ASME Y14.24-2020
(Revision of ASME Y14.24-2012)

Types and Applications of Engineering Drawings

Engineering Product Definition and Related Documentation Practices

AN AMERICAN NATIONAL STANDARD

The American Society of Mechanical Engineers

ASME Y14.24-2020
(Revision of ASME Y14.24-2012)

Types and Applications of Engineering Drawings

Engineering Product Definition and Related Documentation Practices

AN AMERICAN NATIONAL STANDARD

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

Date of Issuance: October 23, 2020

This Standard will be revised when the Society approves the issuance of a new edition.

Periodically certain actions of the ASME Y14 Committee may be published as Cases. Cases are published on the ASME website under the Y14 Committee Page at http://go.asme.org/Y14committee as they are issued.

Errata to codes and standards may be posted on the ASME website under the Committee Pages to provide corrections to incorrectly published items, or to correct typographical or grammatical errors in codes and standards. Such errata shall be used on the date posted.

The Y14 Committee Page can be found at http://go.asme.org/Y14committee. There is an option available to automatically receive an e-mail notification when errata are posted to a particular code or standard. This option can be found on the appropriate Committee Page after selecting "Errata" in the "Publication Information" section.

The American Society of Mechanical Engineers
Two Park Avenue, New York, NY 10016-5990

CONTENTS

Nonmandatory Appendices

Figures

Table

FOREWORD

The American Society for Mechanical Engineers (ASME) Committee Y14, Standards for Product Definition and Related Documentation Practices, formed Subcommittee 24, Types and Application of Engineering Drawings, in June 1973. The purpose was to prepare a standard defining accepted drawing types used to establish engineering requirements in the production and procurement of hardware.

The Subcommittee used Chapter 200 of the military standard MIL-STD-100, Engineering Drawing Practices (now cancelled), as a basis. They considered the types of engineering drawings most frequently used by business, industry, and government in the United States in their effort to serve the needs of these communities and assure consistency of application and interpretation.

A series of meetings were held to identify, select, and prepare proposed text and illustrations. At each stage, the Subcommittee considered which requirements were best suited for a national standard. Members of the Y14.24 Subcommittee represented a cross section of American industry and the Department of Defense (DoD). Liaison with specialized societies such as the National Defense Industrial Association (NDIA), Aerospace Industries Association (AIA), Electronic Industries Association (EIA) [now defunct; the standards brand is continued under the Electronic Components Industry Association (ECIA)], and the Society of Automotive Engineers (SAE) provided additional technical support.

Drawing definitions are intended to permit preparation by any suitable method (manual, computer-aided, photographic, etc.); therefore, preparation techniques and methods of reproduction are not described.

The original edition of ASME Y14.24M was approved as an American National Standard by the American National Standards Institute (ANSI) on November 3, 1989. It was adopted and approved for use by the DoD on March 30, 1990. It was reaffirmed in 1996 without change.

Upon its release, the original edition of Y14.24M was referenced by the DoD as a replacement for the majority of Chapter 200 of MIL-STD-100E (released September 30, 1991). However, input from users of the DoD standard indicated that additional detail and clarification were needed to ensure understanding and application of the requirements when this Standard is invoked on government contracts.

Subcommittee 24 was reformed and began work on revising the Standard at a meeting in Garland, Texas held October 8 through 10, 1991. ASME Y14.24 was approved by ANSI as an American National Standard on June 24, 1999. It was reaffirmed in 2004 without change and published as ASME Y14.24-2012 on April 5, 2013. Work for the current revision was started in November 2012.

The following is a summary of the significant changes incorporated in this revision:

(a) general drawing information was moved to its own clause
(b) layout drawings were moved toward the end of the standard
(c) definitions were added for the following:
  (1) altered item drawing (AID)
  (2) drawing graphic sheet
  (3) enterprise identifier (EID)
  (4) envelope drawing
  (5) NATO Commercial and Government Entity (NCAGE) Code
  (6) procurement specification
  (7) selected item drawing (SID)
  (8) source control drawing (SOCD)
  (9) vendor item control drawing (VICD)
(d) the requirements for source control drawings were listed so users are no longer referred to other paragraphs
(e) procurement control drawing types were moved to Nonmandatory Appendix B
(f) source blocks for VICDs and SOCDs were revised
(g) software item identification drawing type was introduced
(h) new figures were added for the following:
  (1) monodetail 3D model annotation
  (2) exploded view assembly drawing
  (3) inseparable assembly 3D model annotation
  (4) software item identification drawing (SIDD)

(i) figures for the following were revised:
(1) monodetail drawing
(2) installation drawing
(3) modification drawing
(4) software item installation drawing (SIND), formerly called software installation drawing
(j) remaining figures were updated

Commendation is extended to the companies and DoD departments and agencies that sponsored participants in this activity and to those whose earlier efforts provided the basis for this Standard. The success of this Standard can be attributed to their demonstrated interest, cooperation, and support.

Coordination of this Standard with the International Organization for Standardization (ISO/TC10/SC1) is intended to help enhance world understanding of the various types of drawings in use within the United States.

ASME Y14.24-2020 was approved by ANSI as an American National Standard on July 20, 2020.

ASME Y14 COMMITTEE
Engineering Product Definition and Related Documentation Practices

(The following is the roster of the Committee at the time of approval of this Standard.)

STANDARDS COMMITTEE OFFICERS

W. A. Kaba, *Chair*
J. I. Miles, *Vice Chair*
F. Constantino, *Secretary*

STANDARDS COMMITTEE PERSONNEL

F. Bakos, Consultant
F. Constantino, The American Society of Mechanical Engineers
D. O. Coon, Applied Geometrics, Inc.
R. Courson, SAE International
K. Dobert, Siemens PLM Software
P. J. Drake, Jr., MechSigma Consulting, Inc.
S. M. Hauger, Deere & Co.
J. B. Hoskins, The Boeing Co.
J. Houck, Woodward, Inc.
R. C. Jensen, Hexagon Manufacturing Intelligence
W. A. Kaba, Spirit AeroSystems, Inc.
A. Krulikowski, Krulikowski Consulting, LLC
S. P. Lege, U.S. Army
E. F. McCarthy, E. F. McCarthy Consulting, Inc.
P. J. McCuistion, Multimac DMS
J. D. Meadows, James D. Meadows & Associates, Inc.
M. E. Meloro, Northrop Grumman Corp.
J. Michalowicz, Stryker Corp.
J. I. Miles, Technical Consultants, Inc.
H. W. Oakes, U.S. Air Force [University of Dayton Research Institute (UDRI)]
B. A. Wilson, Consultant
E. F. Zwettler, Sigmetrix
A. R. Anderson, *Contributing Member*, Dimensional Dynamics, LLC
J. V. Burleigh, *Contributing Member*, Consultant
K. E. Wiegandt, *Contributing Member*, Consultant

SUBCOMMITTEE 24 — TYPES AND APPLICATION OF ENGINEERING DRAWINGS

S. M. Hauger, *Chair,* Deere & Co.
D. M. Hagler, *Vice Chair*, L3 Technologies
J. A. Gagnon, Engineering Quality Systems
D. Hodgerson, John Deere
J. B. Hoskins, The Boeing Co.
W. A. Kaba, Spirit AeroSystems, Inc.
S. P. Lege, U.S. Army
B. Lumb, Instrumentation Laboratory
C. McFadden, Deere and Co.
G. M. Nelson, Consultant
M. A. Nielsen, Tech Azul
H. W. Oakes, U.S. Air Force [University of Dayton Research Institute (UDRI)]
M. D. Toye, General Electric
P. D. Vaughan, Bell Flight
W. Weiss, IBW — Ingenieurbuero Wolfgang Weiss
A. Wight, The Boeing Co.
M. W. Woodworth, Consultant
L. Arnesen *Contributing Member*, Raytheon Technologies
L. G. Davis, *Contributing Member*, Consultant
R. C. Hearn, *Contributing Member*, The Boeing Co.
B. C. Romero, *Contributing Member*, Raytheon Technologies

CORRESPONDENCE WITH THE Y14 COMMITTEE

General. ASME Standards are developed and maintained with the intent to represent the consensus of concerned interests. As such, users of this Standard may interact with the Committee by requesting interpretations, proposing revisions or a case, and attending Committee meetings. Correspondence should be addressed to:

Secretary, Y14 Standards Committee
The American Society of Mechanical Engineers
Two Park Avenue
New York, NY 10016-5990
http://go.asme.org/Inquiry

Proposing Revisions. Revisions are made periodically to the Standard 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 periodically.

The Committee welcomes proposals for revisions to this Standard. 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 documentation.

Proposing a Case. Cases may be issued to provide alternative rules when justified, to permit early implementation of an approved revision when the need is urgent, or to provide rules not covered by existing provisions. Cases are effective immediately upon ASME approval and shall be posted on the ASME Committee web page.

Requests for Cases shall provide a Statement of Need and Background Information. The request should identify the Standard and the paragraph, figure, or table number(s), and be written as a Question and Reply in the same format as existing Cases. Requests for Cases should also indicate the applicable edition(s) of the Standard to which the proposed Case applies.

Attending Committee Meetings. The Y14 Standards Committee regularly holds meetings and/or telephone conferences that are open to the public. Persons wishing to attend any meeting and/or telephone conference should contact the Secretary of the Y14 Standards Committee. Future Committee meeting dates and locations can be found on the Committee Page at http://go.asme.org/Y14committee.

TYPES AND APPLICATIONS OF ENGINEERING DRAWINGS

1 GENERAL

1.1 Scope

This Standard defines the types of engineering drawings most frequently used to establish engineering requirements. It describes typical applications and minimum content requirements. Drawings for specialized engineering disciplines (e.g., marine, civil, construction, optics, etc.) are not included in this Standard. It is essential that this Standard be used in close conjunction with ASME Y14.34, ASME Y14.35, ASME Y14.41, and ASME Y14.100.

1.2 ASME Y14 Series Conventions

The conventions in paras. 1.2.1 through 1.2.9 are used in this and other ASME Y14 standards.

1.2.1 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," and "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 UOS shall be used to indicate 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.

1.2.2 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 the issue of the standard identified in the References section 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 issue of the standard shall be used to meet the requirement.

1.2.3 Invocation of Reference Standards. The following examples define the invocation of a standard when specified in the References section and referenced in the text of the Y14 Standard:

(a) When a referenced standard is cited in the text with no limitations to a specific subject or paragraph(s) 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 paragraph(s) within the standard is invoked.

(b) When a referenced standard is cited in the text with limitations to a specific subject or paragraph(s) of the standard, only the paragraph(s) on that subject is invoked. For example, "assign part or identifying numbers in accordance with ASME Y14.100" is invoking only the paragraph(s) 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.

1.2.4 Parenthesis 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.

1.2.5 Notes. Notes depicted in the Y14 Standard in ALL UPPERCASE letters are intended to reflect actual drawing entries. Notes depicted in Initial Uppercase or lowercase letters are to be considered supporting data to the contents of the standard and are not intended for literal entry on drawings. 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 text is allowed to vary to suit the application.

1.2.6 Acronyms or Abbreviations. Acronyms and abbreviations are spelled out the first time used in Y14 Standards, followed by the acronym or abbreviation in parenthesis. The acronym is used thereafter throughout the text.

1.2.7 Units. The International System of Units (SI) is featured in Y14 Standards. It should be understood that U.S. Customary units could equally have been used without prejudice to the principles established.

1.2.8 Figures. The figures in Y14 standards 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 figure(s) has no bearing on the applicability of the stated requirements or practice. To comply with the requirements of Y14 Standards, actual data sets shall meet the content requirements set forth in the text. To assist the user of Y14 Standards, a listing of the paragraph(s) that refer to an illustration appears in the lower right-hand corner of each figure. This listing may not be all inclusive. The absence of a listing is not a reason to assume inapplicability. Some figures are illustrations of models in a three-dimensional environment. The absence of dimensioning and tolerancing annotations in a view may indicate that the product definition is defined in 3D. 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 for letter height in figures or for symbol proportions, select the applicable letter height in accordance with ASME Y14.2. Multiview drawings contained within figures are third-angle projection.

NOTE: Figures may refer to specifications or standards being not current or cancelled, or may refer to requirements of stated specifications or standards that have been revised or have been superseded by other requirements of this specification or standard.

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

ASME Y14.1, Decimal Inch Drawing Sheet Size and Format
ASME Y14.1M, Metric 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 in Product Definition and Related Documents
ASME Y14.41, Digital Product Definition Data Practices
ASME Y14.46, Product Definition for Additive Manufacturing
ASME Y14.47, Model Organization 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.

2 REFERENCES

The following is a list of publications referenced in this Standard. Unless otherwise specified, the latest edition shall apply, provided there is no conflict with this Standard. In the event of a conflict between this Standard and the references cited herein, this Standard shall take precedence.

ACodP-1, NATO Manual on Codification
Publisher: North Atlantic Treaty Organization (NATO) Support and Procurement Agency (NSPA), 11, rue de la Gare L-8325, Capellen, G.-D. Luxembourg (www.nato.int)

ASME Y14.1-2012, Decimal Inch Drawing Sheet Size and Format
ASME Y14.1M-2012, Metric Drawing Sheet Size and Format
ASME Y14.2-2014, Line Conventions and Lettering
ASME Y14.31-2014, Undimensioned Drawings
ASME Y14.34-2013, Associated Lists
ASME Y14.35-2014, Revision of Engineering Drawings and Associated Documents
ASME Y14.41-2019, Digital Product Definition Data Practices
ASME Y14.44-2008, Reference Designations for Electrical and Electronics Parts and Equipment
ASME Y14.47-2019, Model Organization Practices
ASME Y14.100-2017, Engineering Drawing Practices
Publisher: The American Society of Mechanical Engineers (ASME), Two Park Avenue, New York, NY 10016-5090 (www.asme.org)

IEEE Std 91/91a, IEEE Standard Graphic Symbols for Logic Functions (Including and Incorporating IEEE Std 91a-1991, Supplement)
IEEE Std 315, IEEE Standard for Graphic Symbols for Electrical and Electronics Diagrams (Including Reference Designation Letters)
IEEE Std 991, IEEE Standard for Logic Circuit Diagrams
Publisher: Institute of Electrical and Electronics Engineers, Inc. (IEEE), 445 Hoes Lane, Piscataway, NJ 08854 (www.ieee.org)

IPC-2221, Generic Standard on Printed Board Design
IPC-2222, Sectional Design Standard for Rigid Organic Printed Boards
IPC-2223, Sectional Design Standards for Flexible/Rigid-Flexible Printed Boards

IPC-2224, Sectional Standard for Design of PWBs for PC Cards
IPC-2225, Sectional Design Standard for Organic Multichip Modules (MCM-L) and MCM-L Assemblies
IPC-D-310, Guidelines for Phototool Generation and Measurement Techniques
IPC-D-325, Documentation Requirements for Printed Boards, Assemblies and Support Drawings
IPC-D-350, Printed Board Description in Digital Form
IPC-D-351, Printed Board Drawings in Digital Form
IPC-D-859, Design Standard for Thick Film Multilayer Hybrid Circuits
IPC-DW-425, Design and End Product Requirements for Discrete Wiring Boards
IPC-T-50, Terms and Definitions for Interconnecting and Packaging Electronic Circuits
Publisher: IPC — Association Connecting Electronics Industries (IPC), 3000 Lakeside Drive, 309 S. Bannockburn, IL 60015 (www.ipc.org)

ISO/IEC 15459-2, Information technology — Automatic identification and data capture techniques — Unique identification — Part 2: Registration procedures
Publisher: International Organization for Standardization (ISO), Central Secretariat, Chemin de Blandonnet 8, Case Postale 401, 1214 Vernier, Geneva, Switzerland (www.iso.org)

MIL-STD-130, Identification Marking of U.S. Military Property
MIL-STD-961, Defense and Program-Unique Specifications Format and Content
Publisher: Defense Standardization Program (DSP), 8725 John J. Kingman Road, Stop 6233, Fort Belvoir, VA 22060 (www.dsp.dla.mil)

DLA Cataloging Handbooks H4 and H8 are no longer maintained by the Defense Logistics Agency (DLA) and have been replaced by the following database: https://cage.dla.mil/HOME

3 DEFINITIONS

The following definitions apply to terms used in this Standard.

3.1 Acceptance Criteria

acceptance criteria: the quality provisions, including inspection and test requirements, that establish the acceptability of an item. These can range from testing the item in its use environment to verification of electrical/mechanical characteristics to a simple visual inspection.

3.2 Administrative Control Number

administrative control number: a number assigned to one or more interchangeable purchased items for administrative purposes. It also serves as the part or identifying number (PIN) (see para. 3.34) for specifying such items in a parts list. An administrative control number may be assigned by a vendor item control drawing (VICD) (see para. 3.58) or to an item defined by an envelope drawing (see para. 3.23). The administrative control number is assigned in addition to the item identification assigned by the original design activity.

3.3 Altered Item Drawing (AID)

altered item drawing (AID): a product definition data depicting the alteration of a nationally recognized standard or an item under the control of another design activity so that the altered item meets specific design requirements and is no longer interchangeable with the original item. The altered item is reidentified with a new part number from the authoring design activity, which replaces the original part number.

3.4 Artwork Master

artwork master: an accurately scaled, usually 1:1, pattern that is used to produce a production master.

3.5 As Applicable

as applicable: a term that requires inclusion of those product definition elements necessary to establish end-product requirements.

3.6 Assembly

assembly: a number of parts, or combination thereof, that are joined together to perform a specific function and subject to disassembly without degradation of any of the parts (e.g., power shovel-front, fan assembly, audio-frequency amplifier, etc.). (ASME Y14.100)

NOTE: The distinction between an assembly and a subassembly is determined by individual application. An assembly in one instance may be a subassembly in another instance where it forms a portion of a higher assembly. (ASME Y14.100)

3.7 Associated Data

associated data: any document referenced on an engineering drawing that establishes some portion of the engineering requirements.

3.8 Associated List

associated list: a tabulation of engineering information pertaining to an item depicted on an engineering drawing or by a set of drawings, e.g., application list, data list, index list, parts list, and wire list. (ASME Y14.34)

3.9 Burn-In

burn-in: the operation of electronic items under specified environmental and test conditions to eliminate early failures and stabilize the items prior to actual use.

3.10 Commercial and Government Entity (CAGE) Code

Commercial and Government Entity (CAGE) Code: a five-character code that provides a unique activity identifier used by the government for activity identification. This method of activity identification has also been widely adopted by industry. CAGE Codes are listed in Cataloging Handbook H4/H8. (ASME Y14.100)

NOTES:
(1) DLA Cataloging Handbooks H4 and H8 are no longer maintained by the Defense Logistics Agency (DLA) and have been replaced by the following database: https://cage.dla.mil/HOME
(2) Wherever "CAGE" or "CAGE Code" is stated in this document, "NCAGE" or "NCAGE code" can be substituted as required. See also *NATO Commercial and Government Entity (NCAGE)* (para. 3.30).

3.11 Commercial Item

commercial item: an existing product, material, component, subsystem, or system sold or traded to the general public during normal business operations at prices based on established catalog or market prices.

3.12 Computer Program/Software

computer program/software: a series of instructions that direct a computer to perform a sequence of operations to produce a desired output. This program may be stored on one or more physical media such as optical discs, magnetic tape, magnetic discs, or punched cards. The terms "computer program" and "computer software" are used synonymously.

3.13 Critical Application

critical application: uses where failure of the item would result in one or more of the following conditions:
(a) risk of personal injury or endangerment of life
(b) loss of or damage to equipment
(d) degradation of performance to a point that would jeopardize the item's capacity to fulfill its intended function

3.14 Design Activity

design activity: an organization that has, or has had, responsibility for the design of an item. (ASME Y14.100)

3.14.1 Current Design Activity

current design activity: the design activity currently responsible for the design of an item. This may be the original design activity or a design activity to which the design responsibility has been transferred. (ASME Y14.100)

3.14.2 Original Design Activity

original design activity: the design activity originally responsible for the design and identification of an item whose drawing number and activity identification is shown in the title block of the drawings and associated documents. (ASME Y14.100)

3.15 Design Activity Identification (DAI)

design activity identification (DAI): the application of a unique identifier that distinguishes an activity or organization from another activity or organization. Examples of activity identification include activity name, activity name and address, and CAGE Code. (ASME Y14.100)

3.16 Design Disclosure Drawing(s)

design disclosure drawing(s): a drawing or set of drawings and associated data that delineates the detailed engineering requirements of an end product necessary for the fabrication, assembly, inspection, and test of the item.

3.17 Discrete Wiring Board

discrete wiring board: a base material upon which discrete wiring techniques are used to obtain electrical interconnections.

3.18 Drawing

drawing: an engineering document or data set that discloses, directly or by reference by means of graphic or textual presentations, or by combinations of both, the physical or functional requirements of an item. (ASME Y14.100)

3.19 Drawing Graphic Sheet

drawing graphic sheet: the two-dimensional geometric elements and annotations that define an item and the product definition elements of the sheet format in accordance with ASME Y14.1 or ASME Y14.1M. (ASME Y14.100)

3.20 Drawing Tree

drawing tree: a block diagram or indented list that identifies all drawings applicable to an end item or program and illustrates the next higher and subordinate relationships that exist between those drawings.

3.21 Enterprise Identifier (EID)

enterprise identifier (EID): a unique identifier used to distinguish one activity or organization from another activity or organization. Examples of enterprise identifiers are CAGE Codes, Department of Defense Activity Address Codes (DODAAC), Dun & Bradstreet's Data Universal Numbering System (D-U-N-S), North Atlantic Treaty Organization (NATO) CAGE (NCAGE) Codes, ISO/SAE WMI

Codes, and GS1 Company Prefixes. An EID code is uniquely assigned to an activity by an issuing agency registered in accordance with procedures outlined in ISO/IEC 15459-2. An enterprise may be a design activity, manufacturer, supplier, depot, program management office, or a third party.

3.22 End Product (End Item)

end product (end item): an item, such as an individual part or assembly, in its final or completed state.

3.23 Envelope Drawing

envelope drawing: product definition data that discloses the basic technical data and performance requirements necessary for development or design selection of an item where it is desirable to have all features other than those shown on the drawing left to the ingenuity of the supplier. An envelope drawing does not establish item identification.

3.24 Inseparable Assembly

inseparable assembly: see *part*. (ASME Y14.100)

3.25 Interchangeable Item

interchangeable item: an item that possesses functional and physical characteristics equivalent in performance to another item of similar or identical purposes. It is capable of being exchanged for the other item without selection for fit or performance or alteration of the items themselves or of adjoining items, except for adjustment. (ASME Y14.100)

3.26 Item

item: a nonspecific term used to denote any unit or product, including materials, parts, assemblies, equipment, accessories, and computer software. (ASME Y14.100)

3.27 Item Identification

item identification: the PIN for a specific item along with the original DAI (see para. 3.15). (ASME Y14.100)

3.28 Multiprogrammable Memory Device

multiprogrammable memory device: a memory device containing software instructions or data that can be changed in the device once programmed [e.g., electrically alterable read-only memory (EAROM)].

3.29 Nationally Recognized Standard

nationally recognized standard: a specification or standard issued with the intent to establish common technical requirements. Such standards are developed by or for a government activity or by a nongovernmental organization.

3.30 NATO Commercial and Government Entity (NCAGE) Code

NATO Commercial and Government Entity (NCAGE) Code: a five-character code that provides a unique identifier used by NATO for enterprise identification. This method of enterprise identification has also been widely adopted by industry. NCAGE codes are governed by the NATO Codification System (NCS). Detailed procedures are described in ACodP-1. Sources for obtaining NCAGE codes are the National Codification Bureaus (NCB) and the NATO Support and Procurement Agency (NSPA) at https://eportal.nspa.nato.int/AC135Public/scage/CageList.aspx.

Wherever "CAGE" or "CAGE Code" is stated in this document, it can be substituted for "NCAGE" or "NCAGE code" as required. See also *Commercial and Government Entity (CAGE)* (para. 3.10).

3.31 Nongovernmental Organization

nongovernmental organization: a private sector association, organization, or technical society that conducts professional standardization activities (e.g., planning, developing, establishing, or publically coordinating standards, specifications, handbooks, or related documents) and is not organized for profit. (ASME Y14.100)

3.32 One-Time Programmable Memory Device

one-time programmable memory device: a memory device containing software instructions or data that cannot be changed in the device once programmed [e.g., programmable read-only memory (PROM), programmable array logic (PAL)].

3.33 Part

part: one item, or two or more items joined together, that is not normally subject to disassembly without destruction or impairment of designed use, e.g., transistor, composition resistor, screw, transformer, and gear. (ASME Y14.100)

3.34 Part or Identifying Number (PIN)

Part or Identifying Number (PIN): the identifier assigned by the original design activity or by the controlling nationally recognized standard that uniquely identifies, relative to that design activity, a specific item. (ASME Y14.100)

3.35 Performance Specification

performance specification: a specification that states the required results with criteria for verifying compliance but without stating the methods for achieving the required results. A performance specification defines the functional requirements for the item, the environment in which the item operates and interfaces, and the interchangeability characteristics.

3.36 Printed Board

printed board: the general term for completely processed printed circuit and printed wiring configurations. These include single-sided, double-sided, and multi-layer boards with rigid, flexible, and rigid-flex base materials.

3.37 Printed Circuit

printed circuit: a conductive pattern composed of printed components, printed wiring, or a combination thereof that is formed in a predetermined arrangement on a common base.

3.38 Printed Component

printed component: a part (e.g., inductor, resistor, capacitor, or transmission line) that is formed as part of the conductive pattern of a printed board.

3.39 Printed Wiring

printed wiring: a conductive pattern that provides point-to-point connections but no printed components in a predetermined arrangement on a common base.

3.40 Procuring Activity

procuring activity: the customer. (ASME Y14.100)

3.41 Procurement Specification

procurement specification: a specification document (not a drawing) that defines the technical requirements (design performance, environmental, testing, reliability, maintainability, etc.) for an item to be developed by a supplier.

3.42 Production Master

production master: a 1:1 scale pattern that is used to produce one or more rigid or flexible printed boards within the accuracy specified on the master drawing. (IPC T-50)

3.43 Purchased Item

purchased item: a term that encompasses both commercial items and vendor-developed items.

3.44 Qualification

qualification: the formal process by which a manufacturer's product is examined for compliance with the procurement requirements of a source control drawing (SOCD) (see para. 3.50) to approve the manufacturer as a source of supply.

3.45 Reference

reference: to invoke associated data by callout on an engineering drawing. Such callouts may be located on the field of the drawing, in a note, in the parts list, or elsewhere on the drawing.

3.46 Reference Data

reference data: information, including dimensions, that does not govern production or inspection operations.

3.47 Run In

run in: to operate mechanical items under specified environmental and test conditions to eliminate early failures and stabilize the items prior to actual use.

3.48 Selected Item Drawing (SID)

selected item drawing (SID): a product definition data depicting an existing standard or vendor-developed item with further required selection or restriction of the item for fit, tolerance, performance, or reliability within the range or limits prescribed for the item. Although the existing item is not physically modified, by virtue of the selection technique employed it is demonstrably different from those identified on the document from which the selection is made. Therefore, the existing item is not interchangeable with the selected item. When the existing item is so restricted, the authoring design activity reidentifies it with a new part number that replaces the original part number.

3.49 Specialized Segment of Industry

specialized segment of industry: a business entity having recognized expertise in developing or developing and manufacturing specific products or product lines to meet customer requirements.

3.50 Source Control Drawings (SOCD)

source control drawing (SOCD): a product definition data that

(a) depicts the requirements for an existing supplier item or a developed supplier item that is required to be approved and qualified for use

(b) exclusively provides the performance, installation, and interchangeable characteristics required for one or more specific critical applications

The specific applications are stated on the drawing. The item is reidentified with a new part number from the authoring design activity.

3.51 Source Control Notation (SOCN)

source control notation (SOCN): a four-letter marking code used to indicate that an item is an SOCD item.

3.52 Subassembly

subassembly: two or more parts that form a portion of an assembly or a unit that is replaceable as a whole but has a part or parts that are individually replaceable [e.g., gun mount stand, window sash, recoil mechanism, floating piston, telephone dial, intermediate frequency strip, terminal board with mounted parts]. (ASME Y14.100)

3.53 Subcontractor

subcontractor: a design activity from whom design development is purchased. The subcontractor may or may not produce the design item.

3.54 Title Block

title block: the block located in the lower right corner of a drawing graphic sheet format that contains the primary drawing identification.

3.55 Type Designation

type designation: a combination of letters and numbers arranged in specific sequence to provide a short, significant method of identification.

3.56 Vendor

vendor: a source from whom a purchased item is obtained.

3.57 Vendor-Developed Item

vendor-developed item: a specialized version of a vendor's general product line that is not normally stocked as an off-the-shelf item but is procurable on order.

3.58 Vendor Item Control Drawing (VICD)

vendor item control drawing (VICD): a product definition data that depicts the requirements for an existing supplier item or a developed supplier item and

(a) does not require item qualification in the use of a critical application

(b) does impose specific engineering design requirements and acceptance criteria on the supplier

The item is not reidentified with a new part number and retains the original supplier item identification. (Formerly called vendor item drawing or specification control drawing.)

3.59 Work Package

work package: a group of related items that do not make up a complete assembly with instructions for installing the items in a major assembly structure (e.g., a power supply and mounting hardware with instructions for installation in a telecommunications satellite structure).

3.60 Acronyms

See the following list for acronyms used in this Standard.

