



INSTRUCTION & MAINTENANCE MANUAL
EDMUNDS TWIN HEAD GAGE BLOCK COMPARATOR
#5020100



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INTRODUCTION

The Edmunds Ultra Precision Twin Head Gage Block Comparator system has been designed for high accuracy comparative measurement of gage blocks. A "click stop" cam adjustment feature on the comparator combines with an automatic zero feature on the readout to provide fast, accurate contact positioning with minimal adjustments during calibration of gage block sets. An Inch/Metric position switch on the gage head allows for quick changeover between English and Metric systems.

The twin gaging diamond contacts provide true point to point measurement, eliminating gage block wringing errors. The reed mounted LVDT transducers transfer the electronic signals from intermediate diamond contacts to the TOL 2200 display.

The Edmunds Model TOL 2200 digital readout has a seven digit, .5" high LCD display with a last digit resolution of 0.0000001" or 0.00001mm. The TOL 2200 can be operated in either "Inch" or "Metric" modes and utilizes an analog meter with a low, medium or high sensitivity selection for calibration and operation.

CONTENTS:

The Edmunds Ultra Precision Twin Head Gage Block Comparator system comes complete with the following components:

- (1) Comparator Base #5020100
- (1) Digital Display #5202200
- (1) Balance Master #5020041
- (1) Setup Plate #5020032

Optional items that should be utilized with the comparator system are:

- (1) Breath Shield #5020035
- (1) Insulated Gaging Tongs
- (1) Dust Cover #5022033
- (1) Part Positioning Assembly # 5022200
- (1) Display Pedestal #5020050
- (1) Serial Printer
- (1) Serial Printer Cable # 5202207
- (1) Foot Switch # 5202208

WARRANTY

Edmunds Manufacturing warrants this product(s) to be free from defects in materials and workmanship under intended use for a period of six months from the date of shipment. We will, at our option, repair or replace any part(s) found by us to be defective, provided that said part(s) are returned to us transportation prepaid. Any downtime of this product due to a warranted failure, will extend the warranty period in an equal amount to the downtime. All products not manufactured by Edmunds will carry the original equipment manufacturer's warranty only. In no event shall Edmunds be liable for special, incidental or consequential damages, including but not limited to, loss of profits or revenue, loss of use of product of other equipment, cost of substitute equipment, down time costs, or claims of buyer's customer's for such damages, including non-contractual liabilities for personal injury or property damage.

SPECIFICATIONS

Gaging Contact to Anvil (Max)	5.000"
Throat Depth	2.68"
Anvil	6.9" x 4.0"
Gage Contacts (Diamond Tips)12" radius
Gaging Pressure	Top - 85 grams Bottom - 25 grams
Overall Height	18.75"
Weight	50 lbs.
Temperature Range	18 ⁰ C - 27 ⁰ C (64 ⁰ F - 81 ⁰ F)
Display	7 digit .500" High LCD
Range	(+/-) .0016" (.040 mm)
Auto Zero Range	(+/-) .0016" (.040 mm)
Resolution	1 tenth microinch, .01 micrometer
Stability	(+/-)1 microinch @ 68 ⁰ 24 hr. period
Non linearity	< 0.25% full scale
Power Requirements	85-240 VAC @ 50-60Hz @ 10 Watts
Printer Output Connector	DB15S
Baud Rate	9600 Baud
Bits/Character	8
Start Bits	1
Stop Bits	1
Parity	None

SAFETY PRECAUTIONS

All materials, components and assemblies described within this manual and related to the Edmunds Gage Block Comparator system have been manufactured in accordance with safety standards established by the Occupational Safety and Health Act (OSHA), Public Law 91-596 and Executive order 12196.

PREPARATION FOR USE AND INSTALLATION INSTRUCTIONS

UNPACKING:

Carefully open the carton containing the TOL 2200 display. Visually inspect the unit for damage, giving special attention to the various switches, LED's and LCD display. Also check the integrity of the external housing, making sure there are no cracks or deformities.

Unpack the comparator stand. Remove the protection pad from the upper gaging tip by loosening the head clamp knob and turning the elevating screw clockwise to raise the head.

Retain the packaging materials for future shipments or storage of the unit. The unit should never be shipped without restraining the upper gage head.

ELECTRICAL CONNECTION:

- 1.) Plug the female end of the power cord into the receptacle located on the back of the TOL 2200 display.
- 2.) Connect the male end of the power cord to a 85-240 VAC 50/60HZ power supply.

