



# INDENTRON

## Rockwell Hardness Testing System NI-600 Series

### User Manual



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## FOREWORD

The machine performs the Rockwell and Rockwell Superficial hardness tests in accordance with established specifications, including ISO 6508 and ASTM E18.

It is an industrial instrument and if it is used in accordance with the following instructions, and given reasonable care and attention, it will maintain accurate and reliable hardness scales.

## SECTION 1: INSTALLATION INSTRUCTIONS

### 1.1 Initial Set-up

1. After the crate is removed from around the tester, two bolts, which holds the tester to the skid, needs to be removed from the bottom 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 back cover.

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

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

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

7. 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.

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

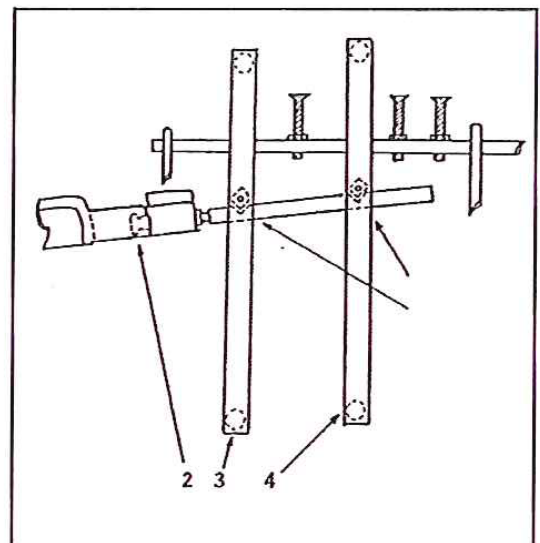
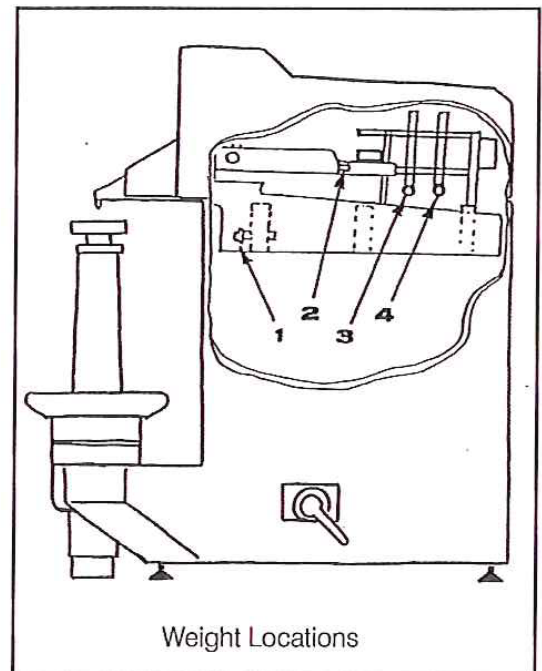
9. Attach the printer cable. Printer cables are supplied with testers that have been sold with printers. The cable connects to the back of the tester.

## 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 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.



## SECTION 2: DISPLAY PANEL

The machine is provided with a backlit LCD display. It is used to display measured hardness results, to monitor the progress of the test and to display secondary information that maybe required when setting up the machine for a variety of parameters.

