COLDTECH

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EVAPORATOR
Installation Manual

Transport | Installation | Commissioning | Operation | Maintenance

Product line	ColdTech Evaporators / Air Coolers
Applicable ranges	Slim-line, Dual Discharge, Compact Cubic, Industrial
Document	General Installation Manual
Revision / Date	Rev. 00 / 2026

www.coldtechgroup.com

Document Use and Reference

This manual has been prepared specifically for ColdTech products using the supplied ColdTech catalogue and draft technical content. Its page architecture follows established industrial-equipment manual conventions, while all ColdTech layouts, safety boxes and technical diagrams in this edition are newly created for this document. Project-specific drawings, nameplate data, wiring diagrams and approved submittals always take precedence.

CONTENTS

1. Introduction

1.1 Purpose

This Installation Manual provides general guidelines for the safe installation, commissioning, operation, and maintenance of ColdTech Evaporators. It is intended for refrigeration contractors, service engineers, technicians, consultants, and facility operators to ensure correct installation, reliable operation, and maximum equipment life.

The manual applies to the following ColdTech evaporator series:

- Slim Line Evaporators
- Slim Dual Discharge Evaporators
- Compact Cubic Evaporators
- Commercial Dual Discharge Evaporators
- Industrial Air Coolers

The procedures described in this manual are based on standard refrigeration engineering practices and should be followed together with local regulations, approved project drawings, and applicable safety standards.

1.2 Scope of Supply

This manual covers the general requirements for:

- Receiving and inspection
- Storage and handling
- Lifting procedures
- Ceiling mounting
- Refrigerant piping
- TXV installation
- Solenoid valve installation
- Drain piping
- Electrical wiring
- Defrost systems
- Pressure testing
- Vacuum evacuation
- Refrigerant charging
- System start-up and commissioning
- Preventive maintenance
- Basic troubleshooting
- Warranty conditions

Project-specific drawings, refrigeration calculations, electrical schematics, and controller programming shall always take precedence over this general manual.

1.3 Product Description

ColdTech Evaporators are high-performance air cooling units designed for commercial and industrial refrigeration applications. Each unit is manufactured using high-quality copper tubes, aluminium fins, high-efficiency axial fans, corrosion-resistant galvanized steel casing, and insulated drain trays to provide reliable cooling performance and long service life.

Typical applications include:

- Walk-in Chillers
- Walk-in Freezers
- Cold Storage Warehouses
- Blast Chillers & Blast Freezers
- Food Processing Facilities
- Meat & Poultry Plants
- Dairy & Beverage Industries
- Pharmaceutical Cold Rooms
- Distribution & Logistics Centres

1.4 Installation Responsibility

Installation, commissioning, and servicing shall be carried out only by qualified refrigeration technicians. The installer is responsible for ensuring that:

- The unit is correctly mounted and adequately supported.
- Refrigerant piping and drain piping are properly installed.
- Electrical connections comply with local regulations.
- The refrigeration system is leak tested, evacuated, charged, and commissioned before operation.
- All safety devices and controls are functioning correctly.

1.5 Important Notice

This manual provides general installation guidelines for ColdTech evaporators. Actual equipment configuration may vary depending on project requirements. ColdTech reserves the right to modify product specifications without prior notice as part of continuous product improvement.

Failure to follow the installation procedures and recommendations contained in this manual may result in reduced performance, equipment damage, unsafe operation, and may affect warranty coverage.

2. Safety Instructions

2.1 General Safety

The safe installation, operation, and maintenance of ColdTech evaporators are essential for ensuring reliable system performance and preventing injury to personnel or damage to equipment. Installation and service work shall be carried out only by qualified refrigeration technicians who are trained in refrigeration systems, electrical installations, and safe working practices.

Before starting any installation or maintenance activity, carefully read this manual and ensure all necessary tools, safety equipment, and approved materials are available. Always comply with local electrical, mechanical, refrigeration, and occupational health and safety regulations.

2.2 Qualified Personnel

Only trained and authorized personnel shall perform:

- Equipment installation
- Refrigerant piping and brazing
- Electrical wiring
- Pressure testing
- Vacuum evacuation
- Refrigerant charging
- Commissioning
- Preventive maintenance
- Repairs and replacement of components

Unqualified personnel should not operate, modify, or service the equipment.

2.3 Personal Protective Equipment (PPE)

Appropriate PPE shall be worn at all times during installation and servicing.

2.4 Electrical Safety

- Disconnect the electrical power supply before servicing the unit.
- Apply Lock-Out/Tag-Out (LOTO) procedures before opening electrical panels.
- Verify that the power supply is isolated using an approved voltage tester.
- Ensure proper earthing (grounding) of the equipment.
- Never work on live electrical circuits.
- Replace damaged cables and electrical components immediately.

2.5 Refrigerant Safety

- Refrigerants must be handled only by qualified personnel using approved equipment.
- Use only the refrigerant specified for the system.
- Avoid direct contact with liquid refrigerant, as it may cause frostbite.
- Ensure adequate ventilation during refrigerant charging or recovery.
- Never release refrigerant directly into the atmosphere.
- Use approved refrigerant recovery equipment where required by local regulations.

2.6 Brazing Safety

During refrigerant piping installation:

- Purge the piping continuously with dry nitrogen while brazing to prevent oxidation inside the copper tubes.
- Remove combustible materials from the work area.
- Keep a suitable fire extinguisher nearby.
- Allow brazed joints to cool naturally before handling.

2.7 Pressure Testing

Before charging the refrigeration system:

- Pressure-test the system using dry nitrogen only.
- Never use oxygen, compressed air, or combustible gases for pressure testing, as they may cause fire, explosion, or serious injury.
- Use calibrated pressure gauges suitable for the test pressure.
- Inspect all joints for leaks before proceeding to vacuum evacuation.

2.8 Safe Lifting Practices

- Evaporators can be heavy and must be lifted correctly.
- Use certified lifting equipment with adequate capacity.
- Lift only from designated lifting points.
- Never lift the unit by refrigerant connections, fan guards, or drain trays.
- Ensure the equipment is securely supported before installation.

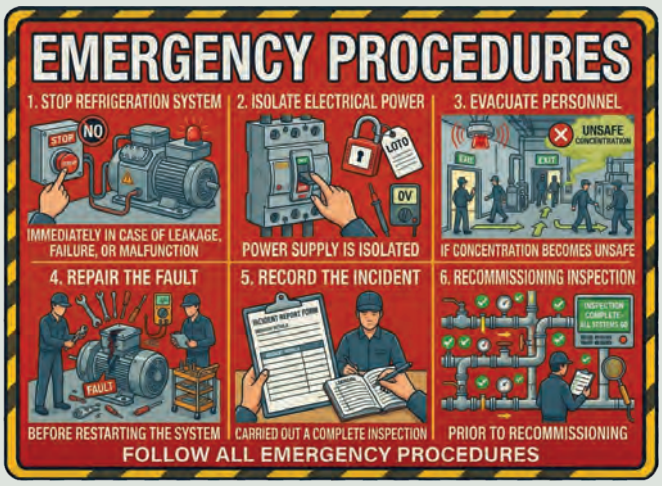
2.9 General Safety Precautions

- Keep the work area clean and free from obstructions.
- Do not modify the equipment without written approval from ColdTech.
- Ensure all guards and electrical covers are installed before operating the unit.
- Verify fan rotation before commissioning.
- Do not operate the unit if abnormal noise, vibration, or refrigerant leakage is detected.

2.10 Emergency Procedures

In the event of refrigerant leakage, electrical failure, or equipment malfunction:

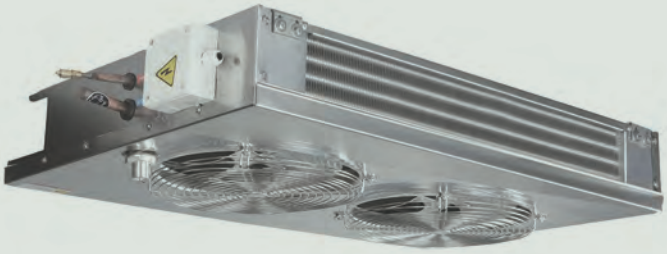
- Stop the refrigeration system immediately.
- Isolate the electrical power supply.
- Evacuate personnel if refrigerant concentration becomes unsafe.
- Repair the fault before restarting the system.
- Record the incident and carry out a complete inspection prior to recommissioning.



Important Safety Notice

Failure to follow the safety instructions contained in this manual may result in personal injury, equipment damage, reduced system performance, loss of warranty coverage, or unsafe operating conditions. ColdTech strongly recommends that all installation and maintenance work be performed in accordance with recognized refrigeration engineering practices and applicable local safety regulations.

3. Product Overview



3.1 General

ColdTech Evaporators are high-performance air cooling units specifically designed for commercial and industrial refrigeration applications. They are engineered to deliver efficient heat transfer, uniform air distribution, reliable operation, and long service life under demanding operating conditions. Each unit is manufactured using premium quality materials and modern production techniques to ensure durability, energy efficiency, and ease of maintenance.

The product range is suitable for both medium-temperature and low-temperature refrigeration systems using industry-standard refrigerants and is compatible with a wide range of condensing units and compressor systems.

3.2 Construction Features

ColdTech evaporators are manufactured with high-quality components to ensure reliable performance and long-term operation.

Standard construction includes:

- High-efficiency copper tube and aluminium fin heat exchanger
- Corrosion-resistant galvanized steel powder-coated casing
- High-performance axial fan motors with low noise operation
- Stainless steel or corrosion-resistant drain tray (model dependent)
- Pressure-tested refrigeration circuit for leak-free operation
- Optimized air distribution for uniform room temperature
- Easy access panels for inspection and maintenance

- Electric defrost heaters (where applicable)
- Factory quality inspection before dispatch

The robust construction minimizes maintenance requirements while providing maximum cooling efficiency.

3.3 Product Range

ColdTech offers a complete range of evaporators to suit different room sizes and refrigeration applications.

The standard product range includes:

- Slim Line Evaporators – Ideal for small and medium-sized cold rooms with limited ceiling space.
- Slim Dual Discharge Evaporators – Designed for improved air distribution in narrow rooms and corridors.
- Compact Cubic Evaporators – Suitable for commercial cold rooms requiring high cooling capacity.
- Commercial Dual Discharge Evaporators – Designed for supermarkets, food processing areas, and medium-sized cold storage applications.
- Industrial Air Coolers – Heavy-duty evaporators for large cold stores, distribution centres, blast chillers, and industrial refrigeration facilities.
- Each series is available in various capacities, fan configurations, fin spacing options, and defrost arrangements to meet specific project requirements.

3.4 Typical Applications

ColdTech evaporators are suitable for a wide range of refrigeration applications, including:

- Walk-in Chillers
- Walk-in Freezers

- Cold Storage Warehouses
- Blast Chillers
- Blast Freezers
- Food Processing Facilities
- Meat & Poultry Processing Plants
- Dairy & Beverage Industries
- Fruit & Vegetable Cold Rooms
- Pharmaceutical Storage
- Hotels, Restaurants & Catering Facilities
- Distribution & Logistics Centres

3.5 Design Philosophy

ColdTech evaporators are designed to provide:

- High cooling efficiency
- Uniform airflow throughout the cold room
- Low energy consumption
- Reduced operating noise
- Easy installation and maintenance
- Long service life
- Reliable performance in demanding environments

All units are manufactured under strict quality control procedures and are pressure tested before leaving the factory to ensure safe and dependable operation.

3.6 Identification

Each evaporator is fitted with a permanent nameplate displaying essential product information, including:

- Model Number
- Serial Number
- Cooling Capacity
- Refrigerant Type
- Electrical Supply
- Fan Motor Details
- Maximum Working Pressure
- Manufacturing Date

This information should be recorded during installation and referenced whenever spare parts, technical support, or warranty service is required.

Product Overview Summary

ColdTech Evaporators combine advanced heat exchanger technology, robust construction, and energy-efficient performance to deliver reliable refrigeration solutions for commercial and industrial applications. With a comprehensive range of models and configurations, they are designed to meet the cooling requirements of modern cold chain facilities while ensuring ease of installation, safe operation, and long-term reliability.

4. Receiving & Storage

4.1 General

Proper receiving, inspection, and storage of ColdTech evaporators are essential to ensure that the equipment arrives in good condition and performs as designed after installation. All units are factory inspected, pressure tested, and securely packaged before shipment. Upon delivery, the customer or installation contractor is responsible for inspecting the equipment and reporting any visible damage or shortages before accepting the shipment.

Improper handling or storage may result in physical damage, corrosion, contamination, or reduced equipment performance.

4.2 Receiving Inspection

Immediately upon delivery, inspect the equipment and packaging for any signs of damage that may have occurred during transportation.

Verify the following:

- Correct model number and quantity as per the delivery note.
- Shipping package is intact and undamaged.
- Casing, fan guards, drain tray, and coil fins are free from dents or deformation.
- Refrigerant connections are sealed with protective caps.
- Electrical terminal box and accessories are undamaged.
- All supplied accessories and documentation are included.

If any damage, missing components, or discrepancies are identified, record the details on the delivery receipt and notify the supplier or carrier immediately before installation.

4.3 Handling During Unloading

Use suitable lifting equipment such as forklifts, cranes, or lifting slings with adequate capacity. Handle the evaporator carefully to prevent damage to the casing, coil, fan motors, and refrigerant connections.

Do Not:

- Lift the unit by the refrigerant connections.
- Lift using the fan guards or drain tray.
- Drag the equipment across the floor.
- Stack evaporators on top of each other unless specifically permitted.
- Always keep the unit in its original packaging until it is ready for installation.

4.4 Storage Requirements

If installation is not carried out immediately after delivery, store the evaporator in a clean, dry, and well-ventilated indoor location.

The storage area should:

- Be protected from rain, direct sunlight, dust, and corrosive environments.
- Maintain an ambient temperature suitable for equipment storage.
- Prevent exposure to excessive moisture or water.
- Be free from chemical vapours or corrosive substances.
- Provide a level surface capable of supporting the equipment weight.
- Keep all refrigerant connection caps in place until refrigerant piping installation begins to prevent dirt, moisture, and contaminants from entering the refrigeration circuit.

4.5 Long-Term Storage

For storage periods exceeding three months:

- Inspect the equipment periodically for signs of corrosion or damage.
- Ensure the packaging remains intact and dry.
- Protect the coil fins from dust and accidental impact.
- Rotate fan blades by hand occasionally to prevent bearing deterioration (if recommended by the motor manufacturer).
- Replace damaged protective caps before installation.

4.6 Pre-Installation Inspection

Before installation, perform a final inspection to confirm that:

- The evaporator has not been damaged during storage.
- Coil fins are clean and undamaged.
- Fan blades rotate freely without obstruction.
- Electrical components are dry and in good condition.
- Refrigerant connections remain sealed and clean.
- All accessories and mounting hardware are available.

Important Notice

ColdTech evaporators are delivered fully factory tested and ready for installation. Any damage resulting from improper transportation, unloading, handling, or storage after delivery is the responsibility of the installer or site owner. Proper receiving and storage practices help ensure safe installation, reliable operation, and maximum equipment service life.

