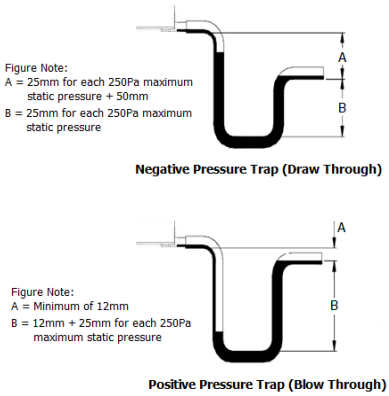


Figure 28– Drain Trap Arrangement

5.8 Ducted Indoor Unit with R32 Refrigerant

5.8.1 Safety Precautions for R32 Refrigerant

WARNING: MILDLY FLAMMABLE MATERIAL

Refrigerant inside this unit is mildly flammable

WARNING

- Do not pierce or burn refrigerant cycle parts.
- Do not use cleaning materials or means to accelerate the defrosting process other than those recommended by the manufacturer.
- Be aware that the R32 refrigerant does not contain an odour.
- The appliance shall be stored to prevent mechanical damage and in a well-ventilated room without continuously operating ignition sources (example: open flames, an operating gas appliance or an operating electric heater) and have a room size as specified in section 5.7.2.
- Make sure that installation, servicing, maintenance and repair comply with instructions from Daikin and with applicable legislation and are executed only by qualified person.
- Do NOT modify, disassemble, remove, reinstall or repair the unit as incorrect dismantling or installation may cause an electrical shock or fire. Contact your dealer.

IMPORTANT

- Factory will send out AHU unit with holding gas only.
- Precautions shall be taken to avoid excessive vibration or pulsation to refrigeration piping.
- Protection devices, piping and fittings shall be protected as far as possible against adverse environmental effects.
- Provision shall be made for expansion and contraction of long runs of piping.
- Piping in refrigerating systems shall be designed and installed such as to minimize the likelihood of hydraulic shock damaging the system.
- The indoor equipment and pipes shall be securely mounted and guarded such that accidental rupture of equipment or pipes cannot occur from events such as moving furniture or reconstruction activities.

CAUTION

Do NOT use potential sources of ignition in searching for detection of refrigeration leaks.

5.8.2 Installation Requirements

Pipe installation should be kept to a minimum, protected from physical damage and should not be installed in an unventilated space.

For AHU including its coupled unit with refrigerant containing components and is located in a room smaller than the required minimum room area, A_{min} as shown in Table 2**,** shall be naturally ventilated to outdoors. Else, the room shall be mechanical ventilation based on ISO 5149-3 or installed as per stated by manufacturer of coupled unit.

Table 2 Minimum Room Area, A_{min} Requirement

m_c(kg) \ A_{min} (m^2)	h_0=0.6m	h_0=1.8m	h_0=2.2 m
1	10.9	3.6	3.0
2	34.0	7.2	5.9
3	76.6	10.9	8.9
4	136.2	15.1	11.8
5	212.8	23.6	15.8
6	306.4	34.0	22.8
7	417.0	46.3	31.0
8	544.7	60.5	40.5
9	689.4	76.6	51.3
10	851.1	94.6	63.3
11	1029.8	114.4	76.6
12	1225.6	136.2	91.2
13	1438.3	159.8	107.0
14	1668.1	185.4	124.1
15	1914.9	212.8	142.4
15.9	2151.6	239.1	160.0

Height of the conditioned room, h_0 shall be **at least 2.2m (refer duct air outlet)

For AHU using R32 is connected to one or more rooms through an air duct system, with supply and return air directly routed through ducts. The maximum refrigerant charge can be increased, or the minimum room area can be reduced if the smallest room space is less than minimum room area, A_{min} stated in Table 2.

Avoid open areas such as false ceilings for return circulation, as shown in Figure 29.

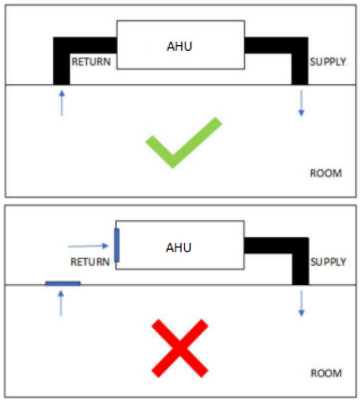


Figure 29 Connection of Supply and Return Air Duct

The fan of the AHU unit must run continuously, except for short maintenance and service breaks. Please refer to Table 3 for the minimum required air flow specifications. AHU must be equipped with supply and return air isolation dampers.

Table 3 Minimum Air Flow Requirement

Actual refrigerant charge, m_c (kg)	Minimum air flow, m^3/h
1	195.4
2	390.9
3	586.3
4	781.8
5	977.2
6	1172.6
7	1368.1
8	1563.5
9	1759.0
10	1954.4
11	2149.8
12	2345.3
13	2540.7
14	2736.2
15	2931.6
15.9	3107.5

The maximum refrigerant charge based on the room area for the total conditioned space shall be in accordance with Table 4.

Table 4 Maximum Refrigerant Charge Requirement

Space Area, m_2	Maximum Refrigerant Charge, kg
10	3.38
12	4.05
14	4.73
16	5.40
18	6.08
20	6.75
22	7.43
24	8.10
26	8.78
28	9.46
30	10.13
32	10.81
34	11.48
36	12.16
38	12.83
40	13.51
42	14.18
44	14.86
46	15.53
47	15.87

****Height of the conditioned room shall be **at least 2.2m** (refer duct air outlet)

CAUTION

Do Not install the unit at altitude over 2000m for both indoor and outdoor.

