



# Standard Guide for Determining Blown Density of Pneumatically Applied Loose-Fill Mineral Fiber Thermal Insulation<sup>1</sup>

This standard is issued under the fixed designation C1574; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

## 1. Scope

1.1 This guide describes two alternate procedures for determining blown density at a predetermined thickness or a range of thicknesses expected in field applications of mineral fiber loose-fill insulation.

1.2 This guide involves blowing a sample of loose-fill insulation into a test frame of known volume, measuring the weight of the insulation captured and calculating the blown density.

1.3 This guide is intended for pneumatically-applied loose-fill mineral fiber insulation designed for use in horizontal open attic spaces.

1.4 This guide is intended for product design and product auditing by manufacturers of loose-fill insulation. This guide is adaptable as a plant quality control procedure.

1.5 This guide does not predict the aged density of the mineral fiber loose-fill insulation.

1.6 *This standard does not purport to address all the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and to determine the applicability of regulatory limitations prior to use.*

1.7 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

## 2. Referenced Documents

### 2.1 ASTM Standards:<sup>2</sup>

**C168 Terminology Relating to Thermal Insulation**

**C1374 Test Method for Determination of Installed Thick-**

**ness of Pneumatically Applied Loose-Fill Building Insulation**

## 3. Terminology

3.1 *Definitions*—Terminology **C168** is applicable to the terms used in this standard.

### 3.2 Definitions of Terms Specific to This Standard:

3.2.1 *Variable blown density*—change in density exhibited by loose-fill insulation as a function of thickness.

3.2.1.1 *Discussion*—Some loose-fill insulation materials exhibit an increase in blown density when thickness increases. Also, the original thickness may or may not decrease with time resulting in the same or somewhat higher densities. This thickness vs density relationship should be considered when developing coverage information for the bag label.

## 4. Significance and Use

4.1 Blown density is used to develop loose-fill coverage charts. Data for blown density vs thickness is used in the development of a variable blown density presentation for loose-fill insulation.

4.2 Thermal resistance (and conductivity) of loose-fill mineral fiber insulation depends on density and thickness. The resulting blown density data is useful in developing an expression for apparent thermal conductivity as a function of density. This will in turn aid the manufacturer in developing coverage information for packages of loose-fill insulation.

4.3 The blown density obtained in this method is for the thickness of the test only. The relationship of blown density with thickness can be determined by repeating the procedures outlined here using different thicknesses.

4.4 These procedures are not the same as the test method described in Test Method **C1374**. Depending on the test conditions utilized, the blown density may, or may not, represent the installed density values obtained by using Test Method **C1374**.

4.5 This guide can be used to develop appropriate blowing machine settings to achieve a target blown density at a predetermined thickness.

<sup>1</sup> This guide is under the jurisdiction of ASTM Committee **C16** on Thermal Insulation and is the direct responsibility of Subcommittee **C16.32** on Mechanical Properties.

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<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

## 5. Summary of Guide

5.1 A standardized test chamber of fixed volume is used to collect the pneumatically-applied insulation.

5.2 There are two types of test chambers that are in common use:

5.2.1 Procedure A uses a moveable test box having a minimum volume of 20 cubic feet ( $0.56 \text{ m}^3$ ). The blown material is weighed while still in the test box and the density is calculated.

5.2.2 Procedure B uses a fixed frame assembly in a test room or blowing shack to simulate an attic application. The blown material is removed from the test frame and weighed separately to calculate the density.

5.3 After the insulation is blown into the chamber, the weight of the insulation is determined.

5.4 From the volume of the sample and its weight, the blown density is determined.

## 6. Apparatus

6.1 *Blowing Machine*—a commercial pneumatic blowing machine, designed for handling mineral fiber loose-fill insulation materials, shall be used for blowing the insulation into the test chamber. This machine shall have throughput and handling characteristics representative of that used in field applications.

