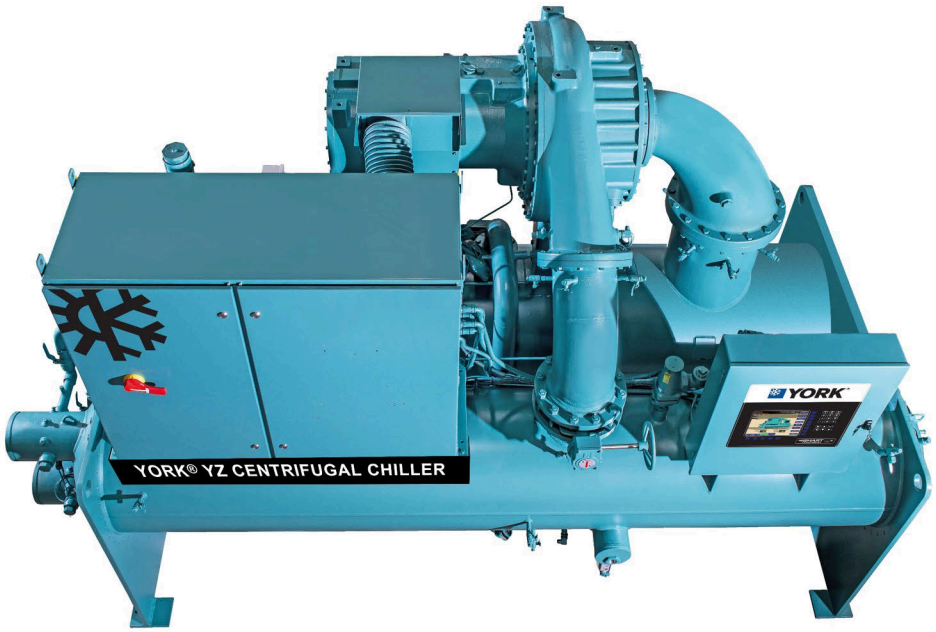
Model YZ Magnetic Bearing Centrifugal Chiller, Style A

530 kW to 7,104 kW (150 ton to 2,020 ton) with R-1233zd Refrigerant



Engineering Guide
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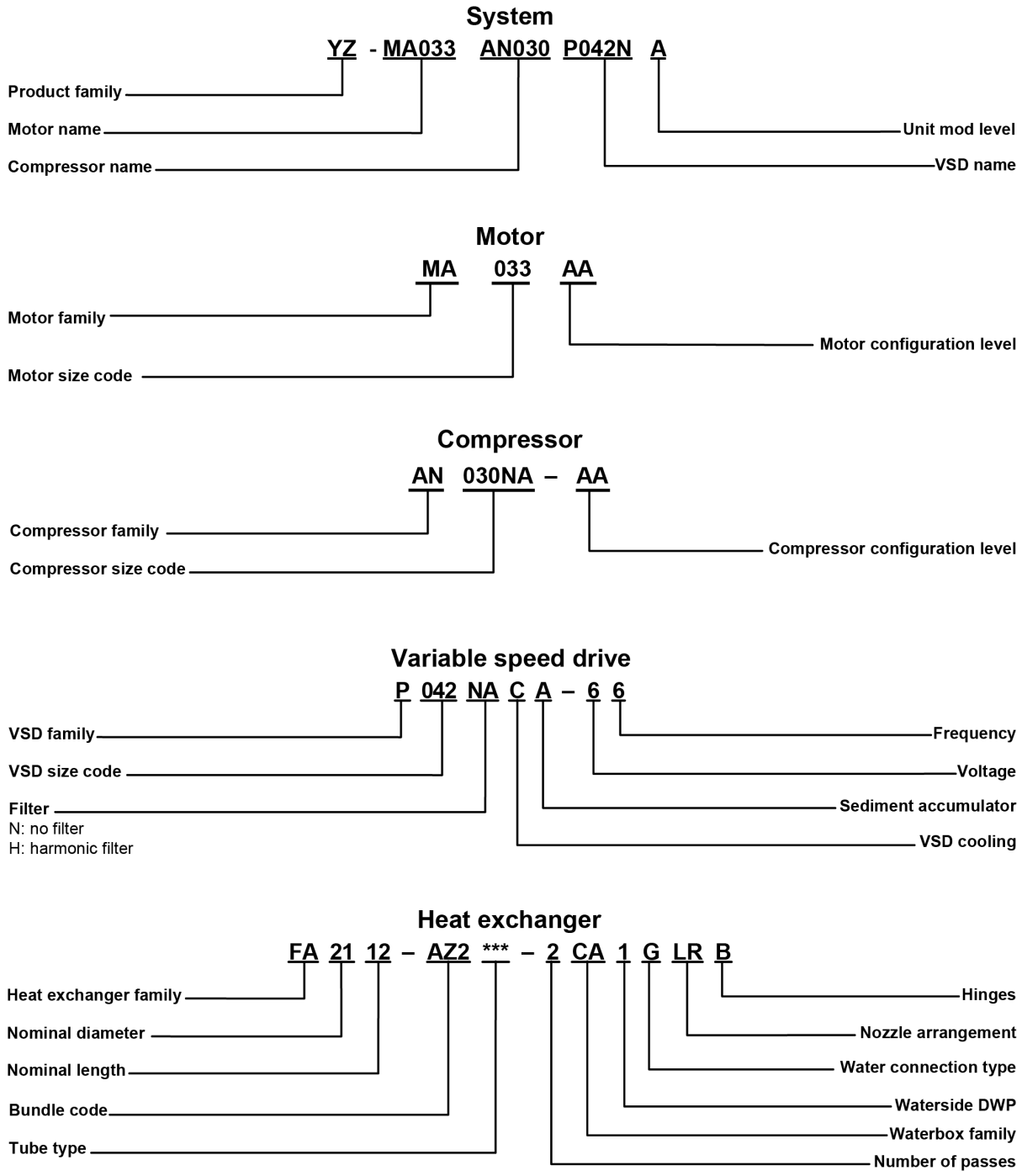
Contents

Nomenclature

Figure 1: Nomenclature for YZ chillers



Introduction

The YORK® YZ Magnetic Bearing Centrifugal Chiller is a revolutionary advancement that challenges everything about conventional chiller design. The result is a chiller fully optimized for ultimate performance with a next generation low global warming potential (GWP) refrigerant, delivering superior real-world performance and a new definition of sustainability. The YORK YZ chiller is available from multiple global factories to meet regional customers' needs.

Efficiency

Johnson Controls pioneered the term "real-world efficiency" to illustrate the energy-saving potential of focusing on chiller performance during off-design conditions. Off-design conditions are not only seen at part-load, but at full-load operation also, by using reduced entering condenser water temperatures (ECWTs). These conditions are where chillers operate up to 99% of the time, and where operating costs add up. YZ chillers are designed to operate on a continuous basis with cold ECWT and full condenser flow at all load points, taking full advantage of real-world conditions. YZ chillers provide the most efficient real-world operation of any chiller, meaning lower operating costs and an excellent return on your chiller investment.

Actual chiller efficiency cannot be determined by analyzing the theoretical efficiency of any one chiller component. It requires a specific combination of heat exchanger, compressor, and motor performance to achieve the best system efficiency. YZ technology matches chiller system components to provide maximum chiller efficiency under actual, and not just theoretical, operating conditions. Now with the YORK YZ chiller, efficiency is improved up to an impressive 7% at part-load and as much as an additional 5% at full-load versus our most efficient previous designs.

Better efficiency in every operating condition

The YZ chiller has been designed to take full advantage of colder cooling tower water temperatures, which are naturally available during most operating hours. Considerable energy savings are available by letting tower water temperature drop, rather than artificially holding it above 66°F (19°C), especially at low load, as some chillers require.

The vast majority of a chiller's operating hours are spent at off-design conditions. Because of this, it is important to select a chiller to meet the full-load design and also for its ability to perform efficiently at lower loads, lower tower water temperatures, and even higher leaving evaporator water temperatures. It is not uncommon for chillers with the same full-load efficiency to have an operating cost difference of over 10% due to differences in part-load efficiencies.

Part-load is important to an owner's operating budget. This information has been standardized in the Air Conditioning, Heating and Refrigeration Institute (AHRI) Certification Program in the form of an integrated part load value (IPLV) and non-standard part load value (NPLV).

Additionally, looking at annual energy costs that use weather data specific to your city, you can get a better understanding of the efficiency benefits the YORK YZ offers across a wide range of operating conditions. This more detailed analysis also takes into account actual building load profiles to provide a more accurate view of chiller operating cost. Customers can request part-load performance data for each job using its own design criteria.

Reliability

Designed for the most reliable chillers we have ever made, the YORK YZ magnetic bearing compressor achieves superior performance because it is based on a successful line of efficient YORK compressors. With fewer moving parts, YORK compressors have proven to be durable in numerous applications, especially where minimal downtime is a critical concern. The lubrication-free, non-contact design of the YORK YZ provides system simplicity and reliability that far exceeds continuous-contact-oil and refrigerant-lubricated bearing chiller designs.

The majority of chiller components on YZ chillers have been time tested on the tens of thousands of air-cooled and water-cooled YORK chillers operating globally. The YZ chiller employs the most advanced driveline available. This is an active magnetic-bearing drive that levitates the driveshaft. The result is frictionless operation and 80% fewer moving parts than oil-lubricated or refrigerant-lubricated systems. This is why, since 1998, we use this type of driveline in our mission-critical chillers.

The YZ chiller incorporates service design principles that are consistent with our family of centrifugal chillers. We made sure that this chiller, and specifically the driveline, was field serviceable by a single source supplier, who also happens to be the industry's largest service force: our own Johnson Controls service team.

AHRI certification program

The performance of the YZ chiller has been certified by the Air Conditioning, Heating and Refrigeration Institute (AHRI) as complying with the certification sections of the latest issue of AHRI Standard 550/590. Under this certification program, chillers are regularly tested in strict compliance with this standard. This provides an independent, third-party verification of chiller performance.

Figure 2: AHRI certification

ISASecure certification program

YORK YZ centrifugal chillers have earned the ISASecure® Component Security Assurance (CSA) certification and the Secure Development Lifecycle Assurance (SDLA) certification in conformance with ISA/IEC 62443-4-2 and ISA/IEC 62443-4-1.

These certifications reinforce the commitment of Johnson Controls to stringent security standards and the security of control system products produced by Johnson Controls. The award recognizes YORK YZ centrifugal chillers for following rigorous testing against technical security requirements and the successful execution of the secure product development lifecycle requirements.

The YORK YZ centrifugal chillers ISASecure certification provides assurance that the solution lowers the cost of safety and improves performance by reducing the risk of incidents, maximizing production uptime, reducing the cost of compliance, and providing productivity tools that help manage safety in mechanical systems.

Note: The ISASecure certification only applies to single driveline chillers.

