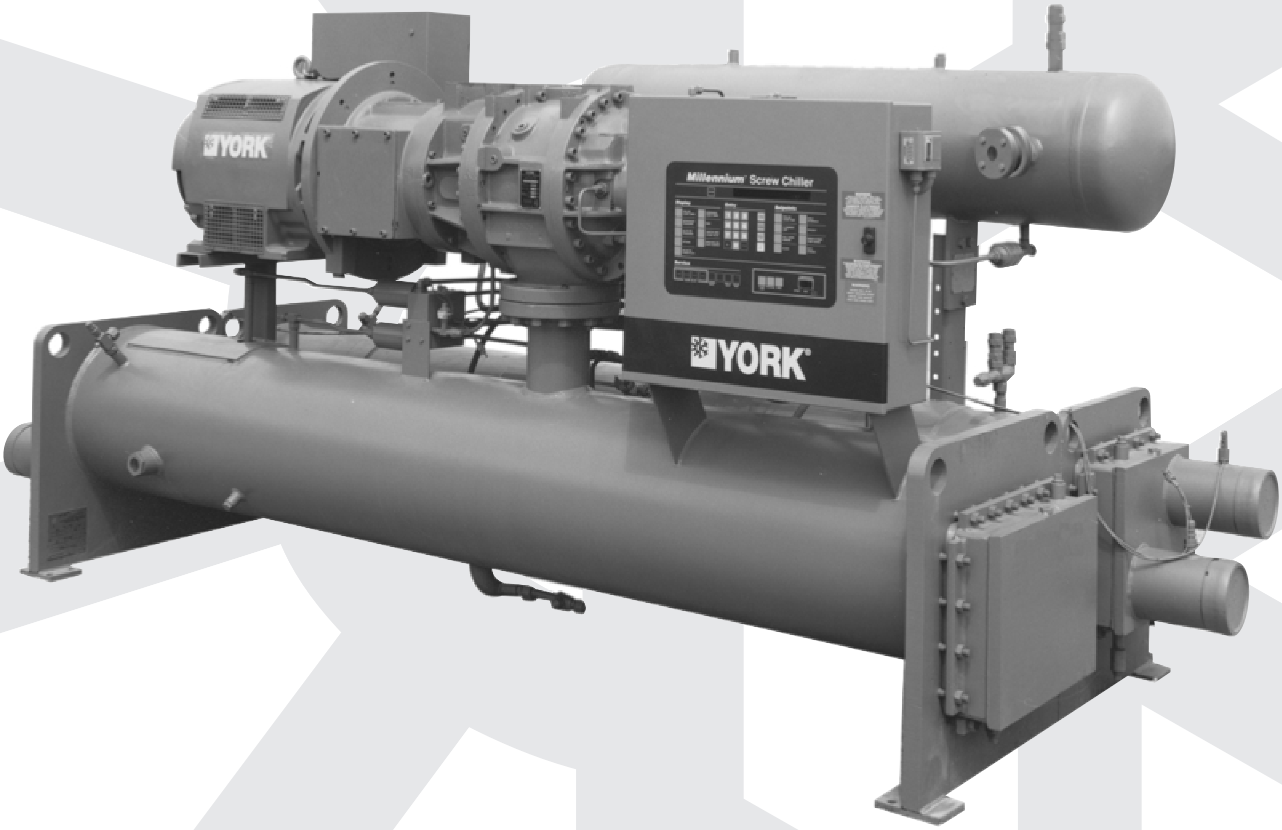
YS

ROTARY SCREW LIQUID CHILLER

INSTALLATION, COMMISSIONING, OPERATION AND MAINTENANCE



STYLE: **D**
REFRIGERANT: **R134a**

CE

Effective from 02/00

YORK®
INTERNATIONAL

GB

Table of Contents

1 SUPPLIER INFORMATION

1.1 Introduction

York YS chillers are manufactured to the highest design and construction standards to ensure high performance, reliability and adaptability to all types of air conditioning installations.

The units are intended for cooling water or glycol solutions and are not suitable for purposes other than those specified in this manual.

This manual and the Control System Operating Instructions contain all the information required for correct installation and commissioning of the unit, together with operating and maintenance instructions. The manuals should be read thoroughly before attempting to operate or service the unit.

All procedures detailed in the manuals, including installation, commissioning and maintenance tasks must only be performed by suitably trained and qualified personnel.

The manufacturer will not be liable for any injury or damage caused by incorrect installation, commissioning, operation or maintenance resulting from a failure to follow the procedures and instructions detailed in the manuals.

1.2 Warranty

York International warrants all equipment and materials against defects in workmanship and materials for one year from initial start-up, or eighteen months from delivery (whichever occurs first) unless extended warranty has been agreed as part of the contract.

The warranty is limited to free replacement and shipping of any faulty part, or sub-assembly which has failed due to poor quality or manufacturing errors. All claims must be supported by evidence that the failure has occurred within the warranty period, and that the unit has been operated within the designed parameters specified.

All warranty claims must specify the unit model, serial number and order number.

The unit warranty will be void if any modification to the unit is carried out without prior written approval from York International.

For warranty purposes, the following conditions must be satisfied:

The initial start of the unit must be carried out by trained personnel from an Authorised York Service Centre.

Only genuine York approved spare parts, oils and refrigerants must be used.

All the scheduled maintenance operations detailed in this manual must be performed at the specified times by suitably trained and qualified personnel.

Failure to satisfy any of these conditions will automatically void the warranty.

1.3 Safety

Standards for Safety

YS chillers are designed and built within an EN ISO 9001 accredited design and manufacturing organisation and, within the limits specified in this manual, are in conformity with the essential health and safety requirements of the following European Union Directives:

Machinery Directive (89/392/EEC)

Low Voltage Directive (73/23/EEC, EN 60204)

EMC Directive (89/336/EEC)

1.4 Responsibility for Safety

Every care has been taken in the design and manufacture of the units to ensure that they meet the safety requirements listed in the previous paragraph. However, the individual operating or working on any machinery is primarily responsible for:

Personal safety, safety of other personnel, and the machinery.

Correct utilisation of the machinery in accordance with the procedures detailed in the manuals.

1.5 About this Manual

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

WARNING

A Warning is given in this document to identify a hazard which could lead to personal injury. Usually an instruction will be given, together with a brief explanation and the possible result of ignoring the instruction.

CAUTION

A **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 and the possible result of ignoring the instruction.

NOTE

A **Note** is used to highlight additional information which may be helpful to you but where there are no special safety implications.

The contents of this manual include suggested best working practices and procedures. These are issued for guidance only, they do not take precedence over the above stated individual responsibility and/or local safety regulations.

1.6 Misuse of Equipment

Suitability for Application

The unit is intended for cooling water or glycol solutions and is not suitable for purposes other than those specified in these instructions. Any use of the equipment other than its intended use, or operation of the equipment contrary to the relevant procedures may result in injury to the operator, or damage to the equipment.

The unit must not be operated outside the design limits specified in this manual.

Structural Support

Structural support of the unit must be provided as indicated in these instructions. Failure to provide proper support may result in injury to the operator, or damage to the equipment.

Mechanical Strength

The unit is not designed to withstand loads or stresses from adjacent equipment, pipework or structures. Additional components must not be mounted on the unit. Any such extraneous loads may cause structural failure and may result in injury to the operator, or damage to the equipment.

General Access

There are a number of areas and features which may be a hazard and potentially cause injury when working with the unit unless suitable safety precautions are taken. It is important to ensure access to the unit is restricted to suitably qualified persons who are familiar with the potential hazards and precautions necessary for safe operation and maintenance of equipment containing high temperatures, pressures and voltages.

Pressure Systems

The unit contains refrigerant vapour and liquid under pressure, release of which can be a danger and cause injury. The user should ensure that care is taken during installation, operation and maintenance to avoid damage to the pressure system. No attempt should be made to gain access to the component parts of the pressure system other than by suitably trained and qualified personnel.

Electrical

The unit must be earthed. No installation or maintenance work should be attempted on electrical equipment without first switching off, isolating and locking-off the power supplies. Work on live equipment must only be carried-out by suitably trained and qualified personnel. No attempt should be made to gain access to inside of the control panel, wiring or other electrical enclosures during normal operation of the unit.

Rotating Parts

Motor air vent guards and drive coupling guards must be fitted at all times and not removed unless the main power supply has been isolated.

Refrigerants and Oils

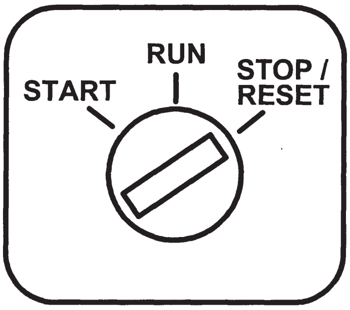
Refrigerants and oils used in the unit are generally non-toxic, non-flammable and non-corrosive, and pose no special safety hazards. Use of gloves and safety glasses are, however, recommended when working on the unit. Build up of refrigerant vapour, from a leak for example, does pose a risk of asphyxiation in confined or enclosed spaces and attention should be given to good ventilation. For more comprehensive information on safety precautions for use of refrigerants and oils, refer to the Materials Safety Data tables provided.

High Temperature and Pressure Cleaning

High temperature and pressure cleaning methods (e.g. steam cleaning) should not be used on any part of the pressure system as this may cause operation of the pressure relief device(s). Detergents and solvents which may cause corrosion should also be avoided.

1.7 Emergency Shutdown

In case of emergency the control panel is fitted with a stop device as shown below. When operated, it removes the 115 Vac supply to the control system. A remote emergency stop device may also be connected to the control system.



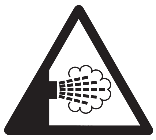
1.8 Safety Labels

The following labels are fixed to each unit to give instruction, or to indicate potential hazards which may exist.

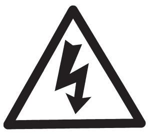
White symbol on blue background
For safe operation, read the Instructions first

Black symbol on yellow background
Warning: This machine may start automatically without prior warning

Black symbol on yellow background
Warning: Hot surface



Black symbol on yellow background
Warning: Safety relief valve may discharge gas or liquid without prior warning



Black symbol on yellow background
Warning: Isolate all electrical sources of supply before opening or removing the cover, as lethal voltages may exist

Black symbol on yellow background
General attention symbol

1.9 Material Safety Data

Refrigerant Data:	
Safety Data	**R134a**
Toxicity	Low.
In contact with skin	Liquid splashes or spray may cause freeze burns. Unlikely to be hazardous by skin absorption. Thaw affected areas with water. Remove contaminated clothing carefully — may adhere to skin in case of freeze burns. Wash affected areas with plenty of warm water. If symptoms occur (irritation or blistering) obtain medical attention.
In contact with eyes	Vapour has no effect. Liquid splashes or spray may cause freeze burns. Immediately irrigate with eyewash solution or clean water for at least 10 minutes. Obtain immediate medical attention.
Ingested	Highly unlikely to occur — but should this occur freeze burn will occur. Do not induce vomiting. Provided patient is conscious, wash mouth with water and give about 250 ml (0.5 pint) to drink. Obtain immediate medical attention.
Inhalation	High atmospheric concentrations may have an anaesthetic effect, including loss of consciousness. Very high exposures may cause an abnormal heart rhythm and prove suddenly fatal.
	At higher concentration there is a danger from asphyxiation due to reduced oxygen content of atmosphere. Remove patient to fresh air, keep warm and at rest. Administer oxygen if necessary. Apply artificial respiration if breathing has ceased or shows signs of failing. In event of cardiac arrest apply external cardiac massage. Obtain immediate medical attention.
Further medical advice	Symptomatic and supportive therapy is indicated. Cardiac sensitisation has been described which may, in the presence of circulating catecholamines such as adrenalin, give rise to cardiac arrhythmia's and subsequent arrest following exposure to high concentrations.
Long term exposure	A lifetime inhalation study in rats has shown that exposure to 50,000 ppm resulted in benign tumours of the testis. This is not considered to be of relevance to humans exposed to concentrations at or below the occupational exposure limit.
Occupational exposure limits	Recommended limit: 1000 ppm v/v - 8 hr TWA.
Stability	Not specified.
Conditions to avoid	Use in presence of naked flames, red hot surfaces and high moisture levels.
Hazardous reactions	May react violently with sodium, potassium, barium and other alkali and alkaline earth metals. Incompatible materials: Magnesium and alloys containing more then 2% magnesium.
Hazardous decomposition products	Halogen acids by thermal decomposition and hydrolysis.
General precautions	Avoid inhalation of high concentrations of vapours. Atmospheric concentrations should be minimised and kept as low as reasonably practicable below the occupational exposure limit. The vapour is heavier than air and collects at low level and in confined areas. Ventilate by extraction at lowest levels.
Respiratory protection	Where doubt exists on atmospheric concentration, approved breathing apparatus should be worn. This should be self contained or of the long breather type.
Storage	Keep containers dry and in a cool place away from fire risk, direct sunlight, and all sources of heat such as radiators. Keep at temperatures not exceeding 45 °C.
Protective clothing	Wear overalls, impervious gloves and goggles/face protection.

Spill/leak procedure	Ensure suitable personal protective clothing and respiratory protection is worn. Provided it is safe to do so, isolate the source of the leak. Allow small spillage's to evaporate provided there is suitable ventilation. Large spillage's: Ventilate area. Contain spillage's with sand, earth or any suitable absorbent material. Prevent liquid from entering drains, sewers, basements and work pits since vapour may create a suffocating atmosphere.
Disposal	Best to recover and recycle. If this is not possible, destruction is to be in an approved facility which is equipped to absorb and neutralise acids and other toxic processing products.
Fire extinguishing data	Non-flammable at atmospheric conditions.
Containers	Fire exposed containers should be kept cool with water sprays. Containers may burst if overheated.
Fire fighting protective equipment	Self contained breathing apparatus and protective clothing must be worn in fire conditions.

Refrigerant Oil Data	
Safety Data	**York "H" Oil**
Classification	Non-hazardous
In contact with skin	Minimally irritating. No first aid necessary. Exercise reasonable personal cleanliness including cleansing exposed skin areas several times daily with soap and water. Launder soiled work clothes at least weekly.
In contact with eyes	Flush eyes with eyewash solution or clean water for 15 minutes and consult a physician.
Ingested	May cause nausea and diahorrhea. Obtain immediate medical attention.
Inhalation	If oil mist is inhaled, remove to fresh air and consult a physician.
Occupational exposure limits	Not determined.
Stability	Stable but hygroscopic - store in sealed containers.
Conditions to avoid	Strong oxidisers, caustic or acid solutions, excessive heat. May degrade some paints and rubber materials.
Hazardous decomposition	Not fully, Analogous compounds evolve carbon monoxide, carbon dioxide and other unidentified fragments when burned. Burning may evolve irritating/noxious fumes.
Respiratory protection	Use in well ventilated areas - ventilate locally.
Protective clothing	Goggles or face shield should be worn. Gloves not necessary, but recommended, especially for prolonged exposure.
Spill / Leak procedure	Wear suitable protective equipment. Especially goggles. Stop source of spill. Use absorbent materials to soak up fluid (i.e. sand, sawdust and commercially available materials).
Disposal	Incinerate the oil and all associated wastes in an approved facility in accordance with local laws and regulations governing oily wastes.
Fire extinguishing data	Flash point over 300°C. Use dry chemical, carbon dioxide or foam. Spraying water on hot or burning liquid may cause frothing or splashing.
	If a leak or spill has not ignited use water spray to disperse the vapours and to provided protection for persons attempting to stop the leak.
Containers	Fire exposed containers should be kept cool with water sprays.
Fire fighting protective equipment	Self contained breathing apparatus should be worn in fire conditions.

Thermal & Acoustic Materials Data	
Health Hazard & First Aid	Toxicity Index <10 to NES713 Issue 3 (1991): Non-hazardous, non-toxic. No first aid necessary.
Stability / Reactivity	Stable.
Handling / Use / Disposal	No special handling precautions required. Dispose of according to local laws and regulations governing non-biodegradable non-hazardous solid wastes.
Fire & Explosion	Flammability rating Class 1 to BS 476 pt 7: Non-flammable. If forced to burn, combustion products are typically over 95% carbon dioxide and carbon monoxide.

2 Product Description

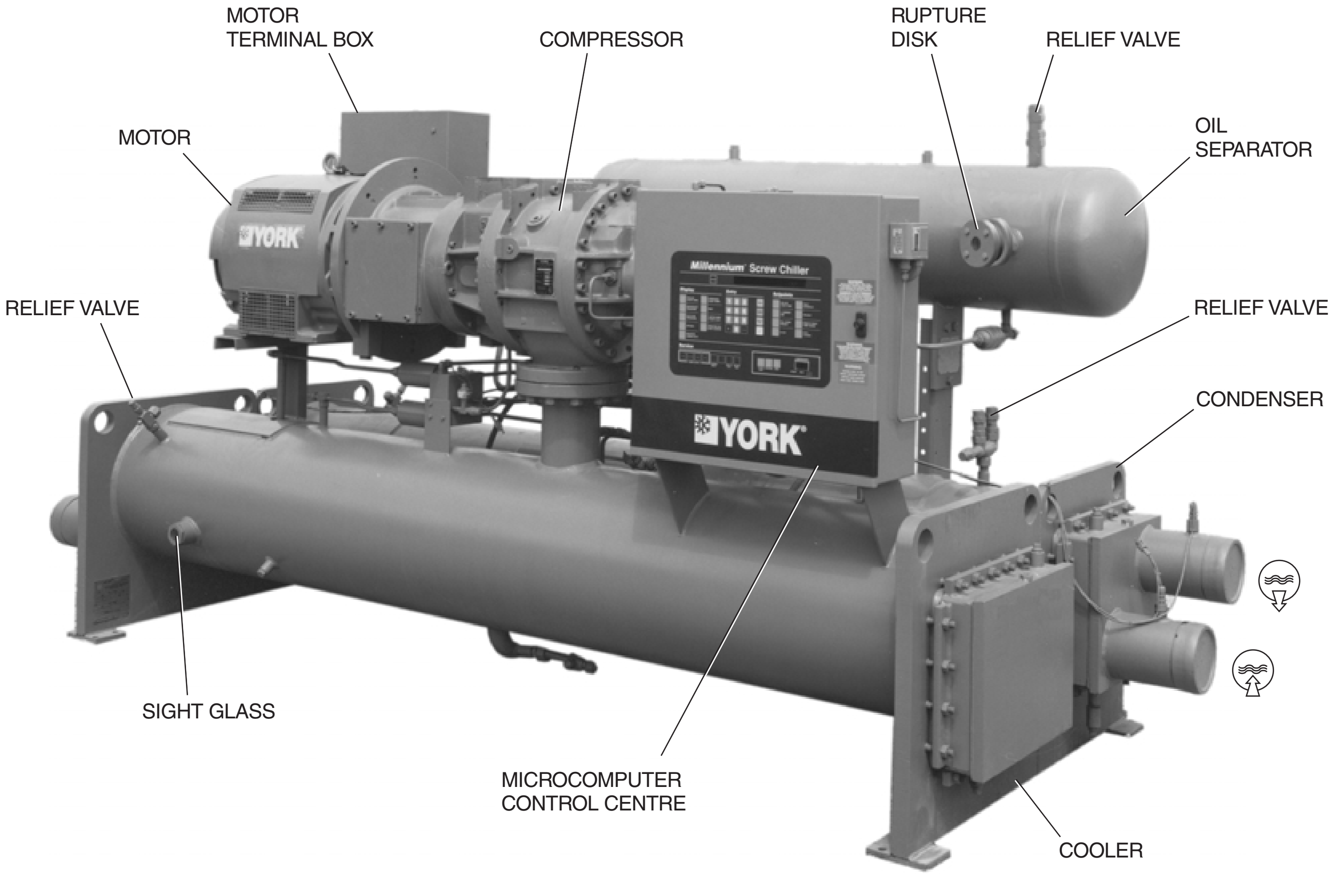


Figure 2.1 YS Rotary Screw Liquid Chiller (Front View)

2.1 General (Figures 2.1 and 2.2)

The York YS *Millennium*™ Rotary Screw Liquid Chiller is primarily used for large air conditioning systems, but may be used on other applications. Each unit is completely factory-packaged including compressor, evaporator, condenser, subcooler, oil separator, lubrication system, isolation valves, drive motor, optional motor starter and control centre.

Units are shipped as standard with a full charge of refrigerant and oil. Units can also be shipped in sections (optional) to accommodate job site requirements. An optional shipping skid is also available for ease of handling.

Exterior surfaces are protected with one coat of Caribbean blue machinery paint.

2.2 Compressor

The rotary screw compressor uses state-of- the-art technology to provide the most reliable and energy efficient compressor available at all operating conditions. The compressor is a positive displacement, variable volume, direct drive, twin helical rotary screw compressor. The male rotor is a direct drive by the motor; the female rotor is an idler that is driven by the male rotor. The rotors do not touch each other or the compressor housing. The rotors are separated by a hydraulic oil seal, which prevents high pressure gas from leaking into low pressure areas.

The compressor housing is made of cast iron, precision machined to provide minimal clearance for the rotors. The housing has a design working pressure (DWP) of 24.1 bar and is hydro-tested at 37.5 bar.

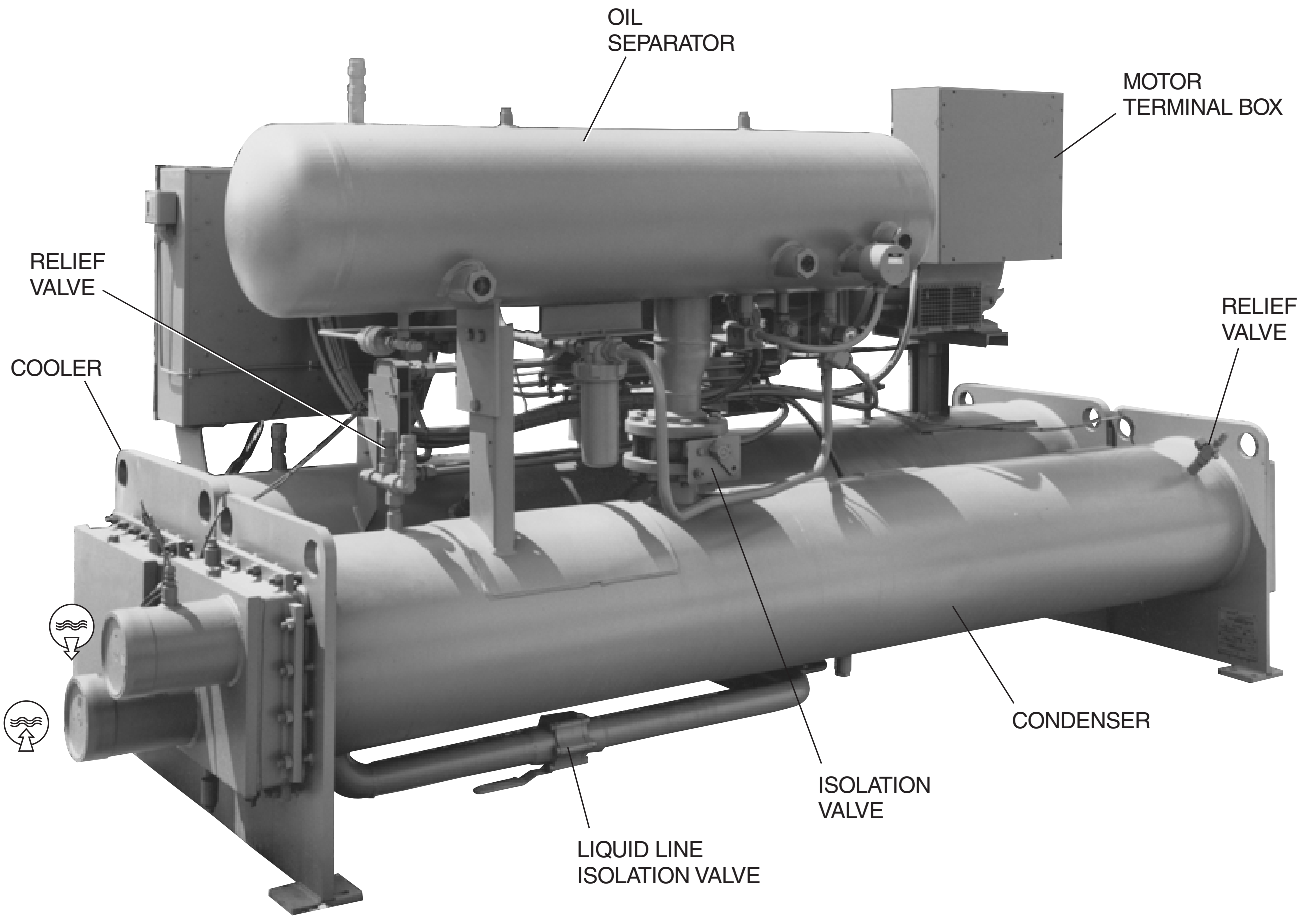


Figure 2.2 YS Centrifugal Liquid Chiller (Rear View)

The rotors are manufactured from forged steel and use asymmetric profiles. The compressor incorporates a complete anti-friction bearing design for reduced power and increased reliability. Four separate cylindrical roller bearings handle radial loads. Two 4-point angular contact ball bearings handle axial loads. Together they maintain accurate rotor positioning at all pressure ratios thereby minimising blow-by and maintaining efficiency.