5. Lifting & Handling

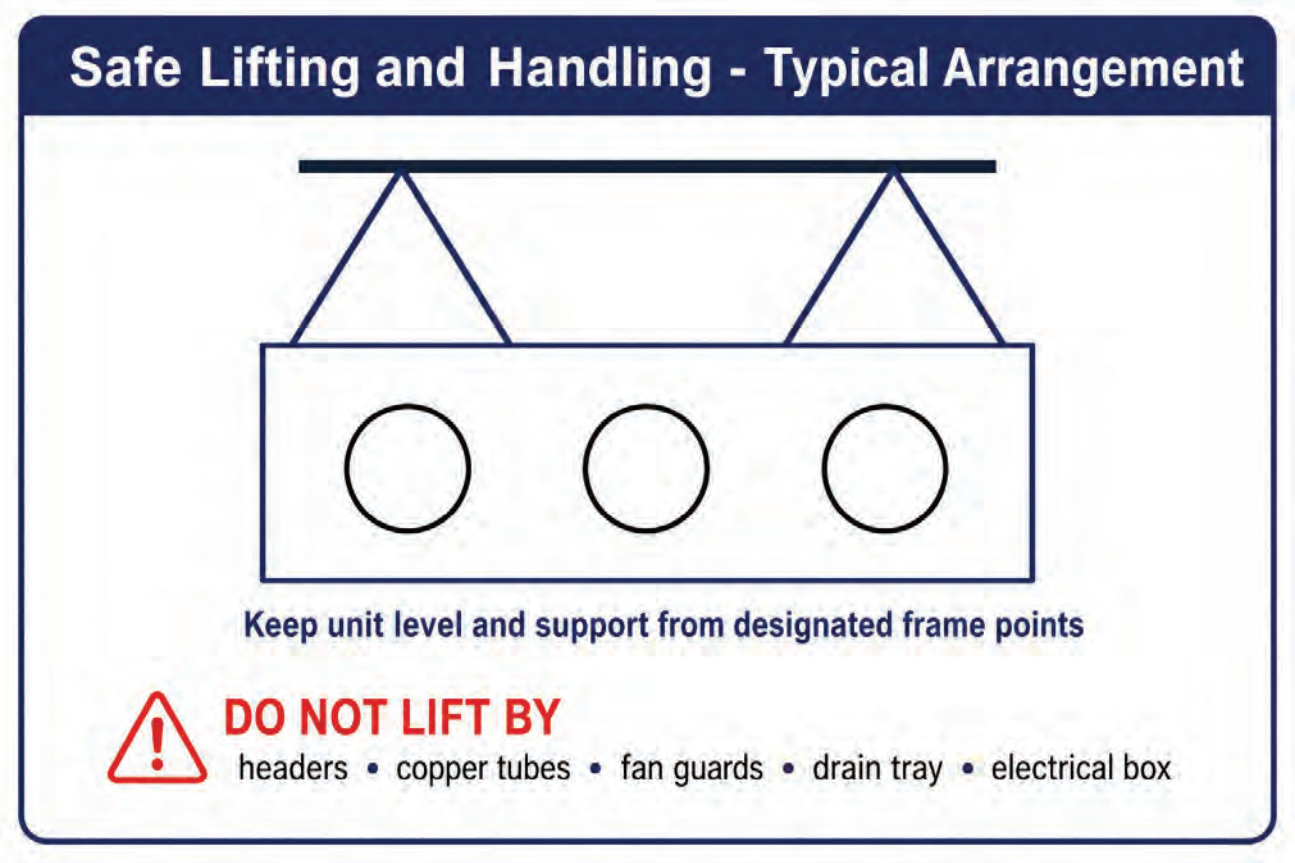


Figure - Typical arrangement for guidance only; not to scale.

5.1 General

Proper lifting and handling of ColdTech evaporators are essential to prevent personal injury and equipment damage during transportation, unloading, and installation. Although every evaporator is carefully packed and inspected before shipment, incorrect handling practices can result in damage to the casing, heat exchanger coil, fan assembly, drain tray, refrigerant connections, and electrical components.

Only trained personnel shall handle the equipment using suitable lifting equipment with adequate load capacity. Before lifting, verify the unit weight from the nameplate or project documentation and ensure that all lifting equipment is certified and in good working condition.

5.2 Lifting Requirements

Before lifting the evaporator:

- Inspect the packaging and unit for any visible damage.
- Confirm that lifting equipment is rated for the load.
- Ensure the lifting path is clear of personnel and obstacles.
- Remove loose accessories that may fall during lifting.
- Maintain the evaporator in a level position throughout the lifting operation.
- Use appropriate lifting slings, spreader bars, or forklifts as required by the unit size.

For larger evaporators, the use of a spreader bar is recommended to distribute the load evenly and prevent excessive stress on the casing.

5.3 Safe Handling Practices

To avoid equipment damage, always follow these recommendations:

- Lift the evaporator only from the designated lifting points or support frame.
- Support the unit evenly during lifting and transportation.
- Handle the equipment carefully to avoid impact or sudden movement.
- Keep the unit in its original packaging until installation whenever possible.
- Store the evaporator on a flat, stable surface if installation is delayed.

Never lift or support the evaporator using:

- Refrigerant headers
- Refrigerant distributors
- Copper tubing
- Fan guards
- Drain trays
- Electrical terminal box
- Fan motors

These components are not designed to support the equipment weight and may become permanently damaged.

5.4 Forklift Handling

When using a forklift:

- Ensure the forks are fully inserted beneath the supporting frame or pallet.
- Lift the unit slowly and evenly.
- Avoid sudden braking or sharp turns during transportation.
- Secure the load if transporting over long distances within the site.

5.5 Storage After Handling

After unloading, store the evaporator in a clean, dry indoor location until installation. Protect the equipment from moisture, dust, direct sunlight, and accidental impact. Keep all refrigerant connection caps fitted to prevent contamination of the refrigeration circuit.

Important Notice

Improper lifting and handling can cause hidden damage to the refrigeration coil, fan assembly, refrigerant piping, and casing, resulting in refrigerant leaks, reduced cooling performance, or premature equipment failure. ColdTech recommends that all lifting and handling operations be performed by qualified personnel using approved lifting methods and suitable equipment in accordance with local safety regulations and good engineering practice.

6. Installation Requirements

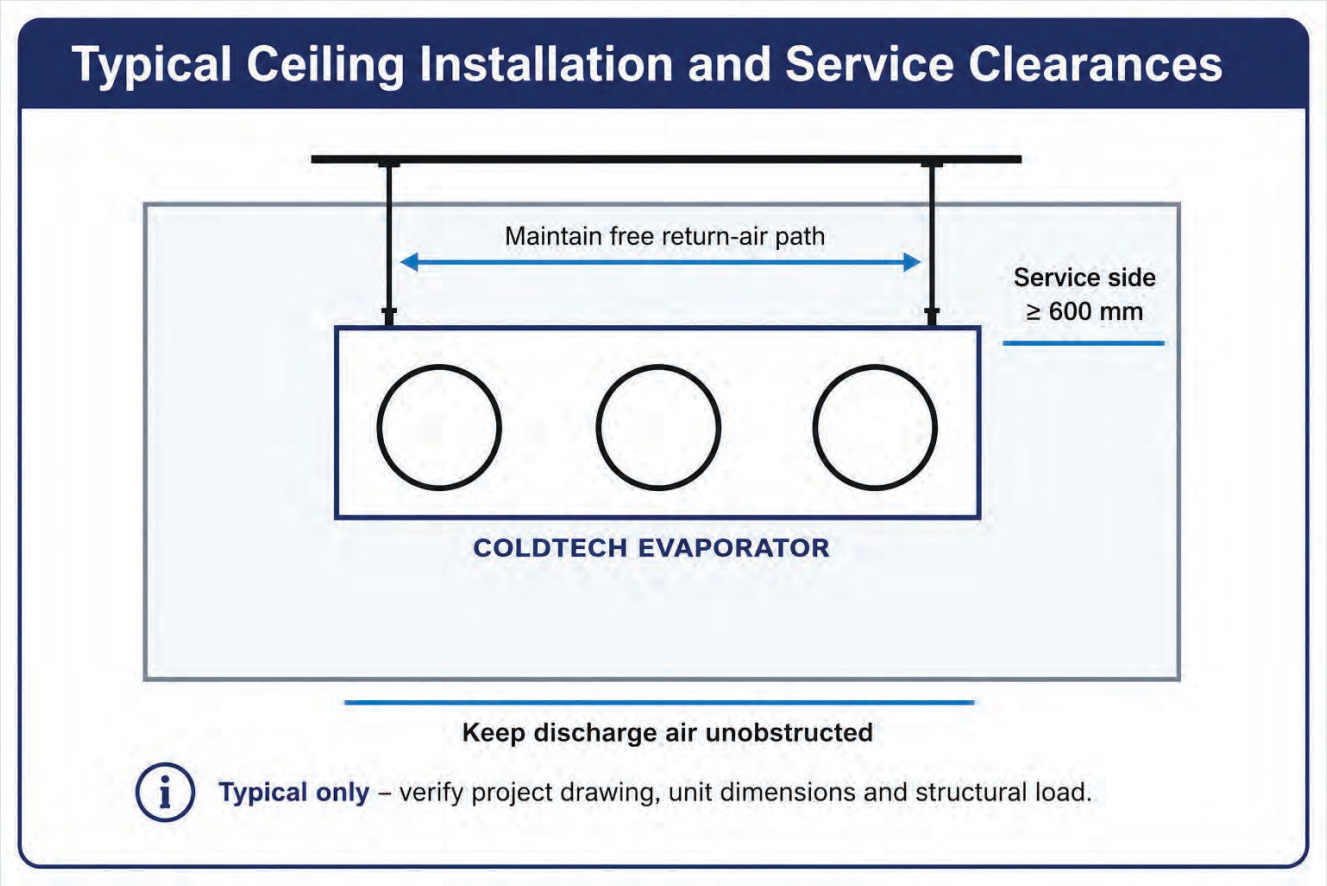


Figure - Typical arrangement for guidance only; not to scale.

Ensure adequate ceiling strength. Maintain minimum clearances: rear 300 mm, top 250 mm, service side 600 mm and unobstructed airflow.

6.1 General

Proper installation is essential to ensure safe operation, maximum cooling performance, and long service life of ColdTech evaporators. Before commencing installation, verify that the supplied equipment matches the approved project drawings and refrigeration design. All installation work shall be carried out by qualified refrigeration technicians in accordance with local regulations and recognized refrigeration engineering practices.

The installation area shall be clean, dry, and structurally suitable for supporting the operating weight of the evaporator. Ensure adequate access is available for future inspection, servicing, and maintenance.

6.2 Location Selection

The evaporator shall be installed inside the insulated cold room where uniform air circulation can be achieved throughout the storage area.

When selecting the installation location:

- Position the evaporator to provide unrestricted air circulation.
- Avoid directing the air discharge directly onto the entrance door or frequently occupied work areas.
- Maintain sufficient distance from stored products to prevent airflow obstruction.

- Install the unit where condensate can drain freely.
- Ensure sufficient space is available for future maintenance and component replacement.

For multiple evaporators, locate the units to provide balanced air distribution and avoid short-circuiting of the air between the air discharge and return.

6.3 Structural Requirements

The supporting ceiling or steel structure shall be designed to safely support the total operating weight of the evaporator, including refrigerant, defrost heaters, and vibration loads.

Before installation:

- Verify the structural load capacity.
- Use suitable threaded rods, anchors, channels, or support brackets.
- Install vibration isolators where required.
- Ensure the evaporator is installed level to allow proper condensate drainage.

ColdTech recommends that all supporting structures be designed and approved by the project structural engineer where necessary.

6.4 Installation Clearances

Adequate clearances shall be maintained around the evaporator to ensure unrestricted airflow and allow safe maintenance access.

Do not install the evaporator directly against walls, ceilings, lighting fixtures, cable trays, or other equipment that may restrict airflow or limit service access.

6.5 Pre-Installation Checklist

Before mounting the evaporator, confirm that:

- Correct model and capacity have been supplied.
- Equipment has been inspected for transportation damage.
- Refrigerant connections remain sealed.
- Mounting hardware is available.
- Ceiling structure is suitable.
- Electrical supply matches the equipment rating.
- Refrigerant piping route has been planned.
- Drain piping route has been confirmed.
- Adequate maintenance access is available.

6.6 General Installation Recommendations

Install the evaporator in accordance with the approved project drawings.

Ensure all mounting bolts are securely tightened.

Protect the coil and fan assembly from damage during installation.

Keep the refrigerant circuit sealed until piping work begins.

Seal all insulated panel penetrations using approved sealant after piping and wiring are completed.

Verify that the unit is level before connecting the drain line.

Important Notice

Correct installation is critical to achieving the designed refrigeration performance. Insufficient structural support, inadequate clearances, restricted airflow, or improper installation practices may result in reduced cooling capacity, uneven room temperature, excessive frost formation, increased energy consumption, or premature equipment failure. Always follow this manual together with the approved project drawings and applicable local regulations.

7. Ceiling Mounting

Suspend units using threaded rods, Unistrut channels and vibration isolators. Tighten hardware evenly and ensure the unit is level to promote proper drainage.

7.1 General

Proper ceiling mounting is essential to ensure the safe operation, structural stability, and long-term reliability of ColdTech evaporators. The evaporator shall be securely suspended from a structural ceiling, steel beam, or suitable support frame capable of supporting the total operating weight of the unit, including refrigerant, defrost heaters, fan motors, and any additional operational loads.

The supporting structure shall be designed and approved in accordance with local building regulations and project structural requirements. Under no circumstances shall the evaporator be supported directly from insulated cold room panels unless specifically designed and approved for the applied load.

7.2 Mounting Method

ColdTech recommends suspending the evaporator using galvanized or stainless steel threaded rods, Unistrut channels, and suitable fixing anchors. All suspension components shall be corrosion-resistant and of sufficient strength for the operating load.

The standard mounting arrangement consists of:

- Structural ceiling or steel support beam
- Expansion anchors or chemical anchors (where applicable)
- Threaded suspension rods
- Unistrut support channel or mounting brackets
- Flat washers, spring washers, and locking nuts
- Rubber vibration isolators (recommended)
- ColdTech evaporator mounting brackets

All fasteners shall be tightened evenly to prevent distortion of the evaporator casing.

7.3 Installation Procedure

Before lifting the evaporator into position:

- Verify the mounting dimensions against the approved drawings.
- Ensure the supporting structure is level and capable of carrying the equipment load.
- Install all suspension rods vertically without bending.
- Fit vibration isolators where specified to minimize vibration transmission.
- Lift the evaporator carefully using approved lifting equipment.
- Secure all mounting hardware and tighten evenly.

After installation, confirm that the evaporator is perfectly level in both directions to ensure proper condensate drainage and prevent water accumulation inside the drain tray.

7.4 Alignment and Clearances

After the unit has been mounted:

- Check that the evaporator is securely fixed.
- Confirm that all mounting bolts are fully tightened.
- Verify that recommended maintenance clearances are maintained.
- Ensure unrestricted airflow to both the air intake and air discharge sides.
- Confirm that the drain connection is positioned at the lowest point of the drain tray.

Where multiple evaporators are installed, maintain sufficient spacing between units to achieve uniform air distribution and allow easy access for future maintenance.

7.5 Vibration Isolation

To minimize vibration and operating noise, ColdTech recommends installing rubber vibration isolators between the evaporator mounting brackets and the supporting structure whenever practical.

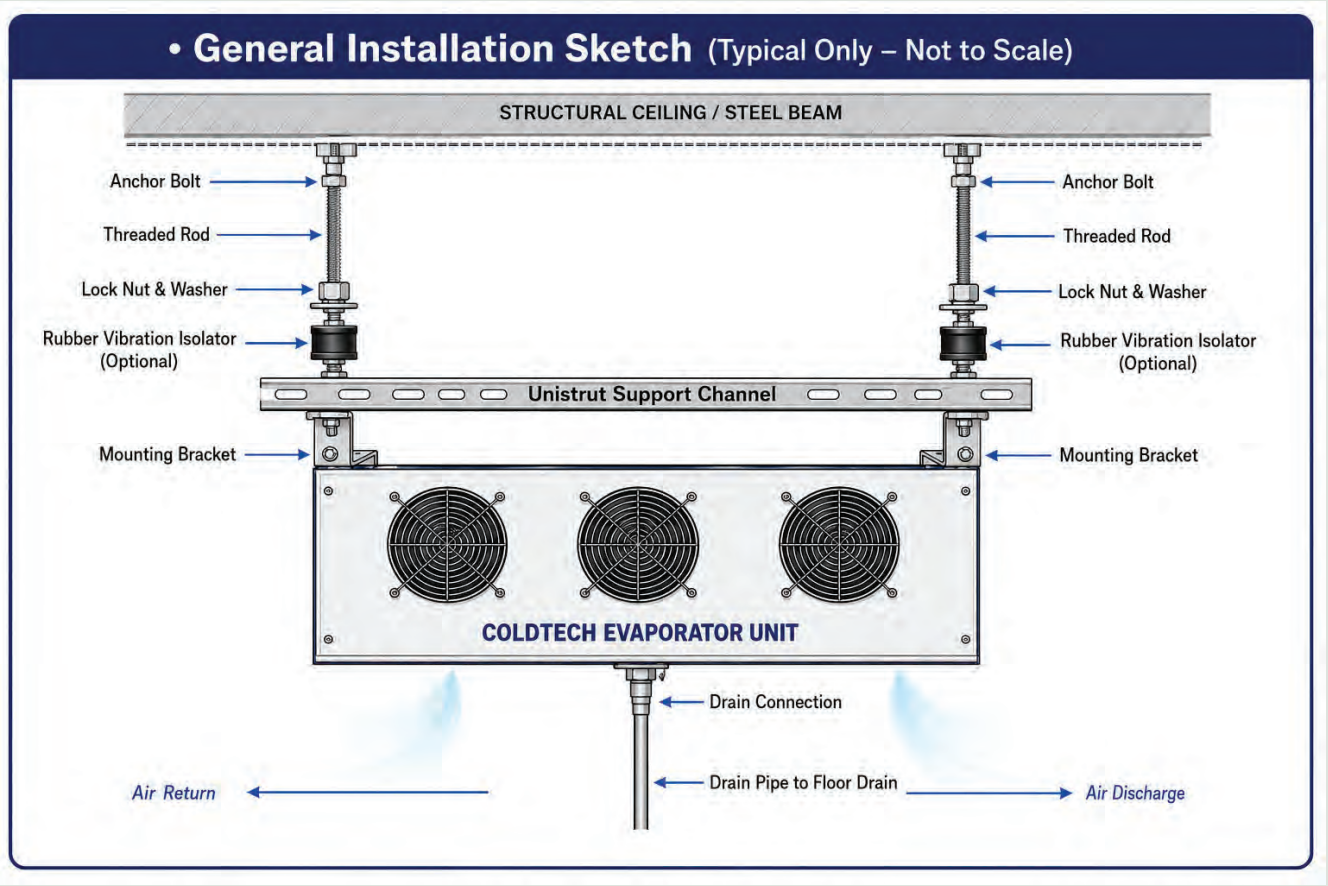
Vibration isolators help to:

- Reduce transmission of vibration to the building structure.
- Minimize operating noise.
- Protect refrigerant piping from vibration stress.
- Improve long-term reliability of the installation.

