# THE SAFE HOME

MASTER INSPECTOR CERTIFICATION BOARD

CERTIFIED MASTER INSPECTOR®

CMI

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This publication is a compilation of well-researched articles especially for homeowners. They include valuable information and tips for helping keep families safe and their homes in top condition.

Please enjoy it with my compliments!

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# Child Safety

### 12 Safety Devices to Protect Your Children

About 2.5 million children are injured or killed by hazards in the home each year. The good news is that many of these incidents can be prevented by using simple child-safety devices on the market today. Any safety device you buy should be sturdy enough to prevent injury to your child, yet easy for you to use. It's important to follow installation instructions carefully.

In addition, if you have older children in the house, be sure they re-secure safety devices. Remember, too, that no device is completely childproof; determined youngsters have been known to disable them. You can childproof your home for a fraction of what it would cost to have a professional do it. And safety devices are easy to find. You can buy them at hardware stores, baby equipment shops, supermarkets, drug stores, home and linen stores, and through online and mail-order catalogues.

Here are some child-safety devices that can help prevent many injuries to young children:

1. Use safety latches and locks for cabinets and drawers in kitchens, bathrooms, and other areas to help prevent poisonings and other injuries. Safety latches and locks on cabinets and drawers can help prevent children from gaining access to medicines and household cleaners, as well as knives and other sharp objects.

Look for safety latches and locks that adults can easily install and use, but that are sturdy enough to withstand pulls and tugs from children. Safety latches are not a guarantee of protection, but they can make it more difficult for children to reach dangerous substances. Even products with child-resistant packaging should be locked away out of reach; this packaging is not childproof.

According to Colleen Driscoll, executive director of the International Association for Child Safety (IAFCS), "Installing an ineffective latch on a cabinet is not an answer for helping parents with safety. It is important to understand parental habits and behavior. While a latch that loops around cabinet knob covers is not expensive and easy to install, most parents do not consistently re-latch it."

Parents should be sure to purchase and install safety products that they will actually adapt to and use.

2. Use safety gates to help prevent falls down stairs and to keep children away from dangerous areas. Look for safety gates that children cannot dislodge easily, but that adults can open and close without difficulty. For the top of stairs, gates that screw into the wall are more secure than "pressure gates."

New safety gates that meet safety standards display a certification seal from the Juvenile Products Manufacturers Association (JPMA). If you have an older safety gate, be sure it doesn't have "V" shapes that are large enough for a child's head and neck to fit into.

3. Use door locks to help prevent children from entering rooms and other areas with possible dangers, including swimming pools.

To prevent access to swimming pools, door locks on safety gates should be placed high, out of reach of young children. Locks should be used in addition to fences and alarms. Sliding glass doors with locks that must be re-secured after each use are often not an effective barrier to pool access.

Door knob covers, while inexpensive and recommended by some, are generally not effective for children who are tall enough to reach the doorknob; a child's ingenuity and persistence can usually trump the cover's effectiveness.

4. Use anti-scald devices for faucets and showerheads, and set your water heater temperature to 120° F to help prevent burns from hot water. A plumber may need to install these.

5. Use smoke detectors on every level of your home and near bedrooms to alert you to fires. Smoke detectors are essential safety devices for protection against fire deaths and injuries. Check them once a month to make sure they're working. If the detectors are battery-operated, replace the batteries at least once a year, or consider using 10-year batteries.

6. Use window guards and safety netting to help prevent falls from windows, balconies, decks and landings. These can help prevent serious injuries. Check these safety devices frequently to make sure they are properly installed, secure and maintained. There should be no more than 4 inches between the bars of the window guard. If you have window guards, be sure at least one window in each room can be easily used for escape in case of a fire. Window screens are not effective for preventing children from falling out of windows.

7. Use corner and edge bumpers to help prevent injuries from falls against the sharp edges of furniture and fireplace hearths. Be sure to look for bumpers that stay securely attached.

8. Use receptacle or outlet covers and plates to help prevent electrical shocks and possible electrocution. Be sure the outlet protectors cannot be easily removed by children and are large enough so that children cannot choke on them if they do manage to remove them.

9. Use a carbon monoxide (CO) detector outside bedrooms to help prevent CO poisoning. Consumers should install CO detectors near sleeping areas in their homes. Households that should use CO detectors include those with gas or oil heat and those with attached garages.

10. Cut window blind cords to help prevent children from strangling in blind-cord loops. Window blind cord safety tassels on miniblinds and tension devices on vertical blinds and drapery cords can help prevent deaths and injuries from strangulation in the loops of the cords. Inner cord stops can help prevent strangulation in the inner cords of window blinds.

However, the IAFCS's Ms. Driscoll states, "Cordless is best. Although not all families are able to replace all products, it is important that parents understand that any corded blind or window treatment can still be a hazard. Unfortunately, children are still becoming entrapped in dangerous blind cords despite advances in safety in recent years."

For older miniblinds, cut the cord loop, remove the buckle, and put safety tassels on each cord. Be sure that older vertical blinds and drapery cords have tension or tie-down devices to hold the cords tight. When buying new miniblinds, vertical blinds and draperies, ask for safety features to prevent child strangulation.

11. Use door stops and door holders to help prevent injuries to fingers and hands. Door stops and door holders on doors and door hinges can help prevent small fingers and hands from being pinched or crushed in doors and door hinges.

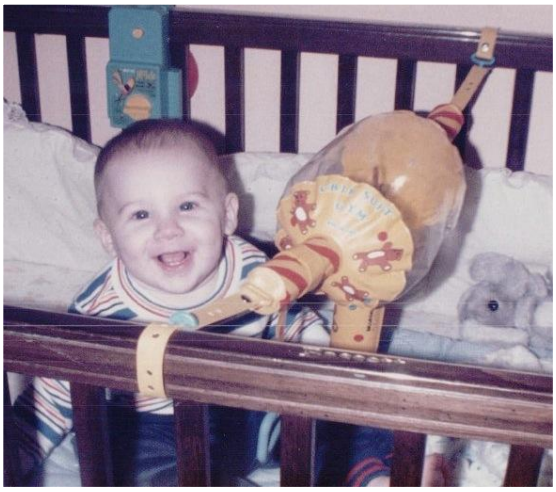
Be sure any safety device for doors is easy to use and not likely to break into small parts, which could be a choking hazard for young children.

12. Use a cell or cordless phone to make it easier to continuously watch young children, especially when they're in bathtubs, swimming pools, or other potentially dangerous areas. Cordless phones help you watch your child without leaving the vicinity to answer a phone call. Cordless phones are especially helpful when children are in or near water, whether it's in the bathtub, the swimming pool, or at the beach.

In summary, there are a number of different safety devices that can be purchased to ensure the safety of children in the home. Homeowners can ask their Certified Master Inspector about these and other safety measures during their next inspection. Parents should be sure to do their own consumer research to find the most effective safety devices for their home that are age-appropriate for their children's protection, as well as affordable and compatible with their household habits and lifestyles.

## Crib Safety

Baby cribs, especially hand-me-down and homemade models, can pose serious hazards to young children, including strangulation, entrapment, and overheating. Government manufacturing standards set in 1973 have greatly improved crib safety, yet defective cribs continue to be responsible for the highest child injury rates of any nursery item. In fact, approximately 50 infants each year are killed and another 9,000 are injured in crib-related accidents in the U.S. To prevent an avoidable tragedy, parents should check their child's crib to ensure against the following defects:



- Screws, bolts and hardware should not be missing, broken or loose.
- Slats cannot be more than 2-3/8 inches apart, which is about the width of a soda can, and none of them should be loose or broken. Older cribs are especially prone to this defect.
- The corner posts cannot extend more than 1/16-inch above the headboard and footboard.
- The mattress must be firm, and it should fit snugly inside the crib so that it does not easily release from the posts. This prevents the baby from getting stuck between the mattress and the crib.

- Check the crib's overall condition. Look for any sharp points or edges (such as those on protruding rivets, nuts, bolts and knobs), and any wood surfaces that have splits, splinters or cracks.
- Lead paint was outlawed in the United States in 1978, so painted cribs made before this year should be tested for lead, or avoided altogether.
- There should be no decorative cutouts in the headboard or footboard in which the baby's head or limbs could get trapped.
- Decorative knobs and corner posts should not be higher than 1/16-inch so that a baby's clothing cannot catch on them.
- The baby should sleep in a sleeper, as opposed to a blanket. Soft bedding and blankets are suffocation hazards. They may also cause the baby to overheat, so it's best to remove all pillows, comforters and quilts from the crib.
- If the crib has ribbons or bows, make sure they are tightly fastened, and no longer than 8 inches.
- Mobiles are for looking at, not touching. Their parts present a choking hazard and can cause the baby to become entangled. Make sure your baby cannot reach the mobile, and when he is old enough to crawl, the mobile should be removed from the crib. While newer mobiles are designed so that they cannot be reached, the risks still exist for older mobiles, homemade mobiles, and mobiles not specifically designed for cribs.

**Crib Recalls**

Cribs that were manufactured between 2000 and 2009 may be included in a voluntary recall issued by the U.S. Consumer Product Safety Commission (CPSC) in June 2010. Seven firms will provide consumers with free repair kits to remedy more than 2 million defective cribs, and they advise consumers not to attempt to fix these cribs using homemade remedies. Consumers should contact manufacturers directly to learn the appropriate remedy. These manufacturers are listed below, along with the number of cribs they recalled:

- 750,000 Jenny Lind drop-side cribs distributed by Evenflo, Inc.;
- 747,000 Delta drop-side cribs. Delta is also urging parents to check all fixed and drop-side cribs that use wooden stabilizer bars to support the mattress. The company says that the bars can be inadvertently installed upside-down, causing the mattress platform to collapse;
- 306,000 Bonavita, Babi Italia, and ISSI drop-side cribs manufactured by LaJobi, Inc.;
- 130,000 Jardine drop-side cribs imported and sold by ToysRUs®;
- 156,000 Million Dollar Baby drop-side cribs;
- 50,000 Simmons® drop-side cribs; and
- 40,000 to 50,000 Child Craft™ brand (now Foundations Worldwide, Inc.) stationary-side cribs, and an unknown number of drop-side cribs.

In summary, parents should ensure a safe sleeping environment for their young children by learning about defective conditions commonly found with cribs.

## Furniture and TV Tip-Over Hazards

"A TV can be a child's best friend, but it also can be a parent's worst enemy," says the mother of a 3-year-old who was crushed by a television, according to the Consumer Product Safety Commission (CPSC). The watchdog organization recently published an 18-year study on the dangers of furniture tip-overs, including startling findings that should be heeded by parents.

Here are some facts and figures from the CPSC study:

- From 1990 to 2007, an average of nearly 15,000 children under 18 visited emergency rooms each year for injuries received from furniture tip-overs. The number shows a 40% increase in injury reports over the duration of the study, hinting that the problem is growing worse. About 300 fatalities were reported.
- Most injuries happened to children 6 and under, and resulted from televisions tipping over.
- The most severe injuries were head injuries and suffocation resulting from entrapment.
- More than 25% of the injuries occurred when children pulled over or climbed on furniture.
- Most of the injured children were males under 7 who suffered blows to the head.
- The newer flat-screen TVs are not as front-heavy as the older, traditional TV sets, which means they may be less likely to tip over. Experts warn, however, that flat-screen TVs are still heavy to children, and they often have sharp, dangerous edges.
- In 2006, Pier 1 Imports® announced the recall 4,300 TV stands after one of them was involved in the accidental death of a child in Canada.

The American Society for Testing and Materials (ASTM) has established standards for manufacturers that stipulate that dressers, chests of drawers, and armoires should be able to remain upright when any doors or all drawers are open two-thirds of the way, or when one drawer or door is opened and 50 pounds of weight are applied to the front, simulating a climbing child. In addition, Underwriters Laboratories (UL) requires units to be able to remain upright when placed on a 10-degree angle with 70 pounds on top to simulate the weight of a television. The ASTM and UL standards are voluntary, however, and many manufacturers cut corners to save money. And, despite efforts by the CPSC to enforce these standards, sub-standard furniture is still regularly sold at retail stores.

Parents can minimize the risks posed to their children from furniture tip-overs by practicing the following strategies:

- Supervise young children at all times.
- Place televisions low to the floor and near the very back of their stands.
- Strap televisions and furniture to the wall with heavy safety straps or L-brackets. Many of these devices do not require that any holes be drilled into furniture, and they can secure items up to 100 pounds.
- Heavy items, such as televisions, should be placed far back on a dresser rather than at the front edge, which would shift the center of gravity forward and make the whole assembly more likely to tip over. Ideally, the center of gravity for furniture should be as low as possible, with the furniture placed back against a wall.
- Only purchase furniture that has a solid base, wide legs, and otherwise feels stable.
- Install drawer stops that prevent drawers from opening to their full extent, as a full extension can cause a dangerous forward-shift in the center of gravity.
- Keep heavier items on lower shelves and in lower drawers.
- Never place items that may be attractive to children, such as toys, candy, or a remote control, on the top of a TV or piece of furniture that poses a tip-over hazard.
- Do not place heavy televisions on dressers or shelving units that were not designed to support such weight.
- Place electrical cords out of the reach of children, and teach kids not to play with them. A cord can be used to inadvertently pull a TV, and perhaps its supporting shelf, onto a child.
- Read the owners' manuals and manufacturers' instructions for your TV and furniture to learn about additional tips and hazards regarding their proper assembly and placement.

In summary, TVs and furniture can easily tip over and crush a small child if safety practices are not followed by parents.

## Anti-Tip Brackets

Anti-tip brackets are metal devices designed to prevent freestanding ranges from tipping. They are normally attached to a rear leg of the range or screwed into the wall behind the range, and are included in all installation kits. A unit that is not equipped with these devices may tip over if enough weight is applied to its open door, such as that from a large Thanksgiving turkey, or even a small child. A falling range can crush, scald, or burn anyone caught beneath.

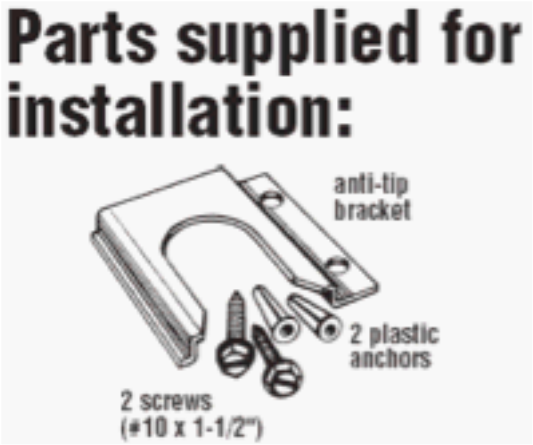
**Bracket Inspection**

Homeowners can confirm the presence of anti-tip brackets through the following methods:

- It may be possible to see a wall-mounted bracket by looking over the rear of the range. Floor-mounted brackets are often hidden, although in some models with removable drawers, such as 30-inch electric ranges made by General Electric, the drawers can be removed and a flashlight can be used to search for the bracket. Homeowners should beware that a visual confirmation does not guarantee that the bracket has been properly installed.

- Homeowners can firmly grip the upper-rear section of the range and tip the unit. If equipped with an anti-tip bracket, the unit will not tip more than several inches before coming to a halt. The range should be turned off, and all items should be removed from the stovetop before this action is performed. It is usually easier to detect a bracket by tipping the range than through a visual search. This test can be performed on all models and it can confirm the functionality of a bracket.

If no anti-tip bracket is detected, homeowners should have them installed. They can contact the dealer or builder who installed their range and request that they install a bracket. If homeowners wish to install a bracket themselves, the part can be purchased at most hardware stores or ordered from a manufacturer. General Electric will send their customers an anti-tip bracket for free.




According to the U.S. Consumer Product Safety Commission (CPSC), there were 143 incidents caused by range tip-overs from 1980 to 2006. Of the 33 incidents that resulted in death, most of those victims were children. A small child may stand on an open range door in order to see what is cooking on the stovetop and accidentally cause the entire unit to fall on top of him, along with whatever hot items may have been cooking on the stovetop. The elderly, too, may be injured while using the range for support while cleaning. Homeowners should never leave the oven door open while the oven is unattended.

In response to this danger, the American National Standards Institute (ANSI) and the Underwriters Laboratories (UL) created standards in 1991 that require all ranges manufactured after that year to be capable of remaining stable while supporting 250 pounds of weight on their open doors. Manufacturers' instructions, too, require that anti-tip brackets provided be installed. Despite these warnings, retail giant Sears estimated in 1999 that a mere 5% of the gas and electric units they sold were ever equipped with anti-tip brackets. As a result of Sears' failure to comply with safety regulations, they were sued and subsequently required to secure ranges in nearly 4 million homes, a measure that has been speculated to have cost the company as much as $500 million.

In summary, ranges are susceptible to tipping and causing grave injury, especially to children, if they are not secured with anti-tip brackets.

## Window Falls

Every year, roughly 2.5 million children in the United States are treated for fall-related injuries. Of these, falls from windows tend to be the most serious and fatal, especially among male toddlers. Older children are more likely to be seriously injured by window falls as summer approaches and they spend more time around the home. This problem is heightened by the fact that windows are left open for ventilation more often during the summer months than the rest of the year.

**Tips for Homeowners:**

- When ventilation is not needed, windows should be closed and locked.
- Windows can be equipped with window guards to prevent children from falling out. In some jurisdictions, such as New York City, window guards are required in apartments where children reside. These devices are constructed of horizontal bars spaced close enough together so that a 5-inch ball cannot pass through. Proper window guard placement can be determined by the local building code official or the local fire department. Window guards should include a quick-release mechanism to allow for a rapid exit in case of an emergency, such as a fire.
- Furniture that children can climb, such as dressers, beds and toy chests, should be kept away from windows.
- Window screens are designed to keep insects outside of the house and should not be relied upon to keep children from falling out of windows.
- Shrubs, wood chips, grass and other soft materials may be strategically placed beneath windows in order to lessen the degree of injury sustained from falls.
- Children's play areas should be kept away from open windows.
- If possible, ventilation should come from the upper sash of a double-hung window rather than the lower sash, which may be more accessible to a child.
- Windows that are low to the floor may be particularly easy for young children to operate.

In summary, homeowners can protect their children from window falls by learning some basic facts about window safety.

## Safety Glass

Safety glass is a stronger, safer version of ordinary glass. It is often used in locations where harm due to breakage is likely, such as in cars and low windows.

It is found in the following two forms:

- Laminated safety glass is commonly found in car windshields. It is produced by bonding a resin or a thin, transparent plastic film, known as PVB, between multiple sheets of ordinary glass. When shattered, this type of glass will adhere to the plastic sheet and be held in place.

Laminated safety glass is effective in blocking most ultraviolet radiation, as well as sound, and it's also used in cutting boards, thermometers, and bullet-resistant bank windows.

- Tempered safety glass fractures parallel to its edge rather than perpendicular, and when it shatters, it breaks into small, rounded, generally safe pieces. It is created by heating glass to a high temperature and then rapidly cooling it to produce compression stress fractures on the surface, while retaining tension in the center. The glass is several times stronger as a result of the process, and it can withstand significantly higher temperatures. Tempered safety glass is commonly found in rear and side car windows, computer monitors, and storm doors. Unlike laminated safety glass, it cannot be custom-cut once it is formed.

**Where in a home might you find it?**

Laminated glass may sometimes be found in shower enclosures, but it's generally uncommon in homes. Tempered glass appears more often and can be found in storm doors, skylights, sliding glass doors, and unsafe locations. Safety glass should be found in locations considered to be, according to the 2006 version of the International Residential Code (IRC), "subject to human impact." It describes these locations, as well as their exceptions, in "R308.4 – Hazardous locations" under "Section R308 – Glazing" as the following:

R308.4: The Following Shall Be Considered Specific Hazardous Locations for the Purposes of Glazing:

1. Glazing in swinging doors except jalousies.
2. Glazing in fixed and sliding panels of sliding door assemblies, and panels in sliding and bifold closet door assemblies.
3. Glazing in storm doors.
4. Glazing in all unframed swinging doors.
5. Glazing in doors and enclosures for hot tubs, whirlpools, saunas, steam rooms, bathtubs, and showers. Glazing in any part of a building wall enclosing these compartments where the bottom exposed edge of the glazing is less than 60 inches measured vertically above any standing or walking surface.
6. Glazing in an individual fixed or operable panel adjacent to a door where the nearest vertical edge is within a 24-inch arc of the door in a closed position and whose bottom edge is less than 60 inches above the floor or walking surface.
7. Glazing in an individual fixed or operable panel, other than those locations described in Items 5 and 6 above, that meets all of the following conditions:
   7.1. Exposed area of an individual pane larger than 9 square feet.
   7.2. Bottom edge less than 18 inches above the floor.
   7.3. Top edge more than 36 inches above the floor.
   7.4. One or more walking surfaces within 36 inches horizontally of the glazing.
8. All glazing in railings regardless of an area or height above a walking surface. Included are structural baluster panels and nonstructural infill panels.
9. Glazing in walls and fences enclosing indoor and outdoor swimming pools, hot tubs, and spas where the bottom edge of the glazing is less than 60 inches above a walking surface and within 60 inches horizontally of the water's edge. This shall apply to single glazing and all panes in multiple glazing.

10. Glazing adjacent to stairways, landings and ramps within 36 inches horizontally of a walking surface when the exposed surface of the glass is less than 60 inches above the plane of the adjacent walking surface.
11. Glazing adjacent to stairways within 60 inches horizontally of the bottom tread of a stairway in any direction when the exposed surface of the glass is less than 60 inches above the nose of the tread.

    Exception: The following products, materials and uses are exempt from the above hazardous locations:

1. Openings in doors through which a 3-inch sphere is unable to pass.
2. Glazing in Section R308.4, Items 1, 6, or 7, in decorative glass.
3. Glazing in Section R308.4, Item 6, when there is an intervening wall or other permanent barrier between the door and the glazing.
4. Glazing in Section R308.4, Item 6, in walls perpendicular to the plane of the door in a closed position, other than the wall toward which the door swings when opened, or where access through the door is to a closet or storage area 3 feet or less in depth. Glazing in these applications shall comply with Section R308.4, Item 7.
5. Glazing in Section R308.4, Items 7 and 10, when a protective bar is installed on the accessible side(s) of the glazing 36 inches ± 2 inches above the floor. The bar shall be capable of withstanding a horizontal load of 50 pounds per linear foot without contacting the glass and be a minimum of 1-1/2 inches in height.
6. Outboard panes in insulating glass units and other multiple glazed panels in Section R308.4, Item 7, when the bottom edge of the glass is 25 feet or more above grade, a roof, walking surface, or other horizontal surfaces within 45 degrees of a horizontal surface adjacent to the glass exterior.
7. Louvered windows and jalousies complying with the requirements of Section R308.2.
8. Mirrors and other glass panels mounted or hung on a surface that provides a continuous backing support.
9. Safety glazing in Section R308.4, Items 10 and 11, is not required where:
   9.1. the side of a stairway, landing or ramp has a guardrail or handrail, including balusters or in-fill panels, complying with the provisions of the handrail and guardrail requirements; and
   9.2. the plane of the glass is more than 18 inches from the railing; or
   9.3. when a solid wall or panel extends from the plane of the adjacent walking surface to 34 inches to 36 inches above the floor and the construction at the top of that wall or panel is capable of withstanding the same horizontal load as the protective bar.
10. Glass block panels complying with Section R610.

**How do you identify safety glass?**

If safety glass is not specifically labeled as such, there are often signs that aid in its identification. Unfortunately, it may be impossible to identify ordinary glass with certainty without breaking it.

According to the IRC, tempered glass must contain an identifying label. It states that a label must be "acid-etched, sandblasted, ceramic-fired, laser-etched, embossed, or be of a type which, once applied, cannot be removed without being destroyed." Tempered spandrel glass, an opaque glass found in commercial curtain walls, is exempt from this rule because an etched label can cause the entire panel to fracture.

Of multipane assemblies containing safety glass, the IRC states the following:

R308.1.1 Identification of multipane assemblies. Multipane assemblies having individual panes not exceeding 1 square foot in exposed area shall have at least one pane in the assembly identified in accordance with Section R308.1. All other panes in the assembly shall be labeled "16CFR1201."

Section R308.1 details identification as follows:

R308.1 Identification. Except as indicated in Section R308.1.1, each pane of glazing installed in hazardous locations as defined in Section R308.4 shall be provided with a manufacturer's or installer's label designating the type and thickness of glass and the safety glazing standard with which it complies, which is visible in the final installation. The label shall be acid-etched, sandblasted, ceramic-fired, embossed-mark, or shall be of a type which, once applied, cannot be removed without being destroyed.

Country-specific laws similarly require a permanent label on most or all safety glass. In the UK, for instance, tempered glass must include a "T," and laminated glass must include an "L." New Zealand requires, according to Clause 303.7 of NZS 4223:Part3:1999, that all safety glass have a label at the bottom that includes the following information:

(a) the name and registered trademark or code of the manufacturer or supplier;
(b) the type of safety glazing material. This may be in the form of a code, such as "T" for toughened glass, or "L" for laminated glass, as indicated by the relevant test Standard (refer to AS/NZS 2208);
(c) the Standard to which the safety glazing material has been tested, e.g. AS/NZS 2208;
(d) if applicable, the classification relating to impact test behaviour, i.e., A for Grade A, B for Grade B, or C for Grade C.

Laminated safety glass is often labeled, although codes do not always require it to be. An easy way to tell if unlabeled glass is laminated is by examining the reflection of your hand or some other object. As there are two pieces of glass, you should see two different images, but you must be careful not to confuse them with the inner and outer surfaces of a single sheet of ordinary glass. Laminated glass is also slightly thicker than ordinary glass, although this difference is difficult to discern without the aid of very precise measuring instruments.

Tempered glass can also be identified through polarized glasses when viewed from an angle. Black lines, a result of the heating and cooling process, should appear as your angle from the glass surface increases and you approach the glass's side.

When uncertain, homeowners should always assume that glass is not safety glass.

## Child-Proofing Windows and Stairs

The number one hazard for children is falls, which are the leading cause of non-fatal injuries for children in the U.S. About 8,000 youngsters wind up in emergency rooms every day for injuries related to falling, adding up to almost 2.8 million per year. With those statistics in mind, it is worth looking at what can be done to prevent such injuries in the home.

In trying to fathom how so many children can be injured on a daily basis from something as simple as slipping and falling, we need to consider an important factor, which is height. Oftentimes, when observing small children at play, we are amazed at their dexterity and ability to take what looks like a fairly serious tumble and hop right back up, unfazed. Likewise, a slip or fall for most adults, more often than not, leads to little more than a poorly chosen expletive being uttered. However, imagine a small child falling a distance equivalent to the average height of an adult, and we begin to see where the danger lies. With this to consider, let's take a closer look at two of the most important areas to childproof in a home: windows and staircases.

**STAIRCASES**

The first thing that probably comes to mind when examining child safety in relation to stairways and staircases is a safety gate, and with good reason: falling down stairs can be a serious hazard for an infant or toddler who is just learning to navigate his or her surroundings. When properly installed, high-quality safety gates can help eliminate this possibility.

**Safety Gates**

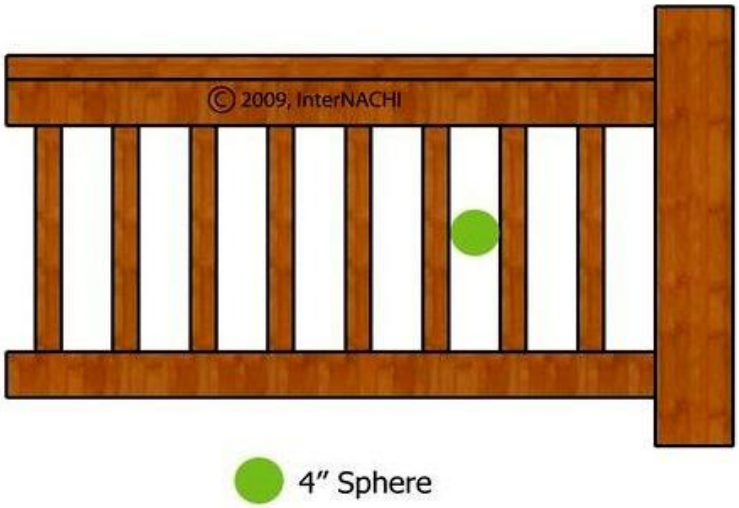
A safety gate is a gate that is temporarily installed in a door or stairway. It allows adults to unlock and pass, but small children will be unable to open it. There are two basic types of gates which differ in the way they are installed. The first type is a pressure-mounted gate. These safety gates are fixed in place by pressure against walls or a doorway. They can be used in doorways between rooms, such as for keeping crawling babies out of a kitchen during cooking, but they are not suitable for keeping kids out of other areas, such as the top of a stairway, where falling could be a risk.

The other type of safety gate, which is recommended specifically for stairways, is hardware-mounted. These gates mount solidly in place with screws but are still easily removable for times when they are unnecessary. A hardware-mounted safety gate will prevent small children from entering stairways where accidents could occur.

When choosing a safety gate, you can refer to established ASTM standards for these products, and some manufacturers also participate in a certification program administered by the Juvenile Products Manufacturers Association (JPMA). Any gate you choose should meet the ASTM standards, which will ensure that the gate itself poses no hazard to the child. Products that comply with these standards have a sticker on the packaging or on the unit itself.

**Railings**

For parents of children who have outgrown the need for safety gates but are still small and curious, especially those prone to climbing on things, baluster spacing on the handrail becomes a concern. A stairway with four or more risers should have a continuous handrail not lower than 34 inches or taller than 38 inches on at least one side, with balustrades not more than 4 inches apart from each other. If there are spaces between vertical rails or risers that will allow an object larger than 4 inches to pass between them, this should be considered a safety hazard to a child who may try to climb on the railing and may get stuck between the balusters or spaces between the railing and risers.




**WINDOWS**

If the dangers associated with falling are compounded by the height of the fall, then windows can present an even greater concern than stairways. It is estimated that more than 4,000 children are treated every year in emergency rooms for injuries sustained by falling from windows. There have been at least 120 such deaths reported since 1990. Risk of injury from window-related accidents in the home can be minimized by addressing several common issues.

The first and simplest thing to do is to ensure that there is no furniture situated in areas that would make it easy for a child to reach and open or close a window. Any furniture a child could potentially climb on should be moved away from windows.

**Latches, Stops and Guards**

As children begin to grow to heights where they may be able to access windows from a standing position, it is important to install secure, child-proof latches. There are many types of window latches that, similar to safety gates, will allow an adult to easily open and close the windows, but will prevent kids from doing the same.

Also available are window stops, which will not allow the window to be opened wider than a pre-determined width. The recommended opening, similar to balustrade spacing, should not exceed 4 inches. This eliminates the possibility of a child or one of his limbs to pass through. These stops are easily removable by an adult whenever necessary.

An additional option to consider is a window guard. A window guard can be vertical or horizontal. It attaches to a frame and can be removed by an adult, but will deter a child. Guards have some form of bars or beams across them, which should be no more than 4 inches apart. Window guards maintain the functionality of the window while ensuring a child's safety when the window is open. However, even with a guard installed, kids should not be allowed to play around windows, whether they are open or

closed. Try to open windows only from the top, if possible. And never rely on window screens to keep a child from falling through the window, as that is not the function they are designed for.

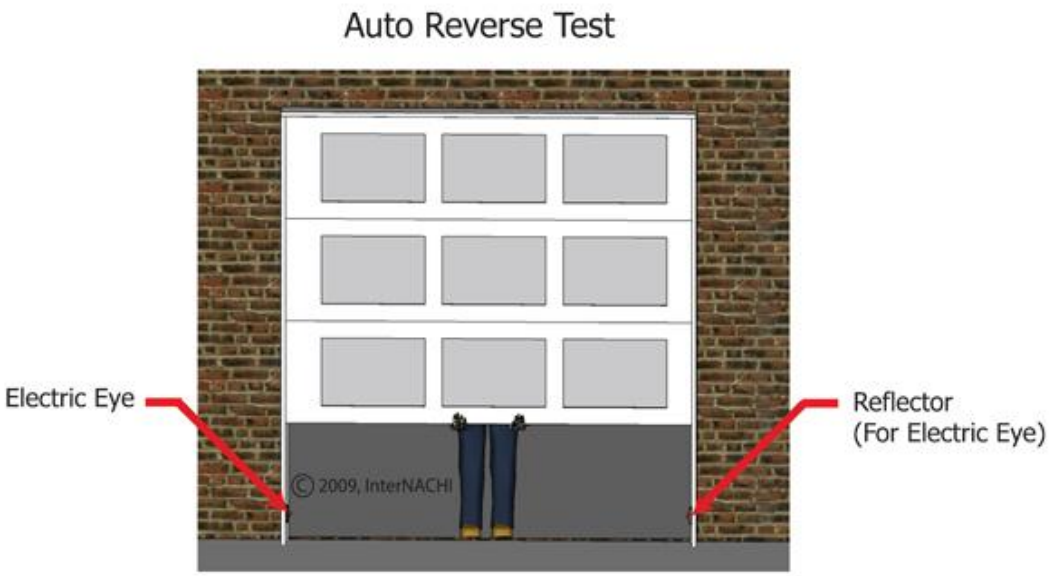
With some foresight, a few clever and fairly inexpensive products, and proper adherence to building codes, the risk of injury from falling can be successfully minimized. Your Certified Master Inspector® can assess the safety issues in your home and advise you on the most effective childproofing measures to keep your family safe.

### Garage Doors and Openers

Garage doors are large, spring-supported doors. Garage door openers control the opening and closing of garage doors, either through a wall-mounted switch or a radio transmitter. Due to the strain that garage door components and openers regularly endure, they may become defective over time and need to be fixed or replaced. Defective components may create safety hazards as well as functional deficiencies to the garage door assembly.

The following facts demonstrate the dangers posed by garage doors:

- Garage doors are typically among the heaviest moving objects in the home and are held under high tension.
- Injuries caused by garage doors account for approximately 20,000 emergency room visits annually, according to the U.S. Consumer Product Safety Commission.
- The majority of the injuries caused by garage doors are the result of pinched fingers, although severe injuries and deaths due to entrapment occur as well. Sixty children have been killed since 1982 as a result of garage doors that did not automatically reverse upon contact.



Methods for testing the automatic reverse system:

1. This safety feature can be tested by grasping the base of the garage door as it closes and applying upward resistance. Homeowners should use caution while performing this test because they may accidentally damage its components if the door does not reverse course.

2. Some sources recommend placing a 2x4 piece of wood on the ground beneath the door, although there have been instances where this testing method has damaged the door or door opener components.

3. Using a supplemental automatic-reverse system. Garage doors manufactured in the U.S. after 1992 must be equipped with photoelectric sensors or a door edge sensor, such as the following:

    a. Photo-electric eyes (also known as photo-electric sensors) are located at the base of each side of the garage door and emit and detect beams of light. If this beam is broken, it will cause the door to immediately reverse direction and open. For safety reasons, photo sensors must be installed a maximum of 6 inches above the standing surface.

    b. A door edge sensor is a pressure-sensitive strip installed at the base of the garage door. If it senses pressure from an object while the door is closing, it will cause the door to reverse. Door edge sensors are not as common in garage door systems as photo-electric eyes.

**Safety Advice for Homeowners:**

- Homeowners should not attempt to adjust or repair springs themselves. The springs are held under extremely high tension and can snap suddenly and forcefully, causing serious or fatal injury.

- No one should stand or walk beneath a garage door while it is in motion. Adults should set an example for children and teach them about garage door safety. Children should not be permitted to operate the garage door opener push button and should be warned against touching any of the door's moving parts.

- Fingers and hands should be kept away from pulleys, hinges, springs, and the intersecting points between door panels. Closing doors can very easily crush body parts that get between them.

- The automatic reversal system may need to be adjusted for cold temperatures, since the flexibility of the springs is affected by temperature. This adjustment can be made from a dial on the garage door opener, which should be changed only by a trained garage door technician.

In summary, garage doors and their openers can be hazardous if certain components are missing or defective, or if people fail to use caution while around them during operation.

## Trampoline Safety

While health-promoting and fun, trampolines can also be dangerous when they're misused or if they're poorly designed.

**Facts and Figures**

- The first modern trampoline was constructed in 1936 by University of Iowa gymnasts George Nissen and Larry Griswold. Trampoline-like devices have been in use for centuries, however, such as walrus skins used by the Inuit to toss each other into the air.
- According to the American Association of Orthopedic Surgeons (AAOS), an average of 246,875 trampoline injuries that require medical treatment occur annually in the U.S. Of this total, the majority -- 186,405 -- occur among children ages 14 and younger. The most common injuries resulting in hospitalization include fractures to the upper and lower extremities. Catastrophic spine injuries are rare, but head and neck injuries constitute a large portion of the more serious reported injuries.
- Most reported injuries and deaths are caused by children colliding with each other, landing improperly while jumping or doing stunts, falling off the trampoline, or falling on the trampoline springs or frame.
- The American Academy of Pediatrics recommends that home trampolines not be used at all. Parents may consider other forms of activity for their children to enjoy, or visit a commercial trampoline park, whose standards for construction must follow strict safety guidelines.

**Trampoline users should practice the following safety tips in order to avoid injury:**

- Allow only one person on the trampoline at a time.
- Use a trampoline that is located in a well-lit area.
- Children should never be allowed to jump onto the trampoline from higher objects, such as a tree or roof.
- Always supervise children who use the trampoline, and never allow a child under the age of 6 to use a full-size trampoline.
- Leave the gymnastics to the professionals. The U.S. Consumer Product Safety Commission cautions against performing somersaults on trampolines because landing on the head or neck can cause an injury resulting in paralysis. The user should never attempt maneuvers beyond their capability or training.

**In addition to safe behavior, trampolines can be arranged to limit the chance of injury using these guidelines:**

- Install a surrounding net. These nets have been shown to reduce the number of injuries from falls off the trampoline, although they are no substitute for supervision, and they do not protect against injuries sustained on the trampoline, according to the Foundation for Spinal Cord Injury Prevention.
- Safety pads should cover all portions of the steel frame, hooks and springs.
- Never place the trampoline on concrete or asphalt. It’s wise to apply wood chips or some other soft surface to the surroundings beneath it.

- Never install a trampoline near structures, power lines, clotheslines, trees, or anything else that may contact a bouncing child.
- The trampoline should be regularly inspected for tears, rust, and detachments.
- Safety harnesses and spotting belts, when appropriately used, may offer additional protection for athletes practicing more challenging skills on the trampoline.
- Trampolines that are set over pits so that the mat is at ground level may be safer because the user will not fall as far if they miss the pad.
- Do not attach a ladder to the trampoline because it can provide unsupervised access for small children.

**Trampolines and Homeowners Insurance**

Trampolines are considered by insurance companies to be an "attractive nuisance" -- something that invites trespassers – and, as such, insurers don't automatically provide coverage for them in their homeowners policies. No matter what signs are posted or gates erected, there is always a possibility that a neighborhood child will trespass, get injured on the trampoline, and sue you in court.

Mary Kaderbek of Allstate® Insurance reminds homeowners that "owning a trampoline can affect your homeowners insurance," so they should check their policies or give their agents a call before purchasing one.

Most insurers handle trampolines in one of three ways:

- No Exclusions: This means that there are no restrictions on owning or using a trampoline on the covered property. While it may be the most desirable coverage, it may not be a standard offering by your insurer.
- Coverage with Safety Precautions: This type of coverage is for trampolines that have safety features installed, such as padded coverings for springs, a netting enclosure, a locking yard gate, etc.
- Trampoline Exclusion: The most restrictive clause, this means that trampolines are excluded from your homeowners coverage, so any damage or injury caused by anyone (invited or not) who uses a trampoline on the insured property is not covered. Furthermore, if a homeowner purchases a trampoline after purchasing the policy, the policy may not be automatically renewed.

In summary, trampolines can cause bodily harm -- and financial hardship -- if not used responsibly. And, as with any major purchase for the home, homeowners should check with their insurance carrier to find out what kind of liability they may face by setting up a trampoline in their yard.

## Tree Swings

A tree swing (or a rope swing or tire swing) is composed of a single rope or chain attached to a high tree branch, along with a seat, which is typically a wooden plank or tire. For many homeowners, tree swings represent fond childhood memories, but this type of DIY play equipment is too often poorly constructed by non-professional builders for their children who can be unaware of the potential dangers.

Consider some recent tragedies. In 2010, a British girl enjoying her tree swing was killed when she was pinned to the ground by the falling silver birch, which is a tree species considered unsuitable for tree swings. That same year, an unsupervised boy accidentally hanged himself when he became tangled in the tree swing's rope. Children are also killed or injured when ropes snap or hanger brackets dislodge. An article in the journal *Pediatrics* stated that "recreational, single-rope tree swing injuries among children resulted in significant morbidity, regardless of the height of the fall. This activity carries a substantial risk for serious injury."

To prevent accidents, homeowners can learn about what goes into a properly installed tree swing, and how to inspect them for potential hazards.

**Tree Inspection**

A sturdy tree is a must for a safe tree swing, but this consideration may be overlooked on properties that lack a variety of healthy trees from which to choose. Also, homeowners should remember that while trees appear stationary, they are actually alive and constantly, albeit slowly, growing and changing shape. As such, branches will "absorb" hanger brackets, and overhead branches will become brittle, gradually transforming what was once a properly installed tree swing into one that is no longer safe to use.

Check for the following indications that the tree will pose dangers to the user:

- Inappropriate tree choice. According to London Play, an organization that promotes outdoor exercise for children, beech, oak, sycamore and Norway maple are suitable for rope swings, while pine, poplar, spruce, willow and silver birch should be avoided. Cherry, cedar and ash can be used only when their limbs are large and the tree is in good condition.
- The branch is too thin. The branch's minimum thickness depends on the tree species, but, in general, it should be at least 8 inches thick.
- Bulges, cracks, or unusual swelling. These tree defects often lead to limb failure. If possible, the candidate limb should be inspected from above as well as from the ground.
- Decay, fungus, or signs of hollowing within the tree. Dead wood is often dry and brittle and cannot bend in the wind under the stresses of the weight of a swinging child. Strike the tree at different points with a hammer to test for the sound of hollowing.

- Poor tree architecture. While a tree that naturally leans may have no structural defects, straight trees that have started to lean recently may be damaged and in danger of collapse.
- Cracks or seams where the branch forks from the larger limb. Weak unions indicate that the limb is at risk of tearing out.
- Dead or hanging branches above the swing. These should be secured or removed, as they are likely to dislodge from the motion of the moving swing.

**Ground Cover**

Whether on purpose or by accident, sooner or later, children will fall from playground equipment, including rope swings, and the extent of their injuries will be determined, in part, by the condition of the ground beneath the swing.

Inspect for the following hazards that may make injuries more likely:

- Asphalt, concrete or other types of hard surfaces. Grass or bare earth covered with leaves is usually safe, although additional safety can be provided by loose-fill material, such as mulch, wood chips, shredded rubber mulch, or engineered wood fiber. Earth that has been compacted by frequent foot traffic may be too hard.
- Natural objects that may be tripped over or injure a child, such as rocks, exposed roots, stumps or branches from a neighboring tree. These objects should be removed so that only a flat surface remains.
- Downward-sloped terrain. This will have the effect of accelerating the speed or adding to the distance for the child to dismount the swing, increasing the likelihood that s/he will trip and fall. Such a slope will also encourage the loss of leaves and other natural loose-fill material to wind and rain.
- Safe ground surface that extends only in a narrow path in front of and behind the swing. Tire swings, which permit a swinging motion in any axis, demand a larger safe-ground surface than other rope swings. The U.S. Consumer Product Safety Commission (CPSC) recommends installing a protective surface outward from the swing equal to the suspension rope plus 6 feet.

**Water**

Tree swings are sometimes installed adjacent to ponds or rivers so the user has the option of a water landing. As exciting as this prospect may be, water presents its own set of dangers. A flotation device may be kept next to the tree so that it can be thrown into the water in case of an emergency.

Also, check for the following:

- Water depth. Check to make sure that the water is sufficiently and uniformly deep within the fall range.
- Sharp rocks, branches or other objects that can cause injury.
- Obvious exit. A steep-walled river can be difficult to escape, as can swift river currents.

**Rope**

A tree swing is only as strong as its rope or chain, so care should be taken to choose adequate material.

Check for the following rope defects:

- Too thin. Rope that is too thin will either not support the weight of a swinging child or be difficult to adequately grasp.
- Too thick. Ensure that the rope is not so thick that a child cannot easily grasp it. Rope that is an inch to 1-1/2 inches thick is typically sufficient, depending on the material.
- Inadequate strength. Remember that as the user swings higher and higher, the tension in the rope or chain will equal several times the rider's weight at the bottom of the arc. Therefore, the rope should be rated to withstand significantly greater weight than that of the intended rider.
- Abrasiveness. Before wrapping the rope around the tree limb, protect the tree from abrasion and subsequent damage and weakening by wrapping a section of rubber around it.
- Unsafe, makeshift or additional ropes. Ensure that the rope does not create strangulation hazards. Also, check for any stray jump ropes, clotheslines, pet leashes, or anything else unnecessarily attached to the tree swing.

**Seat**

The seat should be high enough so that the user's legs do not scrape the ground but not so high that the swing isn't easily accessible or requires unsafe effort for the user to dismount. Remember that tree limbs can sway under the user's weight, and weaker limbs may permit the seat to get too close to the ground. Sufficient clearance is roughly 10 inches between the ground and the user, which may translate into 16 inches for an unoccupied swing. A seat may be made from a wooden plank, which can be inspected for splinters, or a tire, which is usually suspended in a horizontal orientation using three suspension chains or cables connected to a single swivel mechanism that permits both rotation and a swinging motion in any axis.

The tire may be a discarded vehicle tire or a plastic imitation, but it can present its own set of defects, including:

- Exposed metal wires. Newer radial tires should not be used for a swing. In fact, the American Society of Testing and Materials (ASTM) explicitly advises against their use because they can become worn, exposing dangerous metal wires. Radial tires should be closely inspected for wear before their use. Older bias tires are usually safer to use for swings.
- Using a heavy truck tire. This type of tire may be too heavy, causing the hanger clamp to dislodge. According to the ASTM, the entire rope swing assembly should not be greater than 35 pounds.
- No water drainage holes. Tires will collect rainwater if they lack holes through which water can drain.
- Beehives or hornets' nests. Carefully inspect the interior of the tire for dangerous animals and insects and their nests, especially stinging insects, which may require special handling in order to remove safely.

**Hanger Clamp**

Hanger clamps provide a fixed point for the rope and the tree branch to intersect while keeping them properly separated, reducing friction on the rope that can cause it to gradually wear away.

The likelihood of failure at this point is increased due to the additional stress of rotational movement and multiple users.

Check for the following defects:

- Poor clamp location. The hanger should be installed far enough away from the tree trunk that the user cannot inadvertently swing into the tree, especially if the swing permits horizontal motion. Likewise, the hanger should be placed at a point on the branch close enough to the tree trunk that the branch is of desirable strength and thickness.
- The clamp is not securely installed. If it detaches, the swing and its rider will fall to the ground. The CPSC has ordered a recall of tire swings manufactured by Miracle Recreation Equipment Company (model #714-852, #714-852-X and #278) for this safety defect due to reported injuries.
- Pinch points. Hanger clamps, especially for multi-axis tire swings, should not have any accessible pinch points.

**Additional Inspection Tips**

- Check for signs of vandalism. Even if intended as a harmless prank, disaster can result from a partially cut rope.
- Supervise children at play. Children may stand on the swing, swing excessively high to outdo a friend, or spin the swing to create dizziness. A little supervision can mean the difference between childhood antics and serious danger.
- Remove drawstrings from children's clothing, as they can become attached to the moving swing and create a strangulation hazard.
- Remove the swing in bad weather if it may become damaged or damage the tree.
- Clean, sand and repaint rusted areas as needed.
- Occasionally inspect the condition of the equipment for signs of wear (especially after a season of harsh or inclement weather), such as splintering wooden surfaces, damaged suspension ropes, broken and missing components, and bent pipes or tubing.
- Ensure that protective caps and plugs that cover bolts and tubing ends are in place and secure.
- Periodically oil any moving metal parts.
- Maintain adequate loose-fill surfacing beneath the swing.

In summary, tree swings can be great fun if they're used with safety in mind first and foremost. Homeowners should inspect for their proper installation and maintenance to prevent avoidable and potentially tragic accidents.

## Treehouses

Treehouses are great fun for kids, but danger is inherent when you let children play in trees. Homeowners should keep aware of potential hazards.

**Power Lines**

Despite what we know about power line dangers for residential homes and commercial structures, homeowners sometimes build treehouses near power lines, perhaps due to space constraints. This situation increases the likelihood that children will be electrocuted or burned in a tragic treehouse fire, as it becomes quite easy for them to climb onto the power lines or deliberately touch them with sticks or poles. The wind may also cause the branches to contact the power lines. Some utility companies instruct their workers to flag treehouses that are dangerously close to power lines. Homeowners are then notified and, depending on the company, the tree may be either pruned or removed.

In addition to power lines, treehouses should not be built near or over a cliff, a busy road, or dangerous water features.

**Inspection**

The Forestry Commission of England offers the following treehouse safety guidelines (their code is in italics):

- *Fall height. The fall height from the treehouse should not be greater than 2 meters unless the structure has good protection against falls, such as railings or other edge protection.*
- *Fall zone. The fall zone around the treehouse should be free of any pointed stumps, sharp or large rocks, or dangerous waste, such as sharp metal. Normal vegetation cover, saplings and bushes are not a problem.* Wood chips make a good groundcover beneath the treehouse.
- *Access. Access to the treehouse needs to be checked. If a rope or rope ladder is provided, then weight-bearing capacity should be checked by giving the rope a 'good pull' with feet firmly on the ground.* Wooden ladders are better than rope ladders, which are less stable and pose a strangulation risk.
- *Structure. Structure should be checked to ensure that collapse is not likely. This should be done in a safe manner from outside the structure [while] wearing safety helmet. If ladders are used to access the structure, then working at height regulations should be followed.* Also, inspect the tree, as well as neighboring trees, for evidence of weakness, fungus and decay.
- Snag hazards. Inspect for rough, splintered areas that can be sanded down, and for nails sticking out that may be replaced with screws.
- Inspect for loose and rotten boards.
- Is there a railing? According to *The Black and Decker Complete Guide: Build Your Kids a Treehouse*, railings should be at lest 36 inches tall with vertical balusters no more than 4 inches apart. On treehouses designed for small children, rope or cable should not be used for the balusters. Horizontal balusters are dangerous because children use them to climb.

**Advice for Homeowners**

- Check your homeowners insurance policy or give your agent a call to find out what kind of liability you may face by building a treehouse on your property. It may range from full coverage to no coverage at all, including having your policy's renewal revoked if you build one.
- Restrict access to the treehouse, especially if you live in a neighborhood with a lot of children. You may be held responsible if a trespassing child is injured in your treehouse.
- Treehouses allow children privacy and freedom, which can be healthy, but keep an eye out for antisocial activities, such as drug use.

- If the treehouse borders a neighbor's house, it may cause a nuisance. Children might need to keep their voices down and be respectful.
- Is the treehouse not on your property? Build treehouses on public land at your own risk, as the project may be illegal. Also, the treehouse and children's activity may disrupt the enjoyment of others, or negatively impact nature conservation areas.
- Never allow children in the treehouse during inclement weather, especially if you hear thunder.
- Construct a pulley-and-bucket system for hauling items up to reduce the chance of fall or injury that can occur when climbing while carrying items.
- Restrict the number of children allowed in the treehouse at one time.
- Post a list of safety rules for the children to learn, and make sure they follow them.

In summary, treehouses pose some unique risks that can be mitigated with regular inspection and common sense.

## Ladders and Stairways

### Ladder Safety

A ladder is a structure designed for climbing that consists of two long side-pieces joined at uniform intervals by rungs or steps. It's important to use the right tool for the job, and that includes ladders, which come in different types and sizes for different applications. It's also important to exercise extreme caution while using a ladder, as a fall from a ladder can lead to serious injury and even death.

Some common causes of ladder injuries include:

- mounting or dismounting the ladder improperly;
- losing one's balance;
- failing to set up the ladder properly;
- over-reaching while on the ladder; and
- mis-stepping while climbing or descending.

**Statistics Concerning Ladder Dangers**

- According to the World Health Organization, the United States leads the world in ladder deaths. Each year, there are more than 164,000 emergency room-treated injuries and 300 deaths in the U.S. that are caused by falls from ladders.
- Most ladder deaths are from falls of 10 feet or less.
- Falls from ladders are the leading cause of deaths on construction sites.
- Over the past decade, the number of people who have died from falls from ladders has tripled.
- Falls from ladders are the leading cause of ladder-related injuries, followed by using a ladder improperly, using a faulty or defective ladder, and simple carelessness.

Some basic safety tips will help prevent injuries.  And safety begins with understanding the types of ladders available and their common uses.

**Ladder Types**

According to the American Ladder Institute, there are seven common types of ladders:

1. a step ladder, which is a self-supporting ladder that is not adjustable in length, with a hinged design for ease of storage;
2. a single ladder, which is a non-self-supporting ladder that is not adjustable in length, consisting of one section. This type of ladder is rarely used anymore because extension ladders are used instead;
3. an extension ladder, which is a non-self-supporting ladder that is adjustable in length. It consists of two or more sections that travel in guides or brackets arranged so as to permit length adjustment;
4. an articulated ladder, which has one or more pairs of locking articulated joints, allowing the ladder to be set up in several different configurations. It may be used as a step ladder or single ladder;
5. a tripod ladder, which has one leg opposite the rungs and is handy for applications where more support is desired than that provided by an extension ladder but where space to set up the ladder may be limited;
6. a trestle ladder, which is a combination of a step ladder with a single extension ladder that can be raised through the top; and
7. a telescoping ladder, which uses a pin system to "telescope" into variable lengths. As it is more portable than the extension ladder, it is often preferred over that design for indoor applications. Homeowners should be aware that accidents have happened due to failure of the pins, which can be difficult to detect in advance. Some people refuse to use telescoping ladders for this reason.

**Accessories**

**Ladder levels** attached to the bottom of the side rails can provide stability and support on uneven surfaces, but the use of these devices should be limited to people whose expertise and confidence in ladder use is advanced.  For most users, placing the ladder on a flat, even surface is the safest method.

If it's not possible to safely brace an extension ladder against a stable or level surface at the top, a straight **ladder stabilizer** can be used for this purpose.

**Safety Tips for Homeowners**

Never:

- leave a raised ladder unattended. Ladders that are not in use should be laid on the ground or put away;
- place a ladder in front of a door that is not locked, blocked or guarded;
- place a ladder on an unstable or uneven surface;
- use a ladder for any purpose other than the one for which it was designed. Many homeowners and even professionals sometimes use an extension ladder as a ramp between two points or as a shelf to hold materials and supplies, and what may seem convenient in a pinch may lead to an accident or injury;
- tie or fasten ladders together to provide longer sections, unless they are specifically designed for that purpose;
- use a ladder in windy conditions;
- use a ladder if you're not fully alert and physically able;
- skip any rungs while climbing or descending;
- bounce on any rungs;
- use a ladder that has been exposed to fire or strong chemicals, as these conditions may leave residual damage or corrosion, which cannot be detected during use;
- exceed the maximum load rating. The maximum load rating, which should be found on a highly visible label on the ladder, is the maximum intended load that the ladder is designed to carry. Duty ratings are Type lll, ll, l, lA and 1B, which correspond to maximum load capacities of 220, 225, 250, 300 and 350 pounds, respectively. Homeowners should know the duty rating of the ladder they are using, as well as the combined weight of themselves and their tools;
- use a step ladder in the closed or partially closed position, or use it by leaning it against a wall;
- sit on any rung, including the top;
- climb past the fourth rung from the top on a leaning ladder, or the second rung from the top on a step ladder. Never use the top step;
- pull, lean, stretch, or make any sudden moves. Over-reaching is the most common and dangerous form of ladder misuse;
- climb a ladder while holding tools or other items. Both hands are required for safe climbing and descent;
- pull or push any items while ascending or descending. Always wait until you're at the top or bottom of your working point to hoist or lower items;
- step on the rear section of a step ladder or the underside of an extension ladder;
- paint a wooden ladder, as this can conceal cracks and other damage that would require repairing or replacing the ladder; or
- drop or throw a ladder, or allow it to fall, which can create a hazard for others, as well as damage the ladder.

Before mounting a ladder, always check the following:

- that the ladder, steps and rungs are free of oil, grease, wet paint, and other slipping hazards;
- that the feet work properly and have slip-resistant pads. These pads become worn over time and may need to be replaced. On extension ladders, the rubber pads can be turned around to reveal metal spurs, which can be used to secure the ladder in soft surfaces, such as grass or dirt;
- that rung locks and spreader braces are working;

- that all moveable parts operate freely without binding or excessive play;
- that all bolts and rivets are secure;
- that ropes aren't frayed or excessively worn;
- that the ground under the ladder is level and firm. Large, flat, wooden boards braced under the ladder can level a ladder on uneven or soft ground. Also, some companies make leveling devices so that ladders can be used on uneven and hilly terrain;
- that the ladder's rungs, cleats or steps are parallel, level, and uniformly spaced when the ladder is in position for use. Rungs should be spaced between 10 and 14 inches apart;
- that the ladder is anchored. The base can be tied to a nearby sturdy object, such as a pole or a building. If no anchor is available, a stake can be driven into the ground. Homeowners should beware not to anchor their ladders to something that can impale them if they were to fall on it, such as a grounding rod. A 10-inch nail, hammered so as to leave only an inch or two exposed, is usually safe and effective;
- that the area around the ladder is roped off or barricaded;
- for any cracks, bends, splits and corrosion;
- the location of nearby power lines. If setting up a ladder near them or other types of electrical equipment is unavoidable, use a wooden or fiberglass ladder rather than a metal ladder, which can conduct electricity and lead to a shock or electrocution. Do not allow your ladder to make contact with any overhead wires, regardless of the type or whether they're live, as it is not always possible to confirm their status;
- the distance of non-self-supporting ladders from the structure. This type of ladder must lean against a wall or other support, so they should be positioned at such an angle that the horizontal distance from the top support to the foot of the ladder is about one-quarter or at a 4:1 angle of the working length of the ladder. A rough method to test this angle is by placing your toes at the base of the ladder and stretching your arm at shoulder height. Your hand should just touch the ladder;
- that the ladder has slip-resistant feet;
- that the ladder is the proper length for the job. Ladders should extend a minimum of 3 feet over the roofline or working surface;
- the locking devices. Step ladders must have a metal spreader or locking device to hold the front and back sections in an open position when in use; and
- that someone knows where you are. Accidents can and do happen in remote areas where cell phones are ineffective and no one is home. If you are injured under these conditions, no one will know you are hurt and need help.

