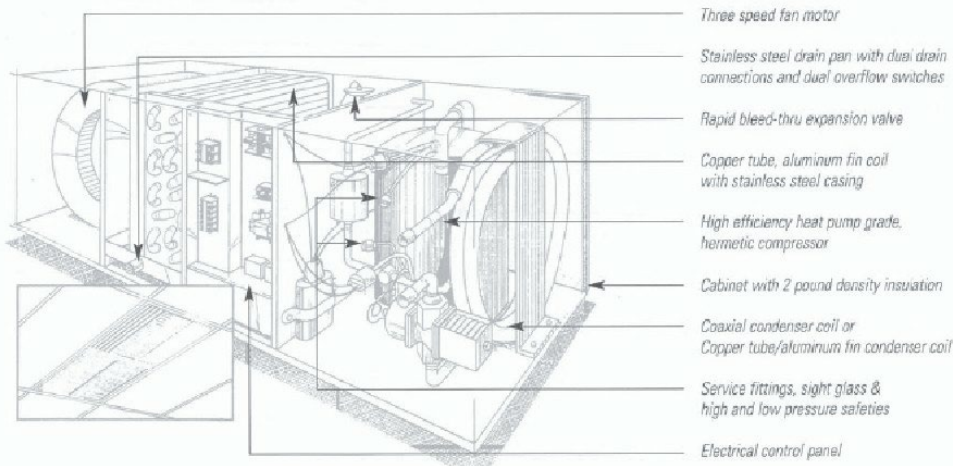


Installation, Operations, and Maintenance

Mini-Might & Spot DX

Ver 2022.1 / November 2022



IOM MANUAL

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1. INTRODUCTION - WARRANTY

1.1 General

Thank you for your purchase of this Tithe Corp. equipment. Tithe Corp. is a woman owned and operated innovative Maryland based manufacturer of air conditioning systems. Specializing in precision, high percentage outside air, and supplemental applications, Tithe Corp. utilizes high quality craftsmanship and materials to produce equipment capable of providing years of trouble free service.

This Tithe Corp. manual is provided as one component of the documentation for your equipment. The product data sheet (submittal or as-built) and wiring diagram should be referenced for specific performance, technical, and physical data. Supplemental manuals for microprocessors and other system components may be included with your unit based on the features requested.

The information contained in this manual provides basic instructions for the installation, operation, and maintenance of your equipment. The directions contained herein will prevent damage to the system from an improper installation and ensure that your unit performs at its peak efficiency. Deviation from these instructions may result in degraded performance, damage to the system, and potentially void the system warranty.

Note: The information contained in this manual in no way absolves the installer of their obligation to meet all applicable codes and comply with other project documentation. In the event of a conflict between these instructions and other project requirements, always observe the strictest requirement.

1.2 Safety Information

Tithe Corp. mechanical equipment presents multiple potential hazards, including high voltage electrical services, rotating components, and high pressure fluids. Only professionally trained, qualified, and licensed (where required) personnel should install and/or service this equipment. Property damage and serious injury or death may result from improper installation or maintenance of this equipment.

Prior to performing any service on this unit, familiarize yourself with this manual, the material safety data sheets (MSDS) for any refrigerant or glycol used in this unit, and the location of the main power switch. Before opening the cabinet to perform any service, always lock out the main power disconnect unless power is required for the procedure/diagnostic being performed.


Tithe Corp. uses notes, cautions and warnings in its manuals to draw attention to important operating and safety information.

A bold text **NOTE** alerts you to an important detail.

A bold text **CAUTION** provides information that is important for protecting your equipment and performance. Be especially careful to read and follow all cautions that apply to your application.

A bold text **WARNING** provides information important for protecting you from harm. Pay very close attention to all warnings that apply to your application.

 precedes a general WARNING or CAUTION safety statement.

 precedes an electrical shock hazard WARNING or CAUTION safety statement.

1.2.1 Safety Summary

The following warnings and cautions appear in this manual. Before performing any installation, operation, maintenance or troubleshooting procedure, read and understand all relevant cautions and warnings. Maintenance and/or repair procedures must be performed by a journeyman refrigeration mechanic or air conditioning technician.

WARNING 

This appliance is not intended for use by persons (including children) with reduced physical, sensory or mental capabilities, or lack of experience and knowledge, unless they have been given supervision or instruction concerning use of the appliance by a person responsible for their safety.

WARNING 

Children should be supervised to ensure that they do not play with the appliance.

WARNING 

Never work on electrical equipment unless another person who is familiar with the operation and hazards of the equipment and competent in administering first aid is nearby.

WARNING 

All personnel working on or near equipment should be familiar with hazards associated with electrical maintenance. Safety placards/stickers have been placed on the unit to call attention to all personal and equipment damage hazard areas.

WARNING 

When working on electrical equipment, remove all jewelry, watches, rings, etc.

WARNING 

A lock-out/tag-out procedure should be followed to ensure that power is not inadvertently reconnected.

WARNING 

To prevent personal injury, stay clear of rotating components, as automatic controls may start them

unexpectedly. Turn off power to the unit unless you are performing tests that require power. With power and controls energized, the unit could begin operating at anytime.

WARNING 

Never lift any component in excess of 35 lb without help. If a lifting device is used to move a unit, ensure it is capable of supporting the weight of the unit.

WARNING 

Do not allow the unit to swing while suspended from a lifting device. Failure to observe this warning may result in injury to personnel and damage to the equipment.

WARNING 

Never operate the unit with any cover, guard, screen panel, etc., removed unless the instructions specifically state otherwise, then do so with extreme caution to avoid personal injury.

WARNING 

Refrigerant is used with this equipment. Death or serious injury may result if personnel fail to observe proper safety precautions. Great care must be exercised to prevent contact of liquid refrigerant or refrigerant gas, discharged under pressure, with any part of the body. The extremely low temperature resulting from the rapid expansion of liquid refrigerant or pressurized gas can cause sudden and irreversible tissue damage.

At a minimum, all personnel should wear thermal protective gloves and face-shield/goggles when working with refrigerant. Application of excessive heat to any component will cause extreme pressure and may result in a rupture.

Exposure of refrigerant to an open flame or a very hot surface may cause a chemical reaction that forms hydrofluoric acid or carbonyl fluoride, a highly poisonous and corrosive gas commonly referred to as fluorophosgene. In its natural state, refrigerant is a colorless, odorless vapor with no toxic characteristics. It is heavier than air and will disperse rapidly in a well-ventilated area. In an unventilated area it presents a danger as a suffocant.

Always review the manufacturer's Safety Data Sheet (SDS) provided with the unit before performing work involving refrigerant.

WARNING 

Do not use cleaning solvents near open flame or excessive heat. Wear eye protection when blowing solvent from parts. The pressure-wash should not exceed 30 psig. Solvent solutions should be disposed of in accordance with local and state regulatory statutes.

WARNING 

Certain maintenance or cleaning procedures may call for the use and handling of chemicals, solvents, or cleansers. Always refer to the manufacturer's Safety Data Sheet (SDS) prior to using these materials. Clean parts in a well-ventilated area. Avoid inhalation of solvent fumes and prolonged exposure of skin to cleaning solvents. Wash exposed skin thoroughly after contact with solvents.

WARNING 

When performing soldering or desoldering operations, make certain the refrigeration system is fully recovered and purged and dry nitrogen is flowing through the system at the rate of not less than 1-2 CFM.

CAUTION 

When the air conditioner operates in cooling mode the return air intake and discharge (supply) must be free of obstructions. Ensure panels are secure and latched into position.

CAUTION 

After interconnecting piping is installed, the piping system must be cleaned. If solvents/cleaning solutions are used, ensure they are completely flushed from the piping before connecting it to the unit. Failure to do so will result in equipment problems.

CAUTION 

When installing and filling a chilled water or water/ glycol loop, all air must be bled from the piping system.

CAUTION 

Do not use chloride-based water conditioning additives in the condensate drain pans. They cause corrosion to occur on the coil fins.

CAUTION 

When transporting and installing the unit, it must be kept in its normal, horizontally installed position. If the unit is not kept level and horizontal, damage to the compressor(s) will result.

1.3 Warranty

1-Year Limited Warranty Policy

Tithe Corp. (The Seller) warrants against defect in materials and workmanship in products which it manufactures for (1) year from the date of installation or up to 15 (fifteen) months from the date of shipment, whichever event occurs first, when properly installed and operated under normal use. This warranty does not include any labor, transportation or other charges made outside of the Seller's factory for replacement or repair of defective parts unless specifically stated in the body of the Seller's invoice. This warranty does not cover failures caused by improper installation, abuse, misuse, misapplication, improper or lack of maintenance, negligence, accident, normal deterioration including wear and tear or the use of improper parts or improper repair.

The Seller's only liability under this warranty or otherwise shall be the repair or replacement (at Seller's option) of nonconforming goods or parts. Seller assumes no liability for incidental or consequential damages such as injury to persons or property, or lost profits.

This warranty is in lieu of all other warranties, expressed or implied, including warranties of merchantability and fitness for a particular purpose and there are no warranties which extend beyond the description on the face hereof.

Four-Year Extended Warranty

(Motor-Compressor Assembly Only)

Tithe Corp. also has available a four year extended warranty for the Motor-Compressor Assembly which follows the expiration of the standard Tithe Corp.'s Warranty. In the event of a defective motor-compressor assembly this warranty would provide replacement to the original purchaser-user, following an inspection by a reputable refrigeration contractor. Contact Tithe Corp. for complete details on pricing and general conditions and information on this warranty.

