



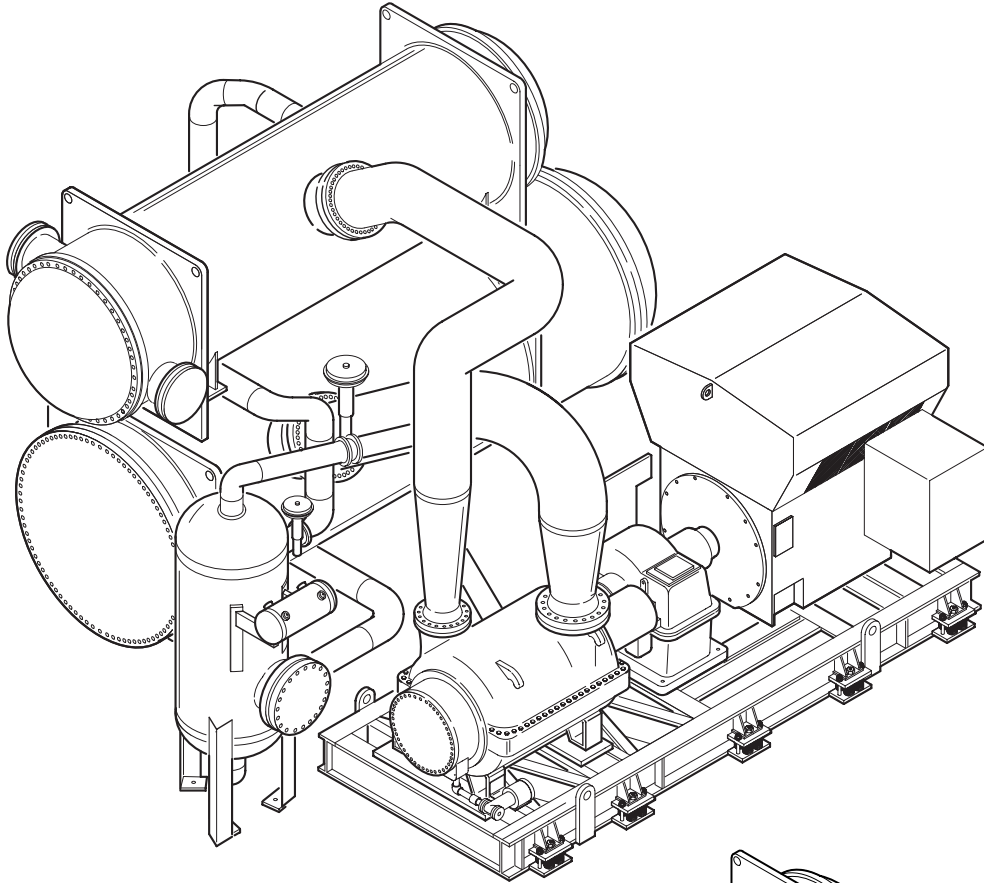
# TITAN™ CENTRIFUGAL CHILLERS

INSTALLATION INSTRUCTIONS

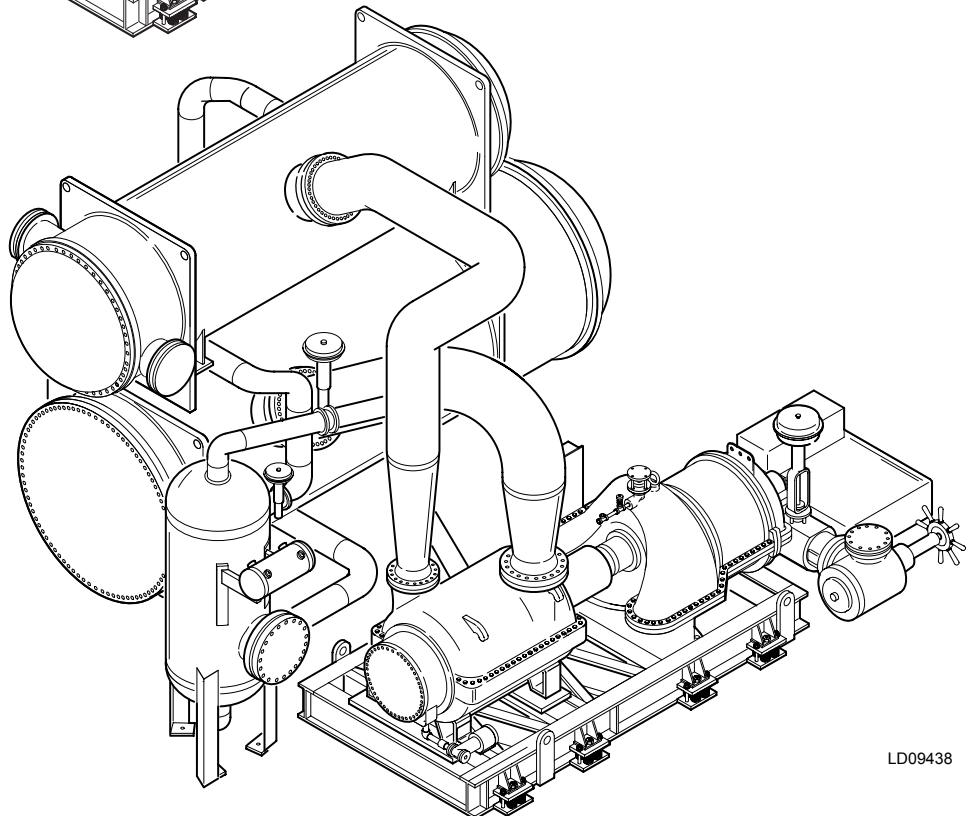
Supersedes: 160.71-N1 (478)

Form 160.72-N1 (304)

## TITAN™ MODEL OM CHILLER



LD09437



LD09438

# IMPORTANT!

## READ BEFORE PROCEEDING!

### GENERAL SAFETY GUIDELINES

This equipment is a relatively complicated apparatus. During installation, operation, maintenance or service, individuals may be exposed to certain components or conditions including, but not limited to: refrigerants, oils, materials under pressure, rotating components, and both high and low voltage. Each of these items has the potential, if misused or handled improperly, to cause bodily injury or death. It is the obligation and responsibility of operating/service personnel to identify and recognize these inherent hazards, protect themselves, and proceed safely in completing their tasks. Failure to comply with any of these requirements could result in serious damage to the equipment and the property in which it is situated, as well as severe personal injury or death to themselves and people at the site.

This document is intended for use by owner-authorized operating/service personnel. It is expected that this individual possesses independent training that will enable them to perform their assigned tasks properly and safely. It is essential that, prior to performing any task on this equipment, this individual shall have read and understood this document and any referenced materials. This individual shall also be familiar with and comply with all applicable governmental standards and regulations pertaining to the task in question.

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### SAFETY SYMBOLS

The following symbols are used in this document to alert the reader to areas of potential hazard:



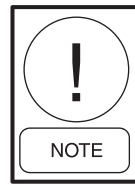
***DANGER*** indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.



***CAUTION*** identifies a hazard which could lead to damage to the machine, damage to other equipment and/or environmental pollution. Usually an instruction will be given, together with a brief explanation.



***WARNING*** indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.



***NOTE*** is used to highlight additional information which may be helpful to you.



***External wiring, unless specified as an optional connection in the manufacturer's product line, is NOT to be connected inside the micro panel cabinet. Devices such as relays, switches, transducers and controls may NOT be installed inside the micro panel. NO external wiring is allowed to be run through the micro panel. All wiring must be in accordance with YORK's published specifications and must be performed ONLY by qualified YORK personnel. YORK will not be responsible for damages/problems resulting from improper connections to the controls or application of improper control signals. Failure to follow this will void the manufacturer's warranty and cause serious damage to property or injury to persons.***

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### REFERENCE DOCUMENTS:

Shipping Damage Claims	50.15-NM
Long Term Storage Instructions	50.20-NM1
Concrete Base Installations	160.71-N1.1
Centrifugal Compressor Alignment	160.71-N2
Refrigerant Recovery and Recycling Units	50.40-OM1
Refrigerant Transfer Unit and Pumpout Receiver	160.71-NM3



***This instruction is to be used in conjunction with certified construction drawings provided by York International Corporation for a specific chiller project. It is important that an up to date set of construction drawings be obtained for use in planning and installation of each TITAN™ model OM chiller. These drawings will depict unique features and details for the specific chiller. The figures and details contained within this instruction are general in nature for illustrative purposes, and may not reflect the exact details of the custom TITAN™ chiller purchased. York International recommends the installation of a TITAN™ system be supervised by a York International Service Representative.***

## INTRODUCTION

### GENERAL

The York TITAN™ model OM industrial liquid chilling unit consists essentially of a centrifugal multistage compressor, condenser, evaporator, intercooler, prime mover, a control center, control valves and interconnecting piping. These units may be driven directly by a steam or gas turbine or by an electric motor, direct or through a speed increaser gear. The TITAN™ chiller, due to its very large size, is shipped in components for field assembly. Field piping, wiring and leak checking must be performed by a qualified Erecting Contractor. Work must be performed as detailed by York drawings, applicable Codes and Standards, and as described in this document. Review the Contract Documents for scope of supply of this rigging and erecting work.

A list of drawings which show the detailed field assembly requirements of the various components is furnished with each unit. The purpose of this instruction is to supplement these drawings by covering, in general, the procedures used for erecting a TITAN™ chiller.



***In the event of conflicting information when installing a TITAN™ chiller, follow the construction drawings carefully.***

### INSPECTION – DAMAGE - SHORTAGE

The unit shipment must be checked on arrival to see that all major pieces, boxes and crates are received. The components will arrive on multiple trailer shipments. Each shipment shall be checked on the trailer when received, before unloading, for any visible signs of damage. Any damage or signs of possible damage must be noted on the unit and reported to the transportation company immediately for their inspection. Also advise the York office so that a York Representative can assist in filing damage claims.

YORK INTERNATIONAL CORPORATION WILL NOT BE RESPONSIBLE FOR ANY DAMAGE IN SHIPMENT OR AT JOB SITE OR LOSS OF PARTS. (Refer to Shipping Damage Claims Form 50.15-NM.)

When received at the job site, all containers should be opened and contents checked against the packing lists.



***All components and contents should be protected from ambient conditions and water damage. Ambient conditions and water may cause damage to the componernts.***

Any material shortage should be reported to York International immediately. (Refer to Shipping Damage Claims, Form 50.15-NM.)

### UNLOADING, HANDLING AND RIGGING



***The evaporator, condenser, intercooler and compressor are sealed and have a minimum of 5 to 10 psig (34 to 69 kPa) charge of nitrogen. DO NOT OPEN these components until they are ready for installation pipe work.***

During installation, all openings must be covered for protection to avoid affecting the warranty. The coverings used must be substantial such as sheet metal, plastic, or solid sheets of rubber of sufficient size and shape so as not to accidentally fall into the opening.



***Coverings such as sheet metal, plastic, or solid sheets of rubber does not prevent water/moisture from entering open piping.***



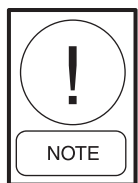
***Do not use cloth rags or other materials which may fall into the components. Any foreign objects which fall inside of the chiller during installation, will cause later damage to the unit.***

If components must be opened or dismantled for rigging, contact the York office responsible for the project, to avoid affecting the warranty.

## LONG TERM OR OUTDOOR STORAGE

Unit components are generally prepared for a short period of storage time while the logistics of shipping and site preparation are arranged. Special provisions may be necessary for time intervals more than six months if the storage area is subject to unusual weather conditions. (Refer to Form 50.20-NM1).

Long-term storage applies if startup does not occur within six months of shipment. Special preparations are required as detailed in the Long Term Storage Instructions, Form 50.20-NM1. The control panel and driveline assembly should be stored indoors. Component piping and piece parts should also be stored indoors whenever possible. If stored outdoors, the piping must be covered by a tarp and protected from temperature extremes.