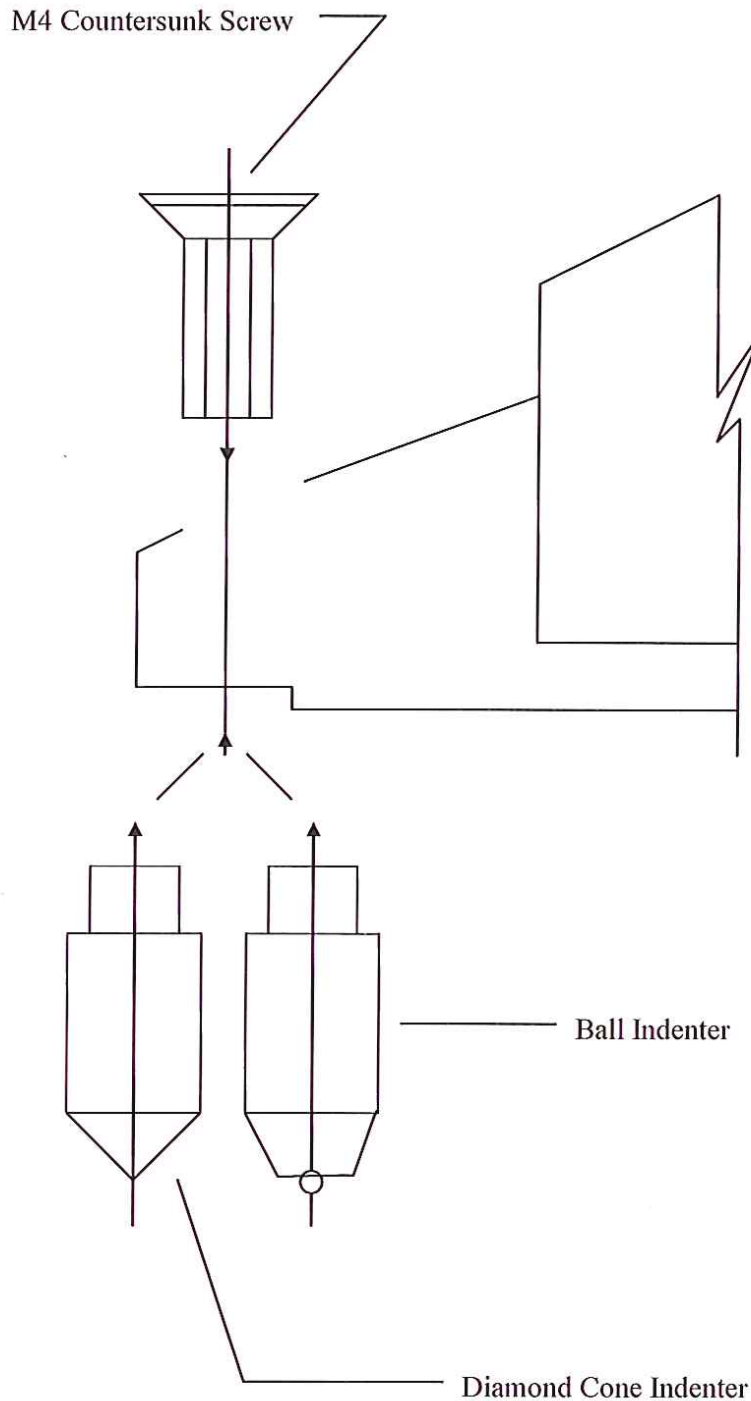
The display panel has eight press keys - See Diagram 1 - the functions of which will be described in the following sections.



### SECTION 3: FITTING THE INDENTER

The machine is supplied with both a diamond cone indenter, and a 1/16" ball indenter as standard.

Both of these are fitted in the same way, and are held in place with the 4mm socket screw provided. Always ensure that the mounting face of the indenter "nose", and the shoulder of the indenter are clean, and that the 4mm draw screw is tight.



## SECTION 4: MAKING A TEST

The pre-load is applied by bringing the specimen into contact with the indenter, by turning the handwheel clockwise.

Movement of the indenter is displayed by a bar graph, and the correct pre-load position is indicated when the horizontal bar touches the end of the fixed bar - See Diagram 2.

When this point is reached, an audible "beep" will be heard, and at this point the hand wheel rotation should be stopped.

The rest of the loading cycle is automatic - application and removal of the additional load - again displayed by the bar graph. At the end of the load cycle, the hardness number will be displayed - resolved to 0.1 units.