WARNING

If one or more rooms are connected to the unit using a duct system, ensure:

- No operating ignition sources (example: open flames, an operating gas appliance or electric heater) in case the floor area is less than the minimum floor area, A_{min} (m^2).
- No auxiliary devices are installed in the duct work (example: hot surfaces with a temperature exceeding 600°C and electric switching device), except those approved by the manufacturer
- Duct for supply and return air shall be directly ducted to the space. Avoid using open areas such as false ceilings as return air ducts.

5.8.3 Checking for refrigerant leaks after charging

All field made refrigerant connections must be tested for tightness. The inspection method must be done using a method sensitive enough to detect leaks of 5g of refrigerant per year. The test should be conducted at a pressure that is at least 25% of the maximum working pressure (refer "PS High" on unit name plate).

CAUTION

Do NOT use potential sources of ignition in searching for detection of refrigeration leaks.

5.8.4 Information on Servicing

i. Safety checks are necessary to ensure that the risk of ignition is minimized.
ii. Work should be carried out under a controlled procedure to minimize the risk of a flammable gas or vapour being present while the work is being performed.
iii. All maintenance staff and others working in the local area shall be instructed on the nature of work being carried out. Work in confined spaces shall be avoided.
iv. The area must be checked with a suitable refrigerant detector before and during work to alert technicians to any toxic or flammable atmospheres. Ensure the leak detection equipment is compatible with all relevant refrigerants and is non-sparking, adequately sealed, or intrinsically safe.
v. If any hot work is to be conducted on the refrigerating equipment or any associated parts, appropriate fire extinguishing equipment shall be available to hand. A dry powder or CO_2 fire extinguisher must be kept adjacent to the charging area.
vi. No ignition sources
- No one working on refrigeration systems with flammable refrigerant shall use ignition sources that could risk fire or explosion.
- All possible ignition sources, including cigarette smoking, should be kept sufficiently far away from the site of installation, repairing, removing and disposal, during which flammable refrigerant can possibly be released to the surrounding space.
- No Smoking signs shall be displayed where applicable.

5.9 Electrical Installation

Electrical wiring design and installation on the unit are based on factory standard practice. All installation and management activities must be carried out by qualified personnel and shall ensure compliance with relevant local laws and regulations.
Referring to the specific wiring diagram and electrical component manual that are attached with the product before electrical installation. The site contractor shall do termination at site for wiring connection between components that are located at different AHU sections and delivered separately.
Site cable entry from bottom of electrical panel is recommended by factory to avoid metal chip residue from drilling process dropping into electrical terminal that may lead to fire hazard when unit in operation.
If site cable entry is not possible on the bottom of electrical panel, and must be on top or side, extra cautious action is required, e.g. place a drill dust collector to prevent dust dropping into electrical components.

IMPORTANT

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

WARNING

MAKE SURE ELECTRICAL PARTS ARE KEEP FREE OF METAL CHIPS, DEBRIS, AND FOREIGN MATERIAL, FAILURE TO FOLLOW THESE PRECAUTIONS CAN LEAD TO SEVERE ELECTRICAL AND FIRE HAZARDS.

5.9.1 Motor Connection

The electric supply to the motor must correspond to the rated voltage stated in the 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, as shown in Figure 30. The fan section metal frame must be grounded. Suitable electrical protection isolators should be installed to protect the motor and other electrical equipment.

Flexible conduits 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.

Recommendation from factory, motor of 4kW and below using Direct On-Line (DOL) while motor of 5.5kW and above using Star-Delta (SD).

For inverter control, refer to the VFD manual for wire size and requirements.

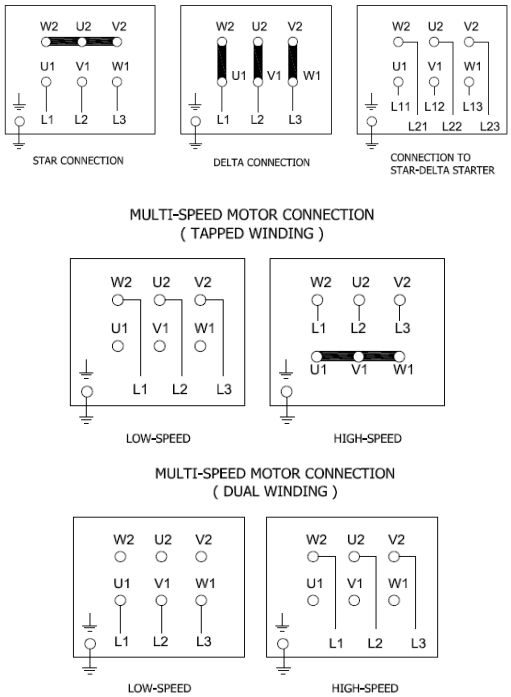


Figure 30– 3 phases motor connection diagram

5.9.2 Motor Cabling

Motor wiring must go downward from the motor terminal box to prevent condensation water flowing into motor and lead to failure, as shown in Figure 31.

