INSTALLATION

OPERATION

MAINTENANCE

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JTS WARRANTY STATEMENT

WARRANTY STATEMENT

Model #	Serial #	Ship Date	Start-up Date	Warranty Period
				12 months parts and not to exceed 18 months from shipping

Seller warrants that Products shall be delivered free from defects in material, workmanship, and title, and that Services shall be performed in a competent, diligent manner in accordance with any mutually agreed specifications.

The Parts Warranty for Products shall expire One (1) Year from date of shipment or initial Start-Up, not to exceed eighteen (18) months from delivery.

Software is warrantied for ninety (90) days from delivery.

For a warranty to be valid, the completed Start and Test form must be returned to the JTS Warranty Department within 6 months of shipment. If the completed S&T form is not provided, the warranty will proactively begin on the date of shipment.

If Products or Services do not meet the above warranties, Buyer shall promptly notify Seller in writing prior to expiration of the warranty period. Seller shall (i) at its option, repair or replace defective Products and (ii) re-perform defective Services. If, despite Seller's reasonable efforts, a non-conforming Product cannot be repaired or replaced, or non-conforming Services cannot be re-performed, Seller shall refund, or credit monies paid by Buyer for such non-conforming Products and Services. Warranty repair, replacement or re-performance by Seller shall not extend or renew the applicable warranty period. Buyer shall obtain Seller's agreement on the specifications of any tests it plans to conduct to determine whether a non-conformance exists.

Buyer shall bear the costs of access for Seller's remedial warranty efforts (including removal and replacement of systems, structures or other parts of Buyer's facility), de-installation, decontamination, re-installation and transportation of defective Products to Seller and back to Buyer.

The warranties and remedies are conditioned upon (a) proper storage, installation, use, operation, and maintenance of Products, (b) Buyer keeping accurate and complete records of operation and maintenance during the warranty period and providing Seller access to those records, and (c) modification or repair of Products or Services only as authorized by Seller in writing. Failure to meet any such conditions renders the warranty null and void. Seller is not responsible for normal wear and tear.

This Article provides the exclusive remedies for all claims based on failure of, or defect in Products or Services, regardless of when the failure or defect arises, and whether a claim, however described, is based on contract, warranty, indemnity, tort/extra-contractual liability (including negligence), strict liability or otherwise. The warranties provided in this Article are exclusive and are in lieu of all other warranties, conditions and guarantees whether written, oral, implied or statutory.

NO IMPLIED OR STATUTORY WARRANTY, OR WARRANTY OR CONDITION OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE APPLIES.

1711 Slipstream Way - Caldwell, Idaho 83605

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www.JohnsonThermal.com

INTRODUCTION

Important User Information

The information in this manual is subject to change without notice and does not represent a commitment on the part of JTS. JTS does not assume any responsibility for any errors that may appear in this manual. In no event will JTS be liable for technical or editorial omissions made herein, nor for direct, indirect, special, incidental, or consequential damages resulting from the use or defect of this manual.

The information in this document is not intended to cover all possible conditions and situations that might occur. The user must exercise caution and reason when installing or maintaining JTS products. If any questions or problems arise, call JTS at 208-453-1000.

We want partners, installers and technicians who are the best at what they do. We encourage fine tuning and modifications as required to best fit your application; that's how you "own" a project. However, JTS should be notified of any changes, and JTS reserves the right to void the product warranty for any unauthorized modifications.

MANUFACTURER

Johnson Thermal Systems (JTS)
1711 Slipstream Way
Caldwell ID 83605
www.johnsonthermal.com
Phone: 208-453-1000
After hours service: 208-697-3974

JTS products are intended to be installed and used as described in this manual and other related literature, specifications, drawings, and data.

This manual includes nominal settings to allow the contractor to start the equipment. The contractor is responsible for reviewing the operation of equipment after start-up, and for making necessary adjustments as needed. Authorization and approval from JTS must be obtained before any warranty rework or repairs are done. Failure to comply with these requirements may void the warranty and charges for repairs or rework may be denied. Please contact us at 208-453-1000 if you have any questions or concerns. This manual covers general instructions for JTS refrigeration systems. For more information about an individual component, refer to the manufacturer's literature.

SAFETY

Beware of possible unsafe conditions when you see the warning symbol. Warning levels may be shown as danger, warning, or caution with definition as follows:

⚠ **DANGER!** APPLIES TO A CONDITION THAT WILL RESULT IN SERIOUS INJURY OR DEATH.

⚠ **WARNING!** APPLIES TO A CONDITION THAT CAN RESULT IN SERIOUS INJURY OR DAMAGE TO EQUIPMENT.

⚠ **CAUTION!** APPLIES TO A CONDITION THAT CAN RESULT IN MODERATE INJURY OR DAMAGE TO EQUIPMENT.

GENERAL SAFETY

Do not service or operate the equipment without reading and understanding the important information and warnings within this manual. Ignoring these warnings can result in death, serious injury, or damage to the system and product. Follow all applicable safety guidelines in all circumstances. This includes, but is not limited to, NEC, OSHA, and national/state/local regulations.

Only qualified and trained personnel should perform maintenance or repairs. The personnel must understand how the system works, how the controls work, safety features, and inspection procedures of the equipment before operating it. Shut off the power supply following a lock-out/tag-out procedure when performing maintenance on the electrical equipment. Do not modify the equipment unless it is approved in writing by JTS. Only operate the equipment under the specified conditions and in a safe manner. Always look for equipment damage during operation. If damage is found, safely shut down the equipment and correct the damage before continuing operation. Do not operate the equipment after an inspection reveals a possible safety hazard, or if any parts require maintenance or replacement. Do not bypass, disconnect, or ignore safety devices of the system. Further safety information can be found within this manual or in the component manufacturer's manual. Please contact JTS for questions not answered in these manuals.

PERSONAL PROTECTIVE EQUIPMENT (PPE)

Personal Protective Equipment (PPE) must be worn and always on your mind. Low risk operations such as maintenance might need safety glasses, gloves, long sleeves and footwear. High risk operations such as isolating a leak on a large system, may require a face shield and thermal gloves. Always think about the situation and use appropriate PPE.

FIRE SAFETY

Fire detection, smoke detection, and fire suppression systems must be installed according to NFPA and local code requirements. Keep the machine clean and free of scrap materials, oils and solvents to reduce the possibility of fire.