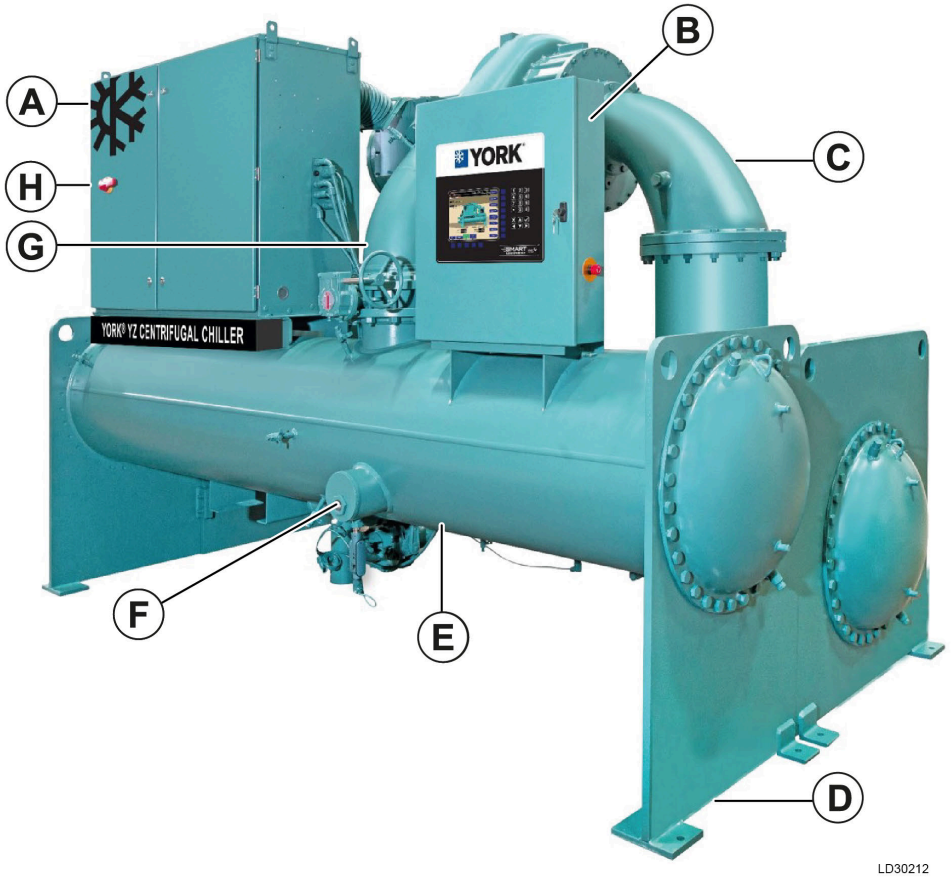
Computerized performance ratings

Each chiller is custom-matched to meet the individual building load and energy requirements. A variety of standard heat exchangers and pass arrangements are available to provide the best possible match.

It is not practical to provide tabulated performance for each combination because the energy requirements at both full-load and part-load vary significantly with each heat exchanger and pass arrangement. Computerized ratings are available through each Johnson Controls sales office. Each rating can be tailored to a specific job requirement, and is part of the AHRI Certification Program.

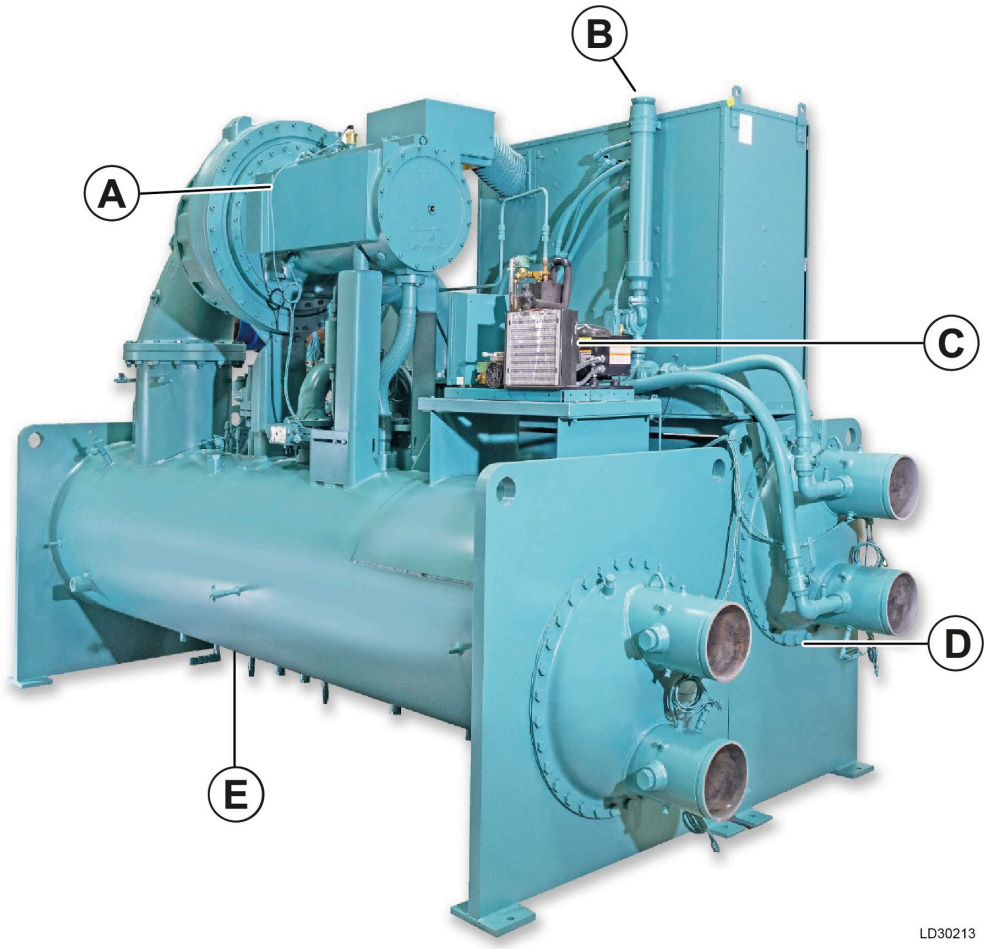
Unit components

Figure 3: YZ components, front view



Callout	Description
A	Variable speed drive
B	OptiView™ control panel
C	Suction line
D	Endsheet
E	Condenser
F	Sight glass
G	Discharge line
H	Lockout handle

Figure 4: YZ components, rear view



Callout	Description
A	Direct drive compressor motor
B	Coolant reservoir for variable speed drive
C	Refrigerant purge unit
D	Compact waterbox
E	Evaporator

Equipment overview

YORK YZ centrifugal chillers are completely factory-packaged including the following components:

- Compressor
- Motor
- Variable speed drive
- OptiView™ Control Center
- Evaporator
- Condenser
- Purge unit
- All interconnecting unit piping and wiring

When selected, the initial charge of refrigerant can be supplied for each chiller from the factory. Actual shipping procedures for the chiller depends on a number of project-specific details. YZ chillers are designed to keep installation costs low. Where installation access is not a problem, the unit can be shipped completely packaged including the unit-mounted variable speed drive. This option requires minimal piping and wiring to complete the installation.

At start-up, the services of a Johnson Controls factory-trained, field service representative are required to supervise or perform the final leak testing, charging, initial start-up, and concurrent operator instructions.

Compressor

ⓘ **Note:** Refer to the *YZ Operations and Maintenance Manual (161.01-OM1)* for a complete description of features and functionality.

The compressor is a single-stage centrifugal design directly driven by a hermetically-sealed motor with a variable speed drive (VSD). A cast-aluminum, fully-shrouded impeller is mounted directly to the motor shaft. Impeller seals employ a labyrinth geometry, sized to provide minimal thrust loading on the impeller throughout the operating range. The impeller is dynamically balanced and overspeed tested for smooth, vibration-free operation.

Capacity control

Capacity control is achieved by the combined use of variable speed control and mechanical flow regulation to provide fully modulating control from maximum to minimum load. For normal air conditioning applications, the chiller can adjust capacity from 100% to 10% of design, without the use of hot gas bypass (HGBP). For each condition, the capacity control devices automatically adjust to maintain a constant leaving chilled liquid temperature at optimized efficiency, based on information fed by sensors located throughout the chiller.

YZ chillers are equipped with sophisticated capacity control as standard. Our capacity control is a patented combination of centrifugal chiller hardware and software that expands the chiller operating range and improves chiller performance. The capacity control continuously monitors the characteristics of the compressor discharge gas and optimizes the diffuser spacing to minimize gas-flow disruptions from the impeller.

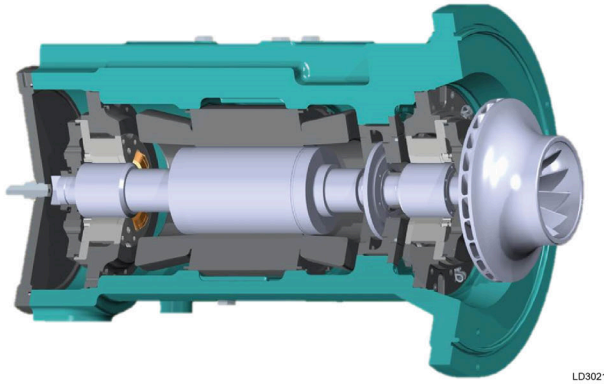
Motor

The compressor motor is a hermetically-sealed, high-speed induction motor supported by active magnetic bearings. The bearing design provides a completely lubrication-free operating system.

The motor rotor and stator are cooled by a pressure driven refrigerant loop to maintain acceptable operating temperatures.

The active magnetic bearings are equipped with balancing systems to ensure smooth and reliable operation. In the event of a power failure, the magnetic bearings remain in operation throughout the compressor coast-down using an uninterruptable power supply. Mechanical bearings are included as backup to the magnetic bearings and are designed for rare emergency touchdown situations where both the main power and uninterruptable power supply fail.

Figure 5: Motor cutaway diagram



Variable speed drive

Note: Refer to the *YZ Operations and Maintenance Manual (161.01-OM1)* for a complete description of features and functionality.

A variable speed drive is factory-packaged and mounted on the YZ chiller. It is designed to vary the compressor motor speed by controlling the frequency and voltage of the electrical power to the motor. The capacity control logic automatically adjusts motor speed and compressor diffuser geometry for maximum part load efficiency by analyzing information fed to it by sensors located throughout the chiller. The variable speed drive is mounted in a NEMA-1/IP22 enclosure. All power and control wiring between the drive and chiller is factory-installed. The chiller uses a single-point power connection with a circuit breaker disconnect. Electrical lugs for incoming power wiring are provided.

Figure 6: Variable speed drive

The variable speed drive provides automatic displacement power factor correction to 0.95 or better at all load conditions. Separate displacement power factor correction capacitors are not required. The displacement power factor is 0.98 or better when the optional harmonic filter is provided, which helps your building comply with the guidelines of IEEE-519. Additionally, variable speed drives provide the following advantages:

- Lowest chiller operating cost through part load energy savings.
- Soft start with input current less than full load current.
- Smooth acceleration reduces stresses on motor and driveline.
- Rugged and reliable with no moving parts.

Standard features include the following:

- Door interlocked lockable circuit breaker
- UL/cUL listed and CE approved ground fault protection
- Overvoltage and undervoltage protection
- Three-phase sensing motor overcurrent protection
- Single-phase protection
- Insensitive to phase rotation
- Over-temperature protection
- Readouts of important values on the OptiView control panel

OptiView Control Center

ⓘ **Note:** Refer to the *YZ Operations and Maintenance Manual (161.01-OM1)* for a complete description of features and functionality.

The YORK OptiView Control Center is a factory-mounted, wired, and tested microprocessor-based control system for centrifugal chillers. It provides control of chiller operation and monitoring of chiller sensors, actuators, relays, and switches. As part of the capacity control logic, OptiView controls the leaving chilled liquid temperature and adjusts the motor current through control of the variable geometry diffuser (VGD) and variable speed drive.

Figure 7: OptiView control panel

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The OptiView control panel comes standard with YORK Chiller Access Manager, a feature that provides secure access to YORK chiller control panels. Users download the YORK Chiller Access Manager app, create an account, and then use the app to generate dynamic access codes. This feature provides owners control and visibility to who is operating, maintaining, and servicing their chiller, which ensures protection of an asset that is critical to facility operation. For more information, visit http://www.york.com/ChillerAccess.

The panel comes configured with a full screen graphic display mounted in the middle of a keypad interface with soft buttons. The operator can view a graphical representation of the operation history of the chiller and the current operation. The locations of various chiller parameters are clearly marked, and instructions for specific operations are available on many of the screens. To prevent unauthorized changes of setpoints and operating conditions, security access is provided with three different levels of access and passwords.

The user can also view information on the graphic display in both SI and imperial units of measure, and in multiple languages.

