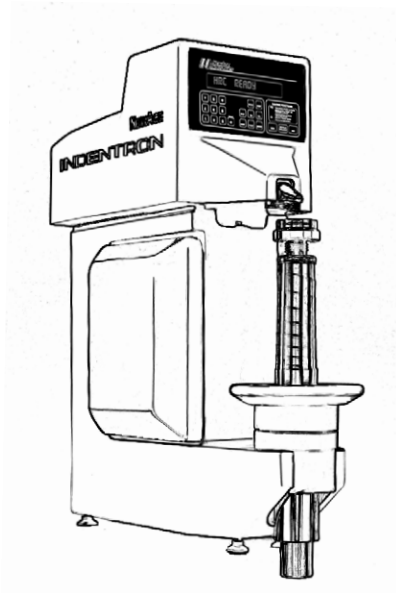


# **INDENTRON®**

## **Rockwell Hardness Testing System**



### **NI400 SERIES OPERATION MANUAL**

V 4.2 3/00







# Contents

1.1 Initial Set-up.....	8
1.2 Assembling Proportional Weights .....	10
1.3 Attaching the Power Cord and Printer Cable .....	10
1.4 Tester Diagram.....	11
2.1 General Procedure.....	12
2.1.1 Basic Operation.....	12
2.1.2 Operation with Motorized Elevating Screw .....	13
2.1.2.1 Keypad Operation for Motorized Elevating Screw .....	13
2.1.2.2 Operating Procedure for Motorized Elevating Screw.....	13
2.1.3 Changing Scales .....	14
2.1.3.1 Changing Scale Displays .....	14
2.1.3.2 Changing Indenters.....	15
2.1.3.3 Changing Loads.....	15
2.1.3.4 Calibration .....	15
2.2 Vee Anvil Alignment.....	16
2.2.1 Checking Vee Anvil Alignment (for Testing Rounds) .....	16
2.2.2 Vee Anvil Adjustment.....	16
2.3 Advanced Digital Keypad Procedures .....	17
2.3.1 List of Individual Key Functions.....	17
2.3.2 Security Code Procedure .....	18
2.3.3 Tolerance (TOL) Key Function .....	19
2.3.4 Statistic (STAT) Key Functions.....	20
2.3.5 Convert (CONV) Key Functions.....	22
2.3.6 Print Key Functions.....	23
2.3.6.1 Sample Printouts .....	26
2.3.7 Mode Key Functions.....	27
2.3.8 Calculation (CAL) Key Functions.....	30
2.3.9 Zero Set (O SET) Key Function (Optional) .....	32
2.3.10 Scale Select.....	33
2.3.11 Digital Readout Codes .....	33
2.3.11.1 Normal Operation Display Codes .....	34
2.3.11.2 Operation Error Codes .....	34
2.3.11.3 Error Messages .....	34
3.1 Test Stand Specifications .....	35
3.1.1 Test Force .....	36
3.2 Power Requirements .....	36
3.3 Electronic Output Specifications .....	36
3.4 Standard Accessories .....	36
3.5 SPARE PARTS AND ACCESSORIES.....	37
4. TROUBLESHOOTING AND MAINTENANCE.....	39
4.1 Maintenance Procedures .....	39
4.2 Troubleshooting.....	39
4.2.1 Pre-trouble Shooting Check List .....	39
4.2.2 Error Codes.....	39

5. SERVICE AND REPAIRS .....	40
5.1 How to get help or order service .....	40
5.1 Troubleshooting Checklist .....	41
6. Reference Tables, ASTM E-18.....	44
6.1 Rockwell Scale Setup Reference Table .....	44
6.2 Superficial Rockwell Scale Setup Reference Table .....	44
6.3 Minimum Thickness Requirement.....	45
6.4 Round Correction Table.....	45
6.5 Hardness Conversion Chart, High Range.....	46
6.6 Hardness Conversion Chart, Low Range.....	46
APPENDIX A: Optional Software Features.....	48
A1. Print Options .....	48
A2. Tolerance Options .....	48
A3. Round Corrections Option.....	48
A4. Scale Select Option .....	49
A5. Split Memory Option .....	49
A6. Alpha-Numeric Characters for Lot Number/Split Memory Option .....	50
ONE YEAR LIMITED WARRANTY.....	52



# 1. INSTALLATION INSTRUCTIONS

## 1.1 Initial Set-up

1. After the crate is removed from around the tester, a bolt, which holds the tester to the skid, needs to be removed from the bottom front of the tester. Then the tester can be lifted onto the workbench either using two people lifting from the bottom of the tester or using a crane with two nylon reinforced straps under the base.

**DO NOT LIFT THE INDENTER NOSE!!!!**

Note: If at any time the unit needs to be moved, always remove the indenter and the weights and sandwich a rubber strip between the indenter and the top of the anvil.

2. Locate the tester on a benchtop with firm support free from vibration. There is no need to have a hole cut into the top of the bench since the elevating screw will hang over the front of the benchtop. The bench height should be between 25" for seated and 32" for standing operation

3. Remove the top canopy screw and lift off the canopy, making sure to avoid damaging the electronic display.

4. Turn the handwheel counterclockwise to lower the elevating screw so the rubber packing between the anvil and indenter nose can be removed.

5. Remove all elastic bands and packing material from inside the machine.

6. Leveling: Lower the elevating screw with the handwheel about 3" and fit the 70 mm dia. flat anvil into the hole on the top of the elevating screw. With a bubble level on the anvil adjust the level with the leveling feet, making certain all levelling feet make firm contact with the support table to prevent rocking.

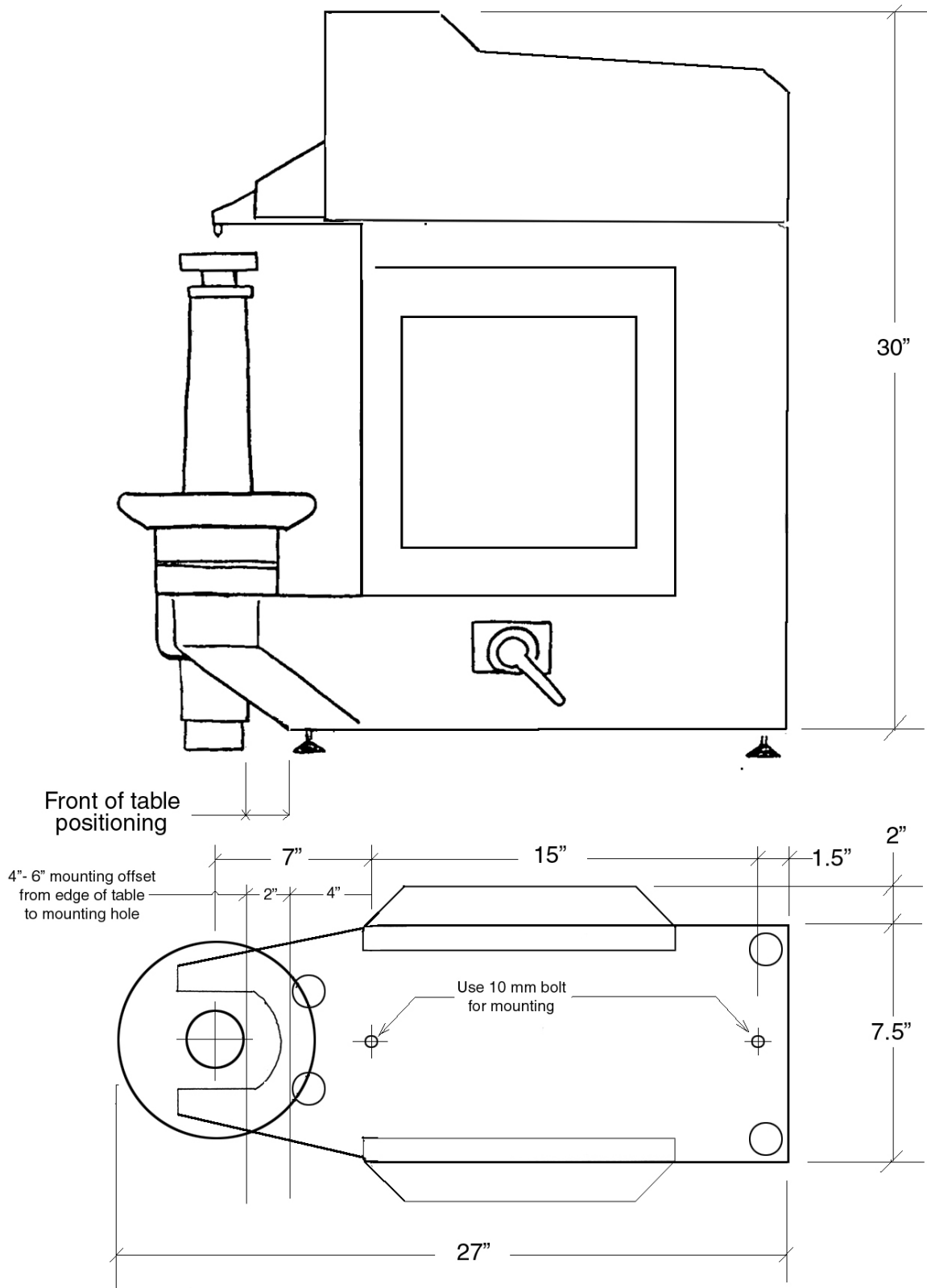
7 Hookup the power supply: Single phase AC, 115V, 60 Hz, 5 amp

8: Attach the printer cable. Printer cables are supplied with testers that have been sold with printers. The cable connects to the back of the tester.

# INDENTRON

## MOUNTING AND ENVELOPE DIMENSIONS

NOTE: Dimensions are approximate except for mounting hole spread  
Not drawn to scale

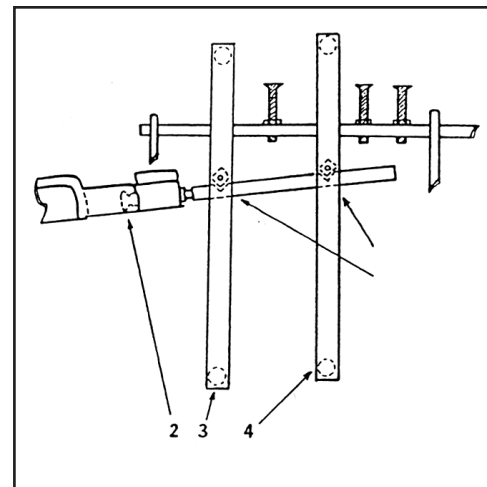
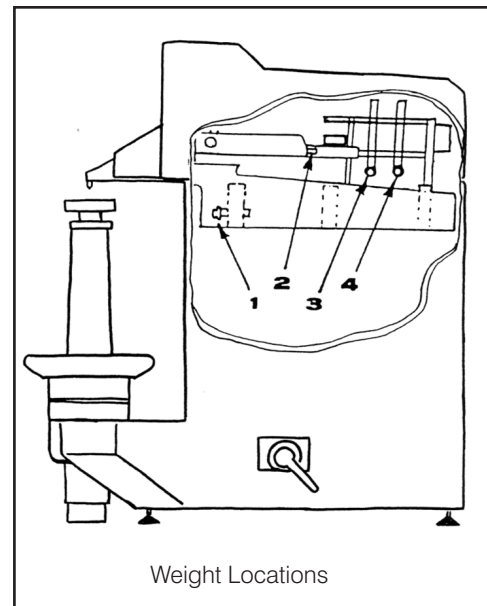


## 1.2 Assembling Proportional Weights

There are four weight assemblies for Regular and Combination models (three in Superficial only models). For identification they are numbered 1 to 4 in 1/16" tall figures on the top surface of each weight. Please check to verify that the serial numbers on the weights match those of the tester. The serial number is located inside the access doors on the side of the machine at the top right-hand side of the machine frame casting.

These weight assemblies should be assembled in numerical order: number 1 at the front of the tester and number 4 in the rear.

1. If the canopy screw has not been removed, remove it now and lift the canopy upward and slightly forward to clear the digital display.
2. Turn the load change knob counterclockwise to the 15/60 kg load position.
3. Fit the No. 1 weight first (only present on Regular and Superficial units). Lift the weight and position on the lower of the two levers, at the front, with the weight ring's knife edge set in the turned groove of the weight hanger. (See drawing for weight positions.)
4. Fit weight No. 4 next for convenience, then 3 and finally No. 2. Weight No. 2 fits as weight No. 1 but to a similar hanger on the top lever. Weights 3 and 4 hook between shake-proof nuts in the weight hangers on the top lever. Ensure that the square knives in the weight hangers are properly located in the vee grooves.
5. Refit the canopy again with the load change knob in the 15/60 kg position.
6. Centralize the canopy about the indenter nose and finally pull the canopy forward to ensure that it clears the main bottom lever. Replace and tighten the canopy screw.

