Amtrak

Mechanical Department
Bureau of Rolling Stock Engineering

SPECIFICATION

for

Drawing Standards for CAD

SPECIFICATION No. 867

Initial Issue

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Bureau of Rolling Stock Engineering

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Table of Contents

1.0 General

2.0 Basic System
- 2.1 Structure
- 2.2 Hierarchy
- 2.3 Reference Guidelines
- 2.4 Other Documents

3.0 Drawing Numbers

4.0 Identification Of Parts And Assemblies

5.0 Part Numbers

6.0 Group/Dash Numbers

7.0 Summary

Amtrak
Bureau of Rolling Stock Engineering

Specification for Drawing Standards for CAD
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1.0 General

This specification contains the drawing and drafting standards for use by the Amtrak Bureau of Rolling Stock Engineering and third party drafting system contractors. The explanations are basic and are not intended to supersede or contradict any of the detailed information in other sections of this manual. Reference should be made to those sections to amplify and clarify this overview.

2.0 Basic System

2.1 Structure

The system is based on a hierarchy of “Lists.” These are data lists, index lists, and lists of parts, assemblies, subassemblies and other instructions which provide the complete product or system description and identification.

2.2 Hierarchy

The hierarchy of lists may take form of a “Document Tree” as illustrated in simple form by Figures 1 and 2. The top product document is a “Master Parts List” from which all information is derived either by direct reference or by reference to other lists at lower levels of the structure. See Figure 1. The top system product document is a “Data List” from which sub-level data lists, index lists, and parts lists are derived. See Figure 2.

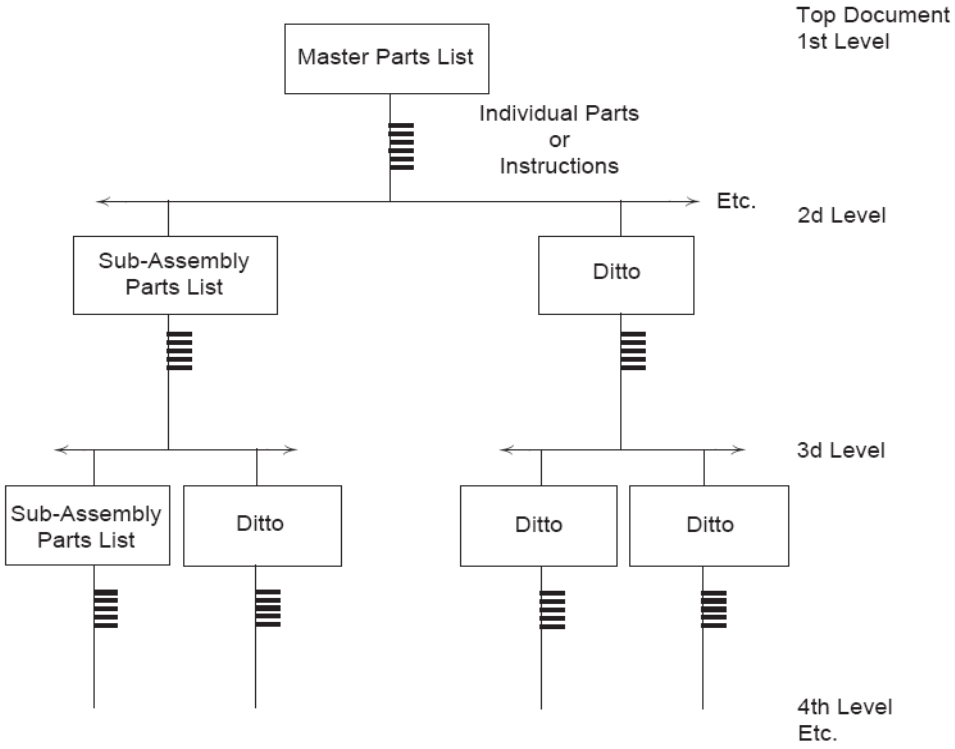

Figure 1 Top Level Tree

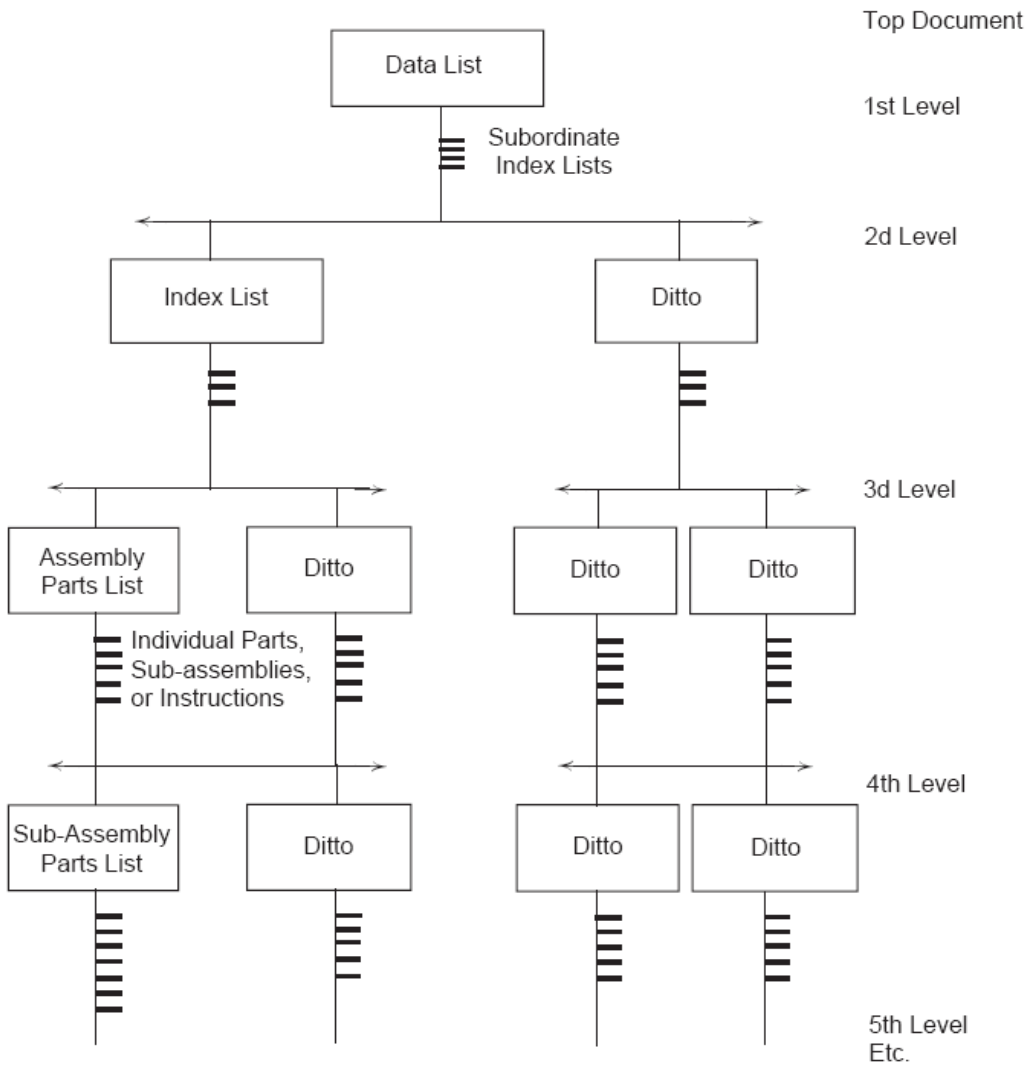

Figure 2 Sub Assembly Tree

2.3 Reference Guidelines

Each list may reference individual parts, other lists or other informative documents. Any combination of entries may be used to adequately describe the “hardware” or system. Data Lists and Index Lists should stand along.

2.4 Other Documents

Instructions other than drawings may be required. Examples are Testing Instructions, Shipping Information, and Installation Requirements. Such documents are prepared on conventional drawing forms and are identified with regular drawing numbers. They are processed in the same manner as drawings. The objective is to make the “Tree” complete so that all required

information is accumulated in one place, organized for convenient reference, and forms a permanent record.

The existence of a drawing or other document does not, in itself, indicate applicability to a product. It must be entered on a parts list that has been allocated to a product before its applicability is established. Furthermore, it must be called out by a quantity in the designated column of that list. Parts lists may be separate documents or may be included on the face of the drawing.

3.0 Drawing Numbers

Several drawing number systems have been developed to meet the changing corporate needs. The common principle for all systems is the non-duplication of numbers. Each document is thus given a unique number that provides identification for the document and for the derived product.

4.0 Identification Of Parts And Assemblies

The complete product described by the Master Parts List, Data List, or Index List is identified by the drawing number of that list. Similarly, sub-assemblies and unit parts are identified by the drawing number of the document on which they are delineated or described. This and the extension of the drawing number by a part, group, or dash suffix number are explained in the following.

