ASME Y14.47-2023
(Revision of ASME Y14.47-2019)

Model Organization Practices

Engineering Product Definition and Related Documentation Practices

AN AMERICAN NATIONAL STANDARD

The American Society of Mechanical Engineers

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The American Society of Mechanical Engineers
Two Park Avenue • New York, NY • 10016 USA

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FOREWORD

The U.S. Department of Defense requested that ASME adapt Appendix B of MIL-STD-31000A, Technical Data Packages (TDP), as a national standard to support broader usage of its concepts. MIL-STD-31000A, Appendix B provides a methodology for organizing the various elements of a product definition data set. The purpose of MIL-STD-31000A, Appendix B is to propose a mechanism for utilizing annotated models in a TDP in a way such that a traditional drawing is not needed.

To address this need for a national standard, the subject of Appendix B, MIL-STD-31000A and the principles defined by the ASME Y14 series of standards formed a basis for the creation of a model organizational framework as outlined in this Standard. The model organizational framework will enable the use of the product definition data by both humans and machines. This capability is also required to support a model-based enterprise (MBE). By supporting an MBE, the product definition data can be readily reused by downstream users throughout the product life cycle.

ASME Y14.47-2023 adds definitions from ASME Y14.41 and a new definition of "metadata elements." The 2023 edition also updates Table 5-2 (formerly Table 6-3), Metadata Elements. Finally, this edition clarifies the purpose of mapping to the base ASME Y14.47 framework and clarifies product definition elements and dataset completeness states, specifically expanding on and clarifying both the geometry state and the annotation and attribute state.

Future editions of this Standard will refine and expand the framework and expand support for both TDP and MBE.

This Standard is available for public review on a continuing basis. This provides an opportunity for additional public review input from industry, academia, regulatory agencies, and the public-at-large.

This Standard was approved by the American National Standards Institute on January 20, 2023.

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Engineering Product Definition and Related Documentation Practices

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Revisions and Errata. The committee processes revisions to this Standard on a continuous basis to incorporate changes that appear necessary or desirable as demonstrated by the experience gained from the application of the Standard. Approved revisions will be published in the next edition of the Standard.

In addition, the committee may post errata on the committee web page. Errata become effective on the date posted. Users can register on the committee web page to receive e-mail notifications of posted errata.

This Standard is always open for comment, and the committee welcomes proposals for revisions. Such proposals should be as specific as possible, citing the paragraph number(s), the proposed wording, and a detailed description of the reasons for the proposal, including any pertinent background information and supporting documentation.

Cases

(a) The most common applications for cases are

(1) to permit early implementation of a revision based on an urgent need

(2) to provide alternative requirements

(3) to allow users to gain experience with alternative or potential additional requirements prior to incorporation directly into the Standard

(4) to permit the use of a new material or process

(b) Users are cautioned that not all jurisdictions or owners automatically accept cases. Cases are not to be considered as approving, recommending, certifying, or endorsing any proprietary or specific design, or as limiting in any way the freedom of manufacturers, constructors, or owners to choose any method of design or any form of construction that conforms to the Standard.

(c) A proposed case shall be written as a question and reply in the same format as existing cases. The proposal shall also include the following information:

(1) a statement of need and background information

(2) the urgency of the case (e.g., the case concerns a project that is underway or imminent)

(3) the Standard and the paragraph, figure, or table number(s)

(4) the edition(s) of the Standard to which the proposed case applies

(d) A case is effective for use when the public review process has been completed and it is approved by the cognizant supervisory board. Approved cases are posted on the committee web page.

Interpretations. The committee does not issue interpretations for this Standard.

Committee Meetings. The Y14 Standards Committee regularly holds meetings that are open to the public. Persons wishing to attend any meeting should contact the secretary of the committee. Information on future committee meetings can be found on the committee web page at https://go.asme.org/Y14committee.

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MODEL ORGANIZATION PRACTICES

1 GENERAL

1.1 Scope

This Standard establishes a framework for organizing a three-dimensional (3D) model and other associated information within the context of a product definition data set, hereafter referred to as data set, for the purpose of conveying a product definition that enables a model-based enterprise (MBE). This Standard contains no requirements pertaining to drawing graphic sheets. The framework defines a common practice to improve design productivity and to deliver consistent data content and structure to consumers of the data to facilitate common exchange interfaces.

1.2 Introduction

This Standard outlines model organization framework practices to support model-based definition (MBD). This Standard provides a set of requirements and guidelines for the computer-aided design (CAD) user. It is intended to be the foundation for design development efforts in an MBE.

Previously, 3D models had an accompanying drawing graphic sheet. Current advances in CAD capabilities allow product definition previously shown on a drawing graphic sheet to be defined and displayed directly in the MBD, which enables the 3D model to be the primary source for obtaining product definition data. Elimination of the drawing graphic sheet can be accomplished by using a combination of annotations and naming conventions to organize the 3D model.

The organization practices defined by this Standard are necessary to establish a common method to facilitate access to the MBD data in the data set. While the focus of this Standard is initially on mechanical items, the intent is to provide a foundation for use in any discipline. The framework is compliant with an annotated model defined in ASME Y14.41.

1.3 ASME Y14 Series Conventions

The conventions in paras. 1.3.1 through 1.3.12 are used in this and other ASME Y14 standards.

1.3.1 Mandatory, Recommended, Guidance, and Optional Words

(a) The word “shall” establishes a requirement.
(b) The word “will” establishes a declaration of purpose on the part of the design activity.
(c) The word “should” establishes a recommended practice.
(d) The word “may” establishes an allowed practice.
(e) The words “typical,” “example,” “for reference,” and the Latin abbreviation “e.g.” indicate suggestions given for guidance only.
(f) The word “or” used in conjunction with a requirement or a recommended practice indicates that there are two or more options for complying with the stated requirement or practice.
(g) The phrase “unless otherwise specified” or the abbreviation “UOS” establishes a default requirement. The phrase is used when the default is a generally applied requirement and an exception may be provided by another document or requirement.

1.3.2 Cross-Reference of Standards. Cross-reference of standards in text with or without a date following the standard designator shall be interpreted as follows:
(a) Reference to other ASME Y14 standards in the text without a date following the standard designator indicates that the edition of the standard identified in the References section (section 2) shall be used to meet the requirement.
(b) Reference to other ASME Y14 standards in the text with a date following the standard designator indicates that only that edition of the standard shall be used to meet the requirement.

1.3.3 Invocation of Referenced Standards. The following examples define the invocation of a standard when specified in section 2 and referenced in the text of this Standard:

(a) When a referenced standard is cited in the text with no limitations to a specific subject or paragraphs of the standard, the entire standard is invoked. For example, "Dimensioning and tolerancing shall be in accordance with ASME Y14.5" is invoking the complete standard because the subject of the standard is dimensioning and tolerancing and no specific subject or paragraphs within the standard are invoked.

(b) When a referenced standard is cited in the text with limitations to a specific subject or paragraphs of the standard, only the paragraphs on that subject are invoked. For example, "Assign part or identifying numbers in accordance with ASME Y14.100" is invoking only the paragraphs on part or identifying numbers because the subject of the standard is engineering drawing practices and part or identifying numbers is a specific subject within the standard.

(c) When a referenced standard is cited in the text without an invoking statement such as "in accordance with," the standard is invoked for guidance only. For example, "For gaging principles, see ASME Y14.43" is only for guidance and no portion of the standard is invoked.

1.3.4 Definitions. Section 3 provides definitions specific to this Standard. For definitions of words used in but not defined in this Standard, see Merriam-Webster's Unabridged Dictionary at https://www.merriam-webster.com/.

1.3.5 Parentheses Following a Definition. When a definition is followed by a standard referenced in parentheses, the standard referenced in parentheses is the source for the definition.

1.3.6 Notes. Notes depicted in this Standard in ALL UPPERCASE letters are intended to reflect actual product definition entries. Notes depicted in initial uppercase or lowercase letters are to be considered supporting data to the contents of this Standard and are not intended for literal entry on the product definition. A statement requiring the addition of a note with the qualifier "such as" is a requirement to add a note, and the content of the note is allowed to vary to suit the application.

1.3.7 Acronyms and Abbreviations. Acronyms and abbreviations are spelled out the first time used in this Standard, followed by the acronym or abbreviation in parentheses. The acronym is used thereafter throughout the text.

1.3.8 Units. The International System of Units (SI) is featured in this Standard. It should be understood that U.S. Customary units could equally have been used without prejudice to the principles established.