Oil is injected into the compressor by differential pressure to lubricate the bearings, seal the rotors and remove the heat of compression. The injected oil mixes with the compressed gas and is separated from the refrigerant gas in the oil separator.

The compressor has an oil reservoir located at the rotor bearings to provide lubrication during start-up and during coast-down even in the event of a power failure.

A check valve is installed in the compressor discharge housing (suction housing for S4 and S5 compressors) to prevent reverse running of the rotors due to system refrigerant pressure gradients during shutdown.

The open-drive compressor shaft seal consists of a spring-loaded, precision carbon ring, high temperature elastomer "0" ring static seal, and stress-relieved, precision lapped collars. The entire shaft seal cavity is at low pressure, being vented to the oil drain from the compressor, combining low pressure with direct oil cooling for long seal life.

Capacity control is achieved by use of a slide valve providing fully modulating capacity control from 10% to 100% of full load. The slide valve is positioned between the male and female rotors and moves axially to match the compressor capacity to that of the evaporator refrigeration load. As the slide valve moves toward the unloaded position, less suction gas is pumped through the compressor.

The slide valve is actuated by oil pressure controlled by external solenoid valves via the control centre. When the compressor is shut off, a spring returns the slide valve to unloaded position to ensure that the compressor starts with the slide valve in the unloaded position.

2.3 Motor

The compressor motor is an open drip-proof, squirrel cage induction type. The motor has a D-flange and cast iron adaptor mounted rigidly to the compressor for accurate alignment of motor and compressor shafts.

The motor drive shaft is connected to the compressor shaft with a flexible disc coupling. Coupling has all metal construction with no wearing parts to assure long life, and no lubrication requirements to provide low maintenance.

On units supplied without the optional solid state starter, for use with a remote electromechanical starter, a large steel motor terminal box with gasketed front access cover is provided for field connected conduit. Six terminals are provided in the terminal box, two for each motor winding, allowing connection for star-delta (S/D) or direct-on-line (DOL) starting. Jumpers are provided for direct-on-line connection. Motor terminal lugs are not provided. Overload/over-current transformers are fitted as standard.

2.4 Oil Separator

The oil separator removes the oil that was injected into the compressor. The separator is a horizontal three stage design without moving parts.

In the first stage of oil separation, high velocity oil and refrigerant gas in the compressor discharge line under goes a rapid reduction in velocity as it enters the large diameter oil separator. Most of the oil drops out of the refrigerant gas stream due to the reduction in velocity. The oil falls by gravity into the oil reservoir located in the bottom of the oil separator.

The second stage of oil separation is accomplished by directing the refrigerant gas through mesh pads that have an extended surface area. Smaller liquid oil droplets are collected on the extended surface area of the wire mesh pads where the oil falls by gravity into the oil reservoir.

The third and final stage of oil separation is achieved in the oil coalescing element section of the oil separator. The oil mixed with the refrigerant entering the coalescer element is a very fine aerosol mist. These small aerosol mist particles wet the coalescer element media and form larger oil droplets which fall by gravity to the bottom of the coalescer element section. The oil collected in the coalescer section is drained from the oil separator with a small amount of refrigerant gas. This provides the high pressure “gas drive” for the eductors to return oil from the evaporator.

The oil separator has a design working pressure (DWP) of 20.6 bar. The separator is fitted with a single or dual pressure relief device (depending on safety code requirements) set at 20 bar.

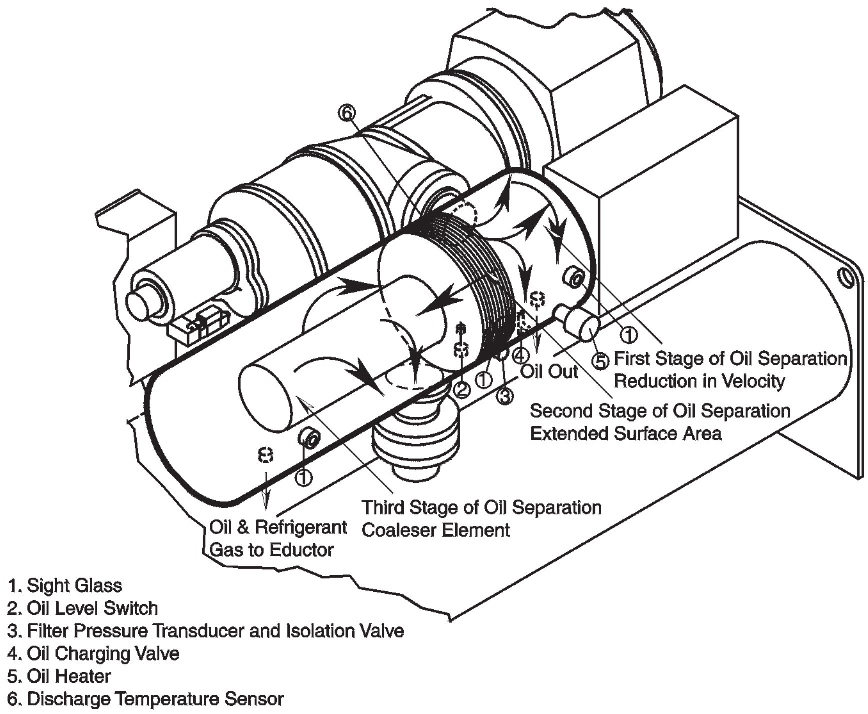


Figure 2.3 Oil Seperator

Three sight glasses are provided in the oil separator for monitoring the oil level and verifying performance of the coalescer element. Liquid oil should be visible in the top glass of the oil separator when the chiller is off. During operation, oil may be higher or lower due to system load and operating conditions.

A low oil level safety switch is provided in the bottom of the oil separator. A safety shutdown will be initiated if the oil level is below the switch setting for a 30 second period after the chiller has been running for 3 minutes.

An oil drain and charging valve is located on the bottom of the oil separator. A 5/8 inch male flare connection is provided for draining and charging. Oil can be added into the oil reservoir with the chiller in service.

A temperature actuated 500 W (115 Vac-1 Ø-50 Hz) immersion oil heater is located in the oil separator reservoir to effectively remove refrigerant from the oil. Power wiring is provided to the control centre.

2.5 Oil Filter

The oil flows from the oil separator through the 3 micron oil filter. Filtered oil then flows to the oil manifold that is located at compressor port SB-2.

A dual oil filter housing with isolation valves is standard on all units. This allows switching between filters and changing of the off line filter during operation. Units are fitted as standard with two 3 micron absolute oil filters for extended compressor life.

2.6 Lubrication

An oil pressure transducer is located at the SB-2 manifold. The differential pressure is measured as the difference between the oil pressure transducer at SB-2 and the filter pressure transducer located in the oil separator.

This value is compared to the limits in the control panel logic. If the oil filter differential reaches 20 PSID, a warning message is displayed on the control panel, at 25 PSID, a safety shutdown is initiated.

Oil flows from the oil manifold at SB-2 to the plate type, refrigerant cooled, oil cooler. Cool oil leaving the plate heat exchanger flows to the eductor block manifold. The eductor block manifold oil circuit contains the seal oil pressure transducer and a high oil temperature safety sensor. The differential pressure between the seal oil pressure and the evaporator pressure transducer is calculated and compared by the control panel. If the differential reaches 20 PSID the control panel will initiate a safety shutdown. A high oil temperature safety shutdown will be initiated at 77°C.

The oil leaving the oil eductor manifold block flows into the compressor at compressor port SB-3 to lubricate the compressor bearings and shaft seal. The oil injected into the compressor mixes with refrigerant gas during compression. The oil and refrigerant gas is discharged into the oil separator, where it is separated and returned to the oil sump. A high discharge temperature safety is located in the discharge line, between the compressor and oil separator. This safety will initiate a safety shutdown at 99°C.

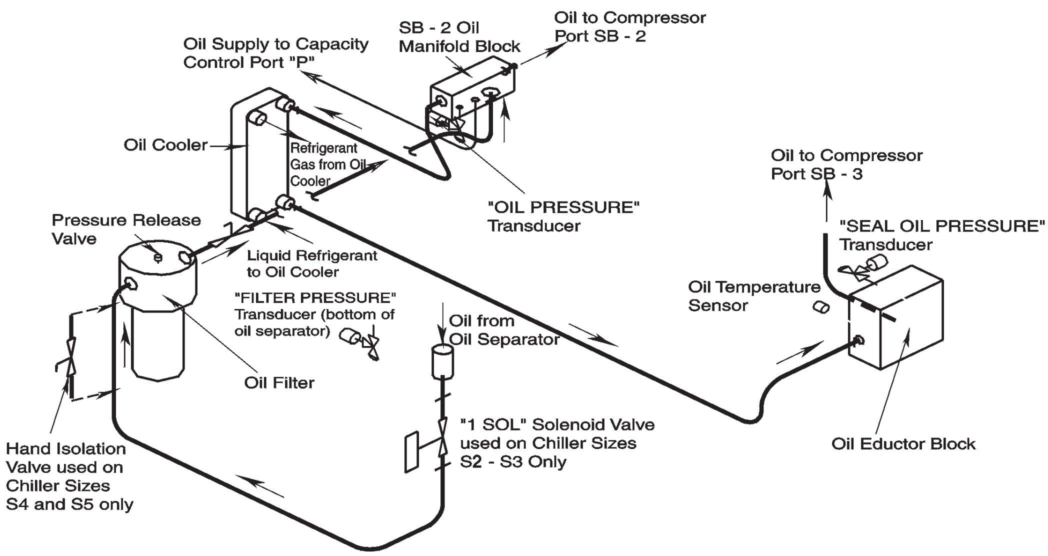


Figure 2.4 Oil Piping

An oil supply line from the manifold at SB-2 is piped to the capacity control directional valve at Port P. The 4-way capacity control solenoid (directional) valve directs oil pressure against one side or the other of the slide valve piston. The opposite side of the slide valve is relieved to suction pressure at compressor port SC-11. The differential pressure between the P port and the suction pressure (Port SC-11) loads or unloads the slide valve to provide capacity control.

2.7 Oil Eductor

Oil eductors are fitted to automatically recover any oil that may migrate to the evaporator and return it to the compressor. The oil eductor circuit manages the amount of oil in the refrigerant charge. A small amount of oil is normal in the refrigerant charge and will be found in the evaporator. If not properly managed the oil will accumulate and have an adverse affect on unit performance.

The oil eductor circuit consists of three refrigerant and oil filter driers, two “jet pump” eductors and the interconnecting piping.

The eductors operate using the “jet pump” principle. Discharge pressure gas and oil flows through a filter dryer located at the bottom of the oil separator to a regulating orifice and nozzle located in the eductor block. The reduced pressure (pumping action) is created by the velocity of the discharge pressure gas and oil flowing through the orifice and nozzle. This creates a reduced pressure area that allows the oil-rich refrigerant and oil to flow from the evaporator into the compressor.

Oil-rich refrigerant flows into the eductor block through the filter drier from the evaporator. The oil rich refrigerant mixes with the discharge pressure gas and flows into the compressor suction line.

A second eductor flows oil, collected in the evaporator trough through the second filter drier located on the eductor block. This oil mixes with the discharge gas in the eductor block and flows to the compressor at port SC-5.

2.8 Heat Exchangers

Shells

Evaporator and condenser shells are fabricated from rolled carbon steel plates and have fusion welded seams. Carbon steel tube sheets, drilled to accommodate the tubes, are welded to the ends of each shell. Intermediate tube supports are fabricated of 12.7 mm thick carbon steel plates, no more than 1220 mm apart. The refrigerant side of each shell has a design working pressure of 20.6 bar and is tested at 31.0 bar. Each vessel has a single or dual refrigerant relief device set at 20.6 bar.

Tubes

Heat exchanger tubes are each 19 mm OD, 0.71 mm wall copper alloy with a high efficiency, internally and externally enhanced design to provide optimum performance. Each tube is roller expanded into the tube sheets to provide a leak-proof seal. Each tube is individually replaceable.

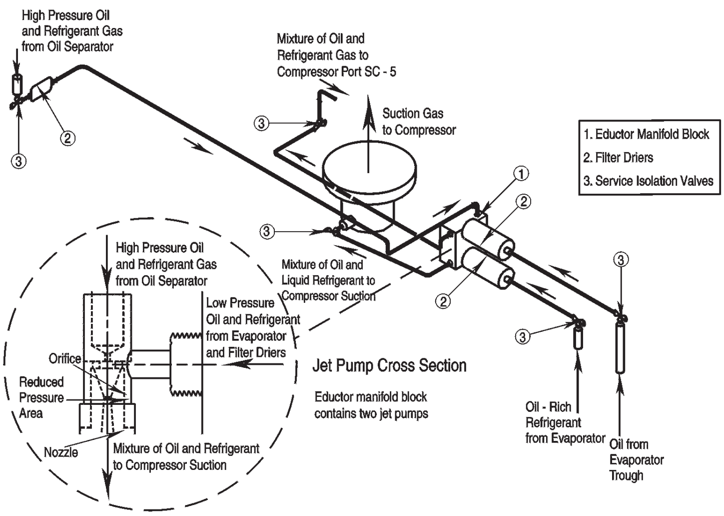


Figure 2.5 Oil Eductor

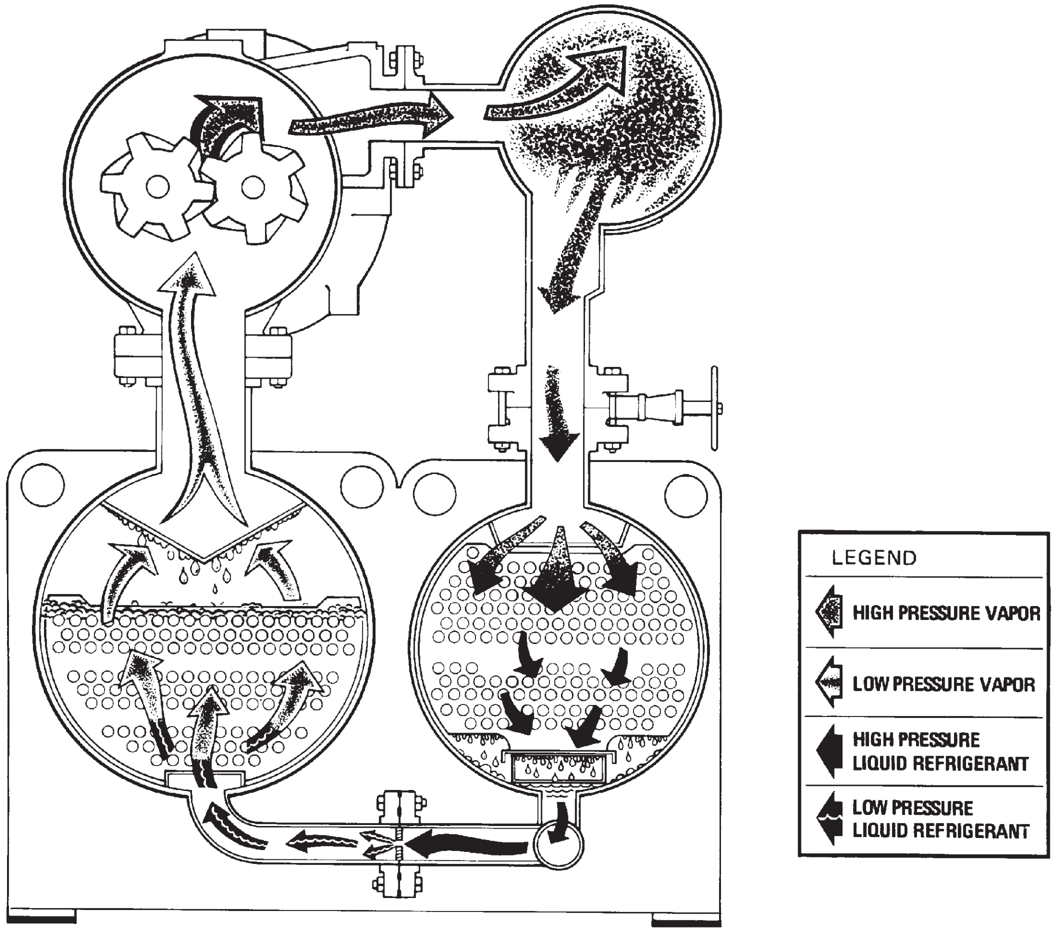


Figure 2.6 Refrigerant Flow Diagram

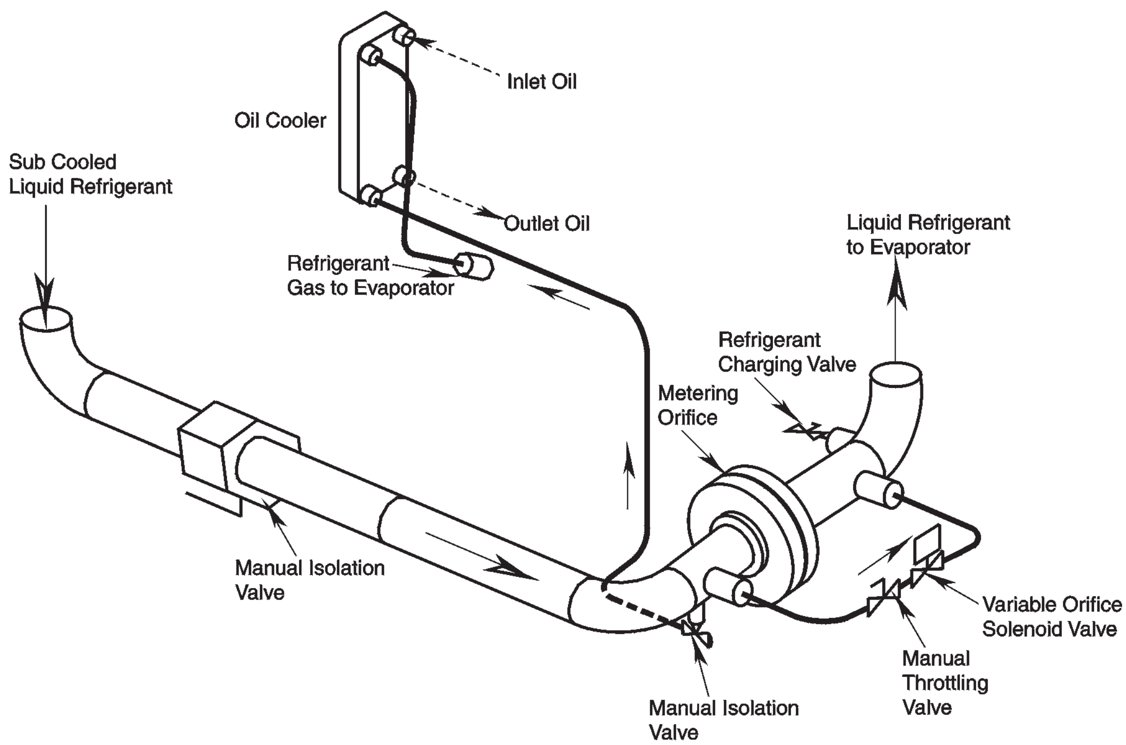


Figure 2.7 Refrigerant Flow Control

2.9 Evaporator

The evaporator is a shell and tube, flooded type, heat exchanger with a distributor trough providing uniform distribution of refrigerant over the entire shell length to ensure optimum heat transfer. A 57 mm diameter liquid level sight glass is located on the side of the shell to aid in determining proper refrigerant charge. A 25 mm refrigerant charging valve is provided.

2.10 Condenser

The condenser is a shell and tube, flooded type, heat exchanger with a discharge gas baffle to prevent direct high velocity impingement on the tubes. The baffle distributes the refrigerant gas flow uniformly over the entire shell length for optimum heat transfer. A subcooler section is located in the bottom of the condenser to provide effective liquid refrigerant subcooling, improving cycle efficiency. The condenser shell also serves as a refrigerant receiver to store the system charge during servicing. Manually operated isolation valves are located at the inlet and outlet of the condenser. Valves are also provided to facilitate removal of the refrigerant from the system.

2.11 Refrigerant Flow Control

Sub-cooled liquid refrigerant flows out of the condenser via the liquid line into the evaporator by differential pressure. A single or dual fixed metering orifice with no moving parts controls refrigerant flow to the evaporator. The orifice is selected based upon the operating conditions of the unit.

A variable orifice arrangement is also supplied in parallel with the metering orifice. This consists of a solenoid valve and hand-throttling valve. The solenoid is energized open by the differential pressure set point that is field programmable in the control panel.

The differential pressure between condensing pressure and evaporating pressure is compared to the set point value. When the differential pressure is at or less than the setpoint, the solenoid valve is energized open. The solenoid valve is de-energized closed when the differential pressure is equal to or greater than the setpoint plus 10 PSIG. A hand-throttling valve is provided to adjust the refrigerant flow rate through the solenoid valve to match the system operating conditions.

A manual isolation valve is located between the condenser and the metering orifice plate. This valve, in combination with the hand isolation valve between the oil separator and the condenser, allows all of the refrigerant charge to be stored in the condenser.

A liquid refrigerant supply is piped from the bottom of the liquid line to the refrigerant cooled oil cooler. The refrigerant gas from the oil cooler is piped directly into the evaporator. A refrigerant charging valve is fitted into the liquid line between the evaporator and the metering orifice. A ¾ inch male flare connection is provided for connecting hoses or transfer lines.

2.12 Capacity Control

Capacity control is accomplished by using differential pressure to move the slide valve. As the slide valve is moved axially between the compressor rotors the volume of vapour pumped by the compressor is changed to match the system requirements.

Leaving chilled water temperature (LCWT) is continuously monitored by the microprocessor and compared to the LCWT Setpoint. When the LCWT is outside the range of the setpoint value a signal is sent via the relay output board to energize the 4-way valve directional solenoid valves.

When solenoid valve B is energised (Port P to Port B and Port A to Port T) the slide valve moves in the load direction.

High pressure oil from the oil circuit flows (Port P) flows through the sub-plate manifold block and out to Compressor Port SC-2 (Port B). Simultaneously, oil flows out of Compressor Port SC-1 (Port A) through the sub-plate manifold block and out to suction pressure (Port T).

