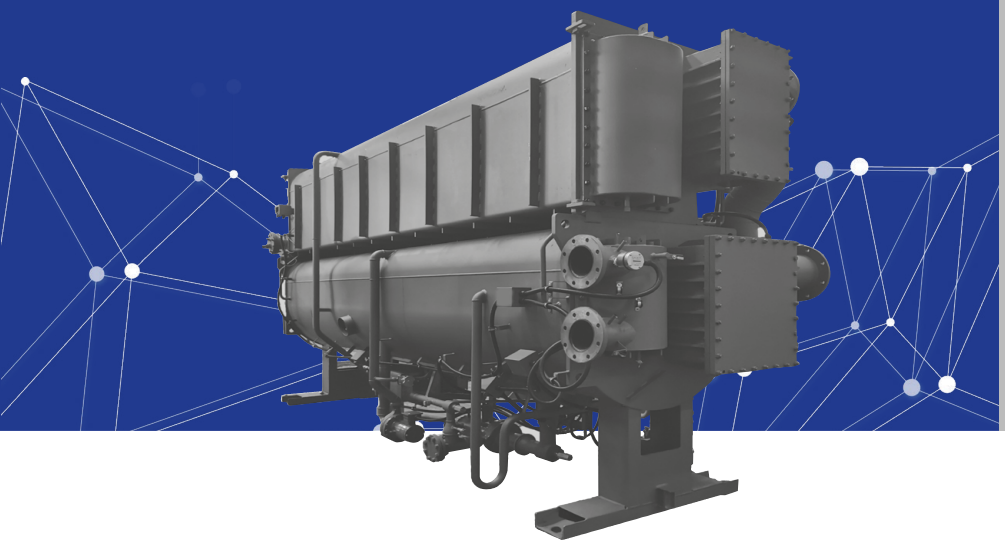
PRODUCT SELECTION DATA

SINGLE-EFFECT HOT WATER-FIRED ABSORPTION CHILLERS



16LJ01-03
16LJ-F11- 83 NEW

Nominal cooling capacity 83-3956 kW

The Carrier Corporation has more than 100 years experience in providing HVAC systems and equipment around the world and offers a complete product solutions for many different type of applications: From residential to industrial.

For all cases where power grid is not available on site or either not extensively developed, or where thermal energy sources (water or steam) are available on site, Carrier offers a complete range of absorption chillers.

FEATURES

- The Carrier 16LJ & 16LJ-F single-effect absorption chillers are designed to provide chilled water from waste heat sources generated from industrial processes and cogeneration systems.
- Carrier absorption chillers allow diversification of critical cooling requirements. Critical cooling loads are met with minimal electrical power input.
- They allow smaller emergency generators compared to an electrical driven chiller.
- The units are ozone-safe and CFC-free. Cooling requirements are met without chlorine-based refrigerants.
- They reduce the contribution to global warming and minimise the global impact by greatly reducing electricity consumption and production of greenhouse gases.
- The solution inhibitor has no impact on the environment.
- An absorption chiller does not utilise mechanical moving parts, and this leads to quiet, vibration-free operation.
- The use of high-efficiency heat transfer surface has reduced the space required for installation of the absorption chiller, resulting in a smaller footprint.

NEW FEATURES OF 16LJ-F

Enhanced durability by Stainless steel generator tubes

- New Carrier 16LJ-F single-effect hot water absorption chillers uses stainless steel tubes (SUS436L) for the generator in order to achieve enhanced durability.

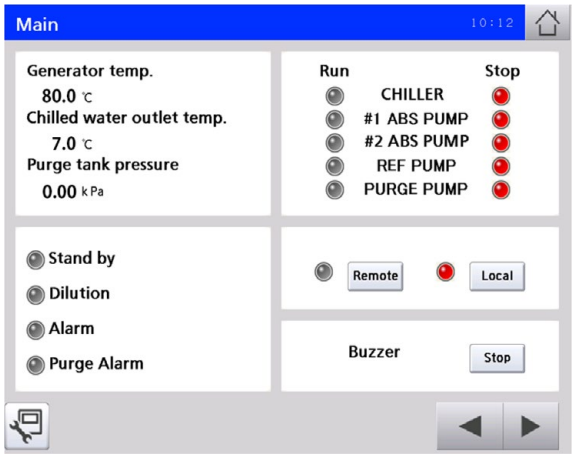
Falling film type generator

- Falling film type generator is applied for New Carrier 16LJ-F single-effect hot water absorption chiller and it reduces amount of Lithium bromide solution and it resulted in quick start-up and quick response for load changes.

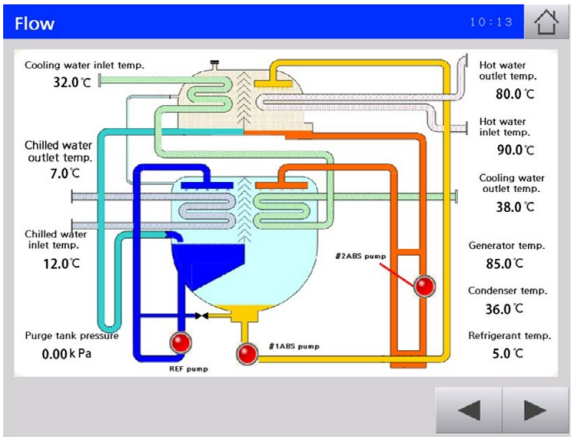
Touch screen

- Carrier New 16LJ-F single-effect hot water absorption chiller is equipped with 8.4 inch Touch screen for easy operation and monitoring.

