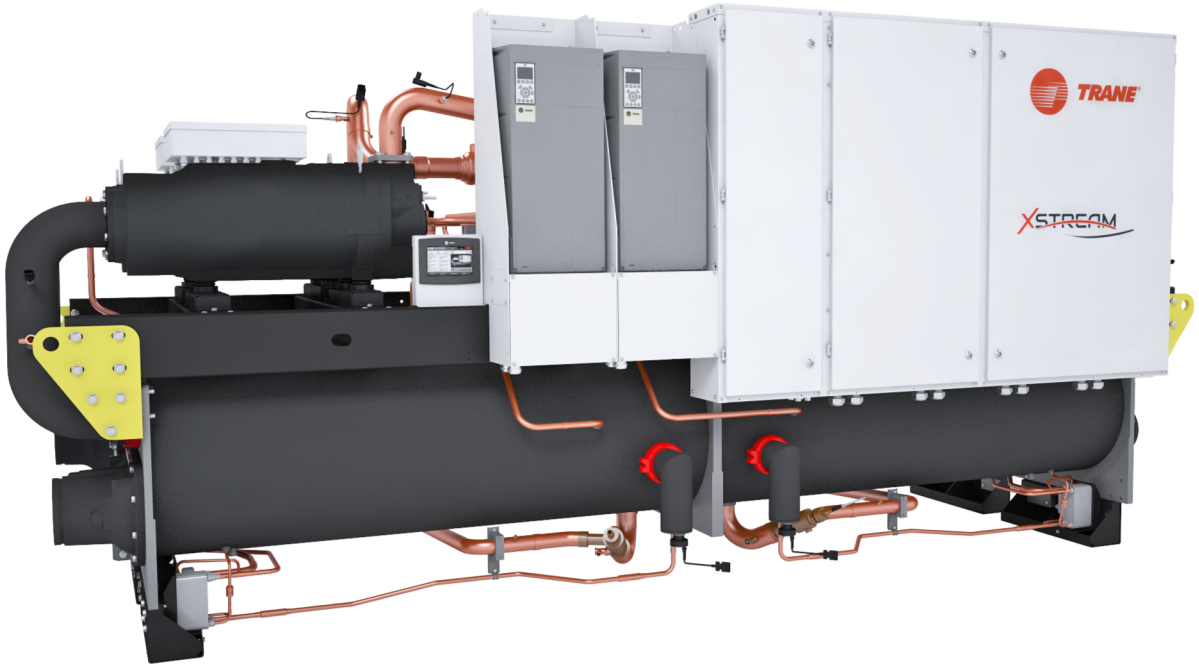
Installation, Operation, and Maintenance

Water-To-Water High Temperature Industrial Heat Pumps with Helical Rotary Compressors

RTWF HT 670 - 1285 kW (R1233zd(E))



⚠ SAFETY WARNING

Only qualified personnel should install and service the equipment. The installation, starting up, and servicing of heating, ventilating, and air-conditioning equipment can be hazardous and requires specific knowledge and training. Improperly installed, adjusted or altered equipment by an unqualified person could result in death or serious injury. When working on the equipment, observe all precautions in the literature and on the tags, stickers, and labels that are attached to the equipment.

March 2026

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Introduction

Read this manual thoroughly before operating or servicing this unit.

Warnings, Cautions, and Notices

Safety advisories appear throughout this manual as required. Your personal safety and the proper operation of this machine depend upon the strict observance of these precautions.

The three types of advisories are defined as follows:

DANGER	Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.
WARNING	Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.
CAUTION	Indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury. It could also be used to alert against unsafe practices.
NOTICE	Indicates a situation that could result in equipment or property-damage only accidents.

Important Environmental Concerns

Scientific research has shown that certain man-made chemicals can affect the earth's naturally occurring stratospheric ozone layer when released to the atmosphere. In particular, several of the identified chemicals that may affect the ozone layer are refrigerants that contain Chlorine, Fluorine and Carbon (CFCs) and those containing Hydrogen, Chlorine, Fluorine and Carbon (HCFCs). Not all refrigerants containing these compounds have the same potential impact to the environment. The Manufacturer advocates the responsible handling of all refrigerants.

Important Responsible Refrigerant Practices

The Manufacturer believes that responsible refrigerant practices are important to the environment, our customers, and the air conditioning industry. All technicians who handle refrigerants must be certified according to Local regulations. The law sets forth the requirements for handling, reclaiming, recovering and recycling of certain refrigerants and the equipment that is used in these service procedures. In addition, some states or municipalities may have additional requirements that must also be adhered to for responsible management of refrigerants. Know the applicable laws and follow them.

⚠ Warning

Proper Field Wiring and Grounding Required!

Failure to follow code could result in death or serious injury.

All field wiring MUST be performed by qualified personnel. Improperly installed and grounded field wiring poses FIRE and ELECTROCUTION hazards. To avoid these hazards, you MUST follow requirements for field wiring installation and grounding as described in NEC and your local/state electrical codes.

⚠ Warning

Refrigerant May Be Under Positive Pressure!

Failure to follow instructions below could result in an explosion which could result in death or serious injury or equipment damage.

System contains refrigerant and may be under positive pressure; system may also contain oil. Recover refrigerant to relieve pressure before opening the system. See unit nameplate for refrigerant type. Do not use non-approved refrigerants, refrigerant substitutes, or non-approved refrigerant additives.

⚠ Warning

Personal Protective Equipment (PPE) Required!

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

- **Before installing/servicing this unit, technicians MUST put on all PPE required for the work being undertaken (Examples; cut resistant gloves/sleeves, butyl gloves, safety glasses, hard hat/bump cap, fall protection, electrical PPE and arc flash clothing). ALWAYS refer to appropriate Safety Data Sheets (SDS) and OSHA guidelines for proper PPE.**
- **When working with or around hazardous chemicals, ALWAYS refer to the appropriate SDS and OSHA/GHS (Global Harmonized System of Classification and Labelling of Chemicals) guidelines for information on allowable personal exposure levels, proper respiratory protection and handling instructions.**
- **If there is a risk of energized electrical contact, arc, or flash, technicians MUST put on all PPE in accordance with OSHA, NFPA 70E, or other country-specific requirements for arc flash protection, PRIOR to servicing the unit. NEVER PERFORM ANY SWITCHING, DISCONNECTING, OR VOLTAGE TESTING WITHOUT PROPER ELECTRICAL PPE AND ARC FLASH CLOTHING. ENSURE ELECTRICAL METERS AND EQUIPMENT ARE PROPERLY RATED FOR INTENDED VOLTAGE.**

⚠ Warning

Follow EHS Policies!

Failure to follow instructions below could result in death or serious injury.

- **All our Manufacturers personnel must follow the company's Environmental, Health and Safety (EHS) policies when performing work such as hot work, electrical, fall protection, lockout/tagout, refrigerant handling, etc. Where local regulations are more stringent than these policies, those regulations supersede these policies.**
- **Non-Trane Technologies personnel should always follow local regulations.**

Copyright

Trademarks

Revision History

Revision A	New Release

Table of Contents

General Information

These instructions provide guidance for proper installation, start-up, operation, and user maintenance of the XStream high-temperature heat pumps RTWF HT, manufactured in France. A separate manual is available for the Symbio™ 800 control system. These instructions do not include the full service procedures required for ongoing reliable operation. A qualified technician should perform such services under a maintenance contract with a reputable service company. Read this manual thoroughly before starting the unit.

Each unit ships from the factory as a hermetically assembled package. It is factory-assembled, wired, and tested. Units are shipped with a Dry Nitrogen holding charge, therefore unit has to be charged with refrigerant by qualified and experienced personnel and according to state of the art processes and procedures, before commissioning.

Safety Recommendations

To avoid death, injury, equipment or property damage, the following recommendations should be observed during maintenance and service visits:

1. The maximum allowable pressures for system leak testing on low and high pressure side are given in the chapter “Installation”. Insure to do note exceed test pressure by using appropriate device.
2. Disconnect the main power supply before any servicing on the unit.
3. Service work on the refrigeration system and the electrical system should be carried out only by qualified and experienced personnel.
4. To avoid any risk, it is recommended to place the unit on an area with restricted access.

Inspection

On arrival, inspect the unit before signing the delivery note. Specify any visible damage on the delivery note, and send a registered letter of protest to the last carrier of the goods within 7 days of delivery.

Notify the local Manufacturer at the same time. The delivery note must be clearly signed and countersigned by the driver.

Any concealed damage shall be notified by a registered letter of protest to the last carrier of the goods within 7 days of delivery. Notify the local sales office at the same time.

Important: *No shipping claims will be accepted by the manufacturer if the above mentioned procedure is not respected. For more information, refer to the general sales conditions of Manufacturer.*

Note: *Unit inspection in France. Delay to send registered letter in case of visible and concealed damage is only 72 hours.*

Loose Parts Inventory

Check all the accessories and loose parts that are shipped with the unit against the shipping list. Included in these items will be the all kind of sensors, thermostat and electrical diagrams, service literature, which are placed inside the control panel and/or indoor section for shipment.

Do not place elements inside of control box during unit operation, it could damage internal components.

Warranty

Warranty is based on the general terms and conditions of the manufacturer. The warranty is void if the equipment is repaired or modified without the written approval of the manufacturer, if the operating limits are exceeded or if the control system or the electrical wiring is modified. Damage due to misuse, lack of maintenance or failure to comply with the manufacturer’s instructions or recommendations is not covered by the warranty obligation. If the user does not conform to the rules of this manual, it may entail cancellation of warranty and liabilities by the manufacturer.

Refrigerant

Consult the addendum PROD-SVX01* to Manuals for units with refrigerant, for conformity to the Pressure Equipment Directive (PED) 2014/68/EU and Machinery Directive 2006/42/EC and for specific caution for R1233zd(E).

Training

To assist you in obtaining the best use of it and maintaining it in perfect operating condition over a long period of time, the manufacturer has at your disposal a refrigeration and air conditioning service school. The principal aim of this is to give operators and technicians a better knowledge of the equipment they are using, or that is under their charge. Emphasis is particularly given to the importance of periodic checks on the unit operating parameters as well as on preventive maintenance, which reduces the cost of owning the unit by avoiding serious and costly breakdown.

Maintenance Contract

It is strongly recommended that you sign a maintenance contract with your local Service Agency. This contract provides regular maintenance of your installation by a specialist in our equipment. Regular maintenance ensures that any malfunction is detected and corrected in good time and minimizes the possibility that serious damage will occur. Finally, regular maintenance ensures the maximum operating life of your equipment. We would remind you that failure to respect these installation and maintenance instructions may result in immediate cancellation of the warranty.

Model Number Description

Digits 1, 2, 3, 4 - Unit Model

RTWF

Digit 5, 6, 7 - Unit Size

196 = 196 Nominal Tons
216 = 216 Nominal Tons
236 = 236 Nominal Tons
266 = 266 Nominal Tons
286 = 286 Nominal Tons
306 = 306 Nominal Tons

Digits 8 - Unit Power Supply

D = 400 Volt 50 Hz 3 Phase

Digits 9 - Factory

E = Europe

Digit 10, 11- Design Sequence Factory Assigned

Digit 12 - Efficiency Level

N = Standard Efficiency

Digit 13 - Starter Type

B = AFD

Digit 14 - Agency Listing

C = CE marking

Digit 15 - Not Used

Digit 16 - Unit Application

T = High Temperature

Digit 17 - Refrigerant

E = R1233zd(E) with Nitrogen (with oil)

Digit 18 - Sound Attenuation Package

X = Without

Digit 19 - Relief Valve Option

L = Single Relief Valve Condenser
2 = Single Relief Valve Condenser & Evaporator
D = Dual relief valve with 3 way valve condenser
4 = Dual relief valve with 3 way valve condenser & Evaporator

Digit 20 - Compressor Type

N = High Temperature GP2 Compressor

Digit 21, 22 - Evaporator Size

1F = Evaporator E379D
1G = Evaporator E379E
2D = Evaporator E519D
2E = Evaporator E519E

Digit 23 - Evaporator Configuration

X = Single Pass

Digit 24 - Evaporator Water Connection

X = Standard Grooved Pipe Connection
L = Left hand Evaporator Grooved pipe
R = Right hand Evaporator Grooved pipe

Digit 25 - Evaporator Water Side Pressure

X = 10 Bar Evaporator Water Pressure

Digit 26 - Evaporator Application

T = High Temperature

Digit 27 - Evaporator thermal Insulation

N = Standard

Digit 28, 29- Condenser Size

1C = Condenser C349C
3B = Condenser C489B

Digit 30 - Condenser Configuration

X = Standard Single Pass
2 = Two-Pass

Digit 31- Condenser Water Connection

X = Standard Grooved Pipe Connection
L = Left hand Condenser Grooved pipe
R = Right hand Condenser Grooved pipe

Digit 32 - Condenser Tubes

N = Enhanced Fin – Copper

Digit 33 - Condenser Water Side Pressure

X = 10 Bar Condenser Water Pressure

Digit 34 - Condenser Thermal Insulation

H = With Condenser Insulation

Digit 35 - Oil Cooler

C = With

Digit 36 - Evaporator Pump Smart Flow Control
X = None

Digit 37 - Power Protection

F = Disconnect Switch with Fuses
B = Disconnect Switch with Circuit breakers

Digit 38 - Under/Over Voltage Protection

X = None

Digit 39 - Human Interface Language

E = English

Digit 40- Smart com Protocol

X = None
B = BACnet MSTP Interface
C = BACnet IP Interface
M = Modbus RTU Interface
L = LonTalk Interface
T = ModBus TCP Interface

Digit 41- Communication Customer Input/ Output
X = None
A = External Set points & Capacity outputs – Voltage Signal
B = External Set points & Capacity outputs – Current Signal

Digit 42 - Outdoor Air Temperature Sensor

0 = No Air Outdoor Temperature Sensor

Digit 43 - Electrical IP Protection

1 = Enclosure with IP20 Internal Protection

Digit 44 - Master Slave Set

X = None
M = with Master/Slave control

Digit 45 - Energy Meter

X = None
M = Included

Digit 46 - Condenser Pump Smart Flow Control
X = None

Digit 47 - Power Socket

X = None
P = Included (230V-100W)

Digit 48 - Factory Test

X = None
B = Visual inspection with Customer attendance
S = Factory Acceptance Test

Digit 49 - Installation Accessory

X = None
1 = Neoprene Isolators
4 = Neoprene Pads

Digit 50 - Connection Accessory

X = Grooved Pipe Connection
W = Grooved Pipe with Coupling and Pipe stub

Digit 51- Flow Switch

X = None
A = 1 Pallet Flow Switch (Evaporator or Condenser)
B = 2 Pallet Flow Switch (Evaporator or Condenser)
F = 2 Pressure Transducers - (Evaporator or Condenser)
G = 4 Pressure Transducers - (Evaporator or Condenser)
H = Hybrid Flow Switch - 1 Pallet 1 for evaporator / 2 pressure transducers for Condenser

Digit 52 - Literature Language

C = Spanish
G = German
E = English
F = French
H = Dutch
I = Italian
M = Swedish
P = Polish
T = Czech
V = Portuguese

Digit 53 - Shipping Package

X = Standard Protection
A = Containerization Package

Digit 54 - EXV Selection

L = Standard EXV

Digit 55 - AFD

X = Standard AFD

Digit 56 - Design Special

X = None
S = Special

Unit Description

The RTWF HT units are helical-rotary type, water-to-water high temperature heat pumps, designed for installation indoors. The RTWF HT have 2 independent refrigerant circuits, with one or two compressors per circuit.

