Chapter

9

Sprayed-in-Place Insulation

Whether referred to as *self-supported, wet-spray, damp-spray stabilized, spray-on,* or *dimensionally stable,* sprayed-in-place insulations are basically modified loose-fill products that are blown into wall cavities or attics. Cellulose, fiberglass, and rock wool are the most common materials used today. This method is similar to the exposed sprayed fireproofing systems commonly found on structural members in many commercial buildings. In contrast to the materials discussed in Chap. 7, a special blowing machine that combines an adhesive, water, and the insulating materials sprays the mixture into or over open wall and ceiling cavities. Sprayed-in-place insulation systems are especially advantageous when insulating irregular or out-of-square framed structures as well as walls with unusual interior geometry (such as cross-bracing, blocking).

Sprayed-in-place insulation adheres tightly to walls, framing members, and any other construction materials it may come into contact with. When installed properly, sprayed-in-place insulation uniformly covers the applied area, completely surrounding any obstructions within the cavity. The adhesive binds the insulation material to itself and to the application area. The adhesive is either a liquid that mixes with the insulation at the nozzle of the blowing machine or a powder premixed in the insulation material.

When applied correctly, this insulation resists settling and shifting and allows the cavity to be filled completely. By forming a continuously uniform blanket throughout the wall cavity, sprayed-in-place insulation allows no air gaps and provides very good resistance to air leakage while not creating any inherent resistance to moisture transmission.

Sprayed-in-place insulation is most practical for new construction or unfinished spaces such as basements with exposed studs. Installing sprayed-in-place insulation is often messy, since some of the insulation can become airborne or adhere to the stud faces and floor. After spraying, the stud faces are scraped clean to provide a flush blanket in the wall cavity. The excess insulation is recycled into the blowing machine for reuse as long as it is free of debris.

Sprayed-in-place insulation in unfinished spaces needs time to dry before being enclosed or sheathed. Sealing up the wall too soon after application sometimes leads to moisture problems, such as mold and mildew growth. The drying time for the insulation varies depending on the type of insulation material and its moisture content, the moisture content of the framing members, and the climate. Most products in use today require no more than 24 hours for drying.

There are a few general limitations. For example, the chemical fire retardants in some products may corrode the metal fasteners, piping, conduit, or structural members they contact. The long-term stability of some plastics in contact with such chemicals is also of concern.

R-value is important, but it is only one of the many factors that affect the actual performance of insulation as installed. Other important factors to consider include air permeability, ability of the insulation to "tighten" the building against air infiltration, susceptibility to convective heat loss under cold conditions, the potential for moisture permeation and accumulation and its deteriorating effects, and proper installation.

Sprayed-in-place insulation of any form should not be relied on to prevent moisture movement within an insulated cavity. Whether blown-in fiberglass, rock wool, slag wool, or cellulose is used, vapor retarders are required unless proper ventilation is provided. As with fiberglass batt insulation, materials used for vapor retarders for blown-in insulations must have a permanence rating of less than 1 perm. In a ceiling where the space above is adequately ventilated, a vapor retarder may not be required. The exception would be in cases where the cold side cannot be ventilated.[1]

Generally speaking, sprayed-in-place insulation systems (including installation costs) are usually more expensive than blanket insulation products. When comparing "apples with apples," sprayed-in-place fiberglass or cellulose insulation costs are comparable. Wet-spray rock wool and slag wool are often less expensive where available. Prices vary, however, depending on local supply and on labor rates.[2]

A similar system, proprietarily known as the Blow-In-Blanket System (BIBS), uses a form of wet- or dry-applied wall insulation. Fiberglass material is blown into the netted wall cavity either dry or with an adhesive binder.

Wet-Spray Cellulose

Cellulose insulation, as discussed in Chap. 7, is produced from recovered wood pulp materials. These include used newsprint and boxes that have been shredded and pulverized into small fibrous particles. Wet-spray cellulose, sometimes called *damp-spray cellulose* or *water-stabilized cellulose,* uses the same base material as loose-fill insulation, except that it is applied using special applicators that mix the material with an adhesive, allowing it to adhere to the surface it is applied to (Fig. 9.1). The adhesive(s) may be added to the insulation at the time of manufacture and, if necessary, activated by the addition of water when installed, or the adhesive may be added to the insulation at the time of installation.[3] Application of the insulation with the glue binder and liquid purportedly results in lower-density cellulose insulations that do not settle like dry-applied loose-fill cellulose insulations. This procedure requires trained or certified contractors for this specific

Figure 9.1 Applying wet-spray cellulose. (*Greenstone*)

installation. Wet-spray cellulose is excellent for sound control. It can be used in walls between rooms and other areas that require sound control. Many application systems are proprietary and are designed for use with specific products and equipment.

Product description

Wet-spray cellulose is designed for use in attics or wall cavities that are fully open (prior to the installation of the interior finish material). The sprayed material conforms to any substrate, around pipes, obstructions, and over cracks, reducing air infiltration and forming a highly efficient and effective thermal barrier.

After application, the insulation is planed even with the stud faces by the use of a "stud scrubber" (Fig. 9.2). The scrubber shaves the insulation mass so that it is flush with the face of the studs, thereby creating an insulation "blanket" custom-fit to the wall cavity (Fig. 9.3). The wall can be closed shortly after installation of the insulation; however, vapor retarders, as well as some types of paint and vinyl wallcoverings, should not be applied to the inner surface of the wall until the insulation has dried. Moisture-to-fiber ratios influence the drying time required after application. Although these times may vary with each manufacturer, 24 hours is a consistent average among most products. Moisture control is critical with wet-blown insulation because overly moist insulation requires a longer drying period before a wall can be closed up. It is also recommended by some that vapor retarders of any type should not be used with spray-applied cellulose. This recommendation may conflict with some building codes.