While on the ladder, always:

- face the ladder;
- wear secure-fitting footwear that’s free of mud and other substances that may cause you to slip;
- consider anchoring the top of the ladder with a bungee cord. Perhaps the most feared move is stepping back onto the ladder from the roof. You must step around the section of the ladder that extends above the roofline, placing lateral pressure on the rung as you make contact with the ladder. A bungee cord is a convenient tool that can be used to reduce any wavering that could otherwise result in a serious accident. Also, a bungee cord may prevent the ladder from being blown over in the wind while you’re on the roof;

- be conscious of the ladder's location, especially while walking on the roof. In an emergency, the homeowner may need to leave the roof quickly. Ladders become much more dangerous when someone becomes covered in a swarm of stinging bees and must get down in a hurry, for instance;
- use a fall-arrest system for working at great heights or while performing complicated tasks;
- use the proper protective equipment for the job, such as a hardhat or eye protection;
- keep your body centered between the rails at all times. Do not lean too far to the side while working; and
- utilize at least three points of contact, because this minimizes the chances of slipping and falling from the ladder. At all times during ascent or descent, the climber must face the ladder and have two hands and one foot, or two feet and one hand, in contact with the ladder cleats and/or side rails. In this way, the climber is unlikely to become unstable if one limb slips during the climb. It is important to note that the climber must not carry any objects in either hand that can interfere with a firm grip on the ladder.

Always use proper mounting hardware on vehicles used to transport ladders, and follow precautionary measures if your ladder exceeds the length of your vehicle so that you don't cause an accident or violate any traffic codes.

## Attic Pull-Down Ladders

Attic pull-down ladders, also called attic pull-down stairways, are collapsible ladders that are permanently attached to the attic floor. Occupants can use these ladders to access their attics without being required to carry a portable ladder.

**Common Defects**

Homeowners, not professional carpenters, usually install attic pull-down ladders. Evidence of this distinction can be observed in consistently shoddy and dangerous work that rarely meets safety standards.

Some of the more common defective conditions include:

- Cut bottom cord of the structural truss. Often, homeowners will cut through a structural member in the field while installing a pull-down ladder, unknowingly weakening the structure.

Structural members should not be modified without an engineer's approval.

- Fastened with improper nails or screws. Homeowners often use drywall or deck screws rather than the standard 16d penny nails or ¼ x 3-inch lag screws. Nails and screws that are intended for other purposes may have reduced shear strength and they may not support pull-down ladders.
- Fastened with an insufficient number of nails or screws. Manufacturers provide a certain number of nails with instructions that they all be used, and they probably do this for a good reason.
- Lack of insulation. Hatches in many houses (especially older ones) are not likely to be weather-stripped and/or insulated. An uninsulated attic hatch allows air from the attic to flow freely into the home, which may cause the heating or cooling system to run overtime. An attic hatch cover box can be installed to increase energy savings.
- Loose mounting bolts. This condition is more often caused by age rather than installation, although improper installation will hasten the loosening process.
- Attic pull-down ladders are cut too short. Stairs should reach the floor.
- Attic pull-down ladders are cut too long. This causes pressure at the folding hinge, which can cause breakage.
- Improper or missing fasteners.
- Compromised fire barrier when installed in the garage.
- Attic ladder frame is not properly secured to the ceiling opening.
- Closed ladder is covered with debris, such as blown insulation or roofing material shed during roof work.
- Cracked steps. This defect is a problem with wooden ladders.
- In sliding pull-down ladders, there is a potential for the ladder to slide down quickly without notice. Always pull the ladder down slowly and cautiously.

**Relevant Codes**

The 2009 edition of the International Building Code (IBC) and the 2006 edition of the International Residential Code (IRC) offer guidelines regarding attic access, although not specifically pull-down ladders. Still, the information might be of some interest to homeowners.

2009 IBC (Commercial Construction):

1209.2 Attic Spaces. An opening not less than 20 inches by 30 inches shall be provided to any attic area having a clear height of over 30 inches. A 30-inch minimum clear headroom in the attic space shall be provided at or above the access opening.

2006 IRC (Residential Construction):

R807.1 Attic Access. Buildings with combustible ceiling or roof construction shall have an attic access opening to attic areas that exceed 30 square feet and have a vertical height of 30 inches or more. The rough-framed opening shall not be less than 22 inches by 30 inches, and shall be located in a hallway or readily accessible location. A 30-inch minimum unobstructed headroom in the attic space shall be provided at some point above the access opening.

**Tips for Homeowners:**

- Do not allow children to enter the attic through an attic access. The lanyard attached to the attic stairs should be short enough that children cannot reach it. Parents can also lock the attic ladder so that a key or combination is required to access it.
- If possible, avoid carrying large loads into the attic. While properly installed stairways may safely support an adult man, they may fail if he is carrying heavy items. These trips can be split up to reduce the weight load.
- Replace an old, rickety wooden ladder with a new one. Newer aluminum models are often lightweight, sturdy, and easy to install.

In summary, attic pull-down ladders are prone to a number of defects, most of which are due to improper installation.

## Stairways

Due to their inherent dangers, stairways and unsafe patterns of use are the cause of a surprising number of injuries. A careful assessment of the risks posed by stairways can prevent unnecessary injuries.

**Facts and Figures**

- More than 1,600 people died from falls on steps and stairs in the United States in 2004. This figure is greater than the combined number of swimming pool and bathtub drownings for the same year, according to the National Safety Council. The actual number of stairway accidents is probably much higher, as many people who sustain injuries don't know why they fell, and others are too embarrassed to admit they fell, so these incidents go unreported.
- Elderly occupants are at particular risk of falling down stairs, mostly due to impaired vision, reduced strength, and poor balance. For individuals age 65 and older, 260,000 are injured every year in falls on steps, stairs and escalators, according to the Centers for Disease Control.
- Handicapped and young children are also at increased risk of sustaining stairway injuries.
- In a study by Loughborough University in England, one-third of surveyed households admitted to leaving objects on stairs, presenting a serious trip hazard.
- In addition to potential physical injury, falls can cause serious psychological and social consequences, affecting confidence, mobility, and general well-being, according to the same study.

While residents may already be aware of stair abnormalities in their own home, their guests may not be prepared for irregular steps or inadequate headroom height, for instance. If you sell your home, prospective home buyers are better off hearing about such irregularities from you than learning through experience after they purchase your home.

The following is a partial list of defects you may find in stairways:

- A handrail is loose, incomplete, missing, splintery, not of a contrasting color with its background, or has insufficient finger clearance. As deck stairways may be open on both sides, missing handrails there put occupants at serious risk.
- Treads are cracked, uneven, worn, loose, or poorly supported.
- Risers are of uneven height.
- Lighting is poor, shadows are numerous, or the corridor leading to the stairs is dark. It's helpful to have a light switch installed at the top and bottom of each staircase.
- The floor is waxed, increasing the chances of slipping.
- Exterior steps are not sloped to prevent water settlement and icing.
- The stair carpeting slides because it is not firmly affixed to the stairs. Double-sided tape or tacks may be used to prevent slipping.
- Balusters are spaced more than 4 inches apart, allowing a child to potentially slip through and get trapped.
- The stairs are not ergonomically designed.
- The stairs are too steep.
- The platform or landing surface is not slip-resistant, and/or it has a sharp object, blunt wall, or window located in the direction of a possible fall.
- The nosing is missing, broken, worn, patched, loose, slippery, or not installed properly.
- Sharp corners are on stair elements.
- Headroom is insufficient.
- There is no safety gate at the top of the stairway in a home with small children.

Note that some design defects would be difficult or cost-prohibitive to remedy, so this would require rebuilding of the stairs.

Tips to reduce the chance of stairway falls include:

- Start a regular exercise program, if you haven't already. Inactivity leads to weakness, inflexibility, and an increased risk of falling.
- Remove trip hazards, such as clothes, shoes, toys and/or books from stairs and other places where you walk.
- Improve the lighting around the stairs. As you age, you'll need brighter lights to see well. Lampshades or frosted bulbs will reduce glare.
- Senior citizens should wear shoes that provide good support and have thin, non-slip soles. Avoid lightweight slippers or shoes with deep treads, as they can reduce your feeling of control.
- Do not carry heavy items up and down stairs, especially if the item blocks your view of the steps. Also, always hold onto the handrail.
- Install a second handrail for additional support. A second handrail will also provide support for two individuals as they pass each other.

In summary, stairways can pose a serious safety risk, but these risks can be minimized by adequate stair construction and safe practices.

## Deck Safety

Even decks that appear to be professionally constructed can have defects that could cause their collapse. These defects are so difficult for the average homeowner to recognize that the Master Inspector Certification Board recommends that all decks be inspected by a Certified Master Inspector®.

More than 2 million decks are built and replaced each year in North America. Of the 45 million existing decks, only 40% are completely safe.

Because decks appear to be simple to build, many people do not realize that decks are, in fact, structures that need to be designed to adequately resist certain stresses. Like any other house or building, a deck must be designed to support the weight of people, snow loads, and objects. A deck must be able to resist lateral and uplift loads that can act on the deck as a result of wind or seismic activity. Deck stairs must be safe, and handrails graspable. And, finally, deck rails should be safe for children by having proper infill spacing.

A deck failure is any failure of a deck that could lead to injury, including rail failure, or total deck collapse. There is no international system that tracks deck failures, and each is treated as an isolated event, rather than a systemic problem. Very few municipalities perform investigations into the cause of the failure, and the media are generally more concerned with injuries rather than the causes of deck collapses. Rail failure occurs much more frequently than total deck collapses; however, because rail failures are less dramatic than total collapses and normally don't result in death, injuries from rail failures are rarely reported.

Here are some interesting facts about deck failure:

- More decks collapse in the summer than during the rest of the seasons combined.
- Almost every deck collapse occurred while the decks were occupied or under a heavy snow load.
- There is no correlation between deck failure and whether the deck was built with or without a building permit.
- There is no correlation between deck failure and whether the deck was built by a homeowner or a professional contractor.
- There is a slight correlation between deck failure and the age of the deck.

- About 90% of deck collapses occurred as a result of the separation of the house and the deck ledger board, allowing the deck to swing away from the house. It is very rare for deck floor joists to break mid-span.
- Many more injuries are the result of rail failure, rather than complete deck collapse.
- Deck stairs are notorious for lacking graspable handrails.
- Many do-it-yourself homeowners, and even contractors, don't believe that rail infill spacing codes apply to decks.

Significant safety hazards are caused by both DIY and commercially built decks that:

- lack adequate attachment to the house, both in terms of the deck's structure and the use of improper fasteners;
- are cantilevered in style without the proper support to prevent weakening and collapse;
- are built too high off the ground for their supporting members;
- are not anchored properly at the base with proper footings and piers;
- lack proper bracing at their underside;
- are built on loose or uneven ground;
- have deck planks installed without adequate spacing to allow for drainage of rainwater;
- have deck planks installed without staggering for adequate load support;
- lack proper rail height and width;
- have baluster infill spacing that is too wide;
- lack graspable handrails at the stairs;
- lack a GFCI-protected and covered electrical receptacle especially for use at the exterior;
- lack adequate exterior lighting at the deck and/or stairs;
- may have its supporting members subject to excessive moisture, such as by a lawn sprinkler system;
- may have been built with reclaimed wood that is too weathered, dried out, splintered and/or cracked to be safe to support the weight of people;
- may be built over an emergency egress window at the home's basement or lower level; and/or
- may be built over a septic system or underground storage tank.

These are just some of the hazards that make a deck that is unsafe to use.

Are you planning on entertaining on your deck? Have your Certified Master Inspector® inspect it first. Visit www.CertifiedMasterInspector.org to find a CMI in your area.

# Swimming Pool Safety

## Home Pools

Swimming pools should always be happy places. Unfortunately, each year thousands of American families confront swimming pool tragedies, drownings, and near-drownings of young children. At the Master Inspector Certification Board, we want to prevent these tragedies. These are guidelines for pool barriers that can help prevent most submersion incidents involving young children. These guidelines are not intended as the sole method to minimize pool drowning of young children, but include helpful safety tips for safer pools.

Each year, hundreds of young children die and thousands come close to death due to submersion in residential swimming pools. The Consumer Product Safety Commission (CPSC) has estimated that each year, about 300 children under the age of 5 drown in swimming pools. Hospital emergency-room treatment is required for more than 2,000 children under 5 who were submerged in residential pools. The CPSC did an extensive study of swimming pool accidents, both fatal drownings and near-fatal submersions, in California, Arizona and Florida -- states in which home swimming pools are very popular and used during much of the year.

Here are some of the study's findings:

- In California, Arizona and Florida, drowning was the leading cause of accidental death in and around the home for children under the age of 5.
- Seventy-five percent of the children involved in swimming pool submersion or drowning accidents were between 1 and 3 years old.
- Boys between 1 and 3 were the most likely victims of fatal drownings and near-fatal submersions in residential swimming pools.
- Most of the victims were in the presence of one or both parents when the swimming pool accident occurred.
- Nearly half of the child victims were last seen in the house before the pool accident occurred. In addition, 23% of the accident victims were last seen on the porch or patio, or in the yard.
- This means that 69% of the children who became victims in swimming pool accidents were not expected to be in or at the pool, but were found drowned or submerged in the water.
- Sixty-five percent of the accidents occurred in a pool owned by the victim's immediate family, and 33% of the accidents occurred in pools owned by relatives or friends.
- Fewer than 2% of the pool accidents were the result of children trespassing on property where they didn't live or belong.
- Seventy-seven percent of the swimming pool accident victims had been missing for five minutes or less when they were found in the pool, drowned or submerged.

The speed with which swimming pool drownings and submersions can occur is a special concern: by the time a child's absence is noted, the child may have drowned. Anyone who has cared for a toddler knows how fast young children can move. Toddlers are inquisitive and impulsive and lack a realistic sense of danger. These behaviors, coupled with a child's ability to move quickly and unpredictably, make swimming pools particularly hazardous for households with young children.

Swimming pool drownings of young children have another particularly insidious feature: these are silent deaths. It is unlikely that splashing or screaming will occur to alert a parent or caregiver that a child is in trouble. The best way to reduce child drownings in residential pools is for pool owners to construct and maintain barriers that prevent young children from gaining access to pools. However, there are no substitutes for diligent supervision.

**Why the Swimming Pool Guidelines Were Developed**

A young child can get over a pool barrier if the barrier is too low, or if the barrier has handholds or footholds for a child to use for climbing. The guidelines recommend that the top of a pool barrier be at least 48 inches above grade, measured on the side of the barrier that faces away from the swimming pool. Eliminating handholds and footholds, and minimizing the size of openings in a barrier's construction, can prevent inquisitive children from climbing pool barriers.

For a solid barrier, no indentations or protrusions should be present, other than normal construction tolerances and masonry joints. For a barrier (fence) made up of horizontal and vertical members, if the distance between the tops of the horizontal members is less than 45 inches, the horizontal members should be on the swimming pool-side of the fence. The spacing of the vertical members should not exceed 1-3/4 inches. This size is based on the foot-width of a young child, and is intended to reduce the potential for a child to gain a foothold. If there are any decorative cutouts in the fence, the space within the cutouts should not exceed 1-3/4 inches.

The definition of a pool includes spas and hot tubs. The swimming pool-barrier guidelines, therefore, apply to these structures, as well as to conventional swimming pools.

**How to Prevent a Child from Getting Over a Pool Barrier**

A successful pool barrier prevents a child from getting over, under or through, and keeps the child from gaining access to the pool except when supervising adults are present.

**The Swimming Pool-Barrier Guidelines**

If the distance between the tops of the horizontal members is more than 45 inches, the horizontal members can be on the side of the fence facing away from the pool. The spacing between vertical members should not exceed 4 inches. This size is based on the head-breadth and chest-depth of a young child, and is intended to prevent a child from passing through an opening. Again, if there are any decorative cutouts in the fence, the space within the cutouts should not exceed 1-3/4 inches.

For a chain-link fence, the mesh size should not exceed 1-1/4 inches square, unless slats fastened at the top or bottom of the fence are used to reduce the mesh openings to no more than 1-3/4 inches.

For a fence made up of diagonal members (lattice work), the maximum opening in the lattice should not exceed 1-3/4 inches.

Above-ground pools should have barriers. The pool structure itself can sometimes serves as a barrier, or a barrier can be mounted on top of the pool structure. Then, there are two possible ways to prevent young children from climbing up into an above-ground pool. The steps or ladder can be designed to be secured, locked or removed to prevent access, or the steps or ladder can be surrounded by a barrier, such as those described above. For any pool barrier, the maximum clearance at the bottom of the barrier should not exceed 4 inches above grade, when the measurement is done on the side of the barrier facing away from the pool.

If an above-ground pool has a barrier on the top of the pool, the maximum vertical clearance between the top of the pool and the bottom of the barrier should not exceed 4 inches. Preventing a child from getting through a pool barrier can be done by restricting the sizes of openings in a barrier, and by using self-closing and self-latching gates.

To prevent a young child from getting through a fence or other barrier, all openings should be small enough so that a 4-inch diameter sphere cannot pass through. This size is based on the head-breadth and chest-depth of a young child.

**Gates**

There are two kinds of gates that may be found at a residential property. Both can play a part in the design of a swimming pool barrier.

Pedestrian gates are the gates people walk through. Swimming pool barriers should be equipped with a gate or gates that restrict access to the pool. A locking device should be included in the gate's design. Gates should open out from the pool and should be self-closing and self-latching. If a gate is properly designed, even if the gate is not completely latched, a young child pushing on the gate in order to enter the pool area will at least close the gate and may actually engage the latch. When the release mechanism of the self-latching device is less than 54 inches from the bottom of the gate, the release mechanism for the gate should be at least 3 inches below the top of the gate on the side facing the pool. Placing the release mechanism at this height prevents a young child from reaching over the top of the gate and releasing the latch. Also, the gate and barrier should have no opening greater than 1/2-inch within 18 inches of the latch’s release mechanism. This prevents a young child from reaching through the gate and releasing the latch.

Other gates should be equipped with self-latching devices. The self-latching devices should be installed as described for pedestrian gates.

**How to Prevent a Child from Getting Under or Through a Pool Barrier**

Many homes with pools have doors that open directly onto the pool area or onto a patio that leads to the pool. In such cases, the wall of the house is an important part of the pool barrier, and passage through any doors in the house wall should be controlled by security measures. The importance of controlling a young child's movements from the house to the pool is demonstrated by the statistics obtained during the CPSC's study of pool incidents in California, Arizona and Florida. Almost half (46%) of the children who became victims of pool accidents were last seen in the house just before they were found in the pool.

All doors that permit access to a swimming pool should be equipped with an audible alarm that sounds when the door and/or screen are opened. The alarm should sound for 30 seconds or more within seven seconds after the door is opened. It should also be loud (at least 85 decibels) when measured 10 feet away from the alarm mechanism. The alarm sound should be distinct from other sounds in the house, such as the telephone, doorbell and smoke alarm. The alarm should have an automatic re-set feature. Because adults will want to pass through house doors in the pool barrier without setting off the alarm, the alarm should have a switch that allows them to temporarily de-activate the alarm for up to 15 seconds. The de-activation switch could be a touch pad (keypad) or a manual switch, and should be located at least 54 inches above the threshold of the door protected by the alarm. This height was selected based on the reaching ability of young children.

Power safety covers can be installed on pools to serve as security barriers. Power safety covers should conform to the specifications in ASTM F 1346-91. This standard specifies safety performance requirements for pool covers to protect young children from drowning. Self-closing doors with self-latching devices could also be used to safeguard doors that permit ready access to a swimming pool.

**Indoor Pools**

When a pool is located completely within a house, the walls that surround the pool should be equipped to serve as pool safety barriers. The measures recommended above where a house wall serves as part of a safety barrier also apply for all the walls surrounding an indoor pool.

**Guidelines**

An outdoor swimming pool, including an in-ground, above-ground, or on-ground pool, hot tub, or spa, should be provided with a barrier that complies with the following:

1. The top of the barrier should be at least 48 inches above grade, measured on the side of the barrier that faces away from the swimming pool. The maximum vertical clearance between grade and the bottom of the barrier should be 4 inches measured on the side of the barrier that faces away from the swimming pool. Where the top of the pool structure is above grade, such as an above-ground pool, the barrier may be at ground level, such as the pool structure, or mounted on top of the pool structure. Where the barrier is mounted on top of the pool structure, the maximum vertical clearance between the top of the pool structure and the bottom of the barrier should be 4 inches.

2. Openings in the barrier should not allow the passage of a 4-inch diameter sphere.

3. Solid barriers, which do not have openings, such as a masonry and stone wall, should not contain indentations or protrusions, except for normal construction tolerances and tooled masonry joints.

4. Where the barrier is composed of horizontal and vertical members, and the distance between the tops of the horizontal members is less than 45 inches, the horizontal members should be located on the swimming pool-side of the fence.

Spacing between vertical members should not exceed 1-3/4 inches in width. Where there are decorative cutouts, spacing within the cutouts should not exceed 1-3/4 inches in width.

5. Where the barrier is composed of horizontal and vertical members, and the distance between the tops of the horizontal members is 45 inches or more, spacing between vertical members should not exceed 4 inches. Where there are decorative cutouts, spacing within the cutouts should not exceed 1-3/4 inches in width.

6. The maximum mesh size for chain-link fences should not exceed 1-3/4 inch square, unless the fence is provided with slats fastened at the top or the bottom, which reduce the openings to no more than 1-3/4 inches.

7. Where the barrier is composed of diagonal members, such as a lattice fence, the maximum opening formed by the diagonal members should be no more than 1-3/4 inches.

8. Access gates to the pool should be equipped to accommodate a locking device. Pedestrian access gates should open outward, away from the pool, and should be self-closing and have a self-latching device. Gates other than pedestrian access gates should have a self-latching device, where the release mechanism of the self-latching device is located less than 54 inches from the bottom of the gate.

- The release mechanism should be located on the pool-side of the gate at least 3 inches below the top of the gate.
- The gate and barrier should have no opening greater than 1/2-inch within 18 inches of the release mechanism.

9. Where a wall of a dwelling serves as part of the barrier, one of the following should apply:

- All doors with direct access to the pool through that wall should be equipped with an alarm that produces an audible warning when the door and its screen, if present, are opened. The alarm should sound continuously for a minimum of 30 seconds within seven seconds after the door is opened. The alarm should have a minimum sound pressure rating of 85 dBA at 10 feet, and the sound of the alarm should be distinctive from other household sounds, such as smoke alarms, telephones and doorbells. The alarm should automatically re-set under all conditions. The alarm should be equipped with manual means, such as touchpads or switches, to temporarily de-activate the alarm for a single opening of the door from either direction. Such de-activation should last for no more than 15 seconds. The de-activation touch pads or switches should be located at least 54 inches above the threshold of the door.
- The pool should be equipped with a power safety cover that complies with ASTM F1346-91.
- Other means of protection, such as self-closing doors with self-latching devices, are acceptable, as long as the degree of protection afforded is not less than the protection afforded by the guidelines above.

10. Where an above-ground pool structure is used as a barrier, or where the barrier is mounted on top of the pool structure, and the means of access is a ladder or steps, then:

- The ladder to the pool or steps should be capable of being secured, locked or removed to prevent access.
- The ladder or steps should be surrounded by a barrier. When the ladder or steps are secured, locked, or removed, any opening created should not allow the passage of a 4-inch diameter sphere.

These guidelines are intended to provide a means of protection against potential drownings of children under 5 years of age by restricting access to residential swimming pools, spas and hot tubs.

## Swimming Pool Barriers

An outdoor swimming pool barrier is a physical obstacle that surrounds an outdoor pool so that pool access is limited to adults. "Pool," in this context, includes outdoor hot tubs and spas. This barrier is often referred to as pool fencing, although walls made from brick or stone are acceptable, as well. Children should not be able to get under, over or through the barrier.

**Why are pool barriers important?**

According to the U.S. Consumer Product Safety Commission (CPSC), approximately 250 children drown every year in residential swimming pools. In states where swimming pools are open year-round, such as Florida, Arizona and California, drowning is the leading cause of death in and around the home for children under 5 years old. Many of these deaths result when young children gain unsupervised access to swimming pools due to inadequate pool fencing.

Codes concerning pool barriers vary by jurisdiction. Some states, such as Arizona, Florida and California, have compiled their own laws concerning pool barriers, while other locations rely on the International Residential Code (IRC). The CPSC has thoroughly researched pool-related hazards and has compiled its own set of codes for pool fencing. The Australian government, too, has placed tremendous emphasis on the development of pool barrier codes in an attempt to reduce the number of deaths due to drowning in that country. The code below is taken mostly from the 2006 edition of the IRC and is substantially similar to the other codes previously mentioned. A few helpful parts of the Australian code are also listed.

**2006 International Building Code Pool Barrier Requirements:**

AG105.2. Outdoor swimming pool. An outdoor swimming pool, including an in-ground, above-ground or on-ground pool, hot tub or spa, shall be surrounded by a barrier which shall comply with the following:

1. The top of the barrier shall be at least 48 inches above grade measured on the side of the barrier which faces away from the swimming pool. The maximum vertical clearance between grade and the bottom of the barrier shall be 2 inches measured on the side of the barrier which faces away from the swimming pool. Where the top of the pool structure is above grade, such as an above-ground pool, the barrier may be at ground level, such as the pool structure, or mounted on top of the pool structure. Where the barrier is mounted on top of the pool structure, the maximum vertical clearance between the top of the pool structure and the bottom of the barrier shall be 4 inches.

2. Openings in the barrier shall not allow passage of a 4-inch-diameter sphere.

3. Solid barriers which do not have openings, such as a masonry or stone wall, shall not contain indentations or protrusions, except for normal construction tolerances and tooled masonry joints.

4. Where the barrier is composed of horizontal and vertical members and the distance between the tops of the horizontal members is less than 45 inches, the horizontal members shall be located on the swimming pool side of the fence. Spacing between vertical members shall not exceed 1-3/4 inches in width. Where there are decorative cutouts within vertical members, spacing within the cutouts shall not exceed 1-3/4 inches in width.

5. Where the barrier is composed of horizontal and vertical members and the distance between the tops of the horizontal members is 45 inches or more, spacing between vertical members shall not exceed 4 inches. Where there are decorative cutouts within vertical members, spacing within the cutouts shall not exceed 1-3/4 inches in width.

6. Maximum mesh size for chain link fences shall be a 2-1/4 inches square unless the fence has slats fastened at the top or the bottom which reduce the openings to not more than 1-1/4 inches.

7. Where the barrier is composed of diagonal members, such as a lattice fence, the maximum opening formed by the diagonal members shall not be more than 1-3/4 inches.

8. Access gates shall comply with the requirements of Section AG105.2, Items 1 through 7, and shall be equipped to accommodate a locking device. Pedestrian access gates shall open outward, away from the pool, and shall be self-closing and have a self-latching device. Gates other than pedestrian access gates shall have a self-latching device. Where the release mechanism of the self-latching device is located less than 54 inches from the bottom of the gate, the release mechanism and openings shall comply with the following:

8.1 The release mechanism shall be located on the pool-side of the gate at least 3 inches below the top of the gate; and
8.2 The gate and barrier shall have no opening larger than 1/2-inch (13 mm) within 18 inches of the release mechanism.

9. Where a wall of a dwelling serves as part of the barrier, one of the following conditions shall be met:

9.1. The pool shall be equipped with a powered safety cover in compliance with ASTM F 1346; or
9.2. Doors with direct access to the pool through that wall shall be equipped with an alarm which produces an audible warning when the door and/or its screen, if present, are opened. The alarm shall be listed in accordance with UL 2017. The audible alarm shall activate within seven seconds and sound continuously for a minimum of 30 seconds after the door and/or its screen, if present, are opened and be capable of being heard throughout the house during normal household activities. The alarm shall automatically re-set under all conditions. The alarm system shall be equipped with a manual means, such as touch pad or switch, to temporarily de-activate the alarm for a single opening. De-activation shall last for not more than 15 seconds. The de-activation switch(es) shall be located at least 54 inches above the threshold of the door; or

9.3. Other means of protection, such as self-closing doors with self-latching devices, which are approved by the governing body, shall be acceptable, so long as the degree of protection afforded is not less than the protection afforded by Item 9.1 or 9.2 described above.

10. Where an above-ground pool structure is used as a barrier, or where the barrier is mounted on top of the pool structure, and the means of access is a ladder or steps:

10.1. The ladder or steps shall be capable of being secured, locked or removed to prevent access; or
10.2. The ladder or steps shall be surrounded by a barrier which meets the requirements of Section AG105.2, Items 1 through 9. When the ladder or steps are secured, locked or removed, any opening created shall not allow the passage of a 4-inch-diameter sphere.

AG105.3 Indoor swimming pool. Walls surrounding an indoor swimming pool shall comply with Section AG105.2, Item 9.

AG105.4 Prohibited locations. Barriers shall be located to prohibit permanent structures, equipment or similar objects from being used to climb them.

AG105.5 Barrier exceptions. Spas or hot tubs with a safety cover, which complies with ASTM F 1346, as listed in Section AG107, shall be exempt from the provisions of this appendix.

The 1994 edition of Australia's Building Code offers the following suggestions concerning fence gaps:

> If a fence has gaps, they should be of such a size that a young child is prevented from slipping through, but the gaps also need to have dimensions such that any part of a young child's body cannot be trapped.

Currently, the IRC makes no mention of regulations for "danger" or CPR signs that should be attached on pool barriers. The Australian Building Code offers the following concerning CPR signs:

> The CPR sign needs to be durable, and placed in a conspicuous place near the pool. It must detail the procedures necessary to undertake cardiopulmonary resuscitation.

In summary, homeowners should try to spot and correct defects in pool fencing.

## Pool Alarms

A pool alarm is a safety feature designed to alert adults when unsupervised children enter a pool. There are many different designs available, but none is foolproof. Pool owners should become acquainted with these innovations, the main types available, and the potential dangers of doing without.

Drowning remains the second leading killer of children under the age of 14 and, in many Sunbelt states, drowning tops the list.

Approximately 350 children under the age of 5 drown in swimming pools annually, mostly in residential settings. Many of these deaths occur when unsupervised children enter a pool and are unable to swim or exit, resulting in drowning or near-drowning within minutes. In these situations, pool alarms may have reduced the response time of adults, perhaps saving the child.

In December 2007, the Virginia Graeme Baker Pool and Spa Safety Act took effect, which created a voluntary grant program that encourages states to pass legislation for pool and spa safety. The bill requires states to write laws that call for pool alarms, as well as door alarms, pool covers, and self-closing/self-latching gates. Currently, however, only California, Connecticut and New York have passed such legislation.

**Pool Alarm Types**

- Surface wave sensor: This type of sensor floats on the water and incorporates an electrical circuit that includes two contacts. One of these contacts rests in the water, while the other is adjusted to remain above the water's surface. When a surface wave touches the above-surface contact, the electrical circuit is completed, causing an alarm to sound. Sensitivity can be increased or decreased by moving the above-surface contact closer to or further away from the water's surface.
- Sub-surface disturbance sensor: Mounted to the pool wall below the water's surface, this type of sensor is activated by wave-induced pressure changes. One design relies on the movement of a magnetic float below a magnetic sensor, while another design relies on a pressure-sensitive switch. Sub-surface alarms can also be used in conjunction with solar covers, whereas the surface wave-sensor alarms cannot.
- Wristband: This device is worn around the child's wrist and it cannot be removed without a key. The alarm will activate when the wristband becomes wet, which creates opportunities for false alarms, such as when the child washes his or her hands, or walks in the rain.

In 2000, the U.S. Consumer Product Safety Commission (CPSC) staff conducted a review of commercially available swimming pool alarm systems designed to detect water disturbance or displacement. The CPSC staff evaluated surface wave sensors, sub-surface disturbance testers, and the wristband. The testers concluded that the sub-surface pool alarms generally performed more consistently for true alarms than the other designs, which were more likely to emit false alarms.

Since pool alarms are not foolproof and they rely on someone remembering to activate them, they should not be depended upon as a substitute for supervision, or for a barrier completely surrounding the pool. Pool alarms should also be used in conjunction with other types of alarms, such as gate alarms, perimeter alarms, and window and door alarms. Even some pet doors come equipped with alarms, owing to the recent attention given to the 100 or so documented accidents when a child escaped to a pool through a pet door. Pool alarms are thus one protective layer of many, none of which is sufficient as a sole preventative measure against child drowning.

Pool alarms can be used to save dogs and cats, too. Data show that one out of every 1,027 pets drown in pools each year, which is a statistically higher risk than the drowning threat for small children. The

reason here is obvious:  pets are more likely to be allowed to roam free and unsupervised compared to small children, especially in rural areas where nearby traffic is not a danger. Also, pool fences may thwart children, while dogs and cats can jump or climb their way to the other side.
Not all dogs are good swimmers, though, and even healthy dogs that are used to swimming in ponds might not be able to lift themselves out of a pool when they're tired.

In summary, pool alarms are useful safety features to be used strictly in conjunction with other strategies.

## Pool Drain Hazards

While drowning is a well-publicized danger associated with swimming pools, comparatively little has been reported about injuries and deaths caused by pool drains. Water rushing out of the drain creates a suction that can ensnare swimmers, usually small children, causing debilitating injuries and death. These drains come standard in swimming pools, hot tubs and wading pools, and while they appear harmless, parents should understand the potential dangers they pose.

Drain covers can break or be removed by people who are unaware of the possible repercussions. When this happens, a swimmer playing with the drain may become stuck to it in a way similar to how a vacuum will stick to the palm of the hand, but with much more force; 350 pounds of pressure is normal for a pool drain, and public pools are even more powerful. This "suction entrapment" can hold the bather in the drain's grasp until the person drowns or escapes, often seriously injured.

In July of 2007, a 6-year-old Minnesota girl was hospitalized after being severely injured when she sat over an open drain in a wading pool. The suction from the drain, which did not have a cover, pulled out her small intestine, requiring her to be fed intravenously. She died months later, joining the 36 other people, mostly children, who are known to have been killed in similar accidents since 1990. The actual numbers are likely much higher, as physicians often do not distinguish drowning caused by drainage suction from ordinary drowning.

The Consumer Product Safety Commission (CPSC) distinguishes between five types of drain entrapment:

1. body entrapment, where a section of the torso becomes entrapped. The CPSC is aware of 74 cases of body entrapment, including 13 confirmed deaths, between January 1990 and August 2004. The deaths were the result of drowning after the body was held against the drain by the suction of the circulation pump;
2. limb entrapment, where an arm or leg is pulled into an open drain pipe;
3. hair entrapment or entanglement, where a person's hair is pulled in and wrapped around the grate of the drain cover. The CPSC is aware of 43 incidents of hair entrapment or entanglement in pools, spas and hot tubs between January 1990 and August 2004. Twelve of the incidents resulted in drowning deaths;

4. mechanical entrapment, where jewelry or part of the swimmer's clothing gets caught in the drain or grate; and
5. evisceration, where the victim's buttocks come into contact with the pool suction outlet and he or she is disemboweled. While these accidents are rare, they result in lifelong impairment.

While laws regulating swimming pools are complex and vary by state, it is still helpful for homeowners to learn the following ways in which pool drains can be made safer:

- Make sure that a drain cover is present and firmly attached to the drain. If the drain cover is missing or damaged, no one should be allowed to enter the pool, and a professional should be contacted immediately. As of December 2008, the CPSC required anti-entrapment drain covers to be installed in all public pools.
- Make sure there is a safety snap fitting serving the ground pool cleaner. These devices automatically suck away dirt and leaves, but if they become disconnected from the suction fitting at the pool wall, a hazardous situation can develop. A safety snap fitting is a spring-loaded stopper that will end any suction through the port if any disconnection occurs.
- Check to see if there is a safety vacuum-release system. This device will cause the drainage to automatically cease if any entrapment occurs.
- Check for an anti-entanglement drain cover. This type of fitting is molded in a particular way so as to prevent hair entanglement.
- Use no drains at all. Gutters and overflows can be used to provide water to the pump without the need for a drain.
- Install an additional drain. According to the CPSC, "providing multiple outlets from the pool to the suction-side of the pump allows flow to continue to the pump, and reduces the likelihood of an entrapping suction from being generated when a body blocks one of the outlets."

In summary, accidents caused by pool drains are often gruesome, but they can be prevented when the appropriate pool safety devices are installed and children are adequately supervised.

### Pool Water Pathogens

Germs from other swimmers and unsafe water supplies can easily contaminate pool water, especially if it isn't properly disinfected. Contaminated recreational water can cause a variety of ailments and diseases, such as diarrhea, and skin, ear and upper respiratory infections, particularly if the swimmer's head is submerged. Homeowners should be familiar with the problems caused by contaminated pool and spa water and the ways to prevent them.

Viruses, bacteria and protozoa are the culprits in most swimming pool-related sickness outbreaks. The mucus, saliva, blood and skin of infected swimmers can directly contaminate pool and spa water with sufficient pathogens to cause infections in other swimmers who come in contact with it. Feces are a particular danger in pools, as the pathogens they contain are typically present in enormous numbers, approaching a million per gram of feces. A single fecal release in a pool could contaminate millions of gallons of water, according to the University of Arizona's College of Public Health. Large outbreaks of disease are uncommon and they don't typically happen in residential settings, but they should alert homeowners to just how contagious pathogens are when they're waterborne.

Consider the following such cases:

- In 1998 in Georgia, 26 people were sickened after swimming in a pool with a child who had *E. coli.* Seven people were hospitalized and one was killed by the outbreak. The pool's chlorine level had not been adequately maintained.
- In New Mexico in 2008, a competitive swimmer who ignored symptoms of diarrhea caused 92 swimmers, including other competitive swimmers, coaches and lifeguards, to contract the illness.
- In 2001 in an Illinois water park, 358 people contracted diarrhea, despite adequate chlorine and pH levels. Swimmers can add up to several pounds of feces per day in a typical water park.

Homeowners can benefit from learning about the basic pathogens that are commonly found in swimming pools:

- bacteria, such as *E. coli*, shigella (which causes dysentery), campylobacter, and salmonella. Bacteria are generally killed quickly by chlorine disinfectant in properly maintained swimming pools at a concentration of 1 part per million. *E. coli*, for instance, will be inactivated in less than one minute if exposed to typical disinfectant concentrations;
- protozoa, such as cryptosporidium (which causes diarrhea), and giardia, also known for its severe gastrointestinal effects. Some of these pathogens are highly resistant to chlorine and can survive for days in typical chlorine concentrations; and
- hepatitis A and noroviruses.

Pool disinfectants can kill most germs in less than an hour, but for others, it can take longer. Cryptosporidium, for instance, can survive for up to 10 days in a properly chlorinated pool, and other pathogens are completely resistant to chlorine. In addition, the unique circulation patterns found in pools may allow poor water circulation in some areas, making it unlikely that all pathogen activity can be fully prevented. The unfortunate truth is that chlorinated swimming pools can and do transmit disease. Swimmers should not rely solely on the pool's chemical treatments and should heed the following precautions:

- Don't ever swallow pool water. Children sometimes jokingly spit pool water back into the pool or at their friends, but this is dangerous, as some of it may be swallowed.
- Shower with soap and water before and after swimming.
- Wash your hands with soap and water after using a toilet or changing diapers.
- Remove small children from pools for bathroom breaks, and check infants' diapers often.
- Change diapers in a bathroom, not beside the pool.
- Wash children, especially their rear ends, thoroughly with soap and water before they enter a pool.
- Don't swim when you have diarrhea. Diarrhea can be transmitted in pool water weeks after symptoms cease.

In summary, pathogens can easily permeate an entire pool. Some are resistant to chlorination. Pool owners should know that chemical treatments for pools and spas are best supplemented with good hygiene.

## Saunas

A sauna is a small, sealed room, typically constructed of wood, designed to safely increase the user's body temperature through a combination of heat and well-controlled humidity. Saunas are used recreationally and therapeutically, as users find them relaxing and health-promoting.

**Facts and Figures**

- "Sauna" is the only Finnish word in the English dictionary. Traditionally, the Finns used the sauna as a place to clear the mind, give birth, and prepare the dead for burial. They were not used for weight loss or as part of an exercise regimen, which are newer concepts for their use today.
- Saunas can be divided into two basic styles:
    - infrared saunas directly warm occupants and other objects (much like the sun) using charcoal or other objects; and
    - conventional saunas heat the room indirectly by warming the air.
- One of the earliest sauna designs is the smoke sauna, in which stones warm the room after being heated by a fire, which is extinguished before the room is ready for bathers. The smoke is vented from the sauna, but its aroma lingers. The concept was nearly abandoned but has seen a revival over the past few decades.

**Safety Tips**

- Saunas stimulate the cardiovascular system and should not be used by anyone with high blood pressure, diabetes, heart disease, or while under the use of antibiotics or other drugs.
- Never stay in a sauna longer than 30 minutes. While it may be fun to see who can stay in the sauna the longest, this sort of game is extremely dangerous and has led to injury and even death. One experienced sauna devotee died in a sauna competition in August 2010.
- Never wear jewelry in the sauna, as the metal and stones may heat up and burn exposed skin.
- Use a towel as a barrier between yourself and the seat in a public commercial sauna to protect yourself against disease. Strains of antibiotic-resistant bacteria, known collectively as methicillin-resistant *Staphylococcus aureus*, have been shown to inhabit excessively humid and poorly cleaned public saunas and steam rooms. Reducing the humidity can also control the risk of transmission.
- Children should not use saunas because their immature bodies and metabolism have trouble thermo-regulating to stave off hyperthermia.

**Recommended Sauna Design Features**

Adequate ventilation is perhaps the most overlooked sauna design feature. Outgoing ventilation expels stale air and reduces humidity-spawned mildew and moisture, which can cause wood decay. Incoming ventilation brings in fresh air, ensuring the safety and comfort of the users. Saunas typically have a vent behind the stove and another on the opposite wall near the ceiling. While the sauna may vent to the outside of the building, this is not required in residential saunas, and many systems utilize interior ventilation to heat the adjacent living space.

Some other essential design features include the following:

- Freestanding saunas must have a solid foundation.
- Sauna doors should be sealed and insulated.
- The sauna door should swing outward and should not be equipped with a latching mechanism. If the user is in distress, he should be able to easily push his way out of the sauna.
- Saunas should be constructed from a decay-resistant species of tree, such as cypress, redwood, spruce, cedar, or Douglas fir.
- Any electrical wiring should be moisture-proof and able to resist high temperatures.
- Metal, especially screw heads, should not be exposed where people sit, lean or walk. Metal will get excessively hot and could burn exposed skin.
- The ceiling height should be between 6½ to 7½ feet, but not higher, as heat will uselessly pool above the user's head. Also, undue stress will be placed on the heater, which will be forced to work harder to heat the room.
- The temperature should not exceed 195° F, as recommended by the Underwriters Laboratories. Saunas heated by wood-burning stoves may be capable of exceeding this temperature, but this is not advisable, as it can endanger the users' safety. Saunas that utilize excessive amounts of steam should be set to a lower temperature, as wet heat can cause scalding.
- The floor can be made from concrete, vinyl or tile, but not carpet, which will deteriorate from the heat and humidity and create moisture-caused health hazards. Carpet is also a fire hazard.
- To best utilize the space and to achieve a balanced temperature throughout the sauna, the shape of the sauna room should be nearly square.
- The sauna should be regularly inspected for mildew and wood decay around its exterior.

In summary, saunas are sealed, heated rooms used for therapeutic purposes and relaxation, but they must be used and maintained properly to ensure the health and safety of their users.

## Home Security

### Burglar-Resistant Homes

There are a number of measures that homeowners can take to ensure that their homes are not attractive to burglars.

**Some interesting statistics concerning break-ins in the United States:**

- The Master Inspector Certification Board estimates that theft makes up more than three-quarters of all reported crime.
- In 2005, law enforcement agencies reported more than 2 million burglary offenses.

According to a survey, burglars tend to enter homes through the following locations:

- 81% enter through the first floor;
- 34% enter through the front door;
- 23% enter through a first-floor window;
- 22% enter through the back door;
- 9% enter through the garage;
- 4% enter through the basement;
- 4% enter through an unlocked entrance;
- 2% enter through a storage area; and
- 2% enter from somewhere on the second floor.

**Some interesting statistics (2002) concerning break-ins in Canada:**

- The burglary rate in Canada (877 per 100,000 people) is seven times higher than that of the country with the fewest break-ins, Norway.
- The burglary rate in Canada is slightly higher than that of the United States (746 per 100,000 people), but significantly less than the burglary rate in Australia (2,275 per 100,000 people).

**Exterior Doors**

- Doors should be made of steel or solid-core wood construction. Hollow-core wood doors are more easily broken than heavy, solid-core doors.
- Doors should be free of signs of rot, cracks and warping.
- Doors should be protected by quality deadbolt locks. Chain locks are not adequate substitutes for deadbolt locks, although chain locks may be used as additional protection.
- If a mail slot is present, it should be equipped with a cage or box. Mail slots that are not equipped with cages or boxes have been used by burglars to enter homes. Burglars can insert a contraption made of wire and cord into the mail slot and use it to open the lock from the inside, if no box or cage is present.
- If a door is equipped with glass panes, they should be installed far from the lock. Otherwise, burglars can smash the glass and reach through to unlock the door.
- Spare keys should not be hidden in obvious locations. Burglars are very good at finding keys that homeowners believe are cleverly hidden. The best place for a spare key is in the house of a trusted neighbor. If keys must be hidden near the door, they should not be placed in obvious locations, such as under a doormat, rock or planter.
- A peephole can be installed in doors so homeowners can see who is on their doorstep before they open the door.
- Homeowners should consider installing bump-resistant locks on their doors. “Bumping” is a technique that can open almost any standard lock with less effort than is required by lock-picking.

This technique uses "bump keys," which are standard house keys with slight modifications. Lock companies, including as Schlage®, Primus® and Medeco®, manufacture a number of locks that offer some bump-resistance.

**Pet Doors**

- Pet doors can be used by burglars to enter homes. Some burglars have reached through pet doors in order to unlock the door. It is advisable to not have a pet door, but if one is necessary, it should be as small as possible and installed far from the lock.
- A crafty burglar may convince or coerce a small child to crawl through a pet door and unlock the door. Also, some burglars *are* children.
- Electronic pet doors are available that open only when the pet, equipped with a signaling device in its collar, approaches the door. These doors are designed to keep stray animals out of the home, and may provide protection against burglars, as well.

**Sliding Glass Doors**

- They should be equipped with locks on their tops and bottoms.
- They should not be able to be lifted from their frames.
- A cut-off broom handle, or a similar device, can be laid into the door track to prevent it from being opened all the way.

**Illumination**

- Lights should be installed on the exterior of all four sides of the house. Burglars prefer darkness so they cannot be seen by neighbors or passersby.
- When building occupants are not home, a few lights should be left on inside.
- It is helpful to install exterior lights that are activated by motion sensors. Burglars that are suddenly illuminated may flee.

**Windows**

- All windows should be composed of strong glass, such as laminated glass, and be in good operating order.
- They can be installed with bars, grilles, grates, or heavy-duty wire screening. Barred windows must be equipped with a quick-release mechanism so occupants can quickly escape during a fire.
- Windows should not be hidden by landscaping or structures. If landscaping or structures cannot be moved, lighting can be installed around the windows.

**Landscaping and Yard**

- Shrubs and trees should not obscure the view of entrances. Shielded entrances can provide cover for burglars while they attempt to enter the residence.
- Fences are helpful burglar deterrents, although they should not be difficult to see through.

**While the house is vacant:**

- A loud radio can be used to make burglars think someone is home. Timers can be used to activate radios and lights to make the home seem occupied.
- A car should always be parked in the driveway. A neighbor's car can be parked there so that it appears as if someone is home.
- The lawn should be mowed regularly. Uncut grass is a clue that no one is home.

**Other Tips**

- Dogs are excellent burglar deterrents. For homeowners who cannot own dogs, they can place "Beware of Dog" signs around the yard for nearly the same effect.
- If no security system is installed, the homeowner can post security alarm stickers around the yard.

In summary, there are many tactics that homeowners can implement to help safeguard their homes from break-ins.

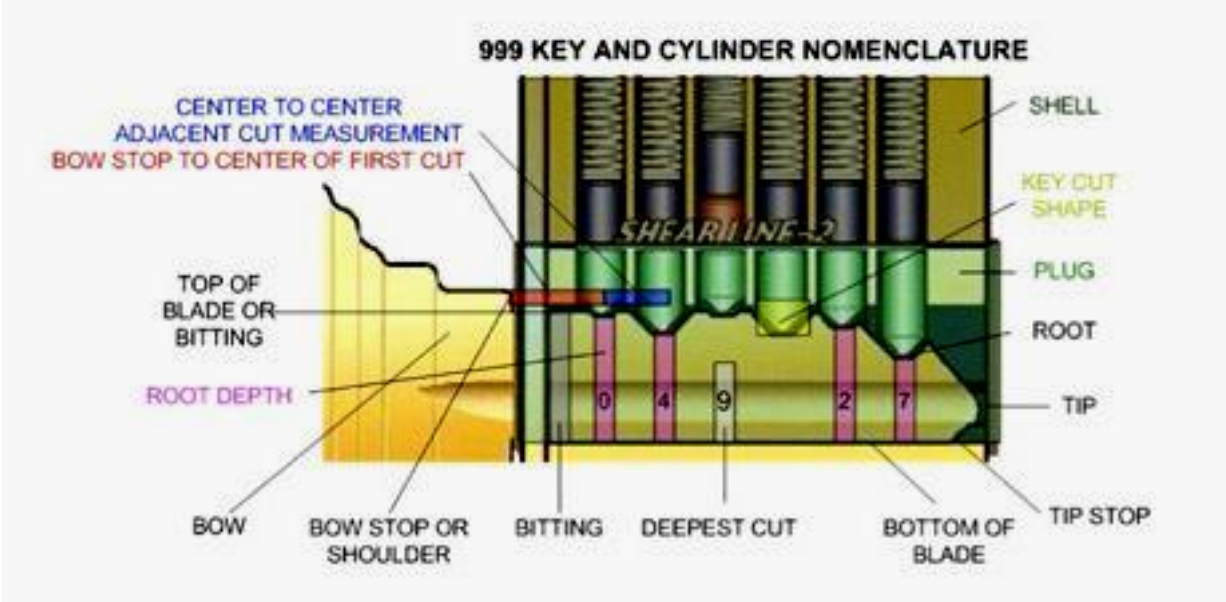
## Bump Keys

**What Is a Bump Key?**

Most people think a locked door affords them security, but to anyone who knows how to use a bump key, a door lock is just a minor inconvenience.

Bump keys are keys cut to a special design that will allow them to be used for picking pin-tumbler locks. Pin-tumbler locks are the world's most popular lock, and these include exterior door entry locks for homes. The process of gaining entry using a bump key is called "bumping," and it can be very effective.

All the cuts on a bump key are made to the maximum depth, so any key blank can be made into a bump key. Bump keys are manufacturer-specific. A Kwikset® lock requires a bump key made from a Kwikset® key. The same is true for other lock brands. So, a full set of bump keys would include one for each of the major lockset manufacturers.



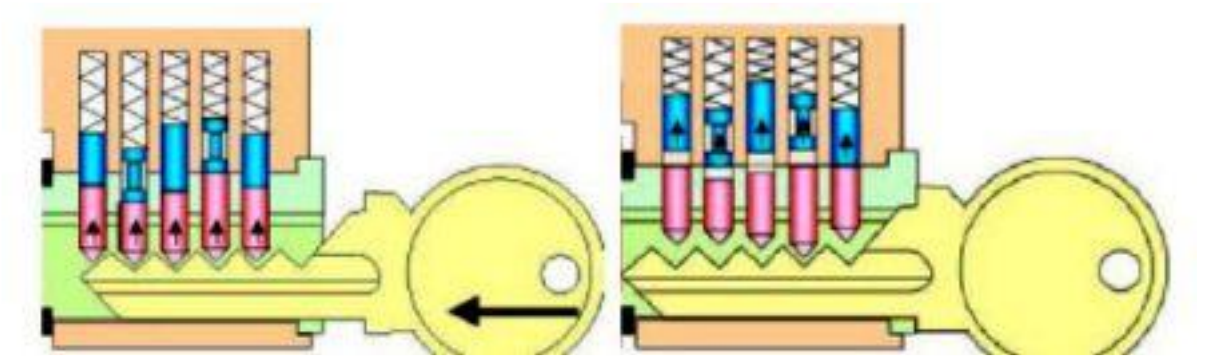

*Above: a pin-tumbler lock*

**How Do They Work?**

Keys operate by aligning tiny spring-loaded pins inside the lock. Once the pins are correctly aligned, the cylinder will turn and the lock can be operated.

To use a bump key, the "pull-back" method is common. With this method, the key is inserted all the way in, and then pulled back out one notch. While keeping rotational pressure on the key, it is then bumped into the keyway with the heel of the hand or with a device of some sort.

The "bumper" needs to bump the key hard enough to jar the pins, but not so much that the lock or key is damaged. Bumping the key causes the pins to jump slightly. Even this slight amount of motion is enough to allow the bump key to turn the cylinder, unlocking the lock.



The image above-left shows the condition just before the key is bumped. The image above-right is just after the key has been bumped. The driver pins (in blue) have bounced above the shear line, while the key pins (in red) are still below the shear line. As long as the shear line is unblocked, the cylinder can turn and the lock will open.

Another method for using a bump key, called "minimal movement," is slightly more sophisticated than the pull-back method. Bump-key performance can be improved by filing away an additional 0.25 to 0.5 mm from the key tip and shoulder, allowing the key to be inserted slightly farther into the lock.

**How Effective Are Bump Keys?**

The success of the bumper depends on practice.  Very little skill is required, and the learning curve is short. Success will also vary with the type of lock and quality of the key. Keys made from soft metal won't last long. Bumping tends to work better on more expensive locks, since the hard, high-quality parts work more smoothly.

Bump keys sometimes deform when they're hit, causing them to jam in the keyway. They can be difficult to remove.

**How Can I Tell if a Lock Has Been Bumped?**

You can sometimes spot a lock that has been opened with a bump key if you see a small indentation just above the keyway. Some older, softer locks will have dents even though they have not been bumped.

It's also possible to make bump keys that are protected from leaving indentations.  You may be able to tell that a lock has been bumped, but don't count on it.

*Above:  a typical bump key*

**Can I Buy a Bump Key?**

Owning or possessing a bump key is not currently illegal, and bump key sets, and videos on how to use them, are available online. To acquire a bump key, all that's needed is the identification of the manufacturer of the lock.

**How Can I Improve My Home's Security?**

At least two companies, Schlage® and Baldwin, make locksets designed to defeat bump keys. But many locks that use a key and the pin-tumbler system are vulnerable to bumping. No standards exist that demonstrate resistance to bumping. The resistance to bumping a deadbolt lockset varies with the manufacturer. Electronic locks that have a key override are also vulnerable.

Bump-proof locks are rare and expensive. Bump-resistant locks are much more common. Some (but not all) lockset manufacturers include bump-resistant features in their newer locks.

Without buying a new, bump-resistant lock, consumers have two options. Usually, for less than $20, a locksmith can replace the original lock pins with "mushroom" pins, sometimes called spool pins, depending on the manufacturer. While these pins will improve the resistance of the lock, they will not make it bump-proof.

Medeco® is a company that makes high-end locks. They can provide bump-proof lock cylinders for which a duplicate key is available only through Medeco®-authorized dealers. Their cylinders start at around $100, although their less-expensive cylinders may not be bump-proof.

**Will Insurance Cover Theft?**

If a home is burglarized using a bump key, the theft may or may not be covered by insurance, depending on how the policy is written. If proof of forced entry is required, the theft may not be covered. Be sure to consult your insurance agent with questions about this.

Although bump keys have been around for more than 50 years, their existence has become more widely-known with the advent of the Internet. Consumers should be aware of this potential danger to their home's security.

In summary, homeowners should make sure their door locks are sufficiently secure to prevent unauthorized entry by someone using a bump key. Taking extra safety precautions, such as installing an alarm system, can provide homeowners with enhanced protection of their property.

## The 10 Best Places to Hide Valuables in Your Home

Burglary is a crime of opportunity. And burglars don’t want to spend a lot of time looking through a home to find things of value to steal, which is why there are obvious locations that they always check. That means that there are ways to outsmart them by hiding your valuables in not-so-obvious places, and sometimes even in plain sight.

Depending on the size and type of item, the best places to hide valuables are those that burglars don’t want to search through or wouldn’t bother with, including places that are inconvenient or difficult to search, messy, or uninteresting.

**Here Are the Top 10:**

1. Hollowed-out books. Criminals tend to be uneducated, which is why they've turned to crime to make their living. They're practically allergic to books! But if you have only a couple of books on a bookshelf, this may be a clue that they're actually hiding places for your valuables, so make sure your library is large enough to serve as a tedious place to search.

2. A false VHS tape or VHS carton. Who watches VHS tapes anymore? Again, follow the rules above for books. A few can be a clue, but many can be a time-consuming distraction.

3. False containers in the kitchen cupboard, under the sink, and in the bathroom, such as fake food cans and boxes, false cleaning product bottles, and personal hygiene items, and even in a heavy tub of "cat litter." Some false containers available on the market today actually look like false containers, so you might want to save yourself the expense and create your own.