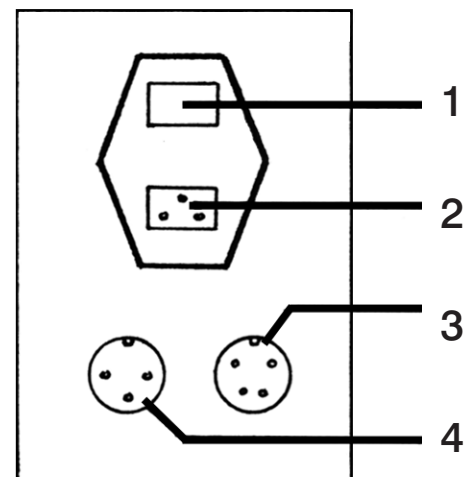


## 1.3 Attaching the Power Cord and Printer Cable

Printer cables are supplied with testers that have been sold with printers. Both power and printer connectors are located on the back of the tester.

Back Panel

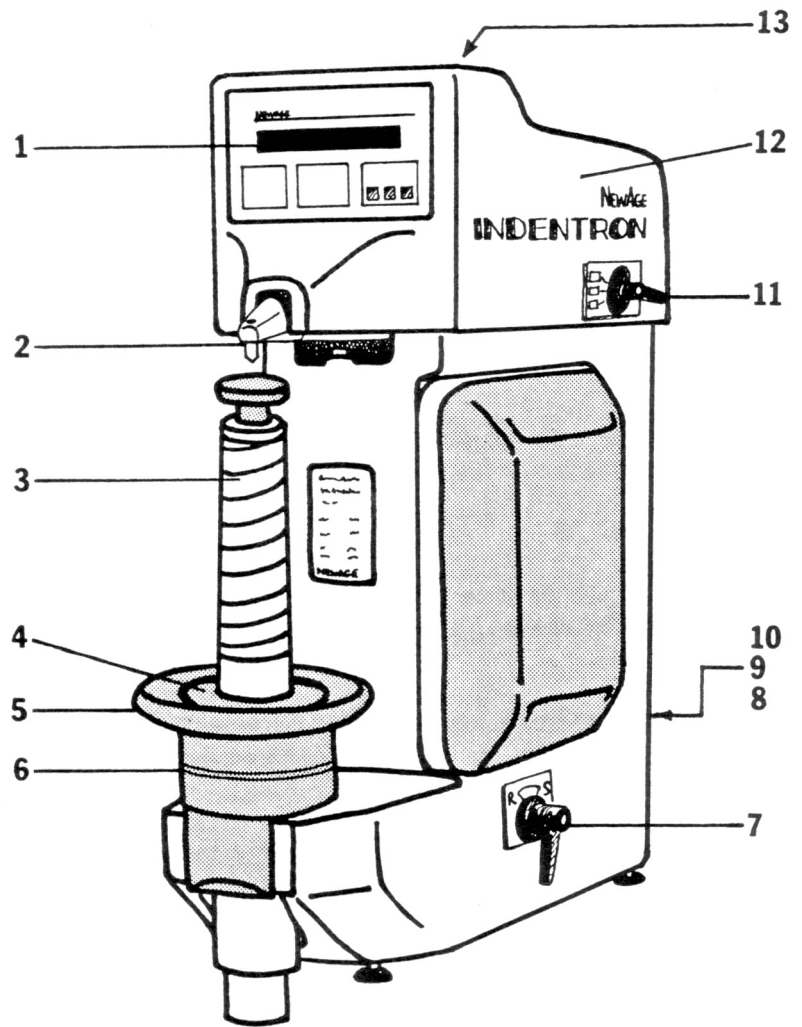
1. ON/OFF switch/Fuse
2. Power Supply Connector
3. Printer Connector
4. Remote Start Connector



## 1.4 Tester Diagram

NI-400 Series

1. Display/keypad
2. Indenter Area
3. Elevating Screw
4. Handwheel cover Plate
5. Handwheel
6. Elevating Bearing Cover
7. Range Lever (Combination Units)
8. ON/OFF Switch/Fuse
9. Printer Connector
10. Remote Start Connector (Optional)
11. Load Selector Lever
12. Canopy
13. Canopy Screw



## **2. TESTER OPERATION**

### **2.1 General Procedure**

This tester uses the standard test method for Rockwell and Superficial Rockwell hardness testing per ASTM E-18.

#### **2.1.1 Basic Operation**

1. Turn power switch on (back of the tester). The display will read

SELF TEST

2. After a few seconds the display will change to show the scale and status, for example:

HRC SET

3. Install the proper indenter, either the diamond or the ball indenter using the Allen screw or thumb screw provided.

Note The indenters are stored inside the door on the left side of the tester. They are threaded into place.

4. Set the Superficial or Regular Rockwell load range with the lever on the lower right side of the tester. This is for proper selection of pre-load. Set the proper full load with the knob on the upper right side of the tester. (See the following section on changing scales.)

5. Select an anvil the best supports the test piece and place it on the elevating screw. Make certain all contact points are clean.

6. Place test piece on the anvil and raise the elevating screw using the handwheel. Make contact with the indenter slowly and without shock. Continue raising the elevating screw until a series of dashes appear, one by one, on the display. They appear like this:

- - - -

Note: If the unit has a motorized elevating screw, refer to Section 2.1.2.

7. Continue turning the handwheel until the display goes blank. Stop turning the handwheel. At this point the preload has been applied.

8. The tester now automatically applies the major load. The time-at-load setting counts down on the display after the major load is reached. See Section 2.3.8 for Mode Key operation to adjust time-at-load.)

9. After the load is applied for the proper length of time, it will automatically be removed and the test result will be displayed.

10. Lower the elevating screw to remove the test piece taking care not to damage the indenter.

NOTE: If the operator applies too much preload, or the specimen shifts under load, the tester will display, "Excess Preload". Lower the elevating screw and return to the starting point and depress the NO key to return to the Ready position and displayed on the electronics.

## 2.1.2 Operation with Motorized Elevating Screw

### 2.1.2.1 Keypad Operation for Motorized Elevating Screw

The elevating screw is controlled through the keypad as follows:

**#3 - Continuous Down:** Lowers the elevating screw until any other key is pressed. Caution: Do not allow the elevating screw to travel all the way down.

**#9 - Continuous Up:** Raises the elevating screw until any other key is pressed. (If the unit is allowed to take a test using this key it will do so, however, the part will remain in contact with the indenter at preload position at the end of the test cycle.)

**#2 - Jog Down:** Lowers the elevating screw for as long as the key is pressed.

**#8 - Jog Up:** Raises the elevating screw for as long as the key is pressed.

NOTE: Use the above keys to adjust the test piece height in relation to the indenter.

**#0 - Start:** Initiates the test cycle. Will start the test cycle from any height and return to the original starting point when complete. (Adjust the start point using the other keys - 2, 3, 8, or 9.)

### 2.1.2.2 Operating Procedure for Motorized Elevating Screw

1. Lower the elevating screw using the #2 or #3 key on the keypad if necessary, to allow space for placement of the test piece on the anvil.
2. Adjust the starting point using the #8 or #9 key on the keypad so that the surface of the test piece is approximately 1/8" to 1/16" from the tip of the indenter.
3. Press the START key to initiate a test cycle
4. The display will count down to "0" (See keypad section of manual to adjust time-at-load).
5. When the test is complete, the elevating screw will return to the start position and the hardness value will be displayed.

### 2.1.3 Changing Scales

When changing scales the indenter, load and scale display must be changed.

The preload is preset inside the test head: 3 kg for Rockwell superficial heads. 10 kg is for regular Rockwell heads.

#### 2.1.3.1 Changing Scale Displays

Press the SCALE SELECT key. A display will appear, such as:

HRC 1 YES?

This display allows the operator to select the Rockwell C scale. The 1 indicates the scale sequence number. If the operator holds the [SCALE SELECT] key down, or presses it again, the display will sequence through all the Rockwell scales in this order:

(Note: If nothing happens when the operator presses the Scale Select key refer to the Security Code Procedure in the Advanced Keypad Operation Section.)

The operator should press YES when the proper scale is shown. The display will change to read:

**CLEAR HISTORY?**

This is a reminder to the operator that the memory will be deleted if the scale is changed. Press YES to continue. If the first selection, HRC, were chosen the display would change to read:

**TYPE=DIAMOND**

The operator must check to make sure diamond indenter is installed. (If not, see next section.) After the correct indenter is installed the operator must press YES key. After pressing YES key, the display will change to read:

**FORCE=150 KG**

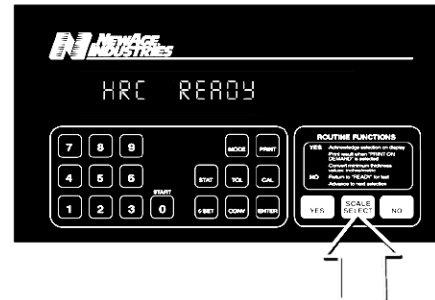
The operator must change the load to 150 kg. (See next section.) Then press the YES key again. The display will read:

**HRC READY**

If the operator presses the NO key at any point during the scale selection sequence, the display will revert back to the last scale used.

Please Note: Changing the scales will cause the test results in memory to be erased unless a semi-custom program designed to save results in different scales is used. (If it is used it will be described in the supplement.) This feature ensures that operators will not enter new data into an old data base.

SCALES AVAILABLE FOR VARIOUS TYPES OF TESTERS			
Regular Rockwell	Superficial Rockwell	Combination Systems	
HRC	HR 15N	C	15N
HRB	HR 30N	B	30N
HRA	HR 45N	A	45N
HRE	HR 15T	E	15T
HRF	HR 30T	F	30T
	HR 45T		45T



Scale Select Key

### 2.1.3.2 Changing Indenters

- 1) Before fitting indenters, be sure the support area is clean.
- 2) Insert indenter and secure with Allen or thumb screw.
- 3) Make several tests to “seat” indenter. Inspect and change balls in ball indenters periodically.

### 2.1.3.3 Changing Loads

1) On a “combination” unit (Model NI-400C) select regular (60, 100, 150 kg) or Superficial (15, 30, 45 kg) load range using the load range lever on the lower right side of the tester. To determine the proper load and indenter for a given scale refer to the Reference Tables Section.

2. Set the full load with the lever on the upper right side of the tester.

Note: Do not attempt to change scales while the tester is in mid-cycle or at preload. This may cause the weights to be dislodged.

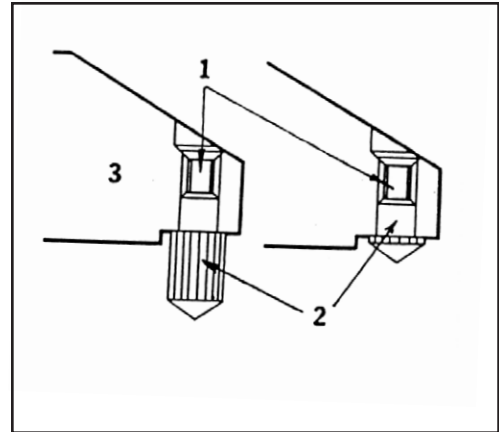
### 2.1.3.4 Calibration

1) Once the tester is set up with the proper indenter and approximate load setting for a given scale, select a test block calibrated for that scale.

Take a test on a test block that is marked for the proper scale with a value that is close to the hardness of the specimens that are to be tested. Take a test. The test result should fall within the tolerance marked on the block. If not, check the indenter and the cleanliness of the block, anvil and elevating screw.

Now make another test with a block of a much higher or lower value for the same scale to check the linearity of the tester. This result should fall within the range specified on that block.

It is advisable to make a test on a test block at regular intervals. Test blocks may be stored inside of the right-hand door located at the side of the tester.

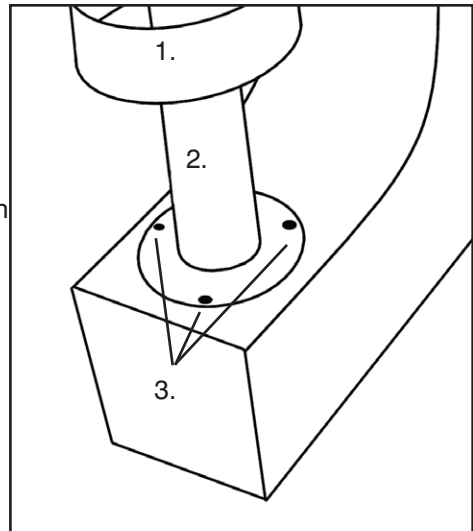


## 2.2 Vee Anvil Alignment

### 2.2.1 Checking Vee Anvil Alignment (for Testing Rounds)

When testing round parts, the indenter tip alignment with the specimen must be precise.