TOL CONNECTION TO COMPARATOR BASE:

- 1.) Plug the gage head connectors into their respective "LVDT" receptacles ("A" - Upper & "B" - Lower) located on the rear of the TOL 2200 display. Use the locking rings on the connectors to secure the cable to the display.

SYSTEM SELF CHECK:

- 1.) Turn the power switch "ON". When power is first applied to the TOL 2200 display, 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.

Power Cord Plug

On/Off Switch



LVDT Cable Plugs

TOL 2200 Rear Panel

AMPLIFIER POLARITY:

The TOL 2200 display is shipped from the factory with its internal polarity jumpers set to the positive displacement mode. By definition, positive displacement occurs when the upper gage head is depressed upward and the lower gage head is depressed downward. This will cause the digital display and analog meter to reflect a positive change in readings.

If for any reason negative displacement is required, it will be necessary to reverse the position of jumpers *J7* & *J8* for the "A" channel and *J10* & *J11* for the "B" channel. These are located on the internal mother board of the display. Access to these jumpers requires the disassembly of the cabinet. Cabinet disassembly should be performed on a soft surface so the case will not be scratched.

- 1.) Turn "OFF" the power switch on the rear of the TOL 2200. Unplug the power cord and LVDT connectors.
- 2.) Position the TOL 2200 so that the case is placed on its top. Remove the (4) Phillips head screws from the bottom of the cabinet. Turn the unit over and remove the top.
- 3.) Reverse the position of the jumpers. The jumpers are located near the face of the front panel.
- 4.) Once the position of the jumpers has been reversed, install the top cover. Turn the unit over and install the (4) Phillips head screws through the bottom of the cabinet to secure the top.
- 5.) To verify the polarity change, plug the power cord and LVDT connectors back into the TOL 2200. Turn the power to the unit "ON". Press up on the upper gage head tip. The display readings should reflect a negative change.

PRINTER OPERATION

The printer port supports popular printers manufactured by Epson, H-P etc. However, the selected printer must be installed with a serial option card for proper operation. Pushing the front panel print switch or using the optional foot switch via the rear panel print connector will output the display contents to the printer port.

The RS-232 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 ---->	0DH

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

TOL 2200 Serial Connector	Printer
PIN 2 TXD ----->	RXD
PIN 3 RXD ----->	TXD
PIN 5 GND ----->	GND

OPERATION INSTRUCTIONS

START UP PROCEDURE

A ten minute warm up period is recommended before any calibration is attempted. For optimum certifiable readings, the comparator should be operated in a clean, 68⁰F constant temperature, humidity controlled environment. The unit should be allowed to stabilize in the gaging environment for 24 hours before use. The master gage blocks and the blocks to be inspected should be allowed to stabilize in the same environment. For best results, gloves should be worn, a breath shield should be utilized and insulated tongs used to keep temperature variations to a minimum.

TOL 2200

- 1.) To prepare the TOL 2200 for operation, push the "NORM/ZERO" mode pushbutton until the "NORM" LED is illuminated.
- 2.) Push the "IN/MM" selection pushbutton until either the "IN" or "MM" LED is illuminated as required.
- 3.) Press the "DIGIT" selection pushbutton to select the last digit resolution you wish to utilize. The options are: 1.0 μ IN (.05 μ MM), 0.5 μ IN (.02 μ MM), 0.2 μ IN (.01 μ MM) or 0.1 μ IN (.005 μ MM).
- 4.) Push the "A/B" selection pushbutton until both the "A" and "B" LEDs are illuminated.
- 5.) The "METER" pushbutton is not utilized in the operation mode. Any of the three magnifications for the analog meter ("LO", "M" or "HI") can be utilized.
NOTE: the "CAL" mode should not be utilized while the comparator is in normal operation mode. (See photo "TOL 2200 Front" for reference)



TOL 2200 Front Panel

COMPARATOR STAND

- 1.) Loosen the column clamp by turning the large knurled steel knob located on the right rear of the upper gage head casting counterclockwise.
- 2.) Raise the upper head, using the black plastic hand wheel located on the top of the comparator stand, to a height greater than that of the gage block to be calibrated.
- 3.) Locate the "GAGE/LOAD" levers on either side of the comparator base casting. Move the lever to the "**LOAD**" position.
- 4.) Select the master block equal in size to that of the gage block to be calibrated.
- 5.) Load the master block on the anvil in the gage position.
- 6.) Locate the "GAGE/LOAD" levers on either side of the comparator base casting. Move the lever to the "**GAGE**" position.
- 7.) Lower the upper head, using the black plastic hand wheel located on the top of the comparator stand, to a position just above the master gage block.
- 8.) Tighten the column clamp by turning the large knurled steel knob located on the right rear of the upper gage head casting counterclockwise.

