Designation: C1558 – 03(Reapproved 2007)

Standard Guide for
Development of Standard Data Records for Computerization of Thermal Transmission Test Data for Thermal Insulation[1]

1. Scope

1.1 This guide provides recommended formats for the recording of thermal transmission test data for thermal insulation and similar materials for inclusion in computerized material property databases. From this information, the database designer should be able to construct the database dictionary preparatory for development of a database schema.

1.2 This guide is applicable to thermal transmission test data obtained from standard test methods that cover planar and radial specimen geometries.

1.3 This guide is not intended for thermal transmission data obtained for thermal insulation assemblies or systems (that is, heat transmission coefficients for walls, roofs, ceilings, and floors).

1.4 *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 requirements prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]
C168 Terminology Relating to Thermal Insulation
C177 Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus
C195 Specification for Mineral Fiber Thermal Insulating Cement
C196 Specification for Expanded or Exfoliated Vermiculite Thermal Insulating Cement
C208 Specification for Cellulosic Fiber Insulating Board

C335 Test Method for Steady-State Heat Transfer Properties of Pipe Insulation
C449/C449M Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement
C516 Specification for Vermiculite Loose Fill Thermal Insulation
C518 Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus
C533 Specification for Calcium Silicate Block and Pipe Thermal Insulation
C534 Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form
C547 Specification for Mineral Fiber Pipe Insulation
C549 Specification for Perlite Loose Fill Insulation
C552 Specification for Cellular Glass Thermal Insulation
C553 Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
C578 Specification for Rigid, Cellular Polystyrene Thermal Insulation
C592 Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type)
C610 Specification for Molded Expanded Perlite Block and Pipe Thermal Insulation
C612 Specification for Mineral Fiber Block and Board Thermal Insulation
C656 Specification for Structural Insulating Board, Calcium Silicate
C665 Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing
C726 Specification for Mineral Wool Roof Insulation Board
C728 Specification for Perlite Thermal Insulation Board
C739 Specification for Cellulosic Fiber Loose-Fill Thermal Insulation
C745 Test Method for Heat Flux Through Evacuated Insulations Using a Guarded Flat Plate Boiloff Calorimeter (Withdrawn 2008)[3]
C764 Specification for Mineral Fiber Loose-Fill Thermal Insulation

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C991 Specification for Flexible Fibrous Glass Insulation for Metal Buildings

C1014 Specification for Spray-Applied Mineral Fiber Thermal and Sound Absorbing Insulation

C1029 Specification for Spray-Applied Rigid Cellular Polyurethane Thermal Insulation

C1033 Test Method for Steady-State Heat Transfer Properties of Pipe Insulation Installed Vertically (Withdrawn 2003)[3]

C1044 Practice for Using a Guarded-Hot-Plate Apparatus or Thin-Heater Apparatus in the Single-Sided Mode

C1045 Practice for Calculating Thermal Transmission Properties Under Steady-State Conditions

C1071 Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material)

C1086 Specification for Glass Fiber Mechanically Bonded Felt Thermal Insulation

C1114 Test Method for Steady-State Thermal Transmission Properties by Means of the Thin-Heater Apparatus

C1126 Specification for Faced or Unfaced Rigid Cellular Phenolic Thermal Insulation

C1149 Specification for Self-Supported Spray Applied Cellulosic Thermal Insulation

C1289 Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board

C1290 Specification for Flexible Fibrous Glass Blanket Insulation Used to Externally Insulate HVAC Ducts

C1363 Test Method for Thermal Performance of Building Materials and Envelope Assemblies by Means of a Hot Box Apparatus

C1410 Specification for Cellular Melamine Thermal and Sound-Absorbing Insulation

C1427 Specification for Extruded Preformed Flexible Cellular Polyolefin Thermal Insulation in Sheet and Tubular Form

2.2 *ISO Standards:*

ISO 8301 Thermal Insulation, Determination of Steady-State Thermal Resistance and Related Properties—Heat Flow Meter Apparatus[4]

ISO 8302 Thermal Insulation—Determination of Steady-State Thermal Resistance and Related Properties—Guarded Hot Plate Apparatus[4]

ISO 8497 Thermal Insulation—Determination of Steady-State Thermal Transmission Properties of Thermal Insulation for Circular Pipes[4]

ISO 8990 Thermal Insulation—Determination of Steady-State Thermal Transmission Properties—Calibrated and Guarded Hot Box[4]

3. Terminology

3.1 *Definitions*—For definitions of some terms applicable to this guide, see Terminology C168

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *class, n*—a major material class, for example, ceramic, insulation, polymer, etc.