Acronyms	Terms
AIA	Aerospace Industries Association
AID	Altered item drawing
ANSI	American National Standards Institute
ASME	The American Society of Mechanical Engineers
CAGE	Commercial and government entity
COTS	Commercial off the shelf

Table continued

Acronyms	Terms
DAI	Design activity identification
DoD	Department of Defense
EAROM	Electrically alterable read-only memory
ECIA	Electronic Components Industry Association
EIA	Electronic Industries of America
EID	Enterprise identifier
FPGA	Field programmable gate arrays
IAW	In accordance with
ICRD	Identification cross-reference drawing
IEEE	Institute of Electrical and Electronic Engineers
IF	Intermediate frequency
IPC	Institute for Interconnecting and Packaging Electronic Circuits
MCM-L	Multichip modules laminated
NCAGE	NATO commercial and government entity
NDIA	National Defense Industrial Association
PAL	Programmable array logic
PIN	Part or identifying number
PL	Parts list
PROM	Programmable read-only memory
SAE	Society of Automotive Engineers
SOCD	Source control drawing
SI	International system of units
SID	Selected item drawing
SIDD	Software item identification drawing
SIND	Software item installation drawing
SOCN	Source control notation
UOS	Unless otherwise specified
VDD	Version description document
VICD	Vendor item control drawing
VIN	Vehicle identification number
WBS	Work breakdown structure

3.61 Abbreviations

See the following list for abbreviations used in this Standard.

Abbreviations	Terms
COM	Commercial
DWG	Drawing
GOV	Government
REQT	Requirement
SPEC	Specification
STD	Standard

4 GENERAL DRAWING INFORMATION

4.1 Preparation Methods and Formats

4.1.1 Preparation Methods. Preparation methods (e.g., manual, digital, photographic, cut and paste, etc.) and methods of depiction (e.g., pictorial, textual, or combinations thereof) are concerns of this Standard only to the extent that the drawing satisfies its intended purpose.

Use of ASME Y14.41 and ASME Y14.47 practices to prepare data sets does not preclude the use of this Standard. Data sets prepared with drawing graphic sheets shall meet the specific requirements for each drawing type defined in this Standard. Data sets prepared with no drawing graphic sheets shall meet the intent of the specific requirements for each drawing type defined in this Standard by using the practices defined in ASME Y14.41 and ASME Y14.47.

4.1.2 Formats. Formats (e.g., manual or digital, single or multisheet, drawing in book form or computer printout) are concerns of this Standard only to the extent that the drawing satisfies its intended purpose. Formats shall be in accordance with ASME Y14.1 or ASME Y14.1M.

4.2 Structure of Drawing Text

Textual information on drawings may be in numbered note form or in a format that uses section headings, numbered paragraphs, and subparagraphs grouped according to subject matter. See Figures 8.1.1-2, 8.2.1-2, and 15.6.1-1 for examples of textual drawings.

4.3 Application Guidelines

Application guidelines are intended to aid in understanding the conditions under which specific types of drawings may be prepared. Application guidelines are not intended to imply that preparation of specific drawing types is always required.

4.4 Drawing Content

Requirements can be satisfied by direct delineation on the drawing or by reference to other documents that are a part of the drawing package. Such documents are invoked in individual drawings either by reference in a note or in the using assembly parts list or both. Parts lists shall be in accordance with ASME Y14.34.

4.5 Tabulation

Any drawing type may be tabulated, as applicable, to delineate similar items that as a group have some common characteristics and some variable features.

4.5.1 Application Guidelines. Tabulated drawings are prepared to avoid preparation of individual drawings for each similar item tabulated. Each item included in the tabulation shall have a PIN assigned.

4.5.2 Requirements. The differences, i.e., variables between the items defined by the drawing shall be tabulated. The common characteristics need only be delineated or stated once. Each individual item shall be identified by a PIN. A single pictorial representation may be used for all items. For example, variable dimensions may be coded by letters used as headings for columns in a tabulation block. Variables shall be entered in the table under the appropriate heading and on the same line as the relevant PIN. Alternate methods may be used to correlate the variations in characteristics to the individual items. The description for each tabulated item shall be as complete as that of an individual item described on the specific drawing type.

4.6 Combination of Drawing Types

The characteristics of more than one drawing type may be combined into a single drawing provided the resulting combination includes the data required by each of the individual types. For example, a modification kit drawing combines a description of the modification and the kit of items needed to accomplish the modification.

NOTE: The decision to combine drawings should be made cautiously. Combining drawing types should result in a significant advantage versus not combining and having separate drawings. Advantages of combining drawings should outweigh any potential disadvantages. Potential disadvantages of combining drawings include

(a) increased complexity of the drawing, which can diminish clarity and usefulness

(b) frequent change activity to the drawing, which can increase the need to update associated records, material control data, manufacturing planning, microfilm, etc.

4.7 Ancillary Drawings

Ancillary drawings may be prepared to supplement end-product drawings. Ancillary drawings may be required for management control, logistics purposes, configuration management, and other similar functions unique to a design activity. Ancillary drawings do not establish item identification. Inclusion of data in an ancillary drawing does not eliminate the need to prepare appropriate drawing types, including the applicable data as defined in this Standard.

4.8 Drawing Hierarchy

Based on the product structure of an item, the different types of drawings required can be prepared at any level of the drawing tree. See section 17.

5 DETAIL DRAWING

5.1 Description

A detail drawing provides the complete end-product definition of the part or parts depicted on the drawing. A detail drawing establishes item identification for each part depicted thereon.

5.2 Application Guidelines

A detail drawing is prepared to provide maximum clarity in defining a part.

5.3 Requirements

A detail drawing shall delineate all features of the part including, as applicable,

(a) configuration
(b) dimensions
(c) tolerances
(d) materials
(e) mandatory processes
(f) surface texture
(g) protective finishes and coatings
(h) markings

5.4 Monodetail Drawing

A monodetail drawing delineates a single part. See Figures 5.4-1 through 5.4-3 for examples of monodetail drawings.

NOTE: A drawing detailing SHOWN and OPPOSITE parts using a single set of views is considered a tabulated monodetail drawing. See para. 4.5.

5.5 Multidetail Drawing

5.5.1 Description. A multidetail drawing delineates two or more parts in separate views or in separate sets of views on the same drawing. See Figure 5.5.1-1 for an example of a multidetail drawing.

5.5.2 Application Guidelines. A multidetail drawing is prepared to describe parts usually related to one another.

NOTE: The decision to use a multidetail drawing should be made cautiously to ensure that benefits outweigh potential disadvantages. The potential disadvantages related to how a drawing is affected when revising or tabulating a multidetail drawing include the following:

(a) A change to one part of the multidetail drawing may affect the associated records (e.g., material control data and manufacturing planning) of other parts.

(b) When tabulating individual parts that are defined on the drawing, additional details or tabulation blocks may be added to define the differences according to para. 4.5. Each individual tabulated part shall be identified according to para. 4.5.2. Tabulating may affect the sequence in the assignment of a PIN for each part.

(c) Increased drawing complexity may cause diminished clarity and usefulness.

5.5.3 Requirements. Each part shall be separately identified per ASME Y14.100

6 ASSEMBLY DRAWING

6.1 Assembly Drawing

6.1.1 Description. An assembly drawing defines the configuration and contents of the assembly or assemblies depicted thereon. It establishes item identification for each assembly. See Figure 6.1.1-1 for an example of an assembly drawing. Where an assembly drawing contains detailed requirements for one or more parts used in the assembly, it is a detailed assembly drawing and establishes item identification for each part detailed. See para. 4.6 for information about combining drawing types and Figure 6.1.1-2 for an example of a detailed assembly drawing.

6.1.2 Application Guidelines. An assembly drawing is prepared for each group of items joined to form an assembly that reflects one or more of the following:

(a) a logical level in the assembly or disassembly sequence
(b) a testable item
(c) a functional item
(d) a deliverable item

6.1.3 Requirements. An assembly drawing shall include, as applicable, the following:

(a) two or more parts, subassemblies, or combination of these items.

(b) a parts list specifying the PIN for all items that become a part of the assembly.

(c) requirements for decorative or protective finishes, processes, settings, and adjustments and other relevant data necessary to complete the item as an assembly (e.g. dimensions).

(d) depiction of the items in the assembly relationship, using sufficient detail for identification and orientation of the items. Details of a subassembly are not normally repeated on the assembly drawing of a higher level.

(e) electrical items depicted as they are to be mounted; however, small electrical items (e.g., diodes, resistors) mounted by wire connections only may be located by either depiction on the assembly drawing or inclusion in the pertinent connection diagram or wiring list. See para. 14.4, which describes connection diagrams, and para. 14.6, which describes wiring lists.

(f) cross-reference to applicable installation drawings, higher-level assemblies, schematic diagrams, test specifications, associated lists, etc.

(g) a PIN assigned to each assembly configuration.

(h) identification marking requirements.

(i) attaching parts (e.g., bolts, nuts, and washers) required to mount assemblies in next-higher assemblies, which shall be called out in the parts list of the drawing that defines that attachment. This is usually the higher-level assembly or installation drawing. Assembly drawings may be shown using an exploded view when needed. See Figure 6.1.3-1 for an example of an exploded view assembly drawing.

(j) tabulation in accordance with para. 4.5 to specify variable items in the parts list. The pictorial representation depicts all tabulated versions. If necessary to depict differences, separate views may be used.

6.2 Inseparable Assembly Drawing

6.2.1 Description. An inseparable assembly drawing delineates two or more parts, subassemblies, or a combination of these items that may be separately fabricated and are permanently joined (e.g., welded, brazed, riveted, sewed, glued, or attached by other processes) to form an integral unit or part not normally capable of being disassembled for replacement or repair of individual pieces. It establishes item identification for the assembly. See Figures 6.2.1-1 and 6.2.1-2 for examples of inseparable assembly drawings.

6.2.2 Application Guidelines. An inseparable assembly drawing may be prepared in lieu of individual detail drawings for the parts of an inseparable assembly. For example, a welded or riveted bracket, a metal chest riveted together, or a canvas case sewed together may be covered by an inseparable assembly drawing without separate detail drawings. Individual pieces may be detailed in the assembled condition in lieu of separate detail views or drawings.

6.2.3 Requirements. An inseparable assembly drawing fully defines the end product as assembled. An inseparable assembly drawing shall include, as applicable, the following:

(a) a PIN for all items that become a part of the inseparable assembly

(b) methods of assembly and requirements for finishes, processes, settings, and adjustments and other relevant data necessary to complete the item

(c) depiction of the items in the assembled condition, using sufficient detail for identification, orientation, and assembly of the items

(d) a PIN assigned to the assembly configuration

(e) identification marking requirements

7 INSTALLATION DRAWING

7.1 Description

An installation drawing provides information for properly positioning and installing items relative to their supporting structure and adjacent items, as applicable. This information can include dimensional data, hardware descriptions, and general configuration information for the installation site. An installation drawing does not establish item identification except for a work package or kit. See para. 15.6 for information on kit drawings. See Figures 7.1-1 and 7.1-2 for examples of installation drawings.

7.2 Application Guidelines

An installation drawing is prepared to provide detailed installation information for the following:

(a) functionally related items, such as a control system, electrical system, or hydraulic system that cannot be effectively shown on an assembly drawing of the item to which it belongs.

(b) an assembly that is so large or complex that the assembly drawing cannot accommodate all relevant data. See Figure 7.1-1.

7.3 Requirements

An installation drawing shall include, as applicable, the following:

(a) dimensions in sufficient detail to establish space requirements for installation, operation, and servicing, including clearance for

(1) opening of doors

(2) removal of plug-in units

(3) travel or rotation of any moving parts, including the centers of rotation, angles of elevation, and depression

(b) interface mounting and mating information (e.g., locating dimensions for attaching hardware).

(c) interfaces for pipe and cable attachments.

(d) references to interconnecting and cabling data and associated lists.

(e) identification of and requirements for installation items not included in the parts list of the using assembly drawing.

(f) reference to the assembly drawing of the major item being installed.

(g) a parts list specifying the items to be installed (see para. 4.4).

(h) the supporting structure and associated items that are not included in the installed items. Providing this information is optional. When shown, such items shall be depicted by phantom lines and identified as reference data. Reference data is indicated by enclosing the data in parentheses or by labeling it REF.

8 MODIFYING DRAWINGS

Modifying drawing types are altered item, selected item, and modification drawings. These drawing types shall not be used for items made from raw or bulk materials, items purchased in bulk lengths (e.g., extrusions, channel nuts, hinges, etc.), or internally semi-processed items such as blank panels, castings, electronic equipment drawers, etc.

For such items, use detail or detail assembly drawings (see sections 5 and 6, respectively).

8.1 Altered Item Drawing (AID)

8.1.1 Description. An AID delineates the physical alteration of an existing item under the control of another design activity or defined by a nationally recognized standard prior to its intended use. The drawing type permits the required alteration to be performed by any competent manufacturer, the altering design activity, or a third party. An AID establishes a new item identification for the altered item. See Figures 8.1.1-1 and 8.1.1-2 for examples of AIDs.

8.1.2 Application Guidelines. An AID is prepared when alteration of an existing item is required. The current design activity shall not prepare an altered item drawing to alter items they have developed.

8.1.3 Requirements. An AID shall include, as applicable, the following:

(a) information necessary to identify the existing item's form, fit, function, and performance requirements prior to alteration, including the original item identification. Unless the item being altered is defined by a nationally recognized standard, this information shall be delineated on the AID or provided by reference to a design disclosure drawing, a VICD, or a source control drawing, as applicable.

(b) complete details of the alteration.

(c) a PIN assigned to the altered item.

(d) reidentification marking, which requires that the original item identification being replaced be removed or obliterated if this can be done without damage to the item. However, microcircuit reidentification marking shall be in addition to the existing original marking and shall be visibly separate from and in no way interfere with the existing marking.

(e) a parts list. Providing this information is optional, unless the alteration necessitates any additional item(s) to produce the altered item.

(f) the notation ALTERED ITEM DRAWING adjacent to the drawing title block.

NOTE: An altered item may be delineated on the using assembly drawing, provided requirements (a) through (e) are met and the item is noted ALTERED ITEM.

8.2 Selected Item Drawing (SID)

8.2.1 Description. An SID defines refined acceptance criteria for an existing item either under the control of another design activity or defined by a nationally recognized standard that requires further selection, restriction, or testing for such characteristics as fit, tolerance, or material in cases where alternate materials are used in the existing item, performance, reliability, etc. This drawing type generally permits selection to be performed by any competent inspection or test facility, including those of the original manufacturer, the selecting design activity, or a third party. See Figures 8.2.1-1 and 8.2.1-2 for examples of SIDs.

An SID establishes a new item identification for the selected item.

Although visible physical modification is not performed, the item is, because of the selection technique employed, demonstrably different from other items that meet only the requirements imposed on the original item.

8.2.2 Application Guidelines. An SID is prepared when it is feasible to select from an existing group of existing items those items that, as applicable:

(a) meet the required characteristics for a particular application

(b) pass additional tests or inspections imposed by the using design activity for characteristics not normally specified for the original item

(c) survive burn-in or run in requirements

The current design activity shall not prepare an SID to select items they have developed.

8.2.3 Requirements. An SID shall establish the detailed criteria on which selection of the item is based and include the following:

(a) information necessary to identify the existing item's form, fit, function, and performance requirements prior to selection, including the original item identification. Unless the item being selected is defined by a nationally recognized industry or government standard, this information shall be delineated on the SID or provided by reference to a design disclosure drawing, a VICD, or an SOCD, as applicable.

(b) full disclosure of the range of restricted characteristics (e.g., fit, tolerance, performance, and reliability).

(c) a PIN assigned to the selected item.

(d) reidentification marking, which requires that the original item identification being replaced be removed or obliterated if this can be done without damage to the item. However, microcircuit reidentification markings shall be in addition to the existing original marking and shall be visibly separate from and in no way interfere with the existing marking.

(e) the notation SELECTED ITEM DRAWING adjacent to the drawing title block.

NOTE: A selected item may be defined on the using assembly drawing, provided requirements (a) through (d) are met and the item is noted SELECTED ITEM.

8.3 Modification Drawing

8.3.1 Description A modification drawing delineates changes to items after they have been delivered. A modification drawing shall require reidentification of the modified item. See Figure 8.3.1-1 for an example of a modification drawing.

8.3.2 Application Guidelines. A modification drawing is prepared to add, remove, or rework items to satisfy the user's requirements or to incorporate mandatory changes in delivered equipment. These would include those that affect safety, reliability, or application extension. A modification drawing is not a production drawing nor a substitute for existing drawing types used to produce the item(s) prior to modification (e.g., detail and assembly drawings). Engineering changes may be incorporated into the latter drawing types to the extent that future production is to reflect the modifications.

8.3.3 Requirements. A modification drawing shall contain complete information for accomplishing the changes including, as applicable, the following:

(a) instructions for the removal or installation of affected items.

(b) special notes.

(c) item identification, including serial number, when used, of affected items prior to modification.

(d) effectivity [e.g., aircraft tail number, Vehicle Identification Number (VIN)] of items to be modified when they can be attributed to a specific end item.

(e) instructions for reidentification of modified items.

(f) dimensions necessary to accomplish the modification. Dimensions shall be given from specific features that are readily identified and accessible, rather than from theoretical reference planes.

(g) a parts list identifying all items required for the modification. See para. 4.4 for information on drawing content and parts lists.

(h) a list of special tools or equipment required or supplied.

(i) the notation MODIFICATION DRAWING adjacent to the drawing title block.

(j) instruction for disposition of unused holes, wires, removed items, etc. Providing this information is optional.

9 ARRANGEMENT DRAWING

9.1 Description

An arrangement drawing depicts the physical relationship of significant items using appropriate projections or perspective views. Reference dimensions may be included. An arrangement drawing does not establish item identification. See Figure 9.1-1 for an example of an arrangement drawing.

9.2 Application Guidelines

An arrangement drawing is prepared to convey a general description of the configuration and location of significant items. It is not normally used to control design.

9.3 Requirements

An arrangement drawing shall include, as applicable, the following:

(a) sufficient views so that a general understanding of the configuration and location of significant items is conveyed

(b) overall, locating, and other general dimensions necessary to describe the configuration

(c) identities of significant items

(d) reference to applicable documents for further details, such as ancillary equipment documentation, system specifications, and associated lists

(e) the notation ARRANGEMENT DRAWING placed adjacent to the drawing title block

10 CONTROL DRAWINGS

A control drawing is a drawing disclosing form, fit, function, and performance requirements for interchangeable purchased items of existing designs or of items to be specially developed by vendors to the control drawing requirements. Control drawings permit the acquisition of commercial items and vendor-developed items from specialized segments of industry without disclosing details of designs or divulging proprietary vendor data. Use Figure 10-1 as an aid in selecting the appropriate control drawing type.

Nonmandatory Appendix A provides more detailed guidance on how to select the appropriate control drawing type. Control drawings should be used for government applications but may also be used for commercial applications.

See Nonmandatory Appendix B for procurement control drawing.

10.1 Vendor Item Control Drawing (VICD)

NOTE: A vendor item control drawing was formerly called a vendor item drawing or a specification control drawing.

10.1.1 Description. A VICD provides an engineering description and acceptance criteria for commercial items or vendor-developed items that are procurable from a specialized segment of industry. It provides a list of suggested source(s) of supply, the vendor's item identification, and sufficient engineering definition for acceptance of interchangeable items within specified limits. The vendor's PIN along with the DAI is the item identification. The VICD number with suffixed identifier, if applicable, establishes the administrative control number(s) for identifying the item(s) on engineering documentation. See Figure 10.1.1-1 for an example of a VICD.

10.1.2 Application Guidelines

10.1.2.1 A VICD is used to provide the following:

(a) a single administrative control number for use in engineering documentation whenever one or more sources exist for the item.

(b) a means of documenting engineering requirements for a purchased item.

(c) documentation to ensure interchangeability of items each time purchased.

(d) coverage of items developed at private expense where the design is controlled by the originating design activity. It is not the intent of a VICD to portray a complete design disclosure.

10.1.2.2 A VICD shall not be used to delineate the following:

(a) an item requiring qualification in advance of a procurement action.

(b) an altered item, selected item, or an item delineated by a nationally recognized standard.

(c) a purchased item upon which the purchasing activity has placed requirements in addition to those normally provided. Instead, the item shall be delineated on either an AID or SID, as appropriate. The addition of the administrative control number established by the VICD does not constitute item reidentification or alteration and shall not be used to reidentify the item.

10.1.2.3 The suggested source(s) listed on a VICD are not intended to represent the only sources for the item. When additional sources are identified they should be added to the list of SUGGESTED SOURCE(S) OF SUPPLY on the drawing. See Figure 10.1.1-1 for an example of how this list of sources may be displayed.

10.1.2.3.1 The use of a CAGE- or NCAGE-type EID for design activity is mandatory for DoD and NATO provisioned items, with the exception of COTS items. For further clarification on CAGE use, refer to ASME Y14.100.

The use of an EID for commercial and COTS items is optional. When providing this information, other types of EIDs, such as a D-U-N-S number, may be used. When the column space in the list does not permit direct entry of other EID code types, state the EID in a (flag) note and refer to it in this column.

10.1.2.3.2 The enterprise activity column in the list is optional and is used in conjunction with the EID column. As the listed EIDs do not distinguish between design activity, built-to-print manufacturer, or distributor, use of this column is recommended for clarification when more than the design activity is shown in the list. The following enterprise activity codes are suggested: DA for design activity, DM for design activity and manufacturer, MF for manufacturer, and DI for distributor.

When used, MF and DI should be associated to the DA for product definition data traceability if the acceptance criteria and requirements warrant it.

10.1.2.3.3 For commercial and COTS items, the EID and enterprise activity may be listed in established parts control records rather than on the drawing.

10.1.3 Requirements. A VICD shall disclose sufficient information to ensure identification and reprocurement of interchangeable items.

10.1.3.1 The VICD shall include, as applicable, the following:

(a) configuration, defined pictorially or by description

(b) dimensions of item envelope and applicable limits

(c) mounting and mating dimensions and applicable limits

(d) interface characteristics and applicable limits

(e) acceptance criteria as necessary for product performance verification

(f) performance, maintainability, reliability, environmental, and other functional characteristics

(g) schematic, interconnection, or other appropriate diagram to define item function or provide interconnection information

10.1.3.2 The VICD shall include

(a) the vendor and item identification listed under the heading SUGGESTED SOURCE(S) OF SUPPLY. Two or more sources are desirable.

(b) the following note:

IDENTIFICATION OF THE SUGGESTED SOURCE(S) OF SUPPLY HEREON IS NOT TO BE CONSTRUED AS A GUARANTEE OF PRESENT OR CONTINUED AVAILABILITY AS A SOURCE OF SUPPLY FOR THE ITEM(S).

(c) the notation VENDOR ITEM CONTROL DRAWING placed adjacent to the drawing title block.

10.2 Source Control Drawing (SOCD)

10.2.1 Description. An SOCD provides

(a) an engineering description, qualification requirements, and acceptance criteria for commercial items or for vendor-developed items procurable from a specialized segment of industry

(b) the performance, installation, interchangeability, or other characteristics required for critical applications

The drawing provides a list of approved sources of supply and the vendor's item identification for the item(s) that have been qualified and approved for use in the critical application(s). The SOCD establishes the source control item identification. See Figure 10.2.1-1 for an example of an SOCD.

10.2.2 Application Guidelines

10.2.2.1 An SOCD is used to provide

(a) a means of establishing engineering requirements for the selection, qualification, and acquisition of an item from commercial sources.

(b) identification of the items/sources qualified to meet the stated requirements for the specific critical application.

(c) documentation to ensure interchangeability of specified items in the stated application each time acquired.

(d) coverage of source-controlled items developed at private expense where the design is controlled by the originating design activity. It is not the intent of an SOCD to define a complete design disclosure.

(e) an item identification, i.e., SOCD number and applicable suffix identifier, along with its DAI for each qualified and approved item.

10.2.2.2 An SOCD shall not be used to delineate

(a) an item that does not require qualification in advance of a procurement action. If qualification is not required, the item is a candidate for VICD coverage.

(b) an altered item, selected item, or item delineated by a nationally recognized standard unless, in the latter case, qualification for the specific application(s) is required.

10.2.3 Requirements. An SOCD shall disclose sufficient information to ensure identification and reprocurement of acceptable items.

NOTE: Preparation requirements for an SOCD are identical to those for a VICD except for identification of critical application(s), qualification and approval requirements, item identification, approved sources of supply in lieu of suggested sources of supply, and required notation.

10.2.3.1 The SOCD shall include, as applicable, the following:

(a) configuration, defined pictorially or by description.

(b) dimensions of item envelope and applicable limits.

(c) mounting and mating dimensions and applicable limits.

(d) interface characteristics and applicable limits.

(e) acceptance criteria as necessary for product performance verification.

(f) performance, maintainability, reliability, environmental, and other functional characteristics.

(g) schematic, interconnection, or other appropriate diagram to define item function or provide interconnection information.

(h) qualification and approval requirements. Successful completion of qualification testing establishes a new item identification for the qualified item.

(i) an identifier assigned to the qualified item.

(j) reidentification marking, which requires that the original item identification being replaced shall not be removed or obliterated. The reidentification markings shall be in addition to the existing original marking and shall be visibly separate from and in no way interfere with the existing markings. The source control item identification shall include a DAI (e.g., CAGE Code, NCAGE Code), the notation SOCN, and the PIN.

NOTE: Additional information on marking is detailed in MIL-STD-130.

10.2.3.2 The SOCD shall include

(a) the vendor and item identification for each item that has been qualified and approved for use, listed under the heading APPROVED SOURCE(S) OF SUPPLY. Two or more sources are desirable.

(b) identification of the specific critical application for which the item is approved.

(c) the following notes:

ONLY ITEMS DESCRIBED ON THIS DRAWING ARE APPROVED FOR USE IN THE APPLICATIONS SPECIFIED HEREON. A SUBSTITUTE ITEM SHALL NOT BE USED WITHOUT PRIOR APPROVAL BY THE QUALIFYING ACTIVITY.

IDENTIFICATION OF THE APPROVED SOURCE(S) OF SUPPLY HEREON IS NOT TO BE CONSTRUED AS A GUARANTEE OF PRESENT OR CONTINUED AVAILABILITY AS A SOURCE OF SUPPLY FOR THE ITEM DESCRIBED ON THE DRAWING.

(d) the notation SOURCE CONTROL DRAWING placed adjacent to the drawing title block.

10.3 Envelope Drawing

10.3.1 Description. An envelope drawing discloses the basic technical data and performance requirements necessary for development or design selection of an item. The envelope drawing will establish an administrative control number for use in engineering documentation until development is complete or until vendor item identification is established. When item development is completed, envelope drawings normally evolve into detail drawings, VICDs, or SOCDs, as applicable. See Figure 10.3.1-1 for an example of an envelope drawing.

10.3.2 Application Guidelines. An envelope drawing is prepared for the following reasons:

(a) to establish the technical definition necessary for development of a new item or define requirements for vendor item selection

(b) to provide an administrative control number, i.e., an envelope drawing number and suffixed identifier, if applicable, for use in engineering documentation until development is complete or until vendor item identification is established

10.3.3 Requirements. Preparation requirements for an envelope drawing are identical to those for a VICD or SOCD, as applicable, except for the requirements of paras. 10.1.3.2 and 10.2.3.2. The drawing shall include the notation ENVELOPE DRAWING placed adjacent to the drawing title block. The vendor(s) developing the item may be specified.

11 INTERFACE DRAWING

11.1 Description

An interface drawing depicts physical and functional interfaces of interconnected items. It does not establish item identification. See Figure 11.1-1 for an example of an interface drawing.

11.2 Application Guidelines

An interface drawing is prepared to

(a) establish and maintain compatibility between items having a common boundary

(b) coordinate and control interfaces between interconnected systems

(c) communicate design decisions to participating design activities

An interface drawing may control one or more of the following types of interfaces: mechanical, electrical, hydraulic, pneumatic, interconnection, configuration, installation, operational sequence requirement, system switching, etc. Each interface type may be described in a separate interface drawing or in combination on a single drawing.

11.3 Requirements

11.3.1 An interface drawing shall include, as applicable, the following:

(a) configuration and interface dimensional data applicable to the envelope, mounting, and interconnection of the related items.

(b) complete interface engineering requirements (e.g., mechanical, electrical, electronic, hydraulic, pneumatic, and optical) that affect the physical or functional characteristics of the cofunctioning items. List all applicable product definition data that are sources of interfacing characteristics.

(c) any other characteristics that cannot be changed without affecting system interfaces.

11.3.2 An interface drawing shall include the notation INTERFACE DRAWING placed adjacent to the drawing title block.

12 IDENTIFICATION CROSS-REFERENCE DRAWING

12.1 Description

An identification cross-reference drawing is an administrative-type drawing that assigns a compatible identifier to provide a cross-reference to the original incompatible identifier(s). This drawing does not establish item identification. See Figure 12.1-1 for an example of an identification cross-reference drawing.

12.2 Application Guidelines

An identification cross-reference drawing is prepared to provide compatible identifiers for nationally recognized standards, customer furnished equipment, etc. when original identifiers are too long, contain characters unacceptable for data processing, are identified by description only, are supported in controlled database systems, etc. As an option, the listing of identification cross-reference identifiers may also be accomplished within a controlled database without the need to create a drawing.