When the Solenoid Valve A is energised (Port P to Port A and Port B to Port T), the slide valve moves in the unload direction. High pressure oil flows into Compressor Port SC-1 (Port A) and oil is relieved out of Compressor Port SC-2 (Port B) to suction pressure.

A slide valve potentiometer is used to provide feedback to the microprocessor to display slide valve position as a percentage of full load.

Four manual isolation valves are incorporated into the 4-way solenoid sub-plate to isolate the 4-way directional valve for service.

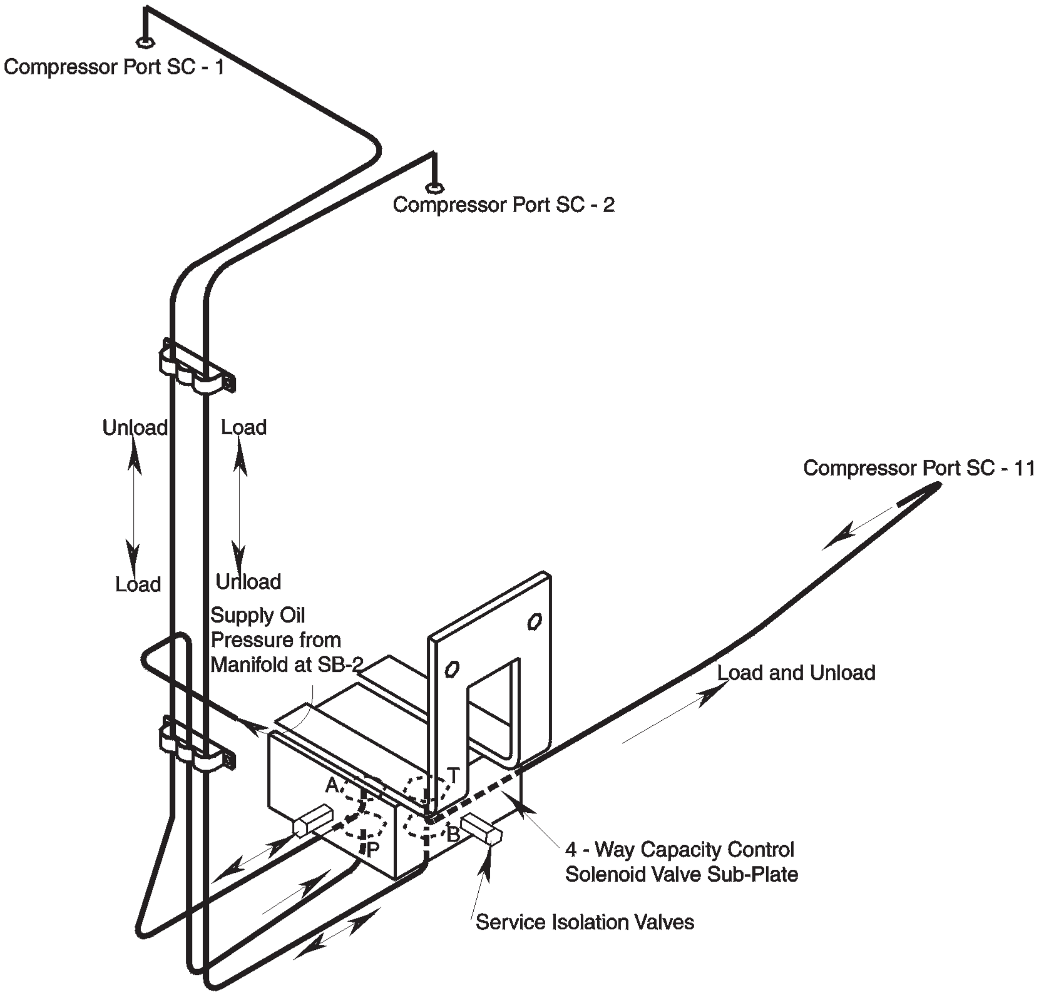


Figure 2.6 Capacity Control

2.13 Water Boxes

Removable water boxes fabricated from heavy gauge sheet steel are fitted to each end of both heat exchangers. The design working pressure is 10 bar and the boxes are tested at 15 bar. Integral steel water baffles are located and welded within the water boxes to provide required pass arrangements. Stub-out water nozzle connections with Victaulic grooves are welded to the water boxes. These nozzle connections are suitable for Victaulic couplings, welding or flanges, and are capped for shipment. Plugged 19mm drain and vent connections are provided in each evaporator and condenser water box.

2.14 Control Centre

The control centre is factory mounted, wired and tested. The centre automatically controls the operation of the unit in meeting cooling requirements while minimising energy usage. Unit operating parameters are sensed by thermistors and transducers and can be viewed on the keypad display. All pressures are taken as gauge pressure. Temperatures and pressures can be displayed in Imperial ('F, psig) or metric ('C, kPa) as required. Display of all information is shown in the English language on a 40-character alphanumeric display.

Available operating information includes return/leaving chilled liquid temperatures; return/leaving condenser water temperatures; evaporator/condenser refrigerant pressures; oil pressures at compressor and oil filter differential; percent motor current; evaporator/condenser saturation temperatures; compressor discharge temperature; oil temperature; percent slide valve position, operating hours and number of compressor starts.

The control centre includes unique safety logic to protect the unit from damaging malfunctions. Comprehensive information can be displayed in the event of a unit shutdown including day, time, and reason for shutdown. Reasons include high condenser pressure, low oil pressure at compressor, clogged oil filter, low oil level in oil separator, high oil temperature, high oil pressure, high compressor discharge temperature, low evaporator pressure, motor controller fault, and sensor malfunction.

Background messages are displayed while the unit is running to inform of any controlling conditions such as: current limit in effect, low pressure limit in effect, high pressure limit in effect, leaving chilled water temperature control, and non-critical sensor error. System cycling messages are displayed in regard to day, time, cause of cycling shutdown, and auto start indication. These include low water temperature, evaporator/condenser water flow interruption, internal time clock, and anti-recycle.

Digital programming of operating setpoints from the keypad include leaving chilled water temperature, current limiting, pulldown demand limiting, daily start/stop scheduling of chiller, pumps and tower, and separate holiday schedule.

Individual LED indicators highlight slide valve loading/unloading/auto control, program mode, and display hold.

Manual operation of slide valve loading and unloading is provided through separate buttons in the service section of the keypad.

All operating and setpoint information can be transmitted to a remote printer through the RS-232 port in the control centre to obtain data logs. This can be accomplished at any time by pressing the "Print" button on the control centre keypad, or automatically at predetermined intervals by programming the panel.

The remote printer will also record time and cause of any safety or cycling shutdown and a history of the last four shutdowns.

The control centre is compatible with remote Building Automation Systems (BAS) and Energy Management Systems (EMS). The remote control functions available as standard include start and stop, leaving chilled water temperature reset and current limit reset through PWM signal, and "ready to start", "safety" and "cycling" shutdown status contacts. Further remote control features are available via an optional York ISN translator.

2.15 Options and Accessories

Motor Starter

The solid state starter is a reduced voltage starter that controls and maintains a constant current flow to the motor during start-up. It is compact and mounted on the unit adjacent to the motor terminals. Power and control wiring is factory supplied. The starter enclosure is IP33 rated with a hinged access door with lock and key.

Standard features include: digital readout at the control centre of 3-phase voltage and current; high and low line voltage protection; 115 V control transformer; three-leg sensing overloads; phase rotation and single-phase failure protection; and momentary power interruption protection. An integral door interlocked and pad-lockable fused disconnect switch is also available.

BAS/EMS Remote Control Interface

A communication interface permitting complete exchange of unit data with any BAS/EMS is available via an optional ISN translator. The ISN translator also allows a BAS/EMS to issue commands to the unit to control its operation. ISN translators are available in two models for controlling up to four, or up to eight units.

Remote Reset Controls

Optional PCB to allow reset of leaving chilled water temperature and percent motor current limit by a BAS/EMS using 4-20 mA, 0-10 Vdc, or discrete stepped signals rather than the standard pulse width modulated (PWM) signal requirement.

Factory Insulation of Evaporator

Factory-applied 19 mm thick anti-sweat insulation (flexible, closed-cell plastic type) is attached with vapour-proof cement to the evaporator shell, flow chamber, evaporator tube sheets, suction connection, and (as necessary) to the auxiliary tubing. This insulation will normally prevent sweating in environments with relative humidity up to 75% and dry bulb temperatures ranging from 10°C to 32°C. 38 mm thick insulation is also available for environments with relative humidity up to 90% and dry bulb temperatures ranging from 10°C to 32°C. Insulation of water boxes and nozzles is not included.

High Water Side Pressure Heat Exchangers

One or both of the evaporator and condenser may be supplied with a water side design pressure of 20 bar (subject to pressure vessel code approval availability).

Water Flanges

Four BS4504/ ISO7005 - NP10 raised-face flanges can be supplied factory welded or for site welding to the condenser and evaporator water nozzles (companion flanges, bolts, nuts and gaskets are not included).

Water Flow Switches

Paddle-type, vapour-proof water flow switches can be supplied suitable for 10 bar DWP chilled and condenser water circuits. This or an equivalent switch must be fitted in the chilled water circuit to protect against loss of water flow. A condenser water flow switch is optional.

Hot Gas Bypass System

A hot gas bypass system can be factory installed to allow unit operation down to virtually zero load if required.

VBG 20 Compliance Kit

Factory fitted T.Ue.V. approved mechanical high pressure cut-out switches (two) as required to comply with some safety codes.

Mechanical Low Pressure Cut-out

Available for under pressure protection on low temperature glycol chilling applications.

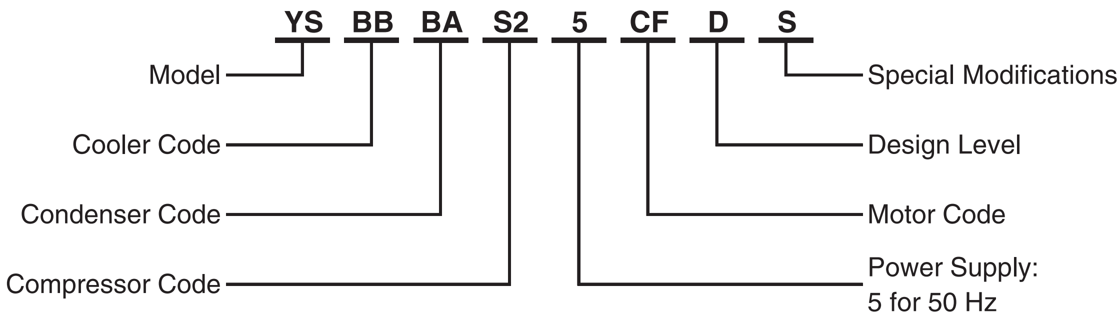
Spring Isolation Mounts

Spring Isolation mounting is recommended instead of standard isolation mounting pads for all upper floor locations. Four level adjusting spring-type vibration isolator assemblies with non-skid pads are provided with mounting brackets for field installation. Isolators are designed for 25 mm deflection.

Printer

Hand held printer for obtaining a printout of unit operating data and history data from the control centre.

2.16 Nomenclature



2.17 Range of Models

COMPRESSOR CODE	COOLER CODE	CONDENSER CODE	MOTOR CODE
S2	BA, BB	BA, BB, CA, CB	5CC, 5CD, 5CE, 5CF, 5CG, 5CH
	CA, CB	BA, BB, CA, CB, DA, DB	
	DA, DB, DC	CA, CB, DA, DB	
S3	CA, CB,	CA, CB, DA, DB	5CC, 5CD, 5CE, 5CF, 5CG, 5CH, 5CI, 5CJ, 5CK
	DA, DB, DC	CA, CB, DA, DB	
S4	DA, DB, DC	CA, CB, DA, DB	5CE, 5CF, 5CG, 5CH, 5CI, 5CJ, 5CK, 5CL, 5CM, 5CN, 5CO
	EA, EB, EC	EA, EB, FA, FB	
	FA, FB, FC	EA, EB, FA, FB	
S5	EA, EB, EC	EA, EB, FA, FB	5CF, 5CG, 5CH, 5CI, 5CJ, 5CK, 5CL, 5CM, 5CN, 5CO
	FA, FB, FC	EA, EB, FA, FB	

3 TRANSPORTATION, RIGGING AND STORAGE

3.1 General

YS units are shipped as a single factory assembled, piped, wired package, requiring minimum installation to make chilled water connections, condenser water connections, refrigerant atmospheric relief connections, and electrical power connections.

Units can also be shipped dismantled when required by rigging conditions, but generally it is more economical to enlarge access openings to accommodate the factory assembled unit. Units shipped dismantled **MUST** be field assembled under the supervision of a York representative.

FIELD ASSEMBLED UNITS ONLY

Use Form 160.47-N3.1 in conjunction with this manual. This instruction will be furnished with all units that are to be field assembled.

A York authorised representative must check the installation, supervise the initial start-up and operation of all newly installed units.

CAUTION

The York Warranty may be voided if the following restrictions are not adhered to:

1. No valves or connections should be opened under any circumstances because such action will result in loss of the factory nitrogen charge.
2. Do not dismantle or open the unit for any reason except under the supervision of a York representative.
3. When units are shipped dismantled, notify the nearest York office in ample time for a York representative to supervise rigging the unit to its operating position and the assembly of components.
4. Do not make final power supply connections to the compressor motor, solid state starter or control centre.
5. Do not charge the compressor with oil.
6. Do not charge the unit with refrigerant.
7. Do not attempt to start the system.
8. Do not run hot water (40°C maximum.) or steam through the cooler or condenser at any time.

3.2 Shipment

The unit may be ordered and shipped in any of the following forms:

Form 1 – Factory Assembled Unit (complete with motor, refrigerant and oil charges)

1. The motor/compressor assembly mounted, with all necessary interconnecting piping assembled. Control centre is mounted on the unit. Complete unit factory leak tested, evacuated and charged with R134a.

   An optional Solid State Starter can be factory mounted and wired.

2. Miscellaneous material – Four (4) vibration isolation pads (or optional spring isolators and brackets).

Form 2 – Factory Assembled Unit (complete with motor, refrigerant and oil charges shipped separately).

1. The motor/compressor assembly mounted, with all necessary interconnecting piping assembled. Control centre is mounted on the unit. Complete unit factory leak tested, evacuated and charged with holding charge of nitrogen.

   An optional Solid State Starter can be factory mounted and wired.

2. Miscellaneous material – Four (4) vibration isolation pads (or optional spring isolators and brackets).

Form 3 – Motor/Compressor Separate From Shells

Shipped as three major assemblies. Unit first factory assembled, refrigerant piped, wired and leak tested; then dismantled for shipment. Compressor/motor assembly removed from shells and skidded. Cooler/condenser shells are not skidded.

All compressor wiring attached, and all conduit is left on shell. All openings on compressor, oil separator, and shell are closed and charged with dry nitrogen (0.14 to 0.2 barg).

Miscellaneous packaging of control centre, tubing, water temperature controls, wiring, oil, isolators, solid state starter (option), etc., refrigerant charge shipped separately.

NOTE

Units shipped dismantled MUST be re-assembled by, or under the supervision of, a York representative.
(See Form 160.47-N3.1)

Form 7 – Split Shells

Shipped as four major assemblies. Unit first factory assembled, refrigerant piped, wired and leak tested; then dismantled for shipment. Compressor/motor assembly removed from shells and skidded.

Cooler and condenser shells are separated at tube sheets and are not skidded. Refrigerant lines between shells are flanged and capped, requiring no welding.

All compressor wiring attached. All wiring harnesses on shells are removed. All openings on compressor and shells are closed and charged with dry nitrogen (0.14 to 0.2 barg).

Miscellaneous packaging of control centre, tubing, water temperature controls, wiring, oil isolators, solid state starter (option), etc.; refrigerant charge shipped separately.

NOTE

Units shipped dismantled MUST be re-assembled by, or under the supervision of, a York representative.
(See Form 160.47-N3.1)

When more than one unit is ordered, the major parts of each unit will be marked to prevent mixing of assemblies. (Piping and Wiring Drawings will be furnished by York.)

3.3 Inspection, Damage and Shortage

The unit shipment should be checked on arrival to see that all major pieces, boxes and crates are received. Each unit should be checked before unloading, for any visible signs of damage. Any damage or signs of possible damage must be reported to the transportation company immediately for their inspection.

NOTE

York will not be responsible for any damage in shipment or at job site or loss of parts.

When received at the job site all containers should be opened and contents checked against the packing list. Any material shortage should be reported to York immediately.

Chiller Data Plate

A unit data plate is mounted on the control panel assembly of each unit, giving unit model number; design working pressure; water passes; refrigerant charge; serial numbers; and motor power characteristics and connection diagrams.

Additional information may be found on the motor data plate. This information should be included when contacting the factory on any problem relating to the motor.

3.4 Rigging

The complete standard unit is shipped without skids. (When optional skids are used it may be necessary to remove the skids so riggers skates can be used under the unit end sheets to reduce overall height.)

Each unit has four (4) lifting holes (two in each end) in the end sheets which should be used to lift the unit.

Care should be taken at all times during rigging and handling of the chiller to avoid damage to the unit and its external connections. Lift only using holes shown.

CAUTION

Do not lift the unit with slings around motor/compressor assembly or by means of eye bolts in the tapped holes of the compressor motor assembly. Do not turn a unit on its side for rigging. Do not rig vertically.

The rigging and operating weights and overall dimensions are given in Section 9 as a guide in determining the clearances required for rigging. (Add 150 mm to overall height for optional skidded unit.).

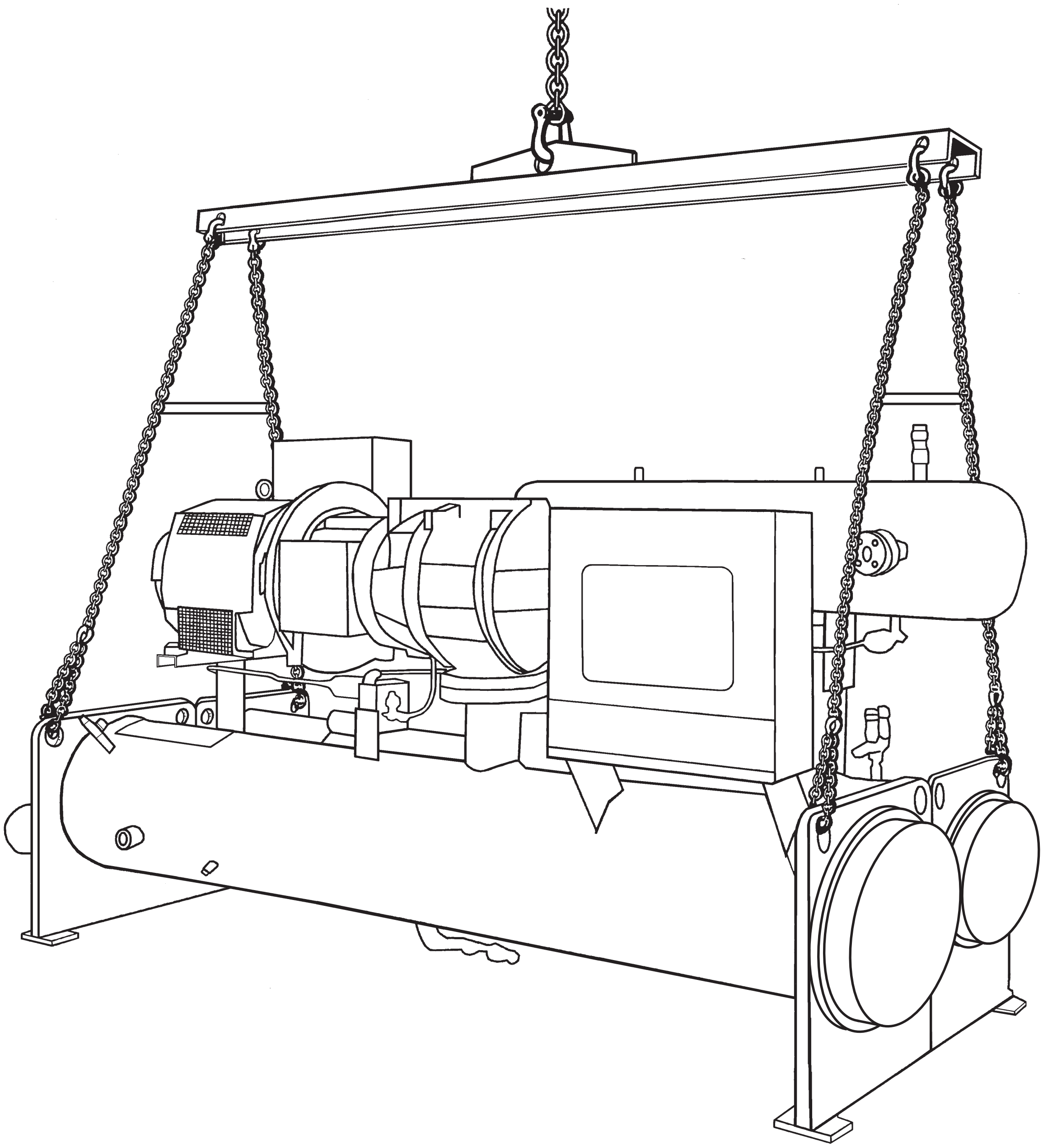


Figure 3.1Rigging

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4 INSTALLATION

4.1 Location

YS units are furnished with vibration isolator mounts for basement or ground level installations. Units may be located on upper floor levels providing the floor is capable of supporting the total unit operating weight and optional spring isolators are used.

Sufficient clearance to facilitate normal service and maintenance work must be provided all around and above the unit and particularly space provided at either end to permit cleaning or replacement of cooler and condenser tubes. (See CLEARANCES).

A doorway or other sufficiently large opening properly located may be used. The chiller should be located in an indoor location where temperatures range from 4°C to 43°C.

4.2 Motors

The YS motor is air cooled. Check national, local and other codes for ventilation requirements.

4.3 Foundation

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

4.4 Clearances

Clearances should be adhered to as follows:

Rear and above unit – 600 mm.

Front of unit – 900 mm.

Tube Removal – see table below

COMPRESSOR	TUBE REMOVAL SPACE (mm)
S2, S3	3073
S4, S5	3683

4.5 Rigging Unit to Final Location

Rig the unit to its final location on the floor or mounting pad, lift the unit (or shell assembly) by means of an overhead lift and lower the unit to its mounting position. (If optional shipping skids are used, remove them before lowering the chiller to its mounting position.)

NOTE

At this point units shipped dismantled should be assembled under the supervision of a York representative.

If cooler is to be field insulated, the insulation should be applied to the cooler before the unit is placed in position while the unit is in the lift position. Be sure unit is properly supported. (See INSULATION).

4.6 Locating and Installing Isolator Pads

The isolator pad mounts are to be located as shown in Figure 4.1

After the isolator pads have been placed into position on the floor, lower the chiller onto the pads. When the unit is in place, remove the rigging equipment and check that the unit is level both longitudinally and transversely. The unit should be level within 6 mm from one end to the other end and from front to the rear. If the chiller is not level within the amount specified, lift it and place shims between the isolation pad and the chiller tube sheets. (Shims furnished by the installer.) Lower unit again and recheck to see that it is level.