The RTWF HT units are packaged with an evaporator and condenser.

Note: *Each RTWF HT unit is a completely assembled, hermetic package that is factory-piped, wired, leak tested, dehydrated, and tested for proper control operations prior to shipment. Units are shipped with a dry Nitrogen holding charge. The water inlet and outlet openings are covered for shipment.*

The RTWF HT series features exclusive Adaptive Control logic with Symbio™ 800 controls. It monitors the control variables that govern the operation of the unit. Adaptive Control logic can correct these variables, when necessary, to optimize operational efficiencies, avoid unit shutdown, and keep producing warm water.

Compressor loading/unloading is provided by AFD (Adaptive Frequency Drive) coordinated with slide valve operation.

Each refrigerant circuit is provided with filter, sight glass, electronic expansion valve, and charging valves on the RTWF HT.

The evaporator and condenser are manufactured in accordance with Pressure Equipment Directive standards.

The evaporator and the condenser are thermally insulated. Both evaporator and condenser water pipes are equipped with water drain and vent connections.

Figure 1. Component Location for Typical RTWF HT Unit

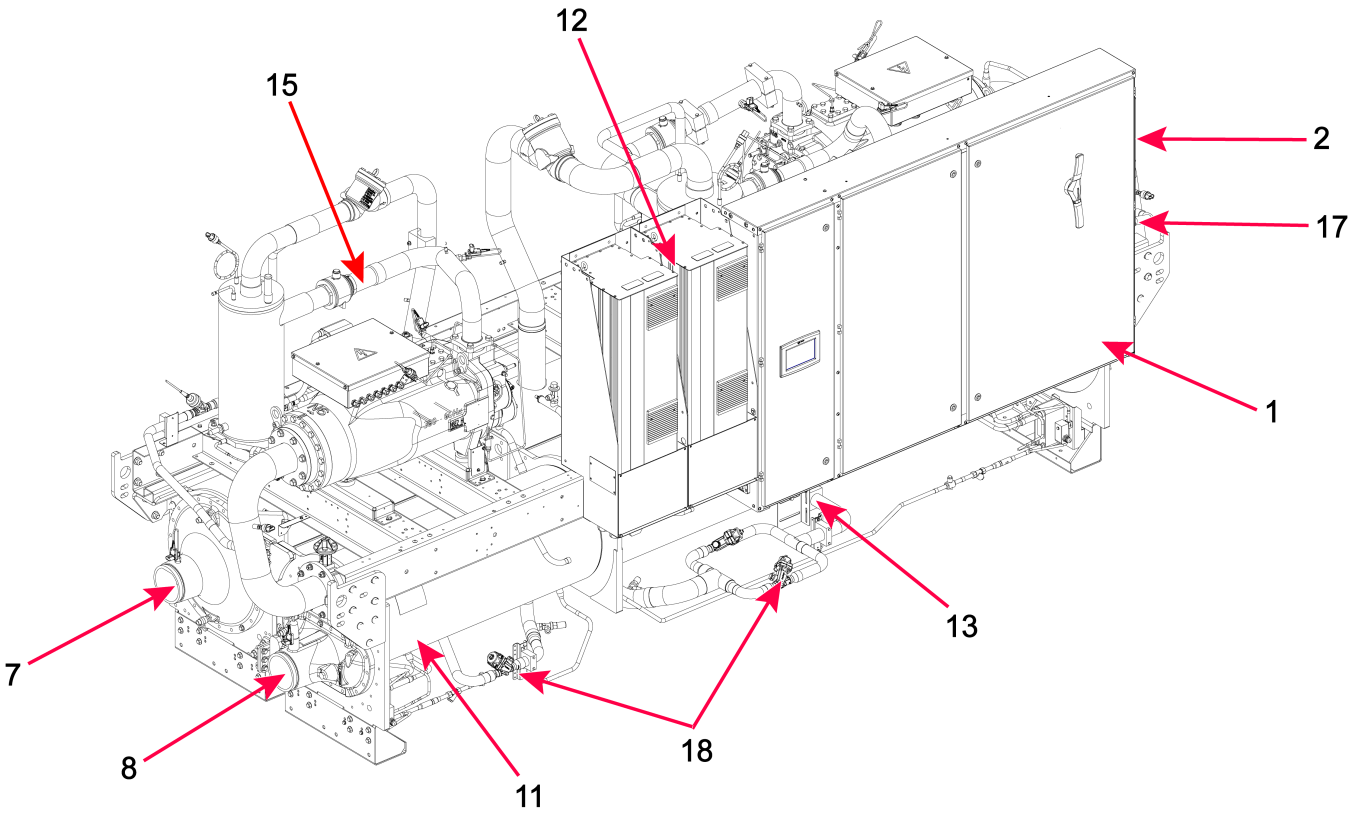
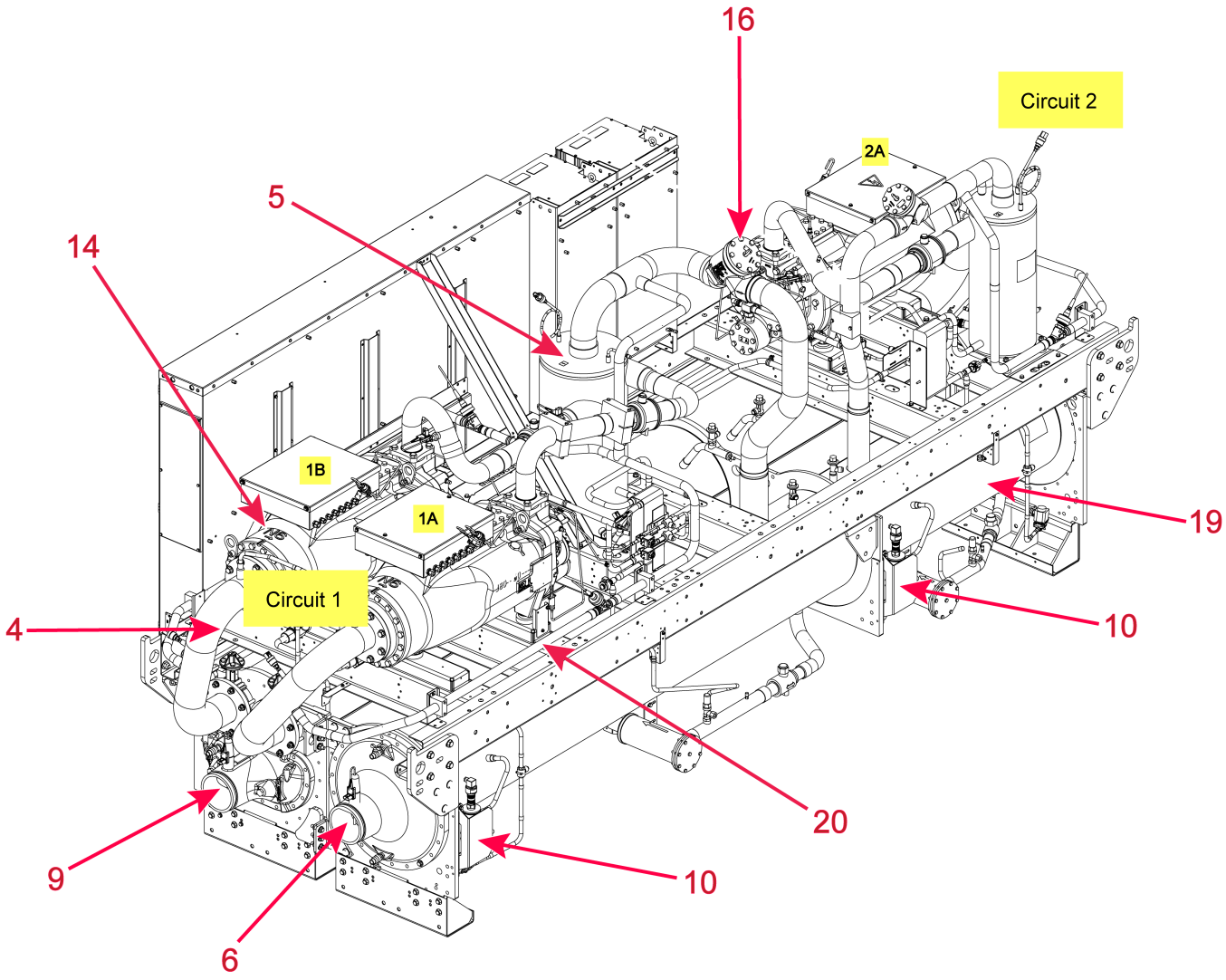


Figure 2. Component Location for Typical RTWF HF Unit



Items	Description	Items	Description
1	Control panel	11	Evaporator
2	Power cable gland plate for customer wiring	12	Adaptive Frequency Drive
3	Tracer TD7 interface	13	External control wiring cable gland plate for customer wiring
4	Suction line	14	Compressor
5	Oil separator	15	Discharge line
6	Condenser water outlet	16	Discharge line check-valve
7	Condenser water inlet	17	Unit nameplate (on side of starter/control panel)
8	Evaporator water outlet	18	EXV
9	Evaporator water inlet	19	Condenser
10	Liquid level sensor	20	Hot-Gas bypass system

Note: *Model presented: 3 compressor unit.*

Detailed location is given on the submittal drawing shipped with the unit.

Installation Overview and Requirements

Contractor Responsibilities

A list of the contractor responsibilities typically associated with the RTWF HT installation process is provided Table 1, p. 14.

- Locate and maintain the loose parts. Loose parts are located in the control panel.
- Install the unit on a foundation with flat support surfaces, level within 5 mm and of sufficient strength to support concentrated loading. Place the manufacturer-supplied isolation pad assemblies under the unit.
- Install the unit per the instructions outlined in the “Mechanical Installation” section.
- Complete all water piping and electrical connections.

  Note: *Field piping must be arranged and supported to avoid stress on the equipment. It is strongly recommended that the piping contractor provide at least 1m of clearance between the pre-installation piping and the planned location of the unit. This will allow for proper fit-up upon arrival of the unit at the installation site. All necessary piping adjustments can be made at that time.*
- Where specified, supply and install valves in the water piping upstream and downstream of the evaporator and condenser, to isolate the shells for maintenance and to balance/trim the system.
- Supply and install flow switches or equivalent devices in both the chilled water and condenser water piping. Interlock each switch with the proper pump starter and Symbio™ 800, to ensure that the unit can only operate when water flow is established.
- Supply and install taps for thermometers and pressure gauges in the water piping, adjacent to the inlet and outlet connections of both the evaporator and the condenser.
- Supply and install drain valves on each water box.
- Supply and install vent cocks on each water box.
- Where specified, supply and install strainers ahead of all pumps and automatic modulating valves.
- Supply and install refrigerant pressure relief piping from the pressure relief to the atmosphere.
- Start the unit under supervision of a qualified service technician.
- The customer wiring connection is from the side of the electrical panel.

Important: *RTWF HT are shipped with a Dry Nitrogen holding charge, therefore unit has to be charged with refrigerant by qualified and experienced personnel and according to state of the art processes and procedures, before commissioning.*

Table 1. Installation Responsibility

Requirement	Trane supplied Trane installed	Trane supplied Field installed	Customer supplied Customer installed
Foundation			Meet foundation requirements
Rigging			• Safety chains • Clevis connectors • Lifting beams
Isolation		Isolation pads	Other type of isolators

Table 1. Installation Responsibility (continued)

Requirement	Trane supplied Trane installed	Trane supplied Field installed	Customer supplied Customer installed
Electrical	• Circuit breakers or fusible disconnects (Optional) • Wye Delta starter and AFD (Adaptive Frequency Drive)	• Flow switches (may be field supplied) • Harmonic filters (on request according to customer electrical network and equipment)	• Circuit breakers or fusible disconnect • Electrical connections to unit mounted starter (optional) • Electrical connections to remote mounted starter (optional) • Wiring sizes per submittal and local regulations • Terminal lugs • Ground connections • BAS wiring (optional) • Control voltage wiring • Chilled water pump contactor and wiring including interlock • Option relays and wiring
Water piping		Flow switches (may be field supplied)	• Taps for thermometers and gauges • Thermometers • Strainers (as required) • Water flow pressure gauges • Isolation and balancing valves in water piping • Vents and drain on waterbox valves • Pressure relief valves for water side
Insulation	Insulation		Insulation
Water piping connection components	• Grooved pipe • Return pipe to get inlet and outlet on same side (optional) • Grooved pipe to flagged connection (optional)		
Caution on exposure to refrigerant			Respect recommendation of IOM addendum

Installation Mechanical

Storage

Each unit is shipped without refrigerant but with a 2 bar Nitrogen pressure.

If the unit is to be stored more than one month prior to installation, observe the following precautions:

- Do not remove the protective coverings from the electrical panel.
- Store the unit in a dry, vibration-free, secure area.
- If the unit pressure is below 2 bar, call a qualified service organization and the appropriate manufacturer sales office.

If the unit has been fully charged and needs to be stored before the installation, observe the following precautions:

- Do not remove the protective coverings from the electrical panel.
- Store the unit in a dry, vibration-free, secure area. and keep the storage place temperature above 20 °C.
- If the unit pressure is below the atmospheric pressure), the risk of humidity ingress into the circuit is high. Call a qualified service organization and the appropriate manufacturer sales office.

Noise Considerations

- Locate the unit away from sound-sensitive areas.
- Install the isolation pads under the unit. Refer to “Unit Isolation”.
- Install rubber vibration isolators in all water piping.
- Use flexible electrical conduit for final connection to the Symbio™ 800.
- Seal all wall penetrations.

Note: *Consult an acoustical engineer for critical applications.*

Foundation

Provide rigid, non-warping mounting pads or a concrete foundation of sufficient strength and mass to support the unit operating weight (including completed piping and full operating charges of refrigerant, oil and water).