3.2.2 *data element, n*—an individual piece of information used to describe a material or to record test results; for example, a variable name or a test parameter.

3.2.2.1 *Discussion*—The term is synonymous with *data item*.

3.2.3 *essential field, n*—a field in a record that must be completed in order to make the record meaningful in accordance with the pertinent guidelines or standard.

3.2.3.1 *Discussion*—Fields are considered essential if required to make a comparison of property data from different sources meaningful. A comparison of data from different sources may still be possible if essential information is omitted, but the value of the comparison may be greatly reduced.

3.2.4 *field, n*—an elementary unit of a record that may contain a data item, a data aggregate, a pointer, or a link.

3.2.5 *field name, n*—a name or code associated with a field and used for identification.

3.2.6 *form, n*—the material form, for example, blanket, board, or roll.

3.2.7 *value set, n*—an open listing of representative acceptable text which could be included in a particular field of a record.

4. Significance and Use

4.1 This guide defines the principal elements of information, which are considered important and worth recording and storing permanently in computerized databases. Sufficient information is provided in this guide to enable the user to construct a database structure suitable for the intended application involving thermal insulation.

4.2 Because of increased activity in building computerized materials databases and the desire to encourage uniformity and ease of data comparison and interchange, these recommended formats provide for the inclusion of specific elements of thermal transmission test data in databases.

4.3 This guide has no implication on data required for materials production or purchase. Reporting of actual test results shall be as described in the actual materials specification or as agreed upon between the vendor and purchaser.

4.4 The suggested set of units for the recommended standard format given in this guide is SI. This guide, however, does not preclude other sets of units, such as inch-pound (IP).

5. Recording of Test Data

5.1 Table 1 is a recommended standard format for the computerization of thermal transmission data for thermal insulation materials. The headings for each field are:

5.1.1 *Field Number*—A reference number assigned to an individual data field that has no permanent value and does not become part of the database.

5.1.2 *Field Name and Description*—The complete name of the field, descriptive of the data element of information of interest.

5.1.3 *Data Type*—Type of data to be included in the field, such as the type of number, character text, logical values (yes/no), and date.

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[4] Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, http://www.ansi.org.

TABLE 1 Data Format for Computerization of Test Data for Thermal Insulation

Field No.	Field Name and Description	Data Type	Value Sets or Units
Material Identification			
1*	Material reference number	text	
2*	Material class	text	
3*	Material name	text	
4*	Material description	text	
5	Material specification	text	
6	Material designation	text	
7	Material manufacturer	text	
8	Material source	text	
9	Material lot code	text	
10	Date of manufacture	text	
11	Material form	text	
12	Material classification	text	
Microstructure			
13*	Microstructure type	text	
14	Cell size	real	µm
15	Fiber size	real	µm
16	Particle size	real	µm
17	Blowing agent	text	
18	Closed-cell content	real	%
19	Binder content	real	%
20	Shot content	real	%
Test Method			
21*	ASTM, ISO, or other designation	text	
22*	Test facility—laboratory	text	
23*	Test facility—city	text	
24*	Test facility—state	text	
25	Test facility—country	text	
26	Test facility—Site elevation	real	m
27	Test operator	text	
28*	Apparatus type	text	
29*	Apparatus arrangement	text	
30*	Apparatus size—outer dimension	real	m
31*	Apparatus size—outer dimension	real	m
32*	Apparatus meter area—dimension	real	m
33*	Apparatus meter area—dimension	real	m
34*	Apparatus identification	text	
35*	Mode of operation	integer	
36*	Direction of heat flow	text	
37	Emittance	real	(dimensionless)
38	Plate flatness	real	mm
39	Method of plate separation	text	
40	Data collection method	text	
41	Sampling interval	real	s
42	Computer software	text	
Specimen Description			
43	Specimen layout reference	text	
44*	Conditioning temperature	real	K
45*	Conditioning humidity	real	% RH
46*	Conditioning time	real	hours
47	Conditioning environment	text	
48*	Number of test specimens	integer	
49*	Specimen identification	integer	
50*	Specimen geometry	text	
51	Specimen width	real	mm
52	Specimen length	real	mm
53	Specimen diameter	real	mm
54	Specimen circumference	real	mm
55*	Specimen thickness	real	mm
56*	Specimen mass	real	kg
57*	Bulk density	real	kg/m^3
58	Porosity	real	(dimensionless)
59	Sub-components	text	
Test Results and Analysis			
60*	Date of test	date	(year, month, day)
61*	Moisture content before testing	real	%
62*	Moisture content after testing	real	%
63*	Hot temperature—average	real	K
64	Hot temperature—standard deviation	real	K
65*	Cold temperature—average	real	K
66	Cold temperature—standard deviation	real	K
67*	Heat flow—average	real	W
68	Heat flow—standard deviation	real	W
69*	Meter area	real	m^2
70*	Specimen test thickness	real	mm

