OPERATIONAL MANUAL
FOR
MODEL:LMM - 600

FORK MEASURING COMPANY
Vavdi Sr No. 17, Plot No 55B, Rani Industrial Estate, Gondal Road, Rajkot-360 002. India.
Tel : +91 281 2925530, Email : sales@forkmeasuring.com Web : www.forkmeasuring.com

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Safe and earthed power source are required to be provided!

Along with the upgrade of the product, certain content of the Operation Manual may be revised, excuse for not being notified later.

Unpacking and installation direction to the user

1. Illustration

Before unpacking and installing the instrument, read the following directions carefully and do by steps in order to guarantee the accuracy of the instrument.

2. The sequence of the unpacking and installation

2.1 Take down the four screws 1# which fasten the box, move out the Abbe measuring unit 2# completely (Fig. 1).

2.2 Open the front cover 8# of the Abbe measuring unit and remove the screws 3#, then close the front cover (Fig. 2).

2.3 Release two screws 4# in right and left a little, then two screws 5#, firstly remove two screws 4# and then two screws 5#

Attention : When removing the screws 4# and 7#, it should be done in the meantime.

2.4 Locking screw 6#, support the Abbe unit 2# with two hands. Take out four screws 7#. Take out 8#, 9# in a whole.

2.5 Take out the bed of the instrument from the box, and mount three foot-screws under it.

2.6 Place the Abbe unit and the tailstock on the bed respectively. So the complete the unpacking and installing of the instrument.