Unit Nos. :	
Evaporator Model No. :	
Condenser Unit Model No. :	
Unit Serial Nos. :	
Tithe Corp. Job No. :	
End User :	
Warranty Begin Date :	



Model Nomenclature

MAA-036

Mini Spot - M		012 - Nominal 1.0 Ton
Air Cooled - A		018 - Nominal 1.5 Ton
Chilled Water - C		024 - Nominal 2.0 Ton
Water Cooled - W		036 - Nominal 3.0 Ton
Glycol Cooled - G		
Comfort - A		
Heat Pump - H		
Outdoor - O		

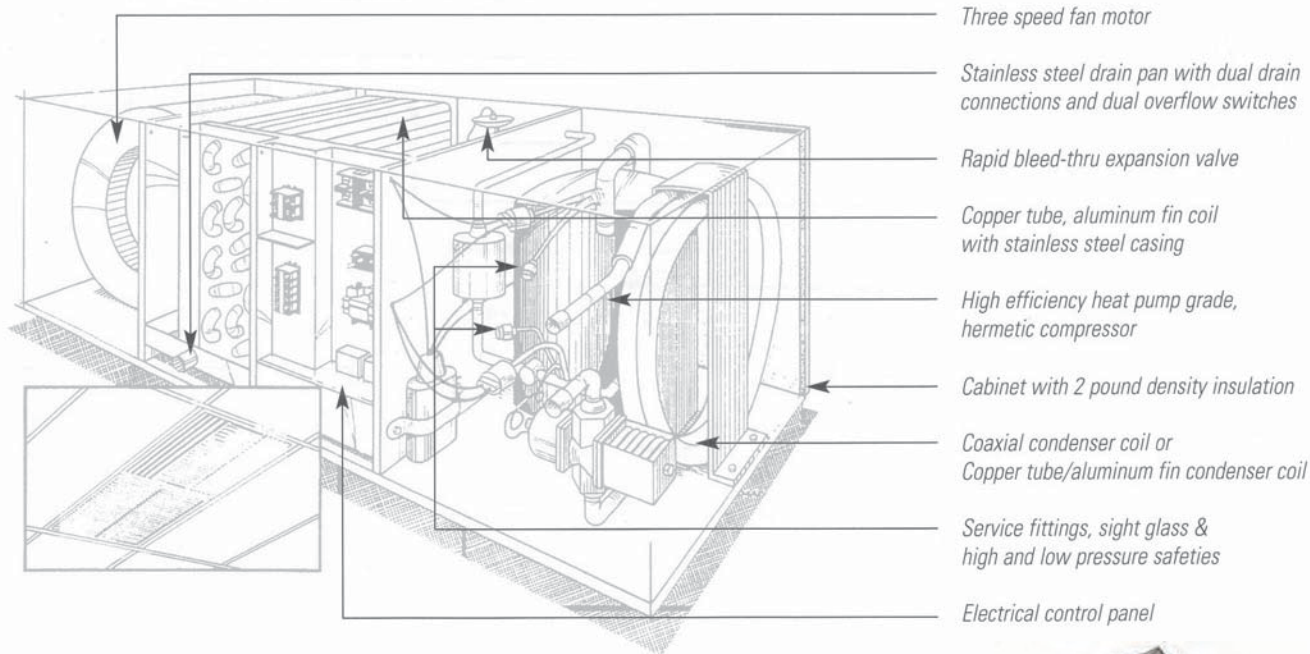
H 1 / D

Horizontal - H		BU - Indoor Centrifugal Blower Air Cooled Remote Condensing Unit
208-230/1/60 - 1		B - Indoor Centrifugal Blower Air Cooled Remote Condenser
208-230/3/60 - 3		D - Self-Contained Air Cooled Unit
480/3/60 - 4		FU - Outdoor Propeller Fan Air Cooled Remote Condensing Unit
575/3/60 - 5		F - Outdoor Propeller Fan Air Cooled Remote Condenser
277/1/60 * - 7		

*) 277/1/60 available via transformers.

Feature

Skil-aire™ Built to Last With Design Features That Assure Superior Performance and Dependability in Any Application.



Invisible Air Conditioning Systems Incorporating Indoor Air Quality Features For Total Comfort:



Microprocessor Controls:

DigiSkil-100/200 (Digital T-Stats)



MicroSkil-100/200 (Micro T/H Controls)



Air Pattern Options:

- 2'x4' Ductless Spot Cooler (standard)
- Ducted Evaporator (optional)

Capacity Modulation:

- Hot Gas Bypass

Select Accessories:

- Condensate Pumps
- Non-Fused Disconnects
- Firestats
- Smoke Detectors
- Remote Water Detectors
- and more ...!

Environmental Control:

- Steam Humidifier
- Electric, Hot Gas, Hot Water or Steam Reheat
- High Efficiency Air Filtration



Head Pressure Control:

- Air Cooled - Choose from 0°F, -20°F and -30°F Low Ambient Options
- Water/Glycol Cooled - 2 and 3-way standard and high pressure regulating valve options



2. INSTALLATION

2.1 Receiving, Unpacking, Inspecting, Handling, and Storing

To ensure that your equipment has been delivered without any external or internal indications of damage, make a visual inspection, including inside all access panels, immediately upon delivery. If there is any shipping damage, it must be noted on the freight carrier's delivery forms before signing for the equipment. If the unit has been damaged, obtain a claim form from the carrier. All freight claims and/or lost material claims must be processed through the freight carrier, typically within 5 business days of receipt of equipment. Tithe Corp. should be notified of any damage prior to repair.

Components and accessories that are shipped loose will be shipped in separate container(s) and may be found within the unit as space allows. Units must remain in the normal upright position at all times. Units should only be moved by pallet jack or similar device on original or correctly sized pallet (pallet must extend beyond the unit on all sides). Units must never be stacked.

If the equipment is not scheduled for immediate installation upon its arrival at the job site, it should be completely inspected per the instructions above, then repacked in the original or equivalent packaging and stored in a clean, dry area.

2.2 Site Location Selection, Preparation, Indoor and Outdoor

2.2.1 Site Selection Considerations

Before the unit is installed, a thorough study of the installation site should be made to verify that the structure is adequate to support the unit's weight. The routing of electrical services, ductwork, condensate piping, and refrigerant piping must be coordinated in order to maintain accessibility to the unit for maintenance and servicing.

A minimum clearance of 24" is recommended at all access panels to allow for equipment service. Clearances for electrical panels are as required by all applicable codes (typical minimum is 36"); contact your authority having jurisdiction for specific local requirements. Refer to your submittal drawings for specific unit layout.

NOTE

For appliances with supplementary heaters, the minimum clearance from the appliance to combustible surfaces should be met per the local code.

2.2.2 Split System Distance & Elevation Considerations

Long distances and elevation changes can reduce the overall efficiency of refrigerant based systems. Extended piping runs also increase the required line size, increasing the cost of refrigerant piping and increasing the amount of refrigerant required for the system. In order to minimize piping costs and maximize unit performance, it is recommended to select component placement to minimize the length of the piping run.

2.2.3 Preparing the Site

One of the most significant site factors that can affect the performance of your unit and its ability to maintain space conditions is the insulation and vapor barrier installed in the space. Tithe Corp.

recommends that the insulation and air/vapor barrier installation meet the standards of ASHRAE/ANSI 90.1 or the local code as a minimum for optimum unit operation. In particular, the air/vapor barrier is vital to properly maintaining space conditions - leakage causes increased heating, cooling, humidification, and dehumidification loads. Failure to provide adequate insulation and a proper air/vapor barrier can lead to unstable room conditions and increased operational costs.

2.3 Rigging

Units are shipped on a skid in order to ease movement and are designed to be kept in the orientation in which they are shipped. This orientation must be maintained at all times during installation. Tithe Corp. units should only be moved by pallet jack or other similar device. Refer to unit documentation for weights.



When moving the unit, it must be kept horizontal and level to prevent damage

2.4 Mounting

2.4.1 Indoor Equipment

2.4.1.1 Ceiling Mounted Equipment

For detailed dimensional data, refer to your submittal drawings. Packaged units are shipped as an integral unit with a cross-member angle attached to both sides of the unit at each of the six mounting channels. Refer to submittal dimensions for mounting system if the evaporator system is separated from the condensing section.

Use 3/8" minimum diameter threaded rod (field-supplied) with proper washers and locknuts to hang equipment. Consult the authority having jurisdiction and/or your project documentation for other requirements. Unit should be lifted into place from underneath. Refer to unit documentation for the unit weight.

2.4.1.3 Vibration Isolation

While various internal components may have their own internal vibration isolation, Tithe Corp. recommends that all of its equipment be provided with external vibration isolation to maximize equipment life and to minimize noise generation.

Floor-mounted units may be mounted on vibration isolation pads or spring isolators. Spring isolators are

recommended for ceiling hung units. Vibration isolators may be provided with your unit or field-supplied. Refer to your unit submittal and packing list to determine if vibration isolators have been supplied by the manufacturer.

2.4.2 Outdoor Equipment

Tithe Corp. recommends mounting all outdoor equipment on a concrete housekeeping pad or equipment supports.

2.5 Condensate Line

2.5.1 Gravity (Units without condensate pumps)

Units have a 3/4" or 1" OD copper condensate drain connection stubbed out through the side of the cabinet. A P-trap is required on the drain line (refer to Figure 1). Note that dimension A must be equal to at least twice the negative static pressure for the unit in order to ensure proper drain operation. The negative static pressure is approximately equal to the unit's fan static pressure minus the ESP allowance. Improperly sizing the trap may result in water being entrained in the air stream or cause the drain pan to overflow. The drain line pipe size should match the connection size. Slope all drain piping away from the unit in accordance with local code and project requirements.

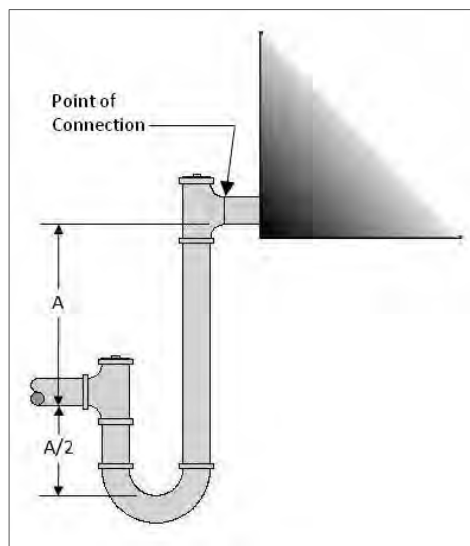


Figure 1 - Gravity Condensate Drain

CAUTION

Properly size and vent the P-trap according to applicable codes and best practices.

