DAIKIN APPLIED (UK) LTD
Technically better...

DWDC / DWSC

Water cooled centrifugal chillers

Product manual

Single and Dual compressor
Nominal capacity range: 700 - 9000 kW
Designed for a wide range of applications
Optional VFD for optimized part load performance

CODE	
Date	11 September 2016
Supersedes	Rev.00

Refrigerant: R134a or R513A

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DWDC / DWSC

Features and benefits

World-Class Design Leader

Daikin is the world's largest air conditioning, heating, ventilating and refrigeration company. We have earned a worldwide reputation for providing a full line of quality products and expertise to meet the demands of our customers. The engineered flexibility of our products allows you to fine tune your HVAC system to meet the specific requirements of your application. You benefit from lower installed and operating costs, high energy efficiency, quiet operation, superior indoor air quality (IAQ) and low cost maintenance and service.

Design Features

Excellent Performance

Daikin offers a wide range of centrifugal vessel and component combinations to provide the right solution for your specific application. The single compressor WSC offers excellent full load performance. Dual compressor DWDC chillers offer many benefits, including outstanding part-load efficiency and system redundancy similar to two separate chillers, with a lower total installed cost.

Fig. 1 - Centrifugal Models & Possible Applications

Application	Daikin Model
Cooling <4400kW (1250 tons), most hours at full load	DWSC
Cooling, most hours at part load	DWDC
Optimized Part Load Performance	Optional VFD

Positive Pressure Design

Positive pressure systems offer numerous advantages over negative pressure design. In a negative pressure system, leaks allow air, moisture, and other contaminants to seep into the system, which will gradually decrease performance, as well as cause corrosion which must be removed. The Daikin positive pressure design eliminates this worry, providing sustainable performance and trouble-free ownership for the life of the unit under normal operation.

Gear Driven Advantage

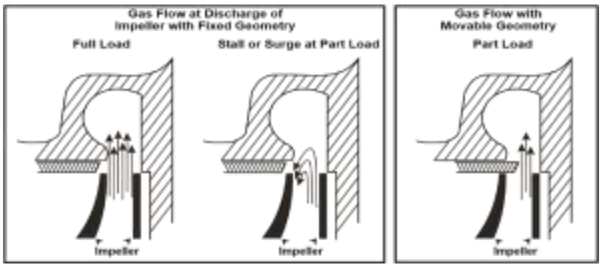
Daikin's precision-engineered gear driven design allows for lighter components, less vibration, and ability to select gear ratios that will provide the optimum impeller speed for your application. Older direct-drive designs must use large, heavy impellers to reach similar tip speeds, which cause more vibration and greater stress on shaft and motor during unexpected electrical interruptions.

The compact design and lighter weight components allow for efficient hydrodynamic bearings to be used. This means that during operation, the shaft is supported on a film of lubricant, with no shaft-to-bearing contact, providing theoretical infinite life bearings under normal circumstances. The design simplicity of the Daikin centrifugal compressors provides increased durability and reliable performance.

Unmatched Unloading

Daikin pioneered the use of moveable discharge geometry to lower the surge point of centrifugal compressors. The point at which the compressor enters a stall or surge condition generally limits compressor unloading. Chillers with a fixed discharge will experience stall or surge at low loads due to refrigerant re-entering the impeller. When in a stall condition, the refrigerant gas is unable to enter the volute due to its low velocity and remains stalled in the impeller. In a surge condition the gas rapidly reverses direction in the impeller causing excessive vibration and heat. Daikin compressors reduce the discharge area as load decreases to maintain gas velocity and greatly reduce the tendency to stall or surge.

Fig.2 - Fixed vs. Moveable Discharge Geometry



In Fig. 2, the drawing on the left shows a cross-section view of the operation at full load of a unit with a fixed compressor discharge. At full load, a large quantity of gas is discharged with a fairly uniform discharge velocity as indicated by the arrows.

The center drawing shows a fixed compressor discharge at reduced capacity. Note that the velocity is not uniform and the refrigerant tends to reenter the impeller. This is caused by low velocity in the discharge area and the high pressure in the condenser, resulting in unstable surge operation and with noise and vibration generated.

Fig. 3 shows the unique Daikin movable discharge geometry. As the capacity reduces, the movable unloader piston travels inward, reducing the discharge cross section area and maintaining the refrigerant velocity. This mechanism allows our excellent unloading capacity reduction.

Fig. 3 - Moveable diffuser closes impeller discharge area as load decreases

Trouble-Free Startup

All Daikin chillers are factory tested on AHRI qualified computer-controlled test stands. Operating controls are checked and adjusted, and the refrigerant charge is adjusted for optimum operation and recorded on the unit nameplate. The testing helps ensure correct operation prior to shipment, and allows factory calibration of chiller operating controls.

All Daikin centrifugal chillers are commissioned by authorized and experienced Daikin startup technicians. This procedure helps ensure that proper starting and checkout procedures are employed and helps in a speedy commissioning process, giving you confidence that your chiller is operating as expected.

Lubrication System

A separately driven electric oil pump assembly supplies lubrication at controlled temperature and pressure to all bearing surfaces and is the source of hydraulic pressure for the capacity control system.

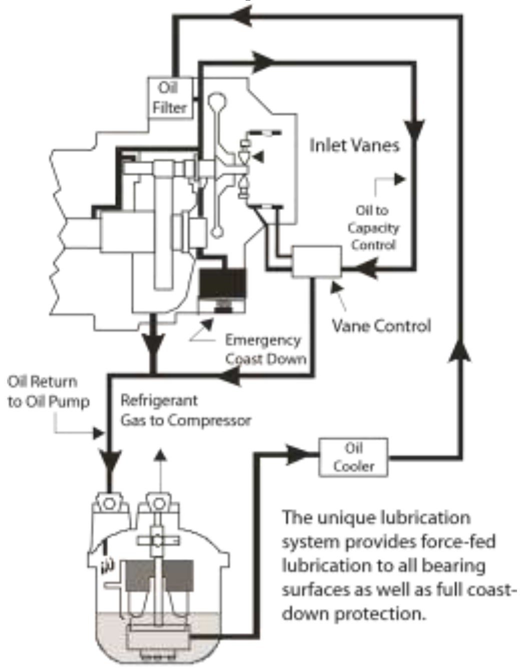
The control system will not allow the compressor to start until oil pressure, at the proper temperature, is established. It also allows the oil pump to operate after compressor shutdown to provide lubrication during coast-down.Lubricant from the pump is supplied to the compressor through a water-cooled, brazedplate heat exchanger and single or dual five-micron oil filters internal to the compressor. All bearing surfaces are pressure lubricated. Drive gears operate in a controlled lubricant mist atmosphere that efficiently cools and lubricates them.

Lubricant is made available under pressure from the compressor oil filter to the unit capacity control system and is used to position the inlet guide vanes in response to changes in leaving chiller water temperature.

If a power failure occurs, an emergency oil reservoir provides adequate lubrication flow under pressure, and prevents damage that could occur during the coast-down period with the oil pump stopped.

Since Daikin chillers are positive pressure, there is no need to change the lubricant or filter on a regular basis. As with any equipment of this type, an annual oil check is recommended to evaluate the lubricant condition.

Fig. 4 - Lubrication System Schematic



Enhanced Surge Protection

When centrifugal compressors operate at part load, the volume of refrigerant gas entering the impeller is reduced. At the reduced flow, the impeller’s capacity to develop the peak load head is also reduced. At conditions of low refrigerant flow and high compressor head (pressure difference), stall and/or surge can occur (a stall is gas static in the impeller, a surge condition is gas rapidly reversing direction through the impeller). A number of things can contribute to this condition including inadequate maintenance of condenser tube cleanliness, a cooling tower or control malfunction, or unusual ambient temperatures among others.

For these abnormal conditions, Daikin compressor designers have developed a protective control system that senses the potential for a surge, looks at the entire chiller system operation and takes corrective action if possible; or stops the compressor, to help prevent any damage from occurring. This protection is provided as standard on all Daikin centrifugal compressors.

Benefits of Dual Compressor Chillers

Daikin is the expert when it comes to dual centrifugal compressor technology, successfully building dual compressor centrifugal chillers since 1971.

Single Circuit WDC Chillers

These chillers have a single-refrigerant circuit for the evaporator and condenser with two compressors running in parallel and are available in one, two or three-pass configurations. Their salient feature is that at single compressor, part load operation, the running compressor can utilize the entire chiller's heat transfer surface, providing outstanding part load performance.

Superior Efficiency

In most applications, chillers spend about 99% of their operating hours at part-load conditions. When coupled with a variable frequency drive, the extremely efficient Dual Compressor Chillers are considerably more efficient than single compressor chillers in the same size range, with IPLVs (Integrated Part Load Value) up to 11,7 (as low as 0.3 kW per ton). IPLV conditions are set by AHRI and subject to stringent testing.

The Redundancy Feature

Daikin dual centrifugal chillers have two of everything connected to the evaporator and condenser - two compressors, two lubrication systems, two control systems, and two starters.

If any component on a compressor system fails, the component can be removed or repaired without shutting down the other compressor; providing an automatic back-up with at least 60 percent of the chiller design capacity available on DWDC units.

Redundancy is also built into the distributed control system, which consists of a unit controller, a compressor controller for each compressor and an operator interface touch screen. The chiller will operate normally without the touch screen being functional. If a compressor controller is unavailable, the other compressor will operate normally and handle as much of the load as possible.

Lower Installed Costs

The redundancy feature pays off in lower installed costs.