5.0 Part Numbers

A drawing may delineate a single part or may show two or more related parts. Parts shown on a drawing are given consecutive part numbers. If a number 123A456 is assigned to the unit part drawing, then the part itself would be identified as 123A456P1 (the Part suffix number is added to the drawing number). Similarly, if a number 456D845 is assigned to the multi-part drawing, then the first part on that drawing would be 456D845P1 and the other parts would be 456D845P2, etc. If the dash numbering practice is used, the numbers would be 456D845-1, 456D845-2, etc.

The use of multi-part drawings reduces the drafting effort and the number of documents in a system. At the same time it provides unique identification for all parts while maintaining an association of like parts.

6.0 Group/Dash Numbers

An assembly or other grouping of items is accumulated by listing on a parts list and by indicating the required quantities of each item in a group/dash numbered column. Variations on the original grouping are described by entering quantities in successive columns. Additional line items are added to the list as required to complete the added groupings.

The assembly or group of items is identified by the list number plus the group/dash suffix in the same manner as was described for parts. This system provides unique identification for each

different set of items even though they share the same basic drawing number. The group/dash system provides the same advantages for collections of parts as previously described for individual parts.

7.0 Summary

The part, group, and dash systems permit full documentation with a minimum of drafting work. In addition, and equally as important, it keeps like items together under the same basic drawing number. This greatly facilitates the ordering and production operations. The system is extremely flexible and can be adapted to any product or circumstances. The flexibility becomes increasingly evident through use.

Refer to Appendix A for specific information.

Appendix A
Drawing Sheets and Formats

1.0 GENERAL

The primary purpose of a drawing is to convey engineering requirements for a finished product or part. A set of drawings for a system or a product contains sufficient engineering information so that the following key functions may be performed by those who are responsible.
a) Order material
b) Plan manufacturing operations, tooling and manufacturing facilities
c) Process material
d) Inspect and control product quality and reliability
e) Assemble
f) Test
g) Package, box and ship
h) Determine cost
i) Catalog
j) Install and service
k) Conduct final acceptance test
l) Make alterations
m) Record for duplication, repair or replacement.

1.1 Copies of engineering drawings should not be distributed outside the company without proper consideration for protection of proprietary information. The company patent counsel should be consulted as to the proper procedures. Copies of engineering drawings which are to be sent to military agencies are subject to the Terms and conditions of the contract under which they are acquired.

1.2 Requirements for drawing content may be satisfied by direct delineation or description on the drawing or by reference to other documents. When items (for example: parts, subassemblies, dimensional or processing data) have multiple usage, the combination of common related data elements in a single document (process specification, kit drawing, design standard, etc.) is encouraged, clarity is provided, and technical adequacy is not impaired. Such documents are invoked in individual drawings, usually by general notes.

1.3 Unless specifically prohibited, the characteristics of more than one drawing type may be combined in a single drawing, provided that the resulting combination includes all of the data required for the combined types. Logical combinations include, but are not limited to:
a) Detailed assembly drawing
b) Assembly installation drawing
c) Assembly mechanical schematic drawing
d) Assembly circuit diagram drawing
e. Detailed matched set drawing
f. Specification control and altered item drawing.

2.0 CATEGORIES OF DRAWINGS

Engineering drawings can be classified in four broad categories:
a) Layouts and design study drawings

b) Production (manufacturing) drawings
c) Installation and outline drawings
d) Design data drawings.

A detailed description of drawings in the four categories that are most commonly used follows.

2.1 LAYOUT AND DESIGN STUDY DRAWINGS

2.1.1 These depict proportions, dimensions, materials, relationship of parts, etc. in new or modified designs. Usually they precede production drawings, are made to scale, and are useful in preparing and checking part drawings and assemblies.

2.1.1.1 As they are often effective in establishing patent claims, it is essential that such drawings be signed and dated by the originator as soon as they are begun. When new and novel features are revealed, the drawing should also be signed and dated by a witness having a working knowledge of the features involved. When new ideas or patentable features of design are involved, the patent counsel should be consulted.

2.1.1.2 When practical, layouts should be prepared in a form suitable for use in manufacturing. This need would be manifest in situations where prototype or developmental models of equipment are required.

2.1.1.3 During the course of preparation, design studies and layouts should be subject to initial design reviews by engineering and manufacturing representatives and others, as appropriate. The purpose of such reviews is to permit assessment of the designs as to engineering and producibility considerations within the project cost parameters and customer requirements.

2.1.2 Checking Assembly Drawings - These drawings are accurate scale assemblies prepared from detail part drawings to assure accuracy of dimensions and relationship of parts. Where continuing record of changes to detail part drawings are reflected on checking assemblies, the delineation thereof should be on dimensionally stable material. In general, such drawings only provide key dimensions and tolerances.

2.2 ENGINEERING PRODUCTION (MANUFACTURING) DRAWINGS

2.2.1 Engineering production drawings should provide complete engineering definition of the finished system, assembly, or part. This includes reference to supplementary data such as design data references, laboratory instructions, engineering instructions, etc., as appropriate. Manufacturing or processing instructions may also be provided for reference
purposes only, unless such data are vital to end definition and engineering control of the product.

2.2.2 Engineering production drawings must not under any circumstances be prepared to accommodate a particular method of manufacture except as described above. In addition, such drawings must not include information relating to manufacturing work stations, as this kind of information should be part of the planning process.

2.2.3 Engineering production drawings should always be prepared so that regardless of location of manufacture, they can be used without additional explanation. If data relating to manufacturing processes, planning records and similar information are shown, they may be referenced on working drawings (not the parts list) thus:

2.2.4 Supplementary data are normally prepared by the operation having design responsibility. They may be in the form of a descriptive drawing, manufacturing process sheet, etc. The responsibility for acquiring such records remains with the user operation.

2.2.5 When practical and when proprietary information is not revealed, a produced assembly drawing may be used as an outline.

2.2.6 Monopart Drawing (also Monodetail Drawing) – A monopart drawing conveys the description of a single part. It provides maximum clarity in defining an individual part and maximum flexibility when product changes are necessary. Moreover, monopart drawings lend themselves more readily to product standardization.

2.2.7 Multipart Drawing (also Multidetail Drawing) - A multipart drawing conveys two or more uniquely identified parts in separate views or sets of views. Such parts may or may not be related to “one another. Multipart drawings are particularly useful for "one shot” jobs, such as tools, test equipment, products for special requisitions, etc.

2.2.8 Modified Part Drawing - A modified part drawing describes a modification to an existing stock, standard or vendor-purchased part. The part should be delineated in sufficient detail to orient the modification and should be re-identified by a new drawing number.

2.2.9 Tabulated Drawing - A tabulated drawing provides a description of similar items which, as a group, have most characteristics in common plus variable features. It is prepared generally with a single delineation to avoid preparation of each tabulated item. Each item in the tabulation is assigned a unique identification; i.e., a drawing number or suffix number.

2.2.10 Assembly Drawing - An assembly drawing defines the complete end item requirements and establishes item identification for the assembled configuration of two or more pieces, parts, subordinate assemblies or any combination of these which are joined together to form an assembly. An assembly drawing may contain the detailed design requirements for one or more parts used in the assembly. It is prepared for each group of items which are to be joined together to form an assembly that reflects either:
a) A logical level in the assembly or disassembly sequence
b) A functional unit
c) An as-stocked/as-built item.
An assembly drawing may define either a separable or inseparable assembly.

2.2.11 Purchased Part or Specification Control Drawing - This type of drawing is generally required when it is necessary to control the physical and functional features of a part purchased from an outside vendor or from another operation of the company. It ensures that future procurement of the original part will not be jeopardized in the event that the supplier makes modifications which would not be compatible with the original application. In addition, it facilitates ordering, incoming inspection, testing and stock keeping. This type of drawing also serves as a record which would other wise be unavailable in the event vendor catalog numbers are changed. The vendor source(s) and identification may be given on the drawing or on supplementary documents which are a part of the drawing structure. A note specifying “similar to vendor part identification” may be added to the drawing either in a note or near the title block. The words “Purchased Part Drawing” or “Specification Control Drawing” may be placed in a conspicuous area of the drawing, preferably in the vicinity of the drawing title block.

2.2.11.1 Such drawings generally contain the following kinds of information, as applicable:
a) Outline delineation with critical and control dimensions
b) Performance data: i.e., electrical and mechanical ratings, environmental conditions, etc.
c) Other special requirements, if any d) Incoming inspection and test instructions, if any limiting instructions to the vendor.

2.2.11.2 Purchased Part or Specification Control Drawings should describe only one type of part per drawing; however, a number of similar parts of the same type and the same general, functional and physical configurations may be tabulated.

