Designation: E 1309 – 00

Standard Guide for Identification of Fiber-Reinforced Polymer-Matrix Composite Materials in Databases[1]

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1. Scope

1.1 This guide establishes essential and desirable data elements for fiber-reinforced composite materials for two purposes: to establish the material identification component of data-reporting requirements for test reporting and to provide information for the design of material property databases.

1.1.1 This guide is the first part of a two-part modular approach. The first part serves to identify the material and the second part serves to describe testing procedures and variables and to record results.

1.1.2 For mechanical testing, the related document is Guide E 1434. The interaction of this guide with Guide E 1434 is emphasized by the common numbering of data elements. Data Elements A1 through G13 are included in this guide, and numbering of data elements in Guide E 1434 begins with H1 for the next data element block. This guide is most commonly used in combination with a guide for reporting the test procedures and results such as Guide E 1434.

1.2 These guidelines are specific to fiber-reinforced polymer-matrix composite materials. Composite materials, which also contain particulates or precipitated particles, are also included provided they can be described adequately as a filler in the matrix.

1.3 The data elements described in this guide are suggested for use in recording data in a computerized database, which is different from contractual reporting of test results. The latter type of information is described in the material specification or shown in business transactions and is subject to agreement between the vendor and the user.

1.4 This guide defines the information that is considered essential to uniquely describe a composite material. Additional data elements that are considered desirable, but not essential, are also defined. The purpose is to facilitate efficient storage and retrieval of information with a computer and to allow the meaningful comparison of data from different sources.

1.5 This guide with Guide E 1434 may be referenced by the data reporting section of a test method to provide common data reporting requirements for mechanical tests of high-modulus fiber-reinforced polymer-matrix composite materials. This guide may also be useful for additional tests, for material identification for databases at the property levels or for other uses of material identification of composite materials.

1.6 From this information and a guide such as Guide E 1434, the database designer should be able to construct the data dictionary preparatory to developing a database schema.

1.7 Data elements in this guide are relevant to test data, data as obtained in the test laboratory and historically recorded in laboratory notebooks. Property data, data that have been analyzed and reviewed, require a different level of data elements. Data elements for property data are provided in Annex A1.

2. Referenced Documents

2.1 *ASTM Standards:*

C 274 Terminology of Structural Sandwich Constructions[2]

D 790 Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials[3]

D 1600 Terminology for Abbreviated Terms to Plastics[3]

D 3410/D 3410M Test Method for Compressive Properties of Polymer Matrix Composite Materials with Unsupported Gage Section by Shear Loading[2]

D 3878 Terminology for High-Modulus Reinforcing Fibers and Their Composites[2]

D 5467 Test Method for Compressive Properties of Unidirectional Polymer Matrix Composites Using a Sandwich Beam[2]

D 6507 Practice for the Fiber Reinforcement Orientation Codes for Composite Materials[2]

E 6 Terminology Relating to Methods of Mechanical Testing[4]

E 1013 Terminology Relating to Computerized Systems[5]

E 1308 Guide for Identification of Polymers (Excluding Thermoset Elastomers) in Computerized Material Property Databases[5]

E 1338 Guide for Identification of Metals and Alloys in Computerized Material Property Databases [5]

IEEE/ASTM SI 10 Standard for Use of the International

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[2] *Annual Book of ASTM Standards*, Vol 15.03.

[3] *Annual Book of ASTM Standards*, Vol 08.01.

[4] *Annual Book of ASTM Standards*, Vol 03.01.

[5] *Annual Book of ASTM Standards*, Vol 14.01.

System of Units (SI): The Modern Metric System[6]

E 1434 Guide for the Development of Standard Data Records for Computerization of Mechanical Test Data for High-Modulus Fiber-Reinforced Composite Materials[2]

E 1443 Terminology Relating to Building and Accessing Materials and Chemical Databases[5]

E 1471 Guide for the Identification of Fibers, Fillers, and Core Materials in Computerized Material Property Databases[2]

E 1484 Guide for Formatting and Use of Material and Chemical Property Data and Database Quality Indicators[5]

2.2 *Other Documents:*

ANSI X3.172-1996 Information Technology—American National Standard Dictionary of Information Technology (ANSDIT)[7]

A Glossary of Terms Relating to Data, Data Capture, Data Manipulation, and Databases, CODATA Bulletin, Vol 23, Nos 1-2, CODATA, Paris, January-June 1991[8]

ISO 8601 Data Elements and Interchange Formats—Information Interchange—Representation of Dates and Times[9]

3. Terminology

3.1 *Definitions*—Terminology in accordance with Terminologies D 3878, C 274, and E 1443 shall be used where applicable.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *category set*—a closed listing of all possible strings which could be included in a particular field of a record. **(E 1443)**

3.2.2 *composite material*—a substance consisting of two or more materials, insoluble in one another, which are combined to form a useful engineering material possessing certain properties not possessed by the constituents.

3.2.2.1 *Discussion*—A composite material is inherently inhomogeneous on a microscopic scale but can often be assumed to be homogeneous on a macroscopic scale for certain engineering applications. The constituents of a composite retain their identities; they do not dissolve or otherwise merge completely into each other, although they act in concert. **(D 3878)**

3.2.3 *data dictionary*—a collection of the names of all data items used in a software system together with relevant properties of those items; for example, length of data item, mode of representation, and so forth. (CODATA)

3.2.4 *data element*—one individual piece of information used in describing a material or to record test results. For example, a variable name, test parameter, and so forth.

3.2.5 *database schema*—in a conceptual schema language, the definition of the representation forms and structure of a database for the possible collection of all sentences that are in the conceptual schema and in the information base, including manipulation aspects of these forms. **(ANSI X3.172)**

3.2.6 *essential data element*—a data element in a record which must be completed in order to make the record meaningful in accordance with the pertinent guidelines or standard. **(E 1443)**

3.2.6.1 *Discussion*—Data elements are considered essential if they are 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.

3.2.7 *gel point, n (or gel time)*—a point in a cure cycle where a thermosetting polymer resin resolidifies after melting.

3.2.8 *lay-up, n*—a process or fabrication involving the placement of successive layers of materials.

3.2.9 *lay-up code, n*—a designation system for abbreviating the stacking sequence of laminated composites. **(D 3878)**

3.2.10 *matrix, n*—in composite materials, the continuous constituent of a composite material which acts as the load transfer mechanism between the discrete dispersed reinforcement constituent.

3.2.10.1 *Discussion*—A composite matrix is a bonding structure which unites, fills, and encloses the composite's reinforcement structures.

3.2.11 *ply count, n*—in laminated composite materials, the number of plies or laminae used to construct the composite.

3.2.12 *prepreg, n*—the admixture of fibrous reinforcement and polymeric matrix used to fabricate composite materials. Its form may be sheet, tape, or tow. For thermosetting matrices, it has been partially cured to a controlled viscosity call "B stage." **(D 3878)**

3.2.13 *sandwich construction, n*—a structural panel concept consisting in its simplest form of two relatively thin sheets of structural material bonded to and separated by a relatively thick lightweight core.