***Coverings such as a tarp does not prevent water/moisture from entering open piping.***

The major components such as the evaporator, condenser, intercooler and compressor have been charged with a minimum of 5 to 10 psig (34 to 69 kPa) of nitrogen to prevent corrosion of internal parts. These major components have also been painted to protect external surfaces.

Compressor, gear and motor drives should be rotated by hand to prevent damage to the bearings, which might occur with time. Turbine bearings may have shipping bearing inserts installed – refer to the vendor literature for details on storage procedures. (Refer to Form 50.20-NM1).

A monthly log sheet showing the condition of the components, and noting any damage, corrosion or leaks should be sent to the York office responsible for the installation and start-up of the chiller. (Refer to Form 50.20-NM1).

## LOCATION

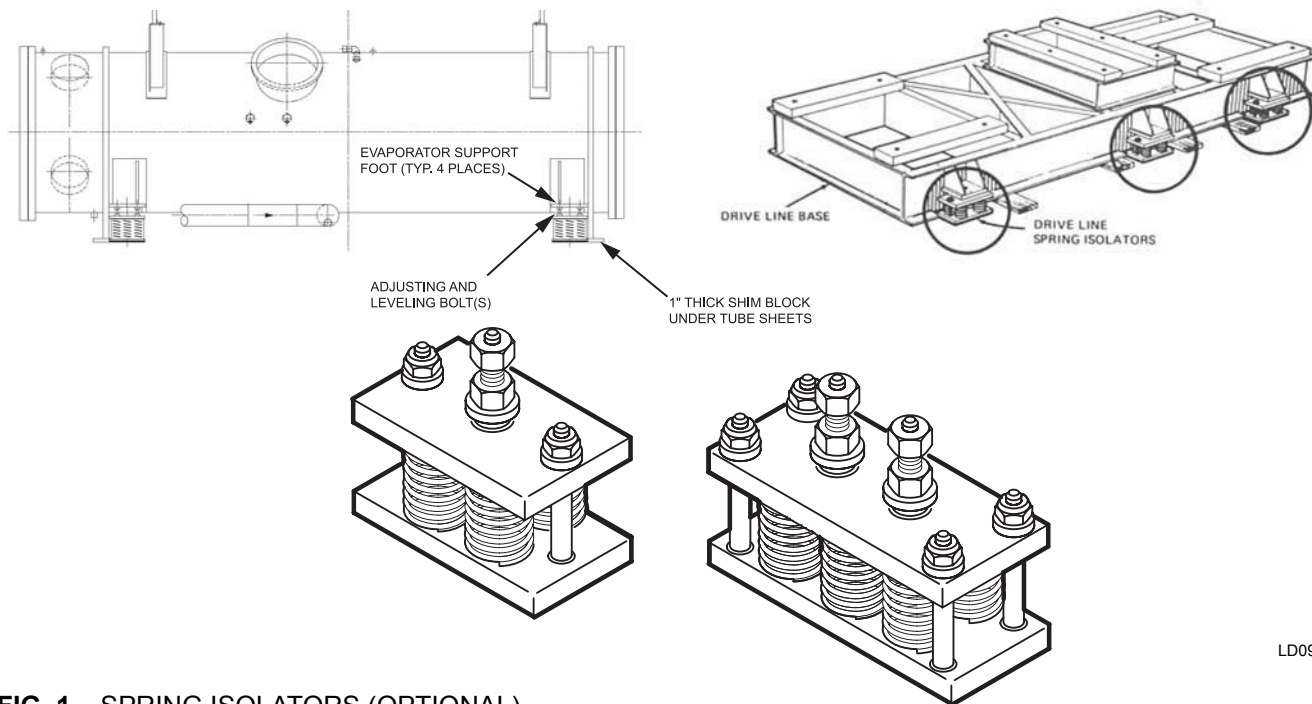
The TITAN™ unit may be located on the ground floor or any upper story capable of supporting the combined operating weights of the drive line and vessels, and point loads detailed on the York construction drawings. The customer shall be responsible to ensure that the installation meets all local building codes and requirements. Ventilation and leak detection equipment shall be furnished by others as required by ASHRAE Standard 15. As with any heavy machinery, it is recommended that the chiller equipment room not be located directly above or adjacent to occupied commercial areas.

## CLEARANCE (Refer to Figure. 3 & 4)

Check the drawings, furnished for the specific installation, for the following minimum space requirements: Clearances for external piping are dictated by installation requirements. A 24” (610 mm) minimum clearance above and along all sides of the unit must be provided. Space for tube removal for both evaporator and condenser (either end) **must** be provided. Approximately four feet (1.2 m) should be allowed at the end of the heat exchangers opposite from the tube pull, to allow for tube expansion tools and other service access. The projected area of the tube removal space must be equal to the full diameter of the evaporator and the condenser. If a building door or window can be conveniently located opposite one end of the chiller, then both evaporator and condenser tubes may be extracted through these openings. When optional water box hinges or davits are furnished, allow space for cover swing. Over head clearance above the compressor must be provided to remove the top compressor casing. A minimum 24” (610 mm) clearance beyond the compressor sump is also required to allow access to the internal pump and bearing. The control panel must have ample clearance for door swing and access to any removable electrical covers. The motor terminal boxes shall have 3 foot (914 mm) clearance at the removable access cover.

## FOUNDATION

A level floor or raised housekeeping pad (plinth), capable of supporting the total weight of the operating unit. If steam turbine drive with down exhaust, anchor bolts are recommended to better accommodate extreme forces in steam exhaust trunk and point loads, as detailed on the construction drawings, must be provided. If the TITAN™ chiller is mounted on an upper floor, level adjusting spring isolator mounting is typically used. If



LD09022

**FIG. 1 – SPRING ISOLATORS (OPTIONAL)**

the chiller is mounted on grade or if the chiller foundation is isolated from the surrounding structure, then the chiller may be directly mounted to the foundation. Typically this involves use of embedded anchor bolts and grouting. A non-shrinking epoxy grout should be poured under all full depth base members and structural drive line base by the Erecting Contractor after the base structure has been leveled.

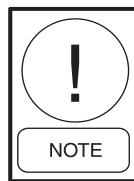
### STRUCTURAL STEEL DRIVE LINE BASES

The TITAN™ chiller compressor and drive train are normally factory installed on a structural steel base. The base has machined mounting pads on which the compressor and drive components are mounted. The drive base, the evaporator shell and intercooler should all be placed on a minimum of 1" (25 mm) thick shim steel blocks (furnished by York) prior to either spring installation or grouting (as applicable). Machined reference plane targets are provided on the drive base to assist in field leveling and alignment procedures. When spring isolator type mountings are sold, outrigger brackets are provided on the sides of the base for the springs.

Since the evaporator-condenser assemblies vary in size to meet individual requirements, and the drive bases vary in both size and shape to suit the driver furnished for each installation, the size and number of isolators required will also vary as necessary to properly support the weight of the unit.

Typical spring isolators which may be used under the drive base and shell assembly are shown in Figure 1. The springs have non-skid neoprene on the bottom surface to prevent movement and dampen vibration. Hold down bolts are not generally required, unless needed for seismic or job specific reasons.

For very large evaporator-condenser packages, the heavy weight of the packages will require the use of a hydraulic or mechanical device for installation of the spring isolators..



**Contact the local YORK Service office for the proper lifting instructions for the package frame.**

All TITAN™ chiller spring isolators are furnished with vertical restraint bolts, which must be adjusted after installation to limit vertical rise to 1/8" (3mm). This will minimize pipe stress when water or refrigerant are removed from the chiller for servicing.

### CONCRETE BASES (See Form 160.71-N1.1)

If a concrete base is utilized, it should be installed per job specifications and certified construction drawings in conjunction with the instructions. See Form 160.71-N1.1.

**RIGGING**

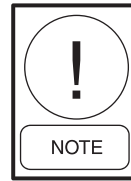
The rigging details shown in Figure 2 are typical suggested methods. In many cases shells and other components will be very large and heavy. Experienced riggers should use the very best equipment and their expert rigging knowledge to rig these unit components.



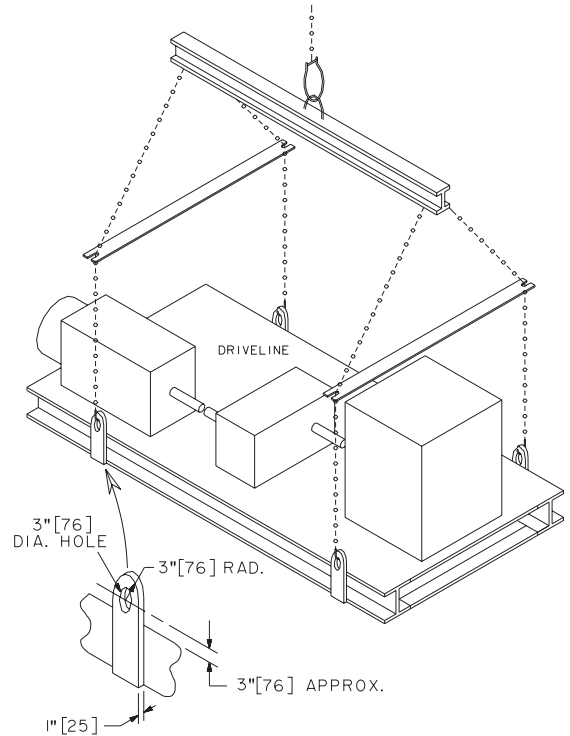
***When rigging unit components, ensure personnel are not in a position for a crunch/pinch situation, if not avoided, will result in death or serious injury.***



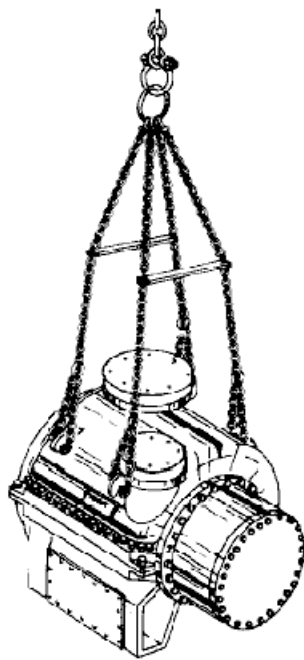
***The rigger should always consult the final certified construction drawings, physical data given to him with job specifications, and any "as shipped" weight information to verify the weight and size of all major components. Crane capacity, chain sizing, rigging bar selection and clevis pin capability must be correctly sized by the rigger, based on component weights and rigging methods to be utilized. Personnel must not stand under equipment while it is being lifted.***



***When rigging the drive line base, ensure that lifting chains do not contact or damage components, piping or electrical devices on the drive line assembly. The use of spreader bars is strongly recommended.***

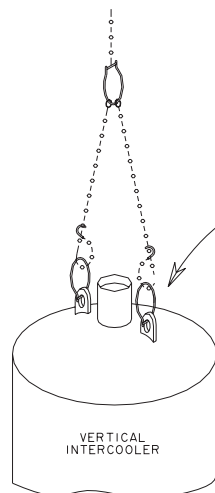


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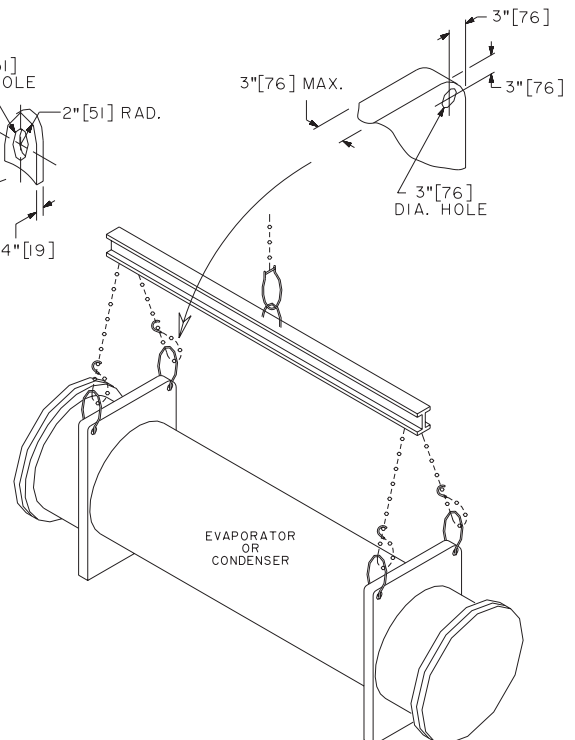