- 1) Insert shallow V anvil.
- 2) Place a small cylindrical specimen (about 1/8" diameter) on the anvil.
- 3) Bring the specimen close to the diamond indenter without making contact.
- 4) Check the alignment in two positions, rotating the anvil 90 degrees each time. The tip of the diamond must line up precisely with center of the specimen.



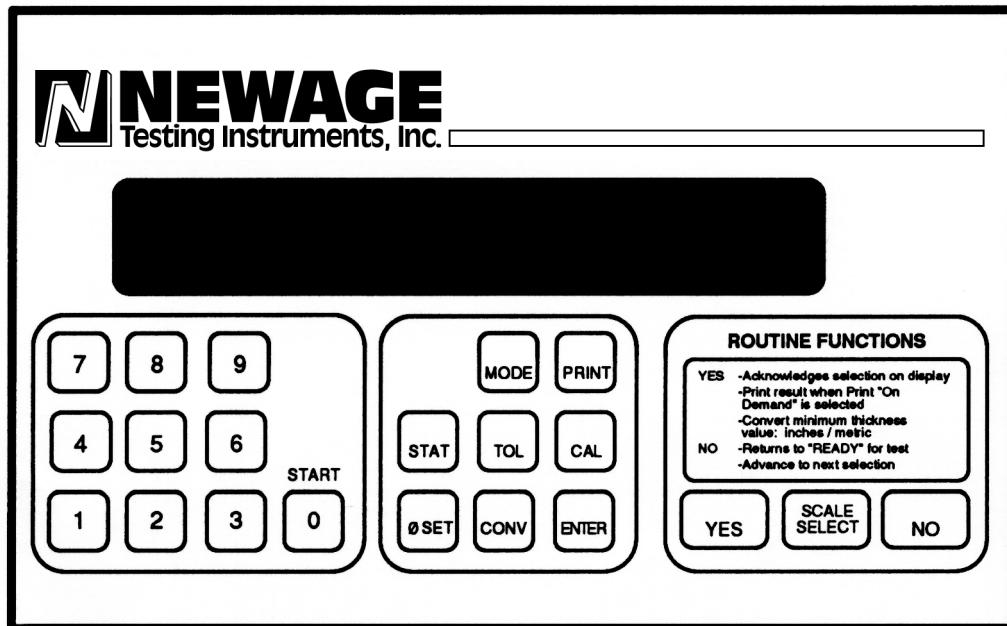
1. Elevating Bearing Cover
2. Elevating Screw
3. Holding Screws

### 2.2.2 Vee Anvil Adjustment

1. Remove the dust cover coil by raising the cover up to the top. Hold the cover together so it does not uncoil and loosen the set screw and remove it. (The cover can be held together with wire or place something heavy on it when it is set down.)
2. Lift off the handwheel cover plate and remove the three screws underneath.
3. Remove the handwheel and the elevating bearing cover.
4. Loosen the three screws holding the base of the elevating screw to the stand.
5. Reposition the elevating screw as needed.
6. Tighten the holding screws and recheck the alignment.
7. Reassemble the tester.

## 2.3 Advanced Digital Keypad Procedures

Before proceeding the operator should be familiar with the basic test operation and scale changing. See previous sections for directions for these functions.



### 2.3.1 List of Individual Key Functions

Each key on the keypad has a number of functions. A brief rundown of these functions is as follows.

TOL: - For viewing or modifying tolerances and (optionally) control limits

SCALE SELECT: - For changing hardness scale displays

YES: - Acknowledges questions on display  
- Prints out results when Print/On Demand is selected  
- Converts minimum thickness values between inch and mm

NO: - Negates selection on display and restores "READY"  
- Advances individual key function selection to next selection

STAT: - Clear Last Result function  
- Clear All Results function  
- Show or Change Sequence Number function  
- Show or Change Lot Number function  
- View Statistics on display  
- Split Memory (Optional - See Appendices)

ENTER: - Enters numeric values in memory

CONV: - Converts hardness result from one scale to another  
- Initiates "SELF TEST" function for Security Code entry

PRINT:     - Totals (Statistics)  
            - Graph (Histogram)  
            - History (Results in memory)  
            - X-Bar & R Chart (Optional - See Appendices)  
            - Verify Chart (Optional - See Appendices)  
            - Results/Values Only (of each test as it is performed)  
            - On Demand (individual results on operator prompting)  
            - Print Off  
            - Trace (all messages and results appear on the display)  
            - Set Baud  
            - Set Codes (Optional - See Appendices)

MODE:     - Timed Load (Setting or Viewing)  
            - Minimum Thickness Calculation  
            - Transducer Check  
            - Automatic Averaging (2-10 tests)  
            - Disable History

CAL        - Calculate Hardness  
            - Calculate Displacement  
            - Clear Hardness  
            - Clear Displacement  
            - A to D Factor  
            - Factory Set

ZERO SET   - Round Correction (See appendices if purchased)

### **2.3.2 Security Code Procedure**

Many of the keypad functions remain inoperable unless a code number

is entered and certain function keys are pressed. This procedure provides access to these keys and their functions. This security feature is designed to prevent unauthorized personnel from changing the test inputs and outputs. Your security code number is listed on the calibration certificate.

The following keys are affected by the security code as follows:

ZERO SET ----- May be viewed but not changed without code  
CHL ----- Not accessible without code  
TOL ----- May be viewed but not changed without code  
STAT ----- Partial access for viewing without code  
PRINT ----- Partial access for operation without code  
MODE ----- Not accessible without code  
CONV ----- Accessible without security code  
SCALE SELECT - Cannot be changed without code

The following routine will enable any of the function keys desired

1. Turning the unit on, or pressing the CONVERT (CONV) key when the tester displays "READY" displays the following message:  
SELF TEST VX.X
2. Within 5 seconds after this display appears the operator must begin to input the security code number. If the operator fails to begin to enter the security code procedure within the time allotted, the system will revert back to the test mode. (Once the first key is pressed the operator has 60 seconds to complete the procedure.)
3. *Firmly* press the function keys that are to be enabled. Any combination of function keys may be enabled so that the operator may have partial or complete access to the machine functions. Do not press YES, NO, or CONV or the system will revert to ready status.
4. Press the ENTER key. This completes the security procedure and the system returns to the test mode.

To lock out all security-controlled key functions, key-in the security code and press ENTER without pressing any function keys.

PLEASE NOTE: The accessed key functions will stay accessible after the system has been switched off and on until they are deliberately locked out. The security code does not need to be used every time the system is turned on.

PLEASE NOTE: If other keys are pressed during the security code input such as the YES key then the system may abort the procedure before the operator can input all the desired keys. Avoid hitting the non-function keys

PLEASE NOTE: Make sure to keep each key depressed firmly for at least 0.2 seconds to ensure acknowledgment of selection.

### **2.3.3 Tolerance (TOL) Key Function**

For viewing or changing tolerance settings.

### OPERATION WITH SECURITY CODE ACCESS

When the TOL key is pressed the display will show the current low tolerance setting such as:

HRC Low=.0  
or HRC LOW=50.1

To change the tolerance setting enter a new number, then press the ENTER key. If the ENTER key is pressed without entering a new number, the low tolerance setting will remain the same.

After the low tolerance numbers and ENTER keys have been pressed the display will immediately show the high tolerance setting such as:

HRC HI=65.0

To change the high tolerance setting enter a new number and press the ENTER key. To leave the current setting press the ENTER key without entering a new number.

When using tolerances, all test results appear with "HI" "LO", or "OK" displays. To eliminate these displays enter "00.0" low tolerance and "100" high tolerance settings.

The "Totals" and "Graph" Print functions will contain the proper calculations when tolerances are entered. Tolerances may be entered or changed after testing is complete.

If the optional Control Limits function is installed, additional functions appear on the display. The "X-BAR LCL" and the "X-BAR LCL" functions allow the operator to establish lower and upper control limits on the X-Bar & R Chart. The "Range UCL" allows the operator to also establish a limit for the range. These values appear on TOTALS and HISTOGRAM printouts.

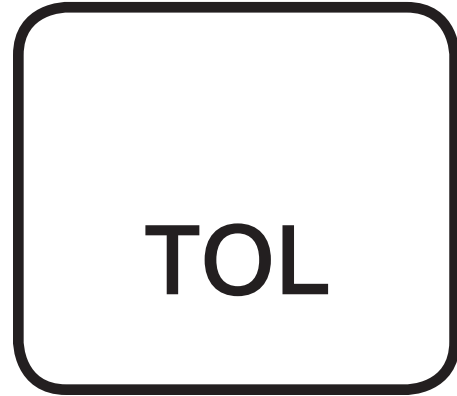
### OPERATION WITHOUT SECURITY CODE ACCESS.

Pressing the TOL key when there is no security code access will cause the display to show both the low and high tolerance settings simultaneously such as:

HRC 30.4, 35.0

These values cannot be changed without the TOL key security code access.

Press the NO key to return to the test mode.

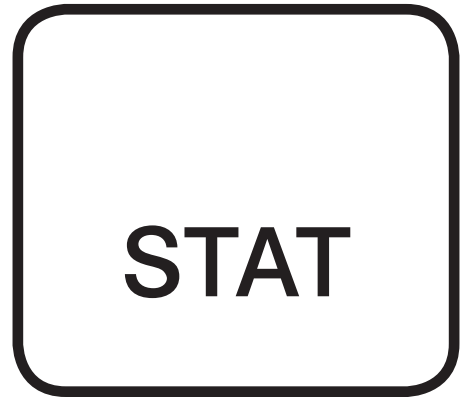


## **2.3.4 Statistic (STAT) Key Functions**

The STAT functions control the test information stored in the system memory. There are five standard STAT functions.

- Clear Last
- Clear All
- Sequence Number
- Lot Number
- Statistics

To enter these functions press the STAT key and the first will appear. Press the NO key and each remaining function will appear in sequence (unless the key does not have security code access.)



#### OPERATION WITH SECURITY CODE ACCESS

- CLEAR LAST

Pressing YES will remove the last hardness reading from the history data and the system will return to the test mode. This procedure can be repeated to remove additional readings.

- HRC CLEAR ALL

Pressing YES will clear all the hardness results from the memory and return the system to the test mode. Note: The sequence number and any lot number will automatically be cleared with the Clear All function.

CAUTION: Once the memory is cleared test results cannot be recovered.

PLEASE NOTE: The Clear All function is automatically performed each time the calibrate function is performed or the scale is changed. (Unless the system has the Optional Split Memory function.)

- SEQUENCE NUMBER

Pressing YES will select the SEQUENCE NUMBER function. The sequence numbers are used to identify individual tests. Each time a test is performed the sequence number is increased by a value of one to a maximum of 65335. The sequence number will appear on the test results printout. When the Sequence Number function is selected by pressing YES the display might read:

HRC SEQ # = 1332

(The “#” symbol as it actually appears on the display is three parallel lines.) This display shows the current scale is HRC and the last sequence number is 1332. To change the sequence number the Clear All function must be performed first. To start a sequence at a given numbers enter the desired sequence number. For example, to start the sequence at “1” the operator Must press “0” then the [ENTER] key.

- LOT NUMBER

Pressing YES at the Lot Number? prompt will select the LOT NUMBER function. The lot number function is used to identify tests performed on particular groups of materials and will appear on the printout. The lot number function allows the operator to observe and change the lot number. When this function is selected the display might read:

HRC LOT # = 5858

This display would indicate the system is in the HRC scale and that the lot number is 5858. The operator may now select and enter a new number by keying in a new number and pressing the ENTER key.

PLEASE NOTE: The display will go blank when this function is selected to allow the entry of up to a 16 digit lot number.

- STATISTICS

Pressing YES will enable the operator to view the statistics. This function displays the mean and standard deviation of the readings in memory. All the readings since the last Scale Select, Clear All, or Calibration function were performed will be included in these calculations. The statistics display might read:

HRC 60.2, 1.443

The first number would indicate an average value of 60.2 and the second number would indicate a standard deviation of 1.443 (based on  $[n-1]$  formula).

OPERATION WITHOUT SECURITY CODE ACCESS.