3.2.14 *stacking sequence, n*—the arrangement of ply orientations and material components in a laminate specified with respect to some reference direction. **(D 3878)**

3.2.15 *value set*—an open listing of representative acceptable strings which could be included in a particular field of a record. **(E 1443)**

3.2.15.1 *Discussion*—A closed listing of such string is called a domain or category set.

3.2.16 *void content, n*—the percentage of voids in a composite.

3.2.17 *volatiles content, n*—the percentage of volatiles which are driven off as vapor from a plastic or an impregnated reinforcement.

3.3 Other relevant terminology can be found in Terminologies E 6 and E 1013.

4. Significance and Use

4.1 This guide provides the recommended data elements for the identification of fiber-reinforced composite materials. The ASTM standards for which this guide was developed are listed in 2.1. The recommended data elements can be used with experimental data records and analyzed property records.

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[6] *Annual Book of ASTM Standards*, Vol 14.04.

[7] *MIL-HDBK-17-2D, Polymer Matrix Composites*, Vol 2, Section 1.6, Feb. 23, 1994, available from Standardization Documents Order Desk, Bldg. 4, Section D, 700 Robbins Ave., Philadelphia, PA 19111-5094. Attn: NPODS Additional information on handbook availability at http:/mil-17.udel.edu/.

[8] *DOD/NASA Advanced Composites Design Guide*, Air Force Wright Aeronautical Laboratories, Dayton, OH, prepared by Rockwell International Corp., 1983 (distribution limited).

[9] *MIL-HDBK-17*, Vol. 2, Section 1.6.1, and Terminology D 1600.

4.2 The intent of this guide is to provide sufficient detail that values are known for the material parameters that may influence test results or material property values. The motivation for this guide is the steadily increasing use of computerized databases. However, these guidelines are equally appropriate for data stored in a hard-copy form.

4.3 This guide is for material identification and description only. It does not include the recommended data elements for mechanical test data or other specific types of test data. These items are covered by separate formats to be referenced in material specifications or other test standards.

4.4 Composite materials are defined as two or more materials that are combined on a macroscale. There is a gray area between composites and other material classes. Two examples of this gray area between polymer matrix composites and plastics are toughened polystyrene and liquid crystal polymer. The present guide may be used to help the database designer determine how to handle materials that fall into this gray area. The selection of which guide to use, this guide or Guide E 1308 for plastics, should depend on whether the additional data elements in this guide are required by the data user, as follows. If information on orientation and form of reinforcement is needed by the intended data/database user, the composite materials guide may be more useful since it contains data elements for this information. Appendix X1 contains a table, which provides guidelines for distinguishing between reinforced polymers and polymer matrix composites.

4.5 Composite materials consist of a matrix phase and one or more discrete reinforcements. Reinforcements may be interpreted broadly to include any macroscale second material, including fibers, particulates, precipitated particles, or structured domains of the parent material. The reinforcements covered in this guide include fibers and such particulates and precipitated particles that can be described adequately as filler within the matrix. The reinforcements may be polymers, metals, ceramics, or other materials. Sandwich constructions are not covered by this guide; data recording for test methods which use a sandwich specimen should refer to Guide E 1471 for identification of the core material. These guidelines are suitable for the identification of composites in simple shapes of constant thickness; for example, plates or tubes. For complex structures, additional information relevant to a specific application may be required.

4.6 Classification of composite materials is complicated by the fact that composites are formed by combining different materials in varying amounts and configurations; this results in an infinite number of possibilities. An effective identification scheme must be capable of possible combinations without overburdening the system with details relevant only to a limited number of material systems. This guide provides both essential data elements and data elements that are considered desirable but not essential. Data elements are considered essential if they are required to make a meaningful comparison of property data from different sources.

4.7 Identification of constituent materials of the composites is included to the level considered necessary for identification of the composite. Additional information may be necessary when the constituent is considered independently. Guides for polymers (E 1308), metals (E 1338), and reinforcements (E 1471) should be consulted in this case.

4.8 Comparison of property data from different databases will be most meaningful if all the essential information defined by the guide is present. Comparison may still be possible if essential information is omitted, but the usefulness of the comparison may be greatly reduced.

4.9 This information should not be considered restrictive. For example, a database designer may find it useful to aggregate several data elements, such as all data elements in a test method data element set or the material and chemical classes, into a single field. This may affect search strategies and other database operations. These considerations are beyond the scope of this guide.

5. Data Reporting

5.1 This guide is intended to provide common data reporting requirements for material identification when used for reporting testing and material properties based on accumulated results from a number of tests. The data reporting section of standard test methods may reference this guide for material identification in conjunction with Guide E 1434 for recording of the test procedure, parameters, and results. In addition, such a data reporting section may identify any usage specific to that document. One example of usage specific to a test method is Test Method D 5467, which may require additional information to identify the core material for the sandwich specimen from Guide E 1471. These requirements do not mean that the information must be reported separately for each specimen or that all information must be reported separately for each batch. Any data elements that are the same for a series of specimens or for a series of batches may be reported once for the entire series, as long as it is clearly indicated that they apply to all specimens or all batches.

5.2 Five levels of requirement are defined in Section 8 and identified in Table 1. The cost of acquiring and storing the data documentation is recognized. Less extensive data reporting requirements may be established for a given program or purpose upon agreement of the parties involved.

5.3 In addition, for identifying materials, some data elements are essential only if relevant. For example, Data Element D3, fabric style is required for material traceability, but is currently used only for certain types of fiber (primarily glass). Fabric styles have not been standardized for carbon fibers.

TABLE 1 Data Elements for Identification of Composite Materials

NOTE 1—Standard Data Element Sets (third column)—enclosed in square brackets.

NOTE 2—Requirement Levels (fifth column):

ET - Essential for Test validity
RT - Recommended for Test validity
EM - Essential for Material traceability
RM - Recommended for Material traceability
O - Optional

