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Terminology Quiz 1

INSTRUCTIONS: The following definitions were selected from the Dictionary of Terms. Enter the proper term for each description.

1. A machining operation that produces a round, flat spot around a hole. Abbreviated SF.
2. A machining operation that uses a toothed cutting tool to produce shapes inside of a hole, such as a keyway.
3. The plural of "radius."
4. The term that means two sides are involved.
5. A tool used for cutting internal threads in a hole.
6. Two lines equidistant from each other, extending in the same direction.
7. The term that describes two lines or planes that are at right angles to one another.
8. A line drawn to an arc that contacts the arc at one point only, without crossing.
9. The thickness of sheet metal by a number rather than a dimension.
10. A shaft or spindle for holding the cutting tool or workpiece.
11. A thin piece of metal inserted between two parts to adjust the fit.
12. The smaller of two mating gears.
13. A hole slightly larger than the fastener intended to pass through it.
14. A projecting rim or collar used to attach to another object.
15. A flat surface perpendicular to the axis, such as the end of a shaft.
16. A point, line, plane, or surface from where other features are located.
17. A spring designed to supply force when pulled end to end.
18. The cooling of metals rapidly by immersing them in a liquid.
19. A dimension used only for information, not for production or inspection.
20. A drawing made by computer-aided drafting methods.
**Terminology Quiz 2**

**INSTRUCTIONS:** The following definitions were selected from the Dictionary of Terms. Enter the proper term for each description.

1. A machining operation that enlarges the end of a hole cylindrically to a specified diameter and depth.
2. A machining operation that produces a cone-shaped end to a hole, usually to accept a flat-head fastener.
3. The permissible variation from a specified dimension.
4. The maximum and minimum permissible dimensions.
5. A tool used for cutting external threads.
6. Cylindrical surfaces that are equally centered about a common axis.
7. Equal halves. The same shape on both sides of a common centerline.
8. A circular centerline upon which two or more hole centers are located.
9. An object made by pouring molten metal into a mold.
10. A model of the part to be cast. Used to create a cavity in the sand.
11. An interior radius (concave) between intersecting surfaces of an object.
12. A circular, raised portion around a hole in a casting or a forging.
13. Metals that contain iron as their base material, such as steel.
14. Metals without iron content, such as brass, copper, or aluminum.
15. Conical shape that permits a shaft or a hole to become gradually smaller from one end to the other.
16. To remove a small amount of material from the end of a shaft or hole to facilitate assembly.
17. A groove in a shaft to position a key.
18. An external groove at a change in diameter of a shaft, usually for another part to fit against its shoulder.
19. The term used to define the angle formed between one side and another.
20. The minimum clearance (or maximum interference) between two mating parts, such as a shaft and a hole.

1. **COUNTERBORE**
2. **COUNTERSINK**
3. **TOLERANCE**
4. **LIMITS**
5. **DIE**
6. **COAXIALITY**
7. **SYMMETRICAL**
8. **BOLT CIRCLE**
9. **CASTING**
10. **PATTERN**
11. **FILLETS**
12. **BOSS**
13. **FERROUS**
14. **NONFERROUS**
15. **TAPER**
16. **CHAMFER**
17. **KEYSEAT**
18. **NECK**
19. **INCLUDED ANGLE**
20. **ALLOWANCE**
INSTRUCTIONS: Many words from the Dictionary of Terms are included in this puzzle. Enter the terms or their abbreviations from the definitions that follow.

HORIZONTAL

3. Abbreviation for “regardless of feature size.”
4. Thin plate used as a guide for form or shape.
6. Angular piece of metal used to add strength.
8. Strike a piece of metal on its end to increase its cross section.
12. Abbreviation for “maximum material condition.”
14. Groove that positions the key in a shaft.
16. Tool for cutting threads in a drilled hole.
17. Abbreviation for “spotface.”
19. Tool for cutting external threads by hand.
20. Ceramics used to wear away softer materials.
21. Cool hot metal slowly to remove stresses.
23. Exterior radius between cast surfaces.
24. Off center. Also cylindrical surfaces with uncommon axes.

