LABORATORY MANUAL

Precision Measurement Laboratory

(ME 603)

DEPARTMENT OF MECHANICAL ENGINEERING

Jorhat Engineering College

Jorhat – 785007 (Assam)

COLLEGE VISION AND MISSION

Vision:

To develop human resources for sustainable industrial and societal growth through excellence in technical education and research.

Mission:

1. To impart quality technical education at UG, PG and PhD levels through good academic support facilities.

2. To provide an environment conducive to innovation and creativity, group work and entrepreneurial leadership.

3. To develop a system for effective interactions among industries, academia, alumni and other stakeholders.

4. To provide a platform for need-based research with special focus on regional development.

DEPARTMENT VISION AND MISSION

Vision:

To emerge as a centre of excellence in mechanical engineering and maintain it through continuous effective teaching-learning process and need-based research.

Mission:

M1: To adopt effective teaching-learning processes to build students capacity and enhance their skills.

M2: To nurture the students to adapt to the changing needs in academic and industrial aspirations.

M3: To develop professionals to meet industrial and societal challenges.

M4: To motivate students for entrepreneurial ventures for nation-building.

Program Outcomes (POs):

Engineering graduates will be able to:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:**Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:**Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Programme Educational Objectives (PEOs):

The Programme Educational Objectives of Department of Mechanical Engineering are given below:

PEO1: Gain basic domain knowledge, expertise and self-confidence for employment, advanced studies, R&D, entrepreneurial ventures activities, and facing challenges in professional life.

PEO2: Develop, improve and maintain effective domain based systems, tools and techniques that socioeconomically feasible and acceptable and transfer those technologies/developments for improving quality of life.

PEO3: Demonstrate professionalism through effective communication skill, ethical and societal commitment, team spirit, leadership quality and get involved in life-long learning to realize career and organisational goal and participate in nation building.

Program Specific Outcomes (PSOs)

The programme specific outcomes of Department of Mechanical Engineering are given below:

PSO1: Capable to establish a career in Mechanical and interdisciplinary areas with the commitment to the society and the nation.

PSO2: Graduates will be armed with engineering principles, analysing tools and techniques and creative ideas to analyse, interpret and improve mechanical engineering systems.

Course Outcomes (COs)

At the end of the course, the student will be able to:

CO603.1	Make use of tool-makers microscope for precise measurements of geometry of single point cutting tools.
CO603.2	Use Slip Gauges to calibrate Micrometer and Vernier Calliper.
CO603.3	Use the surface roughness tester and measure the surface roughness of a given specimen.

Mapping of COs with POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO603.1	2	1	-	1	-	-	-	1	-	-	-	1	-	1
CO603.2	2	2	-	-	-	-	-	1	-	-	-	1	-	1
CO603.3	2	2	-	-	-	-	-	1	=	-	-	1	-	1
C603	**2**	**1.5**	**-**	**1.00**	**-**	**-**	**-**	**1.00**	**-**	**-**	**-**	**1.00**	**-**	**1.00**

STUDENT PROFILE	
NAME :	
ROLL NUMBER :	
SECTION :	
SEMESTER :	6th Semester
YEAR :	

PERFORMANCE RECORD		
EXP. NO.	**TITLE OF EXPERIMENT**	**REMARKS / GRADE**
1	Measurement of Angles of a single Point Cutting Tool using CZ Tool Maker's Microscope	
2	Study of Slip Gauges.	
3	Calibration of Micrometer using Slip Gauges.	
4	Calibration of Vernier Calliperusing Slip Gauges.	
5	Surface Roughness Measurement.	
6	Screw Thread Profile Measurement using Profile Projector.	

OFFICE USE	
Checked By :	
Overall Grade / Marks :	
Signature of Teacher :	

Experiment No. 1

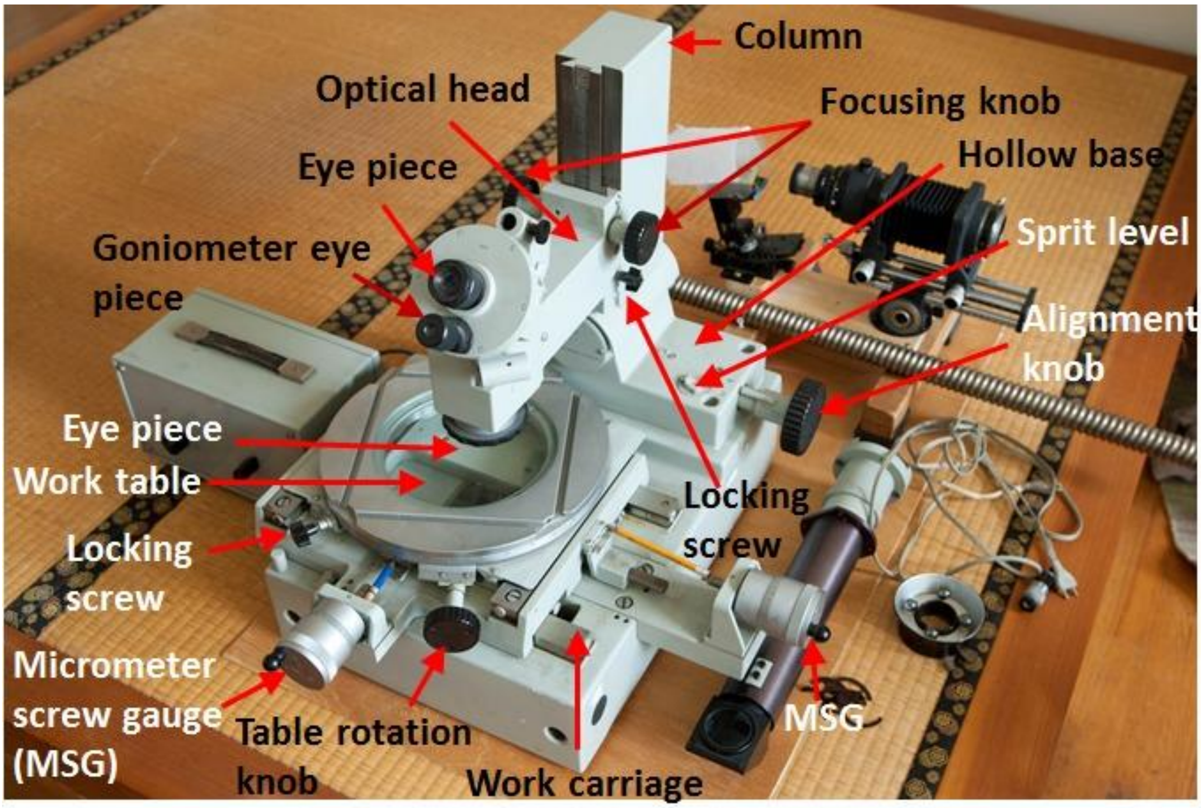
TITLE: Single Point Tool Angles Measurement using CZ Tool Maker's Microscope.

