Designation: C 1058 – 97

Standard Practice for Selecting Temperatures for Evaluating and Reporting Thermal Properties of Thermal Insulation[1]

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1. Scope

1.1 This practice covers standard mean temperatures for reporting thermal properties of thermal insulations, products, and materials, and of related systems and components, both insulated and uninsulated.

1.2 Thermal properties may be determined as a function of temperature by standard test methods. (Test Methods C 177, C 201, C 236, C 335, C 518, C 745, C 976, C 1114, Guide C 653, and Practice C 687, all in combination with Practice C 1045.)

NOTE 1—Standard referenced materials are needed to span the temperature range of the tests.

1.3 This practice recommends standard conditions for use in testing and evaluating thermal properties as a function of temperature by standard test methods.

1.4 General applications of thermal insulations include:

1.4.1 Building envelopes,

1.4.2 Mechanical systems or processes, and

1.4.3 Building and industrial insulations.

1.5 The mean test temperatures to measure thermal properties shall be selected from those listed in Table 1. It is recommended that thermal properties of insulation materials be evaluated over a mean temperature range that represents the intended end use. For this situation, the lowest and greatest mean temperatures should be within 10°C of the maximum and minimum mean temperature of interest. The temperature differences for any chosen mean temperature will depend upon both the thermal insulation application (see appropriate materials specification), the method of evaluation, and the limitations of the apparatus. Temperature differences or relevant temperatue conditions required by ASTM material specifications shall take precedence over those recommended in this practice.

1.5.1 Standard conditions are presented where both surfaces are exposed to fixed ambient temperatures that are typical for testing building constructions, both insulated and uninsulated (Table 2).

1.5.2 Standard conditions are presented where the temperatures of the two surfaces are fixed and surface coefficients are not considered (Table 2 or Table 3).

1.5.3 For conditions where the temperature of only one surface is fixed with the other exposed to fixed ambient temperature, use the mean temperatures of Table 1.

1.6 The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information only. Approximate inch-pound units are provided in the tables.

1.7 *This standard does not purport to address all of 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 determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*

C 168 Terminology Relating to Thermal Insulating Materials[2]

C 177 Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus[2]

C 201 Test Method for Thermal Conductivity of Refractories[3]

C 236 Test Method for Steady-State Thermal Performance of Building Assemblies by Means of a Guarded Hot Box[2]

C 335 Test Method for Steady-State Heat Transfer Properties of Horizontal Pipe Insulation[2]

C 518 Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus[2]

C 653 Guide for Determination of the Thermal Resistance of Low-Density Blanket-Type Mineral Fiber Insulation[2]

C 687 Practice for Determination of the Thermal Resistance of Loose-Fill Building Insulation[2]

C 745 Test Method for Heat Flux Through Evacuated Insulations Using a Guarded Flat Plate Boiloff Calorimeter[2]

C 976 Test Method for Thermal Performance of Building Assemblies by Means of a Calibrated Hot Box[2]

C 1045 Practice for Calculating Thermal Transmission

[1] This practice is under the jurisdiction of ASTM Committee C-16 on Thermal Insulation and is the direct responsibility of Subcommittee C16.30 on Thermal Measurements.

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[2] *Annual Book of ASTM Standards*, Vol 04.06.

[3] *Annual Book of ASTM Standards*, Vol 15.01.

TABLE 1 Mean Test Temperatures for Reporting and Evaluation of Thermal Properties of Thermal Insulations

Insulation Classification	Mean Test Temperature	
	°C	°F[A]
Building Envelopes	−4	25
	4	40
	10	50
	24	75
	38	100
	43	110
Mechanical Systems or Processes and Building and Industrial Insulations: Use those listed in this table above and the following:	−200	−300
	−100	−200
	−75	−100
	−50	−50
	−25	0
	100	200
	150	300
	200	400
	250	500
	300	600
	350	700
	400	800
	500	1000
	600	1200
	700	1400
	800	1600
	1000	1800
	1100	2000

[A] The values in degrees Fahrenheit given in this table are not intended to be exact conversions of those values in degrees Celsius.

Properties from Steady-State Heat Flux Measurements[2]
C 1114 Test Method for Steady State Thermal Transmission Properties by Means of the Thin-Heater Apparatus[2]

3. Terminology

3.1 *Definitions*— For definitions of terms and symbols used in this practice, refer to Terminology C 168.

4. Significance and Use

4.1 The various methods for measuring and calculating thermal properties provide data and information for manufacturer's published information, for comparison of related products, and for designers and users to evaluate insulation products for particular applications. For these purposes it is advisable to provide basic data and information produced under standard temperature conditions.

4.2 Thermal properties of a specimen may change with mean temperature, with temperature difference across the specimens, and with high temperature exposure. Data and information at standard temperatures are necessary for valid comparison of thermal properties.

4.3 These conditions must be stated to describe accurately thermal properties such as thermal conductivity versus mean temperature for thermal insulating materials. Thermal insulations exhibiting inflection points due to the change of state of insulating gases (see Note 2), must be tested at sufficiently small temperature differences between (*1*) the hot and cold sides and (*2*) between mean temperatures. The test temperature differences used depend on the vapor pressure versus temperature relationship of the gases involved and the ability of the test apparatus to provide accurate measurements of low temperature differences.

NOTE 2—Certain closed-cell cellular plastic insulations are of this type.

5. Procedure

5.1 Since there are distinctly different needs or uses for thermal performance information, the test conditions selected must be appropriate to the need or use.