**COMPRESSOR  
(IF SHIPPED  
LOOSE)**

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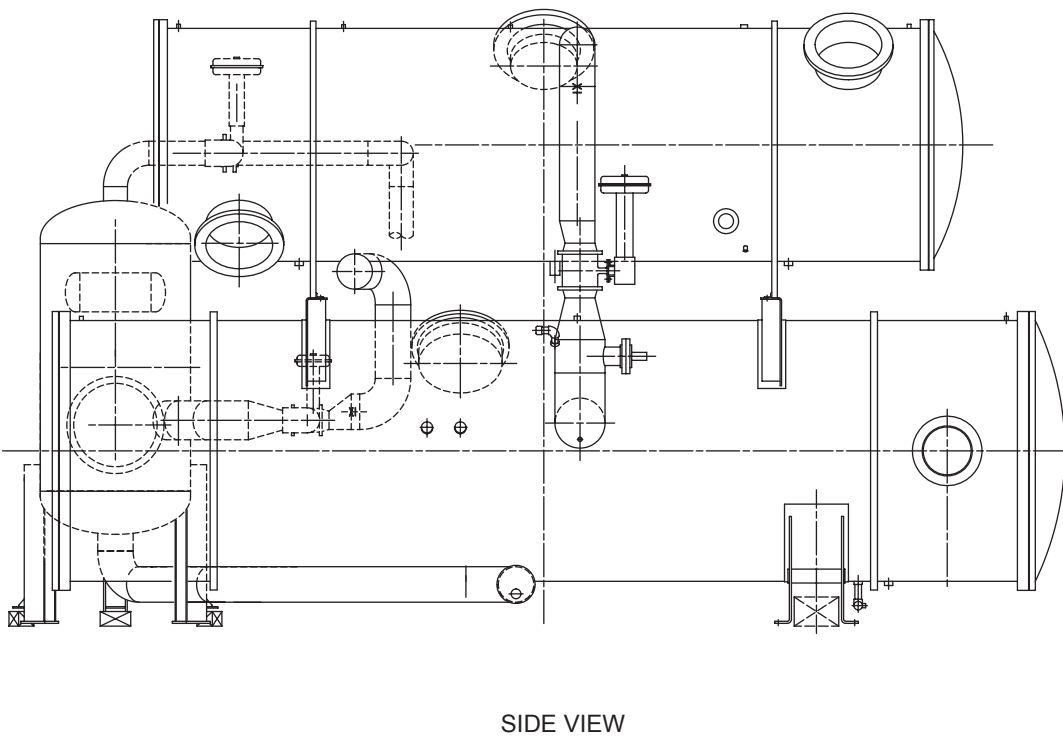
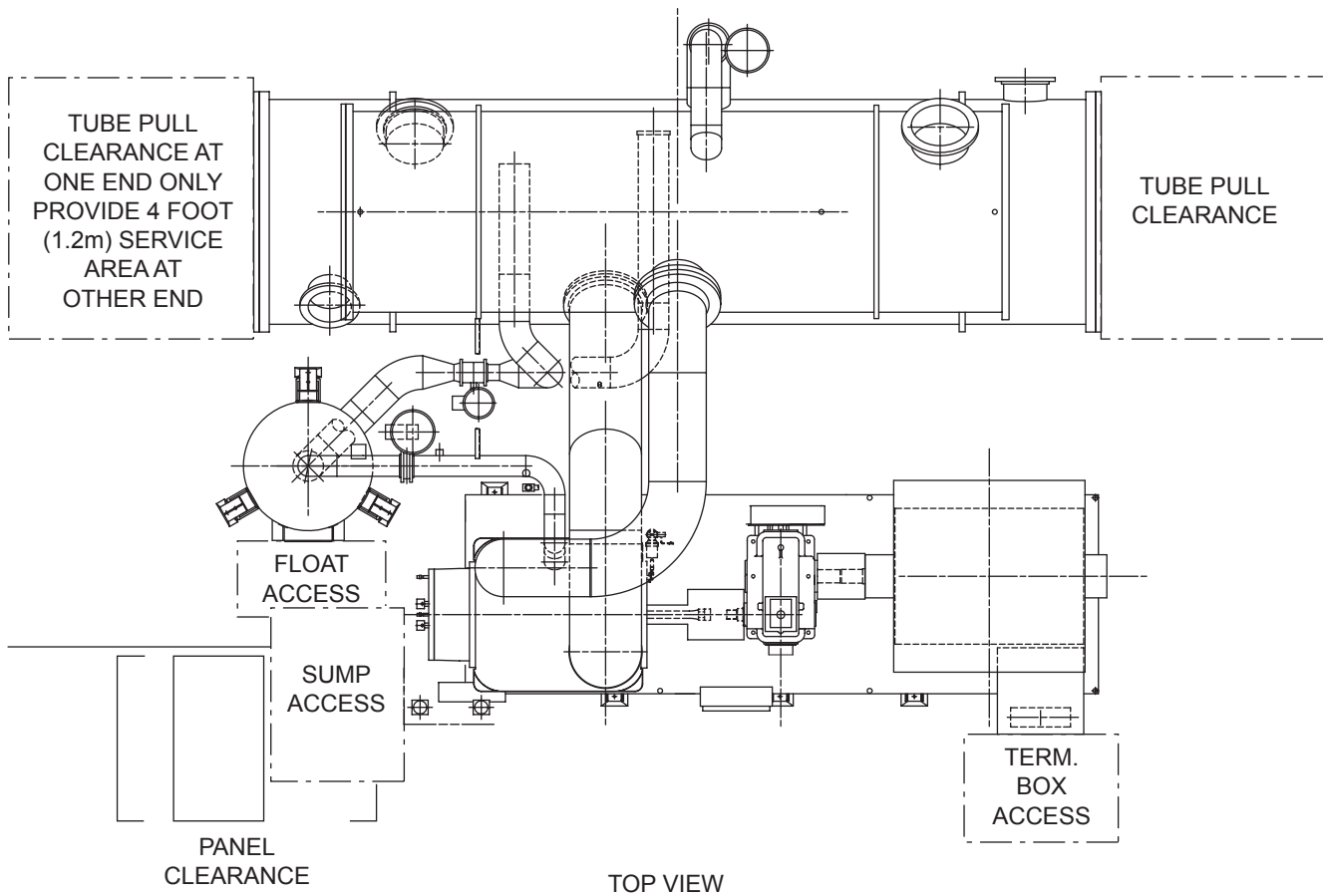
**VERTICAL  
INTERCOOLER**



**EVAPORATOR  
OR  
CONDENSER**

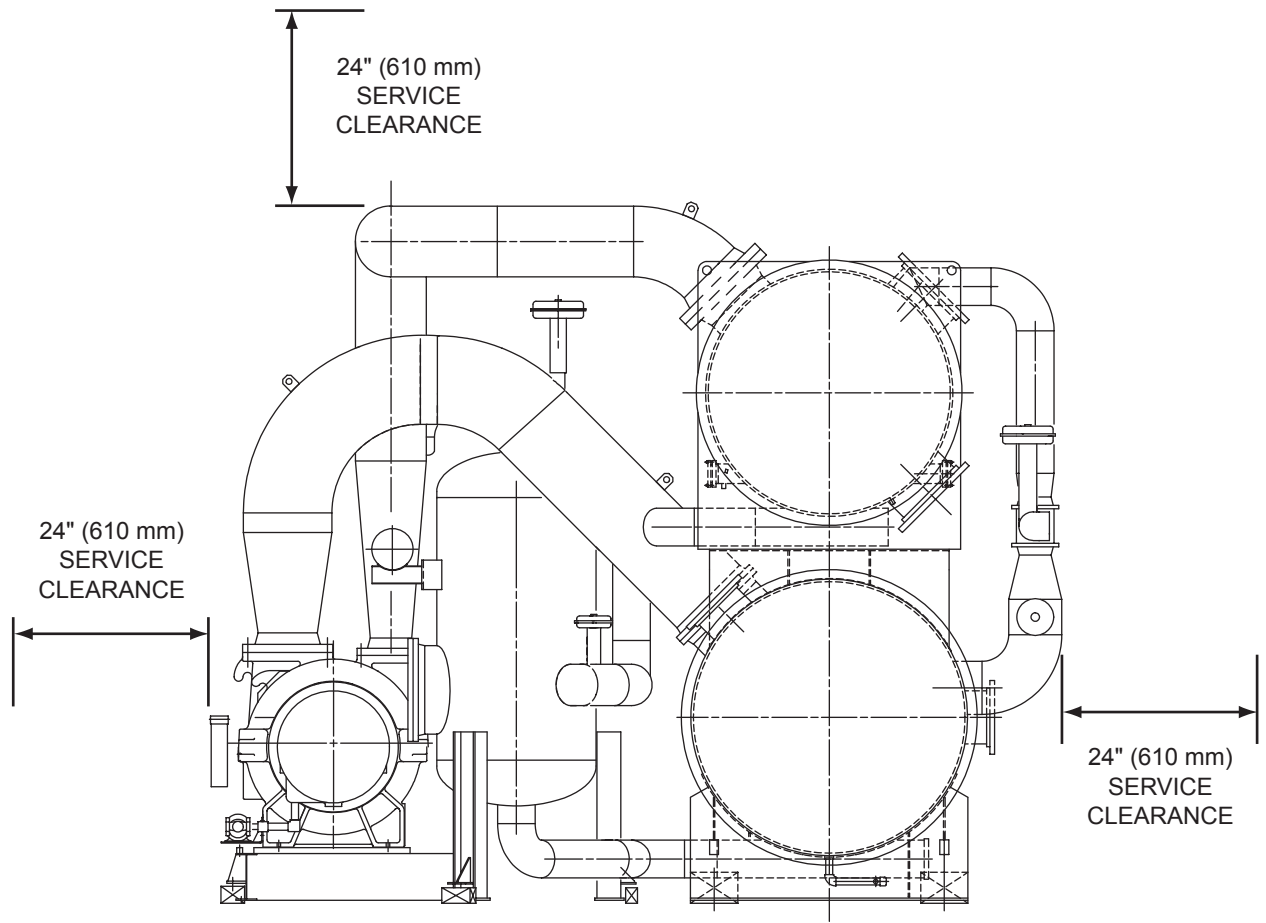
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**FIG. 2 – RIGGING**



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FIG. 3 – GENERAL ARRANGEMENT - TITAN™ UNIT

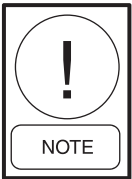


**FIG. 4 – TITAN™ ARRANGEMENT (END VIEW)**

## INSTALLATION OF MAJOR COMPONENTS



***Every effort must be made to prevent any grit or other foreign particles from entering the unit components during installation. All openings should be kept closed, except while working on them, to prevent any foreign material from accidentally entering the unit. Closures should be sheet metal, plastic or rubber of sufficient size and shape so as not to accidentally fall into the opening.***



***Coverings such as sheet metal, plastic or solid sheets of rubber does not prevent water/moisture from entering open piping.***



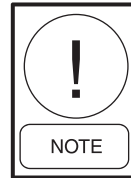
***Rags should not be used as closures. Back-up rings should be used on all welded pipe joints which cannot be cleaned from the inside.***

***Welding is not permitted on the pressure boundary of ASME Code vessels. Welding is permitted to weld pads where provided, and at piping connections within cutoff limits defined on York drawings. Grounding for the welder should be at its weld location to protect against damage due to current flow.***

### GENERAL

Depending on the placement of the TITAN™ chiller within an equipment room, either the evaporator or drive line base may be the first component to locate and install. For clarity this instruction will show the evaporator installed first, followed by mounting of the condenser on top of the evaporator. A free standing vertical intercooler is generally installed between the heat exchangers and driveline. After the shell assembly is completed, then the drive line base should be located using the evaporator suction connection as a datum point. Accurate base positioning and alignment must be done using leveling reference targets prior to any of the assembly and welding of the piping. Spring isolator installation and adjustment should not be done until all pipe work is complete, tested and the unit charged with water and refrigerant.

