

AQS110 – Introduction to Metrology  
LABORATORY EXERCISE #3**PRINT READING AND EVALUATING A COMPONENT****Purpose**

The purpose of this laboratory exercise is two-fold:

- First, reviewing selected drawings from "Print Reading for Industry, by Brown & Brown" for specific features.
- Second, creating a rough drawing of a component used in the product evaluated in previous Exercise #2 creating a purchase specification.

**Background**

When designing and manufacturing products, both consistency and repeatability need to be considered.

- Consistency of the components used to assemble/create the finished good.
- Repeatability of the process used to produce the unit.

A manufacturer will typically assemble their finished good from materials purchased and/or produced on-site. The cycle will continue until the product reaches the end-user.

Purchase specifications are documents provided to the Vendor by the manufacturer to ensure consistency in the materials to be received. Often, a pictorial representation of the component(s) are necessary for the Vendor to ensure the product they sell meet requirements.

This exercise will explore evaluating a component for the various features and characteristics present on a component and initially translating these into a pictorial representation.

In industry this would currently be accomplished using 2-D (or 3-D) CAD (computer aided design) software, to the accuracy level required.

**Due Date** Beginning of class October 5, 2016

**Laboratory Exercise:**

The lab will be conducted in teams of 3-4 students.

- Each team will be given the same drawings from "Print Ready for Industry".
- Using the product assigned to the team for Exercise #2, individual team members shall create a rough drawing of component contained in the final product.

**Procedure**

Part 1 – drawing review

- A. Print exercises 3-1 and 3-2 are reviewing the fundamental sections of a drawing: title block and parts list.
- B. Print exercises 4-1 and 4-2 are reviewing basic geometric shapes and relationships between lines on a drawing. For the purposes of this exercise, there are four possible relationships
  - a. Parallel: elements never intersect, even if extended
  - b. Perpendicular: two elements form a 90° angle with each other
  - c. Concentric: two circles (or arcs) that share common center point
  - d. Tangent: two features share one point (i.e. line touches circle once and doesn't intersect again)
- C. Print exercise 9-2 reviews dimensioning.

## Part 2 – rough drawing of product component

1. Each team member will select a component from the team's product.
2. Evaluate the component regarding various aspects of the dimensioning; refer to the GD&T symbol table below.
3. Create a rough drawing of the component, identifying key dimensions, including any symbols for form, orientation or location. A ruler and protractor are provided for estimated dimensions.
  - a. Note: the following symbol is used for dimensioning a diameter  $\phi$

*Carefully examine the component you're depicting for rounded corners, extended edges, etc. Typically features will have a functional element along with dimension. Evaluate the component both from a manufacturer's and customer's point of view.*

Table 1 Geometric Dimensioning &amp; Tolerancing Symbols

GD & T Symbol	Control Type	Name
	Form	Straightness
	Form	Flatness
	Form	Circularity
	Form	Cylindricity
	Profile	Profile of Surface
	Profile	Profile of Line
	Orientation	Perpendicularity
	Orientation	Angularity
	Orientation	Parallelism
	Location	Position
	Location	Concentricity
	Location	Symmetry

Name \_\_\_\_\_

**Debrief**

Finished Good: \_\_\_\_\_

Component: \_\_\_\_\_

What unique features/characteristics of the component became evident during the evaluation?

Describe any assumptions about the fit/form/function of the component in relation to the finished good that were made during the examination and subsequent drawing process?