The elimination of the extra pumps, valves, piping, controls, rigging, and floor space can result in as much as a 35% reduction in the installation cost for a chiller plant, plus the savings on the chillers themselves.

Application of DWDC Water-Cooled Chillers

Use DWDC chillers when:

- Project requirement is overall lowest energy consumption with best part load performance.
- Project has smaller chilled water plant where unit unloading is expected versus cycling of chillers associated with large multi-chiller plants.
- Floor space is limited (16-foot vessel length compared).
- Two or three pass vessels are required, typical of retrofit applications.
- Built-in redundancy is required. A single compressor will provide 60% of the unit's full load capacity.

Compressor Motor Failure Will Not Contaminate the Common Refrigerant Circuit

A motor burnout on a single-circuit dual compressor chiller is not a problem on the Daikin DWDC chillers, because of compressor construction and chiller layout.

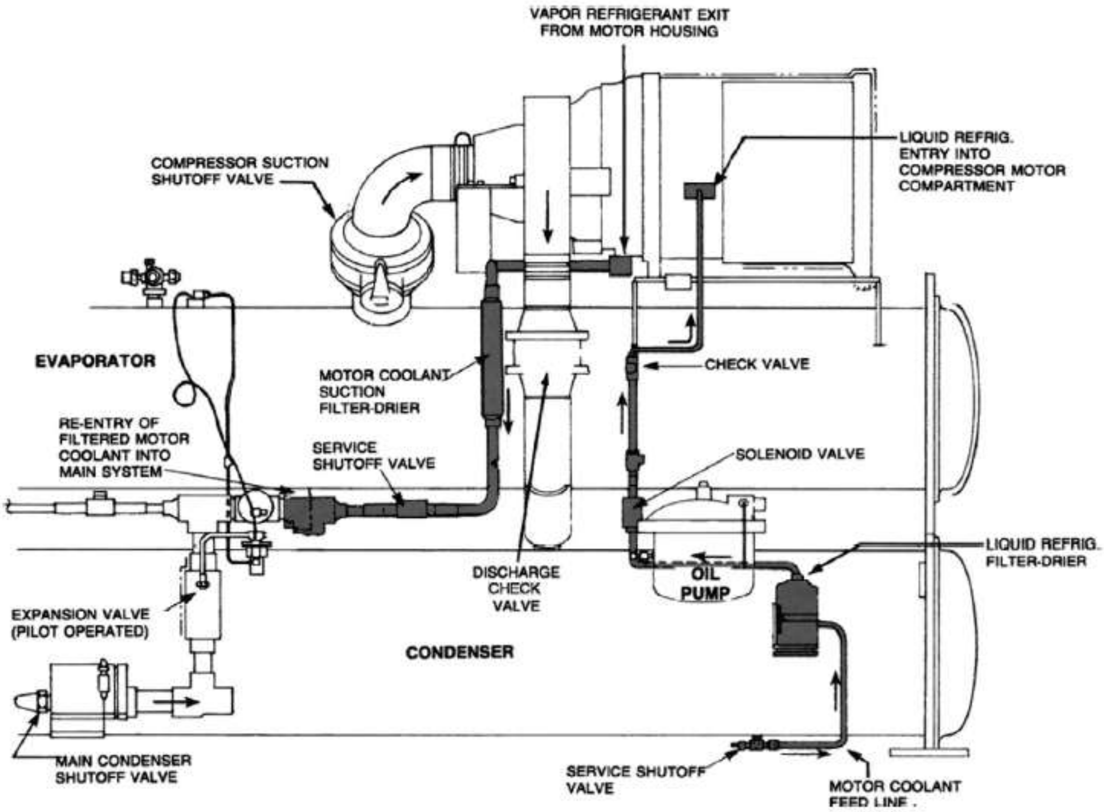
The compressor motor is isolated from the main refrigerant flow circuit so that any contaminants generated by a motor failure will not pass into the main refrigerant circuit. Moisture, acid and/or carbon particles will be automatically trapped within the compressor's dedicated coolant feed and exit lines.

Internally, the compressor motor compartment is separated and sealed from the main refrigerant compression chamber. A double shaft seal on the motor side of the gear housing prevents cross flow of refrigerant along the motor shaft. The motor coolant feed line is equipped with both a solenoid valve and a check valve. These mechanical components, plus the higher pressure of the liquid refrigerant, prevent back feed into the main refrigerant system. Refrigerant vapor exiting the motor compartment must pass through

a high pressure drop filter-drier, sized to immediately plug up and seal off the motor compartment. Both the coolant feed and return lines are equipped with manual shutoff valves to permit component service.

Over 30 years of field experience have proven the reliability of these compressor motors. Despite the reliability inherent in the motor design and the protective control, electrical distribution system faults and lightning strikes can occur that are beyond the control of the most conscientious designer. The coolant protective system protects the unit charge from being contaminated.

Fig. 5 – Motor cooling



Efficiency

Chillers usually spend 99% of their operating hours under part load conditions, and most of this time at less than 60% of design capacity. One compressor of a dual WDC chiller operates with the full heat transfer surface of the entire unit. For example, one 500-ton (1,750 kW) compressor on a 1,000 ton (3,500 kW) dual chiller utilizes 1,000 tons (3500 kW) of evaporator and condenser surface. This increases the compressor's capacity and also results in very high efficiency.

Typical efficiencies for a WDC dual chiller, taken from a selection computer run, look like this:

Full load efficiency: 0.550 kW per ton (6.5 COP)

60% load, one compressor: 0.364 kW per ton (9.6 COP)

IPLV: 0.415 kW per ton (8.5)

The addition of VFDs to the WDC dual compressor chiller produces an astonishing AHRI certified IPLV of 0.340 (10.3) for the above case. Specific selections can vary up or down from this example.

Controls

Daikin Centrifugal chillers are equipped with the proven reliability of the MicroTech® II controls system with touchscreen interface. The control system is designed for easy and intuitive operation, and configured for efficient and reliable operation. Plus, Daikin's Open Choices™ feature allows integration with your building automation system (BAS) through an optional communication module.

Designed with the System Operator in Mind

Reliable, economic use of any chiller depends on an easy operator interface. That's why operation simplicity was one of the primary considerations in the development of the MicroTech® II controller and Operator Interface Touch-Screen (OITS). The 15-inch color touch-screen is mounted on a fully adjustable arm. The chiller is graphically displayed, with key operating parameters viewable on the screen. Alarm history and operation setpoints are easily accessed through intuitive touch-screen buttons. The chiller operating manual is also viewable on the touch screen and can be downloaded via USB.

MicroTech® II Controls Enhance Operating Economy

Many features have been integrated into MicroTech II controls to ensure optimum operating economy. In addition to replacing normal relay logic circuits, we've enhanced the controller's energy saving capabilities with the following features:

• Direct control of water pumps - Optically isolated, digital output relays provide automatic lead-lag of the evaporator and condenser pumps, permitting pump operation only when required.

• User-programmable compressor soft loading - Prevents excessive power draw during pull down from high chilled water temperature conditions.

• Chilled-water reset - Reset the leaving water temperature based on the return water temperature. Raising the chilled water setpoint during periods of light loads dramatically reduces power consumption.

• Demand limit control - Maximum motor current draw can be set on the panel, or can be adjusted from a remote 4-20ma or 1-5 VDC BAS signal. This feature controls maximum demand charges during high usage periods.

• Condenser water temperature control - Capable of four stages of tower fan control, plus an optional analog control of either a three-way tower-bypass valve or variable speed tower-fan motor. Stages are controlled from condenser-water temperature. The three-way valve can be controlled to a different water temperature or track the current tower stage. This allows optimum chilled water plant performance based on specific job requirements.

• Staging Options (Multiple Chiller Installations) - The MicroTech® II controller is capable of compressor staging decisions and balancing compressor loads between up to four DWSC, DWDC chillers using defaults or operator-defined staging.

• Plotting Historic Trends - Past operation of the chiller can be plotted as trend lines and even downloaded to a spreadsheet for evaluation and analysis.

Proactive Controls

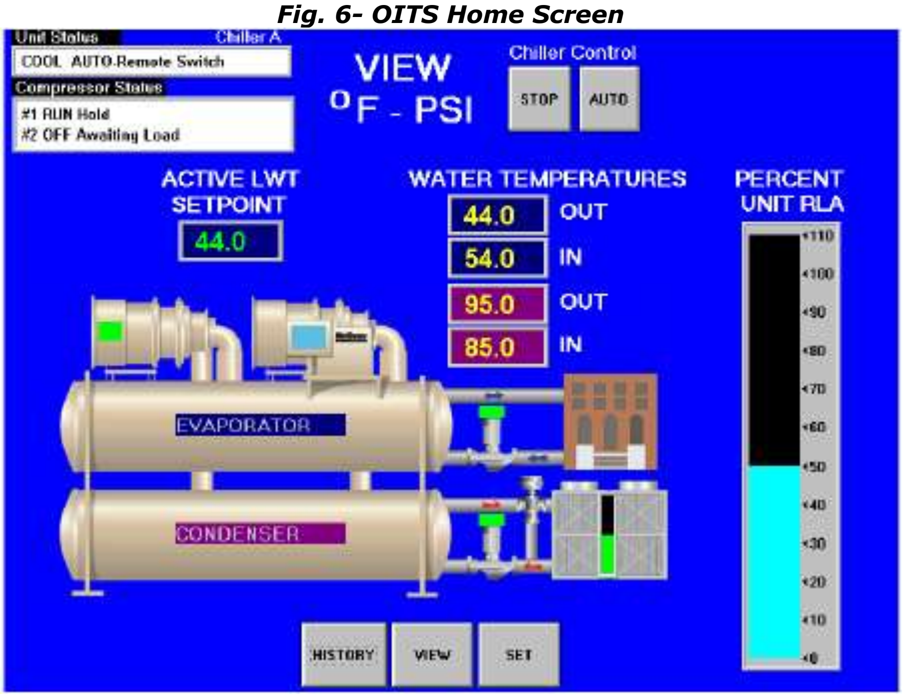
MicroTech® II controls constantly monitor chiller status, and automatically take proactive measures to relieve abnormal conditions or shut the unit down if a fault occurs. For example, if a problem occurs in the cooling tower and discharge pressure starts to rise, the controller will automatically hold the load point and activate an alarm signal. A further rise in pressure will initiate compressor unloading in an effort to maintain the setpoint pressure. If the pressure continues to rise, the unit will shut off at the cutout pressure setting to protect the unit.

