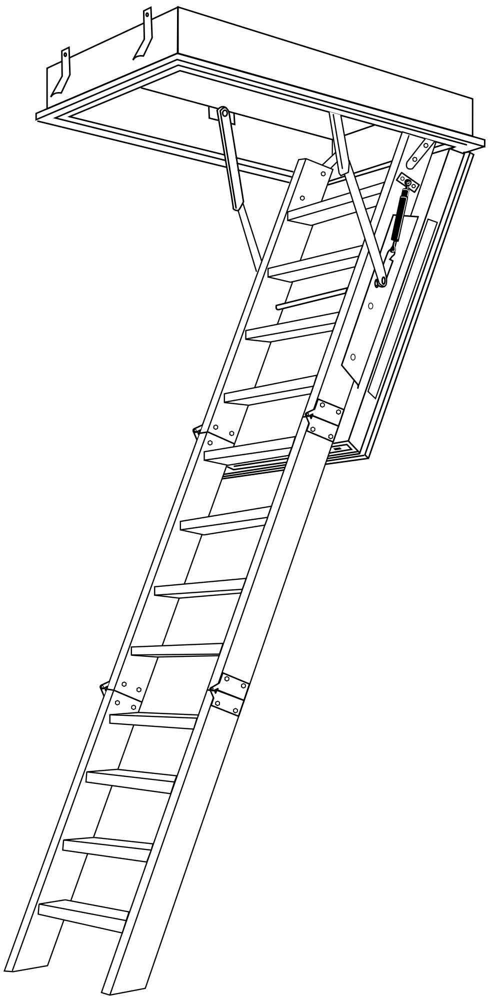
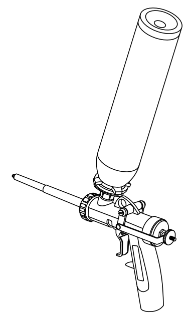
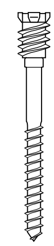
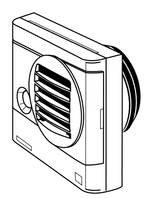
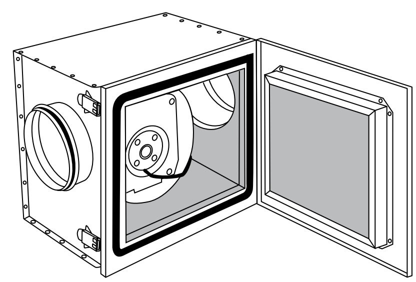
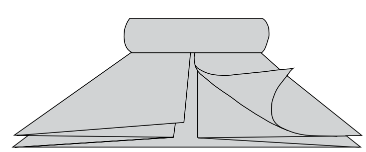
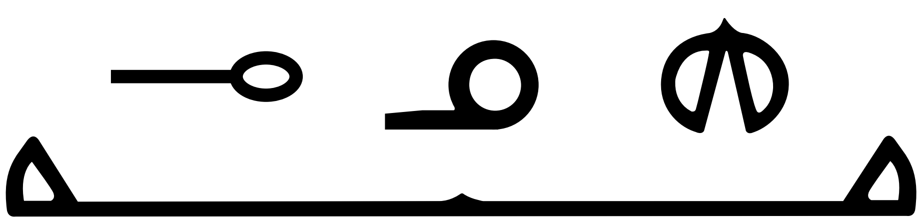
Energy-Efficient Building Handbook

 800-477-7724 www.conservationtechnology.com 06/08

GENERAL INFORMATION

Conservation Technology has been a supplier of state-of-the-art technology for green building since 1984. Our extensive product line is divided into five functional divisions: our RoofTechnology division supplies superior-quality solutions for low-slope roofs including sheet rubber membranes, liquid rubber coatings, and green roof components; our PondTechnology division is a major supplier to the aquatic gardening industry and offers an extensive selection of pumps, filters, and plumbing for water quality management; our RainwaterTechnology division is pioneering rainwater catchment in North America and offers a full range of filters, tanks, pumps, and controls specifically engineered for this application; our WeathersealTechnology division supplies the most advanced weatherstripping and glazing technology in North America; and our BuildingTechnology division offers a wide range of components for energy-efficient building including air-vapor sealing products, ventilation systems, and attic access ladders. For information about our other product divisions, see *www.conservationtechnology.com*.

CONTENTS OF THIS HANDBOOK:

PRICING: Pricing can be found in each section. If you provide a list of materials, we will be pleased to create a project quotation including delivery charges, but we regret that we cannot provide material takeoffs from your drawings. Discounts are available for stocking re-sellers and for contractors purchasing significant quantities on a yearly basis: call for details. Prices and product specifications are subject to change without notice.

TECHNICAL ASSISTANCE: We have tried to convey a great deal of information in this small handbook. If you don't find the answer you need, just call and request assistance, or fax a simple sketch of your design problem. You can also email questions and drawings to sales@conservationtechnology.com.

PAYMENT: Our minimum order is $25. We accept Mastercard, VISA, Discover, American Express, checks, bank drafts, money orders, or wire transfers. Some UPS shippable items can also be sent COD. If you wish to send payment by mail or wire, please call or write to obtain an exact total including shipping charges. Credit terms are available for dealers and active contractors.

HOURS OF OPERATION: We're open Monday through Friday from 8:30 AM until 5:30 PM Eastern time, often longer hours during our busy season. If our telephones are busy, you can fax an order or a list of questions at any time to (410) 366-1202, but please remember to supply your telephone number and to indicate when you can be reached during business hours.

PICKUPS: You are welcome to visit our Baltimore warehouse at 2233 Huntingdon Avenue to pick up merchandise, but please place your order by telephone before you visit and ask for directions. We do not currently have a showroom.

SHIPPING: Since we try to stock everything we sell, we can usually ship very quickly. Most small orders will be shipped UPS. Larger quantities are usually more economical to ship by truck unless we are shipping to a residence. We regret that we cannot ship orders via the US Postal Service except in unusual circumstances where UPS service is impractical.

INSPECTING TRUCK SHIPMENTS: Although we rarely have shipping damage, it is essential that you inspect all truck shipments thoroughly before signing the freight bill, note any damage on the freight bill, and call us within one business day to report the damage. If you follow this procedure, we will guarantee free repair materials in the event of minor damage, and free replacement in the event of major damage. If you fail to note damage before accepting a truck shipment, you may be denied this protection, so insist on taking the time for a thorough inspection.

RETURNS: Tapes, caulks, spray foam, and epoxy compounds are not returnable unless defective. We will accept returns of most other components within 30 days provided they arrive in clean, unused condition. However, you must first call for a return authorization and shipping instructions. We do not refund shipping charges, and we normally charge a restocking fee.

CONSERVATION TECHNOLOGY

tel: (800) 477-7724 fax: (410) 366-1202 email: sales@conservationtechnology.com

ENERGY-EFFICIENT DESIGN

When asked to describe characteristics of an energy-efficient house, most might list the following: well-insulated walls, exterior "housewrap", a ventilated roof with a thick layer of insulation over the ceiling, quality windows with low-E glass, and a high-efficiency heating and cooling system. Surprisingly, many houses with these features experience higher than anticipated utility bills, elevated levels of moisture or indoor air pollutants, and premature deterioration caused by moisture accumulation in walls and roofs. Why is this happening and what can be done to avoid these problems?

HOW TO BUILD HOMES THAT ARE TRULY ENERGY EFFICIENT

RULE #1: Seal all joints in the building shell. It doesn't make sense to invest in well-insulated walls and ceilings yet do little to block air flow around and through the insulated cavities. Wood-to-wood and drywall-to-wood joints in the exterior shell of a building are not airtight and should be sealed with gaskets, foams, caulks, or air barrier films. The illustration "Air Leakage Pathways" shows where these sealing products are needed in conventional residential wood-frame construction. Other wood and masonry building systems have similar pathways.

Since buildings are always moving in response to changing wind, moisture, and temperature conditions, it is critical that air-sealing products last as long as the structure and be capable of withstanding movement. Building gaskets are preferable to foams and caulks because they last longer, respond better to movement, and don't rely on adhesion to maintain an air seal (see BUILDING GASKETS). Most exterior air-control films ("housewrap") are of questionable value because they are difficult to install properly under field conditions and have a relatively short lifetime. Stabilized polyethylene films (see AIR-VAPOR CONTROL FILM) can provide reliable interior air-control in cold or temperate climates provided the wall or roof is designed to prevent vapor condensation.

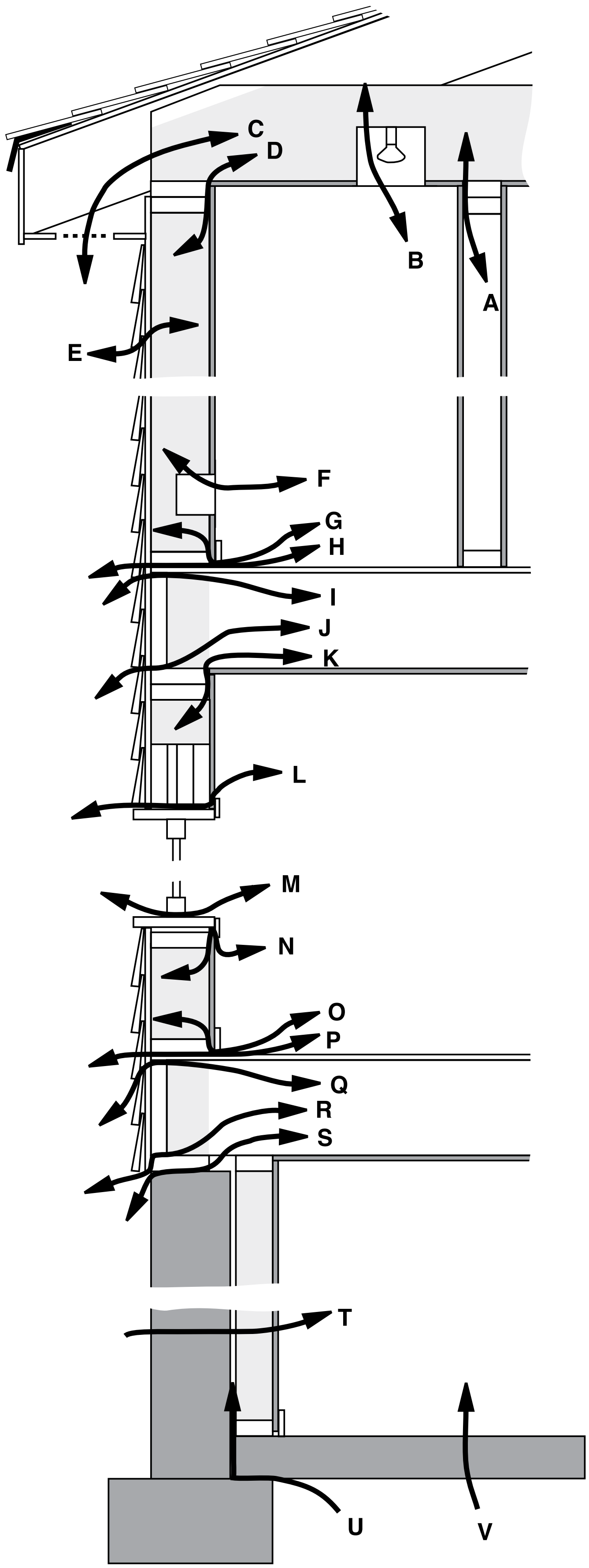
RULE #2: Eliminate unnecessary holes and seal all those that are unavoidable. Locate electrical outlets and switch boxes on interior walls wherever possible, and try to use surface-mounted lights instead of recessed fixtures on insulated ceilings. Where electrical work on exterior walls and ceilings is unavoidable, tightly seal all box edges and wiring holes. Seal plumbing stacks with sheet-rubber gaskets slid over the pipes and mechanically clamped around the edges. Seal fire chases around chimneys with sheet metal flanges and high-temperature sealants. Insulate and gasket attic access doors or replace them with air-sealed versions (see ENERGY-EFFICIENT ATTIC LADDERS). Build removable gasketed lids for whole-house fans, or better yet, don't install this type of fan in an unheated space. Avoid air leakage through unsealed spaces behind bathtubs, showers, staircases, and other construction adjacent to exterior walls by pre-installing plywood or drywall air barriers.

RULE #3: Block heat conduction pathways through framing lumber. Since wood is not a great insulator and conventionally framed walls and ceilings are often 20% lumber, heat loss through the wood is a major component of the total conduction heat loss of a building. As an example, a 2x6 wall with R-19 fiberglass batts and plywood sheathing often has an effective R-value of less than R-15. An effective way to reduce framing heat loss is to apply insulating sheathing: 1" is the minimum required for mild climates and 1-1/2" or more should be used in hot or cold climates. As a side benefit, exterior insulating sheathing will greatly reduce the potential for water condensation on the back side of wood sheathing. As an alternative to foam sheathing, consider "strapping" the interior with horizontal 2x2's and insulating in between the strapping.