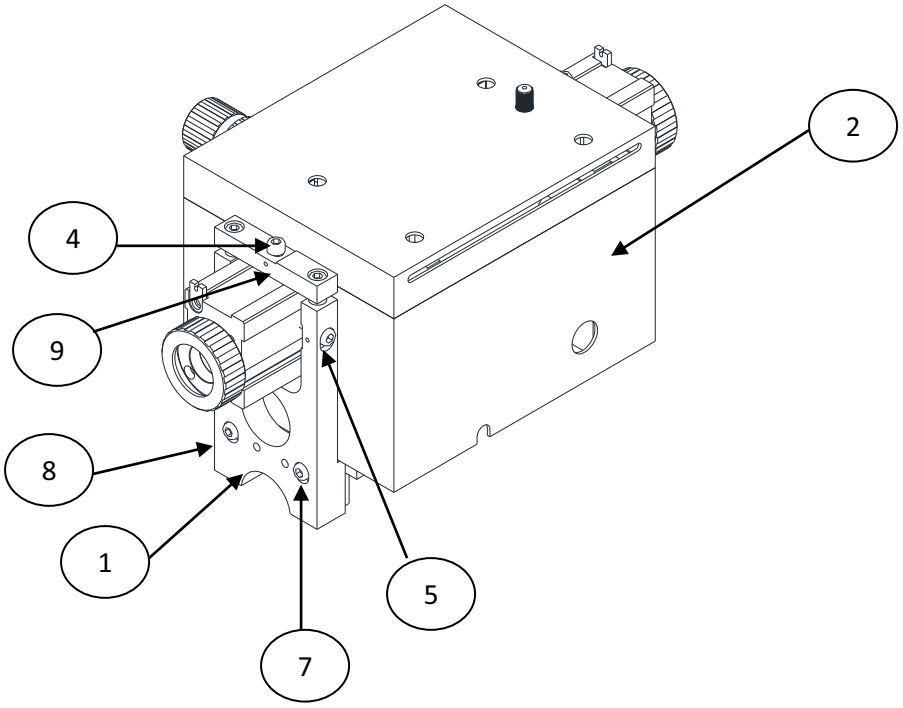


FIG.1

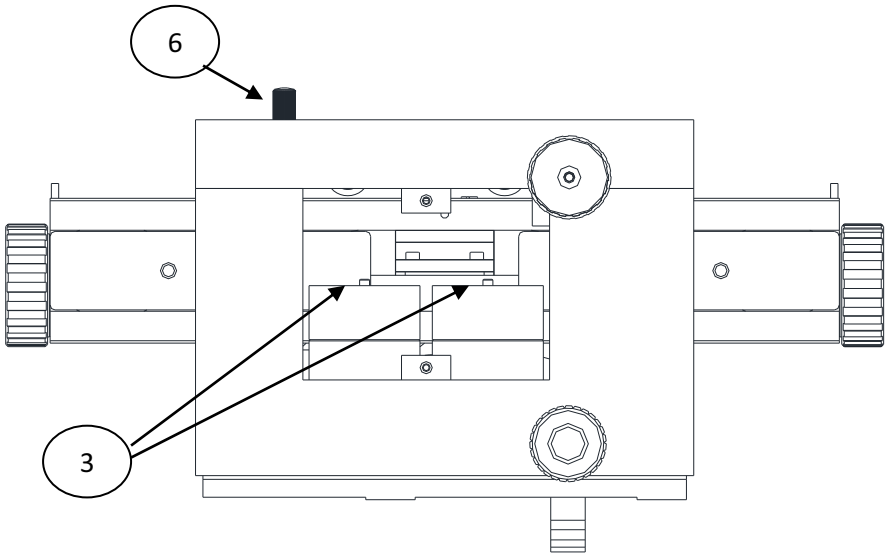


FIG.2

Operation manual

For LMM - 600

1. Uses

The universal metroscope is a metrological instrument for direct and differential measurements. It has high accuracy because it exactly adopts the Abbe Comparator principle and uses a high-precision measuring system. This instrument is mainly used in metal-working industry, especially the inspecting departments of machine building, tool making, in the manufacture of gauges and measuring instruments.

The difference of the LMC-100 and the conventional universal metroscope is: the LMC-100 adopts the grating displaying technology and is the high-technology product of the integration of the optics, mechanic and electricity. This has greatly improved the accuracy and efficiency. At the same time, adding many accessories have improves the universal performance.

Its measuring parts are as follows:

a. Smooth cylindrical work pieces such as axis, hole, gauge and ring gauge.

b. The pitch diameter of internal thread, thread gauge and thread ring gauge.

c. Work piece with parallel plane surface, such as measuring rod and lower grades gauge.

The LMC-100 has a one-dimensional data processing system, which includes single coordinate grating single commutator, DRO, computer and data processing software. Printer outputs their results.

2. Specifications

2.1	**External Measuring range (mm)**	0 – 600 mm
2.1.1	**Internal Measuring Range**	3mm – 400mm
2.1.2	**Thread measurement**	
	a. Measuring the internal pitch diameter	M3 ~ M150
2.2	**Accuracy of the instrument**	
	Internal measurement	0.7+L/2000 µm (20 ± 0.2) ° C)
2.3	**Universal worktable**	
	a. Mounting area	approximately (160 X 160) mm^2
	b. Adjusting range of height	(0 ~ 75) mm

c. Transverse travel	25 mm
d. Tilting range around Y axis	± 3°
e. Work table rotation	± 4°
f. Load capacity	10 Kg

2.6 Instrument dimension (mm)

L x W x H	960 x 390 x 450

3. Measuring Principles:

3.1 The instrument is a contact mode length metrological instrument with a 100 mm scale as its measuring datum. The grating scale is placed in the centerline of the Abbe measuring axis, which is following the Abbe measuring principle. The worktable can move freely in five directions, with the special accessories like internal contact tip, electric measuring equipment. The instrument can fulfill all kinds of internal and external measurements of parts. And these are accordance with the conventional metroscope.

3.2 Grating digital display system

The grating digital display system includes two parts: the grating measuring system and digital display system.

3.2.1 The grating measuring system is composed of a grating scale and reading head.

a. Illuminating system

An infrared light diode is used as a light source in the grating reading head. Through a condenser, a parallel light casts on the surface of grating scale. The infrared light diode has high radiation efficiency and works in lower voltage and current, and has the advantages of small bulk, long life and high reliability.

b. Photo electricity changing-over

The grating scale is white and black grating and each 1 mm has 100 pieces. The indicating grating is four split phase mode. When the two reticles are parallel each other, it forms the moire fringe because of the transmission and blocking light effect. The silicon optical battery, which lies in the back of the indicating grating, will receive the periodic variety luminous flux, which convert into electric signal of 0 degree, 90 degree, 180 degree and 270 degree in sequence and send to the digital display system.

3.2.2 The digital display system is composed of single coordinate grating signal commutator and computer system. Certainly, it also needs the corresponding software to support.