6.2 *Blowing Hose*—the machine shall utilize three (3) 50 ft (15 m) sections to make up 150 ft (46 m) of a minimum of 3

in. (76 mm) diameter flexible corrugated blowing hose. At least 100 ft. (30 m) of the hose shall have an elevation of between 10 and 20 ft (3 and 6 m) above the blowing machine to simulate a typical installation configuration. The hose shall have no more than eight 90-degree bends and no bends may be less than 4 ft (1.2 m) radius. After 50 h of usage, the last 50 ft (15 m) section at the discharge end shall be discarded. A new 50 ft (15 m) shall be attached directly to the blowing wool machine. The remaining 100 ft (30 m) shall then be attached to the end of the new hose. This creates a hose replacement rotation.

6.3 *Scales*—platform scales or load cells accurate to 1 %.

6.4 *Specimen Preparation Room*—an enclosed area where the test material is to be blown into the test chamber. This area is required to protect the blowing operation from wind or strong air currents. Room geometry should provide adequate clearance around the test chamber and large enough not to influence the blowing stream from the hose.

6.5 *Hose Nozzle Stand*—a hose stand on casters that holds the blowing hose at a fixed height of 36 to 48 in. (0.9 to 1.2 m) and is on a swivel that allows the operator to swing the hose horizontally back and forth while slowly moving backwards and forwards to fill the test chamber. A typical hose nozzle stand is shown in Fig. 1. Use of the hose stand is optional.

6.6 *Moveable Test Chamber (Procedure A)*—a wooden open container to collect the insulation. The chamber shall have a