⚠ **DANGER!** IN THE EVENT OF A FIRE, DE-ENERGIZE THE SYSTEM IMMEDIATELY BY DISCONNECTING SUPPLY POWER. ATTEMPTING TO EXTINGUISH A FIRE WITH AN ELECTRICALLY ENERGIZED MACHINE MAY RESULT IN SERIOUS INJURY OR DEATH.

REFRIGERANT SAFETY

Chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFCs), hydrofluorocarbons (HFCs), and hydrofluoroolefins (HFOs) are heavier than air and will displace oxygen in a confined space. There is a possible risk of suffocation if these refrigerants are released into a confined workspace. If a spill occurs, contractors must wear a self-contained breathing apparatus or evacuate the area until it has been properly ventilated. Some refrigerants, such as CFCs and HCFCs, are non-toxic when mixed with air in normal conditions. However, when they come in contact with high temperatures, they breakdown and form toxic substances.

Leak detection systems analyze air samples to determine the concentration of a refrigerant in the air. These systems help limit the environmental impact, reduce running and service costs, and limit health and safety hazards. Leak detection systems are recommended for areas such as mechanical rooms, walk-in coolers and freezers, evaporator coils, and areas where people walk around piping or refrigeration components.

Refrigerant lines are pressurized. Before cutting refrigerant lines or opening and closing valves, make sure the refrigerant lines are properly isolated. Improperly isolated lines or allowing lines to absorb heat can cause lines to burst.

⚠ **DANGER!** NEVER APPLY HEAT DIRECTLY TO A PIPE CONTAINING REFRIGERANT. RAPID THERMAL EXPANSION OF LIQUID REFRIGERANT CAN CAUSE THE PIPE TO BURST!

INSTALLATION

All systems must be installed according to national and local electrical codes. Failure to do so may result in equipment damage or personal injury. The installing contractor is responsible for ensuring that any field-installed materials are compatible with the refrigerant; this includes items such as pipes, valves, fittings, gaskets, or other materials that contact the refrigerant.

RECEIVING

All JTS equipment has been thoroughly inspected at our factory, but the entire system should also be thoroughly examined before unloading. Safe shipment is the responsibility of the carrier.

- Major components should be inspected for damage. Check for any components that may have come loose from the mounting position.
- Refrigerant lines and oil lines should be inspected for any breakage or leaks. Carefully inspect for hidden damage.
- Controls can be damaged in transit and should be inspected.
- Electrical connections often loosen during shipment. The installing contractor must check all connections and tighten / torque before energizing equipment.
- All brazed and mechanical joints should be tested and tightened.

Refrigeration systems are shipped with a 50-psi holding charge of nitrogen. Confirm that the system has the appropriate pressure before cutting any lines or opening the system. In the unlikely event that a system arrives without pressure, the system must be checked for leaks before piping is installed. Contact the JTS Service Department 208-453-1000 for the appropriate steps for repairs.

Note: leaks in threaded fittings are not covered under warranty.

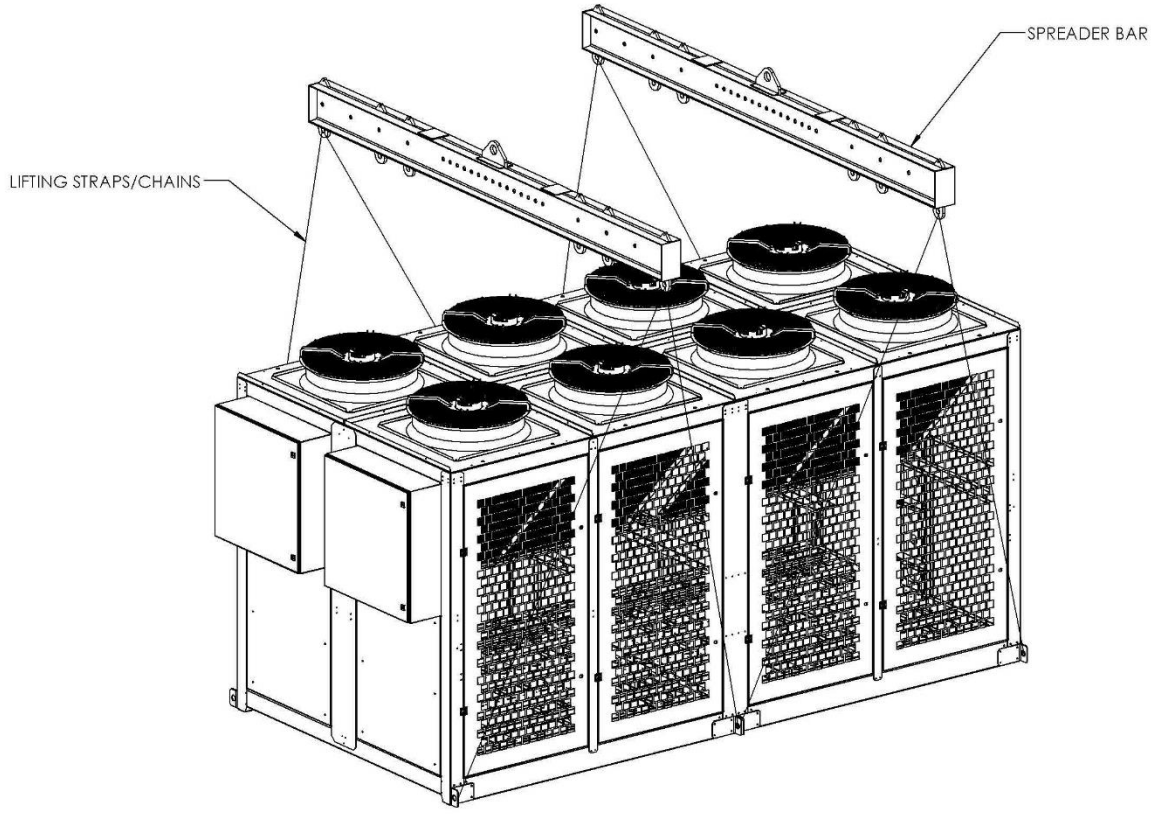
Any damage must be properly documented on the Bill of Lading by the person receiving the shipment. Shipping damage is the responsibility of the carrier. Any damage should be recorded, and a claim should be filed with the shipping company. Photographs of damaged equipment should be taken for documentation. The JTS Service Department will assist in preparing and filing your claims, including arranging for an estimate and quotation on parts. However, filing the claim is the responsibility of the receiving party. JTS must be notified in a timely manner.

