ENGINEERING SUBMITTAL DATA

ED 19134

FEBRUARY 2024

NAVIGATOR® WWV/TWV

WATER-COOLED SCREW CHILLERS

Model WWV, TWV
150 to 300 Tons
R-134a & R-513A Refrigerant

Hazard Identification

⚠ DANGER
Danger indicates a hazardous situation, which will result in death or serious injury if not avoided.

⚠ WARNING
Warning indicates a potentially hazardous situations, which can result in property damage, personal injury, or death if not avoided.

⚠ CAUTION
Caution indicates a potentially hazardous situations, which can result in minor injury or equipment damage if not avoided.

NOTICE
Notice indicates practices not related to physical injury.

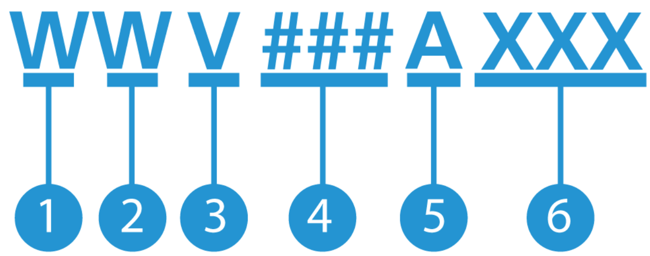
Introduction

General Description

Daikin Applied Navigator® model WWV chillers are complete, self-contained, automatically controlled, liquid-chilling units featuring variable speed screw compressors. All model WWV chillers are equipped with a single cooling circuit and single compressor. Navigator® chillers are designed for indoor installation only. The chillers use refrigerant R-134a or R-513A, with no ozone depletion level.

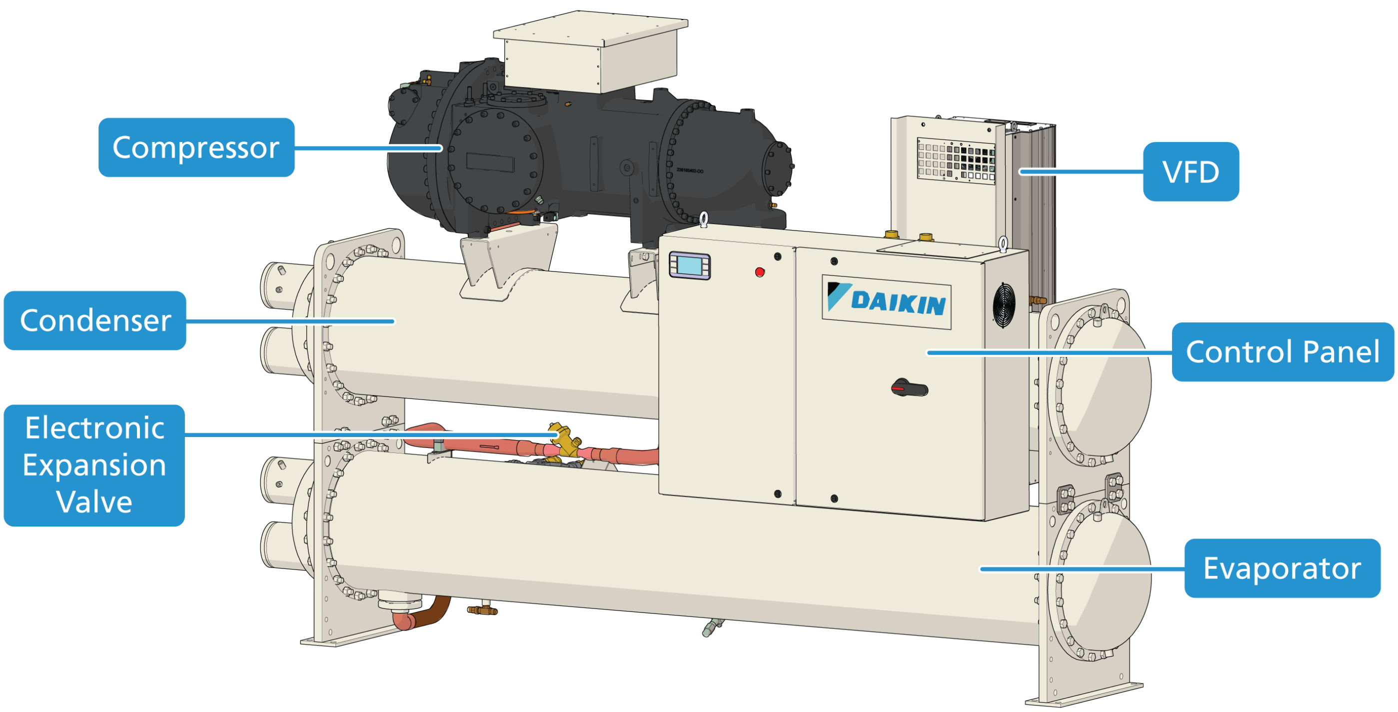
The WWV is made up of a high efficiency, new variable volume ratio (VVR®) series single screw compressor, flooded shell and tube evaporator, and a shell and tube condenser. The compressor is designed to operate in a very wide operating range and ensure the best possible efficiency in each working condition. In this regard, a sophisticated device dynamically manages the VVR®. This system ensures the optimum position of the discharge ports as a function of the operating compression ratio, choosing one among the four available positions.