The "CLEAR LAST" and "CLEAR ALL" functions will appear in sequence only if access is provided with the security code. If not the "Sequence Number", "Lot Number" and "Statistics" functions can be viewed, but not changed.

### **2.3.5 Convert (CONV) Key Functions**

There are 2 CONVERT key functions:

- SECURITY CODE ACCESS

## - TEST RESULT CONVERSION TO A NEW SCALE

### OPERATION WITH SECURITY CODE ACCESS

When the tester display reads "READY", pressing the CONV key causes the tester to change to the SELF TEST status. At this point the operator can perform the security code procedure (See previous section}).

- SCALE CONVERSION

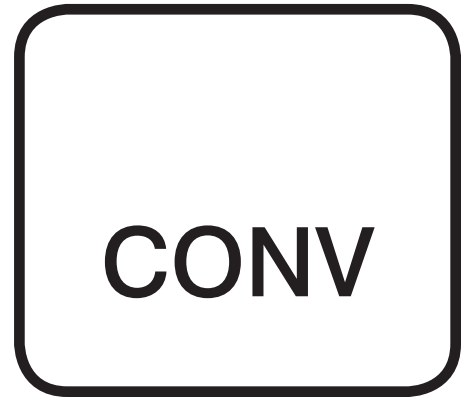
This function allows conversion of a test value from the scale in use to another scale, such as HRC to HR15N.

When the tester display shows a test value, pressing the CONV key will cause the tester to ask for which scale starting with the last scale used. If the operator presses the CONV key repeatedly each possible scale will appear in sequence. When the proper scale is reached the operator must press the YES key and the test result from the current test will be converted to the equivalent value in the converted scale (according to ASTM conversion, E-140). In the case of the HRA scale the display may ask "High Range?". Press YES for high, NO for low. All converted values appear with an 'X' (such as XRC instead of HRC) to indicate it is a converted value.

To continue testing the operator must press the NO key.

### OPERATION WITHOUT SECURITY CODE ACCESS.

The CONV key is not affected by the security code access function.



## **2.3.6 Print Key Functions**

There are six standard PRINT functions:

- TOTALS
- GRAPH

- HISTORY
- RESULTS/VALUES ONLY

There are also three custom PRINT functions which may appear. If these functions are present, refer to the Appendices for information.

- X-BAR & R CHART
- SET CODES

These standard functions appear in sequence (with the possible exception of the Trace function) when the operator presses the NO key repeatedly. Samples of the printouts are included at the end of the section.

At power up the tester defaults automatically to Results mode which prints out test values as performed. Result only mode slows down the tester operation slightly because the data is being transmitted to printer. To speed up operation without a printer, remove the Results function.

#### OPERATION WITH SECURITY CODE ACCESS

All Print functions are accessible with or without security code access

Note concerning Total & Graph Functions - These functions need tolerances to function properly. The operator may add or change tolerances at any time before they are cleared and reprint the Totals and Graph reports.

- TOTALS (see sample printout at the end of this section)

Pressing YES causes the printer to print out the SPC values for the hardness results in memory. These values include number of tests, minimum, maximum, average, standard deviation, etc.

- GRAPH (see sample printout at the end of this section)

If the YES button is pressed at the "Graphics?" prompt, the Graphics printout feature generates a frequency distribution diagram (Histogram) showing the readings obtained in a certain lot grouped in ranges, with the indication of the number of results in each range.

These ranges are automatically scaled to the data and include spec limits, control limits, and mean value. Printing of the results does not affect the stored values, as these can only be cleared by specific command (or scale and calibration changes).

- HISTORY (see sample printout at the end of this section)

If the YES button is pressed the display asks:

HRC HOW MANY?

The operator can select the number of tests he wants to be



printed. If all the tests in memory are needed, enter '9999' followed by the ENTER key. The format of the printout will display the sequence number, the hardness scale, the test result, and the tolerance result for high, low, or OK.

- RESULTS/VALUES ONLY

These two functions toggle depending on which is selected. If "PRINT RESULTS?" appears on the display, selecting Yes will cause the Results print function to be activated. The next time the operator selects the PRINT Key the display will show VALUES ONLY.

When the RESULTS function is confirmed by pressing YES when "PRINT RESULTS" appears on the display, the results of each test will be printed after the tester performs the test along with values for lot number, sequence number, zero displacement, calibration status (with an asterisk), and tolerance settings. For a description of this data string see the Test Head Specifications section.

When the "VALUES ONLY" function is confirmed by pressing YES when the "VALUES ONLY" prompt appears on the display, the test value alone is printed without any tolerances or other descriptive information. This can be useful when the data is being exported to a computer.

- ON DEMAND

This function allows the operator to print the results of the last test by pressing the YES button. The printout will appear in the History Data printout form. If two tests are performed before the YES button is pressed the prior test will not be printed.

The On Demand function is deactivated by entering any other "Print" function or answering NO to all Print modes.

- PRINT OFF

Turns off printing from the PRINT Results or Values only Modes. Only appears in sequence if Results or Values Only Modes are turned on.

- TRACE

If YES is entered at this point the Trace print function is activated (if the PRINT key function has been enabled). This function will automatically cause results to be printed after each test. It will also cause every message which appears on the display to be printed. Whenever the Trace function is activated, the message which was on the display before the PRINT key was pressed will also be printed out.

PLEASE NOTE: If the Trace function is activated, it will remain activated even if the security code procedure is later repeated without enabling the PRINT key again. If the PRINT key is not enabled, the Trace function will not appear as the operator views the Print function sequence so it cannot be deactivated. If this occurs, and the operator wants to stop the Trace function, the security code procedure must be performed again and the Print function, enabled. Then, after pressing the PRINT key and returning to the Trace function, which will now be displayed, the operator must simply answer NO to the Trace function.

- SET BAUD

If the YES button is pressed, the display shows the current baud rate setting for the printer output. The operator may then select 300, 1000, or 9600 baud and press the ENTER key. If any other value is entered, "Incorrect Value" will be displayed. Note: "Set Baud" will not appear if the PRINT key has not been enabled.

PLEASE NOTE: If tolerance values are changed in the middle of a lot number, the printout will use the last tolerance values that were entered in its calculations for the entire lot. When scale or calibration are changed, all previous results and statistics are cleared out of the memory.

#### OPERATION WITHOUT SECURITY CODE ACCESS

All the print functions can be performed without the security code access except the Trace and Baud Rate functions.

### 2.3.6.1 Sample Printouts

Totals

LOT #	SEQ #	Z-DSP	CAL	LOWTOL	HIGHTOL			
102687930	64	100.0		63.0	64.0			
TOT	GOOD	LOW	HIGH	MIN	MAX	CPK	ZCALCMIN	ZCALCMAX
64	43-67%	3- 5%	18-28%	62.5	65.4	.09	1.136	.275
RANGE	AVG	VAR	STD DV (N-1)	STD DEV (N)	PRED % OUT LOW (Z-TABLE MIN)	PRED % OUT HIGH (Z-TABLE MAX)		
2.9	63.80	.501	.707	.702	12.71	39.19		
Z TABLE VALUES GREATER THAN .5%								

Note to TOTALS Function

- Standard deviation (sigma) formula)

$$\sqrt{\frac{\sum (x - \bar{x})^2}{n}} \quad \text{or} \quad \sqrt{\frac{\sum (x - \bar{x})^2}{n - 1}}$$

-Z table scores are derived from a mathematical formula that approximates the actual Z-table values

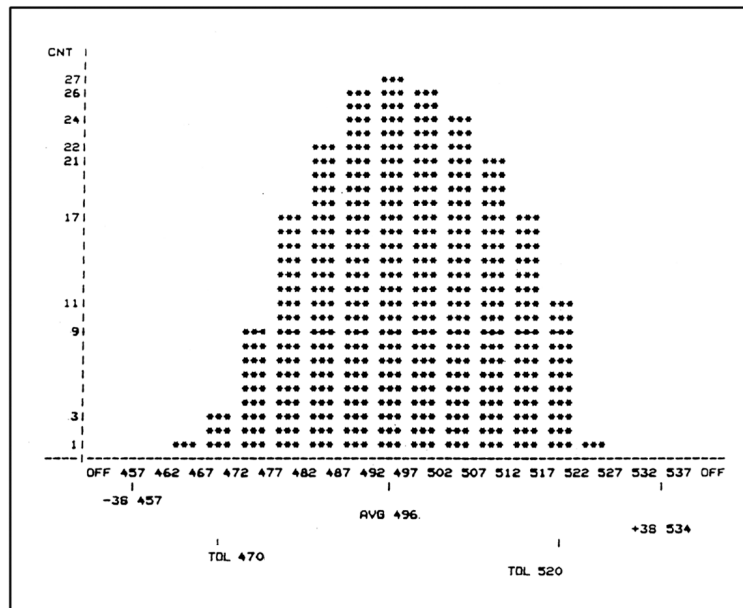
-CPk uses the standard formula

THE FORMULA IS THE LESSER OF:

$$CP_k = \frac{USL - \text{PROCESS AVERAGE}}{1/2 \text{ PROCESS WIDTH}} \quad \text{OR} \quad CP_k = \frac{\text{PROCESS AVERAGE} - LSL}{1/2 \text{ PROCESS WIDTH}}$$

-Variance equals standard deviation <sup>2</sup>

Histogram



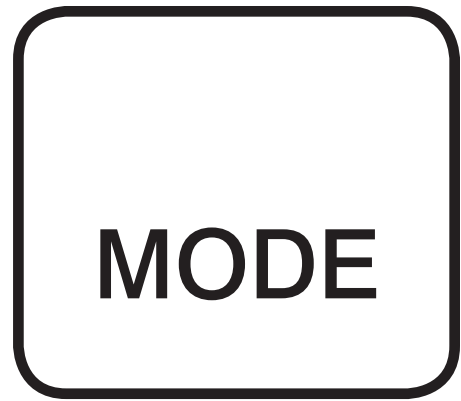
Note: Values on X axis are Rockwell values; decimal places are omitted to make room for more cells.

## 2.3.7 Mode Key Functions

There are five mode key functions:

- Timed load
- Minimum thickness
- Transducer Check
- Automatic Average
- Disable History

After selecting the Mode function these function selections appear in sequence when the operator presses the NO key.



### OPERATION WITH SECURITY CODE ACCESS

#### • TIME AT LOAD

Pressing the YES key will cause the display to show the current time-at-load selection, 10-30 seconds. To change the time-at-load, key in a new number between 0 and 30 and press the ENTER key. To leave the same time simply press the ENTER key without changing the number. Only integer values can be used.

The display will show the time-at-load during the test in half-second intervals. Automatic systems will automatically adjust to the new time setting. On manual systems the operator should release the lever after the time-at-load indicator reaches zero.

To quit this function, enter "0" time-at-load.

#### • MINIMUM THICKNESS FUNCTION

Pressing YES will cause the minimum thickness value for the last test result to be displayed. This value is calculated as ten times the depth of penetration. An example of this display might look like:

HRC MIN = .015IN

This display would indicate the scale was HRC and the minimum thickness for the hardness value displayed was .015 inches. This display can give the minimum thickness value in inches, "IN", or millimeters, "MM". To switch between millimeters and inches press the YES key.

This value will remain on the display until the NO key or another function key is selected.

#### • TRANSDUCER CHECK (Also called CONTINUOUS ON)

Pressing YES will cause the Continuous display mode function to be activated. This function will cause the transducer input value to be displayed. A sample display might appear as:

HRC V=4100

HRC indicates the scale, 4100 is the LVDT input value. The LVDT is

verified to be operating correctly if the readings are at approximately 6000 – 8000 with the tester at rest and 3000 to 4000 with the indenter shroud in contact with the test specimen (preload position). The display should not fluctuate by more than a value of +/- 2 points while the load lever remains steady in this position.

Press the NO key to return to a ready status.

- AUTOMATIC AVERAGE

This function will cause the printer to print out the results from a specified number of tests along with the range and average. It will also display the average on the readout. These average results will be stored in memory under a single sequence number, and the individual tests will not be stored. When the function is initiated the display will read:

AVG OF 0

Enter any number from 2 to 10. Then press the ENTER key. The display will change to:

HRC 1 READY

The operator performs the first series of tests. If the average of three tests was selected, then the printout would occur after the three tests and would appear as follows:

```
1      61.2  61.4  61.4
                                RANGE = .2
                                AVG  =61.3  *H
```

At this time an indication of \*H or \*L appears if the average result is the highest or lowest so far in the sequence in a given series of averaged tests. Over a series of averaged tests the last ones indicated by a \*H or \*L indicate the highest or lowest in the entire series. HI, LO, or OK tolerance indications are also printed if the tolerances function is enabled and tolerance values have been entered.

