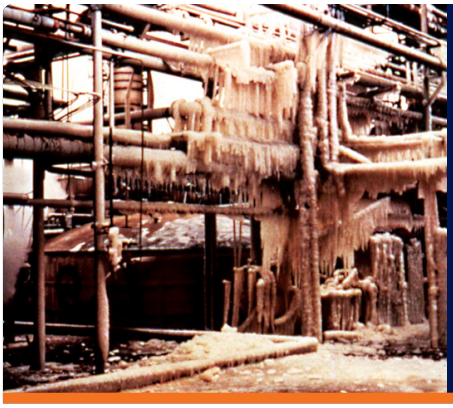

UNDERSTANDING THE HAZARD

Freeze

Natural hazards

Freeze can interrupt production, impair fire protection and ultimately result in the destruction of property by fire. FM can help you understand the freeze hazard and provide solutions for protecting your facility.

UTH topic categories

- ○ Construction
- ○ Equipment
- ○ Fire protection
- ○ Human element
- ◉ **Natural hazards**
- ○ Process hazards

This series of publications is designed to help you understand the everyday hazards present at your company's facilities. For more information on how you can better understand the risks your business and operations face every day, contact FM.

The hazard

Freeze, a winter hazard, can cause substantial damage and affect facilities in the entire temperate zone (middle latitudes), including subtropical regions where freeze is thought to be rare.

In areas where freeze is common, the typical freeze incident results from change within a facility. This could be as simple as not replacing insulation after a repair or leaving a door or window open. Many times, automated louvers fail to close with cold air freezing nearby sprinklers and water coils in air handling units. In regions where freeze is infrequent, inadequate heat in stairwells and above suspended ceilings or inadequate insulation prove insufficient to prevent freeze-ups resulting in broken water piping and water damage, or impaired fire protection sprinkler systems and sprinkler leakage. When this happens, the facility becomes vulnerable to fire.

In regions such as the Gulf Coast in the United States and parts of Europe, including the U.K., freeze usually is expected to be moderate and short term, or is not expected at all. In these regions, freeze can break sprinkler system and other waterfilled piping. In addition, freeze can interrupt production processes. It is common to see freezing of condensation in instrument air tubing on outside equipment, preventing instrument signals from being transmitted, and forcing a process to be stopped. In extreme cases, the instrument tubing may rupture or the instruments may be damaged, resulting in a longer interruption of business to repair or replace the damaged equipment.

Science of the hazard

Freeze damage often results from inadequate preparation. In colder regions, heating and insulation are generally adequate by design. The key factor behind the freeze hazard in these climates often is failure to verify that the building envelope is closed and that all insulation is in place, with heating and heat-tracing systems functioning as intended. During unusual cold periods, building temperature is too often not continuously monitored when it should be—either with the assistance of an alarm connected to a security service, or by a continuously touring watch service. These precautions enable corrective action to prevent a freeze incident. Temperature monitoring is particularly important for idle or vacant buildings, even if only closed for a few holidays.

In warmer temperate regions, it is important to have an alert weather watch and a ready response, such as activation of on-site portable heaters. Among the freeze hazard factors, boilers, conveyors and process equipment are typically not enclosed, dryers for instrument air systems may be undersized, and even steam systems may freeze if condensate return piping is not insulated. Certain municipalities in these

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What you can do at your facility

NOW

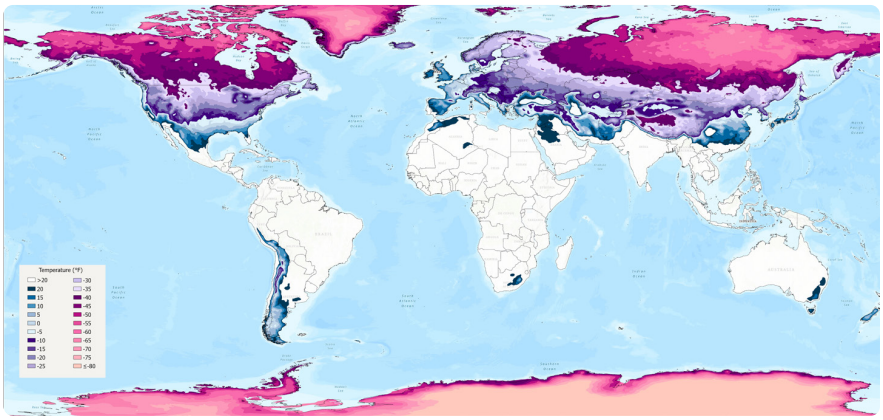
- Inspect and confirm that your buildings are closed to cold air infiltration, including proper operation of automatically operated louvers. Keep all openings in the envelope closed.
- Test the heating system for proper function, and confirm that ample fuel is available. Maintain two fuel sources if one is based on an interruptible contract.
- For outdoor piping and equipment, inspect and test heat tracing and confirm that insulation is in place.
- Check dryers on instrument air systems for proper operation. Verify that dryers can remove sufficient moisture to prevent condensation during coldest possible weather.
- Do not shut down operations during unusually cold weather.