NOTE: MAKE SURE THE CLAMP IS SECURE. INSUFFICIENT CLAMPING FORCE WILL ALLOW THE UPPER GAGE HEAD TO MOVE CAUSING THE CALIBRATION READINGS TO DRIFT.

- 9.) Rotate the "Click Stop" cam black plastic knob located on the right side of the upper comparator head counterclockwise until the analog meter on the TOL 2200 is as close to the "**0**" position as possible.
- 10.) Press the "NORM/ZERO" switch to select the "ZERO" mode. The digital display will read "**0.000000**" and the analog meter will be on "**0**".
- 11.) Utilizing the "ZERO" knob, adjust the display to reflect the master block deviation as noted on the master block's calibration sheet.
- 12.) Locate the "GAGE/LOAD" levers on either side of the comparator base casting. Move the lever to the "**LOAD**" position.

- 13.) Remove the master block. Load the block to be calibrated into the gaging position.
- 14.) Locate the "GAGE/LOAD" levers on either side of the comparator base casting. Move the lever to the "**GAGE**" position and record the reading. If you are using a printer to record the reading, press the "*PRINT*" switch or use the optional foot switch to initiate a print.
- 15.) Position the block to the left and right to check parallelism.
- 16.) Locate the "GAGE/LOAD" levers on either side of the comparator base casting. Move the lever to the "**LOAD**" position.
- 17.) Remove the calibrated block and the master block. Load the next size master block and block to be calibrated.
- 18.) Repeat the above procedure for the remaining blocks.

NOTE: If more than one of the same size blocks is to be calibrated, the master block need not be removed.



CALIBRATION INSTRUCTIONS

The calibration procedure must be performed before initial operation of the comparator. The procedure should be performed in the order as designated in this manual.

All steps of the calibration procedure must be performed for proper calibration of the comparator.

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

INTRODUCTION

Proper operation of the TOL 2200 amplifier requires a mechanical +0.002 inch offset be introduced into each transducer of the gage block comparator stand. This offset ensures that the LVDT sensor's operating point is located on a linear, straight line segment of the voltage/distance graph.

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.

BOTTOM TRANSDUCER

- 1.) Press the "METER" switch on the front of the TOL 2200 readout cabinet until the "CAL" LED is illuminated.
- 2.) Press the "A-B" switch until just the "A" LED is illuminated.
- 3.) Press the "IN/MM" switch to select the "INCH" mode.
- 4.) Locate the "GAGE/LOAD" levers on either side of the comparator base casting. Move the lever to the "LOAD" position.
- 5.) Using insulated tongs, place a 0.100" reference block onto the comparator anvil.

- 6.) Locate the "GAGE/LOAD" levers on either side of the comparator base casting. Move the lever to the "**GAGE**" position.
- 7.) Lower the upper head, using the black plastic hand wheel located on the top of the comparator stand, contacting the 0.100" gage block.
- 8.) Using the hand wheel, adjust the position of the upper transducer until the analog meter hand points to the green calibrate dot.
- 9.) Press the "A-B" switch until just the "B" LED is illuminated.
- 10.) Observe the analog meter. If the meter hand doesn't point to the green dot, mechanical adjustment of the bottom transducer is required (see mechanical section).
- 11.) If the meter hand points to the green dot, the bottom transducer is correctly set and the primary magnification of the system may now be set.

PRIMARY MAGNIFICATION CHECK

The setting need not reflect the gage block calibration deviation at this time.

- 1.) Press the "METER" pushbutton on the front of the TOL 2200 readout cabinet until the "M" LED is illuminated.
- 2.) Press the "A-B" pushbutton until both the "A" and "B" LEDs are illuminated.
- 3.) Press the "IN/MM" pushbutton to select the "INCH" mode.
- 4.) Press the "DIGIT" pushbutton to select the "0.2" μ IN scale.
- 5.) Locate the "GAGE/LOAD" levers on either side of the comparator base casting. Move the lever to the "**LOAD**" position.
- 6.) Using insulated tongs, place a 0.100" reference block onto the comparator anvil in the gage position.
- 7.) Locate the "GAGE/LOAD" levers on either side of the comparator base casting. Move the lever to the "**GAGE**" position.
- 8.) Lower the upper head, using the black plastic hand wheel located on the top of the comparator stand, contacting the 0.100" gage block.