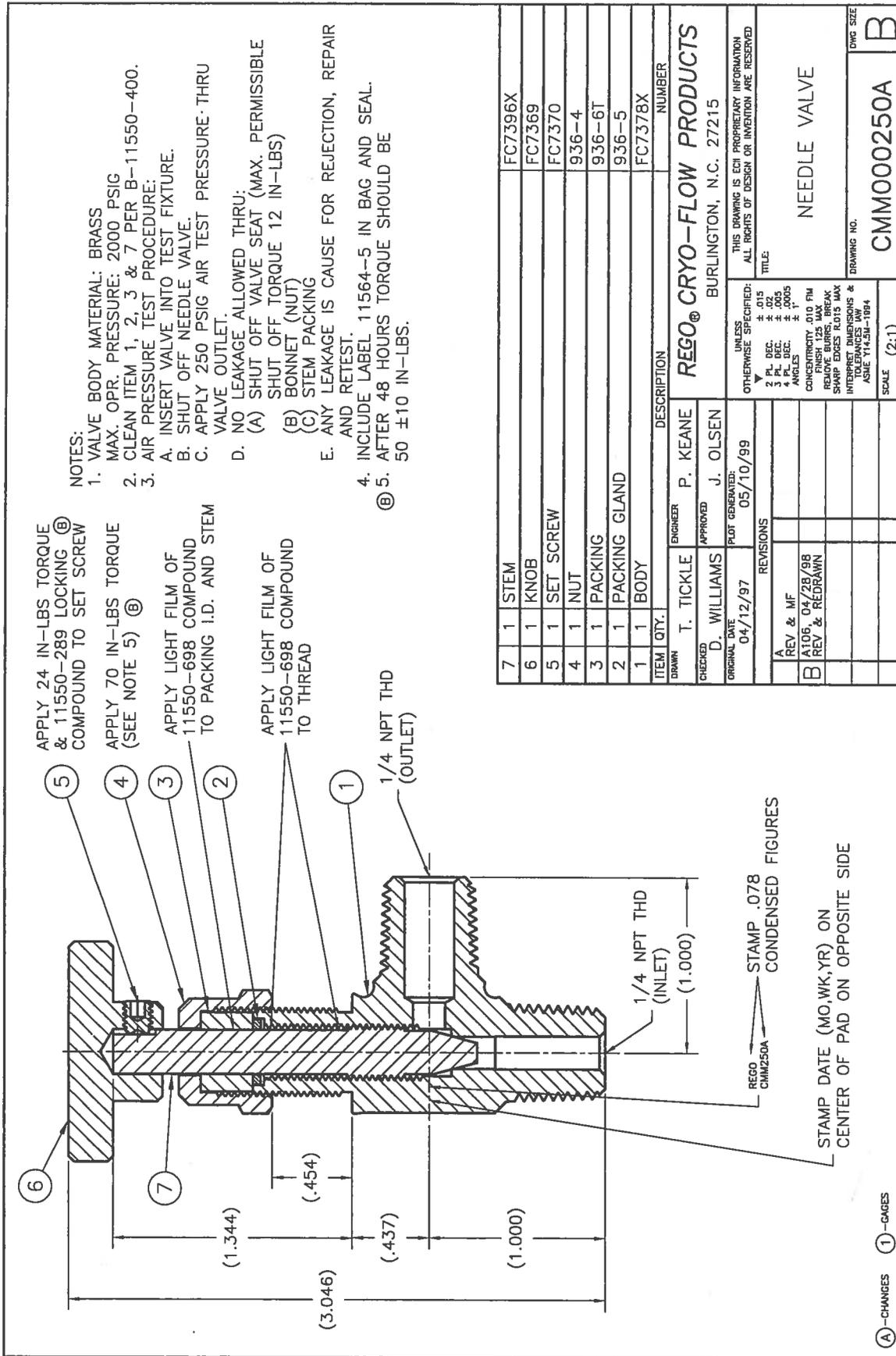
Is an understanding of the manufacturing process for the component needed? Why? How would it help?

Is an understanding of the manufacturing process for the finished good needed? Why? How would it help?

## Industry Print Exercise 3-1

Refer to the print in PR 3-1 and answer the questions below.