## SECTION 5: HANDWHEEL OVER-TRAVEL

The pre-load position can be overrun, with the handwheel, by a significant amount without influencing the test. However, if all the over-travel is taken up the bar graph will flash accompanied by an audible beep to indicate no test.





## **SECTION 6: CHANGING SCALE**

The hardness scale is determined by the combination of the test load and indenter. Scale change is inhibited if the indenter is in contact with a specimen.

## **SECTION 7: LOAD CHANGE**

There are six test loads available:

Rockwell	60, 100 and 150 kgf
Rockwell Superficial	15, 30 and 45 kgf

The large handlever at the bottom right-hand side of the machine is used to convert the machine from Rockwell to Rockwell Superficial mode. The two positions for the handlever are indicated by the letters R (Rockwell) and S (Superficial Rockwell). This handlever operates a platform which either raises or lowers a set of test weights, and the movement of the handlever should be operated carefully and smoothly.

The small handlever at the top right-hand side of the machine is used to select any of the three test loads in either the Rockwell or superficial Rockwell mode.

The position of both handlevers is sensed to provide feed-back for the machine software.

## SECTION 8: SETTING TEST PARAMETERS

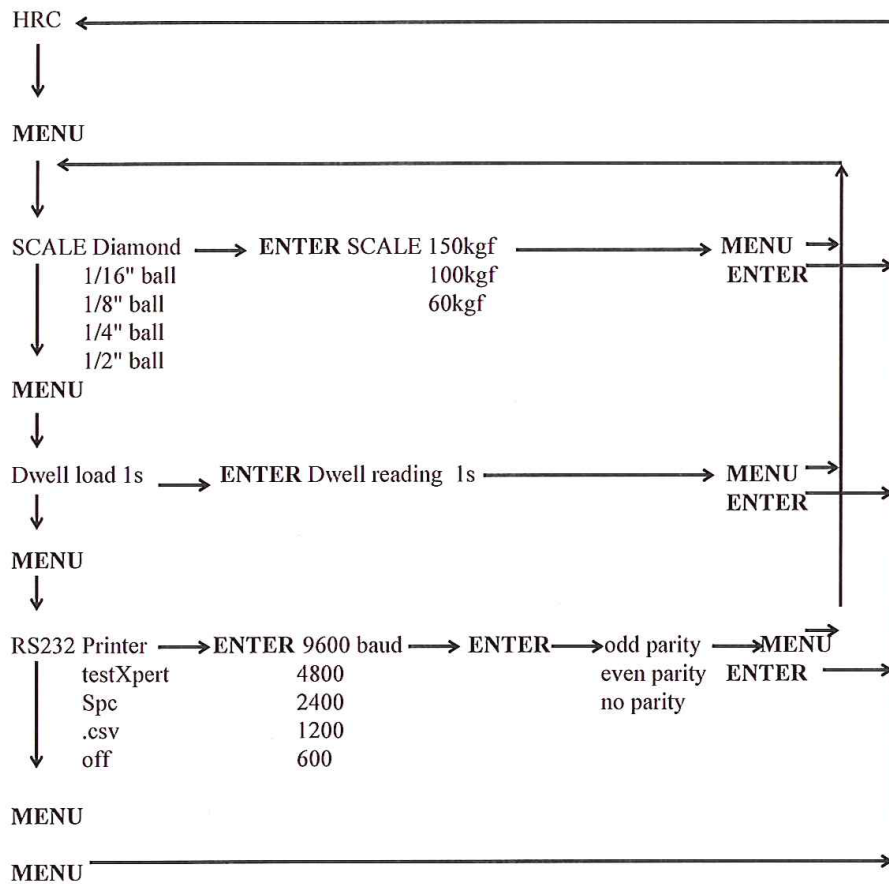
This section deals with the top four keys i.e.

[MENU] [ENTER] ▲ ▼

*Note:*

The following diagram illustrates the use of these four keys.