Main screen



Flow chart screen



Trend screen

Modbus communication

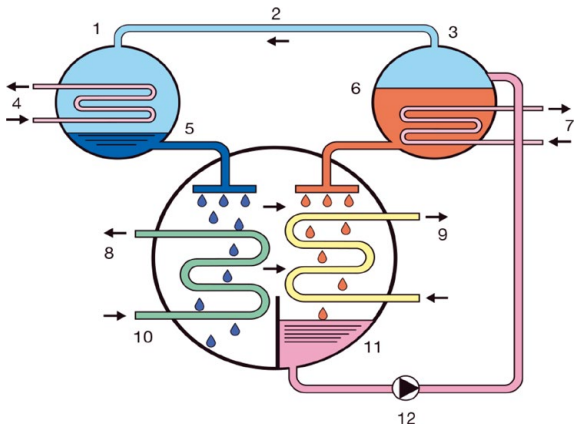
- New 16LJ-F has a capability to communication via Modbusprotocol as standard. Communication via BACnet is alsopossible (optional).

THE ABSORPTION CYCLE

The absorption cooling cycle, like the mechanical vapour compression refrigeration cycle, utilizes the latent heat of evaporation of a refrigerant to remove heat from the entering chilled water. Vapour compression refrigeration systems use a chlorine-based refrigerant and a compressor to transport the refrigerant vapour to be condensed in the condenser. The absorption cycle, however, uses water as the refrigerant and an absorbent lithium bromide solution to absorb the vaporised re-frigerant. Heat is then applied to the solution to release the re-frigerant vapour from the absorbent. The refrigerant vapour is then condensed in the condenser.

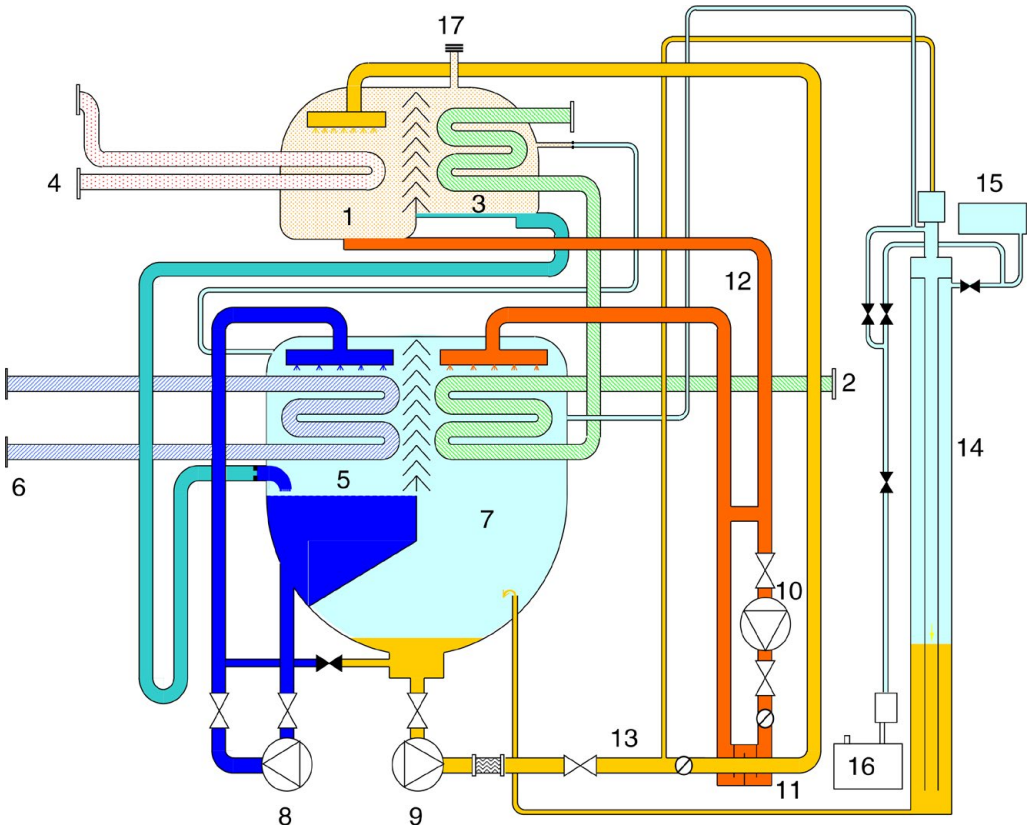
The basic single-effect absorption cycle (see Figure 1) includes generator, condenser, evaporator and absorber with refrigerant (liquid) and lithium bromide as the working solutions. The gen-erator utilizes a heat source (steam or hot water) to vaporise the diluted lithium bromide solution. The water vapour that is released travels to the condenser where it is condensed back into a liquid, transferring the heat to the cooling tower water. Once condensed, the liquid refrigerant is distributed over the evaporator tubes, removing the heat from the chilled water and vaporising the liquid refrigerant. The concentrated lithium bro-mide solution from the generator passes into the absorber, ab-sorbs the refrigerant vapour solution from the evaporator and dilutes itself. The diluted lithium bromide solution is then pumped back to the generator where the cycle is started again.