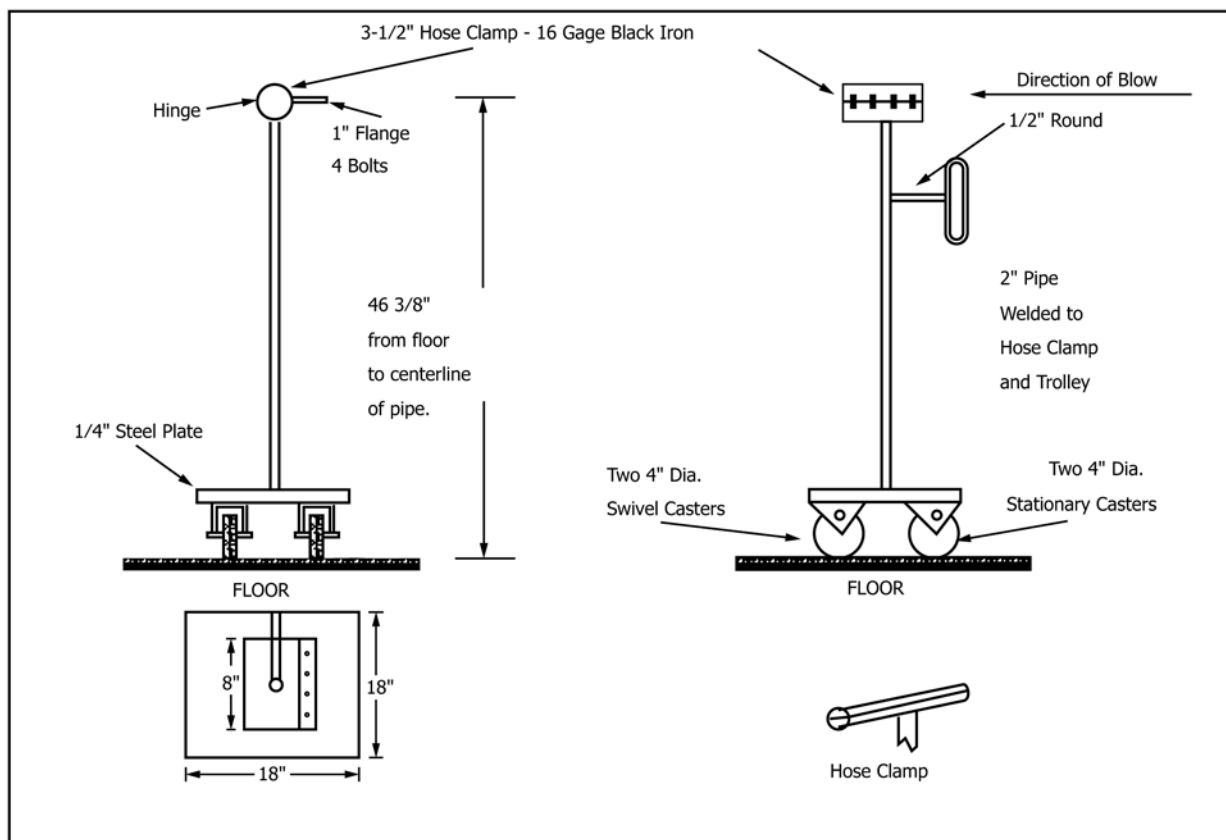


FIG. 1 Hose Nozzle Stand

minimum capacity of 20 ft<sup>3</sup> (0.57 m<sup>3</sup>) and have the minimum inside dimensions of 11 in. high by 28 in. wide by 80 in. long (279 mm by 711 mm by 2032 mm). Note that these minimum dimensions by themselves do not produce the required volume but simply represent the minimum B, C, and D dimensions in Fig. 2. The front of the test chamber is typically angled at 45 degrees to insure proper filling as the operator moves back during the filling operation. A typical test chamber is shown in Fig. 2.

6.7 *Fixed Test Chamber (Procedure B)*—joists are built up on a plywood floor to simulate an open attic structure. Typically 2 in. by 10 in. (50 mm by 254 mm) joists, 16 in. (406 mm) on center, are used to create three sections that are 19 ft long (5.8 m). The joists are marked along their length at 6 in. (152 mm) intervals so that the total insulation volume can be determined after the blowing is completed. A typical test chamber is shown in Fig. 3.

6.8 Compressed air supply, hose, and nozzle.

6.9 Straight edged screed.

## 7. Procedure

### 7.1 Procedure A—Moveable Test Chamber

7.1.1 Within the sample preparation area, position the empty and clean test chamber on the scale and so that the test chamber is approximately centered side to side and from front to back.

7.1.2 Tare the scale/load cells.

7.1.3 Affix the appropriate blowing hose to the blowing machine and, if used, secure the exit hose end in the hose nozzle stand.