Many systems will be sent with ship loose components that must be installed prior to system start-up. When the system is delivered, ensure that all loose items are accounted for. Contact the JTS Service Department at 208-453-1000 to replace lost or damaged components. Once ship loose components have been located and inspected, all ship loose components should be stored in a safe location to avoid misplacing them.

The refrigeration contractor should be careful to verify that each part is installed correctly and on the correct circuit if the machine has multiple circuits. Many components are sized based upon mass flow at specific conditions, not connection size. It is possible to have connection sizes that look odd but are properly sized or ones that look right but are wrong. If in question, refer to the component manufacturer's specification sheet and verify. Always follow components specification sheet for recommended mounting positions, assembly and brazing techniques.

RIGGING

Only properly rated equipment that is in good working condition should be used to move JTS machinery. The only parts of the system designed to carry the entire lifting load are the lift brackets at base of the system (See Figure 1). Many of JTS products will require a crane and the use of spreader bars. Good rigging practice is mandatory.



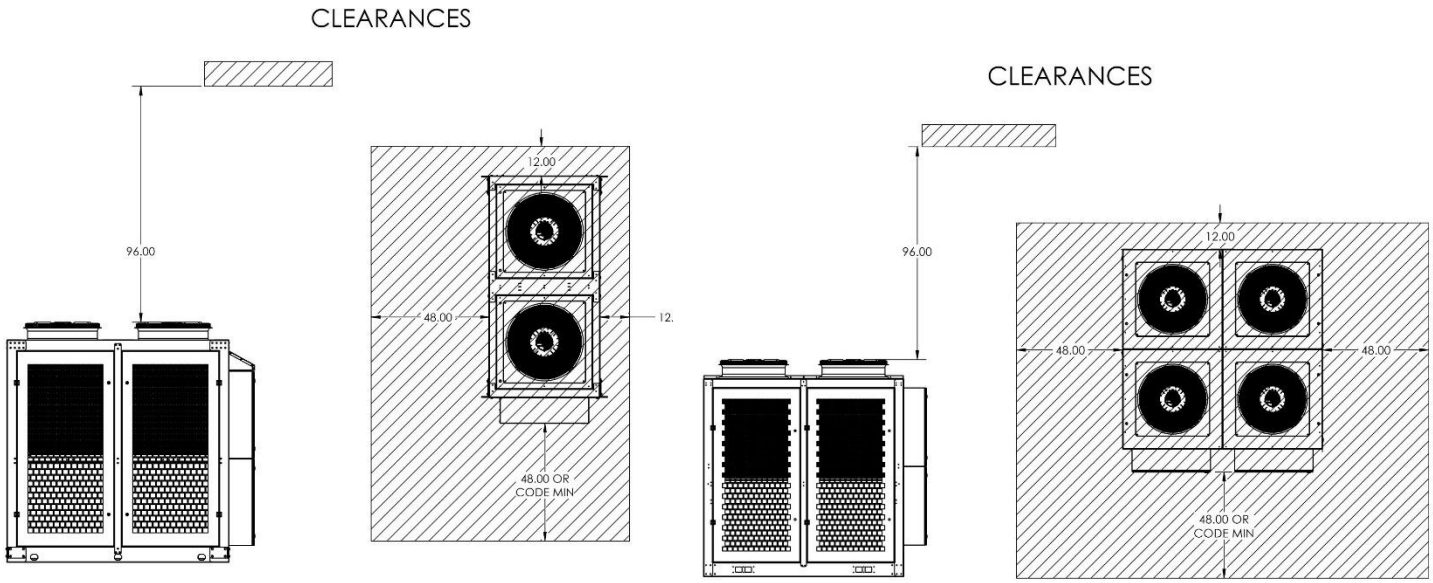
SETTING THE SYSTEM

Proper installation and placement of the system is important for overall performance of the system. It is advisable to install the system as close to the evaporator as practical, but away from windows or inhabited spaces, where noise or vibrations could become a nuisance. Typically, the sound level from a JTS machine is 85 dBA or less, as measured from 5’ away, but this could vary based upon the compressor selection(s), number of fans and the acoustics of the surrounding environment.

JTS systems must be placed on a level and rigid, non-warping mounting surface that can support the entire weight of the system. The entire weight would include the completed piping and weight of the refrigerant as well as any applicable working fluids (add fluid weight if chiller or water-cooled condensers are used). The mounting surface could be a solid, smooth, and level concrete foundation or a steel frame of adequate size and strength. The foundation should be designed to minimize vibrations, noise, and structural fatigue. Always refer to local building codes.

Serviceability is a primary concern when setting the system. Indoor systems typically require a minimum of 24" service clearance around the perimeter of the system. A clearance minimum of 36" is typically required around the perimeter of outdoor systems. Always refer to local building codes.

Adequate free air flow is essential to the performance of air-cooled condenser coils. Installing condensers in a pit should be avoided, as should installing under overhead awnings. If unavoidable, 96” minimum overhead clearance is required along with 36” on all air intake sides. JTS microchannel condensers are of all aluminum construction; care should be taken to avoid installing in an environment that may be corrosive to aluminum. JTS offers coil coatings if a corrosive environment is of concern.



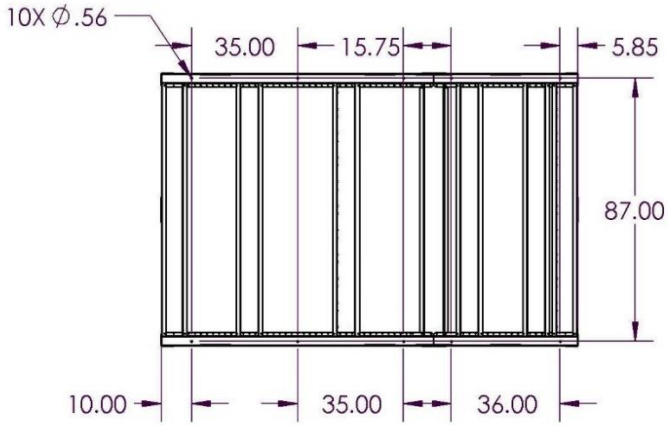
ISOLATION PADS

JTS recommends mounting the system on isolation pads when placed on steel structures connected to the roof of a building or on a concrete floor connected to the building. Pads must be installed before any piping is installed. Pad placement is dependent upon the pads used; pads have a pounds per square inch rating and should be evenly distributed around the frame. The number of pads required can be derived from the machine operating weight, the pad PSI and size of the pad. Outdoor systems do not require isolation pads if the foundation has a floating concrete pad independent of the main building or building structure.