The example shows the selection of the HRC scale, with a load dwell time of 1 second, and a reading dwell time of 1 second. With the exception of the test load, parameters are adjusted by the use of the scroll keys as follows:



## 8.1 Indenter selection

The hardness scale depends upon a combination of test load and indenter type.

There are 5 standard indenters available: diamond cone, 1/16" ball, 1/8" ball, 1/4" ball, and 1/2" ball. Having entered the appropriate Indenter into the software, the selected Indenter must be physically fitted to the machine.

DWELL load - This controls the duration of the total load. It is normally set at 1 or 2 seconds, but can be increased to a maximum of 50 seconds for materials that exhibit creep, i.e. plastics.

DWELL reading - This controls the time at which the final depth reading is taken, after the removal of the additional load. Again this is normally set to one second, but can be increased for materials that exhibit creep.

## 8.2 RS232

The port, on the back of this machine, is a 9 pin 'D' socket, and can be configured as follows:

Printer Format - In this mode a simple printer, with a serial port can be connected and the readings will be recorded in rows of 5, and will be headed by the scale designation selected previously.

Comms Format - In this mode raw data - hardness number and scale - is available for processing by an external data processor.

SPC Format - This is for use in conjunction with Indentrons proprietary SPC software package.

CSV Format - This is used to assist data import into proprietary spreadsheet and database software packages such as Microsoft Excel or Lotus 1-2-3.

**NOTE:** The test load cannot be adjusted with the scroll keys. As described earlier, changing test load is achieved with the handlever, and its position is sensed and the scale is switched automatically.

### 8.3 Communication interface

The serial interface on the Hardness Testing Machine provides the ability to print out results on a standard printer, or to transfer data to a remote computer.

#### Electrical Characteristics

Signal levels conform to RS232C Interface Standards with the following signals available:

PIN	DESIGNATION	DESCRIPTION
2	TXD out	transmit data
3	RXD in	receive data
4	DSR in	data set ready
5	GND	signal ground
6	DTR out	data terminal ready

The connector on the rear of the machine is a 9 way miniature 'D' socket.

#### Data Rates

Baud rates are selected on the RS232 menu. Five standard rates are available between 600 and 9600 baud.

#### Serial Data Format

Data is transferred in asynchronous format consisting of one start bit (zero), seven data bits in least significant bit first order, one parity bit, and one stop bit. The parity bit can be selected on the RS232 menu for odd, even or no parity. All information transfer is in ASCII character format (bit 8 set to zero).

#### Handshake Signals

When data is ready to be transferred, Data Terminal Ready (DTR) is raised and the machine will wait for Data Set Ready (DSR) to be returned before commencing transmission.

If DSR is lowered during transmission, the current character will be completed and then a time out of 50 ms is commenced for DSR to be restored before continuing the message. If the time out is exceeded then the message will recommence from the start.

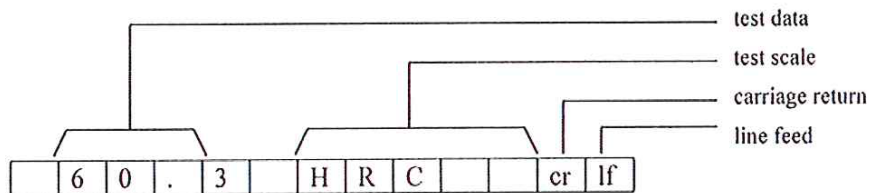
Once transmission is completed, or if DSR is not returned and a new measurement cycle is commenced, then DTR is lowered and the cycle is commenced, then DTR is lowered and the data is cleared from the message buffer.