Refer to General information for unit operating weights.

Once in place, level the unit within 6 mm over its length and width.

The manufacturer is not responsible for equipment problems resulting from an improperly designed or constructed foundation.

Vibration Eliminators

- Provide rubber boot type isolators for all water piping at the unit.
- Provide flexible conduit for electrical connections to the unit.
- Isolate all pipe hangers and be sure they are not supported by main structure beams that could introduce vibration into occupied spaces.
- Make sure that the piping does not put additional stress on the unit.

Note: *Do not use metal braided type eliminators on the water piping. Metal braided eliminators are not effective at the frequencies at which the unit will operate.*

Clearances

Provide enough space around the unit to allow the installation and maintenance personnel unrestricted access to all service points. A minimum of 1 m is recommended for compressor service and to provide sufficient clearance for the opening of control panel doors. Refer to submittals (documents supplied in document package coming with unit) for minimum clearances required for condenser or evaporator tube service. In all cases, local codes will take precedence over these recommendations. If the room configuration requires a variance to the clearance dimensions, contact your sales representative.

Note: *Required vertical clearance above the unit is at least 1 m. There should be no piping or conduit located over the compressor motor.*

Note: *Maximum clearances are given. Depending on the unit configuration, some units may require less clearance than others in the same category. Heat exchanger tube removal clearance is necessary for detubing and retubing.*

Ventilation

The unit produces heat even though the compressor is cooled by the refrigerant. Make provisions to remove heat generated by unit operation from the equipment room. Ventilation must be adequate to maintain an ambient temperature lower than 40 °C. Vent the pressure relief valves in accordance with all local and national codes. Refer to “Pressure Relief Valves”. Make provisions in the equipment room to keep the unit from being exposed to ambient temperatures below 20 °C.

Water Drainage

Locate the unit near a large capacity drain for water vessel drain-down during shutdown or repair.

Condensers and evaporators are provided with drain connections. Refer to “Water Piping,” p. 19. All local and national codes apply.

Access Restrictions

Refer to the unit submittals for specific dimensional information (documents supplied in document package coming with unit).

Lifting Procedure

⚠ Warning

Heavy Object!

Failure to follow the instructions could result in unit dropping which could result in death or serious injury, and equipment or property damage

Always use lifting equipment with a capacity exceeding unit lifting weight by an adequate safety factor.

- **Lifting of the units must be ensured.**
- **Transport may only be carried out using the transport equipment and lifting lugs.**
- **Only approved lifting equipment with sufficient load capacity must be used.**
- **The lifting equipment must be in perfect condition.**
- **The transport aids must be checked for load capacity and damage before use.**
- **The individual components of the system may only be moved using the designated transport aids.**
- **Use only suitable transport devices and suitable industrial trucks.**
- **Maintenance doors must always be closed during transport.**

Important: *Follow the instructions given in the lifting and handling document and submittal supplied with documentation package shipped with the unit.*

⚠ Caution

Equipment Damage!

Failure to do so may result in unit damage.

- **Never use a forklift to move the unit. The skid is not designed to support the unit at any one point and using a forklift to move the equipment may cause unit damage.**
- **Always position the lifting beam so that cables do not contact the unit.**

Note: *If absolutely necessary, the unit can be pushed or pulled across a smooth surface if it is bolted to wood shipping mounts.*

⚠ Warning

Shipping Mounts!

Removal of wood shipping mounts prior to unit final location could result in death or serious injury or equipment damage.

Do not use the threaded holes in the compressor to lift or assist in lifting the unit. They are not intended for that purpose.

Do not remove the wood mounts (option) until the unit is in its final location.

1. When the unit is at its final location, remove the shipping bolts that secure the unit to the wood base mounts (option).
2. Rig the unit properly and lift from above or jack the unit (alternate moving method). Use the points shown on the rigging diagram that ships with the unit. Remove the base mounts.
3. Install clevis connectors in lifting holes provided on the unit. Attach lifting chains or cables to clevis connectors. Each cable alone must be strong enough to lift the unit.
4. Attach cables to lifting beam. Total lifting weight, lifting weight distribution and required lifting beam dimensions are shown in the rigging diagram shipped with each unit. The lifting beam crossbar must be positioned so the lifting cables do not contact unit piping or electrical panel enclosure.

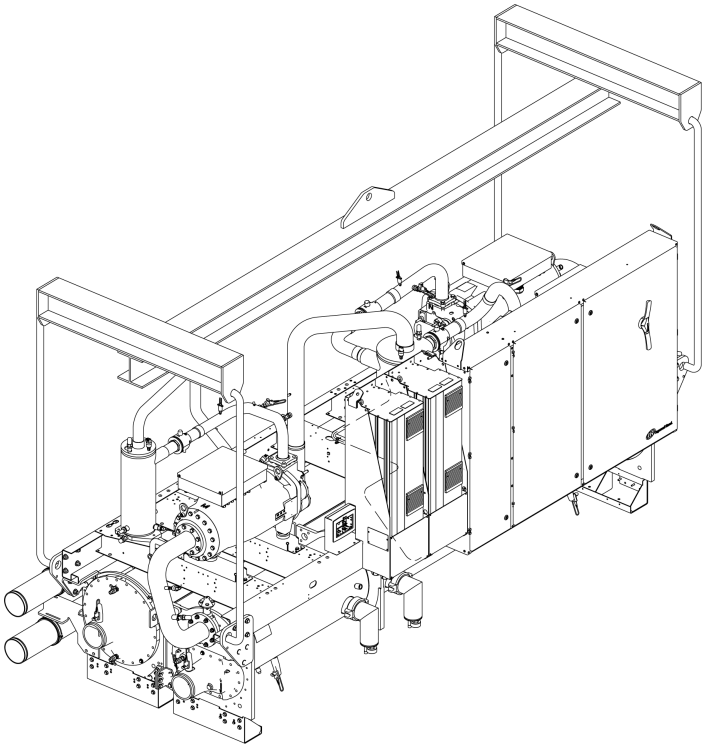
Note: *The anti-rotation strap is not a lifting chain, but a safety device to ensure that the unit cannot tilt during lifting.*

Alternate Moving Method

If it is not possible to rig from above as shown in the figures, the unit may also be moved by jacking each end high enough to move an equipment dolly under each tube sheet support. Once securely mounted on the dollies, the unit may be rolled into position.

Important: *Lifting and handling drawings are included in the document package sent with the unit.*

Figure 3. Example of spreader to be used to lift RTWF HT



⚠ Warning

Anti-rotation Strap!

Failure to do so may result in death or serious injury should a lifting cable fail.
Connect an anti-rotation strap between the lifting beam and compressor before lifting unit.

Isolation Pads

1. The elastomeric pads shipped (as standard) are adequate for most installations. For additional details on isolation practices, consult an acoustical engineer for sensitive installations. For AFD version, it is possible that some vibration frequencies can be transmitted into the foundations. This depends on the building structure. It is recommended for these situations to use neoprene isolators instead of elastomeric pads.

   Note: *Drawings to locate isolation pads are supplied with unit document package.*

2. During final positioning of the unit, place the isolation pads under the evaporator and condenser tube sheet supports. Level the unit.
3. The unit is shipped with spacers on the compressor mount that protect the compressor isolation pads during shipping and in handling. Remove these spacers before the unit is operated.
4. Remove the shipping brackets and spacers of the oil separator(s).

Important: *Drawings to locate isolation pads are included with in document package sent with the unit.*

Unit Leveling

Note: *The electrical panel side of the unit is designated as the "front" of the unit.*

1. Check unit level end-to-end by placing a level on the top surface of the evaporator shell.
2. If there is insufficient surface available on the top of the evaporator shell, attach a magnetic level to the bottom of the shell to level the unit. The unit should be level to within 5 mm over its length.
3. Place the level on the evaporator shell tube sheet support to check side-to-side (front-to-back) level. Adjust to within 5 mm of level front-to-back.

   Note: *The evaporator MUST be level for optimum heat transfer and unit performance.*
4. Use full-length shims to level the unit.

Refrigerant

RTWF HT are shipped with a Dry Nitrogen holding charge, therefore unit has to be charged with refrigerant by qualified and experienced personnel and according to state of the art processes and procedures, before commissioning.

In order to allow appropriate stand by and operating conditions, temperature and humidity in the plant room shall not be below 20 °C.

Water Piping

The RTWF HT condenser leaving water temperature set-point can be up to 105 °C. Therefore, the hydraulic design of piping has to support the operating water temperature unit can produce and comply with relevant local rules if any. If a safety thermostat protects the water loop from temperature above the piping max allowable temperature, this safety thermostat can be connected to the RTWF HT control box to stop the machine when the water temperature coming from the condenser is above the max allowable temperature.

Piping Connections

Note: *To prevent equipment damage, bypass the unit if using an acidic flushing agent.*

Make water piping connections to the evaporator and condenser. Isolate and support piping to prevent stress on the unit. Construct piping according to local and national codes. Insulate and flush piping before connecting to unit. The chilled water connections to the evaporator are to be grooved-pipe type connections. Do not attempt to weld these connections, as the heat generated from welding can cause microscopic and macroscopic fractures on the cast iron water boxes that can lead to premature failure of the water box. Refer to submittal for dimension of tube stub for grooved connection To prevent damage to chilled water components, do not allow evaporator pressure (maximum working pressure) to exceed 10 bar.

Reversing Water Boxes is prohibited.

Heat exchanger are one pass evaporator and condenser. It is critical to keep the factory layout for water boxes. Therefore reversing water boxes may lead to functional disorder.

Note: *Dimensions of tube stub for grooved connection are included in submittal drawings.*

Vents and Drains

Install pipe plugs in evaporator and condenser water box drain and vent connections before filling the water systems. To drain water, remove vent and drain plugs, install a NPT connector in the drain connection and connect a hose to it.

Water Treatment

Notice

Proper Water Treatment Required!

The use of untreated or improperly treated water could result in scaling, erosion, corrosion, algae or slime. Use the services of a qualified water treatment specialist to determine what water treatment, if any, is required. Our Manufacturers assume no responsibility for equipment failures which result from untreated or improperly treated water, or saline or brackish water.

The following disclamatory label is provided on each RTWF HT unit:

The use of improperly treated or untreated water in this equipment may result in scaling, erosion, corrosion, algae or slime. The services of a qualified water treatment specialist should be engaged to determine what treatment, if any, is advisable. The warranty specifically excludes liability for corrosion, erosion or deterioration of the manufacturer's equipment. The manufacturer assumes no responsibilities for the results of the use of untreated or improperly treated water, or saline or brackish water.

Authorized fluids are:

- Pure water
- Ethylene glycol
- Propylene glycol

Note: *For all other fluids, contact the manufacturer office.*

	Materials used on equipment	
RTWF HT	Victaulic connection:	Cast Iron + EPDM seal
	Thermal sensor well:	Brass
	Water box:	Cast Iron EN-GJL-250 according to EN-1561
	Tube sheet:	Steel - P265GH or P275NH according to EN-10028

Evaporator Piping Components

Note: *Make sure all piping components are between the shutoff valves, so that isolation can be accomplished on both the condenser and the evaporator. "Piping components" include all devices and controls used to provide proper water system operation and unit operating safety. These components and their general locations are given below.*

Entering Chilled Water Piping

- Air vents (to bleed air from system)
- Water pressure gauges with shutoff valves
- Pipe unions
- Vibration eliminators (rubber boots)
- Shutoff (isolation) valves
- Thermometers
- Clean out tees
- Pipe strainer

Leaving Chilled Water Piping

- Air vents (to bleed air from system)
- Water pressure gauges with shutoff valves
- Pipe unions
- Vibration eliminators (rubber boots)
- Shutoff (isolation) valves
- Thermometers
- Clean out tees

- Balancing valve
- Pressure relief valve

To prevent evaporator damage, do not exceed 10 bar evaporator water pressure for standard water boxes. To prevent tube damage, install a strainer in the evaporator water inlet piping.

Condenser Piping Components

“Piping components” include all devices and controls used to provide proper water system operation and unit operating safety. These components and their general locations are given below.

Entering Condenser Water Piping

- Air vents (to bleed air from system)
- Water pressure gauges with shutoff valves
- Pipe unions
- Vibration eliminators (rubber boots)
- Shutoff (isolation) valves
- One per each pass
- Thermometers
- Clean out tees
- Pipe strainer
- Flow switch

Leaving Condenser Water Piping

- Air vents (to bleed air from system)
- Water pressure gauges with shutoff valves
- Pipe unions
- Vibration eliminators (rubber boots)
- Shutoff (isolation) valves
- One per each pass
- Thermometers
- Clean out tees
- Balancing valve
- Pressure relief valve

To prevent evaporator damage, do not exceed 10 bar evaporator water pressure for standard water boxes.

To prevent tube damage, install a strainer in the evaporator water inlet piping.

If the RTWF HT is located inside a box for sound purposes, for instance, the controller can activate an air extraction fan to lower the ambient temperature around the machine. A sensor inside the machine is used to maintain the target ambient temperature.

Water Pressure Gauges and Thermometers

Install field-supplied thermometers and pressure gauges (with manifolds, whenever practical). Locate pressure gauges or taps in a straight run of pipe; avoid placement near elbows, etc. Be sure to install the gauges at the same elevation on each shell if the shells have opposite end water connections.

When the machine is in standby mode (no compressor is running), the controller checks the refrigerant pressure and can activate a relay when the pressure is low, close to the atmospheric pressure. This relay can be used to increase the machine room temperature.

Water Pressure Relief Valves

Notice

Equipment Damage!

Failure to do so could result in shell damage

Install a pressure relief valve in both evaporator and condenser water systems.

Install a water pressure relief valve in one of the condenser and one of the evaporator water box drain connections or on the shell side of any shutoff valve. Water vessels with close-coupled shutoff valves have a high potential for hydrostatic pressure buildup on a water temperature increase. Refer to applicable regulation for relief valve installation guidelines.

Flow Sensing Devices

Use field-provided flow switches or differential pressure switches with pump interlocks to sense system water flow.

To provide unit protection, install and wire flow switches in series with the water pump interlocks, for both chilled water and condenser water circuits (refer to the “Installation Electrical” section). Specific connections and schematic wiring diagrams are shipped with the unit.

Flow switches must stop or prevent compressor operation if either system water flow drops off drastically. Follow the manufacturer’s recommendations for selection and installation procedures. General guidelines for flow switch installation are outlined below.

- Mount the switch upright, with a minimum of 5 pipe diameters of straight, horizontal run on each side.
- Do not install close to elbows, orifices or valves.

