

A
Closer
Look

Sentry Guard™ WHITE PAPER

Innovative solutions that protect your systems



HOW TO PREVENT DAMAGE FROM A COIL FREEZE EVENT

With The Sentry Guard™ Burst Resistant Coils

PROBLEM

Freeze damage is one of the leading causes of coil failure in HVAC systems. Water in a coil at ambient temperatures of 32°F or less will freeze and expand, causing internal coil pressures to reach dangerous levels. When cold air is blown across coil surfaces by a fan, freezing can be greatly accelerated, resulting in coil tube and header damage in a matter of minutes.

Heating and cooling coils are commonly used in heat exchange devices for cooling and/or heating. Such coils typically have a heat transfer fluid circulating through to accept or dissipate heat. These coils may face temperature extremes and the fluids in the coils may also face temperature highs and lows having a great differential. At extremely low temperatures, the problems encountered are especially troublesome, as fluids may freeze. Heat exchange fluids may also expand at high temperatures and cause pressure buildups in the coils. The pressure buildup can cause the coils to burst, resulting in irreparable harm, and lead to replacement of the coils. This work is costly, requires labor, and results in substantial down time.

Processes such as installing freeze stats, control systems, adding glycol to a coil, and installing a reheat coil have all been used to try and combat a freeze event from occurring. None of these measures will 100% protect a coil from a freeze event as equipment failures happen and standard maintenance Procedures are not always followed.



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SOLUTION

To prevent pressure buildups and damage to the coils, guaranteed pressure relief devices must be used as a last line of defense against major coil damage.

WHAT TO LOOK FOR IN A SOLUTION

- Pressure relief devices should provide a quick method of replacement if the pressure relief device is activated, limiting system down time.
- Pressure relief devices should have a simple design with no moving parts that could become clogged from deposits at the bottom of the coil header or other sediment growth.
- Such a device should provide consistent and predictable pressure rupturing points so that the relief device is activated at the optimum pressure to protect the coil.
- In addition, such a device should be sufficiently narrow to be easily installed while providing support points for tools, in addition to the copper coil.
- Pressure relief devices should be cost-effective, making it a reasonable addition to any water and/or steam coils.

HYPOTHESIS & TESTING

Why do coils burst from a freeze event? Is it due to ice expansion or pressure build up? To answer this question, in 1996, a testing environment was created in International Falls, MN. Multiple tests were conducted at temperature ranges from 5° F to -10° F. A vertical air handler, with a fan section and coil section holding multiple coils, was observed through the use of a plexi-glass window on the return end of the coils. Plastic caps were developed at varying thicknesses to test pressure ratings. These caps were placed on the stud of each return bend. Thermocouples and pressure monitors were then placed on each coil to read their internal pressures. Control coils, those without studs and plastic caps, were simultaneously tested in this same environment. As pressure inside the coil increased, the plastic caps failed at different pressure points. This finding led to increasing the thickness of each cap to coincide with the higher level of pressure build up inside the coils. The control coils were tested under these same conditions. As pressure reached above 1,100 PSI in a control coil, the return bend would fail and the tube would not.

Findings proved ice can form anywhere in the coil circuits but the weakest area of the coil, the return bend, would ultimately fail.

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DEVELOPMENT

This testing led to the development of the first patented, 100% burst resistant coil. Sentry Guard™ Burst Resistant Coils are designed with a thread-able “plug” or cap attached to every header, bend, and tube stub of a coil. The narrow plug incorporates a hex design making it easy to remove and replace without damaging the delicate copper tubes of a coil.

HOW IT WORKS

The Sentry Guard™ plug design has a membrane, which ruptures upon interior coil pressure reaching a predetermined level. These freeze protection fittings are brazed onto water and steam coil headers, return bends, and tube stubs as part of the factory assembly process. Freeze relief plugs are then screwed onto each fitting. All coils are leak tested at 300 psig before shipping. When freezing occurs, pressure builds until the weakest part of the coil fails, usually above 1000 psig. The patented relief plugs installed with a Sentry Guard™ system are designed to burst at 650 psig, relieving pressure before coil damage occurs. Freeze severity determines how many relief plugs burst. If a freeze event occurs, repair is as simple as unscrewing the ruptured plugs and screwing on a replacement plug.



