	<u>PRODUCT GUIDE SPECIFICATIONS</u>	EVAPCO, INC. 5151 Allendale Lane Taneytown, Maryland 21158 Telephone: 410-756-2600 Facsimile: 410-756-6450
PS-GS-01		

Project Name: Customer PO #: Model Number:	Factory: Greenup Serial No: Representative:
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Product Guide Specification

1. SUMMARY

- 1.1. This specification describes the requirements for the Evapcold Packaged Low Charge Ammonia Refrigeration (LCR) System. The Evapcold roof mounted LCR system shall provide cooling and temperature control for cold storages, distribution facilities and process rooms.
- 1.2. The Evapcold product consists of factory-assembled, self-contained ammonia refrigeration rooftop system designed to ship in one, two or three-piece modules.

2. DESIGN REQUIREMENTS

- 2.1. The refrigeration system shall be an Evapcold Penthouse LCR-P unit designed for easy installation on the roof. Evapcold refrigeration systems shall have a walk-in machine room and shall incorporate all safety and access requirements. The required eye wash and safety showers are not included and shall be provided by others.
- 2.2. The LCR system shall be specifically designed for high sensible heat ratio. Each system shall be capable of handling _____ CFM of refrigerated supply air. The unit shall have the cooling capacity of ___ kBTU/H, based on ___ °F wet bulb ambient temperature for water cooled units and ___ °F dry bulb ambient temperature for air cooled units and room air temperature of ___ °F dry bulb. The unit shall have a power supply of 460/3/60. These LCR units have also been sized to provide spare compressor and condenser capacity up to ___ kBTU/H.
- 2.3. The packaged system shall be designed for reduced system ammonia charge and may vary between 2.5 lbs. and 6.5 lbs. per ton of refrigeration. Ammonia field piping shall not be required.

3. QUALITY ASSURANCE

- 3.1. The manufacturer shall maintain a set of international standards of quality management to ensure product quality. Each system shall be subjected to a complete pressure and leak test, and electrical functional test procedures at the factory prior to shipment.


4. ENCLOSURE

4.1. Unit Base

- 4.1.1. Unit Base shall be made of 8 gauge galvanized steel. The perimeter of the unit base shall be C channels and cross sections shall be I beams. The unit base shall be bolted together and designed to sit directly on the building roof steel or on a structural curb (furnished by others) for sloped roofs.

4.2. Roof insulation tie-in:

- 4.2.1. The connection of the buildings insulated roof system to the insulated enclosure system of the Evapcold product (Penthouse enclosure and Machine Room superfloor) must comply with the Evapco supplied connection detail (this roof insulation tie-in is by others). Particular attention must be made to connecting the roof's insulation vapor barrier (membrane) to the Evapcold connection location, in accordance with the aforementioned connection detail.

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4.3. Penthouse Enclosure

4.3.1. Penthouse enclosure shall have 4" thick R32 thermally insulated walls. Foam panels shall be sandwiched with 26 Ga aluminum sheets on both sides. Surface finish shall be embossed aluminum.

4.4. Machine Room Enclosure

4.4.1. Machine room enclosure walls & roof shall have 2" thick spray insulation with R rating of R13. Interior walls and ceiling of the machine room shall be 14 Ga galvanized, outer walls and roof shall be 16 Ga galvanized steel. Surface finish shall be galvanized sheet metal.

4.4.2. The machine room superfloor shall be 5" thick foam insulation with R rating of R28. Top of the superfloor shall be .125" thick aluminum diamond plate for slip resistance. Bottom of the superfloor shall be 22 Ga galvanized steel.

4.4.3. The designed ambient conditions that the superfloor insulation is rated for are a -20°F freezer space below the floor and 80°F ambient wet bulb in the machine room. The aluminum floor of the superfloor serves as the vapor barrier. The perimeter of the superfloor shall have a down turned angle that is sealed to the superfloor and maintains the integrity of the vapor barrier over the side of the superfloor and into the connecting roof insulation system. The roof membrane (roof vapor barrier) is then sealed to the angle to form a continuous vapor barrier.

5. MECHANICAL COMPONENTS

5.1. Penthouse Evaporator Section

5.1.1. Direct Drive Axial Fans


5.1.1.1. The fans shall be unicast aluminum axial-style direct drive with taper lock bushings. The motors shall be NEMA style, VFD Ready, TEAO, 1.15 SF with double sealed bearings and low temperature synthetic grease.