7.6 Final Inspection

Before proceeding with refrigerant piping and electrical installation, verify the following:

- Supporting structure is secure and capable of carrying the load.
- Threaded rods and support channels are correctly installed.
- All bolts, nuts, and washers are tightened.
- Vibration isolators are correctly positioned (if provided).
- Evaporator is level.
- Service clearances are maintained.
- Airflow is unobstructed.
- Drain connection is correctly oriented.



Note: The above sketch is for general installation guidance only and is not to scale. Actual mounting arrangements may vary depending on the evaporator model, room layout, structural design, and project-specific requirements.

Important Notice

Improper ceiling mounting may result in equipment vibration, condensate drainage problems, refrigerant pipe stress, excessive noise, or structural damage. ColdTech recommends that all evaporators be installed by qualified personnel using approved support systems and in accordance with the approved project drawings and local structural regulations. This section is designed to fit approximately 1–2 pages in a professional OEM installation manual.

8. Refrigerant Piping

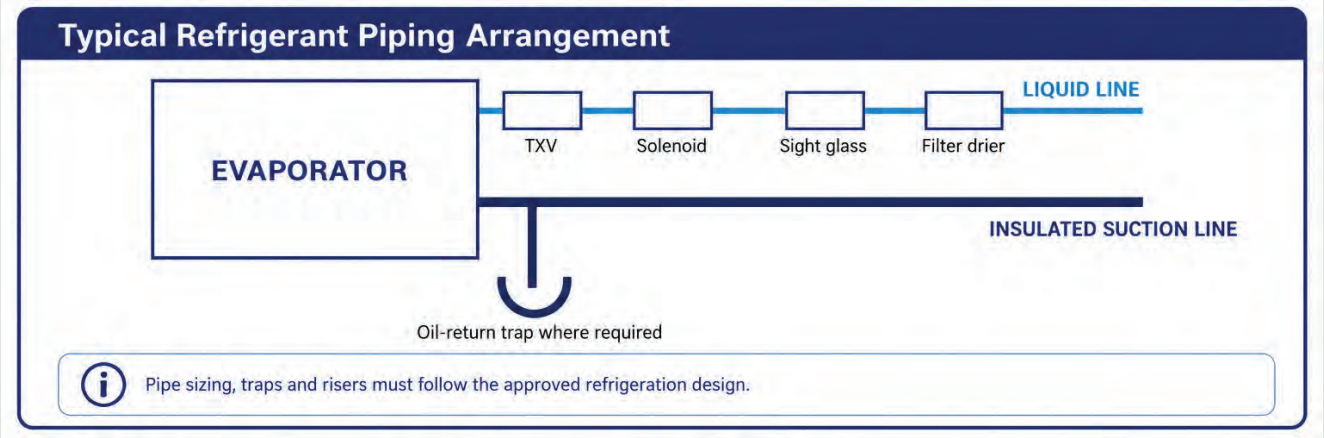


Figure - Typical arrangement for guidance only; not to scale.

Use refrigeration-grade copper tube. Purge with dry nitrogen while brazing. Insulate suction lines and provide oil traps where required.

8.1 General

Correct refrigerant piping is essential for achieving the designed cooling capacity, compressor reliability, and long-term performance of the refrigeration system. Improper pipe sizing, poor brazing practices, inadequate insulation, or incorrect oil return arrangements may result in excessive pressure drop, refrigerant leakage, compressor failure, or reduced system efficiency.

All refrigerant piping shall be installed by qualified refrigeration technicians using recognized refrigeration engineering practices and in accordance with the approved project drawings. Copper tubing and fittings shall be suitable for refrigeration service and capable of withstanding the maximum operating pressure of the system.

8.2 Copper Piping

Use only refrigeration-grade dehydrated copper tubing for all refrigerant lines. Copper pipes shall be clean, dry, and free from moisture, dirt, scale, or other contaminants before installation.

General recommendations include:

- Select pipe sizes according to the refrigeration system design.
- Keep refrigerant piping as short and direct as practical.
- Minimize the number of bends and fittings to reduce pressure losses.
- Properly support piping to prevent vibration and mechanical stress.
- Protect piping from physical damage during installation.
- Do not use damaged or contaminated copper tubing.

8.3 Brazing Procedure

All refrigerant joints shall be brazed using approved silver brazing alloy suitable for refrigeration applications.

During brazing:

- Purge the piping continuously with dry nitrogen to prevent oxidation inside the copper tubes.
- Remove any combustible materials from the work area.
- Use heat-resistant protection where necessary to prevent damage to nearby components.
- Allow joints to cool naturally before handling or pressure testing.
- Inspect every brazed joint for quality before commissioning.

Failure to purge with nitrogen may produce internal oxidation, which can contaminate the refrigeration system and damage expansion valves, solenoid valves, and compressors.

8.4 Suction Line Insulation

All suction lines shall be insulated using closed-cell elastomeric insulation of suitable thickness to prevent condensation, reduce heat gain, and improve refrigeration efficiency.

Ensure that:

- Insulation joints are fully sealed.
- No exposed copper surfaces remain.
- Outdoor insulation is protected against UV exposure where applicable.
- Damaged insulation is repaired before commissioning.
- Proper insulation helps maintain system efficiency and prevents water condensation on the pipe surface.

8.5 Oil Return

Where vertical risers or long refrigerant pipe runs are used, suitable oil traps and piping arrangements shall be provided to ensure reliable compressor oil return.

General recommendations include:

- Install oil traps at the base of vertical suction risers.
- Maintain proper suction gas velocity for oil transport.
- Avoid unnecessary low points where oil may accumulate.
- Follow compressor manufacturer's recommendations for long pipe runs.
- Correct oil return is essential for compressor lubrication and long-term reliability.

8.6 Pipe Supports

Refrigerant piping shall be adequately supported using approved pipe clamps or hangers.

Supports shall:

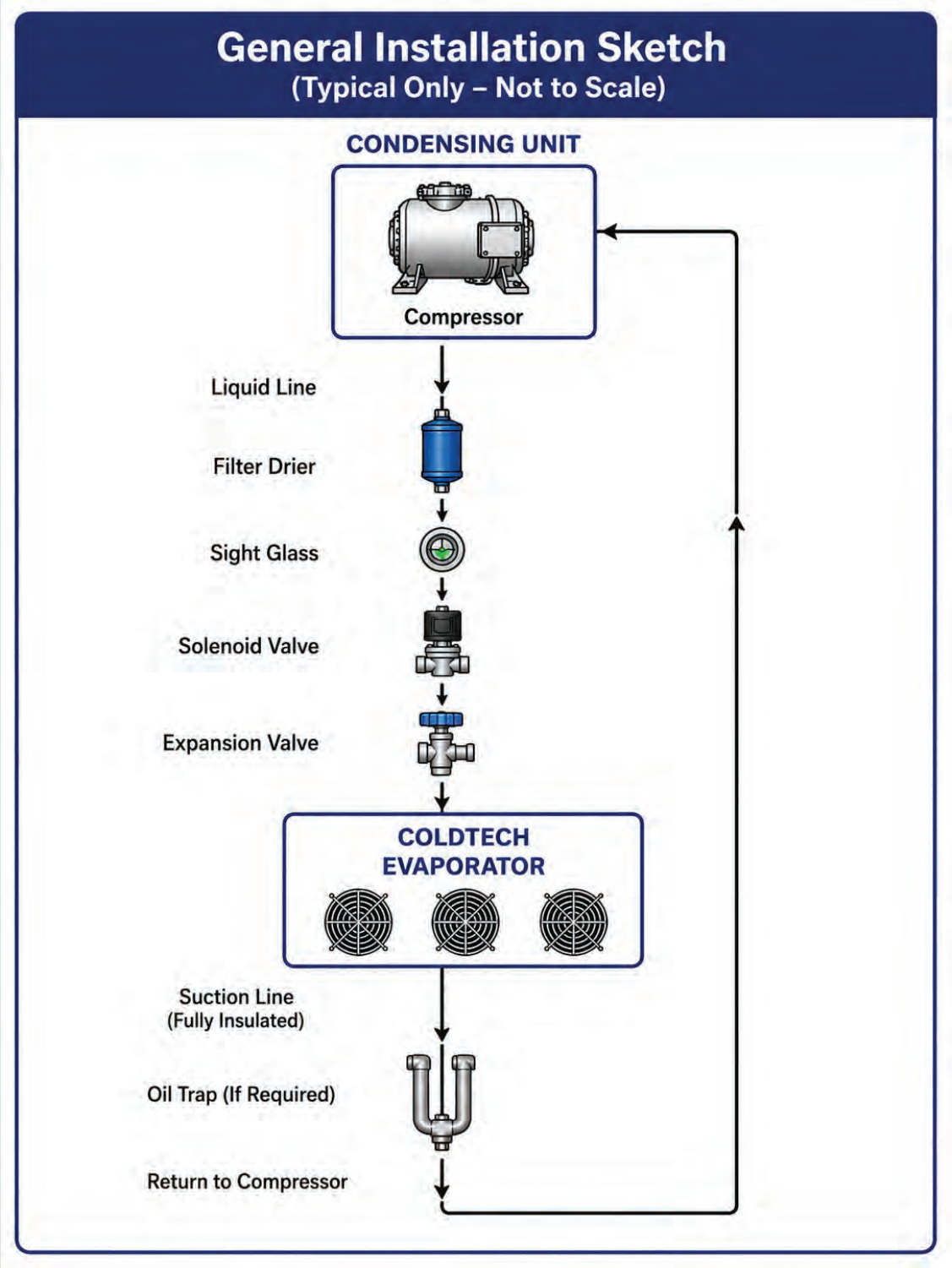
- Prevent pipe sagging.
- Minimize vibration transmission.
- Avoid excessive stress on evaporator connections.
- Allow for normal thermal expansion and contraction.
- Refrigerant piping shall never impose mechanical loads on the evaporator connections.

8.7 Leak Prevention

Before insulation and commissioning:

- Verify that all brazed joints are complete.
- Check refrigerant connections for correct alignment.
- Ensure all service valves are properly tightened.
- Pressure-test the system using dry nitrogen before vacuum evacuation.
- Any detected leaks shall be repaired and the system retested before refrigerant charging.

8.8 General Installation Sketch (Typical Only – Not to Scale)



Note: This sketch illustrates a typical refrigeration piping arrangement for reference only. Actual pipe sizes, routing, oil traps, valves, and accessories shall be determined by the approved refrigeration design and project-specific engineering drawings.

Important Notice

Proper refrigerant piping installation is critical for achieving reliable system performance and compressor longevity. All refrigerant piping shall be clean, leak-free, properly supported, correctly insulated, and installed in accordance with recognized refrigeration engineering standards. ColdTech recommends that all piping work be completed by qualified refrigeration technicians and verified before the system is commissioned.

9. TXV Installation

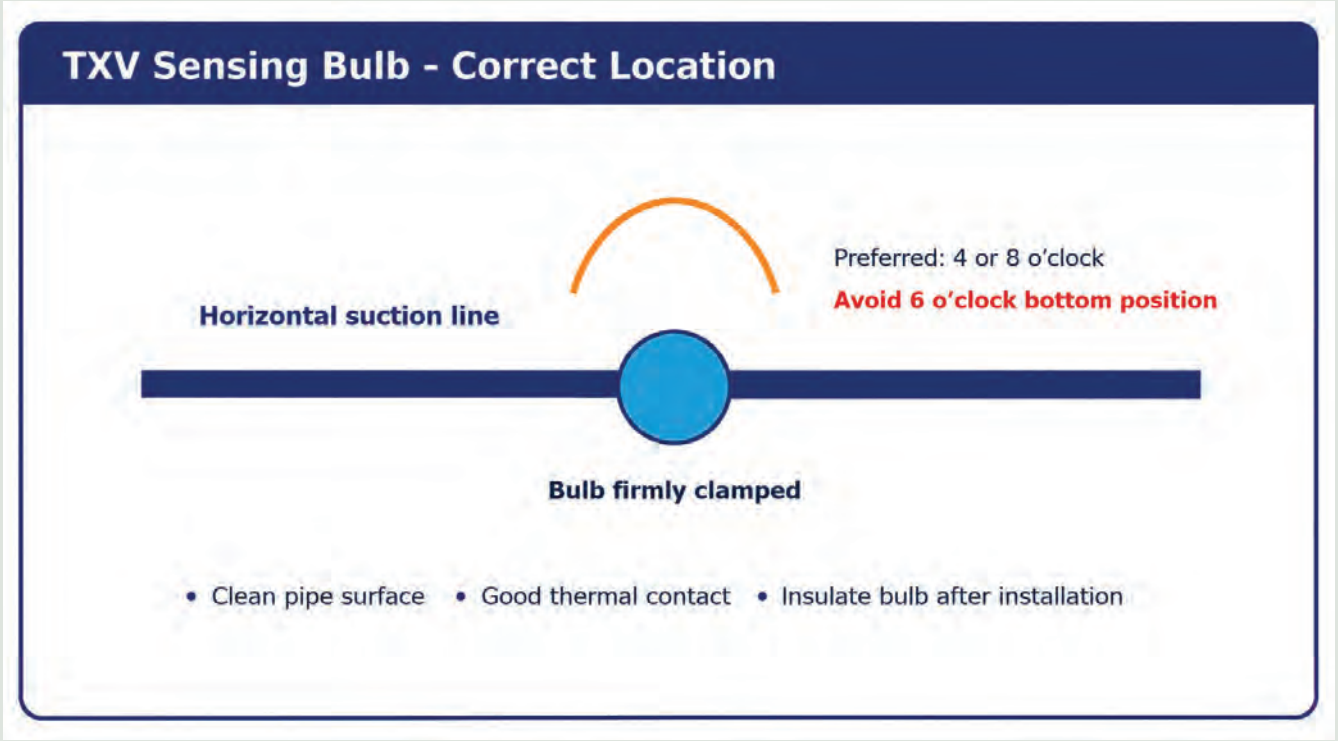


Figure - Typical arrangement for guidance only; not to scale.

Mount the external equalizer correctly. Position the sensing bulb at the 4 or 8 o'clock position on horizontal suction lines and insulate the bulb.

9.1 General

The Thermostatic Expansion Valve (TXV) is a critical component of the refrigeration system, regulating the flow of liquid refrigerant into the evaporator while maintaining the correct superheat at the evaporator outlet. Proper installation of the TXV is essential to achieve optimum cooling performance, stable system operation, and reliable compressor protection.

Incorrect installation of the expansion valve, sensing bulb, or external equalizer may result in improper superheat control, evaporator flooding, reduced cooling capacity, excessive compressor discharge temperatures, or liquid refrigerant returning to the compressor (liquid slugging).

All TXV installation work shall be carried out by qualified refrigeration technicians in accordance with the valve manufacturer's recommendations and accepted refrigeration engineering practices.

9.2 Expansion Valve Installation

The expansion valve shall be installed in the liquid line immediately upstream of the evaporator distributor. The valve body shall be installed in the direction of refrigerant flow, as indicated by the flow arrow marked on the valve.

During installation:

- Ensure the refrigerant circuit is clean and free from moisture or contaminants.
- Protect the valve body from excessive heat during brazing.

- Use wet cloths or approved heat protection materials when brazing near the valve.
- Install a filter drier upstream of the TXV to prevent contamination.
- Do not apply mechanical stress to the valve body or distributor connections.
- After installation, verify that all joints are leak-free before pressure testing.

9.3 External Equalizer Connection

Where an externally equalized TXV is used, the equalizer line shall be connected to the suction line at the evaporator outlet after the sensing bulb location.

The external equalizer should:

- Be connected to a clean section of the suction line.
- Be installed on the side or top of the suction pipe.
- Never be connected upstream of the sensing bulb.
- Be protected from vibration and mechanical damage.
- Remain free from oil traps or restrictions.

An incorrectly installed equalizer line may result in unstable superheat control and poor evaporator performance.

9.4 Sensing Bulb Installation

Correct installation of the sensing bulb is essential for accurate superheat control.

The sensing bulb shall be firmly clamped to a clean horizontal section of the suction line as close as practical to the evaporator outlet.