Note: *The arrow on the switch must point in the direction of the water flow. To prevent switch fluttering, remove all air from the water system.*

Note: *The Symbio™ 800 provides a 6 second time delay on the flow switch input before shutting down the unit on a loss of flow diagnostic. Contact a qualified service organization if nuisance machine shutdowns persist. Adjust the switch to open when water flow falls below nominal. Refer to the General Data table for minimum flow recommendations for specific water pass arrangements. Flow switch contacts are closed on proof of water flow.*

Refrigerant Pressure Relief Valve Venting

Important: *To prevent injury due to inhalation of refrigerant gas, do not discharge refrigerant anywhere. If multiple units are installed, each unit must have separate venting for its relief valves. Consult local regulations for any special relief line requirements*

All relief valve venting is the responsibility of the installing contractor. All RTWF HT units use condenser pressure relief valves that must be vented to the outside of the building. Relief valve connection sizes and locations are shown in the unit submittals. Refer to national regulations for relief valve vent line sizing information.

Notice

Equipment Damage!

Failure to heed specifications could result in capacity reduction, unit damage and/or relief valve damage.

Do not exceed vent piping code specifications

Note: *Once opened, relief valves tend to leak.*

RTWF HT Evaporator and Condenser Pressure drop

Figure 4. Evaporator pressure drop

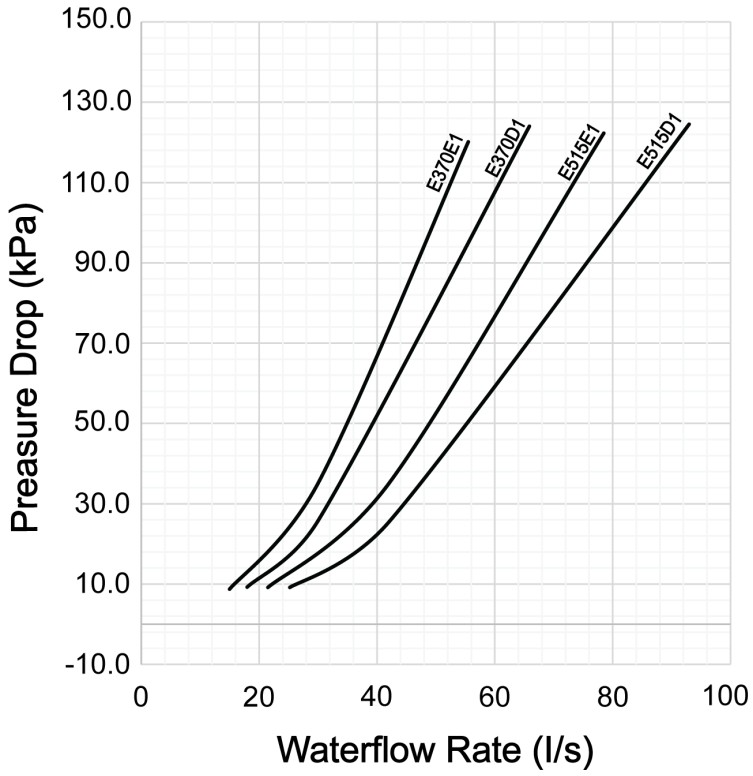


Figure 5. 1-Pass Condensers Pressure Drop

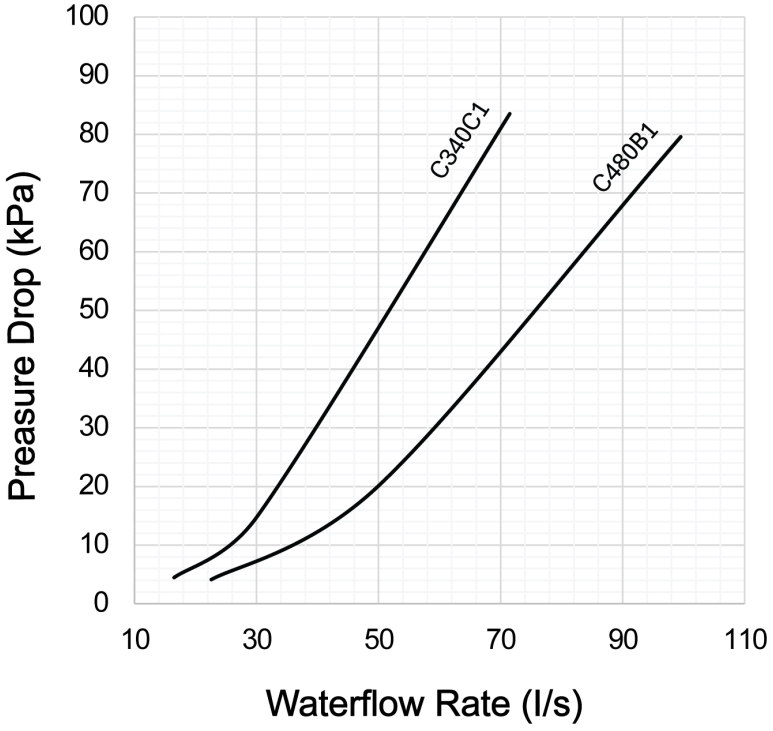
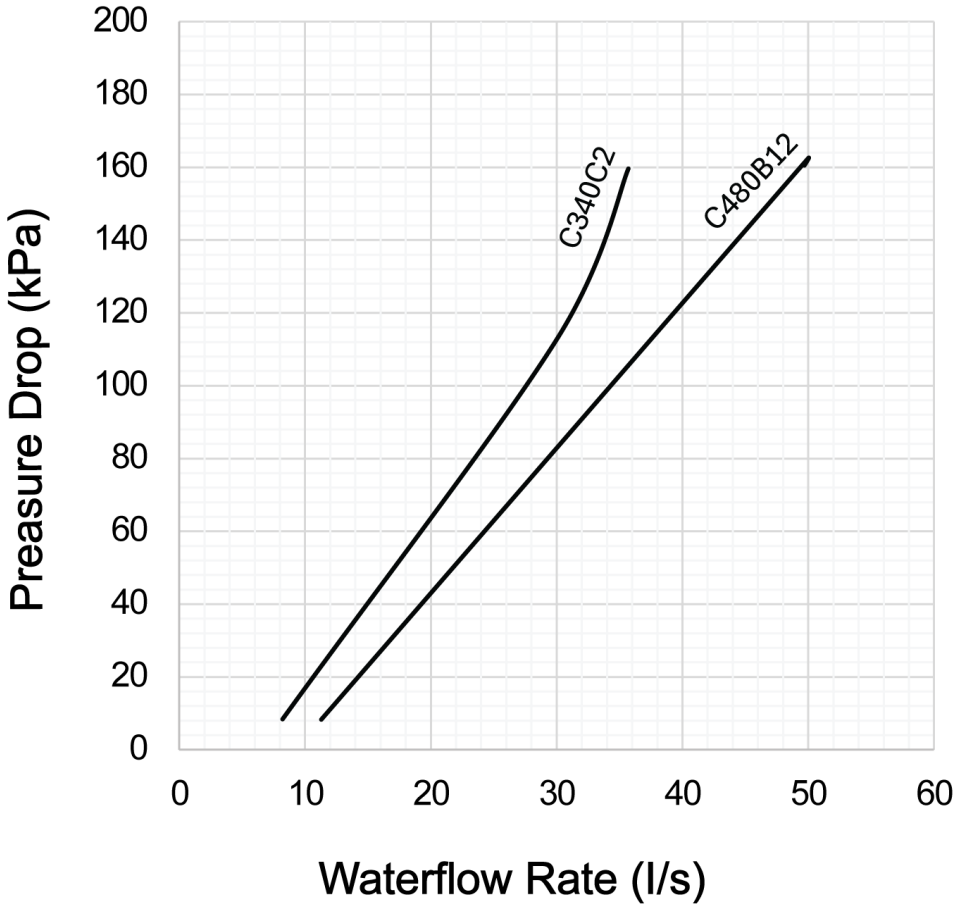


Figure 6. 2-Pass Condensers Pressure Drop



Ethylene Glycol and Propylene Glycol Protection

Table 2. Ethylene Glycol and Propylene Glycol protection settings

	Ethylene Glycol	Mono Propylene Glycol
Glycol Percentage (weight %)	Solution Freeze Point (°C)	Solution Freeze Point (°C)
0	0.0	0.0
2	-0.6	-0.6
4	-1.3	-1.2
5	-1.7	-1.5
6	-2.0	-1.8
8	-2.8	-2.5
10	-3.6	-3.1
12	-4.5	-3.8
14	-5.4	-4.6
15	-5.9	-5.0
16	-6.3	-5.4
18	-7.4	-6.2
20	-8.4	-7.1

Table 2. Ethylene Glycol and Propylene Glycol protection settings (continued)

	Ethylene Glycol	Mono Propylene Glycol
Glycol Percentage (weight %)	Solution Freeze Point (°C)	Solution Freeze Point (°C)
22	-9.6	-8.0
24	-10.8	-9.0
25	-11.4	-9.6
26	-12.1	-10.1
28	-13.5	-11.3
30	-15.0	-12.6
32	-16.5	-14.0
34	-18.2	-15.5
35	-19.0	-16.3
36	-19.9	-17.1
38	-21.8	-18.8
40	-23.8	-20.7
42	-25.9	-22.6
44	-28.1	-24.8
45	-29.3	-25.9
46	-30.5	-27.1
48	-33.0	-29.5
50	-35.6	-32.1

Important:

1. *Additional glycol beyond the recommendations will adversely affect unit performance. For some operating conditions this effect can be significant.*
2. *If additional glycol is used, then use the actual % glycol to establish the low refrigerant cutout setpoint.*
3. *With glycol application, ensure that there is no fluctuation of brine flow versus Order Write Up value, as a reduction of flow will adversely affect unit performance and behavior.*
4. *Tables above should not be interpreted as suggesting operating ability or performance characteristics at all tabulated glycol percentages. Full unit simulation is required for proper prediction of unit performance for specific operating conditions. For information on specific conditions, contact manufacturer.*

Condenser Water Temperature

To start the screw compressor, a minimum differential pressure must be achieved during the compressor startup phase. If the condenser outlet temperature is too low, the minimum differential pressure is not achieved, and the controller is going to stop the machine to protect the compressor. Minimum water temperature must be above 50 °C to allow compressor start. Temperature to start also depends on system inertia, water content of water loop for example. Please refer to sales office to check minimum condition to start.

When the application requires startup temperatures below the prescribed minimums, a variety of options are available. To control a 2-way or 3-way valve, Manufacturer offers a condenser regulating valve control option for the Symbio™ 800 controls.

Condenser leaving water temperature must be 9 °C higher than Evaporator leaving water temperature within 2 minutes after start-up. A minimum differential must be maintained afterwards. The value of this differential is determined according to the unit model and as a function of operating conditions by manufacturer Official Selection software.

The minimum acceptable refrigerant pressure differential between condenser and evaporator is 1.7 Bar. The control system will attempt to obtain and maintain this differential at startup, but for continuous operation a design should maintain the defined differential from evaporator leaving water temperature to condenser leaving water temperature, as indicated above.

Prevent the Boiling of the Heating Fluid

- The operating pressure of the heating fluid must always be maintained above the respective boiling pressure of the heating fluid.
- Maximum leaving condenser temperature is 105 °C. The maximum inlet temperature depends on the DT of Heat exchanger, i.e with a DT = 5K, Max inlet temp = 100 °C. Refer to your sales office to know the DT according to the selected heat exchanger.

⚠ Warning

Equipment Protection!

Operation with water in a vapor state will lead to poor unit performance and may cause damage to the heat exchanger. RTWF HT heat pumps are designed to produce superheated hot water up to 105 °C. Ensure that the pressure in the hot-water circuit remains above 1.2 bar to maintain the water in its liquid state.

Condenser Water Regulation

The condenser head pressure control option provides for a 0-10VDC (maximum range -a smaller range is adjustable) output interface to the customer's condenser water flow device. This option enables the Symbio™ 800 controls to send a signal for opening and closing a 2-way or 3-way valve as necessary to maintain Heat pump differential pressure.

Methods other than those shown can be employed to achieve the same results. Contact your manufacturer office for details.

Throttling Valve

This method maintains condensing pressure and temperature by throttling water flow leaving the condenser in response to condenser pressure or system differential pressures.

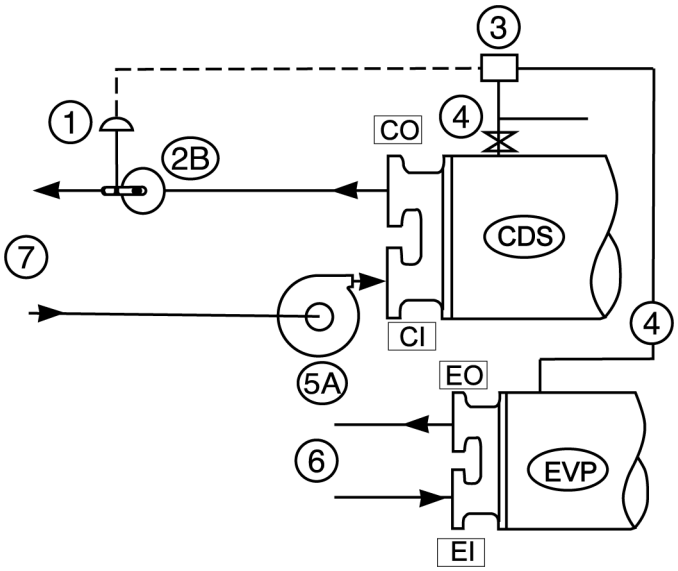
Advantages

- Good control with proper valve sizing at relatively low cost.
- Pumping cost can be reduced.

Disadvantages

- Increased rate of fouling due to lower condenser water velocity.
- Requires pumps that can accommodate variable flow.

Figure 7. Throttling valve



Items	Description	Items	Description
1	Electric valve actuator	6	To/ from cooling load
2A	3-way valve or 2 butterfly valves	7	To/ from cooling device
2B	2 butterfly valves	8	Electric controller
3	Unit controller	EI	Evaporator Inlet
4	Refrigerant pressure line	EO	Evaporator Outlet
5A	Condenser water pump	CI	Condenser Inlet
5B	Condenser water pump with AFD	CO	Condenser Outlet

Installation - Electrical

General Recommendations

For proper electrical component operation, do not locate the unit in areas exposed to dust, dirt, corrosive fumes or excessive humidity. If any of these conditions exist, corrective action must be taken.

When reviewing this manual keep in mind:

- All field-installed wiring must be in accordance with local regulations, CE directives and guidelines. Be sure to satisfy proper equipment grounding requirements according to CE.
- The following standardized values - Maximum Amps - Short Circuit Amps - Starting Amps are displayed on unit nameplate.
- All field-installed wiring must be checked for proper terminations, and for possible shorts or grounds.

