



INSTRUCTION & MAINTENANCE MANUAL
UNIVERSAL INTERNAL/EXTERNAL COMPARTOR

#5102000



EDMUNDS GAGES
Farmington Industrial Park
Farmington CT USA 06032
TEL (860) 677-2813
FAX (860) 677-4243

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1.0 INTRODUCTION

1.1 Product Overview

The Edmunds Universal Internal/External Comparator is a rugged metrology instrument designed for the precise measurement of internal and external diameters. The comparator's Trans-O-Limit readout with its auto zeroing pushbutton and large 6 character LCD digital display makes comparative measurement to a millionth of an inch simple and easy.

A welded steel base supports a steel worktable with serrated steel anvils to support the work piece. A separate column locking control secures the finger height and a two speed, dual knob elevating mechanism allows for the exploration of diameters for taper, barrel and bellmouth conditions.

Two auxiliary "soak" tables are mounted adjacent to the worktable to allow for the reference gage block set up or sequential work pieces to be stored and stabilized for temperature prior to measurement.

The inch/millimeter unit selection and .0001"/.0005"/.002" range selection of the digital meter offer greater flexibility to the exactness of the measurement for a variety of applications.



Figure 1 - Overall View

2.0 GETTING STARTED

Due to the size and weight of the comparator, the unit is broken down at the factory prior to shipment. The unit has been carefully packed, and some components may be packaged in separate cartons within the shipping crate. Verify that you have unpacked all the components before discarding any of the shipping containers.

2.1 Selecting a Location

The performance of the comparator is directly related to the location where it is installed in your facility. Careful consideration should be given to the location including vibration isolation, temperature and humidity control and operator access. We suggest a spot within a laboratory or controlled environment or at a minimum, isolated from heat, sunlight, and any industrial "smog" environment.

2.2 Unpacking Your Comparator

To facilitate shipment without damage, portions of the comparator have been disassembled after testing and prior to shipment from our Farmington, CT. USA facility.

THE FOLLOWING STEPS MUST BE PERFORMED PROIR TO OPERATION OF THE COMPARATOR!

1. Remove the (4) protective caps from the lifting holes located in the comparator base. (See Figure 2).
2. Insert the (2) supplied rigging bars through the lifting holes provided and lift the unit from the shipping skid.
3. Locate and install the four leveling feet packed within the comparator base in the tapped holes provided in the base bottom.
4. Transport the unit with the use of the rigging bars and lower in the location of choice onto the leveling feet.
5. Carefully remove the blocking bar between the contact finger slides by loosening the finger locking screws and sliding the clamps to the sides of the slides.
6. Unpack the readout support and attach to the rear of the base frame using the screws provided. **NOTE:** Be sure to install the rubber isolation pads between the comparator base and the readout support.
7. Level the unit with the use of the double axis bubble level included within the accessory kit by adjusting the heights of the leveling feet.

8. Install the amplifier mount bracket to the rear of the base with the black thumbscrews provided.
9. Unpack the T-O-L amplifier. Mount it to the mount bracket using the clamps provided.
10. Locate and connect the gage probe cable from within the base to the rear of the amplifier.

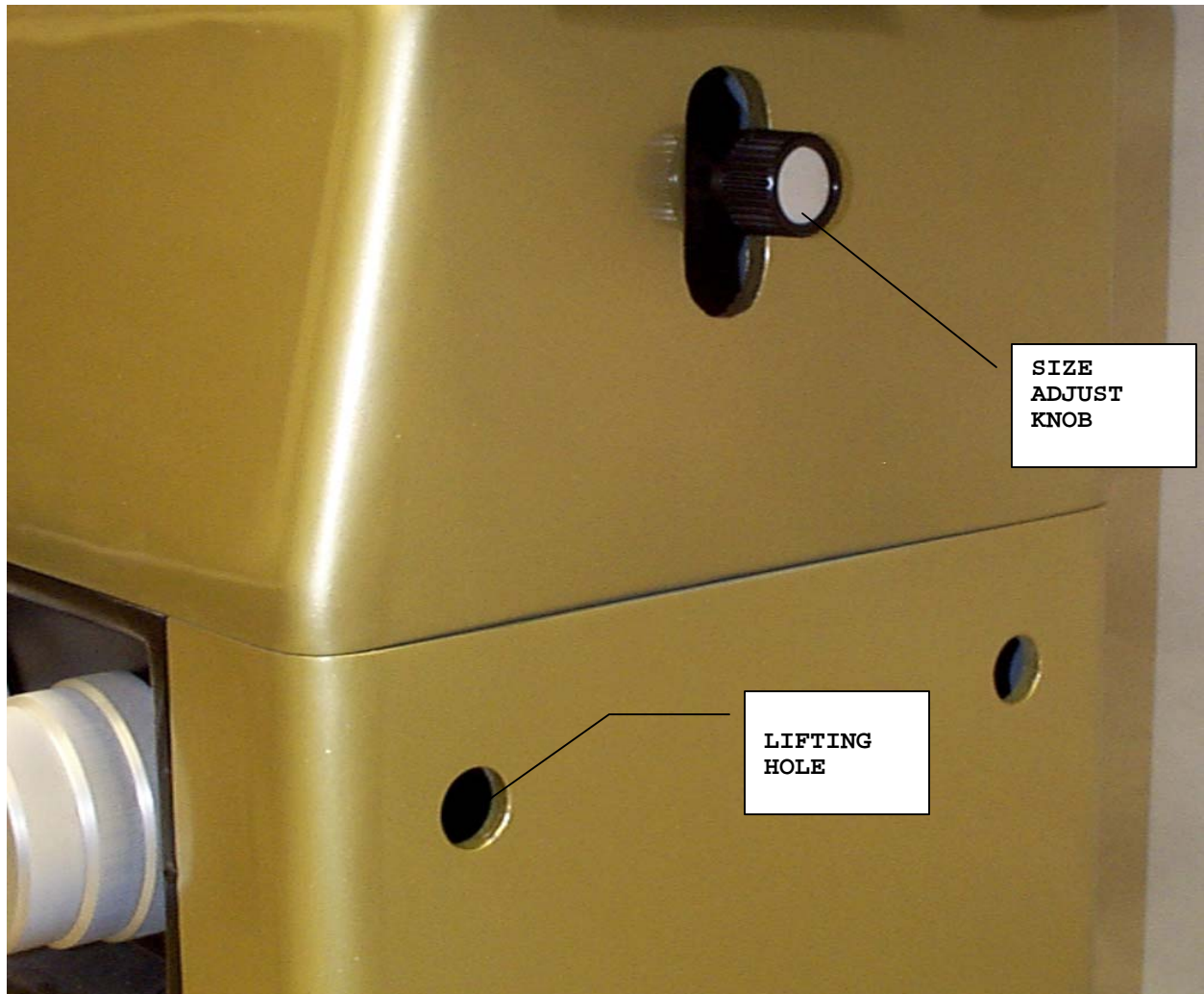


Figure 2 - Lifting Holes

11. Install the two soak tables at the sides of the worktable.
12. Connect the amplifier to any 85 - 240VAC power source and wait approximately 15 minutes before proceeding to calibrate the unit. The amplifier may remain ON at all times due to its extremely low power consumption.

