Vertiv™ Liebert® AFC Chiller
Outdoor Package Air Cooled Free Cooling Chiller
Guide Specifications

1.0 GENERAL

1.1 SUMMARY

The Vertiv™ Liebert® AFC is a high-end air cooled free cooling chiller designed for efficient and reliable thermal management of medium and large data centers. Integral free cooling allows for a vast reduction in energy usage across a large majority of installation locations and applications. The Liebert® AFC is a robust and reliable data center chiller, designed and optimized around data center cooling conditions. The Liebert® AFC is designed for continuous operation with integral power supply options for minimal downtime during a power failure. Designed with modularity, durability, and redundancy in mind provides an air cooled cooling solution for data centers of all sizes and configurations.

1.2 SCOPE

Liebert® AFC air cooled chillers are designed for the production of chilled water. The AFC chiller is a self-contained, outdoor air cooled unit for large heat rejection utilizing chilled water. They are available in three main versions (chiller, direct free cooling, and indirect free cooling) with a wide range of features to fit any application.

The Thermal Management system shall be a Liebert® self-contained, factory assembled unit. Standard 60 Hz units shall be CSA-certified to the harmonized U.S. and Canadian product safety standard, UL/CSA 60335-2-40 and marked with the CSA C-US mark.

1.3 SUBMITTALS

Submittals shall be provided with the agreement of the proposal and shall include: panel diagrams, dimensional, electrical and capacity data, piping schematics, and electrical connection drawings.

1.4 SERVICEABILITY/ACCESS

All service and maintenance shall be performed by a certified technician. All electrical connections are made through the front of the unit with the electrical panel. As standard, all customer piping connections are on the left side of the unit if looking from the front.

1.5 QUALITY ASSURANCE

The specified system shall be factory-tested before shipment. Testing shall include but shall not be limited to: quality control checks, functional performance test, leak tests, pressure tests, electrical tests, and various other physical or visual inspections. The system shall be designed and manufactured according to world-class quality standards and manufactured in an ISO-9001 facility.

2.0 PRODUCT DETAILED DESCRIPTION

2.1 CHILLER TYPE

The Vertiv™ Liebert® AFC has three main variants:

Chiller Only - Mechanical cooling mode only (no integral free cooling). **[Digit 1 = C]**

Direct Free Cooling – Integral free cooling utilizing a combination of ambient air temperature and mechanical cooling to reject heat load when allowable. Return fluid to chiller flows directly through integral waterside economization/free cooling circuit, through integral chilled water piping and exits as chilled fluid back to the process. Free cooling coils are fin and tube type design. **[Digit 1 = F]**

Indirect Free Cooling – Integral free cooling utilizing a combination of ambient air temperature and mechanical cooling to reject heat load when allowable. Return fluid is isolated from internal glycol/water recirculation loop. The integral glycol loop includes inverter duty glycol pump to circulate water/glycol through the free cooling circuit and integral free cooling heat exchangers. This allows for 100% pure water to be circulated through the data center, separated from the internal glycol/water required for freeze protection. Free cooling coils are aluminum micro-channel type design. Integral expansion tank, fill port, wye strainer, and manual air vent valve included as standard. Factory installed and wired heat tracing on integral glycol recirculation circuit. [Digit 1 = N]

- **Free Cooling Mode**: 100% coolant flow through the free cooling coils and then through the evaporator without operation of the compressors. **[Digit 1 = F, N]**
- **Mixed Mode, DX, and Free Cooling:** 100% coolant flow through the free cooling coils and then through the evaporator with partial operation of compressors. **[Digit 1 = F, N]**
- **Mechanical Cooling Mode (or DX = Direct expansion) Mode with Compressor Operation Only:** 100% coolant flow through the evaporator. **[Digit 1 = C, F, N]**

2.2 FRAME

The base is made of six mm gauge steel beam treated with special anticorrosion primers and polyester-powder, painted in RAL7032. The inner hidden frame parts are constructed of galvanized steel. Panels are made of suitable gauge galvanized steel, polyester-powder painted in RAL7032 and provided with waterproof gaskets. Left and right-side lateral condenser panels **[Optional – Digit 18 = 4]** are fixed with screws, lower front, back panels, and the access door for the electrical board are fixed with triangular insert locks (key is factory supplied). All screws are stainless steel or galvanized type, with stainless steel rivets. All exposed sheet steel is painted to meet +1000-hour salt spray test in accordance with the ASTM B117 standard.