2.2.11.3 A specification control drawing is not used for vendor items which are modified or selected or for nationally recognized standards.

2.2.12 Sketch Drawings - When a drawing is prepared and issued which purposely does not conform to company standards, it shall bear the word “SKETCH” printed below the main drawing identification number. If the drawing is later revised to reflect company standards, the word “SKETCH” shall be removed and the drawing reissued as a revision. See Section K4.1, Paragraph 3.0 “Sketch or Advance Copy Drawings” for unissued routines.

2.2.13 Tool and Other Drawings for Limited Internal Use - Drawings for tools, plant maintenance test equipment model shop and other similar activities made for limited internal use should, as far as practical, conform to the basic practices contained herein.

Where test equipment is designed for long life, requiring periodic change to accommodate the state-of-the-art of items under test in such equipment, its drawings should be prepared to the quality of product drawings. Revisions to such drawings should be in accordance with product-drawing procedures.

2.3 INSTALLATION OR OUTLINE DRAWINGS

2.3.1 These types of drawings are prepared for the information of the customer. They give a physical overview of the product or system and generally provide the following typical information:
a) Configuration and size, using a minimum number of views with overall and other dimensions of importance to the customer
b) Space requirements for product installations and servicing, and for safe and functional operating clearance, etc.
c) Mounting data, including centerline or base line of machine, coupling data, location and size of lifting lugs or eye bolts, mounting supports, and holding down bolts. Weights, foot loadings, and center of gravity may be required, depending on the type of installation.
d) Location, type and dimensions of all interface connections, including approach clearance required for making such connections
e) Tolerances or limits on dimensions required by the customer for obtaining fits, clearances, alignment, etc.
f) Electrical and electronic circuit connections, such as terminal boards, receptacles, connector plug configurations, etc. Interconnection or cabling diagrams may also be shown when required for customer inputs. Internal schematic diagrams should not be shown unless specifically required by the customer.

2.3.2 When an installation or outline drawing applicable to a standard line of products is prepared, the title block should include broad product nomenclature, for example, “OUTLINE

DC MOTOR." Drawings for custom-built equipment may also include the customer's name and requisition number.

2.3.3 When practical, an outline or installation drawing may be used as an assembly production drawing.

2.3.4 Customers' drawings should be kept free of all references to information of an internal nature, such as parts lists, production drawings, engineering instructions, etc.

2.3.5 Cross referencing of customer drawing numbers on company installation drawings should be avoided. Such practice would introduce a risk and responsibility for maintaining correct and complete references.

2.3.6 Arrangement or System Drawings - An arrangement drawing conveys information for equipment familiarization or determination of co-functioning requirements. Such drawings depict related but not necessarily connected assemblies and identify principal assembly items.

2.4 DESIGN DATA DRAWINGS

2.4.1 Design data drawings convey design information and practices. These drawings are normally restricted to internal use. These data may be records of engineering and manufacturing investigations, field experience, recommendations of various standardizing groups, etc. Such data may cover the selection of manufacturing process and type of material, methods of calculating strength and other mechanical, electrical and electronic conditions, design hints and instructions to assist in economical manufacturing, as well as miscellaneous data for the convenience of designers.

2.4.2 Drawings in this category may also be of the tabulated type. For example, a drawing may show all sizes of a group of similar products and provide dimensions and data necessary for application specification purposes to avoid necessity for consulting detailed working drawings.

2.4.3 Due to the sensitive nature of design data drawings, they should always be marked "COMPANY PROPRIETARY" to guard against unauthorized distribution outside the company. See also Section 4.10, "Proprietary Information."

2.4.4 Printed Wiring Board Drawings - Printed wiring board and associated documentation are usually prepared and issued as a set. Normally, such drawings comprise master art works, board size, hole coordinates, assembly drawing, schematic diagram and bill of materials for the printed wiring board.

ISO 272:1982	Fasteners — Hexagon products — Widths across flats
ISO 887:1983	Plain washers for metric bolts, screws and nuts — General plan
ISO/DIS 887	Plain washers for metric bolts, screws and nuts for general purposes — General plan
ISO/R 1051:1969	Rivet shank diameters (diameter range 1 to 36 mm)
ISO/DIS 1051	Rivet shank diameters
ISO 1207:1992	Slotted cheese head screws — Product grade A
ISO 1234:1997	Split pins
ISO 1478:1983	Tapping screws thread
ISO/DIS 1478	Tapping screw thread
ISO 1479:1983	Hexagon head tapping screws
ISO 1481:1983	Slotted pan head tapping screws
ISO 1482:1983	Slotted countersunk (flat) head tapping screws (common head style)
ISO 1483:1983	Slotted raised countersunk (oval) head tapping screws (common head style)
ISO 1580:1994	Slotted pan head screws — Product grade A
ISO 2009:1994	Slotted countersunk flat head screws (common head style) — Product grade A
ISO 2010:1994	Countersunk slotted raised head screws (common head style) — Product grade A
ISO 2338:1997	Parallel pins, of unhardened steel and austenitic stainless steel
ISO 2339:1986	Taper pins, unhardened
ISO 2340:1986	Clevis pins without head
ISO 2341:1986	Clevis pins with head
ISO 2342:1972	Slotted headless screws — Metric series
ISO 2702:1992	Heat-treated steel tapping screws — Mechanical properties
ISO 3269:1988	Fasteners — Acceptance inspection
ISO/DIS 3269	Fasteners — Acceptance inspection
ISO 4014:1988	Hexagon head bolts — Product grades A and B
ISO/DIS 4014	Hexagon head bolts — Product grades A and B
ISO 4015:1979	Hexagon head bolts — Product grade B — Reduced shank (shank diameter approximately equal to pitch diameter)
ISO 4016:1988	Hexagon head bolts — Product grade C
ISO/DIS 4016	Hexagon head bolts — Product grade C
ISO 4017:1988	Hexagon head screws — Product grades A and B
ISO/DIS 4017	Hexagon head screws — Product grades A and B
ISO 4018:1988	Hexagon head screws — Product grade C
ISO/DIS 4018	Hexagon head screws — Product grade C
ISO 4026:1993	Hexagon socket set screws with flat point
ISO 4027:1993	Hexagon socket set screws with cone point
ISO 4028:1993	Hexagon socket set screws with dog point
ISO 4029:1993	Hexagon socket set screws with cup point
ISO 4032:1986	Hexagon nuts, style 1 — Product grades A and B
ISO/DIS 4032	Hexagon nuts, style 1 — Product grades A and B
ISO 4033:1979	Hexagon nuts, style 2 — Product grades A and B
ISO/DIS 4033	Hexagon nuts, style 2 — Product grades A and B
ISO 4034:1986	Hexagon nuts — Product grade C

Figure 3. Forty-two of the nearly 150 Standards and Draft Standards (DIS) of TC 2 – Fasteners

TC 1	Screw threads
TC 2	Fasteners
TC 4	Rolling bearings
TC 5	Ferrous metal pipes and metallic fittings
TC 10	Technical drawings, product definition and related documentation
TC 11	Boilers and pressure vessels
TC 12	Quantities, units, symbols, conversion factors
TC 14	Shafts for machinery and accessories
TC 19	Preferred numbers - STAND-BY
TC 24	Sieves, sieving and other sizing methods
TC 25	Cast iron and pig iron
TC 26	Copper and copper alloys
TC 27	Solid mineral fuels
TC 28	Petroleum products and lubricants
TC 29	Small tools
TC 39	Machine tools
TC 41	Pulleys and belts (including v-belts)
TC 43	Acoustics
TC 44	Welding and allied processes
TC 46	Information and documentation
TC 51	Pallets for unit load method of materials handling
TC 60	Gears
TC 69	Applications of statistical methods
TC 86	Refrigeration and air-conditioning
TC 96	Cranes
TC 104	Freight containers
TC 105	Steel wire ropes
TC 107	Metallic and other inorganic coatings
TC 108	Mechanical vibration and shock
TC 111	Round steel link chains, chain slings, components and accessories
TC 115	Pumps
TC 117	Industrial fans
TC 118	Compressors, pneumatic tools and pneumatic machines
TC 119	Powder metallurgy
TC 123	Plain bearings
TC 130	Graphic technology
TC 131	Fluid power systems
TC 132	Ferroalloys
TC 135	Non-destructive testing
TC 142	Cleaning equipment for air and other gases - STAND-BY
TC 144	Air distribution and air diffusion - STAND-BY
TC145	Graphical symbols
TC 146	Air quality
TC 147	Water quality
TC 153	Valves
TC 155	Nickel and nickel alloys
TC 156	Corrosion of metals and alloys
TC 157	Mechanical contraceptives
TC 159	Ergonomics
TC 164	Mechanical testing of metals
TC 176	Quality management and quality assurance
TC 178	Lifts, escalators, passenger conveyors
TC 184 I	ndustrial automation systems and integration
TC 192	Gas turbines
TC 199	Safety of machinery
TC 201	Surface chemical analysis
TC 207	Environmental management
TC 208	Thermal turbines for industrial application (steam & gas turbines)
TC 213	Dimensional and geometrical product specifications and verification
TC 214	Elevating work platforms

Figure 4. List of Selected Technical Committees and Their General Topics. These and other technical committees have accounted for over 2500 international standards.