3.0 HARDWARE

3.1 Comparator Specifications

Size	56.0"H x 20.0"W x 16.0"D
Weight	Approx. 675 lbs.
Measuring Range	Internal .125" to 12.0" External 0.0" to 11.0"
Contact Pressure	0 to 8 oz. adjustable
Contact Elevation Range	1.625" Max
Work Table Size	11.0" x 16.0"

3.2 Product Listing

Universal Comparator	5102000
T-O-L 2010 Digital/Fiducial Amplifier	5202010
Accessory Kit (complete)	5100002

Accessory Kit Components:

Auxiliary Table Plate	5100003
Finger Wrench	5100004
Screwdriver	5100005
Cross-Level	5100006
Outside Caliper Jaw Set	5100007
(2) .100 Dia. Rolls	5101051
Finger Storage Box	5102004

Gaging Finger Sets:

Standard:

Set #0 (.125" to .250" internal range)	5100020
Set #1 (.250" to .500" internal range)	5100021
Set #2 (.500" to 1.00" internal range)	5100022
Set #3 (1.00" to 12.00" internal range)	5100023

Special Order:

Set #000 (.040" to .080" internal range)	5100018
Set #00 (.075" to .125" internal range)	5100019

4.0 FUNCTIONAL DESCRIPTION

4.1 Gaging Fingers

A series of carbide and diamond tipped gaging fingers are included in the standard accessory kit. These fingers allow for internal diameter measurement from .125" to 12.000" or for 0.000" to 11.000" external diameter measurements, depending on their orientation in the measuring machine.

The fingers are constructed to precise "paired" dimensions to ensure contact on a common plane or elevation. If damage to any finger is incurred, BOTH fingers in the set must be returned to Edmunds for repair to maintain the correct alignment.

The gaging fingers will allow for maximum exploration depths from the worktable as follows:

<u>Set #</u>	<u>Internal Range</u>	<u>Max Depth</u>	<u>P/N</u>
0	.125" - .250"	.437"	5100020
1	.250" - .500"	.750"	5100021
2	.500" - 1.000"	1.125"	5100022
3	1.000" - 12.000"	1.625"	5100023

Special depths may be quoted based upon application.

4.2 Worktable

The worktable is solidly mounted to the comparator base. There are (2) hardened steel serrated anvils mounted on either side of the gaging fingers for support of the workpiece.

An auxiliary free sitting table plate is provided in the accessory kit for use while measuring smaller gaging diameters. (.040" - .500") This plate is placed over the gaging fingers resting on the worktable.

Two .100" diameter rolls are also provided to allow easier centering of the workpiece around the gaging fingers.

4.3 Two Speed Elevator

Located on the left side of the front of the comparator's base are two concentric dials that control the vertical travel of the gaging fingers for diameter exploration. Each of these dials is connected to a precision rack and pinion gear train for consistent movement of the gaging fingers.

The smaller inner dial is a rapid, coarse adjustment knob to allow rough positioning of the gaging finger height.

The large outer dial provides a slower, more precise movement of the gaging fingers for taper or bellmouth exploration. (See Figure 4)

4.4 Column Lock

The provision for locking the height of the gaging fingers is provided by the Column Lock knob located on the right side of the front of the comparator base.

Tightening this knob when the appropriate gaging finger height is obtained will lock the fingers in position. The column lock must be released when any vertical movement of the gaging fingers is desired.



Figure 3 - Work Table



Figure 4 – Two Speed Elevator & Column Lock

4.5 Size Actuator

The knob located at the right side of the comparator base under the soak table controls the movement of the gaging fingers in the plane of measurement. This adjusting knob has a limited range and is used primarily for the final setting of the gaging fingers to a known size.

Counter-clockwise rotation of this knob will decrease the gaging finger spacing, while clockwise rotation will increase the spacing. (See Figure 5)

4.6 Soak Tables

Two rugged steel tables are provided for mounting at each side of the worktable for storage of the master and workpiece. These tables are used as the preparation area for succeeding workpieces and masters to stabilize them to the temperature and relative humidity of the work area. This is known as "soaking in" before the pieces are measured. (See Figure 5)



Figure 5 - Size Adjustment, Soak Table

4.7 Accessory Kit

The comparator comes complete with a multiple piece accessory kit, which includes all of the components necessary for diameter measurements. The kit includes the following components:

<u>Part Name</u>	<u>Part #</u>
Auxiliary Table Plate	5100003
Finger Wrench	5100004
Screwdriver	5100005
Cross Level	5100006
Outside Caliper Jaw Set	5100007
(2) .100 Dia. Rolls	5101051
Finger Storage Box	5102004
<u>Gaging Finger Sets</u>	<u>Part #</u>
#0 (.125" - .250" ID)	5100020
#1 (.250" - .500" ID)	5100021
#2 (.500" - 1.00" ID)	5100024
#3 (1.00" - 12.00" ID & all OD)	5100023