Nomenclature



No.	Description
1	W = Water-cooled
2	W = World
3	V = Variable Speed Chiller
4	Compressor Size
5	Design Vintage
6	Circuit Configuration

Figure 1: Major Component Locations



Components and Technology

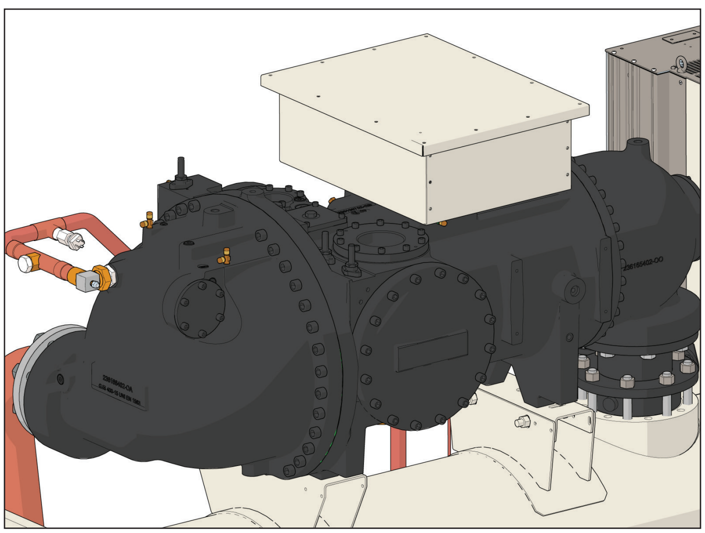
Sustainable Heat Pump Technology

In the evolving energy landscape shaped by electrification, heat pump technology takes center stage as a compelling solution for a cleaner and more sustainable future. The Navigator's optional TWV Templifier configuration, operates with 140˚F CLWT, harnessing the power of heat pump technology.

This sustainable and efficient solution for hot water heating aligns with global electrification trends, reducing reliance on fossil fuels. By utilizing electricity as the primary energy source, heat pump technology eliminates direct fossil fuel consumption, contributing to decarbonization efforts. Operating at lower temperatures than conventional systems, heat pumps conserve energy and lower operational costs. Additionally, heat pumps seamlessly integrate with renewable energy sources, such as solar and wind power, further enhancing their benefits for environmental sustainability.

VVR Compression

Figure 2: WWV Compressor



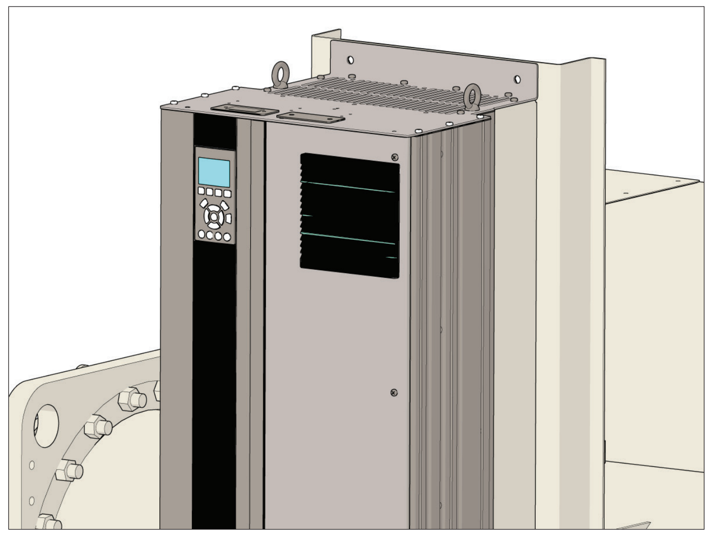
Leveraging the innovative technology found across Daikin Applied's chiller portfolio, Navigator's performance is optimized for every condition and at every hour of the day with Variable Volume Ratio (VVR®) technology and patented high-efficiency oil separation. VVR compression technology senses the precise amount of lift needed and adjusts the compression ratio on the fly to deliver optimal efficiency, regardless of ambient temperature or time of day. This gives you the power of efficiencies that in many cases meet or exceed ASHRAE 90.1 – 2016 levels.

While performance is matched in real-time as conditions vary, built-in and patented compressor mechanics reduce noise and vibration resulting in indoor-friendly sound levels at all load points.

Integrated Variable Frequency Drive

Navigator introduces a breakthrough in performance with a single VFD-driven compressor, ideal for applications unsuited to traditional centrifugals or magnetic bearing solutions. The innovative single rotor design ensures quiet operation across all load conditions, providing a versatile solution for diverse environments. The VFD dynamically adjusts compressor speed in direct response to varying loads and evaporator/condenser pressures.

Figure 3: WWV VFD



The VFD stands out for its ability to significantly reduce annual energy costs, particularly during prolonged part-load operations and low compressor lift scenarios. By maintaining a lower condenser water temperature, the VFD adapts seamlessly to diverse conditions, promoting sustainability and cost optimization. Moreover, the VFD elevates power factor, mitigating utility surcharges. This not only bolsters financial resilience but also fosters a more efficient utilization of electrical power, harmonizing with sustainability initiatives and minimizing environmental impact.

The VFD's intelligent modulation capabilities result in a reduced inrush current during motor starting. This not only enhances the lifespan of the motor but also contributes to a more stable and reliable operation, minimizing stress on the electrical system.

In mission-critical applications, the VFD plays a pivotal role in optimizing emergency power supply. By reducing the size requirements of backup generators, it ensures an efficient use of resources during unexpected outages, enhancing the resilience of essential cooling systems.