28. Cylindrical surfaces with a common axis.
31. Central part of a wheel.
33. Distance between common points on adjacent threads.
35. Metal piece used to prevent rotary movement between hub and shaft.
36. Type of projection used on machinist’s blueprints.
37. Shapes hot metal by hammering or squeezing.

VERTICAL

1. Type of drawing which includes all information necessary to produce the object.
3. Slightly enlarge a drilled hole.
5. Remove oxide scale with an acid solution.
7. Reheat hardened steel.
9. Cylindrical piece threaded on both ends.
10. Permissible variation from a given dimension.

11. Circular, raised portion around a hole in a casting.
13. Mold part that shapes the interior of a casting.
15. Proportion between two sets of dimensions: those of a drawing and the actual object.
18. Thin projecting edge on a casting.
20. Mixture of two or more metals to form a new metal.
22. Insert that provides metal with a better wearing quality.
25. Abbreviation for “carburize.”
26. Groove cut into a cylindrical surface.
27. Cylindrical ring around a shaft.
29. Device that changes rotary motion to reciprocating motion.
30. Constant change in diameter over the length of a cylinder.
32. Unwanted projecting edge of metal.
34. Abbreviation for “typical.”
Abbreviation Quiz 1

INSTRUCTIONS: Enter the word or words that represent the following standard abbreviations found on drawings.

1. CI
   1. CAST IRON

2. CRS
   2. COLD-ROLLED STEEL

3. CBORE
   3. COUNTERBORE

4. CSK
   4. COUNTERSINK

5. DIA
   5. DIAMETER

6. DR
   6. DRILL/DRILL ROD

7. FIL
   7. FILLET/FILLISTER

8. FAO
   8. FINISH ALL OVER

9. GA
   9. GAGE/GAUGE

10. HRS
   10. HOT-ROLLED STEEL

11. ID
   11. INSIDE DIAMETER

12. LH
   12. LEFT HAND

13. MATL
   13. MATERIAL

14. MAX
   14. MAXIMUM

15. OD
   15. OUTSIDE DIAMETER

16. SECT
   16. SECTION

17. STL
   17. STEEL

18. THK
   18. THICK

19. THD
   19. THREAD

20. TOL
   20. TOLERANCE
Abbreviation Quiz 2

INSTRUCTIONS: Enter the word or words that represent the following standard abbreviations found on drawings.

1. BC  
2. BHN  
3. CHAM  
4. CDS  
5. DIM.  
6. FIN.  
7. GRD  
8. HT TR  
9. LG  
10. MI  
11. MIN  
12. NTS  
13. PC  
14. RM  
15. REF  
16. RND  
17. SCR  
18. SPEC  
19. SYM  
20. TYP  

1. BOLT CIRCLE  
2. BRINELL HARDNESS NO.  
3. CHAMFER  
4. COLD-DRAWN STEEL  
5. DIMENSION  
6. FINISH  
7. GRIND  
8. HEAT TREAT  
9. LENGTH/LONG  
10. MALLEABLE IRON  
11. MINIMUM/MINUTE  
12. NOT TO SCALE  
13. PIECE/PITCH CIRCLE  
14. REAM  
15. REFERENCE  
16. ROUND  
17. SCREW  
18. SPECIFICATION  
19. SYMMETRICAL  
20. TYPICAL
Abbreviation Loop-A-Word

INSTRUCTIONS: Listed below are a number of words that have their abbreviations hidden in the puzzle. They appear either horizontally (left to right) or vertically (top to bottom). Can you find them?

ACCESSORY CYLINDER LUBRICATE
ALLOWANCE DIAMETER MACHINE
APPROXIMATE DRAWING MATERIAL
ASSEMBLE EQUIVALENT MAXIMUM
ASSEMBLY FINISH ALL OVER MINIMUM
AUTOMATIC FOUNDRY MISCELLANEOUS
AUXILIARY GASKET NATIONAL
BEARING GRIND NOT TO SCALE
BRACKET HARDEN PIECE
CASTING HEXAGON QUANTITY
CHAMFER HOT-ROLLED STEEL REAM
COLD-ROLLED STEEL HOUSING REFERENCE
COUNTERBORE INTERIOR SPECIFICATION
COUNTERCLOCKWISE JUNCTION STAINLESS STEEL
COUNTERSINK KEYSW STEEL