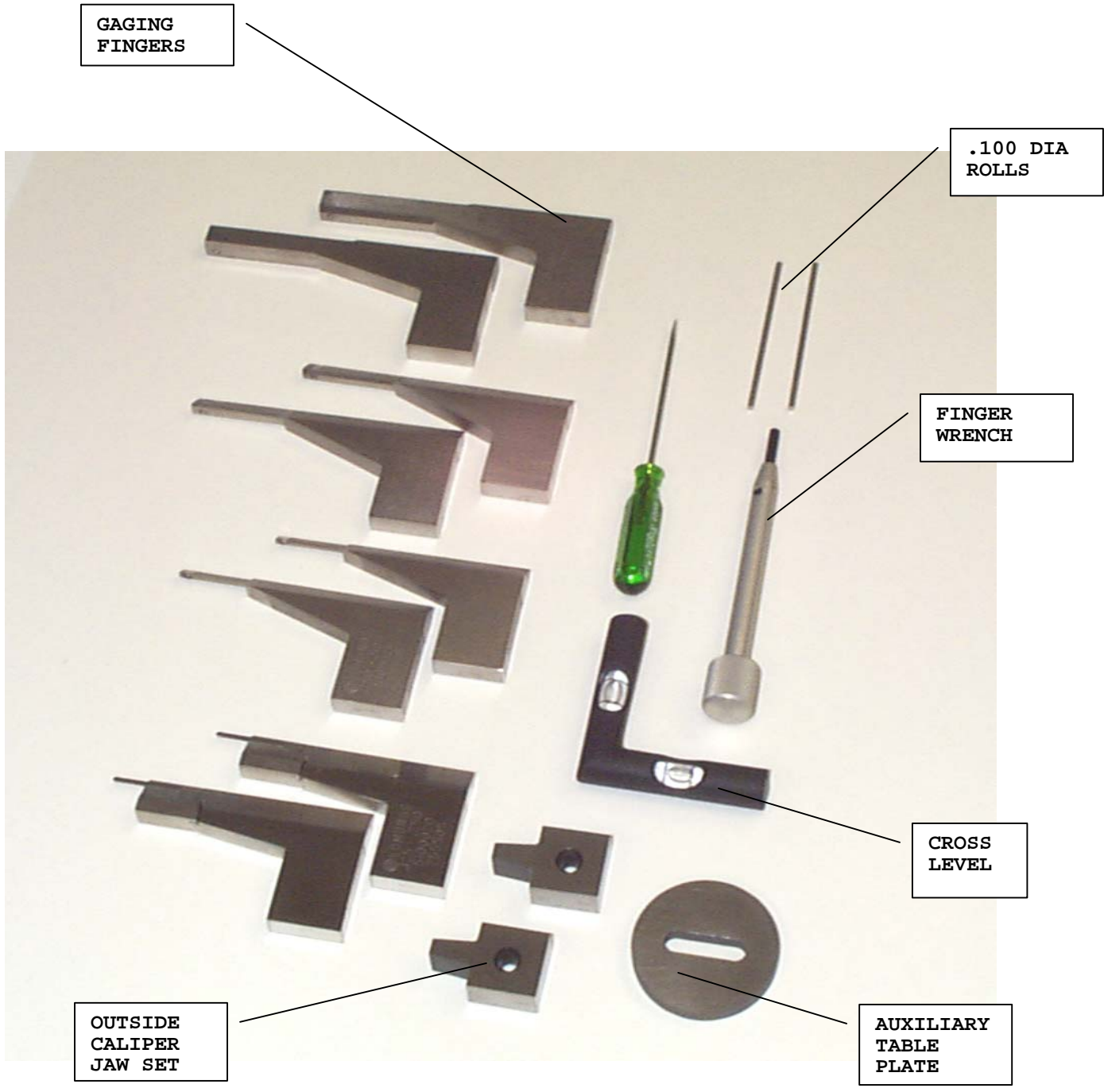


Figure 6 - Accessory Kit



Figure 7- Accessory Kit Storage

5.0 T-O-L MODEL 2010 AMPLIFIER

5.1 Introduction

The TOL2010 readout cabinet is a single transducer, third generation, high stability, low noise, solid state amplifier employing recent advances in signal conditioning technology.

The amplifier is located in view of the operator and contains a low power consuming, low heat producing circuitry required to maintain extremely high levels of accuracy.

The front panel includes a 6 character liquid crystal display for the purpose of displaying the digital measurement size as a deviation from a nominal or "zero" value. An analog "fiducial" or non-graduated indicator is also provided to display the "true" or largest measurement value when transversing the work piece through a true centerline measurement of the contact fingers.

The digital meter has a total range of $\pm 0.0016"$ or $\pm 0.040\text{mm}$, while the fiducial meter sensitivity can be switched with the use of the LOW/MED/HI push button switch. The Low switch setting provides approximately a $.002"$ scale length for rough positioning of the work piece, the MED setting provides approximately $.0005"$ scale length, while the HI switch setting provides approximately a $.0001"$ total scale length for exacting detection of microinch deviations.

INCH/MILLIMETER unit selection is accomplished with the use of a push button switch so labeled.

The MAGNIFICATION adjustment screw is accessible from the front panel of the amplifier and is used in the calibration of the comparator to gage blocks or some primary means of calibration.

The ZERO control knob is provided for use in conjunction with the auto zeroing feature of the amplifier to establish an electrical zero point for a given mechanical offset. The zero control is a 10 turn device with a range of approximately 150 counts on the digital meter.

OVER and UNDER range LED indicators signal the operator that the auto zeroing feature of the amplifier is nearing full capacity.

Attempting to auto zero the amplifier with the over under range indicator illuminated may result in being unable to bring the amplifier to electrical zero. The range indicators will illuminate any time a reading beyond a ± 1000 counts is displayed on the digital readout. Mechanical repositioning of the work piece or gaging fingers may be necessary to extinguish the range indicator.

The ZERO/NORMAL push-button enables or disables the amplifier's auto zeroing feature.

The NORMAL mode is used to defeat the auto zero function to allow the amplifier to display a raw measurement value. In the NORMAL gage operation, the zero control only effects the readout.

The ZERO mode is useful for canceling large values of mechanical or electrical offsets from the displays. This feature saves set-up time that otherwise would be spent repositioning the work piece or "dialing in" a zero value with the zero knob.

When activated, the ZERO feature will force any displayed value within a (+/-)1000 count range to within (+/-) 2 counts of zero. Any residual offset may then be resolved with the ZERO knob. To store a new auto zero value or change the position of the Inch/Millimeter switch, it is necessary to return to the normal gage mode before engaging the ZERO function.

An RS-232 connector located on the rear of the amplifier provides for connection of a serial printer for recording the current gage reading. The rear PRINT connector allows the use of the optional remote foot switch to initiate a print function.

Features Include:

- One micro inch digital resolution.
- Six digit, 0.5 inch high liquid crystal display (LCD).
- Analog meter with low, medium and high sensitivity selection.
- Inch/Metric selector with LED indicator.
- Over and Under LED indicators for out of range conditions.
- Auto zero switch with LED indicator.
- Serial printer port with front panel print switch.
- Rear panel print connector for optional foot switch.
- LVDT polarity available, protected inside the enclosure.

