ASME Y14.24-1999

[Revision of ASME Y14.24M-1989 (R1996)]

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TYPES AND APPLICATIONS OF ENGINEERING DRAWINGS

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FOREWORD

Subcommittee 24, Types and Applications of Engineering Drawings, was formed in June 1973, as a subcommittee of the American Society of Mechanical Engineers (ASME) Committee Y14, Engineering Drawings and Related Documentation Practices. The subcommittee was formed to prepare a standard that defined the accepted drawing types used to establish engineering requirements in the production and procurement of hardware.

The basis for this Standard was Chapter 200 of the military standard, MIL-STD-100, Engineering Drawing Practices. Work on this Standard considered the types of engineering drawings most frequently used by business, industry, and government communities in the United States. This Standard attempts to serve the individual and combined needs of these communities and assure consistency of application and interpretation.

On this basis, a series of meetings were held to identify, select, and prepare proposed text and illustrations. At each stage of development, the Subcommittee considered the selection of elements best suited for a national standard. Members of Subcommittee 24 represented a cross section of American industry and the Department of Defense (DoD). Liaison with technical societies such as the National Defense Industrial Association (NDIA) [formerly known as the American Defense Preparedness Association (ADPA)], Aerospace Industries Association (AIA), Electronic Industries of America (EIA), and the Society of Automotive Engineers (SAE), provided technical support.

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

The original edition of this Standard was approved as an American National Standard 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 release of the original edition, it was referenced by the DoD as a replacement of the majority of Chapter 200 of MIL-STD-100E that was released September 30, 1991. Input received from the DoD user community 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 a revision to the Standard at a meeting in Garland, Texas, October 8-10, 1991.

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

- Added Inseparable Assembly Drawing as an individual drawing type.
- Added information concerning the structure of drawing text.
- Revised Section 8, Control Drawings. Also, deleted Design Control Drawing and replaced it with Envelope Drawing. Changed the name "Vendor Item Drawing" to "Vendor Item Control Drawing." Removed Interface Control Drawing and Identification Cross Reference Drawing from Section 8 and documented them as separate drawing types under new paragraphs. Changed the name "Interface Control Drawing" to "Interface Drawing."
- Minimized the information and detail on Printed Board Drawing Sets and Microcircuit Drawing, and referenced applicable IPC standards for documentation requirements. This was done to eliminate duplication of effort between the ASME and IPC organizations.

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● Deleted the detail requirements and drawing figures for Wiring List. A short descriptive paragraph is provided with reference to ASME Y14.34M for drawing requirements.
● Replaced Computer Program/Software Drawings with Software Installation Drawing and Altered Item Drawing.
● Added Design Parameters Drawing.
● Updated drawing figures.
● Revised the majority of Appendix A definitions to make it compatible with Department of Defense definitions.
● Updated Appendix B.
● Deleted Appendix C.

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

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

Suggestions for the improvement of this Standard are welcome. They should be sent to The American Society of Mechanical Engineers, Att: Secretary, Y14 Main Committee, Three Park Avenue, New York, NY 10016-5990.

This revision was approved as an American National Standard on June 24, 1999.

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Engineering Drawing and Related Documentation Practices

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CONTENTS

Foreword iii
Committee Roster v

1 General 1
1.1 Scope 1
1.2 Applicable Documents 1
1.3 Definitions 1
1.4 Methods and Styles of Preparation 1
1.5 Illustrations 2
1.6 Application Guidelines 2
1.7 Drawing Content 2
1.8 Tabulation 2
1.9 Combination of Drawing Types 2
1.10 Ancillary Drawings 2

2 Layout Drawing 2
2.1 Description 2
2.2 Application Guidelines 2
2.3 Requirements 3

3 Detail Drawing 3
3.1 Monodetail Drawing 3
3.2 Multidetail Drawing 3

4 Assembly Drawings 3
4.1 Assembly Drawing 3
4.2 Inseparable Assembly Drawing 4

5 Installation Drawing 4
5.1 Description 4
5.2 Application Guidelines 6
5.3 Requirements 6

6 Modifying Drawings 6
6.1 Altered Item Drawing 6
6.2 Selected Item Drawing 17
6.3 Modification Drawing 17

7 Arrangement Drawing 21
7.1 Description 21
7.2 Application Guidelines 21
7.3 Requirements 21

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8 Control Drawings 21
8.1 Procurement Control Drawing 21
8.2 Vendor Item Control Drawing 24
8.3 Source Control Drawing 26
8.4 Envelope Drawing 26

9 Interface Drawing 30
9.1 Description 30
9.2 Application Guidelines 30
9.3 Requirements 30

10 Identification Cross Reference Drawing 30
10.1 Description 30
10.2 Application Guidelines 30
10.3 Requirements 30

11 Mechanical Schematic Diagram 30
11.1 Description 30
11.2 Application Guidelines 35
11.3 Requirements 35

12 Electrical/Electronic Diagrams 35
12.1 Functional Block Diagram 35
12.2 Single Line Diagram 35
12.3 Schematic Diagram or Circuit Diagram 35
12.4 Connection Diagram or Wiring Diagram 39
12.5 Interconnection Diagram 39
12.6 Wiring List 39
12.7 Logic Circuit Diagram 39

13 Special Application Drawings 39
13.1 Wiring Harness Drawing 39
13.2 Cable Assembly Drawing 46
13.3 Printed Board and Discrete Wiring Board Drawing Sets 46
13.4 Microcircuit Drawing Set 49
13.5 Undimensioned Drawing 49
13.6 Kit Drawing 49
13.7 Tube Bend Drawing 49
13.8 Matched Set Drawing 52
13.9 Contour Definition Drawing 52
13.10 Software and Memory Device Data 59
13.11 Design Parameters Drawing 61

Figures

1 Indentured Relationship of Installation Drawings (Depicting Work Packages) 5
2 Indentured Relationships of Printed and Discrete Wiring Board Documentation (Typical) 6
3 Layout Drawing 7
4 Monodetail Drawing 8
5 Tabulated Monodetail Drawing 9
6 Multidetail Drawing 10

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7 Assembly Drawing 11
8 Detail Assembly Drawing 12
9 Inseparable Assembly Drawing 13
10 Installation Drawing 14
11 Altered Item Drawing (Mechanical Alteration) 15
12 Altered Item Drawing (Electrical Alteration) 16
13 Selected Item Drawing (Mechanical Selection) 18
14 Selected Item Drawing (Electrical Selection) 19
15 Modification Drawing 20
16 Arrangement Drawing (Pictorial) 22
17 Procurement Control Drawing 23
18 Vendor Item Control Drawing 25
19 Source Control Drawing 27
20 Envelope Drawing 29
21 Interface Drawing 31
22 Identification Cross Reference Drawing 33
23 Mechanical Schematic Diagram 34
24 Functional Block Diagram 36
25 Single Line Schematic Diagram 37
26 Schematic Diagram 38
27 Connection Diagram 40
28 Interconnection Diagram (Point-to-Point, Simple) 41
29 Interconnection Diagram (Point-to-Point, Complex) 42
30 Interconnection Diagram (Cabling Type) 43
31 Logic Circuit Diagram 44
32 Wiring Harness Drawing 45
33 Cable Assembly Drawing 47
34 Undimensioned Drawing 50
35 Kit Drawing 51
36 Tube Bend Drawing (Pictorial) 53
37 Tube Bend Drawing (Tabular) 54
38 Matched Set Drawing 55
39 Contour Definition Drawing (Index) 56
40 Contour Definition Drawing (Pictorial) 57
41 Contour Definition Drawing (Tabulated Coordinates) 58
42 Software Installation Drawing 60
43 Development Options 62
44 Design Parameters Drawing 63

Mandatory Appendix

I Definition of Terms 65

Nonmandatory Appendix

A Selection of Drawing Types 69

Figure

A-1 Decision Diagram for Determining Applicable Drawing Types for Procured Items 71

Table

A-1 Functional Grouping of Drawing Types 70

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ENGINEERING DRAWING AND RELATED DOCUMENTATION PRACTICES

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.

1.2 Applicable Documents

1.2.1 Reference Documents. The following documents form a part of this Standard to the extent specified herein. Unless otherwise indicated, the latest edition shall apply.

ANSI/IEEE 91, Graphic Symbols for Logic Functions
ANSI/IEEE 200, Reference Designations for Electrical and Electronic Parts and Equipment
ANSI/IEEE 991, Logic Circuit Diagrams
IEEE 315, Graphic Symbols for Electrical and Electronic Diagrams

Publisher: Institute of Electrical and Electronic Engineers (IEEE), 445 Hoes Lane, P.O. Box 1331, Piscataway, NJ 08855-1331

ANSI/IPC-D-249, Design Standard for Flexible 1 & 2 Sided Printed Wiring Boards
ANSI/IPC-D-275, Design Standard for Rigid Printed Board and Rigid Printed Board Assemblies
ANSI/IPC-D-310, Guidelines for Artwork Generation and Measurement Techniques
ANSI/IPC-D-325, End Product Documentation for Printed Boards
ANSI/IPC-D-350, Printed Board Description in Digital Form
ANSI/IPC-D-351, Printed Board Drawings in Digital Form
ANSI/IPC-DW-425, Design and End Product Requirements for Discrete Wiring Boards
ANSI/IPC-D-859, Design Standard for Thick Film Multilayer Hybrid Circuits

Publisher: Institute for Interconnecting and Packaging Electronic Circuits (IPC), 2215 Sanders Road, Northbrook, IL 60062

ASME Y14.1, Decimal Inch Drawing Sheet Size and Format
ASME Y14.34M, Associated Lists

Publisher: The American Society of Mechanical Engineers (ASME), Three Park Avenue, New York, NY 10016; Order Department: 22 Law Drive, Box 2900, Fairfield, NJ 07007

Federal Cataloging Handbook H4/H8, Commercial and Government Entity Codes

Publisher: Defense Logistics Services Center, Att: Commander, Battle Creek, MI 49017-3084

1.2.2 Order of Precedence. In the event of conflict between the text of this Standard and the references cited herein, the text of this Standard shall take precedence.

1.3 Definitions

Key terms used in this Standard are italicized in their first appearance in the text. They are defined in Mandatory Appendix I.

1.4 Methods and Styles of Preparation

Preparation methods (manual, computer-aided, photographic, "cut and paste," etc.), method of depiction (pictorial, textual, or combinations thereof), and styles (multisheet, book form, computer printout, etc.) are a concern of this Standard only to the extent that the drawing satisfies its intended purpose.

1.4.1 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 for examples.

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1.5 Illustrations

Sample drawings and other illustrations are included as needed to illustrate the text and characteristics unique to a particular drawing type. To comply with the requirements of this Standard, actual drawings shall meet the content requirements and application guidelines set forth in the text. The content and arrangement of sample drawing types are for illustration only.

1.6 Application Guidelines

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

1.7 Drawing Content

Requirements may be satisfied by direct delineation on the drawing or by *reference* to other documents which are a part of the drawing package. Such documents are invoked in individual drawings either by reference in the general notes, in using the *assembly* parts list, or both. Parts lists shall be in accordance with ASME Y14.34M.

1.8 Tabulation

Any drawing type may be tabulated to delineate similar items which, as a group, have some common characteristics and some variable features. (See Fig. 5 for an example.)

1.8.1 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 *part or identifying number (PIN)* assigned.

1.8.2 Requirements. The differences (variables between the items) defined by the drawing are tabulated. The common characteristics are delineated or stated once. Each item is uniquely identified by a PIN. Normally, a single pictorial representation is shown. For example, variable dimensions are coded by letters used as headings for columns in a tabulation block. Variables are entered in the table under the appropriate heading and on the same line as each specific *item identification.* Alternate methods may be used to correlate the variations in characteristics to the individual items. The description for each tabulated item is as complete as that of an individual item described on the specific drawing type.

1.9 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 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 resulting from combining drawings include (1) increased complexity of the drawing which may diminish clarity and usefulness and (2) frequent change activity to the drawing which may increase the need to update associated record(s), material control data, manufacturing planning, microfilm, etc.

1.10 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.

2 LAYOUT DRAWING (Fig. 3)

2.1 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. 2.3(k), a layout drawing does not establish item identification.

2.2 Application Guidelines

A layout drawing may be prepared for a complete *end product* or any portion thereof and is prepared either as,

(a) a conceptual design layout to present one or more solutions for meeting the basic design parameters

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and to 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; or

(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.

2.3 Requirements

A layout drawing includes, *as applicable,*

(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 bundle, pneumatic line, and hydraulic line 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 to be used as an interim assembly drawing)

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

3 DETAIL DRAWING

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.

3.1 Monodetail Drawing (Figs. 4 and 5)

3.1.1 Description. A monodetail drawing delineates a single *part.*

NOTE: A drawing detailing SHOWN and OPPOSITE parts using a single set of views is considered to be a tabulated monodetail drawing (see para. 1.8).

3.1.2 Application Guidelines. A monodetail drawing is prepared to provide maximum clarity in defining a part.

3.1.3 Requirements. A monodetail drawing delineates all features of the part including, as applicable: configuration, dimensions, tolerances, materials, mandatory processes, surface texture, protective finishes and coatings, and markings.

3.2 Multidetail Drawing (Fig. 6)

3.2.1 Description. A multidetail drawing delineates two or more uniquely identified parts in separate views or in separate sets of views on the same drawing.

3.2.2 Application Guidelines. A multidetail drawing is a single drawing prepared to describe parts usually related to one another.

NOTE: The decision to use a multidetail drawing should be made cautiously. When revising or tabulating a multidetail drawing, the drawing is affected in the following ways:

(1) The same revision status applies to all details on a multidetail drawing; therefore, a change to one detail of the drawing may affect the associated records of all other details (material control data, manufacturing planning, microfilm, etc.).

(2) When tabulating individual parts that are detailed and defined on the drawing, additional details or tabulation blocks are added to detail or define the differences (see para. 1.8). Each individual tabulated item must be uniquely identified (see para. 3.2.3). Tabulating may affect the sequence in the assignment of *unique identifiers* for each item.

Some significant benefit(s) should outweigh these potential disadvantages, as well as such others as diminished clarity and usefulness resulting from increased drawing complexity.

3.2.3 Requirements. Each part delineation on a multidetail drawing meets the design definition requirements for a monodetail drawing and shall be uniquely identified.

4 ASSEMBLY DRAWINGS

4.1 Assembly Drawing (Figs. 7 and 8)

4.1.1 Description. An assembly drawing defines the configuration and contents of the assembly or assemblies depicted thereon. It establishes item identification for each assembly. Where an assembly drawing contains detailed requirements for one or more parts used in the assembly, it is a detail assembly drawing (see para. 1.9 and Fig. 8).

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4.1.2 Application Guidelines. An assembly drawing is prepared for each group of items that are to be joined to form an assembly and that reflect 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

4.1.3 Requirements. An assembly drawing includes, as applicable,

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

(b) a parts list specifying the unique identifier for all items which 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.

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

(e) electrical items depicted as they are to be mounted; however, small electrical items mounted by wire connections only may be located either by depiction on the assembly drawing or inclusion in the pertinent wiring list (see para. 12.6) or connection diagram (see para. 12.4).

(f) cross-reference to applicable installation drawings, wiring lists, schematic diagrams, test specifications, *associated lists*, etc.

(g) a unique identifier assigned to each assembly configuration.

(h) identification marking requirements.

(i) a note to be associated with all control drawing or identification cross reference drawing items listed within the parts list.

Attaching parts (bolts, nuts, washers, etc.) required to mount assemblies in next higher assemblies or on foundations are called out in the parts list of the drawing that define that attachment (usually the higher level assembly or installation drawing).

An assembly drawing may be tabulated in accordance with para. 1.8 by specifying variable items in the parts list. The pictorial representation depicts all tabulated versions. If necessary to depict differences, separate views may be used.

4.2 Inseparable Assembly Drawing (Fig. 9)

4.2.1 Description. An *inseparable assembly* drawing delineates two or more parts, subordinate assemblies, or a combination of these items, which may be separately fabricated and are permanently joined together (as in welded, brazed, riveted, sewed, glued, or other processes) to form an integral unit (part) not normally capable of being disassembled for replacement or repair of individual pieces. It establishes item identification for the assembly.

4.2.2 Application Guidelines. An inseparable assembly drawing may be prepared in lieu of individual detail drawings for the parts of an inseparable assembly. 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.

4.2.3 Requirements. An inseparable assembly drawing fully defines the end product as assembled. An inseparable assembly drawing includes, as applicable,

(a) a unique identifier for all items which 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) an item identification assigned to the assembly configuration; and

(e) identification marking requirements.

5 INSTALLATION DRAWING (Figs. 1 and 10)

5.1 Description

An installation drawing provides information for properly positioning and installing items relative to their supporting structure and adjacent items, as applicable. This information may 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. 13.6).

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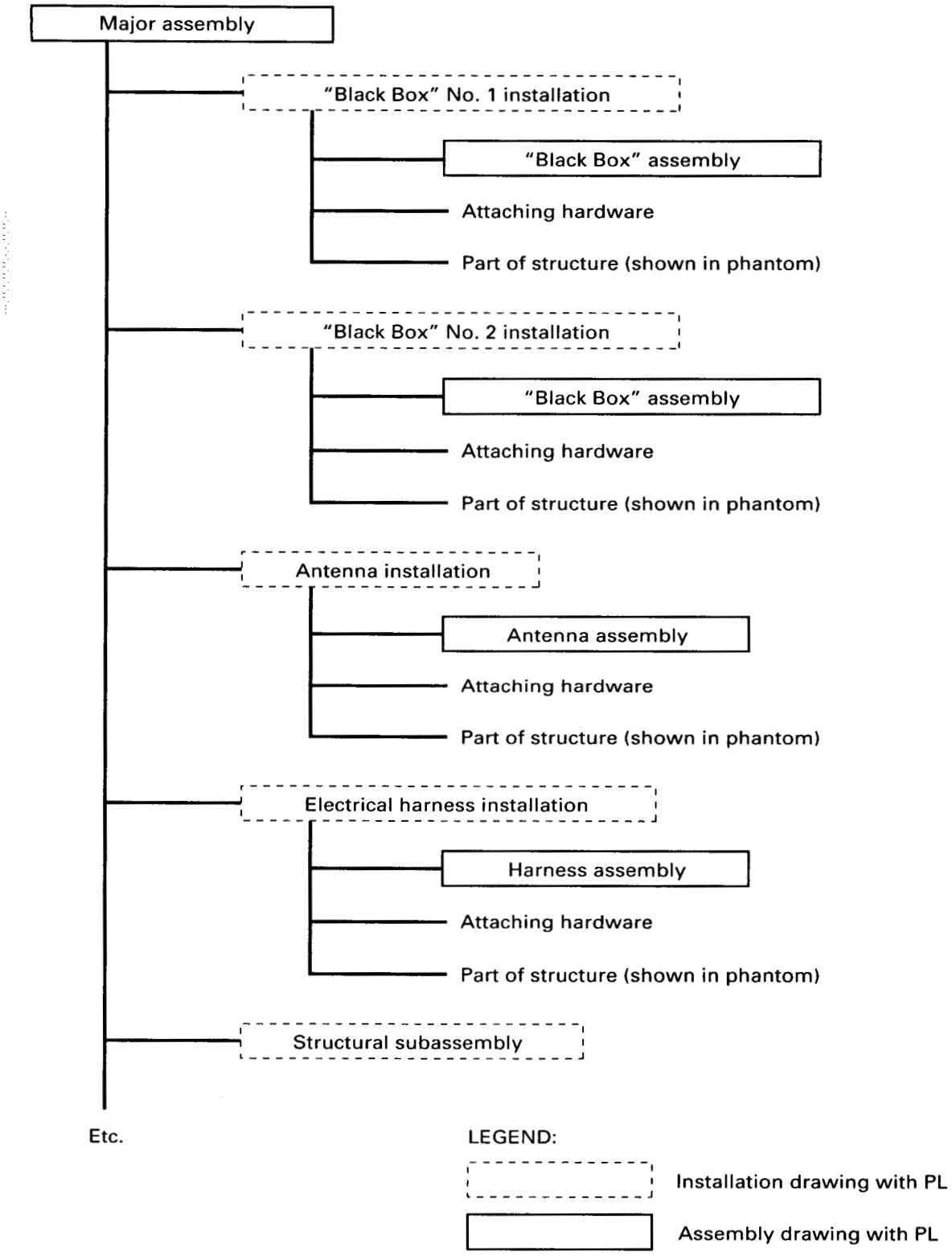


FIG. 1 INDENTURED RELATIONSHIP OF INSTALLATION DRAWINGS (Depicting Work Packages)

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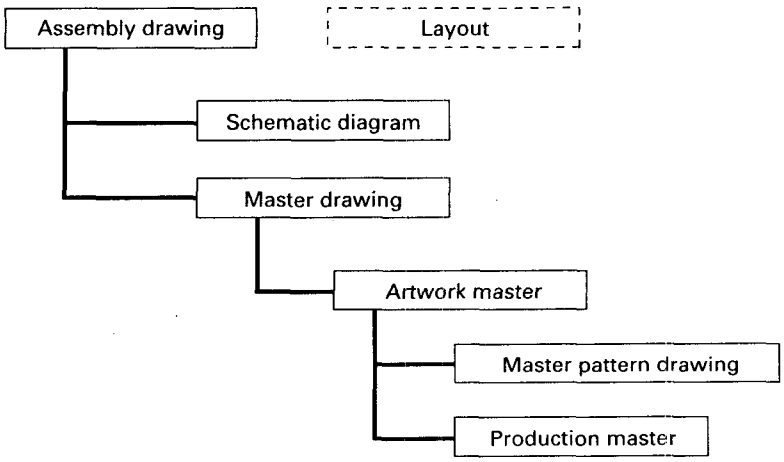


FIG. 2 INDENTURED RELATIONSHIPS OF PRINTED AND DISCRETE WIRING BOARD DOCUMENTATION (Typical)

5.2 Application Guidelines

An installation drawing is prepared to provide detailed installation information for

(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, and

(b) an assembly which is so large or complex that the major assembly drawing cannot accommodate all relevant data (Fig. 1).

5.3 Requirements

An installation drawing includes, as applicable,

(a) overall and principle 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 (for example: locating dimensions for attaching hardware).

(c) interfaces for pipe and cable attachments.

(d) information necessary for preparation of foundation plans including mounting details.

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

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

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

(h) a parts list (see para. 1.7) specifying the items to be installed.

(i) supporting structure or associated items which are not included in the installed items may be shown. When shown, such items shall be depicted by phantom lines and identified as *reference data.*

(j) a note to be associated with all control drawing or identification cross reference drawing items listed within the parts list.

6 MODIFYING DRAWINGS

Modifying drawing types are altered item, selected item, and modification drawings. These drawing types are not used for items made from raw or bulk materials, items purchased in bulk lengths (extrusions, channel nuts, hinges, etc.), or such semiprocessed items as blank panels, castings, electronic equipment drawers, etc. For such items, use detail or detail assembly drawings (see Sections 3 and 4, respectively).

6.1 Altered Item Drawing (Figs. 11 and 12)

6.1.1 Description. An altered item drawing delineates the physical alteration of an existing item under the control of another design activity or defined by a *nationally recognized standard.* The drawing type permits the required alteration to be performed by any competent manufacturer including the original manufacturer, the altering design activity, or a third party. It establishes a new item identification for the altered item.

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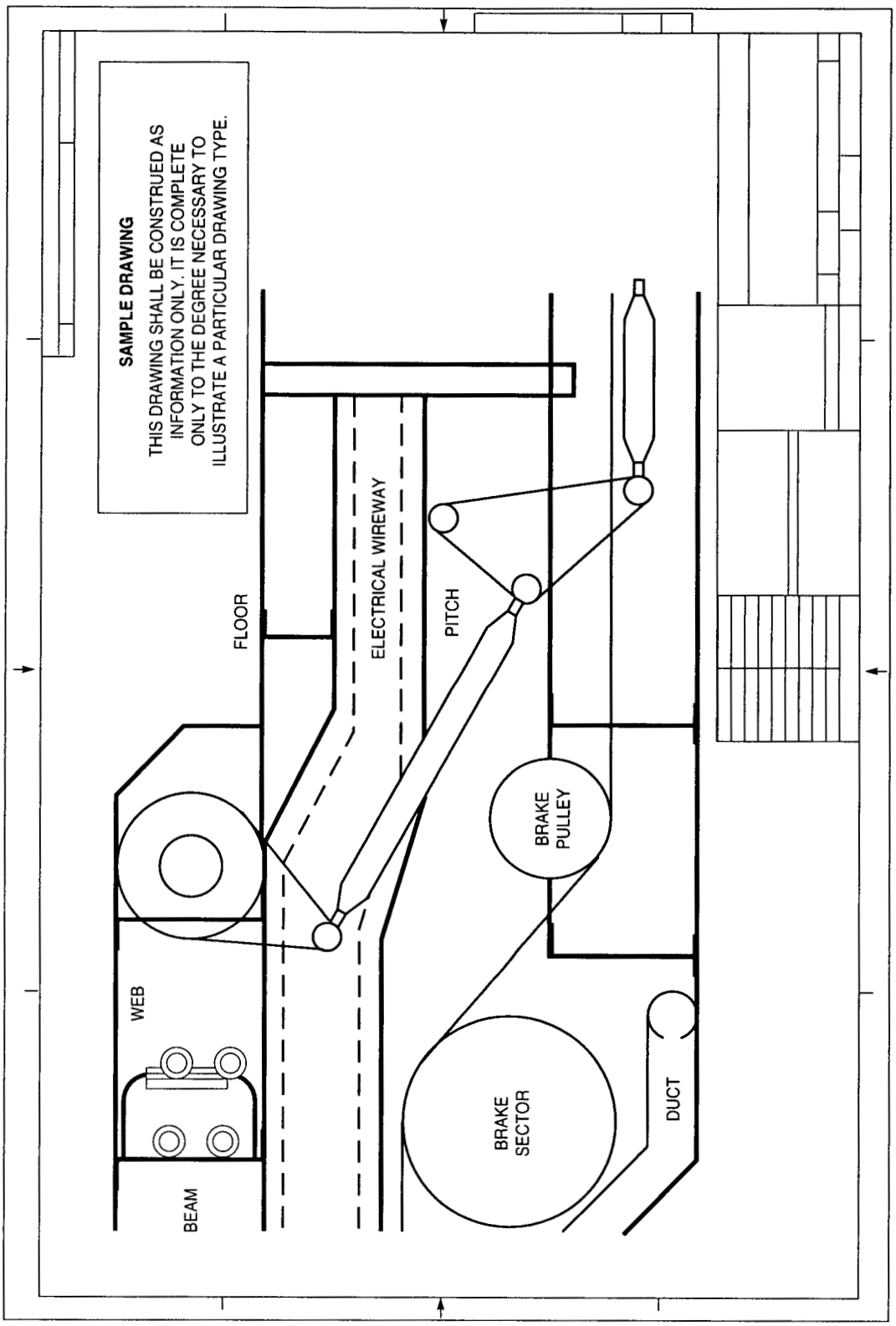


FIG. 3 LAYOUT DRAWING

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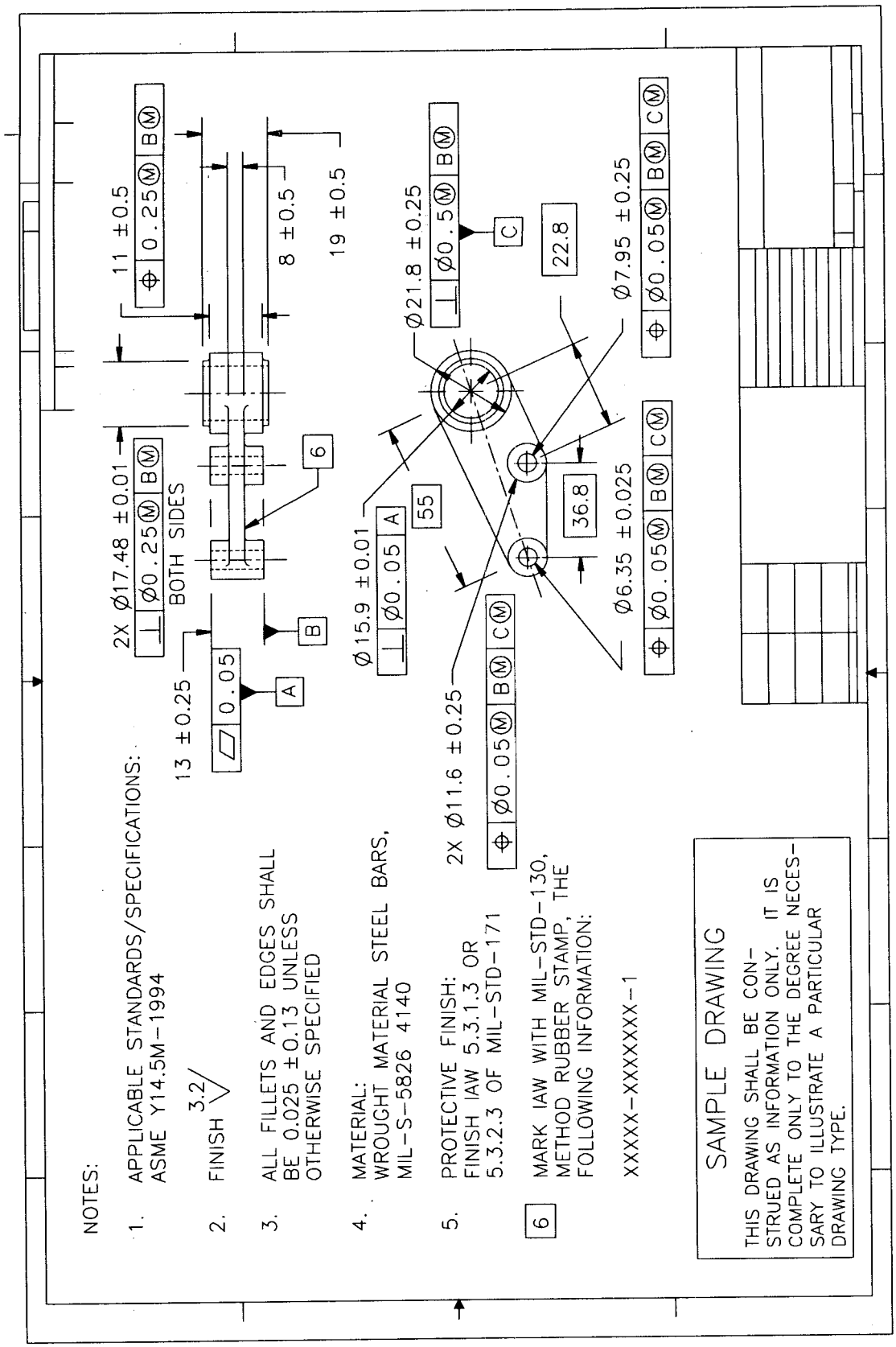