FEATURE	BENEFIT
Open Choices™ Option	Easy integration into a building management system via a factory or field-installed module communicating with BACnet , LONMARK or Modbus protocols.
Touch-screen Interface	Easy to read, adjustable, large 15-inch, color touch screen; See chiller operation at a glance; easily view and change setpoints
Alarm/Fault History and Trend Logging	Historical trend data can be downloaded from an onboard USB port
Precise ± 0.2 °F chilled water controls	Provides stability in chilled water system
Proactive Controls	Proactive correction of "unusual conditions" allows chiller to stay online; activates alarm and modifies chiller operation to provide maximum possible cooling
Integrated lead/lag pump control	Automatic control of chilled water and condenser water pumps; permits pump operation only when required
Condenser Water Temperature Control	Provides tower fan control /modulation based on system conditions
Multiple language capability - Metric or IP units of measure	Great asset for world-wide applications

Alarm History for Easy Troubleshooting

The controller memory can retain and display the cause of the current fault and the last twenty-five fault conditions. This feature is extremely useful for troubleshooting and maintaining an accurate record of unit performance and history. The Home Screen shown below is the primary viewing screen on the Operator Interface Touch Screen (OITS). It gives real time data on unit status, water temperatures, chilled water setpoint and motor amp draw.

Fig. 6- OITS Home Screen

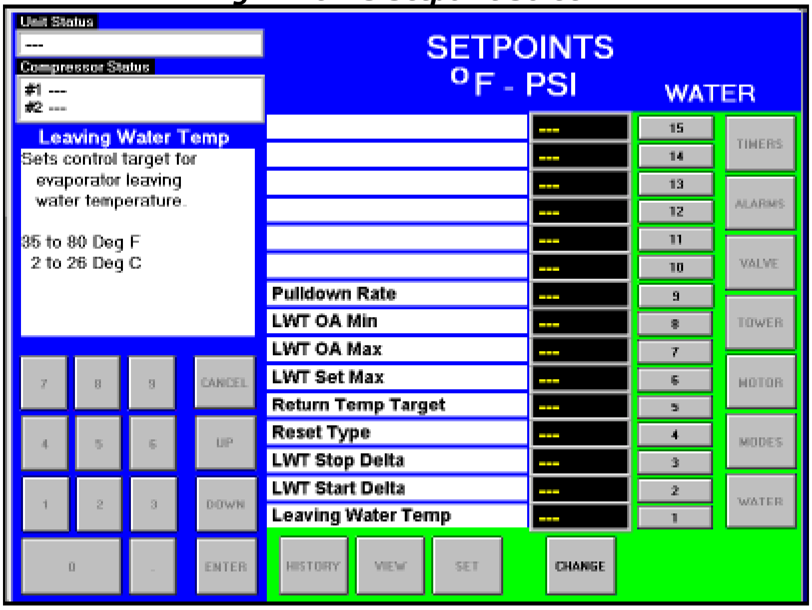


If an alarm occurs, a red button appears on the screen that leads to the Active Fault Screen which gives complete fault information so that the fault can be corrected and cleared.

Changing Setpoints

Changing setpoints is easy with the MicroTech II control. For example, to change the chilled water setpoint, press SET button from any screen, then press WATER and this screen appears, now press button #1, Leaving Water Temperature, and you are ready to input a password and a new value. (The controller features a three-level password security system to provide protection against unauthorized use.)

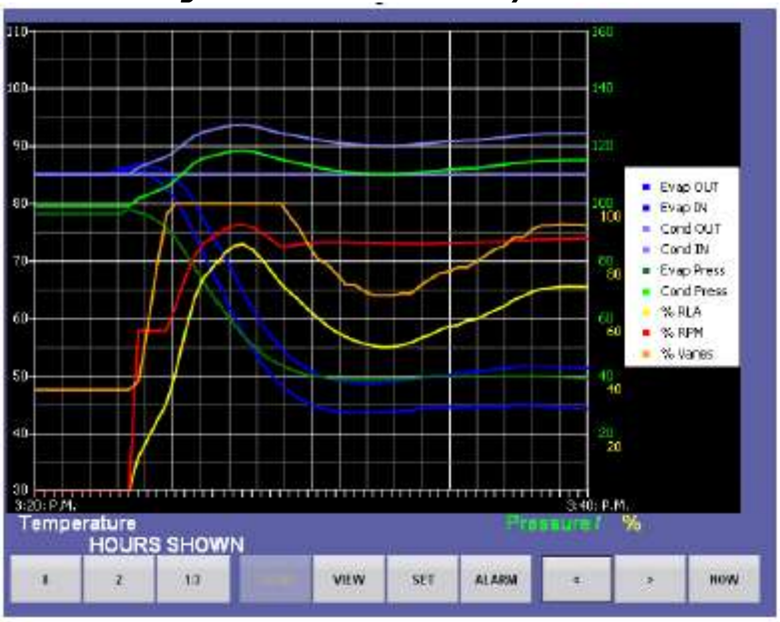
Fig. 7 - OITS Setpoint Screen



Trend Logging

Ever wonder how your chiller performed last night? Were you holding the correct chilled water temperature? What kind of cooling load did the chiller have? The Daikin MicroTech® II controller can provide the answers, thanks to its huge memory, and plot water temperatures, refrigerant pressures, and motor load data. These values can also be downloaded through a convenient USB port (located on the unit control panel) into a spreadsheet for detailed evaluation and analysis.

Fig. 8 - OITS Trend History Screen



DWDC Chiller Controls

Dual compressor model centrifugal chillers feature a MicroTech® II unit controller and a separate controller for each compressor. This distributed control scheme allows the operation of each compressor independently from the other. Performance data for each compressor is monitored separately by each controller, and can be controlled and monitored on the interface panel. Compressor staging and the load balance function are standard features of MicroTech® II controllers. Smart scheduling starts the compressor with the fewest number of starts first, and will only start remaining compressors when sufficient load has been established. The staging function will stop the compressor with the most run-hours as the load decreases to single compressor range. During two-compressor operation, the load balance function will equalize the load between each compressor, providing optimum unit efficiency.

Versatile Communications For Even More Control

For flexibility there are three ways to interface with the MicroTech® II controller:

• Direct entry via Operator Interface Touch-Screen.

• Direct entry as above, plus remote digital and analog input/output signals for certain functions such as enable run input, alarm signal output, chilled water reset and load limiting, outputs for pump and tower fan control, for variable speed tower fan and/or tower bypass valve.

• Interface with a building automation system (BAS) with optional modules, communicating directly with BACnet, LONMARK or Modbus protocols.

Building Automation Systems

All MicroTech II® controllers are capable of communication with BAS, providing seamless integration and comprehensive monitoring, control, and two-way data exchange with industry standard protocols such as LONMARK, Modbus or BACnet.

Open Choices Benefits

• Easy to integrate into your building automation system
• Factory- or field-installed communication modules
• Comprehensive point list for system integration, equipment monitoring and alarm notification
• Comprehensive data exchange

Daikin unit controllers strictly conform to the interoperability guidelines of the LONMARK Interoperability Association and the BACnet Manufacturers Association. They have received LONMARK certification with the optional LONWORKS communication module.

Protocol Options

- BACnet MS/TP
- BACnet IP
- BACnet Ethernet
- LONWORKS (FTT-10A)
- Modbus RTU

Electric Power Options

In order for the BAS to read the full complement of power data on low and medium voltage solid state, across-the-line, and wye-delta starters, the optional Field Metering Package must be ordered with the chiller. Otherwise the BAS will only read the average unit amps. This power data is not available to a BAS on all other starter voltages and types.