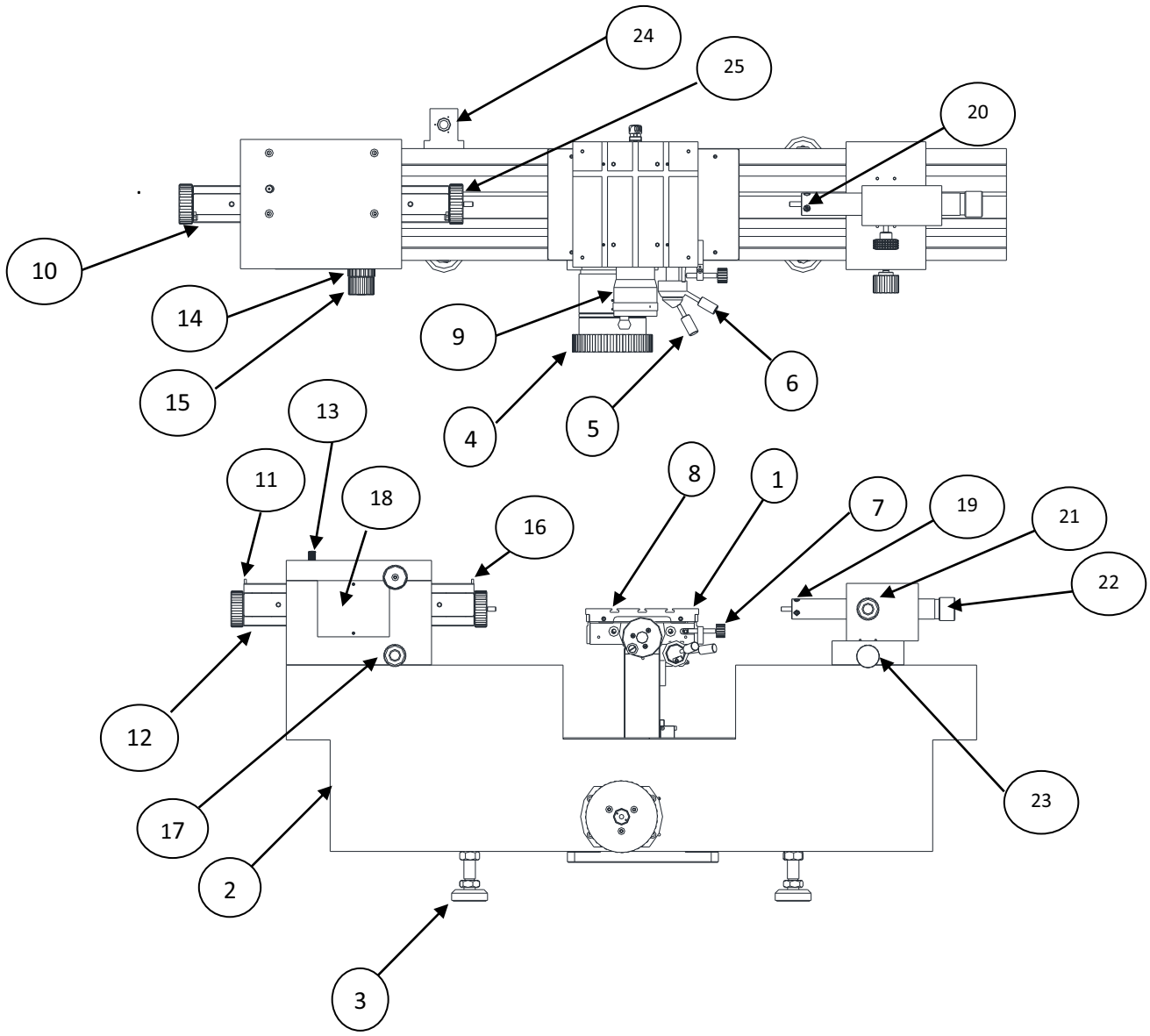


Fig. 3 Outline of the digital universal metroscope

1. Universal worktable 2. Base 3.Foot screws 4.Hand wheel for raising or lowering worktable 5.Locking handle for swinging worktable 6. Adjusting handle for swinging worktable 7.Adjusting knob for rotating worktable 8. "T" slot 9.Micro-drum 10.Abbe measuring head 11.Holder for tension in external measuring 12. Measuring main axis 13. Locking screw for measuring main axis 14. Knob for engaging fine position system 15. Fine knob for measuring axis 16. Holder for tension in internal measuring 17. Locking screw for Abbe head 18. Cover for weight 19,20 Adjusting screw for tailstock tip axis 21. Locking screw for tailstock 22. Tailstock main axis 23. Locking screw of tail stock 24. Level tube 25 Screw cap

4. Structure :

4.1 Bed

The Bed is used to support the main body of the instrument and all kind of accessories and is composed of the base 2 and universal worktable 1.