- 9.) Tighten the column clamp by turning the large knurled steel knob located on the right rear of the upper gage head casting counterclockwise.
- 10.) Press the "ZERO" pushbutton. The digital display should indicate **"0.000000"**. Remove the 0.100" reference block and replace it with a 0.101" block.
- 11.) The digital display should indicate **+0.0010000**. If not, adjust the front panel "MAG" control potentiometer using a small blade screwdriver until the readout matches the block size. It may be necessary to repeat this sequence several times to get the desired magnification.

BALANCE PROCEDURE

Remove the reference gage blocks from the stand and locate the Balance Master #B5020041 and the Set Up Plate Assembly #B5020032.

- 1.) Install the Set Up Plate assembly on the anvil. The Set Up plate is located on the left side of the anvil with the round pin in the top hole in the anvil and the diamond pin in the lower left hole in the anvil.
- 2.) Loosen the column clamp by turning the large knurled steel knob located on the right rear of the gold colored upper gage head casting counterclockwise.
- 3.) Raise the upper head, using the black plastic hand wheel located on the top of the comparator stand, to a height greater than that of the Balance Master Fixture.
- 4.) Locate the "GAGE/LOAD" levers on either side of the comparator base casting. Move the lever to the "LOAD" position.
- 5.) Press the "METER" switch on the front of the TOL 2200 readout cabinet until the "CAL" LED is illuminated.
- 6.) Press the "A-B" switch until just the "A" LED is illuminated.

Notice the balance fixture has a round pin which is common to both faces of the fixture. (See **Figure 1**)

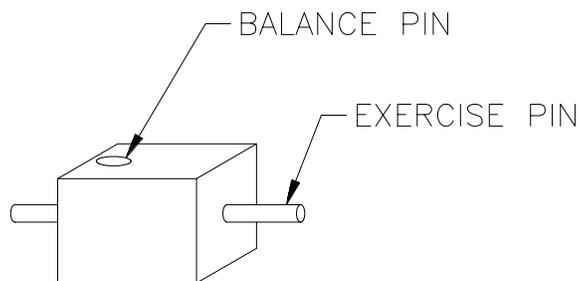


Figure 1

This pin is restrained within the block, but can travel approximately 0.0008" to 0.001" when the rod exiting from the block is pushed upon.

The movement of this pin up and down exercises both upper and lower transducers simultaneously. This is important to properly set balance.

- 7.) Locate the balance fixture on the anvil and nest it into the Set Up Plate assembly. This should align the large round pin with the upper and lower transducer contacts. See **Figure 2**.

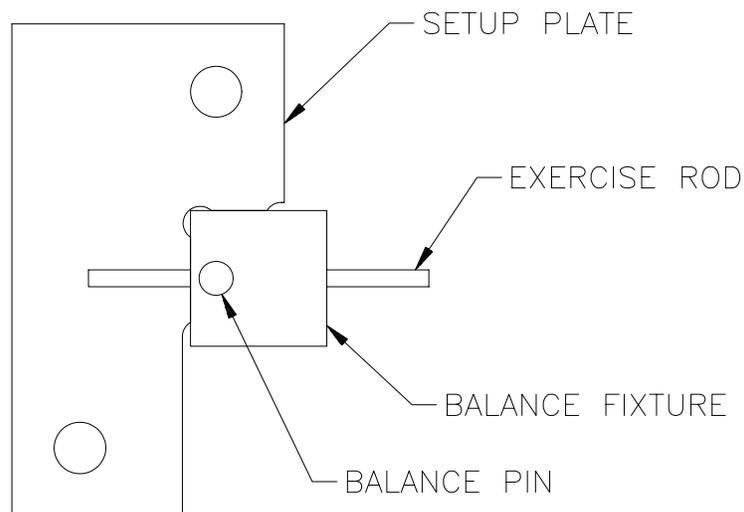
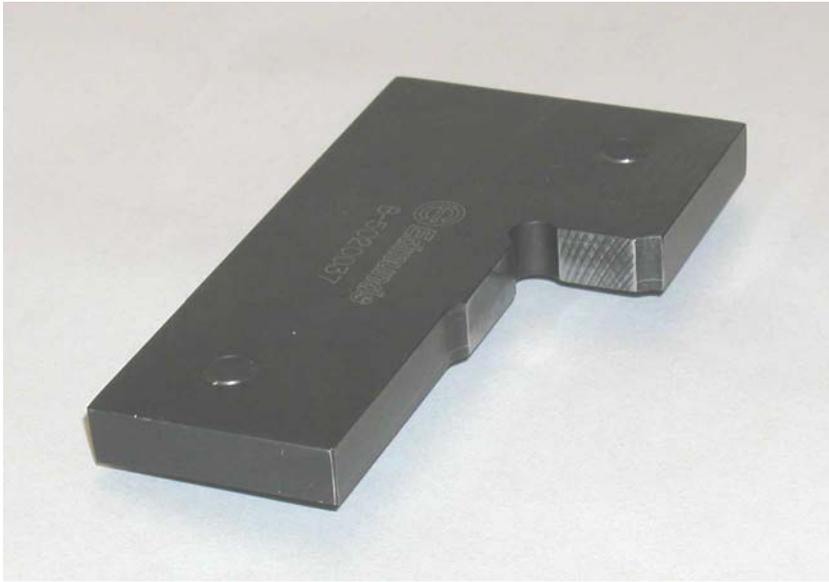