FIG. 4 MONODETAIL DRAWING

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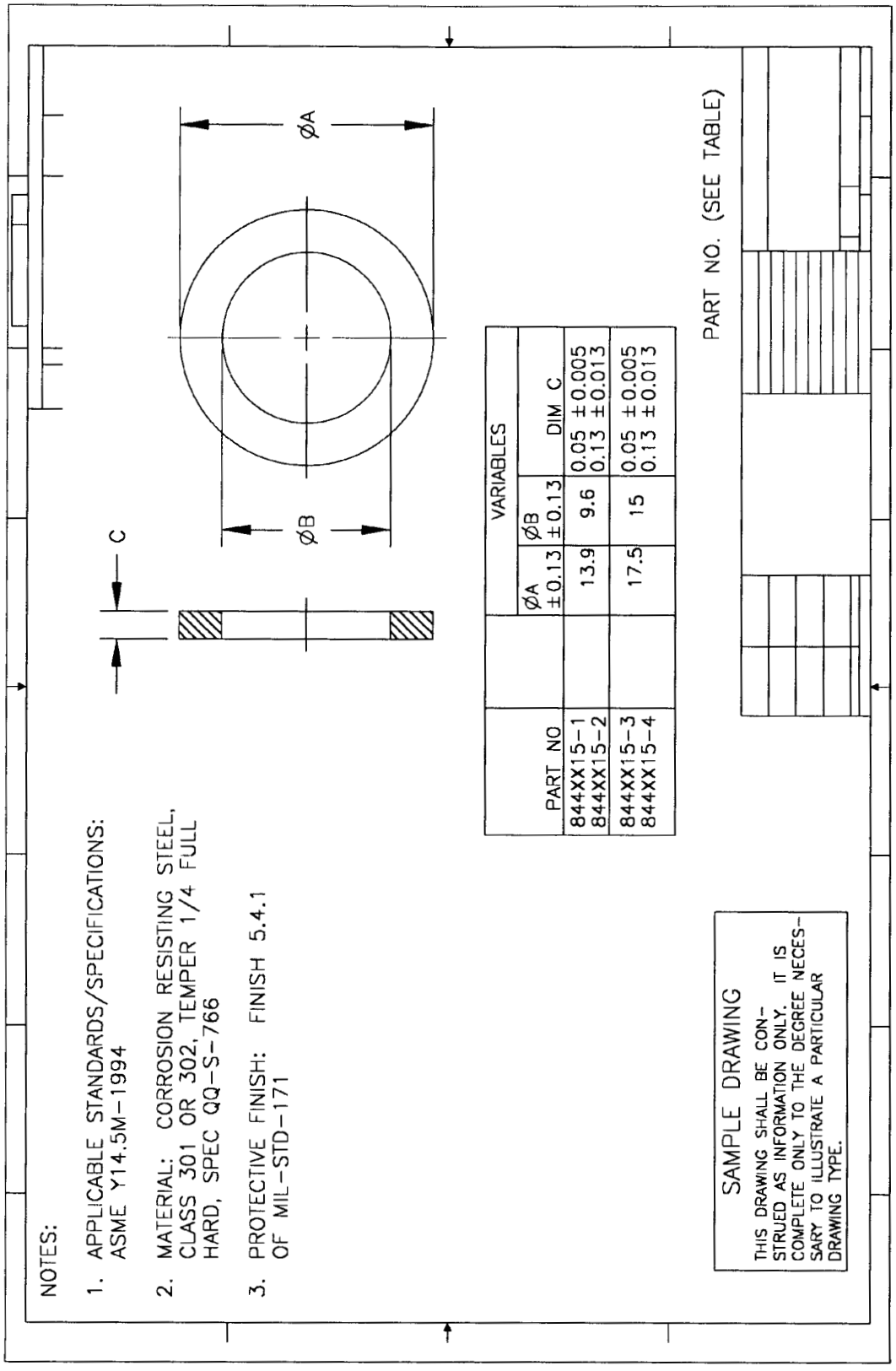


FIG. 5 TABULATED MONODETAIL DRAWING

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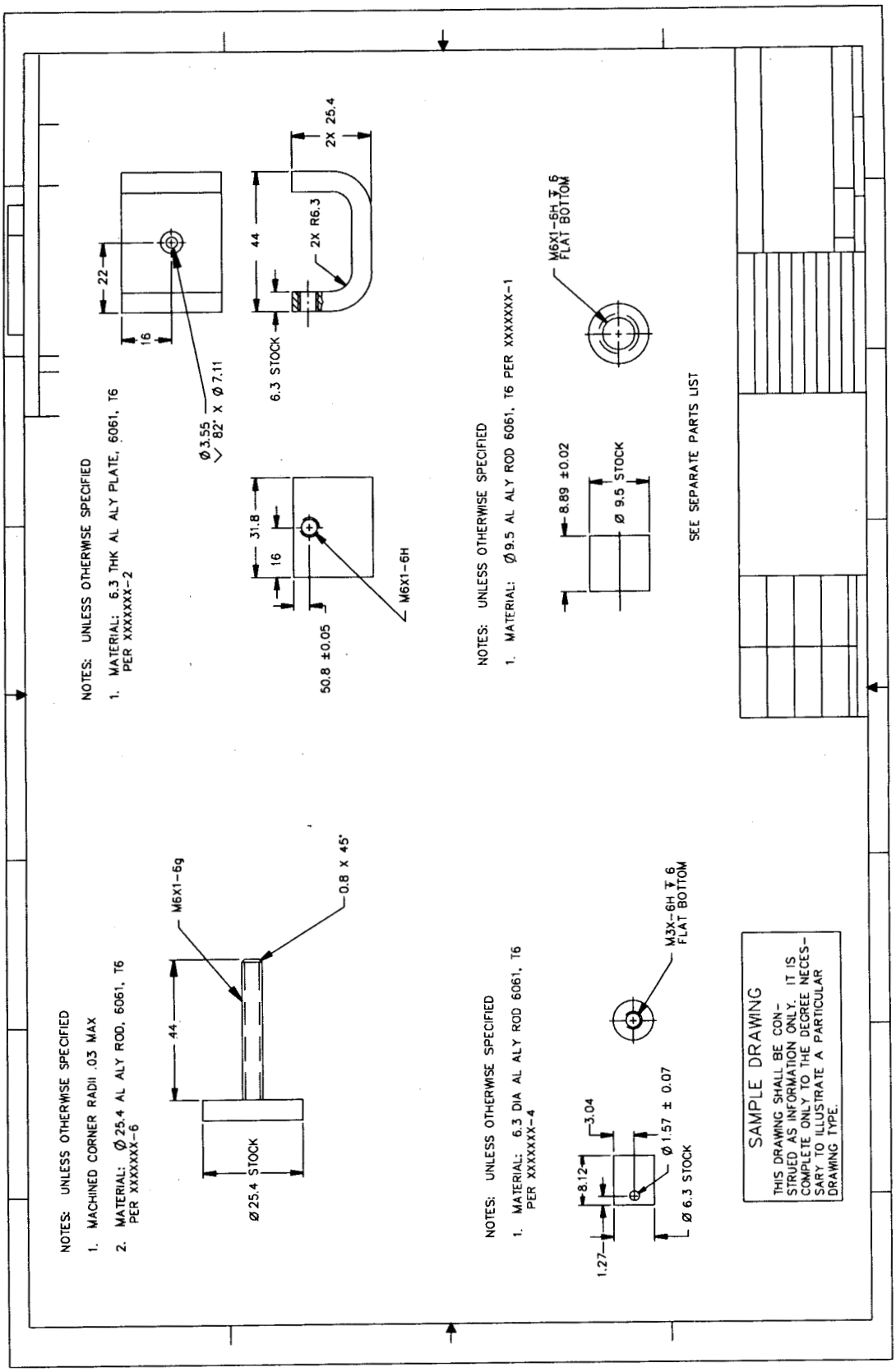


FIG. 6 MULTIDETAIL DRAWING

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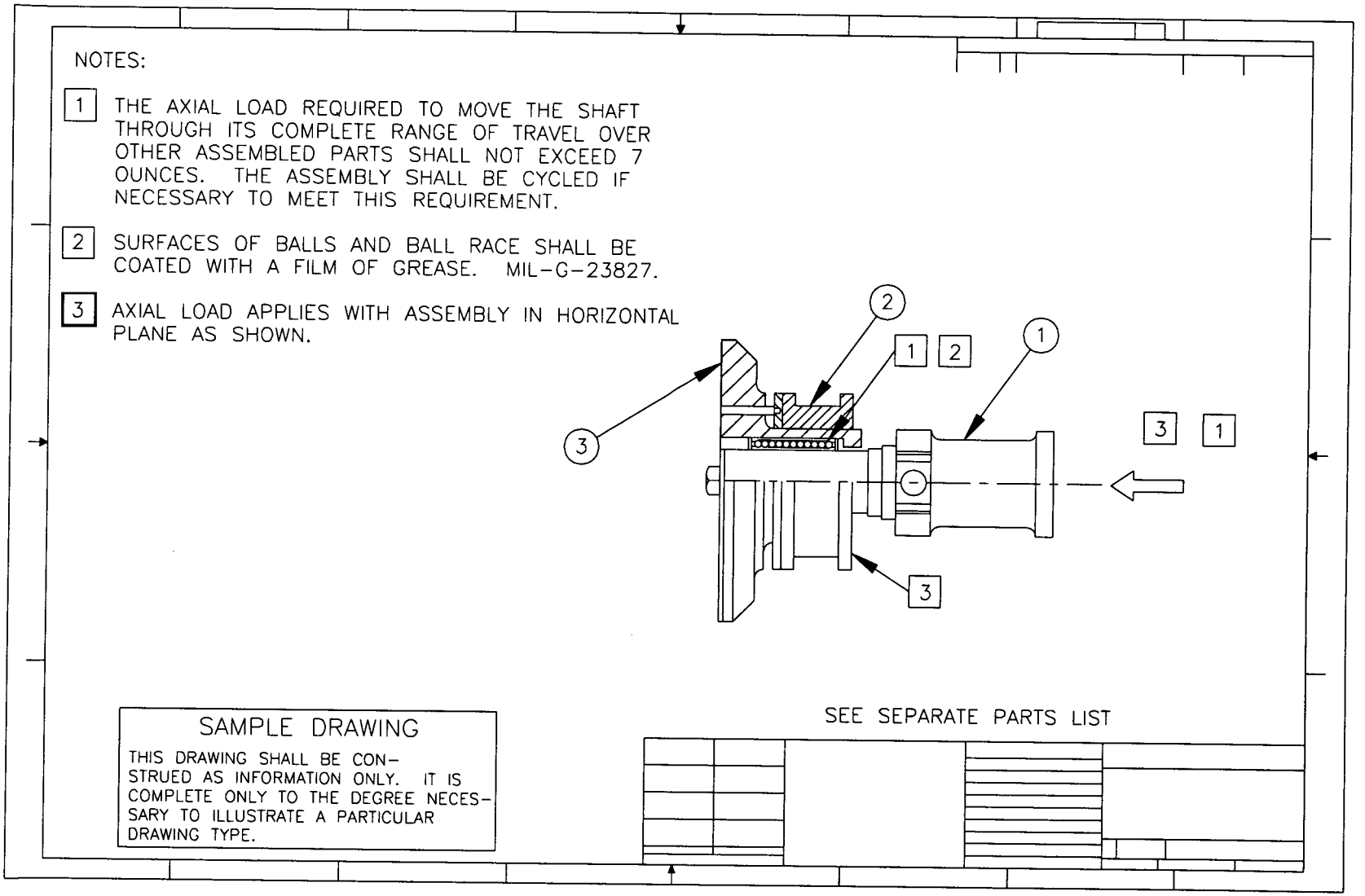


FIG. 7 ASSEMBLY DRAWING

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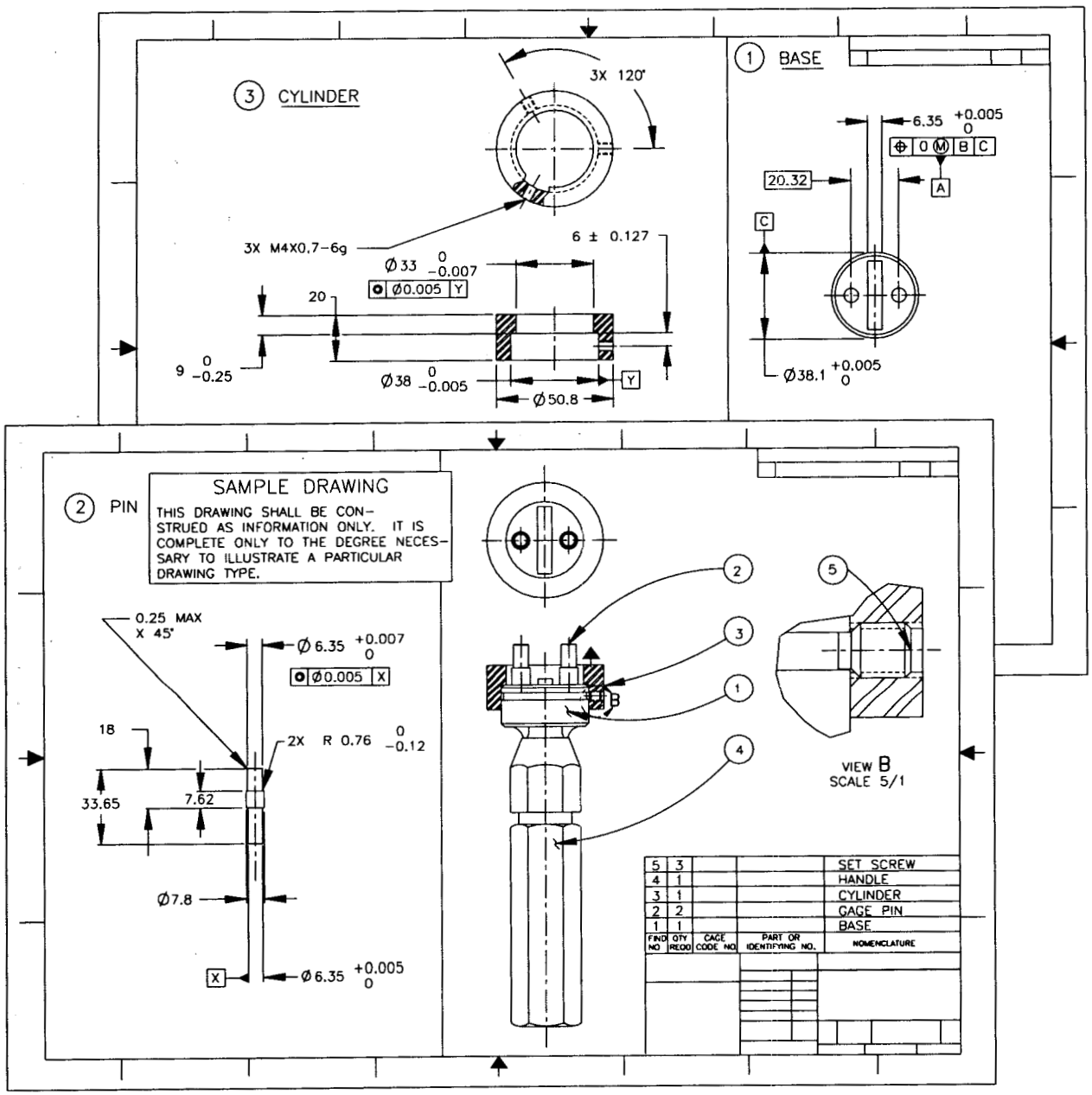


FIG. 8 DETAIL ASSEMBLY DRAWING

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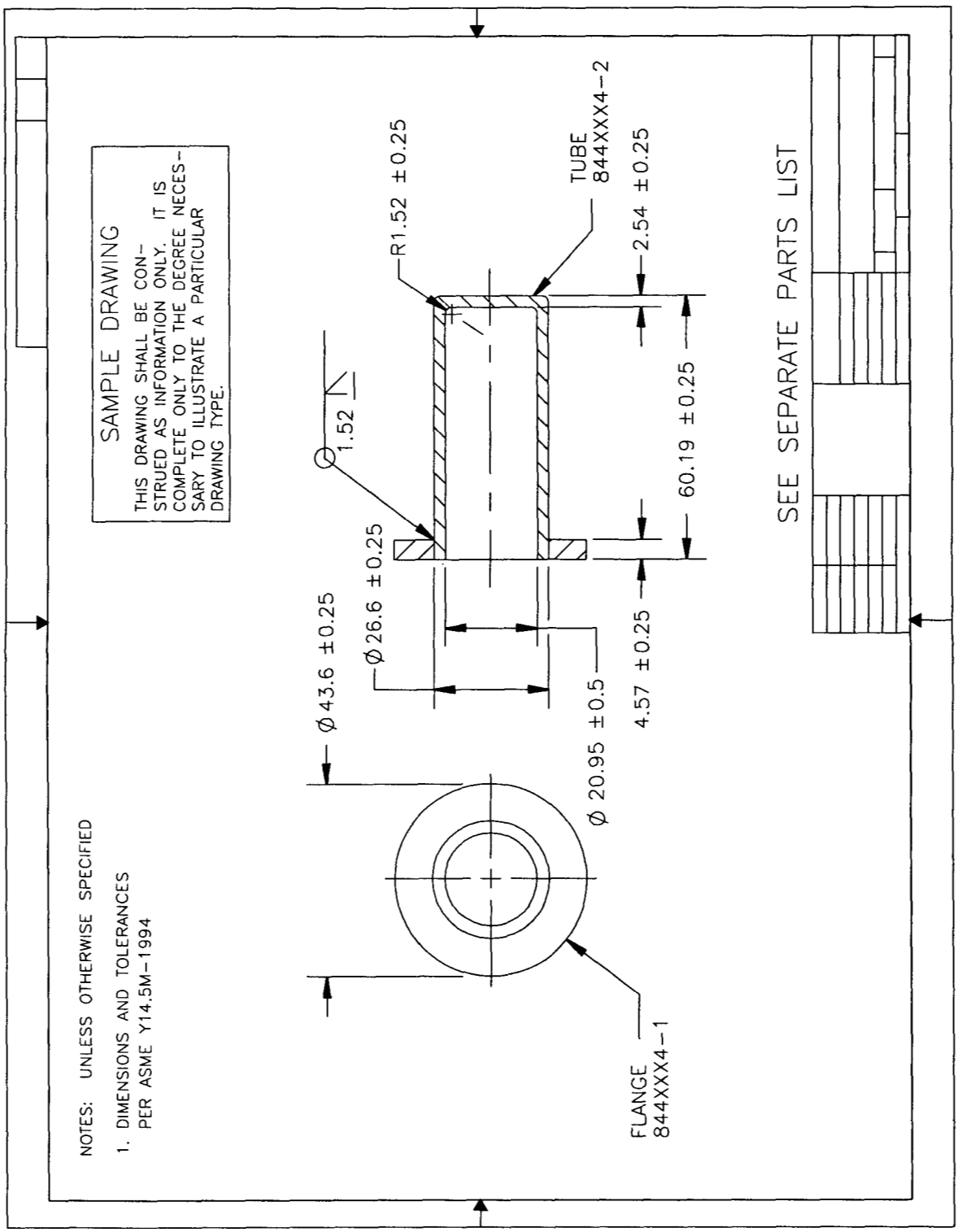


FIG. 9 INSEPARABLE ASSEMBLY DRAWING

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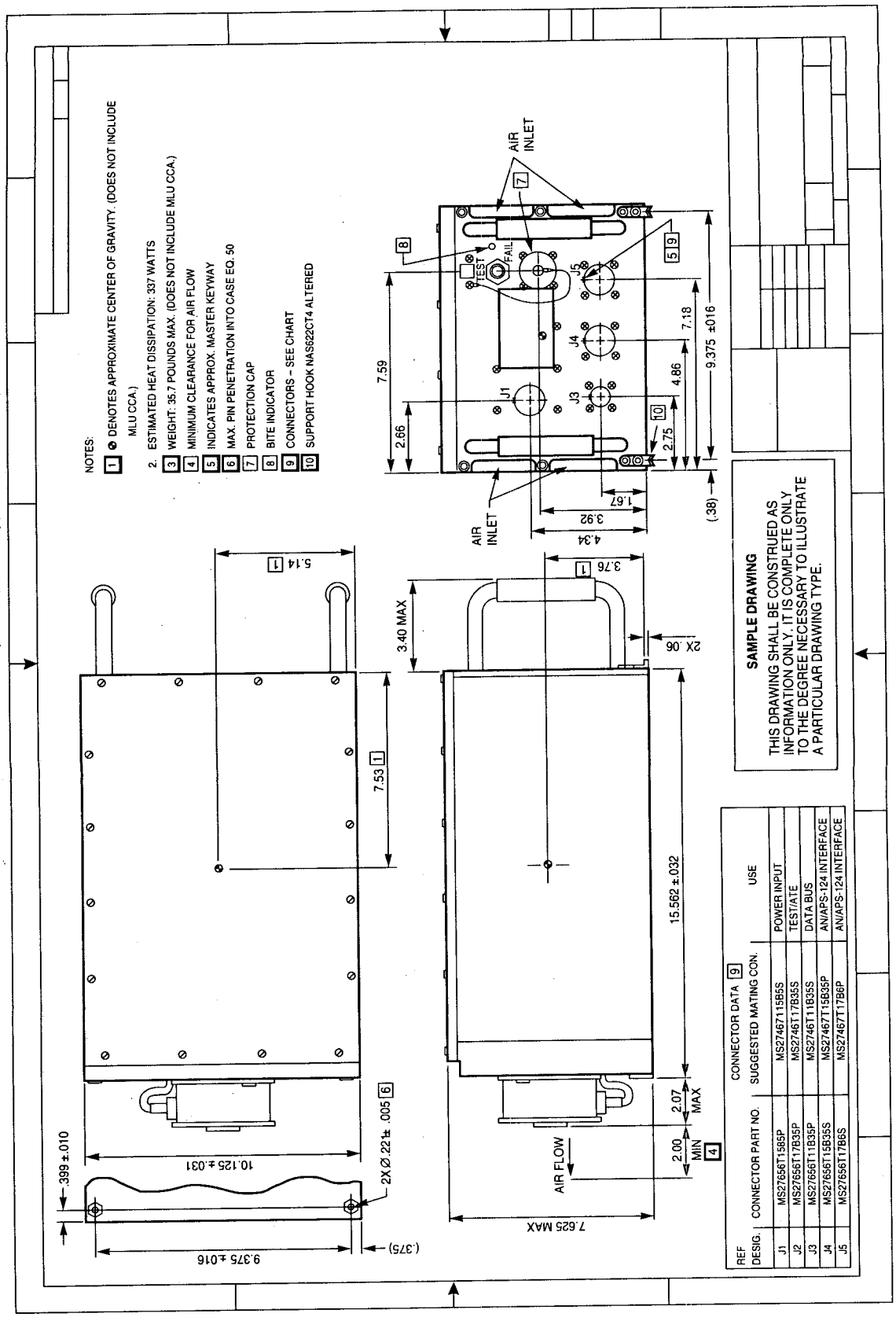


FIG. 10 INSTALLATION DRAWING

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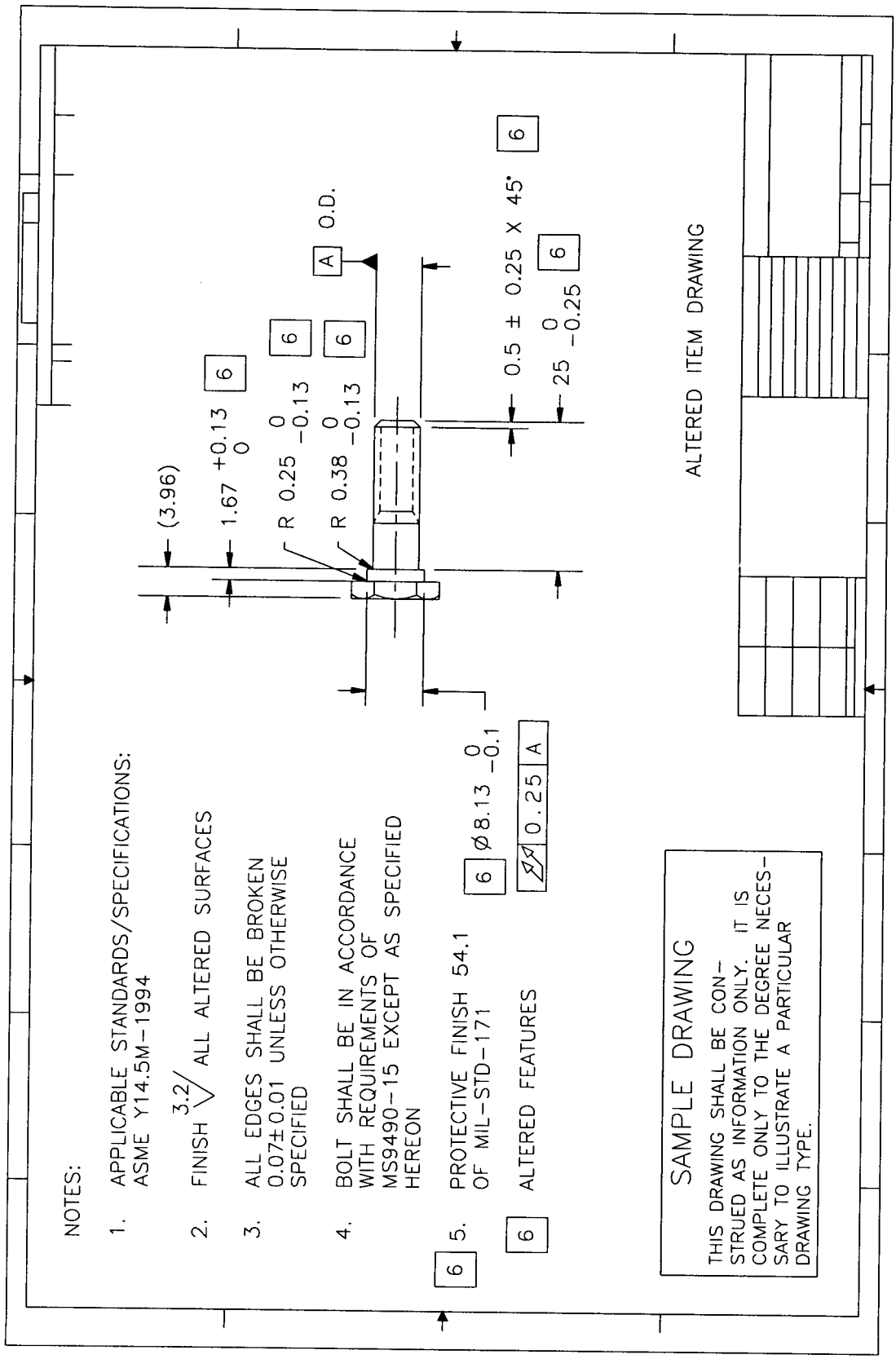


FIG. 11 ALTERED ITEM DRAWING (Mechanical Alteration)

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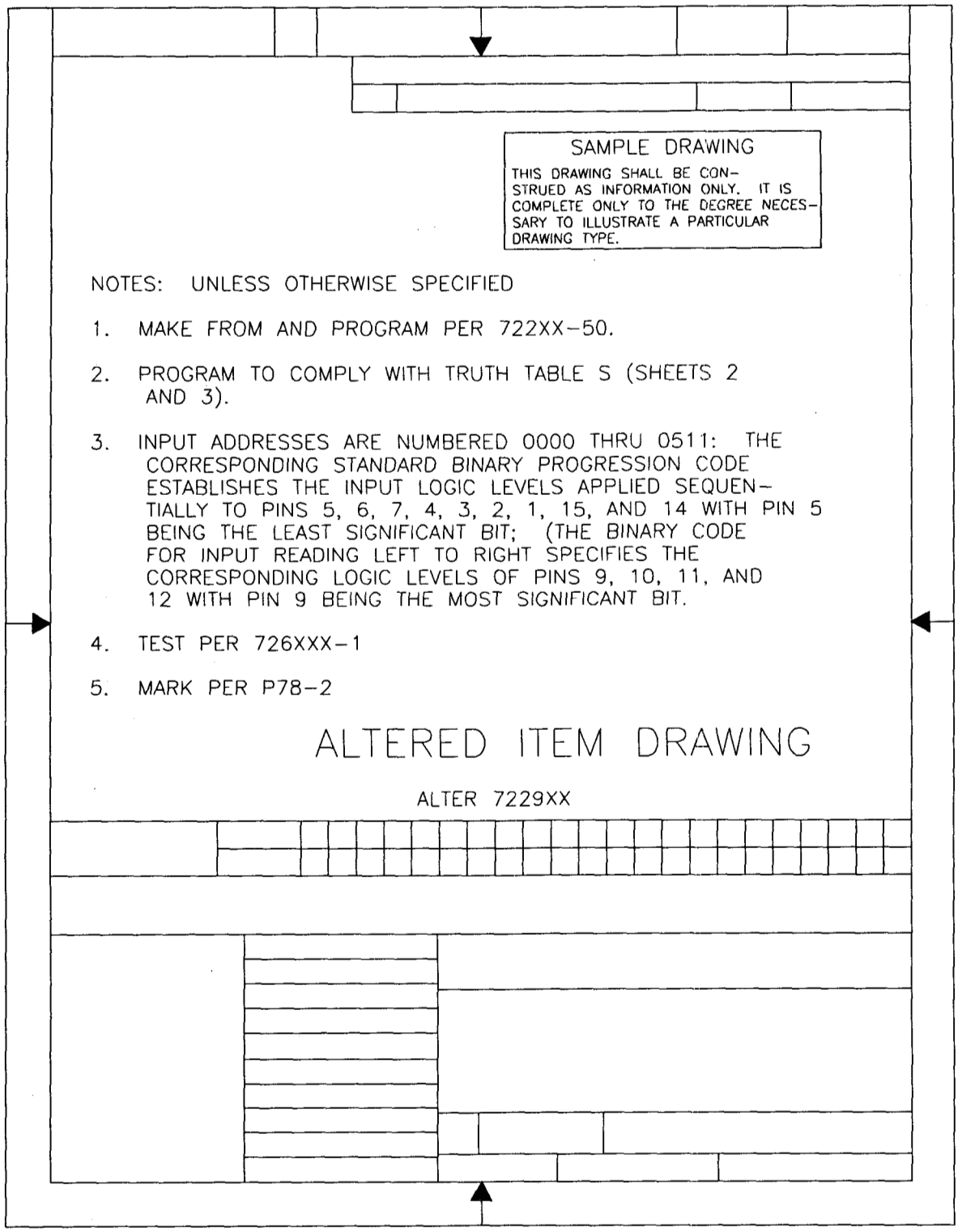


FIG. 12 ALTERED ITEM DRAWING (Electrical Alteration)

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6.1.2 Application Guidelines. An altered item drawing is prepared when alteration of an existing item is required. An altered item drawing shall not be prepared to modify an existing item that was developed by the design activity.