For horizontal suction lines, position the bulb at:

- 4 o'clock position, or
- 8 o'clock position

These locations provide the most accurate sensing of suction gas temperature while minimizing the influence of oil flowing along the bottom of the pipe.

Do not install the sensing bulb:

- At the 6 o'clock position (bottom of the pipe).
- At the 12 o'clock position (top of the pipe on large diameter lines).

On vertical suction risers unless specifically recommended by the valve manufacturer.

Near pipe elbows, oil traps, or fittings.

On damaged or dirty pipe surfaces.

The bulb clamp shall provide firm and continuous contact between the bulb and the copper pipe without crushing the tubing.

9.5 Bulb Insulation

After the sensing bulb has been securely installed, it shall be insulated using closed-cell insulation to protect it from the surrounding air.

Proper insulation:

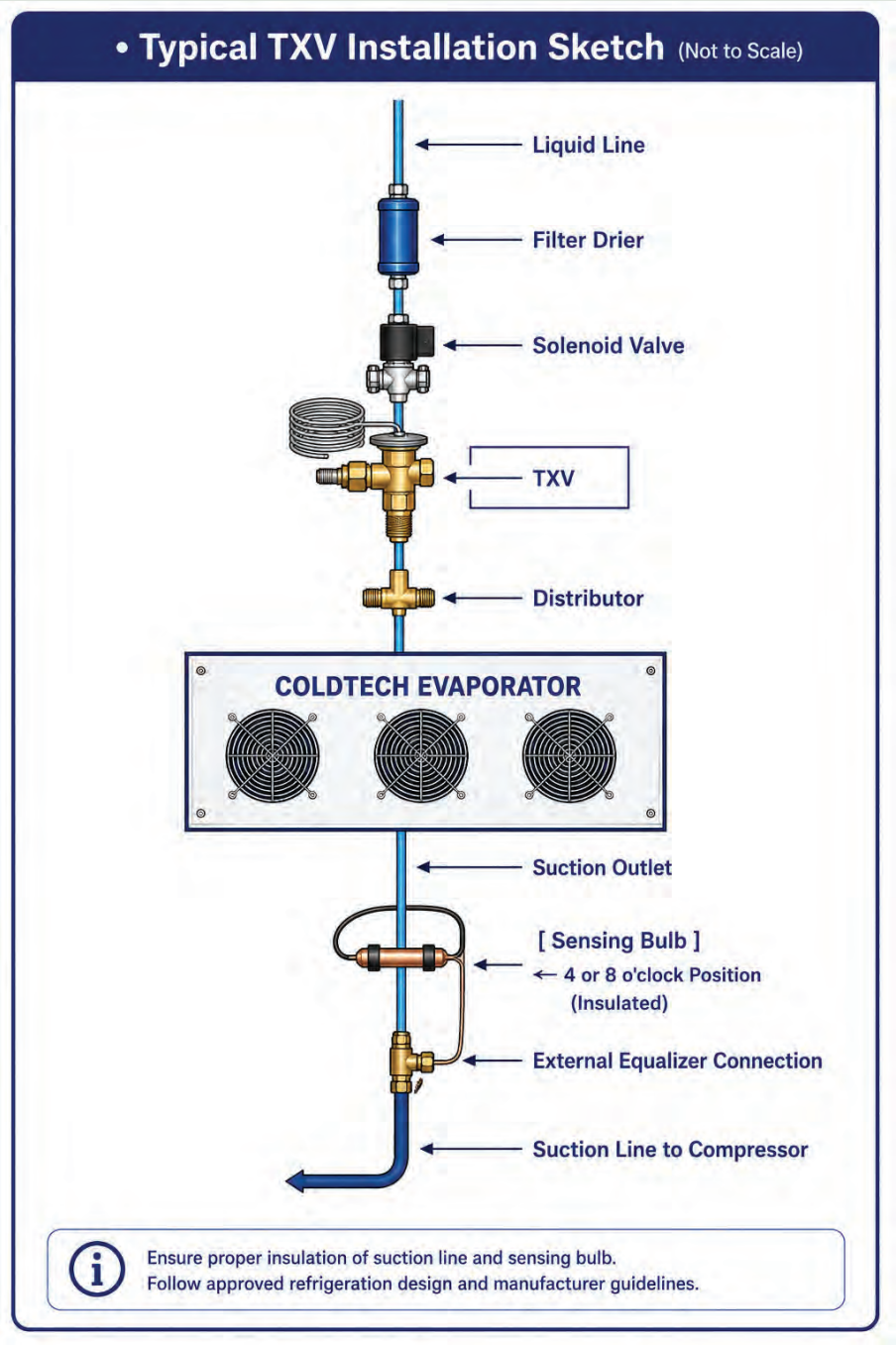
- Prevents false temperature readings.
- Improves superheat stability.
- Prevents condensation on the bulb.
- Ensures accurate valve operation.

Only the sensing bulb shall be insulated. Do not insulate the valve body unless specifically recommended by the valve manufacturer.

9.6 Final Inspection

Before commissioning the refrigeration system, verify the following:

- TXV is installed in the correct direction of refrigerant flow.
- Distributor connections are secure.
- External equalizer is correctly connected.
- Sensing bulb is tightly clamped.
- Bulb is positioned at the 4 o'clock or 8 o'clock position on horizontal suction lines.
- Bulb insulation is properly installed.
- All refrigerant joints have been leak tested.
- Refrigerant piping is adequately supported.



Note: This illustration is for general guidance only. The actual installation arrangement may vary depending on the evaporator model, expansion valve manufacturer, refrigerant type, and project-specific design requirements.

Important Notice

Correct installation of the Thermostatic Expansion Valve is vital for maintaining proper refrigerant flow and stable superheat control. Improper positioning of the sensing bulb, incorrect equalizer connection, or poor insulation can significantly reduce system performance and may lead to compressor damage. ColdTech recommends that all TXV installation and adjustment be carried out by qualified refrigeration technicians in accordance with this manual, the approved refrigeration design, and the expansion valve manufacturer's installation instructions.

10. Solenoid Valve

Install the liquid-line solenoid upstream of the expansion valve. Observe flow direction and wire through the controller.

10.1 General

The liquid line solenoid valve is an electrically operated shut-off valve used to control the flow of liquid refrigerant to the evaporator. It is an essential component in refrigeration systems utilizing pump-down control, temperature regulation, and automatic system operation. When energized, the solenoid valve opens to allow refrigerant to flow to the expansion valve. When de-energized, the valve closes, preventing refrigerant from entering the evaporator.

Correct installation of the solenoid valve is essential for reliable system operation, proper pump-down sequence, and compressor protection. Incorrect installation may result in refrigerant migration, poor temperature control, liquid hammer, or compressor damage.

All installation work shall be performed by qualified refrigeration technicians in accordance with the valve manufacturer's instructions and recognized refrigeration engineering practices.

10.2 Installation Location

The liquid line solenoid valve shall be installed in the liquid refrigerant line upstream of the Thermostatic Expansion Valve (TXV) and as close as practical to the evaporator.

The recommended piping sequence is:

- Receiver → Filter Drier → Sight Glass → Solenoid Valve → TXV → Evaporator

Installing the valve in this position ensures accurate refrigerant control and proper operation of the refrigeration system during normal cooling and pump-down cycles.

Do not install the solenoid valve in the suction line or downstream of the expansion valve.

10.3 Flow Direction

Before installation, verify the flow direction arrow marked on the valve body.

The valve shall always be installed with the refrigerant flowing in the direction indicated by the manufacturer.

Incorrect installation may result in:

- Restricted refrigerant flow.
- Failure of the valve to open or close correctly.
- Excessive pressure drop.
- Reduced cooling capacity.
- Premature valve failure.

After installation, visually confirm that the flow direction matches the refrigeration piping layout.

10.4 Brazing and Piping

When brazing refrigerant connections:

- Purge the piping continuously with dry nitrogen to prevent internal oxidation.
- Protect the solenoid coil from excessive heat by removing the coil where recommended by the manufacturer or by using suitable heat protection.
- Avoid overheating the valve body during brazing.
- Allow the valve to cool naturally before reassembling the electrical coil.
- Ensure that refrigerant piping is properly supported so that no mechanical stress is transferred to the valve body.

10.5 Electrical Wiring

The solenoid valve coil shall be wired through the refrigeration controller, thermostat, or electronic control panel in accordance with the approved electrical wiring diagram.

Before energizing the valve:

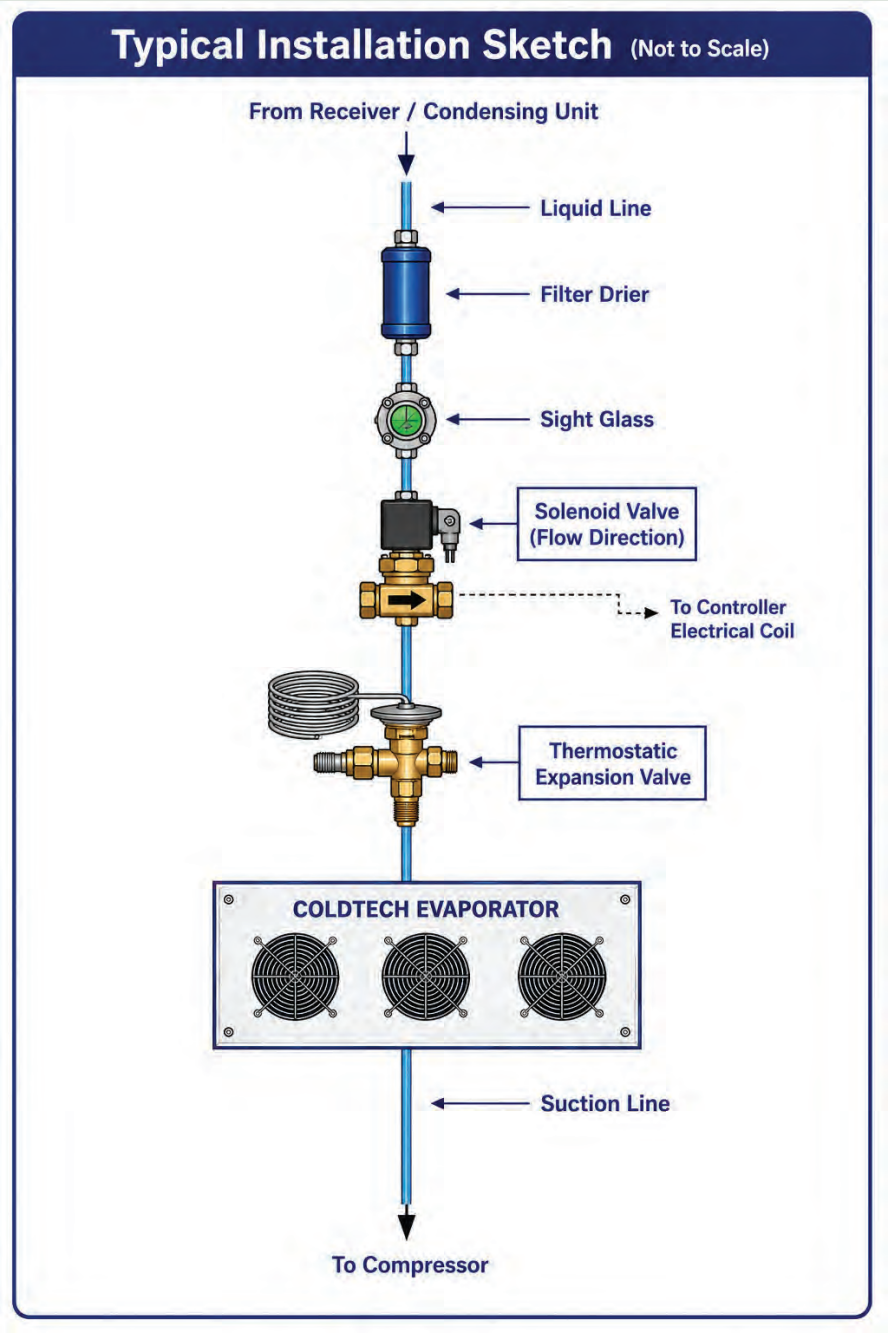
- Verify the correct supply voltage and frequency.
- Ensure all electrical connections are secure.
- Confirm that cable glands are properly tightened.
- Protect wiring from moisture, vibration, and mechanical damage.
- Ensure proper earthing (grounding) where applicable.

The electrical coil should remain easily accessible for inspection and replacement during maintenance.

10.6 Final Inspection

Before commissioning the refrigeration system, verify the following:

- Solenoid valve is installed in the liquid line upstream of the TXV.
- Refrigerant flow direction matches the arrow on the valve body.
- Brazed joints are leak-free.
- Valve body is adequately supported.
- Electrical wiring complies with the approved control diagram.
- Coil voltage matches the specified electrical supply.
- Valve opens and closes correctly during controller operation.
- Refrigerant piping is properly insulated where required.



Note: This illustration is for typical installation guidance only and is not to scale. Actual piping arrangements may vary depending on the refrigeration system design, refrigerant type, valve manufacturer, and project-specific requirements.

Important Notice

The liquid line solenoid valve plays a critical role in refrigerant flow control and pump-down operation. Incorrect installation, reverse flow orientation, improper wiring, or inadequate support may result in valve malfunction, refrigerant migration, unstable temperature control, or compressor damage. ColdTech recommends that all solenoid valves be installed, wired, tested, and commissioned by qualified refrigeration technicians in accordance with this manual, the approved project drawings, and the valve manufacturer's installation instructions.

11. Drain Piping

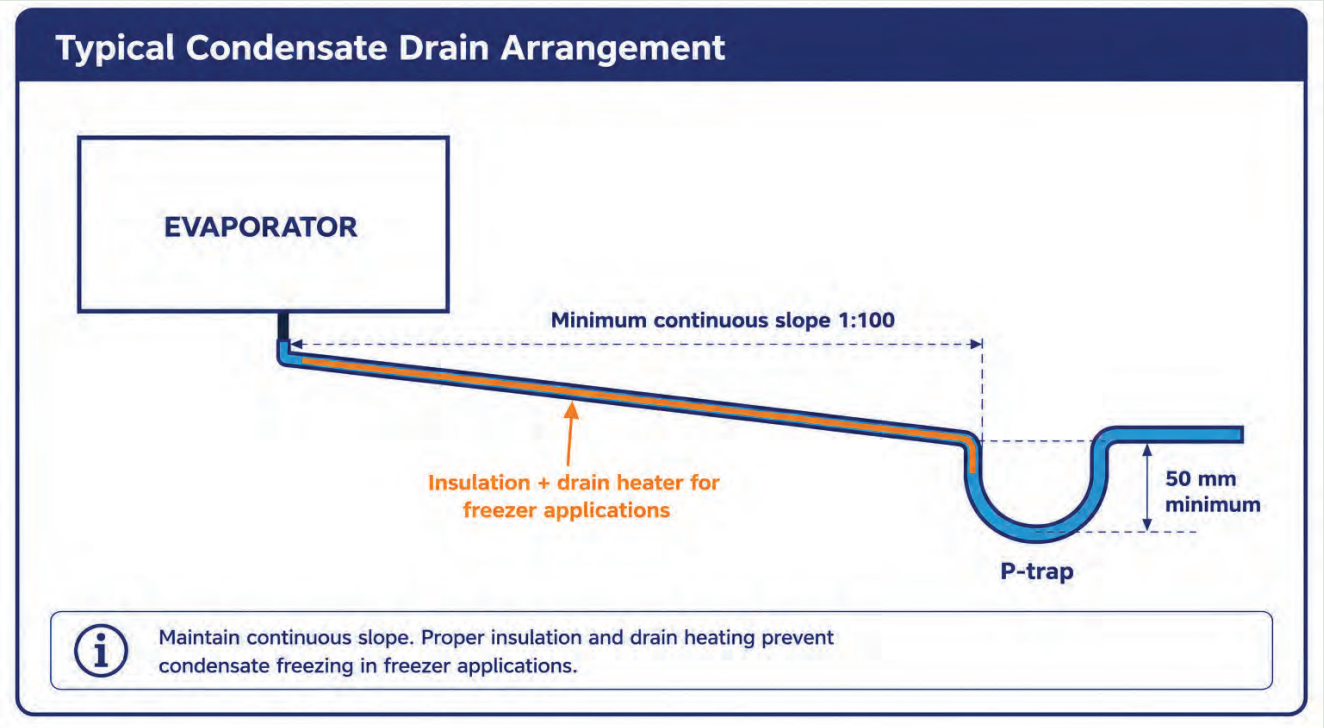


Figure - Typical arrangement for guidance only; not to scale.

Provide a continuous slope of at least 1:100. Install a P-trap and insulate drain lines. Fit drain heaters for freezer applications.