To turn off the AVERAGE function, press the MODE key, press the YES key to the AVG? query, and select "1" to the query for 'HOW MANY'.

PLEASE NOTE: The average value is calculated to the first decimal. There is no round off from the 2nd decimal place value.

ALL TOTAL, GRAPH, and STAT functions use the average value in their calculations and printouts. None of the individual results are stored so only the averages are printed. (Optional programming is available to store individual results.)

If the operator uses the CLEAR LAST function, during or after the sequence of three tests, the last test result (not the last average) is deleted. If the last test in a series is to be deleted the printer will repeat the printout using the same sequence number.

- DISABLE HISTORY

Pressing the Yes key when the display shows "DISABLE HISTORY" or "ENABLE HISTORY" will cause the function to switch from saving test results in memory to not saving any test results or vice-versa.

When the history is disabled the test results are not stored in memory. Print and Stat functions will show only header information or "0" values (after a CLEAR ALL function from the STAT key). Disable History will prevent the occurrence of a "MEMORY FULL" message.

Press the NO Button to keep the settings the same and return to the READY mode.

#### OPERATION WITHOUT SECURITY CODE ACCESS.

No functions can be used or viewed without security code access.

### 2.3.8 Calculation (CAL) Key Functions

IMPORTANT: The tester should normally be calibrated by adjusting the load wheel (See Changing Loads Section). However, for some circumstances, the operator may choose to “calibrate” the machine through the electronics. An example would be to further offset test values for round correction outside the range of ASTM specs. Since this calibration function simply offsets the results by whatever value the operator desires, actual mechanical calibration should still be checked regularly using a standard test block with the electronic calibration setting at its normal value.



There are six standard calibration functions controlled by the CAL key:

- Calculate Hardness
- Calculate Displacement
- Clear Hardness
- Clear Displacement
- A/D Factor
- Factory Set

There are also three custom functions that may appear under the CAL key: “Run Verify”, “Setup Verify”, and “Timed Verify On”. If these functions appear on the display, refer to the Appendices for a complete description

#### OPERATION WITHOUT SECURITY CODE ACCESS

- CALCULATE HARDNESS

The Calculate hardness function is used to adjust the readout in the same way as a mechanical dial is adjusted, per ASTM E-18. The limit of the adjustment range is +/- 0.5 pt. (according to ASTM readout device tolerances)

1. Press the CAL key. The display will read:

HRC CALC HARD?

2. Pressing the YES key will cause the display to read:

ENTER CODE

3. Key in the security code (listed on calibration certificate). Press ENTER. The display will change to read:

HRC VALUE = 0

4. Press the numeric keys to key in the correct value from the test block.

5. Press the ENTER key. The tester will automatically make the proper adjustment and return to the test mode. The display might then read:

HRC READY \*

Note: If a number is entered which differs from the previous value by more than 0.5 Rockwell points, the message ‘Not Allowed’ will appear. Press the NO key to return to test mode.

This display would indicate that the tester was 'READY' to test and the '\*' would indicate that the tester had been corrected in the HRC scale. Other scales will be unaffected.

PLEASE NOTE: Once this calculation has been made, the change will be in effect until cleared.

- CALCULATE DISPLACEMENT

Not accessible. (Factory controlled function.)

- CLEAR HARDNESS

Pressing the YES key while "CLEAR HARD" is on the display will clear the calibration offset after the security code has been entered and will return the tester to its original factory-set calibration value for that scale. The "\*" will no longer appear on the display.

- CLEAR DISPLACEMENT

Not accessible. (Factory controlled function.)

- A/D FACTOR

Not accessible. (Factory controlled function.)

- FACTORY SET

Not accessible. (Factory controlled function.)

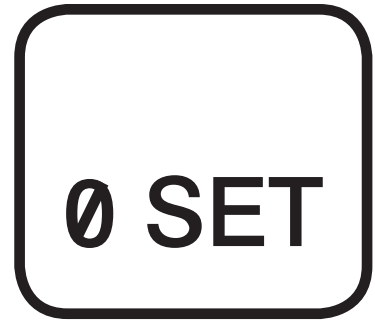
#### OPERATION WITHOUT SECURITY CODE ACCESS

No functions can be used without the security code.

### **2.3.9 Zero Set (O SET) Key Function (Optional)**

This optional function provides a round correction factor according to ASTM specification E-18 for testing small rounds.

If this option has been purchased, refer to the Appendices at the end of the manual for instructions.



### **2.3.10 Scale Select**

Please refer to Section 2.1.3. for a description of the scale selection process.



### 2.3.11 Digital Readout Codes

These codes may appear on the screen. Here is a summary of their meaning:

#### 2.3.11.1 Normal Operation Display Codes

- \*                      Appears when the hardness scale in operation has been changed through an electronic calculation or zero displacement function.
  
- “HI” “LO” “OK”    Indicates whether a hardness result fell within tolerance limits. Appears when the tolerance function is activated.
  
- SELF TEST            Appears whenever the system is turned on or whenever the clear key is pressed while the system is in the test ready mode.
  
- ≡                      Stands for the number sign, “#”.
  
- HISTORY FULL       Indicates that the maximum capacity of this tester memory has been reached. The operator must perform a Clear All function to restore the memory. The operator may want to run a printout of results, a histogram or totals before clearing Memory.

#### 2.3.11.2 Operation Error Codes

Wherever an error occurs during calculations or function selection, the error will be displayed and all the functions will halt until the error is cleared by pressing the NO key which will return the system to the test mode. These codes are:



Appears at right on the display. Indicates that the factory set Displacement Calibration has been changed. If this display appears the operator should call the factory.

- CLEAR MEMORY     Appears when the display first comes on, instead of the display “SELF TEST”. This code indicates there is an error in the memory which must be cleared by pressing the YES key before testing can proceed. PLEASE NOTE: If this display appears, it indicates that there was an error in the system and all the results, statistics, and test parameters have been cleared out of the memory.

### 2.3.11.3 Error Messages

E1	System Failure	
E2	Out of Range	Bad A/D
E3	Not Stable	A/D Not Stable
E4	Off scale:	Reading too low
E5	Invalid test:	Negative result
E6	Bad test:	Operator tries calibration, or conversion and previous test was not valid.
E7	Invalid test:	Test too fast
E8	No history:	No test stored
E9	Motor timeout:	Motor not working on motorized units.
E10	Not allowed:	Load not calibrated for that scale.
E11-E16	Calculation error:	Mathematical error by microprocessor.
E17	History full:	No more memory available, clear all.
E18	Not allowed:	Calibration attempted greater than spec.
E18	Invalid load:	Load out of specification.
E19	Receive timeout:	Connection to X/Y table not working.
E20	Transmit timeout:	Internal UART failure.
E21	Table timeout:	Mechanical failure of table or limit switches over-travel.
E22	Table error:	Connection to X/Y table not working.
WARN:	Memory Almost Full	If the 4 letters of the scale name change to WARN, it means that the memory is 90% full.

### 3. SPECIFICATIONS

#### 3.1 Test Stand Specifications

##### 3.1.1 Test Force

NI-400RDS	Preload: 10 kg; Full load: 60, 100, 150 kg
NI-400SRDS	Preload: 3 kg; Full load: 15, 30, 45 kg
NI400C	All of the above

##### 3.1.2 Dimensions

Dimensions:	26" depth x 12" width x 31" height
Vertical Capacity:	10"
Horizontal Capacity:	6"
Weight:	250 lbs.

#### 3.2 Power Requirements

- 115 V 50/60 Hz, single phase standard (220 /440 optional)

#### 3.3 Electronic Output Specifications

- Serial RS-232 output

- The following is the format of the "Print Results" output of test values to the Printer.

#####:bbbSSSSSHHHHbTT where:  
### = The sequence number  
b = blank space  
SSSS = The scale ID  
HHHH = The hardness result  
TT = The tolerance indicator (Hi, Lo, Ok)

The total length is 22 characters. All 22 characters are printed regardless of whether or not tolerance values are set. If tolerance values are not specified, the last 3 characters are blanks.

- The format of the individual bytes is as follows:

1 start bit  
1 stop bit  
8 data bits  
No parity  
300 Baud (The baud is adjustable - see Print Functions)

- Carriage Ret. and Line Feed Messages are sent after the 22 character string.

-Connector: Amphenol Type 703-91T3300-1

-Pin Assignment:

1 Serial out  
2 Ground  
3 Busy  
4 N.C.

### 3.4 Standard Accessories

These accessories and parts are included in the accessory kit.

- Diamond Indenter, C and/or N scales (depending on model)
- 1/16" Ball Indenter with [10] Extra 1/16" Balls
- Test Blocks, C, B, 30N, 30T scales (depending on model)
- 70mm Flat, Reversible Spot/small vee, Vee Anvil
- Vinyl Cover
- Set of Wrenches
- Power Cord

### 3.5 SPARE PARTS AND ACCESSORIES

#### Diamond Indenters

9110	Certified A, C & N scale diamond (w/ certificate)
8101	International Grade - A scale
8103	International Grade - C scale
8105	International Grade - C & N scales
8108	Domestic Grade - A scale
8109	N scale (Domestic/International Grade**)
8110	Domestic Grade - C scale
NI-SP3	Short Form Diamond Indenter
NI-SP9	Special Diamond Indenter (tapered, chisel, single double cutaway - call for information)
NI-SP22A	Special Extended Diamond for clamp adapter Use with NI-SP22 (at right.)

Note: International Grade diamonds are made to conform to dimensional specifications according to NAMUS (English Standards Organization) and are not polished as opposed to the domestic grade which meet a performance standard. The International Grade read slightly higher than the domestic and are commonly used in conjunction with the Yamamoto test blocks which will read correctly.

\*\*N-Scale Diamonds read the same for both international and domestic grade

#### Ball Indenters

8111	1/16" Ball Indenter with 50 extra balls
NI-SP4	1/16" Short Form ball indenter w/ 10 extra balls
8112	1/8" Ball Indenter with 10 extra balls
8113	1/4" Ball Indenter
8114	1/2" Ball Indenter
NI-SP8	3/4" ball indenter
8118M	1/16" Ball Indenter Cap Only
AT/5112C	1/8" Carbide Ball Only
AT/5116	Qty 50, 1/16" Steel Balls
AT/5116C	1/16" Carbide Ball Only
AT/5117	Qty 10, 1/8" Steel Balls

#### Anvils

NI-SP10	8" anvil table
NI-SP11	Short Workrest
NI-SP12	Extended Workrest
NI-SP13A	Standard 70mm (2-3/4") flat anvil
NI-SP13B	Standard combination spot and vee anvil
NI-SP17	Self-Aligning Cylinder type Vee anvil for use with NI-SP11 or NI-SP12 Workrests
NI-SP19	Adjustable cylinder type Vee anvil

- NI-SP21 Diamond Spot Anvil
  - NI-SP25 2" Extended Spot Anvil (includes locking ring)
  - Other Accessories
  - NI-SP18 External Jack Support (for 10" machines)
  - NI-SP20 Dust Cover (specify model)
  - NI-SP22\* Clamping adapter for any model Indentron. Includes extended diamond & 1/16" ball indenters
  - NI130-B Floor cabinet w/ locking door and drawer
  - NI-07 Adapter to use "Wilson A" style (no internal thread) indenters in any model Indentron
  - AT130-PR Printer w/cable. Dot Matrix, 80 Col., Plain Paper
  - DATAVIEW Data software system
  - NI/5510 Gooseneck Lamp
  - NI-08 Indenter Gripsel
  - SC0046 Indenter Holding Screw
  - ATD98 Printer cable, 25 pin, 6 ft
- \* 450 in./lb capacity - divide 450 by length of part in inches to determine approx. weight that the part can be.

## 4. TROUBLESHOOTING AND MAINTENANCE

### 4.1 Maintenance Procedures

Occasional cleaning is recommended for the elevating screw, height adjuster, anvils, and indenter support area. For long term storage, apply a light oil to elevating screw and anvils.

### 4.2 Troubleshooting

Please do not open the readout box except at the direction of Newage Customer Service. If you think you need service, please review the Troubleshooting Section before you call. Get an exact description of the problem - be as specific as possible. Before you call, get the model and serial number of your unit (located on back of readout).

#### 4.2.1 Pre-trouble Shooting Check List

- Is the current load and indenter being used?
- Is the indenter chipped or flattened?
- If checking rounds, is the V anvil alignment OK?
- Are all connectors tight?
- Is the power turned on?

If these items have been checked, please continue to the next section.