Table 3.1-1
Decimal Inch Flat Sizes

Size Designation	Vertical (Height)	Horizontal (Width)
A Vertical	8.5	11.0
A Horizontal	11.0	8.5
B	11.0	17.0
C	17.0	22.0
D	22.0	34.0
E	34.0	44.0
F	28.0	40.0
All values in inches		

Decimal and Inch Sizes Sheet Formats

2.4.5 Roll Size Sheets - Roll size sheets are designated by the letters G through K. Length of the G sheet size is based on multiples of 7.5 inches. This permits the sheet to be folded to a size appropriate for binding in 8.5 x 11.0 book form documents.

Length of the H, J, and K sheet sizes is based on a multiple of 11.0 inches. See Table 3.1-2 for roll size sheet designations and dimensions.

Table 3.1-2
Decimal Inch Roll Size Sheets

Size	Vertical (Height)	Horizontal (Width)	
		Min	Max
G	11.0	22.5	90.0
H	28.0	44.0	143.0
J	34.0	55.0	176.0
K	40.0	55.0	143.0
All values in inches * Protective margins not included			

2.4.6 Line Widths - A single line width is permitted for all lines, but contrasting lines are often used. For contrasting line widths, borders and outlines for blocks are drawn with wide lines. Division lines are drawn with thin lines. Line widths in compliance with ASME Y14.2M are recommended. ASME Y14.2M defines thin lines as being half the width of wide lines. Recommended widths of lines are .6 mm for wide lines and .3 mm for thin lines.

2.4.7 Line Usage - It is recommended that contrasting line widths be used on drawing formats. It is permissible for a single line width to be used for all format lines. This is sometimes necessary due to CAD system plotting limitations. The following are the recommended line usage when contrasting lines are desired.
(a) Thick lines - Borders, data block outlines, and major segment divisions of data blocks
(b) Thin lines - Minor divisions within data blocks and zone markers

2.4.8 Character Heights - Appendix 1 of ASME Y14.2M-1992 defines the minimum recommended character size for drawing block headings as .10 inch for all sheet sizes. This character height is adequate for microfilming when characters are mechanically produced and the line width is not too wide.

2.4.9 Optional Rounded Corners - All Figures of drawing sheets in this section are shown with square corners. Rounded corners may be used.

3.0 FORMAT LAYOUT

Some sheet formats illustrated in this section do not show all optional blocks. Absence of an optional block from a format does not indicate that the block is prohibited. Optional blocks may be placed on any sheet in an appropriate location as defined by text or as illustrated on other sheet sizes.

3.1 REQUIRED MARGINS (Borders) - The border around a sheet establishes a required margin

between the border and the edge of the sheet. See Figure 3.1-1. The margin must be of adequate size for the needed format items to be entered. Zone markers, zone letters, microfilm arrows, and margin drawing number blocks are all placed in the margin.

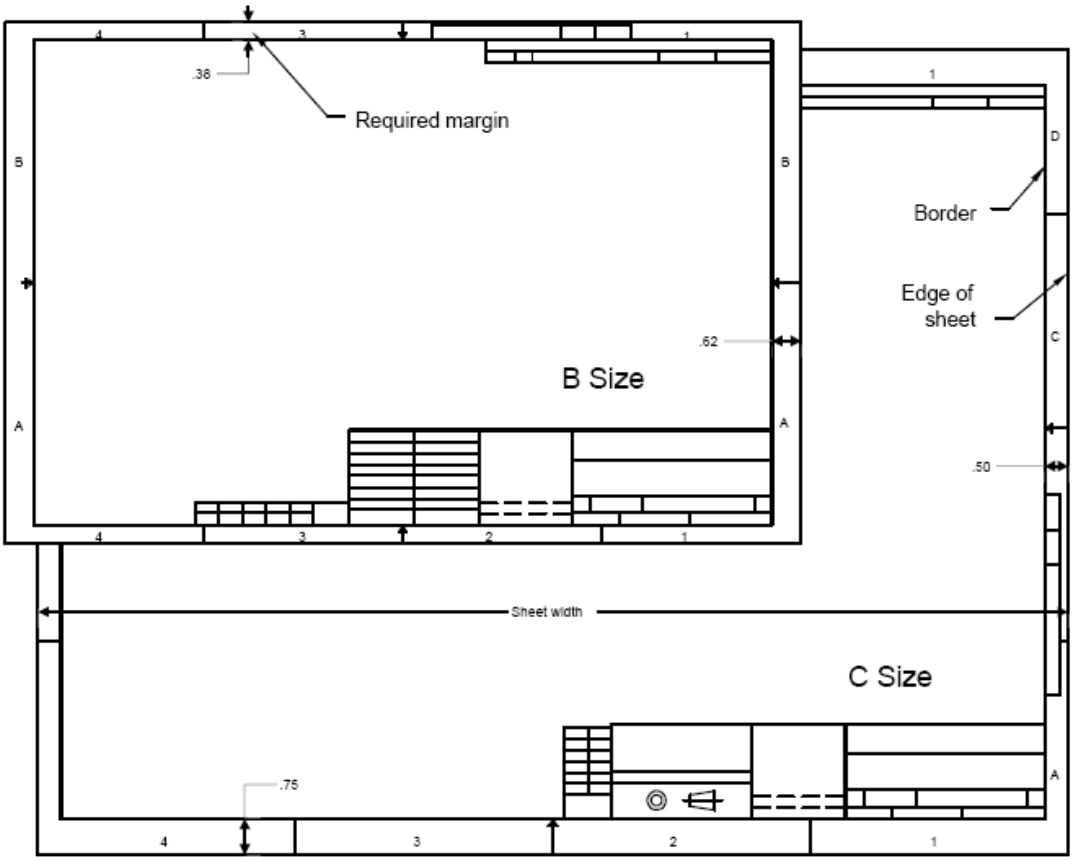

Figure 3.1-1. Basic Sheet Size Margins

3.1.1 Margins, Flat Sizes - Margins vary according to the size of sheet, and the horizontal margin is typically a different size than the vertical margin. See Table 3.1-3. The margin falls inside the sheet size dimensions.

Table 3.1-3
Flat Size Sheet Margins

Size	Horizontal	Vertical
A (hor)	.38	.25
A (vert)	.25	.38
B	.38	.62
C	.75	.50
D	.50	1.00
E	1.00	.50
F	.50	.50

3.1.2 Margins, Roll Sizes - Margins are typically .50 for roll size sheets except for the horizontal

margin on G size sheets which is .38.

3.2 OPTIONAL MARGINS - An additional amount of margin is sometimes needed to provide adequate protection for the edges of drawings that are subject to a large amount of handling. Sheets to be used in book form drawings also require additional margin to permit all of the drawing area to be viewed after the sheets are fastened in a binding. Optional margins of 2.0 inches minimum may be included on one or both ends of a drawing sheet. See Figure 3.1-2. When optional margins are used, the borders for required margins are drawn offset from the standard sheet dimensions excluding any optional margins.

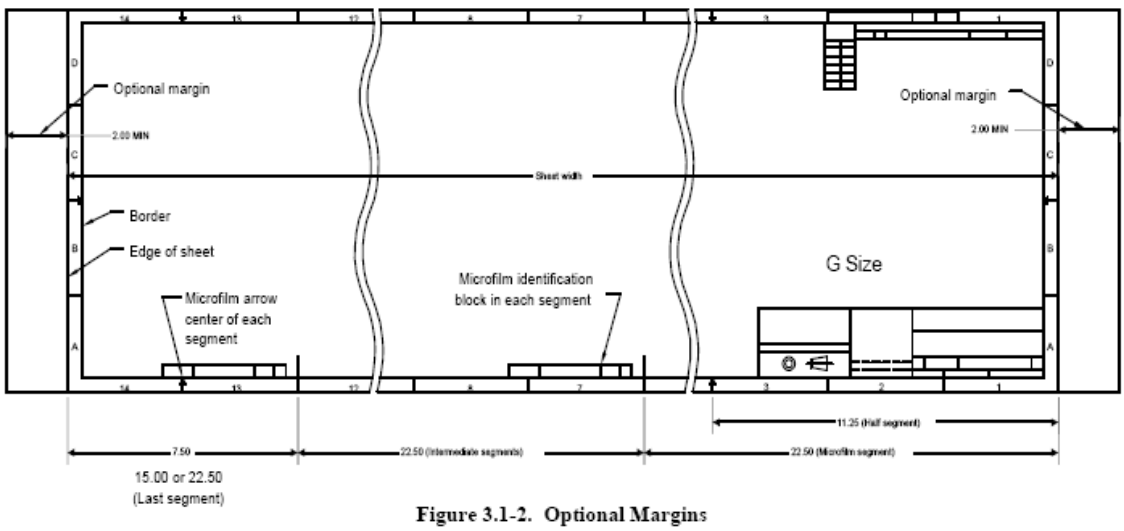

Figure 3.1-2. Optional Margins

3.3 ZONES - Zone divisions are required on all sheet sizes except A and B. Zone divisions are optional on the A and B size sheets. Zone division lines are placed in the required margin (outside the border). Zone sizes are a minimum of 1.0 inch and a maximum of 5.5 inches. Recommended zone dimensions are shown in Tables 3.1-4 and 3.1-5.