Note: *Always refer to wiring diagrams or submittal shipped with unit for specific electrical schematic and connection information.*

Important: *To prevent control malfunctions, do not run low voltage wiring (< 30 V) in conduit with conductors carrying more than 30 volts.*

⚠ Warning

Hazardous Voltage with Capacitor!

Failure to disconnect power and discharge capacitors before servicing could result in death or serious injury. Disconnect all electric power, including remote disconnects and discharge all motor start/run and AFD (Adaptive Frequency Drive) capacitors before servicing. Follow proper lockout/tagout procedures to ensure the power cannot be inadvertently energized.

- For variable frequency drives or other energy storing components provided by manufacturer, refer to the appropriate manufacturer's literature for allowable waiting periods for discharges capacitors. Verify with an appropriate voltmeter that all capacitors have discharged.
- DC bus capacitors retain hazardous voltages after input power has been disconnected. Follow proper lockout/ tagout procedures to ensure the power cannot be inadvertently energized.

After disconnecting input power, wait twenty (20) minutes for units which are equipped with variable frequency drive (0 V DC) before touching any internal components.

Important: *Regarding the safe discharge of capacitors, see "Adaptive Frequency™ Drive (AFD3) Capacitor Discharge".*

However, for any intervention in the AFD, the indicated time on the label of the AFD must be respected.

Before installing the unit with AFD, the user must evaluate the potential electromagnetic problems in the surrounding area. The following should be considered:

1. The presence above, below and adjacent to the unit of for example: welding equipment or other power cables, control cables or signaling and telephone cables.
2. Receivers and transmitters, radio and television.
3. Computer and other control equipment.
4. The critical safety equipment, example protection of industrial equipment.
5. The health of neighboring persons, for example, use of pacemakers or appliances against deafness.
6. The immunity of other equipment in the environment. The user must ensure that the other materials used in the environment are compatible. This may require additional protection measures

If electromagnetic disturbances are detected, it shall be the responsibility of the user to resolve the situation.

In any case, the electromagnetic interferences have to be reduced until they are no longer troublesome.

All wiring must comply with national electric regulations. Minimum circuit ampacities and other unit electrical data is on the unit nameplate. See the unit order specifications for actual electrical data. Specific electrical schematics and connection diagrams are shipped with the unit.

Do not allow conduit to interfere with other components, structural members or equipment. Control voltage (110 V) wiring in conduit must be separate from conduit carrying low voltage (< 30 V) wiring. To prevent control malfunctions, do not run low voltage wiring (< 30 V) in conduit with conductors carrying more than 30 V.

RTWF HT Supply Wiring

The units are designed according to European standard EN 60204-1; therefore, all power supply wiring must be sized and selected accordingly by the project engineer.

Water Pump Power Supply

Provide power supply wiring with fused disconnect for both the chilled water and condenser water pumps.

Electrical Panel Power Supply

Power supply wiring instructions for the starter/control panel are:

Run the line voltage wiring in conduit to the access opening(s) on the starter/control panel. See the product catalog for wire sizing and selection information and refer to general data that show typical electrical connection sizes and locations. Always refer to submittal information for your actual unit specifications.

Note: *Asterisked connections require the user to provide an external source of power. The 110 V control power transformer is not sized for additional load.*

Important: *Unit must not be linked to the neutral wiring of the installation.*

Units are compatible with the following neutral operating conditions:

TNS	IT	TNC	TT
Standard	Special - On request	Special - On request	Special - On request

Differential protection should be suited for industrial machinery with current leak which can be higher than 500 mA (several motors and frequency drives).

⚠ Caution

Equipment Damage!

To avoid corrosion, overheating, or general damage at terminal connections of power supply wiring, the unit is designed for copper mono-conductors only. In the case of multiconductor cable, an intermediate connection box must be added. For cable with alternative material, bi-material connecting devices are mandatory. Cable routing inside the control panel should be done on a case-by-case basis by the installer.

Compressor Motor Phase Sequencing

Always verify that proper rotation of the unit compressor is established before the machine is started. Proper motor rotation requires confirmation of the electrical phase sequence of the power supply. The motor is internally connected for clockwise rotation with the incoming power supply phased A, B, C (L1, L2, L3).

To confirm the correct phase sequence (ABC), use a phase meter.

Basically, voltages generated in each phase of a polyphase alternator or circuit are called phase voltages. In a 3-phase circuit, 3 sine wave voltages are generated, differing in phase by 120 electrical degrees. The order in which the 3 voltages of a 3-phase system succeed one another is called phase sequence or phase rotation. This is determined by the direction of rotation of the alternator. When rotation is clockwise, phase sequence is usually called “ABC.”

This direction may be reversed outside the alternator by interchanging any two of the line wires. It is this possible interchange of wiring that makes a phase sequence indicator necessary if the operator is to quickly determine the phase rotation of the motor.

Module and Control Panel Connectors

All connectors can be unplugged or the wires can be removed. If an entire plug is removed, make sure the plug and the associated jack are marked for proper location identification during reinstallation.

Important: *All electrical drawings, schematics and control panel layout are included in the documentation package sent with the unit.*

Interconnecting Wiring (Field Wiring Required)

Important: *Do not turn unit on or off using the water pump interlocks.*

When making field connections, refer to the appropriate field layout, wiring, schematics and controls diagrams that ship with the unit. Whenever a contact closure (binary output) is referenced, the electrical rating is:

At 120 VAC	7.2 amp resistive 2.88 amp pilot duty 250 W, 7.2 FLA 43.2 LRA
At 240 VAC	5.0 amp resistive 2.0 amp pilot duty 250 W, 3.6 FLA 21.3 LRA

Whenever a dry contact input (binary input) is referenced, the electrical rating is 24VDC, 12 mA.

Whenever a control voltage contact input (binary input) is referenced, the electrical rating is 120 VAC, 5mA.

Note: *Asterisked connections require the user to provide an external source of power. The 115V control power transformer is not sized for additional load.*

Condenser Water Pump Control

Symbio™ 800 provides a contact closure output to start and stop the condenser water pump. It will allow to run the condenser pump after compressor stop to avoid risk of freezing due to refrigerant migration from evaporator.

Condenser Water Pump Pre-start time has been added to help with cold condenser water problems. In very cold outdoor ambient, the cooling device's sump would reach the unit some time after the low system differential pressure protection had run through its ignore time, and result in an immediate shutdown and latching diagnostic. By simply starting the pump earlier, and allowing mixing of the warmer indoor loop with the cooling device's sump, this problem can be avoided.

Condenser Water Flow Interlock

The Symbio™ 800 shall accept an isolated contact closure input from a customer installed proof of flow device such as a flow switch and customer provided pump starter auxiliary contact for interlocking with condenser water flow.

The input shall be filtered to allow momentary openings and closings of the switch due to turbulent water flow, etc. This shall be accomplished with a 6 seconds filtering time. The sensing voltage for the condenser water flow switch is 115/240 VAC.

On a call for cooling after the restart inhibit timer has timed out, the Symbio™ 800 shall energize the condenser water pump relay and then check the condenser water flow switch and pump starter interlock input for flow confirmation.

Startup of the compressor will not be allowed until flow has proven. If flow is not initially established within 1200 seconds (20 minutes) of the condenser pump relay energizing, an automatically resetting diagnostic "Condenser Water Flow Overdue" shall be generated which terminates the pre-start mode and denergizes the condenser water pump relay. This diagnostic is automatically reset if flow is established at any later time.

Note: *This diagnostic would never automatically reset if Symbio™ 800 was in control of the condenser pump through its condenser pump relay since it is commanded off at the time of the diagnostic. It could however reset and allow normal unit operation if the pump was controlled from some external source.*

Evaporator Water Pump Control

Symbio™ 800 has a evaporator water pump output relay that closes when the unit is given a signal to go into the Auto mode of operation from any source. The contact is opened to turn off the pump in the event of most machine level diagnostics to prevent the build up of pump heat. To protect against the build-up of pump heat for those diagnostics that do not stop and/ or start the pump and to protect against the condition of a bad flow switch, the pump shall always be stopped when refrigerant pressure is seen to be close to heat exchanger design pressure.

Evaporator Water Flow Interlock

Symbio™ 800 has an input that will accept a contact closure from a proof of flow device such as a flow switch. The flow switch is to be wired in series with the chilled water pump starter's auxiliary contacts. When this input does not prove flow within 20 minutes relative to transition from Stop to Auto modes of the unit, or if the flow is lost while the unit is in the Auto mode of operation, the unit will be inhibited from running by a non-latching diagnostic. The flow switch input shall be filtered to allow for

momentary openings and closings of the switch due to turbulent water flow. This is accomplished with a 6 seconds filtering time. The sensing voltage for the condenser water flow switch is 115/240 VAC

Important: *DO NOT cycle the unit through starting and stopping the chilled water pump. This could cause the compressor to shut down fully loaded. Use the external stop/start input to cycle the unit.*

Programmable Relays (Alarm and Status)

Symbio™ 800 provides a flexible alarm or units status indication to a remote location through a hard wired interface to a dry contact closure. 4 relays are available for this function as a Quad Relay Output LLID and a second quad relay board can be field mounted if more than 4 different alarm/status are needed (refer to your local maniufacturer service). The events/states that can be assigned to the programmable relays are listed in the following table.

The Symbio™ 800 Service Tool (TU) is used to install and assign any of the above listed events or status to each of the 4 relays. The default assignments for the 4 available relays are listed below.

LLID Name	LLID Software Relay Designation	Output Name	Default
Operating Status Programmable Relays	Relay 0	Status Relay 1, J2-1,2,3	Evaporator Freeze Avoidance Request
	Relay 1	Status Relay 2, J2-4,5,6	Condenser Freeze Avoidance Request
	Relay 2	Status Relay 3, J2-7,8,9	Compressor Running
	Relay 3	Status Relay 4, J2-10,11,12	Latching Alarm

If the evaporator/condenser pump request relays are not used to manage the evaporator/condenser water pumps then the evaporator/condenser freeze avoidance request relays must be connected to the water pump management system to switch the water pumps ON when the Symbio™ 800 identifies a risk of freeze up.

Latching Input

The Symbio™ 800 provides auxiliary control for a customer specified/installed latching trip out. When this customer-furnished remote contact is provided, the unit will run normally when the contact is closed. When the contact opens, the unit will trip off on a manually resettable diagnostic. This condition requires manual reset at the switch on the front of the control panel.

External Auto/Stop

If the unit requires the external Auto/Stop function, the installer must provide leads from the remote contacts to the proper terminals of the LLID on the control panel. The unit will run normally when the contacts are closed. When the contact opens, the compressor(s), if operating, will go to the RUN : UNLOAD operating mode and cycle off. Unit operation will be inhibited. Re-closure of the contacts will permit the unit to automatically return to normal operation.

Note: *A “panic“ stop (similar to “emergency“ stop) can be manually commanded by pressing the STOP button twice in a row, the unit will immediately shut down, but without creating a latching diagnostic.*

Soft Loading

Soft loading will prevent the unit from going to full capacity during the pull-down period. The Symbio™ 800 control system has two soft loading algorithms running all of the time. They are capacity control soft loading and current limit soft loading. These algorithms introduce the use of a Filtered Water setpoint and a Filtered Current Limit setpoint. After the compressor has been started, the starting point of the filtered water setpoint is initialized to the value of the Cds Water Temperature. The filtered current limit setpoint is initialized to the value of the Current Limit Softload Starting Percent. These filtered setpoints allow for a stable pull-down that is user adjustable in duration. They also eliminate sudden transients due to setpoint changes during normal unit operation.

3 settings are used to describe the behavior of soft loading. The setup for soft loading can be done using TU.

- Capacity Control Softload Time: This setting controls the time constant of the Filtered Water Setpoint. It is settable between 0 and 120 min.
- Current Limit Control Softload Time: This Setting controls the time constant of the Filtered Current Limit Setpoint. It is settable between 0 and 120 minutes.
- Current Limit Softload Starting %: This setting controls the starting point of the Filtered Current Limit Setpoint. It is adjustable from 40 to 100% RLA.

LonTalk Communication Interface - Optional

Symbio™ 800 provides an optional LonTalk Communication Interface (LCI-C) between the unit and a BAS. An LCI-C LLID shall be used to provide “gateway” functionality between the LonTalk protocol and the unit.

Bacnet Communication Interface - Optional

Symbio™ 800 provides an optional Bacnet communication interface between the unit and a BAS. Bacnet communication capability is fully integrated on Symbio™ 800. For further information see Integration Guide.

Modbus Communication Interface - Optional

Symbio™ 800 provides an optional Modbus communication Interface between the unit and a BAS. Modbus communication capability is fully integrated on Symbio™ 800. For further information see the Integration guide.

Smart Chiller Mode

The RTWF HT controller can operate the unit in heat pump mode, with a temperature setpoint for the condenser leaving water temperature. At the same time, it can ensure that the evaporator leaving water temperature (ELWT) remains above a configurable minimum threshold. If the ELWT approaches this level, the controller will unload the unit to keep it running in heating mode and avoid a diagnostic shutdown. Finally, if the ELWT then exceeds the minimum acceptable level, the controller will switch to cooling mode, controlling the ELWT to this minimum acceptable level while still producing hot water on the condenser side. Should the ELWT continue to decrease due to insufficient heat energy on the evaporator side, the controller will shut down the last running compressor, switch back to the heating mode, and wait for the evaporator entering water temperature to rise before restarting the unit.

Refrigerant Leak Detector

A refrigerant leak detector can be connected to the RTWF HT controller. if a leak is detected, the controller will not stop the machine, but a warning will be sent to the Building Management System (BMS), if any BMS is connected to the controller.

Flow Sensing and Capacity Calculation

The RTWF HT controller can manage paddle flow sensors as well as pressure sensors mounted on the water inlet and outlet pipes of the heat exchangers. Based on the pressure differential measured by these sensors, the controller can estimate the cooling or heating capacity delivered by the machine.

Auxiliary Hot Setpoint Contact - Optional

Symbio™ 800 accepts a contact closure input to switch from BAS/External/Front Panel setpoint to a customer defined auxiliary setpoint. By default, hot water auxiliary setpoint is set to 58 °C.

External Demand Limit Setpoint - Optional

Symbio™ 800 will accept either a 2-10VDC or a 4-20mA input signal to adjust the demand limit setpoint from a remote location.

Percent Condenser Pressure Output - Optional

Symbio™ 800 provides a 2-10 VDC analog output to indicate condenser pressure in percent of software High Pressure Cutout (soft HPC).