1. What is the name of this drawing? \_\_\_\_\_  
\_\_\_\_\_
2. What is the drawing number? \_\_\_\_\_  
\_\_\_\_\_
3. How many parts have a quantity of two or more? \_\_\_\_\_  
\_\_\_\_\_
4. What is the part number of the NUT? \_\_\_\_\_  
\_\_\_\_\_
5. What is the part number of the KNOB? \_\_\_\_\_  
\_\_\_\_\_
6. At what scale is this drawing created? \_\_\_\_\_  
\_\_\_\_\_
7. For what size sheet is this drawing intended? \_\_\_\_\_  
\_\_\_\_\_
8. In what state is this company located? \_\_\_\_\_  
\_\_\_\_\_
9. How many balloons are used to locate parts for the parts list? \_\_\_\_\_  
\_\_\_\_\_
10. What is the last name of the person who checked this drawing? \_\_\_\_\_  
\_\_\_\_\_



- NOTES:
1. VALVE BODY MATERIAL: BRASS
  2. CLEAN ITEM 1, 2, 3 & 7 PER B-11550-400.
  3. AIR PRESSURE TEST PROCEDURE:
  - A. INSERT VALVE INTO TEST FIXTURE.
  - B. SHUT OFF NEEDLE VALVE.
  - C. APPLY 250 PSIG AIR TEST PRESSURE THRU VALVE OUTLET.
  - D. NO LEAKAGE ALLOWED THRU:
    - (A) SHUT OFF VALVE SEAT (MAX. PERMISSIBLE SHUT OFF TORQUE 12 IN-LBS)
    - (B) BONNET (NUT)
    - (C) STEM PACKING
  - E. ANY LEAKAGE IS CAUSE FOR REJECTION, REPAIR AND RETEST.
  4. INCLUDE LABEL 11564-5 IN BAG AND SEAL.
  5. AFTER 48 HOURS TORQUE SHOULD BE 50 ±10 IN-LBS.

ITEM	QTY.	DESCRIPTION	NUMBER
7	1	STEM	FC7396X
6	1	KNOB	FC7369
5	1	SET SCREW	FC7370
4	1	NUT	936-4
3	1	PACKING	936-6T
2	1	PACKING GLAND	936-5
1	1	BODY	FC7378X

ENGINEER	P. KEANE
APPROVED	J. OLSEN
ORIGINAL DATE	04/12/97
PLOT GENERATED	05/10/99
REVISIONS	
A	REV & MF
B	A106, 04/28/98 REV & REDRAWN

UNLESS OTHERWISE SPECIFIED:	THIS DRAWING IS ECH PROPRIETARY INFORMATION ALL RIGHTS OF DESIGN OR INVENTION ARE RESERVED
7 PL. DEC. ± .015	TITLE:
5 PL. DEC. ± .005	NEEDLE VALVE
4 PL. DEC. ± .0005	DRAWING NO.
ANGLES ± 1'	CMM000250A
CONFORM TO PM	DWG SIZE
FINISH 125 U.A.	B
REMOVE BURRS, BREAK SHARP EDGES R.015 MAX	
INTERPRET DIMENSIONS & TOLERANCES TO ASME Y14.3M-1994	
SCALE (2:1)	