Table 3.1-4
Recommended Zones for Flat Sizes

Size Design	Recommended Vert Zones		Recommended Hor Zones	
	No.	Size	No.	Size
A (hor)	2	4.25	2	5.50
A (vert)	2	5.50	2	4.25
B	2	5.50	4	4.25
C	4	4.25	4	5.5
D	4	5.50	8	4.25
E	8	4.25	8	5.50
F	6	4.67	8	5.00

Table 3.1-5
Recommended Zones for Roll Sizes

Size Design	Recommended Vert Zones		Recommended Hor Zones	
	No.	Size	No.	Size
G	4	2.75	6-24	3.75
H	8	3.50	8-26	5.50
J	8	4.25	10-32	5.50
K	8	5.00	10-26	5.50

3.3.1 Zone Identification - Zones are identified using numbers along the horizontal margin and letters along the vertical margin. Numbers increase from right to left and letters progress from bottom to top. Minimum character size for zone identification is .24 in compliance with ASME Y14.2M-1992.

3.4 MICROFILMING - Microfilming permits drawings to be stored in very little space. Microfilm proportions and reduction capability limit the reduction ratios that may be used for storing drawings. Sheet sizes too large to fit in a single microfilm frame are divided into multiple microfilm segments. Each segment must be properly identified and microfilm alignment arrows shown to assist in aligning the drawing segments for microfilming.

3.4.1 Microfilm Reduction Ratios - Recommended microfilm ratios for sheet sizes are listed in Table 3.1-6. The ratio of reduction used for microfilming is selected with consideration given to the drawing sheet dimensions.

Table 6
Recommended Microfilm Reduction Ratios

Reduction	Size
16X	A, B, C, G
24X	D
30X	E, F, H, J, K

3.4.2 Microfilm Segment Size - Flat size sheets fit within one microfilm frame when the recommended reduction ratios are used. Roll size sheets require multiple microfilm segments. One or more full width segments extending from the right side of the drawing sheet are used. The last segment at the left end of the sheet may be less than a full segment.

3.4.3 Microfilm Alignment Arrow Location - Arrows are placed in the margin of drawing sheets to assist in achieving alignment of the sheets for microfilming. Flat size sheets require one arrow placed midway along each of the horizontal and vertical margins. See Figure 3.1-4. On roll size sheets, an arrow is placed along the horizontal margin at the center of each microfilm segment. Arrows are also placed at the center of the vertical margins.

3.4.4 Microfilm Segment Match Lines - The horizontal limit of each microfilm segment is shown by a vertical line drawn inside the border. When segmented copies of drawings are made from microfilm, the match lines assist in matching the drawing segments. Properly placing the match lines and using the appropriate zone sizes will result in the microfilm segment match lines aligning with a zone division line. Zone division lines coinciding with the match lines result in full

zones being completely inside one microfilm segment.

3.4.5 Microfilm Identification Block Location - Each microfilm segment includes a block in which the drawing number is placed. This results in the drawing number and sheet number being included on every microfilm frame. Omission of this block would make it difficult to assemble a large drawing from microfilm segments.

3.5 ALLOWANCES FOR DATA PROCESSING (and Word Processors) - Not all data processing systems are capable of reproducing the continuous lines required for standard sheet sizes and formats. Although the standard sheet sizes are required when using these systems, the format requirements for the data blocks and borders are not required. Although the data blocks may be omitted due to system capability limitations, the data described for these blocks is required in the location defined for the blocks.

3.6 DATA BLOCK PLACEMENT - Each data block has a required or optional location. See Figure 3.1-4. Placement of the blocks in a consistent position makes it easier for people to find the needed information on a drawing. Unless a company has a compelling reason to do otherwise, the standard locations should be used even if the location is listed as optional. This will help establish consistency in drawing format and will make location of needed information easier when reading drawings.

3.6.1 Title Block and Continuation Sheet Title Block - There are two configurations for title blocks. One is for sheet one, the other for continuation sheets. The title blocks for sheet one and continuation sheet formats are always placed in the lower right corner. See Figure 3.1-4. It is not required that a continuation sheet title block be used since the sheet one title block may be used on all sheets of a drawing.

3.6.2 Revision History Block - The revision history block is placed in the upper right corner of all sheets. The same block format is used for sheet one and continuation sheets. See Figure 3.1-4. A space below this block must be left open to permit entry of revision history data. A space of at least 6.0 inches is recommended, but no standard distance is required. Should the revision history data fill the space below the block, then a duplication of the block may be placed immediately to the left of the first one.

3.6.3 Revision Status of Sheets Block - A revision status of sheets block is placed on sheet one. See Figure 3.1-4. It may be shown near the revision history block, but this placement can interfere with a second column of revision history notes. The revision status block may also be placed adjacent to the title block. This placement doesn’t interfere with entry of a second revisions history column. In the case of a book form drawing, it is permissible to place the revisions history block on a separate sheet. It is typically shown on the second sheet if it is not placed on the first sheet.

3.6.4 Associated Lists - Associated lists such as parts lists are no longer defined as part of the drawing sheet sizes and format standard. Requirements for associated lists are contained in ASME Y14.34M.

3.6.5 Roll Size Drawing Microfilm Identification Blocks - A microfilm identification block is placed .38 to the left of each microfilm segment match line.

3.7 OPTIONAL BLOCKS - Several standard block formats are provided for use when needed. Although the use of these blocks is optional, a standard location has been defined for each of

them.

3.7.1 Angle of Projection Block - Third angle and first angle projection systems are used internationally. According to ASME Y14.3M-1994, the accepted method in the United States is third angle projection. ASME Y14.3M defines a projection symbol that may be shown to indicate the angle of projection used to create a drawing. The application of the symbol is recommended for those situations where it is likely that a drawing will be used in a location where both third angle and first angle drawings are present. Any international company is likely to encounter such a situation. The angle of projection symbol is placed near the title block. See Figure 3.1-4. The location used should be consistent within a company.

