



17.1 SCOPE.

17.1.1 Purpose. This section establishes the procedures to be followed in the preparation of forging drawings. Data on design practices is incidental to subject presentation and is intended only as a guide.

17.2 APPLICABLE DOCUMENTS. Note: DoD Policy Memo 05-3 “Elimination of Waivers to Cite Military Specifications and Standards in Solicitation and Contracts” has eliminated the need for waivers to use MIL-SPECS and MIL-STDS on DoD contracts. (See PREFACE 1, Section 2)

ASME B46.1	Surface Texture, Surface Roughness, Waviness and Lay
ASME Y14.8M	Casting and Forgings
ASME Y14.5M	Dimensioning and Tolerances
ASME Y14.36M	Surface Texture Symbols
ASME Y14.100	Engineering Drawing Practices

17.3 DEFINITIONS. (Alphabetically Listed).

17.3.1 Corner Radius. A convex radius on the surface of a part connecting intersecting surfaces. Also referred to as “edge radius”.

17.3.2 Datum Target. See SECTION 5 herein.

17.3.3 Die Closure. Permissible part thickness variation caused by inconsistent mating of opposing segments of a mold or die.

17.3.4 Draft. The angle or taper given to a pattern or die to facilitate removal of either the pattern or casting from the mold. Draft also describes the angle or taper defined on a drawing or model, and to the angle or taper on the as-produced part. This angle or taper on the drawing, model, and part is due to the reasons stated in the first sentence above.

17.3.5 Dress Out. A localized depression on the surface of a part that results when abrasive tools are used to remove surface discontinuities.

17.3.6 Fillet Radius. A concave radius on the surface of a part connecting intersecting surfaces.

17.3.7 Flash. Excess metal on the forging at the parting line resulting from metal being forced out of the die.

17.3.8 Forging. A part produced by the plastic deformation of a metal or alloy into a predetermined shape and size, using a compressive force exerted by a die or dies.

17.3.9 Forging Die. A forming tool that determines the size and shape of the forged part.



17.3.10 Forging Plane. The theoretical plane perpendicular to the direction of die travel, normally shown only when the parting line and forging planes do not coincide.

17.3.11 Grain Flow. The directional characteristics of grain structure resulting from the flow of metal into the die contour during the forging operation.

17.3.12 Match Draft. Additional draft allowance permitted for matching surfaces at parting line when normal draft allowance would result in an offset of surfaces at the parting line.

17.3.13 Mismatch. A defect resulting from die misalignment, producing an offset on the surfaces of the forging at the parting line.

17.3.14 Mold. A matrix of metal into which the molten material is injected to form the forged piece.

17.3.15 Mold Line. A line generated by the theoretical intersection of projected surfaces.

17.3.16 Movable Targets. Two or more targets with a controlled simultaneous motion used for centering parts.

17.3.17 Parting Line. The plane of separation between die parts that permits removal of the forging. The parting line plane is generally flat, but may be contoured when a complex shape is being forged.

17.3.18 Scale Pit. A surface depression formed on a forging during forging operation due to scale in the dies.

17.3.19 Stocked Forging. A forged item of specified material(s), standard shape(s) and nominal size(s), normally kept in stock for ready availability, i.e., ring billet, etc.


17.4 DESIGN PRACTICE.

17.4.1 Forging Design And Shop Practices. General information pertaining to forging design and shop practices can be found in reference books from publishers of technical books. There is no “rule of thumb” that can be applied to all forging designs; therefore, each design must be considered separately and coordinated with the responsible fabrication specialists.

17.5 MARKINGS.

17.5.1 Location Of Forged Symbols. All forged symbols and markings should be located on a flat or nearly flat surface parallel to the forging plane whenever possible. Raised markings are preferred over depressed markings. (See SECTION 11 herein.)

17.5.2 Preferred Location Of Forged Part Number. The preferred location for the forging part number is a surface that will not be machined and, if possible, adjacent to the forge shop trademark. When located on a surface that will not be machined, the part number shall be preceded by the word “FORGING” or “FORG” as follows:

 MARK PER (applicable standard) WITH .25 CHARACTERS
WITH FORG (drawing number and applicable dash no.)



17.5.3 Forging Shop Trademark Location. The forge shop trademark should be located so that it will not be removed by machining. Its location is indicated and called out as follows:

↙ MARK PER (applicable standard) WITH FORGE SHOP SYMBOL

17.5.4 Raised Pad Suitable For Stamping. All quality control and other applicable markings are located so that they will not be removed in machining. A raised stamping pad on the forging is desirable and, if shown, will be dimensioned. The location is indicated and markings called out as follows:

↙ MARK PER (applicable standard) WITH QUALITY ACCEPTANCE
STAMPS AND ASSIGNED SERIAL NO.

17.5.5 Machined All Over Casting Marking Controls. Forgings subject to the removal of markings by the machining of all surfaces may require forged part identification and forge shop symbol markings, but a record of the above and all other required information markings must also be maintained. When the physical size of a forging prevents the application of legible markings, the required information will be recorded by other acceptable methods, i.e., tag, etc. (See SECTION 11 herein.)

17.6 MATERIAL REQUIREMENTS.

17.6.1 Forging Part Callout In Parts List. The parts list of the forging drawing shall provide a complete description of the material and its specification. (See FIGURES 17-2 and 17-4.)

17.6.1.1 Material Specification Column. Provide as applicable the material heat treatment specification, the lot/melt number, date, code for tractability.

17.6.2 Identical Forgings Of Different Materials. Each forging of the same configuration but of different material is to have separate identification, i.e., different suffix identifier (dash) numbers, or separate drawings identified with different drawing numbers.

17.6.3 Method Of Forging Is Not Identified. Unless specific design requirements exist, the method of forging (Drop, Impact, Upset, Roll, etc.) is not called out. The forging should be designed with a particular process in mind; however, in most cases, more than one process will satisfactorily produce the part.

17.7 DRAWING TITLE. (See SECTION 8 herein.)

17.8 DRAWING NOTES. The most commonly used General Notes that are used on forging drawings are as follows. Other notes for consideration, refer to ASME Y14.8M.