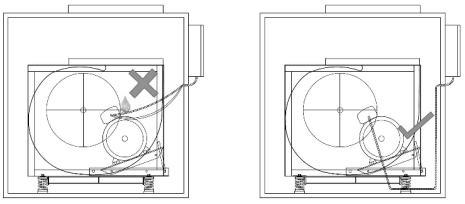


Figure 31 – Motor Cabling

5.9.3 Marine Lamp Cabling

Power cabling for marine lamps will be connected to fan starter panel or VFD panel only if all the following are met:

1. The unit is delivered as CBU
2. The unit comes with a fan starter panel or VFD panel
3. The marine lamp is located at the same section as the fan control panel

If any of the above are not met, the marine lamp will come without power cables connected. In which case, connect the marine lamps to an appropriate power source.

5.10 Drive Belt & Sheave

Improper sheave alignment and belt tension can cause excessive vibration, premature failure of belts and bearings. See Figure 32 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 33). 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 applying a force large enough at the center of the belt to deflect the belt by 16mm per meter (See Figure 34). 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 THE DRIVE BELT WILL CAUSE PREMATURE FAILURE OF BELT AND BEARING DAMAGE.

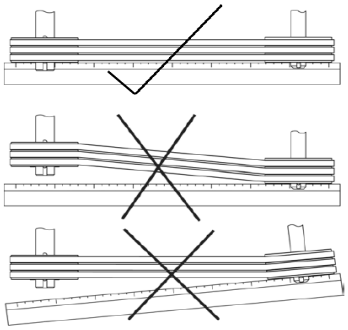


Figure 32 – Alignment of belt pulley

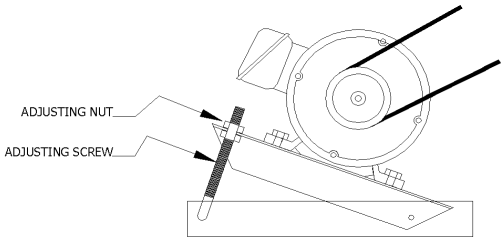


Figure 33 – Belt tensioning

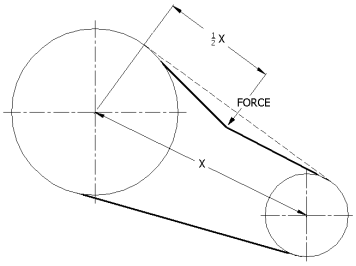


Figure 34 – Belt deflection distance

Table 5 - 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
	126-200	23	34	23	30
SPA	<100	20	29	20	25
	101-140	27	39	27	34
	141-200	32	47	32	40
	201-315	36	55	36	47
SPB	<160	36	54	36	46
	161-224	46	67	46	58
	225-355	53	79	53	69
	356-400	55	82	55	71

Refer to factory specifications for tension values that are not included

Refer to the diameter of smaller pulley

Table 6 - 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	-	-

5.11 Accessory Items

5.11.1 Filter

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

Panel, pleated, bag and compact filters should be installed with their pleats running vertically to ensure optimum performance of filter.

5.11.2 Mixing Box

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

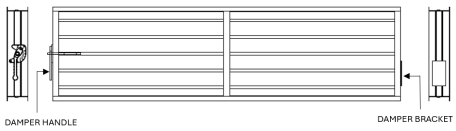


Figure 35 Damper Bracket

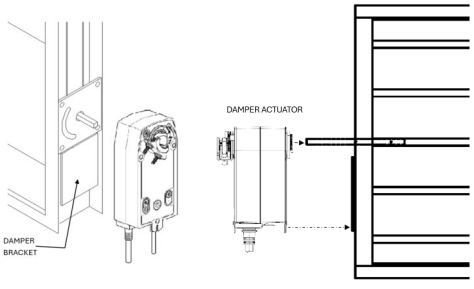


Figure 36 Damper Actuator and Damper Bracket

For damper actuator installation, please use the damper bracket provided on the damper body, which can be found on the opposite side of damper handle (See Figure 35).

Remove the damper bracket from its original side and reinstall it on the side where the damper actuator will be mounted (See Figure 36). Once the actuator is in place, secure it onto the bracket using screws.

5.11.3 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 6 & Figure 37) 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 center line shifts when diameter changes. Driven pulley may need realignment.

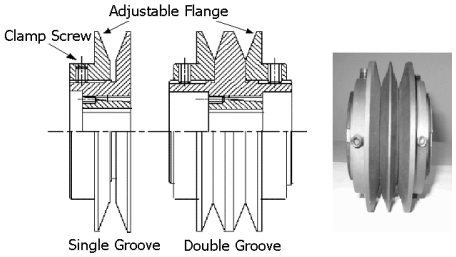


Figure 37 – Variable Pitch Pulley

5.11.4 Heat Wheel

Follow the Heat Wheel manufacturer's recommendations for proper installation

procedure. Apply silicone to air leak spots at baffle plates. (If applicable. For hygienic and clean AHU units, please ensure that any sealant used does not pose a microbiological risk according to the VDI 6022 standard)
Refer to the assembly of heat wheel baffle plates at Appendix 9.1 when the heat wheel section cannot ship in complete build up.

Belts should be periodically checked for tension and wear due to it will stretch over time. When replacing new belts, loosen the tension bolts and do not force the belts on or off. Use the same type of belt as supplied with the unit.
Belt tension should be adjusted to allow 0.016mm of belt deflection per 1 mm of span. For instance, if the distance between the pulleys is 400mm, the belt should deflect about 6.4mm when you press down on it gently at the midpoint, as shown in Figure 38.