OBJECTIVE:

To Measure the Angles of a Single Point Cutting Tool.

THEORY:

The large tool maker's microscope (TMM) essentially consists of the cast base, the main lighting unit, the upright with carrying arm and the sighting microscope. The rigid cast base is resting on three foots screw by means of which the equipment can be levelled with reference to the build in box level. The base carries the co- ordinate measuring table, consists of two measuring slides; one each for directions X and Y and a rotary circular table provided with the glass plate. The slides are running on precision balls in hardened guide ways warranting reliable travel. Two micrometer screw each of them measuring range of 0 to 25 mm permit the measuring table to be displaced in the directions X and y. the range of movements of the carriage can be widened up to 150 m in the X direction and up to 50 mm in the Y direction with the use of gage blocks.



The rotary table has been provided with 360 degrees graduation and with a three minute vernier. The rotary motion is initiated by activation of knurled knob and locked with star handle screw. Slots in the rotary table serve for fastening different accessories and completing elements.
The sighting microscope has been fastened with a carrier arm to column. The carrier arm can be adjusted in height by means of a rack and locked with star handle screw. Thread measuring according to the shadow image permits the column to be tilted in X direction to either side about an axis on centre plane level. The corresponding swivel can be adjusted with a knurled knob with a graduation cellar. The main lighting unit has been arranged in the rear of the cast base and equipped with projection lamp where rays are directed via station mounted mirror through table glass plate into the sighting microscope.

MEASURING PRINCIPLE:

The work piece to be checked is arranged in the path of the rays of the lighting equipment. it produces a shadow image , which is viewed with the microscope eyepiece having either a suitable mark for aiming at the next points of the objects or in case of often occurring profiles . e.g tool, threads or rounding – standard line pattern for comparison with the shadow image of the text object is projected to a ground glass screen. The text object is shifted or turned on the measuring in addition to the comparison of shapes.

The addition to this method (shadow image method), measuring operations are also possible by use of the axial reaction method, which can be recommended especially for thread measuring. This involves approached measuring knife edges and measurement in axial section of thread according to definition. This method permits higher precision than shadow image method for special measuring operations.

APPLICATIONS:
The large tool maker's microscope is suitable for the following fields of applications;
Length measurement in Cartesian and polar co-ordinates.

Angle measurements i.e., Tool angle, profile major and minor diameters, height of lead, thread angle, profile position with respect to the thread axis and the shape of thread. (Rounding, flattering, straightness of flanks)
Comparison between centres and drawn patterns and drawing of projected profiles

Single point lathe tool angle measurements

The various tool angles as per machine reference system (American system of tool nomenclature-ASA) are as follow;

Back rake angle is the angle between the tool face and the Y axis and is measured In Y – Z plane, side rake angle is the angle between the tool face and the X axis measured in X – Z plane. End relief angle is the angle between the end flank and the side flank of the tool and the angle between the trailing edge of the tool and the X axis and is measured in X – Y plane. Side cutting edge and is measured in the X – Y plane.

Procedure of measurement with TMM

Place the tool bit on the glass stage so as to obtain a clear image on which angular measurements are done. Focus the microscope to get a real image super imposed on the graticule pattern of the eye piece. Tilt the graticule pattern so as to align the shank edge with the reference hair line. Read microscope angle scale. Tilt the angle so as to bring the cutting edge of the tool to align with the reference hairline. If necessary X,Y movements may be made to retain the edge in the field of view. A typical field of vision before and after adjustment

OBSERVATION TABLE:

Sl.no.	Tool Angles	Initial reading		Final reading		Difference	
		Degree	Min	Degree	Min	Degree	Min
1	Back Rack						
2	End Clearance or Relief						
3	Side Cutting Edge						
4	End Cutting Edge						
5	Side Rack						
6	Side Clearance						

Exp. No. 1	Title: Single Point Tool Angles Measurement using CZ Tool Maker’s Microscope. .
Name of Student:	
Roll No.:	
Date of Experiment:	
Date of Submission:	
Signature of Teacher with Date of Check	**SEAL**

Experiment No. 2

TITLE: Study of Slip Gauges.

OBJECTIVE:

Students will be able to know the use and working of slip gauges.

