

AQS110 – Introduction to Metrology – Fall 2016
LABORATORY EXERCISE #4

MEASUREMENT ANALYSIS

Purpose

The purpose of this laboratory exercise is to demonstrate how to use various tools for dimensional measurements of objects.

The lab will be conducted in one day; however the data collected and observations regarding the gages may be used for a variety of future exercises

Format

There are three stations set-up with different product parts, a drawing (if needed) and the necessary dimensioning tools. We will be working with a combination of the following gages:

Caliper – digital or manual read out
Micrometer – digital or manual read out
Scales (rulers)
Pin Gages

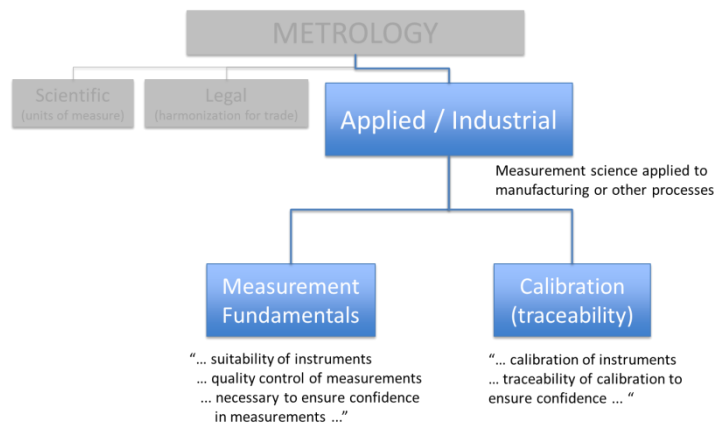
The gages used in this exercise are precision tools and must be handled with care so as not to damage them or compromise their accuracy. Proper handling and use of the gages will be provided before the exercise starts.

Each station will also have the data collection sheets needed for recording the measurement results for the individual parts. (The data sheets are also included on page(s) 5-7 of this document.)

Background

Measurement is a method for evaluating a property or characteristic of an object and describing it with a numerical or nominal value.

Metrology is the science of measurement



Applied/Industrial metrology applies measurement science to manufacturing and other processes. This is often used by the company to determine whether or not to ship the product. Applied metrology is twofold: a) it ensures the suitability of the measurement instruments, their calibration and the quality control of the measurements and b) maintains traceability of the calibration for the instruments to ensure confidence in the results.

An industrial metrology program typically has two aspects: measurement fundamentals and calibration. We will be exploring measurement fundamentals in this exercise.

Due Date: October 12, 2016 for measurement data collection, populated spreadsheet and post-lab question responses.

Laboratory Exercise:

- Three measurement stations have been set-up, to complete the lab each student shall collect data at all three stations.
 - The individual stations present different measurement challenges using similar tools.
- Each station will measure a different product (component) and compare the use of gages. The data sheets on pages 5-7 shall be used for recording data.
 - Additional data sheets will be available at each station, if needed.
 - Data is required in the white spaces only, gray spaces indicate no data is required and do not have to contain "n/a" or initial and dated.
- Four specific measurement tools will be used in this exercise.
 - All measurements will be made in inches.
 - Please be aware that when first evaluating a drawing the units of measure (metric or English) need to be identified.

The video links below will be viewed in class prior to starting the exercise.

https://www.youtube.com/watch?v=Hgd5Rr_aoLA pin gage flexible tube

<https://www.youtube.com/watch?v=VcOMLpjDa9c> dial Vernier caliper

<https://www.youtube.com/watch?v=FgNAIKTTNtE> micrometer

Pictures of how to use the calipers, micrometers and pin gages are contained on page 8.

Procedure:

1. Select a station to begin the exercise. Locate the print and familiarize yourself with the tools
2. Five individual measurements of the part shall be taken. Complete one set of measurements before repeating a second, third, etc.
3. Review the print and the data sheet to verify the following:
 - a. Drawing Number and revision on the print match the information contained on the data sheet.
 - b. Dimensions listed on the print match the dimensions on the data sheet.
4. These should be treated as production documents; good documentation practices shall be followed.
5. Variation between students and individual measurements is anticipated. We will use this data later in the class for analysis.
6. When the measurements at one station have been completed, move to an open seat at another station.
7. Key features to be aware of for each print are listed below for each measurement.

NOTE: Force is not required when using these tools.

Use "medium" pressure for the calipers & micrometers

Station #1 – Washer, Machined (page 5)

The inner diameter of the washer has been cut on a 60° angle to achieve a smaller diameter on the bottom.