Percent HPC = (Lowest Condenser Pressure of all running circuits (abs) / Soft HPC (abs))*100.

Refrigerant Differential Pressure Indication - Optional

Symbio™ 800 provides a 2-10 VDC analog output to indicate refrigerant differential pressure with the endpoints customer defined.

Refrigerant Differential Pressure = Lowest of (condenser refrigerant pressure cktx - evaporator refrigerant pressure cktx).

Unit Percent RLA Output - Optional

Symbio™ 800 provides a 0-10 Vdc analog output to indicate unit %RLA 2 to 10 Vdc corresponds to 0 to 130% RLA.

Operating Principles Mechanical

This section contains an overview of the operation and maintenance of RTWF HT heat pumps equipped with microcomputer-based control systems. It describes the overall operating principles of the RTWF HT design. Following the section is information regarding specific operating instructions, detailed descriptions of the unit controls and options and maintenance procedures that must be performed regularly to keep the unit in top condition. Diagnostic information is provided to allow the operator to identify system malfunctions.

Note: *To ensure proper diagnosis and repair, contact a qualified service organization if a problem should occur.*

General

The RTWF HT units are multi compressors, dual circuit, Water-to-water heat pumps. These units are equipped with unit mounted starter/control panels. The basic components of RTWF HT unit are:

- Unit-mounted panel containing starter and Symbio™ 800 controller and Input/output LLIDS
- Helical-rotary compressors
- Water-to-water evaporator
- Water-to-water condenser
- Oil supply system
- Oil cooler
- Related interconnecting piping
- One AFD (Adaptive frequency drive) per circuit

Thermal Cycle

The thermal cycle of the unit is conceptually similar to that of other heat pump

Heating is accomplished in a shell-and-tube heat exchanger (condenser) where refrigerant is condensed on the shell side and water flows internally in the tubes.

Sourcing of energy consists in the use of a shell-and-tube heat exchanger (evaporator) with refrigerant evaporating on the shell side and water flowing inside tubes having enhanced surfaces.

Refrigerant is metered through the flow system using an electronic expansion valve that maximizes unit efficiency at part load.

The compressor is a twin-rotor helical-rotary type. It uses a suction gas-cooled motor that operates at lower motor temperatures under continuous full- and partload operating conditions.

An oil management system provides oil-free refrigerant to the heat exchangers to maximize heat transfer performance, while providing lubrication and rotor sealing to the compressor.

The lubrication system ensures long compressor life and contributes to quiet operation.

Each unit circuit features an AFD on one compressor and a wye Delta starter on the second compressor. Control panel is provided on every unit.

Microprocessor-based unit control modules (Symbio™ 800) provide for accurate water temperature control as well as monitoring, protection and adaptive limit functions.

The “adaptive” nature of the controls intelligently prevents the unit from operating outside of its limits, or compensates for unusual operating conditions, while keeping the unit running rather than simply tripping due to a safety concern.

When problems do occur, diagnostic messages assist the operator in troubleshooting.

Heat-pump Cycle Description

The Thermal cycle for the RTWF HT Heat pump can be described using the pressure-enthalpy diagram shown in Figure 8, p. 34.

Source energy is absorbed by the system (Segment 1-2) thanks to a heat transfer between source media (Water) and refrigerant through the evaporator resulting in the evaporation of refrigerant.

Metered liquid refrigerant enters a distribution system inside the evaporator (1) and is then distributed to the tubes in the tube bundle vaporizing as it extracts energy from the source media.

The refrigerant vapor generated in the evaporator flows to the suction side of the compressor where it enters the motor compartment of the suction-gas-cooled motor (2).

The refrigerant flows across the motor, cooling it, and is then compressed to discharge pressure conditions (3).

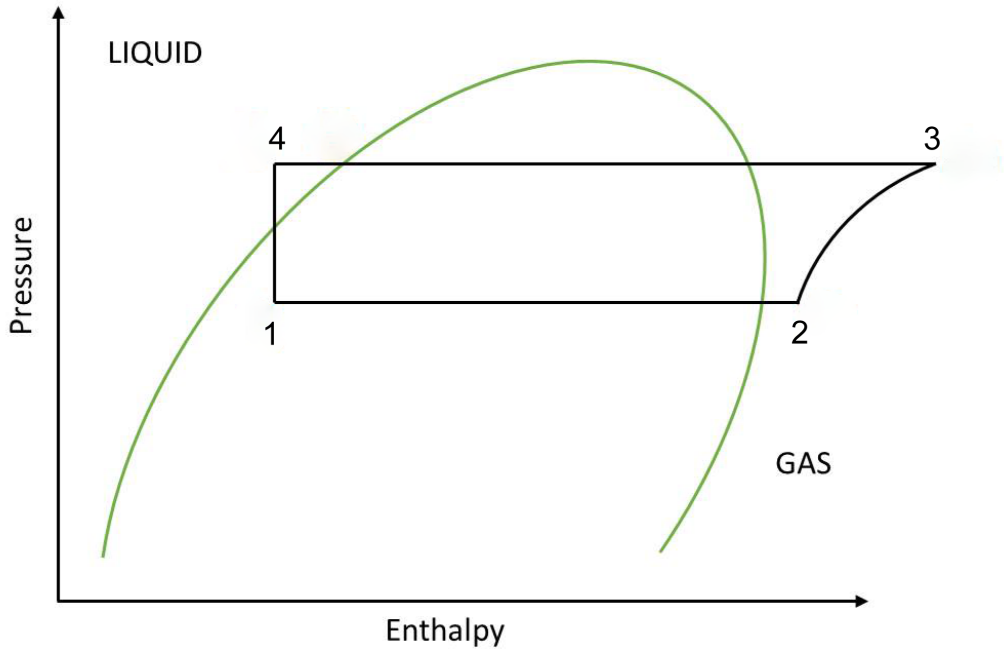
Simultaneously, lubricant is injected into the compressor with purpose of lubricating the bearings and sealing the small clearances between the compressor's twin rotors.

Immediately following the compression process the lubricant and refrigerant are effectively divided using an oil separator. The oil-free refrigerant vapor enters the condenser at State Point 3.

Compressed refrigerant vapor evenly flows across the condenser, releasing the heating energy gathered in Evaporator and created through passing through the compressor to the water passing in the condenser tubes, to ultimately condense.

As the refrigerant leaves the bottom of the condenser (4), it enters an electronic expansion valve. The pressure drop created by the expansion process vaporizes a portion of the liquid refrigerant. The resulting mixture of liquid and gaseous refrigerant then enters the Evaporator at Point 1, initiating a new complete cycle.

Figure 8. Pressure/ Enthalpy Curve



Compressors

The compressor used by the RTWF HT Heat pumps consists of 3 distinct sections: the motor, the rotors and the bearing housing.

Compressor Motor

A two-pole, hermetic, squirrel-cage induction motor directly drives the compressor rotors. The motor is cooled by suction vapor drawn from the evaporator and entering the end of the motor housing through the suction line.

Compressor Rotors

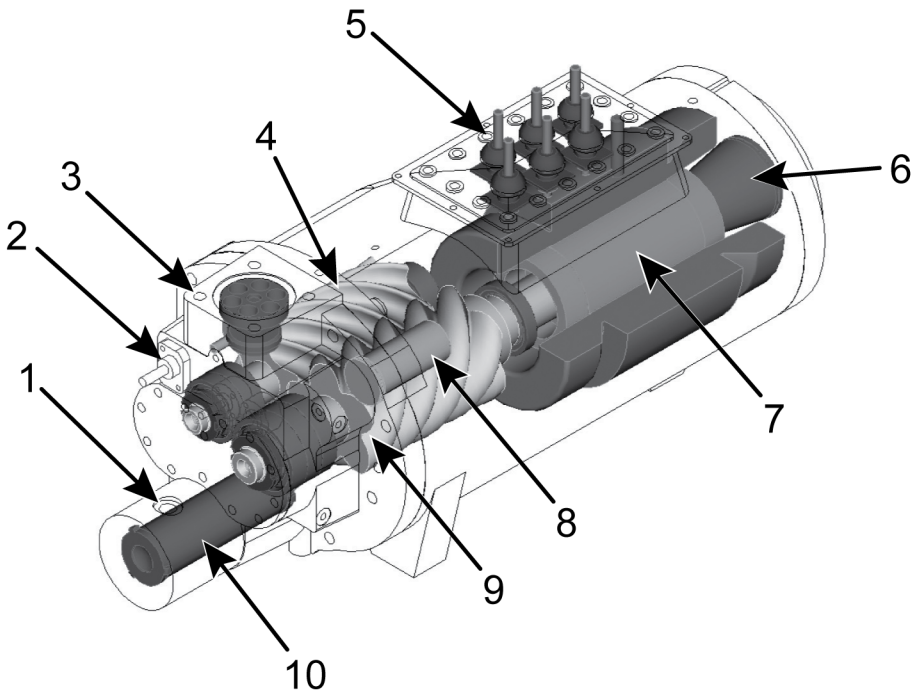
Each RTWF HT Heat pump uses a semi-hermetic, direct-drive Helical-Rotary type compressor. Excluding the bearings, each compressor has only 3 moving parts: 2 rotors - "male" and "female" - provide compression, and a slide valve that controls capacity. The male rotor is attached to, and driven by, the motor, and the female rotor is, in turn, driven by the male rotor. Separately housed bearing sets are provided at each end of both rotors. For RTWF HT, female and male unloader piston moves along the respective rotor.

The helical-rotary compressor is a positive displacement device. Refrigerant from the evaporator is drawn into the suction opening at the end of the motor section. The gas is drawn through a suction strainer across the motor, cooling it, and then into the rotor section. It is then compressed and discharged directly into the discharge line for RTWF HT.

There is no physical contact between the rotors and compressor housing. Oil is injected through adequate ports, coating both rotors and the compressor housing interior. Although this oil does provide rotor lubrication, its primary purpose is to seal the clearance spaces between the rotors and compressor housing. A positive seal between these internal parts enhances compressor efficiency by limiting leakage between the high pressure and low pressure cavities.

Capacity control is accomplished by means of an AFD and a slide valve for variable speed compressor and a male and female unloader piston for fixed speed compressor.

Figure 9. RTWF HT Compressor Description



Items	Description	Items	Description
1	Oil control valve (hidden)	6	Suction strainer
2	Female unloader piston	7	Motor rotor
3	Discharge check valve	8	Male unloader piston
4	Female rotor	9	Male rotor
5	Motor terminals	10	Oil filter

Oil Management System

Oil Separator

The oil separator consists of a vertical tube, joined at the top by the refrigerant discharge line from the compressor. This causes the refrigerant to swirl in the tube and throws the oil to the outside, where it collects on the walls and flows to the bottom. The compressed refrigerant vapor, stripped of oil droplets, exits out the top of the oil separator and is discharged into the condenser.

Oil that collects in the bottom of the oil separator at condensing pressure during compressor operation; therefore, oil is constantly moving to lower pressure areas.

Oil Flow Protection

Oil flow and quality is proven through a combination of a number of sensors, most notably a pressure transducer and the optical oil level sensor.

If for any reason oil flow is obstructed because of a plugged oil filter, closed service valve, faulty master solenoid, or other source, the oil pressure transducer will read an excessively high pressure drop in the oil system (relative to the total system pressure) and shut down the unit.

Likewise, the optical oil level sensor can detect the lack of oil in the primary oil system (which could result from improper oil charging after servicing, or oil logging in other parts of the system). The sensor will prevent the compressor from starting or running unless an adequate volume of oil is present. The combination of these two devices, as well as diagnostics associated with extended low system differential pressure and low superheat conditions, can protect the compressor from damage due to severe conditions, component failures, or improper operation.

To ensure the required system differential pressure is adequate to move oil to the compressor, the Symbio™ 800 attempts to both control a minimum system differential pressure as well as monitor it. Based on readings from pressure transducers in both the evaporator and condenser. Once the minimum is met, the EXV will return to normal liquid level control (see the paragraph on “Cycle Description”). If the differential is significantly lower than required, the unit will trip and initiate appropriate diagnostics and would enforce a compressor “cool down” period. To ensure proper lubrication and minimize refrigerant condensation in the oil sump, heaters are mounted on the bottom of the oil sump. An auxiliary contact of the compressor starter, energizes these heaters during the compressor off cycle to maintain a proper elevation of the oil temperature. The heater element is continuously energized while the compressor is off and does not cycle on temperature.

Oil Filter

All units are equipped with replaceable element oil filters. Each removes any impurities that could foul the compressor internal oil supply galleries. This also prevents excessive wear of compressor rotor and bearing surfaces and promotes long bearing life. Refer to maintenance section for recommended filter element replacement intervals.

Compressor Rotor Oil Supply

Oil flowing through this circuit enters the compressor rotor housing. From there it is injected along the rotors to seal clearance spaces around the rotors and lubricate the contact line between the male and female rotors.

Lubricant Recovery

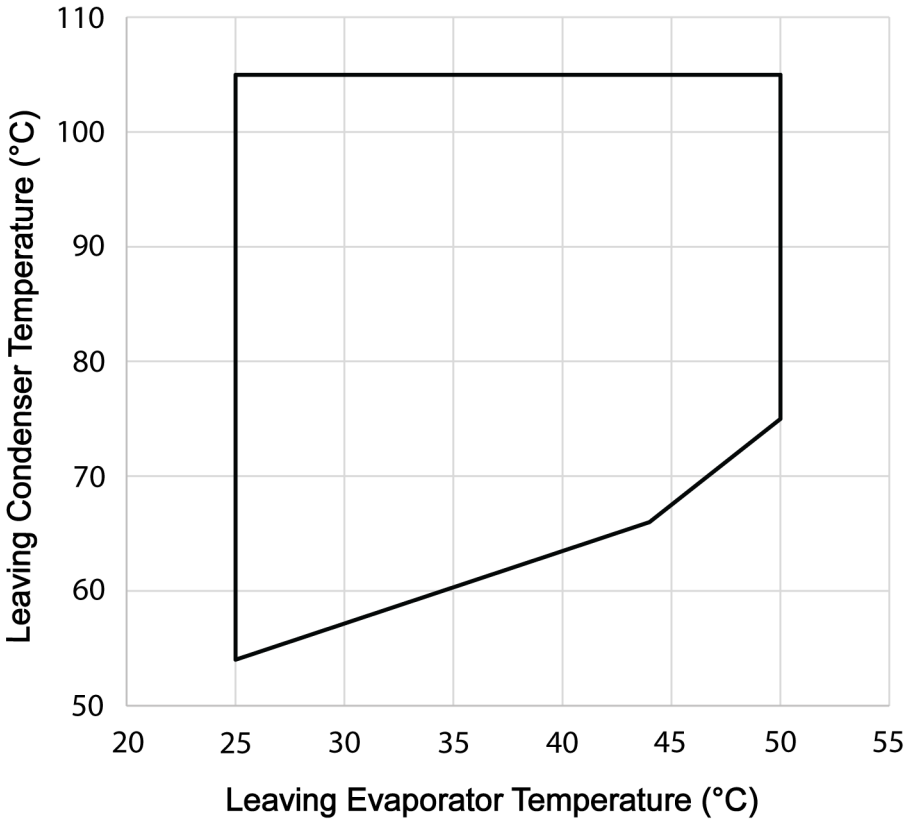
Despite the high efficiency of the oil separators, a small percentage of oil will get past them, move through the condenser, and eventually end up in the evaporator. This oil must be recovered and returned to the oil separator. The function of oil return is accomplished by passive thermosiphon system: a portion of liquid refrigerant + oil of the evaporator goes continuously through a brazed plate heat exchanger to be vaporized by a small amount of heat coming from the condenser. Then this refrigerant in gas state is re-injected to compressor suction line with the oil, carried by thermosiphon effect.