2.5.2 Condensate Pump (Installed in Unit)

Units with a factory mounted condensate pump have a 1/2" OD copper drain stubbed out through the cabinet. A 1/2" copper sweat connection or 1/2" ID vinyl tubing may be used for connection.

2.5.3 Condensate Pump (Field Installed)

Units have a 3/4" or 1" OD copper condensate drain connection stubbed out through the side of the cabinet. A 2" p-trap is required on the drain line. In order to ensure proper drainage, the top of the pipe at the inlet to the condensate pump must be below the top of the drain pan. Condensate pump discharge may be 1/2" OD copper or vinyl tubing.

The condensate pump must be independently supported and level. Do not support pump from piping. Do not support from unit panels - supporting from unit structure is acceptable, if other piping requirements can be met.

CAUTION

Always follow manufacturer's instructions when installing a field-installed condensate pump. If manufacturer's instructions were not provided with the pump, contact Tithe Corp's product support for the pump documentation. Do not install the pump without first reading the manufacturer's instructions. Failure to exactly follow manufacturer's instructions may on rare occasions result in serious damage to the unit and the surrounding facility.

2.6 Controls

Tithe Corp. units are available with a variety of controls options, from standard thermostats to advanced microprocessor controls systems. Refer to the supplemental documentation included with your unit for specific information based on the options selected with your unit.

2.7 Optional Remote Sensors

Remote sensors are shipped loose from the equipment for field installation and wiring. Refer to the packing list, submittal, and electrical wiring diagram to identify sensors included with your unit.

2.7.1 Remote Temperature and Temperature/Humidity Sensors

Wall-mounted temperature sensors should be mounted in the space the unit is serving, on an internal wall, and away from direct sunlight. Sensors should be placed so that they will not be obstructed by furniture or any other equipment. Do not place sensors in close proximity to heat generating equipment such as computers, coffee makers, or ovens. Do not mount sensors directly over sinks. Sensors should be mounted 60 inches above the finished floor, unless otherwise directed.

2.7.2 Duct-Mounted Temperature and Temperature/Humidity Sensors

Refer to the specific project documentation to determine whether duct mounted sensors are to be installed in the supply or return ductwork.

Install sensors on the supply side of the unit in a straight length of duct at least 36 inches away from the unit or any duct-mounted heaters. Do not install the sensors in elbows or any other fittings. Install the sensor in the duct main, prior to any take-offs.

Install sensors on the return side of the unit in a straight length of duct at least 36 inches away from any

heater installed in the unit intake. Do not install the sensor in elbows or any other fittings. Install the sensor downstream of all return air and outdoor air connections.

2.7.3 Remote Water Detector

Install the remote water detector in the unit's auxiliary drain pan. Adjust the height of the sensing probes as required, ensuring that they do not come into direct contact with the drain pan.

2.8 Optional Equipment

Tithe Corp. units air available with a variety of optional equipment, including electric heaters, hot-water heating coils, steam heating coils, and humidifiers. This equipment may be unit mounted or duct mounted. Refer to your system's submittal to identify additional equipment and supplemental documentation for additional requirements for options not listed in this manual.

2.9 Electrical Connections

2.9.1 High Voltage Power Wiring

Tithe Corp. units are shipped from the factory with components selected and internally wired for the specified electrical requirements. Refer to the unit's nameplate for the voltage, phase, and frequency information. Prior to beginning wiring, verify that the main electrical service to be routed to the unit and the nameplate information are properly coordinated.

NOTE

All wiring must be provided in accordance with National Electrical Code and local code requirements. Wiring terminations may become loose during transit of the equipment; verify all wiring terminations are secure.

2.9.1.1 Wire & Fuse Sizing

Check the unit specification plate for the full load amps (FLA), minimum circuit ampacity (MCA), and maximum overcurrent protection (MOP). Select wire and fuse sizes in accordance with Local and National code requirements.

2.9.1.2 Connections

The main power connections to packaged units or split unit sections must be made through a fused disconnect. The disconnect switches may be factory provided or field provided - refer to the submittal for more information.

Refer to the wiring diagram included with the unit for connection to the power distribution block and unit ground lug. Verify that the hot and neutral legs (single phase) or L1, L2, and L3 supply wires (three phase) are connected to the corresponding points on the power block.

Note: Improper wiring of the main power service may result in the unit's compressor(s) and fan operating backwards. This can cause damage to the compressor(s) and may void the unit's warranty.

NOTE

Improper wiring of the main power service may result in the unit's compressor(s) and fan operating backwards. This can cause damage to the compressor(s) and may void the unit's warranty.

2.9.2 Low Voltage Control Wiring

Tithe Corp. units are shipped from the factory with all internal components pre-wired. Terminals are provided for all field-wired connections. Refer to the electrical wiring diagram included with the unit for specific information.

NOTE

Customer-provided wiring must be in accordance with the National Electrical Code and local code requirements for Class 2 circuits.

2.9.2.1 Wire Sizing

Tithe Corp. control wiring is 24 V. Select wire sizes in accordance with Local and National code requirements.

2.9.2.2 Connections

Refer to the wiring diagram included with the unit to identify the components to be field wired and for the terminal connections.

2.9.3 Optional Connections

Your Tithe Corp. unit may include a variety of features depending on the configuration. These features may include dedicated terminals or relays for control wiring and dedicated power/fuse blocks for power wiring.

2.9.3.1 Remote On/Off

Units may be wired to a field provided, normally closed switch in order to provide remote shutoff control. The two wires from the switch must be routed to the electrical box and connected to the appropriate terminals. Refer to the wiring diagram for the points of connection for the remote shutdown switch.

2.9.3.2 Compressor Lockout

Units may be wired to a field-provided, normally closed switch in order to provide compressor lockout. The two wires from the switch must be routed to the electrical box and connected to the appropriate terminals. Refer to the wiring diagram for the points of connection for the compressor lockout switch.

2.9.3.3 Field Installed Condensate Pump

Field installed condensate pumps require power and control wiring to be connected to the unit. The control wiring must be run to the terminals for the overflow switch (NC and ground terminals) in the condensate pump housing. Two power wires and a ground wire must be connected to the dedicated power terminals on the fuse block and to the ground stud, respectively. Refer to the wiring diagram included with the unit for wiring termination at the unit and the wiring diagram included with the condensate pump for wiring at the pump. Note: Condensate pump overflow switch control wiring will be wired in series with the remote water detector, if provided.

2.9.3.4 Remote Water Detector

The remote water detector requires control wiring to be run to the NC and ground terminals and may require an additional power connection (provided from the 24 V control wiring). Refer to the wiring diagram included with the water detector for more information. Refer to the unit wiring diagram for wiring configuration. Note: Remote water detector control wiring will be wired in series with the condensate pump overflow switch, if provided

2.9.3.5 Remote Temperature & Temperature/Humidity Sensors

Use shielded, multi-core cable with 3-5 wires for all sensor connections. Wire should be 16-20 AWG. Use the largest acceptable gage wire in order to minimize signal noise. Avoid running the sensor wiring near power cables or near cables running to contactors. Where possible, minimize the length of the cable run. Refer to the wiring diagram for points of connection.

2.9.3.6 Duct Heaters

Duct heaters may be powered through the unit or powered separately. Control wiring must be connected to the unit. Refer to the documentation included with the duct heater for additional requirements. Refer to the wiring diagram for points of connection and to determine if a dry contact is provided for power from the unit.

2.9.3.7 Damper Actuators

Damper actuators are generally powered separately. A dry contact may be provided for power wiring (typically labeled EDR on the wiring diagram). Refer to the wiring diagram for more information.

2.9.3.8 Pump Enable

For units with the pump enable feature, a dry contact may be provided (typically labeled PER on the wiring diagram). Refer to the wiring diagram for more information.

2.9.3.9 Smoke/Fire Detector

Smoke/fire detectors may be field-wired or factory-wired. Terminals are provided for connection. Refer to the wiring diagram for more information.

2.10 Refrigerant Piping

2.10.1 General

Use Type L or K copper refrigerant grade piping for all refrigerant lines. Securely mount all refrigerant lines to the building structure with brackets intended for use with refrigerant/copper piping. Where refrigerant lines pass through walls or floors, provide a sleeve to prevent the line from rubbing. Select refrigerant piping routes through chases, ceiling plenums, wall cavities, conduit, or similarly protected areas to minimize the possibility of damage to piping and surrounding materials. Ensure that installation takes into account potential pipe expansion.

Piping should be insulated as indicated in Table 1:

Table 1 - Refrigerant Piping Insulation Requirements

Liquid Line	Typical temperatures are 110-120°F. Insulation is recommended on external installations and where piping is routed through non-conditioned spaces. Insulation is also recommended where the hot pipe may present a hazard.
Suction Line	Typical temperatures are in the vicinity of 40-50°F. Insulation is required to prevent condensation and to minimize temperature loss to the environment.
Hot Gas Discharge Line	Typical temperatures may be in excess of 150°F. Insulation is not required. Insulation is recommended where the hot pipe may present a hazard.

2.10.2 Pipe Connections

Braze all piping connections with a high quality, high temperature brazing compound of 15% silver suitable for use with the refrigerant used in your unit and in accordance with all local, national and ASHRAE code requirements. Take care to avoid introducing debris to the piping system. Run dry nitrogen through the piping continuously during the brazing process.

2.10.3 Pipe Routing

For best unit performance, pipe should be routed in the most direct, shortest path possible with as few fittings as possible.

Slope all refrigerant piping in the direction of flow at 1/4" per ten feet: slope the liquid line towards the evaporator, the hot gas discharge line towards the condenser, and/or the suction line towards the compressor. Piping should be installed without sags or bends.

2.10.4 Pipe Sizing

Pipe sizing is based on the method detailed in the 2010 ASHRAE Refrigeration Handbook. The following charts and recommendations are provided for your convenience - Tithe Corp. recommends all refrigerant pipe sizes be calculated by an engineer in accordance with the latest ASHRAE

Refrigeration sizing guidelines.