TABLE 1 *Continued*

Field No.	Field Name and Description	Data Type	Value Sets or Units
71	Clamping pressure	real	kPa
72	Mean temperature	real	K
73	Temperature difference	real	K
74*	Ambient temperature—average	real	K
75	Ambient temperature—standard deviation	real	K
76	Ambient humidity—average	real	%
77	Ambient humidity—standard deviation	real	%
78	Ambient barometric pressure—average	real	kPa
79	Ambient barometric pressure—standard deviation	real	kPa
80*	Thermal conductance—average	real	$W/(m^2 \cdot K)$
81	Thermal conductance—standard deviation	real	$W/(m^2 \cdot K)$
82*	Thermal resistance—average	real	$m^2 \cdot K/W$
83	Thermal resistance—standard deviation	real	$m^2 \cdot K/W$
84	Thermal conductivity—average	real	$W/(m \cdot K)$
85	Thermal conductivity—standard deviation	real	$W/(m \cdot K)$
86	Thermal resistivity—average	real	$m \cdot K/W$
87	Thermal resistivity—standard deviation	real	$m \cdot K/W$
88*	Is the test valid?	logical	
89*	Standard uncertainty of test result	real	%
90*	Footnotes	text	

* Essential field

5.1.4 *Value Sets or Units*—A listing of the types of information which would be included in the field or, in the case of properties or the numeric fields, the SI units in which the numbers are expressed.

5.2 The presentation of the recommended standard format does not require that every element of information be included in every database. There is, however, a minimum number of fields considered essential to any database and these fields are marked with an asterisk (*).

NOTE 1—Many databases are prepared for specific applications and, therefore, some database builders may omit certain elements considered to be of no value for that specific application. Conversely, in some individual cases, additional data elements are needed and the database builder is encouraged to include these elements along with the elements in the recommended standard format. It is important to note that not all of the elements considered essential will be available for every test. Further, not all of the fields included in the recommended standard format are appropriate for all tests.

5.3 The recommended standard format is divided into five sections as illustrated in Fig. 1: material identification; microstructure; test method; specimen description; and test results and analysis.

5.4 Fields that indicate the accuracy of each measurement are beyond the scope of this guide. However, the entries in all fields should be given to the appropriate number of significant figures.

6. Material Identification

6.1 The fields in this section identify the material tested.

NOTE 2—The numbers given in parentheses after the field name refer to the field number in Table 1 and accompanying tables. Essential fields are identified by an asterisk (*).

6.1.1 *Material Reference Number* (1*)—Unique database identifier containing material and process information for the specimens. A typical value set may contain information from the material lot code (see Field 9).

6.1.2 *Material Class* (2*)—A major material class, for example ceramic, insulation, metal, polymer, rubber, etc.

6.1.3 *Material Name* (3*)—A (generic) name for the particular material. A value set of typical responses is given in Table 2.

6.1.4 *Material Description* (4*)—Descriptive name of material tested, for example, E-type fibrous glass with phenolic binder.

6.1.5 *Material Specification* (5)—Specification and year of issue for material name in field (3). A value set of typical responses is given in Table 2.

6.1.6 *Material Designation* (6)—Trade name, trademark, brand name, etc., of material.

6.1.7 *Material Manufacturer* (7)—Manufacturer of material.

6.1.8 *Material Source* (8)—Source of material, if different from manufacturer.

6.1.9 *Material Lot Code* (9)—Manufacturer identification (date, plant, etc.).

6.1.10 *Date of Manufacture* (10)—Date of manufacture.

6.1.11 *Material Form* (11)—Functional form of material. A value set of typical responses is given in Table 2.

6.1.12 *Material Classification* (12)—ASTM Classification for material, see particular material specification (include year of issue).

7. Microstructure

7.1 The fields in this section pertain to the microstructure of the material and provide information complementary to the test results and analysis given in 10. The information requested is basic to the characterization of the insulation and is not intended, in this condensed form, for prediction of thermal performance.

7.1.1 *Microstructure Type* (13*)—Composition (cellular, fibrous, particle, etc.).

7.1.2 *Cell Size* (14)—Diameter of cells, if applicable.

7.1.3 *Fiber Size* (15)—Diameter of fibers, if applicable.