4.1.1 Base (Fig. 3)

The bed is supported by three foot screw 3, which rest in the plates. By means of these screws and level 24 the bed can be leveled.

4.1.2 Universal worktable (Fig. 3)

The front of the universal worktable is provided a hand wheel for adjusting the height. The worktable can be secured against vertical displacement by rotat ing by rotating the hand wheel 4.

The universal worktable 1 is a basic and various accessories can add on it. The worktable 1 also has two "T" slots, which is used to impact the presser. The worktable can do the following movements for operation's need.

a) The worktable can be vertical adjusted within 75 mm by hand wheel 4.

b) The worktable can move within 25 mm in the Y direction by turning hand wheel 9. The scale value of its drum is 0.01 mm.

c) The worktable can tilt ± 3° around the Y axis by adjusting operation level 6. And can be set to a defined position using the locking lever 5.

d) The worktable surface can rotate ± 4° around vertical axis by turning screw 7.

e) The X direction of the worktable moves on the rolling slide. Its travel is 10 mm. thus the test piece can freely positioned without any constraint.

4.2 Abbe measuring head (Fig. 3)

The Abbe measuring head contains the measuring main axis 12 and the grating measuring system. The grating system operates in the case of transmission with a 100 mm grating scale as it measuring datum. The reticle space of the grating scale is 0.02 mm, which has zero mark as absolute starting point for measurement.

The Abbe measuring head can move on the left side of the bed and be fixed in any position by locking hand wheel 17

The measuring main axis on the antifriction bearings can move in the Abbe head. The locking screw 13 can lock the measuring main axis in a position. The measuring main axis moves in the range of 100 mm. the grating reading head is connected with measuring axis and performs the axis movements along the main axis. The grating scale is fixed on the unmovable framework.

Screw caps 25 is used to fasten the contact tip connector. Holding the screw cap 25 with hands can push or pull the main axis. In internal measurement, the end of the cord of the tension has to be attached to holder 16, & in external measurement to holder 11. Inside of the measuring head rolls are provided by which the cords of the tension are suspended. Rubber pads prevent a hard impact of the measuring axis at the end of the measuring range.

For a little displacement the main axis in the axial direction, fine-position knob 15 is used. It can turn only, if the switching knob 14 upwards. The high transmission ratio of the fine knob causes a slow motion of the main axis. The circular movement of the hand wheel is converted into the axial movement of the main axis by frictions gears. The fine-position system is used for measuring holes by means of the electric measuring device. When using the system, the internal and external tension cords should be come away, and the locking screw of the main axis should be loosened.

4.3 Tailstock (Fig. 3)

The tailstock main axis serves as a fixed datum (locating surface). Its slide runs on the right side of the bed and can be locked in any position by knob 23. The tailstock main axis 22 can be axially displaced in its bushing and locked in any position by locking knob 21. The measuring lever mounted the contact tip can be arbitrarily adjusted by screw 19 and 20 so as to make the plane contact tip and measuring surface are parallel to or concentric with each other.

4.3.1 Adjusting the contact tip:

Adjustment of contact tip with plane surface or knife-edge

The purpose is to make the measuring surfaces parallel to each other. Firstly do the coarse adjusting with above the method of finding “turning point” to obtain the minimum value. Then place the test piece, and observe whether the indicating value in different position of the tips is the same. Finely adjust the reading difference by screw until the reading value in each position is the same. For measuring the thread pitch diameter with three-pin, place a three-pin in the up, down, right and left position of the tip to test the parallelism after have done the coarse adjusting. Then be on the fine adjusting with purpose.