THEORY:

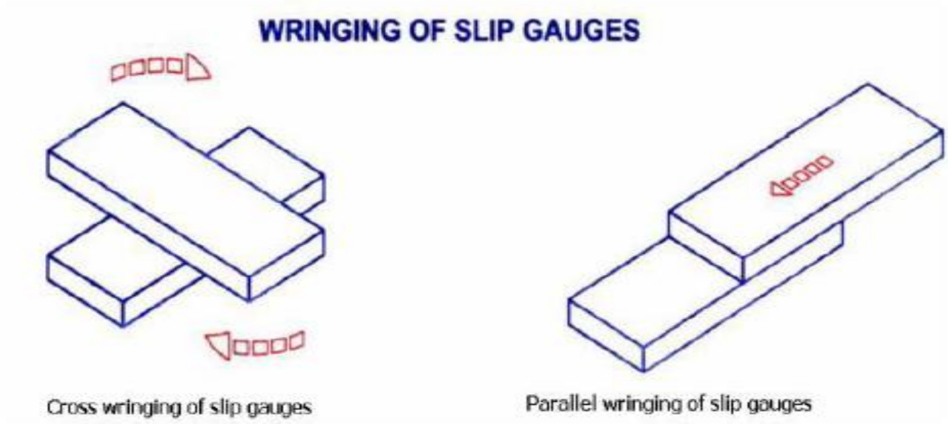
Slip gauges are end standards used in linear measurements. They are used in workshop for work where a tolerance as low as 0.001mm is needed. Slip gauges were invented by Swedish engineer, C.E. Johnson, so they are also called Johnson gauges. Slip gauges are rectangular blocks, made of high grade steel, having cross section about 30 mm x 10mm. These blocks are made into required sizes and hardened to resist wear and allowed to stabilize so as to relieve internal stresses. This prevents occurrence of size and shape variations. After hardening the blocks, measuring faces are carefully finished to fine degree of surface finish, flatness and accuracy. This high grade surface finish is obtained by super finishing process known as lapping.

Wringing of Slip Gauge:

The measuring face of the gauges is flat and it possesses high surface finish. If two slip gauges are forced against each other on measuring faces, because of contact pressure, gauges stick together and considerable force is required to separate these blocks. This is known as wringing of slip gauges. Thus, wringing refers to condition of intimate and complete contact and of permanent adhesion between measuring faces. Slip gauges are wrung to build desired dimension. Slip gauges are wrung together by hand and no other external means.

- Fig. 1.1 (a) shows **Parallel wringing of slip gauges**,and
- Fig. 1.1 (b) shows **Cross wringing of slip gauges**.

In **cross wringing**, the two slip gauges are first cleaned to remove dirt and then they are placed together at right angles in the form of cross and then rotated through 90°, while being pressed together. This method causes less rubbing of surfaces. Almost any dimension may be built by suitable combination of gauges. Wringing phenomenon is purely due to surface contact and molecular adhesion of metal of blocks. Hence, **wringing** is definedas the property of measuring faces of gauge blocks of adhering, by sliding or pressing the gauge against measuring faces of other gauge blocks or reference faces or datum surfaces without the use of external means.



(a) **(b)**

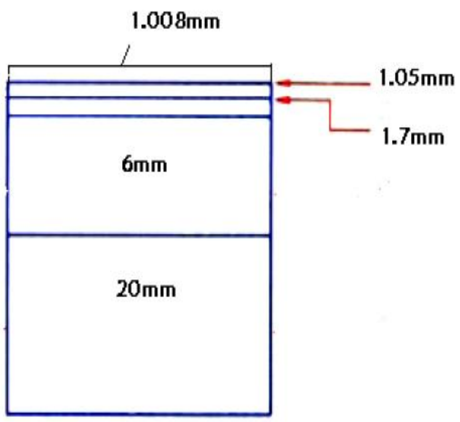
Figure 1.1: Wringing of Slip Gauges

USES/APPLICATIONS OF SLIP GAUGES:

1. As a reference standard.
2. For verification and calibration of measuring apparatus.
3. For adjustment of indicating devices.
4. For direct measurement.
5. For setting of various types of comparators.
6. Micrometers are used to measure the small or fine measurements of length, width, thickness and diameter of the job.

DESCRIPTION OF THE APPAPATUS:

(1) Slip gauge:



PROCEDURE:

Example: Determine the dimension 18.356 by using slip gauge set:

Rule 1: Minimum number of slip gauges should be used to build dimension.

Rule 2: Always start with the last decimal place**.**

Procedure	Least decimal	Calculation
1) Write the required dimension		18.356
2) Starting with least decimal place i.e. 0.006. But we can use 1.006 as to follow rule 1.	0.006	$18.356-1.006=17.35$
3) After subtraction the value remaining is 18.35. Here the least decimal is 0.05. But we can use 1.05 as to follow rule 1.	0.05	$17.35-1.05=16.3$
4) Now value remaining is 18.3. Here the least decimal is 0.3. But we can use 1.3 as to follow rule 1.	0.3	$15.3-1.3=14$
5) Now value remaining is 17. But we have 4 mm gauge block.	4.0	$14-4=10$
6) Final value is 10 mm and this gauge is available. Reminder should always be zero.		$10-10=0$
7) Revised the above procedure for three different dimensions.		
8) After cleaning place the gauge blocks should be placed in their respective places.		

OBSERVATION TABLE:

Sl. No.	Dimensions	Least decimal	Calculation
1			
2			
3			

Exp. No. 2	**Title:** Study of Slip Gauges.
Name of Student:	
Roll No.:	
Date of Experiment:	
Date of Submission:	

Signature of Lab In-charge with Date of Check **SEAL**

Experiment No. 3

TITLE: Calibration of Micrometer Using Slip Gauges.

OBJECTIVE:

To calibrate the micrometer using slip gauges.

THEORY:

Micrometers are designated according to screw and nut principle where a calibrated screw thread and a circular scale division are used to indicate the principle practical part of main scale divisions.