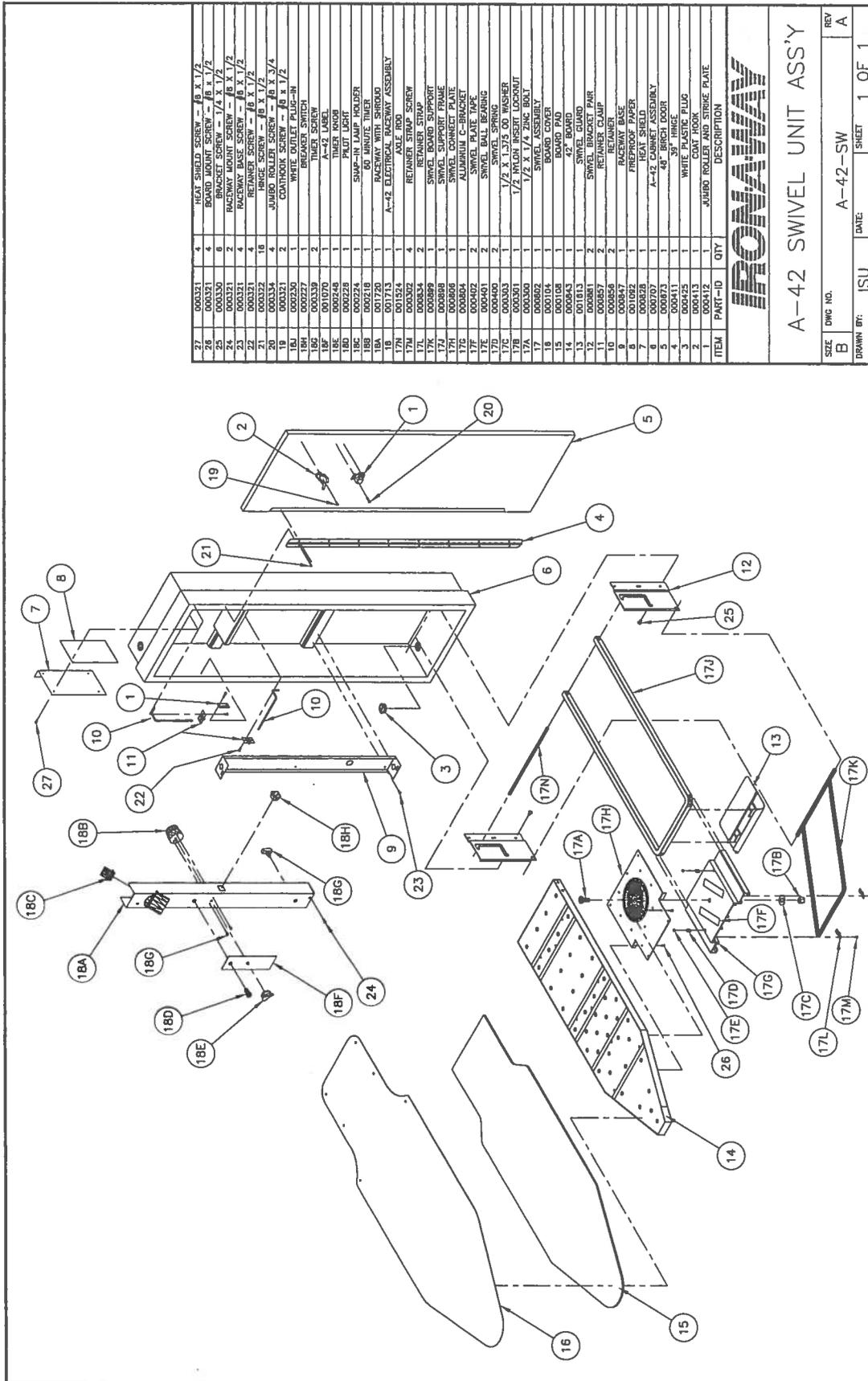
PR 3-1.  
Print supplied by RegO Cryo-Flow Products.

(A) CHANGES (1) PAGES

## Industry Print Exercise 3-2

Refer to the print PR 3-2 and answer the questions below.

1. What is the name of the assembly? \_\_\_\_\_  
\_\_\_\_\_
2. How many rows are there for parts in the parts list? \_\_\_\_\_  
\_\_\_\_\_
3. What is the name of the part with the greatest quantity needed? \_\_\_\_\_  
\_\_\_\_\_
4. What is the name of item #14? \_\_\_\_\_  
\_\_\_\_\_
5. What are the initials of the person who drew the drawing? \_\_\_\_\_  
\_\_\_\_\_
6. What is the name of the company? \_\_\_\_\_  
\_\_\_\_\_
7. For what size sheet is this drawing intended? \_\_\_\_\_  
\_\_\_\_\_
8. Is this drawing part of a multi-sheet set? \_\_\_\_\_  
\_\_\_\_\_
9. What is the name of part number 000412? \_\_\_\_\_  
\_\_\_\_\_
10. What is the individual part number of the WHITE PLASTIC PLUG? \_\_\_\_\_  
\_\_\_\_\_