1.3.9 Figures. The figures in this Standard are intended only as illustrations to aid the user in understanding the practices described in the text. In some cases, figures show a level of detail as needed for emphasis. In other cases, figures are incomplete by intent so as to illustrate a concept or facet thereof. The absence of figures has no bearing on the applicability of the stated requirements or practice. To comply with the requirements of this Standard, actual data sets shall meet the content requirements set forth in the text. To assist the user of this Standard, a list of paragraphs that refer to an illustration appears in the lower right-hand corner of each figure. This list may not be all inclusive. The absence of a paragraph reference is not a reason to assume inapplicability. Some figures are illustrations of models in a three-dimensional (3D) environment. The absence of dimensioning and tolerancing annotations in a view may indicate that the product definition is defined in three dimensions. Dimensions that locate or orient and are not shown are considered basic and shall be queried to determine the intended requirement. When the letter "h" is used in figures for letter heights or for symbol proportions, select the applicable letter height in accordance with ASME Y14.2. Multiview drawings contained within figures are third-angle projection.

1.3.10 Precedence of Standards. The following are ASME Y14 standards that are basic engineering drawing standards:

ASME Y14.1. Drawing Sheet Size and Format.
ASME Y14.2. Line Conventions and Lettering.
ASME Y14.3. Orthographic and Pictorial Views.
ASME Y14.5. Dimensioning and Tolerancing.
ASME Y14.24. Types and Applications of Engineering Drawings.
ASME Y14.34. Associated Lists.
ASME Y14.35. Revision of Engineering Drawings and Associated Documents.
ASME Y14.36. Surface Texture Symbols.
ASME Y14.38. Abbreviations and Acronyms for Use on Drawings and Related Documents.
ASME Y14.41. Digital Product Definition Data Practices.
ASME Y14.100. Engineering Drawing Practices.

All other ASME Y14 standards are considered specialty types of standards and contain additional requirements or make exceptions to the basic standards as required to support a process or type of drawing.

1.3.11 Use of an ASME Y14 Case. Where product definition and engineering documentation are based on an ASME Y14 Case, this fact shall be noted on the documentation or in a referenced document.

1.3.12 Product Definition Without Reference to a Standard. When a product definition is created without a reference document (company, regional, national, or international) or contractually imposed documents, the product definition shall be interpreted in accordance with ASME PDS-1.1–2013.

1.4 Reference to This Standard

When a data set is based on this Standard, this fact shall be noted in the data set or in a document referenced by the data set. A note similar to the following shall be added: "THIS DATA SET SHALL BE INTERPRETED IN ACCORDANCE WITH ASME Y14.47-2022."

1.5 Symbols

The use of symbols to indicate dimensional requirements does not preclude the use of equivalent terms or abbreviations in accordance with ASME Y14.38 when symbology is considered inappropriate.

2 REFERENCES

The following American National Standards form a part of this Standard to the extent specified herein. Later editions may be used, provided there is no conflict with the text of this Standard. In the event of a conflict between the text of this Standard and the references cited herein, the text of this Standard shall take precedence.

ASME Y14.1-2020. Drawing Sheet Size and Format. The American Society of Mechanical Engineers.
ASME Y14.2-2014. Line Conventions and Lettering. The American Society of Mechanical Engineers.
ASME Y14.3-2012. Orthographic and Pictorial Views. The American Society of Mechanical Engineers.
ASME Y14.5-2018. Dimensioning and Tolerancing. The American Society of Mechanical Engineers.
ASME Y14.35-2014. Revision of Engineering Drawings and Associated Documents. The American Society of Mechanical Engineers.
ASME Y14.38-2020. Abbreviations and Acronyms for Use on Drawings and Related Documents. The American Society of Mechanical Engineers.
ASME Y14.41-2019. Digital Product Definition Data Practices. The American Society of Mechanical Engineers.
ASME Y14.100-2017. Engineering Drawing Practices. The American Society of Mechanical Engineers.
IEEE/ASTM SI 10. Standard for Use of the International System of Units (SI): The Modern Metric System. Institute of Electrical and Electronics Engineers.

3 TERMS AND DEFINITIONS

The following terms are defined as their use applies in this Standard.

3.1 Annotated Model

annotated model: a combination of model, annotation, and attributes that describe a product (ASME Y14.41).

3.2 Annotation

annotation: visible dimensions, tolerances, notes, text, or symbols (ASME Y14.41).

3.3 Annotation and Attribute State

annotation and attribute state: the completeness level of the annotations and attributes of an annotated model that are used to define an item.

3.4 Annotation Plane

annotation plane: a conceptual plane containing annotation (ASME Y14.41).

3.5 Associated Group

associated group: a user-defined set of related digital elements (ASME Y14.41).

3.6 Attribute

attribute: a dimension, tolerance, note, text, or symbol required to complete the product definition or feature of the product that is not visible but available upon interrogation of the annotated model (ASME Y14.41).

3.7 Feature

feature: physical portion of an item such as a surface, pin, hole, slot, or its representation on drawings, models, or digital data files (ASME Y14.5).

3.8 Geometry State

geometry state: the level of detail of the geometry as represented in a model.

3.9 Maturity State

maturity state: the condition of the design maturity for the specified use of the data set within the product life cycle.

3.10 Metadata Elements

metadata elements: organizational elements that capture data providing information about a product definition data set.

3.11 Model-Based Definition (MBD)

model-based definition (MBD): an annotated model and its associated data that define the product in a manner that can be used effectively without a drawing graphic sheet.

3.12 Model-Based Enterprise (MBE)

model-based enterprise (MBE): an organization that uses digital methodologies as the foundation to enable deployment of products from concept to disposal.

3.13 Model

model: the portion of the data set that contains model geometry and supplemental geometry (ASME Y14.41).

3.14 Model Geometry

model geometry: geometric elements in product definition data that represent an item (ASME Y14.41).

3.15 Notes

notes: textual information that further delineates the requirements of the item represented (ASME Y14.100).

3.16 Organizational Element

organizational element: a nongeometric model element selected for organization or grouping by a standardized method.

3.17 Presentation

presentation: the manner in which information is displayed for use by a human.

3.18 Presentation State

presentation state: a retrievable collection or set of model display elements arranged for formal display to the viewer.

3.19 Product Definition Data

product definition data: denotes the totality of data elements required to completely define a product. Product definition data includes geometry, topology, relationships, tolerances, attributes, and features necessary to completely define a component part or an assembly of parts for the purpose of design, analysis, manufacture, test, and inspection (ASME Y14.100).

3.20 Product Definition Data Set

product definition data set: a collection of one or more data file(s) that discloses, directly or by reference, by means of presentation (e.g., graphic or textual), representation (e.g., semantics or machine readable), or a combination of both, the physical or functional requirements of an item (ASME Y14.41).

3.21 Representation

representation: the manner in which information is stored for interpretation by a machine.

3.22 Saved View

saved view: a stored and retrievable specific orientation and a magnification factor of a model or design model and may be a view within a model or a view generated from the model and placed in a drawing graphic sheet (ASME Y14.3).

3.23 Acronyms

The following acronyms are used in this Standard:

Acronyms	Terms
AEA	Atomic Energy Act
ASME	The American Society of Mechanical Engineers
CAD	computer-aided design
CAGE	commercial and government entity
CDA	current design activity
DAI	design activity identifier
DLA	Defense Logistics Agency
DoD	U.S. Department of Defense
DoDI	U.S. Department of Defense Instruction
EAR	Export Administration Regulations
IEEE	Institute of Electrical and Electronics Engineers
ITAR	International Traffic in Arms Regulations
MBD	model-based definition
MBE	model-based enterprise
ODA	original design activity
PIN	part or identifying number
PMI	product and manufacturing information
RAD	revision authorization document
SI	International System of Units

4 FRAMEWORK OVERVIEW

4.1 General

Most CAD software contains several tools for organizing product data. The framework in this Standard provides an organized format when creating the product data for ease of use and communication to downstream users and systems. Defining data in a consistent manner is necessary for the communication of shared data.