## 8.4 Interface protocols

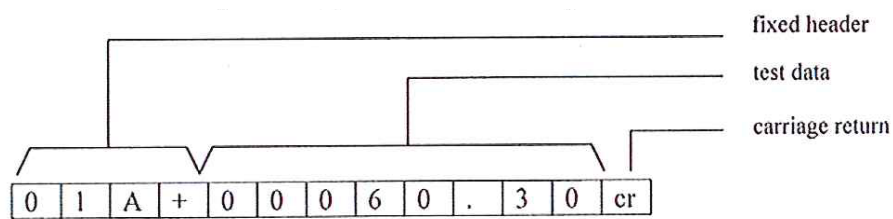
All data output takes place at the end of a measurement sequence as the leadscrew is lowered to remove the test piece. This gives the user the opportunity to cancel the result while the Indenter is still in contact with the test piece at the end of a test cycle.

Three data protocols are available, a testXpert format which outputs a short message giving just resultant data and measurement scale, an, SPC format which emulates a Mitutoyo protocol and enables direct input to several proprietary Statistical Process Control packages available for IDM compatibles, and a PRINT format designed to optimise the use of a full width printer.

The testXpert format outputs strings of 13 character length as follows:

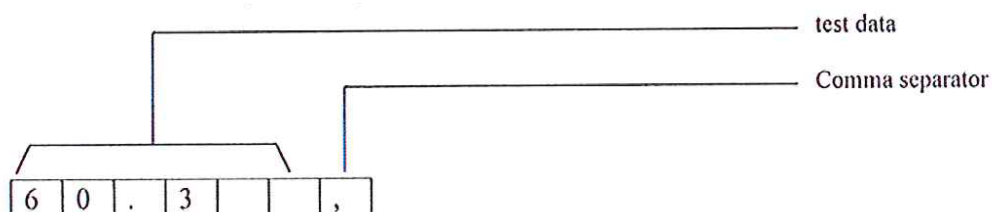


The SPC format outputs strings of 13 character length as follows:



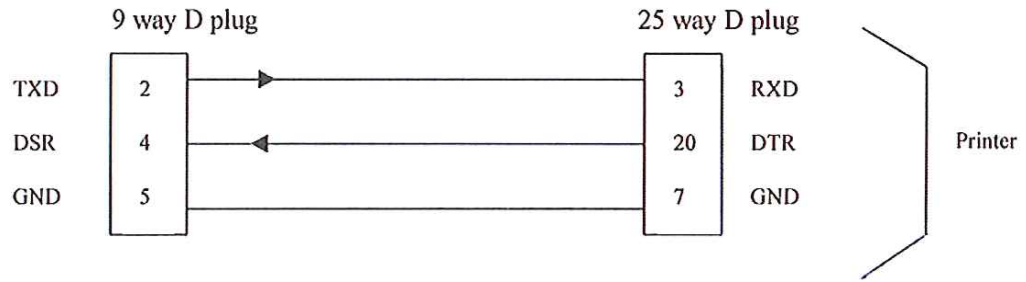
This protocol complies with Mitutoyo MUX I0 format and the target software package should be configured to accept this format with data input on channel 1. The machine should be set to the MUX I0 default values of 1200 baud and no parity.

The CSV format outputs strings of 7 character length as follows:

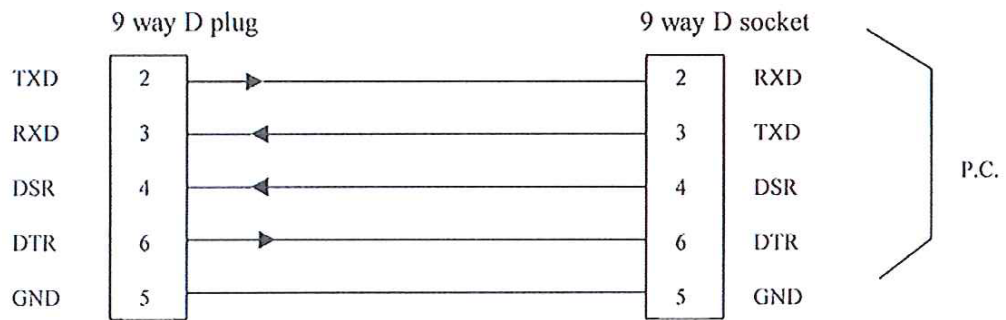


The PRINT format outputs strings of 75 character length with the last two characters as carriage return and line feed. The printout will show a header line giving test scale, conversion scale in brackets. The machine will then output test data (with converted value if selected) at the end of a test as each line of data is completed i.e. after a group of tests. If statistics are selected, the machine will print out the calculated summary as the set sample is completed. Note that the printer connected to a machine needs to be fitted with a serial port and should have a buffer capacity of at least 1K characters.