5.2 Specifications

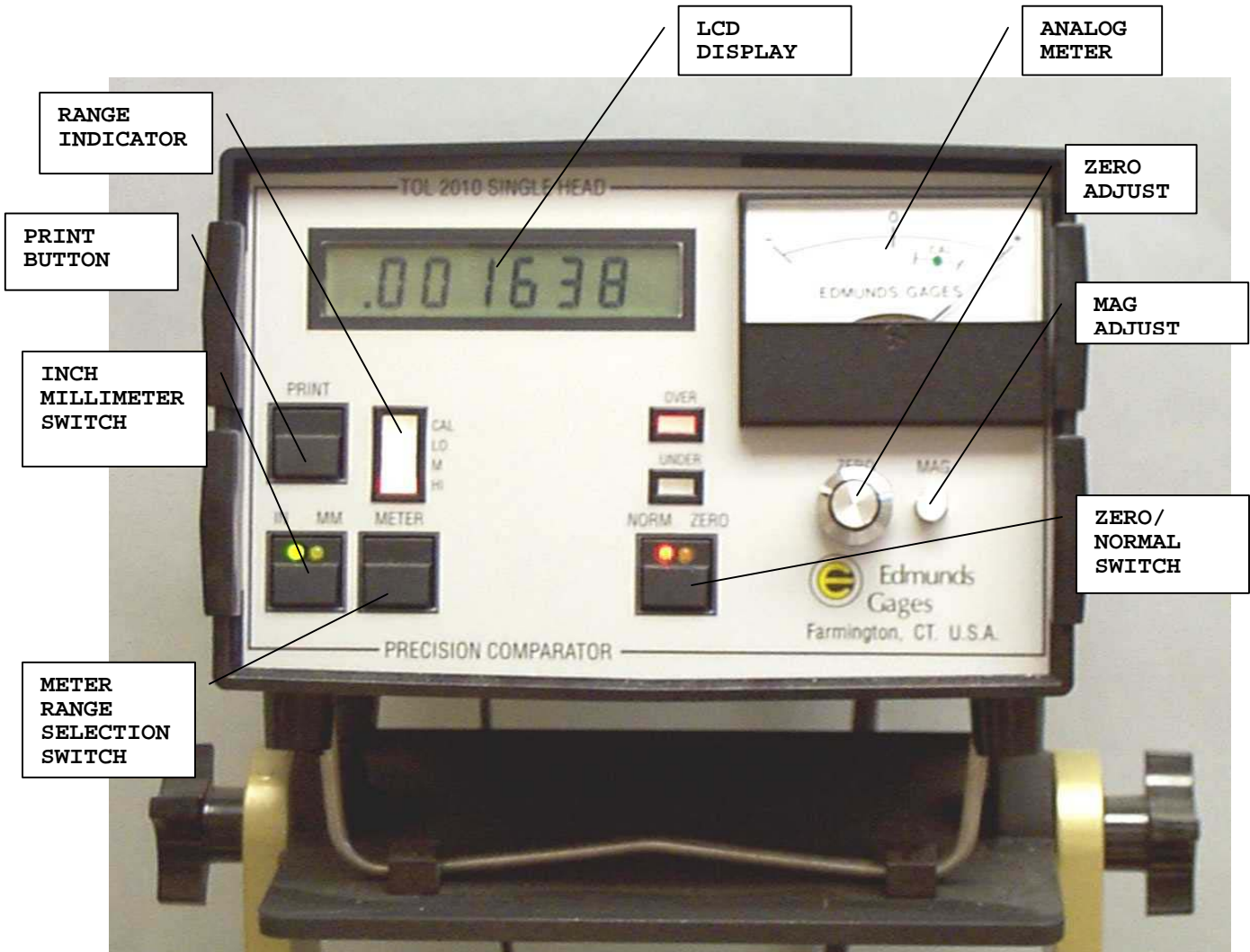
Size	6.00"H x 8.50"W x 9.25"D
Weight	4.5 lbs.
Operating Temperature Range	18 ⁰ C - 27 ⁰ C (64 ⁰ F - 81 ⁰ F)
Display	6 digit .500" High LCD
Range	(+/-) .0016" (.040 mm)
Auto Zero Range	(+/-) .0016" (.040 mm)
Zero Control Sensitivity	(+/-) 20 microinch
Meter Sensitivity	(+/-).0005"/.012mm (+/-).00025"/.006mm (+/-).0010"/.0254mm
Resolution	1 microinch, .1 micrometer
Stability	(+/-) 1 count @ 68 ⁰ 24 hr. period
Non linearity	0.25%< full scale
Line Voltage/Power	85-240 VAC @ 50-60Hz/10 Watts
Fuse Type	5mm x 20 mm - 2 Amp
Transducer Excitation	2.000 VRMS @ 5000 HZ
Recommended Transducer	Edmunds #5010100
Printer Output Connector	DB15S
Baud Rate	9600 Baud
Bits/Character	8
Start Bits	1

