Installation Instructions for Blue Cold Evaporators

A. *Inspection:*

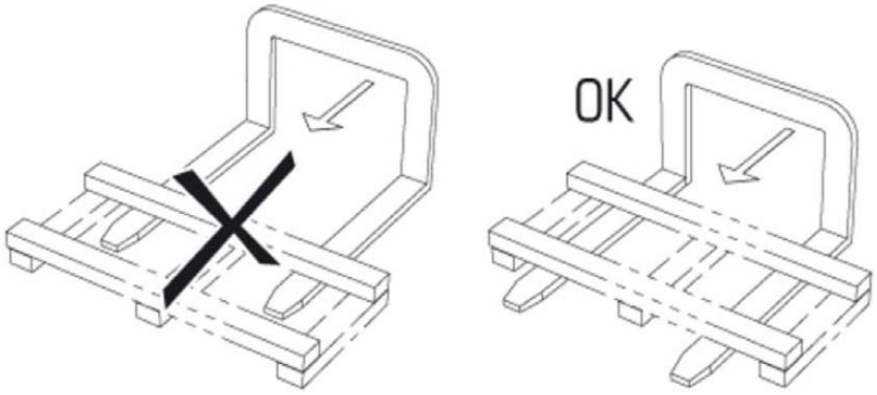
- Responsibility should be assigned to a dependable individual at the job site to receive material.
- Each shipment should be carefully checked against the bill received.

B. *Safety Instructions:*

- While working on pressurized parts (pipelines, heat exchanger components) depressurize before servicing.
- Sharp edges and corners (especially in the fins) can cut fingers and hand. It is advised to wear protective gloves.
- The maximum operating pressure specified on name plate should not be exceeded.
- Installation and maintenance to be performed only by qualified personnel who are familiar with this type of equipment
- Some units are pressurized with dry air or inert gas. All units must be evacuated before charging the system with refrigerant.
- Make sure all power sources are disconnected before any service work is done on units.
- Suitable firefighting equipment must be provided on site when working with flames, e.g. grinding, welding, soldering etc.
- Make sure that all field wiring conforms to the requirements of the equipment and all applicable national and local codes.
- While working on fan motor or removal/installation, it is advised to disconnect the power supply. The system must be secured against unintentional reactivated.
- NH3 is toxic gas, pungent-smelling gas hazardous to eyes, mucous membranes and other unprotective areas of skin. Its effect generates unrest, dizziness, vomiting and cramps. Stronger concentrations cause symptoms of suffocation and life-threatening lung disease.
- While work on the thermostatic expansion valve (e.g. adjusting overheating, changing nozzle inserts) must be performed by trained and qualified personnel only. All of the work referred to above must be documented.
- Danger of frostbite (freezing of unprotected parts of the body) when touching heat exchanger parts and piping at refrigerant temperatures below 0 °C when refrigerating and danger of burns when touching heat exchanger parts, electric heating equipment and piping at temperature above 60 °C during defrosting
- During troubleshooting after HFC refrigerant breakaway releases, please be aware of remaining HFC refrigerant under defervescence as splashes can lead to frostbite on skin and eyes.
- If the unit is installed close to the possible heat sources with danger of occurrence of high temperatures: take effective measures to protect the unit from excessive heat

C. *Transportation & Packaging:*

- The units designated for transport & storage must be adequately protected against transport damage and damaging atmospheric influences.
- An unloading device that is appropriate for the weight of the equipment must always be used and operators must be qualified for unloading the equipment properly. The evaporators may only be lifted with forklift with adequate fork length.
- The units are delivered with pressure of approx. 150 psig.
- Before removing the sealing caps, check pressure level. An unpressurised unit indicates a leak.
- Before installation, pressure test & vacuuming the system properly.
- The units must be protected against hard blows and hard setting down as well as slipping and mechanical damage.



D. *About Evaporator:*

- Blue Cold Evaporators works on the evaporating concept of 'direct expansion' as standard for Freon refrigerant and flooded for Ammonia. The refrigerant fluid directed to the evaporators contains several times the volume required for full evaporation (approx. 2 to 5 time more).
- It is advised to install liquid receiver in condensing units to separate the refrigerant liquid and vapor mixture enabling pure cold transfer medium vapor only.