#### 4.2.2 Error Codes

If any of these error codes, except E-17, appear please call Newage Testing Instruments for help. If E17 appears follow the directions in Section 2-3 for clearing the test results.

<u>CODE</u>	<u>MEANING</u>	<u>CAUSE</u>
<b>E1</b>	System Failure	
<b>E2</b>	Out of Range	Bad A/D
<b>E3</b>	Not stable	A/D not stable
<b>E4</b>	Off scale	Reading too low
<b>E5</b>	Invalid test	Negative result
<b>E6</b>	Bad Test	Operator tries calibration or conversion using invalid test.
<b>E7</b>	Invalid test	Test too fast
<b>E8</b>	No History	No test stored
<b>E9</b>	Motor timeout	Motor not working on motorized units
<b>E10</b>	Not allowed	Load not calibrated for that scale.
<b>E11-16</b>	Calc Error	Mathematical error by microprocessor
<b>E17</b>	History full	No more memory available, clear all
<b>E18</b>	Not allowed	Calibration attempted greater than spec
<b>E18</b>	Invalid load	Load out of specification
<b>E19</b>	Receive timeout	Connection to x/y table not working

## **5. SERVICE AND REPAIRS**

### **5.1 How to get help or order service**

Call Newage Customer Service if you have questions at 215-355-6900.

We may be able to help troubleshoot the problem by phone or refer you to one of our field service representatives. To schedule service call 317-329-4300. Should it be necessary to return the instrument, refer to the shipping instructions. Return all intenders with the test head.

Following are procedures and troubleshooting that can be performed prior to calling Newage. You may be able to isolate and correct problems yourself. Please do not attempt to open the electronics or the load cell itself, as that will void the warranty and will lead to more serious problems

## 5.1 Troubleshooting Checklist

Symptom	Problem	Check/Remedy
Low readings on test block.	Bad test block.	Try different test block.
	Bad indenter.	Substitute new indenter or switch from diamond indenter to ball or vice versa and check calibration on appropriate test block.
	Loose indenter.	Check for proper seating of indenter
	Inaccurate test load	Check for proper load selection.
	Test positions too close to edge or each other	Make test more than 3 impression diameters apart or from edge.
	Specimen dirty or deformation on indenter seat.	Remove indenter and clean contact areas or substitute a new component and clean.
	Bad transducer settings (digital test heads)	Check for LVDT # on MODE key "Continuous On" function
	Electronic error in penetration depth to Rockwell value calculation.	Check for "arrowhead" appearing at right side of display ( if so, call factory).
High reading on part.	Bad test block.	Try different test block.
	Test indentations too close together.	Keep test indentations 2 ½ diameters apart.
	Bad indenter.	Substitute indenters or switch from ball to diamond and retest on test block.
	Time-at-load not long enough (especially on softer materials).	Set time-at-load for 10 seconds on digital test heads. Hold load lever down longer on analog test heads.
	Inaccurate test load	Check for proper load and selection if the test result is off by more than 2 pts.
	No round correction factor.	If testing on round specimens under 1 ½",
	Vee anvil misalignment.	See instruction for vee anvil alignment
	Test specimen does not meet minimum thickness requirements.	Test on test block
	Bad transducer setting (digital test heads).	Check for LVDT# on Mode key "Continuous-On" function.
	Electronic error in indenter depth to Rockwell value calculation	Check for arrowhead symbol on right side of the display - Call Newage to resolve.

<b>Symptom</b>	<b>Problem</b>	<b>Check/Remedy</b>
High reading on part.	Test specimen positioned too far from the indenter.	Raise specimen to within 1/16" of indenter
Erratic readings.	Damaged indenter.	Replace indenter or substitute ball for diamond (or vice-versa) and retest on appropriate test block.
	Surface of test specimen is too rough.	Test on test block.
	Inconsistent power supply voltage.	Check for stability of transducer - output in Continuous-On function (Section 4.4.8)
No display (digital testers)	No power to test head	Check cord and power supply
	Fuse blown	Check fuse
Flickering display (digital testers)	Erratic power connection	Check power cord, cable and power supply source.
No change of display during test.	Tester not "ready".	Test head must show "Ready" or previous test result (Press NO key.)
	Transducer slipped.	Check transducer position in MODE key "Continuous-On" function.
	Preload switch not plugged in.	Check all electrical connections
	Specimen positioned too far from indenter	Position indenter 1/16" or less from specimen.
	Bad contact.	Press keys firmly in the middle of the key.
	Security code not activated for that key.	Follow security code procedure
Breaking diamonds.	Bad vee alignment.	See Section for Vee anvil alignment
	Testing too close to edge of specimen.	Test further from edge.
Display reads "Clear Memory" when turned on.	Electric noise had failed memory or low battery.	Press YES to "Clear Memory" message, then turn unit off then back on again. If message reappears, change memory battery.
Display shows error code	Too much part deflection under load.	See calibration section
Invalid test appears on display.	Operator (machine) error during test cycle.	Test on test block. If message persists, see Troubleshooting: low readings.
		Review basic operation section.
		See error codes to troubleshoot
		If error persists, call factory.

<b>Symptom</b>	<b>Problem</b>	<b>Check/Remedy</b>
No display	No power to test head	Check cord and power supply
	Fuse blown	Check fuse
Flickering display (digital testers)	Erratic power connection	Check power cord, cable and power supply source.
No change of display during test	Tester not "ready".	Test head must show "Ready" or previous test result (Press NO key.)
	Transducer slipped.	Check transducer position in MODE key "Continuous-On" function
	Preload switch not plugged in.	Check all electrical connections
	Broken load yoke or bearings.	Make test and see if the test head is pushed down during the test cycle.
	Specimen positioned too far from indenter	Position indenter 1/16" or less from specimen.
	Lower probe missing	Remove indenter to see if lower probe drops down.
Keypad functions won't work	Bad contact.	Press keys firmly in the middle of the key.
	Security code not activated for that key.	Follow security code procedure
Breaking diamonds.	Specimen not stable under load.	Clamp on fixture specimen.
	Bad vee alignment.	Follow instructions for vee alignment
	Base plate not tightened properly.	Tighten knob.
	Head height locking knob not set tight.	Tighten knob.
	Testing too close to edge of specimen.	Test further from edge.
Display reads "Clear Memory" when turned on.	Electric noise had failed memory or low battery.	Press YES to "Clear Memory" message, then turn unit off then back on again. If message reappears, change memory battery.
Display shows *	Tester has a calibration offset	See calibration section
E5, E6, E7, E8 Invalid test appears on display.	Too much part deflection under load.	Test on test block. If message persists, see Troubleshooting: low readings.
	Operator (machine) error during test cycle.	Review basic operation section. If error persists, call factory.

## 6. Reference Tables, ASTM E-18

### 6.1 Rockwell Scale Setup Reference Table

Scale Symbol	Penetrator	Major Load, kgf	Dial Figures	Typical Applications of Scales
B	1/16-in. ball	100	red	Copper alloys, soft steels, aluminum alloys, malleable iron, etc.
C	diamond	150	black	Steel, hard cast irons, pearlitic malleable iron, titanium, deep case hardened steel, and materials harder than B 100.
A	diamond	60	black	Cemented carbides, thin steel, and shallow case-hardened steel.
D	diamond	100	black	Thin steel and medium case hardened steel, and pearlitic malleable iron.
E	1/8-in. ball	100	red	Cast iron, aluminum and magnesium alloys, bearing metals.
F	1/16-in. ball	60	red	Annealed copper alloys, thin soft sheet metals.
G	1/16-in. ball	150	red	Malleable irons, copper-nickel-zinc and cupro-nickel alloys. Upper limit G 92 to avoid possible flattening of ball.
H	1/8-in. ball	60	red	Aluminum, zinc, lead.
K	1/8-in. ball	150	red	} Bearing metals and other very soft or thin materials. Use smallest ball and heaviest load that does not give an anvil effect.
L	1/4-in. ball	60	red	
M	1/4-in. ball	100	red	
P	1/4-in. ball	150	red	
R	1/2-in. ball	60	red	
S	1/2-in. ball	100	red	
V	1/2-in. ball	150	red	

### 6.2 Superficial Rockwell Scale Setup Reference Table

Scale Symbol	Penetrator	Load in Kilograms
15N	N Diamond	15 kgf
30N	N Diamond	30 kgf
45N	N Diamond	45 kgf
15T	1/16" ball	15 kgf
30T	1/16" ball	30 kgf
45T	1/16" ball	45 kgf
15W	1/8" ball	15 kgf
30W	1/8" ball	30 kgf
45W	1/8" ball	45 kgf
15X	1/4" ball	15 kgf
30X	1/4" ball	30 kgf
45X	1/4" ball	45 kgf
15Y	1/2" ball	15 kgf
30Y	1/2" ball	30 kgf
45Y	1/2" ball	45 kgf

## 6.3 Minimum Thickness Requirement

**TABLE 7 A Guide for Selection of Scales Using the Diamond Indenter (see Fig. 6)**

NOTE—For a given thickness, any hardness greater than that corresponding to that thickness can be tested. For a given hardness, material of any greater thickness than that corresponding to that hardness can be tested on the indicated scale.

Thickness		Rockwell Scale		
		A	C	
in.	mm	Hardness Reading	Approximate Hardness C-Scale <sup>a</sup>	Dial Reading
0.014	0.36	...	...	...
0.016	0.41	86	69	...
0.018	0.46	84	65	...
0.020	0.51	82	61.5	...
0.022	0.56	79	56	69
0.024	0.61	76	50	67
0.026	0.66	71	41	65
0.028	0.71	67	32	62
0.030	0.76	60	19	57
0.032	0.81	...	...	52
0.034	0.86	...	...	45
0.036	0.91	...	...	37
0.038	0.96	...	...	28
0.040	1.02	...	...	20

<sup>a</sup> These approximate hardness numbers are for use in selecting a suitable scale and should not be used as hardness conversions. If necessary to convert test readings to another scale, refer to Hardness Conversion Tables E 140 (Relationship Between Brinell Hardness, Vickers Hardness, Rockwell Hardness, Rockwell Superficial Hardness, and Knoop Hardness).

**TABLE 8 A Guide for Selection of Scales Using the 1/16-in. (1.588-mm) Diameter Ball Indenter (see Fig. 7)**

NOTE—For a given thickness, any hardness greater than that corresponding to that thickness can be tested. For a given hardness, material of any greater thickness than that corresponding to that hardness can be tested on the indicated scale.

Thickness		Rockwell Scale		
		F	B	
in.	mm	Hardness Reading	Approximate Hardness B-Scale <sup>a</sup>	Hardness Reading
0.022	0.56	...	...	...
0.024	0.61	98	72	94
0.026	0.66	91	60	87
0.028	0.71	85	49	80
0.030	0.76	77	35	71
0.032	0.81	69	21	62
0.034	0.86	...	...	52
0.036	0.91	...	...	40
0.038	0.96	...	...	28
0.040	1.02	...	...	...

<sup>a</sup> These approximate hardness numbers are for use in selecting a suitable scale and should not be used as hardness conversions. If necessary to convert test readings to another scale refer to Hardness Conversion Tables E 140 (Relationship Between Brinell Hardness, Vickers Hardness, Rockwell Hardness, Rockwell Superficial Hardness and Knoop Hardness).

**TABLE 9 A Guide for Selection of Scales Using the Diamond Indenter (see Fig. 6)**

NOTE—For a given thickness, any hardness greater than that corresponding to that thickness can be tested. For a given hardness, material of any greater thickness than that corresponding to that hardness can be tested on the indicated scale

Thickness		Rockwell Superficial Scale					
		15N		30N		45N	
in.	mm	Hardness Reading	Approximate Hardness C-Scale <sup>a</sup>	Hardness Reading	Approximate Hardness C-Scale <sup>a</sup>	Hardness Reading	Approximate Hardness C-Scale <sup>a</sup>
0.006	0.15	92	65	...	...	...	...
0.008	0.20	90	60	...	...	...	...
0.010	0.25	88	55	...	...	...	...
0.012	0.30	83	45	82	65	77	69.5
0.014	0.36	76	32	78.5	61	74	67
0.016	0.41	68	18	74	56	72	65
0.018	0.46	...	...	66	47	68	61
0.020	0.51	...	...	57	37	63	57
0.022	0.56	...	...	47	26	58	52.5
0.024	0.61	...	...	...	...	51	47
0.026	0.66	...	...	...	...	37	35
0.028	0.71	...	...	...	...	20	20.5
0.030	0.76	...	...	...	...	...	...

