



NATURAL HAZARD MITIGATION INSIGHTS

A publication of the Institute for Business and Home Safety

FREEZING AND BURSTING PIPES



When water freezes, it expands. That's why a bottle of soda explodes if it's put into a freezer to chill quickly and forgotten.

When water freezes in a pipe, it expands the same way. If it expands enough, the pipe bursts, water escapes and serious damage results.

WHY PIPES BURST

Surprisingly, ice forming in a pipe does **not** typically cause a break where the ice blockage occurs. It's not the radial expansion of ice against the wall of the pipe that causes the break.

PIPES INSIDE A HOUSE THAT ARE PROTECTED ADEQUATELY BY PLACEMENT WITHIN THE BUILDING'S INSULATION, INSULATION ON THE PIPE ITSELF, OR HEATING, ARE SAFE.

Rather, following a complete ice blockage in a pipe, continued freezing and expansion inside the pipe cause water pressure to increase downstream — between the ice blockage and a closed faucet at the end. It's this increase in water pressure, literally thousands of pounds of pressure, that leads to pipe failure. Usually the pipe bursts where little or no ice has formed.

Upstream from the ice blockage the water can always retreat back towards its source, so there is no pressure build-up to cause a break.

Water has to freeze for ice blockages to occur. Pipes inside a house that are protected adequately by placement within the building's insulation, insulation on the pipe itself, or heating, are safe.

REGIONAL DIFFERENCES

Generally, houses in northern climates are built with the water pipes located on the **inside** of the building insulation, which protects the pipes from subfreezing weather. However, extremely cold weather and holes in the building that allow a flow of cold air to come into contact with pipes can lead to freezing and bursting.

Water pipes in houses in southern climates often are more vulnerable to winter cold spells. The pipes are more likely to be located in unprotected areas outside of the building insulation, and homeowners tend to be less aware of freezing problems, which may occur only once or twice a season.

Pipes in attics, crawl spaces and outside walls are all vulnerable to freezing, especially if there are cracks or openings that allow

cold, outside air to flow across the pipes. Research at the University of Illinois has shown that “wind chill,” the cooling effect of air and wind that causes the human body to lose heat, can play a major role in accelerating ice blockage, and thus bursting, in water pipes.

Holes in an outside wall where television, cable or telephone lines enter can provide access for cold air to reach pipes.

The size of pipes and their composition (e.g., copper or PVC) have some bearing on how fast ice forms, but they are relatively minor factors in pipe bursting compared with the absence of heat, pipe insulation and exposure to a flow of subfreezing air.

WHEN IS IT COLD ENOUGH TO FREEZE?

When should homeowners be alert to the danger of freezing pipes?

That depends, but in southern states and other areas where freezing weather is the exception rather than the rule (and where houses typically do not provide adequate built-in protection or builders carelessly place pipes in unprotected areas), **the “temperature alert threshold” is 20 degrees F.**

This threshold is based upon research conducted by the Building Research Council at the University of Illinois. Field tests of residential water systems subjected to winter

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temperatures demonstrated that, for uninsulated pipes installed in an unconditioned attic, the onset of freezing occurred when the **outside** temperature fell to 20° F or below.

VULNERABLE PIPES THAT ARE ACCESSIBLE SHOULD BE FITTED WITH INSULATION SLEEVES OR WRAPPING, THE MORE INSULATION THE BETTER.

This finding was supported by a survey of 71 plumbers practicing in southern states, in which the consensus was that burst-pipe problems began to appear when temperatures fell into the teens.

However, freezing incidents can occur when the temperature remains above 20° F. Pipes exposed to cold air (especially **flowing** air, as on a windy day) because of cracks in an outside wall or lack of insulation are vulnerable to freezing at temperatures above the threshold.

However, the 20° F “temperature alert threshold” should address the majority of potential burst-pipe incidents in southern states.

MITIGATING THE PROBLEM

Water freezes when heat in the water is transferred to subfreezing air. The best way to keep water in pipes from freezing is to slow or stop this transfer of heat.

