COLMAC COIL
Manufacturing Inc.

A+Series™

Refrigeration Air Coolers

"The Heat Transfer Experts"

COLMAC COIL
Manufacturing Inc.

A+Series™

Colmac A+Series™ air coolers offer the most advanced and innovative features in the industry for your industrial refrigeration applications and are designed to provide you with unsurpassed levels of:

Food Safety | Worker Safety | Energy Efficiency | Reliability

A wide range of cabinet construction options are available to enhance corrosion resistance (stainless steel), and food safety (CIP). A+Series™ coil construction options give you the flexibility to match any working fluid or environment:

TUBES	FINS
Copper	Plain or Epoxy Coated Aluminum
Aluminum	304 or 316 SS
304 or 316 SS	Anti-Microbial
Galvanized Steel	Galvanized Steel

Three unique tube patterns are used to optimize cooling performance, fan power, and defrost frequency depending on the capacity requirements, working fluid used, and operating temperatures specific to your application. Other manufacturers use a single tube and fin pattern for their product lines, forcing you to accept 'one-size-fits-all' and a less than optimum solution. Not with Colmac Coil!

A number of Colmac innovations have been incorporated into the A+Series™ line as optional features, including:

ADX™ Low Charge DX Ammonia Technology
- Significantly reduced ammonia charge
- Energy efficient
- Lower first cost compared to pumped ammonia

High Performance Glycol Coolers
- Proprietary tube enhancement technology
- 30% increase in cooling capacity
- Reduced glycol pumping power

Return Air Defrost Hoods
- Captures defrost heat and moisture
- Fully insulated with optional active heating
- Collapses for shipment

Reversing Airflow Fans
- Reduces blast freezing time by as much as 20%
- Improves product quality
- Cost Effective

Anti-microbial Coil Construction
- Anti-microbial fin material actively kills pathogens
- Corrosion resistance equivalent to SS
- Good thermal performance

Epoxy Coated Fins
- 300% more corrosion resistant than plain aluminum
- Flexible - will not chip or peel
- Cost effective

Read on to learn more about A+Series™ air coolers from Colmac Coil!

Cover photo by: Gary Jensen

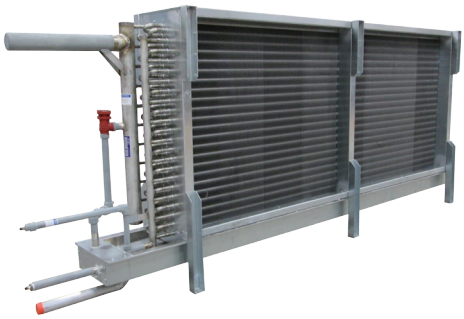
A+L High Profile

A+M Medium Profile

A+S Low Profile

A+R Process Rooms

A+D Low Profile Dual Discharge



A+B Coil Block with Drainpan

A+E Low Profile
for Commercial Applications

FEATURES

UNCRATING AND RIGGING MADE SAFE AND EASY

Colmac A+Series™ evaporators are crated and designed for fast and safe installation.

Cradle Crating System. The unique cradle crating system from Colmac is made of heavy duty 2"x8" dimensional lumber to support the full weight of the evaporator while withstanding the rigors of shipment. The cradle crate safely supports the weight of the evaporator while it is lifted into position from below. Then after the evaporator is secured to the ceiling, the crate easily comes away from the unit by gravity allowing it to be safely lowered to the ground.

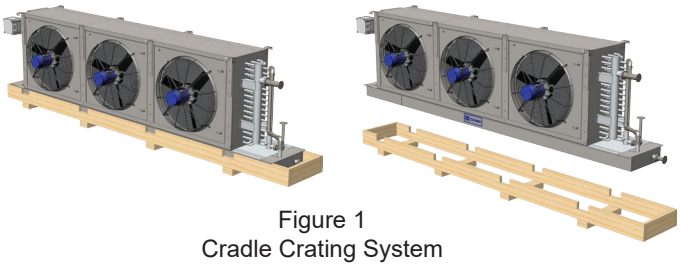


Figure 1
Cradle Crating System

Smart Hanger System. This optional patented design was developed to make the process of mounting ceiling-hung evaporators faster and safer. Smart hanger brackets and rails allow evaporator units to be hung from the ceiling without any personnel leaving the floor level. The time consuming process of aligning threaded rods into mounting holes while the unit is being lifted into position is eliminated, reducing suspended load time by as much as 75%. Side to side placement of the evaporator on the Smart Hanger rails is non-critical and therefore faster.