ITEM	PART-ID	QTY	DESCRIPTION
27	000321	4	HEAT SHIELD SCREW - #8 X 1/2
26	000321	4	BOARD MOUNT SCREW - #8 X 1/2
25	000330	6	BRACKET SCREW - 1/4 X 1/2
24	000321	2	HEAT SHIELD SCREW - #8 X 1/2
23	000321	2	RACEWAY BRACKET - #8 X 1/2
22	000321	4	RETAINER SCREW - #8 X 1/2
21	000322	16	WEDGE SCREW - #8 X 1/2
20	000334	4	JUMBO ROLLER SCREW - #8 X 3/4
19	000321	2	COATHOOK SCREW - #8 X 1/2
18J	000323	1	WHEEL PLATE PIN
18I	000323	1	WHEEL SCREW
18G	000319	2	TIMER SCREW
18F	001070	1	A-42 LABEL
18E	000248	1	TIMER ROBOG
18D	000238	1	SWIVEL PLATE LIGHT
18C	000218	1	SWIVEL PLATE LIGHT
18B	000218	1	60 MINUTE TIMER
18A	001720	1	RACEWAY WITH SHROUD
17H	001713	1	A-42 ELECTRICAL RACEWAY ASSEMBLY
17G	001524	1	AXLE ROD
17F	000302	4	RETAINER STRIP SCREW
17E	000302	4	RETAINER STRIP
17D	000889	1	SWIVEL BOARD SUPPORT
17C	000889	1	SWIVEL SUPPORT FRAME
17B	000889	1	SWIVEL CONNECT PLATE
17A	000884	2	ALUMINUM C-BRACKET
17	000302	2	SWIVEL PLATE TIME
16	000400	2	SWIVEL SPRING
15	000303	1	1/2 X 1.375 OD WASHER
14	000301	1	SWIVEL ASSEMBLY
13	000301	1	SWIVEL ASSEMBLY
12	000301	1	SWIVEL ASSEMBLY
11	000301	1	SWIVEL ASSEMBLY
10	000301	1	SWIVEL ASSEMBLY
9	000301	1	SWIVEL ASSEMBLY
8	000301	1	SWIVEL ASSEMBLY
7	000828	1	FIREPROOF PAPER
6	000707	1	HEAT SHIELD
5	000411	1	A-42 CABINET ASSEMBLY
4	000411	1	48" HINGE
3	000425	1	WHITE PLASTIC PLUG
2	000413	1	CONT. HOOK
1	000412	1	JUMBO ROLLER AND STRIKE PLATE



