AMP

INSTALLATION, MAINTENANCE & DECOMMISSIONING

AIR SOURCED MODULAR HEAT PUMPS

60335-2-40

Intertek

ASHRAE

A2L COMPATIBLE

MADE IN U. S. A.

R-454B

REVISION: NOV. 2025

ENGLISH

WARNING

Only qualified personnel should install and service the equipment. The installation, starting, and servicing of equipment can be hazardous and requires specific knowledge and training. Improperly installed, adjusted or altered equipment by an unqualified person could result in death or serious injury. When working on the equipment, observe all precautions in the literature and on the tabs, stickers, and labels that are attached to the equipment. Servicing should only be done with power supplies switched off and locked out.

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MODEL & SERIAL NUMBER IDENTIFICATION TABLE

For future reference, fill out the table below in the case that the name plate becomes separated from the equipment. Before contacting American GeoThermal for technical support or parts requests, be prepared to have the following information available. Refer to each module nameplate for the model & serial number. Additional information regarding model nomenclature in Section 2 of this manual.

MODULE NO.	MODEL NO.	SERIAL NO.
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

EQUIPMENT DELIVERY

Verify the model number of each model with the bill of lading. Inspect the equipment and any additional packages upon delivery for shipping related damages. If damage is suspected, contact the motor carrier and American GeoThermal immediately. All damages must be noted on the bill of lading unless internal damage is found after unboxing. It is the responsibility of the customer to contact American GeoThermal within 5 days of

delivery if equipment is damaged during shipping. Do not proceed with installation of damaged equipment without approval of American GeoThermal.

EXTENDED STORAGE

If the equipment must be stored prior to installation, the following requirements must be met to ensure damage does not occur. American GeoThermal is not responsible for preparing the equipment for such storage. If the equipment must be transported long distances or via ocean freight, the manufacturer must be notified prior to shipment. Special instruction may be given on a case by case basis. All equipment is quality tested at the factory prior to shipment, small amounts of water may be lingering in the bottom section of the coil. WARNING– Heat exchanger may bust if the below procedure is ignored.

1. For equipment containing brazed plate heat exchangers i.e. the model number shows “S” or “D” in the 14th digit (not including the underscore) must be winterized using a glycol solution if storage conditions are less than 32° F (0°C). Refer to Section 10 of this manual for instructions on proper winterizing.
2. Proper precautions must be taken to prevent rodents from entering the equipment. For example, a shrink wrap film must be applied to the equipment for long term protection.
3. Moisture absorbent packs must be placed in and around the electrical panel, variable speed drives or any electrical containing components to prevent corrosion or degradation.

American GeoThermal is not responsible for warranty claims as a result of improper storage.

INSTALLATION SITE PERPARATION

Refer Section 3 for details on clearance requirements. It is imperative that the heat pump has available air flow to the coils for proper performance. Never block or restrict the air flow to the coils. Additionally, there should be no overhead obstacles blocking or restricting the discharge of the fans. The unit must be mounted on a solid and even surface or rail system that adequately supports the equipment. Consult with a certified structural engineer (PE) to determine if the proposed site is safe for installation. Equipment mounted on rooftop curbs should meet the minimum requirements outlined in Section 3. Vibration pads should be used to mitigate the equipment's vibration and when required, spring isolators may be used between mounting rails and the adjacent surface. Never install spring isolators between the equipment and the mounting rails.

WARNING

FLAMMABLE REFRIGERANT

FAILURE TO FOLLOW THE FOLLOWING WARNINGS COULD RESULT IN SERIOUS BURNS, INJURY OR DEATH.

- **RISK OF FIRE**, Flammable refrigerant used. To be repaired only by trained service personnel. Do not puncture refrigerant tubing.
- Do not use means to accelerate the defrosting process or to clean, other than those recommended by the manufacturer. The appliance shall be stored in a room without continuously operating ignition sources. For example, do not install or store in an equipment room with open flames, an operating gas appliance or an operating electric heater.
- Do not pierce or burn.

- **NO ODOR** Be aware that refrigerants may not contain an odor.

- **UNVENTED AREAS** - Do not install in unvented areas. For equipment installed in mechanical rooms, the room should be constructed so that in the case of a refrigerant leak, refrigerant will not stagnate so as to create a fire or explosion hazard. Equipment rooms should be equipped with leak detection systems and include the proper notification systems.

- **SERVICE PERSONNEL** - All service personnel should be trained to service equipment containing A2L refrigerants. The achieved competence should be documented by a certificate and kept on file by the employing company.

SERVICING NOTICE

THE FOLLOWING PROCEDURES SHOULD BE FOLLOWED PRIOR TO SERVICING EQUIPMENT CONTAINING FLAMMAMBLE REFRIGERANT. FAILURE TO DO SO CAN RESULT IN SERIOUS INJURY OR DEATH.

- **CHECKS TO THE AREA** - Prior to beginning work on equipment, safety checks are necessary to ensure that the risk of ignition is minimized.

- **WORK PROCEDURE** - Work shall be undertaken under a controlled procedure so as to minimize the risk of a flammable gas or vapor being present while the work is being performed. All maintenance staff and others working in the local area shall be instructed on the nature of work being carried out. Work in confined spaces shall be avoided.

- **PRESENCE OF REFRIGERANT** - The area shall be checked with an appropriate refrigerant detector prior to and during work, to ensure the technician is aware of potentially toxic or flammable atmospheres. Ensure that the leak detection equipment being used is suitable for use with all applicable refrigerants, i.e. non-sparking, adequately sealed or intrinsically safe.

- **FIRE EXTINGUISHER** - If any hot work is to be conducted on the refrigerating equipment or any associated parts, appropriate fire extinguishing equipment shall be available within arms reach. Have a dry powder or CO_2 fire extinguisher adjacent to the charging area.

- **NO IGNITIOIN SOURCES** - No person carrying out work in relation to a refrigerating system which involves exposing any pipe work shall use any source of ignition in such a

WARNING

manner that it may lead to the risk of fire or explosion. All possible ignition sources, including cigarette smoking, should be kept sufficiently far away from the site of installation, repairing, removing and disposal, during which refrigerant can possibly be released to the surrounding space. Prior to work taking place, the area around the equipment is to be surveyed to make sure that there are no flammable hazards or ignition risks. "No smoking" signs shall be displayed at the location of installation.

- **VENTILATED AREA** - Ensure that the area is in the open or that is adequately ventilated before breaking into the system or conducting any hot work. A degree of ventilation shall continue during the period that the work is carried out. The ventilation should safely disperse any released refrigerant and preferably expel it externally into the atmosphere.

- **CHECKS TO THE EQUIPMENT**
  1. Refrigerant charge (in lbs. or kgs.) is in accordance with the room size within which the refrigerant containing parts are installed.
  2. The ventilation machinery and outlets are operating adequately and are not obstructed.
  3. If an indirect refrigerating circuit is being used, the secondary circuit shall be checked for the presence of refrigerant, i.e. split systems only.
  4. Marking to the equipment continues to be visible and legible. Markings and signs that are illegible shall be corrected.
  5. Refrigerating pipe or components are installed in a position where they are unlikely to be exposed to any substance which may corrode the refrigerant containing components, unless the components are constructed of materials which are inherently resistant to being corroded or are suitably protected against being corroded.

- **CHECKS TO ELECTRICAL COMPONENTS** - Repair and maintenance to electrical components shall include initial safety checks and component inspection procedures. If a fault exists that could compromise safety, then no electrical supply shall be connected to the circuit until it is satisfactorily secured. IF the fault cannot be corrected immediately but it is necessary to continue operation, an adequate temporary solution shall be used. This shall be reported to the owner of the equipment, all parties are to be advised. Particular attention shall be given to ensure that by working on electrical components, the casing is not altered in such a way that the level of protection is affected. This shall include damage to cables, excessive number of connections, terminals not made to original specification, damage to seals, incorrect fitting of glands, etc. In addition, ensure that seals or sealing materials have not degraded to the point that they no longer serve the purpose of preventing the ingress of flammable atmospheres. Replacement parts shall be in accordance with the manufacturer's specifications. Check that cabling will not be subject to wear, corrosion, excessive pressure vibration, sharp edges or any other adverse environmental effects. The check shall also take into account the effects of aging or continual vibration from sources such as compressors, fans, or any other rotating component.

- **LEAK DETECTION** - Under no circumstances shall potential sources of ignition be used in the searching for or detection of refrigerant leaks. A halide torch (or any other detector using a naked flame) shall not be used. Electronic leak detectors may be used to detect refrigerant leaks but, in the case of flammable refrigerants, the sensitivity may not be adequate, or may need recalibration. (Detection equipment shall be calibrated in a refrigerant-free area.) Ensure that the detector is not a potential source of ignition and is suitable for the refrigerant used. Leak detection equipment shall be set at a percentage of the LFL of the refrigerant and shall be calibrated to the refrigerant employed, and the appropriate percentage of gas (25% maximum) is confirmed. Leak detection fluids are also

WARNING

suitable for use with most refrigerants but the use of detergents containing chlorine shall be avoided as the chlorine may react with the refrigerant and corrode the copper pipe-work. If a leak is detected, all naked flames shall be removed/ extinguished. If a leakage of refrigerant is found which requires brazing, all of the refrigerant shall be recovered from the system, or isolated (by means of shut off valves) in a part of the system remote from the leak.

- **REMOVAL AND EVACUATION** - When breaking into the refrigerant circuit to make repairs - or for any other purpose - conventional procedures shall be used. However, for flammable refrigerants it is important that best practice is followed since flammability is a consideration. The following procedure shall be adhered to:
  1. Evacuate refrigerant using non spark recovery machinery only.
  2. Purge the circuit with inert gas and continue purging when using a flame to open or service an open circuit.
  3. Open the circuit by cutting or brazing.

  NOTE: If part of the system remains charged i.e. using isolation valves to separate the refrigerant from the section of the piping being worked on, the following procedure should be supplemented:
  1. Isolate the refrigerant from the section containing the leak or the component being serviced. Only use the factory provided ball valves or isolation valves located on the liquid line or receiver. Do not attempt to service a component within 2 feet (free air or along the pipe length) of the isolated refrigerant as this can result in an explosion. If the repair being made is questionable, remove all of the refrigerant.
  2. Ensure that the ball valves or isolation valves are in proper working condition. Use a leak detection system to ensure that flammable refrigerant isn't leaking past the ball valves. For example, Testo digital manifolds contain leak detection software that measures pressure loss as a function of time. This method may be used however, the detection system should be employed for a minimum of 1 hr.
  3. Evacuate refrigerant using non spark recovery machinery only.
  4. Purge the circuit with inert gas and continue purging when using a flame to open or service an open circuit.
  5. Open the circuit by cutting or brazing.

  The Refrigerant charge shall be recovered into the correct recovery cylinders if venting is not allowed by local and national codes. For equipment containing flammable refrigerants, the system shall be purged with oxygen-free nitrogen to render the appliance safe for flammable refrigerants. This process might need to be repeated several times. Compressed air or oxygen shall not be used for purging refrigerant systems. Ensure that the outlet for the vacuum pump is not close to any potential ignition sources and that ventilation is available. Additionally, refrigerant purging shall be achieved by breaking the vacuum in the system with oxygen-free nitrogen and continuing to fill until the working pressure is achieved, venting to atmosphere and finally, pulling down to a vacuum. This process shall be repeated until no refrigerant is within the system. When the final oxygen-free nitrogen charge is used, the system shall be vented down to atmospheric pressure to enable work to take place.

- **CHARGING** - To ensure the safety of the service technician, the following must be completed prior to charging. Prior to recharging the system, it shall be pressure tested with the appropriate purging gas. The system shall be leak-tested on completion of charging but prior to commissioning. A follow-up leak test shall be carried out prior to leaving the work site.

WARNING

1. Earth bonds are maintained during all service work.
2. All disconnects and power sources to the equipment have been properly deenergized and any live or exposed wiring has been properly secured.
3. Ensure that contamination of different refrigerants does not occur when using charging equipment. Hoses or lines shall be as short as possible to minimize the amount of refrigerant contained in them.
4. Cylinders shall be kept in an appropriate position according to the instructions.
5. Label the system when charging is complete (if charge is different than factory charge.)
6. Extreme care shall be taken not to overfill the refrigerating system.

- **DECOMMISSIONING** - Before carrying out the procedure, it is essential that the technician is completely familiar with the equipment and all it's detail. "Good Practice" methods are recommended when refrigerants are recovered. Prior to the task being carried out, an oil and refrigerant sample shall be taken in case analysis is required prior to re-use of recovered refrigerant. It is essential that electrical power is available before the task is commenced.

  1. Become familiar with the equipment and its operation.
  2. Isolate the system electrically.
  3. Before attempting the procedure, ensure that; mechanical handling equipment is available, all personal protective equipment is available and being used correctly, the recovery process is supervised at all times by a competent person, recovery equipment and cylinders conform to the appropriate standards.
  4. Pump down refrigerant system, if possible.
  5. If a vacuum is not possible, make a manifold so that refrigerant can be removed from various parts of the system.
  6. Make sure that cylinder is situated on the scales before recovery takes place to ensure all charge is removed.
  7. Start the recovery machine and operate in accordance with instructions.
  8. Do not over fill cylinders (no more than 80% volume liquid charge)
  9. Do not exceed the maximum working pressure of the cylinder, even temporarily.
  10. When cylinders have been filled correctly and the process completed, make sure that the cylinders and the equipment are removed from site promptly and all isolation valves on the equipment are closed off.
  11. Recovered refrigerant shall not be charged into another refrigerating system unless it has been cleaned and quality checked.

- **DECOMMISSIONED LABELING** - Equipment shall be labelled stating that it has been decommissioned and emptied of refrigerant. The label shall be dated and signed. For equipment containing flammable refrigerant, ensure that there are labels on the equipment stating the equipment contains flammable refrigerant.
- **RECOVERY** - When removing refrigerant from a system, either for servicing or decommissioning, it is recommended good practice that all refrigerants are removed safely. When transferring refrigerant into cylinders, ensure that only appropriate refrigerant recovery cylinders are employed. Ensure that the correct number of cylinders for holding the total system charge is available. All cylinders to be used are designated for the recovery refrigerant and labelled for that refrigerant (i.e. special cylinders for the recovery of refrigerant). Cylinders shall be complete with pressure-relief valves and associated shut-off valves in good working order. Empty recovery cylinders are evacuated and, if possible,

WARNING

cooled before recovery occurs. The recovery equipment shall be in good working order with a set of instructions concerning the equipment that is at hand and shall be suitable for the recovery of all appropriate refrigerants including, when applicable, flammable refrigerants. In addition, a set of calibrated weight scales shall be available and in good working order. Hoses shall be complete with leak-free disconnect coupling and in good working condition. Before using the recovery machine, check that it is in satisfactory working order, has been properly maintained and that any associated electrical components are sealed to prevent ignition in the event of refrigerant release. Consult with the American GeoThermal service department if in doubt. Recovered refrigerant shall be returned to the refrigerant supplier in the correct recovery cylinder, and the relevant waste transfer not arranged. Do not mix refrigerants in recovery units and especially not in cylinders. If compressors or compressor oils are to be removed, ensure that they have been evacuated to an acceptable level to make certain that flammable refrigerant does not remain within the lubricant. The evacuation process shall be carried out prior to returning the compressor to the suppliers. The compressor body shall not be heated by an open flame or other ignition sources to accelerate this process. When oil is drained from a system, it shall be carried out safely.

For any questions or concerns regarding the safe installation, service, or decommissioning of refrigerating equipment, contact the American GeoThermal service department. When in doubt, stop and reassess the situation before attempting to service any and all equipment, especially those containing flammable refrigerants.

CAUTION

WORKING MECHANICAL LIMITS

- Equipment must not be installed in altitudes greater than 6561.7 ft or 2000 meters. If equipment must be installed at higher elevations, contact the manufacturer as the ambient operating conditions may be derated.
- Fluid circuit pressure must not exceed 125 psi (861.8 kPa)
- Units connected directly to water mains must not exceed 125 psi (861.8 kPa)
- Units must not be connected to any pressurized fluid system using flexible hosing.
- Fluid circuit water temperature limitations; 32°F (0°C) minimum / 160°F (71.1°C)

TRANSPORTATION & STORAGE

- Additional transportation regulations may exist with respect to equipment containing flammable gasses. To determine the maximum number of units to be transported at once, refer to the unit nameplate for the refrigerant charge (per module) and transport regulators. Local restrictions may differ from the state of manufacture. Do not assume the equipment transfer status on the premise that the equipment was once delivered.
- Storage package protection should be constructed in such a way that mechanical damage to the equipment inside the package will not cause a leak of the refrigerant charge. The maximum number of pieces of equipment permitted to be stored together will be determined by local regulations. Refer to the equipment nameplate for refrigerant charge (per module).

WARNING

TRAINED AND CERTIFIED PERSONNEL ONLY. ANY DISREGARD OF THE FOLLOWING NOTICES OR WARNINGS CAN RESULT IN SERIOUS HARM OR DEATH. THE EQUIPMENT IS NOT TO BE USED BY PERSONS (INCLUDING CHILDREN) WITH REDUCED PHYSICAL, SENSORY OR MENTAL CAPABILITIES, OR LACK OF EXPERIENCE AND KNOWLEDGE, ULESS THEY HAVE BEEN GIVEN SUPERVISION OR INSTRUCTION. CHILDREN SHOULD BE SUPERVISED TO ENSURE THAT THEY DO NOT PLAY WITH THE EQUIPMENT.

PERSONAL PROTECTIVE EQUIPMENT REQUIRED

PPE

Failure to wear proper PPE for the job being undertaken could result in death or serious injury. Technicians, in order to protect themselves from potential electrical, mechanical, and chemical hazards, MUST follow precautions in this manual and on the tags, stickers, and labels, as well as the instructions below:

- Before installing/ servicing this unit, technicians MUST put on all PPE required for the work (Examples; cut resistant gloves/ sleeves, safety glasses, hard hat/bump cap, fall protection, electrical PPE, and arc flash clothing) ALWAYS refer to appropriate Material Safety Data Sheets and OSHA guidelines for proper PPE.
- NEVER perform any switching, disconnect, or voltage testing without proper electrical PPE and arc flash clothing. Ensure electrical meters and equipment are properly rated for intended voltage.

ELECTRICAL SHOCK HAZARD

Failure to follow this warning could result in personal injury or death. Before installing, modifying, or servicing system, main electrical disconnect switch must be in the OFF position. There may be more than 1 disconnect switch. Lock out and tag switch with a suitable warning label.

EXPLOSION HAZARD

Failure to follow this warning could result in personal injury, death and/or property damage. Never use air or gases containing oxygen for leak testing of operating refrigerant compressors. Pressurized mixtures of air or gases containing oxygen can lead to an explosion.

HOT SURFACES

Failure to follow this warning could result in personal injury or death. This equipment contains hot surfaces when in normal operation or when powered. Resistive heaters are installed around the sump of the compressors to prevent liquid migration. In some cases, heat trace is installed on fluid circuits to prevent freezing. In extreme low ambient conditions, resistive heating elements are installed electrical panels to prevent components from freezing. Refer to model nomenclature to determine if these components are installed prior to servicing.

ROTATING PARTS

Failure to follow this warning could result in personal injury or death. Never attempt to service while in normal operation, this equipment contains live rotating parts and motors. Do not climb on top of unit as fan blade can blow debris at high velocities.

SUPERVISION

Under no circumstance should a child be left unsupervised in the installation area of this equipment. Children should always be supervised to ensure they do not play with the equipment.

AUTORIZED PERSONNEL ONLY

This equipment contents pose multiple hazards. This equipment should not be installed in a place that is accessible to the general public. If the equipment must be installed in such a place, the proper fencing should be installed to prevent unintentional entrance to the site.

INSTALLATION NOTICES

SAFETY CONSIDERATIONS

ONLY INSTALL EQUIPMENT ONCE THE ENTIRE EQUIPMENT MANUAL HAS BEEN REVIEWED. THIS EQUIPMENT POSES MULTIPLE HAZARDS INCLUDING FLAMMABLE GASES, ELECTRIC SHOCK AND ROTATING PARTS.

Improper installation, adjustment, alteration, service, maintenance, or use can cause explosion, fire, electrical shock, or other conditions which may cause death, personal injury, or property damage. Consult a qualified installer, service agency, or your distributor or branch for information or assistance. The qualified installer or agency must use factory−authorized kits or accessories when modifying this product. Refer to the individual instructions packaged with the kits or accessories when installing. Follow all safety codes. Wear safety glasses, protective clothing, and work gloves when necessary. Use quenching cloth or heat absorbent materials for brazing operations. Never braze on a system when refrigerant charge is present and always have fire extinguisher available. Read these instructions thoroughly and follow all warnings or cautions included in literature and attached to the unit. Consult local building codes and current editions of the National Electrical Code (NEC) NFPA 70. In Canada, refer to current editions of the Canadian electrical code CSA 22.1.

EQUIPMENT ELECTRICAL DISCONNECTS

When installing equipment, a service disconnect must be installed in the fixed wiring in accordance with local electrical code.

CLEARANCE REQUIREMENTS

When installing, allow sufficient space for airflow clearance, wiring, refrigerant piping, and service. Allow 36 in. clearance to service end of unit and 72in. above unit without any major air flow obstructions. For proper airflow, a 48in. clearance on all remaining sides must be maintained. Position so water, snow, or ice from roof or eaves cannot fall directly on unit. Never install equipment indoors or in areas with improper venting to the environment.

EQUIPMENT PLACEMENT

Equipment MUST be installed on a level and solid surface or on rails intended for chiller installation. Consult with the American GeoThermal service department for additional installation requirements when installing equipment on rail systems. Failure to do so can result in improper oil distribution in compressors and will terminate factory warranty. Anchor bolts must be used in the provided locations on each of the mounting feet *(refer to fig. 1 for details)*. For hurricane tie downs, contact a local distributor for details and PE *(professional Engineer)* certification, if required by local authorities. On rooftop applications, mount on level platform or frame. Place unit above a load−bearing wall and isolate unit and piping set from structure. Arrange supporting members to adequately support unit and minimize transmission of vibration to building. Consult local codes governing rooftop applications.

COMPRESSOR CRANKCASE HEATER

When equipped with a crankcase heater, furnish power to heater a minimum of 12 hrs. before starting unit. To apply power to the heater only, set low voltage breaker (CB6) to off and the compressor breakers (CB1 and CB2) to the on position. Close all cabinet covers during the waiting period to prevent burns or electrical shock.

3 - PHASE MONITOR

In 3 - phase equipment, a small circuit board is factory installed to prevent incorrect rotation of motors. A small LED will flash if a phase problem exists. Depower the equipment by switching the appropriate disconnect and interchange two of the field wiring leads on the distribution block.

RESPONSIBLE REFRIGERANT PRACTICES

Responsible refrigerant practices are important to the environment, our customers, and the industry. All technicians who

INSTALLATION NOTICES

handle refrigerants must be certified according to local codes. For the USA, the federal Clean Air Act (section 608) sets forth the requirement for handling, reclaiming, recovering and recycling certain refrigerants and the equipment that is used in the service procedures. In addition, some states or municipalities may have additional requirements that must also be adhered to for responsible management of refrigerants. Know the applicable laws and follow them.

INSTALLATION CHECK LIST

INSTALLATION CHECK LIST

□Equipment is installed on a level and solid surface. If installed on a roof top, all precautions have been taken when considering load bearing supports. Refer to Section 3 of this manual for additional information on installing units on a roof top curb.

* Equipment is properly grounded. Ground rods may be required depending on installation and application. Electrical installation must be compliant with local codes.
* Equipment is properly fastened to the mounting surface. If the installation must withstand hurricane winds, consult with a certified engineer (PE) to determine fastening requirements.
* Equipment is clear of air flow obstructions. Refer to Section 3 for additional information on surround clearance requirements.
* Equipment has proper overcurrent protection, wire size, and means of electrical disconnect. Refer to the unit nameplate for MCA and MOP values. Refer to Section 7 for wiring sizing.
* 3 Phase wiring is the correct phasing and phase monitor indicates no issues.
* The appropriate plumbing connections have been made with respect to Section 3 of this manual. If the equipment is installed on a potable water system, refer to local code for acceptable plumbing materials - flexible hoses may not be used.
* Y-strainers have been installed on the inlet of the chiller.
* Piping loops have been cleared/flushed of all contaminants. Warning - Always avoid flushing external piping loops with the chiller isolation valves in the open position. Ignoring this warning will nullify the manufacturer's warranty.
* Will the chiller be exposed to harsh environments such as, salty air, alcohols, petroleum, alkalines, or acids? If so, has the air coil been coated to protect it from corrosion?
* All local codes and installation permits have been considered before applying power to the chiller.
* All proper precautions have been taken before turning on the chiller.

Contact the American GeoThermal service department for any questions regarding rigging, installation, service and decommissioning.

INSTALLATION NOTES:

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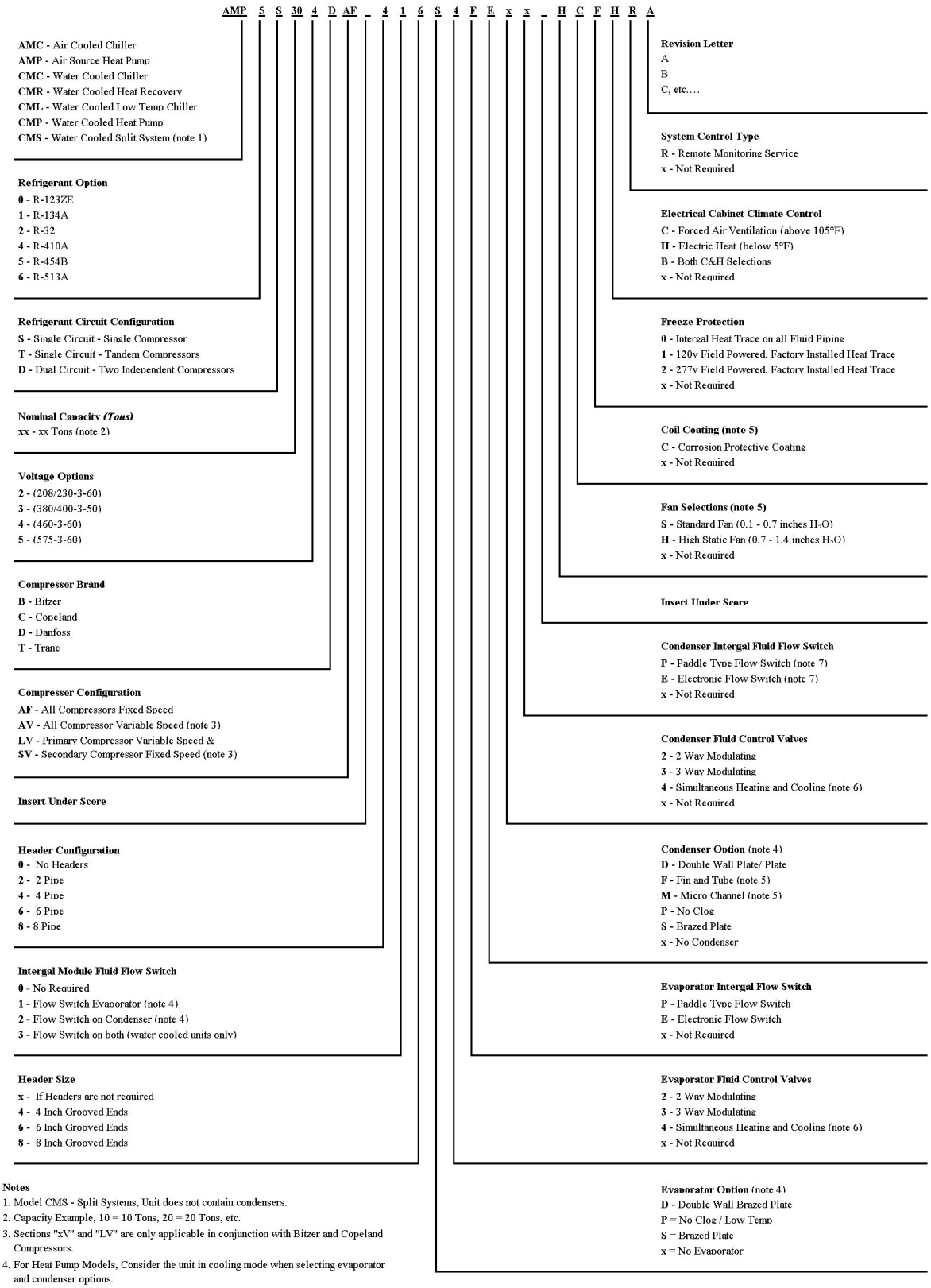
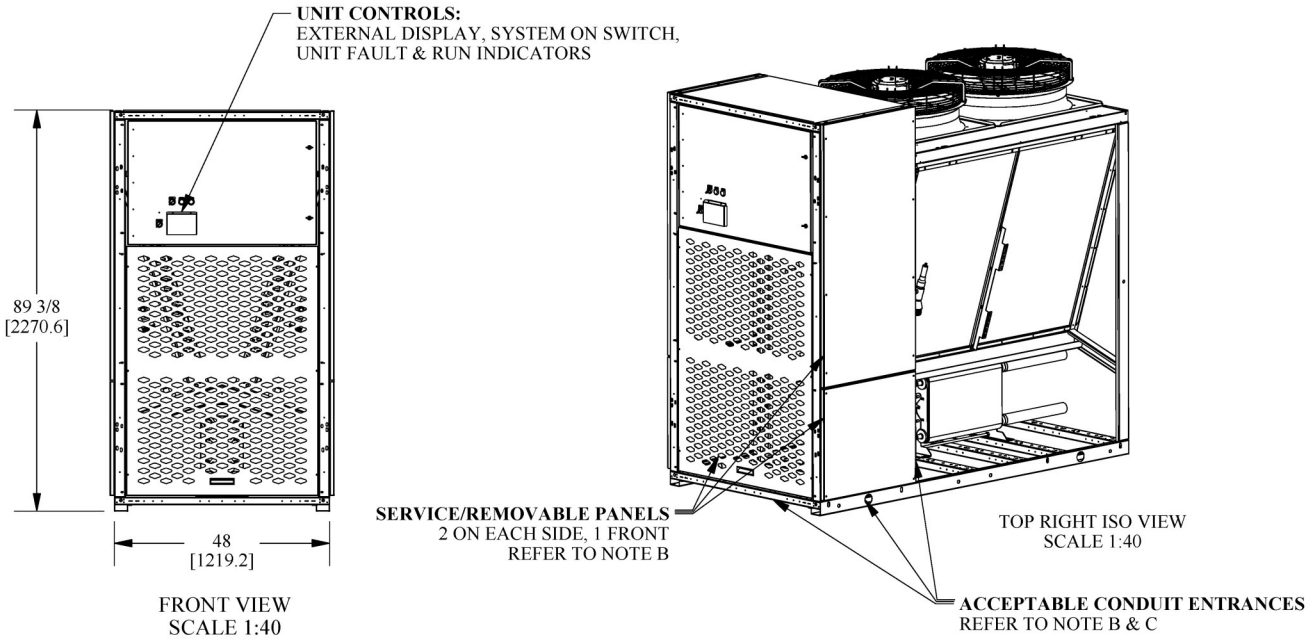
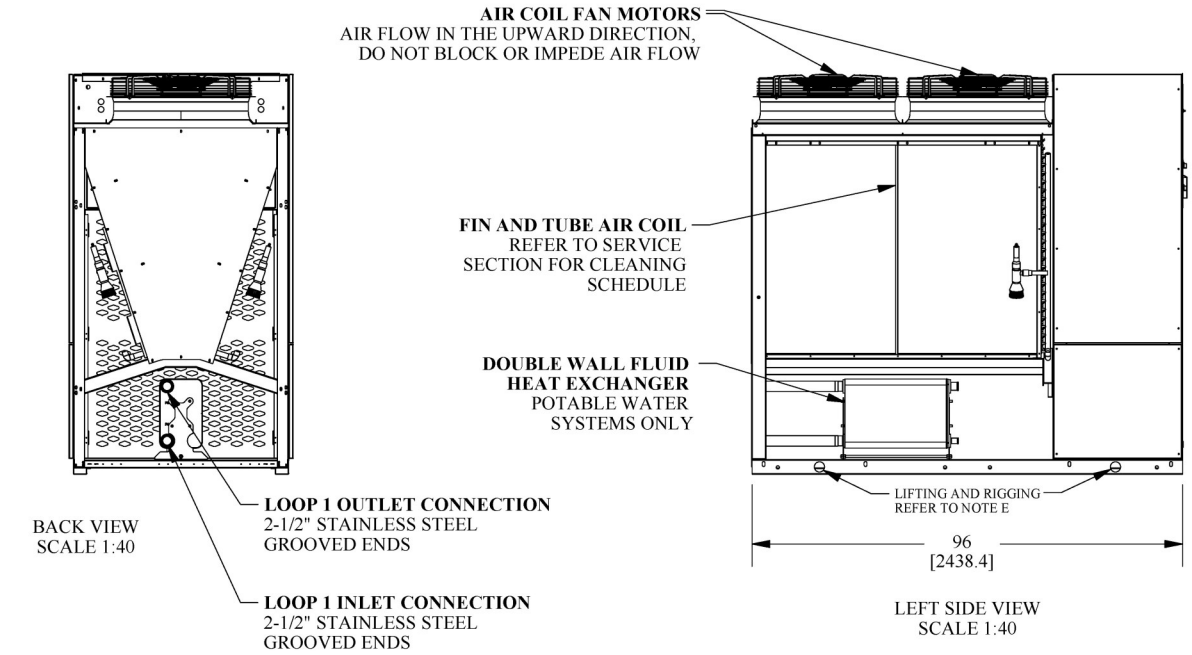
MODEL NOMENCLATURE



Notes

1. Model CMS - Split Systems, Unit does not contain condensers.
2. Capacity Example, 10 = 10 Tons, 20 = 20 Tons, etc.
3. Sections "xV" and "LV" are only applicable in conjunction with Bitzer and Copeland Compressors.
4. For Heat Pump Models, Consider the unit in cooling mode when selecting evaporator and condenser options.
5. Selections only applicable in AMC or AMP models.
6. Selection only applicable with 4, 6, 8 pipe header configurations.
7. Selection only applicable for CMC, CMR, CML, CMP Models.