Heat loss through window headers, exterior corners, and rim joists can be significantly reduced with simple framing modifications. Install rigid insulation between the inside and outside window and door headers, frame corners so that they are open on the interior and can be filled with insulation, and recess rim joists to create a space for several inches of insulation. Use raised-heel trusses or other roof framing modifications that create space for more insulation at the corners where walls and ceilings meet, thereby reducing heat loss and lessening the chance for mold and mildew at these points.

RULE #4: Completely fill all cavities with insulation. Even the smallest gaps between insulation and framing can cause a significant loss of insulation performance, especially where then is a space between the insulation and the drywall that allows air to move freely. Insulation should completely fill all wall and ceiling cavities and should be installed flush with the interior surfaces. When using batt insulation such as fiberglass, always use unfaced batts: if cut properly, they will stay in place in both walls and ceilings without any support. Avoid kraft-faced or foil-faced fiberglass because the paper facing hides the insulation from view, making it difficult to determine if it has been fit properly. If you must use faced insulation, staple the facing to the edges of the joists or studs, not to their sides, to avoid creating any cavity behind the drywall. As an alternative to batt insulation, use a spray-applied cellulose or fiberglass with an adhesive binder, or use spray applied foam.

RULE #5: Insulate foundations adequately, preferably on the exterior. Basements are rarely insulated to the same standards as upper floors, even though basement walls often have a similar exterior exposure. When an uninsulated or poorly insulated basement is later converted to living space, it is often difficult to retrofit sufficient insulation, and many basement insulation techniques can create condensation problems that can lead to mold and wood rot. Basements should be properly insulated during the initial construction process, preferably on the exterior. Exterior insulation reduces the chance of condensation and eliminates the extreme thermal cycling that causes foundations to crack.



Air Leakage Pathways

This illustration shows the cross-section of a building that many would consider to be energy-efficient: 2x6 studs, "housewrap" on the exterior, thick roof insulation, and insulated windows. As the arrows show, there can still be many places where there can be substantial air leakage. Some arrows indicate how air can flow from the interior to the exterior or from the exterior to the interior; other arrows indicate how exterior air blowing past the drywall can cause energy loss through conduction without entering or leaving the interior of the building; still other arrows indicate pathways for radon and other soil gases.

A – between interior wall top plates and drywall

B – through cracks in recessed fixtures

C – short circuits through attic insulation

D – between exterior wall top plates and drywall

E – through gaps in siding and sheathing

F – through holes in electrical boxes

G – between bottom plate and drywall

H – between bottom plate and subfloor

I – between rim joist and subfloor

J – between rim joist and top plate

K – between top plates and drywall

L – around window and door jambs

M – poorly weatherstripped windows and doors

N – between window rough framing and drywall

O – between bottom plate and drywall

P – between bottom plate and subfloor

Q – between rim joist and subfloor

R – between rim joist and sill plate

S – between sill plate and foundation wall

T – through cracks in foundation wall

U – between floor slab and foundation wall

V – through cracks in floor slab

HOW TO BUILD DURABLE AND HEALTHY HOMES

Houses cannot be designed solely for energy-efficiency: they must also be designed for durability, comfort, and health. Failure to consider the impact of house-tightening on indoor comfort and air quality has led to serious moisture and air-quality problems. Consider some of the changes in the way we have built and lived in houses over the past few decades:

• In the past, building lumber was usually air dried over a period of many months, and the building process was so slow that even wet lumber could dry fully before the walls were closed in. Today, homes are often built of lumber that is inadequately kiln dried, and the walls are closed in so quickly that the wood cannot dry on site.

• In the past, homes had little insulation, so there was plenty of air circulation in stud and joist cavities to promote drying. Today, homes have walls and roofs filled with insulation that blocks most air circulation in the cavities.

• In the past, homes had board sheathing that was quite leaky and had a high moisture-absorption capacity. Today, homes have plywood, chipboard, or foam sheathings that are air and moisture impermeable and have little or no moisture storage capacity.

• In the past, homes were heated with combustion furnaces that consumed interior air and created negative interior air pressure. As air flowed from the outside in, the air temperature rose and its humidity fell, drying the wood framing. Today, homes have heat-pumps and high-efficiency sealed combustion furnaces that do not require inside air, so buildings often operate under neutral or even positive pressure.

• In the past, homes had leaky single-pane glass windows that let in plenty of dry outside air and caused excess interior moisture to condense as water in cold climates, dehumidifying the air. Today, homes have tight insulated glass units that let in little air and cannot provide winter dehumidification by condensation because their interior surfaces are too warm.

• In the past, foundations could be economically backfilled with gravel and good soil. Today, homes are usually backfilled with the same material that was excavated which often drains poorly and allows water pressure to build against the foundation.

• In the past, home dwellers were content to bathe and shower infrequently in small, simple bathrooms. Today, the norm is to shower daily in elaborate baths equipped with multiple sinks, whirlpools, hot tubs, and saunas, all of which generate moisture.

• In the past, the average home contained a few potted houseplants. Today, many homes contain a rainforest of plants, and some have integral sunspaces, greenhouses, waterfalls, pools, and other moisture generators.

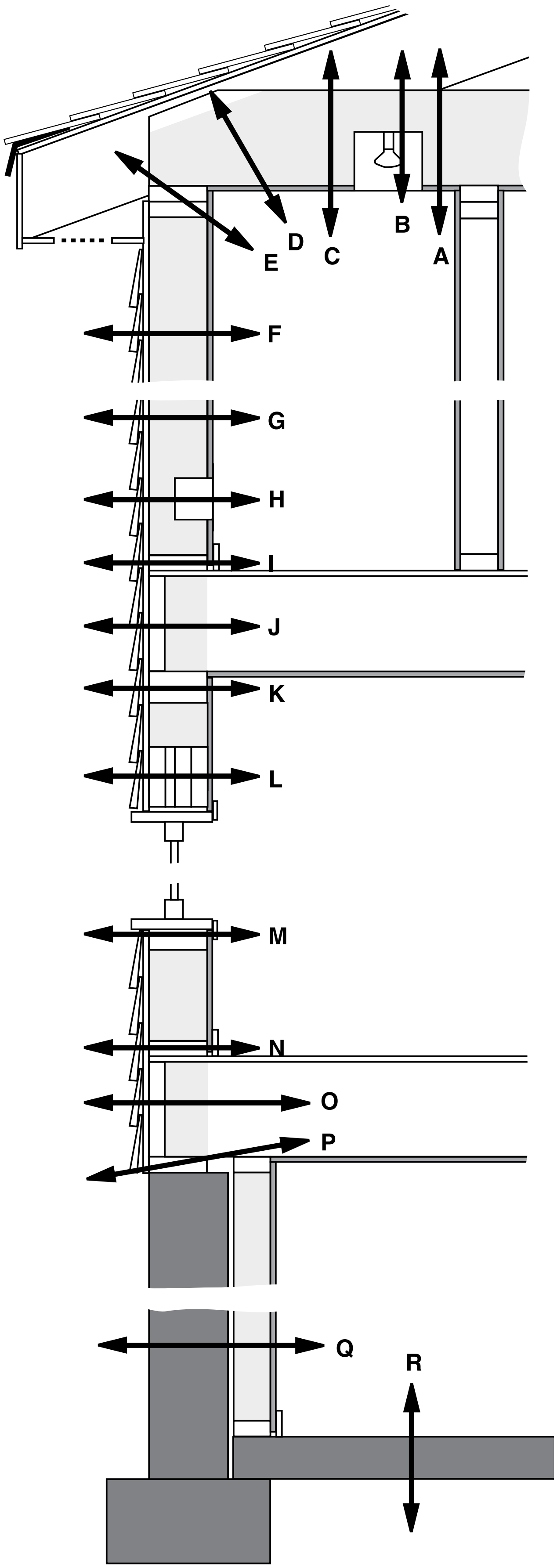
• In the past homes were built with mostly natural materials such as plaster, wood, clay tile, and natural fibers. Today, most building products and furnishings are made of plastics and composition materials emitting a bewildering assortment of chemicals. Combined with the dozens of new chemical-laden cleansers, paints, glues, and personal hygiene products, the emission of indoor air pollutants has risen enormously.

All this is a formula for disaster, so it should not be surprising that problems with uncomfortably high moisture levels, interior mold and mildew, rotting in sheathing and framing, and high levels of indoor air pollution have appeared. The issue is how to prevent these problems without reducing the level of interior thermal comfort we have come to expect.

Some builders have proposed that we leave framing joints a little leaky, omit air and vapor barrier films, and generally build houses that are less airtight. Unfortunately, while these actions may sometimes reduce visible interior moisture problems, they can significantly worsen invisible moisture problems within walls and roofs where the potential for lasting damage is much greater. In addition, leaving framing joints leaky or omitting vapor barriers may have little or no effect on indoor air pollution levels, since there is considerable evidence that very tight buildings do not have higher levels of indoor air pollution than other new houses and may, in fact, have lower levels. A better way to avoid moisture and air-quality problems is to follow these five additional construction rules that directly address the problems:

RULE #6 : Block all pathways for moisture to enter walls and ceilings from the exterior. The illustration “Moisture Transmission Pathways” shows the many ways in which moisture can get into a wall or ceiling from the building exterior. One common problem is the direct flow of water though roof and walls, such as when wind-driven rain manages to pass between roof shingles or wall siding boards. Ventilating under the roof or behind the siding generally solves this problem by equalizing air pressures on both sides of the shingles or siding, removing the driving force. A simple way to vent siding is to install it on furring strips: in the case of wood siding, this will have the added benefit of reducing the chance for warping and paint-peeling due to uneven wetting and drying. Rigid roof units such as wood shingles, slates, and tiles can similarly be installed on furring.

Below ground, water enters through floor slabs and foundation walls by capillary wicking, moisture diffusion, and by direct flow through cracks. Wicking and diffusion through floor slabs can be eliminated by using polyethylene and gravel under floor



Heat Conduction Pathways

This illustration shows the cross-section of a building that many would consider to be energy-efficient: 2x6 studs, “housewrap” on the exterior, thick roof insulation, and insulated windows. As the arrows show, there can still be many places where substantial heat loss can occur through conduction.

A – uninsulated joists

B – minimal insulation above recessed fixtures

C – insufficient ceiling insulation thickness

D – insufficient insulation at corners

E – uninsulated double top plates

F – uninsulated wall studs

G – poorly fitted insulation

H – minimal insulation around electrical boxes

I – uninsulated bottom plate

J – inadequately insulated rim joist

K – uninsulated double top plates

L – uninsulated window header

M – improperly insulated gap around windows

N – uninsulated bottom plate

O – inadequate rim joist insulation

P – uninsulated sill plate

Q – inadequate wall insulation

R – uninsulated slab

slabs. Wicking and diffusion through foundation walls can be eliminated by exterior dampproofing or waterproofing. Gravel or synthetic drain materials can relieve hydrostatic pressure against both floor slabs and foundation walls if a drain line carries water to daylight or to a sump. It is also important to provide capillary breaks at footings and between the foundation wall (polyethylene sheet or rubber) and sill plate (rubber sill-plate gasket) to prevent moisture from rising up the foundation wall and into the wood framing.

RULE #7 Block all pathways for moisture to enter walls and ceilings from the interior. The illustration "Moisture Transmission Pathways" also shows the many ways in which moisture can get into a wall or ceiling from the building interior either by transmission in air that flows through holes and cracks or by diffusion through drywall and other building materials. Of these two mechanisms, air-carried moisture is the most significant. In cold or moderate climates, air-carried moisture can be stopped by an airtight seal at the inner surface of the wall. An exterior seal would not be as effective in preventing the entry of warm, moisture-laden air into the wall where the water might condense. The methods for creating interior air seals have already been identified (seal all building joints and holes with rubber gaskets, continuous sheets of air-impermeable materials, molded wiring enclosures, etc.).

Moisture movement through diffusion can be easily stopped with vapor barrier films, paints, or other materials with low moisture permeability. It is generally not necessary to have a perfect diffusion barrier unless, as can be done with a quality polyethylene film (such as our Tenoarm film), it is desirable to have one product serve as both an air transmission and vapor-diffusion barrier simultaneously.