The semi circular frame caries a fixed anvil at one extremely and cylindrical barrel at the other end. A fine accurately cut screw of uniform pitch is machined on a spindle. The spindle passes through the barrel and its left hand side constitutes the movable anvil. A sleeve fits on the screw and caries on its inner edge a circular scale divided into desired no. of divisions. The spindle with its screw and thimble are in one piece and sleeve forms the nut. The thimble scale serves to measure the friction of its circular rotations. The number of complete rotations is read from main scale, which is graduated in ‘mm’ on nut parallel to axis of screw.

DESCRIPTION OF THE APPAPATUS:

(1) Micrometer, (2) Slip gauges

Figure 2.1

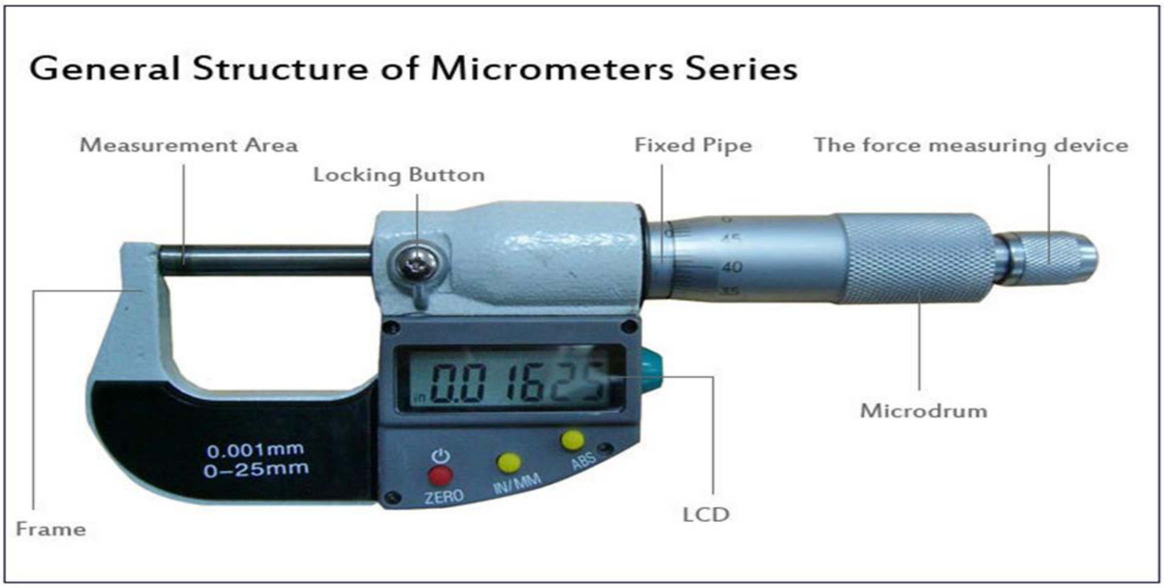


Figure 2.2

PROCEDURE:

1. Clean the fixed vice and micrometer
2. Clamp the micrometer in vice putting cushioning material between micrometer and jaw of vice to protect the micrometer from probable damage due to clamping force.
3. Make pile of gauge blocks and insert between two anvils of the micrometer and take reading.
4. Increase the value of gauge blocks pile and take next few readings.
5. Then decrease the value of gauge blocks pile and take same readings in decreasing order.
6. Tabulate the readings.
7. After cleaning place the gauge blocks should be placed in their respective places.

OBSERVATION TABLE:

Sl. No.	Slip gauge combination	Slip gauge dimensions D_a (mm)	Micrometer Reading D_m (mm)	Correction $(D_a - D_m)$	Error $\lvert D_m - D_a \rvert$	Percentage error $\frac{\lvert D_m - D_a \rvert}{D_m} \times 100$
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						

PLOT THE GRAPHS:

1. Micrometer Readings (D_m) vs. Slip Gauges combination (D_a)
2. Error vs. Micrometer Readings (D_m)

Graph 2.1: Micrometer Readings (D_m) vs. Slip Gauges combination (D_a)

Graph 2.2: Error vs. Micrometer Readings (D_m)

Exp. No. 3	**Title:** Calibration of Micrometer Using Slip Gauges.
Name of Student:	
Roll No.:	
Date of Experiment:	
Date of Submission:	

Signature of Lab In-charge with Date of Check **SEAL**

Experiment No. 4

TITLE: Calibration of Vernier Caliper using Slip Gauges.

OBJECTIVE:

To Calibrate and measure the given component by using Vernier Caliper.

THEORY:

The Vernier Caliper is a precision instrument that can be used to measure internal and external distances extremely accurately. Measurements are interpreted from the LCD digital display by the user. These sensors detect changes in electrical charge that occur when the distance between the jaws changes. Manual Vernier Caliper is more difficult than using a digital vernier. Manually operated vernier calipers can still be bought and remain popular because they are much cheaper than the digital version. Also, the digital version requires a small battery whereas the manual version does not need any power source. The **main use of the vernier caliper** is to measure the internal and the external diameters of an object.