Standards

Cellulose insulation has been exposed to a broad range of construction, environmental, and various code requirements that have called for a more elaborate definition of physical properties. These requirements have been identified and met in the following federal regulations, federal procurement specifications, and industry standards.[4]

> Cellulose insulation intended for spray-on application in new walls is classified as a type II material under American Society for Testing and Materials (ASTM) Standard C1149. These materials normally contain adhesive to produce the cohesion necessary to make the insulation self-supporting. The adhesive may be

Figure 9.2 Stud scrubber. (*Greenstone*)

liquid added during the spraying process, or it may be dry adhesive contained in the insulation during the manufacturing process and activated by moisture during application.

16 CFR Part 1209, "Consumer Products Safety Commission Interim Safety Standard for Cellulose Insulation," also referred to as the *CPSC Safety Standard.* This is the Consumer Products Safety Commission (CPSC) safety standard that covers four product attributes: settled density, corrosiveness, critical radiant

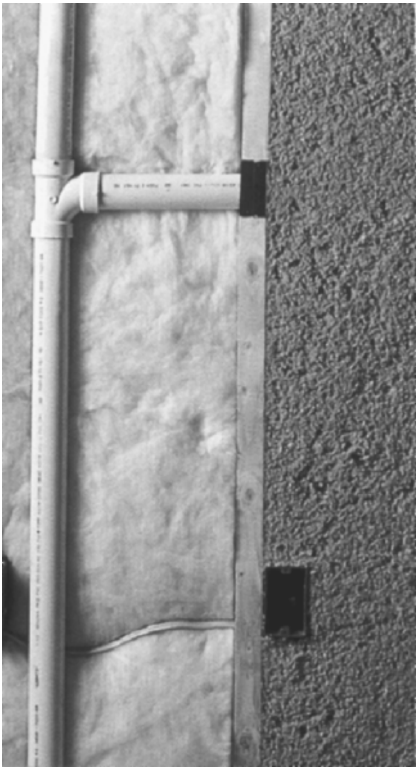

Figure 9.3 Fiberglass (*far left*) and cellulose (*near left*) (*Greenstone*)

flux (a measure of surface burning), and smoldering combustion. It is illegal to market cellulose insulation that does not conform with this section of the *Code of Federal Regulations*.

16 CFR Part 460, "FTC Trade Regulation Rule, Labeling and Advertising of Home Insulation," also known as the *FTC R-Value Rule*.

ASTM C167, "Test Methods for Thickness and Density of Blanket or Batt Thermal Insulations."

ASTM C168, "Terminology of Terms Relating to Thermal Insulating Materials."

ASTM C739, "Specification for Cellulosic Fiber (Wood Based) Loose Fill Thermal Insulation." This is the industry standard for loose-fill cellulose insulation. It covers all the factors of the CPSC regulation and five additional characteristics: R-value, starch content, moisture absorption, odor, and resistance to fungus growth.

ASTM C755, "Recommended Practice for Selection of Vapor Barriers for Thermal Insulation."

ASTM C1015, "Practice for Installation of Cellulosic and Mineral Fiber Loose Fill Thermal Insulation."

ASTM C1149, "Standard Specification for Self-Supported Spray Applied Cellulosic Thermal/Acoustical Insulation."

ASTM C1338, "Test Method for Determining Fungi Resistance of Insulation Materials and Facings."[11]

ASTM E 970-89, "Test Method for Critical Radiant Flux of Exposed Attic Floor Insulation Using Radiant Heat Energy Source."

Cellulose insulation is formulated and labeled as self-supporting, spray-applied material. Spray-applied cellulose installed in closed walls and in attics is approved for use in every code jurisdiction on the basis of conformance with the CPSC safety standard for loose-fill cellulose.

Although many of the tests described in ASTM C1149 differ from those in C739 and the similar CPSC 16 CFR Part 1209 procedures, manufacturers are justified in claiming CPSC compliance on the basis of the C1149 methodology because the tests described in C1149 are "reasonable test procedures."[4]

ASTM C1149 covers 10 material attributes: density, thermal resistance, surface burning characteristics, adhesive/cohesive strength, smoldering combustion, fungi resistance, corrosion, moisture vapor absorption, odor, and flame resistance permanency. Material installed using liquid adhesive (type I) also has substrate deflection and air erosion characteristic requirements. Obviously, under C1149, spray-applied material is tested in the sprayed state. The requirements for type III material defined by ASTM C1149 cover some attributes of stabilized cellulose. Specifiers may wish to require conformance with this standard.[4]

R-value

The typical R-value of spray cellulose insulation ranges from 3.5 to 3.8 per inch depending on the manufacturer. See Fig. 9.4 for one manufacturer's coverage specification sheet.

Limitations

Wet-spray cellulose for residential application is limited to enclosed or covered applications.

COCOON STABILIZED INSULATION

ATOMIZED PNEUMATIC APPLICATION COVERAGE CHART

R-Value at 75 F Mean Temperature	Minimum Thickness	Net Coverage No Adjustment for Trusses		
		Maxiumum Net Coverage		Minimum Weight Per Square Foot
To Obtain an Insulation Resistance (R) of	Installed Insulation Should Not Be Less Than: (inches)	Square Feet Per Bag	Minimum Bags Required Per 1,000 Square Feet	Wt./ Sq. Ft. of Installed Insulation Shouldn't Be Less Than: (lbs)
R-50	13.5	20.5	48.8	1.464
R-42	11.4	24.4	41.0	1.230
R-40	10.8	25.6	39.0	1.172
R-38	10.3	27.0	37.1	1.113
R-32	8.6	32.0	34.1	.937
R-30	8.1	34.2	29.3	.878
R-24	6.5	42.7	23.4	.703
R-22	5.9	46.6	21.5	.644
R-19	5.1	53.9	18.5	.556
R-13	3.5	78.8	12.7	.381
R-11	3.0	93.1	10.7	.322
Sidewalls (Wall Spray)				
R-13 (2 x 4)	3.5	51.4	19.4	.583
R-20 (2 x 6)	5.5	32.7	30.6	.917

NOTE: The above coverage figures compensate for settling and are for estimating purposes only. To achieve stated R-Value do not exceed minimum square feet coverage per bag. Actual coverage will be influenced by job conditions and application techniques. This product is intended for spray applied application. This coverage chart does not apply to dry loose fill application.