Figure 1 - Simplified absorption cycle



Legend
1. Condenser
2. Refrigerant vapour
3. Generator
4. Cooling water
5. Liquid refrigerant
6. Concentrated solution
7. Heat source
8. Chilled water
9. Cooling water
10. Evaporator
11. Absorber
12. Absorbent pump

Figure 2 – Cooling cycle schematic
16LJ - F 11 - 82



Legend
1. Generator
2. Cooling water
3. Condenser
4. Hot water
5. Evaporator
6. Chilled water
7. Absorber
8. Refrigerant pump
9. Absorbent pump No. 1
10. Absorbent pump No. 2
11. Heat exchanger
12. Concentrated solution
13. Diluted solution
14. Purge unit
15. Purge tank
16. Purge pump
17. Rupture disk

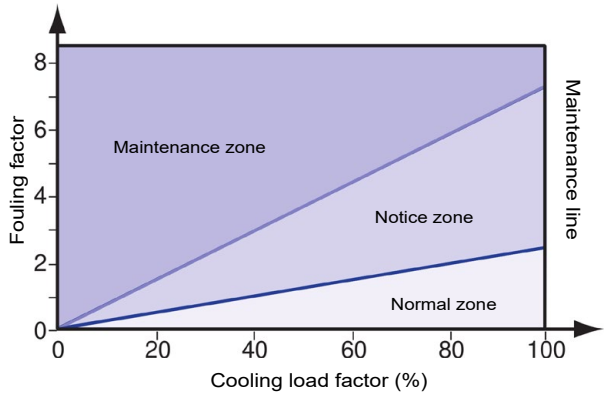
CHILLER FEATURES

Expert self-diagnosis function

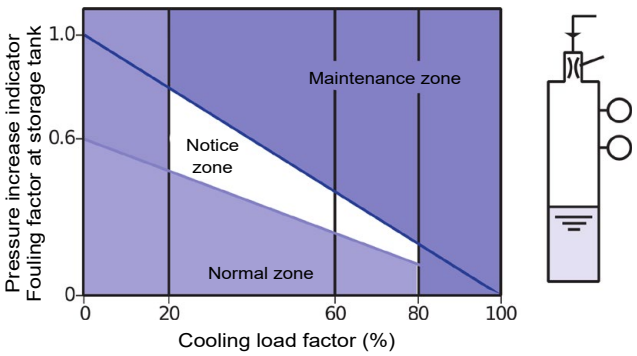
- The expert function is provided to monitor operating conditions, predict chiller information and maintain stable operation.

Predictive maintenance information

Graph 1 - Fouling of heat transfer tubes in coolin water system



Graph 2 - Vacuum condition monitoring



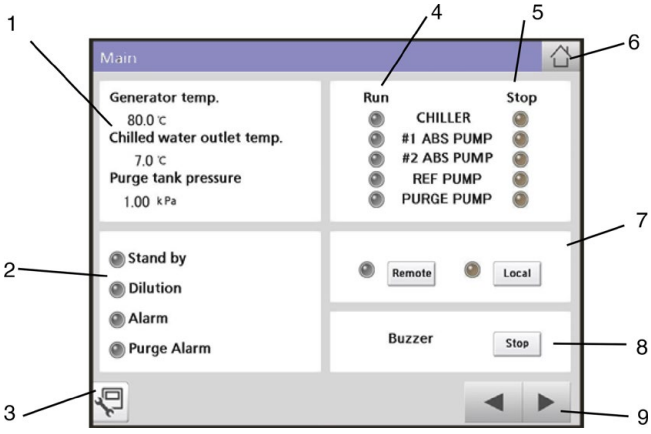
Legend
1. Storage tank
2. Diluted solution
3. Purge nozzle
4. Palladium cell
5. Pressure sensor

Control system

- The Carrier control system surpasses other proportional only control systems available today. The digital PID (proportional plus integral plus derivative) control maximises unit performance by maintaining a ±0.5 K variance in leaving chilled-water temperature from the setpoint. Proportional controls can typically only maintain a ±1 K variance from the setpoint. The controller's innovative design also incorporates the ability to start and stop the system chilled/ hot and cooling water pumps. During shutdown these pumps are sequenced to ensure a complete dilution cycle.
- The leaving chilled-water temperature is measured every five seconds and steam input is changed according to the gradient of the leaving chilled-water temperature curve. System temperatures, setpoints, and operational records are displayed along with indicator lights for the chiller and pumps.
- The Carrier control system offers its users selfdiagnostics by constantly monitoring the chiller status and will automatically shut the chiller down if a fault occurs. The cause of shutdown will be retained in the memory and can be displayed for immediate operator review. The controller's memory will also retain and display the cause of the last three system fault conditions. This method of retaining fault conditions is extremely useful for maintaining an accurate record of unit performance and fault history.

Touch Panel

Figure 3 - Touch Panel Screen



Legend
1. Data display area
2. Status display area
3. Setting menu
4. Operation indication lamp
5. Stop indication lamp
6. Main menu key
7. Remote/local select key
8. Alarm/Buzzer stop key
9. Display switching ley

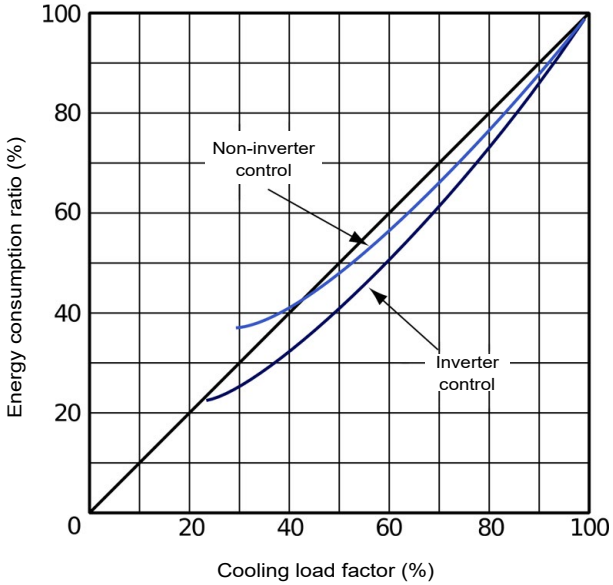
CHILLER FEATURES

Fast digital PID control

The introduction of new digital PID control stabilises the chilled/ hot water temperature with high accuracy. It quickly responds to the load fluctuation and supplies stable chilled/hot water temperature. It is suitable for air-conditioning intelligent buildings which require sophisticated control.

