CELLULOSE The Perfect Insulation

DENSE-PACK

In new construction, dense-pack cellulose is often blown behind an air-permeable polypropylene netting using a professional blowing machine. Achieving the proper density (at least 3½ lb. per cu. ft.) pushes the netting out beyond the face of the framing, so installers use an aluminum roller to flatten the material prior to hanging drywall. Properly installed, dense-pack cellulose is fully self-supporting, even if the netting is removed.

LOOSE-FILL

Loose-fill cellulose is typically seen in attic floors. Densely packed bales of cellulose are broken apart and fed into the cellulose blower's hopper, where the material is agitated and blown onto the attic floor through a 2½-in.-dia. to 4-in.-dia semicorrugated hose. To stop air leaks, installers must first air-seal any penetrations (can lights; holes around pipes, ducts, and cables; and the gap around chimneys) before blowing. Loose-fill settles about 10% after installation, so this must be accounted for when planning how deep to blow in the insulation.

DAMP-SPRAY

Damp-spray adds water and sometimes adhesive to the cellulose fiber at the end of the blowing hose so the cellulose sticks to the framing. Cavities are overfilled and then the excess removed with a rotating brush and vacuumed up for reuse. Although damp-spray involves less prep work and installs faster than dense-pack, it's tough to find installers who use this method, and it doesn't work for roofs or ceilings as it doesn't adhere well enough to support its own weight.

Cost-effective, versatile, and green, cellulose may be the hardest-working insulation available

BY MICHAEL MAINES

No other insulation takes less energy to produce, uses more recycled content, or is less toxic to humans than cellulose. It has respectable R-values, resists air movement, absorbs sound, and is highly resistant to fire, pests, and moisture. No insulation is perfect for every situation, but my first choice whenever it will do the job is cellulose.

A lot of older attics feature a thin layer of flaky, dusty cellulose, blown in sometime between the 1950s and 1970s, but cellulose didn't really take off until the 1990s, when high-powered blowers, insulation netting, borate treatment, and fiberizing combined to create an insulation product that was cost-effective and versatile with three common methods of installation: loose-fill, dense-pack, and damp-spray.

The installation cost of loose-fill, which is most common on attic floors, starts at $1.30 to $2 per sq. ft. of floor. This assumes you're working with a reasonably accessible attic and an insulation layer from R-38 to R-60. Expect to pay several hundred dollars more for setup, breakdown, and air-sealing measures.

The cost of dense-pack installation, which is used in both new construction and remodeling, starts at about $2 per sq. ft. of wall area. Projects with difficult access and those requiring scaffolding or extension ladders will cost more, as will air-sealing measures. Double-stud walls and extra-deep ceiling cavities also cost more (in the $3 to $4 per sq. ft. range), and are best done by creating "cells" with scraps of netting, as large cavities don't allow for consistent packing.

I'm not aware of any damp-spray installers here in Maine where I work, but I'm told it works out to $1.25 per sq. ft. for 2x4 walls and $1.75 per sq. ft. for 2x6 walls.

In addition to the bagged product used in the three installation methods described above, one company, Cellulose Material Solutions (cmsgreen.com), makes cellulose batts and blankets. The batts are meant to replace fiberglass or mineral-wool batts and the blankets give fans of cellulose a replacement for rigid foam and semirigid mineral-wool insulation. □

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Photo middle: John Patriquin/Portland Press Herald via Getty Images

ONE MATERIAL MULTIPLE METHODS

Whether it's dense-pack, damp-spray, loose-fill, or made into batts or blankets, all cellulose insulation starts with the same raw material: recycled paper. Most manufacturers use recycled newspaper (80% to 85% by weight) to make cellulose insulation, although new start-up UltraCell (ultracellinsulation.com) is working on cellulose made primarily from recycled cardboard, which is less dusty than newspaper. The remaining 15% to 20% of the cellulose mix is boron compounds, which act as a fire retardant and pest deterrent. Some products substitute ammonium sulfate, sodium sulfate, or magnesium sulfate for some of the boron compounds. These sulfates are less expensive fire retardants, but there are some claims of an unpleasant odor and possible corrosion issues when exposed to moisture.