2.3 COMPRESSORS

Compressors are semi-hermetic, positive displacement, screw type compressors designed for high temperature applications in air cooled refrigeration circuits. Compressors are available as fixed speed **[Digit 2 = H]** or inverter duty **[Digit 2 = I or 2]**. The screw compressors are designed with high efficiency profile geometry. Reliable and robust axial bearings allow for minimum refrigerant dilution in the oil and a higher oil viscosity, extending compressor life.

All Liebert® AFC chillers include an integrated three-stage oil separator as standard. A three-phase asynchronous two-pole motor is located on the shaft of the male screw rotor and cooled by the suction gas. It is removable for inspection and maintenance.

Standard features and safety devices include:

- Bearing chamber pressure isolated by seal rings
- Cast iron housing
- Pressure unloading of axial bearings
- Compressor heater
- Weatherproof terminal box

- Winding temperature, using a PTC sensor in the motor windings
- Oil temperature, using a PTC sensor
- Phase sequence/direction of rotation
- Thermal overload protection
- Discharge and suction shut-off valve
- Oil level safety switch, sight glass, heater, fill/drain valve
- Oil lubrication system with oil charging valve, separator, and oil filter to ensure adequate lubrication during starting, stopping, and normal operation
- Direct liquid injection
- Automatic start unloading
- Long-life fine oil filter, with 10 µm mesh size
- Statically and dynamically balance rotating parts
- Individual compressors mounted on vibration isolators attached to frame

Compressors are located at the bottom of the unit and isolated from the main airflow to minimize noise transmission. The compressor box is designed to reduce noise emitted from the compressors and the interior is encased in sound proofing insulation. Compressors are mounted on anti-vibration mounts to prevent vibration transmission to the unit casing.

Optional Inverter Duty Compressors: The Vertiv™ Liebert® AFC chiller includes one fixed speed and one inverter duty semi-hermetic screw type compressor. Each inverter duty compressor includes an integrated solenoid valve for automatic Vi control and for automatic inverter cooling. A line reactor is factory mounted and installed inside the chiller for reducing harmonics transmitted by the inverter to the power supply. **[Digit 2 = I]**

Optional Dual Inverter Duty Compressors: The Liebert® AFC chiller includes two inverter duty semi-hermetic screw type compressors. Each inverter duty compressor includes an integrated solenoid valve for automatic Vi control and for automatic inverter cooling. A line reactor is factory mounted and installed inside the chiller for reducing harmonics transmitted by the inverter to the power supply. **[Digit 2 = 2]**

2.4 CONDENSOR AND FREE COOLING COILS

Condenser coils are two-pass all aluminum brazed micro-channel type design and are to be mounted in modular configuration with multiple V geometries to allow for a larger heat exchange surface.

Free cooling coils are seamless copper tubes with aluminum fins installed in series with microchannel condenser coils with multiple V geometries to allow for a larger heat exchange surface. Design working pressure of 150 psig.

Optional Mesh Filters: The condensing section is equipped with metallic mesh filters factory mounted to protect coils from dirt and maintain the correct operating/heat exchange efficiency. **[Digit 18 = 1]**

Optional Protection Grid: A metal anti-intrusion protection grid is positioned on all open areas. **[Digit 18 = 2]**

Optional Mesh Filters + Protection Grid: Factory mounted metallic mesh filters plus a metal anti-intrusion protection grid. **[Digit 18 = 3]**

Optional Aesthetic Lateral Panels: Lateral V shaped steel panels installed over V-bank condenser headers and manifolds. **[Digit 18 = 4]**

