CASE STUDY

COLMAC COIL
Manufacturing Inc.

FUTURE-READY COLD STORAGE: COLMAC COIL CO2 SOLUTIONS FOR AUTOMATED COLD STORAGE

Location: Hebron, Indiana

Type of System: Freezer and Cooler in an ASRS Cold Storage Facility

Size: 260,000 sq. ft | 40,000+ pallet positions

Type of Refrigeration System: CO2 Direct Expansion

Frozen Product: Mixed frozen goods for regional and national distribution

Air temperature for Freezer: -20.0°F

Air temperature for Cooler: 35.0°F

Equipment:
- A+Series® A+L Penthouse Air Coolers (qty. 12)
- A+Series® A+P Insulated Penthouse Air Coolers (qty. 2)

Results/Benefits Delivered:

- Future-ready refrigeration system enabled by CO2 DX technology, eliminating refrigerant phaseout risk and supporting long-term sustainability goals.
- Continuous operations supported by advanced defrost strategies and high-performance air cooler design, minimizing downtime and temperature disruption.
- Improved energy efficiency through optimized CO2 DX air coolers, EC fan motors, and enhanced refrigerant distribution.
- Maximized usable storage space through a penthouse evaporator solution that preserves interior volume while delivering uniform airflow across high-bay ASRS racks and convertible temperature rooms.

Executive Summary:

A leader in third-party cold storage logistics expanded its presence in the Chicago market with a high-rise automated storage and retrieval system (ASRS) cold storage facility offering 40,000+ pallet positions. To meet the unique cooling system requirements, Colmac Coil developed air coolers (evaporators) for convertible temperature cold storage rooms and dock areas.

The facility was designed with a CO2 direct expansion refrigeration system, selected for its superior efficiency at low temperatures, removal of refrigerant regulatory phaseout risk, and to meet long-term sustainability goals. Colmac Coil's customized evaporator designs supported both fixed-temperature zones and convertible rooms capable of switching between freezer, cooler, and tempering modes, while also reducing defrost cycle time and ensuring continuous operation, delivering an energy-efficient and future-ready solution.

Introduction:

A major cold storage company faced several engineering and operational challenges when designing its high-bay automated storage and retrieval (ASRS) facility in Hebron, Indiana. The project required air coolers that could operate reliably under high-pressure CO2 direct expansion conditions while fitting into the compact footprint of an automated warehouse. The facility also included convertible rooms capable of shifting between freezer, cooler, and tempering modes without compromising food safety or hygiene.

In addition, the dock area featured a pitched roof, requiring insulated penthouse evaporators to be custom designed with a pitched base to match the roof slope while maintaining optimal airflow, clearance, and serviceability. Finally, the equipment needed to maximize runtime and minimize defrost interruptions to support continuous 24/7 operation.

High Density Storage, Convertible Rooms, and CO2 Industrial Refrigeration System Design Challenges

- ASRS high-bay design created space constraints while also requiring uniform airflow across tall racks and adaptability for convertible room operation between freezer, cooler, and tempering modes.
- High-pressure (1740 PSIG) CO2 refrigerant demanded equipment capable of safe, long-term operation.
- Continuous 24/7 distribution required air coolers designed to reduce defrost frequency and maintain precise temperature.
- The project called for industrial-grade materials and components that meet rigorous safety standards and deliver reliable long-term air cooler operational lifetime.

Customized Penthouse CO2 Air Cooler Solutions

Adaptive Performance

- Designed to serve both fixed-temperature zones and convertible rooms.
- EC fan motors with onboard speed control, sensors, electronic expansion valves, and optimized defrost strategies allowed coolers to adapt seamlessly to changing temperature setpoints.

Durability Under Pressure

- CO2 evaporator design with tube pressure capacity up to 1740 PSIG.
- UL 207 certification ensure safe, reliable operation at high operating pressures.
- Stainless steel venturi distributor provides uniform refrigerant distribution, improved heat transfer, and reduced frost buildup, with corrosion resistance for washdown environments.

Defrost Reliability

- Effective hot gas defrost through both the coil and drain pan.
- Inlet air hood with heat trace ensures consistent defrost and airflow.
- Hot Gas defrost system and heated EC fan tube rings prevent ice buildup during defrost.

COLD STORAGE DOCK - A+SERIES® A+P INSULATED PENTHOUSE AIR COOLERS

A+P Pitched Base:
Matches dock roof slope for seamless integration

Factory-Provided Ducting:
Simplifies installation and ensures proper airflow

EC Fan Motors in Insulated Penthouse:
Precision airflow with built in fan speed control

Structural Integration

- A+P Insulated Penthouse Pitched Base design matched the dock's roof slope.
- Allowed removal of equipment and refrigerant from the interior space, increased usable cooling space, and safe technician access for serviceability.
- Factory-provided ducting simplified installation while maintaining precise airflow.

Industrial-Grade Materials

- Stainless steel tubes, aluminum fins, and G235 galvanized steel coil housing coating.
- Provide long-term integrity in demanding and corrosive environments, supporting food safety compliance and reducing lifetime maintenance costs.

Efficiency, Reliability, Space Optimization, and Future Proof Cooling Delivered

- **Continuous Operation:** Reduced defrost cycle times by utilizing a custom 2-pipe hot gas reverse cycle system that circulates through both the drain pan and coil, sequential defrosting system, and heated tube fan rings improved uptime and operational reliability.
- **Energy Efficiency:** Advanced CO2 DX design, EC fan motors, venturi distributor, and optimized defrost system increased overall refrigeration efficiency.
- **Space Maximization:** Penthouse evaporator designs enhanced high-bay ASRS layout, enabling 48,000 pallet positions. Evaporators designed for convertible room operation gave the company greater flexibility, allowing space to shift between temperature modes without the cost of building additional dedicated rooms.
- **Future Ready Refrigeration Solution:** CO2 as a refrigerant aligns with the company's sustainability goals and is future proof due to the inherited low GWP and positions the company to operate without risk of future refrigeration phaseouts.

COLD STORAGE DOCK - A+SERIES® A+P INSULATED PENTHOUSE AIR COOLERS

Stainless Steel Venturi Distributor:
Ensures uniform refrigerant distribution and enhanced heat transfer

A+P PVC Membrane Roof:
Durable, corrosion-resistant protective roof

CONVERTIBLE FREEZER & COOLER ROOMS – A+SERIES® A+L AIR COOLERS

Inlet Air Hood:
Provides more effective defrost and directs return airflow

Insulated Drain Pan with Hot Gas Loop & Heat Trace:
Enables complete and fast defrost

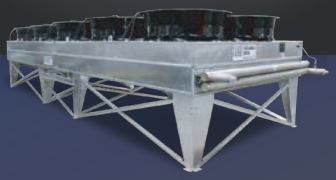
Shrink-Wrapped Equipment:
Arrives at the jobsite in factory condition for installation or storage

QUALITY PRODUCTS FROM COLMAC COIL

COLMAC COIL
Manufacturing Inc.

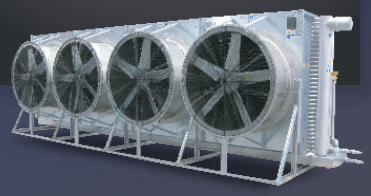
A+Series®
Air Coolers

Fluid Coolers
and Condensers



HygenAir™ Hygienic
Air Handlers

Custom Evaporators
and Blast Freezers



Heating and
Cooling Coils

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ASME Sec. VIII, Canadian Registration Number, UL508

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