Fig. 9 - Typical BAS Read/Write Data points

Typical BAS Read/Write Data Points Typical Data Points[1] (W = Write, R = Read)

Active Setpoint	R	Cond EWT	R	Evap Water Pump Status	R
Actual Capacity	R	Cond Flow Switch Status	R	Heat Recovery EWT	R
Capacity Limit Output	R	Cond LWT	R	Heat Recovery LWT	R
Capacity Limit Setpoint	W	Cond Pump Run Hours	R	Heat Setpoint	W
Chiller Enable	W	Cond Refrigerant Pressure	R[2]	Ice Setpoint	W
Chiller Limited	R	Cond Sat. Refrigerant Temp	R[2]	Liquid Line Refrigerant Pressure	
Chiller Local/Remote	R	Cond Water Pump Status	R	Liquid Line Refrigerant Temp	R
Chiller Mode Output	R	Cool Setpoint	W	Maximum Send Time	W
Chiller Mode Setpoint	W	Current Alarm	R	Minimum Send Time	W
Chiller On/Off	R	Default Values	W	Network Clear Alarm	W
Chiller Status	R	Evap EWT	R	Oil Feed Pressure	R
Compressor Discharge Temp	R	Evap Flow Switch Status	R	Oil Feed Temp	R
Compressor Percent RLA	R	Evap LWT for Unit	R	Oil Sump Pressure	R
Compressor Run Hours	R	Evap LWT for Compressor	R	Oil Sump Temp	R
Compressor Select	W	Evap Pump Run Hours	R	Outdoor Air Temp	
Compressor Starts	R	Evap Refrigerant Pressure	R2	Pump Select	W
Compressor Suction Line Temp	R	Evap Sat. Refrigerant Temp	R2	Run Enabled	R

1.) Data points available are dependent upon options selected
2.) Per compressor

Unit layouts

Fig. 10 - DWSC Layout

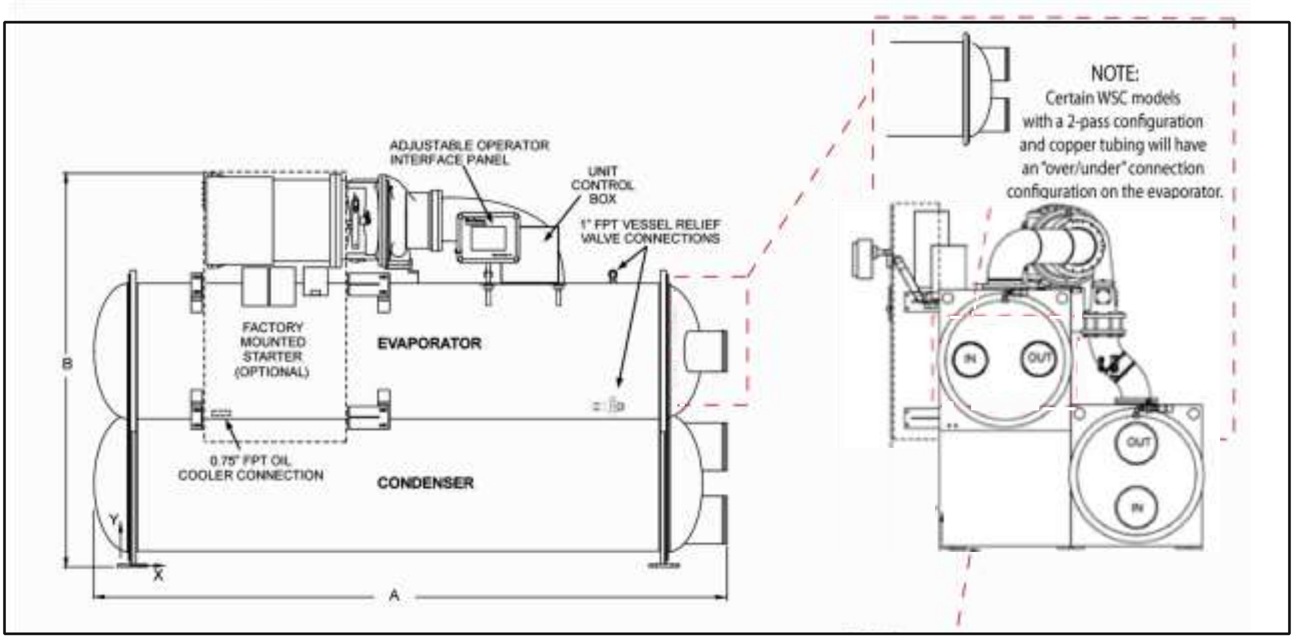
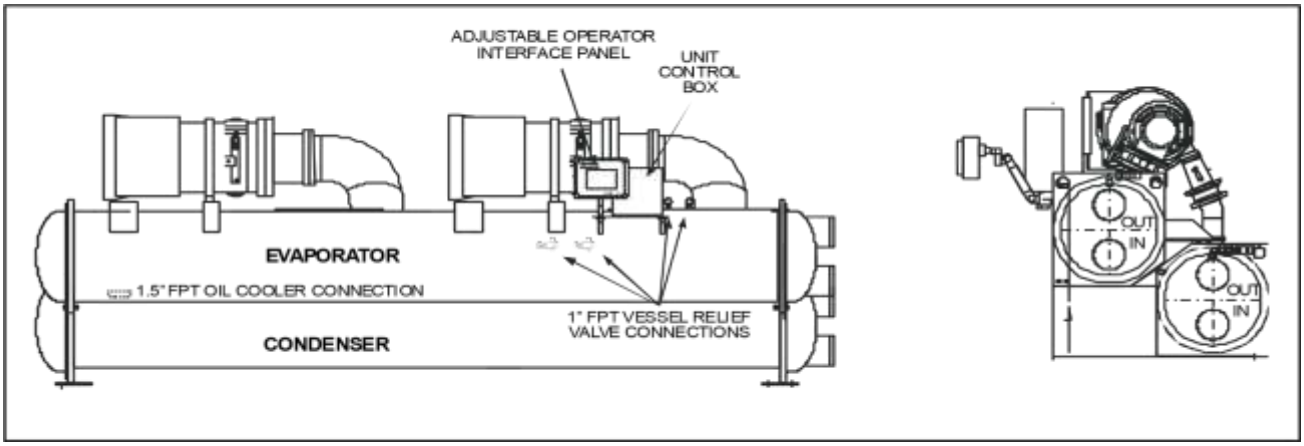


Fig. 11 - DWDC Layout



Options and Accessories

Vessels

Marine water boxes
Provides tube access for inspection, cleaning, and removal without dismantling water piping.

Flanges (Victaulic. connections are standard)
ANSI raised face flanges on either the evaporator or condenser. Mating flanges are by others.

0.028 or 0.035 in. tube wall thickness
For applications with aggressive water conditions requiring thicker tube walls.

Cupro-nickel or titanium tube material
For use with corrosive water conditions, includes clad tube sheets and coated water heads.

Water-side vessel construction of 300 psi (150 psi is standard)
For high-pressure water systems, typically high-rise building construction.

Water differential pressure switches
This option provides evaporator and condenser water thermal dispersion flow sensors as a factory mounted and wired option. A proof-of-flow device is mandatory in both the chilled water and condenser water systems.

Single insulation
¾-inch, on evaporator, suction piping, and motor barrel; For normal machine room applications.

Double insulation
1-½ inch, on evaporator, suction piping, and motor barrel; For high humidity locations and ice making applications.

Electrical

Optional starters for factory or field mounting
See details in the Motor Starter section.

Variable frequency drives (VFD)
The variable frequency drive option is a technology that has been used for decades to control motor speed on a wide variety of motor-drive applications. When applied to centrifugal compressor motors, significant gains in compressor part load performance can be realized. The improvement in efficiency and reduction of annual energy cost is maximized when there are long periods of part load operation, combined with low compressor lift (lower condenser water temperatures). When atmospheric conditions permit, Daikin chillers equipped with VFDs can operate with entering condenser as low as 50.F (10 .C), which results in extremely low kW/ton values.

Starting Inrush: The use of a VFD on centrifugal chillers also provides an excellent method of reducing motor starting inrush, even better than solid-state starters. Starting current can be closely controlled since both the frequency and voltage are regulated. This can be an important benefit to a building’s electrical distribution system.

NEMA 4 watertight enclosure
For use where there is a possibility of water intrusion into the control panel.

NEMA 12 Dust tight enclosure
For use in dusty areas.

Controls

BAS Interface Module

Factory-installed on the unit controller for integration to BAS using LonTalk®, BACnet® or Modbus® protocols.

Unit

Export packaging

Can be either slat or full crate for additional protection during shipment. Units normally shipped in containers.

Pumpout Unit, Model RRU with or without storage vessel

Available in a variety of sizes. Details under the Pumpout section.

Refrigerant monitor

For remote mounting, including accessories such as 4-20ma signal, strobe light, audible horn, air pick-up filter.

Hot gas bypass

Reduces compressor cycling and its attendant chilled water temperature swings at very low loads.

Sound attenuation package

For extremely sensitive projects, an optional discharge line sound package is offered consisting of sound insulation installed on the unit’s discharge line. An additional 2 to 4 dbA reduction normally occurs.

Optional Witness Test

A Daikin engineer oversees the testing in the presence of the customer or their designate and translates the test data onto an easy-to-read spreadsheet. Contact Factory for further details.

Special Order Options

The following special order options are available; requiring factory pricing, additional engineering and possible dimension changes or extended delivery: Consult the Daikin sales office for other possible specials.

- Non-standard location of nozzle connections on heads (compact water boxes) or marine water boxes
- Special corrosion inhibiting coatings on any “wetted surface” including tubesheets, heads (compact water boxes), marine water boxes, or nozzles
- Clad tube sheets
- Sacrificial anodes in heads (compact water boxes) or marine water boxes
- Special NEMA enclosures
- Hinges for marine water box covers or heads (compact water boxes)

Refrigerant Recovery Units/Monitors

Although Daikin chillers can pump the entire refrigerant charge into the condenser and valve it off, there are occasions when pumpout units are required, due purely to specification requirements or unusual job considerations. Daikin offers two sizes of refrigerant recovery units (Model RRU).

The storage tank is designed, constructed and stamped in accordance with ASME standards.

MODEL RRU134

Large 1 ½-HP open drive compressor, ½-inch lines, two-point vapor extraction and oversized aircooled condenser speed recovery on smaller size chillers. Purging and switching from liquid to vapor recovery only involves turning 3-way valves-no switching of hoses is necessary. Capacity with R 134a is 55 lb/min liquid, 1.34 lb/min vapor.