5.1.2. Evaporators

5.1.2.1. The evaporator coils shall be constructed of 1100 alloy enhanced aluminum fins and 304L internally enhanced annealed stainless tubes hydraulically expanded into tubular fin collars. Coils shall be circuited for low refrigerant charge in thermal counter flow. Coils shall be rated in accordance with AHRI standard 420 for recirculated ammonia refrigerant flow. Coils shall be pressure tested at 400 psig minimum.

5.1.2.2. Evaporator coils shall be bottom liquid feed and designed for a liquid recirculation rate of 1.2:1.0.

5.1.2.3. Low and Medium Temperature LCR units shall have (2) – 50% evaporator coils (and fans sections) to allow for hot gas defrost of one coil while the other is in refrigeration. The two evaporator sections shall be separated by an internal baffle to prevent cross flow during defrost. High Temperature LCR units shall have (1) – 100% evaporator coil and no hot gas defrost.

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5.2. MACHINE ROOM SECTION

5.2.1. Compressor Package:

- 5.2.1.1. Compressor shall be open drive screw type with high-efficiency profile rotor and advanced geometry and high rigidity. The compressor in Low and Medium Temperature LCR units shall be optimized for economizer operation. High Temperature LCR units shall be non-economized.
- 5.2.1.2. VFD shall be provided for the compressor motor in order to modulate the refrigeration capacity of the packaged system to very closely match the cooling demands.
- 5.2.1.3. Motor shall be 460 Volt three-phase ODP type induction motor with squirrel cage rotor, 1.15 SF, insulation Class F and VFD compatible. 100 HP and above include space heaters.
- 5.2.1.4. The compressor oil separator shall be ASME stamped and contain a coalescer element designed to maximize the advantages of the lubricant properties and minimize the oil carry over rate to the low side of the system. Oil separated from the compressor discharge vapor flow stream by the coalescer shall be returned to the compressor economizer port to avoid a parasitic loss on compressor capacity. The coalescer oil return flow rate shall be managed by means of hand-adjustable metering valve to provide adequate flow while minimizing the impact on compressor power consumption.
- 5.2.1.5. Compressor oil shall be polyalphaolefin (PAO) type CP-4600-46.
- 5.2.1.6. Oil separator shall have (2) 300 Watt electric heating elements to heat the oil during low ambient temperatures while the unit is in stand-by mode.

5.2.2. Water Cooled LCR Units – Water Cooled Condenser + Oil Cooler:

- 5.2.2.1. Water Cooled Condenser and oil cooler shall be plate and shell type to reduce the ammonia charge and achieve low pressure drops. The heat exchanger shall be ASME stamped and assembled from a plate pack made of stainless steel plates and a shell made of carbon steel.
- 5.2.2.2. Water Control Valve: A two-way fully modulating control valve shall be factory installed and wired to control the constant flow of cooling fluid to maintain ammonia condensing pressure. The two-way modulating valve shall automatically meter the flow of cooling water to the heat exchanger in response to a proportional signal provided to the valve by the microprocessor controller. Manual override capabilities shall be included on the actuator drive. Design pressure shall be 150 psig.

5.2.3. Air Cooled LCR Units – Air Cooled Condenser + Oil Cooler

- 5.2.3.1. Condenser fans shall be unicast aluminum, 42” induced draft axial-style, direct drive with taper lock bushings. The motors shall be three phase synchronous induction NEMA style, VFD ready, TEAO, 1.15 SF, double sealed. The motors shall have 120 VAC space heaters.
- 5.2.3.2. All condenser fan motors shall have a common variable frequency drive and each fan motor shall have its own motor starter protector (MSP).
- 5.2.3.3. Each unit shall be furnished with roof mounted microchannel condenser coils and condenser fans. The single pass condenser coil shall be fabricated from vertically



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oriented brazed aluminum channels and louvered aluminum fins and epoxy coated. The oil cooler shall be flooded plate and shell thermosiphon type and installed in the machine room.

5.2.3.4. A working platform and standard ladder shall be provided for easy service and removal of motors and fans and shall consist of a heavy-duty, self-supporting working platform with vertical hand rails. The ladder and safety cage shall ship loose for easy installation.

5.2.3.5. The air cooled condenser shall incorporate a low ambient variable speed fan head pressure control for year-round system operation down to -20°F DB minimum ambient air temperature. The control system shall be provided with refrigerant pressure transducer to monitor refrigerant discharge pressure and control the condenser fans to the precise speed as needed to maintain design refrigerant discharge pressures.

