INSULATION CONTRACTORS ASSOCIATION OF AMERICA

Technical Bulletin

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No. 33: LOOSE-FILL INSULATION - MEASUREMENT AND COMPLIANCE

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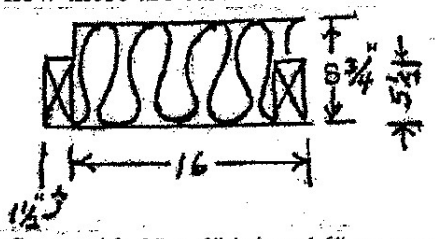
SECTION 1 - MEASURING THE JOB

Once the gross insulatable area is established, the net area can be calculated by adjusting for the volume of the framing members. Most insulation manufacturers have adjustment factors to compensate for the attic joist area. These are based on the calculation approach below but some may also include some additional small adjustments for overlaps, bracing, etc. Some manufacturers choose to use a multiplier to compensate for joist space. The illustration below shows how these are calculated:



Looking at a cross section of an attic floor with 2" x 6" joists 16" on center, we can see that the cross-sectional area for an R-19 (minimum thickness) installation is 16" x 8 3/4" or 140 square inches. The 2" x 6" joist occupies a space 1 1/2" or 8.25 square inches. The percent of the blown space to the whole is:

$$\frac{140 - 8.25}{140} \quad \text{or} \quad \frac{131.75}{140} = .941$$

For 24" on center this would be:

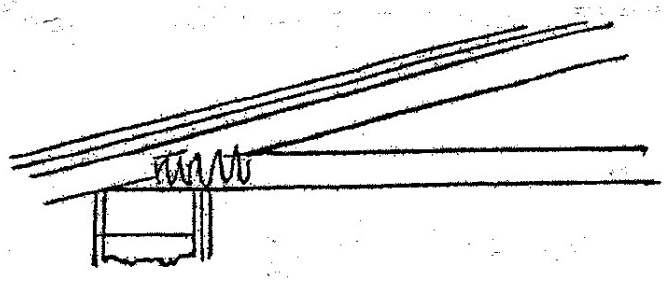
$$\frac{210 - 8.25}{210} = .961$$

To use these adjustment factors, multiply the total square footage by the adjustment factor to calculate the net square footage. Use this resultant number in calculating the amount of insulation required for the desired R-value.

MEASURING THE HOUSE

Most builders and contractors agree that the total (or gross) attic should be measured from the outside of the top plate on one side to the outside of the top plate on the other side. However, it often is impractical to determine the gross area by any other means than the exterior house measurements. For standard frame construction these lengths and widths are adequate, but for other type walls, they may be too large. In these cases some contractors have used the following technique for determining the gross insulatable area from the exterior measurements. The specific factors will vary with different constructions.

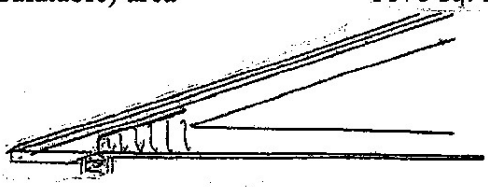
Exterior Measurements 30' x 40'	= 1200 sq. ft.
Factor for masonry block wall thickness	= .94
Gross (insulatable area)	= .94 x 1200 - 1128 sq. ft.



BLOCK CONSTRUCTION

In a similar fashion the gross (insulatable) area may be reduced by the planned installation of ventilation baffles. This can be accommodated by a factor to account for the (2" or so) reduction in the <u>width</u> of the attic floor.

Exterior Measurements 30' x 40'	= 1200 sq. ft
Factor for ventilation baffles	= .98
Gross (insulatable) area	= 1176 sq. ft.



FRAME CONSTRUCTION WITH BAFFLES

<u>CALCULATING THE MATERIAL NEEDED</u>

Multiply the gross (insulatable) area by the manufacturer's framing adjustment factor to get the net square footage. The bag count for this area (from the bag label) will be the minimum count required to insulate the net measured area.

<u>SECTION 2 - EVALUATING R-VALUE USING COOKIE CUTTING</u>

Installing loose-fill insulation is a technically demanding job. ICAA recognizes the need for a practical procedure to evaluate the installation of loose-fill products. This section provides a step-by-step procedure to determine if an open-blow installation meets the manufacturer's bag label specification.