The OptiView Control Center continually monitors the system operation and records the cause of any shutdowns, including safety, cycling, or normal shutdowns. This information is recorded and preserved in the system memory even during power failures and can be recalled at any time. During operation, the user is continually advised of the operating conditions by various status and warning messages. By providing a common networking protocol through the building automation system (BAS), YORK chillers not only work well individually, but also as a part of the building system. This networking protocol provides increased remote control of the chiller and 24-hour performance monitoring using a remote site. In addition, compatibility is maintained with the present network of BAS communications. Both of these remote control capabilities allow for the standard Energy Management System (EMS) interface, which includes the following features:

- Remote start
- Remote stop
- Remote leaving chilled liquid temperature setpoint adjustment
- Remote current limit setpoint adjustment
- Pulse-width modulation (PWM)
- Remote ready-to-start contacts
- Safety shutdown contacts
- Cycling shutdown contacts

The YZD uses two OptiView Control Centers that are tied together with a Red Lion PLC for system control.

Heat exchangers

Shells

Evaporator and condenser shells are made from rolled carbon steel plates with fusion welded seams or carbon steel pipe. Carbon steel tube sheets, which are drilled and reamed to accommodate the tubes, are welded to the end of each shell. Intermediate tube supports are made from carbon steel plates, and are drilled and reamed to remove sharp edges. The refrigerant side of each shell is designed, tested, and stamped in accordance with local pressure vessel codes.

Tubes

Heat exchanger tubes are copper alloy high-efficiency and are externally and internally enhanced to provide optimum performance. The skip-fin tube design provides a smooth internal and external surface at each intermediate tube support. This provides extra wall thickness up to twice as thick and non-work-hardened copper at the support location, extending the life of the heat exchangers.

Each tube is expanded into the tube sheets providing a leak-proof seal, and can be replaced individually.

Evaporator

The evaporator is a patented hybrid falling-film type heat exchanger. It contains a balance of flooded and falling-film technology to optimize efficiency, minimize refrigerant charge, and maintain reliable control. A specifically designed spray header provides uniform distribution of refrigerant over the entire shell length to yield optimum heat transfer. A suction eliminator is located above the tube bundle to prevent liquid refrigerant carryover into the compressor. A 1 1/2 in. (38 mm) liquid level sight glass is conveniently located on the side of the shell to aid in determining the correct refrigerant charge. The evaporator shell contains a dual refrigerant relief valve arrangement or a single relief valve arrangement if the chiller is supplied with the optional refrigerant isolation valves. A 1 in. (25.4 mm) refrigerant charging valve is provided for service access.

Condenser

The condenser is a shell and tube type heat exchanger with a discharge gas baffle to prevent direct high velocity impingement on the tubes. The baffle is also used to distribute the refrigerant gas flow for the most efficient heat transfer. An integral subcooler is located at the bottom of the condenser shell, providing highly effective liquid refrigerant subcooling to provide the highest possible cycle efficiency. A 1 1/2 in. (38 mm) liquid level sight glass is conveniently located on the side of the shell to aid in determining the correct refrigerant charge. The condenser contains dual refrigerant relief valves.

Waterboxes

The removable waterboxes are made of steel. Integral steel water baffles are located and welded within the waterbox to provide the required pass arrangements. Stub-out water nozzle connections welded to the waterboxes are suitable for ANSI/AWWA C-606 couplings, welding or flanged, and are capped for protection during shipment. Plugged 3/4 in. (19 mm) drain and vent connections are provided in each waterbox, except for marine waterboxes with vertical nozzles where there are drain connections only.

Water flow switches

Thermal or differential pressure type water flow switches are factory-mounted in the evaporator and condenser water nozzles. The switches are factory-wired to the OptiView control panel.

Refrigerant flow control

Refrigerant flow to the evaporator is controlled by the YORK variable orifice control system. Liquid refrigerant level is continuously monitored to provide optimum subcooler, condenser, and evaporator performance. The variable orifice electronically adjusts to all real-world operating conditions, providing the most efficient and reliable operation of refrigerant flow control without the use of a refrigerant pump.

Refrigerant purge unit

The purge is designed to meet the ASHRAE Standard 147 where at most one unit mass of refrigerant is purged per one unit mass of air removed by the unit. This automatic, self-contained, high-efficiency purge unit collects non-condensable gases to be removed from the chiller. The YORK purge is factory assembled, mounted, piped, and wired, and operates automatically. Purge exhaust cycles are monitored, and if excessive, provide warning of a potential system leak to the OptiView Control Center.

Isolation mounting

The unit has four vibration isolation mounts of nominal 1 in. (25.4 mm) operating height. The isolators have a neoprene pad to contact the foundation, bonded to a steel plate. The vibration isolation pad assemblies mount under steel plates welded to the chiller tube sheets.

Optionally, spring isolation mounting is available instead of standard isolation mounting pads. Four level-adjusting, spring-type vibration isolator assemblies with non-skid pads are provided for field-installation. Isolators are designed for 1 in. (25.4 mm) of deflection.

Refrigerant containment

The standard unit is designed as a complete factory-packaged chiller that minimizes the joints from which refrigerant can leak. The entire assembly is thoroughly leak tested at the factory before shipment. The YZ chiller includes service valves conveniently located to facilitate transfer of refrigerant to a remote refrigerant storage or recycling system.

Optional factory-installed isolation valves in the compressor discharge line and refrigerant liquid line allow isolation and storage of the refrigerant charge in the chiller condenser.

Factory testing

Johnson Controls has the ability to factory performance test every type of chiller that we engineer and manufacture. Testing options, including performance, vibration, and sound, can be performed as factory or remote customer witness tests.

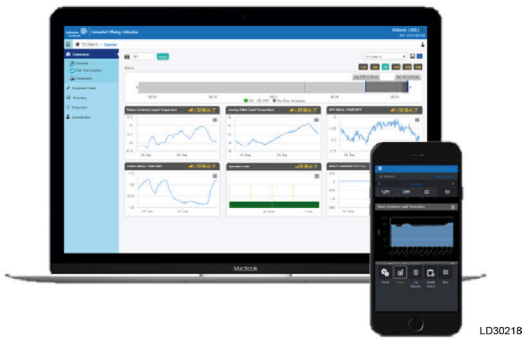
Smart Equipment

You can use Smart Equipment™ by Johnson Controls to connect data streams from equipment to the cloud, which provides unprecedented insights into operations. Smart Equipment can maximize system control for greater efficiency, extended equipment life, and reduced operating costs. The YORK YZ chiller has controls embedded at the factory so that the chiller can connect seamlessly to a controls system. Onboard controls that support cloud-based data analytics, including fault detection, enables proactive maintenance and minimizes downtime.

YORK Smart Connected Chillers

YORK Smart Connected Chiller functionality feeds YZ chiller data to a secure, cloud-based dashboard, enabling analysis of historical data to diagnose the chiller, observe long-term trends, and investigate potential issues. The dashboard collects status-related data warnings, cycling, and safety fault codes. Advanced algorithms detect problems such as condenser or evaporator tube fouling or low refrigerant charge. A more strategic approach to maintenance can be implemented to stay a step ahead of emergencies to save time and money.

Figure 8: YORK Smart Connected Chiller



Shipment

Each unit can be broken down into several form shipment configurations for ease of transportation and installation. For all broken down shipment options, the unit is first factory assembled, refrigerant piped, wired, and leak tested. The unit is then disassembled according to the shipment option selected.

Protective covering is provided on the OptiView and variable speed drive. Water nozzles are capped with fitted plastic enclosures. Then the entire unit is protected with industrial-grade, reinforced shrink-wrap covering.

Form 1

The unit is shipped as one assembly with refrigerant charge inside the unit.

Form 2

The unit is shipped as one assembly with refrigerant charge shipped separately.

Form 3

The driveline is separate from the shells. The unit is shipped as three major subassemblies with refrigerant charge shipped separately. This form is best used when height is a limiting dimension to enter the installation site. The subassemblies are as follows:

- Driveline: This includes the motor and compressor assembly.
- Evaporator and condenser shell assembly: This is not skidded.
- Variable speed drive.

Form 7

The driveline is separate from split shells. The unit is shipped as four major subassemblies, with refrigerant charge shipped separately. This form is best used when the chiller must fit through a tight space, limited by multiple dimensions. The YZD ships Form 7 as standard. The subassemblies are as follows:

- Driveline: This includes the motor and compressor assembly.
- Evaporator: This is not skidded.
- Condenser: This is not skidded.
- Variable speed drive.

Form 11

The unit is shipped as two major subassemblies, with refrigerant charge shipped separately. This form is best used when width is a limiting dimension to enter the installation site. The subassemblies are as follows:

- Condenser side assembly: This includes the condenser, OptiView, and variable speed drive. It is not skidded.
- Evaporator side assembly: This includes the evaporator, driveline, and magnetic bearing controller. It is not skidded.

Codes and standards

Chiller standards and codes vary based on factory source. Any of the following standards and codes can be met when ordering the YZ chiller. Work with your local sales contact for a unit that meets your local codes and standards.

Performance and energy standards

- ASHRAE 90.1
- AHRI Standard 550/590
- IECC: International Energy Conservation Code
- GBCI: Green Business Certification Inc.
- Eurovent (EN14511, EN14825)
- GB 18430.1
- GB 19577/GB 50189
- GB/T 50378
- MEPS: Minimum Energy Performance Standards
- ECBC: Energy Conservation Building Code
- Greenmark
- BEC: Business Environment Council
- SASO: Saudi Standards, Metrology and Quality Organization
- ESMA: Emirates Authority for Standardization and Metrology
- LEED EA4 enhanced refrigerant management credit
- BREEAM Refrigerant Credit: Building Research Establishment Environmental Assessment Method
- OSHA: Occupational Safety and Health Act
- ISA/IEC 62443-4-2 and ISA/IEC 62443-4-1: Security standard of control system products

  ⓘ **Note:** These ISA/IEC standards only apply to single driveline chillers.

Sound ratings

- AHRI 575
- ISO 9614/3744
- JB/T 4330

Pressure vessel codes

- ASME Boiler and Pressure Vessel Code: Section VIII
- PED: European Pressure Equipment Directive
- NB/T 47012
- KHK: High Pressure Gas Control Law

Electrical codes

- c/UL: Underwriters Laboratory

- NEC: National Electrical Code
- CE: Directive 93/68/EEC
- IP: Ingress Protection
- GB 5226.1
- ETL: Electrical Testing Labs

Safety codes

- ASHRAE 15: Safety Code for Mechanical Refrigeration
- ASME
- Safety Code for Mechanical Refrigeration (EN 378-2/A2)
- Machinery Directive (2006/42/EC)
- EMC Directive (2004/108/EC)
- Safety of machinery: Electrical Equipment of Machine (EN 60204-1)
- GB 25131

Manufacturing requirements

- Manufactured in an EN ISO 9001 accredited organization
- Conform to CE Testing Services for construction of chillers and provide CE listed mark
- EN 61000-6-2:2005 and EN 61000-6-4:2007 compliance for use in an industrial environment

Chiller options

Table 1: Chiller options for variable speed drive

Description	Standard	Optional
Harmonic filter	None	Input harmonic filter
Incoming customer wiring	60 Hz: 460 V, 400 V, 380 V	
	50 Hz: 415 V, 400 V, 380 V	
VSD cooling heat exchanger protection, for condenser fluid lines	None	Sediment accumulator

Table 2: Chiller options for heat exchangers

Description	Standard	Optional
Tube wall thickness	0.025 in. (0.635 mm)	0.028 in. and 0.035 in. (0.711 mm and 0.889 mm)
Factory tube testing	None	Factory eddy current testing
Evaporator thermal insulation	None	3/4 in., 1 in., 1 1/4 in., 1 1/2 in. (19 mm, 25.4 mm, 32 mm, and 38 mm) standard thickness

Note:

- The 1 in. (25.4 mm) optional evaporator thermal insulation is for Asia source only.
- The 1 1/4 in. (32 mm) optional evaporator thermal insulation is for Europe source only.