ANCHORING

JTS equipment should be anchored to prevent shifting or changing of position. Mounting holes are provided in the underside of the base as shown below:

MOUNT LOCATIONS



REFRIGERATION PIPING

All piping from the factory or installed in the field should meet the specified JTS engineering requirements for material, diametric, and rated maximum working pressure. Piping must be installed in compliance with good piping practices. All piping and fittings shall be joined according to best piping practices so that the maximum working pressure of the pipe is not de-rated below the specified design working pressure.

REFRIGERATION PIPING REQUIREMENTS

1. ACR copper Type K or L based on size (Type L up to 1 3/8", Type K greater than 1 3/8" OD).
2. Copper piping must be brazed using SILVERPHOS 15 or equivalent (15% Silver).
3. Mechanical joints such as flare and compression fittings should be avoided wherever possible.

WATER AND GLYCOL PIPING REQUIREMENTS

1. ACR copper Type K, L, and M should be used unless otherwise specified. All joints shall be brazed or soldered.
2. Piping material other than copper may be used.

Before installing refrigeration lines, confirm load calculations to ensure piping supports will bear the entire weight of the refrigeration lines. The supports should be spaced so the line will not sag, which will minimize the possibility of refrigerant oil pooling in the suction line. Refrigerant suction lines should be pitched at least 1/2" per 10' in the direction of refrigerant flow. JTS recommends using vibration dampening style clamps. When hanging pipes, check specifications for pipe support.

Refrigerant lines must be purged with dry nitrogen to eliminate oxidation within the copper lines during brazing or welding. Suggested minimum flow rate is 2-3 cubic feet/hour (or 1.5-2.0 psi). It is critical to keep internal components and piping clean during installation. Without nitrogen purging, the oxidation residue will eventually be swept off the pipe walls by the polyolester oil (POE oil), causing the oil to become dirty and discolored. This residue will collect in the filters, thermostatic expansion valve screens, and other components, and may cause undesirable performance.

SUCTION LINE SIZING

Suction lines must be sized correctly to avoid excessive pressure drop, which will cause poor system performance, higher energy costs, and possible system damage. The overall pressure drop in suction lines must be kept to a minimum, typically 2°F maximum change in saturation temperature. Length of runs, elbows, suction control valves, suction-line filters, and accumulators must be factored into the overall pressure drop. All branch connections should tee into the top of the main horizontal suction lines. Suction lines must be sized based on total equivalent length of run from the evaporator to the compressors with minimal use of 90° elbows (long radius only). For more information, see ASHRAE piping guidelines.

Horizontal suction lines should be pitched in the direction of flow and sized to maintain 700 fpm velocity at minimum capacity. All branch connections should tee into the top of the main horizontal suction lines to avoid oil draining from a main suction line into a branch line during an off cycle or shutdown of the branch circuit.

Vertical suction risers should be sized to maintain 1,250 fpm at minimum capacity. Vertical suction risers greater than 4' tall will require a P-trap at the base to facilitate oil return. Vertical suction risers greater than 15' will require a P-trap every 15'. An inverted trap at the top of the riser is recommended. To avoid excess oil accumulation, oil traps should be as short as possible in length and depth. Oil traps can easily be configured with a long radius 90° elbow and two long radius 90° street elbows. Oil traps should always be the full pipe size as that of the main horizontal line and, if needed, reduced once the trap is directed upward.

If large capacity reductions within the system are expected, double risers should be considered. Double risers are sized so both lines equal the total cross-sectional area of a single riser appropriately sized for the maximum load at design conditions. The small riser is sized for 1,250 fpm, or greater, at minimum capacity, and the larger riser makes up the difference. When operating at minimum capacity, oil fills and seals the trap on the large riser allowing full flow to the small riser.

LIQUID LINE SIZING

Liquid lines must be sized so that a solid column of liquid is continuously delivered to the expansion valve with minimal pressure drop. If liquid line pressure drops below its saturation temperature (2°F or greater), the liquid will begin to flash off into vapor, which will cause poor system performance. Subcooling the liquid refrigerant will help avoid the possibility of vapor flashing off before the expansion valve, however, subcooling is not a good substitute for improperly sized liquid lines. For pump down systems, use velocities below 300 fpm to avoid the chance of hydraulic shock or liquid hammer from the cycling of the liquid-line solenoid. All liquid branch tee connections should be pulled from the bottom of the horizontal liquid lines or liquid loops to ensure a full column of liquid is supplied to the expansion valve. Never pull liquid branch circuits from a vertical rise liquid line.

For piping arrangements where the evaporator is higher in elevation than the condenser, the weight of liquid refrigerant adds pressure to the bottom of the liquid riser. At the top of the riser, there will always be less pressure. Carefully consider liquid pressure at the top of the riser when doing liquid line size calculations.

ELECTRICAL INSTALLATION

⚠ **CAUTION!** ELECTRICITY CAN BE DANGEROUS, ONLY QUALIFIED ELECTRICAL CONTRACTORS SHOULD SERVICE SYSTEMS.

Note: Electrical connections may loosen during shipment. The contractor must check and tighten all electrical connections.

ELECTRICAL DATA

For specific system data, always refer to the serial label located on the electrical enclosure near the main electrical feed. Main voltage typically operates between 480V-460V, 230V-240V, or 208V. Systems must operate within 10% of the rated voltage.

ELECTRICAL INSTALLATION

Field Wiring Note: Always follow the National Electrical Code (NEC) and local codes for field wiring. All field wiring should be completed by an experienced, licensed contractor.