If the drive line base is to be installed first, refer to the sections on installing the compressor and drive components first prior to returning to the next section “INSTALLING THE EVAPORATOR”. If a steam condenser is to be mounted below a down discharge turbine, this condenser should be mounted first. Location of steam condenser inlet may fix the drive component positions. In this case the drive line base should be installed prior to locating the evaporator.



***This instruction should be used in conjunction with the General Arrangement, Piping and Wiring drawings issued through the York Regional or District Offices. The purpose of this instruction is to cover details of location and preliminary alignment of major components of the unit. York International recommends the installation of a TITAN™ system be supervised by a York International Service Representative.***



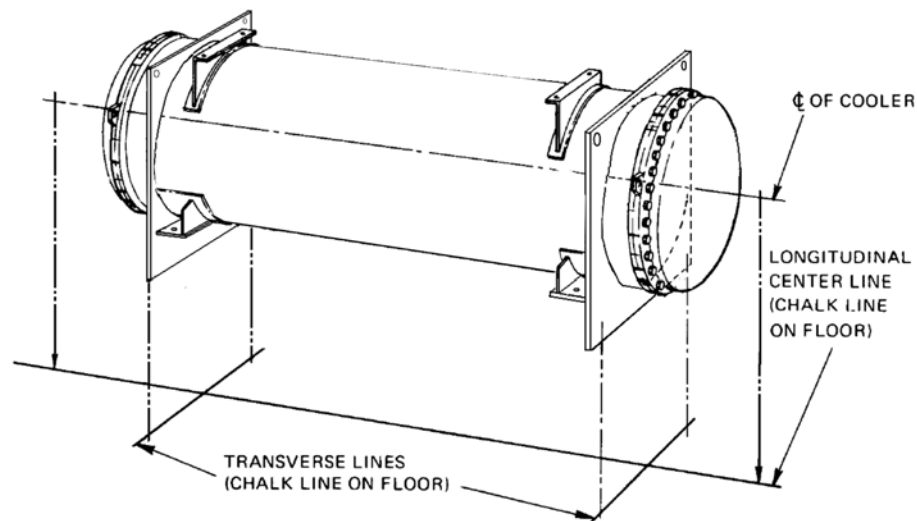
***A level floor, mounting pad or foundation must be provided by others, capable of supporting the operating weight of the unit.***

### INSTALLING THE EVAPORATOR

To install the evaporator, refer to Figures 5 & 6 and proceed as follows:

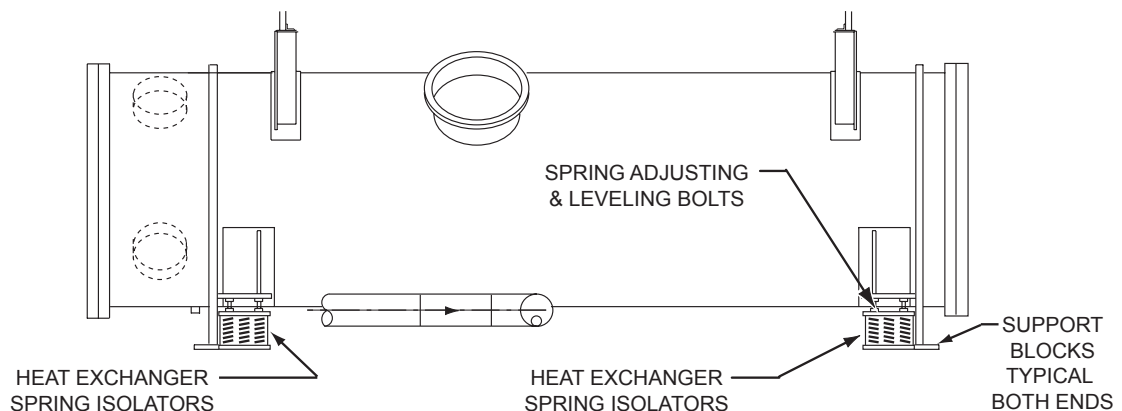
1. Move the evaporator into position near the equipment pad. The large suction connection must be directed towards the spot where the compressor base will be located.
2. Using a chalk line, strike the transverse lines and a longitudinal center line on the surface of the evaporator section of the floor or equipment pad in accordance with Fig. 5. The transverse lines should be located at either the outer edge of the support feet, or at the outer bolt holes if provided. TITAN™ evaporators normally use the tube sheets for support. However, alternate inboard support saddles may be furnished to meet specific job requirements.
3. Place 1” (25 mm) thick steel shim blocks on the transverse chalk lines at locations detailed by construction drawings. The position of the blocks must

- be under the evaporator support (tube sheets or saddle type). The blocks must not interfere with subsequent positioning of the spring isolator mounts.
4. Align the evaporator with the center lines on the floor or equipment pad.
  5. Lower the evaporator onto the shim blocks.
  6. Check the evaporator for elevation relative to construction drawings.
  7. Level the evaporator lengthwise using a precision level on the evaporator cylinder, and crosswise on the tube sheets or support feet. The level tolerance on the evaporator should be in keeping with good workmanship and practices and unless otherwise dictated on drawings may be within  $\frac{1}{4}$ " (7 mm) end to end. Additional shim materials may be required to achieve a level condition.
  8. When the driveline has been mounted first, the evaporator axial position should be ascertained by aligning the shell suction connection with the compressor suction center.
  9. Verify that water nozzle locations meet customer expectations, and verify centerline spacing of the water piping to fixed positions, such as floor penetrations can be made.
  10. Place the spring isolator mountings in the positions shown on the York general arrangement drawing. Make certain that the isolators fit in the brackets provided. Check that the spring capacity corresponds to the requirements shown on the York drawings. The spring adjusting bolt may be turned out to hold the mount in position. But, do not compress the springs at this point. Spring adjustment is done after fabrication, testing and charging of refrigerant and water.



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**FIG. 5 – LOCATING THE EVAPORATOR**

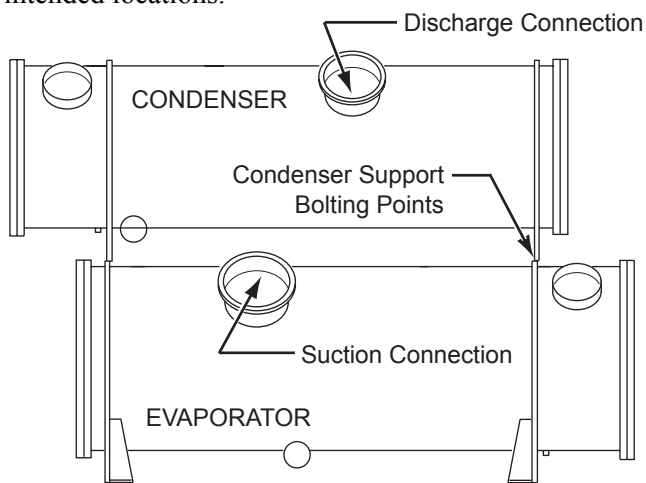


**FIG. 6 – EVAPORATOR LOCATING THE SUPPORT BLOCKS AND ISOLATORS**

LD09048

## INSTALLING THE CONDENSER

After the evaporator has been properly located, the condenser is to be positioned, aligned and bolted onto its supports on top of the evaporator (Refer to Fig. 7). For chillers with equal length heat exchangers, the condenser will stack onto the evaporator tube sheet as shown (Fig. 7). When the condenser is shorter than the evaporator, the condenser tube sheets will be mounted to supports on the evaporator at the necessary position (See Figs. 5 & 6 for this type of condenser support on top of the evaporator). Ensure that the discharge connection points towards the compressor. Verify that water nozzle positions and water piping connections can be mounted to intended locations.



LD09049

FIG. 7 – FRONT VIEW OF SHELL ASSEMBLY

## INSTALLING THE INTERCOOLER

The flash type intercooler is to be installed at the location shown on the General Arrangement drawing. The typical location is between the drive base and heat exchangers beyond the compressor end of the base (See Fig. 3). The TITAN™ standard intercooler is a vertical cylindrical vessel, which has three support feet (Refer to Fig. 8).



***The intercooler may require temporary bracing to prevent accidental tipping during the installation process.***

### INSTALLATION

1. The center of the intercooler should be marked on the floor in relation to the evaporator centerline using dimensions shown on the construction prints. The three

### INTERCOOLER



FIG. 8 –

### INTERCOOLER SUPPORT



FIG. 9 –

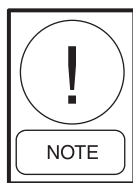
support feet are located equally 120° apart around the vessel at a diameter indicated on the drawings. Mark these locations and position the intercooler. Verify that the intercooler float access port orientation matches the drawing requirements.

2. Place 1" (25 mm) steel shim blocks under the jacking screw locations (Fig. 9) in the support feet and lower the intercooler onto the blocks. The shim blocks must not interfere with positioning of the spring isolator supports or hold down bolts (as applicable).
3. Adjust the jacking screws to plumb the intercooler in both planes, using a precision level along the sides of the vessel cylinder wall.
4. Place the spring isolator mounts in position to verify clearance. The isolator adjusting bolt may be snug fit in position, but do not compress the springs until after all pipe work, testing and charging is complete.
5. If a support bracket to the heat exchanger package is shown on the Construction Drawings, it should be installed now to provide stability.



***The intercooler float valves in the intercooler are wired in place to prevent damage in shipment. While a hoist is available, remove the intercooler access cover and remove the shipping wires. A spare gasket will be provided inside the intercooler access cover.***

## INSTALLING THE COMPRESSOR & DRIVER BASE

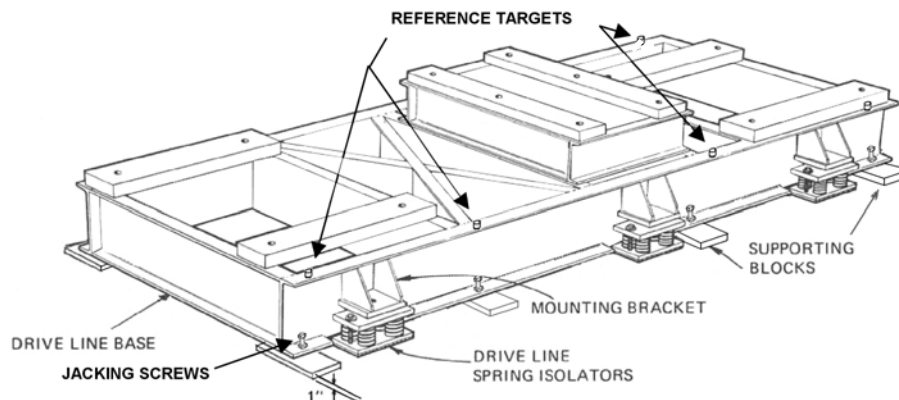


***TITAN™ chillers can be provided with a structural steel drive line base. This allows the compressor and drive components to be factory mounted and rough aligned. It is important that the base placement and adjustment procedures described in the instruction be used to restore the base to the same reference plane as was used during factory alignment. Machined reference targets are provided to assist in this process after placement leveling. The alignment should be checked and adjusted if necessary before installing discharge, suction and interstage piping on the compressor.***

After the evaporator, condenser and intercooler have been properly positioned, the drive line base must be located. The compressor suction connection must be aligned with the connection on the evaporator. Snap chalk lines for high and low speed shafts in relation to the evaporator longitudinal center line (Fig. 5) to ensure that the driveline is mounted parallel to the heat exchangers.

