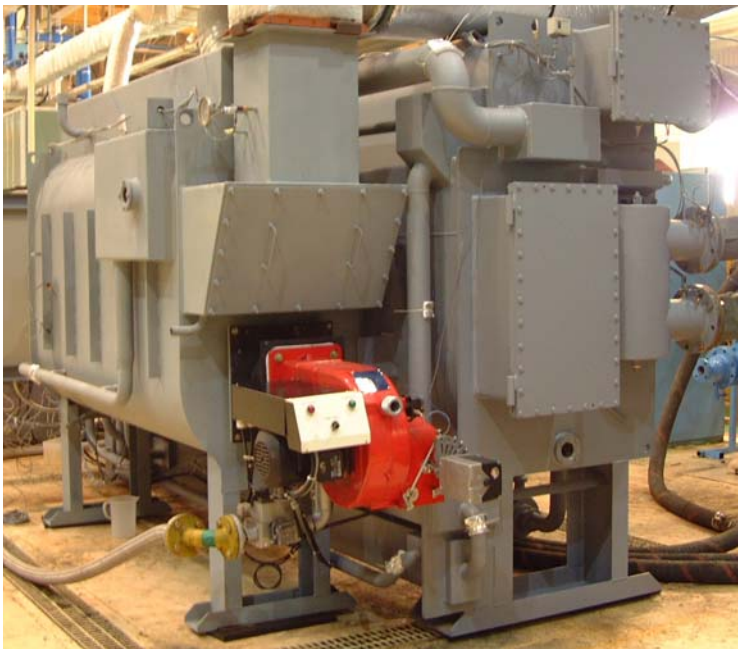
16DN
Direct-Fired, Double Effect, Hermetic Absorption Liquid Chiller/Heater

100 to 700 Nominal Tons (352 to 2462 kW)



16DN033

Carrier's 16DN direct-fired, double effect, hermetic absorption liquid chiller/heater offers a viable alternative to traditional electric driven chillers. Fired by natural gas or No.2 oil, the 16DN reduces costly electricity bills and qualifies for utility rebates and incentives as a gas cooling product. The 16DN can operate in the heating mode to provide hot water, thereby reducing the size of the required boiler or even eliminating the need for a boiler.

- no CFCs; environmentally friendly
- two-stage high efficiency design reduces energy costs
- fired by clean burning natural gas or No. 2 oil
- operates as a chiller or heater
- quiet. vibration-free operation
- few moving parts equates to high reliability

Features/Benefits

Direct-fired, double effect absorption provides efficient, economical water chilling or heating with minimal use of electricity.

Cost-effective cooling and heating

Alternative-energy chiller/heater

– The 16DN offers an alternative for building owners who want to avoid the high operating costs associated with electric-driven chillers. Fired by natural gas or No. 2 oil, the Carrier 16DN direct-fired, double effect, absorption chiller/heater not only reduces or eliminates electric demand and/or rachet charges, but also allows the owner to take advantage of gas cooling rebates and incentive programs offered by many utility companies.

Several configurations of heating mode

operation provide hot water for a variety of applications.

High-efficiency, double effect, Absorption cooling cycle – The 16DN design incorporates a high-stage generator and a low-stage generator (double effect) that provide 2 stages of solution reconcentration. As a result of this double-effect cycle, the 16DN has lower operating costs than single-effect machines. When using natural gas, full load cooling operation results in a COP (coefficient of performance) of 1.01 at standard ARI (Air Conditioning and Refrigeration Institute) operating conditions.

Superior part-load performance – The 16DN's standard concentration control system allows stable, part-load operation at cooling water temperatures as low as 64.4 F (18 C) without the need for a cooling tower bypass. For maximum efficiency, a variable frequency drive pump automatically maintains optimum solution flow to the high- and low-stage generators at all operating conditions. This will result in improved part-load efficiency and eliminate the need for manual setup adjustments of the solution flow. The 16DN has a continuous operating range from 100% to 25% capacity, based on minimum fire requirements for the burner.

Operates in the heating mode for additional savings – In the heating mode, the 16DN can deliver hot water for space heating or other applications to reduce or eliminate dependency on existing or supplemental boilers. Operation in the heating mode can be done instead of cooling mode operation. When operated as a heater, hot water temperatures of 140 F (60 C) are standard and do not require additional components. In the heating mode, the evaporator is used as the heating bundle and the machine is configured as a 2-pipe system with the chilled water nozzles serving as hot water nozzles. Quick changeover from cooling to heating is accomplished by switching the positions of two hand valves, draining the absorber-condenser water circuit, and putting the machine into heating mode by selecting a heating mode operation from the control panel.

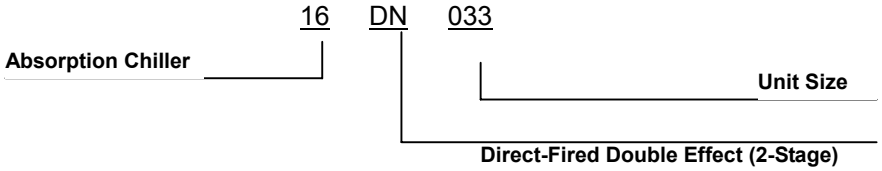
Application versatility

Ideal for new or retrofit applications – Whether intended for replacement of existing chiller and/or boiler systems or for new construction purposes, the 16DN is well suited to meet the needs of most cooling/heating applications for which a supply of natural gas or No. 2 oil is available. The 16DN's 17 model sizes, spanning a capacity range of 100 to 700 tons, make the 16DN direct-fired, double effect, absorption chiller/heater the ideal choice for comfort cooling and /or light industrial applications. Carrier's computerized performance ratings assist in the selection of the correct size machine to meet exact job requirements. Dependable operation, as well as low sound and vibration levels, ensures occupant comfort, even when the machine is installed on upper floors.

Combined use of absorption and electric-driven chillers – Utilizing both absorption and electric chillers in a central plant offers the flexibility to base load one chiller, while using the other to handle peak load requirements. Hybrid chiller systems have proven to be an economical solution for many comfort cooling installations. In many geographical areas, operating the electric chiller as the base loaded machine, while using the absorption chiller during peak load conditions, reduces or avoids electric demand charges. Depending on utility rate structures, the 16DN direct-fired absorption chiller/heater used in conjunction with an electric-driven chiller may be the most efficient and cost-effective combination available.

Table of contents

Model number nomenclature



Location and installation savings

Ease of installation – All 16DN units are completely fabricated, assembled, and wired in the factory as single-piece units. Standard shipping configuration is either 1 or 2 piece, depending on size. Refer to the 16DN Standard Shipping Configuration table below.

16DN STANDARD SHIPPING CONFIGURATION

UNIT SIZE	1-PIECE ASSEMBLY	2-PIECE ASSEMBLY	BURNER/GAS TRAIN ASSEMBLY
010-050	X		Factory Installed
056-070		X	Factory Installed

TYPICAL 16DN 1-PIECE SHIPMENT

The 16DN015-050 machines are shipped completely assembled as a standard feature with an option for 2-piece shipment. The 2-piece option is ideal for retrofit or replacement installations where access into the equipment room may be limited. The 16DN056-070 machines ship in 2 pieces as a standard feature for easier handling and rigging. When rigging access is extremely limited, the 16DN can be shipped in 2 pieces. On 16DN010-070 machines, the burner and gas train are installed at the factory to minimize field assembly. Job-site reassembly and alignment of machines shipped in multiple sections is simplified by pre-erecting the machine in the factory and by incorporating weld-type assembly flanges on all interconnecting piping.

Flanged waterbox nozzles – To simplify chiller installation and field piping, all waterbox nozzles on the evaporator, absorber, and condenser are factory-supplied with ANSI (American National Standards Institute) raised face (RF) flanges.

Factory-installed burner – Every 16DN machine through 700 tons is shipped from the factory with the burner, refractory assembly, and gas train installed in the high-stage generator to simplify the chiller/heater installation. This facilitates easier and quicker installation and reduces jobsite costs. It also ensures that all burner-related components are properly installed and wired to the main chiller center for proper control.

16DN BURNER ASSEMBLY

Single-point box electrical connection – Installation costs are further reduced by eliminating field wiring between machine components. On units shipped as a single assembly, all unit-mounted electrical items, including the burner control center, are factory-wired to the chiller microprocessor control center. Only a single-point electrical connection to the machine from the building's electrical service is required. When units are shipped in multiple pieces, a wiring harness is provided for interconnection between the burner control center and chiller control center. A multi-tap transformer, mounted in the chiller control center, provides secondary, single-phase power for the 16DN controls.

Low noise and vibration allows location flexibility – Low sound and vibration levels are characteristic of absorption chillers, primarily due to the fact that the only rotating parts are the refrigerant and solution pumps. The overall sound level of a Carrier 16DN is typically 80 dbA. This allows the machines to be installed near occupied spaces or in areas with strict sound requirements. Low vibration levels also make it possible to install the chiller/heater on upper floors without special consideration for vibration dampening systems.

Features/Benefits (cont)

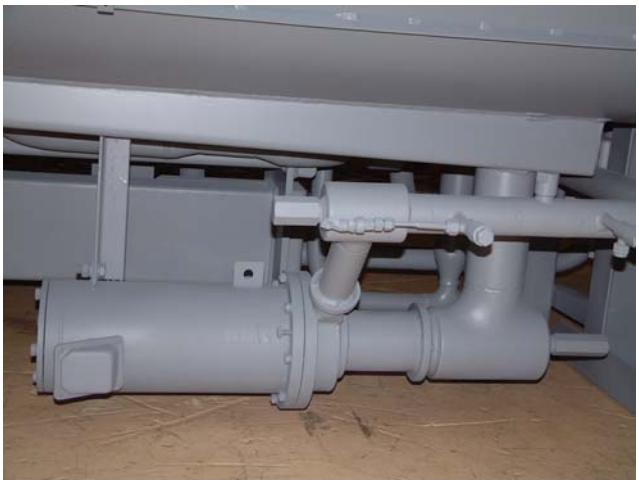
Low maintenance

Standard features allow simple maintenance procedures – Every 16DN machine has numerous standard design features that provide for convenient and simple maintenance. Hinged waterbox cover on the absorber, and condenser facilitate tube and waterbox inspection. A flange type refractory door on the high-stage generator simplifies inspection and cleaning of the combustion chamber and fire tubes. In addition, epoxy coating of the waterboxes and covers, standard on all machines, protects against corrosion and extends machine life. All moving parts are easily accessible for inspection or replacement, as required.

Factory-trained service organization – Carrier's extensive service organization offers trained and experienced service technicians in every major city. In addition to routine maintenance and repair services, Carrier also offers a wide array of preventative maintenance, full maintenance, and/or extended service contracts that can be custom tailored to any level of service.

Leak-proof hermetic pumps/motors cut maintenance costs – Carrier's proven solution and refrigerant pumps/motors are leak-proof, completely self-contained, and hermetically sealed. The hermetic design eliminates the need for a separate, complicated, and possibly leak-prone seal water system while providing leak tightness and longer machine life. Specially designed bearings absorb both radial and axial thrusts to ensure correct fit at all times. There is no possibility of external contamination since the fluid being pumped lubricates and cools the pump and motor assemblies. In addition, both the rotor and the stator are separated by a stainless steel liner that protects the windings from the fluid being pumped. As an additional safety feature, thermal overload switches are embedded in the stator to protect against high winding temperatures. The pumps are field serviceable. Inspection is recommended after 5 years or 20,000 hours of operation, whichever comes first. Pump isolation valves are included on 16DN machines to make field service easy, if required.

VIEW OF TYPICAL HERMETIC PUMP/MOTOR ASSEMBLIES



Reliable operation

Microprocessor control center continuously monitors machine operation, ensuring precise control – Each Carrier 16DN direct-fired chiller/heater includes a factory mounted and wired microprocessor control center that is functionally tested prior to shipment. Continuous monitoring and control of machine operation are performed automatically. A multi-language display on the front of the control center identifies operational status and fault indication. All control center components and the assembly will meet local codes including UL (Underwriters' Laboratories), CE, and KS where appropriate and include a microprocessor CPU (central processing unit) board, molded case circuit breaker, pump contactors, ambient compensated 3-phase pump overload protection, multi-tap control power transformer, and all other necessary safeties and controls.

As part of the start-up sequence, the chiller microprocessor control center and the burner combustion controller initiate a self-diagnostic system check to verify that all sensors are in range. Other standard features include a remote start/stop switch and a key-locked control center door that protects against unauthorized access.

16DN CONTROL CENTER

Superior corrosion protection – Absorption chillers must be protected from the possibility of internal corrosion that is always present when lithium bromide solution is in contact with internal machine surfaces. The Carrier 16DN absorption chiller/heater incorporates a highly effective corrosion inhibitor to provide an extra margin of protection against internal corrosion. Other inhibitors may require the use of exotic tube materials in certain heat exchangers since they are less effective and require frequent maintenance and analysis. The superior corrosion protection of the Carrier inhibitor allows for the use of standard copper tubes throughout the machine (except for the high-stage generator fire tubes that are made of carbon steel and the high temperature solution heat exchanger tubes made of cupronickel). This results in long machine life and dependable operation.