Stop Bits

1

Parity

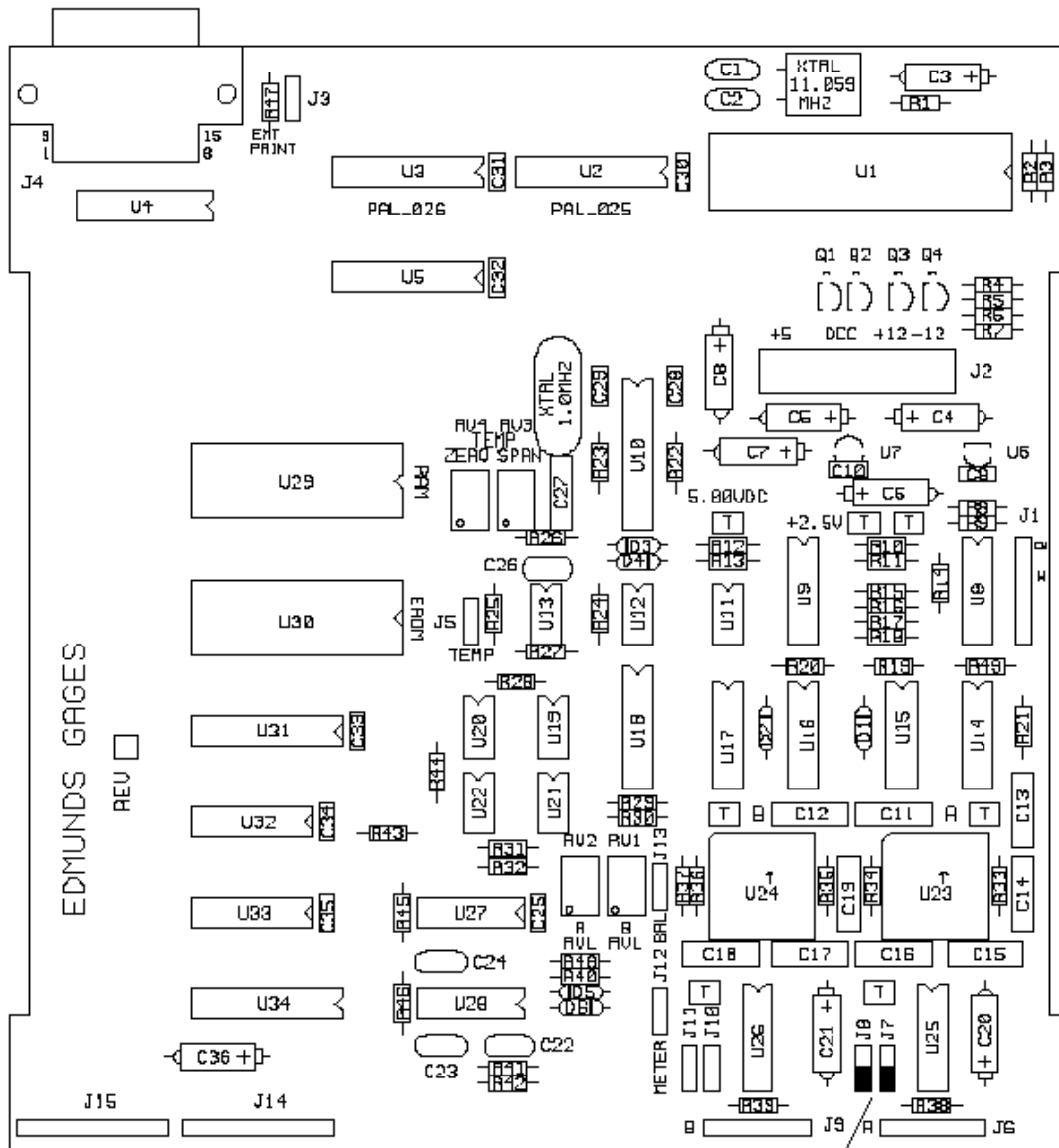
None



5.3 Figure 8 - Front Photo



5.4 Figure 9 - Rear Photo



J7, J8 JUMPERS

Figure 10 – Internal Circuit Board

5.6 T-O-L Amplifier Installation

1. Carefully unpack the readout. Place the TOL cabinet on the mounting plate.
2. Secure the TOL to the plate with the two clamps supplied.
3. Plug the power cord into the receptacle located on the back of the TOL readout and connect it to a 85-240 VAC 50/60HZ power supply.
4. Plug the gage head connector into the "LVDT" receptacle located on the rear of the TOL readout.
5. Turn the power switch located on the rear of the TOL cabinet "ON". When power is first applied to the unit, the onboard micro-controller performs a self check of the external display components. The LCD display is indexed through its numeric range and the LED indicators are turned on/off in sequence.

5.7 Amplifier Polarity

The TOL 2010 amplifier is shipped from the factory with its internal polarity jumpers set to the negative displacement mode.

By definition, negative displacement occurs when the gage head is depressed. This will cause the digital display and analog meter to reflect a negative change in readings. If for any reason positive displacement is required, it is necessary to reverse the position of jumpers J7 & J8 located on the internal motherboard of the display. Access to these jumpers requires the disassembly of the cabinet.

Cabinet disassembly is performed on a soft surface with the cabinet placed on its top. Remove the (4) Phillips head screws from the bottom of the cabinet. Turn the unit over and remove the top. The jumpers are located near the face of the front panel. (See Figure 10 Internal Circuit Board for reference).

5.8 Operation

The TOL2010 has two modes of operation:

1. Calibration mode
2. Measurement mode

5.9 Calibration Mode

5.9.1 Calibration of Operating Range

A ten-minute warm up period is recommended before any calibration is attempted.

Proper operation of the TOL 2010 amplifier requires a mechanical (+)0.002 inch offset be introduced into the comparator. This offset ensures that the LVDT sensor's operating point is located on a linear straight-line segment. Failure to properly establish this condition may result in non-linear and erroneous measurements.

To assist the operator in the calibration procedure, a special calibration scale has been included on the analog meter. This scale is utilized by activating the "Meter" switch and selecting the "CAL" mode.

To calibrate, install the #3 fingers in the comparator in the external position. This will allow the operator to utilize certified gage blocks to calibrate the comparator. Place a .100" gage block between the gaging fingers on the worktable. Adjust the finger clamps so that the fingers almost contact the gage block. Using the "METER" switch, set the analog meter to the "CAL" position.

Adjust the Size Actuator Knob until the analog meter's pointer is on the green dot of the minor "CAL" scale. The length of the minor "CAL" scale is the actual linear measurement range of the instrument. The two end markers denote the (+/-) 0.0016" range of the instrument. Hence, it is of utmost importance to remain within the limits of this scale while measuring cylindricals or other geometric pieces.

To assist the operator, electronic under/over range indicators monitor the scale limits and alert the operator if limits are exceeded. Should such a condition exist, it will be necessary to re-calibrate as described above.

5.9.2 System Calibration

The final step before use is to set the systems magnification, and check midpoint linearity. This procedure is accomplished using good quality, Class 1, 0.100", 0.1005", and 0.101" gage blocks. Using the "METER" switch, place the TOL2010 into one of the three meter sensitivity modes. Place the 0.100" block between the gaging fingers and zero the display with the "ZERO" switch.

Remove the 0.100" block and replace with 0.101" block. Adjust the "MAG" potentiometer located on the front panel until the LCD display reads exactly .001000 counts (+/- block cal. error). Repeat this procedure several times until satisfied with the "MAG" setting. Check midpoint linearity with the 0.1005" block. The resulting number should be .0005", (+/-) the block calibration error, (+/-) 4 microinches.

5.10 Measurement Mode

The instrument is now ready for use. Select the appropriate digital meter sensitivity. Follow the measurement procedure outlined in Section 7.0 in this manual.

5.11 Printer Operation

The printer port supports any serial printer. However, the selected printer must be installed with a serial option card for proper operation. Pushing the front panel print switch or closing contacts via the rear panel print connector will output the display contents via the printer port.

The port outputs standard ASCII characters, which represent the digital display contents. The output will consist of (8) numeric characters, followed by a line feed and carriage return.

Table I

(+) Reading	----->2BH
(-) Reading	----->2DH
Decimal Point	----->2EH
Characters 0-9	----->30H - 39H
Line Feed	----->0AH
Carriage Return	---->DEE

5.12 Electrical Interface

The electrical interface consists of three wires and is RS-232C compatible. Baud rate is fixed at 9600 baud, 8 bits/character, one start bit, one stop bit, no parity.

Table II

TOL2010 Serial Connector _____ Printer

PIN 2 TXD -----> RXD

PIN 3 RXD -----> TXD

PIN 5 GND -----> GND

6.0 OPERATING ADJUSTMENTS

6.1 Contact Pressure Adjustment

The contact pressure of the gaging fingers is set using the contact pressure adjustment shaft accessible from the left hand side of the machine. The shaft has a screwdriver slot for adjustment. See figure 11 below. The recommended contact pressure is 3 ounces (85 grams). The contact pressure is set using the scale and point on the left hand finger mount that can be viewed through the finger slot in the anvil. See figure 12 below. Note that one end of the scale is marked "INT" and on end of the scale is marked "EXT".

<p>NOTE: THE CONTACT PRESSURE MUST BE SET TO "INT" FOR I.D. MEASUREMENT OR "EXT" FOR O.D. MEASUREMENT.</p>

Setting contact pressure

- 1) Using a screwdriver rotate the contact pressure adjustment shaft until the pointer is aligned with the 3 ounce mark on the "INT" side of the scale for ID measurement or the 3 ounce mark on the "EXT" side of the scale for OD measurement.