The procedure described can be used to estimate the average square foot weight of loose-fill insulation and the average thickness when <u>only</u> one type of insulation has been used. The accuracy of this procedure will depend on the skill of the person conducting the evaluation, the care taken in securing and measuring the samples, and the number and location of samples used for the evaluation.

It is important to remember that this is only an evaluation of the installation. The accuracy of the measurement procedure is approximately +/- 2 1/2% but the variability of the installed product may be +/- 15%.

<u>EQUIPMENT REQUIRED:</u> The following lists the equipment necessary to perform the evaluation:

- Sampling tool

- Scale
- Probe
- Steel rule
- Plastic bags
- Identification labels
- Knife
- Flashlight
- Gloves

Scale: Spring type scales are usually not accurate enough for this task. The most accurate type of scale would be a digital electronic balance. These balances are usually accurate to within +/- 2 grams or +/- 0.004 pounds.

Probe and rule: A satisfactory probe can be fabricated from 1/8 inch diameter welding rod. A probe 24 inches long and pointed on one end has proven to be effective. A steel rule graduated in either hundredths of an inch, sixty-fourths of an inch, or millimeters is satisfactory for measuring thickness.

Plastic bags: Larger, locking-lip type works well to hold sample or any medium size plastic bag with twist tie.

Identification labels: Adhered to or placed in bag to keep track of samples.

Sampling Tool: Construct a sheet metal coring cylinder at least 18 inches in length or longer than the thickest insulation to be sampled. A cylinder with a serrated edge will separate the material much easier when taking the insulation sample.

The cross sectional area of the sampling tool must be accurately determined. A 13.54 inch inside diameter cylinder equals one square foot area.

Note: Cross sectional area (sq. ft.) = .005454 x (cylinder diameter in inches)^2

COLLECTING LOOSE-FILL ATTIC SAMPLES

Initially, a visual inspection of the attic area is necessary to note the evenness of the loose-fill insulation and the uniformity of depth. There should be no low areas or voids in the insulation. A probe and measuring rule will be used to check the actual thickness of the insulation.

REMEMBER: Four points of caution must be exercised while making an attic inspection:

- Wear longsleeve, loose-fitting clothing, gloves, and eye protection when handling material. A disposable mask designed for nuisance type dust is advisable when high dust levels are encountered.

- Since moving about the attic is required, the inspector must be careful of his footing. Step only on the joists. Walking in the area between joists can result in falling through the ceiling drywall, causing injury to the inspector and damage to the house.

- The inspection procedure disturbs the integrity of the insulation thus reducing its thermal effectiveness. Therefore, be sure to restore any disturbed insulation as close to its original condition as possible.

- Be careful to avoid body contact with protruding roof deck nails.

STEP-BY-STEP INSPECTION

It is important to take at least three samples or one sample for every 400 sq. ft. of insulated area, whichever is larger. Sampling within four feet of the access opening should be avoided. Samples must be representative of the entire attic area.

Step A. Select sample locations from between joists where the insulation is level and undisturbed.

Step B. Measure the thickness of insulation at each sample location using the probe and rule. The thickness for a selected sample should be the average of five thickness measurements made inside the envisioned coring area. Record and average the measurements.

Step C. Take a plug of the loose-fill insulation with the sample tool at the point where depth measurements were made. Work the cylinder of the tool into the insulation perpendicular to the loose-fill surface, rotating the tool back and forth so the serrated edge creates a circular sawing action. Work the cylinder all the way through the insulation until it meets the ceiling or backing material underneath.

WARNING: Care should be taken to check the area before rotating the sampling tool to make sure there is no wiring that could be damaged or cause electrical shock to the inspector.

Step D. Remove the insulation from within the cylinder and place it in the plastic bag.

Step E. Weigh the bag containing the sample. The weight of the bag must be subtracted from the total weight to obtain the weight of insulation. Divide the sample weight by the sq. ft. area of the coring cylinder to determine the sample sq. ft. weight. Record the sample sq. ft. weight with the average sample thickness determined in **Step B.**

Step F. Once the sample has been weighed, return the insulation to the place from which it was taken, making sure that the insulation is returned to its original condition as closely as possible.

EVALUATING THE RESULTS

You should have at least three sample measurements. Each sample measurement should provide: 1) the sample sq. ft. weight in pounds (sample weight of insulation in pounds divided by the sq. ft. area of the sampling tool); and 2) the sample average thickness (average of fine probe measurements).

Now average these values to get an attic average to make the comparison to the manufacturer's bag label specification.