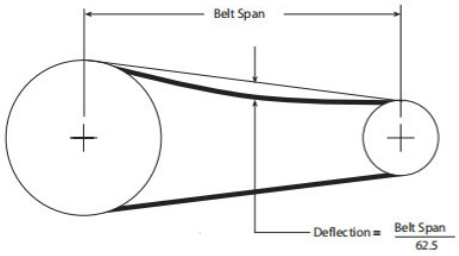


Figure 38 Drive Belt Deflection for Heat Wheel

Heat recovery wheel is supplied with a motor. It is recommended to use a soft starter or variable frequency drive for motor start-up and speed control, depending on the specific application requirements.

5.11.5 Heat Pipe

After installation of Heat Pipe with references 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)

5.11.6 Electric Heater

Power supply to electric heaters and electric connection is in accordance with wiring diagram in terminal box of electric heaters.
The rated voltage of electric heaters 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.

5.11.5 Ductwork

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

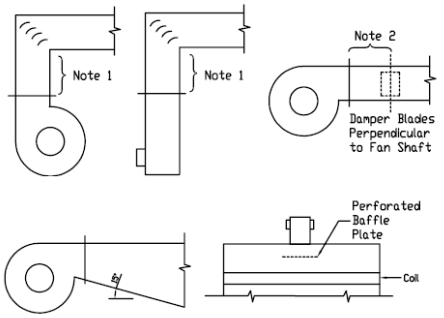


Figure 39 – Discharge duct layout

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, and 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 rainwater seepage into the unit (if unit is placed outdoor).

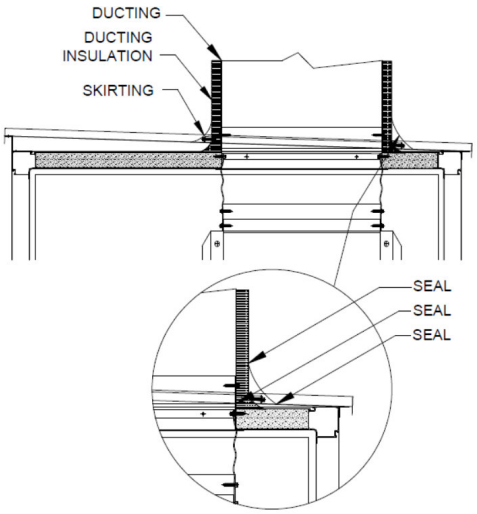


Figure 40 – Site to seal gap between roof and duct

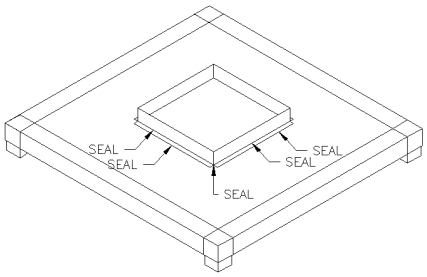


Figure 41 – All edge to be seal by site if the flange was sent separately / unit is CKD

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

In case of hygienic and clean AHU, the ducts should be made from closed pore material without grooves. A flexible connection with folds is not allowed.

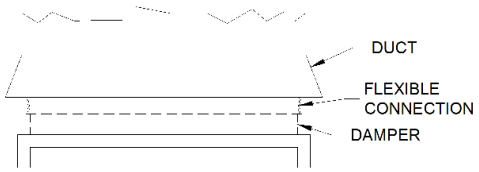


Figure 42 – Front view of Return duct to be large enough to cover exposed area

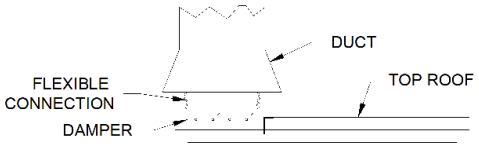


Figure 43 – Side view of Return duct to be large enough to cover exposed area

IMPORTANT

THE TOP ROOF IS NOT INTENDED FOR PEOPLE TO STEP ON.

5.12 Assembly of Complete Knock Down Unit (CKD)

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

5.13 Component Removal and Replacement

5.13.1 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.

5.13.2 Fan / Motor

The fan shaft, motor and drive components can be removed and replaced through the access door opening or side

panel removal if additional access is 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 followed by loosening bolts & nuts at motor and drive belts. Then remove the belts and nuts from the Fan mounting frame. Take out the fan and replace the new fan with care. Re-connect the shaft and bearings and fan assembly.

5.13.3 Coil

The coil can be pulled out from the 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 stacked, remove the drip pan and join brackets which hold the two coils together.
For DX coils, it is advisable that the refrigerant 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 IS 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 sealed with additional baffle plates or seal with silicone to prevent air bypassing. For Hygienic and clean AHU, please ensure that any sealant used does not pose a microbiological risk according to the VDI 6022 standard.
The lamination films stick on the PU panel act as protection film for PU panel. It is normal that the films are torn or dirt from the protection purpose. Peel off the lamination film when the unit is in position.

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 the correct voltage is supplied. If a standby motor is available, make sure only one motor to power source.
Seal the end of fan motor conduit (if applicable) and the motor terminal box with silicon sealant. For Hygienic and clean AHU, please ensure that any sealant used does not pose a microbiological risk according to the VDI 6022 standard.

VFD/Frequency Inverter for 50/60 Hz TEFC motor can only vary the frequency within **30 to 60 Hz** to control the motor rotation speed. For VFD setup, make sure the VFD settings according to recommendations at VFD manual.
When multiple fans with multiple VFDs, fans must set up to always start simultaneously and with same speed.
It is recommended that the fan speed does not exceed the speed specified in the technical report. When ramping up fan

speed beyond specified limits, it is important to make sure it does not cause any issues such as water carryover.