Table 3: Chiller options for waterboxes

Description	Standard	Optional
Customer piping connections	Grooved	Flanges
Waterbox design	Compact	Marine
Design working pressure	1,034 kPa (150 psig) DWP	2,070 kPa (300 psig) DWP (YZD special quote)
Hinges	None	1,034 kPa and 2,070 kPa (150 psig and 300 psig) DWP
Corrosion protection	None	Internally epoxy coated waterboxes and tubesheets, sacrificial anodes (YZD special quote)

Table 4: Chiller options for unit configuration

Description	Standard	Optional
Ability to isolate refrigerant charge in the condenser	None	Isolation valves
Minimum load (assuming AHRI unloading)	Down to 10% unloading	Down to 0% with hot gas bypass
Unit mount	Neoprene pads	Spring isolation (not available on YZD)
Flow switches in the evaporator and condenser water nozzles	Thermal flow switch or differential pressure flow switch	Ship loose paddle flow switches
Unit paint	Caribbean blue paint	Amerlock® 400, Amershield™ (YZD special quote)
Factory knock-down shipment options	Form 1, Form 2, or Form 7	Form 3, Form 7, or Form 11
Unit wrapped before shipment	Partial wrapping (driveline and electrical)	Complete chiller wrapping
Temporary shipping skids	None	Shipping skids
Long-term storage requirements	None	Long-term storage

Note:

- The differential pressure flow switch is provided as the source standard for Asia.
- Form 2 shipment is provided as the source standard for Europe.
- Form 7 shipment is provided as the standard for YZD chillers.

For more information, contact your local sales representative.

Application data

The following section is a guide to the application of YZ chillers to ensure reliable operation. While this guide is directed towards normal, water-chilling applications, a Johnson Controls sales engineer can provide complete recommendations on other types of applications.

Location

YZ chillers are virtually vibration free and can generally be located at any level in a building where the construction can support the total system operating weight.

The unit site must be a floor, mounting pad, or foundation. The site must be level within 1/4 in. (6.5 mm) and capable of supporting the operating weight of the unit.

Provide sufficient clearance to permit normal service and maintenance work all around and above the unit. Additional space must be provided at one end of the unit to permit cleaning of evaporator and condenser tubes as required. Use a doorway or other suitably located opening if convenient.

Install the chiller in an indoor location where temperatures range from 40°F to 104°F (4.4°C to 40.0°C). The dew point temperature in the equipment room must be below the entering condenser water temperature to prevent condensing water vapor inside of the variable speed drive. Applications using cooling sources other than evaporative or closed loop air exchange methods need to request a factory-supplied temperature control valve to prevent condensation inside the variable speed drive cabinet. Other areas susceptible to water vapor condensate are outside of the condenser shell and condenser waterboxes. Example applications include cooling condenser water using chilled water, wells, river, or other low temperature fluids.

For outdoor applications, contact the Large Tonnage Application team.

Refrigerant relief piping

Each chiller is equipped with dual pressure relief valves on the condenser and two dual relief valves on the evaporator, or two single relief valves on the evaporator if the optional refrigerant isolation valves are ordered. The dual relief valves on the condenser are redundant and allow changing of either valve while the unit is fully charged. The purpose of the relief valves is to quickly relieve excess pressure of the refrigerant charge, as a safety precaution in the event of an emergency such as a fire. They are set to relieve at an internal pressure as noted on the pressure vessel data plate, and are provided in accordance with local pressure vessel codes.

Sized to the requirements of applicable codes, a vent line must run from the relief device to the outside of the building. This refrigerant relief piping must include a cleanable, vertical leg dirt trap to catch vent-stack condensation. Arrange vent piping to avoid imposing a strain on the relief connection and must include one flexible connection.

Sound and vibration considerations

A YZ chiller is not a source of objectionable vibration in most air conditioning applications. Standard neoprene isolation mounts are available with each unit to reduce vibration transmission. Optional level-adjusting spring isolator assemblies designed for 1 in. (25.4 mm) static deflection are also available for further isolation. YZ chiller sound pressure level ratings are available upon request. Control of sound and vibration transmission must be taken into account in the equipment room construction and in the selection and installation of the equipment.

Thermal insulation

You must insulate the chiller's cold surfaces with a vapor barrier insulation sufficient to prevent condensation. As an option, a chiller can be factory-insulated. This insulation normally prevents condensation in environments with dry bulb temperatures of 50°F to 90°F (10.0°C to 32.2°C) and relative humidity up to 75% (3/4 in. [19 mm] thickness), 85% (1 in. [25.4 mm] thickness), or 90% (1.5

in. [38 mm] thickness). It is intended for a chiller installed indoors and, as a result, no protective covering of the insulation is usually required. If you apply insulation at the job site, it must be removable to permit access to the tubes for routine maintenance.

Ventilation

Some standards requires that all machinery rooms be vented to the outdoors using mechanical ventilation by one or more fans. Review state, local, and any other related codes for specific requirements. Because the YZ chiller motor is hermetically sealed, no additional ventilation is needed due to motor heat.

In addition, the ASHRAE Standard 15 requires a refrigerant vapor detector to be employed for all refrigerants. It is to be located in an area where refrigerant from a leak would be likely to concentrate. An alarm is to be activated and the mechanical ventilation started at a value no greater than the threshold limit value (TLV) of the refrigerant.

Water circuits

Flow rate

For normal water chilling duty, evaporator and condenser flow rates are permitted at water velocity levels in the heat exchanger tubes of between 3.0 ft/s and 12.0 ft/s (0.91 m/s and 3.66 m/s) for evaporators and 3.3 ft/s and 12.0 ft/s (1.0 m/s and 3.66 m/s) for condensers. Two pass units are also limited to 134 kPa (45 ft H_2O) water pressure drop. The three pass limit is 201 kPa (67.5 ft H_2O). Variable flow in the condenser is not recommended, as it generally raises the energy consumption of the system by keeping the condenser pressure high in the chiller. Additionally, the rate of fouling in the condenser increases at lower water velocities associated with variable flow, raising system maintenance costs. Cooling towers have narrow ranges of operation with respect to flow rates, and are more effective with full design flow.

The chillers can tolerate a 50% flow rate change in 1 min that is usually associated with the staging on or off of an additional chiller. However, a lower flow rate change is normally used for better system stability and setpoint control. Correct sequencing using the building automation system can make this a smooth transition.

Variable primary flow

There is increasing interest to use variable primary flow (VPF) systems in large chilled water plants. VPF systems can provide lower installation and operating costs in many cases, but do require more sophisticated control and flow monitoring. YZ chillers operate successfully in VPF systems. With a minimum allowable evaporator tube velocity of 1.5 ft/s (0.5 m/s) for standard tubes at part load rating conditions, YZ chillers accommodate the wide variation in flow required by many chilled water VPF applications.

Temperature ranges

For normal water chilling duty, leaving chilled water temperatures may be selected between 38°F (3.3°C) and 70°F (21.0°C) to obtain temperature deltas between entering chilled and leaving chilled water temperature of 3°F up to 30°F (1.7°C up to 16.7°C).

Water quality

The practical and economical application of liquid chillers requires that the quality of the water supply for the condenser and evaporator be analyzed by a water treatment specialist. Water quality can affect the performance of any chiller through corrosion, deposition of heat-resistant scale, sedimentation, or organic growth. This degrades chiller performance and increases operating and maintenance costs. However, performance can be maintained by corrective water treatment and periodic cleaning of tubes. If water conditions exist that cannot be corrected by water treatment,

it may be necessary to provide a larger allowance for fouling and to specify special materials of construction.

General piping

All chilled water and condenser water piping must be designed and installed in accordance with accepted piping practice. Chilled water and condenser water pumps must be located to discharge through the chiller to assure positive pressure and flow through the unit. Piping must include offsets to provide flexibility and must be arranged to prevent drainage of water from the evaporator and condenser when the pumps are shut off. Piping must be adequately supported and braced independently of the chiller to avoid the imposition of strain on chiller components. Hangers must allow for alignment of the pipe. Isolators in the piping and in the hangers are highly desirable in achieving sound and vibration control.

Convenience considerations

To facilitate the performance of routine maintenance work, some or all of the following steps can be taken by the purchaser. Evaporator and condenser waterboxes are equipped with plugged vent and drain connections, except for marine waterboxes with vertical nozzles where there are drain connections only. If required, vent and drain valves can be installed with or without piping to an open drain. Pressure gauges with stop-cocks and stop-valves can be installed in the inlets and outlets of the condenser and chilled water line as close as possible to the chiller. An overhead monorail or beam can be used to facilitate servicing.

Connections

The standard chiller is designed for 150 psig (1,034 kPa) design working pressure in both the chilled water and condenser water circuits. The connections, or water nozzles, to these circuits are furnished with grooves to ANSI/AWWA C-606 standard for grooved and shouldered joints. Piping must be arranged for ease of disassembly at the unit for tube cleaning. All water piping must be thoroughly cleaned of all dirt and debris before final connections are made to the chiller.

Chilled water

A water strainer of maximum 1/8 in. (3.2 mm) perforated holes must be field-installed in the chilled water inlet line as close as possible to the chiller. If located close enough to the chiller, the chilled water pump can be protected by the same strainer. The strainer is important to protect the chiller from debris or objects, which could block flow through individual heat exchanger tubes. A reduction in flow through tubes could seriously impair the chiller performance or even result in tube freeze-up. A flow switch is factory installed in the evaporator nozzle and connected to the OptiView panel, which ensures adequate chilled water flow during operation.

Condenser water

The chiller is engineered for maximum efficiency at both design and part load operation by taking advantage of the colder cooling tower water temperatures which naturally occur during the winter months. Appreciable power savings are realized from these reduced heads. At initial startup, entering condensing water temperature may be as much as 30°F (16.7°C) colder than the standby chilled water temperature.

Brine applications

Various types of brine can be used in both the evaporator and condenser in place of water. The OptiView control panel is programmed in the factory to allow extending the evaporator leaving brine temperature setpoint below 36°F (2.2°C). The low evaporator pressure cutout is factory programmed to the appropriate value depending on the percent (%) concentration and type of brine solution.

When the chiller is not running, brine must not be run through the evaporator. However, if there is brine running through the evaporator, there must be flow through the condenser to prevent tubes from freezing. In brine applications, the condenser pump control closes when the condenser saturation temperature reaches 35°F (1.7°C) and the pump shuts off when the temperature increases to 40°F (4.4°C). This is applicable if tied to the condenser pump control.

For brine applications, the condenser water pump and control power may both require a backup power supply in the event of a utility power loss. This backup power maintains flow until the refrigerant saturation temperature is at 40°F (4.4°C) or higher to prevent freezing of the condenser tubes.

Water flow rate limits

The following water flow rate limits are based on standard tubes at design load conditions.