Oil Cooler

The oil cooler is a brazed plate heat exchanger located near the oil filter

Typical Operating Map

Figure 10. RTWF HT Full Load Operating Map



Controls/Tracer TD-7 Operator Interface

Controls Overview

The units use the following control/ interface components:

- Symbio™ 800 Controller
- Tracer TD-7 Operator Interface

Communication Interfaces

There are four connections on the Symbio™ 800 that support the communication interface. See User Guide to locate the following ports: “Wiring and Ports Description” section.

- BACnet ® MS/TP
- BACnet® IP (Only with Symbio™ 800)
- MODBUS™ RTU
- MODBUS™ TCP-IP (Only with Symbio™ 800)
- LonTalk® (LCI-C)

See User Guide for information on communication interface.

Tracer TD-7 Operator Interface

Operator Interface

Information is tailored to operators, service technicians and owners. When operating a unit, there is specific information you need on a day-to-day basis, like set points, limits, diagnostic information, and reports.

Day-to-day operational information is presented at the display. Logically organized groups of information mode of operation, active diagnostics, settings and reports put information conveniently at your fingertips.

Tracer® TU

The TD-7 operator interface allows for daily operation tasks and set point changes. However to adequately service of units, Tracer® TU service tool is required (personnel, contact your local office for software purchase information). Tracer TU adds a level of sophistication that improves service technician effectiveness and minimizes unit downtime. This portable PC-based service-tool software supports service and maintenance tasks.

Pre-Start Checkout

Notice

Proper Water Treatment Required!

The use of untreated or improperly treated water could result in scaling, erosion, corrosion, algae or slime. Use the services of a qualified water treatment specialist to determine what water treatment, if any, is required. Our Manufacturers assume no responsibility for equipment failures which result from untreated or improperly treated water, or saline or brackish water.

Installation Checklist

Complete this checklist as the unit is installed, and verify that all recommended procedures are accomplished before the unit is started. This checklist does not replace the detailed instructions given in the “Installation Mechanical” and “Installation Electrical” sections of this manual. Read both sections completely, to become familiar with the installation procedures, prior beginning the work.

General

When installation is complete, before starting the unit, the following pre-start procedures must be reviewed and verified:

1. Inspect all wiring connections in the compressor power circuits (disconnects, terminal block, contactors, compressor junction box terminals and so forth) to ensure they are clean and tight.
2. Open all refrigerant valves in the discharge, liquid, and oil return lines.
3. Check the power-supply voltage to the unit at the main-power fused-disconnect switch. Voltage must be within the voltage use range and also stamped on the unit nameplate. Voltage fluctuation must not exceed 10%.Voltage imbalance must not exceed 2%
4. Check the unit power phasing L1-L2-L3 in the starter to ensure that it has been installed in a “A-B-C” phase sequence.
5. Fill the evaporator chilled-water circuit. Vent the system while it is being filled. Open the vents on the top of the evaporator water box while filling and close when filling is completed.
6. Close the fused-disconnect switch(es) that supplies power to the water pump starter.
7. Start the chilled-water pump to begin circulation of the water. Inspect all piping for leakage and make any necessary repairs.
8. With water circulating through the system, adjust the water flow and check the water pressure drop through the evaporator.
9. Adjust the water flow switch for proper operation.
10. Reapply power to complete the procedures
11. Prove all Interlock and Interconnecting Wiring Interlock and External as described in the Electrical Installation section.
12. Check and set, as required, all Symbio™ 800 TD7 menu items.
13. Stop the chilled-water pump.
14. Energize the compressor and oil separator heaters 24 hours, prior to unit start up.

Unit Voltage Power Supply

Unit voltage must meet the criteria given in the electrical installation section. Measure each lead of the supply voltage at the main power fused disconnect switch for the unit. If the measured voltage on any lead is not within the specified range, notify the supplier of the power and correct the situation before operating the unit.

Unit Voltage Imbalance

Excessive voltage imbalance between the phases of a three-phase system can cause motors to overheat and eventually fail. The maximum allowable unbalance is 2%. Voltage imbalance is determined using the following calculations:

% Imbalance = [(Vx – Vave) x 100/Vave]

Vave = (V1 + V2 + V3)/3

Vx = phase with greatest difference from Vave (without regard to the sign)

Unit Voltage Phasing

It is important that proper rotation of the compressors be established before the unit is started. Proper motor rotation requires confirmation of the electrical phase sequence of the power supply. The motor is internally connected for clockwise rotation with the incoming power supply phases A-B-C.

When rotation is clockwise, the phase sequence is usually called “ABC”, when counterclockwise “CBA”

This direction may be reversed by interchanging any two of the line wires.

1. Stop the unit from TD7/Symbio™ 800.
2. Open the electrical disconnect or circuit protection switch that provides line power to the line power terminal block(s) in the starter panel (or to the unit mounted disconnect).
3. Connect the phase-sequence indicator leads to the line power terminal block as follows:

Phase Sequence Lead	Terminal
Black (Phase A)	L1
Red (Phase B)	L2
Yellow (Phase C)	L3

4. Turn power on by closing the unit supply-power fused-disconnect switch.
5. Read the phase sequence on the indicator. The ABC LED of the phase indicator will glow.

Important: *It is imperative that L1, L2, and L3 in the starter be connected in the A-BC phase sequence to prevent equipment damage due to reverse rotation.*

⚠ Warning

Proper Wiring Required!

To prevent injury or death due to electrocution
Take extreme care when performing service procedures with electrical power energized.

⚠ Caution

Equipment Damage!

Doing so may damage the equipment.
Do not interchange any load leads that are from the unit contactors or the motor terminals.

Water System Flow Rates

Establish a balanced water flow through the evaporator and condenser. The flow rates should be between the minimum and maximum values given on the pressure drop curves.

Water System Pressure Drop

Measure the water-pressure drop through the evaporator and condenser on the field installed pressure taps on the system water piping. Use the same gauge for each measurement. Do not include valves, strainers, or fittings in the pressure drop readings.

Unit Start-up

Daily Unit Start-Up

The timeline for the sequence of operation begins with a power-up of the main power to the unit. The sequence assumes 2 circuits, RTWF HT Water-to-water Heat pump with no diagnostics or malfunctioning components. External events such as the operator placing the unit in AUTO or STOP,water flow through the heat exchangers, and application of load to the water loop causing loop water-temperature variations, are depicted and the responses to those events are shown, with appropriate delays noted. The effects of diagnostics, and other external interlocks other than evaporator water-flow proving, are not considered.

Note: *Unless the Symbio™ 800/ TD-7 and building automation system are controlling the water pumps, the manual unit start sequence is as follows. Operator actions are noted.*

General

If the present checkout, as discussed above, has been completed, the unit is ready to start.

1. Press the STOP key on the TD-7 display.
2. As necessary, adjust the set point values on the TD-7 menus using Tracer TU.
3. Close the fused-disconnect switch for the water pumps. Energize the pump(s) to start water circulation
4. Check the service valves on the discharge line, suction line, oil line, and liquid line for each circuit. These valves must be open (back seated) before starting the compressors.
5. Verify that water pumps run for at least one minute after the unit is commanded to stop (for normal systems).
6. Press the AUTO key. If the unit control calls forheating, and all safety interlocks are closed, the unit will start. The compressor(s) will load and unload in response to the leaving hot – water temperature.

After the system has been operating for approximately 30 minutes and has become stabilized, complete the remaining start up procedures, as follows:

1. Check the evaporator refrigerant pressure and the condenser refrigerant pressure under Refrigerant Report on the TD-7.
2. Check the EXV sight glasses after enough time has elapsed to stabilize the unit. The refrigerant flow through the sight glasses should be clear. Bubbles in the refrigerant indicate either low refrigerant charge or excessive pressure drop in the liquid line, or an expansion valve that is stuck open. A restriction in the line can sometimes be identified by a noticeable temperature differential between the two sides of the restriction.
3. Measure the system discharge superheat.
4. Clean the air filter located on the door of the control panel of AFD when required.

Seasonal Unit Start-Up Procedure

1. Close all valves and reinstall the drain plugs in the evaporator.
2. Service the auxiliary equipment according to the startup and maintenance instructions provided by the respective equipment manufacturers.
3. Close the vents in the evaporator and condenser water circuits.
4. Open all the valves in the evaporator and condenser water circuits.
5. Open all refrigerant valves.
6. If the evaporator and condenser was previously drained, vent and fill the evaporator and chilled water circuit. When all air is removed from the system (including each pass), install the vent plugs in the evaporator water boxes.
7. Check the adjustment and operation of each safety and operating control.
8. Close all disconnect switches.
9. Refer to the sequence for daily unit start up for the remainder of the seasonal start up.

Important: *Ensure that the compressor and heaters have been operating for a minimum of 24 hours before starting. Failure to do so may result in equipment damage.*

System Restart After Extended Shutdown

1. Verify that the liquid-line service valves, compressor discharge service valves, and optional suction service valves are open (back seated).
2. Check the oil level (see Maintenance procedures section).
3. Fill the evaporator and condenser water circuit. Vent the system while it is being filled. Open the vent on the top of the evaporator and condenser while filling, and close it when filling is completed.
4. Close the fused-disconnect switches that provide power to the water pumps.
5. Start the evaporator and condenser water pump and, while water is circulating, inspect all piping for leakage. Make any necessary repairs before starting the unit.
6. While the water is circulating, adjust the water flow and check the water pressure drops through the evaporator and condenser. Refer to “water-system flow rates” and “water-system pressure drop”.
7. Adjust the flow switch on the evaporator and condenser piping for proper operation.
8. Stop the water pumps. The unit is now ready for startup as described “Start-Up procedures”.

⚠ Caution

Compressor Damage!

Failure to follow the safety instructions below could result in damage the compressor.

Do not operate the unit until all refrigerant valves and oil line service valves are opened.

Periodic Maintenance

Overview

This section describes preventative maintenance procedures and intervals. Use a periodic maintenance program to ensure optimal performance and efficiency of the units. An important aspect of the maintenance program is the regular completion of the “Operating Log“. When filled out properly the completed logs can be reviewed to identify any developing trends in the operating conditions.

Weekly Maintenance and Checks

After the unit has operated for approximately 30 minutes and the system has stabilized, check the operating conditions and complete the procedures below:

- Log the unit,
- Check evaporator and condenser pressures with gauges and compare to the reading on the TD-7 Display. Pressure readings should fall within the following ranges specified in the Operating Conditions.

Note: *Optimum condenser pressure is dependent on condenser water temperature, and should equal the saturation pressure of the refrigerant at a temperature 1 to 3 °C above that of leaving condenser water at full load.*

Monthly Maintenance and Checks

- Review operating log.
- Clean all water strainers in both evaporator and condensing water piping systems.
- Measure the oil filter pressure drop. Replace oil filter if required. Refer to “Service Procedures“.
- Measure and log the sub-cooling and superheat.
- If operating conditions indicate a refrigerant shortage, leak check the unit.
- Repair all leaks.

Annual Maintenance

⚠ Warning

Hazardous Voltage!

Failure to disconnect power before servicing could result in death or serious injury.

Disconnect all electric power, including remote disconnects before servicing. Follow proper lockout/tagout procedures to ensure the power can not be inadvertently energized. Verify that no power is present with a voltmeter.

- Shutdown the unit once each year to check the following:
- Perform all weekly and monthly maintenance procedures.
- Check the refrigerant charge and oil level. Refer to “Maintenance Procedures “. Routine oil changing is not necessary on a hermetic system.
- Have a qualified laboratory perform an oil analysis to determine system moisture content and acid level.
- Check the pressure drop across the oil filter. Refer to “Maintenance Procedures“.
- Contact a qualified service organization to leak check the unit, to inspect safety controls, and inspect electrical components for deficiencies.
- Inspect all piping components for leakage and/or damage. Clean out any in-line strainers.
- Clean and repaint any areas that show signs of corrosion.
- Test vent piping of all relief valves for presence of refrigerant to detect improperly sealed relief valves. Replace any leaking relief valve.
- Inspect the water tubes for fouling; clean if necessary. Refer to “Maintenance Procedures“.
- Check to make sure that the crank case heater is working.

Scheduling Other Maintenance

- Use a nondestructive tube test to inspect the condenser and evaporator tubes at 3-year intervals.

  Note: *It may be desirable to perform tube tests on these components at more frequent intervals, depending upon unit application. This is especially true of critical process equipment.*

- Depending on unit duty, contact a qualified service organization to determine when to conduct a complete examination of the unit to determine the condition of the compressor and internal components.
- Follow national regulation when special prescriptions.

Contractor Confirmation Check Sheet

This check sheet must be completed by the installing contractor and submitted prior to requesting manufacturer service start-up support. The check sheet identifies a list of items that need to be completed prior to actual machine start-up.

Contractor Confirmation Check Sheet	
Addressed to the Service office of:	
Job Name:	**Job location:**
Model No.:	**Sales order No.:**
Unit	**Condenser - Load Loop**
☐ Unit installed	☐ Connected to the unit
☐ Isolator pads in place	☐ Connected to the load loop
Evaporator - Source Loop	☐ Connected to the pumps
☐ Connected to the unit	☐ System flushed and then filled
☐ Connected to the source loop	☐ Pumps run and air bled
☐ Connected to the pumps	☐ Strainers cleaned
☐ System flushed and then filled	☐ Flow switch installed and checked/set
☐ Pumps run and air bled	☐ Throttling cock installed in leaving water
☐ Strainers cleaned	☐ Thermometers installed in leaving/entering water
☐ Flow switch installed and checked/set	☐ Gauges installed in leaving/entering water
☐ Throttling cock installed in leaving water	☐ Water treatment equipment
☐ Thermometers installed in leaving/entering water	**Wiring**
☐ Gauges installed in leaving/entering water	☐ Power supply connected and available
	☐ External interlock connected
	Load
	☐ System can be operated under load condition
We will therefore require your service technician on job by[(a)] _____.	
Checklist completed by_____.	
Date_____.	