6.1.3 Fan Array

Fan array is available for EC plug fan. Ensure all fans are controlled to run simultaneously and at the same speed.
Fans running at unequal speeds can result in uneven airflow that cause performance, sound, and vibration problems that lead to failure.
In case one of the fans is down, blank off plate should be temporarily installed on the nonfunctional fan to prevent air re-circulation while waiting for fan replacement, as shown in Figure 44. If a differential pressure controller is present, ensure the pressure tube of non-functional fan is capped and amend the controller setting accordingly.

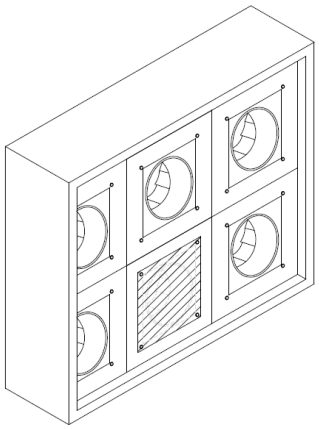


Figure 44 - Fan Array with Blank-off Plate

6.1.4 Vibration Isolator Mount

Ensure the vibration isolator mounts and flexible connections allow the fan and motor to move freely without constraint.
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 10-20 MM.

6.1.5 Coils

Check the pipework to coil is correctly connected and the fins are free from foreign matters or damage.
Check that the condensate drain is trapped.
Ensure proper silicone sealing around the coil headers and drainpipe.
Make sure operating pressure is within design limits.

6.1.6 Steam Coils

Proper air distribution is vital to coil performance. Air velocity anywhere on the coil should not vary by more than 15% from the average velocity. Air velocities should be maintained between 200 and 1500 feet per minute. Operating pressures must be at or below the maximum operating pressure for the coil at steam temperature. Pressure and temperature limitations can be referred to COC of vendor provide.

6.1.7 Damper & Filters

Check all dampers are operating correctly as per design.
Make sure all filter media are installed in correct airflow direction. If the filter has any pleats, make sure that all the pleats are installed with its pleats running vertically to ensure optimum performance of the filter.

6.1.8 Panel & Section

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

6.1.9 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 heater overheating. Optional items such as differential pressure switch (50-500Pa setpoint range) only indicate fan is running. Adjusting the settings is

necessary in some situations for proper operation.

For Hygienic and clean AHU, it is recommended to select and adjust the electric heater such that the relative humidity in the Air Handling unit is less than 80% to avoid microbial growth issues.

WARNING

FOR 380-415V/3PH, STAR CONNECTION WITHOUT NEUTRAL AS SHOWN IN Figure 45, UNBALANCED PHASE VOLTAGE MAY CAUSE DAMAGE ON THE ELECTRIC HEATER. FOR 220-240/1PH WITH NEUTRAL AS SHOWN IN Figure 46.

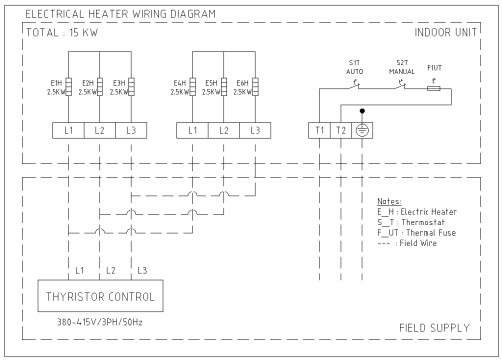


Figure 45 – Wiring Diagram of 380-415V/3PH, Star Connection Without Neutral

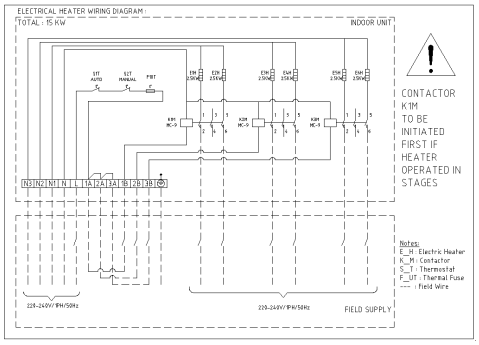


Figure 46 – Wiring Diagram of 220-240V/1PH, With Neutral

IMPORTANT

SAFETY THERMOSTAT IS FOR OVERHEATING PROTECTION ONLY, NOT FOR CONTROL PURPOSE. 1 MANUAL RESET AND 1 AUTO RESET THERMOSTAT FITTED. FOR SOME SPECS, THERMOSTATS ARE SETTABLE. DO NOT ATTEMPT TO CHANGE THE SETTING OF THE THERMOSTATS UNLESS ARE TRAINED TO DO SO.

THERMAL FUSE AS LAST SAFETY DEVICE. PLEASE CHECK ROOT CAUSE OF OVERHEATING. SPARE THERMAL FUSE LOCATED IN ENVELOPE OF HEATER CONTROL BOX.

IT MUST BE CONNECTED TO CONTACTOR (WHETHER SUPPLIED BY FACTORY OR SITE) TO CUT-OFF HEATER IN CASE OF OVERHEATING HEATER.