Table 5: Evaporator and condenser water flow rate limits for YZ chiller, gpm (L/s)

Evaporator model	Evaporator flow rate						Condenser model	Condenser flow rate					
	1 pass		2 pass		3 pass			1 pass		2 pass		3 pass	
	Min.	Max.	Min.	Max.	Min.	Max.		Min.	Max.	Min.	Max.	Min.	Max.
FA3312-12Z	1090 (70)	4320 (270)	550 (40)	2050 (120)	—	—	**CA2110-12Z**	890 (60)	3220 (200)	450 (30)	1610 (100)	—	—
FA3312-13S	920 (60)	3670 (230)	460 (30)	1730 (100)	310 (20)	1150 (70)	**CA2110-13O**	690 (50)	2480 (150)	350 (30)	1240 (70)	230 (20)	820 (50)
FA3312-A2Z	970 (70)	3860 (240)	490 (40)	1540 (90)	—	—	**CA2110-A2V**	830 (60)	2990 (180)	420 (30)	1490 (90)	—	—
FA3312-A3O	780 (50)	3100 (190)	390 (30)	1240 (70)	260 (20)	820 (50)	**CA2110-A2Z**	920 (60)	3320 (200)	460 (30)	1660 (100)	—	—
FA3312-A3R	810 (60)	3200 (200)	410 (30)	1280 (80)	270 (20)	840 (50)	**CA2110-A3J**	600 (40)	2160 (130)	300 (20)	1080 (60)	200 (20)	720 (40)
FA3312-A3S	830 (60)	3300 (200)	420 (30)	1320 (80)	280 (20)	880 (50)	**CA2110-A3N**	690 (50)	2490 (150)	350 (30)	1240 (70)	230 (20)	1240 (70)
FA3314-12Z	1090 (70)	4320 (270)	550 (40)	1940 (120)	—	—	**CA2110-A3T**	790 (50)	2840 (170)	400 (30)	1420 (80)	270 (20)	940 (50)
FA3314-13S	920 (60)	3670 (230)	460 (30)	1640 (100)	310 (20)	1090 (60)	**CA2512-12Z**	1380 (90)	5000 (310)	690 (50)	2550 (160)	—	—
FA3314-A2Z	970 (70)	3860 (240)	490 (40)	1440 (90)	—	—	**CA2512-13N**	1030 (70)	3740 (230)	520 (40)	1920 (120)	350 (30)	1230 (70)
FA3314-A3O	780 (50)	3100 (190)	390 (30)	1160 (70)	260 (20)	770 (40)	**CA2512-A2Z**	1330 (90)	4800 (300)	670 (50)	2270 (140)	—	—
FA3314-A3R	810 (60)	3200 (200)	410 (30)	1200 (70)	270 (10)	790 (40)	**CA2512-A3O**	1030 (70)	3710 (230)	520 (40)	1820 (110)	350 (30)	990 (60)
FA3314-A3S	830 (60)	3300 (200)	420 (30)	1230 (70)	280 (20)	820 (50)	**CA2512-A3U**	1160 (80)	4200 (260)	580 (40)	2030 (120)	390 (30)	1440 (90)
FA3914-12Z	1340 (90)	5330 (330)	670 (50)	2390 (150)	—	—	**CA3314-12Z**	2450 (160)	8880 (560)	1230 (80)	4220 (260)	—	—
FA3914-13U	1200 (80)	4780 (300)	600 (40)	2150 (130)	400 (30)	1430 (90)	**CA3314-13N**	1850 (120)	6690 (420)	930 (60)	3410 (210)	620 (40)	2270 (140)
FA3914-A2Z	1480 (100)	5880 (370)	740 (50)	2200 (130)	—	—	**CA3314-A2Y**	2450 (160)	8900 (560)	1230 (80)	3780 (230)	—	—
FA3914-A3P	1210 (80)	4810 (300)	610 (40)	1800 (110)	410 (30)	1200 (70)	**CA3314-A2Z**	2480 (160)	8990 (560)	1240 (80)	3820 (240)	—	—
FA3914-A3T	1290 (90)	5140 (320)	650 (50)	1920 (120)	430 (30)	1280 (80)	**CA3314-A3I**	1640 (110)	5950 (370)	820 (60)	2680 (160)	550 (40)	1780 (110)
FA3914-A3V	1350 (90)	5380 (330)	680 (50)	2010 (120)	450 (30)	1340 (80)	**CA3314-A3L**	1790 (120)	6500 (410)	900 (60)	2920 (180)	600 (40)	1950 (120)
FA3916-12Z	1340 (90)	5330 (330)	670 (50)	2260 (140)	—	—	**CA3314-A3T**	2160 (140)	7810 (490)	1080 (70)	3320 (200)	720 (50)	2340 (140)

Table 5: Evaporator and condenser water flow rate limits for YZ chiller, gpm (L/s)

Evaporator model	Evaporator flow rate						Condenser model	Condenser flow rate					
	1 pass		2 pass		3 pass			1 pass		2 pass		3 pass	
	Min.	Max.	Min.	Max.	Min.	Max.		Min.	Max.	Min.	Max.	Min.	Max.
FA3916-13U	1200 (80)	4780 (300)	600 (40)	2030 (120)	400 (30)	1310 (80)	**CA3916-12U**	3120 (200)	11330 (710)	1560 (100)	5380 (330)	—	—
FA3916-A2Z	1480 (100)	5880 (370)	740 (50)	2050 (120)	—	—	**CA3916-12Z**	3490 (220)	12660 (790)	1750 (110)	5700 (350)	—	—
FA3916-A3P	1210 (80)	4810 (300)	610 (40)	1680 (100)	410 (20)	1120 (70)	**CA3916-13P**	2790 (180)	10130 (630)	1400 (90)	4810 (300)	930 (60)	3210 (200)
FA3916-A3T	1290 (90)	5140 (320)	650 (50)	1790 (110)	430 (30)	1200 (70)	**CA3916-A2Z**	3620 (230)	13160 (830)	1810 (120)	5260 (330)	—	—
FA3916-A3V	1350 (90)	5380 (330)	680 (50)	1880 (110)	450 (30)	1250 (70)	**CA3916-A3H**	2320 (150)	8400 (530)	1160 (80)	3570 (220)	780 (50)	2380 (150)
FB2910-12Z	910 (60)	3630 (220)	460 (30)	1710 (100)	—	—	**CA3916-A3M**	2680 (170)	9730 (610)	1340 (90)	3890 (240)	900 (60)	2590 (160)
FB2910-13I	620 (40)	2470 (150)	310 (20)	1230 (70)	210 (20)	820 (50)	**CA3916-A3T**	3120 (200)	11320 (710)	1560 (100)	4520 (280)	1040 (70)	3010 (180)
FB2910-13O	720 (50)	2860 (180)	360 (30)	1430 (90)	240 (20)	950 (50)	**CA4418-A2Z**	4630 (300)	16810 (1060)	2320 (150)	8400 (530)	—	—
FB2910-A2Z	910 (60)	3600 (220)	460 (30)	1440 (90)	—	—	**CB2110-12Z**	920 (60)	3330 (210)	460 (30)	1660 (100)	—	—
FB2910-A3D	520 (40)	2070 (130)	260 (20)	920 (50)	180 (20)	620 (30)	**CB2110-13R**	740 (50)	2660 (160)	370 (30)	1330 (80)	270 (20)	950 (50)
FB2910-A3L	670 (50)	2650 (160)	340 (30)	1120 (70)	230 (20)	790 (40)	**CB2110-A2Z**	960 (60)	3450 (210)	480 (30)	1720 (100)	—	—
FB2910-A3R	760 (50)	3010 (190)	380 (30)	1270 (80)	260 (20)	900 (50)	**CB2110-A3T**	820 (60)	2950 (180)	410 (30)	1470 (90)	280 (20)	1060 (60)
FB2912-12Z	910 (60)	3630 (220)	460 (30)	1530 (90)	—	—	**CB2112-22V**	760 (50)	2730 (170)	380 (30)	1360 (80)	—	—
FB2912-13I	620 (40)	2470 (150)	310 (20)	1160 (70)	210 (20)	820 (50)	**CB2112-22Z**	840 (60)	3040 (190)	420 (30)	1520 (90)	—	—
FB2912-13O	720 (50)	2860 (180)	360 (30)	1280 (80)	240 (20)	900 (50)	**CB2112-23O**	650 (50)	2350 (140)	330 (30)	1170 (70)	220 (20)	780 (40)
FB2912-A2Z	910 (60)	3600 (220)	460 (30)	1710 (100)	—	—	**CB2112-32T**	690 (50)	2480 (150)	350 (30)	1250 (70)	—	—
FB2912-A3D	520 (40)	2070 (130)	260 (20)	970 (60)	180 (20)	650 (40)	**CB2112-32Z**	790 (50)	2860 (180)	400 (30)	1460 (90)	—	—
FB2912-A3L	670 (50)	2650 (160)	340 (30)	1250 (70)	230 (20)	830 (50)	**CB2112-33N**	600 (40)	2150 (130)	300 (20)	1080 (60)	200 (20)	730 (40)
FB2912-A3R	760 (50)	3010 (190)	380 (30)	1200 (70)	260 (20)	800 (50)	**CB2112-A2Z**	960 (60)	3450 (210)	480 (30)	2360 (140)	—	—
FB4816-12Z	2510 (160)	10000 (630)	1260 (80)	4000 (250)	—	—	**CB2112-A3T**	820 (60)	2950 (180)	410 (30)	1470 (90)	280 (20)	980 (60)
FB4816-13V	2300 (150)	9180 (570)	1150 (80)	3670 (230)	770 (50)	2600 (160)	**CB2112-B2Z**	870 (60)	3150 (190)	440 (30)	1570 (90)	—	—
FB4816-A2Z	2490 (160)	9930 (620)	1250 (80)	3220 (200)	—	—	**CB2512-12S**	1130 (80)	4080 (250)	570 (40)	2040 (120)	—	—
FB4816-A3S	2120 (140)	8440 (530)	1060 (70)	2950 (180)	710 (50)	1960 (120)	**CB2512-12Z**	1350 (90)	4900 (300)	680 (50)	2450 (150)	—	—
FB4816-A3W	2300 (150)	9170 (570)	1150 (80)	3200 (200)	770 (50)	2130 (130)	**CB2512-13N**	1020 (70)	3680 (230)	510 (40)	1840 (110)	340 (30)	1220 (70)
FB4818-12Z	2510 (160)	10000 (630)	1260 (80)	3750 (230)	—	—	**CB2512-A2X**	1240 (80)	4490 (280)	620 (40)	2240 (140)	—	—
FB4818-13V	2300 (150)	9180 (570)	1150 (80)	3440 (210)	770 (50)	2440 (150)	**CB2512-A2Z**	1310 (90)	4730 (290)	660 (50)	2360 (140)	—	—

Table 5: Evaporator and condenser water flow rate limits for YZ chiller, gpm (L/s)