11.1 General

A properly designed and installed condensate drain system is essential for the reliable operation of ColdTech evaporators. During normal refrigeration operation and defrost cycles, condensate water produced by the evaporator must be removed efficiently to prevent water accumulation, ice formation, and potential damage to stored products or building structures.

Improper drain piping installation may result in water overflow, blocked drainage, freezing inside the drain line, excessive frost formation, unpleasant odors, or water leakage into the cold room. All drain piping shall be installed in accordance with recognized refrigeration engineering practices and local plumbing regulations.

11.2 Drain Pipe Installation

The condensate drain shall be connected directly to the evaporator drain outlet using suitable corrosion-resistant piping.

The drain line shall:

- Be adequately supported throughout its length.
- Be routed using the shortest practical path.
- Be protected from mechanical damage.
- Be accessible for future inspection and cleaning.
- Discharge into an approved floor drain or drainage system.

Drain pipe diameter shall not be smaller than the evaporator drain connection unless specifically approved by the system designer.

11.3 Drain Pipe Slope

To ensure reliable condensate removal, the drain line shall be installed with a continuous downward slope of not less than 1:100 (1%) from the evaporator to the discharge point.

The drain pipe shall:

- Maintain a constant downward gradient.
- Avoid horizontal sections where water may collect.
- Avoid reverse slopes or low points.
- Be securely supported to prevent pipe sagging.

Standing water inside the drain pipe may cause bacterial growth, unpleasant odors, freezing, and drainage failure.

11.4 P-Trap Installation

A properly sized P-trap shall be installed in the condensate drain line to prevent warm air infiltration through the drain piping and to ensure proper drainage.

The P-trap should be:

- Installed as close as practical to the evaporator drain outlet.
- Filled with water before system start-up where applicable.
- Easily accessible for cleaning and maintenance.

Where multiple evaporators are installed, each unit should be provided with its own dedicated P-trap unless otherwise specified by the project design.

11.5 Drain Line Insulation

Drain piping located within refrigerated spaces or exposed to ambient conditions shall be insulated using closed-cell insulation to prevent external condensation and reduce the possibility of freezing.

Ensure that:

- Insulation completely covers the drain pipe.
- All insulation joints are sealed.
- Damaged insulation is repaired before commissioning.
- Outdoor insulation is protected against weather and UV exposure where applicable.

Proper insulation improves system reliability and minimizes maintenance requirements.

11.6 Drain Heaters for Freezer Applications

For freezer applications operating below 0°C, the drain line shall be fitted with an electric drain heater to prevent condensate from freezing inside the drain pan and drain piping.

The drain heater should:

- Extend from the evaporator drain pan into the drain pipe for the recommended distance.

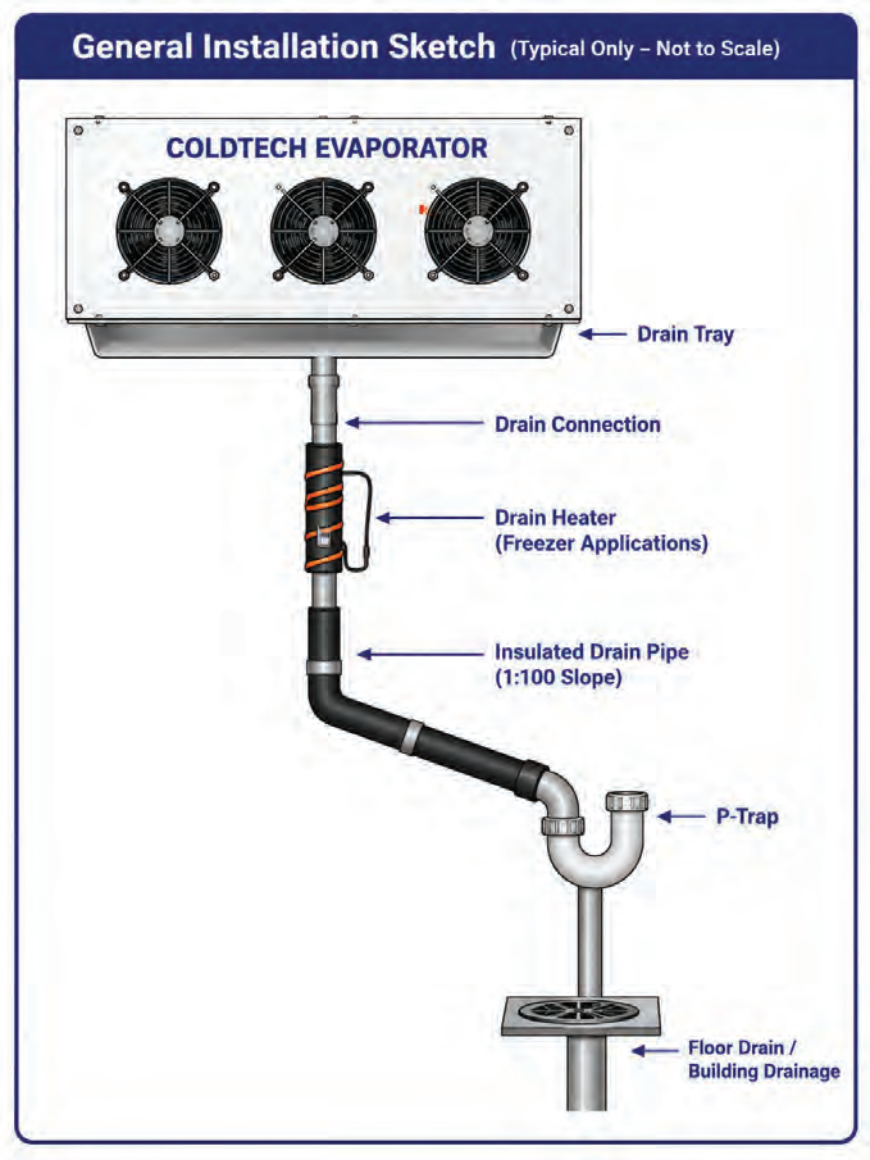
- Be securely fixed to maintain effective heat transfer.
- Be connected through the evaporator defrost control circuit or as specified by the electrical design.
- Be electrically protected in accordance with local electrical regulations.

Failure to install an adequate drain heater may result in blocked drains, ice accumulation, water overflow, and damage to the evaporator.

11.7 Final Inspection

Before commissioning the refrigeration system, verify the following:

- Drain pipe is securely connected to the evaporator.
- Continuous downward slope of minimum 1:100 is maintained.
- P-trap is correctly installed.
- Drain line is properly insulated.
- Drain heater is installed for freezer applications.
- Drain water flows freely without obstruction.
- No water remains in the drain tray after testing.
- Drain piping is adequately supported throughout its length.



Note: The above illustration is for general installation guidance only and is not to scale. Actual drain piping arrangements may vary depending on the evaporator model, room layout, drain location, and project-specific design requirements.

Important Notice

Correct installation of the condensate drain system is essential for reliable refrigeration operation. An improperly sloped drain line, missing P-trap, inadequate insulation, or absence of a drain heater in freezer applications may result in water leakage, ice formation, blocked drains, and equipment malfunction. ColdTech recommends that all condensate drain piping be installed, tested, and commissioned by qualified personnel in accordance with this manual, approved project drawings, and applicable local plumbing and refrigeration standards.

12. Electrical Wiring

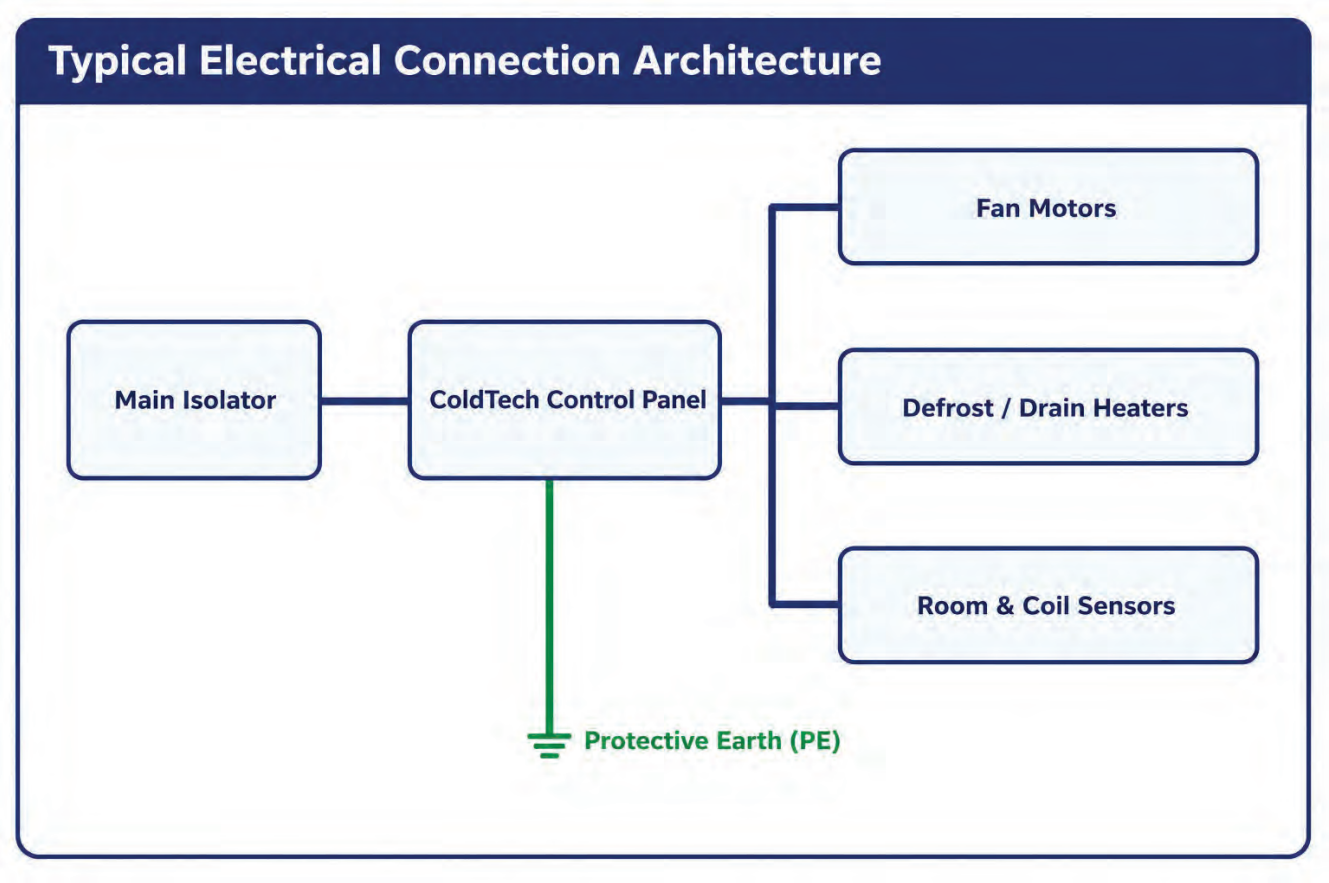


Figure - Typical arrangement for guidance only; not to scale.

Confirm supply voltage and phase. Connect fan motors, heaters, sensors and earth in accordance with the wiring diagram supplied with the unit.

12.1 General

Proper electrical wiring is essential for the safe and reliable operation of ColdTech evaporators. All electrical work shall be carried out by qualified electricians or refrigeration technicians in accordance with the approved wiring diagram supplied with the unit, local electrical regulations, and applicable international standards.

Before commencing any electrical work, ensure that the power supply is isolated and locked out to prevent accidental energization. Failure to follow proper electrical installation procedures may result in equipment damage, electrical shock, fire hazards, or personal injury.

Each ColdTech evaporator is supplied with a dedicated wiring diagram identifying all electrical components, terminals, cable sizes, and control connections. The wiring diagram shall always take precedence over general installation guidance.

12.2 Power Supply Verification

Before connecting the evaporator, verify that the site electrical supply matches the equipment nameplate and wiring diagram.

Confirm the following:

- Supply voltage.
- Number of phases (Single Phase or Three Phase).
- Supply frequency (50 Hz or 60 Hz).
- Available circuit protection.
- Cable size and current carrying capacity.
- Correct phase sequence for three-phase fan motors where applicable.

Operation with incorrect voltage or frequency may result in overheating, reduced motor life, poor performance, or equipment failure.

12.3 Electrical Connections

All electrical cables shall be installed using approved cable glands, conduits, or cable trays to protect against moisture, mechanical damage, and vibration.

Connect the following components in accordance with the supplied wiring diagram:

- Fan motor(s).
- Electric defrost heater(s) (where fitted).
- Drain heater(s) (freezer models).
- Temperature sensor(s).
- Defrost termination sensor(s).
- Room temperature controller.
- Terminal block connections.
- Protective earth (ground).

Ensure that all terminals are securely tightened and that no exposed conductors remain after installation.

12.4 Earthing (Grounding)

Every ColdTech evaporator shall be connected to a reliable protective earth (PE) before the power supply is energized.

Proper grounding:

- Protects personnel from electric shock.
- Reduces the risk of electrical faults.
- Improves equipment safety.
- Assists in correct operation of electrical protection devices.
- Never operate the evaporator without an effective earth connection.

12.5 Cable Routing

Electrical cables shall be routed separately from refrigerant piping wherever practical.

During cable installation:

- Avoid sharp bends.
- Protect cables from hot surfaces.
- Prevent contact with rotating fan blades.
- Secure cables using approved cable ties or clamps.
- Maintain sufficient clearance from defrost heaters and moving parts.
- Damaged cable insulation shall be repaired or replaced before commissioning.

12.6 Functional Verification

After completing the electrical installation, perform the following checks before energizing the equipment:

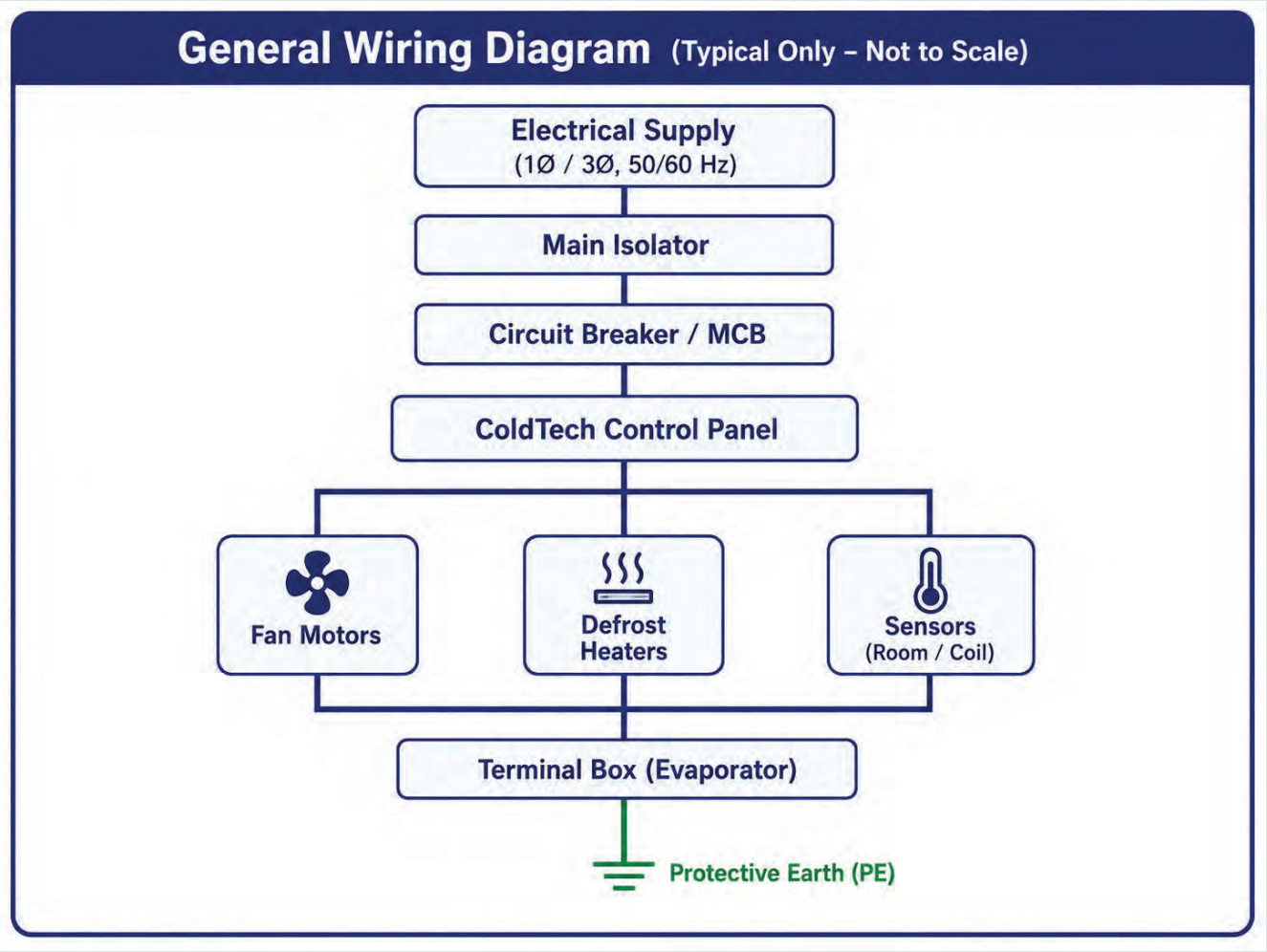
- Verify supply voltage and phase.
- Confirm correct motor rotation (where applicable).
- Check continuity of the protective earth.
- Verify all sensors are correctly connected.
- Confirm heater wiring is secure.
- Tighten all terminal connections.
- Inspect cable routing and cable gland sealing.
- Verify controller operation in accordance with the control sequence.