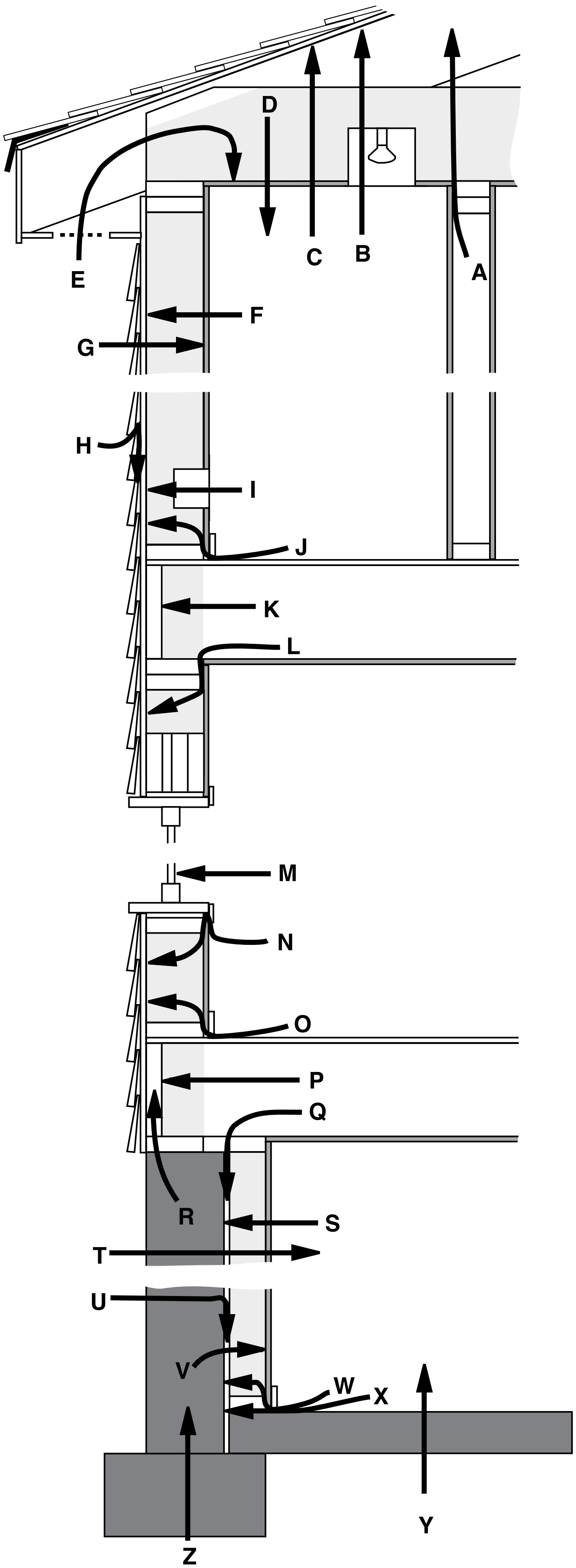
RULE #8: Design walls and roofs so that water and moisture that enters can't do any damage. Regardless of how effective a defense is built to keep water and moisture out of walls and roofs, some will always get in. Good design provides a way for this water to drain or diffuse outward without jeopardizing the integrity of the wall or roof system. Using a thick layer of insulating sheathing is one of the best precautions: if the insulation is thick enough, its interior surface will not be cold enough for the moisture to condense as water. In cold climates where the required sheathing thickness might be unmanageable, floor-to-floor transitions and flashings can be designed so that any water that does condense will drain out of the wall harmlessly.

RULE #9 Ventilate adequately with a continuously running mechanical ventilation system. All homes built today – regardless of whether they are designed to be energy-efficient – are too airtight and should have mechanical ventilation. Intermittent bathroom and kitchen exhaust fans do not constitute an effective ventilation system because they may not be used enough: water vapor and indoor air pollutants are produced on a continuous basis, not just when we cook or take a shower. Every home should have a continuously operating mechanical ventilation system that draws a small controlled air flow from bathrooms and kitchens (see OCCUPANT-SENSING VENTILATION SYSTEM).

A major benefit of this type of system is that it helps create negative indoor air pressure, just as inefficient gas and oil furnaces have always done (unlike modern sealed-combustion furnaces and heat pumps that do not use interior combustion air and have no effect on air pressures). Negative pressure encourages dry outdoor air to move inward to dry out walls and ceilings and prevents indoor air from entering the walls and ceilings where moisture can condense and do damage.

RULE #10: Control air pollution and moisture at the source. It's often very easy to reduce the amount of moisture and air pollution that is emitted into the interior of a building at a very low cost. Buildings built in areas with known radon problems can be inexpensively radon-proofed at the time of construction, whereas to do this later can cost thousands of dollars. Houses built for sensitive individuals can be allergy-proofed with proper selection of building materials. Major moisture sources such as sunrooms containing hot-tubs or large numbers of plants or indoor swimming pools can be carefully isolated from the remainder of the house. Laundry and bathroom exhausts should always be vented outdoors, never into attics.

Since building materials such as concrete and drywall contain enormous amounts of water and can take a year or more to dry, it should not be surprising that the worst indoor moisture problems such as mold and mildew are often seen in the first year. Wise practice would dictate that builders supply every new building with a dehumidifier for the first year which could later be used on another house.



Moisture Transmission Pathways

There are four basic ways moisture moves in and out of buildings: it can flow as liquid water (since this is usually a consequence of poor flashing and drainage details, it is not covered here), it can can be sucked as liquid water by capillary forces acting in narrow spaces, it can be carried in as a vapor in air, and it can diffuse as a vapor through building materials.

A – in air, between top plates and drywall

B – in air, through cracks in recessed fixtures

C – by diffusion, upward in winter

D – by diffusion, downward in summer

E – in air, through ventilation inlets in summer

F – by diffusion, outward in winter through wall

G – by diffusion, inward in summer through wall

H – by capillarity, through closely spaced siding

I – in air, through cracks in electrical boxes

J – in air, between bottom plate and drywall

K – in air, through insulation materials

L – in air, between drywall and top plates

M – in air, condensation on cold glass

N – in air, between framing and drywall

O – in air, between bottom plate and drywall

P – in air, through insulation materials

Q – in air, behind basement walls

R – by capillarity, from foundation to sill and joists

S – by diffusion, through basement drywall

T – by diffusion and capillarity through foundation

U – by water flow, through cracks in foundation

V – by diffusion, from foundation to back of drywall

W – in air, between bottom plate and drywall

X – in air, between bottom plate and slab

Y – by diffusion or capillarity through slab

Z – by diffusion, through footer and up wall

BUILDING GASKETS

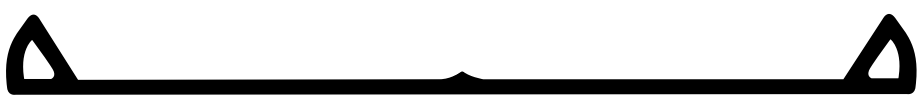
A well-insulated building may not be energy-efficient, comfortable, or safe unless adequate attention is given to air sealing. Air leakage between sill plates and foundations, between wall plates and floors, between drywall and studs, between window or door frames and rough openings, and through other cracks and openings can lead to high utility bills, uncomfortable drafts, and unpredictable indoor air quality.

Effective air sealing requires more than simply caulking or spraying foam. Building materials expand and contract with temperature and humidity fluctuations, walls settle with age, and roofs flex in the wind or when loaded with snow. Long-term performance requires durable, elastic materials that will respond to this movement over the life of a building.

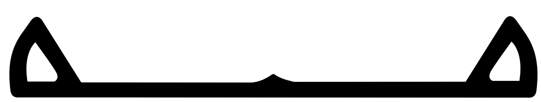
Our gaskets meet the most stringent installation and performance criteria. Developed for the Swedish manufactured housing industry, they have been in use for a half century in one of the world's most rigorous climates. They're made from cellular (foam) EPDM, a synthetic rubber with extraordinary aging properties. Compare them with other common sealing products:

- Plastic foam gaskets are too stiff for drywall sealing. Our gaskets are soft and easy to compress.
- Plastic foam gaskets lose their ability to respond to movement after long term compression. Our gaskets suffer very little "compression set", so they respond well to settling, shrinkage, and warping for decades after installation.
- Caulks and adhesives can't be used with building materials that are wet, dirty, or cold. Our gaskets are stapled or wedged in place, so surface conditions are of no consequence.
- Spray foams expand when applied, often bowing window and door jambs, and may contain gases that are harmful to the environment and chemical compounds that are harmful to the installer. Our gaskets pose no threat to the building, the builder, or the environment.
- Saturated polyurethanes stiffen in cold weather and become very difficult to apply. Our gaskets remain flexible to -60°F and can be applied in sub-zero conditions while wearing gloves.
- Caulks and spray foams have short shelf-lives and must be used soon after opening. EPDM gaskets have an indefinite shelf life, so leftovers from one job will be usable years later.

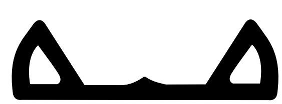
STRUCTURAL GASKETS: Structural gaskets are designed to seal under heavy loads, such as under sill plates, wall plates, roof panels, wall panels, and rim joists. Since they are effective moisture barriers, they eliminate the need for dampproofing between wood and masonry or concrete foundations. We stock three sizes: BG65 for 2 x 6's, BG63 for 2 x 4's, and BG61 for edges of rim joists, joints in exterior foam sheathing, or connections between stress-skin panels and posts or purlins.



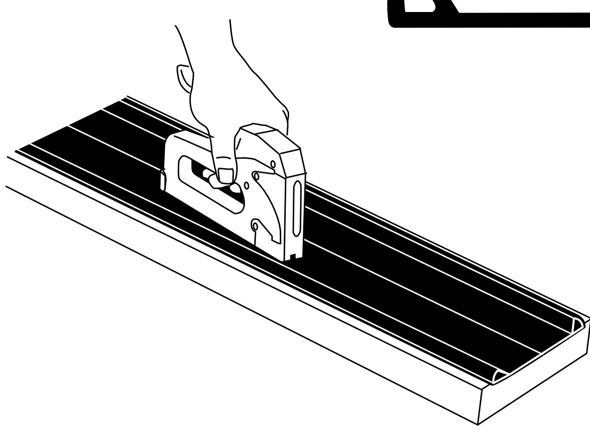
BG65 Structural Gasket



BG63 Structural Gasket

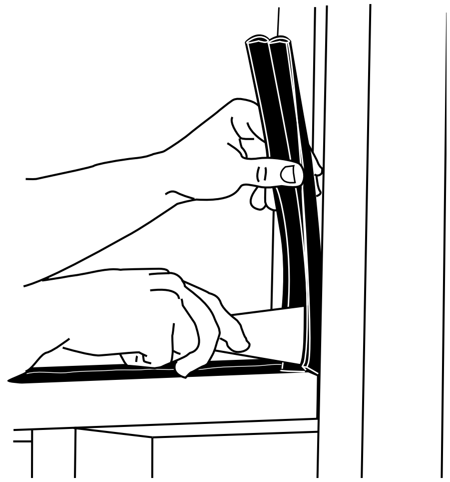


BG61 Structural Gasket

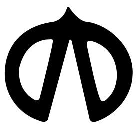


To gasket a foundation sill, cut and fit the first board and flip it over. Staple a structural gasket on top with the flat side of the gasket against the wood and the gasket ends overhanging slightly. Flip the board back over, bolt it to the foundation, and repeat the process for the next board.

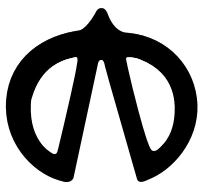
GAP GASKETS: Gap gaskets seal gaps, such as those between window or door jambs and the rough framing. They seal air as effectively as spray foams, yet are much more durable and elastic. When polyethylene is used as an interior vapor barrier, the plastic should be tucked into the shim space around windows or doors before a gap gasket is pressed in place. That way, the gasket seals the gap and anchors the plastic at the same time. We offer three sizes of gap gaskets: BG44 for gaps 1/4" to 1/2", BG46 for gaps 3/8" to 3/4", and BG48 for gaps 1/2" to 1". Remember to frame window openings at least 3/4" wider and taller than the window frame to assure sufficient space for a proper air seal. We also recommend mounting windows and doors with our shim screws to permit an uninterrupted air seal.



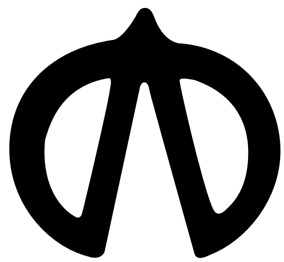
Push the gasket into the shim space around a window or door by inserting a dull putty knife into the "mouth" of the gasket. Firmly butt the gaskets at the corners.