Evaporator model	Evaporator flow rate						Condenser model	Condenser flow rate					
	1 pass		2 pass		3 pass			1 pass		2 pass		3 pass	
	Min.	Max.	Min.	Max.	Min.	Max.		Min.	Max.	Min.	Max.	Min.	Max.
FB4818-A2Z	2490 (160)	9930 (620)	1250 (80)	3220 (200)	—	—	**CB2512-A3U**	1150 (80)	4160 (260)	580 (40)	2080 (130)	390 (30)	1380 (80)
FB4818-A3S	2120 (140)	8440 (530)	1060 (70)	2740 (170)	710 (50)	1820 (110)	**CB2914-12Z**	1990 (130)	7220 (450)	1000 (70)	3610 (220)	—	—
FB4818-A3W	2300 (150)	9170 (570)	1150 (80)	2970 (180)	770 (50)	1980 (120)	**CB2914-13T**	1690 (110)	6110 (380)	850 (60)	3050 (190)	570 (40)	2030 (120)
FB5618-12Z	3400 (220)	13560 (850)	1700 (110)	4740 (290)	—	—	**CB2914-22Z**	1960 (130)	7100 (440)	980 (70)	3550 (220)	—	—
FB5618-13V	3090 (200)	12330 (770)	1550 (100)	4310 (270)	1030 (70)	3080 (190)	**CB2914-23P**	1540 (100)	5590 (350)	770 (50)	2790 (170)	520 (40)	2010 (120)
FB5618-A2Z	3320 (210)	13240 (830)	1660 (110)	3970 (250)	—	—	**CB2914-32Z**	1870 (120)	6790 (420)	940 (60)	3430 (210)	—	—
FB5618-A3X	3130 (200)	12510 (780)	1570 (100)	4060 (250)	1050 (70)	2710 (170)	**CB2914-33N**	1430 (90)	5180 (320)	720 (50)	2640 (160)	480 (30)	1760 (110)
FC2510-22Z	710 (50)	2810 (170)	360 (30)	1400 (80)	—	—	**CB2914-B2Z**	1950 (130)	7090 (440)	980 (70)	3540 (220)	—	—
FC2510-23F	440 (30)	1730 (100)	220 (20)	860 (50)	150 (10)	570 (30)	**CB2914-B2Z**	1950 (130)	7090 (440)	980 (70)	3540 (220)	—	—
FC2510-23P	580 (40)	2300 (140)	290 (20)	1150 (70)	200 (20)	760 (40)	**CB2914-B3V**	1760 (120)	6390 (400)	880 (60)	3190 (200)	590 (40)	2300 (140)
FC2510-B2Z	770 (50)	3060 (190)	390 (30)	1370 (80)	—	—	**CB2914-C2Z**	1870 (120)	6770 (420)	940 (60)	3380 (210)	—	—
FC2510-B3H	500 (40)	1970 (120)	250 (20)	880 (50)	170 (20)	580 (30)	**CB2914-C3V**	1680 (110)	6100 (380)	840 (60)	3050 (190)	560 (40)	2030 (120)
FC2510-B3O	610 (40)	2420 (150)	310 (20)	1080 (60)	210 (20)	720 (40)	**CB3316-12Z**	2530 (160)	9190 (580)	1270 (80)	4590 (280)	—	—
FC2512-12Z	600 (40)	2380 (150)	300 (20)	1130 (70)	—	—	**CB3316-13R**	2080 (140)	7550 (470)	1040 (70)	3770 (230)	700 (50)	2510 (150)
FC2512-13P	490 (40)	1920 (120)	250 (20)	910 (50)	170 (20)	640 (40)	**CB3316-22Z**	2470 (160)	8970 (560)	1240 (80)	4480 (280)	—	—
FC2512-32Z	780 (50)	3100 (190)	390 (30)	1390 (80)	—	—	**CB3316-23P**	1970 (130)	7150 (450)	990 (70)	3570 (220)	710 (50)	2610 (160)
FC2512-33M	590 (40)	2350 (140)	300 (20)	1110 (70)	200 (20)	780 (40)	**CB3316-32U**	1930 (130)	7000 (440)	970 (70)	3500 (220)	—	—
FC2512-A2Z	610 (40)	2420 (150)	310 (20)	1080 (60)	—	—	**CB3316-32Z**	2290 (150)	8310 (520)	1150 (80)	4150 (260)	—	—
FC2512-A3N	470 (30)	1870 (110)	240 (20)	790 (40)	160 (10)	520 (30)	**CB3316-B2Z**	2490 (160)	9020 (560)	1250 (80)	4510 (280)	—	—
FC2512-C2Z	820 (60)	3250 (200)	410 (30)	1210 (70)	—	—	**CB3316-B3U**	2160 (140)	7850 (490)	1080 (70)	3920 (240)	720 (50)	2610 (160)
FC2512-C3O	650 (50)	2570 (160)	330 (30)	1020 (60)	220 (20)	720 (40)	**CB3316-B3W**	2270 (150)	8240 (520)	1140 (80)	4120 (250)	760 (50)	2740 (170)
FC2912-12Z	830 (60)	3310 (200)	420 (30)	1650 (100)	—	—	**CB3316-C2Z**	2460 (160)	8930 (560)	1230 (80)	3570 (220)	—	—
FC2912-13L	620 (40)	2450 (150)	310 (20)	1220 (70)	210 (20)	810 (50)	**CB3316-D2Z**	2170 (140)	7880 (490)	1090 (70)	3940 (240)	—	—
FC2912-A2Z	860 (60)	3430 (210)	430 (30)	1360 (80)	—	—	**CB3616-A2Z**	3080 (200)	11170 (700)	1540 (100)	4190 (260)	—	—
FC2912-A3P	710 (50)	2810 (170)	360 (30)	1190 (70)	240 (20)	740 (40)	**CB3616-A3T**	2310 (150)	8390 (520)	1160 (80)	3770 (230)	770 (50)	2650 (160)
FC3312-12Z	1460 (100)	5810 (360)	730 (50)	2610 (160)	—	—	**CB3616-B2Z**	2760 (180)	10010 (630)	1380 (90)	4750 (290)	—	—

Table 5: Evaporator and condenser water flow rate limits for YZ chiller, gpm (L/s)

Evaporator model	Evaporator flow rate						Condenser model	Condenser flow rate					
	1 pass		2 pass		3 pass			1 pass		2 pass		3 pass	
	Min.	Max.	Min.	Max.	Min.	Max.		Min.	Max.	Min.	Max.	Min.	Max.
FC3312-13P	1180 (80)	4710 (290)	590 (40)	2230 (140)	400 (30)	1410 (80)	**CB3616-B3R**	2210 (140)	8020 (500)	1110 (70)	3810 (240)	800 (60)	2540 (160)
FC3312-A2Z	1460 (100)	5800 (360)	730 (50)	2170 (130)	—	—	**CB3916-A2Z**	3880 (250)	14090 (880)	1940 (130)	7040 (440)	—	—
FC3312-A3I	970 (70)	3860 (240)	490 (40)	1540 (90)	330 (30)	1020 (60)	**CB3916-A3S**	3220 (210)	11700 (730)	1610 (110)	4380 (270)	1080 (70)	3120 (190)
FC3312-A3S	1250 (80)	4990 (310)	630 (40)	1930 (120)	420 (30)	1280 (80)	**CB3916-B2Z**	3560 (230)	12930 (810)	1780 (120)	5170 (320)	—	—
FC3614-12Z	1360 (90)	5400 (340)	680 (50)	2290 (140)	—	—	**CB3916-B3R**	2870 (190)	10420 (650)	1440 (100)	4160 (260)	960 (70)	2770 (170)
FC3614-13T	1190 (80)	4730 (290)	600 (40)	2000 (120)	400 (30)	1410 (80)	**CB4416-12Z**	4920 (310)	17850 (1120)	2460 (160)	8920 (560)	—	—
FC3614-A2Z	1800 (120)	7180 (450)	900 (60)	2510 (150)	—	—	**CB4416-13J**	3210 (210)	11660 (730)	1610 (110)	5830 (360)	1070 (70)	3880 (240)
FC3614-A3N	1410 (90)	5600 (350)	710 (50)	1960 (120)	470 (30)	1300 (80)	**CB4416-A2Z**	4770 (310)	17320 (1090)	2390 (160)	8660 (540)	—	—
FC3614-A3T	1570 (100)	6250 (390)	790 (50)	2180 (130)	530 (40)	1560 (90)	**CB4416-A3O**	3700 (240)	13410 (840)	1850 (120)	6700 (420)	1240 (80)	4470 (280)
FC3914-22Z	1980 (130)	7880 (490)	990 (70)	3150 (190)	—	—	**CB4418-12Z**	4920 (310)	17850 (1120)	2460 (160)	8920 (560)	—	—
FC3914-23E	1200 (80)	4780 (300)	600 (40)	2030 (120)	400 (30)	1430 (90)	**CB4418-13J**	3210 (210)	11660 (730)	1610 (110)	5830 (360)	1070 (70)	3880 (240)
FC3914-23H	1330 (90)	5280 (330)	670 (50)	2240 (140)	450 (30)	1580 (90)	**CB4418-22Z**	4670 (300)	16940 (1060)	2340 (150)	8470 (530)	—	—
FC3914-23V	1790 (120)	7140 (450)	900 (60)	2850 (170)	600 (40)	2020 (120)	**CB4418-23P**	3730 (240)	13550 (850)	1870 (120)	6770 (420)	1250 (80)	4510 (280)
FC3914-A2Z	1980 (130)	7880 (490)	990 (70)	2750 (170)	—	—	**CB4418-32Z**	4860 (310)	17630 (1110)	2430 (160)	7930 (500)	—	—
FC3914-A3M	1480 (100)	5880 (370)	740 (50)	2050 (120)	500 (40)	1470 (90)	**CB4418-33K**	3310 (210)	12000 (750)	1660 (110)	5700 (350)	1110 (70)	3800 (230)
FC3914-A3T	1710 (110)	6810 (420)	860 (60)	2380 (150)	570 (40)	1700 (100)	**CB4418-33W**	4450 (290)	16150 (1010)	2230 (150)	7260 (450)	1490 (100)	4840 (300)
FC3914-B2V	2180 (140)	8700 (540)	1090 (70)	3040 (190)	—	—	**CB4418-A2Z**	4770 (310)	17320 (1090)	2390 (160)	8660 (540)	—	—
FC3914-B2Z	2380 (150)	9500 (590)	1190 (80)	3320 (200)	—	—	**CB4418-A3O**	3700 (240)	13410 (840)	1850 (120)	6700 (420)	1240 (80)	4480 (280)
FC3914-B3U	2110 (140)	8420 (530)	1060 (70)	3150 (190)	710 (50)	2100 (130)	**CB4418-B2Z**	4630 (300)	16800 (1060)	2320 (150)	8400 (530)	—	—
FC3916-12Z	1700 (110)	6780 (420)	850 (60)	2880 (180)	—	—	**CB4818-12Y**	5650 (360)	20540 (1290)	2830 (180)	8730 (550)	—	—
FC3916-13U	1530 (100)	6080 (380)	770 (50)	2580 (160)	510 (40)	1710 (100)	**CB4818-12Z**	5900 (380)	21430 (1350)	2950 (190)	9100 (570)	—	—
FC4416-12Z	2110 (140)	8410 (530)	1060 (70)	3360 (210)	—	—	**CB4818-13H**	3630 (230)	13170 (830)	1820 (120)	5930 (370)	1210 (80)	4170 (260)
FC4416-13S	1810 (120)	7230 (450)	910 (60)	2880 (180)	610 (40)	1920 (120)	**CB4818-13W**	5430 (350)	19720 (1240)	2720 (180)	8380 (520)	1810 (120)	5910 (370)
FC4416-13V	1930 (130)	7710 (480)	970 (70)	3060 (190)	650 (50)	2040 (120)	**CB4818-A2Z**	5900 (380)	21420 (1350)	2950 (190)	7500 (470)	—	—
FC4416-22Z	2880 (190)	11490 (720)	1440 (100)	4300 (270)	—	—	**CB4818-A3X**	5580 (360)	20270 (1270)	2790 (180)	7090 (440)	1860 (120)	5060 (310)
FC4416-23L	2110 (140)	8430 (530)	1060 (70)	3360 (210)	710 (-)	2240 (140)	**CB4818-B2Z**	5760 (370)	20910 (1310)	2880 (190)	10450 (650)	—	—

Table 5: Evaporator and condenser water flow rate limits for YZ chiller, gpm (L/s)