Electrical Data

Power wiring connections to the chiller may be done with either copper or aluminum wiring. Wire should be sized and installed per NEC and/or local codes. Wire sizing and wire count must fit in the power connection lug sizing listed in chiller submittals. All wiring within the unit is sized in accordance with the U.S.A National Electrical Code. Refer to the unit nameplate and the submittals for the correct electrical ratings.

⚠ DANGER

Qualified, licensed electricians must perform wiring. Electrical shock hazard exists that can cause severe injury or death.

The field power wiring required varies depending on unit model. See page 6 for wiring information. These wiring diagrams are also provided with the chiller.

NOTICE

Wiring, fuse, and wire size must be in accordance with the National Electric Code (NEC). The voltage to these units must be within ±10% of nameplate voltage (415V units must have voltage within -13% and +6% of nameplate voltage) and the voltage unbalance between phases must not exceed 2%. Since a 2% voltage unbalance will cause a current unbalance of 6 to 10 times the voltage unbalance per the NEMA MG-1 Standard, it is most important that the unbalance between phases be kept at a minimum.

⚠ CAUTION

Do not use power factor correction capacitors with WWV chillers. Doing so can cause harmful electrical resonance in the system. Correction capacitors are not necessary since VFDs inherently maintain high power factors.

Control panels are rated for the amount of current that can be passed through it and still contain the damage within the enclosure; this value is known as the short circuit panel rating as shown in Table 1 and is standard on all WWV models.

Table 1: Short Circuit Current Ratings (kAmps)

Voltage/Hz	High Short Circuit Panel Rating
460/60	65kA
380/60	
400/50	
575/60	25kA

Field-supplied disconnect switches are required if not factory-supplied with the unit. Disconnecting means are addressed by Article 440 of the U.S.A. National Electrical Code (NEC), which requires "disconnecting means capable of disconnecting air conditioning and refrigerating equipment including motor-compressors, and controllers from the circuit feeder." Select and locate the disconnect switch per the NEC guidelines.

Control Circuit

The unit control circuit is powered at 120 Vac. Terminals are provided in the unit control panel for optional field hookup of the control circuit to a separate fused 115-volt power supply in lieu of the standard factory installed control transformer.

Water flow switch interlock terminals are included in the controller. See Figure 4 for the correct connections in the field. The purpose of the water flow switch interlock is to prevent the compressor from running while the evaporator and condenser water pumps come online and provide the correct water flow.

It is best to leave pump control to the unit controller for better system management. If an external system independently manages pump starts, use the following guidelines:

- Turn on evaporator pump 2 minutes before enabling the machine
- Turn off evaporator pump 5 minutes after disabling the machine

Use with On-Site Generators

Switching from site grid power to generator power and vice versa requires that the chiller must either be powered down or the power must be off for more than 5 seconds to avoid sending out of phase voltage to the chiller. A properly installed, fully Synchronized Automatic Transfer Switch must be used to transfer power if the chiller is running under load.

Generator Sizing

⚠ WARNING

Generator must be sized by an electrical engineer familiar with generator applications.

Transfer Back to Grid Power

Proper transfer from stand-by generator power back to grid power is essential to avoid chiller damage and must be used to ensure proper function of the unit.

⚠ WARNING

Stop the chiller before transferring supply power from the generator back to the utility power grid. Transferring power while the chiller is running can cause severe chiller damage.

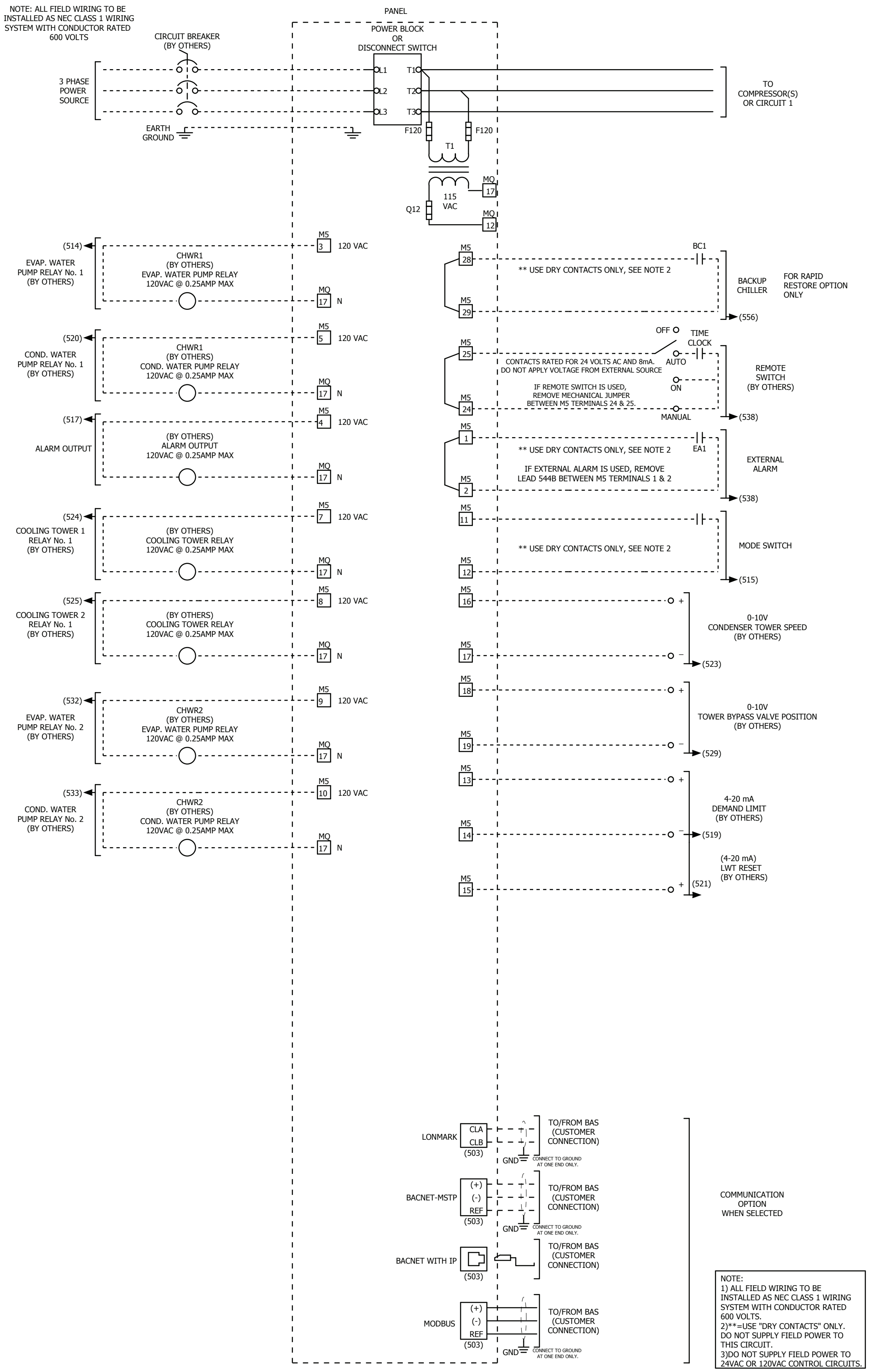
The necessary procedure for reconnecting power from the generator back to the utility grid is as follows:

1. Set the generator to always run five minutes longer than the unit start-to-start timer, which can be set from two to sixty minutes, while keeping the chiller powered by the generator until the fully Synchronized Automatic Transfer Switch properly hands over chiller power from the site.
2. Configure the transfer switch provided with the generator to automatically shut down the chiller before transfer is made. The automatic shut-off function can be accomplished through a BAS interface or with "remote on/off" wiring connection..

A start signal can be given anytime after the stop signal since the three-minute start-to-start timer will be in effect.

Wiring Schematics

Figure 4: Unit Schematic



Installation Considerations

Operating Limits

Table 2: WWV Operating/Standby Limits

Operating/Standby Limit	Temperature
Maximum mechanical room ambient temperature during chiller operation	113°F (45°C)
Maximum mechanical room ambient temperature during chiller storage - with maximum non-condensable relative humidity of 95%	122°F (50°C)
Evaporator outlet fluid temperature setpoint range - Cool Mode	25.0°F (-3.9°C) to 77°F (25°C)
Evaporator outlet fluid temperature requiring glycol	< 40°F (4.4°C)
Maximum fluid temperature in evaporator for startup	109.4° F (43°C)
Range of evaporator and condenser fluid temperature change across vessels	Condenser Single Pass and Evaporator 2 Pass: 7.2°F (-13.8°C) to 14.4°F (-9.8°C) Condenser 2 Pass: 10°F (-12.2°C) to 40°F (4.4°C)
NOTES:	
Contact a Daikin Applied representative for performance at specific operating conditions, as some limits depend on unit configuration (including heating and heat recovery mode limits)	
Antifreeze temperature limits must have appropriate glycol concentration	
Depends on specific selection/rating conditions	

Table 3: Templifier Operating Limits

Description	Limit
Maximum allowable condenser water pressure	225 psig (1552 kPa)
Maximum allowable evaporator water pressure	175 psig (1207 kPa)
Maximum allowable water temperature to evaporator in a non-operating cycle	105°F (40.5°C)
Maximum entering water temperature for operating cycle (for example, during system changeover from heating to cooling cycle)	90°F (32.2°C)
NOTE:	
Contact a Daikin Applied representative for performance at specific operating conditions, as some limits depend on unit configuration	

Source Water Piping

The system water piping must be flushed thoroughly prior to making connections to the unit evaporator. Lay out the water piping so the source water circulating pump discharges into the evaporator inlet.

⚠ CAUTION

Templifier Models must have clean source water from a closed and treated loop going to the brazed-plate evaporator. For open water loop applications, an intermediate heat exchanger between the source water and evaporator is required. Failure to provide a clean, closed water loop can cause equipment failure and possible revocation of the unit warranty.

Templifier evaporator water can come from various sources and care must be exercised to avoid sources that can cause corrosion, fouling, or accumulation of debris in the heat exchanger. Borderline cases will require a careful and rigorously performed maintenance schedule.

Heating and Cooling Units

Templifier units can be arranged and controlled to act as either a water chiller or a water heater. These systems vary considerably in the specifics of the piping arrangement. Care must be exercised when changeover occurs to avoid mixing water streams that could possibly contaminate a water system. For example, a unit can have chilled water in the evaporator and tower water in the condenser when in the cooling mode. Changeover to heating could put tower water through the evaporator and hot water (possibly potable water) through the condenser. This could introduce tower water into the chilled water system and into the hot water system and should be avoided.

Source/Hot Water Thermostat

The source water temperature sensor is factory installed in the leaving water connection on the evaporator. The controlling hot water sensor is in the leaving condenser connection. A sensor is also located in the entering water connection in order to measure the condenser Delta-T. Care should be taken not to damage the sensor cable or lead wires when working around the unit. It is also advisable to check the lead wire before running the unit to be sure that it is firmly anchored and not rubbing on the frame or any other component.