5. Method of operation:

5.1 Thread Ring Gauge

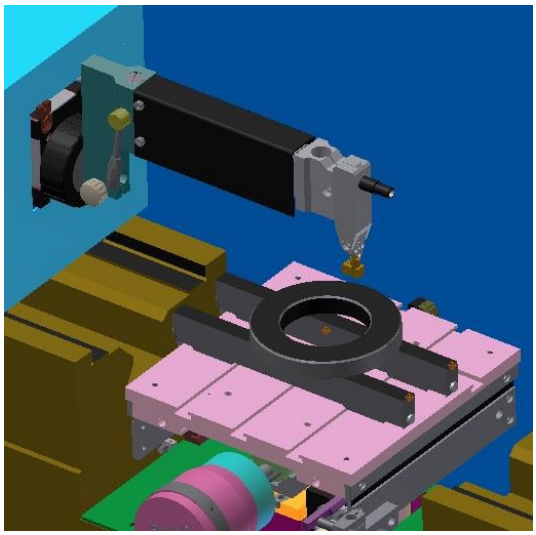
PITCH DIAMETER.

REQUIRED EQUIPMENT

- *Master ring gage.*
- *Accessory. : - 1) Internal measurement accessories*
- *Clamp (2nos.).*

SETUP.

Clamp internal measurement accessories in anvil of Abbes head. Mode of DRO select Probe (see Page No. 12 in DRO Manual Point No. 08). Select correct T–Styles for measurement of thread ring gauge (Refer Page No. 13).



MEASURING:

A) For Evaluation of Probe Constant.

- *Place plain ring on the table.*
- *Visually center the ring. Clamp the ring gauge by using clamps. Advance the anvil so that the T- styles make contact with ring gauge until the Analog scale is null out.*
- *Center the ring for the maximum value on the digital readout of SM1 by using the micro drum (9).*
- *Re-adjust the Digital readout of SM1 to null. Make Zero on DRO. Lift the table up using hand wheel (4) to maximum value on digital readout of SM1.*
- *Adjust the squareness of ring by using lever (6).*
- *Release the probe and move down the table again repeat the above procedure up to squareness within 1 micron.*
- *Bring T –styles at ring center approximately Advance the anvil so that the T- styles make contact with ring gauge until the Digital readout is null out.*
- *Make Zero on digital readout of scale on DRO. Move anvil another side to contact T – styles with ring gauge until the Analog scale is null out.*
- *Center the ring for the maximum value on the digital readout of SM1 by using the micro drum (9).*
- *Re-adjust the Digital readout of SM1 to null. Record the reading as 'X'. Repeat procedure for confirmation.*

Calculations

Probe Constant = X1 – P value

Where,

X1 = Ring actual size - X

Select P value from chart.

(E.g. Ring size = 14.0002, X= 8.7248, P value = 0.404.

X1= 14.0002 – 8.7248

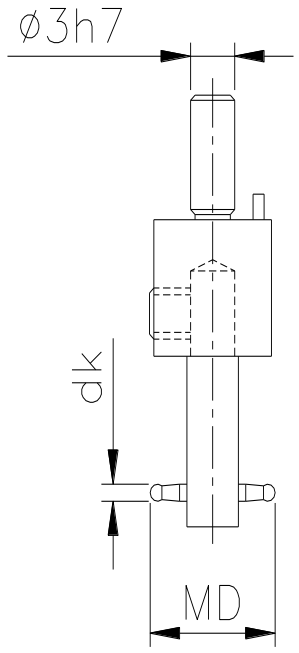
X1= 5.2754

Probe Constant = 5.2754 - 0.404 Probe Constant = 4.8714.)

B) For Evaluation of PITCH DIAMETER of thread ring gauge.

- *Place thread ring on the table.*
- *Visually center the ring. Clamp the ring gauge by using clamps.*
- *Insert T –styles in second number thread of thread ring gauge.*
- *Center the ring for the maximum value on the digital readout of SM1 by using the micro drum (9).Re-adjust the Digital readout of SM1 to null.*
- *Re-adjust the Digital readout of SM1 to null. Preset probe constant value by using preset function of DRO.*
- *Move anvil to contact T –styles in Third number (opposite to first thread) thread of thread ring gauge.*
- *Center the ring for the maximum value on the digital readout of SM1 by using the micro drum (9).Re-adjust the Digital readout of SM1 to null.*
- *Move table up to see maximum value on the digital readout of SM1 by using the lifting hand wheel (4). Re-adjust the Digital readout of SM1 to null.*
- *Record the reading as 'Pitch Diameter' of thread ring gauge.*
- *Lift the table to find 'Pitch Diameter' at another thread of thread ring gauge.*
- *Calculate variation between 'Pitch Diameters' and record as taper of ring gauge.*
- *Rotate thread ring gauges in 90-degree approximately and repeated above procedure.*
- *Calculate variation between 'Pitch Diameters' and record as oval of ring gauge.*