Rugged machine construction – Every Carrier 16DN chiller/heater offers numerous standard features designed to provide reliable, trouble-free operation. The machine is fabricated to meet stringent manufacturing and design requirements and is UL-listed to ensure product safety and machine integrity. Non-clogging, corrosion proof spray nozzles protect the 16DN from corrosion and blockage for continuous, reliable operation. Horizontally-positioned, carbon steel fire tubes with flue gas on the inside and lithium bromide on the outside are located above the combustion chamber to allow easy soot removal and tube cleaning. This design feature also prevents the flame inside the combustion chamber from direct contact with the fire tubes to ensure maximum life and reliability. A heated palladium cell is provided as a standard feature. As part of the purge system, the heated palladium cell assists in the removal of hydrogen gas from inside the 16DN. This action minimizes the need for manual evacuation of the purge storage chamber. The above standard features are evidence of Carrier's commitment to building a direct-fired, double effect chiller/heater able to withstand the most rigorous comfort cooling or light industrial applications.

Automatic, motorless purge system extends machine life and ensures optimum efficiency and performance – The purge system of an absorption chiller is critical to ensuring efficient operation and long machine life. Even when machines are vacuum tight or properly inhibited, all absorption chillers generate hydrogen and other noncondensable gases in small quantities. Since these gases are present in sufficient volume to interfere with proper machine operation, they must be removed to protect the unit from internal corrosion, lithium bromide solution crystallization, and/or a reduction in chiller capacity. Carrier's motorless purge system protects 16DN machines from these potential hazards by working continuously during machine operation.

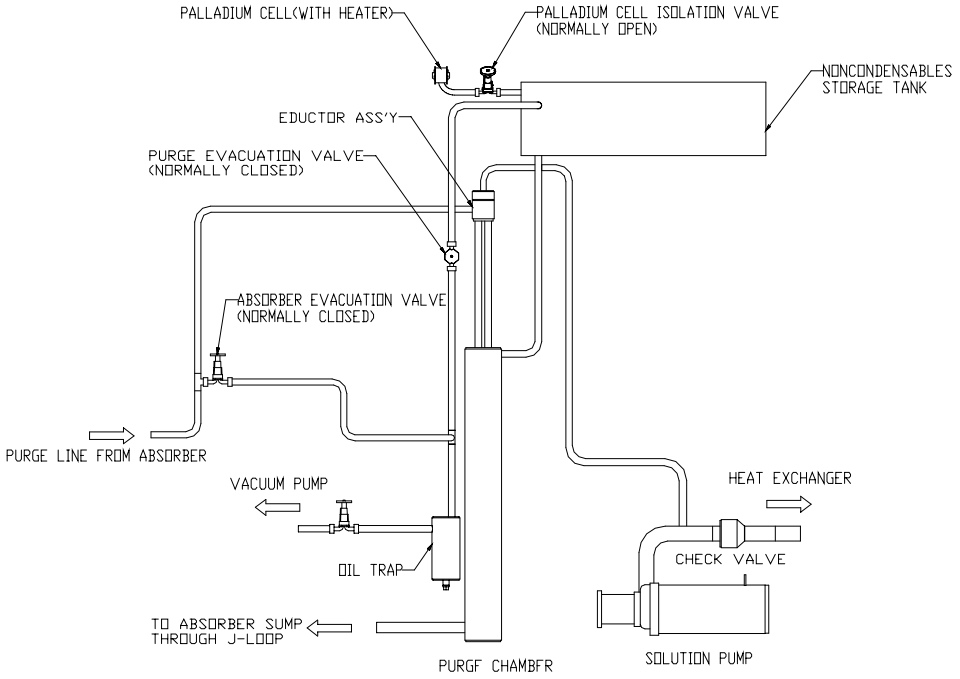
Motorless purge system operation – During operation, noncondensables tend to accumulate in the absorber section, which operates at the lowest internal pressure. A slip-stream of lithium bromide solution from the solution pump discharge flows through an eductor, creating a suction that draws noncondensables from the absorber. The noncondensables are then entrained by the solution flowing through the eductor. The eductor discharges the solution and noncondensables into a separator in a purge chamber, where the noncondensables are separated from the solution. The noncondensables flow to a storage tank, while the solution returns to the absorber sump. Typically, most of the noncondensable gas is composed of hydrogen, which is automatically dissipated to the atmosphere through a heated palladium cell.

As noncondensables accumulate in the external storage tank, they are isolated from the chiller and cannot reenter the machine (even during shutdown). These gases must periodically be exhausted (as required) from the storage tank by a simple procedure performed while the machine is running. Evacuation is performed by a unit-mounted vacuum pump that

Features/Benefits (cont)

is connected to the purge evacuation valve.
Evacuation through the vacuum pump is necessary because the palladium cell will be damaged if wetted by the lithium bromide solution. Therefore, pressurizing the purge tank above atmospheric pressure with lithium bromide solution is not permitted. The unit-mounted vacuum pump can also be used during chiller maintenance or service to remove non-condensables directly from the machine.

TYPICAL MOTORLESS PURGE OPERATION SCHEMATIC



MOTORLESS PURGE

Anti-crystallization controls maintain proper solution concentration – The 16DN automatically limits solution concentration in several ways to avoid both crystallization and overdilution to provide dependable, trouble-free operation. Crystallization of the lithium bromide solution depends on the combination of temperature and concentration. Carrier's concentration control system automatically monitors the refrigerant water level in the evaporator in conjunction with the solution temperature returning to the absorber. Because concentration varies with the amount of water in the lithium bromide solution, a rising evaporator level indicates less water in the solution and thus a higher solution concentration. When the refrigerant in the evaporator rises to a weir level, water is transferred from the evaporator to the absorber thus preventing overconcentration to ensure continuous, reliable operation even at cooling water temperature as low as 64.4 F (18 C). Overdilution (and possible refrigerant pump cavitation) shall be controlled by transferring an additional amount of refrigerant from the condenser to the evaporator.

The 16DN also incorporates a simple, passive method of control to correct any crystallization that would typically start to occur on the shellside of the low temperature solution heat exchanger under abnormal conditions. As the hot solution begins to back up in the generator, as a result of any shellside blockage, it rises above the overflow pipe and returns directly to the absorber. It is subsequently pumped through the tubeside (heating the shellside) to restore proper operation.

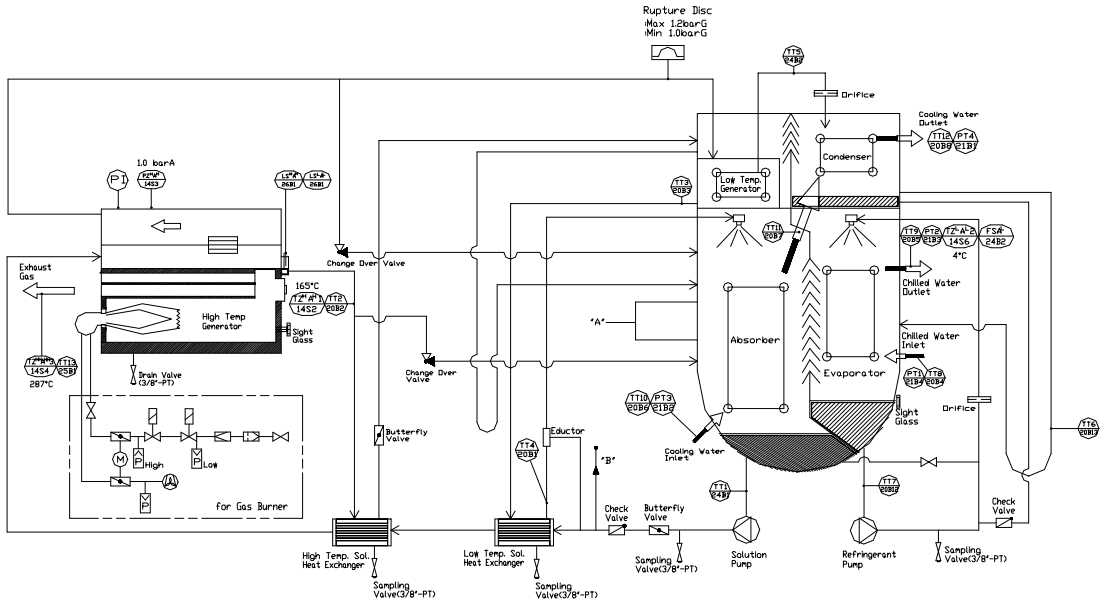
In addition, the 16DN automatic dilution cycle ensures proper concentration after unit shutdown so that the unit will not crystallize when the machine cools to ambient or machine room temperature. The dilution cycle controls operation of the pumps for a set period of time after shutdown to dilute the solution to prevent an overconcentration condition.

16DN direct-fired, double effect, absorption cooling cycle – The 16DN direct-fired double effect, absorption chiller/heater consists of an evaporator, absorber, condenser, high- and low-stage generators, solution heat exchangers, refrigerant/solution pumps, burner and gas train assembly, purge, controls and auxiliaries. Water is used as the refrigerant in vessels maintained under low absolute pressure (vacuum). In the cooling mode, the chiller operates on the principle that under vacuum, water boils at a low temperature. In this case water boils at approximately 40 F (4.4 C), thereby cooling the chilled water circulating through the evaporator tubes. A refrigerant pump is used to circulate the refrigerant water over the evaporator tubes to improve heat transfer.

To make the cooling process continuous, the refrigerant vapor must be removed as it is produced. To accomplish this, a lithium bromide solution (which has a high affinity for water) is used to absorb the water vapor. As this process continues, the lithium bromide becomes diluted, reducing its absorption capacity. A solution pump then transfers this weak (diluted) solution to the generators where it is reconcentrated in 2 stages to boil off the previously absorbed water. A variable frequency drive pump automatically maintains optimum solution flow to the generators at all operating conditions for maximum efficiency. The diluted solution is pumped to the high-stage generator where it is heated and reconcentrated to a medium concentration solution by the heat from the combustion of natural gas or No. 2 oil. The medium concentration solution from the high-stage generator flows to the low-stage generator where it is heated and reconcentrated to a strong solution by the high temperature water vapor released from the solution in the high-stage generator.

Since the low-stage generator acts as the condenser acts as the

16DN ABSORPTION COOLING & HEATING CYCLE (140 F [60 C])



Features/Benefits (cont)

condenser for the high-stage generator, the heat energy first applied in the high-stage generator is used again in the low-stage generator thus reducing the heat input by approximately 45% as compared to an absorption chiller with a single stage of reconcentration. The water vapor released in the shellside of the low-stage generator, in addition to the now condensed water vapor from the tubeside of the low-stage generator, enters the condenser to be cooled and returned to a liquid state. The refrigerant water then returns to the evaporator to begin a new cycle.

To remove heat from the machine, relatively cool water from a cooling tower or other source is first circulated through the tubes of the absorber to remove the heat of vaporization. The water is then circulated through the tubes of the condenser. The strong (reconcentrated) solution from the low-stage generator flows back to the absorber to begin a new cycle. For efficiency reasons, the medium concentration solution from the high-stage generator is passed through the high-temperature solution heat exchanger to pre-heat the weak solution, while pre-cooling the medium concentration solution. The strong solution from the low-stage generator is passed through the low-temperature solution heat exchanger to preheat/precool the solution before being returned to the absorber.

16DN direct-fired, double effect, absorption heating cycle – The 16DN direct-fired, double effect, absorption chiller/heater can also be operated in a non-simultaneous heating (only) mode to provide 140 F (60 C) hot water for space heating or other purposes without any additional components. In this mode, the cycle follows a different vapor flow path than that undertaken for cooling and does not use the absorption process. In addition, the absorber-condenser cooling water circuit is drained, and thus not operated, since all heat rejection from the machine is designed to take place through the evaporator (now the heating bundle) in a classic 2-pipe system which utilizes only the evaporator nozzles. High temperature water vapor produced in the high-stage generator section is passed directly to the evaporator via absorber where it condenses and transfers its heat to the water circulating through the evaporator tubes. This condensed water then flows to the absorber section where it mixes with the concentrated solution returning from the high-stage generator. The diluted solution is then pumped back to the high-stage generator to repeat the vapor generation phase for the heating function.