Saving energy with the inverter (option)

Balancing the load and flow rate with the absorbent pump's inverter control enables efficient and energy-saving operation. As a result, it reduces input energy and electric power consumption. Running cost is decreased by 5% compared to non-inverter control.



Notes
1. Chilled water leaving temperature : 7 °C constant
2. Cooling water entering temperature

Load factor (%)	Temperature (°C)
100	32
50	27
30	25

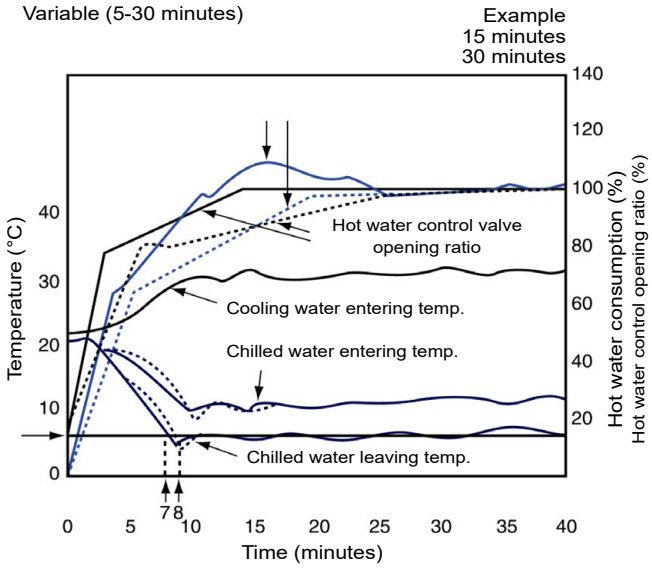
Purge system

- The high-performance purge system maintains the required operating pressure, preserves chiller performance characteristics, minimises chiller maintenance to one purge operation per season (for year-round operation).

Hot water control valve

- At the start-up, the opening angle of the hot-water control valve is controlled in three stages, reducing the amount of hot water and the time needed to reach the desired level, compared with the previous model.
- Adjusting the opening speed of the hot-water control valve at the second and third stage, it is possible to set up the most suitable conditions for the site auxiliary equipment.

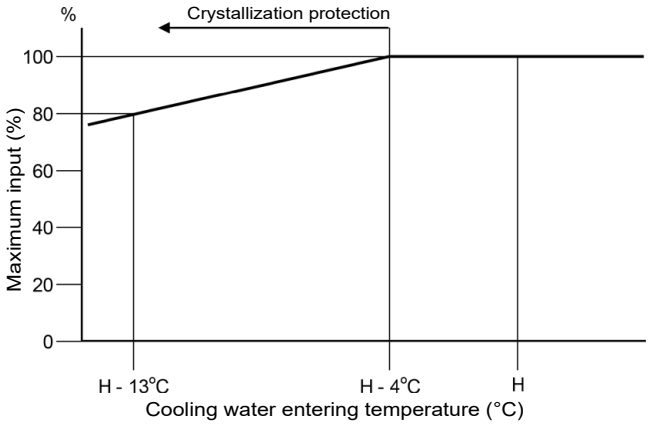
Graph 4 - Hot water valve opening control



Expansion of safe operating zone

- This ensures quick response to rapid changes and maintains stable operation.
- he safe operating zone is between 19 °C and 34 °C cooling water temperature (for a nominal cooling water entering temperature of 32 °C).

Graph 5 - Safe operating zone chart



Crystallisation protection

- A microprocessor monitors the absorbent concentration. Steam supply is stopped, and the unit is returned to normal operation, when the concentration is over a certain limit, to prevent the crystallisation of absorbent