B C C W Z J G K A U T O B H R N L Y D
M E I K D O D W G F U J D Q K U G F H
J E T B I C V P L N G I M K E F O T D T A
F Q E Y M S O N A T I C A V Z H J X K O B
D R E T I R Y D H Z P V X A B S E M I N F
J X D Z G X Q V Z X U T V Q Z G M G C I H
I H O B Z P L N C Y L F R Z X P H Y Q L U
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G T X S T J A U F Y A G Z K R G Y X P
V Q S E B M L Y C Z H N L V U D B H E E L
I J N H X K A K H F B I F Z D L V R V C
D A C C E S S Q P D S Z O Y H U N P G F O
E I Q T Y Q T F Y N N J I K T A L P A B
S V P L O G A D Z O K I M H E I U X N U O
T H E D R Y X P F I C B X F Q X E G V R
M S V Y K P H Q O B P H N D U P D I L
J T O T D C R S U G F J E L L Q A Q E Q N
D G I H E F B L D C H A M I B O S K T G
Alphabet of Lines Quiz 1

INSTRUCTIONS: Answer the following questions by referring to the illustrations on the preceding page. In questions 1 through 11, enter the name of the line that does the following:

1. Shows the outline of the object.
2. Indicates the place from where the removed view is viewed.
3. Points diagonally to an area or a feature.
4. Represents a surface not visible in the view drawn.
5. Shows an alternate position of the movable arm.
6. Terminates with arrowheads and encloses a dimension figure.
7. Extends the visible line for the purpose of dimensioning to it.
8. Indicates the place where the section is cut.
9. Shows the axis of symmetrical parts and the arm’s path of motion.
10. Permits the use of a partial view to conserve space and avoid congestion.
11. Represents the exposed surface of a sectioned feature.
12. List the five lines that are drawn thick.

13. List the six lines that include short dashes.

14. List the four lines that include arrowheads.

15. How does the cutting-plane line differ from the viewing-plane line (in application)?

1. VISIBLE
2. VIEWING-PLANE
3. LEADER
4. HIDDEN
5. PHANTOM
6. DIMENSION
7. EXTENSION
8. CUTTING-PLANE
9. CENTER
10. BREAK
11. SECTION
12. VISIBLE CUTTING-PLANE VIEWING-PLANE SHORT BREAK CHAIN
13. HIDDEN CENTER CUTTING-PLANE VIEWING-PLANE PHANTOM CHAIN
14. DIMENSION LEADER CUTTING-PLANE VIEWING-PLANE
15. CP CUTS OBJECT VP VIEWS OBJECT
Alphabet of Lines Quiz 2

INSTRUCTIONS: Enter the proper names of the various types of lines used in the illustration below.

1. **VIEWING-PLANE**  
2. **EXTENSION**  
3. **DIMENSION**  
4. **CENTER**  
5. **HIDDEN**  
6. **SHORT BREAK**  
7. **CUTTING-PLANE**  
8. **VISIBLE**  
9. **CENTER**  
10. **LEADER**  
11. **SECTION**  
12. **PHANTOM**

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Alphabet of Lines Quiz 3

INSTRUCTIONS: Match the lines used in the drawing with their correct names from the following list.

Center Line  Hidden Line  Short Break Line
Chain Line    Leader       Viewing-plane Line
Cutting-plane Line  Long Break Line  Visible Line
Dimension Line  Phantom Line
Extension Line  Section Line

1 LEADER
2 EXTENSION
3 DIMENSION
4 VISIBLE
5 CENTER
6 SECTION
7 SHORT BREAK
8 VIEWING-PLANE
9 CHAIN
10 CUTTING-PLANE
11 LONG BREAK
12 HIDDEN
13 PHANTOM
Alphabet of Lines Quiz 4

INSTRUCTIONS: Listed below are the various lines that comprise the Alphabet of Lines. Match the letters from the list with the numbers in the illustration.