DESCRIPTION OF THE APPAPATUS:

(1) Micrometer, (2) Slip gauges

Figure 3.1

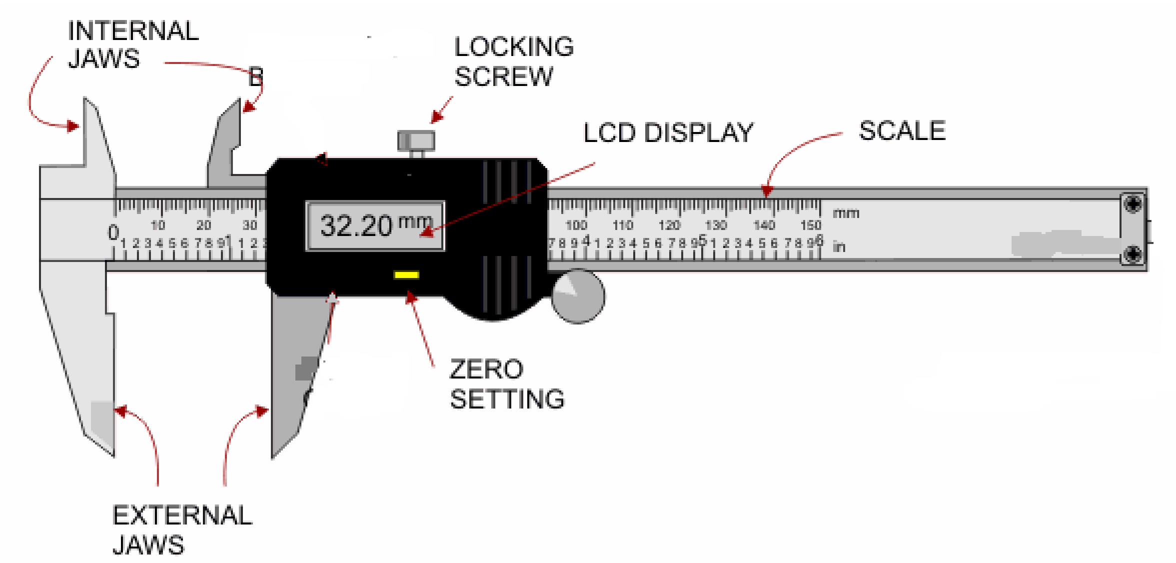


Figure 3.2

PROCEDURE:

1. Clean the Vernier Caliper's measuring surfaces and the work piece/gauge blocks surface to be used.
2. Before using the instrument should be checked by zero error on LCD display.
3. Place the gauge block/work piece appropriately.
4. After closing the jaws on the work surface, take the readings from LCD display.
5. Revised the above procedure for different gauge blocks/work pieces.
6. Tabulate the readings.
7. After cleaning the place the gauge blocks should be placed in their respective places.

OBSERVATION TABLE:

Sl. No.	Slip gauge combination	Slip gauge dimensions D_a (mm)	Vernier Reading T_y (mm)	Correction $(D_a - T_y)$	Error $\lvert T_y - D_a \rvert$	Percentage error $\frac{\lvert T_y - D_a \rvert}{T_y} \times 100$
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						

PLOT THE GRAPHS:

1. Vernier Readings (T_y) vs. Slip Gauges combination (D_a)

2. Error vs. Vernier Readings (T_y)

Graph 3.1: Vernier Readings (T_y) vs. Slip Gauges combination (D_a)

Graph 3.2: Error vs. Vernier Readings (T_y)

Exp. No. 4	**Title:** Calibration of Vernier Caliper using Slip Gauges.
Name of Student:	
Roll No.:	
Date of Experiment:	
Date of Submission:	
Signature of Lab In-charge with Date of Check	**SEAL**

Experiment No. 5

Title: Surface Roughness Measurement.

OBJECTIVE:

To measure the surface roughness of the given specimens using surface roughness tester.

THEORY:

Surface texture is deemed to include all those irregularities which, recurring many times across the surface, tend to form on it a pattern or texture. The irregularities in the surface texture which result from the inherent action of the production process is called roughness or primary texture. That component of surface texture upon which roughness is super imposed is called waviness or secondary texture. This may result from such factors as machine or work deflections, vibrations, chatter, heat treatment or warping strains. The direction of the predominant surface pattern, ordinarily determined by the production method used is called lay. The parameters of the surface are conveniently defined with respect to a straight reference line. The most widely used parameter is the arithmetic average departure of the filtered profile from the mean line. This is known as the CLA (Centre Line Average) or Ra (roughness average).

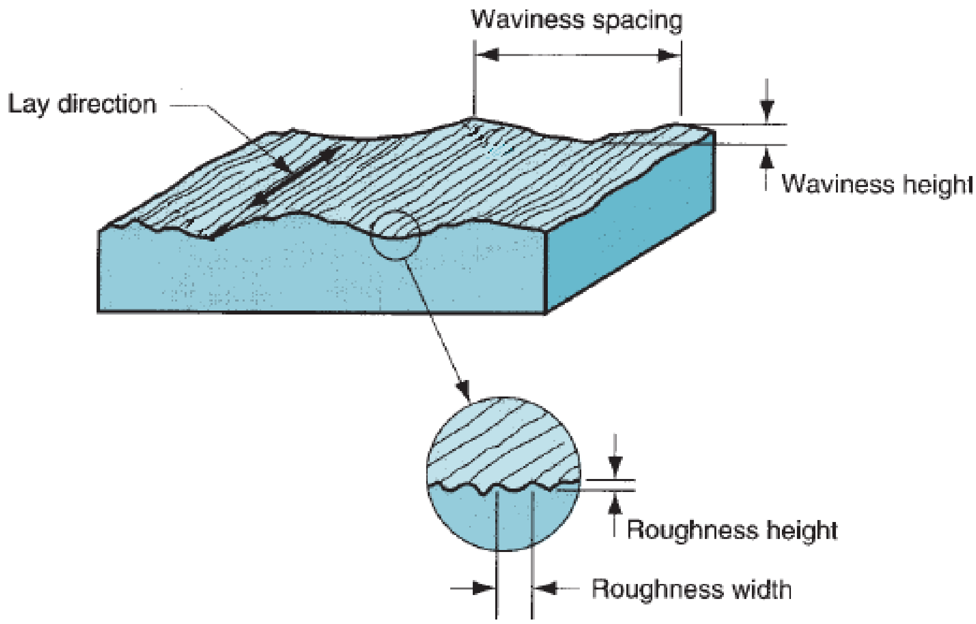


Figure 4.1

Elements of Surface Texture:

- **Actual Surface:** It refers to the surface of apart which is actually obtained after manufacturing process.

