3.5 Insulation Material Characteristics

SWS Detail: 4.0 Insulation

The purpose of insulation is to provide thermal resistance that reduces the rate of heat transmission through building assemblies. Characteristics such as R-value per inch, density, fire safety, vapor permeability, and airflow resistance help weatherization specialists choose the right insulation for the job.

3.5.1 Fibrous Insulation Materials

Fibrous insulation materials are the most economical insulations for buildings. If blown at a high density, fibrous insulations aren't air barriers themselves, but they may contribute to the airflow resistance of a building assembly that functions as an air barrier. The term *mineral wool* describes both fiberglass and *rock wool*. Rock wool is both a generic term and a trade name. We use rock wool in the generic sense as an insulating wool spun from rocks or slag. Fiberglass is wool spun from molten glass.

Cellulose was once made from virgin wood fiber under trade names like Balsam Wool. Now cellulose is manufactured primarily from recycled paper, treated with a fire retardant.

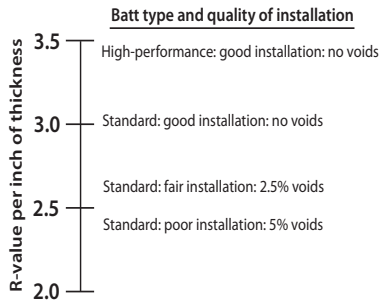
A vapor permeable air barrier should cover fibrous insulation installed vertically or horizontally in human-contact areas to limit exposure to fibers, which may cause respiratory distress.

Fiberglass Batts and Blankets

Most fiberglass batts are either 15 inches wide or 23 inches wide to fit 16-inch or 24-inch spacing for wood studs or joists. However, manufacturers also provide 16-inch or 24-inch widths for metal stud construction.

The advertised R-values of batts vary from 3.1 per inch to 4.2 per inch depending on density. Installed fiberglass R-values may

be 5% to 30% less than advertised depending on installation quality and the effectiveness of the assembly's air barrier.



Evaluating batt performance: The thermal performance of batts depends on density and installation.

Installers must cut and fit batts very carefully. Batts achieve their advertised R-value only when they are touching all six sides of the cavity it inhabits.

See "Open-Cavity Wall Insulation" on page 194.

Fiberglass blankets are typically three to six feet wide. Blankets come in a variety of thicknesses from 1 to 6 inches. Fiberglass blankets are used to insulate metal buildings, to insulate crawl spaces from the inside, and to insulate water heaters.

Although fiberglass doesn't absorb much moisture, the facings on blankets and batts can trap water in the batts, which can dampen building materials and provide a water source for pests.

Facings for Fiberglass Batts

Insulation manufacturers make batts and blankets with a number of facings, including the following.

- Unfaced: Vapor permeable and Class-A fire rating of ≤25 flame spread.
- Kraft paper: A Class II vapor retarder that is flammable (Class-C or Class 3) with a flame spread ≥150.
- Foil-kraft: foil bonded to kraft paper. A vapor barrier with a flame spread of >75 (Class-C or Class 3).

- Foil-skrim-kraft (FSK): Aluminum foil bonded to kraft paper with skrim netting in-between as reinforcement. A vapor barrier available as a Class-A material with a flame spread of ≤25.
- White poly-skrim-kraft (PSK): White polyvinylchloride bonded to kraft paper with skrim netting in-between as reinforcement. A vapor barrier available as a Class A fire-rated material with a flame spread of ≤25. The white surface maximizes light reflection.

Blown Fiberglass

Loose fiberglass is blown in attics from 0.3 to 0.8 pcf and at that density range, the R-value is around 2.9 per inch. Expect around 5% settling within five years after installation.

Blown fiberglass is non-combustible as a virgin product. However, some blown fiberglass is made from chopped batt waste that contains a small amount of combustible binder.

Fiberglass manufacturers now provide two blowing products, one for standard densities of up to about 1.4 pcf, and another for dense-packing to more than 2.0 pcf.