The evaporator shall not be commissioned until all electrical inspections have been successfully completed.

12.7 Final Inspection

Before placing the unit into service, verify the following:

- Supply voltage and frequency match the equipment nameplate.
- Correct phase sequence has been verified.
- Fan motors are correctly wired.
- Defrost heaters and drain heaters are properly connected.
- Temperature and defrost sensors are installed.
- Protective earth (PE) connection is complete.
- Terminal screws are securely tightened.
- Cable glands are sealed against moisture ingress.
- Wiring complies with the supplied electrical schematic.



Note: This diagram is for general installation guidance only and is not to scale. Always refer to the specific electrical wiring diagram supplied with the ColdTech evaporator, as wiring configurations may vary depending on the model, motor arrangement, defrost system, operating voltage, and customer specifications.

Important Notice

Incorrect electrical installation may result in equipment malfunction, electrical hazards, or permanent damage to the evaporator. ColdTech recommends that all electrical wiring, testing, and commissioning be carried out only by qualified personnel in accordance with the wiring diagram supplied with the unit, applicable electrical codes, and local regulations. The equipment shall not be energized until all electrical connections have been inspected, tested, and approved.

13. Defrost Systems

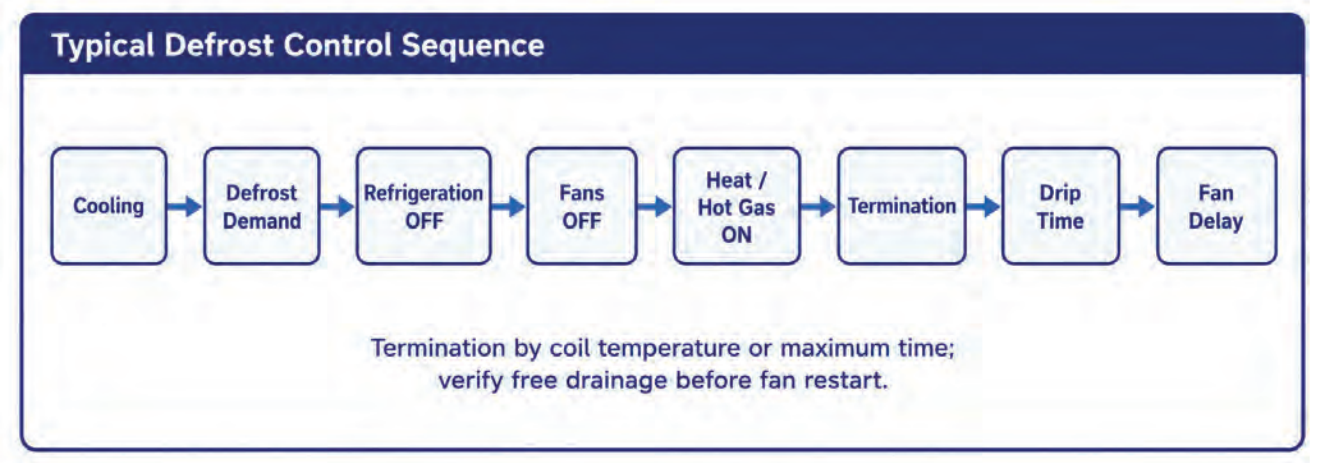


Figure - Typical arrangement for guidance only; not to scale.

ColdTech units support off-cycle, electric or hot-gas defrost depending on model. Set defrost intervals, termination temperature and fan delay in the controller.

13.1 General

Frost forms on the evaporator coil whenever moisture in the room air freezes on the coil surface. Excessive frost restricts airflow, reduces heat transfer, increases fan energy consumption, and may prevent the evaporator from achieving the required room temperature.

ColdTech evaporators may be designed for off-cycle, electric, or hot-gas defrost, depending on the evaporator model, room temperature, refrigerant system, and project requirements. The applicable defrost method and electrical arrangement shall be confirmed from the unit nameplate, approved drawings, and wiring diagram supplied with the equipment.

The defrost controller shall be programmed to suit the application. Incorrect defrost settings may cause incomplete ice removal, excessive room-temperature rise, unnecessary energy consumption, or damage to the coil, heaters, fans, and stored products.

13.2 Off-Cycle Defrost

Off-cycle defrost is generally used for medium-temperature applications where the room operates above freezing.

During off-cycle defrost:

- The compressor or liquid-line solenoid valve stops refrigerant flow to the evaporator.
- The evaporator fans may continue operating, depending on the control sequence.
- Room air passes across the coil and melts the frost naturally.
- Normal refrigeration resumes after the programmed defrost period.

Off-cycle defrost is not normally suitable for low-temperature freezer applications because the surrounding air temperature may be insufficient to melt accumulated ice.

13.3 Electric Defrost

Electric defrost is commonly used for freezer applications. Electric heaters are installed within or around the evaporator coil and, where applicable, beneath the drain tray.

During electric defrost:

- Refrigeration is stopped.
- Evaporator fans are switched off.
- Electric defrost heaters are energized.
- Frost and ice melt from the coil.
- Defrost terminates by temperature or maximum time.
- A drip time allows meltwater to drain.
- Fans restart after the coil temperature has reduced sufficiently.

The heater supply voltage and electrical load shall match the unit wiring diagram. All heaters must be protected by correctly rated contactors, circuit breakers, overload protection, and earth-leakage protection where required.

Do not energize electric defrost heaters while the evaporator fans are operating unless specifically required by the approved control sequence.

13.4 Hot-Gas Defrost

Hot-gas defrost uses high-temperature compressor discharge gas to heat the evaporator coil and remove accumulated frost. This method is generally applied to industrial or centralized refrigeration systems designed specifically for hot-gas operation.

A typical hot-gas defrost sequence may include:

- Closing the liquid-line solenoid valve.
- Pumping down or isolating the evaporator.
- Stopping the evaporator fans.
- Opening the hot-gas valve.
- Controlling evaporator pressure during defrost.
- Terminating defrost by temperature or time.
- Allowing pressure equalization and drainage.
- Returning the evaporator gradually to refrigeration operation.

Hot-gas defrost piping, valves, regulators, check valves, and control logic shall be designed by a qualified refrigeration engineer. Incorrect sequencing may cause hydraulic shock, excessive pressure, refrigerant migration, or compressor damage.

13.5 Controller Settings

The following defrost parameters shall be programmed in the refrigeration controller:

- Defrost Frequency
- Set the number of defrost cycles according to:
- Room operating temperature.
- Door-opening frequency.
- Product moisture load.
- Air infiltration.

- Coil frost accumulation.
- Operating hours.

Defrost should occur only as often as necessary to maintain a clean coil and unrestricted airflow. Excessive defrost increases energy consumption and room-temperature fluctuations, while insufficient defrost causes coil blockage.

- **Maximum Defrost Duration**

Set a maximum defrost time as a safety limit. The defrost cycle should normally terminate by coil temperature before this time expires.

- **Defrost Termination Temperature**

Install the defrost termination sensor securely at the designated location on the evaporator coil. The sensor shall detect when the coil is sufficiently free from ice and stop the defrost cycle.

The termination temperature shall be selected according to the evaporator design and controller settings. Excessively low settings may cause incomplete defrost, while excessively high settings may overheat the evaporator and increase room temperature.

- **Drip Time**

After defrost termination, provide a short drip period before refrigeration and fan operation resume. This allows melted frost to drain from the coil and drain tray.

- **Fan Delay**

The evaporator fans shall remain off after defrost until the coil temperature has reduced to the programmed fan-start temperature or the fan-delay timer has expired.

Correct fan delay prevents:

- Warm air from being discharged into the refrigerated room.
- Water droplets being blown from the coil.
- Moisture refreezing on products or room surfaces.
- Unnecessary room-temperature rise.

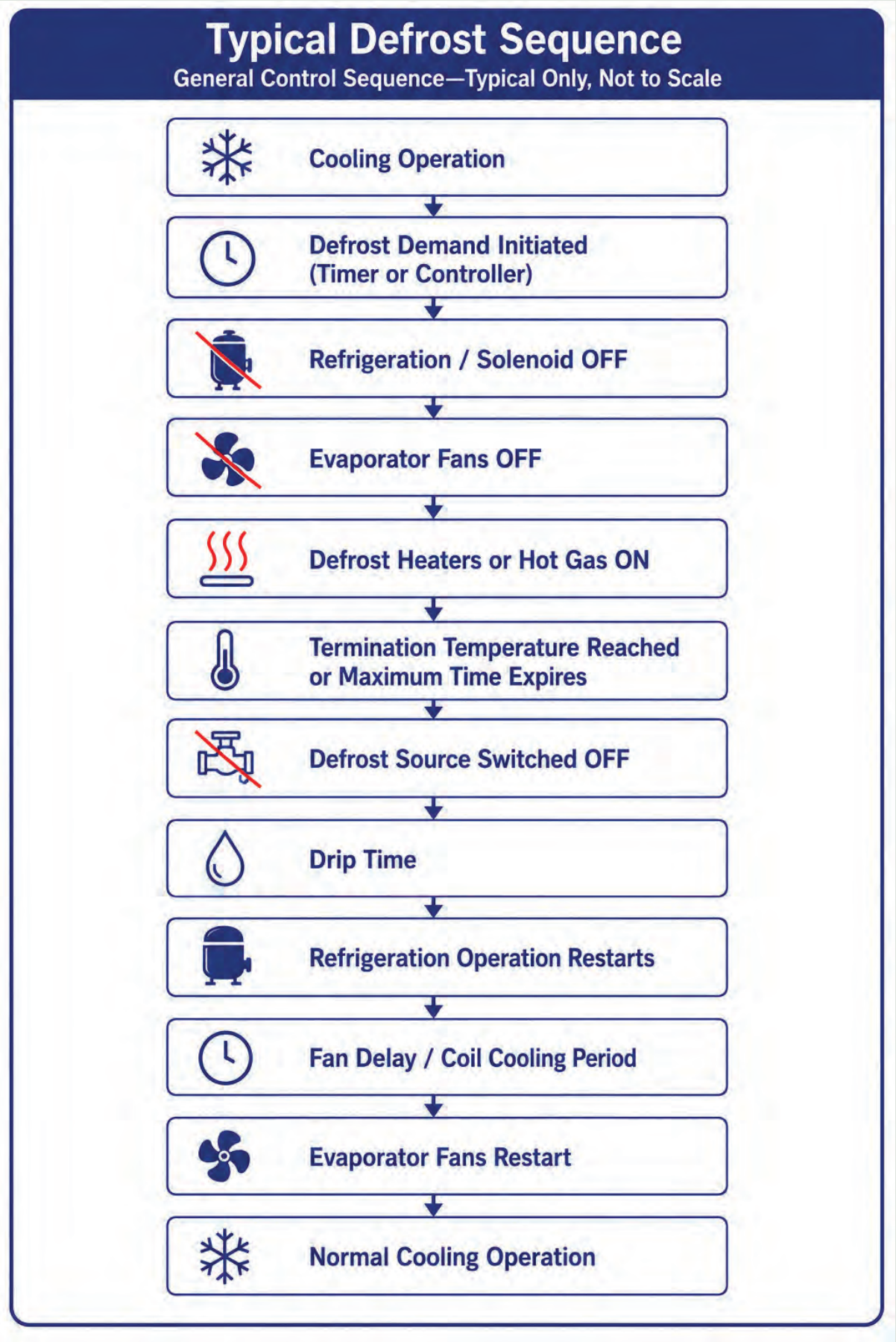
13.6 Drainage During Defrost

Verify that the drain tray, drain connection, P-trap, insulation, and drain heater are operating correctly before enabling defrost.

For freezer applications:

- The drain heater shall operate during the defrost cycle where required.
- Meltwater shall flow freely from the drain tray.
- The drain line shall remain free from ice.
- The drain heater shall not contact plastic components unless approved for that installation.
- Blocked drainage may cause water overflow, ice formation around the fans, and damage to the evaporator.

13.7 Typical Defrost Sequence



The actual sequence shall follow the controller program, wiring diagram, and approved refrigeration design supplied for the project.

13.8 Final Inspection

Before commissioning, verify that:

- The selected defrost method matches the evaporator model.
- Defrost heaters are correctly connected and earthed.
- Hot-gas valves and controls are installed correctly where applicable.
- The termination sensor is securely positioned.
- Defrost frequency and maximum duration are programmed.
- Termination temperature is correctly set.
- Drip time and fan delay are enabled.
- Fans remain off during electric or hot-gas defrost.
- Drain heaters and drain piping operate correctly.
- The complete defrost sequence has been functionally tested.

Important Notice

Defrost settings shall be adjusted according to actual operating conditions. Settings that are suitable for one cold room may not be suitable for another room with a different temperature, humidity, door-opening frequency, or product load.

ColdTech recommends observing the evaporator during the initial operating period and optimizing the defrost frequency, termination temperature, drip time, and fan delay where necessary. Any adjustment shall be carried out by qualified personnel without exceeding the limits stated in the controller, heater, and evaporator documentation.

14. Pressure Testing & Vacuum

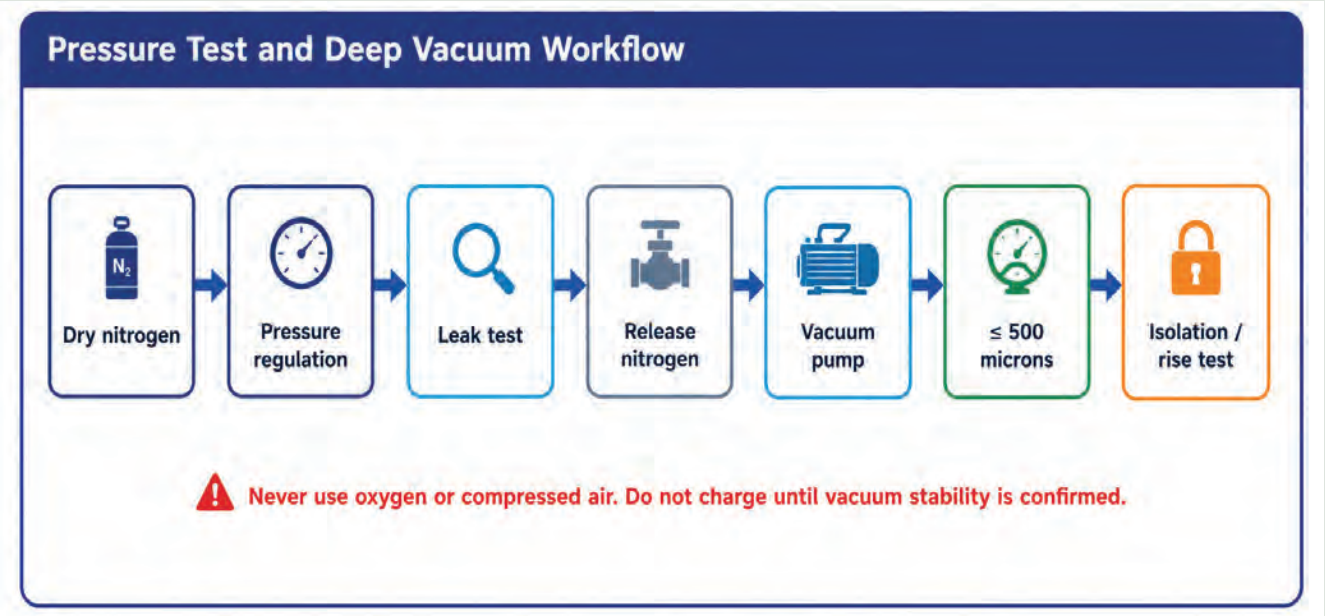


Figure - Typical arrangement for guidance only; not to scale.

Pressure-test with dry nitrogen only. Evacuate the system below 500 microns and verify vacuum stability before charging.

14.1 General

Pressure testing and evacuation are essential procedures before charging and commissioning the refrigeration system. Pressure testing confirms that the refrigerant circuit is mechanically sound and free from leaks, while evacuation removes air, moisture, and other non-condensable gases from the system.