PERFORMANCES

Model name		16LJ			16LJ-F									
Size		01	02	03	11	12	13	14	21	22	23	24	31	32
Capacity	KW	88	140	176	264	316	387	475	545	633	738	844	949	1055
Chilled water system (1)														
Flow rate	l/sec	3,50	5,61	7,00	12,6	15,1	18,5	22,7	26	30,3	35,3	40,3	45,3	50,3
Pressure drop	kPa	71	60	59	72	78	48	53	47	50	101	105	50	52
Connection (DIN)	inch	2	2 1/2	2 1/2	3	3	4	4	5	5	5	5	6	6
Retention volume	m^3	0,06	0,08	0,08	0,11	0,13	0,15	0,17	0,22	0,25	0,28	0,30	0,35	0,38
Cooling water system (1)														
Flow rate	l/sec	10,1	16,2	20,2	20,8	25,0	30,6	37,5	43,1	50,0	58,3	66,7	75,0	83,3
Pressure drop	kPa	77	48	49	62	64	72	80	74	78	83	84	114	117
Connection (DIN)	inch	3	4	4	5	5	5	5	6	6	8	8	8	8
Retention volume	m^3	0,13	0,18	0,23	0,38	0,42	0,48	0,54	0,68	0,74	0,82	0,90	1,12	1,20
Hot water system (1)														
Flow rate	l/sec	3,06	4,89	6,11	8,4	10,1	12,3	15,1	17,3	20,1	23,4	26,8	30,1	33,5
Pressure drop	kPa	52	31	36	54	54	74	78	74	76	71	71	96	97
Connection (DIN)	inch	2	2 1/2	2 1/2	3	3	4	4	4	4	5	5	5	5
Retention volume	m^3	0,04	0,06	0,07	0,20	0,22	0,26	0,29	0,38	0,41	0,46	0,50	0,57	0,61
Rupture disk connection	inch	2	2	2	2	2	2	2	2	2	2	2	2	2
Dimmensions														
Length (L)	mm	1 745	2 450	2 450	2 640	2 640	3 650	3 650	3 690	3 690	4 770	4 770	5 300	5 300
Height (H)	mm	2 115	2 115	2 115	2 430	2 430	2 430	2 430	2 600	2 600	2 600	2 600	2 840	2 840
Width (W)	mm	1 255	1 255	1 435	1 400	1 400	1 400	1 400	1 500	1 500	1 500	1 500	1 580	1 580
Tube removal	mm	900	1 350	1 350	2 400	2 400	3 400	3 400	3 400	3 400	4 500	4 500	5 000	5 000
Weight														
Operation weight	kg	2 070	2 680	3 150	4 100	4 300	5 200	5 600	6 900	7 300	8 400	8 800	11 000	11 500
Max shipping weight	kg	1 820	2 380	2 720	3 400	3 500	4 400	4 600	5 700	5 900	6 800	7 100	9 000	9 300
Shipping method	u	1	1	1	1	1	1	1	1	1	1	1	1	1
Power supply	V-ph-Hz	400-3-50			400-3-50									
Apparent power	kVA	3,5	3,5	3,5	4,6	4,6	4,6	6,5	6,9	6,9	7,2	7,2	8,6	8,6
Total electric current	A	5,3	5,3	5,3	7,1	7,1	7,1	9,8	10,3	10,3	10,8	10,8	12,8	12,8
Absorbent pump N°1, power input	kW	0,75	0,75	0,75	1,1	1,1	1,1	2,2	2,2	2,2	2,2	2,2	3,0	3,0
Absorbent pump N°1, electric current	A	2,2	2,2	2,2	2,8	2,8	2,8	5,5	5,5	5,5	5,5	5,5	7,5	7,5
Absorbent pump N°2, power input	kW	/	/	/	0,2	0,2	0,2	0,2	0,4	0,4	0,4	0,4	0,4	0,4
Absorbent pump N°2, electric current	A	/	/	/	1,1	1,1	1,1	1,1	1,6	1,6	1,6	1,6	1,6	1,6
Refrigerant pump, power input	kW	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,4	0,4	0,4	0,4
Refrigerant pump, electric current	A	1,1	1,1	1,1	1,1	1,1	1,1	1,1	1,1	1,1	1,6	1,6	1,6	1,6
Purge pump, power input	kW	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4
Purge pump, electric current	A	1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,2
PD cell heater	kW	0,038	0,038	0,038	0,038	0,038	0,038	0,038	0,038	0,038	0,038	0,038	0,038	0,038
Control circuit	kW	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,3

* Condition for 16LJ — Chilled water temperature 12/6°C (Fouling factor = 0,018 m^2°C/kW)
Cooling water temperature 29/34°C (Fouling factor = 0,044 m^2°C/kW)
Hot water temperature 90/80°C (Fouling factor = 0,018 m^2°C/kW)

* Condition for 16LJ-F — Chilled water temperature 12/7°C (Fouling factor = 0,018 m^2°C/kW)
Cooling water temperature 29.4/36.3°C (Fouling factor = 0,044 m^2°C/kW)
Hot water temperature 90/80°C (Fouling factor = 0,018 m^2°C/kW)