A Center Line
B Chain Line
C Cutting-plane Line
D Dimension Line
E Extension Line
F Hidden Line
G Leader
H Long Break Line
I Phantom Line
J Section Line
K Short Break Line
L Viewing-plane Line
M Visible Line

1 L
2 M
3 F
4 I
5 H
6 C
7 K
8 B
9 D
10 E
11 G
12 A
13 J
14 A
15 J
**Fractional Dimensioning**

Although the majority of prints in this workbook will be decimally dimensioned, there are still a great number of industrial blueprints that are fractionally dimensioned. A machine operator should become skilled at reading the fractional scale and metric scale as well as the decimal scale.

Most fractional-type steel rules (scales) are subdivided into units of 1/16, 1/32, or 1/64 in. Major graduations along the rule are accented by longer lines. Some have small numbers printed adjacent to the lines that correspond with the number of graduations. *Example:* The number 16 on a scale graduated into 32’s would represent 16/32, which would reduce to 1/2 in. Always reduce a fraction to its lowest terms. If the numerator is an even number, you know that it can be further reduced. It is often quicker to begin your count from a major graduation close to the reading, rather than to begin from a full inch. *Example:* A reading of 2 3/8 could be read faster by starting at 2" instead of 2 3/8". (See no. (3) below.)

(Courtesy The L. S. Starrett Co.)

**Scale Reading Quiz 1**

**INSTRUCTIONS:** Determine the readings from the illustrations shown below and enter your answers in the appropriate spaces.

1. \( \frac{3}{4} \)
2. \( 1 \frac{5}{8} \)
3. \( 2 \frac{7}{16} \)
4. \( 3 \frac{3}{16} \)
5. \( 3 \frac{15}{16} \)
6. \( 13 \frac{1}{16} \)
7. \( 1 \frac{3}{4} \)
8. \( 2 \frac{11}{16} \)
9. \( 3 \frac{17}{32} \)
10. \( 3 \frac{3}{32} \)
Decimal Scales

Most decimal-type scales (steel rules) are subdivided into units of 1/10, 1/20, 1/50, or 1/100 in. The 1/50 will provide sufficiently accurate readings for most applications. This scale can usually be recognized by the number 50 stamped near the left edge. With 50 increments to the inch, each increment then represents .02 in. By reading between these increments, the machinist is capable of determining the closest .01 measurement (ten thousandths of an inch). Closer measurements require the use of other instruments, such as the micrometer, vernier calipers, and so on.

Major graduations along the scale are accented by longer lines, usually every 1/10 in. (.10). In addition, they may include numbers as shown in the illustration below. A popular graduation style has the .04 and .06 increment lines slightly longer than the .02 and .08 increment lines. This allows for quicker reading of the commonly used .05 increment.

(Courtesy The L. S. Starrett Co.)

Scale Reading Quiz 2

INSTRUCTIONS: Determine the readings from the illustration shown below, and enter your answers to the closest .01 in.

\[ \begin{align*}
1 & \quad 0.80 \\
2 & \quad 1.60 \\
3 & \quad 2.50 \\
4 & \quad 3.32 \\
5 & \quad 3.86
\end{align*} \]
### Decimal and Metric Equivalents of Fractions

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<td>.44</td>
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### Decimal Rounding Quiz

**INSTRUCTIONS:** Round the following three-place decimals to two-place decimals. Follow the rules given on page 24.

1. $\frac{1}{109} = \boxed{.11}$
2. $\frac{1}{125} = \boxed{.12}$
3. $\frac{1}{156} = \boxed{.16}$
4. $\frac{1}{234} = \boxed{.23}$
5. $\frac{1}{438} = \boxed{.44}$
6. $\frac{1}{547} = \boxed{.55}$
7. $\frac{1}{562} = \boxed{.56}$
8. $\frac{1}{641} = \boxed{.64}$
9. $\frac{1}{797} = \boxed{.80}$
10. $\frac{1}{875} = \boxed{.88}$
11. $\frac{1}{1056} = \boxed{1.06}$
12. $\frac{1}{1672} = \boxed{1.67}$
13. $\frac{2}{2205} = \boxed{2.20}$
14. $\frac{2}{2454} = \boxed{2.45}$
15. $\frac{3}{335} = \boxed{3.34}$
16. $\frac{3}{3767} = \boxed{3.77}$
17. $\frac{5}{555} = \boxed{5.56}$
18. $\frac{6}{665} = \boxed{6.66}$
19. $\frac{7}{7045} = \boxed{7.04}$
20. $\frac{8}{885} = \boxed{8.88}$
**Metric Dimensioning**

The increment of measurement on metric drawings for the machine trade is the millimeter, unless otherwise specified. A note to this effect is normally located in the area of the title block on a drawing. Many industries in the United States and Canada that use the metric system of dimensioning also include the inch equivalent in decimal form. The dual dimensioning system and the SI metric system are illustrated on page 21, "Dimensioning Systems."