12.3 Requirements

An identification cross-reference drawing shall include the following:

(a) assignment of the compatible identifier(s)

(b) cross-reference to the original item identification or description

(c) the notation IDENTIFICATION CROSS-REFERENCE DRAWING adjacent to the drawing title block

12.3.1 The identification cross-reference drawing shall not specify any engineering or design requirements beyond those already contained in the drawings, specification, etc., governing the original item.

13 MECHANICAL SCHEMATIC DIAGRAM

13.1 Description

A mechanical schematic diagram depicts mechanical and other operational, structural loading, or fluid circuitry functions using appropriate standard symbols and connecting lines. Although it contains design information, it does not establish item identification of the item(s) delineated thereon. See Figure 13.1-1 for an example of a mechanical schematic diagram.

13.2 Application Guidelines

When operating principles cannot be readily determined from a study of the assembly drawing, a mechanical schematic diagram is prepared to illustrate design information for any of the following:

(a) hydraulic or pneumatic systems

(b) complex mechanical systems (e.g., complex arrangement of gears, clutches, linkages, cams, etc.)

(c) rigging instruction involving wire, cable, rope, etc.

(d) critical structural items to display loading or lifting data

13.3 Requirements

A mechanical schematic diagram symbolically depicts elements of the unit, assembly, or system involved and displays the relation of each element by interconnecting lines. The elements may be arranged functionally or as they are actually arranged in their assembly or installed

position, whichever is clearest for the specific diagram and its intended use. The diagram can use either single line or complete pictorial presentation.

Loading diagrams for hoists and slings, flow diagrams for hydraulic or pneumatic control valves, simple unit flow diagrams, etc., can frequently be combined with the assembly or installation drawing. Hydraulic or pneumatic system diagrams, complicated rigging diagrams, complex mechanical function diagrams, etc., normally require separate drawings.

14 ELECTRICAL/ELECTRONIC DIAGRAMS

Electrical/electronic diagrams depict the elements or functions of electrical or electronic items using standard symbols in accordance with IEEE Std 91 and IEEE Std 315 and connecting lines or data in tabular form. These diagrams do not depict items to scale. They contain design information and do not establish item identification for the item(s) depicted thereon. See Figures 14.1.1-1 through 14.7.1-1 for examples of electrical and electronic diagrams.

14.1 Functional Block Diagram

14.1.1 Description. A functional block diagram depicts the functions of the major elements of a circuit, assembly, system, etc., in simplified form. See Figure 14.1.1-1 for an example of a functional block diagram.

14.1.2 Application Guidelines. A functional block diagram is prepared to illustrate the functional relationship of major elements of an assembly, system, etc.

14.1.3 Requirements. A functional block diagram includes major circuit functions depicted by single lines, rectangular blocks, and explanatory notes or text. Graphic symbols or reference designations other than unit numbers are not normally used.

14.2 Single-Line Diagram

14.2.1 Description. A single-line diagram depicts the course of an electrical/electronic circuit or system of circuits and the elements thereof using single lines, symbols, and notes. A single-line diagram conveys basic information about the operation of the circuit but omits much of the detailed information usually shown on schematic diagrams. See Figure 14.2.1-1 for an example of a single line schematic diagram.

14.2.2 Application Guidelines. The single-line form of presentation provides for the following:

(a) simplified diagrams of complex circuits

(b) diagrammatic representation of systems in which a single line represents a multi-conductor circuit.

14.2.3 Requirements. A single-line diagram includes, as applicable, the following:

(a) connections of major elements of a circuit represented by single-line graphic symbols in accordance with IEEE Std 91 and IEEE Std 315

(b) the course of the main circuits, i.e., connection of major components, shown in the most direct path and logical sequence

(c) electrical characteristics that are essential to an overall understanding of the system

14.3 Schematic Diagram

14.3.1 Description. A schematic diagram depicts the electrical connections and functions of a specific circuit arrangement without regard to the physical shape, size, or location of the elements. See Figure 14.3.1-1 for an example of a schematic diagram.

14.3.2 Application Guidelines. A schematic diagram is prepared to illustrate the detailed design of a circuit and assist in tracing the circuit and its functions. It may be prepared for any level of assembly and may include one or more levels.

14.3.3 Requirements. A schematic diagram shall include, as applicable, the following:

(a) symbolic representation of each element in the circuit with the symbols interconnected to depict circuit paths. Graphic symbols for both discrete parts (see IEEE Std 315) and logic elements (see IEEE Std 91) may be used on the same diagram.

(b) reference designations in accordance with ASME Y14.44 and IEEE Std 315 for each item.

(c) values for such items as resistors, capacitors, and inductors.

(d) standard type designation, when assigned, for such items as semiconductor devices, microcircuits, electron tubes, etc. When no type designation is assigned to the specific configuration used in the circuit by a nationally recognized standard, the item may be identified on the diagram by reference designation only, provided the item description is included in related documentation (e.g., the assembly drawing parts list).

14.4 Connection Diagram or Wiring Diagram

14.4.1 Description. A connection or wiring diagram drawing, herein referred to as a connection diagram, depicts the general physical arrangement of electrical connections and wires between circuit elements in an installation or assembly. It shows internal connections but can include external connections that have one termination inside and one outside the assembly. It contains the details necessary to make or trace connections involved. See Figure 14.4.1-1 for an example of a connection diagram.

14.4.2 Application Guidelines. A connection diagram may be prepared to illustrate the connection of wires and circuit elements at any level of assembly or installation.

14.4.3 Requirements. A connection diagram shall include, as applicable, the following:

(a) physical relationship of circuit elements and their connections

(b) items identified by reference designations in accordance with ASME Y14.44 and IEEE Std 315

(c) terminal arrangements clearly identified

(d) wires numbered for reference

(e) wire and termination descriptions

14.5 Interconnection Diagram

14.5.1 Description. An interconnection diagram depicts only external connections between assemblies, units, or higher-level items. See Figures 14.5.1-1 through 14.5.1-3 for examples of interconnection diagrams.

14.5.2 Application Guidelines. An interconnection diagram is prepared to illustrate the interconnections between units, sets, groups, and systems.

14.5.3 Requirements. An interconnection diagram is prepared either as a wiring-type diagram, which shows each wire, or as a cabling-type diagram, which primarily shows cables but may also include wires. It does not necessarily show physical relationship.

14.6 Wiring List

A wiring list consists of tabular data and instructions necessary to establish wiring connections. See ASME Y14.34 for drawing requirements.

14.7 Logic Circuit Diagram

14.7.1 Description. A logic circuit diagram depicts the logic functions of a system at any level of assembly. See Figure 14.7.1-1 for an example of a logic circuit diagram.

14.7.2 Application Guidelines. A logic circuit diagram is prepared to

(a) illustrate logic functions

(b) facilitate circuit analysis and diagnosis of equipment problems

14.7.3 Requirements. A logic circuit diagram shall be prepared in accordance with IEEE Std 991 and shall include, as applicable, the following:

(a) logic functions depicted by logic symbols in accordance with IEEE Std 91/91a and connected by lines that represent signal paths

(b) PINs, test points, assembly boundaries, and nonlogic functions necessary to describe the physical and electrical aspects of the circuit

15 SPECIAL APPLICATION DRAWINGS

15.1 Wiring Harness Drawing

15.1.1 Description. A wiring harness drawing specifies the engineering requirements and establishes item identification for a wiring harness, i.e., a group of individually insulated conductors, including shielded wires and coaxial cables, held together by lacing cord or other binding. A wiring harness may or may not terminate in connectors, terminal lugs, or other similar fittings and may include small electronic parts. See Figure 15.1.1-1 for an example of a wiring harness drawing.

15.1.2 Application Guidelines. A wiring harness drawing is prepared when it is determined that a harness should be fabricated as a discrete item rather than by individually connecting conductors during assembly.

15.1.3 Requirements. A wiring harness drawing shall define the wiring harness configuration (i.e., form and termination points) by direct application of dimensions and tolerances, use of a reproducible grid system, or inclusion of horizontal and vertical graphic scales for determining the required dimensional data. The drawing shall include, as applicable, the following:

(a) pictorial views.

NOTE: When pictorial wiring harness information is omitted, a note similar to the following shall be placed on the drawing:

WIRING HARNESS CONFIGURATION IS DETERMINED AT ASSEMBLY OR INSTALLATION.

Critical routing requirements are defined on the assembly or installation drawing.

(b) a wiring tabulation or reference to a wiring list that identifies wire numbers or color codes, circuit reference designations in accordance with IEEE Std 315 (“from-to” data), wire lengths, wire type and gage, termination methods, and other related data. See ASME Y14.34.

(c) instructions for fabrication of the harnesses, minimum bend radii for conductors, and cross-references to the using assembly or installation drawings and associated electrical diagrams.

(d) a parts list specifying parts (e.g., connectors, terminal and lugs, and similar fittings) and bulk materials (e.g., wire, sleeving, jacketing, and twine) required for the fabrication of the harness.

(e) applicable processes. Items used to install the harness (e.g., cable clamps) that are not an integral part of the harness shall be itemized in the using assembly or installation drawings.

(f) when the harness routing information is omitted, a note similar to the following shall be placed on the drawing:

HARNESS ROUTING CONFIGURATION TO BE DETERMINED AT ASSEMBLY OR INSTALLATION.

The using assembly or installation drawing shall then specify any critical routing requirements.

15.2 Cable Assembly Drawing

15.2.1 Description. A cable assembly drawing depicts an electrical cable assembly of defined length and establishes item identification for that assembly. The assembly consists of conductors (e.g., insulated wires, shielding, and coaxial cables) within a common molded or jacketed covering and has one or more ends terminating in connectors, terminal lugs, or similar fittings. See Figure 15.2.1-1 for an example of a cable assembly drawing.

15.2.2 Application Guidelines. A cable assembly drawing is prepared to describe power, signal, radio frequency, audio, and general-purpose electrical cable assemblies including both single-run and branched cables.

15.2.3 Requirements. A cable assembly drawing shall include, as applicable, the following:

(a) dimensions and tolerances for overall length and breakout locations. A simplified, single-line diagram is generally sufficient to define these requirements.

(b) identification of parts, bulk materials, and processes required for fabrication of the cable assembly.

(c) preparation of the cable ends.

(d) orientation and offset of connectors.

(e) maximum diameter of cable.

(f) minimum bend radii for wiring within the assembly.

(g) detail views of molded areas.

(h) conductor lay patterns (optional).

(i) identification band or other marking requirements.

(j) a wiring list, wiring diagram, or schematic diagram defining electrical connections and specifying wire number, color codes, and termination requirements.

(k) instructions for finish, special assembly, and storage (e.g., dust covers).

(l) test requirements.

Views in a cable assembly drawing need not be to scale.

15.3 Printed Board and Discrete Wiring Board Drawing Sets

15.3.1 Description. Printed board and discrete wiring board drawing sets consist of those drawings that define the configuration of printed wiring or printed circuit and discrete wiring boards and assemblies. They establish requirements for board fabrication, board assembly (e.g., mounting of electrical items and attaching hardware), and testing.

The term "board" as used in this Standard includes all types of dielectric base materials (i.e., flex, rigid, or a combination thereof). The term "printed" applies to all circuitry patterns that are etched, deposited, screened, or bonded to the base material. The term "discrete wiring" applies to circuitry patterns that are defined by the routing and terminating of discrete wires to form point-to-point electrical connections.

A typical drawing set may include, as applicable, an assembly drawing, schematic diagram, master drawing, master pattern drawing, artwork, artwork master, and production master. A typical drawing relationship is shown in Figure 15.3.1-1. The assembly and master drawing establish item identification for the assembly and board, respectively.

15.3.2 Application Guidelines. Printed board drawing sets are prepared to describe and control printed wiring or printed circuit boards and assemblies. Discrete wiring board drawing sets are prepared to describe and control discrete wiring boards and assemblies. Boards may be single-sided, double-sided, or multi-layer.

15.3.3 Requirements. In addition to other drawing requirements specified in this Standard, design and documentation requirements of board drawing sets shall be in accordance with the specifications and standards referenced in paras. 15.3.3.1 through 15.3.3.7. Other standards and specifications referenced within these documents may also apply.

The individual drawing types that make up a printed board or discrete wiring board drawing set are listed in paras. 15.3.3.1 through 15.3.3.6. A short description is provided for informational purposes, and reference is made to the applicable specification or standard that defines requirements for this drawing type.

No indication is made to identify a specific combination of drawings that may be used to complete a printed board or discrete wiring board drawing set. An assembly and master drawing are normally required to provide complete end-item definition, but the use of a master pattern drawing, artwork, artwork master, and/or a production master is dependent on the type of board being designed, how it will be fabricated, and how the documentation will be used.

15.3.3.1 Board Assembly Drawing

(a) Printed Board Assembly Drawing. A printed board assembly drawing shows a printed board, separately manufactured components, and any information necessary to describe the joining of them to perform a specific function. See IPC-2221, IPC-2222, IPC-2223, IPC-2224, and IPC-2225 for design requirements and IPC-D-325 for drawing requirements.

NOTE: "Circuit card assembly" is the general term used for titling assembly drawings that include electrical or electronic parts mounted on printed boards.

(b) Discrete Wiring Board Assembly Drawing. A discrete wiring board assembly drawing shows a discrete wiring board, separately manufactured components, and any information necessary to describe the joining of them to perform a specific function. See IPC-DW-425 for design and drawing requirements.

15.3.3.2 Master Drawing

(a) Printed Board Master Drawing. A printed board master drawing shows the dimensional limits or grid locations that are applicable to any and all parts of a product (i.e., printed board) to be fabricated, including the arrangement of conductors and nonconductive patterns or elements; the size, type, and location of holes; and all other necessary information. See IPC-2221, IPC-2222, IPC-2223, IPC-2224, and IPC-2225 for design requirements and IPC-D-325 for drawing requirements.

(b) Discrete Wiring Board Master Drawing. A discrete wiring board master drawing includes all information to guarantee fit, form, and function of the discrete wiring board and shall establish, as a minimum, interconnection techniques; wire type and gage; and size, shape, location, and tolerance of all discrete wiring board features. Material, plating, marking, and coating requirements shall also be indicated, as applicable. See IPC-DW-425 for design and drawing requirements.

15.3.3.3 Artwork. Artwork consists of an accurately scaled configuration used to produce the artwork master, production master, or master pattern drawing. See IPC-D-310 for artwork generation requirements and IPC-2221, IPC-2222, IPC-2223, IPC-2224, IPC-2225, and IPC-D-325 for documentation requirements.

15.3.3.4 Artwork Master (Photoplot Master). The artwork master (photoplot master) is an accurately scaled, usually 1:1, pattern used to produce the production master. See IPC-D-310 for phototool generation requirements and IPC-2221, IPC-2222, IPC-2223, IPC-2224, IPC-2225, and IPC-D-325 for documentation requirements.

15.3.3.5 Production Master. The production master is a 1:1 scale pattern that is used to produce rigid or flexible printed boards within the accuracy specified on the master drawing. See IPC-2221, IPC-2222, IPC-2223, IPC-2224, IPC-2225, and IPC-D-325 for documentation requirements.

15.3.3.6 Master Pattern Drawing. The master pattern drawing is a reproduction of the original artwork, artwork master, or database prepared in drawing format. See IPC-2221, IPC-2222, IPC-2223, IPC-2224, and IPC-2225 for drawing requirements.

15.3.3.7 Digital Form of Printed Boards. A digital form of printed boards is an automated layout technique (e.g., computer-aided). It can be used to generate various aspects or descriptions (e.g., drill data, artwork, testing, etc.) of the printed board information and document a digital form of the drawings that are a part of the printed board drawing set. See IPC-D-350 for requirements on generating printed board descriptions in digital form and IPC-D-351 for generating a digital form of printed board drawings.

15.4 Microcircuit Drawing Set

15.4.1 Description. A drawing set is composed of drawings necessary to specifically define physical, electrical, and environmental criteria for a microcircuit (e.g., monolithic, thin and thick film, hybrid circuit, etc.). It also establishes item identification.

A typical drawing set may include, as applicable, a master drawing, schematic, assembly, and artwork.

15.4.2 Application Guidelines. A microcircuit drawing set is prepared to establish the physical and functional characteristics necessary to ensure microcircuit interchangeability.

15.4.3 Requirements. In addition to other drawing requirements specified in this Standard, design and documentation requirements for microcircuit drawing sets shall be in accordance with IPC-D-859 and its related referenced documents.

15.5 Undimensioned Drawing

15.5.1 Description. An undimensioned drawing defines the shape and other design features of an object at a precise scale predominantly without dimensions. It provides an accurate pattern of the feature or features of an item.

15.5.2 Application Guidelines. An undimensioned drawing is prepared to delineate items that can be fabricated by use of the patterns to produce the item or to produce a tool for use in fabricating the item. Its use as a contour definition drawing provides the definition of contoured surfaces for engineering references and for design of tooling. See para. 15.9 for information on contour definition drawings.

15.5.3 Requirements. In addition to other drawing requirements in this Standard, design and documentation requirements for undimensioned drawings shall be in accordance with ASME Y14.31 and its related referenced documents.

15.6 Kit Drawing

15.6.1 Description. A kit drawing identifies an item or group of items with instructions for their use. The kit does not necessarily define a complete functional assembly. A kit drawing establishes item identification for the kit, not for the items in the kit. See Figure 15.6.1-1 for an example of a kit drawing.

15.6.2 Application Guidelines. A kit drawing is prepared when it is desired to identify all of the items required to perform a specific operation (e.g., maintenance, overhaul, modification, installation, conversion, or similar operations) in kit form.

15.6.3 Requirements. A kit drawing shall include, as applicable, the following:

(a) a parts list of the contents of the kit, including the identification of each item. See para. 4.4 on parts lists.
(b) documents that are a part of the kit, itemized in the parts list.
(c) pictorial representations.
(d) special tool requirements for installation of the kit.
(e) retest or recalibration requirements.

15.7 Tube Bend Drawing

15.7.1 Description. A tube bend drawing establishes by pictorial/coordinate or tabular delineation or combination thereof end-product definition for a single- or multi-plane tube or inseparable tube assembly (e.g., tube with end fittings). It establishes item identification for the bent tube or inseparable tube assembly. See Figures 15.7.3.1-1 and 15.7.3.2-1 for examples of tube bend drawings.

15.7.2 Application Guidelines. Pictorial/coordinate tube bend drawings are used to accommodate different methods of manufacture (e.g., roll bending or vector tube bender). Tabular tube bend drawings are prepared to specify complete requirements and configuration of rigid or semi-rigid tubing for direct use in forming on a draw bending machine, i.e., the tube to be bent is clamped against a bending form that rotates and draws the tube through a pressure die and over a mandrel. Tubing of complex configuration can be described using a combination of pictorial/coordinate and tabular delineation.

15.7.3 Requirements

15.7.3.1 Pictorial/Coordinate Delineation. A pictorial/coordinate tube bend drawing shall be prepared as a detail, assembly, or detail assembly drawing. A pictorial/coordinate tube bend drawing shall include, as applicable, the following:
(a) tube material
(b) end types
(c) identification and quantity of fittings
(d) dimensional requirements including bend radii, angles, end points and intersecting point coordinates, and overall lengths
(e) other data necessary to define design requirements
(f) XYZ coordinate system with indicated positive direction displayed in each detail view

See Figure 15.7.3.1-1 for an example of a tube bend drawing with a pictorial/coordinate delineation.

15.7.3.2 Tabular Delineation. The drawing format and informational entries shall be in accordance with Figure 15.7.3.2-1, which shows an example of a tube bend drawing with a tabular delineation.

A tube bend drawing shall include, as applicable, the following:

(a) the information required for the tube bending entered in the five columns shown in Figure 15.7.3.2-1 as follows:
(1) Bend Number. This is the number of the bend to be performed. Bends are numbered consecutively from the "B" end of the tube.
(2) "C" Distance. The dimension, before bending, from the "A" end of the tube to the beginning point of the bend, i.e., centerline of radius block, to be performed.
(3) "F" Bend Radius. The radius of the bend to be performed, measured from the centerline of the tube.
(4) "E" Turn Angle. The counterclockwise angle, as viewed from "B" end, through which the tube is rotated from a zero-reference plane established by Bend Number 1 to the plane of the bend to be formed.
(5) "G" Bend Angle. The clockwise angle through which the tube is bent. Counterclockwise bend angles are so noted. The bend angle is the finished angle and does not include spring back.
(b) the type of end (e.g., flare, bead, etc.) designated by the appropriate number and the item identification of the required end fittings entered in the "end fittings" block. Any variation from the standard end types shall be noted in the "type of end" block.
(c) a PIN assigned to each bent tube and assembly consisting of a bent tube and end fittings.
(d) material requirements.
(e) stock tube size specified as the outside diameter, wall thickness, and length "D" of the tube before bending, which includes the necessary allowance for beading or flaring the ends. This length does not include allowances that may be required for clamping when bends are near either end of the tube. These allowances, when required, are specified in a note.
(f) heat treatment requirements after bending and before or after attaching end fittings.
(g) finish requirements.
(h) identification marking requirements.
(i) required processes.
(j) test requirements and procedures.
(k) any other information required to fully describe the item.

15.8 Matched Set Drawing

15.8.1 Description. A matched set drawing delineates items that are matched and for which replacement as a matched set is essential. A matched set drawing establishes item identification. See Figure 15.8.1-1 for an example of a matched set drawing.

15.8.2 Application Guidelines. A matched set drawing is prepared when the required dimensions, tolerances, or other characteristics of items can be specified only in terms of the matched relationship. This includes items that are interchangeable only as a set because of special requirements for machining, electrical

characteristics, performance, etc. Under such conditions, a matched set drawing defines the matching relationship. Individual parts of the set may be delineated by the matched set drawing or by other drawings.

15.8.3 Requirements. The matched set drawing shall include, as applicable, the following:

(a) the physical or functional mating characteristics of the matched items, i.e., set

(b) the PIN assigned to each of the parts and the matched set

(c) discrete identification marking of the matched set (DAI, MSET, and PIN in accordance with MIL-STD-130, when applicable)

(d) the statement FURNISH ONLY AS A MATCHED SET or similar note

15.9 Contour Definition Drawing

15.9.1 Description. A contour definition drawing contains the mathematical, numeric, or graphic data elements used to describe a contoured surface. It establishes identification for the contoured surfaces delineated thereon. A contour definition drawing is a type of ancillary drawing (see para. 4.7). See Figures 15.9.1-1 through 15.9.1-3 for examples of contour definition drawings.

15.9.2 Application Guidelines. A contour definition drawing is prepared to define complex surface geometry that cannot be conveniently included in the detail drawing(s) of an item. Due to the complexity of a surface, the contour definition drawing may define two or more item surfaces on the same drawing.

15.9.3 Requirements. A contour definition drawing shall include, as applicable, the following:

(a) mathematical equations for the contoured surface.

(b) tabulated coordinates point values. The spacing of these points is dependent upon the desired degree of curvature and the surface tolerance.

(c) graphic sections.

(d) a summary of features and relationships to more basic coordinate systems in appropriate combinations to define the contoured surface or the desired points on a contoured surface.

15.10 Software and Memory Device Data

Drawings defining software (i.e., instructions) or data that will be or are intended to be resident in a memory device or other type of media that becomes a part of the end item shall be prepared as either a software item installation drawing (SIND) or an AID. This is determined by whether the software is one-time programmable or multiprogrammable. Software item identification drawings (SIDD) are used when unique identification is needed between software versions.

15.10.1 Memory Device Categories. For purposes of this Standard, memory devices are categorized as being either one-time programmable or multiprogrammable.

(a) One-time programmable devices shall be documented using the requirements of the AID (see para. 8.1).

(b) Multiprogrammable devices shall be documented using the requirements of the SIND (see para. 15.10.2).

15.10.2 Software Item Installation Drawing (SIND)

15.10.2.1 Description. An SIND identifies the characteristics of the software, instructions for programming into the memory device, and its master media and physical location. Software programs shall be referenced by PIN within the drawing. This drawing does not establish item identification. See Figure 15.10.2.1-1 for an example of an SIND.

15.10.2.2 Application Guidelines. An SIND is prepared when it is necessary to define the characteristics of the software, instructions for programming into a memory device, and its master media and physical location.

15.10.2.3 Requirements. The drawing shall include the following:

(a) identification of the item to be programmed by PIN by referencing the original vendor's PIN or by providing complete description of the item or by VICD or SOCD if a nationally recognized standard is not available

(b) the PIN of the software, software version, and other characteristics such as operating system and version, programming language used, source file identification and version, and object file identification and version

(c) physical location of the master software or data and the DAI of the repository having custody of the master software programs or data required to program items

(d) detailed instructions needed to load software into an item

(e) acceptance requirements in the form of a test procedure or checksum

15.10.3 Assemblies Containing Multiprogrammable Devices. Software or data that is programmed into a device at a higher level of assembly shall be documented using SIND requirements. The device shall not be reidentified after programming or loading.

15.10.4 One-Time Programmable Devices and Multiprogrammable Devices Used as One-Time Programmable. Drawings describing the programming requirements of a one-time programmable device shall be prepared as AIDs. This type of drawing shall be prepared only for those devices that are permanently altered prior to installation into a higher level of assembly.

15.10.4.1 One-Time Programmable Devices and Media Requirements. The requirements for AIDs shall be in accordance with the requirements herein and include the following:

(a) identification of the item to be programmed by PIN (by referencing the original vendor's PIN, or by providing complete description of the item, or by VICD or SOCD if a nationally recognized standard is not available)

(b) PIN of the software, software version, and other characteristics such as operating system and version, programming language used, source file identification and version, and object file identification and version

(c) physical location of the master software or data and the DAI of the repository having custody of the master software programs or data required to program items

(d) detailed instructions needed to load software into an item

(e) acceptance requirements in the form of a test procedure or checksum

(f) altered item identification marking requirements

15.10.5 Software Item Identification Drawing (SIDD)

15.10.5.1 Description. An SIDD provides item identification for application level callout (i.e., drawing/model and associated lists/records). It enables distinct identification of executable software units produced for different computer hardware and permits easy reidentification of software that is updated for changed functionality, enhanced performance, or elimination of errors.

An SIDD can be used for identifying software units or configuration items, firmware program code, and configuration files for field programmable gate arrays (FPGA) and similar applications.

A typical SIDD for software units may contain

(a) a listing of software components by description, identifiers, and associated metadata, including checksum information

(b) compiler, interpreter, assembler, or linker identifiers, when required

(c) the resulting software release number

(d) the software part or identifying number consisting of the software drawing number plus suffix ("dash number")

(e) the associated version description document (VDD) by number and issue/revision

See Figure 15.10.5.1-1 for an example of an SIDD.

15.10.5.2 Application Guidelines. An SIDD is prepared when a single, unique identification is required to distinguish different executable software releases at application level. As described in para. 4.6, the contents of an SIND may be merged with an SIDD when suitable and as applicable. The drawing title/item name should include a noun or noun phrase such as "Software...," "Firmware Program Code...," or "Configuration File..."

15.10.5.3 Requirements. An SIDD shall contain but not be limited to the following:

(a) PIN of executable release (load)

(b) software release number

(c) software component name, identifier, description, version/build number (if not part of identifier or description), and checksum (hexadecimal, bytesum)

(d) VDD number (or similar) with issue status

(e) identification requirements for both the software header and the electronic media (when used)

(f) conformance inspection requirements

(g) reference to the applicable SIND when required and when not part of the SIDD

(h) the notation SOFTWARE ITEM IDENTIFICATION DRAWING above the title block (regardless of the specific application)

NOTE: For application other than software (e.g., firmware program code), replace the term "software" with the applicable terminology.

15.11 Alternate Parts Drawing

15.11.1 Description. The alternate parts drawing discloses parts, assemblies, materials, or processes that may be interchangeable on an unlimited basis for any application in past, present, or future use. See Figure 15.11.1-1 for an example of an alternate parts drawing. An alternate parts drawing provides a cross-reference listing of items that

(a) possess such functional and physical characteristics as to be equivalent in performance, reliability, and maintainability to another item of similar or identical purpose

(b) are capable of being exchanged for the other item

(1) without selection for fit or performance

(2) without alteration of the items themselves or of adjoining items, except for adjustment

The alternate parts drawing may be invoked via direct reference on a drawing or parts list, or within a referenced specification. Alternate parts drawings do not create item identification but merely provide a suitable cross-reference to interchangeable parts, materials, or processes. As an option, the listing of alternate parts may also be accomplished within a controlled database without the need of creating a drawing.

15.11.2 Application Guidelines. An alternate parts drawing is prepared to

(a) provide a listing of parts, materials, or processes that can be interchanged on assemblies without further consideration

(b) eliminate the need for costly and continual design changes to drawings and parts lists where newer, interchangeable items are available

(c) provide users with guidance and authorization to interchange items on an as-needed basis

(d) provide a method to implement across-the-board, systematic changes due to procurement difficulties

15.11.3 Requirements. The alternate parts drawing shall include, as applicable, the following:

(a) a listing of the required item, its PIN and part name, and the alternate PIN(s) and part name(s). This may be set up in a column or table format for ease of reading and use.

(b) any applicable drawing notes needed for explanations, references, etc.

All uses of the drawing within the design activity shall allow the use of the interchangeable item. The item to be interchanged shall not affect form, fit, function, or performance.

16 LAYOUT DRAWING

16.1 Description

A layout drawing depicts design development requirements. It is similar to a detail, assembly, or installation drawing, except that it presents pictorial, notational, or dimensional data to the extent necessary to convey the design solution used in preparing other engineering drawings. Except as specified in para. 16.3(k), a layout drawing does not establish item identification. See Figure 16.1-1 for an example of a layout drawing.