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APPLICATIONS

Freeze damage protection is available for a wide variety of coil configurations. It is particularly useful for the following applications:

PREHEAT OUTSIDE AIR STEAM AND HOT WATER COILS

Steam/Hot Water - 100% outside air, where air is 40° F or lower. The system may have built-in controls, freeze stats, etc. to prevent freezing, but often systems stop working due to failure of these controls.

WINTER-OPERATING, CHILLED WATER COOLING COILS

Coils that operate during the winter may experience freezing air temperatures. The coil may see 60° F air one day and 25° F air the next day. Chilled water coils can be 5 or 10 times as expensive to replace as heating coils due to increased rows, size, weight, etc.

MAKE-UP AIR SYSTEMS

Many applications such as kitchens, health facilities, and industrial applications require 100% exhaust. These systems work 365 days a year and any mechanical malfunction can cause heating or cooling coils to freeze.

IDLE CHILLED WATER COOLING COILS

During the winter, chilled water coils that are not in operation need to be fully drained or filled with a mixture of glycol/water, which is costly and corrosive. These standard maintenance procedures are often ignored or not completed properly in most systems. The Sentry Guard™ requires partial draining. The worst case is freezing occurs in small areas of the coil and a few plugs rupture. Upon start-up in the spring, easy replacement of the plugs is all that is necessary to get the coils working. Complete coil replacement is not necessary.

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ALTERNATIVE TO GLYCOL FOR MILD CLIMATES OR REDUCTION OF GLYCOL FOR COLDER CLIMATES

For chilled water applications in mild climates, a water-only system with freeze relief plugs can be very cost-effective for protecting coils against occasional freezing weather conditions. To understand why, compare the costs of water-only systems to the cost of purchasing a 20% glycol (by weight) system to provide the same protection:

- The coil for the glycol system requires an additional two rows to provide the same heat transfer as the water system. The result is a coil cost increase of up to 14%.
- The additional two rows of coil required for the glycol system and the glycol solution itself increases the fluid pressure drop across the coil by up to 52%. This increases the associated pump size requirements and pump operating costs.
- The air pressure drop across the larger coil increases by up to 15%. This can increase fan size requirements, motor horsepower requirements, and associated operating costs.
- Glycol systems can degrade faster than water-only systems, raising maintenance costs.

ADVANTAGES OVER ALTERNATIVES

OVERALL DESIGN

Our extensive tests and installation knowledge over the last decade and a half, confirms that freeze relief must be at both ends of the coil. We know that ice can form at one end and block the pressure from reaching the freeze relief on that side of the coil. Therefore, plugs are placed on every return bend at both ends, including the supply and return headers, to give 100% complete protection.

PRESSURE RELIEF DESIGN

The plugs used on our Sentry Guard™ coils are easy to replace. Its simple screw-on screw-off design has no moving parts and no pressure or temperature sensors to start the protection relief process. If pressure builds up due to a freeze event, our plugs will simply pop, relieve the pressure, and stop the coil from sustaining damage. Every Sentry Guard™ coil is shipped with extra plugs for easy replacement if needed.

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MINIMIZED REDUCTION OF FACE AREA

Sentry Guard™ freeze relief plugs minimize the length reduction in finned area required to fit the coil within the air handler walls that exist. Easily removable screw off and on plugs add an additional 1 ¼" to the ends of a coil. Bulky valves and intermediate headers are not needed to apply the Sentry Guard™ design to a water or steam coil application.

CIRCUITRY

The Sentry Guard™ design uses plugs on all return bends and headers at both ends of a coil, so it can be applied to any existing or required circuit design. Circuit design of a coil affects heat transfer performance and water side pressure drop. There are no requirements to change or alter circuitry with the Sentry Guard™ design.