6.1.10 Transportation Metals

To ensure the AHU remains in good condition during transportation, additional metal parts may be installed to protect it. These metal parts must be removed after installation of the unit and before commissioning (e.g. spring isolator bracket, top damper cover, etc.). The transportation metal parts can be easily identified by the yellow and black striped transportation stickers, as shown in Figure 47

Figure 47 – Transportation Sticker

6.2 Start-up Check

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

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 the opposite direction from desire, reverse any two-phase connection at the 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 the drawn current of the motor. The drawn current must not exceed the full load current mentioned on the motor nameplate.
d. Heat Wheel – Ensure the heat wheel can rotate freely by hand.
e. Heat Pipe – Ensure installations are as per manufacturer recommendation.

6.3 After the first 48 hours of operation

a. Make sure to completely 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 THE 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^{0}F (40^{0}C).

6.4 Fan Operating Limits

The fan operating limits shall refer to the fan datasheet and individual technical specification file of the AHU to determine the operation of the AHU blower and motor.
Fan speed maximum operation should be $\leqslant$ 90% of max. fan speed. The motor running current should not be more than the motor nominal current.

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 advice.

6.6 MicroTech III Commissioning

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

6.7 Door opening

6.7.1 DM1

Follow the instructions of the door handle sticker to open the door.

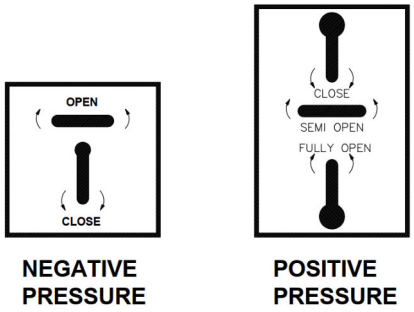


Figure 48 – Door Handle Stickers

For positive pressure doors, be careful when attempting to open doors while the unit is still running, as the high air pressure can violently push/swing open the door and cause injury. Make sure all handles are turned into semi-open positions to release the air pressure in the unit before continuing to turn the handles to the fully open position to open the door carefully.

6.7.2 DM2/DM2TB & DMA6 Door Opening

For DM2/DM2TB, follow the instructions of the door handle sticker, as shown in Figure 49. Turn the handle anticlockwise to unlock, and clockwise to lock.

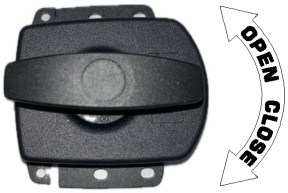
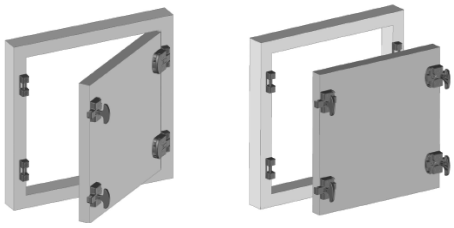


Figure 49 DM2/DM2TB Door Handle and Sticker

For DMA6, it uses universal handle as shown in Figure 50. Universal handle can be mounted on left or right side of the door, one side acting as a hinge and the other side acting as a lock, as shown in Figure 51(a). Alternatively, it can be used as a removable door by open both side of the handle, as shown in Figure 51(b).

Figure 50 – DMA6 Universal Handle



(a) (b)

Figure 51 (a) swing door (b) removable door

Both DM2TB/DM2 and DMA6 positive pressure door are equipped with a safety latch at the top, as shown in Figure 52. If the unit is running, make sure to follow the instruction shown in Figure 52. For example, only open all handles either on the left or right side. Do not pull the safety latch immediately. Allow the pressure to be released first by letting the door be stopped on the safety latch. Once the pressure has been released, pull the safety latch to fully open the door carefully.

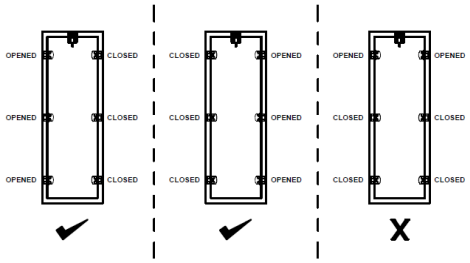


Figure 52 –Door Opening Procedure while fan running

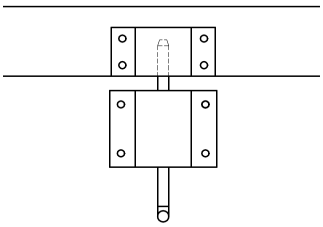


Figure 53 – Safety Latch

6.8 Humidifier Commissioning

When turning on the humidifier, ensure that the moisture eliminator is installed to avoid water carrying over during system commissioning.

During system standstills, blow dry the drain pan by turning on the fan but keeping the humidifier turned off.

For Hygienic and Clean AHUs, ensure that the water in the humidifier is clean according to standards of the Drinking Water Ordinance (TrinkwV) and the requirements of VDI 3803 Part 1, Table B1.

6.9 View Port Cover Commissioning

After AHU has been placed at the desired location, remove the 2 screws at the bottom of view port cover so that view port cover is able to swing open or be removed.

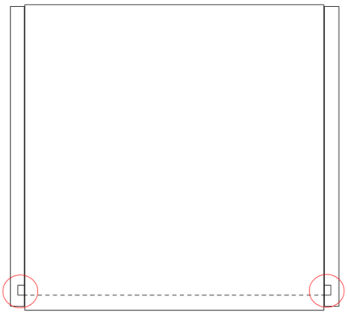


Figure 54 – Screw Location on view port cover

6.10 Heat Wheel

6.10.1 Start-up Check

- Check if casing / cassette is installed properly and sealed between the air streams.
- Check if the rotor is centered within the casing / cassette and can rotate freely with light force.
- Check if the seals are fitted correctly along the periphery and the middle beam on both sides of the rotor face.
- Check if the drive motor and pulley are securely installed.
- Check if the drive belt is tensioned and aligned properly (Refer to Section 5.10.4)
    - Re-check and re-tension the drive belt **after the first 100 hours**
- Verify correct voltage to the drive system
- Check if the direction of rotor when unit is equipped with purge sector. Else, ignore this statement.