Figure 9.4 Coverage chart. (*Greenstone*)

Health considerations

Cellulose fiber is characterized as a nuisance dust but is not a health hazard. The fire retardants used in cellulose insulation are also regarded as nonhazardous. For example, the toxicity of boric acid is one-sixth that of table salt. Nevertheless, respiratory protection should be worn while handling and installing the insulation material. Cellulose will not cause skin irritation. Special clothing is not required during installation.

Environmental considerations

Most cellulose insulation is approximately 80 percent postconsumer recycled newspaper by weight. The remaining 20 percent is comprised of fire-retardant chemicals and/or acrylic binders depending on the product. In 1994 alone, the cellulose industry used approximately 840 million lb of recycled newspaper. Experts suggest that if all new home construction in the United States were insulated with cellulose, over 3.2 million tons of waste newsprint would be used each year.[4]

According to the Cellulose Insulation Manufacturers Association (CIMA), cellulose has a very low comparative embodied energy, calculated to be 20 to 40 times less than mineral fiber insulations. (*Embodied energy* is the total energy, such as the fuels, electric power, transportation, and job-site power, used to extract, fabricate, package, transport, install, and commission a building product, material, or system.)

Fire resistance

Boron-based chemicals are added to the cellulose as a fire retardant. These chemicals also work as fungicides in protecting against mold, mildew, and other microbes. Manufacturers will list the specific product as having a class 1 rating for flame spread and smoke development when tested in accordance with ASTM E84.[5]

Cellulose insulation made from postconsumer paper is not a fire hazard. All cellulose insulation, including that made from postconsumer materials, must meet the flammability standards set by the CPSC. Because of its density, cellulose insulation keeps oxygen (the fuel of fire) away from structural building components, making them fire resistant.

In fire testing done at the National Research Council of Canada (NRCC), wet-spray cellulose, although not combustible, may have contributed to poor fire resistance as compared with dry-blown cellulose or rock wool batts. Since wet-spray insulation adheres to the wall sheathing, when the sheathing is exposed to the fire and collapses, it pulls the insulation out of the cavity, exposing the entire cavity to the fire. A cavity without any fireblocking or fireproof insulation functions like a chimney, but this may only be a problem with party (fire) walls that separate habitable dwellings.[2]

Installation standards and practices

Although this book is not intended to serve as a training manual for wet-spray cellulose installers, the following guidelines will provide a general framework for a better understanding of the application procedures. The guidelines listed below are to be used for general information purposes only and are not intended to supplant or override instructions provided by a specific manufacturer or applicable installation standards. When installing wet-spray cellulose materials, it is essential that the guidelines of the manufacturer are followed, unless superseded by local, state, or federal codes.[6]

Preliminary inspection and equipment. An inspection of the building should be made prior to installation, with special consideration given to the following areas:

1. All voids around windows and doors should be sealed to stop air infiltration. Various materials such as foam backer rod or urethane spray foam are available for this purpose.
2. All pipes, ducts, conduits, wiring, and outlets should be installed in the wall before the insulation is applied.
3. Any small areas from which the insulation is to be excluded, such as electrical boxes, should be masked.
4. Seal all vertical plumbing and electrical penetrations through both top and bottom plates of all walls.
5. Cover finished areas including windows, doors, fireplaces, etc. It is faster to protect finished surfaces than to clean them later. For this purpose, 2 or 4 mil polyethylene sheeting works well.
6. Cover electrical boxes until the spraying is completed. Duct tape works well.
7. If recycling the wet-spray cellulose, a totally clean floor is absolutely essential before starting to spray. Objects such as nails, wood, wire, etc. could damage the machine. Sweep these from the floor before starting to spray the wet-spray cellulose.
8. Shovels, brooms, and trash cans are usually needed for recycling and cleanup.

Application. Wet-spray cellulose insulation should be applied with the manufacturer-approved spray application machines and spray nozzles. The nozzles are a tube with a liquid atomizing unit attached to intermix fibers and liquid. Nozzles may have from two to six spray tips and must provide a consistent fiber-to-water ratio. A $2^1/_2$" semispiral hose, which allows the material to tumble and stay in the air stream, should be used. A diaphragm pump capable of 200 to 300 lb/in^2 at a flow rate of 2 to 5 gal/min is used to supply the pressure.

The blower machine may be mounted in a truck or trailer to be positioned at the job site as close to a door as practicable to make recycling easier and increase production. An alternative is to take the machine into the building in a central location. This works very well when spraying in cold weather.

The hose, a minimum of 100 ft in length, should be pulled to the farthest point to be insulated and have as few bends as possible. The water line, run alongside the hose, should be taped to the last 10 or 12 ft of insulation hose for ease of use. After all hoses and nozzles have been connected and properly tested, the installer is ready to begin. It is important to note that specific recommendations from the thermal insulation manufacturer must be followed. Liquid flow tests also should be made periodically to ensure a proper liquid-to-fiber ratio.

When spraying, the installer should aim with a downward spray angle of approximately 5 to 10 degrees and about 4 ft away from the wall. When spraying layers on layers, the cavity becomes one solid mass, with no inner voids, giving it structural integrity. As the nozzle moves from one side to the other, angle the nozzle sideways and maintain 5 to 10 degrees down, spraying into the existing insulation. Nearing the top of the wall, keep the nozzle angled down. To fill the very top, under the plate, turn the nozzle angle up and step in a little closer to pack the insulation against and into the top of the cavity. After the top portion is almost full, step back and level out the nozzle to finish the cavity. Be careful not to overfill the top portion of the wall cavity. The cavities under windows, soffits, etc. must be treated the same as the top plate.