5.2.4. High Side Float Control & Economizer Intermediate Level Control:

5.2.4.1. A high side float drainer shall be located at the water cooled condenser outlet (or thermosiphon oil cooler outlet for air cooled) to facilitate low charge and to supply liquid ammonia from the condenser into the intermediate pressure flash economizer vessel (for Low and Medium Temperature models) or into the recirculator vessel (for High Temperature models).

5.2.4.2. On Low and Medium Temperature systems a flash economizer shall be furnished to provide optimum refrigeration cycle efficiency. The economizer flash gas shall feed the compressor side port and also handle liquid surge from evaporator defrost condensate during coil defrost.

5.2.4.2.1. The flash economizer shall have liquid level control and supply liquid ammonia through a motorized liquid expansion valve into the low pressure liquid recirculation vessel.

5.2.4.2.2. The flash economizer vessel shall be ASME stamped.


5.2.5. Liquid Recirculator:

5.2.5.1. A horizontal liquid recirculator vessel shall be provided with a hermetic liquid ammonia pump and liquid level monitoring. The recirculator shall provide liquid carryover protection to the compressor while providing reliable and efficient evaporator and system operation. The pump shall provide liquid ammonia to the evaporators at recirculation rate of 1.2:1.0. The liquid recirculator shall be ASME "U" stamped.

5.2.6. Piping & Valves:

5.2.6.1. Ammonia piping shall be 304L stainless steel for corrosion protection. Pipe sizes up to and including 2" shall be schedule 40, and 2 -1/4" and above piping shall be schedule 10. Carbon steel transitions or fittings may be used where required to connect to valves, vessels or similar components.

5.2.6.2. Ammonia control valves shall be Danfoss ICF or ICM type and isolation valves shall also be Danfoss.

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5.2.7. Pipe & Vessel Insulation:

5.2.7.1. Pipe and vessel insulation shall be Owings Corning Foamular XPS and vapor retarder jacket shall be Polyguard Zero perm. Outer jacketing shall be white PVC.

5.2.8. Ammonia Relief Valves:

5.2.8.1. ASME Section VIII code compliant ammonia relief valves shall be provided and piped to a common relief discharge header. Relief valves shall be provided for the high side (including the oil separator & condenser), economizer/intermediate and the recirculator vessel.

5.2.8.2. The entire ammonia system has a system design pressure of 350 PSIG and the relief valves are rated accordingly.

5.3. Machine Room Auxiliaries:

5.3.1. Machine Room Ammonia Detection

5.3.1.1. (2) Ammonia sensors shall be provided in the Machine Room (low level and high level concentrations) and (1) ammonia sensor shall be provided in the common relief valve header to detect any leaks. Ammonia detectors shall be connected to the main control panel for monitoring and annunciation.

5.3.2. Ventilation Fans

5.3.2.1. (2) - 1000 CFM centrifugal ventilation fans shall be provided in the machine room. Only one fan is required per code to evacuate the ammonia in the event of a leak in the machine room. Two fans allow for the necessary motor heat removal from the machine room (based on largest motor).

5.3.3. Lighting:

5.3.3.1. Three lights shall be provided in the machine room. Lights shall be LED type and installed and wired in the machine room for ease of service.


5.3.4. Optional Accessories

5.3.4.1. Optional Machine Room Accessories are available as listed in Section 6.4.

6. ELECTRICAL SYSTEM

6.1. The electrical system shall conform to National Electrical Code requirements. The control circuit shall be 120 volts AC, wired in accordance with NEC Class II requirements. The control circuit wire shall not be smaller than 18 AWG. All wiring shall be neatly routed in cable tray or protective sheathing in the Machine Room, and EMT conduit in Penthouse.

6.2. Each wire shall end with a service loop and be securely fastened by an approved method. Each wire in the unit shall be numbered for ease of service tracing. All electrically actuated components shall be easily accessible without reaching over exposed 460V components or rotating parts. Each 460V circuit shall be individually protected by circuit breakers or manual motor starters on all three phases. The motors shall have thermal and short circuit protection. 460 volt and 120 volt control circuit wiring shall be routed in separate tray sections, bundles or conduit. The electric panel shall be positioned for service convenience and shall include all the contactors, starters, fuses, circuit breakers, terminal boards and control transformer required for operation of the

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Evapcold unit and shall allow for full service access.