If the sensor is ever removed from the well for servicing, care must be taken as not to wipe off the heat conducting compound supplied in the well.

The units can be switched from heating to cooling. In the cooling mode they are controlled by a thermistor in the leaving evaporator connection, in the heating mode by the leaving condenser thermistor.

System Applications

Variable Fluid Flow Rates and Tube Velocities

Many chiller system control and energy optimization strategies require significant changes in evaporator water flow rates. The Navigator chiller line is well suited to take full advantage of these energy saving opportunities using different combinations of shell sizes, number of tubes, and pass arrangements.

Both excessively high and excessively low fluid flow rates should be avoided. Excessively high fluid flow rates and correspondingly high tube velocities will result in high fluid pressure drops, high pumping power, and potential tube erosion or corrosion damage. Excessively low fluid flow rates and correspondingly low velocities should also be avoided as they will result in poor heat transfer, high compressor power, sedimentation, and tube fouling.

Water Volume

All chilled water systems need adequate time to recognize a load change to avoid short cycling of the compressors or loss of control. The potential for short cycling usually exists when the building load falls below the minimum chiller plant capacity or on close-coupled systems with very small water volumes. Some of the things the designer should consider when looking at water volume are the minimum cooling load, the minimum chiller plant capacity during the low load period and the desired cycle time for the compressors.

Assuming that there are no sudden load changes and that the chiller plant has reasonable turndown, a rule of thumb of “gallons of water volume equal to two to three times the chilled water gpm flow rate” is often used. A properly designed storage tank should be added if the system components do not provide sufficient water volume.

Reducing Evaporator Fluid Flow

Several popular chiller plant control practices — including Variable Primary Flow systems — advocate reducing the evaporator fluid flow rate as the chiller capacity is reduced. This practice can significantly reduce the evaporator pumping power while having little effect on chiller energy consumption. Navigator chillers— with their wide range of shell, tube, and pass combinations— are ideal for application in variable evaporator flow systems as long as the minimum and maximum tube velocities are taken into consideration when selecting the chiller. If it is decided to vary the evaporator water flow rate, the rate of change should not exceed the minimum or maximum velocity limits. Additionally, the rate of change should not exceed 50% per minute.

Reducing Condenser Fluid Flow

Several popular chiller plant control practices also advocate reducing the condenser fluid flow rate as the chiller load is reduced. This practice can significantly reduce the condenser pumping power, but it may also have the unintended consequence of significantly increasing compressor power since the leaving condenser water temperature is directly related to compressor lift and power. The higher compressor power will typically be larger than the condenser pumping power reduction and will result in a net increase in chiller plant energy consumption. Therefore, before this strategy is applied for energy saving purposes it should be extensively modeled or used in an adaptive chiller plant control system which will take into account all of the interdependent variables affecting chiller plant energy. If it is decided to use variable condenser fluid flow, the model WWV chiller can operate effectively as long as the minimum and maximum tube velocities are taken into consideration when selecting the chiller.

Reducing Condenser Entering Water Temperature

As a general rule, a 1°F (0.5°C) drop in condenser entering water temperature will reduce chiller energy consumption by two percent. Cooler water lowers the condensing pressure and reduces compressor work. One or two degrees can make a noticeable difference. The incremental cost of a larger tower can be small and provide a good return on investment. When the ambient wet bulb temperature is lower than design, the entering condenser water temperature of Navigator WWV chillers can be lowered to improve chiller performance. Navigator WWV chillers can start and run with very low entering condenser water temperatures. The WWV chillers can also start and maintain operation with inverted conditions, meaning the entering condenser water temperature can be lower than the leaving chilled water temperature. Depending on local climatic conditions, using the lowest possible entering condenser water temperature may be more costly in total system power consumed than the expected savings in chiller power would suggest, due to the excessive fan power required. The trade-off between better chiller efficiency and fan power should be analyzed for best overall system efficiency. The Energy Analyzer™ II program (available from your Daikin Applied sales representative) can optimize the chiller/tower operation for specific buildings in specific locales.

Condenser Water Temperature Difference

The industry standard of 3 gpm/ton or about a 9.5°F (5.3°C) delta-T works well for most applications.

Condenser Water Temperature Control

Condenser water control is an important consideration in chiller plant design since condenser water temperature will directly impact chiller operation and efficiency. When the ambient wet bulb temperature is lower than peak design, the entering condenser water temperature from the cooling tower can be allowed to fall, improving chiller performance. However, operational issues may occur when the condenser water temperatures are either too high or too low. The WWV chiller provides several options to assist the chiller plant designer in providing the optimum control of condenser water temperature

Cooling Tower Control

Control of the cooling tower is required to maintain stability and avoid operational issues. This can be achieved through a BAS or by using the MicroTech controller. For systems utilizing a common condenser water loop for multiple purposes, the BAS contractor must provide the control but use of the MicroTech output signal is still recommended. The preferred cooling tower control utilizes a variable speed fan. MicroTech will provide a control signal to determine the proper fan speed. It can also control up to three stages of fan cycling. Note that fan cycling can cause cooling tower water temperature to fluctuate as fans stage on/off, potentially adding instability to the system. Special consideration must be given to starting the chiller when cold condenser water is present, such as with inverted starts or changeover from free (tower) cooling to mechanical cooling. It is required that some method be used to control the condenser water to maintain proper head pressure as indicated by the MicroTech controller. Acceptable methods are outlined below and each of these options can be controlled by the MicroTech or through a BAS utilizing the MicroTech output signals.