BG44 Gap Gasket

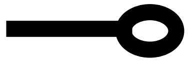


BG46 Gap Gasket

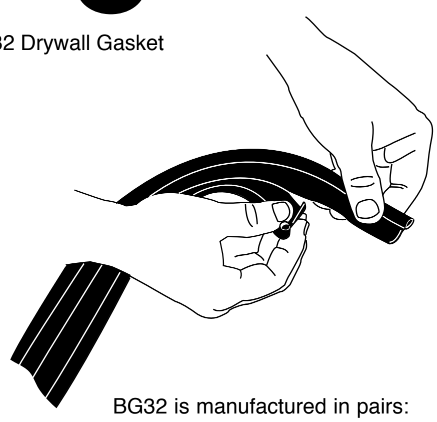


BG48 Gap Gasket

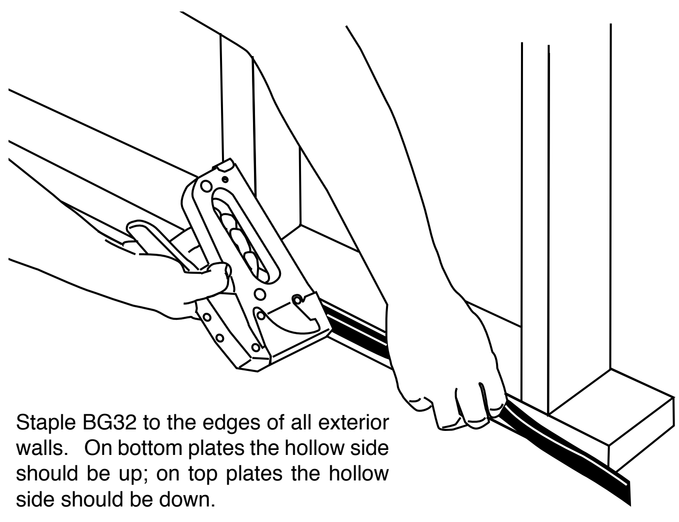
DRYWALL GASKETS: BG32 drywall gaskets are stapled to wall studs, top plates, and bottom plates before drywall is installed in order to prevent air flow between the drywall and the wood. They can be easily installed in any weather, even when wood is cold, wet, or dirty. The head of the seal compresses easily to less than 1/8", so there is minimal pressure on the drywall. Always screw the drywall where gaskets are used.



BG32 Drywall Gasket



BG32 is manufactured in pairs: separate them before use.



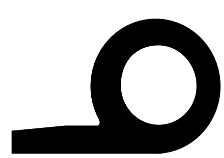
Staple BG32 to the edges of all exterior walls. On bottom plates the hollow side should be up; on top plates the hollow side should be down.

P-GASKETS: P-gaskets solve many difficult sealing problems such as joints between logs, structural insulated panels, and sections of manufactured homes. All feature wide stapling flanges for easy installation in any weather, even when the lumber is wet or dirty. The hollow center assures effortless compression over a wide range of movement. We stock three sizes: BG34 for gaps up to 3/8", BG36 for gaps up to 5/8", and BG38 for gaps up to 7/8".

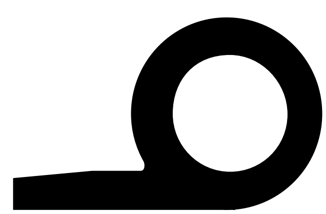
SIZES AND PRICING:

- BG32 Drywall Gasket, 1/4" x 328 ft, $52.00
- BG34 P-Gasket, 3/8" x 328 ft, $60.00
- BG36 P-Gasket, 5/8" x 164 ft, $68.00
- BG38 P-Gasket, 7/8" x 82 ft, $60.00
- BG44 Gap Gasket, 1/2" x 164 ft, $52.00
- BG46 Gap Gasket, 3/4" x 164 ft, $76.00
- BG48 Gap Gasket, 1" x 164 ft, $144.00
- BG61 Structural Gasket, 1.5" x 164 ft, $52.00
- BG63 Structural Gasket, 3" x 164 ft, $72.00
- BG65 Structural Gasket, 5" x 82 ft, $48.00

BG34 P-Gasket



BG36 P-Gasket



BG38 P-Gasket

NOTE: All building gasket cross-sections are approximately full scale.

AIR-VAPOR CONTROL FILM

Air-vapor control films are widely used to block the movement of air, vapor, and soil gases through the walls, roofs, and floors of buildings. Unfortunately, building science research in the Scandinavian countries has confirmed what many builders have always suspected: ordinary polyethylene films can deteriorate in a relatively short time, even when sealed within a wall or buried under a concrete floor. Such failures can result in higher energy costs, drafty interior spaces, elevated radon levels, and serious moisture problems.

Our Swedish-made Tenoarm polyethylene film is designed to last the life of any building and complies with Swedish government building standards which require use of properly stabilized virgin resins. Tenoarm is resistant both to oxidation, the principal cause of polyethylene failure in walls, and to alkali attack, the principal cause of polyethylene failure under concrete slabs. It has also been tested to be compatible with pressure-treated wood foundations. Performance is continually tested with a six-month oven-ageing test, the recognized standard for predicting long-term performance in real-world conditions.

Tenoarm is eight mils thick, so it is strong enough to withstand construction abuse as well as severe wind stress. Since it is made from impurity-free virgin resins, it is also extremely flexible and easier to install than many thinner films. Tenoarm is transparent to simplify installation, but unlike most other clear construction films, is stabilized against UV exposure during construction. We stock four convenient widths: 4’6” x 164’, 9’ x 100’, 12’ x 100’, and 16’ x 100’. The 9’ size has a unique fold system for quick installation on walls. For quality assurance during construction, the name Tenoarm is imprinted on the sheet.

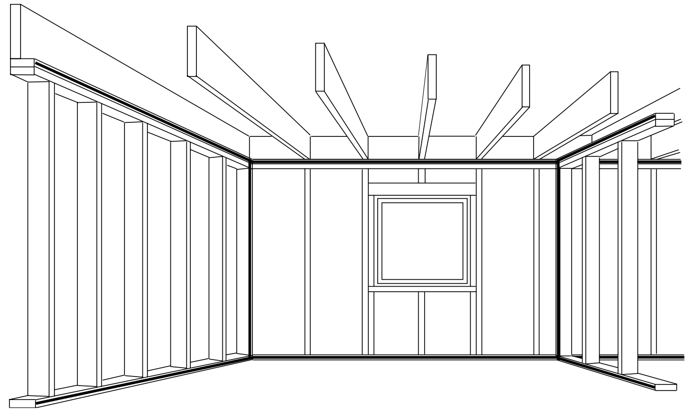
We recommend that all seams and edges be sealed with Teno Tape, Teno Sealant, or our EPDM building gaskets. Teno Tape, a tacky rubber double-stick tape supplied in 3/4” x 132 ft rolls, is best for general-purpose seaming provided there is a firm surface behind the seam so pressure can be applied to the tape. Teno Sealant, a mastic supplied in 11 oz. tubes, is more appropriate for irregular sealing around penetrations, or for seaming where there is no firm backup. Building gaskets offer the least expensive and most reliable method to seal the plastic to other materials such as wood or concrete: see BUILDING GASKETS for details. We do not recommend the use of construction tapes, caulks, or acoustical sealant in contact with any quality polyethylene since these can cause premature deterioration and are often short-lived.

SIZES AND PRICING:

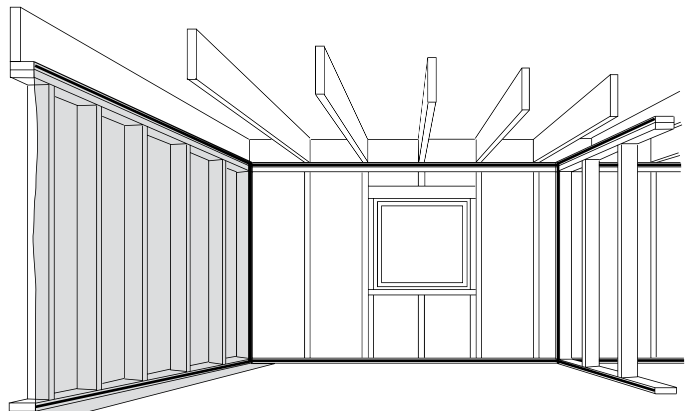
Tenoarm Film, 8 mil x 4’6” x 164’, $68.00
Tenoarm Film, 8 mil x 9’ x 100’, $80.00
Tenoarm Film, 8 mil x 12’ x 100’, $112.00
Tenoarm Film, 8 mil x 16’ x 100’, $144.00
Teno Tape, 132’, $36.00
Teno Sealant, $8.80

INSTALLATION TECHNIQUES FOR WOOD FRAME CONSTRUCTION: Since Tenoarm is strong enough to resist wind pressures and durable enough to last indefinitely, it can serve both as an air barrier and as a vapor-diffusion retarder in wood frame construction. The following illustrations show how to apply Tenoarm to the interior of the insulated walls, floors, and ceilings of buildings in cold climates. The use of interior plastic films is not recommended in hot humid climates and should be evaluated on a case-by-case basis in mixed climates with cold winters and hot summers.

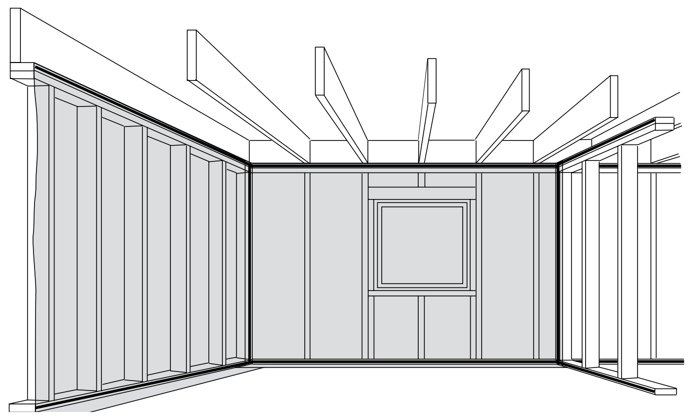
Before installing Tenoarm, insulate walls and ceilings with unfaced insulation batts or spray-applied insulation, completely filling the stud and joist bays. Then staple BG32 gasket (see BUILDING GASKETS) along the bottom plate and the upper top plate of insulated walls, along both edges of the upper top plates of interior walls that join insulated ceilings, and along both edges of the end studs of interior walls that join insulated walls. When the drywall is screwed in place, it will compress the gaskets to make an air seal between the plastic and the wood, blocking air flow between the interior and exterior as well as between adjacent wall or ceiling cavities. The bottom plate of the exterior walls should also be sealed to the subfloor to prevent air movement under the walls: this is best accomplished by installing BG63 or BG65 gaskets as the walls are erected, but can also be accomplished by caulking with polyurethane caulk after the walls are in place.



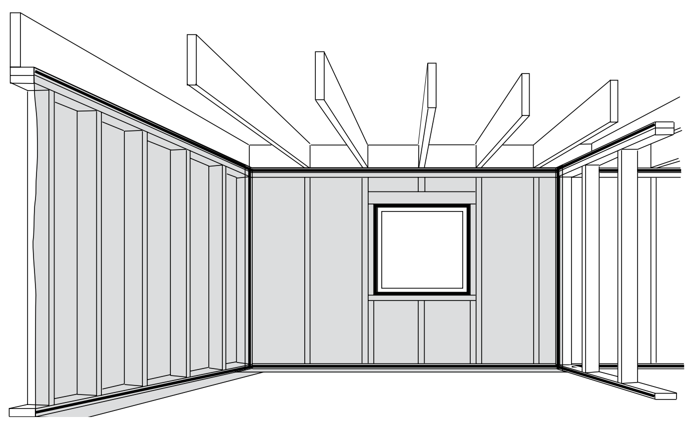
Since seams must always be made over a gasketed stud, the first wall must be one with a gasketed end stud. Staple Tenoarm to the first wall, overlapping the gaskets on the top plate, bottom plate, and end stud. If desired, several walls can be covered with a single sheet of plastic to reduce the number of seams.



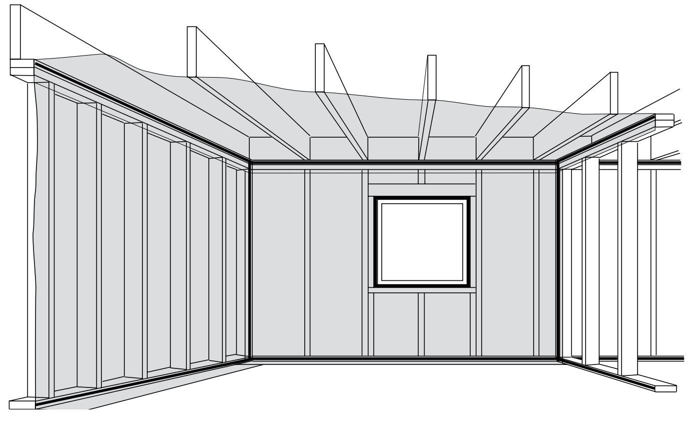
Staple Tenoarm to the second wall, overlapping the plastic on the first wall.



Where Tenoarm covers a window, carefully cut out a rectangle of plastic a few inches smaller than the window frame. Make four slits at the corners of the hole and tuck the plastic into the spaces outside the window jambs. Stuff fiberglass insulation into these spaces and then insert either a BG44 gasket (for 1/4" to 1/2" gaps), BG46 gasket (for 3/8" to 3/4" gaps), or BG48 gasket (for 5/8" to 1" gaps) to lock in the plastic and make an air seal. This system eliminates the need for additional sealing around windows. Gaskets are far more reliable than spray foams or caulks since they will last indefinitely, they won't take a "set", and they will absorb building movement without transferring any stresses to the window.