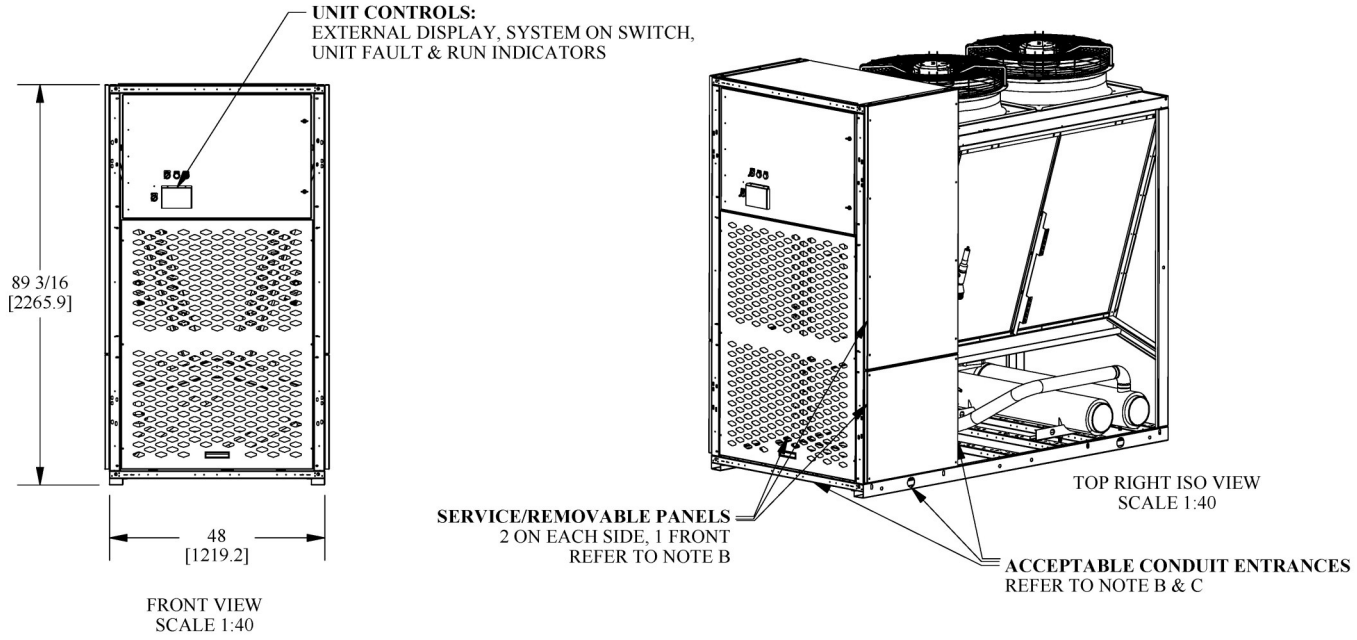


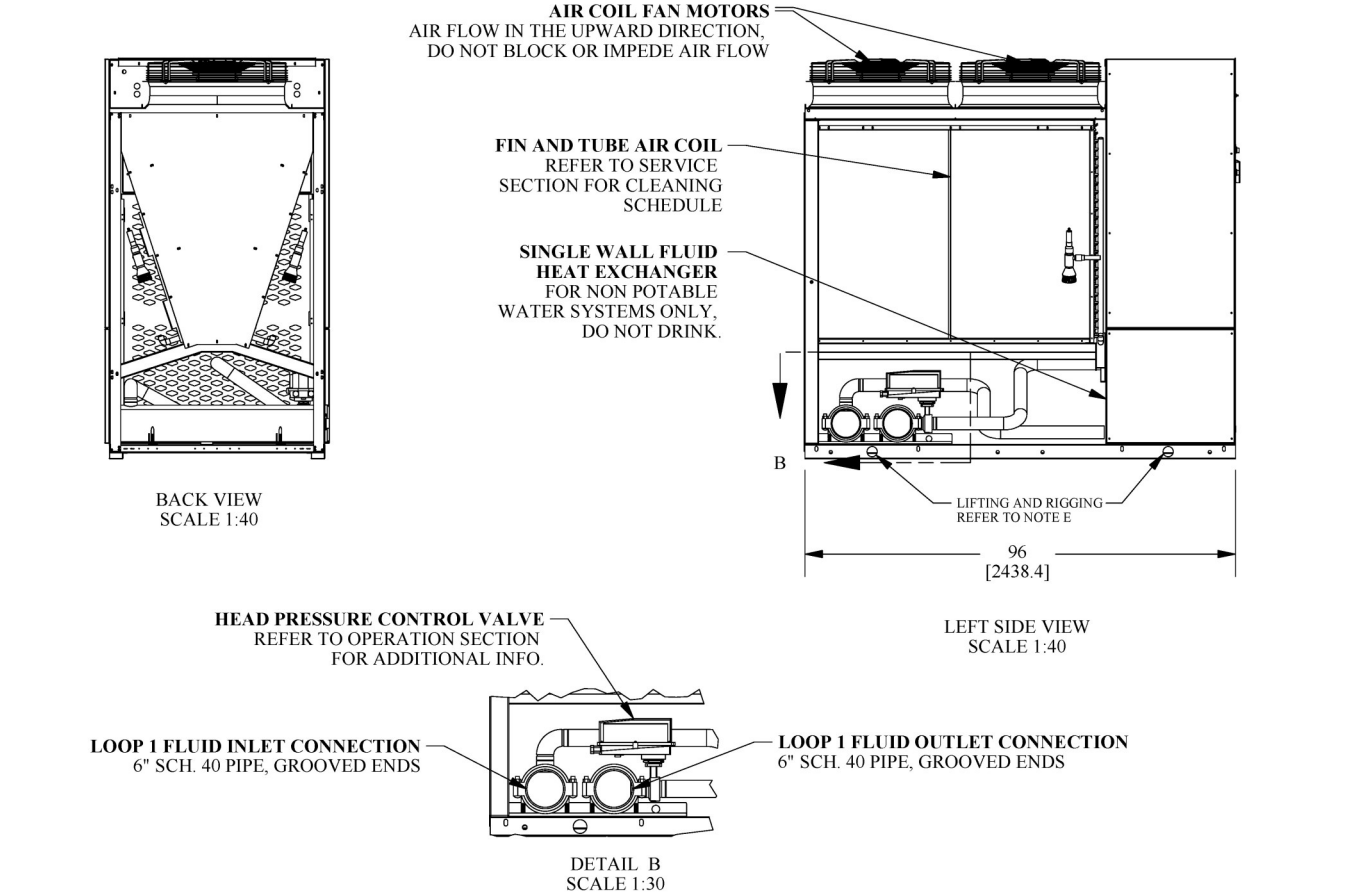


NOTES:

A. DIMENSIONS ARE EXPRESSED IN INCHES [MILLIMETERS].
B. DO NOT INSTALL CONDUIT IN SUCH A WAY THAT IT PREVENT SERVICE PANELS FROM BEING REMOVED. ALL CONDUIT SHOULD BE RUN SO THAT IT DOES NOT INTERSECT WITH COPPER PIPING INSIDE THE EQUIPMENT. POINTS OF ENTRANCE; THROUGH THE BOTTOM OF THE UNIT, THROUGH THE LEFT OR RIGHT SIDE LIFTING HOLE OR THOUGH THE BACK OF THE MAIN REFRIGERATION CABINET.
C. UNIT MUST BE INSTALLED WITH EXTERNAL FUSED DISCONNECT AND COMPLIANT TO LOCAL ELECTRICAL CODES.
D. NEVER BLOCK PERFORATIONS IN THE FRONT PANEL AS IT IS CRITICAL TO THE PERFORMANCE OF THE EQUIPMENT REFER TO THE CLEARANCE SECTION FOR SURROUNDING OBJECTS.
E. 2-1/4" DIAMETER HOLES. WHEN LIFTING OR RIGGING, NEVER ATTEMPT TO LIFT WITH THE BOTTOM PANEL SIDE PANELS INSTALLED. DAMAGE MAY OCCUR AND WILL NOT BE COVERED BY THE FACTORY WARRANTY.

DOMESTIC WATER WITH DOUBLE WALL HEAT EXCHANGER





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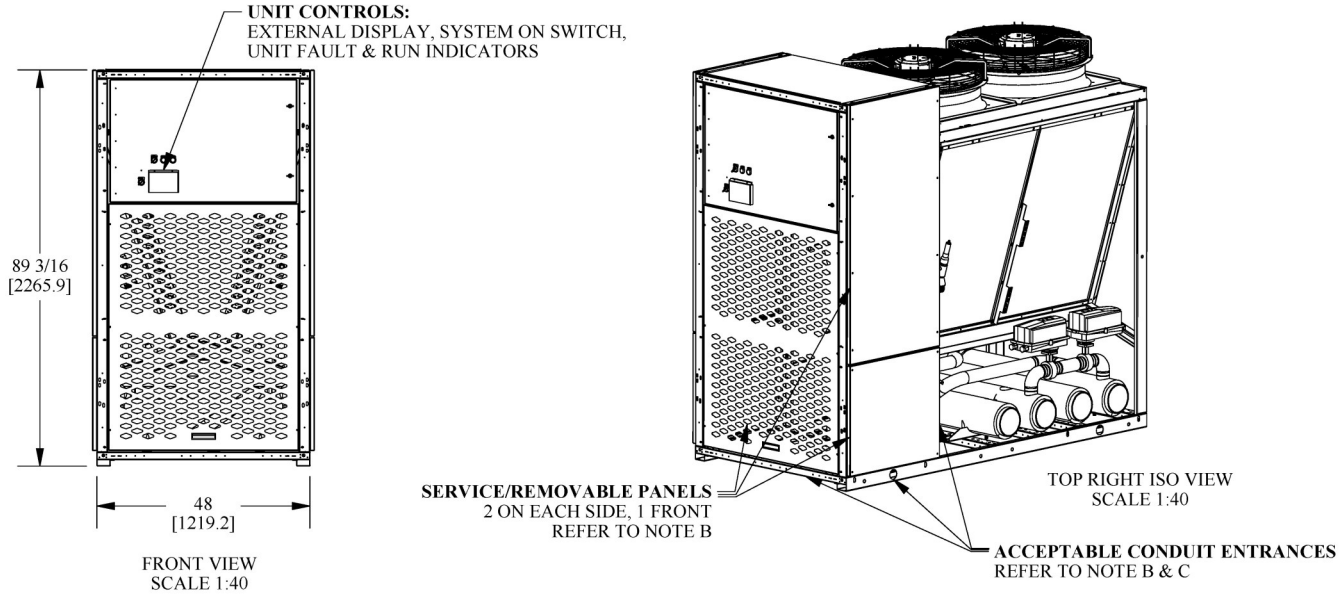
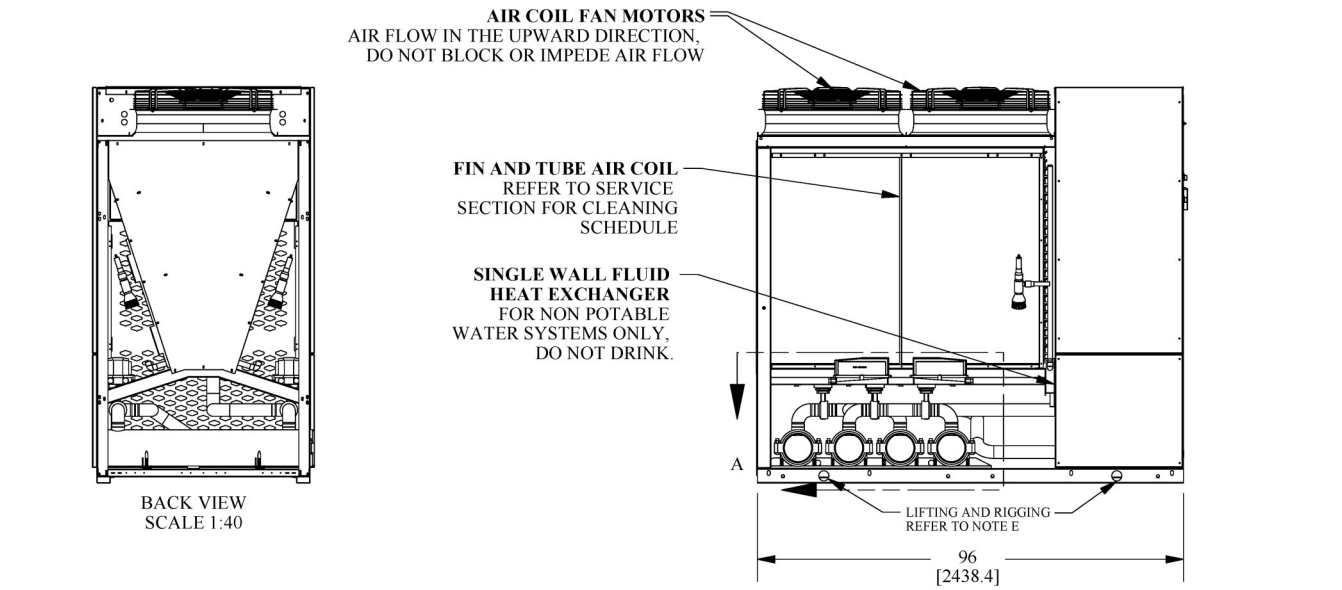
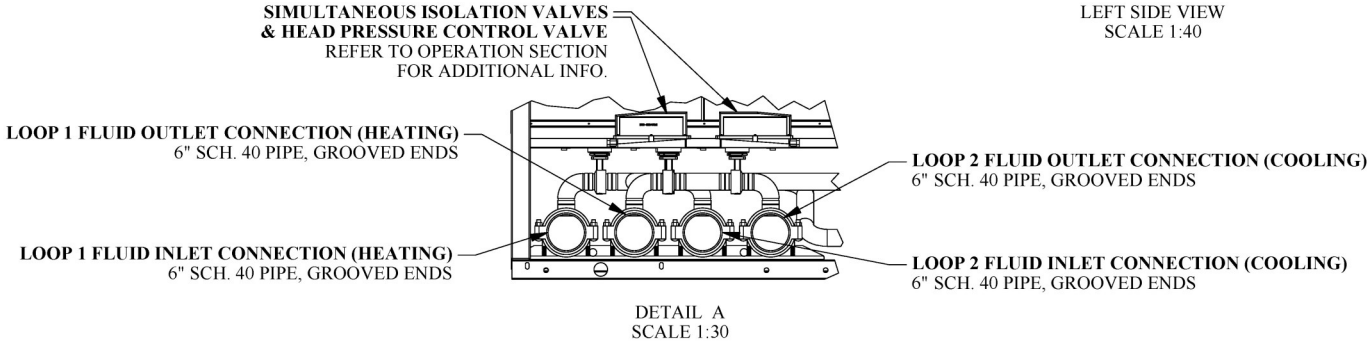
2 PIPE HEADER WITH BRAZED PLATE OR TUBE/TUBE HEAT EXCHANGERS







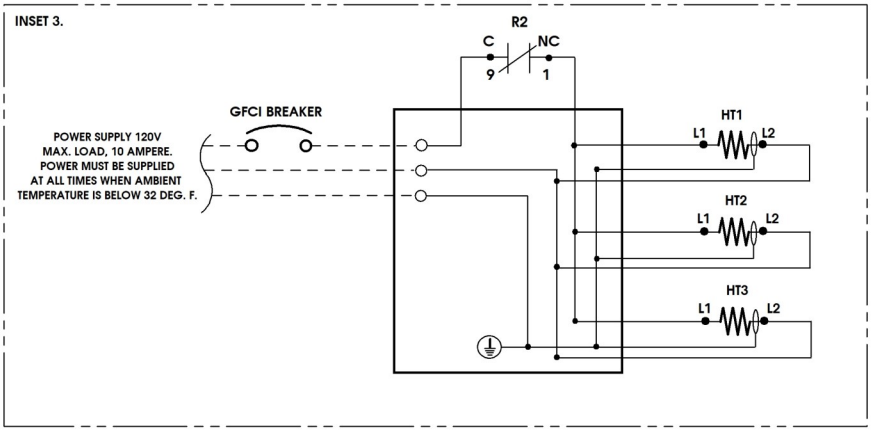
NOTES:

A. DIMENSIONS ARE EXPRESSED IN INCHES [MILLIMETERS].
B. DO NOT INSTALL CONDUIT IN SUCH A WAY THAT IT PREVENT SERVICE PANELS FROM BEING REMOVED. ALL CONDUIT SHOULD BE RUN SO THAT IT DOES NOT INTERSECT WITH COPPER PIPING INSIDE THE EQUIPMENT. POINTS OF ENTRANCE; THROUGH THE BOTTOM OF THE UNIT, THROUGH THE LEFT OR RIGHT SIDE LIFTING HOLE OR THOUGH THE BACK OF THE MAIN REFRIGERATION CABINET.
C. UNIT MUST BE INSTALLED WITH EXTERNAL FUSED DISCONNECT AND COMPLIANT TO LOCAL ELECTRICAL CODES.
D. NEVER BLOCK PERFORATIONS IN THE FRONT PANEL AS IT IS CRITICAL TO THE PERFORMANCE OF THE EQUIPMENT REFER TO THE CLEARANCE SECTION FOR SURROUNDING OBJECTS.
E. 2-1/4" DIAMETER HOLES. WHEN LIFTING OR RIGGING, NEVER ATTEMPT TO LIFT WITH THE BOTTOM PANEL SIDE PANELS INSTALLED. DAMAGE MAY OCCUR AND WILL NOT BE COVERED BY THE FACTORY WARRANTY.

4 PIPE HEADER WITH BRAZED PLATE OR TUBE/TUBE HEAT EXCHANGERS

HEAT TRACE CIRCUIT

Heat trace power and over current protection shall be supplied and installed by others. The R2 relay will remain closed when ambient temperature is less than 32° F or when the unit is in defrost mode. Each module is equipped with a junction box for field wiring - see below.



DEVICE KEY

R2 - Heat Trace Temperature Control Relay

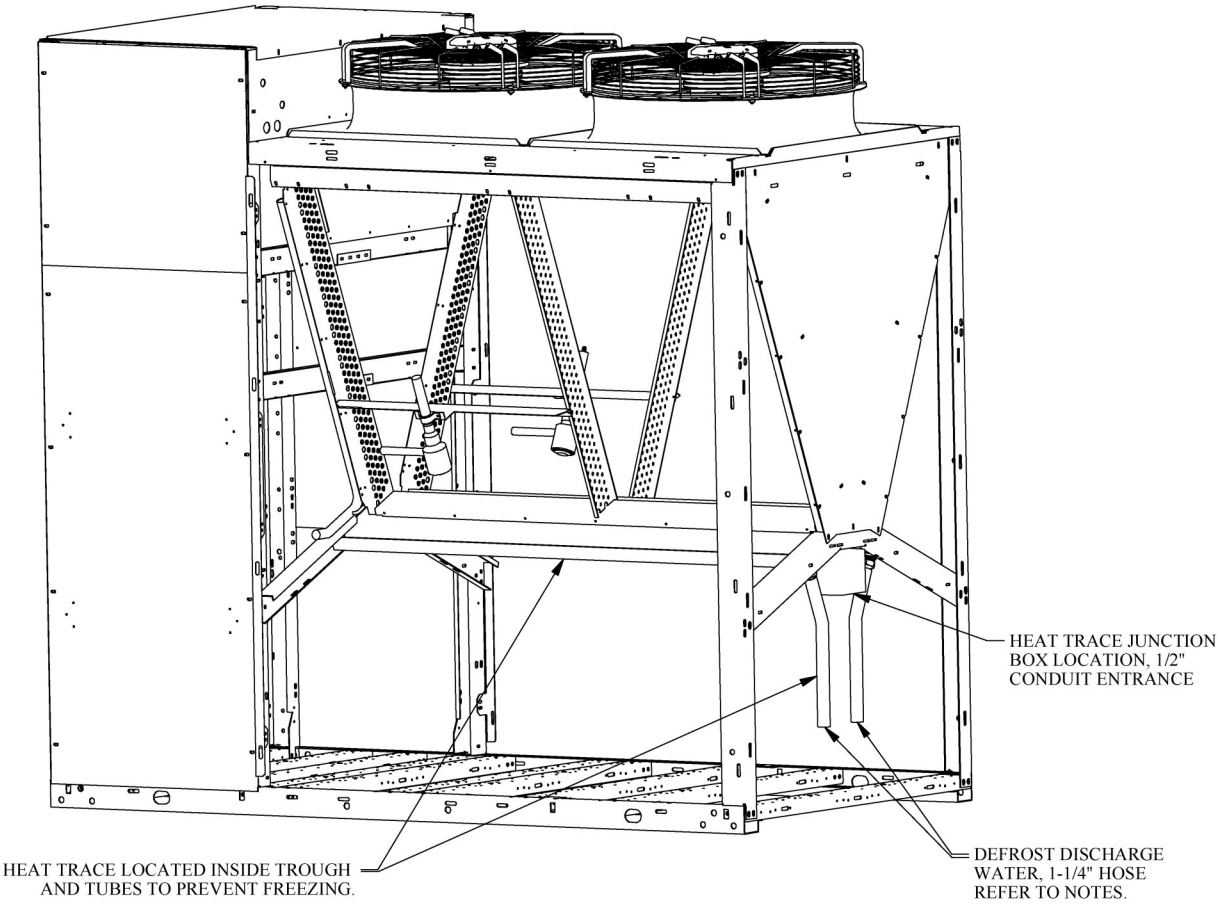
HT1 - Defrost Pan Heater

HT2 - Heat Exchanger Heater

HT3 - Headers and Fluid Piping Heaters

Solid Lines - Factory Installed

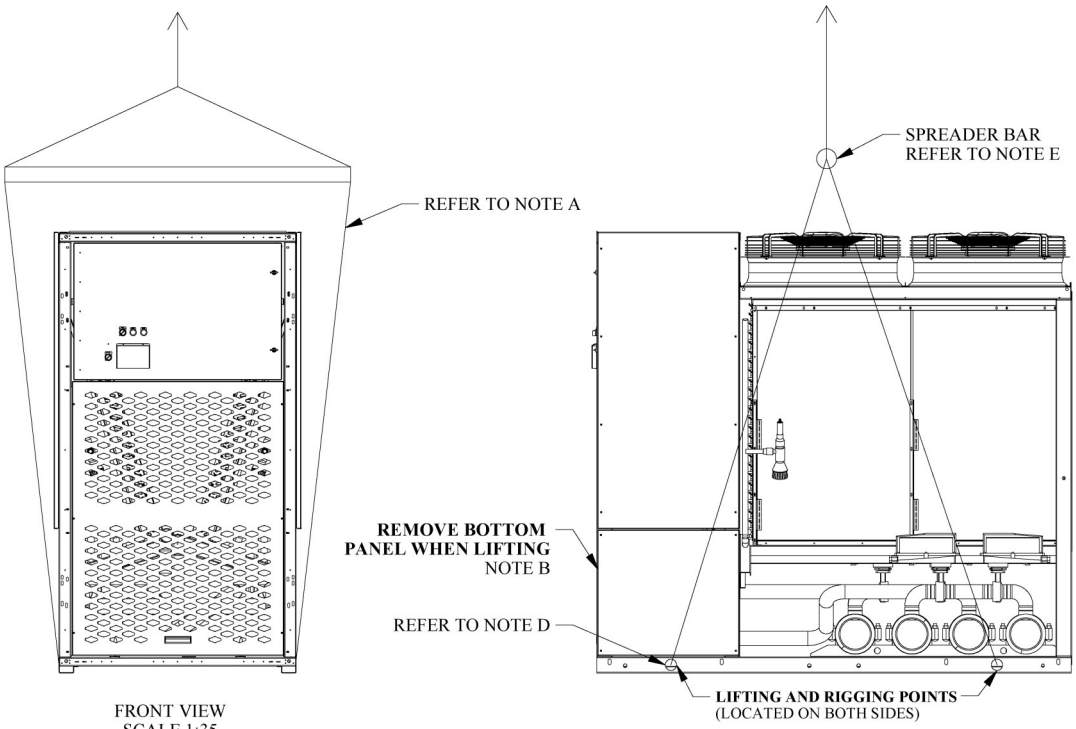
Dashed Lines - Field Installed



NOTES:

A. DISCHARGE TUBE SHALL REMAIN CLEAR OF DEBRIS AT ALL TIMES.
B. DRAWING IS NOT TO SCALE, TUBES WHEN EXTENDED ARE 1" FROM THE BOTTOM OF THE UNIT.
C. IF EXTENSIONS ARE REQUIRED TO REACH A COMMON SITE DRAIN, ROUTE THE EXTENSION TUBES SO THAT FLOW IS ALWAYS PROMOTED BY GRAVITY. NEVER ROUTE THE TUBES UPHILL.
D. EXTENSION TUBES SHALL INCLUDE HEAT TRACE TO PREVENT FREEZING AND SHALL BE ENTERGIZED WHEN THE AMBIENT TEMPERATURE IS BELOW 32 DEG. F

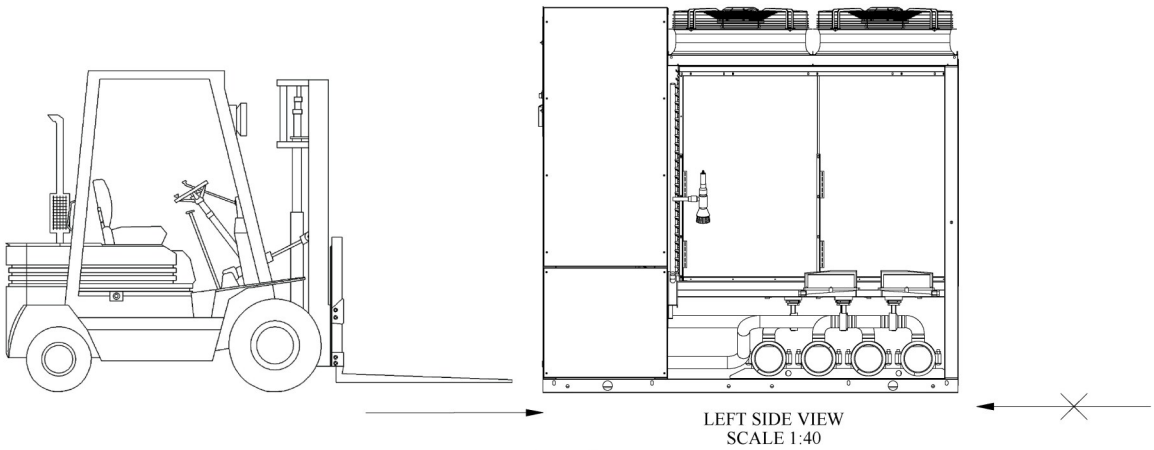
HEAT TRACE AND DEFROST DISCHARGE WATER



FRONT VIEW
SCALE 1:35

- WARNING -
REMOVE LOWER SIDE PANELS WHEN LIFTING
DAMAGE OCCURRED WILL NOT BE COVERED BY
THE MANUFACTURERS WARRANTY

LEFT SIDE VIEW
SCALE 1:35



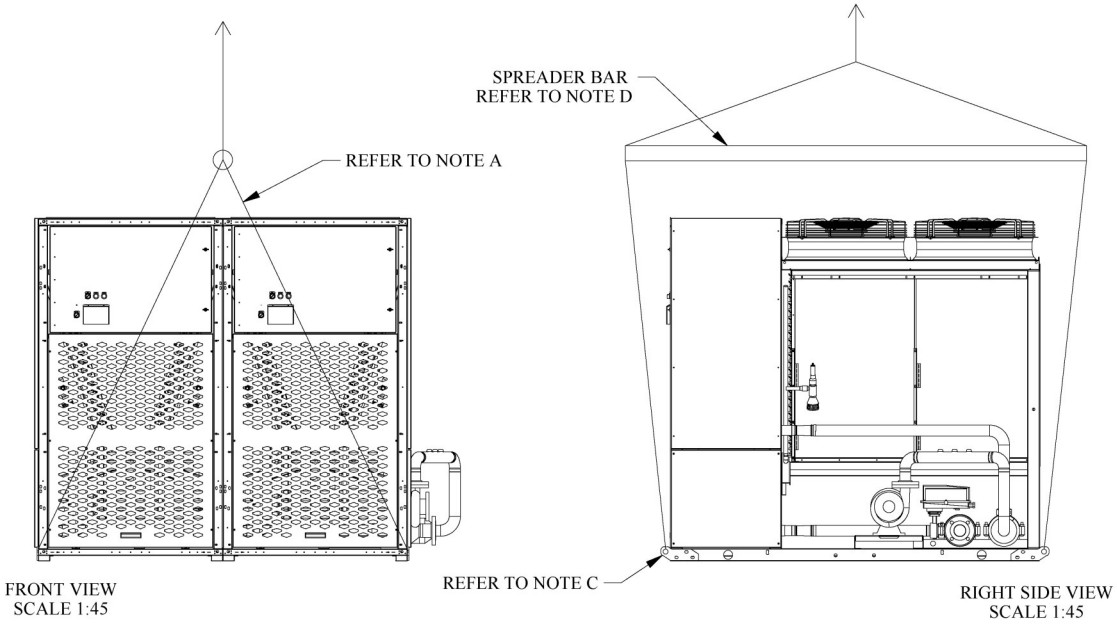
LEFT SIDE VIEW
SCALE 1:40

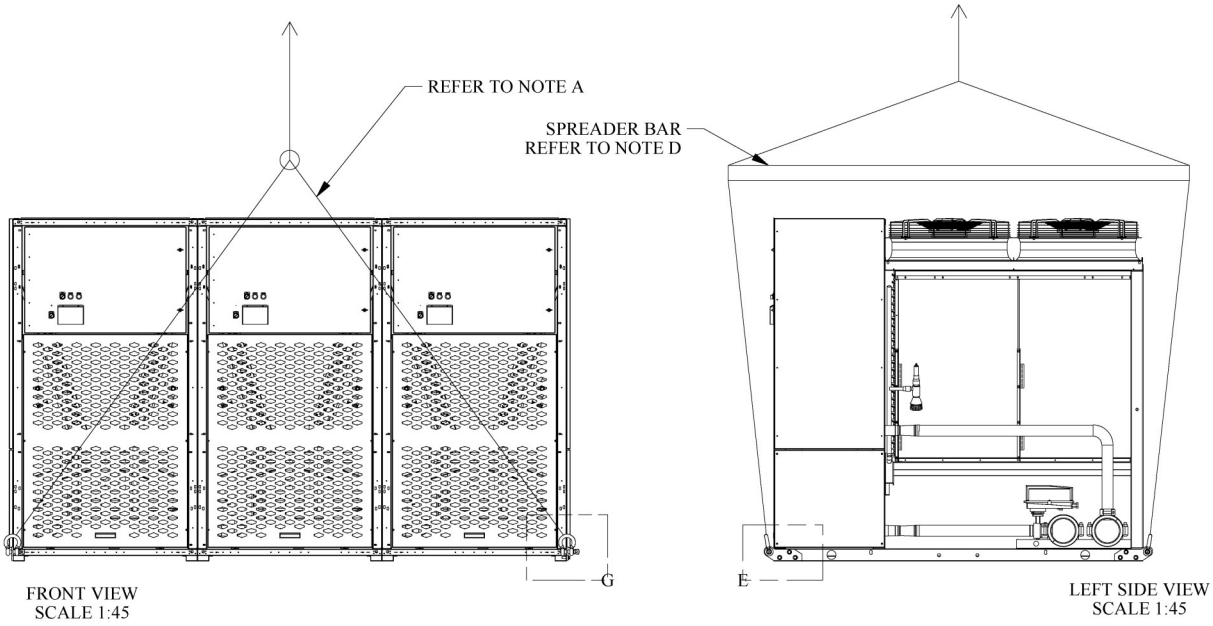
- WARNING -
FORKS MUST EXTEND 6 FT INTO THE BOTTOM OF THE UNIT TO
PREVENT TIPPING. FORKING THE UNIT IS ONLY RECOMMENDED
FROM THE FRONT. DO NOT ATTEMPT TO PICK FROM BACK.