16.2 Application Guidelines

A layout drawing may be prepared for a complete end product or any portion thereof and is prepared as one of the following:

(a) a conceptual design layout to present one or more solutions for meeting the basic design parameters and provide a basis for evaluation and selection of an optimum design approach

(b) a design approval layout to present sufficient detail of the design approach for cost estimating and design approval

(c) a detailed design layout depicting the final development of the design in sufficient detail to facilitate preparation of detail and assembly drawings

(d) a geometric study to develop movement of mechanical linkages, clearances, or arrangements

A layout is not normally used to fabricate equipment; however, a detailed design layout is sometimes used as an interim assembly drawing for development equipment.

16.3 Requirements

A layout drawing shall include, as applicable, the following:

(a) location of primary components

(b) interface and envelope dimensions including a cross-reference to applicable interface documentation

(c) paths of motion

(d) operating positions

(e) critical fits and alignments

(f) selected materials, finishes, and processes

(g) wire, pneumatic, and hydraulic routing and sizes

(h) adjustments

(i) critical assembly details and sequence

(j) identification for selected purchased items and new design items

(k) identification for the assembly depicted (when the layout is used as an interim assembly drawing)

A layout shall be drawn to scale with sufficient accuracy and completeness for its intended use.

17 DRAWING TREE

17.1 Description

A drawing tree is a block diagram or indented list that identifies all drawings applicable to an end item or program. It illustrates the next higher and subordinate relationships that exist between those drawings. This is typically shown as a graphical representation of drawings linked in a hierarchical order beginning with the top assembly and ending at the lowest level assembly or the lowest item similar to what is shown in Figure 17.1-1. These drawings are listed so that the relationship of each drawing can be established in the assembly structure.

17.2 Application Guidelines

A drawing tree may, as applicable,

(a) represent the entire product design showing relationships of parts and assemblies, thus serving as a starting point from which specific tasks can be identified and monitored

(b) clarify to the various engineering design organizations what should be developed and documented and where it fits in the overall tree

(c) clarify the specific interfaces and their relationships and help identify the need for controls

(d) provide the basis for the development of a work breakdown structure (WBS)

(e) provide a basis for developing a manufacturing plan, test plan, quality plan, logistics plan, configuration management plan, maintenance plan, etc.

(f) provide a basis for scheduling design and development efforts, releases, manufacturing, testing, procurement, etc.

(g) provide a basis for developing traceability and serialization requirements

(h) aid in providing a scope to the size of a product effort in concise format

(i) provide a ready reference in assessing the impact of a proposed change

(j) provide the customer with definition, scope, and control information

(k) provide configuration structure options within a product

17.3 Requirements

The drawing tree shall be structured in hierarchical order beginning with the assembly drawing for the end item and ending at the lowest level of assembly or the lowest item. Each drawing included on the drawing tree shall be shown as an individual block or as an individual entry on the indented list. Each authorized variation in configuration of the end item should be identified by a separate drawing tree. Only drawings should be included on a drawing tree.

17.3.1 Mandatory Entries. Each block or individual entry on the indented list shall include as a minimum drawing number and drawing title. See Figure 17.3.1-1 for an example of a mandatory block entry.

17.3.2 Optional Entries. Optional items that should be added to the block or individual entry on the indented list, depending on the intended use, include

(a) DAI, if not the same as the one applicable to the drawing tree

(b) drawing status (e.g., released or unreleased)

(c) drawing size

(d) change authority number

(e) the drawing WBS identifier

(f) reference designations when applicable at all levels where assigned

See Figure 17.3.2-1 for an example of a block entry that includes optional entries.

Figure 5.4-1 Monodetail Drawing

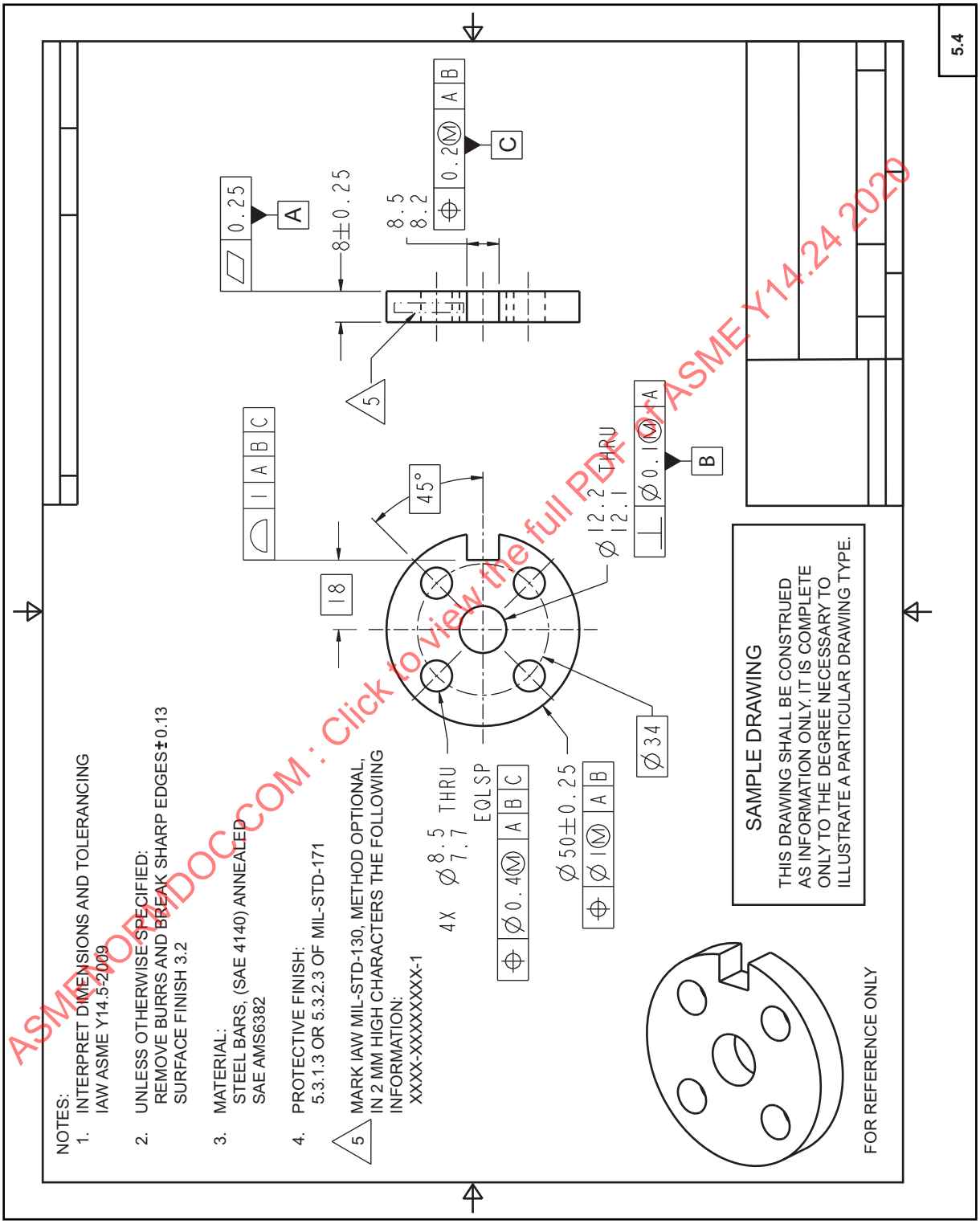


Figure 5.4-2 Monodetail Tabulated Drawing

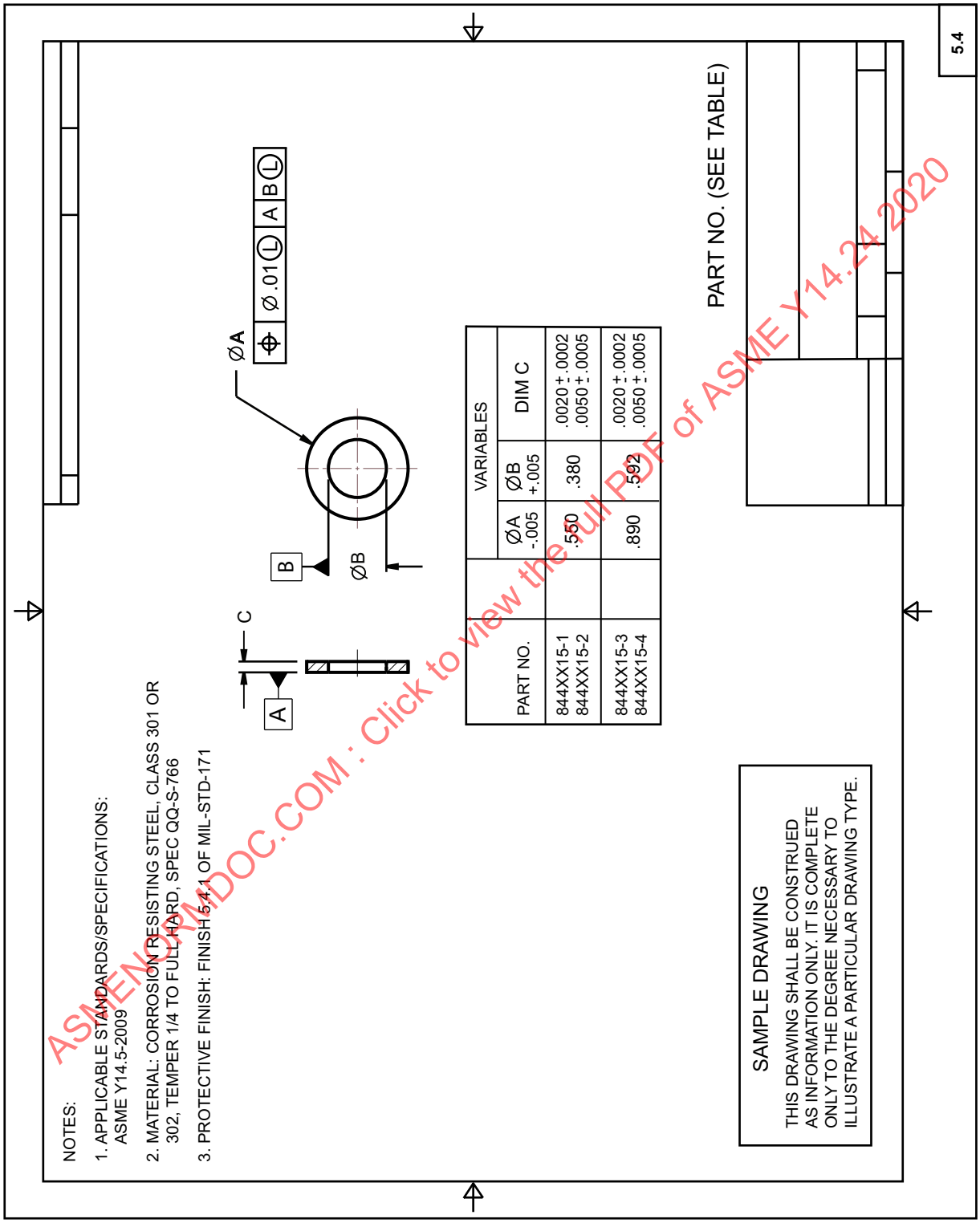


Figure 5.4-3 Monodetail 3D Model Annotation

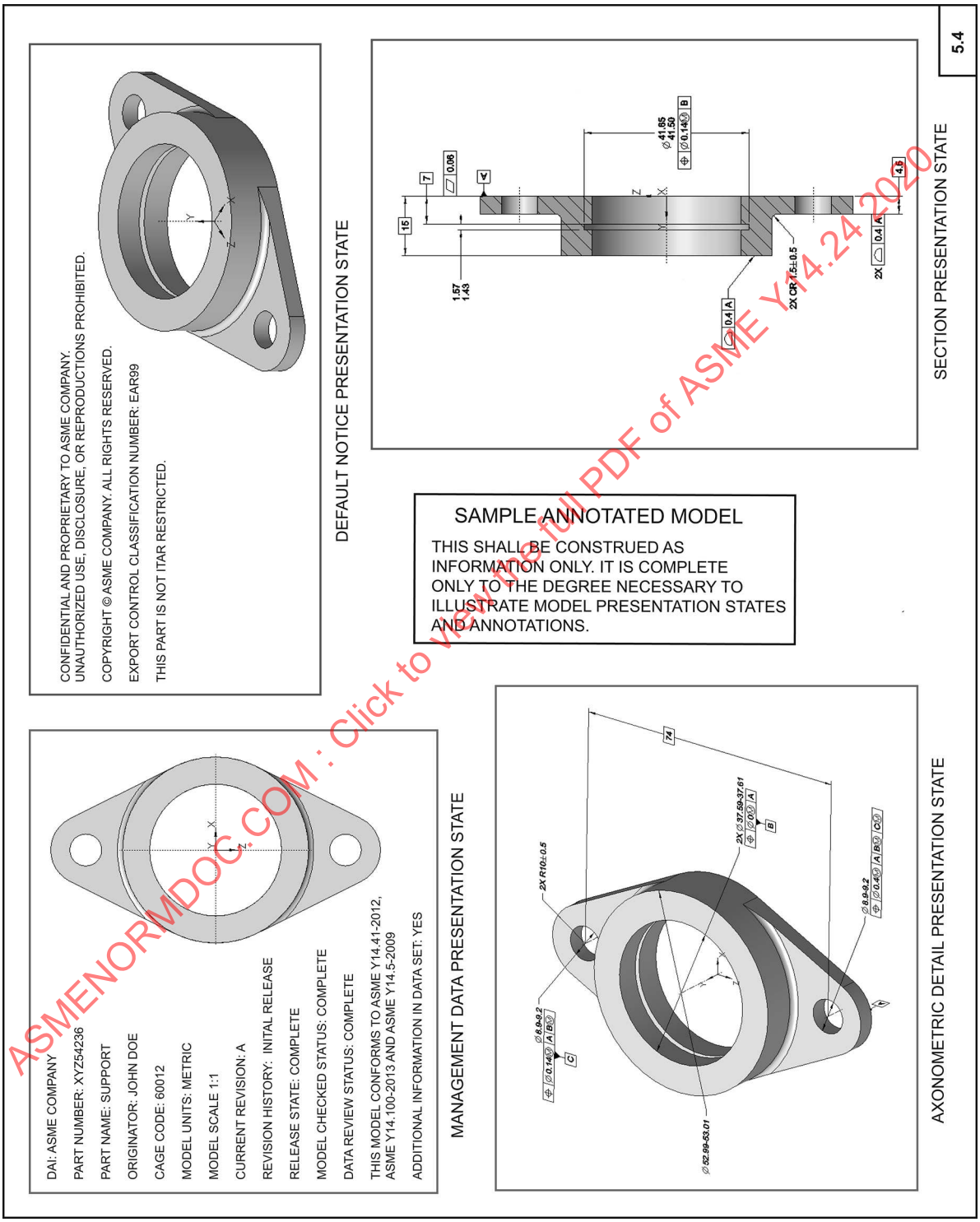


Figure 5.5.1-1 Multidetail Drawing

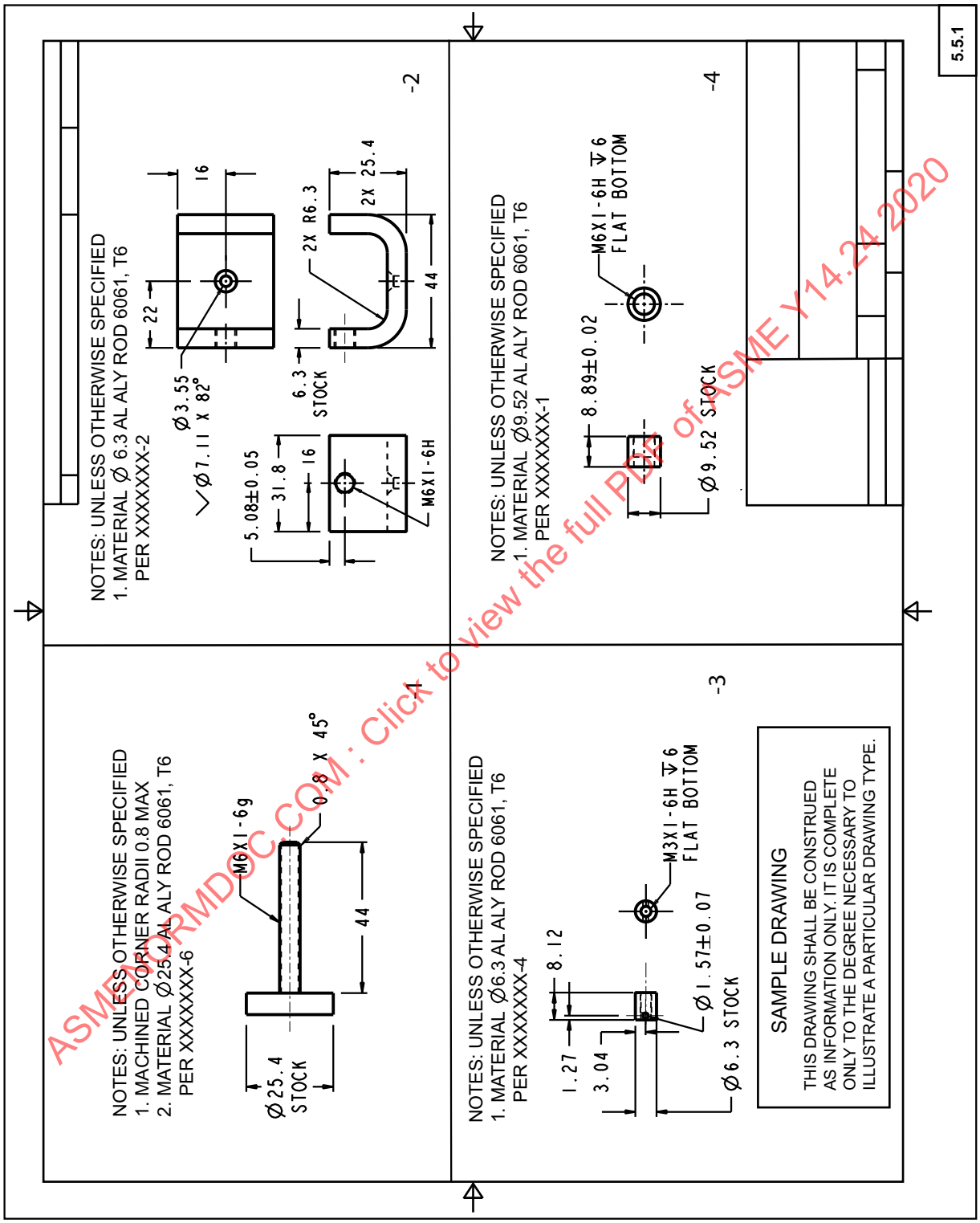


Figure 6.1.1-1 Assembly Drawing

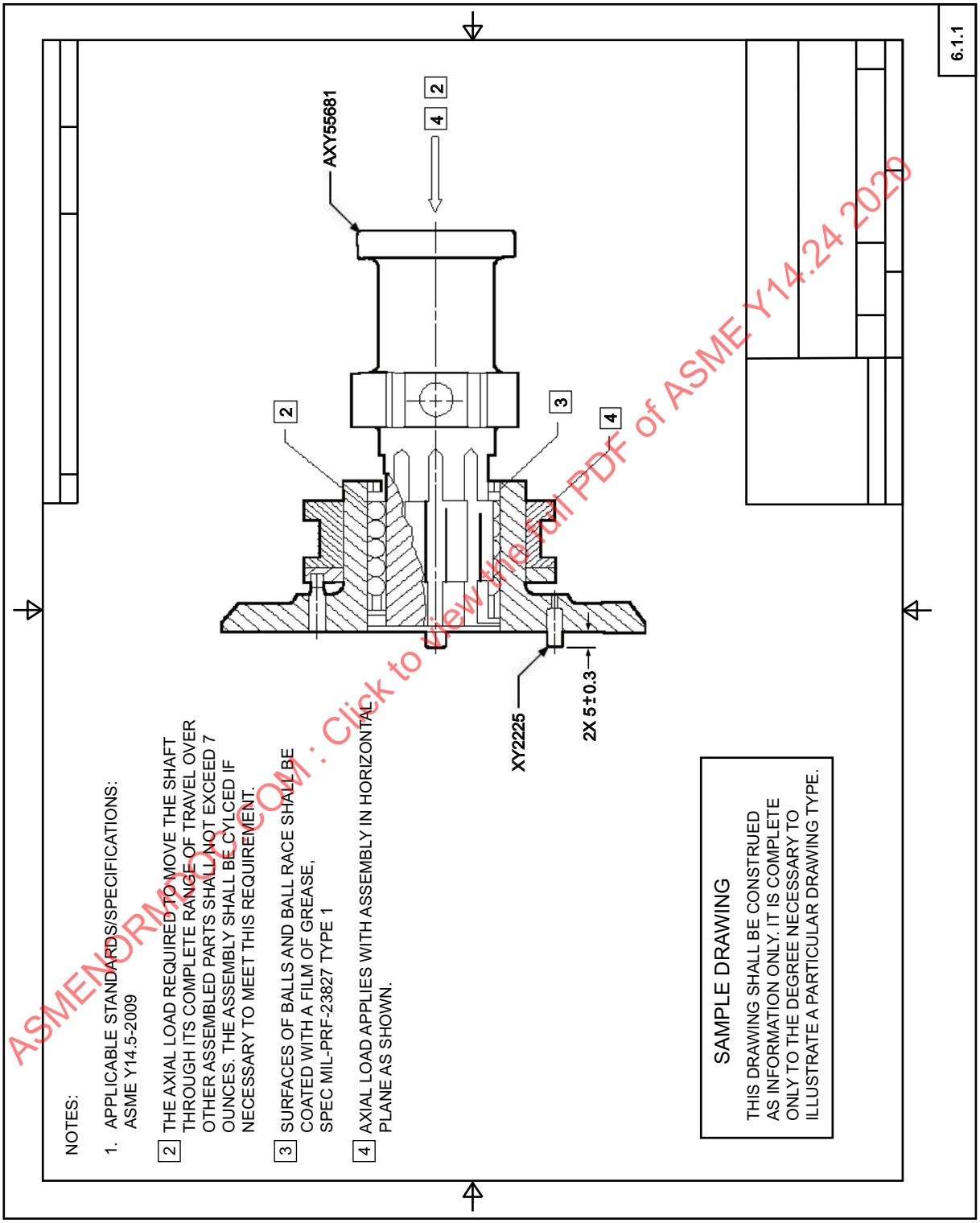
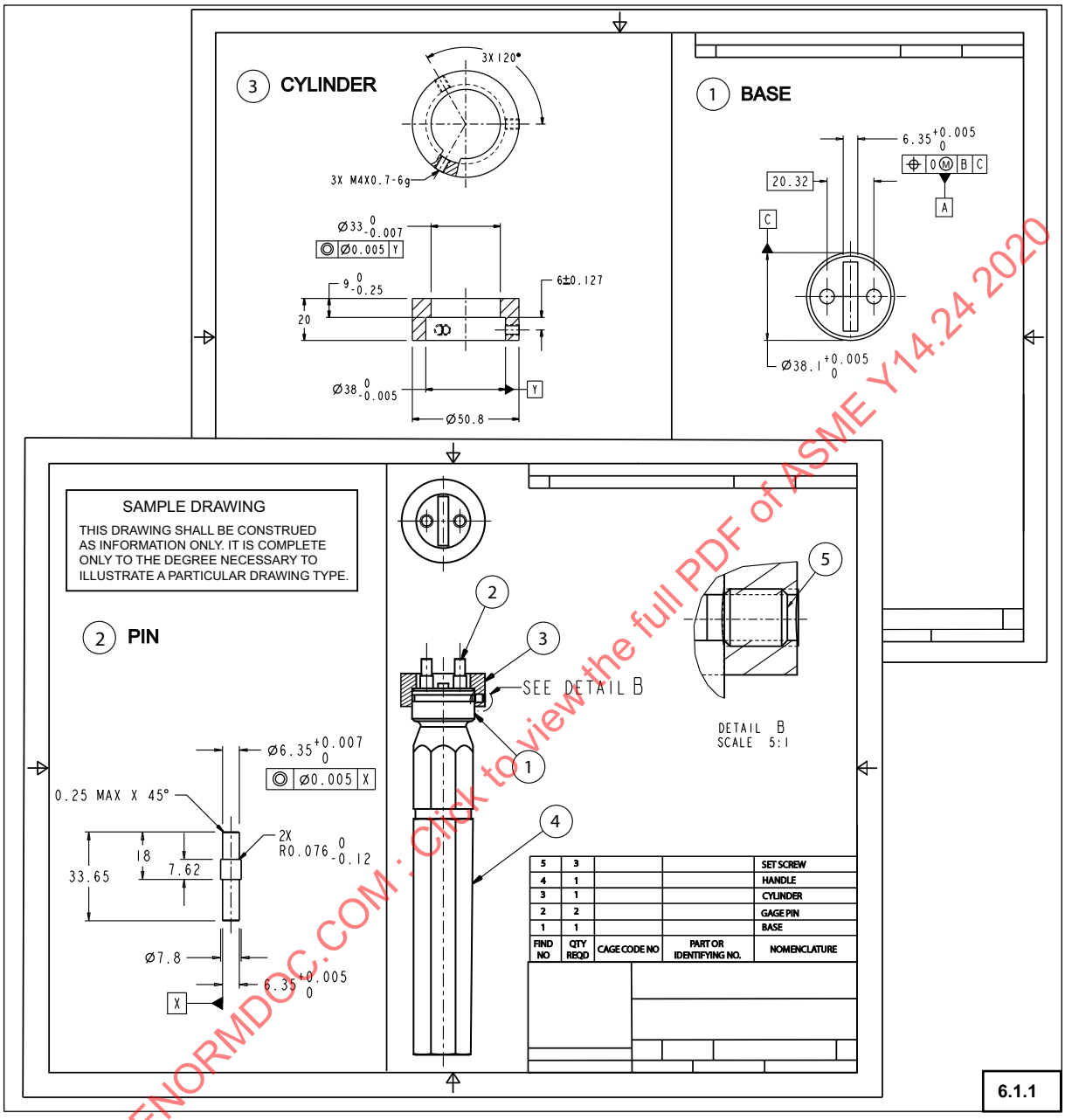