17.8.1 Machined Surfaces.



17.8.1.1 Identification Of Forging Surfaces For Machining. Those surfaces which are to be subsequently machined are indicated on the drawing by a flagnote, cross-referenced to the following general note:



SURFACES INDICATED TO BE SUBSEQUENTLY MACHINED.

17.8.1.2 Forging Machined All Over. A part to be machined all over is indicated by the following general note:

X. THIS FORGING TO BE SUBSEQUENTLY MACHINED ALL OVER.

17.8.2 Forged Surfaces.

17.8.2.1 Forging Left As-Forged. Those surfaces which are to be left as-forged or require minimal cleanup operations may be covered by a general note as follows:

X. TRIM FLASH FLUSH WITH CONTOUR + .XX - .XX.

17.8.2.2 Forged Fillets And Corner Radii. Fillets and corner radii which are not dimensioned on the drawing are covered by a general note as follows:

X. UNLESS OTHERWISE NOTED, FORGED FILLETS R .XX AND CORNER RADII R .XX.

17.8.2.3 Surface Roughness Acceptable As Forged. Surface roughness acceptable by forging the part may be listed by a general note as follows:

X. FORGED SURFACES \sqrt{XX}

17.8.3 Acceptance Requirements Notes.

17.8.3.1 Heat Treatment. May be listed by a general note as follows:

X. FLUORESCENT PENETRANT INSPECT PER (applicable specification) AFTER HEAT TREATMENT AND BEFORE RADIOGRAPHIC INSPECTION. INTERPRET PER (applicable specification or note acceptance standards).

17.8.3.2 Radiographic Inspection. May be indicated on the drawing by a flagnote cross-referenced to the following general note:



THIS AREA SHALL CONFORM TO (applicable class, level, etc.)
RADIOGRAPHIC QUALITY LEVEL PER (applicable specification).

(If applicable, the forging is zoned into different quality level areas to denote the critically stressed sections by using phantom lines.) (See FIGURE 17-2.)



17.8.3.3 Discontinuities Inspection. May be listed by a general note as follows:

- X. DYE (or FLUORESCENT PENETRANT or MAGNETIC PARTICLE)
INSPECT PER (applicable specification and type, class, condition, etc.).
INTERPRET PER (applicable specification or note acceptance standards).

17.8.3.4 Classification. May be listed by a general note as follows:

- X. FORGINGS SHALL CONFORM TO (applicable specification, grade, type, class, etc.)

17.8.3.5 Straightening. May be listed by a general note as follows:

- X. FORGING TO BE STRAIGHTENED PRIOR TO FLAW INSPECTION.

17.8.3.6 Sandblasting Or Shot Peening. May be listed by a general note as follows:

- X. NO SANDBLASTING OR SHOT PEENING PRIOR TO FLAW INSPECTION.

17.8.3.7 Forging Material Scheduled For Removal. May be listed by a general note as follows:

- X. EXCEPT FOR THE DIMENSIONS MARKED “FORG”, THE CONTOUR OF THE FORGING IS NOT RESTRICTED BY THE ENVELOPE SHOWN IN PHANTOM.

17.8.3.8 Forging Requiring Pressure Testing. May be listed by a general note as follows:

- X. MACHINED FORGING SHALL WITHSTAND XXX ± XX PSI. HOLD FOR X MINUTES MINIMUM. NO PERMANENT SET IN EXCESS OF X.X% PERMITTED.



17.9 STOCKED FORGING.

17.9.1 Stocked Forging Parts List Callout. A stocked forging is called out in the parts list by the forged material and applicable specification. List size and form only when required by design. See FIGURE 17-1. General notes are used as applicable and should indicate application for the forged or machined part.

			-3	HUB	FORGED CRES	QQ-S-763 CL 347 COND A	
QTY REQD	CAGE CODE	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION		MATERIAL SPECIFICATION		FIND NO.
PARTS LIST							

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES. TOLERANCES ARE: DECIMALS ANGLES .XX±.03 ±2° .XXX±.010 DO NOT SCALE DRAWING	CONTRACT NO.		TITLE					
	APPROVALS	DATE						
	TREATMENT	DRAWN		SIZE	CAGE CODE	DWG NO.	9701203	REV.
	FINISH	CHECKED						
		ENGR						
SIMILAR TO	SPECIAL MARKING SYM	DESIGN ACTIVITY	SCALE	CALC.WT	ACT.WT	SHEET		

STOCKED FORGING
 FIGURE 17-1



FORGING DRAWING

DESCRIPTION:

A forging drawing shows the molded condition and requirements for a part made of a specific material. See FIGURE 17-2.

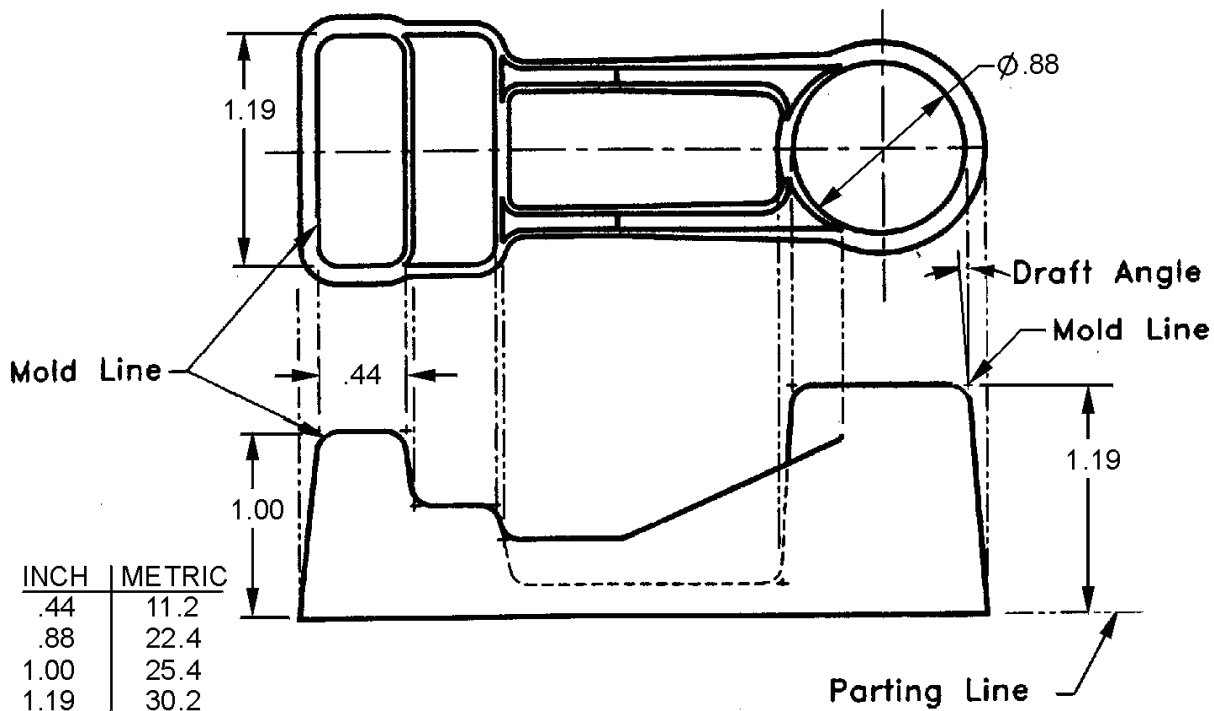
USE:

This type of a drawing is normally used when a part, due to material features and physical shape, can be fabricated by a forged method to a related size of the desired finished part at less cost than machining it from bulk or stock material.

DRAWING REQUIREMENTS:

1. Separate drawings may be required for the forging and the item made from the forging (e.g. forging, machined forging.)
2. Drawing shows sufficient number of principal, auxiliary, sectional and detail views with adequate dimensions and notes for every feature of the forging.
3. Features of a forging are defined by dimensions to surfaces, intersecting planes, etc. rather than to centerline of a corner radius or fillet.

For Example:



4. As-forged surfaces on drawings shall specify whether machining as-forged surfaces is permitted or prohibited (other than removing gates, risers, flash, etc.). Where machining is permitted, the surface texture value shall be specified.

5. Corner Radii size and tolerance shall be specified on the drawing.



6. Fillet Radii size and tolerance shall be specified on the drawing.
7. The use of temporary datum features should be avoided. Use surfaces for datum features that will not be subsequently machined (see SECTION 5).
8. Die closure tolerance is applied to the appropriate dimensions.

For Example:

THIS ON THE DRAWING	MEANS THIS
<p>DIE CLOSURE NOT SPECIFIED DIMENSIONAL TOLERANCE: $\pm .03$ EXCEPT AS NOTED.</p> <p>UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE RELATED TO DATUM A (PRIMARY), DATUM B (SECONDARY), AND DATUM C (TERTIARY).</p>	<p>Die closure tolerance is included in dimensions shown.</p>
<p>DIE CLOSURE NOT SPECIFIED AND PARTING LINE INDICATED DIMENSIONAL TOLERANCE: $\pm .03$ EXCEPT AS NOTED. DIE CLOSURE TOLERANCE: $-.05$</p> <p>UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE RELATED TO DATUM A (PRIMARY), DATUM B (SECONDARY), AND DATUM C (TERTIARY).</p>	<p>Die closure tolerance applies to dimensions that cross the parting line.</p>
<p>DIE CLOSURE NOT SPECIFIED AND PARTING LINE NOT INDICATED DIMENSIONAL TOLERANCE: $\pm .03$ EXCEPT AS NOTED. DIE CLOSURE TOLERANCE: $-.05$</p> <p>UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE RELATED TO DATUM A (PRIMARY), DATUM B (SECONDARY), AND DATUM C (TERTIARY).</p>	<p>Die closure tolerance applies to dimensions that cross the parting line.</p>

INCH	METRIC
.03	0.8
.05	1.3
.09	2.3
1.05	26.7
1.07	27.2
1.10	27.9
1.13	28.7
1.19	30.8
1.25	31.8
1.27	32.3
1.30	33.0
1.33	33.8
1.39	35.3
5.95	151.1
5.97	151.6
6.00	152.4
6.03	153.2
6.09	154.7



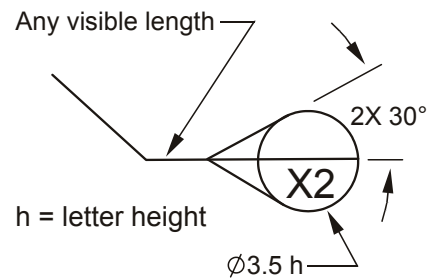
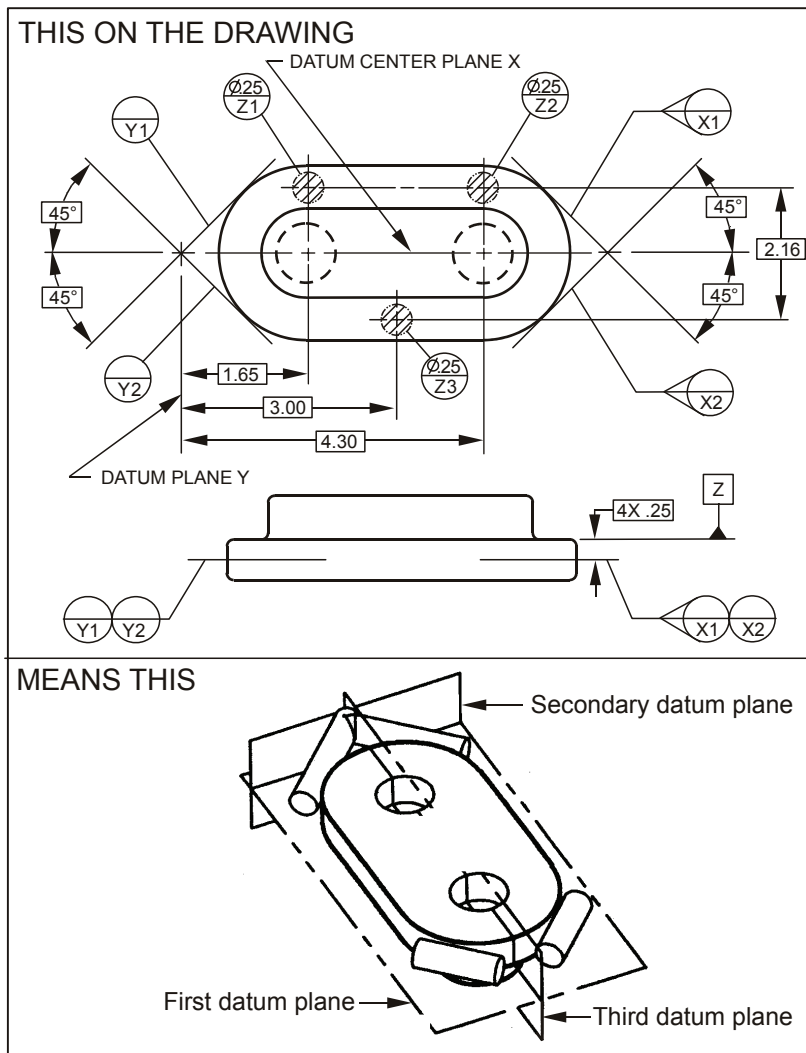
9. Use correlated datums between forging and machine drawings. Indicate by a general note:

X. CORRELATED DATUMS INDICATED BY  ,  AND  .

10. Because of the inherent irregularity of forged surfaces, it may be a good idea to use datum targets to define a datum reference frame on an as-forged part. See SECTION 5 herein, ASME Y14.8M, and ASME Y14.5M-1994 for more information about datum targets.

11. Datum Targets may be used when it is necessary to coordinate measurements for fabrication. (See SECTION 5 herein.)

12. Equalizing datums should be considered to center a forging. The associated datum plane (or axis) may be identified by note. The example illustrates the application of an equalizing datum established by two fixed datum targets, Y1 and Y2 and two simultaneous movable targets, X1 and X2. The movable target symbol was added in the revised 1996 publication of ASME Y14.8M. It is presented here until it is added to ASME Y14.5M together with the other target symbol applications.



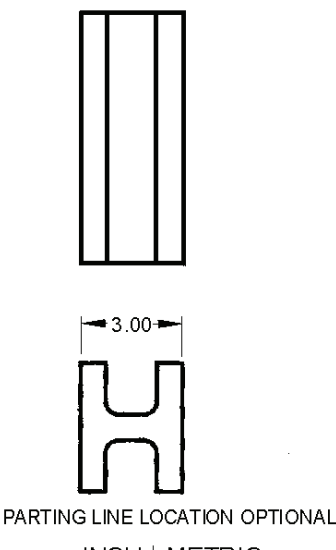
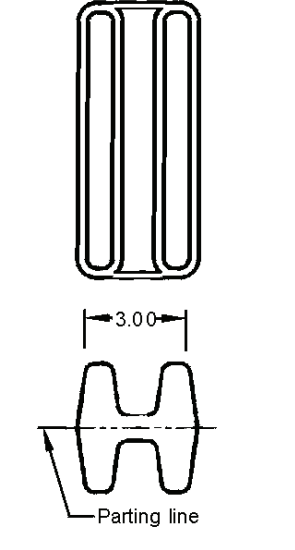
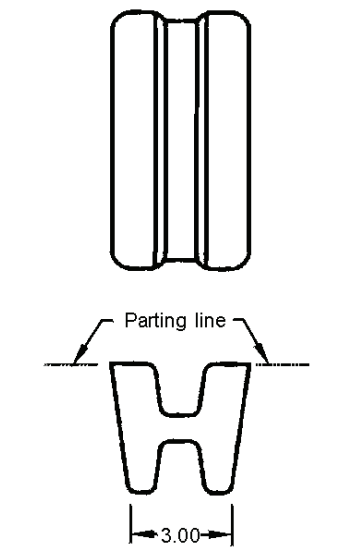
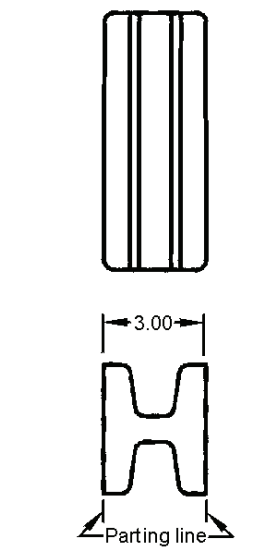
MOVABLE DATUM TARGET SYMBOL FORM AND PROPORTION

INCH	METRIC
.25	6.4
.50	12.7
1.65	42.0
2.16	54.9
3.00	76.2
4.30	109.2

MOVABLE DATUM TARGETS ESTABLISHING A DATUM CENTER PLANE



13. Parting lines are generally not shown; but when required by design, they shall be shown as a phantom line (or lines or curves, as applicable) extending beyond the part in applicable views and identified. A local note is used to indicate their location.

THIS ON THE DRAWING	MAY MEAN ANY OF THESE						
 <p>PARTING LINE LOCATION OPTIONAL</p> <table border="1"> <tr> <td>INCH</td> <td>METRIC</td> </tr> <tr> <td>3.00</td> <td>76.2</td> </tr> </table>	INCH	METRIC	3.00	76.2	 <p>Parting line</p>	 <p>Parting line</p>	 <p>Parting line</p>
INCH	METRIC						
3.00	76.2						
<p>Dimensions and tolerances exclude draft. Draft adds mass.</p>							

PARTING LINE LOCATIONS

A local note may also be used when design is a requirement.

PARTING LINE IN THIS AREA ONLY.

14. Including draft on a model or on features depicted on a drawing is options, but it is a good design practice to do so. If desired, the requirements may be indicated by a General Note:

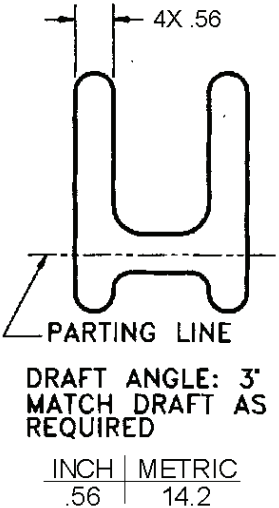
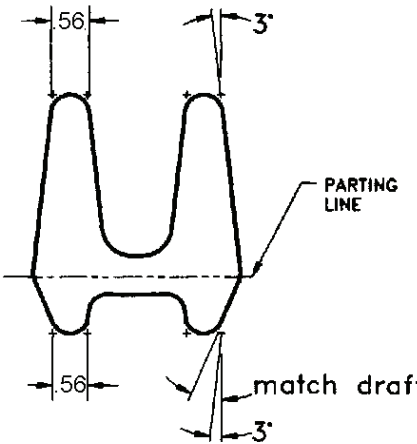
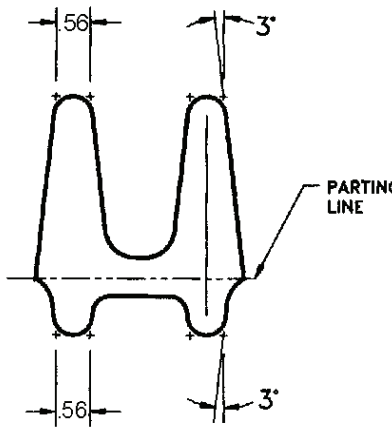
← UNLESS OTHERWISE SPECIFIED, DRAFT ANGLE X° MAX MAY BE APPLIED TO INCREASE STOCK. MATCH DRAFT WHERE NECESSARY.