6.1.3 Requirements. An altered item drawing includes

(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 altered item drawing, or provided by reference to a *design disclosure drawing*, a vendor item control drawing, or source control drawing as applicable.

(b) complete details of the alteration.

(c) a unique identifier assigned to the altered item.

(d) re-identification marking requirements; the original item identification being replaced shall be removed or obliterated, if this can be done without damage to the item. (However, microcircuit re-identification 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) the notation ALTERED ITEM DRAWING adjacent to the drawing *title block.*

(f) a parts list when the alteration necessitates any additional item(s) to produce the altered item.

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

6.2 Selected Item Drawing (Figs. 13 and 14)

6.2.1 Description. A selected item drawing defines refined *acceptance criteria* for an existing item under the control of another design activity or defined by a nationally recognized standard which requires further selection, restriction, or testing for such characteristics as fit, tolerance, 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.

A selected item drawing 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, demonstratively different from other items which meet only the requirements imposed on the original item.

6.2.2 Application Guidelines. A selected item drawing 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; and

(c) survive *burn-in* or *run-in* requirements.

A selected item drawing shall not be prepared to select items that were developed by the design activity.

6.2.3 Requirements. A selected item drawing establishes the detailed criteria on which selection of the item is based including

(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 selected item drawing, or provided by reference to a design disclosure drawing, a vendor item control drawing, or source control drawing as applicable.

(b) full disclosure of the range of restricted characteristics (for example: fit, tolerance, performance, reliability, etc.).

(c) a unique identifier assigned to the selected item.

(d) re-identification marking requirements; the original item identification being replaced shall be removed or obliterated, if this can be done without damage to the item. (However, microcircuit re-identification 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) above are met and the item is noted SELECTED ITEM.

6.3 Modification Drawing (Fig. 15)

6.3.1 Description. A modification drawing delineates changes to items after they have been delivered. When required for control purposes, a modification drawing shall require re-identification of the modified item.

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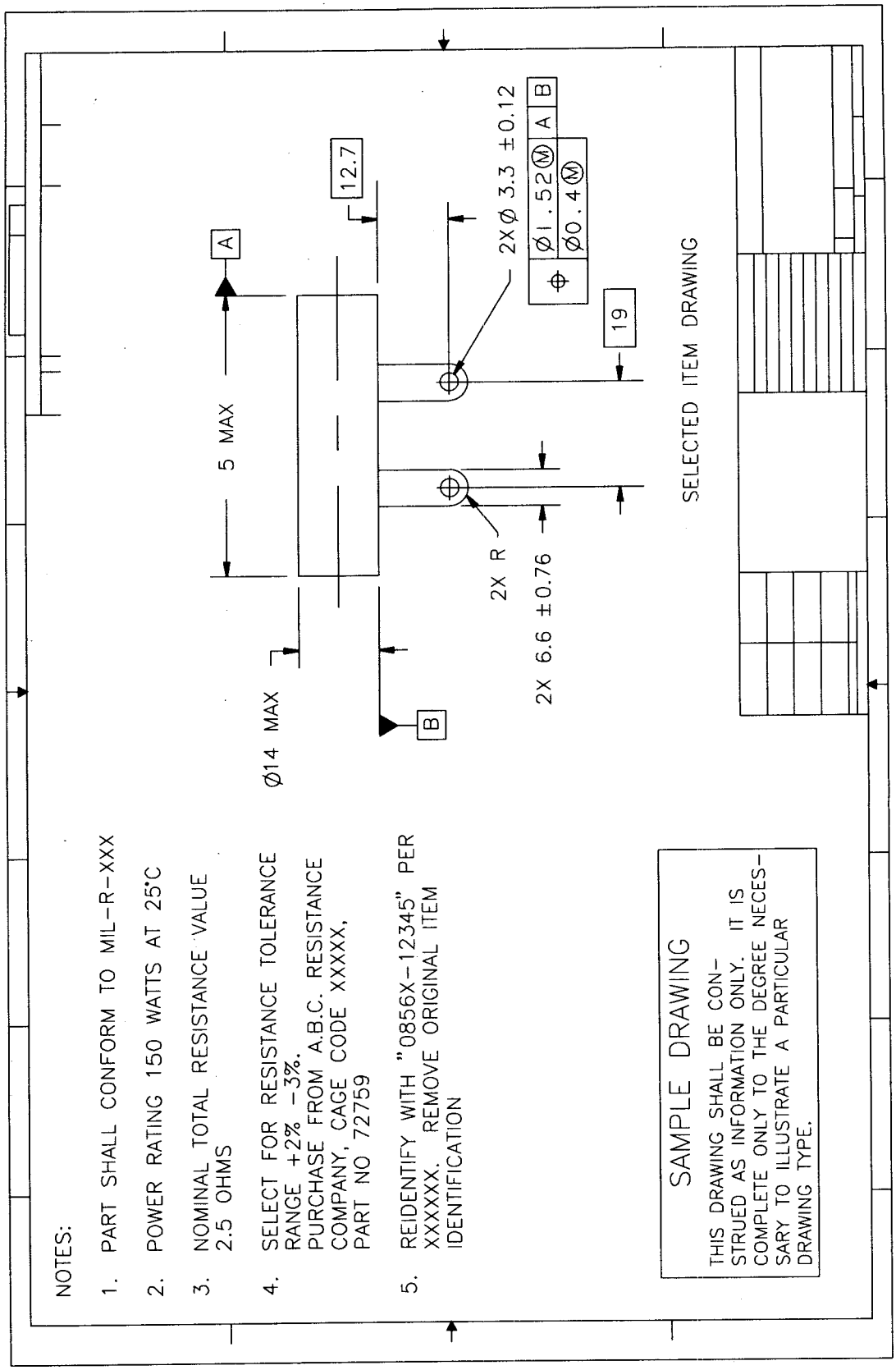


FIG. 13 SELECTED ITEM DRAWING (Mechanical Selection)

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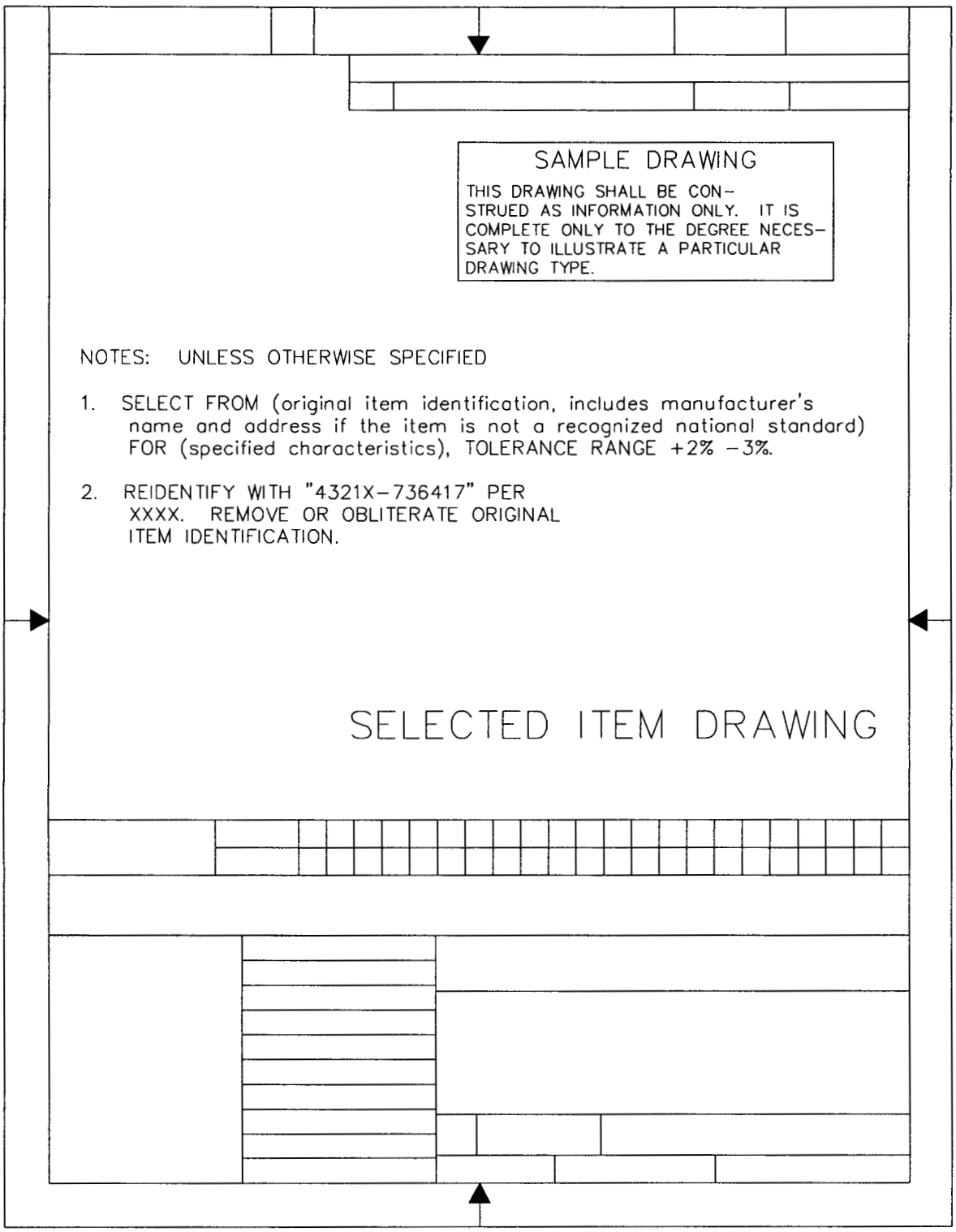


FIG. 14 SELECTED ITEM DRAWING (Electrical Selection)

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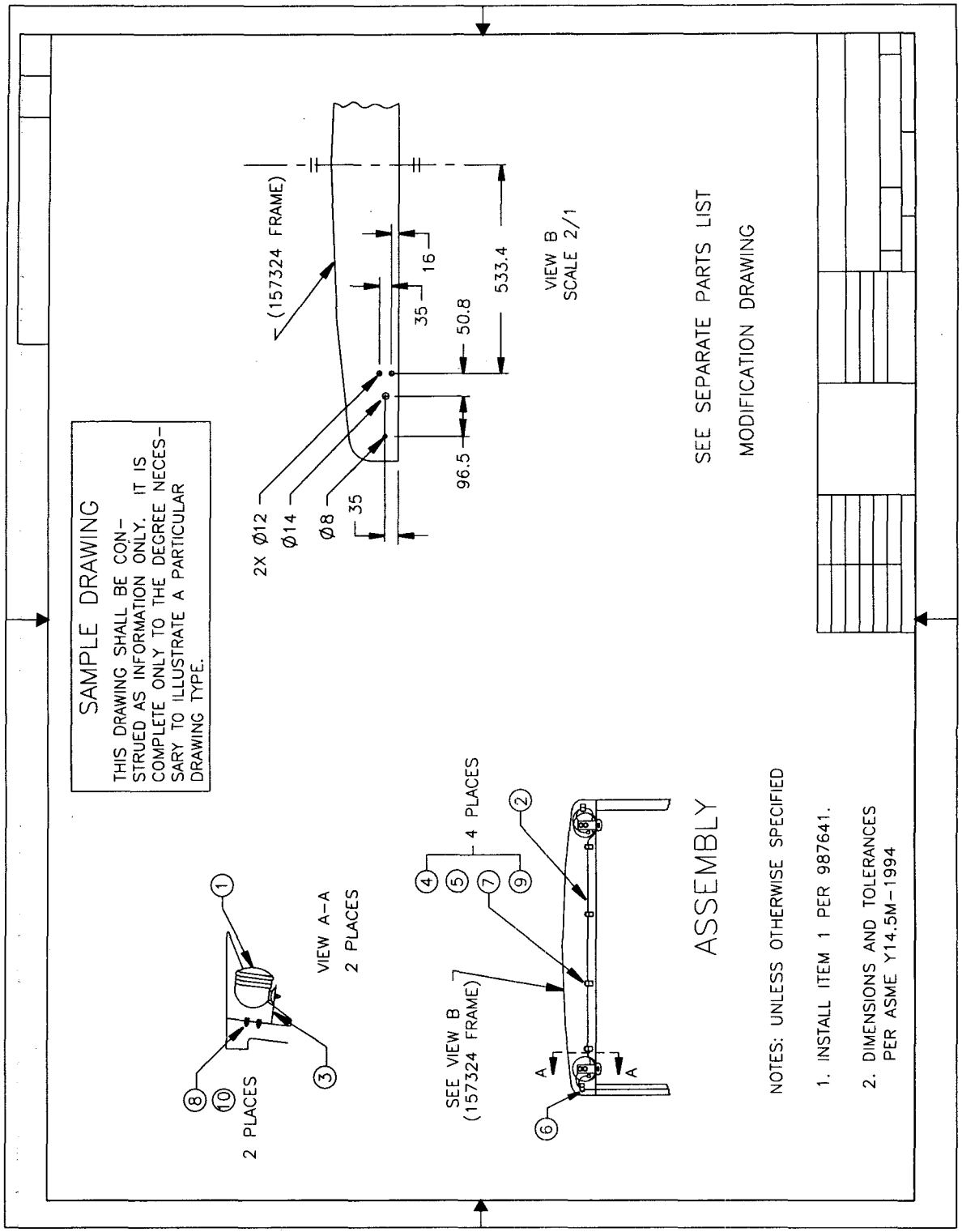


FIG. 15 MODIFICATION DRAWING

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6.3.2 Application Guidelines. A modification drawing is prepared to add, remove, or rework items to satisfy the user's requirements or to incorporate mandatory changes (for example, those which affect safety, reliability, or application extension) in delivered equipment. A modification drawing is not a substitute for existing drawing types used to produce the item(s) prior to modification (for example, detail and assembly drawings). Engineering changes are incorporated into the latter drawing types to the extent that future production is to reflect the modifications.

6.3.3 Requirements. A modification drawing contains complete information for accomplishing the changes including, as applicable,

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

(b) special notes.

(c) item identification of affected items prior to modification.

(d) effectivity (serial number, aircraft tail number, etc.) of items to be modified.

(e) instructions for re-identification of modified items.

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

(g) a parts list (see para. 1.7) identifying all items required for the modification.

(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. (optional).

7 ARRANGEMENT DRAWING (Fig. 16)

7.1 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.

7.2 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.

7.3 Requirements

An arrangement drawing includes, as applicable,

(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; and

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

8 CONTROL DRAWINGS[1]

A control drawing is a drawing disclosing engineering form, fit, function, and performance requirements for the acquisition of interchangeable purchased items of existing designs, or of items specially developed by vendors to the control drawing requirements. Control drawings permit the acquisition of *vendor-developed items* from specialized segments of industry without disclosing details of designs or divulging proprietary *vendor* data.

8.1 Procurement Control Drawing (Fig. 17)

8.1.1 Description. A procurement control drawing provides criteria for performance, acceptance, and identification of purchased items by disclosing the engineering design characteristics required: (1) for control of interfaces, and (2) to ensure repeatability of performance.

8.1.2 Application Guidelines. A procurement control drawing may be prepared in lieu of another type of control drawing to specify criteria for

(a) a purchased item,

(b) the alteration of a purchased item or an item defined by a nationally recognized standard,

(c) the selection of a purchased item or an item defined by a nationally recognized standard,

(d) the development and *qualification* of a new item, and

[1] Nonmandatory Appendix A provides guidance to aid in selecting the appropriate control drawing type. It should be used in support of the Application Guidelines for the specific drawing types.

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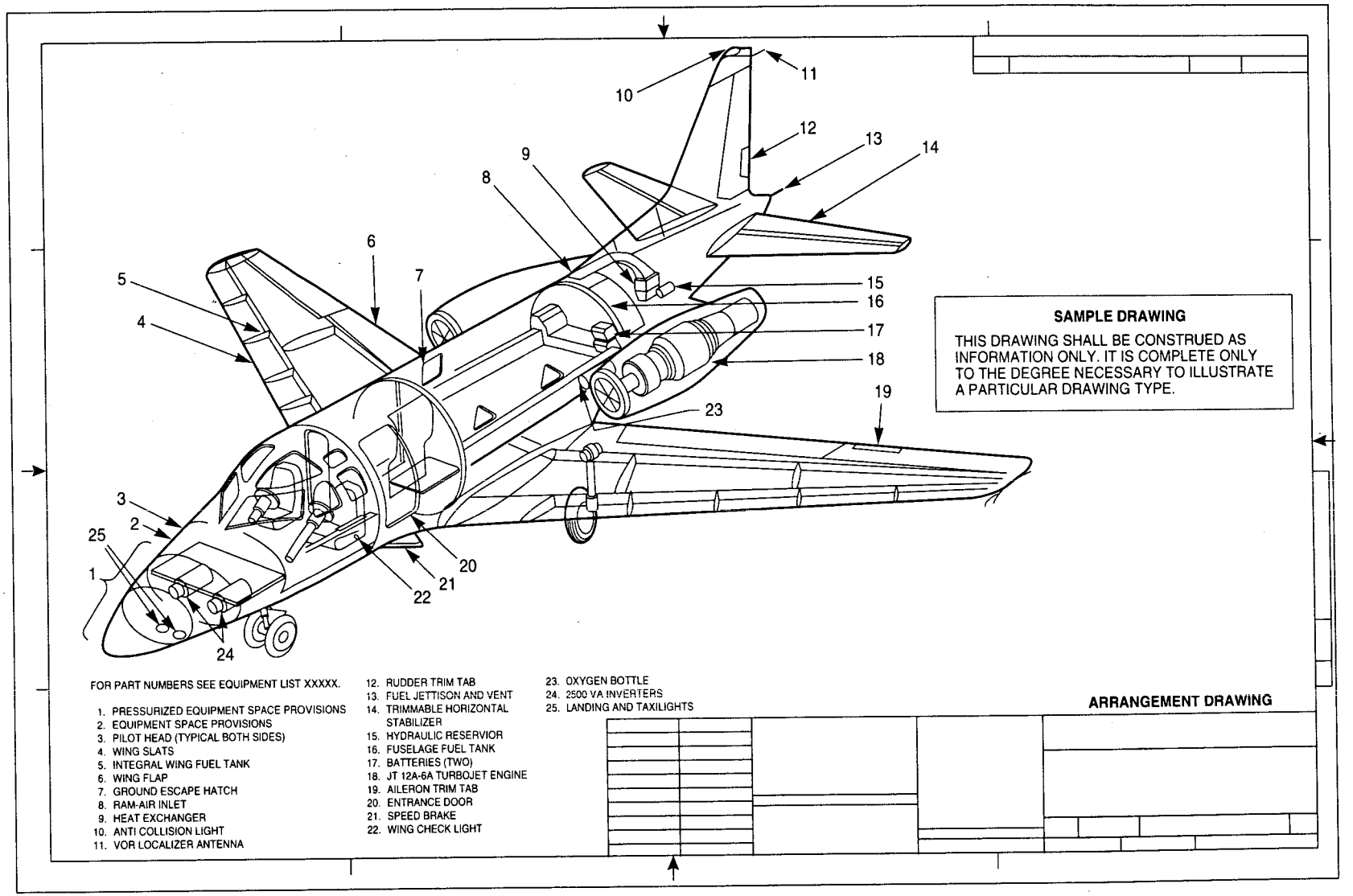


FIG. 16 ARRANGEMENT DRAWING (Pictorial)

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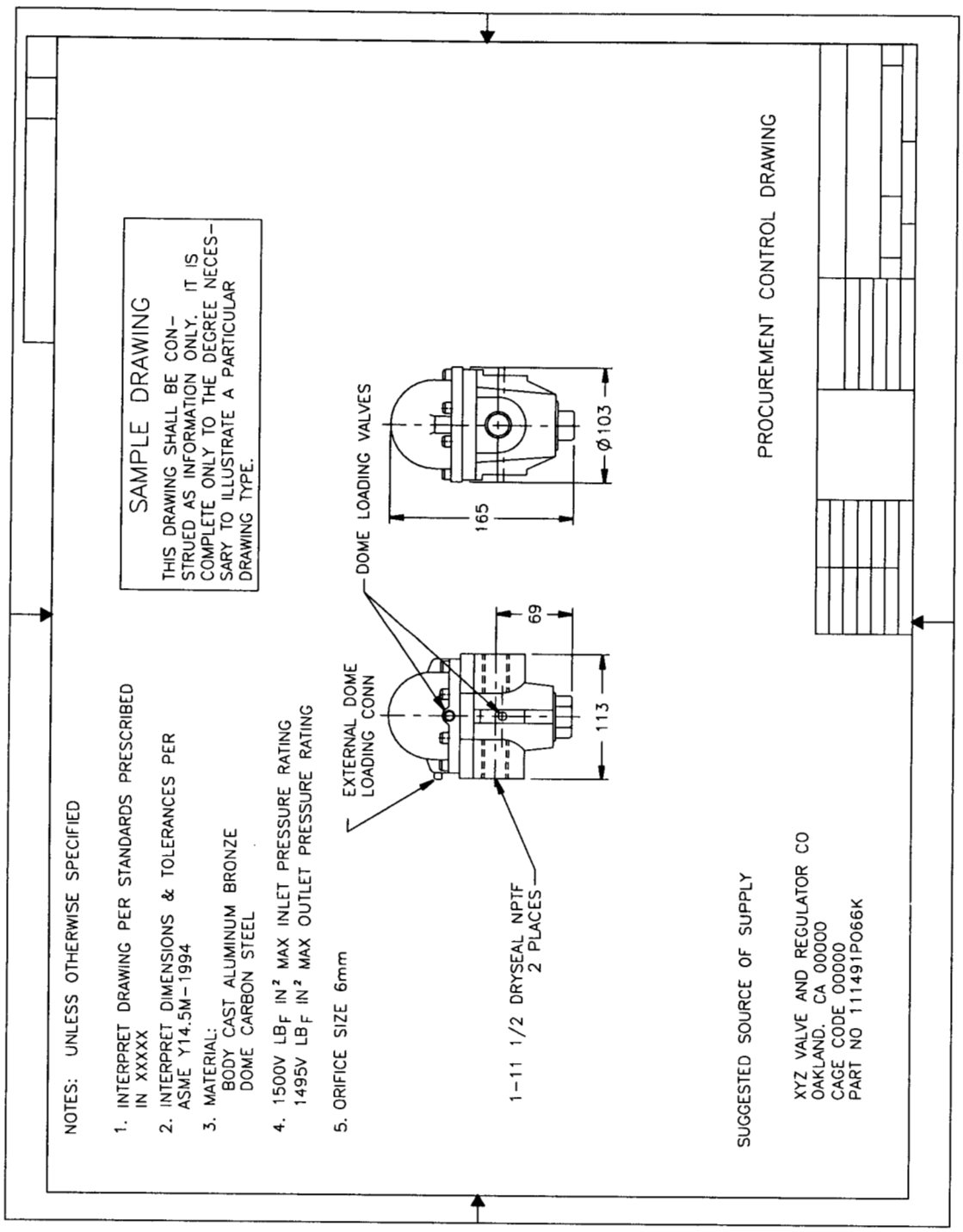


FIG. 17 PROCUREMENT CONTROL DRAWING

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(e) item identification.

8.1.3 Requirements

8.1.3.1. A procurement control drawing includes, as applicable,

(a) performance requirements to ensure that performance characteristics critical to the intended application are met;

(b) envelope dimensions to ensure physical interchangeability in using assemblies;

(c) interface characteristics to ensure functional interchangeability in using assemblies;

(d) qualification requirements necessary to verify that performance requirements and physical and functional interchangeability can be provided by each proposed source;

(e) identification requirements including marking instructions, lot serialization, etc.;

(f) procurement data (approved or suggested sources, qualification required for procurement of item from alternate sources, etc.); and

(g) acceptance criteria to verify that requirements established by (a) through (f) are met by each item or lot of items received by the purchaser and to identify any variations between items or lots of items.

8.1.3.2. A procurement control drawing shall include the notation PROCUREMENT CONTROL DRAWING adjacent to the drawing title block.

8.2 Vendor Item Control Drawing (Fig. 18)

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

8.2.1 Description. A vendor item control drawing provides an engineering description and acceptance criteria for *commercial items* or *vendor-developed* items that are procurable from a *specialized segment of industry*. The manufacturer's (vendor's) part or identifying number is the item identification. 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 item control drawing number with suffixed identifier, if applicable, establishes the administrative control number(s) for identifying the item(s) on engineering documentation.

8.2.2 Application Guidelines

8.2.2.1 A vendor item control drawing is used to provide

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

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

(c) documentation to assure 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 vendor item control drawing to portray a complete design disclosure.

8.2.2.2 A vendor item control drawing shall not be used to delineate

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

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

(c) a purchased item upon which a design activity has placed requirements in addition to those normally provided by the vendor. The item shall be delineated on either an altered or selected item drawing, as appropriate. The addition of the administrative control number does not constitute item reidentification or alteration.

8.2.2.3 The suggested source(s) listed on a vendor item control drawing are not intended to represent the only sources for the item.

8.2.3 Requirements. A vendor item control drawing discloses sufficient information to ensure identification and reprocurement of *interchangeable items.*

8.2.3.1 The drawing includes, as applicable,

(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; and

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

8.2.3.2 The drawing shall include

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

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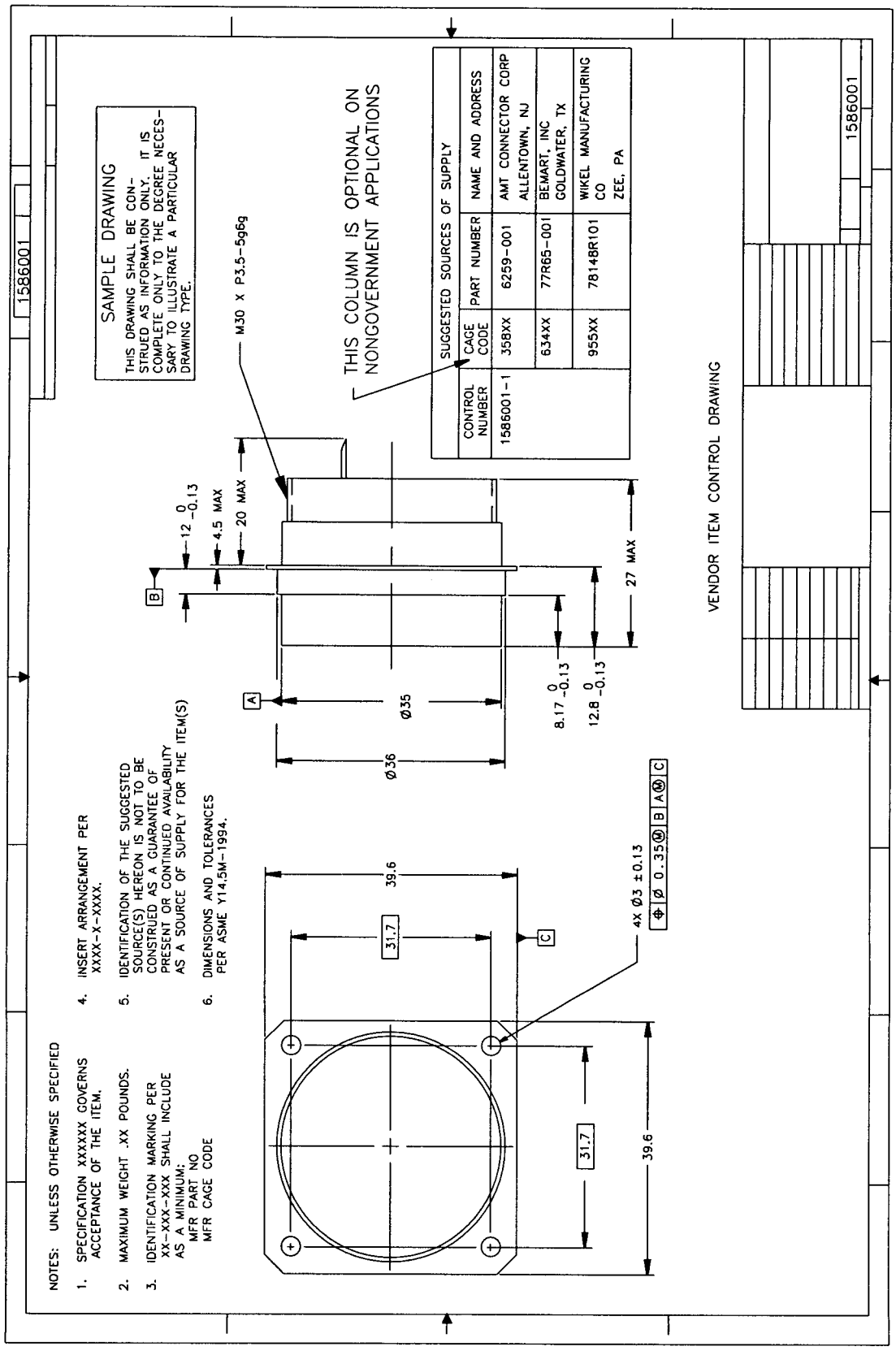


FIG. 18 VENDOR ITEM CONTROL DRAWING

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(b) the 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 ITEMS(S).

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

8.3 Source Control Drawing (Fig. 19)

8.3.1 Description. A source control drawing provides an engineering description, qualification requirements, and acceptance criteria for commercial items or vendor-developed items procurable from a *specialized segment of industry*, that provide 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 source control drawing number, and applicable suffixed identifiers, establishes the source control item identification.

8.3.2 Application Guidelines

8.3.2.1 A source control drawing 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.

NOTE: "Critical application" as used herein refers to those uses where failure of the item would result in one or more of the following conditions: (a) endanger life or cause personal injury; (b) loss or damage to equipment; and (c) degrade the performance to a point that would jeopardize its capacity to fulfill its intended function.

(c) documentation to assure 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 a source control drawing to define a complete design disclosure.

8.3.2.2 A source control drawing shall not be used to delineate

(a) an item which does not require qualification in advance of a procurement action. If qualification is not required, the item is normally a candidate for vendor item control drawing 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.

8.3.3 Requirements. A source control drawing discloses sufficient information to ensure identification and reprocurement of acceptable items.

NOTE: Preparation requirements for a source control drawing are identical to a vendor item control drawing 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.

8.3.3.1 The drawing includes, as applicable,

(a) requirements of a vendor item control drawing specified in para. 8.2.3.1.

(b) qualification and approval requirements.