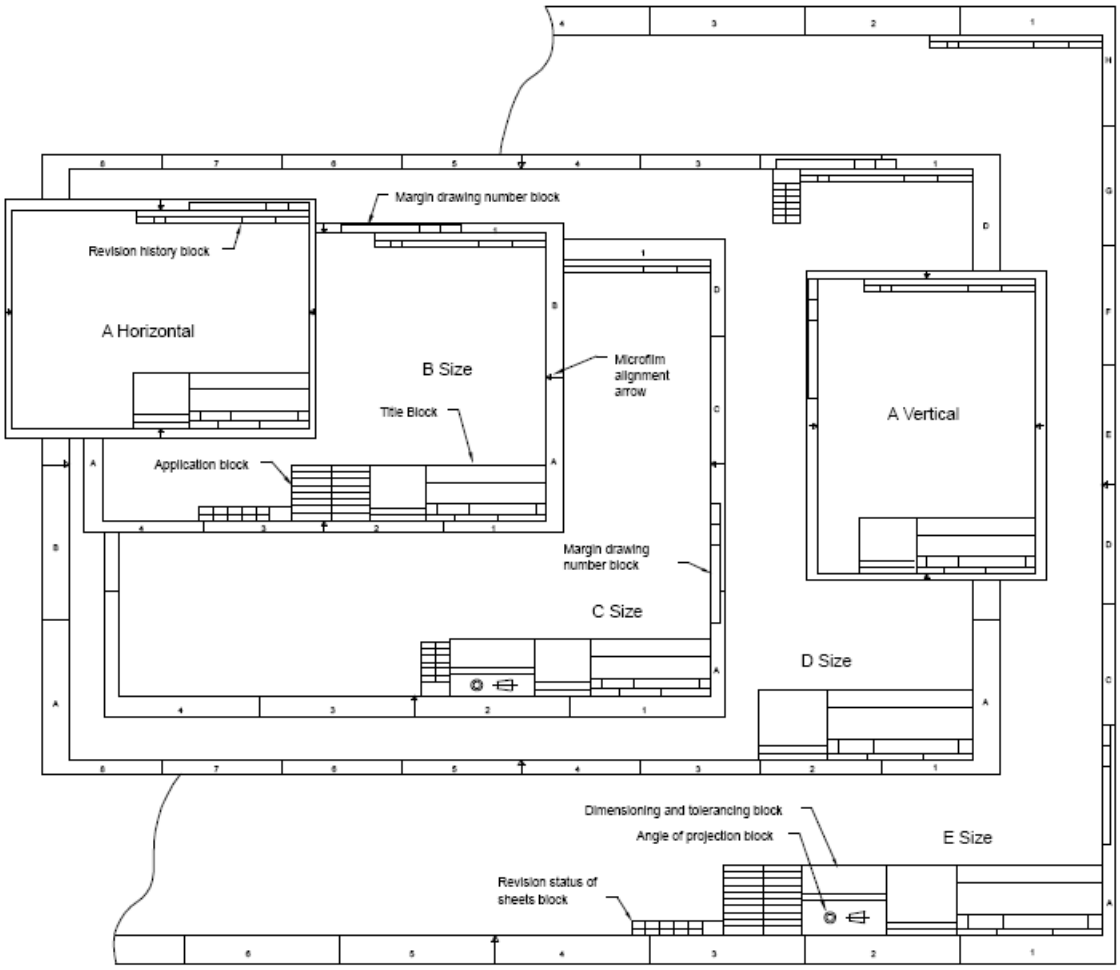

Figure 3.1-4. Format Element Placement

3.7.2 Dimensioning and Tolerancing Block - General tolerances or a note referencing the applicable dimensioning standard may be shown in a block placed adjacent to the title block. See Figure 3.1-4. Placement of the block containing tolerance information should be consistent for all drawings completed by a company.

3.7.3 Margin Drawing Number Block - A margin drawing number block is optional. When used, it is placed in the right vertical margin near the bottom of the sheet or in the top horizontal margin near the right end of the sheet. See Figure 3.1-4. This block is most beneficial on drawings that are rolled for storage, but it is also of benefit on flat sheet sizes. Margin drawing number blocks

make it possible to read drawing numbers without unrolling drawings or unfolding folded copies of the drawings.

3.7.4 Application Block - The application for the item or items contained in a drawing may be shown in an application block that is placed adjacent to the title block. See Figure 3.1-4. An application block is not always needed since a separately maintained document or data base can be used to identify applications.

3.7.5 Computer Generated Drawing File Identifier - If the file identification or location are to be shown on a drawing, a block for this purpose may be included in the format and placed adjacent to the title block.

3.7.6 Limited Rights or Copyright Legends - A block may be included as part of the drawing format and placed adjacent to the title block for the purpose of including legal notices such as limited rights or copyright legends.

4.0 SHEET COMPONENT CONTENTS AND DIMENSIONS

Each component of the drawing sheet format is provided for a specific purpose. Additional data blocks may be added as necessary to meet individual company needs. If additional blocks are added, they should be in a consistent location and of a consistent size. Achieving consistency is made easy by including all data blocks as part of the drawing format. Appropriate data are placed in the data blocks when a drawing is completed. Sizes for data blocks are to be appropriate for the number of characters to be entered, the character height, and the character font. Data block dimensions shown in this section are based on ASME Y14.1, which provides dimensions for guidance purposes. They may be varied to meet individual company requirements. The minimum character height for block headings is .10.

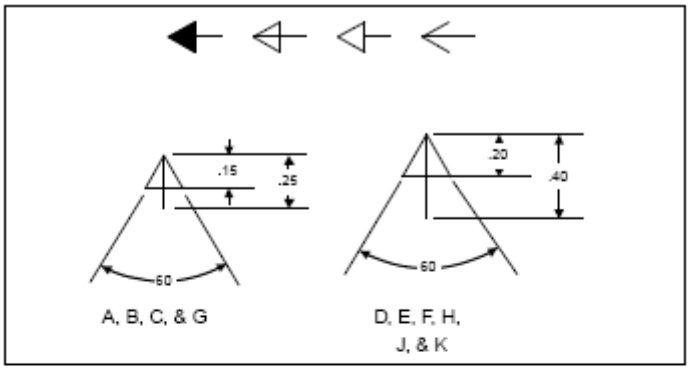

Figure 3.1-5. Microfilm Arrows

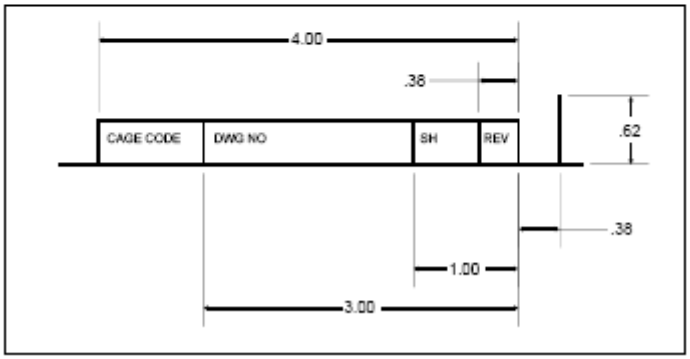

Figure 3.1-6. Microfilm Identification Block and Match Line

4.1 MICROFILM ELEMENTS

4.1.1 Microfilm Arrow Size - The microfilm alignment arrowhead may be filled solid, enclosed but not filled, or open. See Figure 3.1-5. Arrowhead dimensions are based on the drawing sheet. There are two arrowhead sizes. The small arrowhead is used on A, B, C, and G sheet sizes. The large arrowhead is used on all other sheet sizes.

4.1.2 Microfilm Segment Match Lines - Microfilm segment match lines are .62 long. See Figure 3.1-6.

4.1.3 Microfilm Identification Block - The microfilm identification block includes a drawing number, sheet number, and revision block. It may also include a cage code block. Dimensions are shown in Figure 3.1-6. This block is located .38 to the left of each microfilm segment match line.

4.2 TITLE BLOCK, SHEET ONE - The sheet one title block includes data blocks for drawing number, revision, CAGE code, sheet size, drawing scale, sheet number, title, company, approvals, and sometimes weight. The sheet one title block may be used for all sheets when a continuation sheet format is not used. See Figure 3.1-7. Title block size requirements vary according to the sheet size. Size requirements for title blocks on standard sheet sizes are shown.