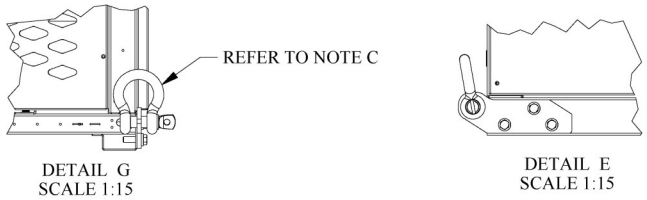
NOTES:

A. IT IS UP TO THE INSTALLER TO DETERMINE THE APPROPRIATE CABLE LENGTHS. DEPENDING ON INDIVIDUAL UNIT FEATURES, THE EQUIPMENT CENTROID MAY VARY. IF THE EQUIPMENT DOES NOT LIFT EVENLY, ADJUST THE CABLE LENGTHS AND REATTEMPT THE LIFT. NEVER LIFT A UNIT THAT IS UNLEVELED AS IT MAY BECOME TOP HEAVY AND FLIP OVER. IMPROPER LIFTING PRACTICES ARE NOT COVERED UNDER THE MANUFACTURES WARRANTY.
B. ALWAYS REMOVE THE BOTTOM SIDE PANELS BEFORE LIFTING. FAILURE TO DO SO MAY RESULT IN DAMAGE TO THE EQUIPMENT PANELS. DAMAGE AS A RESULT OF IGNORING THIS WARNING WILL NOT BE COVERED UNDER THE MANUFACTURERS WARRANTY.
C. REFER TO PHYSICAL DATA CHART FOR EQUIPMENT WEIGHTS PER MODEL NO.
D. USE SCREW PIN SHACKLES WHEN POSSIBLE. WARNING, DO NOT ATTEMPT TO LIFT WITH NON-LOCKING HOOKS.
E. SPREADER BAR MINIMUM LENGTH, 6FT. SMALLER SPREADER BARS CAN RESULT IN EQUIPMENT DAMAGE.

SINGLE MODULE LIFTING

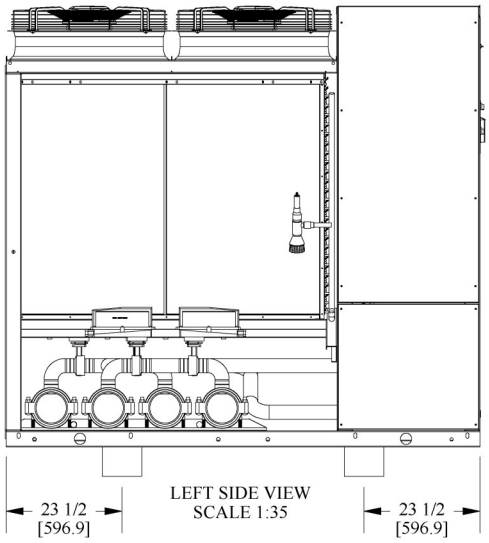




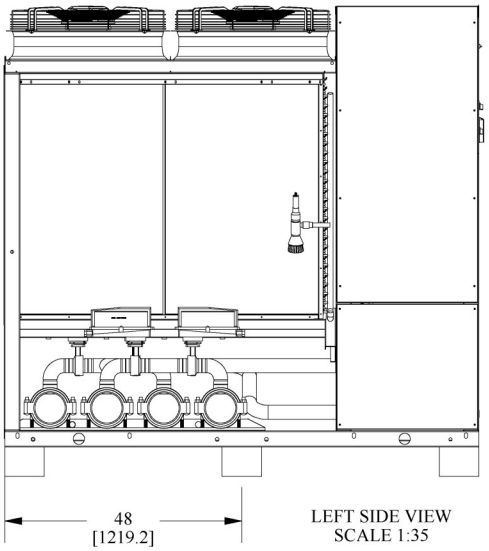


NOTES:
A. IT IS UP TO THE INSTALLER TO DETERMINE THE APPROPRIATE CABLE LENGTHS. DEPENDING ON INDIVIDUAL UNIT FEATURES, THE EQUIPMENT CENTROID MAY VARY. IF THE EQUIPMENT DOES NOT LIFT EVENLY, ADJUST THE CABLE LENGTHS AND REATTEMPT THE LIFT. NEVER LIFT A UNIT THAT IS UNLEVELED AS IT MAY BECOME TOP HEAVY AND FLIP OVER. IMPROPER LIFTING PRACTICES ARE NOT COVERED UNDER THE MANUFACTURES WARRANTY.
B. REFER TO PHYSICAL DATA CHART FOR EQUIPMENT WEIGHTS PER MODEL NO.
C. USE SCREW PIN SHACKLES WHEN POSSIBLE AS SHOWN IN DETAIL E AND G. WARNING, DO NOT ATTEMPT TO LIFT WITH NON-LOCKING HOOKS.
D. SPREADER BAR MINIMUM LENGTH, 10FT. SMALLER SPREADER BARS CAN RESULT IN EQUIPMENT DAMAGE.

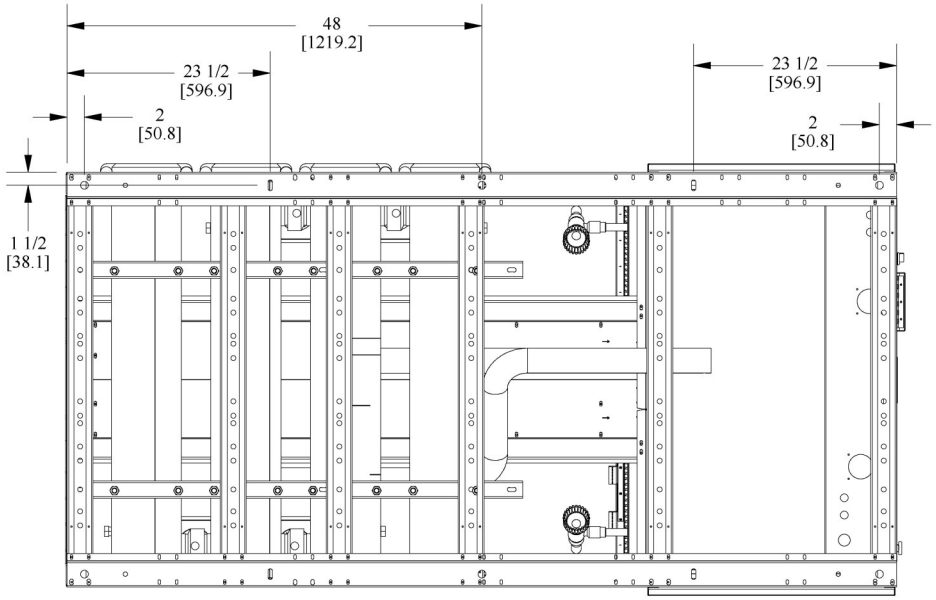
2 AND 3 MODULE LIFTING



ACCEPTABLE CURB PLACEMENT FOR CURB CONTAINING 2 RAILS



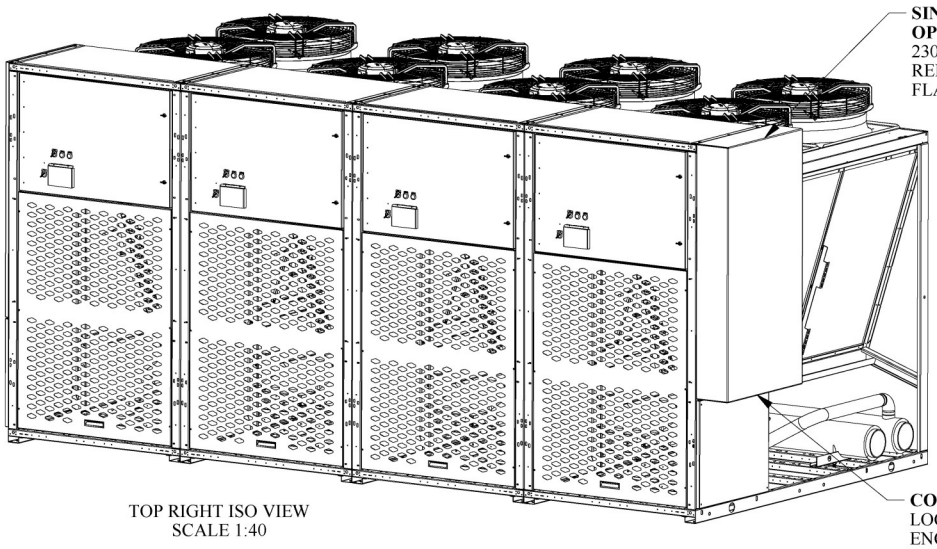
ACCEPTABLE CURB PLACEMENT FOR CURB CONTAINING 3 RAILS



BOTTOM VIEW
SCALE 1:20

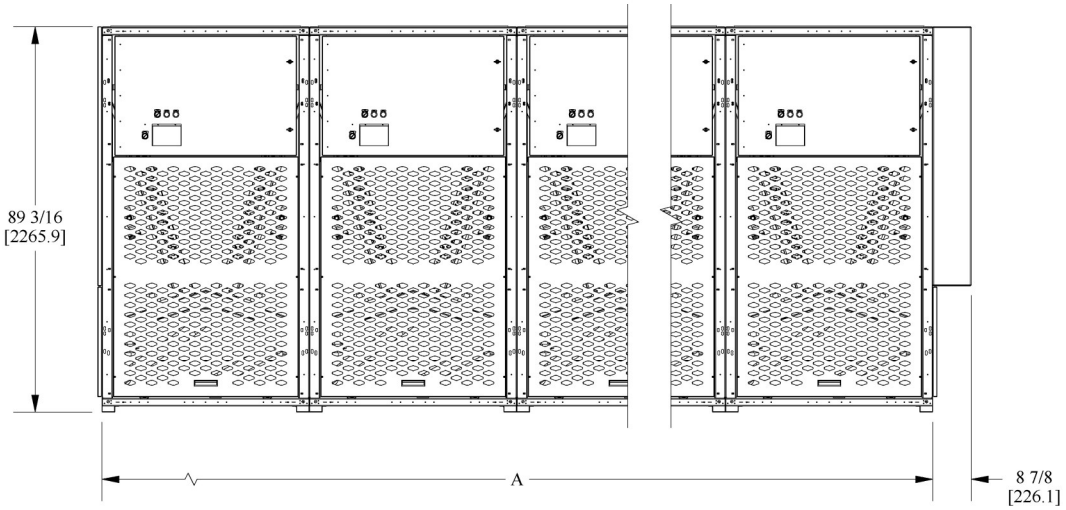
ALL MOUNTING HOLES ARE 3/4" IN DIAMETER. APPROPRIATE FASTENER RATINGS SHOULD BE CONSIDERED ON A PER APPLICATION BASIS. CONSULT WITH A CERTIFIED ENGINEER FOR DIAMETER AND FASTENER TYPE.

INSTALLATION DETAILS AND MOUNTING HOLE LOCATIONS



TOP RIGHT ISO VIEW
SCALE 1:40

TABLE	
# OF UNITS	A (INCH)
2	96
3	144
4	192
5	240
6	288
7	336
8	384
9	432
10	480

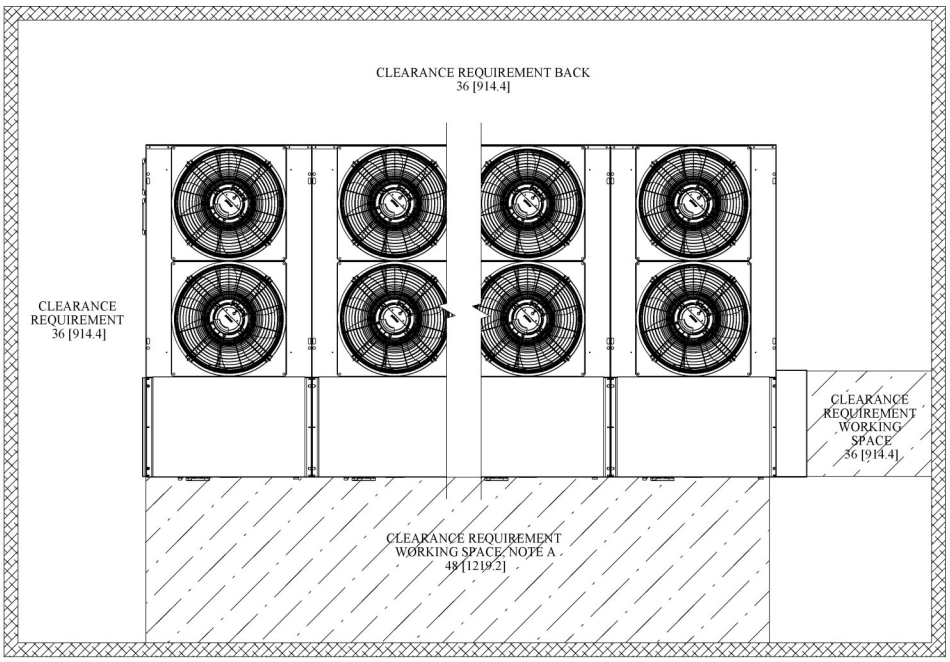


FRONT VIEW
SCALE 1:40

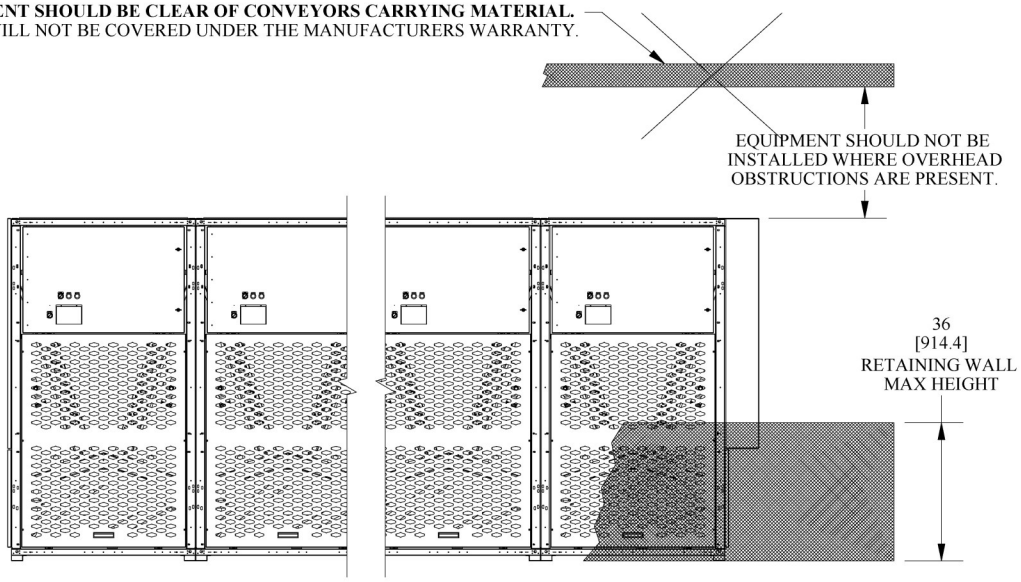
NOTES:

A. MAXIMUM NUMBER OF UNITS IS DETERMINED BY THE FLUID FLOW RATE.
B. ONLY THE FIRST MODULE IN A BANK WILL CONTAIN AN EXTERNAL DISPLAY UNLESS OTHERWISE STATED IN THE EQUIPMENT SPECIFICATION.
C. A MAXIMUM OF 4 UNITS CAN BE SHIPPED AS ONE ASSEMBLY WITHOUT ADDITIONAL SUPPORT. REFER TO LIFTING INSTRUCTIONS FOR LIFTING AND RIGGING MULTIPLE UNITS AT ONCE. DO NOT ATTEMPT TO LIFT MORE THAT 4 UNITS AT ONCE AS THE FRAME WORK IS INSUFFICIENT TO HANDLE SUCH LOADS.

MULTIPLE MODULE BANKS



WARNING - EQUIPMENT SHOULD BE CLEAR OF CONVEYORS CARRYING MATERIAL.
DAMAGE TO UNIT WILL NOT BE COVERED UNDER THE MANUFACTURERS WARRANTY.



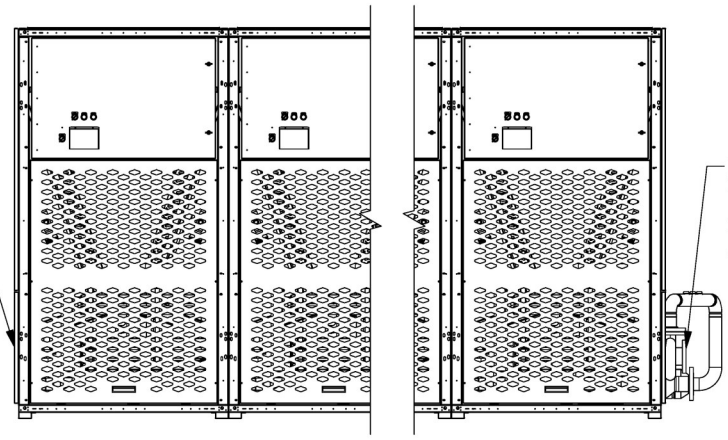
NOTES:

A. DO NOT INSTALL IN A PLACE THAT 48 INCH CLEARANCE CAN NOT BE MET. THIS CLEARANCE IS REQUIRED TO ALLOW THE ELECTRICAL CABINET DOOR TO FULLY OPEN AT 90 DEGREES.

B. IF CLEARANCE EQUIPMENTS ARE NOT MET DURING THE TIME OF INSTALLATION. AMERICAN GEOTHERMAL RESERVES THE RIGHT TO REFUSE SERVICE AND OR WARRANTY.

C. UNITS SHOULD NOT BE INSTALLED WHERE RETAINING WALLS ARE HIGHER THAT 36 INCHES. IN ORDER FOR THE EQUIPMENT TO FUNCTION PROPERLY, THE AIR COILS MUST REMAIN UNBLOCKED AT ALL TIMES. CONSULT WITH THE AMERICAN GEOTHERMAL SERVICE DEPARTMENT IF IN QUESTION.

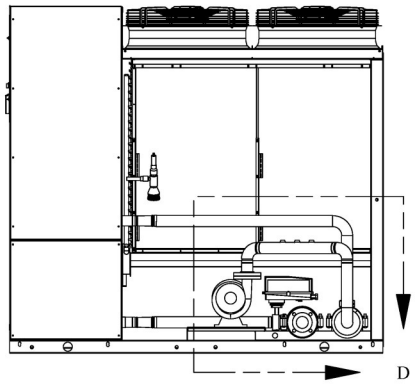
CLEARANCES FOR SURROUNDING EQUIPMENT AND OBSTRUCTIONS



VICTUALIC CAPS ON OPPOSITE SIDE
EACH HEADER CONTAINS A 1/2" PLUG
(1/2" WATER BALL VALVE OPTIONAL)

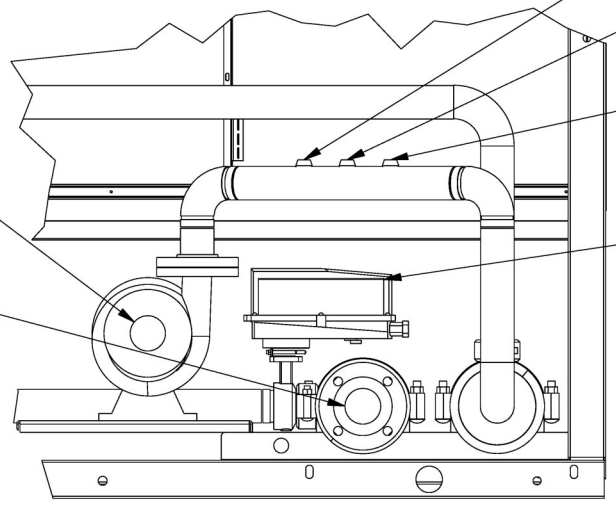
INTEGRAL SYSTEM FLUID PUMP
LOCATED RIGHT SIDE ONLY
HP RATINGS: 5, 7-1/2, 10, 15, 20.
REFER TO MODEL NOMENCLATURE
AND NAMEPLATE TO DECIPHER
WHICH PUMP IS INSTALLED.

FRONT VIEW
SCALE 1:40



RIGHT SIDE VIEW
SCALE 1:45

FLUID CONNECTION SIZE	
PUMP SIZE	FLANGE SIZE
5 HP	3 INCH
7-1/2 HP	3 INCH
10 HP	4 INCH
15 HP	4 INCH
20 HP	5 INCH



LOOP 1 INLET TEMPERATURE SENSOR
OPTIONAL, REFER TO NOTE A

LOOP 1 PRESSURE TRANSDUCER
0-100PSI (0-200PSI OPTIONAL)
ALL UNITS

AIR PURGING VALVE
OPTIONAL

LOOP 1 FLUID
INLET CONNECTION
ANSI #125 FLANGE
REFER TO CHART
CONNECTION SIZE.

LOOP 1 FLUID
OPUTLET CONNECTION
ANSI #125 FLANGE
REFER TO CHART
CONNECTION SIZE.

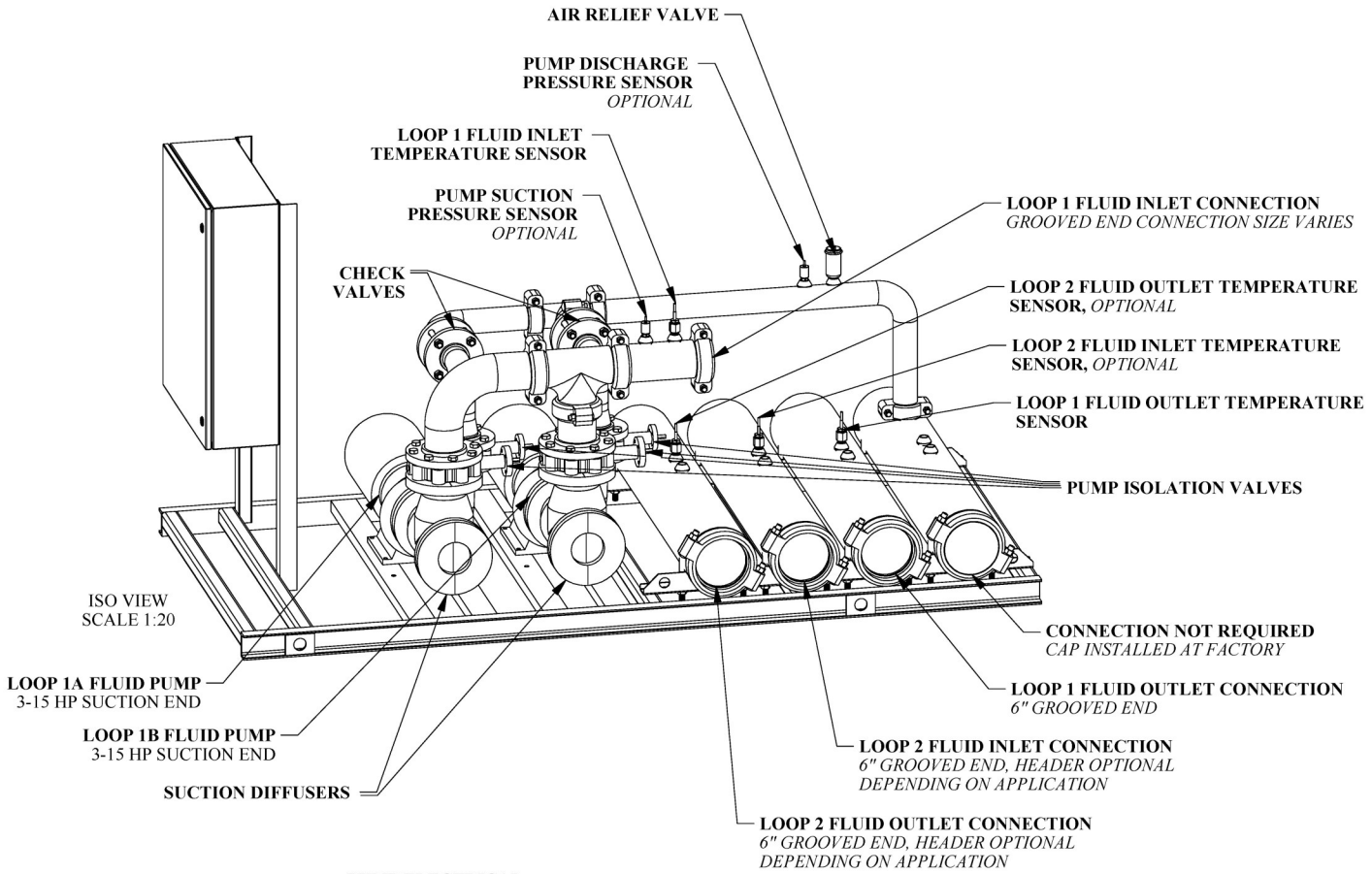
HEAD PRESSURE CONTROL VALVE
REFER TO OPERATION SECTION
FOR ADDITIONAL INFO.

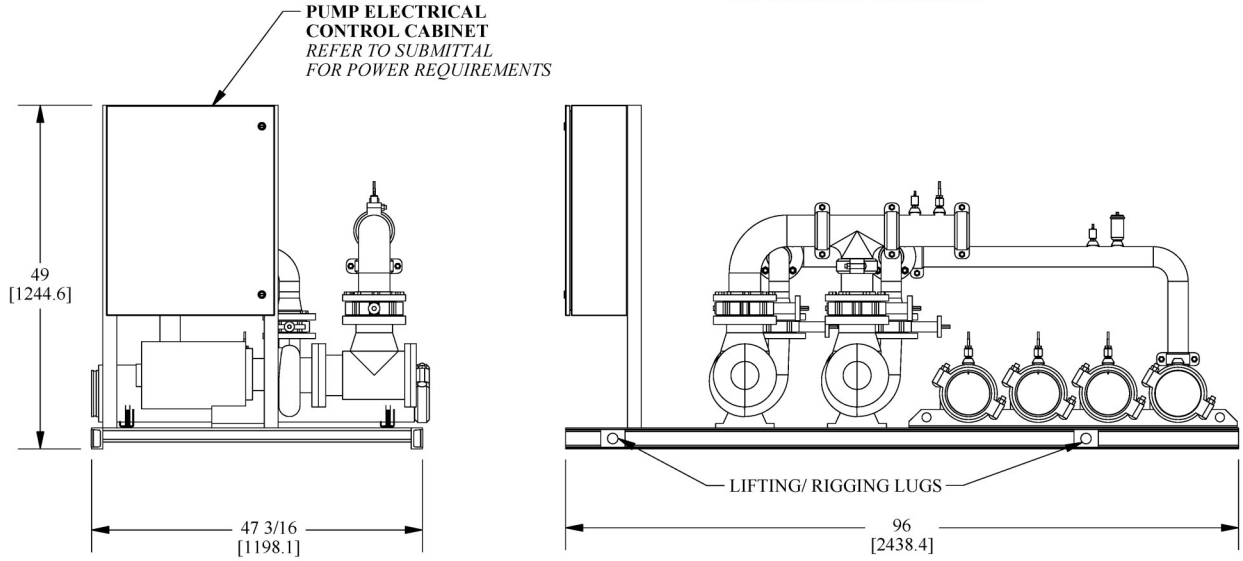
DETAIL D
SCALE 1:15

NOTES:

A. IF A FLUID INLET SENSOR IS NOT SELECTED IN THE EQUIPMENT QUOTE, A 50 FT. CABLE AND 12" THERMOWELL CONTAINING 1/2" MNPT THREADS WILL BE SUPPLIED AS A STANDARD MEANS OF MEASURING THE FLUID INLET TEMP. SUCH SENSOR WOULD TYPICALLY BE INSTALLED ON A HOLDING OR BUFFER TANK.
B. INTEGRAL SYSTEM FLUID PUMPS MAY ONLY BE INSTALLED ON THE RIGHT SIDE OF THE UNIT.
C. IN SOME CASES, A SYSTEM CIRCUIT SETTER MAY BE INSTALLED TO ADJUST THE WATER FLOW. NEVER ADJUST OR RESTRICT THE WATER FLOW WITHOUT CONSULTING THE MANUFACTURER.

2-PIPE, SINGLE INTERGAL PUMP



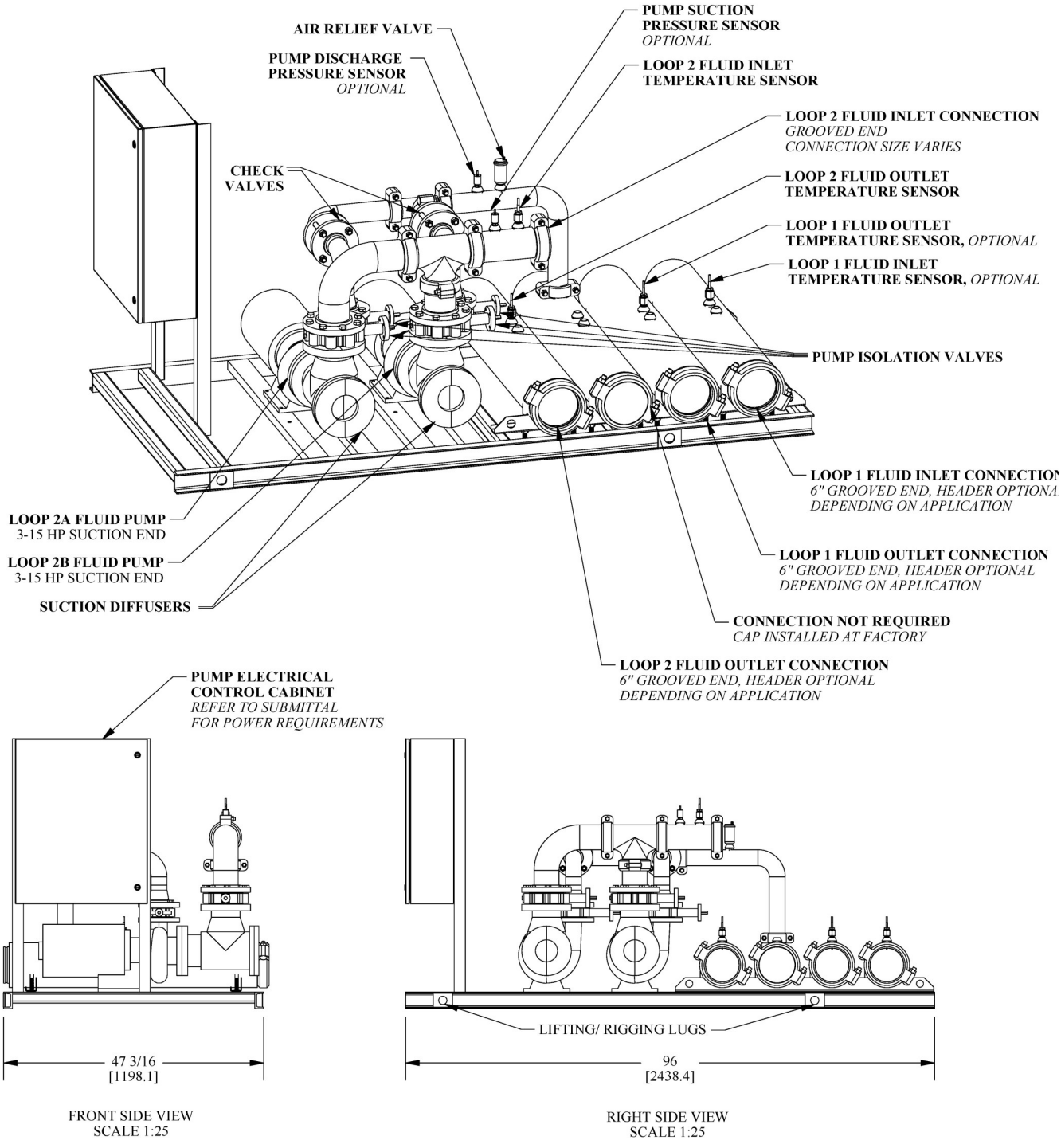


FRONT VIEW
SCALE 1:25

RIGHT SIDE VIEW
SCALE 1:25

NOTES:
1. CONFIGURATION: PUMP MODULES CAN BE CONFIGURED WITH EITHER LEFT OR RIGHT SIDE INLET CONNECTIONS. FOR THE PURPOSES OF THIS MANUAL, ONLY THE RIGHT SIDE CONFIGURATION IS SHOWN. IN ADDITION, PUMP MODULES CAN BE CONFIGURED TO MATE WITH 2-PIPE OR 4-PIPE HEAT PUMP MODULES.
2. CONNECTIONS: PUMP MODULES MATE DIRECTLY WITH THE HEAT PUMP MODULE USING 6" GROOVED END CONNECTORS (SUPPLIED BY FACTORY, INSTALLED BY OTHERS)
3. EQUIPMENT: PUMP MODULES ARE PROVIDED WITH THE SHOWN COMPONENTS UNLESS OTHERWISE STATED IN THE EQUIPMENT SUBMITTAL.
4. ELECTRICAL CONTROLS: ALL CONTROLS ARE CONFIGURED PER THE APPLICATION. BOTH FIXED AND VARIABLE SPEED PUMPS ARE AVAILABLE AND MUST BE SELECTED PRIOR TO THE SCHEDULED BUILD DATE.
5. SUCTION END DIFFUSERS: ALL REDUNDANT OPERATED PUMP MODULES ARE PROVIDED WITH SUCTION END DIFFUSERS ELIMINATE TURBULENT FLOW AT THE PUMP INLET. SUCTION DIFFUSERS ARE PROVIDED WITH A REMOVABLE MESH SCREEN TO FILTER OUT CONTAMINANTS. A Y-STRAINER SHOULD STILL BE INSTALLED ON ALL INLET CONNECTIONS PER THE REQUIREMENTS OF THIS MANUAL.
6. PUMP REDUNDANCY: ALL PUMPS ARE SUPPLIED WITH ISOLATION VALVES IN THE CASE OF A FAILURE. THIS ALLOWS THE BACK UP PUMP TO OPERATE DURING THE REPAIR. PROPER LOCK OUT TAG OUT METHODS SHOULD BE CONSIDERED WITH SERVICING ANY AND ALL MOTORS OR LOADS.