(c) identification requirements, including marking instructions that clearly differentiate between the source control PIN and the vendor PIN. For example, the source control identification may include a design activity identifier, (e.g., *CAGE Code*), the notation SOCN, and the PIN.

8.3.3.2 The drawing 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.

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

(c) the 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.

8.4 Envelope Drawing (Fig. 20)

8.4.1 Description. An envelope drawing discloses the basic technical data and performance requirements necessary for development, or design selection of an

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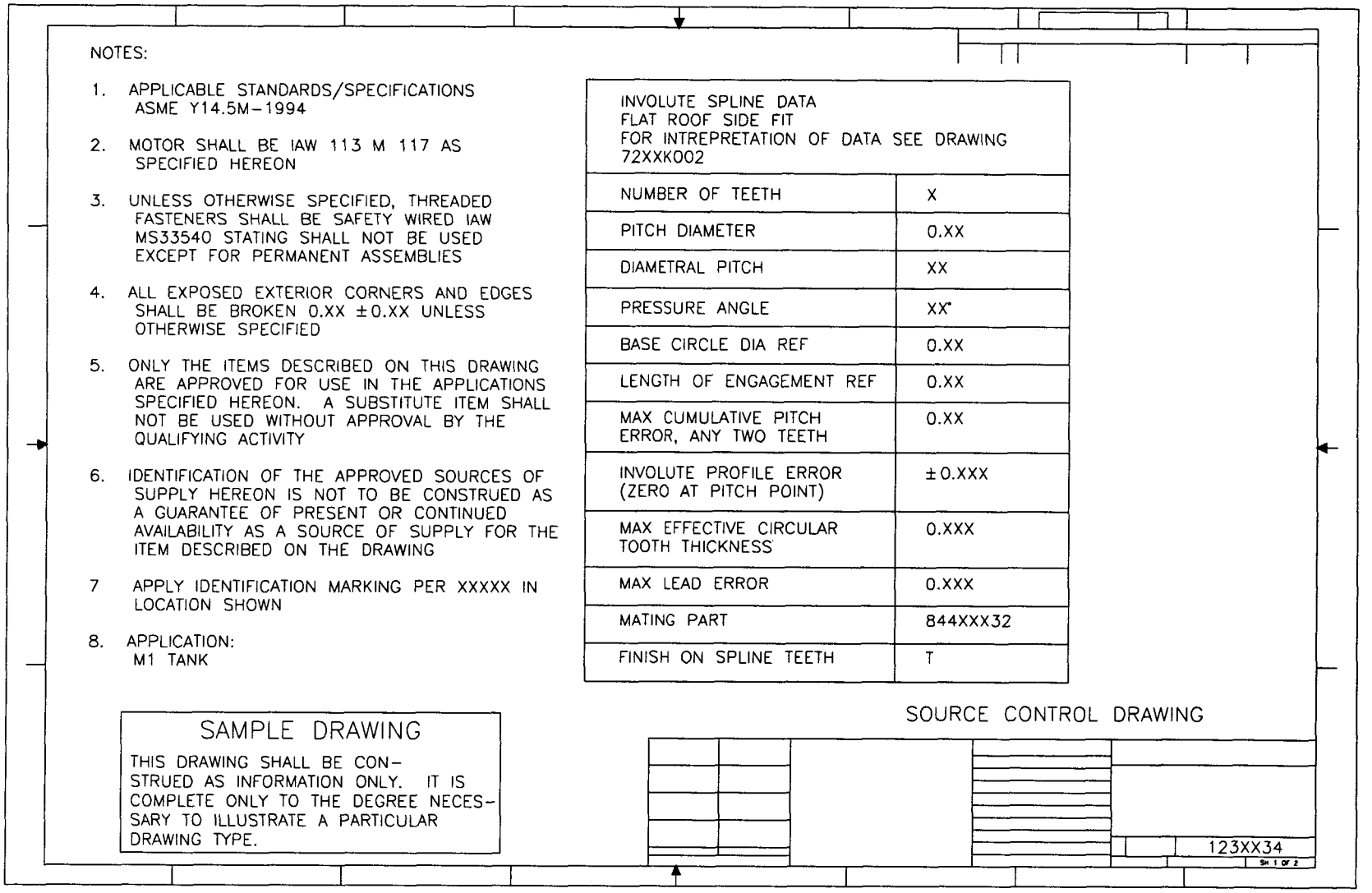


FIG. 19 SOURCE CONTROL DRAWING (Sheet 1 of 2)

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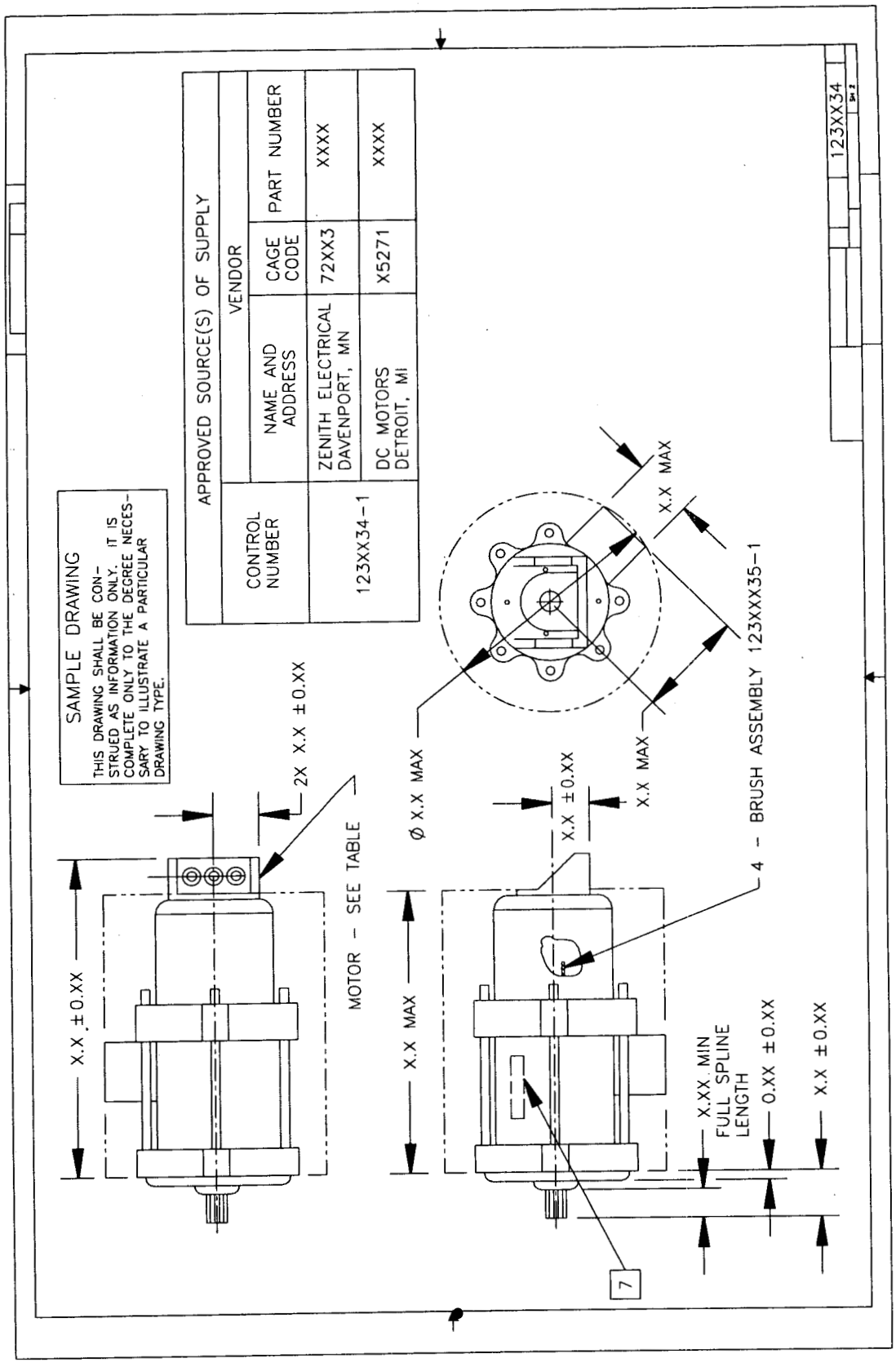


FIG. 19 SOURCE CONTROL DRAWING (Sheet 2 of 2)

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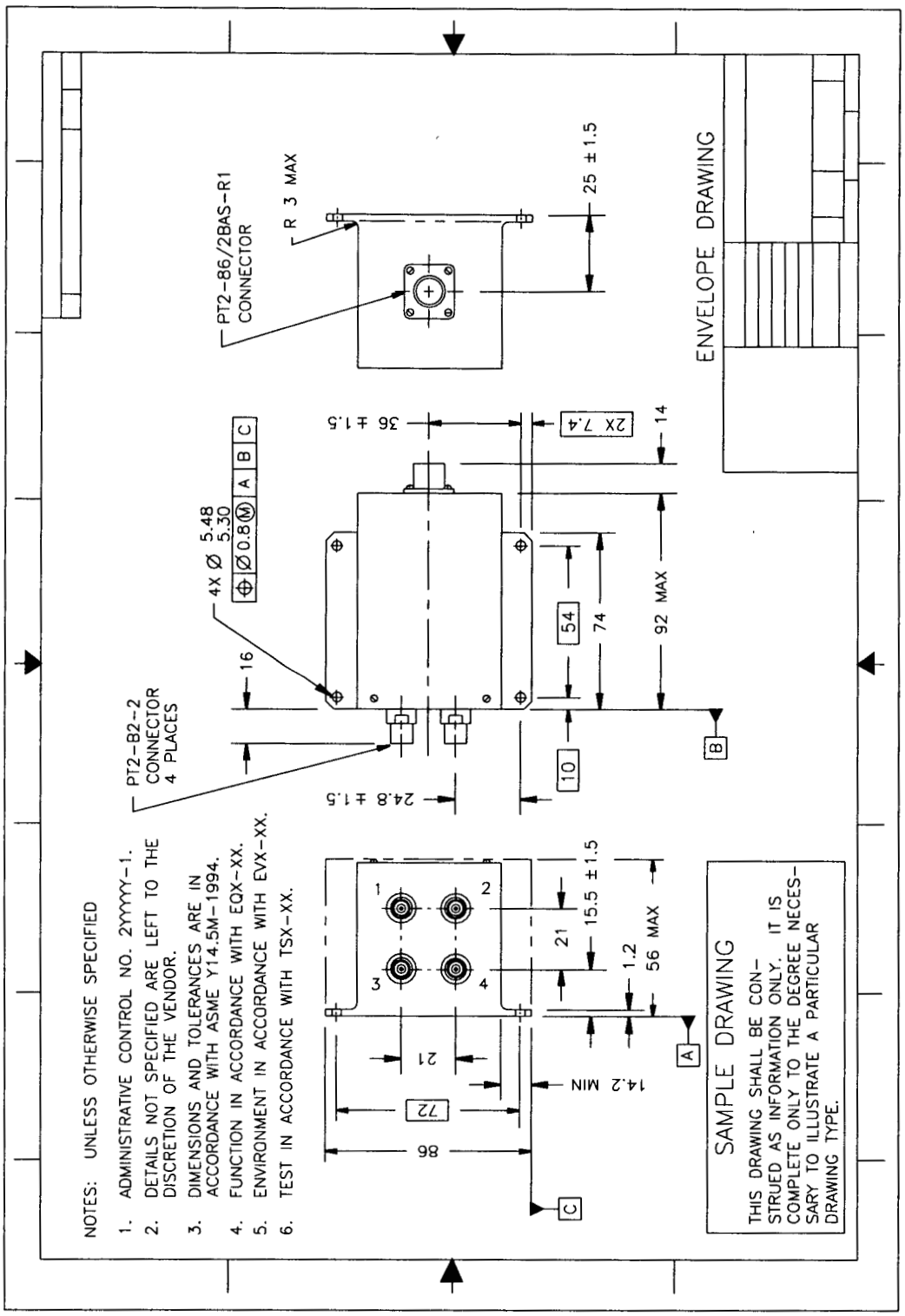


FIG. 20 ENVELOPE DRAWING

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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, specifications, or vendor item control or source control drawings, as applicable.

8.4.2 Application Guidelines. An envelope drawing is prepared to

(a) establish the technical definition necessary for development of a new item, or

(b) define requirements for vendor item selection.

8.4.3 Requirements. Preparation requirements for an envelope drawing are identical to a vendor item control drawing or source control drawing, as applicable, except for the requirements of paras. 8.2.3.2 and 8.3.3.2. The drawing shall include the notation ENVELOPE DRAWING placed adjacent to the drawing title block.

9 INTERFACE DRAWING (Fig. 21)

9.1 Description

An interface drawing depicts physical and functional interfaces of related or co-functioning items. It does not establish item identification.

9.2 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 related or cofunctioning systems, and

(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, interconnections, configuration, installation, operational sequence requirements, system switching, etc. Each interface type may be described in a separate interface drawing or in combination on a single drawing.

9.3 Requirements

An interface drawing includes, as applicable,

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

(b) complete interface engineering requirements (mechanical, electrical, electronic, hydraulic, pneumatic, optical, etc.) that affect the physical or functional characteristics of the co-functioning items; and

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

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

10 IDENTIFICATION CROSS REFERENCE DRAWING (Fig. 22)

10.1 Description

An identification cross reference drawing is an administrative type drawing which assigns unique identifiers to provide a cross reference to the original incompatible identifier. This drawing does not establish item identification.

10.2 Application Guidelines

An identification cross reference drawing is prepared to provide compatible identifiers for nationally recognized standards, customer furnished equipment, etc., when the original identifier is too long, contains characters unacceptable for data processing, or is identified by description only, etc.

10.3 Requirements

An identification cross reference drawing shall include

(a) assignment of the compatible identifier;

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

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

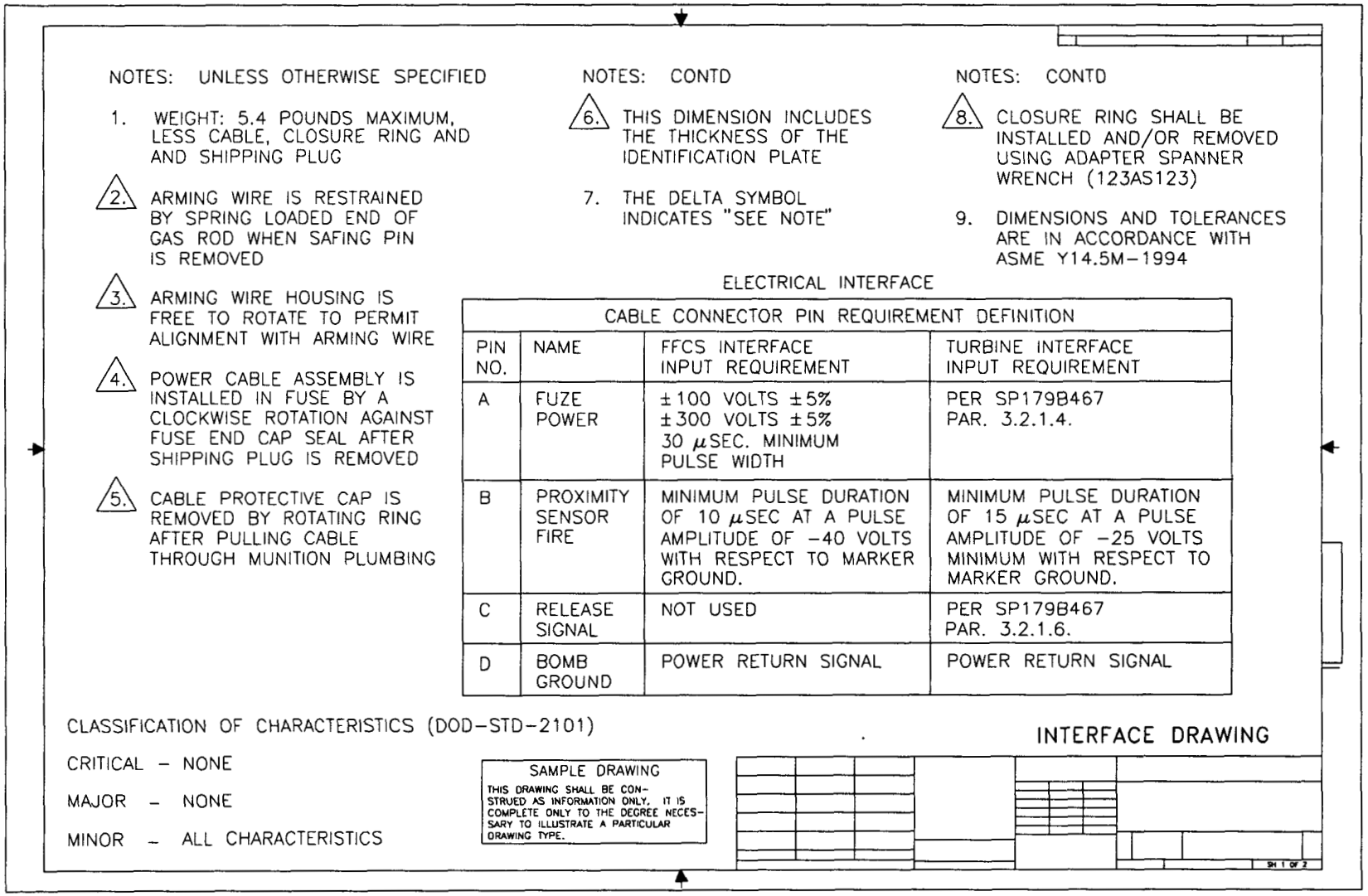
10.3.2 The identification cross reference drawing shall not specify any engineering or design requirements beyond those already contained in the drawings, specification, etc., governing the original item.

11 MECHANICAL SCHEMATIC DIAGRAM (Fig. 23)

11.1 Description

A mechanical schematic diagram depicts mechanical and other functional operation, structural loading, fluid circuitry, or other functions using appropriate standard

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NOTES: UNLESS OTHERWISE SPECIFIED

1. WEIGHT: 5.4 POUNDS MAXIMUM, LESS CABLE, CLOSURE RING AND AND SHIPPING PLUG

2. ARMING WIRE IS RESTRAINED BY SPRING LOADED END OF GAS ROD WHEN SAFING PIN IS REMOVED

3. ARMING WIRE HOUSING IS FREE TO ROTATE TO PERMIT ALIGNMENT WITH ARMING WIRE

4. POWER CABLE ASSEMBLY IS INSTALLED IN FUSE BY A CLOCKWISE ROTATION AGAINST FUSE END CAP SEAL AFTER SHIPPING PLUG IS REMOVED

5. CABLE PROTECTIVE CAP IS REMOVED BY ROTATING RING AFTER PULLING CABLE THROUGH MUNITION PLUMBING

NOTES: CONTD

6. THIS DIMENSION INCLUDES THE THICKNESS OF THE IDENTIFICATION PLATE

7. THE DELTA SYMBOL INDICATES "SEE NOTE"

NOTES: CONTD

8. CLOSURE RING SHALL BE INSTALLED AND/OR REMOVED USING ADAPTER SPANNER WRENCH (123AS123)

9. DIMENSIONS AND TOLERANCES ARE IN ACCORDANCE WITH ASME Y14.5M–1994

ELECTRICAL INTERFACE

CABLE CONNECTOR PIN REQUIREMENT DEFINITION

PIN NO.	NAME	FFCS INTERFACE INPUT REQUIREMENT	TURBINE INTERFACE INPUT REQUIREMENT
A	FUZE POWER	±100 VOLTS ±5% ±300 VOLTS ±5% 30 μSEC. MINIMUM PULSE WIDTH	PER SP179B467 PAR. 3.2.1.4.
B	PROXIMITY SENSOR FIRE	MINIMUM PULSE DURATION OF 10 μSEC AT A PULSE AMPLITUDE OF −40 VOLTS WITH RESPECT TO MARKER GROUND.	MINIMUM PULSE DURATION OF 15 μSEC AT A PULSE AMPLITUDE OF −25 VOLTS MINIMUM WITH RESPECT TO MARKER GROUND.
C	RELEASE SIGNAL	NOT USED	PER SP179B467 PAR. 3.2.1.6.
D	BOMB GROUND	POWER RETURN SIGNAL	POWER RETURN SIGNAL

CLASSIFICATION OF CHARACTERISTICS (DOD–STD–2101)

CRITICAL – NONE

MAJOR – NONE

MINOR – ALL CHARACTERISTICS

SAMPLE DRAWING

THIS DRAWING SHALL BE CONSTRUED AS INFORMATION ONLY. IT IS COMPLETE ONLY TO THE DEGREE NECESSARY TO ILLUSTRATE A PARTICULAR DRAWING TYPE.

INTERFACE DRAWING

SH 1 OF 2

FIG. 21 INTERFACE DRAWING (Sheet 1 of 2)

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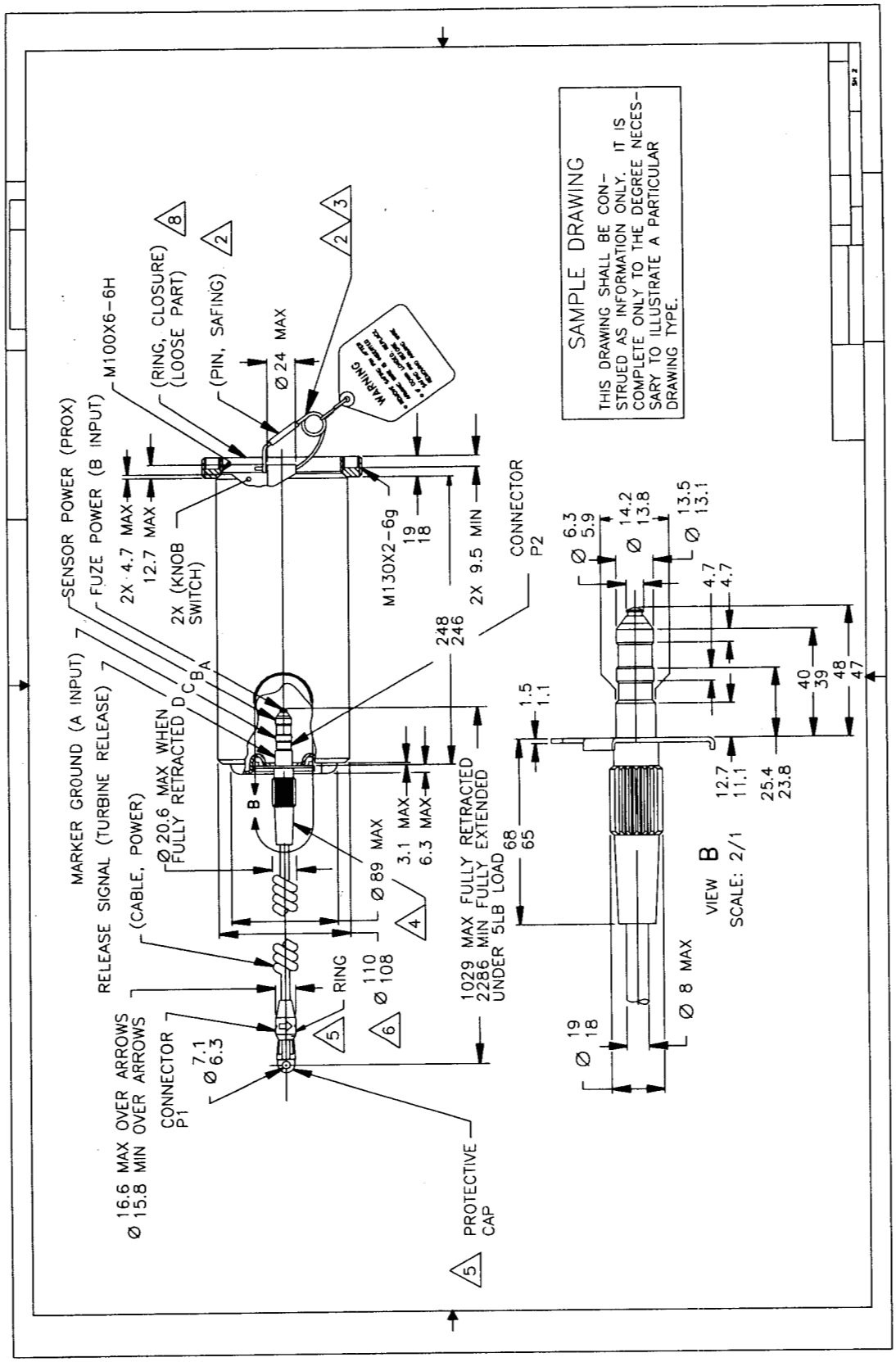


FIG. 21 INTERFACE DRAWING (Sheet 2 of 2)

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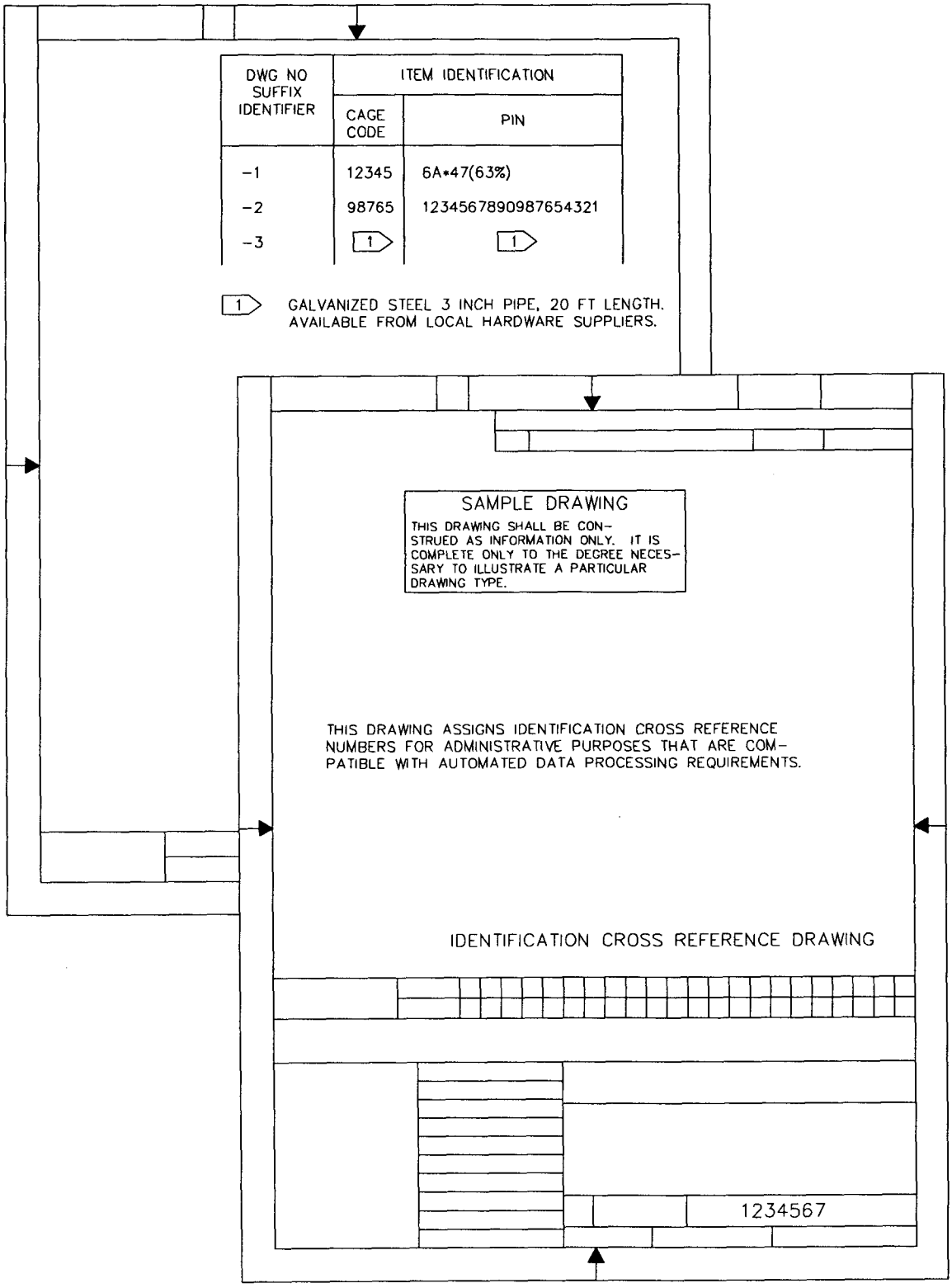


FIG. 22 IDENTIFICATION CROSS REFERENCE DRAWING

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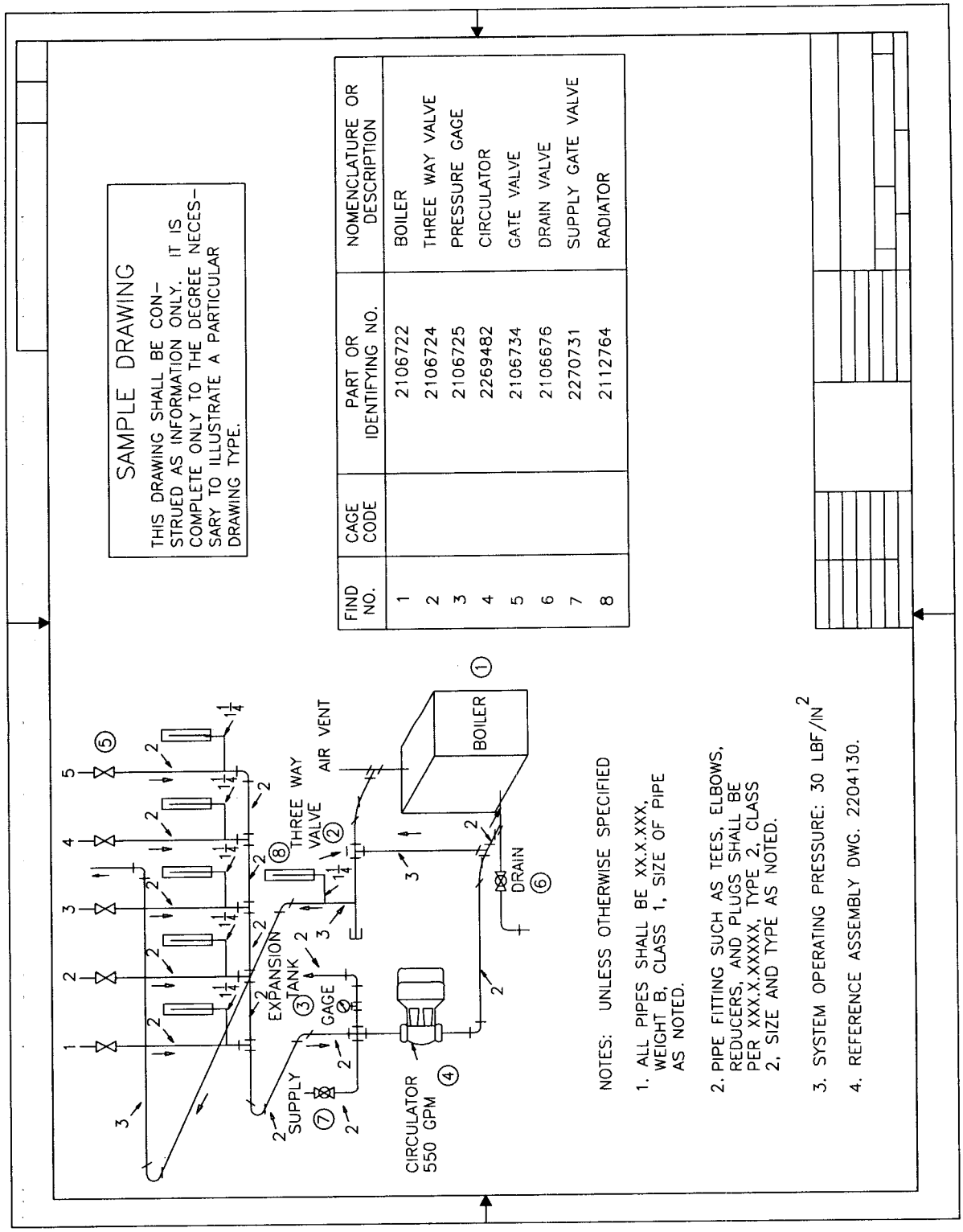


FIG. 23 MECHANICAL SCHEMATIC DIAGRAM

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symbols and connecting lines. Although it contains design information, it does not establish item identification of the item(s) delineated thereon.