Figure 2

- 7.) Locate the "GAGE/LOAD" levers on either side of the comparator base casting. Move the lever to the "GAGE" position.
- 8.) Lower the upper head, using the black plastic hand wheel located on the top of the comparator stand, until it contacts the Balance Master.
- 9.) Continue lowering the upper transducer and clamp into position when the analog meter hand points to the green dot. Test the fixture by depressing the rod and observing the minor calibration analog scale. The movement of the pin should deflect the meter pointer between the end markers of the minor calibration scale.

- 10.) Press the "A-B" pushbutton until just the "B" LED is illuminated. Repeat the fixture test as above. Reposition the upper transducer as necessary to remain within the scale limits.
- 11.) To set the final balance press the "METER" pushbutton until the "M" LED is illuminated.
- 12.) Press the "A-B" pushbutton until both the "A" and "B" LEDs are illuminated.
- 13.) Autozero the digital display by depressing the "NORM /ZERO" pushbutton until the "ZERO" LED is illuminated.
- 14.) Move the Exercise Rod in an up and down motion and observe the digital readout. If balance is properly set, the movement of the pin will not cause the digital display to vary by more than 2 microinches.
- 15.) If a larger movement is observed, it will be necessary to adjust the **"BAL B"** balance potentiometer located on the rear panel of the TOL 2200 readout. (See photo "TOL 2200 Rear" for reference).
- 16.) Using a small blade screwdriver, rotate the control by one turn.
- 17.) Repeat steps 13 and 14. If the observed reading increases, rotate the balance control in the opposite direction and repeat the above procedure. When the displayed number approaches 2 microinches or less, the unit is in balance.
- 18.) Locate the "GAGE/LOAD" levers on either side of the comparator base casting. Move the lever to the **"LOAD"** position.
- 19.) Remove the Balance Master and the Set Up Plate Assembly upon completion of balancing.



Setup Plate #5020032



Balancing Master #5020041

CALIBRATION OF THE OPERATING RANGE

- 1.) Place a 0.100 inch reference block into position on the anvil.
- 2.) Locate the "GAGE/LOAD" levers on either side of the comparator base casting. Move the lever to the "**GAGE**" position.
- 3.) Loosen the column clamp by turning the large knurled steel knob located on the right rear of the upper gage head casting counterclockwise.
- 4.) Lower the upper head, using the black plastic hand wheel located on the top of the comparator stand, until it contacts 0.100" gage block.
- 5.) Continue lowering the upper transducer and clamp into position when the analog meter hand points to the green dot of the minor "CAL" scale when contacting the gage block. Then reclamp the comparator stand.

★ **NOTE:** When reclamping the comparator stand, it is good practice to adjust the elevating screw slightly past the green dot, then take up the backlash. This final step eliminates the possibility of mechanical drift.

System Calibration:

The final step before use is to set the systems magnification, and check midpoint linearity. This procedure is accomplished using good quality, Grade 1, 0.100", 0.1005", and 0.101" gage blocks.

- 1.) Press the "METER" pushbutton until the "M" LED is illuminated.
- 2.) Locate the "GAGE/LOAD" levers on either side of the comparator base casting. Move the lever to the "**LOAD**" position.
- 3.) Place the 0.100" block on the anvil.
- 4.) Locate the "GAGE/LOAD" levers on either side of the comparator base casting. Move the lever to the "**GAGE**" position.
- 5.) Autozero the digital display by depressing the "NORM /ZERO" pushbutton until the "ZERO" LED is illuminated.
- 6.) Locate the "GAGE/LOAD" levers on either side of the comparator base casting. Move the lever to the "**LOAD**" position.