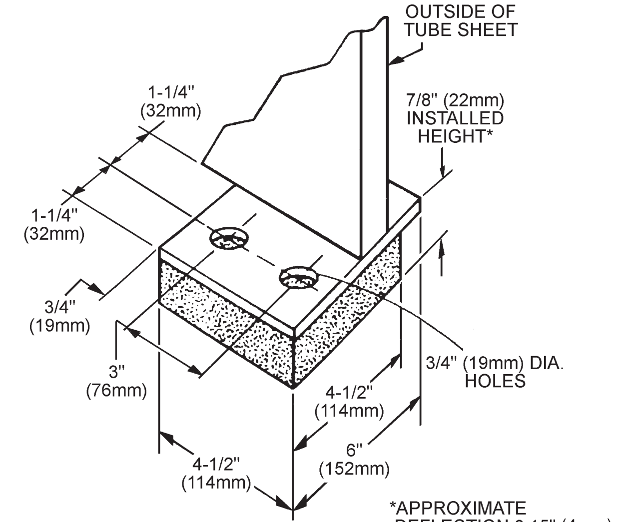
Checking the Isolator Pad Deflection

All isolator pads should be checked for the proper deflection while checking to see if the unit is level. Each pad should be deflected approximately 4 mm. If an isolation pad is under-deflected, shims should be placed between the unit tube sheet and the top of the pad to equally deflect all pads.

Levelling the Unit

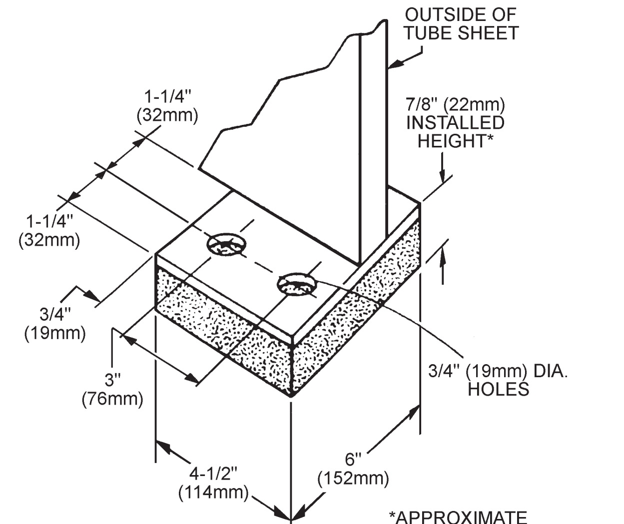
The longitudinal alignment of the unit should be checked by placing a level on the top centre of the cooler shell under the compressor/motor assembly. Transverse alignment should be checked by placing a level on top of the shell end sheets at each end of the chiller.

Unit Weights less than 7423 kg



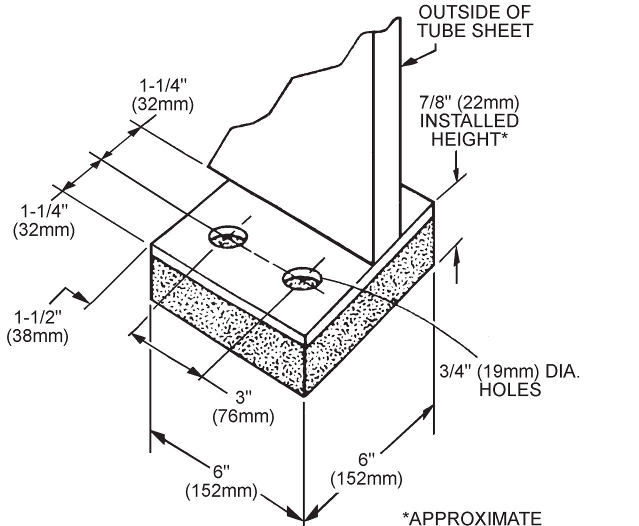
DETAIL A

Unit Weights 7546 kg to 13080 kg



DETAIL B

Unit Weights 13080 kg to 24281 kg



DETAIL C

Figure 4.1 Neoprene Isolators

4.7 Installing Optional Spring Isolators

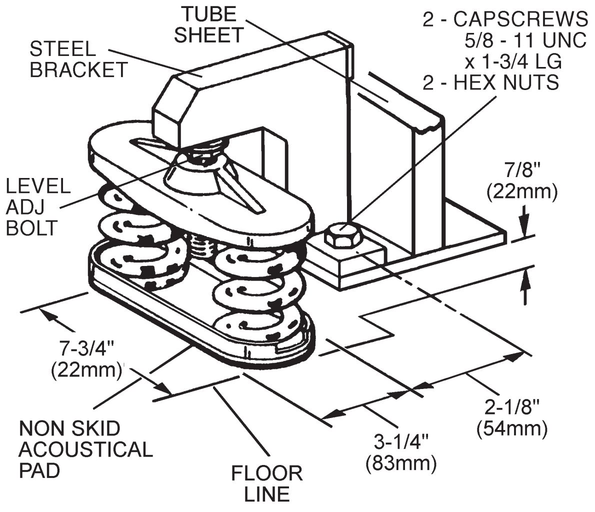
When ordered, 4 spring type isolator assemblies will be furnished with the unit (see table below). The 4 assemblies are identical and can be placed at any of the 4 corners of the unit.

While the unit is still suspended by the rigging, the isolator mounting brackets should be bolted to the unit . Place the four spring isolators in position. The threaded adjusting bolts in each isolator should be screwed out of the isolator until the extended head of the screw fits snugly into the isolator bracket hole. The unit should be lowered over the adjusting bolts.

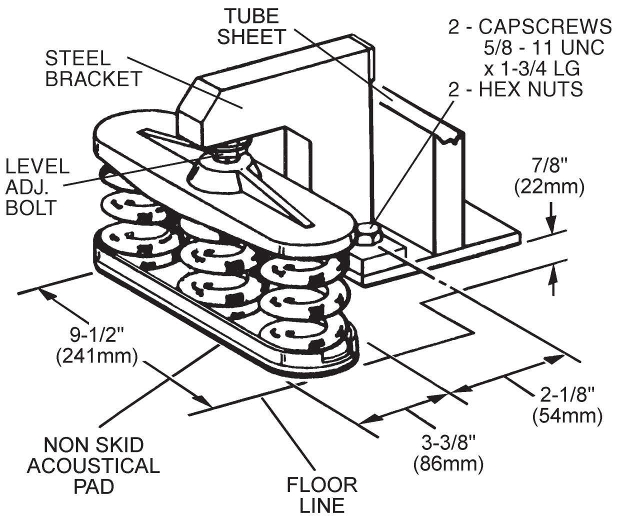
The levelling bolts should now be rotated one (1) turn at a time, in sequence, until the unit end sheets are clear of the floor by 22 mm and the unit is level. Check that the unit is level, both longitudinally and transversely (see Levelling the Unit). If the levelling bolts are not long enough to level unit due to an uneven or sloping floor or foundation, steel shims (grouted, if necessary) must be added beneath the isolator assemblies as necessary.

After the unit is levelled, wedge and shim under each corner to solidly support the unit in this position while piping connections are being made, pipe hangers adjusted and connections checked for alignment. Then the unit is filled with water and checked for leaks. The levelling bolts should now be finally adjusted until the wedges and shims can be removed. The unit should now be in correct level position, clear of the floor or foundation and without any effect from the weight of the piping (spring isolator deflection should be approximately 25 mm).

COMPRESSOR SIZE	SYSTEM OPERATING WEIGHT (kg)	PART No.
S2, S3	Up to 5525	029-18479-003
	5526 to 6927	029-18479-004
	6928 to 8288	029-18480-001
	8289 to 10392	029-18480-002
S4, S5	Up to 10392	029-18480-002
	10393 to 11813	029-18480-003
	11814 to 14561	029-18480-004



PART NO. 029-18479



PART NO. 029-18480

Figure 4.2 Optional Spring Isolators

4.8 Piping Connections

After the unit is levelled (and wedged in place for optional spring isolators) the piping connections may be made; chilled water, condenser water and refrigerant relief. The piping should be arranged with offsets for flexibility, and adequately supported and braced independently of the unit to avoid strain on the unit and vibration transmission. Hangers must allow for alignment of pipe. Isolators (by others) in the piping and hangers are highly desirable, and may be required by specifications, in order to effectively utilise the vibration isolation characteristics of the vibration isolation mounts of the unit.

Check for piping alignment – Upon completion of piping, a connection in each line as close to the unit as possible should be opened, by removing the flange bolts or coupling and checked for piping alignment. If any of the bolts are bound in their holes, or if the connection springs are out of alignment, the misalignment must be corrected by properly supporting the piping or by applying heat to anneal the pipe.

If the chiller/cooling water piping needs to be welded directly to the water pipe nozzles, the temperature sensors should be removed to prevent heat damage.

If the piping is annealed to relieve stress, the inside of the pipe must be cleaned of scale before it is finally bolted in place.

4.9 Cooler and Condenser Water Piping

The cooler and condenser liquid heads have nozzles which are grooved, suitable for welding 10.3 bar DWP flanges or the use of Victaulic couplings. Factory mounted flanges are optional.

The nozzles and water pass arrangements are delivered in accordance with the job requirements (see Product Drawings delivered with the job and Section 9). Standard units are designed for 10.3 bar DWP on the water side. If job requirements are for greater than 10.3 bar DWP, check the unit Data Plate before applying pressure to cooler or condenser to determine if the chiller has provisions for the required DWP.

Inlet and outlet connections are identified by labels placed adjacent to each nozzle.

Foreign objects which could lodge in, or block flow through the cooler and condenser tubes must be kept out of the water circuit. All water piping must be cleaned or flushed before being connected to the chiller pumps, or other equipment.

Permanent strainers (supplied by others) are required in both the cooler and condenser water circuits to protect the chiller as well as the pumps, tower spray nozzles, chilled water coils and controls, etc. The strainer should be installed in the entering chilled water line, directly upstream of the chiller.

Water piping circuits should be arranged so that the pumps discharge through the chiller, and should be controlled as necessary to maintain essentially constant chilled and condenser water flows through the unit at all load conditions.

If pumps discharge through the chiller, the strainer may be located upstream from pumps to protect both pump and chiller. (Piping between strainer, pump and chiller must be very carefully cleaned before start-up.) If pumps are remotely installed from chiller, strainers should be located directly upstream of the chiller.

4.10 Water Treatment

The unit performance given in the Design Guide is based on a fouling factor of 0.044 m² °C/kW (0.00025 ft²hr °F/Btu). Dirt, scale, grease and certain types of water treatment will adversely affect the heat exchanger surfaces and therefore unit performance. Foreign matter in the water system(s) can increase the heat exchanger pressure drop, reducing the flow rate and causing potential damage to the heat exchanger tubes.

Aerated, brackish or salt water is not recommended for use in the water system(s). York recommend that a water treatment specialist is consulted to determine that the proposed water composition will not affect the evaporator materials of carbon steel and copper. The pH value of the water flowing through the heat exchangers must be kept between 7 and 8.5.

4.11 Glycol Solutions

For unit operation with chilled liquid temperatures leaving the cooler at below 4°C, glycol solutions should be used to help prevent freezing. Section 9, gives recommended solution strength with water, as a percentage by weight, for the most common types of glycol. It is important to check glycol concentration regularly to ensure adequate concentration and avoid possible freeze-up in the cooler.

CAUTION

When using glycol solutions, pressure drops are higher than with water. Special care must be taken not to exceed the maximum pressure drop allowed.

4.12 Condenser Water Circuit

For proper operation of the unit, condenser refrigerant pressure must be maintained above cooler pressure. If operating conditions will fulfill this requirement, no attempt should be made to control condenser water temperature by means of automatic valves, cycling of the cooling tower fan or other means, since chillers are designed to function satisfactorily and efficiently when condenser water is allowed to seek its own temperature level at reduced loads and off-peak seasons of the year. However, if entering condenser water temperature can go below the required minimum, condenser water temperature must be maintained equal to or slightly higher than the required minimum. Refer to Figure 4.3 for a typical water piping schematic.

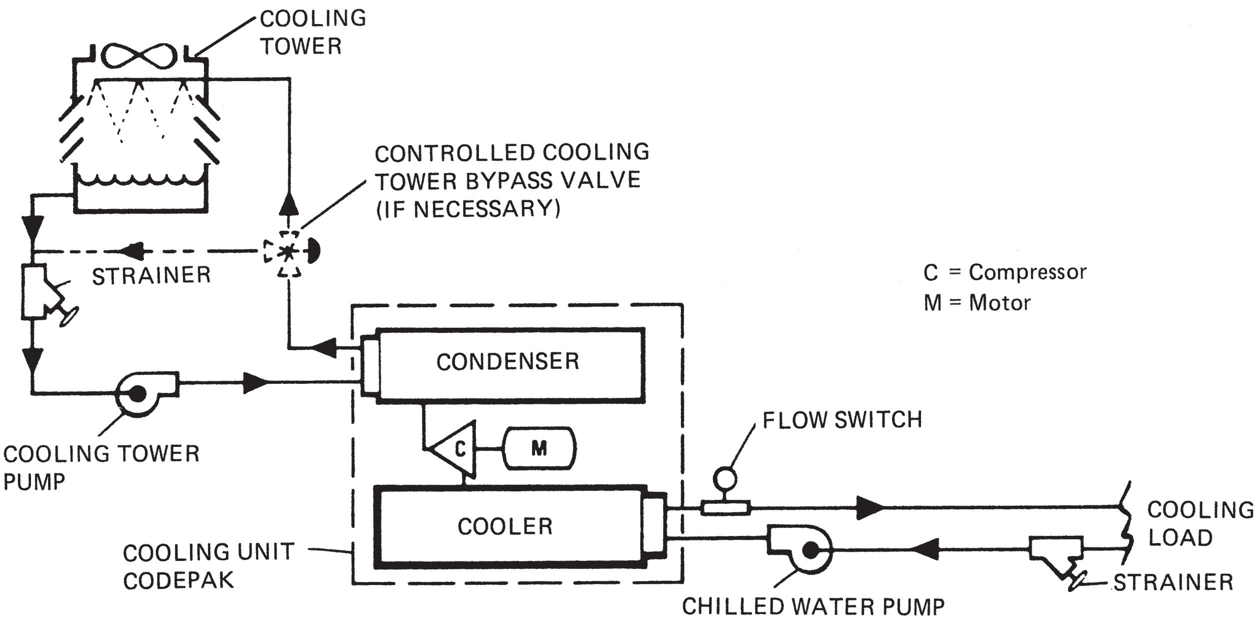


Figure 4.3 Typical Piping Arrangement

4.13 Stop Valves

Stop valves may be provided (by others) in the cooler and condenser water piping adjacent to the unit to facilitate maintenance. Thermometer wells and pressure taps should be provided (by others) in the piping as close to the unit as possible to facilitate operating check.

4.14 Flow Switches (Field Installed)

A flow switch or pressure differential control in the chilled water line(s) adjacent to the unit is an accessory furnished for connection to the control panel. If a flow switch is used, it must be directly in series with the chiller and sensing only water flow through the chiller. The differential switch must sense pressure drop across the unit.

4.15 Drain and Vent Valves

Drain and vent valves (by others) should be installed in the connections provided in the cooler and condenser liquid heads. These connections may be piped to drain if desired.

4.16 Checking Piping Circuits and Venting Air

After the water piping is completed, but before any water box insulation is applied. Tighten and torque (to maintain between 41 and 82 Nm) the nuts on the liquid head flanges. Gasket shrinkage and handling during transit may cause the nuts to loosen. If water pressure is applied before tightening is done, the gaskets may be damaged and have to be replaced.

Fill the chilled and condenser water circuits, operate the pumps manually and carefully check the cooler and condenser water heads and piping for leaks. Repair leaks as necessary.

Before initial operation of the unit both water circuits should be thoroughly vented of all air at the high points.

4.17 Refrigerant Relief Piping

Each unit is equipped with pressure relief valves located on the condenser, oil separator and evaporator for relieving excess pressure of the refrigerant charge to the atmosphere as a safety precaution in case of an emergency, such as fire.

Refrigerant relief vent piping (by others), from the relief valves to the outside of the building, is required by code in most areas and should be installed on all chillers. The vent line should be sized in accordance with the ANSI/ASHRAE-15, or local code. The vent line must include a dirt trap in the vertical leg to intercept and permit clean out and to trap any vent stack condensation. The piping MUST be arranged to avoid strain on the relief valves, using a flexible connection, if necessary.

4.18 Unit Piping

Compressor lubricant piping and system external piping are factory installed on all units shipped assembled. On units shipped dismantled, the lubricant piping to oil sump and oil cooler and system oil return connections should be completed, under the supervision of the York representative, using material furnished. See Form 160.47-N3.1.

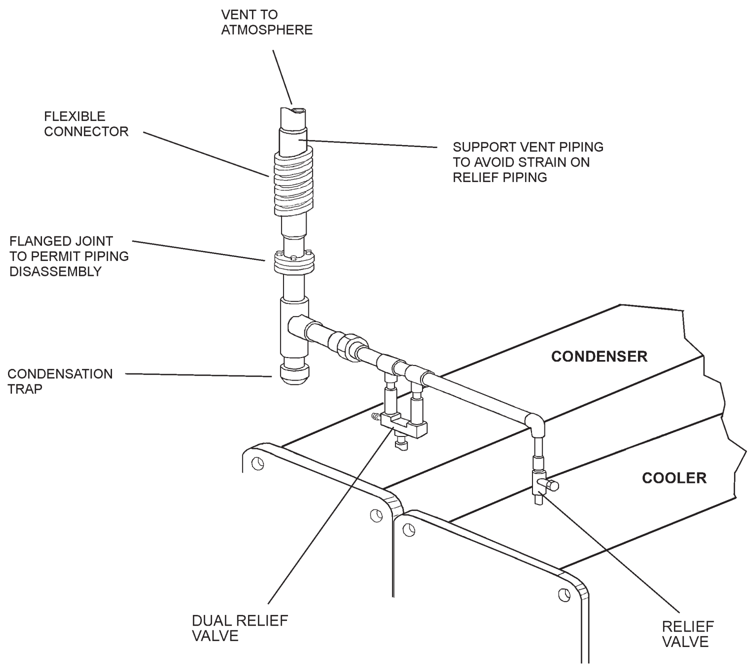


Figure 4.4 Typical Refrigerant Vent Piping from Relief Valves

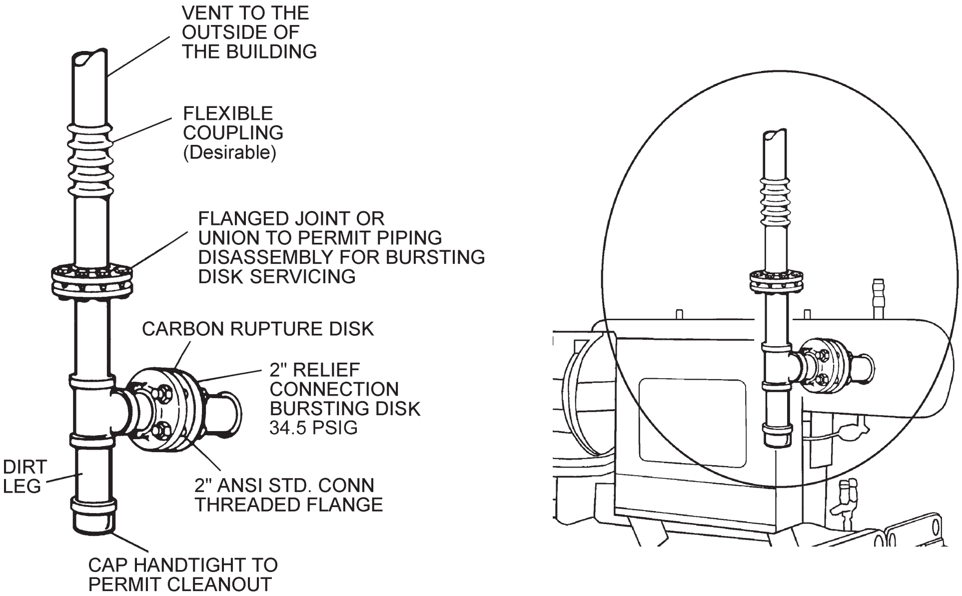


Figure 4.5 Typical Refrigerant Vent Piping from Rupture Disk

CAUTION

Piping should be properly supported to prevent any strain on bursting disk mounting.

Be careful not to puncture bursting disk when thread protector is removed.

Refrigerant Relief Sizes

OIL SEPARATOR		
COMPRESSOR CODE	RELIEF VALVE	RUPTURE DISK
	DUAL (1)	SINGLE
	OUTLET NPT	OUTLET NPT
S2, S3 (2)	3/4"	2"
S4 (2)	1"	2-1/2"
S5 (2)	1"	2-1/2"

COOLER	
SHELL	SINGLE RELIEF VALVE
	OUTLET
	NPT
B	3/4"
C	3/4"
D	1"
E	1"
F	1"

CONDENSER	
SHELL	DUAL RELIEF VALVE
	OUTLET
	NPT
B	3/4"
C	3/4"
D	3/4"
E	1"
F	1"

Notes: 1). Dual relief valve consists of one three-way shut off valve and two single relief valves. The valve configuration will not allow both valves to be shut off at the same time, and valves are sized such that each relief valve has sufficient discharge capacity when used alone. This permits safe removal of either relief valve for repair or replacement, while maintaining vessel protection.

4.19 Electrical Connection

The following connection recommendations are intended to ensure safe and satisfactory operation of the unit. Failure to follow these recommendations could cause harm to persons, or damage to the unit, and may invalidate the warranty.

WARNING

No additional controls (relays, etc.) should be mounted in the control panel. Power and control wiring not connected to the control panel should not be run through the control panel. If these precautions are not followed it could lead to a risk of electrocution. In addition, electrical noise could cause malfunctions or damage the unit and its controls.

WARNING

After connection do not switch on mains power to the unit until it has been commissioned by York Authorised personnel. Some internal components are live when mains is switched on.

On units shipped disassembled, after installation of the control panel, control wiring must be completed between unit components and control panel or solid state starter, when used, using wiring harness furnished.

NOTE

No changes in unit wiring from that shown on drawings delivered shall be made without prior approval of the York representative.

WARNING

All electrical wiring should be carried out in accordance with local regulations. Customer supplied isolators and fuses may be installed next to the unit, avoiding locations close to refrigerant and water lines.

WARNING

All sources of supply to the unit must be taken via a common point of isolation (not supplied by York).

WARNING

After connection DO NOT switch on mains or control system power to the unit. Some internal components are live as soon as mains is switched on the unit and this must only be done by authorised persons.

The main 'START/RUN/STOP-RESET' selector switch on the control centre must remain in 'STOP/RESET' position until the unit is commissioned by authorised personnel. If the switch has been placed in the 'RUN' or 'START' position before commissioning, this must be reported to York otherwise warranty may be invalidated.

4.20 Power Wiring

Units are suitable for 380/400V - 3 Ph - 50 Hz or 415V - 3 Ph - 50 Hz nominal power supplies only. The correct electrical power supply is given on the unit data plate, which also details the motor connection diagrams.

4.20.1 Units with Electro-Mechanical Starter
(field supplied)

Units supplied without a starter require one three phase supply to the motor from a remote electro mechanical starter (field supplied). A 115 Vac - 1Ph - 50 Hz supply of 15 amp capacity is also required for the control centre. An optional control transformer (1-1/2 KVA required) is available to meet this requirement.

CAUTION

Electro-Mechanical starters for the unit must be furnished in accordance with York Standard R-1079 to provide the features necessary for the starter to function properly with the York control system.

Route the cables forming the 3 phase power supply via the same hole in the motor terminal box gland plate, using a suitable cable gland, to ensure that no eddy currents are set up in the metal gland plate. If separate entries for each cable forming the 3 phase supplies are used, the metal gland plate must be replaced by a non-metallic gland plate.

DO NOT cut wires to final length or make final connections to the motor or starter power input terminals until approved by a York representative. To ensure correct motor rotation the starter power input and starter to motor connections must be checked with a phase sequence indicator in the presence of the York representative.

Route the main earth cable via the motor terminal box gland plate to the main earth connection stud on the side of the box.

Route the single phase control supply to the control centre with bare wire ends of maximum cable size 4 mm^2. Also connect an earth wire to the earth terminal using the M4 lug.

