



Winter Threats: Freeze-Ups and Snow Loading



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Plunging temperatures and snow buildup can cause problems that may result in damage to buildings, equipment or other property. This Risk Management Guide discusses two significant winter hazards and outlines loss prevention practices that can minimize your exposure to loss.

Freeze-ups

During severe cold spells, water in sprinkler system piping, domestic water systems, HVAC or process equipment can freeze and expand causing pipes or fittings to burst. Water damage from this type of incident can be extensive, especially if the water continues to flow for an extended period. Total costs of the damage and business interruption can be substantial.

In deep freeze conditions, a broken window or an open door can let in enough cold air to freeze nearby water pipes and start a catastrophic chain of events. In addition, any equipment that contains or uses water, produces condensation or depends on pneumatic controls is vulnerable to freezing. Other conditions that make your business susceptible to freeze-ups are heating systems that lack reserve capacity beyond their normal heating load, inadequate building insulation and piping that runs through unheated areas or concealed spaces.

Many businesses find themselves unprepared when normal winter weather suddenly turns extreme. The following guidelines will help you implement preventative measures to better protect your business from the threat of freeze-ups.

Before the Cold Weather Season

When possible, implement these measures before the onset of cold weather:

- Update your Emergency Response Program to include appropriate response procedures for belownormal temperatures or extreme cold.
- Appoint one or more members of the Emergency Response Team to monitor weather forecasts and initiate winter emergency procedures when appropriate.
- Develop procedures to be followed if you lose heat or electricity.
- Determine which processes depend on continued building heat for safety (i.e., processes that are subject to solidification or runaway reactions) and need prompt attention.
- Identify equipment, processes and piping that contain or use water or other liquids that could freeze and take the appropriate measures to prevent potential damage during cold spells.
- Identify building areas that are unusually difficult to heat or that lose heat rapidly. Install an ordinary thermometer and monitor temperatures during cold spells. If these areas are unattended, provide low temperature detectors that can be monitored from a central location.
- Identify equipment or piping that is vulnerable to freezing.
 - CE Drain any idle equipment,
 - CE Frequently drain condensation from equipment and pneumatic lines,
 - CE Provide adequate heat and relocate the equipment to a heated enclosure, protect it with suitable antifreeze or install electrical heat tracing and insulation.
- Service heating systems.
- Make sure adequate supplies of alternate fuels are on hand if the heating systems are capable of dual fuel firing.

- Inspect and maintain the building exterior to minimize openings. Fix windows and doors so they close tightly. Caulk, insulate and apply weather stripping as needed. Close and seal unneeded dampers, louvers, vents and openings.
- Drain condensation from dry pipe sprinkler system piping by opening the priming water level drain valve until the water has been expelled. Also, make sure auxiliary drains installed at the system™s low points are regularly inspected and drained.
- If there are any trapped sections of branch line piping, it may be necessary to briefly shut down the system to drain the water. Shut off and drain automatic sprinkler systems only as a last resort. Use the Liberty Mutual Insurance Sprinkler Impairment Program to report impairments.

During Cold Spells

- Monitor temperatures every few hours in vulnerable areas. This can be done by regular watch tours or by providing low-temperature alarms that are connected to a constantly attended location.
- Provide approved portable heaters for vulnerable areas that might fall below 40°F.
- Provide heat or steam tracing for exterior piping that contains liquids subject to freezing.
- Use tarps to erect temporary windbreaks. For a permanent windbreak, consider planting evergreen trees and hedges upwind (prevailing winter wind direction) of vulnerable buildings and equipment.
- If pipes freeze, turn off the water supply and thaw or repair damaged piping. If the frozen piping affects fire protection systems, use the Sprinkler Impairment Program to notify Liberty Mutual Insurance.
- Do not use open flame devices to thaw frozen pipes or equipment.

Snow Loading and Roof Collapse

Most businesses plan for snow and severe weather by winterizing vehicles, contracting for snowplowing, etc. However, many businesses neglect to adequately plan for excessive snow-loading on roofs. The potential for roof collapse or structural damage increases as the weight of accumulated snow and ice exceeds the snow load capacity of the roof.

Rain falling on accumulated snow is especially dangerous because snow-covered roofs do not drain well and accumulating water and ice can quickly exceed the design limits of the roof. This was illustrated in 1996 when warm weather and heavy rain followed winter storms that left several feet of snow across much of New England. The weight of the snow and rain exceeded the roof load design of many buildings resulting in numerous roof collapses and large losses to buildings, contents and business interruption.