PERFORMANCES

Model name		16LJ-F												
Size		41	42	51	52	53	61	62	63	71	72	73	81	82
Capacity	KW	1 178	1 319	1 477	1 653	1 846	2 110	2 373	2 637	2 901	3 165	3 428	3 692	3 956
Chilled water system (1)														
Flow rate	l/sec	56,4	63,1	70,6	78,9	88,3	100,8	113,3	126,1	138,6	151,1	163,9	176,4	188,9
Pressure drop	kPa	45	42	97	47	62	58	77	106	61	93	94	91	92
Connection (DIN)	inch	8	8	8	8	8	10	10	10	12	12	12	14	14
Retention volume	m^3	0,48	0,54	0,75	0,81	0,87	0,98	1,04	1,17	1,41	1,49	1,59	1,77	1,88
Cooling water system (1)														
Flow rate	l/sec	93,1	104,2	116,7	130,6	145,8	166,7	187,5	208,3	229,2	250,0	270,8	291,7	312,5
Pressure drop	kPa	117	120	102	84	110	140	71	96	130	91	95	96	94
Connection (DIN)	inch	10	10	12	12	12	14	14	14	16	16	16	16	16
Retention volume	m^3	1,39	1,50	2,37	2,53	2,70	2,94	3,11	3,44	3,47	3,69	3,92	4,31	4,55
Hot water system (1)														
Flow rate	l/sec	37,4	41,8	46,8	52,4	58,5	66,9	75,2	83,6	91,9	101	109	117	126
Pressure drop	kPa	97	98	88	37	49	46	61	83	61	93	94	93	92
Connection (DIN)	inch	6	6	6	8	8	10	10	10	10	10	10	10	10
Retention volume	m^3	0,74	0,8	1,02	1,09	1,17	1,42	1,51	1,69	1,98	2,08	2,20	2,50	2,61
Rupture disk connection	inch	2	2	2	2	2	2	2	2	2	2	2	2	2
Dimmensions														
Length (L)	mm	5 330	5 330	5 500	5 950	6 480	6 710	7 210	8 230	7 230	8 220	8 220	8 320	8 320
Height (H)	mm	3 080	3 080	3 450	3 450	3 450	3 680	3 680	3 680	4 000	4 000	4 000	4 180	4 180
Width (W)	mm	1 690	1 690	2 000	2 000	2 000	2 230	2 230	2 230	2 730	2 730	2 730	3 010	3 010
Tube removal	mm	5 000	5 000	5 100	5 700	6 200	6 200	6 700	7 700	6 700	7 700	7 700	7 700	7 700
Weight														
Operation weight	kg	13 700	14 300	20 200	21 500	22 800	28 300	30 100	33 500	39 100	42 400	43 700	46 300	49 200
Max shipping weight	kg	11 100	11 500	16 000	17 100	18 100	11 200	11 800	12 900	14 600	15 800	16 200	17 900	18 400
Shipping method	u	1	1	1	1	1	2	2	2	2	2	2	2	2
Power supply	V-ph-Hz	400-3-50												
Apparent power	kVA	8,6	8,6	10,2	10,2	9,4	18,8	18,8	18,8	19,3	20,9	22,0	22,0	22,0
Total electric current	A	12,8	12,8	15,1	15,1	13,9	27,5	27,5	27,5	28,2	30,5	32,2	32,2	32,2
Absorbent pump N°1, power input	kW	3,0	3,0	3,0	3,0	3,0	7,5	7,5	7,5	7,5	7,5	7,5	7,5	7,5
Absorbent pump N°1, electric current	A	7,5	7,5	7,5	7,5	7,5	19,0	19,0	19,0	19,0	19,0	19,0	19,0	19,0
Absorbent pump N°2, power input	kW	0,4	0,4	1,3	1,3	0,75	1,5	1,5	1,5	1,5	1,5	2,2	2,2	2,2
Absorbent pump N°2, electric current	A	1,6	1,6	3,9	3,9	2,7	4,8	4,8	4,8	4,8	4,8	6,5	6,5	6,5
Refrigerant pump, power input	kW	0,4	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,75	0,75	1,2	1,2	1,2
Refrigerant pump, electric current	A	1,6	1,6	1,6	1,6	1,6	1,6	1,6	1,6	1,6	3,9	3,9	3,9	3,9
Purge pump, power input	kW	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,75	0,75	0,75	0,75	0,75
Purge pump, electric current	A	1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,9	1,9	1,9	1,9	1,9
PD cell heater	kW	0,038	0,038	0,038	0,038	0,038	0,038	0,038	0,038	0,038	0,038	0,038	0,038	0,038
Control circuit	kW	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,3

* Condition for 16LJ-F Chilled water temperature 12/7°C (Fouling factor = 0,018 m^2°C/kW)
Cooling water temperature 29.4/36.3°C (Fouling factor = 0,044 m^2°C/kW)
Hot water temperature 90/80°C (Fouling factor = 0,018 m^2°C/kW)

GUIDE SPECIFICATIONS

Single-Effect Hot Water Absorption Chillers

Size Range: 75 to 1125 Tons

Carrier Model Number: 16LJ-F

Part 1 — General

1.01 SYSTEM DESCRIPTION

Electronically controlled, single effect (one-stage) absorption liquid chiller utilizing hermetic refrigerant and absorbent pumps, lithium bromide solution as the absorbent, and water as the refrigerant. Low temperature hot water shall be supplied to the generator as the heat source.

1.02 QUALITY ASSURANCE

A. Chiller performance shall be rated in accordance with ARI Standard 560-2000.

B. Chiller shall be designed and constructed to meet applicable CE requirements and shall bear the CE marking.

C. 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 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 48 kPaG with nitrogen and then checked by spraying a soap and 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 1 Pa absolute, cover-ing 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 total leak rate as measured by the mass spectrometer test shall not exceed 2.0*10-7 Pa m3 / sec .
2. The tubeside of the evaporator, absorber, con-denser and generator shall be hydrostatically tested at 1.5 times rated design pressure and held for 1 hour.
3. All machine wiring shall undergo an insulation resistance test. The machine control panel and all electrical components shall also be function-ally tested to verify continuity and proper electrical operation.
4. 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.
5. Each unit shall be checked for overall appearance and dimensional accuracy.
6 Final inspection shall be performed on each unit to check that the 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 if the machine is configured to ship in one piece. For shipments of multiple pieces, charging of lithium bromide solution shall be performed at the jobsite in accordance with the manufacturer's writ-ten instructions.

C. All units shall be shipped with 20 kPaG nitrogen pressure.

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

Part 2 — Products

2.01 EQUIPMENT

A. General:

Absorption liquid chiller shall include evaporator, absorber, condenser, generator, solution heat exchanger, refrigerant/ absorbent pumps, purge system, piping, wiring, controls and auxiliaries. Standard shipment of the machine shall be in one piece. Initial charge of lithium bromide shall be shipped inside the machine for all single-piece shipments. For multiple-piece shipments, initial charge of lithium bromide shall be shipped separately for charging at the jobsite. Generator shall be designed for operation on low temperature hot water as specified on the equipment schedule. A rupture disk shall be provided as standard on all machines.