Bag Label Specification - To evaluate the results, compare the attic average sample sq. ft. weight and attic average sample thickness with the loose-fill bag label minimums. If both minimum conditions are equaled or exceeded, the bag label R-value conditions have been met within the sampling accuracy previously stated.

The following tables are useful in carrying out the inspection procedure:

TABLES

OUNCES/POUND CONVERSION	
Oz.	Lb.
1.0	= 0.0625
1.5	= 0.0938
2.0	= 0.1250
2.5	= 0.1563
7.0	= 0.4375
10.0	= 0.6250

GRAMS/POUNDS CONVERSION	
g.	Lb.
50g	= 0.110 lb.
100g	= 0.220 lb.
125g	= 0.275 lb.
150g	= 0.330 lb.
300g	= 0.660 lb.
575g	= 1.265 lb.

For pricing and availability of the sampling tool to perform cookie cutting, contact Conklin Metal Industries, 404-688-4510.

SECTION 3 - EVALUATING R-VALUE IN IMPROVED EXISTING ATTICS

Improving thermal performance in existing homes usually includes installing additional insulation over existing attic insulation. Existing insulation may be in the form of either batts (fiber glass or rock wool) or loose-fill (fiber glass, rock wool, or cellulose).

Existing insulation may become significantly disturbed during the life of a structure. Attics of some older homes may have little insulation in some areas due to code requirements at the time of construction.

Often it is difficult to estimate the R-value of existing insulation with great accuracy. Thus, contractors, utility auditors, and homeowners face a common dilemma in determining how much more insulation to install over existing insulation in order to achieve an R-value in keeping with modern standards of energy efficiency. Verification of improved R-value is extremely important if energy-efficient HVAC is to operate correctly and energy cost savings are to be realized.

This section addresses problems associated with auditing the R-value of existing insulation prior to retrofit, determining what form of insulation to add, and determining how much R-value to add to achieve the desired level of improved R-value. Here are three options by which the final R-value in retrofitted attics may be confidently verified:

OPTION 1 - BATTS OVER BATTS

The retrofit and original insulation is batt insulation. Batts are marked for identification of R-value.

OPTION 2 - LOOSE-FILL OVER BATTS

The retrofit insulation is loose-fill installed over batts.

OPTION 3 - LOOSE-FILL OVER LOOSE-FILL

The retrofit insulation is loose-fill installed over loose-fill insulation.

Care and skill are required to accurately audit R-values in existing attics. Existing loose-fill insulation may vary in thickness from one location to another within an attic. Batts may be installed in one location but loose-fill in another. Voids may exist where no insulation was installed. Existing insulation may have been made by manufacturers no longer in business. Older batts may have no marking to identify their R-value. Older loose-fill may not have an accompanying attic card.

If no identifying marks are present, contractors and auditors should use the following procedure to assess the existing R-value:

(1) Identify the form and type of insulation:
a. Batts - fiber glass or rock wool.
b. Loose-fill - fiber glass, rock wool, or cellulose.

Experienced auditors easily distinguish among these forms and types of insulation most often encountered in attics of older homes.

(2) Estimate the R-value of existing insulation.

In the case of older batts, whether fiber glass or rock wool, their thickness is easily measured. Thicknesses and R-values may be correlated, as follows:

2" to 2 1/2" R-7
3" to 3 1/2" R-11
5 1/4" to 6 1/2"..... R-19

Thicknesses for respective R-values vary among manufacturers of similar types of batts. Rock wool batts were less thick than fiber glass batts having equal R-values. The above table is close enough for auditing.

In the case of loose-fill, first determine the type of insulation: Fiber glass may be either pink, yellow, yellow mixed with gray and/or green, or white fibrous material. Rock wool may range from light gray to dark gray/brown or off-white fibrous material. Cellulose is usually gray flecked with various ink colors, and sometimes is nearly white macerated paper and may turn brown with age.

Next, using a thin straight wire and ruler, make 10 to 15 probes to measure thickness in inches; judge whether or not the existing insulation is reasonably uniform in thickness, and locate any uninsulated voids. Calculate the average thickness in inches; then multiply the average thickness by the following generic R/inch values for the existing loose-fill insulation:

Fiber glass..... R-2.2
Rock wool..... R-3.0
Cellulose..... R-3.5

Attic rulers should be installed in plain view before blowing additional insulation; one per 500 sf (minimum of three). Attic rulers must be secured to framing and extend vertically up from the bottom of the ceiling joist or truss system.