6.10.2 After 1 week of operation

- Ensure a positive seal between the rotor face and frame structure.
- Check if the seals are intact and in contact with the casing and rotor media.
- Check if there is excessive wear. Replace it, if any.
- Inspect drive motor.
- Check for misalignment of the drive belt on the pulley or periphery of the rotor.
- Check the belt joint. Replace it, if necessary.
- Check the length of the drive belt. Replace it, if necessary. (Refer to Section 5.10.4)
- Check if the drive belt is tension.

6.10.3 6 months after commissioning

- Check item same as section 6.10.2
- Tension all the tension bolts of a circle for 10, 20, 30, 40, 50Nm by torque wrench.

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 observing/listening using metal bar as a conductor.
If the unit is equipped with a belt guard, check that it is fitted correctly and secure.
If there is any undue noise or knocking from the bearing, replace both bearings. Fan bearings are greased 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 tension and alignment of the belt, re-tension and re-align if necessary. Refer to Section 5.7 for belt tensioning procedure. The 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 tend 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 the coil is very dirty, coils need to be removed for wet cleaning by trained personnel. Ensure coil fins are not damaged when performing dry/wet cleaning. If the fin edges have been bent, treat them with the aid of a coil comb.

Check that frost protection is working before the start 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 iced 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 Steam Coil Section

Scheduled plant maintenance should include the draining and flushing of the condensate drip legs and sediment traps as well as inspection of condensate traps, vacuum breakers, air vents, and valves. Boiler water analysis should also be performed on a regular basis. To continually deliver full heating capacity, both the external and internal heat transfer surfaces must be maintained as clean and corrosion free as possible. The finned surface can be maintained by the use and constant inspection of pre-filters. The filters should be replaced as needed.

Should the finned surface become fouled, the coil can be cleaned using commercially available coil cleaning fluids. Caution should be exercised in selecting the cleaning solution as well as the cleaning equipment. Improper selection can result in damage to the coil and health hazards. Be sure to carefully read and follow the cleaner manufacturer's recommendations before using any cleaning fluid. Clean the coil from the leaving airside so that foreign material will be washed out of the coil rather than pushed further in. Internal coil maintenance consists primarily of preventing scale and corrosion. This is accomplished through aggressive boiler water treatment, removal of dissolved oxygen, and the removal or non-condensable gases such as carbon dioxide.

7.5 Filter Section

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

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

7.6 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 7 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 does 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 Pipe	Functionality	Refer Manufacturer Recommendation					●
Heat Wheel	Functionality	Refer Manufacturer Recommendation					●
	Sealing	Check / Replace				●	
	Drive Motor	Check				●	
	Drive Belt	Check / Replace				●	
	Rotor	Check / Clean					●
Moisture Eliminator	Dirt accumulation	Check / Clean				●	

* Depend on bearing type and condition

Table 8 Recommended Maintenance interval for hygienic and clean AHU

Component	Description	Action if required	Maintenance interval (months)				
			1	3	6	12	24
Outdoor - air inlets and exhaust-air outlets	Check for any signs of damage, corrosion or contamination	Clean / Repair				●	
Unit casings	Check for contamination, damage and corrosion on airside	Clean / Repair				●	
	Check for condensation	Clean			●		

	Check casing for contamination, damage and corrosion	Clean / Repair					●
Static cooling components	Check condition of condensate trays and drains	Clean / Repair				●	
Recirculating Air humidifiers	Check if there is any contamination, damage, microbial growth and corrosion	Clean / Repair	●				
	Function-check shutdown controls	Readjust					●
	Determine the total number of Colony Forming Units (CFUs) in the recirculating water	If number of CFUs > 1000 CFU/mℓ: Clean, rinse and dry the tray; disinfect; test quality of supply water	Semi - monthly				
	Check spray nozzles for deposits	Clean / replace nozzles	●				
	Check circulation pump for contamination and scaling in the suction line, check condition and functioning of filters	Clean pump circuit		●			
	Function-check conductivity sensor	Repair	●				
	Function-check disinfection system	Repair				●	
	Completely empty and dry humidifier system		During standstills				
	Check moisture eliminator for contamination, damage, scaling and corrosion	If deposits formed, extract and clean unit and then check the region downstream of droplet eliminator	●				
Non - recirculating Air Humidifiers	Check if there is any contamination, damage, microbial growth and corrosion	Clean / Repair		●			
	Check for condensate precipitation in the chamber	Clean / Repair	●				
	Check steam distribution system for deposits	Clean				●	
	Check spray nozzles for deposits	Clean / replace nozzles	●				
	Check drain pan	Clean / Repair		●			
	Determine the total number of Colony Forming Units (CFUs) in the humidifier water	If number of CFUs > 1000 CFU/mℓ: Clean, rinse and dry the tray; disinfect; test quality of supply water				●	
	Function-check control valve	Repair				●	
	Check humidity limiter	Repair				●	