SUPPLY POWER

Minimum circuit ampacity (MCA) and maximum over-current protection device (MOPD) are listed on the serial label. The field-supplied protective device must not exceed the listed MOPD value on serial label. Main power conductors must be sized based on the MOPD. The electrical contractor is responsible for proper sizing of all conductors. Always follow NEC and local codes when sizing main power conductors. Ground conductors must be sized based on the MOPD. The electrical contractor is responsible for proper grounding. Always follow NEC and local codes when sizing ground conductors.

SSCR

The Standard Short Circuit Current Rating of JTS equipment is 5kA. Higher ratings are available; however, the equipment must be special ordered and designed for higher SSCR ratings.

SENSOR INPUT WIRING

All field-wired inputs to system controllers should be wired with shielded cable to protect from noise associated with induced voltage. Always avoid running sensor wires parallel with high voltage wires, past lighting ballasts, motors, or other electrical devices. Field-wired sensors are indicated on the wiring diagram.

OTHER FIELD CONNECTIONS

Several field connections may be required for proper system operation. Field wiring is shown with dashed lines on electrical diagrams. All electrical diagrams should be examined thoroughly to ensure that all required connections are completed.

AUXILIARY EQUIPMENT

Only equipment represented by the serial label and wiring diagram should be connected to JTS a system.

PRE-START CHECK

SUPPLY POWER

Identify main voltage and control circuit voltage on the serial label.

Measure each leg of the main power supply voltage at the main power source. Voltage must be within +/-10%. If the measured voltage on any leg is not within the specified range, notify JTS and correct before operating the unit. Voltage imbalance must not exceed 2.0%. Excessive voltage imbalance between the phases of a 3-phase system can cause motors to overheat and eventually fail.

Measure and verify phase loss monitor. If an adjustable phase loss monitor is used, set trip delay to 0, reset delay to 180 seconds, and unbalanced load to 2%. If a phase monitor light is not green after power is applied, it indicates the phases are wrong or else there may be a safety lockout due to voltage tolerance or imbalance.

Reciprocating and scroll compressors are equipped with a crankcase heater that must be energized 24 hours before starting. The crankcase heater energizes when the compressor is off to ensure liquid refrigerant does not accumulate inside the compressor crankcase. Disconnecting main power causes the crankcase heater to lose power, only disconnect main power during system service.

Compact screw compressors also have a crankcase heater. Refrigeration screw compressors have oil heaters in the oil reservoir. Like crankcase heaters, oil heaters must be energized at least 24 hours in advance to compressor start.

CONTROL POWER

Identify control circuit voltage on the serial label. Measure and verify control voltage supply to the system. Check control amperage after start-up.

SYSTEM PRESSURE TESTING & EVACUATION

⚠ **WARNING!** DO NOT ATTEMPT TO START ANY COMPRESSORS UNTIL LEAK TESTING, EVACUATION AND REFRIGERANT CHARGING OF THE SYSTEM HAVE BEEN COMPLETED. LEAK TESTING AND PROPER EVACUATION ARE ESSENTIAL FOR A SUCCESSFUL START-UP. CONFIRM THAT MAIN POWER AND CONTROL POWER ARE SHUT OFF, ALL COMPRESSOR BREAKERS AND SWITCHES MUST ALSO BE OFF. THE COMPRESSOR CAN BE SERIOUSLY DAMAGED IF IMPROPERLY STARTED. ALWAYS FOLLOW LOCK-OUT/TAG-OUT PROCEDURES.

BEFORE LEAK AND PRESSURE TESTING VERIFY THE FOLLOWING

- The refrigeration system must be set and anchored securely in place.
- All system components must be installed, including evaporators, condensers, auxiliary heat exchangers, valves, and sensors.
- Field piping must be installed, properly supported, and all joints connected according to code.
- All isolation and ball valves must be opened.

- Solenoid valves must be open. For solenoids with manual opening stems, open the manual stem. Alternatively, solenoid magnets or energizing the coil are suitable methods for opening of solenoids valves during pressure testing / evacuation.
- Pressure testing and evacuation equipment must be in good repair and have been recently calibrated.

PRESSURE TESTING

The unit is pressure tested at the factory prior to shipping, but it must be checked again after installing field piping to ensure a tight and leak-free system. Make sure to account for ambient temperature change, which can affect system pressure.

1. Ensure all Schrader valves have caps and that all threaded fittings are tight.
2. Open all isolation valves, including solenoid valves.
3. Use dry nitrogen to pressure test the entire system.
4. The high side of the system could be pressure tested to a maximum of 90% of the receiver relief valve setting.
5. Pressurize the low side of the system no higher than design pressure as listed on the serial label.
6. The system should remain pressurized for at least 24 hours, or per local codes.
7. Check system pressure in multiple locations to confirm that the entire system is pressurized.

Any loss of pressure must be thoroughly investigated, the leak must be found and repaired. After a successful pressure test, the system should be opened to atmospheric pressure.

SYSTEM EVACUATION

Evacuate only after the system is confirmed to be leak free from a pressure test. Install the liquid filter driers, and all other filters at this time.

1. Ensure all Schrader valves have caps and that all threaded fittings are tight.
2. Confirm all isolation, service and solenoid valves are open.
3. Use a high-quality vacuum pump containing fresh, clean oil.
4. Observe check valve locations to ensure the entire system gets evacuated.
5. Continuously monitor the oil level and oil quality in the vacuum pump.

Evacuate to 500 microns, then allow the system to stand for 30 minutes. If pressure does not rise, the system is moisture and leak free. If pressure rises, there may be moisture or a leak in the system. If moisture is found, continued evacuation is required. If a leak, system must be re-pressure tested, find the leak and make the repair.

CHARGING PROCEDURE

Note: Before charging with refrigerant, the system must be evacuated. Break the vacuum with virgin refrigerant. The type of refrigerant used will be listed on the serial label.

1. Verify that all solenoid valves with manual stems are closed.
2. Only charge with liquid when using blended refrigerants (R404A, R407A, R448A).
3. Connect a bottle of refrigerant to a charging manifold and connect a charging hose to the charging port located on the liquid filter drier.