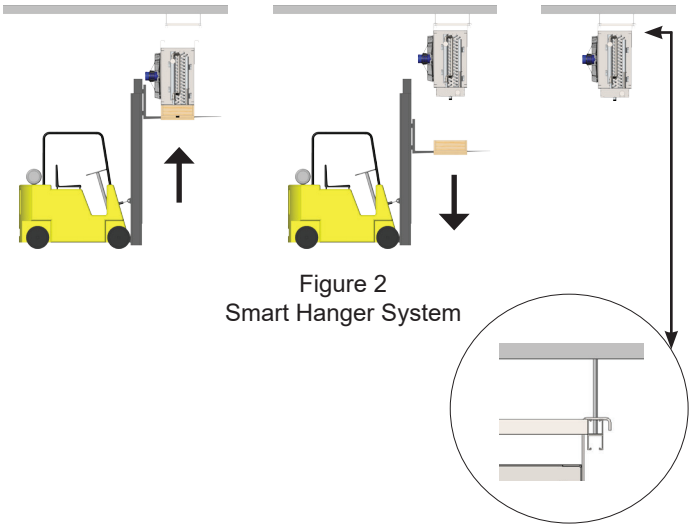


Figure 2
Smart Hanger System

ENERGY EFFIICIENT AIRFLOW

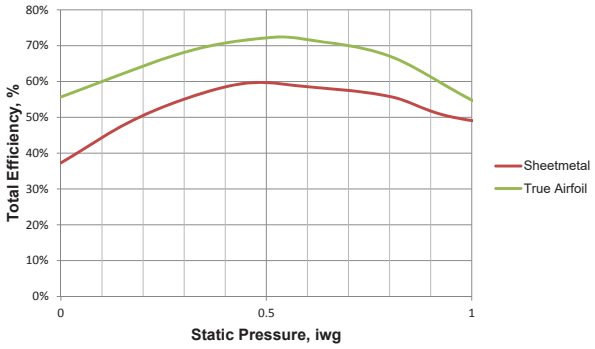
Fans

Colmac A+Series™ evaporators use high efficiency fan blades having a true airfoil shape profile for all fan diameters greater than 24 inches. This type of fan offers several advantages over stamped steel or aluminum blades:

Figure 3
Multi-Wing Blade Cross Section

High Efficiency. The true airfoil blade shape can achieve mechanical efficiencies of 70%+. The best a stamped steel or aluminum sheetmetal blade can achieve is approximately 60%. This means Colmac A+Series™ evaporators will operate with 10% less fan power for the same cooling load, which not only translates to lower operating costs, but also lower first cost for power cabling and transforming.

FIGURE 4
36" Diameter Prop Fans @ 1140 RPM
Total Efficiency vs Static Press

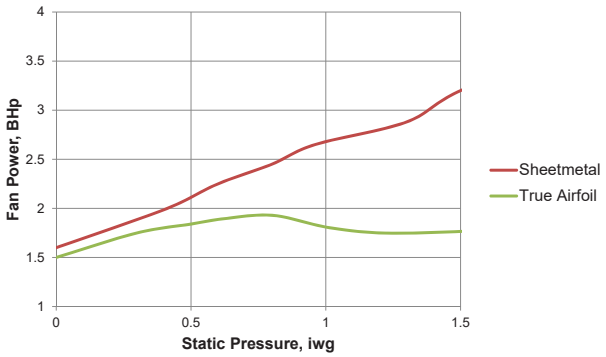


Low Noise. The higher efficiency of A+Series™ fans also results in lower sound levels during operation. A wide range of fan diameters and speeds are available to allow the selection of the appropriate sound level for the application and customer requirements.

Non-overloading. Another benefit of A+Series™ fans with airfoil shape profile is the non-overloading power vs pressure characteristic curve. The power vs pressure curve is very flat which means that as frost accumulates on the evaporator and static pressure through the coil block increases, the brake power load imposed on the fan motor remains constant. Stamped steel and aluminum

sheetmetal fan blades have a steeper power vs pressure curve which results in brake power (and amperage) continuing to rise as frost accumulates and static pressure increases.

FIGURE 5
36" Diameter Prop Fans @ 1140 RPM
Power vs Static Press

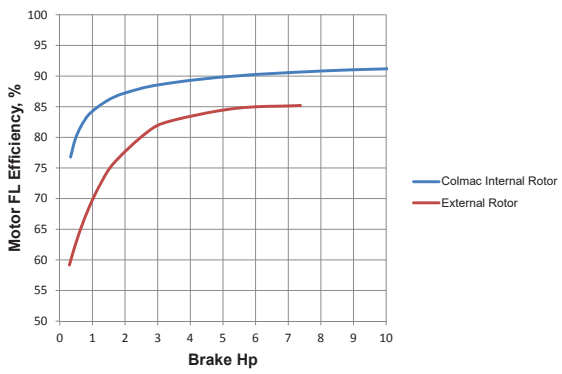


Motors

All standard fan and motor combinations on A+Series™ evaporators are optimized for maximum total efficiency. This is different from the integral external rotor fan motor units supplied by other manufacturers. While certain airflow and pressure conditions may result in total efficiencies approaching the A+Series™ efficiency, in many cases the total efficiency for integral external rotor fan motor units is inferior.

