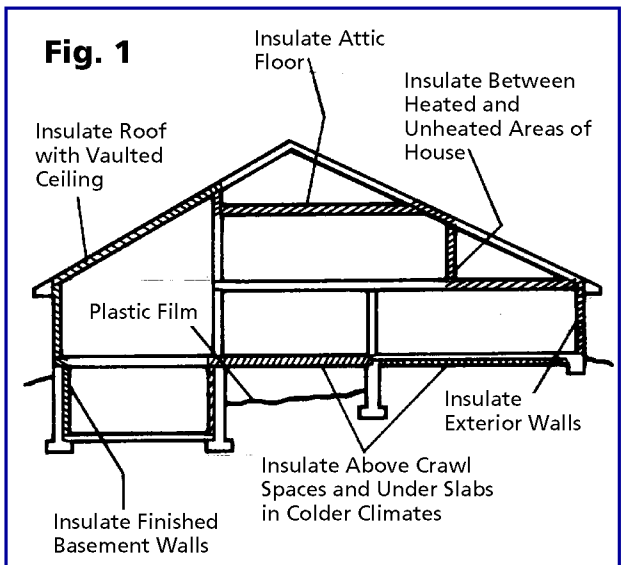
HOW-TO BOOKLET #3065

INSULATION: HOW MUCH IS ENOUGH

TOOL and MATERIAL CHECKLIST

- ❑ Measuring Tape
- ❑ Screwdriver
- ❑ Flashlight
- ❑ Calculator
- ❑ Ladder (or Built-in Attic Access)

Read This Entire How-To Booklet for Specific Tools and Materials Not Noted in the Basics Listed Above.



Areas to insulate

One of the fundamental laws of physics is that heat flows from a warm space to a cool space. For a home, this means that the heat of summer comes into your house, while any heat in your house flows out during the cold of winter. Heat, in fact, flows constantly through the walls, ceiling, and floor of your home. Insulation is the ability of a material to restrict this flow of heat. Almost all materials have some degree of insulating quality, though some are much more effective than others. The effectiveness of an insulating material is measured by its resistance to the flow of heat, or thermal resistance. This thermal resistance is called the R-value of the material. The higher the R-value, the more effective the material is in restricting the flow of heat.

WHY INSULATE YOUR HOME?

There are some notable advantages to insulating your home. They are listed below.

Reduced Heating and Cooling Costs. The main reason for insulating is to lower the cost of heating and cooling a home. The more insulation you have, the less heat flow to and from the outside will occur. Your heating and cooling system will run less, thus giving you lower monthly utility bills. Energy savings is often the sold consideration when making the decision whether to insulate or not, as well as how much insulation to install.

Increased Comfort. A home that is well insulated and sealed form the weather is comfortable at 65 to 68 degrees Fahrenheit during the winter. A home that is not properly insulated requires a temperature at least three degrees higher to achieve a similar level of comfort. But the comfort level is still not quite the same, since trying to heat or cool a house that has poor insulation and weatherstripping creates "hot" and "cold" spots. Factoring in the effects of air drafts, the result is that you simply cannot get as comfortable in a poorly insulated home as you can in one that is well insulated.

Increased Home Value. Simply stated, a well-insulated home is worth more at resale time. For instance, by bringing your attic up to the insulation specifications for your area, the average increase in value is about double the cost if you do the insulating yourself.

Environmental Conservation. Since a well insulated home uses less energy, the amount of fuel required is reduced. This not only conserves natural resources, but also lowers the amount of pollutants going into the atmosphere.

Reduced Noise Levels. Insulation helps to reduce the amount of sound that passes through an exterior wall or ceiling, thus keeping your home quieter inside. Many homes have unfaced insulation in the interior walls as well in order to reduce the amount of noise. While placing insulation in a standard wall cavity will reduce the amount of sound passing through, the reduction may not be enough for some soundproofing purposes. If you want to build a quiet room in your home for something like audio recording, other measures such as staggered stud or split stud framing will need to be combined with the insulation. You would also need to carefully weatherstrip all doors and windows in the room, including interior doors.

COMMON INSULATION AREAS

Generally, you should place insulation in a wall, ceiling, or floor between heated and unheated spaces (**Fig. 1**). If your attic is not used for living space, insulate between the joists that form the floor of the attic. If your attic does contain living space, insulate between the studs in the walls and between the rafters for ceiling joists, whichever is between heated and unheated space.