To install the drive line base, refer to Figs. 10 and 11 and proceed as follows:

1. Rig the drive line steel base to its final location on the foundation. Place 1" (25 mm) thick steel shim blocks under the jacking bolt positions.

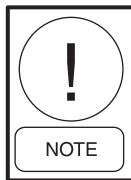


**FIG. 10 – SPRING ISOLATED STEEL BASE**

2. Place the spring isolator mountings, if utilized, in the positions shown on the York certified construction drawings. Make certain the mounts are placed according to capacity requirements at the assigned positions, to withstand the weight at each location. Snug the height adjustment bolt, but do not compress the springs at this time.
3. Clean the surface of the 2" (50 mm) diameter machined target reference points and observe the numbers stamped into the targets. Also clean the sludging compound from the equipment mounting pads if compressor or drive components were not factory mounted.

## STEEL DRIVELINE BASE LEVELING

Chiller mechanical drive train components need an accurate alignment to operate smoothly without undue vibration or wear. General guidelines for a cold misalignment (allowing for thermal growth and mechanical bearing clearance) are detailed in York Form 160.71-N2. Cold misalignment values for new drivelines are calculated by York Engineering, and are shown on the Unit Arrangement drawing. In general 80°F (27°C) is assumed for an ambient on indoor projects. For cold misalignments at other ambient temperatures (more than 15°F (8°C) above or below), contact York factory service or engineering.



***Cold misalignment is to be performed with all components at ambient temperature. Motor/Gear/Compressor heaters should be off for a minimum of 24 hours before misalignment.***

The York factory performs a cold misalignment prior to shipping a driveline base (if factory mounted driver).

It is IMPORTANT that the driveline be restored to the same reference plane by leveling and shimming in the field as was used during factory alignment. Even slight twist or bending of the base can and will result in large changes to the drive line alignment.

TARGETS are provided by the factory on the top surface perimeter of the drive base structure. These targets are steel bar stock which are machined to the same reference plane as the lowest component pad on the base, generally about 2" (50mm) above the main base structure. These target surfaces are machined true at the same plane with the base in its "free state". York assembly personnel then set the base on the floor, with varied shims under the base to keep the targets essentially flat and level. A transit is used to measure the deviation in elevation of the targets after mounting of the components, and the deviation is stamped onto the top surface of the target for future reference. The targets are stamped according to the reading on the Engineering scale story pole, in decimal inch format in increments of 0.06" (half a division on the story pole, which is half a hundredth of a foot). A minus reading indicates a rising trend at the base.

It is important that the steel base be leveled and restored to the same flat plane state in the field as it was during factory rough alignment. The targets must be used for leveling purpose, preferably using a transit to a maximum deviation of 0.12 inches overall and 0.060" target to target. York provides 1" (25mm) shim blocks for placement under vertical jacking screws in the base near the target locations. Raise the base using the jack bolts, starting from the lowest target, until all targets are level. Raise adjacent bolts prior to turning any one screw more than a full turn at a time. It should not be necessary to raise the jack screw associated with the initial high spot target. (Used as the bender mark for leveling)



***Never use the top or bottom of the structural steel as a leveling reference. Only use the machined target pads.***

Field cold alignment must only be checked after proper target leveling is complete. Alignment should be re-checked after all conduit and tubing supports are welded to the base, since welding heat can cause base distortion and change alignment.

Bases which are **bolted** to the foundation: Grouting must be done **AFTER** shimming and leveling the base.

## INSTALLING THE COMPRESSOR ON THE BASE

### (If Compressor Is Shipped Separately)

1. Mark the high speed shaft center on the base using half the distance between predrilled mounting holes. Place the base in position on shims and parallel to the evaporator longitudinal center line.
2. Carefully place the compressor onto the machined mounting pads on the base. Use 1/8" (3mm) nominal shim thickness under each foot.
3. Install the compressor foot bolts for preliminary alignment.
4. Use horizontal jacking screws to move the compressor until each bolt is centered within its hole in the compressor feet. Tighten the horizontal jack screws and locking nuts to limit further compressor movement.
5. Check that the compressor suction connection is axially aligned with the evaporator connection.

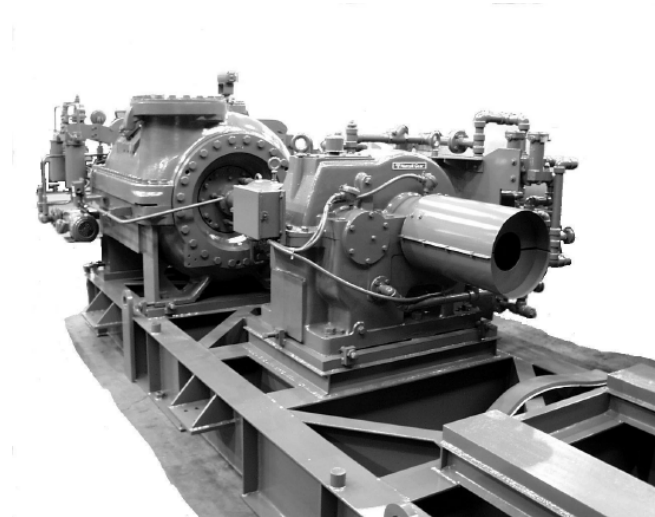


FIG. 11 – COMPRESSOR AND GEAR MOUNTING

## INSTALLING THE SPEED INCREASER

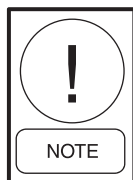
### (If not mounted at the Factory)

If the compressor is to be driven by an electric motor, an external speed increaser gear maybe located between the motor and compressor to produce the required rotational speed. The low speed shaft of the speed increaser is on a common center line with the motor shaft and the high speed shaft is aligned to the compressor shaft.

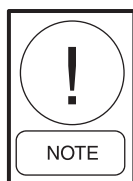
To install the speed increaser, proceed as follows:

1. Set the speed increaser on its machined supports, using shims (1/8" Min., 3/8" Max.) as necessary for leveling and raising the shafts to proper elevation.
2. Be sure to obtain axial clearances between the compressor and pinion gear shafts as shown on the certified Unit Arrangement drawing. Most double helical gears are furnished with an axial float or clearance to allow for thermal expansion. The shaft gap should be checked with the gear in the center of its axial travel or with gears slightly towards the compressor from axial center.
3. Install high speed coupling hubs and perform a rough alignment of the gear. (Refer to "Installation and final alignment of flexible couplings" Form 160.71-N2). Use jacking screws to move the gearbox while performing the alignment.
4. Mark the center points of the gear bolt holes on the base by using the gearbox as a template.
5. Remove the gearbox from the base.
6. Drill and tap holes in the base. Signs for the holddown bolts will be defined on the construction points.
7. Reset gearbox onto the base (repeat steps 1 to 3). Lock the jacking screws in position.
8. Complete assembly of the Yorkflex coupling.

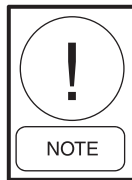
#### **INSTALLING THE LOW SPEED COUPLING (If not mounted at the Factory)**



***Refer to the 160.71-N2 Centrifugal Compressor Drive-Line Coupling Alignment Instruction manual.***



***Refer to the Coupling Manufacture Installation Instructions for additional coupling information.***



***Some larger types of couplings may be provided with dynamic balancing. For multiple TITAN™ chiller installations, check that any serial numbers or match marked sets are installed on the same TITAN™ gear/motor drive train.***



***The drive shaft key must be machined to half height for any portion which extends beyond the coupling hub. Failure to machine the hub can result in higher vibration levels during operation.***

#### **INSTALLING THE ELECTRIC MOTOR (If not mounted at the Factory)**

The electric motor should be mounted after the speed increaser is installed and approximately aligned. Since the motors vary in construction (size and shape) the manufacturer's instructions must be followed for details. The motor must be mounted on its supports and aligned to the low speed shaft of the speed increaser.

1. Locate the motor on its mounting supports using shims (1/8" min (3.2 mm); 3/8" max (9.5 mm)) as necessary for leveling and raising the shaft to its proper elevation relative to the gear input shaft.
2. Obtain the proper axial clearance between the motor shaft and the gear input shaft. Refer to the construction drawings for the shaft gap appropriate to the coupling used. Motors with sleeve bearings will have an axial end play. The axial alignment is to be set with the motor at its magnetic center. This running position may be indicated with a pointer or on a motor nameplate. The magnetic center position may not be the same as the geometric center of axial travel.

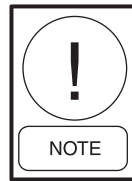
3. Perform a rough alignment of the motor relative to the gear position. (Refer to "Installation and final alignment of flexible couplings" Form 160.71-N2). Use jacking screws to move the motor while performing the alignment
4. Mark the center points of the motor bolt holes on the base by using the motor frame as a template.
5. Remove the motor from the base.
6. Drill and tap mounting holes in the base. Sizes for the hold down bolts will be defined on the construction prints.
7. Reset the motor onto the base (repeat steps 1 to 3). Lock the jacking screws in position.
8. Complete coupling assembly. Install lubricant for gear type couplings. Be sure that the end float bump disc has been installed (if applicable).
9. Mount motor main terminal box and add supports if needed as detailed on York drawings. Check orientation of the box that incoming connections meet with cable routing of the incoming power.
10. Larger size motors often require flood lube oil supply from the gear. Pipe oil supply and drain lines on such motors as detailed by the York drawings.

### **INSTALLING THE STEAM TURBINE (If not mounted at the Factory)**

If the compressor is to be driven by a steam turbine, a speed increaser gear is usually not required. The speed of the turbine is high enough to permit the turbine and compressor to be directly connected through a York flex coupling.

When installing a steam turbine, the manufacturer's instructions and assembly drawings should be carefully followed. To install the steam turbine:

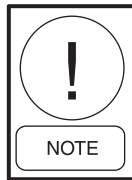
1. Set the steam turbine on its machined supports, using shims as necessary for leveling and raising the shaft to proper elevation. Refer to the Unit Arrangement drawing for cold misalignment values.
2. Be sure to obtain axial clearances between the compressor and steam turbine shafts as shown on the certified Unit Arrangement drawing.
3. Install coupling hubs and perform a rough alignment of the turbine. (Refer to "Installation and final alignment of flexible couplings" Form 160.71-N2). Use jacking screws to move the turbine while performing the alignment.



***Many turbines are provided with sleeve bearing protection inserts for shipment. These must be removed prior to rotating the shaft during alignment procedures.***

4. Mark the center points of the turbine bolt holes on the base by using the turbine frame as a template.
5. Remove the turbine from the base.
6. Drill and tap holes in the base. Sizes for holddown to will be defined on the construction prints
7. Reset steam turbine onto the base (repeat steps 1 to 3). Lock the jacking screws in position.
8. Complete assembly of the Yorkflex coupling
9. Install turbine lube console on the framework. The lube package has normally been prepiped by the turbine vendor using the dimensional locations shown on the turbine prints. It may be necessary to adjust the lube console location and shim the lube tank to fit up the piping between turbine and lube console.
10. Install inlet steam trip and throttle valve and support as detailed by drawings. Larger size trip and throttle valves may be supplied with a spring support which must be installed.
11. Top exhaust turbines will be furnished with a condensate drain tank which must be mounted and piped.
12. Mount and pipe the gland seal condenser if furnished.

### **FINAL ALIGNMENT ASSEMBLY OF DRIVE COUPLINGS**



***Final alignment of drive components must be done by the YORK Start-Up Engineer at time of chiller startup commissioning. Refer also to York Form 160.71-N2 "Instructions - Centrifugal Compressor Drive-line Coupling Alignment".***

## INSTALLING THE MAJOR REFRIGERANT PIPING

Refrigerant piping must be assembled, welded and tested on site to the requirements of the ASME Code for Pressure Piping, Refrigerant Piping B31.5, and all customer defined requirements. This standard defines material requirements, procedures, joints and fit up, welder qualifications and pressure testing of field erected piping. The erecting contractor must have a copy of this standard and comply with the requirements of B31.5 when erecting the chiller.