Optional Base Coating: Coil coating for coastal or potentially corrosive installation locations includes e-coating on all microchannel condenser coils and epoxy powder coating on fin and tube free cooling coils, if applicable (+1000-hour ASTM B117). **[Digit 13 (C, F, N - Type Chillers) = 1, E, B]**

Optional Premium Coating: Coil coating for coastal or potentially corrosive installation locations includes e-coating + TCP coating on all microchannel condenser coils and electrofin coating on fin and tube free cooling coils, if applicable (+15000-hour ASTM B117). **[Digit 13 (C, F, N - Type Chillers) = 2, F, C]**

2.5 EVAPORATOR

Each unit is equipped with one direct expansion evaporator shell and tube type with two refrigeration circuits and one water circuit, in counter-current configuration. The shell is fabricated from seamless carbon steel with internally inner grooved type copper tubes and tube sheets of heavy gauge carbon steel. Headers is constructed of carbon steel, gaskets of an asbestos free compound and bolts of steel alloys; baffles are of carbon steel. The evaporator is equipped with drainage and vent connections. The evaporator is protected against freezing by an integral evaporator heater and sensor directly managed by the Vertiv™ Liebert® iCOM™ controls. Factory insulated with ¾ inch thick UV protected closed cell elastomeric thermal insulation. Evaporator is constructed, tested, and stamped in accordance with applicable sections of ASME pressure vessel code for a refrigerant side working pressure of 200 psig and waterside working pressure of 150 psig.

2.6 FANS

Fans are axial type, with die-cast aluminum blades statically and dynamically balanced and directly coupled to an EC motor with external rotor. Fan blades are corrosion resistant, designed for low noise, full airfoil cross section, providing vertical air discharge from extended orifices.

Fans have a degree of protection equal to IP54. Fans have electronically commutated motors (EC-Fans) and are available as standard with high efficiency. **[Digit 10 = E]**

Fans are complete with safety protection grilles and high efficiency nozzles with a specific design to eliminate cross and recycling airflow. There are stator blades that allow the redirection of the air flow, with a consequent increase in efficiency and noise reduction. Fan speed control is continuously regulated and monitored, managed directly by Liebert® iCOM™ control for higher energy saving and lower sound emissions.

Optional Low Noise: Reduced fan RPM and added insulation to compressor box for noise suppression. **[Digit 10 = L]**

Optional Ultra Quiet: Alternate fan type, reduced fan RPM and added insulation to compressor box for noise suppression. **[Digit 10 = Q]**

2.7 HYDRAULIC CIRCUIT

The hydraulic circuit utilizes carbon steel pipes connected with grooved-end (Victaulic type) fittings and couplings; gaskets are made of EPDM. This arrangement permits compensation for thermal expansion, reduces noise and vibration propagation through the hydraulic circuit, and improves ease of maintenance.

Insulation of the hydraulic circuit is made of ¾ inch thick close cell synthetic elastomer with high resistance to UV rays, HT type for outdoor installations. No use of flexible piping or connections in hydraulic circuit. The internal chiller hydraulic circuit is designed to 150 psi (10.5 bar). Drain valves installed at low point of hydraulic circuit for draining the unit.

Customer supply and return fluid connections are schedule 40 grooved end (Victaulic type).

Optional Flanged Connections: 150 lb. ANSI flanged connections factory installed. **[Digit 21 = 1]**

Optional Integral Heat Tracing: Heat tracing for added freeze protection factory wired and installed on integral chilled water piping including integral indirect free cooling circuit (if applicable). Heat tracing is wrapped cable type and installed on the return header for direct (F type) and indirect (N) type free cooling chillers. Integral chilled water piping includes factory installed insulation covering heat tracing cable. Heat tracing is powered by customer supplied single phase power. **[Digit 16 = A]**

2.8 INTEGRAL FREE COOLING

Integrated direct free cooling system, consisting of free cooling coils with seamless copper tubes with aluminum fins installed in series with all aluminum brazed microchannel condenser coils in multiple V geometries to allow for a larger heat exchange surface. **[Digit 1 = F]**