DO NOT make final power supply connections to control centre until approved by a YORK representative.

CAUTION

To ensure proper motor rotation the starter power input and starter to motor connections must be checked with a phase sequence indicator in the presence of the York representative.

The figure below shows the power wiring for the motor connections. (Refer to wiring labels in motor terminal box for details to suit motor voltage and amperage.)

For high voltage applications motor leads are furnished with a crimp type connection having a clearance hole for a 3/8" bolt, motor terminal lugs are not furnished.

For low voltage applications terminal block connections are fitted.

4.20.2 Units with Solid State Starter (Optional)

Units equipped with a solid state starter require a three phase power supply plus earth to the starter. Power wiring from the starter to the motor is factory fitted. Power wiring to the control centre is also factory fitted via a control transformer supplied with the Solid State Starter.

Route the cables forming the 3 phase power supply via the same hole in the solid state starter gland plate / gland box on top of the starter, using a suitable cable gland, to ensure that no eddy currents are set up in the metal gland plate. If separate entries for each cable forming the 3 phase supplies are used, the metal gland plate / gland box must be replaced by a non-metallic version.

DO NOT cut wires to final length or make final connections to starter input terminals until approved by a York representative.

CAUTION

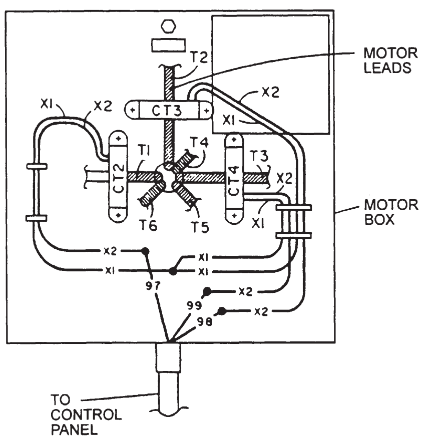
To ensure proper motor rotation the starter power input connections must be checked with a phase sequence indicator in the presence of the York representative.

Route the earth cable via the starter gland plate to the main earth connection stud on the side of the starter.

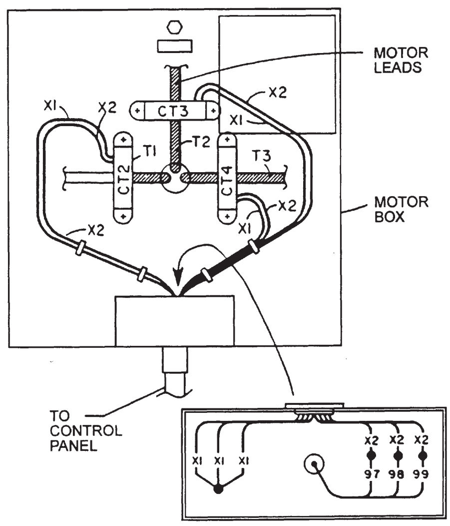
4.21 Control Connections

CAUTION

Customer voltage free contacts must be suitable for device contact rating to be 5 mA at 115 Vac. If the voltage free contacts form part of a relay or contactor, the coil of the device



LOW VOLTAGE (6 LEAD MOTOR)
(200V – 600V)



HIGH VOLTAGE (3 LEAD MOTOR)
(2300V – 4160V)

Figure 4.6 Motor Connections (Electro-Mechanical Starter)

MUST be suppressed using a standard R/C suppressor to avoid electrical noise which could cause a malfunction or damage to the unit.

CAUTION

To avoid the possibility of motor failure due to excessive start cycles, the unit should not normally be cycled using the remote connections. Cycling of the unit based on cooling demand is accomplished automatically by the control centre. In addition, the control centre has a programmable time clock function as a standard feature with holiday capability. This offers one preset automatic Start-Stop per day on a seven day calendar basis with the ability to program a single additional holiday start and stop time up to a week in advance.

4.21.1 Remote Start / Stop (R/STT - TB2: terminals 1 & 7)
(R/STP - TB2: terminals 1 & 8)

With the control centre is in the "REMOTE" operating mode, the "COMPRESSOR' switch is in the "run" position and the Remote Ready to Start Contacts indicate the unit is ready to start, holding contacts open across the Remote Stop Connections and closing contacts across the Remote Start Connections will start the unit. A subsequent closure of the Remote Stop Contacts causes the unit to shutdown.

If the Remote Start and Remote Stop connections are to be used at a remote control station rather than by an EMS/ BAS it is recommended that a change over contact is used between the terminals.

When the unit is operated in remote mode using the Remote Start-Stop connections, an EMERGENCY STOP by an operator or others will STOP the compressor from the control centre and prevent the unit from restarting. However, the operator cannot locally start the compressor using the COMPRESSOR start switch, when the control centre is in the "REMOTE" operating mode

4.21.2 Remote / Local Cycling
(R/LC - TB2: terminals 1 & 13)

The closure of an automatic reset device across these terminals will permit the unit to operate in all operating modes. Conversely, an opening of the device contacts will inhibit the unit from operating. (These connections may also be used to install a condenser water flow switch to give protection against loss of cooling water through the condenser).

4.21.3 Chilled Water Flow Interlock
(CPWI - terminals 1 & 12)

A suitable flow switch which closes on presence of flow must be installed between these contacts, to give adequate protection against loss of chilled liquid flow. The flow switch contacts should be rated for 5 mA at 115 Vac.

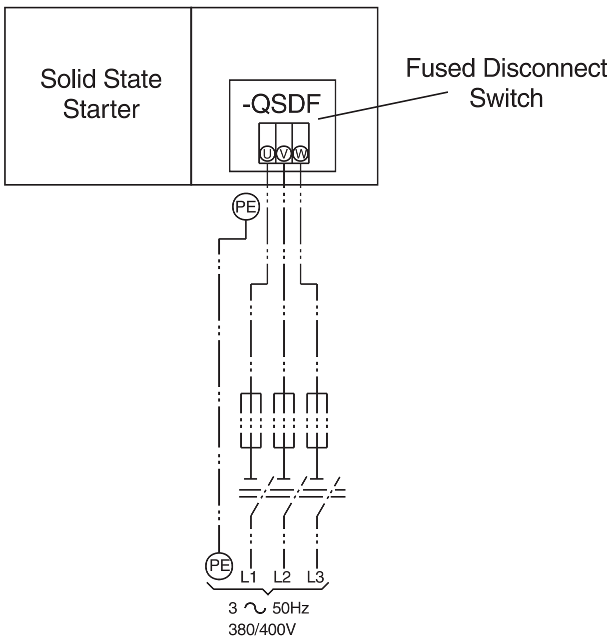


Figure 4.7 Solid State Starter Connections

4.21.4 Multi Unit Sequence Connections
(MUS - TB2: Terminals 1 & 9)

For multiple unit installation applications, Multi Unit Sequence connections are available to start and stop each unit. The maintained closure of remote contacts will permit the unit to operate in all operating modes with the "COMPRESSOR" switch in the "RUN" position. Conversely, an opening of the contacts will inhibit the unit from operating.

4.21.5 Manual Reset Overload
(EMS MRO - TB5, terminals 1 & 53)

Connect these contacts to the manual reset overloads and/or safety devices in the electro mechanical starter. An opening of the contacts causes the system to shutdown.

To restart the chiller, reset the external device in the starter and the unit will automatically restart.

4.21.6 Auxiliary Safety Shutdown
(ASSI - TB5, terminals 1 & 31)

Momentary or maintained closure of a normally open switch or relay contacts will cause the unit to shutdown. The unit will not restart until the contacts open and a manual reset and restart of the unit is carried out.

4.21.7 Remote Leaving Chilled Water Temperature Setpoint Reset (RLCWTSP - TB2: terminals.1 & 19)

The locally programmed leaving chilled water temperature setpoint can be reset by a 1 to 11 second timed closure of remote contacts connected to these terminals. The signal will only be accepted when the control centre is in the "REMOTE" operating mode.

An accepted signal will adjust the leaving chilled water temperature up to 11°C upwards from the locally programmed value. Unit capacity will be adjusted to achieve the new setting of leaving chilled water temperature, providing the compressor motor current is below the current limit setpoint.

A one-second pulse corresponds to no offset and therefore no adjustment of the preprogrammed leaving chilled liquid temperature setpoint. An eleven second pulse corresponds to the locally preprogrammed maximum allowable offset (5.5'C or 11.1'C) above the leaving chilled water temperature setpoint. The amount of offset varies linearly with pulse-width.

An EMS / BAS interface card option is available to allow remote reset of the leaving water temperature setpoint using a 4 to 20 mAdc. current signal, a 0 to 1O Vdc signal, or a single contact closure.

4.21.8 Remote Current Limit Setpoint
(RCSP - TB2: Terminals 1 & 20)

The motor current limit setpoint can be adjusted remotely by a 1 to 11 second timed closure of remote contacts connected to these terminals. The input signal will only be accepted when the control centre is in the "REMOTE" operating mode. An accepted signal will set the motor current between 100% and 40% of full load amps. Unit capacity control will remain from the leaving chilled water temperature, providing the current limit setpoint is satisfied. If the compressor motor current exceeds the current limit setpoint, it will override the temperature control system to reduce unit capacity.

A one-second pulse corresponds to 100% full load amperes and an eleven-second pulse corresponds to 40% of full load amperes. The current limit setpoint varies linearly from 100% to 40% as the pulse-width changes from 1 to 11 seconds.

An EMS / BAS interface card option is available to allow remote adjustment of the Current Limit setpoint using a 4 to 20 mAdc. current signal, a 0 to 1O Vdc signal, or a single contact closure.

4.22 Status Connections

Wiring to the status volt free contacts requires a supply provided by the customer. Particular care must be taken deriving the supplies for the volt free terminals with regard to a common point of isolation. These circuits when used must be fed via the common point of isolation so that the voltage is removed when the common point of isolation to the unit is opened.

WARNING

In accordance with EN 60204 it is recommended that the customer wiring to these terminals uses orange wires. This will ensure that circuits not switched off by the unit supply disconnecting device are distinguished by colour so that they can easily be identified as live even when the unit disconnecting device is off.

CAUTION

Unless otherwise stated the volt-free contacts are rated at 5 amps resistive at 250 Vac and 30 Vdc, 2 amp inductive (0.4 pf) at 250 Vac and 30 Vdc. All inductive devices (relays) switched by the volt-free contacts must have their coil suppressed using standard R/C suppressors.

4.22.1 Remote Mode Ready to Start Status
(RMR/S - TB4: terminals 26 & 27)

When closed, these contacts signify the control centre is in "REMOTE" operating mode, allowing the energy management system or the remote start/stop to control the unit. Holding the Remote Stop Contact open, and momentarily closing the Remote Start will now start the unit.

4.22.2 Cycling Shutdown Status
(C/S - TB4: terminals 40 & 41)

When closed, these contacts signify the unit is not permitted to start due to one or more cycling conditions. The cycling shutdown contacts function in all operating modes.

4.22.3 Safety Shutdown Status
(S/S - TB4: terminals 42 & 43)

When closed, these contacts signify the unit is not permitted to start due to one or more safety controls. A closure of the safety shutdown contacts means that the operator must manually reset and restart the unit. Safety shutdown contacts function in any operating mode, remote, local and service.

4.22.4 System Operating Status
(RUN - TB5, terminals 35 & 36)

When closed these contacts signify that the unit is operating.

4.23 Pump Control Connections

The control centre provides connections to allow automatic control of both the chilled and condenser water pumps.

4.23.1 Chilled Water Pump (CWP - TB4 terminals 44 & 45)

Internal volt free contacts between terminals 44 and 45 on TB4 can be used to control the pump starter via a separate customer supply. The pump is started 30 seconds before compressor start and runs during compressor operation, coast-down and during LWT cycling shutdowns.

4.23.2 Condenser Water Pump Starter
(CPMSS - TB5, Terminals 2 & 24)

Connections are provided to allow automatic control of the condenser water pump motor starter (CPMSS) by the control centre. The pump motor starter holding coil should be suitable for 115 Vac. The power requirement for the pump motor starter and the compressor motor starter must be a maximum of 2 amps holding and 10 amps inrush. If power requirement exceeds this, a control relay of suitable rating should be used between the unit and the pump starter.

4.24 Thermal Insulation

(See Product Drawings Form 160.47-PA1)

NOTE

DO NOT field insulate until the unit has been leak tested under the supervision of the York representative.

Insulation of the type specified for the job, or minimum thickness to prevent sweating of 0°C (30°F) surfaces should be furnished (by others) and applied to the cooler shell, end sheets, liquid feed line to flow chamber, compressor suction connection, and cooler liquid heads and connections. The liquid head flange insulation must be removable, to allow head removal for the tube maintenance. Details of areas to be insulated are given on the Product Drawing.

Units are furnished factory anti-sweat insulated on order at additional cost. This includes all low temperature surfaces except the two (2) cooler liquid heads.

4.25 Installation Check

After the unit is installed, piped and wired the services of a York representative should be requested to check the installation and supervise the initial start-up and operation on all chillers.

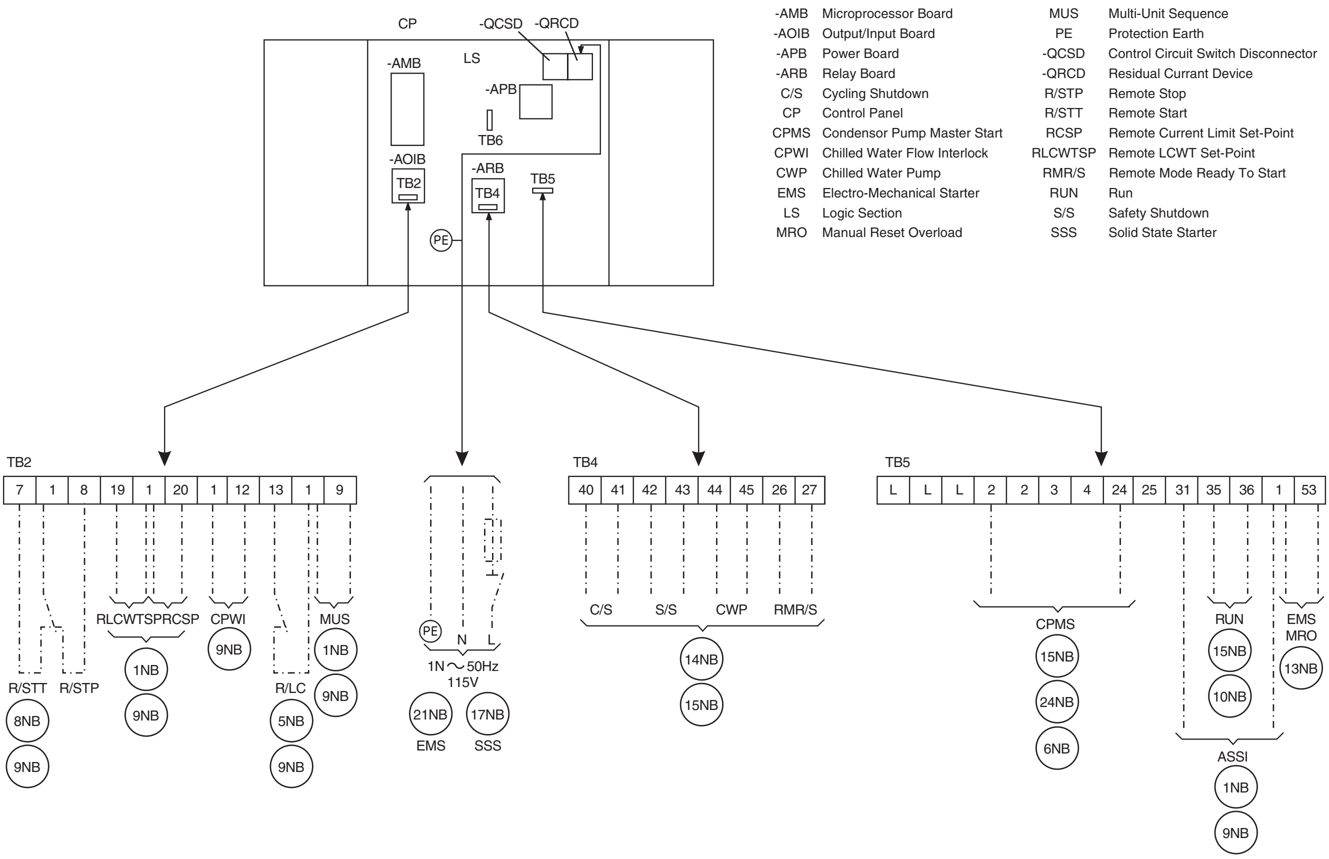


Figure 4.8 Customer Connections

NOTES	
1	THIS WIRING DIAGRAM DESCRIBES THE STANDARD ELECTRONIC CONTROL SCHEME FOR USE WITH AN ELECTROMECHANICAL STARTER EMS, OR SOLID STATE STARTER (SSS). FOR DETAILS OF STANDARD MODIFICATIONS, REFER TO PRODUCT FORM 160.47-PA11.
5	TO CYCLE UNIT ON AND OFF AUTOMATICALLY WITH CONTACTS OTHER THAN THOSE SHOWN. INSTALL A CYCLING DEVICE BETWEEN TERMINALS 1 & 13 (SEE NOTE 9). IF A CYCLING DEVICE IS INSTALLED, JUMPER MUST BE REMOVED BETWEEN TERMINALS 1 & 13.
6	COMPRESSOR MOTOR STARTER WITH STARTER INTERLOCK CONTACTS (RATED 0.2 AMPS @120 VOLTS A.C.) MUST BE PER FORM 160.47-PA12. CONTROL PANEL SHALL BE GROUNDED.
8	TO STOP UNIT AND NOT PERMIT IT TO START AGAIN INSTALL A STOP DEVICE BETWEEN TERMINALS 1 & 8. (SEE NOTE 9). A REMOTE START -STOP SWITCH MAY BE CONNECTED TO TERMINALS 1,7 5 8 (SEE NOTE 9). REMOTE START-STOP SWITCH IS OPERATIVE ONLY IN THE "REMOTE" OPERATING
9	DEVICE CONTACT RATING TO BE 5 MILLIAMPERES AT 115 VOLTS A.C.
10	CONTACT RATING IS 5 AMPS RESISTIVE AT 120 VOLTS A.C. OR 240 VOLTS A.C.
13	FOR HIGH AND LOW VOLTAGE UNITS, THE FACTORY SUPPLIED JUMPER BETWEEN 1 & 53 MUST BE REMOVED WHEN ELECTROMECHANICAL STARTER OVERLOADS AND/OR SAFETY DEVICES ARE USED. FOR HIGH VOLTAGE (2300-4160) UL AND CSA APPROVED UNITS ONLY. ELECTROMECHANICAL COMPRESSOR M
14	CONTACT RATING IS 5 AMPS RESISTIVE @250 VOLTS A.C. AND 30 VOLTS D.C., 2 AMP INDUCTIVE (0.4 PF) @ 250 VOLTS A.C. & 30 VOLTS D.C.
15	EACH 115VAC FIELD-CONNECTED INDUCTIVE LOAD; I.E., RELAY COIL, MOTOR STARTER COIL, ETC. SHALL HAVE A TRANSIENT SUPPRESSOR WIRED IN PARALLEL WITH ITS COIL, PHYSICALLY LOCATED AT THE COIL. SPARE TRANSIENT SUPPRESSORS AND CONTROL CIRCUIT FUSES ARE SUPPLIED IN
17	FIELD CONNECTED CONTROL POWER SUPPLY IS NOT REQUIRED, AS CONTROL TRANSFORMER IS SUPPLIED ON THE SOLID STATE STARTER.
21	ALL SOURCES OF SUPPLY SHOWN ON THIS DIAGRAM TO BE TAKEN FROM ONE MAIN ISOLATOR, NOT SHOWN OR SUPPLIED BY YORK.
24	MAX. ALLOWABLE CURRENT DRAW FOR THE SUM OF ALL LOADS IS 2 AMPS HOLDING, 10 AMPS INRUSH.

5 COMMISSIONING

5.1 Preparation

CAUTION

Commissioning of this unit should only be carried out by York authorised personnel.

The Operating Instruction manual must be read in conjunction with this section.

Preparation - Power Off

The following checks should be made with the customer supply/supplies to the unit switched off.

Inspection: Inspect unit for installation damage. If found take action and/or repair as appropriate.

Valves: Open the oil separator valve, liquid line service valve, oil system, unloader and liquid injection service valves.

Compressor Coupling Alignment: Verify that the compressor drive coupling is correctly aligned.

Refrigerant Charge: Units are normally shipped as standard with a full refrigerant operating charge. Check that refrigerant is present and that no leaks are apparent (the refrigerant level should be in the middle of the evaporator sight glass). If no refrigerant is present a leak test must be undertaken, the leak(s) located and repaired. Repaired systems and units supplied with a nitrogen holding charge must be evacuated with a suitable vacuum pump/recovery unit as appropriate (refer to Section 7 for details).

Oil System: Check the oil system is correctly charged and the oil level is visible in the upper sight glass on the oil separator.

Isolation/Protection: Verify that all sources of electrical supply to the unit are taken from a single point of isolation.

Control Panel, Motor Terminal Box or Solid State Starter: Check the panels to see that they are free of foreign materials (wire, metal chips, etc.) and clean out if required.

Power connections: Check the customer power cables are connected correctly.

Earthing: Verify that the units protective terminal(s) are properly connected to a suitable earthing point. Ensure that all unit internal earth connections are tight.

Supply voltage: Verify that the site voltage supply corresponds to the unit requirement and is within the limits given on the unit data plate.

The customers disconnection devices can now be set to ON.

WARNING

The machine is now live!

Oil Heater: Verify the oil heater is energised for at least 24 hours prior to start-up.

Compressor Motor: Check the phase rotation sequence of the incoming supply corresponds to the required rotation for the motor.

Water/Glycol system(s): Verify that the cooling and chilled water systems have been installed correctly, and commissioned with the correct direction of water flow through the condenser and cooler. Purge air from the top of the condenser and cooler using the plugged air vents.

Flow switch(es): Verify a chilled water flow switch is correctly fitted in the customer's pipework on the cooler outlet, and wired into the control panel.

Temperature sensor(s): Ensure the temperature sensors are coated with heat conductive compound (Part No. 013-00890-000) and inserted into the sensor pockets.

Programmed options: Verify that the options factory programmed into the control centre are in accordance with the customers order requirements. Refer to the Operating Instructions for details.

Programmed settings: Ensure the system setpoints, cut-outs and operational settings are in accordance with the instructions given in the Operating Instructions.

Date & time: Programme the date and time (see Operating Instructions).

Start/Stop schedule: Programme the daily and holiday start/stop (see Operating Instructions).

5.2 First Time Start-up

NOTE

During the commissioning period there should be sufficient heat load to run the unit under stable full load operation to enable the unit controls, and system operation to be set up correctly and a commissioning log taken. Read the following section in conjunction with the control centre Operating Instructions and Section 6.

Interlocks: Verify that water is flowing through the cooler and that heat load is present. Ensure that any remote run interlocks are in the run position and that the run schedule requires the unit to run or is overridden.

Start-up: Start the unit in accordance with Section 6 and be ready when the compressor starts to switch the unit off immediately if any unusual noises or other adverse conditions develop.

Operation: Check the system operating parameters are normal by selecting the various readouts of pressure, temperature, etc on the control centre.

Oil Level: After operation on full load for around half an hour, recheck the separator oil level. The level should be visible in the first stage sight glass. Add or drain oil as necessary to achieve this level. No oil level should be visible in the second stage sight glass.

Superheat: The suction superheat at the compressor can be assessed by checking the discharge temperature. The discharge temperature should always be at least 8°C above discharge saturated on temperature, but never more than 100°C.