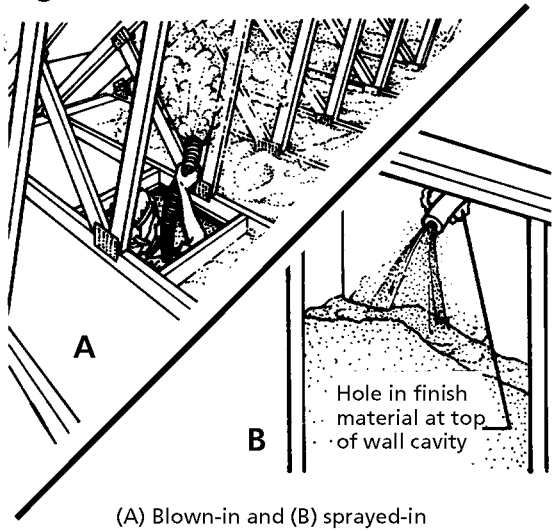
Insulate exterior walls, unheated garages, unheated sunrooms, and any other unheated areas. Insulate floors that overhang a lower floor, as well as floors over cold spaces such as crawl spaces, unheated basements, and unheated garages. Insulate beneath concrete slabs in colder climates. For crawl spaces and overhangs, insulate the floor above, ventilate, and spread plastic film over the ground. Insulate basement walls if the basement contains living space. In extreme cold climates (**zone 8 on the map in Fig. 4**), a specialist should be consulted when insulating basement walls.

TYPES OF INSULATION

The most common types of insulation are discussed below. While this is not a comprehensive list, other insulating materials (reflective insulators, for example) are less effective than those presented here.

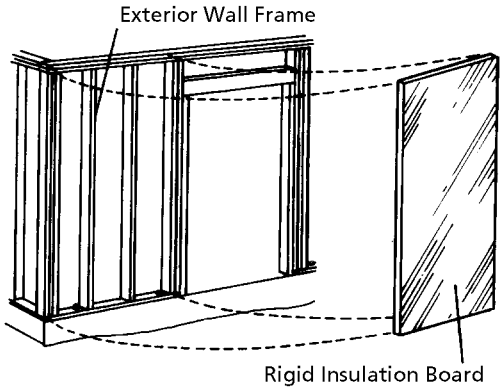
Batts and Blankets. Batts and blankets are the most common type of insulation, particularly for do-it-yourselfers; they are what most people imagine when they think of insulation. Batts and blankets are made from either rock wool or, more commonly, fiberglass. Blankets are continuous rolls that are hand cut to fit the application. Batts come in precut 4' and 8' lengths. Batts and blankets are available in two widths: one for 16" stud or joist spacing and one for 24" spacing. Both come with a foil or paper facing as a vapor barrier, or they can be unfaced. This is the easiest insulation material for the do-it-yourselfer to install in most applications. Batts and blankets cannot, however, be used in existing finished walls without removing the finish material on one side.

Fig. 2



(A) Blown-in and (B) sprayed-in

Fig. 3



Rigid insulation board

Loose Fill. Loose fill is commonly used to add insulation to attics and to existing finished walls. There are a variety of materials used for loose fill, including cellulose (shredded and treated newsprint), fiberglass, rock wool, vermiculite or perlite beads, and others. Vapor barriers must be installed separately when using loose fill. This is particularly important for cellulose loose fill, since vapor can turn cellulose into a soggy mess that is totally ineffective. Loose fill materials come in bags and bales. Some of them are poured directly from the bag and others can be placed by hand (be sure to wear gloves). All are easily installed in an attic floor and in existing finished walls. Loose fill poured directly from the bag can be installed by do-it-yourselfers, while other types may require professional installation.

Blown-In. Blown-in insulation is loose fill, including loose fibers or fiber pellets, that is installed in attics and finished walls using a blower (**Fig. 2A**). This is normally done by a professional, but there are types that can be installed by a do-it-yourselfer using a blower rented from a building supply store. Another type of blown-in insulation is cosprayed with an adhesive. It takes a few days for the insulation to cure, after which it is resistant to settling and provides an effective seal of cavities.

Sprayed-In. Plastic foam insulation can be sprayed in as a liquid foam that solidifies in place (**Fig. 2B**). It is an excellent insulator for filling the cavities of existing finished walls, and does not require a separate vapor barrier. However, installation is expensive, it requires special equipment, and must be done by a professional.

NOTE: Never use urea-formaldehyde sprayed-in insulation. It emits a hazardous vapor and also shrinks, leaving gaps in the insulation.