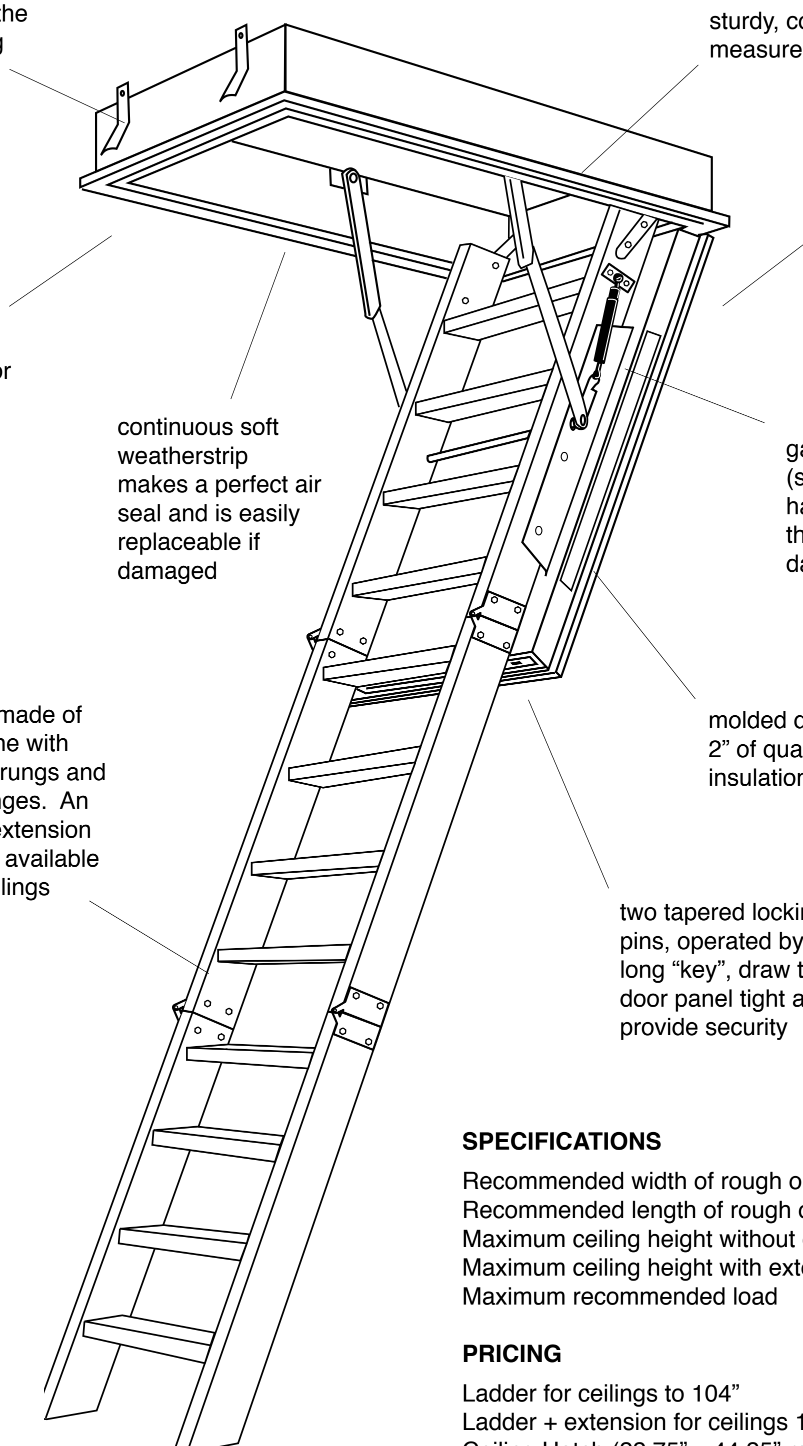


Cut a 12' wide or 16' wide roll of Tenoarm for the ceiling, allowing at least 6" excess on all sides, and staple it in place (inexperienced installers will find the 4'7" or 9'2" rolls much easier to install overhead). Avoid construction damage by applying the interior wall finish (drywall, wood) as soon as possible. Just before the finish floor surface is installed, complete the plastic installation by cutting from the widest practical roll of Tenoarm (16' maximum) and then stapling the sheet to the floor. There is no need to lap this plastic up the wall, since there should be plenty of excess wall plastic on the floor for a suitable overlap.



ENERGY-EFFICIENT ATTIC LADDER

Our insulated, airtight attic ladders solve the problem of how to provide convenient access to an attic without compromising a building's thermal performance. Unique design features also make them easier to install, more reliable, and more attractive than traditional attic ladders. We also offer an insulated, airtight access door for use in knee walls or celiings where a permanently mounted ladder is not required.

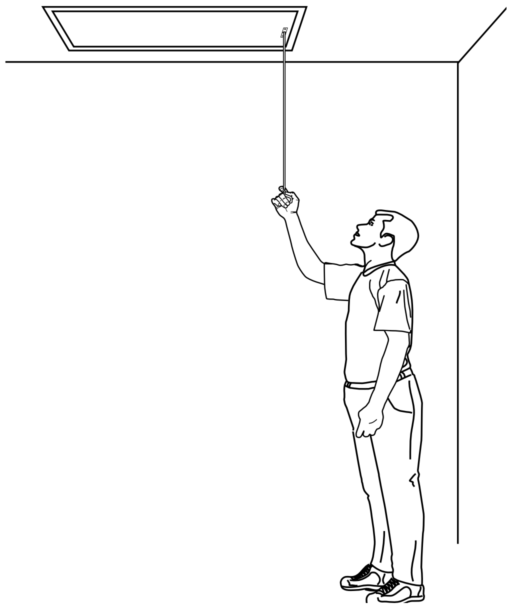


SPECIFICATIONS

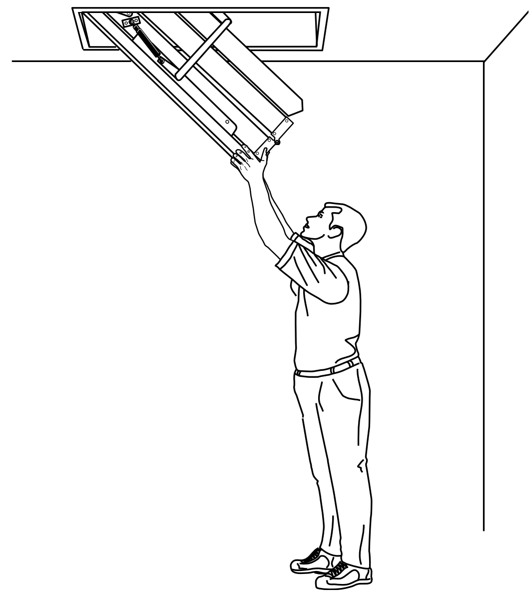
Recommended width of rough opening	22.75"
Recommended length of rough opening	44.25"
Maximum ceiling height without extension	104"
Maximum ceiling height with extension	125.5"
Maximum recommended load	330 lbs

PRICING

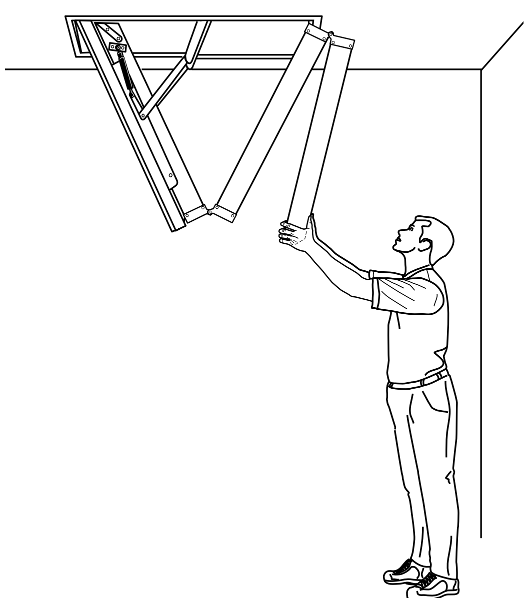
Ladder for ceilings to 104"	$480
Ladder + extension for ceilings 104" to 125.5"	$540
Ceiling Hatch (22.75" x 44.25" rough opening)	$220
Wall Hatch (22.75" x 31.75" rough opening)	$220



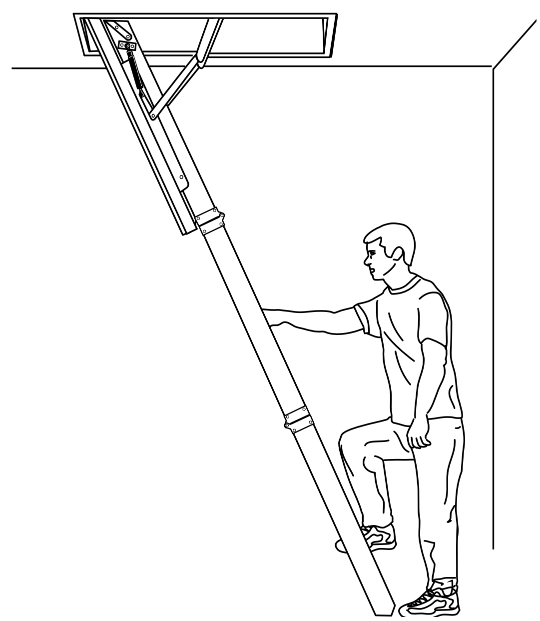
Unlock the ladder door panel with the long key provided. If the door does not begin to drop, lever the key slightly until it starts to fall.



The gas piston lets the door drop slowly. After it stops, press down on the door panel until it locks into the fully open position.



Grab the bottom section and unfold the ladder. Hold it firmly so that it doesn't swing out too fast!



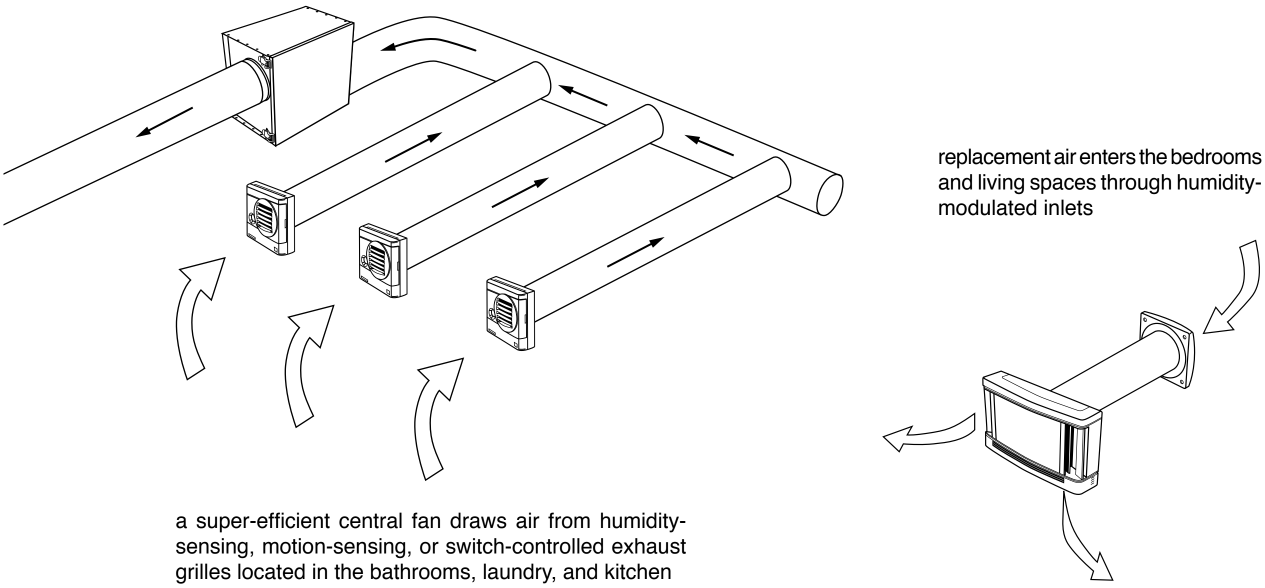
Test the ladder before climbing to be certain it is resting firmly on the floor. The ladder should not move when weight is applied.

OCCUPANT-SENSING VENTILATION

Energy-efficient homes need mechanical ventilation to maintain indoor air quality and prevent premature building deterioration. A ventilation system can operate all the time (continuous ventilation) or only when desired (intermittent ventilation). It can draw air from one room (single-point ventilation) or from multiple rooms (multi-point ventilation). It can exhaust air from the building and let fresh air leak in through building openings (exhaust-only ventilation) or it can transfer energy between the exhaust air duct and a fresh air duct (energy-recovery ventilation).

Until now, selecting a ventilation system has always involved significant compromises. Continuous ventilation doesn't respond to changes in occupant behavior, while intermittent ventilation doesn't control background air pollutants. Single-point ventilation requires multiple holes through the building envelope, while multi-point ventilation often requires difficult balancing. Exhaust-only ventilation wastes energy, while energy-recovery ventilation is expensive.