MODEL RRU570

Recovers at R-134a at 300 lb/ min liquid and 5.7 lb/min vapor, ideal for the medium size chiller job. Rugged 3 hp open-drive compressor provides years of reliable service, even on refrigerants heavily contaminated with oil, air, moisture, or acids. Purging and switching from liquid to vapor recovery only involves turning 3-way valves-no switching of hoses is necessary. Suitable for most high-pressure refrigerants and blends. Equipped with aircooled condenser.

Refrigerant Monitors

Contact Factory for selection and quotation.

Shipped Disassembled

Chillers can be shipped knocked down from the factory. The evaporator, condenser and oil pump are shipped bolted together and easily unbolted at the job site into the pieces shown on the following page. Other options, such as shipping less compressor or less compressor and control panel are also available. Site reassembly must be supervised by Daikin startup personnel. Contact Factory for further details.

Electrical data

Wiring and Conduit

Wire sizes must comply with local and state electrical codes. Where total amperes require larger conductors than a single conduit would permit, limited by dimensions of motor terminal box, two or more conduits can be used. Where multiple conduits are used, all three phases must be balanced in each conduit. Failure to balance each conduit will result in excessive heating of the conductors and unbalanced voltage.

An interposing relay can be required on remote mounted starter applications when the length of the conductors run between the chiller and starter is excessive.

NOTE: On DWDC dual compressor units, dual power leads are standard, requiring separate power leads properly sized and protected to each compressor starter or VFD. Separate disconnects must be used.

Use only copper supply wires with ampacity based on 75°C conductor rating. (Exception: for equipment rated over 2000 volts, 90°C or 105°C rated conductors shall be used).

Power Factor Correction Capacitors

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

Control Power

The 115-volt control power can be supplied from the starter or a transformer separate from the starter. Either source must be properly fused with 25-amp dual element fuses or with a circuit breaker selected for motor duty. If the control transformer or other power source for the control panel is remote from the unit, conductors must be sized for a maximum voltage drop of 3%. Required circuit ampacity is 25 amps at 115 volts. Conductor size for long runs between the control panel and power source can be determined from the table below.

Fig. 12 - Control Power Line Sizing

Maximum Length, ft (m)	Wire Size (AWG)	Maximum Length, ft (m)	Wire Size (AWG)
0 (0) to 50 (15.2)	12	120 (36.6) to 200 (61.0)	6
50 (15.2) to 75 (22.9)	10	200 (61.0) to 275 (83.8)	4
75 (22.9) to 120 (36.6)	8	275 (83.8) to 350 (106.7)	3

Notes:

1. Maximum length is the distance a conductor will traverse between the control power source and the unit control panel.
2. Panel terminal connectors will accommodate up to number 10 AWG wire. Larger conductors will require an intermediate junction box.

Motor Starters and VFDs

Daikin has a wide variety of starter types and options to fit virtually all applications. This section contains a general overview of the wide variety of starters available on Daikin Centrifugal Chillers.

Starter Types and Descriptions

Solid state starters are available for both low and medium voltages and are similar in construction and features regardless of voltage. For low voltage application, WyeDelta Closed Transition starters are available, in addition to solid state. For medium voltage application across-the-line (Direct On Line) starters are offered in addition to solid state.

Mounting Options, Low Voltage, 200 to 600 Volts

Factory-mounted

Starters are furnished, mounted and wired in the factory. Availability as per list price file.

Freestanding

Furnished by Daikin and shipped to the job site for setting and wiring by others. Conncetion cable are not provided by the Factory.

Starters by others

Starters furnished and installed by others must meet Daikin Specification. Please contact Factory for further details.

Mounting Options, Medium Voltage, 2300 to 6000 Volts

All starter types in these voltages are for field setting and wiring only.

Variable Frequency Drives (VFD)

A VFD modulates the compressor speed in response to load and evaporator and condenser pressures. Due to the outstanding part load efficiency, and despite the small power penalty attributed to the VFD, the chiller can achieve outstanding overall efficiency. VFDs really prove their worth when there is reduced load combined with low compressor lift (lower condenser water temperatures) dominating the operating hours.

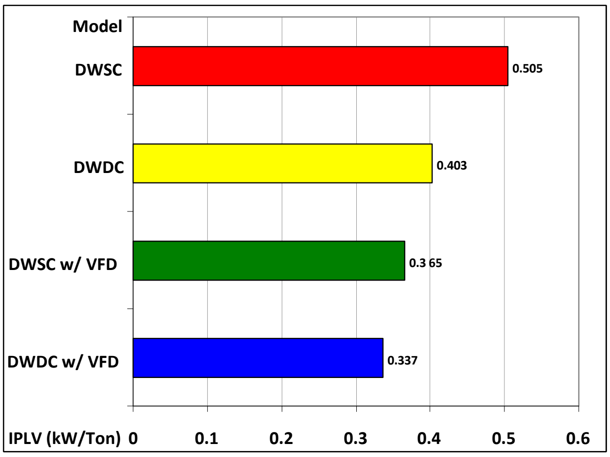
The traditional method of controlling centrifugal compressor capacity is by inlet guide vanes. Capacity can also be reduced by slowing the compressor speed and reducing the impeller tip speed, providing sufficient tip speed is retained to meet the discharge pressure requirements. This method is more efficient than guide vanes by themselves.

In actual practice a combination of the two techniques is used. The microprocessor slows the compressor (to a fixed minimum percent of full load speed) as much as possible, considering the need for tip speed to make the required compressor lift. Guide vanes take over to make up the difference in required capacity reduction. This methodology provides the optimum efficiency under any operating condition.

Impact of Variable Frequency Drives

The chart below illustrates the relative IPLV efficiencies of various Daikin options for a typical 500-ton (1758kW) selection. The chiller cost increases as the efficiency improves.

Fig. 13 - IPLV Comparison by Model



The IPLV values are AHRI Certified. Ratings based on AHRI Standard 550/590, Standard for Water Chilling Packages Using the Vapor Compression Cycle.

VFD Mounting

VFDs can be factory-mounted on the same units and in the same location as conventional starters or can be free-standing as shown below. Availability as per list price file.

VFDs and Distortion

Despite the many benefits, care must be taken when applying VFDs due to the impact that they may have on the building's electrical system. VFDs can cause distortion of the AC line because they are nonlinear loads; that is, they don't draw sinusoidal current from the line. They instead only draw current during the peaks of the AC line. This flattens the top of the voltage waveform. Most other modern electronic equipment is also a nonlinear load, but VFDs tend to have a greater impact because of their large power demand. Although harmonics are associated with non-linear loads, itis extremely rare that VFD generated harmonics are an issue in systems with a minimum of 5% internal impedance.

Power line harmonic distortion can be a concern for a number of reasons:

1. Current harmonics can cause additional heating of transformers, conductors, and switchgear. They can also cause nuisance tripping of circuit breakers and clearing of fuses.
2. Voltage harmonics may disrupt the operation of devices which require a smooth, sinusoidal voltage waveform.
3. High-frequency components of voltage distortion can interfere with signals which are transmitted on the AC power line.

The harmonics of concern are often the 5th, 7th, 11th, and 13th. Even harmonics, harmonics divisible by three, and harmonics above the 13th harmonic are usually not a problem for three-phase power systems.

The Daikin Drive Passive filter Package provides a broader range of harmonic reduction performance than VFDs which use active rectifiers. This is particularly true at reduced loads, where VFDs provide the greatest energy savings.

Current Harmonics

An increase in reactive impedance in front of the VFD helps reduce the harmonic currents. Reactive impedance can be added in the following ways:

1. Mount the drive far from the source transformer.

2. Add line reactors.
3. Use an isolation transformer.

Voltage Harmonics

Voltage distortion is caused by the flow of harmonic currents through a source impedance. A reduction in source impedance to the point of common coupling (PCC) will result in a reduction in voltage harmonics. This may be done in the following ways:

1. Keep the PCC as far from the drives (close to the power source) as possible.
2. Increase the size (decrease the impedance) of the source transformer.
3. Increase the capacity (decrease the impedance) of the busway or cables from the source to the PCC.
4. Make sure that added reactance is downstream (closer to the VFD than the source) from the PCC.

The IEEE 519 Standard

The Institute of Electrical and Electronics Engineers (IEEE) has developed a standard that recommends distortion limits for both power utilities and their customers. The purpose of these limits is to ensure that the voltage distortion of the utility's public power grid is maintained at an acceptable level. To accomplish this, IEEE 519-2014 presents recommended harmonic current distortion limits for utility customers. These limits are based on the peak demand of the customer. This is called the Total Demand Distortion (TDD). This standard provides a sliding scale for the recommended TDD limit for each utility customer. The greater the demand that a customer places on the utility, the more stringent the recommended TDD limits.