1. Three-Way Bypass Valve Operation A traditional method for building condenser pressure at startup with colder condenser water is with the use of a three-way bypass valve. The device blends warmer water leaving the condenser with cooler water from the cooling tower at the condenser inlet. The bypass valve position will change until full flow from the tower to the condenser is obtained. The MicroTech provides only the valve position control signal. Main power to drive the valve's actuator must be provided by the installer. The three-way valve should be located close to the chiller within the equipment room to minimize the volume of water.
2. Two-Way Valve Operation Another condenser control method is to use a modulating two-way control valve located on the outlet connection of the condenser. The valve will be nearly closed at startup to restrict water flow, which keeps generated heat in the condenser until an acceptable minimum condenser pressure is reached. As heat builds, the valve will open slowly until a full flow condition from the cooling tower is established. A separate power source is required to provide power to the valve actuator.
3. VFD Operating with a Condenser Water Pump A third method of condenser control for startup is utilizing a variable frequency drive with the condenser water pump. The speed will change as directed by the MicroTech output signal until design flow is reached. Speed adjustments may be required during the initial chiller startup as determined by the service technician.

NOTICE
Not using the MicroTech logic to control valves and variable frequency drives may result in system instability, capacity reduction, and issues starting the chiller with cold condenser water temperature.

Condenser Pump Sequencing

It is recommended to utilize the logic built into the MicroTech controller to start the condenser pump. MicroTech has the capability to operate a primary pump and a secondary standby pump. The condenser water flow should be stopped when the chiller shuts off. This will conserve energy and prevent refrigerant from migrating to the condenser.

Water Side Economizer Cycle Operation

Water side economizers are commonly used for ASHRAE 90.1 compliance and energy savings. This system utilizes a heat exchanger external to the chiller when cold cooling tower water is available to provide cooling. The most common system has a heat exchanger used in conjunction with the chiller's evaporator. The BAS contractor will need to provide controls for the heat exchanger including isolation valves and temperature control. The BAS contractor will also need to control the isolation valves for the chiller. It is important to use slow-acting type valves to prevent rapid changes in system flows. Changeover from economizer cooling to mechanical cooling requires one of the methods previously mentioned to maintain suitable condenser head pressure. Contact your local Daikin Applied representative for more information on this application.

Engineering Specifications

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes design, performance criteria, refrigerants, controls, and installation requirements for water-cooled rotary screw packaged chillers.

1.02 REFERENCES

A. Comply with applicable Standards/Codes of AHRI 550/590, ANSI/ASHRAE 15, ASHRAE 90.1 current version requirements, and ASME Section VIII. ETL listed.

1.03 SUBMITTALS

A. Submit shop drawings and product data in accordance with specification requirements.

B. Submittals shall include the following:

1. Dimensioned plan and elevation view drawings, required clearances, and location of all field connections.
2. Single line schematic drawing of the field power hookup requirements, indicating all items that are furnished.
3. If field refrigerant piping is required, furnish a single line piping drawing.
4. Schematic diagram of the control system indicating points for field connection(s) that fully delineates field and factory wiring.
5. Installation manuals.

1.04 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with the codes and standards specified.

B. Factory Tested: Packaged chiller shall be pressure-tested, evacuated, and fully charged with refrigerant and oil, and be functionally run-tested at the factory.

C. Chiller must be manufactured in an ISO certified facility.

D. Factory trained and authorized service personnel shall perform pre-startup checks and startup procedures.

1.05 DELIVERY AND HANDLING

A. Packaged chillers shall be delivered to the job site completely assembled and charged with refrigerant and oil by the manufacturer.

[OPTIONAL] Knockdown Construction: Compressor(s), power boxes, and control box shall be removed at the factory and shipped on separate skids; combined vessel stack shall be shipped together as a sub-assembly. Units shall ship with an inert gas holding charge in the compressor and vessels.

B. Comply with the manufacturer's instructions for rigging and handling.

C. If unit is to be stored, comply with Manufacturer's instructions for storage.

1.06 WARRANTY

A. The chiller manufacturer warranty shall cover parts and labor costs for the repair or replacement of defects in material or workmanship,

[OPTIONAL] including refrigerant for the entire unit, for a period of one year from equipment startup or 18 months from shipment, whichever occurs first,

[OPTIONAL] and also include an additional extended warranty for (one OR two OR three OR four) years on (the entire unit) OR (on entire unit including refrigerant coverage) OR (compressor and drive train only).

Warranty support shall be provided by company direct or factory authorized service permanently located near the job site.

1.07 SUSTAINED OPERATIONAL PERFORMANCE AND RELIABILITY

A. Maintenance of the chiller in accordance with manufacturer's recommendations as published in the installation and maintenance manual shall be the responsibility of the owner.

PART 2: PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Basis of Design - Daikin Model WWV, including the standard product features and all special features required per the plans and specifications.

B. Equal Products - Equipment manufactured by [ENTER MANUFACTURER NAME HERE] may be acceptable as an equal. Equipment proposed "as equal" must meet the specifications including all architectural, mechanical, electrical, and structural details, all scheduled performance, and the job design, plans and specifications.