Options and accessories

ITEM	OPTION*	ACCESSORY+
250 psig (1724 kPa)/300 psig (2068 kPa) Waterboxes	X	
Special Tubing	X	
Unit Voltage (208, 230, 400, 460, or 575-3-60/50)	X	
Dual-Fuel Burner	X	
FM/IRI Approved Burner	X	
Low NO_X		X
Shipping Configuration (1 or 2-piece)	X	
Isolation Package		X
Condenser Water Flow Switch	X	

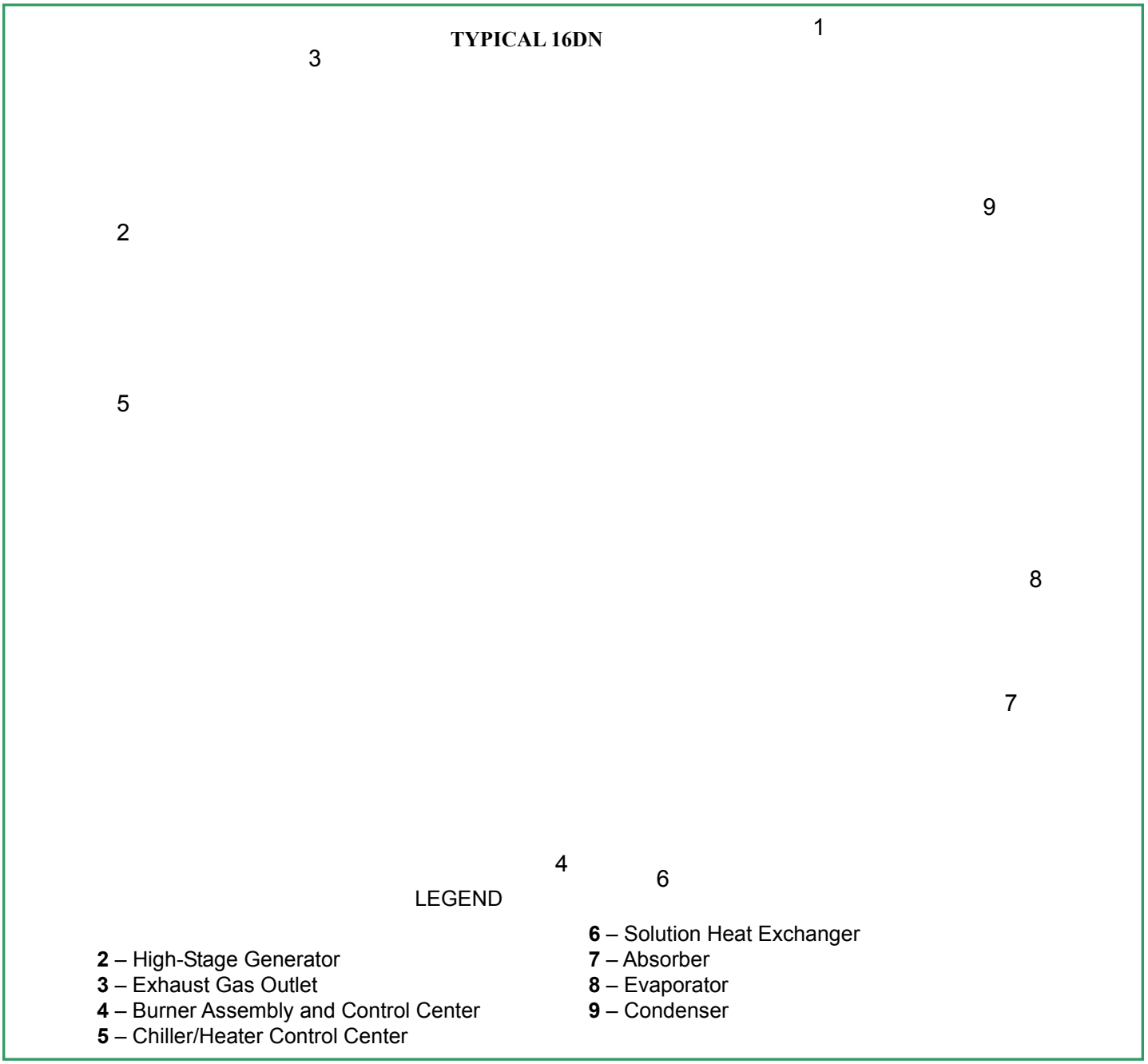
LEGEND

FM – Factory Mutual
IRI – Industrial Risk Insurers

*Factory installed.
+Field installed.

Machine components

TYPICAL 16DN



LEGEND

2 – High-Stage Generator
3 – Exhaust Gas Outlet
4 – Burner Assembly and Control Center
5 – Chiller/Heater Control Center
6 – Solution Heat Exchanger
7 – Absorber
8 – Evaporator
9 – Condenser

Physical data

ENGLISH

Unit 16DN	010	012	015	018	021	024
NOMINAL COOLING CAPACITY (ton)	100	120	150	180	021	024
RIGGING WEIGHT* (lb)						
Absorber/Evaporator/G2/Condenser	6,720	6,980	8,320	8,840	10,190	10,870
G1 (Includes Burner)	2,380	2,740	2,840	2,960	3,200	3,660
Total	9,100	9,720	11,160	11,800	13,390	14,530
OPERATING WEIGHT (lb)	12,560	13,260	14,950	15,940	18,170	19,620
LITHIUM BROMIDE SOLUTION CHARGE (gal)	154	154	156	169	190	202
REFRIGERANT (WATER) CHARGE (gal)	63	63	63	61	82	80
CHILLED/HOT WATER (Evap)						
Pipe Connection Size (in.)	4	4	4	4	5	5
No. Passes	4	4	3	3	3	3
COOLING WATER						
Pipe Connection Size (in.)	5	5	5	5	6	6
No. Passes						
Absorber	3	3	2	2	2	2
Condenser	1	1	1	1	1	1
GAS-TRAIN INLET						
Standard Pipe Connection Size, NPT (in.)	1.5	1.5	1.5	1.5	1.5	1.5
EXHAUST GAS OUTLET						
Nominal Flange Connection Size (in.)	11 x 8	11 x 8	11 x 8	11 x 8	12 x 12	12 x 12

Unit 16DN	028	033	036	040	045	050
NOMINAL COOLING CAPACITY (ton)	280	330	360	400	450	500
RIGGING WEIGHT* (lb)						
Absorber/Evaporator/G2/Condenser	12,940	13,450	14,370	15,480	19,140	19,510
G1 (Includes Burner)	4,010	4,540	5,220	5,930	7,140	7,940
Total	16,950	17,990	19,590	21,410	26,280	27,450
OPERATING WEIGHT (lb)	24,100	25,680	26,940	29,190	33,200	35,830
LITHIUM BROMIDE SOLUTION CHARGE (gal)	281	301	320	320	418	439
REFRIGERANT (WATER) CHARGE (gal)	116	114	132	132	122	119
CHILLED/HOT WATER (Evap)						
Pipe Connection Size (in.)	6	6	6	6	8	8
No. Passes	2	2	2	2	2	2
COOLING WATER						
Pipe Connection Size (in.)	8	8	8	8	10	10
No. Passes						
Absorber	2	2	2	2	2	2
Condenser	1	1	1	1	1	1
GAS-TRAIN INLET						
Standard Pipe Connection Size, NPT (in.)	1.5	1.5	1.5	1.5	1.5	1.5
EXHAUST GAS OUTLET						
Nominal Flange Connection Size (in.)	12 x 12	12 x 12	14 x 12	14 x 12	16 x 12	16 x 12

Unit 16DN	056	060	063	066	070
NOMINAL COOLING CAPACITY (ton)	560	600	630	660	700
RIGGING WEIGHT* (lb)					
Absorber/Evaporator/G2/Condenser	25,070	27,600	27,980	30,290	30,800
G1 (Includes Burner)	10,300	10,300	10,300	10,820	10,820
Total	35,370	37,900	38,280	41,110	41,620
OPERATING WEIGHT (lb)	49,210	52,470	53,090	56,880	57,620
LITHIUM BROMIDE SOLUTION CHARGE (gal)	530	564	564	609	609
REFRIGERANT (WATER) CHARGE (gal)	206	220	220	238	238
CHILLED/HOT WATER (Evap)					
Pipe Connection Size (in.)	8	8	8	8	8
No. Passes	2	2	2	2	2
COOLING WATER					
Pipe Connection Size (in.)	12	12	12	12	12
No. Passes					
Absorber	2	2	2	2	2
Condenser	1	1	1	1	1
GAS-TRAIN INLET					
Standard Pipe Connection Size, NPT (in.)	2	2	2	2	2
EXHAUST GAS OUTLET					
Nominal Flange Connection Size (in.)	20 x 14	20 x 14	20 x 14	20 x 14	20 x 14

G1 – High-Stage Generator

G2 – Low-Stage Generator

*Standard shipping configuration is 1-piece for sizes 010-050; 2-piece for sizes 056-070.

Physical data

SI

Unit 16DN	010	012	015	018	021	024
NOMINAL COOLING CAPACITY (kW)	352	422	528	633	739	844
RIGGING WEIGHT* (kg)						
Absorber/Evaporator/G2/Condenser	3,050	3,170	3,770	4,010	4,620	4,930
G1 (Includes Burner)	1,080	1,240	1,290	1,340	1,450	1,660
Total	4,130	4,410	5,060	5,350	6,070	6,590
OPERATING WEIGHT (kg)	5,700	6,020	6,780	7,230	8,243	8,900
LITHIUM BROMIDE SOLUTION CHARGE (kg)	950	950	960	1,040	1,170	1,240
REFRIGERANT (WATER) CHARGE (kg)	240	240	240	230	310	304
CHILLED/HOT WATER (Evap)						
Pipe Connection Size (in.)	4	4	4	4	5	5
No. Passes	4	4	3	3	3	3
COOLING WATER						
Pipe Connection Size (in.)	5	5	5	5	6	6
No. Passes						
Absorber	3	3	2	2	2	2
Condenser	1	1	1	1	1	1
GAS-TRAIN INLET						
Standard Pipe Connection Size, NPT (in.)	1.5	1.5	1.5	1.5	1.5	1.5
EXHAUST GAS OUTLET						
Nominal Flange Connection Size (mm.)	280 x 210	280 x 210	280 x 210	280 x 210	310 x 310	310 x 310

Unit 16DN	028	033	036	040	045	050
NOMINAL COOLING CAPACITY (kW)	985	1161	1266	1407	1583	1758
RIGGING WEIGHT* (kg)						
Absorber/Evaporator/G2/Condenser	5,870	6,100	6,520	7,020	8,680	8,850
G1 (Includes Burner)	1,820	2,060	2,370	2,690	3,240	3,600
Total	7,690	8,160	8,890	9,710	11,920	12,450
OPERATING WEIGHT (kg)	10,930	11,650	12,220	13,240	15,060	15,800
LITHIUM BROMIDE SOLUTION CHARGE (kg)	1,730	1,850	1,970	1,970	2,570	2,700
REFRIGERANT (WATER) CHARGE (kg)	440	430	500	500	460	450
CHILLED/HOT WATER (Evap)						
Pipe Connection Size (in.)	6	6	6	6	8	8
No. Passes	2	2	2	2	2	2
COOLING WATER						
Pipe Connection Size (in.)	8	8	8	8	10	10
No. Passes						
Absorber	2	2	2	2	2	2
Condenser	1	1	1	1	1	1
GAS-TRAIN INLET						
Standard Pipe Connection Size, NPT (in.)	1.5	1.5	1.5	1.5	1.5	1.5
EXHAUST GAS OUTLET						
Nominal Flange Connection Size (mm.)	310 x 310	310 x 310	360 x 310	360 x 310	410 x 310	410 x 310

Unit 16DN	056	060	063	066	070
NOMINAL COOLING CAPACITY (kW)	1,969	2,110	2,216	2,321	2,462
RIGGING WEIGHT* (kg)					
Absorber/Evaporator/G2/Condenser	11,370	12,520	12,690	13,740	13,970
G1 (Includes Burner)	4,670	4,670	4,670	4,910	4,910
Total	16,040	17,190	17,360	18,650	18,880
OPERATING WEIGHT (kg)	22,320	23,800	24,080	25,800	26,130
LITHIUM BROMIDE SOLUTION CHARGE (kg)	3,260	3,470	3,470	3,750	3,750
REFRIGERANT (WATER) CHARGE (kg)	780	830	830	900	900
CHILLED/HOT WATER (Evap)					
Pipe Connection Size (in.)	8	8	8	8	8
No. Passes	2	2	2	2	2
COOLING WATER					
Pipe Connection Size (in.)	12	12	12	12	12
No. Passes					
Absorber	2	2	2	2	2
Condenser	1	1	1	1	1
GAS-TRAIN INLET					
Standard Pipe Connection Size, NPT (in.)	2	2	2	2	2
EXHAUST GAS OUTLET					
Nominal Flange Connection Size (mm.)	500 x 350	500 x 350	500 x 350	500 x 350	500 x 350

G1 – High-Stage Generator

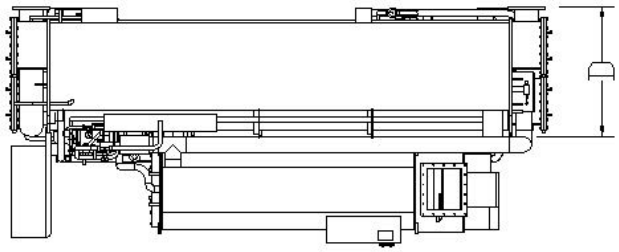
G2 – Low-Stage Generator

*Standard shipping configuration is 1-piece for sizes 010-050; 2-piece for sizes 056-070.

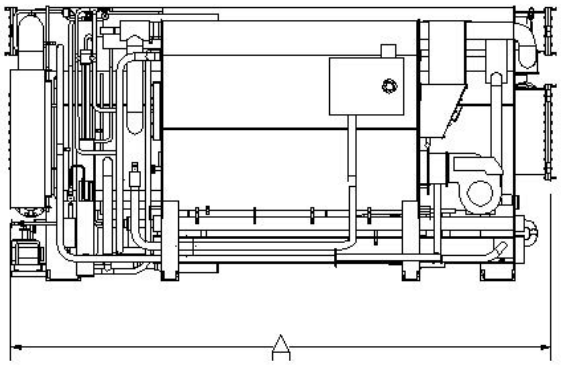
Dimensions

16DN SIZES 010-070

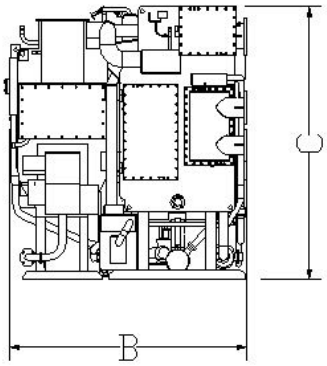
TOP VIEW



SIDE VIEW



TYPICAL END VIEW



DIMENSIONS (ft-in.)