Integrated indirect free cooling system, consisting of all aluminum brazed microchannel free cooling and condenser coils installed in series in multiple V geometries to allow for a larger heat exchange surface. An integral glycol/water inverter duty recirculation pump, wye-strainer, expansion tank(s), fill port, drain valve, and other ancillary closed loop components are included. Brazed plate heat exchangers are installed to isolate process water loop from integral glycol free cooling circuit. Pump is monitored and controlled by onboard unit controls and includes safeties for normal operation including pump failure alarm, high/low fluid temperature, and pump enable signal. Pump speed will modulate flow to maintain exiting chiller supply fluid temperature based on actual load. Free cooling **[Digit 1 = N]**

Integral water piping and headers to free cooling coils utilizes carbon steel pipes connected with grooved-end (Victaulic type) fittings and couplings; gaskets are made of EPDM. Distribution pipes to each V bank made of brazed copper. No use of flexible piping or connections in hydraulic circuit. Design working pressure of 150 psig.

The precise control of supply fluid temperature in free cooling mode is maintained by adjusting fan speed and control of quantity two interlocked 2-way modulating valves modulating the flow of water through the free cooling circuit based on ambient air temperature.

2.9 REFRIGERATION CIRCUIT

The unit is equipped with quantity two screw compressors, configured in two independent refrigeration circuits.

Standard features and safety devices include:

- Safety pressure switch for high pressure
- Safety pressure switch for low pressure
- Electronic expansion valve, including a stepper motor with:
  - Continuous adjustment with unlimited adjustment position
  - Extremely high positioning speed (< 1.0 sec for an adjustment 0-100%)
- Very accurate control on overheating; Vertiv™ Liebert® iCOM™ - algorithms highly adjustable and adaptable for the different load variations (transients)
- Humidity indicator and liquid sight glass
- Filter drier with disposable anti-acid solid cartridge
- High and low pressure safety valves
- Charge connections and a manual on-off valve
- Compressor discharge and suction shut-off valve
- Discharge and oil line check valves
- Fully tested and charged with refrigerant prior to shipment
- Capacity modulation
- Single or dual pressure relief valves

The units are supplied pre-charged with refrigerant, and oil as determined in the factory for the operating conditions within the indicated limits.

Optional Dual Relief Valves: Dual relief valves installed on refrigeration circuit. **[Digit 15 = 2]**

2.10 POWER SUPPLY

Several power supply options for 3 phase 460V main line and single phase 120V controls power for redundancy as follows:

- **1 Single Line** (460V/3/60hz) 3 phase power supply is installed for the main components. **[Digit 17 = 0]**
- **Optional Single Line (460V/3/60hz) with Buffer Module and Fast Restart:** Single power supply is installed for the main components with a backup, integrated buffer module for the Vertiv™ Liebert® iCOM™ controls. In the event of external power instability or power loss, the Liebert® iCOM™ controls are powered by the internal buffer module for a ride through power of approximately 120 seconds. **[Digit 17 = 1]**
- **Optional Single Line (460V/3/60hz) with Dedicated 120 UPS Line and Fast Restart:** 3 phase power supply is installed for the main components with a dedicated 120V backup UPS line for powering the controls system. In the event of external power instability or power loss, the Liebert® iCOM™ controls are powered by the 120V UPS power line for quicker restart. **[Digit 17 = 2]**
- **Optional Single Line with Buffer Module, Dedicated 120 UPS Line and Fast Restart:** 3 phase power supply is installed for the main components with an integrated buffer module and a dedicated 120V backup UPS line for redundancy to maintain power to the controls system. In the event of external power instability or power loss, the Liebert® iCOM™ controls are powered by the 120V UPS power line or buffer module for quicker restart. **[Digit 17 = 3]**

Restart Sequence with Power Instability or Power Outage (with Fast Restart Options Digit 17 = 1, 2 or 3):

- The Liebert® iCOM™ controls are kept operational by the integrated buffer module or 120V dedicated UPS line

After power is restored the fast restart function procedure begins:

- The typical reboot time of the control is reduced to zero seconds.
- Ten seconds for the auto restart of the main components (pumps, fans).
- The unit flow check time is reduced from 120 seconds to 10 seconds.
- The Vertiv™ Liebert® AFC chiller reverts to last operating parameters prior to outage.
- After flow check, the compressors are activated and staged on with an interval of 10 seconds. **[Digit 17 = 1, 2, 3, B, C, D]**

2.11 ELECTRICAL PANEL

There is one electrical panel mounted and installed front of the unit.