Our solution is a continuous, multi-point, exhaust-only system with the responsiveness of intermittent systems, the simplicity of single-point systems, and the efficiency of energy-recovery systems. A super-efficient continuous exhaust fan connects through a simple trunk duct to humidity and motion-sensing exhaust grilles located in the bathrooms, laundry, and kitchen. When rooms are unoccupied, airflow rates are just sufficient to exhaust background air pollutants; when a room is occupied or too humid, airflow rates automatically boost sixfold. Air quality and building longevity is assured, regardless of user behavior. For buildings that are unusually airtight, we also offer through-wall humidity-modulated vents that introduce a small amount of fresh air into bedrooms and other living spaces.

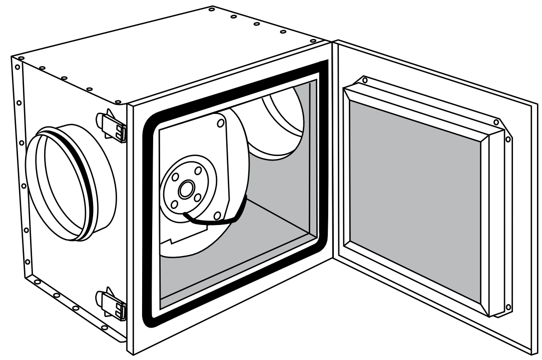


While it might seem that exhaust-only ventilation systems are less energy-efficient than heat-recovery ventilation systems, this is not necessarily the case. Air infiltrates (leaks into) and exfiltrates (leaks out of) all buildings, even the most air-tight, super-insulated buildings. Since heat-recovery ventilation systems are designed for balanced airflow, they exhaust roughly the same amount of air from the interior as they bring in from the exterior and have little effect on this natural infiltration and exfiltration. Exhaust-only systems, on the other hand, create a negative pressure inside the building, causing some of the air that would have normally exfiltrated from the building to pass through the exhaust fan. The energy in this diverted air can't be counted as lost energy because it would have been lost anyway by natural exfiltration.

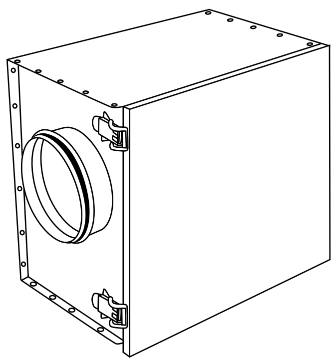
Occupant-sensing exhaust-only ventilation systems waste even less energy because their exhaust rate is extremely low for the major part of the day when the bathrooms and kitchen are not in use. As a consequence, they offer energy-efficiency comparable to heat-recovery systems. Consider the example of a house with a natural infiltration/exfiltration rate of 80 cfm. With a heat-recovery system operating at 100 cfm and 80% efficiency, 20% of the 100 cfm = 20 cfm can be considered lost energy. Adding this to the natural infiltration/exfiltration rate of 80 cfm yields 100 cfm of lost energy. Compare this to an occupant-sensing exhaust-only system operating 20 hours at 32 cfm (all four grilles at their minimum flow) and 4 hours at 116 cfm (two grilles at maximum flow) which yields an average of 46 cfm lost energy. Assuming half of the 80 cfm natural exfiltration is diverted throught the fan, then the remaining half, or 40 cfm, can also be considered lost energy. Adding the two yields 86 cfm of lost energy. In other words, the occupant-sensing exhaust-only system is more efficient than the heat-recovery system!

FAN SPECIFICATIONS

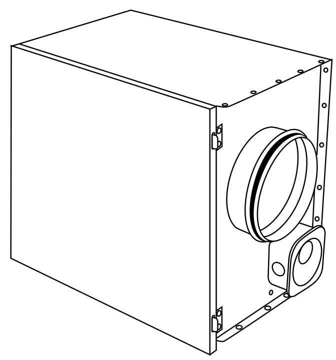
airflow	0 to 145 cfm (≥ 0.4”)
voltage	120v, 60 Hz
power	38 watts
sound level	≤ 55 dB at inlet
insulation	2” lined rockwool
housing	galvanized steel
size	16” x 15” x 10”



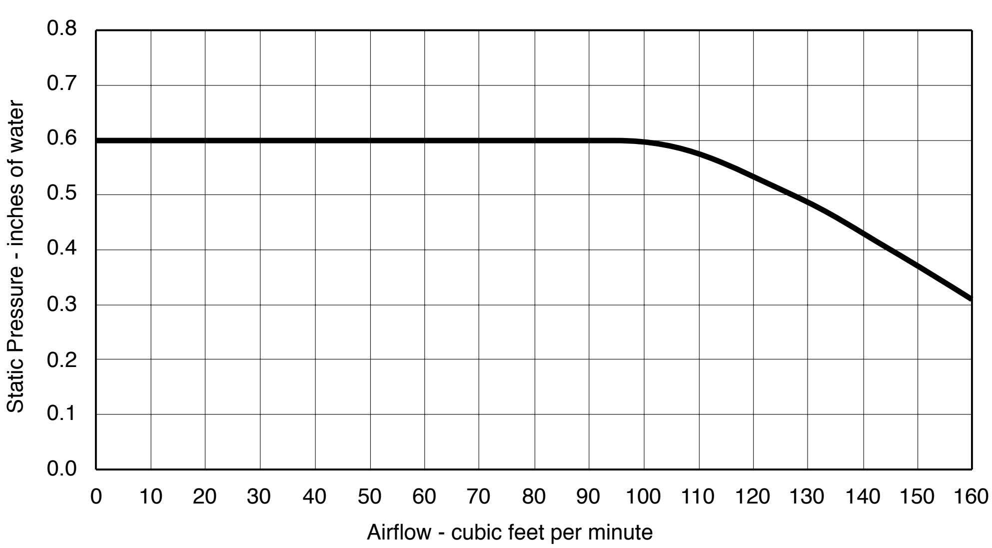
access door open showing blower, thick insulation, and door gasket



exhaust end showing 6” gasketed exhaust duct connector

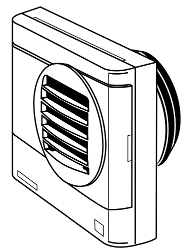


suction end showing 6” gasketed duct connector and electrical junction box

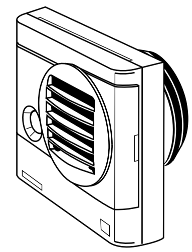


EXHAUST GRILLE SPECIFICATIONS

airflow	8 to 50 cfm (0.6” static pressure)
power	humidity: none required motion: 9 VDC (optional 10-12 VAC) switch: 9 VDC (optional 10-12 VAC)
housing	white plastic
duct	100 mm (4”)
size	6” x 6” x 1.5”

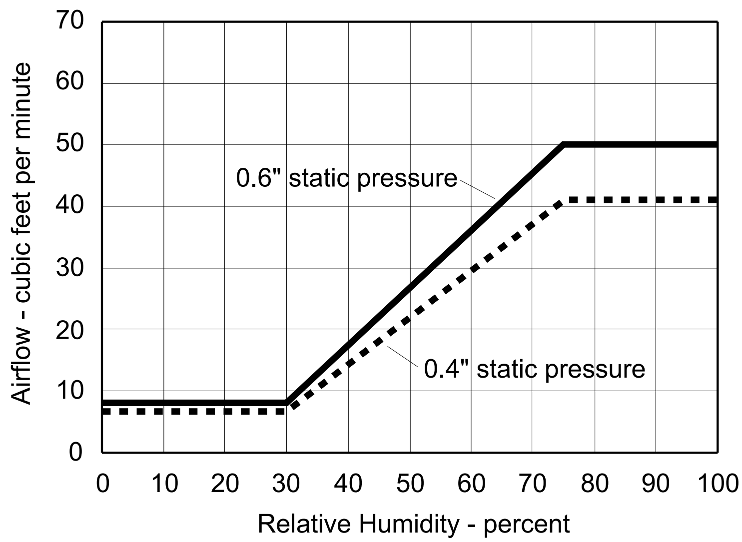


Humidity-Sensing Grille
Switched Humidity-Sensing Grille
Switched Grille

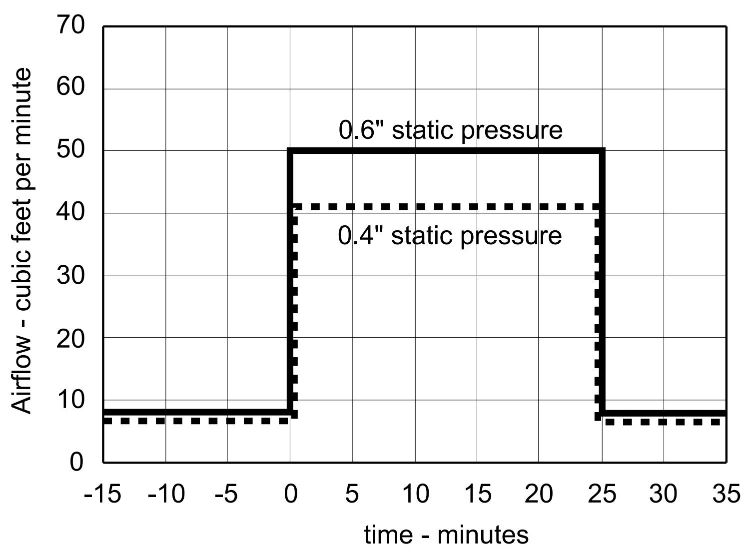


Motion-Sensing Grille
Humidity+Motion-Sensing Grille

HUMIDITY-SENSING GRILLES

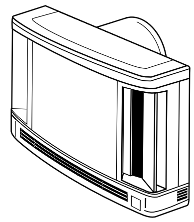


MOTION-SENSING OR SWITCHED GRILLES

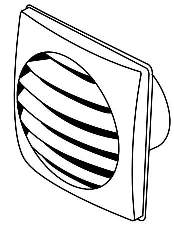


FRESH-AIR INLET SPECIFICATIONS

airflow	3 to 24 cfm
power	none required
housing	white plastic
duct	100 mm (4")
size	5.5" x 9.5" x 2" (grille)
	6" x 6" x 1.5" (hood)

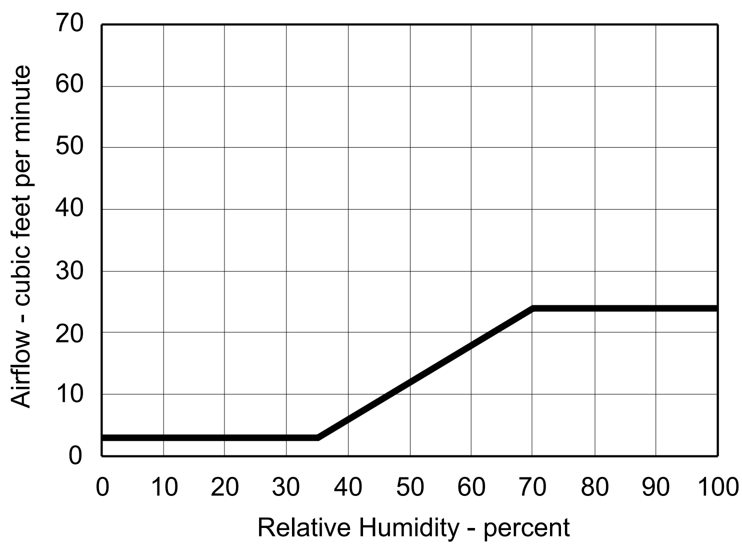


Humidity-Sensing Fresh-Air Grille



External Hood with Insect Screen

HUMIDITY-SENSING FRESH-AIR INLET



PRICING:

Central Exhaust Fan	$396.00
Humidity-Sensing Grille	$76.00
Motion-Sensing Grille	$88.00
Switched Grille	$88.00
Humidity+Motion-Sensing Grille	$124.00
Switched Humidity-Sensing Grille	$124.00
AC Adapter*	$10.00
Fresh-Air Inlet Kit	$94.00

* Requires one 10-12 volt AC transformer per system

CAULKS AND SPRAY FOAM

Unlike gaskets that are manufactured in shapes and seal building joints under pressure, caulks and spray foams are manufactured as liquids or pastes that flow into place and adhere to the surrounding surfaces. These characteristics make them ideal for filling irregular joints and cavities that would be difficult to seal with gaskets, provided temperature and moisture conditions are suitable for bonding and curing. We offer professional-quality polyurethane and silicone caulks that are far superior to the consumer caulks sold in home centers, as well as a spray foam with environmental propellants.

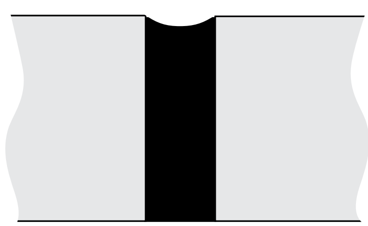
HOW TO CAULK: Simply using a caulk that has a twenty to fifty year lifetime is no assurance that the caulk joint will last that long. If the caulk is not applied properly, the bond between the caulk and substrate can fail in just a few years and make the caulk worthless. A few basic rules for proper caulking follow:

- Design wide joints. A caulk that can accommodate 50% joint movement (typical of the best caulks) can fail with only 1/16” movement when sealing a 1/8” joint. The same caulk will withstand 1/4” movement when sealing a 1/2” joint.
- Apply caulks when the temperature is between 40°F and 100°F. The surface must be completely dry.
- Clean the surface: vacuum or wipe dust and dirt, then remove any oils or surface deposits with a suitable solvent.
- Use a backer rod to limit joint depth to half the joint width.
- Tool with a spoon or other rounded instrument to completely fill the joint and force the caulk against the sides.