FREEZE STATS, CONTROLS, WINTER MAINTENANCE, AND GLYCOL

Freeze relief equipment such as freeze stats and other expensive controls have been known to fail, are not checked regularly, or many times are disabled by maintenance personnel leaving a system in danger of a freeze event. During winter maintenance coils should be drained and glycol added, but many times these measures aren't enough. The Sentry Guard™ design greatly reduces the cost and time required for repair since only the burst relief plugs need replacement after a freeze .

PROVEN HISTORY

Sentry Guard™ coils have been successfully installed in thousands of applications throughout the USA and Canada since the late 1990's. This proven design has over 20 years of reliable application history including installations at the following:

- Chicago – O'Hare Airport
- NYC Post Office
- Ritz Carlton
- Mayo Clinic
- NYU Medical Center
- Bristol Myers-Squibb
- Pratt-Whitney
- Princeton University
- NJ Turnpike Authority
- Georgia Pacific
- Atomic Energy Commission Lockheed Martin
- Siemens
- Argonne National Labs
- U.S. Submarine Base
- Frito Lay
- Pfizer, Inc.
- Dupont
- Toyota
- Nestle
- Liberty Mutual
- SUNY State University of NY
- Marriott
- Texas Instruments
- Intel Corp.
- Navy Public Works
- Columbia University
- General Electric
- U.S. Postal Service

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TUBES

Tubes and return bends shall be constructed from seamless UNS C12200 copper conforming to ASTM B75 and ASTM B743. Properties shall be O50 light annealed, with a maximum grain size of 0.040mm. Tubes are to be mechanically expanded into plate fins for maximum heat transfer.



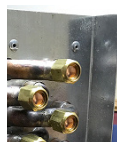
FINS

Secondary surface (fins) are of the plate-fin design using aluminum or copper, with die-formed collars. The fin design for 5/8" & 1/2" O.D. tubes is to be flat, waffle, or sinewave in a staggered tube pattern to meet performance requirements. The fin design for 3/8" O.D. tubes is to be flat, louvered, or sinewave in a staggered tube pattern to meet performance requirements. Collars will hold fin spacing at specified density and cover the entire tube surface. Aluminum properties are to be Alloy 1100 per ASTM B209, with O (soft) temper; copper is to be Alloy 11000 per ASTM B152-06 with soft (anneal) temper. Fins are to be free of oils and oxidations.



AHRI STANDARD

All water coils designed with 1/2" or 5/8" tubes are to be AHRI performance certified and bear the AHRI symbol. Coils outside the scope of the AHRI's standard rating conditions or the manufacturer's certification program will be acceptable since the manufacturer is a current member of the AHRI coil certification program, and coils will be rated in accordance with AHRI Standard 410.



CASING

Coil casing material shall be of G90 galvanized steel, 16 gauge minimum. Heavier gauge and optional material casings are available as required. Intermediate tube supports are to be provided on all coils 50" and longer fin length. Coil casings on top and bottom of coils are to have double-flange construction, allowing for vertical stacking of coils.



HEADERS

Standard headers are constructed of seamless UNS C12200, Type L copper material sized to match specified connection size. Headers are to have finished integral spin-closed ends designed to withstand test pressure. 1/4" vents and drains are provided for all fluid coils unless specified otherwise.



PRESSURE TESTING

Coils shall be tested at 300 PSIG using dry nitrogen, submerged under water. Dual-operator verification shall determine that all coils are leak free. Plugs are certified to withstand 650 PSIG working pressure.

FLUID & STEAM COILS		
MATERIAL	STANDARD	OPTIONAL
Fin	Aluminum	Copper, Stainless Steel
Casing	16 Ga. Galv. Steel	12,14 and 18 Ga. Galv. Steel 12, 14 and 16 Ga. 304 & 316 Stainless Steel 14 Ga. Aluminum
Connection	Copper	Steel, Red Brass
Tube	Copper	N/A
Header	Copper	N/A

FLUID & STEAM COILS				
TUBE	STANDARD	OPTIONAL	STANDARD	OPTIONAL
O.D.	WALL THICKNESS		FIN THICKNESS	
1/2"	.016	.025	.006	.0075 .010
5/8"	.020	.025 .035 .049	.006	.0075 .010
*Products and specifications are subject to change without notice				

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CONCLUSION

Heating and cooling coils often have pressure buildups due to freezing, fluid expansion, and/or other complications. The coils often burst due to the increased pressure, requiring repair and/or replacement. To combat the effects of a freeze event, pressure relief devices must be utilized to eliminate damage and to decrease equipment down time caused by coil damage from pressure buildups.