Draft may be shown for clarity. When shown, draft angle and tolerance shall be specified. Show draft pictorially on forged surfaces that remain on the finished part when the external draft exceeds 2 degrees and internal draft exceeds 3 degrees. Draft may exceed perfect form boundary at MMC unless otherwise specified. Drafted surfaces may also be defined with basic dimensions and their variation defined using profile of a surface. Remember, profile of a surface applies normal to the true profile, which in this case is the drafted surface. This method offers the most robust and best way to define the surface and its allowable variation, and presents the clearest requirements for verification.

Note: Including draft on the drawing or in a 3D solid model also allows for more accurate calculation of mass, center of gravity or mass (for balance), stress or strength using finite element analysis (FEA), and it presents a much more accurate picture of the final part geometry than would be obtained if draft was not shown. As shown above, the difference in allowable part geometry where the parting line and resulting draft has not been specified (or modeled) can be severe.

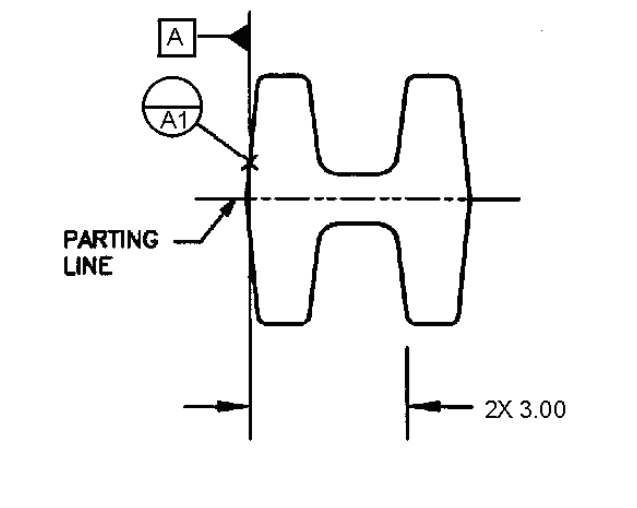
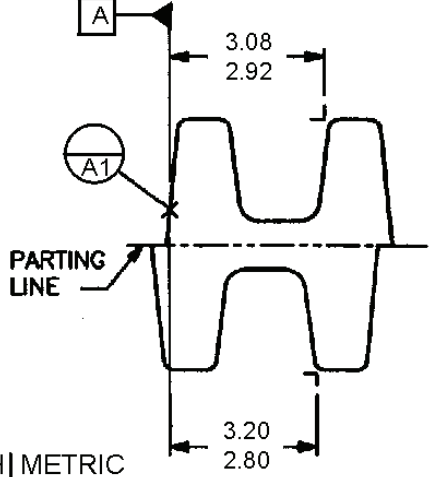


15. Match Draft shall be specified where applicable.

THIS ON THE DRAWING	MAY MEAN EITHER OF THESE					
 <p>DRAFT ANGLE: 3° MATCH DRAFT AS REQUIRED</p> <table border="1"> <tr><td>INCH</td><td>METRIC</td></tr> <tr><td>.56</td><td>14.2</td></tr> </table>	INCH	METRIC	.56	14.2	 <p>PARTING LINE</p> <p>match draft</p>	 <p>PARTING LINE</p>
INCH	METRIC					
.56	14.2					

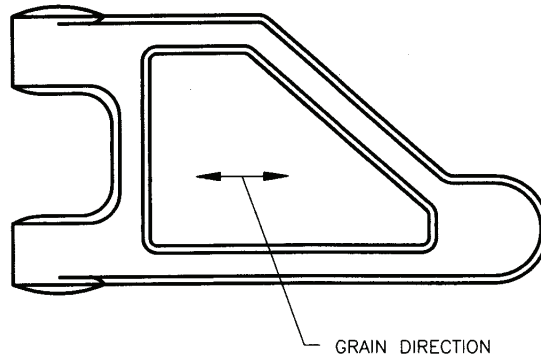
MATCH DRAFT

16. Mismatch where applicable, shall be specified as a maximum value. Mismatch may exceed perfect form boundary at MMC, unless otherwise specified.

THIS ON THE DRAWING	MEANS THIS																
 <p>PARTING LINE</p> <p>2X 3.00</p> <p>UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE RELATED TO DATUM A (PRIMARY), DATUM B (SECONDARY), AND DATUM C (TERTIARY) DIMENSIONAL TOLERANCE: ±2 MISMATCH: 3 MAX</p> <table border="1"> <tr><td>INCH</td><td>METRIC</td></tr> <tr><td>.08</td><td>2.0</td></tr> <tr><td>.12</td><td>3.0</td></tr> <tr><td>2.80</td><td>71.1</td></tr> <tr><td>2.92</td><td>74.2</td></tr> <tr><td>3.00</td><td>76.2</td></tr> <tr><td>3.08</td><td>78.2</td></tr> <tr><td>3.20</td><td>81.3</td></tr> </table>	INCH	METRIC	.08	2.0	.12	3.0	2.80	71.1	2.92	74.2	3.00	76.2	3.08	78.2	3.20	81.3	 <p>PARTING LINE</p> <p>3.08 2.92</p> <p>3.20 2.80</p>
INCH	METRIC																
.08	2.0																
.12	3.0																
2.80	71.1																
2.92	74.2																
3.00	76.2																
3.08	78.2																
3.20	81.3																