<sup>a</sup> These approximate hardness numbers are for use in selecting a suitable scale, and should not be used as hardness conversions. If necessary to convert test readings to another scale, refer to Hardness Conversion Tables E 140 (Relationship Between Brinell Hardness, Vickers Hardness, Rockwell Hardness, Rockwell Superficial Hardness and Knoop Hardness).

## 6.4 Round Correction Table

**TABLE 11 Corrections to Be Added to Rockwell C, A, and D Values Obtained on Convex Cylindrical Surfaces<sup>a</sup> of Various Diameters**

Dial Reading	Diameters of Convex Cylindrical Surfaces									
	1/8 in. (6.4 mm)	1/4 in. (10 mm)	3/8 in. (13 mm)	1/2 in. (16 mm)	5/8 in. (19 mm)	3/4 in. (22 mm)	1 in. (25 mm)	1 1/4 in. (32 mm)	1 1/2 in. (38 mm)	2 in. (51 mm)
Corrections to be Added to Rockwell C, A, and D Values <sup>a</sup>										
20	6.0	4.5	3.5	2.5	2.0	1.5	1.5	1.0	1.0	1.0
25	3.5	4.0	3.0	2.0	1.5	1.0	1.0	1.0	1.0	1.0
30	5.0	3.5	2.5	2.0	1.5	1.0	1.0	1.0	0.5	0.5
35	4.0	3.0	2.0	1.5	1.0	1.0	1.0	0.5	0.5	0.5
40	3.5	2.5	2.0	1.5	1.0	1.0	1.0	0.5	0.5	0.5
45	3.0	2.0	1.5	1.0	1.0	1.0	0.5	0.5	0.5	0.5
50	2.5	2.0	1.5	1.0	1.0	0.5	0.5	0.5	0.5	0.5
55	2.0	1.5	1.0	1.0	0.5	0.5	0.5	0.5	0	0
60	1.5	1.0	1.0	0.5	0.5	0.5	0.5	0	0	0
65	1.5	1.0	1.0	0.5	0.5	0.5	0.5	0	0	0
70	1.0	1.0	0.5	0.5	0.5	0.5	0.5	0	0	0
75	1.0	0.5	0.5	0.5	0.5	0.5	0	0	0	0
80	0.5	0.5	0.5	0.5	0.5	0	0	0	0	0
85	0.5	0.5	0.5	0	0	0	0	0	0	0
90	0.5	0	0	0	0	0	0	0	0	0

<sup>a</sup> When testing cylindrical specimens, the accuracy of the test will be seriously affected by alignment of leveling screw, V-anvil, indenter, surface finish, and the straightness of the cylinder.  
<sup>b</sup> These corrections are approximate only and represent the averages to the nearest 0.5 Rockwell number, of numerous actual observations.

**TABLE 12 Corrections to Be Added to Rockwell B, F, and G Values Obtained on Convex Cylindrical Surfaces<sup>a</sup> of Various Diameters**

Hardness Reading	Diameters of Convex Cylindrical Surfaces									
	1/8 in. (6.4 mm)	1/4 in. (10 mm)	3/8 in. (13 mm)	1/2 in. (16 mm)	5/8 in. (19 mm)	3/4 in. (22 mm)	1 in. (25 mm)	1 1/4 in. (32 mm)	1 1/2 in. (38 mm)	2 in. (51 mm)
Corrections to be Added to Rockwell B, F, and G Values <sup>a</sup>										
0	12.5	8.5	6.5	5.5	4.5	4.5	3.5	3.0	3.0	3.0
10	12.0	8.0	6.0	5.0	4.0	4.0	3.5	3.0	2.5	2.0
20	11.0	7.5	5.5	4.5	4.0	4.0	3.5	3.0	2.5	2.0
30	10.0	6.5	5.0	4.0	3.5	3.5	3.0	2.5	2.0	1.5
40	9.0	6.0	4.5	4.0	3.0	3.0	2.5	2.5	2.0	1.5
50	8.0	5.5	4.0	3.5	3.0	3.0	2.5	2.0	2.0	1.5
60	7.0	5.0	3.5	3.0	2.5	2.5	2.0	2.0	1.5	1.0
70	6.0	4.0	3.0	2.5	2.0	2.0	2.0	1.5	1.0	1.0
80	5.0	3.5	2.5	2.0	1.5	1.5	1.5	1.5	1.0	0.5
90	4.0	3.0	2.0	1.5	1.5	1.5	1.5	1.0	1.0	0.5
100	3.5	2.5	1.5	1.5	1.0	1.0	1.0	0.5	0.5	0.5

<sup>a</sup> When testing cylindrical specimens, the accuracy of the test will be seriously affected by alignment of leveling screw, V-anvil, indenter, surface finish, and the straightness of the cylinder.  
<sup>b</sup> These corrections are approximate only and represent the averages to the nearest 0.5 Rockwell number, of numerous actual observations.

**TABLE 13 Corrections to Be Added to Rockwell Superficial 15N, 30N, and 45N Values Obtained on Convex Cylindrical Surfaces<sup>a</sup> of Various Diameters<sup>b</sup>**

Hardness Reading	Diameters of Convex Cylindrical Surfaces									
	1/8 in. (6.4 mm)	1/4 in. (10 mm)	3/8 in. (13 mm)	1/2 in. (16 mm)	5/8 in. (19 mm)	3/4 in. (22 mm)	1 in. (25 mm)	1 1/4 in. (32 mm)	1 1/2 in. (38 mm)	2 in. (51 mm)
Corrections to be Added to Rockwell Superficial 15N, 30N, and 45N Values <sup>a</sup>										
20	6.0	3.0	2.0	1.5	1.5	1.5	1.5	1.5	1.5	1.5
25	5.5	3.0	2.0	1.5	1.5	1.5	1.5	1.5	1.5	1.5
30	5.0	3.0	2.0	1.5	1.5	1.5	1.5	1.5	1.5	1.5
35	5.0	2.5	2.0	1.5	1.5	1.5	1.5	1.5	1.5	1.5
40	4.5	2.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
45	4.0	2.0	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
50	3.5	2.0	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
55	3.5	2.0	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
60	3.0	1.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
65	2.5	1.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
70	2.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
75	1.5	1.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
80	1.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
85	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
90	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5

<sup>a</sup> When testing cylindrical specimens, the accuracy of the test will be seriously affected by alignment of leveling screw, V-anvil, indenter, surface finish, and the straightness of the cylinder.  
<sup>b</sup> These corrections are approximate only and represent the averages, to the nearest 0.5 Rockwell superficial number, of numerous actual observations.

**TABLE 14 Corrections to Be Added to Rockwell Superficial 15T, 30T, and 45T Values Obtained on Convex Cylindrical Surfaces<sup>a</sup> of Various Diameters<sup>b</sup>**

Hardness Reading	Diameters of Convex Cylindrical Surfaces									
	1/8 in. (6.4 mm)	1/4 in. (10 mm)	3/8 in. (13 mm)	1/2 in. (16 mm)	5/8 in. (19 mm)	3/4 in. (22 mm)	1 in. (25 mm)	1 1/4 in. (32 mm)	1 1/2 in. (38 mm)	2 in. (51 mm)
Corrections to be Added to Rockwell Superficial 15T, 30T, and 45T Values <sup>a</sup>										
20	13.0	9.0	6.0	4.5	4.5	4.5	4.5	3.0	3.0	2.0
30	11.5	7.5	5.0	3.5	3.5	3.5	3.5	2.5	2.5	2.0
40	10.0	6.5	4.5	3.5	3.5	3.5	3.0	2.5	2.5	2.0
50	8.5	5.5	4.0	3.0	3.0	3.0	2.5	2.5	2.0	1.5
60	8.5	4.5	3.0	2.5	2.5	2.5	2.0	2.0	1.5	1.5
70	5.0	3.5	2.5	2.0	2.0	2.0	1.5	1.5	1.0	1.0
80	3.0	2.0	1.5	1.5	1.5	1.5	1.0	1.0	1.0	0.5
90	1.5	1.0	1.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5

<sup>a</sup> When testing cylindrical specimens, the accuracy of the test will be seriously affected by alignment of leveling screw, V-anvil, indenter, surface finish, and the straightness of the cylinder.  
<sup>b</sup> These corrections are approximate only and represent the averages, to the nearest 0.5 Rockwell superficial number, of numerous actual observations.

## 6.5 Hardness Conversion Chart, High Range

TABLE 1 Approximate Hardness Conversion Numbers for Non-Austenitic Steels (Rockwell C to Other Hardness Numbers)

Rockwell C Hardness Number	Vickers Hardness Number	Brinell Hardness Number <sup>a</sup>		Rockwell Hardness Number		Rockwell Superficial Hardness Number			Scleroscope Hardness <sup>b</sup>	Rockwell C Hardness Number
		10-mm Standard Ball, 3000-kgf Load	10-mm Carbide Ball, 3000-kgf Load	A Scale, 60-kgf Load, Diamond Penetrator	D Scale, 100-kgf Load, Diamond Penetrator	15-N Scale, 15-kgf Load, Superficial Diamond Penetrator	30-N Scale, 30-kgf Load, Superficial Diamond Penetrator	45-N Scale, 45-kgf Load, Superficial Diamond Penetrator		
68	940	...	...	85.6	76.9	93.2	84.4	75.4	97.3	68
67	900	...	...	85.0	76.1	92.9	83.6	74.2	95.0	67
66	865	...	...	84.5	75.4	92.5	82.8	73.3	92.7	66
65	832	...	...	83.9	74.5	92.2	81.9	72.0	90.6	65
64	800	...	...	83.4	73.8	91.8	81.1	71.0	88.5	64
63	772	...	...	82.8	73.0	91.4	80.1	69.9	86.5	63
62	746	...	...	82.3	72.2	91.1	79.3	68.8	84.5	62
61	720	...	...	81.8	71.5	90.7	78.4	67.7	82.6	61
60	697	...	...	81.2	70.7	90.2	77.5	66.6	80.8	60
59	674	...	...	80.7	69.9	89.8	76.6	65.5	79.0	59
58	653	...	...	80.1	69.2	89.3	75.7	64.3	77.3	58
57	633	...	...	79.6	68.5	88.9	74.8	63.2	75.6	57
56	613	...	...	79.0	67.7	88.3	73.9	62.0	74.0	56
55	595	...	...	78.5	66.9	87.9	73.0	60.9	72.4	55
54	577	...	...	78.0	66.1	87.4	72.0	59.8	70.9	54
53	560	...	...	77.4	65.4	86.9	71.2	58.6	69.4	53
52	544	500	512	76.8	64.6	86.4	70.2	57.4	67.9	52
51	528	487	496	76.3	63.8	85.9	69.4	56.1	66.5	51
50	513	475	481	75.9	63.1	85.5	68.5	55.0	65.1	50
49	498	464	469	75.2	62.1	85.0	67.6	53.8	63.7	49
48	484	451	455	74.7	61.4	84.5	66.7	52.5	62.4	48
47	471	442	443	74.1	60.8	83.9	65.8	51.4	61.1	47
46	458	432	432	73.6	60.0	83.5	64.8	50.3	59.8	46
45	446	421	421	73.1	59.2	83.0	64.0	49.0	58.5	45
44	434	409	409	72.5	58.5	82.5	63.1	47.8	57.3	44
43	423	400	400	72.0	57.7	82.0	62.2	46.7	56.1	43
42	412	390	390	71.5	56.9	81.5	61.3	45.5	54.9	42
41	402	381	381	70.9	56.2	80.9	60.4	44.3	53.7	41
40	392	371	371	70.4	55.4	80.4	59.5	43.1	52.6	40
39	382	362	362	69.9	54.6	79.9	58.6	41.9	51.5	39
38	372	353	353	69.4	53.8	79.4	57.7	40.8	50.4	38
37	363	344	344	68.9	53.1	78.8	56.8	39.6	49.3	37
36	354	336	336	68.4	52.3	78.3	55.9	38.4	48.2	36
35	345	327	327	67.9	51.5	77.7	55.0	37.2	47.1	35
34	336	319	319	67.4	50.8	77.2	54.2	36.1	46.1	34
33	327	311	311	66.8	50.0	76.6	53.3	34.9	45.1	33
32	318	301	301	66.3	49.2	76.1	52.1	33.7	44.1	32
31	310	294	294	65.8	48.4	75.6	51.3	32.5	43.1	31
30	302	286	286	65.3	47.7	75.0	50.4	31.3	42.2	30
29	294	279	279	64.8	47.0	74.5	49.5	30.1	41.3	29
28	286	271	271	64.3	46.1	73.9	48.6	28.9	40.4	28
27	279	264	264	63.8	45.2	73.3	47.7	27.8	39.5	27
26	272	258	258	63.3	44.6	72.8	46.8	26.7	38.7	26
25	266	253	253	62.8	43.8	72.2	45.9	25.5	37.8	25
24	260	247	247	62.4	43.1	71.6	45.0	24.3	37.0	24
23	254	243	243	62.0	42.1	71.0	44.0	23.1	36.3	23
22	248	237	237	61.5	41.6	70.5	43.2	22.0	35.5	22
21	243	231	231	61.0	40.9	69.9	42.3	20.7	34.8	21
20	238	226	226	60.5	40.1	69.4	41.5	19.6	34.2	20

<sup>a</sup> The Brinell hardness numbers in boldface type are outside the range recommended for Brinell hardness testing in 3.2.2 of Test Method E 10.  
<sup>b</sup> These Scleroscope hardness conversions are based on Vickers—Scleroscope hardness relationships developed from Vickers hardness data provided by the National Bureau of Standards for 13 steel reference blocks. Scleroscope hardness values obtained on these blocks by the Shore Instrument and Mfg. Co., Inc., the Rockwell Manufacturers Institute, and members of this institute, and also on hardness conversions previously published by the American Society for Metals and the Rockwell Manufacturers Institute.