All standard fan motors supplied with A+Series™ evaporators are high efficiency, internal rotor, totally enclosed, VFD compatible. Integral horsepower motors (greater than 1 Hp) are supplied standard as NEMA Premium Efficiency. See the NEMA definition of Premium Efficiency for actually motor efficiencies. Fractional horsepower motors (1 Hp and less) are supplied standard as 80% minimum efficiency.

FIGURE 6
Motor Efficiency vs Brake Power
Internal vs External Rotor



Both 1140 rpm (6 pole) motors for high capacity applications and 850 rpm (8 pole) motors for low noise applications are available. Motors are suitable for either 50 or 60 Hz supply voltage.

A+S and A+R air coolers utilize robust C-face motors for reliability, low noise, and ease of replacement. These fractional horsepower motors are designed for 80% minimum efficiency as standard and can be supplied for washdown duty as an option.

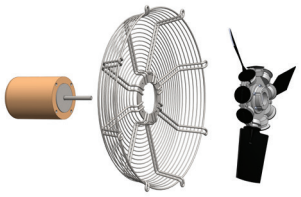
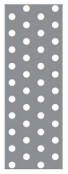


Figure 7
C-face Motor and Guard Combination A+S unit

OPTIMIZED HEAT TRANSFER

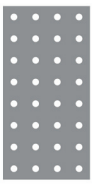
Unlike other manufacturers who offer a single “one-size-fits-all” tube pattern in their evaporators, Colmac A+Series™ evaporators feature optimized tube patterns to precisely match the operating conditions:

'I' Pattern (5/8" diameter staggered tubes)



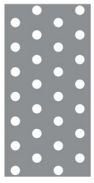
- Enhanced plate fins
- Compact pattern for highest heat transfer efficiency in high heat flux applications
- Best for high temperature wet fin applications with large TD

'T' Pattern (5/8" diameter inline tubes)



- Enhanced plate fins
- Lowest fan power
- Large secondary (fin) surface area for maximum frost carrying capacity and extended runtime between defrosts
- Best for low temperature frosted fin applications

'M' Pattern (7/8" diameter staggered tubes)



- Enhanced plate fins
- Low fan power
- Large secondary (fin) surface area for maximum frost carrying capacity and extended runtime between defrosts
- Best for:
  - Gravity flooded ammonia
  - Large capacity pumped ammonia

COLMAC COIL Manufacturing Inc.

FEATURES

Available For Any Working Fluid

Colmac A+Series™ evaporators can be supplied to utilize any working fluid (refrigerant), either volatile or non-volatile, primary or secondary. This includes (but is not limited to):

Volatile

- Ammonia
- CO_2
- HFCs
- Liquid Nitrogen

Non-Volatile

- Glycols
- Calcium or Potassium Chloride
- Dynalene
- d-Limonene
- Potassium Formate

Circuiting is matched to each application and optimized for highest heat transfer with lowest tubeside pressure drop.

- Pumped or CPR bottom feed
- Pumped or CPR top feed
- Gravity flooded
- Direct expansion
- ADX™ Low Charge Ammonia

ADX™ LOW CHARGE AMMONIA TECHNOLOGY

The industrial refrigeration industry has always used the old rule of thumb: “Don’t use DX Ammonia below 0 degrees F, it won’t work!”. Now with patented Colmac ADX™ technology, DX with ammonia is finally possible down to blast freezing temperatures (-40º to -50ºF). The benefits of Colmac ADX™ Low Charge Ammonia technology include:

- Dry suction – no wet suction risers to worry about
- Very low system ammonia charge
- Ultra-low evaporator ammonia charge
- Lower first cost – no recirculator pumps, smaller line sizes, simpler controls
- Lower operating costs – liquid pumping power is eliminated

Colmac ADX™ is available on all A+ Series™ evaporators.

Colmac has published the DX Ammonia Piping Handbook to explain how ADX™ works and guide the reader through the process of successfully designing an ADX™ low charge ammonia refrigeration system. See www.colmaccoil.com to download a free copy of the handbook.

HIGH PERFORMANCE GLYCOL COOLERS

Secondary refrigerants (glycols and brines) are widely used in industrial refrigeration systems as a means of (a) reducing the total ammonia charge, and (b) removing ammonia from occupied spaces (i.e. loading docks, and process rooms) and other areas highly sensitive to the risk of ammonia leaks. Unfortunately, these benefits are accompanied by a number of disadvantages including:

- Added complexity
- Increased first cost
- Increased power consumption

To minimize air cooler power consumption (added pumping power and fan power) with secondary refrigerants, Colmac A+ Series™ liquid-to-air coolers have been designed with a revolutionary new tubeside enhancement system which significantly boosts cooling performance. Compared to traditional cooler designs offered by other manufacturers, A+ Series™ liquid-to-air coolers with enhanced tubes have:

- 30% more cooling capacity
- Reduced pumping power
- Reduced fan power
- Reduced piping and insulation costs

MATERIALS OF CONSTRUCTION

A+Series™ air coolers are offered in a variety of construction materials to match the operating environment and provide the most cost effective solution.