No.	Data Element Descriptive Name	Data Type or Standard Data Element Set	Category Set, Value Set, or Units	Level
	A. Composite Material Identification Block			
A1	Material identifier	STRING		ET
A2	Data source identification	STRING		ET
A3	Composite material name	STRING	Calculated	O
A4	Material class	STRING	“Composite”	O
A5	Material subclass	STRING	Calculated	O
A6	Material form	STRING		EM
A7	Matrix class	STRING	“Polymer”	EM
A8	Reinforcement class	STRING	Table 2	EM
A9	Reinforcement subclass	STRING	Table 3	EM
A10	Material specification	[Specification]		RM
A11	Material source (if not from manufacturer)	[Organization]		RM
A12	Material maximum temperature, nominal	REAL	C(F)	O
A13	Material minimum temperature, nominal	REAL	C(F)	O
A14	Material MSDS and assigning organization	STRING		O
A15	Contract number	STRING		O
A16	Data restrictions	STRING		O
	B. Fiber Information Block			
B1	Fiber class	STRING	Table 4	RM
B2	Fiber chemical class	STRING	Table 5	ET
B3	Fiber chemical family	STRING	Table 6	RM
B4	Fiber modulus subfamily	STRING	Table 7	O
B5	Fiber commercial name	STRING		EM
B6	Fiber additional name information	STRING		RM
B7	Fiber manufacturer’s specification	[Specification]		RM
B8	Fiber user’s specification	[Specification]		O
B9	Fiber manufacturer’s internal designation	STRING		O
B10	Fiber manufacturer	[Organization]		RM
B11	Fiber lot	STRING		EM
B12	Fiber date of manufacture	DATE		RM
B13	Fiber batch certification number	STRING		O
B14	Fiber density	REAL	g/cm^3	EM
B15	Fiber density test method	[Test method]		EM
B16	Tow or yarn filament count	INTEGER		EM
B17	Tow or yarn filament count test method	[Test method]		RM
B18	Tow/strand linear density	REAL	tex	O
B19	Tow/strand linear density test method	[Test method]		O
B20	Tow yield	REAL	m/g	O
B21	Fiber filament diameter	REAL	mm	EM
B22	Fiber filament diameter test method	[Test method]		RM
B23	Filament cross-section type	STRING	Table 8	RM
B24	Surface treatment type	STRING	Table 9	RM
B25	Surface treatment detail	STRING		RM
B26	Tow or yarn sizing identification	STRING		RM
B27	Tow or yarn sizing amount	REAL		RM
B28	Tow or yarn twist amount	REAL	t/m	RM
B29	Tow or yarn twist direction	STRING	Table 10	RM
	C. Matrix Information Block			
C1	Matrix subclass	STRING	Table 11	EM
C2	Matrix chemical family	STRING	Table 12	ET
C3	Matrix subfamily	STRING	Table 13	O
C4	Matrix commercial name	STRING		EM
C5	Matrix manufacturer	[Organization]		EM
C6	Matrix lot number	STRING		RM
C7	Matrix date of manufacture	DATE		RM
C8	Matrix filler type	STRING		RM
C9	Matrix filler amount	REAL		RM
C10	Matrix nominal density	REAL	g/cm^3	RM
C11	Matrix nominal density test method	[Test method]		RM
C12	Matrix internal designation	STRING		O
C13	Matrix manufacturer specification	[Specification]		O

TABLE 1 *Continued*

No.	Data Element Descriptive Name	Data Type or Standard Data Element Set	Category Set, Value Set, or Units	Level
C14	Gel time	[Auxiliary test]		O
	D. Preform Information Block			
D1	Preform architecture	STRING	Table 14	EM
D2	Preform identifier	STRING		EM
D3	Preform manufacturer	[Organization]		EM
D4	Preform method of manufacture	STRING	Table 15	
D5	Number of preform layers	INTEGER		EM
	2-D Fabric Information Subblock			
D6	Fabric manufacturer	[Organization]		EM
D7	Fabric weave type	STRING	Table 16	EM
D8	Fabric style number	STRING		EM
D9	Fabric lot	STRING		EM
D10	Fabric date of manufacture	DATE		RM
D11	Fabric batch certification number	STRING		O
D12	Fabric manufacturer specification	[Specification]		O
D13	Fabric user specification	[Specification]		O
D14	Fabric sizing identification	STRING		EM
D15	Fabric sizing content	REAL		EM
D16	Fabric end count (warp)	REAL	/m	EM
D17	Fabric fill fiber (if different)	STRING		EM
D18	Fabric pick count (fill)	REAL	/m	EM
D19	Fabric nominal fiber areal weight	REAL	g/mm^2	O
D20	Tracer warp name	STRING		O
D21	Tracer warp linear density	REAL	g/m	O
D22	Tracer warp spacing	REAL	/mm	O
D23	Tracer warp sizing	REAL		O
D24	Tracer fill name	STRING		O
D25	Tracer fill linear density	REAL	g/m	O
D26	Tracer fill spacing	REAL	/mm	O
D27	Tracer fill sizing	REAL		O
	3-D Woven Materials Subblock			
D28	Interlock description	STRING		EM
D29	Warp fiber filament count	INTEGER		EM
D30	Weft fiber filament count	INTEGER		EM
D31	Angle fiber filament count	INTEGER		EM
D32	Weaver yarn filament count	INTEGER		EM
D33	Percentage of warp yarn	REAL	%	EM
D34	Percentage of weft yarn	REAL	%	EM
D35	Angle of angle yarn (positive with respect to axial yarn)	REAL	degrees	EM
D36	Percentage of angle yarn	REAL	%	EM
D37	Percentage of weaver yarn	REAL	%	EM
D38	Percentage of through-thickness yarn	REAL	%	EM
D39	Pitch length	REAL	in.	EM
D40	Warp end count	REAL	tow/in.	EM
D41	Weft end count	REAL	tow/in.	EM
D42	Unit cell width	REAL	in.	O
D43	Unit cell length	REAL	in.	O
D44	Unit cell depth	REAL	in.	O
	Stitching Information Subblock			
D45	Stitch type	STRING		EM
D46	Stitch thread	STRING		EM
D47	Stitch axial pitch	REAL	degrees	EM
D48	Stitch row spacing	REAL	in.	EM
D49	Stitch denier	REAL	denier	RM
D50	Stitch filament count	INTEGER		EM
D51	Bias yarn end count	INTEGER		EM
D52	Bias yarn angle	REAL	degrees	EM
	Braiding Information Subblock			
D53	Braid description	STRING		EM
D54	Axial fiber type	STRING		EM
D55	Braid fiber type	STRING		EM
D56	Axial fiber filament count	INTEGER		EM
D57	Braid fiber filament count	INTEGER		EM
D58	Braid angle	REAL	degrees	EM
D59	Percentage of axial yarn	REAL	%	EM
D60	Percentage of braid yarn	REAL	%	EM
D61	Axial yarn spacing in braids	REAL	in.	RM
D62	Unit cell width	REAL	in.	O

