USA coil & air

REPLACEMENT ENGINEERING MADE EASY

WHITE PAPER

HOW TO PREVENT DAMAGE FROM A COIL FREEZE EVENT

Sentry Guard™ Burst Resistant Coils

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 due to coil damage caused by pressure buildups.

SENTRY GUARD COILS

800-USA-COIL

WWW.USACOIL.COM

MADE IN USA

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 well known for use in heat-exchange devices for cooling and/or heating. Such coils typically have a heat transfer fluid circulating through to accept or dissipate heat. It can be appreciated that these coils may face temperature extremes and that 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 or otherwise cause pressure buildups in the coils. The pressure buildup may cause the coils to burst, causing irreparable harm and leading to replacement of the coils. This work is costly and requires labor intensive, in the field repairs resulting in substantial system down time.

Historically, 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.

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 should the pressure relief device be 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.

HOW TO PREVENT DAMAGE FROM A COIL FREEZE EVENT

Sentry Guard™ Burst Resistant Coils

HYPOTHESIS & TESTING

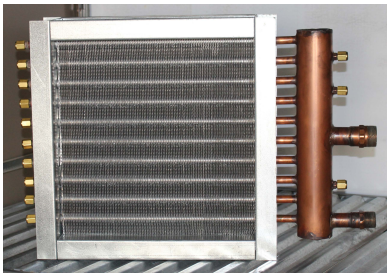
Why do coils burst from a freeze event? Is it due to ice expansion or pressure build up? To answer this question, in 1996 a testing environment was created in International Falls, MN. Multiple tests were conducted at temperature ranges from 5° F to -10° F. A vertical air handler, with a fan section and 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 not the tube.

Findings proved ice can form anywhere in the coil circuits but the weakest area of the coil, the return bend with a thinner wall than the tube, would ultimately fail.

DEVELOPMENT

The above testing led to the development of the first patented, 100% burst resistant coil. These Sentry Guard™ Burst Resistant Coils were 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 fitting 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 as 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.

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 fail due to failure of these controls.

WINTER-OPERATING, CHILLED WATER COOLING COILS

Coils that are in operation during the winter and 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 not in operation need to be fully drained or filled with a mixture of glycol/water, which is costly and corrosive. These are standard maintenance procedures, which often are ignored or not accomplished very well in most systems. Sentry Guard™ requires partial draining (which should be done most of the time regardless of other freeze resistant actions taken). The worst case is freezing occurs in small areas of the coil and that 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.

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 more quickly than water only systems, this raising maintenance costs.

ADVANTAGES OVER ALTERNATIVES

OVERALL DESIGN

Our extensive tests and installation knowledge over the last decade and a half, which includes thousands of installations, 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 to 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. Their simple screw on screw off design have 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, relieving the pressure and stop the coil from sustaining damage. Every Sentry Guard coil is shipped with extra plugs for easy replacement if needed.

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

Because the Sentry Guard™ design uses plugs on all return bends and headers at both ends of a coil then 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 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 event.

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
- Georgie Pacific
- Atomic Energy Commission
- Lockheed Martin
- Siemens
- Argonne National Labs
- U.S. Submarine Base
- International Paper
- 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

See last page below – Specifications Sheet

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.

SENTRY GUARD™ FREEZE RESISTANT COILS

White Paper

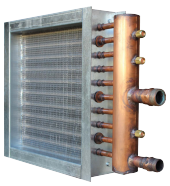
MATERIALS & SPECIFICATIONS

TUBES

Seamless copper tubes shall be mechanically expanded into plate aluminum or copper fins to form an everlasting bond between primary and secondary surfaces. Tubes are to be mechanically expanded into fins (secondary surface) for maximum heat transfer.

FINS

Secondary surface (fins) shall be of the plate-fin design using aluminum or copper, with die-formed collars. Fin design to be flat, waffle, or sine-wave in a staggered tube pattern to meet performance requirements. Collars will hold fin spacing at specified density, and cover the entire tube surface. Fins are to be free of oils and oxidation.



HEADERS

Headers (manifolds), if required, shall be constructed of a minimum .060" wall seamless copper. Die-formed copper end caps are brazed on the inside of the headers, and rounded so as to prevent excessive pressure drop. (Unless spun-closed — for sizes up to 1-3/8") All water coils shall be provided with 1/4" vents and drains.

CONNECTIONS

Coil connections shall be copper or steel MPT type and shall be brazed into the manifold. Booster heating coils without manifolds may be copper sweat connections.

CASING

Coil casing material shall be galvanized steel at a 16 gauge minimum. Heavier material, stainless steel, copper or aluminum casings are available as required.

Intermediate supports are required every 42" of finned length and shall be bolted to top and bottom casing channels.

Coil casings on top and bottom of coils are to have double-flange construction, allowing for vertical stacking of coils.

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.

SG Fluid coils are designed for 200 PSIG water working pressure.

SG Steam coils are designed for 100 PSIG operating steam pressure for both standard and steam distributing types.

All SG coils are guaranteed up to 300° F working temperatures.

AHRI STANDARD 410

All USA Coil water and steam coils designed in accordance with AHRI Standard 410.

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.

FLUID & STEAM COILS

Standard / Base in **Bold** Below

Tube O.D.	**Tube Thick**	Optional Tube	**Fin Thick**	Optional Fin
1/2"	**.016**	.025	**.006**	.0075 .010
5/8"	(fluid) **.020** (steam) **.025**	.025 .035 .049	**.006**	.0075 .010
1" (SD only)	**.035**	.049	**.010**	N/A

FLUID & STEAM COILS

	Standard	Optional
Fin Material	**Aluminum**	Copper
Casing Material	**Galv. Steel 16 gauge**	Galv. Steel 14 gauge
Connection Material	**Copper**	N/A
Tube Material	**Copper**	N/A
Header Material	**Copper**	N/A

Products and specifications subject to change without notice.