Aluminum tubes and fins: Colmac Coil has specialized in all aluminum construction for ammonia air coolers for over 30 years. All aluminum construction offers:

- Lightest weight
- Best performance
- Lowest cost
- Fastest defrost
- Good corrosion resistance
- Patented Bi-Metallic Couplers eliminate flange union connections

Stainless steel tubes with aluminum fins: The stainless steel tubes used in this type of construction offers some

added corrosion resistance and resistance to mechanical damage compared to all aluminum construction. However, the poor conductivity and higher cost of stainless steel tubes means relatively lower performance and higher cost compared to all aluminum construction.

A variety of different fin materials are available with stainless steel tubes on A+Series™ air coolers:

- Aluminum fins
- Epoxy coated aluminum fins
- 304 or 316 stainless steel fins
- Anti-microbial fins

Galvanized steel tubes and fins: In certain cases where highly alkaline cleaners are used directly on coil surfaces, galvanized steel construction may be desirable. This type of construction is significantly heavier (2 or 3 times), has significantly lower performance (12 to 15% less), and is costlier when compared to all aluminum or stainless/aluminum construction.

More detailed information on coil construction can be found in the Colmac Coil Technical Bulletin "Comparing Ammonia Evaporator Construction: Which One is Best?". Go to www.colmaccoil.com to download a free copy of this bulletin.

BREAKTHROUGH IN HYGIENIC DESIGN

Colmac specializes in hygienic coil designs for the food processing industry. A+Series™ air coolers can be supplied with the following types of coil construction to match more demanding cleaning and sanitizing requirements:

All Stainless: Both tubes and fins can be made of type 304 or type 316 stainless steel.

Anti-Microbial: Stainless steel tubes with proprietary anti-microbial fin alloy provides:

- Equivalent corrosion resistance to stainless steel tubes and fins
- Equivalent performance to stainless steel tube and aluminum fins
- Active anti-microbial action. Pathogen colony counts approach zero after just 2-3 hours exposure to this fin alloy
- Not a coating which can chip or peel off and contaminate food products

3-A Sanitary Design: The only design USDA approved for direct contact with food. Only available from Colmac Coil.

CLEANABILITY IS STANDARD

Cabinet Materials: Cabinet sheet metal is offered in galvanized steel, aluminum, or stainless steel.

Hinged Fan Panels: Fan panels on all A+S, A+M, A+L, and A+R air coolers are hinged for ease of inspection, cleaning, and service. The A+D has an optional hinged fan panel.

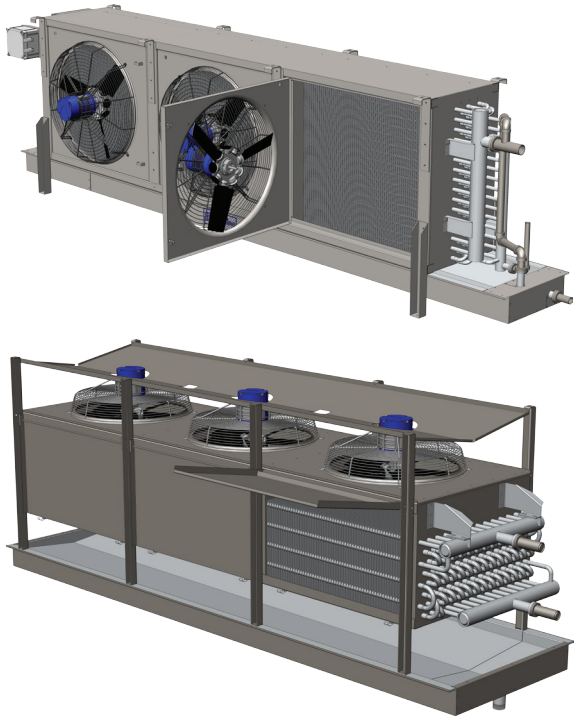


Figure 8
Hinged Access Panels

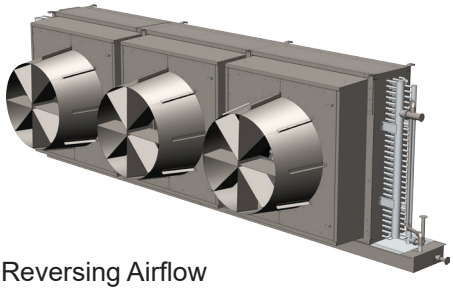
Cleaning Clearance: Care has been taken to eliminate difficult to inspect and clean areas on top of the fins and between the bottom of the fins and the drainpan. The “Triple Pitch” drainpan is designed to be easily cleaned, drain quickly, and leave no standing water after a defrost or cleaning cycle.