Refer to the York construction drawings for details on additional York piping requirements and testing.

Piping materials may be supplied in either of two forms (refer to project requirements and drawings).

Non-fabricated piping: Piping materials are provided as loose fittings, flanges and straight lengths of pipe. The materials are provided as typical from a piping supply

house with an internal and external coating. All joint preparations and welds are made on site. After welding, the major piping must be removed from the chiller and blast cleaned to near white metal condition externally and internally. Painting is done after pressure testing.

Partially pre-fabricated piping: Piping materials and fittings are provided from the York factory (Fig. 13). Some sections of pipe are cut and welded to selected fittings as defined on the Unit Arrangement drawing. Field fit up and welding in each plane is still required on each pipe connection. The factory pipe sections are blast cleaned and externally painted (except weld joints). The ends of the pipe are compensated and capped. However, it must be recognized that no amount of preparation will completely prevent the internal surfaces from rusting. Some amount of cleaning the inside should be expected on site prior to field assembly work. No loose rust or scale is permissible, straining in the pores of the metal is acceptable.

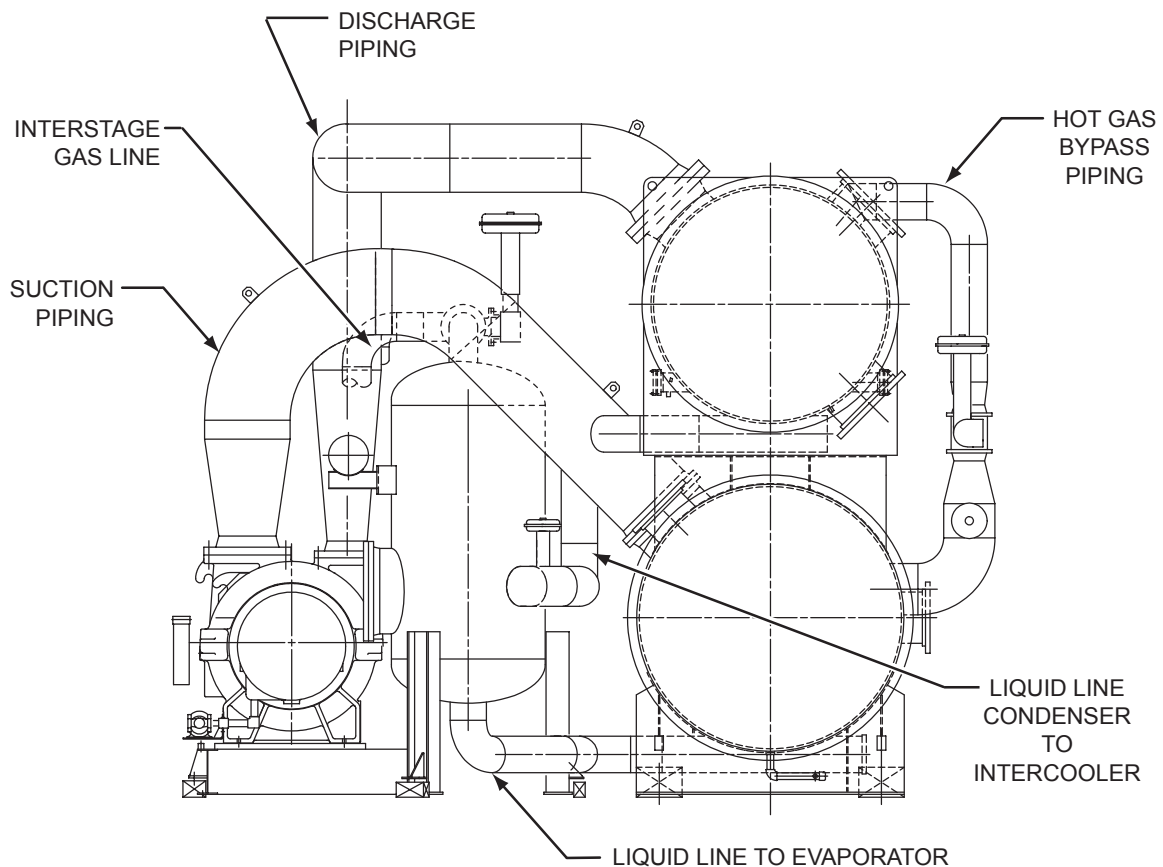
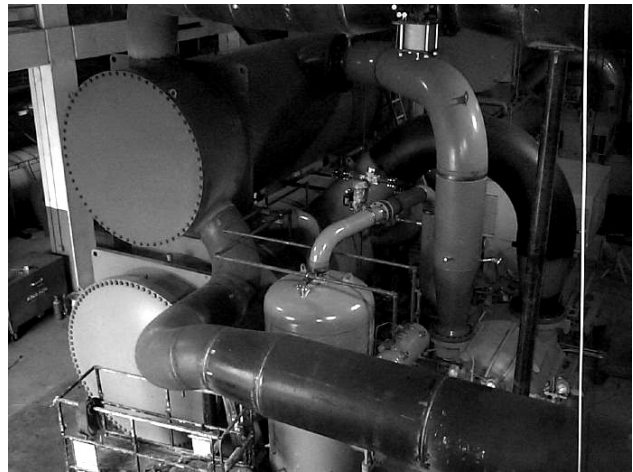


FIG. 12 – MAJOR REFRIGERANT PIPING LINES



**FIG. 13 – PARTIAL PREFABRICATING PIPING**



**FIG. 14 - MAJOR REFRIGERANT PIPING ASSEMBLY**

### **INSTALLING THE ANCILLARY REFRIGERANT PIPING**

Auxiliary refrigerant piping is required for liquid injection, system relief, oil return system and optional purge unit. Refer to the York TITAN™ construction drawings for piping requirements and bills of material. This piping is generally 2" (50 mm) size and smaller. Carbon steel pipe is typical with socket or butt weld joints where possible to minimize leakage potential. Pipe materials are typically provided direct from a piping supply house in straight lengths. Cutting, end preparation, cleaning, testing and painting of this piping is the responsibility

of the erecting contractor. Requirements of ANSI B31.5 also apply to the smaller Refrigerant piping.

### **Liquid Injection Piping**

Install liquid injection piping to the hot gas line and inter-stage gas lines as shown on the construction drawings. See Fig. 15 for a typical example.

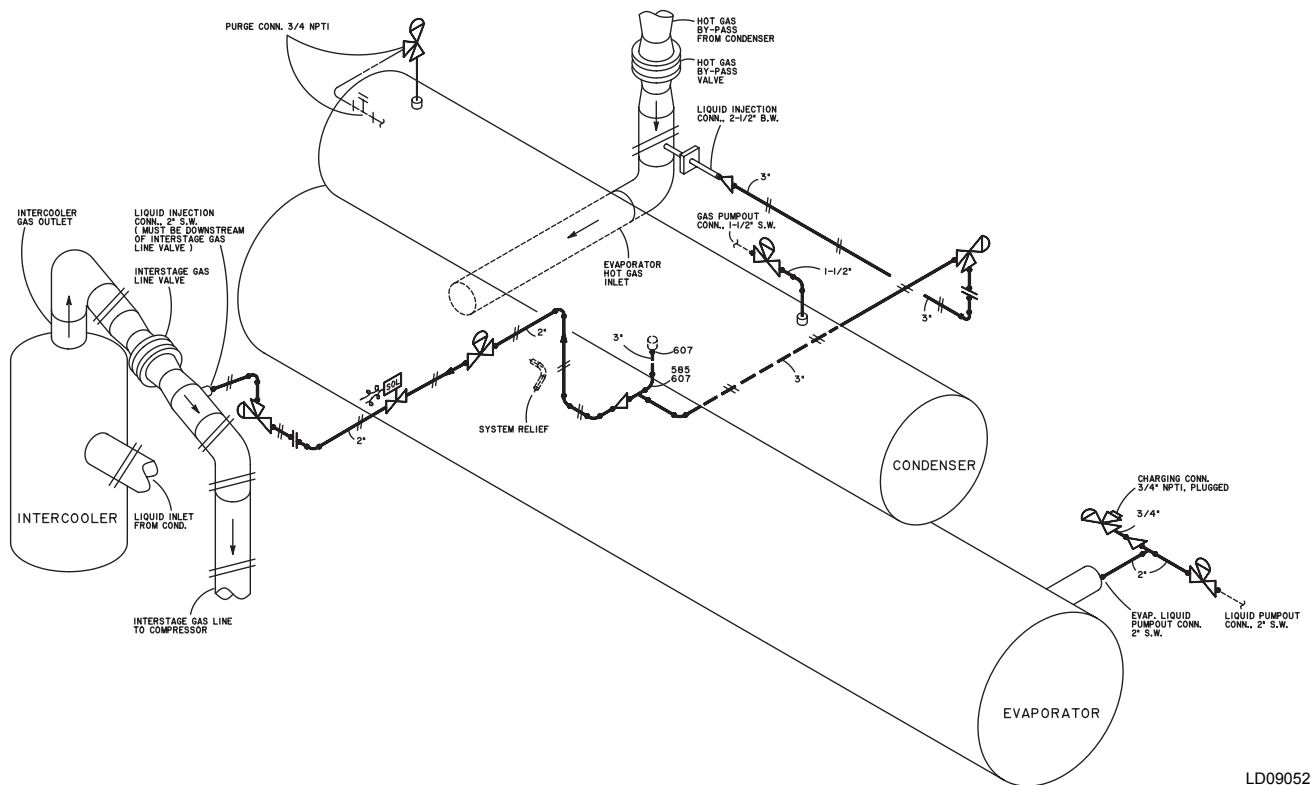


FIG. 15 – LIQUID INJECTION PIPING

### Relief Piping

Install relief piping as shown on construction drawings. See Fig. 16 for a typical example. System relief valves may be single or dual with change over valve. Multiple valves may be required to meet the capacity requirements of the pressure vessels. When the condenser or intercooler may be isolated from the evaporator shell (for instance when a discharge line check valve is furnished), those vessels should be furnished with their own relief devices.



**Relief valves should be vented to a safe location. Relief valve vent line sizing must meet the requirements dictated by ASHRAE standard 15. Use the stamped valve capacity to calculate required line sizes based on vent piping length as dictated by this standard. Vent piping should be supported and furnished with a flexible connection to eliminate any piping loads on the valve outlet connection.**