Figure 6.1.1-2 Detail Assembly Drawing



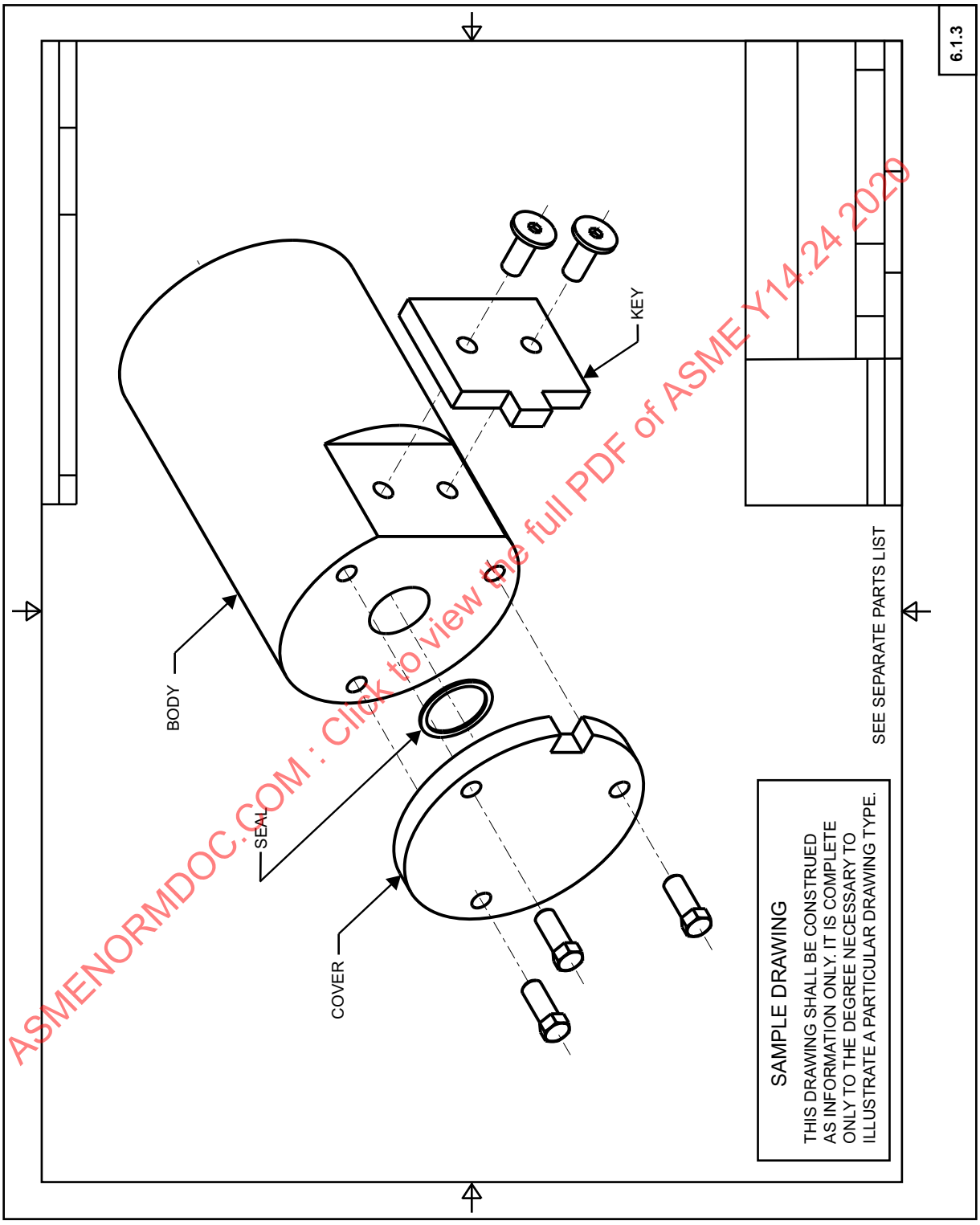


Figure 6.1.3-1 Exploded View Assembly Drawing

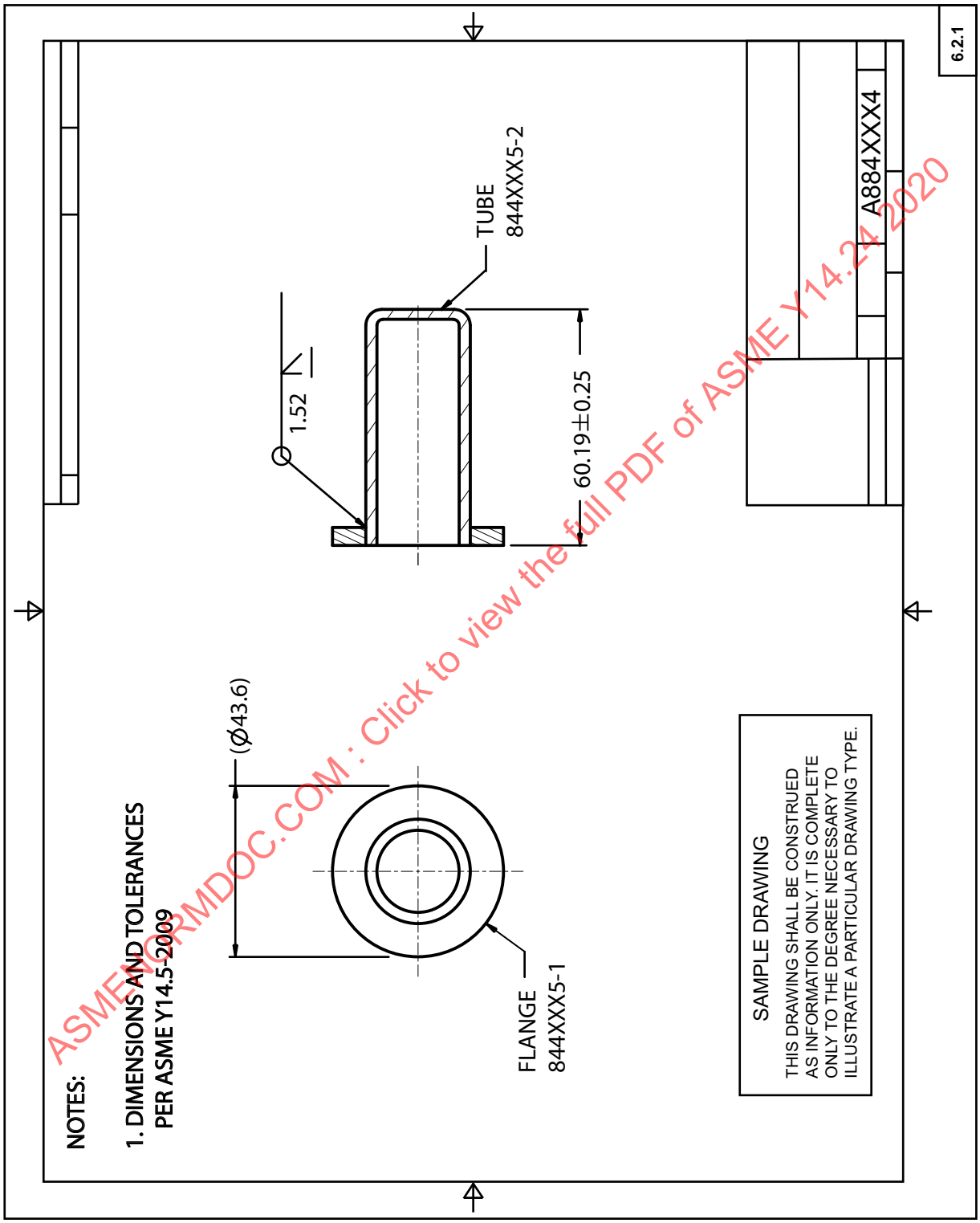


Figure 6.2.1-1 Inseparable Assembly Drawing

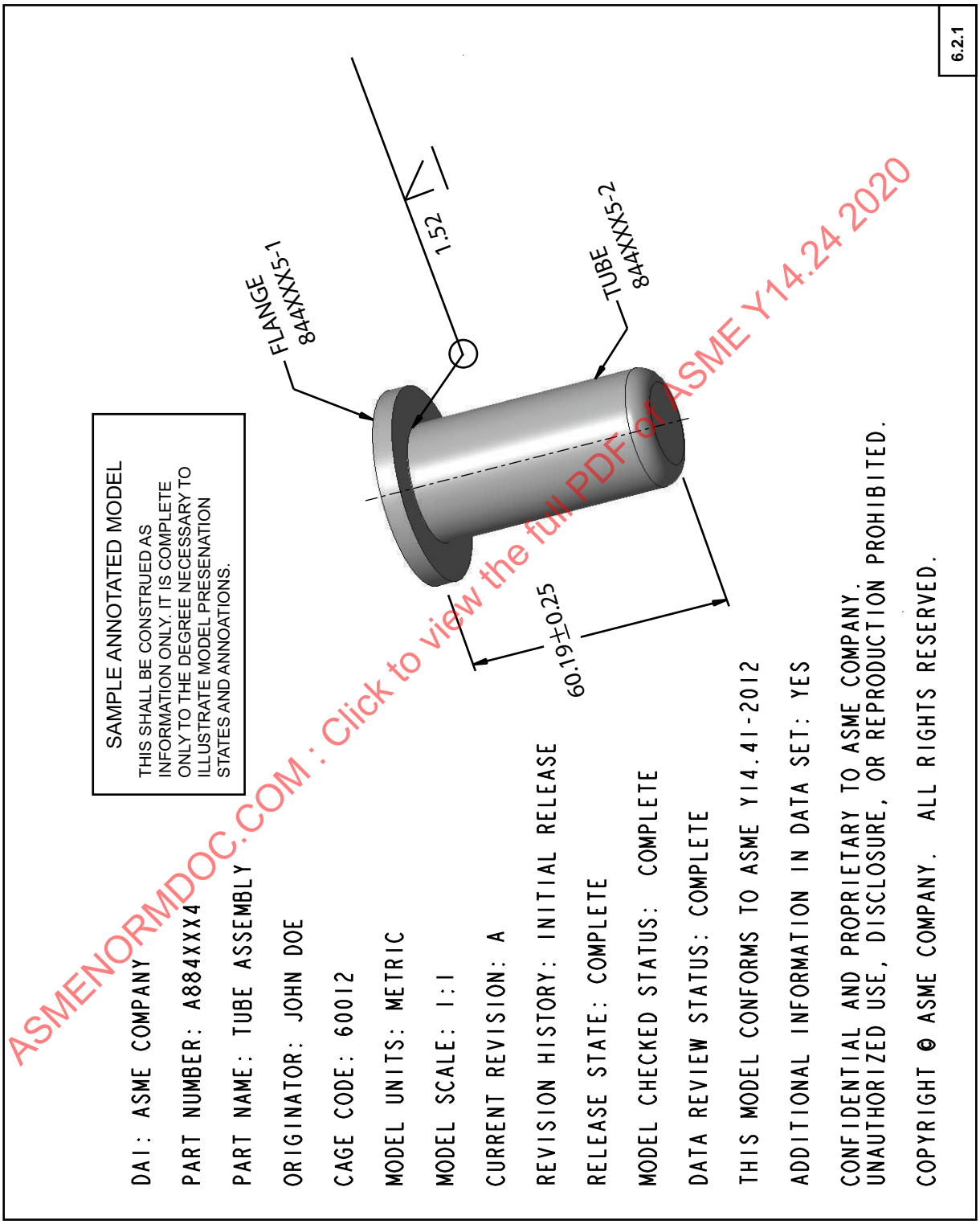


Figure 6.2.1-2 Inseparable Assembly 3D Model Annotation

Figure 7.1-1 Relationship Structure of Installation Drawings (Depicting Work Packages)

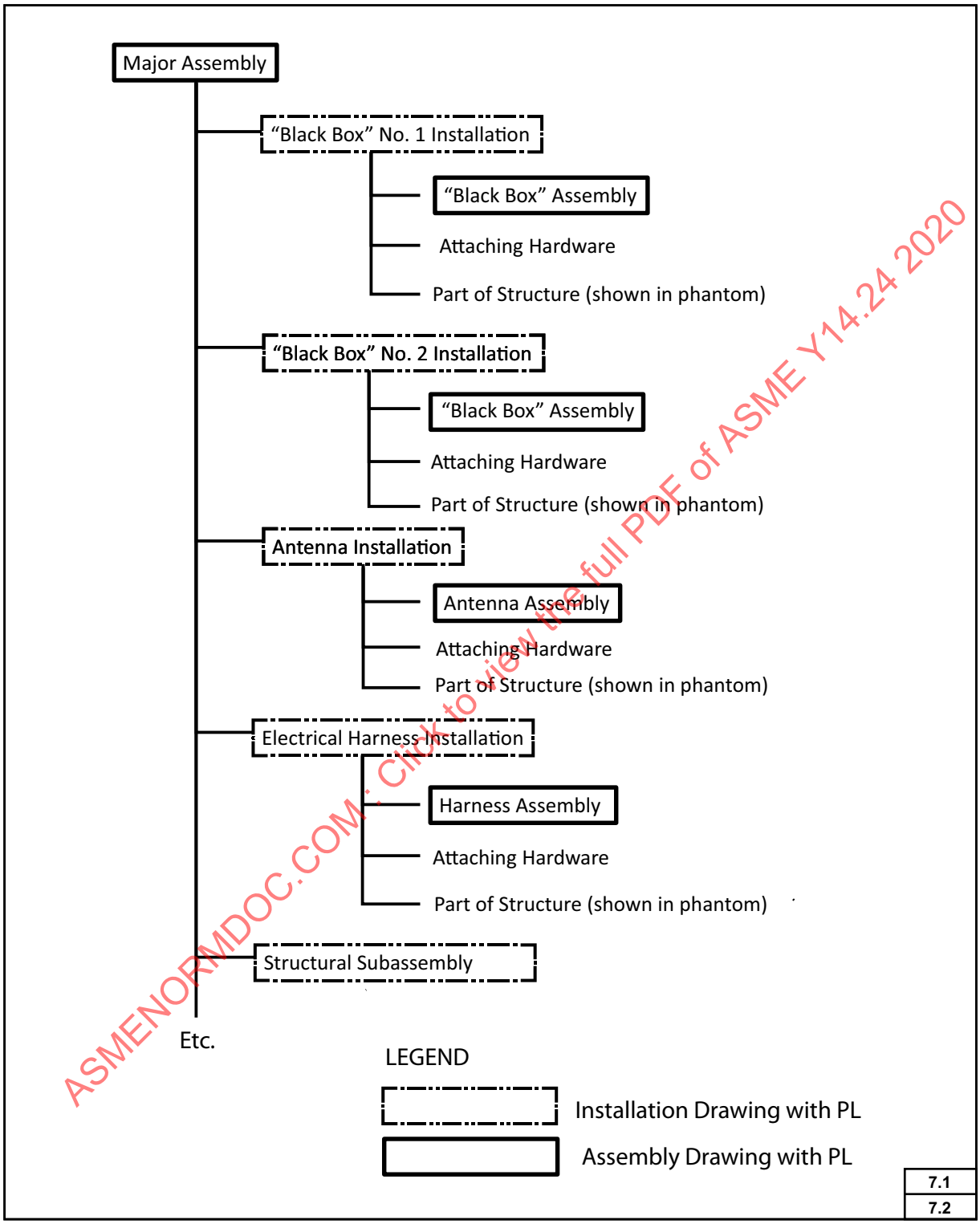
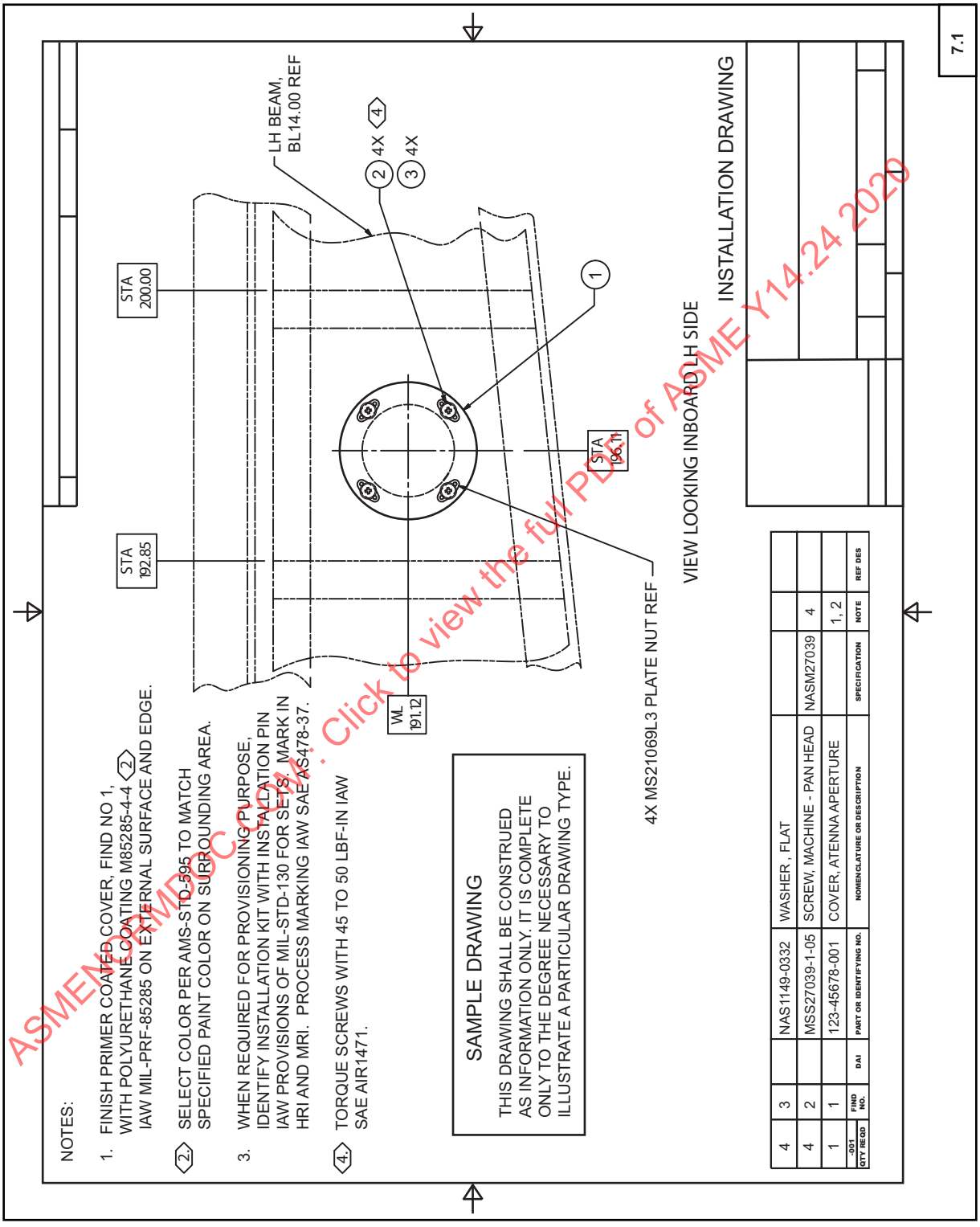


Figure 7.1-2 Installation Drawing



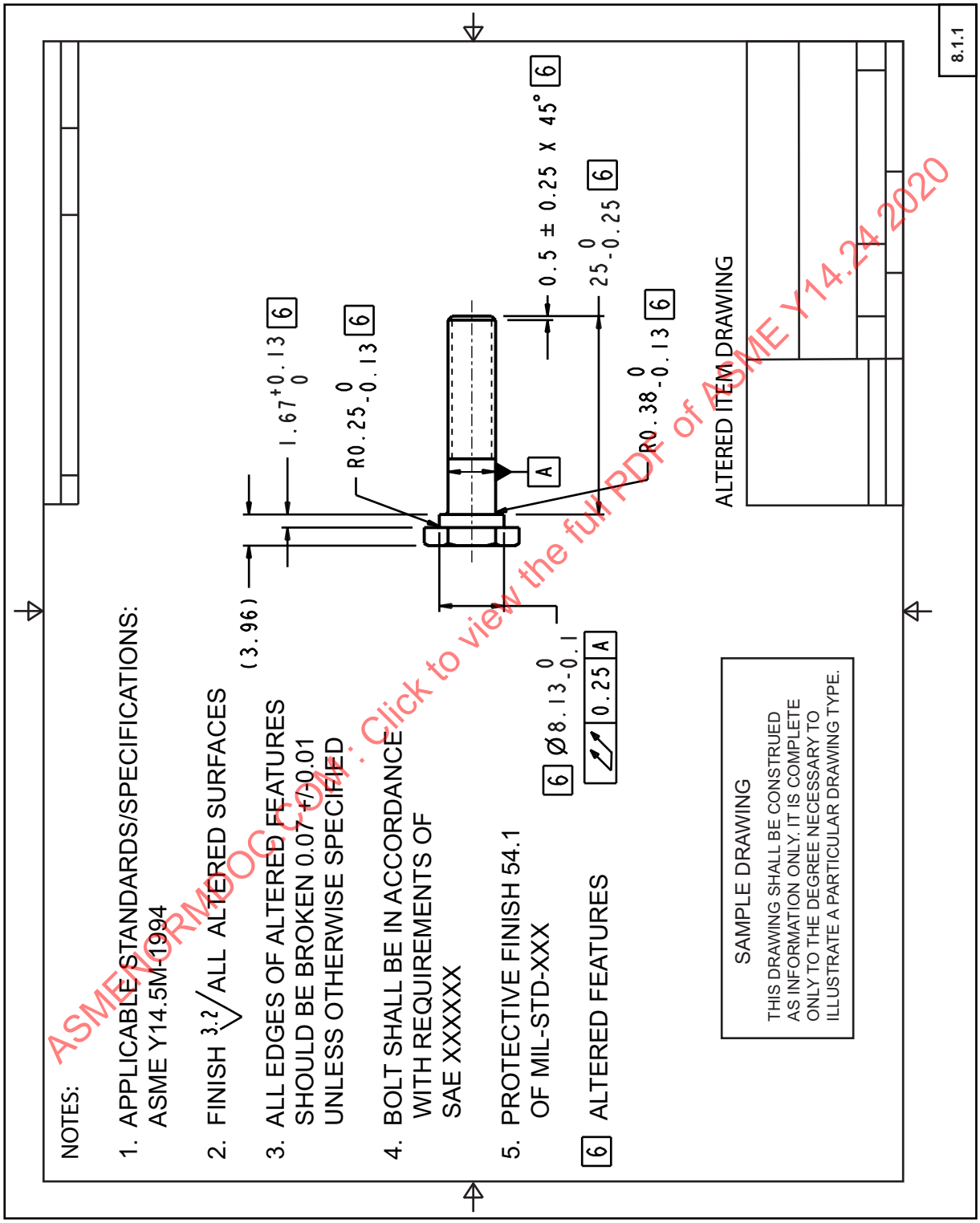
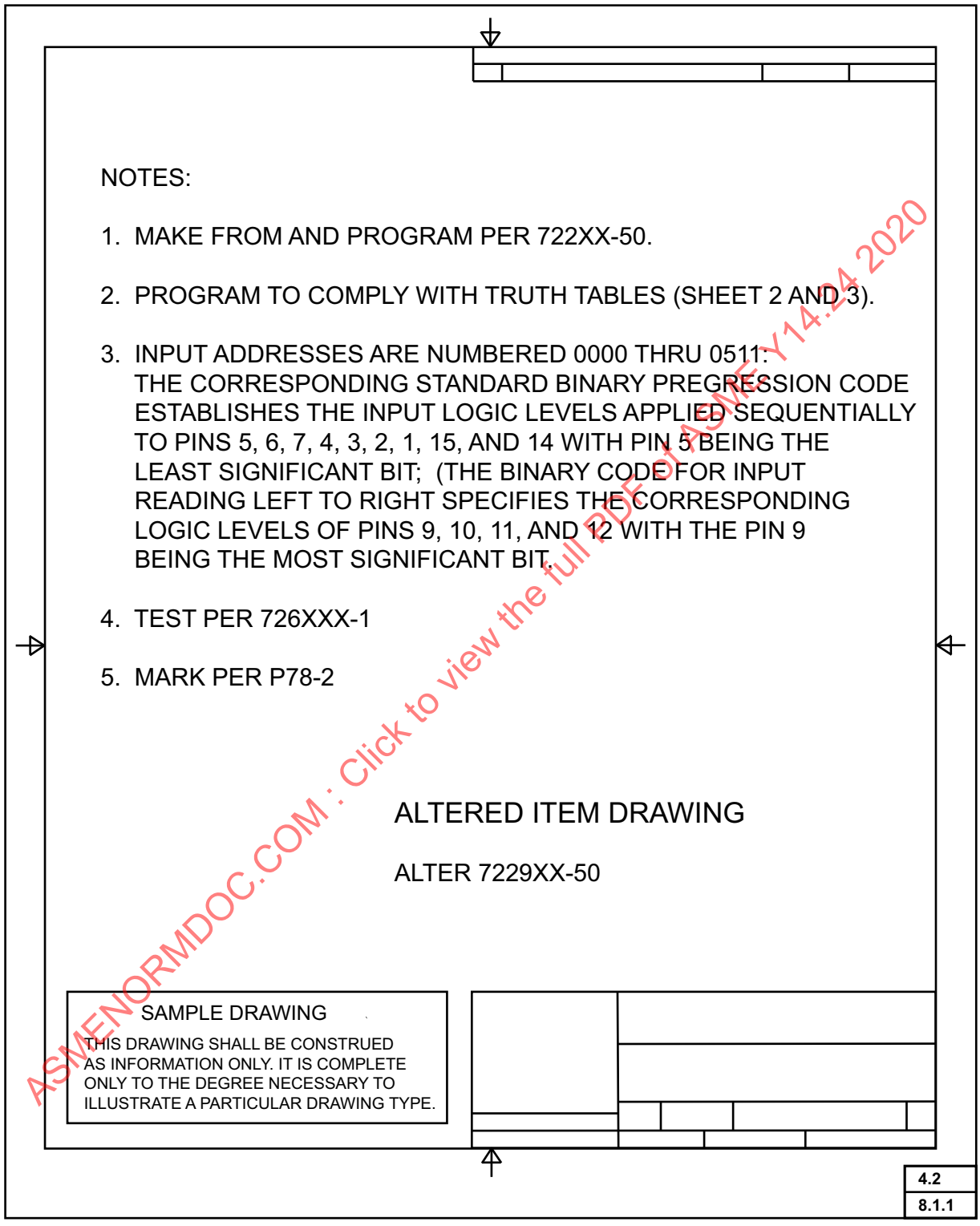


Figure 8.1.1-1 Altered Item Drawing (Mechanical Alteration)

Figure 8.1.1-2 Altered Item Drawing (Electrical Alteration)



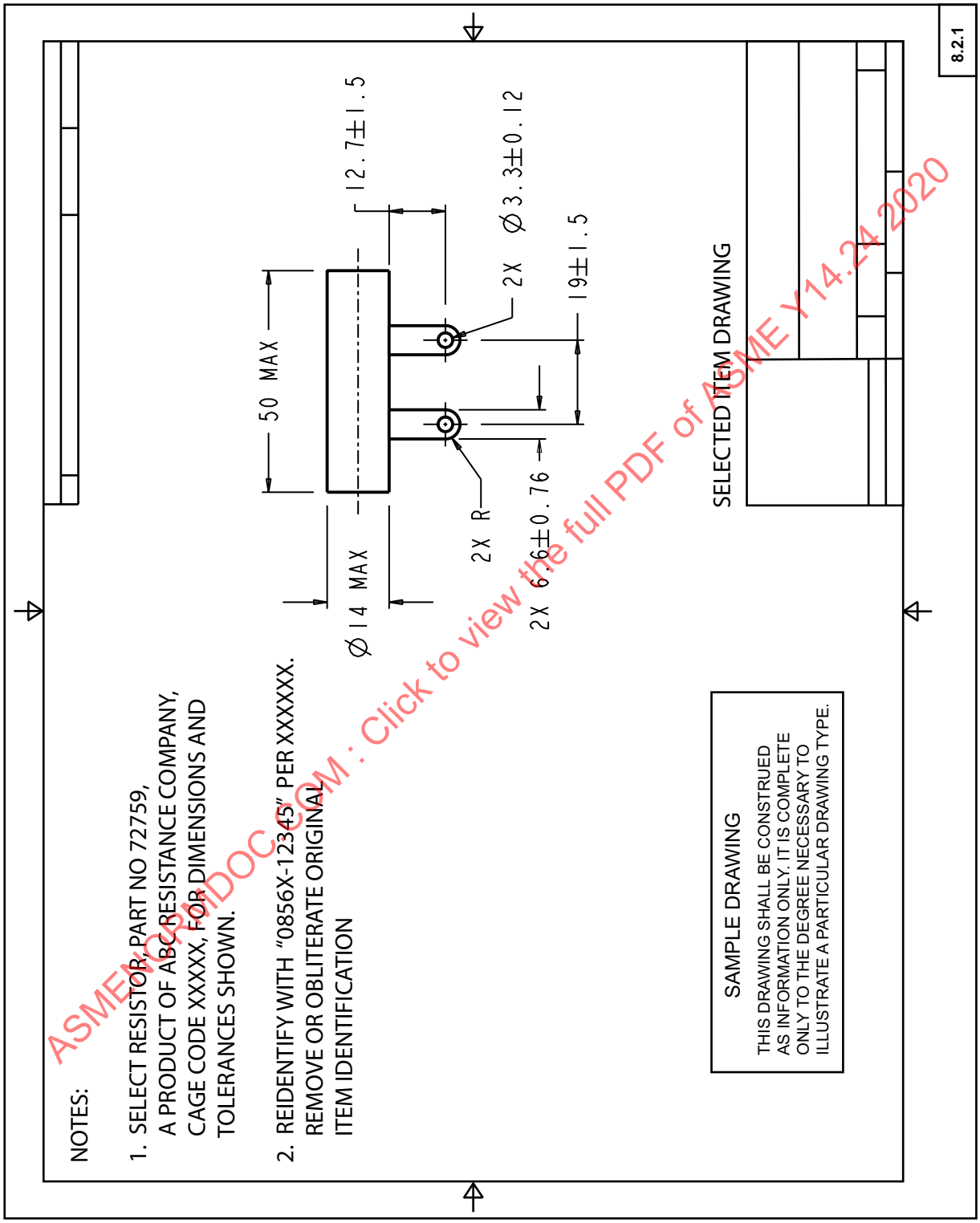
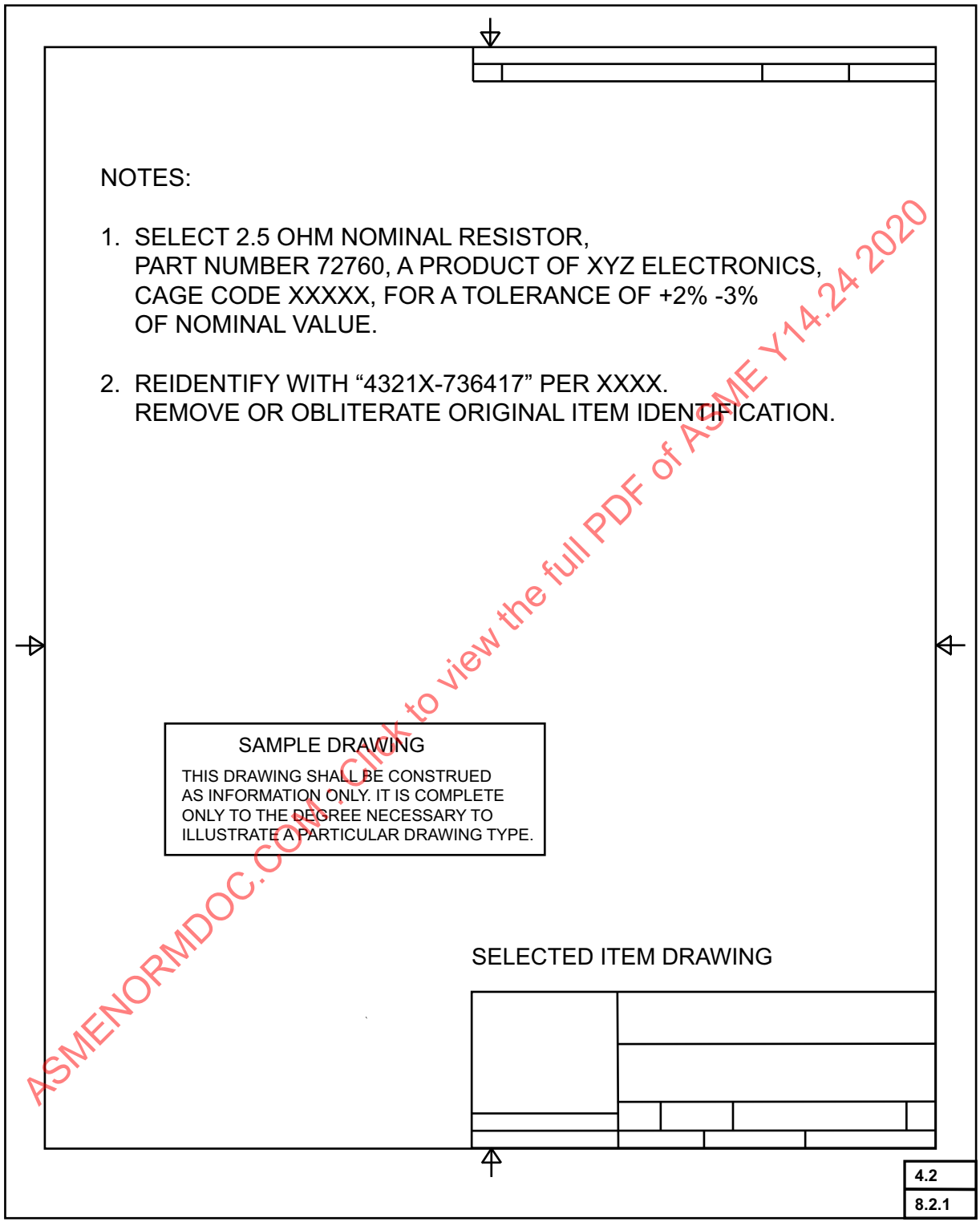