FEATURES

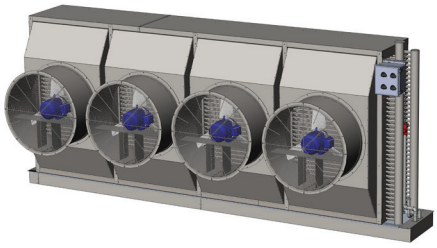
AIR DISCHARGE ARRANGEMENTS:

On applicable models, air discharge alternatives include:

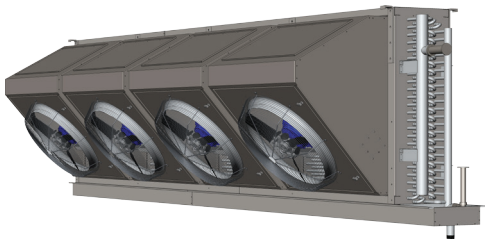
- Long throw adapters



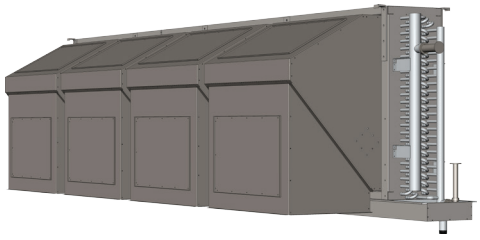
- Reversing Airflow



- 45° down discharge



- 90° down discharge (penthouse adapters)



45° and 90° penthouse options feature heavy-duty discharge housings that tilt the fans 45° down from the vertical plane. These housings ship installed for ease of installation. Access panels are provided on penthouse adapters to permit service access.

- Fans selected for external static pressure (ESP)

FACTORY ELECTRICAL WIRING OPTIONS:

- All motors wired to a common fused or non-fused disconnect switch located in a NEMA 4X box
- Each motor wired to an individual fused or non-fused disconnect switch located in a NEMA 4X box
- All motors wired to a control panel with a common fused disconnect switch and individual IEC motor starters. All located in a NEMA 4X box.
- Customized UL508 listed control panels available for all units

OTHER OPTIONS

Re-heat coil

- Installed to re-heat air leaving the evaporator coil

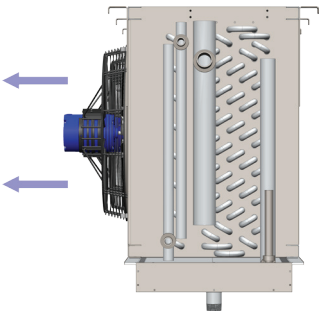


Figure 8
A+S Air Cooler With Re-Heat Coil

Variable fin spacing

- For severe frost applications, fins on the air inlet face of the coil have wider fin spacing than the remainder of the coil. The wider spacing allows for more frost build-up before defrosting becomes necessary, resulting in fewer defrosts compared to a coil without variable fin spacing.

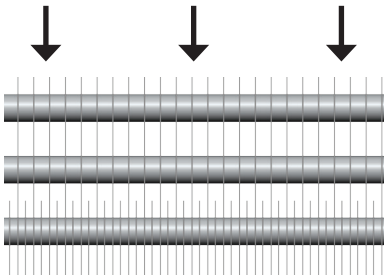


Figure 9
Variable Fin Spacing

Electric heat trace in the drain pan cover

- Use this option for conditions where the room temperature is above freezing and the drain pan cover temperature may drop below the dew point temperature of the room air, resulting in condensate forming on the cover and dripping. The heat trace keeps the drain pan cover above the room dew point temperature, and eliminates the possibility of condensation.

Extended legs

- For applications where a floor mounted coil must be elevated

Alternate voltages and 50 Hz fan motors

- Units can be designed and manufactured to be compatible with power supplies anywhere in the world.

NEW DEFROST TECHNOLOGY FROM COLMAC COIL

Colmac Coil A+Series™ air coolers are designed to:

1. Defrost faster
2. Use less energy during defrost
3. Eliminate drain pan icing problems

"Triple Pitch" Drainpan

Colmac Coil's innovative "triple pitch" V-bottom drainpan design provides for rapid and complete drainage of melted frost and ice. The drainpan is conveniently pitched to a single drain connection on one end of the unit, simplifying drain piping. The "V" shape acts to quickly move melted frost to the center of the pan where it flows to the end of the pan and the drain. Low spots and "pooling" of melted frost in the pan are completely eliminated. Pitching the drainpan in three directions (front to center, rear to center, and end-to-end) combined with continuous hot gas loop contact has resulted in "the perfect pan"!