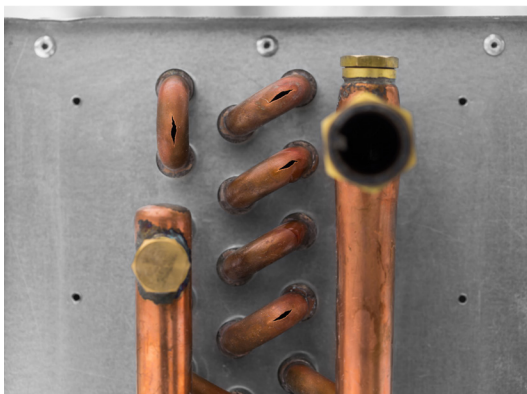
FREEZE-RELIEF

All coils shall be furnished with special Sentry Guard™ freeze relief plugs/caps. These special fittings are of a unique design with a specific copper membrane set in place by a brass washer and crimped into the seat. This screw-on, screw-off removable plug/cap is designed to relieve pressure at 650 PSI, which is well below the tubing burst pressure rating. Plugs are installed on all return bends on both sides of coils, on all applicable headers and tube ends as required. Use of intermediate headers and pressure sensitive valves on one or both ends are not needed for relief and freeze protection. All Sentry Guard™ coils are guaranteed against freeze damage for a period of 30 months from date of shipment.

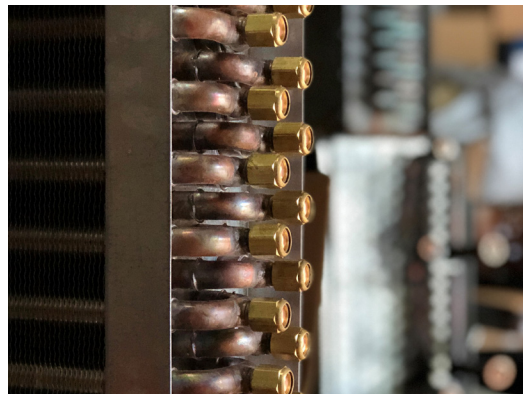
MORE INFORMATION

Contact your USA Coil & Air sales representative for more information on the benefits of coil freeze damage protection for your application. For the name of your local USA Coil & Air representative, call (800) 872-2645 or visit www.usacoil.com/online-quote for your free online quote.