Refrigerant Charge: If stable full load operation can be achieved at design conditions, than the refrigerant charge should be trimmed to give the correct split temperatures across the heat exchangers. The level this charge represents in the evaporator sight glass (after shutdown and temperature equalisation) should be recorded for reference.

6 OPERATION

CAUTION

If the oil heater is de-energised during a shutdown period, it must be energized for 24 hours prior to starting the compressor.

6.1 General

YS chillers are designed to work independently, or in conjunction with other equipment via a York ISN building management system or other automated control system. The compressor can be started and loaded as required using a range or input signals to achieve the desired cooling effect. This section describes the normal procedures for operation of the unit and should be read in conjunction with the control centre Operation Instruction.

6.2 Pre-Startup

Prior to starting the chiller, observe the control centre. Make sure the display reads **SYSTEM READY TO START**.

The internal clock, all the control setpoints and any other required settings, eg., daily schedule, should be programmed before the unit is started. (Refer to Control Centre Operation Instruction).

If the chilled water pump is manually operated, start the pump, the control centre will not allow the unit to start unless chilled liquid flow is established through the unit. If the chilled liquid pump is wired to the control centre the pump will automatically start.

6.3 Start-up

1. To start the chiller, press the compressor **START** switch. This switch will automatically spring return to the **RUN** position. When the start switch is energised, the control centre is placed in an operating mode and any fault will be shown by a display message.

NOTE

Any faults which occur during STOP/RESET are also displayed.

NOTE

The slide valve is returned to the unload position automatically when the unit is shut down to prevent loading the compressor on start-up.

When the unit starts, the following automatic sequences are initiated: (Refer to Figure 6.1 Starting & Shutdown Sequence).

1. The control centre display message will read **SYSTEM START SEQUENCE INITIATED** for the first 30 seconds of the starting sequence.

2. The measured oil and evaporator pressures are compared during system equalization so that any offset is stored for use in calculating deferential trip points during compressor operation.

3. The chilled liquid pump contacts close starting the chilled liquid pump to allow liquid flow through the cooler. The chilled water flow switch is bypassed for the first 25 second of the start sequence.

4. After 30 seconds of start sequence operation, the compressor will start. While the motor is accelerating to full speed the control centre display will read: **SYSTEM RUN - CURRENT LIMIT IN EFFECT**.

5. When the motor reaches full speed and the current falls below 100% FLA the message will read: **SYSTEM RUN - LEAVING TEMP. CONTROL**.

6. The anti-recycle timer begins after the 30 seconds of pre-run time. The timer will run for 30 minutes after the compressor starts. If the unit shuts down during this period of time it cannot be started until the timer completes the 30 minute cycle.

NOTE

For display messages and information pertaining to operation, refer to the control centre Operating Instruction.

6.4 Normal Operation

After the compressor reaches its operating speed the slide valve will begin to load, under the control of the control Centre, based on the leaving chilled liquid temperature. The unit capacity will vary to maintain the leaving chilled liquid temperature at the programmed setpoint. A drop in chilled liquid temperature will cause the slide valve to unload to decrease unit capacity. When the chilled liquid temperature rises, the slide valve loads the compressor and increases the unit capacity.

The compressor motor current will be limited to a programmable maximum during the unit operation. The control centre can be programmed in various ways to limit the motor current to between 40 and 100% of Full Load Current as required (see the control centre Operation Instruction for more details).

While the compressor is running a wide variety of system parameters are monitored automatically by the control centre. These can be accessed and displayed as required via the control centre keypad and display. If any problems are detected the cause will be shown on the display and the appropriate action will be taken, eg reducing slide valve loading, giving a warning message, or shutting down the unit.

6.5 Shutdown

During normal operation the unit may shut down for a number of reasons such as low load, scheduled daily shutdowns and multi unit cycling. In each case the control centre display will indicate the reason for the shutdown. For example, if during operation the control centre has unloaded the compressor completely and load continues to fall, the unit will be shut down and the display will read: **DAY-TIME - LOW WATER TEMPERATURE - AUTOSTART**.

This occurs when the leaving water temperature falls to 2.2°C below setpoint or 2.2°C, whichever is higher. "Autostart" indicates that the unit will restart automatically if the water temperature rises again.

If the unit is shut down because a problem has been detected by the control centre, a similar type of message will be displayed indicating the nature of the problem (see control centre Operation Instruction, for more information).

When the unit is shutdown, the slide valve will close automatically to minimise load on the compressor motor during startup. A minimum of two minutes after shutdown is required for system pressure equalisation before the compressor will be allowed to restart.

6.6 Manual Shutdown

To stop the unit manually:

1. Push the COMPRESSOR "STOP/RESET" switch. The control centre display will show: **2.0 MIN. LOCKOUT DELAY**. This prevents compressor restart until system equalization is achieved.

2. Stop the chilled water pump (if not wired into the control centre, in which case it will shut off automatically.)

3. Open the switch to the cooling tower fan motors, if used.

NOTE: The compressor sump oil heater (thermostatically controlled) is energised when the unit is stopped.

6.7 Prolonged Shutdowns

If the unit is to be shut down for an extended period of time (for example, over the winter season), the following procedure should be followed:

1. If freezing temperatures are likely to be encountered while the system is idle, carefully drain the cooling water from the cooling tower, condenser, condenser pump, and the chilled water system, chilled water pump and cooler. Open the drains on the cooler and condenser liquid heads to assure complete drainage. If a Solid State Starter is fitted drain water from starter cooling loop.

2. Move jumper J-57 on the microprocessor board to the OFF position to conserve the battery (see control centre Operation Instruction).

3. Open the main disconnect switches to the compressor motor, condenser water pump and the chilled water pump. Open the 115 Vac circuit to the control centre.

To return the unit to operation is the reverse of this procedure, however, after a prolonged shutdown it will be necessary to replace all of the oil and install a new oil filter element. This should only by done by suitably qualified personnel.

6.8 Operating Inspections

By following a regular inspection schedule any potential problems with the unit can be identified early and attended to before serious operating difficulties occur. The following list of inspections and procedures should be used as a guide. In all cases the inspections should only be carried out by properly trained personnel. If a problem is identified, no attempt should be made to carry out any repairs unless properly qualified and equipped to do so. Where appropriate, refer to the control centre Operation Instruction for correct keypad operation to access data on the control centre display.

Daily

1. **Check the bearing oil pressure**: The actual bearing oil pressure will vary with compressor suction and discharge pressures. When a new system is first operated under normal full load conditions, the bearing oil pressure should be recorded as a reference point with which to compare subsequent readings.

2. **Check Oil Pressure Display**: The oil and oil filter transducers are compared during compressor operation. If the differential filter pressure exceeds 140 kPa for 5 seconds, the message **WARNING - DIRTY OIL FILTER** is displayed. If the differential filter pressure exceeds 170 kPa for 5 seconds, the unit shuts down and the displayed message is **CLOGGED OIL FILTER**. A gradual decrease in bearing pressure of 30 to 60 kPa (with constant suction and discharge pressures) may be an indication of a dirty filter. The filter should be replaced when pressure loss is 30% of the original pressure.

3. **Check the oil level in the oil separator reservoir**: The correct oil level is half way up the sight glass but this may vary depending on load. The level should not disappear from the sight glass.

4. Check entering and leaving condenser water temperatures and condenser pressure for comparison with design conditions.

5. Check the entering and leaving chilled liquid temperatures and evaporator pressure for comparison with design conditions.

6. **Check the compressor discharge temperature**: During normal operation discharge temperature should not exceed 100°C

7. **Check the compressor motor voltage and current**: At the Electro Mechanical Starter or on the control centre display for units with a Solid State Starter.

8. Check for any signs of dirty or fouled condenser tubes. The temperature difference between water leaving condenser and liquid refrigerant leaving the condenser should not exceed the difference recorded for a new unit by more than 2.2°C.

9. Check water treatment is correct.

10. Any time the control centre display indicates **PRESS STATUS KEY**, do so to read any warning messages to be displayed.

6.9 Operating Log Sheet

An accurate record of system operating conditions (temperatures and pressures) recorded at regular intervals throughout each 24 hour operating period should be kept. An optional status printer is available for this purpose using automatic data logging after programming the **DATA LOGGER** function.

The record of readings serves as a valuable reference for operating the system. Readings taken when a system is newly installed will establish normal conditions with which to compare later readings. A sample log sheet is provided opposite, listing the appropriate unit information which should be recorded regularly.

6.10 Maintenance and Service

Units are not generally user serviceable and no attempt should be made to rectify any faults found with the unit unless suitably qualified and equipped to do so. If the unit is malfunctioning in any manner, or the unit is stopped by one of the safety controls, consult Section 8. After repair or adjustment if the compressor cannot be started or the particular fault continues to affect the performance of the unit, please call the nearest York Office. Failure to report recurring problems or continued operation of a malfunctioning unit may lead to personal injury or damage to the unit.

6.10.1 Normal and Safety System Shutdowns

Normal and safety system shutdowns have been built into the unit to protect it from damage during certain operating conditions. The unit will be stopped automatically by controls that respond to high temperatures, low temperatures, and low and high pressures, etc. These safety shutdowns require the operator to manually reset the control centre prior to restarting the unit.

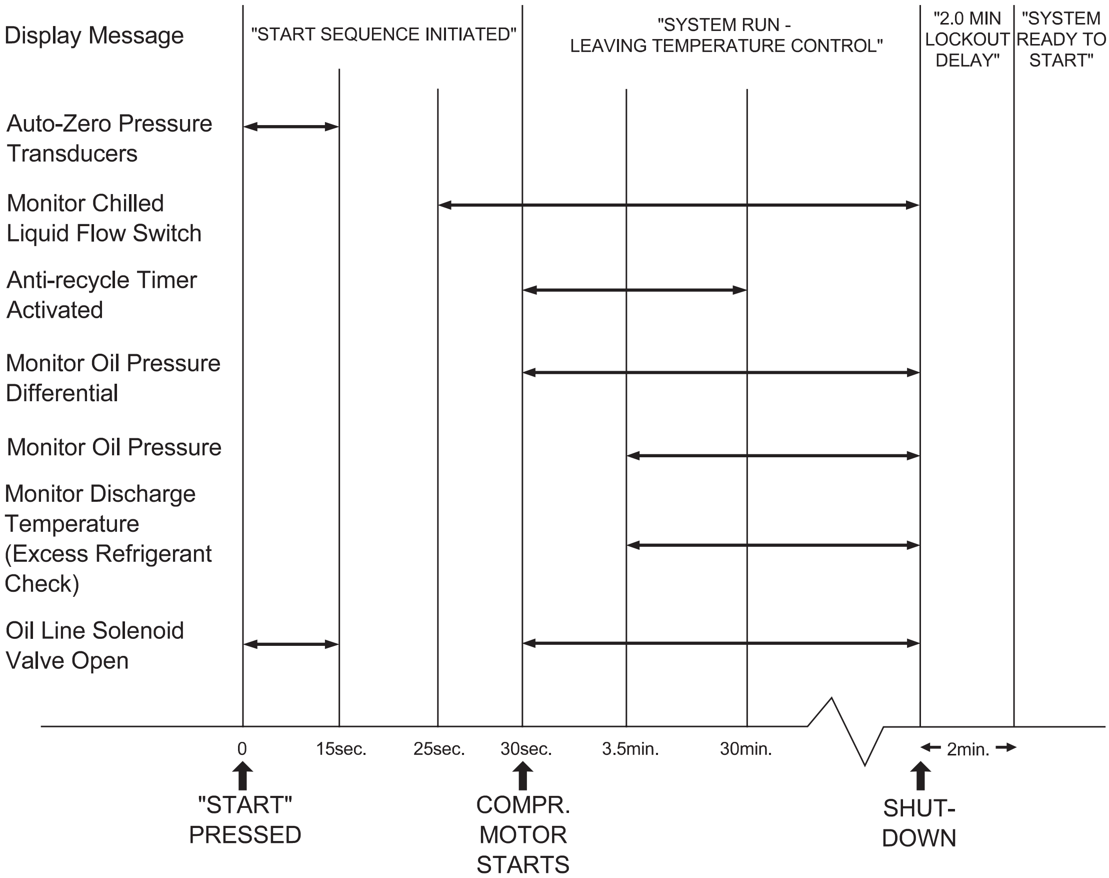


Figure 6.1 Start-up, Operation and Shutdown Sequence

Date									
Time									
Hour Meter Reading									
Outside Ambient Temperature			DB deg C						
			WB deg C						
Compressor	Oil Level		SG U/L %						
	Oil Pressure		bara						
	Oil Temperature		deg C						
	Suction Temperature		deg C						
	Discharge Temperature		deg C						
	Oil Filter Differential Pressure		bar						
	Slide Valve Position		%						
Motor	Line Voltage		volts						
	Current		amps						
Evaporator	Refrigerant Pressure		bara						
	Chilled Liquid	Inlet Temperature	deg C						
		Outlet Temperature	deg C						
		Inlet Pressure	kPa						
		Outlet Pressure	kPa						
		Flow Rate	ltr/s						
Condenser	Refrigerant Pressure		bara						
	Liquid Outlet Temperature		deg C						
	Water	Inlet Temperature	deg C						
		Outlet Temperature	deg C						
		Inlet Pressure	kPa						
		Outlet Pressure	kPa						
		Flow Rate	ltr/s						

Figure 6.2 Log Sheet

7 MAINTENANCE

WARNING

The Safety Section of this manual should be read carefully before attempting any maintenance operations on the unit. This section should be read in conjunction with the control centre Operation Instruction.

The units have been designed to operate continuously provided they are regularly maintained and operated within the limitations given in this manual. Each unit should be included in a routine schedule of daily inspection checks by the operator/ customer (see Section 6), backed up by regular service inspection and maintenance visits by a suitably qualified Service Engineer.

It is entirely the responsibility of the owner to provide for these regular maintenance requirements and/or enter into a maintenance agreement with York International to protect the operation of the unit. If damage or a system failure occurs due to improper maintenance during the warranty period, York shall not be liable for costs incurred to return the unit to satisfactory condition.

This maintenance section applies only to the basic YS unit and may, on individual contracts, be supplemented by additional requirements to cover any modifications or ancillary equipment as applicable.

7.1 Scheduled Maintenance

The table on the following page lists the regular maintenance operations which should be carried out by a suitably qualified Service Engineer.

The interval necessary between each 'minor' and 'major' service can vary depending on, for example, application, site conditions and expected operating schedule. Normally a 'minor' service should be carried out every three to six months and a 'major' service at least once a year. It is recommended, however, that York Service is contacted for recommendations for individual sites.

7.1.1 Check the oil and refrigerant levels - Weekly

The refrigerant charge must be checked with the unit shut down and all pressures and temperatures equalised between the evaporator and condenser. The level should be half way up the evaporator sight glass.

The oil charge should be checked after operation on full load for around half an hour. The level should be visible in the first stage sight glass. Add or drain oil as necessary to achieve this level. No oil level should be visible in the second stage sight glass.

7.2 Special Maintenance Requirements

In addition to the regular maintenance schedule, there are some further special requirements for maintenance of the unit based on the number of operating hours from initial start-up:

At 200 hours of operation:

- Check operating temperatures / pressures
- Check chemical condition of oil
- Change oil filter elements
- Change oil return strainers
- Check drive coupling
- Check compressor / motor alignment
- Check vibration levels

At 1000 hours of operation:

- Check operating temperatures / pressures

At 5000 hours of operation:

- Check operating temperatures / pressures
- Check chemical condition of oil
- Change oil filter elements
- Change oil return strainers
- Change oil
- Check drive coupling
- Check compressor / motor alignment

At 30,000 hours of operation:

- Replace compressor shaft seal

At 50,000 hours of operation:

- Compressor internal inspection

For practical reasons it is not necessary to carry out these maintenance operations at the exact operating hours specified. The work should, however, be carried out slightly before rather than after the specified hours.

The calendar time taken to reach the number of operating hours specified above will vary significantly depending on operating schedule. If a maintenance operation given above closely coincides with, or has been recently been completed as, part of the regular scheduled maintenance then the operation need not be repeated.

7.3 Regular Maintenance Operations

Service Schedule	MINOR SERVICE (3 - 6 monthly) *	MAJOR SERVICE (6 - 12 monthly) * All items under Minor Service plus:
General	Check thermal insulation Check vibration isolators	Check main structure Check paint-work Check vibration levels
Refrigerant Systems	Check relief valves Check for pipework damage Check for leaks Check operating temps./press. Check suction superheat Check liquid subcooling	Pressure test complete system Check chemical condition of system
Oil System	Check oil level Check oil pressure Check oil differential pressure Change oil filter element Check eductor nozzles Change oil return strainers Check oil heater Check chemical condition of oil	Change oil Check solenoid valves
Compressor	Check unloader operation	Check drive coupling Check compressor / motor alignment
Drive Motor	Check mounting bolts	Clean air passages Clean windings Megger test Lubricate bearings
Evaporator & Condenser		Clean water strainers Check tubes Check end sheets Mechanically brush condenser tubes. Verify evaporator and condenser water flow rates against design conditions.
Power & Control System	Check panel condition Check mains and control wiring Check sensors Check mechanical HP cut-outs Check emergency stop Check 3-phase voltage and current balance	Check all connections Check compressor contactors / SSS Check sensor / transducer calibration Check motor protectors
Microcomputer	Check fault history Check program settings Check HP / LP cut-out functions Check load / unload function	Check ambient cut-out function Check low oil pressure function

* Service interval depends on operational requirements - please contact York for individual site recommendations .

7.4 Oil Filters and Strainers

The oil return system ensures that oil removed from the discharge gas by the oil separator and oil reaching the evaporator are returned to the compressor effectively. The return system is in three sections, each with its own strainer/filter elements:

7.4.1 Separator Oil Return (First Stage)

The oil return from the first stage of the oil separator reservoir is fitted with twin replaceable cartridge filters. A change over valve system keeps one filter in operation and one on stand-by. The stand-by filter element can be cleaned/ changed whilst the unit is in operation.

To replace the filter proceed as follows:

1. Check commuter valve is closed (in).
2. Each filter is equipped with a small valve which should be used to relieve the pressure within the filter via a suitable refrigerant recovery unit. Relieve the pressure slowly and carefully.
3. Use a spanner on the hexagonal boss on the bottom of the housing to remove the filter element. Inspect the element for foreign materials and, provided none are found, discard the filter element. Clean the inside of the housing and install a new filter element. Reinstall the filter on the unit.
4. Evacuated the air from the filter via the small valve mounted on the filter.
5. Open commuter valve (out one or two turns only) to fill element with oil then re-close commuter valve .

7.4.2 Oil Return (Secondary Stage)

The oil return from the second stage of the oil separator is fitted with a single strainer between the separator and the restrictor orifice.

To replace the strainer proceed as follows:

1. Close the stop valves on both sides of the strainer.
2. Check each eductor orifice is clear.
3. Replace filter.
4. Purge lines then open all stop valves.

7.4.3 Evaporator Oil Return (Eductors)

High pressure condenser gas flows continuously through two eductors mounted on top of the evaporator inducing the low pressure, oil rich liquid to flow from the evaporator, through the strainer to the compressor suction.

To replace the strainer proceed as follows:

1. Close the stop valves on both sides of the eductor / strainer assembly.
2. Carefully remove thermal insulation from around strainers and eductor block as necessary.
3. Check each eductor orifice is clear.
4. Replace filter.
5. Purge lines then open all stop valves.
6. Replace thermal insulation using suitable insulation adhesive.

7.5 Oil Charging

S2, and S3 compressors require approximately 38 litres of oil and S4 and S5 compressors require approximately 76 litres of oil, the actual amount of oil required depends on the compressor/ separator combination and the condition of the refrigerant. The actual operating level in the separator should be kept from exceeding the top of the highest sight port. All units use York Grade 'H' oil.

7.5.1 Oil charging procedure

The oil should be charged into the oil separator using the York Oil Charging Pump (Part No. 070- 10654).

To charge oil proceed as follows:

1. If the oil charging is to restore the correct oil level the unit may be kept in operation. If the oil charge is being replaced the unit must be shut down and the supply switched off to prevent operation of the oil heater.
2. Immerse the suction connection of the oil charging pump in a clean container of new oil and connect the pump discharge connection to the oil charging valve. Do not tighten the connection at the charging valve until after the air is forced out by pumping a few strokes of the oil pump. This fills the lines with oil and prevents air from being pumped into the system.

3. Open the oil charging valve and pump oil into the system until oil level in the oil separator is about midway in the upper sight glass. Then, close the charging valve and disconnect the hand oil pump.

4. As soon as oil charging is complete, close the power supply to the starter to energise the oil heater. This will keep the concentration of refrigerant in the oil to a minimum.

Draining the oil

1. If the oil draining is to restore the correct oil level the unit may be kept in operation. If the oil charge is being replaced the unit must be shut down and the supply switched off to prevent operation of the oil heater.

2. If possible run the unit at full load for a short period to recover most of the oil in the system to the oil separator.

3. Drain the oil into a suitable container from the oil charging valve on the bottom of the oil separator.

4. Dispose of old oil according to local regulations for the disposal of oily wastes.

7.6 Refrigerant Charge

The refrigerant system is pressure tested and evacuated at the factory.

7.6.1 Checking The Refrigerant Charge

The refrigerant level should have been observed and the level recorded after initial charging. With the correct charge the level should visible in the sight glass.

NOTE: The refrigerant charge should always be checked and trimmed when the system is shut down.

The refrigerant charge level must be checked after the pressure and temperature have equalised between the condenser and cooler. This would be expected to be 4 hours or more after the compressor and water pumps are stopped.

7.6.2 Leak Testing

After the system has been charged, the system should be carefully leak tested with a R134a compatible leak detector to ensure all joints are tight.

If any leaks are indicated, they must be repaired immediately. Usually, leaks can be stopped by tightening flare nuts or flange bolts. However, for any major repair, the refrigerant charge must be removed.

7.6.3 Vacuum Testing

Vacuum testing should be conducted as follows:

1. Connect a high capacity vacuum pump, with indicator, to the system charging valve and start the pump.

2. Open wide all system valves. Be sure all valves to the atmosphere are closed.

3. Operate the vacuum pump until a wet bulb temperature of 0°C or a pressure of 5 mm Hg (absolute) is reached.

4. To improve evacuation circulate warm water (not to exceed 50°C) through the cooler and condenser tubes to thoroughly dehydrate the shells. If a source of hot water is not readily available, a portable water heater should be employed. **DO NOT USE STEAM**. A suggested method is to connect a hose between the source of hot water under pressure and the cooler head drain connection, out the cooler vent connection, into the condenser head drain and out the condenser vent. To avoid the possibility of causing leaks, the temperature should be brought up slowly so that the tubes and shell are heated evenly.

5. Close the system charging valve and the stop valve between the vacuum indicator and the vacuum pump. Then disconnect the vacuum pump leaving the vacuum indicator in place.

6. Hold the vacuum in the system for 8 hours; the slightest rise in pressure indicates a leak or the presence of moisture, or both. If, after 8 hours the wet bulb temperature in the vacuum indicator has not risen above 4.4°C or a pressure of 6.3 mm Hg, the system may be considered tight.

Be sure the vacuum indicator is valved off while holding the system vacuum and be sure to open the valve between the vacuum indicator and the system when checking the vacuum after the 8 hour period.

7. If the vacuum does not hold for 8 hours within the limits specified, the leak must be found and repaired.

7.6.4 Refrigerant Charging

NOTE

When opening any part of the refrigerant system for repairs, the refrigerant charge must be removed. If the chiller is equipped with optional valves, the refrigerant can be isolated in either the condenser or evaporator / compressor while making repairs.

To prevent liquid freezing within the cooler tubes when charging an evacuated system, only refrigerant vapour must be added to the system until the system pressure is raised above the point corresponding to the freezing point of the cooler liquid. For water, the pressure corresponding to the freezing point is 58.9 kPa for R134a (at sea level).