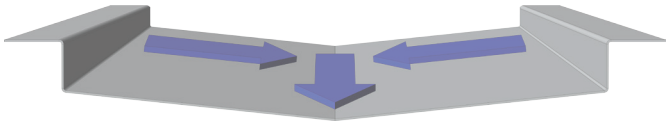


Figure 10
Triple Pitch Drain Pan

Drain connections found in other manufacturers' drainpans are typically made of pipe nipples cut at 90 degrees and welded onto a flat hole in the drainpan sheetmetal. This type of construction distorts the drainpan and can cause incomplete drainage because of high spots around the drain outlet. Colmac Coil has solved this problem with a full radius drain outlet formed into the drainpan to eliminate the possibility of water pooling around the drain after a defrost. The Colmac A+ drainpan drains completely. No more time and money wasted de-icing drain pans!

Figure 11
Full Radius Drain Outlet

Continuous Contact Pan Loop

Other manufacturers attach the hot gas pan loop (tubes and headers) underneath the drainpan in such a way that complete contact over the length of the pan is not possible. The tubes in the drainpan loop on Colmac evaporators are held tightly in contact along the entire length of the underside of the drainpan by means of special spring tension clips. No thermal mastic paste is used or needed with the Colmac A+ design. Pan loop headers are held outside the ends of the drainpan to allow full contact of the tubes with the pan. Defrost heat is transferred to the pan surface not only by the tubes themselves, but also through the metal of the full length clips.

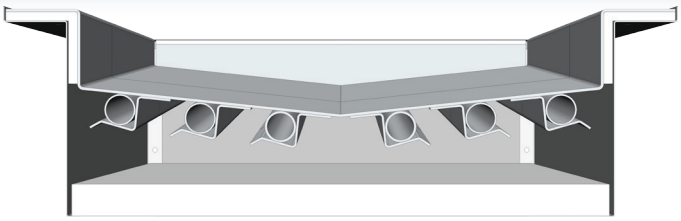


Figure 12
Continuous Contact Pan Loop

"It's All In The Piping"

Liquid Seal Hot Gas Drainpan Loop: In conventional hot gas drainpan designs, liquid refrigerant can flood the lower tubes in the drainpan hot gas loop, rendering them much less effective in heating the pan, and resulting in slow and uneven drainpan defrosting. Colmac Coil's trapped outlet design ensures that condensed, liquid refrigerant is carried out of the pan ensuring fast, complete, and uniform heating of the pan during defrost.

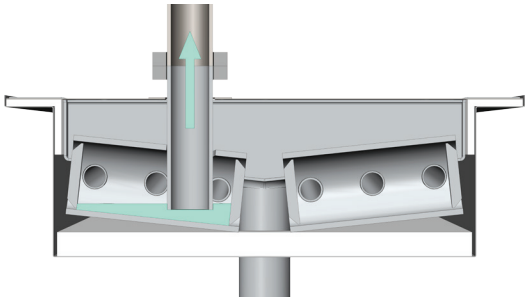


Figure 13
Liquid Seal Loop Outlet

Free Draining Liquid Connections: With conventional coil designs, the liquid connection enters the liquid header in such a way that the bottom tubes in the coil stay flooded during defrost with condensed, liquid refrigerant. The result is slow, uneven (or incomplete) defrosting of the coil. Colmac Coil has solved this problem by extending the liquid header downward and placing the liquid connection below the level of the lowest tube in the coil. This design effectively traps all of the condensed liquid refrigerant and forces it out of the coil during defrost, resulting in a fast, complete and effective defrost of the entire coil.

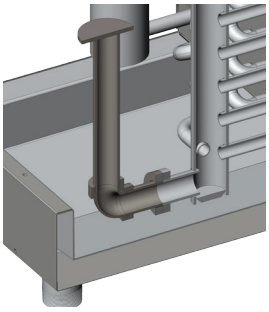


Figure 14
Trapped Liquid Connection

Vertical Liquid and Hot Gas Connections: Since nearly all piping in a refrigerated warehouse runs along the ceiling, and then vertically down to the evaporator coil connections, Colmac Coil's vertical liquid and hot gas connections eliminates the need for field installed elbows and piping required to connect to horizontal connections. The result is time and money saved on the jobsite during installation.

Return Air Defrost Hoods

As much as 60% of the energy used to defrost air coolers is lost to the room due to convection of heated air. Colmac Coil has developed a device which captures and uses the majority of this heated air. The Colmac Return Air Defrost Hood is a fully insulated series of hinged panels which collapse for shipment and then open quickly and easily into the operating position. The sturdy panels are of insulated double-wall construction with active heating to prevent condensation and frosting on the interior surfaces of the hood during defrost. Colmac Return Air Defrost Hoods can be added as an option to any A+Series™ air cooler.