6.3. Evapcold Controller (Power and Control Panel)


- 6.3.1.** A primary electrical panel shall be provided with the LCR package which houses the power distribution, safety controls and microprocessor control system for the entire unit. This panel shall be located inside the Machine Room, and called the Main Control Panel. It shall also have a panel face that is located outside the Machine Room and contain the main disconnect and safety controls (this section is called the Service Panel).
- 6.3.2.** To power the LCR unit, a single 460 Volt, 3 phase, 60 Hz power feed shall be brought to the package and connected to the main termination lugs inside the panel. This power feed shall enter the LCR package through a removable panel located below the external Service Panel. The power shall then sub feed to the rest of the package, with all starters and VFDs included in the Main Control Panel. The power side of the Main Control Panel shall be separated from the system controls side (HMI user interface screen, microprocessor controller, input/output cards and termination blocks).
- 6.3.3.** The outside Service Panel shall contain the main disconnect, emergency shut down button, emergency beacon/light and a manual override for the ventilation system. Placing the main power disconnect in the off position shall not disconnect power for lighting, microprocessor controls and ammonia detection electrical circuits. There shall be a separate 120 Volt disconnect at the outside Service Panel for these circuits.
 - 6.3.3.1.** Also on the Service Panel shall be a dedicated 460 Volt plug to power an available modular pump down unit (optional) to service the package.

6.3.4. General

- 6.3.4.1.** The advanced microprocessor based Evapcold controller shall be equipped with flexible software capable of meeting the specific needs of the application. The setpoints shall be default and their ranges shall be easily viewed and adjusted from the user interface display. The program and operating parameters shall be permanently stored on a non-volatile system in the event of power failure.
- 6.3.4.2.** The controller shall be designed to manage temperature levels to a user defined setpoint via the user interface display or remotely through the BMS. The controller shall be capable of varying machine load from 20 to 100% of the full rated capacity.
- 6.3.4.3.** The controller shall receive inputs for measurable control conditions (temperature, pressure, and levels) via return air or machine room mounted sensors. The internal logic will then determine if the conditions require cooling and the amount of it. Control setpoints shall be established to maintain design conditions of the installation. The controller will respond accordingly to changes in these conditions and control the output/demand for the appropriate mode of operation until user defined conditions are achieved.

6.3.5. Field Configurable

- 6.3.5.1.** The program for the Evapcold Series controller shall be field configurable, allowing the operator the capability of selecting control setpoints specific to the application. Operator interface for the Evapcold controller is provided via a control panel door mounted user interface display panel. The display panel shall have a backlit graphical display and

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touchscreen giving the user complete control and monitoring capability of the refrigeration system. The menu driven interface shall provide users the ability to scroll through and enter various menu screens.

6.3.6. Password Protection

6.3.6.1. Access to the Information Menu, Alarms Log, and the ability to monitor conditions shall be allowed without the use of a password. Modifications to the control setpoints shall require the use of a password. The controller shall be programmed to recognize predetermined security levels before allowing access to display screens containing critical variables. Five secured menu levels (Basic, User, Maintenance, Administrator and Factory) will support unique passwords that must be entered to access the menu screens so only authorized personnel may perform modifications to the settings.

6.3.7. Restorable Parameters/Factory Defaults

6.3.7.1. Upon initial start-up, the Evapcold system shall operate using the setpoints programmed by the factory. The customer may enter new operating parameters in the Control menu and the system will then operate accordingly. The new setpoints may be stored as, "Customer Backup Setpoints". The primary setpoints entered by the factory still remain stored in the controllers' memory as, "Factory Setpoints". The setpoints for the system may be re-adjusted in the Control menu at any time. If it becomes necessary, the customer may restore the setpoints back to the Customer Backup setpoint values or to the original Factory (primary) setpoint values.

6.3.8. Remote Interface

6.3.8.1. The Evapcold controller incorporates a communication interface port that can be field connected through an Ethernet interface to a Building Management System (BMS) via Modbus TCP or VNC Native. A controller interfaced to a network shall be configured for BMS communication.

6.3.9. Alarms


6.3.9.1. Alarm conditions shall activate an indicator that backlights the alarm function. An alarm condition may also be enunciated by an audible alarm signal. An alarm is acknowledged by pressing the alarm key. This calls up alarm display screens that provide a message detailing the alarm conditions. After an alarm condition is corrected, the alarm can be cleared by pressing the alarm key.