R-value

The R-value of cellulose is based mainly on its installed density, with denser installations generally delivering higher R-values. Loose-fill cellulose has an R-value of R-3.7 to R-3.8 per in., while damp-spray and dense-pack assemblies are rated at R-3.6 per in. or higher depending on its installed density. The difference in appearance between a proper dense-pack installation and one with a lower R-value that is prone to settling or air leaks is tough to spot in existing construction, so you should ask for empty bag counts from the insulation contractor. Knowing the weight and number of bags blown and then doing some quick math to determine the density of the installed insulation will ensure you're getting a quality job.

Fire control

Cellulose insulation is so fire-resistant you can melt a penny with a propane torch while it sits on a handful of cellulose and the material will be only slightly charred. Its performance during a fire is backed up by its Class 1/Class A fire rating (it has a flame-spread rating of 15 or less and a smoke-developed index of 5 or less). These properties mean that cellulose will smolder, but it won't burn without applying a high-temperature flame. Nu-Wool and other manufacturers offer over 50 UL-listed fire-rated assemblies, some providing up to three hours of fire resistance.

Air control

Cellulose is not technically an air barrier on its own, although at sufficient densities it can slow air movement enough to meet the envelope airtightness requirements of the 2012 IRC (3 ACH50 for most climate zones) without an additional air barrier. Cellulose's air-sealing qualities are especially useful in retrofit work where existing walls are left intact and the cellulose is installed though holes made in the home's exterior or interior. Cellulose is also less affected by wind-washing—a condition where air moving past the insulation reduces its insulating ability—than unprotected fiberglass batts or blown-in fiberglass. (See assembly details pp. 64.)

Sound control

Cellulose performs well in assemblies meant to minimize sound because its small fibers fill the voids that transmit high-frequency sound and its density helps dampen lower frequencies. One maker's testing shows that a cellulose-insulated 2x4 wall spaced 16 in. on-center with no exotic sound-control measures (only cellulose and air-sealing) could achieve an STC (sound transmission class) of 41, and a double-stud wall could reach STC-61, which is virtually soundproof. According to the same company, a typical wall insulated with fiberglass batts is STC-39.

Water resistance

Due to its unique makeup, cellulose has a helpful relationship with water. It can take on and release moisture seasonally as it pulls moisture away from framing and sheathing. Research done by Building Science Corp., a leader in building science and technology, found that although computer modeling predicted high moisture levels and data loggers confirmed this on a superinsulated project in Western Massachusetts, when they opened the walls they found no evidence of damage.

Environmental impact

According to the Cellulose Insulation Manufacturers' Association, cellulose production diverts almost one-million tons of paper waste from landfills annually in the United States, and insulating a single 1,500-sq.-ft. house with cellulose will recycle as much newspaper as an individual will consume in 40 years. As long as the recycled content is at least 10% (it usually is) and is manufactured within 500 miles (there are a lot of manufacturers spread throughout the country), cellulose insulation is worth LEED points and the NAHB's Green Building Program points.

Mold/fungus resistance

Testing conducted by Building Science Corp. found no evidence of mold or fungal growth in cellulose insulation, even when environmental conditions are conducive to growth (meaning 100% relative humidity and temperatures above 50°F.) A four-year study conducted at Truman State University found that even a 5% borate treatment was enough to effectively halt mold and fungal growth, and cellulose includes even higher percentages of borates (in the range of 15% by weight) in order to meet fire-resistance requirements.

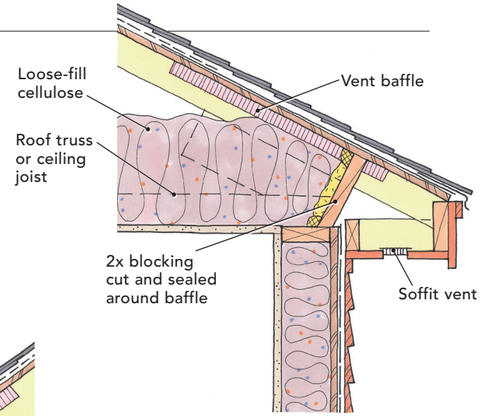
Photos this page and facing page: Rodney Diaz