4. In the false bottom or under the plastic liner of a bathroom or kitchen trash can. No one wants to go pawing through your trash in the slim hope of finding something worth pawning.

5. Wrapped in plastic and aluminum foil and stored in the back of the freezer. This is also a good place to store documents and paper currency in case of a house fire.

6. In a floor safe in the bedroom closet. While this location may be obvious, a burglar would have to exert a lot of time and energy—and create a lot of noise—trying to break into a floor safe, which is also generally of the heavy variety, making it not only hard to open, but hard to steal whole, if the thief had plans to break into it later.

7. Inside a house plant. Using the same method as for trash containers, a plant's soil can be contained in a waterproof liner that can be lifted up to hide items underneath. Just make sure the items you're hiding are in a waterproof container, too.

8. Inside a false wall outlet. Make sure it's not a live receptacle or in the way of any electrical wiring.

9. Within hollowed-out/removable building components, such as wainscoting, floor panels, door jambs, window sills, and cabinet doors.

10. In the garage inside boxes marked with mundane labels, such as "Xmas Ornaments," "Kid's Clothes," "School Projects," etc. Again, the more boxes you have, the longer the burglar will have to search—if he's so inclined—to find something worth stealing.

**Hiding Places to Avoid:**

1. Areas that can damage your valuables with water or invasive matter, such as the water tank of a toilet, inside a mayonnaise jar that still has mayonnaise in it, or a paint can filled with paint. There are high-quality waterproof containers on the market that will allow you to hide items in water (and possibly other places), but err on the side of caution. Documents, jewelry and electronics that become wet or permeated with chemicals or food matter may be damaged beyond repair in your zeal to outsmart a tenacious burglar.

2. A jewelry box. This is a good place to store jewelry that you can afford to lose, but not your diamond tennis bracelet or your grandmother's antique wedding ring.

3. Your desk drawer, bedside drawer, or underwear drawer. Too obvious.

4. Inside CD cases. It's true: burglars still prefer CDs to MP3s.

5. Inside DVD cases. DVDs and Xbox®-type games are worth between $2 and $10 at pawn and re-sale shops; count on being cleaned out of your collection during a home burglary, regardless of the titles.

6. A wall safe. Unless it's high-end and professionally installed, a wall safe can be dislodged by cutting the drywall seam around it, and wall safes are typically small and light enough to easily transport off site to be opened later. Opt for the heavier and harder-to-access floor safe.

7. Inside picture frames with false backs/interiors. These tend to be thicker than typical picture frames, so they're easy to spot as a hiding place.

8. A cookie jar. Put cookies in it, not your grocery money.

9. An electrical item or heated area, such as a lamp base, toaster oven, or HVAC duct. You could accidentally ignite your valuables and put your entire home at risk for a house fire.

10. Any locked box or locking file cabinet. A box that has a lock on it will be stolen regardless of what's inside, and the lock on a file cabinet can be popped out with the right tool and a little effort.

**Other Precautions**

For valuables that you can't hide or lock up, such as a flat-screen TV, stereo system, and computers, make sure they're insured through your homeowner's or renter's insurance. Unless you invest in a home security system (and sometimes even if you do), it's not possible to protect every item in your home. But you can take precautions to password-protect and GPS-activate laptops and smartphones so that their recovery is more likely, should they be stolen.

Also, firearms should be properly locked in an approved gun safe that is stored out of reach for the safety of the home's occupants, as well as to deter theft.

Place a pole in the bottom track of your sliding glass patio doors so that they can't be forced open wide enough to permit the entry of an intruder. Install burglar-proof window locks that will allow you to leave your windows open slightly for fresh air, but not wide enough to allow a person to get through.

Remember that burglary is a crime of opportunity, so don't tempt fate by leaving any exterior doors unlocked (including sliding glass patio doors, and the door between the garage and the living area), hiding a spare house key outdoors (under the "Welcome" mat, a large potted plant, statuary, or a solitary or fake rock), leaving the doors to your attached garage open (even when you're home), or leaving the curtains or drapes open so that your valuables are in full view of prowlers and passersby. Your personal safety is at risk as much as your personal property.

Also, don't over-share personal information with the world by advertising your absence from home on social media. When leaving on vacation, have a trusted neighbor, friend or family member monitor your home and bring in the newspaper, mail, and random take-out menus hung on your doorknob. Install light timers indoors, and security/motion detectors outdoors to illuminate your property's exterior. And go ahead and apply security company stickers to your windows/doors that advertise that your home is professionally protected, even if it's not.

In short, do what you can to make your home a difficult, inconvenient, and time-consuming target that will force a would-be burglar to move on. And do your part to keep your neighborhood safe by reporting suspicious activity on your street to the police.

## Window Bars

Window bars (also called safety bars and security bars) are metal bars that are installed to prevent intruders from entering a building. As an unintended consequence, window bars can slow or prevent egress during an emergency.

**Facts**

- Roughly 25 people die or are injured annually in fires where escape is hindered by window bars.
- According to the National Fire Protection Agency, the number of deaths caused by fire related to security bars is on the rise.
- The fear of burglary, theft and/or physical attack presents a greater perceived risk than the threat of fire.
- Seventy people died in a hotel fire on August 18, 2001 in the Philippines. The victims were trapped inside the six-story hotel by window bars.

**Advantages of Window Bars**

- They are a deterrent to potential burglars. They are mostly used in ground-floor windows, which are most vulnerable to intrusion.
- They provide a sense of security to building occupants.
- They can prevent children from falling out of the window.

**Disadvantages of Window Bars**

- They can block the exit for occupants during an emergency, such as a fire. The occupants may feel secure from burglary, but they have severely limited their avenues of egress. Ironically, it is possible for occupants to become trapped behind window bars while trying to escape from an intruder who has managed to enter the home.
- They can potentially block the entry point for firefighters.
- Houses equipped with window bars can potentially decrease the home's property value. Window bars can make a neighborhood appear unsafe to potential home buyers.

**Requirements for a Quick-Release Mechanism**

According to the 2006 International Residential Code (IRC), basements and sleeping rooms should have at least one operable emergency escape and rescue opening. Windows that are equipped with bars and which are intended for emergency egress should have a quick-release mechanism installed. If a room's egress requirements are already satisfied by another window or door, it is still helpful for window bars to be equipped with a quick-release mechanism.

Where window bars are installed in windows that are part of a building's means of egress, the IRC requires that they be equipped with a quick-release mechanism that complies with the following requirements:

- It should be accessible from the inside of the house. Although not addressed by the IRC, the device should not be accessible from outside the house if the window were to be broken.
- It should not require a key or combination. Likely reasons for this requirement are as follows:
    - During an emergency, occupants may become too panicked or confused to remember the combination or where they put the key.
    - Fire and smoke may prevent access to the key or obscure view of the lock.
    - Occupants may not know the combination or know where the key was placed.
- It should not require any special tools, such as a screwdriver.
- The mechanism should be able to be operated with relatively little force. Children and the elderly should be strong enough to operate the release mechanism.
- Operation of the mechanism should not require special knowledge.

In summary, window bars are valuable anti-burglary features in residences, but they should be able to be easily disengaged so occupants are not trapped during an emergency.

## Safe Rooms (Panic Rooms)

A safe room, also known as a panic room, is a fortified room that is installed in a private residence or business to provide a safe hiding place for inhabitants in the event of an emergency.

**Safe Rooms Around the World**

- In Mexico, where kidnappings are relatively common, some people use safe rooms as an alternative (or a supplement) to bodyguards.
- In Israel, bullet- and fire-resistant security rooms have been mandated for all new construction since 1992.
- Since the 1980s, every U.S. embassy has included a safe room with bullet-resistant glass.

- Perhaps the world's largest safe room will belong to the Sultan of Brunei. The planned 100,000-square foot room will be installed beneath his 1,788-room, 2,152,782-square foot residence.

**Why are safe rooms used? Some reasons include:**

- to hide from burglars. The protection of a safe room will afford residents extra time to contact police;
- to hide from would-be kidnappers. Many professional athletes, actors and politicians install safe rooms in their houses;
- protection against natural disasters, such as tornadoes and hurricanes. Underground tornado bunkers are common in certain tornado-prone regions of the United States;
- protection against a nuclear attack. While safe rooms near the blast may be incinerated, those far away may be shielded from radioactive fallout. This type of safe room, known as a fallout shelter, was more common during the Cold War than it is today;
- to provide social distancing in the event of a serious disease outbreak; and
- fear of an abusive spouse.

**A Brief History of Safe Rooms**

Safe rooms can be traced as far back as the Middle Ages. Castles had a "castle keep," a room located in the deepest part of the castle, which was designed so the feudal lord could hide during a siege. In the United States, safe rooms were used in the Underground Railroad during the 1800s, where secret rooms hid escaping slaves. In the 1920s, hidden rooms stored Prohibition-banned liquor. Safe rooms designed for weather protection have their origins in storm cellars. The features of the modern safe room are mostly derived from fallout shelters popular during the 1950s, which were created in response to the fear of nuclear attacks.

Various events of the past decade have spurred a rise in the popularity of safe rooms, including New Year's Eve during "Y2K," the terrorist attacks in New York City in 2001, and the subsequent anthrax poisonings that led to fears of civil unrest and war. Yet, it was the 2002 film *Panic Room*, starring Jodie Foster, that heightened public awareness of safe rooms and their perceived need. In fact, the term "panic room" became the popular name for what were previously known as "safe rooms" as a result of the movie, although companies that create the rooms still prefer to call them "safe rooms."

Today, they have become a status symbol in wealthy areas, such as Bel Air and Manhattan, where it is believed there are thousands of such rooms. However, it is difficult to estimate the number of safe rooms because many homeowners will not publicize the existence of their safe rooms. Even real estate agents tend to hide the location of safe rooms, or even the fact that a house has one, until they know a buyer is serious about purchasing the house.

**Location**

The safe room's location must be chosen carefully. It should not be located in the basement, for instance, if intruders are likely to enter the house from that area. Ideally, occupants will be closer than the intruders to the safe room at the time that the intrusion has been detected. This way, the occupants will not be forced to cross paths with the intruder in order to reach the safe room, such as in a stairway.

Occupants can plan multiple routes to their safe room to avoid detection by the intruder who is blocking the main route.

**Design**

Safe-room designs vary with budget and intended use. Even a closet can be converted into a rudimentary safe room, although it should have a solid-core door with a deadbolt lock. High-end custom models costing hundreds of thousands of dollars boast thick steel walls, video banks, computers, air-cleaning systems, bulletproof Kevlar®, and protection against bacterial and chemical infiltration.

Recommendations for specific design elements include the following:

- Doors: These are one of the most critical components of the safe room design. A bullet-resistant door with internal steel framing can weigh several hundred pounds, yet it must operate smoothly, easily, and without fail in an emergency. The hardware must be selected to provide substantial, secure locking without compromising the smooth operation of the door itself. Most importantly, it must allow the door to be secured quickly, preferably from a single control point. The hardware should not be capable of being overridden or tampered with from the outside.
- Floors: Concrete is an adequate material for the floor. In other forms of floor construction, such as wood, it is important to provide supplementary protection suitable to the anticipated type of emergency. As safe room construction often uses heavy materials, it is important to ensure that the floor can support a heavy load.
- Sound insulation: The attackers may try to verbally coerce the occupants to leave the safe room. Effective sound insulation will limit the ability for such unwanted communication. Also, sound insulation will prevent the intruders from hearing phone conversations between the occupant and police.
- Walls and ceilings: Wall construction that spans from floor to ceiling is generally preferred because of the structural continuity of the framing. Bricks and blocks, while bullet-resistant, can become dislodged from repeated sledgehammer battering. Steel stud walls, braced with additional reinforcing ties, can be faced with steel sheet or bullet-resistant materials, such as Kevlar®. These, in turn, may be covered with tile, sheetrock or other decorative finishes. Steel and Kevlar® panels are available in large sheet sizes. This helps minimize the number of joints that can be potential weak points of an assembly. It is important to not overlook penetrations that may be made for light fixtures, power points and plumbing pipes. Ductwork that passes through protected walls should also be carefully considered to ensure that the security is not breached and that they are not used to transfer poisonous gases into the safe room.
- Cameras and monitors: Concealed cameras located outside the room enable its occupant to secretly monitor the movement and numbers of intruders. Effective camera systems may incorporate one visible camera outside the room so that an intruder disabling the exposed camera may not think to look for hidden cameras.
- Generator: A self-contained power system is standard in most higher-end safe rooms.

Items to keep in a safe room:

- Bottled water and non-perishable foods: There should be a small provision of bottled water and non-perishable foods (such as dried trail mix);

- Communication devices: Ideally, all three of the following devices should be stored in the safe room:
    - a cell phone and charger, which are convenient, but they may not operate through thick safe room walls. The charger will not work if no electrical receptacles are installed, so those are required, too;
    - a land-line phone: Since cell phones may not work in a safe room, or because they may lose power, a land-line phone is recommended. It should, however, be on a separate line from the rest of the house so that intruders are less likely to disable it; and
    - a two-way radio.
- Blankets: Occupants may be there for a while, so they might as well be comfortable;
- First aid kit: Even if occupants make it to the safe room, they may have been injured by the intruder en route. It is unlikely that he will allow the occupants to re-enter the room after they leave it to look for bandages;
- Prescription medication: Small quantities of necessary medications should be stored in the safe room, or else occupants may be forced to surrender their position during a medical emergency. Having a hundred cans of tuna and a flat-screen TV does little good if your only asthma inhaler is left on the kitchen table;
- Flashlights: Severe weather can knock out electricity to the house, or intruders may intentionally cut the power;
- Sanitation supplies: Safe rooms built on a budget often don't have a toilet. A bucket can be used as a low-cost alternative;
- Weapons: If the intruders manage to enter the safe room, occupants should be prepared to defend themselves. Pepper spray is a common choice, and firearms are certainly no less effective; and
- Gas masks, which may become necessary in the event that the intruders force poisonous gas into the safe room. Where an odorless gas might be used, an electronic device may be installed to detect any noxious fumes or poisons.

In summary, safe rooms are increasingly popular rooms designed to protect occupants from various types of emergencies.

## Fire Safety

### Dryer Vent Safety

Clothes dryers work by evaporating the water from wet clothing by blowing hot air past them while they tumble inside a spinning drum. Heat is provided by an electrical heating element or gas burner. Some heavy-garment loads can contain more than a gallon of water, which, during the drying process, will become airborne water vapor and leave the dryer and home through an exhaust duct, more commonly known as a dryer vent.

A vent that exhausts damp air to the home's exterior has a number of requirements:

1. It should be connected. The connection is usually behind the dryer but may be beneath it. Look carefully to make sure it's actually connected.
2. It should not be restricted. Dryer vents are often made from flexible plastic or metal duct, which may be easily kinked or crushed where they exit the dryer and enter the wall or floor. This is often a problem, since dryers tend to be tucked away into small areas with little room to work. Vent hardware is available which is designed to turn 90 degrees in a limited space without restricting the flow of exhaust air. Air flow restrictions are a potential fire hazard.
3. One of the reasons that restrictions are a potential fire hazard is that, along with water vapor evaporated out of wet laundry, the exhaust stream carries lint – highly flammable particles of clothing made of cotton and polyester. Lint can accumulate in an exhaust duct, reducing the dryer's ability to expel heated water vapor, which then accumulates as heat energy within the machine. As the dryer overheats, mechanical failures can trigger sparks, which can cause the lint trapped in the dryer vent to burst into flames. This condition can lead to a house fire. Fires generally originate within the dryer but spread by escaping through the ventilation duct, incinerating trapped lint, and following its path into the building wall.

The Master Inspector Certification Board believes that house fires caused by dryers are far more common than are generally believed, a fact that can be appreciated upon reviewing statistics from the National Fire Protection Agency. Fires caused by dryers in 2005 were responsible for approximately 13,775 house fires, 418 injuries, 15 deaths, and $196 million in property damage. Most of these incidents occur in residences and are the result of improper lint cleanup and maintenance. Fortunately, these fires are very easy to prevent.

The recommendations outlined below reflect International Residential Code (IRC) "Section M1502 Clothes Dryer Exhaust" guidelines:

> M1502.5 Duct construction.
> Exhaust ducts shall be constructed of minimum 0.016-inch-thick (0.4 mm) rigid metal ducts, having smooth interior surfaces, with joints running in the direction of air flow. Exhaust ducts shall not be connected with sheet-metal screws or fastening means which extend into the duct.

This means that the flexible, ribbed vents used in the past should no longer be used. They should be considered a potential fire hazard if discovered.

> M1502.6 Duct length.
> The maximum length of a clothes dryer exhaust duct shall not exceed 25 feet from the dryer location to the wall or roof termination. The maximum length of the duct shall be reduced 2.5 feet for each 45-degree bend, and 5 feet for each 90-degree bend. The maximum length of the exhaust duct does not include the transition duct.

This means that vents should also be as straight as possible and cannot be longer than 25 feet. Any 90-degree turns in the vent reduce this 25-foot limit by 5 feet, since these turns restrict air flow.

A couple of exceptions exist:

1. The IRC will defer to the manufacturer's installation instructions, so if the manufacturer's recommendation permits a longer exhaust vent, that's acceptable.
2. The IRC will allow large-radius bends to be installed to reduce restrictions at turns, but confirming compliance requires performing engineering calculations in accordance with the ASHRAE Fundamentals Handbook.

M1502.2 Duct termination.
Exhaust ducts shall terminate on the outside of the building or shall be in accordance with the dryer manufacturer's installation instructions. Exhaust ducts shall terminate not less than 3 feet in any direction from openings into buildings. Exhaust duct terminations shall be equipped with a backdraft damper. Screens shall not be installed at the duct termination.

Homeowners may see many dryer vents terminate in crawlspaces or attics where they deposit moisture, which can encourage the growth of mold, promote wood decay, or create other material problems. Sometimes they will terminate just beneath attic ventilators. This is a defective installation. They must terminate at the exterior and away from a door or window.

Also, a screen may be installed at the duct termination to prevent birds and other small animals from building nests in the protected and warm tunnel of the vent, but a screen can prevent the expulsion of lint, which can accumulate, along with other debris. This is an improper and dangerous situation, so the screen should be removed and replaced with a movable damper.

M1502.3 Duct size.
The diameter of the exhaust duct shall be as required by the clothes dryer's listing and the manufacturer's installation instructions. Look for the exhaust duct size on the data plate.

M1502.4 Transition ducts.
Transition ducts shall not be concealed within construction. Flexible transition ducts used to connect the dryer to the exhaust duct system shall be limited to single lengths not to exceed 8 feet, and shall be listed and labeled in accordance with UL-2158A.

## Pilot Lights

A pilot light is a small flame that is kept constantly lit in order to serve as an ignition source for a gas burner. It's used on many natural gas and propane appliances, such as water heaters, clothes dryers, central heating systems, fireplaces and stoves.

The pilot light is fueled by a small amount of gas released from the gas pipe. When the appliance is turned on, a valve releases more gas, which is ignited by the pilot light. The light may need to be re-lit from time to time after being extinguished on purpose or by accident. Modern alternatives to the pilot light include a high-voltage electric arc between two electrodes placed close to the gas flow, and a red-hot surface made from silicon carbide, silicon nitride, or another material that can withstand prolonged heat exposure. While most commercial kitchens still rely on pilot lights for ovens and grills, their residential counterparts typically use electronic ignitions.

**Safety**

If a pilot light is accidentally extinguished, there exists a danger that the gas used to keep the flame lit will continue to vent, possibly into the living space. If this leak continues, its concentration may reach a point where a spark – such as that from a cigarette lighter, static electricity, or even the pilot light itself as it is being re-lit – will cause a fire or even an explosion. As a precaution, the flow of gas to the pilot light is maintained by electrical circuitry that relies on the detection of the flame by a sensor.

Modern appliances that use pilot lights should be equipped with one or more of the following sensor types:

- a photo-resistor, which detects the light emitted by the pilot light;
- a thermometer, which detects the heat created by the pilot light; or
- a voltmeter, which detects the electrical current created by the heat of the flame as it warms a thermocouple. A thermocouple is a device that creates a voltage related to the temperature difference at the junction of two different metals.

Natural gas and propane can usually be detected by a home's occupants by their odor, which is added to these naturally odorless fuels specifically to alert people to a lurking danger. Numerous injuries have been reported, however, when homeowners have tried to re-light a pilot light after the appliance's malfunctioning sensor failed to stop the flow of gas into the room. Thermocouples are degraded by continued exposure to the pilot light's flame, which increases their electrical resistance and reduces their effectiveness as flame sensors. Periodic testing and replacement of these devices will mitigate the safety hazards posed by pilot light-equipped appliances.

While many homeowners may not be aware of the danger, a number of houses are destroyed every year when a pilot light ignites the explosive gases released from insecticide "bug bombs" and foggers. A fire erupted in a Newburgh, Ohio house after a man placed a roach fumigator under his kitchen sink and the fumes reached his oven's pilot light. Even worse, when homeowners employ a recklessly large

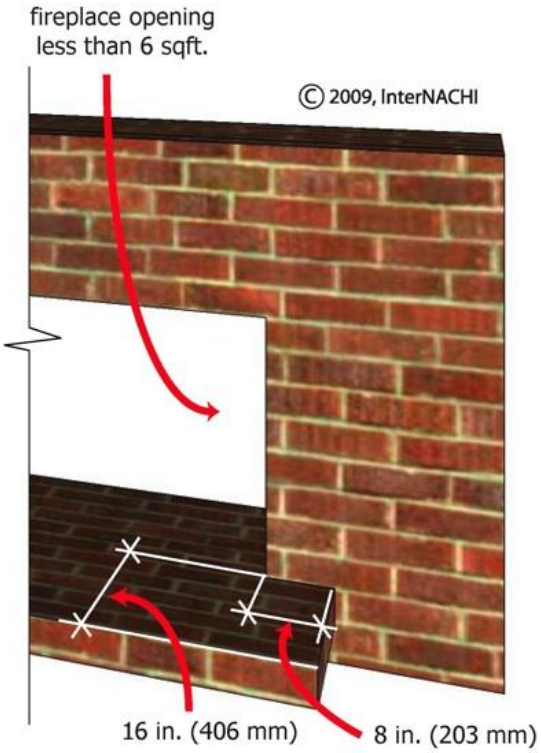
number of these foggers, they can generate enough gas to create a catastrophic explosion, and the determination of homeowners driven mad by cockroaches and fleas is occasionally enough incentive for them to employ such overkill. In one case, 19 foggers were unleashed in a 470-square foot San Diego home, filling the building with so much gas that the pilot light destroyed the home and launched shrapnel into the street. Fortunately, foggers are typically used in buildings that have been vacated. However, three men were hospitalized when an oven's pilot light in a Thai restaurant in Perth, Australia ignited the gas released from 36 foggers – enough to blow the roof off the building in a massive explosion that rocked the suburban neighborhood, causing $500,000 in damages.

**Energy Waste**

Pilot lights are not needed for the majority of the time that they're lit, which is how they waste a large amount of fuel. The exact amount of energy wasted depends on the unit, but various studies report that a pilot light burns $7.50 to $18 per month of natural gas, and even more for propane-fueled appliances. They waste more than 20% of the gas used in the United States, according to Cornell Environmental Health and Safety. A constantly burning pilot light also adds heat to the house, which may be convenient in the winter, but adds to the heat load in the summer and places an unnecessarily greater burden on the air-conditioning system. Even in the winter, the appliance may be located in a utility room or other area that doesn't require heating. Also, a typical pilot light can generate 450 pounds of carbon dioxide – a greenhouse gas -- over a six-month period.

If an appliance isn't needed for a long period of time, its pilot light may be extinguished to save energy, reduce greenhouse gas emissions, and reduce the risk of a fire or explosion. Concerned homeowners can also purchase appliances equipped with the aforementioned alternatives to the pilot light. If they have any additional issues or concerns related to pilot lights or fuel-burning appliances, they should consult with their Certified Master Inspector® during their next scheduled inspection.

In summary, pilot lights are a somewhat antiquated technology plagued by fears concerning fire and energy waste, but safer and more energy-efficient alternatives are available.



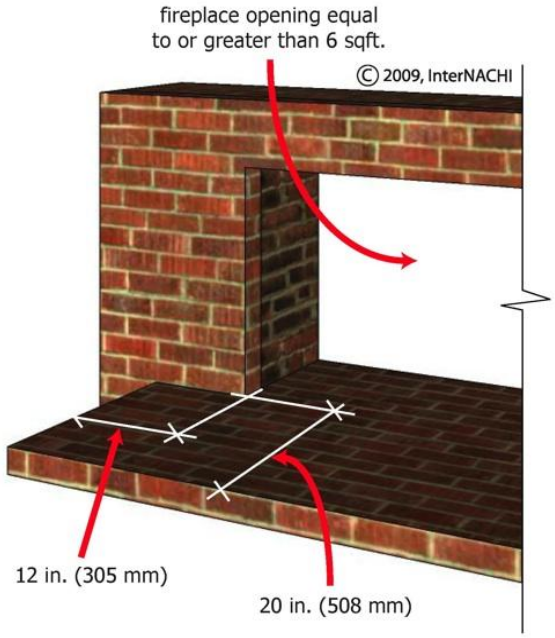

## Hearths and Hearth Extensions

A fireplace hearth is the floor area within a fireplace. It is made from noncombustible materials, such as brick or stone. The hearth extension is the noncombustible material in front of and at the sides of a fireplace opening. Hearths and hearth extensions are designed to prevent sparks that leave the fireplace area from igniting nearby combustibles.

Guidelines for sufficient thickness and size of hearths and hearth extensions can be found in the International Phase I Standards of Practice for Inspecting Fireplaces and Chimneys and in the manufacturer's instructions.

The following guidelines are from the International Phase I Standards of Practice for Inspecting Fireplaces and Chimneys, which are also useful for homeowners to know:

- The inspector should inspect for hearth extensions that have a thickness of less than 2 inches.
- The inspector should inspect for hearth extensions that are less than 16 inches in front or less than 8 inches beyond each side of fireplace openings that are 6 square feet or less.
- The inspector should inspect for hearth extensions that are less than 20 inches in front or less than 12 inches beyond each side of fireplace openings that are greater than 6 square feet.
- The inspector should inspect the hearth, hearth extension, and chambers for joint separation, damage and deterioration.




The 2006 International Residential Code (IRC) offers the following exception to the *2 inch-thick* rule: When the bottom of the firebox opening is raised at least 8 inches above the top of the hearth extension, a hearth extension of not less than 3/8-inch thick brick, concrete, stone, tile, or other approved noncombustible material is permitted.

Homeowners should note that carpet or tile may obscure the hearth extension so that it may be difficult to tell how thick it is.

In summary, hearths and hearth extensions are noncombustible surfaces designed to prevent fires from spreading beyond the fireplace. If they are not large and thick enough, they might not be sufficient to prevent the spread of fire.

## Holiday Safety

The winter holidays are a time for celebration, and that means more cooking, home decorating, entertaining, and an increased risk of fire and accidents. The Master Inspector Certification Board recommends that you follow these guidelines to help make your winter holiday season safer and more enjoyable.

**Holiday Lighting**

- Use caution with holiday decorations and, whenever possible, choose those made with flame-resistant, flame-retardant, and non-combustible materials.
- Keep candles away from decorations and other combustible materials, and do not use candles to decorate Christmas trees.
- Carefully inspect new and previously used light strings, and replace damaged items before plugging lights in. If you have any questions about electrical safety, ask your Certified Master Inspector® during your next scheduled inspection.
- Do not overload extension cords.
- Don't mount lights in any way that can damage the cord's wire insulation. To hold lights in place, string them through hooks or insulated staples--don't use nails or tacks. Never pull or tug lights to remove them.
- Keep children and pets away from light strings and electrical decorations.
- Never use electric lights on a metallic tree. The tree can become charged with electricity from faulty lights, and a person touching a branch could be electrocuted.
- Before using lights outdoors, check their labels to be sure they have been certified or UL-Listed for outdoor use.
- Make sure all the bulbs work and that there are no frayed wires, broken sockets, or loose connections.
- Plug all outdoor electric decorations into circuits with ground-fault circuit interrupters to avoid potential shocks.
- Turn off all lights when you go to bed or leave the house. The lights could short out and start a fire.

**Decorations**

- Use only non-combustible and flame-resistant materials to trim a tree. Choose tinsel and artificial icicles of plastic and non-leaded metals.
- Never use lighted candles on a tree or near other evergreens. Always use non-flammable holders, and place candles where they will not be knocked down.
- In homes with small children, take special care to avoid decorations that are sharp and breakable, and keep trimmings with small removable parts out of their reach.
- Avoid trimmings that resemble candy and food that may tempt a young child to put them in his mouth.

**Holiday Entertaining**

- Unattended cooking is the leading cause of home fires in the U.S. When cooking for holiday visitors, remember to keep an eye on the range.
- Provide plenty of large, deep ashtrays, and check them frequently. Cigarette butts can smolder in the trash and cause a fire, so completely douse cigarette butts with water before discarding.
- Keep matches and lighters up high, out of sight and out of reach of children (preferably in a locked cabinet).
- Test your smoke alarms, and let guests know what your fire escape plan is.

**Trees**

- When purchasing an artificial tree, look for the label "fire-resistant."
- When purchasing a live tree, check for freshness. A fresh tree is green, needles are hard to pull from their branches, and when bent between your fingers, they will not break.
- When setting up a tree at home, place it away from fireplaces, radiators and portable heaters.
- Also, place the tree out of the way of foot traffic, and don't block any doorways.
- Cut a few inches off the trunk of your tree to expose the fresh wood. This allows for better water absorption, which will help keep your tree from drying out and becoming a fire hazard.
- Be sure to keep the tree stand filled with water. Heated rooms can dry live trees out rapidly.
- Make sure the base is steady so the tree won't tip over.

**Fireplaces**

- Before lighting any fire, remove all greens, boughs, papers, and other decorations from the fireplace area. Check to see that the flue is open.
- Use care with "fire salts," which produce colored flames when thrown on wood fires. They contain heavy metals that can cause intense gastrointestinal irritation and vomiting if eaten.
- Do not burn wrapping paper in the fireplace. A flash fire may result as wrappings ignite suddenly and burn intensely.

**Toys and Ornaments**

- Purchase age-appropriate toys for children. Some toys designed for older children may be dangerous for younger children.
- Electric toys should be UL-Listed and approved.
- Toys with sharp points, sharp edges, strings, cords, and parts small enough to be swallowed should not be given to small children.
- Place older ornaments and decorations that might be painted with lead paint out of the reach of small children and pets.

**Children and Pets**

- Poinsettias are known to be poisonous to humans and animals, so keep them well out of reach, or avoid having them in the house.
- Keep decorations at least 6 inches above the child's reach.
- Avoid using tinsel. It can fall on the floor and a curious child or pet may eat it. This can cause anything from mild distress to death.
- Make sure that any ribbons on gifts and tree ornaments are shorter than 7 inches. A child could wrap a longer strand of ribbon around his neck and choke.
- Avoid mittens with strings for children. The string can get tangled around the child's neck and cause him to choke. Use clips instead. It's easier to replace a mitten than a child.
- Watch children and pets around space heaters or the fireplace. Never leave a child or a rambunctious pet unattended.

- Store scissors and any sharp objects that you use to wrap presents out of your child's reach.
- Inspect wrapped gifts for small decorations, such as candy canes, gingerbread men, and mistletoe berries, all of which are choking hazards.

**Security**

- Activate your home's burglar alarm system.
- If you plan to travel for the holidays, don't discuss your plans with strangers or on social media.
- Have a trusted friend or neighbor keep an eye on your home.

## Firestops

A firestop is a passive fire-protection method designed to reduce the opportunity for fire to spread through unprotected openings in a rated firewall. Such openings are found around the perimeter of pipes and wiring that penetrate firewalls.

**Places where firestops are required:**

Firestops must seal all unprotected openings in firewalls. In homes, firewalls are found in the following locations:

- between the garage and the living space, including the overhead ceiling;
- between the attic and the living space. Homeowners should be on the lookout for fireplace and wood stove flues that lack adequate fire-rated sheetrock or metal flashing firestopping;
- firewalls that separate condominium units are often penetrated by utilities that serve multiple units. These utilities are sometimes contained inside chases that should be sealed where they pass through the firewall between units. Firewalls between units must be continuous, all the way to the roof. Homeowners should have their CMI check in attics of multi-family dwellings to make sure that the firewall has not been violated in the attic space.

**Common Problems with Firestops**

Homeowners should look for any instances where firestops are missing, damaged, or otherwise inadequate. Some descriptions of firestop deficiencies are as follows:

- Missing firestop: Unsealed pipe penetrations will greatly reduce the ability for a firewall to contain a fire. This situation is more common in old buildings than in new ones due to changes in building code.
- Cable or pipe replacement: Electricians and plumbers may partially remove a firestop in order to install new cables and plumbing. A firewall's fire-resistance rating will be compromised if the opening created by this removal is not filled.
- Improper installation: Firestops will be effective only if they are installed correctly. For instance, firestop mortars are sometimes smeared into place unevenly and lack the required thickness at certain points. Also, firestops that are installed on only one side of a penetration may not be sufficient to prevent the spread of fire through the opening.

**Common Firestop Materials**

- Firestop mortar: Cements made from lightweight aggregates, such as vermiculite or perlite, can be used as firestopping. They are typically colored to distinguish them from other types of cement that lack firestopping characteristics. For example, firestopping mortar made by Nelson is colored red, and 3M™ Fire Barrier Mortar is bluish-gray.

- Intumescent: Any substance that expands as a result of heat exposure is considered an intumescent. Intumscents used as firestops can be made from a variety of flame-retardant materials, such as graphite, hydrates, and sodium silicates. They are especially useful firestopping materials for electrical cables, which can completely melt or burn away in a fire. The expanding intumescent will partially or completely cover the exposed opening created by a melted wire.

- Firestop pillows: These items contain various flame-retardant and intumescent substances, such as rockwool and graphite. They are filled loosely inside of a fiberglass fabric case that resembles a small pillow. Firestop pillows can be inserted into openings in firewalls and used in conjunction with other firestopping materials.

- Sheet metal.

- Fire-rated sheetrock.

In summary, firestops are designed to prevent the spread of fire through unprotected openings in rated firewalls.

## Clothes Closet Lighting

People don't often think about the fire risks posed by the light in their clothes closet, but it's one of the few places in the house where a source of high heat can get too close to flammable materials. Lighting must be installed safely with adequate separation from clothes, boxes and other flammables stored in the closet. Additionally, the quality of the light, as well as bulb efficiency, will influence your lighting choices.

**The 2009 International Residential Code (IRC) on "Permitted Luminaires and Clearance from Clothing"**

The IRC defines a "luminaire" as follows:
*a complete lighting unit consisting of a lamp or lamps, together with the parts designed to*

*distribute the light, to position and protect the lamps and ballast (where applicable), and to connect the lamps to the power supply.*

Types of luminaires permitted by the 2009 IRC include:

- surface-mounted or recessed incandescent luminaires with completely enclosed lamps, surface-mounted or recessed fluorescent luminaires; and
- surface-mounted fluorescent or LED luminaires identified as suitable for installation within the storage area.

Luminaires not permitted by the 2009 IRC:

- Incandescent luminaires with open or partially enclosed lamps and pendant luminaires or lamp-holders are prohibited.

Clearances permitted by the 2009 IRC:

The minimum distance between luminaires installed in clothes closets and the nearest point of a storage area shall be as follows:

1. Surface-mounted incandescent or LED luminaires with a completely enclosed light source shall be installed on a wall above the door or on the ceiling, provided that there is a minimum clearance of 12 inches between the fixture and the nearest point of a storage space.
2. Surface-mounted fluorescent luminaires shall be installed on the wall above the door or on the ceiling, provided that there is a minimum clearance of 6 inches.
3. Recessed incandescent luminaires or LED luminaires with a completely enclosed light source shall be installed in the wall or the ceiling, provided that there is a minimum clearance of 6 inches.
4. Recessed fluorescent luminaires shall be installed in the wall or on the ceiling, provided that there is a minimum clearance of 6 inches between the fixture and the nearest point of storage space.
5. Surface-mounted fluorescent or LED luminaires shall be permitted to be installed within the storage space where identified within this use.

Also, metal pull chains may be dangerous; if the base cracks, the chain can become electrified.

**Color Rendering Index (CRI)**

CRI is a quantitative measure of the ability of a light source to reproduce the colors of various objects faithfully, in comparison with an ideal or natural light source. The closer the CRI of a lamp is to 100, the more "true" it renders colors in the environment. Poor CRI is the reason that a shirt and pants that seemed to match at home now clash in the restroom at work. For clothes closets lighting, the CRI should be as high as possible. Incandescent lights are inefficient but they have a CRI of 100, making them the most aesthetic lighting choice. Compact fluorescents lights (CFLs) are far more efficient and have a longer life than incandescent bulbs, but they have a CRI in the low 60s, making them a poor choice for

clothes closet applications. Low-voltage halogen and LED lights are relatively efficient, long-lasting, and have a high CRI, although not as high as incandescent bulbs.

In summary, homeowners should replace lighting in their clothes closets if the light has the potential to ignite flammable materials in the closet.

### Barbeque Safety

During barbeque season, homeowners should heed the following safety precautions in order to keep their families and property safe.

1. Propane grills present an enormous fire hazard, as the Consumer Product Safety Commission (CPSC) is aware of more than 500 fires that result annually from their misuse or malfunction. The following precautions are recommended specifically when using propane grills:
    a. Store propane tanks outdoors and never near the grill or any other heat source. In addition, never store or transport them in your car's trunk.
    b. Make sure to completely turn off the gas after you have finished, or when you are changing the tank. Even a small gas leak can cause a deadly explosion.
    c. Check for damage to the tank before refilling it, and only buy propane from reputable suppliers.
    d. Never use a propane barbecue grill on a terrace, balcony or roof, as this is dangerous and illegal.
    e. No more than two 20-pound propane tanks are allowed on the property of a one- or two-family home.
    f. To check for a leak, spray a soapy solution over the connections and watch for bubbles. If you see evidence of a leak, reconnect the components and try again. If bubbles persist, replace the leaking parts before using the grill.
    g. Make sure connections are secure before turning on the gas, especially if the grill hasn't been used in months. The most dangerous time to use a propane grill is at the beginning of the barbeque season.
    h. Ignite a propane grill with the lid open, not closed. Propane can accumulate beneath a closed lid and explode.
    i. When finished, turn off the gas first, and then the controls. This way, residual gas in the pipe will be used up.

2. Charcoal grills pose a serious poisoning threat due to the venting of carbon monoxide (CO). The CPSC estimates that 20 people die annually from accidentally ingesting CO from charcoal grills. These grills can also be a potential fire hazard. Follow these precautions when using charcoal grills:
    a. Never use a charcoal grill indoors, even if the area is ventilated. CO is colorless and odorless, and you will not know you are in danger until it is too late.
    b. Use only barbeque starter fluid to start the grill, and don't add the fluid to an open flame. It is possible for the flame to follow the fluid's path back to the container as you're holding it.
    c. Let the fluid soak into the coals for a minute before igniting them to allow explosive vapors to dissipate.

d. Charcoal grills are permitted on terraces and balconies only if there is at least 10 feet of clearance from the building and a water source immediately nearby, such as a hose (or 4 gallons of water).
e. Be careful not to spill any fluid on yourself, and stand back when igniting the grill. Keep the charcoal lighter fluid container at a safe distance from the grill.
f. When cleaning the grill, dispose of the ashes in a metal container with a tight lid, and add water. Do not remove the ashes until they have fully cooled.
g. Fill the base of the grill with charcoal to a depth of no more than 2 inches.

3. Electric grills are probably safer than propane and charcoal grills, but safety precautions need to be used with them, as well. Follow these tips when using electric grills:
    a. Do not use lighter fluid or any other combustible materials.
    b. When using an extension cord, make sure it's rated for the amperage required by the grill. The cord should be unplugged when not in use and kept out of a busy foot path to prevent tripping.
    c. As always, follow the manufacturer's instructions.

**Safety Recommendations for General Grill Use:**

- Always make sure that the grill is used in a safe place where kids and pets won't touch or bump into it. Keep in mind that the grill will still be hot after you finish cooking, and anyone coming into contact with it could be burned.
- If you use a grill lighter, make sure you don't leave it lying around where children can reach it. They will quickly learn how to use it.
- Never leave the grill unattended, as this is generally when accidents happen.
- Keep a fire extinguisher or garden hose nearby.
- Ensure that the grill is completely cooled before moving it or placing it back in storage.
- Ensure that the grill is only used on a flat surface that cannot burn, and well away from any fencing, shed, trees and shrubs.
- Clean out the grease and other debris in the grill periodically. Be sure to look for rust and other signs of deterioration.
- Don't wear loose clothing that might catch fire while you're cooking.
- Use long-handled barbecue tools and flame-resistant oven mitts.
- Keep alcoholic beverages away from the grill; they are flammable!

In summary, homeowners should exercise caution when using any kind of grill, as they can harm life and property in numerous ways.

## Kerosene Heaters

A kerosene heater, also known as a paraffin heater, is a portable, unvented heating appliance that runs on the controlled burning of kerosene. In the U.S., it is used mainly for supplemental heating and for emergency heat during a power outage. In Japan and other countries, it is used as the primary source for home heating.

Kerosene burners operate in a manner similar to kerosene lamps: a fabric wick draws kerosene from a tank via capillary action into a burning chamber mounted above. Once lit, the wick warms nearby objects through radiation and convection. The user may control the burner's heat by raising or lowering the wick's height inside the burning chamber. The heater is turned off by fully withdrawing the exposed wick into a cavity beneath the burner.

Kerosene heaters are favored for their portability, efficiency, and lack of reliance on electricity. They also lack a pressure-fed fuel system, which is a significant safety advantage over standard heating systems.

However, the following problems plague kerosene heaters:

- Odor. While newer kerosene heaters do not present as much of a problem, all such heaters emit a smell when they are being fueled. Odors typically cease after the heater begins burning normally. If the odor does not dissipate, the cause may be because the wick may be too thin for the heating unit, allowing kerosene vapors to pass through the wick gap and vent into the room. Odors and excess smoke may also result from the combustion of low-grade fuel or contaminated kerosene.
- Inadequate ventilation. Kerosene heaters, like ventless fireplaces, vent soot, sulfur dioxide, carbon dioxide, and carbon monoxide directly into the living space. In modern well-insulated homes, an improperly adjusted, improperly fueled, or poorly maintained kerosene heater can pose a serious health hazard.
- Fire hazard. Highly flammable liquids are burned within the living space, creating vulnerability to mechanical and human-caused problems.

The aforementioned safety concerns can be addressed by inspecting for the presence of the following safety design features:

- an Underwriters Laboratory (UL) seal, guaranteeing that it has passed certain safety requirements;
- a push-button, automatic starter, which eliminates the need for matches;
- a low center of gravity, which makes accidentally tipping the burner over less likely;
- an automatic cut-off device to turn the heater off in case it is tipped over. This device also prevents kerosene from spilling during a tip-over;
- a grille attached to the front to prevent contact burns;
- placement of the heater on a large, fireproof surface;
- a model that is equipped with a wick -- this makes flooding of the burner impossible;
- all components made from heavy, durable metal;
- a sturdy fuel tank, sealed and installed beneath the burner; and
- a fuel gauge to prevent inadvertent over-fueling.

**Safe-Use Practices**

- Burn only water-clear, K1 kerosene that is not yellow or contaminated. While other grades of kerosene may look like K1, they will release more pollutants into the home. Never burn gasoline or any other flammable liquids, as they dramatically increase the risk of fire or explosion.
- Do not use a kerosene heater in areas where explosive vapors may be present, such as in a garage.
- Always store kerosene in a container intended for kerosene and marked as such, and never in a can that previously contained gasoline. Gasoline containers are typically red, while kerosene containers are usually blue. The container should have a tight-fitting lid to avoid spills. Do not store large amounts of kerosene or any other flammable liquid.
- Never bring kerosene into the house other than the fuel in the heater, which should be filled outdoors after the heater has cooled down.
- Maintain a safe clearance between the heater and furniture, drapes, and other combustibles.
- Do not place the heater in a high-traffic area or in the way of an exit.
- Instruct children to never touch the controls, and keep children and pets away from the heater at all times.
- Do not let the heater operate while the house is empty.
- Ventilate the room by opening a door or window.
- Never move or carry the heater in the event of an explosion or flare-up. In an emergency, activate the manual shut-off switch, if the heater has one.

In summary, kerosene heaters are attractive alternatives to standard heating systems, although they present certain health and safety concerns if improperly designed or operated.

## Attached Garage Fire Containment

An attached garage is a garage that is physically attached to a house. Fires that begin in attached garages are more likely to spread to living areas than fires that originate in detached garages. For this reason, combined with the multitude of flammable materials commonly found in garages, attached garages should be adequately sealed from living areas. A properly sealed attached garage will ideally restrict the potential spread of fire long enough to allow the occupants time to escape the home or building.

**Why are garages (both attached and detached) fire hazards?**

- Oil or gasoline can drip from cars. These fluids may collect unnoticed and eventually ignite.
- Flammable liquids, such as gasoline, oil and paint, are commonly stored in garages. Some other examples are brake fluid, degreaser, motor oil, varnish, lighter fluid, and fluids containing solvents, such as paint thinner. These chemicals are flammable in their fluid form, and some may create explosive vapors.
- Heaters and boilers, which are frequently installed in garages, create sparks that can ignite fumes or fluids. Car batteries, too, will spark under certain conditions.

- Mechanical or electrical building projects are often undertaken in the garage. Fires can easily start while a careless person is welding near flammable materials.

**Doors**

The 2006 edition of the International Residential Code (IRC) states the following concerning doors that separate garages from living areas:

> R309.1. Opening Penetration:
> Openings from a private garage directly into a room used for sleeping purposes shall not be permitted. Other openings between the garage and the residence shall be equipped with solid wood doors not less than 1-3/8 inches in thickness, solid- or honeycomb-core steel doors not less than 1-3/8 inches thick, or 20-minute fire-rated doors.

In addition, homeowners can check for the following while inspecting the door that separates their garage from the living areas:

- While not required by the IRC, it is helpful if there is at least one step leading up to the door from the garage. Gasoline fumes and other explosive gases are heavier than air, and they will accumulate at ground level. Their entry beneath a door will be slowed by an elevation increase.
- Doors should have tight seals around their joints to prevent seepage of fumes into the living areas of the house. Carbon monoxide, with the same approximate density as air (and often warmer than surrounding air), will easily rise above the base of an elevated door and leak through unsealed joints.
- Doors should be self-closing. Many homeowners find these doors inconvenient, but they are safer than doors that can be left ajar. While this requirement is no longer listed in the IRC, it is still a valuable recommendation.
- If the doors have windows, the glass should be fire-rated.
- Pet doors should not be installed in fire-rated doors. Pet doors violate the integrity of a fire barrier.

**Walls and Ceilings**

The 2006 edition of the IRC states the following concerning garage walls and ceilings:

> R309.2. Separation Required:
> The garage shall be separated from the residence and its attic area by not less than 1/2-inch gypsum board applied to the garage side. Garages beneath habitable rooms shall be separated from all habitable rooms above by not less than 5/8-inch Type X gypsum board or equivalent. Where the separation is a floor-ceiling assembly, the structure supporting the separation shall also be protected by not less than 1/2-inch gypsum board or equivalent. Garages located less than 3 feet from a dwelling unit on the same lot shall be protected with not less than 1/2-inch gypsum board applied to the interior side of exterior walls that are within this area. Openings in these walls shall be regulated by Section 309.1. This provision does not apply to garage walls that are perpendicular to the adjacent dwelling unit wall.

In addition, homeowners can check for the following while inspecting walls and ceilings:

- In garages that have access to the attic, a hatch cover made from an approved, fire-rated material should protect this access at all times. Missing or opened covers should be noted, as should covers made from flammable materials, such as thin plywood. Garage attic doors must be constructed such that the 45-minute rating is maintained; any drywall edges on both the hatch and the surrounding area exposed to physical damage are protected. The cover or door is installed so that it is permanent (non-removable) with hardware to maintain it in a closed position and with latching hardware to maintain it in a closed position. This could be accomplished by the use of spring-loaded hinges, a door closer, or hardware that will not allow it to be left in an open position when not in use. A single bolt-type or hook-and-eye hardware does not provide a positive closure, since these would allow the door to be left open. Likewise, drywall screws are "fasteners" and not hardware, so they cannot be used as the only means of keeping access doors closed.
- The living space is separated from the garage by a firewall that extends from the floor to the roof. If the ceiling material is fire-rated, the firewall can terminate at the ceiling.
- Drywall joints should be taped or sealed. Joints should be fitted so that the gap is no more than 1/20-inch, with joints backed by either solid wood or another layer of drywall such that the joints are staggered.

**Ducts**

The 2006 edition of the IRC states the following concerning ducts that penetrate garage walls and ceilings:

> R309.1.1. Duct Penetration
> Ducts in the garage and ducts penetrating the walls or ceilings separating the dwelling from the garage shall be constructed of a minimum No. 26-gauge steel sheet or other approved material, and shall have no openings in the garage.

Dryer exhaust ducts that penetrate garage walls are serious fire hazards. These ducts are generally made from plastic and will easily melt during a fire, creating a large breach in the firewall.

**Floors**

The 2006 edition of the IRC states the following concerning floors in garages:

> R309.3. Floor Surface
> Garage floor surfaces shall be of approved, non-combustible material. The area of the floor used for parking of automobiles or other vehicles shall be sloped to facilitate the movement of liquids to a drain or toward the main vehicle entry doorway.

Homeowners may also want to check for the following:

- A curb is present along the perimeter of the garage floor. This curb is designed to prevent fluids from entering the living areas of the house. Curbs are often useful barriers for melted snow carried into the garage by automobiles, but curbs can also keep chemical spills contained in the garage.
- Water heaters should be elevated above the floor by at least 18 inches. A pilot light may ignite spilled fluid or floor-level flammable fumes if the water heater is placed at floor level.

Concerning items placed on the floor, homeowners should check for the following:

- All flammable liquids are stored in clearly labeled, self-closing containers, and in small amounts. They should be stored away from heaters, appliances, pilot lights, and other sources of heat and flame.
- Propane tanks should never be stored indoors. If they catch fire, a serious explosion may result. Propane tanks are sturdy enough to be stored outdoors.
- The floor should be clear of clutter. Loose papers, matches, oily rags, and other flammable items are dangerous if they are strewn about the garage floor.

General Safety Tips for Attached Garages:

- Use light bulbs with the proper wattage.
- Do not overload electrical outlets.
- Tape down all cords and wires so that they're not twisted or accidentally yanked out of the outlet.

In summary, attached garages should be sealed off from the living space so that fire may be contained.

### Non-Conforming Bedrooms

A room must conform to specific requirements in order for it to be considered a bedroom or sleeping room. The reason for this law is that the inhabitant must be able to quickly escape in case of a fire or other emergency.

Why would a homeowner use a non-conforming room as a bedroom?

Some of the reasons include:

- to earn money from it as a rental. While they run the risk of being discovered by the city, landlords can profit by renting out rooms that are not legally considered bedrooms;
- to increase the value of the home. All other considerations being equal, a four-bedroom house will usually sell for more than a three-bedroom house; and
- lack of knowledge of code requirements. To the untrained eye, there is little obvious difference between a conforming bedroom and non-conforming bedroom. When an emergency happens, however, the difference will be more apparent. If you have any questions about safety requirements, ask your Certified Master Inspector® during your next scheduled inspection.

Homeowners run serious risks when they use a non-conforming room as a bedroom. An embittered tenant, for instance, may bring their landlord to court, especially if the tenant was forced out when the faux bedroom was exposed. The landlord, upon being exposed, might choose to adjust the bedroom to make it code-compliant, but this can cost thousands of dollars. Landlords can also be sued if they sell the home after having advertised it as having more bedrooms than it actually has. And the owner might pay more than they should be paying in property taxes if they incorrectly list a non-conforming bedroom as a bedroom. Perhaps the greatest risk posed by rooms that unlawfully serve as bedrooms stems from the reason these laws exist in the first place: rooms lacking egress can be deadly in case of an emergency. For instance, in January 2002, four family members sleeping in the basement of a Gaithersburg, Maryland townhome were killed by a blaze when they had no easy escape.

The following requirements are taken from the 2006 International Residential Code (IRC), and they can be used as a general guide, but bear in mind that the local municipality determines the legal definition of a bedroom. Such local regulations can vary widely among municipalities, and what qualifies as a bedroom in one city might be more properly called a den in a nearby city. In some municipalities, the room must be above grade and equipped with an AFCI or smoke alarm to be considered a conforming bedroom. Ceiling height and natural lighting may also be factors. The issue can be extremely complex, so it's best to learn the code requirements for your area. Nevertheless, the IRC can be useful, and it reads as follows:

- *<u>EMERGENCY ESCAPE AND RESCUE REQUIRED SECTION: R 310.1.</u> Basements and every sleeping room shall have at least one operable emergency escape and rescue opening. Such opening shall open directly into a public street, public alley, yard or court. Where basements contain one or more sleeping rooms, emergency egress and rescue openings shall be required in each sleeping room, but shall not be required in adjoining areas of the basement. Where emergency escape and rescue openings are provided, they shall have a sill height of not more than 44 inches above the floor. Where a door opening having a threshold below the adjacent ground elevation serves as an emergency escape and rescue opening and is provided with a bulkhead enclosure, the bulkhead enclosure shall comply with SECTION R310.3. The net clear opening dimensions required by this section shall be obtained by the normal operation of the emergency escape and rescue opening from the inside. Emergency escape and rescue openings with a finished sill height below the adjacent ground elevation shall be provided with a window well, in accordance with SECTION R310.2.*
    - *<u>MINIMUM OPENING AREA: SECTION: R 310.1.1.</u> All emergency escape and rescue openings shall have a minimum net clear opening of 5.7 square feet. Exception: Grade floor openings shall have a minimum net clear opening of 5 square feet.*

- *MINIMUM OPENING HEIGHT: R 310.1.2. The minimum net clear opening height shall be 24 inches.*
- *MINIMUM OPENING WIDTH: R 310.1.3. The minimum net clear opening width shall be 20 inches.*
- *OPERATIONAL CONSTRAINTS: R 310.1.4. Emergency escape and rescue openings shall be operational from the inside of the room without the use of keys or tools or special knowledge.*

- *WINDOW WELLS: SECTION R310.2. The minimum horizontal area of the window well shall be 9 square feet, with a minimum horizontal projection and width of 36 inches. The area of the window well shall allow the emergency escape and rescue opening to be fully opened. Exception: The ladder or steps required by SECTION R 310.2.1 shall be permitted to encroach a maximum of 6 inches into the required dimensions of the window well.*

- *LADDER AND STEPS: SECTION R 310.2.1. Window wells with a vertical depth greater than 44 inches shall be equipped with a permanently affixed ladder or steps usable with the window in the fully open position. Ladders or steps required by this section shall not be required to comply with SECTIONS R311.5 or R311.6. Ladders or rungs shall have an inside width of at least 12 inches, shall project at least 3 inches from the wall, and shall be spaced not more than 18 inches on-center vertically for the full height of the window well.*

- *BULKHEAD ENCLOSURES: SECTION R 310.3. Bulkhead enclosures shall provide direct access to the basement. The bulkhead enclosure with the door panels in the fully open position shall provide the minimum net clear opening required by SECTION R 310.1.1. Bulkhead enclosures shall also comply with SECTION R 311.5.8.2.*

- *BARS, GRILLES, COVERS AND SCREENS: SECTION R 310.3. Bars, grilles, covers, screens and similar devices are permitted to be placed over emergency escape and rescue openings, bulkhead enclosures, and window wells that serve such openings, provided the minimum net clear opening size complies with SECTIONS R 310.1.1 to R 310.1.3, and such devices shall be releasable or removable from the inside without the use of a key, tool, special knowledge, or force greater than that which is required for normal operation of the escape and rescue opening.*

- *EMERGENCY ESCAPE WINDOWS UNDER DECKS AND PORCHES: SECTION R 310.5. Emergency escape windows are allowed to be installed under decks and porches, provided the location of the deck allows the emergency escape window to be fully opened and provides a path not less than 36 inches in height to a yard or court.*

In summary, non-conforming bedrooms are rooms that unlawfully serve as bedrooms, as the occupant would lack an easy escape in case of emergency.

### Window Wells

A window well is a semi-circular excavation that surrounds a basement window. It is typically constructed from a solid barrier made from corrugated galvanized metal, masonry, plastic, or pressure-treated wood.

Window wells are usually installed for the following purposes:

- emergency egress. If the window serves a living area -- as opposed to an unfinished basement with exposed utilities -- emergency escape at a minimum of two locations is required. Window wells allow windows to be used by escaping occupants and emergency crews attempting to enter the house;
- to prevent moisture damage to basement windows that are at or below grade. The window wells keep the soil away from openings in the foundation walls while still allowing proper grading and drainage away from the house; and
- to allow sunlight into a below-grade room that would otherwise rely solely on artificial lighting.

Window wells are often covered to prevent falls, as well as to discourage small children, pets and wild animals from entering the wells and becoming trapped. For instance, a deer fawn made the news in Utah after it was recovered safely after falling down a 12-foot-deep uncovered window well. Covers will also prevent the accumulation of twigs, grass, mulch, and blowing snow that would obscure sunlight and complicate emergency escape through the well. Covers may be locked from the inside to prevent unwanted intrusion.

Window well covers, however, can block sunlight, ventilation, and emergency egress, especially if they become covered with snow and ice. It is the homeowner's responsibility to make sure that the cover is cleared of snow and has not been frozen shut from ice. No items, such as garden hoses, potted plants or tools, should be placed on top of window well covers. Note that covers that are locked from the inside to prevent unlawful entry will be inaccessible to fire crews and first-responders.