Addition of these optional Return Air Defrost Hoods will result in:

- Faster defrosts
- More complete defrosts
- Reduced frost and ice on ceilings and walls
- Reduced power consumption

Figure 15
Hoods in Operation and Collapsed

A thermal finite element analysis was performed on two evaporators mounted in a single penthouse arranged for sequential defrosting, to visualize the effect of adding Colmac Return Air Defrost Hoods on heat loss during defrost. The result is a dramatic reduction in heat lost by the defrosting unit and an increase in the cooling performance of the operating unit.

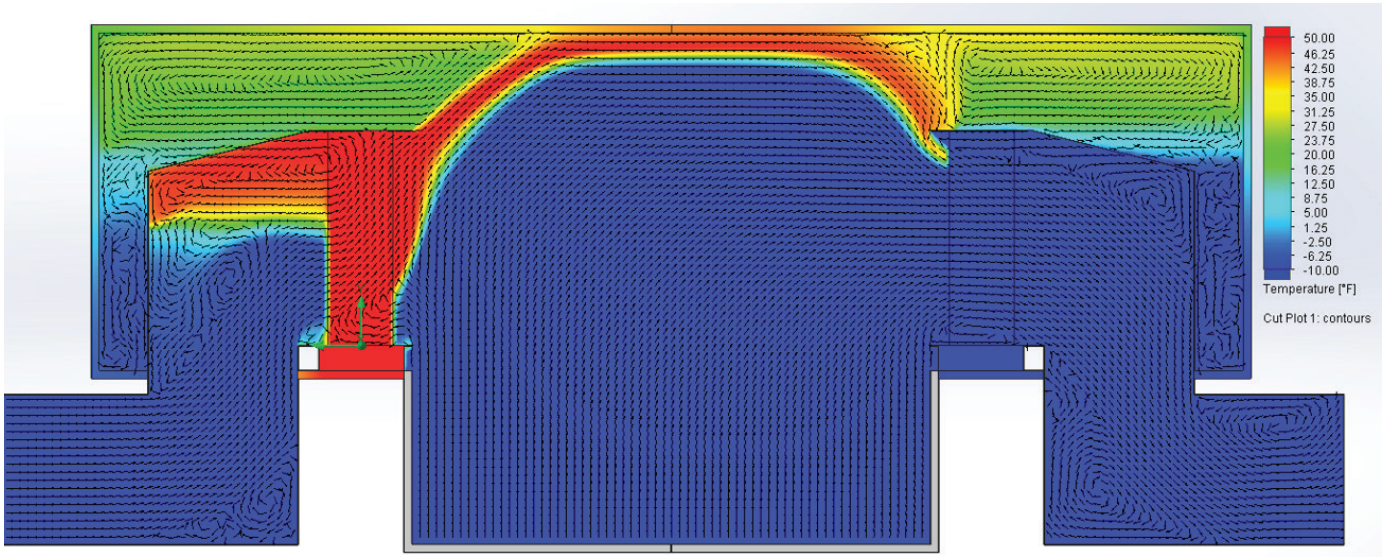


Figure 16a
Finite Element Thermal Analysis
A+L Penthouse Without Hoods

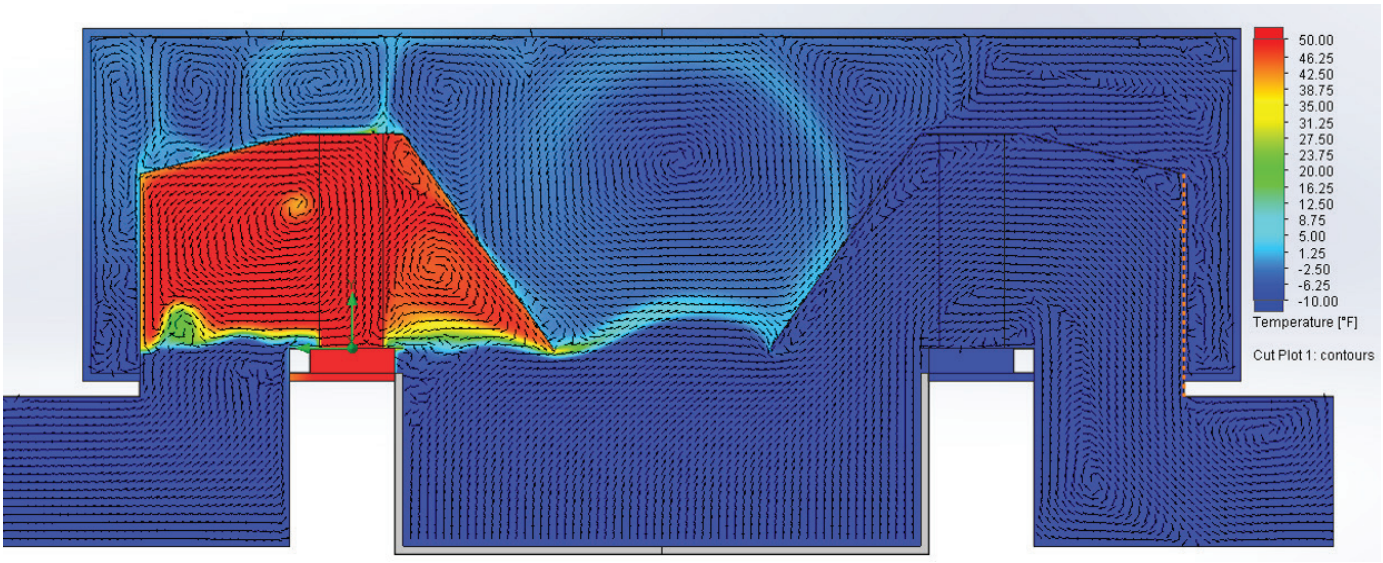


Figure 16b
Finite Element Thermal Analysis
A+L Penthouse With Hoods

FEATURES

WATER DEFROST THAT WORKS

Water defrost has many advantages:

- Fast – defrost duration is short
- Washes/cleans fin surfaces
- Energy efficient
- Simple

In spite of the benefits listed above water defrost has seen limited use, particularly at freezer temperatures, due to the perceived disadvantages of:

- Large water flowrate required
- Messy – frost and ice buildup from overspray
- Tendency of spray nozzles to foul and plug

A+Series™ air coolers with water defrost are designed to address each of these challenges.

Thermodynamically correct water flow rate: Traditionally, the amount of defrost water shown by evaporator manufacturers has been based on rules of thumb such as “1-1/2 to 2 gpm per sq foot of face area”, or “3 gpm per sq foot of top area”. These rules of thumb are overly conservative and result in higher-than-needed defrost water flow rates and pumping power. Colmac limits the defrost water flow rate to only the amount needed to heat the mass of the coil metal and melt the frost, no more.