- When using the calipers, be sure that you are near the edge of the part to get an accurate reading.
- When using the pin gage for the bottom diameter, it can fall through the part
- When using the pin gage for the top diameter, it should sit just inside the part but not fall through.

To measure the outer diameter, be sure the ruler and/or calipers are centered and not off to one side.

When using the micrometer for thickness, measure 4 points around the component to ensure the thickness is even.
(e.g. measure at 12:00, 3:00, 6:00, 9:00)

- If different measurements are obtained record an average and make a note on the back of the data sheet regarding the spread of the individual results.
(e.g. 0.090 0.091 0.093 0.090 , average = 0.091 inch and range = 0.003 inch)

Station #2 – Bracket (page 6)

When measuring the distances from the holes to the edge, be sure you are starting from the center of the hole, estimation will be required.

Station #3 – Material demonstration (page 7)

When measuring the flexible tube, be aware of not stretching or compressing the material.

The purpose of this measurement is to demonstrate how the type of material can affect the measurement and where errors can occur.

Post-Lab Questions

Reflect on the challenges presented at each station, considering the questions below. When evaluating each station, also review the measurement fundamentals covered during lecture and incorporate the concepts in your answers.

Which gage or gages are easier to use on a specific part?

How would (could) the gage differences affect their selection for a specific part?

What affect does the material type and shape have on the use and/or selection of the gage?

What considerations are necessary to determine accuracy/precision?

Measurement fundamentals (refer to lecture slides for details)

Methods

Equipment specifications

Confidence (uncertainty) programs

Environmental Controls

Systems

Capability

Standards Usage

Data

Name _____

POST LAB (cont.)

Station #1 – Machined Washer

Station #2 - Bracket

Station #3 – Materials & Pin Gages

STATION #1

Gray areas do not require data.

WASHER, MACHINED**Drawing Number MW-256, Rev. D**

TRIAL	EQUIPMENT	MEASUREMENT				
		SPECIFICATION	Bottom Inner Diameter (ID)	Top Inner Diameter (ID)	Thickness	Outer Diameter (OD)
		Target Tolerance	0.255 inch + 0.005 / - 0.000 inch	0.330 inches +/- 0.015 inch	0.09 inch +/- 0.02 inch	0.745 inch +0.000 / -0.005 inch
1	Caliper					
	Micrometer					
	Pin Gage					
	Ruler					
2	Caliper					
	Micrometer					
	Pin Gage					
	Ruler					
3	Caliper					
	Micrometer					
	Pin Gage					
	Ruler					
4	Caliper					
	Micrometer					
	Pin Gage					
	Ruler					
5	Caliper					
	Micrometer					
	Pin Gage					
	Ruler					

STATION #2

Gray areas do not require data.

BRACKET, 90° 1" x 1" x 4"**Drawing Number 028078, Rev. D**

TRIAL	EQUIPMENT	MEASUREMENT							
		SPECIFICATION	Overall Length	Thickness	Distance between hole and short edge	Distance between hole and long edge	Hole Diameter (4X)		
		Target Tolerance	4.00 inch +/- 0.02 inch	0.09 inch +/- 0.02 inch	0.875 inch +/- 0.015 inch	0.562 inch +/- 0.015 inch	1/4 inch (0.25) +/- 1/32 inch (0.03)		
1	Caliper								
	Ruler								
	Micrometer								
	Pin Gage								
2	Caliper								
	Ruler								
	Micrometer								
	Pin Gage								
3	Caliper								
	Ruler								
	Micrometer								
	Pin Gage								
4	Caliper								
	Ruler								
	Micrometer								
	Pin Gage								
5	Caliper								
	Ruler								
	Micrometer								
	Pin Gage								

STATION #3

Gray areas do not require data.

MATERIAL DIFFERENCES**no drawing reference**

TRIAL	EQUIPMENT	Steel Tube Inner Diameter (ID)	White Plastic (4X)				Flexible Tubing	
			#1	#2	#3	#4	Inner Diameter (ID)	Outer Diameter (OD)
1	Caliper							
	Pin Gage							
2	Caliper							
	Pin Gage							
3	Caliper							
	Pin Gage							
4	Caliper							
	Pin Gage							
5	Caliper							
	Pin Gage							

Measuring Instruments DIGITAL CALIPERS



Developed as part of NSF ATE Grant #200474

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Measuring Instruments DIGITAL MICROMETER



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Measuring Instruments PRECISION PIN GAGES



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