**Construction**

Regarding their strength and operability, the 2007 edition of the International Code Council (ICC), Section 3.4, states that window well covers shall support *"*a minimum live load of 40 pounds per square foot. The cover shall be operable from within the window well without the use of tools or special knowledge, and shall require no more than 30 pounds of force to fully open*."*

Additional safety concerns include the following:

- Size. According to the 2006 edition of the International Residential Code (IRC), Section R310:

  *The minimum horizontal area of the window well shall be 9 square feet, with a minimum horizontal projection and width of 36 inches.*

  Even if the well seems large enough for members of a particular household, it might be a tight fit for a fully equipped firefighter.

- Structural damage to the barrier. Hydrostatic pressure and freeze-thaw cycles can exert a great deal of pressure on window wells and, over time, cause masonry to bend or crack. Check for:
  - spalling, bowing, cracking or leaning in concrete;
  - cracking or bowing in plastic;
  - rust, bowing or ruptures in metal; and
  - insect damage or cracks in wood.

- Improper drainage. Waterlogged window wells can easily leak through a window into the basement, especially following a heavy rain. Water intrusion can cause a variety of undesirable conditions, such as mold growth, wood decay, corrosion, and insect damage. Check for a lack of sufficient cleaning and maintenance both in the window well and elsewhere. Homeowners should first make sure that gutters and downspouts are clear of debris, which can force water to overflow from the gutters and collect in the window well and other low areas. Dirt and debris should also be collected from the well. A qualified professional may be required to correct structural sources of drainage issues, such as soil erosion, insufficient or settled drainage stone, or the pulling away from the foundation of the barrier.

- Lack of a ladder. The 2006 IRC, Section 310.2, states:

  *Window wells with a vertical depth greater than 44 inches shall be equipped with a permanently affixed ladder or steps usable with the window in the fully open position*.

**Additional Tips for Homeowners**

- Window well covers can be screened or barred to provide pest-free ventilation.
- Teach children to avoid window wells, even if they are covered and appear sturdy.
- Practice exiting the window, window well and window cover so that any previously unnoticed obstacles can be removed. Repair or replace any equipment that does not function properly.
- Speak with your local building department if you are unsure whether a window well is required in your home. Your jurisdiction may mandate special size restrictions.
- Metal window wells can have rolled edges for safety against cuts.
- Consult with your Certified Master Inspector® if you have additional concerns regarding window wells, covers, moisture problems, or emergency egress.

In summary, window wells are installed to allow emergency egress and to protect windows from damp soil, but improper installation and maintenance can lead to moisture damage and safety hazards, especially in an emergency.

## Fire Extinguishers

Fire extinguishers are devices commonly found indoors and are used to douse fire and prevent its spread. They are small metal canisters that contain compressed gas (usually nitrogen) that, when activated, propel a directed spray of flame-retardant chemicals. Fire extinguishers are effective only if the users understand where and why they are used.

**Fire Type**

Fire extinguishers are distinguished based on the types of fires on which they are effective. These fires are classified by their fuel source and assigned identifying letters as follows:

- A class: fires that result from ordinary combustibles, such as wood and paper.
- B class: fires that result from combustible liquids, such as kerosene, gasoline, oil and grease.
- C class: fires of an electrical nature. These result from the combustion of circuit breakers, wires, outlets, and other electrical devices and equipment. Extinguishers designed to handle this type of fire cannot use chemicals that are conductive, since conductive agents increase the risk of electric shock to the operator.
- D class: fires resulting from combustible metals, such as sodium, potassium, titanium and magnesium. These fires occur mostly in chemical laboratories and are rare in most other environments.
- K class: These types of fires consume vegetable oils and animal fats, and generally happen in kitchens.

NOTE: Although, technically, the letter rankings listed above refer to fire types, these symbols can also be used to identify the extinguishers themselves. For instance, an extinguisher that uses $CO_2$ can be called a "$CO_2$ extinguisher" or a "BC extinguisher."

**Extinguisher Types**

No fire extinguisher can be safely and effectively used for every type of fire. Some contain chemicals that are ineffective in certain situations and can even cause harm to the operator if misapplied. To prevent confusion, extinguishers are classified by the type of chemical agents they contain.

| CLASSES OF FIRES | TYPES OF FIRES | PICTURE SYMBOL |
|---|---|---|
| A | Wood, paper, cloth, trash & other ordinary materials. | |
| B | Gasoline, oil, paint and other flammable liquids. | |
| C | May be used on fires involving live electrical equipment without danger to the operator. | |
| D | Combustible metals and combustible metal alloys. | |
| K | Cooking media (Vegetable or Animal Oils and Fats) | |

A few of the most common extinguisher types are listed below:

- Dry Chemical: There are two types of fire extinguishers that use a dry chemical. One is called multi-purpose dry chemical and uses ammonium phosphate as the extinguishing agent, which is effective on A, B, and C class fires. This chemical is corrosive and must be scrubbed from surfaces after use. These types of extinguishers are very common and are found in schools, homes, hospitals and offices. Sodium bicarbonate is used in extinguishers known as regular dry chemical, which are capable of handling B and C class fires. These extinguishers are found in garages, kitchens and laboratories. Sodium bicarbonate is easy to clean and non-toxic.
- Carbon Dioxide: These extinguishers contain liquid $CO_2$ that is expelled as a gas. They are effective against B and C class fires. Unlike other chemicals, $CO_2$ does not leave a harmful residue and is environmentally friendly.

It also poses very little danger to electronics and is effectively employed in laboratories, computer rooms, and other areas with sensitive equipment.

- Water Extinguishers: These extinguishers are most suited for A class fires. However, they cannot be used in B, C or D class fires. In B and D class fires, the water will spread the flames. In a C class fire, the water is conductive and poses a risk of electric shock to the operator. However, the misting nozzle of a water mist extinguisher breaks up the stream of de-ionized water so that there is no conductive path back to the operator. Since the agent used is water, these types of extinguishers are inexpensive and environmentally friendly.
- Wet Chemical Fire Extinguishers: These devices are designed to combat K class fires and commonly use potassium acetate. They are appropriately employed in commercial kitchens and restaurants, especially around deep fryers. The chemical is emitted as a fine mist that does not cause grease to splash onto other surfaces. They can also be used in A class fires.

**Extinguisher Testing and Replacement**

The National Fire Protection Agency (NFPA) recommends that extinguishers be tested every five or 12 years, depending on the type. The standard method of testing—hydrostatic—is conducted underwater where the cylinders are subjected to pressures that exceed their ratings. Vessels that fail the test are condemned and destroyed, while the rest are reassembled and put back into service.

According to the NFPA, extinguishers should be destroyed if any of the following conditions are present (and they should not be tested):

a. if repairs by soldering, welding, brazing, or the use of patching compounds exist;
b. if the cylinder threads are worn, corroded, broken, cracked or nicked;
c. if there is corrosion that has caused pitting, including pitting under a removable nameplate or name band assembly;
d. if the fire extinguisher has been burned in a fire;
e. if a calcium chloride-type of extinguisher agent was used in a stainless steel fire extinguisher;
f. if the shell is of copper or brass construction joined by soft solder or rivets;
g. if the depth of a dent exceeds 1/10 of the greatest dimension of the dent if not in a weld, or exceeds 1⁄4-inch if the dent includes a weld;
h. if any local or general corrosion, cuts, gouges or dings have removed more than 10% of the minimum cylinder wall thickness; and/or
i. if the fire extinguisher has been used for any purpose other than that of a fire extinguisher.

**When should a fire extinguisher be used?**

Small fires can be controlled through the use of household or commercial fire extinguishers. A household extinguisher can often completely douse a very small fire and prevent the need for professional assistance. Even if a fire cannot be completely doused, a homeowner can potentially control a blaze long enough with an extinguisher for firefighters to arrive. Fire extinguishers should not be used if the operator is not sure if they have the proper type of extinguisher, if they are not sure how to use it, or if they cannot avoid smoke or are in imminent danger. If the operation of an extinguisher may place other people in danger, they should evacuate the building and wait for fire crews to arrive.

**What is on an extinguisher's label? You'll find:**

- essential information about the types of fires they can combat. Newer devices have pictures on their labels that correspond directly to the fire types listed previously. Older models have letters that serve the same purpose;
- a numerical rating that designates the extinguishing potential for that particular model (Class A and B);
- instructions for operation; ad
- a tag that indicates if and when it was inspected.

**Do fire extinguishers expire?**

Fire extinguishers expire and they do this for a few different reasons. One common reason is that, over time, the seal on the neck will weaken and allow compressed gas to escape. Extinguishers that have lost much of their pressure will not operate properly. Pressure within an extinguisher can be conveniently checked through a pressure gauge. ABC-class (ammonium phosphate) extinguishers have the tendency to fail due to solidification of the chemical in the canister base. Homeowners can delay this process by periodically shaking the extinguisher. Expensive extinguishers that have expired, especially those designed for commercial use, can be refilled and resealed by companies that specialize in this service. Inexpensive models are disposable.

Unfortunately, an expiration date cannot be fully trusted, and there is no foolproof way to know if an extinguisher is no longer functional. Due to the extremely destructive potential of fires and the relatively low cost of extinguishers, it is advisable to replace or recharge questionable extinguishers.

In summary, extinguishers are classified based on their chemical ingredients, all of which have their own strengths and limitations. It is important to know what type of extinguisher combats what type of fire. Fire extinguishers are critical indoor safety devices that must be maintained and checked regularly.

## Smoke Alarms

A smoke alarm, also known as a smoke detector, is a device that detects smoke and emits an audible sound and/or visual signal to alert residents to a potential fire.

**Facts and Figures**

According to the Consumer Product Safety Commission:

- Almost two-thirds of reported deaths caused by home fires from 2003 to 2006 resulted from fires in homes that lacked working smoke alarms.
- Older homes are more likely to lack an adequate number of smoke alarms because they were built before requirements increased.
- In 23% of home fire deaths, smoke alarms were present but did not sound. Sixty percent of these failures were caused by the power supplies having been deliberately removed due to false alarms.
- Every year in the United States, about 3,000 people lose their lives in residential fires. Most of these deaths are caused by smoke inhalation, rather than as a result of burns.

**Smoke Alarm Types**

Ionization and photo-electric are the two main designs of smoke detectors. Both types must pass the same tests to be certified to the voluntary standard for smoke alarms, but they perform differently in different types of fires. Detectors may be equipped with one or both types of sensors -- known as dual-sensor smoke alarms -- and possibly a heat detector, as well. These sensors are described as follows:

- Ionization smoke sensors are the most common and economical design, and are available at most hardware stores. They house a chamber sided by small metal plates that irradiate the air so that it conducts electricity. When smoke enters the chamber, the current flow becomes interrupted, which triggers an alarm to sound. These sensors will quickly detect flaming-type fires but may be slower to react to smoldering fires.
- Photo-electric smoke sensors use a light-sensitive photocell to detect smoke inside the detector. They shine a beam of light that will be reflected by smoke toward the photocell, triggering the alarm. These sensor types work best on smoldering fires but react more slowly to flaming fires. They often must be hard-wired into the house's electrical system, so some models can be installed only in particular locations.

While heat detectors are not technically classified as smoke detectors, they are useful in certain situations when smoke alarms are likely to sound false alarms. Dirty, dusty industrial environments, as well as the area surrounding cooking appliances, are a few places where false alarms are more likely and where heat detectors may be more useful.

**Location**

Individual authorities having jurisdiction (AHJs) may have their own requirements for smoke-alarm placement, so homeowners can check with their local building department if they need specific instructions. However, the following guidelines can be helpful.

Smoke alarms should be installed in the following locations:

- on the ceiling or wall outside of each separate sleeping area in the vicinity of bedrooms;
- in each bedroom, as most fires occur during sleeping hours;

- in the basement, preferably on the ceiling near the basement stairs;
- in the garage, due to all the combustible materials commonly stored there;
- on the ceiling or on the wall with the top of the detector between 6 to 12 inches from the ceiling; and/or
- in each story within a building, including basements and cellars, but not crawlspaces or uninhabited attics.

Smoke alarms should not be installed in the following locations:

- near heating or air-conditioning supply and return vents;
- near a kitchen appliance;
- near windows, ceiling fans, or bathrooms equipped with a shower or tub;
- where ambient conditions, including humidity and temperature, are outside the limits specified by the manufacturer's instructions;
- within unfinished attics or garages, or in other spaces where temperatures can rise or fall beyond the limits set by the manufacturer;
- where the mounting surface could become considerably warmer or cooler than the rest of the room, such as an inadequately insulated ceiling below an unfinished attic; or
- in dead-air spots, such as the top of a peaked roof or a ceiling-to-wall corner.

**Power and Interconnection**

Power for smoke alarms may come from being hard-wired directly into the home's electrical system, or it may come from just a battery. Hard-wired smoke detectors are more reliable because the power source cannot be removed or drained, although they will not function in a power outage. Battery-operated units often fail because the battery can be easily removed, dislodged or drained, although these units can be installed almost anywhere. Older buildings may be restricted to battery-powered designs, while newer homes generally offer more options for power sources. If possible, homeowners should install smoke alarms that are hard-wired with a battery backup, especially during a renovation or remodeling project.

Smoke alarms may also be interconnected so that if one becomes triggered, they all sound in unison. Interconnected smoke alarms are typically connected with a wire, but new technology allows them to be interconnected wirelessly. The National Fire Protection Agency requires that smoke alarms be AFCI-protected.

**Tips for Homeowners:**

- Parents should stage periodic night-time fire drills to assess whether their children will awaken from the alarm and respond appropriately.
- Never disable a smoke alarm. Use the alarm's silencing feature to stop nuisance or false alarms triggered by cooking smoke or fireplaces.
- Test smoke alarms monthly, and replace their batteries at least twice a year. Change the batteries when you change your clocks for Daylight Saving Time. Most models emit a chirping noise when the batteries are low to alert the homeowner that they need replacement.

- Smoke alarms should be replaced when they fail to respond to testing, or every 10 years, whichever comes first. The radioactive element in ionization smoke alarms will decay beyond usability within 10 years.
- Smoke detectors should be replaced if they become damaged or wet, are accidentally painted over, are exposed to fire or grease, or are triggered without apparent cause.
- Note the sound of the alarm. It should be distinct from other sounds in the house, such as the telephone, doorbell and pool alarm.
- If you have any questions or concerns related to smoke alarms or fire dangers in your home, consult with your Certified Master Inspector® during your next scheduled inspection.

In summary, smoke alarms are invaluable, life-saving appliances when they are installed properly and adequately maintained.

### Fire Sprinklers

In a growing trend that many say will save even more lives than smoke alarms and carbon-monoxide detectors, fire sprinklers are now available for residences.

Every year, residential fires destroy lives and property. In 2007 in the U.S., there were 414,000 residential fires that caused:

- 2,895 fire deaths;
- 14,000 injuries; and
- $7.5 billion in property damage.

Residential sprinklers, listed by the Underwriters Laboratories (UL), are now available to homeowners. The development of chloro-polyvinyl chloride and other listed non-metallic pipe has simplified installation, making sprinkler systems more cost-effective. Because of their improved sensitivity, they are designed to respond to fires much faster than standard commercial and industrial sprinkler systems.

Here are a few facts you might not know about fire sprinklers:

- On average, they use significantly less water to extinguish a fire than would be required by the fire department. Sprinklers use just 10 to 26 gallons per minute (gpm), while fire crews use 125 gpm per hose.
- Insurance premiums are often lower for homes that are equipped with fire sprinklers, which help pay for the systems.
- In houses equipped with sprinklers, 90% of fires are contained by the operation of a single sprinkler head.
- Newer fire sprinkler heads are designed to activate independently of one another, leaving unneeded heads in reserve, and sparing water-sensitive items.
- Fire sprinklers are triggered only by temperatures that surpass a certain heat threshold, making it practically impossible to trigger them accidentally.

A recent study conducted by the UL found that house fires are getting worse; the time needed to escape some types of fires has been reduced from approximately 17 minutes to as little as three minutes, in some situations. According to the study, this change is largely due to the disuse of natural fabrics for furnishings, such as wool, cotton and rayon, in favor of more flammable synthetics, such as polyester and plastic. Sprinkler systems are thus becoming increasingly more important in residences, just as they have been relied upon in commercial buildings for decades.

Sprinklers respond to fires immediately and automatically from locations that may be dangerous for firefighters to reach. In contrast, fire departments can be quite slow to respond, given the following potential delays:

- In rural areas, it may take a long time for fire trucks to reach their destination.
- Calls made at night are responded to more slowly than calls made during the day, as most career and volunteer firefighters are asleep.
- If the 9-1-1 call comes from a cell phone, the dispatcher will have greater difficulty pinpointing the fire's location than if the call comes from a landline.
- While some fire departments are always well-prepared, in many areas, the firefighters require time to assemble, get suited up, and prepare the fire truck.
- Fire trucks can be slowed by traffic, and they can even get lost en route.

In residential applications, sprinklers are smaller than traditional commercial sprinklers, and they can be aesthetically coordinated with any room décor and mounted flush with walls and ceilings. They are also inexpensive, relative to the value of the structure and the potential damage inflicted by a fire. Presently, the cost of a home sprinkler system will add 1% to 1.5% to the cost of new construction, and the price will probably come down in the future. Although more expensive, it is possible to retrofit existing homes with sprinkler systems.

**Tips for Homeowners:**

- Always make sure control valves are in the open position.
- Always report damage to any part of a sprinkler system immediately.
- Never paint a fire sprinkler.
- Never stack items close to fire sprinklers, as this may reduce their heat sensitivity. The tops of stored items and furniture should be at least 18 inches below fire sprinklers, according to the National Fire Sprinkler Association.
- Never hang anything from any part of a fire sprinkler system.

In summary, residential fire sprinklers are a valuable, cost-effective safety addition to any home, although they require periodic maintenance.

### House Numbers

House numbers should be clear enough so that police, the fire department, paramedics, etc., can quickly locate properties in an emergency. House numbers are often the only way that first-responders can identify their intended destinations. A number of jurisdictions have begun enforcing laws through strict fines for homeowners who do not comply with laws that impose requirements for house numbers.

**Local Regulations**

Many municipalities and counties have implemented ordinances requiring property owners to standardize the display of house numbers on buildings. The city of St. Martinville, Louisiana, for instance, is considering requiring its citizens to display street numbers in block numbering that is at least 4 inches tall and is either illuminated at night or has a reflective finish. If the ordinance is passed, the city will fine offenders $200, plus hundreds more in court fees. In Florida, the cities of Clearwater, Largo and St. Petersburg have begun enforcing their own municipal codes that regulate the visibility of house numbers, imposing fines for violators.

**Common Requirements**

In order for house numbers to be visible from the street, Certified Master Inspectors® advise that they should:

- be large. Jurisdictions that regulate the size of street numbers generally require them to be 3 to 6 inches tall. Many jurisdictions require that the numbers be of a certain thickness, such as 1/2-inch, as required by New York City;
- be of a color that contrasts with their background. Reflective numbers are usually helpful because they are easier to see at night than numbers that are not reflective;
- not be obscured by any trees, shrubs, or other permanent objects;
- face the street that is named in the house's address. It does emergency workers no good if the house number faces a different street than the one the workers are traveling on;
- be clearly displayed at the driveway entrance if the house is not visible from the road.

According to 6.5.12 of the International Standards for Inspecting Commercial Properties, inspectors should:

> *Inspect the address or street number to determine that it is visible from the street with numbers in contrast to their background.*

**Future Adjustments**

Even if a house number is currently adequate, it might need adjustment in the future. The following are common reasons for future adjustments:

- The numbers assigned to houses by the municipality occasionally change, and homeowners must adjust their house numbers accordingly.
- The trees or shrubs in front of the house have grown so much that the number is no longer visible. House numbers installed in the winter may be visible during that season but become blocked by budding vegetation by spring or summer.
- House numbers will require maintenance when they get dirty. Numbers may not be reflective or contrasting if they are covered in mud.

- Snow piles created by snow plows during the winter may be high enough to cover the number. If this happens, the number should be raised so this situation does not repeat.

In summary, house numbers serve a critical function for emergency personnel and should be clearly displayed.

## Electrical Safety

### Aluminum Wiring

Between approximately 1965 and 1973, single-strand aluminum wiring was sometimes substituted for copper branch-circuit wiring in residential electrical systems due to the sudden escalating price of copper. After a decade of use by homeowners and electricians, inherent weaknesses were discovered in the metal that led to its disuse as a branch wiring material. Although properly maintained aluminum wiring is acceptable, aluminum will generally become defective faster than copper due to certain qualities inherent in the metal. Neglected connections in outlets, switches and light fixtures containing aluminum wiring become increasingly dangerous over time. Poor connections cause wiring to overheat, creating a potential fire hazard. In addition, the presence of single-strand aluminum wiring may void a homeowner's insurance policy. Homeowners should talk with their insurance agents about whether the presence of aluminum wiring in their home is a problem that requires changes to their policy.

**Facts and Figures**

- In April 1974, two people were killed in a house fire in Hampton Bays, New York. Fire officials determined that the fire was caused by a faulty aluminum wire connection at an outlet.
- According to the Consumer Product Safety Commission (CPSC), "Homes wired with aluminum wire manufactured before 1972 ['old technology' aluminum wire] are 55 times more likely to have one or more connections reach fire hazard conditions than is a home wired with copper."

**Aluminum as a Metal**

Aluminum possesses certain qualities that, compared with copper, make it an undesirable material as an electrical conductor. These qualities all lead to loose connections, when fire hazards become likely. These qualities are as follows:

- higher electrical resistance. Aluminum has a high resistance to electrical current flow, which means that, given the same amperage, aluminum conductors must be of a larger diameter than that required by copper conductors.
- less ductile. Aluminum will fatigue and break down more readily when subjected to bending and other forms of abuse than copper, which is more ductile. Fatigue will cause the wire to break down internally and will increasingly resist electrical current, leading to a buildup of excessive heat.
- galvanic corrosion. In the presence of moisture, aluminum will undergo galvanic corrosion when it comes into contact with certain dissimilar metals.
- oxidation. Exposure to oxygen in the air causes deterioration to the outer surface of the wire. This process is called oxidation. Aluminum wire is more easily oxidized than copper wire, and the compound formed by this process – aluminum oxide – is less conductive than copper oxide. As time passes, oxidation can deteriorate connections and present a fire hazard.
- greater malleability. Aluminum is soft and malleable, meaning it is highly sensitive to compression. After a screw has been over-tightened on aluminum wiring, for instance, the wire will continue to deform or “flow” even after the tightening has ceased. This deformation will create a loose connection and increase electrical resistance in that location.
- greater thermal expansion and contraction. Even more than copper, aluminum expands and contracts with changes in temperature. Over time, this process will cause connections between the wire and the device to degrade. For this reason, aluminum wires should never be inserted into the “stab,” “bayonet” or “push-in” type terminations found on the back of many light switches and outlets.
- excessive vibration. Electrical current vibrates as it passes through wiring. This vibration is more extreme in aluminum than it is in copper, and, as time passes, it can cause connections to loosen.

**Identifying Aluminum Wiring**

- Aluminum wires are the color of aluminum and are easily discernible from copper and other metals.
- Since the early 1970s, wiring-device binding terminals for use with aluminum wire have been marked CO/ALR, which stands for “copper/aluminum revised."
- Look for the word "aluminum" or the initials "AL" on the plastic wire jacket. Where wiring is visible, such as in the attic or electrical panel, homeowners can look for printed or embossed letters on the plastic wire jacket. Aluminum wire may have the word "aluminum," or a specific brand name, such as "Kaiser Aluminum," marked on the wire jacket. Where labels are hard to read, a light can be shined along the length of the wire.
- When was the house built? Homes built or expanded between 1965 and 1973 are more likely to have aluminum wiring than houses built before or after those years.

**Options for Correction**

Aluminum wiring should be evaluated by a qualified electrician who is experienced in evaluating and correcting aluminum wiring problems. Not all licensed electricians are properly trained to deal with defective aluminum wiring. The CPSC recommends the following two methods for correction for aluminum wiring:

- Rewire the home with copper wire. While this is the most effective method, rewiring is expensive and impractical, in most cases.
- Use copalum crimps. The crimp connector repair consists of attaching a piece of copper wire to the existing aluminum wire branch circuit with a specially designed metal sleeve and powered crimping tool. This special connector can be properly installed only with the matching AMP tool. An insulating sleeve is placed around the crimp connector to complete the repair. Although effective, they are expensive (typically around $50 per outlet, switch or light fixture).

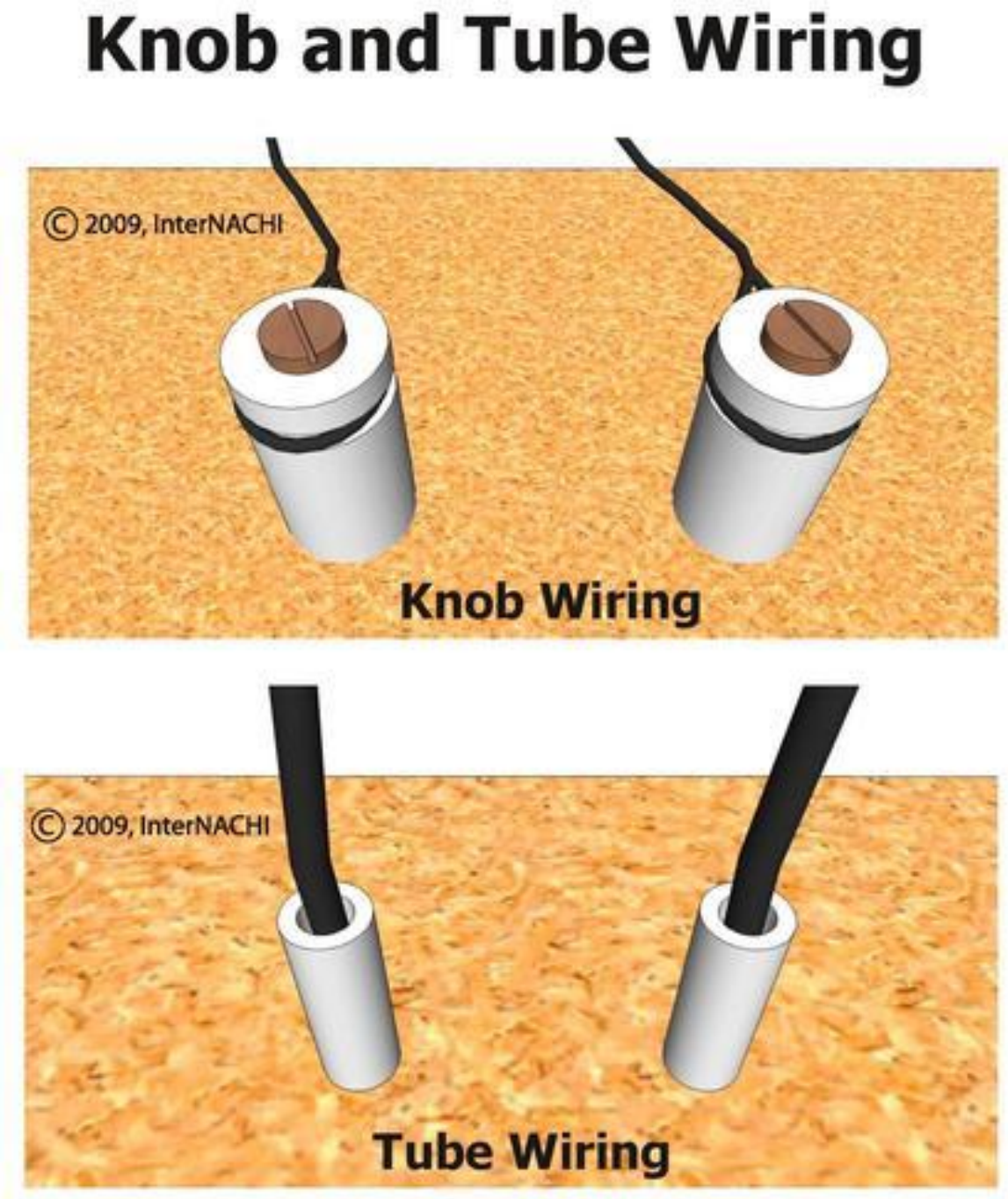
Although not recommended by the CPSC as methods of permanent repair for defective aluminum wiring, the following methods may be considered:

- application of anti-oxidant paste. This method can be used for wires that are multi-stranded or wires that are too large to be effectively crimped.
- pigtailing. This method involves attaching a short piece of copper wire to the aluminum wire with a twist-on connector. the copper wire is connected to the switch, wall outlet or other termination device. This method is only effective if the connections between the aluminum wires and the copper pigtails are extremely reliable. Pigtailing with some types of connectors, even though Underwriters Laboratories might presently list them for the application, can lead to increasing the hazard. Also, beware that pigtailing will increase the number of connections, all of which must be maintained. Aluminum Wiring Repair (AWR), Inc., of Aurora, Colorado, advises that pigtailing can be useful as a temporary repair or in isolated applications, such as the installation of a ceiling fan.
- CO/ALR connections. According to the CPSC, these devices cannot be used for all parts of the wiring system, such as ceiling-mounted light fixtures or permanently wired appliances and, as such, CO/ALR connections cannot constitute a complete repair. Also, according to AWR, these connections often loosen over time.
- alumiconn. Although AWR believes this method may be an effective temporary fix, they are wary that it has little history, and that they are larger than copper crimps and are often incorrectly applied.
- Replace certain failure-prone types of devices and connections with others that are more compatible with aluminum wire.
- Remove the ignitable materials from the vicinity of the connections.

In summary, aluminum wiring can be a fire hazard due to inherent qualities of the metal.

### Knob-and-Tube Wiring

Knob-and-tube (K&T) wiring was an early standardized method of electrical wiring in buildings, in common use in North America from about 1880 to the 1940s. The system is considered obsolete and can be a safety hazard, although some of the fear associated with it is undeserved.



**Facts About Knob-and-Tube Wiring:**

- It is not inherently dangerous. The dangers from this system arise from its age, improper modifications, and situations where building insulation envelops the wires.
- It has no ground wire and thus cannot service any three-pronged appliances.
- While it is considered obsolete, there is no code that requires its complete removal.
- It is treated differently in different jurisdictions. In some areas, it must be removed at all accessible locations, while others merely require that it not be installed in new construction.
- It is not permitted in any new construction.

**How Knob-and-Tube Wiring Works**

K&T wiring consists of insulated copper conductors passing through lumber framing drill holes via protective porcelain insulating tubes. They are supported along their length by nailed-down porcelain knobs. Where wires enter a wiring device, such as a lamp or switch, or were pulled into a wall, they are protected by flexible cloth or rubber insulation called loom.

**Advantages of Knob-and-Tube Wiring:**

- K&T wiring has a higher ampacity than wiring systems of the same gauge. The reason for this is that the hot and neutral wires are separated from one another, usually by 4 to 6 inches, which allows the wires to readily dissipate heat into free air.
- K&T wires are less likely than Romex® cables to be punctured by nails because K&T wires are held away from the framing.
- The porcelain components have an almost unlimited lifespan.
- The original installation of knob-and-tube wiring is often superior to that of modern Romex® wiring. K&T wiring installation requires more skill to install than Romex® and, for this reason, unskilled people rarely ever installed it.

**Problems Associated with K&T Wiring:**

- Unsafe modifications are far more common with K&T wiring than they are with Romex® and other modern wiring systems. Part of the reason for this is that K&T is so old that more opportunity has existed for improper modifications.
- The insulation that envelopes the wiring is a fire hazard.
- It tends to stretch and sag over time.
- It lacks a grounding conductor. Grounding conductors reduce the chance of electrical fire and damage to sensitive equipment.
- In older systems, the wiring is insulated with varnish and fiber materials that are susceptible to deterioration.

Compared with modern wiring insulation, K&T wiring is less resistant to damage. K&T wiring insulated with cambric and asbestos is not rated for moisture exposure. Older systems contain insulation with additives that may oxidize copper wire. Bending the wires may cause insulation to crack and peel away.

K&T wiring is often spliced with modern wiring incorrectly by amateurs. This is perhaps due to the ease by which K&T wiring is accessed.

**Building Insulation**

K&T wiring is designed to dissipate heat into free air, and insulation will disturb this process. Insulation around K&T wires will cause heat to build up, and this creates a fire hazard. The 2008 National Electrical Code (NEC) requires that this wiring system not be covered by insulation. Specifically, it states that this wiring system should not be in…

> *hollow spaces of walls, ceilings and attics where such spaces are insulated by loose, rolled or foamed-in-place insulating material that envelops the conductors.*

Local jurisdictions may or may not adopt the NEC's requirement. The California Electrical Code, for instance, allows insulation to be in contact with knob-and-tube wiring, provided that certain conditions are met, such as, but not limited to, the following:

- A licensed electrical contractor must certify that the system is safe.
- The certification must be filed with the local building department.
- Accessible areas where insulation covers the wiring must be posted with a warning sign. In some areas, this sign must be in English and Spanish.
- The insulation must be non-combustible and non-conductive.
- Normal requirements for insulation must be met.

**Modifications**

When K&T wiring was first introduced, common household electrical appliances were limited to little more than toasters, tea kettles, coffee percolators and clothes irons. The electrical requirements of mid- to late-20$^{th}$ century homes could not have been foreseen during the late 18$^{th}$ century, a time during which electricity was seen as a passing fad to many people. Existing K&T systems are notorious for modifications made in an attempt to match the increasing amperage loads required by televisions, refrigerators, and a plethora of other electrical appliances. Many of these attempts were made by insufficiently trained handymen, rather than experienced electricians, whose work made the wiring system vulnerable to overloading.

Many homeowners adapted to the inadequate amperage of K&T wiring by installing fuses with resistances that were too high for the wiring. The result of this modification is that the fuses would not blow as often and the wiring would suffer heat damage due to excessive amperage loads. It is not uncommon for homeowners to find connections wrapped with masking tape or Scotch tape instead of electrical tape.

**K&T Wiring and Insurance**

Many insurance companies refuse to insure houses that have knob-and-tube wiring due to the risk of fire. Exceptions are sometimes made for houses with such systems that have been deemed safe by an electrical contractor.

**Advice for Homeowners with K&T Wiring:**

- Have the system evaluated by a qualified electrician. Only an expert can confirm that the system was installed and modified correctly.
- Do not run an excessive amount of appliances in the home, as doing so can cause a fire.
- Where the wiring is brittle or cracked, it should be replaced. Proper maintenance is crucial.
- K&T wiring should not be used in kitchens, bathrooms, laundry rooms, or at the exterior. The wiring must be grounded in order to be used safely in these locations.
- Rewiring a house can take weeks and cost thousands of dollars, but unsafe wiring can cause fires, complicate real estate transactions, and make insurers skittish.
- Homeowners should carefully consider their options before deciding whether to rewire their house.
- The homeowner or an electrician should carefully remove any insulation that is found surrounding K&T wires.
- Prospective home buyers should get an estimate of the cost of replacing K&T wiring. They can use this amount to negotiate a lower price for the house.

In summary, knob-and-tube wiring is likely to be a safety hazard due to improper modifications and the addition of building insulation.

## Ungrounded Electrical Receptacles

Grounding of electrical receptacles (which some laypeople refer to as outlets) is an important safety feature that has been required in new construction since 1962, as it minimizes the risk of electric shock and protects electrical equipment from damage. Modern grounded 120-volt receptacles in the United States have a small, round ground slot centered below two vertical hot and neutral slots, and it provides an alternate path for electricity that may stray from an appliance. Older homes often have ungrounded, two-slot receptacles that are outdated and potentially dangerous.

Homeowners sometimes attempt to perform the following dangerous modifications to ungrounded receptacles:

- the use of an adapter, also known as a "cheater plug." Adapters permit the ungrounded operation of appliances that are designed for grounded operation. These are a cheaper alternative to replacing ungrounded receptacles but are less safe than properly grounding the connected appliance;
- replacing a two-slot receptacle with a three-slot receptacle without re-wiring the electrical system so that a path to ground is provided to the receptacle. While this measure may serve as a seemingly proper receptacle for three-pronged appliances, this “upgrade” is potentially more dangerous than the use of an adapter because the receptacle will appear to be grounded and future owners might never be aware that their system is not grounded. If a house still has knob-and-tube wiring, it is likely that any three-slot receptacles are ungrounded; and
- removal of the ground pin from an appliance. This common procedure not only prevents grounding but also bypasses the appliance’s polarizing feature, since a de-pinned plug can be inserted into the receptacle upside-down.

While homeowners may be made aware of the limitations of ungrounded electrical receptacles, upgrades are not necessarily required. Many small electrical appliances, such as alarm clocks and coffee makers, are two-pronged and are thus unaffected by a lack of grounding in the home’s electrical system.

However, upgrading the system will bring it closer to modern safety standards, and this may be accomplished in the following ways:

- Install three-slot receptacles and wire them so that they’re correctly grounded.
- Install ground-fault circuit interrupters (GFCIs). These can be installed upstream or at the receptacle itself. GFCIs are an accepted replacement because they protect against electric shocks even in the absence of grounding, but they may not protect the powered appliance. Also, GFCI-protected ungrounded receptacles may not work effectively with surge protectors. Ungrounded GFCI-protected receptacles should be identified with labels that come with the new receptacles that state: “No Equipment Ground.”
- Replace three-slot receptacles with two-slot receptacles. Two-slot receptacles correctly represent that the system is ungrounded, lessening the chance that they will be used improperly.

Neither homeowners nor unqualified professionals should attempt to modify a building’s electrical components. Misguided attempts to ground receptacles to a metallic water line or ground rod may be dangerous.

In summary, adjustments should be made by qualified electricians -- not homeowners -- to an electrical system to upgrade ungrounded receptacles to meet modern safety standards and the requirements of today's typical household appliances and electronics.

## Ground-Fault Circuit Interrupters (GFCIs)

**What is a GFCI?**

A ground-fault circuit interrupter, or GFCI, is a device used in electrical wiring to disconnect a circuit when unbalanced current is detected between an energized conductor and a neutral return conductor. Such an imbalance is sometimes caused by current "leaking" through a person who is simultaneously in contact with a ground and an energized part of the circuit, which could result in a lethal shock. GFCIs are designed to provide protection in such a situation, unlike standard circuit breakers, which guard against overloads, short circuits and ground faults.

It is estimated that about 300 deaths by electrocution occur every year, so the use of GFCIs has been adopted in new construction, and recommended as an upgrade in older construction, in order to mitigate the possibility of injury or fatality from electric shock.

**History**

The first high-sensitivity system for detecting current leaking to ground was developed by Henri Rubin in 1955 for use in South African mines. This cold-cathode system had a tripping sensitivity of 250 mA (milliamperes), and was soon followed by an upgraded design that allowed for adjustable trip-sensitivity from 12.5 to 17.5 mA. The extremely rapid tripping after earth leakage-detection caused the circuit to de-energize before electric shock could drive a person's heart into ventricular fibrillation, which is usually the specific cause of death attributed to electric shock.

Charles Dalziel first developed a transistorized version of the ground-fault circuit interrupter in 1961. Through the 1970s, most GFCIs were of the circuit-breaker type. This version of the GFCI was prone to frequent false trips due to poor alternating-current characteristics of 120-volt insulations. Especially in circuits with long cable runs, current leaking along the conductors' insulation could be high enough that breakers tended to trip at the slightest imbalance.

Since the early 1980s, ground-fault circuit interrupters have been built into outlet receptacles, and advances in design in both receptacle and breaker types have improved reliability while reducing instances of "false trips," also known as nuisance-tripping.

**NEC Requirements for GFCIs**

The National Electrical Code (NEC) has included recommendations and requirements for GFCIs in some form since 1968, when it first allowed for GFCIs as a method of protection for underwater swimming pool lights. Throughout the 1970s, GFCI installation requirements were gradually added for 120-volt receptacles in areas prone to possible water contact, including bathrooms, garages, and receptacles located outdoors.

The 1980s saw additional requirements implemented. During this period, kitchens and basements were added as areas that were required to have GFCIs, as well as boat houses, commercial garages, and indoor pools and spas. New requirements during the '90s included crawlspaces, wet bars and rooftops. In 1996, GFCIs were mandated for all temporary wiring for construction, remodeling, maintenance, repair, demolition, and similar activities.

The 2008 NEC contains additional updates relevant to GFCI use, as well as some exceptions for certain areas. The 2008 language is presented here for reference.

**2008 NEC on GFCIs**

***100.1 Definition***

*100.1 Definitions. Ground-Fault Circuit Interrupter. A device intended for the protection of personnel that functions to de-energize a circuit or portion thereof within an established period of time when a current to ground exceeds the values established for a Class A device.*

*FPN: Class A ground-fault circuit interrupters trip when the current to ground has a value in the range of 4 mA to 6 mA. For further information, see UL 943, standard for Ground-Fault Circuit Interrupters.*

***210.8(A)&(B) Protection for Personnel***

*210.8 Ground-Fault Circuit Interrupter Protection for Personnel.*

*(A) Dwelling Units. All 125-volt, single-phase, 15- and 20-ampere receptacles installed in the locations specified in (1) through (8) shall have ground-fault circuit-interrupter protection for personnel.*

*(1) bathrooms;*

*(2) garages, and also accessory buildings that have a floor located at or below grade level not intended as habitable rooms and limited to storage areas, work areas, and areas of similar use;*

*Exception No. 1: Receptacles not readily accessible.*

*Exception No. 2: A single receptacle or a duplex receptacle for two appliances that, in normal use, is not easily moved from one place to another and that is cord-and-plug connected in accordance with 400.7(A)(6), (A)(7), or (A)(8).*

*Receptacles installed under the exceptions to 210.8(A)(2) shall not be considered as meeting the requirements of 210.52(G)*

*(3) outdoors;*

*Exception: Receptacles that are not readily accessible and are supplied by a dedicated branch circuit for electric snow melting or de-icing equipment shall be permitted to be installed in accordance with the applicable provisions of Article 426.*

*(4) crawlspaces at or below grade level.*

*Exception No. 1: Receptacles that are not readily accessible.*

*Exception No. 2: A single receptacle or a duplex receptacle for two appliances that, in normal use, is not easily moved from one place to another and that is cord-and-plug connected in accordance with 400.7(A)(6), (A)(7), or (A)(8).*

*Exception No. 3: A receptacle supplying only a permanently installed fire alarm or burglar alarm system shall not be required to have ground-fault circuit interrupter protection.*

*Receptacles installed under the exceptions to 210.8(A)(2) shall not be considered as meeting the requirements of 210.52(G)*

*(6) kitchens, where the receptacles are installed to serve the countertop surfaces;*

*(7) wet bar sinks, where the receptacles are installed to serve the countertop surfaces and are located within 6 feet of the outside edge of the wet bar sink;*

*(8) boathouses;*

*(B) Other Than Dwelling Units. All 125-volt, single-phase, 15- and 20-ampere receptacles Installed in the locations specified in (1), (2), and (3) shall have ground-fault circuit interrupter protection for personnel:*

*(1) bathrooms;*

*(2) rooftops;*

*Exception: Receptacles that are not readily accessible and are supplied by a dedicated branch circuit for electric snow-melting or de-icing equipment shall be permitted to be installed in accordance with the applicable provisions of Article 426.*

*(3) kitchens.*

**Testing Receptacle-Type GFCIs**

Receptacle-type GFCIs are currently designed to allow for safe and easy testing that can be performed without any professional or technical knowledge of electricity. GFCIs should be tested right after installation to make sure they are working properly and protecting the circuit. They should also be tested once a month to make sure they are working properly and are providing protection from fatal shock.

To test the receptacle GFCI, first plug a nightlight or lamp into the outlet. The light should be on. Then press the "TEST" button on the GFCI. The "RESET" button should pop out, and the light should turn off.

If the "RESET" button pops out but the light does not turn off, the GFCI has been improperly wired. Contact an electrician to correct the wiring errors.

If the "RESET" button does not pop out, the GFCI is defective and should be replaced.

If the GFCI is functioning properly and the lamp turns off, press the "RESET" button to restore power to the outlet.

## Arc-Fault Circuit Interrupters (AFCIs)

Arc-fault circuit interrupters (AFCIs) are special types of electrical receptacles or outlets and circuit breakers designed to detect and respond to potentially dangerous electrical arcs in home branch wiring.

**How do they work?**

AFCIs function by monitoring the electrical waveform and promptly opening (interrupting) the circuit they serve if they detect changes in the wave pattern that are characteristic of a dangerous arc. They also must be capable of distinguishing safe, normal arcs (such as those created when a switch is turned on or a plug is pulled from a receptacle) from arcs that can cause fires. An AFCI can detect, recognize and respond to very small changes in wave pattern.

**What is an arc?**

When an electric current crosses an air gap from an energized component to a grounded component, it produces a glowing plasma discharge known as an arc. For example, a bolt of lightning is a very large, powerful arc that crosses an atmospheric gap from an electrically charged cloud to the ground or another cloud. Just as lightning can cause fires, arcs produced by domestic wiring are capable of producing high levels of heat that can ignite their surroundings and lead to structure fires.

According to statistics from the National Fire Protection Agency for the year 2005, electrical fires damaged approximately 20,900 homes, killed 500 people, and cost $862 million in property damage.

Although short-circuits and overloads account for many of these fires, arcs are responsible for the majority and are undetectable by traditional (non-AFCI) circuit breakers.

**Where are arcs likely to form?**

Arcs can form where wires are improperly installed or when insulation becomes damaged. In older homes, wire insulation tends to crystallize as it ages, becoming brittle and prone to cracking and chipping. Damaged insulation exposes the current-carrying wire to its surroundings, increasing the chances that an arc may occur.

Situations in which arcs may be created:

- electrical cords damaged by vacuum cleaners or trapped beneath furniture or doors.
- damage to wire insulation from nails or screws driven through walls.
- appliance cords damaged by heat, natural aging, kinking, impact, or over-extension.
- spillage of liquid.
- loose connections in outlets, switches and light fixtures.

**Where are AFCIs required?**

Locations in which AFCIs are required depend on the building codes adopted by their jurisdiction.

The 2006 International Residential Code (IRC) requires that AFCIs be installed within bedrooms in the following manner:

*E3802.12 Arc-Fault Protection of Bedroom Outlets. All branch circuits that supply120-volt, single-phase, 15- and 20-amp outlets installed in bedrooms shall be protected by a combination-type or branch/feeder-type arc-fault circuit interrupter installed to provide protection of the entire branch circuit.*

*Exception: The location of the arc-fault circuit interrupter shall be permitted to be at other than the origination of the branch circuit, provided that:*

- *the arc-fault circuit interrupter is installed within 6 feet of the branch circuit overcurrent device, as measured along the branch circuit conductor; and*
- *the circuit conductors between the branch circuit overcurrent device and the arc-fault circuit interrupter are installed in a metal raceway or a cable with metallic sheathing.*

The National Electrical Code (NEC) offers the following guidelines concerning AFCI placement within bedrooms:

*Dwelling Units. All 120-volt, single-phase, 15- and 20-ampere branch circuits supplying outlets installed in dwelling units in family rooms, dining rooms, living rooms, parlors, libraries, dens, sun rooms, recreation rooms, closets, hallways, and similar rooms or areas shall be protected by a listed arc-fault circuit interrupter, combination-type installed to provide protection of the branch circuit.*

Some jurisdictions do not yet require their implementation in locations where they can be helpful.

**What types of AFCIs are available?**

AFCIs are available as circuit breakers for installation in the electrical distribution panel.

**Nuisance Tripping**

An AFCI may activate in situations that are not dangerous and create needless power shortages. This can be particularly annoying when an AFCI stalls power to a freezer or refrigerator, allowing its contents to spoil. There are a few procedures an electrical contractor can perform in order to reduce potential “nuisance tripping," such as:

- Check that the load power wire, panel neutral wire, and load neutral wire are properly connected.
- Check wiring to ensure that there are no shared neutral connections.
- Check the junction box and fixture connections to ensure that the neutral conductor contacts a grounded conductor.

**Arc Faults vs. Ground Faults**

It is important to distinguish AFCI devices from ground-fault circuit interrupter (GFCI) devices. GFCIs detect ground faults, which occur when current leaks from a hot (ungrounded) conductor to a grounded object as a result of a short circuit. This situation can be hazardous when a person unintentionally becomes the current’s path to the ground. GFCIs function by constantly monitoring the current flow between hot and neutral (grounding) conductors, and activate when they sense a difference of 5 milliamps or more. Thus, GFCIs are intended to prevent personal injury due to electric shock, while AFCIs prevent personal injury and property damage due to structure fires.

In summary, AFCIs are designed to detect small arcs of electricity before they have a chance to lead to a structure fire.

## Electric Fences

Electric fences are a "fear" barrier that use electric shock to delineate a boundary and discourage animals and people from crossing it. Primarily, they are used to protect livestock and domestic pets by preventing them from leaving a sanctioned area and by deterring predators from entering the area.

An effective electric fence involves the interconnection of the following four components:

- The **energizer** turns low-voltage battery power, household current, or converted sunlight into a high-voltage electric shock.
- The **conductor** is the wire that transmits the energizer's shock to the animal or person who touches it. This is usually galvanized or aluminum-coated steel wire, or poly-tape or poly-rope wire. Manufactured in a number of configurations, all "poly" wires contain tiny stainless steel or copper wires woven into the synthetic fabric, enabling them to conduct electricity.
- The **post** supports the conductor at the desired height, while the **insulator** prevents the electricity in the wire from leaking into the ground through the post. Some posts are non-conductive and thus do not require an insulator.
- The **ground** is typically composed of metal rods driven into the soil near the energizer and are connected to it by a wire. A complete circuit occurs when an animal or person touches the conductor, allowing electricity to flow from the conductor through their body and into the soil, where moisture carries the current to the ground rods and back into the energizer. The absence of a ground circuit is how a bird can casually rest on a high-voltage power line.

In general, an electric fence should be supplied with only enough power to startle -- not injure -- so that an animal that brushes up against the fence will recoil but not suffer electrical burns or permanent injury. The feeling should be similar to the stinging sensation of a snapped rubber band. Exceptions are made for prisons, military installations, and vital utility stations to discourage escapes and vandalism attempts.

Fences that are too strongly electrified for their application, whether by accident or design, are a serious safety hazard. Aside from unnecessarily and inhumanely exposing farm animals or pets to unsafe shocks, homeowners must consider the inherent dangers that these fences may pose to firefighters, police and trespassers. Note that "trespasser" can refer to an innocent child, such as a 6-year-old Texas girl who was killed instantly when she touched a neighbor's electric fence. The investigating police captain said the amperage was far too high, "enough to power half of a house. She didn't have time to scream for help, close her eyes... nothing," according to KLTV. The owner of the fence pleaded guilty to criminally negligent homicide.

Other cases of over-powered fences abound; an elderly New York woman was killed when she tried to free her pet from an electric fence. The voltage was too high and the fence lacked a regulator to pulse the shock. A Colorado man even succumbed to his own fence –- a DIY project designed to keep his dogs in the yard, yet set to deliver lethal voltage, and designed without a regulator. (He did, however, receive a posthumous Darwin Award for his efforts.)

**A few Additional Tips:**

- Lightning is one of the main causes of electric fence fires and controller malfunction. Use the following strategies to minimize lightning dangers:

- Disconnect the controller from the fence line and power source before a storm is expected.
- Install a lightning diverter (commonly referred to as a lightning arrestor) between the fence and the controller. This will divert a lightning strike's electricity to the earth before it does any damage to the controller.
- Install a surge suppressor to protect the controller on the utility side. The suppressor is plugged into the outlet and the controller is plugged into the suppressor.
- Install a cutoff switch as a quick way to disconnect the fence from the controller without actually getting near the fence. This switch also allows the fence to be conveniently turned off while it's being worked on.

- The energizer must be sized properly for the type of animal to be contained within the perimeter. Extra voltage may be required for sheep, for instance, as their thick wool (especially in the winter) is an effective insulator against shock. Their burned wool can wrap around the conductor and further nullify the shock against the rest of the herd, as the other sheep follow the first sheep into the road, a neighbor's yard, or into a waiting pack of hungry coyotes. Of course, the size of the animal is also a factor, as a small dog will not need as much of a jolt as a horse. The length of the fence must be considered, too, as the potency of the shock will dissipate if it's forced to travel too far from the conductor.

- Poor grounding weakens the electric shock and can interfere with radios, telephones and televisions. Multiple ground rods should be installed, each 6 to 8 feet long, and attached with adequate ground clamps. In very dry or cold climates, a ground wire may be needed to run parallel to the hot wire so that the system does not depend on insulating dry or frozen soil.

- Poly-tape and poly-rope give greater tensile strength and are useful in high-voltage applications, although most electric fences are made from aluminum or galvanized steel. Never use more than one type of metal, as galvanic corrosion can occur when two different metals are hooked together, weakening the connection and the whole electric fence.

- Fences should be equipped with warning signs that alert passersby to their danger, as it isn't always obvious that a fence is electrified. In one bizarre instance that was conveniently captured by a security camera, a man was knocked unconscious when he urinated on a fence that he did not realize was electrified. Signage will also protect the homeowner against liability.

- Equip the fence with a light that shines when the fence is not operational. This way, fence operators can quickly fix a malfunction before penned animals become wise to the failing. Professionals can tell if a fence is working by touching the metal end of a long screwdriver to the conductor while holding the plastic insulated end. An active fence should create a visible, audible arc. Do not use an uninsulated item for this purpose, such as a blade of grass.

- Never touch a fence that may be electrified (or any live circuits of hazardous voltage) with two hands, as this will allow the current to travel through the heart and lungs. Always keep one hand in your pocket so you don't accidentally touch something that will turn a painful but non-lethal shock into cardiac arrest.

- Never electrify barbed-wire fences. It takes little imagination to picture what will happen if electrified barbs become trapped in an animal's fur.

- Keep flammable materials far from the electric fence. Small sparks and arcs can easily occur due to weather conditions, lightning strikes, vegetation brushing against the fence, and fence malfunctions.

- Be sure to purchase high-quality, long-lasting insulators that will not degrade from exposure to ultraviolet light. Cheap insulators will grow weak and eventually shatter.

- Plant fence posts solidly, at least 2 feet in the ground in solid earth or concrete, especially if you plan to contain large animals. Space the posts far enough apart so that the wires have room to bend, rather than forcing undue stress on the posts and insulators.

In summary, electric fences are useful and practical deterrents in a number of applications, both commercial and residential. But improperly maintained or designed electric fences can seriously injure or kill animals and humans.

## Generators

Homeowners may use a generator to supply electricity to their home in the case of a power outage, either out of necessity or convenience. Homeowners may want to know about generators and the potential hazards they present when improperly wired or utilized.

**Generator Types**

There are two main types of generators: permanently installed standby generators; and gasoline-powered portable generators.

**Standby Generators**

Standby generators typically operate on natural gas or liquid propane. They remain fixed in place outside the home and are designed to supply on-site power to specified circuits through a home's electrical wiring. These generators work in tandem with a manual or automatic transfer switch, which automatically detects an interruption in grid-powered electricity and subsequently transfers over electrical input to the generator. The transfer switch suspends input from the generator once it senses that utility-powered electricity has resumed. Generators for small- to medium-size homes are typically air-cooled and employ fans to regulate the temperature inside the unit. Liquid-cooled units are used for the larger energy loads in larger homes.

Some advantages of standby generators are as follows:

- They may be turned on manually, or they may be programmed to switch on automatically in the case of a power outage even when no one is home.
- Power may be supplied for extended periods of time.
- Hard-wired systems, such as a home's furnace, well pump and air conditioner, may maintain continuous power.
- Uninterrupted power can be supplied to systems that must remain turned on continuously, such as home medical equipment used for breathing, etc.

Disadvantages of standby generators:

- Installation may require a permit.
- A qualified technician, such as an electrician, is required to install the ATS and to determine the electrical load requirements for the circuits in the home.
- Routine maintenance is required.
- Standby generators may be prohibitively expensive for the average homeowner.

**Portable Generators**

Gasoline-powered portable generators are typically smaller in size and power capacity than permanently installed generators. They are designed so that corded electrical devices can be plugged directly into them.

Advantages of portable generators:

- They're versatile. They may be used at home or transported and utilized in remote locations, such as a campground or construction site.
- They do not require complicated installation.
- They typically do not require a permit.
- Portable units are generally less expensive than standby generators.

Disadvantages of portable generators:

- Devices that are hard-wired into a home's electrical system cannot be powered by a portable generator if no transfer switch is installed.

**Hazards**

- Portable and standby generators produce dangerous carbon monoxide (CO) gas, which can be deadly if inhaled.
- Inexperienced installers are exposed to the risk of electrical shock. Only qualified electricians should attempt to install a generator.

- Overloading a generator may result in reduced fuel efficiency, damage to appliances, or fire.
- Standby generators and their required transfer switches that are incorrectly wired or missing may result in "back-feed" -- a hazardous condition in which an electrical current is fed back into the grid -- which could potentially electrocute and kill homeowners, utility workers, and others who are using the same utility transformer.
- Connecting a portable generator directly into a home's wall outlet can also cause dangerous back-feed.
- Generators that are exposed to water or that are not properly grounded can cause electrocution.
- Gasoline for portable generators is highly flammable and may cause a fire when exposed to an open flame or when spilled on the hot generator.
- Over-taxed cords attached to a portable generator may cause a fire.

**Inspection**

Homeowners should check for the following:

- Generators should never be used anywhere indoors, even if the area is ventilated.
- Portable generators placed outside should not be near doors, vents, or open windows leading into the home.
- Carbon-monoxide detectors should be installed in case CO is accidentally released into the home.
- A portable generator should not be plugged directly into a home's electrical receptacle. Only a heavy-duty three-prong electrical cord that's rated for outdoor use should be used to connect the generator to the power source.
- A standby generator hard-wired into a home should have a transfer switch installed to prevent back-feeding. A Certified Master Inspector® can locate this device so that it's situated between the generator and the main electrical panel.
- Generators should be properly grounded.
- Units should be dry and shielded from contact with liquid.
- Electrical cords should not have any punctures or exposed wiring.
- Cords running from portable generators should be kept out of the way of foot traffic and should not run underneath rugs.
- The total electrical capacity of the generator should exceed the power requirements of the devices that the unit is supplying.
- Fuel for portable generators should be stored away from the home (and children) in clearly labeled and durable containers.