## 6.6 Hardness Conversion Chart, Low Range

TABLE 2 Approximate Hardness Conversion Numbers for Non-Austenitic Steels (Rockwell B to Other Hardness Numbers)

Rockwell B Scale, 100-kgf Load, 1/16-in. (1.588-mm) Ball	Vickers Hardness Number	Brinell Hardness, 3000-kgf Load, 10-mm Ball	Knoop Hardness, 500-g Load and Over	Rockwell A Scale, 60-kgf Load, Diamond Penetrator	Rockwell F Scale, 60-kgf Load, 1/16-in. (1.588-mm) Ball	Rockwell Superficial Hardness			Rockwell B Scale, 100-kgf Load, 1/16-in. (1.588-mm) Ball
						15-T Scale, 15-kgf Load, 1/16-in. (1.588-mm) Ball	30-T Scale, 30-kgf Load, 1/16-in. (1.588-mm) Ball	45-T Scale, 45-kgf Load, 1/16-in. (1.588-mm) Ball	
100	240	240	251	61.5	...	93.1	83.1	72.9	100
99	234	234	246	60.9	...	92.8	82.5	71.9	99
98	228	228	241	60.2	...	92.5	81.8	70.9	98
97	222	222	236	59.5	...	92.1	81.1	69.9	97
96	216	216	231	58.9	...	91.8	80.4	68.9	96
95	210	210	226	58.3	...	91.5	79.8	67.9	95
94	205	205	221	57.6	...	91.2	79.1	66.9	94
93	200	200	216	57.0	...	90.8	78.4	65.9	93
92	195	195	211	56.4	...	90.5	77.8	64.8	92
91	190	190	206	55.8	...	90.2	77.1	63.8	91
90	185	185	201	55.2	...	89.9	76.4	62.8	90
89	180	180	196	54.6	...	89.5	75.8	61.8	89
88	176	176	192	54.0	...	89.2	75.1	60.8	88
87	172	172	188	53.4	...	88.9	74.4	59.8	87
86	169	169	184	52.8	...	88.6	73.8	58.8	86
85	165	165	180	52.3	...	88.2	73.1	57.8	85
84	162	162	176	51.7	...	87.9	72.4	56.8	84
83	159	159	173	51.1	...	87.6	71.8	55.8	83
82	156	156	170	50.6	...	87.3	71.1	54.8	82
81	153	153	167	50.0	...	86.9	70.4	53.8	81
80	150	150	164	49.5	...	86.6	69.7	52.8	80
79	147	147	161	48.9	...	86.3	69.1	51.8	79
78	144	144	158	48.4	...	86.0	68.4	50.8	78
77	141	141	155	47.9	...	85.6	67.7	49.8	77
76	139	139	152	47.3	...	85.3	67.1	48.8	76
75	137	137	150	46.8	99.6	85.0	66.4	47.8	75
74	135	135	147	46.3	99.1	84.7	65.7	46.8	74
73	132	132	145	45.8	98.5	84.3	65.1	45.8	73
72	130	130	143	45.3	98.0	84.0	64.4	44.8	72
71	127	127	141	44.8	97.4	83.7	63.7	43.8	71
70	125	125	139	44.3	96.8	83.4	63.1	42.8	70
69	123	123	137	43.8	96.2	83.0	62.4	41.8	69
68	121	121	135	43.3	95.6	82.7	61.7	40.8	68
67	119	119	133	42.8	95.1	82.4	61.0	39.8	67
66	117	117	131	42.3	94.5	82.1	60.4	38.7	66
65	116	116	129	41.8	93.9	81.8	59.7	37.7	65
64	114	114	127	41.4	93.4	81.4	59.0	36.7	64
63	112	112	125	40.9	92.8	81.1	58.4	35.7	63
62	110	110	124	40.4	92.2	80.8	57.7	34.7	62
61	108	108	122	40.0	91.7	80.5	57.0	33.7	61
60	107	107	120	39.5	91.1	80.1	56.4	32.7	60



## APPENDIX A: Optional Software Features

Following is a description of the operation for these options:

### A1. Print Options

In addition to the standard print functions, there may be optional functions installed: X-Bar/R Chart, Verify Chart, or Set Codes.

- A. The X-Bar & R Chart prints these two statistical charts (at right) for all the results stored in memory. The X-Bar (average) chart is always printed, while the R (range) chart is printed only if the average mode is in effect. If the results in memory are mixed single readings and averaged readings, the charts will show zero range for the single readings.
- B. The Set Codes option allows the operator to enter codes specific to the printer that he is using to print in compressed mode (132 columns on a column printer) and cancel compressed mode. Please refer to the manual of your printer for these codes. (Note: These are used only for chart printing.)

### A2. Tolerance Options

Under the Tolerance Function, in association with the X-Bar & R chart, there may be selections for XLCL, XUCL and Range UCL. These three values represent the X-Bar Chart Lower Control Limit, the X-Bar Chart Upper Control Limit and the Range Chart Upper Control Limit, respectively. These selections allow the operator to enter predetermined values. The defaults for these values are 0 and 9999 for X-Bar and 0 for Range. If the default values are not entered the software automatically calculates the XLCL and XUCL for the X-Bar chart; if values are entered, those values are used and the calculated ones are ignored.

### A3. Round Corrections Option

The round correction function is implemented through the 0-Set Key, which is protected by the security code. This function provides automatic compensation for hardness tests taken on small diameter parts, according to the ASTM chart. For each scale there are certain diameters which need round correction. Only these diameter values can be entered; entering a different one produces an error message.

When testing these diameters proceed as follows: Press the 0-Set key, the readout will display:

**Diameter?**

This is the prompt to enter the diameter value. The first digit is for inch integers, the other two are for fractions. If the diameter is less than one inch, "0" must be entered for the first digit.

Examples are:

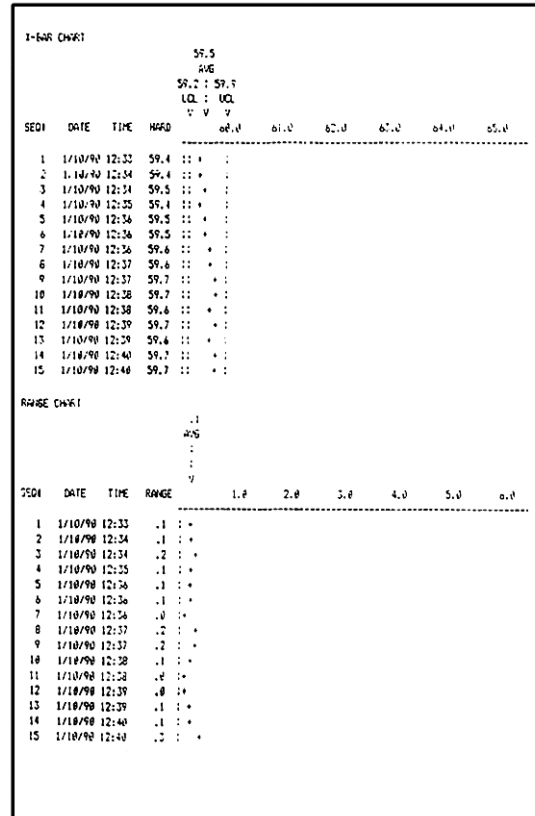


CHART PRINTOUT

**1 1/2 for 1 1/2”**  
**0 3/4 for 3/4”**  
**1 0/0 for 1”**

After completing the three digits, press the enter key, and the last character on the display will flash off and on to indicate that the round correction is in effect. At this point the tester is ready to test small round parts.

To eliminate the round correction factor, reenter the function and use “0 0/0” for the diameter and press enter. The flashing character will disappear, returning the tester to normal operation.

NOTE: If a printer is being used when the round correction is in effect, the message “Corrected for xxx diameter” will be printed after the value in print result mode and on the header in print totals mode. No message will be printed in print history mode.

#### **A4. Scale Select Option**

For version 5.0 and higher (see self test message to determine release number) the scale can also be selected by pressing the Scale Select key followed by the number associated with the desired scale and the Enter key. For example, instead of going through the scales sequentially to display HRC 1, HRB 2, HRA 3, etc.; HRA can be selected by pressing Scale Select, 3, and Enter.

#### **A5. Split Memory Option**

This feature allows the available memory to be divided into 20 separate files (10 for diamond scales, 10 for ball scales) to allow independent data analysis of each file. For instance, multiple HRC scales (files) could be used and named HRC1, HRC2, etc. Each file will have its own tolerances, history, etc. The file name is user defined with up to 5 characters. The percentage of memory per file can also be set.

Press the ‘STAT’ key and then the ‘NO’ key until the display shows ‘SPLIT MEMORY?’ Pressing the ‘YES’ key will cause the display to read ‘ENTER CODE’. At this point enter the code for Split Memory. This will clear the history files to allow for reassignment of memory.

The display will now read “HRC1” If you wish to change the heading, press the Scale Select button to begin character selection sequence (see section on alpha/numeric characters in these appendices for details). If you wish to use the current heading, press ENTER to proceed.

-The display will read “HRC MEM PCT XX”. The XX is the percentage assigned to this scale by default. The desired percentage can now be entered followed by pressing the ENTER key. The display will go to the next scale until all available scales have been displayed.

NOTE: Care must be taken when assigning percentages not to

go over 100% or data will be lost.

The History Function can be turned off so that test results are not stored in memory.

-Press the MODE key, then the NO key, until the display reads DISABLE HISTORY?

-Press the YES key.

-To turn Split Memory back on, repeat the procedure above. The display will read ENABLE HISTORY?, then press YES.

## **A6. Alpha-Numeric Characters for Lot Number/ Split Memory Option**

The alphanumeric characters allow the selection of letters and/or numbers as well as the hyphen, "-", period ".", slash "/" or blank spaces in printouts of lot numbers and user assignable headings in split memory.

To select a numeric character, press the desired number on the keypad. It will be automatically locked in so the operator can proceed to the next character.

To select an alpha or miscellaneous character, press the "Select" key to scroll through the alphabet including the special characters. Press the NO key to scroll through the characters in reverse. Note: a blank space appears before the letter "A".

Press the YES key to lock-in your selection and proceed to the next character. Press the CONV key to delete the last selection. Press the ENTER key to end the sequence and return to the test mode.





## **ONE YEAR LIMITED WARRANTY**

Should Newage Testing Instruments, Inc. equipment require service, we will repair or replace, at our option, any part or product which upon examination by a Newage service technician, shows to be defective in material or workmanship. Excluded from this warranty are any parts that are to be replaced as part of normal product operation, such as indenters, test blocks, and indenter shrouds.

This warranty is extended to the original purchaser only, for a period of one year (12 months) from owners date of purchase.

This warranty IS NOT VALID IF THE INSTRUMENT HAS BEEN MODIFIED, MISUSED OR DAMAGED in any way. This includes damage caused by disassembly by any person other than an authorized Newage Testing Instruments' service technician.

Please read all operating instructions according to the manual supplied with the instrument prior to operation. This warranty applies only to instruments sold by Newage Testing Instruments, Inc. and its authorized distributors.

Newage Testing Instruments, Inc. is not responsible in any way for losses, damage, or other form of consequential damage resulting from equipment failure or improper use.

**IMPORTANT:** Register your instrument with Newage Testing Instruments, Inc. service department by filling out and returning the enclosed warranty registration card









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