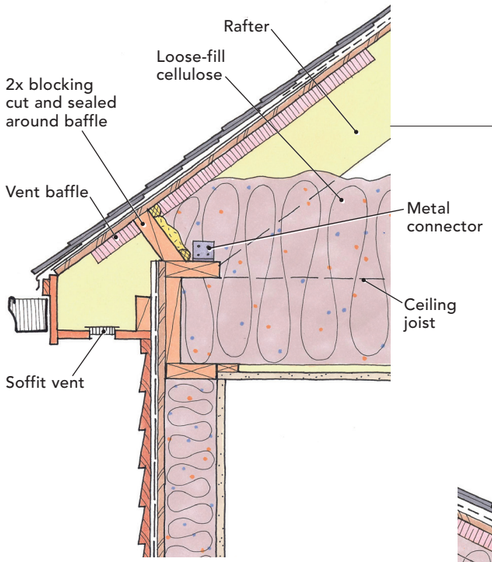
COMMON ASSEMBLIES

Like any air-permeable insulation, cellulose will only perform to its highest potential if installed as part of a well-designed assembly that controls airflow.

Loose-fill attic

Inexpensive and effective, a loose-filled attic is the most common use of cellulose insulation. Before blowing, any penetrations and air leaks in the ceiling drywall should be sealed and vent baffles installed to provide ventilation and reduce wind-washing.



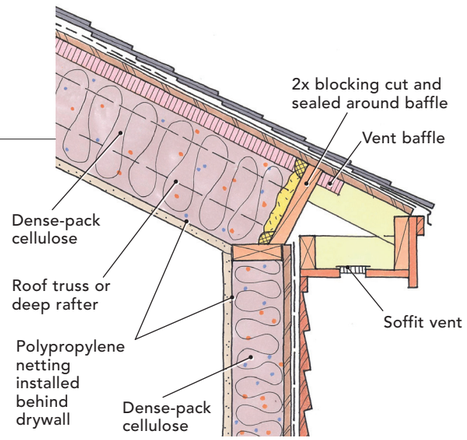


Deep loose-fill attic

Moving the top plate and rafters up to the top of the ceiling joists provides more room for a deep layer of cellulose. Complete any air-sealing before installing the insulation. Extra-deep fills (more than 12 in.) may require strapping or other reinforcement of the ceiling drywall, especially when framing is 24 in. o.c.

Dense-pack wall and ceiling

Contained with non-woven netting stapled to the framing, dense-packed walls and ceilings should be blown to a density of at least a 3½ lb. per cu. ft. to prevent settling and achieve the specified R-value. Cavities deeper than 12 in. should be divided into smaller sections with the netting so they can be filled enough to resist settling.



Dense-packing takes time

With dense-pack cellulose, installing the polypropylene netting (insulweb .com) often takes as long as filling the bays. Properly installed, the netting is tight and usually "lip stitched," meaning it's fastened to the corners of framing members and not just to the face that receives the drywall. Deep cavities also require that installers create smaller cells within the cavity, so the cellulose can be installed at a high enough density to resist settling. Installers use an upholstery stapler with an extended magazine to fasten the netting, and the spacing between staples should be so tight that the staples nearly touch.

Drawings: Martha Garstang Hill; Photo facing page top: Andy Engel

COMING TO A JOB NEAR YOU

If you're using cellulose for the first time, you'll want to keep these things in mind.

You still have to air-seal

Like all fibrous insulation, cellulose requires proper air-sealing to work effectively. Gaps around windows and doors as well as any other penetrations in the air barrier should be fully sealed. Although some weatherization professionals prefer air-sealing tapes or non-hardening acoustical sealant, canned spray foam is generally the go-to choice for filling most small or narrow gaps. Larger holes and gaps are closed off with rigid insulation held in place with a perimeter bead of spray foam.

Make room

Cellulose insulation contractors generally have a box truck or medium-sized trailer to house their tools, blowing equipment, and bales of cellulose. Although some trucks have a generator on board, most plug in to the house's power and require two 15-amp circuits—one for the blower and one for the agitator. The smallest setups take up two parking spaces and dense-packing an entire house or large addition will have the truck taking up this amount of space for several days.