E. *General Information on the Unit:*

Manufacturer	Blue Cold Refrigeration Pvt. Ltd.
Serial No	--
Project No	--
Year of Production	--
Unit Type / Model No.	--
Max allowable working pressure	--
Max / Min allowable working temp	--
Test Pressure	--
Test Date	--
Test Medium	--
Volume (in liter)	--
Fan Brand	--

F. Fan Motors:

- The fan motors can be operated by means of star-delta connection with single speed or with multiple speed control. The direction of rotation must be checked. If the direction is wrong, it can be changed by interchanging two phases.
- During longer downtime periods, the fans must be operated for 2-4 hours in a month.
- Motors with PTC resistors require an additional trigger device for the installed thermistors. Locking is recommended to prevent reactivation, Max. 2.5 V test voltage or current-limited meters on thermistors.
- For motor with direct start and a connection value > 4.0 kW, a startup current limitation (soft start using thyristor) may be necessary.
- When using step switching, the corresponding time delays must be taken into consideration for motors with 2 speeds.

G. Storage:

- Storage of the units need to be done only with protection against dust, contamination, moisture, damage and other damaging influences.
- Letting the units stand around unnecessarily and permeation by humidity and dirt into the open unit is not permissible on account of the lack of water and danger of corrosion and contamination. The same applies to unpacking the units, cleaning, and installation before startup.

H. Installation:

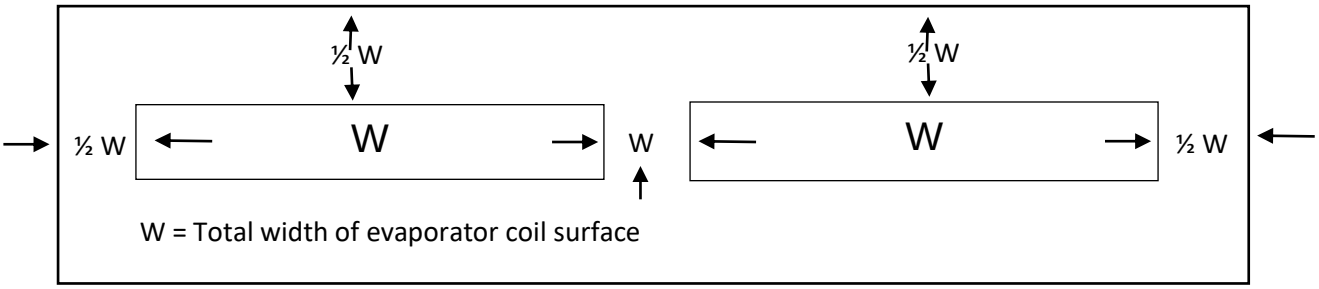
The units must be fixed at the fasting points appropriate for their weight and must be bolted down with fastening bolts. When fastening the units, following instructions must be observed:

- The diameters of the mounting holes have been statically determined by manufacturer; the fastening bolts must be adopted accordingly.
- The fastening bolts must not be over tightened or stripped.
- The units must be installed with sufficient slope towards the drain of condensation water.
- Installation needs to be done in such a way that they can be inspected, checked and maintained from all the sides at any time i.e. there must be unrestricted access to the fluid carrying and electrical components, connections and lines, and the pipeline labels must be identifiable as well as offering adequate space for testing.
- Fluid carrying pipelines must be protected against mechanical damage while mounting on cold room walls. Force may not be applied on the distribution and header pipes.
- System piping must be in accordance with good refrigeration condition.
- Inert gas must be charged into the piping during brazing.
- Three phase voltages must be +/- 10% of nameplates ratings. Single phase must be within 10% or -5% of nameplate ratings.
- Phase imbalance cannot exceed 2%.
- The drain pipes must be absolutely free of any mechanical stress. When connecting the drip tray to discharge line, the connection nut must be tightened by hands, do not use tools.