UNIT 16DN	010	012	015	018	021	024	028	033	036	040	045	050	056	060	063	066	070
Overall Length A	9- 9	9- 9	11-11	11-11	12- 1	12- 1	15- 8	15- 8	15- 9	15- 9	16- 0	16- 0	16-9	18- 6	18- 6	20- 2	20- 2
Overall Width B	5-11	5-11	6- 2	6- 2	6- 8	6- 8	6-10	6-10	7- 7	7- 7	8- 2	8- 2	9- 9	9- 9	9- 9	9- 9	9- 9
Overall Height C	6-10	6-10	6- 9	6- 9	7- 7	7- 7	7-10	7-10	8- 8	8- 8	9- 4	9- 4	9-11	9-11	9-11	9-11	9-11
Width D*	4- 3	4- 3	4- 0	4- 0	4- 4	4- 4	4- 8	4- 8	4- 9	4- 9	5- 2	5- 2	6- 3	6- 3	6- 3	6- 3	6- 3

DIMENSIONS (mm)

UNIT 16DN	010	012	015	018	021	024	028	033	036	040	045	050	056	060	063	066	070
Overall Length A	2,966	2,966	3,638	3,638	3,679	3,679	4,780	4,780	4,788	4,788	4,867	4,867	5,100	5,634	5,634	6,142	6,142
Overall Width B	1,797	1,797	1,830	1,830	2,034	2,034	2,072	2,072	2,299	2,299	2,493	2,493	2,973	2,973	2,973	2,973	2,973
Overall Height C	2,082	2,082	2,056	2,056	2,313	2,313	2,381	2,381	2,630	2,630	2,820	2,820	3,016	3,016	3,016	3,016	3,016

Performance data

ENGLISH

UNIT 16DN	010	012	015	018	021	024
COOLONG CAPACITY (ton)	100	120	150	180	210	240
HEATING CAPACITY (MBh)	1,002	1,202	1,503	1,803	2,104	2,404
CHILLED WATER						
Flow Rate (gpm)	240	288	360	432	504	576
Pressure Drop (ft)	19.6	21.2	25.1	27.2	26.1	26.7
COOLING WATER						
Flow Rate (gpm)	400	480	600	720	840	960
Pressure Drop (ft)	14.1	15.4	21.3	24.4	17.2	19.1
HOT WATER						
Flow Rate (gpm)	195	234	292	351	409	468
Pressure Drop (ft)	11.6	12.9	14.7	16.3	15.2	15.8
FUEL CONSUMPTION						
Natural Gas (MBh)	1,188	1,426	1,782	2,139	2,495	2,851
No. 2 Oil (gph)	8.5	10.2	12.7	15.3	17.8	20.4
COEFFICIENT OF PERFORMANCE (COP)						
Natural Gas	1.01	1.01	1.01	1.01	1.01	1.01
No. 2 Oil	1.01	1.01	1.01	1.01	1.01	1.01

UNIT 16DN	028	033	036	040	045	050
COOLONG CAPACITY (ton)	280	330	360	400	450	500
HEATING CAPACITY (MBh)	2,805	3,306	3,607	4,008	4,509	5,010
CHILLED WATER						
Flow Rate (gpm)	672	792	864	960	1,080	1,200
Pressure Drop (ft)	17.5	18.4	18.1	18.6	18.1	18.2
COOLING WATER						
Flow Rate (gpm)	1,120	1,320	1,440	1,600	1,800	2,000
Pressure Drop (ft)	26.0	27.8	30.4	31.9	28.1	29.0
HOT WATER						
Flow Rate (gpm)	546	643	701	779	877	974
Pressure Drop (ft)	10.2	10.9	10.9	11.4	10.4	10.6
FUEL CONSUMPTION						
Natural Gas (MBh)	3,327	3,921	4,277	4,752	5,347	5,941
No. 2 Oil (gph)	23.8	28.0	30.6	33.9	38.2	42.4
COEFFICIENT OF PERFORMANCE (COP)						
Natural Gas	1.01	1.01	1.01	1.01	1.01	1.01
No. 2 Oil	1.01	1.01	1.01	1.01	1.01	1.01

UNIT 16DN	056	060	063	066	070
COOLONG CAPACITY (ton)	560	600	630	660	700
HEATING CAPACITY (MBh)	5,611	6,012	6,313	6,613	7,014
CHILLED WATER					
Flow Rate (gpm)	1,344	1,440	1,512	1,584	1,680
Pressure Drop (ft)	12.4	16.3	16.7	21.3	21.7
COOLING WATER					
Flow Rate (gpm)	2,240	2,400	2,520	2,640	2,800
Pressure Drop (ft)	18.9	25.5	25.8	33.4	33.8
HOT WATER					
Flow Rate (gpm)	1,091	1,169	1,228	1,286	1,364
Pressure Drop (ft)	9.7	12.7	13.1	16.5	17.0
FUEL CONSUMPTION					
Natural Gas (MBh)	6,653	7,129	7,485	7,842	8,317
No. 2 Oil (gph)	47.5	50.9	53.5	56.0	59.4
COEFFICIENT OF PERFORMANCE (COP)					
Natural Gas	1.01	1.01	1.01	1.01	1.01
No. 2 Oil	1.01	1.01	1.01	1.01	1.01

LEGEND

ARI – Air Conditioning and Refrigeration Institute
HHV – Higher Heating Value
MBh – Btuh in thousands

Note: Ratings are based on ARI 560, latest edition, 54/44 F (2.4 gpm/ton) chilled water; 85 F (4.0 gpm/ton) cooling water; 130/140 F hot water; fouling factor .00025 ft^2-hr-°F/Btu for absorber and condenser, .0001 ft^2-hr-°F/Btu for evaporator; natural gas heating value 1,000 Btu/ft^3 (HHV); No 2 oil heating value 140,000 Btu/gal.

SI

UNIT 16DN	010	012	015	018	021	024
COOLONG CAPACITY (kW)	352	422	528	633	739	844
HEATING CAPACITY (kW)	294	352	440	528	616	704
CHILLED WATER						
Flow Rate (L/s)	15.1	18.1	22.7	27.3	31.8	36.3
Pressure Drop (kPa)	58.5	63.4	75.0	81.2	77.9	79.7
COOLING WATER						
Flow Rate (L/s)	25.3	30.4	37.9	45.4	53.0	60.6
Pressure Drop (kPa)	42.0	46.1	63.6	72.9	51.3	57.0
HOT WATER						
Flow Rate (L/s)	12.3	14.8	18.4	22.1	25.8	29.5
Pressure Drop (kPa)	34.8	38.4	44.1	48.6	45.6	47.3
FUEL CONSUMPTION						
Natural Gas (M^3/hr)	33.6	40.4	50.5	60.6	70.7	80.7
No. 2 Oil (L/hr)	32.1	38.6	48.2	57.8	67.5	77.1
COEFFICIENT OF PERFORMANCE (COP)						
Natural Gas	1.01	1.01	1.01	1.01	1.01	1.01
No. 2 Oil	1.01	1.01	1.01	1.01	1.01	1.01

UNIT 16DN	028	033	036	040	045	050
COOLONG CAPACITY (kW)	985	1161	1,266	1,407	1,583	1,758
HEATING CAPACITY (kW)	821	968	1,055	1,173	1,319	1,466
CHILLED WATER						
Flow Rate (L/s)	42.4	50.0	54.5	60.6	68.1	75.7
Pressure Drop (kPa)	52.4	54.9	54.2	55.7	54.1	54.5
COOLING WATER						
Flow Rate (L/s)	70.7	83.3	90.8	100.9	113.6	126.2
Pressure Drop (kPa)	77.8	83.0	90.9	95.2	83.9	86.8
HOT WATER						
Flow Rate (L/s)	34.4	40.6	44.3	49.2	55.3	61.5
Pressure Drop (kPa)	30.6	32.6	32.6	34.1	31.1	31.6
FUEL CONSUMPTION						
Natural Gas (M^3/hr)	94.2	111.0	121.1	134.6	151.4	168.2
No. 2 Oil (L/hr)	90.0	106.0	115.7	128.5	144.6	160.6
COEFFICIENT OF PERFORMANCE (COP)						
Natural Gas	1.01	1.01	1.01	1.01	1.01	1.01
No. 2 Oil	1.01	1.01	1.01	1.01	1.01	1.01

UNIT 16DN	056	060	063	066	070
COOLONG CAPACITY (kW)	1,969	2,110	2,216	2,321	2,462
HEATING CAPACITY (kW)	1,644	1,762	1,850	1,938	2,056
CHILLED WATER					
Flow Rate (L/s)	84.7	90.7	95.3	99.8	105.9
Pressure Drop (kPa)	36.9	48.8	49.9	63.6	65.0
COOLING WATER					
Flow Rate (L/s)	141.8	151.9	159.5	167.1	177.2
Pressure Drop (kPa)	56.6	76.3	77.1	99.8	100.9
HOT WATER					
Flow Rate (L/s)	68.9	73.8	77.5	81.2	86.1
Pressure Drop (kPa)	29.0	38.0	39.1	49.4	50.7
FUEL CONSUMPTION					
Natural Gas (M^3/hr)	188.4	201.9	212.0	222.1	235.5
No. 2 Oil (L/hr)	179.9	192.8	202.4	212.0	224.9
COEFFICIENT OF PERFORMANCE (COP)					
Natural Gas	1.01	1.01	1.01	1.01	1.01
No. 2 Oil	1.01	1.01	1.01	1.01	1.01

LEGEND

ARI – Air Conditioning and Refrigeration Institute
HHV – Higher Heating Value

Note: Ratings are based on ARI 560, latest edition, 12.2/6.7 C (.043 L/s-kW) chilled water; 29.4 C (.072 L/s-kW) cooling water; 54.4/60 C hot water; fouling factor .000044 m^2-hr-ºC/W for absorber and condenser, .0000176 m^2-hr-ºC/W for evaporator; natural gas heating value 8899 kcal/m^3 (HHV); No 2 oil heating value 9320 kcal/L

Fuel heating values

In accordance with ARI 560, latest edition, performance ratings of the Carrier 16DN are based on the gross or higher heating value (HHV) of the fuel employed which accounts for condensation of water vapor formed during the combustion process. In comparison, the net or lower heating value (LHV) is approximately 90% of the higher heating value, since it does not account for the latent heat of vaporization of water formed during combustion. The use of higher heating value is a customary practice in North America. Typical HHVs are 1,000 Btu/ft^3 (8,889 kcal/m^3) and 140,000 Btu/gal (9,320 kcal/L) for No. 2 oil. Actual HHV may differ and will directly impact the required *volumetric* flow rate of the fuel. The required MBh (Btuh in thousands) input to the burner remains unchanged.

Part-load performance

To determine part-load performance, refer to the 16DN Part-Load Performance curve shown below. This curve depicts Fuel Consumption Ratio (FCR) versus Percent Capacity at several cooling water temperatures and in accordance with the ARI load line which is based on a 2.5 F (1.4 C) reduction in cooling water temperature for every 10% reduction in load.

Fuel requirements at part-load can be calculated with one of the following equations:

Gas: Fuel Consumption MBh = Full Load Consumption (MBh) x FCR x Percent Capacity

Oil: Fuel Consumption (gph) = Full Load Oil Consumption (gph) x FCR x Percent Capacity

Fuel consumption for natural gas, expressed as a volumetric flow rate (ft^3/hr), is determined by dividing the fuel consumption (in units of Btuh) by the higher heating value of the natural gas (in units of Btu/ft^3).

As shown on the part-load performance curve, the continuous operating range for the 16DN is approximately 25 to 100% of full load when operated on either natural gas or No. 2 oil, based on minimum fire requirements of the burner. Below 25% the burner will cycle on and off to meet the required load and water temperature.

ARI 560, latest version, defines Integrated Part Load Value (IPLV) as a measure of part-load efficiency representing the weighted average of overall chiller performance calculated by the following equation:

IPLV = .01A + .42B + .45C + .12D

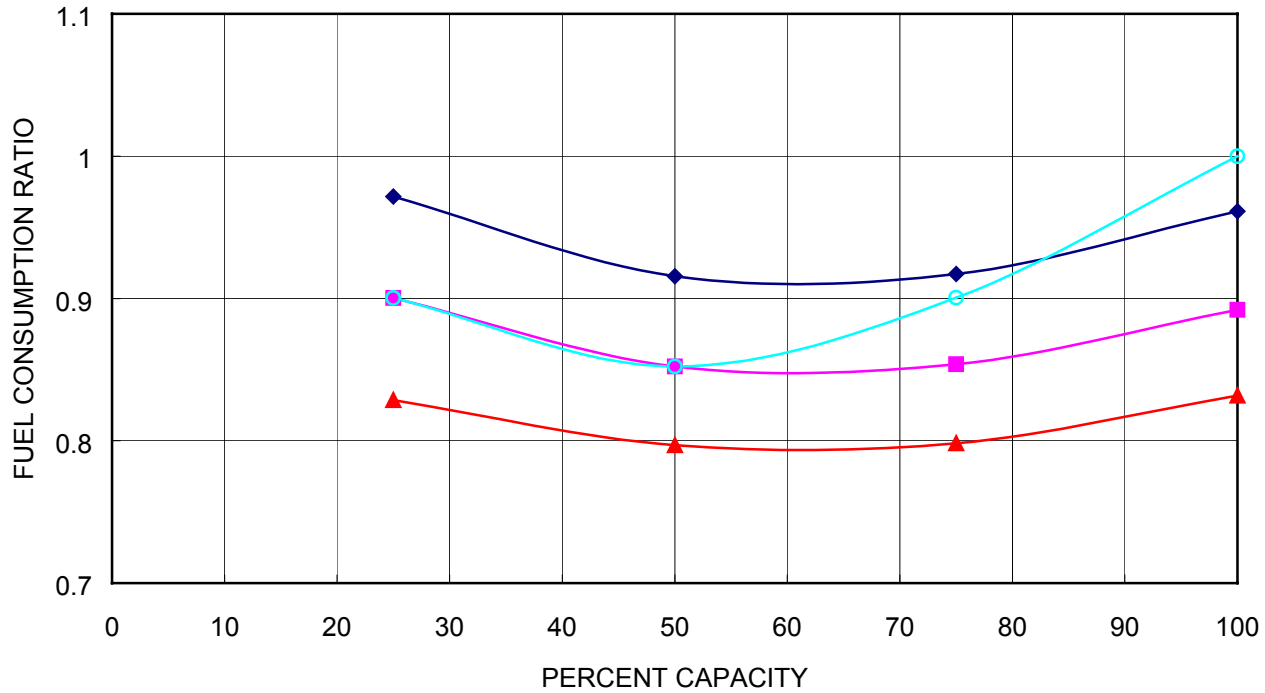
Where A = COP at 100%
B = COP at 75%
C = COP at 50%
D = COP at 25% or minimum load

NOTE: COP is the Coefficient of Performance.