For optimal unit operation, a maximum total equivalent length (linear feet of pipe + equivalent lengths of fittings) of 150 feet is permissible. The allowed vertical component varies depending on system configuration. Refer to Table 2 for maximum total equivalent piping lengths including vertical components and fittings. Installations that exceed these lengths without consultation with the manufacturer prior to the submittal phase of the project may result in degraded unit performance.

Table 2 - Maximum Total Equivalent Lengths for Refrigerant Piping

Condenser or Condensing Unit, Same Level	150 total equivalent feet.
Condenser above Evaporator	150 total equivalent feet, including up to 100 feet vertical.
Condenser below Evaporator	150 total equivalent feet, including up to 20 feet vertical.
Condensing Unit above Evaporator	150 total equivalent feet, including up to 50 feet vertical.
Condensing Unit below Evaporator	150 total equivalent feet, including up to 50 feet vertical.

To calculate the required line sizes for your system and for future reference, note the refrigerant type, unit tonnage, and number of circuits in the table below.

Table 3 - Record of Tonnage per Refrigerant Circuit

Refrigerant Type:	
Unit Tonnage:	
Number of Circuits:	
Tonnage per Circuit:	

Calculate the tonnage per circuit by dividing the unit tonnage by the number of circuits; record this value above.

To determine the pipe size to be used for installation, the total equivalent length must be determined. The following worksheets in Tables 4-6 provide a basic walk through of the method to determine pipe size. Start by recording the total length of piping to be installed, including any risers, in box a. for each pipe type on your project. For an initial estimated total equivalent length, multiply this value by 1.5. Using Tables 11 and 12 for R-407c or R-410a, round up to the nearest 25 feet and record the initial line sizes in the worksheets.

Record the total number of any 90 degree, 45 degree, and traps/180 degree fittings in the worksheets. Refer to Table 7 to find the equivalent length for the fitting at the initial line size and record all applicable values in the indicated space on the worksheet. Multiply the quantity of fittings times the equivalent length for the fitting type and record the value in boxes b, c, and d. Add boxes a, b, c, and d together to determine the total equivalent feet of piping for your system; use this value with the R-407c or R-410a sizing table to determine the line size and record this final line size in the worksheet. *Note:*

this calculation should be repeated with the new line size as a new initial value if there are significant changes in the line size. Record the final total equivalent feet and line sizes in Table 8 for future reference.

Table 4 - Discharge Line Sizing

Discharge Line Sizing Worksheet							
Total Line Length (ft)	Total length of all piping, including any risers.			a.	Initial Line Size (in)		
Length for estimating initial line size (ft)	a.	x	1.5	=		Final Line Size (in)	
Fitting Type	Qty	x	Equivalent Length (Table 5)	=			
90 Degree fittings		x		=			b.
45 Degree fittings		x		=			c.
Traps/180 fittings		x		=			d.
Total Equivalent Length (ft)	a + b + c + d =			e.			

Table 5 - Suction Line Sizing

Suction Line Sizing Worksheet							
Total Line Length (ft)	Total length of all piping, including any risers.			a.	Initial Line Size (in)		
Length for estimating initial line size (ft)	a.	x	1.5	=		Final Line Size (in)	
Fitting Type	Qty	x	Equivalent Length (Table 5)	=			
90 Degree fittings		x		=			b.
45 Degree fittings		x		=			c.
Traps/180 fittings		x		=			d.
Total Equivalent Length (ft)	a + b + c + d =			e.			

Table 6 - Liquid Line Sizing

Liquid Line Sizing Worksheet				
Total Line Length (ft)	Total length of all piping, including any risers.		a.	Initial Line Size (in)
Length for estimating initial line size (ft)	a.	x 1.5	=	Final Line Size (in)
Fitting Type	Qty	x Equivalent Length (Table 5)	=	
90 Degree fittings		x	= b.	
45 Degree fittings		x	= c.	
Traps/180 fittings		x	= d.	
Total Equivalent Length (ft)	a + b + c + d =		e.	

Table 7 - Equivalent Feet for Pipe Fittings

Equivalent Feet for Common Fittings			
Pipe Size	Fitting Type		
	90°	45°	180°
3/8	0.9	0.7	2.3
1/2	1.0	0.8	2.5
5/8	1.2	0.9	2.9
3/4	1.4	0.9	3.2
7/8	1.6	1.1	3.7
1 1/8	2.0	1.4	4.9
1 3/8	2.5	1.8	6.0
1 5/8	2.8	2.2	6.8
2 1/8	3.5	2.8	8.7

Table 8 - Line Set Information

	Hot Gas Discharge	Suction	Liquid
Total Equivalent Feet			
Installed Pipe Size			
Riser Length (ft)			
Riser Size			

2.10.4.1 Flooded Condenser to Receiver Sizing

Pipes from a remote flooded condenser to a receiver should be sized for a maximum of 100 fpm. Refer to the following table for the required pipe sizes.

Table 9 - Flooded Condenser to Receiver

Flooded Condenser to Receiver Sizing Chart (100 fpm max flow rate)												
Refrigerant Type	Circuit Tonnage											
	1	1.5	2	2.5	3	4	5	6	7.5	8	10	15
R-407c	3/8	1/2	1/2	5/8	5/8	3/4	3/4	7/8	1 1/8	1 1/8	1 1/8	1 3/8
R-410a	3/8	1/2	1/2	5/8	5/8	3/4	3/4	7/8	1 1/8	1 1/8	1 1/8	1 3/8

2.10.4.2 Riser Sizing

Vapor piping must be sized to maintain a minimum velocity of 1,000 fpm for oil transport. Refer to the following table for the maximum pipe sizes to maintain this velocity; if your horizontal piping run is larger than the indicated pipe size, use the value from the table for the risers. Note that this may increase system pressure drop and degrade unit performance - long risers should be avoided, if possible. Record riser sizes in Table 8 for future reference.

Table 10 - Riser Sizing

Riser Sizing Chart (Maximum pipe size to maintain 1,000 fpm for oil return)													
Refrigerant Type	Line Type	Circuit Tonnage											
		1	1.5	2	2.5	3	4	5	6	7.5	8	10	15
R-407c	Discharge	3/8	1/2	1/2	5/8	5/8	3/4	7/8	7/8	7/8	1 1/8	1 1/8	1 3/8
	Suction	5/8	3/4	7/8	7/8	1 1/8	1 1/8	1 3/8	1 5/8	1 5/8	1 5/8	1 5/8	2 1/8
R-410a	Discharge	3/8	3/8	1/2	1/2	5/8	5/8	3/4	7/8	7/8	7/8	1 1/8	1 3/8
	Suction	1/2	5/8	3/4	7/8	7/8	1 1/8	1 1/8	1 1/8	1 3/8	1 3/8	1 5/8	2 1/8

2.10.5 Traps

Riser traps should be sized as small as possible. Trap risers as indicated in the following table:

Liquid Line	No traps required.
Suction Line	Provide vertical risers with a trap at the bottom of the riser and an inverted trap at the top of the riser.
Hot Gas Discharge Line	Provide vertical risers with a trap at the bottom of the riser and an inverted trap at the top of the riser.

In addition to these requirements, any vapor riser not sized for 1,000 fpm minimum pipe velocity should be trapped every 20 feet. Traps may be omitted for risers less than 5 feet in height.

2.11 Water/Glycol Piping

2.11.1 General

Tithe Corp. recommends Type L copper or Schedule 40 steel for all chilled water, condenser water, or glycol water installations. Weld or sweat joints should be used where possible. Support pipe with hangers designed for the appropriate pipe type. Comply with all national and local code requirements.

Insulation is required on chilled water piping. Glycol and condenser water piping do not require insulation unless fluid temperature will be below the ambient dewpoint temperature. Refer to project documentation, local, and national codes for additional requirements, insulation types, and thicknesses.

Tithe Corp. units are available with a variety of control valves when designed for chilled water service; refer to the documentation included with your control valve for installation requirements.

2.12 Air Distribution

2.12.1 Ducted Units

Tithe Corp. produces units with a variety of airflow patterns, including same-face, straight-thru, and 90° configurations. Connections to the unit should be made with a 1-inch flange. The duct connection to the unit should be the same size as the connection on the unit - do not blank off any portion of the inlet or outlet. Refer to the project documentation for size, material, and other connection requirements.

NOTE

The unit's blower has been selected based on static pressure requirements included in the project documentation. While the unit is provided with adjustable pulleys for adjustment, significant deviations from the design external static pressure may result in blower stability issues or inadequate airflow. Consult the factory prior to making any changes that might cause significant changes in the external static pressure.

NOTE

Units with supplementary heaters are tested at the following external static pressures based on total cooling ca:

- .10" H2O up to 28.8 MBTUh
- .15" H2O for 29 to 42.5 MBTUh
- .20" H2O for 43 to 65 MBTUh
- .20" H2O for 65 to 70 MBTUh
- .25" H2O for 71 to 105 MBTUh
- .30" H2O for 106 to 134 MBTUh