4-PIPE, LOOP 1 REDUNDANT PUMP MODULE



NOTES:
1. CONFIGURATION: PUMP MODULES CAN BE CONFIGURED WITH EITHER LEFT OR RIGHT SIDE INLET CONNECTIONS. FOR THE PURPOSES OF THIS MANUAL, ONLY THE RIGHT SIDE CONFIGURATION IS SHOWN. IN ADDITION, PUMP MODULES CAN BE CONFIGURED TO MATE WITH 2-PIPE OR 4-PIPE HEAT PUMP MODULES.
2. CONNECTIONS: PUMP MODULES MATE DIRECTLY WITH THE HEAT PUMP MODULE USING 6" GROOVED END CONNECTORS (SUPPLIED BY FACTORY, INSTALLED BY OTHERS)
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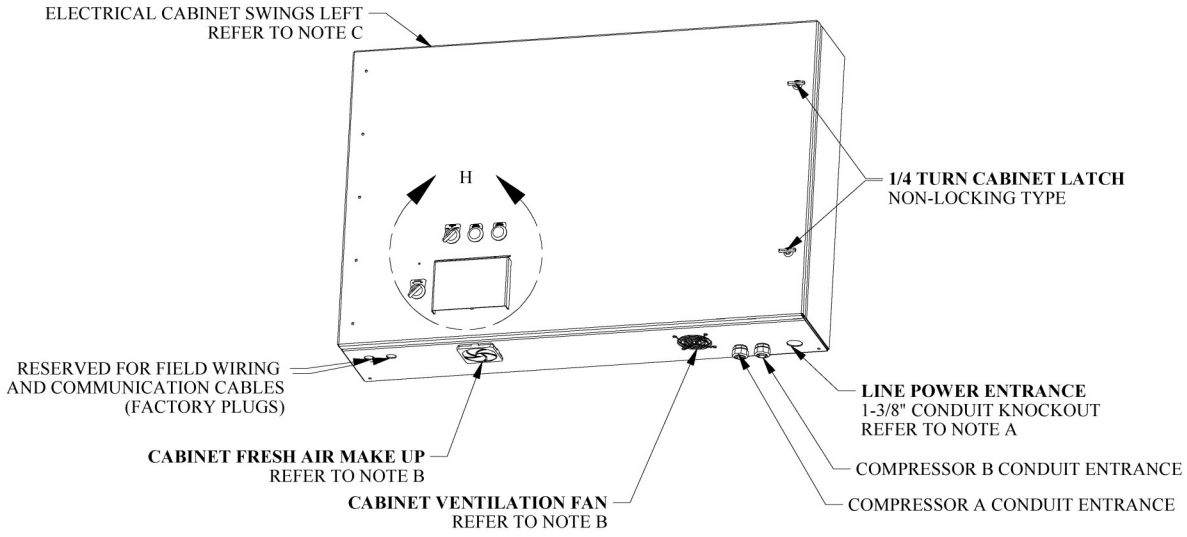
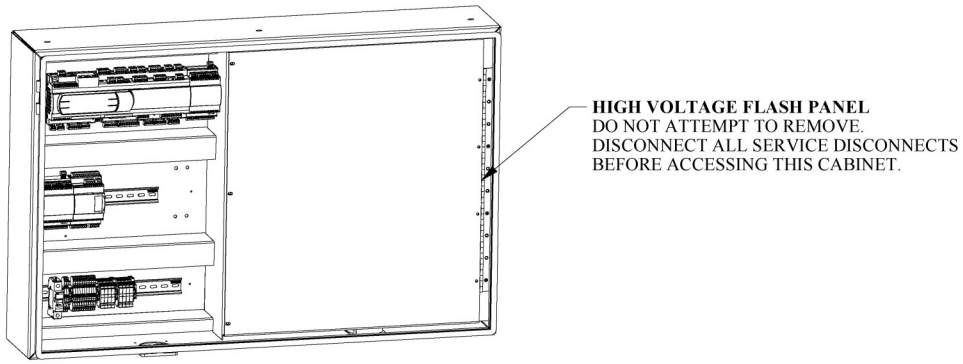
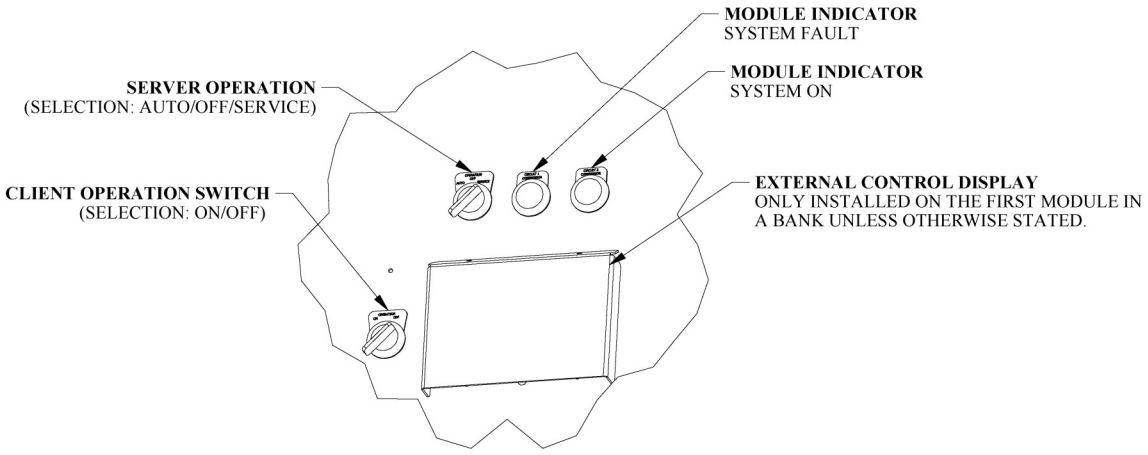
4. ELECTRICAL CONTROLS: ALL CONTROLS ARE CONFIGURED PER THE APPLICATION. BOTH FIXED AND VARIABLE SPEED PUMPS ARE AVAILABLE AND MUST BE SELECTED PRIOR TO THE SCHEDULED BUILD DATE.
5. SUCTION END DIFFUSERS: ALL REDUNDANT OPERATED PUMP MODULES ARE PROVIDED WITH SUCTION END DIFFUSERS ELIMINATE TURBULENT FLOW AT THE PUMP INLET. SUCTION DIFFUSERS ARE PROVIDED WITH A REMOVABLE MESH SCREEN TO FILTER OUT CONTAMINANTS. A Y-STRAINER SHOULD STILL BE INSTALLED ON ALL INLET CONNECTIONS PER THE REQUIREMENTS OF THIS MANUAL.
6. PUMP REDUNDANCY: ALL PUMPS ARE SUPPLIED WITH ISOLATION VALVES IN THE CASE OF A FAILURE. THIS ALLOWS THE BACK UP PUMP TO OPERATE DURING THE REPAIR. PROPER LOCK OUT TAG OUT METHODS SHOULD BE CONSIDERED WITH SERVICING ANY AND ALL MOTORS OR LOADS.

4-PIPE, LOOP 2 REDUNDANT PUMP MODULE







DETAIL H
SCALE 1:6

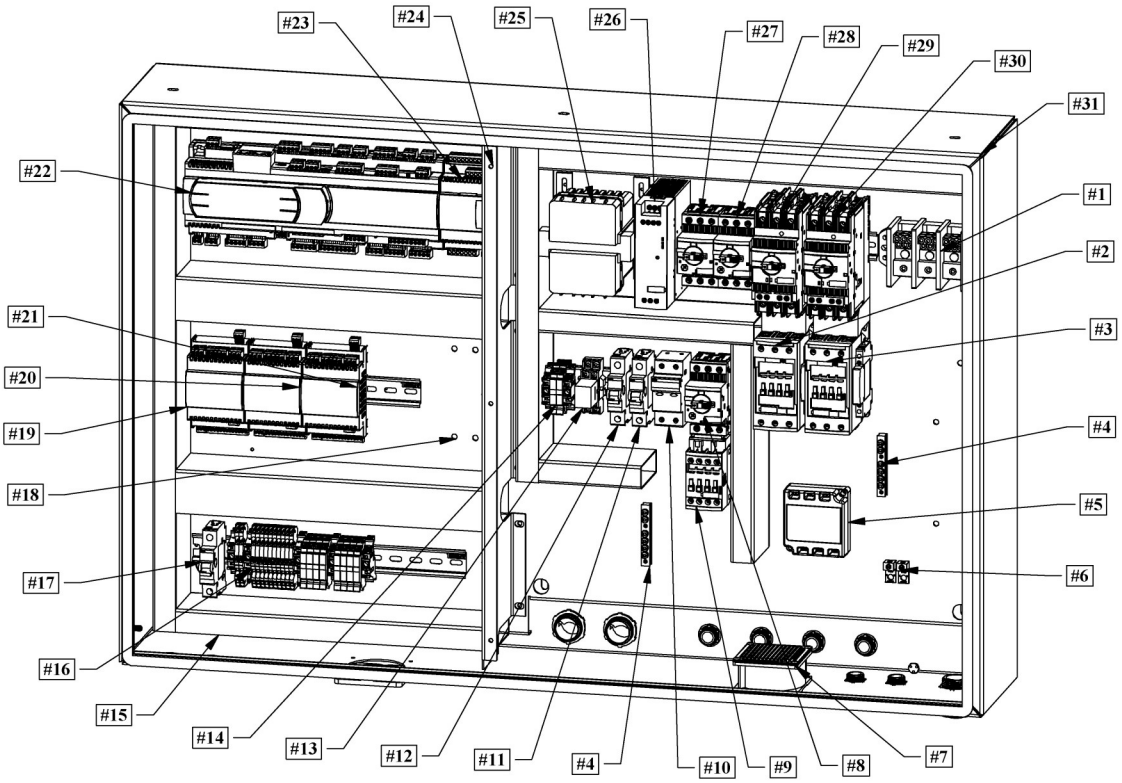
NOTES:

A. IF A CONDUIT SIZE OTHER THAN THE SIZE SPECIFIED IN THE DRAWING IS REQUIRED, IT IS UP TO THE INSTALLED TO PUNCH THE APPROPRIATE SIZE HOLE OR SUPPLY THE REDUCING BUSHINGS.

B. REFER TO SECTION 2 OF THIS MANUAL TO DETERMINE IF "FORCED AIR VENTILATION" WAS SELECTED FOR THE EQUIPMENT. IF IT WAS NOT SELECTED, BOTH VENTS WILL COME WITH FINGER SAFE FILTERED COVERINGS.

C. SERVICE SPACING TO ALLOW THE DOOR TO FULLY OPEN IS 48". REFER TO SECTION 3 OF THIS MANUAL FOR ADDITIONAL CLEARANCE REQUIREMENTS.

ELECTRICAL CABINET LAYOUT



ELECTRICAL COMPONENET ID				
ITEM NO.	DECRIPTION	-	ITEM NO.	DECRIPTION
1	POWER DISTRIBUTION BLOCK		17	24V CIRCUIT BREAKER
2	COMPRESSOR A CONTACTOR		18	RESERVED FOR REMOTE MONITORING (NOTE E)
3	COMPRESSOR B CONTACTOR		19	CONTROL - EXPANSION BLOCK - DUAL CIRCUIT
4	COMPONENT GROUND BAR		20	CONTROL - EXPANSION BLOCK - MASTER ONLY
5	PHASE MONITOR		21	CONTROL - EXPANSION BLOCK - MASTER ONLY
6	LINE CONNECTION & BONDING GROUND BLOCK		22	CONTROL - MAIN
7	CABINET VENTILATION FAN (NOTE A)		23	CONTROL - ELECTRONIC EXPANSION VALVE
8	INTERGAL PROCESS PUMP BREAKER (NOTE B)		24	HIGH/LOW VOLTAGE PANEL DIVIDER (NOTE F)
9	INTERGAL PROCESS PUMP CONTACTOR (NOTE B)		25	CONTROL TRANSFORMER
10	TRANSFORMER PRIMARY SIDE FUSE BLOCK		26	REMOE MONITORING POWER SUPPLY (NOTE E)
11	120V CIRCUIT BREAKER		27	FAN A CIRCUIT BREAKER
12	277V CIRCUIT BREAKER (NOTE C)		28	FAN B CIRCUIT BREAKER
13	HEAT TAPE CONTROL RELAY (NOTE D)		29	COMPRESSOR A CIRCUIT BREAKER
14	COMPRESSOR A & B CRANKCASE HEATER FUSES		30	COMPRESSOR A CIRCUIT BREAKER
15	WIRING TROUGH		31	TYPE X4 ENCLOSURE
16	24V CONTROL TERMINAL STRIP			

NOTES:

A. REFER TO SECTION 2 OF THIS MANUAL TO DETERMINE IF "FORCED AIR VENTILATION" WAS SELECTED FOR THE EQUIPMENT. IF IT WAS NOT SELECTED, BOTH VENTS WILL COME WITH FINGER SAFE FILTERED COVERINGS.
B. OPTIONAL AND NOT INCLUDED IN INDIVIDUAL MODEL NOMENCLATURE. REFER TO EQUIPMENT QUOTE FOR ADDITIONAL DETAILS.
C. CIRCUIT BREAKER ONLY INSTALLED ON 460V/3PH/60HZ SYSTEMS. REFER TO EQUIPMENT NAMEPLATE FOR LINE VOLTAGE.
D. REFER TO SECTION 2 OF THIS MANUAL TO DETERMINE IF "HEAT TRACE" WAS SELECTED FOR THE EQUIPMENT. LOW AMBIENT CONDITIONS AND TYPICALLY FOR SYSTEMS WITHOUT GLYCOL.
E. REFER TO SECTION 2 OF THIS MANUAL TO DETERMINE IF "REMOTE MONITORING" WAS SELECTED FOR THE EQUIPMENT. TYPICALLY ONLY INSTALLED ON THE FIRST MODULE IN A BANK.
F. DO NOT REMOVE.

ELECTRICAL CABINET LAYOUT CONT.

EQUIPMENT OPERATION & CONTROLS

CAUTIONARY NOTICE

UNDER NO CIRCUMSTANCES SHOULD THE CONTROLS BE TAMPERED WITH, MODIFIED OR REMOVED IN ATTEMPT TO SERVICE THE EQUIPMENT. CHOOSING TO IGNORE THIS NOTICE CAN RESULT IN DAMAGE TO THE EQUIPMENT, BODILY INJURY AND/OR SUDDEN DEATH. THE MANUFACTURER RESERVES THE RIGHT TO NULLIFY THE EQUIPMENT WARRANTY IF ANY MODIFICATION TO THE UNIT IS SUSPECTED WITHOUT PROPER PERMISSIONS. ALL FIELD WIRING SHOULD BE CONNECTED VIA THE CONTROLS DIAGRAM LOCATED ON THE INSIDE OF EQUIPMENT CONTROL PANEL DOOR. CONTACT THE AMERICAN GEOTHERMAL SERVICE DEPARTMENT IF FIELD WIRING CONNECTIONS ARE MADE UNCLEAR.

WARMING PERIOD

As mentioned in Section 1, all scroll compressors come equipped with crankcase heaters. Furnish power to heater a minimum of 12 hours before starting unit. To apply power to the heater only, set low voltage breaker (CB6) and (CB7) to the off position and the compressor breakers (CB1 and CB2) to the on positions. Close all cabinet covers during the warming period to prevent burns or electrical shock. If the waiting period is ignored, damage to the unit can occur. If the equipment is operating on a generator, contact the American GeoThermal service department immediately for further assistance. Additional parts and set up are required unless the equipment was built with a generator warming kit. The generator warming kit consists of additional crankcase heaters (typically 120v) and are constantly powered during main line power interruptions.

AIR COIL PROTECTION (optional)

Protective Coil Coating - In some conditions, specifically in corrosive environments; a cathodic, epoxy-type electrodeposition coating may have been applied to the microchannel coil. Such coating provides excellent resistance and durability in potentially corrosive environments due to alkalines, acids, alcohols, petroleum, seawater, salty air, etc. To confirm, refer to the equipment model number and reference the 15th digit regarding the model nomenclature on page 6 of this manual.

FREEZE PROTECTION - HEAT TRACE

Freeze protection is recommended by the manufacturer unless the appropriate concentration of glycol is added to the fluid piping. If using glycol, a concentration test should be conducted biannually to ensure the level of freeze protection remains unchanged. Brazed plate heat exchangers will be provided with two adhesive backed pads that stick to the side of the heat exchanger, all other fluid piping is wrapped by standard heat trace regardless of header configuration, pipe length or pipe material.

Factory Installed/ Powered by Others - All heat trace, heat exchanger heating pads, and defrost pan heaters will be installed by the factory. A junction box is provided by the factory and located at the back of the unit above the fluid headers. All heat tracing packages will be provided with a voltage rating of 120v and a maximum current draw of 10 ampere. A GFCI breaker shall be installed by others. Refer to Section 3.4 for additional information on heat trace connection location and protecting defrost discharge water drain tubes.

COMPERSSOR ANTI-SHORT CYCLE TIMER

Under all normal running conditions, a 3–minute minimum ON timer is maintained for the first compressor and a 5 second delay for every compressor thereafter. Once a compressor is turned OFF via the thermostat or alarm

conditions, it will remain OFF for a minimum of 3-minutes unless the alarm warrants a system locked out. System overrides that require immediate shutdown of the equipment, test modes, and compressor diagnostics/protection functions can override these 3–minute timers. However, for normal temperature and thermostatic-based control, these minimum ON timers are maintained.

CAREL C.PCO CONTROLS

Client Control (device code, SC): The main control uses state of the art software to achieve the highest possible efficiency and reliability. The main control commands the operation sequence of individual modules. It contains digital inputs, digital outputs, analog inputs and configurable analog outputs. The control measures dynamic functions of the equipment such as water temperature, refrigerant pressures and temperatures, and much more. The primary function of the control is to demand and protect the equipment from improper function. The control has many fault and alarm codes that will display on the user interface to make diagnostics simple for the end user. Refer the Section 11 of this manual for additional information on fault codes, diagnostics and troubleshooting.

Expansion Controls (device code, EC1, EC2, EC3): Expansion controls are utilized for the addition of features, such as client control, when multiple units are paired into a bank. Additionally, expansion controls are added to a panel when 4 pipe (simultaneous operation) is required, or the unit contains 2 refrigerant circuits. The expansion control, similar to the main control, contains dry inputs, digital outputs, analog inputs an configurable analog outputs. The expansion control communicates directly with the main control via Modbus, using a shielded cable.

Electronic Expansion Valve Control (device code, EEC): The primary function of the electronic expansion valve control is to control the expansion valves located on each outdoor air coil. By measuring the coil return pressure and temperature in heating mode, the control modulates the expansion valve to maintain a predetermined superheat for each coil. Each valve contains its own set of sensors. The electronic expansion valve control communicates directly with the main control via Modbus, using a shielded cable.

SEQUENCE OF OPERATION

System Staging Sequence (auto mode): The auto mode uses the client control logic to drive all functionality for the entire equipment bank - up to 10 modules. Auto mode looks at the main fluid inlet and outlet temperature sensors and determines the number of compressors that should be staged to provide the required heating or cooling capacity to the load. Auto mode also includes a “lead lag” function that selects the compressor with the least amount of run time to act as the lead compressor. Auto mode also has the ability to start and stop pumps based on control activation set up. For example, the pumps can either run 24hrs/day or be set up to stage on/off with lead compressor to optimize energy efficiency.

1. Run/Start signal is activated due to fluid inlet and outlet temperatures being in range per the system setpoints.
2. Client control calls for either heating or cooling mode and selects the compressor with the least amount of run time to be the primary stage.
3. Client control demands server controls to start the compressor delay timers (~ 180 seconds) and initiate the start up sequence. All compressors start at different time intervals to minimize power inrush from the power supply.
4. Liquid line solenoid valve opens 60 seconds before the compressor starts and the reversing valve switches to its respective mode.
5. Head pressure control valve begins start up sequence.

   Heating mode uses the fluid outlet modulating valve for head pressure modulation. Initial valve position is determined with respect to current fluid outlet temperature. If the fluid outlet temperature is less than 100°F,

the valve will automatically snap to 40 percent open. If the fluid outlet temperature is greater than 100°F, the valve will automatically snap to 100 percent open. The head pressure control uses the discharge pressure sensor to push a 0-10vdc signal to the valve for positioning, the valve then sends a signal back to the control to verify the position has been set. Default head pressure settings are 380 psi and can be changed based on operating conditions. Always consult with the manufacturer before adjusting the head pressure control.

Cooling mode uses the fan speed control for head pressure modulation. Similar to the heating mode operation, the control again uses the discharge pressure sensor to push a 0-10vdc signal to set the fan speed. Default head pressure settings are 380 psi and can be changed based on operating conditions. Always consult with the manufacture before adjusting the head pressure control.

5. Compressor delay timers are complete and the compressors begin to run. All safety switches, temperature sensors and pressure sensors are now active for potential alarm state.
6. Compressors shut down sequence is activated due to inlet and outlet water temperatures being out of range with respect to system setpoints. Note: each compressor in a bank can be controlled to stage on its own setpoint - this allows complete power consumption optimization for specific applications. The liquid line solenoid valve closes and initiates a pump down. Once the refrigerant suction pressure reaches 40psig, the compressor will automatically shut down. The compressor will remain off unit the system setpoints allow a restart.

System Staging Sequence (service mode): Service mode should only be used by certified technicians during service periods or in the case of a client control failure. In order for the modules to operate in service mode, the following must be completed.

1. Turn the main client control switch into the “off” position.
2. Override the fluid pump control. If pumps are integral to the equipment, this can be done on the control screen in the first unit within a bank or by placing a jumper to the contactor coil.
3. Turn the server control switch into the “service” position—this must be done on all modules in the bank.
4. Locate the “service overrides” page in each of the modules. The heating/cooling mode must be set per the desired mode. In addition, the fluid outlet temperature setpoint must be set to the desired temperature—this setpoint is what stages the compressors on/off. In order to prevent all compressors in the bank from starting and stopping at the same time, respect should be given when determining the setpoint for each module. For example, the first module set point for cooling mode is set to 42.0°F, the second module should be set to 42.1°F, the third module set to 42.2°F and so on.

The Service mode sequence of operation utilizes only the controls within a given module where the fluid outlet temperature sensor is used to stage the compressors as mentioned above.

1. Run/Start signal is activated due to fluid outlet temperatures being in range per the module setpoint on the service overrides page.
2. The module control demands the compressor delay timers (~ 180 seconds) and initiates the start up sequence.
3. Liquid line solenoid valve opens 60 seconds before the compressor starts. Reversing valve is already in the correct mode per the selection on the “service overrides” page.
4. Head pressure control valve begins start up sequence.

   Heating mode uses the fluid outlet modulating valve for head pressure modulation. Initial valve position is determined with respect to current fluid outlet temperature. If the fluid outlet temperature is less than 100°F, the valve will automatically snap to 40 percent open. If the fluid outlet temperature is greater than 100°F, the valve will automatically snap to 100 percent open. The head pressure control uses the discharge pressure

sensor to push a 0-10vdc signal to the valve for positioning, the valve then sends a signal back to the control to verify the position has been set. Default head pressure settings are 380 psi and can be changed based on operating conditions. Always consult with the manufacture before adjusting the head pressure control.

Cooling mode uses the fan speed control for head pressure modulation. Similar to the heating mode operation, the control again uses the discharge pressure sensor to push a 0-10vdc signal to set the fan speed. Default head pressure settings are 380 psi and can be changed based on operating conditions. Always consult with the manufacture before adjusting the head pressure control.

5. Compressor delay timers are complete and the compressors begin to run. All safety switches, temperature sensors and pressure sensors are now active for potential alarm state.
6. Compressors shut down sequence is activated due to module outlet water temperatures being out of range with respect to module setpoint on the "service overrides" page. The liquid line solenoid valve closes and initiates a pump down. Once the refrigerant suction pressure reaches 40psig, the compressor will automatically shut down. The compressor will remain off unit the system setpoints allow a restart.

NOTE: When switching from service mode back to auto mode, remember to turn off the pump override or undo any implemented process to override the system fluid pumps.

Fluid Pump Staging Sequence: Fluid pumps can either be staged by the control logic or from an external source. Refer to Section 8 of this manual for installation instructions on fixed speed single and redundant pumps. Variable speed installation instructions are available upon request. When the main "on/off" switch is activated on the client control module, the pumps will begin to operate. Once flow is established and proved by the field supplied and installed flow switch and the server switches are in the "auto" position, the equipment will per the mode selection and per the system setpoints. **If service mode is required at any point, the fluid pumps must be switched on manually.**

Head Pressure Control: The head pressure control uses the refrigerant discharge pressure transducer and is responsible for keeping the compressor operating within its intended operation envelope. In heating mode, the heat pressure control sends a 0-10vdc signal to set the position of the fluid outlet valve. The fluid outlet valve is a true modulating valve and has a positioning range of 0-100% and sends a feedback signal to verify positioning. In cooling mode, the head pressure control sends a 0-10vdc signal to the outdoor air coil fans. For example, on a cooler day, the user may notice the fans operating slower than normal—this is due to head pressure management.

Defrost Enable & Disable: The equipment has its own proprietary defrost management system that uses both evaporation temperature and ambient temperature to determine if defrost is required or not. In order for defrost to initiate, the ambient temperature must be below 52°F and the evaporation temperature must less than its setpoint (adjustable when needed). Once these two requirements are met, a timer begins and control logic determines the defrost initiation setpoint. Once the defrost initiation setpoint is met, the auto defrost cycle will begin.

1. Liquid line solenoid valve closes to initiate a pump down.
2. Once the low pressure transducer setpoint is met, the compressors shut off.
3. The reversing valve switches from heating mode to defrost (cooling) mode.
4. The compressors continue operating until the coil is completely defrosted. The auto defrost cycle is terminated on either; a max 10 min defrost timer, condensing temperature reaches its setpoint or, the discharge pressure reaches its setpoint.
5. Once the defrost cycle is terminated, the compressors continue running and the reversing valve will automatically switch back to heating mode.

In certain circumstances, a manual defrost may be required. Contact the American GeoThermal service department if a service technician suspects a failure in the auto defrost cycle.

System Protection & Limit Switches: System protection limits are a critical aspect of any refrigeration system. Limit switches ensure that the equipment stays within its intended operation envelope. For a list of default limit switch settings, refer to the back of this section. Under no circumstance should a limit or safety switch be jumped, removed or replaced with a switch not approved by the manufacturer.

Compressor Liquid Injection: The compressor liquid injection control operates on refrigerant discharge temperature. When the discharge temperature exceeds 250°F, the liquid injection solenoid valve opens and injects liquid refrigerant into the compressor to cool the motor windings. Capacity losses during this injection sequence are minimal however, the compressor superheat will change rapidly.

2 Pipe Operation: Units configured with 2 header pipes contain (1) fluid inlet and (1) fluid outlet pipe connection. The fluid outlet on each module contains a head pressure control valve that modulates the flow in heating mode to maintain a satisfactory head pressure. Flow will be restricted and the fluid outlet water temperature will increase as a result.

4 Pipe Operation: Units configured with 4 header pipes contain (2) fluid inlet and (2) fluid outlet pipe connection. This configuration is used for dedicated heating and cooling connections. The heating fluid outlet on each module contains a head pressure control valve that modulates the flow in heating mode to maintain a satisfactory head pressure. Flow will be restricted and the fluid outlet water temperature will increase as a result. The other three headers contain isolation valves that restrict flow to the 2 headers not being used.

EQUIPMENT SAFTY SWITCHES AND SENSORS

Fluid Temperature Sensors (NTC) - Each module contains a fluid outlet temperature sensor located on each steel pipe connecting the heat exchanger to the header. The fluid outlet sensor is responsible for monitoring and protecting the heat exchanger in the event that the unit operates outside of its intended envelope. Temperature limits can be adjusted with the approval of the manufacturer. Units shipped in a complete bank contain a client fluid inlet and outlet temperature sensor responsible for measuring the main inlet and outlet temperatures and must be field installed. Units shipped in a complete bank that contain an included system fluid pump, temperature sensors are installed by the factory near the system fluid connections.

Fluid Pressure Sensors *(0-100 psig range)* - Fluid pressure sensors are responsible for measuring the differential pressure of the entire fluid circuit and in some cases can be used to protect the heat exchanger. 0-200 psi transducers can be supplied upon request if loop pressures exceed 100 psi. Contact the American GeoThermal service department for additional information.

Loss of Charge Pressure Switch - Designed to cut out at 20 psig. and reopen at 40 psig. However, a loss of charge condition will result in a system lockout *(Low Lockout Alarm)* and requires the user to physically reset the alarm by pressing and holding the caution symbol on the c.pco control for 3 seconds. If repetitive low pressure conditions occur, refer to the troubleshooting guide located at the back of Section 4.

High Pressure Switch - Designed to cut out at 630 psig. and reopen at 430 psig. Like the Loss of Charge Switch, the High Pressure Switch fault will result in a system lockout *(High PSI Switch Alarm)* and requires the user to physically reset the alarm. If repetitive high pressure conditions occur, refer to the troubleshooting guide located at the back of Section 4.

Suction Pressure Ratiometric Transducer *(0-250 psig range)*- This pressure transducer is designed to measure and display dynamic conditions of the compressors suction line and can serve as a level of protection for the compressor. In

addition, this sensor combined with other dynamic conditions calculates the Super Heat reading on the display. Default cut in/out values are 25/45 psig. respectively and will lock the compressor out immediately. A "Suction Trans. Alarm" will require a physical reset by pressing and holding the caution symbol on the c.pco control. If repetitive low pressure conditions occur, refer to the troubleshooting guide located at the back of Section 4.

Discharge Pressure Ratiometric Transducer *(0-650 psig range)* - This pressure transducer is designed to measure and display dynamic conditions of the compressors discharge line. In addition, the Discharge Pressure Transducer is used in the head pressure control sequence during cooling modes and adjusts the fan speed accordingly. The Discharge Pressure Sensor also plays a pivotal role in disabling the defrost mode. Default cut in/out values are 595/645 psig respectively *(Dis Trans Alarm)* and can trip 3 times within 1 hour before locking out the compressor. If the equipment contains condenser protection filters and repetitive high pressure conditions are observed, check the filters and clean as often as necessary. Dirty filters will result in continued high refrigerant pressure conditions and can damage equipment if periodic maintenance is not maintained. Refer to the maintenance and troubleshooting sections of this manual for more details. If repetitive high pressure conditions occur, refer to the troubleshooting guide located at the back of Section 4.

Liquid Pressure Ratiometric Transducer *(0-650 psig range)*- This pressure transducer is designed to measure and display dynamic conditions of the compressors liquid line and is used in conjunction with the liquid line temperature sensor to calculate the Subcooling reading on the user interface. Unlike the other ratiometric transducers, the Liquid Pressure Transducer does not contain protection limits. However if the sensor fails, an alarm will result.