NO FREEZE PROTECTION

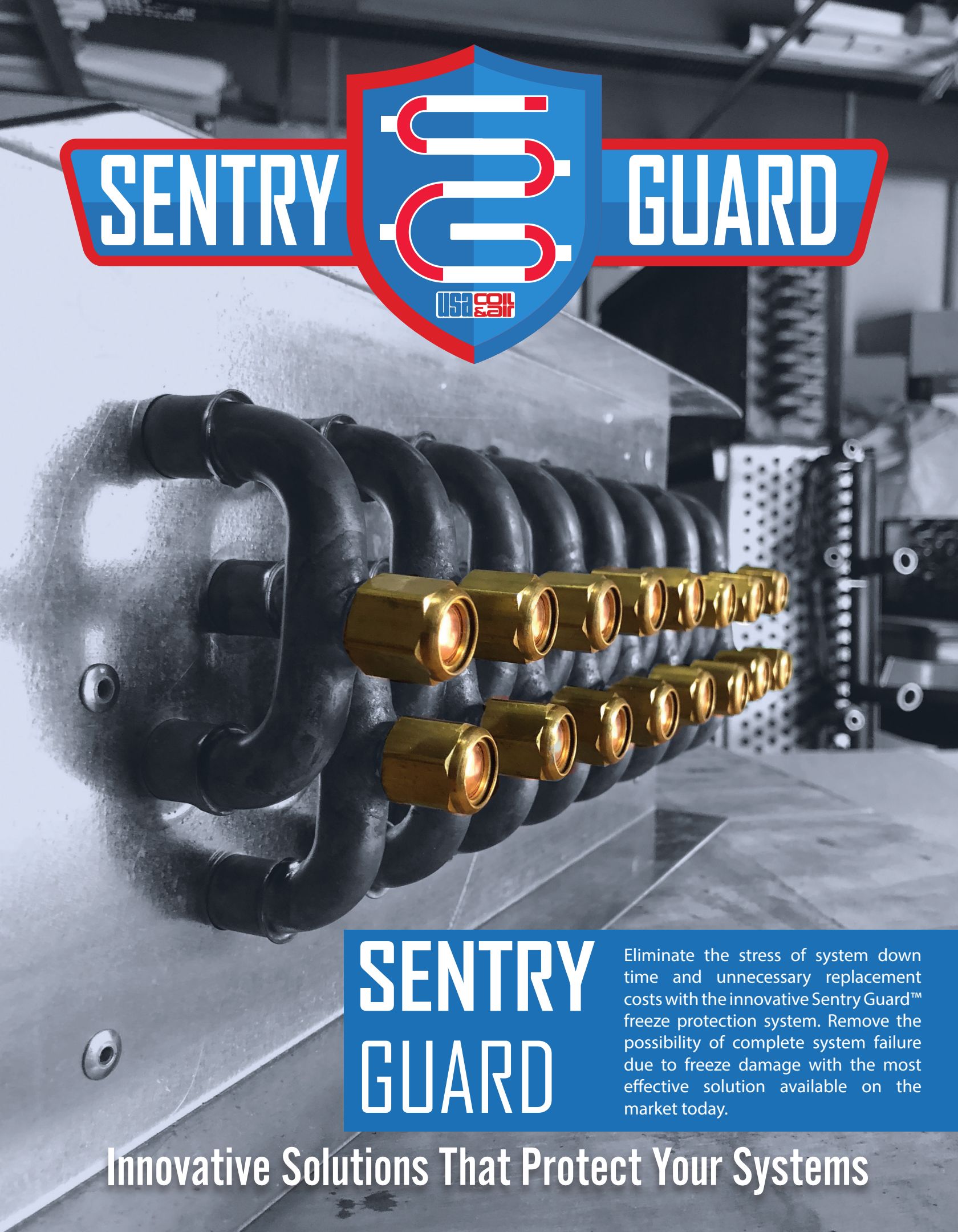
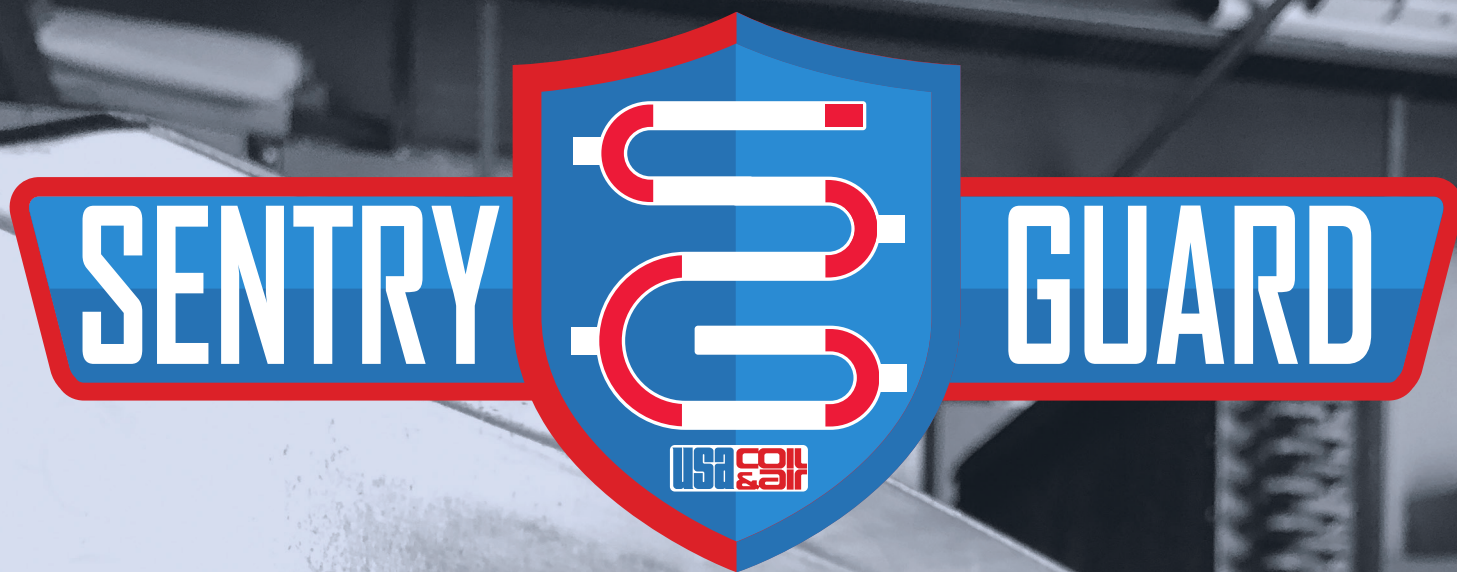