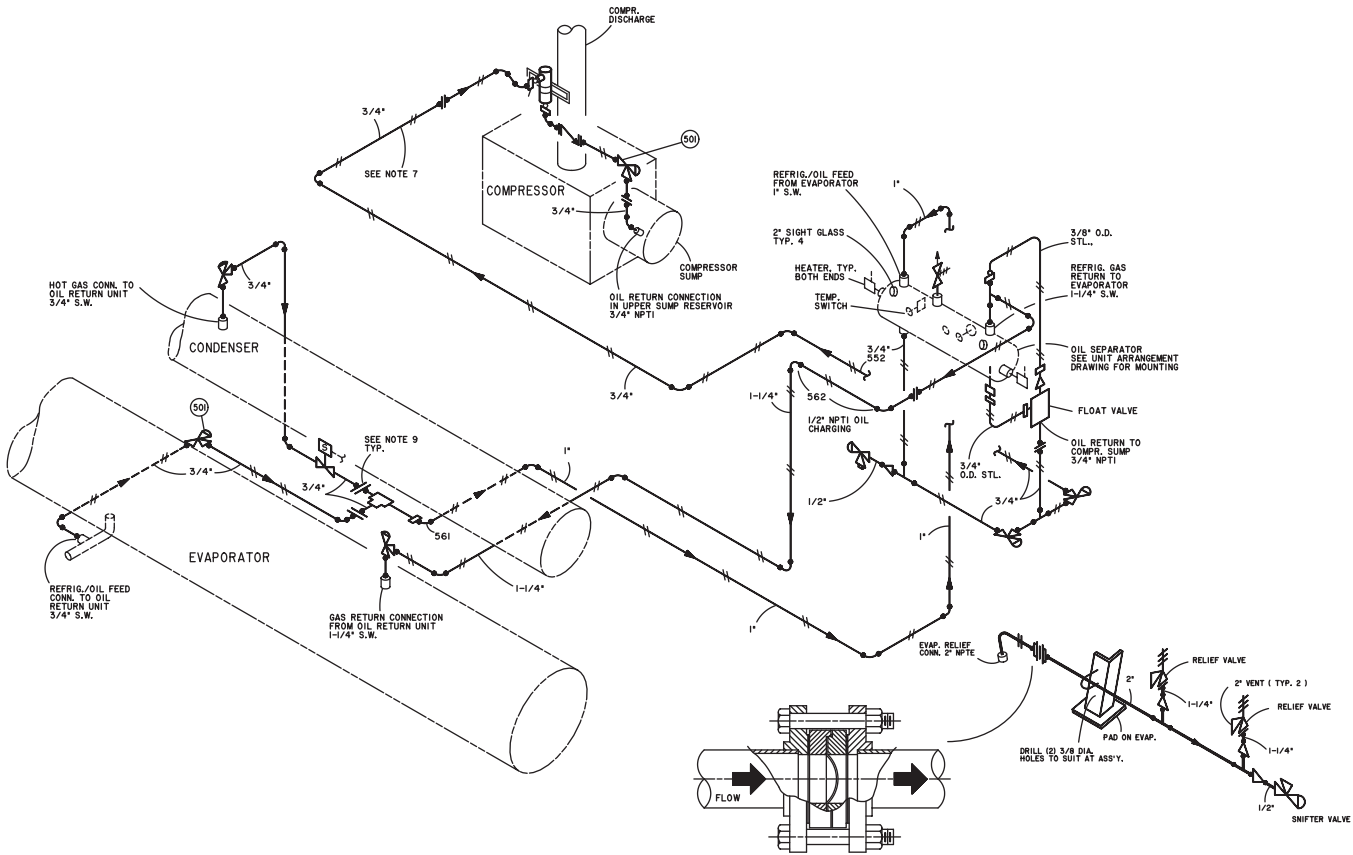


**To prevent premature burst, the rupture disk and relief valves must be removed prior to the chiller piping strength test and leak test procedures, and re-installed at the completion of testing.**

### Installing the Oil Return System (See Fig. 16)

The oil return system consists of an oil separator pressure vessel with electric heaters and temperature control, a jet pump type oil eductor block, a solenoid control valve in the motive gas line, a float operated oil return line metering valve and oil filter. These parts are shipped loose and require field installation as follows:

1. Assemble the oil return unit in the location of the vertical intercooler (or as dictated by York construction drawings). The oil separator drum relies on elevation to return oil to the compressor by gravity. Install heaters, controls, thermometer and other accessories as shown on drawings.
2. Pipe from the evaporator and condenser to the eductor body. Be especially careful that lines to the eductor and solenoid are clean. These have small diameter passages which can easily be plugged by dirt during construction, which would limit their operational effectiveness.



**FIG. 16 – PIPING, OIL RETURN & SYSTEM RELIEF**

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3. Weld the oil return filter drier bracket to the discharge pipe or other suitable structure (do not weld to pressure vessels). Install the filter drier body and pipe to the compressor and oil return unit (separator drum).
4. Install the oil return float valve assembly. Steel tubing and fittings for the small vent line.

the erecting contractor verify flange specifications for sizes above 24" (DN600) where various options exist in the industry.

When making up water piping connections it is important that the pipe is properly supported and braced independently of the chiller, to prevent excessive strain on the nozzles.

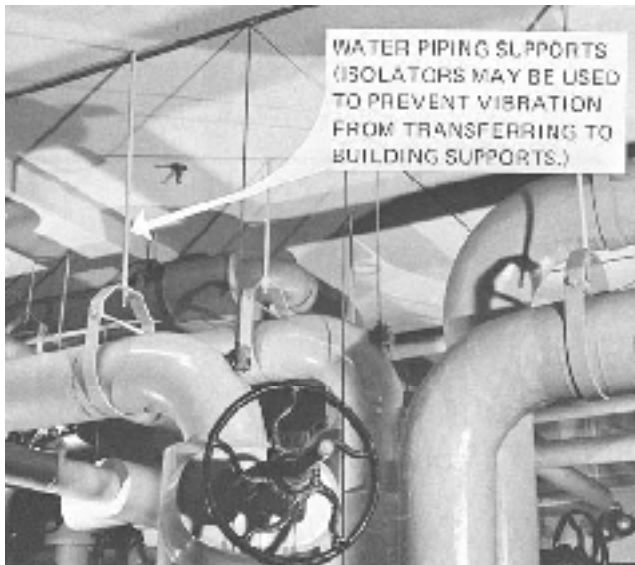
**WATER PIPING  
(Figs. 17 thru 19)**

The water piping connections may be made after the equipment has been installed on the base, leveled, and preliminary alignment has been obtained. The water piping should be connected while the chiller remains set on the 1" (25 mm) shim blocks. Water connections will include but may not be limited to chilled water piping to the evaporator, cooling water connections to the condenser, and cooling water connections to the drive line oil coolers.

For TITAN™ chillers mounted on springs, the water piping connections should use flexible piping connectors. These are necessary as the chillers operating height can change slightly when water or refrigerant are later removed from the chiller for service. Flexible connectors may also reduce vibration transmission from the chiller to the piping system.



***Strainers are to be provided to protect the evaporator and condenser from foreign objects which could block or damage heat exchanger tubes. These strainers may be the same strainers used to protect chilled and cooling water pumps, so long as the pumps are located in close proximity to the inlet of the chiller.***



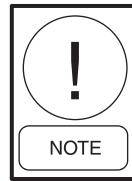
**FIG. 17 – TYPICAL EVAPORATOR - CONDENSER WATER PIPING SUPPORTS**



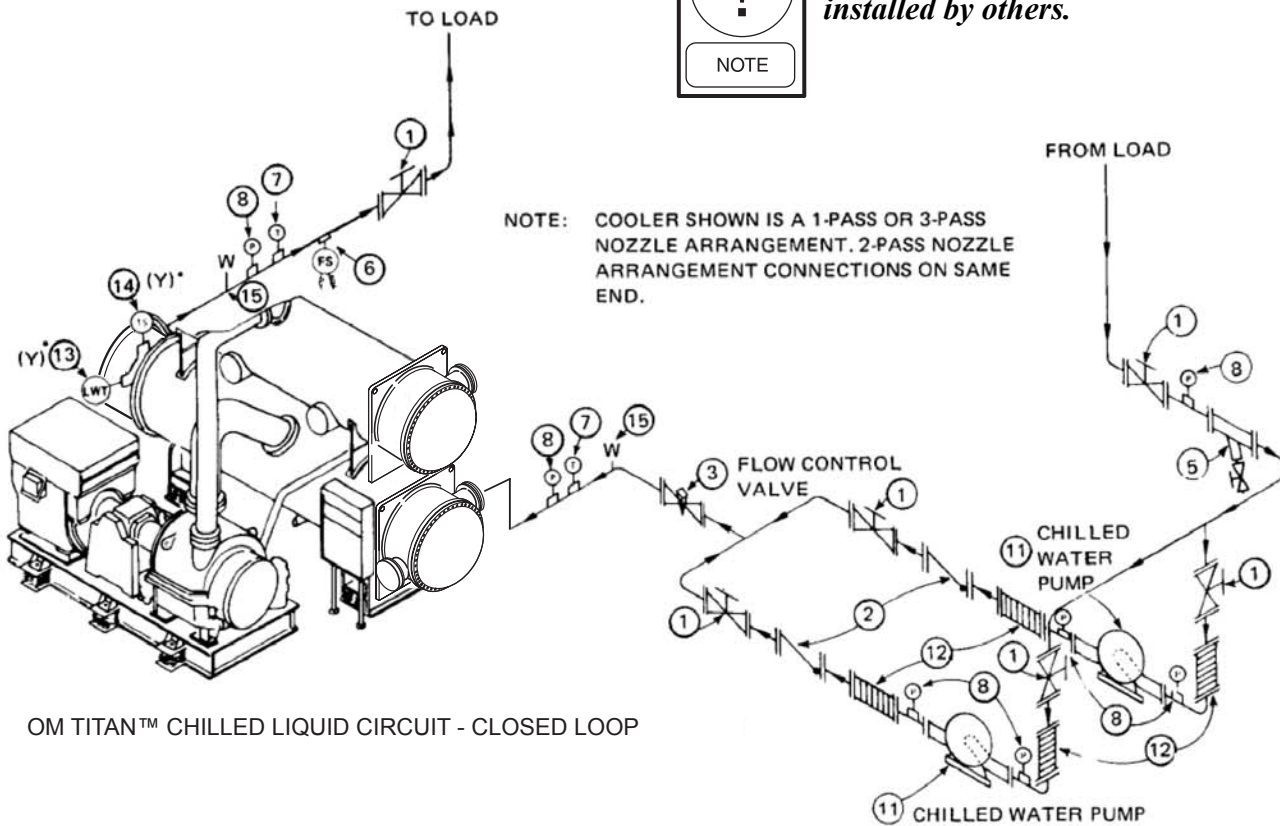
***The chiller heat exchangers should not be subjected to equipment room piping loop pressure tests or flushing procedures. Chemicals within the test water and/or foreign materials flushed into the chiller from the piping system can cause premature corrosion of the chiller heat exchanger tubes within a short period of time, especially if subjected to oxygen. Should the tubes become wet as part of the facility testing process, the tubes should be thoroughly cleaned out and dried with warm air or dry nitrogen immediately until the chillers are ready for commissioning.***

The compressor and gear or steam turbine will usually have water cooled oil coolers. The various oil coolers on the drive line base are connected together for a common cooling water supply and return connection point. When a factory assembled drive train is provided, this header piping is normally factory piped. For field mounted drive components, the oil cooler water piping must be field erected on site by the erecting contractor. The water piping is generally galvanized steel with threaded joints below 3" (75 mm) size and black carbon steel for 3" (75 mm) and larger. Refer to the York construction drawings for details.

The oil cooler water piping supply may be from condenser cooling water, chilled water loop or separate city water supply. Any change from source defined by construction prints must be authorized by York International. The source supply must have sufficient head available to drive the required cooling water flow against the pressure loss across the oil coolers and header piping. Check York construction drawings for pressure drop estimates and design temperatures.