Suction Temperature Sensor (NTC) - This sensor is responsible for measuring the compressors suction temperature and is used in conjunction with Suction Pressure to calculate the Superheat reading on the user interface. *Note: The suction temperature sensor should be wrapped in cork tape and positioned on the line using the 2 & 10 method.*

Discharge Temperature Sensor (NTC) - This sensor is responsible for measuring the compressor discharge or high side temperature. It prevents the equipment from operating outside the intended envelope in the case of a component failure.

Liquid Temperature Sensor (NTC) - This sensor is responsible for measuring the compressors liquid temperature and is used in conjunction with Liquid Pressure to calculate the Subcooling reading on the user interface. *Note: The suction temperature sensor should be wrapped in cork.*

Air Coil Temperature Sensors (NTC) - This sensor is solely responsible for deriving the position of the electronic expansion valve and keeping the system superheat within range. Each left and right outdoor air coil contains it's own air coil temperature sensor located on the return line in heating mode. This sensor serves no purpose in cooling mode.

Ambient Temperature Sensor (NTC) - This sensor is responsible for measuring atmospheric operating conditions and serves as a protection device to prevent the equipment from operating outside its intended envelope. The Ambient Temperature Sensor also plays a pivotal role in determining the defrost frequency.

High Pressure Relief Valve - The equipment contains a high pressure relief valve in the case of unexpected compressor failure or control failure. The pressure relief valve is located on the top of the refrigerant receiver where it can be isolated by a shutoff valve. Never isolate or close the pressure relief isolation valve during normal operation. The isolation valve should be used only in the case that the pressure relief valve should be serviced or replaced. If the pressure relief valve opens, refrigerant will be discharged from the unit at the back of the main refrigerant cabinet near the fans. If local codes require a pressure relief holding tank to be connected i.e. venting of refrigerant is not permitted, the equipment comes ready for field connection. The connection can be made with either a high pressure hose or copper tubing using a 5/8" female flare connector.

TOTAL FILL VALVE CONTROL (optional)

Note: For systems that require large storage tanks where the fluid is used in a batching process. Typically installations contain a system fluid pump to batch the fluid and a fill valve to replace the fluid.

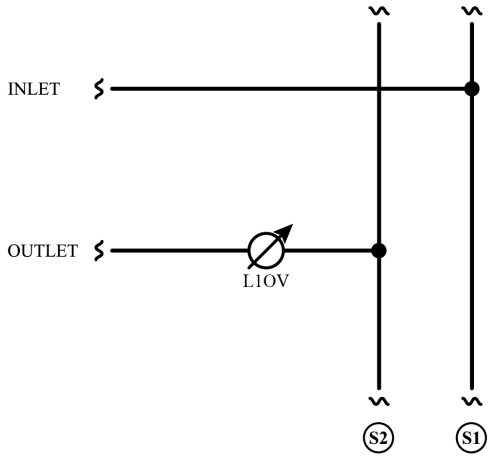
The Total Fill Valve Control (TFVC), formerly Dilution Control, allows the operator complete control over the storage tank temperature and volume. APPLICABLE FOR INSTALLATIONS INCLUDING STORAGE TANKS THAT REQUIRE MAKE UP WATER ONLY. For example, when fluid is batched from the tank, the volume removed is replaced by some form of filling mechanism - typically a fill solenoid valve and a pressure or float switch. In turn, the tank temperature is affected in some way i.e. in cooling modes, tank temp increases. Due to this external heat load being introduced, the operator often has little to no control over the final temperature of the tank caused by the dilution. In some instances, this large uncontrolled temperature swing may not be acceptable and a different control method is required. American GeoThermal developed TFVC using state of the art temperature control software that allows the operator to set desired minimum and maximum tank temperatures for both cooling and heating modes. Once the minimum and maximum temperatures are set and the TFVC is activated, the fill solenoid valve will shut off regardless of the tank fill level to prevent dilution beyond desire. Refer to the electrical drawings located on the electrical panel door for installation requirements, wiring, and set up. Contact the American GeoThermal service department for additional assistance.

Header Configuration - Depending on application, the equipment will be provided with one of the following header configurations; (A) no headers, (B) 2-pipe headers or, (C) 4 pipe headers. All headers will be provided with 6" grooved end connections. If an integral fluid package is purchased, field connection sizes will vary.

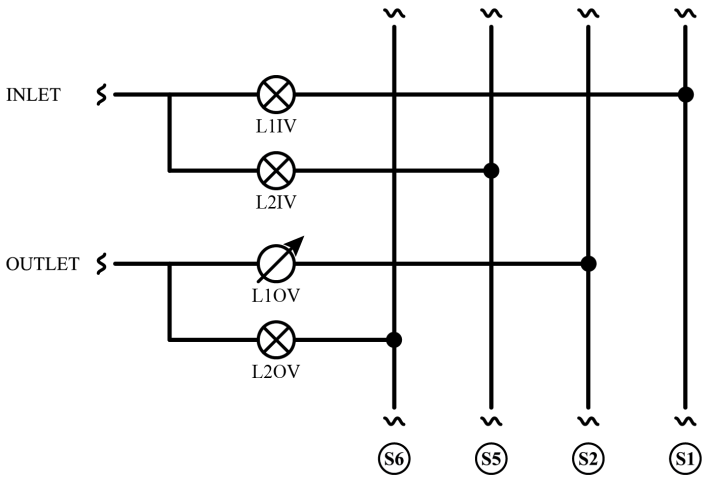
A. **No Headers** - Typically this configuration is for potable water systems only. The equipment will come provided with the standard head pressure control valve (L1OV) however, it will not be equipped with a manifolding pipe system. All plumbing or manifolding will be supplied and installed by others.

B. **2-Pipe Headers** - Configured for standard heating and cooling operations but not both at the same time. All fluid piping is equipped by the factory and ready for easy installation. The installer should simply mate the units together and tighten the factory supplied groove end couplings. This configuration is provided with the standard head pressure control valve (L1OV) however, it does not come standard with an isolation valve on the fluid inlet.

C. **4-Pipe Headers** *(Simultaneous Heating & Cooling Operation)* - Configured for complex heating and cooling operations where part of the module bank must operate in heating mode and the other part must operate in cooling mode. This configuration requires control activations and setup, as well as additional valves supplied and installed by the factory. This configuration is provided with the standard head pressure control valve (L1OV) in addition to other control valves (L1IV, L2IV, L2OV) required for 4-pipe headers. Each valve will automatically open or close to route the fluid to the correct fluid pipe depending on the load setpoints. If the modules are being controlled by a building management system, the cooling/heating requirements can be pushed to the controls to drive the staging sequence. In other cases where BMS is not being used, the controls must be set up to prioritize the heating or cooling setpoints. The controls will automatically calculate the required number of modules in a given bank and maintain the prioritize mode. Other modules not required in the staging priority will automatically operate in the opposite mode.

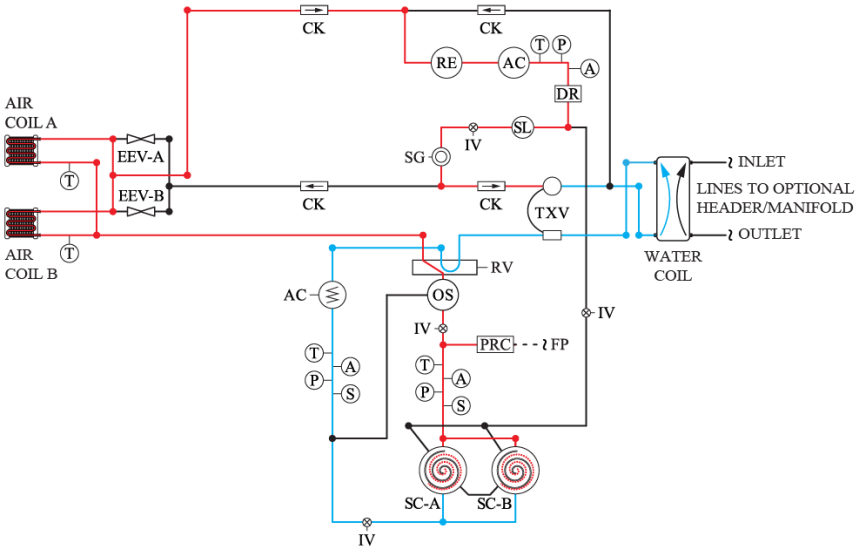


2 PIPE HEADER CONFIGURATION

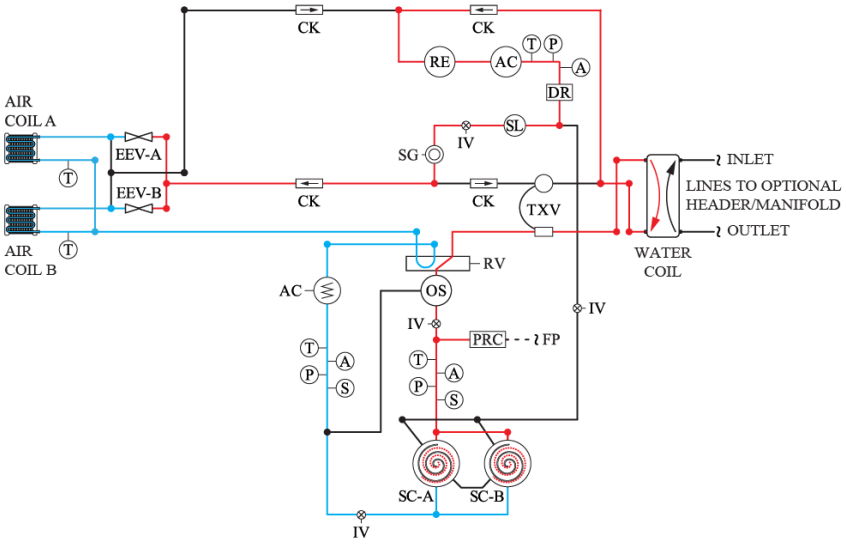


4 PIPE HEADER CONFIGURATION

COMPONENT KEY				
SHORT	**COMPONENT**		**SHORT**	**COMPONENT**
S1	LOOP 1 FLUID INLET HEADER		L1IV	LOOP 1 INLET VALVE (ON/OFF TYPE)
S2	LOOP 1 FLUID OUTLET HEADER		L10V	LOOP 1 OUTLET VALVE (MODULATING TYPE)
S5	LOOP 2 FLUID INLET HEADER		L2IV	LOOP 2 INLET VALVE (ON/OFF TYPE)
S6	LOOP 2 FLUID OUTLET HEADER		L2OV	LOOP 2 OUTLET VALVE (ON/OFF TYPE)



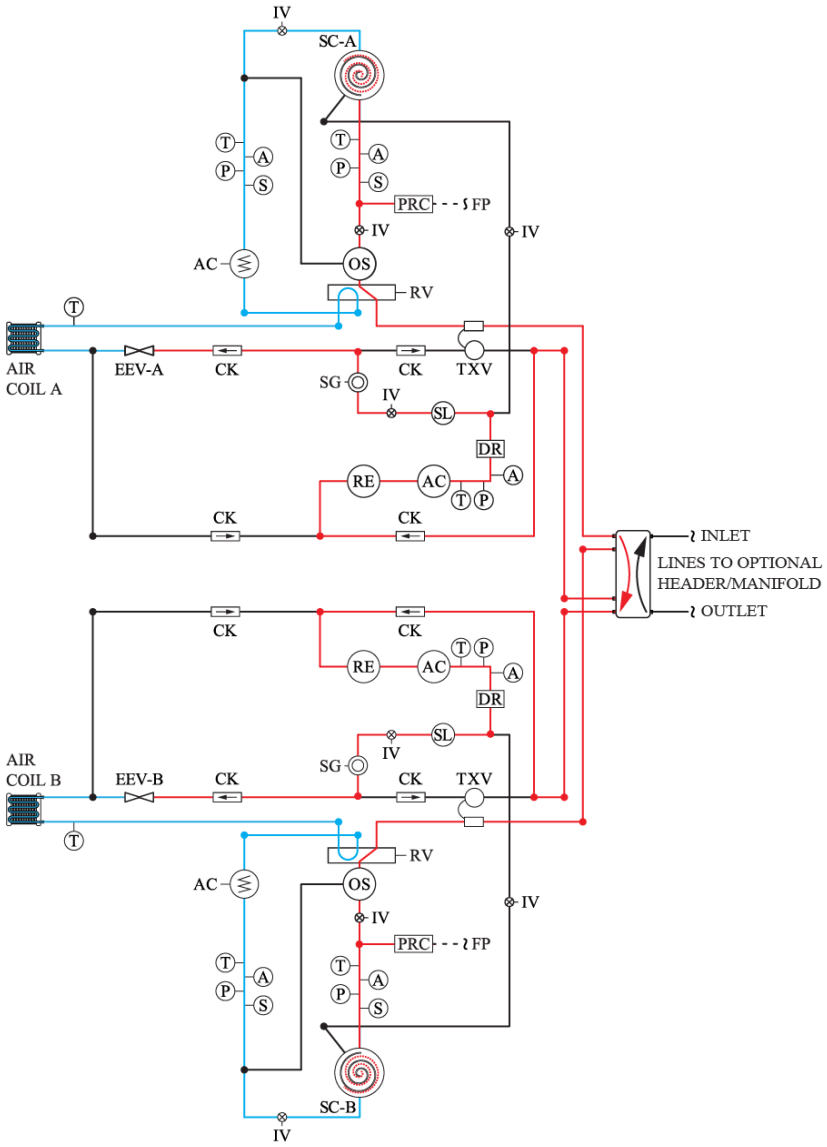
SINGLE & TANDEM CIRCUIT UNITS - COOLING/ DEFROST MODE



SINGLE AND TANDEM CIRCUIT UNITS - HEATING MODE

System schematics may vary depending on specific application. ** In the case of a component failure, pressure relief valves may open and vent refrigerant to the atmosphere. Each unit is provided with a pressure relief connection where local codes should be considered before connecting reservoir tanks or any other storage tanks to the relief connection. Not all installations require pressure relief field connections.

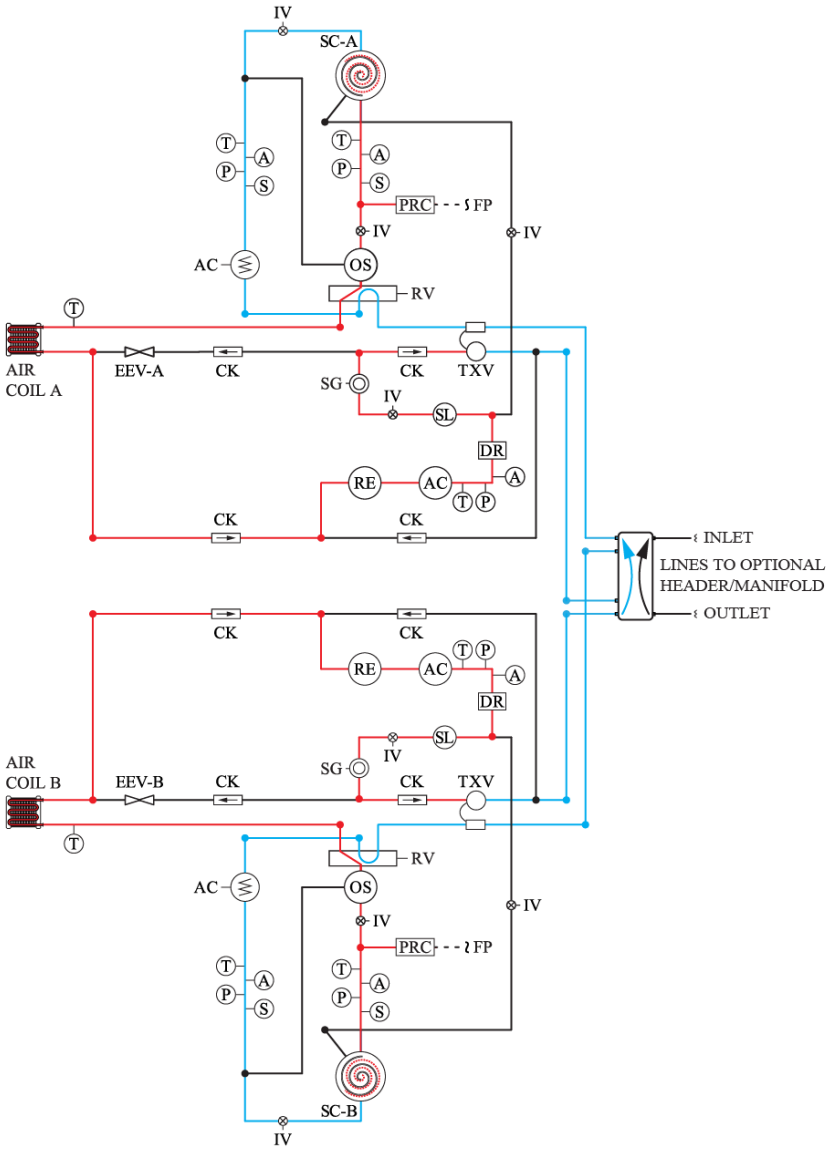
COMPONENT KEY							
SHORT	**COMPONENT**		**SHORT**	**COMPONENT**		**SHORT**	**COMPONENT**
A	ACCESS PORT		IV	ISOLATION VALVE		SC-A	SCROLL COMPRESSOR A
AC	ACCUMULATOR		OS	OIL SEPARATOR		SC-B	SCROLL COMPRESSOR B
CK	CHECK VALVE		P	PRESSURE SWITCH		SG	LIQUID LINE SIGHT GLASS
EEV-A	ELECTRONIC EXPANSION VALVE A		RE	LIQUID RECEIVER		SL	LIQUID LINE SOLENOID VALVE
DR	LIQUID LINE DRIER		PR	PRESSURE RELIEF VALVE		T	TEMPERATURE SENSOR
EEV-B	ELECTRONIC EXPANSION VALVE B		PRC **	PRESSURE RELIF VALVE FIELD CONNECTION, 5/8" MALE FLARE		TXV	THERMAL EXPANSION VALVE
FP **	PRESSURE RELIEF FIELD PIPING		S	PRESSURE SWITCH			



DUAL CIRCUIT UNITS - HEATING MODE

System schematics may vary depending on specific application. ** In the case of a component failure, pressure relief valves may open and vent refrigerant to the atmosphere. Each unit is provided with a pressure relief connection where local codes should be considered before connecting reservoir tanks or any other storage tanks to the relief connection. Not all installations require pressure relief field connections.

COMPONENT KEY							
SHORT	**COMPONENT**		**SHORT**	**COMPONENT**		**SHORT**	**COMPONENT**
A	ACCESS PORT		IV	ISOLATION VALVE		SC-A	SCROLL COMPRESSOR A
AC	ACCUMULATOR		OS	OIL SEPARATOR		SC-B	SCROLL COMPRESSOR B
CK	CHECK VALVE		P	PRESSURE SWITCH		SG	LIQUID LINE SIGHT GLASS
EEV-A	ELECTRONIC EXPANSION VALVE A		RE	LIQUID RECEIVER		SL	LIQUID LINE SOLENOID VALVE
DR	LIQUID LINE DRIER		PR	PRESSURE RELIEF VALVE		T	TEMPERATURE SENSOR
EEV-B	ELECTRONIC EXPANSION VALVE B		PRC **	PRESSURE RELIF VALVE FIELD CONNECTION, 5/8” MALE FLARE		TXV	THERMAL EXPANSION VALVE
FP **	PRESSURE RELIEF FIELD PIPING		S	PRESSURE SWITCH			

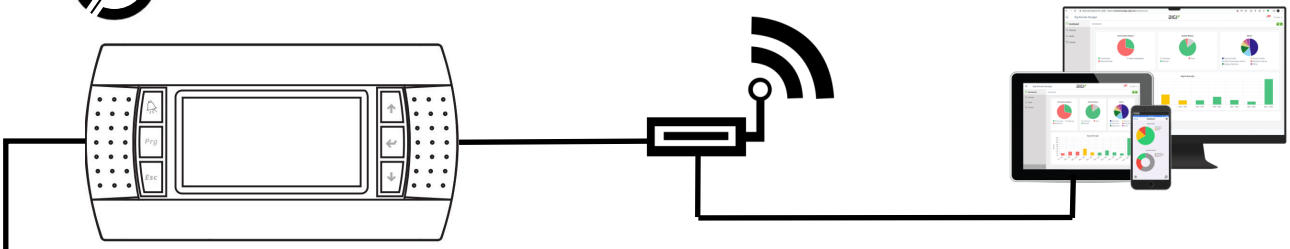


DUAL CIRCUIT UNITS - COOLING/ DEFROST MODE

System schematics may vary depending on specific application. ** In the case of a component failure, pressure relief valves may open and vent refrigerant to the atmosphere. Each unit is provided with a pressure relief connection where local codes should be considered before connecting reservoir tanks or any other storage tanks to the relief connection. Not all installations require pressure relief field connections.

COMPONENT KEY							
SHORT	**COMPONENT**		**SHORT**	**COMPONENT**		**SHORT**	**COMPONENT**
A	ACCESS PORT		IV	ISOLATION VALVE		SC-A	SCROLL COMPRESSOR A
AC	ACCUMULATOR		OS	OIL SEPARATOR		SC-B	SCROLL COMPRESSOR B
CK	CHECK VALVE		P	PRESSURE SWITCH		SG	LIQUID LINE SIGHT GLASS
EEV-A	ELECTRONIC EXPANSION VALVE A		RE	LIQUID RECEIVER		SL	LIQUID LINE SOLENOID VALVE
DR	LIQUID LINE DRIER		PR	PRESSURE RELIEF VALVE		T	TEMPERATURE SENSOR
EEV-B	ELECTRONIC EXPANSION VALVE B		PRC **	PRESSURE RELIF VALVE FIELD CONNECTION, 5/8” MALE FLARE		TXV	THERMAL EXPANSION VALVE
FP **	PRESSURE RELIEF FIELD PIPING		S	PRESSURE SWITCH			

Client (Bank) Control Switch: The bank control switch allows the user to operate the entire bank as one system. The client control contains built in staging sequences that optimize energy consumption and performance. In order for the entire bank to operate as intended, each server control switch must be placed in/into the auto mode.

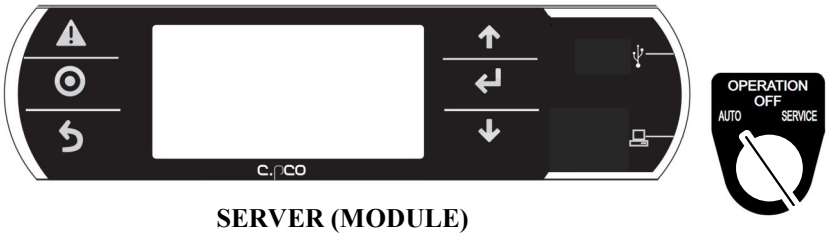


CLIENT (BANK) CONTROL

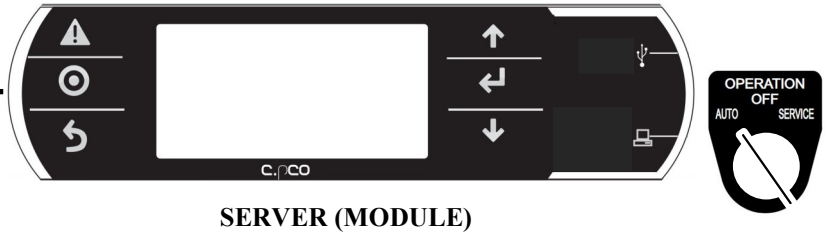
RPM, REMOTE MONITORING ROUTER

AMERICAN GEOTHERMAL INFORMATION SYSTEM

Communication network: The Client Control is connected to the 1st module control in a bank. All units can be observed via the Client Control.



SERVER (MODULE) CONTROL, UNIT 1



SERVER (MODULE) CONTROL, REMAINING MODULES

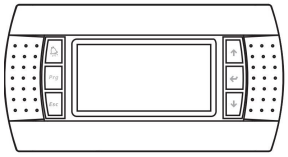
Server (Module) Control Switch: The module control switch allows the user to either use the Client Control staging sequence (auto mode) or allow the module to function independently in the case of a client control failure (service mode). Before switching the control mode into service mode, it is recommended to contact a qualified service technician to ensure the equipment will function properly. If a fluid pump is staged on and off by the equipment, those pumps must be energized via bypass switch.

Symbol	Description	Function
⚠	Alarm	Alarm Log, hold for 3 sec. to clear Alarm
⊙	Target	Submenu
↩	Return	Return one level
↑	Up	Page up, increase write parameter.
↵	Enter	Enter lower submenu levels, confirm parameter
↓	Down	Page up, decrease write parameter

System Control Navigation of Client (Bank) Control: Using either the external display or the controller inside the first module in a bank, the user can navigate the control in the shown sequence below. The Client Control, does not provide total access to the Server Control but it does however allow the user to view server control parameters, main setpoints and fault status.

CLIENT CONTROL NAVIGATION (EXTERNAL DISPLAY)

CLIENT NAVIGATION CAN ONLY BE ACCESSED FROM THE FIRST MODULE IN A BANK.



PRESS ⚠

ALARM LOG

Active alarms are shown in this menu, by pressing and holding the triangle for 3 seconds, an alarm can be reset. If multiple alarms are present, the user can navigate them by pressing the up and down buttons.

PRESS ◎

SUBMENU

- Activations
- Submenu Setpoints
- I-O Configuration
- EVD Settings
- Settings
- Control Information

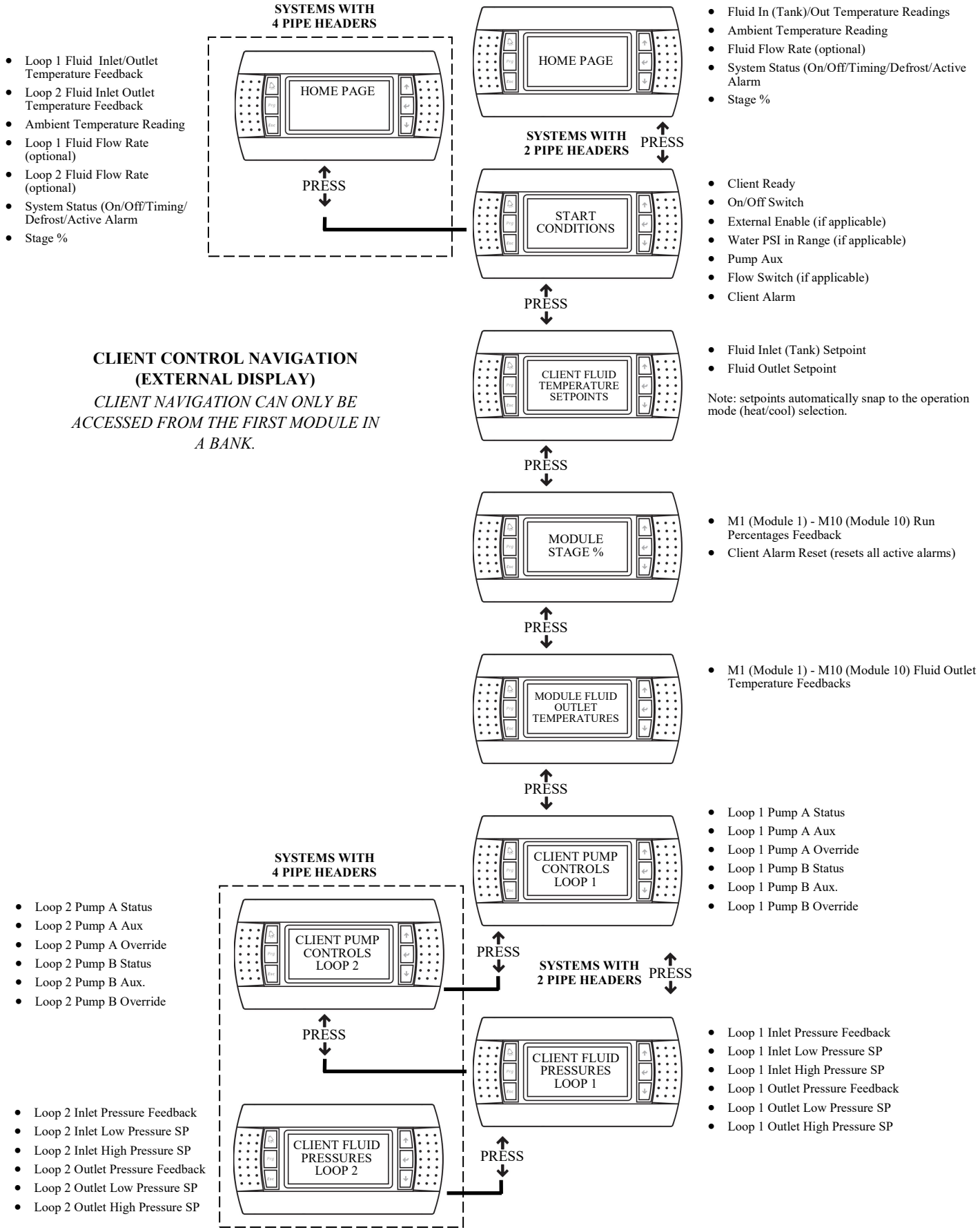
PRESS ↩ TO RETURN TO THE PREVIOUS PAGE OR TO RETURN TO THE HOME PAGE.

PRESS ↵ TO MOVE THE CURSER DOWN THE CURRENT PAGE OR TO SELECT A SUBMENU WITHIN A MENU.

PRESS ⚠ & ↵ TOGETHER TO ACCESS THE SUBMENU OF THE OPERATING SYSTEM.

WARNING

Use caution when opening electrical cabinets as high voltage could be present. Always use the appropriate PPE when working in areas with high voltage hazards and disconnect electrical services if necessary.



- Loop 1 Fluid Inlet/Outlet Temperature Feedback
- Loop 2 Fluid Inlet Outlet Temperature Feedback
- Ambient Temperature Reading
- Loop 1 Fluid Flow Rate (optional)
- Loop 2 Fluid Flow Rate (optional)
- System Status (On/Off/Timing/ Defrost/Active Alarm
- Stage %

- Fluid In (Tank)/Out Temperature Readings
- Ambient Temperature Reading
- Fluid Flow Rate (optional)
- System Status (On/Off/Timing/Defrost/Active Alarm
- Stage %

- Client Ready
- On/Off Switch
- External Enable (if applicable)
- Water PSI in Range (if applicable)
- Pump Aux
- Flow Switch (if applicable)
- Client Alarm

CLIENT CONTROL NAVIGATION (EXTERNAL DISPLAY)

CLIENT NAVIGATION CAN ONLY BE ACCESSED FROM THE FIRST MODULE IN A BANK.

- Fluid Inlet (Tank) Setpoint
- Fluid Outlet Setpoint

Note: setpoints automatically snap to the operation mode (heat/cool) selection.

- M1 (Module 1) - M10 (Module 10) Run Percentages Feedback
- Client Alarm Reset (resets all active alarms)

- M1 (Module 1) - M10 (Module 10) Fluid Outlet Temperature Feedbacks

- Loop 1 Pump A Status
- Loop 1 Pump A Aux
- Loop 1 Pump A Override
- Loop 1 Pump B Status
- Loop 1 Pump B Aux.
- Loop 1 Pump B Override

- Loop 2 Pump A Status
- Loop 2 Pump A Aux
- Loop 2 Pump A Override
- Loop 2 Pump B Status
- Loop 2 Pump B Aux.
- Loop 2 Pump B Override

- Loop 1 Inlet Pressure Feedback
- Loop 1 Inlet Low Pressure SP
- Loop 1 Inlet High Pressure SP
- Loop 1 Outlet Pressure Feedback
- Loop 1 Outlet Low Pressure SP
- Loop 1 Outlet High Pressure SP

- Loop 2 Inlet Pressure Feedback
- Loop 2 Inlet Low Pressure SP
- Loop 2 Inlet High Pressure SP
- Loop 2 Outlet Pressure Feedback
- Loop 2 Outlet Low Pressure SP
- Loop 2 Outlet High Pressure SP

System Control Navigation of Server (Module) Control: Using the following buttons, the user can navigate the control in the shown sequence below. In order to access the below controls, the user must open the electrical cabinet of the desired module and use the onboard screen in the electrical cabinet. The following information can not be accessed from the client control screen or external screen. The client control can however access a portion of the information shown below.

INDIVIDUAL MODULE CONTROL NAVIGATION (SERVER)

SERVER NAVIGATION MUST BE ACCESSED AT EACH RESPECTIVE MODULE

PRESS ⚠

ALARM LOG

Active alarms are shown in this menu, by pressing and holding the triangle for 3 seconds, an alarm can be reset. If multiple alarms are present, the user can navigate them by pressing the up and down buttons.

PRESS ⊙

SUBMENU

- Activations
- Submenu Setpoints
- I-O Configuration
- EVD Settings
- Settings
- Control Information

PRESS ↩ TO RETURNTO THE PREVIOUS PAGE OR TO RETURN TO THE HOME PAGE.

PRESS ↵ TO MOVE THE CURSER DOWN THE CURRENT PAGE OR TO SELECT A SUBMENU WITHIN A MENU.