A smooth and steady movement of the nozzle also will help to decrease the amount of overspray (the portion of material from a spray pattern not filling or adhering to intended substrates). Many new applicators have problems with falloff.

The thicker the wall, the more weight is pulling on the sprayed insulation. Therefore, it is very important to know the fiber-to-water ratio and keep it consistent. The thicker the walls, the more important this becomes.

The wider the distance between the studs, the less surface area the sprayed material has to attach itself to. Thus, 16" on-center stud spacing is much more forgiving than 24" on-center stud spacing. In framing with 2 × 8s, 24" on-center studs can be sprayed successfully with the right equipment and material.

The angle of the nozzle and the velocity of the material are the two most important factors to reduce falloff. The sprayed insulation must hit the substrate and stay. This can be achieved only with the proper angle. If the angle is not correct, the material will tend to deflect or slide off the studs and substrate. This can be mastered with practice and training.

A “stud scrubber,” a rotating brush that grooms the insulation level with the face of the studs, is the best tool for cleaning down walls. Scrubbing typically can be performed immediately after the spray-on application. The product does not have to be dry in order to plane the wall cavity. Recycling of excess material is also performed as the installation process progresses. Normal drying will occur within 24 to 48 hours depending on climatic conditions, depth of fill, and initial moisture content. The manufacturer’s recommended drying times should be followed.

Recycling the excess material translates to very little waste, although it can be more time-consuming. The material must be mixed properly when recycling, or problems are likely to occur. If the material is mixed improperly, the wall cavity insulation may be too wet, causing inconsistent flow and leading to instability, and the insulation may fall out of the wall cavity. The moisture or fiber volume must be adjusted carefully when the recycling method begins. The recycled material adds moisture mixed with the dry product. Adjusting the water pressure or changing the spray tips will help maintain the same moisture percentage throughout the job.

Installation of the interior finish should not be done until the insulation has dried. This should be monitored using a moisture meter. (CIMA recommends the Wagner Electronics Model L6101.) The wet-spray cellulose may be enclosed when it is sufficiently dry, having a measured moisture content of 25 percent or less.

Wet-spray cellulose can be applied successfully in freezing conditions, but the manufacturer should be consulted for recommendations on spraying in severe climates and conditions. Since the entire spray system can freeze up, heating the building while spraying is necessary if the temperatures are below freezing. After the spraying is completed, the heat can be turned off. The windows should be opened in order to facilitate air movement and moisture removal. If heat is used during the drying process, it is imperative to have ventilation to the outside. Dry heat, such as electric, works the best. It will speed up the drying process. Propane or gas heat can add high percentages of moisture and should be avoided.

The wet-spray cellulose will take longer to dry in colder climates. If ambient temperatures are expected to drop below 40°F before drying is completed, it may be necessary to use supplemental heat until the moisture content measures 25 percent or less.

Vapor retarders

As discussed in Chap. 4, the need for vapor retarders and their proper location within a wall assembly are influenced by the interior and exterior environmental conditions, as well as the wall's thermal and vapor flow characteristics. When installing loose-fill insulations, a material such as 6-mil (0.006-in) polyethylene plastic sheeting can be used as a vapor retarder. Some cellulose manufacturers recommend against the use of vapor retarders in walls insulated with spray-applied cellulose. CIMA is not aware of any endemic problems resulting from this practice.[7] Research reviewed for this book does not suggest that there is sufficient evidence to eliminate vapor retarders from conventional construction. It is important to note that each building is fairly unique in terms of wall construction, interior use, and environmental conditions, and should be evaluated individually by the building designer. If unsure, the homeowner could consult the local or state building codes about the use of vapor retarders. The insulation manufacturer also may provide recommendations on where to place a vapor retarder.

Installation precautions and limitations

As stated earlier, the following items may be in concert with or in contradiction with the adopted state and federal building codes. The building codes are a minimum level of safety and quality and must be adhered to.

1. Heaters and recessed light fixtures must not be covered by the insulation unless the fixture has a direct-contact rating. It is recommended that a minimum of 3 in of airspace be maintained between any fixtures and the blocking.
2. Cold air returns and combustion air intakes for hot-air furnaces must not be blocked, or the insulation installed in such a manner as to allow it to be drawn into the system.
3. Insulation must not be in contact with chimneys or flues. A minimum of 3" of airspace must be maintained, with blocking used to retain the insulation.

4. This insulation is not recommended for filling the cavities of masonry walls.
5. Consult the manufacturer about using wet-spray cellulose below grade or ground level because of moisture considerations.
6. This insulation is to be used in the temperatures range of −50 to 180°F.
7. The installer must wear appropriate respiratory protective equipment.

Spray-on Fiberglass

As discussed in Chap. 7, fiberglass is one of a group of glassy, noncrystalline materials historically referred to as *man-made mineral fibers* (MMMFs) or *man-made vitreous fibers* (MMVFs). The fiber is made from molten sand, glass, or other inorganic materials under highly controlled conditions. After the glass is melted in a high-temperature gas or electric furnace, the material is spun or blown into fibers that are then processed into the final product. The base material for spray-on fiberglass is fiberglass loose-fill insulation. Inorganic and noncombustible, the fibers will not rot or absorb significant amounts of moisture. Fiberglass does not support the growth of mildew, mold, or fungus.

The terminology used in the spray-on fiberglass industry can be overlapping in discipline and at times confusing. Applying wet-spray fiberglass is similar to applying sprayed-on fireproofing. The material typically is left exposed and is suited for commercial projects or, on rare occasions, high-end residential projects. There are two predominant methods of spraying fiberglass loose-fill in residential construction. The most common method is proprietarily known as the *Blow-In-Blanket System (BIBS).* A second method, known as *dimensionally stable fiberglass,* uses loose-fill insulation applied in a manner similar to stabilized cellulose insulation and is discussed later in this chapter.