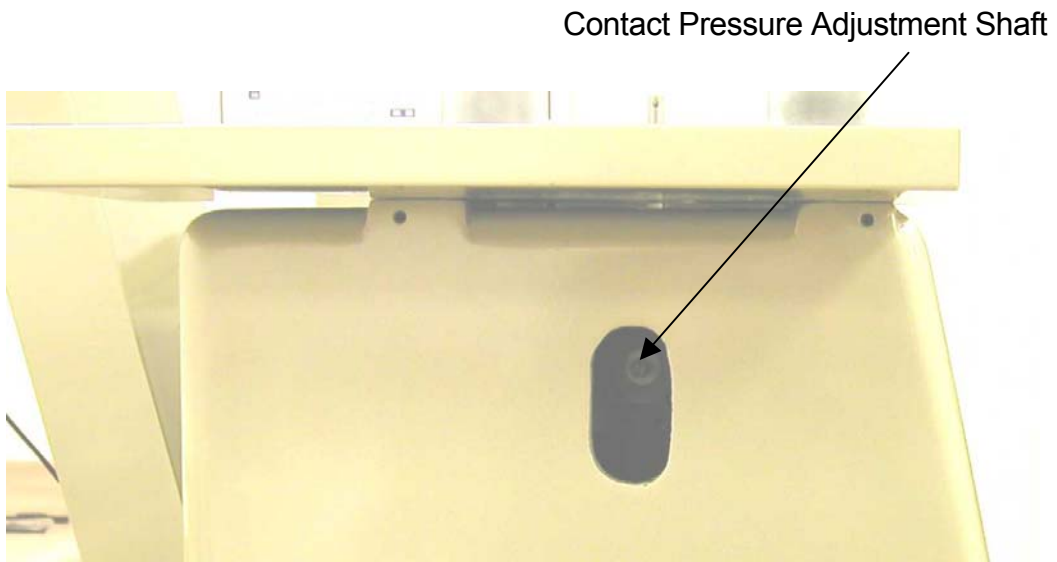


Figure 11 – Contact Pressure Adjustment Shaft

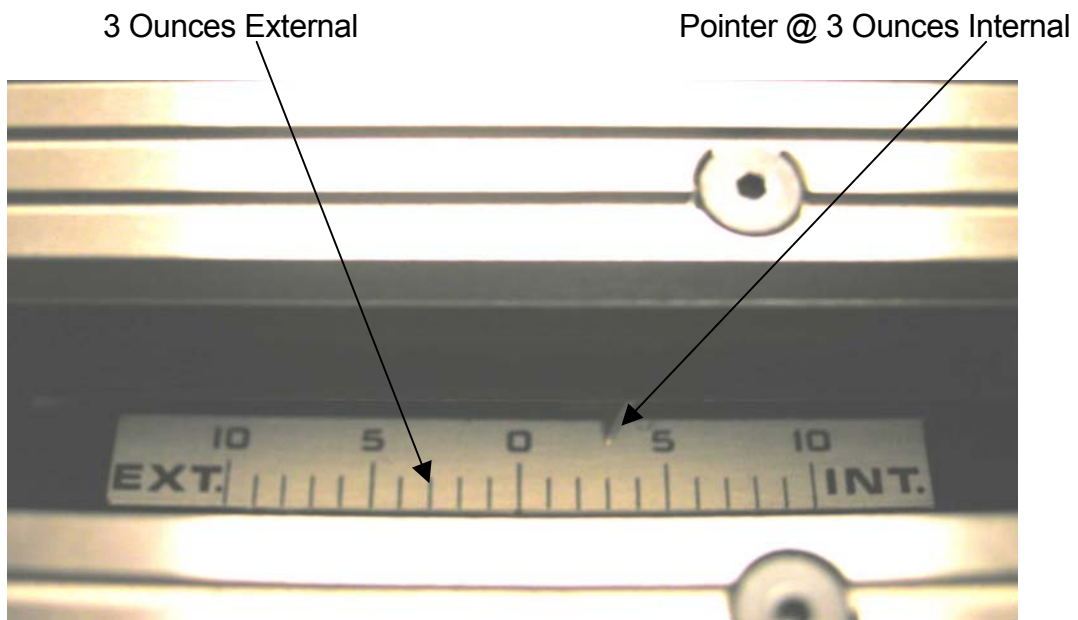


Figure 12 – Contact Pressure Scale & Pointer

6.2 Contact Finger Installation

6.2.1 Internal Finger Installation

1. Select the respective finger set for the diameter range to be measured from the accessory kit.
2. Collapse the current gaging fingers in the machine, or if there are none, the finger mounts by rotating the size actuator knob counter-clockwise to its most min position.
3. Loosen the finger clamp screws by inserting the finger wrench through the slot in the worktable. Once the screw is fully loosened, slide each finger out from under the clamp screw and lift the finger out of the comparator. **DO NOT REMOVE THE CLAMP SCREWS.** Place the fingers in their respective storage areas in the accessory kit.
4. Carefully lower the right and left fingers into the finger mounts and position them so that the contacts are positioned slightly smaller than the inner diameter to be measured. Tighten the clamp screws.

NOTE: BE SURE THE GAGING FINGER CONTACT IS POSITIONED FOR THE TYPE OF MEASUREMENT BEING TAKEN.

INTERNAL - CONTACTS FACE OUTWARD

5. Verify the gaging pressure is set for 3 ounces on the INTERNAL side of the pressure scale. See Section 6.1 for gage pressure setting.
6. Rotate the size actuator knob clockwise until the fingers expand to approximately the size to be measured. If the size actuator knob reaches the most max position and the contacts are not close to the size to be measured then return the size actuator knob to the most min position, loosen the clamp screws for the left and right contact fingers and reposition the fingers at a wider position. Rotate the size actuator knob clockwise until the fingers expand to approximately the size to be measured. Repeat if necessary.
7. Place the setting master over the contact fingers. Continue rotating the size actuator knob until the fiducial meter displays a signal near the center of the scale.

6.2.2 External Finger Installation

1. Select the respective finger set for the diameter range to be measured from the accessory kit.
2. Open the current gaging fingers in the machine, or if there are none, the finger mounts by rotating the size actuator knob clockwise to its most max position.
3. Loosen the finger clamp screws by inserting the finger wrench through the slot in the worktable. Once the screw is fully loosened, slide each finger out from under the clamp screw and lift the finger out of the comparator. **DO NOT REMOVE THE CLAMP SCREWS.** Place the fingers in their respective storage areas in the accessory kit.
4. Carefully lower the right and left fingers into the finger mounts and position them so that the contacts are positioned slightly larger than the outer diameter to be measured. Tighten the clamp screws.

NOTE: BE SURE THE GAGING FINGER CONTACT IS POSITIONED FOR THE TYPE OF MEASUREMENT BEING TAKEN.

EXTERNAL - CONTACTS FACE INWARD

5. Verify the gaging pressure is set for 3 ounces on the INTERNAL side of the pressure scale. See Section 6.1 for gage pressure setting.
6. Rotate the size actuator knob counter-clockwise until the fingers collapse to approximately the size to be measured. If the size actuator knob reaches the most min position and the contacts are not close to the size to be measured then return the size actuator knob to the most max position, loosen the clamp screws for the left and right contact fingers and reposition the fingers at a narrower position. Rotate the size actuator knob counter-clockwise until the fingers collapse to approximately the size to be measured. Repeat if necessary.
7. Place the setting master between the contact fingers. Continue rotating the size actuator knob until the fiducial meter displays a signal near the center of the scale.