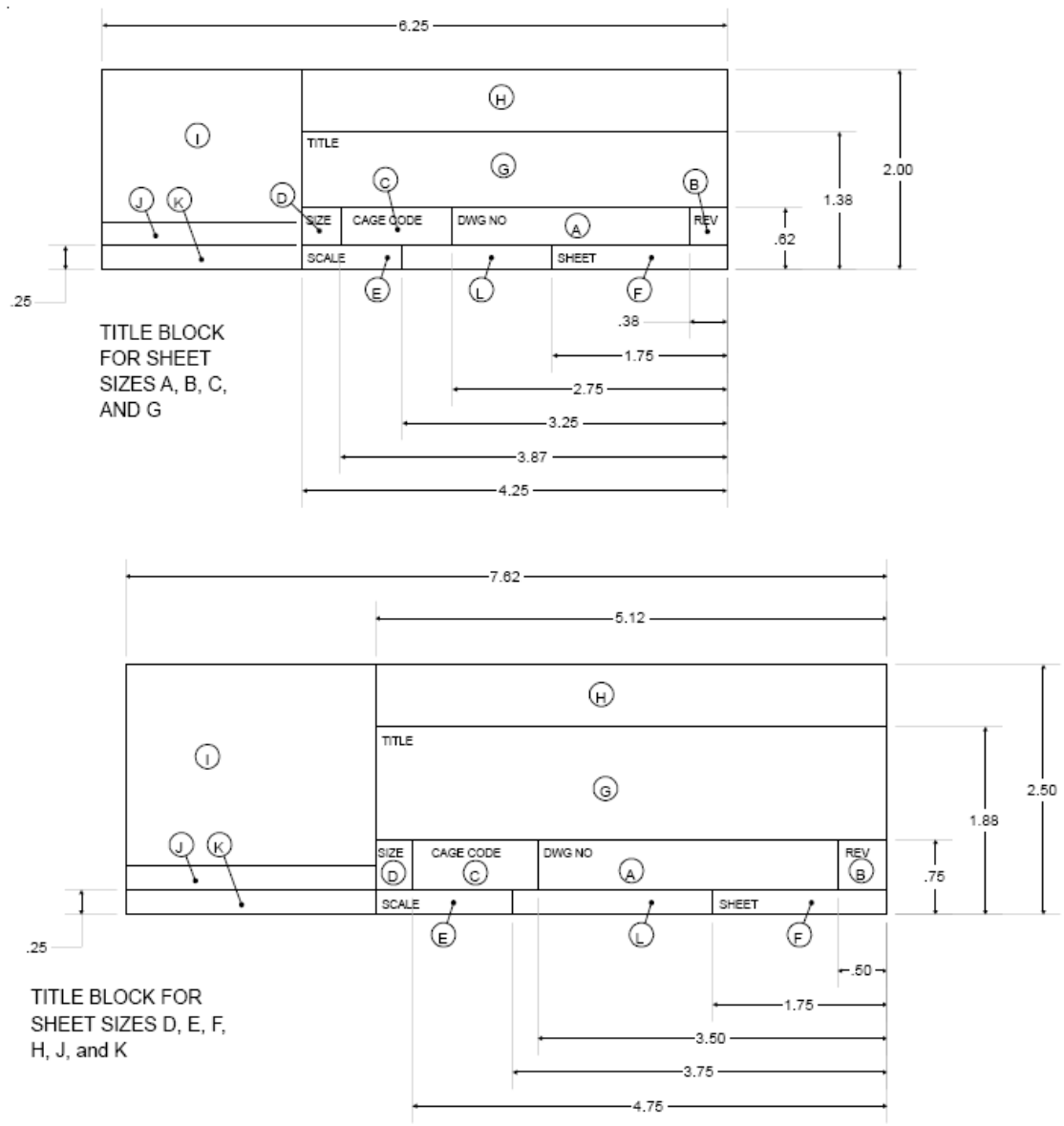

Figure 3.1-7. Title Block - Sheet One

4.2.1 Drawing Number - See block “A” in Figure 3.1-7. The drawing number that identifies a drawing is placed in this block. The recommended character height for A, B, C, and G size sheets is .12. For larger sheets, .24 characters are recommended.

4.2.2 Revision - See block “B” in Figure 3.1-7. The revision block indicates the revision level of the sheet. This block may be omitted when a revision history block is included on the format. The recommended character height for A, B, C, and G size sheets is .12. For larger sheets, .24 characters are recommended.

4.2.3 CAGE Code - See block “C” in Figure 3.1-7. A CAGE code is a five-character code used to identify companies or other activities that have provided or are providing items to the United

States Government. If the design activity is not required to have a CAGE code, this block may be left empty or omitted. The recommended character height for A, B, C, and G size sheets is .12. For larger sheets, .24 characters are recommended.

4.2.4 Size - See block “D” in Figure 3.1-7. The appropriate drawing sheet size designator from Tables 1, 2, and 3 is placed in this block. The recommended character height for A, B, C, and G size sheets is .12. For larger sheets, .24 characters are recommended.

4.2.5 Scale - See block “E” in Figure 3.1-7. The predominant scale for a drawing sheet is entered in this block. The title block for each sheet includes a notation of the predominant scale since it is possible for separate sheets of the same drawing to have different scales. The recommended character height for all sheet sizes is .12.

4.2.6 Sheet - See block “F” in Figure 3.1-7. The first sheet includes the sheet number and an indication of the total number of sheets. As an example, sheet one of a four-sheet drawing is numbered as ‘1 of 4.’ Computer generated drawings may include the total number of sheets either on sheet 1 or the last sheet. Placement of the total number of sheets on the last page is not recommended unless there is a computer system limitation which restricts placement to the last sheet. The recommended character height for all sheet sizes is .12.

4.2.7 Title - See block “G” in Figure 3.1-7. The drawing title is shown in this block. The recommended character height for A, B, C, and G size sheets is .12. For larger sheets, .24 characters are recommended.

4.2.8 Company (Design Activity) - See block “H” in Figure 3.1-7. The design activity responsible for the drawing is normally shown in this block. The name of the design activity identified in this block is the same as the one identified by the CAGE code. There is no recommended character size listed in ASME Y14.2M for this block.

4.2.9 Approvals - Drawing approval procedures vary between companies, so flexibility in the approvals block format is necessary. Many companies only require approvals within the design activity. Approval of people outside the design activity is often required when a product is to be manufactured by a remote plant or when the design is created under a contract with another organization.

4.2.9.1 Internal Approvals - See block “I” in Figure 3.1-7. Room is provided for several signatures. The number of spaces allowed is dependent on approval procedures.

4.2.9.2 External Approvals - See block “J and K” in Figure 3.1-7. Blocks for external approvals are provided below the internal approvals blocks. The number of blocks provided is dependent upon the number of external approvals required. Two spaces are common on drawing formats used when the United States Government is the customer. The external approvals blocks may be omitted if there is no requirement for external approval.

4.2.10 Weight (optional) - See block “L” in Figure 3.1-7. The weight of the part or assembly on a drawing may be shown in this block. The use of this block is optional. Even when this block is included in the title block, it is often left empty.

4.3 TITLE BLOCK, CONTINUATION SHEET - All sheets of a drawing except sheet one are considered continuation sheets. Much of the information included in the sheet-one title block is not needed on continuation sheets and may be omitted. A continuation sheet title block that

provides only the needed title block elements may be used. However, the use of a continuation sheet format is not required. It is permissible to use the sheet-one title block on all sheets. Advantages of using a continuation sheet title block are: added drawing space is available on the continuation sheets, less time is used for data entry because of the reduced number of blocks to complete, and there is a reduced risk of data entry errors. Continuation sheet title block elements have the same dimensions as the sheet-one title block.

4.3.1 Required Elements - The continuation sheet title block includes some of the same elements as the sheet-one title block. See Figure 3.1-8. Required elements include the drawing number, revision, CAGE code, size, scale, and sheet.

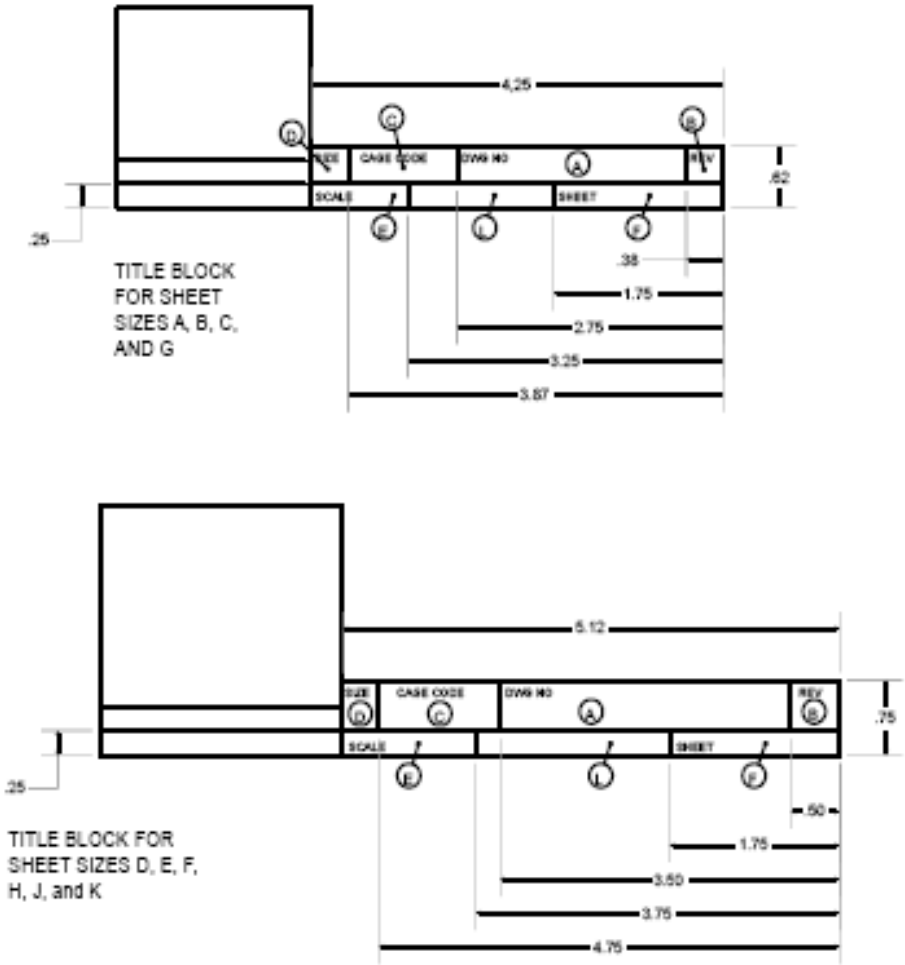

Figure 3.1-8. Title Block - Continuation Sheet

4.3.2 Optional Elements - Additional elements are commonly included in the continuation sheet title block. These include the drawing title, weight, and approvals.

4.4 REVISIONS HISTORY BLOCK - A revisions history block placed in the upper right corner of the drawing format is used to record changes made after the original release of the drawing. This block may also include as the first entry the original release date. Columns in the revisions history block include the revision, description, date, and approval. Additional columns may be

included such as a zone reference to indicate the location of the listed revisions. See Figure 3.1-9.