Component	Description	Action if required	Maintenance interval (months)				
			1	3	6	12	24
Air filters	Check for contamination, leaks and odours for filters	Change affected air filters		●			
	Check differential pressure	Replace filter stage			●		
	Maximum interval until first filter needs to be changed					●	
	Maximum interval until second filter needs to be changed						●
Fan	Check for contamination, damage and corrosion on airside	Clean / Repair			●		
Heat exchangers	Visual inspection of air-to-air plate heat exchangers for contamination, damage and corrosion	Clean / Repair			●		
	Visual inspection of rotary heat exchangers for contamination,	Clean / Repair			●		

damage, corrosion and tightness

Visual inspection of directly heated heat exchangers for tightness	Ensure tightness		●
Heaters: Check for contamination, damage, corrosion and tightness	Clean / Repair. Replace if required	●	
Coolers: Check tube bundle, moisture eliminator and condensate tray for contamination, corrosion, damage and tightness	Clean / Repair	●	
Function-check drain and drain trap	Clean / Repair	●	

7.7 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.

7.8 Heat Wheel

For rotor inspection,

- Check for signs of damage, dirt or contamination accumulation on the face of the rotor. Clean when pressure drops greater than 1.25.

For seal inspection,

- Ensure a positive seal between the rotor face and frame structure.
- Check if the seals are intact and contact the casing and rotor media.
- Check if there is excessive wear. Replace it (if any).
- Ensure there is no significant leakage between the casing and interconnecting duct work.

For drive inspection,

- Check for misalignment of the drive belt on the pulley or periphery of the rotor.
- Check the belt joint. Replace it, if necessary.
- Check the length of the drive belt. Replace it, if necessary. (refer to Section 5.10.4)
- Check if the drive belt is tension.

7.9 Heat Pipe & Plate Heat Exchanger

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

For Hygienic and Clean AHU, the face of the heat wheel should be inspected regularly for dust and dirt to check if the self-cleaning due to counter flow and rotation of the heat wheel is insufficient. For a small amount of dirt, use a vacuum cleaner to clear off the dirt. For more stubborn dirt, use compressed air to dislodge the dirt but handle with care so that the heat wheel media is not damaged. Finally, for firmly attached dirt in the rotor, use hot water and a mild detergent to remove the dirt. The mild detergent may be removed with high pressure water cleaner with the nozzle 300mm from the heat wheel. For disinfection, please use an isopropanol-based substance such as LIV +45.

For Hygienic and Clean AHU plate heat exchangers, please use a brush to clean the inlets and the outlets for normal ventilation applications. Otherwise, use compressed air or high-pressure water cleaning and disinfection.

Please note that when using high pressure cleaning, do not spray the nozzle directly against the plates and pressure must be kept below 100bar. This is to ensure the plates do not deform when removing the dirt.

When disinfecting, the recommended detergent is Yes/Fairy detergent, which can be diluted with up to 75% water. Alternatively, LIV +45 can be used for disinfection.

7.10 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.

7.11 Maintenance Plan for Air Handling Units

The schedule provided gives recommended maintenance intervals for the AHU unit (Guideline only).
Table 4 gives recommended maintenance intervals for Hygienic and Clean AHU units (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.

7.12 Cleaning (Hygienic and Clean AHU)

When cleaning the AHU, lint-free cloths and non-corrosive and silicone-free cleaning agents should be used unless specified otherwise. Ensure that dirt and dust does not enter adjacent parts of the system.
If disinfection is required for example in hospital environments, the surfaces can be treated with all-purpose, biodegradable cleaning agents. However, avoid using aluminum cleaners as they corrode the surfaces of the metals. Only disinfectants from the list of the Robert-Koch Institute (RKI) or Der Verbund für Angewandte Hygiene (VAH) should be used.
Only personnel that have passed the hygienic qualification of at least category A VDI 6022 part 4 are qualified to service the AHU.

8. Storage

Please store the AHU in a dry place protected from the weather. Cover the AHU with tarps and additional packaging as necessary to protect them from contamination in harsh conditions.
Spare filters should be stored in a clean dry place that is protected from contamination and weather

9. Trouble Shooting

Use Table 6 to assist in trouble-shoot the malfunction in Air Handling Unit operation.

Table 9 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. d) Missing control signal & improper setting (EC fan).	a) Replace fuse or reset circuit breaker. b) Check wiring with diagram supplied. c) Check motor & drive rotate freely & bearing lubricant. d) Check control signal & fan ID setting & high/low level control source setting.
Motor stall	a) Short circuit or phase to earth. b) Overload motor. c) Low line voltage. d) Over tensioned belts. e) Misalign drive.	a) Check line phases and terminal block connection. b) Reduce system load. c) Check the 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 the wrong direction. b) Air damper not properly set. c) Pressure drops by filter above recommended level.	a) Reverse any two-phase connection at motor terminal. b) Ensure the system correctly balance & set. c) Change filters – (complete bank).
Excessive motor noise	a) Motor mounting bolt loosens.	a) Tighten motor mounting bolt.

	b) Worn motor bearing.	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 the bearing and seals. b) Check clearance or remove for repair. c) Check tension.
Excessive vibration	a) Fan impeller out of balance. b) Transport bracket does 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 the 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 the tension and alignment. b) Replace it with a full set. c) Clean belt & pulley, check for grease leak. d) Remove obstructions. e) Replace sheaves.
Belt swelling or softening	a) Excessive contamination by oil, certain cutting fluids or rubber solvent.	a) Replace it with a 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.

10. Appendix

10.1 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.

10.2 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	
	Sulphate 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					

10.2 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.