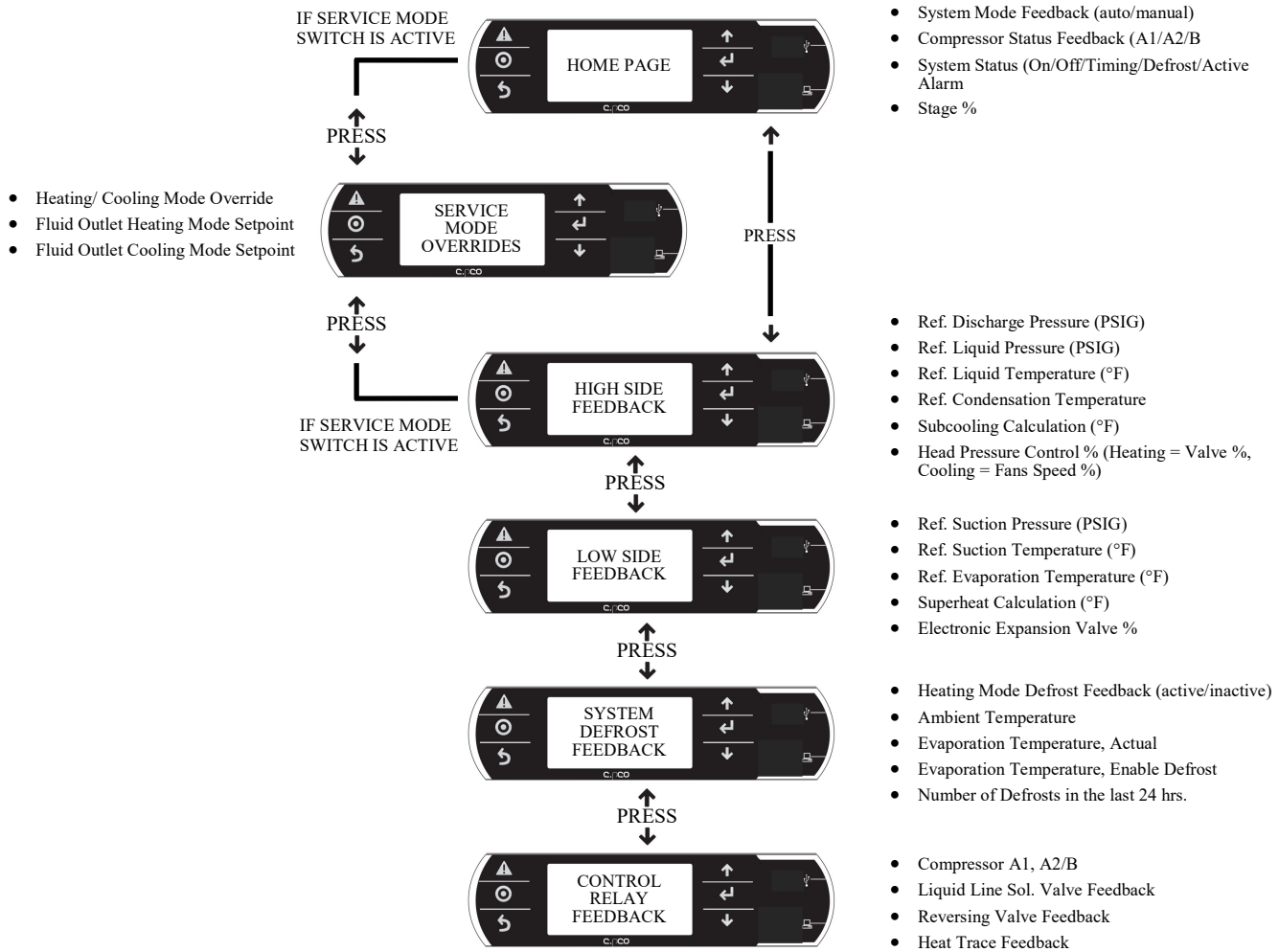
PRESS ⚠ & ↵ TOGETHER TO ACCESS THE SUBMENU OF THE OPERATING SYSTEM.

WARNING

Use caution when opening electrical cabinets as high voltage could be present. Always use the appropriate PPE when working in areas with high voltage hazards and disconnect electrical services if necessary.

INDIVIDUAL MODULE CONTROL NAVIGATION (SERVER)

SERVER NAVIGATION MUST BE ACCESSED AT EACH RESPECTIVE MODULE



Standard Sensors and Protection Switches - The below chart describes sensor location, the variable type and the sensor type. Review Section 11 of this manual for the procedure required to calibrate or adjust pressure and temperature sensors. S1 through S6 Sensors are used during auto operation only and control the temperature and pressure conditions of the entire bank of modules. Fluid inlet and outlet pressure sensors can be set up to accept a 0-200 psi switch if required. Contact the American GeoThermal service department for additional information as control set up is required. Safety switches should never be jumped, overridden, or removed and should always be replaced by the manufacturer's approved replacement.

STANDARD SENSORS AND PROTECTION SWITCHES			
DESCRIPTION	**LOCATION**	**TYPE**	**SENSOR INFO.**
Loop 1 Inlet Fluid Temperature Sensor	FM	A, R, C, SP	NTC, -40/120°C
Loop 1 Outlet Fluid Temperature Sensor	FM	A, R, C, SP	NTC, -40/120°C
Loop 1 Inlet Fluid Pressure Sensor	FM	A, R, C, SP	0-10vdc/0-100PSI
Loop 1 Outlet Fluid Pressure Sensor	FM	A, R, C, SP	0-10vdc/0-100PSI
Loop 2 Inlet Fluid Temperature Sensor (4-pipe operation only)	FM	A, R, C, SP	NTC, -40/120°C
Loop 2 Outlet Fluid Temperature Sensor (4-pipe operation only)	FM	A, R, C, SP	NTC, -40/120°C
Loop 2 Inlet Fluid Pressure Sensor (4-pipe operation only)	FM	A, R, C, SP	0-10vdc/0-100PSI
Loop 2 Outlet Fluid Pressure Sensor (4-pipe operation only)	FM	A, R, C, SP	0-10vdc/0-100PSI
Refrigerant Suction Pressure Sensor	IM	A, R, C, SP, W	4-20mA/0-250PSI
Refrigerant Suction Temperature Sensor	IM	A, R, C	NTC, -40/120°C
Refrigerant Liquid Pressure Sensor	IM	A, R, C	4-20mA/0-650PSI
Refrigerant Liquid Temperature Sensor	IM	A, R, C	NTC, -40/120°C
Refrigerant Discharge Pressure Sensor	IM	A, R, C, SP, W	4-20mA/0-650PSI
Refrigerant Discharge Temperature Sensor	IM	A, R, C, SP, W	NTC, -40/120°C
Refrigerant Air Coil Pressure Sensor	IM	A, R, C	4-20mA/0-650PSI
Refrigerant Air Coil Temperature Sensor	IM	A, R, C	NTC, -40/120°C
Refrigerant Suction Pressure Switch	IM	R, F	On/Off, 20psi/40psi
Refrigerant Discharge Pressure Switch	IM	R, F	On/Off, 630psi/430psi
Refrigerant Discharge Temperature Switch	IM	R, F	On/Off, 356°F
Subcooling Calculation (uses liquid pressure and liquid temperature)	IM	R, SP	Value Derived
Superheat Calculation (uses suction pressure and suction temperature)	IM	R	Value Derived
HX1 Fluid Outlet Temperature Sensor	IM	A, R, C, SP	NTC, -40/120°C

KEY

A - Alarm if signal is lost, **C** - Calibratable value, **F** - Fault activated when limit is reached, **FM** - Sensor installed in the first module/client, **IM** - installed in each individual module, **R** - Readable value, **SP** - Controlled by a setpoint, **W** - Writable value

Standard Setpoints and Protection Limits - The chart on the next page describes the equipment's default setpoints and protection limits for various sensing equipment. Heating and Cooling modes must be changed from the client control display. In the case of a client control failure, the server controls may be switched into "service mode" and the heating/cooling setpoint as well as the temperature outlet setpoint be overridden. Any alarm with a "lockout" reset type must be manual reset by holding down the red caution button on the control, this may be done at the server control respective to the fault or from the client control display. Heating and cooling setpoints shown in the chart are default setpoints, the user may adjust the setpoints per the application and within the limits of operation shown on the equipment submittal.

Heat Exchanger Under Temperature Limit Faults are specific to each type of heat exchanger. The type of heat exchanger installed is shown in the units unique model nomenclature - refer to Section 2.

STANDARD SETPOINTS AND PROTECTION LIMITS				
DESCRIPTION	**LOCATION**	**TYPE**	**DEFAULT SETPOINT/ RESET VALUE**	**RESET TYPE**
Heating Mode	FM & IM	R, W	On	N/A
Cooling Mode	FM & IM	R, W	Off	N/A
Simultaneous Heating/Cooling Mode (activation required)	FM	R, W	Off	N/A
Defrost	FM & IM	R, W	On/Off	N/A
Outdoor Fan Speed - Auto Mode	IM & FM	R		
Outdoor Fan Speed - Manual Override	IM	R, W	On/Off 0-100%	N/A
Client Fluid Inlet/ Tank Setpoint (loop 1)	FM	R, W	COOLING: 50/55°F HEATING: 125/120°F	Auto
Client Fluid outlet Setpoint (loop 1)	FM	R, W	COOLING: 40/45°F HEATING: 135/130°F	Auto
Client Fluid Inlet/ Tank Setpoint (loop 2)	FM	R, W	COOLING: 50/55°F HEATING: 125/120°F	Auto
Client Fluid Outlet Setpoint (loop 2)	FM	R, W	COOLING: 40/45°F HEATING: 135/130°F	Auto
Heat Exchanger Temperature Over Limit Fault (heating mode)	IM	F, R, W	150°F/140°F	Lockout
Heat Exchanger Temperature Under Limit Fault (cooling mode)	IM	F, R, W	Double Wall HX: 47°F/53°F Plate/Plate HX: 40°F/46°F No Clog HX: 34°F/40°F	Lockout
Low Subcooling Warning	IM	F, R	< 0°F for 5min	Auto, after 1 hr.
Low Subcooling Alarm	IM	F, R	< 0°F for 5min, 4x/hr. < 0°F for 20min, 1x/hr.	Lockout
Low Pressure Sensor Limit Alarm	IM	F, R, W	25psi /45psi	Lockout
Low Pressure Switch Alarm	IM	F, R	20psi/ 40psi	Lockout
High Pressure Sensor Limit Alarm	IM	F, R, W	625psi /575 psi	Lockout
High Pressure/ (Temperature) Switch Alarm	IM	F, R	630/ 430psi (275/239°F)	Lockout

KEY

F - Fault activated when limit is reached, **FM** - First module/client, **IM** - Individual module, **R** - Readable value, **W** - Writable value

EQUIPMENT PERFORMANCE

The below data is with respect to one module, brazed plate (plate/plate) heat exchangers, and 100% water only. If the equipment specified contains a "no clog" heat exchanger, please contact the American GeoThermal engineering department for additional information. To ensure capacity performance, always install the equipment with proper clearances as the equipment relies heavily on air flow. If the equipment contains air coil filtration, the equipment performance will be derated due to a slight decrease in air flow rate.

AMP, HEAT PUMP SYSTEM			
		AMPx(S or T) SINGLE & TANDEM CIRCUIT	**AMPxD DUAL CIRCUIT**
COMPONENT	**TYPE [UNITS]**	**QTY**	**QTY**
REFRIGERANT CIRCUITS		1	2
REFRIGERANT CHARGE/ CIRCUIT	LBS. [KG.]	50 [23]	TBD
FANS	EC AXIAL	2	
COMPRESSORS	SCROLL	2	
WATER HX	BRAZED PLATE OR TUBE X TUBE	1	
AIR COIL	AL. FIN X CU. TUBE	2	
TOTAL UNIT WEIGHT [TUW] = NW + HW			
NET WEIGHT [NW]	LBS. [KG.]	2850 [1293]	TBD
NO HEADERS [HW]	LBS. [KG.]	45 [21]	
6" 2 PIPE HEADERS [HW]	LBS. [KG.]	205 [93]	
6" 4 PIPE HEADERS [HW]	LBS. [KG.]	346 [157]	
INSTALLATION WEIGHT [IW]			
NO HEADERS	LBS. [KG.]	IW = TUW + 32 [15]	
6" 2 PIPE HEADERS [HW]	LBS. [KG.]	IW = TUW + 148 [67]	
6" 4 PIPE HEADERS [HW]	LBS. [KG.]	IW = TUW + 246 [112]	
ELECTRICAL POWER			
VOLTAGE SUPPLY		208/230V-3PH-60HZ	
RATED LOAD AMPACITY [RLA		134.4	
MIN. CIRCUIT AMPACITY [MCA]		147.8	
MAX. OVERCURRENT PROTECTION [MOP]		200.0	
VOLTAGE SUPPLY		460V-3PH-60HZ	
RATED LOAD AMPACITY [RLA]		67.8	
MIN. CIRCUIT AMPACITY [MCA]		75.7	
MAX. OVERCURRENT PROTECTION [MOP]		100.0	

EQUIPMENT PERFORMANCE

AMP, HEAT PUMP SYSTEM AMP			
		AMPx(S or T) SINGLE & TANDEM CIRCUIT	AMPxD DUAL CIRCUIT
COMPONENT	**TYPE [UNITS]**	**QTY**	**QTY**
COOLING OPERATING EVELOPE			
MIN./MAX. AMBINET	°F [°C]	0/125 [-18/52]	
MIN. OUTLET TEMP	°F [°C]	40 [4.4]	
MAXIMUM ΔT	°F [°C]	30 [16.7]	
FOULING FACTOR	h ft2- °F/Btu	0.00010	
MAX. ELEVATION	FT. [M]	5000 [1524]	
COOLING PERFORMANCE @ 95 °F AMBIENT & 54/44 °F WATER CONDITIONS			
COOLING CAPACITY	TONS	26.6	
COMPRESSOR INPUT POWER	KW	12.9	
FAN INPUT POWER	KW	4.6	
TOTAL POWER INUPT	KW	29.8	
COP	COP	3.14	
AIR FLOW	CFM	24,000	
FLOW RATE	GPM	63.7	
PRESSURE DROP	FT. H_2O	10	
HEATING OPERATING EVELOPE			
MIN./MAX. AMBINET	°F [°C]	-5/80 [-20.6 /26.7]	
MAX. OUTLET TEMP	°F [°C]	150 [65.6]	
MAXIMUM ΔT	°F [°C]	40 [22.3]	
MAX. ELEVATION	FT. [M]	5000 [1524]	
COOLING PERFORMANCE @ 20 °F AMBIENT, 20%RH, & 120/130 °F WATER CONDITIONS			
HEATING CAPACITY	KBTU/HR	243.8	
COMPRESSOR INPUT POWER	KW	16.11	
FAN INPUT POWER	KW	4.6	
TOTAL POWER INUPT	KW	36	
COP	COP	1.97	
AIR FLOW	CFM	24,000	
FLOW RATE	GPM	48.7	
PRESSURE DROP (no frost)	FT. H_2O	8.2	

PLUMBING REQUIREMENTS

CAUTIONARY NOTICE

All equipment must be installed with a Y-Strainer with a mesh count of 30 or higher. All building or system piping should be properly flushed prior to connecting the equipment. Before using detergents or cleaners during flushing, check with the manufacturer to ensure the chemical composition of the cleaner is safe for use. Equipment should not be connected to questionable accumulation of debris and sediment. Any warranty claim as a result of not flushing new or old work piping and or, not installing a Y-strainer on the inlet of the equipment will result in a denied claim. The manufacturer will not be responsible for plugged or clogged heat exchangers as a result of negligent installation or operation. All piping connections should be made with consideration to local codes and industry standards. To reduce thermal line loss, all piping and piping components should be insulated with adequate thermal resistance rating (R-value) and with respect to installation environmental conditions.

Additional Installation Components:

1. **Fluid Pumps & Accessories** - Fluid pumps can be supplied by and installed by the factory. Not all equipment contains an integrated fluid pump by the factory and those in which should supplied by and installed by others. To determine if the equipment should contain an integrated fluid package, check with the sales rep. or locate fluid pump section on the equipment selection.
2. **Variable Speed Drives for Fluid Pump** - Check with the sales rep. or locate the fluid pump section on the equipment selection. Variable speed drives that are supplied and installed by the manufacturer are preprogrammed for each specific application. Adjustments can be made in the field by a manufacturer's approved technician, contact the American GeoThermal service department for additional information on variable speed drives and fine tuning capabilities.
3. **Y-Strainers** - Y-strainers can be supplied by and installed by the factory depending on the level of integrated fluid pump package supplied with the equipment. All Y-Strainers should have a mesh count of 30 or higher. Y-Strainers should be serviced biannually or as necessary to ensure the equipment maintains proper fluid flow. To determine if the equipment should contain Y-Strainer, check with the sales rep. or locate the hydronics section on the equipment selection. All Y-Strainers supplied by the manufacturer will be flanged and the size specified on the equipment selection.
4. **Flow Balancing Valves** - Flow Balancing Valves are an optional component used to properly adjust fluid flow rate in a hydronic system. They are typically installed where changes have been made to a piping system or a fluid pump was intentionally oversized. Balancing Valves are never set up by the factory, even if one is installed by the factory - all adjustments must be made by the startup technician during installation. Contact the American GeoThermal service department for assistance on set up, installation, or additional information.
5. **Connection Ports for External Temperature Sensors** - Connection ports for temperature sensors should be welded to the pipe at minimum 24" from the equipment connection. For two pipe systems, both a fluid in and out temperature sensors must be installed by others. For 4 pipe systems, Loop 1 In, Loop 1 out, Loop 2 In and Loop 2 out temperature sensors must be installed by others. For systems containing integrated fluid pump packages, fluid temperature sensors will be installed by the factory.
6. **Connection Ports for External Pressure Sensors** - Connection ports for pressure sensors should be welded to the pipe at minimum 6" from the equipment connection. For two pipe systems, both fluid in and out pressure sensors must be installed by others. For 4 pipe systems, Loop 1 In, Loop 1 out, Loop 2 In and Loop 2 out pressure sensors will be installed by others. For systems containing integrated fluid pump packages, fluid pressure sensors will be installed by the factory.
7. **System Flow Switches -** Flow switches are installed in each module to verify flow for each branch of the main

header unit. In some cases, the user may want to verify flow on the main connecting pipe. In this case, flow switches are supplied by and installed by others. Refer to the electrical diagram located on the inside of the electrical panel cabinet and located the connection points for external flow switches.

8. **Isolation valves, Unions, Flanges, Groove Connectors, etc. -** All piping components are supplied by and installed by others unless otherwise specified in the equipment selection. Each module with be provided with the appropriate quantity of conjoining grooved end connectors to install multiple modules. The unit connecting to the field piping will be supplied with its own grooved end connectors and grooved end caps for the opposite side of the header. Caps will be supplied with water ball valves for draining system piping during routine maintenance or hydronic flushing. For information on what piping components are supplied with units containing integrated system fluid pumps, refer to the equipment selection.

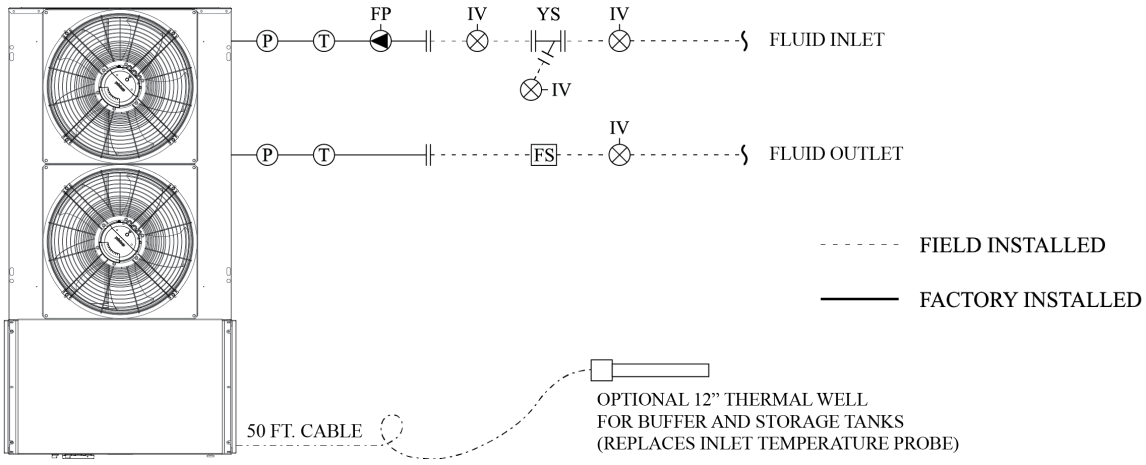
Locate the drawings located on the next few pages for examples of system piping installations. Equipment connected to fluid holding or buffer tanks should be cleaned of sludge/debris on the bottom of the tank before connecting the equipment.

WATER QUALITY REQUIREMENTS

Potable Water Systems: Equipment intended for potable water connections contain double wall heat exchangers (digit 15 = D in the model number, not including underscores) shall comply with national or where applicable, local codes. Water quality shall comply with EPA standards as well as NSF 61 for the construction of all plumbing connected to the equipment.

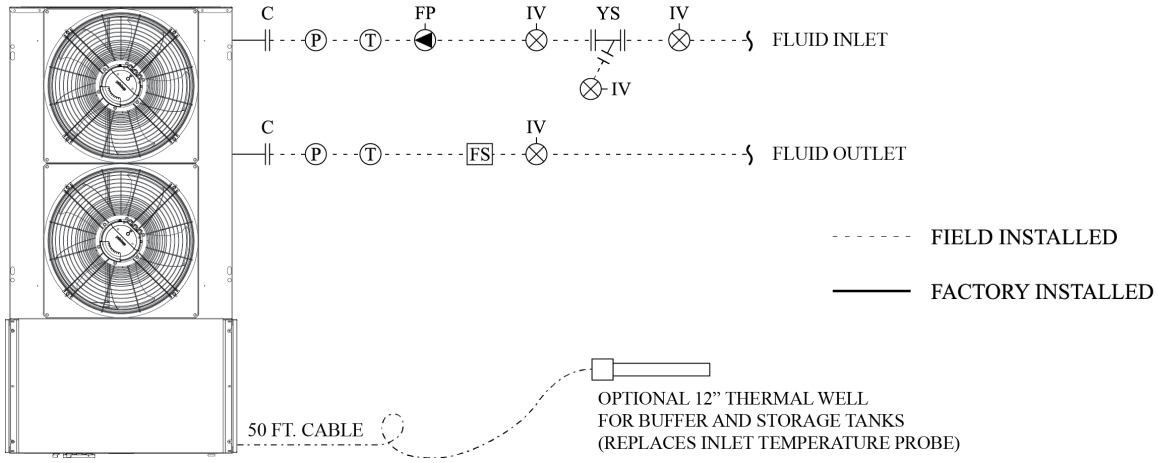
All Other Water Systems: Equipment intended for comfort heating/cooling or process heating/cooling (digit 15 = P or S in the model number, not including underscores) shall comply with the below fluid quality requirements and treatments. The manufacturer reserves the right to nullify the heat exchanger warranty if clear evidence suggests the water quality standards were ignored and/or, a lack of periodic monitoring during the time of installation or operation. All fluids entering the equipment should meet the following requirements unless otherwise specified on the equipment selection.

1. pH should be greater than 7 and less than 9.
2. Total Dissolved Solids (TDS) must be less than 1000 ppm.
3. Hardness as CaCO3 should be between 30 and 500 ppm.
4. Alkalinity as CaCO3 should be between 30 and 500 ppm.
5. Chlorides to be less than 200 ppm.
6. Sulfates to be less than 200 ppm.



2– PIPE FACTORY INSTALLED PUMPS

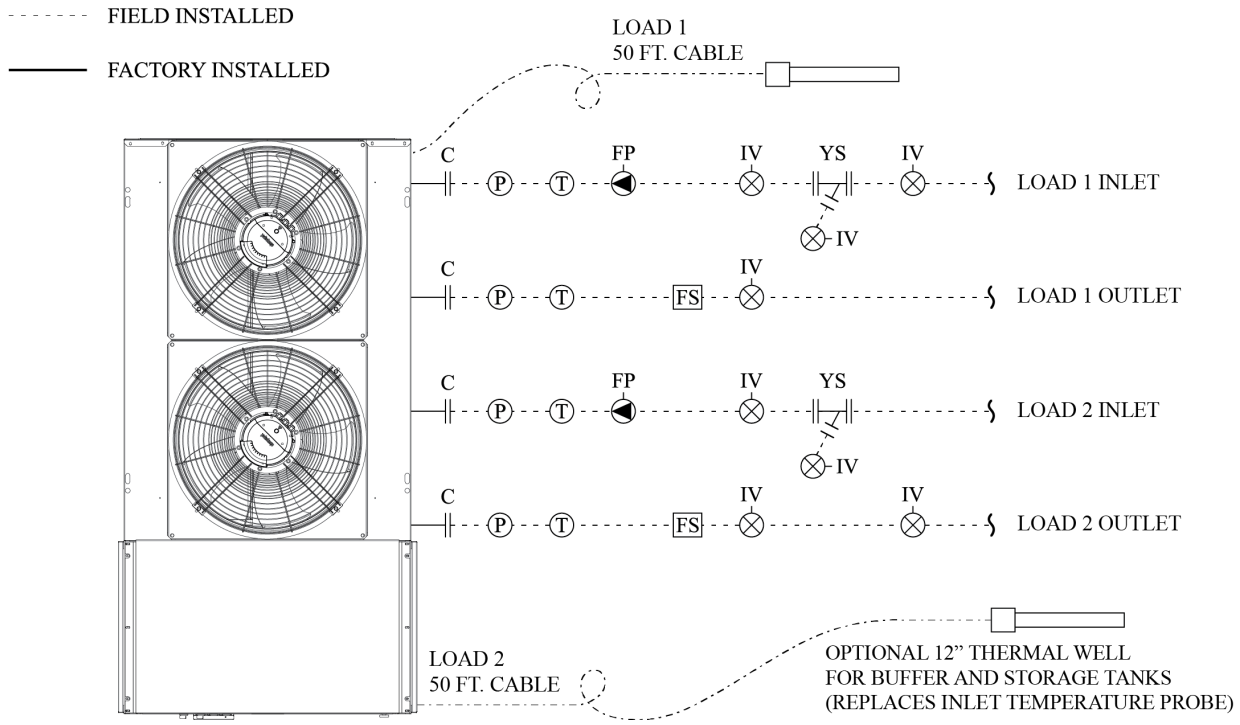
COMPONENT KEY						
SHORT	**COMPONENT**	**TYPE**		**SHORT**	**COMPONENT**	**TYPE**
C	UNIT CONNECTION (FLG OR GRV)	FACTORY SUPPLIED, INSTALLED BY OTHERS		P	PRESSURE SENSOR	FACTORY SUPPLIED AND INSTALLED
FS	FLOW SWITCH	SUPPLIED AND INSTALLED BY OTHERS		T	TEMPERATURE SENSOR	FACTORY SUPPLIED AND INSTALLED
FP	FLUID CIRCULATION PUMP	FACTORY SUPPLIED AND INSTALLED		YS	Y-STRAINER	SUPPLIED AND INSTALLED BY OTHERS
IV	ISOLATION VALVE	SUPPLIED AND INSTALLED BY OTHERS				



2-PIPE FIELD INSTALLED PUMPS

COMPONENT KEY						
SHORT	**COMPONENT**	**TYPE**		**SHORT**	**COMPONENT**	**TYPE**
C	UNIT CONNECTION (FLG OR GRV)	FACTORY SUPPLIED, INSTALLED BY OTHERS		P	PRESSURE SENSOR	FACTORY SUPPLIED, INSTALLED BY OTHERS
FS	FLOW SWITCH	SUPPLIED AND INSTALLED BY OTHERS		T	TEMPERATURE SENSOR	FACTORY SUPPLIED, INSTALLED BY OTHERS
FP	FLUID CIRCULATION PUMP	SUPPLIED AND INSTALLED BY OTHERS		YS	Y-STRAINER	SUPPLIED AND INSTALLED BY OTHERS
IV	ISOLATION VALVE	SUPPLIED AND INSTALLED BY OTHERS				

The above diagrams indicate the minimum recommended field plumbing methods for both field installed pumps and factory installed pumps. All factory supplied temperature sensors require a 1/2" NPT connection, Pressure sensors require a 1/4" NPT connection unless otherwise specified in the equipment submittal. Use the respective chart above to determine which components are factory supplied, factory installed, field supplied and field installed.



4– PIPE FIELD INSTALLED PUMPS

COMPONENT KEY						
SHORT	**COMPONENT**	**TYPE**		**SHORT**	**COMPONENT**	**TYPE**
C	UNIT CONNECTION (FLG OR GRV)	FACTORY SUPPLIED, INSTALLED BY OTHERS		P	PRESSURE SENSOR	FACTORY SUPPLIED, INSTALLED BY OTHERS
FS	FLOW SWITCH	SUPPLIED AND INSTALLED BY OTHERS		T	TEMPERATURE SENSOR	FACTORY SUPPLIED, INSTALLED BY OTHERS
FP	FLUID CIRCULATION PUMP	SUPPLIED AND INSTALLED BY OTHERS		YS	Y-STRAINER	SUPPLIED AND INSTALLED BY OTHERS
IV	ISOLATION VALVE	SUPPLIED AND INSTALLED BY OTHERS				

The above diagram indicate the minimum recommended field plumbing methods for 4-Pipe field installed pumps. 4-Pipe plumbing diagrams for factory installed pumps are available upon request as diagrams vary depending on application. All factory supplied temperature sensors require a 1/2” NPT connection, Pressure sensors require a 1/4” NPT connection unless otherwise specified in the equipment submittal. Use the chart above to determine which components are factory supplied, factory installed, field supplied and field installed.

FIELD WIRING

1. **Field Wire Sizing:** For the most accurate information, refer to the equipment nameplate. The nameplate is located on the outside of the electrical cabinet door. This will serve as the data for each module in a bank. For units containing single point power packages, refer to the single point power nameplate, this will be located on outside of the single point power cabinet. If the unit does not require a separate single point power cabinet, the label will be located on the outside of the main electrical cabinet of the first module in a bank. Use the MCA data on the appropriate label to determine the field wiring conductor size.

2. **Overcurrent Protection:** Using the same procedures in the field wiring section above, locate the appropriate nameplate and located the MOP value. The overcurrent protection provided in the field shall never exceed the value shown on the nameplate. To maintain the short circuit rating shown on the nameplate, give consideration to the type of breaker installed on the supply.

NOTES:

A. All fuses should follow UL 248-12 which indicates that all fuses should be class R rated for either 250V or 600V and current ratings under 600 Ampere.

B. If the wire pull exceeds 100 ft. Table 3 shall not be used to select wire. Proper voltage drop calculation should be considered and the wire size must be adjusted per the adjusted ampere rating.

Table 3,Wiring Sizing Specifications

(Applicable codes may require different wire sizing)

MCA	3 Conductors (1 raceway)	6 Conductors (1 raceway)
65	6	-
85	4	-
100	3	-
115	2	-
130	1	-
150	1/0	-
175	2/0	-
200	3/0	-
230	4/0	-
255	250 MCM	-
285	300 MCM	1/0
300	-	2/0

Field Connections and Installations: All field wiring must be made in conjunction with local codes and with respect to the intended use by the manufacturer. All conduits, wireways, cables should be routed in such a way that does not prevent the equipment panels from being removed. American GeoThermal reserves the right to refuse service if electrical installation is not to such standard.

(1) **Tank Temperature Sensor.** Connect the factory supplied tank temperature sensor into the fluid tank. (if applicable)

(2) Customer Interlock: Connect a 2 wire cable to an external start stop relay for remote operations. Refer to wiring diagram for additional details. (optional)

(3) Flow Switch: Connect a 2 wire cable to a field supplied/installed flow switch. Refer to unit wiring diagram for additional details. (if applicable)

(4) Total Fill Valve Control: For applications that require storage tanks with process water connections and make up fill water only. Refer to system wiring diagram for additional details. (if applicable)

(5) **Building Management System (BMS):** RJ45 Connection at the J25 Port of the main control "device code SC" on the wiring diagram. Connections should be made in conjunction with local codes and industry acceptable methods. Contact the American Engineering Department for additional information on BMS set up.

(6) **The high voltage line connection:** 230-460/3ph/60hz input voltages, refer to the unit data sheet for MCA and MOP, determine the minimum wire size using Table 3. If MCA exceeds the values in table 3, use NEC Article 310 to determine the appropriate wire size. Proper voltage drop calculations should be considered and the wire size must be adjusted per the adjusted ampere rating. If multiple parallels are required in the same raceway to achieve the required ampere rating, use NEC article 310 to determine the appropriate derate factor.