Therefore,

IPLV = .01 (1.01) + .42 (1.15) + .45 (1.21) + .12 (1.15)
= 1.17

16DN PART-LOAD PERFORMANCE



Application data

Vent and drain connections

All vents and drain connections are found on the waterbox covers. Connection size is 3/4-in. FPT.

Provide high points of the machine piping system with vents and the low points with drains. If shutoff valves are provided in the main water pipes near the unit, a minimum amount of the system water is lost when the heat exchangers are drained.

It is recommended that pressure gages be provided at points of entering and leaving water to measure pressure drop through the heat exchanger. Gages may be installed as shown in the table below. Pressure gages installed at the vent and drain connections do not include nozzle pressure losses.

Use a reliable manometer to measure pressure differential when determining water flow. Regular gages are insensitive and do not provide accurate measurement of flow conditions.

NUMBER OF PASSES	GAGE LOCATION
1, 3	One gage in each waterbox
2, 4	Two gages in waterbox with nozzles

Range of application

The 16DN absorption chiller/heater is designed for standard water chilling applications of 100 to 700 tons (352 to 2462 kW) at standard ARI rating conditions.

UL listing

The burner assembly, unit control center, machine mounted controls, wiring, and the entire chiller/heater are listed together as a whole, in accordance with the requirements of UL-795, UL-726, UL-296, and UL-465, as well as other associated UL standards as applicable.

Rupture disk piping

The 16DN is equipped with a rupture disk (optional) or a fusible plug on the high-stage generator. It is recommended that piping from these devices be routed to appropriate areas away from the machine in accordance with Carrier's written installation instructions, the current version of ANSI/ASHRAE 15 (American Society of Heating, Refrigeration, and Air Conditioning Engineers), and any local jurisdictional requirements that may apply. Piping should be adequately supported and the proper fittings should be provided to allow periodic inspection of the disk. Refer to Carrier certified drawings for exact location of the rupture disk on the chiller.

UNIT SIZE	RUPTURE DISK CONNECTION SIZE
16DN010-070	3 in. 300 psig RF flange

LEGEND
RF – Raised Face

MATERIAL SPECIFICATIONS

ITEM		MATERIAL	SPECIFICATIONS
SHELL:			
	Evaporator	Steel	ASTM A283
	Absorber	Steel	ASTM A283
	Condenser	Steel	ASTM A283
	G1 Generator	Steel	ASTM A283
	G2 Generator	Steel	ASTM A283
TUBESHEET:			
	Evaporator	Steel	ASTM A283
	Absorber	Steel	ASTM A283
	Condenser	Steel	ASTM A283
	G1 Generator	Steel	ASTM A283
	G2 Generator	Steel	ASTM A283
WATERBOX:			
	Evaporator	Steel	ASTM A283
	Absorber	Steel	ASTM A283
	Condenser	Steel	ASTM A283
	G1 Generator	Steel	ASTM A283
	G2 Generator	Steel	ASTM A283
TUBES:			
	Evaporator	Copper	ASME SB359
	Absorber	Copper	ASME SB75
	Condenser	Copper	ASME SB75
	G1 Generator	Steel	ASTM A53
	G2 Generator	Copper	ASME SB75
PIPING		Steel	ASTM A53

LEGEND
ASME – American Society of Mechanical Engineers
ASTM -- American Society for Testing and Materials
G1 -- High-Stage Generator
G2 -- Low-Stage Generator

Thermal insulation

Application of cold/hot surface thermal insulation should be done after final installation at jobsite and machine leak integrity has been verified. Refer to Carrier certified drawings for material specifications and recommended chiller/heater insulation requirements.

THERMAL INSULATION SURFACE AREA REQUIREMENTS – ENGLISH (FT^2)

UNIT SIZE	010,012	015, 018	021, 024	028, 033	036, 040	045, 050	056	060, 063	066, 070
COLD SURFACE	47.4	63.5	72.1	77.5	91.5	105.5	128.1	138.9	148.6
HOT SURFACE	122.7	170.9	194.9	235.8	268.0	313.3	377.9	377.9	385.4

THERMAL INSULATION SURFACE AREA REQUIREMENTS – SI (m^2)

UNIT SIZE	010,012	015, 018	021, 024	028, 033	036, 040	045, 050	056	060, 063	066, 070
COLD SURFACE	4.4	5.9	6.7	7.2	8.5	9.8	11.9	12.9	13.8
HOT SURFACE	11.4	15.9	18.1	21.9	24.9	29.1	35.1	35.1	35.8

STANDARD WATERBOX AND CROSSOVER PIPE CONFIGURATION

16DN UNIT	EVAPORATOR		ABSORBER		CONDENSER		CROSS-OVER PIPE
	Inlet	Outlet	Inlet	Outlet	Inlet	Outlet	
010-070	N	N	M	M	M	M	Included

LEGEND

M -- Marine Waterbox

N -- Nozzle-In-Head Waterbox

HEAT EXCHANGER STANDARD PASS AND NOZZLE ARRANGEMENT

16DN	EVAPORATOR		ABSORBER		CONDENSER	
	Pass	Inlet	Pass	Inlet	Pass	Inlet
010-012	4	L or R	2	L	1	L
015-024	3	L or R	2	L	1	L
028-070	2	L or R	2	L	1	L

LEGEND

L -- Left End Inlet

R -- Right End Inlet

HEAT EXCHANGER MINIMUM/MAXIMUM FLOW RATES* -- ENGLISH (gpm)

16DN SIZE	EVAPORATOR							
	1-Pass		2-Pass		3-Pass		4-Pass	
	Min	Max	Min	Max	Min	Max	Min	Max
010	–	–	218	868	145	578	114	453
012	–	–	260	1043	175	694	136	529
015	–	–	218	868	145	578	114	453
018	–	–	260	1043	175	694	136	529
021	–	–	316	1264	211	844	159	632
024	–	–	348	1393	232	929	175	697
028	619	2472	310	1242	207	827	–	–
033	722	2888	362	1447	161	965	–	–
036	779	3132	390	1553	260	1043	–	–
040	861	3463	432	1731	287	1154	–	–
045	969	3894	486	1946	333	1298	–	–
050	1075	4326	538	2162	359	1440	–	–
056	1075	4326	538	2162	359	1440	–	–
060	1075	4326	538	2162	359	1440	–	–
063	1075	4326	538	2162	359	1440	–	–
066	1075	4326	538	2162	359	1440	–	–
070	1075	4326	538	2162	359	1440	–	–

*Flow rates based on standard tubes. Minimum flow based on tube velocity of 3 ft/sec; maximum flow based on 12 ft/sec.

HEAT EXCHANGER MINIMUM/MAXIMUM FLOW RATES* -- SI (L/s)

16DN SIZE	EVAPORATOR							
	1-Pass		2-Pass		3-Pass		4-Pass	
	Min	Max	Min	Max	Min	Max	Min	Max
010	–	–	14	54	9	36	7	27
012	–	–	17	65	11	43	9	32
015	–	–	14	54	9	36	7	27
018	–	–	17	65	11	43	9	32
021	–	–	20	79	14	53	10	39
024	–	–	22	87	15	59	11	44
028	39	156	20	78	13	52	–	–
033	46	182	23	91	10	60	–	–
036	50	197	25	98	17	65	–	–
040	55	218	28	109	19	72	–	–
045	62	245	31	122	21	81	–	–
050	68	272	34	136	23	90	–	–
056	68	272	34	136	23	90	–	–
060	68	272	34	136	23	90	–	–
063	68	272	34	136	23	90	–	–
066	68	272	34	136	23	90	–	–
070	68	272	34	136	23	90	–	–

*Flow rates based on standard tubes. Minimum flow based on tube velocity of .9 m/sec; maximum flow based on 3.6 m/sec.

16DN SIZE	ABSORBER-CONDENSER			
	2-Pass/1-Pass		3-Pass/1-Pass	
	Min	Max	Min	Max
010	–	–	293	983
012	–	–	355	1182
015	362	1169	–	–
018	409	1401	–	–
021	536	2073	–	–
024	611	2373	–	–
028	576	2044	–	–
033	674	2387	–	–
036	666	2631	–	–
040	746	2931	–	–
045	830	3301	–	–
050	922	3660	–	–
056	922	3660	–	–
060	922	3660	–	–
063	922	3660	–	–
066	922	3660	–	–
070	922	3660	–	–

*Flow rates based on standard tubes. Minimum flow based on tube velocity of 3 ft/sec; maximum flow based on 12 ft/sec.

16DN SIZE	ABSORBER-CONDENSER			
	2-Pass/1-Pass		3-Pass/1-Pass	
	Min	Max	Min	Max
010	–	–	19	61
012	–	–	22	73
015	23	73	–	–
018	26	88	–	–
021	34	130	–	–
024	38	149	–	–
028	37	129	–	–
033	43	150	–	–
036	42	166	–	–
040	47	184	–	–
045	53	208	–	–
050	59	230	–	–
056	59	230	–	–
060	59	230	–	–
063	59	230	–	–
066	59	230	–	–
070	59	230	–	–

*Flow rates based on standard tubes. Minimum flow based on tube velocity of .9 m/sec; maximum flow based on 3.6 m/sec.

Application data (cont)

Burner mounting

Depending on unit size, burner assemblies on the 16DN are either factory-installed as an integral part of the chiller or shipped as a separate component for field installation. The 16DN010-070 models are shipped with the burner factory-installed in the high-stage generator.

On models where field-installation is required, rigging should be used to position both the front plate assembly and the burner assembly because of their heavy weights. For the front plate, either webbed strapping placed around the re-factory or a lifting bar in the center opening may be used.

For burner assemblies that do not have lifting lugs, place webbed strapping around a central balance area of the burner. Rig burner assemblies that have lifting lugs in accordance with standard rigging procedures.

STANDARD BURNER CONFIGURATION

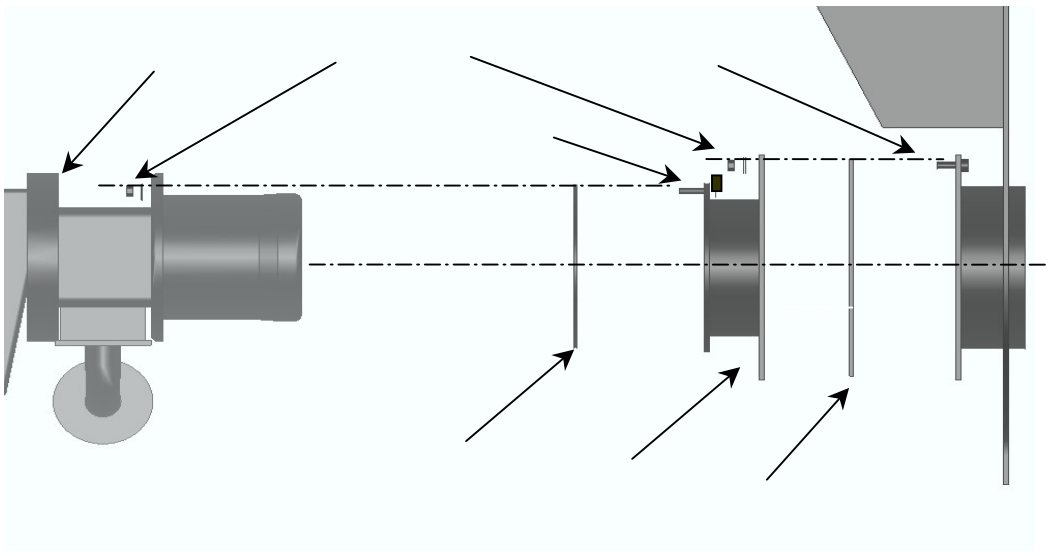
UNIT 16DN	WEISHAUPT BURNER MODEL NO.	STANDARD GAS SUPPLY PRESSURE RANGE	MAXIMUM FIRING RATE GAS (MBh)	MAXIMUM FIRING RATE OIL (gph)
010	RGL3	40 to 120 in. wg	1,188	8.5
012	RGL3	40 to 120 in. wg	1,426	10.2
015	RGL3	40 to 120 in. wg	1,782	12.7
018	RGL3	40 to 120 in. wg	2,139	15.3
021	RGL5	40 to 120 in. wg	2,495	17.8
024	RGL5	40 to 120 in. wg	2,851	20.4
028	RGL5	40 to 120 in. wg	3,327	23.8
033	RGL7	40 to 120 in. wg	3,921	28.0
036	RGL7	40 to 120 in. wg	4,277	30.6
040	RGL7	40 to 120 in. wg	4,752	33.9
045	RGL7	40 to 120 in. wg	5,347	38.2
050	RGL7	40 to 120 in. wg	5,941	42.4
056	RGL8	40 to 120 in. wg	6,653	47.5
060	RGL8	40 to 120 in. wg	7,129	50.9
063	RGL8	40 to 120 in. wg	7,485	53.5
066	RGL8	40 to 120 in. wg	7,842	56.0
070	RGL8	40 to 120 in. wg	8,317	59.4

LEGEND

MBh -- Btuh in thousands

NOTE: Actual gas train size is dependent on gas pressure, agency approvals, gas specifications, burner input and the required burner manifold gas pressure. Higher gas pressures than those listed above are available.