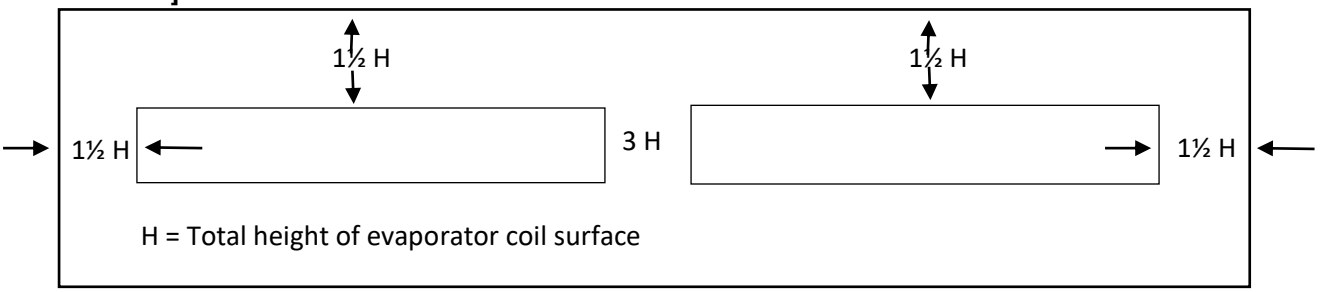
Recommended Unit's placement:

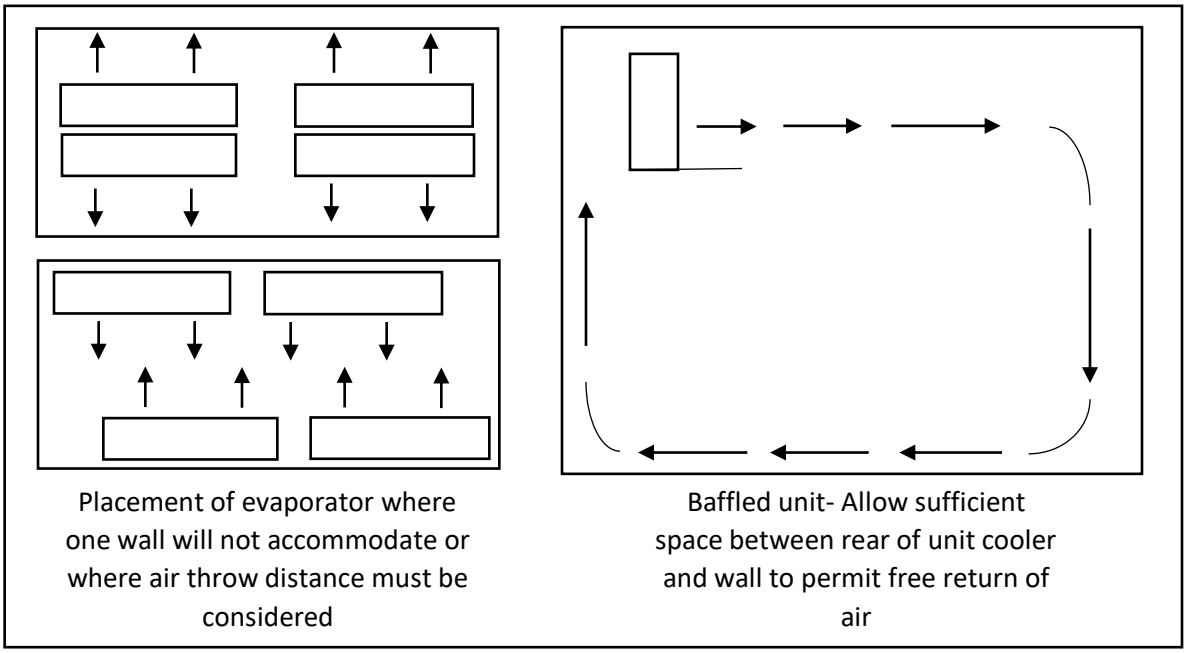
- The air pattern must cover the entire room.
- Never locate evaporators over doors.
- Location of aisles, racks etc. must be pre-defined.
- Piping distance between condensing unit and evaporator has to be minimum.
- Leave space equal to unit height between bottom of unit and product. Do not stack product in front of fans.
- Most evaporators can be mounted with rod hangers or bolts. Use 8 mm bolt and washer or rod for up to 100 Kg, 10 mm for up to 250 Kg & 16 mm for over 250 Kg.
- Minimum unit clearance:

A] Medium & Large unit coolers:



B] Small Unit coolers:





Placement of evaporator where one wall will not accommodate or where air throw distance must be considered

Baffled unit- Allow sufficient space between rear of unit cooler and wall to permit free return of air