- 7.) Remove the 0.100" block and replace with the 0.101" block.
- 8.) Locate the "GAGE/LOAD" levers on either side of the comparator base casting. Move the lever to the "**GAGE**" position.
- 9.) Using a small blade screwdriver, adjust the "MAG" potentiometer located on the front panel of the TOL 2200 until the LCD display reads exactly .0010000 counts (+/- the block calibration error).
- 10.) Alternate the 0.100" block and the 0.101" block several times until satisfied with the "MAG" setting.
- 11.) Check the midpoint linearity with the 0.1005" block. The resulting number should be .0005", (+/-) the block calibration error, (+/-) 2 micrometers.

Upon completion of the calibration procedure, the system is ready for operation.

MAINTENANCE AND SERVICE INSTRUCTIONS

COMPARATOR STAND

UPPER GAGE HEAD ADJUSTMENTS

The upper gage head adjustments are accessed by removing the upper gage head cover on the upper gage head.

- 1.) Loosen and remove the three Button Head Cap Screws which hold the upper head cover to the upper head.
- 2.) Remove the upper head cover by sliding it towards the operator.

Over Travel

- 1.) Locate the "GAGE/LOAD" levers on either side of the comparator base casting. Move the lever to the "**GAGE**" position.
- 2.) Press the "NORM/ZERO" pushbutton until the "NORM" LED is illuminated.
- 3.) Turn the "ZERO" knob at its midpoint setting.
- 4.) With the gage head in the free state (no contact with the anvil or block), loosen the locking screws holding the steel discs in position.
- 5.) Rotate the discs to a position where the display is over range in the minus direction: approximately (-)0.002". Tighten the locking screws.

Contact Pressure

- 1.) Using a gram force gage under the diamond gaging contact, lift the gage head off the pick up point and take the reading at "ZERO" on the meter. The contact pressure should be set to approximately 60 grams.
- 2.) Adjust the tension screw "A" located on the top of the gage head until the proper reading is obtained.
- 3.) Install the upper head cover by sliding it towards the comparator stand.
- 4.) Install and tighten the three Button Head Cap Screws that hold the upper head cover to the upper head.

LOWER GAGE HEAD ADJUSTMENTS

The lower gage head is identical mechanically to the upper head. The over travel stops have been factory preset to stop the head at approximately -0.002" from zero. The bottom diamond contact should protrude through the anvil 0.002". When the contact is depressed with a block flush with the anvil, the analog "CAL" meter hand should be on the green dot.

Gage Contact Travel

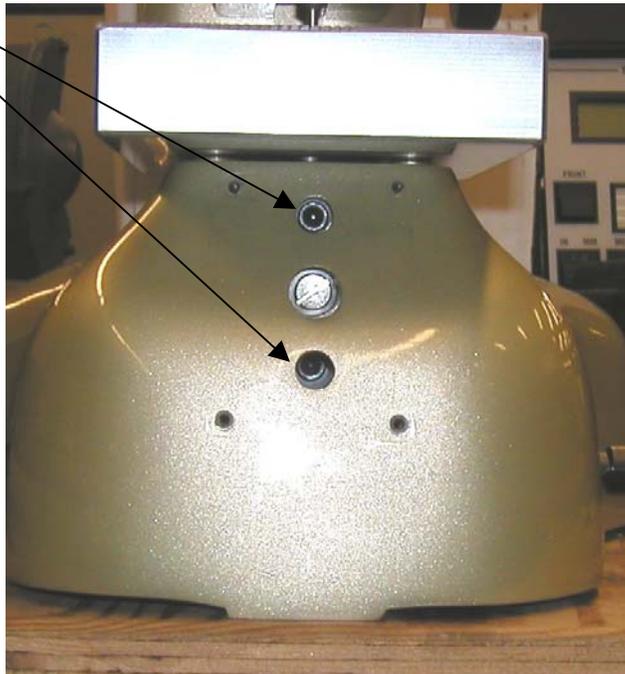
- 1.) Press the "METER" switch on the front of the TOL 2200 readout cabinet until the "CAL" LED is illuminated.
- 2.) Press the "A-B" switch until just the "B" LED is illuminated.
- 3.) Locate the "GAGE/LOAD" levers on either side of the comparator base casting. Move the lever to the "GAGE" position.
- 4.) Remove the four screws which hold the lower cover plate on the front of the gage base. Remove the cover plate to expose (3) counterbored screws. (See photo "[Gage Base Adjustments](#)" for reference)
- 5.) The top and bottom screws are the locking screws. The middle screw holds the gage head in position under spring tension and allows for fine adjustment. **DO NOT** remove this screw unless the lower gage head must be removed from the gage base for replacement or to set the overtravel stops.
- 6.) Loosen the top and bottom screws slightly.
- 7.) Position the gage base on a bench so that it overhangs the edge, allowing access to the large slotted screw on the bottom of the gage base. (See photo "[Internal Gage Base](#)" for reference).
- 8.) Press the "A-B" switch until just the "A" LED is illuminated.
- 9.) Place a gage block into gaging position. Using the elevating screw, lower the gage head until the analog "CAL" meter hand is on the green dot. This will hold the gage block flush on the anvil.
- 10.) Press the "A-B" switch until just the "A" LED is illuminated.