NOTE

While charging, care must be taken to prevent moisture laden air from entering the system.

Make up a suitable charging connection from new copper tubing to fit between the system charging valve and the fitting on the charging drum. This connection should be as short as possible but long enough to permit sufficient flexibility for changing drums. The charging connection should be purged each time a new container of refrigerant is connected and changing containers should be done as quickly as possible to minimise the loss of refrigerant.

7.7 Condenser and Cooler

Maintenance of condenser and cooler shells is important to provide trouble free operation of the chiller. The water side of the tubes in the shell must be kept clean and free from scale. The following recommendation should be followed in determining the condition of the water side of the condenser and cooler tubes.

1. The condenser tubes should be cleaned annually or earlier if conditions warrant. If the temperature difference between the water off the condenser and the condenser liquid temperature is more than 4° greater than the difference recorded on a new unit, it is a good indication that the condenser tubes require cleaning.

2. The cooler tubes under normal circumstances will not require cleaning. If however the temperature difference between the refrigerant and the chilled water increases slowly over the operating season, it is an indication that the cooler tubes may be fouling or that there may be a water by-pass in the water box requiring gasket replacement or refrigerant may have leaked from the chiller.

7.7.1 Chemical Water Treatment

Since the mineral content of the water circulated through the cooler and condenser varies with almost every source of supply, it is possible that the water being used may corrode the tubes or deposit heat resistant scale in them. Reliable water treatment will greatly reduce the corrosive and scale forming properties of almost any type of water.

As a preventive measure against scale and corrosion and to prolong the life of cooler and condenser tubes, a chemical analysis of the water should be made preferably before the system is installed. A water treatment expert should be consulted to determine whether water treatment is necessary, and if so, to furnish the proper treatment for the particular water condition.

7.7.2 Tube Cleaning

Cooler

It is difficult to determine by any particular test whether possible lack of performance of the water cooler is due to fouled tubes alone or due to a combination of troubles. Trouble which may be due to fouled tubes is indicated when, over a period of time, the cooling capacity decreases and the split (temperature difference between water leaving the cooler and the refrigerant temperature in the cooler) increases. A gradual drop-off in cooling capacity can also be caused by a gradual leak of refrigerant from the system or by a combination of fouled tubes and shortage of refrigerant charge. An excessive quantity of oil in the cooler can also contribute to erratic performance.

Condenser

Condenser trouble due to fouled tubes is usually indicated by a steady rise in head pressure, over a period of time, accompanied by a steady rise in condensing temperature, and noisy operation. These symptoms may also be due to foul gas build-up. Purging will remove the foul gas revealing the effect of fouling.

Tube Fouling

Fouling of the tubes can be due to deposits of two types as follows:

1. **Rust or sludge** - which finds its way into the tubes and accumulates there. This material usually does not build up on the inner tube surfaces as scale, but does interfere with the heat transfer. Rust or sludge can generally be removed from the tubes by a thorough brushing process.

2. **Scale** - due to mineral deposits. These deposits, even though very thin and scarcely detectable upon physical inspection, are highly resistant to heat transfer. They can be removed most effectively by circulating an acid solution through the tubes.

7.7.3 Tube Cleaning Procedures

Brush Cleaning of Tubes

If the tube consists of dirt and sludge, it can usually be removed by means of the brushing process. Drain the water sides of the circuit to be cleaned (cooling water or chilled water) remove the heads and thoroughly clean each tube with a soft bristle bronze or nylon brush. **DO NOT USE A STEEL BRISTLE BRUSH**. A steel brush may damage the tubes.

Improved results can be obtained by admitting water into the tube during the cleaning process. This can be done by mounting the brush on a suitable length of 1/8" pipe with a few small holes at the brush end and connecting the other end by means of a hose to the water supply.

NOTE

The tubes should always be brush cleaned before acid cleaning.

Acid Cleaning of Tubes

If the tubes are fouled with a hard scale deposit, they may require acid cleaning. It is important that before acid cleaning, the tubes be cleaned by the brushing process described above. If the relatively loose foreign material is removed before the acid cleaning, the acid solution will have less material to dissolve and flush from the tubes with the result that a more satisfactory cleaning job will be accomplished with a probable saving of time.

Acid cleaning should only be performed by an expert. Please consult your local water treatment representative for assistance in removing scale build-up and preventative maintenance programs to eliminate future problems.

7.7.4 Tube Leaks

Cooler and condenser tube leaks may result in refrigerant leaking into the water circuit, or water leaking into the shell depending on the pressure levels. If refrigerant is leaking into the water, it can be detected at the liquid head vents after a period of shutdown. If water is leaking into the refrigerant, system capacity and efficiency will drop off sharply.

If a tube is leaking and water has entered the system, the cooler and condenser should be valved off from the rest of the water circuit and drained immediately to prevent severe rusting and corrosion. The refrigerant system should then be drained and purged with dry nitrogen to prevent severe rusting and corrosion. If a tube leak is indicated, the exact location of the leak may be determined as follows:

1. Remove the heads and listen at each section of tubes for a hissing sound that would indicate gas leakage. This will assist in locating the section of tubes to be further investigated. If the probable location of the leaky tubes has been determined, treat that section in the following manner (if the location is not definite, all the tubes will require investigation).

2. Wash off both tube heads and the ends of all tubes with water.

3. With nitrogen or dry air, blow out the tubes to clear them of traces of refrigerant laden moisture from the circulation water. As soon as the tubes are clear, a cork should be driven into each end of the tube. Pressurise the dry system with 3.5 to 6.9 barg of nitrogen. Repeat this with all of the other tubes in the suspected section or, if necessary, with all the tubes in the cooler or condenser. Allow the cooler or condenser to remain corked up to 12 to 24 hours before proceeding. Depending upon the amount of leakage, the corks may blow from the end of a tube, indicating the location of the leakage. If not, it will be necessary to make a very thorough test with the leak detector.

4. After the tubes have been corked for 12 to 24 hours, it is recommended that two men working at both ends of the cooler carefully test each tube – one man removing corks at one end and the other at the opposite end to remove corks and handle the leak detector. Start with the top row of tubes in the section being investigated. Remove the corks at the ends of one tube simultaneously and insert the exploring tube for 5 seconds – this should be long enough to draw into the detector any refrigerant gas that might have leaked through the tube walls. A fan placed at the end of the cooler opposite the detector will assure that any leakage will travel through the tube to the detector.

5. Mark any leaking tubes for later identification.

6. If any of the tube sheet joints are leaking, the leak should be indicated by the detector. If a tube sheet leak is suspected, its exact location may be found by using a soap solution. A continuous buildup of bubbles around a tube indicates a tube sheet leak.

7.8 Electrical Controls

1. All electrical controls should be inspected for obvious malfunctions.

2. It is important that the factory settings of controls (operation and safety) are not changed. If the settings are changed without York approval, the warranty will be invalidated.

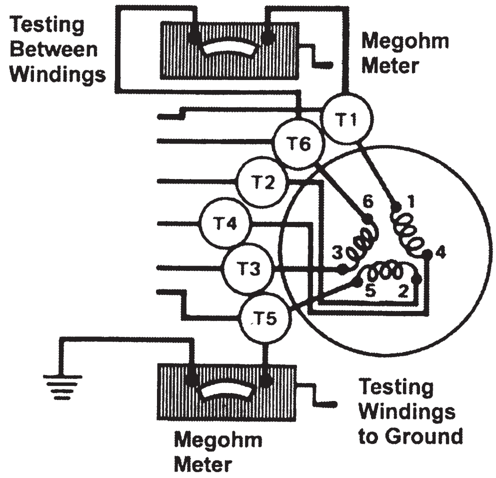
7.9 Testing Motor Winding Insulation

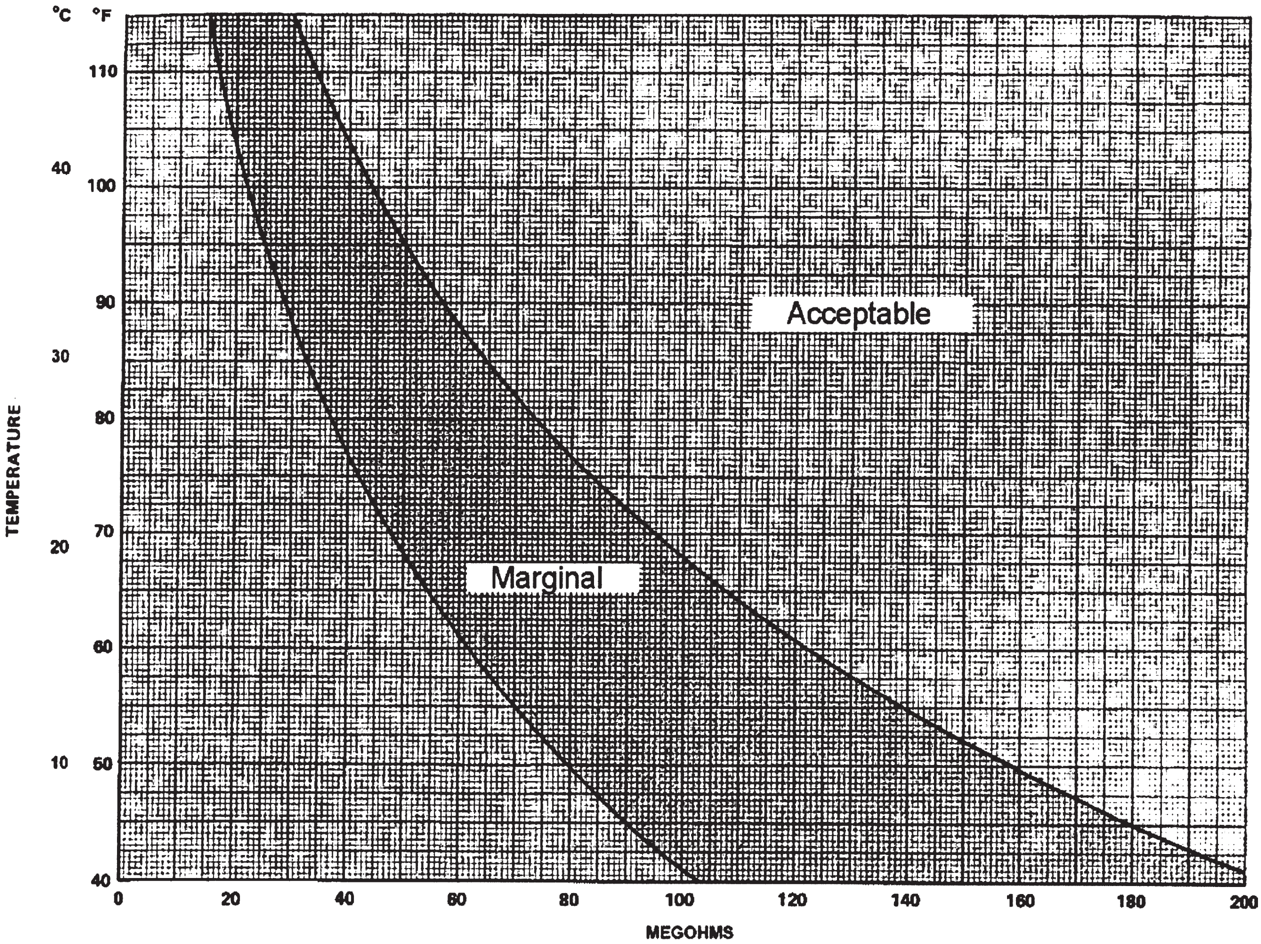
With the main disconnect switch and compressor motor starter open, test the motor as follows:

1. Test the insulation, using a megohm meter (megger), between phases and each phase and ground as shown; these readings are to be interpreted using the graph shown in below.

2. If readings fall below shaded area, remove external leads from motor and repeat test.

NOTE: Motor is to be megged with the starter at ambient temperature after 24 hours of idle standby.





8 TROUBLE SHOOTING

8.1 General Requirements

Units are not generally user serviceable and no attempt should be made to rectify any faults found with the unit unless suitably qualified and equipped to do so. If in any doubt, contact your local York Agent. To avoid personal injury or possible damage to the unit, the trouble shooting information given in the following section must only be used by competent service personnel using correct procedures and equipment.

8.2 Trouble Shooting

In any case where the control centre detects conditions or control functions requiring the unit to stop, it will shut down the unit and display the reason for the shutdown.

Most shutdowns will be due to normal cycling of the unit due to lack of load, scheduled off cycles etc., but others may be caused by an internal or external fault detected by the control centre. For a full description of the operation of each of these shutdown functions refer to the control centre Operation Instruction.

In the case of shutdowns caused by cycling contacts, or by other conditions unlikely to cause an ongoing problem, the control centre will automatically restart the unit as soon as the contacts or conditions allow the unit to run. If, however, this type shutdown occurs unexpectedly or repeatedly, a problem may exist which requires attention.

For shutdowns caused by conditions which may lead to damage to the unit, the control centre will require a manual reset before allowing a restart. In this situation it is essential to determine the exact cause of the shutdown and rectify the problem before putting the unit back into service.

Some operating conditions are not monitored by the control centre such as compressor wear, oil condition, water treatment levels, etc. Detection of any potential problems caused by these conditions relies on daily monitoring of the unit and by regular service inspections - see Sections 6 & 7.

The possible causes and recommended actions listed in these tables should be used for guidance only and should not be considered exhaustive.

Control Centre Initiated Shutdowns - Automatic Restart

Displayed Reason for Shutdown	Control Function	Possible Cause	Recommended Action
LOW WATER TEMP	Leaving chilled liquid more than 2.2 °C below setpoint	Load on system less than min. capacity	Check water temperature differential is as expected
		Temperature sensor fault	Check sensor operation and wiring
SLIDE VALVE ABOVE 10%	Start attempt while slide valve is at greater than 10% load position	Slide valve not unloading	Check slide valve operation
INTERNAL CLOCK	Programmed Daily Schedule in shutdown period	Incorrect programming	Check programmed Daily Schedule is correct
MULTI UNIT CYCLING	Multi-Unit cycling device contacts closed	Incorrect use of contacts	Check correct operation of Multi-Unit cycling device
SYSTEM CYCLING	Remote/Local cycling device contacts closed	Incorrect use of contacts	Check correct operation of remote cycling device

Displayed Reason for Shutdown	Control Function	Possible Cause	Recommended Action
AC UNDERVOLTAGE	Motor current below 10% for more than 25 seconds during RUN mode	Low AC voltage at control centre	Check power supply
		Faulty Start Relay	Check Relay1R
		Low motor current	Check CT operation and wiring
			Check motor
HIGH LINE VOLTAGE / LOW LINE VOLTAGE (Solid State Starter only)	Line Voltage for any phase above/below voltage limit for more than 20 seconds	Power supply fault	Check mains supply
POWER FAULT	Motor controller contact cycling in less than 3 seconds	Power supply fault	Check mains supply
		Motor fault	Check motor
FLOW SWITCH	Flow switch contacts open for more than 2 seconds during RUN mode	Lack of water flow	Check chilled liquid pump operation
			Check for flow blockage or shut water service valve
		Flow switch fault	Check flow switch operation and wiring
PROGRAM INITIATED RESET	Microprocessor signal error	Electrical noise	Check for possible sources of electrical noise interference

Refrigerant System Control Centre Initiated Shutdowns - Manual Reset Restart

Displayed Reason for Shutdown	Control Function	Possible Cause	Recommended Action
HIGH PRESSURE	High pressure cut-out switch open	High condenser water temperature	Check cooling tower operation
		Low condenser water flow	Check service valves are open fully
			Check pump operation
		High evaporator load	Check chilled water temperature
		Blocked dirty condenser tubes	Clean tubes
		Air in condenser	Change refrigerant charge
HIGH DISCHARGE TEMP	Discharge temperature more than 100 °C	High discharge pressure	See HIGH PRESSURE
		High suction superheat	Check chilled water temperature
		Compressor lubrication failure	Check oil system
FAULTY DISCHARGE TEMP SENSOR	Discharge temperature measured as below -1.2 °C	Defective discharge temperature sensor or wiring	Check sensor operation and wiring

Displayed Reason for Shutdown	Control Function	Possible Cause	Recommended Action
LOW EVAP PRESSURE	Evaporator pressure below 172 kPa	Blocked / dirty evaporator tubes	Clean tubes
		Insufficient load for compressor capacity	Check low water temperature cut-out setting
			Check slide valve operation
		Insufficient refrigerant	Check charge level
		Blocked orifice	Check orifice
LOW EVAP PRESSURE-BRINE	Evaporator low pressure switch contacts open	As for LOW EVAP PRESSURE	As for LOW EVAP PRESSURE
EVAP TRANS OR PROBE ERROR	Leaving chilled liquid temp less calculated evaporator saturation tem p is more than 13.9 °C or less than -1.4 °C	Defective evaporator pressure transducer or wiring	Check transducer operation and wiring
		Defective leaving water temperature sensor or wiring	Check sensor operation and wiring

Oil System Control Centre Initiated Shutdowns - Manual Reset Restart

Displayed Reason for Shutdown	Control Function	Possible Cause	Recommended Action
HIGH OIL TEMP	Oil temp. More than 76.7°C	Blocked oil filter or restricted oil cooler line	Check for correct oil flow and cooler operation
CLOGGED OIL FILTER	Oil filter pressure diff. More than 172 kPa for more than 5 seconds	Oil line blockage	Check for blocked oil filter
			Check oil line service valves are open
LOW OIL PRESSURE	Oil pressure differential less than 138 kPa with compressor running	No oil flow	Check all oil system service valves are open
OIL PRESSURE TRANSDUCER	Oil pressure at entry to compressor measured as more than 2069 kPa while compressor is running	Defective oil pressure transducer or wiring	Check transducer operation and wiring
LOW SEPARATOR OIL LEVEL	Oil level float switch open	Low oil level	Determine if there is a leak or there is an oil system fault (see separate table)
		Defective float switch or wiring	Check float switch operation and wiring
FAULTY OIL OR CONDENSER XDCR (transducer)	Oil pressure at entry to compressor measured as more than 138 kPa above condenser pressure for more than 10 minutes	Defective discharge or oil pressure transducer or wiring	Check transducer operation and wiring

Oil System Faults Detected During Regular Inspections

Fault	Possible Cause	Recommended Action
OIL RESERVOIR LEVEL DROPPING WHILE UNIT SITTING IDLE	System cycling without compressor run being achieved	Check correct control system and start-up operation
	Main oil supply line solenoid valve by-passing	Repair or replace valve
	Internal separator reservoir leak	Repair or replace oil separator
OIL RESERVOIR LEVEL DROPPING SLOWLY WHILE UNIT RUNNING LIGHTLY LOADED	System cycling without compressor running long enough to return oil	Do not run unit at very low loads
	Discharge pressure too low	Check cooling tower / cooling water system arrangement and operation
		Check refrigerant charge
	Second stage separation fault	Repair or replace oil separator
OIL RESERVOIR LEVEL DROPPING QUICKLY WHILE UNIT RUNNING LIGHTLY LOADED	Unit running too lightly loaded	Restrict minimum SV position to 5%
	Upper evaporator eductor system not returning oil	Change oil line strainer
		Check eductor operation
OIL RESERVOIR LEVEL DROPPING SLOWLY WHILE UNIT RUNNING LOADED	Lower evaporator eductor system not returning oil	Change oil line strainer
		Check eductor operation
OIL RESERVOIR LEVEL DROPPING QUICKLY WHILE UNIT RUNNING LOADED	Oil separator capacity exceeded	If at pulldown: limit unit capacity using pulldown demand limit
		If at steady load with high chilled leaving temp: limit unit capacity to design using current limit
	Incorrect oil type	Check oil
	Second stage separation fault	Repair or replace oil separator
OIL RESERVOIR LEVEL DROPPING WHILE LEVEL INCREASING IN SECOND STAGE SIGHT GLASS	Second stage oil return line blocked	Check valves are open
		Change oil line strainer
		Check orifice
OIL RESERVOIR LEVEL DROPPING WHILE CONTROL CENTRE GIVING EXCESS CHARGE WARNING	Excess refrigerant	Trim refrigerant charge
	Excess oil in refrigerant	Clean up charge

Electrical System Control Centre Initiated Shutdowns - Manual Reset Restart

Displayed Reason for Shutdown	Control Function	Possible Cause	Recommended Action
MTR PHASE CURRENT UNBALANCE(SSS only)	Current in one phase differs from average by more than 30%	Loss of supply to one phase	Check mains supply
			Check power connections
		Motor fault	Check fuses
			Check motor windings
MOTOR CONTROLLER - EXT RESET	Solid state starter or remote starter current module contacts open	Fault in motor starter	Check starter operation
POWER FAILURE	Microprocessor board detects loss of supply	Power supply failure	Check mains supply
REMOTE STOP	Remote stop contacts closed	Wiring fault	Check correct operation of remote stop contacts
REPLACE RTC, U16 - REPROGRAM SETPOINTS	Real Time Clock chip internal battery fault detected	Old or faulty chip U16	Replace RTC IC Chip and reprogram unit.
STARTER MALFUNCTION DETECTED	Motor current measured as more than 15% FLA for more than 10 seconds with no compressor start signal	Defective motor starter	Check starter operation
		Defective CTs	Check CT operation and wiring

System Faults Warnings Displayed During Normal Running

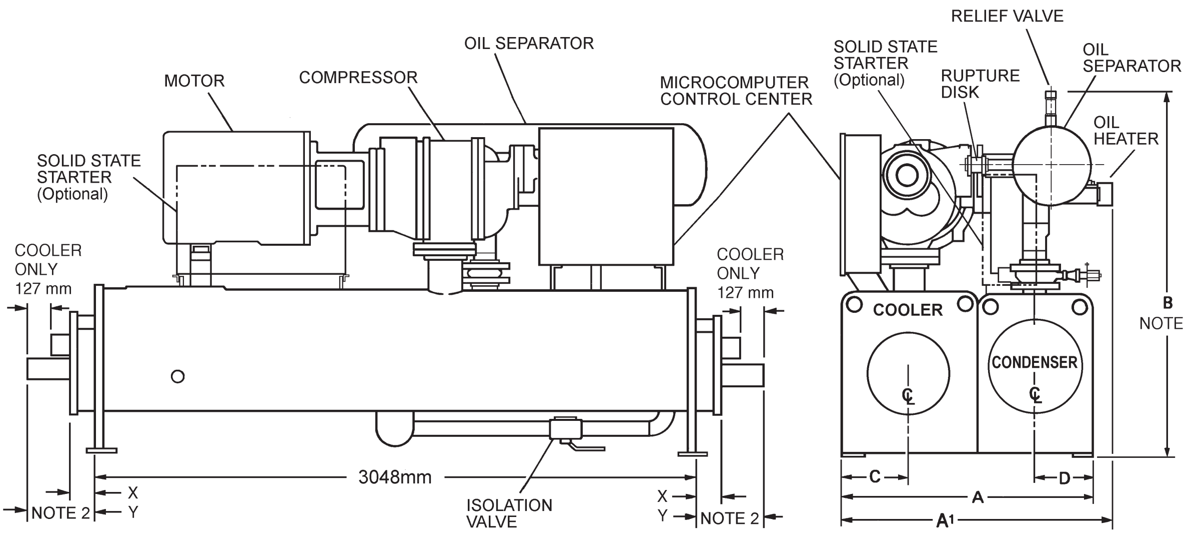
Displayed Reason for Shutdown	Control Function	Possible Cause	Recommended Action
HIGH OIL TEMPERATURE	Oil temp. Between 73.9 and 76.7 deg C	Blocked oil filter or restricted oil cooler line	Check for correct oil flow and cooler operation
DIRTY OIL FILTER	Oil filter pressure differential is between 138kPa and 176kPa for more than 5 seconds	Oil line blockage	Check for blocked oil filter
			Check oil line service valves are open
COND TRANSDUCER ERROR	Condenser pressure measured as more than 2138 kPa	Defective discharge pressure transducer or wiring	Check sensor operation and wiring
EXCESS REFRIGERANT CHARGE	Discharge superheat is in less than 2.8 °C after 3 minutes run time	Excess refrigerant in system	Trim refrigerant charge