I. Defrost Techniques:

All air coolers operating with coil surface temperatures beneath freezing [32°F (0°C)] will experience some form of frost accumulation. In order to maintain the performance of the coil it is imperative that some form of defrost is incorporated into the system. Typically, the defrosting of the coil will be accomplished by air [for rooms above 36°F (2.2°C)], hot gas, electric or water

a) Air Defrost

- For applications where the room temperature is above freezing, defrosting of the finned surface area is possible by closing the liquid feed to the coil and allowing the fans to continue running. The warmer air passing over the coil will melt the frost accumulation, but dependent on the frost formation and room temperature will determine the rate of frost melt. It is therefore recommended to only use air defrost when the room temperature is above 36°F (2.2°C).

b) Electric Defrost

- For DX halocarbon applications the most common method of defrost is with electric heater rods. The heaters are placed in both the coil and the pan section. The heater rods are installed within support tubes in the coil bundle and held in place with "C" clips, which are positioned such that there is sufficient space for the rods to expand and contract due to the thermal changes. All heater rods require a pull space for removal and / or replacement that is equal to 0.8 x the coil length.
- The heater rods for the drain pan section are attached to the underside of the heater sheet which is positioned below the coil and held in place with clips. All wiring for heater rods is terminated within a junction box located on the end tube sheet of the unit. Wattages for heater elements will be dependent on the room temperature, and this should be carefully checked at the time of selection.
- It is recommended to use only company manufactured heater in case of replacement or defrost.

c) Hot Gas Defrost

- Most refrigeration systems incorporate a central compressor room. This is an ideal source for hot gas and only requires the piping to make it available for the evaporators. The latent heat content of the vapor makes this method of defrost very effective and is essentially a byproduct of the refrigeration system. It is essential that not more than 1/3 of the evaporators in the system are defrosted simultaneously.
- Reverse cycle defrost is not recommended for non – commercial applications. Therefore, forward cycle should always be used which requires a three-pipe arrangement at the evaporator, the third pipe being the hot gas supply line. The hot gas flow through the unit should always be a series arrangement, first through the pan section and then into the coil from top to bottom. For DX applications where a distributor is used the hot gas feed into the coil should always be through the distributor, not reverse cycle.
- Evaporators with capacities greater than 15 tons (52 kW) should incorporate a soft start hot gas solenoid valve in the valve station. This valve will allow the coil to ease up to the hot gas pressure and prevent problems such as check valve chatter, liquid hammer and piping vibrations.

- The pump out phase is critical to optimum defrost performance. Additionally, if liquid is still present in the tubes when the hot gas enters the coil, condensate induced hydraulic shock is possible which can have severe consequences, including the rupturing of the pipes. Hot gas piping located within the refrigerated spaces and / or outdoors in cold climates must be insulated. It is also recommended to have liquid drainers installed in these lines to prevent liquid condensate entering the evaporator during the defrost phase. The hot gas mass flow supplied to the evaporator is dependent on the capacity of the unit and the hot gas pressure entering the evaporator. More often than not there is insufficient volume flow to the evaporator than a hot gas pressure or temperature issue, that results in poor defrost performance.

d) Water Defrost

- For water defrost to function correctly it is essential that an adequate supply of suitably warm water [> 55°F (13°C)] is available at the job site. The defrost method consists of the water being evenly distributed over the coil from a water distribution pan positioned on top of the coil. Water flow is required until all frost has been melted off the finned surface.
- The flow rate should be controlled by regulating a balancing valve located at the inlet to each unit. The flow must be adjusted to ensure full coverage of the coil plan area and take care not to allow the water distribution pan to overflow. Flow rate requirements for each unit are indicated on the submittal drawings. During the set up and commissioning the defrost operation must be carefully observed to ensure that the entire coil is cleared of frost. The time required to clear the coil can vary from three to fifteen minutes – and should never exceed fifteen minutes. If this is the case typically inadequate water supply and / or inlet temperature is too low.
- All water lines within refrigerated spaces must be insulated and heat traced to prevent these lines freezing. Lines must also be pitched up to ½" per linear foot to allow the water to drain at the completion of the defrost period.
- Large volumes of water also require adequately sized condensate drain lines. Condensate drain lines must have a minimum inclination of ½" per linear foot and sufficient fall from the drain pan outlet is required prior to entering the trap in order for the static head to overcome the pressure drop of the water flow through the trap. Traps should always be situated outside the refrigerated space. Condensate lines must be heat traced and insulated.