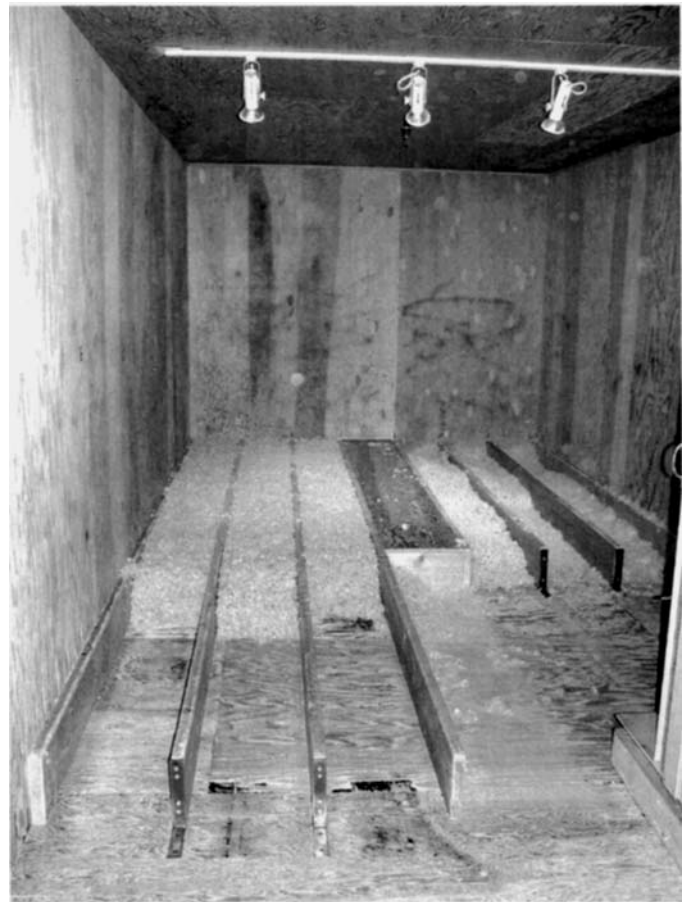


FIG. 3 Fixed Test Chamber – Procedure B

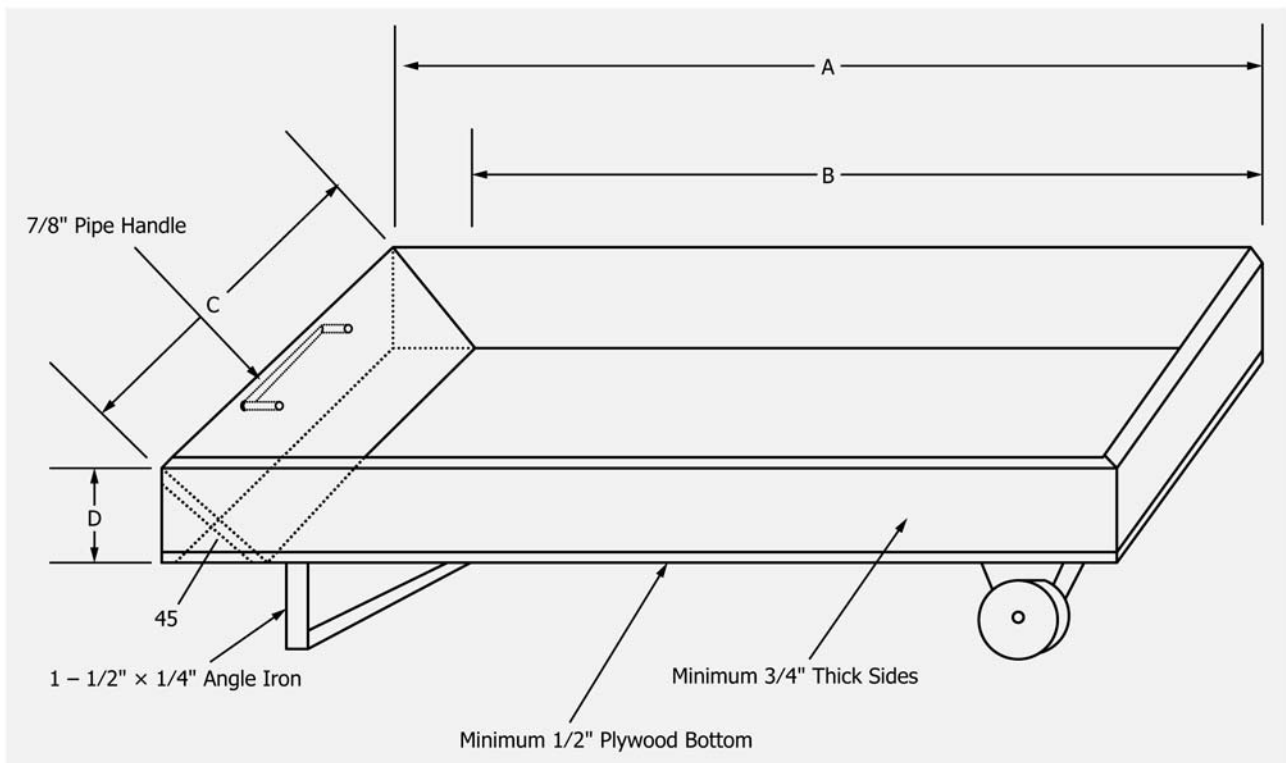


FIG. 2 Movable Test Chamber – Procedure A

7.1.4 Set the blowing machine with the desired gear, gate opening, and air pressure settings required to obtain the blown insulation conditioning that is representative of a field blown application.

7.1.5 Load the appropriate amount of loose-fill in the blowing machine hopper.

7.1.6 Start the blowing machine and direct the hose and material flow to the side away from the test chamber. Verify proper air pressure by checking machine gauge or blown material arc length.

7.1.7 If blowing by hand, position the end portion of the blowing hose horizontal to the floor at all times and at a minimum of 3 ft (0.9 m) and a maximum of 4 ft (1.2m) above the floor of the test chamber.

7.1.8 When the insulation is flowing smoothly (about 10-20 s) begin filling the test chamber. Fill the test chamber from back to front using a slow sweeping motion from side to side overlapping all sides of the test chamber by at least one foot.

7.1.9 Slowly and uniformly move backwards and forwards to uniformly fill the chamber and capture the most representative stream of blown material.

7.1.10 When the chamber is full, direct the hose away from the test fixture and stop the machine.

7.1.11 Remove by broom or air any insulation that is on the floor and touching the test chamber or the scale/ load cells so the proper weight of test insulation will be obtained.