Ideally, it is best not to expose water pipes to subfreezing temperatures, by placing them only in heated spaces and keeping them out of attics, crawl spaces and vulnerable outside walls. In new construction, proper placement can be designed into the building.

In existing houses, a plumber may be able to reroute at-risk pipes to protected areas, although this may not be a practical solution. If that’s the case, vulnerable pipes that are accessible should be fitted with insulation sleeves or wrapping (which slows the heat transfer), the more insulation the better. It is important not to leave gaps that expose the pipe to cold air.

Hardware stores and home centers carry the necessary materials, usually in foam rubber

or fiberglass sleeves. Better yet, plumbing supply stores and insulation dealers carry pipe sleeves that feature extra-thick insulation, as much as 1" or 2" thick. The added protection is worth the extra cost.

Cracks and holes in outside walls and foundations near water pipes should be sealed with

caulking to keep cold wind away from the pipes.

Kitchen and bathroom cabinets can keep warm inside air from reaching pipes under sinks and in adjacent outside walls. It's a good idea to keep cabinet doors open during cold spells to let the warm air circulate around the pipes.

JACK FROST NIPS AT WATER PIPES WHEN TEMPERATURE DIPS TO 20 DEGREES IN THE SOUTH

Homeowners in the south need to be alert to the danger of freezing and bursting water pipes when the outdoor temperature threatens to drop to 20 degrees F.

That's the temperature at which ice is likely to start forming in water pipes located in an unheated portion of a house.

Once ice forms into a blockage in a pipe, continued growth of ice in the pipe can lead to excessive water pressure. It's pressure of the water that has no place to go when ice builds that causes the pipe to burst, rather than ice pushing against the wall of a pipe.

Although 20 degrees F is well below the freezing temperature of water, two factors make this the critical outdoor temperature:

1. The temperature of an unheated portion of a house is almost always at least a few degrees above the outdoor temperature. For example, an insulated attic may be at 37° or 38°F when the outdoor temperature is 32 degrees F.
2. Water "supercools" several degrees below freezing before any ice begins to form.

In research tests at the University of Illinois, water pipes placed in an unheated, insulated attic consistently started forming ice when the outdoor temperature dipped just below 20° F.

The 20 degree F threshold is primarily for homes in the south and other areas where freezing may occur only once or twice a season. Homebuilders in these areas often overlook the threat of freezing and place pipes in vulnerable locations.

Builders in the north, where temperatures in the teens and lower are common, routinely install more building insulation and usually do not place pipes in unheated portions of a building.

There are several precautions homeowners in the south can take when the temperature is expected to dip into the low 20s:

- l Seal all openings where cold air can get at unprotected water pipes. It's especially important to keep cold wind away from pipes, which speeds up the freezing process.
- l Cover pipes with foam or fiberglass insulation sleeves, the thicker the better.
- l Install heating tapes or cables on vulnerable pipes. **Be sure to follow manufacturer instructions carefully to avoid starting a fire.**
- l Leave cabinet doors open under the kitchen and bathroom sinks to allow warmer room air to circulate around pipes.
- l Let faucets drip slowly to keep water flowing through pipes that are vulnerable to freezing. Ice might still form in the pipes, but an open faucet allows water to escape before the pressure builds to where a pipe can burst. If the dripping stops, it may mean that ice is blocking the pipe; **keep the faucet open, since the pipe still needs pressure relief.**

Electric heating tapes and cables are available to run along pipes to keep the water from freezing. **These must be used with extreme caution; follow the manufacturer's instructions carefully to avoid the risk of fire.**

Tapes and cables with a built-in thermostat will turn heat on when needed. Tapes without a thermostat have to be plugged in each time heat is needed, and may be forgotten.

LETTING THE WATER RUN

Letting a faucet drip during extreme cold weather can prevent a pipe from bursting. It's not that a small flow of water prevents freezing; this helps, but water can freeze even with a slow flow.

Rather, opening a faucet will provide relief from the excessive pressure that builds between the faucet and the ice blockage when freezing occurs. If there is no excessive water pressure, there is no burst pipe, even if the water inside the pipe freezes.