J. Defrost Troubleshooting:

a) Fan Motor

If the motor does not operate or it cycles on thermal overload, remove motor leads from terminal block and apply correct voltage across the leads. If motor still does not operate satisfactorily, it must be replaced. Before starting the unit, rotate fan blades to make sure they turn freely and have sufficient clearance.

b) Defrost heater

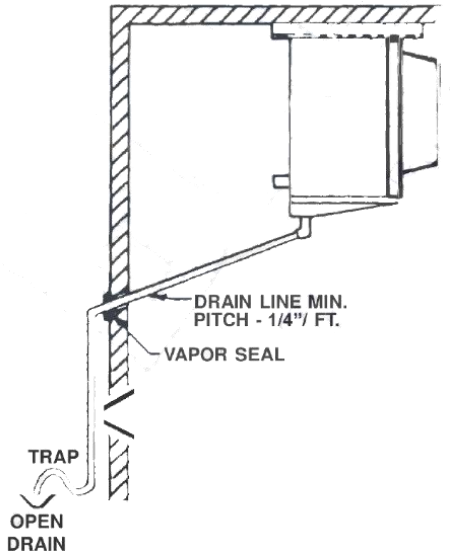
If unit shows very little or no defrosting and does not heat, disconnect heater and check to find if it is burned out. To test, apply correct voltage across heater or use continuity flashlight battery tester.

c) ***Drain Pan***

If drain pan has an ice build-up, drain line may be frozen. The drain line should be pitched sharply and exit cabinet as quickly as possible. Sometimes location and ambient at the drain outside of cabinet may cause freeze-up. A drain line heater may be required to correct the freeze-up. Any traps in the drain line must be located in a **warm ambient.**

K. Condensate Drain Line:

- Either copper or steel drain line should be used and properly protected from freezing. In running drain lines, provide a minimum 1/4 inch per foot pitch for proper drainage.
- Drain lines should be at least as large as the evaporator drain connection. All plumbing connections should be made in accordance with local plumbing codes.
- All condensate drain lines must be trapped, and run to an open drain. They must never be connected directly to the sewer system. Traps in the drain line must be located in a warm ambient.
- We recommend a trap on each evaporator drain line prior to any tee connections. Traps located outside, or extensive outside runs of drain line must be wrapped with a drain line heater.
- The heater should be connected so that it operates continuously. It is recommended that the drain line be insulated to prevent heat loss. A heat input of 20 watts per liner foot of drain line for -18 °C room temperature and 30 watts per liner foot of drain line for -30 °C room temperature is satisfactory.
- In freezers, the evaporator drain pan fitting should be included when heating and insulating the drain line.
- Inspect drain pan periodically to insure free drainage of condensate. If drain pan contains standing water, check for proper installation. The drain pan should be cleaned regularly with warm soapy water.
- Traps on low temperature units must be outside of refrigerated enclosures. Traps subject to freezing temperatures must be wrapped with heat tape and insulated.



L. Field Wiring:

The field wiring should enter the areas as provided on the unit. The wiring diagram for each unit is located on the inside of the electrical panel door. All field wiring should be done in a professional manner and in accordance with all governing codes. Before operating unit, double check all wiring connections, including the factory terminals. Factory connections can vibrate loose during shipment.

- The serial data tag on the unit is marked with the electrical characteristic for wiring the unit.
- Consult the wiring diagram in the unit cooler and in the condensing unit for proper connections.
- Wire type should be of copper conductor only and of the proper size to handle the connected load.
- The unit must be grounded.
- For multiple evaporator systems, the defrost termination controls should be wired in series. Follow the wiring diagrams for multiple evaporator systems carefully. This will assure complete defrost of all evaporators in the system.
- Multiple evaporator systems should operate of one thermostat.
- If a remote defrost timer is to be used, the timer should be located outside the refrigerated space.

M. Start up:

After the installation has been completed, following points should be covered before operating system:

- Check all electrical and refrigerant connections.
- Check the room thermostat for normal operation and adjust.
- Wiring diagram, instruction bulletins etc. attached to the condensing units should be read and filed for future reference.
- All fan motors on evaporators should be checked for proper rotation. Fan motors mount should be carefully checked for tightness and proper alignment.
- Electric and hot gas evaporator fan motors should be temporarily wired for continuously operation until the room temperature has stabilized.
- Do not leave unit unattended until the system has reached normal operating conditions and the oil charge has been properly adjusted to maintain oil level maintain between ¼ to bottom of the sight glass.
- Make sure all Schrader valve caps are in place and tight.