7.0 MEASUREMENT PROCEDURES

7.1 Internal Diameters

1. Select the proper set of gaging fingers for the diameter size being measured and install per the installation instructions in section 6.2 making sure the contacts are facing outward.
2. Prepare a gage block set up utilizing the caliper jaws supplied with the accessory kit. Total the deviation (+ or -) of the individual gage blocks and record the reading.
3. Place the gage block set up on the table with the caliper jaws positioned over the contacts on the gaging fingers.
4. Raise the gaging fingers to position the contacts in the center of the caliper jaws.
5. Tap the gage block set up to align the finger contacts and the calipers jaws and observe the digital display. The correct alignment will occur when the display is at its most minus reading. This indicates the set up is perpendicular to the gage contacts, therefore measuring the actual set up size.
6. Utilizing the zero knob on the T-O-L display, set the reading on the display to the recorded deviation from Step 2. Press the auto zero button and remove the set up. The comparator is now calibrated for the size gage you wish to measure. To check the calibration, place the gage block set up back onto the gage and align as in Step 5. You should be able to read ".000000" on the display as your most minus reading.
7. To gage any internal diameter of the size set up, place the part over the gaging fingers. Raise or lower the gaging fingers to the desired height. Align the part in the same manner as the gage block set up. The most minus reading obtained is the deviation of the part from the size of the gage block set up.

7.2 External Diameters

1. Select the proper set of gaging fingers for the diameter size being measured and install per the installation instructions in section 6.2 making sure the contacts are facing inward.
2. Prepare a gage block set up utilizing the caliper jaws supplied with the accessory kit. Total the deviation (+ or -) of the individual gage blocks and record the reading.
3. Place the gage block set up on the table with the caliper jaws positioned over the contacts on the gaging fingers.
4. Raise the gaging fingers to position the contacts in the center of the caliper jaws.
5. Tap the gage block set up to align the finger contacts and the caliper jaws and observe the digital display. The correct alignment will occur when the display is at its most minus reading. This indicates the set up is perpendicular to the gage contacts, therefore measuring the actual set up size.
6. Utilizing the zero knob on the T-O-L display, set the reading on the display to the recorded deviation from Step 2. Press the auto zero button and remove the set up. The comparator is now calibrated for the size gage you wish to measure. To check the calibration, place the gage block set up back onto the gage and align as in Step 5. You should be able to read ".000000" on the display as your most minus reading.
7. To gage any external diameter of the size set up, place the part between the gaging fingers. Raise or lower the gaging fingers to the desired height. Align the part in the same manner as the gage block set up. The maximum reading obtained is the deviation of the part from the size of the gage block set up.

7.3 Taper of Diameters

1. Set up the comparator for the type of measurement (internal or external) for the workpiece being calibrated.
2. Place the workpiece on the worktable and position it according to the respective measurement procedure outlined in section 6.0.
3. Using the elevating mechanism, raise the contacts so they are at the uppermost position on the part.
4. Zero the TOL display. Using the elevating mechanism, lower the contacts and observe the display. Taper will be indicated as a gradual change in the readings as the contacts transverse the workpiece.

7.4 Bellmouth and Barrel Geometry

1. Set up the comparator for the type of measurement (internal or external) for the workpiece being calibrated.
2. Place the workpiece on the worktable and position it according to the respective measurement procedure outlined in section 6.0.
3. Using the elevating mechanism, raise the contacts so they are at the uppermost position on the part.
4. Zero the TOL display. Using the elevating mechanism, lower the contacts and observe the display.
5. Bellmouth Geometry will be indicated as a gradual decrease and then increase in the readings as the contacts transverse the workpiece.
6. Barrel Geometry will be indicated as a gradual increase and then decrease in the readings as the contacts transverse the workpiece.