Table 11 - R-407c Line Sizing Chart

Refrigerant Line Sizing Chart for R-407c													
Total Equivalent Length	Line Type	Tonnage per Circuit											
		1	1.5	2	2.5	3	4	5	6	7.5	8	10	15
< 25 ft (7.6 m)	Discharge	3/8	1/2	1/2	5/8	5/8	5/8	3/4	3/4	7/8	7/8	7/8	1 1/8
	Suction	1/2	5/8	5/8	3/4	3/4	7/8	7/8	1 1/8	1 1/8	1 1/8	1 1/8	1 3/8
	Liquid	3/8	3/8	3/8	3/8	3/8	1/2	1/2	1/2	5/8	5/8	5/8	3/4
< 50 ft (15.2 m)	Discharge	1/2	1/2	5/8	5/8	3/4	3/4	7/8	7/8	7/8	1 1/8	1 1/8	1 1/8
	Suction	5/8	3/4	3/4	3/4	7/8	1 1/8	1 1/8	1 1/8	1 1/8	1 3/8	1 3/8	1 5/8
	Liquid	3/8	3/8	3/8	3/8	1/2	1/2	1/2	5/8	5/8	5/8	5/8	3/4
< 75 ft (22.9 m)	Discharge	1/2	5/8	5/8	3/4	3/4	7/8	7/8	7/8	1 1/8	1 1/8	1 1/8	1 3/8
	Suction	5/8	3/4	3/4	7/8	7/8	1 1/8	1 1/8	1 1/8	1 3/8	1 3/8	1 3/8	1 5/8
	Liquid	3/8	3/8	3/8	1/2	1/2	1/2	5/8	5/8	5/8	5/8	3/4	7/8
< 100 ft (30.5 m)	Discharge	1/2	5/8	3/4	3/4	3/4	7/8	7/8	1 1/8	1 1/8	1 1/8	1 1/8	1 3/8
	Suction	3/4	3/4	7/8	7/8	1 1/8	1 1/8	1 1/8	1 3/8	1 3/8	1 3/8	1 5/8	2 1/8
	Liquid	3/8	3/8	1/2	1/2	1/2	1/2	5/8	5/8	3/4	3/4	3/4	7/8
< 125 ft (38.1 m)	Discharge	**	5/8	3/4	3/4	7/8	7/8	1 1/8	1 1/8	1 1/8	1 1/8	1 3/8	1 3/8
	Suction	3/4	3/4	7/8	1 1/8	1 1/8	1 1/8	1 3/8	1 3/8	1 3/8	1 3/8	1 5/8	2 1/8
	Liquid	3/8	3/8	1/2	1/2	1/2	5/8	5/8	5/8	3/4	3/4	3/4	7/8
< 150 ft (45.7 m)	Discharge	**	5/8	3/4	3/4	7/8	7/8	1 1/8	1 1/8	1 1/8	1 1/8	1 3/8	1 5/8
	Suction	3/4	7/8	7/8	1 1/8	1 1/8	1 1/8	1 3/8	1 3/8	1 5/8	1 5/8	1 5/8	2 1/8
	Liquid	3/8	3/8	1/2	1/2	1/2	5/8	5/8	5/8	3/4	3/4	3/4	7/8

**Installation not recommended.

Table 12 - R-410a Line Sizing Chart

Refrigerant Line Sizing Chart for R-410a													
Total Equivalent Length	Line Type	Tonnage per Circuit											
		1	1.5	2	2.5	3	4	5	6	7.5	8	10	15
< 25 ft (7.6 m)	Discharge	3/8	1/2	1/2	1/2	5/8	5/8	5/8	3/4	3/4	3/4	7/8	1 1/8
	Suction	1/2	1/2	5/8	5/8	5/8	3/4	3/4	7/8	7/8	7/8	1 1/8	1 1/8
	Liquid	3/8	3/8	3/8	3/8	3/8	1/2	1/2	1/2	5/8	5/8	5/8	3/4
< 50 ft (15.2 m)	Discharge	1/2	1/2	5/8	5/8	5/8	3/4	3/4	7/8	7/8	7/8	1 1/8	1 1/8
	Suction	1/2	5/8	5/8	3/4	3/4	7/8	7/8	7/8	1 1/8	1 1/8	1 1/8	1 1/8
	Liquid	3/8	3/8	3/8	3/8	3/8	1/2	1/2	1/2	5/8	5/8	5/8	3/4
< 75 ft (22.9 m)	Discharge	1/2	1/2	5/8	5/8	3/4	3/4	3/4	7/8	7/8	1 1/8	1 1/8	1 1/8
	Suction	1/2	5/8	3/4	3/4	3/4	7/8	1 1/8	1 1/8	1 1/8	1 1/8	1 3/8	1 3/8
	Liquid	3/8	3/8	3/8	3/8	1/2	1/2	1/2	5/8	5/8	5/8	5/8	3/4
< 100 ft (30.5 m)	Discharge	1/2	5/8	5/8	5/8	3/4	3/4	7/8	7/8	1 1/8	1 1/8	1 1/8	1 3/8
	Suction	5/8	5/8	3/4	3/4	7/8	7/8	1 1/8	1 1/8	1 1/8	1 1/8	1 3/8	1 3/8
	Liquid	3/8	3/8	3/8	1/2	1/2	1/2	5/8	5/8	5/8	5/8	3/4	7/8
< 125 ft (38.1 m)	Discharge	**	5/8	5/8	3/4	3/4	7/8	7/8	1 1/8	1 1/8	1 1/8	1 1/8	1 3/8
	Suction	5/8	3/4	3/4	7/8	7/8	1 1/8	1 1/8	1 1/8	1 1/8	1 3/8	1 3/8	1 5/8
	Liquid	3/8	3/8	3/8	1/2	1/2	1/2	5/8	5/8	5/8	5/8	3/4	7/8
< 150 ft (45.7 m)	Discharge	**	5/8	5/8	3/4	3/4	7/8	7/8	1 1/8	1 1/8	1 1/8	1 1/8	1 3/8
	Suction	5/8	3/4	3/4	7/8	7/8	1 1/8	1 1/8	1 1/8	1 3/8	1 3/8	1 3/8	1 5/8
	Liquid	3/8	3/8	1/2	1/2	1/2	5/8	5/8	5/8	3/4	3/4	3/4	7/8

**Installation not recommended.

2.12.2 Free Discharge

Tithe Corp.'s units are available in a variety of free discharge options. When locating the unit, pay careful to the airflow pattern. Ensure the grille or air device is directed so that airflow is not directed into walls or corners.

2.13 System Charging

The procedures for charging your Tithe Corp. unit will vary according to the system features and refrigerant used in the system. Refer to your system documentation and the unit's nameplate prior to beginning system charging.

Packaged units and units with water or glycol condensers installed in the same cabinet as the evaporator ship pre-charged with the specified refrigerant and ready for operation - field charging is not required during initial installation. Refer to the nameplate for system operating parameters, including the system charge and system operating pressures.

Split systems ship with a dry nitrogen holding charge. Prior to piping and charging the unit, this charge must be removed.

NOTE

Your unit utilizes an HFC refrigerant and POE compressor oil. POE oil readily absorbs moisture - excessive moisture levels in the POE oil may react with the refrigerant to form acid and contaminate the system. Maintain the holding charge for as long as possible and keep the system sealed as much as possible during installation to minimize the exposure to outside air.

WARNING

If refrigerant gas is released in an enclosed area, it may accumulate in low areas and near the floor, displacing available oxygen. If a major leak occurs, there is a risk of asphyxiation. In such case, immediately evacuate personnel and ventilate the area. Personnel should remain away from the area until it is determined safe.

2.13.1 R-407C Refrigerant

R-407C is a blended refrigerant (a zeotropic of R-32, R-125, and R-134a) formulated as a non-ozone depleting replacement for R-22 in residential and commercial air conditions and heat pumps, with operating temperatures and pressures similar to R-22.

Your equipment is designed specifically for use with this refrigerant, if indicated on the unit nameplate.

The coil(s), compressor(s), and other components are selected specifically for R-407c refrigerant. In order to protect the compressor(s), the system is shipped with normally closed, automatically resetting low pressure switches (25 psi open, 50 psi reset) and high pressure switches (400 psi open, 200 psi reset) installed on each refrigeration circuit.

R-407C's component refrigerants remain well blended in its liquid phase, but tend to separate in the vapor phase. In order to ensure that your unit is charged with the proper composition of refrigerant, the system must be charged with liquid refrigerant only. Refer to the instructions printed on your refrigerant cylinder to verify that the cylinder is oriented properly for charging.

1. After completing all system piping connection and prior to introducing any refrigerant to the system, pressurize the system to 150 psig with dry nitrogen. Once the system has been pressurized, monitor the pressure to verify there are no leaks in the system.
2. In order to dehydrate the system, a high vacuum pump must be used to pull vacuum. Draw a vacuum of at least 50 micron (0.05 torr) and hold the vacuum for at least 2 hours. Proper system evacuation is essential because the formation of acid within the system can reduce the life of the compressor.
3. To break the vacuum on the system, supply R-407C to the discharge port near the compressor. Supply liquid refrigerant slowly until the pressure is raised to approximately 50 psig.
4. Remove the refrigerant cylinder connection from the discharge side of the system and reconnect it to the suction side.
5. Turn the system on.
 - a) Thermostat controlled systems: Set the system setpoint 5°F below room temperature to the compressor operates while the unit is charged.
 - b) Microprocessor controlled systems: Refer to the supplemental controller manual included with your system. Compressors should be set for manual control and run continuously while the unit is charged.
6. Allow the discharge pressure to rise to 225-280 psig. Refer to the unit nameplate for the unit's high side design pressure.
7. Supply liquid R-407C to the system to the suction side of the system slowly. Monitor the sight glass to clear of bubbles.
8. Measure the system superheat near the thermal expansion valve's sensing bulb - the superheat should be 12-15°F and must not exceed 20°F.
9. Measure the system sub-cooling near the outlet of the condenser. The sub-cooling should be between 10°F and 20°F.
10. Continue to add liquid refrigerant as necessary to maintain adequate sub-cooling temperature at the outlet of condenser.
11. (UNITS WITH HOT GAS REHEAT) If the unit is equipped with hot gas reheat, the unit must be charged with the reheat valve open to obtain the proper system charge. Refer to the supplemental controller manual included with your system. Heater 1 should be set for manual control and set to open while the unit is charged. After charging with the hot gas reheat valve open, verify charge with valve closed.
12. (UNITS WITH FLOODED CONDENSER CONTROL) Units utilizing flooded condenser control for

low ambient conditions contain a receiver for storing extra refrigerant to flood the condenser. After charging the system, additional refrigerant must be added to the receiver.

13. Return thermostat or microprocessor to their normal settings.

2.13.2 R-410a Refrigerant

R-410A is a blended refrigerant (a near azeotropic of R-32 and R-125) formulated as a non-ozone depleting replacement for R-22 in residential and commercial air conditions and heat pumps. R-410A exhibits higher operating pressures and refrigerant capacity than R-22. Due to the higher pressures, ensure that all service tools used for charging an R-410A system are designed for use with R-410A.

Your equipment is designed specifically for use with this refrigerant, if indicated on the unit nameplate. The coil(s), compressor(s), and other components are selected specifically for R-407c refrigerant. In order to protect the compressor(s), the system is shipped with normally closed, automatically resetting low pressure switches (50 psi open, 90 psi reset) and high pressure switches (600 psi open, 475 psi reset) installed on each refrigeration circuit.