Figure 8.2.1-1 Selected Item Drawing (Mechanical Selection)

Figure 8.2.1-2 Selected Item Drawing (Electrical Selection)



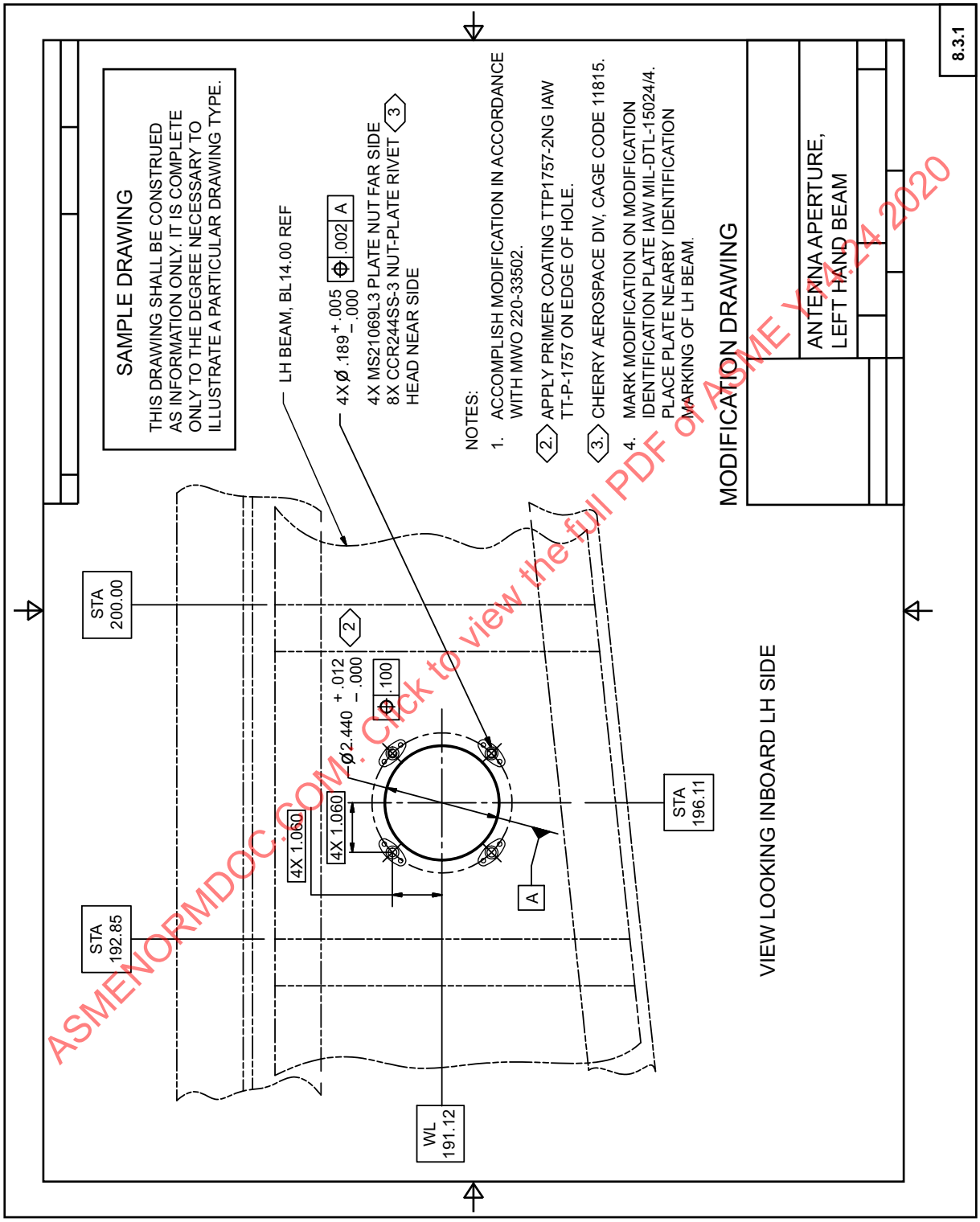
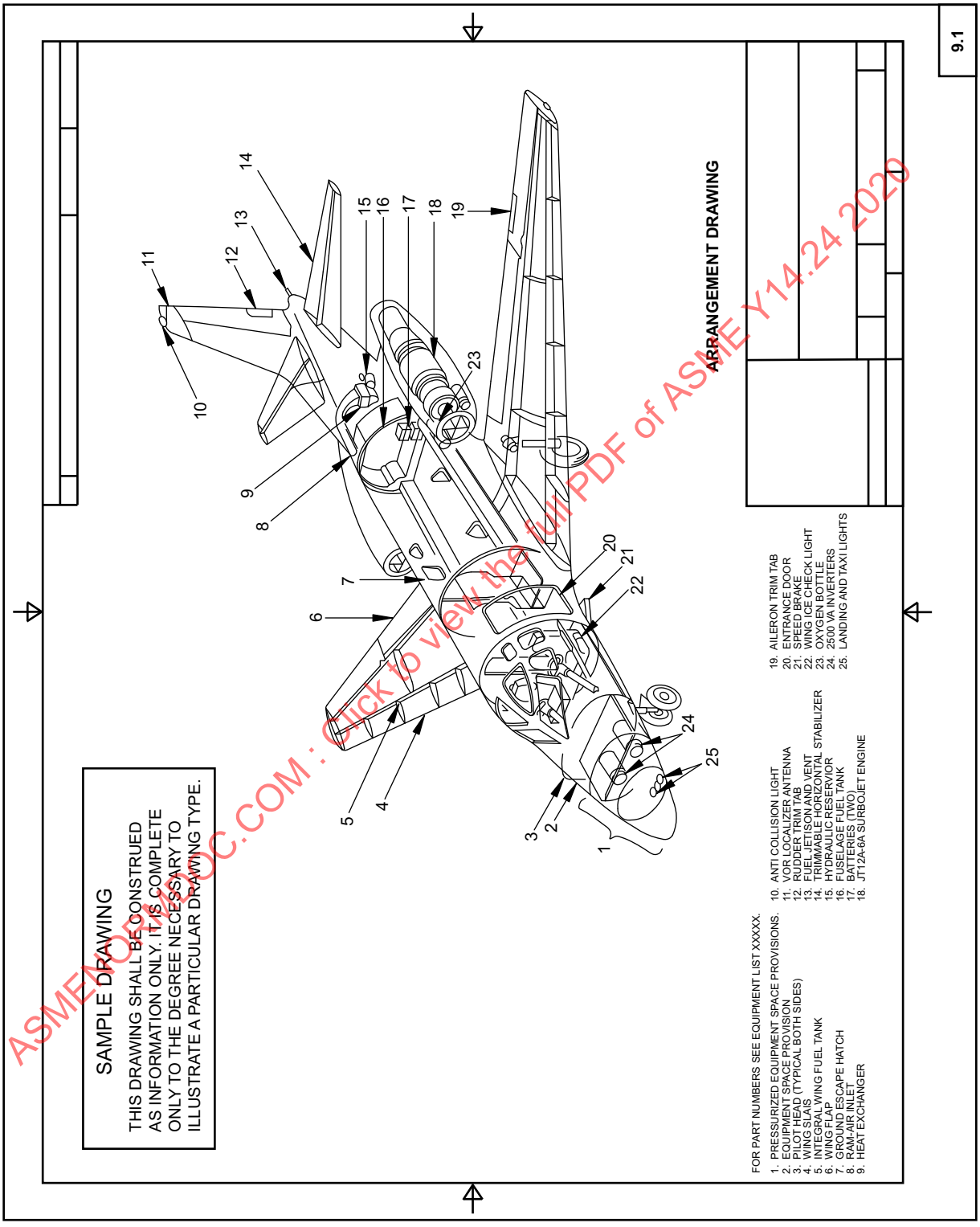


Figure 8.3.1-1 Modification Drawing

Figure 9.1-1 Arrangement Drawing (Pictorial)



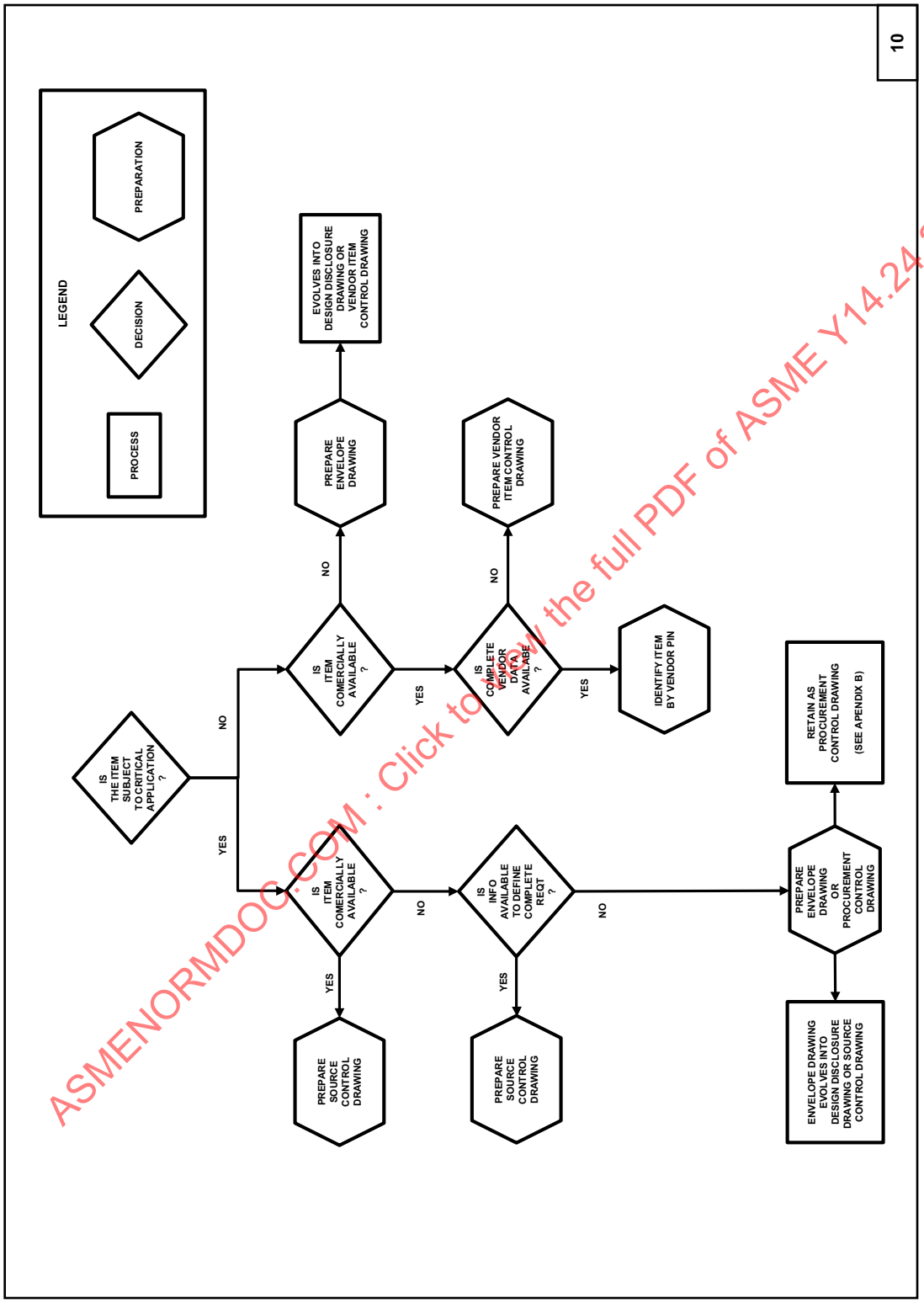


Figure 10-1 Control Drawing Decision Chart (Aid in Selecting the Appropriate Control Drawing Type)