T-STYLI FOR THREAD MEASUREMENT



SIZE	*BALL*	*dk(mm)*	*MD (mm)*	*PITCH (mm)*
0	*RUBY*	*0.335*	*2.0*	*0.60*
1	*RUBY*	*0.455*	*2.5*	*0.70/0.75/ 0.80*
2	*RUBY*	*0.530*	*3.3*	*0.90*
3	*RUBY*	*0.620*	*4.0*	*1.00*
4	*RUBY*	*0.725*	*5.0*	*1.25*
5	*RUBY*	*0.895*	*6.0*	*1.50*
6	*RUBY*	*1.100*	*8.0*	*1.75*
7	*RUBY*	*1.350*	*9.0*	*2.00*
8	*RUBY*	*1.650*	*12.0*	*2.50*
9	*RUBY*	*2.050*	*13.0*	*3.00/3.50*
10	*RUBY*	*2.550*	*16.0*	*4.00/4.50*
11	*RUBY*	*3.200*	*20.0*	*5.00/5.50*
12	*RUBY*	*4.000*	*25.0*	*6.00*

Chart A:

Nominal sizes of cylinders & corresponding "P" values of various thread form.

Nominal Size (d)	***Screw Thread for which these Cylinders are suitable***							
	ISO metric Pitches In MM.		***Unified & ISO INCH T. P. I.***		***Whitworth T. P. I. Parallel Threads***		***B. A. No.***	
	Pitch P	***P Value***	***T. P. I.***	***P Value***	***T. P. I.***	***P Value***	***No.***	***P Value***
1	***2***	***3***	***4***	***5***	***6***	***7***	***8***	***9***
0.170	*0.25*	*0.047*	*-*	*-*	*-*	*-*	*10*	*0.146*
	0.30	*0.090*	*-*	*-*	*-*	*-*	*-*	*-*
0.195	*-*	*-*	*80*	*0.080*	*-*	*-*	*9*	*0.154*
0.220	*0.35*	*0.083*	*72*	*0.086*	*-*	*-*	*8*	*0.162*
0.250	*0.40*	*0.096*	*64*	*0.094*	*-*	*-*	*7*	*0.175*
0.290	*0.45*	*0.100*	*56*	*0.103*	*-*	*-*	*6*	*0.172*
	0.50	*0.143*	*-*	*-*	*-*	*-*	*-*	*-*
0.335	*0.60*	*0.185*	*48*	*0.123*	*40*	*0.219*	*5*	*0.174*
	-	*-*	*-*	*-*	*-*	*-*	*4*	*0.253*
0.390	*-*	*-*	*44*	*0.110*	*36*	*0.223*	*3*	*0.251*
	-	*-*	*40*	*0.160*	*-*	*-*	*-*	*-*
0.455	*0.70*	*0.151*	*36*	*0.156*	*32*	*0.232*	*2*	*0.246*
	0.75	*0.195*	*-*	*-*	*-*	*-*	*1*	*0.348*
	0.80	*0.238*	*-*	*-*	*-*	*-*	*-*	*-*
0.530	*0.90*	*0.249*	*32*	*0.157*	*28*	*0.253*	*0*	*0.350*
	-	*-*	*28*	*0.256*	*-*	*-*	*-*	*-*
0.620	*1.00*	*0.246*	*26*	*0.226*	*26*	*0.216*		
0.725	*1.25*	*0.358*	*24*	*0.192*	*22*	*0.264*		
	-	*-*	*22*	*0.275*	*20*	*0.375*		
	-	*-*	*20*	*0.375*	*19*	*0.439*		
	-	*-*	*19*	*0.433*	*-*	*-*		
0.895	*1.50*	*0.404*	*18*	*0.327*	*18*	*0.312*		
	-	*-*	*-*	*-*	*16*	*0.482*		
1.10	*1.75*	*0.416*	*16*	*0.275*	*14*	*0.460*		
	-	*-*	*14*	*0.471*	*-*	*-*		
	-	*-*	*13*	*0.592*	*-*	*-*		
1.35	*2.00*	*0.382*	*12*	*0.483*	*12*	*0.459*		
	-	*-*	*11*	*0.650*	*11*	*0.644*		
1.65	*2.50*	*0.515*	*10*	*0.550*	*10*	*0.516*		
	-	*-*	*9*	*0.794*	*9*	*0.788*		
2.05	*3.00*	*0.548*	*8*	*0.700*	*8*	*0.660*		
	3.50	*0.981*	*7*	*1.092*	*7*	*1.096*		
2.55	*4.00*	*0.914*	*6*	*1.116*	*6*	*1.094*		
	4.50	*1.347*	*-*	*-*	*-*	*-*		
3.20	*5.00*	*1.130*	*5*	*1.199*	*5*	*1.149*		
	5.50	*1.563*	*4.5*	*1.688*	*4.5*	*1.692*		
4.00	*6.00*	*1.196*	*4*	*1.499*	*4*	*1.437*		
	-	*-*	*-*	*-*	*3.5*	*2.308*		
5.05	*-*	*-*	*-*	*-*	*-*	*-*		
6.35	*-*	*-*	*-*	*-*	*-*	*-*		