TABLE 1 *Continued*

No.	Data Element Descriptive Name	Data Type or Standard Data Element Set	Category Set, Value Set, or Units	Level
D63	Unit cell length	REAL	in.	O
D64	Braider identification	STRING		RM
D65	Number of carriers	INTEGER		RM
	Winding Information Block			
D66	Winding description	STRING		EM
D67	Winder identification	STRING		RM
D68	Mandrel identification	STRING		EM
	E. Prepreg Information Block Prepreg Identification Subblock			
E1	Prepreg type	STRING	Table 17	EM
E2	Prepreg commercial name	STRING		EM
E3	Prepreg manufacturer	[Organization]		EM
E4	Prepreg manufacturer's internal spec	[Specification]		O
E5	Prepreg source	[Organization]		O
E6	Prepreg dimension parameter	STRING	Table 18	RM
E7	Prepreg dimension value	REAL		RM
E8	Prepreg reinforcement orientation(s)	STRING		RM
E9	Scrim fiber chemical class	STRING	Table 5	RM
E10	Scrim fabric style	STRING		RM
E11	Prepreg additional information	STRING		RM
	Prepreg Batch Information Subblock			
E12	Prepreg batch number	STRING		EM
E13	Prepreg batch certification date	STRING		O
E14	Prepreg batch expiration date	DATE		RM
E15	Prepreg batch roll number	STRING		RM
	Prepreg Auxiliary Test Subblock			
E16	Prepreg fiber areal weight	[Auxiliary test]	g/m^2	EM
E17	Prepreg volatile content, wt%	[Auxiliary test]	wt%	EM
E18	Prepreg fiber content, vol%	[Auxiliary test]	vol%	RM
E19	Prepreg matrix content, wt%	[Auxiliary test]	Wt%	RM
E20	Prepreg matrix flow	[Auxiliary test]	Wt%	RM
E21	Prepreg matrix gel time	[Auxiliary test]		RM
E22	Prepreg tack	[Auxiliary test]		O
E23	Prepreg drape	[Auxiliary test]		O
	F. Process Information Block Process Specification Subblock			
F1	Process specification	[Specification]		RM
F2	Process reinforcement application	STRING	Table 19	EM
F3	Process mold type	STRING	Table 20	EM
F4	Tackifier common name	STRING		RM
F5	Tackifier chemical class	STRING	Table 12	RM
F6	Tackifier form	STRING	Table 21	RM
F7	Tackifier manufacturer	STRING		RM
	Process Description Subblock			
F8	Process stage type	STRING	Table 22	RM
F9	Process stage temperature	REAL	C(F)	RM
F10	Process stage pressure	REAL	psig	RM
F11	Process stage vacuum	REAL	psig	RM
F12	Process stage duration	REAL	min	RM
F13	Process ramp rate	REAL	C/min (F/min)	RM
F14	Process stage other parameter	STRING	degrees	RM
F15	Processor	[Organization]		EM
F16	Process start date	DATE		RM
F17	Process end date	DATE		RM
F18	Process records reference	STRING		RM
	G. Part Information Block Part Description Subblock			
G1	Part form	STRING	Table 23	EM
G2	Material orientation code	STRING		EM
G3	Part specification	[Specification]		RM
G4	Part dimension parameter	STRING		RM
G5	Part dimension value	REAL		RM
G6	Part history	STRING		EM
G7	Part additional information	STRING		RM
	Part Auxiliary Test Subblock			
G8	Part resin content by weight	[Auxiliary test]	wt%	
G9	Part fiber content, by volume	[Auxiliary test]	vol%	EM

TABLE 1 *Continued*

No.	Data Element Descriptive Name	Data Type or Standard Data Element Set	Category Set, Value Set, or Units	Level
G10	Part fiber areal weight	[Auxiliary test]	g/m^2	
G11	Part void content, by volume	[Auxiliary test]	vol%	EM
G12	Part mass density	[Auxiliary test]	g/cm^3	EM
G13	Part glass transition temperature—dry	[Auxiliary test]	C(F)	EM
G14	Part glass transition temperature—wet	[Auxiliary test]	C(F)	EM
G15	Footnotes	STRING		EM

6. Database Design

6.1 This guide defines the principal elements of information, which are considered worth recording and storing permanently in computerized data storage systems from which machine-readable databases will be developed. These are not intended to be requirements of any specific database, but if available, are likely to be valuable to engineers or material specialists building databases for various applications.

6.2 It is recognized that many databases are prepared for specific applications, and individual database builders may elect to omit certain pieces of information considered to be of no value for that specific application. However, there are a certain minimum number of data elements considered essential to any database, without which the user will not have sufficient information to interpret the data reasonably. In the recommended standard format, these data elements are indicated by levels of requirement of ET or EM as defined in 8.2. Data elements that are considered essential depending on the value of another data element are generally considered essential for database design.

6.3 The presentation of this format does not represent a requirement that all of the elements of information included in the recommendation must be included in every database. Rather, it is a guide as to those elements of information recommended for inclusion in all databases. This should not discourage database builders and users from proceeding as long as the minimum basic information is included (based on the level or requirement). Compared to the guide for identifying metals, there are many more data elements, and more data elements are identified as essential. This relatively large number of data elements is due to the complexity of the materials. These data elements represent information that is needed to reproduce the material and may influence material property values. These requirements do not mean that each of these data elements must be included in each record for individual test specimens or material property values. A database specific to a project or to common practice within an organization may be structured so that values for data elements that are the same for the same material processing procedure, for a group of specimens, or for a group of material property values need only be entered once, as long as it is clearly indicated to which material they apply.

6.4 The order of the data elements or the block and subblock organization of these elements is not intended to establish a standard database schema. For a given database, it may be desirable to reorganize these data elements to suit the database application and the scope of data to be included in a database.

6.5 It is not uncommon for one or more elements of essential information to be unavailable, as noted in 5.3. It may be appropriate for databases to differentiate between zero values and null entries in data elements that are not used for a given test. Also it is recognized that in some individual cases, additional elements of information of value to users of a database may be available. In those cases, database builders are

TABLE 2 Value Set for Reinforcement Class

Fiber	Filler	Core

TABLE 3 Value Set for Reinforcement Subclass

Fiber	Filler	Core
Continuous	particulate	honeycomb
Discontinuous, long	platelet	close-cell foam
Discontinuous, short	hollow sphere	open-cell foam
Staple	hollow cylinder	
Milled		
Whisker		
Pulp		

TABLE 4 Category Set for Fiber Class

Polymer
Metal
Carbon
Ceramic

TABLE 5 Value Set for Fiber Chemical Class

Alumina	AlO
Aluminum	Al
Aramid	Ar
Boron	B
Carbon	C
Glass	Gl
Graphite	Gr
Liquid crystal polymer	LCP
Lithium	Li
Metallic oxide	MO
Polybenzothiazole	PBT
Quartz/silica	Q
Silicon	Si
Silicon carbide	SiC
Titanium	Ti
Tungsten	W
Ultrahigh molecular weight polyethylene	UHMWPE

TABLE 6 Value Set for Reinforcement Chemical Family

Carbon	Glass	Quartz	Boron	Silicon Carbide
PAN precursor	E-glass	mineral	TBD	monofilament
Pitch precursor	S-glass	manmade		multifilament
Rayon precursor	S2-glass			
	D-glass			

Aramid	Metallic Oxide	LCP	UHMWPE	Other
TBD	TBD	TBD	TBD	TBD

TABLE 7 Value Set for Modulus Subfamily

<69 GPa	<10 Msi
69-138 GPa	10-20 Msi
138-207 GPa	20-30 Msi
207-276 GPa	30-40 Msi
275-345 GPa	40-50 Msi
345-483 GPa	50-70 Msi
483-621 GPa	70-90 Msi
621-758 GPa	90-110 Msi
>758 GPa	>110 Msi

TABLE 8 Value Set for Fiber Cross-Section Type

Circular (round)
Annular
Rectangular
Square
Oval
Irregular

TABLE 9 Value Set for Surface Treatment Type

Chemical oxidation
Plasma etching
Adhesion promoting
Sizing
Anticorrosion
Finish free
Lubricant
Release treatment
No surface treatment

TABLE 10 Category Set for Twist Direction

S	Z	N - none	U - unknown

TABLE 11 Category Set for Matrix Subclass

Thermoset	Thermoplastic

encouraged to include them as well as the elements in the recommended format.