7.1.4 *Particle Size* (16)—Diameter of particles, if applicable.

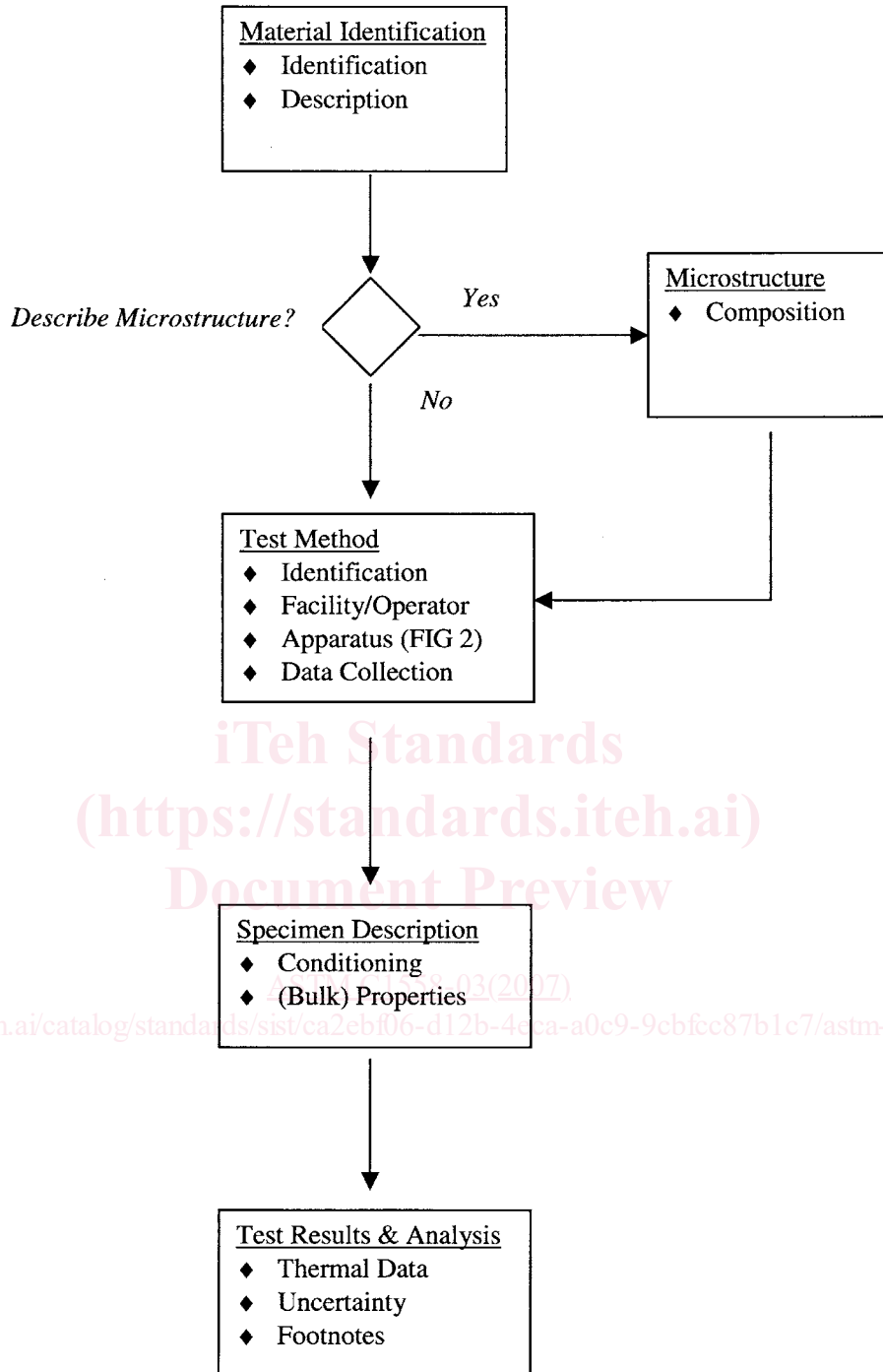7.1.5 *Blowing Agent* (17)—Name of blowing agent, if applicable.

FIG. 1 Sequence of Steps for Entering Data

7.1.6 *Closed-cell Content* (18)—Percentage of closed cells, if applicable.

7.1.7 *Binder Content* (19)—Binder content, if applicable.

7.1.8 *Shot Content* (20)—Shot content, if applicable.