The Blow-In-Blanket System (BIBS)

A technological variation from the simple blown-in loose-fill fiberglass insulation discussed in Chap. 7 is the Blow-In-Blanket System (BIBS). Developed by Ark-Seal, Inc., in 1985, BIBS is a patented and trademarked system that is installed exclusively by certified contractors using proprietary equipment and approved ingredients. The system is used in residential and commercial construction for thermal and acoustical insulation. The system also can be used to insulate floors, attics, and cathedral ceilings. BIBS insulation technically could qualify as a loose-fill insulation product because the netting used in this system is actually creating the wall cavity. The presence of a binder is the reason it is included in this chapter (Figs. 9.5 and 9.6).

In 1998, Ark-Seal unveiled a dry product, proprietarily known as the *Blow-In-Blanket Dry System*. R-values for a 2 × 4 wall and a 2

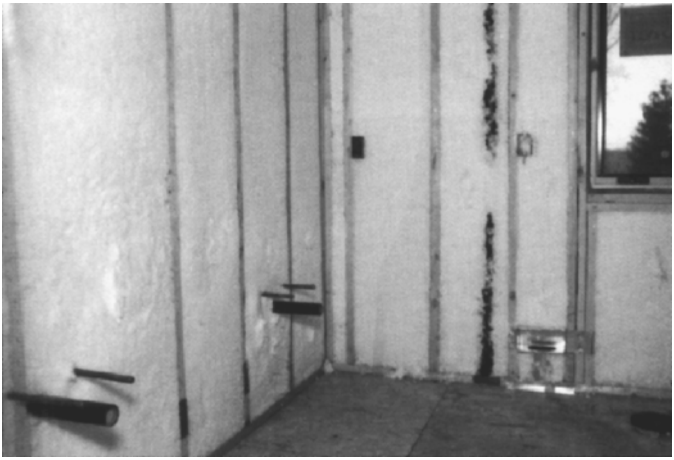

Figure 9.5 BIBs in sidewalls. (*Ark-Seal*)

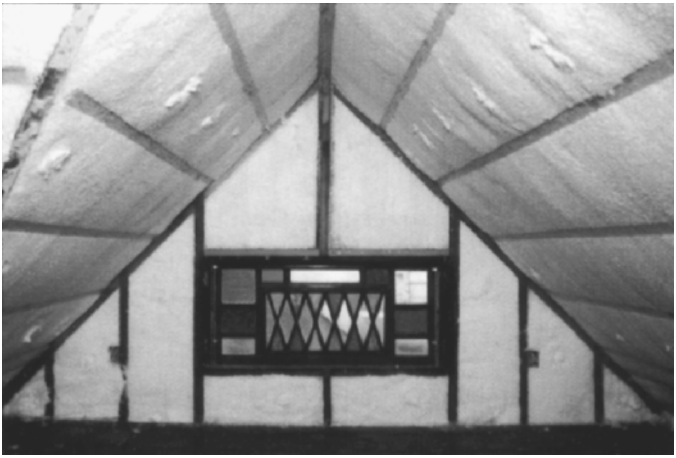

Figure 9.6 BIBs in cathedral ceiling. (*Ark-Seal*)

$\times$ 6 wall are R-15 and R-23, respectively. As with the original system, fiberglass is blown in behind a special netting. Since the insulation is dry, gypsum wallboard can be applied immediately. The original Blow-In-Blanket System will be discussed in this chapter.

Product description

The original BIBS insulation consists of adhesive-coated white fiberglass loose-fill fibers that are blown into wall cavities and retained by a lightweight polypropylene netting that is typically stapled to wood framing studs. Double-sided tape or special hooks are used for attaching the netting to metal stud framing. The netting is slit with a utility knife where necessary so that the installation hose will fit through to the area to be filled. Wall cavities are then filled with insulation through a hose connected to the "heart" of the system, a patented high-pressure machine called "the big blower." A thin mist of latex binder blends with the fiberglass at the blower to prevent the fiberglass from sagging. Insulation is added to the wall cavity until the netting bulges out about 1 to $1^1/_2$". The fibers will compress beneath the gypsum wallboard to achieve the proper density and R-value (Fig. 9.7).

The Blow-In-Blanket System completely fills the wall cavity, including all wiring and fixtures, while eliminating voids and air gaps. Tests conducted by the National Association of Home Builders' (NAHB) National Research Center show that the Blow-In-Blanket System reduces air infiltration by up to 68 percent over conventional batt-type insulation. (This may not be as dramatic as it appears, since tests show that wall insulation is insignificant in controlling air leakage; gypsum wallboard is a much bigger factor.)[8]

The BIBS insulation has a resistance to settling and drifting. When installed correctly, BIBS insulation provides a uniform density even in hard-to-insulate sidewall areas. Typically installed using a two-person crew, BIBS insulation can be used in renovation and new construction for either wood or steel stud framing systems.

R-value

Insulating values of up to R-15 for 2 $\times$ 4 walls and up to R-23 for 2 $\times$ 6 walls can be achieved. The ASTM C518 test for the Blow-In-Blanket System states that the R-value is 4.2 per inch, although some manufacturers have the R-value listed as 4.0 per inch (Fig. 9.8).

Figure 9.7 Installing the blow-in-blanket system. (*CertainTeed*)

Limitations

The only limitation is that BIBS insulation must be installed by a certified BIBS contractor. There are currently about 300 licensed installers in the United States and another 400 in other parts of the world.[9] The loose-fill insulation also must be fully compatible with The Blow-In-Blanket System. As with any loose-fill insulation product (see Chap. 7), dishonest installers can even “fluff” BIBS insulation by installing it at lower density than disclosed to the homeowner.

Fire resistance

BIBS insulation meets HH-I-1030B testing criteria for smoldering combustion and ASTM E136 criteria for noncombustion. The flame spread rating is 0, and the smoke development rating is 5.