In summary, generators can be lifesavers during a power outage, but they present serious health and safety concerns if they are not installed and used properly.

# Environmental Concerns

## Asbestos

**What is asbestos?**

Asbestos is a mineral fiber that can be positively identified only with a special type of microscope. There are several types of asbestos fibers. In the past, asbestos was added to a variety of products to strengthen them and to provide heat insulation and fire resistance.

**How can asbestos affect my health?**

From studies of people who were exposed to asbestos in factories and shipyards, we know that breathing high levels of asbestos fibers can lead to an increased risk of lung cancer in the form of mesothelioma, which is a cancer of the lining of the chest and the abdominal cavity, and asbestosis, in which the lungs become scarred with fibrous tissue.

The risk of lung cancer and mesothelioma increase with the number of fibers inhaled. The risk of lung cancer from inhaling asbestos fibers is also higher for smokers. People who get asbestosis have usually been exposed to high levels of asbestos for a long time. The symptoms of these diseases do not typically appear until about 20 to 30 years after the first exposure to asbestos.

Most people exposed to small amounts of asbestos, as we all are in our daily lives, do not develop these health problems. However, if disturbed, asbestos material may release asbestos fibers, which can be inhaled into the lungs. The fibers can remain there for a long time, increasing the risk of disease. Asbestos material that is in a friable state – that is, if it would crumble easily if handled, or if it has been sawed, scraped, or sanded into a powder – is more likely to be a health hazard.

**Where would I find asbestos and when can it be a problem?**

Most products made today do not contain asbestos. The few products still made that contain asbestos that could be inhaled are required to be labeled as such. However, until the 1970s, many types of building products and insulation materials used in homes contained asbestos. Common products that may have contained asbestos in the past, and conditions which may release fibers, include:

- steam pipes, boilers, and furnace ducts insulated with an asbestos blanket or asbestos paper tape. These materials may release asbestos fibers if damaged, repaired, or removed improperly;
- resilient floor tiles (vinyl asbestos, asphalt and rubber), the backing on vinyl sheet flooring, and adhesives used for installing floor tile. Sanding tiles can release fibers, and so can scraping or sanding the backing of sheet flooring during removal;

- cement sheet, millboard, and paper used as insulation around furnaces and wood-burning stoves. Repairing or removing appliances may release asbestos fibers, and so may cutting, tearing, sanding, drilling, or sawing insulation;
- door gaskets in furnaces, wood stoves and coal stoves. Worn seals can release asbestos fibers during use;
- soundproofing or decorative material sprayed on walls and ceilings. Loose, crumbly or water-damaged material may release fibers, and so will sanding, drilling or scraping the material;
- patching and joint compounds for walls and ceilings, and textured paints. Sanding, scraping or drilling these surfaces may release asbestos fibers;
- asbestos cement roofing, shingles and siding. These products are not likely to release asbestos fibers unless sawed, drilled or cut;
- artificial ashes and embers sold for use in gas-fired fireplaces, and other older household products, such as fireproof gloves, stove-top pads, ironing board covers, and certain hairdryers; and
- automobile brake pads and linings, clutch facings, and gaskets.

**Where Asbestos Hazards May Be Found in the Home**

- Some roofing and siding shingles are made of asbestos cement.
- Houses built between 1930 and 1950 may have asbestos as insulation.
- Asbestos may be present in textured paint and in patching compounds used on wall and ceiling joints. Their use was banned in 1977.
- Artificial ashes and embers sold for use in gas-fired fireplaces may contain asbestos.
- Older products, such as stove-top pads, may contain some asbestos compounds.
- Walls and floors around wood-burning stoves may be protected with asbestos paper, millboard, or cement sheets.
- Asbestos is found in some vinyl floor tiles and the backing on vinyl sheet flooring and adhesives.
- Hot water and steam pipes in older houses may be coated with an asbestos material or covered with an asbestos blanket or tape.
- Oil and coal furnaces and door gaskets may have asbestos insulation.

**What should be done about asbestos in the home?**

If you think asbestos may be in your home, don't panic. Usually, the best thing to do is to leave alone any asbestos material that is in good condition. Generally, material in good condition will not release asbestos fibers. There is no danger unless the asbestos is disturbed and its fibers are released and then inhaled into the lungs. Check the material regularly if you suspect it may contain asbestos. Don't touch it, but look for signs of wear or damage, such as tears, abrasions, and water damage. Damaged material may release asbestos fibers. This is particularly true if you often disturb it by hitting, rubbing or handling it, or if it is exposed to extreme vibration or air flow. Sometimes, the best way to deal with slightly damaged material is to limit access to the area and not touch or disturb it. Discard damaged or worn asbestos gloves, stove-top pads, and ironing board covers. Check with local health, environmental or other appropriate agencies to find out about proper handling and disposal procedures.

If asbestos material is more than slightly damaged, or if you are going to make changes in your home that might disturb it, repair or removal by a professional is needed. Before you have your house remodeled, find out whether asbestos materials are present.

**How to Identify Materials That Contain Asbestos**

You can't tell whether a material contains asbestos simply by looking at it, unless it is labeled. If in doubt, treat the material as if it contains asbestos, or have it sampled and analyzed by a qualified professional. A professional should take samples for analysis, since a professional knows what to look for, and because there may be an increased health risk if its fibers are released. In fact, if done incorrectly, sampling can be more hazardous than leaving the material alone. Taking samples yourself is not recommended. If you nevertheless choose to take the samples yourself, take care not to release any asbestos fibers into the air or onto yourself. Material that is in good condition and will not be disturbed (by remodeling, for example) should be left alone. Only material that is damaged and is in a friable state and material that will be disturbed should be sampled. Anyone who samples asbestos-containing materials should have as much information as possible on its proper handling beforehand.

When sampling asbestos for lab analysis, the person should observe the following procedures:

- Make sure no one else is in the room when the sampling is done.
- Wear disposable gloves and wash hands after sampling.
- Shut down any heating or cooling systems to minimize the spread of any airborne fibers.
- Do not disturb the material any more than is necessary to take a small sample.
- Place a plastic sheet on the floor below the area to be sampled.
- Wet the material using a fine mist of water containing a few drops of detergent before taking the sample. The water/detergent mist will reduce the release of asbestos fibers into the air.
- Carefully cut a piece from the entire depth of the material using a small knife, corer or other sharp object. Place the small piece into a clean container, such as a 35-mm film canister, small glass or plastic vial, or a high-quality re-sealable plastic bag.
- Tightly seal the container after placing the sample in it.
- Carefully dispose of the plastic sheet. Use a damp paper towel to clean up any material on the outside of the container and around the area sampled. Dispose of asbestos materials according to state and local procedures.
- Label the container with an identification number and clearly state when and from where the sample was taken.
- Patch the sampled area with the smallest possible piece of duct tape to prevent fiber release.
- Send the sample to an asbestos analysis laboratory accredited by the National Voluntary Laboratory Accreditation Program (NVLAP) at the National Institute of Standards and Technology (NIST). Your state or local health department may also be able to help.

**How to Manage an Asbestos Problem**

If the asbestos material is in undamaged condition and is not going to be disturbed, do nothing. If it is a problem, there are two types of corrections: repair and removal. Repair usually involves either sealing or covering asbestos material. Sealing or encapsulation involves treating the material with a sealant that either binds the asbestos fibers together or coats the material so that fibers are not released. Pipe, furnace and boiler insulation can sometimes be repaired this way. This should be done only by a professional trained to handle asbestos safely. Covering or enclosure involves placing something over or around the material that contains asbestos to prevent the release of fibers. Exposed insulated piping may be covered with a protective wrap or jacket. With any type of repair, the asbestos remains in place. Repair is usually cheaper than removal, but it may make removal of asbestos later (if found to be necessary) more difficult and costly. Repairs can be major or minor. Major repairs must be done only by a professional trained in methods for safely handling asbestos. Minor repairs should also be done by professionals, since there is always a risk of exposure to fibers when asbestos is disturbed.

**Repairs**

Doing minor repairs yourself is not recommended, since improper handling of asbestos materials can create a hazard where none existed previously. If you choose to do minor repairs yourself, you should have as much information as possible on the safe handling of asbestos beforehand. Contact your state or local health department or regional EPA office for information about asbestos training programs in your area. Your local school district may also have information about asbestos professionals and training programs. Even if you have completed a training program, do not try anything more than minor repairs. Before undertaking minor repairs, carefully examine the area around the damage to make sure it is stable. As a general rule, any damaged area that is bigger than the size of your hand is not considered a minor repair.

Before undertaking minor repairs, be sure to follow all the precautions described previously for sampling asbestos material. Always wet the asbestos material using a fine mist of water containing a few drops of detergent. Commercial products designed to fill holes and seal damaged areas are available. Small areas of material, such as pipe insulation, can be covered by wrapping a special fabric, such as re-wettable glass cloth, around it. These products are available from stores (listed in the directory under "Safety Equipment and Clothing") that specialize in asbestos materials and safety items.

Removal is usually the most expensive method and, unless required by state or local regulations, should be the last option considered in most situations. This is because removal poses the greatest risk of fiber release. However, removal may be required when remodeling or making major changes to your home that will disturb asbestos material. Also, removal may be called for if asbestos material is damaged extensively and cannot be otherwise repaired. Removal is complex and must be done only by a contractor with special training. Improper removal may actually increase the health risks to you and your family.

**Asbestos Professionals: Who Are They and What Can They Do?**

Asbestos professionals are trained in handling asbestos material. The type of professional will depend on the type of product and what needs to be done to correct the problem. You may hire a general asbestos contractor or, in some cases, a professional trained to handle specific products containing asbestos.

Asbestos professionals can conduct inspections, take samples of suspected material, assess its condition, and advise on the corrections that are needed, as well as the specific personnel qualified to make these corrections. Once again, material in good condition need not be sampled unless it is likely to be disturbed. Professional correction or abatement contractors repair and remove asbestos materials.

Some firms offer combinations of testing, assessment and correction. A professional hired to assess the need for corrective action should not be connected with an asbestos-correction firm. It is better to use two different firms so that there is no conflict of interest. Services vary from one area to another around the U.S.

The federal government offers training courses for asbestos professionals around the country. Some state and local governments also offer or require training or certification courses. Ask your asbestos professional to document their completion of federal- or state-approved training. Each person performing work in your home should provide proof of training and licensing in asbestos work, such as completion of EPA-approved training. State and local health departments or EPA regional offices may have listings of licensed professionals in your area.

If you have a problem that requires the services of asbestos professionals, check their credentials carefully. Hire professionals who are trained, experienced, reputable and accredited -- especially if accreditation is required by state or local laws. Before hiring a professional, ask for references from previous clients. Find out if they were satisfied. Ask whether the professional has handled similar situations. Get cost estimates from several professionals, as the charges for these services can vary.

Though private homes are usually not covered by the asbestos regulations that apply to schools and other public buildings, asbestos professionals should still use the procedures described in federal- or state-approved training. Homeowners should be alert to the chance of misleading claims by asbestos consultants and contractors. There have been reports of firms incorrectly claiming that asbestos materials in homes must be replaced. In other cases, firms have encouraged unnecessary removal or performed it improperly. Unnecessary removal is a waste of money. Improper removal may actually increase the health risks to you and your family. To guard against this, know what services are available and what procedures and precautions are needed to do the job properly.

In addition to general asbestos contractors, you may select a roofing, flooring or plumbing contractor trained to handle asbestos when it is necessary to remove and replace roofing, flooring, siding or asbestos-cement pipe that is part of a plumbing system. Normally, roofing and flooring contractors are exempt from state and local licensing requirements because they do not perform any other asbestos-correction work.

Asbestos-containing automobile brake pads and linings, clutch facings, and gaskets should be repaired and replaced only by a professional using special protective equipment. Many of these products are now available without asbestos.

If you hire a Certified Master Inspector® who is trained in asbestos inspection:

- Make sure that the inspection will include a complete visual examination, and the careful collection and lab analysis of samples. If asbestos is present, the inspector should provide a written evaluation describing its location and extent of damage, and give recommendations for correction.
- Make sure an inspecting firm makes frequent site visits if it is hired to assure that a contractor follows proper procedures and requirements during a construction or remodeling project. The inspector may recommend and perform checks after the correction to assure that the area has been properly cleaned.

If you hire a corrective-action contractor:

- Check with your local air pollution control board, the local agency responsible for worker safety, and the Better Business Bureau. Ask if the firm has had any safety violations. Find out if there have been any legal actions filed against it.
- Insist that the contractor use the proper equipment to do the job. The workers must wear approved respirators, gloves, and other protective clothing.
- Before work begins, get a written contract specifying the work plan, cleanup, and the applicable federal, state and local regulations which the contractor must follow (such as notification requirements and asbestos disposal procedures). Contact your state and local health departments, EPA regional office, and the Occupational Safety and Health Administration's regional office to find out what the regulations are. Be sure the contractor follows local asbestos removal and disposal laws. At the end of the job, get written assurance from the contractor that all proper and mandated procedures have been followed.
- Assure that the contractor avoids spreading or tracking asbestos dust into other areas of your home. They should seal off the work area from the rest of the house using plastic sheeting and duct tape, and also turn off the heating and air conditioning system. For some repairs, such as pipe insulation removal, plastic bags may be adequate. They must be sealed with tape and properly disposed of when the job is completed.
- Make sure the work site is clearly marked as a hazardous area. Do not allow household members or pets into the area until the work is completed.
- Insist that the contractor apply a wetting agent to the asbestos material before removal using a hand sprayer that creates a fine mist. Wet fibers do not float in the air as easily as dry fibers and will be easier to clean up.
- Make sure the contractor does not break removed material into smaller pieces. This could release asbestos fibers into the air. Pipe insulation was usually installed in pre-formed blocks and should be removed in complete pieces.

- Upon project completion, assure that the contractor cleans the area well with wet mops, wet rags, sponges and/or HEPA (high-efficiency particulate air) filter vacuum cleaners. A regular household vacuum cleaner must never be used with asbestos. Wetting helps reduce the chance of spreading asbestos fibers in the air. All asbestos materials and disposable equipment and clothing used in the job must be placed in sealed, leak-proof, and labeled plastic bags. The work site should be visually free of dust and debris. Air monitoring (to make sure there is no increase of asbestos fibers in the air) may be necessary to assure that the contractor's job was done properly. Monitoring should be done by someone not connected with the contractor to avoid a potential conflict of interest.

***Caution!***

Do not dust, sweep or vacuum debris that may contain asbestos. These actions will disturb tiny asbestos fibers and may release them into the air. Remove any dust by wet-mopping or with a special HEPA-filter vacuum cleaner used by trained asbestos contractors.

## Asbestos Cement Siding

Asbestos cement is a composite material consisting of Portland cement reinforced with asbestos fibers. When manufacturers figured out ways to produce siding using asbestos cement, it became very popular for a number of years before being banned in the U.S. in the 1970s.

**History**

Asbestos cement first came into use as an exterior cladding after 1907, when Austrian engineer Ludwig Hatschek came up with a way to shape the material into sheets, allowing it to be manufactured as siding and shingles. By the 1920s, the National Board of Fire Underwriters recommended that asbestos cement replace wood as siding and roofing material because of its superior fire-resistant properties. This recommendation from a nationally known insurance board contributed to a boost in sales and, by the 1940s, hundreds of thousands of homes in the U.S. had been constructed using asbestos cement siding.

During the late 1960s and early '70s, however, the news media began to report on the health hazards associated with asbestos. As reports increased, concern grew, so the federal government took action and, in 1973, the EPA banned the use of asbestos in the manufacture of building products.

**Health Risks Associated with Asbestos Cement**

Asbestos fibers are a proven health hazard if inhaled. Asbestos dust is a known cause of a type of lung disease called asbestosis. Mesothelioma, a deadly form of cancer that attacks the internal organs, can also be caused by exposure to asbestos. However, asbestos cement siding that has been properly installed and is not in a state of decay presents no health risks as long as it remains undisturbed. This is because the cement binds the asbestos fibers and prevents their release into the air, under normal installation and maintenance.

The EPA deems asbestos to be hazardous when it is in a friable state, meaning that it can be crumbled, crushed or pulverized by hand pressure. Crushed asbestos in a powdery form can allow its particles to become airborne and then inhaled, causing potential health problems. Asbestos cement products that are not in a friable state are not considered hazardous. The only potential danger is when the cement is disturbed in a way that causes the asbestos fibers to become airborne.

If mechanical activities performed on the siding, such as chipping, sawing, grinding or sanding, allow particles to become airborne, then the cement is considered to be in a friable state and, consequently, hazardous. Deterioration can also lead to particles becoming airborne and potentially dangerous.

**Advantages**

- Asbestos cement siding is highly fire-resistant and will not burn or melt the way vinyl and wood siding will.
- It resists termite damage.
- It resists rotting.
- It has been manufactured with textures intended to simulate the look of other cladding materials, such as wood grain.
- It is fairly easy to clean and maintain.
- Unlike more porous siding materials, such as wood clapboard, asbestos cement siding will not quickly soak up paint, which allows it to be painted more easily.

**Disadvantages**

- Asbestos cement siding is very brittle and can be easily chipped, cracked and broken.

- The use of a pressure washer for maintenance can crack the siding and lead to moisture intrusion, if the pressure setting is too high.
- Asbestos cement can be dangerous if pulverized by sawing, sanding, breaking, etc.
- It is difficult to find replacement siding for repairs.
- This product cannot be refurbished, unlike other forms of siding. Wood clapboard, for example, can be sanded and re-painted, and cedar shake siding can be sand-blasted and re-stained. Either of these methods can restore wood close to its original state. But this is not possible with asbestos cement siding.
- It is no longer considered aesthetically desirable.

**Maintenance**

Damage and deterioration can lead to structural and health issues, so proper maintenance of asbestos cement building materials is a primary concern. Keeping the siding clean and performing any minor repairs as soon as they become necessary are both important.

Asbestos cement siding is fairly brittle and has little resistance to cracking, chipping and damage from impact, which can cause asbestos particles to become airborne. Damage to the siding can also lead to other damage related to moisture intrusion. Damaged areas that cannot be fixed can be replaced with non-asbestos fiber cement by a professional. Specific fiber cement materials have been manufactured for repairs that are intended to mimic the look of asbestos cement siding.

Landscaping features, such as a row of shrubs, can be incorporated around the home to help protect the siding from impact damage.

**Inspection Tips**

Here are some common problems associated with asbestos cement siding that homeowners are likely to encounter:

- Chipping and cracking often occur with this brittle material.
- Fasteners used to hold the siding in place may deteriorate at a faster rate than the siding.
- Discoloration and staining may occur from corrosion or runoff from an adjacent material. The discoloration may be normal, but it could also indicate a chemical reaction that has decreased the durability of the material.
- Like many other cement products, efflorescence may appear on asbestos cement siding. This crystalline growth can indicate that water is passing through the material, promoting deterioration of the cement.
- Biological growth, such as moss and algae, can occur if conditions are favorable. This growth may stimulate surface deterioration and staining.

Knowing some of the health risks associated with this material can be useful when deciding to use or replace it, although any specific concerns should be deferred to the appropriate construction and healthcare professionals.

## Lead Facts

**Did you know the following facts about lead?**

FACT: Lead exposure can harm young children and babies even before they are born.
FACT: Even children who seem healthy can have high levels of lead in their bodies.
FACT: You can get lead in your body by breathing or swallowing lead dust, or by eating soil or paint chips containing lead.
FACT: You have many options for reducing lead hazards. In most cases, lead-based paint that is in good condition is not a hazard.
FACT: Removing lead-based paint improperly can increase the danger to your family.

If you think your home might have lead hazards, read on to learn about lead and some simple steps to protect your family.

**Health Effects of Lead**

- Childhood lead poisoning remains a major environmental health problem in the U.S.
- Even children who appear healthy can have dangerous levels of lead in their bodies.
- People can get lead in their body if they:
    - put their hands or other objects covered with lead dust in their mouths;
    - eat paint chips or soil that contains lead; or
    - breathe in lead dust, especially during renovations that disturb painted surfaces.

- Lead is even more dangerous to children than to adults because:
    - babies and young children often put their hands and other objects in their mouths. These objects can have lead dust on them;
    - children's growing bodies can absorb more lead; and
    - children's brains and central nervous systems are more sensitive to the damaging effects of lead.

- If not detected early, children with high levels of lead in their bodies can suffer from:
    - damage to the brain and nervous system;
    - behavioral and learning problems (such as hyperactivity);
    - slowed growth;
    - hearing problems; and
    - headaches.

- Lead is also harmful to adults. Adults can suffer from:
    - difficulties during pregnancy;
    - other reproductive problems (in both men and women);
    - high blood pressure;
    - digestive problems;
    - nerve disorders;
    - memory and concentration problems; and
    - muscle and joint pain.

**Where is Lead Found?**

In general, the older your home, the more likely it has lead-based paint.

**Paint**

Many homes built before 1978 have lead-based paint. The federal government banned lead-based paint from housing in 1978. Some states stopped its use even earlier.

Lead can be found:

- in homes in the city, country and suburbs;
- on apartments, single-family homes, and both private and public housing complexes;
- on the interior and exterior of the house;
- in the soil around a home. Soil can pick up lead from exterior paint and other sources, such as past use of leaded gas in cars;
- in household dust. Dust can pick up lead from deteriorating lead-based paint and from soil tracked into a home;
- in drinking water. Your home may have plumbing that uses lead pipes or lead solder. Call your local health department or water supplier to find out about testing your water. You cannot see, smell or taste lead, and boiling your water will not get rid of it. If you think your plumbing might have lead in it:
    - Use only cold water for drinking and cooking.
    - Run water for 15 to 30 seconds before drinking it, especially if you have not used your water for a few hours.

- on the job. If you work with lead, you could bring it home on your hands or clothes. Shower and change clothes before coming home. Launder your work clothes separately from the rest of your family's clothes;
- in old (vintage or antique) painted toys and furniture;
- in food and liquids stored in lead crystal, and lead-glazed pottery and porcelain;
- from lead smelters and other industries that release lead into the air;
- with hobbies that use lead, such as making pottery or stained glass, or refinishing furniture; and
- in folk remedies that contain lead, such as *greta* and *azarcon* used to treat an upset stomach.

**Where is lead likely to be a hazard?**

- Lead from paint chips, which you can see, and lead dust, which you can't always see, can be serious hazards.
- Peeling, chipping, chalking and cracking lead-based paint is a hazard and needs immediate attention.
- Lead-based paint may also be a hazard when found on surfaces that children can chew or that endure a lot of wear and tear. These areas include:
    - windows and window sills;
    - doors and door frames;
    - stairs, railings and banisters; and
    - porches and fences.

Note: Lead-based paint that is in good condition is usually not a hazard.

- Lead dust can form when lead-based paint is dry-scraped, dry-sanded, or heated. Dust also forms when painted surfaces bump or rub together. Lead chips and dust can get on surfaces and objects that people touch. Settled lead dust can re-enter the air when people vacuum, sweep or walk through it.
- Lead in soil can be a hazard when children play in bare soil, or when people bring soil into the house on their shoes.

**Checking Your Family and Home for Lead**

- Have your children and home tested if you think your home has high levels of lead.
- Just knowing that a home has lead-based paint may not tell you if there is a hazard.

To reduce your child's exposure to lead, get your child checked, have your home tested (especially if your home has paint in poor condition and was built before 1978), and fix any hazards you may have.

**Your Family**

- Children's blood lead levels tend to increase rapidly from 6 to 12 months of age, and tend to peak at 18 to 24 months of age.
- Consult your doctor for advice on testing your children. A simple blood test can detect high levels of lead. Blood tests are important for:
    - children at ages 1 to 2;
    - children and other family members who have been exposed to high levels of lead; and
    - children who should be tested under your state or local health screening plan.

Your doctor can explain what the test results mean and if more testing will be needed.

**Your Home**

You can get your home checked in one of two ways (or both):

- A paint inspection tells you the lead content of every different type of painted surface in your home. It won't tell you whether the paint is a hazard or how you should deal with it, though.
- A risk assessment tells you if there are any sources of serious lead exposure, such as peeling paint and lead dust. It also tells you what actions to take to address such hazards.

Have qualified professionals do the work. There are standards in place for certifying lead-based paint professionals to ensure that their work is done safely, reliably and effectively. Be sure to ask your Certified Master Inspector® about lead paint during your next inspection. Trained professionals use a range of methods when checking your home, including:

- a visual inspection of paint condition and location;
- a portable X-ray fluorescence (XRF) machine;
- lab tests of paint samples; and
- surface-dust tests.

Note: Home test kits for lead are available, but studies suggest that they are not always accurate. Consumers should not rely on these tests before doing renovations or to assure safety.

**What You Can Do to Protect Your Family**

If you suspect that your house has lead hazards, you can take some immediate steps to reduce your family's risk:

- If you rent, notify your landlord of peeling or chipping paint.
- Clean up paint chips immediately.
- Clean floors, window frames, window sills, and other surfaces weekly. Use a mop, sponge or paper towel with warm water and a general all-purpose cleaner, or a cleaner made specifically for lead.

REMEMBER: NEVER MIX AMMONIA AND BLEACH PRODUCTS TOGETHER, SINCE THEY CAN FORM A DANGEROUS GAS.

- Thoroughly rinse sponges and mop heads after cleaning dirty and dusty areas.
- Wash children's hands often, especially before they eat, and before nap time and bed time.
- Keep play areas clean. Wash bottles, pacifiers, toys and stuffed animals regularly.
- Keep children from chewing window sills and other painted surfaces.
- Clean or remove shoes before entering your home to avoid tracking in lead from soil outside.
- Make sure children eat nutritious meals high in iron and calcium, such as spinach and dairy products. Children with balanced diets absorb less lead.

In addition to day-to-day cleaning and good nutrition, you can temporarily reduce lead hazards by taking actions such as repairing damaged and painted surfaces, and by planting grass to cover soil with high lead levels. These actions, called interim controls, are not permanent solutions and will need ongoing attention. To permanently remove lead hazards, you must hire a certified lead-abatement contractor. Abatement (or permanent hazard elimination) methods include removing, sealing or enclosing lead-based paint with special materials. Just painting over the hazard with lead-free paint is not enough. Always hire a person with special training for correcting lead problems -- someone who knows how to do this work safely and has the proper equipment to clean it up thoroughly. Certified contractors employ qualified workers and follow strict safety rules set by their state or the federal government. To be safe, hire a Certified Master Inspector® trained in lead detection for your next inspection.

**Are you planning to buy or rent a home built before 1978?**

Many houses and apartments built before 1978 have paint that contains lead (lead-based paint). Lead from paint, chips and dust can pose serious health hazards if not taken care of properly. Federal law requires that individuals receive certain information before renting or buying pre-1978 housing.

- Residential Lead-Based Paint Disclosure Program
    - Landlords have to disclose known information on lead-based paint and lead-based paint hazards before leases take effect. Leases must include a disclosure form about lead-based paint.

    - Sellers have to disclose known information about their property's lead-based paint and lead-based paint hazards before selling their house. Sales contracts must include a disclosure form about lead-based paint. Buyers have up to 10 days to check for lead hazards.

If not conducted properly, certain types of renovations can release lead from paint and dust into the air.

- Pre-Renovation Education Program (PRE)
    - Renovators have to give you a pamphlet titled "Protect Your Family from Lead in Your Home" before starting work.
- Take precautions before you or your contractor begins remodeling or renovations that disturb painted surfaces (such as scraping off paint or tearing out walls).
    - Have the area tested for lead-based paint.
    - Do not use a belt-sander, propane torch, heat gun, dry scraper, or dry sandpaper to remove lead-based paint. These actions create large amounts of lead dust and fumes.
    - Lead dust can remain in your home long after the work is done.
    - Temporarily move your family (especially children and pregnant women) out of the apartment or house until the work is done and the area is properly cleaned. If you can't move your family, at least completely seal off the work area with plastic sheeting and duct tape.
    - If you have already completed renovations or remodeling that could have released lead-based paint or dust, get your young children tested and follow the steps outlined to protect your family.

## Formaldehyde

Formaldehyde is a colorless, pungent-smelling chemical widely used in industries that manufacture building materials and numerous household products. Thus, it may be present in substantial concentrations in indoor environments.

**Where can formaldehyde be found indoors?**

- pressed-wood products (such as hardwood plywood wall paneling, particleboard and fiberboard), and furniture made with these pressed-wood products. Mobile homes are especially at risk for indoor formaldehyde pollution because of their abundance of composite wood in construction, and relatively compact interior space;
- carpet backing and urea-formaldehyde foam insulation (UFFI). In the 1970s, many homes were insulated with UFFI as an energy-conservation measure before it was discovered that UFFI contained dangerously high levels of formaldehyde. Fortunately, formaldehyde emissions in this product decline over time, so older houses with UFFI are unlikely to have high levels of formaldehyde now. This insulation is not very common in modern housing;
- tobacco smoke;
- durable-press drapes and other textiles;
- un-vented, fuel-burning appliances, such gas stoves and kerosene space heaters; and
- glues.

**Is it dangerous?**

Years after concerns arose over high levels of formaldehyde found in some FEMA trailers used as emergency housing for disaster victims, there is still a great deal of confusion regarding permissible levels of airborne formaldehyde in indoor environments.

Formaldehyde is known to cause the following conditions:

- watery eyes;
- burning sensations in the eyes and throat;
- nausea;
- wheezing, coughing, and difficulty breathing;
- asthma attacks;
- fatigue;
- skin rashes;
- severe allergic reactions; and
- cancer. Uncertainty remains as to how to compare measured air concentrations of formaldehyde to cancer incidence. No definitive "high-risk" level can be drawn because many other factors besides formaldehyde exposure play a role in the development of cancer. In general, however, the lower the level and shorter the duration of exposure, the less risk of cancer and other health effects there are.

In 1992, the California Air Resources Board (CARB) declared formaldehyde a “toxic air contaminant,” meaning that there is no safe level of exposure. In June 2004, the International Agency for Research on Cancer (IARC) reclassified formaldehyde from “probably carcinogenic to humans” to “carcinogenic to humans,” specifically concerning nasopharyngeal (upper throat) cancer, while the National Toxicology Program (NTP) continues to classify formaldehyde as “reasonably anticipated to be a carcinogen in humans” for that disease.

**Steps to Reduce Exposure**

- Use exterior-grade pressed-wood products, which are lower-emitting because they contain phenol resins, not urea resins.
- Use air conditioning and dehumidifiers to maintain a moderate temperature and reduce humidity levels.
- Increase ventilation, particularly after bringing new sources of formaldehyde indoors.
- Seal non-laminated surfaces of products containing formaldehyde with paints, varnish or polyurethane-like materials.

In summary, formaldehyde is an irritating and potentially dangerous gas that may accumulate in indoor environments.

## Carbon Monoxide

Carbon monoxide (CO) is a colorless, odorless, poisonous gas that forms from the incomplete combustion of fuels, such as natural or liquefied petroleum gas, oil, wood or coal.

**Facts and Figures**

- Nearly 500 people in the U.S. died between 2001 and 2003 from non-fire-related carbon-monoxide poisoning.
- Most CO exposure occurs during the winter months, especially in December (including 56 deaths and 2,157 non-fatal exposures between 2001 and 2003), and in January (including 69 deaths and 2,511 non-fatal exposures). The peak time of day for CO exposure is between 6 and 10 p.m.
- Many experts believe that CO poisoning statistics understate the problem. Because the symptoms of CO poisoning mimic a range of common health ailments, it is likely that many mild to mid-level exposures are never identified, diagnosed, or accounted for in any way in carbon monoxide statistics.
- Out of all reported non-fire carbon-monoxide incidents, 89% or almost nine out of 10 of them take place in a home.

**Physiology of Carbon Monoxide Poisoning**

When CO is inhaled, it displaces the oxygen that would ordinarily bind with hemoglobin, a process that effectively suffocates the body. CO can poison slowly over a period of several hours, even in low concentrations. Sensitive organs, such as the brain, heart and lungs, suffer the most from a lack of oxygen.

High concentrations of carbon monoxide can kill in less than five minutes. At low concentrations, it will require a longer period of time to affect the body. Exceeding the EPA concentration of 9 parts per million (ppm) for more than eight hours may have adverse health effects. The limit of CO exposure for healthy workers, as prescribed by the U.S. Occupational Health and Safety Administration, is 50 ppm.

**Potential Sources of Carbon Monoxide**

Any fuel-burning appliances that are malfunctioning or improperly installed can be a source of CO, such as:

- furnaces;
- stoves and ovens;
- water heaters;
- clothes dryers;
- room and space heaters;
- fireplaces and wood stoves;
- gas and charcoal grills;
- automobiles;
- clogged chimneys and flues;
- power tools that run on fuel;
- certain types of swimming pool heaters; and
- boat engines.

| PPM | % CO in air | Health Effects in Healthy Adults | Source/Comments |
|---|---|---|---|
| 0 | 0% | No effects; this is the normal level in a properly operating heating appliance | |
| 35 | 0.0035% | Maximum allowable workplace exposure limit for an eight-hour work shift | The National Institute for Occupational Safety and Health (NIOSH) |
| 50 | 0.005% | Maximum allowable workplace exposure limit for an eight-hour work shift | OSHA |
| 100 | 0.01% | Slight headache, fatigue, shortness of breath, errors in judgment | |
| 125 | 0.0125% | | Workplace alarm must sound (OSHA) |
| 200 | 0.02% | Headache, fatigue, nausea, dizziness | |
| 400 | 0.04% | Severe headache, fatigue, nausea, dizziness, confusion; can be life-threatening after three hours of exposure | Evacuate area immediately |
| 800 | 0.08% | Convulsions, loss of consciousness; death within three hours | Evacuate area immediately |
| 12,000 | 1.2% | Nearly instant death | |

**CO Detector Placement**

Carbon-monoxide detectors can monitor CO exposure levels, but do not place them:

- directly above or beside fuel-burning appliances, as the appliances may emit a small amount of carbon monoxide upon start-up;
- within 15 feet of heating and cooking appliances, or in or near very humid areas, such as bathrooms;
- within 5 feet of kitchen stoves and ovens, or near areas where household chemicals and bleach are stored (store such chemicals away from bathrooms and kitchens, whenever possible);
- in garages, kitchens, furnace rooms, or in any extremely dusty, dirty, humid, or greasy areas;
- in direct sunlight, or in areas subjected to temperature extremes. These include unconditioned crawlspaces, unfinished attics, un-insulated or poorly insulated ceilings, and porches; or

- in turbulent air near ceiling fans, heat vents, air conditioners, fresh-air returns, or open windows. Blowing air may prevent carbon monoxide from reaching the CO sensors.

Do place CO detectors:

- within 10 feet of each bedroom door and near all sleeping areas, where it can awaken sleeping household members. The Consumer Product Safety Commission (CPSC) and Underwriters Laboratories (UL) recommend that every home have at least one carbon monoxide detector for each floor of the home, and within hearing range of each sleeping area;
- on every floor of your home, including the basement;
- near or over any attached garage. Carbon-monoxide detectors are affected by excessive humidity and by close proximity to gas stoves;
- near, but not directly above, combustion appliances, such as furnaces, water heaters, and fireplaces;
- in the garage; and
- on the ceiling in the same room as permanently installed fuel-burning appliances, and centrally located on every habitable level, and in every HVAC zone of the building. This rule applies to commercial buildings.

In North America, some national, state and local municipalities require installation of CO detectors in new and existing homes, as well as commercial businesses, including: Illinois, Massachusetts, Minnesota, New Jersey, Vermont and New York City, and the Canadian province of Ontario. Installers are encouraged to check with their local municipality to determine the specific requirements that have been enacted in their jurisdiction.

**How can I prevent CO poisoning?**

- Purchase and install carbon monoxide detectors with labels showing that they meet the requirements of the new UL Standard 2034 or Comprehensive Safety Analysis 6.19 safety standards.
- Make sure that appliances are installed and operated according to the manufacturers' instructions and local building codes. Have the heating system professionally inspected by a Certified Master Inspector® and serviced annually to ensure proper operation. The inspector should also check chimneys and flues for blockages, corrosion, partial and complete disconnections, and loose connections.
- Never service fuel-burning appliances without the proper knowledge, skill and tools. Always refer to the owner's manual when performing minor adjustments and when servicing fuel-burning equipment.
- Never operate a portable generator or any other gasoline engine-powered tool either in or near an enclosed space, such as a garage, house, or other building. Even with the doors and windows open, these spaces can trap CO and allow it to quickly build up to lethal levels.
- Never use portable fuel-burning camping equipment inside a home, garage, vehicle or tent unless it is specifically designed for use in an enclosed space and provides instructions for safe use in an enclosed area.
- Never burn charcoal inside a home, garage, vehicle or tent.
- Never leave a car running in an attached garage, even with the garage door open.
- Never use gas appliances, such as ranges, ovens or clothes dryers, to heat your home.
- Never operate un-vented fuel-burning appliances in any room where people are sleeping.

- During home renovations, ensure that appliance vents and chimneys are not blocked by tarps or debris. Make sure appliances are in proper working order when renovations are completed.
- Do not place generators in the garage or close to the home. People lose power in their homes and get so excited about using their gas-powered generator that they don't pay attention to where it is placed. The owner's manual should explain how far the generator should be from the home.
- Clean the chimney. Open the hatch at the bottom of the chimney to remove the ashes. Hire a chimney sweep annually.
- Check vents. Regularly inspect your home's external vents to ensure they are not blocked by debris, dirt or snow.

In summary, carbon monoxide is a dangerous poison that can be created by various household appliances. Carbon-monoxide detectors must be placed strategically throughout the home or business in order to alert occupants of high levels of the gas.

## Backdrafting

Backdrafting is the reverse flow of gas in the flues of fuel-fired appliances that results in the intrusion of combustion byproducts into the living space. Many fuel-fired water heaters and boilers use household air and lack an induced draft, which makes them especially vulnerable to backdrafting when indoor air pressure becomes unusually low. Homeowners should try to spot evidence of backdrafting in their homes.

**How does backdrafting happen?**

Fuel-fired water heaters, boilers, wall heaters, and furnaces are designed to exhaust the byproducts of combustion to the outdoors through a flue. These hot gases rise through the flue and exit the home because they are not as dense as indoor air. The pressure differential that allows for the release of combustion gases can be overcome by unusually low indoor air pressure caused by a high rate of the expulsion of air to the outdoors through exhaust fans, fireplaces and dryers. When this happens, combustion gases can be sucked back into the house and may potentially harm or kill the home's occupants. Improperly configured flues and flue blockages can also cause backdrafting.

**How can homeowners test for backdrafting?**

- The homeowner can release smoke or powder into a draft diverter to see whether it gets sucked into the duct or if it spills back into the room. A smoke pencil or a chemical puffer can be used to safely simulate smoke.

- The homeowner can hold a lighter beside the draft diverter to see whether there is sufficient draft to pull the flame in the direction of the flue.

- Combustion gases that back-draft into a house may leave a dark residue on the top of the water heater. The presence of soot is an indication of backdrafting, although its absence does not guarantee that backdrafting has not happened.

A carbon monoxide analyzer can be used to test for backdrafting of that gas. Your Certified Master Inspector® may be properly trained to use one during an actual inspection, which will help to avoid getting false negatives.

While the CMI performs these tests, it is helpful if the homeowner turns on all devices that vent air to the outdoors in order to simulate worst-case conditions. Such appliances include clothes dryers, and bathroom and kitchen vent fans.

**Types of Fuel-Fired Water Heaters:**

- Atmospheric Draft
  Most backdrafting is the result of the characteristics of this type of water heater. Combustion gases rise through the ventilation duct solely by the force of convection, which may not be strong enough to counter the pull from dips in indoor air pressure.

- Induced Draft
  This system incorporates a fan that creates a controlled draft. The potential for backdrafting is reduced because the induced draft is usually strong enough to overcome any competing pull from a drop in indoor air pressure.

- Sealed Combustion
  The combustion and venting systems are completely sealed off from household air. Combustion air is drawn in from the outdoors through a pipe that is designed for that purpose. The potential for backdrafting is nearly eliminated because the rate of ventilation is not influenced by indoor air pressure, and the vented gas has no pathway into the home.

**Water Heater Location**

The installation of fuel-fired water heaters in certain household locations can increase the chances of personal harm caused by backdrafting. The 2006 edition of the International Residential Code (IRC) states the following concerning improper location:

*Fuel-fired water heaters shall not be installed in a room used as a storage closet. Water heaters located in a bedroom or bathroom shall be installed in a sealed enclosure so that combustion air will not be taken from the living space.*

## Fireplace Fuel

Fireplaces and wood stoves are designed to burn only one type of fuel. If improperly used as all-purpose incinerators, these devices can pose the following hazards:

- Harmful vapors can vent into the living space. Even the most efficient fireplaces will vent directly into the living space while they're opened and closed for cleaning and refueling, exposing everyone in the house to potentially dangerous fumes.
- Harmful vapors will vent to the outdoors. Most newer fireplaces and wood stoves do an excellent job of funneling smoke and fumes to the outdoors, but the problem doesn't end there; this pollution persists, contaminating household and environmental air.
- Burning inappropriate fuel can cause mechanical damage. Chimneys can become lined with residue from inappropriate items, which may lead to a dangerous chimney fire. The fumes from certain items will quickly wear out sensitive components, such as catalytic combustors in wood stoves.

Read the following guidelines to better understand what can and cannot be safely burned in a residential fireplace or wood stove.

**What can be burned in a fireplace?**

- dried, cut firewood. An adequate fuel supply will consist of a mixture of hardwoods, such as maple and oak, and softwoods, such as fir and pine. Softwoods ignite quickly and are useful in the early stages of the fire, while hardwoods provide a longer-lasting fire, and are best used after pre-heating the chimney. Despite the different burning characteristics of hardwoods and softwoods, which can be attributed to differences in density, the heat-energy released by burning wood is the same, regardless of species. To dry out wood, it should be stacked outdoors in an open area so that the sun can warm the pieces and the breezes can carry away the moisture. Poplar, spruce and other softwoods generally dry quickly, as do wood that has been split into small pieces.

  Adequately seasoned wood has a moisture content of less than 20%, which can be checked using the following indicators:

  - The wood has darkened from white or a cream color to yellow or grey.
  - There are cracks or checks in the end-grain.
  - A hollow sound is produced when two pieces of wood are banged together.
  - You can split a piece and feel if the new surface is damp or dry.
  - The wood does not hiss while burning.
  - You can check its moisture content using a moisture meter.

- pallets. Generally, pallets are safe to burn in fireplaces, although those that are treated with the fumigant methyl bromide (labeled with the initials MB) are unsafe to burn. Also, pallets may have been exposed to a variety of chemicals while they were in use. Aside from these concerns, pallets produce a hot flame because they're usually very dry and their segments are thin. Be careful to check for nails while cutting pallets, as they may damage a saw blade. You may also wind up with nails in your ash, which should be disposed of far from roads and driveways.
- fallen tree limbs. These can generally be collected and used for kindling, provided they have been given time to dry.
- wood collected from housing developments. If it is truly trash and not someone's property (including the housing contractor's), using scavenged wood that has been cleared away for housing developments is good for burning. Try to obtain it before the non-lumber grade wood is pushed into massive piles and burned as a means of disposal by the contractor.
- fire logs. These artificial logs burn relatively cleanly and release less ash than their natural wood counterparts.

**What should never be burned in a fireplace?**

- painted wood. Paint contains heavy metals, such as lead, chromium and titanium, which are used to make the different colors. These metals, especially lead, can be toxic even in small quantities if inhaled.
- pressure-treated wood. Wood is commonly made resistant to fungus and insects through the addition of copper, chromate and arsenic, in a process known as CCA treatment. CCA treatment places roughly 27 grams of arsenic in every 12-foot 2x6, which is sufficient to kill about 250 adults, which is why it is illegal in the U.S. to burn pressure-treated wood. Vaporized CCA wood, known as fly ash, is extremely toxic; in one case, as reported by the American Medical Association, a family was stricken with seizures, hair loss, debilitating headaches, blackouts and nosebleeds from fly ash released when they unknowingly used CCA wood to burn in their fireplace. Even the family's houseplants and fish succumbed to the toxic fumes.
- plywood, particleboard, and chipboard or OSB. These manmade woods release formaldehyde, and possibly also hydrochloric acid and dioxin when burned. Some states have outlawed the incineration of some or all of these artificial wood products.
- rotted, diseased or moldy wood. This wood will not burn as long as healthy wood. It may produce bad smells when burned, and could bring insects into the house.
- damp wood. Wood that has a moisture content higher than 20% will burn inefficiently and will contribute to a greater accumulation of creosote in the chimney, as well as air pollution.
- allergenic plants. Urushiol is the chemical that induces a minor allergic reaction when skin is exposed to poison ivy, poison sumac and poison oak, but it's far more dangerous when inhaled. Urushiol is not destroyed by fire and can quickly cause life-threatening respiratory distress if any of these plants are burned.
- dryer lint. While it's often used effectively as a fire-starter, lint can contain a wide array of dangerous chemicals that come from your clothes and fabric softener.
- trash. Never burn household garbage, as it contains a range of potentially hazardous materials and chemicals that react in unpredictable ways when burned together. Newspaper ink, plastics, aluminum foil, plastic baggies, and whatever else constitutes your particular trash can create a deadly chemical cocktail.
- driftwood. Wood found on the beach of an ocean or salty lake will release salt when burned, which will quickly corrode any metal and etch the glass of a wood stove or fireplace.

Catalytic converters are especially vulnerable to salt corrosion. In addition to potential damage to the stove or fireplace, the EPA claims that driftwood releases toxic chemicals when burned.

In summary, use only approved and appropriate fuel to burn in your fireplace or wood stove. Certain items should never be burned because they can cause problems ranging from minor irritation to a hazardous health threat to your family.

### Ventless Fireplaces

Ventless fireplaces, more accurately known as duct-free fireplaces and room-venting fireplaces, are a type of residential gas-heating appliance. Ventless fireplaces are preferred because they burn at nearly 100% efficiency, release far less harmful gases than most other heating alternatives, and their installation is restricted minimally by architectural constraints.

They are controversial, however. Despite their name, they vent unburned combustion byproducts directly into the living space. Traditional fireplaces, by contrast, are equipped with a flue that vents to the outdoors, saving humans and their pets from exposure to the bulk of the carbon monoxide (CO) and airborne particulates created by the fire. As a less serious yet still important side effect, ventless fireplaces create high levels of water vapor, which can lead to mold growth and a variety of other moisture-related structural problems. Mold can be a serious health hazard for at-risk individuals, and it can damage fabric, photographs, books, and building materials.

To mitigate CO dangers, manufacturers instruct consumers to keep a window open while their ventless fireplace is in operation – advice that is easy to ignore, as an open window allows the entry of cold air, defeating the efforts of the fireplace to warm the living space. Many manufacturers also install an oxygen-detection sensor (ODS) in their ventless fireplace that will automatically shut down the appliance if oxygen levels in the home become dangerously low. Critics point out that this sensor is typically located at the lower part of the unit near the floor, where it detects cool, fresh, oxygen-filled air and misses hot combustion gases as they rise and pool toward the ceiling. And if the sensor fails, any CO-producing abnormality experienced by the fireplace will continue unnoticed and potentially harm the home's occupants.

Massachusetts, California, and several other states in the U.S., as well as Canada and other countries, have outlawed ventless gas fireplaces due to the aforementioned safety concerns. Many individual municipalities, too, have outlawed these appliances in states where they are otherwise legal. The U.S. Department of Housing and Urban Development bans ventless fireplaces in their housing, and advisements against the use of these appliances have been issued by various watchdog groups, such as the American Lung Association, the Centers for Disease Control, the Environmental Protection Agency,

and even the Mayo Clinic. In particular, these organizations warn against exposure of individuals who are particularly vulnerable to CO – namely, the elderly, pregnant women, small children, those with pre-existing cardiovascular difficulties, and small pets. To be fair, there have been no documented cases of fatalities caused by ODS-equipped ventless fireplaces, according to the U.S. Consumer Product Safety Commission.

Ventless fireplaces can be inspected by your Certified Master Inspector® for the following safety defects:

- a gas leak. During production, installation or servicing, a leak can be created;
- plugged burner ports. The contractor may accidentally plug the burner ports while installing ceramic tile over the burners, or they may be painted over at the factory. The resulting unbalanced burn will create excessive carbon monoxide;
- a clogged burner. Dust, carpet lint, and pet hair can gradually choke off the fireplace's air supply, leading to incomplete combustion and high amounts of CO that can vent into the living space;
- high gas-input rate. Excessive CO ventilation or overheating of the unit will result from firing the gas higher than the input rate set by the manufacturer's specifications. This can be caused by high gas-supply pressure, an incorrect orifice drill size done at the factory, or if the installer sets the unit's flame larger for aesthetic reasons;
- the fireplace is oversized for the square footage of the area to be heated;
- a cracked burner. The gas burner may develop a crack over time and function erratically, producing high levels of CO;
- the fireplace contains items other than the artificial logs designed for the unit. Problems caused by the incineration of firewood or other flammable items will be immediate and extreme. A more likely and less obvious hazard is created by adding pebbles, lava rocks, and other non-combustible aesthetic touches to the fireplace, as their exposure to flames will cause an unsafe rise in the CO level; and
- a missing or defective ODS. As these components may fail, it is advisable to install a CO detector near a ventless fireplace and, ideally, in other rooms, as well, especially near bedrooms.

In summary, ventless fireplaces, while attractive and portable, suffer from a design flaw that may allow dangerous gases to enter the living space.

## Mold

### Mold Basics

- The key to mold control is moisture control.
- If mold is a problem in your home, you should clean up the mold promptly and fix the source of the water problem.
- It is important to dry water-damaged areas and items within 24 to 48 hours to prevent mold growth.

**Why is mold growing in my home?**

Molds are an important part of the natural environment. Outdoors, molds break down dead organic matter, such as fallen leaves and dead trees, providing nutrients for the soil and growing vegetation. But indoors, mold growth should be prvented. Molds reproduce by means of tiny spores; the spores are invisible to the naked eye and float through outdoor and indoor air. Mold may begin growing indoors when mold spores land on surfaces that are wet. There are many types of mold, and none of them will grow without water or moisture.

**Can mold cause health problems?**

Molds are usually not a problem indoors, unless mold spores land on a wet or damp spot and begin growing. Molds have the potential to cause health problems. They produce allergens (substances that can cause allergic reactions), irritants, and, in some cases, potentially toxic substances called mycotoxins. Inhaling or touching mold or mold spores may cause allergic reactions in sensitive individuals. Allergic responses include hay fever-type symptoms, such as sneezing, a runny nose, red eyes, and skin rashes (dermatitis). Allergic reactions to mold are common. They can be immediate or delayed. Molds can also cause asthma attacks in people with asthma who are also allergic to mold. In addition, mold exposure can irritate the eyes, skin, nose, throat and lungs of both mold-allergic and non-allergic people. Symptoms other than the allergic and irritant types are not commonly reported as a result of inhaling mold. Research on mold and its negative health effects is ongoing. There are many more potential health effects related to mold exposure. For more detailed information, consult a healthcare professional. You may also wish to consult your state or local health department.

**How do I get rid of mold?**

It is impossible to get rid of all mold and mold spores indoors. Some mold spores can be found floating through the air and in household dust. Mold spores will not grow if moisture is not present. Indoor mold growth can and should be prevented or controlled by controlling moisture indoors. If there is mold growing in your home, you must clean up the mold and fix the source of the water problem. If you clean up the mold but don't fix the water problem, then, most likely, the mold problem will recur.

**Who should do the cleanup?**

This depends on a number of factors. One consideration is the size of the mold problem. If the moldy area is less than about 10 square feet (less than roughly a 3x3-foot patch), in most cases, you can handle the job yourself, following the guidelines below.

- If there has been a lot of water damage, and/or mold growth covers more than 10 square feet, consult with a Certified Master Inspector®.
- If you choose to hire a contractor or other professional service provider to do the cleanup, make sure the contractor has experience cleaning up mold. Check their references and ask the contractor to follow the recommendations of the EPA, the guidelines of the American Conference of Governmental Industrial Hygienists (ACGIH), or other guidelines from professional organizations or governmental agencies.
- Do not run the HVAC system if you know or suspect that it is contaminated with mold. This could spread mold throughout the house.

- If the water and/or mold damage was caused by sewage or other contaminated water, then call in a professional who has experience cleaning and fixing homes damaged by contaminated water.
- If you have health concerns, consult a healthcare professional before starting the cleanup.

**Tips and Techniques**

The tips and techniques presented here will help guide you in cleaning up your mold problem. Professional cleaners or remediators may use methods not covered here. Please note that mold may cause staining and cosmetic damage. It may not be possible to clean an item such that its original appearance is restored.

- Fix plumbing leaks and other water problems as soon as possible. Dry all items completely.
- Scrub mold off hard surfaces with detergent and water, and dry completely.
- Porous and absorbent materials, such as ceiling tiles and carpet, may have to be thrown away if they become moldy. Mold can grow on or fill in the empty spaces and crevices of porous materials, so the mold may be difficult or impossible to remove completely.
- Avoid exposing yourself or others to mold.
- Do not paint or caulk moldy surfaces. Mold can continue to grow beneath these applications. Clean up the mold and dry the surfaces before painting. Paint applied over moldy surfaces is likely to peel.
- If you are unsure about how to clean an item, or if the item is expensive or of sentimental value, you may wish to consult a specialist. Specialists in furniture repair and restoration, painting and art restoration and conservation, carpet and rug cleaning, water damage, and fire or water restoration are commonly listed in the directory. Be sure to ask for and check references. Look for specialists who are affiliated with professional organizations.

**What to Wear When Cleaning Moldy Areas:**

- Avoid breathing in mold or mold spores. In order to limit your exposure to airborne mold, you may want to wear an N-95 respirator, available at many hardware stores and from companies that advertise on the Internet. Some N-95 respirators resemble a paper dust mask with a nozzle on the front, and others are made primarily of plastic or rubber and have removable filter cartridges that trap and prevent most of the mold spores from entering. In order to be effective, the respirator or mask must fit properly, so carefully follow the instructions supplied with the respirator.
- Wear gloves. Long gloves that extend to the middle of the forearm are recommended. When working with water and a mild detergent, ordinary household rubber gloves may be used. If you are using a disinfectant, a biocide such as chlorine bleach, or a strong cleaning solution, you should select gloves made from natural rubber, neoprene, nitrile, polyurethane or PVC. Avoid touching mold or moldy items with your bare hands.
- Wear goggles. Goggles that do not have ventilation holes are recommended. Avoid getting mold or mold spores in your eyes.

**How do I know when the remediation or cleanup is finished?**

You must have completely fixed the water or moisture problem before the cleanup or remediation can be considered finished, based on the following guidelines:

- You should have completed the mold removal. Visible mold and moldy odors should not be present. Please note that mold may cause permanent staining and cosmetic damage.
- You should have revisited the site of mold growth shortly after cleanup, and it should show no signs of water damage or mold re-growth.
- Family members should have been able to occupy or re-occupy the area without health complaints or physical symptoms.
- Ultimately, this is a judgment call; there is no easy answer. If you have concerns or questions, be sure to ask your Certified Master Inspector® during your next scheduled inspection.

**Moisture Control and Mold Prevention Tips**

- Moisture control is the key to mold control, so when water leaks or spills occur indoors, act quickly. If wet or damp materials or areas are dried within 24 to 48 hours after a leak or spill happens, in most cases, mold will not grow.
- Clean and repair roof gutters regularly.
- Make sure that the ground around the home slopes away from the foundation so that water does not enter or collect around it.
- Keep air-conditioning drip pans clean and the drain lines unobstructed and flowing properly.
- Keep indoor humidity low. If possible, keep it below 60% relative humidity (ideally, between 30% and 50%). Relative humidity can be measured with a moisture or humidity meter, which is a small, inexpensive instrument that is available at many hardware stores.
- If you see condensation or moisture collecting on windows, walls or pipes, act quickly to dry the wet surfaces and reduce the moisture/water source. Condensation can be a sign of high indoor humidity.

**Actions That Will Help to Reduce Indoor Humidity:**

- Vent appliances that produce moisture, such as clothes dryers, stoves, and kerosene heaters, to the outdoors, where possible. Combustion appliances, such as stoves and kerosene heaters, produce water vapor and will increase the humidity unless vented to the outside.
- Use air conditioners and/or de-humidifiers when needed.
- Run the bathroom fan or open the window when showering. Use exhaust fans or open windows whenever cooking, running the dishwasher or washing dishes, etc.

**Actions That Will Help Prevent Condensation:**

- Reduce the humidity (see methods above).
- Increase ventilation and air movement by opening doors and/or windows, when practical. Use fans as needed.

- Cover cold surfaces, such as cold water pipes, with insulation.
- Increase the indoor air temperature.

**Testing or Sampling for Mold**

Is sampling for mold needed? In most cases, if visible mold growth is present, sampling is unnecessary. Since no EPA or other federal limits have been set for mold or mold spores, sampling cannot be used to check a building's compliance with federal mold standards. Surface sampling may be useful to determine if an area has been adequately cleaned or remediated. Sampling for mold should be conducted by professionals who have specific experience in designing mold sampling protocols, sampling methods, and interpreting results. Sample analysis should follow analytical methods recommended by the American Industrial Hygiene Association (AIHA), the American Conference of Governmental Industrial Hygienists (ACGIH), or other professional organizations.

**Suspicion of Hidden Mold**

You may suspect hidden mold if an area of your home smells moldy but you cannot see the source, or if you know there has been water damage and family members are reporting health problems. Mold may be hidden in places such as the backside of drywall, wallpaper or paneling, the top-side of ceiling tiles, or the underside of carpets and pads, etc. Other possible locations of hidden mold include areas inside walls around pipes (especially if the pipes are leaking or have condensation on them), the surface of walls behind furniture (where condensation can form), inside ductwork, and in roof materials above ceiling tiles (due to roof leaks or insufficient insulation).