Even though R-410A retains a similar composition in both the liquid and vapor phases, it is recommended that the system be charged with liquid refrigerant only. Refer to the instructions printed on your refrigerant cylinder to verify that the cylinder is oriented properly for charging.

1. After completing all system piping connection and prior to introducing any refrigerant to the system, pressurize the system to 150 psig with dry nitrogen. Once the system has been pressurized, monitor the pressure to verify there are no leaks in the system.
2. In order to dehydrate the system, a high vacuum pump must be used to pull vacuum. Draw a vacuum of at least 50 micron (0.05 torr) and hold the vacuum for at least 2 hours. Proper system evacuation is essential because the formation of acid within the system can reduce the life of the compressor.
3. To break the vacuum on the system, supply R-410A to the discharge port near the compressor. Supply liquid refrigerant slowly until the pressure is raised to approximately 90 psig.
4. Remove the refrigerant cylinder connection from the discharge side of the system and reconnect it to the suction side.
5. Turn the system on.
 - a) Thermostat controlled systems: Set the system setpoint 5°F below room temperature to the compressor operates while the unit is charged.
 - b) Microprocessor controlled systems: Refer to the supplemental controller manual included with your system. Compressors should be set for manual control and run continuously while the unit is charged.
6. Allow the discharge pressure to rise to 335-420 psig. Refer to the unit nameplate for the unit's high side design pressure.
7. Supply liquid R-410A to the system to the suction side of the system slowly. Monitor the sight glass to clear of bubbles.

8. Measure the system superheat near the thermal expansion valve's sensing bulb - the superheat should be 12-15°F and must not exceed 20°F.
9. Measure the system sub-cooling near the outlet of the condenser. The sub-cooling should be between 10°F and 20°F.
10. Continue to add liquid refrigerant as necessary to maintain adequate sub-cooling temperature at the outlet of the condenser.
11. (UNITS WITH HOT GAS REHEAT) If the unit is equipped with hot gas reheat, the unit must be charged with the reheat valve open to obtain the proper system charge. Refer to the supplemental controller manual included with your system. Heater 1 should be set for manual control and set to open while the unit is charged. After charging with the hot gas reheat valve open, verify charge with valve closed.
12. (UNITS WITH FLOODED CONDENSER CONTROL) Units utilizing flooded condenser control for low ambient conditions contain a receiver for storing extra refrigerant to flood the condenser. After charging the system, additional refrigerant must be added to the receiver.
13. Return thermostat or microprocessor to their normal settings.

2.13.3 Adding POE Oil

Depending on the length of your piping installation, additional POE oil may be required. After your system has been fully charged with refrigerant, this can be calculated using the equations below. If b is larger than a, then no adjustment to the compressor's oil charge is necessary.

$$\begin{array}{rclcl}
 \underline{\hspace{2cm}} & \times & 0.352 & = & \text{a. } \underline{\hspace{2cm}} \\
 \text{Refrigerant Charge} & & & & \\
 \\
 \underline{\hspace{2cm}} & \times & 0.1 & = & \text{b. } \underline{\hspace{2cm}} \\
 \text{Oil Charge} & & & & \\
 \\
 \text{a.} & - & \text{b.} & = & \underline{\hspace{2cm}} \\
 & & & & \text{Fl. Oz. of oil required}
 \end{array}$$

3. START-UP

3.1 Pre-Start-Up Checks

3.1.1 Electrical/Check Rotation

The unit has been shipped from the factory wired properly phased for all of the components. Verify proper power wiring to ensure that the fan and compressor will operate as designed. Note that improper wiring may result in the compressor being operated backwards and this will void the compressor warranty.

3.1.2 Refrigerant Charge

If the unit is a refrigerant based system, verify that the unit has been fully charged prior to attempting start-up.

3.1.3 Water/Glycol Source

If the unit utilizes water or glycol, verify that the water or glycol system is fully installed and all pumps, dry coolers, chillers, and other associated equipment are active prior to equipment start-up. Verify that interlocks with pumps have been wired, if required.

3.1.4 Blower Belts

Drive belts should be inspected prior to start-up for correct tension. Refer to the Maintenance section of this manual for information on belt tensioning.

3.2 Step-by-Step Start-Up Instructions

Refer to the supplemental controller IOM manual or the pamphlet included with the thermostat in order to complete the following procedures.

1. After completing the installation procedure and final pre-start-up checks, ensure that all tools, meters, and other items are cleared from the unit case. Replace all access panels and ceiling tiles. After verifying fan operation, panels and tiles can be removed as necessary to verify component operation.
2. Move the disconnect switch to the ON position.
3. (MC controller systems only) Verify that all system components are enabled. Refer to controller IOM manual. Note that there may be a delay of up to a minute before the fan activates.
4. Verify that the fan is operating. Airflow should be felt at the unit outlet or air device.
5. Verify cooling operation (if applicable). Set the unit's setpoint approximately 2°F above room temperature.
 - a) DX units: The compressor should activate and the air discharged from the unit should be cooler than room temperature. For units with multiple compressors, increase set point in 0.5°F increments to activate all compressors in succession.

- b) Chilled water units: The chilled water valve should be energized and the air discharge from the unit should be cooler than room temperature. Use a volt meter to check the voltage from the chilled water valve actuator and ground to verify the circuit is operational. Verify that the water temperature has increased after passing through the coil.
6. Verify heating operation (if applicable). Set the unit's setpoint approximately 5°F below room temperature. The air discharge from the unit should be warmer than room temperature.
 - a) Electric Heaters: Apply an amp meter to the electric heater circuit to verify the heater is operational.
 - b) Steam or Heating Water Heaters: Use a volt meter to check the voltage from the chilled water valve actuator to ground to verify the circuit is operational. Verify temperature has decrease after passing through the coil.
7. Verify dehumidification operation (if applicable). Set the unit's heating setpoint 2°F below room temperature to create a heating demand. Increase the unit's dewpoint temperature setpoint to create a call for dehumidification. Verify that a compressor or the chilled water valve is energized.
 - a) Hot Gas Reheat: Use a volt meter to verify the control signal to the hot gas reheat coil.
8. Verify humidifier operation (if applicable). Set the unit's humidification setpoint 10% below the current room humidity to create a call for humidification. Verify that the humidifier is activate (cylinder should be warm) with an amp meter applied to the humidifier circuit.

3.3 Thermostat Programming

Your unit may have been provided with a thermostat. Refer to the documentation accompanying the thermostat for any supplemental instructions.

3.4 Microprocessor Programming

Your unit may have been provided with a MS-100, MS-200, or MS-2015 microprocessor or other controller. Refer to the supplemental instruction manual included with the unit for programming instructions.

4. MAINTENANCE

Performing systematic, periodic general maintenance and inspection of your Tithe Corp. unit is imperative for maintaining peak operation condition. General maintenance should include, but not be limited to, the following: Replacing filters and humidifier cylinders; tightening loose fasteners and electrical connections; checking the condensate line to ensure it is free of debris; cleaning the interior of the unit; visually inspecting the units' components; checking belt tension; checking the level of refrigerant; and ensuring no moisture is in the refrigerant.

WARNING

Tithe Corp.'s equipment should be serviced and repaired by a journeyman refrigeration mechanic or air conditioning technician only.

WARNING

If refrigerant gas is released in an enclosed area it will displace oxygen and act as a suffocant. Always ensure adequate ventilation during refrigeration repairs.

Always recover all refrigerant prior to any system repairs. Failure to do so may result in system over pressurization and rupture.

WARNING

Turn off power to the unit at the service disconnect switch unless you are performing tests that require power. With power and controls energized, the unit could begin operating automatically at any time.

Hazardous voltage will still be present at the evaporator, condenser, heater/reheater and humidifier, even with the unit turned off at the controller. To isolate the unit for maintenance, turn off power at a non-fused service switch.

Always disconnect main power prior to performing any service or repairs. To prevent personal injury, stay clear of rotating components because automatic controls may start them unexpectedly.

WARNING

This unit employs high voltage equipment with rotating components. Exercise extreme care to avoid accidents and ensure proper operation.

4.1 Filters

A dirty filter results in increased static pressure and leads to less efficient operation. Do not wait for the dirty filter switch alarm for filter maintenance. Examine the filter monthly, as a minimum, and replace when necessary. Frequency of filter replacement will vary based on specific local conditions and outside air percentage. High outside air units will typically require filter replacement monthly.

4.2 Electrical Panels

Biannually, inspect the components in the electrical panel. Confirm that all electrical connections are tight. Check all contacts for pitting.

4.3 Blowers

Checks of the blower system should be performed biannually at minimum. Check the blower wheel for any signs of damage. Verify that the blower wheel is mounted tightly on the shaft and does not make contact with the unit housing. The squirrel cage should rotate freely. Check that the blower motor mounts, all housing bolts, and all electrical connections are secure.

The blower motor features permanently lubricated bearings and should not require lubrication during the useful life of the equipment.

4.4 Belts

Drive belts should be examined prior to start-up and then checked monthly for wear and correct tension. An over tensioned belt can cause wear; an under tensioned belt can cause slippage and excessive noise. If the two legs of the belt are pressed in midway between the pulley and the sheave, a properly tensioned belt will result in 1 to 1-1/2 inches of movement. Belt tension can be adjusted by means of the adjusting bolt attached to the motor bracket. Larger units may have motors mounted to a support on the bottom pan, which requires loosening of four nuts to adjust the motor location and change belt position.

4.5 Coils

All cooling and heating coils should be maintained biannually. Inspect the coil for bent or damaged fins and repair if necessary. Clear all debris from the coil(s) using industry standard coil cleaning techniques. Check all coil connections for signs of damage or leakage and repair as necessary.

4.6 Drain Pan

Prior to start-up, pour a small amount of water into the drain to fill the p-trap to ensure proper drainage and trap seal. Inspect the drain pan monthly to verify it is free from debris and leaks. Verify that the drain is clear and that the drain pan is draining properly.

4.7 Refrigeration System

Biannually, inspect the refrigerant system. Check the sight glass to verify adequate charge and to verify that the system is moisture free. Check the suction and discharge pressures to verify proper system operation. Inspect refrigerant piping for signs of damage or leaking.