Note: - (1) Wires nominal sizes 5.05 mm is used for 9 & 10 mm Trapezoidal pitches & 6.35 is used for 12 mm Trapezoidal pitch. (2) All P value in mm.

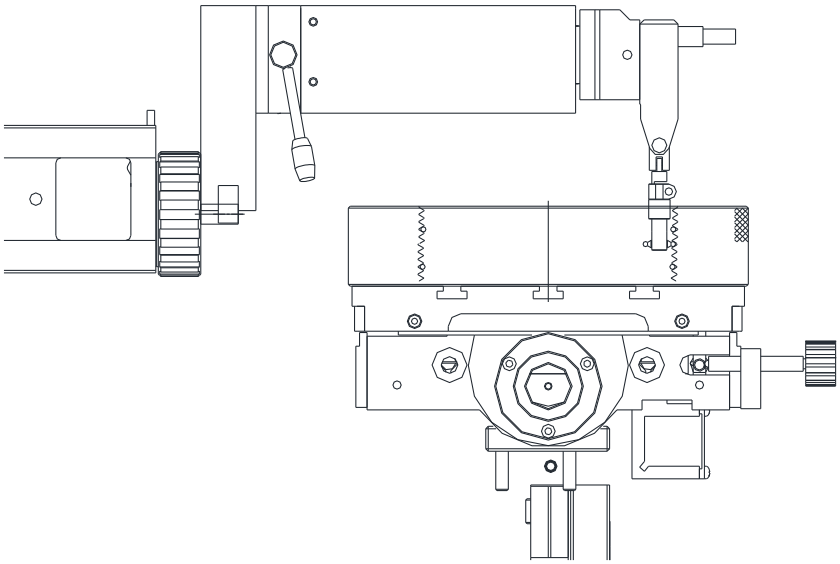


Fig. 4 Internal thread ring checking layout

6. Maintenance:

6.1 The room for installing the LMC 100 should be kept as far as possible from dust, vibration, and corrosive atmosphere and moisture. A thermostat should be installed in the room so as to keep the room temperature about (20 ± 0.5) °C. The relative humidity should not exceed 60%, otherwise the optical parts would get moldy. The instrument should not be placed near the thermal sources.

6.2 After each measurement is completed, the surfaces of worktable, contact tips and other accessories should first be cleaned with gasoline and then coated with a thin film of non-acid Vaseline.

6.3 When it is necessary to clean the surface of the optical parts, the dust should be removed first with a soft, clean and degreased brush, then mop slightly the unclean parts with a soft fine cloth (already degreased or cleaned), or with degreased cotton soaked with a mixture of a alcohol (30%) and other (70%).

6.4 When the instrument is not in use, its accessories should be placed in their containers or dry tanks. The instrument proper should be covered with a plastic hood.