WIRING DIAGRAMS

ELECTRICAL SHOCK HAZARD

Failure to follow this warning could result in personal injury or death. Before installing, modifying, or servicing system, main electrical disconnect switch must be in the OFF position. There may be more than 1 disconnect switch. Lock out and tag switch with a suitable warning label.

ROTATING PARTS

Failure to follow this warning could result in personal injury or death. Never attempt to service while in normal operation, this equipment contains live rotating parts and motors. Do not climb on top of unit as fan blade can blow debris at high velocities.

SUPERVISION

Under no circumstance should a child be left unsupervised in the installation area of this equipment. Children should always be supervised to ensure they do not play with the equipment.

AUTHORIZED PERSONNEL ONLY

This equipment contents pose multiple hazards. This equipment should not be installed in a place that is accessible to the general public. If the equipment must be installed in such a place, the proper fencing should be installed to prevent unintentional entrance to the site.

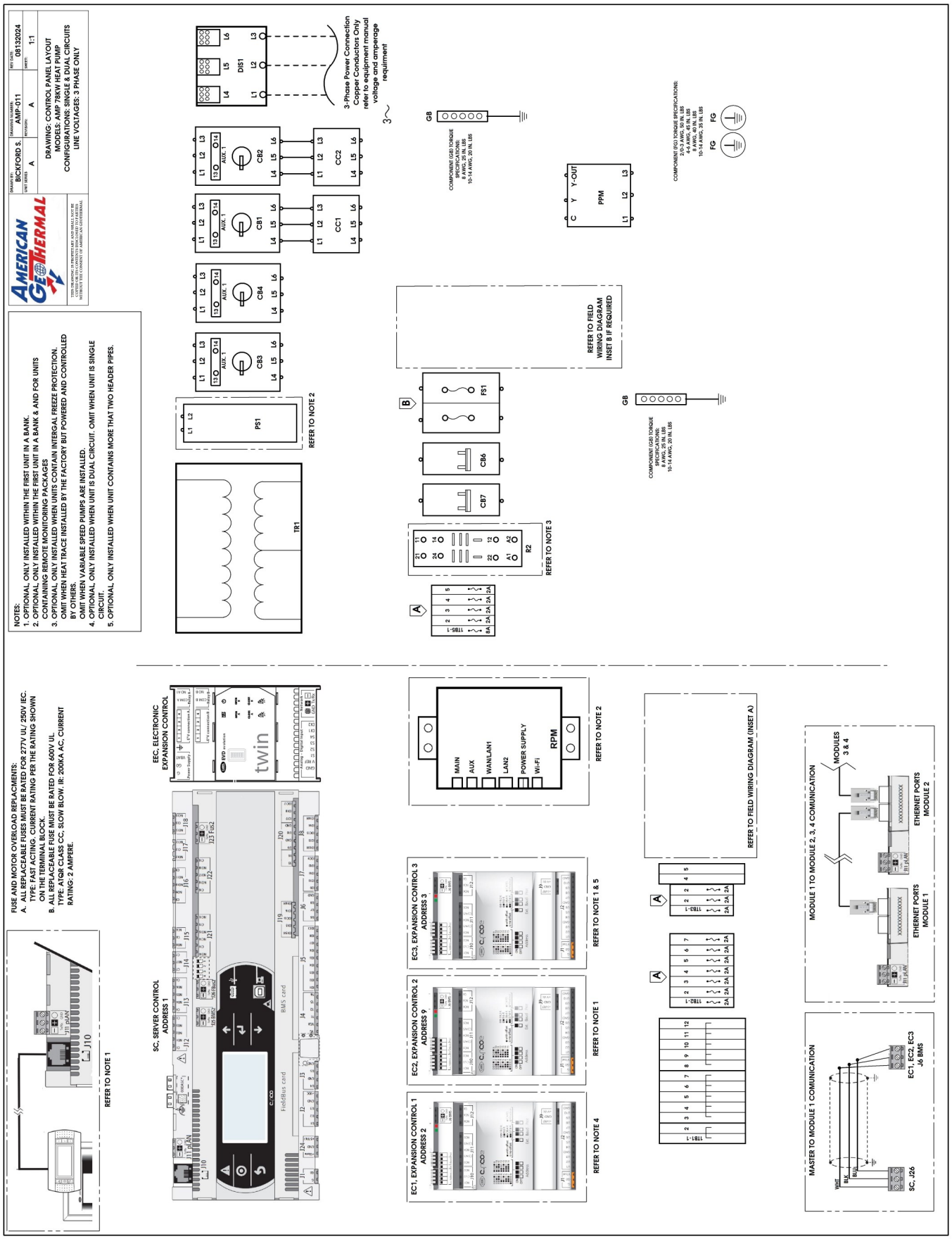
Field Wiring Diagrams - Refer to the inside of the panel for field wiring requirements on components supplied and installed by others. No deviations to the field wiring diagrams shall be made with out the approval of the manufacture - the factory warranty may be nullified if field wiring is connected incorrectly or suspected modifications are made without proper approval.

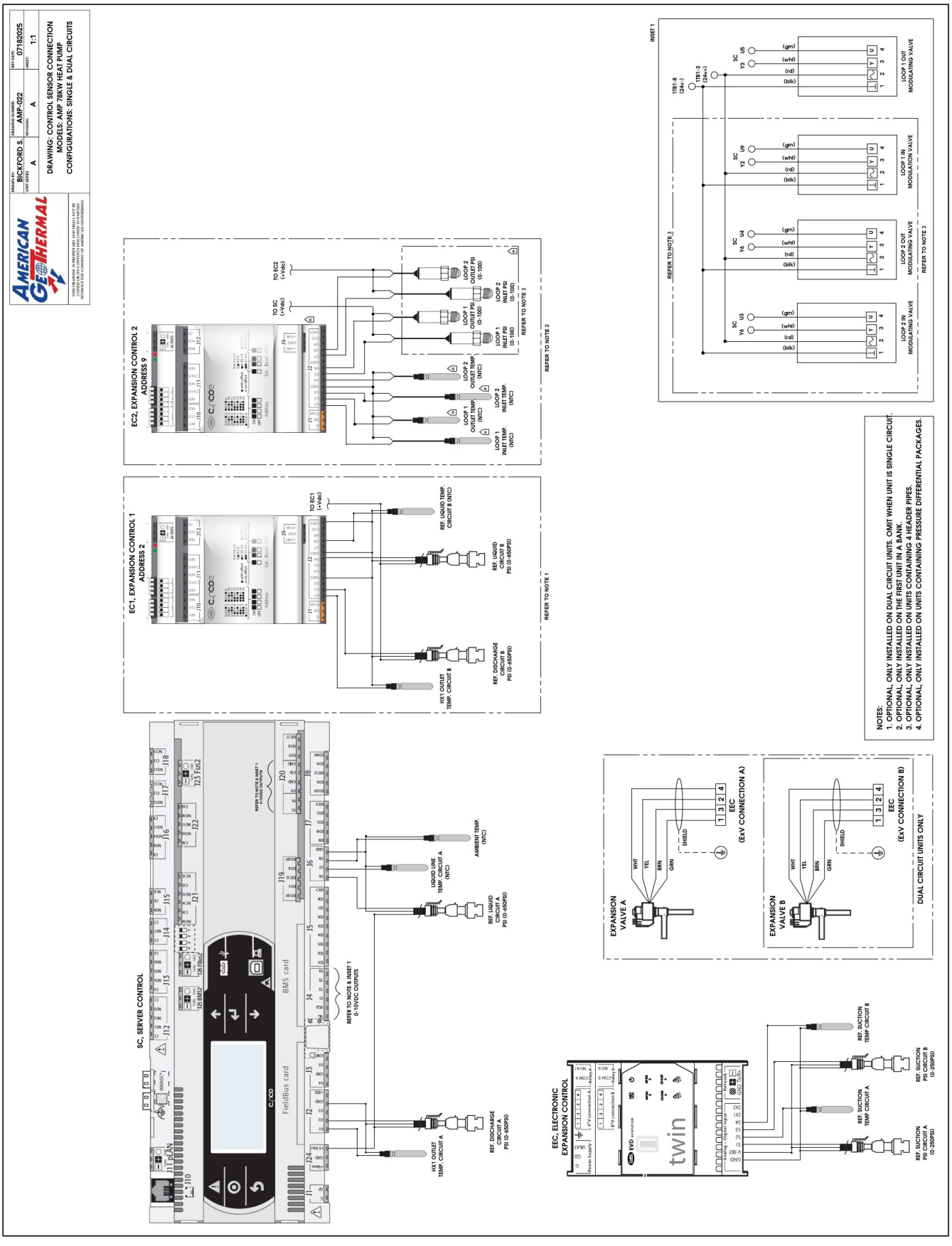
Overcurrent Protection - All overcurrent protection should comply with local code and with respect to the equipment nameplate.

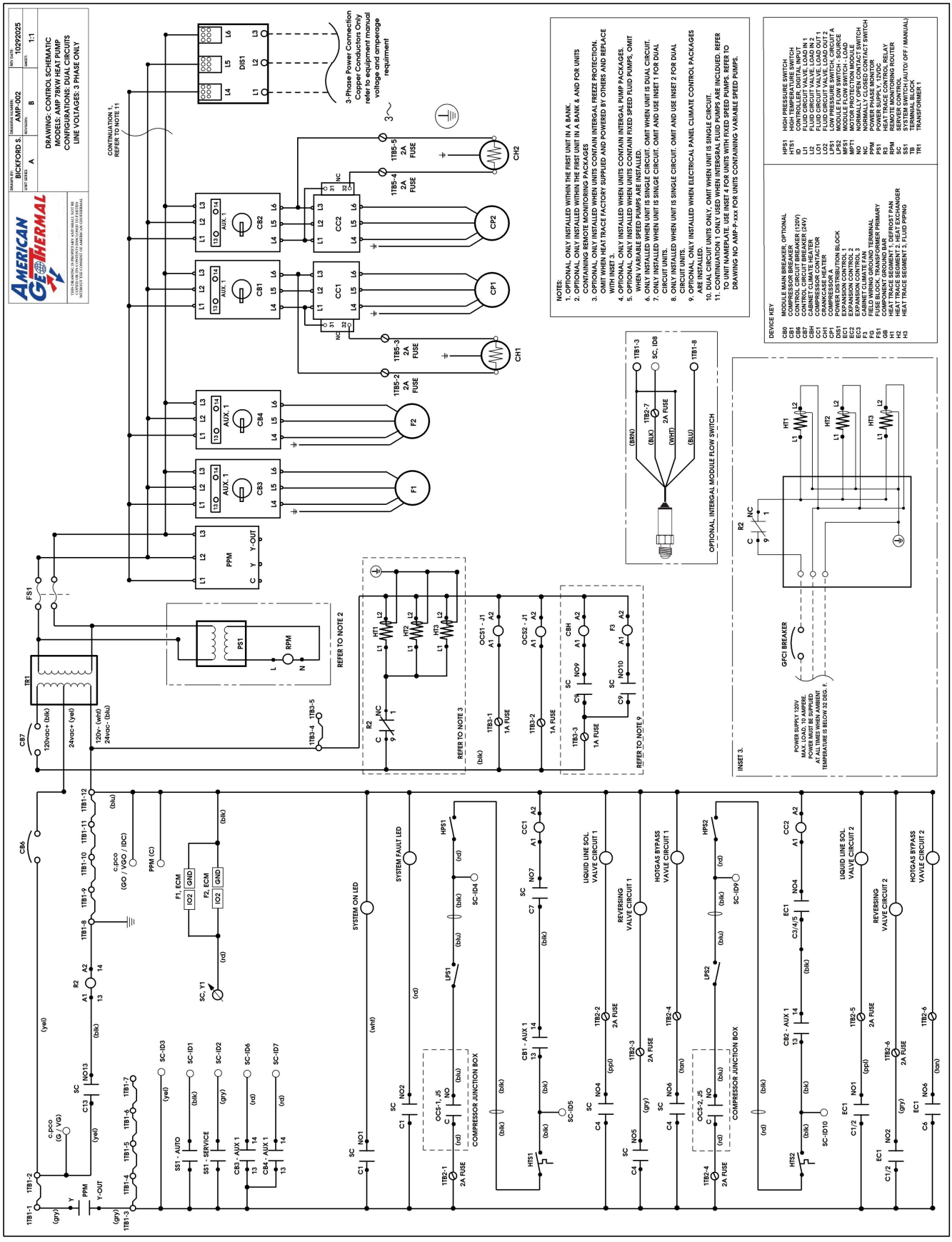
Replaceable fuses - This equipment contains two types of fuses, refer to the electrical panel layout diagram to determine fuse type and size. Fuses other than the specified are not authorized by the manufacturer for use. All fuses must be UL listed and have the appropriate voltage, amperage, and acting time.

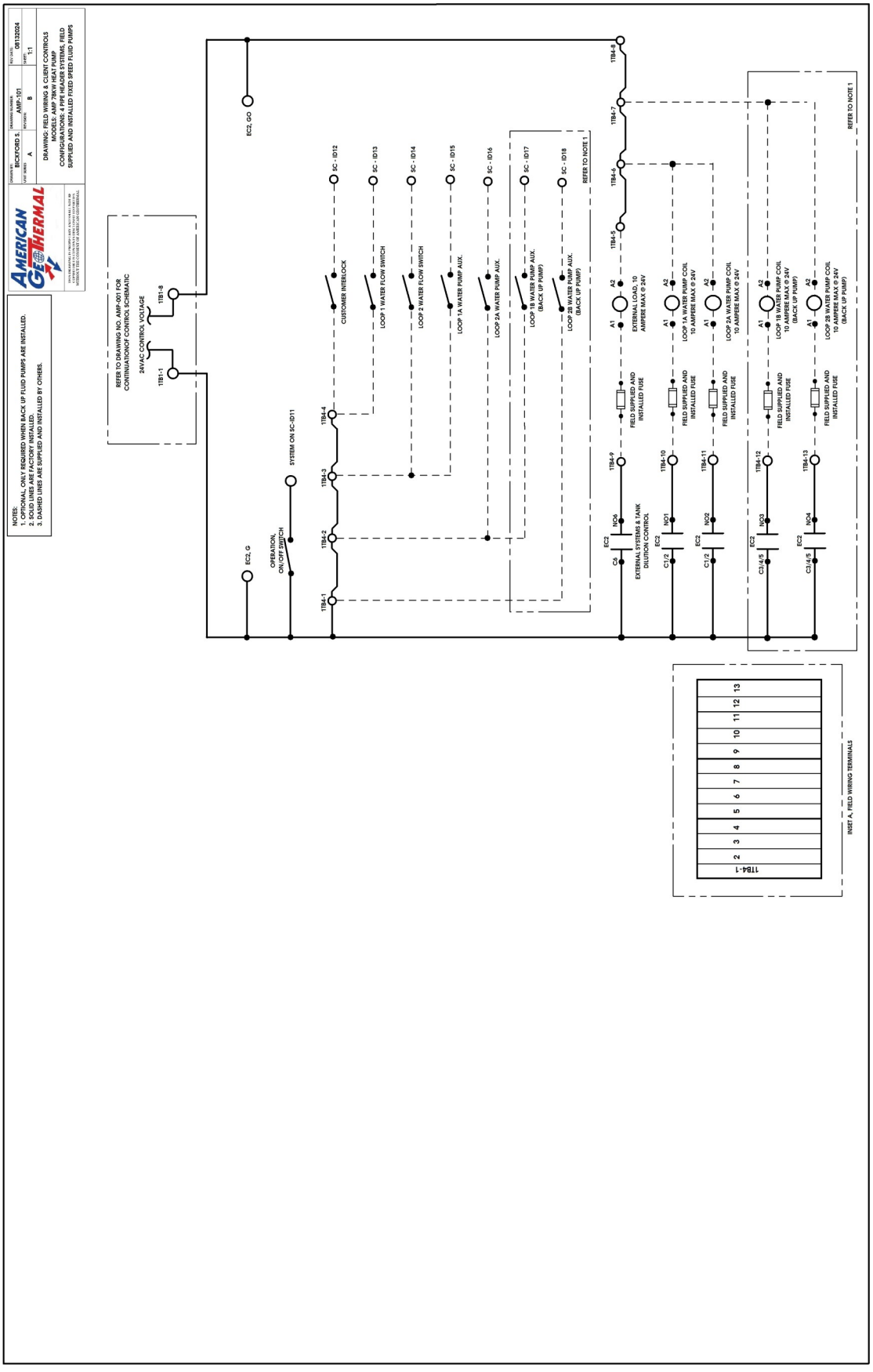
Electrical Component Replacement - Sealed electrical components shall be replaced, and intrinsically safe components must be replaced.

Control Communication - Depending on several factors, the equipment may use either serial or ethernet communication for controls. In some cases, both communication types may be used when certain features are selected.


AMERICAN GEOTHERMAL
DRAWN BY: BICKFORD S.
DRAWING NUMBER: AMP-011
REV DATE: 08132024
UNIT SERIES: A
REVISION: A
SHEET: 1:1
DRAWING: CONTROL PANEL LAYOUT
MODELS: AMP 78KW HEAT PUMP
CONFIGURATIONS: SINGLE & DUAL CIRCUITS
LINE VOLTAGES: 3 PHASE ONLY
NOTES:
1. OPTIONAL, ONLY INSTALLED WITHIN THE FIRST UNIT IN A BANK.
2. OPTIONAL, ONLY INSTALLED WITHIN THE FIRST UNIT IN A BANK & AND FOR UNITS CONTAINING REMOTE MONITORING PACKAGES
3. OPTIONAL, ONLY INSTALLED WHEN UNITS CONTAIN INTERGAL FREEZE PROTECTION. OMIT WHEN HEAT TRACE INSTALLED BY THE FACTORY BUT POWERED AND CONTROLLED BY OTHERS.
OMIT WHEN VARIABLE SPEED PUMPS ARE INSTALLED.
4. OPTIONAL, ONLY INSTALLED WHEN UNIT IS DUAL CIRCUIT. OMIT WHEN UNIT IS SINGLE CIRCUIT.
5. OPTIONAL, ONLY INSTALLED WHEN UNIT CONTAINS MORE THAT TWO HEADER PIPES.
FUSE AND MOTOR OVERLOAD REPLACMENTS:
A. ALL REPLACEABLE FUSES MUST BE RATED FOR 277V UL / 250V IEC.
TYPE: FAST ACTING. CURRENT RATING PER THE RATING SHOWN ON THE TERMINAL BLOCK.
B. ALL REPLACEABLE FUSE MUST BE RATED FOR 600V UL.
TYPE: ATQR CLASS CC, SLOW BLOW. IR: 200KA AC, CURRENT RATING: 2 AMPERE.
REFER TO NOTE 1
J10
J11 pLAN
SC, SERVER CONTROL ADDRESS 1
EEC, ELECTRONIC EXPANSION CONTROL
twin
FieldBus card
BMS card
EC1, EXPANSION CONTROL 1 ADDRESS 2
EC2, EXPANSION CONTROL 2 ADDRESS 9
EC3, EXPANSION CONTROL 3 ADDRESS 3
REFER TO NOTE 4
REFER TO NOTE 1
REFER TO NOTE 1 & 5
MAIN
AUX
WAN/LAN1
LAN2
POWER SUPPLY
Wi-Fi
RPM
REFER TO NOTE 2
TB1-1
TB2-1
TB3-1
REFER TO FIELD WIRING DIAGRAM (INSET A)
MASTER TO MODULE 1 COMUNICATION
SC, J26
EC1, EC2, EC3 J6 BMS
MODULE 1 TO MODULE 2, 3, 4 COMUNICATION
MODULES 3 & 4
ETHERNET PORTS MODULE 1
ETHERNET PORTS MODULE 2
L1 L2
PS1
REFER TO NOTE 2
L1 L2 L3
AUX. 1
CB3
CB4
CB1
CB2
CC1
CC2
DIS1
3~
3-Phase Power Connection
Copper Conductors Only
refer to equipment manual voltage and amperage requirment
TR1
CB7
CB6
FS1
B
A
R2
REFER TO NOTE 3
REFER TO FIELD WIRING DIAGRAM INSET B IF REQUIRED
GB
COMPONENT (GB) TORQUE SPECIFICATIONS:
#6 AWG, 45 IN. LBS
8 AWG, 25 IN. LBS
10-14 AWG, 20 IN. LBS
C Y Y-OUT
PPM
FG


AMERICAN GEOTHERMAL
DRAWN BY: BICKFORD S.
UNIT SIZED: A
DRAWING NUMBER: AMP-1022
REVISION: A
REV DATE: 07182025
SHEET: 1:1
DRAWING: CONTROL SENSOR CONNECTION
MODELS: AMP 78KW HEAT PUMP
CONFIGURATIONS: SINGLE & DUAL CIRCUITS
EC2, EXPANSION CONTROL 2
ADDRESS 9
EC1, EXPANSION CONTROL 1
ADDRESS 2
SC, SERVER CONTROL
EEC, ELECTRONIC
EXPANSION CONTROL
REFER TO NOTE 1
REFER TO NOTE 2
REFER TO NOTE 3
INSET 1
EXPANSION VALVE A
EXPANSION VALVE B
EEV (EXV CONNECTION A)
EEV (EXV CONNECTION B)
DUAL CIRCUIT UNITS ONLY
NOTES:
1. OPTIONAL, ONLY INSTALLED ON DUAL CIRCUIT UNITS. OMIT WHEN UNIT IS SINGLE CIRCUIT.
2. OPTIONAL, ONLY INSTALLED ON THE FIRST UNIT IN A BANK.
3. OPTIONAL, ONLY INSTALLED ON UNITS CONTAINING 4 HEADER PIPES.
4. OPTIONAL, ONLY INSTALLED ON UNITS CONTAINING PRESSURE DIFFERENTIAL PACKAGES.


AMERICAN GEOTHERMAL
DRAWN BY: BICKFORD S.
DRAWING NUMBER: AMP-002
DATE: 10/29/2025
DATE ISSUED: A
REVISION: B
SHEET: 1:1
DRAWING: CONTROL SCHEMATIC
MODELS: AMP 78KW HEAT PUMP
CONFIGURATIONS: DUAL CIRCUITS
LINE VOLTAGES: 3 PHASE ONLY
CONTINUATION 1, REFER TO NOTE 11
3-Phase Power Connection Copper Conductors Only refer to equipment manual voltage and amperage requirment
NOTES:
1. OPTIONAL, ONLY INSTALLED WITHIN THE FIRST UNIT IN A BANK.
2. OPTIONAL, ONLY INSTALLED WITHIN THE FIRST UNIT IN A BANK & AND FOR UNITS CONFIGURED FOR DUAL CIRCUITS.
3. OPTIONAL, ONLY INSTALLED WHEN UNITS CONTAIN INTERGAL FREEZE PROTECTION. OMIT WHEN HEAT TRACE FACTORY SUPPLIED AND POWERED BY OTHERS AND REPLACE WITH INSET 3.
4. OPTIONAL, ONLY INSTALLED WHEN UNITS CONTAIN INTERGAL PUMP PACKAGES.
5. OPTIONAL, ONLY INSTALLED WHEN UNITS CONTAIN FIXED SPEED FLUID PUMPS, OMIT WHEN VARIABLE SPEED PUMPS ARE INSTALLED.
6. ONLY INSTALLED WHEN UNIT IS SINGLE CIRCUIT. OMIT WHEN UNIT IS DUAL CIRCUIT.
7. ONLY INSTALLED WHEN UNIT IS SINLGE CIRCUIT. OMIT AND USE INSET 1 FOR DUAL CIRCUIT UNITS.
8. ONLY INSTALLED WHEN UNIT IS SINGLE CIRCUIT. OMIT AND USE INSET 2 FOR DUAL CIRCUIT UNITS.
9. OPTIONAL, ONLY INSTALLED WHEN ELECTRICAL PANEL CLIMATE CONTROL PACKAGES ARE INSTALLED.
10. DUAL CIRCUIT UNITS ONLY, OMIT WHEN UNIT IS SINGLE CIRCUIT.
11. CONTINUATION 1 ONLY USED WHEN INTERGRAL FLUID PUMPS ARE INCLUDED. REFER TO UNIT NAMEPLATE. USE INSET 4 FOR UNITS WITH FIXED SPEED PUMPS. REFER TO DRAWING "AG AMP-P-XXX FOR UNITS CONTAINING VARIABLE SPEED PUMPS.
DEVICE KEY
CB0 MODULE MAIN BREAKER, OPTIONAL
CB1 COMPRESSOR BREAKER
CB6 CONTROL CIRCUIT BREAKER (120V)
CB7 CONTROL CIRCUIT BREAKER (24V)
CBH CABINET CLIMATE HEATER
CC1 COMPRESSOR CONTACTOR
CC2 COMPRESSOR B
CP1 COMPRESSOR A
DIS1 POWER DISTRIBUTION BLOCK
EC1 EXPANSION CONTROL 1
EC2 EXPANSION CONTROL 2
EC3 EXPANSION CONTROL 3
F1 FIELD WIRING TERMINAL
FG FIELD WIRING GROUND TERMINAL
FS1 FUSE BLOCK, TRANSFORMER PRIMARY
GFCI GROUND FAULT CIRCUIT INTERRUPTER
H1 HEAT TRACE SEGMENT 1, DEFROST PAN
H2 HEAT TRACE SEGMENT 2, HEAT EXCHANGER
H3 HEAT TRACE SEGMENT 3, FLUID PIPING
HPS1 HIGH PRESSURE SWITCH
HTS1 HIGH TEMPERATURE SWITCH
ID CONTROLLER, DIGITAL INPUT
LO1 FLUID CIRCUIT VALVE, LOAD OUT 1
LI2 FLUID CIRCUIT VALVE, LOAD IN 2
LO1 FLUID CIRCUIT VALVE, LOAD OUT 1
LO2 FLUID CIRCUIT VALVE, LOAD OUT 2
LPS1 LOW PRESSURE SWITCH, CIRCUIT A
LPS2 LOW PRESSURE SWITCH, CIRCUIT B
MFS1 MODULE FLOW SWITCH - SOURCE
MFS2 MODULE FLOW SWITCH - LOAD
MPT1 MOTOR PROTECTION MODULE
NO NORMALLY OPEN CONTACT SWITCH
NC NORMALLY CLOSED CONTACT SWITCH
PPM POWER PHASE MONITOR
PS1 POWER SUPPLY, 12VDC
R2 FLUID PUMP CONTROL RELAY
RPM REMOTE MONITORING ROUTER
SC SERVER CONTROL
SS1 SYSTEM SELECTOR SWITCH (AUTO/ OFF / MANUAL)
TB TERMINAL BLOCK
TR1 TRANSFORMER 1
INSET 3.
POWER SUPPLY 120V, MAX LOAD, 10 AMPERE. POWER MUST BE SUPPLIED AT ALL TIMES WHEN AMBIENT TEMPERATURE IS BELOW 32 DEGR. F.
OPTIONAL INTERGAL MODULE FLOW SWITCH
REFER TO NOTE 2
REFER TO NOTE 3
REFER TO NOTE 9
SYSTEM ON LED
SYSTEM FAULT LED
LIQUID LINE SOL. VALVE CIRCUIT 1
LIQUID LINE SOL. VALVE CIRCUIT 2
REVERSING VALVE CIRCUIT 1
REVERSING VALVE CIRCUIT 2
HOTGAS BYPASS VAVLE CIRCUIT 1
HOTGAS BYPASS VAVLE CIRCUIT 2
COMPRESSOR JUNCTION BOX
SC-ID0
SC-ID1
SC-ID2
SC-ID3
SC-ID4
SC-ID5
SC-ID6
SC-ID7
SC-ID9
SC-ID10


NOTES:
1. OPTIONAL, ONLY REQUIRED WHEN BACK UP FLUID PUMPS ARE INSTALLED.
2. CONTROLLER ARE FACTORY INSTALLED.
3. DASHED LINES ARE SUPPLIED AND INSTALLED BY OTHERS.
AMERICAN GEOTHERMAL
DRAWN: BICKFORD S.
DRAWING NUMBER: AMP-101
REV LTR: A
REVISION: B
SHEET: 1:1
REV DATE: 08132024
DRAWING: FIELD WIRING & CLIENT CONTROLS
MODELS: AMP 7kW HEAT PUMP
CONFIGURATIONS: 4 PIPE HEAT PUMPS, FIELD SUPPLIED AND INSTALLED FIXED SPEED FLUID PUMPS
REFER TO DRAWING NO. AMP-001 FOR CONTINUATION OF CONTROL SCHEMATIC
24VAC CONTROL VOLTAGE
1TB1-1
1TB1-8
EC2, GO
EC2, G
OPERATION ON/OFF SWITCH
SYSTEM ON SC-ID11
1TB4-1
1TB4-2
1TB4-3
1TB4-4
CUSTOMER INTERLOCK
SC - ID12
LOOP 1 WATER FLOW SWITCH
SC - ID13
LOOP 2 WATER FLOW SWITCH
SC - ID14
LOOP 1A WATER PUMP AUX.
SC - ID15
LOOP 2A WATER PUMP AUX.
SC - ID16
LOOP 1B WATER PUMP AUX. (BACK UP PUMP)
SC - ID17
LOOP 2B WATER PUMP AUX. (BACK UP PUMP)
SC - ID18
REFER TO NOTE 1
1TB4-5
1TB4-6
1TB4-7
1TB4-8
EXTERNAL LOAD, 10 AMPERE MAX @ 24V
FIELD SUPPLIED AND INSTALLED FUSE
1TB4-9
EC2
C4
NO4
EXTERNAL SYSTEMS & TANK DILUTION CONTROL
1TB4-10
NO1
C1/2
LOOP 1A WATER PUMP COIL 10 AMPERE MAX @ 24V
1TB4-11
NO2
LOOP 2A WATER PUMP COIL 10 AMPERE MAX @ 24V
1TB4-12
NO3
C3/4/5
LOOP 1B WATER PUMP COIL 10 AMPERE MAX @ 24V (BACK UP PUMP)
1TB4-13
NO4
LOOP 2B WATER PUMP COIL 10 AMPERE MAX @ 24V (BACK UP PUMP)
A1
A2
1TB4-1
2 3 4 5 6 7 8 9 10 11 12 13
INSET A, FIELD WIRING TERMINALS

SYSTEM SERVICE & TROUBLESHOOTING

Routine Maintenance - In order to keep the equipment functioning properly, it is important to have scheduled maintenance periods. Using the chart below, determine the level of maintenance required for your specific equipment. In addition to the tasks listed below, visual inspection of the equipment should be done as often as possible. For example, if the equipment services critical business operations, visual inspections should be done as frequently as once or multiple times per week. All aspects of routine maintenance serve as critical functions in minimizing equipment failures and unexpected down time. Considerations such as severe weather, equipment age and importance of operation should factor into how a service technician should schedule routine maintenance and visual inspections.

MAINTENANCE SCHEDULE				
SERVICE PERIODS	**MONTHLY**	**BIANNUALLY**	**ANNUALLY**	**AS NEEDED**
Check wiring connections and torque per the device specification.		**X**		
Check all plumbing connections including Victaulic clamps for fluid leaks.		X		
Clean Fluid Y-Strainer.	X			X
Check fluid quality and ensure contaminants are not entering the equipment. Refer to Section 6 for information on fluid quality requirements. If bad water quality is confirmed, perform follow up testing each day until water quality is nominal.		X		X
Check superheat readings in heating and cooling mode. Reading should be between 8-12°F.		X		
Check subcooling readings in heating and cooling mode. Reading should be between 3-9°F.		X		
Clean outdoor air coils.	X			X
Clean outdoor air coil filters (if installed).	X			X
Check for accumulation on fan blades. Blades should be free of dirt to ensure proper balance.		X		X
Calibrate pressure sensors & temperature sensors.				X
Fill out the service log on at the back of this section.		X		

Federal Clean Air Act - Responsible refrigerant practices are important to the environment, our customers, and the industry. All technicians who handle refrigerants must be certified according to local rules. For the USA, the federal Clean Air Act (section 608) sets forth the requirement for handling, reclaiming, recovering and recycling certain refrigerants and the equipment that is used in the service procedures. In addition, some states or municipalities may have additional requirements that must also be adhered to for responsible management of refrigerants. Know the applicable laws and follow them.

MAINTENANCE SCHEDULE PROCEDURES

Checking Wiring Connections:

1. Disconnect all field supplied voltage disconnects.
2. Remove all covered panels including external panels, electrical cabinet openings and compressor covers.
3. Perform a “pull test” on each wire connection including but not limited to, breaker, contactor, controller, terminal blocks, spliced, and fuse block connections. This should be performed in all areas mentioned in step 2 of this procedure. If a wiring connection comes loose, make the repair. If a wiring connection comes loose that contains a screw type connection, make the repair and use the torque specification sheet shown in this section to determine the appropriate torque. If a wire shows signs of burn or electrical fire, replace the wire and any damaged

components connected to such wire.