If you encounter a drawing dimensioned only in millimeters, you may convert each dimension to inches by multiplying it times 0.03937, or you may use a conversion chart. However, metric scales are available to eliminate the need for conversion. These scales have graduations every millimeter or half-millimeter, and may be recognized by the designation “mm” or “1/2 mm” stamped near the left edge. Normally, every fifth millimeter is accented by a longer line and every tenth millimeter is identified by number, as shown below.

(Courtesy The L. S. Starrett Co.)

**Scale Reading Quiz 3**

INSTRUCTIONS: Determine the readings from the illustration shown below, and enter your answers to the closest 0.5 mm.

![Scale Reading Illustration]

1. 20
2. 35
3. 51
4. 77.5
5. 93.5
BLUEPRINTS

Most of us continue to use the term "blueprint" when referring to prints of engineering drawings, although today the majority of prints produced are actually "whiteprints." The true blueprint contained white lines on a blue background. Today the term "blueprint" can be interpreted as a drawing or picture of a part to be made along with the required sizes, tolerances, essential requirements, notes, and instructions necessary to produce the part. No matter how the drawing is created, whether by the latest CAD process or sketched on a piece of paper, if the drawing does not contain the correct information about the part to be made, then the part cannot be made. From the information contained on the drawings shown below, could you make these two parts?

NO. THE UPPER FIGURE IS AN OPTICAL ILLUSION AND THE 3.50 LENGTH IN THE LOWER FIGURE IS .50 SHORT.

(6 X .50 TYP. + .50 LEFT END + .50 RIGHT END = 4.00)
ENGINEERING DRAWINGS

The original drawings made by a drafter or engineer are referred to as “engineering drawings.” Prints made from these drawings may be referred to as engineering drawings or, the more common term, “blueprints.” The sizes of these drawings have been standardized, and are shown on the illustration below. The 8 1/2 × 11 inch A-size is the same size as typing paper, thereby fitting into mailing envelopes, file drawers, and other standard office equipment. B-size through E-size are all in multiples of 8 1/2 × 11 so that they too will fit when folded. Metric drawing sizes have been standardized on a width-to-length basis and are shown at the right.

![Diagram of drawing sizes]

**Drawing Size Quiz**

**INSTRUCTIONS:** Answer the following questions about drawing sizes.

1. What are the basic dimensions of the A-size drawing? (Inches)
   - 8 1/2 × 11

2. If C-size is twice as large as B-size, how much larger is it than A-size?
   - 4X

3. Will an E-size print fold to fit in the same envelope with an A-size print?
   - YES

4. What metric size is twice as large as the A3 size?
   - A2

5. Are the A4 metric size and the A inch size exactly the same? (Use 1 in. = 25.4 mm, or 1 mm = .03937 in. to compare.)
   - NO
TITLE BLOCKS

Each drawing sheet normally contains a title block that includes information pertaining to the part drawn. The title block also contains information that pertains to the company that made the drawing. The most prominent lettering in the title block is the drawing number, which is also the part number of the part shown. The title or part name is also lettered larger to make it stand out. An important entry in the title block for you, the blueprint reader, is entitled "scale." This information will tell you whether or not the part shown appears actual size.

If an item is too large to comfortably fit onto a standard size sheet, it may be drawn to a smaller scale (size). Similarly, if it is too small to adequately show all details or dimensions, it may be drawn to a larger scale. However, you must understand that only the size of the illustration is affected, not the dimensions that appear adjacent to the illustration. For example, if a 6-in. cube were drawn to half-scale, the cube would be drawn 3 in., but the dimension alongside it would still be written 6. A 1-in. sphere drawn four times scale would actually measure 4 in., but its dimension would be written 1. The dimension figure is always the actual size, regardless of scale.