2.02 UNIT DESCRIPTION

A. Provide and install as shown on the plans, factory assembled, factory charged with R-134a, and factory run-tested, water-cooled, rotary screw compressor packaged chillers in the quantity and capacity specified. Each chiller shall consist of a single screw compressor, evaporator, condenser, control system and all components necessary for protected and controlled unit operation.

2.03 DESIGN REQUIREMENTS

A. General: Provide a complete rotary screw packaged chiller as specified and as shown on the drawings. The unit shall be in accordance with the standards referenced in section 1.02.

B. Performance: Refer to the schedule of performance on the drawings. The chiller system shall be capable of stable minimum part load operation without hot gas bypass.

C. Acoustics: Manufacturer must provide both sound power and sound pressure data in decibels. Sound pressure data per AHRI 575 must be provided in 8 octave band format at full load. In addition, A-weighted sound pressure at 3 feet should be provided at 100% load points to identify the full operational noise envelope. Sound power must be provided in 1/8 octave band format to highlight any tonal quality issues.

If manufacturer cannot meet the noise levels (per the attached chart), sound attenuation devices and/or barrier walls must be installed to meet this performance level.

[OPTIONAL] Each compressor shall have a factory installed, rigid, sound enclosure with removable panels for compressor access.

Sound Pressure at 3 feet (Hz)								
63	125	250	500	1K	2K	4K	8K	Overall dBA

Sound Power (Hz)								
63	125	250	500	1K	2K	4K	8K	Overall dBA

2.04 CHILLER COMPONENTS

A. Compressors:

1. The compressors shall be field serviceable, semi-hermetic, single-rotor screw type with one central helical rotor meshing with two opposing gaterotors. The gaterotor contact element shall be constructed of engineered composite material, dimensionally stable up to 1500°F and wear resistant for extended life. If a twin-screw design is used, the manufacturer shall provide an extended 5-year parts and labor warranty covering all additional moving parts.
2. Compressor Motors: Motors shall be high torque, two pole, semi-hermetic, squirrel cage induction type with inherent thermal protection on all three phases and cooled by suction gas.
3. Compressor Motor Control: Each compressor shall be equipped with a VFD providing compressor speed control as a function of the cooling load. Each VFD shall provide controlled motor acceleration and deceleration, and shall provide protection for the following conditions: electronic thermal overload, over/under current, stalled motor, input and output phase loss, high load current, and current unbalance. The VFD shall provide a minimum 95% displacement compressor power factor at all load points. Compressors used in VFD controlled units must have electrically insulated, ceramic bearings to mitigate bearing and/or lubricant damage from stray electric current passage. Compressor shall be able to control compression ratio to optimize efficiency at all operating conditions. Units without this protection must have an extended 5-year compressor warranty.

a. The unit controller shall display the following data:

- Output Frequency
- Output Current
- Output Voltage
- Output Power
- Fault Code

b. The unit controller shall display the following alarms and faults:

- Over Current-Hold
- Over Current-Unload
- Over Current-Alarm
- Overheat-Hold
- Overheat-Unload
- Overheat-Alarm
- Communication Fault
- System power not three phase
- Phase sequence incorrect
- Line frequency less than 25 Hz
- Line frequency more than 72 Hz
- Excessive current unbalance
- Operating parameters lost
- No current after “Run” command
- Undercurrent trip occurred
- Overcurrent trip occurred
- Control power too low
- Motor stalled during acceleration
- External fault

c. The unit controller shall display the following operating messages:

- Line voltage not present
- Voltage present, starter ready
- Motor accelerating
- Motor at full speed
- Motor at full speed, ramp time expired
- Stop command received, motor decelerating
- Thermal overload has reached 90% to 99%
- Thermal overload at 100%, motor stopped
- Thermal overload reduced to 60%, motor can restart
- Passcode enabled
- Passcode disabled
- Thermal overload content in percentage

B. Evaporator:

1. The evaporator shall be designed, inspected, and stamped in accordance with ASME Section VIII requirements. It shall be mounted and piped in the unit. The water side shall be designed for a

minimum of 232 psig.

[OPTIONAL] The evaporator vessel, including suction line and any other component or part of a component subject to condensing moisture shall be insulated with ¾" (19 mm) –OR– 1.5" (38 mm) thick CFC and HCFC-free closed-cell flexible elastomeric foam insulation material with 100% adhesive coverage. The insulation shall have an additional outer protective layer of 3mm thick PE embossed film to provide superior damage resistance. Insulation without the protective outer film shall not be acceptable. UV resistance level shall meet or exceed a rating of 'Good' in accordance with the UNI ISO 4892 - 2/94 testing method. All joints and seams shall be carefully sealed to form a vapor barrier.

[OPTIONAL] Water heads shall have ¾" (19 mm) –OR– 1.5" (38 mm) thick CFC and HCFC-free closed-cell flexible elastomeric foam insulation material with 100% adhesive coverage.

2. The evaporator shall have [dished heads with valved drain and vent connections] –OR– [shall be equipped with marine waterboxes with removable covers and vent and drain connections].
3. The evaporator shall have standard left-hand [grooved couplings] –OR– [flanged connections] when looking at the control panel end.
4. The evaporator shall be equipped with a factory-supplied and wired flow switch.

C. Condenser:

1. The condenser shall be of the shell-and-tube type, designed, constructed, tested and stamped according to the requirements of the ASME Code, Section VIII. The tubes shall be individually replaceable and secured to the intermediate supports without rolling. The water side shall be designed for a minimum of 250 psig.
2. The condenser shall have [0.025-inch] tubes. Water connections shall be [grooved suitable for grooved couplings] —OR– [flanged]. The condenser shall have [dished heads with valved drain and vent connections] –OR– [shall be equipped with marine waterboxes with removable covers and vent and drain connections].