(a) Return this completed checklist to your Service office as soon as possible to enable the start-up visit to be scheduled. Be aware that advance notification is required to allow scheduling of the start-up as close to the requested date as possible. Additional time required to complete the start-up and adjustment due to incompleteness of the installation will be invoiced at prevailing rates.

Maintenance Procedures

Cleaning the Evaporator

Notice

Proper Water Treatment Required!

The use of untreated or improperly treated water could result in scaling, erosion, corrosion, algae or slime.
Use the services of a qualified water treatment specialist to determine what water treatment, if any, is required. Our Manufacturers assume no responsibility for equipment failures which result from untreated or improperly treated water, or saline or brackish water.

Evaporator tube fouling is suspect when the “approach” temperature (i.e., the difference between the refrigerant condensing temperature and the leaving condenser water temperature) is higher than predicted. Standard water applications will operate with less than a 5 °C approach. If the approach exceeds 5 °C and there is no condensable in the system cleaning the condenser tubes is recommended.

Note: *Glycol in the water system typically doubles the standard approach.*

If the annual Evaporator tube inspection indicates that the tubes are fouled, 2 cleaning methods can be used to rid the tubes of contaminants. The methods are:

Mechanical Cleaning Procedure

Mechanical tube cleaning this method is used to remove sludge and loose material from smooth-bore condenser tubes.

1. Remove the retaining bolts from the water boxes at each end of the condenser. Use a hoist to lift the water boxes.
2. Work a round nylon or brass bristled brush (attached to a rod) in and out of each of the condenser water tubes to loosen the sludge.
3. Thoroughly flush the condenser water tubes with clean water. (To clean internally enhanced tubes, use a bi-directional brush or consult a qualified service organization for recommendations.)

Chemical Cleaning Procedure

Scale deposits are best removed by chemical means. Consult a qualified water treatment specialist (i.e., one that knows the local water supply chemical/ mineral content) for a recommended cleaning solution suitable for the job. (A standard condenser water circuit is composed solely of copper, cast iron and steel.) Improper chemical cleaning can damage tube walls.

All of the materials used in the external circulation system, the quantity of the solution, the duration of the cleaning period, and any required safety precautions should be approved by the company furnishing the materials or performing the cleaning.

Note: *Chemical tube cleaning should always be followed by mechanical tube cleaning.*

Cleaning the Condenser

Since the condenser is typically part of a closed circuit, it does not accumulate appreciable amounts of scale or sludge. However, if cleaning is deemed necessary, use the same cleaning methods described for the evaporator tubes.

Compressor Oil

⚠ Caution

Equipment Damage!

Failure to do so may leads to oil sump heater burnout.
Open the unit main power disconnect switch before removing oil from the compressor.

Trane Mineral Oil is the approved oil for the unit. If moisture enters the refrigerant system, it will react with the oil to form acids and also react to break down the refrigerant. Trane approved oil is OIL0078E. The proper charge amounts are given on General data. Note: Use an oil transfer pump to change the oil regardless of unit pressure. For R1233zd, approved oil is OIL0078E.

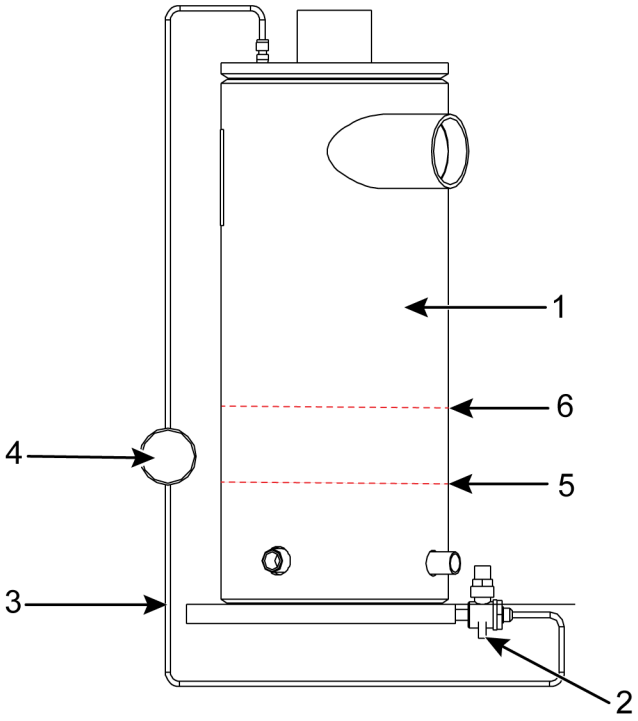
Running the unit at minimum load is the best for the quickest return of oil to the separator and sump. The machine still needs to sit for approximately 30 minutes before the level is taken. At minimum load, the discharge superheat should be highest. The more heat in the oil as it lays in the sump, the more refrigerant will boil off in the sump and leave more concentrated oil. The oil

level in the oil sump can be measured to give an indication of the system oil charge. Follow the procedures below to measure the level.

1. Run the unit fully unloaded for approximately 20 minutes.
2. Cycle the compressor off line.

Oil Level Check

Figure 11. Determining oil level in the oil separator



Items	Description	Items	Description
1	Oil separator	4	Sight glass
2	Valve	5	Minimum oil level
3	1/4” refrigeration hose	6	Maximum oil level

How to Measure the Oil Level

Use the oil drain valve (bottom side) and the service valve on the oil separator (top side). This measurement can be made, when the circuit is not running. Note: the bottom plate of the oil separator is approximately 25 mm thick.

Excessive oil in the system will deteriorate the evaporator approach temperature.

The nominal oil level in the oil separator is 14 cm +/- 1 cm for the 10" oil separator for the single compressor circuits and 16 cm for the 14" of dual compressor circuits. This is the level without refrigerant in the circuit.

The field charging procedure depends on the circumstances that resulted in the need for oil charge.

1. Some services procedures may result in loss of small quantities of oil that must be replaced (oil analysis, compressor filter replacement, and so forth).
2. Additionally, some maintenance procedures may result in virtually all the oil being removed (compressor motor burn or total removal of the charge to trouble shoot a unit).
3. Finally, leaks may result in a loss of oil that must be replaced.

Oil Charging Data

The oil quantity is written on the nameplate of the unit.

Removing Compressor Oil

The oil in the compressor oil separator is under a constant positive pressure at ambient temperature. To remove oil, open the service valve located on the bottom of the oil separator and drain the oil into a suitable container using the procedure outlined below:

- Oil should not be removed until the refrigerant is isolated or removed.
- Connect a line to the oil sump drain valve.
- Open the valve and allow the desired amount of oil to flow into the container and close the charging valve.
- Measure the exact amount of oil removed from the unit.

Oil Charging Procedure

It is critical to fill the oil lines feeding the compressor when charging a system with oil. The diagnostic “Loss of oil at the compressor stopped“ will be generated if the oil lines are not full on start-up.

To properly charge the system with oil, follow the steps below:

1. Locate the 5/16“ schrader valve between the ball valve and oil filter (or the ball valve and oil cooler, if so equipped) on the end of the compressor.
2. Loosely connect oil pump to schrader valve called out in step 1.
3. Operate oil charging pump until oil appears at the charging valve connection, then tighten the connection.

   Note: *To keep air from entering the oil, the charging valve connection must be air-tight.*
4. Open the service valve and pump in the required amount of oil.
5. Monitor the “Oil Loss Level Sensor Status in TD7 in Compressor status view. This display shows whether the optical sensor is seeing oil (wet) or if it is not (dry) the oil level.

Note: *The remainder of the oil charge can be charged into the 5/16“ service valve located at the bottom of the separator if a larger connection is preferred.*

Replacing the Main Oil Filter (Hot Filter)

The filter element should be changed if the oil flow is sufficiently obstructed. Two things can happen: first, the unit may shut down on a “Low Oil Flow“ diagnostic, or secondly, the compressor may shut down on a “Loss of Oil” at Compressor (Running) diagnostic. If either of these diagnostics occurs, it is possible the oil filter needs replacement. The oil filter is not usually the cause of a Loss of oil at Compressor diagnostic.

Specifically, the filter must be changed if the pressure drop between the 2 service valves in the lubrication circuit exceeds the maximum level as given in Figure 11, p. 46. The charts shows the relationship between the pressure drop measured in the lubrication circuit as compared with operating pressure differential of the unit (as measured by pressures in the condenser and evaporator).

Normal pressure drops between the service valves of the lubrication circuit are shown by the lower curve. The upper curve represents the maximum allowable pressure drop and indicates when the oil filter must be changed. Pressure drops that lie between the lower and upper curves are considered acceptable.

Under normal operating conditions the element should be replaced after the first year of operation and then as needed thereafter.

Refrigerant Charge

If a low refrigerant charge is suspected, first determine the cause of lost refrigerant. Once the problem is repaired follow the procedures below for evacuating and charging the unit.

Refrigerant Recovery

1. Insure that the water flow is maintained on condenser and evaporator during all the recovery operation.
2. Connections on evaporator and condenser are available to remove the refrigerant. Weigh the refrigerant removed.

⚠ Caution

Freezing Hazard!

Evaporator or condenser could freeze and bringing severe damages to the unit.
Never recover refrigerant without maintaining nominal water flow on heat exchangers during all the recovery operation.

3. Use a “refrigerant transfer machine” and adequate service cylinders to stock the recovered refrigerant.
4. According to its quality, use recovered refrigerant to charge the unit or give it to refrigerant producer for recycling or elimination.

Evacuation and Dehydration

1. Disconnect ALL power before/ during evacuation.
2. Connect the vacuum pump to the 1/2“ flare connection on the bottom of the evaporator and/or condenser.
3. To remove all of the moisture from the system and to insure a leak free unit, pull the system down below 500 microns.
4. After the unit is evacuated, perform a standing rise test for at least an hour. The pressure should not rise more than 150 microns. If the pressures rises more than 150 microns, either a leak is present or moisture still in the system.

Note: *If oil is in the system, this test is more difficult. The oil is aromatic and will give off vapors that will raise the pressure of the system.*

Refrigerant Charging

Once the system is deemed leak and moisture free, use the 1/2“ SAE connections at the bottom of the evaporator and condenser to add refrigerant charge. Refer unit nameplate for refrigerant charge information

Recommended Service Routine Frequencies

As a commitment to our customers, we have created a wide service network staffed with experienced factory-authorized technicians. We offer all the benefits of after sales service direct from the manufacturer and we are committed to our mission statement to provide efficient customer care.

We would be delighted to discuss your individual requirement with you. For further information regarding maintenance agreements please contact your local sales office.

Year	Commis-sioning	Inspec-tion visit	Seasonal shut down	Seasonal start up	Oil analysis [a]	Vibration analysis[b]	Annual maintenance	Preventive maintenance	Tube analysis[c]
1	X	X	X	X		X		XX	
2			X	X	X		X	XXX	
3			X	X	X		X	XXX	
4			X	X	X		X	XXX	
5			X	X	X	X	X	XXX	X
6			X	X	X	X	X	XXX	
7			X	X	X	X	X	XXX	
8			X	X	X	X	X	XXX	
9			X	X	X	X	X	XXX	
10			X	X	X	X	X	XXX	X
Over 10			every year	every year	every year [d]	X	every year	every three year	every three year

[a] Schedule as per previous analysis result or at least once a year.
[b] Year 1 to define equipment baseline. Subsequent year based on oil analysis results or schedule as per vibration analysis.
[c] Tube testing required if aggressive water conditions exist. Applies to condensers only on water cooled units.
[d] Schedule as per previous analysis result or at least once a year.

This timetable is applicable to units operating in normal conditions with an average of 4000 hours per year. If operating conditions are abnormally severe, an individual timetable must be made for that unit.

Seasonal start up and shutdown are mainly recommended for comfort air conditioning. Annual and preventive maintenance are mainly recommended for Process applications.

Additional Services

Oil Analysis

Trane oil analysis is a predictive tool used to detect minor issues before they become major problems. It also reduces failure detection time and allows planning for appropriate maintenance. Oil changes can be reduced by half resulting in lower operating costs and a lower impact on the environment.

Vibration Analysis

Vibration analysis is required when oil analysis reveals the presence of wear indicating the start of possible bearing or motor failure. Oil analysis has the ability to identify the type of metallic particles in the oil which, when combined with the vibration analysis, will clearly point out the failing components.

Vibration analysis should be performed on a regular basis to build a vibration trend of the equipment and avoid unplanned downtime and costs.

System Upgrade

This Service provides a consulting service.

Upgrading your equipment will increase the unit reliability and can reduce the operating costs by optimizing the controls A list of solutions / recommendations to the system will be explained to the customer Actual upgrade for the system will be costed separately.

Water Treatment

This Service provides all of the necessary chemicals to properly treat each water system for the period designated.

The inspections will be conducted at agreed upon intervals, and service will submit a written report to the customer after each inspection.

These reports will indicate any corrosion, scaling, and alga growth in the system.

Refrigerant Analysis

This service includes a thorough analysis for contamination and solution upgrade. It is recommended that this analysis be performed every six months.

24 Hours Duty

This service includes emergency calls outside of the office normal working hours.

This Service is only available with a Maintenance Contract, where available.

Trane Select Agreements

Trane select agreements are programs tailored to your needs, your business and your application. They offer four different levels of coverage. From preventive maintenance plans to fully comprehensive solutions, you have the option of selecting the coverage that best suits your requirements.

5 Years Motor Compressor Warranty

This service will provide a 5 years part and labor warranty for the motor compressor only. This service is only available for units covered by a 5 years maintenance contract.

Tube Analysis

- Eddy Current Tube Testing for prediction of tube failure/ wear
- Frequency - every 5 years for first 10 years (depending on the water quality), then every 3 years thereafter.

Energy Enhancement

With Trane Building Advantage explore cost effective ways to optimize the energy efficiency of your existing system and generate immediate savings. Energy management solutions are not only for new systems or buildings. Trane Building Advantage offers solutions designed to unlock energy savings in your existing system.

Trane – by Trane Technologies (NYSE: TT), a global climate innovator – creates comfortable, energy efficient indoor environments through a broad portfolio of heating, ventilating and air conditioning systems and controls, services, parts and supply. For more information, please visit www.trane.eu or www.tranetechnologies.com

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