4. Using Table 4, use a calibrated torque screwdriver to check each bolted connection. If a screw is stripped or will not tighten, replace the component.
5. Remember to replace all cabinet covers and inspect the gaskets while reinstalling. If gaskets are damaged beyond repair, contact the manufacturer for a replacement.
6. Remove lock out tagout and resume normal operation or continue routine maintenance.

TABLE 4, TORQUE SPEC. FOR VARIOUS ELECTRICAL DEVICES

DEVICE CODE	TORQUE SPECIFICATION (IN. LBS)	
EQUIPMENT INPUT VOLTAGE	**230V**	**460V & 575V**
CB1 & CB2, Compressor Breaker Main Lugs	35	18
CB1 & CB2, Compressor Breaker Aux 1	11	11
CB3 & CB4, Fan Breaker Main Lugs	18	18
CB3 & CB4, Fan Breaker Aux 1	11	11
CB6 & CB7, Control Circuit Breakers	18	18
CB12, Fluid Pump Breaker	Refer to Component Specs.	
CC1 & CC2, Compressor Contactor Main Lugs	36	22
CC1 & CC2, Compressor Contactor Aux 1	11	11
CC1 & CC2, Compressor Contractor Coil	11	11
CP1 & CP2, Compressor Main Lugs	24	24
CP1 & CP2, Compressor Ground Lug	12	12
DIS1, Power Distribution Block	Refer to Component Specs.	
EC1, EC2, EC2, Carel Expansion Module	5.3	5.3
FG, Field Wiring Ground Terminal	Refer to Component Specs.	
FS1, Fuse Block	18	18
GB, Internal Component Ground Bar	Refer to Component Specs.	
PS1, Power Supply	12	12
R2, Heat Trace Relay	5	5
RPM, Remote Monitoring Router	4	4
TB, Terminal Block (screw type)	5	5
TR1, Control Transformer	20	20

Checking Plumbing Connections:

1. Visually inspect each fluid connection and the surrounding insulation.
2. Isolate any section of the fluid circuit that is being serviced to prevent losing undesired fluid volumes. Do not attempt to tighten or service any fluid system when under pressure. Always shut down and lock out fluid pump delivering fluid to such piping.
3. If leaks are observed on fitting gaskets, replace the gasket and reassemble. Repair any insulation post welding and reassemble the fluid piping.
4. If leaks are observed in the rigid fluid piping, isolate the fluid piping from the equipment before welding. Repair any insulation post welding and reassemble the fluid piping.
5. If no leaks are observed, check for loose hardware such as flange bolts, grooved end coupling bolts, unions, etc.
6. Reopen any isolation valves and resume normal operation or continue routine maintenance.

Cleaning the Y-Strainer:

1. Isolate the Y-Strainer from the fluid circuit using the appropriate isolation valves.
2. Locate the flange bolts located on the bottom of the Y-Strainer that contains the screen and remove the flange.
3. Remove the mesh filter located inside the cavity and clean with the appropriate cleaner for the application. If the equipment is connected to a potable water circuit, do not use cleaners or detergents that are unsafe for drinking water.
4. Inspect the mesh filter for damage and replace if necessary. If the mesh filter can not be cleaned due to excess build up, replace.
5. Reassemble the Y-Strainer and torque the flange bolt back to the specific manufacturer specification.
6. Reopen any isolation valves and resume normal operation or continue routine maintenance.

Checking Water Quality:

Water quality testing and monitoring are the processes of measuring and evaluating the physical, chemical, and biological characteristics of water in plumbing systems. Locate the water quality requirements in Section 6 of this manual. Water quality best practices involve designing and installing plumbing systems that are suitable for the

water source and use, conducting regular inspections and maintenance to prevent leaks or malfunctions. Improved water quality will result in longer service life of the equipment and higher efficiency ratings. The American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) sets voluntary or recommended water quality to help improve performance.

1. **Potable Water Systems (double wall heat exchanger types):** Caution, if the equipment is connected to a potable water system, always use the appropriate cleaners or detergents designed for drinking water when treating any section of the fluid piping. Always follow the EPA guidelines for potable water and NSF-61 water quality standards.
2. **Non-Potable Water Systems (plate/plate & no clog heat exchanger types):** Detergents and cleaners are approved by the manufacturer as long as they follow the water quality standards provided in Section 6 of this manual. Do not use abrasive chemicals such as strong acids or bases to clean or descale the piping system. Contact the manufacturer for addition information on detergents and cleaners for descaling.
3. Locate a fluid ball valve that allows a sample of water to be obtained. Refer to the water quality testing kit for the appropriate volume of water to be sampled.
4. Use the appropriate water quality kit for the application and always follow the guidelines of the water quality kit being used. For non-potable water systems, select a kit that measures pH, Hardness, Chlorine, Lead and Alkalinity.
5. Document the water quality test results for future reference. If water quality diminishes over time, correct the issue and resume normal operations. Flushing the system is recommended by the manufacturer if water quality is ever in question.

Checking the System Superheat:

Having the correct super heat is critical for proper operation of a refrigeration system. Superheat should always be measured between the compressor and the accumulator. Superheat is the measure of heat added to a vapor above its boiling temperature. As a result, it models the amount of additional heat or unnecessary heat the refrigerant has absorbed over time. When the superheat is high (greater than 20°F), too much heat is being added to the refrigerant and therefore a loss of efficiency can be observed. Additionally, a high superheat can cause intermittent compressor failures due to overheating. On the other hand, when superheat is extremely low (less than 4°F), the refrigerant phase change is impartial. In this case, liquid refrigerant could be introduced back into the compressor (liquid flood back). Ideally superheat should be between 8-12°F to prevent liquid flood back and compressor overheating.

1. Connect a calibrated gauge manifold or Testo to the suction line. To minimize refrigerant burns, always use the appropriate hoses for the refrigerant in conjunction with low loss fittings. Always wear PPE such as eye protection and gloves to minimize the risk of injury. .
2. Attach a calibrated temperature probe to the suction line and place a small dab of thermal paste between the temperature probe and the copper line. Insulate the temperature sensor so that it is unaffected by ambient conditions. If insulation is insufficient, the superheat reading will be incorrect.
3. Record both readings and convert the suction pressure to temperature using the appropriate refrigerant Pressure vs. Temperature chart.
4. Subtract the converted temperature (saturation temperature) from the measured suction temperature. The calculated value is the superheat reading. If the superheat reading is not between 8-12°F, repeat the test and compare the results. If the superheat reading remains high or low, system service may be required by either adjusting the Expansion Valve or adding refrigerant to the equipment.
5. Once the superheat check is complete, make sure to replace any refrigerant access port cap that was used to gain access and repair any insulation that was cut when attaching the temperature probe.

Checking the System Subcooling:

System subcooling is similar to system super heat in that it measures the amount of heat lost or rejected by the refrigerant during heat transfer in the condenser. Having the appropriate subcooling is equally important as it models the difference between the condensation temperature and the actual liquid temperature. If the subcooling is too high (greater than 19°F), too much heat is being rejected. In the case of high subcooling, the compressor is requiring more energy to accomplish the same mechanical work, the charge could be too high or the heat exchanger could be fouled. On the other hand, if subcooling is too low (less than 3°F), not enough heat is being rejected and therefore, vapor could be entering the liquid line.

1. Connect a calibrated gauge manifold or Testo to the liquid line of the refrigerant system. To minimize refrigerant burns, always use the appropriate hoses for the refrigerant in conjunction with low loss fittings. Always wear PPE

such as eye protection and gloves to minimize the risk of injury.

2. Attach a calibrated temperature probe to the liquid line and place a small dab of thermal paste between the temperature probe and the copper line. Insulate the temperature sensor so that it is unaffected by ambient conditions. If insulation is insufficient, the superheat reading will be incorrect.
3. Record both readings and convert the liquid line pressure to temperature using the appropriate refrigerant Pressure vs. Temperature chart.
4. Subtract the converted temperature (saturation liquid temperature) from the measured liquid temperature. The calculated value is the subcooling reading. If the subcooling reading is not between 3-9°F, repeat the test and compare the results. If the subcooling reading remains high or low, system service may be required by adding or removing refrigerant to the equipment.
5. Once the subcooling check is complete, make sure to replace any refrigerant access port caps that were removed to gain access.

Cleaning the Outdoor Air Coils:

Maintaining the quality of the outdoor air coil may be the most important routine maintenance topic on an air source heat pump or chiller. Equipment performance is directly related to the heat transfer efficiency heat exchangers. If the air coil or heat exchanger is clogged or filled with debris, the heat transfer efficiency will be low. The outdoor air coil should never be blocked or restricted in any way. Fan speed should never be manually set, adjusted or overridden unless instructed to do so by American GeoThermal's service staff. The outdoor air coil is constructed of aluminum, copper, galvanized steel, and brass alloys. Never use a coil cleaner that will degrade any of the materials listed above. The manufacturer strongly advises against the use of strong acids or bases when cleaning or descaling coils.

1. Remove any panels or filters blocking access to the outdoor air coils.
2. Rinse the coil with warm water not exceeding 150°F in an up and down fashion. In some cases, coils may need to be cleaned by accessing the top on the unit and rinsed from the inside out. Use caution when climbing atop the unit and comply with OSHA standards for when and how to use fall protection. Warning, do not spray with pressurizing equipment such as power sprayers or power washers, as damage to the air coil fin may occur.
3. If warm water rinsing is ineffective, an alkaline based coil cleaner may be used to dissolve hardened materials. Apply the coil cleaner using a common weed spraying bottle and follow the manufacturer recommendations on application, concentration, waiting periods and safety precautions. Use PPE such as gloves, eye protection and face shields when using cleaning agents. Do not scrub or press the coil with a brush or any abrasive cleaning pad. If the unit is installed near clean water supplies such as wells or freshwater springs, consult with the Environmental Protection Agency (EPA) before using cleaners or detergents when washing coils.
4. Rinse the coil from top down removing all coil cleaner from the coil and be aware of chemical run off.
5. Replace any panels or filters before resuming normal operation. If operating below freezing ambient temperatures, allow the coil to dry before resuming normal operation to prevent immediate frosting from occurring.

Cleaning Air Filters:

1. Rinse the filters with warm water up to 150°F while installed on the equipment. Do not use pressurizing equipment if cleaning filters while installed on the unit, damage to the outdoor air coil may occur.
2. If rinsing the filters while installed on the equipment is ineffective, remove the filters and place on the ground or on a hanging rack.
3. Use pressurizing equipment such as power sprayers or power washers to free debris from the filter. The filter may be damaged if the nozzle of the pressurizing equipment is placed too close to the filter, use discretion when determining closeness of the nozzle.
4. Reinstall the filters and resume normal operation. If operating below freezing ambient temperatures, allow the coil to dry before resuming normal operation to prevent immediate frosting from occurring.

Fan Blade Inspection:

1. Disconnect any field supplied voltage powering the equipment and use the appropriate lockout/tagout procedures.

2. Remove the back outdoor air coil cabinet cover.
3. Inspect the tops and bottoms of each fan blade for dirt build up and damage. Use caution when climbing atop the unit and comply with OSHA standards for when and how to use fall protection. If the fan blade is damaged beyond repair, replace with manufacturer approved replacement only.
4. If fan blade cleaning is required. Warm water not exceeding 125°F may be sprayed onto the tops and bottoms fan blade. Use caution when spraying as balancing weights could become dislodged or knocked loose during cleaning. Do not use pressurizing equipment when washing fan blades, pressurized fluids may result in the fan blade becoming imbalanced.

Calibrating Temperature and Pressure Sensors:

Accurate temperature and pressure sensors are critical to proper operation of the equipment and if calibrated incorrectly, the equipment may not operate as intended. For example, the discharge pressure sensor is used in the head pressure control mechanism that controls the fan speed in cooling mode and the water outlet valve position in heating mode. If temperature sensors must be corrected by ± 5°F, the sensor should be replaced. If pressure sensors must be corrected by ± 15psi, the sensor should be replaced.

Note: the equipment should be in the off position when calibrating temperature or pressure sensors.

Temperature Sensors:

1. Remove the temperature sensor from the thermal well or remove the sensor from the copper line. Do not disconnect the sensor from the controller.
2. Place the temperature sensor in an insulated container of fresh water.
3. Place a calibrated temperature meter into the container along with the sensors to be calibrated. Calibrating temperature equipment should have the ability to measure down to 1/10th °C (Celsius) and should have an accuracy of ± 0.2°C.
4. Open the electrical cabinet to access the low voltage controller. Use caution when opening electrical panel covers and review all warning labels located on the outside of each cover. If high voltage warnings are observed, PPE such as flash protection or flash suits may be required.
5. By pressing the target button on the control (center left), navigate to the “Alarm Log” menu and press enter (center right). Insert 1037 into control to gain hidden control access. Once the password is successfully entered, press the back button (bottom left) and navigate to the “I-O Config” menu. Navigate to the “Inputs” menu and locate the sensor to be calibrated. All temperature readings on this screen are expressed in °C (Celsius).
6. Correct the “write value” to the desired temperature until the calibrated temperature sensor and the sensor being calibrated are equal using the “Offset” Parameter. Repeat this process until all temperature sensors are calibrated.

Pressure Sensors:

1. Locate the pressure sensor needing to be calibrated by removing the refrigeration access panels but do not remove the sensor.
2. If the unit contains flammable refrigerant, the combination of the appropriate refrigeration hoses and low loss fitting should be used to minimize risk of fire and chemical burns. Use caution when gaining access to refrigerant systems and always use the approved PPE such as gloves, eye protection, face shields and protecting suits. Connect a calibrated pressure sensor to the connection port alongside the pressure sensor needing to be calibrated by removing the refrigeration access port. Caution, some access ports may have upwards of 650psi.

3. Open the electrical cabinet to access the low voltage controller. Use caution when opening electrical panel covers and review all warning labels located on the outside of each cover. If high voltage warnings are observed, PPE such as flash protection or flash suits may be required.
4. By pressing the target button on the control (center left), navigate to the "Alarm Log" menu and press enter (center right). Insert 1037 into control to gain hidden control access. Once the password is successfully entered, press the back button (bottom left) and navigate to the "I-O Config" menu. Navigate to the "Inputs" and locate the sensor to be calibrated using the "Offset" Parameter. All pressure readings on this screen are expressed in °C PSI.
5. Correct the "write value" to the desired temperature until the calibrated pressure sensor and the sensor being calibrated are equal. Repeat this process until all pressure sensors are calibrated.

SYSTEM SERVICE & TROUBLESHOOTING CONT.

TROUBLESHOOTING GUIDE	
CONDITION	**SOLUTION**
Compressor is loud or creating excess vibration	
Voltage phase imbalance	- Ensure the unit is supplied with the correct input voltage shown on the equipment nameplate. Voltage should be evenly balanced.
Mounting hardware issue	- Ensure the compressors are bolted down properly. - Mounting supports could need to be replaced. - Ensure the piping is strapped properly, all lines connecting to the compressors should be fully strapped.
Crankcase heater malfunction	- Disconnect the heater and check for resistance, the heater may need to be replaced. - Check crankcase heater fuses. Refer to the equipment electrical diagram and locate the fuse block containing the fuses.
Liquid flood back	- Check superheat readings, TXV's should be adjusted to 8-12°F - For units containing electronic expansion valve(s), ensure the electronic control module is working properly and the settings are correct.
Compressor not running and no faults are present	
Contactor not energizing	- Contactor is operating correctly, check resistance between legs to ensure no short circuit has occurred. - Check the resistance of the coil windings (A1 & A2). If open, contactor should be replaced. - Check the control circuit fuse. If blown, determine what created the short circuit before replacing components.
Incorrect input voltage or phase imbalance	- Phase monitor is tripped or faulty. - Adjust the equipment input voltage.
Setpoint not adjusted properly	- Ensure the fluid setpoints are set to the desired condition.
Pressure switch is tripped	- Pressure switch has tripped however the control did not respond with a fault code. The control input could be shorted and need to be replaced. If a short is suspected, determine what created the short circuit before changing components.
Compressor or Fan overload is tripped	- Compressor aux 1 or Fan aux 1 switch is open, but the control did not respond with a fault code. The control input could be shorted and need to be replaced. If a short is suspected, determine what created the short circuit before changing components.
Motor or control breakers are repeatedly tripping	
Low or imbalanced input voltage being applied to the unit	- Ensure the unit is supplied with the correct input voltage shown on the equipment nameplate. Voltage should be evenly balanced.
Bad wiring connection	- Ensure that all wiring connections are properly landed and no wires are burnt. If burned wires are observed, replace immediately before resuming normal operation.
Compressor oil level is low.	
Low Refrigerant	- Check subcooling reading. If low, the unit may have a leak or the charge needs adjusting.
Oil trapped in the system	- Low refrigerant velocity caused by operating outside the indented envelope. Refer to the equipment submittal and ensure the ambient and water conditions are not outside the specified range.
Crankcase heaters not working properly	- Disconnect the heater and check for resistance, the heater may need to be replaced. - Check crankcase heater fuses. Refer to the equipment electrical diagram and locate the fuse block containing the fuses.
Equipment is operating outside its intended operation envelope	- Refer to the equipment submittal and ensure the ambient and water conditions are not outside the specified range.
Compressor is short cycling	- On/Off times are not working properly, adjust if needed. - Setpoint differential is too small, adjust if needed.

TROUBLESHOOTING GUIDE CONT.	
CONDITION	**SOLUTION**
Liquid flood back	- Check superheat readings, TXV's should be adjusted to 8-12°F - For units containing an electronic expansion valve, ensure the electronic control module is working properly and the settings are correct.
Refrigerant suction pressure is abnormally low	
Liquid line is restricted (either mode)	- Check to ensure the liquid line solenoid valve is working properly. - Check to ensure the liquid line filter drier isn't clogged. - Check to ensure the liquid line is not flashing. - Check to ensure the expansion valves are working properly.
Suction line blockage (either mode)	- Check to ensure the reversing valve is working properly. In some cases, the reversing valve can get stuck between modes.
Improper charge (either mode)	- Check the unit subcooling and ensure the charge is set correctly. - Check for refrigerant leaks. If leaks are present, repair and add charge.
Low water temperature (cooling mode)	- Check the fluid inlet and outlet water setpoints, adjust if required. - Calibrate fluid inlet and outlet water temperature sensors.
Restricted water lines (cooling mode)	- Check to ensure all valves are open with in the piping system.
Dirty or fouled water heat exchanger (cooling mode)	- Heat exchanger may need to be cleaned. Review Section 6 of this manual for fluid quality requirements of detergents and cleaners.
Fluid flow rate is insufficient (cooling mode)	- Check to ensure all valves are open within the piping system. - Check to ensure the fluid pump is working properly. Check ampere readings, differential pressure, etc. and compare to the fluid pump curve chart. Ensure the fluid pump is operating at the correct duty point.
Water or Glycol is contaminated (cooling mode)	- Flush all water piping and replace the fluid within the piping system.
Glycol concentration is too high (cooling mode)	- If the glycol concentration is too high, the fluid pumps may not be able to deliver the appropriate water flow rate.
Low refrigerant discharge pressure (cooling mode)	- Head pressure control not functioning properly. Check to ensure the fans are modulating to control the discharge pressure.
Dirty or clogged air coil (heating mode)	- Air coil should be cleaned if debris is observed between the fins.
Dirty or clogged air filters (heating mode)	- Air filters should be cleaned if debris is observed blocking the openings of the filter.
Low refrigerant discharge pressure (heating mode)	- Head pressure control valve not functioning properly. Check to ensure the water valve is modulating to control the discharge pressure.
Defrost mode is not triggering (heating mode)	- Ice is observed on the air coil and defrost is not activating. Check calibration of suction temperature and suction pressure sensors.
Refrigerant suction pressure is abnormally high	
Head pressure control malfunction (cooling mode)	- Head pressure is also observed to be high. Head pressure control is not working properly. Check setting and adjust if required. - Dirty or clogged air coil or air filters.. - Bad fan motor. Verify the failure and replace or repair.
Fan speed is incorrect (heating mode)	- Fan speed is too low or fans not functioning at all. - Bad fan motor. Verify the failure and replace or repair.
Refrigerant discharge pressure is abnormally low	
Improper fan speed (cooling mode)	- Fan speed is too high. Check head pressure control settings. Settings should be between 380-420psi depending on the application.

SYSTEM SERVICE & TROUBLESHOOTING CONT.

TROUBLESHOOTING GUIDE CONT.	
CONDITION	**SOLUTION**
Ambient Temperature is too low (cooling mode)	- Ambient temp is too low. Check the equipment submittal and ensure the unit is operating within the intended operating conditions.
Fluid temperature is too low (heating mode)	- Fluid inlet temperature is below 60°F. Fluid inlet temp should be above 60°F.
Fluid flow rate is too high (heating mode)	- Head pressure control valve not working properly. Check head pressure control setpoints, setpoint should be between 380-420psi. - High fluid flow rate. Check to ensure the fluid pump is working properly.
Compressor Operating too Loud	- Check to ensure that the discharge pressure is greater than suction pressure by a multiple of 2 - Check head pressure control settings. - Check Subcooling/ charge.
Refrigerant discharge pressure is abnormally high	
High refrigerant charge (both modes)	- Check subcooling reading, adjust charge as necessary.
Contaminants in the refrigerant (both modes)	- Purge all non-condensables from the refrigerant circuit.
Blockage in the discharge line (both modes)	- Check to ensure the reversing valve is working properly. In some cases, the reversing valve can get stuck between modes.
Air coil or air filters are clogged (cooling mode)	- Coils or air filters are no longer semi transparent/no light can be seen. Clean air coil or air filters.
Fan speed is too low (cooling mode)	- Head pressure control not working properly. Check head pressure control setpoints, setpoint should be between 380-420psi. - Bad fan motor. Verify the failure and replace or repair.
Expansion valve malfunction (heating mode)	- During low ambient heating modes, check to make sure proper superheat is observed. In the case of the expansion valve issue, abnormal suction pressure should also be observed.
Outlet water temperature is too high or ΔT is too high	- Blockage in the piping system. Ensure that all valves are fully open. - Head pressure control valve not working properly. Check head pressure control setpoints, setpoint should be between 380-420psi. - Low fluid flow rate. Check to ensure the fluid pump is working properly.
Outlet water is abnormally low	
Inlet water is abnormally low (both modes)	- Refer to equipment submittal and ensure the equipment is operating as intended.
Fluid pump malfunction (both modes)	- Refer to the equipment submittal and ensure the fluid pump is sized appropriately, using the fluid pump curve chart and the differential pressures. - Ensure that the fluid pump is operating correctly. Check pump overloads. Check motor windings for short circuits and replace if necessary.
Temperature control setpoints are set incorrectly (both modes)	- Refer to the equipment submittal and ensure the equipment is operating as intended. Reset the setpoint for the desired temperature range.
Blockage in the piping system (cooling mode)	- Piping is restricted in some way. Ensure that all valves are open.
Head pressure control malfunction (heating mode)	- Head pressure control valve not working properly. Check head pressure control setpoints, setpoint should be between 380-420psi.
Outlet water is abnormally high	
Inlet water is abnormally high (both modes)	- Refer to equipment submittal and ensure the equipment is operating as intended.
Temperature control setpoints are set incorrectly (both modes)	- Refer to the equipment submittal and ensure the equipment is operating as intended. Reset the setpoint for the desired temperature range.
Head pressure control malfunction (heating mode)	- Head pressure control valve not working properly. Check head pressure control setpoints, setpoint should be between 380-420psi.

TROUBLESHOOTING GUIDE CONT.	
CONDITION	**SOLUTION**
Compressor is abnormally hot (discharge temp greater than 275°F)	
Oil level is low (both modes)	- Oil level should be visible in the compressor sight glass. - Oil is trapped in the system. - Abnormally high superheat, adjust the expansion valves or replace if faulty - Blockage in the system. - Low refrigerant velocity as a result of the equipment running outside of its intended envelope. Refer to the equipment submittal.
Liquid injection valve is malfunctioning (both modes)	- Locate the liquid injection control module inside the compressor junction box. Ensure the control module is not in fault state. - If liquid injection moule is in fault state, check the resistance of the valve stator. - Loss of voltage to the liquid injection control module. Powered by device code CB6. If tripped, check the resistance of the control input connections. If a short circuit is suspected, replace the liquid injection control module. - Bad wiring connection.
Ambient temperature is too high (cooling mode)	- Ambient temperature is above 125°F. Ambient temperature should not exceed 125°F. Equipment is operating outside of its intended envelope.
Outlet water temperature is too high (heating mode)	- Outlet water temperature should not exceed 150°F. Maximum water inlet temp at this point should not exceed 140°F - Head pressure control valve not working properly. Check head pressure control setpoints, setpoint should be between 380-420psi.
Ambient temperature is too low (heating mode)	- Ambient temperature is below –5°F. Ambient temp should be above –5°F equipment is operating outside of its intended envelope.
Controller display is not lit up	
Improper input voltage	- Refer to the equipment nameplate, the input voltage should be the same as the nameplate and with respect to the system utilization voltage. - Input voltage is imbalanced.
Circuit breakers are not turned on or a fuse is blown.	- Check to ensure all circuit breakers are in the on position. - Check primary side fuses on the transformer, device code FS1. If blown, locate the cause of the short circuit, repair the issue and replace the fuses.
Transformer has shorted	- Check the resistance of both primary and secondary sides of the transformer. If zero resistance or abnormally high resistance, the transformer may have shorted to ground or burnt a winding. In this case, replace the transformer and replace all fuses. Ensure all wiring connections up and down stream are properly landed and torqued to the specification in Section 11 of this manual.
Voltage loss at the control input voltage	- Bad wiring connection. Ensure all control circuit wiring is sufficient and properly torqued to listed in the torques specification in Section 11 of this manual. - Control circuit breaker is tripped due to a short circuit, device code CB7
Bad controller screen	- The equipment functions properly but the screen is not lit. Replace the screen.
Bad controller	- A short circuit has occurred somewhere within the control circuit. Locate the short circuit using a multimeter and replace or repair the issue. - Check the resistance on the control at points VG & VGO with the wires unhooked. If zero resistance is observed, replace the controller.

TROUBLESHOOTING GUIDE CONT.	
CONDITION	**SOLUTION**
Superheat is abnormally high	
Flashing in the liquid line (both modes)	- Blockage in the liquid line. - Solenoid valve is stuck partially open. Tap lightly to unstick, if unsuccessful, replace the solenoid valve or solenoid valve coil. - Liquid line filter drier is clogged with contaminants. - Check valve is stuck partially open. Replace the check valve.
Expansion valve is hunting (both modes)	- For TXV's, check that the sensing bulb is installed and insulated correctly. For EEV's, check the calibration of the suction pressure and temperature sensors. - Defective TXV or EEV. - TXV sensing bulb cap. tube is broken or leaking.
Low refrigerant charge (both modes)	- Check the subcooling reading and adjust if required. - Check for refrigerant leaks. Repair and add charge.
Inlet water is to high (cooling mode)	- Refer to submittal and ensure the equipment is operating as intended. The equipment may be operating outside the intended envelope.
Dirty or clogged air coil or air filters (heating mode)	- Coils or air filters are no longer semi transparent/no light can be seen. Clean air coil or air filters.
Improper fan speed (heating mode)	- Fan speed is too low. Check to ensure fans are working properly.
Superheat is abnormally low	
Expansion valve is hunting or stuck open (both modes)	- For TXV's, check that the sensing bulb is installed and insulated correctly. - For EEV's, check the calibration of the suction pressure and temperature sensors. - Debris trapped in the valve body. Disassemble, clean the valve body, replace the liquid line filter drier, recharge.
Thermal expansion valve adjusted improperly (cooling mode)	- Manually adjust the thermal expansion valve.
Electronic expansion valve settings are too low (heating mode)	- Adjust the settings in the control.
Heat exchanger is freezing up	
Freeze protection limit setpoint is too low	- Adjust the freeze protection limit setpoint. For brazed plate heat exchangers, fluid outlet should not be less than 40°F. For tube/tube heat exchangers, fluid outlet temperature should not be less than 32.5°F.
Fluid outlet water temperature sensor reading incorrectly	- Calibrate the fluid outlet temperature sensor or replace if necessary.
Low water flow rate	- Ensure that the fluid pump is operating correctly. Check pump overloads. Check motor windings for short circuits and replace if necessary.
Low suction pressure	- Low refrigerant charge. Check subcooling reading and adjust change if necessary.
Low section temperature/ low super heat	- Abnormally low water inlet temperature. Refer to the equipment submittal to ensure the equipment is operating within the intended envelope.

SYSTEM SERVICE & TROUBLESHOOTING CONT.

SERVICE SCHEDULE											
DATE											
MODE, HEATING OR COOLING?											
AMBIENT TEMP. (°F)											
FLUID INLET TEMP. (°F)											
FLUID OUTLET TEMP. (°F)											
SUCTION PRESSURE(PSIG)											
SUCTION TEMP. (°F)											
SUPER HEAT (°F)											
LIQUID PRESSURE (PSIG)											
LIQUID TEMP. (°F)											
SUB COOLING (°F)											
DISCHARGE PRESSURE (PSIG)											
DISCHARGE TEMP. (°F)											
COMPRESSOR A AMPERE READING											
COMPRESSOR B AMPERE READING											
FAN 1 AMPERE READING											
FAN 2 AMPERE READING											
FLUID PUMP AMPERE READING											

SERVICE SCHEDULE											
DATE											
MODE, HEATING OR COOLING?											
AMBIENT TEMP. (°F)											
FLUID INLET TEMP. (°F)											
FLUID OUTLET TEMP. (°F)											
SUCTION PRESSURE(PSIG)											
SUCTION TEMP. (°F)											
SUPER HEAT (°F)											
LIQUID PRESSURE (PSIG)											
LIQUID TEMP. (°F)											
SUB COOLING (°F)											
DISCHARGE PRESSURE (PSIG)											
DISCHARGE TEMP. (°F)											
COMPRESSOR A AMPERE READING											
COMPRESSOR B AMPERE READING											
FAN 1 AMPERE READING											
FAN 2 AMPERE READING											
FLUID PUMP AMPERE READING											

COLD STORAGE & WINTERIZING

If the equipment must be stored prior to installation, the following requirements must be met to ensure damage does not occur. American GeoThermal is not responsible for preparing the equipment for such storage. If the equipment must be transported long distances or via ocean freight, the manufacturer must be notified prior to shipment. Special instruction may be given on a case by case basis. All equipment is factory quality testing prior to shipment, small amounts of water may be lingering in the bottom section of the coil. WARNING, heat exchanger may bust if the below procedure is not followed.

1. Equipment containing brazed plate heat exchangers i.e. the model number shows “S” or “D” the 14th digit in (not including the underscore) must be winterized using a glycol solution if storage conditions are less than 32° F (0° C). Refer to Section 10 of this manual for instruction on proper winterizing.
2. Proper precautions must be taken to prevent rodents from entering the equipment. For example, a shrink wrap film must be applied to the equipment for long term protection.
3. Moisture absorbent packs must be placed in and around the electrical panel, variable speed drives or any electrical containing components to prevent corrosion or degradation.

For additional freeze protection, the fluid circuit can be flushed with a glycol solution, however it is not advised to leave such solution within the fluid piping. All glycol solutions must be drained or blown out with compressed air. For units containing factory supplied fluid pumps. Additional steps may be required to prevent the fluid pump impeller from freezing. Most pumps contain a drain valve located below the suction port of the pump. If one is not supplied with the pump, contact American GeoThermal for additional steps for freeze protection.

American GeoThermal is not responsible for warranty claims as a result of improper storage.

WARRANTY AND LIABILITY CLAUSE

The Warranty is extended by American GeoThermal Inc. (Company) and applies to all commercial equipment and related accessories unless otherwise stated.

The Company warrants for a period of 12 months from initial start-up or 15 months from date of shipment, whichever is less, that the Company products covered by this (1) are free from defects in material and workmanship and (2) have the capacities and rating set forth in the Company's catalogs and bulletins, provided that no warranty is made against corrosion, erosion, or deterioration. The Company's obligations and liabilities under the warranty are limited to furnishing f.o.b factory or warehouse at Company designated shipping point, freight allowed to Buyer's city (or port of export for shipment outside the conterminous United States) replacement equipment (or at the option of the Company part therefore) for all Company products not conforming to this warranty and which have been returned to the manufacturer. The Company shall not be obligated to pay for the cost of lost refrigerant. No liability whatever shall attach to the Company until said products have been paid for and then said liability shall be limited to the purchase price of the equipment shown to be defective.

The Company may make certain further warranty protection available on an optional extra-cost basis. Any further warranty must be in writing, signed by an officer of the Company.

The warranty and liability set forth herein are in lieu of all other warranties and liabilities, whether in contract or in negligence, express or implied, in law or in fact, including implied warranties of merchantability and fitness for particular use. In no event shall the Company be liable for any incidental or consequential damages.

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