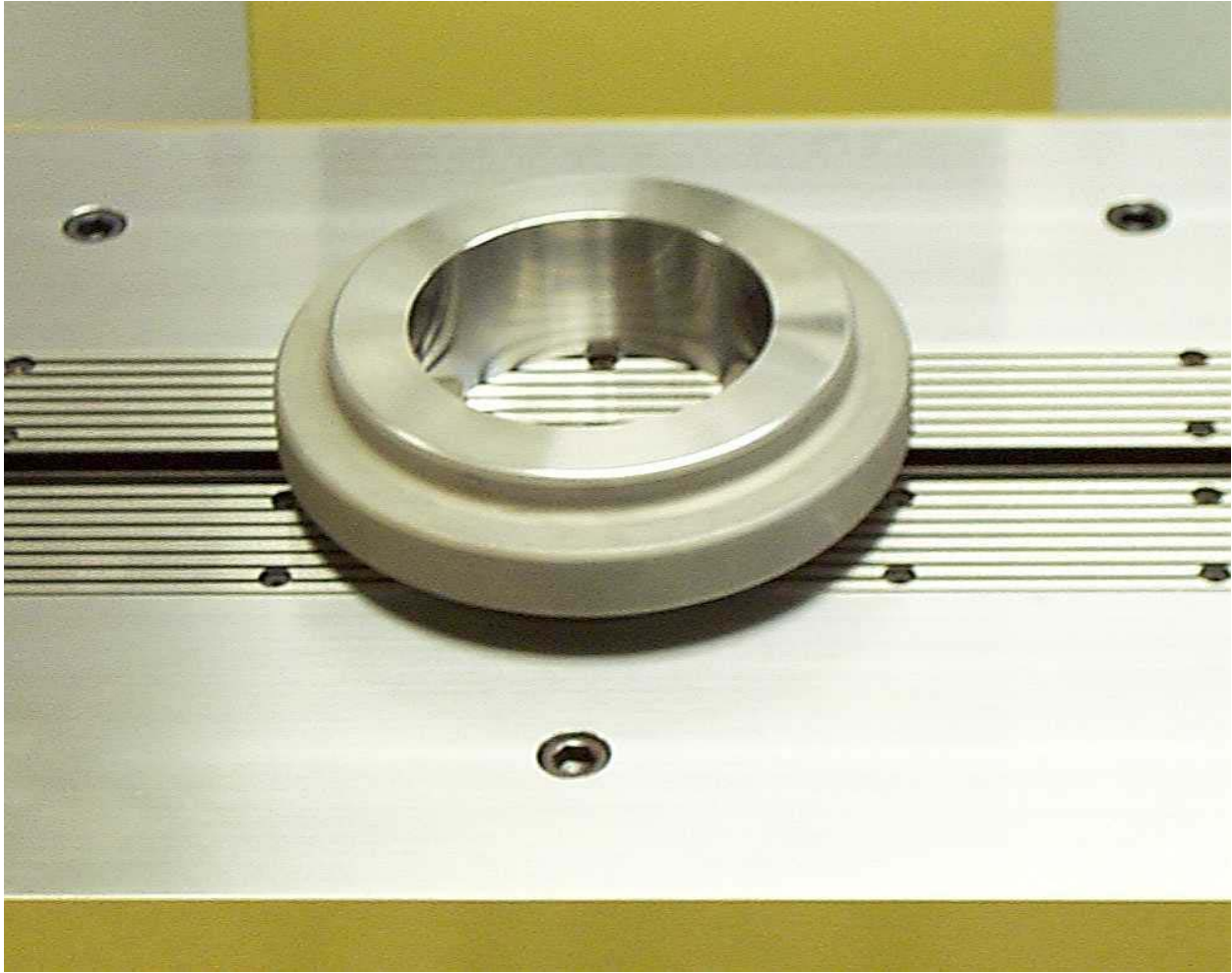


Figure 13 – Ring Gage on Work Table

8.0 MAINTENANCE

Due to the high accuracy and extreme sensitivity of the comparator, gaging pressure and magnification have a direct relationship to each other especially in the smaller gaging ranges.

After long periods of comparator use, or if the gage head has been replaced, it may become necessary to readjust the pre-travel and overtravel screws and the gage head core, all of which have a direct bearing on the comparator magnification.

NOTE: It will be necessary to remove the table to gain access to all adjustments. Removal of the front plate will also facilitate adjustment of the finger assemblies.

8.1 Pre-travel Over-travel Screw Adjustments

1. Set the TOL 2010 meter sensitivity to the +/- .001" range.
2. Disconnect the two gaging pressure springs.
3. Tighten two opposing guide screws on the left-hand finger assembly so that the assembly cannot move. Allow the gage head to "settle". It should read approximately "0".
4. By hand, move the right-hand finger assembly to the right and hold it against the stop.
5. Adjust the pre-travel screw for the right-hand finger assembly until the display reads plus (+).0007".
6. By hand, move the right-hand finger assembly to the left and hold it against the stop.
7. Adjust the over-travel screw for the right-hand finger assembly until the display reads minus (-) .0007".
8. Release the right-hand finger assembly and allow it to settle.
9. Release the two opposing guide screws on the left-hand finger assembly.
10. Repeat steps 2-8 for the left-hand finger assembly.
11. Reconnect the two gaging pressure springs.
12. Set the gaging pressure as described in Section 6.1.

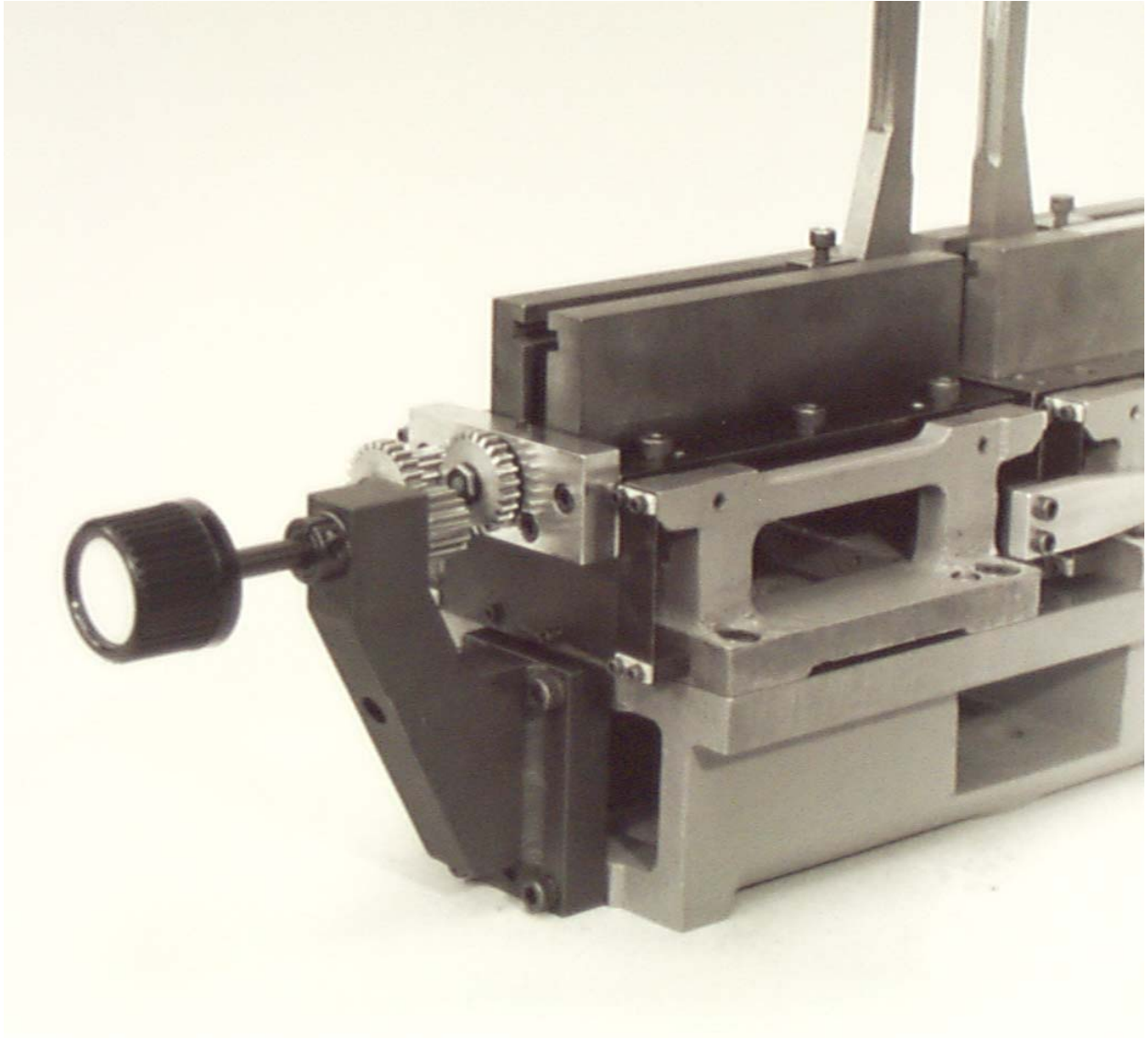


Figure 14 - Pre-Travel/Overtravel Screws

9.0 TROUBLESHOOTING

9.1 Symptoms and Causes

<u>Symptom</u>	<u>Cause</u>
Non-repeatability of Comparator Reading.	Gaging pressure too light.
	Bent reed in finger assembly.
	Gaging ball slide gummed up with a foreign substance.
	Broken/disconnected gaging pressure spring.
Non-linearity of Scale	TOL on wrong sensitivity.
	Magnification not properly calibrated.
Gaging Fingers will not raise.	Broken counterweight spring(s).
	Column lock engaged.