6.6 The method of including information identifying the units for each data element is left to the database designer. Frequently used units, in both SI and inch-pound systems, are listed in the tables to clarify the format and examples. This should not be interpreted as requiring any particular implementation of data elements for units.

6.7 While data elements indicating the accuracy of each measurement are beyond the scope of this guide, it is recommended that entries in all data elements be given to the correct number of significant digits.

7. Data Element Sets

7.1 Sets of data elements that are used repetitively or are common to many documents have been identified. The following standard sets of data elements are used in this guide: Auxiliary Test, Date, Organization, Specification, and Test Method.

7.1.1 The format of the data elements sets is data_element-_name : data type - definition.

7.1.2 The data type of an data element may be STRING, NUMBER (REAL or INTEGER), LOGICAL or DATE.

TABLE 12 Value Set for Matrix Chemical Family with Common Abbreviations[A]

Bismaleimide	BMI
Epoxy	EP
Fluorocarbon	
Liquid crystal polymer	LCP
Phenolic (urea-formaldehyde)	PF
Polyamide-imide	PAI
Polyarylsulfone	PAS
Polybenzimidazole	
Polybutylene terephthalate	PBT
Polycyclohexylenedimethylene terephthalate	PCT
Polyester, thermoplastic (general)	TPES
Polyester, unsaturated	UP
Polyethelene terephthalate	PET
Polyetheretherketone	PEEK
Polyetherimide	PEI
Polyethersulfone	PES
Polyimide	PI
Polyimide, thermoplastic	TPPI
Polyphenylene sulfide	PPS
Polysulfone	PSU
Silicone	SI

[A] MIL-HDBK-17, Volume 2, Section 1.6.1, and Terminology D 1600

TABLE 13 Value Set for Matrix Subfamily (by Processing Temperature)

Ambient Temperature, °C	Ambient Temperature, °F
<93	<200
93-149	200-300
149-204	300-400
204-260	400-500
260-316	500-600
316-371	600-700
371-427	700-800
>427	>800

TABLE 14 Value Set for Preform Architecture

Filament winding
Braid
2-D Fabric
3-D Fabric
Stitched Fabric

TABLE 15 Value Set for Preform Method of Manufacture

Molded
Stitched
RFI

TABLE 16 Value Set and Common Abbreviations for Fabric Weave Type

Plain	PW
Crowfoot	CSW
5-harness satin	5HS
8-harness satin	8HS
12-harness satin	12HS

7.1.2.1 For database development, the closest available data type should be used. If a DATE type is not available, STRING should be used. The format for DATE is YYYY-MM-DD, where YYYY is a four-character string for the year, MM is a two-character string for the month as defined in ISO 8601 (5.2.1) for example, January is 01, February is 02, and so forth, and DD is a two-character string for the specified day of the month.

TABLE 17 Value Set for Precursor Type

Prepreg
Prelam
Preimpregnated tow
BMC (bulk molding compound)
SMC (sheet molding compound)
XMC

TABLE 18 Value Set for Dimension Parameters

Length
Outside diameter
Width
Thickness
Inside diameter
Fiber diameter
Wall thickness

TABLE 19 Value Set for Reinforcement Application

Automated fiber placement—tape	preform—braid
Automated fiber placement—towpreg	preform—weave
Automated fiber placement—wet	spray
Automated lay-up—prepreg	wound—dry
Automated lay-up—wet	wound—wet
Hand lay-up—prepreg	wound—prepreg
Hand lay-up—wet	

TABLE 20 Value Set for Process Mold Type

Autoclave	injection molding—vacuum assisted
Compression molding	oven
Diffusion bonding	pultrusion
Ebeam	resin transfer molding
Hydroclave	trapped rubber
Induction	vacuum infiltration
Injection molding	vapor deposition
Injection molding—liquid	VARTM (vacuum-assisted resin transfer molding)
Injection molding—reaction	

TABLE 21 Value Set for Tackifier Form

Aerosol	Liquid

TABLE 22 Value Set for Process Stage Types

Age-harden	injection
Anneal	part insertion
Consolidate	part removal
Cool down	postcure
Cure—bleed	prebleed
Cure—no bleed	preform insertion
Debulk	preheat
Densify	isothermal dwell

TABLE 23 Value Set for Part Forms

Panel
Rod
Cylinder
Channel
Hoop
Shell
Ring

7.1.2.2 The hyphens in the date format shall be used for compatibility with ISO 8601. Dates are presented according to the Gregorian calendar.

7.2 *Use of Standard Data Element Sets*—The name of a standard data element set, indicated in this guide in brackets, represents all of the data elements in that set. The following example illustrates identical data elements, using a standard data element set. The descriptive name of the data element in the standard set is attached to the referring data element to help clarify the usage.

7.2.1 *Example*—Table 1, Data Element A12, Specification, indicates the standard data element set for Specification in square brackets in the third column. This is equivalent to listing the five data elements in the Specification standard data element set as individual data elements. Thus:

Data Element A12 Material specification [Specification]

is equivalent to:

Data Element A12a Material_specification_organization_name: string - name of organization responsible for specification
Data Element A12b Material_specification_id: string - identification of specification
Data Element A12c Material_specification_date: date - date of approval of most recent technical revision or initial release
Data Element A12d Material_specification_version: string - identification of a specific version of a specification
Data Element A12e Material_specification_designation: string - identification of a specific procedure or method when the Specification document contains more than one.

7.2.2 Note, as discussed in 4.9, that a database designer may combine these elements into a single field.

7.3 *Auxiliary Test*:

7.3.1 *Data Element Set Definition*—The auxiliary test is a record of information for a test method and results which are used as metadata or information used to define the material.

7.3.2 *Data Elements*:

property : string - objective of auxiliary test
value : real - result of auxiliary test
units : string - units for value
test method : [Test method] - test method used to generate value

7.3.3 *Example Usage*—The standard data element set Auxiliary test is used in Table 1 in the Part Auxiliary Test Subblock.

7.4 *Organization*:

7.4.1 *Data Element Set Definition*—An organization is an administrative structure.

7.4.2 *Data Elements*:

id : string - the means by which the organization's individuality may be deduced
name : string - the word, or group of words, by which an organization is referred to
description : string - text that relates the nature of an organization
organization_role_name : string - the word, or group of words, that indicate the function being performed

7.4.3 *Example Usage*—The standard data element set Organization is used in Table 1 in B11, Fiber manufacturer.