Figure 10.1.1-1 Vendor Item Control Drawing

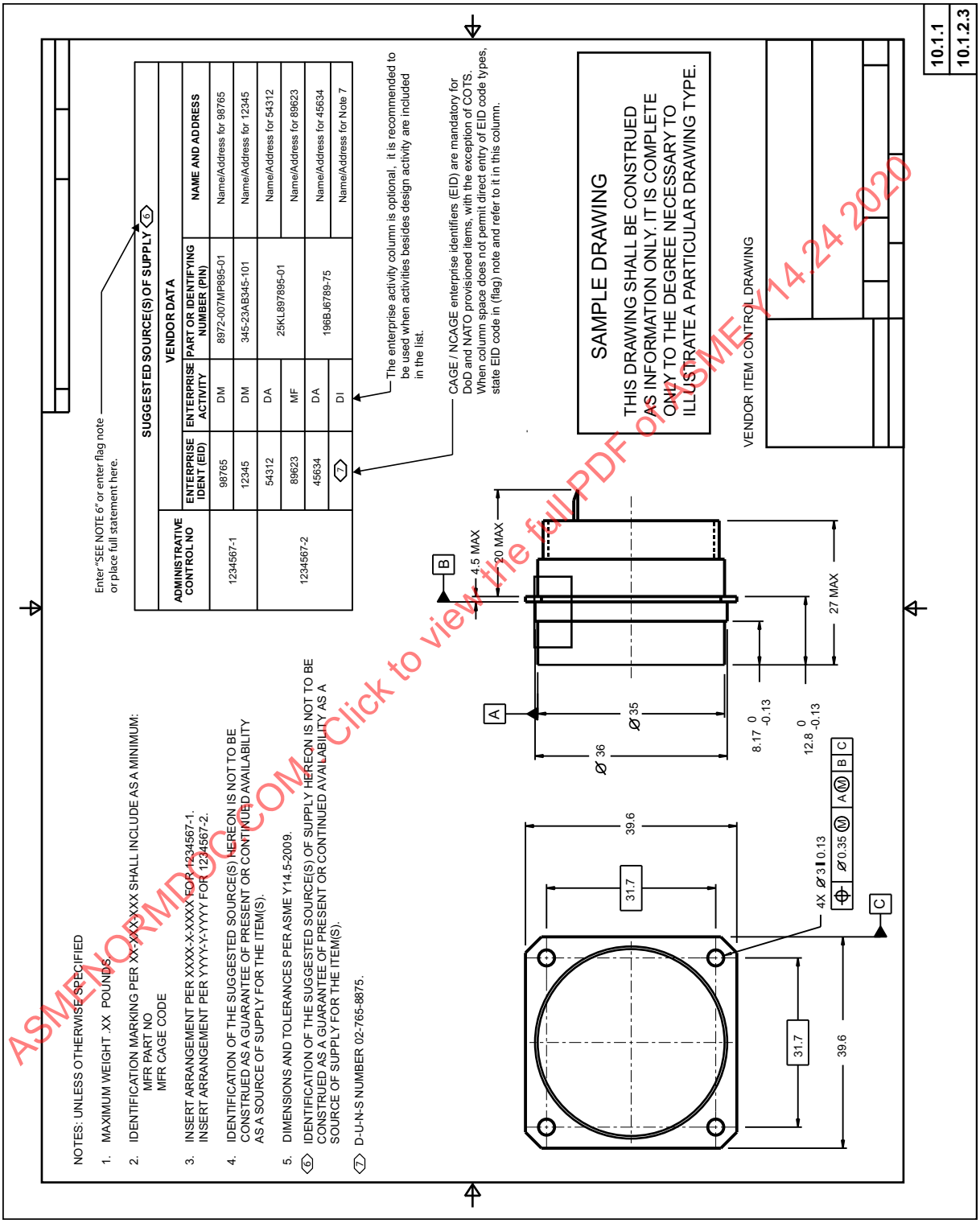


Figure 10.2.1-1 Source Control Drawing

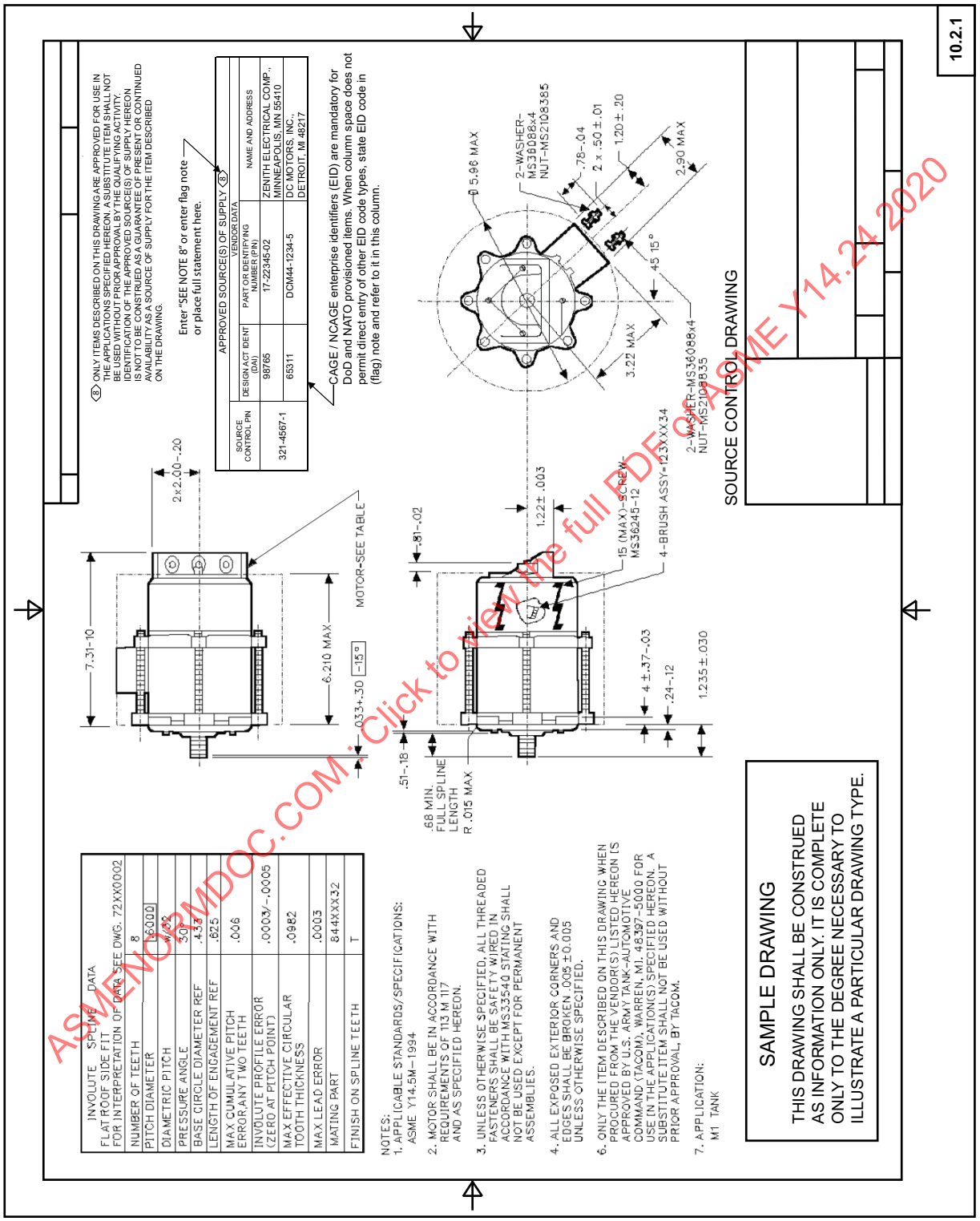


Figure 10.3.1-1 Envelope Drawing

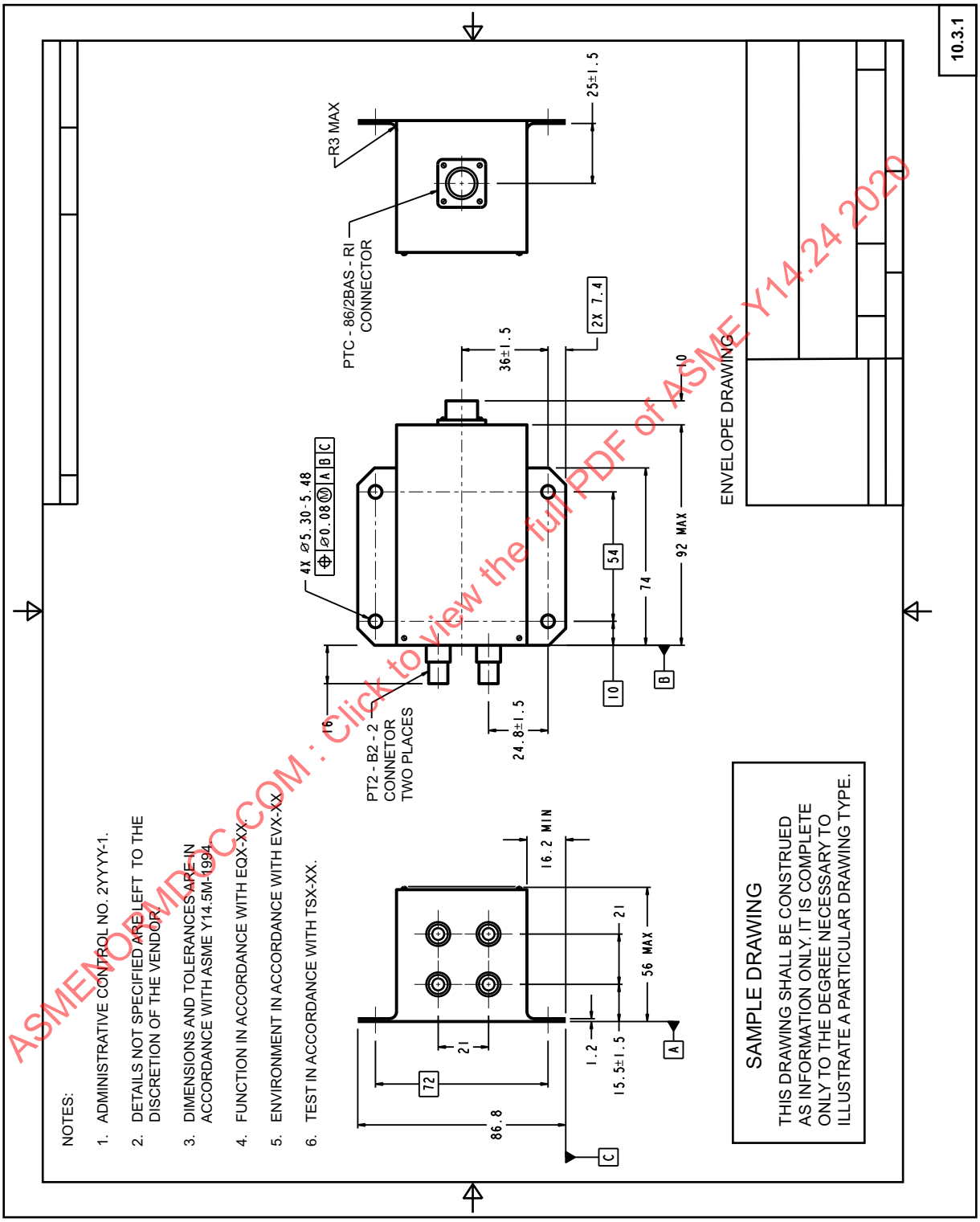


Figure 11.1-1 Interface Drawing

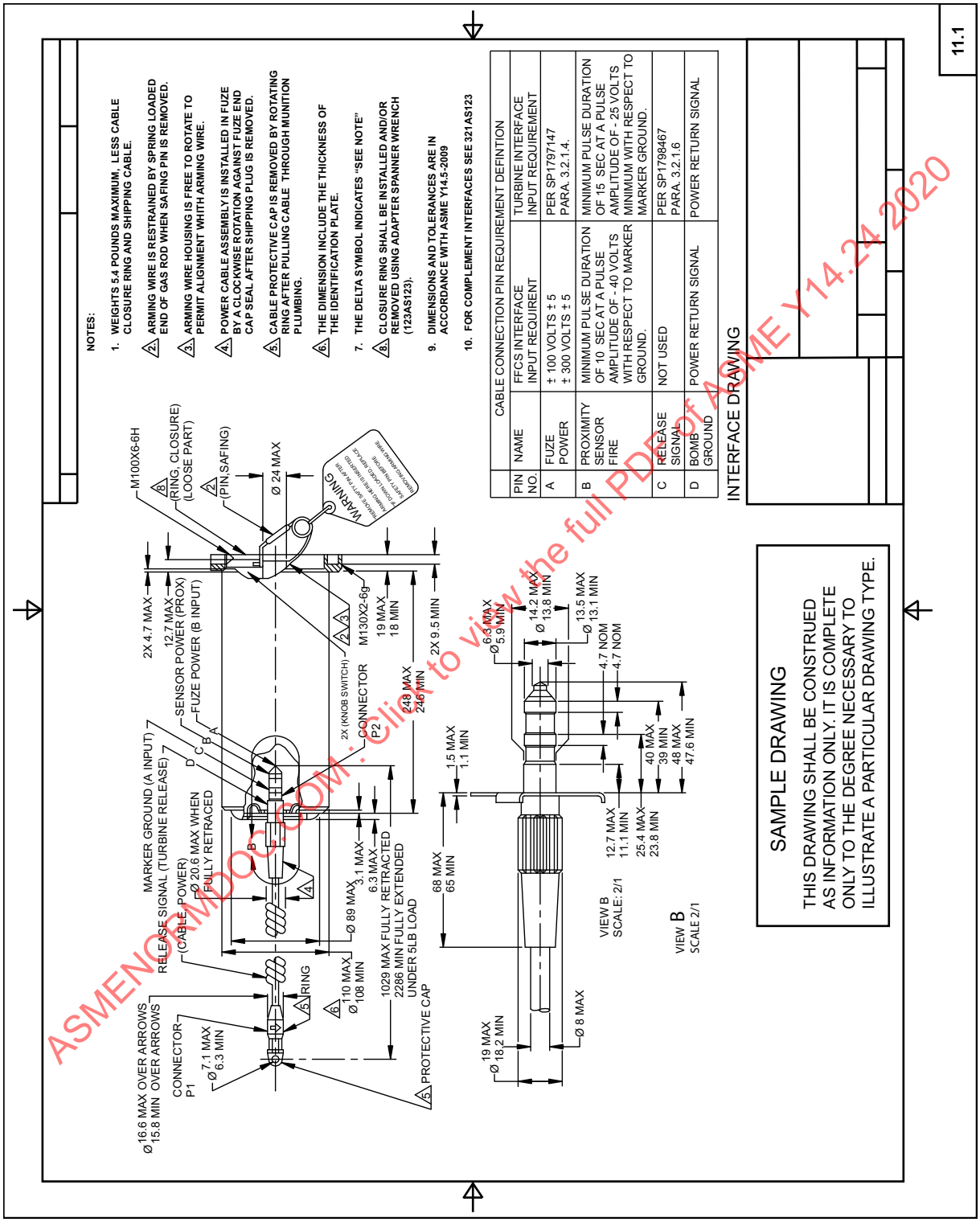


Figure 12.1-1 Identification Cross-Reference Drawing

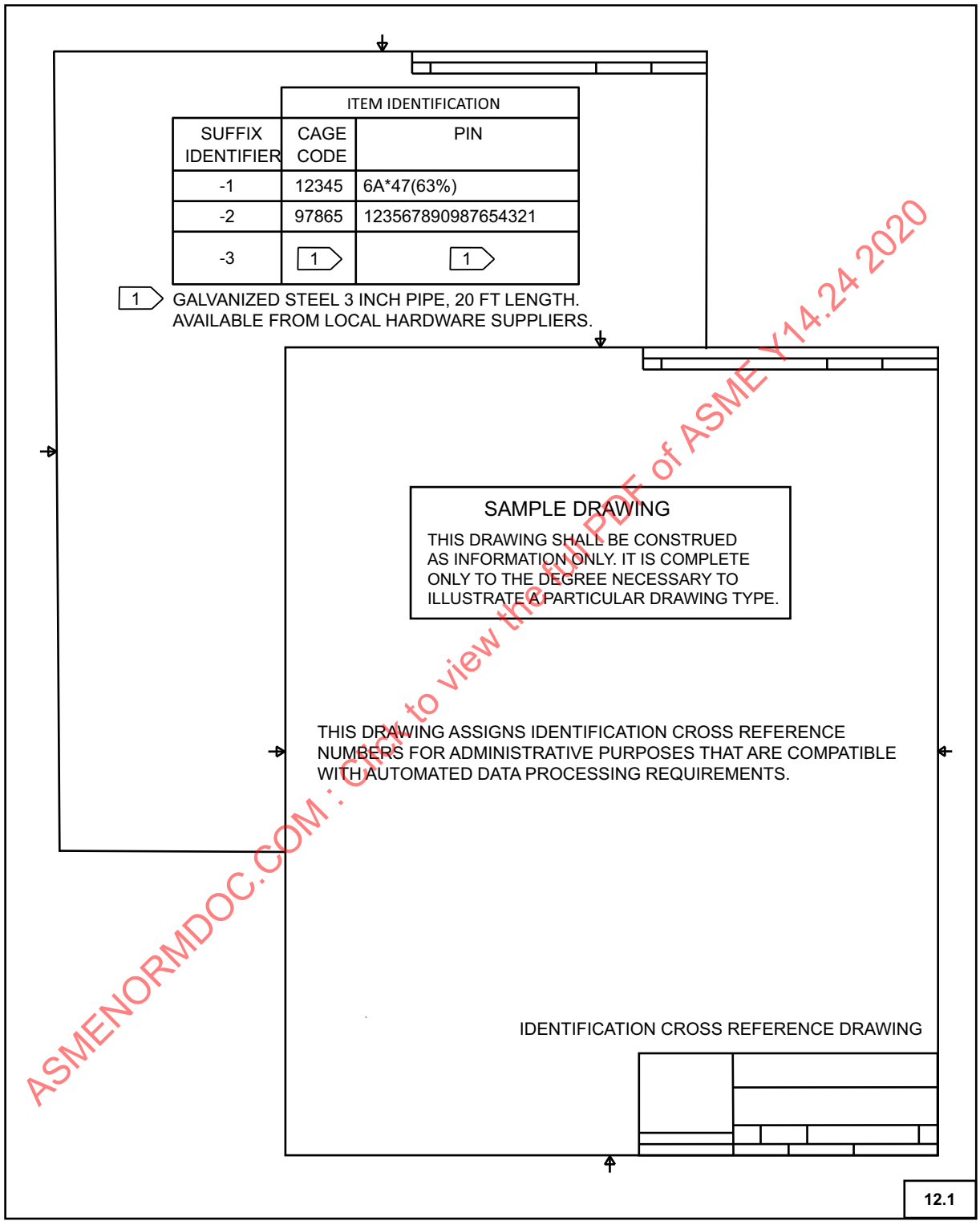
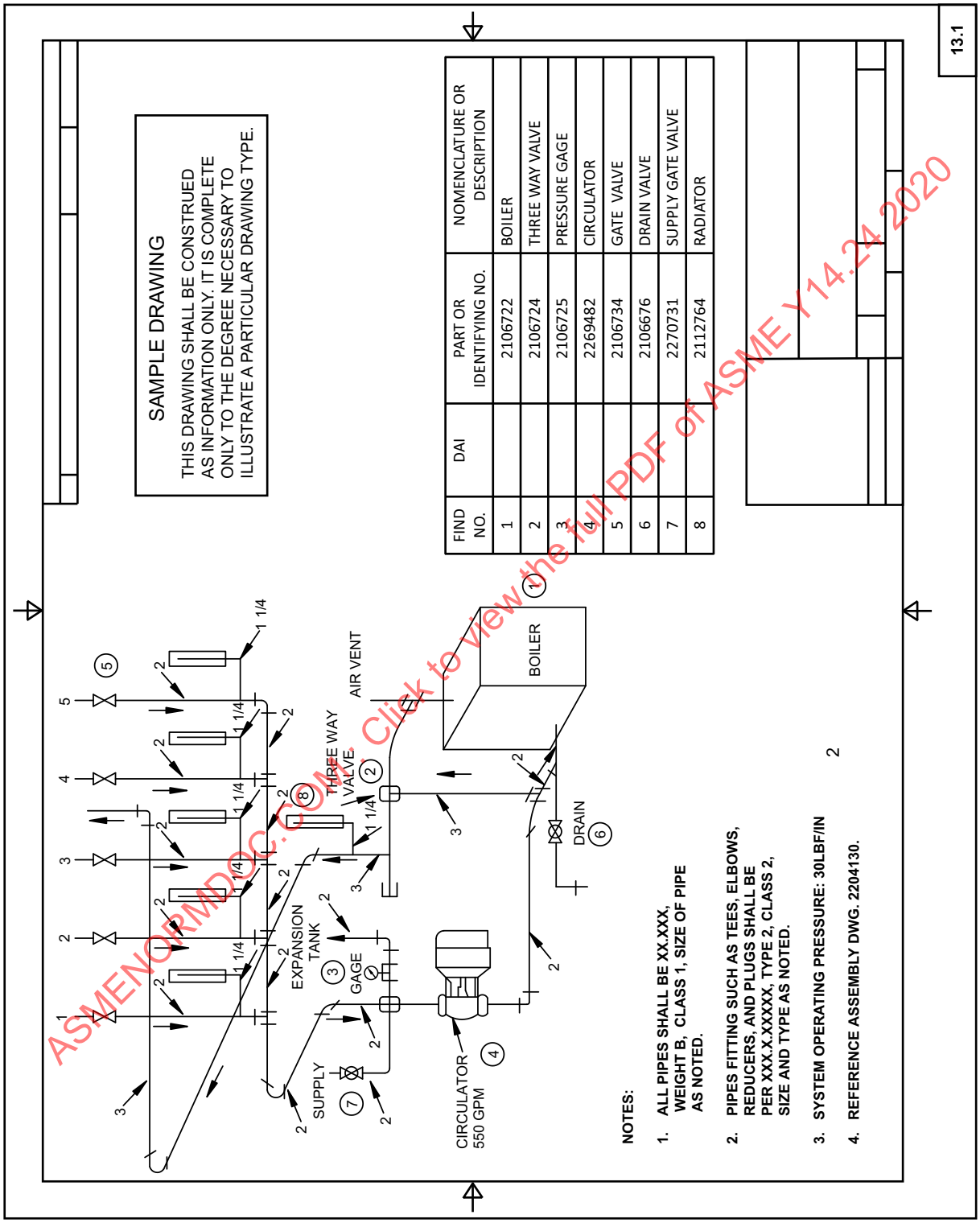


Figure 13.1-1 Mechanical Schematic Diagram



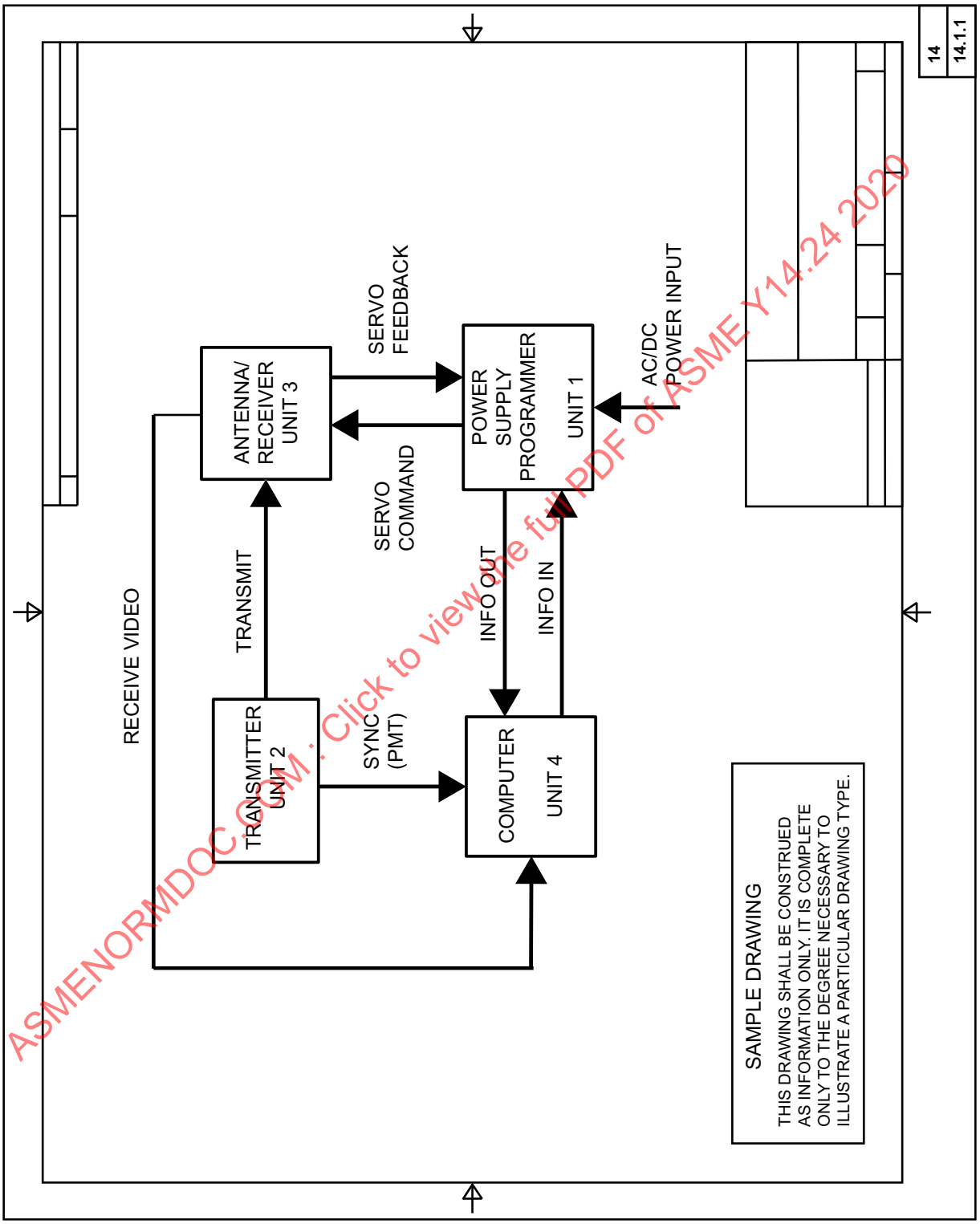


Figure 14.1.1-1 Functional Block Diagram

Figure 14.2.1-1 Single Line Schematic Diagram

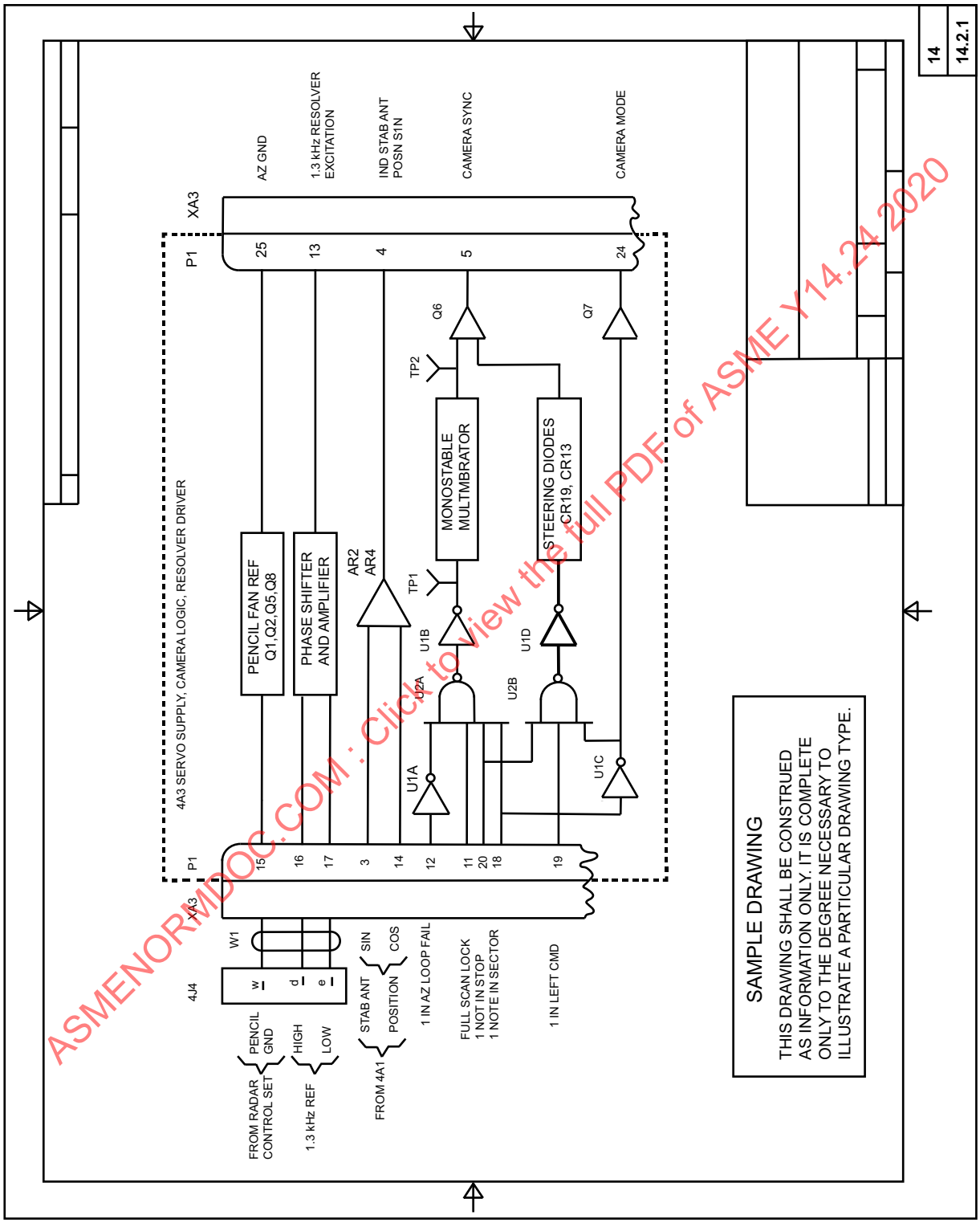


Figure 14.3.1-1 Schematic Diagram

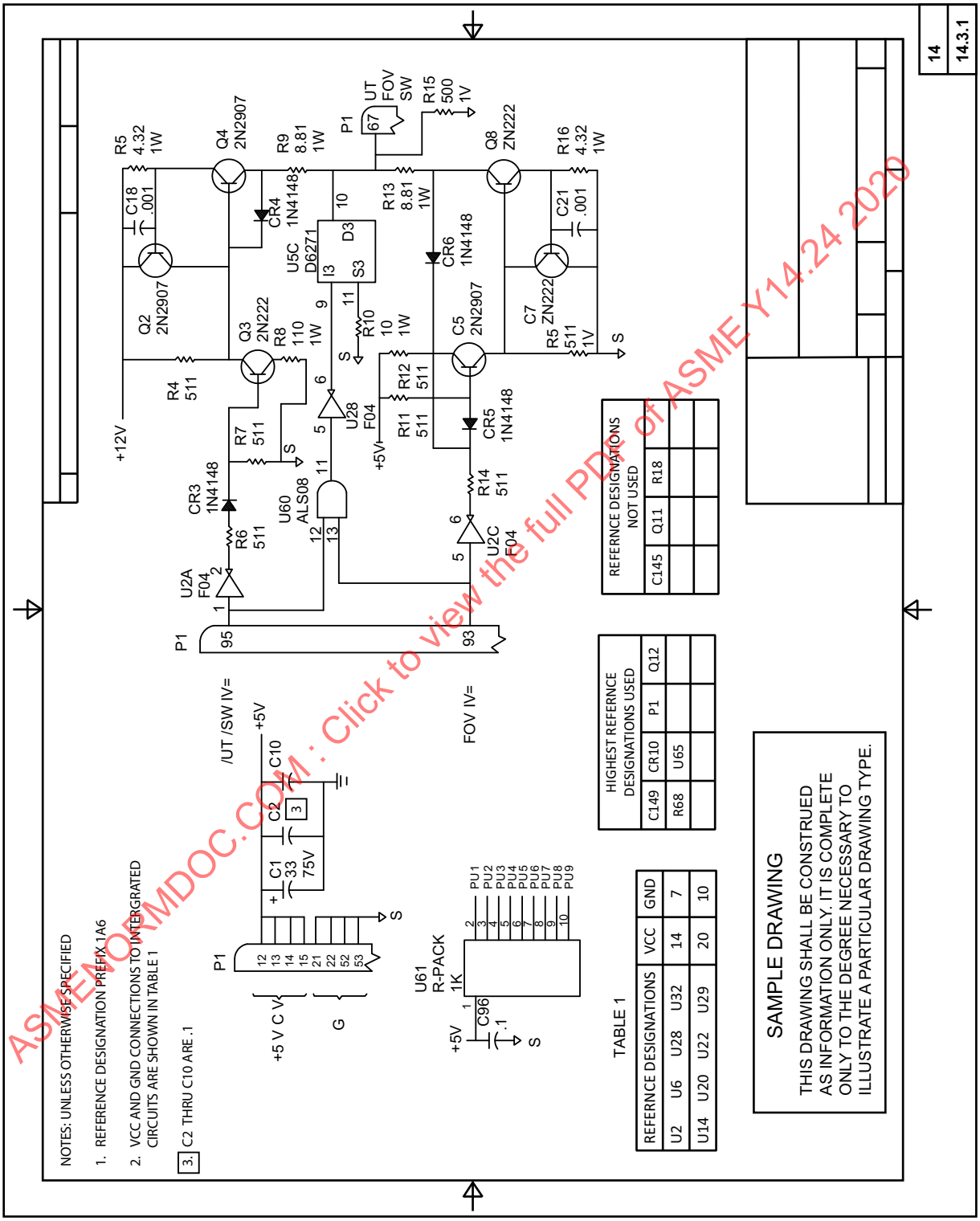
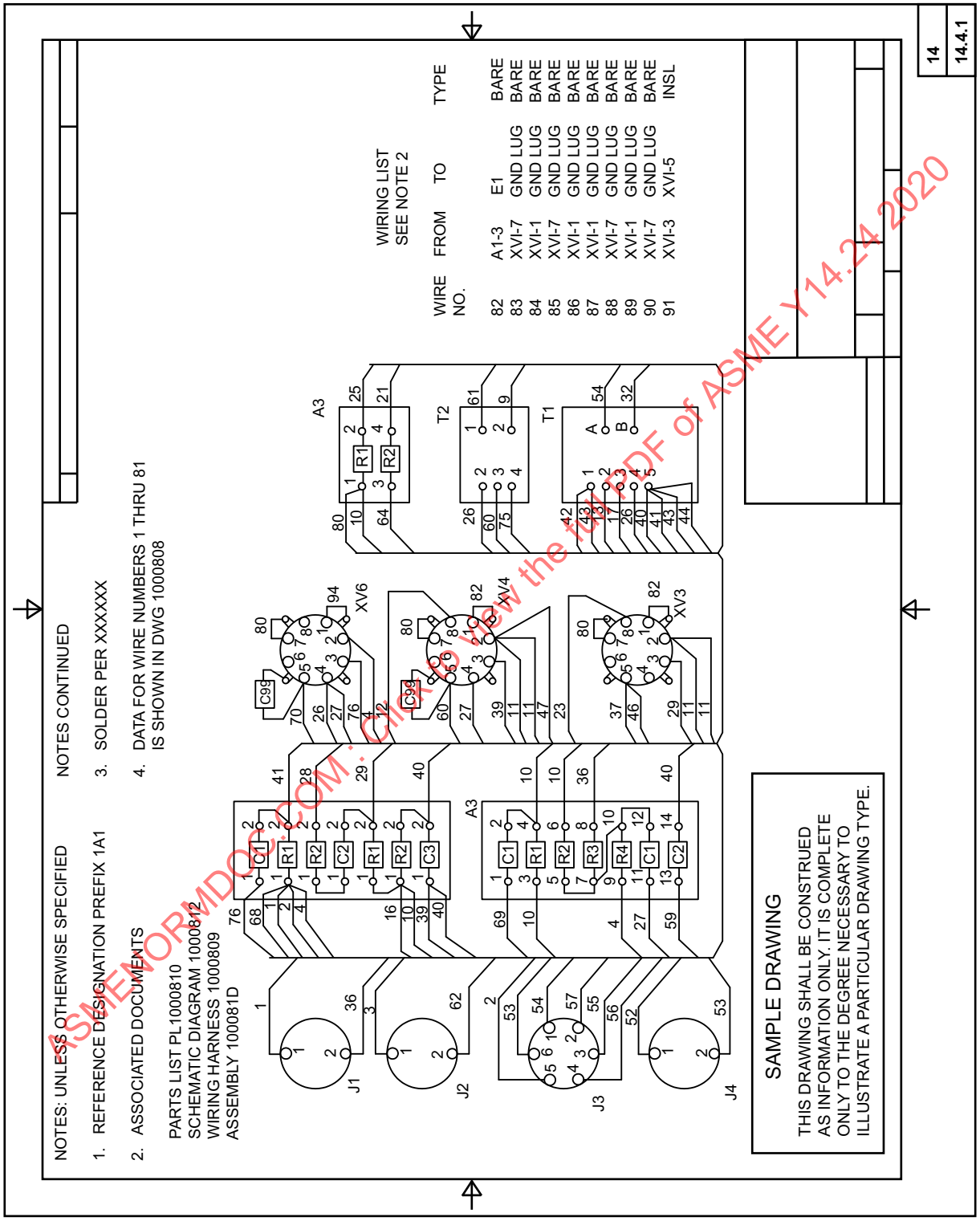


Figure 14.4.1-1 Connection Diagram



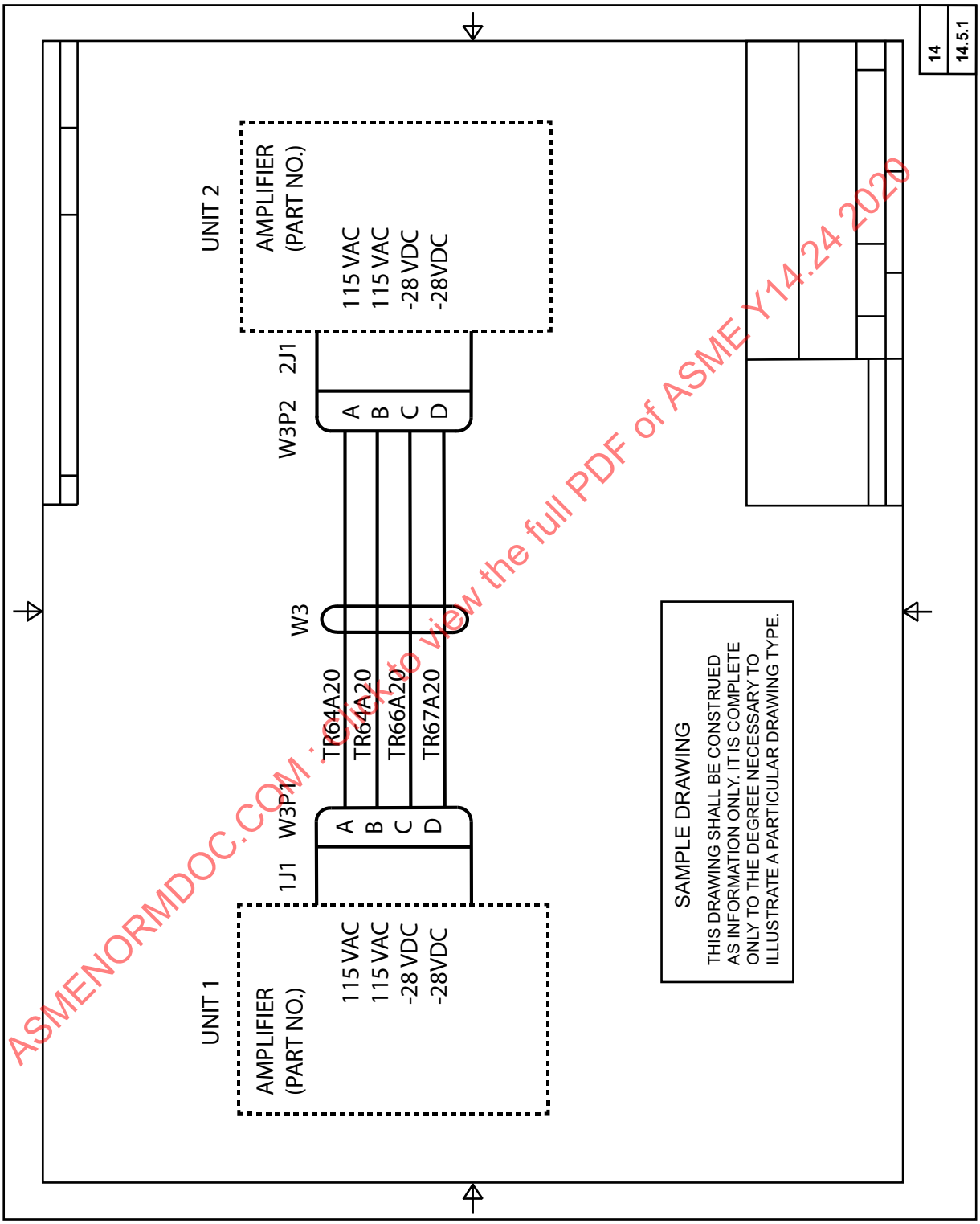


Figure 14.5.1-1 Interconnection Diagram (Point-to-Point, Simple)

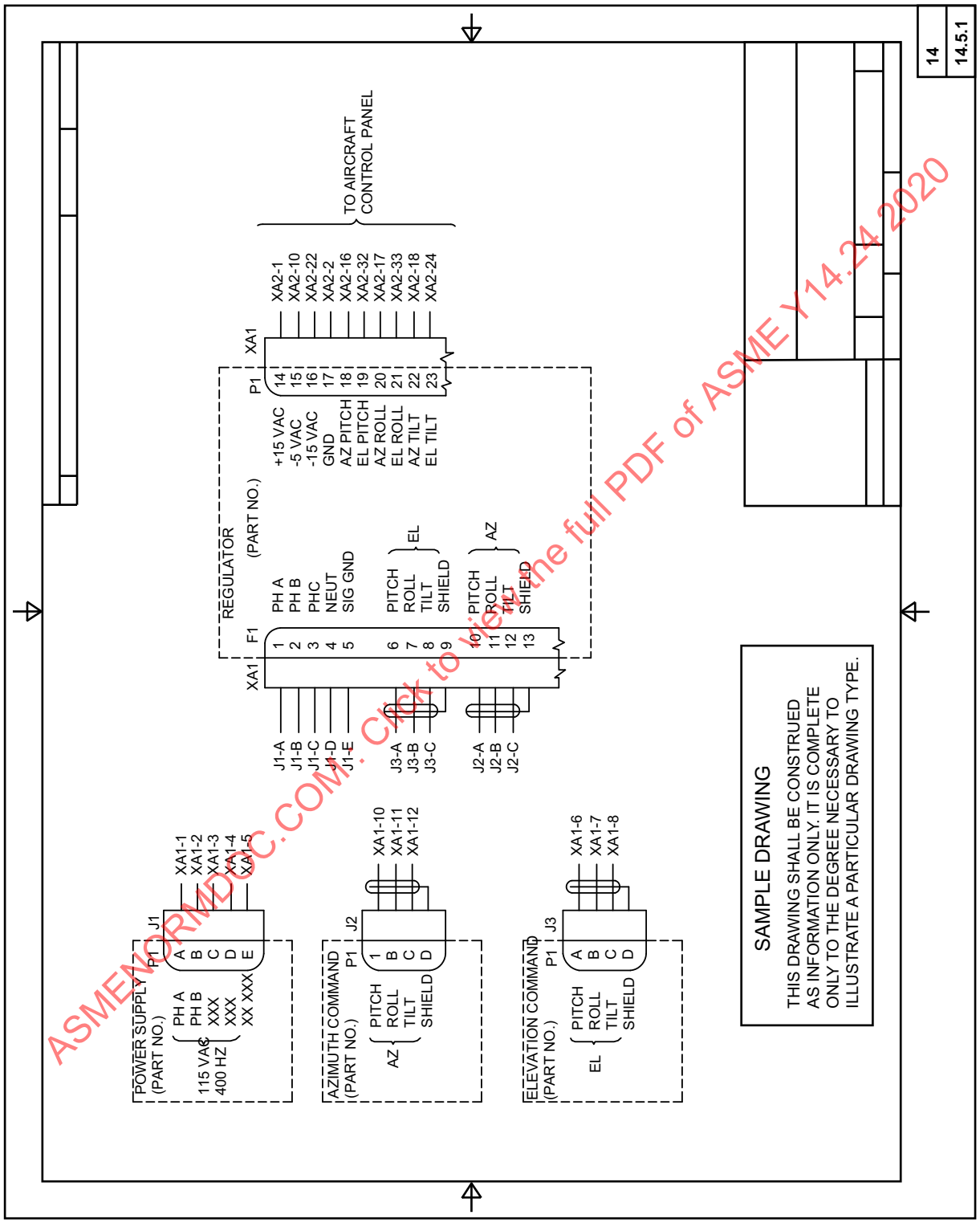


Figure 14.5.1-2 Interconnection Diagram (Point-to-Point, Complex)