MISMATCH TOLERANCE

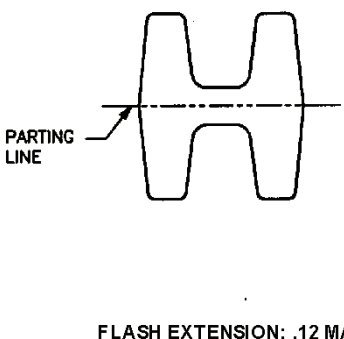
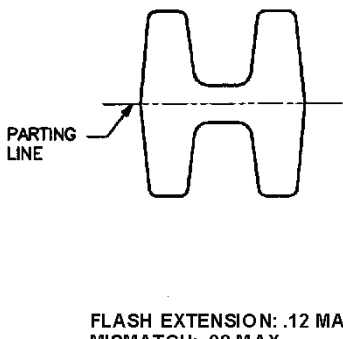
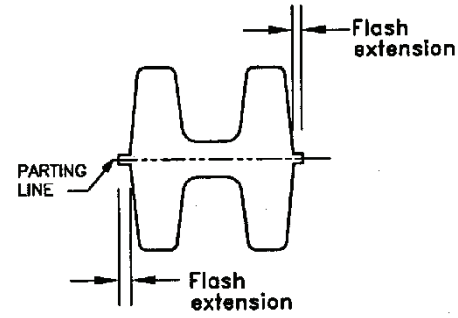
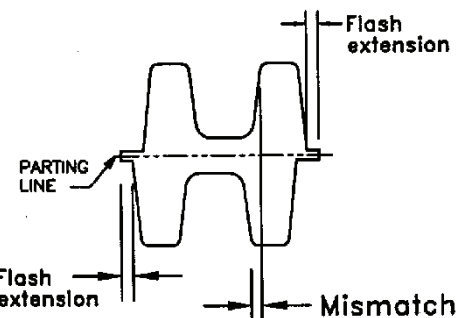
17. Grain Direction when required by design is specified on the drawing and shown in an appropriate



view.

GRAIN DIRECTION SPECIFIED

18. Flash Extension limits shall be specified on the drawing. Flash extension may exceed perfect form boundary at MMC unless otherwise specified.

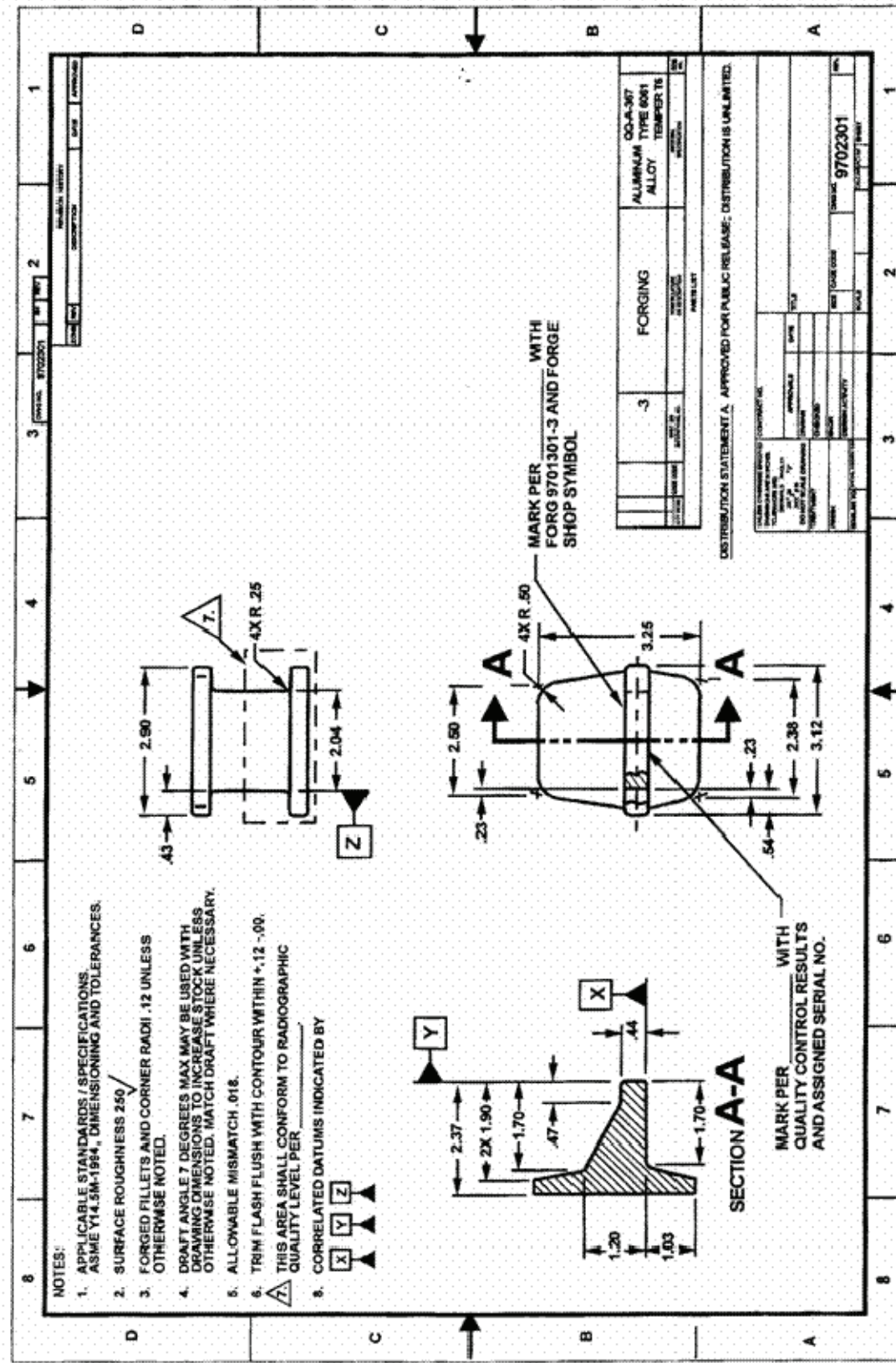
<p>THIS ON THE DRAWING</p>  <p>FLASH EXTENSION: .12 MAX</p>	<p>THIS ON THE DRAWING</p>  <p>FLASH EXTENSION: .12 MAX MISMATCH: .08 MAX</p>						
<p>MEANS THIS</p>  <p>Flash extension</p> <p>Flash extension</p> <table border="1" data-bbox="284 1795 470 1890"> <thead> <tr> <th>INCH</th> <th>METRIC</th> </tr> </thead> <tbody> <tr> <td>.08</td> <td>2.0</td> </tr> <tr> <td>.12</td> <td>3.0</td> </tr> </tbody> </table>	INCH	METRIC	.08	2.0	.12	3.0	<p>MEANS THIS</p>  <p>Flash extension</p> <p>Mismatch</p>
INCH	METRIC						
.08	2.0						
.12	3.0						