B. Operating Characteristics:

1. Chiller operation shall be characteristic of a single - effect absorption cycle. The weak solution pumped from the absorber to the generator shall initially pass through a solution heat exchanger to improve operating efficiency by preheating the weak solution on the tube side with the strong solution returning from the generator on the shellside.
2. Unit shall be capable of continuous operation from 100 to 10% capacity, with entering condenser water temperatures as low as 18oC 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 18oC.

C. Heat Exchangers:

1. All heat exchangers shall be of shell and tube construction with shells, tube sheets, tube support sheets and waterboxes fabricated of carbon steel. All heat exchangers shall incorporate straight tubes. Tube material for the generator and condenser shall be stainless steel. For the evaporator and absorber, tube material shall be copper. The evaporator, absorber, condenser and generator tubes shall be rolled into grooved tubesheets and expanded into tube support sheets, and shall be individually replaceable.
2. The evaporator, absorber and condenser water-boxes shall be designed for 1034 kPaG working pressure. The absorber and condenser water-boxes shall be hinged to permit access to all tubes from either end. Nozzle-in-head (NIH) type waterboxes shall be supplied on the evaporator while the absorber-condenser water-boxes shall be marine type. Waterboxes shall be provided with vent and drain connections. Epoxy painting of the waterboxes and tube sheets shall be provided for corrosion protection. DIN PN10 flanges shall be furnished on all waterbox nozzle connections.

3. The generator tube side shall be designed for 1034 kPaG working pressure for use with low temperature hot water.
4. A solution heat exchanger shall be an integral part of the machine to increase cycle efficiency by preheating the weak solution on its way to the generator while pre-cooling the strong solution returning from the generator.
5. Dispersion trays shall evenly distribute refrigerant over the evaporator tubes and lithium bromide over the absorber tubes. These trays shall be fabricated of stainless steel to ensure continuous, corrosion-free, high-efficiency operation.
6. Generator structure shall be falling file type.

D. Pump/Motors:

Refrigerant and absorbent pump/motor assemblies shall be of the self contained, leakproof, hermetic type, without an external 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. Each pump casing shall be welded into the piping at the factory and shall be furnished with isolation valves on the suction and discharge side. Each pump shall include spring-loaded, wear-compensating tapered carbon bearings to ensure long life and reliability. Pump/motor assemblies shall be designed for 25,000 hours of normal operation between inspections.

E. Purge System:

An automatic 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 absorbent 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 chamber to the atmosphere. It shall be continuously energized, even during machine shutdown. Further evacuation of the external storage chamber shall be accomplished with a factory-mounted purge pump, piped and wired to the machine. The need to operate the purge pump shall be indicated on the front of the control panel.

F. Controls, Safeties and Diagnostics:

1. Controls:
   a. The chiller shall be provided with a factory-installed and factory-wired microprocessor control system with modular component construction. The controls shall be of the PID type and shall continuously monitor the operation of the chiller and perform self-diagnostic checks to ensure that all control limits are satisfied and maintained. The system shall include a control center, power supply, temperature sensors, pressure sensors and all necessary auxiliary devices required for safe and proper chiller operation housed in a NEMA-1 enclosure with a hinged, lockable door. Control power shall be AC24V, Single-phase, 50Hz.

      The chiller control system shall have the ability to interface and communicate with a building management system through Modbus protocol as standard, BACnet as option.

      The control system shall include Touch Screen GUI (Graphical User Interface), PLC, functional keys, emergency stop button (connected to a circuit breaker) and indication lamps and an alarm buzzer. Touch screen GUI shall be configurable to display either English or metric units.

   b. The control panel touch screen shall allow an operator to easily set and display the operating mode and configurable settings of the machine. The display shall indicate chiller run status, alarm status, remote/local operation, standby mode and dilution cycle operation. Data input and machine settings shall be done via a touch screen and shall allow scrolling through the individual chiller parameter settings.
   c. Monitoring the operation of the chiller shall be done on a continuous basis. The touch screen GUI shall indicate all pertinent system operating parameters and alarms, as necessary, including the following:
      1) Chiller operating hours.
      2) Chilled water inlet temperature.
      3) Chilled water outlet temperature.
      4) Chilled water temperature set point.
      5) Cooling water inlet temperature.
      6) Condenser temperature.
      7) Generator temperature.
      8) Hot water inlet temperature.
      9) Hot water outlet temperature.
      10) Absorbent pump No. 1 start counter and operating hours.
      11) Absorbent pump No.2 start counter and operating hours.
      12) Refrigerant pump start counter and operating hours.
      13) Purge pump start counter and operating hours.
      14) Chiller start counter.
      15) Purge tank pressure.
   d. Capacity control shall be by means of electronically modulating the hot water control valve to maintain the temperature of the chilled water. Load modulation shall be from 100% to 10% of machine full load under normal ARI conditions. The hot water control valve shall be positioned by a PID control algorithm to ensure precise control of desired chilled water temperature without hunting or overshooting the set point.
   e. The microprocessor control system shall include a programmed sequence to ensure machine readiness prior to machine start-up. The microprocessor shall automatically enable and interlock the chilled water pump, cooling water pump and cooling tower fans upon chiller activation.
   f. Upon request to start the chiller, the control system shall start the chilled water pump and verify chilled water flow. The controller shall then start the cooling water pump and verify interlock signal, before starting tower fan(s), absorbent pump No.1, absorbent pump No.2 and refrigerant pump.
   g. The control system shall automatically sense impending abnormalities in the absorption operating cycle and take the following actions to either self-correct and/or limit the machine from approaching cycle crystallization line:
      1) Close hot water control valve for a set period.
      2) Stop the operation of the machine after performing a dilution cycle if the solution concentration is still over the pre-set level.
   h. The rate at which the hot water control valve is opened shall be precisely controlled.

i. The control system shall automatically cycle the refrigerant pump whenever the leaving chilled water temperature falls below the desired set point. The chilled water pump shall remain on and when the leaving chilled water temperature rises above the set point, the refrigerant pump shall automatically restart.

j. The control center shall allow reset of the chilled water temperature set point based upon any one of the following criteria:

1) Chilled water reset based on an external 4 to 20 mA signal.