N. Operational check out:

After the system has been charged and has operated for at least two hours at normal operation conditions without any indication of malfunction, it should be allowed to operate overnight on automatic controls. Then a thorough recheck of the evaporator operation should be made as follow:

- Check liquid line sight glass and expansion valve operation. If there are indications that more refrigerant is required, leak test all any leaks before adding refrigerant.
- Thermostatic expansion valve must be checked for proper superheat settings. Feeler bulbs must be in positive contact with the suction line and should be insulated. Valves set at high superheat will lower refrigeration capacity. Low superheat promotes liquid slugging and compressor bearing washout.

- Check defrost controls for initiation and termination settings, and length of defrost period. Set fail safe at length of defrost + 25%.
  Example: 20 minute defrost + 5 minute = 25-minute fail safe.
- Check drain pan for proper drainage.

O. Evaporator Superheat:

Check you superheat. After the room temperature has reached to desired temperature or it's closed to reach, the evaporator superheat should be checked and adjustments made if necessary. Generally, systems with a designed TD of 6 should have a superheat value of 4 to 5 K for maximum efficiency. For systems operating at higher TD's, the superheat can be adjusted to 8 K to 10 K as required.

To properly determine the superheat of evaporator, we recommend following procedure:

- Measure the temperature of the suction line at the point the bulb is clamped.
- Obtain the suction pressure that exists in the suction line at the bulb location by either of following method:
  a) A gauge in the external equalized line will indicate the pressure directly and accurately.
  b) A gauge directly in the suction line near the evaporator or directly in the suction header of the evaporator will yield the same reading as 'a' above.
- Convert the pressure obtained in 'a' or 'b' above to saturated evaporator temperature by using a temperature-pressure chart.
- Subtract the saturated temperature from the actual suction line temperature. The difference is superheat.

Alternative Superheat Method:

The most accurate method of measuring superheat is found by following the previous procedure, Temperature/Pressure method. However, that method may not always be practical.

- Measure the temperature of the suction line at the point the bulb is clamped (outlet).
- Measure the temperature of one of the distributor tubes close to the evaporator coil (inlet).
- Subtract the inlet temperature from the outlet temperature. The difference is Superheat.
- This method will yield fairly accurate results as long as the pressure drop through the evaporator coil is low.

P. Maintenance:

Monthly

- Inspect coil by opening the drain pan – clean if required
- Confirm defrost operation and effectiveness.

Six Monthly

- Confirm correct operation of all safety components
- Clean finned surface area of coil
- Inspect drain pan – clean if necessary
- Confirm drainage from pan is unobstructed
- Check all strainers – replace / clean if required
- Tighten all electrical connections
- Check all wiring
- Confirm motor integrity – check / grease bearings
- Check operation of all heaters (coil, pan and drain lines)
- Check piping insulation – repair / replace if damaged

Cleaning

Coils should be kept clean to maintain optimum performance. During periods of high cooling demand or when dirty conditions prevail the coil should be cleaned more regularly. Always remove large debris from the coil and straighten fins prior to cleaning. When using a high-pressure washer to clean the coil, the spray pressure must not exceed 1,100 psig (75 bar) and the spray head must be at least 12 inches (300mm) away from the finned surface area. The spray angle should not be wider than 15 degrees and must be directed perpendicular to the coil face area.