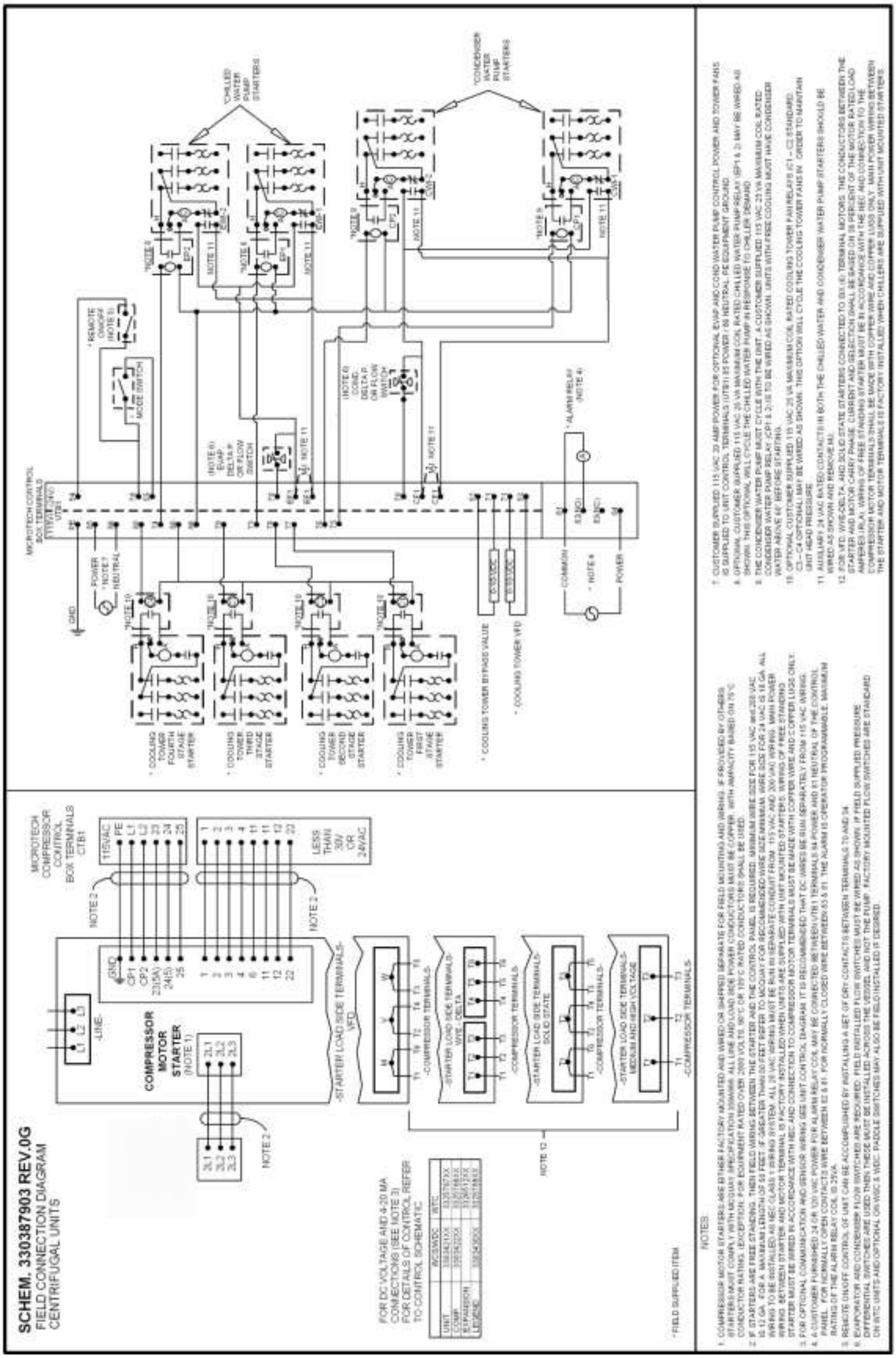
IEEE 519-2014 clearly states that the TDD is to be measured at the point where a utility customer connects to the public utility. It does not apply to any points inside the customer's facility; it only applies to the point where another utility customer could connect to the public power grid. If the utility's customers comply with the TDD limits stated in IEEE 519-2014, it is then the utility's responsibility to provide voltage to its customers that meets the harmonic voltage recommendations of this standard.

Actual optimum unit selection will vary with building application and system design. Applications with minimal hours of operation cannot justify a very low kW per ton (COP) unit. Applications with high hours of operation will justify high part load as well as full load efficiency units.

Notes for following Wiring Diagram:

1. Optional Open Choices BAS interfaces. The locations and interconnection requirements for the various standard protocols are found in their respective installation manuals.
2. The "Full Metering" or "Amps Only Metering" option will require some field wiring when free-standing starters are used. Wiring will depend on chiller and starter type.

Fig.14 – Wiring diagram



Application considerations

Location

These chillers are intended only for installation in an indoor or weather protected area consistent with the NEMA 1 rating on the chiller, controls, and electrical panels. If indoor sub-freezing temperatures are possible, special precautions must be taken to avoid equipment damage.

CAUTION

Daikin Centrifugal Chillers are intended only for installation in indoor areas protected from temperature extremes. Failure to comply may result in equipment damage and may void the manufacturer warranty.

Operating/Standby Limits

Fig. 15 - Operating/Standby Limits

Equipment room operating temperature:	40°-104°F (4.4°-40°C)
Equipment room temperature, standby, with water in vessels and oil cooler:	40°-104°F (4.4°-40°C)
Equipment room temperature, standby, without water in vessels and oil cooler:	0°F-122F (-18°C-50°C)
Maximum entering condenser water temperature, startup:	design + 5°F (2.7°C)
Maximum entering condenser water temperature, operating:	job-specific design temperature
Minimum entering condenser water temperature, operating:	see this page for more detail
Minimum leaving chilled water temperature:	38°F (3.3°C)
Minimum leaving chilled fluid temperature with correct antifreeze fluid:	15°F (9.4°C)
Maximum entering chilled water temperature, operating:	90°F (32.2°C)
Maximum oil cooler or VFD entering temperature:	80°F (26.7°C)
Minimum oil cooler/VFD entering temperature:	42°F (5.6°C)

Piping

The piping must be supported to eliminate weight and strain on the fittings and connections. Piping must also be adequately insulated. A cleanable perforated basket strainer with 0.125in perforations and 40 % open area must be installed in the evaporator water inlet line. Sufficient shutoff valves must be installed to permit draining the water from the evaporator or condenser without draining the complete system. Do not use PVC or CPVC piping.

⚠ CAUTION

Freeze Notice: The evaporator and condenser are not self-draining. Both must be blown out to completely remove water to help prevent freeze-up.

Include thermometers and pressure gauges at the chiller inlet and outlet connections and air vents at the high points of piping. The water heads can be interchanged (end for end), allowing water connections to be made at either end of the unit. Use new head gaskets when interchanging water heads. When water pump noise is objectionable, use rubber isolation sections at both the inlet and outlet of the pump. Vibration eliminator sections in the condenser inlet and outlet water lines are not normally required. Where noise and vibration are critical and the unit is mounted on spring isolators, flexible piping and conduit connections are necessary. If not factory installed, a flow switch or pressure differential switch must be installed in the leaving chilled water line in accordance with the flow switch manufacturer's instructions.

Optimum Water Temperatures and Flow Rates

A key to improving energy efficiency for any chiller is minimizing the compressor pressure lift. Reducing the lift reduces the compressor work and its energy consumption per unit of output.
The optimum plant design must take into account all of the interactions between chiller, pumps, and tower.

Evaporator

Evaporator temperature drop

The industry standard has been a 10F temperature (5.5°C) drop in the evaporator. Increasing the drop to 12F or 14 F will improve the evaporator heat transfer, raise the suction pressure, and improve chiller efficiency. Chilled water pump energy will also be reduced.

Higher leaving chilled water temperatures

Warmer leaving chilled water temperatures will raise the compressor's suction pressure and decrease the lift, improving efficiency. Using 45° F (7.0° C) leaving water instead of 42° F (5.5° C) will make a significant improvement.

Condenser

Condenser entering water temperature

As a general rule, a one F degree 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.

Minimum Condenser Water Temperature Operation

When ambient wet bulb temperatures are lower than design, the condenser water temperature can be allowed to fall. Lower temperatures will improve chiller performance.

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.

Cooling tower fans must continue to operate at 100% capacity at low wet bulb temperatures. As chillers are selected for lower kW per ton, the cooling tower fan motor power becomes a higher percentage of the total peak load chiller power. Even with tower fan control, some form of water flow control, such as tower bypass, is recommended.

Condenser water temperature rise

The industry standard of 3 gpm/ton or about a 9.5-degree delta-T works well for most applications. Reducing condenser water flow to lower pumping energy will increase the water temperature rise, resulting in an increase in the compressor's condensing pressure and energy consumption. This is usually not a productive strategy.

System analysis

Although Daikin is a proponent of analyzing the entire system, it is generally effective to place the chiller in the most efficient mode because it is, by far, a larger energy consumer than pumps.

Mixing Single and Dual Compressor Chillers

DWDC dual compressor chillers excel at part load operation, while single compressor chillers usually have better full load efficiency. A good chiller plant strategy is to install one dual and one or more single compressor units. Run the dual until it is fully loaded, then switch to the single compressor unit and run it only at full load, using the dual to trim the load.

Series Counterflow and Series Parallel Chillers

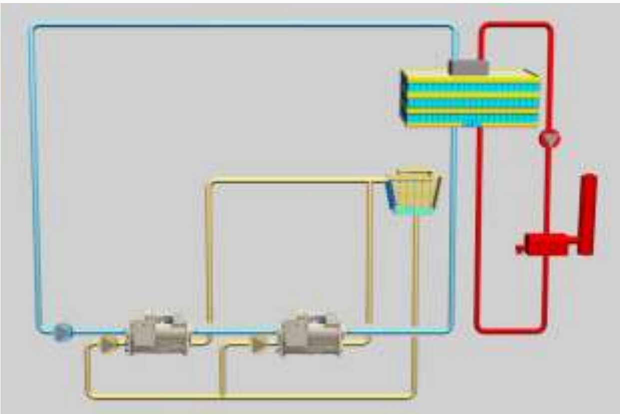
The design of piping systems can greatly impact chiller performance. A popular system is to place the evaporators in series with the chilled water flowing from one evaporator to the next as shown. Two different condenser water piping arrangements can be used. Parallel flow (Fig. 12) divides the total condenser flow between the two condensers. The counterflow system (Fig. 13) puts all of the condenser water through the condenser of the lag chiller (chiller producing the coldest evaporator leaving water) and then through the lead chiller (chiller seeing the warmest evaporator water temperatures).