6.3.10. Control Functions

6.3.10.1. The Evapcold controller shall contain all necessary control functions and algorithms to provide a fully functioning refrigeration system. This includes system temperature control, capacity control, defrost control, head pressure control, liquid management and ammonia detector safety system.

6.3.11. System & Compressor Capacity Control

6.3.11.1. The system shall include a variable compressor speed control package. Minimum and maximum compressor speed settings shall be factory set. The system controller shall have the capability to vary the output of the compressor to match the required system


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load and operating conditions.

6.4. OPTIONAL EQUIPMENT/ACCESSORIES

Several optional accessories are available with the Evapcold LCR roof mounted refrigeration system which can be added, deleted and/or substituted (at time of order) with optional features to allow you the flexibility to select the configuration best suited for your application.

- 6.4.1. Variable frequency drive for evaporator fans:** Each evaporator will have a common VFD feeding its respective fan motors and each fan motor will have its own motor starter protector (MSP).
- 6.4.2. Penthouse supply air plenum:** A custom designed supply air discharge plenum shall be provided, which is to be mounted under the penthouse for proper air distribution.
- 6.4.3. Penthouse lighting:** (2) lights per evaporator section in the Penthouse shall be provided, installed and wired to the main panel.
- 6.4.4. Penthouse ammonia detection:** (1) ammonia sensor per evaporator compartment in the Penthouse shall be provided to detect any leaks in the Penthouse. Ammonia detectors shall be connected to the main control panel for monitoring and annunciation.
- 6.4.5. Motor davit for evaporator fans:** (1) motor davit shall be provided to ease removal and service of the evaporator fans and motors. The davit is movable and can be used for all fans.
- 6.4.6. Machine room platform step:** A step shall be provided to be mounted on the outside of the machine room beneath the door. The platform step shall ship loose and shall be installed in the field.
- 6.4.7. Machine room winterization:** A factory mounted and wired low-watt density, plated fin-tubular design electric resistance heater shall be included to heat the machine room when the machine room temperature falls below 40°F. Electric heaters shall be provided with miniature thermal/magnetic circuit breakers, which shall protect each ungrounded conductor. Also included will be one automatic reset and one manual reset over-temperature safety device (pilot duty).
- 6.4.8. 3-Way water regulating control valve:** In lieu of the standard two-way control valve, a three-way fully modulating control valve can be factory installed and wired to control the constant flow of cooling fluid to maintain ammonia condensing pressure. The three-way modulating valve shall automatically meter the flow of cooling water to the condenser in response to a proportional signal provided to the valve by the microprocessor controller. Manual override capabilities shall be included on the actuator drive. Design pressure shall be 150 psig.
- 6.4.9. BMS interface with Ethernet IP protocol:** Ethernet IP communication protocol shall be provided to connect the unit controller to the BMS system.
- 6.4.10. Ambient temperature/humidity sensor:** A temperature/humidity sensor shall be provided to measure the ambient temperature and humidity.

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- 6.4.11. Emergency pressure control system:** An emergency pressure control system (EPCS) shall provide an independent means of preventing overpressure in the refrigeration system. The EPCS controller shall monitor the high side of the refrigeration system and automatically take action to avert a refrigerant release where without it, the pressure relief valves may release.
- 6.4.12. Motor davit for condenser fans:** One motor davit shall be provided to ease the removal and service of the condenser fans and motors. The davit shall be constructed of aluminum and shall be mounted on the side of the unit with a galvanized steel bracket. Davit shall be shipped loose and installed in the field.
- 6.4.13. Adiabatic cooling pads on air cooled condenser:** Adiabatic pads shall be provided to trim the ambient temperatures during the summer. Evapcold systems shall be designed with an adiabatic cooling system which utilizes high performance mold and bacteria-resistant evaporative media elements. The water distribution system consists of solenoid controlled spray nozzles to evenly distribute the water over the media elements. The controlled water supply achieves optimal performance and minimizes water consumption. Automatic real-time flush, wash and dry cycles reduce deposit accumulation on the evaporative media elements in order to extend media life and maintain peak evaporative effectiveness. A corrosion resistant stainless steel drain pan shall be provided. The water shall be supplied and drained through the designated exterior cabinet water inlet/outlet ports. Note: An external source of water must be provided. Municipal clean filtered water is recommended, but a recirculating system may be used (provided by others).