Mechanical engineering drawings may be reduced to half-size, quartersize, or one-eighth size. If they are enlarged, it is customary to use double size, four times size, or ten times size. Several methods of designating the scale may be used. For example, half-scale may appear as 1/2, 1:2, or 1/2" = 1", whereas twice scale would appear as 2/1, 2:1, 2-1, 2" = 1", or 2X. Note that the arrangement of numbers (1:2 vs. 2:1) indicates the relationship between the drawing and the actual part. An easy way to remember this is to refer to the scale as the "DO SCALE," where "D" stands for drawing and "O" stands for object. Thus a "DO SCALE" of 1:2 means that the drawing is one inch while the object is two inches or twice the size of the drawing. Conversely, a "DO SCALE" of 2:1 means that the drawing is two inches while the part is one inch or half the size of the drawing.

INSTRUCTIONS: Circle the scale specified in each of the sample title blocks shown below and on the next page.

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(Courtesy of Great Dane Trailers, Inc.)

(Courtesy Deere & Co.)
DRAWING NOTES

Notes are classified as local notes when they apply only to specific items or areas, and as general notes when they apply to the entire drawing or product. Local notes use leaders to direct the notes to where they apply. General notes contain information pertaining to machining, finishing, heat treatment, material, tolerances, and so on, and will normally appear just above the drawing title block. Abbreviations are commonly used in notes to keep them brief. Typical examples of drawing notes you might encounter are shown below.

(GENERAL)  (LOCAL)

UNLESS OTHERWISE SPECIFIED:
1. METRIC UNITS ARE mm
2. FLS & RNDs .12R
3. PART SYM ABOUT CL

5 HOLES EQL SP ON 6.000 BC
.344 DR, .500 CBORE, .30 DP
.281 DR, 82° CSK, .53 DIA

Drawing Notes Quiz

INSTRUCTIONS: Answer the following questions pertaining to the notes above.

1. What type of note applies to an entire drawing?
2. What type of line is used with local notes?
3. Where do general notes usually appear on a drawing?
4. Interpret the abbreviations SYM and CL used in the third general note.
5. Interpret the abbreviations DR and CSK used in the third local note.
DIAMETERS AND RADII

Observe the symbol (Ø) that follows the dimensions for the holes in the gasket in drawing 11A001. It is the internationally recognized symbol for diameter, and is used in place of the abbreviation DIA. The ASME Y14.5M-1994 standard for dimensioning and tolerancing recommends placing the symbols for diameter (Ø) and radius (R) before the value given for the specific diameter or radius: Ø.500 or R.500. However, on drawings currently used in industry, you will find these symbols (Ø and R) placed before or after the values given. This depends upon the preference of the individual who made the drawing.

When more than one hole of the same size is specified, common practice uses only one leader and includes the quantity in the local note.

Note that the 3.62 dimension that appears in the gasket drawing is used for locating the holes and the radii that surround the holes. Round holes will always be located by their centers, not by their sides.

Shapes such as the one illustrated in drawing 11A001 do not ordinarily include overall dimensions, but you can calculate them by adding the radii to their location. Material that remains around a hole can be determined by either of the concentric calculation methods illustrated at the right.

INSTRUCTIONS: Study the title block and dimensions in drawing 11A001 before answering the following questions.

1. What is the part number?
2. What is the name of the part?
3. What is the drawing size?
4. What scale is the drawing?
5. Use words to explain the answer to question 4.
6. How thick is the part?
7. Is the part symmetrical?
8. Which system of dimensioning was used? (Refer to page 21.)
9. What is the fractional equivalent of the center hole size? (Refer to the equivalency chart, page 25.)
10. What is the fractional equivalent of the mounting hole spacing? (Refer to the equivalency chart, page 25.)
11. Calculate the longest overall dimension of the part.
12. Calculate the other overall dimension of the part (height).
13. Calculate the material remaining between the large hole and the nearest outside edge.
14. Calculate the material remaining between the small hole and the nearest outside edge.
15. Calculate the material remaining between the edge of the large hole and the edge of the small hole.