*The Chilled Liquid Circuit Closed Loop materials are supplied and installed by others.*



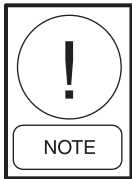
OM TITAN™ CHILLED LIQUID CIRCUIT - CLOSED LOOP

**PIPING SYMBOL LEGEND**

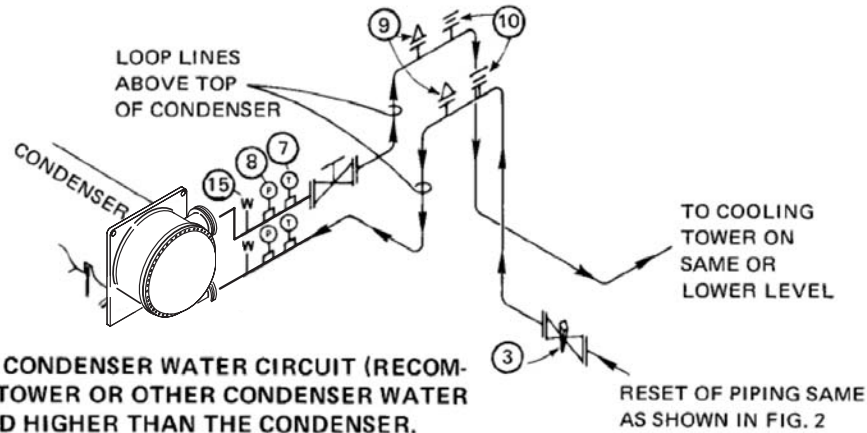
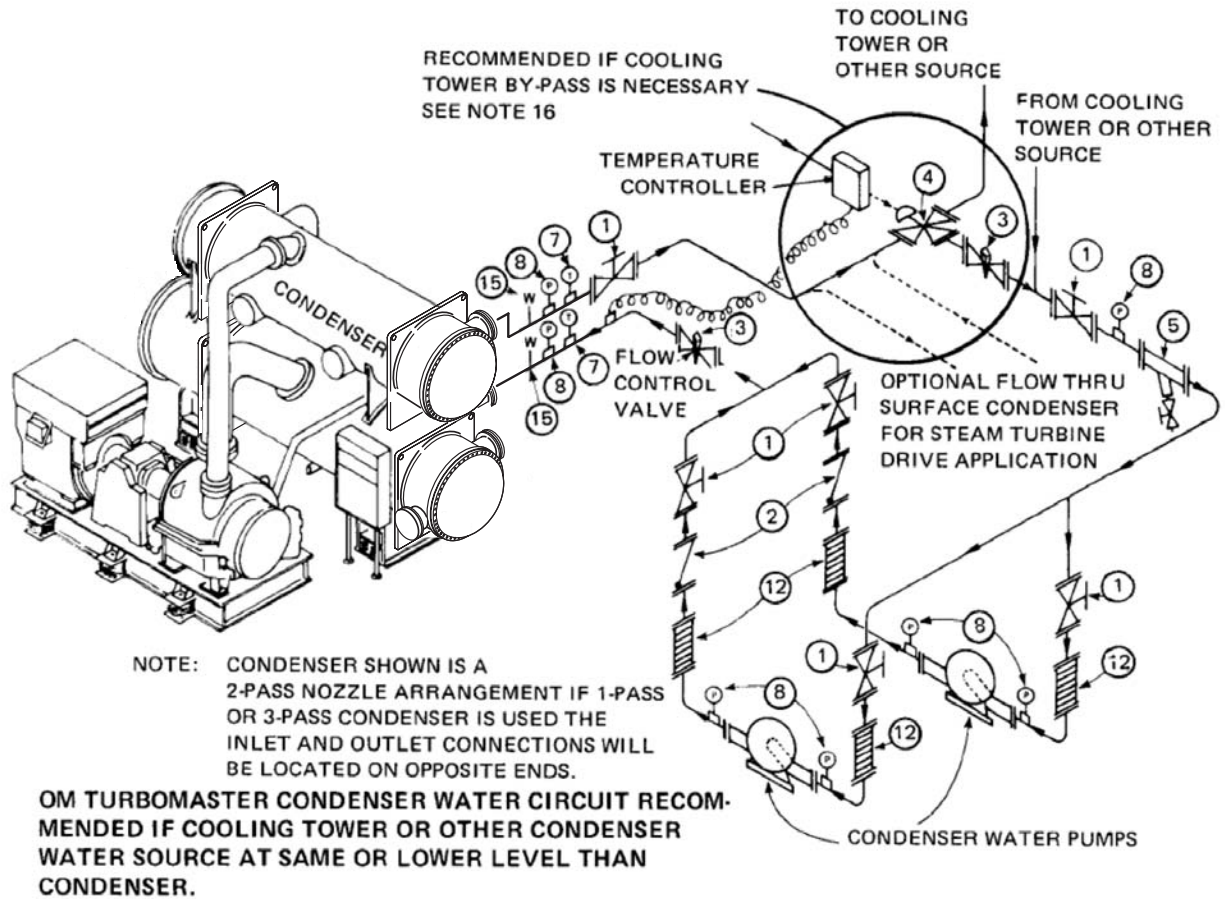
1.		STOP VALVE (FLANGED)	8.		PRESSURE GAUGE
2.		CHECK VALVE (FLANGED)	9.		AIR VENT
3.		SQUARE HEAD PLUG COCK (FLANGED)	10.		VACUUM BREAKER
4.		3 - WAY CONTROL VALVE (FLANGED) PNEUMATICALLY OPERATED OR TANDEM BUTTERFLY VALVES	11.		PUMP (FLANGED)
5.		STRAINER (FLANGED)	12.		FLEXIBLE CONNECTION (FLANGED)
6.		FLOW SWITCH (FS)	13.	<b>LWT*</b>	LOW WATER TEMPERATURE CONTROL
7.		THERMOMETER (DIAL OR INDUSTRIAL)	14.	<b>TS*</b>	TEMPERATURE SENSOR
			15.	<b>W</b>	TEST THERMOMETER WELL
			*	<b>(Y)</b>	FURNISHED BY YORK

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**FIG. 18 – TYPICAL CHILLED WATER CIRCUIT**



**The Typical Condenser Cooling Water Circuit materials are supplied and installed by others.**



**FIG. 19 – TYPICAL CONDENSER COOLING WATER CIRCUIT**

## INSTALLING THE CONTROL CENTER

The chiller control center is typically a free standing electrical enclosure. Most projects are furnished with a microprocessor or PLC (programmable logic controller) type panel with a graphic display. The chiller control panel should be mounted at a readily accessible location near the chiller, often at the compressor end of the unit. If refrigerant /oil impulse lines are used to interconnect to the panel, the panel should be installed within 20 feet (6.3m) of the driveline. Otherwise the panel should be located within view or range an unaided voice may be heard from the driveline. Space must be provided for door swing or access panel clearance to the front and rear of the panel.

Pressure sensors, temperature detectors and other devices provide input to the control center. The control center regulates the compressor pre-rotation vanes, capacity control, liquid and gas control valves, solenoids and other devices located at many points around the chiller. Field wiring is required from the chiller mounted devices to the control center.

Refer to the York construction drawings for control installation requirements. Drawings include a schematic wiring diagram, a field wiring connection diagram, gauge & control piping requirements, and a field mounted sensor bill of material. All tubing and wiring must be properly protected and supported.

A pneumatic air supply is required for operation of the compressor pre-rotation vane motor and the control valve actuators. This 80-100 psig (550-700 kPa) supply air must be filtered instrument quality air dry to a dew point of 32°F (0°C). Dirt or moisture can damage the pneumatic controls.



FIG. 20– TYPICAL CHILLER CONTROL CENTER

## THERMAL INSULATION

Thermal insulation is not required for the operation of the chiller. However, thermal insulation is usually provided on the cold operating surfaces to prevent excessive moisture from forming. The thickness of insulation depends on the operating temperature of the chiller (generally not less than 32°F ( 0°C) for water chillers) and the relative humidity in the equipment room environment. Thermal insulation types and thickness may be defined on the customer specifications. Aluminum jacketing is sometimes specified to protect some types of insulation materials. Provisions in the insulating system must be planned for service access to water box end covers, flanges and valves.

Refer to the York Thermal Insulation drawing provided with the construction drawings for details. Cold operating surfaces generally include the evaporator, mounting feet, and evaporator water boxes, compressor, suction line, bottom half of the intercooler and liquid line, pipe downstream of the hot gas valve, and smaller lines as detailed on the York Thermal Insulation drawing. Additional thermal insulation is required when the TITAN™ chiller is provided with optional free cooling.



***Hot surfaces operating over 120°F (50°C) associated with steam piping must be insulated to protect personnel.***



***Burn hazard.***

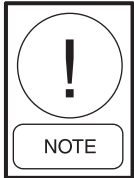
## ACOUSTICAL INSULATION

Acoustical insulation may be desired to meet the chiller sound level requirements of the project. Refer to the contract documents and York construction drawings. Chiller noise is often generated by blade tones in the impeller carried in the discharge gas to the condenser. Application of acoustic treatment to the compressor, condenser and discharge pipe can lower noise generated by the chiller, since these components act as a radiator of sound.

The acoustic treatment recommendations are shown on the York Acoustic Insulation drawing. The insulation most commonly recommended uses a multi-layer material with an inner foam layer to absorb noise, a heavy dampening layer to prevent transmission, and an outer mylar layer to protect the insulation. Other acoustic insulation systems may be used if approved by York. Fiberglass with plastic vapor barrier and a lead lined aluminum sound deadening jacket may be used for outdoor applications or when discharge pipe temperatures exceed 150°F (65°C).

## PUMPOUT (RECOVERY) UNIT

A recovery unit should be provided on site to hold the refrigerant charge of the largest unit when it is necessary to service the TITAN™ chiller. A recovery unit can be piped to multiple TITAN™ chillers located in the same equipment room. Piping consists of a liquid line header and a gas line header from the recovery unit to each chiller. Refer to the York construction drawings for details.

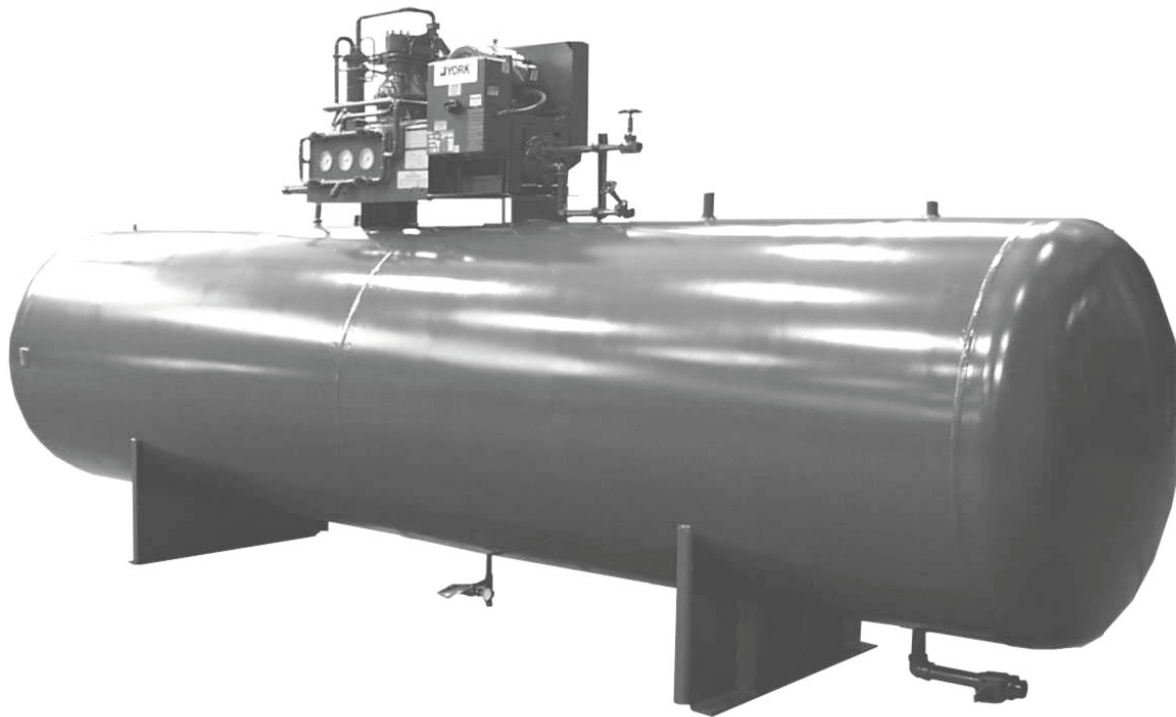


***It is preferable that the recovery unit be located at a level lower than the TITAN™ chillers. This will allow for faster transfer of liquid by gravity assist, in the event that a major leak should require rapid removal of the refrigerant inventory from the chiller.***



***Improper use of the operation of a pump out unit can result in serious damage caused by freezing of water in the tubes. York suggests this procedure only be performed by properly trained technicians or personnel.***

If ordered with a new TITAN™ chiller, York will provide a model RSR transfer unit mounted on a custom sized storage receiver vessel to handle the chiller refrigerant charge. Refer to Form 50.40-OM1 for operation and maintenance details on the York RSR transfer unit.



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**FIG. 21 – PUMPOUT (RECOVERY) UNIT**