- **Nominal surface:** A nominal surface is theoretical, geometrically perfect surface which does not exist in practice, but it is an average of the irregularities that are superimposed on it.

- **Profile**: It defined as contour of any section through a surface.

- **Lay:** It is the direction of predominant surface pattern produced by the tool marks or scratches, generally surface roughness is measured perpendicular to the lay.

- **Sampling Length:** It is the length of the profile necessary for the evaluation of the irregularities to be taken in to account.

- **Roughness Height:** This is rated as the arithmetical average deviation expressed in micro-meters normal to an imaginary center line, running through the profile.

- **Roughness Width**: Roughness width is the distance parallel to the normal surface between successive peaks or ridges that constitute the predominant pattern of the roughness.

DESCRIPTION OF THE APPAPATUS:

(1) Surface roughness tester (SJ - 410), (2) Test specimens.

The surface tester SJ-410 is a stylus type surface roughness measuring instrument developed for shop floor use. The SJ-410 is capable of evaluating surface texture with variety of parameters according to various national standards and international standard. The measurement results are displayed digitally/graphically on the touch panel, and output to the built-in printer. The stylus of the SJ-410 detector unit traces the minute irregularities of the work piece surface. Surface roughness is determined from the vertical stylus displacement produced during traversing over the surface irregularities. The measurement results are displayed digitally/graphically on the touch panel.

Figure 4.2

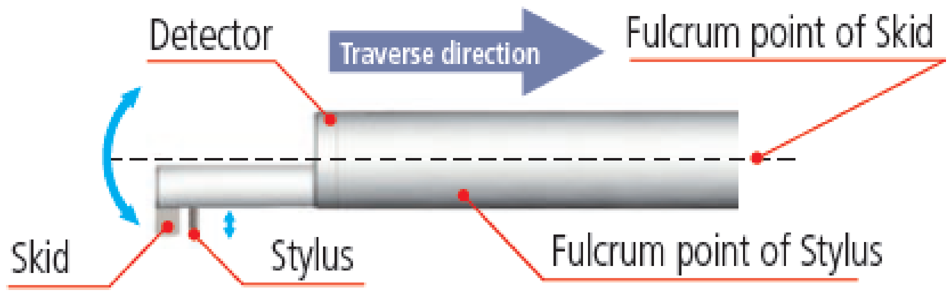


Figure 4.3

PROCEDURE:

1. Connect the surface tester SJ-401 to the power supply.
2. Place the work piece over the foundation.
3. Adjust the detector over the work piece by adjustment knob.
4. Start the machine by pressing start button on LED display.
5. Print the results by pressing print button and Tabulate the all results.
6. Remove the work piece by adjusting the detector.
7. Follow the above procedure for different surface.

Note:

- R_a is the arithmetic average of the absolute values of the profile heights over the evaluation length.

- R_q is the root mean square average of the profile heights over the evaluation length.

- R_z is the vertical distance between the highest and lowest points of the profile within the evaluation length.

OBSERVATION TABLE:

Observation No.	**Specimen**	R_a **micron**	R_q **micron**	R_z **micron**

Exp. No. 5	**Title:** Surface Roughness Measurement.
Name of Student:	
Roll No.:	
Date of Experiment:	
Date of Submission:	

Signature of Lab In-charge with Date of Check **SEAL**

Experiment No. 6

Title: Screw Thread Profile Measurement using Profile Projector.

OBJECTIVE:

To measure the external thread profile of the given bolt specimen using profile projector.

THEORY:

A screw thread is obtained by cutting a continuous helical groove on a cylindrical surface(external thread). The threaded portion engages with a corresponding threaded hole (internalthread); forming a screwed fastener. Following are the terms that are associated with screwthreads (Fig. 5.1).

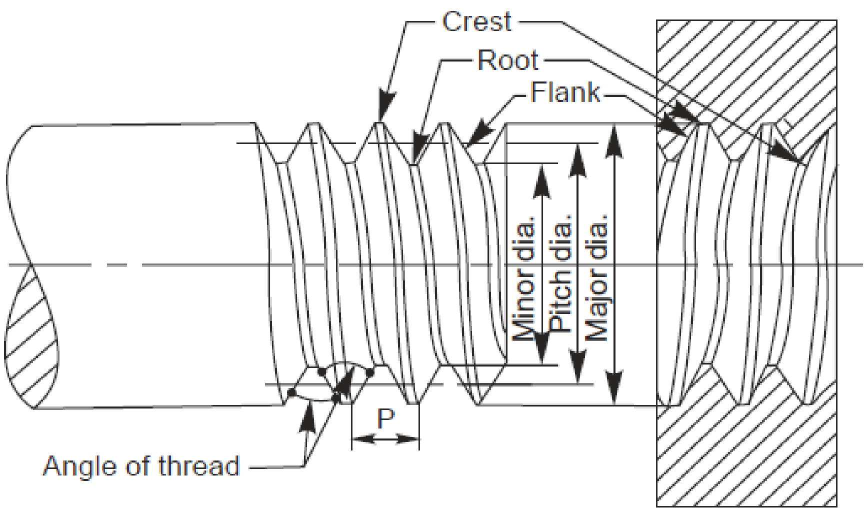


Figure 5.1: Screw Thread Nomenclature

- **Major (nominal) diameter:** This is the largest diameter of a screw thread, touching the crests on an external thread or the roots of an internal thread.
- **Minor (core) diameter:** This is the smallest diameter of a screw thread, touching the roots or core of an external thread (root or core diameter) or the crests of an internal thread.
- **Pitch diameter:** This is the diameter of an imaginary cylinder, passing through the threads at the points where the thread width is equal to the space between the threads.
- **Pitch:** It is the distance measured parallel to the axis, between corresponding points on adjacent screw threads.
- **Lead:** It is the distance a screw advances axially in one turn.
- **Flank:** Flank is the straight portion of the surface, on either side of the screw thread.