4. Purge air from hoses & manifold set. Low loss fittings are recommended.
5. While the unit is under a vacuum, break the vacuum with refrigerant until the system pressure rises above atmospheric pressure.
6. Continue to charge with liquid until the system is equalized and will not accept more refrigerant.
    a. As the refrigerant is charged, the bottle cools and internal pressure drops until no refrigerant can be further charged into the system. As much as 25% of the contents may remain in the bottle. A heat pad will increase the pressure in the bottle allowing faster and more complete yield from the bottle without running the compressor.
7. The estimated refrigerant capacity is 90% of the receiver plus liquid line volume.
8. The initial charge should be half the estimated refrigerant capacity.

The specific amount of refrigerant charge is different for each model and is highly dependent on field-installed piping. Actual system charge must be verified and documented after the system is running, all circuits are operating, expansion valves are set, and system has stabilized at design conditions.

COMPRESSOR

JTS systems may use reciprocating, scroll, or screw compressors. Since each compressor is different, the following instructions are general. Refer to the compressor manufacturer's manual for specific instructions.

- Ensure all individual compressor power switches are off.
- Ensure all compressor breaker/disconnects are off.
- Ensure all high voltage electrical connections to compressor are tight and torqued to manufacturers specifications.
- Ensure main supply power is correct at power distribution block and matches the compressor serial tag.
- Ensure voltage is correct at line side of compressor breaker/disconnect.
- Ensure compressor oil level is correct (typically 1/3 to 1/2 a sight glass).

OIL FAIL CONTROL

All oil fail controls must be tested to ensure that the compressor will be protected. To test the oil fail control, with the compressor breaker off, simulate a compressor start; once the contactor pulls in, the oil failure timing will begin, typically 30 seconds of no pressure will cause a trip. When the oil fail control trips, the compressor contactor should immediately drop out. To reset the oil fail control, cycle the "fault reset switch" or control circuit power.

OIL SEPARATOR

The oil separator, located in the discharge line, separates oil droplets from discharge gas. JTS uses several types of oil separators, including coalescent, centrifugal, and impingement. All separators must be primed with oil and is done so at the factory with oil that matches the compressor manufacturers recommendation. Check that the oil return components are installed correctly and that all threaded fittings are tight. The oil return solenoid should energize at same time as the compressor contactor.

OIL RESERVOIR

For parallel compressor systems, an oil separator/reservoir combo vessel is used. Oil is stored in the lower chamber and the level must be between the upper and lower sight glasses. Confirm that the oil level is satisfactory.

OIL PRESSURE REDUCING VALVE

For parallel compressor systems, oil is fed from the reservoir to a pressure reducing valve. The Y1236C valve is adjustable and used to set the oil pressure at a desired pressure that is somewhat higher than the suction pressure. Out of the box, Y1236C is set for 17 psi. One turn of the stem, in clockwise rotation, increases the pressure 2.5 psi. JTS recommends setting oil pressure 17 to 22 psi higher than suction pressure.

OIL LEVEL REGULATORS

For parallel compressor systems, oil is fed from the pressure reducing valve to individual regulators on each compressor. Follow the manufacturer's instructions for adjusting the oil level, and set according to compressor manufacturer's specifications, typically one-third to half of a sight glass.

PRESSURE CONTROLS

LOW PRESSURE CONTROL

The low-pressure control is field adjustable and recommended to be set per the table below. The minimum system temperature is the coldest point of the system; either the outdoor winter ambient or suction temperature, whichever is coldest. When possible, keep low-pressure cutout at positive pressure. When using refrigerants with glide, reference the dew point.

	R404A		R407A		R448A/449A	
Minimum System Temp	Max Cut-in	Cut-out	Max Cut-in	Cut-out	Max Cut-in	Cut-out
50	85	35	65	22	67	23
40	70	35	50	22	52	23
30	55	35	38	22	40	23
20	50	30	34	18	35	20
10	45	25	30	14	31	15
0	25	5	16	3" vac	15	1
-10	20	1	10	4" vac	11	4" vac
-20	12	1	3	4" vac	5	4" vac
-30	8	0	1	4" vac	2	4" vac
-40	3	4" vac	NA	NA	1	5" vac

HIGH PRESSURE CONTROL

1. Most JTS systems are equipped with a non-adjustable, encapsulated high-pressure switch.
2. Adjustable high-pressure switches should be set to a pressure that is below that of the receiver pressure relief valve.
3. JTS recommends and supplies high-pressure switches with manual reset as a standard.

OTHER CONTROLS

Review the wiring and the P&ID diagrams supplied with the JTS machine. There may be other controls that need to be set. The wiring diagram and P&ID will callout recommend initial setpoints.

LIQUID INJECTION

Low temperature compressors using high-glide refrigerants run hot and require liquid injection to help keep the motor cool. Refer to the compressor manufacturer's manual for operation and testing of liquid injection controls.

EVAPORATORS

- If evaporator fan motors or heaters are powered through a JTS machine, confirm that the voltage and amperage of the evaporator serial label matches that of JTS serial label.
- Confirm voltage at evaporator with a voltage meter. The voltage should match the voltage on the evaporator manufacturer's nameplate.
- Confirm fan rotation for all fans on 3-phase units. Make sure all fans are working and are not obstructed.
- Expansion Valves, either thermostatic (TEV or TXV) or an electronic (EEV) must be connected to the evaporator. Verify that the expansion valve is properly sized and installed correctly.

DEFROST

Defrost operation must be pre checked and adjusted by a qualified refrigeration contractor. An AC Indicator should be used to verify if a solenoid is energized or not.

ELECTRICAL DEFROST

Check the defrost termination & fan delay, at the evaporator, set to the manufacturer's specifications. Initiate defrost and confirm that the liquid solenoid valve de-energizes, and the evaporator heating elements energize. Defrost should terminate on its own. Defrost cycle time and duration is highly dependent upon the application, the defrost times will need to be set and adjusted once the system is running.

AIR DEFROST

Initiate defrost and confirm liquid solenoid valve de-energizes during the defrost cycle. Defrost cycle time and duration is highly dependent upon the application, the defrost times will need to be set and adjusted once the system is running.

3 PIPE HOT GAS DEFROST

Reference the P&ID diagram. Initiate defrost, confirm liquid solenoid valve de-energizes; simultaneously, the discharge, hot gas and boil out solenoid valves should energize. Defrost cycle time and duration is highly dependent upon the application, the defrost times will need to be set and adjusted once the system is running.