A-42 SWIVEL UNIT ASS'Y

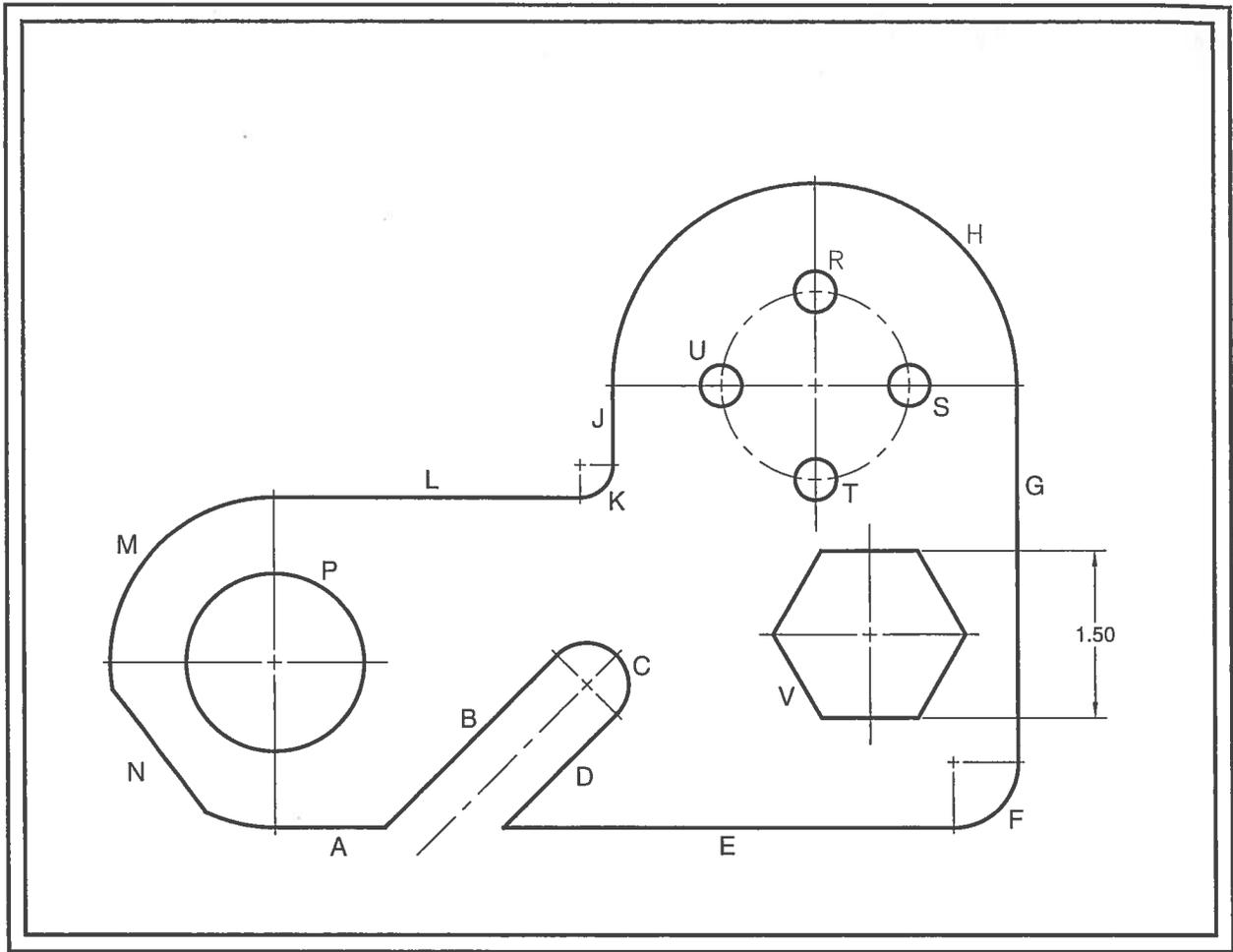
SIZE	DWG. NO.	DATE	SHEET	REV
B	A-42-SW		1 OF 1	A
DRAWN BY:	ISU			

PR 3-2.  
Print supplied by Iron-A-Way.

## Review Activity 4-1

Study the drawing on the following page and answer the questions.

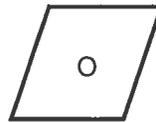
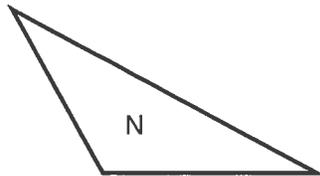
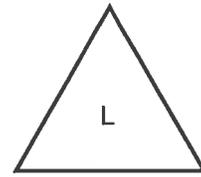
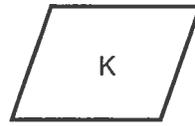
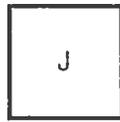
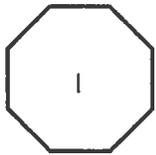
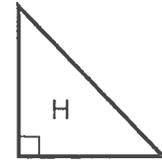
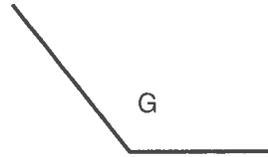
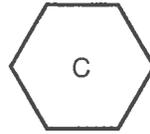
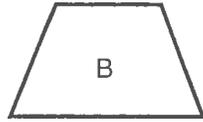
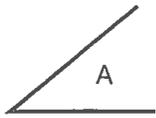
1. Considering four possibilities: parallel, perpendicular, concentric, and tangent, what relationship exists between:
  - A. Line A & Line L \_\_\_\_\_
  - B. Line E & Line G \_\_\_\_\_
  - C. Line J & Arc K \_\_\_\_\_
  - D. Line B & Line D \_\_\_\_\_
  - E. Line L and Arc M \_\_\_\_\_
  - F. Circle P & Arc M \_\_\_\_\_
  - G. Line G & Line J \_\_\_\_\_
  