- **Crest:** It is the peak edge of a screw thread, that connects the adjacent flanks at the top.
- **Root:** It is the bottom edge of the thread that connects the adjacent flanks at the bottom.
- **Thread angle:** This is the angle included between the flanks of the thread, measured in an axial plane.

DESCRIPTION OF THE APPAPATUS:

Profile Projector: The projector magnifies the profile of the specimen, and displays this on the built-in projection screen. On this screen there is typically a grid that can be rotated 360 degrees so the X-Y axis of the screen can be aligned with a straight edge of the machined part to examine or measure. This projection screen displays the profile of the specimen and is magnified for better ease of calculating linear measurements.An edge of the specimen to examine may be lined up with the grid on the screen. From there, simple measurements may be taken. This is being done on a magnified profile of the specimen. It can be simpler as well as reduce errors by measuring on the magnified projection screen of a profile projector. The typical method for lighting is by diascopic illumination, which is lighting from behind. This type of lighting is also called transmitted illumination when the specimen is translucent and light can pass through it. If the specimen is opaque, then the light will not go through it, but will form a profile of the specimen. Measuring of the sample can be done on the projection screen. A profile projector may also have episcopic illumination (which is light shining from above). This useful in displaying bores or internal areas that may needed to be measured.

Components of Mitutoyo Profile Projector PJ-A3000 (with QM Data 200 2D Data Processing unit): Various Components of the Profile Projector are shown in Fig. 5.2.

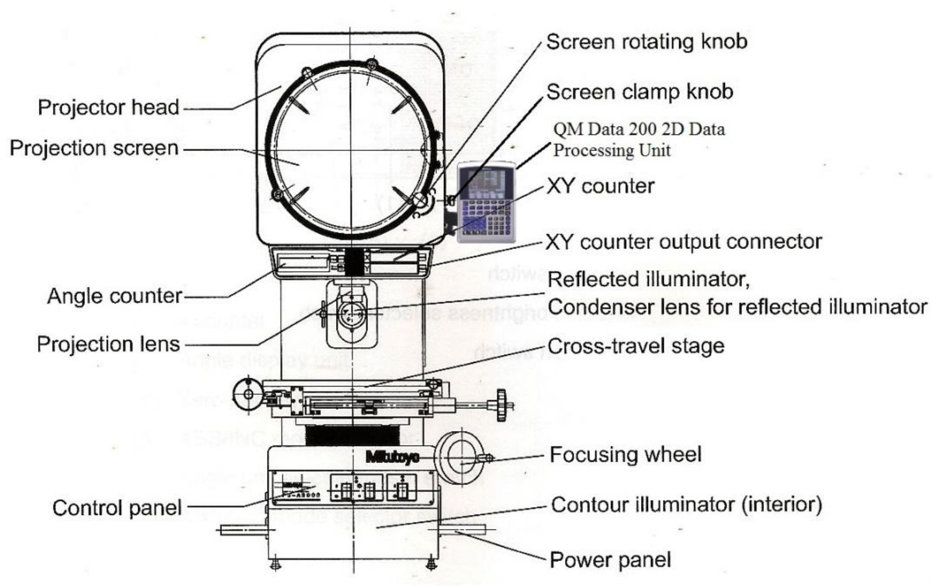


Figure 5.2: Components MitutoyoProfile Projector PJ-A3000

Specification:

- Max. X-Axis travel length of the cross-travel stage: 100 mm
- Max. Y-Axis travel length of the cross-travel stage: 100 mm
- Max. work piece height: 91 mm

PROCEDURE:

1. Switch on the power supply to Profile Projector and Data Processing unit.
2. Place the work piece over the Cross-travel stage and remove the protective cover from the projection lens.
3. Switch on the contour light source (first switch from the RHS).
4. Adjust focusing wheel to bring the image formed in the screen on focus.
5. Perform the required measurements following the procedure given in Quick help manual and note down in the observation table.
6. For surface measurements instead of contour light source the reflective light source to be switched on (third switch from the RHS) and reflective lens attachment to be attached in the projection lens.
7. After measurement, remove the specimen, cover the projection lens and switch off all power supplies to the unit.
8. Draw the thread profile using a suitable scale.

OBSERVATION TABLE:

Observation No.	Major (nominal) diameter in mm	Minor (core) diameter in mm	Pitch in mm	Thread angle in degree
1				
2				
3				

Mitutoyo

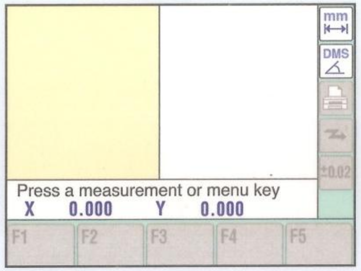
QM-Data 200 Quick Help Manual

User's Manual
No. 99MBA215A
SERIES No. 264

This Quick Help Manual contains brief descriptions of frequently used operating procedures.
See the other User's Manuals for items not discussed here and for further details on the procedures.

Measurement Preparations

1. The startup screen appears when the power switch is turned ON.



2. Prepare a workpiece.
Set the workpiece on the XY table and adjust the focus.

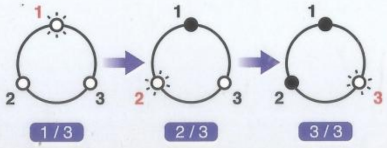
Basic Measurement Procedure

Example : Circle measurement

Press the Circle Measurement command key.