REVERSE CYCLE HOT GAS DEFROST

Reference the P&ID diagram. Initiate defrost, confirm liquid solenoid valve de-energizes; simultaneously, the 3-way, suction stop, and bypass valve should energize. Defrost cycle time and duration is highly

dependent upon the application, the defrost times will need to be set and adjusted once the system is running.

START-UP PROCEDURE

Ensure crankcase heater has run for 24 hours. Open isolation ball valves, turn on compressor circuit breakers, flip up “fault reset switch” and flip up “pump down switch”. If the room thermostat is calling for cooling, the liquid line solenoid will open, and the compressor will start.

START-UP CHECK LIST

Every JTS machine is supplied with a startup form for documenting start-up performance. This should be completed by a qualified refrigeration contractor and returned to JTS in a timely manner.

SHUTDOWN PROCEDURE

SHORT TERM (a week or less)

Flip down “pump down switch” to close liquid line solenoid and pump down the system. Once compressor cycles off, flip down the “fault reset switch”. Turn off compressor circuit breakers. Do not de-energize main power or the control circuit unless needed for service. Removing power means the crankcase heater will not be energized.

LONG TERM (seasonal operations)

Flip down “pump down switch” to close liquid line solenoid and pump down the system. Once compressor cycles off, flip down the “fault reset switch”. Turn off compressor and condenser fan circuit breakers. Close isolation valves. It is preferred to keep main power on, this will keep the crankcase heaters energized. Should main power be turned off, crankcase heaters will need to be energized at least 24 hours before the next compressor start. It is advised to have a qualified refrigeration contractor re-start JTS equipment after a long-term shutdown.

REFRIGERANT CHARGE

The initial charge as weighed in during pre-start, may not be enough. Use the below procedure to finalize the charge.

1. Only charge liquid with blended refrigerants (R404A, R407A, R448A).
2. Connect a bottle of refrigerant to a charging manifold and connect a charging hose to the charging port located on the liquid filter drier.
3. Purge air from hoses & manifold set. Low loss fittings are recommended.
4. Start the compressor and charge through the liquid filter.
5. With a condensing temperature above 80°F, charge liquid until the sight glass clears.
6. After charge is complete, initiate a pump down to verify the receiver has enough volume to hold the pump down charge.

SUPERHEAT SETTING

While the system is pulling down, monitor superheat at the compressor. Once the system has reached design conditions and is in a steady state, the superheat can be finely tuned. Typical superheat settings are 6-8°F. A minimum of 20°F superheat and a maximum of 40°F superheat is allowed at the compressor. Be careful when using high glide refrigerants, ensure superheat is set with reference to the dew point.

MAINTENANCE

FILTER MAINTENANCE

Liquid filter cores must always be in place during system operation. Anytime the system is open to the atmosphere, drier cores should be replaced. A vacuum must be pulled after changing cores and before restarting system.

Suction filter elements should be used for the first several days after startup. The filter will most likely have caught debris during installation. Suction filter elements create pressure drop and should be removed after two weeks of continuous operation. Suction filter cores should be installed anytime a major repair event occurs. A vacuum must be pulled after changing filters and before restarting the system. If the system becomes contaminated, various suction filters are available to remove moisture, acid, or other contaminants from the system. After the system is clean, remove the suction filter.

Coalescent oil separator elements must always be in place. Oil separator filter elements should be replaced when the indicator needle approaches the upper range (12 psi). When experiencing oil issues, replace with the oil filter.

START-UP FOLLOWUP

Two weeks after continuous operation, perform the following:

- Remove suction filter element.
- Check coalescing oil separator filter differential gauge.
- Check oil levels in compressor & oil reservoirs, top off if needed.
- Observe superheat at compressors and adjust if necessary.
- Verify the evaporator is defrosting properly, adjust if needed.

LOSS OF OIL CHARGE

- It is typical to lose some of the initial oil charge during the first several days of operation; the internal walls of piping, pressure vessels and heat exchangers will have a thin film of oil; P-traps on the suction line will consume the most of the lost oil.
- If a system continuously loses oil, don't keep adding oil; find out where the oil is going. Oil may be accumulating in the low side of the system if there is inadequate suction velocity for oil return. Oil loss can also be a symptom of liquid flood back – so check your superheat.

⚠ **WARNING!** CONTINUOUSLY ADDING OIL MAY RESULT IN AN OIL SLUG, WHICH COULD DAMAGE A COMPRESSOR.

⚠ **WARNING!** OIL LOSS FAULTS COULD BE A SYMPTOM OF LIQUID FLOODBACK, WHICH COULD DAMAGE A COMPRESSOR.

MECHANICAL MAINTENANCE

PERFORM MECHANICAL MAINTENANCE EVERY 3 MONTHS.

- Ensure all piping clamps are tight.
- Listen for vibration, rattling, and other abnormal sounds.
- Visually inspect for signs of oil leakage.
- Check receiver refrigerant level.
- Check moisture indicating sight glass, is it bubble & moisture free?
- Check oil levels in compressors and oil reservoirs.
- Inspect compressor mounting bolts.
- Observe superheat at compressors and adjust if necessary.

ELECTRICAL MAINTENANCE

Turn off all power and comply with lock-out tag-out procedure. Perform electrical maintenance once per year.

- Check compressor contactors for excessive pitting of contacts.
- Check and tighten high-voltage wiring.
- Check and tighten low-voltage wiring.
- Check and measure supply voltages.

CONTROL MAINTENANCE

Perform control maintenance once per year.

- Check and tighten electrical connections to the controls.
- Inspect and test oil fail controls.
- Inspect and test low-pressure/high-pressure controls.
- Inspect and test phase loss monitor.
- Measure amperage on crankcase heater.

CONDENSER MAINTENANCE

Condensers should be cleaned quarterly, or more frequently, if in an environment prone to fouling. Perform condenser maintenance every 3-6 months.

- Microchannel condensers are particularly susceptible to cottonwood and other fibrous materials; contaminants tend to build on the face of the coil and can inhibit air flow.

Removal is simple, debris can be unpeeled, like removing lint from the filter of your drier at home.

- Check fan motors for air flow; do all the fans still work?
- Check fan motors for excessive noise or unusual vibrations.
- Check condensers and piping for leaks, often a pool of oil indicates a leak.
- Clean condenser coils and cabinet with garden hose and low-pressure spray wand, using only fresh clean water. Avoid control spraying water on control and power enclosures.