1. 11A001
2. THERMOSTAT GASKET
3. NOT GIVEN
4. 1:1
5. ACTUAL SIZE
6. .06
7. YES
8. DECIMAL
9. 2 3/16
10. 3 7/8
11. 4.24
12. 2.88
13. .345
14. .155
15. .56
BREAK LINES

One purpose for using break lines is to permit the removal of a portion of the view, thereby allowing the paper size to be smaller or the drawing scale to be larger. The portion removed, however, must be uniform in shape. Drawing 11A002 uses long break lines, allowing it to be drawn to full scale without requiring B-size vellum.

TYPICAL DIMENSIONS

Drawing 11A002 also uses the abbreviation TYP after one of the radial dimensions. This means that all other undimensioned radii appearing on that drawing are the same size as the one marked TYP. It eliminates repetition of dimensions and saves drawing space. Another practice used to reduce dimensions on drawings is to indicate symmetry either by note, or with the view’s center line carrying the abbreviation C. Dimension A on drawing 11A002 was eliminated by this practice.

INSTRUCTIONS: Refer to drawing 11A002. Enter the dimensions for the following letters.

A 1.50  G .19  
B 3.60  H .57  
C .30  I .86  
D 1.47  J .68  
E 6.10  K .10  
F 2.00  L .46  

INSTRUCTIONS: Answer the following questions.

1. What type of line was drawn to indicate symmetry?
2. What word is abbreviated TYP?
3. What is the thickness of the plate?
4. How many round holes does the plate contain?
5. What is the fractional equivalent of the small hole diameter? (Refer to page 25.)
6. How much material remains between the Ø.62 hole and the nearest outside edge?
7. How much material remains between a Ø.28 hole and the nearest outside edge?
8. Calculate the longest overall dimension of the plate.

1. CENTERLINE
2. TYPICAL
3. .25
4. 10
5. 9/32
6. .25
7. .16
8. 6.76
TOLERANCES

Detail drawings will have a tolerance assigned to every dimension that appears on the drawing. Recognizing the fact that perfect sizes cannot be obtained consistently in production manufacturing, engineers and designers assign the maximum acceptable deviation from the desired dimension. This allowable variation is the tolerance. It may be shown individually beside a dimension, or it may be shown in the title block as a general tolerance. Dimensions appearing without individual tolerances are automatically covered by general tolerances in the title block.

A tolerance is the specified amount that a dimension is permitted to vary from the stated size. It may be stated as equal bilateral such as ±.005, unequal bilateral such as +.008/-.002, or unilateral such as +.010/-.000 or +.000/-.010. Total tolerance, on the other hand, is the total amount of variation permitted from a specified size. The total tolerance for the previous examples is the same, namely .010. If, however, the dimension is given in limit form such as .500/+.510, then the tolerance is .010 and the total tolerance is also .010.

This is a somewhat different interpretation than the one stated in the ASME Y14.5M, 1994 Standard, but it is one that is easier to understand by people entering the field of blueprint reading.

A common method used to assign general tolerances to dimensionally dimensioned drawings is the decimal-place method. Whereas a decimal dimension and its tolerance always have the same number of decimal places, it is easy for you to determine which tolerance applies. (The dimension .50 will carry a two-decimal-place tolerance, while the dimension .500 will carry a three-decimal-place tolerance.) Most general tolerances are expressed bilaterally, although not always equal in both directions. Such is the case with the drilled hole tolerance in Example A on the right. General tolerance values apply only to the drawing on which they appear, and often vary from one drawing to another.

Tolerance Quiz

INSTRUCTIONS: Answer the following questions pertaining to the examples above.

1. What is the two-place decimal inch tolerance in Example A?
   - \( \pm .03 \)

2. What is the tolerance for drilled holes in Example A?
   - \( \pm .010 \)

3. What is the three-place decimal tolerance in Example B?
   - \( \pm .004 \)

4. What is the fractional tolerance in Example C?
   - \( \pm \frac{1}{64} \)

5. What is the angular tolerance in Example C?
   - \( \pm 0^\circ 30' \)

6. What is the total tolerance for the two-place decimal inch in Example A?
   - \( .06 \)

7. What is the total tolerance for the three-place decimal inch in Example B?
   - \( .008 \)

8. What is the total tolerance for drilled holes in Example A?
   - \( .012 \)