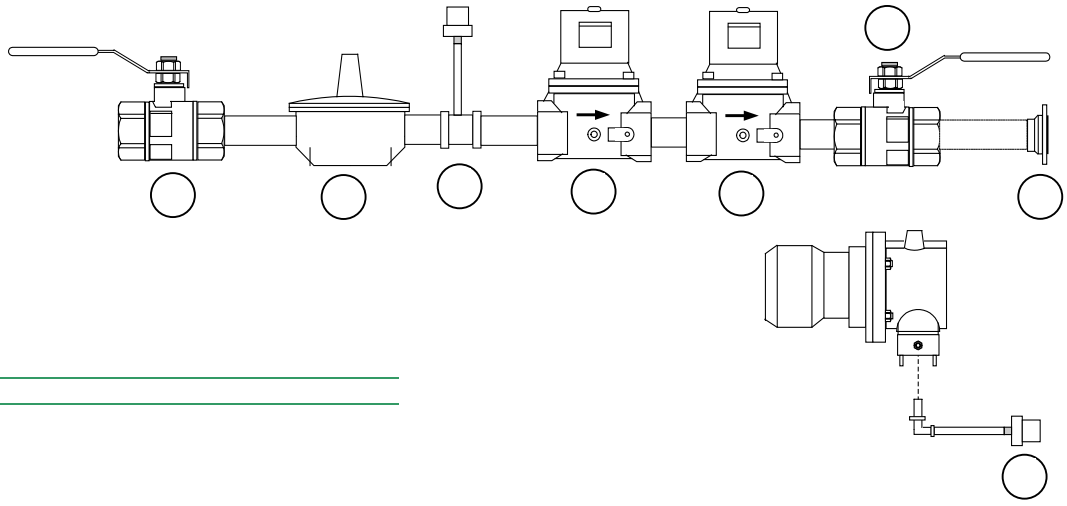
TYPICAL BURNER MOUNTING



Fuel systems

The gas train and oil supply systems are supplied pre-assembled and with pre-installed interconnection fittings. Specific fuel system components and instrumentation will vary depending on local regulations, codes, and ordinances and on the particular job requirements. UL certification is standard on every system supplied with an option to provide FM (Factory Mutual), IRI (Industrial Risk Insurers) or other code requirements that may be necessary.

TYPICAL GAS TRAIN



TYPICAL OIL SUPPLY SYSTEM

10

12

5

: Supply Line

4

: Return Line

7

6

3

2

11

8

9

1

13

14

ITEM	DESCRIPTION
1	Oil Pump without Oil Solenoid
2	Filter
3	Oil Solenoid
4	Oil Solenoid
5	Nozzle Holder with Integral Shutoff Device
6	Oil Solenoid
7	Oil Flow Regulator
8	Oil Pressure Switch
9	Oil Solenoid
10	Nozzle Supply Line
11	Nozzle Return Line
12	Nozzle Control Circuit
13	System Return Line
14	System Supply Line

Application data (cont)

Combustion air supply

An adequate supply of combustion air is required by the burner for proper, efficient operation and to ensure complete combustion. It is recommended that excess air be provided to the burner to account for variations in fuel properties and air/fuel supply rates. As a general rule, 12 cu ft of combustion air should be supplied for every 1000 Btu of fuel provided to the burner. This equates to approximately 20% excess air for natural gas and ensures complete combustion and efficient operation while minimizing smoke, soot, and the formation of carbon monoxide (CO) and nitrogen oxides (No_x). The source of combustion air to the burner should be in accordance with all local codes and regulations.

Exhaust gas flue and stack recommendations

Design and construction of the flue stack should comply with all municipal, state, and federal codes and regulations, as applicable. Typical exhaust gas temperature for the 16DN is 375 F (190 C). However, the stack design temperature should be no less than 675 F (360). It is recommended that insulated, double-wall, round ducting be used in all applications. Flat-sided ducting should not be used since it has a tendency to flex. Flexing causes pulsations in the flue stack, inefficient combustion, and possibly erratic chiller/heater operation. Proper stack design should allow continuous flow by avoiding sharp bends and should be sized to maintain a static pressure between 0 to –0.20 in. wg (0 to –5 mm) at the stack entrance. Use of a barometric damper or sequential motorized draft control is required to properly regulate exhaust gas static pressure and maintain optimum performance. A vent cap, lighting arrestor, and provisions for a condensate drain are also required.

Cross-sectional area of the stack is determined by calculating the volumetric flow rate of the exhaust gases and then selecting a diameter that results in an exhaust gas velocity of no greater that 12 to 15 ft/sec (3.6 to 4.6 m/sec).

Height of the stack is determined by the length of the horizontal run and the number of 90 degree bends. As a general rule, provide 7 in. (180 mm) of stack height for every 1 ft (300 mm) of horizontal length and 4 ft (1.20 m) for every 90 degree bend. The location, height, and positioning of the stack outside the building should consider roof patterns, projections, ancillary equipment, aesthetics, and wind flow.

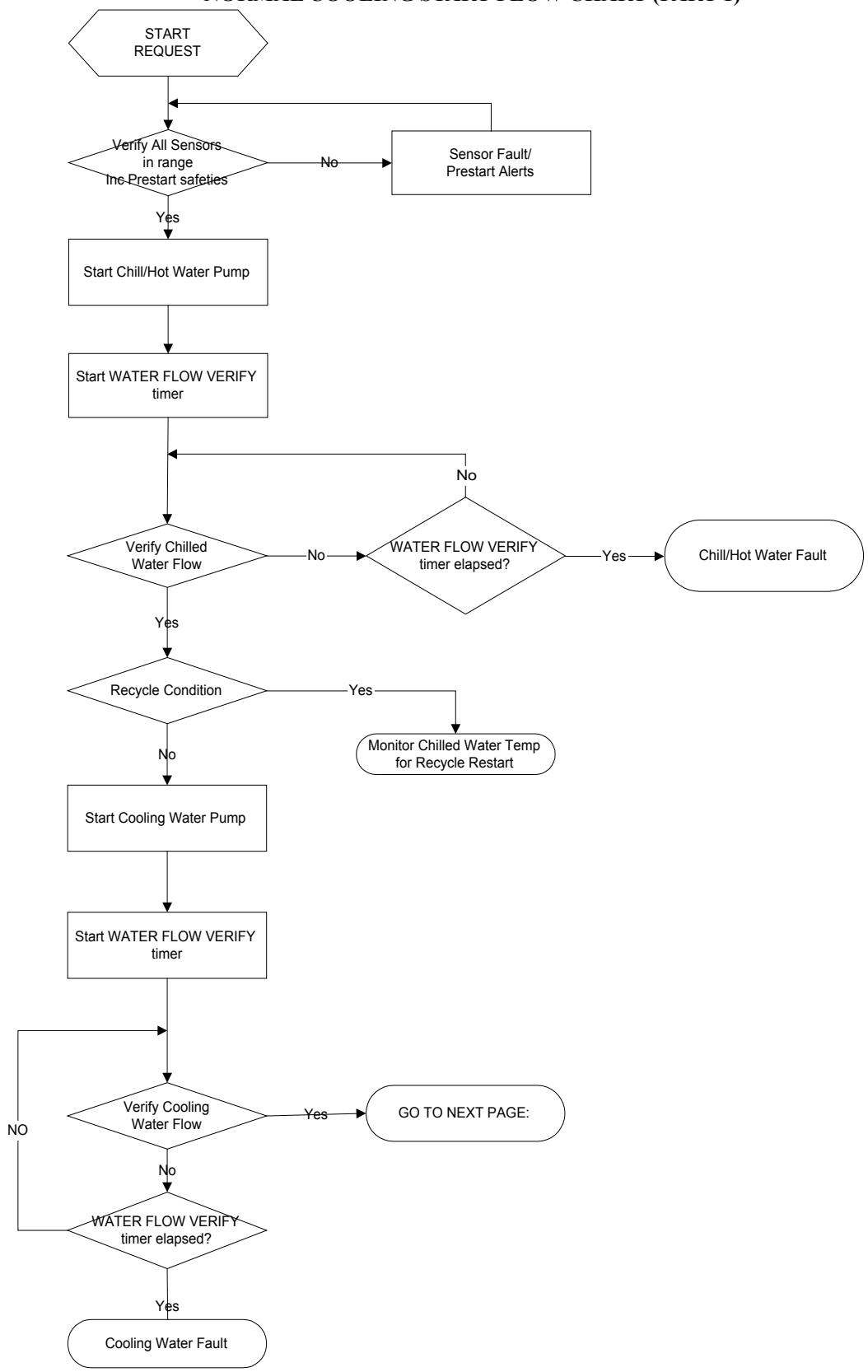
In situations where multiple machines will utilize a common exhaust gas flue stack, individual dampers and/or draft control systems for each unit are recommended.

Connection of the stack to the 16DN exhaust gas outlet flange should be made using a rectangular-to-round transition piece. Dimensions of the exhaust gas flange can be found on the appropriate 16DN certified drawings.

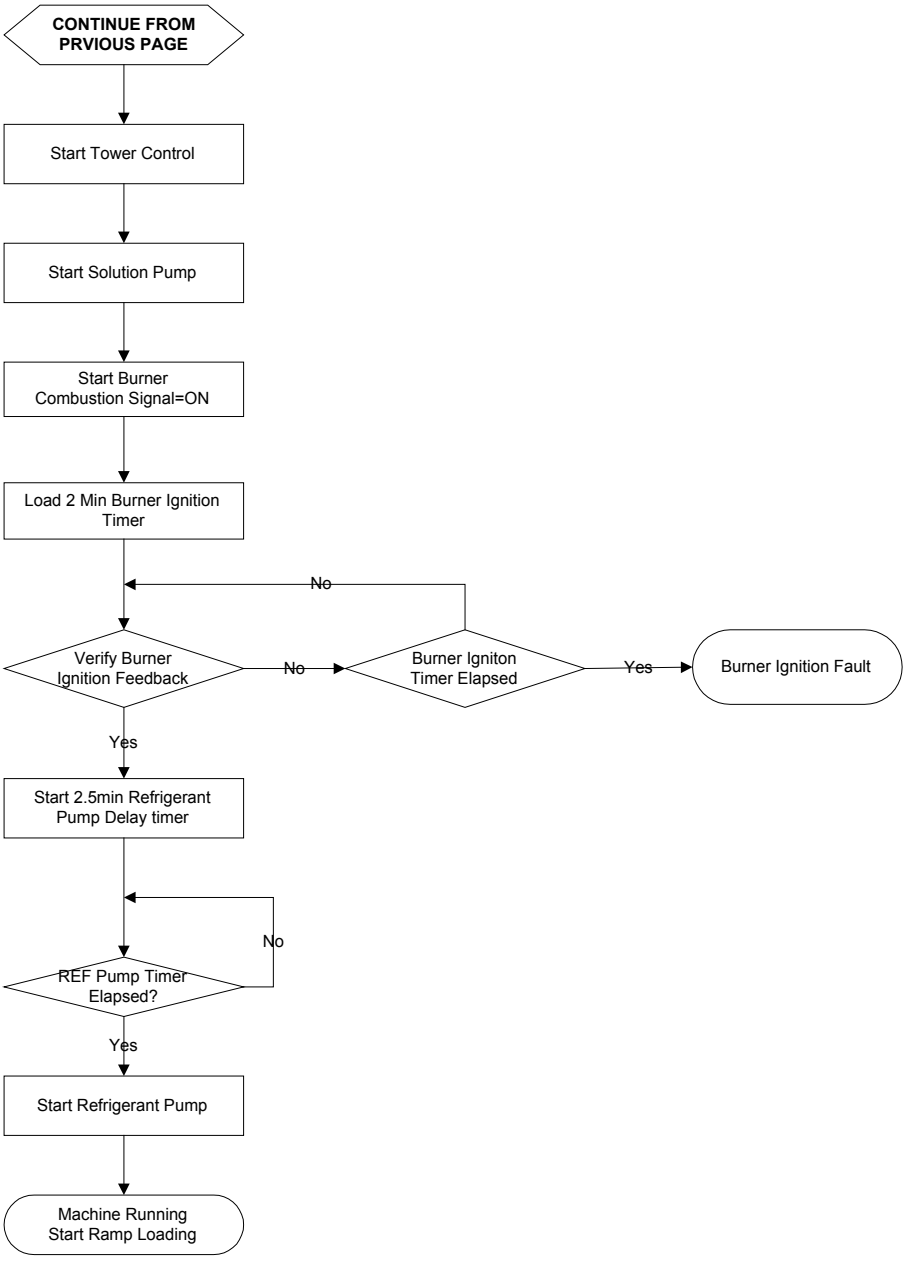
Service access

To perform routine maintenance, allow 3 ft (1 m) clearance on all sides of machine and 6 in. (150 mm) above the chiller/heater. For proper tube removal, a clearance equal to the overall length of the machine should be provided on each end of the 16DN. To service the high-stage generator, provide a clearance equal to the length of the high stage generator assembly on both ends of the machine. To allow for opening of hinged waterbox cover, clearance area must be provided at the waterbox end of the chiller. The space opposite the water nozzle must be equal to half the width of dimension “D” on page 11.