SOON

- Establish a freeze emergency plan, including a reliable weather watch, and train employees in proper response techniques.
- Install an alternate fuel source if in an interruptible contract that cannot be changed.
- Obtain portable heaters for use during cold-weather emergencies.
- Provide additional dryer capacity for outdoor instrument air systems to avoid condensation during extended cold periods.
- Plan to maintain full operation of the facility during cold periods but monitor power and utilities for shut offs or curtailment and plan for loss of power and resultant loss of building heat, and power and steam for heat tracing systems.

areas do not have the snow removal and ice treatment equipment for roads resulting in roads that may be impassable for days. Utilities may also be curtailed or lost, affecting production and heating of the facility since their facilities and fuel supplies may not be protected from freeze. In these regions, it is vital to identify equipment and piping that should be drained, and to train operators and maintenance staff how to prevent process upsets when draining.

Freeze areas are where the 100-yr. return period daily minimum temperature is 20°F (-6.7°C) or colder as shown on the FM Worldwide Freeze Map available online at fm.com.

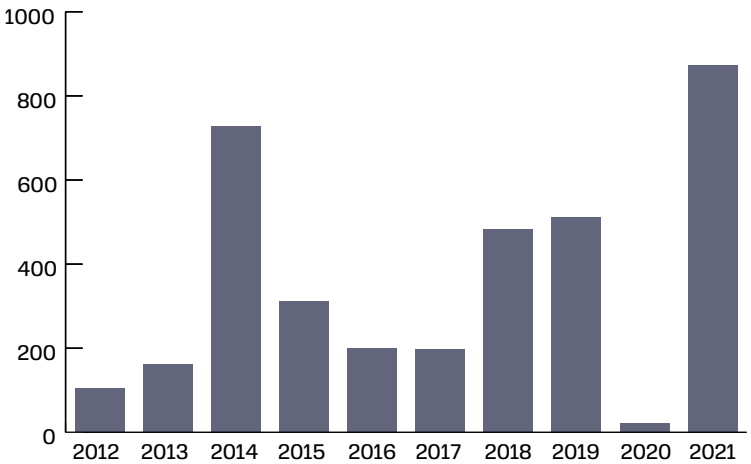


Loss experience

During a recent 10-year period, FM clients reported almost 3,600 freeze related incidents. Incidents at non-manufacturing facilities accounted for 87% of those losses by frequency, and 42% by severity, with an average gross loss of US$545,000. Incidents at manufacturing facilities accounted for 13% of freeze related losses by frequency and 58% by severity with an average gross loss of US$1.3 million.

Severe freeze events generally occur every few years and are often not top-of-mind, particularly in regions not accustomed to freezing temperatures. Over 75% of losses from the U.S. Deep Freeze event of February 2021 occurred in Arkansas, Louisiana, Mississippi, Oklahoma, Texas and Coahuila, Mexico, regions where freeze is infrequent.

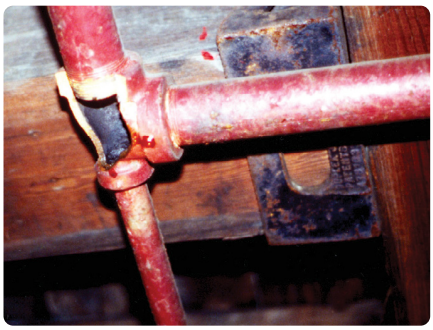
Number of Freeze Losses



Loss examples

A process plant in Panama City, Florida, USA, had planned a maintenance outage for several days during winter. Steam was provided by one of two 125,000 lb./hr. (56,700 kg/hr.) boilers: one (interruptible) gas-fired and the other waste fuel-fired. With unusually cold weather predicted, the plant drained its idle equipment, adding steam heat tracing, wind breaks, insulation, portable heaters and extra personnel. At 5 p.m. a day earlier, gas service was interrupted, deactivating the gas-fired boiler. At 5:30 p.m., instrument lines on the remaining boiler began to freeze. At 6 p.m., that boiler tripped, causing loss of all steam. When both boilers were started four hours later, steam tracing, steam piping, and water and process lines were already frozen. Repairs delayed resumption of full production for several days.