11.2 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 (complex arrangement of gears, clutches, linkages, cams, etc.);

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

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

11.3 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 may 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.

12 ELECTRICAL/ELECTRONIC DIAGRAMS (Figs. 24 through 32)

Electrical/electronic diagrams depict the elements or functions of electrical or electronic items using standard symbols in accordance with ANSI/IEEE 91 and IEEE 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 except as specified in para. 12.6.1.

12.1 Functional Block Diagram (Fig. 24)

12.1.1 Description. A functional block diagram depicts the functions of the major elements of a circuit, assembly, system, etc., in simplified form.

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

12.1.3 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.

12.2 Single Line Diagram (Fig. 25)

12.2.1 Description. A single line diagram depicts the course of electrical/electronics 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.

12.2.2 Application Guidelines. The single line form of presentation provides for

(a) simplified diagrams of complex circuits; and

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

12.2.3 Requirements. A single line diagram includes, as applicable,

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

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

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

12.3 Schematic Diagram or Circuit Diagram (Fig. 26)

12.3.1 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.

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

12.3.3 Requirements. A schematic diagram includes, as applicable,

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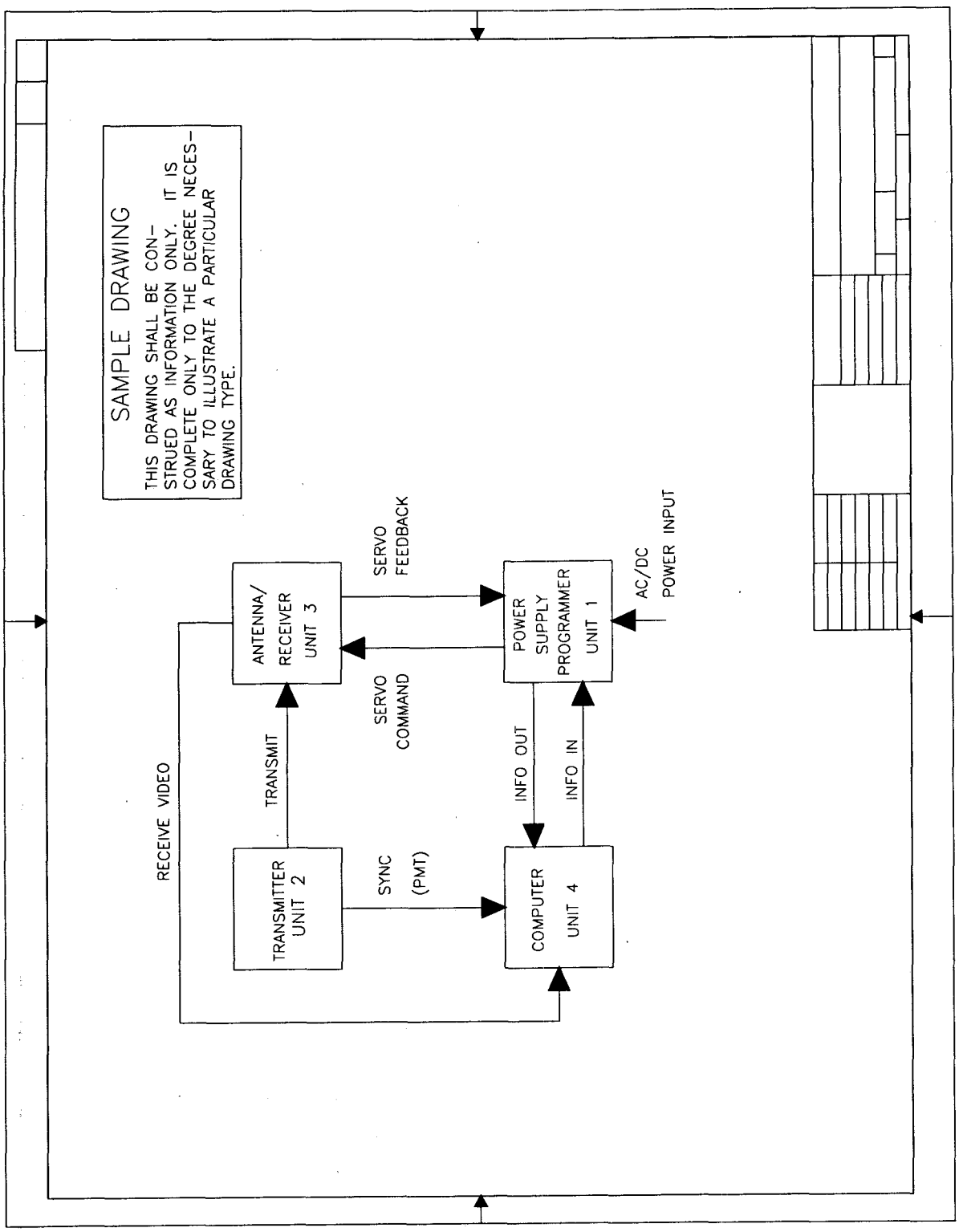


FIG. 24 FUNCTIONAL BLOCK DIAGRAM

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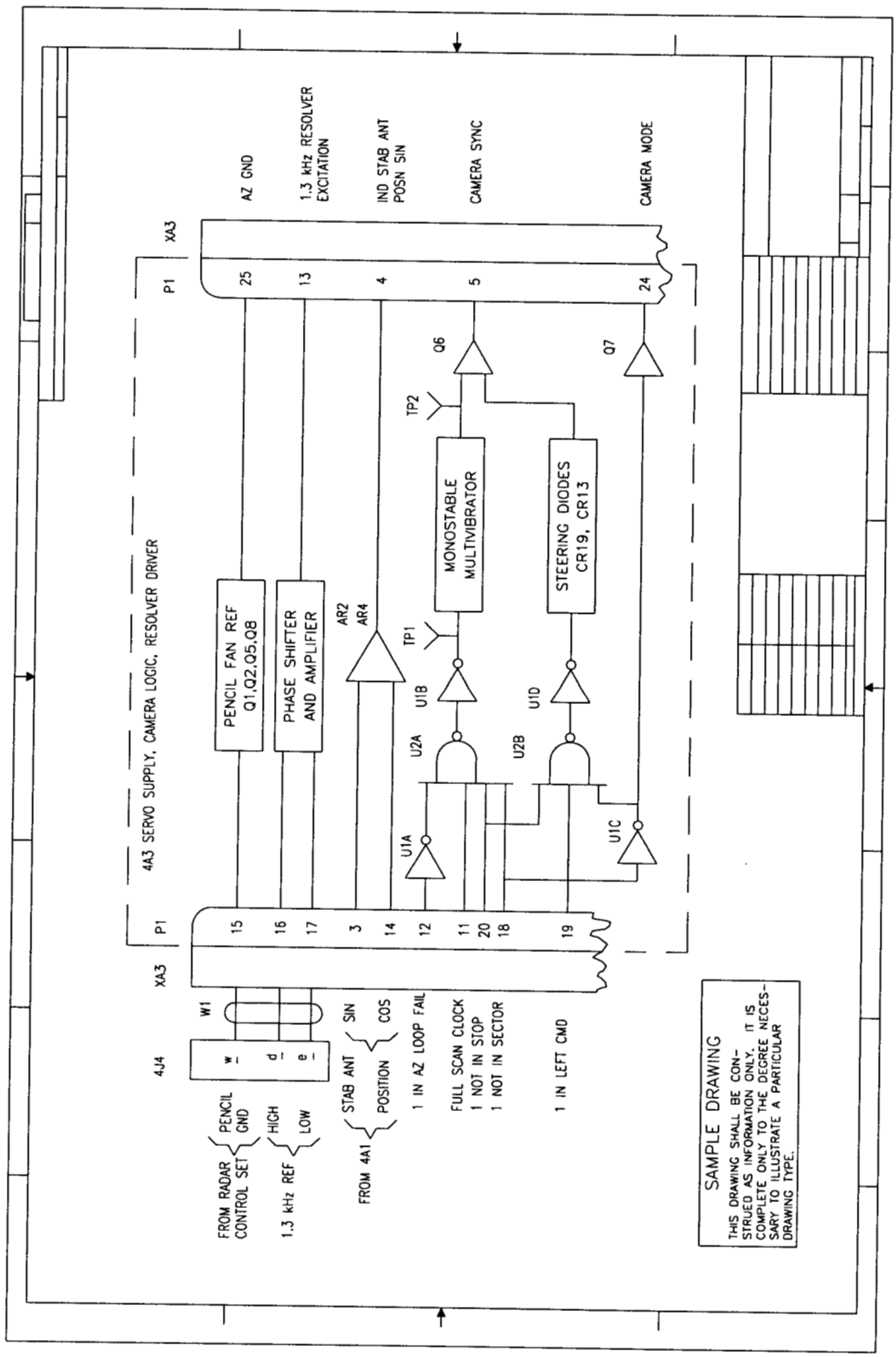


FIG. 25 SINGLE LINE SCHEMATIC DIAGRAM

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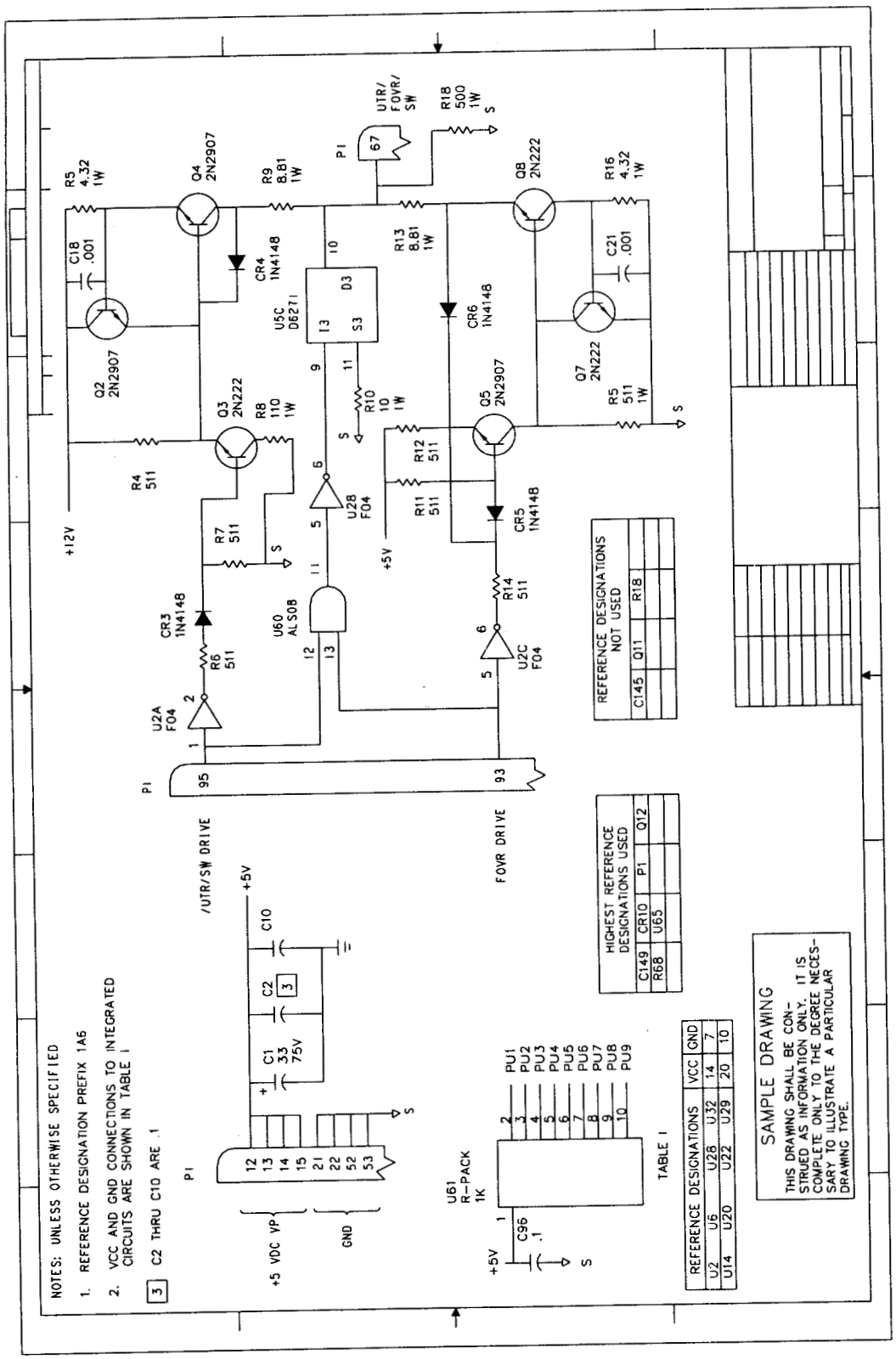


FIG. 26 SCHEMATIC DIAGRAM

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

(b) reference designations in accordance with ANSI/IEEE 200 and IEEE 315 for each item.

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

(d) standard type designation (if 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).

12.4 Connection Diagram or Wiring Diagram (Fig. 27)

12.4.1 Description. A connection diagram drawing depicts the general physical arrangement of electrical connections and wires between circuit elements in an installation or assembly. It shows internal connections, but may include external connections that have one termination inside and one outside the assembly. It contains the details necessary to make or trace connections involved.

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

12.4.3 Requirements. A connection diagram includes, as applicable,

(a) physical relationship of circuit elements and their connections,

(b) items identified by reference designations in accordance with ANSI/IEEE 200 and IEEE 315,

(c) terminal arrangements clearly identified,

(d) wires numbered for reference, and

(e) wire and termination descriptions.

12.5 Interconnection Diagram (Figs. 28, 29, and 30)

12.5.1 Description. An interconnection diagram drawing depicts only external connections between assemblies, units, or higher level items.

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

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

12.6 Wiring List

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

12.7 Logic Circuit Diagram (Fig. 31)

12.7.1 Description. A logic circuit diagram depicts the logic functions of a system at any level of assembly.

12.7.2 Application Guidelines. A logic circuit diagram is prepared to

(a) illustrate logic functions, and

(b) facilitate circuit analysis and diagnosis of equipment problems.

12.7.3 Requirements. A logic circuit diagram is prepared in accordance with ANSI/IEEE 991 and includes, as applicable,

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

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

13 SPECIAL APPLICATION DRAWINGS

13.1 Wiring Harness Drawing (Fig. 32)

13.1.1 Description. A wiring harness drawing specifies the engineering requirements and establishes item identification for a wiring harness (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.

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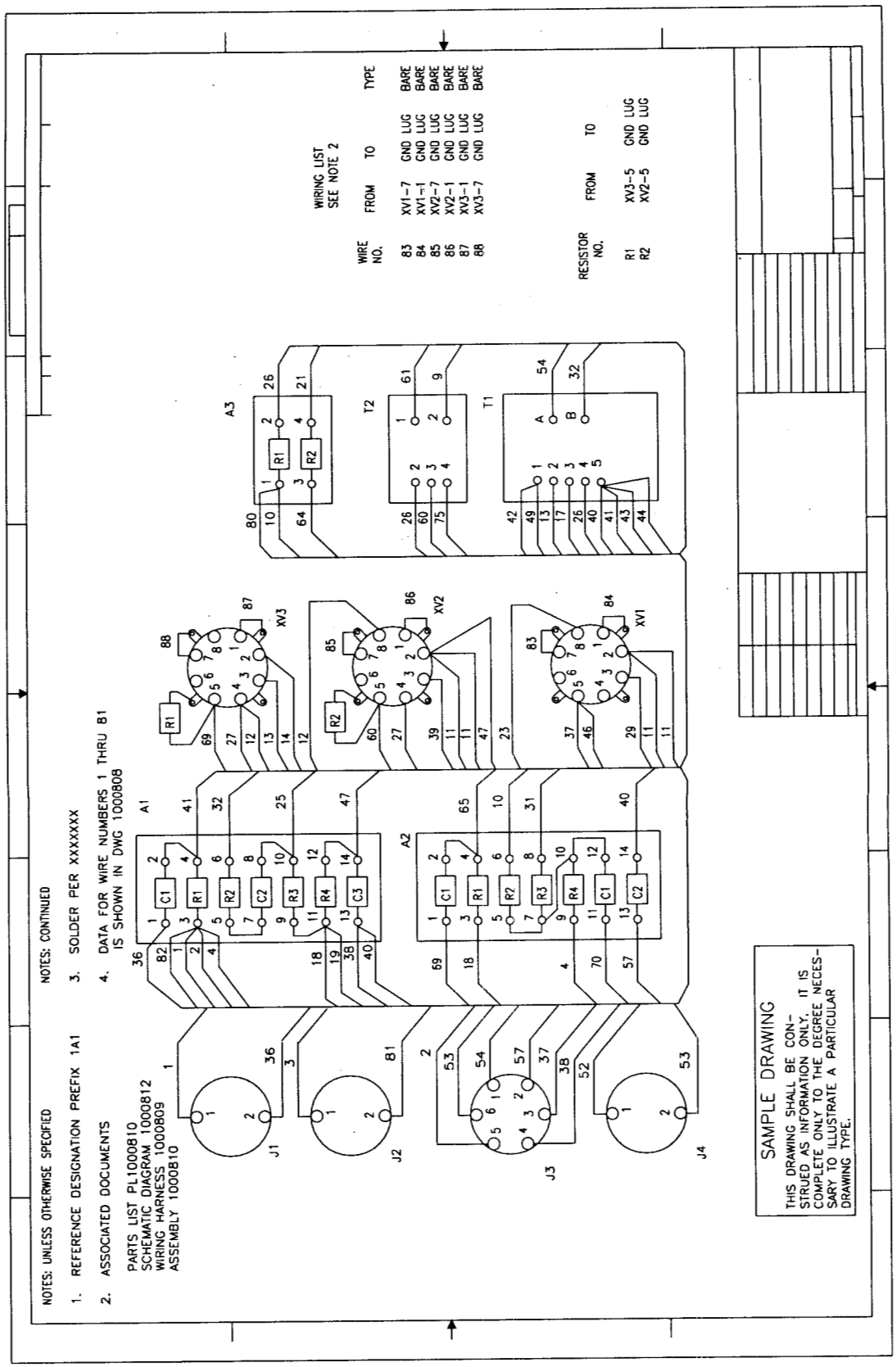


FIG. 27 CONNECTION DIAGRAM

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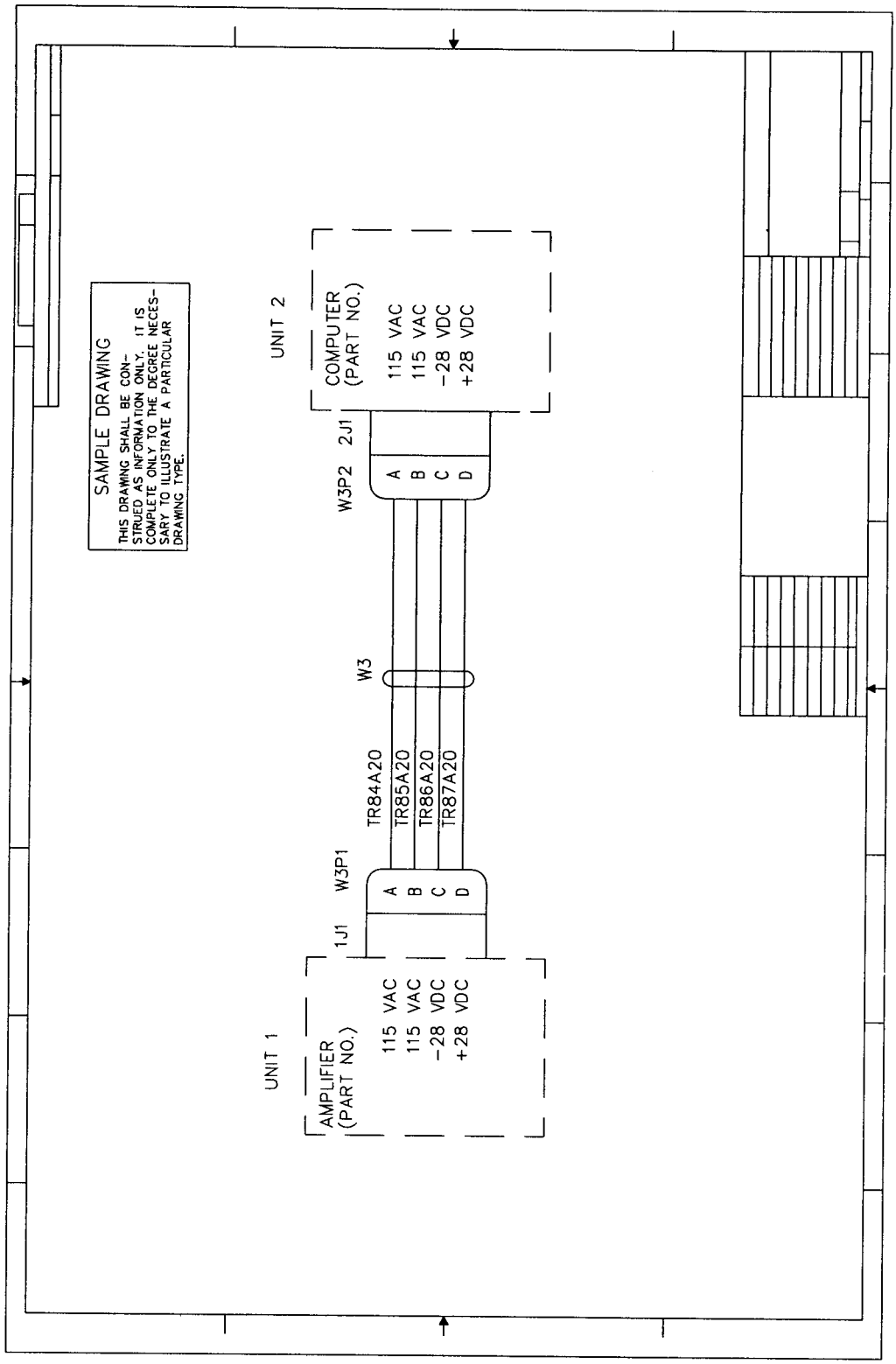


FIG. 28 INTERCONNECTION DIAGRAM (Point-to-Point, Simple)

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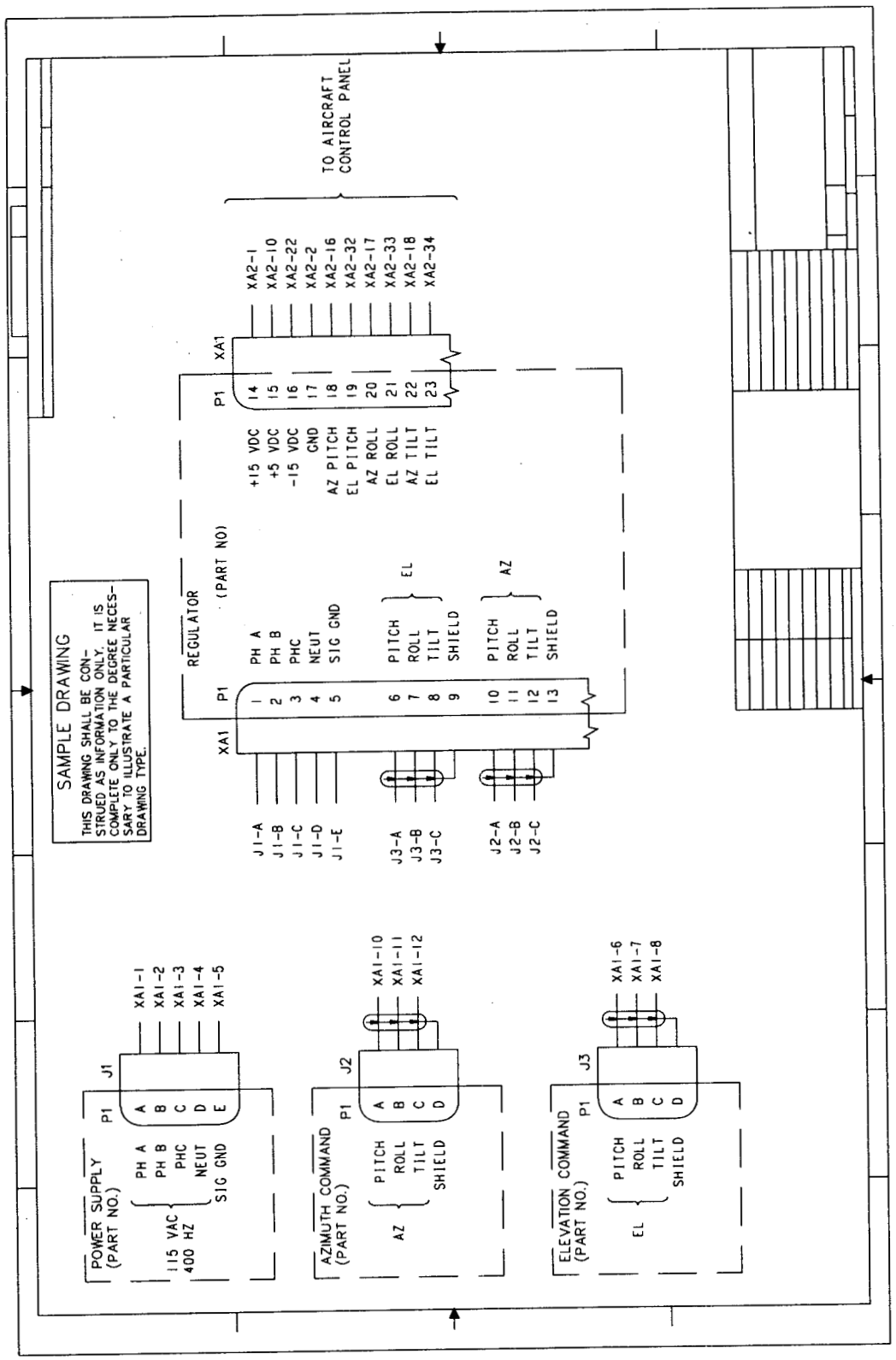


FIG. 29 INTERCONNECTION DIAGRAM (Point-toPoint, Complex)

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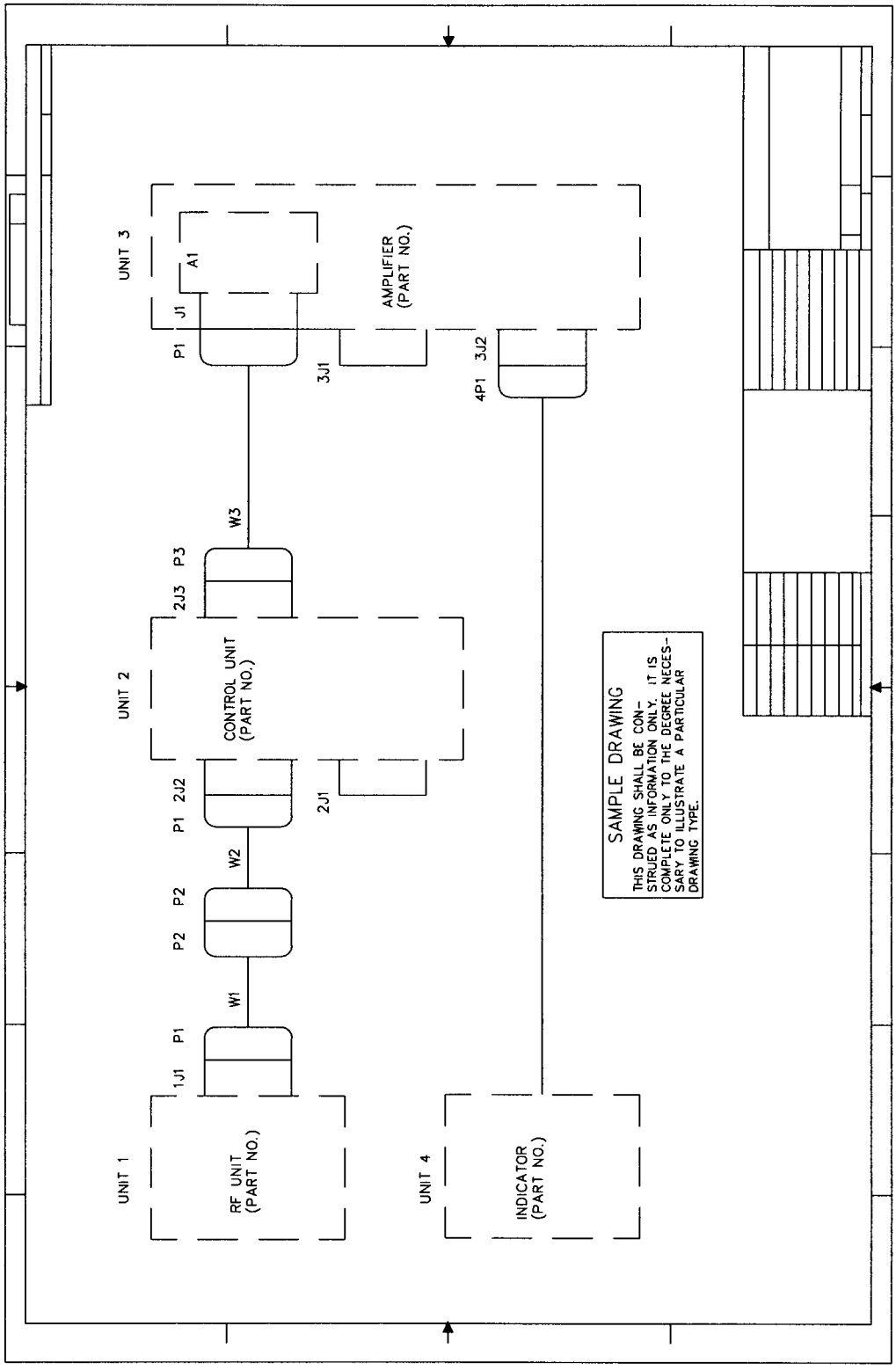