Typical control sequence

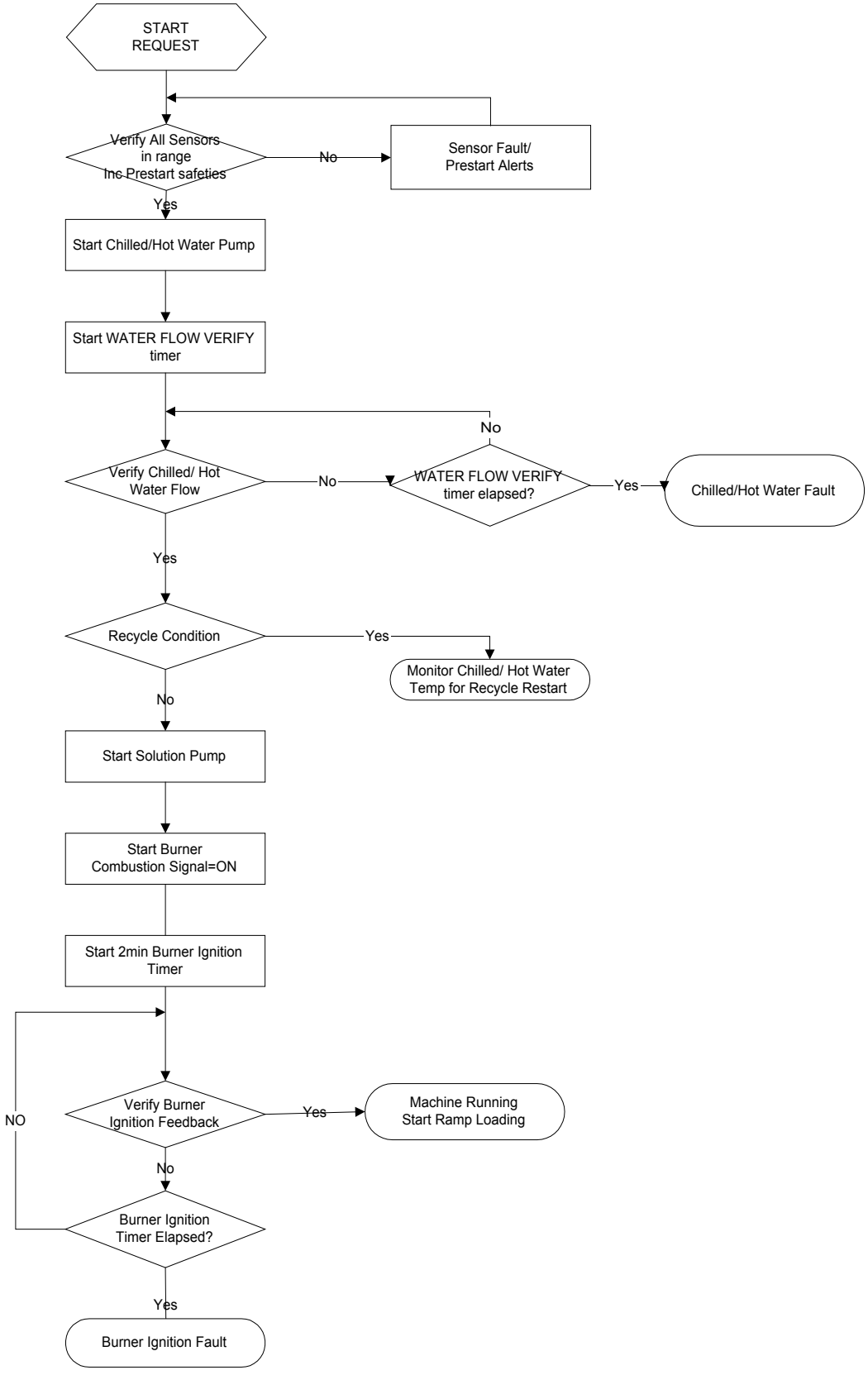


NORMAL COOLING START FLOW CHART (PART 2)



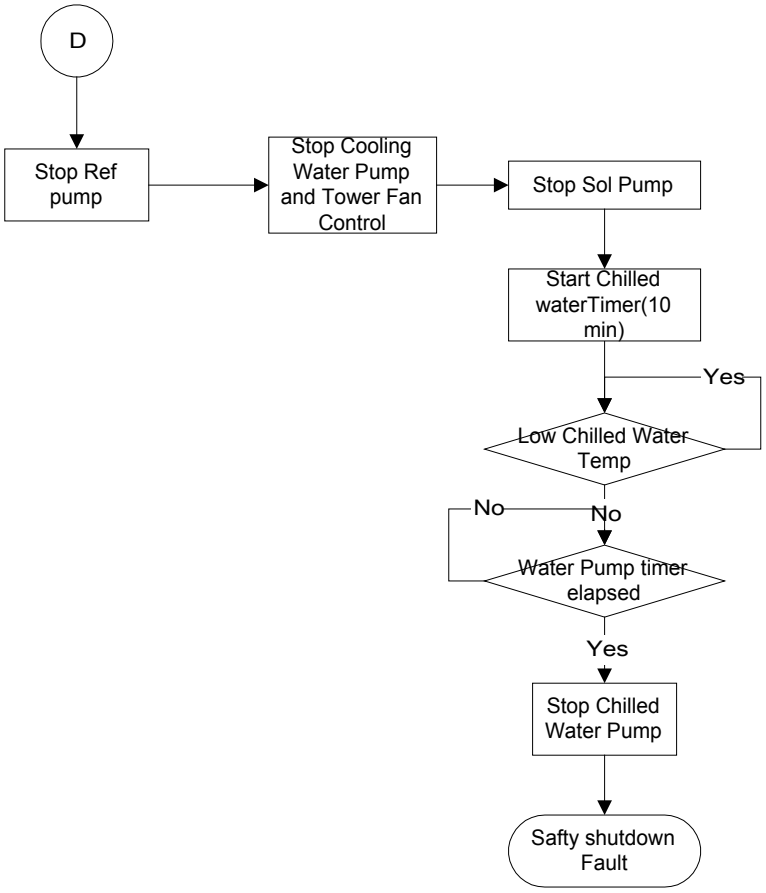
Typical control sequence (cont)

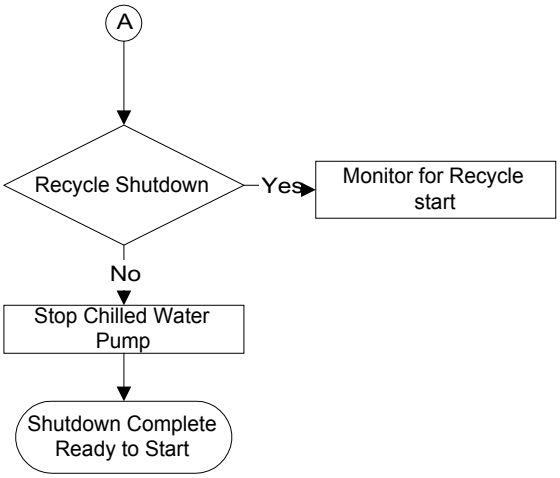
NORMAL HEATING START FLOW CHART



NORMAL COOLING STOP FLOW CHART (PART 1)

NORMAL COOLING STOP FLOW CHART (PART 2)





NORMAL HEATING STOP FLOW CHART

Hermetic Absorption Liquid Chiller/Heater

Size Range: **100 to 700 tons (352 to 2462 kW)**
Carrier Model Numbers: **16DN**

Part 1 – General

1.01 SYSTEM DESCRIPTION

Electronically controlled, double-effect (two-stage) absorption liquid chiller/heater utilizing hermetic refrigerant and solution pumps, lithium bromide solution as the absorbent, and water as the refrigerant. The combustion of natural gas or No. 2 oil within the generator shall serve as the heat source.

1.02 QUALITY ASSURANCE

A. Chiller performance shall be rated in accordance with ARI Standard 560 (latest edition).

B. Chiller shall be manufactured in accordance with ANSI/ASHRAE 15 (latest edition), Safety Code for Mechanical Refrigeration or JIS B8622 (Japanese Industrial Standard), as applicable.

C. Chiller shall be designed and constructed to meet applicable (UL or CE) requirements and shall bear the UL or CE label.(If required)

D. Each chiller shall undergo a series of standard factory tests to ensure that the unit is leak tight, that all electrical components operate as intended, and that every aspect of the unit fabrication meets stringent quality standards in accordance with good practice and the manufacturer's quality assurance requirements.

1. The shellside of each chiller shall be leak tested by pressurizing to 11 psig (76 kPa) with nitrogen and then checked by spraying a soap/water mixture on all welds, tube joints, and/or gasketed joints to identify any major leaks. Afterward, a mass spectrometer test shall be performed by evacuating the unit to .001mmHg absolute, covering the machine with a vinyl tent, and introducing helium gas under the tent. Any remaining leaks will allow the helium to be drawn into the shellside of the machine. The acceptable leak rate as measured by the mass spectrometer test shall not exceed .00001 cc/sec standard air.
2. The tubeside of the evaporator, absorber, and condenser shall be hydrostatically tested at 1.5 times rated design pressure and held for one hour.
3. The refrigerant and solution pump/motors shall undergo standard factory tests to ensure proper head flow, and motor output characteristics.
4. All machine wiring shall undergo an insulation resistance test. The chiller/heater control center and all electrical components shall also be functionally tested to verify continuity and proper electrical operation.
5. Final assembly inspection shall consist of verifying that all valves, controls, instrumentation, pumps, purge components, and all other machine components have been properly installed on the machine.
6. Each unit shall then be checked for overall appearance and dimensional accuracy.
7. Final inspection shall be performed on each unit to check that painting of the unit is as specified, nameplate data is correct, and that all accessories are furnished as required.

1.03 DELIVERY, STORAGE, AND HANDLING

A. Unit shall be stored and handled in accordance with the manufacturer's recommendations.

B. Unit shall *be* factory-charged with lithium bromide solution and performance tested before shipping. But if customer requires, unit shall *not* be factory-charged with lithium bromide solution to prevent possible internal corrosion damage from occurring should the inside of the machine be accidentally exposed to air during shipment and/or installation. Charging of lithium bromide solution shall be performed at the jobsite in accordance with the manufacturer's written instructions.

C. Machines shipped shall be pressurized with nitrogen to 5 psig (34 kPa).

D. Burner, burner control center and gas train (or oil control system) shall be factory-installed for sizes 16DN010-070.

E. Chiller shall be shipped with nameplates indicating name of manufacturer, model size, serial number, and all other pertinent machine data.

1.04WARRANTY

Manufacturer shall guarantee the chiller against defects in materials or workmanship for a period of one year from date of initial operation or 18 months from date of shipment, whichever occurs first. Manufacturer shall provide the labor to repair or replace any part found to be defective in material or workmanship within the warranty period.

Part 2 – Products

2.01 EQUIPMENT

A. General:

Absorption liquid chiller/heater shall include evaporator, absorber, condenser, high- and low-stage generators, solution heat exchanger, burner/gas train (or burner/oil control system) assembly, refrigerant/solution pumps, purge system, piping, wiring, controls, and auxiliaries. Shipment of the machine shall be in 1 piece with an option for 2-piece shipment. Initial charge of lithium bromide can be included with the chiller/heater for charging at the jobsite. The high-stage generator shall be configured such that the fire tubes are horizontally positioned above the combustion chamber with flue gas inside the tube and lithium bromide solution on the outside of the tubes. This design shall simplify the process of tube cleaning and shall prevent the flame from coming into direct contact with the tubes. This shall ensure maximum life and reliability.

B. Operating Characteristics:

1. Chiller operation shall be characteristic of a double-effect absorption cycle with series solution flow.

The weak solution from the absorber shall be entering the high-stage generator via the low- and the high-temperature solution heat exchangers. A variable frequency drive pump shall automatically regulate the flow of solution to the generators to maintain optimum flow at all operating conditions. This shall result in improved part-load efficiency and eliminate the need for manual set-up adjustments of the solution flow.

2. Unit shall be capable of continuous operation from 100 to 25% capacity, with entering condenser water temperatures as low as 64 F (18 C), without the need for a cooling tower bypass valve. Thermostat ON/OFF control of the cooling tower fan is recommended when cooling water temperature falls below 64 F (18 C).
3. Standard chiller design shall be based on a 2 –pipe system capable of operation in either the cooling or heating mode. When in the heating mode, the evaporator tube bundle shall be utilized as the heating bundle supplying hot water through the standard evaporator nozzle connections to simplify piping. The hot water temperature leaving the unit shall be 140 F (60 C).