7.5 *Specification*:

7.5.1 *Data Element Set Definition*—A specification is a documented set of requirements for a material or process

7.5.2 *Data Elements*:

organization_name : string - name of organization responsible for specification, for example, AMS
id : string - identification of specification, for example, AMS3892
date : date - date of approval of most recent technical revision or initial release. For the example, October, 1997
version : string - identification of a specific version of a specification. For example, Revision A.

designation : string - identification of a specific procedure or set of requirements when the specification contains more than one. For this example /10.

7.5.3 *Example Usage*—The standard data element set Specification is used in Table 1 in A12 Material specification. The example used in 7.5.2 is AMS 3892/10, "Tow, Carbon Fiber For Structural Composites 550 (3792) Tensile Strength, 38 (262) Tensile Modulus," Revision A, October 1997.

7.6 *Test Method*:

7.6.1 *Data Element Set Definition*—Identification of the documented test method used.

7.6.2 *Data Elements*:

organization_name : string - name of organization responsible for test method, for example, ASTM
id : string - identification of test method, for example, Test Method D 3410/D 3410M
date : date - date of approval of most recent technical revision or initial release
version : string - identification of a specific version of a test method. For example, ASTM uses lowercase letters to distinguish between revisions, to a document, in the same calendar year.
designation : string - identification of a specific procedure or method when the test method document contains more than one. For example, Test Method II, Procedure A in Test Methods D 790.

7.6.3 *Example Usage*—The standard data element set Test Method is used in Standard Data Element Set Auxiliary Test and in Table 1 in Data Element B15, Fiber Density Test Method.

8. Levels of Requirement

8.1 It is recognized that these data elements may be used by two different communities—testing laboratories, which do not necessarily have access to full material identification, and material suppliers and users, for whom material traceability is often important. To address the needs of both of these groups, data-reporting requirements in this guide have been separated into data elements for test validity and for material traceability.

8.2 The five levels of requirement are as follows:

8.2.1 ET—Essential for Test validation.

8.2.2 RT—Recommended for Test validity.

8.2.3 EM—Essential for Material traceability.

8.2.4 RM—Recommended for Material traceability.

8.2.5 O—Optional.

9. Recording of Material Identification

9.1 Table 1 lists the recommended data elements for the identification of fiber-reinforced composite materials. There are five columns of information:

9.1.1 *Data Element Number*—A reference number for ease of dealing with the individual data elements within this format guideline. It has no permanent value and does not become part of the database itself. Data element numbers are for reference only. They do not imply a necessity to include all these data elements in any specific database nor imply a requirement that data elements used be in this particular order.

9.1.2 *Data Element Descriptive Name*—The descriptive name of the data element, identifying of the element of information that would be included in this data element of the database.

9.1.3 *Data Type or Standard Data Element Set*—A data type is indicated for each individual data element. These are the same data types discussed in Section 8. Data types are presented in capital letters. Data element sets are indicated by the name of the standard data element set in brackets. This indicates that each element of the set is included, as demonstrated in 7.2.

9.1.4 *Category Set, Value Set, or Units*—A listing of the types of information which would be included in the data element or, in the case of properties or other numeric data elements, the units in which the numbers are expressed. Category sets list all possible values for a data element. Value sets are representative sets, listing sample (but not necessarily all acceptable) inputs to the data element. The units listed are SI, in accordance with IEEE/ASTM SI 10, followed by inch-pound units in parentheses. References to Tables 2-23 provide appropriate category sets or value sets as listed in Table 1. Also noted in this column are data elements where the recommended entry is calculated. Two examples of calculated data elements are Composite Material Name (A3) and Material Subclass (A5). These elements are often useful for accessing and presenting data but are redundant with other data elements. As maintaining redundant data elements is not considered good database practice, the data elements are presented as calculated elements.

9.1.5 *Level of Requirement*—The fifth column indicates the level of requirement. The information for identifying materials is divided into nine blocks: Composite, Fiber, Matrix, Fabric, Preform, Winding, Prepreg, Process, and Part. Depending on the constituents of the material and how the fibers are manipulated or organized during fabrication, several of the blocks may be required to adequately identify a material while others are unnecessary. For example, a two-dimensional fabric that is laid up and cured into a laminate would require Material, Fiber, Matrix, Fabric, Prepreg, Processing, and Part blocks. A filament wound material that is resin transfer molded would require Material, Fiber, Matrix, Filament Winding, Processing, and Part blocks.

9.2 *Dates*—Several data elements require a date, for example, date of test. If process or procedure took more than one day, then the date of completion is reported.

9.3 *Composite Material Identification Block*—Data elements in this section should be considered as having the level of requirement shown for all materials. Data elements with particular concerns are discussed in the following sections.

9.3.1 *Composite Material Name*—This data element is calculated. Based on MIL-HDBK-17, one frequent calculation for this element is as follows:

[Composite Material Name] = [Fiber Commercial Name] + " " + [Tow or Filament Count] + "/" + [Matrix Commercial Name] + " " + [Fabric Weave Type] + " " + [Critical Processing Information]

9.3.2 *Material Class*—The material class for all uses of this guide is "Composite."

9.3.2.1 *Material Subclass*—This data element is calculated. Common usage is as follows:

[Matrix Subclass] = [Fiber Class] + '/' + [Matrix Class]

9.3.3 *Matrix Class*—The matrix class for all uses of this guide is "Polymer."

9.3.4 *Reinforcement Class*—The reinforcement class for most uses of this guide is "Fiber." Guide E 1471 provides more information about reinforcement classes.

9.4 *Fiber Identification Block*—Data elements in this section should be considered as having the level of requirement shown for all materials. All essential data elements for fiber identification from Guide E 1471 have been included in this guide.

9.5 *Matrix Identification Block*—Data elements in this section should be considered as having the level of requirement shown for all materials.

9.6 *Gel Time*—Gel time is considered an auxiliary test, a property determined to help identify a particular material. In this case, gel time is measured on the matrix material prior to its incorporation into a composite material.

9.7 *Preform Identification Block*—For the purposes of this guide, preform encompasses all types of fiber assemblies that may or may not approach the final geometry of the part. These range from traditional two-dimensional fabrics to complex three-dimensional woven materials. The block contains several header elements followed by subblocks - 2-D Fabric, 3-D Woven Materials, Stitching, Braiding Materials, and Winding. The appropriate subblock(s) is used based on the stags of assembly of fibers for the material product being identified. Note that there is some redundancy among the subblocks. The data elements are listed in the subblocks for which the data elements are appropriate to address the objective of data recording. It may be desirable in a database design to combine the subblocks and eliminate redundant data elements.

9.8 *Prepreg Information Block*—Elements in the block identify and describe the combination of matrix and fiber materials in a partially cured state. Prepreg batch identification and description is included as well as auxiliary tests that help identify the prepreg or that are performed on the prepreg to help identify the composite product. This block is used only for materials that are partially cured prior to final assembly. Based on the definition of prepreg (3.2.12), thermoset and thermoplastic materials may be covered.