Installation standards and practices

The Blow-In-Blanket System must be operated by a certified BIBS contractor. This requirement should help maintain a consistent quality of installation of the product. Natural ventilation must be

Sidewall Applications

When installed with BIBS equipment in sidewalls, the following thermal performance based on a nominal 27 lb. bag is achieved at the thicknesses, weights and coverages specified:

Thickness				Density		Minimum Weight		Maximum Coverage per Bag	
in.	mm.	R-Value	RSI	Lbs./Cu. Ft.	Kg/Cu. Meter	Lbs./Sq. Ft.	Kg/Sq. Meter	Sq. Ft.	Sq. Meters
3½ (2X4)	89	14	2.5	1.8	28.8	0.525	2.563	51	4.7
3½ (2X4)	89	15	2.6	2.3	36.8	0.671	3.276	40	3.7
5½ (2X6)	140	22	3.9	1.8	28.8	0.825	4.028	33	3.1
5½ (2X6)	140	23	4.1	2.3	36.8	1.054	5.146	26	2.4
7¼ (2X8)	184	29	5.1	1.8	28.8	1.087	5.307	25	2.3
7¼ (2X8)	184	31	5.5	2.3	36.8	1.389	6.782	19	1.8
9¼ (2X10)	235	37	6.5	1.8	28.8	1.387	5.772	20	1.9
9¼ (2X10)	235	39	6.9	2.3	36.8	1.772	8.652	15	1.4

Figure 9.8 BIBs sidewall specification chart. (*CertainTeed*)

provided to properly dry the insulation material during and after its application.

Dimensionally Stable Fiberglass

Dimensionally stable (DS) fiberglass is a patented process by Guardian Fiberglass, Inc., called *UltraFit DS*. Relatively new to the market, DS fiberglass spray-on insulation is applied by a process that is similar to that used for stabilized cellulose insulation. A fine mist of water is combined with the loose-fill fiberglass and a dry adhesive binder. As in wet-spray cellulose applications, the excess fiberglass material is scrubbed off the face of the studs and is immediately recyclable.

Product description

DS fiberglass can be used in nonexposed applications of residential or light commercial projects, whether it be new construction or renovation. The UltraFit DS System does not contain any chemicals or additives that are conducive to corrosion of pipes, wires, or metal stud framing systems. The inorganic qualities of this system do not cause fungus growth or promote an attraction for insects or pests.

The binder is a powdered inorganic adhesive that gets mixed in with the loose-fill fiberglass at the manufacturing plant. Once the job site has been prepared and cleaned, a certified installer blows the DS fiberglass through a hose into the wall. Nozzles mix water with the fiberglass as it is sprayed into the wall, activating the premixed adhesive. This chemical reaction automatically bonds the fibers together, creating a monolithic blanket of insulation in sidewall applications that significantly reduces voids and air gaps. After spraying, the installer goes back over the face of the wall framing with a power scrubber to plane off excess insulation, which is vacuumed up and fed back into the hopper. The drying time is also similar to wet-spray cellulose. A curing period of 24 hours is the typical waiting period after application before gypsum wallboard can be installed.

According to the manufacturer, there is very little airborne glass fiber during application. Water is used to activate the glue, which keeps the material wet during application.

Limitations

Only qualified contractors approved by Guardian Fiberglass, Inc., may install and market the UltraFit DS System. Any installation must be done in accordance with all product label instructions, as set forth by Guardian Fiberglass, Inc., as determined by its testing. Guardian fiberglass also must be used during installation.

Airtightness test results have not been released as of this writing. It also has not been determined if airborne fiberglass particles released during installation are problematic.

Fire resistance

DS fiberglass is noncombustible, as determined by tests based on ASTM E136.

Installation standards and practices

General work practices applicable to all work involving synthetic vitreous fibers (SVFs) such as fiberglass (rock wool and slag wool) have been established by the U.S. Occupational Safety and Health Administration (OSHA). Excerpts of the guidelines are as follows[10]:

1. Minimize dust generation.
   - Keep the material in its packaging as long as practicable and if possible.
   - Tools that generate the least amount of dust should be used. If power tools are to be used, they should be equipped with appropriate dust collection systems as necessary.
   - Keep work areas clean and free of scrap SVF material.
   - Do not use compressed air for cleanup unless there is no other effective method. If compressed air must be used, proper procedures and control measures must be implemented. Other workers in the immediate area must be removed or similarly protected.
   - Where repair or maintenance of equipment that is either insulated with SVF or covered with settled SVF dust is necessary, clean the equipment first with a HEPA vacuum or equivalent (where possible), or wipe the surface clean with a wet rag to remove excess dust and loose fibers. If compressed air must be used, proper procedures and control measures must be implemented. Other workers in the immediate area must be removed or similarly protected.
   - Avoid unnecessary handling of scrap materials by placing them in waste disposal containers and by keeping equipment as close to working areas as possible, which prevents release of fibers.

2. Ventilation
   - Unless other proper procedures and control measures have been implemented, dust-collection systems should be used in manufacturing and fabrication settings where appropriate and feasible.
   - Exhausted air containing SVFs should be filtered prior to recirculation into interior workspaces.
   - If ventilation systems are used to capture SVFs, they should be checked and maintained regularly.

3. Wear appropriate clothing.
   - Loose-fitting, long-sleeved, and long-legged clothing is recommended to prevent irritation. A head cover is also recommended, especially when working with material overhead. Gloves are also recommended. Skin irritation cannot occur if there is no contact with the skin. Do not tape sleeves or pants at wrists or ankles.
   - Remove SVF dust from the work clothes before leaving work, to reduce potential for skin irritation.

4. Wear appropriate personal protective equipment.
   - To minimize upper respiratory tract irritation, measures should be taken to control the exposure. Such measures will be dictated by the work environment and may include appropriate respiratory protective equipment. See OSHA's respiratory protection standard.
   - When appropriate, eye protection should be worn whenever SVF products are being handled.
   - Personal protective equipment should be fitted properly and worn when required.