All pressure testing and vacuum work shall be carried out by qualified refrigeration technicians using calibrated instruments and approved equipment. The maximum allowable test pressure stated on the evaporator nameplate, approved project documentation, and component manufacturer's instructions shall not be exceeded.

Never use oxygen, compressed air, refrigerant, or any combustible gas for pressure testing. Use dry, oxygen-free nitrogen only.

14.2 Preparation Before Pressure Testing

Before pressurizing the system, verify the following:

- All refrigerant piping and brazed joints are complete.
- Dry nitrogen was used during brazing.
- Service valves are positioned correctly.
- Expansion valves, solenoid valves, pressure controls, gauges, and other components are suitable for the test pressure.
- The system is isolated from components that must not be exposed to the selected pressure.
- Relief valves and safety devices are installed where required.

- Electrical power to the compressor, heaters, and fans is isolated.
- All pipe supports and brackets are secure.

The refrigeration circuit shall be visually inspected for damaged tubing, loose fittings, incomplete brazed joints, and improperly capped service connections.

14.3 Nitrogen Pressure Testing

The system shall be pressurized gradually using dry nitrogen through an approved pressure regulator.

Do not connect a nitrogen cylinder directly to the refrigeration system without a pressure regulator and suitable pressure-relief arrangement.

The recommended procedure is:

- Connect the nitrogen cylinder, regulator, manifold, and calibrated pressure gauges.
- Introduce nitrogen at a low initial pressure.
- Check all joints for major leaks.
- Increase the pressure gradually in controlled stages.
- Stabilize the system at the specified final test pressure.
- Isolate the nitrogen supply.
- Record the pressure, ambient temperature, and test start time.
- Maintain the test pressure for the specified test period.
- Inspect all joints and components for leakage.

The selected pressure shall comply with the approved refrigeration design and shall never exceed the lowest allowable pressure rating of any component within the test section.

14.4 Leak Detection

All brazed joints, flare connections, valve stems, service ports, distributor connections, and mechanical fittings shall be checked using an approved leak-detection method.

Acceptable methods include:

- Approved electronic leak detector.
- Refrigeration-grade bubble solution.
- Pressure decay monitoring.
- Other approved project-specific methods.
- Do not use an open flame for leak detection.
- Where leakage is identified:
- Safely release the nitrogen pressure.
- Repair the defective joint.
- Re-pressurize the system with dry nitrogen.
- Repeat the complete leak test.

The system shall not be evacuated until it has successfully passed the pressure test.

14.5 Nitrogen Removal

After the pressure test has been successfully completed, release the nitrogen slowly and safely through an approved discharge point.

Nitrogen shall not be released into confined or poorly ventilated spaces because it can displace oxygen and create an asphyxiation hazard.

Do not begin evacuation while positive nitrogen pressure remains within the system.

14.6 Vacuum Pump Connection

Use a correctly sized, clean, and well-maintained vacuum pump fitted with fresh vacuum pump oil. Connect the pump using short, large-diameter vacuum-rated hoses to reduce evacuation time and pressure drop.

Where practical:

- Remove Schrader valve cores using approved core-removal tools.
- Connect the vacuum pump to both high- and low-pressure sides.
- Use a dedicated micron gauge.
- Install the micron gauge as far as practical from the vacuum pump.
- Avoid relying only on the compound gauge of a standard manifold.

A manifold pressure gauge cannot accurately confirm a deep vacuum. Final evacuation shall be measured using a calibrated electronic micron gauge.

14.7 Evacuation Procedure

Evacuate the refrigeration system to a pressure of 500 microns or lower before charging.

The recommended procedure is:

- Connect the vacuum pump and micron gauge.
- Open all required service valves and evacuation connections.
- Start the vacuum pump.
- Continue evacuation until the system reaches 500 microns or below.
- Isolate the system from the vacuum pump.
- Stop the pump.
- Observe and record the vacuum rise.

For systems containing significant moisture, long piping runs, or large internal volumes, a triple-evacuation method may be required. This involves breaking the vacuum with dry nitrogen and repeating the evacuation process until the required vacuum and stability are achieved.

Never use refrigerant to break a vacuum during dehydration.

14.8 Vacuum Stability Test

After reaching the required vacuum level, isolate the vacuum pump and monitor the micron gauge.

The vacuum shall remain stable without a rapid pressure rise.

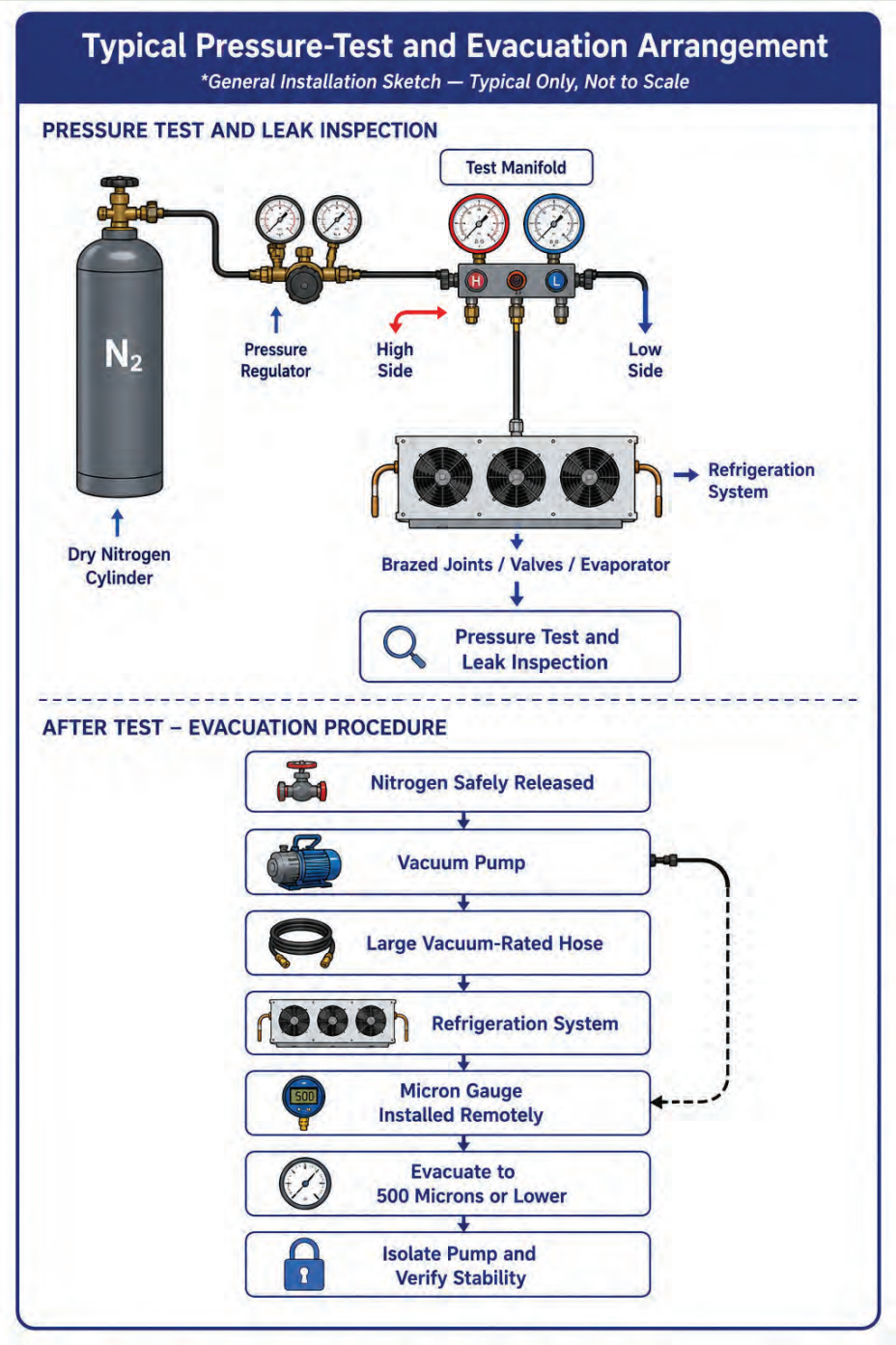
A rapid rise may indicate:

- Refrigerant leakage into the evacuated section.
- An external air leak.
- Moisture remaining within the system.
- Leaking service hoses or manifold connections.
- Closed or restricted sections not fully evacuated.

A slow rise that stabilizes may indicate moisture releasing from the piping or oil. Continue evacuation until the vacuum reaches the required level and remains stable for the specified test period.

Do not charge the system unless vacuum stability has been confirmed.

14.9 Typical Pressure-Test and Evacuation Arrangement



14.10 Final Inspection

Before charging the refrigeration system, verify that:

- Pressure testing was completed using dry nitrogen only.
- Test pressure did not exceed component ratings.
- All refrigerant joints were inspected for leakage.
- Identified leaks were repaired and retested.
- Nitrogen was safely released.
- Vacuum pump oil was clean and suitable.
- A calibrated micron gauge was used.
- The system reached 500 microns or below.
- The vacuum remained stable after isolation.
- Test pressure, test duration, final vacuum, and stability results were recorded.

Important Notice

Never energize the compressor while the system is under vacuum. Never use the compressor as a vacuum pump.

Moisture and non-condensable gases remaining inside the refrigeration system can cause corrosion, ice formation at the expansion device, high condensing pressure, oil deterioration, reduced cooling capacity, and compressor failure.

ColdTech recommends that pressure-test and evacuation records be included in the commissioning documentation. The refrigeration system shall not be charged or started until it has successfully passed both the nitrogen pressure test and vacuum stability test.

15. Refrigerant Charging

Charge liquid refrigerant by weight according to the condensing unit manufacturer. Verify superheat and subcooling after start-up.

15.1 General

Correct refrigerant charging is essential for achieving the designed cooling capacity, system efficiency, and compressor reliability. An incorrect refrigerant charge may result in poor performance, excessive energy consumption, unstable evaporator operation, compressor overheating, liquid floodback, or premature equipment failure.

Refrigerant charging shall only be carried out after the refrigeration system has successfully passed the pressure test and vacuum stability test described in the previous section.

Charging shall be performed by qualified refrigeration technicians using calibrated charging equipment and in accordance with the condensing unit manufacturer's instructions, the refrigerant manufacturer's recommendations, and the approved project documentation.

15.2 Refrigerant Selection

Only the refrigerant specified on the condensing unit nameplate shall be used.

Before charging, verify:

- Refrigerant type.
- Refrigerant grade.
- System compatibility.
- Compressor oil compatibility.
- Maximum refrigerant charge where applicable.

Never mix different refrigerants or use recovered refrigerant unless it has been reclaimed and certified in accordance with applicable regulations.

15.3 Charging Procedure

Following successful evacuation, the refrigeration system shall be charged using the specified refrigerant.

For systems using blended refrigerants such as R404A, R448A, R449A, R452A, R407 series, or similar zeotropic blends, refrigerant shall always be introduced as a liquid to prevent fractionation.

The recommended charging procedure is:

- Confirm the refrigeration system has achieved the required vacuum.
- Place the refrigerant cylinder on a calibrated electronic charging scale.
- Purge charging hoses to remove trapped air.
- Open the liquid charging valve gradually.
- Charge refrigerant into the liquid line or receiver, as recommended by the condensing unit manufacturer.
- Continue charging until the specified refrigerant weight has been introduced.

Where the entire refrigerant charge cannot be introduced before start-up, complete the remaining charge carefully during system operation in accordance with the condensing unit manufacturer's recommendations.

15.4 Charging by Weight

ColdTech recommends charging the refrigeration system by weight using a calibrated electronic charging scale.

The required refrigerant charge shall be determined by:

- Condensing unit manufacturer.
- Refrigeration system design.
- Refrigerant piping volume.
- Receiver capacity (if fitted).
- Evaporator and condenser internal volume.
- Do not estimate refrigerant charge using suction pressure or sight glass alone.
- Charging by weight provides the most accurate starting point for commissioning.

15.5 Initial Start-Up

After charging the specified refrigerant quantity:

- Energize the refrigeration system.
- Allow the system to stabilize under normal operating conditions.
- Observe compressor operation.
- Confirm normal oil return.
- Check suction and discharge pressures.
- Verify condenser fan operation.
- Confirm evaporator airflow.

Additional refrigerant adjustments shall only be made after stable operating conditions have been achieved.

15.6 System Performance Verification

After the refrigeration system has stabilized, verify the following operating conditions:

- **Superheat**

Measure suction line temperature at the evaporator outlet together with suction pressure.

Confirm that the operating superheat is within the limits recommended by the expansion valve and condensing unit manufacturer.

Incorrect superheat may indicate:

- Incorrect refrigerant charge.
- Improper TXV adjustment.

- Restricted refrigerant flow.
- Airflow problems.
- Moisture within the system.
- **Subcooling**

Measure liquid line temperature leaving the condenser together with condensing pressure.

Verify that the liquid subcooling is within the manufacturer's recommended operating range.

Insufficient subcooling may indicate:

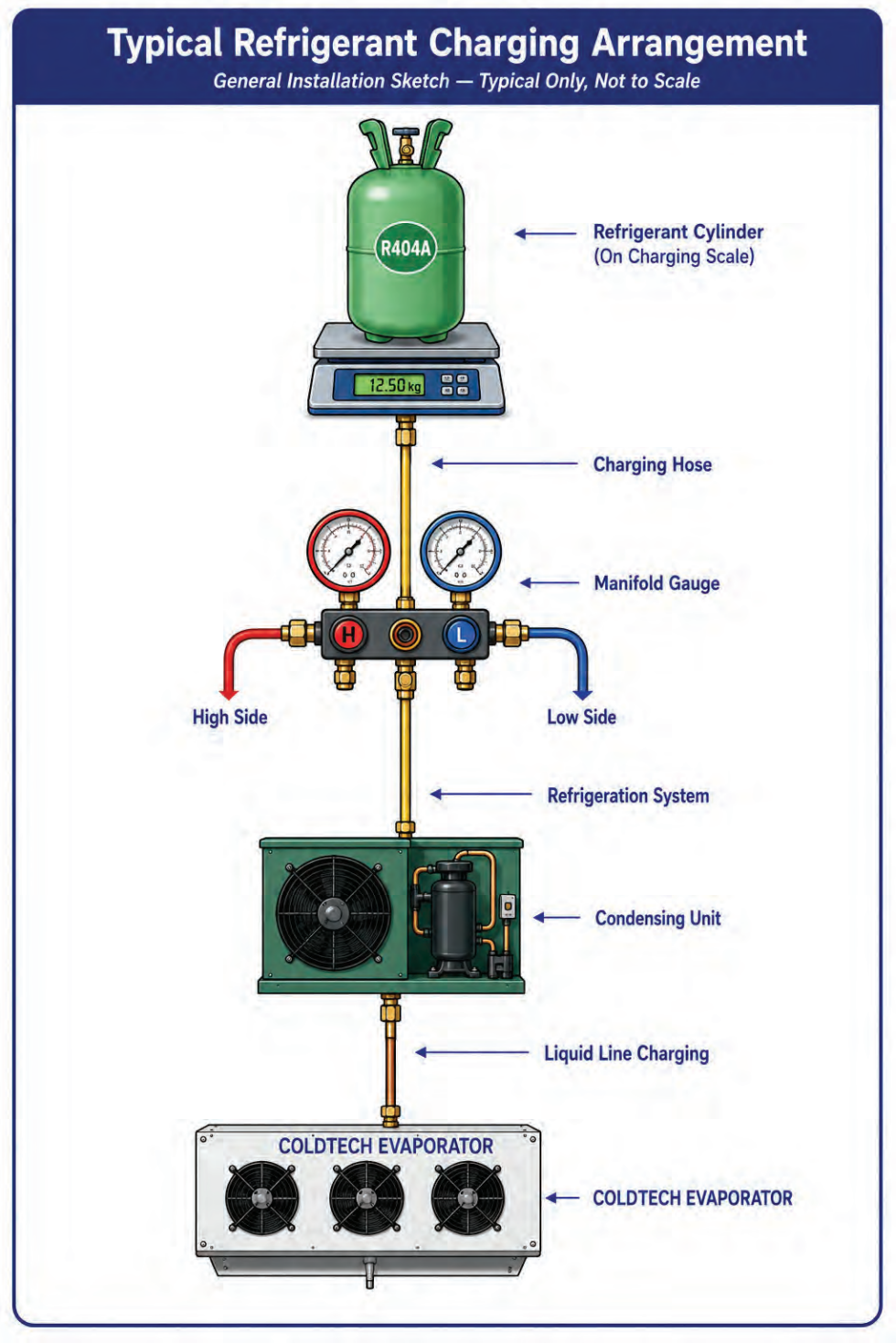
- Low refrigerant charge.
- Flash gas in the liquid line.
- High condenser load.
- Excessive subcooling may indicate:
- Refrigerant overcharge.
- Receiver overfilling.
- Condenser control issues.