4.2 Defining a Data Set Using MBD

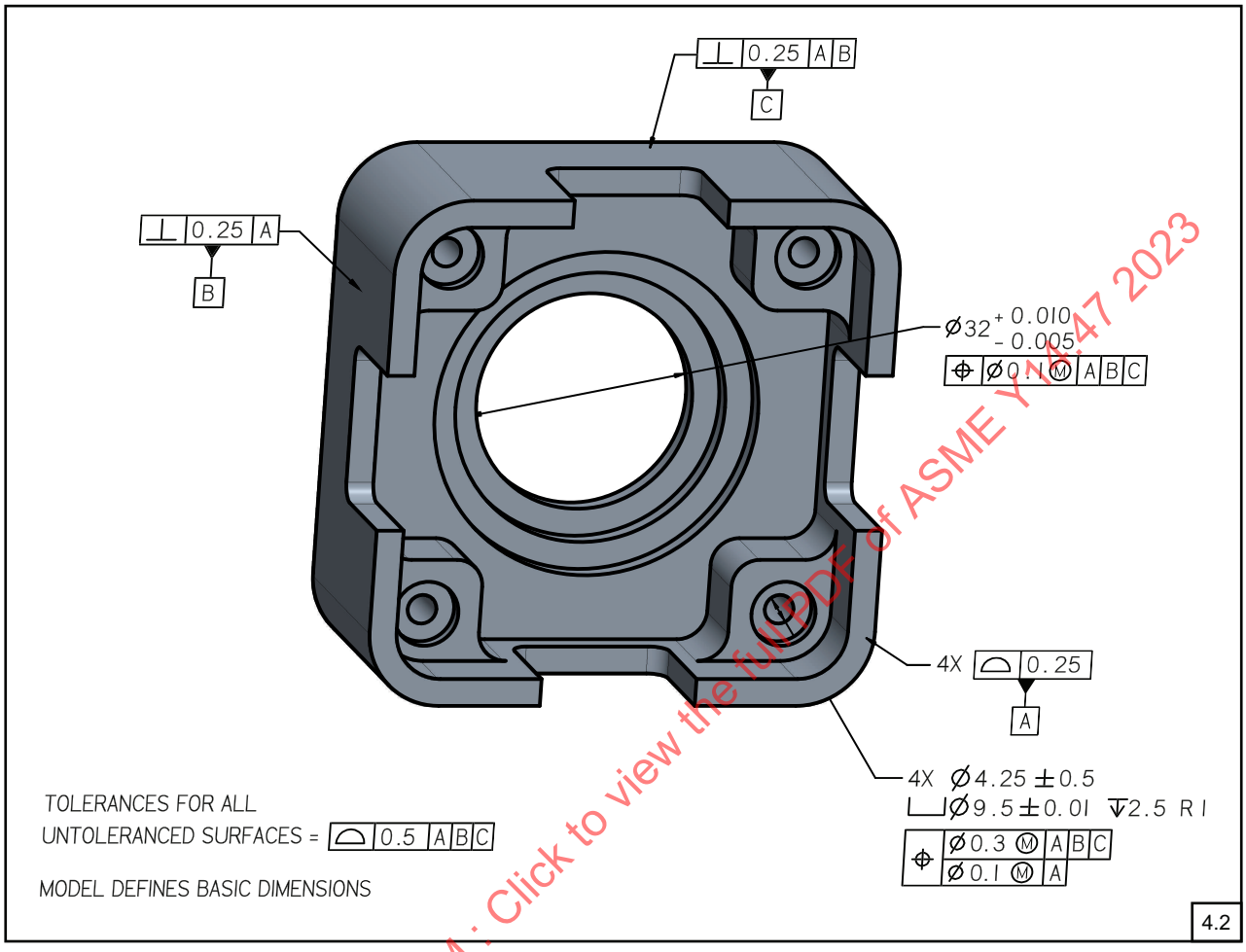
The goal of MBD is to provide a complete product definition within the data set to downstream users and systems. Consistency is needed in the creation and presentation of each product to ensure information is communicated effectively. See Figure 4-1 for an example of an annotated model in MBD.

MBD is created with all the information that facilitates model-specific information extraction, aids in navigating through model data, and provides for or facilitates an efficient MBE that uses MBD for the life cycle of a product. Maintaining the integrity of model information is the responsibility of the design activity that creates or revises the model.

4.3 Mapping Between Frameworks

A mapping shall be provided to identify the location and method of accessing all elements of the data set to the framework described by this Standard. Each nongeometric element of the data set shall have a one-to-one, one-to-many, or many-to-one relationship with an equivalent element defined by this Standard. If the name or data type (e.g., numeric, string) is different, that shall be documented so recipients of the data are clearly notified of the difference. The document identifying the mapping shall be provided as part of or along with the data set.

Figure 4-1
Example of an Annotated Model Used in MBD



5 ORGANIZATIONAL FRAMEWORK REQUIREMENTS

This section defines the framework for organizing the nongeometric elements within the data set.

5.1 Naming Conventions

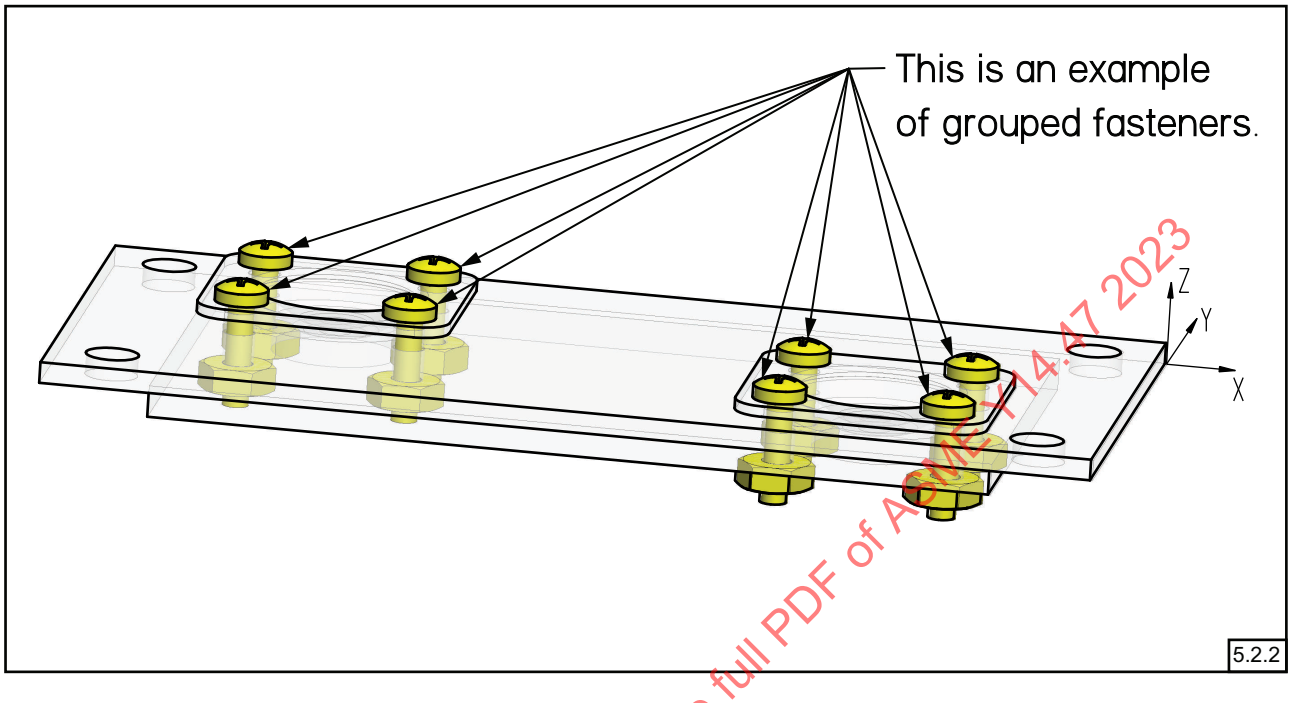
Each organizational element (e.g., features, saved views, presentation states, and annotation) shall be named consistently. Examples of a consistent naming convention may include, but are not limited to, a prefix, digits, and a descriptive name. The use of company-specific or system-default naming conventions is acceptable.

5.2 Associated Groups

5.2.1 Associated Group Content. Associated groups are used to group digital elements for quick selection, demonstrating commonality, or conveying an organizational intent. Examples include, but are not limited to, the following:

(a) organizational elements related to a specific product feature
(b) organizational elements used in a particular downstream activity
(c) elements used to define a presentation state
(d) annotation that defines a functional interface

Figure 5-1
Associated Group of Fasteners



5.2.2 Naming Associated Groups. Each associated group shall be named in accordance with para. 5.1. Organizations may choose to require a certain set of groups for every annotated model. Examples of associated groups are listed below, and an example of an associated group of fasteners is shown in Figure 5-1.