FLASH EXTENSION

FLASH EXTENSION AND MISMATCH



19. Geometric Dimensioning and Tolerancing (GD&T) should be used to define forged surfaces on forging drawings and annotated models to ensure complete and unambiguous definition. Profile of a surface is often a good choice for cast and forged parts, as castings and forgings often include complex-shaped surfaces. Such surfaces can only be adequately defined using basic dimensions and unambiguously toleranced using profile of a surface. From the standpoint of doing a complete and thorough job, profile of a surface is often the only choice available.
20. All forged symbols and markings should be located on a flat or nearly flat surface parallel to the parting line whenever possible and preferably on a surface that will not be machined (see PARAGRAPH 17.5 and SECTION 11 herein).
21. Each forging of the same configuration but of different material is to have separate identification, i.e., different suffix identifier (dash) numbers or separate drawings.
22. Unless specific design requirements exist, the method of forging (drop, impact, upset, rolled) is not called out.
23. Forgings are preferably drawn and modeled full size.



THIS SAMPLE DRAWING IS INFORMATIONAL ONLY AND COMPLETE TO THE DEGREE NECESSARY TO ILLUSTRATE THE TYPE OF DRAWING BEING DESCRIBED
DRAWING FORMAT SIZE PROPORTIONS HAVE BEEN EXAGGERATED FOR CLARITY

FORGED PART DRAWING
FIGURE 17-2



FORGING MACHINE DRAWINGS

DEFINITION:

A drawing that defines the machining and other requirements of a part made from a forging. See FIGURE 17-3.

USE:

The purpose of a forging machine drawing is the same as a detail drawing of an item to be made from raw stock.

DRAWING REQUIREMENTS:

1. Sufficient views, dimensions and notes are given to adequately define the part to be machined from the forging.
2. The forging part number is entered in the material column of the parts list. (See SECTIONS 7 and 10.)
3. Markings to identify part after machining.
4. Forge and machine drawing general notes as per PARAGRAPH 17.8.
5. Designations of datum features and/or datum targets to be carried over from the forging drawing are shown and noted (see SECTION 5 herein).

6. Correlation of datums is indicated by a general note:

:

X

▲

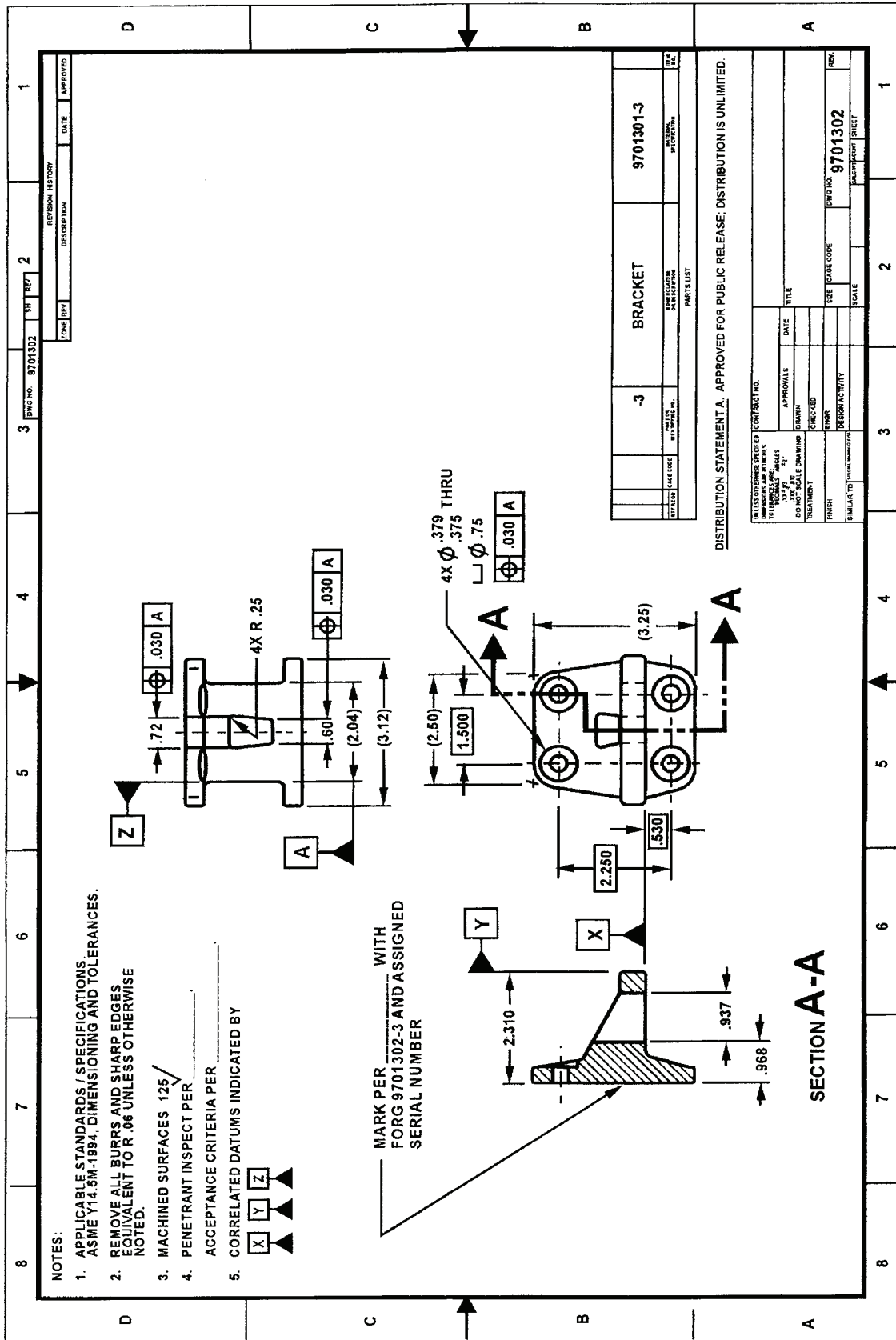
Y

▲

Z

▲
 X. CORRELATED DATUMS INDICATED BY ▲ , ▲ AND ▲

7. If a separate datum reference frame is to be established on the machined casting drawing from machined datum features, the appropriate machined datum features should be related to the cast/correlated datum reference frame.
8. All other machined features should be related to this or other datum reference frames derived from machined features