No more overspray: Colmac Coil engineers have solved the problem of splashing and overspray with a patented system combining a special fin design to limit water leaving the edges of fins, and a drain pan designed to fully contain defrost water.

Removable, cleanable water distribution pans: Fouling and plugging of spray nozzles is mitigated by the use of removable, cleanable water distribution pans. The distribution pans are designed to be easily removable for inspection and cleaning while the evaporator remains in -place, undisturbed.

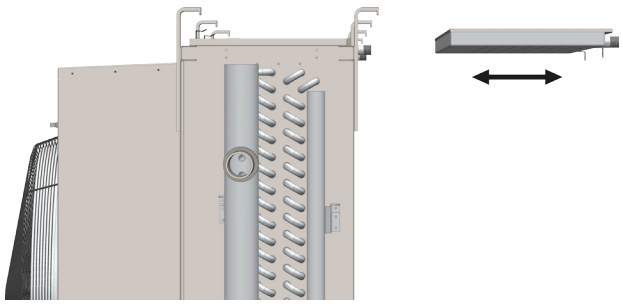


Figure 17
Removable Water Defrost Pan

PATENTED ELECTRIC DEFROST

This patented electric defrost heater element design eliminates elements “creeping” or “walking” out of the heat exchanger, which can cause damage to elements and wiring. The new proprietary design extends heater element life and reduces the risk of damage and electrical failures.

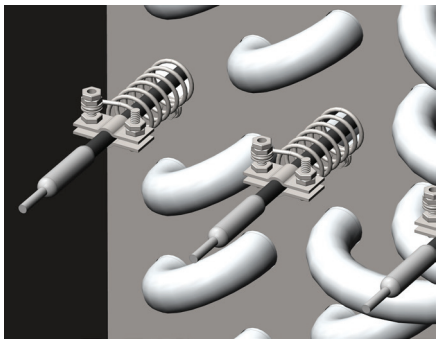


Figure 18
Heater Element
With Self Centering Spring

ONLINE SELECTION SOFTWARE

Colmac offers qualified users access to its powerful online applications software. The Refrigeration Load Simulator application accurately models and predicts the refrigeration load for an entire facility. This first-of-its-kind program calculates sensible and latent cooling loads, moisture removal rates, room rh%, fan power, defrost frequency, and other useful operating parameters. Output is saved and transferred directly to A+Pro™ air cooler selection software for accurate selection, specification, and pricing of A+Series™ air coolers.

NOTES

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NOTES

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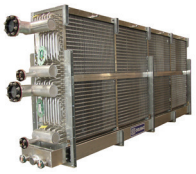
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