4.4.1 Revision - Each revision is identified in the revision column.

4.4.2 Description - A description of the revision is included to provide adequate information to determine what changed. This description may be a reference to a change document that provides a detailed description of the change.

4.4.3 Date - The date of the revision is placed in this column.

4.4.4 Approved - If no change document is referenced in the description column, then the person with change authority indicates approval of the change in this column. If a change document is referenced, then the approval signature is usually placed only on the change document.

4.4.5 Zone (optional) - The location of the revision may be referenced by indicating the appropriate sheet zone.

4.5 REVISIONS STATUS OF SHEETS BLOCK - A drawing revision may impact any number of sheets in a drawing. If a revision does not affect a drawing sheet, then there is no reason to change the revision status of the unaffected sheet. This results in the possibility that separate sheets of a drawing may have different revision levels shown in the title block for the individual sheets. When this occurs, it is necessary to have a method to determine the current revision status of each drawing sheet. A revisions status of sheets block provides a means to record the current status of each sheet. See Figure 3.1-10. This block may be formatted in a horizontal or vertical orientation. The number of spaces contained within the block is dependent upon the number of sheets in the drawing. This block may be left empty or omitted when all sheets of the drawing are at the same revision level and a drawing note such as the following is used. ALL SHEETS ARE THE SAME REVISION STATUS.

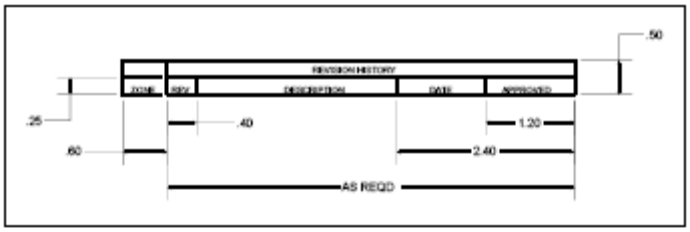

Figure 3.1-9. Revisions History Block

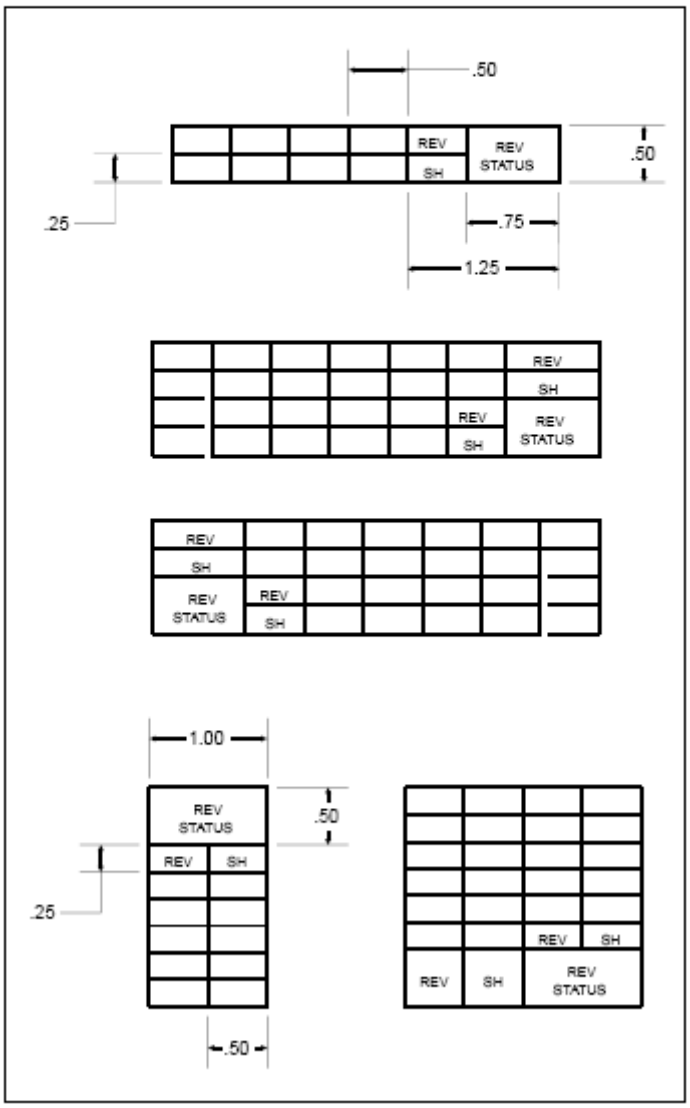

Figure 3.1-10. Revisions Status of Sheets Block

4.5.1 Horizontal - The horizontal format takes very little drawing space and may be placed adjacent to the title block. It may also be placed adjacent to the revisions history block. Drawing sheet numbers may be entered in the horizontal format from left to right, or from right to left. If drawing sheet numbers are entered with sheet one on the right end of the block, then additional sheets may be easily added on the left end.

4.5.2 Vertical - A vertical orientation may be placed adjacent to the revisions history block or at the left end of the title block. Placement near the revision history block provides history and status information in one location, but this placement can cause a problem if a second set of revision history columns is needed. When a vertical orientation is used at the top of the sheet, additional spaces may be added to the status list if the sheets are entered from the top down. When a vertical orientation is used at the bottom of the sheet, additional spaces may easily be added at the top of the status list if the sheets are entered with sheet one at the bottom of the list.

4.6 OPTIONAL BLOCKS - Consistency in block size and contents is recommended even for optional blocks.

4.6.1 Angle of Projection Block - The angle of projection block is used to indicate whether third or first angle projection is being used. See Figure 3.1-11. The block is generally aligned with other blocks and is drawn to the same width as the adjacent block. The height is approximately 1.25 on large sheet sizes. It is approximately .75 for A, B, C and G sheet sizes. The projection symbol is drawn in accordance with ASME Y14.3M. A note indicating the angle of projection may be placed above the angle of projection symbol.

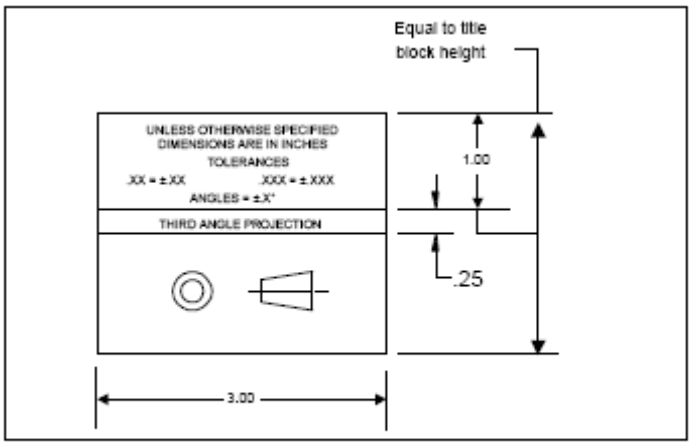

Figure 3.1-11. Tolerances and Angle of Projection Blocks

4.6.2 Dimensioning and Tolerancing Block - General tolerances may be shown in a block. See Figure 3.1-11. The width of the block is generally 3.0 inches. General tolerances are provided that relate to the number of decimal places in the dimension value. A note indicating the applicable dimensioning and tolerancing standard may also be included. A recommended height for this block is 1.0 inch.

4.6.3 Margin Drawing Number Block - When a margin drawing number block is included on the format, it includes a block for the drawing number and the sheet number. It may also include a block for the sheet revision status. See Figure 3.1-12.

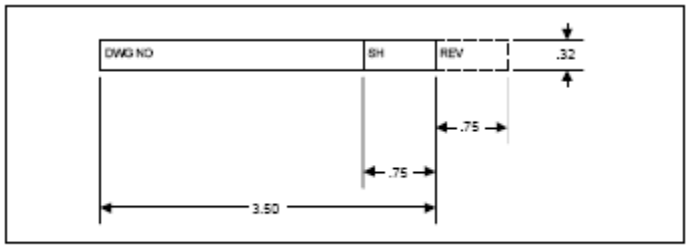

Figure 3.1-12. Margin Drawing Number Block

4.6.4 Applications Block - An applications block includes two columns approximately 1.38 wide. The left column is titled NEXT ASSY and is for a listing of the next assemblies. The right column is titled USED ON and is for listing the end item on which the next assembly is used. Segments in the applications block are .25 high. The column height can be limited to be equal with the title block height. If additional space is needed for more applications, a second applications block may be placed adjacent to the first one. It is also possible to extend the columns above the title block.

4.6.5 Computer Generated Drawing File Identifier - A special block may be provided for showing information regarding file name, location, or other appropriate information for computer generated drawings. The size of this block depends on the information to be shown.

4.6.6 Limited Right or Copyright Legends - A block may be used to include notices regarding legal rights. The size of this block is not defined.