7.1.12 Using compressed air, carefully move along the side of the chamber blowing the high insulation area away to achieve a level surface.

7.1.13 Using a straight edged screed, start in the middle of the test chamber and work to each end carefully, so the insulation is not compressed, screeding the insulation surface level to the top of the test chamber.

7.1.14 Record the weight of the insulation in the test chamber to the nearest 0.05 lb (0.02 kg).

7.1.15 Calculate the blown density by dividing the insulation weight by the volume of the test chamber.

## 7.2 Procedure B— Fixed Test Chamber

7.2.1 Make sure the test frame is empty and clean. Then follow steps 7.1.3 – 7.1.10 from the procedure above.

7.2.2 Starting at the back of the joist cavities, use a straight edged screed to level the insulation to the top of the joists. Avoid raking, packing, or pushing the insulation down.

7.2.3 Using the screed, cut off all insulation in each of the three cavities beyond the marks where the cavities are not filled. Separate this material from the leveled material. For example, when the insulation completely fills the 8.75 in. (212 mm) cavity created by the 2 ×10 lumber framework after leveling, separate and discard the material beyond the last mark where the filling has occurred.

7.2.4 Count and record the number of 6 in. (152 mm) cavity lengths filled with insulation.

7.2.5 Collect and weigh the insulation to the nearest 0.05 lb (0.02 kg) from the filled cavities.

7.2.6 Calculate the volume of insulation using Eq 1.

$$Vol = \frac{N \times Length \times Width \times Height}{Conversion} \quad (1)$$

Where:

*Vol* = Volume (ft<sup>3</sup> or m<sup>3</sup>)

*N* = Number of cavity spaces filled

*Length* = Separation length of cavity space marks (in. or mm)

*Width* = Width of cavity space between joists (in. or mm)

*Height* = Height of the joists (in. or mm)

*Conversion* = Units conversion (1728 IP or 10<sup>+9</sup> SI)

7.2.7 Calculate the blown density in lb/ft<sup>3</sup>(kg/m<sup>3</sup>) by dividing the weight from 7.2.5 by the volume determined in 7.2.6.

## 8. Report

8.1 Report the following information:

8.1.1 Test location, date, time, and operator.

8.1.2 Temperature and relative humidity.

8.1.3 Product identification with manufacturer, product name, date of manufacture (if available), and bag weight.

8.1.4 Product preconditioning, if any.

8.1.5 Blowing machine type and settings.

8.1.6 Test chamber dimensions and volume.

8.1.7 Procedure used.

8.1.8 Insulation weight.

8.1.9 Blown density.

8.1.10 Blow hose type, diameter, length, and maximum elevation.

## 9. Precision and Bias

9.1 *Precision*—The following repeatability values have been determined for this guide.

9.1.1 The repeatability standard deviation has been determined at one laboratory to be 0.01 lb/ft<sup>3</sup> (0.16 kg/m<sup>3</sup>) for an average density of 0.44 lb/ft<sup>3</sup> (7.0 kg/m<sup>3</sup>) when testing a light density, unbonded mineral fiber loose-fill insulation using Procedure A methodology.

9.1.2 The repeatability standard deviation has been determined at one laboratory to be 0.02lb/ft<sup>3</sup> (0.32 kg/m<sup>3</sup>) for an average density of 0.60 lb/ft<sup>3</sup> (9.6 kg/m<sup>3</sup>) when testing a light density, unbonded mineral fiber loose-fill insulation using Procedure B methodology.

9.1.3 *Bias*—No information can be presented on the bias of the procedures in this guide for measuring the blown density of loose-fill insulation because no standardized material is available that has an accepted reference value.

9.1.4 The results of the laboratory study of the test repeatability can be found in ASTM Research Report RR:C16-1027<sup>3</sup>.

9.1.5 There has not been an interlaboratory testing program to establish the precision for either Procedure A or Procedure B. When data is available this section will be revised.

## 10. Keywords

10.1 blown density; loose-fill; mineral fiber; thermal insulation

<sup>3</sup> Supporting data have been filed at ASTM International Headquarters and may be obtained by requesting Research Report RR:C16-1027.

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