FIG. 30 INTERCONNECTION DIAGRAM (Cabling Type)

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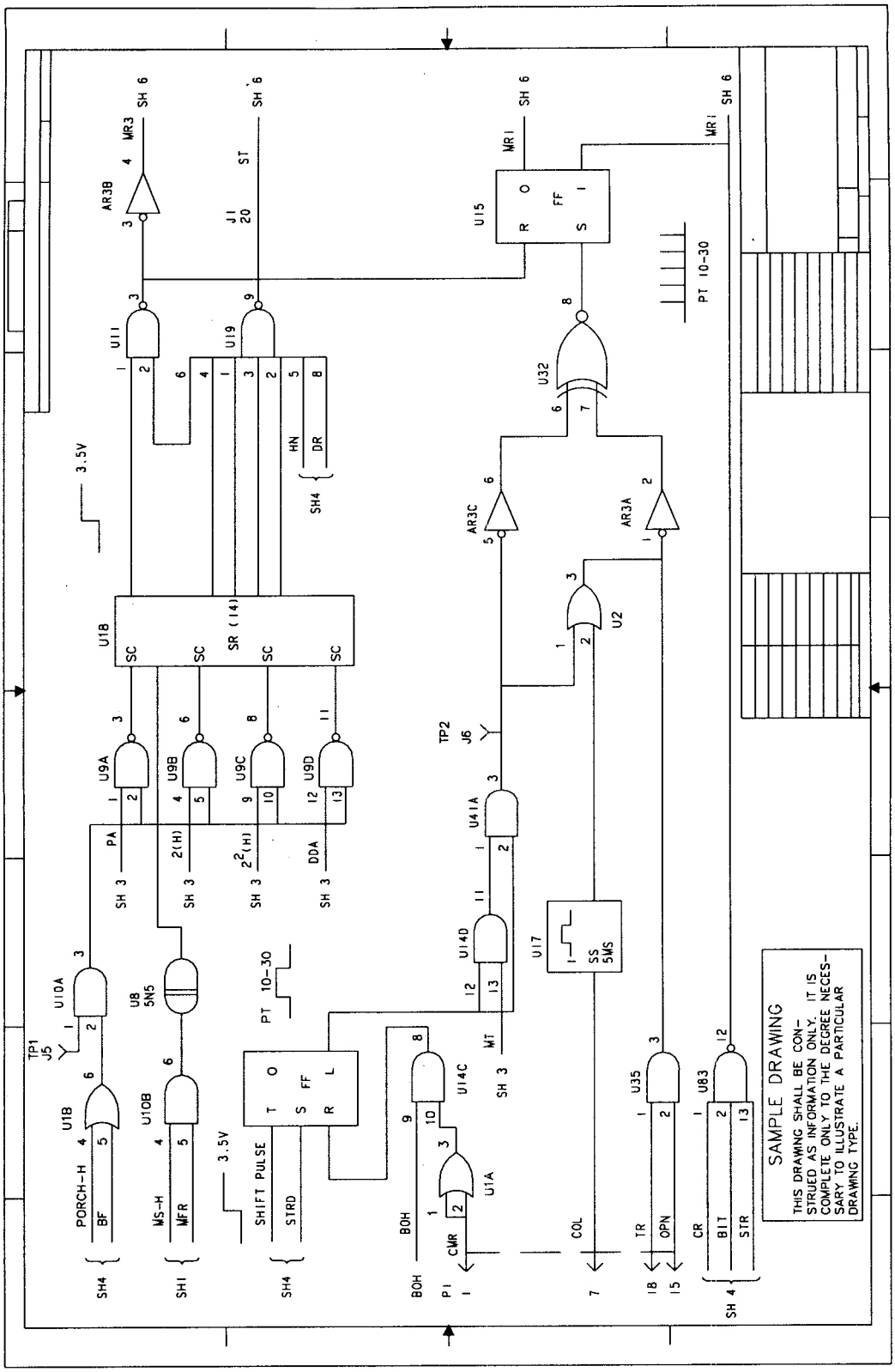


FIG. 31 LOGIC CIRCUIT DIAGRAM

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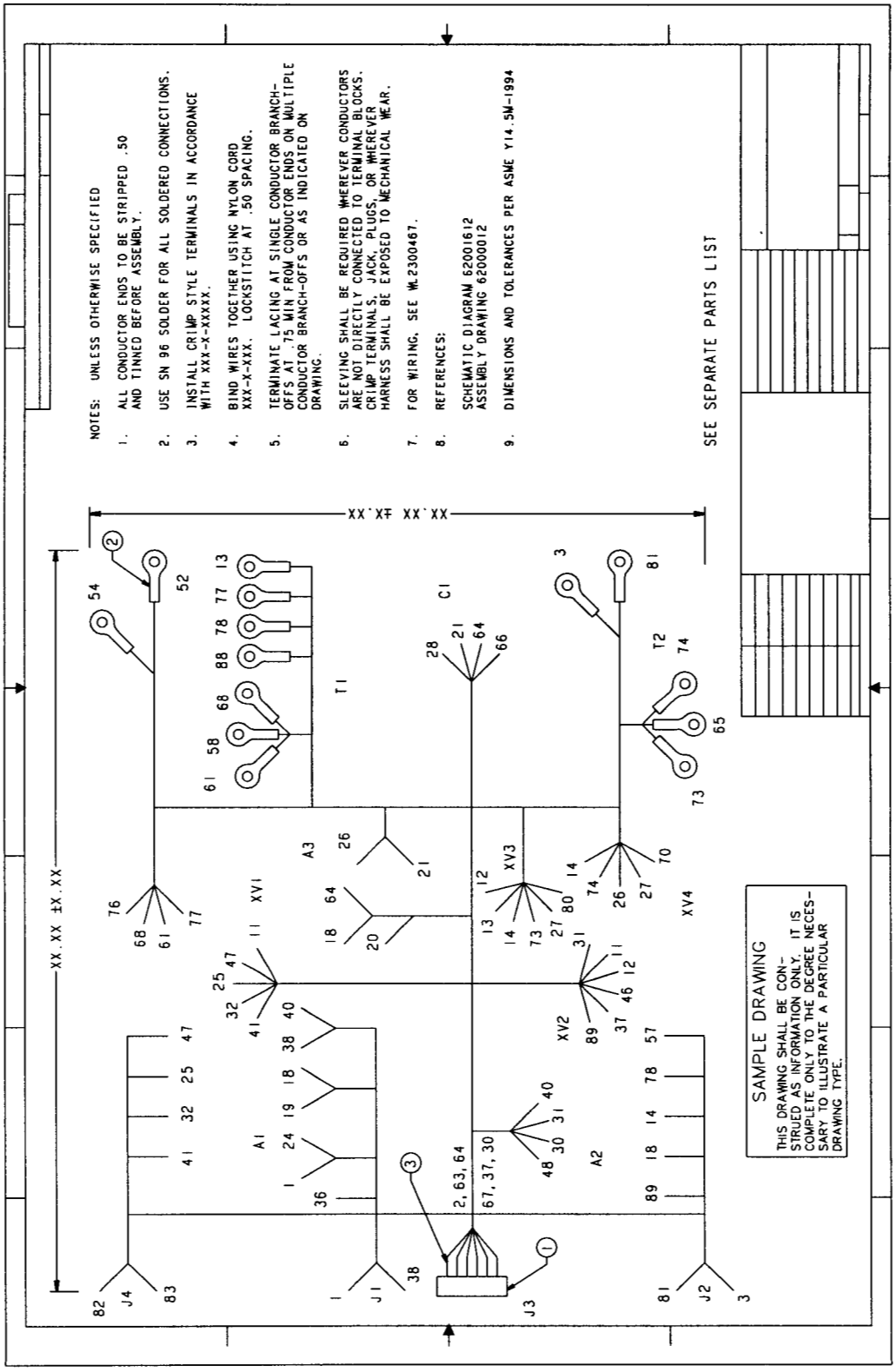


FIG. 32 WIRING HARNESS DRAWING

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

13.1.3 Requirements. A wiring harness drawing is prepared as either a detailed or simplified drawing as follows:

(a) A detailed wiring harness drawing defines the harness configuration (form and termination points) by direct application of dimensions and tolerances, by use of a reproducible grid system, or by inclusion of horizontal and vertical graphic scales for determining the required dimensional data. The drawing includes, as applicable,

(1) pictorial views.

(2) a wiring tabulation or reference to a wiring list that identifies wire numbers or color codes, circuit reference designations in accordance with ANSI/IEEE 200 and IEEE 315 ("from-to" data), wire lengths, wire type and gage, termination methods, and other related data.

(3) 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.

(4) parts list specifying parts (connectors, terminal lugs, etc.) and bulk materials (wire, sleeving, jacketing, twine, etc.) required for the fabrication of the harness.

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

(b) A simplified wiring harness drawing satisfies the requirements for a detailed wiring harness drawing, except that the pictorial may be omitted and the note HARNESS CONFIGURATION TO BE DETERMINED FROM ASSEMBLY included. The assembly drawing then specifies any critical routing or dimensional requirements.

13.2 Cable Assembly Drawing (Fig. 33)

13.2.1 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 (insulated wires, shielding, coaxial cables, etc.) within a common molded or jacketed covering and has one or more ends terminated in connectors, terminal lugs, or similar fittings.

13.2.2 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.

13.2.3 Requirements. A cable assembly drawing includes, as applicable,

(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) detailed 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) finish, special assembly, and/or storage (e.g., dust covers) instructions, and

(l) test requirements.

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

13.3 Printed Board and Discrete Wiring Board Drawing Sets

13.3.1 Description. *Printed board* and *discrete wiring board* drawing sets consist of those drawings which define the configuration of *printed wiring* or *printed circuit* and discrete wiring boards and assemblies. They establish requirements for board fabrication, board assembly (mounting of electrical items, attaching hardware, etc.), and test.

The term "board," as used in this Standard, includes all types of dielectric base materials (e.g., flex, rigid, or a combination thereof). The term "printed" applies to all circuitry patterns which 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

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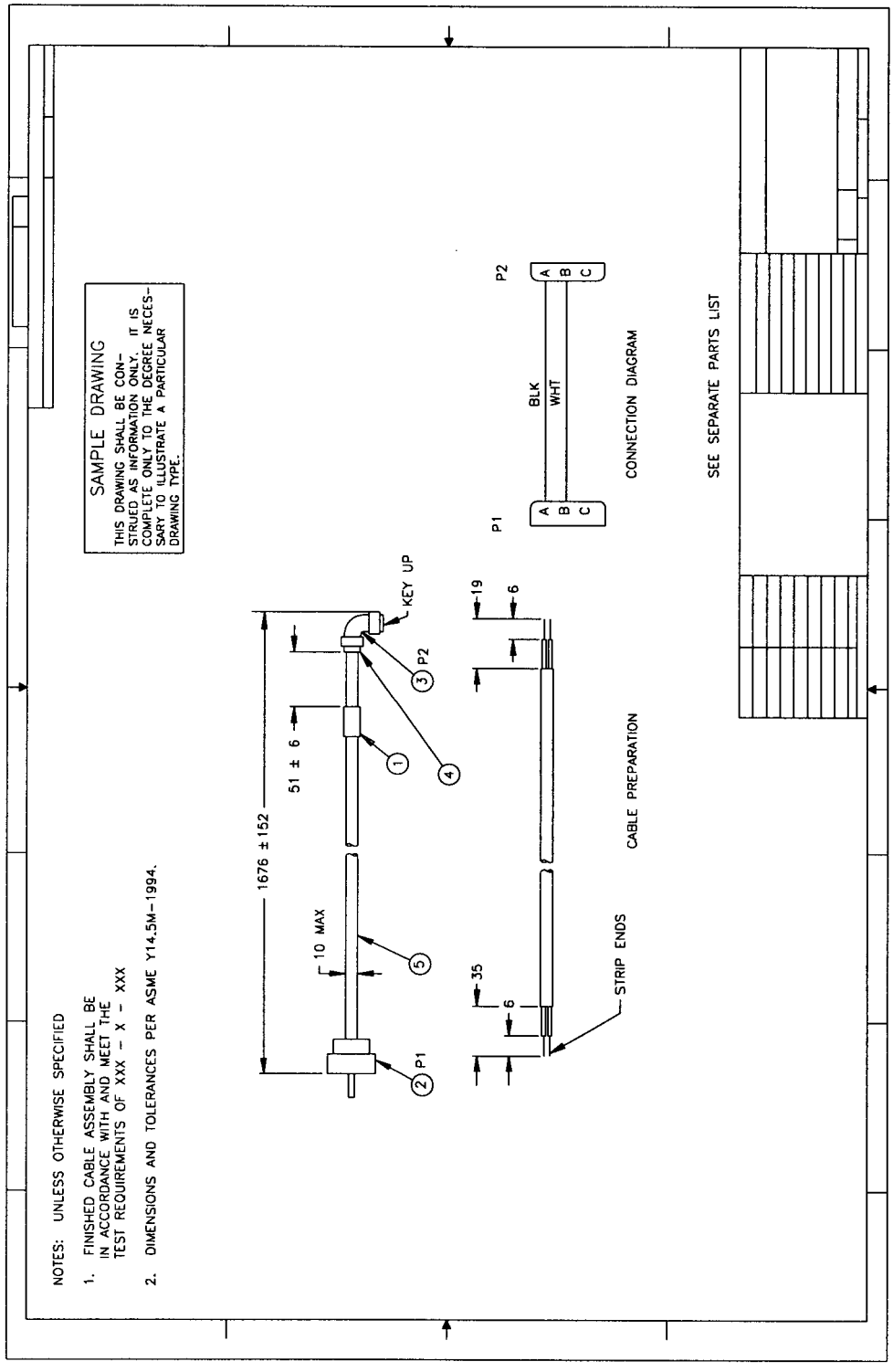


FIG. 33 CABLE ASSEMBLY DRAWING

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shown in Fig. 2. The assembly and master drawing establishes item identification for the assembly and board, respectively.

13.3.2 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 multilayer.

13.3.3 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. 13.3.3.1 through 13.3.3.7. 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. 13.3.3.1 through 13.3.3.6. 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, and 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.

13.3.3.1 Board Assembly Drawing

(a) Printed Board Assembly Drawing. The document that shows a printed board, separately manufactured components, and any information necessary to describe the joining of them together in order to perform a specific function. See ANSI/IPC-D-249 and ANSI/IPC-D-275 for design requirements and ANSI/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 document that shows a discrete wiring board, separately manufactured components, and any information necessary to describe the joining of them together in order to perform a specific function. See ANSI/IPC-DW-425 for design and drawing requirements.

13.3.3.2 Master Drawing

(a) Printed Board Master Drawing. A document that shows the dimensional limits or grid locations that are applicable to any and all parts of a product (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 ANSI/IPC-D-249 and ANSI/IPC-D-275 for design requirements and ANSI/IPC-D-325 for drawing requirements.

(b) Discrete Wiring Board Master Drawing. A document that 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 gauge, size, shape, location, and tolerance of all discrete wiring board features. Material, plating, marking and coating requirements shall also be indicated as applicable. See ANSI/IPC-DW-425 for design and drawing requirements.

13.3.3.3 Artwork. An accurately scaled configuration that is used to produce the artwork master, production master, or master pattern drawing. See ANSI/IPC-D-310 for artwork generation requirements and ANSI/IPC-D-275 and ANSI/IPC-D-325 for documentation requirements.

13.3.3.4 Artwork Master (Photoplot Master). An accurately scaled, usually 1:1, pattern that is used to produce the production master. See ANSI/IPC-D-310 for phototool generation requirements and ANSI/IPC-D-275 and ANSI/IPC-D-325 for documentation requirements.

13.3.3.5 Production Master. A 1:1 scale pattern that is used to produce rigid or flexible printed boards within the accuracy specified on the master drawing. See ANSI/IPC-D-275 and ANSI/IPC-D-325 for documentation requirements.

13.3.3.6 Master Pattern Drawing. The master pattern drawing is a reproduction of the original artwork, artwork master, or data base prepared on drawing format. See ANSI/IPC-D-275 for drawing requirements.

13.3.3.7 Digital Form of Printed Boards. Automated layout techniques (computer-aided) may be used to generate various aspects or descriptions (drill data, artwork, testing, etc.) of the printed board information and to document a digital form of the drawings that are a part of the printed board drawing set. See ANSI/IPC-D-350 for requirements on generating printed board descriptions in digital form and ANSI/IPC-D-351 for generating a digital form of printed board drawings.

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13.4 Microcircuit Drawing Set

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

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

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

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

13.5 Undimensioned Drawing (Fig. 34)

13.5.1 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.

13.5.2 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 (see para. 13.9) provides the definition of contoured surfaces for engineering references and for design of tooling.

13.5.3 Requirements. An undimensioned drawing includes, as applicable,

(a) information necessary to manufacture the depicted items within required design limits. This may include toleranced dimensioning of features unsuitable for definition by pattern, bend lines, mold lines, hole centers, reference dimensions, and other elements as necessary.

NOTE: If dimensioned features are specified with the same tolerance as that specified for undimensioned features (which may be provided by note), it is not considered double dimensioning.

(b) an X-Y coordinate grid or scale for dimensional verification of the drawing. This is required on each sheet of a multisheet drawing.

(c) toleranced dimensions where greater or lesser control is required for specific features.

(d) for manufacturing purposes this drawing shall be produced at a specified scale on stable base material or in a digital data file. A digital data file electronically describes the engineering definition described in subparagraphs (a), (b), and (c).

(e) a note: FOR MANUFACTURING PURPOSES, THIS DRAWING SHALL BE REPRODUCED ON STABLE BASE MATERIAL.

13.6 Kit Drawing (Fig. 35)

13.6.1 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.

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

13.6.3 Requirements. A kit drawing includes, as applicable,

(a) a parts list (see para. 1.7) of the contents of the kit, including the identification of each item;

(b) documents which are a part of the kit, itemized in the parts list;

(c) pictorial representations;

(d) special tool requirements for installation of the kit; and

(e) retest or recalibration requirements.

13.7 Tube Bend Drawing (Figs. 36 and 37)

13.7.1 Description. A tube bend drawing establishes, by pictorial or tabular delineation or combination thereof, end product definition for a single or multiplane tube or inseparable tube assembly (tube with end fittings). It establishes item identification for the bent tube or inseparable tube assembly.

13.7.2 Application Guidelines. Tabular tube bend drawings are prepared to specify complete requirements and configuration of rigid or semirigid tubing for direct use in forming on a draw bending machine (the tube to be bent is clamped against a bending form which rotates and draws the tube through a pressure die and over a mandrel). Pictorial tube bend drawings are used for other methods of manufacturing (for example: roll bending). Tubing of complex configuration

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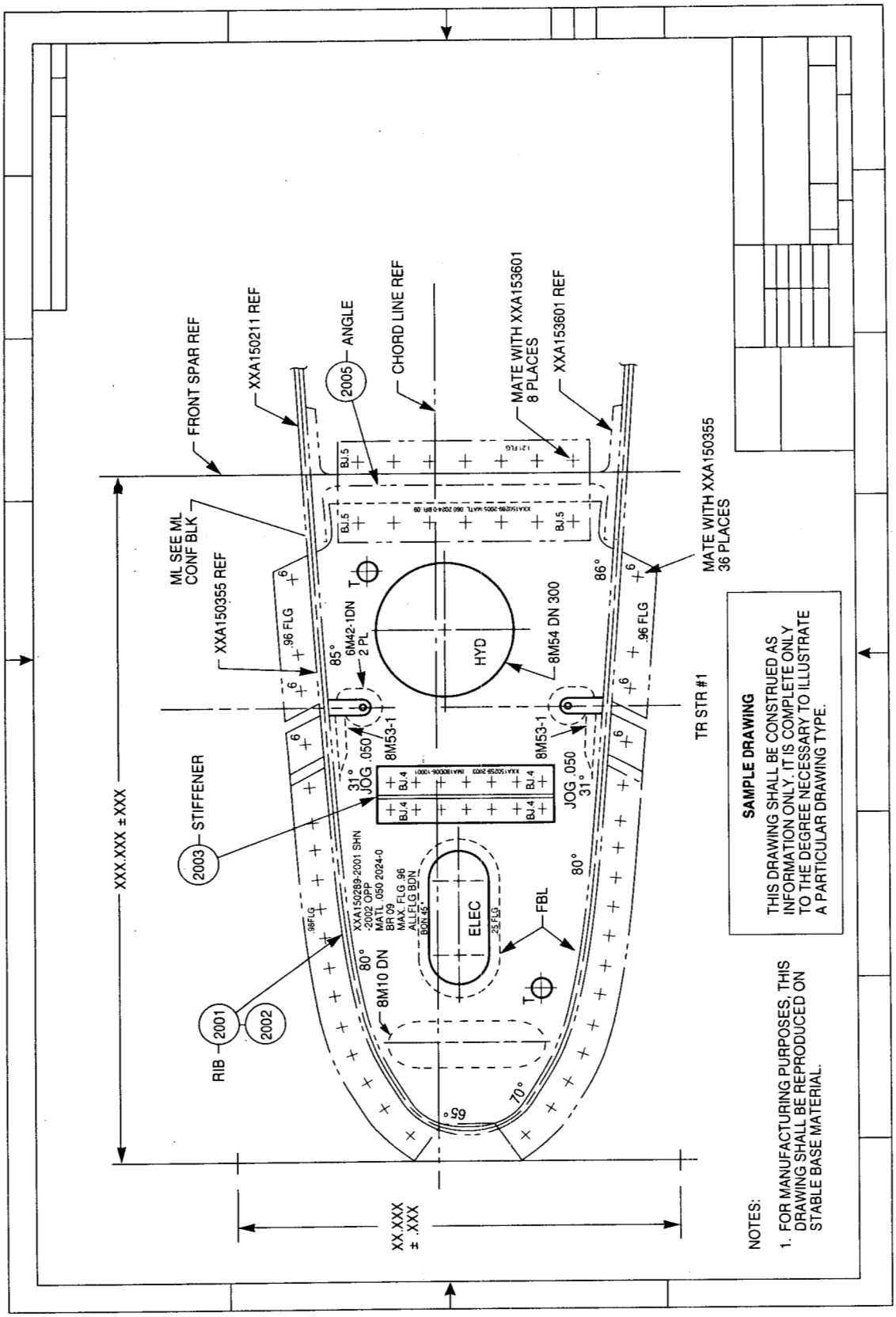


FIG. 34 UNDIMENSIONED DRAWING

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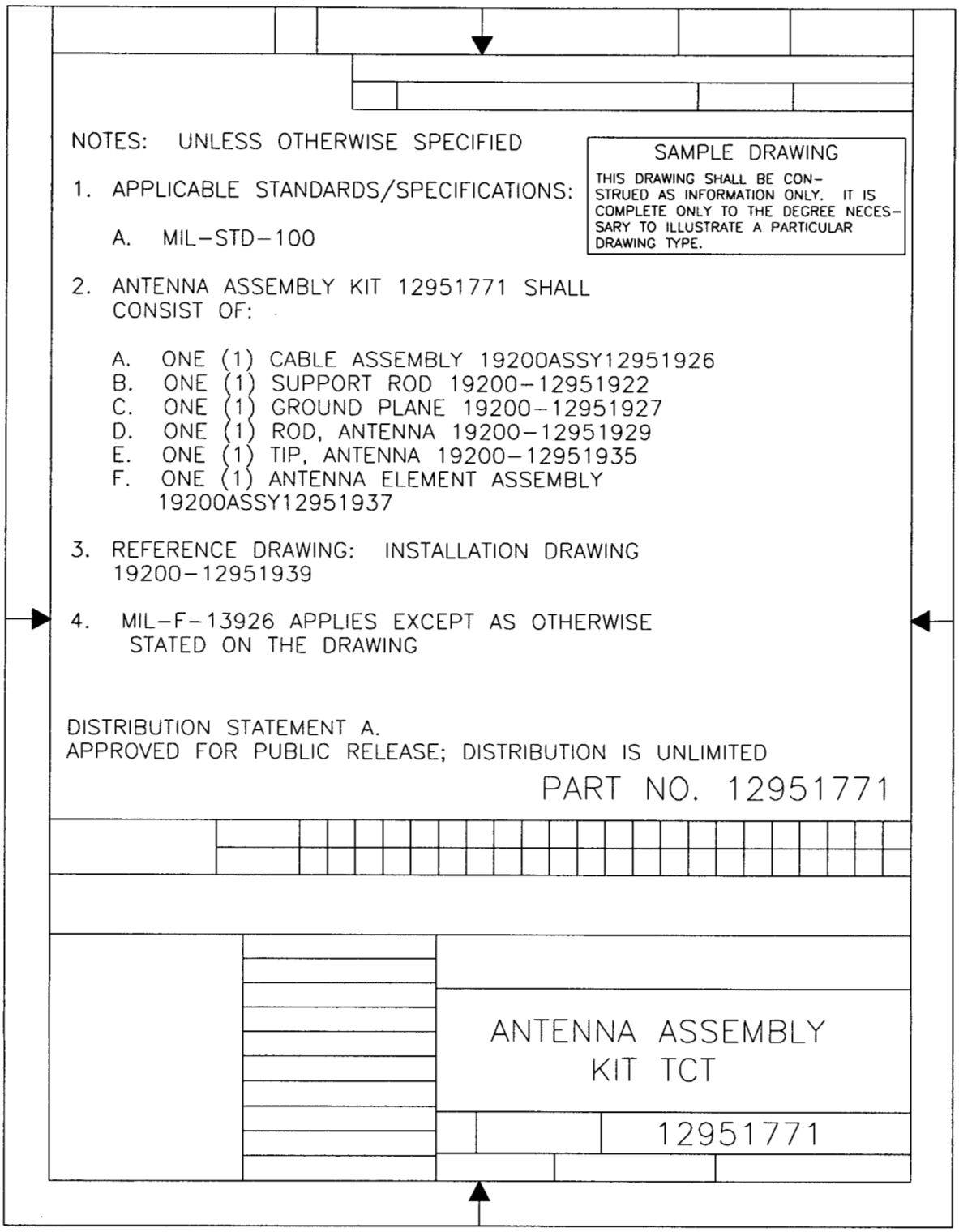


FIG. 35 KIT DRAWING

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may be described using a combination of pictorial and tabular delineation.

13.7.3 Requirements

13.7.3.1 Pictorial Delineation (Fig. 36). A pictorial tube bend drawing is prepared as a detail, assembly, or detail assembly drawing. A pictorial tube bend drawing includes, as applicable,

(a) tube material;

(b) end types;

(c) identification and quantity of fittings;

(d) dimensional requirements including bend radii, angles, intersection points, intermediate and overall lengths; and

(e) other data necessary to define design requirements.

13.7.3.2 Tabular Delineation (Fig. 37). The drawing format and informational entries shall be in accordance with Fig. 37.

A tube bend drawing includes, as applicable,

(a) the information required for the tube bending entered in the five columns shown in Fig. 37 as follows.

(1) Bend Number: 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 (centerline of radius block) to be performed.

(3) "F" Bend Radius: 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 to be 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 (flare, bead, etc.) designated by the appropriate number and the item identification of the required end fittings is entered in the End Fittings block. Any variation from the standard end types shall be noted in the Type of End block.

(c) unique identifiers assigned to each bent tube and to each assembly consisting of a bent tube and end fittings.

(d) material requirements.

(e) Stock Tube Size specified as outside diameter, wall thickness, and Length "D" is that 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.

13.8 Matched Set Drawing (Fig. 38)

13.8.1 Description. A matched set drawing delineates items which are matched and for which replacement as a matched set is essential. A matched set drawing establishes item identification.

13.8.2 Application Guidelines. A matched set drawing is prepared when the required dimensions, tolerances, or other characteristics of items can only be specified in terms of the matched relationship. This includes items which 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.

13.8.3 Requirements. The matched set drawing includes, as applicable,

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

(b) the unique identifier assigned to each of the parts and to the matched set,

(c) discrete identification marking of the matched set, and

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

13.9 Contour Definition Drawing (Figs. 39, 40, and 41)

13.9.1 Description. A contour definition drawing contains the mathematical, numeric, or graphic definition required to locate and define a contoured surface. It does not establish item identification for the items delineated thereon. The contour of a part is defined on a detail drawing or by reference to a contour definition drawing.