Rigid. Rigid insulation is a stiff board that is relatively easy to handle (**Fig. 3**). These boards usually come in 4' widths, 8' and 9' lengths, and a variety of thicknesses. The boards are made of polystyrene (styrofoam) or isocyanurate, and can include a foil facing that acts as a vapor barrier and provides additional insulating value when facing a dead air space. Rigid boards have high R-values for their thickness and are normally used under the siding on the exterior of a home, or above the rafters on a vaulted ceiling where the rafters will be exposed. They also provide a measure of sound insulation. Rigid boards are somewhat expensive, however, and must be covered with another finish material for fire-proofing purposes.

R-VALUES

The first step in determining how much insulation is needed is to obtain the optimal R-value of insulation for your home. The R-value needed depends on the type of insulation to be used and the climate in which you live. The United States Department of Energy (DOE) has established optimal R-values for walls, floors, and ceilings in each of eight different zones in the continental United States (**Fig. 4**). As a point of comparison, Hawaii, Puerto Rico, and the Virgin Islands are in zone 1; all of Alaska and most of Canada are in zone 9. Find your locality on the map to determine which zone you live in, then consult the accompanying chart for the recommended R-values in your area. If you are on a borderline, use the higher number zone.

Some manufacturers of insulation recommend slightly different values than those found in the R-value chart—particularly for exterior walls. As shown in the chart, the DOE recommends R-11 for exterior walls in all zones. This is based on the maximum value for fiberglass batts that were found to fit in 2X4 wall at the time the recommendations were developed. Some manufacturers recommend R-13 for existing exterior walls and R-19 for new exterior walls. This is based on increased fuel costs and new manufacturing capabilities. They and other companies now make insulation for 2X4 walls with a value of R-13 and R-15. Some manufacturers, in fact, no longer produce R-11 material. R-19 can be achieved by building 2X6 exterior walls, or with 2X4 walls by using R-13 material and a 3/4" foil-covered rigid insulation on the outside of the exterior wall, beneath the siding.

You should call your local building department and request the recommended R-values for your area. It is possible that local codes might be higher than the recommendations given here. After consulting both sources, use the higher figures. For new construction, determine the type of insulation to be used, then compute the number of inches of insulation needed to achieve the R-values for your area. This can be done by finding the type of insulation you are using on the material R-value table. Divide the R-value per inch into the R-value for your zone to get the inches of insulation needed.

TABLE OF MATERIAL R-VALUES

MATERIAL	R-VALUE (PER INCH)
Batts and Blankets:	
Glass Fiber	3.3
Rock Wool	3.7
Loose Fill and Blown-In:	
Perlite	2.7
Vermiculite	2.4
Cellulose	3.6
Glass Fiber	2.2
Rock Wool	2.9
Rigid Boards:	
Molded Polystyrene	4.0
Extruded Polystyrene	5.0
Fiberglass Board	4.5
Isocyanurate Board	6.0 to 7.0
Phenolic	8.0