8. Test Method

8.1 The fields in this section describe the test procedure, apparatus, and data collection for a particular test method.

TABLE 2 Typical Information for Material Name, Specification, and Form

Material Name	Material Specification[A]	Material Form
Calcium Silicate	C533, C656	Block/Pipe, Board
Cellular Glass	C552	Block/Board/Pipe/Special
Cellular Elastomeric	C534	Pipe/Sheet
Cellular Melamine	C1410	Slab/Pipe/Special
Cellular Phenolic	C1126	Board/Pipe
Cellular Polyisocyanurate	C1289	Board
Cellular Polyolefin	C1427	Pipe/Sheet
Cellular Polystyrene	C578	Board
Cellular Polyurethane, Spray	C1029	Spray
Cellulosic Fiber	C739	Loose
Cellulosic Fiberboard	C208	Board
Cellulosic, Spray	C1149	Spray
Fibrous Glass	C991, C1071, C1290	Blanket, Blanket/Board, Blanket
Glass Fiber Felt	C1086	Mat
Mineral Fiber	C553, C592, C665, C612, C764, C726, C547	Blanket, Block, Board, Loose, Pipe
Mineral Fiber Insulating Cement	C195	Paste (dry after application), Flat/Special
Mineral Fiber Hydraulic Cement	C449/C449M	Paste (dry after application), Flat/Special
Mineral Fiber, Spray	C1014	Spray
Perlite	C549, C610, C728	Loose, Block/Pipe, Board
Vermiculite	C516	Loose
Vermiculite Insulating Cement	C196	Paste

[A] Include year of issue.

8.1.1 *Test Method* (21*)—ASTM, ISO, or other designation, for example, Test Method C177 or ISO 8302 (include year of issue, if applicable). A value set of typical responses is included in Table 3.

8.1.2 *Test Facility* (22*, 23*, 24*, 25, 26)—Laboratory, city, state, country, and site elevation where the tests were performed.

8.1.3 *Test Operator* (27)—Include as a minimum the operator responsible for the test report.

8.1.4 *Apparatus Type* (28*)—Differentiate between planar or radial geometry. A value set of typical responses is included in Table 3 and Fig. 2.

8.1.5 *Apparatus Arrangement* (29*)—Provide apparatus arrangement. A value set of typical responses is included in Table 3 and Fig. 2.

8.1.6 *Apparatus Size* (30*, 31*)—Outer dimensions of apparatus. A value set of typical responses is included in Table 3 and Fig. 2.

8.1.7 *Apparatus Meter Size* (32*, 33*)—Dimensions of meter area. A value set of typical responses is included in Table 3 and Fig. 2.

8.1.8 *Apparatus Identification* (34*)—Documentation of apparatus including serial number, for example, line-heat-source guarded-hot-plate apparatus (SN NIST LHS/GHP02).

8.1.9 *Mode of Operation* (35*)—Differentiate between double-sided (2) test or single-sided (1) test (for example, Practice C1044). A value set of typical responses is included in Table 4.

8.1.10 *Direction of Heat Flow* (36*)—Direction of heat flow through specimens. A value set of typical responses is included in Table 4.

8.1.11 *Emittance* (37)—Total hemispherical or normal emittance value of heat transfer surfaces of apparatus.

8.1.12 *Plate Flatness* (38)—Flatness of plates, if applicable.

8.1.13 *Method of Plate Separation* (39)—Technique used to maintain plate separation between the hot surfaces and cold surfaces, for example spacers.

8.1.14 *Data Collection Method* (40)—Method of data collection, for example manual or computer.

8.1.15 *Sampling Interval* (41)—Sampling interval for data collection.

TABLE 3 Typical Information for Test Apparatus (see also Fig. 2)

Method[A]	Figure	Type	Arrangement	Outer/Inner Dimensions		Meter Dimensions	
C177	(2a)	Planar	Square	A_1	A_1	B_1	B_1
	(2b)		Round	D_1	...	D_2	...
C335	(2d)	Radial	Cylindrical, guarded end	A_1	D_1/D_2	B1	D_1
			Cylindrical, insulated end	A_1	D_1/D_2	B_1	D_1
C518	(2a)	Planar	Square	A_1	A_1	B_1	B_1
C745	(2a)	Planar	Square	A_1	A_1	B_1	B_1
	(2b)		Round	D_1	...	D_2	...
C1033	(2e)	Radial	Cylindrical, guarded end	A_1	D_1/D_2	B_1	D_1
C1114	(2c)	Planar	Rectangular	A_1	A_2	B_1	B_2
C1363	(2c)	Planar	Rectangular	A_1	A_2	B_1	B_2

[A] Include year of issue.