ASTM INTERNATIONAL

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

This standard is issued under the fixed designation C1558; 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 (ε) indicates an editorial change since the last revision or reapproval.

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 is 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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.5 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

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

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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

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

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

C1482 Specification for Polyimide Flexible Cellular Thermal and Sound Absorbing Insulation

C1484 Specification for Vacuum Insulation Panels

C1534 Specification for Flexible Polymeric Foam Sheet Insulation Used as a Thermal and Sound Absorbing Liner for Duct Systems

C1594 Specification for Polyimide Rigid Cellular Thermal Insulation

C1631 Specification for Cellular Polypropylene Thermal Insulation (Withdrawn 2011)[3]

C1676 Specification for Microporous Thermal Insulation

C1685 Specification for Pneumatically Applied High-Temperature Fiber Thermal Insulation for Industrial Applications

C1728 Specification for Flexible Aerogel Insulation

C1902 Specification for Cellular Glass Insulation Used in Building and Roof Applications

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

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[3] The last approved version of this historical standard is referenced on www.astm.org.

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

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 shall 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 where essential information is omitted reduces the value of the comparison.

3.2.4 *field, n*—an elementary unit of a record that contains 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 is 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. Guidance on the storage of (optional) digital images associated with test data is provided in Appendix X1.

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

4.3 The key benefit of using this guide is the establishment of a systematic approach to the management of thermal transmission test data. Other advantages include: *(1)* an increase in data accuracy because new test data are vetted in real time; *(2)* increased efficiency in data retrieval and storage; and, *(3)* improved data consistency. Over time, historical data can show important trends in the test measurements.

4.4 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.

4.5 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.

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	text	
50*	Specimen geometry	text	
51	Specimen length	real	mm
52	Specimen width	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			

5.1.3 *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.

5.1.4 *Value Sets or Units*—A listing of the types of information which are 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 will 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 shall 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 contains 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.
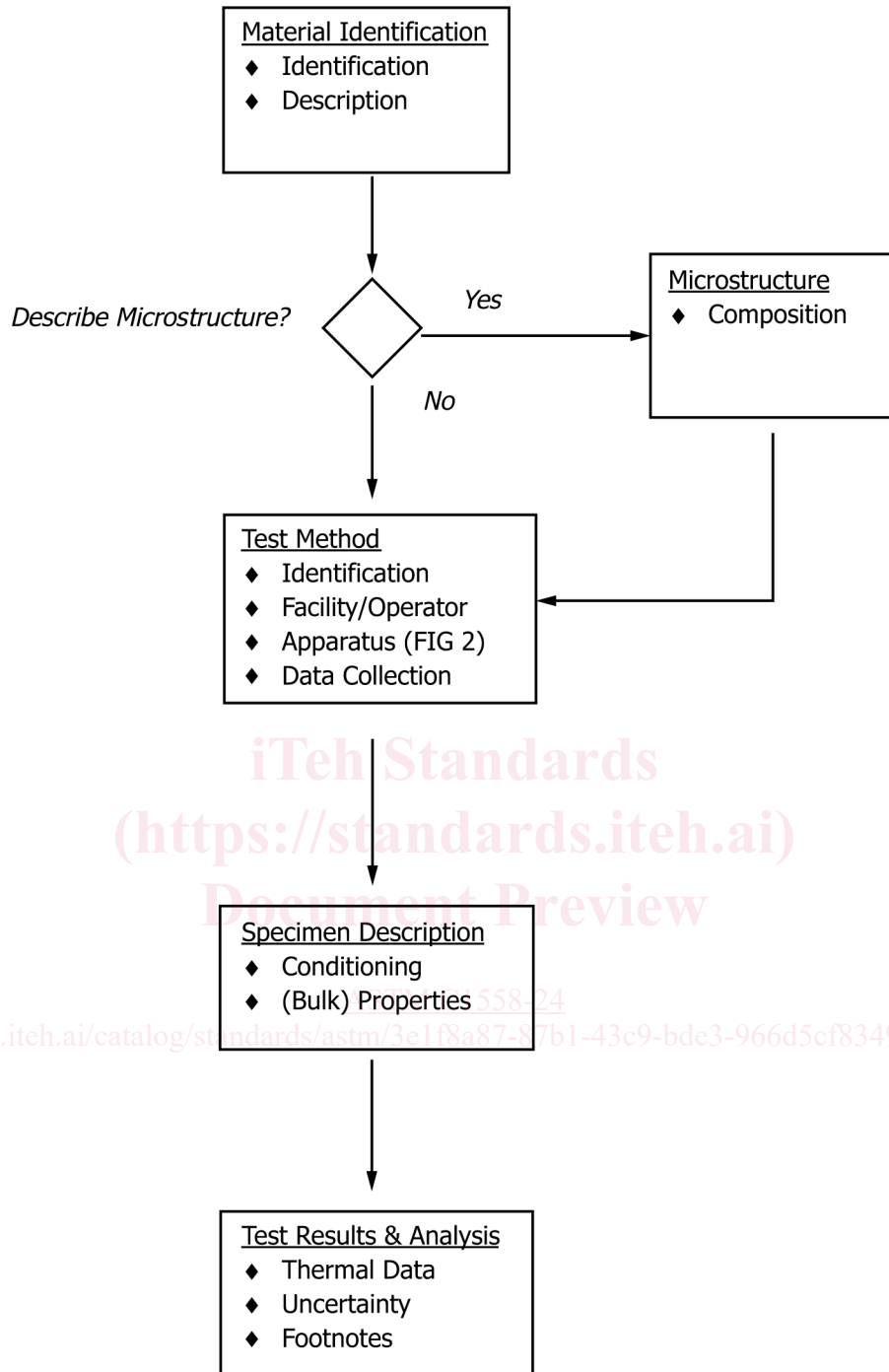
FIG. 1 Sequence of Steps for Entering Data

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.