- Supply is 460 Voltage, 3 Phase, 60 Hz
- Lockable fused disconnect
- The panel is rated to NEMA-3R with IP54 protection and is cooled by an internal fan (with thermostat).
- Short circuit current rating (SCCR) – The electrical panel shall provide at least 65,000A SCCR. Short circuit current rating (SCCR) is the maximum short circuit current of any component or assembly can safely withstand when protected by a specific overcurrent protection device(s) or for a specified time.
- Integral panel heater (optional) **[Digit 16 = A]**

Standard Electrical Connections:

- **High Voltage Entrance** - Located on bottom right of electric box, removable sealed plate. Enclosure is provided with provisions for a field installed power entry kit to be completed by installer in the field. Power entry kits are not provided with holes or knockouts, which must be done by the installer in the field. The fittings used must have the proper environmental rating per code.
- **Low Voltage Entrance** - Located on bottom left of electric box, recommended location. Enclosure is not provided with holes or knockouts, which must be done by the installer in the field. The fittings used must have the proper environmental rating per code.
- **3-Phase Electrical Service** - Terminals are on bottom of disconnect switch. See serial tag for electrical values. 3-Phase service not provided by Vertiv.
- **1-Phase Electrical Service** - Terminals for GFCI (standard) and low ambient heat tracing (optional) are behind dead front. See circuit breaker for max amperage, 120VAC. 1-Phase service not provided by Vertiv.
- **Earth ground** - Terminal for field supplied earth grounding wire. Earth grounding required for Vertiv units.
- **Unit Factory Installed Disconnect Switch and Main Fuses** - Access to the high voltage electrical box door can be obtained only with the switch in the off position. A fused disconnect is provided with a defeater button that allows access to the electrical box when power is on.

Standard Electrical Connections:

- **Customer Connection Terminals** - Use field supplied Class 1 wiring.
- **Remote Shutdown Device** - Terminals for field supplied, 24VAC signal, minimum 100mA, between terminals 37 and 38.
- **Common Alarm** - On any alarm, normally open dry contact is closed across terminals 75 and 76 for remote indication. 1 AMP, 24VAC max load.
- **General Alarm** - On alarm, normally open to common, across terminals 52 and 53 and 94 and 95 and normally closed to common dry contact across terminals 53 and 54, and 95 and 96, 1 AMP, 24VAC max load.
- **User Input** - Terminals for field supplied, 24VAC signal, minimum 100mA, between terminals 50 and 51.
- **Programmable Events** - On programmed alarm, normally open dry contact is closed across terminals 55 and 56 for remote indication. 1 AMP, 24VAC max load.
- **Dedicated 120VAC Circuit for Service Outlet** - In 120VAC section.
- **Dedicated 120VAC Circuit for Low Ambient Heat Tracing (Optional)** - In 120VAC section. **[Digit 16 = A]**

Communication Connections (Optional):

- **Unit-to-Unit Communication** - On network switch, Port 5 is reserved for U2U connections. Use an eight pin RJ45 for cat 5 cable.
- **Site and BMS Communication** - On the controller, BMS single port is reserved for Site and BMS connections. Use an eight pin RJ45 cable.

2.12 CONTROLS

Units are equipped with an on-board Liebert® iCOM™ control for unit optimization and energy savings.