C. Heat Exchangers:

1. All heat exchangers shall be of shell and tube construction with shells, tubesheets, tube support sheets, and waterboxes fabricated of carbon steel. All heat exchangers shall incorporate straight tubes. All tubes shall be rolled into grooveless tubesheets and expanded into tube support sheets, except for the high- and low- stage generator tubes. High-stage generator tubes shall be welded into tube sheets. All tubes shall be individually replaceable. Low-stage tubes shall be rolled into grooved tubesheets and expanded into tube support sheets
2. The evaporator, absorber, and condenser waterboxes shall be designed for 150 psig (1034 kPa) working pressure. Nozzle-in-head (NIH) type waterboxes shall be supplied on the evaporator while the absorber-condenser waterboxes shall be either marine type. All waterboxes shall be provided with vent and drain connections. ANSI 150 psig RF flanges shall be furnished on all waterbox nozzle connections.
3. The high-stage generator shall incorporate a cylindrical combustion chamber. The carbon steel (boiler type) fire tubes shall be located above the combustion chamber in a horizontal position and shall be seal welded to the tubesheets. Turbulators shall be provided in each fire tube to increase heat transfer. Access to the high-stage generator shall be provided via a flange type refractory door on the end opposite the burner. A sightglass shall be provided in the chamber to observe flame size and shape. A flanged rectangular flue gas outlet connection shall be located on the burner end above the burner assembly.
4. A high-temperature and a low-temperature solution heat exchanger shall be an integral part of the machine to increase efficiency by pre-heating weak solution on the tubeside with strong solution on the shellside. Tube material for the high-temperature heat exchanger shall be cupronickel, and tube material for the low-temperature heat exchanger shall be copper.
5. Spray heads for the evaporator and absorber shall be of a non-clogging design, specifically designed for the intended duty, and shall be fabricated of a corrosion-proof material to ensure continuous, high-efficiency operation.
6. Heat exchanger tube material and minimum wall thickness shall be contingent on the type of corrosion inhibitor used in the machine. For molybdate systems, the following tube specifications shall apply to ensure long machine life and continuous operation:
   Evaporator…….copper, externally-finned
   Absorber……..…..……..copper, corrugated
   Condenser. ……..……copper, corrugated
   Low-Stage Generator……copper, externally-finned
   High-Stage Generator……carbon steel, prime surface
   If chiller manufacturer requires the use of tube materials other than as listed above, due to the use of a less effective inhibitor, the chiller manufacturer shall guarantee performance of the machine for its design life and shall replace tubes and/or tube bundles as necessary during this period at no additional cost to the owner.

D. Pump/Motors:

Refrigerant and solution pump/motors shall be self-contained, leakproof, hermetic type, with isolation valves, and internal seal water system to minimize air leakage into the machine. Lubrication and cooling shall be accomplished by the fluid being pumped; auxiliary water piping for cooling and lubrication shall not be acceptable. Pump/motor assemblies shall be designed for a minimum of 5 years (or 20,000 hours) normal operation between inspections. If pump/motor assemblies are furnished with less than a design of 20,000 hours between inspections, they must be provided with a bearing monitoring system to aid in diagnosing and performing on-going maintenance.

E. Purge System

An automatic, motorless purge system shall be furnished to provide a continuous purging action whenever the chiller is in operation to assure long machine life and efficient performance. Noncondensables shall be removed from the absorber by a liquid eductor, which shall use flow from the solution pump to create a suction. Noncondensables shall be stored external to the unit and shall be prevented from diffusing back into the machine when the unit is not operating. A palladium cell shall be provided to automatically vent hydrogen gas from the purge tank to the atmosphere to minimize the need for manual evacuation of the storage tank. Evacuation of the external storage tank shall be accomplished by the use of a unit-mounted vacuum pump to ensure that the palladium cell is not wetted with lithium bromide solution. The vacuum pump shall be factory mounted on the chiller and wired to the control center by the chiller manufacturer.

F. Burner Assembly:

1. Burner shall be manufactured by Weishaupt Co. or supplier with equivalent quality and shall be of the turbo-ring forced draft type with stainless steel flame retention-type combustion head to assure stable, pulsation-free operation. Primary-secondary air ratio and total air volume shall be manually adjustable to provide control at the firing head for optimum burner efficiency. The burner shall incorporate its own sequence, combustion, supervision, and safety controls but shall operate under the direction of the chiller microprocessor. Interfacing with the chiller control center shall be done via a field-installed wiring harness. The burner assembly shall be UL listed.
2. The burner assembly and gas train (or oil control system) shall consist of strainers, shutoff valves, regulators, control valves, safety valves, ignition transformers, flame detectors, and pressure switches as necessary to meet national, state, and/or local code requirements. The burner control center shall house the blower motor contactor, overloads, combustion safety controls, and all other components for safe, proper operation.
3. Burner shall be capable of operation on either natural gas, No. 2 oil, or both (dual-fuel). A fuel transfer switch shall be provided on the burner control center to enable switching between gas and oil when configured for dual-fuel operation.

G. Controls:

1. General

The 16DN series chiller contains a microprocessor-based control center that monitors and controls all operations of the machine. The microprocessor controls system matches the cooling capacity of the machine to the cooling load while providing state-of-the-art machine protection. The system controls cooling capacity within the set point plus the deadband by sensing the leaving chilled water and regulating the burner capacity valve via a mechanically linked actuator motor.

2. 16DN Series PIC (Product Integrated Control)

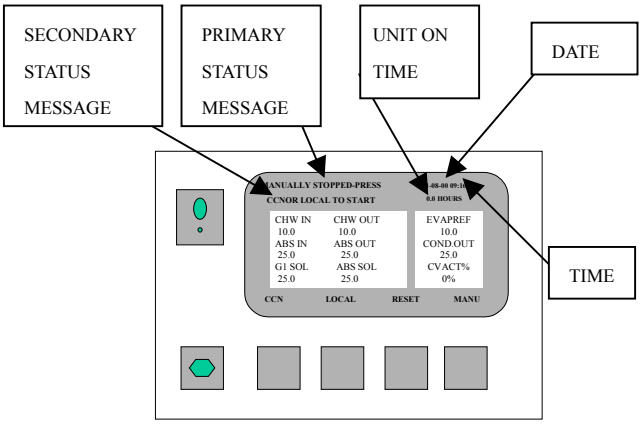
The Product Integrated Control (PIC) is the control system on the machine. The PIC controls the operation of the machine by monitoring all operating conditions. The PIC can diagnose a problem and let the operator know what the problem is and what to check. It promptly positions the burner capacity valve to maintain leaving chilled water temperature. It can interface with auxiliary equipment such as pumps and cooling tower fans. It continually checks all safeties to prevent any unsafe operating condition. The PIC can be interface with the Carrier Comfort Network (CCN). It can communicate with other PIC-equipped chiller and CCN device.

- ICVC (International Chiller Visual Controller): The ICVC contains all the information of control which feed all input signals by SIO from CCM. It controls output making CCM generate output signals. Also it provides user interface by LCD and five keypads. Using CCN, it can communicate with PC or other monitoring systems.
- CCM (CHILLER I/O MODULE):
  The CCM is SIO slave which sends the chiller condition to ICVC, there are 13 of 5KΩ or 100KΩ thermistor inputs, 4 of differential pressure inputs and 2 of 4~20mA outputs and 6 of triac outputs which associated with triac/timed-triac.

3. ICVC Operation & Menus

1) The ICVC may be configured in English or SI units, through the ICVC configuration screen.
2) Local Operation: By pressing the **LOCAL** softkey, the PIC is in the LOCAL operation mode and the control will accept modification to programming from the ICVC only. The PIC will use the Local Time Schedule to determine machine start and stop times.
3) CCN Operation: By pressing the **CCN** softkey, the PIC is in the CCN operation mode and the control will accept modification from any CCN interface or module, as well as the ICVC. The PIC will use the CCN time schedule to determine start and stop time.

Guide specifications (cont)



4. PIC System Functions
   - Capacity Control:

   The PIC controls the chiller capacity by modulating the capacity valve in response to chilled water temperature changes away from the CONTROL POINT. The CONTROL POINT may be changed by a CCN network device, or is determined by the PIC adding any active chilled water reset to the ECW (Entering Chilled Water) SET POINT or LCW (Leaving Chilled Water) SET POINT
   - Entering Chilled Water Control (Optional):

   The PIC uses ENTERING CHILLED WATER temperature to modulate the vanes instead of LEAVING CHILLED WATER temperature.
   - Chiller Timer:

   The PIC maintains 2 runtime clocks, known as SOLUTION PUMP ONTIME AND SERVICE ONTIME. SOLUTION PUMP ONTIME indicates the total lifetime. The SERVICE ONTIME is a re-settable timer that can be used to indicate the hours since the last service visit or any other reason.
   - Occupancy Schedule:

   This schedule determine when the chiller is either occupied or unoccupied. The chiller will shut down when the schedule goes to UNOCCUPIED. These schedules can be set up to the follow the building schedule or to be 100% OCCUPIED if the operator wishes. The schedules also can be bypassed by forcing the Start/Stop commend on the PIC Status screen to start. The schedules also can be overridden to keep the unit in an OCCUPIED mode for up to 4 hours, on a one-time basis.
5. Safety Control

   The PIC monitors all safety control inputs and if required shuts down the chiller or VFD speed stops solution pump to protect the chiller from possible damage from any of the critical conditions. The ICVC screen displays primary and secondary massage if the controller starts safety controls to stop, the alarm relay operates and alarm indicator is brink. The alarm is saved in the ICVC alarm table to correct the problems.
6. Remote Start/Stop Control

   A remote device, such as a time clock which uses a set of contacts, may be used to start and stop the chiller.
7. Spare Safety Inputs

   Normally closed (NC) digital inputs for additional field-supplied safeties may be wired to the spare protective limits input channel in place of the factory-installed jumper. (Wire multiple inputs in series.) The opening of any contact will result in a safety shutdown and ICVC display.
8. Tower-Fan Relay

   The tower-fan relay control is in cooling mode. It operates when the cooling water pump is running, cooling water flows and temperature of the weak solution leaving from absorber is 30 C. it may stop when the cooling water pump is stopped, cooling water is not flow and the weak solution temperature leaving from absorber is below 25C.
9. Auto Restart After Power Failure

   If the control power is interrupted during operation, the chiller stops immediately without the normal shutdown sequence and dilution. Solution crystallization can occur if the concentration is high (chiller was operating with a relatively large load). The machine will start automatically when the power is back on.
10. Water Temperature Reset

    This process shall only run when the Heat/Cool Mode is set to Cooling. Three types of chilled water reset are available and can be viewed or modified.
    - mA Reset
    - Remote Temp Sensor Reset
    - Machine Delta T Reset

H. Machine Safety Devices:
   1. Machine safety and limit devices shall be included as follows:
      a. High solution level – generator (limit)
      b. Low solution level – generator
      c. Low chilled water temperature
      d. Low chilled water flow
      e. Low cooling water flow (optional)
      f. High solution temperature – generator
      g. High hot water temperature (limit)
      h. High flue gas temperature
      i. High motor winding temperature – refig/sol pump
      j. High motor amperage – refrigerant/solution pump
      k. High pressure – generator
      l. Low fuel pressure
      m. Low combustion airflow

n. Flame failure
o. Low fire at ignition verification

2. Chiller shall include a rupture disk (optional) or a fusible plug to protect against accidental overpressure.

I. Electrical Requirements:
1. Power supply to the unit shall be 3-ph, 60Hz with voltages of 208, 230, 460, or 575, 3-ph, 50Hz, with 220V, 380V, 400V or 440V as specified on the equipment schedule. A multitap transformer shall provide 100, 110 or 200, 220 shingle-phase secondary power for the control center.
2. Contractor shall supply and install the electrical power line and all auxiliary electrical protection devices per local code requirements and as indicated necessary by the chiller manufacturer.
3. Contractor shall supply and install electrical wiring and devices required to interface the chiller controls with the building control system, if applicable.

J. Piping Requirements:
1. Piping and instrumentation for the chilled water, cooling water, flue supply (except for the gas train), and breaching shall be supplied and installed by the contractor/owner.
2. Chilled water flow switch shall be factory supplied and factory installed in the evaporator water nozzle. Condenser water flow switch shall be field installed or factory installed if customer requires and supplied by either the chiller manufacturer or the contractor/owner.
3. Piping from the rupture disk shall be provided and installed by the contractor/owner and piped in accordance with the chiller manufacturer's written instructions and any local jurisdictional requirements.

K. Thermal Insulation:
Insulation of cold or hot surfaces shall be field supplied and field installed on the machine. Chiller manufacturer shall specify the recommended material and surface area to be insulated.

L. Sound Level:
The overall sound pressure level of the chiller shall not exceed 80 dbA when measured per ARI Standard 575 (latest edition).

M. Start-up:
1. Unit manufacturer shall provide a factory-trained service representative, employed by the chiller manufacturer, to perform and/or supervise chiller pressure test (when required), charge chiller with refrigerant (water) and lithium bromide solution, place unit into operation, and calibrate all controls in accordance with the manufacturer's written start-up, operating, and maintenance instructions.
2. After unit start-up has been performed, the same factory representative shall be available for a period of instruction (not to exceed 4 hours) to instruct the owner's personnel in the proper start-up, operation, and maintenance procedures.
3. Manufacturer shall provide the following literature:
a. Installation Instructions
b. Star-up, Operating and Maintenance Instructions
c. Field Wiring Diagrams

N. Options and Accessories:
1. High-Pressure Waterboxes:
Waterboxes rated for 250 psig (1724 kPa) or 300 psig (2068 kPa) working pressure shall be furnished when specified on the equipment schedule
2. Special Tubing:
Tubing of non-standard materials and/or wall thickness shall be provided when specified on the equipment schedule.
3. Dual-Fuel Burner:
A burner capable of operation on either natural gas or No. 2 oil shall be furnished when specified on the equipment schedule.
4. FM/IRI Approved Burner:
Factory Mutual or Industrial Risk Insurers approved burner shall be supplied when required and/or specified on the equipment schedule.
5. Shipping Configuration:
Chiller shall ship in 1 or 2 pieces, as specified on the equipment schedule.
6. Isolation Package:
A vibration isolation package consisting of machine soleplates and neoprene isolation pads shall be furnished for field installation when specified on the equipment schedule.
7. Condenser Water Flow Switch:
A condenser water flow switch, rated for either 150 psig (1034 kPa), 250 psig (1724kPa), or 300 psig (2068 kPa) shall be field installed or factory installed if customer requires and supplied by either the chiller manufacturer or the contractor/owner.