1. Operate the XY table to align the measurement position with the center of the crosshairs.
2. Press the [LOAD] key.
   ➢ The measured data will be acquired.
3. Repeat steps 1 and 2, following the measuring procedure's navigation displayed on the LCD.

Measurement



Results display

N0001 (M0001)
X = 2.487
Y = 6.015
D = 4.018

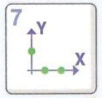
Part Coordinate System Alignment Procedure

Example : Coordinate system alignment macro command

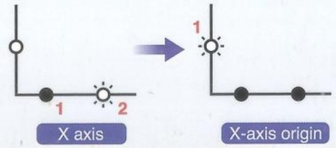
The part coordinate system must be aligned in order to accurately evaluate a circle's center coordinates, etc.

1. Press the coordinate system alignment menu key.

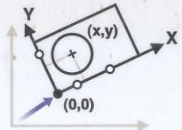
2. Select the icon shown below using the "7" numeric key.



3. Measure the points, following the measuring procedure's navigation displayed on the LCD.



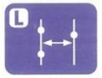
4. The part coordinate system is aligned.



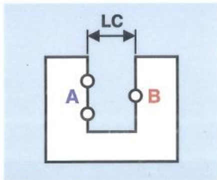
Example Measurements

Width measurement

1. Press the key shown below.



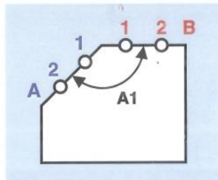
2. Measure portion "A" at two points.
3. Measure portion "B" at one point.
   ➢ The measurement results are displayed on the LCD.



Angle measurement

1. Press the key shown below.

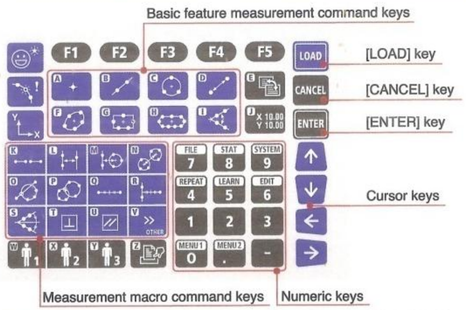
2. Measure portion "A" at two points.
3. Measure portion "B" at two points.
   ➢ The measurement results are displayed on the LCD.



Note The measured angle varies depending on the order in which the measured points are input.

Mitutoyo

Operation Keys



Basic feature measurement command keys

Key	Function	Measurement Results
A	Measures a point.	Coordinate : X Coordinate : Y
B	Measures a line.	Angle : CX Straightness : F1
C	Measures a circle.	Coordinate : X Coordinate : Y Diameter : D Circularity : F2
D	Measures the distance between two points.	Distance : LC Coord. difference : XD Coord. difference : YD
F	Measures an ellipse.	Coordinate : X Coordinate : Y Diameter : D1 Diameter : D2 Deviation : F3
G	Measures a rectangular hole.	Coordinate : X Coordinate : Y Length : L1 Length : L2
H	Measures a slot.	Coordinate : X Coordinate : Y Radius : R1 Radius : R2 Length : L1 Length : L2
I	Measures a point & angle.	Coordinate : X Coordinate : Y Angle : A1 Angle : A2

Measurement macro command keys

Key	Function	Measurement Results
K	Measures pitches.	Distance : LC Coord. difference : XD Coord. difference : YD Angle : AC Cumulative dist. : LT Cumulative angle : AT
L	Measures the distance between a line and a point.	Distance : LC
M	Measures the distance between a line and a circle.	Distance : LC Max. distance : LL Min. distance : LS
N	Measures the distance between two circles.	Distance : LC Max. distance : LL Min. distance : LS Coord. difference : XD Coord. difference : YD
O	Measures the intersection point of a line and a circle.	Coordinate : X Coordinate : Y
P	Measures the intersection point of two circles.	Coordinate : X Coordinate : Y
Q	Measures the midpoint between two points.	Coordinate : X Coordinate : Y
R	Measures the midpoint between a line and a point.	Coordinate : X Coordinate : Y
S	Measures the midline between two lines.	Angle : CX
T	Measures perpendicularity.	Perpendicularity : VT
U	Measures parallelism.	Parallelism : PA
V OTHER	Opens the menu for other measurement functions.	

Note The measurement result output items are those of the factory default settings.

[LOAD], [CANCEL], and [ENTER] keys

Key	Function
LOAD	Used to input a measured point.
CANCEL	Cancels a measured point, or goes back to the immediately previous menu.
ENTER	Enters the selection or entry, and goes to the next step.

Other operation keys

Key	Function	Key	Function
(AI)	Starts the AI measurement.	E	Changes the screen display mode.
(coordinate input)	Opens the coordinate data input style menu.	J X 10.00 Y 10.00	Switches to the counter mode.
Y X	Opens the coordinate system alignment menu.	Z	Used for manual printing.

Numeric keys (corresponding functions)

Key	Function	Key	Function
MENU1 0	Opens the output function menu.	EDIT 6	Edits a part program.
MENU2 .	Opens the setting function menu.	FILE 7	Performs file management.
REPEAT 4	Executes a part program.	STAT 8	Performs statistical processing.
LEARN 5	Creates a part program.	SYSTEM 9	Configures the system.

Thread Profile Drawing:

Exp. No.6	**Title:** Thread Profile Measurement using Profile Projector.
Name of Student:	
Roll No.:	
Date of Experiment:	
Date of Submission:	

Signature of Lab In-charge
with Date of Check

SEAL