(a) annotations
(b) references
(c) fasteners
(d) cabling
(e) loft sketches
(f) assembly cuts
(g) hole patterns

5.3 Presentation States

Presentation states shall be used to arrange the presentation of the annotated model for consumption by the user. An example set of elements in a presentation state may include annotation display, assembly component configurations including selective display of components, and geometry display methods including appearance. The following are example presentation states that may be used in the data set. More than one of each presentation state may be included as needed. See Table 5-1 for four example naming conventions.

(a) Characteristics. Contains annotations that are designated as various product characteristics for accountability, e.g., key or critical characteristics (see Figure 5-2).

(b) Datums. Contains annotations defining all of the defined datums contained in the annotated model (see Figure 5-3).

(c) Default Notice. Contains all required legal and regulatory notices; when required, this view shall be the first view displayed upon opening the data (see Figure 5-4).

(d) Management Data. Displays management data (see Figure 5-5 and ASME Y14.41).

(e) Model Only. Displays only model geometry, without annotation (see Figure 5-6).

(f) Notes. Organized in a set for visibility and consumption within the data set (see Figure 5-7).

(g) Properties. Contains annotations depicting the summary properties of the item such as boundary dimensions, mass properties, material, and finish requirements (see Figure 5-8).

(h) Site_Map. Supports navigation among the presentation states or saved views in the data set (see Figure 5-9).
(i) User Defined. Defines presentation state(s) to present specific product information as needed (see Figure 5-10).

These presentation states and their organizational elements are contained in the mapping described in para. 4.3.

Table 5-1
Example Naming Conventions for Presentation States

Description/Contents	Example 1	Example 2	Example 3	Example 4
Geometry only — no annotations	Model Only	D0_Model	0_Model	0_MDL
Notices such as proprietary markings, ITAR	MBD0_Default	D0_Default	...	...
Visual indicators to various other presentation states	MBD1_Site_Map	D1_Map	1_Map	1_MAP
General product and data management information	MBD2_Titles	D2_Titles	2_Information	2_GENL
Basic material information, units, and envelope dimensions	MBD3_Properties	D3_Properties	3_Properties	3_PROP
	MBD4_Notes	D4_Notes	4_Notes	4_NOTE
	MBD5_Datums	D5_Datums	5_Datums	5_DTM
Various uses depending on model type	MBD6	D6	6	6
Descriptions also shown in 1_Map	MBD7A_view description	D7A_view description	7A_view description	7A
	MBD7B_view description	D7B_view description	7B_view description	7B
	MBD7C_view description	D7C_view description	7C_view description	7C
	MBD7D_view description	D7D_view description	7D_view description	7D
	8_Finish	8_Finish	8_Finish	8_FNSH
	9_Test	9_Test	9_Test	9_TEST