A metalworking plant in Houston, Texas, USA, shut down for the holidays. Some water-cooled equipment was located outdoors or in open buildings, cooling water was left circulating to prevent freezing and guard service was provided. On the third day, maintenance personnel discovered electricity was out in several areas and water in equipment had frozen. A valve in a water cooling line had broken, and water was flowing into electrical switch gear. Repairs were completed prior to the end of shutdown. In addition to improving the checklist, guards were instructed afterward to promptly report power failures.



Here, a dock door was left open overnight. The extreme temperature caused freezing of the overhead water supply to the hydrant. This resulted in considerable leakage from the pipe.

But what about...

...the warm climate in our area?

A look back at the loss data and the 2021 February Deep Freeze in the U.S. clearly shows that some of the most devastating events happened in regions where freeze was not expected. Recognizing that, it is best to monitor the winter weather in your region.

...the shortness of the cold weather season? It's not long enough to cause problems.

It only takes a couple of days of freezing temperatures to cause severe freeze damage to even large paper mills and chemical facilities.

...our existing freeze-prevention plan?

Make sure your plan includes a reliable weather watch, arrangements to call in proper staff, and that emergency personnel know how to respond. Plan for loss of utilities and failure of your heating system during freezing weather. In such situations, timing is critical.

...hidden corrosion that can be caused by insulating piping?

Selection of compatible insulation and maintenance of a properly installed jacket will minimize potential of corrosion under insulation. The cost of one freeze incident can far exceed the cost of installing and maintaining an insulation system, including inspections for corrosion under insulation.

...our experience with cold weather—we know how to deal with it!

Despite that fact, or perhaps because of it, businesses in freeze-prone regions still have freeze losses every year. Management becomes complacent about freeze. Often overlooked are freeze hazards such as old, untested heat trace wire that will no longer work at minus 40° F (minus 40° C); broken warehouse windows near wet-pipe sprinklers; or the water pipe that is supposed to be 9 feet (3 m) underground, but no longer is, due to erosion.

...our current treatment when our buildings lose heat? (We just drain the sprinkler system.)

Though this action prevents freeze of the system, it should be a last resort because it removes fire protection from service. Take great care to remove all ignition sources and report the draining to FM, so we may help you with other precautions and assist you in restoring protection as soon as possible.

Need more information?

Ask your FM engineer or client service team about the following:

- *My*Risk®, your website for up-to-the-minute weather information
- Video showing the ultimate risk of not being well-prepared
- FM Red Tag Permit System Kit
- Explanation of why "dry pipe" sprinkler systems can freeze

Ordering information

For additional copies of *Understanding the Hazard* publications, contact your FM engineer or client service team.

Additional FM brochures and educational material can be found in the FM Resource Catalog and ordered or downloaded online at fmcatalog.com. Or for personal assistance worldwide, contact our U.S.-based customer services team, Monday – Friday, 8 a.m. – 5 p.m. ET:

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By phone: +1 (1)401 477 7744
By fax: +1 (1)401 477 7010
Email:
fmcustomerservices@fmglobal.com

Don't let this happen to you

The plan to increase minimum heat in this idle building was far from adequate and resulted in extensive freeze damage.

FM resources to help you avoid a freeze loss:

- *Emergency Checklist: Freeze-Up* (P9521)
- Complete guidelines for preparing your facility for the onslaught of cold weather and carrying out your emergency plan
- *Freeze Emergency Response Plan* (F7650)
- *Protecting Your Facility from Winter Storms* (P0101)
  While winter weather cannot be avoided, its destructive impact can be prevented. This publication explains the risks from both freeze and collapse, provides details on preventive steps and describes actions to take after damage to minimize additional loss.
- *Protecting Your Pulp and Paper Mill from Winter Storms* (P0049)
  Historically, the pulp and paper industry, in particular, has experienced large losses from freezing, with the most severe taking place at mills in areas generally unprepared for extreme winter weather. Learn how to protect your facility by assessing your vulnerability to such harsh conditions and developing a contingency plan.
- FM Property Loss Prevention Data Sheet 10-1, *Pre-Incident Planning*.

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