2) Chilled water reset based on cooling water inlet temperature.

k. When the stop button is pressed or remote contacts open the control center shall immediately drive the hot water control valve to the closed position and initiate the normal shutdown sequence including dilution cycle. The display shall indicate that the machine is in the dilution cycle.

2. Safeties:

a. Unit shall automatically shut down when any of the following conditions occur. In addition, the chiller goes into alarm mode and indicates the reason for the shutdown on the chiller data display.

1) Absorbent pump No.1 motor overload.

2) Absorbent pump No.2 motor overload

3) Refrigerant pump motor overload.

4) Purge pump motor overload.

5) Low chilled water temperature.

6) Low cooling water temperature.

7) Generator high temperature.

8) Loss of chilled water flow.

9) (Optional) loss of cooling water flow.

10) Loss of chilled water pump interlock.

11) Loss of cooling water pump interlock.

12) High solution concentration.

b. The control system shall detect conditions that approach protective limits and take self-corrective action prior to an alarm occur-ring. The system shall automatically reduce chiller capacity when any of the following parameters are outside their normal operating range:

1) Low cooling water inlet temperature.

2) High cooling water inlet temperature.

3) High solution concentration.

3. Diagnostics and Service:

a. The chiller control system shall execute a series of self-diagnostic checks whenever power is first turned on to determine if temperatures are within pre-start limits, thereby allowing start-up to proceed. If any of the limits are exceeded, an alert message will be displayed, informing the operator of the cause of the pre-start alert.

b. The control system shall provide an alarm display on the front of the panel for any sensor that has failed. These sensors include:

1) Chilled water inlet temperature.

2) Chilled water outlet temperature.

3) Cooling water inlet temperature.

4) Cooling water outlet temperature.

5) Cooling water intermediate temperature.

6) Hot water inlet temperature.

7) Hot water outlet temperature.

8) Condenser temperature.

9) Refrigerant temperature.

10) Diluted solution temperature.

11) Generator temperature.

12) Purge tank pressure.

c. The chiller controls shall display maintenance messages and alarms when efficient operation of the chiller is in jeopardy or when immediate attention is necessary. When operating conditions are predicted to be problematic, the following messages shall be displayed on the panel:

1) Purge tank high pressure.

2) Cooling water tubes excessive fouling.

3) Cooling water high temperature.

4) Power failure.

4. Building Control System Interface:

The chiller control system shall have the ability to interface and communicate directly to the building control system through Modbus as standard, BACnet as option without additional field-installed hardware and software.

G. Electrical Requirements:

1. Power supply to the unit shall be 3 ph, 50 Hz with voltages of 400 as specified on the equipment schedule. A control transformer shall provide 24-volt single-phase secondary power for the control panel.

2. Contractor/owner 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/owner shall supply and install electrical wiring and devices required to interface the chiller controls with the building controls system if applicable.

H. Piping Requirements:

1. Piping and instrumentation for the chilled water, cooling water and hot water shall be supplied and installed by the contractor/owner.

2. Absorber-condenser crossover piping shall be furnished by the chiller manufacturer.

3. Cooling water flow switch shall be supplied by either the chiller manufacturer or the contractor/owner.

4. 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.

I. Thermal Insulation:

Insulation of the evaporator, refrigerant pump, sump, piping and chilled water headers, in addition to any hot surfaces shall be field supplied and installed on the machine. Chiller manufacturer shall recommend the material and specify surface area to be insulated.

J. Sound Level:

The overall sound pressure level of the chiller shall not exceed 80 dbA when measured per ARI Standard 575-1994.

K. Start-up:

1. Unit manufacturer shall provide a factory-trained service representative, employed by the chiller manufacturer, to perform and/or super-vise 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, operating and maintenance procedures.
3. Manufacturer shall provide the following documentation and literature:
   a. Installation Instructions.
   b. Start-Up, Operating and Maintenance Instructions.
   c. Dimensional Drawing.
   d. Foundation Drawing.
   e. Field Wiring Diagram.

L. Options and Accessories:

1. Marine Waterboxes:
   Marine waterboxes with removable covers to facilitate tube cleaning and maintenance shall be furnished when specified on the equipment schedule.
2. High-Pressure Waterboxes:
   Waterboxes rated for 2000 kPaG working pressure with removable covers shall be furnished when specified on the equipment schedule.
3. Special Tubing:
   Tubing of non-standard materials, geometry or wall thickness shall be provided when specified on the equipment schedule.
4. Shipping Configuration:
   Chiller shall ship either fully assembled or in multiple pieces as specified on the equipment schedule.
5. Victaulic Nozzle Connections:
   Victaulic grooves shall be provided on all water-box nozzle connections when specified on the equipment schedule.
6. Cooling Water Flow Switch:
   Cooling water flow switch, rated for either 1034 kPaG or 2000 kPaG, shall be factory supplied when specified on the equipment schedule.
7. Isolation Package:
   A vibration isolation package consisting of neoprene isolation pads shall be furnished when specified on the equipment