15.7 Final Refrigerant Adjustment

If refrigerant adjustment is required:

- Add refrigerant slowly in small increments.
- Allow the system to stabilize after each adjustment.
- Recheck superheat and subcooling.
- Confirm stable suction and discharge pressures.
- Verify compressor current draw.
- Confirm room temperature control.
- Do not overcharge the refrigeration system.
- An overcharged system may cause:
- High condensing pressure.
- Increased compressor power consumption.
- Liquid floodback.
- Reduced cooling efficiency.
- Compressor damage.

15.8 Typical Refrigerant Charging Arrangement



After Start-Up:

- Verify Superheat
- Verify Subcooling
- Confirm Stable Operation
- General Installation Sketch – Typical Only, Not to Scale

The actual charging arrangement may vary depending on the refrigerant type, condensing unit design, receiver configuration, and manufacturer's charging procedure.

15.9 Final Inspection

Before placing the refrigeration system into continuous operation, verify that:

- Correct refrigerant type has been used.
- Refrigerant was charged by weight using a calibrated scale.
- Refrigerant cylinder was charged in the correct phase (liquid where required).
- System has been started successfully.
- Compressor operates normally.
- No refrigerant leaks are present.
- Suction and discharge pressures are stable.
- Superheat is within the manufacturer's recommended range.
- Subcooling is within the manufacturer's recommended range.
- Room temperature is approaching the design operating condition.

Important Notice

Refrigerant charging shall always follow the condensing unit manufacturer's specified refrigerant charge and commissioning procedure. Final system performance shall be confirmed by verifying superheat, subcooling, operating pressures, compressor current, and room temperature under stable operating conditions. ColdTech recommends documenting the final refrigerant charge, superheat, subcooling, suction pressure, discharge pressure, ambient temperature, and room temperature as part of the system commissioning records.

16. Start-up & Commissioning

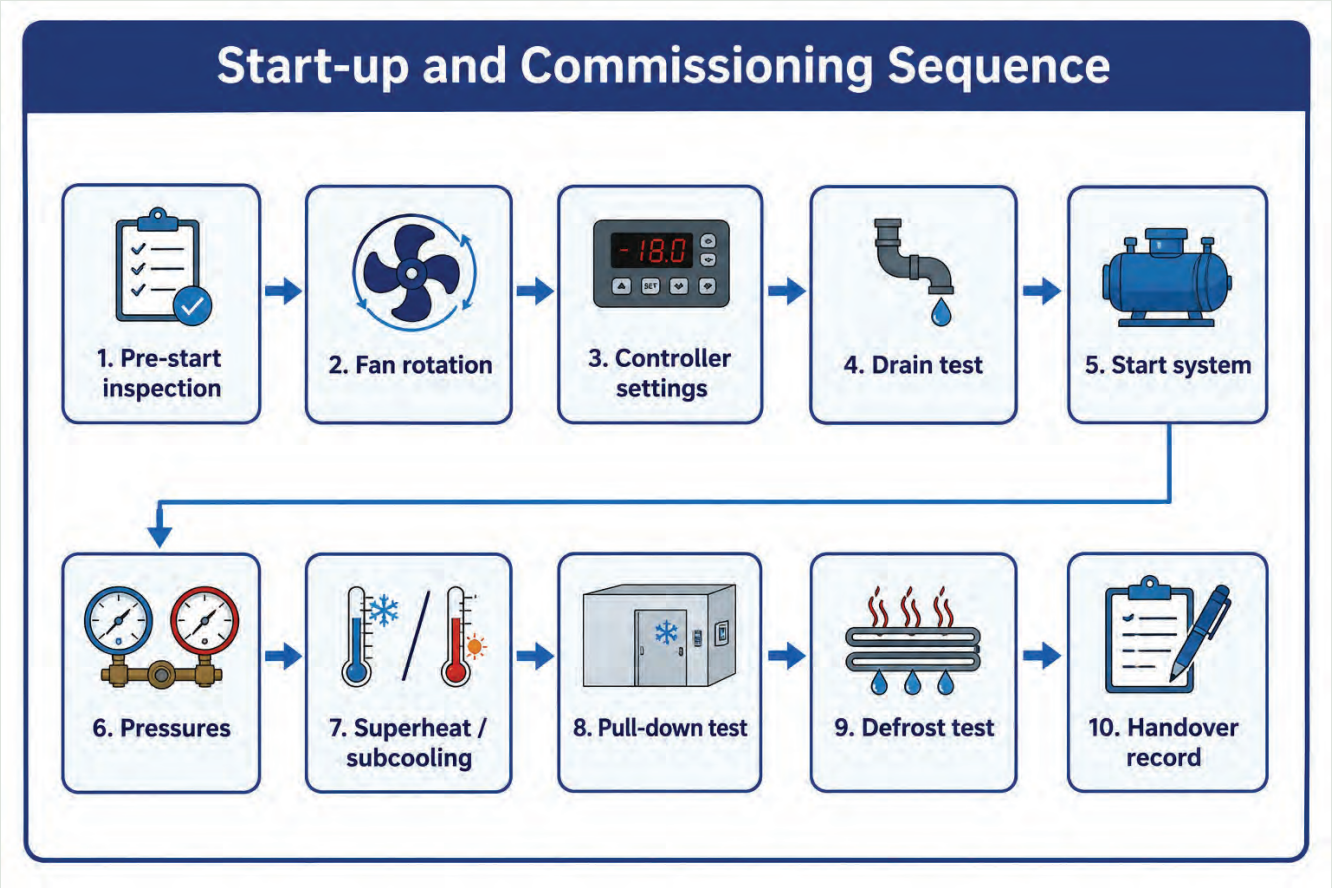


Figure - Typical arrangement for guidance only; not to scale.

Check fan rotation, controller settings, drain operation, suction pressure, discharge pressure, room pull-down and defrost cycle.

16.1 General

Start-up and commissioning shall be carried out only after the evaporator, refrigerant piping, condensate drainage, electrical wiring, controls, pressure testing, evacuation, and refrigerant charging have been completed and inspected.

The purpose of commissioning is to confirm that the ColdTech evaporator and associated refrigeration system operate safely, reliably, and in accordance with the approved design conditions.

Commissioning shall be performed by qualified refrigeration personnel using calibrated instruments. All readings and controller settings should be recorded on the commissioning sheet for future service reference.

16.2 Pre-Start Inspection

Before energizing the system, verify the following:

- The evaporator is securely mounted and correctly levelled.
- All mounting bolts and supports are tight.
- Fan guards and access panels are securely fitted.
- Refrigerant piping is properly supported and insulated.

- Service valves are in the correct operating position.
- The refrigerant circuit has passed pressure and vacuum tests.
- The correct refrigerant charge has been introduced.
- Drain piping is connected, trapped, insulated, and unobstructed.
- Drain and defrost heaters are correctly installed where applicable.
- Electrical supply matches the unit nameplate.
- Fan motors, heaters, sensors, controls, and protective earth are correctly wired.
- All tools, packaging materials, and loose objects have been removed.

Do not start the system if any refrigerant leak, damaged component, loose electrical connection, or unsafe condition is identified.

16.3 Electrical Supply Verification

Before start-up, measure and record:

- Supply voltage.
- Number of phases.
- Supply frequency.
- Phase-to-phase voltage where applicable.
- Phase-to-neutral voltage where applicable.
- Earth continuity.
- Phase sequence for three-phase motors.

The measured voltage shall remain within the allowable range specified by the fan motor, heater, controller, and condensing unit manufacturers.

After start-up, verify the operating current of the fan motors, defrost heaters, and other electrical components. The current shall not exceed the applicable nameplate rating.

16.4 Fan Operation and Rotation

Momentarily energize the evaporator fans and confirm that every fan rotates in the correct direction.

Verify that:

- Air is drawn through the coil and discharged in the intended direction.
- All fans operate smoothly.
- No fan blade contacts the guard or casing.
- There is no excessive vibration or abnormal noise.
- Motor current is within the nameplate rating.
- Air discharge is not obstructed by products, shelving, walls, or pipework.

For three-phase motors, incorrect rotation may be corrected by isolating the power supply and interchanging two incoming phases. This work shall only be carried out by qualified electrical personnel.

Never operate the evaporator without the fan guards securely installed.

16.5 Controller Settings

Confirm that the refrigeration controller has been programmed according to the approved operating requirements.

Check and record:

- Room temperature setpoint.
- Temperature differential.
- Compressor or solenoid control mode.
- Defrost type.
- Defrost frequency.
- Maximum defrost duration.
- Defrost termination temperature.
- Drip time.
- Fan start temperature.
- Fan delay.
- High- and low-temperature alarms.
- Sensor calibration or offset.
- Communication and BMS settings where applicable.
- Ensure that room and coil sensors are correctly identified and display realistic temperatures.

Controller settings shall not be altered without understanding their effect on system operation and product temperature.

16.6 Drain Operation Test

Test the condensate drainage system before prolonged refrigeration operation.

Introduce clean water into the drain tray and verify that:

- Water flows freely toward the drain outlet.
- No water remains trapped in the drain tray.
- The drain pipe maintains a continuous downward slope.
- The P-trap functions correctly.
- No leakage occurs at pipe joints.
- The drain line is adequately insulated.
- The drain heater operates correctly in freezer applications.
- Water discharges safely into the approved drainage system.
- Any drainage restriction shall be corrected before commissioning continues.

16.7 Initial System Start-up

Start the refrigeration system in accordance with the condensing unit manufacturer’s instructions.

During the initial operating period:

- Confirm that the compressor starts normally.
- Verify condenser and evaporator fan operation.
- Confirm that the liquid-line solenoid valve opens correctly.
- Check for abnormal noise or vibration.
- Observe oil level and oil return where applicable.
- Inspect all refrigerant connections for leakage.
- Monitor suction and discharge pressures.
- Confirm refrigerant flow through the sight glass, where fitted.
- Allow the system to stabilize before making adjustments.

Avoid making immediate TXV or refrigerant-charge adjustments before stable operating conditions have been achieved.

16.8 Operating Pressure Checks

Measure and record the operating suction and discharge pressures after the system has stabilized.

- **Suction Pressure**

The suction pressure shall correspond with the expected evaporating temperature for the room application.

Abnormally low suction pressure may indicate:

- Low refrigerant charge.
- Restricted liquid flow.
- Incorrect TXV adjustment.
- Iced or blocked evaporator coil.
- Low evaporator airflow.
- Closed solenoid or service valve.
- Abnormally high suction pressure may indicate:
- Excessive refrigeration load.
- TXV overfeeding.
- Incorrect compressor capacity control.
- Warm room conditions during initial pull-down.

- **Discharge Pressure**

The discharge pressure shall be appropriate for the refrigerant, ambient temperature, condenser type, and design condensing condition.

Abnormally high discharge pressure may indicate:

- Dirty or obstructed condenser.
- Condenser fan failure.
- Refrigerant overcharge.
- Non-condensable gases.

- High ambient temperature.
- Restricted airflow or water flow.
- Abnormally low discharge pressure may indicate:
- Low refrigerant charge.
- Low ambient conditions.
- Incorrect condenser control.
- Compressor performance problems.

Never operate the system outside the compressor manufacturer's approved operating envelope.

16.9 Superheat and Subcooling Verification

After stable operation is achieved, measure and record:

- Evaporator outlet superheat.
- Compressor inlet superheat where required.
- Liquid-line subcooling.
- Suction-line temperature.
- Liquid-line temperature.

The measured values shall be compared with the recommendations of the TXV and condensing unit manufacturers.

Adjustments shall be made only in small increments, allowing sufficient stabilization time after each adjustment.

16.10 Room Pull-Down Test

Monitor the room temperature from initial start-up until the design setpoint is achieved.

- During the pull-down test, record:
- Start time.
- Initial room temperature.
- Room temperature at regular intervals.
- Product load, if present.
- Suction and discharge pressures.

- Ambient temperature.
- Compressor current.
- Time required to reach the design temperature.

Confirm that:

- The room temperature decreases progressively.
- Air circulation is uniform.
- Door seals and penetrations do not permit excessive infiltration.
- The evaporator coil does not become abnormally blocked with frost.
- The compressor operates within its approved limits.
- The required room temperature is achieved and maintained.

Pull-down time depends on room size, insulation, initial temperature, product load, door openings, ambient conditions, and installed refrigeration capacity.

16.11 Defrost Cycle Test

Initiate a manual defrost cycle and observe the complete sequence.

Verify that:

- Refrigeration stops at the start of defrost.
- Evaporator fans stop where required.
- Electric heaters or hot-gas valves operate correctly.
- Frost melts uniformly across the coil.
- The drain heater operates where applicable.
- Meltwater drains freely.
- Defrost terminates at the set temperature or maximum time.
- The programmed drip time is completed.
- Refrigeration restarts correctly.
- Fans remain off during the fan-delay period.
- Fans restart only after the coil has cooled sufficiently.

Ensure that no water is blown from the coil and no excessive ice remains after the defrost cycle.

16.12 Typical Commissioning Sequence

16.13 Final Commissioning Checklist

Before handing over the system, verify that:

- Evaporator mounting and supports are secure.
- Fan rotation and airflow are correct.
- Fan motor current is within the rated value.
- Controller settings are correctly programmed.
- Temperature sensors display accurately.
- Drain tray and drain piping operate correctly.
- Drain and defrost heaters function correctly.
- Suction pressure is stable.
- Discharge pressure is within the acceptable range.
- Superheat and subcooling have been verified.
- Refrigerant leak inspection has been completed.
- Room pull-down performance is satisfactory.
- The complete defrost sequence operates correctly.
- Alarm and safety functions have been tested.
- All access panels and fan guards are secured.
- Final readings and settings have been documented.

Important Notice

The refrigeration system shall not be handed over for normal operation until the complete start-up and commissioning procedure has been successfully completed.

Abnormal pressure, excessive current, incorrect fan rotation, blocked drainage, unstable temperature control, or incomplete defrost shall be investigated and corrected before continuous operation.

ColdTech recommends retaining the completed commissioning report, controller settings, refrigerant charge, electrical readings, pressure readings, superheat, subcooling, pull-down results, and defrost test results as part of the permanent equipment service record.

17. Preventive Maintenance

Inspect monthly. Clean coils, tighten electrical terminals, inspect heaters, clean drains and verify operating temperatures.

18. Troubleshooting

Common faults include iced coils, high room temperature, fan failure, blocked drains, high superheat and low suction pressure. Check airflow, refrigerant charge and controls systematically.

19. Warranty

Warranty is subject to correct installation, commissioning and maintenance. Damage due to misuse, incorrect refrigerant, improper wiring or unauthorized modification is excluded.

20. Installation Checklist

Verify unit model, mounting, piping, leak test, vacuum, electrical wiring, controller configuration, drain, airflow, defrost and customer handover.

- Figure: Typical general arrangement for reference only.
- Figure: Typical general arrangement for reference only.
- Figure: Typical general arrangement for reference only.

Appendix A - General Installation Notes

- Maintain unrestricted airflow around the evaporator.
- Do not use the unit as a structural support.
- Use vibration isolators where required.
- Always insulate suction piping and drain lines.
- Seal all panel penetrations with approved sealant.
- Verify fan rotation before handover.
- Record commissioning readings for future maintenance.
-

General Piping Arrangement

Typical sequence:

Condensing Unit → Filter Drier → Sight Glass → Solenoid Valve → TXV → Evaporator → Suction Line → Compressor.

General Maintenance Schedule

Manufacturer Contact and Document Control

For product-specific technical assistance, spare parts identification or warranty support, quote the evaporator model, serial number, refrigerant, electrical supply and project reference shown on the unit nameplate and approved submittal.

ColdTech Refrigerating & Freezing Equipment Manufacturing LLC
Dubai, United Arab Emirates
www.coldtechgroup.com

Activity	Recommended PPE
General Installation	Safety shoes, gloves, helmet
Brazing	Welding gloves, face shield, fire-resistant clothing
Electrical Work	Insulated gloves and insulated tools
Refrigerant Charging	Safety goggles and protective gloves
Ceiling Installation	Safety harness (where applicable)

Location	Recommended Minimum Clearance
Rear of Unit	300 mm
Top of Unit	250 mm
Service Side	600 mm
Front (Air Discharge)	Keep completely unobstructed

Inspection Item	Status
Model verified	☐ OK ☐ N/A
Unit level	☐ OK ☐ N/A
Leak test	☐ OK ☐ N/A
Vacuum completed	☐ OK ☐ N/A
Electrical checked	☐ OK ☐ N/A
Fan rotation	☐ OK ☐ N/A
Drain tested	☐ OK ☐ N/A
Defrost checked	☐ OK ☐ N/A
Customer handover	☐ OK ☐ N/A

Frequency	Activity	Responsible
Monthly	Clean coil & inspect drain	Technician
Quarterly	Check electrical terminals	Technician
Yearly	Full performance verification	Service Engineer