Q. Evaporator Troubleshooting:

Symptoms	Possible Causes	Possible Corrective Steps
Fan(s) will not operate	1) Main switch open 2) Blown fuses 3) Defective motors 4) Defective time or defrost thermostat 5) Unit in defrost cycle 6) Coil does not get cold enough to reset thermostat	1) Close switch 2) Replace fuses. Check for short circuits or overload conditions 3) Replace motor 4) Replace defective component 5) Wait for completion of cycle 6) Adjust fan delay setting of thermostats
Room temperature too high	1) Room thermostat set too high 2) Superheat too high 3) System low on refrigerant 4) Coil iced-up 5) Unit cooler located too close to door 6) Heavy air infiltration	1) Adjust thermostat 2) Adjust thermal expansion valve 3) Add refrigerant 4) Check defrost controls for malfunction 5) Relocate unit cooler or add strip curtain to door opening 6) Seal unwanted openings in room
Ice accumulating on ceiling around evaporator or on fan guard's venturi or blades	1) Defrost duration is too long 2) Fan delay after defrost period 3) Defective defrost thermostat or timer 4) Too many defrosts	1) Adjust defrost termination thermostat 2) Defective defrost thermostat or not adjusted properly 3) Replace defective component 4) Reduce number of defrosts
Ice accumulating in drain pan	1) Defective heater 2) Unit nit pitched properly 3) Drain line plugged 4) Defective drain line heater 5) Defective timer or thermostat	1) Replace heater 2) Check and adjust in necessary 3) Clean drain line 4) Replace heater 5) Replace defective component
Frost not clearing from coil during defrosting	1) Coil temperature not getting above freezing point during defrost 2) Not enough defrost cycles per day 3) Defrost cycle too short 4) Defective timer or defrost thermostat	1) Cheater operation 2) Adjust timer for more defrost cycle 3) Adjust defrost thermostat or timer for longer cycle 4) Replace defective component
Uneven coil frosting	1) Defective heater 2) Located to close to door or opening 3) Defrost termination set too low 4) Incorrect or missing distributor nozzle	1) Replace heater 2) Relocate evaporator 3) Adjust defrost termination setting higher 4) Add or replace nozzle with appropriately sized orifice for conditions

BLUECOLD® REFRIGERATION

Checklist for Installation and Commissioning of Evaporator *

1. Check the unit must be bolted down with fastening bolts ☐
2. Check the units must be installed with sufficient slope towards the drain of Condensation water ☐
3. Ensure that Inert gas must be charged into the piping during brazing ☐
4. Ensure that when connecting the drip tray to discharge line, the connection nut must be tightened by hands, do not use tools ☐
5. Check the System piping must be in accordance with good refrigeration condition ☐
6. Ensure that Piping distance between condensing unit and evaporator has to be minimum ☐
7. Check the Fluid carrying pipelines must be protected against mechanical damage while mounting on cold room walls ☐
8. Check piping insulation – repair / replace if required ☐
9. Check that all system liquid line solenoid valves at fixtures are connected to the correct ☐
10. Check Thermostatic Expansion -Valves including bulb location, bulbs positive contact with the suction line and that the bulb is properly insulated ☐
11. Check that the location of Evaporator, air pattern must cover the entire room ☐
12. Ensure that Never locate evaporators over doors ☐
13. Check the finned surface area of coil should be clean ☐
14. Check all strainers - replace / clean if required ☐
15. Ensure that electrical wiring is in accordance with previously mentioned drawings or documentation and that all fan motor direction is correct ☐
16. Make sure that the power supply must meet three phase voltages must be +/- 10% of nameplates ratings ☐
17. Check / verify that all breakers and switches are in ON position during commissioning ☐
18. Check / verify that all refrigeration loads are in refrigeration mode ☐
19. Check all entire system fans for operation (Direction & function) ☐
20. Check operation of all heaters (coil, pan, and drain lines) ☐

21. Check all temperature probes at fixtures and confirm that they assigned to the correct ☐
22. Ensure that all Evaporators are delivering correct superheat and that no flooding back occurs ☐
23. Check Air Flow and Air Throw distance ☐
24. Check that the condensate drains tubes are free of any obstruction and terminated at the appropriate point of discharge ☐

Commissioning Checklist *

1. Check all electrical and refrigerant connections ☐
2. Check the room thermostat for normal operation and otherwise adjust ☐
3. Make sure all Schrader valve caps are in place and tight ☐
4. All fan motors on evaporators should be checked for proper rotation and fan motors mount should be carefully checked for tightness and proper alignment ☐
5. Check the operation of compressor ☐
6. Check liquid line, sight glass and expansion valve operation ☐
7. Feeler bulbs must be in positive contact with the suction line and should be insulated ☐
8. Thermostatic expansion valve must be checked for proper superheat settings of approx. 5-8 K ☐
9. Ensure that the evaporator coil to achieve required cooling ☐
10. Check drain pan for proper drainage ☐
11. Check the defrost operation during unit running time ☐

- ***Property of Blue Cold Refrigeration***