Other System Faults Detected During Regular Inspections

Fault	Possible Cause	Remedy
EXCESSIVE NOISE I VIBRATION	Liquid refrigerant entering compressor	Check suction superheat
		Check for load surges
	Motor / compressor shaft coupling	Check for loose coupling
	Bearing damage or excessive wear	Check filters for metal
		Check bearings
SLIDE VALVE MALFUNCTION	Hydraulic service valve(s) closed	Check valves are all open
	Failed actuator solenoid valve	Check slide valve is free to move
		Check solenoid valve coil
		Check solenoid valve
	Unloader spindle or slide valve jammed	Check slide valve is free to move
	Slide valve indicator rod jammed	Check indicator rod is straight
	Slipper seals worn or damaged	Check seals

9 TECHNICAL DATA

9.1 Dimensions



Overall Dimensions - S2 and S3 Compressor

	S2 COMPRESSOR			S2 and S3 COMPRESSOR			
	SHELL CODES - (Cooler-Condenser)						
	B-B	B-C	C-B	C-C	C-D	D-C	D-D
A - TUBE SHEET WIDTH	1,588	1,588	1,588	1,588	1,588	1,588	1,588
A[1] - OVERALL WIDTH	1,591	1,591	1,591	1,591	1,591	1,591	1,591
B - OVERALL HEIGHT	1,848	1,946	1,946	1,946	2,054	2,102	2,102
C - COOLER C/L	432	432	432	432	432	432	432
D - CONDENSER C/L	362	362	362	362	362	362	362

Dimensions in mm

Notes

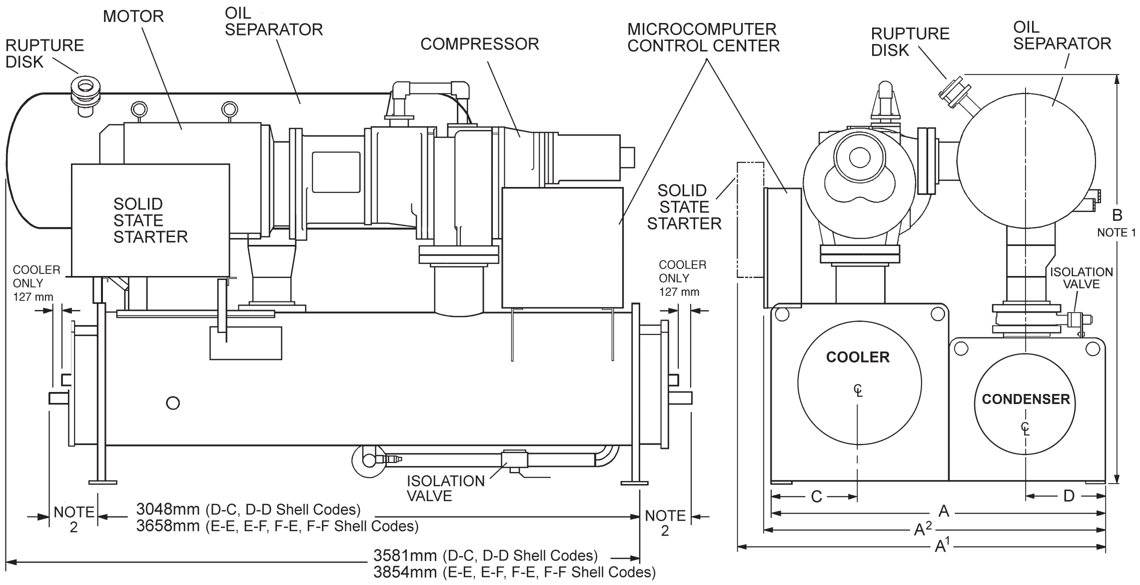
1. Unit height includes steel mounting plates under tube sheets. To determine overall installed height, add 22 mm for neoprene isolators (25 mm for optional spring isolators).

2. Determine overall unit length by adding water box depth from table below to tube sheet length.

3. All dimensions are approximate. Certified dimensions are available on request.

TYPE COMPACT WATER BOX	COOLER CODE			CONDENSER CODE		
	B	C	D	B	C	D
RETURN BOX	178	178	178	178	178	178
1 PASS	324	324	324	324	324	324
2 PASS	324	324	324	433	552	552
3 PASS	324	324	324	-	-	-

Dimensions based on Victaulic connection. Add 6 mm to each compact water box with optional flanged nozzles.



Overall Dimensions - S4 and S5 Compressor

	S4 COMPRESSOR		S4 and S5 COMPRESSOR			
	SHELL CODES - (Cooler-Condenser)					
	D-C	D-D	E-E	E-F	F-E	F-F
A - TUBE SHEET WIDTH	1,880	1,880	1,880	1,943	1,994	2,057
A[1] - WITH SOLID STATE STARTER	2,080	2,080	2,080	2,143	2,226	2,200
A[2] - OVERALL WIDTH (Less S.S.S.)	1,915	1,915	1,880	1,943	1,994	2,057
B - OVERALL HEIGHT	2,365	2,365	2,365	2,496	2,496	2,496
C - COOLER C/L	502	502	502	502	559	559
D - CONDENSER C/L	438	438	438	470	438	470

Dimensions in mm

Notes

1. Unit height includes steel mounting plates under tube sheets. To determine overall installed height, add 22 mm for neoprene isolators (25 mm for optional spring isolators).

2. Determine overall unit length by adding water box depth from table below to tube sheet length.

3. All dimensions are approximate. Certified dimensions are available on request.

TYPE COMPACT WATER BOX	COOLER CODE			CONDENSER CODE			
	D	E	F	C	D	E	F
RETURN BOX	178	178	178	178	178	178	178
1 PASS	324	324	324	324	324	324	324
2 PASS	324	324	324	552	552	552	433
3 PASS	324	324	324	-	-	-	-

Dimensions based on Victaulic connection. Add 6 mm to each compact water box with optional flanged nozzles.

9.2 Weights

Shell Code Cooler-Condenser	Compressor	Shipping Weight (kg)	Operating Weight (kg)	Refrigerant Charge (kg)
BA-BA	S2	4,782	5,069	200
BA-BB	S2	4,850	5,167	200
BB-BA	S2	4,830	5,145	188
BB-BB	S2	4,898	5,243	188
BA-CA	S2	5,125	5,473	212
BA-CB	S2	5,249	5,691	212
BB-CA	S2	5,183	5,598	196
BB-CB	S2	5,308	5,777	196
CA-BA	S2	5,195	5,553	253
CA-BB	S2	5,264	5,650	253
CB-BA	S2	5,299	5,700	253
CB-BB	S2	5,367	5,798	253
CA-CA	S2	5,509	5,937	278
CA-CB	S2	5,633	6,115	278
CB-CA	S2	5,614	6,086	278
CB-CB	S2	5,738	6,263	278
CA-DA	S2	6,059	6,663	306
CA-DB	S2	6,293	7,000	306
CB-DA	S2	6,164	6,812	306
CB-DB	S2	6,398	7,148	306
DA-CA	S2	6,030	6,530	343
DA-CB	S2	6,159	6,708	343
DB-CA	S2	6,200	6,770	343
DB-CB	S2	6,324	6,947	343
DC-CA	S2	6,362	7,016	343
DC-CB	S2	6,486	7,194	343
DA-DA	S2	6,599	7,271	388
DA-DB	S2	6,834	7,607	388
DB-DA	S2	6,745	7,491	371
DB-DB	S2	6,979	7,827	371
DC-DA	S2	6,902	7,871	343
DC-DB	S2	7,136	7,574	343
CA-CA	S3	5,606	6,066	278
CA-CB	S3	5,730	6,243	278
CB-CA	S3	5,711	6,213	278
CB-CB	S3	5,836	6,391	278
CA-DA	S3	6,157	6,796	306
CA-DB	S3	6,391	7,133	306
CB-DA	S3	6,261	6,946	306
CB-DB	S3	6,497	7,282	306
DA-CA	S3	6,122	6,618	343
DA-CB	S3	6,246	6,795	343
DB-CA	S3	6,287	6,857	343
DB-CB	S3	6,411	7,035	343
DC-CA	S3	6,450	7,103	343
DC-CB	S3	6,573	7,281	343
DA-DA	S3	6,687	7,358	388
DA-DB	S3	6,921	7,694	388
DB-DA	S3	6,832	7,578	371
DB-DB	S3	7,066	7,919	371
DC-DA	S3	6,989	7,824	343
DC-DB	S3	7,224	8,160	343
DA-CA	S4	7,742	8,277	336
DA-CB	S4	7,866	8,455	336
DB-CA	S4	7,907	8,517	336
DB-CB	S4	8,031	8,695	336
DC-CA	S4	8,070	8,764	336
DC-CB	S4	8,194	8,940	336
DA-DA	S4	8,307	9,023	376
DA-DB	S4	8,543	9,360	376
DB-DA	S4	8,453	9,243	363
DB-DB	S4	8,688	9,580	363
DC-DA	S4	8,611	9,486	336
DC-DB	S4	8,812	9,821	336

Shell Code Cooler-Condenser	Compressor	Shipping Weight (kg)	Operating Weight (kg)	Refrigerant Charge (kg)
EA-EA	S4	9,281	9,866	572
EA-EB	S4	9,573	10,253	572
EB-EA	S4	9,505	10,138	551
EB-EB	S4	9,767	10,525	551
EC-EA	S4	9,690	10,437	531
EC-EB	S4	9,979	10,823	531
EA-FA	S4	10,653	11,541	621
EA-FB	S4	11,202	12,266	621
EB-FA	S4	10,847	11,807	621
EB-FB	S4	11,394	12,535	592
EC-FA	S4	11,060	12,109	592
EC-FB	S4	11,609	12,832	592
FA-EA	S4	10,397	11,339	767
FA-EB	S4	10,722	11,727	767
FB-EA	S4	10,755	11,749	767
FB-EB	S4	11,017	12,137	767
FC-EA	S4	10,964	12,282	735
FC-EB	S4	11,404	12,669	735
FA-FA	S4	11,783	12,907	816
FA-FB	S4	12,332	13,633	816
FB-FA	S4	12,078	13,314	816
FB-FB	S4	12,624	14,045	776
FC-FA	S4	12,314	13,853	776
FC-FB	S4	13,013	14,576	776
EA-EA	S5	9,424	10,074	572
EA-EB	S5	9,717	10,462	572
EB-EA	S5	9,650	10,345	551
EB-EB	S5	9,913	10,742	551
EC-EA	S5	9,835	10,642	531
EC-EB	S5	10,125	11,030	531
EA-FA	S5	10,799	11,757	621
EA-FB	S5	11,349	12,484	621
EB-FA	S5	10,995	12,024	621
EB-FB	S5	11,542	12,752	592
EC-FA	S5	11,207	12,325	592
EC-FB	S5	11,757	13,050	592
FA-EA	S5	10,557	11,467	767
FA-EB	S5	10,850	11,855	767
FB-EA	S5	10,882	11,877	767
FB-EB	S5	11,144	12,264	735
FC-EA	S5	11,092	12,409	735
FC-EB	S5	11,532	12,797	735
FA-FA	S5	11,910	13,034	816
FA-FB	S5	12,459	13,760	816
FB-FA	S5	12,205	13,441	816
FB-FB	S5	12,751	14,172	776
FC-FA	S5	12,591	13,980	776
FC-FB	S5	13,140	14,703	776

NOTE:
Calculate total chiller weight by adding motor weight and solid state starter weight, if applicable.
Shipping weight includes refrigerant and oil charge.
Operating weight includes water in tubes and water boxes.
Weights based on standard tubes in coolers and condensers.

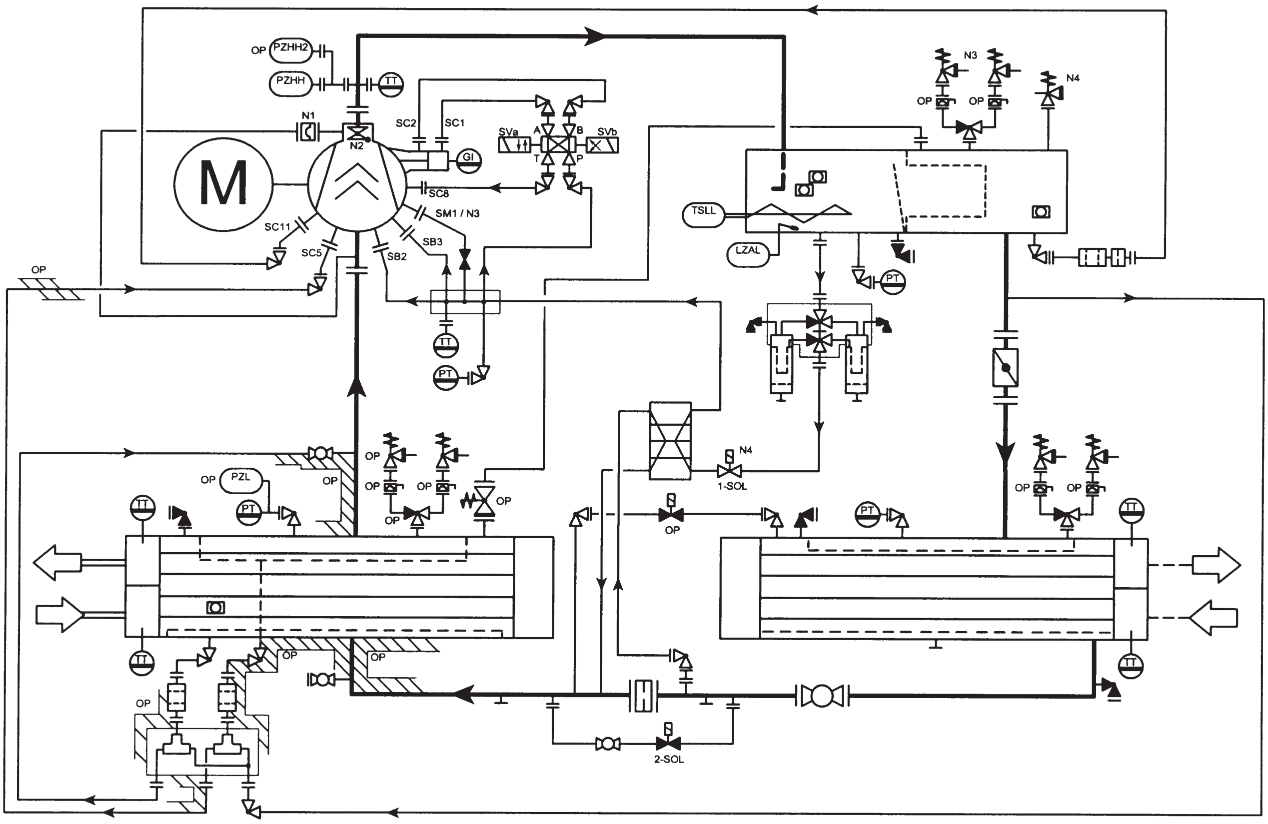
9.3 Motor Weights

Motor Code 50 Hz	Weight (kg)
5 CC	490
5 CD	508
5 CE	508
5 CF	662
5 CG	689
5 CH	875
5 CI	875
5 CJ	898
5 CK	898
5 CL	1075
5 CM	1125
5 CN	1125
5 CO	1195

9.4 Optional Solid State Starter Weights

Size	Weight (kg)
7L, 14L	91
26L, 33L	136

9.5 Process and Instrumentation Diagram



- Compressor with slide valve unloading
- Electric drive motor
- Primary heat exchanger
- Chilled liquid flow
- Condenser cooling water flow
- Refrigerant / oil flow
- Demountable connection
- Oil cooler
- Oil eductor tee
- Oil distribution manifold
- Sight glass
- Insulation
- Removable cartridge filter with vent valve
- In line filter
- Orifice plate
- Bursting disc with indicator connection
- Angle valve shown normally open
- Angle valve shown normally closed
- Butterfly Valve
- Three way change-over valve
- Check Valve
- Ball valve
- Solenoid valve
- Pressure relief valve
- Oil connection change-over valve
- PT Pressure transducer
- TT Temperature transducer
- GI Slide valve position indicator
- PZL Low pressure cutout switch
- PZHH High pressure cutout switch
- LZAL Low level alarm sensor
- TSLL Thermostatic immersion heater

Compressor Connections :

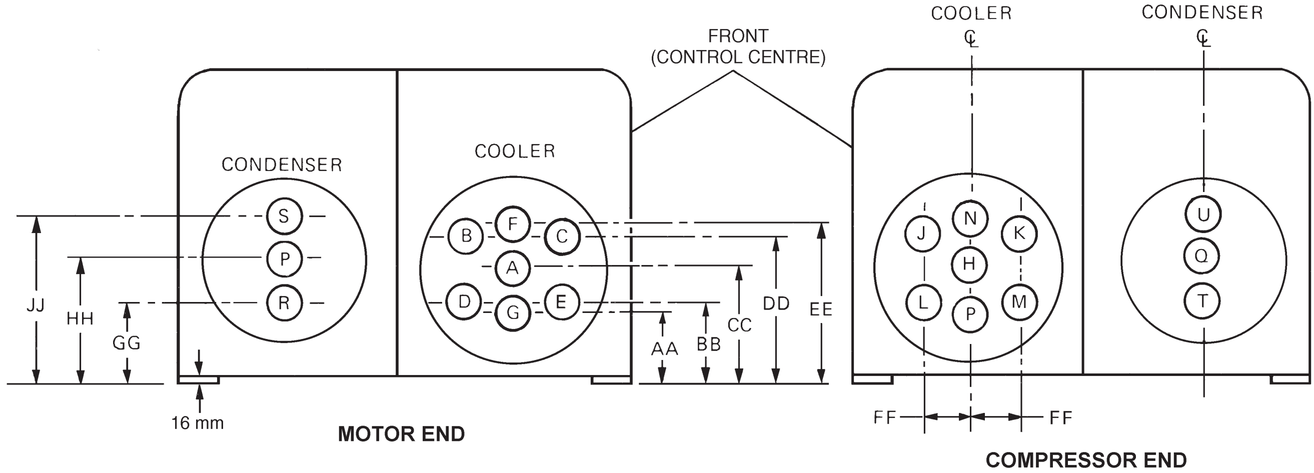
SB2	Inlet bearing and balance piston
SB3	Discharge Bearing and shaft seal
SC1	Slide valve unload
SC2	Slide valve load
SC5	Suction gallery
SC8	Closed thread drain
SC11	Closed thread drain
SM 1	Oil Injection

Notes :

Pressure Relief arrangements may vary due to local safety requirements.

OP	Optional item.
N1	Fitted with S4 and S5 compressors only.
N2	Check valve is fitted on suction side of rotors on S4 and S5 compressors.
N3	Fitted with S2 - S5 compressors only.
N4	Fitted with S0 - S3 compressors only.

9.6 Water Box Nozzle Arrangements



COOLER NOZZLE DIMENSIONS									
Cooler Code	**Nozzle Size (in)**			**Dimensions (mm)**					
	No. of Passes								
	1	**2**	**3**	**AA**	**BB**	**CC**	**DD**	**EE**	**FF**
B	8	6	4	268	313	414	465	510	127
C	10	6	6	298	354	425	573	565	149
D	12	8	6	325	389	557	592	657	168
E	12	8	6	310	373	490	576	640	191
F	14	10	8	370	443	564	684	757	233

CONDENSER NOZZLE DIMENSIONS					
Condenser Code	**Nozzle Size (in)**		**Dimensions (mm)**		
	No. of Passes				
	1	**2**	**GG**	**HH**	**JJ**
B	8	6	331	475	568
C	10	8	352	524	645
D	12	10	396	548	748
E	12	10	396	548	748
F	14	12	421	672	872

Notes

A. Standard water nozzles are furnished as welding stub-outs with Victaulic grooves, allowing the option of welding, flanges, or use of Victaulic couplings. Factory installed PN10 or PN20 round slip-on water flanged nozzles are optional. Companion flanges, nuts, bolts and gaskets are not furnished.

B. One, two and three pass nozzle arrangements are available only in pairs shown and for all shell codes. Any pair of cooler nozzles may be used in combination with any pair of condenser nozzles. Compact water boxes on one heat exchanger may be used with marine water boxes on the other heat exchanger.

C. Condenser water must enter the water box through the bottom connection for proper operation of the subcooler to achieve rated performance.

D. Connected piping should allow for removal of compact water box for tube access and cleaning.

E. Allow 4267mm tube pulling space either end.

NOZZLE ARRANGEMENTS		
No. of Passes	**Cooler In - Out**	**Condenser In - Out**
1	A - H H - A	P - Q Q - P
2	E - B D - C M - J L - K	R - S T - U
3	P - F G - N	

10 SPARE PARTS

It is recommended that the following common spare parts are held for preventative of corrective maintenance operations.

Part	Qty.	Part No.
Information Required		

Other spare parts vary depending on the unit model. Contact your local York Sales and Service Centre for information and please quote the unit model number and serial number.

When ordering spare parts, we will require the following information to ensure the correct parts are supplied:

Full unit model number, serial number, application and details of the parts required.

All requests for parts should be made to your local York Sales and Service Centre.

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11 DE-COMMISSIONING, DISMANTLING AND DISPOSAL

WARNING **Never release refrigerant to the atmosphere when emptying the refrigerating circuits. Suitable retrieval equipment must be used. If reclaimed refrigerant cannot be re-used. It must be returned to the manufacturer.**

WARNING **Never discard used compressor oil, as it contains refrigerant in solution. Return used oil to the oil manufacturer.**

Unless otherwise indicated the operations described below can be performed by any properly trained maintenance technician.

11.1 General

Isolate all sources of electrical supply to the unit including any control system supplies switched by the unit. Ensure that all points of isolation are secured in the 'OFF' position. The supply cables may then be disconnected and removed. For connection points refer to Section 4.

Remove all refrigerant from the unit into a suitable container using a refrigerant reclaim or recovery unit. This refrigerant may then be re-used, if appropriate, or returned to the manufacturer for disposal. Under NO circumstances should refrigerant be vented to atmosphere. Drain the oil from the unit into a suitable container and dispose of according to local laws and regulations governing the disposal of oily wastes. Any spilt oil should be mopped up and similarly disposed of.

Isolate the unit heat exchangers from all external water systems and drain the heat exchanger sections of the system. If no isolation valves are installed it may be necessary to drain the complete systems.

WARNING **If glycol or similar solutions have been used in the water system(s), or Chemical additives are contained, the solution MUST be disposed of in a suitable and safe manner. Under NO circumstances should any system containing glycol or similar solutions be drained directly into domestic waste or natural water systems.**

After draining, the water pipework can be disconnected and removed.

Packaged units can generally be removed in one piece after disconnection as above. Any fixing down bolts should be removed and then the unit should be lifted from position using the points provided and equipment of adequate lifting capacity.

Reference should be made to Section 4 for unit installation instructions, Section 9 for unit weights and Section 3 for handling.

Units which cannot be removed in one piece, after disconnection as above, must be dismantled in position. Special care should be taken regarding the weight and handling of each component. Where possible units should be dismantled in the reverse order of installation.

Residual solution, refrigerant, oil and glycol or similar fluids may remain in some parts of the system. These should be mopped up and disposed of as described above.

It is important to ensure that whilst components are being removed the remaining parts are supported in a safe manner.

WARNING **Only use lifting equipment of adequate capacity.**

After removal from position the unit parts may be disposed of according to local laws and regulations.

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Part No. 035L02381-CB0 (02/00)

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