2. Fill in the blank with the geometric name (arc, chord, etc.) for each of these letters:
  - A. F \_\_\_\_\_
  - B. P \_\_\_\_\_
  - C. N (as related to M) \_\_\_\_\_
  - D. U \_\_\_\_\_
  - E. H \_\_\_\_\_
  - F. V \_\_\_\_\_
  
3. If Item V is circumscribed around a circle, what is the radius of the circle? \_\_\_\_\_
  
4. How many degrees, measured clockwise along the center line circle, is it from center point to center point?
  - A. Center point R to center point S \_\_\_\_\_
  - B. Center point S to center point U \_\_\_\_\_
  - C. Center point U to center point T \_\_\_\_\_
  
5. What type of angle is formed between D and E? \_\_\_\_\_
  
6. What type of angle is formed between B and A? \_\_\_\_\_
  
7. How many degrees are in arc C? \_\_\_\_\_
  
8. How many degrees are in arc K? \_\_\_\_\_
  
9. How many degrees are in arc F? \_\_\_\_\_
  
10. How many degrees are in arc H? \_\_\_\_\_



**Review Activity 4-2**

*Match the letter of each illustrated shape with the correct name. Items are matched only once.*

- \_\_\_\_\_ 1. Pentagon
- \_\_\_\_\_ 2. Scalene triangle
- \_\_\_\_\_ 3. Equilateral triangle
- \_\_\_\_\_ 4. Acute angle
- \_\_\_\_\_ 5. Trapezoid
- \_\_\_\_\_ 6. Isosceles triangle
- \_\_\_\_\_ 7. Octagon
- \_\_\_\_\_ 8. Square
- \_\_\_\_\_ 9. Right triangle
- \_\_\_\_\_ 10. Hexagon
- \_\_\_\_\_ 11. Rhombus
- \_\_\_\_\_ 12. Rectangle
- \_\_\_\_\_ 13. Obtuse angle
- \_\_\_\_\_ 14. Heptagon
- \_\_\_\_\_ 15. Rhomboid



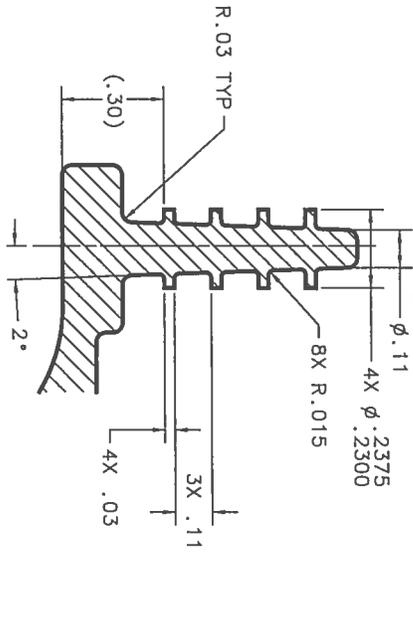
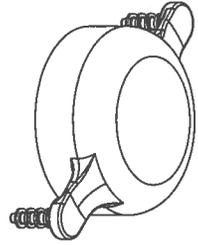
## Industry Print Exercise 9-2

Refer to the print PR 9-2 and answer the questions below.