Figure 5-2
Characteristics Example

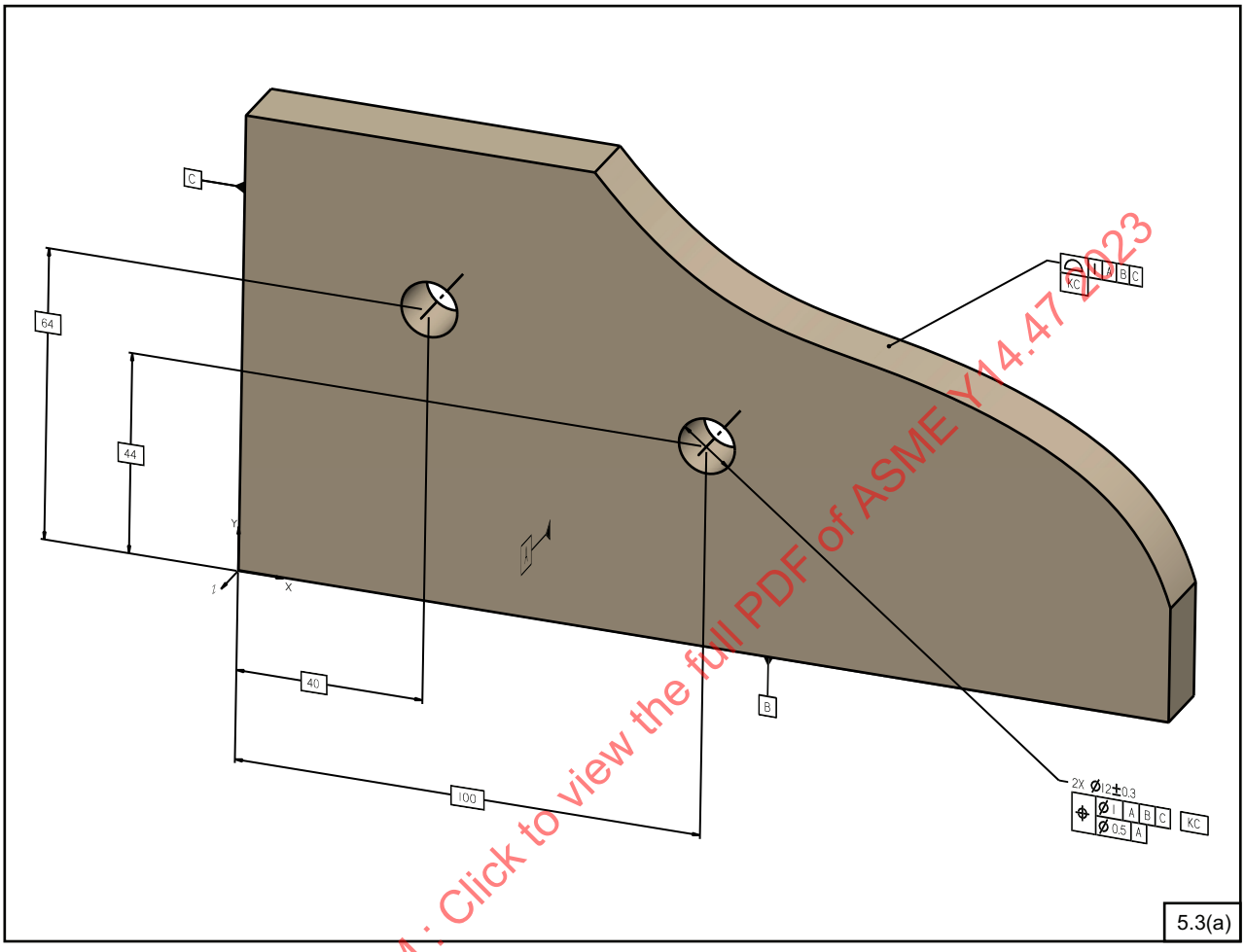


Figure 5-3
Datums Example

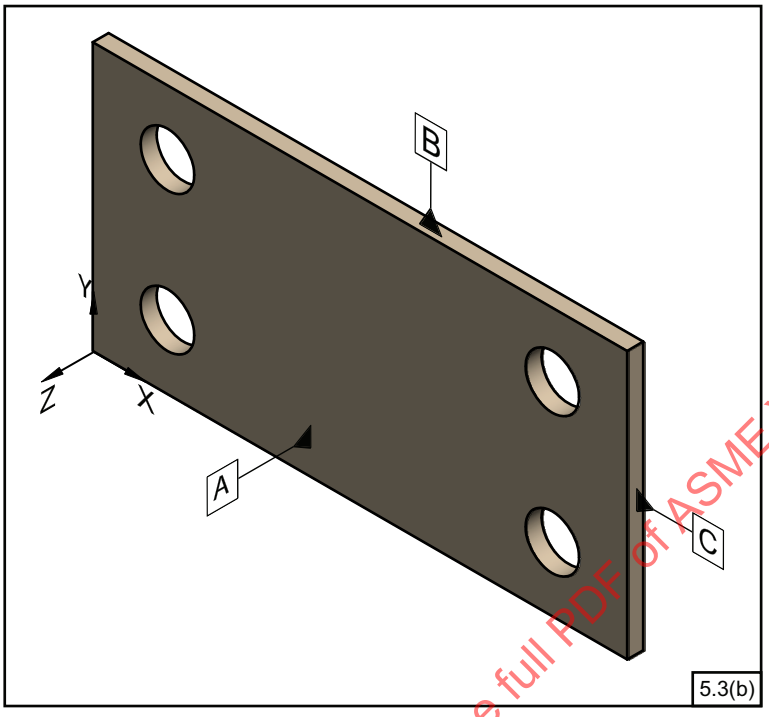


Figure 5-4
Default Notice Example

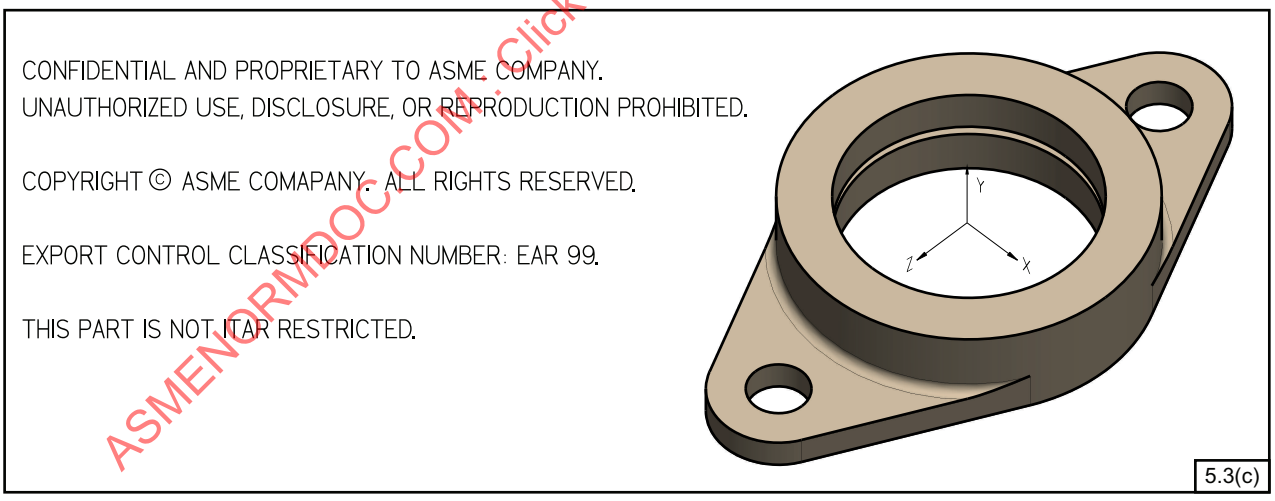


Figure 5-5
Management Data Example

DAI: ASME COMPANY

PART NUMBER: XYZ54236

PART NAME: SUPPORT

ORIGINATOR: JOHN DOE

CAGE CODE: 60012

MODEL UNITS: METRIC

MODEL SCALE: 1:1

CURRENT REVISION: A

REVISION HISTORY: INITIAL RELEASE

RELEASE STATE: COMPLETE

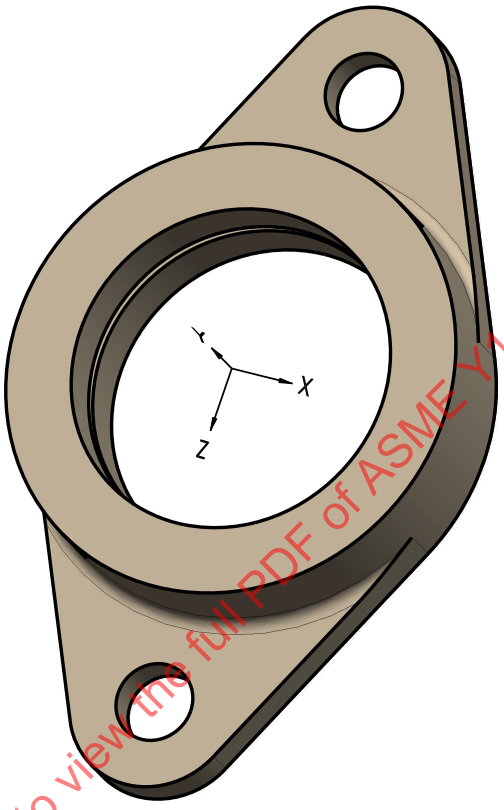
MODEL CHECKED STATUS: COMPLETE

DATA REVIEW STATUS: COMPLETE

THIS MODEL CONFORMS TO ASME Y14.41-YYYY

ADDITIONAL INFORMATION IN DATA SET: YES

Note: Specify the applicable year of the standard in place of YYYY.



5.3(d)

Figure 5-6
Model-Only Example

GENERAL NOTE: This is an interactive 3D model that can be used in Adobe Acrobat.