CHECKING EXISTING INSULATION

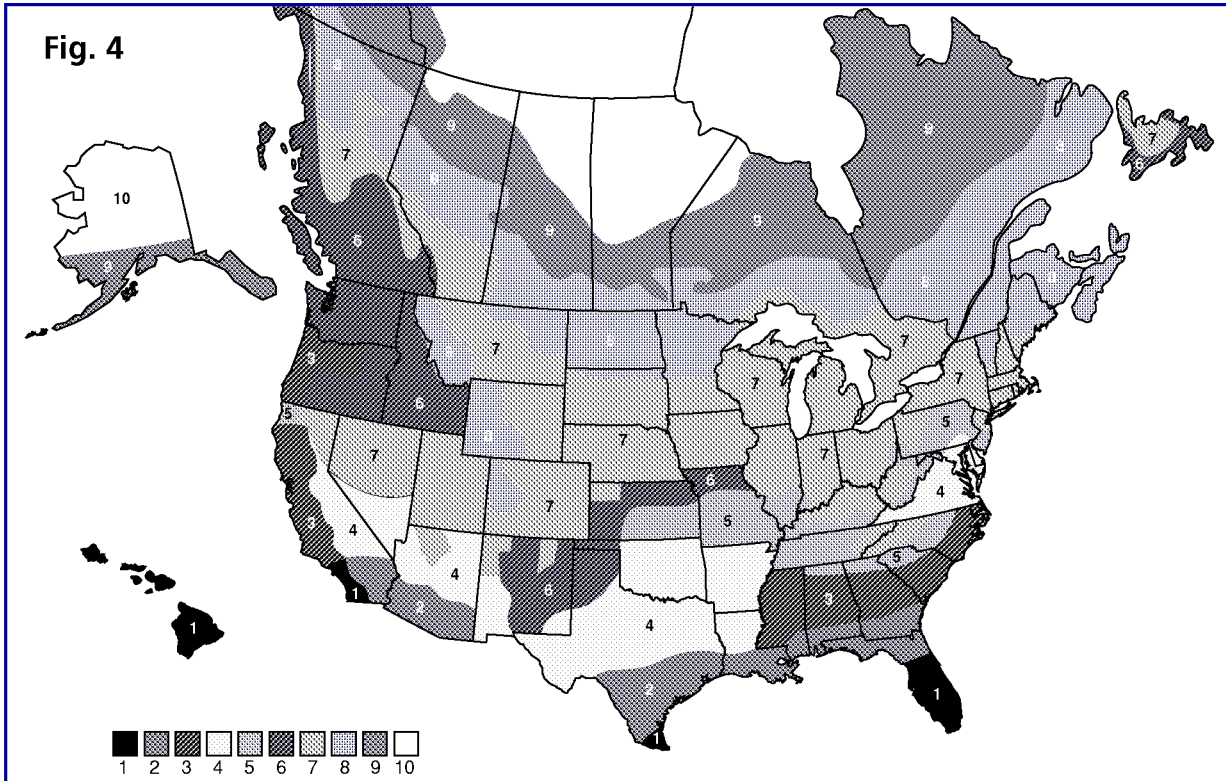
For existing construction, the next step is to determine the R-value of the insulation you have, if any. Start with the attic. Determine what type of insulation there is, then measure the average thickness. Use the material R-value table to find the R-value for 1" of the material in your home. Multiply this figure by the number of inches of insulation you have to determine the R-value of the existing insulation. Subtract this number from the optimal R-value to determine the additional insulation needed.

It is perfectly acceptable to mix types of insulation, but the heavier type should be on the bottom. For instance, your attic might have blown-in insulation and you want to add more insulation. The easiest type of install is blankets. Simply lay the blankets over the existing insulation, making them perpendicular to the joists for standard construction and parallel to the joists for trussed roofs.

Walls are a little more difficult since you can't see inside them. The easiest way to determine if you have wall insulation is to remove a switch plate or plug plate and look around the electrical box. Be sure to turn the circuit breaker off first. If you have fiberglass insulation and 2X4 construction, the existing R-value is probably 11—unless your home is brand new. For 2X6 construction, the R-value will be 19 if the cavity is completely filled with fiberglass insulation. Compute the amount needed for walls and floors in the same manner just described for attics.

The utility company or agency in your area or your local building department may perform an energy audit for you free or at minimal cost. If survey services are provided, they can range from determining what R-values you have to giving you a complete report on exactly what you need to do to bring your home up to codes. Once you determine just how much insulation you need, read How-To Booklets #3086: Insulate an Attic, and #3087: Insulate Sidewalls, to find out how to install the insulation.

Fig. 4



RECOMMENDED TOTAL R-VALUES FOR EXISTING HOUSES IN TEN INSULATION ZONES[a]

Component	Ceilings Below Ventilated Attics		Floors Over Unheated Crawl Spaces, Basements		Exterior Walls[b] (Wood Frame)		Crawl Space Walls[c]	
Insulation	Oil,Gas, Heat Pump	Electric Resistance	Oil,Gas, Heat Pump	Electric Resistance	Oil, Gas, Heat Pump	Electric Resistance	Oil, Gas, Heat Pump	Electric Resistance
1	19	30	0	0	0	11	11	11
2	30	30	0	0	11	11	19	19
3	30	38	0	19	11	11	19	19
4	30	38	19	19	11	11	19	19
5	38	38	19	19	11	11	19	19
6	38	38	19	19	11	11	19	19
7	38	49	19	19	11	11	19	19
8	49	49	19	19	11	11	19	19
9	49	49	19	19	11	11	19	19
10	55	55	19	19	11	11	19	19

a These recommendations are based on the assumption that no structural modifications are needed to accomodate the added insulation.
b R-Value of wall insulation, which is 3-1/2 inches thick, will depend on material used. Range is R-11 to R-13. For new construction R-19 is recommended for exterior walls. Jamming an R-19 batt in a 3-1/2 inch cavity will not yield R-19.
c Insulate crawl space walls only if the crawl space is dry all year, the floor above is not insulated, and all ventilation to the crawl space is blocked. A vapor barrier (e.g., 4- or 6-mil polyethylene film) should be insulated on the ground to reduce moisture migration into the crawl space.