9.9 *Process Information Block*—Data elements in this block are appropriate for all composite materials. Subblocks are included to identify specification information and to describe the process. Depending on the level of detail desired, the process description subblock may be repeated several times to identify one material.

9.10 *Part Information Block*—The final configuration of a material. Data elements in this block are appropriate for all composite materials.

9.10.1 *Part History*—Service history or similar information for the part (in contrast to a specimen in a controlled environment) is included in this data element.

9.10.2 *Material Orientation Code*—The lay-up code to describe stacking sequence in a laminar composite or a braiding orientation code for braided material forms. These material orientation codes are defined in Practice D 6507 based on the convention used in MIL-HDBK-17-2[7] and the DOD/NASA Advanced Composites Design Guide[8]. Practice D 6507 includes the following modifications to the convention since many database programs do not accommodate subscripts and superscripts:

9.10.2.1 Information provided in a subscript is preceded by a colon (:) in the computerized notation. For example, [90/0:2/45]:s is the computerized notation for $[90/0_2/45]_s$.

9.10.2.2 The presence of a bar over a ply (designating a non-repeated ply in a symmetric laminate with an odd number of plies) is indicated by a backslash (\) after the ply in the computerized notation. For example, [90/45/0\]:s is the computerized notation for $[90/45/\bar{0}]_s$.

9.10.2.3 The lay-up code should also indicate the location of core if the composite is a sandwich, for example, [(0/45/90)/core/(90/45/0)].

9.10.3 *Footnotes*—A brief statement of any significant information helpful in identifying the material. The method for including this information in a database should be determined by the database designer. Notes or comment fields may be appropriate for each block or subblock of data elements provided in Table 1 or for each database table in a database design.

10. Keywords

10.1 databases; data elements; fiber-reinforced polymer-matrix composite materials

ANNEX

(Mandatory Information)

A1. DATA ELEMENTS FOR PROPERTY-LEVEL COMPOSITE MATERIALS IDENTIFICATION

A1.1 This annex provides data elements for data that have been generally grouped, analyzed, and reviewed and are considered property-level data rather than test data. Data element numbers in this annex are coordinated with data element numbers in Table 1. As Table 1 is the first part of a modular approach with Guide E 1434, Table 1, this annex is coordinated with Guide E 1434, Annex A1. All table numbers refer to Guide E 1309.

TABLE A1.1 Data Elements for Property-Level Composite Materials Identification

NOTE 1—Requirement levels:
ET - Essential for Test validity
RT - Recommended for Test validity
EM - Essential for Material traceability
RM - Recommended for Material traceability
O - Optional

No.	Data Element Descriptive Name	Data Type or Standard Data Element Set	Category Set, Value Set, or Units	Level
	A. Composite Material Identification Block			
A1	Material identifier	STRING		ET
A2	Data source identification	STRING		ET
A3	Composite material name	STRING	Calculated	O
A4	Material class	STRING	“Composite”	O
A5	Material subclass	STRING	Calculated	O
A6	Material form	STRING		EM
A7	Matrix class	STRING	“Polymer”	EM
A8	Reinforcement class	STRING	Table 2	EM
A9	Reinforcement subclass	STRING	Table 3	EM
A10	Material specification	[Specification]		RM
A14	Material MSDS and assigning org.	STRING		O
A16	Data restrictions	STRING		O
	B. Fiber Information Block			
B1	Fiber class	STRING	Table 4	RM
B2	Fiber chemical class	STRING	Table 5	ET
B3	Fiber chemical family	STRING	Table 6	RM
B4	Fiber moduli subfamily	STRING	Table 7	O
B5	Fiber commercial name	STRING		EM
B6	Fiber additional name information	STRING		RM
B7	Fiber manufacturer’s specification	[Specification]		RM
B8	Fiber user’s specification	[Specification]		O
B10	Fiber manufacturer	[Organization]		RM
B12	Fiber date of manufacture—minimum	DATE		RM
B12	Fiber date of manufacture—maximum	DATE		RM
B14	Fiber density—nominal	REAL	g/cm^3	EM
B14	Fiber density—minimum	REAL	g/cm^3	EM
B14	Fiber density—maximum	REAL	g/cm^3	EM
B15	Fiber density test method	[Test method]		EM
B16	Tow or yarn filament count	INTEGER		EM
B24	Surface treatment type	STRING	Table 9	RM
B25	Surface treatment detail	STRING		RM
B26	Tow or yarn sizing identification	STRING		RM
B27	Tow or yarn sizing amount	REAL		RM
B28	Tow or yarn twist amount	REAL	t/m	RM
	C. Matrix Information Block			
C1	Matrix subclass	STRING	Table 11	EM
C2	Matrix chemical family	STRING	Table 12	ET
C3	Matrix subfamily	STRING	Table 13	O
C4	Matrix commercial name	STRING		EM
C5	Matrix manufacturer	[Organization]		EM
C7	Matrix date of manufacture—minimum	DATE		RM
C7	Matrix date of manufacture—maximum	DATE		RM
C10	Matrix density—nominal	REAL	g/cm^3	RM
C10	Matrix density—minimum	REAL	g/cm^3	RM
C10	Matrix density—maximum	REAL	g/cm^3	RM
C11	Matrix density test method	[Test method]		RM
C13	Matrix manufacturer specification	[Specification]		O
	D. Preform Information Block			
D1	Preform architecture	STRING	Table 14	EM
D2	Preform identifier	STRING		EM
D3	Preform manufacturer	[Organization]		EM
D4	Preform method of manufacture	STRING	Table 15	EM
D5	Number of preform layers	INTEGER		EM
	2-D Fabric Information Block			
D6	Fabric manufacturer	[Organization]		EM
D7	Fabric weave type	STRING	Table 16	EM
D8	Fabric style number	STRING		EM
D10	Fabric date of manufacture—minimum	DATE		O
D10	Fabric date of manufacture—maximum	DATE		O
D12	Fabric manufacturer specification	[Specification]		O