- 11.) Carefully turn the slotted adjusting screw until the analog "CAL" meter hand is on the green dot.
- 12.) Remove the gage block and observe if the reading goes off scale. If not, the overtravel requires adjustment. Repeat to check the settings. If acceptable, tighten the locking screws and replace the cover plate.

Contact Pressure

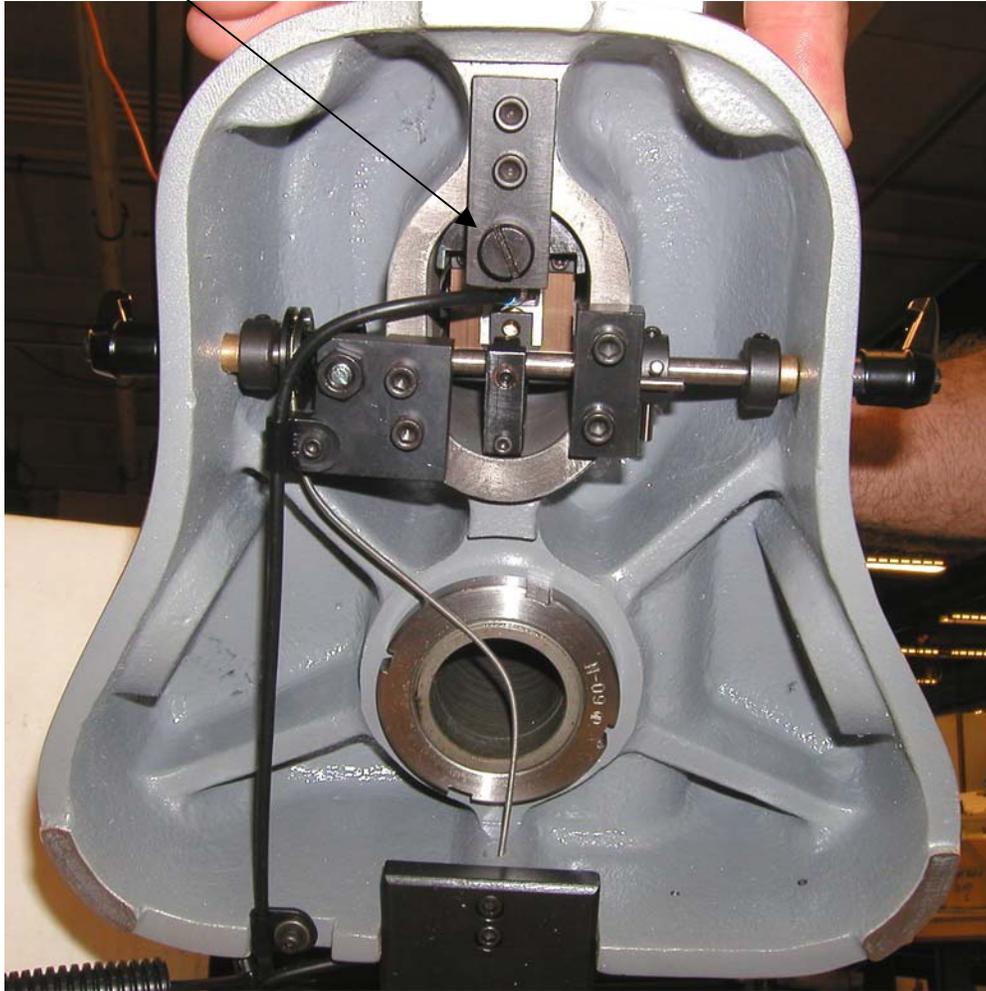
- 1.) Using a gram force gage over the diamond gaging contact, push the gage head off the pick up point and take the reading at "ZERO" on the meter. The contact pressure should be set to approximately 30 grams.
- 2.) Adjust the tension screw "A" located on the top of the gage head until the proper reading is obtained. The adjusting screw is accessible by positioning the gage base so that it overhangs the edge of the bench.