Figure 5-7
Notes Example

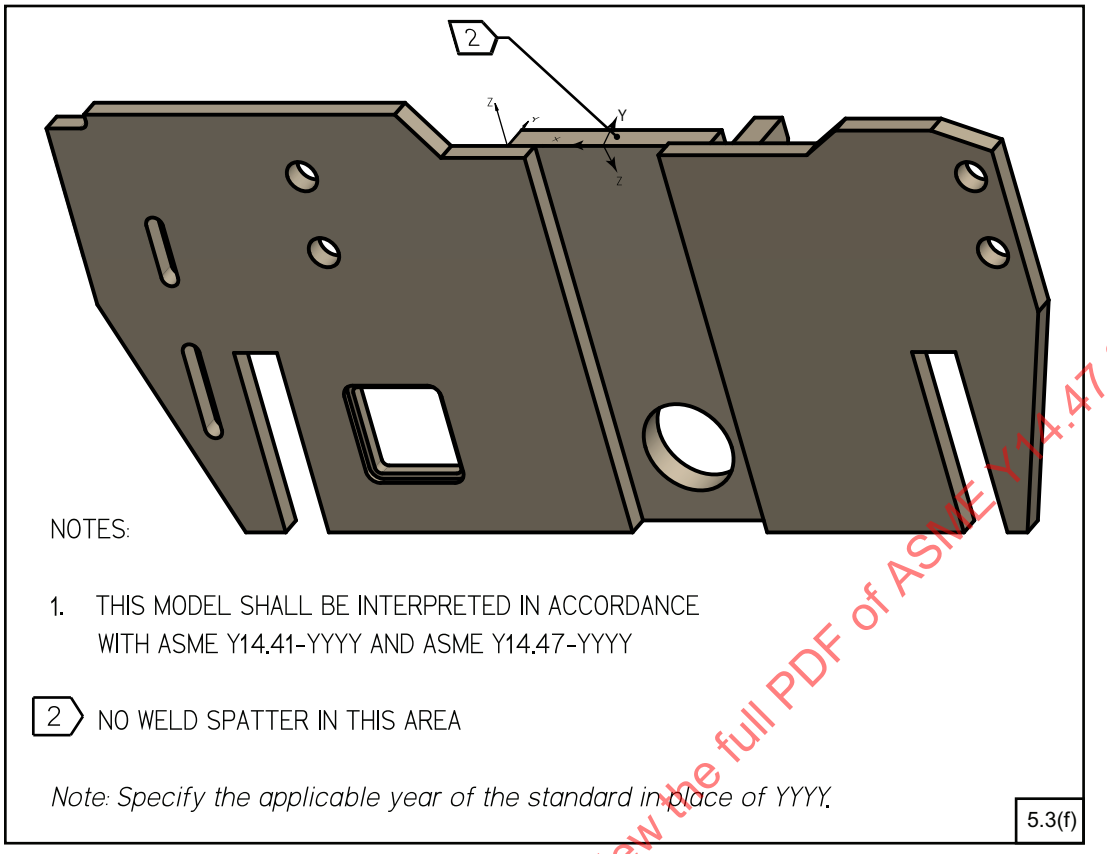


Figure 5-8
Properties Example

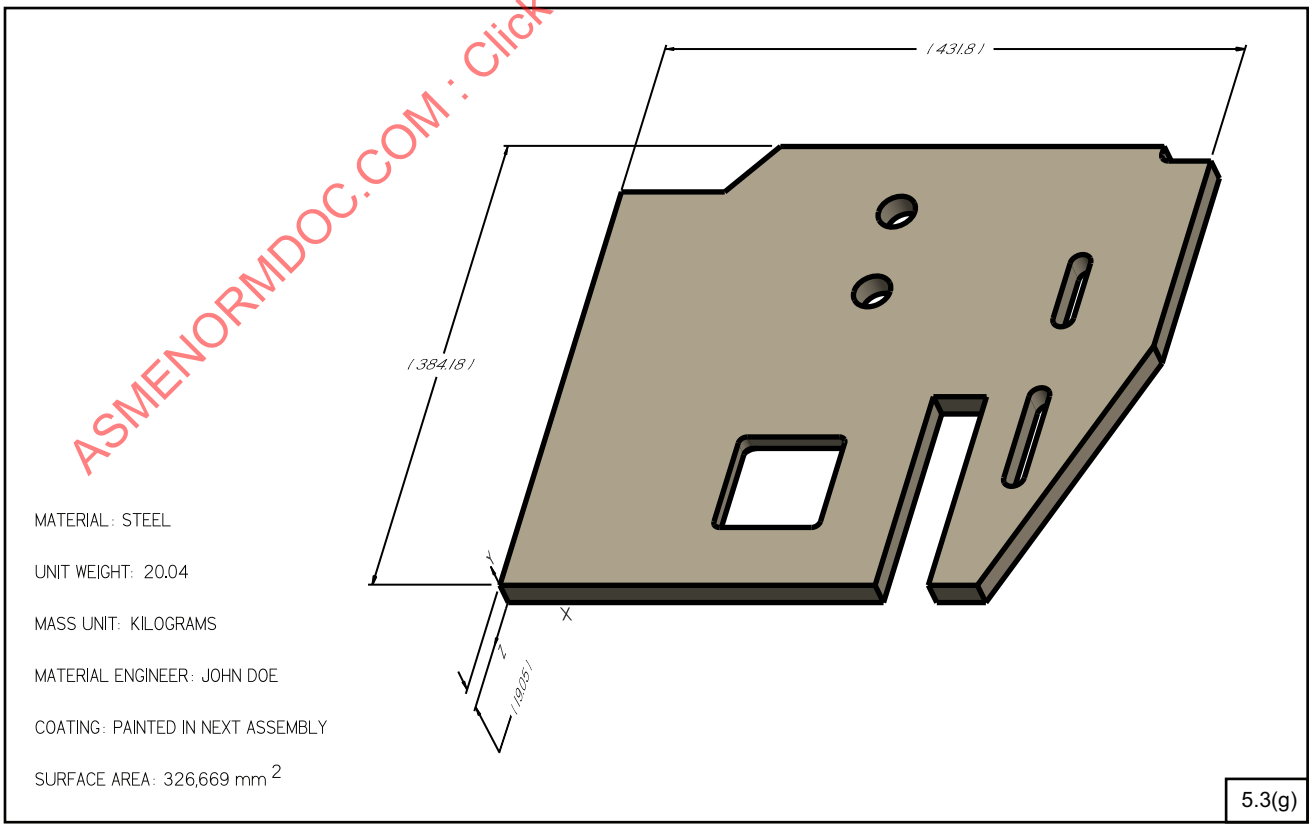
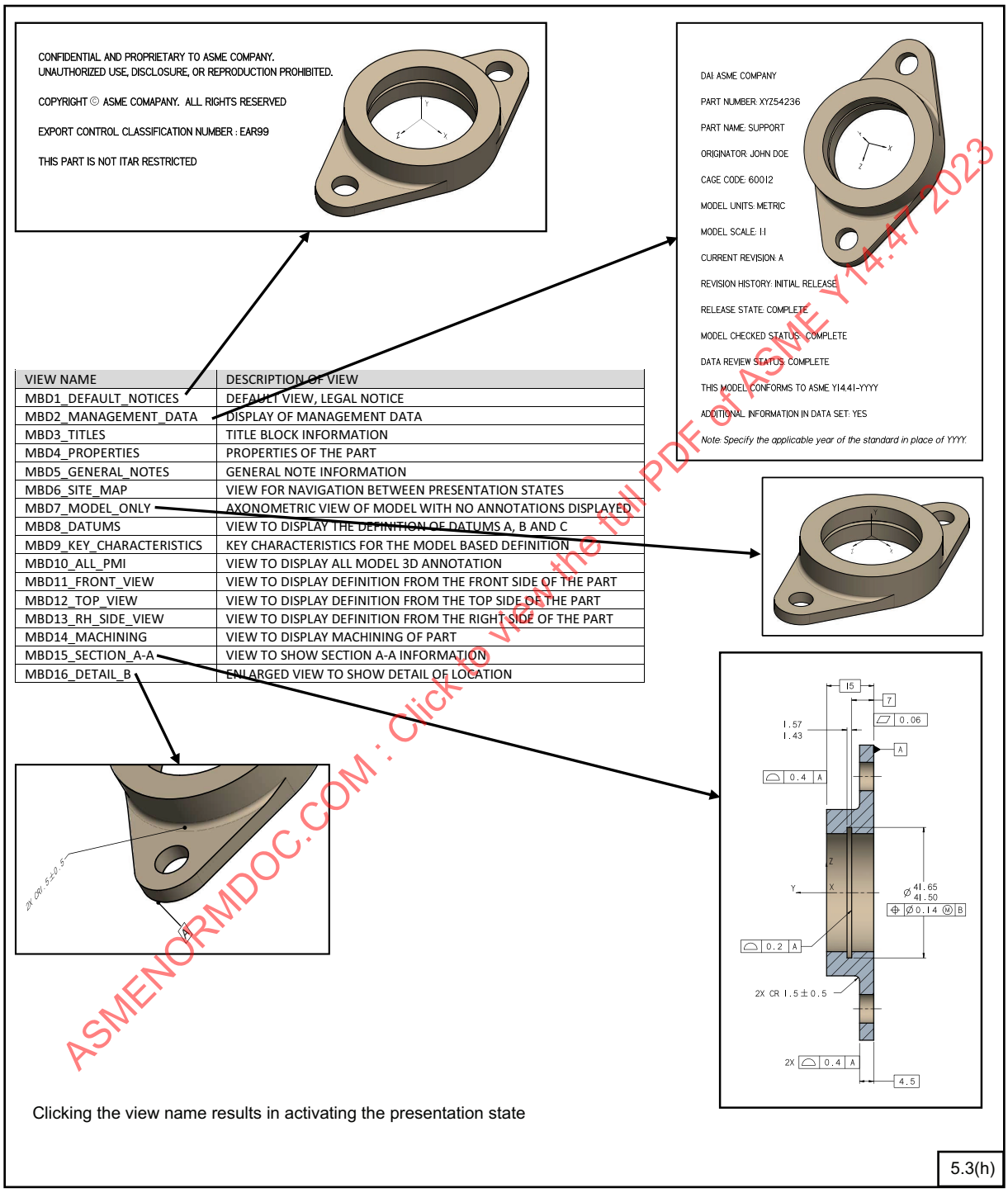