MACHINING DRAWING OF A FORGED PART
 FIGURE 17-3

THIS SAMPLE DRAWING IS INFORMATIONAL ONLY AND COMPLETE TO THE DEGREE NECESSARY TO ILLUSTRATE THE TYPE OF DRAWING BEING DESCRIBED. DRAWING FORMAT SIZE PROPORTIONS HAVE BEEN EXAGGERATED FOR CLARITY.



COMBINATION FORGED AND MACHINE DRAWING

DESCRIPTION:

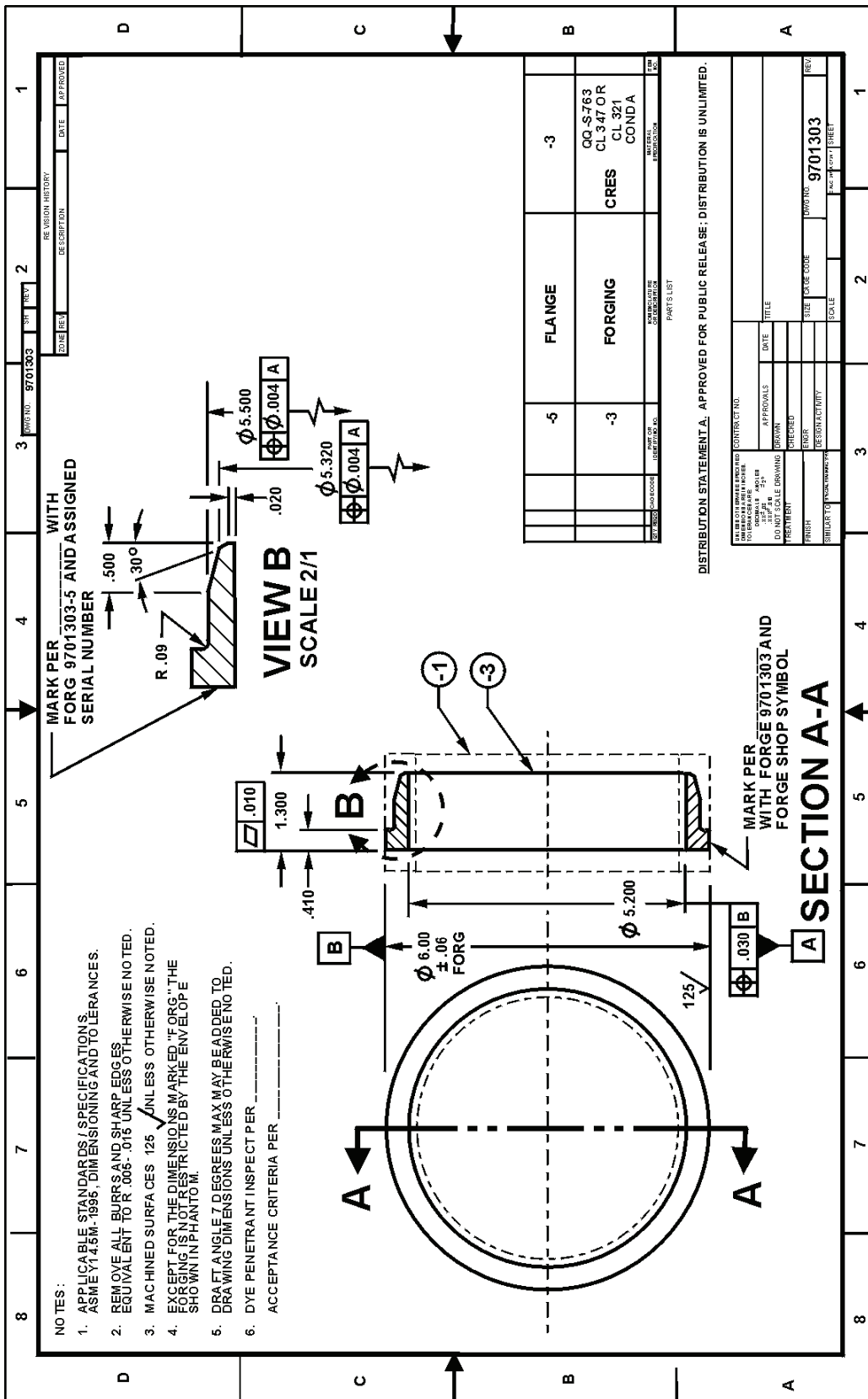
A drawing that shows the forged and machine features of a part on the same drawing. See FIGURE 17-4.

USE:

This type of drawing may be used where essential controls of the forged part can adequately be shown in conjunction with the machined part and on the same drawing.

DRAWING REQUIREMENTS:

1. The part is drawn as a “machined” item and the outlines of forged surfaces to be machined are shown on the machined detail drawing by phantom lines with limiting dimensions.
2. All forging dimensions are indicated as FORG.
3. The forging and machined parts are identified with different dash numbers, e.g., -3 and -5.
4. Sufficient views, dimensions and notes are given to adequately define and differentiate between the forging and the part machined from the forging.
5. An alternate method would be to show the forging and the machined part in separate views on the same drawing.



COMBINATION FORGED PART AND MACHINED DRAWING

FIGURE 17-4

THIS SAMPLE DRAWING IS INFORMATIONAL ONLY AND COMPLETE TO THE DEGREE NECESSARY TO ILLUSTRATE THE TYPE OF DRAWING BEING DESCRIBED. DRAWING FORMAT SIZE PROPORTIONS HAVE BEEN EXAGGERATED FOR CLARITY.