Locking Screws



Gage Base Adjustments

Slotted screw



Internal Gage Base

TOL 2200

The TOL 2200 readout is a self contained unit which houses factory serviceable components only. All adjustments to the TOL 2200, with the exception of polarity reversal, are accomplished with a small blade screwdriver on the outside of the cabinet.

Any internal component failure will necessitate the return of the unit to Edmunds Manufacturing for service.



TROUBLESHOOTING

The foremost step in the troubleshooting procedure is to identify the problem and its source. Do this by observing the symptoms and noting each. Ensure all adjustments and calibration procedures have been followed when troubleshooting.

MECHANICAL CONSIDERATIONS

<u>Description</u>	<u>Probable Cause</u>	<u>Recommended Action</u>
Gage Heads don't Move from Load To Gage	Broken/bound up cable assembly	Check cable, cable clamps, cams for damage or out of adjustment.
	Improperly set Over travels	Follow upper and lower head adjustment procedure.
Inconsistent readings	Loose Gaging Tip	Tighten gaging tip.
	Insufficient gage contact pressure	Check the upper and lower gage heads for the proper contact pressure.
	Damaged gaging Contact(s)	Check the diamond contacts for damage.
Drifting Readings	Insufficient gaging pressure	Check the upper and lower gage heads for the proper contact pressure.
	Upper head loose	Tighten upper head clamp.
	Gage contact position	Check to see if the gage contact lever is in the "GAGE" position.
Gage head bottoms out	Incorrect block sizes	Check that the master block size is the same as the block to be calibrated.
	Improperly set Over travels	Follow upper and lower gage head adjustment procedures.

ELECTRICAL CONSIDERATIONS

Description	Probable Cause	Recommended Action
TOL is blank	No line power	Check 120VAC power supply
	Poor power cable connection	Inspect power cable connections
	Blown Fuse	Check 2 Amp fuse on rear of TOL cabinet
LCD Digital Display does not read in "A" mode	Gage head connections	Check the connections on the rear of the TOL to see if the upper gage head is plugged into the "A" port
LCD Digital Display does not read in "B" mode	Gage head connections	Check the connections on the rear of the TOL to see if the lower gage head is plugged into the "B" port

OVERHAUL INSTRUCTIONS

UPPER CONTACT TIP REPLACEMENT

- 1.) Loosen the column clamp by turning the large knurled steel knob located on the right rear of the gold colored upper gage head casting counterclockwise.
- 2.) Raise the upper head, using the black plastic hand wheel located on the top of the comparator stand, to a height where the upper head is accessible.
- 3.) Loosen and remove the three Button Head Cap Screws which hold the upper head cover to the upper head.
- 4.) Remove the upper head cover by sliding it towards the operator.
- 5.) Using a 1/4" open end wrench, loosen the contact tip by turning it counterclockwise. Unscrew the tip by hand and remove it from the gage head assembly.
- 6.) Install the replacement contact tip by hand, screwing it into the gage head assembly clockwise.
- 7.) Tighten the tip using the 1/4" open end wrench. **DO NOT** over tighten as this may distort the head or strip the threads out of the aluminum body.
- 8.) Perform the Upper Gage Head Adjustments: "Gage Contact Travel" and "Contact Pressure".
- 9.) Install the upper head cover by sliding it towards the comparator column.
- 10.) Install and tighten the three Button Head Cap Screws which hold the upper head cover to the upper head.
- 11.) Calibrate the comparator system.

LOWER CONTACT TIP REPLACEMENT

- 1.) Loosen the column clamp by turning the large knurled steel knob located on the right rear of the gold colored upper gage head casting counterclockwise.
- 2.) Raise the upper head, using the black plastic hand wheel located on the top of the comparator stand, to a height of approximately 12".
- 3.) Using a 5/32" hex key, loosen and remove the three #10-32 SHCS which hold the anvil to the gage base.
- 4.) Carefully raise the anvil off the gage base.
- 5.) Using a 1/4" open end wrench, loosen the contact tip by turning it counterclockwise. Unscrew the tip by hand and remove it from the gage head assembly.
- 6.) Install the replacement contact tip by hand, screwing it into the gage head assembly clockwise.
- 7.) Tighten the tip using the 1/4" open end wrench. **DO NOT** over tighten as this may distort the head or strip the threads out of the aluminum body.
- 8.) Carefully position the anvil with the hole in the center of the anvil over the contact tip. Lower the anvil straight down on the gage base.
- 9.) Using a 5/32" hex key, install and tighten the three #10-32 SHCS which hold the anvil to the gage base.
- 10.) Perform the Lower Gage Head Adjustments: "Gage Contact Travel" and "Contact Pressure".
- 11.) Calibrate the comparator system.