Liebert® iCOM™ control with 10-inch Touch Screen Display

- The Liebert® ICOM™ control is the standard on-board control system with advanced secure system optimization and energy savings. Full management of the Vertiv™ Liebert® AFC unit is performed by the on-board controller, which manages temperature and pressure thresholds.
- User set-up can be done through the on-board display that ensures a reliable, flexible, and user friendly HMI interface.

- The standard software of each Vertiv™ Liebert® AFC unit includes proprietary control algorithms that ensure efficient operation and enhanced reliability.
- Sequential auto-restart timer allows phased units restart after power failure.
- Double/shift setpoint for improved and efficient operation.
- Optimization of condenser fan speed for improved operating efficiency.
- High level protection through a 3-Level password system.
- Input for remote on-off and voltage free contacts for convenient remote monitoring of alarms and warnings are also available.

Available Connectivity Protocols:

- Web
- MODBUS on RS485 and over-IP
- BACnet MS/TP and IP
- SNMP

2.13 END OF LINE (EOL) FUNCTIONAL TEST

Every Liebert® AFC chiller is functionally tested in a state of the art end of line (EOL) testing system. The chamber is used for performance testing each Liebert® AFC chiller being manufactured to ensure the capacity and performance fall within the tolerance of acceptable deviation from theoretical calculations.

This system includes a climate controlled EOL chamber to maintain the ambient air temperature to which the unit under test (UUT) is subjected. The temperature in the chamber and the inlet/outlet water temperature can be maintained to steady state conditions. The unit is tested with 100% water and no glycol in the circuit. Along with performance testing, each Liebert® AFC undergoes electrical quality checks (including operation of system safeties), pressure tests, leak tests, and a wide range of quality checks (both visual and physical).

Factory witness testing (FWT) or factory acceptance testing (FAT) is available upon request and can be quoted as a separate line item. Test methods and test procedures can be curated to specific operating conditions, parameters, and situations (within limitation).

2.14 PACKAGING

Unit is wrapped in heavy duty plastic wrapping and heat sealed for open air truck transit (flatbed, step deck, or extended step deck depending on model). Unit ships in a single piece, one chiller per trailer.

Optional Crating: Unit is packaged and crated in solid wood paneled crate suitable for container shipment (not available for all models). **[Digit 19 = 1, 2]**

3.0 INSTALLATION

3.1 GENERAL

Install Vertiv™ Liebert® AFC units in accordance with both the manufacturer's installation instructions and local codes and regulations. Install units plumb and level, firmly anchored in locations indicated and maintain the manufacturer's recommended clearances.

3.2 ELECTRICAL WIRING

Install and connect electrical devices furnished by the manufacturer but not specified to be factory mounted. Furnish copy of the manufacturer's electrical connection diagram submittal to electrical contractor.

3.3 PIPING CONNECTIONS

Install and connect devices furnished by manufacturer but not specified to be factory mounted. Furnish copy of the manufacturer's piping connection diagram submittal to piping contractor.

3.4 FIELD QUALITY CONTROL

Start cooling units in accordance with the manufacturer's start-up instructions. Test controls and demonstrate compliance with requirements. The system shall be designed to maintain supply fluid temperature and cooling capacity to the process loop.

3.5 WARRANTY START-UP AND CONTROL PROGRAMMING

Install the outdoor unit in accordance with manufacturer's installation. Firmly anchor maintaining manufacturer's recommended clearances. Mounting requirement details such as anchor brand, type, embedment depth, edge spacing, anchor-to-anchor spacing, concrete strength, special inspection and attachment to non-building structures must be outlined and approved by the engineer of record for the projection or building. Electrical, pipe and duct connections must permit movement in three dimensions and isolate the unit from field connections. Electrical conduit shall be flexible, having at least one bend between the rigid connection at the unit cabinet and the connection to rigid conduit or foundation. The piping flexible connection or loop must be suitable for the operation pressure and temperature of the system. Furnish a copy of manufacturer's piping connection diagram submittal to the piping contractor.

Engage manufacturer's field service technician to provide warranty start-up supervision and assist in programming of unit(s) controls and ancillary equipment supplied by them.