5. Removal of fibers from the skin and eyes.
   - If fibers accumulate on the skin, do not rub or scratch. Never remove fibers from the skin by blowing with compressed air.
   - If fibers are seen penetrating the skin, they may be removed by applying and then removing adhesive tape so that the fibers adhere to the tape and are pulled out of the skin.
   - SVFs may be deposited in the eye. If this should happen, do not rub the eyes. Flush them with water or eyewash solution (if available). Consult a physician if the irritation persists.

The following work also typically should be performed in order to properly prepare the job site prior to installation:

1. Examine all surfaces and conditions to which the insulation is to be applied. Ensure that they are adequate to provide a satisfactory application of the specified materials.
2. Provide adequate protection to adjacent surfaces by means of drop cloths or polyethylene sheets.
3. Close off and seal any duct work in areas where sprayed insulation is being applied.
4. Clean off any dust, loose dirt, foreign material, etc. on surfaces to which the insulation is to be applied, which could otherwise create a false bond.

Health considerations

As discussed in Chap. 7, the debate has been intensifying since the mid-1980s as to the safety of using fiberglass insulation. The concern has been that the fibers that comprise fiberglass may replicate the affects of the fibers found in another silicon dioxide material, asbestos. The structure and size of these glass fibers vary. The smaller fibers, which cannot be seen by the naked eye, are suspected of entering the lungs, whereas larger, visible fiberglass particles can be irritating to the skin, eyes, nose, and throat.

Fiberglass is listed by the International Agency for Research on Cancer (IARC) as a potential carcinogen and by the National Toxicology Program (NTP) as "reasonably anticipated to be a carcinogen." Although occupational and residential exposures to fiberglass fibers are low when compared with past asbestos exposures, all fiberglass insulation is required to have a cancer warning label as mandated by the OSHA Hazard communication standard.[11]

The Consumer Product Safety Commission also has found that "fibrous glass is carcinogenic in animals only when surgically implanted into the lung or abdomen. In tests where animals were exposed by inhalation, the expected route of human exposure, the animals did not develop tumors. Therefore, the animal implantation studies do not establish a hazard to humans."[12]

Nevertheless, fiberglass as a simple irritant is well documented. Fiberglass released into the air during its manufacture or handling also may create temporary upper respiratory tract irritation. Like skin irritation, upper respiratory tract irritation is a mechanical reaction to the fibers. It is not an allergic reaction, and the irritation generally does not persist. Such exposures to high concentrations of airborne fiberglass may result in temporary coughing or wheezing. These effects will subside after the worker is removed from exposure.[13]

Workers in fiberglass manufacturing plants, as well as people working with or using materials that contain fiberglass, may develop a skin irritation. This mechanical irritation is a physical reaction of the skin to the ends of fibers that have rubbed against or become embedded in the skin's outer layer. Any skin irritation caused by fiberglass is temporary. Washing the exposed skin gently with warm water and mild soap can relieve it. The vast majority of workers and consumers, however, can control skin irritation by following recommended work practices when handling the material. Fiberglass is also the catalyst for eye irritation if deposited in the eye by the user's fingers or through fibers in the air. If this should happen, the eyes should not be rubbed but rinsed thoroughly with warm water, and a doctor should be consulted if irritation persists.[13]

Environmental considerations

Fiberglass uses two resources, sand and recycled glass. Sand does not impose an impact on nonrenewable natural resources. Recycled plate and bottle glass is considered a secondary raw material, so, when used as raw material, recycled glass is changed into a product that can save energy and reduce pollution.

Wet-Spray Rock Wool and Slag Wool

Rock wool and slag wool fall within a group of materials historically referred to as *man-made mineral fibers* (MMMFs) or *synthetic vitreous fibers* (SVFs); however, a more appropriate name is *man-made vitreous fibers* (MMVFs). First patented as a commercial product in the United States in 1875, MMVFs were not used as a wet-spray insulation for residential open-wall cavities until approximately 10 years ago in Texas.

Rock wool and slag wool each use different raw materials in their manufacture. Rock wool is made primarily from natural rock such as basalt or diabase. Slag wool is made primarily from iron ore blast furnace slag. The base material of wet-spray rock wool is the same material used in rock wool loose-fill insulation (see Chap. 7), except that it is smaller in particle size and mixed with an adhesive.

Product description

Wet-spray rock wool insulation is applied in the same manner as wet-spray cellulose insulation. The mineral wool material, which contains a dry adhesive, is mixed with a small amount of water and blown into open wall cavities at a density of approximately 4 lb/ft^3. The water activates the binder, which strengthens the bonding of the material to the sheathing and studs. After spraying onto the substrate, contractors screed the wall framing members using a motorized roller that runs down the face of the studs (Fig. 9.9). The mixture ratio is usually 1 gal of water per 55 lb of rock wool, but may vary among manufacturers. The vapor retarder, if applicable to the specific locality or building code, can be installed immediately after the wet-spray insulation cures.

Like other wet-spray insulation types, rock wool is very effective for insulating behind and around electrical boxes, wires, and pipes. It can fill the most difficult wall cavities, leaving virtually no voids. It will not support the growth of mildew, mold, or bacteria when tested in accordance with the specifications of the ASTM (C1338).