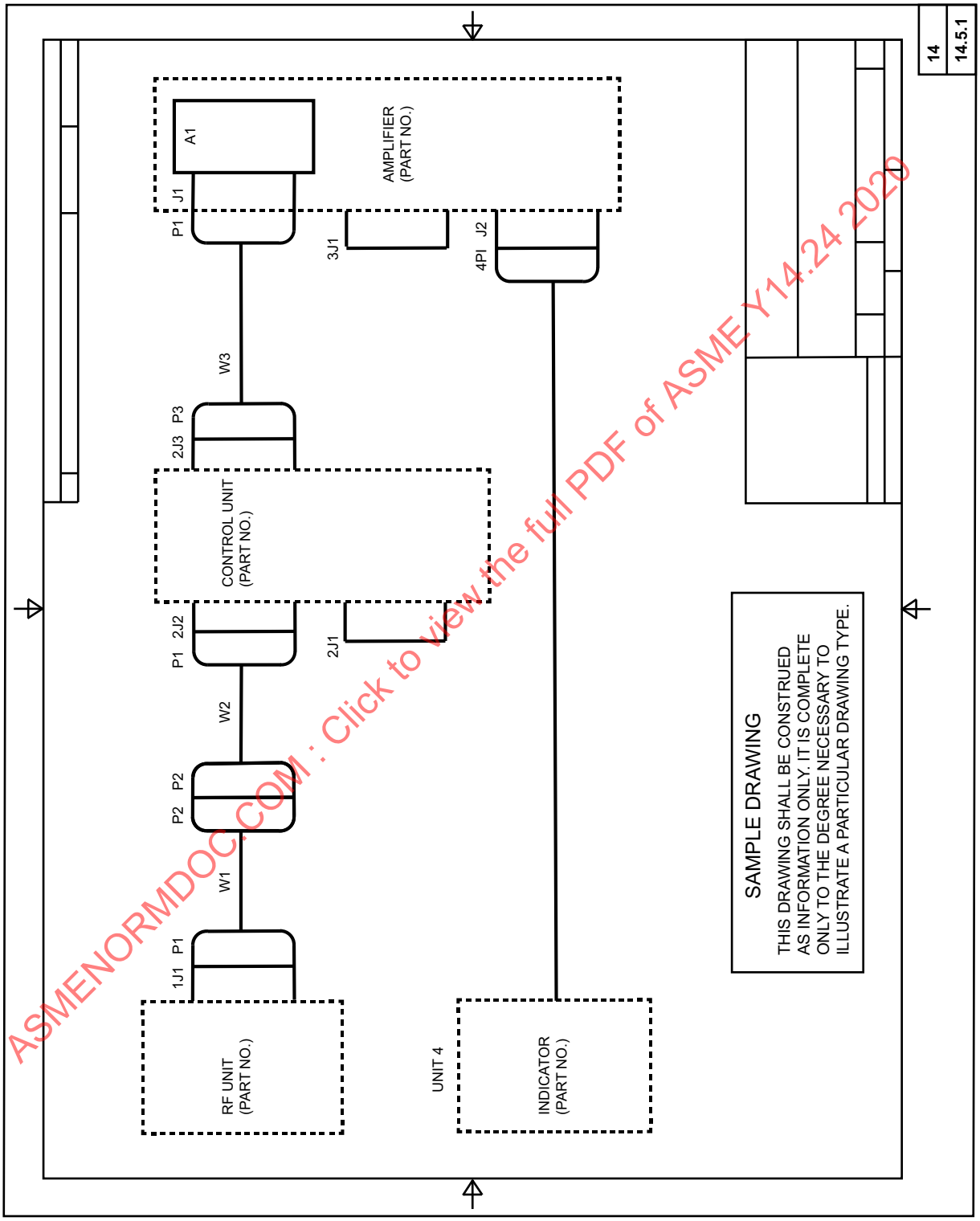


Figure 14.5.1-3 Interconnection Diagram (Cabling Type)

Figure 14.7.1-1 Logic Circuit Diagram

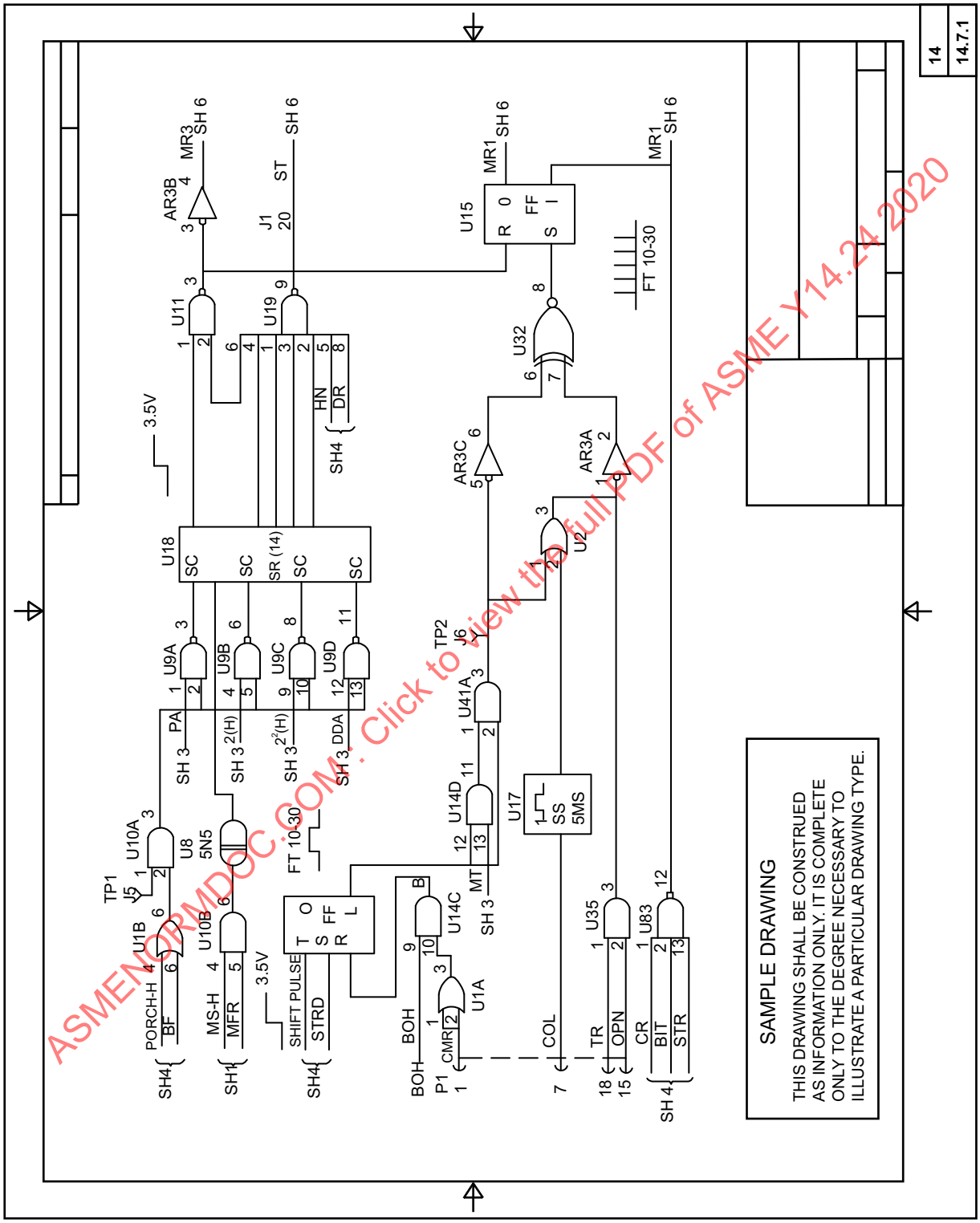


Figure 15.1.1-1 Wiring Harness Drawing

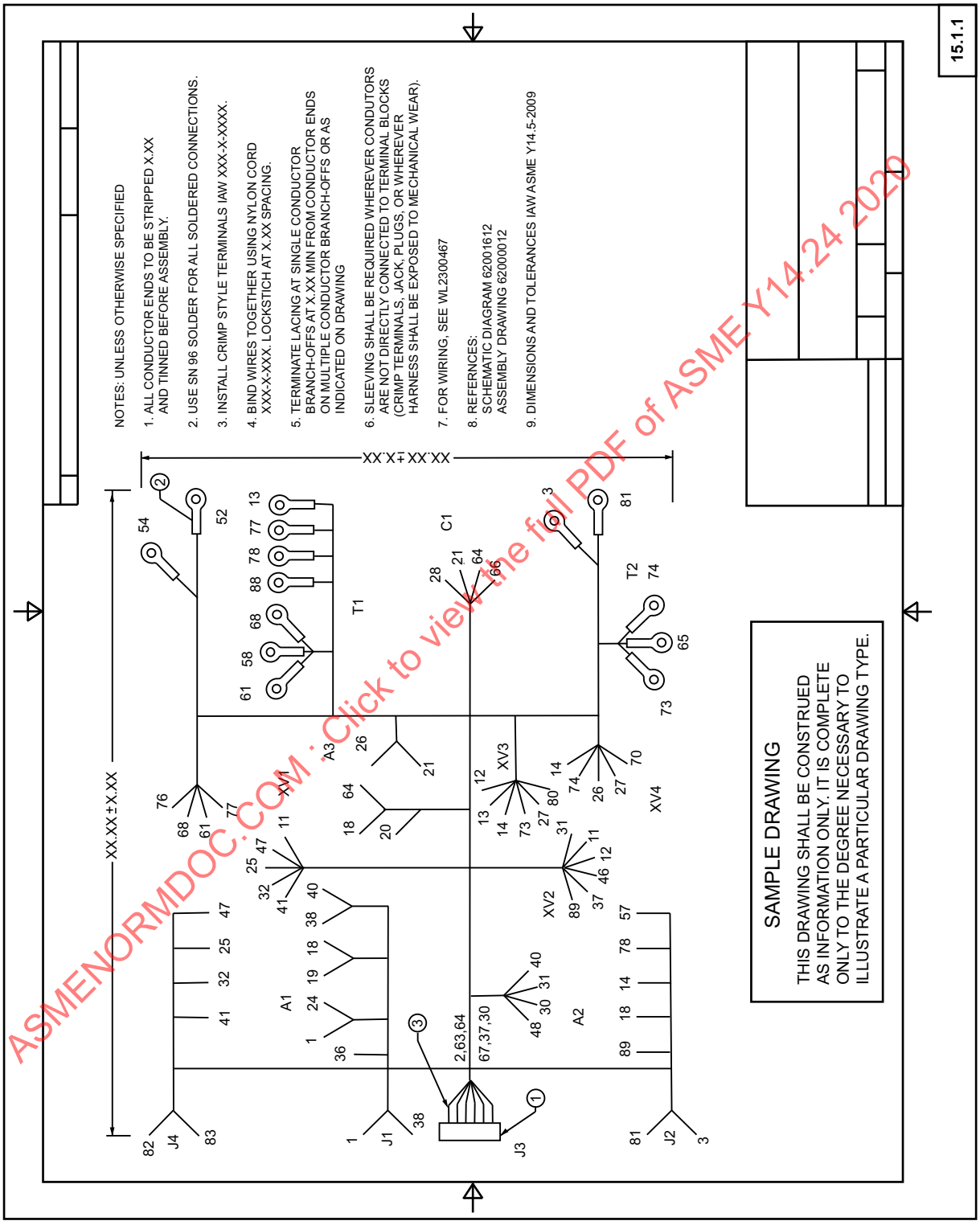


Figure 15.2.1-1 Cable Assembly Drawing

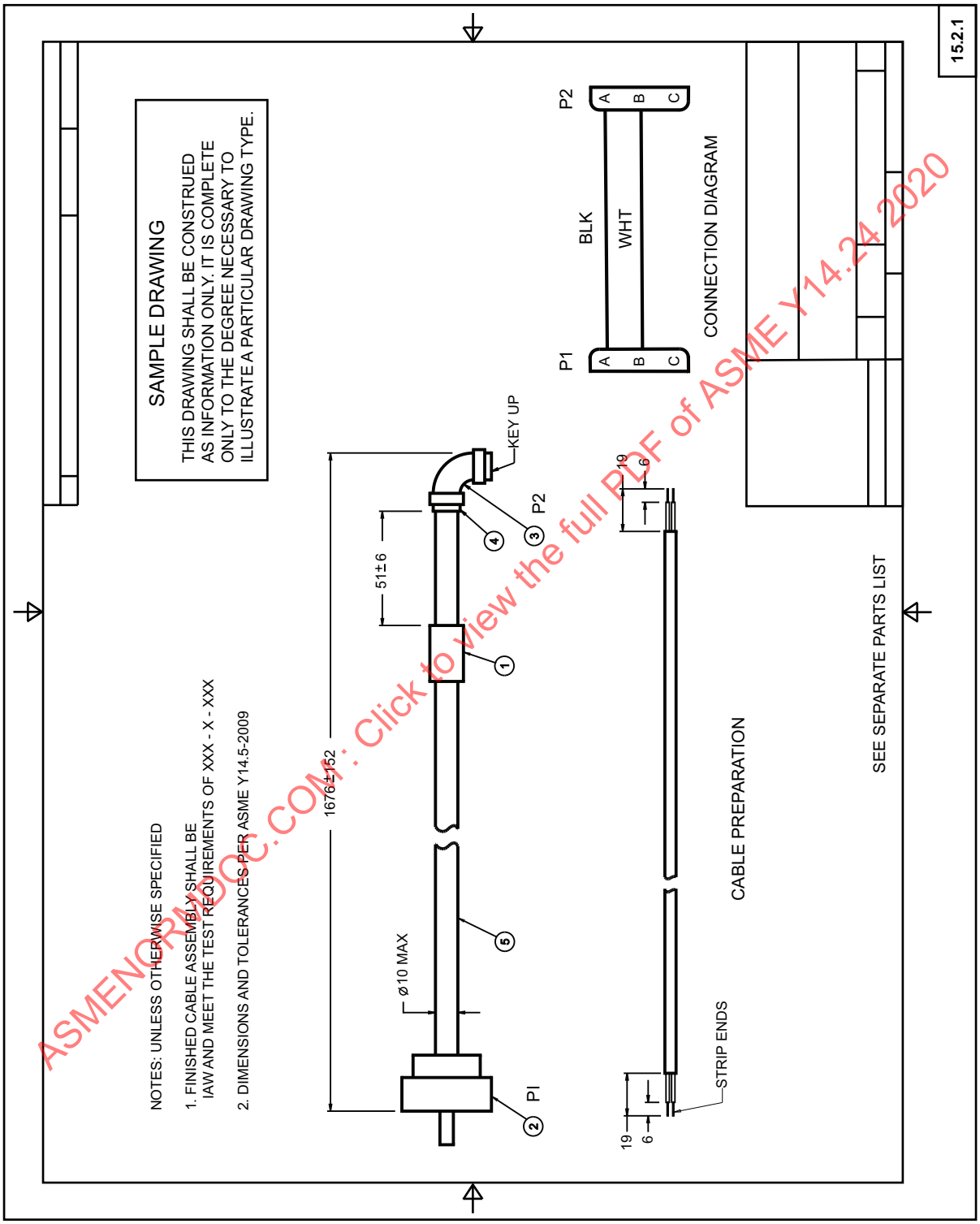


Figure 15.3.1-1 Relationship Structure of Printed and Discrete Wiring Board Documentation (Typical)

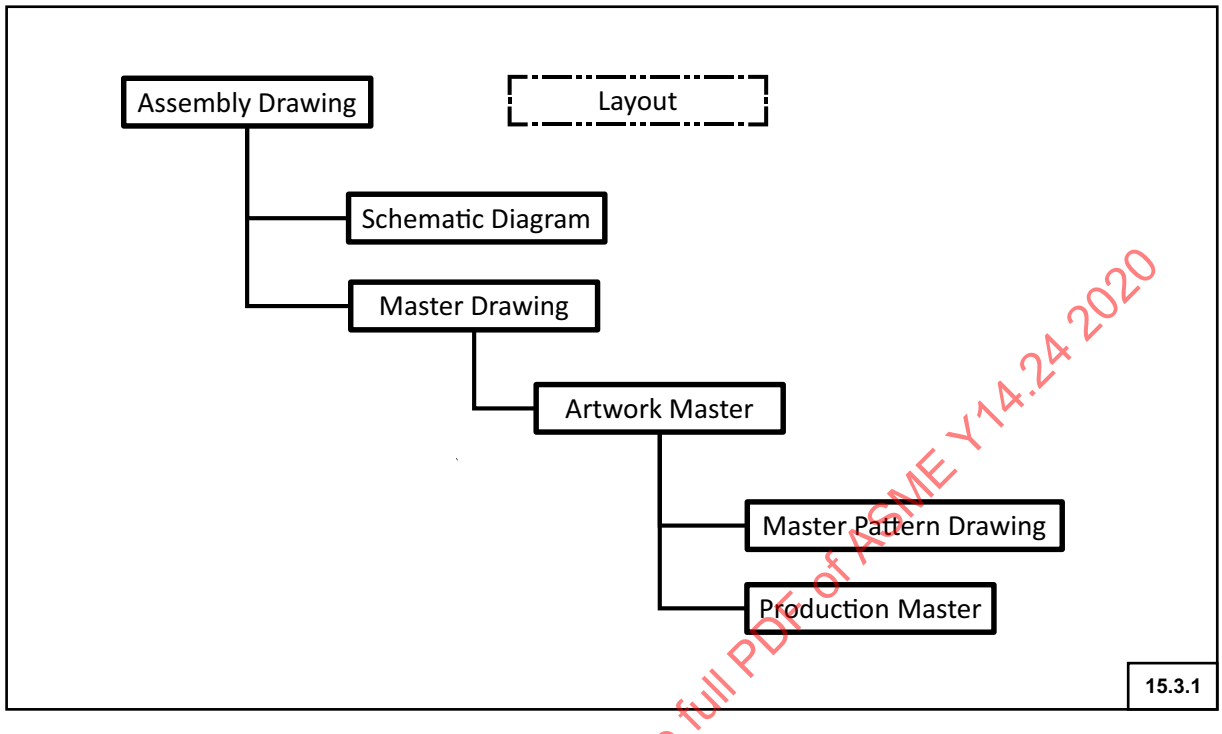


Figure 15.6.1-1 Kit Drawing

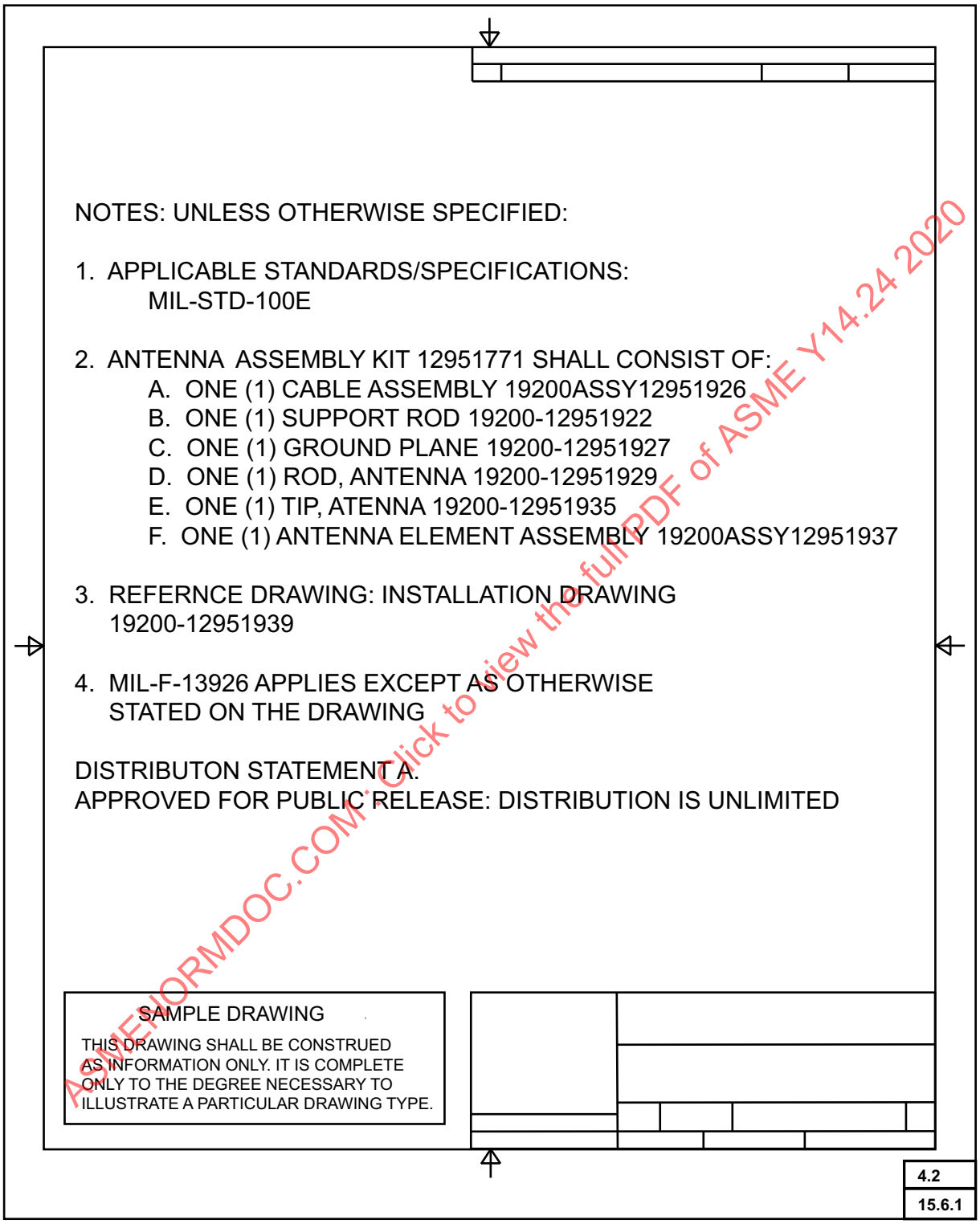


Figure 15.7.3.1-1 Tube Bend Drawing (Pictorial/Coordinate)

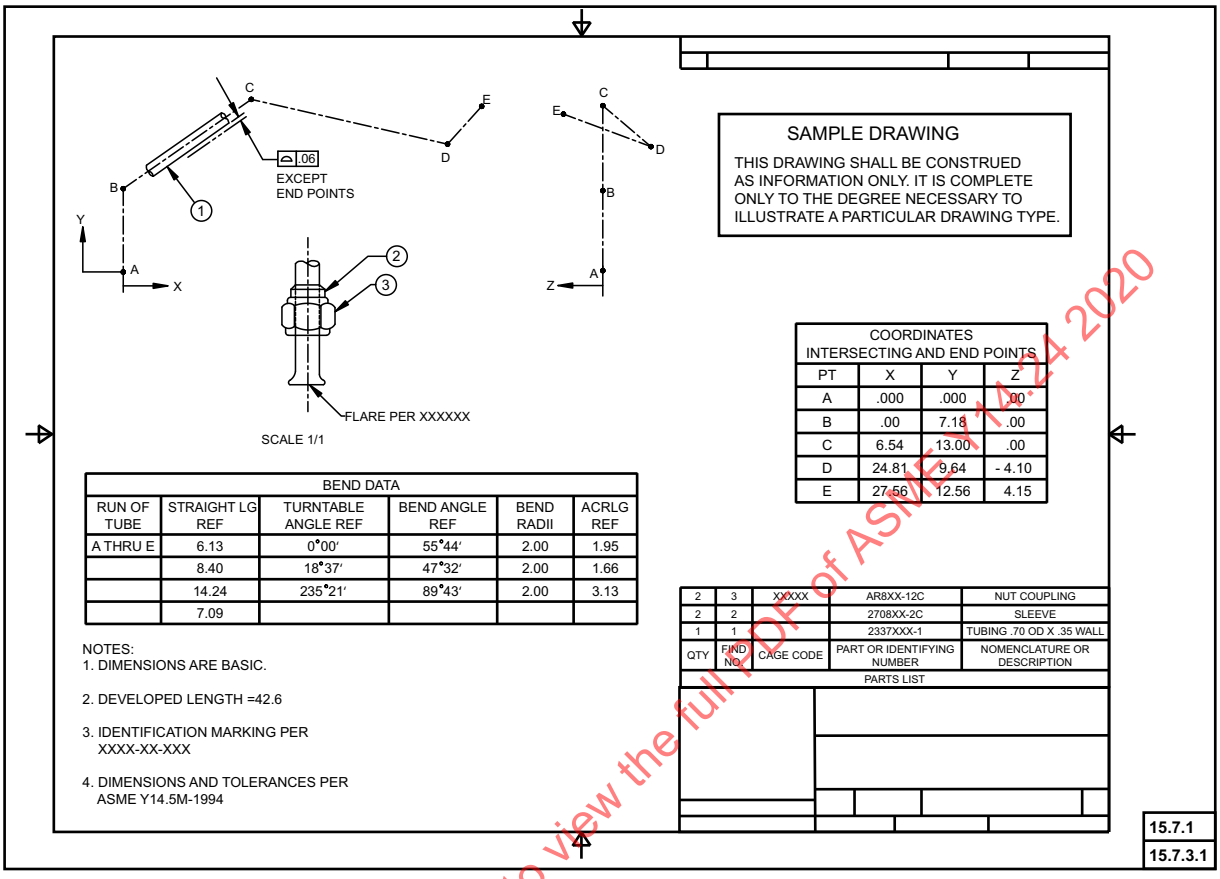


Figure 15.7.3.2-1 Tube Bend Drawing (Tabular)

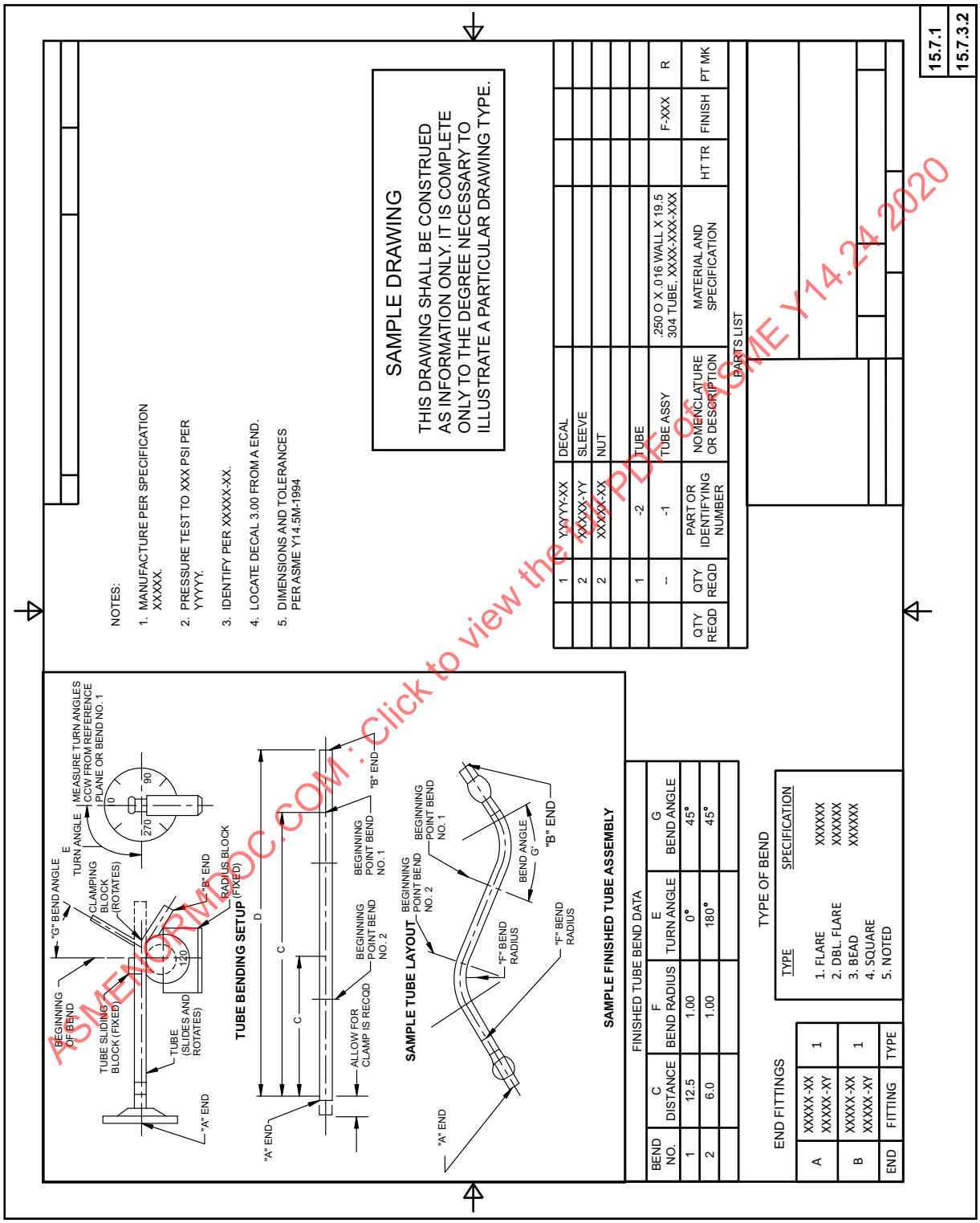


Figure 15.8.1-1 Matched Set Drawing