**Investigating Hidden Mold Problems**

Investigating hidden mold problems may be difficult and will require caution when the investigation involves disturbing potential sites of mold growth. For example, removing wallpaper can lead to a massive release of spores if there is mold growing on the underside of the paper. If you believe that you may have a hidden mold problem, consider hiring an experienced professional.

**Cleanup and Biocides**

Biocides are substances that can destroy living organisms. The use of a chemical or biocide that kills organisms such as mold (chlorine bleach, for example) is not recommended as a routine practice during mold cleanup. There may be instances, however, when professional judgment may indicate its use (for example, when immune-compromised individuals are present). In most cases, it is not possible or desirable to sterilize an area; a background level of mold spores will remain, and these spores will not grow if the moisture problem has been resolved. If you choose to use disinfectants or biocides, always ventilate the area and exhaust the air to the outdoors. Never mix chlorine bleach with other cleaning solutions or detergents that contain ammonia because toxic fumes could be produced.

Note: Dead mold may still cause allergic reactions in some people, so it is not enough to simply kill the mold; it must also be removed.

**Ten Things You Should Know About Mold**

1. Potential health effects and symptoms associated with mold exposure include allergic reactions, asthma, and other respiratory complaints.

2. There is no practical way to eliminate all mold and mold spores in the indoor environment; the way to control indoor mold growth is to control moisture.

3. If mold is a problem in your home, you must clean up the mold and eliminate the sources of unwanted moisture.

4. Fix the source of the water problem or leak to prevent mold growth.

5. Reduce indoor humidity to 30% to 60% to decrease mold growth by:
    a. venting bathrooms, dryers, and other moisture-generating sources to the outside;
    b. using air conditioners and de-humidifiers;
    c. increasing ventilation; and
    d. using exhaust fans whenever cooking, dishwashing, and cleaning.

6. Clean and dry any damp or wet building materials and furnishings within 24 to 48 hours to prevent mold growth.

7. Clean mold off hard surfaces with water and detergent, and dry completely. Absorbent materials that are moldy (such as carpeting and ceiling tiles) may need to be replaced.

8. Prevent condensation. Reduce the potential for condensation on cold surfaces (i.e., windows, piping, exterior walls, ceilings and floors) by adding insulation.

9. In areas where there is a perpetual moisture problem, do not install carpeting.

10. Molds can be found almost anywhere; they can grow on virtually any surface, provided moisture is present. There are molds that can grow on wood, paper, carpet, and foods.

## Central Humidifiers

Humidifiers are devices that humidify the indoor air so that family members are comfortable. Central humidifiers are hard-wired into a house's plumbing and forced-air heating systems.

**What is humidity?**

Humidity refers to the amount of moisture in the air. "Relative humidity" signifies the amount of moisture in the air relative to the maximum amount of water the air can contain before it becomes saturated. This maximum moisture count is related to air temperature in that the hotter the air is, the more moisture it can hold. For instance, if indoor air temperature drops, relative humidity will increase.

**How do central air humidifiers work?**

Central air humidifiers are integrated into the forced-air heating system so that they humidify air while it is being heated. The water that is used by the device is pumped automatically into the humidifier from the household plumbing, unlike portable humidifiers, which require the user to periodically supply water to the device. Humidifiers are available in various designs, each of which turns liquid water into water vapor, which is then vented into the house at an adjustable rate.

**Why humidify air?**

Certain airborne pathogens, such as those that cause the flu, circulate more easily in dry air than in damp air. Damp air also seems to soothe irritated, inflamed airways. For someone with a cold and thick nasal secretions, a humidifier can help thin out the secretions and make breathing easier.

Indoor air that is too dry can also cause the following problems:

- damage to musical instruments, such as pianos, guitars and violins;
- dry skin;
- peeling wallpaper;
- static electricity, which can damage sensitive electrical equipment, cause hair to stick up, and be painful or annoying; and
- cracks in wooden furniture, floors, cabinets and paint.

**Central Humidifier Dangers**

Humidifiers can cause various diseases. The young, elderly and infirm may be particularly at risk to contamination from airborne pollutants, such as bacteria and fungi. These can grow in humidifiers and get into the air by way of the vapor, which can be breathed in.

Some of the more common diseases and pathogens transmitted by humidifiers are:

- Legionnaires' Disease. Health problems caused by this disease range from flu-like symptoms to serious infections. This problem is generally more prevalent with portable humidifiers because they draw standing water from a tank in which bacteria and fungi can grow;
- thermophilic actinomycetes. These bacteria thrive at temperatures of 113° to 140° F and can cause hypersensitivity pneumonitis, which is an inflammation of the lungs; and
- "humidifier fever," which is a mysterious and short-lived, flu-like illness marked by fever, headache, chills and malaise, but without prominent pulmonary symptoms. It normally subsides within 24 hours without residual effects.

Other problems associated with humidifiers include:

- accumulation of white dust from minerals in the water. These minerals may be released in the mist from the humidifier and settle as fine white dust that may be small enough to enter the lungs. The health effects of this dust depend on the types and amounts of dissolved minerals. It is unclear whether these minerals cause any serious health problems;

- moisture damage due to condensation. Condensed water from over-humidified air will appear on the interior surfaces of windows and other relatively cool surfaces. Excessive moisture on windows can damage windowpanes and walls, but a more serious issue is caused when moisture collects on the inner surfaces of exterior walls. Moisture there can ruin insulation and rot the wall, and cause peeling, cracking and blistering of the paint; and
- mold growth. This organic substance grows readily in damp environments, such as on the surfaces in a home that are made damp by an overworked humidifier. Mold can damage building components, as well as pose health hazards to people with allergies or compromised immune systems.

**Designs and Maintenance**

- A drum-type humidifier has a spongy, rotating surface that absorbs water from a tray. Air from the central heating system blows through the sponge, vaporizing the absorbed water. The drum type requires care and maintenance because mold and impurities can collect in the water tray. According to some manufacturers' instructions, this tray should be rinsed annually, although it usually helps to clean it several times per heating season.
- A flow-through or “trickle” humidifier is a higher-quality though more expensive unit than the drum-type. It allows fresh water to trickle into an aluminum panel. Air blows through the panel and forces the water to evaporate into the air stream. Excess water exits the panel into a drain tube. This design requires little maintenance because the draining water has a self-cleaning effect and, unlike the drum-type humidifier, there is no stagnant water.

**Other Tips for Homeowners:**

- If equipped with a damper, the humidifier should be closed in the summer and opened in the winter. The damper may appear as a knob that can be set to its “summer” or “winter” setting, or it may be a piece of metal that can be inserted to cover the duct opening.
- The humidifier is controlled by a humidistat, which must be adjusted daily. Some new models do this automatically, although most require daily attention from the home’s occupants. The humidistat should include a chart that can be used to identify the proper setting based on the outdoor temperature. If this adjustment is not performed, condensation will likely collect on the home’s cool surfaces and potentially lead to mold growth and wood rot. Many homeowners do not know that this calibration is necessary.
- The furnace may need to be checked for rust. Some humidifiers are installed inside the plenum of the furnace, which can be damaged by rust if the humidifier leaks.
- Central humidifiers may have a solid core that should be replaced each year. The manufacturer’s instructions should be consulted regarding this replacement.

In summary, central humidifiers are used to humidify indoor air to make it more comfortable, but they can cause health problems and building damage if they are not properly maintained.

## Bathroom Ventilation

Bathroom ventilation systems are designed to exhaust odors and damp air to the home's exterior. Typical systems consist of a ceiling fan unit connected to a duct that terminates at the roof.

**Fan Function**

The fan may be controlled in one of several ways:

- Most are controlled by a conventional wall switch.
- A timer switch may be mounted on the wall.
- A wall-mounted humidistat can be pre-set to turn the fan on and off based on different levels of relative humidity.

Newer fans may be very quiet but work just fine. Older fans may be very noisy or very quiet. If an older fan is quiet, it may not be working well. Homeowners can test for adequate fan air flow with a chemical smoke pencil or a powder puff bottle.

Bathroom ventilation fans should be inspected for dust buildup that can impede air flow. Particles of moisture-laden animal dander and lint are attracted to the fan because of its static charge. Homeowners should clean dirty fan covers.

Ventilation systems should be installed in all bathrooms. This includes bathrooms with windows, since windows will not be opened during the winter in cold climates.

**Defects**

The following conditions indicate insufficient bathroom ventilation:

- moisture stains on walls or ceilings;
- corrosion of metal;
- visible mold on walls or ceilings;
- peeling paint or wallpaper;
- frost on windows; and
- high levels of humidity.

The most common defect related to bathroom ventilation systems is improper termination of the duct. The vent must terminate at the home’s exterior.

The most common improper termination locations are:

- mid-level in the attic. This is easy to spot;
- beneath the insulation. You need to remember to look. The duct may terminate beneath the insulation or there may be no duct installed; and
- under attic vents. The duct must terminate at the home's exterior, not just under it.

Improperly terminated ventilation systems may appear to work fine from inside the bathroom, so the homeowner may have to look in the attic or on the roof. Sometimes, poorly installed ducts will loosen or become disconnected at joints or connections.

Ducts that leak or terminate in the attic can cause problems from condensation. Warm, damp air will condense on cold attic framing, insulation, and other building materials. This condition has the potential to cause health and/or decay problems from mold, or damage to building materials, including drywall. Dampness also reduces the effectiveness of thermal insulation.

**Mold**

Perhaps the most serious consequence of an improper ventilation setup is the potential accumulation of mold in the attic or crawlspace. Mold may appear as a fuzzy, thread-like, cobwebby fungus, although it can never be identified with certainty without being lab-tested. Health problems caused by mold are related to high concentrations of spores in the indoor air. Spores are like microscopic seeds, released by mold fungi when they reproduce. Every home has mold. Moisture levels above about 20% in building materials will cause mold colonies to grow. Inhaling mold spores can cause health problems in those with asthma or allergies, and serious or fatal fungal infections in those with lung disease or compromised immune systems.

Decay or rot is also caused by fungi. Incipient or early decay cannot be seen. By the time it becomes visible, the affected wood of the home's structure may have lost up to 50% of its original strength and integrity.

In order to grow, mold fungi require the following conditions to be present:

- oxygen;
- temperatures between approximately 45° F and 85° F;
- food. This includes a wider variety of materials found in homes; and
- moisture.

If insufficient levels of any of these requirements exist, all mold growth will stop and the fungi will go dormant. Most fungi are difficult to actually kill.

Even though mold growth may take place in the attic, mold spores can be sucked into the living areas of a residence by low air pressure. Low air pressure is usually created by the expulsion of household air from exhaust fans in bathrooms, kitchens and heating equipment, and the vent from a clothes dryer.

**Improper Ventilation**

Ventilation ducts must be made from the appropriate materials and installed properly and oriented effectively to ensure that stale air is adequately exhausted.

Ventilation ducts must:

- terminate outdoors. They should never terminate within the building's envelope;
- include a screen or louvered (angled) slats at its termination to prevent the entry of birds, rodents and insects;
- be as short and straight as possible, and avoid turns. Longer ducts allow more time for vapor to condense and also force the exhaust fan to work harder;
- be insulated, especially in cold climates. Cold ducts encourage condensation to form;
- protrude at least several inches from the roof;
- be equipped with a roof termination cap that protects the duct from the elements; and
- be installed according to the manufacturers' recommendations.

The following tips are helpful, although not required. Ventilation ducts should:

- be made from inflexible metal, PVC, or other rigid material. Unlike dryer exhaust vents, they should not droop; and
- have smooth interiors. Ridges will encourage vapor to condense, allowing water to back-flow into the exhaust fan or leak through joints and onto vulnerable surfaces below.

Above all else, a bathroom ventilation fan should be connected to a duct capable of venting water vapor and odors to the outdoors. Mold growth within the bathroom or attic is a clear indication of improper ventilation that must be corrected in order to avoid structural decay and respiratory health issues.

## Sewer Gases

Decomposing waste materials in public and private sewer and septic systems create sewer gases. Methane is the greatest single constituent of sewer gas, which includes an assortment of toxic and non-toxic gases, such as hydrogen sulfide, carbon dioxide, ammonia, nitrogen oxides, and sulfur dioxide. Improperly disposed gasoline and mineral spirits may also contribute to sewer gases.

Sewer gases pose the following risks:

- hydrogen sulfide poisoning. Hydrogen sulfide is an explosive and extremely toxic gas that can impair several different systems in the body at once, most notably the nervous system. So potent that it can be smelled at 0.47 parts per billion by half of all adults, the gas will begin to cause eye irritation at 10 parts per million (ppm) and eye damage at 50 ppm. Other low-level symptoms include nervousness, dizziness, nausea, headache and drowsiness.

Exposure to higher concentrations can lead to pulmonary edema, and still higher levels (800 to 1,000 ppm) will cause almost immediate loss of consciousness and death;

- asphyxiation. When sewer gases diffuse into household air, they gradually displace oxygen and suffocate the home's occupants. The effects of oxygen deficiency include headache, nausea, dizziness and unconsciousness. At very low oxygen concentrations (less than 12%), unconsciousness and death will occur quickly and without warning. Oxygen will be at its lowest concentrations in the basement, which is where heavy sewer gases, principally methane, are likely to collect;
- fire or explosion. Methane and hydrogen sulfide are explosive components of sewer gas. Vapors from improperly disposed fuel can further increase the risk of fire or explosion; and
- odor. Hydrogen sulfide is responsible for sewer gas's characteristic rotten-egg smell, which can be overbearing even at extremely low concentrations. The gas's odor is a safeguard, however, because it alerts the home's occupants to the leak long before they're in any serious danger. It is important to note that at roughly 100 ppm, the olfactory nerve becomes paralyzed, removing the victim's sense of smell and, subsequently, their awareness of the danger. Another "warning smell" comes from ammonia, which will sear the nostrils and progressively irritate the mucous membranes and respiratory tract. This gas, unlike hydrogen sulfide, is sufficiently irritating that the home's occupants are likely to vacate before its concentration rises to toxic levels.

If you suspect that any odors might be caused by sewer gases, contact a qualified plumber.

The design of the plumbing system relies on a connection between household fixtures and the sewer system, which is why a great deal of effort is spent to ensure that waste products -- and the gases that result from their decay -- flow in one direction.

The following failures in the plumbing system may allow sewer gases to flow back into the house:

- dried-out piping and plumbing fixtures. In most cases, intruding sewer gases are caused by a loss of the water barrier where traps have gone dry. Especially in dry weather, infrequent use of a toilet, shower or floor drain can allow for rapid evaporation and entry of sewer gases into the living space. Particularly common culprits are floor drains placed in locations where they are likely to dry out, such as near water heaters and furnaces, as well as seldom-used drains, such as those in janitor's closets, workshop areas, and mechanical rooms. Homeowners can maintain the water barriers by using the fixtures more often or by pouring water down the drains. Automatic drain-trap primers may also be installed so that a small amount of water is periodically delivered;
- cracks in the plumbing drain line or vent pipes. A water leak typically accompanies a crack in the drain line, but vent pipe cracks are more difficult to diagnose, and they can vent a large quantity of sewer gases into the home. Plumbers can locate these cracks by using a special machine that generates artificial smoke and pumps it into the plumbing drain system. The smoke pressurizes the system and exits through any cracks and loose fittings;
- diffusion from a leachfield septic system;
- through cracks in a building's foundation; and
- plumbing vents installed too close to air intakes, or windows in homes equipped with HVAC air handlers that admit outside air for ventilation. Wind and air flow around the house can allow for sewer gas to enter even where plumbing vents and air intakes are appropriately placed. Homeowners can add vent pipe filters or alter the height of the vents to alleviate the problem.

In summary, the intrusion of sewer gases into the living space should be fixed before occupants suffer ill health.

## Pesticides

Pesticides are poisons designed to kill a variety of plants and animals, such as insects (insecticides), weeds (herbicides), and mold or fungus (fungicides). They are each composed of an inert carrier and a pest-specific active ingredient, both of which are toxic to humans and pets.

**Human Exposure**

Pesticides may enter the body in one of the following three ways, which are ordered from least to most dangerous:

- absorbed through the skin. People can get pesticide on their skin because it is likely to splash or mist while mixing, loading or applying the chemicals. Skin contact may also occur while touching protective clothing, a piece of equipment, or any other surface that was exposed to pesticides;
- swallowed. Numerous reports exist of people accidentally drinking or eating a pesticide that had been placed in an unlabeled container, or by children whose access was not adequately child-proofed. Toxic substances can also be ingested when eating or smoking near those who have handled the chemicals; and
- inhaled. Powders, and airborne droplets and vapors can be easily inhaled. Low-pressure applications present a relatively limited hazard because most of the droplets are too large and heavy to remain in the air. High-pressure applications, however, are particularly dangerous because the droplets are small enough that they can be carried by winds for considerable distances. Pesticides with a high inhalation hazard should have a label that instructs the user to use a respirator.

**Health Effects and Symptoms of Pesticide Exposure**

The health effects of pesticides are specific to their ingredients. Organophosphates and carbamates, for instance, affect the nervous system, while others may irritate the skin and eyes, influence the body's hormone or endocrine system, and even cause cancer. Symptoms of pesticide exposure may appear immediately and disappear soon after exposure has ceased, or they may take a long time -- even years -- to develop. Specific symptoms include, but are not limited to, the following.

Acute symptoms include:

- mild poisoning: irritation of the nose, throat, eyes and/or skin, headache, dizziness, loss of appetite, thirst, nausea, diarrhea, sweating, weakness or fatigue, restlessness, nervousness, changes in mood, and/or insomnia;
- moderate poisoning: vomiting, excessive salivation, coughing, constriction of the throat and chest, abdominal cramps, blurred vision, rapid pulse, excessive perspiration, profound weakness, trembling, lack of muscular coordination, and/or mental confusion;
- severe poisoning: inability to breathe, small or pinpoint pupils, chemical burns, uncontrollable muscular twitching, unconsciousness, and/or death.

Long-term health effects include:

- cancer (lung, brain, testicular, lymphoma, leukemia);
- spontaneous abortion and stillbirth;
- genetic damage;
- infertility, including lowered sperm count;
- liver and pancreatic damage;
- neuropathy; and
- disturbances to the immune system (including minor ones, such as asthma and allergies).

**Drift**

Only a small percentage of insecticides and herbicides actually reach their intended destinations. The bulk of the chemicals find their way to other places, such as the air, water, food sources, and non-targeted insect and animal species. People and pets track pesticide residue into the house where it may settle on laundry, furniture, toys, and virtually anyplace else. Most runs off into water or dissipates in the air, where it may endanger the environment. This incidental or unintended travel is known as "drift."

Fumigant pesticides used outdoors have the potential to travel many miles from their intended targets, drifting through the air into schools, homes, parks and playgrounds. Pesticide drift has resulted in cases of mass hospitalizations, such as in 2007 when 121 workers in Nevada were rushed to the hospital after fumigant pesticide traveled a quarter-mile from its intended target. Home gardens usually require significantly less pesticide than large-scale agriculture, although the latter is held to safety standards that home gardeners are likely to ignore.

**Warning Labels on Pesticides**

Manufacturers of pesticides create warning labels for their products by considering how harmful the chemical would be through each route of entry into the body. The signal word that applies to the most dangerous route of entry is the one that goes on the label. Any one of the following signal words should appear on pesticide warning labels:

- CAUTION: slightly hazardous by any of the routes of entry.
- WARNING: moderately hazardous by at least one route of entry.
- DANGER: highly hazardous by at least one route of entry. The word "DANGER" alone means that the pesticide's greatest hazard is that it can severely irritate the skin or eyes, or both. If the pesticide has the word "DANGER" plus a skull-and-crossbones symbol, it means that the pesticide is highly toxic through one or more routes of entry. Funginex®, for instance, has the signal word "DANGER" on its label because it is a severe eye irritant. If it were highly toxic through oral, dermal or inhalation exposure, it would have the word "POISON" and the skull-and-crossbones symbol.

Labels should also contain a "hazard to humans" section and a "personal protective equipment" section, which instructs users about the kinds of exposures the signal word for that particular pesticide refers to.

**Safety Tips:**

- Limit termite infestation -- and the necessity for pesticide use -- by building with steel, concrete or brick. Borate-treated lumber will repel carpenter ants and termites.
- Plant disease-resistant plants around the home.
- Always keep chemicals out of reach of children.
- If you must handle pesticides, wear gloves and long sleeves, and avoid breathing the vapors.
- Carefully follow directions with regard to concentration, protective gear, and restricting access to areas that have been treated.
- Always ventilate the area well after use.
- Mix or dilute chemicals outdoors, if possible.
- Dispose of unwanted pesticides safely, and store partially-used containers outside the living space.
- Leather items contaminated with pesticides should be discarded. According to Montana State University, when leather watch bands, boots and gloves are worn and become damp, the wearer will again be exposed to the pesticide.
- Address any additional concerns with your Certified Master Inspector® during your next scheduled inspection.

## Pet Allergens

Cats and dogs produce allergens that pose a health threat to certain individuals.

**Modes of Transmission**

Cat dander consists of microscopic pieces of cat skin that have dried, flaked off, and become airborne. Shed dander can land on and stick to bedding, curtains, carpeting, and other surfaces, including people's skin and clothing. It contains Fel D1, a glycoprotein found in the cat's sebaceous glands located under their skin, and, to a lesser extent, it is found in cats' saliva and urine. Fel D1 can cause rapid allergic reactions in sensitive individuals. Unlike cats, the dogs' allergen, Can F1, is found in higher concentrations in their saliva than in their sebaceous glands.

**Facts and Figures**

- More people are allergic to cats than they are to dogs. This may be due to the severity of the allergen Fel D1, or because dogs are generally bathed regularly, whereas cats are not.
- Between 6 and 10 million Americans are allergic to cats, and approximately one-third of them have cats in their homes.
- Animal dander, hair, and other organic debris in homes can also result in a significant increase in the level of dust mites, mite feces, and other allergenic insect parts.
- Allergens may be found months or years after a pet has been removed from a house.
- Pet-borne allergens commonly infiltrate places where pets have never been present, such as schools, workplaces, and other public spaces. Since dander allergens are sticky, they can be transported to these places on the clothing of pet owners.
- Animal hair, despite popular belief, is not considered to be a significant allergen. However, hair can collect pollen, dust, mold, and other allergens.

- There are no "non-allergenic" breeds of dogs or cats. Some breeds of both species, however, are believed to be hypoallergenic. Anecdotal reports claim that the Siberian, Cornish Rex, and hairless Canadian Sphynx cat breeds are less likely to provoke an allergic attack than most other cats. Similarly, poodles and schnauzers have been reported to be less allergenic. None of these claims has been validated scientifically.

**Cat and Dog Allergy Symptoms**

These include:

- itching, rashes and hives;
- sneezing and congestion;
- redness, itching, swelling and watering of the eyes;
- post-nasal drip, itching or hoarseness of the throat, and the need to clear the throat often;
- itching, plugging or popping in the ears; and
- coughing, wheezing, tightness in the chest, frequent bronchitis, and shortness of breath.

**How to Test Whether a Cat or Dog Has Been in a Home**

Pets are forbidden by many rental lease agreements, which may then be violated by tenants who secretly house cats or dogs. Also, cats may visit a residence at night to forage for food or find shelter. The following detection methods may be used:

- Smell for the animal. If the cat is an indoor cat, a litter box must have been used somewhere in the building, and they almost always produce an odor. Even after they are removed, the smell from a litter box may linger for quite some time. If a male cat was present in the house and he has urinated on or "marked" any areas, the odor will be very strong.
- Look for hair. Somewhere in the home, especially where the cat likes to sleep or rest, there will be large amounts of hair.
- Use a blacklight to check for pet urine.

**Cleaning Tips:**

- Obtain a thorough, professional duct cleaning.
- Commercially steam-clean, professionally dry-clean, or use very hot water to launder clothing.
- Wash and use a HEPA-filter vacuum for interior surfaces. Note that ordinary vacuum cleaners, which cause allergenic particles to become airborne, are ineffective and may even worsen the problem for sensitive occupants.

**Advice for People with Pets**

A combination of approaches—medical control of symptoms, good housecleaning, and planning—is most likely to succeed in allowing an allergic person to live with pets. Tips for homeowners:

- Take allergy medication. Most fall under one of the following three categories:
    - antihistamines, such as over-the-counter Claritin® and Benadryl®, and the prescription drugs Allegra® and Zyrtec®;

    - decongestants, such as OTC Sudafed® and prescription Allegra-D®; and
    - prescription steroids, such as Flonase® and Nasonex® sprays.
- Get allergy shots. These are not always effective, however, and completing treatment can take years.
- Bathe your pet on a weekly basis. Cats can get used to being bathed, but it's critical to use only products labeled for them.
- Keep the pet outdoors as much as possible.
- Allergic individuals should not hug, pet or kiss their pets.
- Have your pet spayed or neutered. The allergen produced by a cat is highest in unaltered males and lowest in altered males.
- Remove clothing worn after grooming or playing with pets.
- Litter boxes should be placed in an area far away from the air supply to the rest of the home, and should be avoided by allergic individuals.
- Design a cleaning regimen that can substantially reduce those levels, ranging from discarding materials to HEPA-vacuuming and washing certain surfaces.
- Maintain adequate ventilation.
- Remove as much carpet from the home as is feasible. The less dander-catching furnishings, such as carpeting and cloth curtains, the better.
- Clean frequently and thoroughly to remove dust and dander, and wash articles such as couch covers, throw pillows, curtains, and pet beds.
- Create an "allergy-free" zone in your home—preferably, the allergic person's bedroom—and strictly prohibit the pet's access to it. Consider using impermeable covers for the mattress and pillows.
- Keep pets off furniture, especially upholstered furniture where dander can be easily transferred.

In summary, irritation and contamination caused by pet allergens can be limited by proper care of their hygiene, homes and owners.

### Greywater

Greywater (also spelled graywater) is wastewater collected from household showers, sinks, tubs, and washing machines that would otherwise be sent down the drain and into the sewage system. Greywater is not potable water, but it can be used for some household activities, such as flushing toilets and, more commonly, for irrigation. Greywater differs from blackwater, which is water that has come into contact with fecal matter and people who carry infectious diseases.

There are two main classifications of greywater:

- Untreated greywater is collected relatively cheaply and is always used immediately. It may be utilized for flushing toilets and for outdoor irrigation, where it is then purified by plant roots and soil life.
- Treated greywater is collected using automated diversion, purification and irrigation systems, which render greywater suitable for storage and for additional uses, such as for washing and laundry.

Opponents of greywater usage cite concerns that greywater systems could harbor and spread disease. Proponents of greywater systems acknowledge that much household water usage does not actually require potable water, and that greywater systems, when implemented properly, provide an important secondary source of household water.

**Facts and Figures**

- According to Oasis Design, "The total number of households utilizing greywater is estimated to range from 660,000 to 1.77 million in California, and 8 million in the United States." In 2009, Oregon passed a law that encourages the use of greywater.
- Although there is no comprehensive study on the public health risks of greywater, there have been no reported cases of illness from contact with greywater in the United States.
- Greywater usage is common and often not regulated in many Third-World nations.

**Potential Hazards**

- All greywater has the potential to harbor dangerous bacteria and viruses.
- It is not potable.
- Micro-organisms present in untreated greywater can damage foliage.
- Untreated greywater should not be used for lawn sprinklers, as this could spread dangerous, airborne bacteria.
- Greywater that is not able to permeate down into the soil can create pools that may leach out and contaminate neighboring surface waters.
- Harsh detergents from laundry and washing water, such as dyes, bleaches and bath salts, may have a negative impact on vegetation.
- High levels of fats and food residue from kitchen waste may block plumbing.
- Accidental cross-contamination of pipes can lead to contamination of drinking water. Only a licensed plumber should implement changes to existing plumbing structures.
- Irrigating too closely to a private well could lead to contamination of the drinking water supply.
- Emptying untreated greywater into a toilet's tank may cause a foul odor; when flushing with greywater, pour it directly into the toilet bowl.

**Adavantages of Greywater**

- Implementing greywater systems may result in a substantial cost savings, both in fresh water and sewage costs.
- Using greywater lessens stress on municipal sewage systems and water supplies, which is especially important in times of drought and water rationing.
- Implementing greywater systems allows for abundant landscapes in locales where adequate water for irrigation is not readily available.
- Nutrients from kitchen wastewater, which would otherwise be wasted, are able to help replenish the fertility of soils.
- Greywater is easier to reclaim and treat than blackwater, and breaks down more quickly in the environment.
- Greywater systems can be implemented in new homes and also retrofitted into older homes.
- Devices may be added to systems to capture and utilize heat from greywater, such as the hot water from showers.
- Some municipalities offer tax incentives for implementing greywater systems.

- Many municipal golf courses and public parks use treated greywater in their watering systems, which saves money for the community.

**Disadvantages of Greywater**

- Improper handling could impose serious health hazards.
- Some municipalities require expensive and complex permits and inspections to legally operate a greywater system.
- In some jurisdictions, the use of greywater indoors may be prohibited.
- Implementing intricate filtration and treatment systems can be prohibitively expensive.
- Claims made by retailers of expensive greywater filtration systems may be inflated or incorrect.
- Greywater systems are poorly understood by many professionals compared to standard plumbing practices.
- Greywater systems require regular maintenance and may require replacement of expensive parts.

**Inspection**

Here are some tips:

- Appropriate protective attire, such as gloves, should always be worn when handling greywater.
- Untreated greywater should not be stored longer than 24 hours.
- Irrigation should be implemented with drip hoses at the root level or with sub-surface irrigation techniques. Greywater should not be applied to the surface of edible vegetable gardens.
- Greywater should be applied intermittently in order to allow it to be properly absorbed by the soil.
- Greywater should not be used on exterior surfaces, such as patios or driveways.
- Only biodegradable detergents should be used for laundry.
- Pipes carrying greywater should be clearly labeled and kept separate from fresh-water and blackwater pipes.
- County guidelines should be followed when irrigating close to a private well.
- Systems should be set up such that excess greywater flows into the sewer system, and that sewage backup never causes greywater contamination.
- Only pipes with a diameter of 1½ to 2 inches should be used for greywater lines.
- In systems utilizing valves, only electric sewage valves should be used, as greywater may eventually corrode less expensive valves.
- U-shaped pipes should not be used for greywater, as particles may clog them.
- In order to determine the proper irrigation area, a percolation test can determine the rate at which the soil will drain.
- Consult with local authorities to determine guidelines for greywater usage and necessary permit regulations.

In summary, greywater systems demand serious caution and proper handling to implement safely. But as water conservation becomes more important, especially in areas where resources are scarce, greywater systems are becoming an increasingly important option to augment traditional water supply systems.

## Backflow Prevention

Backflow is the reversal of the normal and intended direction of water flow in a water system. Devices and assemblies known as backflow preventers are installed to prevent backflow, which can contaminate potable water supplies.

**Why is backflow a problem?**

Backflow is a potential problem in a water system because it can spread contaminated water back through a distribution system. For example, backflow at uncontrolled cross-connections (cross-connections are any actual or potential connections between the public water supply and a source of contamination or pollution) can allow pollutants or contaminants to enter the potable water system. Sickness can result from ingesting water that has been contaminated due to backflow.

Backflow may occur under the following two conditions:

1. Back-pressure, which is the reverse from the normal direction of flow within a piping system as the result of the downstream pressure being higher than the supply pressure. This reduction in supply pressure occurs whenever the amount of water being used exceeds the amount of water being supplied, such as during water-line flushing, fire-fighting, and breaks in water mains.

2. Back-siphonage, which is the reverse from normal directional flow within a piping system that is caused by negative pressure in the supply piping (i.e., the reversal of normal flow in a system caused by a vacuum or partial vacuum within the water supply piping). Back-siphonage can occur when there is a high velocity in a pipe line, when there is a line repair or break that is lower than a service point, or when there is lowered main pressure due to high-water withdrawal rate, such as during fire-fighting and water-main flushing.

**Atmospheric Vacuum Breakers**

Backflow prevention for residences is most commonly accomplished through the use of atmospheric vacuum breakers or AVBs. AVBs operate by allowing the entry of air into a pipe so that a siphon cannot form. AVBs are bent at 90 degrees and are usually composed of brass. Compared with backflow-preventer assemblies, AVBs are small, simple and inexpensive devices that require little maintenance or testing. They have long lifespans and are suitable for residential purposes, such as sprinkler systems. Homeowners can check for the following:

- The AVB must be at least 6 inches above any higher point downstream of the device. For this reason, they can never be installed below grade. Even if they are installed 6 inches above grade, homeowners should make sure that they are not installed less than 6 inches above some other point in the system downstream of the device.

- The AVB cannot be installed in an enclosure containing air contaminants. If contaminated air enters the water piping, it can poison the potable water supply.

- A shut-off valve should never be placed downstream of any AVB, as this would result in continuous pressure on the AVB.

- AVBs cannot be subject to continuous pressure for 12 hours in any 24-hour period or they may malfunction.

- Spillage of water from the top of the AVB is an indication that the device has failed and needs to be replaced.

**Types of Backflow-Preventer Assemblies**

Some types of assemblies are common in commercial and agricultural applications but are rare for residential uses. The appropriate type of backflow preventer for any given application will depend on the degree of potential hazard. The primary types of backflow preventers appropriate for use at municipalities and utilities are:

- double check valves: These are commonly used in elevated tanks and non-toxic boilers. Double check-valve assemblies are effective against backflow caused by back-pressure and back-siphonage and are used to protect the potable water system from low-hazard substances. Double-checks consist of two positive-seating check valves installed as a unit between two tightly closing shut-off valves, and are fitted with testcocks.

- reduced pressure-principle assemblies: These are commonly used in industrial plants, hospitals, morgues, chemical plants, irrigation systems, boilers, and fire sprinkler systems. Reduced pressure-principle assemblies (RPs) protect against back-pressure and back-siphonage of pollutants and contaminants. The assembly is comprised of two internally loaded, independently operating check valves with a mechanically independent, hydraulically dependent relief valve between them.

- pressure vacuum breakers: These are commonly used in industrial plants, cooling towers, laboratories, laundries, swimming pools, lawn sprinkler systems, and fire sprinkler systems. Pressure vacuum breakers use a check valve designed to close with the aid of a spring when water flow stops. Its air-inlet valve opens when the internal pressure is 1 psi above atmospheric pressure, preventing non-potable water from being siphoned back into the potable system. The assembly includes resilient, seated shut-off valves and testcocks.

**Requirements for Testers and Inspectors**

A number of organizations, such as the American Water Works Association (AWWA) and the American Backflow Prevention Association (ABPA) offer certification courses designed to train professionals to test backflow preventers. Requirements for training vary by jurisdiction. Inspection of backflow preventers requires knowledge of installation requirements.

In summary, backflow preventers are designed to prevent the reverse flow of water in a potable water system. They come in a number of different types, each of which is suited for different purposes.

## Carpeted Bathrooms

Carpeted bathrooms have carpeting on their floors instead of traditional flooring, such as tile or vinyl. Despite their tendency to foster mold and bacteria, carpets are sometimes installed in residential bathrooms for aesthetic purposes. Carpets should never be installed in bathrooms in commercial buildings.

**Advantages of Carpets in Bathrooms**

- They make bathrooms appear more warm and inviting.
- They are softer than tile and many people find them comfortable on bare feet.
- Slip hazards are reduced. It's easier to slip on tile than on carpeting.
- Installation is generally quick and inexpensive.

**Disadvantages of Carpets in Bathrooms**

The pad beneath the carpet may soak up large amounts of moisture. Some of the common ways that carpets may come into contact with moisture in bathrooms include:

- steam from the shower condenses on the carpet;
- water splashing from the tub or shower;
- water shed from shower/tub users as they step onto the carpet;
- water splashing out of the sink;
- water dripping from the vanity; and
- water leaking from the toilet.

The presence of moisture in the pad will lead to the growth of decay fungi on the wood or oriented strand board (OSB) sub-floor. The sub-floor will become decayed and weakened by mold. Mold also releases spores that can cause respiratory ailments, especially for those with certain health problems. Moisture meters can be used to determine if there is excess moisture in the flooring beneath a carpet.

In addition to potential mold growth beneath the carpet, bacteria can accumulate in carpeting that surrounds the toilet. Bacteria are contained in urine, which can be accidentally deflected onto the carpet.

**Carpeted Bathrooms in Commercial Buildings**

It is against code to install carpet in commercial bathrooms. The 2007 edition of the International Building Code (IBC) states the following concerning carpeted bathrooms in commercial buildings:

> *In other than dwelling units, toilet, bathing and shower room floor finish materials shall have a smooth, hard, non-absorbent surface. The intersections of such floors with walls shall have a smooth, hard, non-absorbent vertical base that extends upward onto the walls at least 4 inches.*

**Recommendations:**

- Clean the carpet regularly to remove any mold and urine that may be present.
- Keep the carpet as dry as possible. Various devices exist that prevent water from bypassing the shower curtain.
- Install a bathroom vent fan, if one is not installed already. If a fan is installed, operate it more often.

In summary, carpets installed in bathrooms can trap moisture and urine, substances that can cause structural damage and health problems.

## Chinese Drywall

Amidst a wave of Chinese import scares, ranging from toxic toys to tainted pet food, reports of contaminated drywall from that country have been popping up across the American Southeast. Chinese companies use unrefined fly ash, a coal residue found in smokestacks in coal-fired power plants in their manufacturing process. Fly ash contains strontium sulfide, a toxic substance commonly found in fireworks. In hot and wet environments, this substance can offgas into hydrogen sulfide, carbon disulfide, and carbonyl sulfide and contaminate a home's air supply.

The bulk of these incidents have been reported in Florida and other southern states, likely due to the high levels of heat and humidity in that region. Most of the affected homes were built during the housing boom between 2004 and 2007, especially in the wake of Hurricane Katrina when domestic building materials were in short supply. An estimated 250,000 tons of drywall were imported from China during that time period because it was cheap and plentiful. This material was used in the construction of approximately 100,000 homes in the United States, and many believe this has led to serious health problems and property damage.

Although not believed to be life- threatening, exposure to high levels of airborne hydrogen sulfide and other sulfur compounds from contaminated drywall can result in the following physical ailments:

- sore throat;
- sinus irritation;
- coughing;
- wheezing;
- headache;
- dry or burning eyes; and/or
- respiratory infections.

Due to this problem's recent nature, there are currently no government or industry standards for inspecting contaminated drywall in homes. Certified Master Inspectors® who have dealt with contaminated drywall in the past may know how to inspect for sulfur compounds, but there are no agencies that offer certification in this form of inspection. Homeowners should beware of con artists attempting to make quick money off of this widespread scare by claiming to be licensed or certified

drywall inspectors. The Master Inspector Certification Board has assembled the following tips that inspectors can use to determine whether a home's drywall is contaminated:

- The house has a strong sulfur smell reminiscent of rotten eggs.
- Exposed copper wiring appears dark and corroded. Silver jewelry and silverware can become similarly corroded and discolored after several months of exposure.
- A manufacturer's label on the back of the drywall can be used to link it with manufacturers that are known to have used contaminated materials. One way to look for this is to enter the attic and remove some of the insulation.
- Drywall samples can be sent to a lab to be tested for dangerous levels of sulfur. This is the best testing method but also the most expensive.

Contaminated Chinese drywall cannot be repaired. Affected homeowners are being forced to either suffer bad health and failing appliances due to wire corrosion or replace the drywall entirely, a procedure that can cost tens of thousands of dollars. This contamination further reduces home values in a real estate environment already plagued by crisis. Some insurance companies are refusing to pay for drywall replacement, and many of their clients are facing financial ruin. Class-action lawsuits have been filed against home builders, suppliers, and importers of contaminated Chinese drywall. Some large manufacturers named in these lawsuits are Knauf Plasterboard Tianjin, Knauf Gips, and Taishan Gypsum.

The Florida Department of Health recently tested drywall from three Chinese manufacturers along with a domestic sample and published their findings. They found "a distinct difference in drywall that was manufactured in the United States and those that were manufactured in China." The Chinese samples contained traces of strontium sulfide and emitted a sulfur odor when exposed to moisture and intense heat, while the American sample did not. The U.S. Consumer Product Safety Commission is currently performing similar tests. Other tests performed by Lennar, a builder that used Chinese drywall in 80 Florida homes, and Knauf Plasterboard, a manufacturer of the drywall, came to different conclusions than the Florida Department of Health. Both found safe levels of sulfur compounds in the samples they tested. There is currently no scientific proof that Chinese drywall is responsible for the allegations against it.

Regardless of its source, contamination of some sort is damaging the property and health of homeowners in the southern U.S. The media almost unanimously report that the blame lies with imported Chinese drywall that contains corrosive sulfur compounds originating from ash produced by Chinese coal-fired power plants. Homes affected by this contamination can suffer serious damage to the metal parts of appliances and piping, which can potentially lead to health issues for the homes' families.

### Home Heating Oil Tanks

Heating oil, which is more commonly known as Fuel Oil No. 2, is used to heat 7.7 million American homes each year, according to the U.S. Department of Energy. Heating oil is in a category of fuel oil that also includes Fuel Oil No. 1 (kerosene), range oil, and jet fuel. It is essentially the same as diesel fuel except without dye (and the state taxes). For home heating use, oil is usually stored in tanks that are underground, in basements, or above ground outside of the house. Heating oil is safe when stored and used appropriately, but accidental spills and undetected leaks can endanger health, property, and the environment. Homeowners should be aware of some of the hazards of a leaking or damaged above-ground oil tank.

**How common are leaks?**

Oil leaks and spills can happen at a residential property for a number of reasons, such as when a storage tank develops a leak, is damaged, is overfilled, or if a septic tank whose fuel lines are no longer attached to the tank is filled with oil. A spill might even happen on a nearby property and the oil may flow into neighboring yards. Regardless of its cause, cleaning up an oil spill is extremely expensive, often costing hundreds of thousands of dollars or more, putting homeowners in danger of bankruptcy.

**How toxic is home heating oil?**

Heating oil is also an environmental pollutant that can poison soil, groundwater, and wildlife and their habitats. It has a relatively low toxicity to humans –- less than that of gasoline – although it can harm people through the following methods of exposure:

- inhalation of vapors:
    - Short-term exposure to heating oil vapors can cause headaches, nausea, increased blood pressure, dizziness, difficulty concentrating, and irritation to the eyes, nose and throat.
    - Long-term exposure to heating oil vapors, often due to undetected leaks, can cause liver and kidney damage, diminished ability to smell and taste, and other serious health problems. Heating oil is not currently known to cause cancer, although one of its constituents – benzene – is carcinogenic.
- skin contact, which can lead to itchiness, redness, pain, blisters and peeling; and
- ingestion, which can cause vomiting, diarrhea, restlessness, and breathing difficulties. In large enough quantities, ingestion can lead to coma or death.

**Signs of a Possible Leak**

The following conditions can aid homeowners in identifying leaks or conditions that may lead to leaks in above-ground heating oil tanks:

- drips or any signs of leaks around the tank, filter, fuel-delivery line, valves, piping or fittings;
- signs that the tank has been patched to temporarily conceal a leak;
- rusty, loose, wobbly or bent tank legs, or a cracked foundation, which can indicate poor tank stability. A full 275-gallon heating oil tank weighs more than 2,000 pounds, so it needs strong legs and a sturdy foundation;
- poor condition of oil tank lines. Check these periodically and contact the oil supplier if they look questionable. Keep the vent line clear of any snow, ice and insect nests;
- dying vegetation surrounding an outdoor tank. An oil leak may be the cause of damaged or dying plants or grass nearby;
- wet spots or rust on the tank's outer surface;
- old fuel-fill lines are no longer connected to the tank in use. If these lines are inadvertently filled, a massive oil leak will result. Unused/unconnected fuel lines from replaced oil tanks should be removed;

- overhanging eaves that may allow ice and snow to fall onto the tank and melt, potentially corroding the tank;
- fuel lines that are not covered by protective casing, even if the tank is underground;
- a strong odor of oil around the tank;
- a cracked, stuck or frozen fuel-level gauge, or signs of fuel around the gauge;
- a clogged or restricted tank vent blocked by snow, ice or insect nests; or
- signs of an oil spill around the fill pipe or vent pipe.

**What should you do in case of an oil spill?**

Homeowners should take the following steps in the event of a residential oil spill or leak.

- Act immediately. Even after the source of the leak is stopped, the leaked oil will saturate surrounding soil, flow into cracks and drains, and get beneath floors and walls and remain there until it is cleaned up.

- Turn off all sources of flames or sparks in the area, such as pilot lights in water heaters and furnaces. Unplug any sparking mechanisms. Do not smoke or light matches in the area. While heating oil is less flammable than gasoline, it is still possible for it to ignite.

- Ventilate the area. Clothes and furniture will absorb the oil smell and may need to be discarded. Open windows and close cold-air returns, heat registers, and other openings that may allow odors to enter other areas of the home. Make every effort to seal off any air flow between the spill and the inhabited areas of the home.

- Be sure to keep pets away from any contaminated area.

- Clean up small spills by donning rubber gloves and old shoes and clothing that can be thrown away afterward. Avoid skin contact and inhalation of vapors. Larger spills will require professional cleanup.

In summary, home heating oil is a moderately toxic substance that can do serious damage to buildings and the environment. Homeowners should keep an eye out for any signs of an undetected leak or an accidental spill. If a leak or spill is discovered, take immediate safety measures, including contacting the fuel supplier.

## Underground Fuel Storage Tanks

Buried storage tanks that contain petroleum and other hazardous chemicals may pose a safety hazard to those living in homes nearby, as well as significant financial liability to the owner. Homeowners who suspect that there's an underground tank on their property should try to confirm its presence and location, and whether it's in service or inactive, and what it holds. The homeowner should have the tank tested for leaks, especially if testing has never been performed, if the tank is unused, or if the tank is old.

According to the Groundwater Protection Council, there are currently more than 640,000 federally regulated buried tanks that store fuels and other hazardous substances. Of these, about 465,000 have leaked, and most have required cleanup, although tens of thousands were never repaired because a responsible party could not be identified. Actual figures are likely far greater than these totals, which represent only the documented cases. At particular risk are households that use groundwater, which comprise a large part of the total U.S. population, and 99% of families in rural areas.

Tanks are capable of leaking chemicals for many years, since the corrosion process is typically slow. Once free from the tank, petroleum will sink through unsaturated soil and enter the water table. There, much of the chemical will vaporize and eventually bubble up through the ground's surface. In addition to the risks posed by other petroleum products, leaked gasoline presents the risk of fire and explosion, especially if the vapors collect inside buildings. Any petroleum-contaminated water that is ingested or used to bathe is potentially deadly.

Benzene, toluene, ethylbenzene and xylenes, collectively known as the BTEX compounds, are the most hazardous chemicals found in petroleum. Benzene-contaminated water has been proven to cause cancer, along with water contaminated by methyl tertiary butyl ether, which is added to gasoline to make it burn cleaner. The latter chemical has infiltrated 9,000 community water wells in 31 states, although its use in gasoline is being phased out.

The liability connected with leaking buried tanks can be huge for the property owner. Testing typically costs around $500, which is considerably less expensive than the amount of money required to clean up a subterranean oil spill and install a new tank. The test should show that there is no leakage. If there has been a leak, the situation should be remedied before the property is sold.

Testing requires one or more of the following technical measures:

- Pressure testing: Tanks are pressurized and then monitored for a period of time to observe for fluctuations that indicate a leak.
- Soil testing: Soil samples are taken from around the tank and sent to a lab for analysis. If the tests show chemicals have leaked, it is advisable for additional samples to be taken so that the extent of the contamination can be better understood.
- Water in the tank: If water has entered the tank through a crack, chemicals may leave the tank through the same path. If water is pumped through the fuel lines into the burner, it may rust the metal parts of the oil filter, which is one way to check for water in the tank. It is possible, however, for water to enter an oil tank through faulty oil delivery or via condensation.
- Other methods: Ultrasound and ground-penetrating radar can be used to create an image of the tank and identify any leaks.

Tanks that show leakage must be removed from the ground or filled with a chemically inert solid, such as sand. Groundwater contaminants must also be removed by pumping air through the water, which causes volatile petroleum compounds to vaporize and biodegrade naturally. The process of treating or removing the tank, water and soil, known as remediation, costs thousands of dollars and is not guaranteed to succeed. Many communities have been forced to find alternative sources of drinking water because of petroleum contamination. To avoid this costly and difficult mess, new installations should be buried far from potable water sources and properly maintained, once the system is in service.

## Compost Pile Hazards

Compost is an accumulation of degrading food scraps, plants, and other nutrient-rich organic matter. It is an easy and environmentally responsible way to dispose of biodegradable kitchen waste, which can then be returned to the soil as fertilizer for vegetable and flower gardens.

**Composting is Good**

- Composting helps to reduce the volume of material in landfills.
- Compost is used to improve soil structure and provide nutrients for growing plants.

So, what's wrong with composting? The benefits of the practice are generally well-known, but few people are actually aware of the potential hazards and dangers composting can pose.

**Diseases Contracted from Handling Compost**

Compost can be a breeding ground for dangerous pathogens, some of which have killed or seriously harmed unsuspecting gardeners. Listed below are some of the more common physical ailments that can result from unprotected contact with compost:

- Aspergillosis is a fungal infection of the lungs that is caused after the inhalation of a fungus commonly found in rotting plant matter. While normally not life-threatening, aspergillosis can be extremely dangerous if enough spores are inhaled. The disease killed a 47-year-old British man after he was engulfed in clouds of dust from the compost he had intended to use in his garden.
- The symptoms of Farmer's Lung resemble pneumonia, and may result from respiratory exposure to certain fungal and bacterial pathogens present in rotting organic materials, such as mushrooms, hay and sugar cane. Beware of dusty white patches, as they are a sign that dangerous spores are present. Farmer’s Lung can usually be treated with antibiotics.
- Histoplasmosis is caused by fungus that grows in guano and bird droppings. Healthy immune systems can usually fight off histoplasmosis, although infections can become serious if large amounts of the toxin are inhaled, or if the infected person has a weakened immune system.
- Legionnaire’s Disease is a respiratory infection that's caused by the inhalation of *L. Longbeachae*.
- Paronychia is a local infection that occurs in the tissue around the fingernails and toenails. Prolonged moisture and the abrasive effects of soil can create openings in the skin that allow the infection to occur, producing pain and throbbing.

- Tetanus is a disease of the central nervous system that's caused by bacteria that is very common in soil. While even a minor cut can allow the bacteria to enter the bloodstream, immunizations against tetanus are quite common.

**How to Avoid Potential Hazards of Composting**

The following general safety precautions should be followed in order to avoid transmission of dangerous fungi, bacteria and other pathogens found in compost:

- Always wear dry, breathable gloves to avoid direct contact with compost, and to protect yourself from injury while using gardening tools and implements.
- Wear protective footwear that covers your skin adequately to avoid direct contact with compost. Do not wear them anywhere except outdoors.
- When stirring and tilling the compost, which is required on a regular basis in order for it to process and break down, always wear a nose and mouth guard or dust mask to avoid inhaling the various spores that will become airborne during tilling and turning.
- Avoid tilling on windy days.
- Do not store compost in fully closed or airtight containers. Without any air, compost can actually become combustible.
- Wash your hands after dealing with compost. While this suggestion may sound obvious, many garden enthusiasts get so absorbed with their activities that they forget the potential dangers from poisoning.
- If you develop a severe cough or infection of the skin (especially if there is an open sore or puncture wound), seek medical attention immediately. You may require antibiotics or a tetanus shot.

**Compost Fires**

Surprisingly, a great deal of heat is created by the microbial activity, which is occasionally enough to cause a fire. In August 2009, a compost pile spontaneously combusted at the Saginaw Compost Facility in Saginaw, Michigan. However, these fires are extremely rare, as they occur only under a limited set of circumstances that would ordinarily be avoided using common sense.

According to the Alberta (Canada) Department of Agriculture, the following key conditions must be met in order for a compost pile to light itself on fire:

- dry materials have gone unattended;
- there is biological activity;
- dry pockets of debris form among a non-uniform mix of materials;
- the compost is in large, well-insulated piles;
- there is limited air flow;
- there is poor moisture distribution due to neglect or oversight in monitoring; and
- the temperature within the pile is unknown, with time for the temperature to increase.

WARNING: While self-incineration of compost is possible, compost piles probably catch fire more often from ordinary sources, such as a discarded lit cigarette or due to electrical mishaps. Also, gardeners who use ash from incinerated trash or the fireplace sometimes neglect to make sure that the ash has cooled sufficiently before adding it to the compost pile.

Tips to help avoid compost fires:

- Assure that there's adequate ventilation in the pile to release heat. Turn the pile or use a mechanical aeration system to ensure proper ventilation. Narrow, short piles generally have adequate ventilation.
- Do not turn a pile that is smoldering, as the sudden infusion of oxygen can cause the pile to erupt into flames.
- Do not let the pile get too dry. The University of Missouri states, "Organic material can ignite spontaneously due to biological activity at a moisture content between 26 and 46%, if the temperature exceeds 200° F."
- Monitor the pile's temperature, focusing on the hottest spot in the pile. Use a thermometer long enough to reach the center of the pile. Do not let the pile get too hot. If the temperature of the pile exceeds 160° F, reduce the temperature through the following methods:
    - reduce the size of the pile;
    - add water to 55% moisture;
    - mix in coarse, bulky material, such as wood chips; and
    - do not pile compost next to buildings or any flammable structures, as a fire can spread easily.

**Compost-Friendly Pests**

Worms are often added to compost piles to aid in the breakdown of organic matter. But if the compost piles are not constructed and maintained properly, they have the tendency to attract unwanted pests. Flies, termites and beetles are attracted to the smell of decay, and they, in turn, will attract larger predatory critters to the pile.

Use the following pest-control tips:

- Do not compost eggs, meat, oils, bones, cheese or fats. Compost piles should be "vegetarian."
- Bury the compost with soil or leaves to contain the smell and to aid with the biodegrading process.
- If using a portable composter, make sure it has a cover that will discourage the entry of pests and animals.
- Beware that enclosed compost piles can overheat and create high levels of dangerous gases, such as methane, so be sure to rotate the container or till the pile daily.
- Do not place compost near a building. In addition to the fire concerns, compost placed adjacent to buildings can promote infestation.

NOTE: These practices can also mitigate the foul smells that can plague compost piles.

In summary, the benefits of compost piles can be quickly eclipsed by health hazards and nuisance pests if they are not designed correctly and maintained properly.

## Hantavirus

Hantavirus is the name commonly applied to the pathogen that causes the rare yet potentially deadly disease known as hantavirus cardiopulmonary syndrome (HPS).

HPS is actually caused by several forms of this virus, which, collectively, account for just a fraction of all hantaviruses, most of which are not a threat to humans.

HPS is transmitted through rodent feces, urine and saliva, and the primary mode of human contact with hantavirus is through inhalation. Crawlspaces and vacated houses are areas where rodent infestations are likely.

**Symptoms of HPS**

Although researchers are not certain as to how long the virus' incubation period may last, it is generally believed to last up to five weeks. Symptoms of HPS will follow this period.

Early symptoms of HPS almost always include muscle aches, fever and fatigue. Sufferers may also experience nausea, chills, dizziness, diarrhea, abdominal pain and headaches. Four to 10 days after these symptoms first appear, infected persons will find it hard to breathe as their lungs begin to fill with fluid. Coughing and shortness of breath are common respiratory symptoms of the later stages of infection.

There is no known cure, vaccine or treatment that specifically targets HPS. However, if the symptoms are recognized early, patients may benefit from oxygen therapy. If the symptoms of HPS are recognized late, it is less likely that medical intervention will be helpful. The hantavirus kills roughly 30% to 40% of those who become infected.

**Places Where the Hantavirus is Likely to Be Encountered**

The Master Inspector Certification Board believes that crawlspaces are the most likely locations that the hantavirus may be encountered. This is partly due to the fact that rodents are attracted to areas that are undisturbed by humans. Also, crawlspaces are generally dark places that lack ultraviolet (UV) radiation, which can rapidly inactivate the hantavirus. The virus will be less likely to be dangerous in areas of the house that receive sunlight through windows. Open windows will also allow contaminants to vent from the home.

Homes that have not been occupied for long periods of time are more likely to experience heavy rodent infestation and hantavirus contamination, among other viruses and bacteria.

The hantavirus can be transmitted to humans in the following ways:

- When fresh rodent droppings and urine that contains the hantavirus are disturbed, the virus will become airborne and can be more easily transmitted to humans. The majority of transmissions occur due to inhaled aerosolized droplets that are contaminated with hantavirus.

- Touching the nose or mouth after touching anything contaminated by infected rodents can lead to contamination and human infection.

- Eating food contaminated by infected rodents can transmit the virus.

- Although extremely rare, the virus can be transmitted through a bite from an infected rodent.

The hantavirus cannot be transmitted from infected humans to other humans, or to any other non-rodent animals.

If a homeowner must enter a rodent-infested area of the house, s/he should wear personal protective equipment. The primary mode of transmission for hantavirus is through inhalation, so a respirator is necessary. The Centers for Disease Control (CDC) states that a half-face respirator is adequate, although other sources say that a full-face respirator (covering the eyes, nose and mouth) is required. To be safe, it is a good idea to wear goggles to prevent contaminated dust from coming into contact with the eyes if only a half-face respirator is being used.

The following are specific instructions from the CDC concerning appropriate respirators for hantavirus exposure:

> Wear either a half-face, tight-seal, negative-pressure respirator, or a positive-pressure, powered air-purifying respirator (PAPR) equipped with N-100 or P-100 filters (formerly designated as high-efficiency particulate air [HEPA] filters). Negative-pressure respirators are not protective if facial hair interferes with the face-piece to face seal because a proper fit cannot be assured.

**Rodents That Carry Hantavirus**

Four species of mice and rats have been confirmed as carriers of the hantavirus. The CDC offers the following information to identify them:

1. The deer mouse is a deceptively cute animal, with big eyes and big ears. Its head and body are normally about 2 to 3 inches long, and the tail adds another 2 to 3 inches in length. You may see it in a variety of colors, from gray to reddish-brown, depending on its age. The underbelly is always white, and the tail has sharply defined white sides. The deer mouse is found almost everywhere in North America. Usually, the deer mouse likes woodlands, but it also turns up in desert areas.