4.7.1 Air Cooled System

Follow the maintenance recommendations for blowers, belts, and coils. During winter operation with a remote outdoor condenser/condensing unit, do not allow snow to build up on or around the unit.

4.7.2 Water/Glycol System

Biannually, inspect the water or glycol piping and any valves for signs of leakage or corrosion. Check the glycol solution concentration to ensure it meets the system requirements.

4.8 Chilled Water System

Biannually, inspect the water piping and control valve for any signs of leakage or corrosion.

4.9 Optional Features

4.9.1 Condensate Pump

Verify that the float operates freely on a monthly basis. Biannually, clean the condensate pump.

4.9.2 Humidifier

Examine the humidifier cylinder on a monthly basis for build-up. Refer to the supplemental humidifier IOM manual for further information.

4.10 COMPRESSOR FAILURE

In DX units, the compressor is the centerpiece of the system; all other refrigerant components are selected and designed to maximize compressor life. Tithe Corp. units contain a number of features to protect the compressor, including filter-driers, high and low pressure switches, and minimum run times. In spite of these protective measures, compressors are still susceptible to failure through a variety of mechanisms.

Compressors may fail by either mechanical or electrical means. The mode of failure will determine the steps necessary to return your Tithe Corp. unit to working order. Electrical failures will be accompanied by a pungent odor at the compressor and the motor will not run. A mechanical failure will not be accompanied by an odor. The motor may run, but operation may be accompanied by abnormal and/or excessive noise. In either case, a new compressor will be required.

In order to determine the proper method of cleaning prior to installing the new compressor, an analysis of the oil in the failed system is recommended. Procure a commercially available acid test kit and follow the instructions to determine if there is acid in the system. In lieu of performing an acid test, a visual comparison of a pristine sample of oil to the oil in the failed compressor may be made. If no acid is detected in the system, perform the following Standard Cleanout Procedure. If the system tests positive for acid contamination, perform the following Acidic Cleanout Procedure.

Note: Improper refrigeration system cleaning following a failure will void the warranty on the replacement compressor. Always consult the factory prior to replacing the compressor.

4.10.1 Standard Cleanout Procedure

Parts required: new compressor, new liquid line filter-drier one size larger than the original.

1. Reclaim the refrigerant from the system.
2. Remove the old compressor and filter-drier.
3. Verify that the replacement compressor is filled with POE oil. Install the new compressor.
4. Install a new filter-drier.
5. Recharge the unit - refer to the System Charging instructions under the Installation section of this IOM manual.
6. Follow the standard Start-Up procedures to restart the unit.

4.10.2 Acidic Cleanout Procedure

Parts required: new compressor, new liquid line filter-drier one size larger than the original, new suction line filter-drier (acid removal model).

1. Reclaim the refrigerant from the system.
2. Remove the old compressor and filter-drier.
3. Examine the sight glass, thermal expansion valve, and all other valves for proper operation. Clean if necessary.
4. Verify that the replacement compressor is filled with POE oil. Install the new compressor.
5. Install the new liquid line filter-drier.
6. Install the new suction line filter-drier designed for acid cleanup duty in the suction line near the inlet of the compressor.
7. Recharge the unit - refer to the System Charging instructions under the Installation section of this IOM manual.
8. Follow the standard Start-Up procedures to restart the unit.
9. Check the pressure drop across the suction line filter-drier at the end of the first hour of operation. If the pressure drop is excessive (refer to documentation included with the suction line filter-drier for guidelines), replace filter-drier.
10. After 24 hours of operation, take an oil sample. Test oil for acidity. If the sample is acidic, replace the suction line filter-drier.
11. After 2 weeks of operation, take an oil sample. Test oil for acidity. If the sample is acidic, replace the filter-drier. Repeat test as necessary in two week increments until the sample is no longer acidic.

5. TROUBLESHOOTING

5.1 Common Problems

The following table lists potential problems that you may encounter with the system, probable causes, and steps to follow to diagnose the call. Prior to performing any work in the cabinet, close and lockout the disconnect (unless the unit is required to be operational for the investigative procedure). Follow through each diagnostic step in order, they are ordered from most likely cause/least expensive repair to less likely cause/more expensive repair.

Problem	Possible Cause	Checks & Solutions	
Unit will not start	Display/T-Stat Wiring	Verify Power to Display/T-Stat »If no power: Check that wiring is tight and verify points of connection with wiring diagram.	
	System not enabled (MC Controller only)	Refer to controller IOM	
	System locked out		Check remote on/off and compressor lockout switches.
			Check alarms. »If active alarm: Troubleshoot alarm, then refer to controller IOM to re-enable system.
	No power to the unit		Verify disconnect is on.
			Check disconnect fuses. »If fuse is blown: check for shorts and replace fuse.
			Check voltage at terminal block. »If voltage: check that wiring in unit is tight, fuses are in tact, and circuit breaker on control transformer. »If no voltage: check distribution wiring and circuit breaker/fuse box.
	Unit wiring issue		Examine unit wiring diagram »Verify that all switches are wired NC, or as indicated.
			»Verify all indicated jumpers are in place.

Problem	Possible Cause	Checks & Solutions
Blower does not start	System locked out on alarm	Verify unit is not in alarm condition.
	Fan set in auto mode (MC controller only)	Refer to controller IOM.
	No control power to fan relay	Verify that all wiring is tight. Verify that condenser relay is pulling in. <i>»If relay does not pull in: Verify 24 V signal to relay. If proper voltage is applied and relay does not operate, replace relay.</i> <i>»If relay pulls in: Verify voltage to blower.</i>
No heat/reheat	No heat/reheat demand	Check system setpoints.
	No power to heater	Verify that heater relay is pulling in. <i>»If relay does not pull in: Verify 24 V signal to relay. If proper voltage is applied and relay does not operate, replace relay.</i> <i>»If relay pulls in: Verify voltage to heater.</i>
	Refer to supplemental manual included with heater.	
Optional humidifier does not operate	No humidification demand	Check system setpoints.
	No power to heater	Verify that humidifier relay is pulling in. <i>»If relay does not pull in: Verify 24 V signal to relay. If proper voltage is applied and relay does not operate, replace relay.</i> <i>»If relay pulls in: Verify voltage to humidifier.</i>
	Refer to supplemental manual included with humidifier.	

Problem	Possible Cause	Checks & Solutions
Compressor high pressure alarm (DX/heat pump only)	Condenser is obstructed (air-cooled units only)	Check condenser for debris, blockage, or damage. »If damage or blockage, clean condenser and/or repair fins.
	Condenser fan is not operating (air-cooled units only)	Verify that condenser relay is pulling in. »If relay does not pull in: Verify 24 V signal to relay. If proper voltage is applied and relay does not operate, replace relay. »If relay pulls in: Verify voltage to condenser fan.
		Verify power wiring to condenser fan is tight.
		Examine condenser fan for damage.
	No/inadequate fluid flow through the condenser (water/glycol units only)	Verify fluid flow to the condenser. »If fluid flow is low: adjust valve so fluid flow meets design parameters.
		Check entering fluid temperature. »If entering fluid temperature is high: troubleshoot fluid loop.
		Check leaving fluid temperature »If leaving fluid temperature is low: troubleshoot refrigerant system for obstruction.
	Overcharge of refrigerant	Check refrigerant system temperatures and pressures. Reclaim excess refrigerant.
Obstruction in filter-drier	Check filter drier »If significantly colder on leaving side: replace filter-drier.	
Compressor low pressure alarm (DX/heat pump only)	Loss of refrigerant	Check sight glass »If bubbles are visible: Recharge unit. »On multiple recharges: Reclaim refrigerant, leak test unit, repair any leaks, replace filter-drier, recharge unit.
	Expansion valve obstructed or non-operable	Remove expansion valve and clean or replace. Replace filter-drier.

Problem	Possible Cause	Checks & Solutions
No Cooling	No cooling demand	Check system setpoints.
No Cooling (DX system and heat pumps only)	Compressors not enabled (MC Controller only)	Refer to controller IOM to enable compressors.
	Compressor high pressure alarm	Refer to compressor high pressure alarm trouble shooting.
	Compressor short cycle prevention	Wait for three minute time delay for compressor to reset.
	No power to compressor	Verify compressor relay is pulling in. »If relay is not pulling in: Check for 24 V control signal. If proper voltage is applied and relay does not operate, replace relay.
	Low refrigerant charge	Check sight glass for bubbles. Check refrigerant pressure. »If refrigerant is low, recharge unit.
	Obstruction in filter-drier	Check filter drier »If significantly colder on leaving side: replace filter-drier.
No Cooling (Chilled water system)	No/inadequate water flow	Verify chilled water flow to valve »If no flow to to the valve: trouble shoot chilled water system.
	Entering water temperature too high	Check entering water temperature »If high water temperature: trouble shoot chilled water system.
	No control power to actuator	Check for 0-10 V or 24 V signal from controller to chilled water valve actuator. »If refrigerant is low: recharge unit.
	Faulty Actuator	Replace actuator.
Noisy compressor	Unit improperly phased	Verify unit wiring matches wiring diagram. »If incorrectly phased: rewire unit at terminal block.
	Liquid Slugging	System overcharged - verify system charge. »If overcharged: reclaim excess refrigerant
	Worn Bearings	Replace compressor.
	Broken Compressor Valve	Replace compressor.

5.2 Technical Support

Tithe Corp. is dedicated to supporting its product installations. If a problem arises that cannot be handled through following the directions in this manual or one of the supplemental manuals included with your unit, contact Tithe Corp. at (410) 625-7545 Monday through Friday from 7:00 AM to 4:00 PM Eastern Standard Time. You may also reach us at HelpDesk@TitheCorp.com

So that we can provide prompt and accurate support, please have the following information available when you call:

- Your Name/Company/Phone Number
- Job Number (8 digits printed on the unit nameplate)
- Serial Number (6 digits printed on the unit nameplate)
- Model Number (printed on the unit nameplate)
- Date of Manufacture (printed on the unit nameplate)
- A brief description of the problem

If a problem occurs outside of the business hours, leave a message with the aforementioned information and one of our support staff will return your call as soon as possible.