In closed cavities, installers blow fiberglass from 1.2 to 2.2 pcf, with the R-value per inch varying from 3.6 to 4.2. Higher density achieves a higher R-value. The high-density fiberglass is typically reserved for walls where the superior resistance to settling, airflow, and convection has extra value over lesser density.

Blown Cellulose

Cellulose is the most inexpensive insulation and among the easiest insulations to install. Loose cellulose is blown in attics from 0.6 to 1.2 pcf and at that density range, the R-value is around 3.7 per inch. Expect around 15% settling within five years after installation.

In wall cavities, cellulose is blown at a higher density of between 3.5 to 4.0 pcf, to prevent settling and to maximize its airflow

resistance. At that high density, cellulose's R-value per inch is around 3.4. Evaluate the strength of wall cladding before blowing a wall with cellulose to prevent damage during installation.

Cellulose absorbs up to 130% of its own weight in water. Before anyone discovers a moisture problem, the cellulose could be soaked, shrunken, double its dry weight, and far less thermally resistant. Avoid using cellulose in regions with an annual average precipitation of more than 50 inches or an annual average relative humidity of more than 70%. We believe that cellulose shouldn't be installed in the following places regardless of climate.

- Horizontal or sloped closed roof cavities
- Floor cavities above crawl spaces or unconditioned basements
- Crawl space walls or basement walls

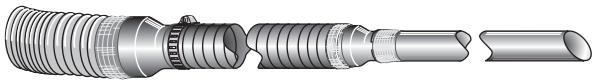
Rock Wool

Rock wool is a type of mineral wool like fiberglass. Rock wool has a small market share in North America. Rock wool batts have similar R-values per inch as fiberglass batts and contain flammable binders. Rock wool itself is non-combustible so blown rock wool doesn't burn.

Rock wool is also the most moisture-resistant insulation discussed here. In rainy and humid climates, rock wool is the least likely insulation to harbor moisture or support pests.

Damp Spray Fibrous Insulation

Installers mix fibrous insulation with sprayed water and a small amount of adhesive in damp-spray applications either in open cavities or directly adhered to building surfaces. Sprayed cellulose contains a non-corrosive fire retardant to prevent metal corrosion when used in contact with metal building components.



Insulation hoses, fittings, and the fill tube: Smooth, gradual transitions are important to the free flow of insulation.

3.6 Insulation Blowers and Hoses

The quality and ease of a wall dense packing job depends on the blowing equipment and the skills of the installers. Dense packing requires experienced installers and good equipment, kept in good working order.

3.6.1 Inexpensive Blowers

Manufacturers make a variety of inexpensive blowers for small contractors and for hardware dealers to rent to do-it-yourselfers. If these blowers are maintained, they can do an adequate job on easy insulation-blowing projects.

Some inexpensive insulation machines use a single control for both the feed and the air. This control strategy isn't as good as being able to control the feed in the air separately. Also, the agitator may merely stir the insulation, resulting in inefficient insulation flow.

3.6.2 Professional Blowers

For professionals who often insulate closed cavities, modern airlock machines are essential. Either electricity or fuel engines power these professional blowing machines. You can stop insulation from entering the tube by shutting down the agitator. The blowing air continues to empty the hose. This independent control is an advantage in achieving the correct density and complete coverage in every closed building cavity, while minimizing spillage.

3.6.3 Main Parts of Insulation Blowers

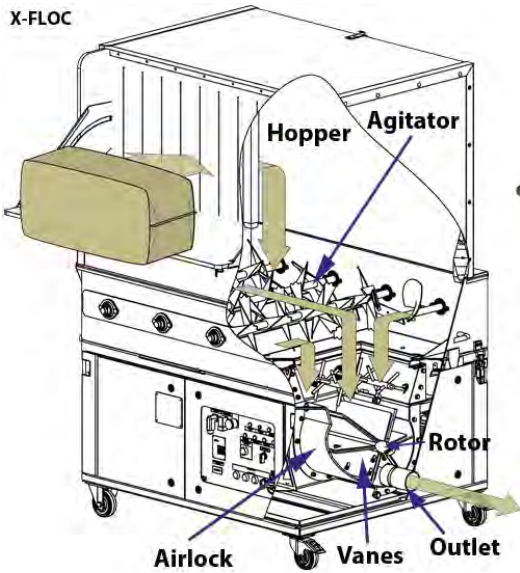
Installers should be familiar with the main parts of insulation-blowing machines. Blowing machines require periodic maintenance, especially to the airlock's vane seals, which wear out with use.