Evaporator model	Evaporator flow rate						Condenser model	Condenser flow rate					
	1 pass		2 pass		3 pass			1 pass		2 pass		3 pass	
	Min.	Max.	Min.	Max.	Min.	Max.		Min.	Max.	Min.	Max.	Min.	Max.
FC4416-23V	2640 (170)	10550 (660)	1320 (90)	3920 (240)	880 (60)	2800 (170)	**CB4818-B3T**	4880 (310)	17720 (1110)	2440 (160)	8860 (550)	1630 (110)	5900 (370)
FC4416-A2Z	2260 (150)	9000 (560)	1130 (80)	3150 (190)	—	—	**SA2512-12M**	950 (60)	3420 (210)	480 (30)	1710 (100)	—	—
FC4416-A3U	2020 (130)	8040 (500)	1010 (70)	2810 (170)	680 (50)	1870 (110)	**SA2512-12R**	1060 (70)	3810 (240)	530 (40)	1900 (110)	—	—
FC4416-B2Z	2720 (180)	10840 (680)	1360 (90)	3520 (220)	—	—	**SA2512-12Z**	1310 (90)	4750 (290)	660 (50)	2370 (140)	—	—
FC4416-B3R	2260 (150)	9000 (560)	1130 (80)	3150 (190)	760 (50)	2100 (130)	**SA2512-13F**	730 (50)	2640 (160)	370 (30)	1290 (80)	250 (20)	860 (50)
FC4416-B3U	2440 (160)	9730 (610)	1220 (80)	3150 (190)	820 (60)	2100 (130)	**SA2512-A2R**	1040 (70)	3780 (230)	520 (40)	1890 (110)	—	—
FC4816-22Z	3680 (240)	14710 (920)	1840 (120)	5140 (320)	—	—	**SA2512-A2S**	1060 (70)	3830 (240)	530 (40)	1910 (120)	—	—
FC4816-23V	3340 (220)	13340 (840)	1670 (110)	4660 (290)	1120 (80)	3550 (220)	**SA2512-A2T**	1100 (70)	3970 (250)	550 (40)	1980 (120)	—	—
FC4816-A2Z	3740 (240)	14940 (940)	1870 (120)	4850 (300)	—	—	**SA2512-A2Z**	1280 (90)	4630 (290)	640 (50)	2310 (140)	—	—
FC4816-A3A	2000 (130)	7990 (500)	1000 (70)	2790 (170)	670 (50)	1860 (110)	**SA2512-A3F**	710 (50)	2580 (160)	360 (30)	1290 (80)	240 (20)	860 (50)
FC4816-A3V	3400 (220)	13580 (850)	1700 (110)	4410 (270)	1140 (80)	3160 (190)	**SA2512-A3I**	810 (60)	2930 (180)	410 (30)	1460 (90)	270 (20)	970 (60)
FC4816-B2Z	1990 (130)	7920 (490)	1000 (70)	2770 (170)	—	—	**SA2512-A3J**	830 (60)	2990 (180)	420 (30)	1490 (90)	280 (20)	990 (60)
FC4816-B3L	1440 (100)	5720 (360)	720 (50)	2000 (120)	480 (40)	1330 (80)	**SA2512-A3O**	970 (70)	3500 (220)	490 (40)	1750 (110)	330 (30)	1160 (70)
FC4816-B3N	1540 (100)	6140 (380)	770 (50)	2140 (130)	520 (40)	1420 (80)	**SA3314-12W**	2460 (160)	8910 (560)	1230 (80)	4450 (280)	—	—
FC4816-B3W	1790 (120)	7140 (450)	900 (60)	2490 (150)	600 (40)	1660 (100)	**SA3314-12Z**	2650 (170)	9620 (600)	1330 (90)	4810 (300)	—	—
FC4818-12Z	2340 (150)	9350 (590)	1170 (80)	3260 (200)	—	—	**SA3314-13P**	2040 (130)	7400 (460)	1020 (70)	3700 (230)	680 (50)	2460 (150)
FC4818-13V	2150 (140)	8580 (540)	1080 (70)	3430 (210)	720 (50)	2280 (140)	**SA3314-A2Z**	2660 (170)	9640 (600)	1330 (90)	4820 (300)	—	—
FC5616-B2Z	3910 (250)	15630 (980)	1960 (130)	5070 (310)	—	—	**SA3314-A3A**	1140 (80)	4130 (260)	570 (40)	2060 (120)	380 (30)	1370 (80)
FC5616-B3L	2830 (180)	11300 (710)	1420 (90)	3950 (240)	950 (60)	2630 (160)	**SA3314-A3E**	1410 (90)	5090 (320)	710 (50)	2540 (160)	470 (30)	1690 (100)
FC5616-B3N	3060 (200)	12210 (770)	1530 (100)	4270 (260)	1020 (70)	2840 (170)	**SA3314-A3I**	1650 (110)	5960 (370)	830 (60)	2980 (180)	550 (40)	1980 (120)
FC5616-B3W	3610 (230)	14420 (900)	1810 (120)	4680 (290)	1210 (80)	3360 (210)	**SA3314-A3U**	2290 (150)	8290 (520)	1150 (80)	4140 (260)	770 (50)	2760 (170)
FC5618-12Z	3370 (220)	13460 (840)	1690 (110)	5040 (310)	—	—	**SA3916-12H**	2320 (150)	8420 (530)	1160 (80)	4210 (260)	—	—
FC5618-13V	3110 (200)	12400 (780)	1560 (100)	4650 (290)	1040 (70)	2060 (120)	**SA3916-12M**	2720 (180)	9880 (620)	1360 (90)	4940 (310)	—	—
FC5618-22Z	4510 (290)	18000 (1130)	2260 (150)	6300 (390)	—	—	**SA3916-12O**	2890 (190)	10480 (660)	1450 (100)	5240 (330)	—	—
FC5618-23V	4100 (260)	16390 (1030)	2050 (130)	5730 (360)	1370 (90)	4090 (250)	**SA3916-12Z**	3750 (240)	13610 (850)	1880 (120)	6800 (420)	—	—
FC5618-A2Z	4550 (290)	18170 (1140)	2280 (150)	5440 (340)	—	—	**SA3916-13G**	2220 (140)	8060 (500)	1110 (70)	4030 (250)	740 (50)	2680 (160)

Table 5: Evaporator and condenser water flow rate limits for YZ chiller, gpm (L/s)

Evaporator model	Evaporator flow rate						Condenser model	Condenser flow rate					
	1 pass		2 pass		3 pass			1 pass		2 pass		3 pass	
	Min.	Max.	Min.	Max.	Min.	Max.		Min.	Max.	Min.	Max.	Min.	Max.
FC5618-A3L	3290 (210)	13140 (820)	1650 (110)	4270 (260)	1100 (70)	2840 (170)	SA3916-A2Z	3670 (240)	13320 (840)	1840 (120)	6660 (420)	—	—
FC5618-A3N	3550 (230)	14180 (890)	1780 (120)	4600 (290)	1190 (80)	3060 (190)	SA3916-A3J	2420 (160)	8790 (550)	1210 (80)	4390 (270)	810 (60)	2930 (180)
FC5618-A3W	4200 (270)	16780 (1050)	2100 (140)	5030 (310)	1400 (90)	3630 (220)	SA3916-A3S	3060 (200)	11100 (700)	1530 (100)	5550 (350)	1020 (70)	3700 (230)
FC6218-A2Z	5060 (320)	20210 (1270)	2530 (160)	6060 (380)	—	—	SA4418-12Z	5140 (330)	18650 (1170)	2570 (170)	9320 (580)	—	—
							SA4418-13G	3070 (200)	11150 (700)	1540 (100)	5570 (350)	1030 (70)	3710 (230)
							SA4418-A2Z	4730 (300)	17190 (1080)	2370 (150)	8590 (540)	—	—
							SA4418-A3N	3520 (230)	12790 (800)	1760 (120)	6390 (400)	1180 (80)	4260 (260)

Multiple units

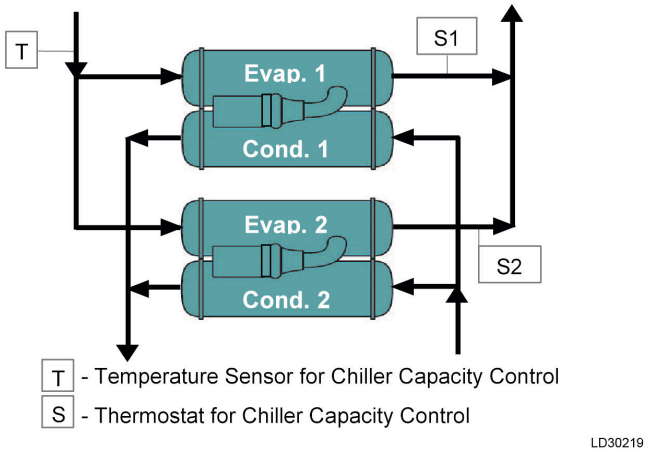
Selection

Many applications require multiple units to meet the total capacity requirements as well as to provide flexibility and some degree of protection against equipment shutdown. There are several common unit arrangements for this type of application. The YZ chiller has been designed to be readily adapted to the requirements of these various arrangements.

Parallel arrangement

Chillers can be applied in multiples with chilled and condenser water circuits connected in parallel between the units. Figure 9 represents a parallel arrangement with two chillers. Parallel chiller arrangements can consist of equally or unequally sized units. When multiple units are in operation, they load and unload at equal percentages of design full load for the chiller.

Figure 9: Parallel evaporators and parallel condensers



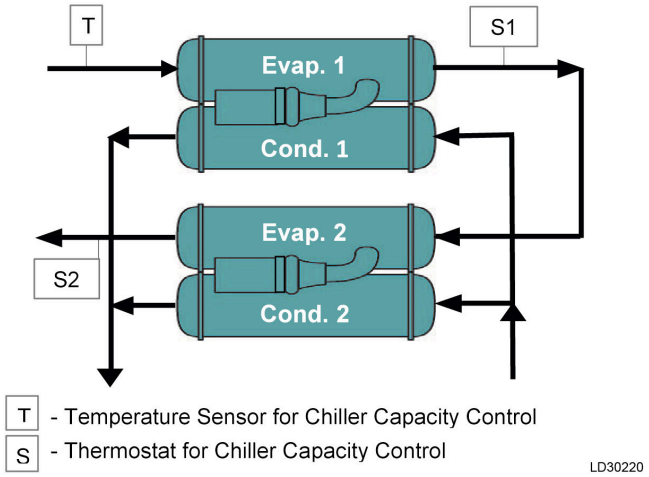
Depending on the number of units and operating characteristics of the units, loading and unloading schemes must be designed to optimize the overall efficiency of the chiller plant. You can use an evaporator bypass piping arrangement to bypass fluid around evaporator of any unit which

has cycled off at reduced load conditions. It is also recommended to alternate the chiller cycling order to equalize chiller starts and run hours.

Series and parallel arrangement

Chillers can be applied in pairs with chilled water circuits connected in series and condenser water circuits connected in parallel, as shown in Figure 10. All of the chilled water flows through both evaporators, with each unit handling approximately half of the total load. When the load decreases to a customer-selected load value, one of the units shuts down by a sequence control. Because all water flows through the operating unit, that unit cools the water to the preferred temperature.

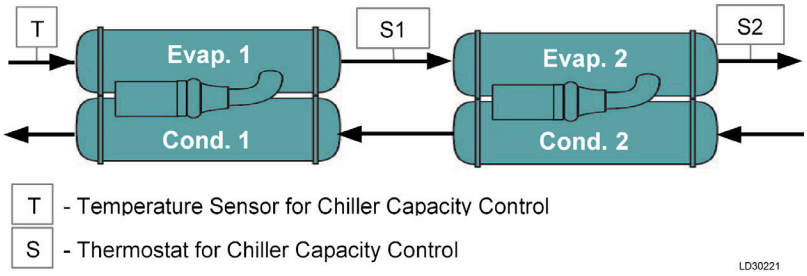
Figure 10: Series and parallel arrangement



Series counterflow arrangement

Chillers can be applied in pairs with chilled water circuits connected in series and with the condenser water in series counterflow, as shown in Figure 11. All of the chilled water flows through both evaporators. All of the condenser water flows through both condensers. The water ranges are split, which allows a lower temperature difference or head on each chiller, than multiple units in parallel. For equal chillers, the machine at the higher temperature level generally provides slightly more than half the capacity. The compressor on each chiller is often matched, such that the high temperature machine can operate at the low temperature conditions when one unit is cycled off at part load. This is in comparison to series-parallel chillers, which are usually not identical.

Figure 11: Series evaporators series and counterflow condensers



Electrical considerations

Unit input conductor size must be in accordance with applicable electrical codes for the unit full load amperes (FLA). Refer to the submittal drawings for the FLA and minimum current ampacity

(MCA) specific to each application. Flexible conduit must be used for the last several feet to the chiller in order to provide vibration isolation. Table 6 lists the range in voltage that can be supplied to the chiller. The unit nameplate is stamped with the unit voltage and frequency.