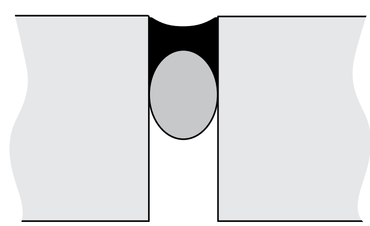
POLYURETHANE CAULK: Polyurethanes are probably the best general-purpose construction caulks available today – better than silicones for most common building applications. We offer a superior quality polyurethane that adheres to most common construction materials without primers, offers a long service life in severe climates, offers excellent cut and tear resistance, has exceptional elasticity, spans wide joints without sagging, tools and masks well, is non-toxic when cured, and is paintable. It is packaged in metalized cardboard tubes that offer twice the shelf life of plastic tubes used by cheaper brands. Polyurethane caulk becomes tack-free within eight hours and cures fully in about a week. It can be painted, but the paint will not stretch like the caulk and may crack or peel.

SILICONE CAULK: Although silicones are the most durable of all caulks, the bonding characteristics of most silicones are not as good as polyurethane. We recommend using silicone caulk for adhering our caulk-in silicone weatherstrip, for capping the exterior edges of our EPDM glazing gaskets, and for sealing joints between non-porous surfaces such as metal and glass. We offer a superior quality neutral-cure silicone that does not emit the noxious and corrosive acetic acid (vinegar) fumes typical of consumer-grade silicones, is stiff enough to span wide joints without sagging, and tools and masks well. Like all pure silicones, it should not be painted. Note that we do not offer clear silicone caulk or recommend their use: clear silicones are UV transparent and will permit sunlight to pass through the caulk and quickly deteriorate the bond between the caulk and substrate.

BACKER ROD: For optimal performance, a caulked joint should be shaped like an hourglass with the center thickness approximately half the joint width. The narrow center stretches easily with joint movement, and the wide sides offer maximal contact area with the substrate. This shape can be achieved by tooling the surface and by using a round “backer rod” to limit the depth of caulk penetration in a joint. We offer an advanced hybrid backer rod that compresses easily, works with any caulk, and doesn’t release gases that can ruin caulk joints. Stock diameters are 3/8” (joints 0 to 1/4”), 5/8” (joints 1/4” to 1/2”), 7/8” (joints 1/2” to 3/4”), and 1-1/8” (joints 3/4” to 1”).

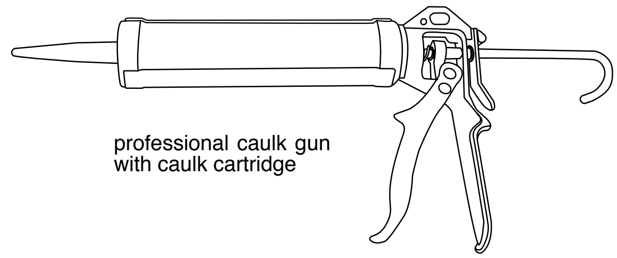


Example of a poorly designed caulk joint. Excessive caulk thickness makes the caulk difficult to stretch, leading to failure of the bond between the caulk and substrate.



Example of a well-designed caulk joint. Backer rod limits the caulk thickness to half the joint width so that the caulk stretches easily. Stress on the caulk-to-substrate bonds is minimal.

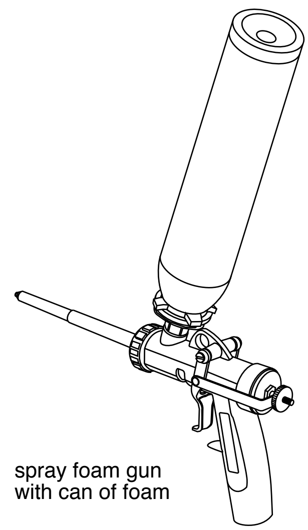
PROFESSIONAL CAULK GUNS: This is by far the best caulk gun we have ever used, a professional-quality tool that is much better made than similar-looking Far-East imports sold in home centers. It holds a standard 11 oz. cartridge and features comfortable, extra-long, cast-aluminum handles that make dispensing stiff-bodied caulks, adhesives, and sealants almost effortless. The frame is made of wide, thick steel ribs welded to a sturdy front plate and is designed so that the entire "cradle" can be rotated while caulking, eliminating the need to stop at corners. The drive shaft is made of hardened-steel and is smoothly driven with a jam-proof clutch mechanism. Quick-release levers stop the flow of caulk immediately at the end of a run. The gun can be completely disassembled for cleaning and all parts are replaceable.



professional caulk gun
with caulk cartridge

SPRAY FOAM: Our single-component polyurethane spray foam does not contain CFC's, HCFC's, or formaldehydes, so it does not contribute to ozone depletion, global warming, or indoor air pollution. It bonds to most common building materials including concrete, masonry, stone, wood, fiberboards, metals, plaster, and foam insulation boards. Typical applications include filling pipe and wire penetrations, sealing around air-barrier blocking at rim joists, bonding foam panels to masonry or wood, sealing joints in structural insulated panels, and building rock walls in gardens and ponds . Considered a minimal-expansion foam, it can also be used to seal and insulate the shim space between window and door frames with less risk of bowing the frames than many other spray foams. (However, see BUILDING GASKETS for an alternative sealing method with zero bowing potential). We stock black foam that offers enhanced ultraviolet resistance outdoors, but it can be easily painted after a 24-hour cure.

We supply spray foam in twenty-four ounce recyclable aluminum cans designed to fit all standard foam applicator guns, and we offer two guns: an inexpensive plastic gun as well as a more durable all-metal professional-quality gun. "Gun foam" cans are much more economical than the unregulated single-use foam cans sold in home centers because the guns permit precise foam application and make it possible to store partially used cans for many weeks. One can of foam yields more than 2500 cubic inches (11 gallons) of expanded foam, the equivalent of several thousand feet of caulk.



spray foam gun
with can of foam

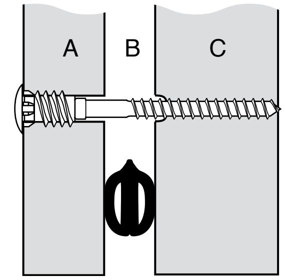
For best results, the application temperature should be between 40°F and 95°F. Surfaces should be clean and free from dust and oils. Non-porous surfaces such as metal or wood should be dry, but porous surfaces such as masonry should be moistened with a fine mist of water. Fill shallow joints and cavities about three-quarters to allow room for expansion. When filling deep cavities, apply several layers of foam at intervals of one to two hours. Always leave a can of foam in the gun, and flush the gun with Spray Foam Cleaner before installing a new can of foam (order one cleaner for every six cans of foam).

PRICING:

Professional Caulk Gun	$19.00
Polyurethane Caulk, bronze, 11 oz.	$5.20
Polyurethane Caulk, limestone gray, 11 oz.	$5.20
Polyurethane Caulk, white, 11 oz.	$5.20
Silicone Caulk, black, 11 oz.	$7.20
Silicone Caulk, bronze, 11 oz.	$7.20
Silicone Caulk, white, 11 oz.	$7.20
Backer Rod, 3/8", per foot	$0.10
Backer Rod, 3/8" x 1800'	$72.00
Backer Rod, 5/8", per foot	$0.15
Backer Rod, 5/8" x 1550'	$104.00
Backer Rod, 7/8", per foot	$0.25
Backer Rod, 7/8" x 850'	$88.00
Backer Rod, 1-1/8", per foot	$0.35
Backer Rod, 1-1/8" x 500'	$92.00
Black Spray Foam, 24oz	$16.00
Spray Foam Cleaner	$12.00
Spray Foam Gun, economy	$36.00
Spray Foam Gun, professional	$56.00

SHIM SCREWS

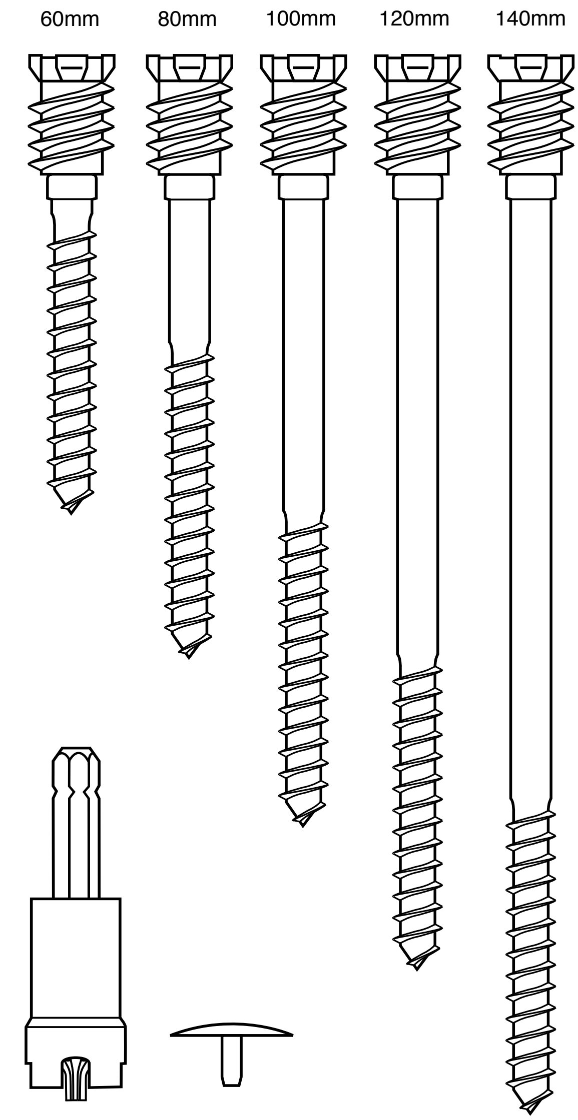
To operate properly, windows and doors must be securely fastened with plumb jambs and level headers. Traditionally this has been accomplished by carefully shimming and nailing the perimeter, a time consuming procedure that requires considerable experience to achieve accurate results. In addition, the shims make it impossible to achieve the continuous air seals required for energy-efficient building. Modern windows are often supplied with nailing flanges designed to be fastened to the exterior sheathing. Although these flanges significantly speed installation, they don't offer the strength or accuracy of properly installed wood shims. Neither nailing flanges nor shims can be adjusted to compensate for framing shrinkage or settling.



top view showing window or door frame (A), shim space with gasket (B), and rough frame (C)

Our shim screws can replace shims and supplement nailing flanges, overcoming the limitations of both. Each screw consists of a threaded outer sleeve with a captured free-spinning lag screw through the center. A special installation tool is used to grab both parts simultaneously and to twist them into a pre-drilled hole in the window or door frame. Then the inner part of the same tool is used to turn only the lag screw while the outer sleeve remains fixed. Since the lag screw is captured in the sleeve, turning the screw into or out of the rough framing lumber causes the window or door frame to move in the desired direction.

Shim screws are quick and easy to install, are extremely strong, and permit precise adjustment. The window or door frame is suspended in the rough opening, leaving an uninterrupted space that can be easily air-sealed with a gasket or spray-applied foam. When used in conjunction with our EPDM building gaskets, window and door frames can be re-adjusted years later to compensate for framing shrinkage or settling.



SELECTING A SHIM SCREW: Stock shim screw lengths are 60mm (2-3/8"), 80mm (3-1/8"), 100mm (4"), 120mm (4-3/4"), and 140mm (5-1/2"). To select the best size, add the thickness of the window or door frame (A) to the shim space (B) and consult the table. Order a minimum of four screws for windows and six for doors.

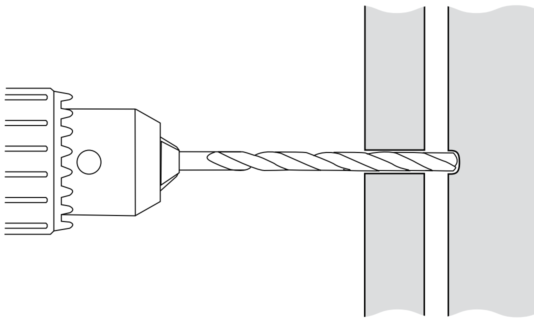
A + B	Screw
3/4" - 1-3/4"	60 mm
1-1/4" - 2"	80 mm
2" - 2-3/4"	100 mm
2-3/4" - 3-1/2"	120 mm
3-1/2" - 4-1/4"	140 mm

PRICING: Shim screws are available both individually and in boxes of either 50 or 100, depending on length. An installation tool is required, but one free tool is provided in each box. Caps are also available individually or in boxes of 100. Cap colors are beige, medium brown, dark brown, black, gray, and white.