Blower Motors

Blowers move air through the airlock, forcing insulation through the airlock into the blower hose. The blowing machine should match the power of the machine's blower or blowers to the typical jobs that the insulation contractor does. Wet spray fibrous insulation requires more blower power than dry applications. Long hose lengths also demand more blower power to maintain efficient installation rates (bags per hour).

Agitators or Augers

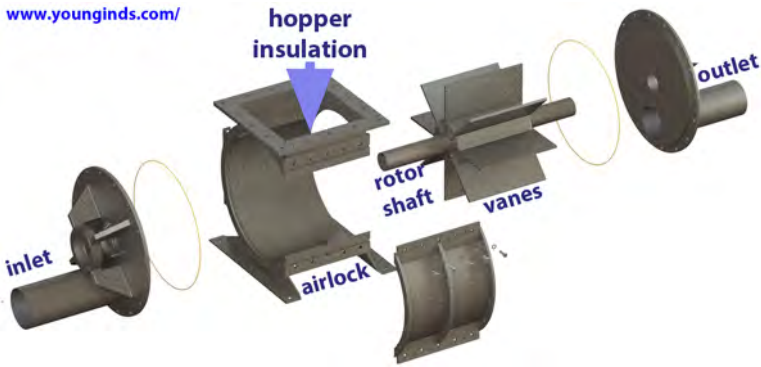
Agitators or augers break up the compressed insulation into small clumps and individual fibers. The agitators of some blowing machines actively force the insulation into the airlock. This feature has an advantage over agitators and hoppers that depend on gravity to fill the airlock.



Airlocks

The airlock is a cylinder with a rotor that drives a set of rotating vanes. The vanes seal tightly to the cylinder and lock the blower's air pressure away from the atmosphere outside the airlock. Insulation fills the triangular area between vanes and rotates until it reaches the outlet, where the blower forces it into the blower hose.

The airlock's size determines how many bags per hour that the machine blows. The agitator, along with gravity, must keep the airlock full of insulation for the machine to provide efficient operation.



Feed gates

Feed gates regulate the flow of the insulation into the airlock. They determine the amount of area that the insulation moves through to get inside the airlock. The area created by the feed gate varies, depending on the type of insulation and insulation job.

Remotes

There are two types of remotes: remotes with cords and cordless remotes. Remotes control the blower and the agitator. The better machines allow the insulation installer to control the blower and the agitator independently by remote control.

3.6.4 Operating the Insulation Blowing Machines

Perform these important steps before and during insulation-blowing.

- ✓ Verify that the electrical source can provide the ampere draw of the insulation machine.
- ✓ Measure the pressure created by a blowing machine by connecting the hose to a fitting attached to a pressure gauge. Close the feed gate, and turn the air to the highest setting. For cellulose, the blowing machine should develop at least 2.9 pounds per square inch (psi) or 80 inches of

water (IWC) of pressure for dense-packed cellulose. Dense-packed fiberglass may require up to 4.0 psi or 110 IWC, depending on the type of fiberglass and the design of the blowing machine.

- ✓ Verify that you're blowing the correct density of fibrous insulation by using the bag's weight or the manufacturer's coverage tables.
- ✓ Control the agitator and the blower separately, if you can, to achieve adequate coverage and density, and also to minimize spillage.

Important Note: Dense-packed fibrous insulation can reduce air leakage and convection in closed building cavities. However, don't use dense-packed fibrous as a substitute for the air-sealing techniques described throughout this guide.

Blower pressure gauge: For blowing closed cavities, blower pressure should be at least 80 IWC or 2.9 psi. Measure the pressure with maximum air, feed gate closed, and agitator on.