FREEZE PROTECTION



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SENTRY GUARD

Eliminate the stress of system down time and unnecessary replacement costs with the innovative Sentry Guard™ freeze protection system. Remove the possibility of complete system failure due to freeze damage with the most effective solution available on the market today.

Innovative Solutions That Protect Your Systems

SENTRY GUARD BURST PROOF RELIEF CAPS

APPLICATIONS:

Preheat Coils

Steam/Hot Water- 100% outside air, where air is 40 degrees Fahrenheit or lower. The system may have built-in controls, freezstats, etc. to prevent freezing. Often, systems stop working due to the failure of these controls. The Sentry Guard™ becomes the "Last Line of Defense" against freeze damage.

Chilled Water Coils

Coils that operate during the winter may experience freezing air temperatures. The coil may see 60-degree Fahrenheit air one day and 25-degree Fahrenheit air the next day. Chilled water coils can be 5 to 10 times as expensive to replace as heating coils due to the increased number of rows.

Make-up Air Systems

Many applications such as kitchens, health facilities, and industrial applications require 100% exhaust. These systems work 365 days a year and any mechanical malfunction can cause heating or cooling coils to freeze.

Idle Chilled Water Coils

During the winter, chilled water coils that are not in operation need to be completely drained and/or filled with a mixture of glycol/water. This process is costly and corrosive. Sentry Guard™ coils reduce the need for glycol additives. During a freeze event, the Sentry Guard™ caps will rupture to release pressure and prevent tube bursting. Upon startup in the spring, easy replacement of the caps is all that is needed to get the coils back in service.

USA Coil & Air developed this patented product over a period of four years. Extensive testing was conducted in International Falls, Minnesota with ambient temperatures as low as -30 degrees Fahrenheit. Based on this testing, USA offers a 30-month burst protection warranty on all Sentry Guard™ Coils.

Benefits

- ✓ Avoid whole coil replacement
- ✓ Works well with steam coil systems
- ✓ No changing row or circuitry arrangement
- ✓ Decreases downtime from freeze damage
- ✓ Eliminates or lowers cost of repairs
- ✓ Guaranteed burst resistant



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EST. 1984

OUR STORY

USA Coil & Air is one of the largest and oldest replacement coil companies in our industry. Over the years, we have developed other great lines of HVAC equipment to include direct drive and belt drive fan coil units, central station units with emphasis on the replacement market as well as fluid coolers, remote air-cooled condensers and tube bundles. Every one of our lines is specific to the quick shipment and requirements of the replacement market. You will find that we make this process simple and easy. We have expedited schedules for all our equipment and know how to deal with existing facilities and the problems related to shipment and delivery. We also pride ourselves with great application engineering so that you don't replace equipment without having a true understanding of why the original might have failed and what can be provided in the replacement to increase longevity.



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