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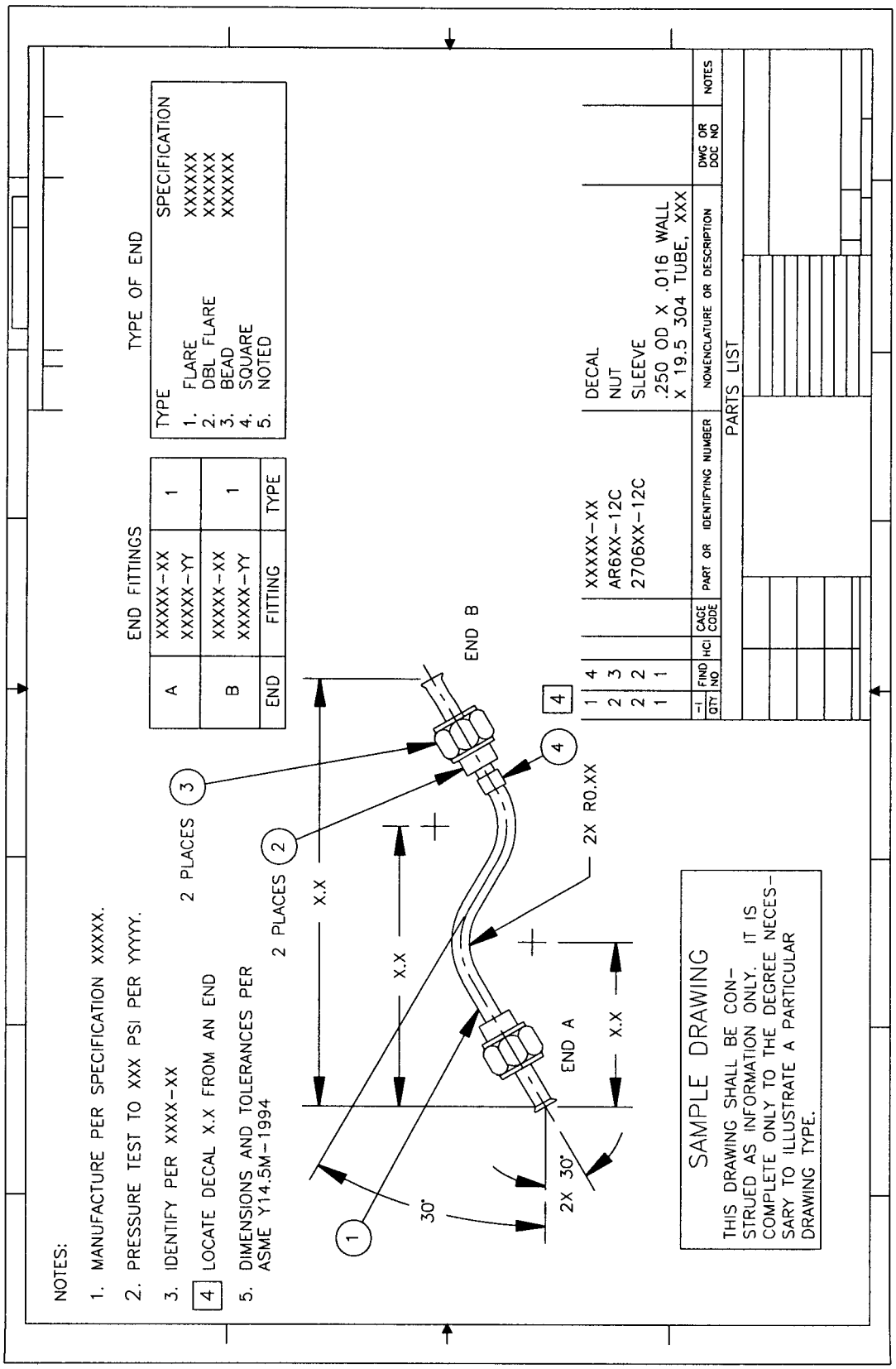


FIG. 36 TUBE BEND DRAWING (Pictorial)

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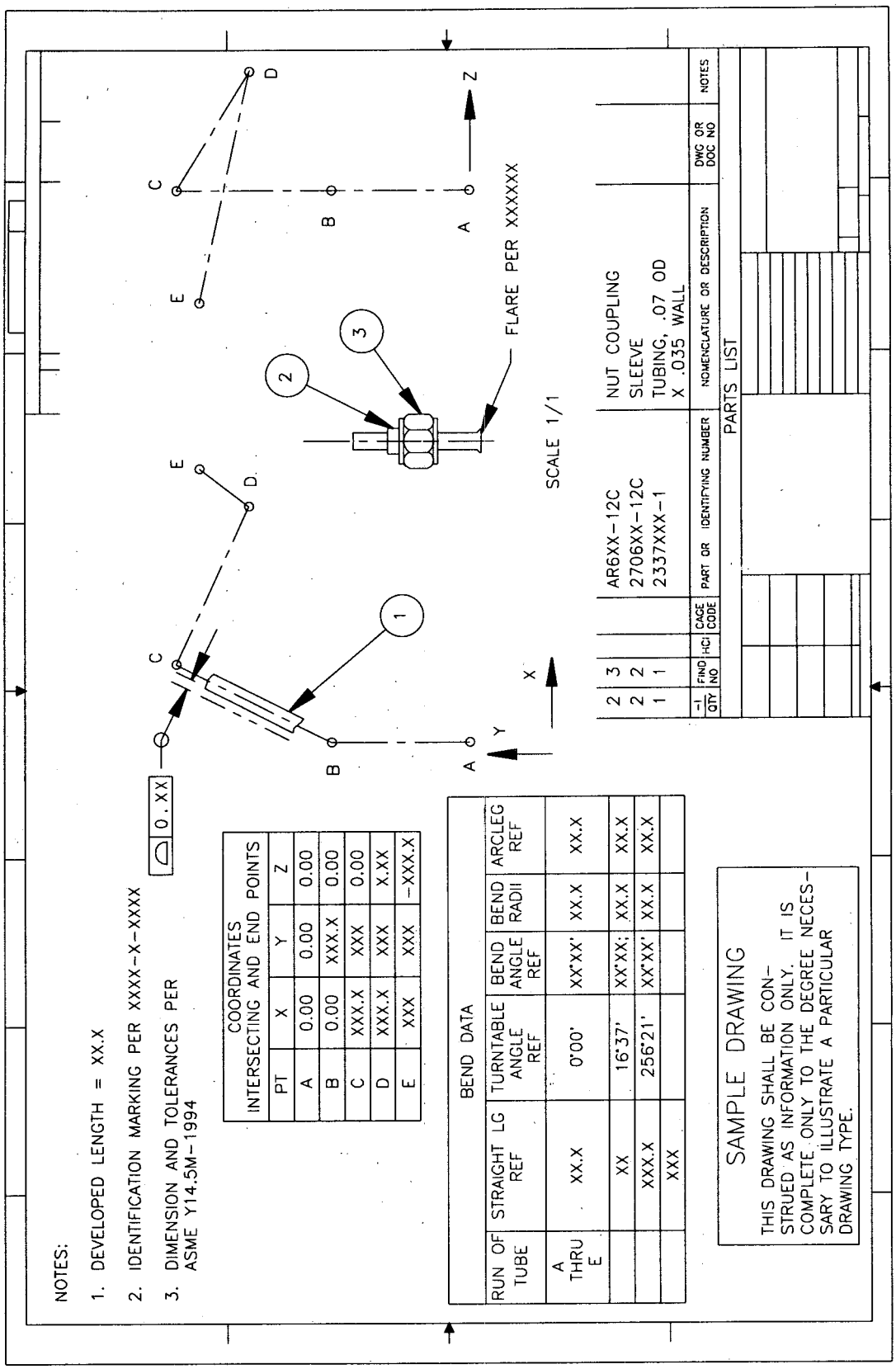


FIG. 37 TUBE BEND DRAWING (Tabular)

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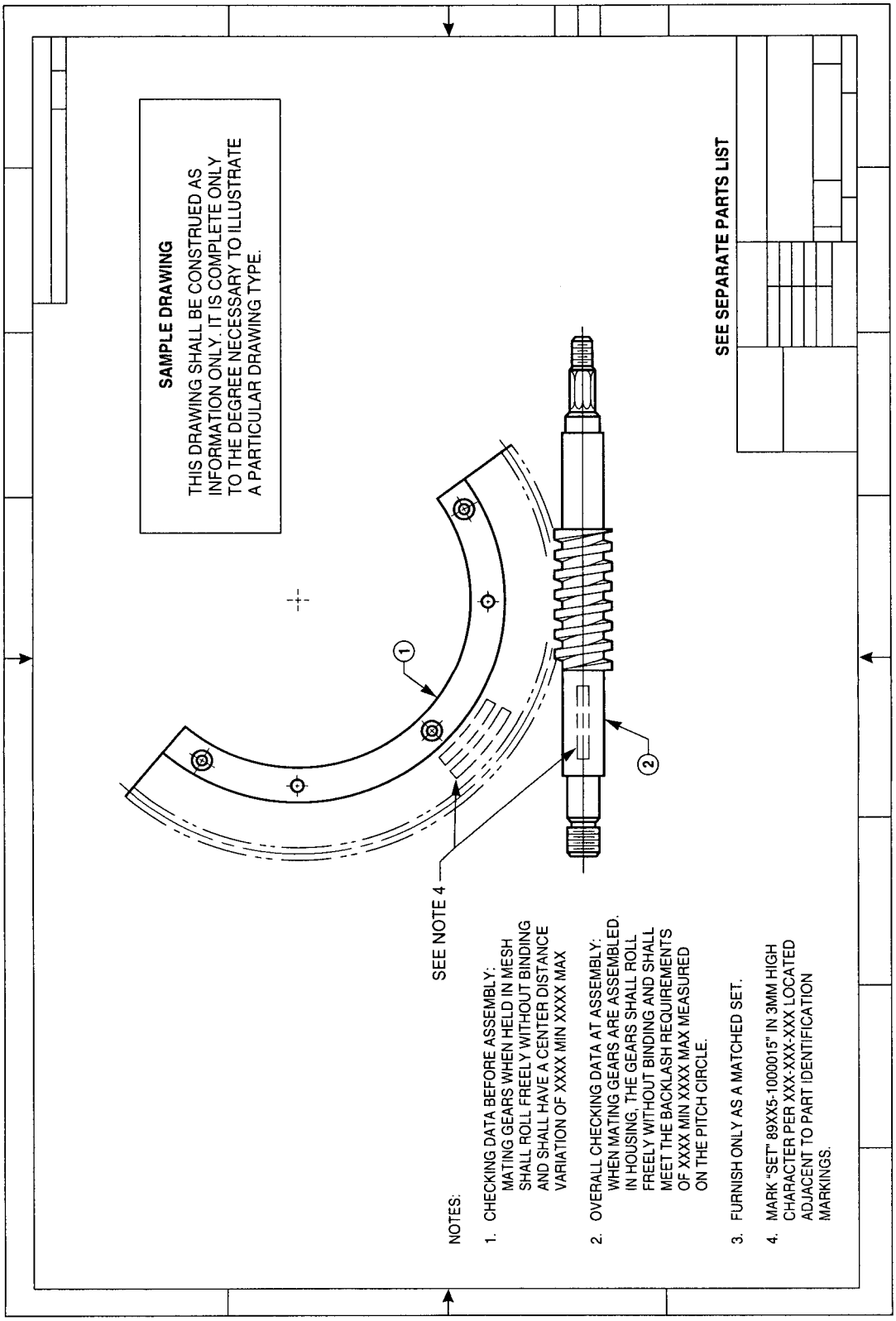


FIG. 38 MATCHED SET DRAWING

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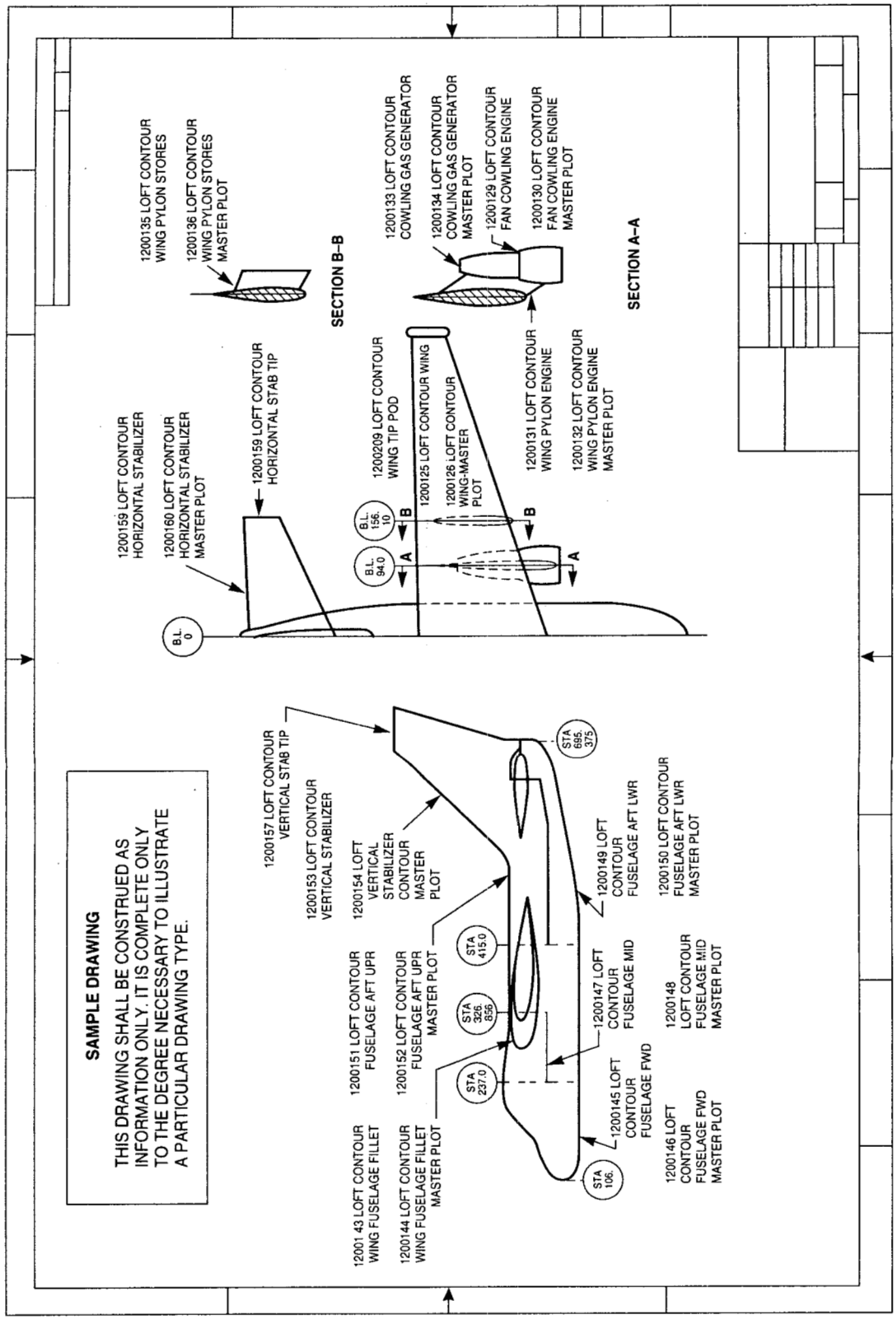


FIG. 39 CONTOUR DEFINITION DRAWING (Index)

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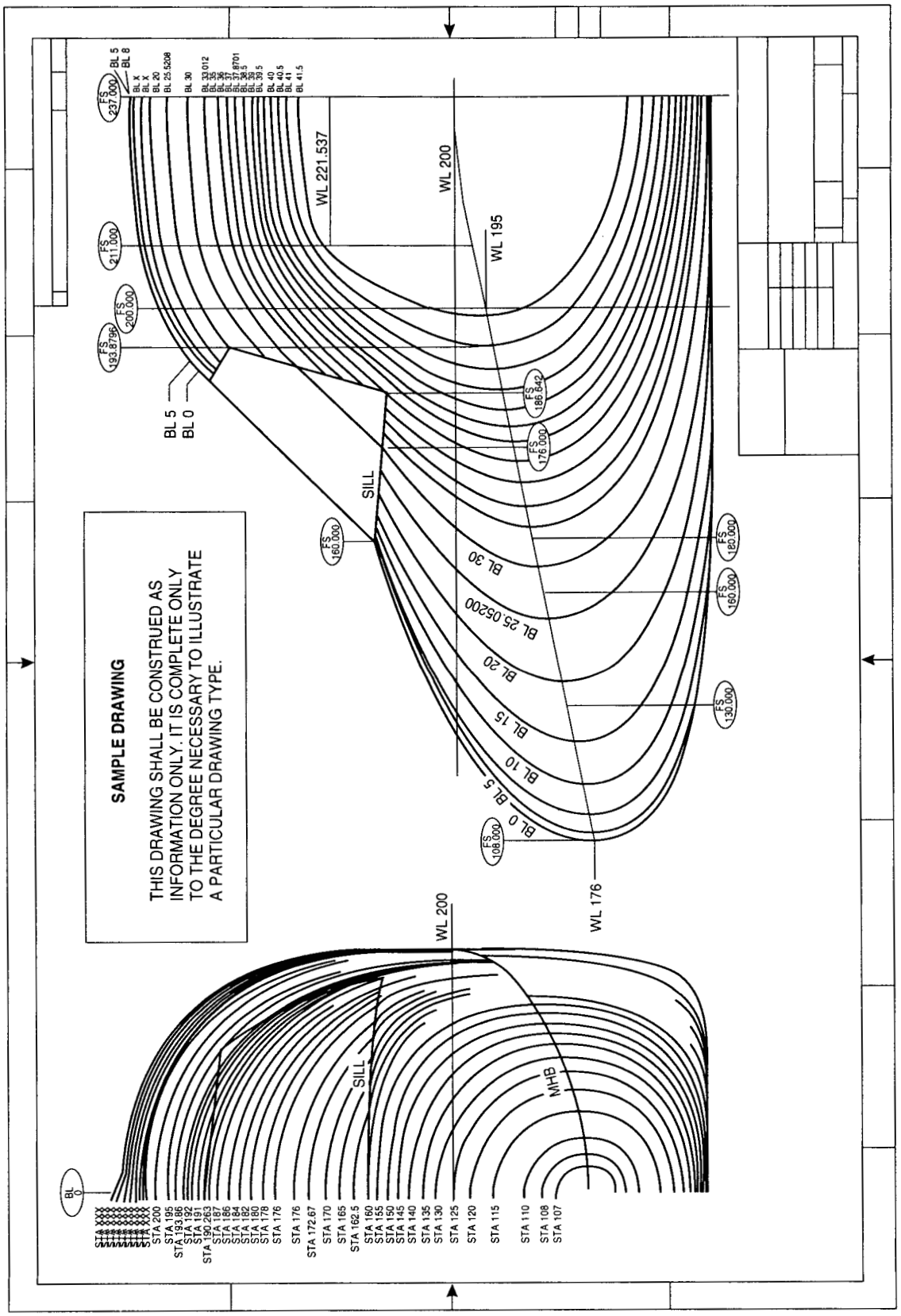
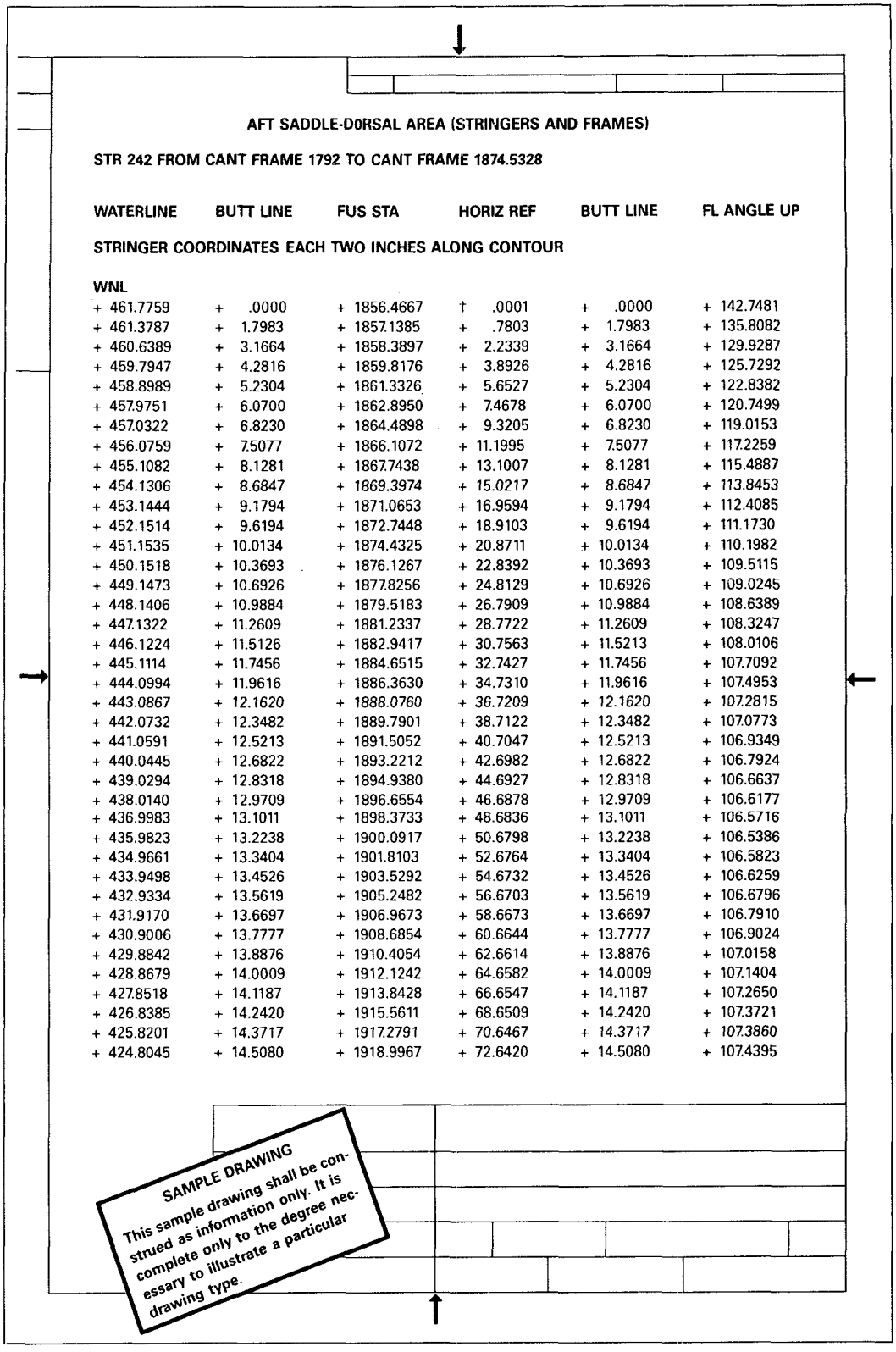


FIG. 40 CONTOUR DEFINITION DRAWING (Pictorial)

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AFT SADDLE-DORSAL AREA (STRINGERS AND FRAMES)

STR 242 FROM CANT FRAME 1792 TO CANT FRAME 1874.5328

WATERLINE	BUTT LINE	FUS STA	HORIZ REF	BUTT LINE	FL ANGLE UP
STRINGER COORDINATES EACH TWO INCHES ALONG CONTOUR					
WNL					
+ 461.7759	+ .0000	+ 1856.4667	† .0001	+ .0000	+ 142.7481
+ 461.3787	+ 1.7983	+ 1857.1385	+ .7803	+ 1.7983	+ 135.8082
+ 460.6389	+ 3.1664	+ 1858.3897	+ 2.2339	+ 3.1664	+ 129.9287
+ 459.7947	+ 4.2816	+ 1859.8176	+ 3.8926	+ 4.2816	+ 125.7292
+ 458.8989	+ 5.2304	+ 1861.3326	+ 5.6527	+ 5.2304	+ 122.8382
+ 457.9751	+ 6.0700	+ 1862.8950	+ 7.4678	+ 6.0700	+ 120.7499
+ 457.0322	+ 6.8230	+ 1864.4898	+ 9.3205	+ 6.8230	+ 119.0153
+ 456.0759	+ 7.5077	+ 1866.1072	+ 11.1995	+ 7.5077	+ 117.2259
+ 455.1082	+ 8.1281	+ 1867.7438	+ 13.1007	+ 8.1281	+ 115.4887
+ 454.1306	+ 8.6847	+ 1869.3974	+ 15.0217	+ 8.6847	+ 113.8453
+ 453.1444	+ 9.1794	+ 1871.0653	+ 16.9594	+ 9.1794	+ 112.4085
+ 452.1514	+ 9.6194	+ 1872.7448	+ 18.9103	+ 9.6194	+ 111.1730
+ 451.1535	+ 10.0134	+ 1874.4325	+ 20.8711	+ 10.0134	+ 110.1982
+ 450.1518	+ 10.3693	+ 1876.1267	+ 22.8392	+ 10.3693	+ 109.5115
+ 449.1473	+ 10.6926	+ 1877.8256	+ 24.8129	+ 10.6926	+ 109.0245
+ 448.1406	+ 10.9884	+ 1879.5183	+ 26.7909	+ 10.9884	+ 108.6389
+ 447.1322	+ 11.2609	+ 1881.2337	+ 28.7722	+ 11.2609	+ 108.3247
+ 446.1224	+ 11.5126	+ 1882.9417	+ 30.7563	+ 11.5213	+ 108.0106
+ 445.1114	+ 11.7456	+ 1884.6515	+ 32.7427	+ 11.7456	+ 107.7092
+ 444.0994	+ 11.9616	+ 1886.3630	+ 34.7310	+ 11.9616	+ 107.4953
+ 443.0867	+ 12.1620	+ 1888.0760	+ 36.7209	+ 12.1620	+ 107.2815
+ 442.0732	+ 12.3482	+ 1889.7901	+ 38.7122	+ 12.3482	+ 107.0773
+ 441.0591	+ 12.5213	+ 1891.5052	+ 40.7047	+ 12.5213	+ 106.9349
+ 440.0445	+ 12.6822	+ 1893.2212	+ 42.6982	+ 12.6822	+ 106.7924
+ 439.0294	+ 12.8318	+ 1894.9380	+ 44.6927	+ 12.8318	+ 106.6637
+ 438.0140	+ 12.9709	+ 1896.6554	+ 46.6878	+ 12.9709	+ 106.6177
+ 436.9983	+ 13.1011	+ 1898.3733	+ 48.6836	+ 13.1011	+ 106.5716
+ 435.9823	+ 13.2238	+ 1900.0917	+ 50.6798	+ 13.2238	+ 106.5386
+ 434.9661	+ 13.3404	+ 1901.8103	+ 52.6764	+ 13.3404	+ 106.5823
+ 433.9498	+ 13.4526	+ 1903.5292	+ 54.6732	+ 13.4526	+ 106.6259
+ 432.9334	+ 13.5619	+ 1905.2482	+ 56.6703	+ 13.5619	+ 106.6796
+ 431.9170	+ 13.6697	+ 1906.9673	+ 58.6673	+ 13.6697	+ 106.7910
+ 430.9006	+ 13.7777	+ 1908.6854	+ 60.6644	+ 13.7777	+ 106.9024
+ 429.8842	+ 13.8876	+ 1910.4054	+ 62.6614	+ 13.8876	+ 107.0158
+ 428.8679	+ 14.0009	+ 1912.1242	+ 64.6582	+ 14.0009	+ 107.1404
+ 427.8518	+ 14.1187	+ 1913.8428	+ 66.6547	+ 14.1187	+ 107.2650
+ 426.8385	+ 14.2420	+ 1915.5611	+ 68.6509	+ 14.2420	+ 107.3721
+ 425.8201	+ 14.3717	+ 1917.2791	+ 70.6467	+ 14.3717	+ 107.3860
+ 424.8045	+ 14.5080	+ 1918.9967	+ 72.6420	+ 14.5080	+ 107.4395

SAMPLE DRAWING
This sample drawing shall be construed as information only. It is complete only to the degree necessary to illustrate a particular drawing type.

FIG. 41 CONTOUR DEFINITION DRAWING (Tabulated Coordinates)

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13.9.2 Application Guidelines. A contour definition drawing is prepared to define complex surface geometry which cannot be conveniently included in the detail drawings of an item.

13.9.3 Requirements. A contour definition drawing includes, as applicable,

(a) mathematical equations for the geometric features,

(b) tabulated coordinates,

(c) graphic sections, and

(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.

13.10 Software and Memory Device Data (Fig. 42)

Drawings defining software such as instructions, or data that will be or is intended to be resident in a memory device or other type of media which becomes a part of the end item shall be prepared as either a Software Installation Drawing or Altered Item Drawing to be determined by whether the software is *one-time programmable* or *multi-programmable*.

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

(a) One-time programmable devices shall be documented using the requirements of the ALTERED ITEM DRAWING.

(b) Multi-programmable devices shall be documented using the requirements of the SOFTWARE INSTALLATION DRAWING.

13.10.2 Software Installation Drawing (Fig. 42)

13.10.2.1 Description. A software installation drawing identifies the characteristics of the software, instructions for programming into the memory device, its master media, and physical location. Software programs will be identified by PIN within the drawing form rather than defined using "truth tables." This drawing does not establish item identification.

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

13.10.2.3 Requirements. The drawing shall identify

(a) identification of the item to be programmed by PIN (by referencing the original vendor's part number or by providing complete description of the item) or by vendor item control drawing or source control drawing 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, object file identification and version;

(c) physical location of the master software or data. Name and address reference will be made or CAGE Code 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; and

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

13.10.3 Assemblies Containing Multi-Programmable Devices. Software or data that is programmed into a device at a higher level of assembly shall be documented using software installation drawing requirements. The device (after programming or loading) shall not be re-identified.

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

13.10.4.1 One-Time Programmable Devices and Media Requirements. The requirements for Altered Item Drawings shall be in accordance with the requirements here-in and the following

(a) identification of the item to be programmed by PIN (by referencing the original vendor's PIN or providing complete description of the item) or by vendor item control drawing or source control drawing 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, object file identification and version.

(c) physical location of the master software or data. Name and address reference will be made or CAGE

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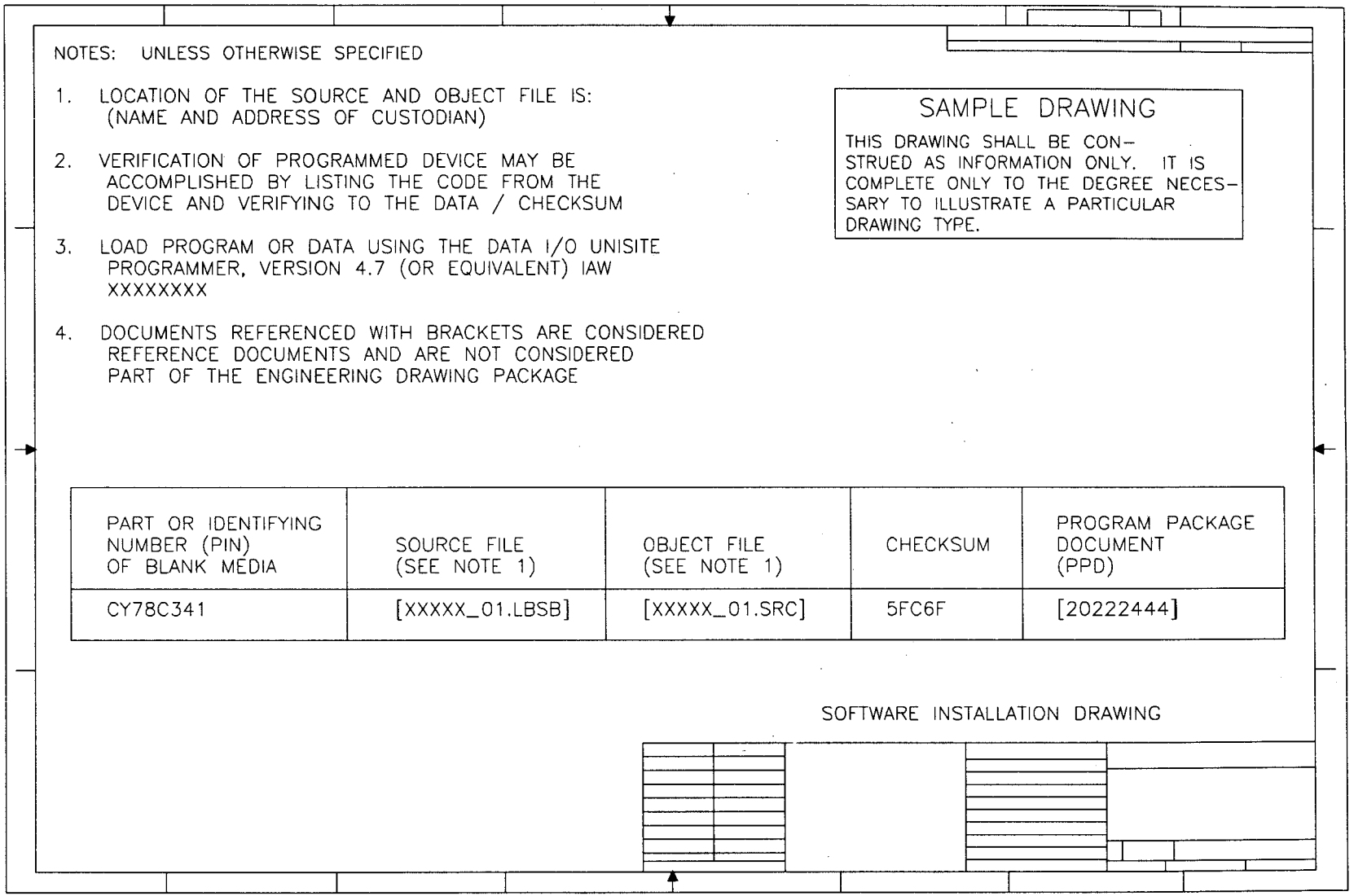


FIG. 42 SOFTWARE INSTALLATION DRAWING

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Code 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.