2. The **c**otton rat, found in the southeastern United States (and way down into Central and South America), has a bigger body than the deer mouse—the head and body are about 5 to 7 inches, and another 3 to 4 inches with the tail. The hair is longer and coarser and of a grayish-brown color, even grayish-black. The cotton rat prefers overgrown areas with shrubs and tall grasses.

3. The rice rat is slightly smaller than the cotton rat, having a head and body 5 to 6 inches long, plus a very long, 4- to 7-inch tail. Rice rats sport short, soft, grayish-brown fur on top, and gray or tawny underbellies. Their feet are whitish. As you might expect from the name, this rat likes marshy areas and is semi-aquatic. It's found in the southeastern United States and in Central America.

4. The white-footed mouse is hard to distinguish from the deer mouse. The head and body together are about 4 inches long. Its tail is normally shorter than its body (about 2 to 4 inches long). Topside, its fur ranges from pale brown to reddish-brown, while its underside and feet are white. The white-footed mouse is found throughout southern New England, the Mid-Atlantic and southern states, the Midwestern and western states, and Mexico. It prefers wooded and brushy areas, although sometimes it will live in more open ground.

Although the virus can appear anywhere in the United States, it is more prevalent West of the Mississippi. Males and Caucasians are also somewhat more likely to contract HPS than females and other races, although it is likely that this occurrence is due to factors that are not gender- or ethnicity-specific, but are probably more attributable to occupational exposure and the greater populations of Caucasians in the western United States.

It is possible that the virus can be carried by other species of rodents that have yet to be identified.

In summary, hantavirus should be taken seriously by every homeowner because this virus is encountered in homes more than in any other location. The disease that it causes, HPS, has no cure, and very few people know enough about it to protect themselves from infection.

## Plants and Indoor Air Quality

Raising plants indoors is a home-healthy move because of their ability to clean the air of carbon dioxide, but their benefits don't stop there. According to several studies, the average houseplant can remove formaldehyde, benzene, and a host of other toxins that plague typical indoor air.

It may come as a surprise, but indoor air is often much more polluted than the air outdoors. Off-gassing from paints, adhesives, and even unsuspected items, such as clothing and tap water, infuse the air we breathe with a host of chemicals, many of which are proven carcinogens. Newer, tighter homes are especially problematic, since they limit the amount of fresh air that can make its way into the interior. Compound this with the average time that citizens of developed nations spend indoors – approximately 90% – and the need for remediation becomes clear. Answering this need can be as simple as the addition of green, leafy plants to the living space.

**Interesting Facts**

- Removal of environmental airborne toxins with the aid of plants is called phytoremediation.
- Plants can reduce stress, increase work performance, and reduce symptoms of ill health.

**Study Performed by NASA**

While researching the ability of plants to cleanse air in space stations, NASA made some fascinating and important discoveries concerning the role that houseplants play here on Earth. They tested the ability of a variety of plants to remove common volatile organic compounds (VOCs) from the air.

The toxins tested include:

- benzene:
  - It's found in petroleum-based indoor coatings, gasoline, inks, oils, paints, plastics, rubber, cleaning solutions, and exterior exhaust fumes emanating into buildings.
  - It's an irritant and probable carcinogen. The inhalation of benzene has been reported to cause dizziness, weakness, euphoria, headache, nausea, blurred vision, respiratory diseases, tremors, irregular heartbeat, liver and kidney damage, paralysis, and unconsciousness.
- trichloroethylene (TCE):
  - It's found in a wide variety of products, such as inks, paints, lacquers, varnishes and adhesives.
  - It's a potent liver carcinogen.
- formaldehyde:
  - It's found in virtually all indoor environments due to its widespread use in many kinds of products. Specifically, it may be found in:
    - urea-formaldehyde foam insulation (UFFI), particleboard and pressed-wood products;
    - paper products, such as grocery bags, waxed papers, facial tissues, and paper towels;
    - common household cleaning agents;
    - stiffeners, wrinkle-resisters, water-repellents, fire-retardants, and adhesive binders in floor coverings, carpet backings, and permanent-press clothes; and
    - heating and cooking fuels, such as natural gas and kerosene, and cigarette smoke.
  - Formaldehyde causes watery eyes, nausea and wheezing. More seriously, the chemical is classified as carcinogenic to humans by the International Agency for Research on Cancer.
- toluene:
  - It's found in adhesives, disinfectants, rubber, printing ink, lacquers, and leather tanners;
  - Symptoms in low doses include sleepiness, confusion, weakness, memory loss, nausea, loss of appetite, and hearing and color-vision loss. High levels of toluene may cause light-headedness, unconsciousness, and death.

In the NASA testing, flowering plants, such as chrysanthemums and gerbera daisies, effectively removed benzene from the chamber's atmosphere. Golden pothos, spider plants and philodendron were the most effective in removing formaldehyde molecules. Other top performers were red-edged dracaena and the Peace Lily. The rest of the plants tested, with the exception of Chinese evergreen (*Aglaonema modestum*), were effective at removing at least one of the chemicals from the air. NASA researchers found that plants absorb airborne substances through tiny openings in their leaves, but roots and soil bacteria are also part of the purification process.

The study concluded that in an 1,800-square-foot house, the occupants should incorporate 15 to 18 houseplants in 6- to 8-inch diameter containers to improve air quality. The larger and more vigorously they grow, the better.

**India Study**

The government of India published the results of a groundbreaking study in September 2008 that analyzed the effects of certain species of plants on indoor air quality. Three plant species – areca palm, pothos (known as Mother-in-Law's Tongue), and the Money Plant – were tested for 15 years at the Paharpur Business Centre and Software Technology Incubator Park in New Delhi. The building was 20 years old and 50,000 square feet, and it housed more than 1,200 plants for 300 workers. The study found that the building had the healthiest indoor air in the city.

Specifically, compared to other buildings in New Delhi, the building showed reductions of:

- eye irritation by 52%;
- respiratory conditions by 34%;
- headaches by 24%;
- lung impairment by 12%; and
- asthma by 9%.

In addition, energy costs were reduced by 15% because less outside air infiltration was required. Worker productivity showed an increase of 20%, perhaps as a result of fewer sick days and increased blood-oxygen levels.

**Is There a Downside to Indoor Plants?**

Some controversy exists regarding how healthy it is to keep plants indoors. In a recent paper about plants and indoor air quality, co-authored by BuildingEcology.com editor Hal Levin, it was concluded that the positive effects of keeping plants indoors were negligible, at best, and, in some cases, it could possibly be harmful.

The authors conclude that there are "significant methodological issues" for previous research conducted. The positive gains, they argue, were likely the result of the potting soil and its abilities to cleanse or aerate indoor air, rather than the leaves of the plants themselves. Additionally, they point out, some of these earlier studies were conducted under circumstances that do not reflect real-world conditions, so testing results can be skewed. Experiments conducted in a sealed chamber, such as some of those performed by NASA, will have very different results than one conducted where ventilation rates mimic those in the average office building. And, these days, there are many interpretations for what an "average" work environment is. Every workplace is different, and every variable -- from the number of people, the level of ventilation, other airborne pollutants (such as personal scents, cleaning supplies, office printers, etc.) – can confuse any reasonable measurements, making an across-the-board recommendation realistically difficult.

Additionally, keeping plants indoors affects the moisture content of the air, which must be regulated so as not to promote mold growth. Some people may have allergies to certain flowering plants, and moisture, along with airborne pollutants that are not effectively mitigated by plants, can exacerbate such problems for the building's occupants.

Finally, as with any study promoting a point of view, consumers should be wary of who is behind it. Just as some of the most publicized research on heart health in the 1990s recommended eating oatmeal every morning was paid for by Quaker Oats, some plant studies have been scrutinized for their funding sources, as well.

Homeowners should note whether plant containers are leaking, or if there are water stains under them. Over-watering indoor plants can lead to cosmetic and even moisture-related structural problems, as well as mold and other serious indoor air quality issues.

In summary, plants can generally be used to enhance the aesthetic environment and the air quality inside the home and other buildings, but care must be taken to account for potential allergies, the use of fertilizers and pesticides indoors, adequate ventilation and air flow, and the level of moisture maintained for the plants -- all factors that can affect the building and its occupants.

## Mother Nature

### Earthquake Preparedness

Earthquakes are a serious threat to life and property not just in California, but in many parts of the United States. Areas of the country that are less prone to seismic activity typically have less stringent building codes that govern earthquake preparedness. Catastrophic earthquakes are rare, but even minor ones can cause substantial damage to homes that are not sufficiently reinforced.

Homeowners significantly decrease the probability that their homes will be adversely affected by a seismic event if these weak spots have been identified and addressed before an earthquake strikes.

**Facts and Figures**

According to the Federal Emergency Management Agency (FEMA), 45 states and territories in the United States are at moderate to very high risk for earthquakes.

Damage resulting from earthquakes in the United States is estimated at $4.4 billion per year, according to a 2000 FEMA report.

Shaking ground accounts for 99% of earthquake-related damage to residences. Other earthquake-related events, such as fault ruptures, liquefaction of soil, dam failure, lateral spreading, landslides, and tsunamis account for the remaining 1% of damage.

**Potential Hazards**

- Natural gas connections may rupture or break during an earthquake, which, if ignited by an errant spark or other catalyst, results in gas leaks, fire and/or an explosion.

- Full water heaters typically weigh approximately 450 pounds. Unbraced water heaters may fall over during an earthquake and rupture water, gas and/or electrical connections, resulting in an electrical or fire hazard.

- Homes that are not properly secured to their foundations or that do not have sturdy foundations may break loose and cause gas connections to rupture and a subsequent fire hazard. Older concrete foundations are at a higher risk because the concrete may have already started to weaken and crumble over time. Homes built on unreinforced concrete, or brick or stone masonry foundations are also at a higher risk.

- Stud walls holding up a home's crawlspace that are not properly braced for horizontal movement may fail, causing a home to collapse.

- Homes that are built on steep slopes may collapse if the posts that support them are not properly braced.

- Walls that are constructed out of unreinforced clay, concrete, stone, adobe or brick masonry may fail in an earthquake because the mortar that binds them together is typically not strong enough to sustain seismic activity.

- Rooms that are built over garages may collapse during an earthquake because the strength of the walls in the vicinity of the opening of the garage door is reduced.

- Unreinforced masonry chimneys may collapse during an earthquake. The section above the roofline is particularly at risk, and bricks may fall into the home.

- Heavy furniture, shelving and appliances that are not anchored may become dislodged during an earthquake and can cause damage or injury, or can block an emergency exit for occupants trying to escape.

- Windows may shatter during an earthquake and can cause injury.

- Toxic substances that are stored in breakable containers may spill during an earthquake and cause a hazard of inhalation, slipping, and burns and irritation due to skin exposure.

**Inspection**

Homeowners may want to check for the following:

- Any appliances in the home that run on natural gas should be securely anchored to the floor or walls.

- Water and gas pipes should be flexible to prevent ruptures and leaks.

- If no automatic gas shutoff valve is installed, the manual gas shutoff valve should be in a location that is accessible to occupants in the event that they need to shut it off quickly.

- Cement foundations should not be seriously cracked or crumbling.
- Homes should be securely bolted to the foundation.
- Wood stud walls supporting the first floor should be braced with plywood panels nailed to the studs or diagonal wood sheathing.
- Freestanding water heaters should be braced with steel plumber's tape or with metal straps attached to wall studs.
- Braces or plywood panels should surround and reinforce garage doors that are not in line with the rest of the house.
- Masonry foundations and walls should be strengthened with steel reinforcement.
- Columns and walls that support homes on hillsides should be adequately braced.
- There should be sheet metal straps and angle bracing installed to hold the unreinforced masonry chimney to the house. Plywood panels should be present at the ceiling or roof to prevent bricks from falling into the home. Children's play areas should be located away from the chimney.
- Large appliances and furniture inside the home should be secured to the walls or floor with flexible cable, braided wire, or metal strapping.
- Heavy objects and mirrors should be installed away from beds.
- Cabinets that contain heavy and breakable objects should be secured with sliding bolts or childproof latches on the doors.
- Hazardous materials should be kept in non-breakable containers and stored securely away from heat sources and appliances.

In summary, the extent of damage caused by an earthquake is typically more substantial if a home has not been prepared for an earthquake before it strikes. Homeowners can take appropriate measures by having their homes inspected annually by a Certified Master Inspector®.

### Tornado Inspections

Tornadoes, also known as twisters and cyclones, are whirling columns of air that form with little warning and carve unpredictable paths of destruction through communities worldwide. America's "Tornado Alley" – roughly the area between the Rocky Mountains and the Appalachian Mountains – where tornadoes kill dozens and cause billions of dollars in damage annually, sustains the majority of these storms. The extreme danger posed by tornadoes to families and their homes justifies the need for homeowners to learn some basic tips concerning tornado behavior, preparedness, and post-storm damage inspection.

**What Causes Tornadoes?**

Tornadoes form from giant storms called supercells, which are rapidly rotating updrafts created when colder polar air meets warmer tropical air. Changing wind speeds and direction can cause rising air to rotate vertically, creating within the larger supercell what is known as a mesocyclone. For reasons not yet understood, columns of strong rotating air can develop within the mesocyclone, eventually extending from the cloud base to the ground in the form of a tornado. The size, shape and color of tornadoes vary greatly, from transparent, narrow funnels several hundred feet across to dark wedges wider than they are tall.

Tornadoes damage small areas and thus cause less damage nationwide than hurricanes and tropical storms, but for those caught in their path, tornadoes can wreak havoc unmatched by any other weather phenomenon. Most tornadoes have wind speeds of less than 110 miles per hour and dissipate after several miles, but larger storms can exceed 300 miles per hour and devastate communities hundreds of miles apart.

**Facts and Figures**

- Of the 50 states, Florida experiences the most tornadoes per unit area, while Oklahoma is hit by the strongest tornadoes per unit area. Due to its poor building construction and general lack of tornado awareness, Bangladesh has the highest annual tornado death toll of any country.
- Tornadoes in the northern hemisphere generally rotate in a counterclockwise direction, while the opposite is true in the southern hemisphere.
- Supercells spawn land tornadoes. Dust devils and “gustnadoes” appear similar to tornadoes but they are distinct and far less dangerous phenomena.
- A waterspout is a relatively weak tornado that forms over water as a result of cumulus congestus clouds.
- Tornadoes are intense and can be long-lived. Consider the following extremes:
    - The Bridge Creek-Moore Tornado that happened just outside Oklahoma City in 1999 had winds of 301 mph, the highest wind speed ever recorded.
    - The Great Bend Tornado in Kansas that occurred in 1915 hurled a sack of flour 110 miles and a cancelled check 305 miles.
    - In 1925, the nicknamed Tri-State Tornado that affected Missouri, Illinois and Indiana holds three records for traveling 219 miles at 73 mph and killing 295 people.

**Classifications**

Tornado strength is categorized by the following Enhanced Fujita Scale, whereby the storm receives an “F” rating from 0 to 5 based on the severity of the inflicted damage:

- EF0: The weakest type of tornado can cause superficial damage to structures and vegetation.
- EF1: This rated tornado can cause major roof damage, with mobile homes seriously damaged.
- EF2: This stronger tornado may result in roof loss and wall collapse, with mobile homes destroyed, and smaller trees uprooted.
- EF3: This is the maximum level that allows for reasonably effective residential sheltering in a first-floor interior room. Small cars can become projectiles, and large trees can be snapped.

- EF4: At this level, most homes are completely destroyed, leaving a pile of debris on the foundation. A storm shelter is required to ensure safety. Trains and large trucks can be pushed over, and cars and large trees can be flung long distances.
- EF5: As the result of this strongest and most dangerous tornado, well-built homes can be lifted from their foundations and shredded in mid-air, then dispersed as coarse granules over large areas. Large trucks and farm equipment can be smashed into their component parts, skyscrapers may actually be deformed, and entire communities may be leveled. At a rate of occurrence of just 0.1%, EF5 tornadoes are extremely rare, yet they have caused more than 20% of all tornado casualties.

While no two tornadoes are alike, the anatomy of a tornado's attack on a house is as systematic as it is fierce, and is defined as "a progressive failure [that] begins top-down, then outside-in," according to Timothy Marshall, a tornado expert who writes for *Popular Mechanics*. Within the first second, pummeling debris tears away a structure's roof shingles and decking, while wind shatters and rushes through windows and raises the internal pressure. The upward force of the wind on the underside of the already weakened roof, combined with the uplift forces above the roof caused by the high wind, quickly overcome the relatively weak connections between the roof and the walls. The roof tears away from the house, leaving the exterior walls unsupported. In another second, the exterior walls blow out – first, the side walls parallel to the straight-line winds, followed by the windward wall, and finally the back wall – leaving the interior walls unprotected against the maelstrom. An EF4 tornado needs only four seconds to wipe a foundation clean.

**Myth vs. Fact**

Knowing what not to do can be just as essential as taking the proper safety precautions. Misconceptions concerning tornadoes persist in the media, which may lead to avoidable damage and even unnecessary injuries and deaths.

The Master Inspector Certification Board would like to dispel the following tornado myths that may harm a home's occupants:

MYTH: Open windows to equalize the barometric pressure between the interior and the exterior pressure caused by a nearby tornado, thereby preventing damage to the building.
FACT: While a pressure imbalance does exist, it is not great enough to cause a building to explode outward, as was once hypothesized. Damage is primarily caused where wind breaches the building from the outside, which is why windows and other openings should remain closed. Moreover, openings on the windward side of a building actually increase internal wind pressure, resulting in additional uplift force on the roof.

MYTH: The safest location in a house is its southwest corner.
FACT: This notion originated in the 1887 text *Tornadoes*, from which it became conventional wisdom until a 1966 study indicated that the southwest corner is actually the most dangerous place to be during a tornado. The safest part of a structure during a tornado is the lowest central room, especially a bathroom or the area beneath a stairwell.

MYTH: Tornadoes always travel in a northeasterly direction.
FACT: While in most areas tornadoes tend to follow their parent storms to the northeast, they may stop, change direction, or suddenly backtrack, seemingly at random. Local geography plays a part, too, such as in Minnesota, where tornadoes sometimes travel northwest, and in coastal south Texas, where they sometimes travel southeast.

MYTH: Tornadoes are "attracted to" mobile homes.
FACT: The inordinate severity of damage inflicted on trailer parks, compared to conventional homes, can be attributed to the weakness of the building materials commonly used in mobile homes, their lack of foundations, and their small size.

MYTH: Large auditoriums are safer during tornadoes than houses.
FACT: Many studies have concluded that large-span structures, such as auditoriums and gymnasiums, are vulnerable to high winds because of their high surface area. As such, these buildings should be avoided.

MYTH: Tornadoes do not strike cities.
FACT: This myth is based on the comparatively small area occupied by downtown areas, which make them uncommon targets for tornadoes. Also, the urban heat-island effect may discourage the formation of weaker tornadoes. Significant tornadoes are unaffected by turbulent warm air, however, and EF4 and EF5 tornadoes have struck Atlanta, Georgia, Lubbock, Texas and even London, England.

MYTH: Mountains, lakes and rivers are significant barriers against tornadoes.
FACT: Tornadoes have formed over rivers and lakes, and more than a dozen have crossed over the Mississippi River. Twisters have been observed as high as 12,000 feet above sea level and ascend 3,000-foot ridges without slowing down.

**Damage to Homes**

While much tornado destruction is obvious, some of the damage is only apparent upon closer inspection. Even an insurance adjuster can miss critical structural and safety defects that may cost the homeowner a fortune to repair. According to CNN, a jury found that a major insurer acted "recklessly and with malice" while handling insurance claims resulting from the 1999 Oklahoma tornado, which posed serious safety defects to a home's occupants. An unbiased and comprehensive assessment of the damage inflicted on a home by a tornado can be obtained by hiring a Certified Master Inspector®.

Specifically, the following items and conditions should be assessed for damage:

- gas leaks. Uprooted trees may have damaged underground gas pipes, which can lead to deadly fires;
- electrical damage. Electrical equipment should be dried and checked before being returned to service. If you see sparks or broken or frayed wires, or if you smell burning insulation, turn off the electricity at the main fuse box or circuit breaker. If you have to step in water to get to the fuse box or circuit breaker, call a utility repair person or an electrician first for advice;
- plumbing. Tornadoes can easily shake and rattle a home, causing plumbing lines to twist and crack. Following the storm, homeowners can check their plumbing by turning on all plumbing

fixtures, checking cabinets for signs of water damage, and checking ceilings from below for staining. Avoid using toilets if sewage lines have been damaged;

- roof and siding. Cracking, tears and gouges caused to the roof and siding by flying debris will eventually allow for the entry of rainwater and snowmelt. Gable roofs are especially vulnerable to damage from the high winds generated by tornadoes. For additional support, attach wall studs to roof rafters using hurricane clips, not nails;
- chimney damage. Chimney damage may slow or stop the ventilation of carbon monoxide (CO) – a poisonous, colorless, odorless and tasteless gas – allowing it to accumulate in the living area. Inspect the chimney closely for damage in a tornado-damaged house;
- windows and gutters. Flying debris can smash windows, damage windowpanes and shutters, rip screens, and dent and tear away gutters;
- foundation. Strong winds can cause foundations to uplift. Check the perimeter of crawlspaces for any changes, and inspect masonry for signs of separation and cracking;
- interior. Inspect for stress cracks in the corners where walls and ceilings meet, and especially the areas above windows and doors. Use a level to check for cupping of the floor and bowing of the walls. Water stains and mold on interior walls may appear some time after the tornado, indicating overlooked damage to the roof that has permitted water intrusion; and
- garage doors. Due to their large surface area, garage doors can be damaged or blown in before other parts of the house are damaged. The wind may then damage the interior and accelerate the home's collapse. Garage door system technicians can be hired to install horizontal bracing and impact-resistant coverings, and to strengthen weak hinges and glider wheel tracks. Old and damaged doors should be replaced.

**Tips for Homeowners**

If a tornado is in your area, immediately take shelter indoors, preferably in a basement or first-floor room, closet, hallway, or the void beneath a stairwell. Bathrooms are generally safe, as plumbing fixtures strengthen the walls and anchor them to the ground, and bathtubs can protect against flying debris. Crouch face down beneath a heavy table or workbench, and cover your head with your hands to protect against falling debris. Do not leave the home until the storm has passed. If possible, cover yourself with some sort of thick padding, such as blankets or a mattress.

Also, avoid the following areas:

- rooms with many windows. Before any other part of the house fails, windows typically shatter and allow the entry of dangerous projectiles, such as broken masonry and gravel, in addition to glass shards from the windows itself;
- rooms with exterior walls. Exterior walls will fail before interior walls, which often survive intact;
- under heavy objects that are located on the floor above. A piano or refrigerator may fall through a weakened floor and crush anything below; and
- mobile homes. Only 10% of Americans live in mobile homes but nearly half of all tornado fatalities happen in them. Mobile homes that are not tied down can be flipped in 60- to 70-mph winds, and even small tornadoes can cause them to completely disintegrate, leaving their occupants unprotected. Leave a mobile home immediately and seek shelter elsewhere. If none can be found, lie flat in the nearest ditch with your hands shielding your head.

Also:

- Watch for atmospheric conditions that accompany tornadoes, such as a dark, greenish sky, large hailstones, a cloud of debris, a roaring noise, or a lowering, spinning storm cloud.
- Monitor the Emergency Alert System (EAS) on the radio or TV and listen for tornado advisories. A tornado watch means that conditions are favorable for a tornado to form, while a tornado warning means a tornado has been sighted or detected on radar.
- If a tornado is approaching, shut off the water either at the main meter or at the water main that leads into the home.
- Before a storm, shut off the electricity, as sparks from electrical switches could ignite gas and cause an explosion.
- Keep all hazardous materials, such as poisons and chemical solvents, stored in a secure area away from emergency food and water supplies.
- Arrange furniture so that chairs and beds are away from windows, mirrors and picture frames.
- Secure top-heavy, freestanding furniture, such as bookcases and China cabinets, with L-brackets, corner brackets, eyebolts, flexible cable, or braided wire, and place heavy items on the bottom shelves. This is an advisable safety precaution in general for families with small children and those who reside in earthquake-prone regions.
- Keep a disaster supply kit on hand. It should include a first-aid kit, a flashlight with extra batteries, essential medicines, a battery-operated radio, emergency food and water, and a hand-held can opener.
- Install a safe room or storm shelter in or near the house.
- Following a storm, do not use matches, lighters or appliances or operate light switches until you are sure there are no gas leaks. If you smell gas or hear a hissing noise, open a window and leave the building as quickly as possible. Turn off the gas at the outside main valve if you can, and call the gas company from a neighbor's home. Wait for a professional to turn the gas back on.

In summary, tornadoes are devastating and unpredictable, but a little knowledge concerning their basic behavior can save lives. Homeowners can benefit by being aware and prepared in order to protect both their families and their properties.

## Wind Mitigation

Wind mitigation is the implementation of certain building techniques in order to limit damage caused by intense winds.

**A Few Facts About Wind Storms and Wind Insurance:**

- In 2006, Citizens Insurance, one of the largest property insurers in Florida, requested a 45% rate increase for wind insurance. Other insurers took similar actions.
- In Florida, the portion of a homeowner's premium covering wind damage can be up to 70% of the total, depending on location.
- Wind mitigation benefits homeowners, private insurers, and all levels of government.

**Incentives for Wind Mitigation:**

- Homeowners can benefit from reduced insurance premiums offered in some states if they use wind mitigation techniques to reinforce their homes. The Gulf Coast states, which are most prone to wind storm damage from hurricanes, have each considered mandating incentives to mitigate damage due to wind. Mississippi and Texas currently do not have such legislation, although Florida has been successful. Following Hurricane Andrew, Florida passed a law requiring insurance companies to offer their customers discounts and credits for existing building features and home improvements that reduce damage and loss from wind. In order to qualify for this discount, homes must undergo a certified home wind inspection. However, many Floridians do not know of this law.
- Those with wind storm insurance can avoid a costly deductible. Deductibles for homes in hurricane-prone areas can exceed $20,000, meaning that mild to moderate wind damage might not be covered by insurance at all. If proper wind mitigation techniques have been used, these expenses can be avoided altogether.
- Wind mitigation helps protect the home from damage. Even if a home is insured, it is always costly when a house is damaged, both for the homeowner and the insurer. Repairs can take months, especially during material and labor shortages that follow massive destruction to entire communities, as was the case after Hurricane Katrina struck Louisiana.
- Mortgage lenders in Florida require homeowners to carry wind storm insurance in order to be approved for a home loan. Insurers may not provide wind storm insurance to homeowners whose homes are vulnerable to wind damage.

**Checklist for Wind Mitigation Techniques:**

- garage doors: These commonly fail during windstorms due to:
    - inadequate door-track strength and mounting systems; and
    - flimsy metal panels.

  The following features can protect a garage door from wind damage:
    - no windows;
    - the tracks for the door that have six to nine mounting brackets, or continuous mounting;
    - track brackets that are securely attached to the wall; and
    - horizontal and/or vertical reinforcement on all panels.

- opening protection: Glass doors and windows should be replaced with impact-resistant glass. They should be structurally attached to the building in order to prevent the entire window from popping out of its frame. Sliding glass doors are especially vulnerable to flying debris due to their large expanse. Once an opening is created during a wind storm, the pressure within the house can rise high enough to cause the roof to fail in areas of low pressure.
- roof covering: There are many kinds of roof covering materials, and some resist wind damage better than others. The most common roof covering materials in Florida are composition shingles and tiles. A key factor in roof covering performance is the method of attachment of the roof covering material to the roof deck. Nails—not staples—should be used to fasten these materials.
- roof shape: "Roof shape" refers to the geometry of the roof, rather than the type of roof covering. The end-walls of gable roofs extend vertically to the sloping roofline. These gable end-

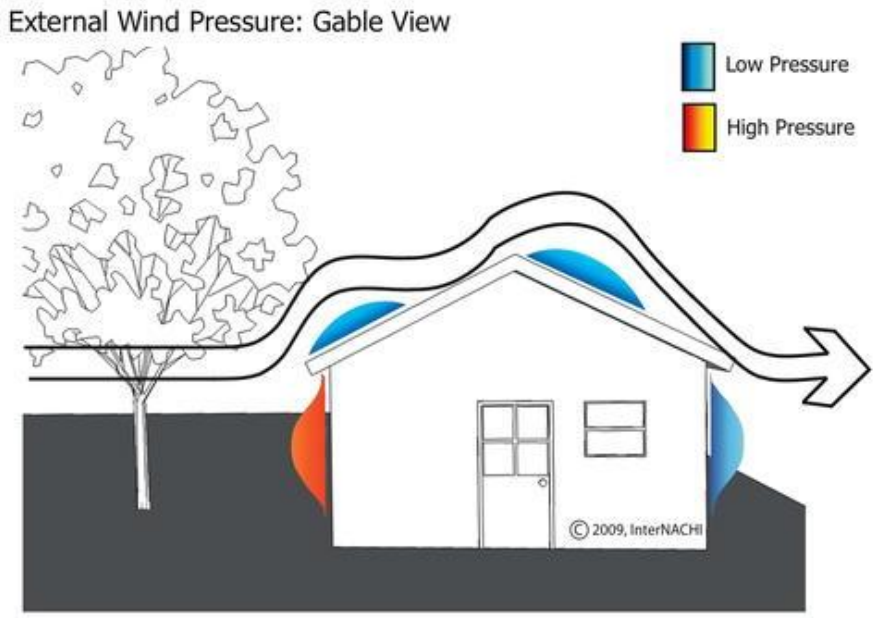
walls, if not properly built and braced, have been known to fail outward due to the negative suction on the wall. Additionally, field testing has shown that hip roofs receive up to 40% less pressure from wind than gable roofs.

- roof deck attachment: According to insurance claim data, a house becomes a major loss once the roof deck fails, even partially. The most common roof deck types are plywood and OSB. The most important feature by far of the roof deck is the attachment to the framing compared to the deck's thickness.

  The following building techniques can help prevent wind damage:
  - roof coverings using shingles that meet the FBC requirements;
  - roof decks that have been installed with large nails and close spacing;
  - hurricane clips/straps that hold the roof structure to the walls; and
  - protection of windows and glass doors with impact-resistant glazing or other protection systems.

- roof-to-wall connections: This connection is a critical safeguard that keeps the roof attached to the building and acts to transfer the uplift loads into the vertical walls. This connection is crucial to the performance of the building due to the large negative pressures acting on the roof. Proper installation is essential to connector performance.
- secondary water resistance: This is a layer of protection that shields the home in the event that the roof covering fails. It will reduce leakage if the shingles are blown off. A secondary water barrier is relatively rare in homes.

  The two most common types are:
  - self-adhering modified bitumen underlayment, which is applied to the exterior of all joints; and
  - foam seal, which is sprayed onto the underside of the decking.



In summary, wind mitigation is a strategy designed to limit the amount of wind damage inflicted on a structure. Various incentives are in place to motivate homeowners to implement these enhancements, and Certified Master Inspectors® may be able to determine the improvements that are necessary.

## Windbreaks

Windbreaks are dense rows of trees and shrubs designed to reduce wind speed before it reaches a building. These landscape elements provide numerous other perks for the homeowner, their neighborhood, and the environment.

Some of the advantages provided by windbreaks, beyond simple wind mitigation, include the following.

- Many animals rely on windbreaks. Food, shelter from severe weather, nesting sites, and a means of escape cover are all provided by the vegetation that composes a windbreak. For example, the planting of windbreaks during the Dust Bowl of the 1930s is believed to have allowed the expansion of woodland birds and other creatures, such as Mississippi kites and fox squirrels. Birds, in particular, are known to rely on windbreaks for temporary cover during winter storms. Even large mammals, such as white-tailed deer, use windbreaks for cover, food and fawning. Employ a variety of trees and shrubs in your windbreak to create an abundance of different kinds of nuts, seeds and berries, which will, in turn, attract a diversity of wildlife.
- While any vegetation will increase the appeal of an otherwise barren yard, a uniform, well-maintained windbreak can actually increase property values with their pleasing aesthetics. Also, they allow the homeowner to strategically screen out undesirable sights.
- Windbreaks are effective for noise deflection. Windbreaks reduce the infiltration of traffic noise into a property by absorbing and deflecting it with leaves and large branches. In addition, traffic noises will be replaced with the sounds of rustling leaves or the singing of birds that are drawn to the vegetation.
- Windbreaks assist agriculture. According to the University of Florida's School of Forest Resources and Conservation, "A well-designed windbreak located in the direction of a prevailing wind can increase crop yield, reduce soil erosion, influence microclimate around the crops, increase irrigation efficiency, and control the spread of some pathogens." Erosion, in particular, is a serious threat to farmers. By clearing trees from the Western regions of Canada and the United States, farmers in the 1930s inadvertently encouraged evaporation and subsequent erosion that were largely responsible for the infamous Dust Bowl. Although rains eventually remedied the situation, farmers learned to place windbreaks around their lands to keep soil damp during droughts.
- Windbreaks provide snow control. A properly placed windbreak prevents snowdrifts in areas such as driveways and building entrances. Valuable time and effort can then be spent on activities other than snow removal.

Windbreaks work either by deflecting the wind up and over a building, thereby forming a protective wind shadow, or by catching it to reduce its speed. And as the windbreak captures the winter wind, so too does the wind chill diminish. For example, if the outside temperature is 12° F (-11° C), a windbreak can reduce a 20-mph wind to 5 mph, and the wind chill will be reduced from -22° F (-30° C) to a more bearable 8° F (-11° C).

The best windbreaks block wind close to the ground by using fast-growing trees and shrubs that have low crowns. Deciduous trees, while they are favored as shade trees during the summer, lose their leaves in cold weather, which makes them less effective than evergreens at stopping the frigid winter wind. The best choices are dense, fat, fast-growing conifers that will mature to a height higher than the roof. These qualities may be found with Norway, white, and Colorado blue spruce.

**Tips for Homeowners:**

- For maximum protection, plant your windbreak at a distance from your home of three to five times the height of the mature trees. Studies have shown, however, that the effective distance of wind reduction is sometimes as high as 30 times the height of the windbreak, depending on the tree species.
- Do not plant trees too close to the home's south side, as this will reduce the warmth supplied by the winter sun.
- Arrange windbreaks in multiple rows to increase their effectiveness.
- Do not prune the lower branches of the windbreak, as this will increase the wind speed near the ground.
- Thin the trees and shrubs as they grow to ensure that competition does not jeopardize the health of the windbreak. For instance, you can plant trees 3 feet apart, but then you should remove every second tree when their crowns begin to intersect.
- Incorporate numerous plant species in the windbreak to impede wind from ground level to the treetops. Even non-living yard features, such as walls, fences and raised soils, can be incorporated into a single windbreak.
- Decide which direction the prevailing winds come from in your area so you know where the best places are to plant the windbreak.
- Be careful not to plant large trees too close to the home, as they may fall during a storm, shed leaves or needles on your roof, allow pests to access your roof, or even penetrate your basement walls with their root structure. If you are experiencing any of these conditions, be sure to talk about it with your Certified Master Inspector® during your next scheduled inspection.
- Arrange the windbreak in such a way that it will provide a conduit for breezes and desired winds.

In summary, homeowners can use well-designed windbreaks for many purposes.

## Tree Dangers

Although trees are generally a desirable feature of home landscaping, they can pose a threat to buildings in a number of different ways. Homeowners may want to educate themselves about these potentially dangerous situations.

**Tree Roots and Foundations**

Contrary to popular belief, the Master Inspector Certification Board has found that tree roots cannot normally pierce through a building's foundation. They can, however, damage a foundation in the following ways:

- Roots can sometimes penetrate a building's foundation through pre-existing cracks.
- Large root systems that extend beneath a house can cause foundation uplift.
- Roots can leach water from the soil beneath foundations, causing the structures to settle and sink unevenly.

**Other Dangers:**

- Trees that are too close to buildings may be fire hazards. Soffit vents provide easy access for flames to enter a house.
- Leaves and broken branches can clog gutters, potentially causing ice dams or water penetration into the building.
- Old, damaged and otherwise weak trees may fall and endanger lives and property. Large, weak branches, too, are a hazard, especially if weighed down by ice.
- Tree roots can potentially penetrate underground drainage pipes, especially when they leak. Water that leaks from a drainage or sanitary pipe can encourage root growth in the direction of the leak, where the roots may eventually enter the pipe and obstruct its flow.
- Trees may be used by insects and rodents to gain access to the building.
- Falling trees and branches can topple power lines and communication lines.

**Structural Defects in Trees**

Trees with structural defects likely to cause failure to all or part of a tree can damage nearby buildings. The following are indications that a tree has a structural defect:

- dead twigs, dead branches, or small, off-color leaves;
- species-specific defects. Some species of maple, ash and pear often form weak branch unions, while some other fast-growing species of maple, aspen, ailanthus and willow are weak-wooded and prone to breakage at a relatively young age;
- cankers, which are localized areas on branches and stems of a tree where the bark is sunken or missing. Cankers are caused by wounding or disease. The presence of a canker increases the chance that the stem will break near the canker. A tree with a canker that encompasses more than half of the tree's circumference may be hazardous even if the exposed wood appears healthy;
- hollowed-out trunks;

- advanced decay; wood that is soft, punky or crumbly, or a cavity where the wood is missing can create a serious hazard. Evidence of fungal activity, such as mushrooms, conks and brackets growing on root flares, stems or branches are indications of advanced decay. A tree usually decays from the inside out, eventually forming a cavity, but sound wood is also added to the outside of the tree as it grows. Trees with sound outer wood shells may be relatively safe, but this depends on the ratio of sound-to-decayed wood, and other defects that might be present;
- cracks, which are deep splits through the bark, extending into the wood of the tree. Cracks are very dangerous because they indicate that the tree is presently failing;
- V-shaped forks. Elm, oak, maple, yellow poplar, and willow are especially prone to breakage at weak forks;
- the tree is leaning at more than 15 degrees from vertical. Generally, trees bent to this degree should be removed if they pose a danger. Trees that have grown in a leaning orientation are not as hazardous as trees that were originally straight but subsequently developed a lean due to wind or root damage. Large trees that have tipped in intense winds seldom recover. The general growth-form of the tree and any uplifted soil on the side of the tree opposite the lean provide clues as to when the lean developed.

**Tips for Homeowners:**

- Binoculars are helpful for examining the higher portions of tall trees for damage.
- When planting trees, they should be kept far from the house. It is impossible for the homeowner to reliably predict how far the roots will spread, and trees that are too close to a building may be a fire hazard.
- Do not damage roots. In addition to providing nutrition for the tree, roots anchor the tree to the ground. Trees with damaged roots are more likely to lean and topple over than trees with healthy roots. Vehicles are capable of damaging a tree's root system.
- Dead trees within the range of a house should be removed. If they are not removed, the small twigs will fall first, followed by the larger branches, and eventually the trunk. This process can take several years.
- Inspect your trees periodically for hazards, especially large, old trees. Every tree likely to have a problem should be inspected from bottom to top. Look for signs of decay, and continue up the trunk toward the crown, noting anything that might indicate a potential hazard.

In summary, trees that are too close to buildings can potentially cause structural damage.

## Lightning

Lightning is the "visible discharge of static electricity within a cloud, between clouds, or between the earth and a cloud," as defined by Underwriters Laboratories. Lightning is unpredictable and a serious threat to buildings and their occupants virtually everywhere.

**Facts About Lightning:**

- Benjamin Franklin invented the first lightning rod in 1752 – a kite outfitted with a metal key -- while waiting impatiently for the completion of a church on top of which he would mount a lightning rod.
- Lightning comes *up* from the *earth* – as well as down from a cloud -- from high vertical features, such as chimneys and trees.
- A typical lightning bolt carries 50,000 amps and tens of millions of volts, and can reach 50,000° F. "Superbolts" may be 100 times more powerful than typical bolts and travel much farther, too; one such superbolt went from Waco to Dallas, Texas, after having traveled about 118 miles.
- According to the National Weather Service, of the 34 people killed by lightning in the United States in 2009, all were outdoors when they were struck. Thus, homes provide a great deal of safety against lightning strikes. Interestingly, the same report indicates that 82% of lightning casualties were male.
- Permanent injuries caused by lightning strikes are predominantly neurological and can include sleep disorders, attention deficits, numbness, dizziness, irritability, fatigue, depression, and an inability to sit for long periods of time.
- Between 2002 and 2005, lightning caused an annual average of $213 million in property damage.

The types of dangers from lightning to houses and occupants include:

- damaged appliances from power surges;
- electrocution risk;
- fire risk to the building and its occupants;
- damage to the structure from water used to douse a fire by the fire department; and
- damage to the structure and endangered health from mold colonies, if the building was not dried quickly following fire suppression.

**Corrugated Stainless Steel Tubing (CSST)**

CSST is a relatively new type of gas tubing that has been widely installed in houses and in commercial applications in recent years. Its small diameter makes it flexible and relatively easy to install when compared with traditional, rigid, heavy-walled pipes, although this same quality is believed to make it susceptible to fire due to lightning strikes. Lightning that travels down the CSST can burn holes in the tubing and allow gas leakage and fire. In the worst cases, gas leaks have led to disastrous gas explosions. CSST has been found to be susceptible to damage from direct and even nearby lightning strikes.

These claims have lead to a class-action lawsuit against manufacturers of CCST (Titeflex, Ward, OmegaFlex®, and Parker Hannifin) installed in homes as of September 5, 2006. Plaintiffs claimed that the CSST tubing is not thick enough to prevent becoming damaged in the event of a lightning strike, and that CSST manufacturers failed to warn consumers about such dangers. The defendants claimed that CSST is safe if properly installed, in accordance with local codes and the manufacturers' instructions. According to the Lightning Protection Institute, dangerous CSST has been installed in more than a million homes in the United States.

**Identification of CSST**

Typically, these products may be visible in attic spaces, along floor joists, above basements, or connected to exposed appliances, such as water heaters. The piping can be identified by its manufacturer's mark, each of which is listed below:

- OmegaFlex's CSST is stamped with the marks "TracPipe®" or "CounterStrike®."
- Parker Hannifin's CSST is stamped with the mark "Parflex®."
- Titeflex's CSST is stamped with the mark "Gastite®."
- Ward's CSST is stamped with the mark "Wardflex®."

Additional bonding to ground is recommended for houses with CSST.

**Thunderstorm Safety Tips for Homeowners:**

- Unplug sensitive appliances and electronic equipment, such as computers and telephones, from electrical outlets and phone lines. Surge protectors are helpful, but they should not be relied upon during a storm.
- Stay off corded phones, computers, and other electronic equipment that put you in direct contact with electricity. If you are unable to unplug them, turn them off. Lightning may strike nearby electric or phone lines and enter your home.
- Unplug other appliances, such as air conditioners.
- Stay away from windows.
- Avoid washing your hands, bathing/showering, doing laundry, and washing dishes -- activities that put you in direct contact with running water.

**Lightning Protection Systems**

Lightning protection systems are devices intended to divert lightning into low-resistance paths to or from the earth and away from non-conducting parts of a structure.

**Lightning Rods**

Metal rods are fastened to the building to intercept electrical discharges that might otherwise strike a building component, such as a chimney or metal roof. Electrical discharges striking the air terminal are directed through metal conductors to a grounding system and thence into the earth.

Controversy has existed for centuries concerning whether lightning rods should have blunt or sharp tips. Recent studies have found that moderately blunt metal rods are better lightning-strike receptors than sharper rods or very blunt rods.

In summary, lightning can be very dangerous to homes and its occupants, although devices and measures exist to limit this danger.

## Poison Ivy, Oak and Sumac

In almost all suburban and rural regions of the United States and Canada, homeowners run the risk of developing potentially debilitating, allergic symptoms from exposure to urushiol-secreting plants. This potent, clear oil causes an itching rash (called contact dermatitis) in 350,000 people each year, but these numbers can be reduced through education and by taking appropriate precautions. Exposure can put sufferers out of work for days or weeks, and they may even require hospitalization.

Urushiol oil is potent -- just 0.25 ounces of the allergen is sufficient to cause a rash on every person on earth, according to the Poison Ivy, Oak and Sumac Information Center. The oil begins to penetrate the skin within minutes after contact, but the rash usually takes 12 to 72 hours to appear, at which point the person experiences severe itching, redness and swelling of the skin, followed by blisters. While the rash appears to spread, it is not contagious, but it will continue to grow due to differing rates of the immune system's response to the oil.

A few other important facts about urushiol oil:

- A segment of the population – perhaps as much as 30% -- is not allergic to urushiol oil, although many people may become sensitized after repeated exposure.
- Never burn any plants having this oil. Urishiol vapors can travel long distances, and inhaling them can create potentially life-threatening respiratory distress.
- Do not handle dead urushiol-secreting plants. The oil can remain active for several years, so handling dead leaves and vines can cause a reaction.
- Oil transferred from the plant to other objects (such as pet fur) can cause a rash if it comes into contact with human skin. Domesticated animals and wildlife do not appear to be allergic to urushiol.
- The oil may be removed with alcohol or cold water for a short period following exposure.
- Urushiol oil is found in virtually every part of the host plant, including the leaves, vines and roots. Tearing the plant in an attempt to kill it will release far more oil than can be contracted from just accidentally brushing against it.

**The Three Most Notorious Allergenic Plants in North America**

- Poison ivy accounts for the majority of contact dermatitis resulting from urushiol oil.
    - Habitat: Poison ivy grows throughout much of suburban and rural North America, including the Canadian maritime provinces, Quebec, Ontario, Manitoba, and all U.S. states east of the Rockies except North Dakota, as well as in mountainous areas of Mexico below 4,900 feet (1,500 m). It is common in wooded areas, especially along lawn edges, as well as in exposed rocky areas, and in open fields and disturbed areas.
    - Identification: Poison ivy can be found in any of the following three forms:
        - as a trailing vine or groundcover that is 4 to 10 inches long;
        - as a shrub that can grow up to 4 feet tall; and
        - as a climbing vine that grows on trees or some other support, which may act as a tree limb.

Regardless of its form, alternating clusters of three almond-shaped leaves that range in color from light to dark green, turning red in the fall, easily distinguish poison ivy. Its leaf surfaces are smooth and become shiny with maturity, and their edges may or may not be ridged. Poison ivy vines have no thorns.

- Poison oak is a poisonous, upright shrub. Just as poison ivy merely resembles actual ivy, poison oak owes its name to a superficial resemblance to the oak tree's leaves.
    - Habitat: Poison oak comes in two region-based varieties:
        - Atlantic poison oak, which can be found growing in forests, thickets, and dry, sandy fields; and
        - western poison oak, which is found only on the North American Pacific coast. It is typically found in damp, semi-shady areas near running water but thrives in direct sunlight and requires water only in early spring. The plant is common in Douglas fir forests and California oak woodlands. Poison oak vines climb far up the trunks of coastal redwoods, sometimes killing small trees.
    - Identification: Due to its tendency to mimic its surroundings, identifying poison oak can be difficult. In open sunlight, it grows as a dense shrub, and as a climbing vine in shaded areas. Its leaves are somewhat larger than poison ivy leaves, although, similarly, poison oak displays an alternating three-leaf pattern. The leaves are hairy, scalloped and toothed, resembling real oak leaves, although they tend to be glossier. The leaf colors range from bronze to green, and red and pink in the fall. Poison oak's small, round fruit emerges from white flowers. Once the leaves have shed in the winter, the plant may be identified by black marks where milky sap once cooled and dried.

- Poison sumac is a highly poisonous woody shrub or small tree. Although its rarity reduces the incidence of human exposure, the plant is far more virulent than other urushiol-secreting plants.
    - Habitat: Poison sumac grows exclusively in wet soils, typically in peat bogs and swamps of the eastern United States and Canada.
    - Identification: Poison sumac is a shrub or small tree that can grow up to 20 feet high. Unlike poison ivy and poison oak, poison sumac leaves come in long, paired rows with an additional leaf at the end. The leaves may have black spots made up of urushiol oil, which turns dark upon exposure to air. The fruits are semi-spherical, small and white, while non-poisonous sumac berries are red.

In summary, urushiol-secreting plants should be protected against in order to avoid painful allergic reactions. Homeowners should be aware of the plant species that may surround their homes and take steps to remove those that threaten the health of their family members.

### Rodents

Rodents are a problem not just because they can destroy personal property and damage a home's structure, but also because they can spread serious diseases to humans and their pets. Rodent-borne disease may be spread directly -- by touching rodents or their urine, feces or saliva -- or indirectly -- by coming into contact with fleas and other insects that have fed on an infected rodent host. Homeowners should use extreme caution and wear appropriate personal protective equipment when entering an area in the home that is known to be infested with rodents.

Some diseases resulting from direct contact with mice and rats include:

- hantavirus pulmonary syndrome (HPS);
- hemorrhagic fever with renal syndrome;
- Lassa fever;
- leptospirosis;
- lymphocytic chorio-meningitis;
- plague;
- rat-bite fever;
- salmonellosis;
- South American arenaviruses; and
- tularemia.

Some diseases resulting from indirect contact with mice and rats include:

- babesiosis;
- Colorado tick fever;
- human granulocytic anaplasmosis;
- lyme disease;
- murine typhus;
- scrub typhus;
- rickettsialpox;
- relapsing fever; and
- Rocky Mountain spotted fever.

Rodents also pose a danger to the integrity of the structures they inhabit. They have strong teeth and they may chew through structures to gain access to food sources. The best method for preventing exposure to rodents is to prevent rodent infestation in the first place, according to the Centers for Disease Control (CDC) and the U.S. Environmental Protection Agency (EPA).

**How can you tell whether a home is infested?**

Actual rodent sightings in the home are a good indicator that a severe infestation may be in progress. Mild cases of infestation may not result in actual rodent sightings.

Indicators of an infestation include:

- chewing or clawing sounds that come from inside or outside the home. Noises may even come from the roof, as tree-dwelling rodents may try to gain access to a home from above the living space;
- stale smells coming from hidden areas;
- evidence of structural damage that can provide entry points into the home;
- evidence of gnawing and chewing on food packaging;
- nesting material found in small piles, such as shredded paper, fabric, and dried plant matter; and
- rodent droppings anywhere in the home, especially near food packages in drawers and cupboards, and under the sink.

**How can rodent infestation be prevented?**

The following measures can be taken to eliminate rodents' food sources, according to the CDC:

- Keep food in thick plastic or metal containers with tight-fitting lids.
- Clean up spilled food right away, and wash dishes and cooking utensils soon after use.
- Keep outside cooking areas and grills clean.
- Always put pet food away after use and do not leave pets' food or water bowls out overnight.
- Keep bird feeders away from the house. Utilize squirrel guards to limit access to feeders by squirrels and other rodents.
- Use thick plastic or metal garbage cans with tight-fitting lids.
- Keep compost bins as far away from the house as possible.
- Dispose of household trash on a frequent and regular basis, and eliminate clutter in and around the property to discourage nesting.

Mice can squeeze through a hole the size of a nickel, and rats can squeeze through a hole the size of a half dollar, according to the CDC. Consequently, smaller gaps may be filled cheaply and easily with steel wool, and caulk may be used to seal it in place. Larger gaps and holes may be filled with lath screen or lath metal, cement, hardware cloth, or metal sheeting.

Common places where gaps may be found inside the home are:

- inside, under and behind kitchen cabinets, refrigerators and stoves;
- inside closets near the floor's corners;
- around the fireplace;
- around doors;
- around plumbing pipes under sinks and washing machines;
- around the piping for hot water heaters and furnaces;
- around floor vents and dryer vents;
- inside the attic;
- in the basement or crawlspace;
- near the basement and laundry room floor drains; and
- between floor and wall junctures.

Common places where gaps may be found outside the home include:

- in the roof among the rafters, gables and eaves;
- around windows;
- around doors;
- around the foundation;
- near attic vents and crawlspace vents;
- under doors; and
- around holes for electrical, plumbing, cable and gas lines.

Any potential nesting sites outside the home should be eliminated. Elevate hay, woodpiles, and garbage cans at least a foot off the ground. Move woodpiles far away from the house. Get rid of old trucks, cars and old tires that mice and rats could use as homes. Keep grass cut short, and keep shrubbery planted within 100 feet of the home well-trimmed.

**What should be done if a house is found to be infested with rodents?**

It is important to stay away from rodents, and to protect children and pets from direct and indirect contact if rodents are found in the home. Droppings should be handled only with extreme caution, even if they have dried. A face mask and gloves should be worn if handling and cleaning up these droppings because disturbing fecal particles may precipitate airborne contaminants. Affected areas should be sterilized after the droppings have been removed.

In mild cases of infestation, homeowners may choose to eliminate the rodents themselves. They should make sure to take preventative measures while doing so. To remove rodents, homeowners will need to use traps or rodenticides.

Some different types of traps include:

- lethal traps, such as snap traps, that are designed to trap and kill rodents;
- live traps, such as cage-type traps, that capture rodents alive and unharmed, requiring that the rodents then be released or killed; and
- glue boards, which are low-cost devices that use sticky substances to trap rodents, requiring a further decision regarding disposal, since such traps are not lethal.

Traps should be set in any area where there is evidence of frequent rodent activity. Some rodents, particularly rats, are very cautious, and several days may pass before they approach the traps. Other rodents, such as house mice and deer mice, are less cautious and may be trapped more quickly. Glue traps and live traps may scare mice that are caught live, causing them to urinate. This may increase a homeowner's risk of being exposed to diseases, since the rodent urine may contain germs and disease-borne pathogens.

Rodenticides are products intended to kill rodents and are typically sold as powders in bait and tracking form. Some rodenticides include:

- baits, which combine rodenticides with food to attract rodents. They may be formulated as blocks or paste and may be enclosed in a bait station;
- tracking powders, which are rodenticides combined with a powdery material. The powder sticks to the rodents' feet and fur and is swallowed when the animals groom themselves. After consuming the chemical poison contained in the bait or tracking powder, the rodents die. Some rodenticides (including tracking powders) may be legally applied only by certified pesticide applicators because they may pose a risk to human health.

The following measures should be observed when an infestation is being eliminated:

- Traps and baits should be placed in areas where children and pets cannot reach them.
- Products should be used according to the label's directions and precautions.
- Only traps that are appropriate to the type and size of the targeted rodent should be used.
- Glue boards should be placed in dry, dust-free areas, as moisture and dust will reduce their effectiveness.

It is advisable to contact a professional exterminator to deal with more severe infestations, since rodents reproduce constantly and quickly.

In summary, rodent infestation poses a serious risk to human health, and extreme caution must be taken when eliminating the problem.

### Bed Bugs

Bed bugs are small, flightless, rust-colored parasites that feed on the blood of humans and other warm-blooded animals.

Bed bugs were diminished to an historical footnote after their near-eradication in the 1950s, but they are re-emerging in a big way. At the EPA's National Bed Bug Summit in 2009, researchers decided that the parasite's revival is more appropriately termed a pandemic rather than an epidemic, noting its rapid spread across large regions and different continents. For those afflicted by the bug, humiliated and defeated by its persistence, many prefer to refer to the infestation as "house herpes." The United States has seen a 50-fold increase in bed bug infestations over the last five years, according to the National Pest Management Association. An entomologist told MSNBC, "It's like the return of the woolly mammoth," as many of his peers had previously never seen a single bed bug in their careers. The outbreak has affected most parts of North America and Europe, especially in urban areas.

Researchers believe bed bugs have roused from a half-century of hibernation for two reasons: the termination of the use of the pesticide DDT; and a rise in international travel. DDT, a powerful synthetic pesticide, was used widely in agriculture until a public outcry concerning its safety lead to a U.S.-ban of the chemical in 1972, followed by international bans. Unbeknownst to the environmentalists of the time, these laws would permit future outbreaks to grow unchecked, which is precisely what happened when travel increased from countries where bed bugs were never subjugated, such as India.

New York City and other hubs of international travel have hosted the bulk of the carnage. The bugs hitch rides from country to country in suitcases, and creep into hotel rooms where other guests are then exposed and unknowingly spread the parasites to movie theatres, cabs, buses, hospitals, houses, and everywhere in between. In New York City, bed bug reports increased 800% from 2008 to 2009, a year in which the Department of Housing Preservation and Development received 13,152 bed bug infestation complaints.

The unpleasantness of a typical rodent or insect extermination is largely the fee charged by the exterminator. But with bed bugs, this fee is just one piece of a greater nightmare. Because bed bugs are adept at hiding almost anywhere, an alarming quantity of possessions, from curtains to books and picture frames, must be discarded or quarantined. In one posh New York City rental tower, a tenant was

forced to part with carpets, bedding, curtains, 20 cashmere sweaters, an Armani suit, a couch, a headboard, a night table, a bed frame, and an exercise bike, according to the New York Daily News. Other victims have had to throw away their books unless they were willing to inspect each one, page by page. Some possessions may be salvaged if they are sealed in special casing long enough for the bed bugs to die, which can takes several months. During this time, residents may be forced to move to temporary housing elsewhere.

Fortunately, the health dangers posed by bed bugs seem to be limited to temporary skin irritation and inflammation, akin to mosquito bites. There are no known cases of disease transmission from bed bugs to humans, despite the fact that the parasites seem similar to other parasites that do transmit disease, such as fleas and ticks. Anaphylactic shock, however, may be experienced by a small percentage of the population, and measures should be taken to prevent bacterial infection of bitten areas.

Adult bed bugs are flat, apple-seed sized with rusty-colored, oval bodies. Newly hatched bed bugs are semi-transparent, light tan in color, and the size of a poppy seed. Yet, due to their elusive nature, their presence is usually discovered through peripheral clues rather than by seeing the bugs themselves. Some of these signs include fecal spots, blood smears, crushed bugs, or the itchy bumps that may result from bites. The bugs may be disturbed while feeding and leave a cluster of bumps, or they may bite in a row, marking the path of a blood vessel. The parasites emit a characteristic musty odor, although the smell is sometimes not present in even severe infestations. The bugs also emit a smell that is detectable by dogs, which has lead to the implementation of dogs in bed bug detection. Properly trained dogs can find bed bugs in wall voids, furniture gaps, and other places that humans may overlook and, in doing so, they focus on the area where exterminators must spray.