Typically, since the lead machine will see the warmest evaporator water, it will have the greater capacity and larger portion of the total system evaporator temperature drop. The lead machine has an 8.4 degree drop (56.0°F-47.6°F) and the lag machine has a 5.6 degree drop (47.6°F - 42.0°F).

Condenser water flow is important to overall system efficiency. With parallel flow, the condensers have identical flow conditions (95 to 85 degrees in this example) with the compressor lift shown. With counterflow arrangement the lift on the lead machine is significantly lower, reducing compressor work and making the overall system efficiency about 2% better. Even though the chiller performance is different, it is good practice to use the same chiller models.

Both the DWSC and DWDC chillers are suitable for series counterflow arrangement and include controls specifically designed for series chillers.

Fig. 16 - Series Parallel Flow



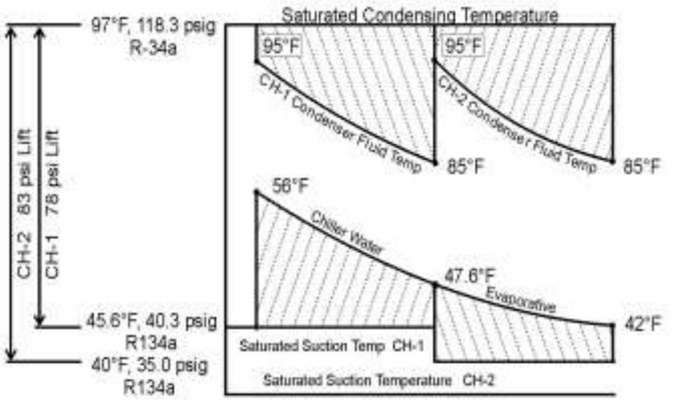
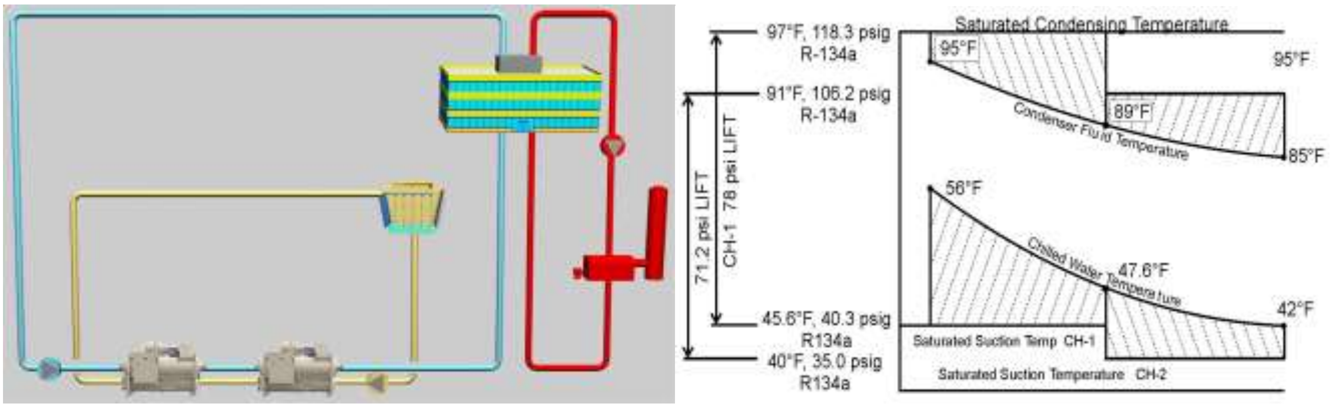


Fig. 17 - Series counterflow



Oil Coolers

Daikin centrifugal chillers have a factory-mounted oil cooler with a temperature controlled water regulating valve and solenoid valve for each compressor. Cooling water connections are located at the rear of the unit, near the compressor and are shown on the specific unit certified drawings. Models DWDC 063 through 087 have the cooling water connections in the lower portion of one tube sheet.

DWDC 063, 079, 087, 100 and 126 dual compressor chillers are equipped as above, but the water piping for the two oil coolers is factory piped to a common inlet and outlet connection.

Field water piping to the inlet and outlet connections must be installed according to good piping practices and must include stop valves to isolate the cooler for servicing. A 1" minimum cleanable filter (40 mesh maximum) and drain valve or plug

must also be field installed. The water supply for the oil cooler must be from the chilled water circuit, or from an independent clean source such as city water. When using chilled water, it is important that the water pressure drop across the evaporator is greater than the pressure drop across the oil cooler or insufficient oil cooler flow will result. If the pressure drop across the evaporator is less than the oil cooler, the oil cooler must be piped across the chilled water pump, provided that its pressure drop is sufficient. The water flow through the oil cooler will be adjusted by the unit's regulating valve so that the temperature of oil supplied to the compressor bearings (leaving the oil cooler) is between 90°F and 110°F (32°C and 43°C).

NOTE: The system must be designed for the highest cooling water temperature possible, which may occur for a short time during startup.

Compressors using chilled water for oil cooling will often start with warm "chilled water" in the system until the chilled water loop temperature is pulled down. With cooling water in the 40°F to 55°F (4°C to 13°C) range, considerably less water will be used and the pressure drop will be greatly reduced. The following table contains oil cooler data at various inlet water temperatures.

Fig. 18 - DWSC Oil Cooler Data

	Hot Side POE Lube	Cold Side Water			
DWSC 063 - 087					
Flow, gpm	9.9	11.9	2.9	2.0	1.54
Inlet Temperature, F	118.0	80.0	65.0	55.0	45.0
Outlet Temp., F	100.0	87.3	94.5	98.3	101.4
Pressure Drop, psi	-	4.3	0.3	0.14	0.09
WSC 100 - 126					
Flow, gpm	15.8	21.9	5.11	3.5	2.7
Inlet Temperature, F	120.0	80.0	65.0	55.0	45.0
Outlet Temp., F	100.0	87.0	95.0	99.0	102.3
Pressure Drop, psi	-	3.78	0.23	0.11	0.07

Fig. 19 - DWSC with VFD Oil Cooler Data

	Hot Side POE Lub.	Cold Side Water			
DWSC 063 - 087					
Flow, gpm	9.9	13.4	4.0	2.9	2.3
Inlet Temperature, F	118.0	80.0	65.0	55.0	45.0
Outlet Temp., F	100.0	90.3	99.6	103.1	105.6
Pressure Drop, ft.	-	30.5	6.7	4.8	3.6
DWSC 100 - 126					
Flow, gpm	15.8	24.4	7.0	5.0	4.0
Inlet Temp., F	120.0	80.0	65.0	55.0	45.0
Outlet Temp., F	100.0	89.8	100.1	103.6	106.2
Pressure Drop, ft.	-	30.6	15.7	11.4	9.3

NOTE:

1. DWDC units have twice the cooling water flow rate of the comparable DWSC chiller.
2. Pressure drops include valves on the unit.

When supplied with city water, the oil piping must discharge through a trap into an open drain to prevent draining the cooler by siphoning. The city water can also be used for cooling tower makeup by discharging it into the tower sump from a point above the highest possible.

Note: Particular attention must be paid to chillers with variable chilled water flow through the evaporator. The pressure drop available at low flow rates can very well be insufficient to supply the oil cooler with enough water. In this case an auxiliary booster pump can be used or city water employed. Cooling Water Connection Sizes: DWDC 100/126 have 1- 1/2 in. FPT connections, all other DWDC and DWSCs are 1 in. FPT

Fig. 20 - DWSC/DWDC Oil Cooler Piping Across Chilled Water Pump

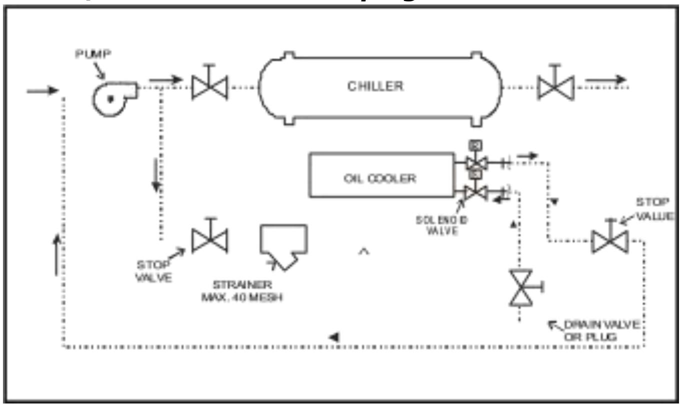
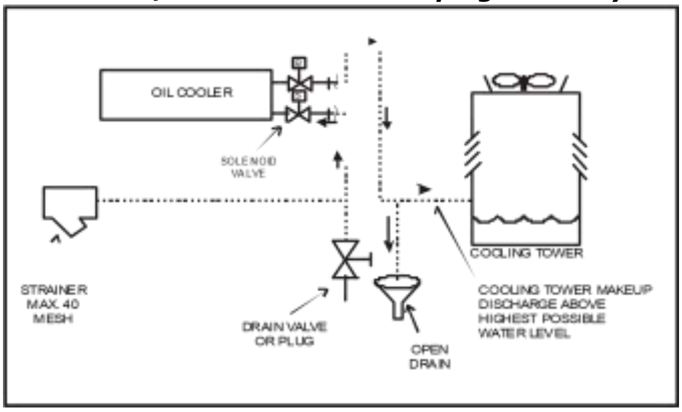


Fig. 21- DWSC/DWDC Oil Cooler Piping With City Water



Pumps

Model DWSC, DWDC chiller compressor motors operate at 3600 rpm on 60 Hz power (3000 rpm on 50 Hz). When VFDs are employed, the hertz/speed can be reduced by 70%. To avoid the possibility of objectionable harmonics in the system piping, 4-pole, 1800/1500 rpm system pumps should be used. The condenser water pump(s) must be cycled off when the last chiller of the system cycles off. This will keep cold condenser water from migrating refrigerant to the condenser. Cold liquid refrigerant in the condenser can make start-up difficult. In addition, turning off the condenser water pump(s) when the chillers are not operating will conserve energy.