13.11 Design Parameters Drawing (Figs. 43 and 44)

13.11.1 Description. The design parameters drawing discloses features and characteristics that are critical to the delineation of the geometric, functional, operational, performance, quality, and safety requirements of an item. A design parameters drawing provides a graphic description of requirements for design development/evaluation or item production, as applicable, or it provides sufficient technical information for the development of *design disclosure drawings.*

The design parameters drawing may be independent but is primarily intended for use with or in support of a *performance specification* or another requirements document. The design parameters drawing establishes item identification when design disclosure drawings are not created and delivered to the customer.

13.11.2 Application Guidelines. A design parameter drawing is prepared to

(a) supplement specifications utilized for design definition and development,

(b) establish design objectives and parameters,

(c) establish a configuration baseline for the generation of design disclosure documentation,

(d) retain design intent of an item for historical reference; and

(e) acquire an item without the requirement for full design disclosure.

The design parameters drawing should be prepared in the beginning design phases for major interface items. The design parameters drawing provides a graphic means to convey design intent for production, design development, the creation of a design disclosure package, and historical reference. Unlike the envelope drawing, it will not be converted into any other drawing type regardless of its utilization.

13.11.3 Requirements

13.11.3.1 The design parameters drawing contains a technical description of the critical geometric, functional, operational, performance, safety, and quality characteristics of the item. Although full design disclosure is not required, sufficient information is provided to support design development and the follow-on procurement of interchangeable items, such as,

(a) geometric definition of features including mounting, mating, and volume utilizing the necessary size, form, and location controls;

(b) physical, performance, installation, reliability, safety, and interchangeability requirements;

(c) materials requirements including hardness and protective coatings;

(d) quality requirements including test and inspection;

(e) schematic, connection, or other appropriate diagrams;

(f) the mating connection location(s), and connection diagram(s) to provide information for external connectors when required; and

(g) reference to other documentation, if necessary.

13.11.3.2 The drawing includes the notation DESIGN PARAMETERS DRAWING placed adjacent to the drawing title block.

13.11.3.3 When a design parameters drawing is generated in conjunction with a performance specification, a note is added to the general notes of the drawing as follows: THIS DRAWING IS A SUPPLEMENT TO SPECIFICATION (number).

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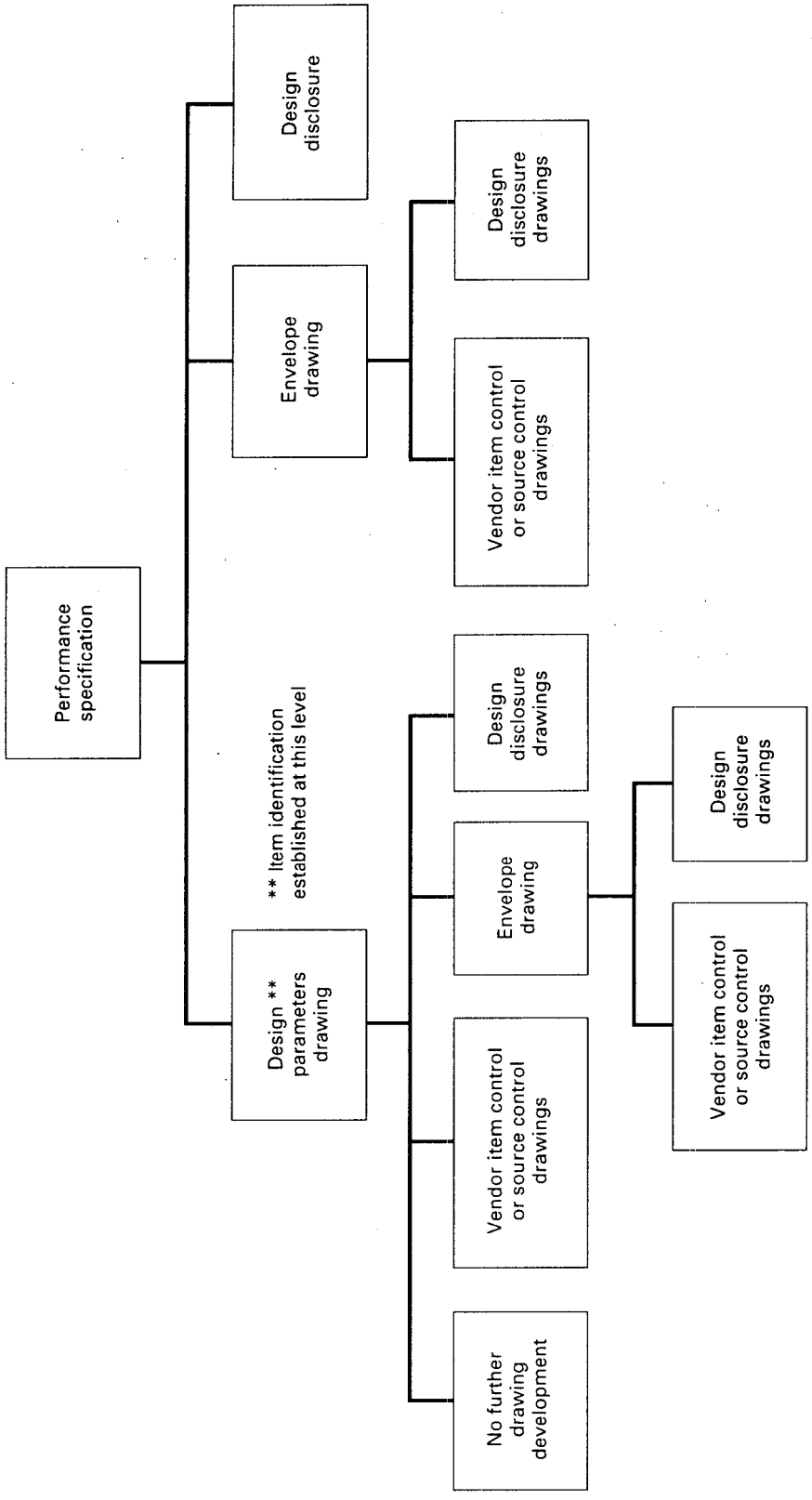


FIG. 43 DEVELOPMENT OPTIONS

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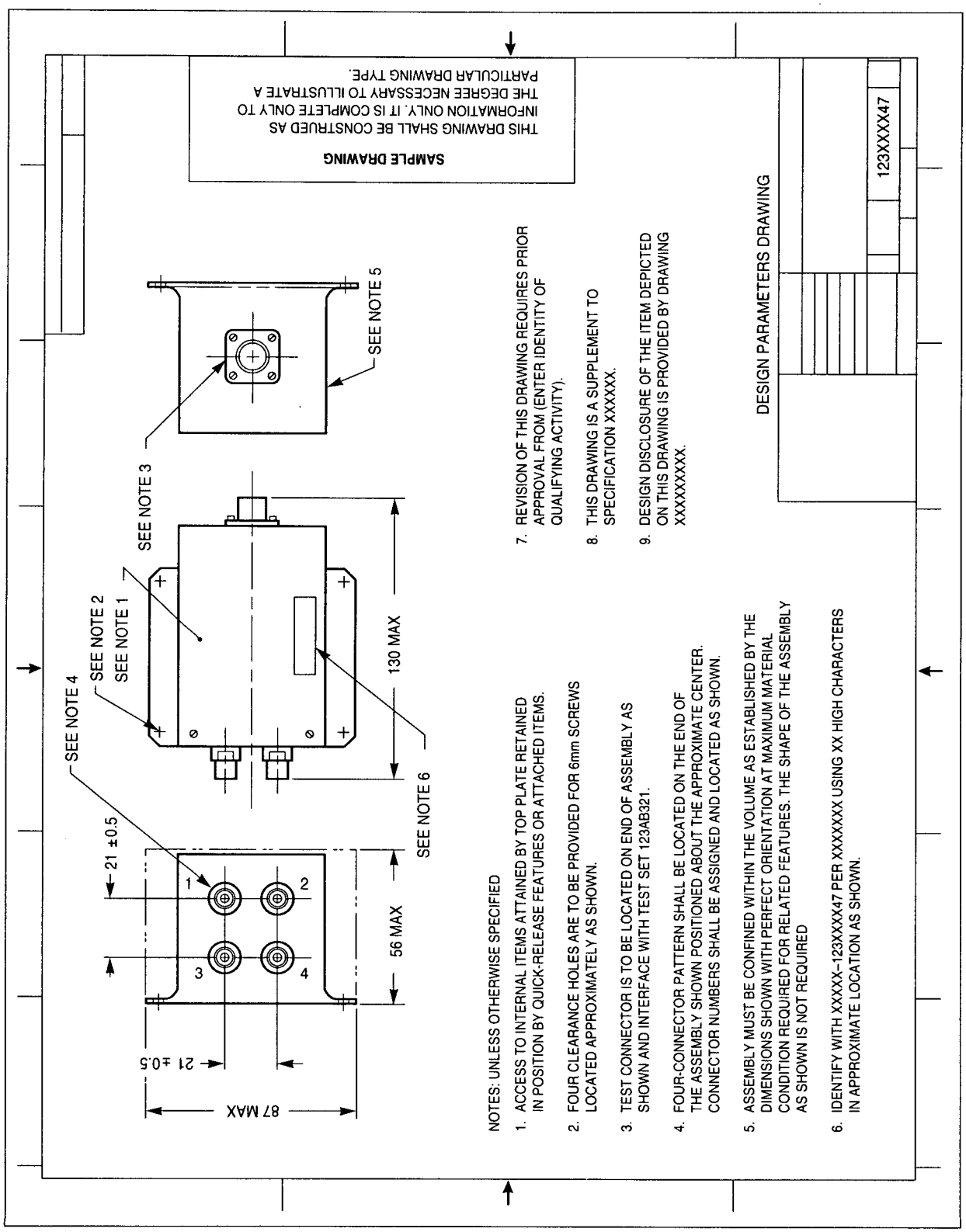


FIG. 44 DESIGN PARAMETERS DRAWING

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MANDATORY APPENDIX I
DEFINITION OF TERMS

The following definitions apply to terms as used in this Standard.

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

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

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

as applicable: the term *as applicable* is intended to require inclusion of those data elements necessary to establish the engineering definition or end product requirements.

assembly: a number of parts or subassemblies or any combination thereof joined together to perform a specific function, and subject to disassembly without degradation of any of the parts. (Examples: power shovel-front, fan assembly, audio-frequency amplifier.)

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.

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

associated list: a tabulation of engineering information pertaining to an item depicted on an engineering drawing or by a set of drawings. For example: parts list, data list, and index list.

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

Commercial and Government Entity (CAGE) Code: a five character code listed in Cataloging Handbook H4/H8, Commercial and Government Entity (CAGE) Code, that is assigned to commercial and Government activities that manufacture or develop items, or provide services or supplies for the Government. When used with a drawing number or part number, the CAGE Code designates the design activity from whose series the drawing or part number is assigned. The CAGE Code was previously called "manufacturer's code," "code identification number," or "Federal Supply Code for Manufacturer's (FSCM)."

commercial item: a product, material, component, subsystem, or system sold or traded to the general public in the course of normal business operations at prices based on established catalog or market prices.

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

current design activity (CDA): an activity currently having responsibility for the design of an item and the preparation or maintenance of drawings and associated documents. Current design activity could be the original activity or new activity when that responsibility is transferred from another design activity.

design activity: a design activity is an activity that has, or has had, responsibility for the design of an item. The activity may be a Government, commercial, or nonprofit organization.

design disclosure drawing(s): a drawing or set of drawings and associated data which delineates the de-

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tailed engineering requirements of an end product necessary for the fabrication, assembly, inspection, and test of the item.

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

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

engineering drawing: an engineering document or digital data file(s) that discloses (directly or by reference), by means of graphic or textual presentations, or combinations of both, the physical and functional requirements of an item.

FSCM Number: see *CAGE Code.*

inseparable assembly: see *part.*

interchangeable item: one that possesses such functional and physical characteristics as to be equivalent in performance to another item of similar or identical purposes; and is capable of being exchanged for the other item without selection for fit or performance, and without alteration of the items themselves or of adjoining items, except for adjustment.

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

item identification: the part or identifying number or descriptive identifier for a specific item along with the design activities name and address (city and state) or CAGE Code.

multi-programmable memory device: a memory device containing software instructions or data that can be changed in the device once programmed. Example: Electrically Alterable Read Only Memory (EAROM), Floppy Disk.

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 nongovernment organization (private sector association, organization, or technical society) that conducts professional standardization activities (plans, develops, establishes, or publicly coordinates standards, specifications, handbooks, or related documents) and is not organized for profit.

one-time programmable memory device: a memory device containing software instructions or data that cannot be changed in the device once programmed. Example: Programmable Read Only Memory (PROM), Programmable Array Logic (PAL).

original design activity (ODA): an activity having had responsibility originally for the design of an item and whose drawing number, name and address (city and state), or CAGE Code is shown in the title block of drawings and associated documents.

part: one piece, or two or more pieces joined together, that are not normally subjected to disassembly without destruction or impairment of designed use. (Examples: transistor, composition resistor, screw, gear, transformer, milling cutter, bearing.)

part or identifying number (PIN): the identifier assigned by the design activity or by the controlling nationally recognized standard which uniquely identifies (relative to that design activity) a specific item. The PIN generally includes the controlling drawing or document number and optional suffix. The PIN does not include the drawing revision identifier, drawing size, or CAGE Code.

performance specification: a specification that states requirements in terms of 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 it must operate, and interface and interchangeability characteristics.

printed board: the general term for completely processed printed circuit and printed wiring configurations. (This includes single-sided, double-sided, and multilayer boards with rigid, flexible, and rigid-flex base materials.)

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

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

procuring activity: the procuring activity is the customer.

production master: a 1:1 scale pattern that is used to produce rigid or flexible printed boards within the accuracy specified on the master drawing.

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

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qualification: the formal process by which a manufacturer's product is examined for compliance with the procurement requirements of a source control drawing for the purpose of approving the manufacturer as a source of supply.

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

reference data: information (including dimensions) that does not govern production or inspection operations. Reference data is indicated by enclosing the data in parentheses or by labeling it REF.

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

separable assembly: see *assembly.*

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.

subassembly: see *assembly.*

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

supplier: see *vendor.*

title block: the block located in the lower right corner of the drawing format which contains the primary drawing identification. (see ASME Y14.1)

unique identifier: see *part or identifying number* and *item identification.*

vendor: a source from whom a purchased item is obtained; used synonymously in this Standard with the term supplier.

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

work package: a group of related items (which 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 installing them in a telecommunications satellite structure).

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NONMANDATORY APPENDIX A
SELECTION OF DRAWING TYPES

1 INTRODUCTION

This Appendix provides additional guidance for the selection of drawing types contained in ASME Y14.24-1999. Proper use will minimize preparation of nonstandard drawing types.

2 GROUPINGS

Table A-1 categorizes the basic drawing types (Sections 2 through 12) and defines the relationship between these types and the special application drawings (Section 13).

3 SELECTION

The types of drawings to be prepared are based on
(a) contractual requirements, if applicable,
(b) type of item involved,
(c) development phase of the item, and
(d) intended use of the drawing package.

Figure A-1 provides guidance for selecting drawing types for procured items. This figure illustrates the selection process for DoD application. However, the same selection process and documentation may be used in a commercial application if desired.

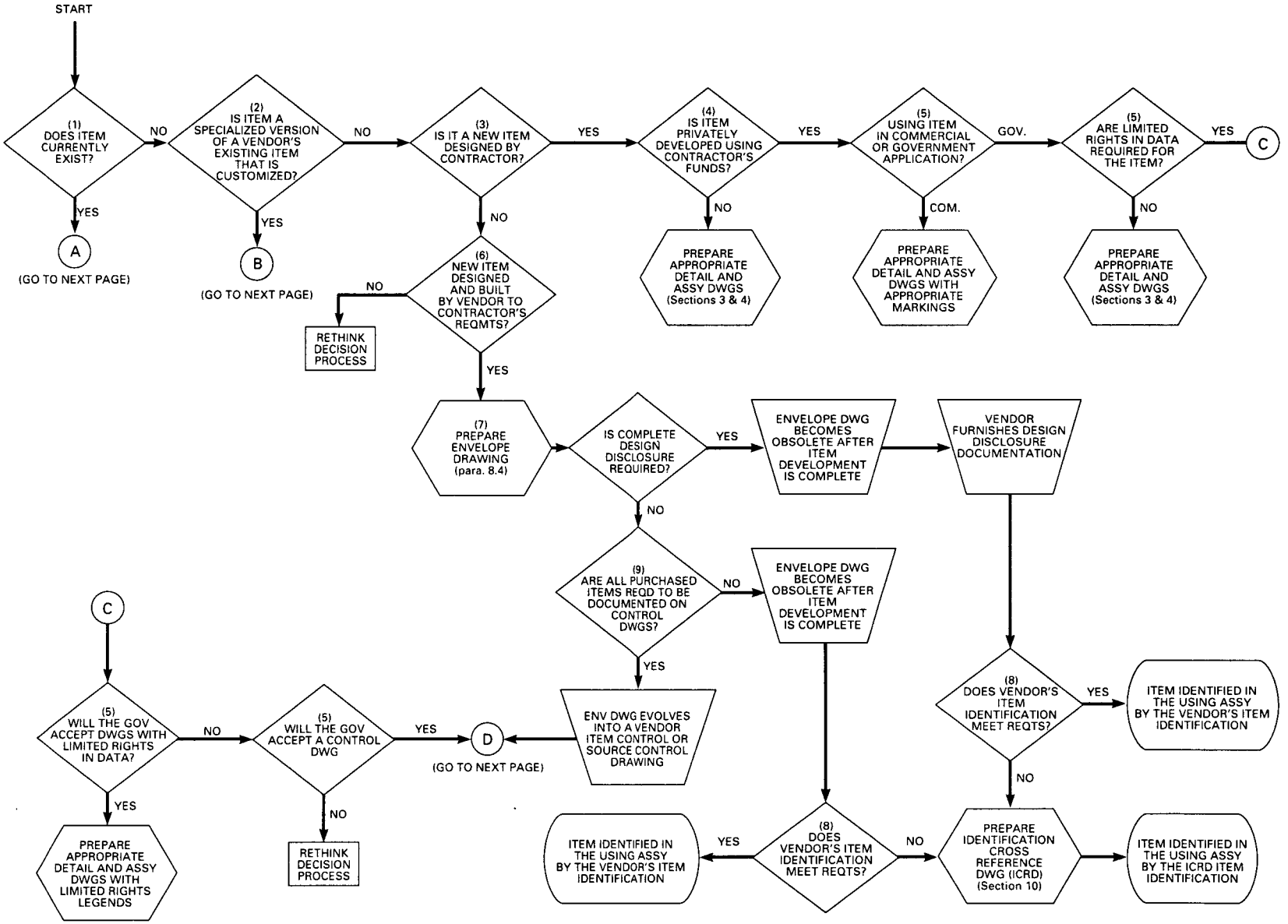
Normally, in a commercial environment, the contractor (or customer) does not require extensive detail and documentation for purchased items, the alteration or selection of purchased items or nationally recognized standard items, the development of a new item, or the reidentification of an item. A PROCUREMENT CONTROL DRAWING may be used instead of a VENDOR ITEM CONTROL, SOURCE CONTROL, ALTERED ITEM, SELECTED ITEM, ENVELOPE or IDENTIFICATION CROSS REFERENCE DRAWING to provide the minimum detail necessary for commercial requirements. See para. 8.1.

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TABLE A-1 FUNCTIONAL GROUPING OF DRAWING TYPES

Design Information Drawings (No Direct Hardware Control)	Hardware and Software Drawings (Fabrication and Kit Control)	Control Drawings (Interchangeability Control)
Layout drawing (Section 2) Contour definition drawing (para. 13.9)	Layout drawing [para. 2.3(k)]	Procurement control drawing (para. 8.1)
Installation drawing (Section 5)	Detail drawing (Section 3) Monodetail drawing (para. 3.1) Multidetail drawing (para. 3.2) Master drawing (para. 13.3.3.2) Tube bend drawing (para. 13.7) Contour definition drawing (para. 13.9) Software installation drawing (para. 13.10.2)	Vendor item control drawing (para. 8.2)
Arrangement drawing (Section 7)		Source control drawing (para. 8.3)
Interface drawing (Section 9)		Envelope drawing (para. 8.4)
Mechanical schematic diagram (Section 11)		Identification cross reference drawing (Section 10)
Functional block diagram (para. 12.1)		Microcircuit drawing set (para. 13.4)
Single line diagram (para. 12.2)	Assembly drawing (Section 4) Assembly drawing (para. 4.1) Inseparable assembly drawing (para. 4.2) Wiring harness drawing (para. 13.1) Cable assembly drawing (para. 13.2) Board assembly drawing (para. 13.3.3.1) Tube bend drawing (para. 13.7)	Design parameter drawing (para. 13.11)
Schematic or circuit diagram (para. 12.3)		
Connection or wiring diagram (para. 12.4)		
Interconnection diagram (para. 12.5)		
Wiring list (para. 12.6)		
Logic circuit diagram (para. 12.7)		
	Installation drawing [para. 5.3(h)]	
	Modifying drawings (Section 6) Altered item drawing (paras. 6.1, 13.10.4, 13.10.4.1) Selected item drawing (para. 6.2) Modification drawing (para. 6.3)	
	Wiring list (para. 12.6)	
	Artwork (para. 13.3.3.3)	
	Artwork master (para. 13.3.3.4)	
	Production master (para. 13.3.3.5)	
	Master pattern drawing (para. 13.3.3.6)	
	Undimensioned drawing (para. 13.5)	
	Kit drawing (para. 13.6)	
	Matched set drawing (para. 13.8)	

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NOTE: Chart legend is shown on next page.

FIG. A-1 DECISION DIAGRAM FOR DETERMINING APPLICABLE DRAWING TYPES FOR PROCURED ITEMS (Sheet 1 of 2)

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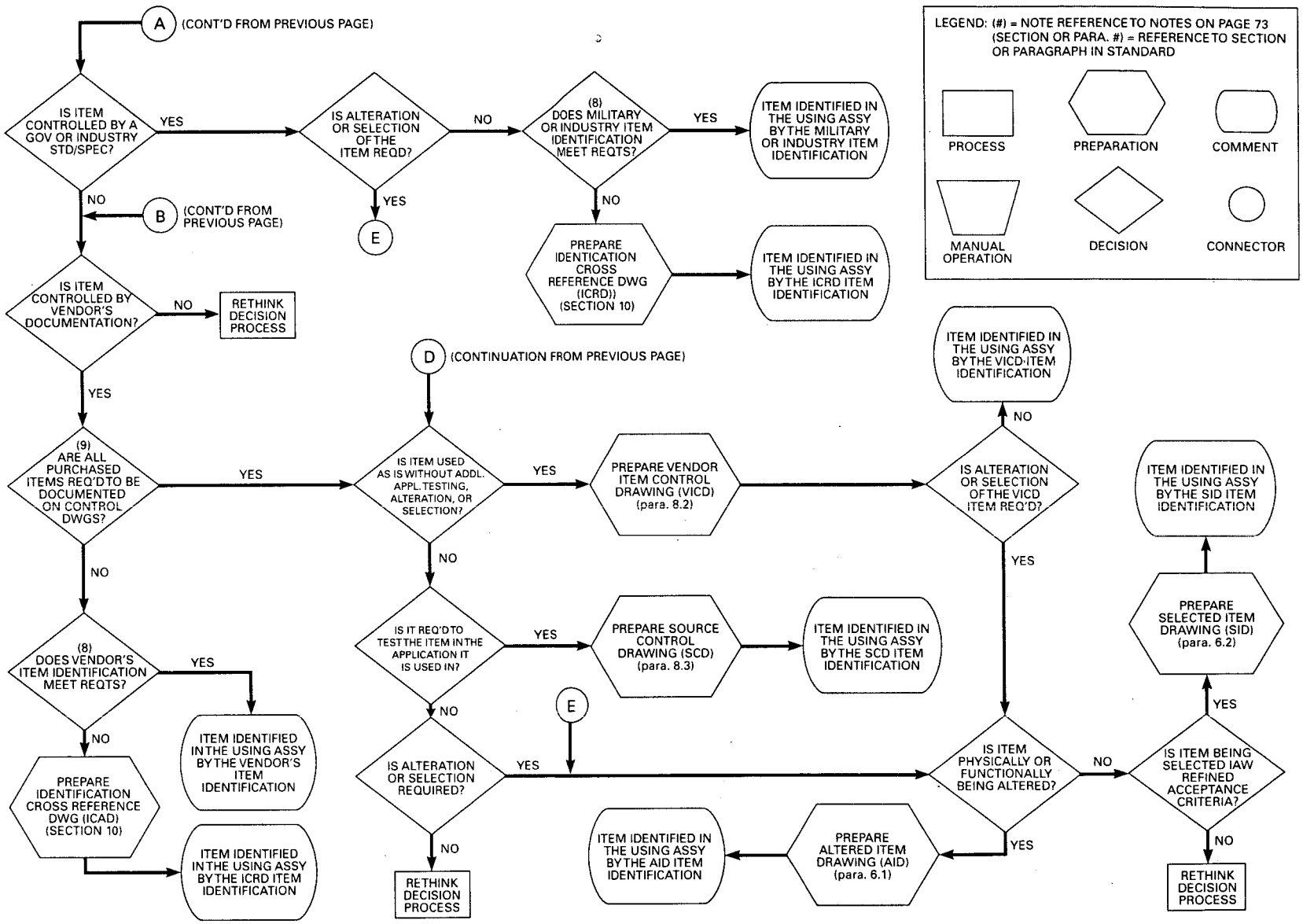


FIG. A-1 DECISION DIAGRAM FOR DETERMINING APPLICABLE DRAWING TYPES FOR PROCURED ITEMS (Sheet 2 of 2)

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FIGURE A-1 NOTES:

(1) An existing item is an item that is currently sold or traded.

(2) Also referred to as a "vendor-developed item."

(3) The contractor is the design activity. Any item for which the configuration (e.g., size, shape, tolerance, finish, etc.) is developed and specified by the design activity shall be considered the contractor's design. If the item is subcontracted to a vendor to be manufactured (contractor's design documentation is submitted to the vendor), it is still considered the contractor's design regardless of whether a vendor's proprietary process is required in manufacturing it.

(4) COMMERCIAL APPLICATION: If a customer is buying design disclosure drawings of the item that is being designed and built, negotiations must be made between the contractor and customer to determine how a contractor's proprietary design information will be protected. One option a contractor could do is to copyright their design information.
GOVERNMENT APPLICATION: If a customer is buying design disclosure drawings of the item that is being designed and built, a contractor may prepare documentation with limited rights legends to protect their proprietary information. A careful analysis of the contract and a review and approval with the customer should be made prior to determining the proper method of documenting the item.

(5) COMMERCIAL APPLICATION: If the data is being sold to a commercial customer, contractual agreements may be made between the contractor and customer limiting the customer's use of the data. A contractor may protect their data by applying a proprietary legend, copyright or both to their drawings.
GOVERNMENT APPLICATION: A contractor may protect their data by limiting the Government's right in using the data. An appropriate limited rights legend and suitable markings (if needed) may be added to the drawing to indicate limitations in the use of the data. In some contractual situations, the Government may not accept data with limited rights, but will allow the contractor to document their design (end item) on an appropriate control drawing (i.e., VENDOR ITEM CONTROL DRAWING or SOURCE CONTROL DRAWING). The contractor is identified as a source of supply on the drawing. A careful analysis of the contract and a review and approval with the customer should be made prior to determining the proper method of documenting the item.

(6) The contractor supplies basic technical information and performance requirements about an item to a subcontractor (vendor). This data may be detailed in a procurement specification that is referenced on an ENVELOPE DRAWING or all design parameter data may be included on the drawing (i.e., the procurement specification is not needed). The subcontractor designs and builds an item that meets the contractor's design parameters. The subcontractor is the controlling design activity for the item.

(7) If required, design disclosure drawings are purchased from the subcontractor and included in the contractor's drawing package. ENVELOPE DRAWINGS are only temporary drawings and become obsolete after development of the item is complete or the drawing may evolve into an applicable control drawing (see Fig. A-1). An ENVELOPE DRAWING should never be referenced on a using assembly unless it is later removed or is replaced with another appropriate item identification.

(8) COMMERCIAL APPLICATION: Item identification may consist of a part or identifying number or a descriptive identifier of the item along with the manufacturer's name and address or CAGE Code.
GOVERNMENT APPLICATION: An acceptable item identification consists of (1) a valid CAGE Code of the responsible design activity plus (2) the part or identifying number that includes the controlling document number and optional suffix, and consists of 15 characters or less. Limitations on the acceptable characters are stated in MIL-STD-100, military specification for Engineering Drawing Practices. EXCEPTION: The part number of a government or industry standard item may or may not include the controlling document number as a part of the item identification.

(9) COMMERCIAL APPLICATION: Unless otherwise specified by contract, a contractor may choose to document all purchased items on applicable control drawings for traceability and interchangeability purposes. If not, the ENVELOPE DRAWING becomes obsolete and the contractor must rely solely on the vendor's item identification for subsequent procurements of the item.
GOVERNMENT APPLICATION: The contract should specify whether purchased items will be documented on applicable control drawings or vendor item identifications will be used.

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