It is best for bed bugs to be treated by pest management professionals (PMPs), not homeowners, as there is risk that an inexperienced person may spread the infestation further throughout the home. For instance, bug bombs will be ineffective and merely spread bed bugs. Even chemical sprays designed to kill bed bugs, if used by inexperienced homeowners, may make the infestation worse. PMPs can inspect for bed bugs in their immature stages of development, including their eggs, while homeowners cannot. In addition, prep work performed by a homeowner may make it difficult for the PMP to assess the extent of the infestation.

The following tactics may be useful for temporary relief and confirmation of the presence of bed bugs:

- Remove bed skirts, as they provide easy access for the bugs to travel from the floor to your bed. If you must have bed skirts, make sure they do not reach the floor.
- Move your bed away from the wall. Bed bugs cannot fly, but they can climb walls in order to fall onto the bed.
- Place furniture legs in tin cans coated with talcum powder, petroleum jelly or a non-evaporative liquid, to deter the bugs from climbing.
- Place a strip of duct tape at the base of furniture with the sticky side out. This tactic can be used to confirm the presence of bed bugs because it will trap them in place.
- Spray cracks and crevices with an insecticide designed to control bed bugs. Follow the label's directions carefully. However, do not treat bedding, towels or clothing with insecticide.

Homeowners can limit their chances of bed bug exposure by purchasing only new furniture, as stowaway bugs can hide in older or used chairs and mattresses. Hostels, hotels and motels host many travelers and are obvious breeding grounds for bed bugs, and many hostels ban sleeping bags for this reason. Unfortunately, person-to-person contact is difficult to avoid.

In summary, bed bugs are a growing, serious threat.

## Venomous Pests

Venomous pests are found virtually everywhere. For their safety, homeowners should learn how to identify venomous insects and reptiles.

**Bees and Wasps**

Bees and wasps are flying, stinging insects commonly found in and around homes throughout much of the world. Stings from these insects are normally not serious, except in people who are allergic to the venom, or when large numbers of the insects attack at once. Even when they are not a serious threat, bees and wasps can be a nuisance and a source of fear, especially during the summer months when people gather outside the home.

- A few facts about bees and wasps:
    - More than half of all fruit and vegetable crops are pollinated by honey bees.
    - Wasps contribute to the ecological cycle by preying on many insect pests that are harmful to crops.
- Bees vs. Wasps: While many homeowners refer to bees and wasps interchangeably, they are, in fact, different. Differentiation between these insects is important because different methods may be necessary to remove them if they become a nuisance. Bees and wasps differ in the following ways:

- Bees feed solely on pollen. Wasps, by contrast, are predatory and feed mostly on insects. Some common bees include honeybees, carpenter bees and bumblebees. Some common wasps are yellowjackets, hornets and paper wasps. Yellowjackets and hornets can look virtually identical, although hornets usually have larger heads.
- While bees have robust, hairy bodies with flat rear legs, wasps' bodies are slender with narrow waists connecting the thorax and abdomen. Wasps appear smooth and shiny and have slender legs shaped like cylinders.
- Wasps, especially yellowjackets, are generally more aggressive than bees and they are more likely to come into contact with humans while in search of food. Wasps can become a nuisance in the warmer months because they often disrupt outdoor activities where meats and sweet liquids are present. A flying insect that repeatedly lands on a hot dog at a picnic or circles a dumpster is almost certainly not a bee.
- Stinging wasps can sting repeatedly, while honeybees will die shortly after stinging once. Other bees, however, can sting repeatedly.

- Where do bees and wasps nest?

    - Bees and wasps prefer attics because they are warm and protected. They will find it easier to enter and infest an attic that is covered by slate or wood roofing as opposed to metal or asphalt shingles. Poor flashing may also allow easy entry. Homeowners entering attics with open (unscreened) gable vents should be on the lookout for a bee or wasp infestation.
    - Yellowjackets typically nest underground using existing hollows. Occasionally, nests can be found in dark, enclosed areas in a building, such as crawlspaces, wall voids and attics. Nests are enclosed in a paper-like envelope, but they are rarely exposed or observed unless excavated. The nest entrance is small and inconspicuous. Colonies are readily defended because yellowjackets will sting when the nest area is disturbed.
    - Hornets produce large, conspicuous grayish paper-like nests in trees and shrubs and beneath building eaves.
    - Paper wasps will nest in small cavities in the sides of buildings, within metal gutters and poles, outdoor grills, and similar items.
    - Honeybees, unlike wasps and other types of bees, produce a persistent, perennial colony. These hives can grow very large, containing tens of thousands of bees, and are usually found outdoors, especially on trees. Hives that are discovered inside buildings must be eliminated as soon as possible. If allowed to develop, large amounts of wax and honey will be produced, which may damage the building when the hive dies out or when the combs melt due to excessive heat. Rodents and insects will also be attracted to such sites.
    - Bumblebee nests are commonly constructed in abandoned rodent burrows, and they may also be found indoors in small hollow spaces, particularly if insulating debris is available.

- Nest control: Nests should be destroyed if they are close enough to humans to pose a stinging threat. They should always be approached with caution, preferably at night when most of the "workers" are present but reluctant to fly. A few additional tips:

    - Be aware that bees and wasps are attracted to lights, especially flashlights carried by homeowners as they enter dark attics and crawlspaces.

- Use extreme caution when performing bee or wasp control from a ladder.
- If a nest is not discovered until fall, pest control may be unnecessary, as imminent freezing temperatures will kill the colony.
- If there is direct access to the nest, a fast-acting dust or wettable powder formulation can be applied. If the nest must be removed during the daytime, a can of aerosol insect killer can be used to keep the bees or wasps at bay. Heavy clothing should be worn for added protection.

**Snakes**

Rattlesnakes, copperheads, and other snakes often reside in crawlspaces with dirt floors and in a home's landscaping and drainage. Snakes are easily startled and may react aggressively toward intruders. The following snakes may be encountered by homeowners:

- Bull snakes are large, non-venomous snakes common in the central parts of the U.S., northern Mexico, and southern Canada. They are usually yellow in color, with brown, black or reddish-colored blotching. Due to its patterns and semi-keeled scalation, the bull snake is often mistaken for the Western Diamondback rattlesnake. The bull snake capitalizes on this similarity by performing an impressive rattlesnake impression when threatened; the snake can produce a convincing "rattle" sound, and flatten its head to appear more characteristically triangular. Their mimicry is so impressive that it is frequently the bull snake's undoing when discovered by humans.

- Copperheads are fairly large, venomous snakes with broad, triangular heads, vertically elliptical pupils, and heat-sensitive pits between each eye and nostril. The body is tan to brown, with dark hourglass-shaped crossbands down the length of the body. Small dark spots are common between crossbands on the back. The unpatterned head is dull orange, copper or rusty-red. When young, a copperhead has a yellow-tipped tail. The head is solid brown, and there are two tiny dots in the center of the top of the head. Copperheads are quite tolerant of habitat alteration and remain common in suburban areas of many large cities. They can be found throughout the eastern and central United States but are absent from most of Florida and south-central Georgia. Copperhead bites can be painful, although the symptoms are generally not as severe as bites from rattlesnakes.

- Coral snakes possess the most potent venom of any North American snakes, and they can be found in a number of southern states from North Carolina to Texas, although they account for less than 1% of venomous snake bites in the U.S. There are several reasons they don't claim more human victims -- they have short fangs that have difficulty penetrating clothing, they are more reclusive than most other snakes, and they typically inject only a relatively small quantity of venom when they bite. Any skin penetration, however, is a medical emergency that requires immediate attention. Coral snakes have a powerful neurotoxic venom that paralyzes the breathing muscles.

  The following symptoms are characteristic of coral snake envenomation:

  - nausea;
  - drowsiness;
  - vomiting;

- excessive salivation;
- difficulty breathing; and
- paralysis.

It is important to note that coral snake bites do not result in significant swelling, discoloration or pain, and the effects of the venom may take hours to develop.

Identification: Physically, coral snakes are anomalies among North American venomous snakes. Unlike rattlesnakes, cottonmouths and copperheads, coral snakes are not pit vipers. Thus, they lack the characteristic pit viper's triangular head and vertically-oriented eyes, and they are quite small, shy, and may appear harmless. Fortunately, they can be easily identified by their distinctive red, yellow and black color pattern. The sequence of these colors -- red-yellow-black -- is critical for identification, as other snakes perform a successful mimicry except in this one aspect. The harmless milk snake, for instance, would appear almost identical if its color pattern were not red-black-yellow. A useful way to remember this distinction is: "Red touch yellow, kill a fellow. Red touch black, poison lack."

- Garter snakes are harmless and can be found everywhere from Canada to Central America. Most garter snakes are striped or banded lengthwise, and some are spotted between the stripes. They are found in moist environments, and most varieties are roughly 2 feet long.

- Rattlesnakes are the most dangerous venomous snakes in North America. They bite thousands of people annually, although very few bites are fatal. The rattlesnake is easily distinguished by a rattle at the end of its tail, which is composed of a series of dried, hollow segments of skin, which, when shaken, make a rattling sound. When the snake is alarmed, it shakes its tail, and the noise serves as a warning to the attacker. While most rattlesnakes are concentrated in the southwestern United States, they extend north, east and south in diminishing numbers and varieties. Every contiguous state has one or more varieties of rattlesnake. Rattlesnakes can be identified in the following ways:

  - broad, triangular head;
  - eyes have vertical "cat-like" pupils;
  - scales are keeled (having a raised center ridge);
  - body appears heavy or fat in the middle;
  - large tubular fangs that fold out when the mouth opens;
  - blunt tail with rattle, although baby rattlesnakes don't have rattles, and some adult snakes may break or lose their rattles; and
  - typically, rattlesnakes range from 3 to 4 feet in length. Eastern Diamondback rattlesnakes can be significantly longer, however -- sometimes in excess of 7 feet.

  Symptoms of rattlesnake bites include:

  - pain and swelling in the area surrounding the bite, which may take several hours to develop;
  - rapid pulse and labored breathing;
  - progressive, general weakness;

- visual impairment;
- nausea and vomiting;
- seizures; and
- drowsiness and unconsciousness.

The following tips can help differentiate bull snakes from rattlesnakes:

- Bull snakes have no rattler. When threatened, they will often forcefully vibrate their tails, which serves as a warning to potential predators. In dry leaves and grass, this will produce a sound that is quite similar to one emitted by a rattlesnake. Another related indicator is that bull snakes will keep their tails low to the ground while producing their rattling sound, while most rattlesnakes will elevate their tail while rattling.
- Although the two often have similar patterns, bull snakes are generally cream or pale yellow in color with brown or black markings; rattlesnakes, on the other hand, are typically much darker, depending upon the subspecies.
- The body of a bull snake is more streamlined than that of a rattlesnake. A bull snake is noticeably thinner and its body becomes proportionately narrower down to its tail, which ends at a defined point. A rattlesnake looks thicker, particularly in its mid-section, with a more rounded tail due to its rattle.
- The head of a bull snake is nearly identical in size to the upper portion of its body. The head of a rattlesnake, however, is more triangular in shape and is perceptibly wider than its upper body.
- Bull snakes' pupils are circular, while those of rattlesnakes are vertically-oriented. All venomous snakes in North America have vertically-oriented pupils, except for the coral snake.
- Bull snakes lay eggs, while rattlesnakes give birth to live offspring.

**Spiders**

Most spiders pose no threat to humans. In fact, of the 20,000 species of spiders that inhabit the Americas, only 60 are capable of biting humans. Within that small group, only a handful of species is known to be dangerous to humans. Of these, only the brown recluse and the black widow have ever been associated with significant harm and rare reports of death. Tarantula bites, despite common fears, are not significantly more dangerous to humans than wasp stings.

- Black widow spiders are perhaps the most venomous spiders in North America.
    - Identification: The female black widow is normally shiny black, with a red hourglass-shaped marking on the underside of the abdomen. The abdominal marking may range in color from yellowish-orange to red, and its shape may range from an hourglass to a dot. In a few widow spiders, however, no pattern is obvious on the abdomen. The body of an adult black widow female is about 1/2-inch long, while the male widow spiders are smaller. They usually are not black in overall color, and instead appear light brown or gray and banded. Male widows may have an hourglass pattern, but coloration often is more orange and sometimes yellow. Widow spiders build loose and irregular mesh-type webs, often on plants, in loose stone and wood piles, and in the corners of rooms,

garages and outbuildings. They do not produce the symmetrical web typical of orb-weaving spiders or the distinctive funnel-shaped pattern of funnel weaver spiders.

- Symptoms of a bite: While the area around the bite may result in swelling, the venom is primarily a neurotoxin, which does not cause significant localized tissue death. Rather, the venom and other neurotoxins affect the nervous system of the afflicted animal. Without medical attention, the symptoms of a black widow bite can last for days, and a complete recovery may take weeks.

  Black widow bites commonly cause the following symptoms:

  - painful rigidity in the muscles of the abdomen;
  - tightness in the chest accompanied by labored breathing;
  - elevated blood pressure;
  - elevated body temperature;
  - nausea; and
  - sweating.

Death is uncommon (less than 1% of the reported cases), but in the elderly and very young, death may occur from asphyxia. Seek medical attention if you suspect you have been bitten.

- Habitat: Black widow spiders and their relatives can be found almost anywhere in the Western hemisphere in damp and dark places. The spider prefers the following exterior environments: wood piles, rubble piles, under stones, in hollow stumps, and in rodent burrows, sheds and garages. Indoors, they are found in undisturbed, cluttered areas in basements and crawlspaces.

- Brown Recluse: Along with the black widow, the brown recluse is potentially the most dangerous spider in North America. Despite their reclusive habits, they do occasionally bite humans. Recluses typically bite when they are trapped between flesh and another surface, as when a sleeping human rolls over on a prowling spider, or when a person is putting on clothing or shoes containing the spider.

  - Identification: The brown recluse is usually between 1/4-inch to 3/4-inch but may grow larger. They are notable for the characteristic violin-shaped pattern on the back of their cephalothorax -- the body part to which the legs are attached. These spiders are not aggressive and bite only when threatened, usually when pressed up against the victim's skin. They seek out dark, warm, dry environments such as attics, closets, porches, barns, basements, wood piles and old tires.

  - Symptoms of bite:
    - severe pain at the bite site after about four hours;
    - severe itching;
    - nausea;
    - vomiting;
    - fever;
    - muscle pain; and
    - potentially severe localized tissue damage.

- Hobo Spider: This spider is not native to the U.S., but by the mid-1960s, it had become established in Washington, Oregon and Idaho, as well as British Columbia in Canada. The current population distribution also places it also in Montana, northern Utah, and western Wyoming. Although the bite of the hobo spider is initially painless, it can be serious. Hobo spiders are often confused with wolf spiders, which produce a painful but relatively harmless bite. If serious symptoms develop, the victim should seek medical attention.

  - Symptoms of bite:
    - immediate redness, which develops around the bite;
    - after 24 hours, the bite develops into a blister, and after 24 to 36 hours, the blister breaks open, leaving an open, oozing ulceration;
    - severe headache;
    - temporary memory loss;
    - impairment of vision;
    - nausea; and
    - weakness.

**Preventing Spider Infestation**

The Master Inspector Certification Board believes that spiders can be discouraged from entering the home by increasing the lighting in darkened corners, such as by appropriate furniture arrangement and the use of artificial lighting. Insecticides should be applied in dark, undisturbed areas where spiders are likely to produce webs. Insecticides can also be used to prevent spider migrations into homes by spraying around the exterior foundation and lower-story windows. Preventative spraying should be performed before temperatures get low since, by this point, spiders and other insects may have already entered the house. The insecticide chlorpyrifos (Dursban®) is the most widely available product for the control of spiders around a home. Chlorpyrifos has a residual effectiveness of several weeks, particularly if not exposed to light and moisture. However, it is moderately toxic to humans.

In summary, there are many kinds of venomous pests that homeowners may encounter in and around their homes, and knowing what they are and the hazards they pose can help homeowners act with appropriate caution.

## Snow Guards

Snow guards are protruding metal or plastic devices (or lengths of bars) that are installed in intermittent locations on a roof that are intended to prevent accumulated snow and ice from sliding in great sheets off the roof. They encourage the gradual melt and breakdown of the snow mass into smaller sections. They vary in their method of attachment to the roof, as well as their color (they usually match the roof or are transparent), and their material (typically, they're made of metal or polycarbonate).

Snow and ice are surprisingly heavy -- a single cubic foot of ice weighs more than 52 pounds -- and when they avalanche down off a roof, they can cause a great deal of property damage and even injury. Roof avalanches can injure pedestrians and livestock, bend gutters, and damage vehicles, lower roofs, HVAC equipment, and other property below. This typically happens when warm weather follows a snowstorm, creating melt water that lubricates the roof.

In many cases, snow guard systems are not included during initial roof installations because of the additional cost and the general lack of awareness of their need. Nevertheless, homeowners can be held liable for any property damage and personal injury resulting from excessive snow if it could have been prevented with snow-retention systems. Investing in the right snow-management system may mitigate liability, prevent property damage, and reduce threats to pedestrian safety.

Snow guards are not always effective or helpful, however. In very heavy snow, they may not be tall enough to resist the snow's downward force, and shingle roofs typically have enough resistance to hold the snow naturally. To act as effective restraints, snow guards should be installed by qualified roofers who can competently consider factors such as sheathing type and thicknesses, roof type, roof slope, and snow loads in determining proper snow guard sizing, design and placement. Homeowners and handymen who attempt snow guard installation may install them in an improper pattern, or only weakly attach them to the roof, which may actually increase the potential damage due to falling snow and ice. Also, snow guards should never be used as anchors in fall-arrest systems, as they are not strong enough to support roof workers, and the guards themselves may be damaged.

**Inspection**

Snow guard placement should be consistent with the following safety and efficiency standards:

- Snow guards should be mounted on the lowest portion of a roofing panel where the snow and ice actually move. Snow guards mounted on a high seam will be ineffective when the snow and ice compact beneath them.
- Snow guards should not be mounted beyond the bearing wall on an extended roof section, as this placement can result in ice damming and roof damage.
- Snow guards should be installed over sidewalks, doorways, driveways, and anywhere else that people are likely to walk or gather, or where personal property is stored.
- Check the mounting tape, if it is present. Tape has very little or no resistance to ultraviolet light and tends to roll up underneath the snow guard when exposed to shear loads.
- There should not be more snow guards installed than necessary, as they might allow too much snow to accumulate and damage the roof. Snow guards should be installed in the critical areas listed here, but not necessarily in areas where snow and ice can be released safely onto the ground by gravity and natural warming.
- Only adhesive should be used to mount snow guards to standing-seam, floating-type roofs, as this technique allows for thermal expansion and contraction of the panels. It also allows for quick release during extreme snow accumulation that might otherwise damage the panels.

In summary, snow guards are devices that attach to the roof in order to hold snow and ice in place so they can melt slowly and safely.

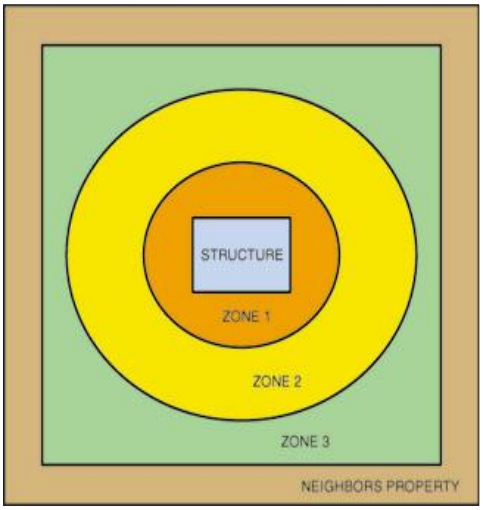
## Defensible Space

Defensible space refers to the area surrounding a building that is mitigated to protect it from wildfires. Along with the quality of a building's roofing material, adequate defensible space is one of the most important factors in determining a building's ability to survive a wildfire.

Defensible space performs the following functions:

1. Ideally, a carefully maintained defensible space will not contain enough fuel to allow a wildfire to reach a house. Even if the space is breached, the fire will have been slowed and weakened, helping firefighters to defend the house.
2. A defensible space provides an accessible area for fire trucks to park and firefighters to work during a structure fire.
3. If there is a pond near a burning house, it can be used to replenish a fire truck's water supply. The perimeter of the pond should be thinned of trees and brush sufficiently so that firefighters can access it.

The size requirements for defensible space vary by jurisdiction because the potential for wildfires varies by region. Buildings in forested areas of the Southwest need a much larger protective space than in New Jersey, for instance. As of 2006, California state law mandates a minimum of 100 feet of defensible space for houses in rural locations. Trees and shrubs surrounding a house should be trimmed and spaced a safe distance apart from one another. Chainsaws can be used to remove trees and branches, pruning shears can be used to trim plants, and rakes can be used for removing pine needles and other ground-level combustibles. Trees that are very close to the house should be removed because this is where fire-prevention is most critical. Vegetation can be plentiful toward the perimeter of the space if it is green and pruned.




Colorado State University divides defensible space into three categories in the following manner:

Zone 1: The first 15 feet from a home should be devoid of all flammable vegetation. Firewood and other flammable materials should not be stored in this region.

Zone 2: This area of fuel reduction should extend from Zone 1 outward to between 75 to 125 feet from the structure. Trees and large shrubs should be no less than 10 feet apart, especially in steep terrain. Trees must also be pruned to a height of 10 feet from the ground, and any "ladder fuels" -- vegetation with vertical continuity – should be removed from the base of the trees. Grass, trees and shrubs in this region should be green and adequately spaced. Pine needles, dead leaves, branches, dead and dying vegetation, and other flammable debris on the ground should be removed whenever they appear.

Zone 3: This region of traditional forest management is of no particular size, although it normally extends to the property limits. More trees are permitted here than in Zone 2, although their health and vigor should be maintained.

**Tips for Homeowners**:

- Homeowners should obey all environmental protection laws while creating and maintaining defensible spaces. In particular, removal of vegetation should not interfere with the well-being of endangered species, air quality, water quality, or archaeologically significant resources. Homeowners may need to obtain a permit to cut down trees over a certain size, depending on the local jurisdiction.

- Vegetation removal can cause soil erosion, especially in steep terrain. The Master Inspector Certification Board advises that in areas that are prone to wildfire and soil erosion, it can be helpful to replace highly flammable plants and trees with less-flammable alternatives.

In summary, homes and outbuildings can be spared from wildfire damage through the removal of surrounding flammable vegetation. Defensible spaces are critical in hot, dry, forested regions, although their implementation is recommended everywhere.

## Emergency Preparedness

Whether you're facing rising floodwaters or a wildfire that's too close for comfort, many homeowners confront seasonal threats to their safety that force them to flee their properties, at least temporarily. In the last few years alone, damage created by severe weather and natural disasters in the U.S. has reached the tens of billions of dollars, as well as caused hundreds of deaths.

Here are some tips everyone can use to make a strategic retreat, as well as ways that homeowners can both prepare for an emergency and assess any property damage upon their return home.

Evacuating in the event of an emergency is often difficult under the best of circumstances. Sometimes, we may receive ample warning to prepare, but many dangers are unpredictable. Given the emotional stress and panic that can compromise decision-making abilities in the moment, an important aspect to consider is whether the emergency is localized or widespread. An emergency such as a ruptured gas pipe, a chemical spill from a nearby truck or train accident, or a home fire suggests that help is just beyond the immediate zone of danger and the evacuation will be temporary, from just a few hours to one or two nights. All families should devise a Family Evacuation Plan that includes a location outside the home where family members can meet.

But a larger disaster, such as the aforementioned flood or wildfire, or an earthquake, hurricane or tornado tends to affect a wider area and may compromise or fully disable public utilities, including communications, electricity, water and sewer. Roads within the danger zone may be blocked or difficult to travel, and emergency personnel may encounter problems reaching those who need assistance.

Regardless of the type of disaster, there are many things you can do to mitigate potential property damage and make for a secure departure, should the time come, especially given some warning to evacuate safely. And, upon returning home, we'd all like the shock to be minimized as much as possible.

To help you get organized before an emergency, we've broken down these common concerns into three categories:

- personal health and safety;
- home security; and
- re-entry.

**PERSONAL HEALTH AND SAFETY**

Homeowners should take certain measures to ensure their personal safety when they need to leave their homes for an unknown period of time. Make sure that you watch or listen to TV or radio for local news and broadcasts by the Emergency Alert System to stay advised of the latest weather or other conditions, as well as to find out what local emergency management recommends, including the location of public shelters.

Here's a list of things to pack that will help relieve the last-minute panic of leaving home in a hurry. This list may vary for each person, but the items are generally based on these priorities: short-term vs. long-term evacuation, and what you'll need while you're away, as well as what you shouldn't leave behind while you're gone:

- an all-purpose, waterproof first aid and emergency kit that includes hand sanitizer, a flashlight, a radio with batteries, and matches;
- glasses, hearing aids, and prescription medications for all family members;
- supplies for pets, including carriers, leashes, plastic or collapsible/camping-type water bowls, food and medication;
- a kit of personal toiletries for each family member that's ready to grab and go;
- a change of clothes, including undergarments, footwear and outerwear;
- sleeping bags and Mylar™ camping blankets;
- personal paperwork in waterproof pouches, including irreplaceable or hard-to-replace documents, such as:
    - drivers' licenses and other ID;
    - birth certificates;
    - Social Security cards;

    - passports;
    - insurance policies, and other banking, business and legal cards and documents;
- contact information for relatives, friends and neighbors, as well as local shelters, including the Red Cross and the Federal Emergency Management Agency (FEMA), which may be directing disaster relief activities in your area;
- keys;
- cash and credit cards;
- firearms;
- personal electronics, including cell phones and chargers;
- irreplaceable personal effects, such as albums of photos that haven't been digitally preserved;
- enough snacks, including special food items such infant formula, and non-perishables, along with a can opener (if needed), to last until reaching alternative housing and supplies;
- water. If the emergency may be extended, FEMA recommends a three-day supply of one gallon per person per day, to be used for both drinking and sanitation;
- plastic bags, wet wipes, hand sanitizer, and other items for personal sanitation and hygiene; and
- a basic toolkit that includes work gloves, pliers, an adjustable wrench, a hacksaw, and other tools to fix a flat tire, turn off and on household utility shut-off valves, pry open a damaged door, and cut through tree branches that may be blocking a road.

An expanded emergency supply list can include the following items:

- a gallon of bleach to be used as a disinfectant and to purify drinking water, if necessary. Adding 16 drops of plain household chlorine bleach to a gallon of water will make the water potable;
- a gasoline-powered portable generator, along with extra gasoline;
- a portable fire extinguisher;
- portable lanterns and flashlights;
- a camping toilet;
- tents;
- a portable cook stove and mess kits;
- face masks for every family member;
- plastic sheeting or tarps, duct tape and scissors to create a "shelter in place," if a more secure shelter cannot be accessed in time. These can also be used to create a barrier from flying debris if it is not safe to leave and you must take refuge in your home; and
- other supplies that can aid in daily routines if temporary accommodations are too difficult to reach or overcrowded.

These items can help a family be self-sufficient while temporary accommodations and plans for returning home are sorted out. With the exception of medications and electronics that are used every day, most of the items can be stored in a central location, such as a coat closet or garage cupboard, or already loaded in your vehicle.

**Other Considerations**

For residents with special needs, such as infants, the elderly, and those with mobility issues, an emergency evacuation plan is essential because the time needed to leave is greater, and the list of personal items is often specialized. For example, a lightweight, collapsible wheelchair may be a more practical option for short-term use for someone who is wheelchair-bound. A person who relies on

oxygen may be able to invest in a portable, backpack-type supply. Those who wear hearing aids should keep extra batteries in their toiletries kit.

In all cases, emergency personnel and first responders should be notified as soon as possible regarding the location of at-risk and elderly residents whose mobility may be compromised so that they can receive the additional assistance they need to make a safe getaway.

**The B-List**

If a forced evacuation is predicted to be long-term and residents are afforded extra time to pack more than just the essentials, some homeowners may opt to pack items that have special sentimental or luxury value, such as heirlooms, jewelry, artwork, and other prized possessions.

Like most lists, this "B-list" should be made well in advance, including how such items can be packed into your vehicle while leaving room for occupants and emergency essentials, or even stored off-site at a secure location.

**HOME SECURITY**

On a regular basis, homeowners should make sure that their property's drainage is unobstructed, including gutters, downspouts and drainfields. Tree limbs should be trimmed back so that they don't break off and damage the roof or become entangled in nearby power lines during a storm. Shingles and chimneys should be in good repair, with no loose elements that can become dangerous projectiles in high winds. Homeowners living in wildfire-prone areas should maintain an adequate defensible space around their properties.

In addition to learning about the maintenance of their homes, homeowners should also take inventory of potential hazards within the home that can compromise personal safety, such as light fixtures, windows and shelf units. Things such as these can become unsteady or damaged and cause serious injury while a family takes shelter indoors during a severe storm or earthquake.

If you're not familiar with the locations of your shut-off valves and how to operate them, it's critical for you to schedule an inspection with your Certified Master Inspector®, who can walk you through these essential steps so that, when the time comes, you can act confidently and quickly.

**Shutting Off Utilities**

If you have time, prior to shutting off the utilities to your home, turn off all of your household appliances and unplug them. If you do not turn off the electrical service at the panel, your plugged-in appliances will still draw current and create potential hazards in an already unstable situation.

- Electricity: The method for disconnecting your electrical service depends on the age of your home and the type of system it has. Most homes have circuit breakers, but

some older homes have fuses. Locate your main panel and open the door, called the dead front. For a fuse panel, you should find a knife-switch handle or pullout fuse clearly marked "main." For a circuit breaker panel, there should be one switch marked "main," with directions marked "on" and "off." If you have more than one panel, it's a good idea to turn off the switches or remove the fuses at the sub-panels because current can sometimes bypass the main breaker or fuse.

- Gas: Each of your gas-fueled appliances, such as your water heater and stove, should have its own shut-off valve. The service for your home is located outside at your gas meter. It may be exposed, it may be in a box underground, or it may be in an above-ground cabinet. Make sure that you have easy access to it (especially if it is a locked box), and make sure you know which service is yours if you live in multi-family housing. The shut-off valve itself generally runs parallel to the pipe that extends from the ground to the meter. Turning this valve 90 degrees in either direction so that the valve is crosswise to the pipe will shut off the gas supply.

  If you suspect a leak, do not ignite any fire source (candle, cigarette, etc.) or turn on or off any electrical switches nearby, including lights, as even a minor spark can cause an explosion. Make sure that the service is safe to turn back on when you return home.

- Water: Each sink, commode and water-supplied appliance has its own shut-off valve. If you have time and depending on the type of emergency, shutting off the water to these appliances may prevent accidental flooding of the home. If you find it necessary to shut off the home's water supply, make sure you know where the valve is located. Typically, it's in an area of the home or garage that's nearest the exterior valve at the meter. Similar to the gas shut-off valve, those with a blade-type valve are aligned with the pipe when turned on, and turning it a quarter-turn will shut the water off.

**Lock Your Doors and Windows**

Secure the home's window and door locks to prevent unwanted entry by intruders during a time of crisis. This includes all exterior doors and doors leading from an attached garage to the home, as well as yard gates and all outbuildings. During a tornado, some homes may become overly pressurized unless some windows are left open a crack. In hurricane-prone regions, windows may need to be boarded up. Use your judgment and the recommendations of local experts based on the type of emergency.

**Other Security Issues**

Ranchers and farmers have their own particular concerns because of livestock, as well as additional buildings and equipment to secure. Likewise, commercial property owners and managers of multi-unit housing have their own unique priorities that should be addressed ahead of time with employees and

tenants in an emergency evacuation plan. Fire marshals generally require that signage for the emergency escape route, of specified dimensions for easy visibility, be posted in a common location. Such signage is typically located near fire pull alarms and fire extinguishers. All residents and employees should concentrate on safe evacuation and leave security of the property to those charged with such responsibilities.

**RE-ENTRY**

Being let back onto one's property after a disaster or emergency can be an emotional time, so it's important to allow emergency personnel and first responders to do their jobs and to follow their instructions. Generally, unless you can turn on all of your utilities again, your access may be limited, but it depends on your municipality and the scope of the damage. You may be instructed to boil your water for a brief period of time while governmental agencies confirm that it's potable and safe without treatment.

Before you re-enter your property, check the exterior.

**Check the exterior.**

- Make sure that there are no downed power lines on or near your property. If there are, do not attempt to move them yourself; immediately contact utility company personnel or law enforcement.
- Check for broken tree branches that may impede your access to your property, or which themselves may be in contact with power lines; again, enlist help in such situations to avoid a potentially fatal injury.
- Make sure the perimeter of your property is secure before allowing pets back onto the property. Natural disasters can be disorienting for them, and they may try to escape.
- Check any damage to windows and exterior doors, as well as the roof, chimney and other penetrations, but do so safely. You may defer this to your Certified Master Inspector®.
- Check gutters, downspouts and exterior drainage for blockages, and clear them as soon as it's possible to do so safely.
- It's always best to document damage from the ground and contact your Certified Master Inspector®, who can make a more in-depth and detailed inspection. Even after you contact your insurance carrier, an unbiased inspection by a trained home inspector may reveal issues that are not immediately apparent, such as hail damage, which requires some expertise to properly identify, especially if the insurance investigator must inspect damage incurred by multiple clients in the aftermath of a widespread emergency.

**Check the interior.**

- Before turning on the water and gas service to the home, check the individual appliances to make sure that they're undamaged. Document all damage, and contact utility personnel if you don't feel safe turning the fuel or water back on yourself. If there is no apparent damage or telltale smells or sounds (such as hissing) emanating from any appliances, it should be safe to turn on the gas and water at their shut-off valves. Make the same damage assessment before turning the electricity back on, too.

- Securely dispose of perishable food items left in the refrigerator during a power outage. Ensure that stray animals foraging for food can't access it. Some food left in the freezer may be salvageable, but always err on the side of caution to avoid serious illness caused by bacteria.
- Go back through your home to check for structural damage, including broken glass.
- In the aftermath of a storm or flood, check the basement, crawlspace and attic areas for moisture intrusion, as well as areas at window sills and exterior doors. Unchecked moisture can lead to mold problems and structural issues down the road. Have your Certified Master Inspector® survey your home with an infrared camera, which can identify areas of moisture intrusion and energy loss that may not be visible to the naked eye.

**Check in with neighbors and others.**

- At-risk and elderly neighbors should be accounted for.
- Notify pet owners or Animal Control if you see disoriented domestic pets searching for their owners or homes. Also, avoid contact with wildlife that may have been forced from their natural habitat. Report their location to Animal Control.

Those of us untouched by disaster sometimes daydream about what we would grab if we had only moments to spare. The fact is, there is no bad time to actually make that list and prepare those plans. Talk with your entire family about what to do in an emergency. By making practical preparations and involving all family members, chances are that when disaster strikes, you'll feel less panicked and more in control to guide your family in a safe and orderly evacuation. They'll know what to expect, too (as much as possible), and that will lessen their fear, which is especially important for keeping calm and acting quickly. Schedule a meeting with your Certified Master Inspector® to help you devise a checklist to prepare your house in the event of an emergency, and to assess its condition afterward to make sure it's safe for you to re-occupy. He or she can also help you get started on an action plan for repairs. And don't forget to replenish your emergency supply kits so that you can be prepared the next time, too.

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**The CMI Big Survival List for Ultimate Self-Sufficiency**

There was a time when citizens were encouraged to build bomb shelters in their backyards for nearly unimaginable worst-case scenarios, such as a foreign invasion or nuclear fallout. While U.S. national security has been reinforced to unprecedented levels, not every contingency can be met by third parties.

The following list represents the items a family will need to be truly self-sufficient if the grid goes down and public services and utilities are disabled for three months or longer. The list is long and comprehensive, and all the items will take time to assemble, so consider getting started now.

- BOOKS
    - Gardening books
    - Baking and cookbooks
    - Manuals for butchering livestock and game
    - Cookbooks for cooking with stored food
    - Homeopathy books

    - Food preservation books
    - First-aid manuals
    - Pens and paper
- CLOTHING
    - Hats (baseball cap for sun protection, and wool cap/balaclava for warmth)
    - Socks
    - Boots & other footwear
        - Spare laces
    - Work gloves
    - Overalls
    - Coats
    - Rubber boots
    - Rain suit or poncho
    - Clothes pins (for air-drying clothes)
    - Sewing kit
    - Sewing awl
    - Treadle sewing machine
    - Wash tubs
    - Laundry tongs
    - Hand washer/wringer for laundry
    - Diapers
    - Diaper pins
    - Antique iron (that can be used without power)
- COMMUNICATION
    - Cell phone charger (car)
    - Walkie-talkies (MURS band)
    - Two-way radios
    - CB radio
    - Weather radio (hand-cranked)
    - Whistle
- CURRENCY & BARTER
    - Cash
    - Silver
    - Gold
    - Jewelry
    - Wine, beer & spirits
- DEFENSE & SECURITY
    - Firearms
        - Ammunition
        - Gun-cleaning kit
            - Cotton gloves
    - Knives
    - Night-vision scope and gear
    - Fully opaque blackout curtains
    - Earth-tone or camouflage clothing
    - Green and brown dye
    - Locks
    - Detection systems

    - Alarms
    - Camera systems
    - Camouflage face vale
    - Jobsite boxes ("Vicki boxes") to cache preparedness goods
- ENTERTAINMENT
    - Playing cards
    - Board games and toys for young children
    - Harmonica and other acoustic musical instruments
    - Coloring books and crayons
- FOOD & COOKING SUPPLIES
    - Energy bars
    - MREs (Meals, Ready-to-Eat)
    - Canned goods
    - Wheat (hard red)
    - Rice (white rice stores longer than brown, but has fewer nutrients)
    - Dried beans
    - Dried lentils
    - Oatmeal
    - Corn (whole-kernel)
    - Peanut butter and other nut butters
    - Dried fruit
    - Honey (liquid/pure stores the longest)
    - Sugar
    - Canned sardines, tuna, salmon
    - Cooking oil
    - Olive oil
    - Nuts
    - Powdered milk
    - Vinegar
    - Salt (large supply)
    - Baking soda
    - Nitrogen-packed food
    - Freeze-dried food
    - Ground coffee
    - Smoker
    - Food bags
    - Fishing gear
        - Fishing nets
        - Fishing lines
        - Sinkers
        - Hooks
    - Bow & arrows
        - Bow strings (spares)
    - Snare wire (stainless steel)
    - Hunting rifle & shotgun
        - Ammunition
        - Gun-cleaning kit
            - Cotton gloves

        - Ear protection
        - Eye protection
        - Rifle scope
    - Boar spear
    - Meat grinder (hand-cranked)
    - Meat saw
    - Skinning knife
    - Gambrel
    - Garden seeds (non-hybrid, open-pollinated)
    - Sprouts
    - Gardening tools
    - Grain grinder (hand-operated)
        - Spare set of coarse burrs for grain grinder
        - Mortar and pestle
    - Aluminum foil
    - Refrigeration:
        - Cooler
    - Food preparation items:
        - Stainless steel bowl
        - Large skillet
        - Large stew pot
        - Mess kits
        - Can opener
        - Knives
        - Cooking utensils
        - Eating utensils
        - Camp stove
        - Dutch oven
        - Coffee pot (French press, reusable filter with holder)
        - Bay leaves
        - Dehydrator
        - Canning supplies
        - Mixing bowl
        - Wire whisk
        - Muffin tin
    - Vitamins
    - Baby food
    - Pet food and bowls
- FUEL & POWER
    - Propane cylinders
    - Gasoline
    - Diesel
    - Kerosene
    - Storage tanks
    - Siphoning tube
    - Motor oil
    - Generator (tri-fuel)
    - Coal

    - Photovoltaic power system
    - Photovoltaic battery charger
    - Rechargeable batteries
    - Inverter
- HEAT & WARMTH
    - Wool blankets
    - Bedrolls
    - Pocket lighters
    - Matches (waterproof)
    - Fire steels
    - Fresnel magnifying lens
    - Hexamine fuel tablets
    - Sleeping bags
    - Insulated pads (to sleep on)
    - Firewood (split)
    - Axe
    - Wedge
    - Splitting maul
    - Log splitter (manual)
    - Saw
    - Sawhorse
    - Sterno®
    - Woodburner
        - Fire extinguisher
- HYGIENE
    - Toilet paper
    - Soap (Fels Naptha®)
    - Toothbrush
        - Toothpaste
        - Baking soda
        - Floss
    - Feminine hygiene products
    - Straight razor
    - Bucket toilet
    - Garbage bags
    - Powdered lime
    - Towels
- IDENTIFICATION & DOCUMENTS
    - Passport
    - Birth certificate
    - Driver's license
    - Insurance policies
    - Deeds
    - Wills
- LIGHT
    - Flashlight
        - Batteries
    - Candles (beeswax is best)

    - Lantern
        - Lantern oil (clear)
        - Lantern wicks
- MEDICAL
    - First-aid kit
    - Bandages
    - Gauze
    - Quick-clot sponges
    - Rubbing alcohol (pure grain alcohol from the liquor store comes in a glass bottle and will last forever)
    - Tincture of iodine
    - Tincture of benzoin
    - Potassium iodate tablets (to prevent thyroid damage from nuclear fallout)
    - Cotton balls
    - EMT shears (stainless steel)
    - Burn treatment kit
    - Oil of cloves
    - Temporary dental filling kit
        - CIMPAT™
        - Tempanol™
        - Cavit™
    - Crutches
    - SAM® splint
    - Disinfectants
    - Witch Hazel
    - Hydrocortisone cream
    - Calamine lotion
    - Aloe vera gel
    - Grapefruit seed extract (nutribiotic, liquid)
    - Hot water bottle
- PERSONAL
    - Spare prescription eyeglasses
    - Sunglasses
    - Birth control
    - Medical prescriptions
    - Sunscreen
    - Bug repellent
- SHELTER & COMFORT
    - Tent
    - Tent seam tape
    - Plastic sheets
    - Tarp
    - Ground cloth
    - Folding/camp chairs
    - Folding/camp tables
- TOOLS & SUPPLIES
    - Anvil
    - Duct tape

    - Multi-tool
    - Chainsaw
    - Binoculars
    - Cable ties
    - Tie-downs
    - Come-along
    - Sharpening stone
    - Chain
    - Rope
    - Wire
    - Buckets with turn lids
    - Nails
    - Radiacmeter (hand-held Geiger counter)
    - N-95 respirator masks
    - Bolt cutters
    - Other hand-powered tools
    - Shovels
    - Pulley
    - Paracord
    - Large adjustable wrench (to shut off gas and water service)
- TRANSPORTATION
    - Snowshoes
    - Backpack
    - Compass
    - Jumper cables
    - Local maps
    - Snowmobile
    - ATV
    - Diesel pickup truck
    - Cart
    - Sled
    - Tire chains
    - GPS
    - High-lift jack
    - Transfer pump
- WATER
    - Bottled water
    - Purifier
    - Canteen
    - Sodium hypochlorite bleach
    - Storage containers/barrels
    - Pick-up truck water tank
    - Solar distiller
    - HTH dry chlorine

# Elderly Safety

## Aging in Place

"Aging in place" is the phenomenon describing senior citizens' ability to live independently in their homes for as long as possible. Those who age in place will not have to move from their present residence in order to secure necessary support services in response to their changing needs.

**The Baby Boomers**

As the baby boomers age, the 60+ population will spike from roughly 45 million in recent years to more than 70 million by 2020. Research shows that baby boomers' expectations of how they will receive care differ from that of their parents' generation. Overwhelmingly, they will seek care in their own homes and will be less likely to move into congregate living settings.

**Why do many senior citizens prefer to age in place?**

Nursing homes, to many, represent a loss of freedom and a reduced quality of life. Here are a few good reasons why these fears are justified:

- In 2007, inspectors received 37,150 complaints about conditions in nursing homes. Roughly one-fifth of the complaints verified by federal and state authorities involved the abuse or neglect of patients. Specific problems included infected bedsores, medication mix-ups, poor nutrition, and other forms of neglect.
- The proportion of nursing homes cited for deficiencies ranged from 76% in Rhode Island to as high as 100% in Alaska, Idaho, Wyoming and Washington, D.C.
- Many cases have been exposed in which nursing homes billed Medicare and Medicaid for services that were not provided.
- A significant percentage of nursing homes had deficiencies that caused immediate jeopardy or actual harm to patients.

**Aging-in-Place Inspections**

Your Certified Master Inspector® may recommend corrections and adaptations to the home to improve maneuverability, accessibility, and safety for elderly occupants. Some such alterations and recommendations for a home are as follows:

Appliances:

1. microwave oven in wall or on counter;
2. refrigerator and freezer side by side;
3. side-swing or wall oven;
4. controls that are easy to read;
5. raised washing machine and dryer;
6. front-loading washing machine;
7. raised dishwasher with push-button controls;

8. stoves having electric cooktops with level burners for safely transferring between the burners; front controls and downdraft feature to pull heat away from user; light to indicate when surface is hot; and
9. replace old stoves with induction cooktops to help prevent burns.

Bathroom:

1. fold-down seat installed in the shower;
2. adjustable showerheads with 6-foot hose;
3. light in shower stall;
4. wall support, and provision for adjustable and/or varied-height counters and removable base cabinets;
5. contrasting color edge border at countertops;
6. at least one wheelchair-maneuverable bath on main level;
7. bracing in walls around tub, shower, shower seat, and toilet for installation of grab bars;
8. if stand-up shower is used in main bath, it is curbless and wide;
9. low bathtub;
10. toilet higher than standard toilet, or height-adjustable;
11. design of the toilet paper holder allows rolls to be changed with one hand;
12. wall-hung sink with knee space and panel to protect user from pipes; and
13. slip-resistant flooring in bathroom and shower.

Counters:

1. base cabinet with roll-out trays;
2. pull-down shelving;
3. wall support, and provision for adjustable and/or varied-height counters and removable base cabinets;
4. upper wall cabinetry lower than conventional height;
5. accented stripes on edge of countertops to provide visual orientation to the workspace;
6. counter space for dish landing adjacent to or opposite all appliances;
7. glass-front cabinet doors; and
8. open shelving for easy access to frequently used items.

Exterior:

1. low-maintenance exterior (vinyl, brick, etc); and
2. low-maintenance shrubs and plants.

Entry:

1. sensor light at exterior no-step entry focusing on the front-door lock;
2. non-slip flooring in foyer;

3. accessible path of travel to the home;
4. at least one no-step entry with a cover;
5. entry door sidelight or high/low peep hole viewer; sidelight should provide both privacy and safety;
6. doorbell in accessible location; and
7. a surface on which to place packages while opening door.

Electrical, Lighting, Safety and Security:

1. install new smoke and CO detectors;
2. install automated lighting, an emergency alert system, or a video-monitoring system;
3. easy-to-see and read thermostats;
4. light switches by each entrance to halls and rooms;
5. light receptacles with at least two bulbs in vital places (exits, bathroom);
6. light switches, thermostats, and other environmental controls placed in accessible locations no higher than 48 inches from floor;
7. move electrical cords out of the flow of traffic;
8. replace standard light switches with rocker or touch-light switches; and
9. pre-programmed thermostats.

Faucets:

1. thermostatic or anti-scald controls;
2. lever handles or pedal-controlled; and
3. pressure-balanced faucets.

Flooring:

1. if carpeted, use low-density with firm pad;
2. smooth, non-glare, slip-resistant surfaces, interior and exterior; and
3. color and texture contrast to indicate change in surface levels.

Hallways:

1. wide;
2. well-lit; and
3. fasten down rugs and floor runners, and remove any that are not necessary.

Heating, Ventilation and Air Conditioning:

1. install energy-efficient units;
2. HVAC should be designed so filters are easily accessible; and
3. windows that can be opened for cross-ventilation and fresh air.

Miscellaneous:

1. 30-inch by 48-inch clear space at appliances, or 60-inch diameter clear space for turns;
2. multi-level work areas to accommodate cooks of different heights;
3. loop handles for easy grip and pull;
4. pull-out spray faucet;
5. levered handles;
6. in multi-story homes, laundry chute or laundry facilities in master bedroom;
7. open under-counter seated work areas; and
8. placement of task lighting in appropriate work areas.

Overall Floor Plan:

1. main living in a single story, including full bath;
2. 5x5-foot clear turn space in living area, kitchen, a bedroom and a bathroom; and
3. no steps between rooms on a single level.

Reduced Maintenance and Convenience Features:

1. easy-to-clean surfaces;
2. built-in recycling system;
3. video phones;
4. central vacuum system;
5. built-in pet feeding system; and
6. intercom system.

Stairways, Lifts and Elevators:

1. adequate hand rails on both sides of stairway;
2. residential elevator or lift; and
3. increased visibility of stairs through contrast strip on top and bottom stairs, and color contrast between treads and risers on stairs with use of lighting.

Storage:

1. lighting in closets;
2. adjustable closet rods and shelves; and
3. easy-open doors that do not obstruct access.

Windows:

1. plenty of windows for natural light;
2. low-maintenance exterior and interior finishes;

3. lowered windows, or taller windows with lower sill height; and
4. easy-to-operate hardware.

**Advice for those who wish to age in place:**

- Talk with family members about your long-term living preferences. Do you want to downsize to a smaller single-family home, or do you plan to stay put in your traditional family home?
- Take a look at your finances and retirement funds. With your current savings and assets, will you be able to pay for home maintenance? Consider starting a separate retirement savings account strictly for home maintenance.
- Remodel your home before your mobility becomes limited. As you age, changes in mobility, hearing, vision, and overall health and flexibility will affect how easily you function in your home. Consider making your home "age-friendly" as a phased-in and budgeted home improvement, rather than waiting until you need many modifications at a time due to a health crisis.
- If you decide before you retire that you want to live in your current home through the remainder of your life, consider paying for big-ticket/long-life home projects while you still have a healthy income. Such items may include having the roof assessed or replaced, replacing and upgrading the water heater or cooling unit, completing termite inspections and treatment, having a septic tank inspection and replacement, as needed, and purchasing a riding lawn mower.
- The Master Inspector Certification Board advocates healthy living, as it plays a vital role in your ability to age in place. Most seniors leave their homes due to functional and mobility limitations that result from medical crises, and an inability to pay for healthcare support to stay with them in their home. Effectively managing health risks and maintaining a healthy lifestyle can help you stay strong, age well, and live long in your own home.

In summary, aging in place is a way by which senior citizens can avoid being dependent on others due to declining health and mobility.

## Aging-in-Place Checklist

EXTERIOR

_____ Slip-resistant stairs and ramp, with color contrast or glow-strips at treads

_____ Handrails are easy-to-reach, of graspable size, and slip-resistant

_____ Porch area is in usable condition and free of obstructions and dark areas

_____ Accessible doorways for walkers, wheelchairs, etc.

_____ Lighting (security or interior-controlled, or both)

_____ Low-maintenance exterior (vinyl, brick, etc.)

_____ Driveway and walkways (in good repair for safe walking)

_____ Yard, gates, fence (easy to access, locking/secured)

_____ Garage (attached or freestanding); other outbuildings

_____ Low-maintenance shrubs and plants, lawn care, trees on property

_____ Snow-blower or other provisions for snowy weather, where applicable

ENTRANCE

_____ House number is clearly visible from street for first-responders

_____ Motion sensor/security light at main exterior door

_____ Peephole of proper height for all residents (may require multiples)

_____ Doorbell in accessible location

_____ Surface on which to place packages while opening door

_____ All exterior doors have secure, easy-to-use locks, bolts and knobs

_____ Non-slip flooring in foyer

INTERIOR: Electrical, Lighting, Safety and Security

_____ Light-activated doorbell for hard-of-hearing residents

_____ Smoke and CO detectors

_____ Security alarm, emergency alert system and/or video-monitoring system

_____ Thermostats are easy to locate; settings are easy to read (and no higher than 48 inches from floor); thermostats are pre-programmed

_____ Light switches located near each entrance to each hallway and room

_____ Standard light switches, or rocker or touch light switches

_____ Two light bulbs or receptacles in each vital place (exits, bathrooms, etc.)

_____ Electrical cords out of the path of traffic

_____ Receptacles are easy to reach; receptacles are not overloaded

_____ Windows and safety locks are easy to operate

_____ Window drapes/shades/cords are easy to reach and open/close

_____ Interior stairs use contrast strip on top and bottom stairs, and color contrast between treads and risers on stairs, with use of lighting

KITCHEN: Appliances & Maneuverability

_____ Microwave oven in wall or on counter; settings are easy to read

_____ Refrigerator and freezer in a side-by-side unit

_____ Side-swing or wall oven; settings are easy to read; knobs are easy to turn

_____ Raised washing machine and dryer; settings are easy to read; knobs are easy to turn; washing machine is front-loading

_____ Raised dishwasher with push-button controls or easy-to-turn knobs

_____ Stoves with electric cooktops (safer than gas), with level burners for safely transferring between the burners; front controls and downdraft feature to pull heat away from user; light to indicate when surface is hot

_____ Space around counters, islands, etc., are wide enough for residents: 30x48-inch clear space at appliances, and 60-inch diameter clear space for turns

_____ Cabinets are easy to reach; knobs/pulls are easy to use to open/close, or shelves are open/doorless, or have glass fronts

_____ Counters are of ample area; custom-height/adequate and safe for residents; countertops have contrasting-color edges for the vision-impaired and to provide visual orientation to workspace

_____ Placement of task lighting in appropriate work areas

_____ Rugs have slip-resistant backing to prevent slips and falls

_____ Window curtains/shades/cords are easy to reach and open/close

BATHROOM: Fixtures & Maneuverability

_____ Counter heights are custom-fit/adequate and safe for residents

_____ Rugs have slip-resistant backing to prevent slips and falls

_____ Windows are easy to reach and open/close

_____ Door access to tub/shower

_____ Fold-down seat installed in shower

_____ Shower(s) equipped with adjustable showerhead with 6-foot hose

_____ Shower stall has recessed, waterproof, automatic light

_____ If stand-up shower is used in main bath, it is curbless and wide; if tub is used, it is low for easy access and egress

_____ Flooring in bathtub/shower is slip-resistant

_____ Emergency call button or intercom is located in bathroom, easy to reach, and is easily operated

_____ Wall grab-bars of appropriate height located in tub/shower/toilet areas

_____ Adjustable or appropriate-height counters with removable base cabinet for wheelchair-accessibility

_____ Countertops have contrasting-color edges

_____ Toilet is raised or height-adjustable

_____ Toilet-paper holder is designed such that rolls can be switched out using only one hand

_____ Faucet handles are lever design rather than knob, or pedal-controlled

_____ Cabinets are easy to reach and are open shelves/glass fronts/doorless

_____ At least one bathroom is wheelchair-accessible and on main level

FLOORING

_____ If carpeted, use low-density pile with firm pad

_____ Smooth, non-glare, slip-resistant surfaces

_____ Color and texture contrast to indicate change in surface levels

_____ Rugs and rug runners are secure and non-slip; edges are secured down

_____ No steps between rooms on a single level

MISCELLANEOUS TIPS

_____ In multi-story homes, laundry chute or laundry facilities located on same floor as master bedroom

_____ Main living area is on a single floor, including full bath

_____ 5x5-foot clear turn space in all main rooms

_____ For multi-level home, residential elevator or lift installed

_____ Lighting in all closets

## Anti-Scald Valves

Anti-scald valves, also known as tempering valves and mixing valves, mix cold water in with outgoing hot water so that the hot water that leaves a fixture is not hot enough to scald a person.

**Facts and Figures**

- Scalds account for 20% of all burns.
- More than 2,000 American children are scalded each year, mostly in the bathroom and kitchen.
- Scalding and other types of burns require costly and expensive hospital stays, often involving skin grafts and plastic surgery.
- Scalding may lead to additional injuries, such as falls and heart attacks, especially among the elderly.
- Water that is 160° F can cause scalding in 0.5 seconds.

Unwanted temperature fluctuations are an annoyance and a safety hazard. When a toilet is flushed, for instance, cold water flows into the toilet's tank and lowers the pressure in the cold-water pipes. If someone is taking a shower, they will suddenly feel the water become hotter as less cold water is available to the shower valve. By the same principle, the shower water will become colder when someone in the house uses the hot-water faucet. This condition is exacerbated by plumbing that's clogged, narrow, or installed in showers equipped with low-flow or multiple showerheads. A sudden burst of hot water can cause serious burns, particularly in young children, who have thinner skin than adults. Also, a startling thermal shock – hot or cold – may cause a person to fall in the shower as he or she scrambles on the slippery surface to adjust the water temperature. The elderly and physically challenged are at particular risk.

Anti-scald valves mitigate this danger by maintaining water temperature at a safe level, even as pressures fluctuate in water supply lines. They look similar to ordinary shower and tub valves and are equipped with a special diaphragm or piston mechanism that immediately balances the pressure of the hot- and cold-water inputs, limiting one or the other to keep the temperature within a range of several degrees. As a side effect, the use of an anti-scald valve increases the amount of available hot water, as it is drawn more slowly from the water heater. Homeowners may want to check with the authority having jurisdiction (AHJ) to see if these safety measures are required in new construction in their area.

Installation of anti-scald valves is typically simple and inexpensive. Most models are installed in the hot-water line and require a cold-water feed. They also require a swing check valve on the cold-water feed line to prevent hot water from entering the cold-water system. They may be installed at the water heater to safeguard the plumbing for the whole building, or only at specific fixtures.

The actual temperature of the water that comes out of the fixture may be somewhat different than the target temperature set on the anti-scald valve. Such irregularities may be due to long, uninsulated plumbing lines, or defects in the valve itself. Users may fine-tune the valve with a rotating mechanism that will allow the water to become hotter or colder, depending on which way it's turned. Homeowners should contact a Certified Master Inspector® or a qualified plumber if they have further questions or concerns about anti-scald valves.

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