TABLE A1.1 *Continued*

No.	Data Element Descriptive Name	Data Type or Standard Data Element Set	Category Set, Value Set, or Units	Level
D13	Fabric user specification	[Specification]		O
D14	Fabric sizing identification	STRING		EM
D15	Fabric sizing content	REAL		EM
D16	Fabric end count (warp)	REAL	/m	EM
D17	Fabric fill fiber (if different)	STRING		EM
D18	Fabric pick count (fill)	REAL	/m	EM
D19	Fabric nominal fiber areal weight	REAL	g/mm^2	O
	3-D Woven Materials Subblock			
D28	Interlock description	STRING		EM
D29	Warp fiber filament count	INTEGER		EM
D30	Weft fiber filament count	INTEGER		EM
D31	Angle fiber filament count	INTEGER		EM
D32	Weaver yarn filament count	INTEGER		EM
D33	Percentage of warp yarn	REAL	%	EM
D34	Percentage of weft yarn	REAL	%	EM
D35	Angle of angle yarn (positive wrt axial yarn)	REAL	degrees	EM
D36	Percentage of angle yarn	REAL	%	EM
D37	Percentage of weaver yarn	REAL	%	EM
D38	Percentage of through-thickness yarn	REAL	%	EM
D39	Pitch length	REAL	in.	EM
D40	Warp end count	REAL	tow/in.	EM
D41	Weft end count	REAL	tow/in.	EM
	Stitching Information Subblock			
D45	Stitch type	STRING		EM
D46	Stitch thread	STRING		EM
D47	Stitch axial pitch	REAL	degrees	EM
D48	Stitch row spacing	REAL	in.	EM
D49	Stitch denier	REAL	denier	RM
D50	Stitch filament count	INTEGER		EM
D51	Bias yarn end count	INTEGER		EM
D52	Bias yarn angle	REAL	degrees	EM
	Braiding Information Subblock			
D53	Braid description	STRING		EM
D54	Axial fiber type	STRING		EM
D55	Braid fiber type	STRING		EM
D56	Axial fiber filament count	INTEGER		EM
D57	Braid fiber filament count	INTEGER		EM
D58	Braid angle	REAL	degrees	EM
D59	Percentage of axial yarn	REAL	%	EM
E60	Percentage of braid yarn	REAL	%	EM
E61	Axial yarn spacing in braids	REAL	in.	RM
	Winding Information Subblock			
D66	Winding description	STRING		EM
	E. Prepreg Information Block Prepreg Identification Subblock			
E1	Prepreg type	STRING	Table 17	EM
E2	Prepreg commercial name	STRING		EM
E3	Prepreg manufacturer	[Organization]		EM
E9	Scrim fiber chemical class	STRING	Table 5	RM
E10	Scrim fabric style	STRING		RM
	Prepreg Batch Information Subblock			
E13	Prepreg batch certification date - minimum	DATE		O
E13	Prepreg batch certification date - maximum	DATE		O
	Prepreg Auxiliary Test Subblock			
E16	Prepreg fiber areal weight—nominal	[Auxiliary test]	g/m^2	EM
E16	Prepreg fiber areal weight—minimum	[Auxiliary test]	g/m^2	EM
E16	Prepreg fiber areal weight—maximum	[Auxiliary test]	g/m^2	EM
E16	Prepreg fiber areal weight—test method	[Auxiliary test]	g/m^2	EM
E17	Prepreg volatile content, wt%	[Auxiliary test]	wt%	EM
E18	Prepreg fiber content, vol%	[Auxiliary test]	vol%	RM
E19	Prepreg matrix content, wt%	[Auxiliary test]	Wt%	RM
	F. Process Information Block Process Specification Subblock			
F1	Process specification	[Specification]		RM
F2	Process reinforcement application	Table	Table 19	EM
F3	Process mold type	Table	Table 20	EM
F4	Tackifier common name	STRING		RM

TABLE A1.1 *Continued*

No.	Data Element Descriptive Name	Data Type or Standard Data Element Set	Category Set, Value Set, or Units	Level
F5	Tackifier chemical class	STRING	Table 12	RM
F6	Tackifier form	STRING	Table 21	RM
F7	Tackifier manufacturer	STRING		RM
	Process Description Subblock			
F8	Process stage type	STRING	Table 22	RM
F9	Process stage temperature—nominal	REAL	F	RM
F9	Process stage temperature—minimum	REAL	F	RM
F9	Process stage temperature—maximum	REAL	F	RM
F10	Process stage pressure—nominal	REAL	psig	RM
F10	Process stage pressure—minimum	REAL	psig	RM
F10	Process stage pressure—maximum	REAL	psig	RM
F11	Process stage vacuum	REAL	psig	RM
F12	Process stage duration—nominal	REAL	min	RM
F12	Process stage duration—minimum	REAL	min	RM
F12	Process stage duration—maximum	REAL	min	RM
F13	Process ramp rate	REAL	C/min (F/min)	RM
F14	Process stage other parameter	STRING		RM
F17	Process end date—minimum	DATE		RM
F17	Process end date—maximum	DATE		RM
	G. Part Information Block Part Description Subblock			
G1	Part form	STRING	Table 23	EM
G2	Material orientation code	STRING		EM
G3	Part specification	[Specification]		RM
G6	Part history	STRING		EM
G7	Part additional information	STRING		RM
	Part Auxiliary Test Subblock			
G4	Part cured ply thickness—nominal	REAL		RM
G4	Part cured ply thickness—minimum	REAL		RM
G4	Part cured ply thickness—maximum	REAL		RM
G9	Part fiber areal weight	[Auxiliary test]		RM
G11	Part mass density—nominal	[Auxiliary test]		EM
G11	Part mass density—minimum	[Auxiliary test]		EM
G11	Part mass density—maximum	[Auxiliary test]		EM
G11	Part mass density—test method	[Auxiliary test]		EM
G12	Mean glass transition temperature—dry	[Auxiliary test]		EM
G13	Mean glass transition temperature—wet	[Auxiliary test]		EM
G13	Mean glass transition temperature—test method	[Auxiliary test]		EM

APPENDIX

(Nonmandatory Information)

X1. CONSIDERATIONS IN DIFFERENTIATING BETWEEN A REINFORCED PLASTIC AND A POLYMER MATRIX COMPOSITES

TABLE X1.1 Differences Between Reinforced Plastics and Polymer Matrix Composite

Polymer, Reinforced	Polymer Matrix Composite
Reinforcement (enhances polymer properties)	Reinforcement (usually controls properties)
Short fibers (usually <½ in.)	Long or continuous fiber/filament/tow
Macerated fabric	Fabric and tape, woven or nonwoven
Particulate	Braided, stitched, knitted preforms
Flake	High-modulus fiber
(randomly mixed in molding compound or during flow to mold, or both, reinforcement simple and small relative to part size)	(Emphasis on properties of reinforcement and its geometric placement; reinforcement dimensions approximate part dimensions)
Polymer	Polymer Matrix
Generally >50 mass% polymer content	Generally <50 mass% polymer content
(compared to total, excluding from polymer mass percent any polymeric reinforcement added).	(compared to total, excluding from polymer mass percent any polymeric reinforcement added).
The polymer has the structural role.	Role is often as a binder for the reinforcement.
Molding Material	Molding Material
Pellets, powder, or granules (B-stage for thermosets)	Prepreg
Dough or putty-like molding compounds (bulk molding compound, BMC)	Sheet molding compound
1- or 2-part (base and hardener) thermosets	Polymer system often kept separate from the reinforcement (united in the mold)
(Molding compound contains the reinforcement; carries it to the mold.)	Polymer carried to mold by reinforcement (filament winding and pultrusion.)
Processing	Processing
Injection molding	Lamination
RRIM	Lay-up
Screw extrusion	Spray-up
Transfer molding	Resin transfer molding; mat molding
Compression molding	Compression molding
Rotational molding	Pultrusion
Thermoforming	Filament winding
(Movement and orientation of reinforcement with resin flow in the mold)	RIM with preform