Even if you are in a warm area of the country, you should not ignore this hazard. In fact, your facilities may be more susceptible to an unusually severe winter storm because they are not designed for extreme weather and personnel are less accustomed to, and less prepared for, extreme conditions. In addition, building codes in these areas have lower snow load requirements that can make roofs more susceptible to collapse from unusual snow loading.

Planning, preparation and prompt action to remove accumulated snow help minimize the potential risk of roof collapse.

Planning and Preparation

- Be sure your Emergency Response Program covers winter emergencies, including appropriate response procedures for excessive snow loads.
- Determine the maximum safe snow depth for the roof based on its load capacity as indicated in the building plans and specifications or in an engineering analysis of the roof design.
- For new construction or when reinforcing roof load limits, follow the design guidelines in the American Society of Civil Engineers *Standard for Minimum Design Loads for Buildings and Other Structures* - ASCE 7.

- Inspect the roof structure for damage or deterioration and repair or reinforce as needed.
- Inspect all roof drains and downspouts and clean any accumulated debris from the roof to prevent clogging the drainage system.
- Look for evidence of past water ponding and eliminate the causes.

When the Snow Flies

- Regularly monitor snow depth on the roof, paying close attention to areas where snow tends to drift and accumulate. Areas such as roof valleys (low sections adjacent to higher sections) and roof-mounted structures, such as tanks and penthouses, are particularly susceptible.
- Remove snow accumulations from the roof before the snow reaches 50% of the safe maximum depth, (see Table 1) and use safe roof practices. Do not send employees on to the roof once the snow load approaches the load capacity. Remove snow during a storm only if the forecast indicates that the total snowfall will result in dangerous accumulations.
- Remove snow in layers uniformly across the roof to prevent unbalanced loads that might cause a collapse. Avoid making snow piles on the roof during the removal process.
- Clear snow and ice from storm drains and catch basins. Periodically inspect the roof drainage system to make sure that it is not clogged with ice or debris.
- Use care with snow removal equipment (shovels, ice spades, snow blowers, etc.) to prevent roof cover damage. It is not necessary to clean completely down to the roof surface as long as melting snow and water can freely flow to drains.

Insured losses from the 2010-2011 winter season that affected much of the United States could reach \$1.4 billion.

Source: *Business Insurance Magazine*

Measuring the Snow Load

Table 1 below is a guide that combines live load design (lbs/ft²) and the density (lbs/ft³) of the accumulating snow, ice or water to determine when to take corrective action. For example, a roof designed to handle a snow load of 20 lb/ft² could possibly withstand 11.5 inches of heavy wet snow. Therefore, you should remove it from the roof (if it is safe to do so) when it reaches approximately six inches.

Table 1:
Equivalent Snow Load Table

Density Information	Light/Dry Snow	Heavy/Wet Snow	Ice	Water
Density (lb/ft ³)	3.12	20.81	57.25	62.43
% of Water Weight	5%	33%	92%	100%

Equivalent Inches of Precipitation

Design Load (lb/ft ²)	Light/Dry Snow		Heavy/Wet Snow		Ice		Water
	Depth	Consider Clearing Roof at	Depth	Consider Clearing Roof at	Depth	Consider Clearing Roof at	Depth
5	19.2	10	2.9	1.5	1.0	.5	1.0
10	38.4	19	5.8	3	2.1	1	1.9
15	57.7	28	8.6	4	3.1	1.5	2.9
20	76.9	38	11.5	6	4.2	2	3.8
25	96.1	48	14.4	7	5.2	2.5	4.8

References

American Society of Civil Engineers, *Standard for Minimum Design Loads for Buildings and Other Structures* - ASCE 7.

Dr. Karl VanDevender, Doug Petty, Miller, *Ice and Snow Accumulation*, University of Arkansas, Division of Agriculture, Cooperative Extension Service, March 2006.

For more information on our Risk Management Guides, email us at propertyengineering@libertymutual.com or go to www.libertymutualgroup.com/business for a listing of additional guides.

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While following the procedures and information outlined in this brochure may minimize the likelihood of freeze-ups and roof collapse, they do not contemplate every potential for loss or damage. Therefore, every situation should be reviewed by the appropriate safety manager in an effort to take all appropriate steps and precautions to minimize the risk. No duty or undertaking is intended or assumed by Liberty Mutual Insurance by this publication, or its content, as they are informational in purpose.

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