A dripping faucet wastes some water, so only pipes vulnerable to freezing (ones that run through an unheated or unprotected space) should be left with the water flowing. The drip can be very slight. Even the slowest drip at normal pressure will provide pressure relief when needed.

Where both hot and cold lines serve a spigot, make sure each one contributes to the drip, since both are subjected to freezing.

If the dripping stops, leave the faucet(s) open, since a pipe may have frozen and will still need pressure relief.

IF YOU SUSPECT A FROZEN PIPE

If you open a faucet and no water comes out, don't take chances. Call a plumber.

If a water pipe bursts, turn off the water at the main shut-off valve; leave the faucet(s) open until repairs are completed.

**IF THERE IS NO EXCESSIVE WATER
PRESSURE, THERE IS NO BURST PIPE,
EVEN IF THE WATER INSIDE
THE PIPE FREEZES.**

Don't try to thaw a frozen pipe with an open flame; you may start a building fire.

You might be able to thaw a pipe with a hand-held hair dryer. **Slowly** apply heat, starting close to the faucet end of the pipe, with the faucet **open**. Work toward the coldest section. **Don't use electrical appliances while standing in water; you could get electrocuted.**

GOING ON A TRIP

When away from the house for an extended period during the winter, be careful how much you lower the heat. A lower temperature may save on the heating bill, but there could be a disaster if a cold spell strikes and pipes that normally would be safe, freeze and burst.

A solution is to drain the water system. This is the best safeguard. With no water in the pipes, there is no freezing. This remedy should be considered even when the homeowner is not leaving but is concerned about a serious overnight freeze.

To drain the system, shut off the main valve (usually at the water meter or where the main line enters the house) and turn on every water fixture (both hot and cold lines) until water stops running. It's not necessary to leave the fixtures open, since the system is filled mostly with air at that point and not subject to freezing.

When returning to the house, turn on the main valve and let each fixture run until the pipes are full again.

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SOUTHERN HOMEOWNERS FACE THREAT OF FROZEN PIPES

Water damage from frozen pipes that burst can be a major problem for homeowners in southern states, maybe even a bigger problem than in the colder north.

Home builders in the south often do not consider the threat of freezing weather and thus place water pipes in vulnerable locations.

Houses built on slab foundations, common in the south, frequently have water pipes running through the attic, an especially vulnerable location.

In addition, southern homeowners experience relatively few severe cold spells, so they don't consider freezing a problem and don't bother checking the condition or location of pipes in their homes.

In the north, by contrast, home builders know freezing is a threat, and they usually do not place water pipes in unheated portions of a building or outside of insulated areas.

Southern homeowners should be aware that pipes in attics, crawl spaces and outside walls are all subject to freezing and bursting. If these pipes don't have insulation or heat to protect them, a strong overnight freeze can cause trouble.

Changes in building codes will require homes built in the future to have adequate protection for pipes, but many plumbing installers are not aware of the changes. Houses already built remain vulnerable.

These suggestions for homeowners in southern states will help them prevent freezing pipe damage:

- | Pipes in attics and crawl spaces should be protected with insulation or heat. Pipe insulation is available in fiberglass or foam sleeves. Home centers and hardware stores have sleeves providing 1/8 to 5/8 inches of insulation; specialty dealers have products that provide up to 2 inches of insulation. (Check the Yellow Pages under "Insulation" or "Plumbing Supplies" for sources.) The extra thickness is worth the price and can save a pipe that would freeze with less insulation.
- | Heating cables and tapes are effective in freeze protection. Select a heating cable with the UL label and a built-in thermostat that turns the heat on when needed (without a thermostat, the cable has to be plugged in each time and might be forgotten). Follow the manufacturer's instructions closely.
- | Doors on cabinets under kitchen and bathroom sinks should be left open during cold spells to allow the warmer air of the room to circulate around the pipes.
- | Exterior pipes should be drained or enclosed in 2" fiberglass insulation sleeves.
- | Pipes leading to the exterior should be shut off and drained at the start of the winter. If these exterior faucets do not have a shut-off valve inside the house, have one installed by a plumber.
- | Hoses should be removed and stored inside during the winter.

INSTITUTE FOR BUSINESS AND HOME SAFETY

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