Although prices will vary depending on local supply and labor rates, wet-spray rock wool and slag wool are often less expensive than wet-spray fiberglass and wet-spray cellulose insulation.[2]

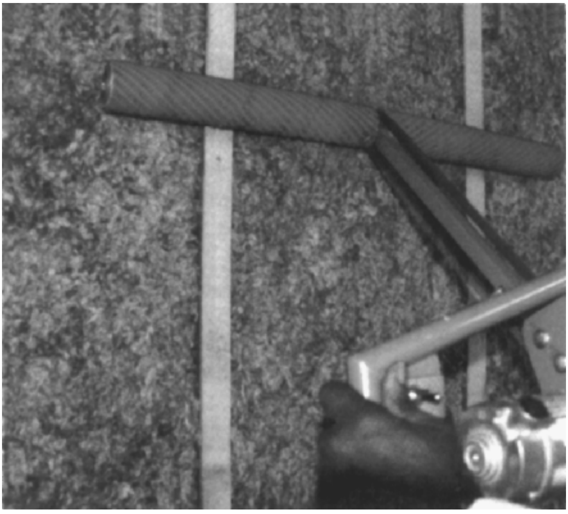

Figure 9.9 Rock wool wall scrubber. (*American Rockwool*)

R-value

Rated R-value in wall applications is 4.1 per inch, or about R-14.5 in a $3^1/_2$" wall cavity. Small amounts of moisture have no effect on the R-value, provided the material is not mechanically disturbed and is allowed to dry.

Limitations

Wet-spray rock wool insulation must be installed by a certified contractor if possible. Manufacturer's recommendations must be followed because the quality of the installation is directly rated to the proper mixing of water with the insulation.

Health considerations

As discussed in Chap. 7, human epidemiologic studies have not demonstrated evidence of a dose-related causal association between lung cancer or nonmalignant respiratory disease and occupational exposure to rock and slag wools. Animal inhalation studies using massive doses of rock and slag wool fibers, hundreds to thousands of times greater than human exposures, have not shown a relationship between inhalation of rock and slag wool fibers and lung cancer either. Since 1987, several major reviews have been undertaken on the health and safety of rock and slag wools. All these reviews concluded that inhalation of rock and slag wool fibers does not induce significant disease in animals.[14]

With publication of the OSHA hazard communication standard in 1983 and the IARC decision in 1987 to classify rock and slag wool as "possibly carcinogenic to humans," rock and slag wool manufacturers have added cancer warnings to their product labels. While this may be alarming to an uninformed user of rock and slag wool products, the primary purpose of the labels is simply to identify a potential hazard. The labels do not signify that there is any real risk to humans at actual levels of exposure.

The use of injection/implantation studies as the sole determinant of the carcinogenic hazard of a fibrous material is not generally accepted for human health hazard assessment. These studies, however, have not produced significant tumors except for one injection test at an exceedingly high concentration.[15] However, the fact that rock wool fibers, when intentionally inserted into animals, have produced tumors may not be a practical analysis for casual exposure. Based primarily on these studies using nonphysiologic routes of exposure, IARC considered the animal evidence as limited for rock wool and inadequate for slag wool and, following its own guidelines, classified both rock and slag wool as a "2B, possibly carcinogenic to humans."[14]

Some of the mineral wool insulation manufactured before about 1970 has been found to contain lead particles. According to industry sources, lead slag is no longer used in the manufacture of mineral wool, although lead can be present as a trace impurity.[16]

Rock and slag wool fibers are a source of skin irritation. This irritation is a mechanical reaction of the skin to the ends of rock and slag wool fibers that have rubbed against or become embedded in the skin's outer layer. Workers in contact with mineral wool during manufacturing processes or installation are susceptible to this temporary nuisance. It can be relieved by washing the exposed skin gently with warm water and mild soap.

Eye irritation occurs when rock wool or slag wool are deposited in the eye by the user's fingers or through airborne mineral wool fibers. If this occurs, the eyes should not be rubbed but rinsed thoroughly with warm water. A doctor should be consulted if the irritation persists.

If sufficient amounts of rock wool and slag wool are released into the air during manufacture or handling, some workers may experience temporary upper respiratory tract irritation. Such exposures to high concentrations of airborne rock and slag wool fibers may result in temporary coughing or wheezing, a mechanical reaction. These effects will subside after the worker is removed from exposure. The use of approved National Institute of Occupational Safety and Health (NIOSH) respiratory protection can effectively control upper respiratory tract irritation by limiting exposure to airborne fibers.

Fire resistance

Rock and slag wool fibers are noncombustible.

Installation standards and practices

Certified contractors, if available, should install a proprietary wet-spray rock wool insulation product. It is still prudent, whether installing or observing an installation, to follow a number of general work practices during spraying. These general work practices, applicable to all work involving synthetic vitreous fibers (SVFs) such as rock wool and slag wool, have been established by OSHA.

These are listed in the sprayed-in-place fiberglass section of this chapter.

Appendix

The Blow-in Blanket Contractors Association (BIBCA)
1051 Kennel Drive
Rapid City, SD 57701
800-451-8862

The Energy Efficiency and Renewable Energy Clearinghouse (EREC)
P.O. Box 3048
Merrifield, VA 22116
800-DOE-EREC (363-3732)
Fax: 703-893-0400

Cellulose Insulation Manufacturers Association (CIMA)
136 South Keowee Street
Dayton, OH 45402
937-222-2462

Insulation Contractors Association of America (ICAA)
1321 Duke Street, Suite 303
Alexandria, VA 22314
703-739-0356

North American Insulation Manufacturers Association (NAIMA)
44 Canal Center Plaza, Suite 310
Alexandria, VA 22314
703-684-0084
Fax: 703-684-0427
E-mail: *insulation@naima.org*
Website: *http://www.naima.org*

Ark-Seal, Inc., International
2190 So. Klammath Street
Denver, CO 80223
800-525-8992
303-934-7772
Fax 303-934-5240
E-mail: *arkseal@hotmail.com*

Cocoon/Greenstone
6500 Rock Spring Dr.
Suite 400 Bethesda, MD 20817
888-592-7684
Fax: 402-379-2780
http://www.greenstone.com/

Guardian Fiberglass, Inc.
Gary Romes
1000 East North Street
Albion, MI 49224
800-748-0035
517-629-6361
Fax: 800-748-0437
E-mail: *fiberglass_webmaster@guardian.com*

Thermafiber Mineral Wool
James Shriver
3711 W. Mill Street
Wabash, IN 46992
219-563-2111
Fax: 219-563-8979
E-mail: *jshriver@thermafiber.com*

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