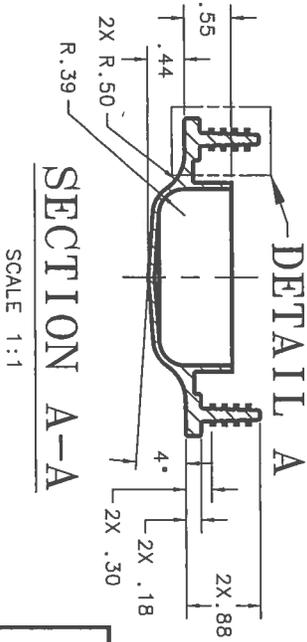
1. According to the front view, what is the center-to-center width between the two "posts" of this object? \_\_\_\_\_
2. On the enlarged Detail A, two dimensional values begin with 4X. What does that mean?  
\_\_\_\_\_
3. On the enlarged Detail A, what dimensional value is repeated as a reference measurement?
4. Of all of the diameters specified on this print, which is the largest? \_\_\_\_\_
5. Of all of the arcs that are specified by radius, which is the smallest? \_\_\_\_\_
6. The main stem of each post is tapered with a smaller diameter at the tip. What is the angle of the taper? \_\_\_\_\_

Review questions based on previous units:

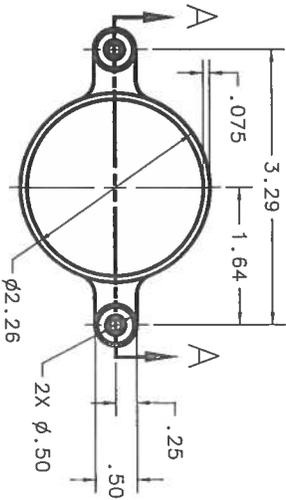
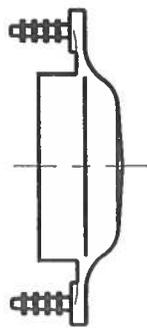
7. Are there any section lines shown on this drawing? \_\_\_\_\_
8. What is the name of this part? \_\_\_\_\_
9. What is the number of this part? \_\_\_\_\_
10. What geometric 3D shape is created due to the 4° dimension shown in Section A-A? \_\_\_\_\_
11. Does this object have any features that could be described as cylindrical? \_\_\_\_\_
12. If the view that contains the cutting-plane line is the front view and the view above it the top view, what view direction is removed Section A-A? \_\_\_\_\_
13. What scale is used for Detail A? \_\_\_\_\_
14. Does this drawing feature any auxiliary views? \_\_\_\_\_
15. Does this part feature any threads? \_\_\_\_\_



2X  
SCALE 4:1  
DETAIL A

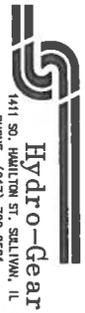


SCALE 1:1  
SECTION A-A



**NOTES:**

1. THIS DRAWING IS IN ADDITION TO THE HYDRO-GEAR I-DEAS 3D SOLID MODEL. THAT MODEL IS TO BE USED FOR DIMENSIONAL AND FORM CONTROL PURPOSES. THIS DRAWING PROVIDES ADDITIONAL PART SPECIFICATION, SUCH AS TOLERANCES, CRITICAL FEATURES AND NOTES.
2. THIS DOCUMENT REFLECTS CRITICAL DIMENSIONS ONLY. ALL FEATURES IN THE SOLID MODEL TO BE .032.



1411 SO. HAMILTON ST. SHELBYVILLE, IL 61951  
PHONE (217) 728-2891

MATERIAL: NYLON W/O GLASS

REGRIND PERMISSIBLE COLOR: BLACK

FINISH:



SIZE SCALE  
C FULL

NAME CAP, BRAKE

APPR.

CHECKED

DRAWN

DATE

NAME

PER ASME Y14.5M-1994

DRAWING INTERPRETATION

UNLESS SPECIFIED

TOLERANCES

±.020

±.010

±.005

±.0005

±.1°

ANGLE

DRAWN IN INCHES

PROJECT REFERENCE: IZT

FORMER PART NO.

SHEET 1 OF 1

PART NO. 51774

CHANGES