5.3 Warranty Parts

All warranty inquiries are handled through technical support. After troubleshooting the unit with a qualified field service technician, a determination will be made on whether a part(s) may be defective. If a part is determined to possibly be defective through the troubleshooting process, a replacement part will be shipped to the address provided by the customer.

A purchase order is required for all warranty parts. The following information is required:

- Customer Contact Name
- Customer Billing Address
- Credit Card Authorization or Approved Credit
- Customer Shipping Address
- Customer Telephone Number
- Date of Order
- Unit Serial Number

A Return Material Authorization (RMA) number will be provided for the defective part(s). Clearly note the RMA number on the address label. The customer is responsible for the shipping cost to return the defective part(s) to the Tithe Corp. factory. The defective part(s) must be returned within 30 days for evaluation by the service department. If the part is found to be defective after examination by the technical support team, a credit will be issued. Refer to the warranty certificate included in the Introduction section of this IOM manual for further details.

5.4 Spare and Replacement Parts

Requests for spare and replacement parts are made through the service department at Tithe Corp. at (410) 625-7545. Quotes will be provided for the specified parts for a specific unit. Visa and Mastercard or approved credit with Tithe Corp. are acceptable forms of payment.

Any returned parts sold as spare/replacement items will be subject to a 25% restocking charge. If the part is not a stocked item, a 50% restocking charge will be applied. In order to return a part, contact Tithe Corp. at (410) 625-7545 for a Return Material Authorization (RMA) number. Parts are eligible for return for 15 days after the original purchase date and must be returned in their original packaging with all associated materials. Spare or replacement parts sales over 15 days are not eligible for return.



Tithe Corp.

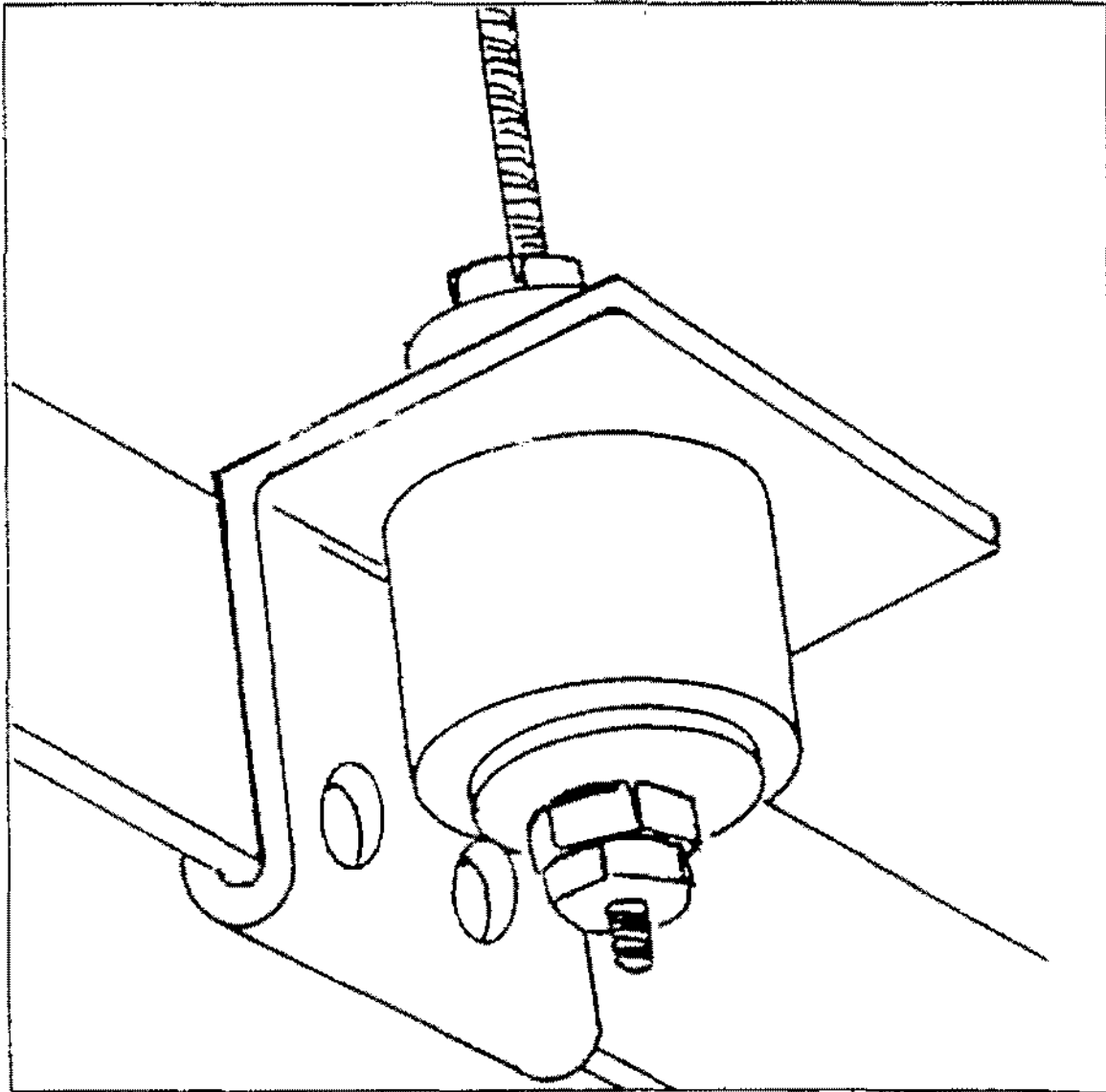
1621 Cole St, Baltimore, MD 21223
Technical Support: 800-625-7545

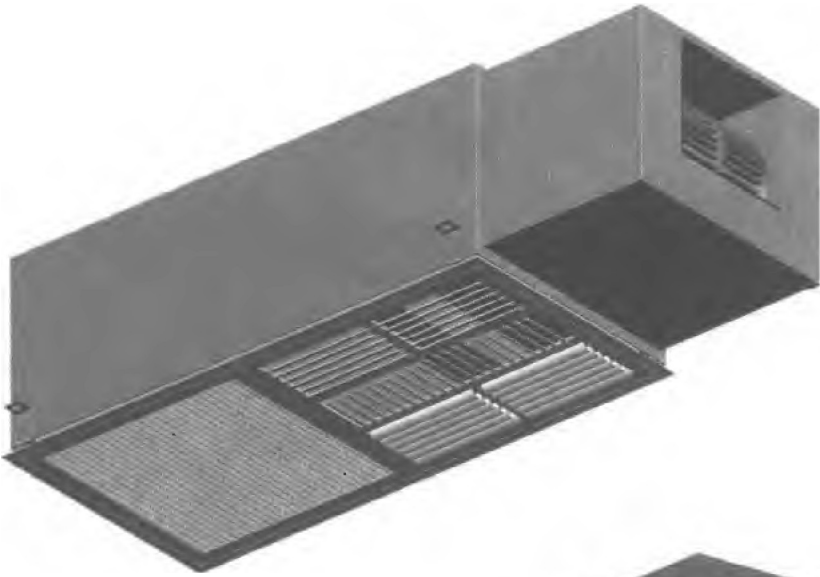
6. SUPPLEMENTAL INFORMATION

6.1 Mini Hangers

Quick-clip hanging system

Means fast, easy installation. No complicated hanging alignment or procedures necessary. Quick-clip mounts adjust easily for quick levelling.

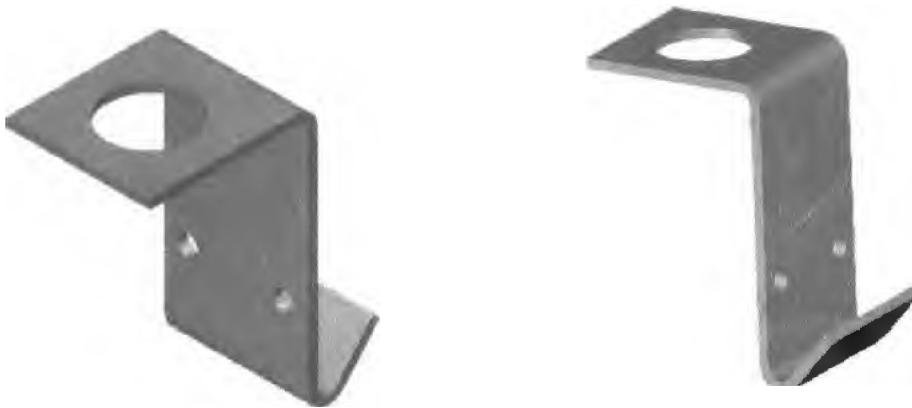




Hanging Orack••
(Qty 4 per unit)



**Hanging Brackets
(Qty 4 per unit)**



6.2 Terminal Connections

Skil-Aire Terminal Connections Thermo-stat Equipped Units

Low/Signal Voltage (24VAC)

R	24VAC source
T	24VAC common
G	Evaporator fan*
Y	Cooling or (Y1) first stage of multistage cooling
Y2	Second stage cooling
W	Heating, or (W1) first stages of multistage heating, or reheat for units with external humidifier/dehumidifier control
W2	Second stage heating
W3	Third stage heating
K	Emergency heat control
HC	Humidifier (Humidity S-TAT)
HO	Humidifier (Humidity S-TAT)
Z	System malfunction
CC	24VAC common interlock for remote condenser (T)
CR	(CRi) 24VAC interlock to remote condensers
CR2	24VAC interlock to circuit #2 remote condensers
CR3	24VAC interlock to circuit #3 remote condensers
O	Heat pump switch over heat priority
B	Heat pump switch over cool priority

Power Voltage (115-480VAC)

L1, L2	Line connections for single phase power. Check unit specification for proper power requirements.
L1, L2, L3	Line connections for 3 phase power. Check unit specifications for proper power requirements.
GROUND LUG	Chassis ground connection

- * Some units are supplied with a removable jumper (RtoG) for continuous evaporator fan operation. Remove jumper to control fan externally. Jumper should be left in place for any units utilizing humidification or dehumidification.