Figure 5-9
Site Map Example

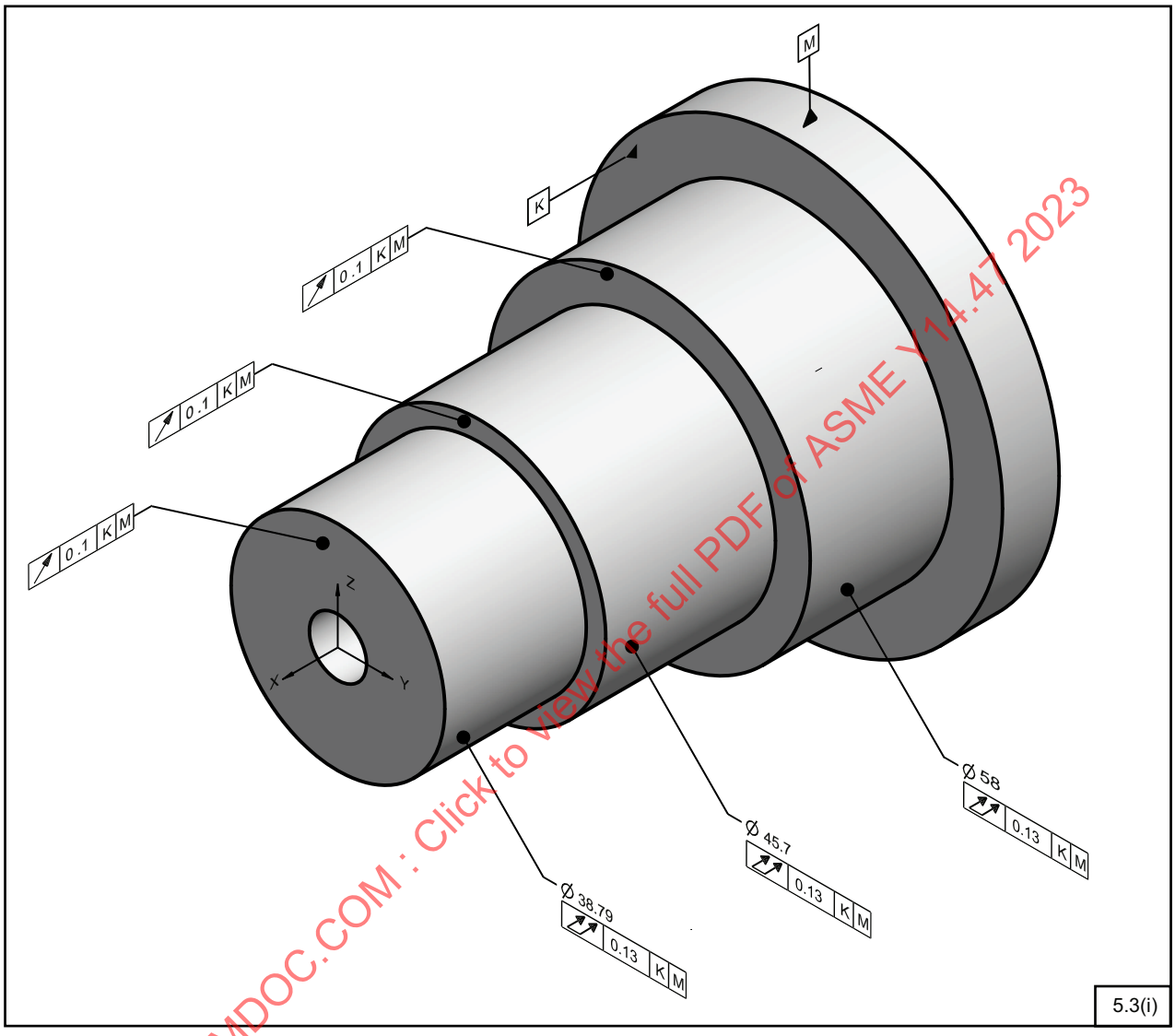


VIEW NAME	DESCRIPTION OF VIEW
MBD1_DEFAULT_NOTICES	DEFAULT VIEW, LEGAL NOTICE
MBD2_MANAGEMENT_DATA	DISPLAY OF MANAGEMENT DATA
MBD3_TITLES	TITLE BLOCK INFORMATION
MBD4_PROPERTIES	PROPERTIES OF THE PART
MBD5_GENERAL_NOTES	GENERAL NOTE INFORMATION
MBD6_SITE_MAP	VIEW FOR NAVIGATION BETWEEN PRESENTATION STATES
MBD7_MODEL_ONLY	AXONOMETRIC VIEW OF MODEL WITH NO ANNOTATIONS DISPLAYED
MBD8_DATUMS	VIEW TO DISPLAY THE DEFINITION OF DATUMS A, B AND C
MBD9_KEY_CHARACTERISTICS	KEY CHARACTERISTICS FOR THE MODEL BASED DEFINITION
MBD10_ALL_PMI	VIEW TO DISPLAY ALL MODEL 3D ANNOTATION
MBD11_FRONT_VIEW	VIEW TO DISPLAY DEFINITION FROM THE FRONT SIDE OF THE PART
MBD12_TOP_VIEW	VIEW TO DISPLAY DEFINITION FROM THE TOP SIDE OF THE PART
MBD13_RH_SIDE_VIEW	VIEW TO DISPLAY DEFINITION FROM THE RIGHT SIDE OF THE PART
MBD14_MACHINING	VIEW TO DISPLAY MACHINING OF PART
MBD15_SECTION_A-A	VIEW TO SHOW SECTION A-A INFORMATION
MBD16_DETAIL_B	ENLARGED VIEW TO SHOW DETAIL OF LOCATION

Clicking the view name results in activating the presentation state

5.3(h)

Figure 5-10
User-Defined Example — Runout Values



5.4 Product Definition Elements

The following elements of the product definition shall be included in the data set when required.

finish: finish specification, preparation call out, paint note, or other surface finishing requirement.

general (block) tolerances: one-place tolerance, two-place tolerance, angle tolerance, length-based tolerances, and UOS profile tolerance.

legal: competition sensitive, government rights, or distribution statement.

management data (title block): information such as company name and address, revision, date, or item description (see ASME Y14.1).

material: material specification, coating, heat treating, unit weight, mass units, and material engineer record.

notes: originator-specific notes.

notice: Export Notice or other classified or specifically restricted data information.

proprietary: company proprietary information (as required).

signatures: designer name, design approval record, engineer name, engineer release record, checker name, and check date.

site map: note(s) identifying all available presentation states.

5.5 Metadata Elements

This subsection contains requirements for representing metadata elements used by an organization to describe the product. Table 5-2 lists both required and optional metadata elements. Metadata elements are categorized under one of the following:

(a) Category 1: data that shall be able to be processed via software application without human processing (i.e., representation).

(b) Category 2: data that shall be able to be processed via software application but also be human consumable (i.e., presentation and representation).

(c) Category 3: data that shall be available for consumption by a human (i.e., presentation).

The metadata elements listed in Table 5-2 ensure interoperability by minimizing the number of mappings required when data are exchanged between organizations. An organization may choose not to define its metadata per Table 5-2. However, the organization shall map its metadata to the elements listed in Table 5-2 when exchanging data with another organization (see para. 4.3).

The data set shall contain all elements from Table 5-2 that are required. The data set may contain optional elements from Table 5-2. The optional elements may be defined as required by the terms of a contract or business requirement.

The user may generate additional metadata elements not listed in Table 5-2. Additional elements not listed in Table 5-2 are not required to be mapped between frameworks.

Table 5-2
Metadata Elements

Element Name [Note (1)]	Required/ Optional [Note (2)]	Data Type [Note (3)]	Description [Note (4)]	Data Category
***_DATE	Optional	ISO 8601 extended form date/time	Date that data set was reviewed and approved by a function or role. "***" is a wild card.	2
***_NAME	Optional	String	Name of person for function or role that reviewed and approved the data set. "***" is a wild card.	3
***_NAME_CERTIFICATE	Optional	Digital certificate per X.509PKI	Digital certificate for function or role that reviewed and approved the data set. "***" is a wild card.	1
***_UNITS	Optional	String	Other units of measure including, but not limited to, area, temperature, time, velocity, mass, force, and pressure.	2
ALT_MATERIAL_*	Optional	String	Definition for alternative materials that are defined for the product. When more than one alternate material is supplied, append "_*" to the attribute element name where a number(s) or letter(s) code is substituted for "*." See also *MATERIAL*.	2
ALT_PIN_*	Optional	String	PIN of an equal item for product defined in data set. When more than one alternate PIN is supplied, append "_*" to the element name where number(s) or letter(s) code is substituted for "*."	2
ANGULAR_UNITS	Required	String	Angular units of measure (e.g., radians, degrees, minutes, seconds) of the model.	2
CDA_CAGE_CODE	Optional	String	Company CAGE Code assigned by DoD DLA for the current design activity.	2
CODE_ANN_ATTR_STATE	Optional	String	Code that represents the annotation and attribute state.	2
CODE_EXPORT	Optional	String	Code for EAR from U.S. Dept. of Commerce, ITAR from U.S. Dept. of State, or AEA Regulations from U.S. Dept. of Energy.	1
CODE_GEOMETRY_STATE	Optional	String	Code that represents the geometry state.	2
CODE_MATURITY_STATE	Optional	String	Code that represents the maturity state.	2
CONTRACT_NUMBER	Optional	String	Contract number for product design.	3
COPYRIGHT_YEAR_*	Optional	ISO 8601 extended form date/time	Year of copyright. When more than one copyright year is supplied, append "_*" to element name where number(s) or letter(s) code is substituted for "*."	1
CREATE_DATE	Optional	ISO 8601 extended form date/time	Date that data set was initially created.	2
CREATE_NAME	Optional	String	Name of author who created the data set.	2
CREATE_NAME_CERTIFICATE	Optional	Digital certificate per X.509PKI	Digital certificate for author who created the data set.	1
CURRENT_DESIGN_ACTIVITY	Optional	String	Name of organization with the current design activity.	3
DATA_SET_IDENTIFIER	Required	String	In accordance with ASME Y14.41.	2
DIST_CODE_DOD	Optional	String	The DoD distribution statement code letter of the product in accordance with DoD Instruction 5230.24.	2
LINEAR_UNITS	Required	String	Length units of measure (SI or U.S. Customary) of the model.	2
MASS	Optional	Real	Mass of product defined in data set.	2
MASS_UNITS	Optional	String	Units of the mass identified in the model. Include when *MASS* is supplied.	2
MATERIAL	Optional	String	Definition for primary material of the product. Include when material is specified for the product.	2
NEXT_ASSY	Optional	String	PIN of next higher assembly using this product.	2