Table 6: Voltage variations

Frequency (Hz)	Rated voltage (V)	Nameplate voltage (V)	Operating voltage (V)	
			Minimum	Maximum
60 Hz	460	460	414	504
	400	400	360	440
	380	380	342	423
50 Hz	415	415	374	456
	400	400	360	440
	380	380	342	423

Copper conductors

Only copper conductors must be connected to compressor motors and starters. Aluminum conductors have proven to be unsatisfactory when connected to copper lugs. Aluminum oxide and the difference in thermal conductivity between copper and aluminum cannot guarantee the required tight connection over a long period of time.

Displacement power and factor correction capacitors

The VSD provides automatic displacement power factor correction to a minimum of 0.95 at all operating conditions, so additional capacitors are not required.

Branch circuit overcurrent protection

The branch circuit overcurrent protection device(s) must be a time-delay type, with a minimum rating equal to the next standard fuse/breaker rating above the calculated value. Refer to the submittal drawings for the specific calculations for each application.

Unit weights and dimensions

Figure 12: Unit dimensions, front view

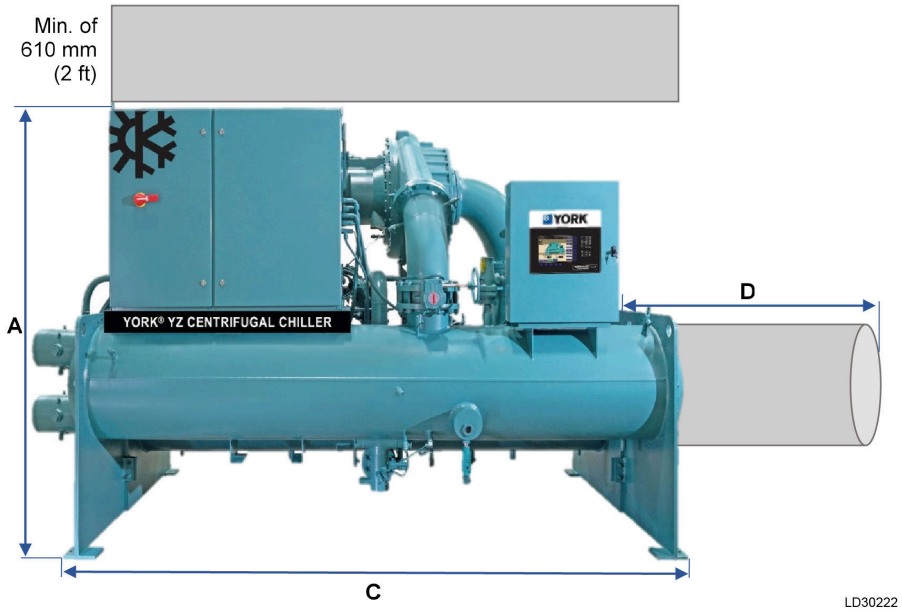


Figure 13: Unit dimensions, side view

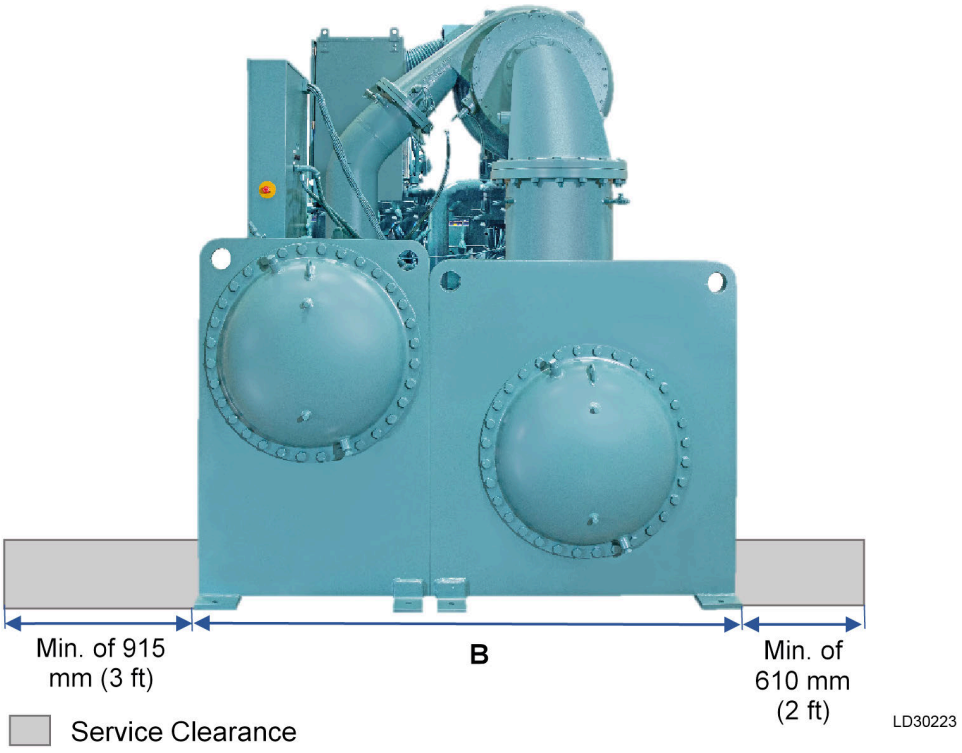


Table 7: Unit weight and dimensions

Heat exchanger size	A - Height, m (ft)	B - Width, m (ft)	C - Length, m (ft)	D - Tube removal clearance, m (ft)	Maximum shipping weight, kg (lb)
FC2510/CB2110	2.3 (7.4)	1.8 (5.8)	3.1 (10)	3.1 (10)	6,140 (13,536)
FC2512/CB2112	2.2 (7.3)	1.8 (5.8)	3.7 (12)	3.7 (12)	6,450 (14,220)
FB2910/CA2110	2.3 (7.4)	1.8 (5.8)	3.1 (10)	3.1 (10)	6,450 (14,220)
FC2912/CB2112	2.5 (8.3)	2.0 (6.5)	3.7 (12)	3.7 (12)	8,500 (18,740)
FC2912/CB2512	2.5 (8.3)	2.1 (6.9)	3.7 (12)	3.7 (12)	9,230 (20,350)
FB2912/SA2512	2.4 (7.9)	1.9 (6.2)	3.7 (12)	3.7 (12)	8,420 (18,563)
FA3312/CA2512	2.6 (8.5)	2.1 (6.9)	3.7 (12)	3.7 (12)	9,860 (21,730)
FA3312/SA2512	2.5 (8.2)	2.1 (6.9)	3.7 (12)	3.7 (12)	9,140 (20,150)
FC3312/CB2512	2.5 (8.3)	2.1 (6.9)	3.7 (12)	3.7 (12)	9,980 (22,000)
FC3312/CB2912	2.5 (8.3)	2.4 (8)	3.7 (12)	3.7 (12)	10,440 (23,000)
FA3314/SA3314	2.8 (9.2)	2.3 (7.5)	4.3 (14)	4.3 (14)	12,490 (27,320)
FD3612/CB2912	2.9 (9.4)	2.4 (7.7)	3.7 (12)	3.7 (12)	11,109 (24,493)
FC3614/CB2914	2.8 (9.2)	2.3 (7.4)	4.3 (14)	4.3 (14)	12,430 (27,410)
FA3914/CB2914	3.0 (9.9)	2.3 (7.6)	4.3 (14)	4.3 (14)	13,220 (29,140)
FC3914/CB2914	2.8 (9.2)	2.3 (7.6)	4.3 (14)	4.3 (14)	12,970 (28,590)
FA3914/CA3314	3.1 (10.0)	2.4 (7.9)	4.3 (14)	4.3 (14)	13,990 (30,850)
FC3914/CB3314	2.8 (9.2)	2.4 (7.9)	4.3 (14)	4.3 (14)	14,060 (30,990)
FA3914/SA3314	2.9 (9.4)	2.4 (7.9)	4.3 (14)	4.3 (14)	13,320 (29,360)
FC3916/CB3316	3.0 (10.0)	2.5 (8.2)	4.9 (16)	4.9 (16)	14,760 (32,540)
FA3916/SA3916	3.3 (10.7)	2.6 (8.5)	4.9 (16)	4.9 (16)	17,710 (39,040)
FD4414/CB3314	3.4 (11.1)	2.6 (8.6)	4.3 (14)	4.3 (14)	15,052 (33,184)
FC4416/CB3316	3.5 (11.5)	2.7 (8.7)	4.9 (16)	4.9 (16)	17,560 (38,710)
FC4416/CB3616	3.5 (11.5)	2.8 (9.2)	4.9 (16)	4.9 (16)	18,120 (39,930)
FC4416/CB3916	3.5 (11.5)	2.8 (9.3)	4.9 (16)	4.9 (16)	19,900 (43,860)
FB4816/CB3316	3.5 (11.4)	2.7 (9.0)	4.9 (16)	4.9 (16)	17,776 (39,189)
FC4816/CB3316	3.2 (10.6)	2.7 (8.9)	4.9 (16)	4.9 (16)	17,560 (38,710)
FB4816/CB3616	3.5 (11.4)	2.8 (9.1)	4.9 (16)	4.9 (16)	18,766 (41,372)
FB4816/CA3916	3.5 (11.4)	2.9 (9.3)	4.9 (16)	4.9 (16)	22,070 (48,660)
FB4816/CB3916	3.5 (11.4)	2.8 (9.2)	4.9 (16)	4.9 (16)	19,539 (43,076)
FB4816/SA3916	3.4 (11.2)	2.9 (9.3)	4.9 (16)	4.9 (16)	20,280 (44,710)
FC4816/CB4416	3.7 (12.0)	3.3 (10.2)	4.9 (16)	4.9 (16)	22,688 (50,018)
FC4818/CB4418	3.7 (12.0)	3.3 (10.7)	5.5 (18)	5.5 (18)	23,451 (51,700)
FB4818/SA4418	3.9 (12.5)	3.1 (10.0)	5.5 (18)	5.5 (18)	25,160 (55,460)
FC5616/CB4416	3.8 (12.5)	3.4 (11.1)	4.9 (16)	4.9 (16)	26,798 (59,079) with compressor BV100
	3.8 (12.6)	3.4 (11.2)	4.9 (16)	4.9 (16)	25,812 (56,905) with compressor BV120
FC5616/CB4816	3.9 (12.8)	3.5 (11.5)	4.9 (16)	4.9 (16)	27,538 (60,711)
FB5618/CA4418	3.9 (12.8)	3.4 (11.2)	5.5 (18)	5.5 (18)	28,660 (63,180)
FB5618/CB4418	3.9 (12.8)	3.4 (11.2)	5.5 (18)	5.5 (18)	29,849 (65,806)
FB5618/SA4418	4.0 (13.0)	3.4 (11.2)	5.5 (18)	5.5 (18)	27,520 (60,670)
FC5618/CB4418	3.9 (12.6)	3.4 (11.2)	5.5 (18)	5.5 (18)	28,140 (62,039)
FB5618/CB4818	3.9 (12.8)	3.5 (11.6)	5.5 (18)	5.5 (18)	30,207 (66,594)
FC5618/CB4818	4.0 (13.0)	3.5 (11.5)	5.5 (18)	5.5 (18)	31,773 (70,047)
FC6218/CB4418	4.0 (13)	3.7 (12)	5.5 (18)	5.5 (18)	33,011 (72,777)
FC6218/CB4818	4.0 (13)	3.7 (12)	5.5 (18)	5.5 (18)	34,800 (76,721)
F17218/C16218	4.2 (13.9)	4.6 (15)	5.5 (18)	5.5 (18)	70,310 (155,000)

Note:

- Contact your local sales representative for actual weights and dimensions and for specific configurations.
- Weights are based on common unit configurations. Some options could cause the shipping weight to increase.

- Length (C) does not include length of waterboxes.
- The shipping weight does not include refrigerant, which varies based on design condition.