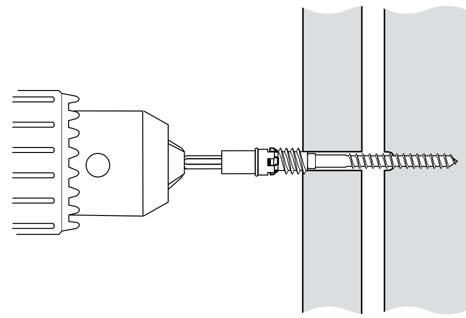
Shim Screw, 60 mm, each	$1.36
Shim Screw, 60 mm, 100 + tool	$124.00
Shim Screw, 80 mm, each	$1.52
Shim Screw, 80 mm, 100 + tool	$136.00
Shim Screw, 100 mm, each	$1.72
Shim Screw, 100 mm, 100 + tool	$156.00
Shim Screw, 120 mm, each	$1.96
Shim Screw, 120 mm, 50 + tool	$88.00
Shim Screw, 140 mm, each	$2.44
Shim Screw, 140 mm, 50 + tool	$100.00
Shim Screw Installation Tool	$8.24
Shim Screw Press-In Cap, each	$0.10
Shim Screw Press-In Cap, 100	$9.24
Shim Screw Self-Adhesive Cap, 36	5.00

installation tool

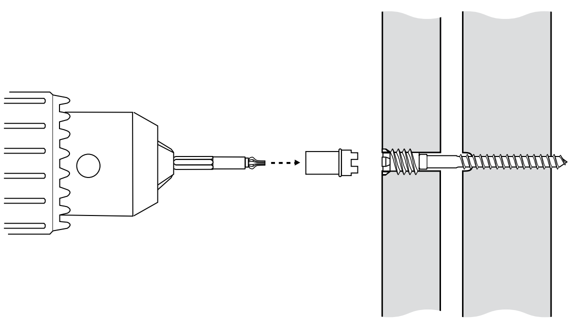
cap



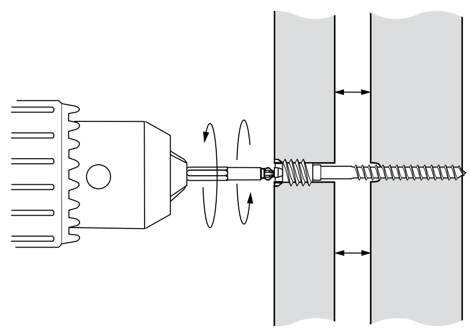
STEP 1: Drill a 5/16” hole through the window or door jamb or header and approximately 1/8” into the rough building framing.



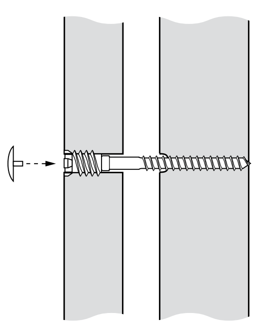
STEP 2: Insert the shim screw using the drive tool which simultaneously turns the outer sleeve and the inner lag screw.



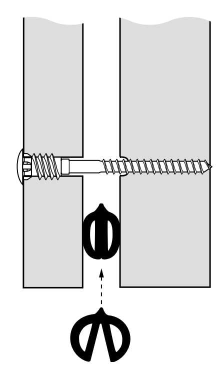
STEP 3: After driving the screw flush with the finished surface, remove the outer part of the drive tool to expose the inner adjuster.



STEP 4: Using the adjuster, turn the lag-screw clockwise to move the jamb outward or counter-clockwise to move the jamb inward.



STEP 5: If no molding will hide the shim screw, insert a plastic cap. The cap can be easily removed for future adjustments.



STEP 6: For optimal energy efficiency, seal the gap between the finished and rough framing with BG44, BG46, or BG48 gaskets. (Note: Illustration shows top view of jamb.)

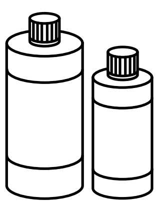
WOOD REPAIR SYSTEM

There are many reasons to repair wood windows and doors instead of replacing them. Wood used in older windows and doors was milled from select mature trees and is more resistant to decay and warping than currently available domestic woods. It is usually less expensive to repair windows and door than it is to replace them, especially when the woodwork is large or complex. Repairing is also preferable for reasons of historic preservation and environmental conservation.

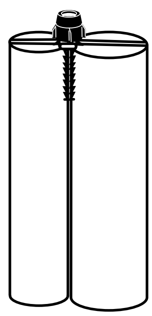
Our wood repair system is based on a unique epoxy compound with cured properties similar to wood. It is supplied in a dual-cartridge system that assures precise mixing and easy application. It does not slump or sag, even in very thick applications, and works on both horizontal and vertical surfaces. It tools well, has a long working time (30 minute minimum), doesn't shrink (less than 1%), and is easily sanded and painted. It bonds exceedingly well with wood and does not become brittle with age.

In comparison, other wood repair systems all have serious limitations. Polyester wood fillers (Minwax, Bondo) are less flexible than epoxies and don't adhere as well to wood. Marine epoxy systems (WEST) require complicated mixing and are often too brittle. Consolidation systems (Abatron) recommend application over deteriorated wood fibers, risking bond failure due to expansion and contraction, leading to further decay.

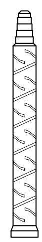
MATERIALS REQUIRED:



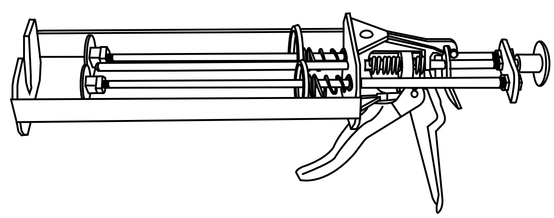
primer
(2 component)



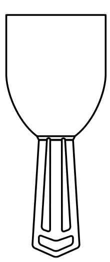
epoxy cartridge
(2 component)



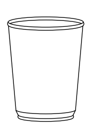
static mixer



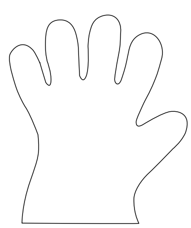
standard
2-component gun



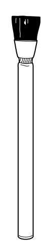
plastic
putty knife



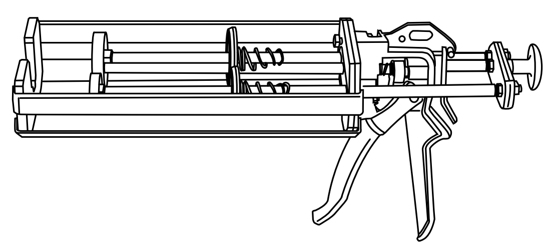
plastic
mixing cup



disposable
gloves



primer
brush



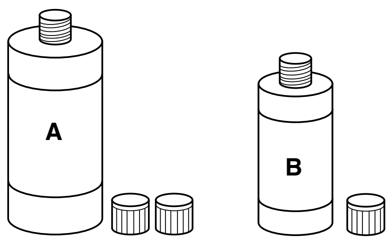
high-pressure
2-component gun

PRICING: One epoxy cartridge yields 24 cubic inches, roughly the size of a grapefruit or softball. Order one primer for every four epoxy cartridges. Static mixers, mixing cups, primer brushes, and gloves are designed for a single use. When stored in a cool environment, primer and epoxy cartridges have a one-year shelf life. Primer and epoxy are not returnable.

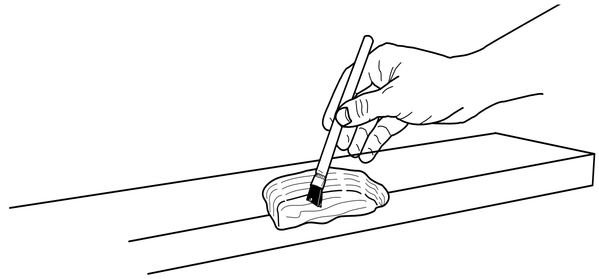
Primer, each	$30.00	Static Mixer (for High-Pressure Gun)	$1.60
Primer, box of 5	$130.00	Plastic Putty Knife	$1.00
Epoxy Cartridge, each	$52.00	Primer Brush	$0.24
Epoxy Cartridge, box of 10	$460.00	Disposable Gloves, each	$0.05
Standard 2-Component Gun	$42.00	Disposable Gloves, 100	$3.00
High-Pressure 2-Component Gun	$92.00	Plastic Mixing Cup	$0.10

PREPARATION: The temperature must be at least 40°F and rising. In warm weather, do not work in direct sunlight. Surfaces must remain dry until the epoxy is cured and painted, so postpone exterior work when rain is anticipated within 24 hours. If a moisture meter is available, verify that the wood moisture content is less than 18%. The repair compound contains no VOC's but interior workspaces should be well-ventilated. Wear plastic gloves to avoid skin contact.

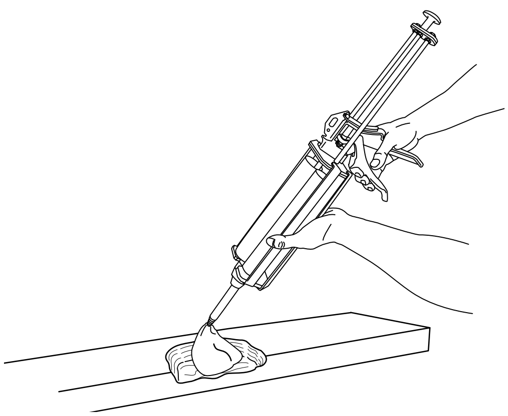
APPLICATION PROCEDURE: Begin by removing all paint near the area to be repaired. If stripping with heat, be careful to avoid burning since epoxy will not bond properly to burnt wood. For best results, we recommend our infrared paint stripper (see separate information sheet). Sand the surface to bare wood and remove fibers, paint residue, sawdust, and dirt. Remove all decayed wood to expose sound, bright wood (no red-brown or gray spots). Enlarge any cracks and joints to at least 1/4" wide by 1/2" deep. Then follow the following procedures:



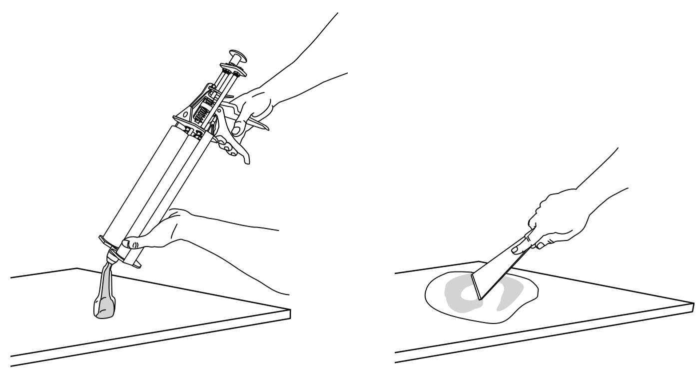
Step 1: Mix the primer in a disposable plastic cup, two capfuls of part A to one capful of part B.



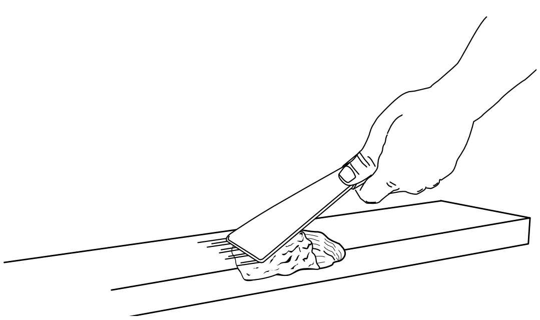
Step 2: Apply the primer with a small disposable brush, wait ten minutes, and then remove excess liquid with a paper towel. Primed surfaces must be coated with epoxy within twenty minutes, or they must be re-primed.



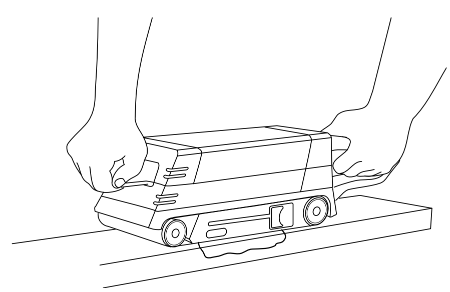
Step 3A: When using a high-pressure gun with a static mixer (a special mixing nozzle), simply extrude pre-mixed epoxy into place.



Step 3B: When using a standard gun, extrude ribbons of both components (automatically proportioned by the gun) onto a clean surface and mix well with a putty knife.



Step 4: Spread epoxy over the area to be repaired, filling the full thickness required, and tool the surface to the final shape. Wait 12 hrs at 70°F for the epoxy to cure (longer if colder).



Step 5: Sand the epoxy as needed. Remove all dust and inspect the repair. If needed, apply a second coat, sand again, and remove all dust. Then paint as you would any bare wood surface: never leave the epoxy unfinished!