Table 5-2
Metadata Elements (Cont'd)

Element Name [Note (1)]	Required/ Optional [Note (2)]	Data Type [Note (3)]	Description [Note (4)]	Data Category
ODA_CAGE_CODE	Optional	String	Company CAGE Code assigned by DoD DLA for the original design activity.	2
ORIGINAL_DESIGN_ACTIVITY	Required	String	Name of original design activity for the data set. Required per ASME Y14.100.	3
PIN	Required	String	PIN (part or identifying number) for product defined in data set. Required per ASME Y14.100.	2
PROCUREMENT_TYPE	Optional	String	Value = "Make" when an item is built by internal organization; value = "Buy" when an item is procured from external supplier.	2
RELEASE_CERTIFICATE	Optional	Digital certificate per X.509PKI	Digital certificate for release (approval) of data set. Include when data set is for released data.	1
RELEASE_DATE	Required	ISO 8601 extended form date/time	Initial release (or approval) date for data set. Include when data set is for released data.	2
RELEASE_NAME	Required	String	Name of person who approved release (approval) of the data set. Include when data set is for released data.	2
REV	Required	String	Current revision of the design per ASME Y14.35.	2
REV_DATE	Optional	ISO 8601 extended form date/time	Date of release for current revision of the data set.	2
REV_DESCRIPTION	Required	String	Revision description of the design per ASME Y14.35.	2
STATEMENT_COPYRIGHT	Optional	String	Copyright statement and associated legends.	3
STATEMENT_DATA_RIGHTS	Optional	String	Data rights statement.	3
STATEMENT_EXPORT	Optional	String	Export control statement.	3
STATEMENT_PROPRIETARY	Optional	String	Proprietary notice statement and associated legends.	3
STATEMENT_SECURITY_LVL	Optional	String	Security-level classification statement.	3
TITLE	Required	String	Name and description of product. Title of the data set equivalent to drawing title and data set title defined in ASME Y14.100 and ASME Y14.41, respectively.	2

NOTES:
(1) This identifies the name for use in labeling the metadata element.
(2) This denotes whether the element is optional or required. Metadata elements marked as "optional" may be required per the terms of a contract or business requirement.
(3) This denotes the format and kind of values that apply to the data item.
(4) This provides further detail of the metadata element.

6 DATA SET COMPLETENESS STATES

6.1 General

A data set may contain a model or other items that are at different states of completeness. These states of completeness may be documented in the data set.

When the completeness states are included in the data set, the data set completeness states shall be kept as codes in the metadata elements. Nonmandatory Appendix A provides application examples of data set completeness states.

When used, data set completeness states shall consist of three categories, each given a specific code that describes the state of completeness for that category. The three categories are: maturity state, geometry state, and annotation and attribute state. Each category is defined as specified in paras. 6.2 through 6.4.

6.2 Maturity State

The maturity state sets the limits of the use of the model. The maturity state consists of three completeness levels of conceptual, developmental, and production, with corresponding codes of M1, M2, and M3.

M1 (conceptual): a data set that is used when there is a need to verify preliminary design and engineering and to confirm that the technology is feasible and that the design concept has the potential to be useful in meeting a specific requirement [see Figure 6-1, illustration (a)].

M2 (developmental): a data set that is used for testing or experimentation and for the analytical evaluation of the inherent ability of the design approach to attain the required performance [see Figure 6-1, illustration (b)].

M3 (production): a data set that is used for the commission, operation, service, and decommission of a product [see Figure 6-1, illustration (c)].

6.3 Geometry State

The geometry state consists of four completeness levels of none, partial, full, and absolute, with corresponding codes of G1, G2, G3, and G4.

G1 (none): the model that is created with no distinctions made for individual features [see Figure 6-2, illustrations (a) and (b)].

G2 (partial): the model that has a portion of the features represented [see Figure 6-2, illustration (c)].

G3 (full): the model that has all features represented or simplified, which may require human interpretation of annotation or attributes for complete geometric definition [see Figure 6-2, illustration (d)].

NOTE: The geometry state may still be considered G3 if part feature details (e.g., threads, knurling, holes, fillets, rounds, paint layers, edge breaks, drafts) are shown using partial geometry definition, annotations, attributes, or a combination thereof and said feature details are not produced nor inspected based on the model geometry.

G4 (absolute): the model has all the features represented [see Figure 6-2, illustration (d)].

NOTE: Part feature details (e.g., threads, knurling, holes, fillets, rounds, paint layers, edge breaks, drafts) are shown using model geometry, and said feature details are produced or inspected based on the model geometry.

6.4 Annotation and Attribute State

The annotation and attribute state consists of four completeness levels of none, partial, full, and presented, with corresponding codes of A1, A2, A3, and A4.

A1 (none): the data set contains no annotation that defines the product requirements [see Figure 6-3, illustration (a)].

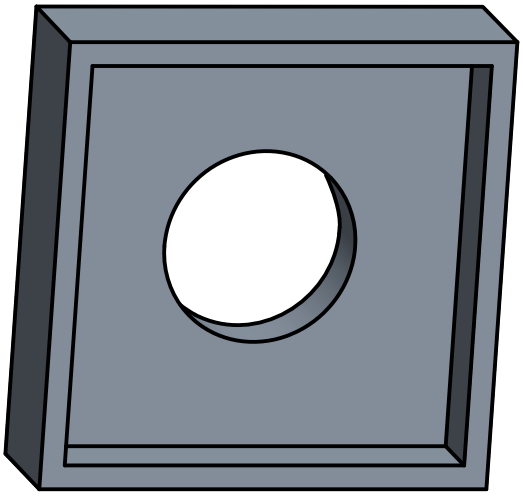
A2 (partial): the data set contains a subset of all the annotation and attributes that define the product requirements [see Figure 6-3, illustration (b)].

A3 (full): the data set contains the annotation and attributes that define all product requirements [see Figure 6-3, illustration (c)].

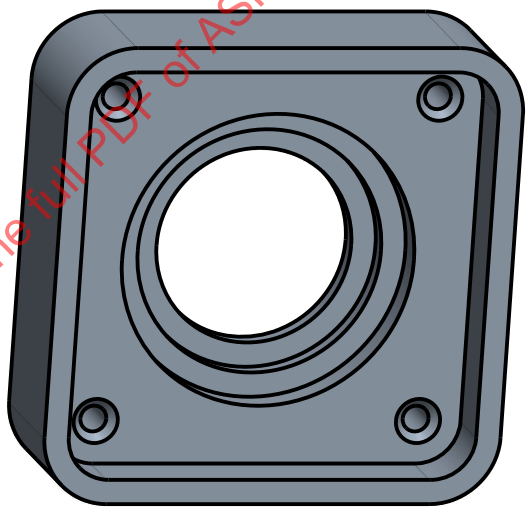
A4 (presented): the data set contains and displays the annotation (including items such as general notes and other product and manufacturing information) that communicates all product requirements without querying the model geometry, regardless of attributes (see Figure 6-4).

NOTE: Both the A3 and A4 annotation and attribute states provide complete product definition. The A4 state requires that all annotations are displayed through the use of various presentation states without the need for a user to query the model. The A3 state requires a user of the data to query the annotated model for features that do not have displayed annotation.

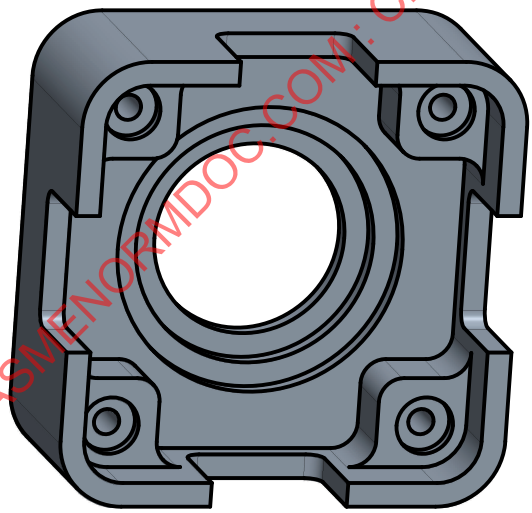
Figure 6-1
Examples of Maturity States



(a) Maturity State M1 — Conceptual



(b) Maturity State M2 — Development



(c) Maturity State M3 — Production

6.2