OIL SYSTEM MAINTENANCE

Perform oil system maintenance every 3-6 months.

- Inspect the oil for discoloration or dirtiness.
- Check for oil leaks.
- Check oil in compressors and oil reservoir for proper level.
- Check coalescent oil separator differential gauge.

GLOSSARY

ACCUMULATOR is a pressure vessel on the suction line that protects the compressor from trying to compress unevaporated liquid refrigerant.

AC INDICATOR is a tool that is sensitive to magnetic fields. When placed on an energized solenoid coil, the indicator will spin. AC indicators can also be used to verify the rotation of a pump.

BALL VALVE is a type of valve used for the isolation of refrigeration piping.

CHARGING VALVE is installed on the liquid filter shell and used to add or remove refrigerant. Most access ports are ¼", a charging valve is 3/8" it can add or remove refrigerant faster.

CHECK VALVE is used in refrigeration piping to allow flow to only travel in one direction.

CIRCUIT BREAKER is located inside the power enclosure and is used to protect the compressor and condenser fans from over current.

COMPRESSOR is the heart of the refrigeration system, pumping refrigerant through the system. Compressors pictured above, from left to right: reciprocating compressor, refrigeration screw compressor and compact screw compressor.

CONDENSER is a type of heat exchanger used to reject refrigerant heat. As the heat is removed, it condenses from a gas into a liquid. JTS uses microchannel condensers for their high heat transfer rates, low charge requirements, and low leak rates.

CONDENSER FAN moves air through an air-cooled condenser. JTS applies Electrically Commutated Motors, ECM, in variable speed applications to maintain condensing temperature on cold days and maximize energy efficiency.

CONTACTOR is located inside the power enclosure and is used to start and stop the compressor.

CONTROL CIRCUIT BREAKER is in the power enclosure and used to protect the control circuit from over current.

CRANKCASE HEATER is plugged into the bottom of reciprocating compressors. Its job is to keep the compressor warm when the compressor is off.

CPR VALVE is a pressure actuated control valve that tries to maintain constant suction pressure to the compressor.

DEFROST TIMER is used to defrost evaporators on an automated time schedule.

DEFROST TERMINATION FAN DELAY is located on the evaporator and used to stop defrost when its complete. It also delays the fans from starting until condensate can re-freeze.

DISCONNECT is a power switch used to turn on and off power to the entire machine. Left image: Thru door disconnect installed by JTS. Right image: external disconnect field installed.

ELECTRIC DEFROST HEATER is a tubular heating element that gets hot when energized. Its job is to melt any frost or ice that builds on the evaporator.

ELECTRICAL ENCLOSURE is a cabinet that houses electrical components and wiring.

ELECTRONIC EXPANSION VALVE is an electronic valve that precisely controls the rate of evaporation within the evaporator. The EEV sets the superheat.

EVAPORATOR is a heat exchanger that absorbs heat by boiling and vaporing liquid refrigerant. It's the cold part of a refrigeration system.

FILTER SHELL is a component that houses a filter element, which is used to clean or dehydrate a refrigeration system.

LIQUID RECEIVER is a pressure vessel used to store high pressure liquid refrigerant.

MOISTURE INDICATING SIGHT GLASS is a component on the liquid line used for charging and system diagnostics. If you see bubbles, it is an indication that the system is undercharged with refrigerant and the possible presence of a leak. Observe the color indicator to see if there is moisture in the system, or if it is dry.

OIL FAIL CONTROL is a safety that prevents reciprocating compressors from running without lubrication. The oil failure control is mounted directly to the compressor and can be replaced without opening the system.

OIL DIFFERENTIAL GAUGE is a pressure gauge used as an indication for when to change oil filter element on a coalescing oil separator.

OIL LEVEL REGULATOR sometimes called an oil float, is used to set the oil level in reciprocating compressors when multiple compressors are piped in parallel.

OIL SEPARATOR is a pressure vessel located on the discharge line; it is used to separate oil from refrigerant. Captured oil is returned to the compressor.

P315 FAN SPEED CONTROLLER is used on systems without electronic system controllers. The P315 is located on the compressor discharge line, it converts discharge pressure into a 0-10v signal that is used to control the condenser fan speed. The adjustment screw is used to set pressure high or lower.

PHASE LOSS MONITOR is an electrical safety used to monitor and protect from power supply variances that could cause damage to system components.

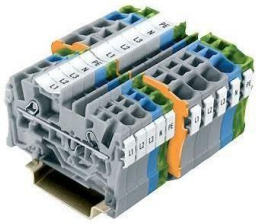
POWER DISTRIBUTION TERMINAL BLOCK is an electrical component used to transfer high voltage power to multiple branches.

PRESSURE RELIEF CHANGE OVER VALVE is a valve that allows you to service the pressure relief valve without opening the system.

PRESSURE RELIEF VALVE is installed on the liquid receiver and used to vent refrigerant should the system become over pressurized. The high-pressure switch should be set lower than the pressure relief valve.

PRESSURE SWITCH is a device that opens and closes an electrical signal based upon its setpoint and the pressure it reads. From left to right: adjustable pressure switch, non-adjustable encapsulated pressure switch.

RECEIVER LEVEL GAUGE is a device that is used to measure and monitor the liquid level inside a receiver. A low level could indicate a refrigerant leak or flooded condition in suction line.



TERMINAL BLOCK is an electrical component used for landing and organizing wires.

THERMOSTAT is an electrical switch that opens, or closes based upon its setpoint and the temperature it reads. From left to right: electronic T-Stat, mechanical T-Stat.

THERMOSTATIC EXPANSION VALVE is a mechanical valve that controls the rate of evaporation within the evaporator. Its known as TXV or TEV, its job is to set the superheat.

SCHRADER VALVE is a service valve used for charging, evacuating, purging and pressure sensing of refrigeration piping.

SOLENOID VALVE is a refrigeration piping component that shuts off or allows refrigerant flow. Normally closed solenoid valves are most common, when electrically energized normally closed valves open, allowing refrigerant to flow.

SUCTION STRAINER is a component that filters large debris from the suction line, protecting the compressor.

Y1236C VALVE is a pressure reducing valve used to lower oil pressure to slightly higher than suction pressure.