5.2 Determine the use classification described in 5.3 and choose the appropriate temperature conditions from the tables.

5.2.1 If the tables do not contain the appropriate temperature conditions, specifically report exceptions.

5.3 Thermal insulation classifications are:

5.3.1 *Building Envelopes*—Typically, building assemblies or constructions, both insulated and uninsulated, are tested with both surfaces exposed to fixed ambient temperatures as prescribed in Table 2. Normally, Test Methods C 236 and C 976 are used for evaluation of building assemblies. For building envelopes in moderate climates with an anticipated exterior temperature range of 0 to 50°C (nominally 30 to 120°F), recommended mean temperatures are 4, 24, and 43°C (40, 75 and 110°F).

5.3.2 *Mechanical Processes or Systems and Building and Industrial Insulations*—Evaluations of thermal performance are generally limited to a single material where data is needed for codes, specifications, and technical literature. Evaluations involve either (*1*) fixing both surface temperatures where surface coefficients are not necessary as prescribed in Table 2 or Table 3 and Test Methods C 177, C 201, C 518, and C 1114 or (*2*) fixing one surface temperature with the other exposed tofixed ambient temperature using the mean temperatures of Table 1 and Test Method C 335. For mechanical systems and processes for applications from − 100 to 150°C (nominally − 200 to 300°F), recommended mean temperatures are those in 5.3.1 plus 100 and − 50°C (200 and − 50°F). For industrial applications from − 200 to 600°C (nominally − 300 to 1200°F), recommended mean temperatures are − 100, 24, 150, 300, and 500°C (−200, 75, 300, 600, and 1000°F).

6. Keywords

6.1 building envelope; industrial application; mean test temperature; mechanical process; selecting temperatures; thermal insulation; thermal property

TABLE 2 Standard Temperatures for Thermal Transmittance Evaluations With Both Specimen Surfaces Exposed to Fixed Ambient Temperatures[A]

NOTE 1—Typical for use with Test Methods C 236 and C 976.

Temperature,° C[B]			Temperature,° F[B]		
Mean	Hot Ambient[C]	Cold Ambient[C]	Mean	Hot Ambient[C]	Cold Ambient[C]
−4	24 ± 5	−32± 5	25	75 ± 9	−25 ± 9
4	24 ± 5	−15± 5	40	75 ± 9	5 ± 9
10	24 ± 5	−4 ± 5	50	75 ± 9	25 ± 9
24	38 ± 5	10 ± 5	75	100 ± 9	50 ± 9
38	52 ± 5	24 ± 5	100	125 ± 9	75 ± 9
43	63 ± 5	24 ± 5	110	145 ± 9	75 ± 9

[A] Thermal transmission properties of panels of various building constructions are thermal transmittance (U), and thermal conductance (C).
[B] Celsius temperatures are standard. The values in degrees Fahrenheit given in this table are not intended to be exact conversions of those values given in degrees Celsius.
[C] Ambient temperatures other than shown may be required for applications other than normal building interior ambient temperatures. Thermal properties should be determined from test data using ambient temperatures suitable for the applications, but the change must be reported.

TABLE 3 Standard Temperatures for Thermal Transmission Property Testing and Evaluation Both Surface Temperatures Fixed[A]

NOTE 1—Typical for use with Test Methods C 177, C 201, C 518, and C 1114.

Temperature,° C[B]			Temperature,° F[B]		
Mean	Temperature Difference[CD]		Mean	Temperature Difference[CD]	
	Small	Large		Small	Large
−200	25± 5	100 ± 20	−300	50± 10	200 ± 30
−100	25 ± 5	200 ± 20	−200	50 ± 10	300 ± 30
−75	25 ± 5	150 ± 20	−100	50 ± 10	300 ± 30
−50	25 ± 5	150 ± 20	−50	50 ± 10	300 ± 20
−25	25 ± 5	100 ± 10	0	50 ± 10	300 ± 20
−4	25± 5	50 ± 10	25	50 ± 10	100 ± 20
4	25 ± 5	40± 10	40	50 ± 10	80 ± 20
10	25± 5	40± 10	50	50± 10	80 ± 20
24	25 ± 5	40± 10	75	50 ± 10	80 ± 20
38	25 ± 5	40± 15	100	50 ± 10	80 ± 25
43	25 ± 5	40± 15	110	50 ± 10	80 ± 25
100	50 ± 15	150 ± 30	200	100 ± 25	250 ± 50
150	50± 15	275 ± 30	300	100 ± 25	450 ± 50
200	50 ± 15	400 ± 30	400	100 ± 25	650 ± 50
250	50± 15	525 ± 30	500	100± 25	850 ± 50
300	50 ± 15	650 ± 30	600	100 ± 25	1050 ± 50
350	50 ± 15	775 ± 30	700	100 ± 25	1250 ± 50
400	100 ± 30	800 ± 60	800	200 ± 50	1400 ± 100
500	100 ± 30	900 ± 60	1000	200 ± 50	1800± 100
600	100± 30	1000 ± 60	1200	200± 50	2200 ± 100
700	100 ± 30	1300 ± 60	1400	200 ± 50	2600 ± 100
800	100 ± 30	1500 ± 60	1600	200± 50	3000 ± 100
1000	100 ± 30	1700 ± 60	1800	200 ± 50	3200± 100
1100	100 ± 30	2100 ± 60	2000	200 ± 50	3600 ± 100

[A] Thermal properties of insulation materials and systems such as thermal transference (T_t), conductance (C), and surface heat transfer coefficient (h_o) are calculated from test measurements of heat input, hot surface temperature, cold surface temperature and ambient air temperature.
[B] Celsius temperatures are standard. The values in degrees Fahrenheit are not intended to be exact conversions of those values in degrees Celsius.
[C] Ambient temperatures other than shown may be required for applications other than normal building interior ambient temperatures. Thermal properties should be determined from test data using ambient temperatures suitable for the applications, but the change must be reported.
[D] Selection of temperature difference for property evaluations should reflect the actual temperature differences of the intended applications.