Include thermometers and pressure gauges at the chiller inlet and outlet connections and air vents at the high points of piping. The water heads can be interchanged (end for end), allowing water connections to be made at either end of the unit. Use new head gaskets when interchanging water heads.

When water pump noise is objectionable, use rubber isolation sections at both the inlet and outlet of the pump. Vibration eliminator sections in the condenser inlet and outlet water lines are not normally required. Where noise and vibration are critical and the unit is mounted on spring isolators, flexible piping and conduit connections are necessary. If not factory installed, a flow switch or pressure differential switch must be installed in the leaving chilled water line in accordance with the flow switch manufacturer's instructions.

Victaulic connections are AWWA C-606 on 14-inch and larger sizes. Field supply transitions if Victaulic brand AGS® (Advanced Groove System) type grooves are used on the field piping.

Filtering and Treatment

Owners and operators must be aware that if the unit is operating with a cooling tower, cleaning and flushing the cooling tower is required. Ensure tower blow-down or bleedoff is operating. Atmospheric air contains many contaminants, which increases the need for water treatment. The use of untreated water will result in corrosion, erosion, slime buildup, scaling, or algae formation. A water treatment service should be used. Daikin is not responsible for damage or faulty operation from untreated or improperly treated water.

Machine Room Ventilation

In the market today, centrifugal chillers are available with either hermetic or open type motors. Hermetic motors are cooled with refrigerant and dissipate their heat through the cooling tower. On the other hand, open motors circulate equipment room air across themselves for cooling and reject the heat to the equipment room. Daikin chillers have hermetic motors and DO NOT require additional ventilation.

For chillers with open-drive type, air-cooled motors, good engineering practice dictates that the motor heat be removed to prevent high equipment room temperatures. In many applications this requires a large volume of ventilation air, or mechanical cooling to properly remove this motor heat.

EXAMPLE: 1000 tons x 0.6 kW/Ton x 0.04 motor heat loss x
0.284 Tons/kW = 7 tons (24 kW) cooling

The energy and installation costs of ventilation or mechanical cooling equipment must be considered when evaluating various chillers. For a fair comparison, the kW used for the ventilation fans, or if mechanical cooling is required, the additional cooling and fan energy must be added to the open motor compressor energy when comparing hermetic drives. Additionally, significant costs occur for the purchase, installation, and maintenance of the ventilation or air handling units.

Equipment room ventilation and safety requirements for various refrigerants is a complex subject and is updated from time to time. The latest edition of ASHRAE 15 should be consulted.

Thermal Storage

Daikin chillers are designed for use in thermal storage systems. The chillers have two operating conditions that must be considered. The first is normal air-conditioning duty where leaving evaporator fluid temperatures range from 40°F to 45°F (4.4°C to 7.2°C). The second condition occurs during the ice making process when leaving fluid temperatures are in the 22°F to 26°F (-5.6°C to -3.3°C) range.

The MicroTech® II control system will accommodate both operating points. The ice mode can be started or stopped by an input signal to the microprocessor from a BAS or through a chilled water reset signal. When a signal is received to change from the ice mode to the normal operating mode, the chiller will shut down until the system fluid temperature rises to the higher setpoint. The chiller will then restart and continue operation at the higher leaving fluid temperature. When changing from normal cooling to the ice mode, the chiller will load to maximum capacity until the lower setpoint is reached.

Computer selections must be made to check that the chiller will operate at both conditions. If the "ice mode" is at night, the pressure differentials between the evaporator and condenser are usually similar to normal cooling applications. The leaving fluid temperature is lower, but the condensing temperature is also lower because the cooling tower water is colder. If the ice mode can also operate during the day, when cooling tower water temperatures are high, a proper selection becomes more difficult because the two refrigerant pressure differentials are significantly different.

A three-way condenser water control valve is always required.

Variable Speed Pumping

Variable speed pumping involves changing system water flow relative to cooling load changes. Daikin centrifugal chillers are designed for this duty with two limitations.

First, the rate of change in the water flow needs to be slow, not greater than 10% of the change per minute. The chiller needs time to sense a load change and respond.

Second, the water velocity in the vessels must be 3 to 10 fps (0.91 and 3.0 m/sec). Below 3 fps (0.91 m/sec), laminar flow occurs which reduces heat transfer. Above 10 fps (3.0 m/ sec), excessively high pressure drops and tube erosion occur. These flow limits can be determined from the Daikin selection program.

We recommend variable flow only in the evaporator because there is virtually no change in chiller efficiency compared to constant flow. In other words, there is no chiller energy penalty. Although variable speed

pumping can be done in the condenser loop, it is usually unwise. The intent of variable flow is to reduce pump horsepower. However, reducing condenser water flow increases the chiller's condensing pressure, increasing the lift that the compressor must overcome which, in turn, increases the compressor's energy use. Consequently, pump energy savings can be lost because the chiller operating power is significantly increased.

Low condenser flow can cause premature tube fouling and subsequent increased compressor power consumption. Increased cleaning and/or chemical use can also result.

System Water Volume

All chilled water systems need adequate time to recognize a load change, respond to that load change and stabilize, without undesirable short cycling of the compressors or loss of control. In air conditioning systems, 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.

Vibration Mounting

Every Daikin chiller is run tested and compressor vibration is measured and limited to a maximum rate of 0.14 inches per second, which is considerably more stringent than other available compressors. Consequently, floor-mounted spring isolators are not usually required. Rubber mounting pads are shipped with each unit. It is wise to continue to use piping flexible connectors to reduce sound transmitted into the pipe and to allow for expansion and contraction.

AHRI Standard 575 Sound Ratings

Sound data in accordance with AHRI Standard 575 for individual units are available from factory. Due to the large number of component combinations and variety of applications, sound data is not included in this manual.

Glycol operation

The addition of glycol to the chilled water system for freeze protection can be required for special applications. Glycol solutions are required where the evaporating temperatures are below 33°F (1°C).

Certifications and Standards

As with many other Daikin Applied chiller products, the centrifugal chiller models meet all necessary certifications and standards.

AHRI Certification

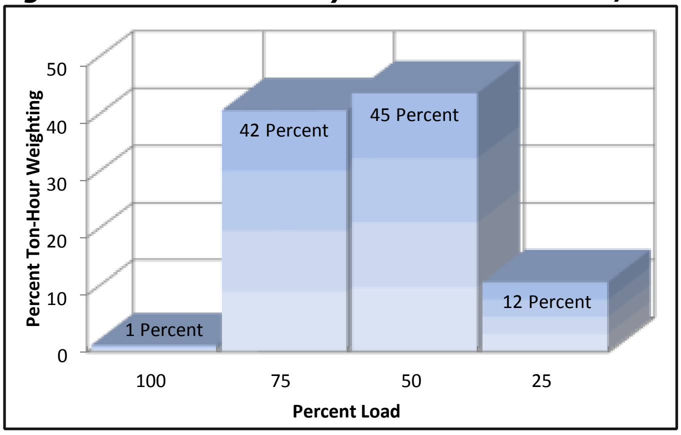
AHRI Standard 550/590 for Water-Chilling and Heat Pump Water-Heating Packages Using the Vapor Compression Cycle defines certification and testing procedures and performance tolerances of all units that fall within the scope of the standard.

Full AHRI 550/590 participation and certification is an on-going commitment at Daikin. Daikin centrifugal chillers are rated and certified in accordance with the latest edition of AHRI Standard 550/590. The AHRI label affixed to units certifies that the unit will meet the specified performance.

Daikin SelectTools (DST) for Centrifugal Chillers is used to select and rate chillers for specific job conditions. The program version number and issue date are listed in the AHRI Directory of Certified Applied Air-Conditioning Products available at www.ahridirectory.org

Part load performance can be presented in terms of Integrated Part Load Value (IPLV) or Non-Standard Part Load Values (NPLV), both of which are defined by AHRI Standard 550/590. Based on this standard, and as shown in Fig. 18, a typical chiller can operate up to 99% of the time at off-peak conditions and usually spends most of this time at less than 60% of design capacity.

Fig. 18 - IPLV Defined by AHRI Standard 550/590



Relief Values

Relief valve connection sizes are 1-inch FPT, with a relief valve (3/8 inch flare) on the top of the oil sump of all units.

All relief valves (including the oil sump) must be piped to the outside of the building.

For more information email **info@daikinapplied.uk** or visit **www.daikinapplied.uk**

For all Daikin Applied UK,

Daikin Applied Service &

Spares enquiries call us on:

0345 565 2700

Daikin Europe N.V. participates in the Eurovent Certified Performance programme for Liquid Chilling Packages and Hydronic Heat Pumps, Fan Coil Units and Variable Refrigerant Flow systems. Check ongoing validity of certificate: www.eurovent-certification.com