   [OPTIONAL] The condenser vessel, including discharge line and liquid line shall be insulated with ¾" (19 mm) thick CFC and HCFC-free closed-cell flexible elastomeric foam insulation material with 100% adhesive coverage. The insulation shall have an additional outer protective layer of 3mm thick PE embossed film to provide superior damage resistance. Insulation without the protective outer film shall not be acceptable. UV resistance level shall meet or exceed a rating of 'Good' in accordance with the UNI ISO 4892 - 2/94 testing method. All joints and seams shall be carefully sealed to form a vapor barrier.

   [OPTIONAL] Water heads shall have ¾" (19 mm) thick CFC and HCFC-free closed-cell flexible elastomeric foam insulation material with 100% adhesive coverage.
3. Re-seating type spring loaded pressure relief valves according to ASHRAE 15 safety code shall be furnished. The condenser shall be provided with dual relief valves equipped with a transfer valve so one relief valve can be removed for testing or replacement without loss of refrigerant or removal of refrigerant from the condenser. Rupture disks are not acceptable.
4. Provide factory-supplied and wired thermal dispersion water flow switches on each vessel to prevent unit operation with no or low water flow.
5. [OPTIONAL]: Provide suction and discharge isolation valves to hold the unit refrigerant charge in the condenser during servicing or provide a separate pumpout system and storage tank sufficient to hold the charge of the largest unit being furnished.

D. Refrigerant Circuit: The unit must have a single refrigerant circuit with one compressor. The refrigerant circuit shall include an electronic expansion valve, liquid line shut-off valve, replaceable core filter-drier, and sight glass with moisture indicator.

E. Electrical Panel:

1. A centrally located, UL-approved electrical control panel shall contain the unit control system, control interlock terminals and field-power connection points. Box shall be designed in accordance with NEMA 1 rating. Hinged control panel access doors shall be tool-lockable. Door mounted controller shall be provided to allow control of chiller without opening panel door.
2. Power Section: Power supply shall be to a high short circuit current rated panel with a factory-mounted single-point high interrupting capacity unit disconnect switch breaker.
3. Control Section: The control logic shall be designed to maximize operating efficiency and equipment life with protections for operation under unusual conditions and to provide a history of operating conditions. The system shall intelligently stage the unit to sustain leaving water temperature precision and stability while minimizing compressor cycling.

   Equipment protection functions controlled by the microprocessor shall include high discharge pressure, loss of refrigerant, loss of water flow, freeze protection, and low refrigerant pressure.

   User controls shall include auto/stop switch, chilled water set-point adjustment, anti-recycle timer, and digital display with water temperature setpoint, operating temperatures and pressures, and diagnostic messages.

   The following features and functions shall be included:

   a. Durable liquid crystal display (LCD) screen type, having minimum four 20-character lines with 6 key input pad conveniently mounted on the unit controller. Default language and units of measure shall be English and IP respectively. Messages shall be in plain English. Coded messages, LED indicators and LED displays are not acceptable.

b. Separate control section and password protection for critical parameters.

c. Remote reset of chilled water temperature using a 4-20mA signal.

d. Soft-load operation, protecting the compressor by preventing full-load operation during the initial chilled fluid pull-down period.

e. Non-volatile program memory allowing auto-restart after a power failure.

f. Recording of safety shutdowns, including date-and-time stamp, system temperatures and pressures. A minimum of six previous occurrences shall be maintained in a revolving memory.

F. Start-to-start and stop-to-start cycle, giving minimum compressor off time and maximizing motor protection.

a. Discharge pressure control.

b. Pro-active compressor unloading when selected operating parameters exceed design settings, such as high discharge pressure or low evaporator pressure.

c. Diagnostic monitoring of unit operation, providing a pre-alarm signal in advance of a potential shutdown, allowing time for corrective action.

[OPTIONAL]: The factory-mounted DDC controller shall support BAS operation via Open Choices™ standard protocols using either BACnet MS/TP, BACnet IP or BACnet, or LonMark. The information communicated between the BAS and the factory mounted unit controllers shall include the reading and writing of data to allow unit monitoring, control and alarm notification as specified in the unit sequence of operation and the unit points list.

[OPTIONAL]: The unit shall be equipped with a RapidRestore® feature to restart a unit within 35 seconds of power interruption and a Fast Loading feature to minimize the time to restore full load operation.

[OPTIONAL] The unit shall be equipped with an emergency stop button on the control panel door.

[OPTIONAL]: The unit shall be equipped with ground fault protection.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install in strict accordance with manufacturer's requirements, shop drawings, and contract documents.

B. Measures must be taken to avoid accumulation of debris in the evaporator and condenser during initial system flushing. A cleanable strainer must be placed in the supply water line prior to the inlet of the evaporator and condenser

Care shall be exercised when welding pipe or flanges to the evaporator or condenser to prevent any slag from entering the vessel. Any welds after the strainer must be mechanically cleaned to avoid slag entering the vessel.

C. Adjust and level chiller in alignment on supports.

D. Coordinate electrical installation with electrical contractor.

E. Coordinate controls with control contractor.

F. Provide all required accessories or accompanying parts to insure a fully operational and functional chiller.

3.02 STARTUP

A. Provide Factory Authorized starting of chillers, and instruction to the owner on operation and maintenance.

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