### 8.5 Hardness testing machine to printer cable



### 8.6 Hardness testing machine to pc cable



## SECTION 9: CHANGING PROGRAMME

In addition to measuring and displaying hardness, the machine can be programmed to display additional data, and to perform a number of auxiliary tasks. A description of these features is given below:

### 9.1 +/- Tolerance Level Controls

Press this key, a reading with the + sign will now be displayed.

Scroll the reading until the appropriate level is obtained. The reading will initially scroll in increments of 0.1 units, for 1 unit and then speed up to increments of 1.0 units.

It will not be possible to adjust the level of the + reading below the level of the - reading. When the appropriate reading is displayed enter by pressing the [ENTER] key. A reading with a - sign will now be displayed.

Repeat the procedure.

When the - level has been entered, the yellow L.E.D. in the top left-hand corner of the +/- key will illuminate.

In use, an out of tolerance reading, will be indicated by a flashing display and an audible bleep.

To switch off the facility, press the +/- key twice.

### 9.2 Statistic Control Settings

Press this key,  $n = ?$  will appear, scroll until the desired number is displayed (maximum 30).

Enter by pressing the [ENTER] key, the yellow LED in the top left-hand corner of the key will illuminate.

In use the successive test number will appear at the right of the screen.

When the correct number of tests have been made, with the reading still on the screen, i.e. do not lower specimen away from the indenter, press the [E] key and the mean (X bar) and range (R) will be displayed.

The X-bar and R are continually updated and can be accessed by pressing this key at the end of a test.

To switch off the facility, press the [E] twice.

#### Notes:

1) If using a printer, when the number of tests equals that entered, i.e.  $n = ?$ , the X-bar and R will automatically be printed.

2) If it is desired to edit a particular reading, proceed as follows:

With the spurious reading still displayed and the component still in contact with the indenter, press the scroll down [ ▼ ] key. This reading is then erased.

### 9.3 = Conversion Setting Controls

Pressing the = Key displays HR = ?. Scroll until the desired conversion is displayed.

Enter by pressing the [ENTER] key, the yellow LED in the top left-hand corner will illuminate.

Hardness conversions can be calculated in accordance with either ASTM E140 or DIN50150. Use the [ ▲ ] key to select the appropriate conversion standard and press the [ENTER] key to confirm.

At the end of the test with the component still in contact with the indenter and with the measured reading still displayed, press the = key and the converted reading will be displayed. As soon as the key is released the measured reading will be displayed once more.

*Note:*

It is only possible to convert between compatible scales. Generally these are between diamond scales, HRC - HRA - HV, or ball scales, HRB - HB.

It should be borne in mind that these conversions are approximate and should only be used as a guide.

They should not be used for soft alloys, including aluminium, or austenitic stainless steels or high HRB values.

To switch off the facility, press the = Key twice.

### 9.4 Correction Setting Control

Press Ø once, external diameter = ? will appear.

Press this key again, internal diameter = ? will appear.

Scroll to the appropriate setting until the desired diameter is obtained (maximum 30.0mm). Confirm by pressing the [ENTER] key.

The yellow LED in the top left hand corner will illuminate.

In use the displayed reading will be the corrected reading. To view the measured reading, together with the amount of correction applied, press the [0] key with the reading still on the screen.

To switch off the facility, press the [0] key three times.



## SECTION 10: EXAMPLE OF STATISTICS PRINT-OUT

SCALE HRC	MEAN	RANGE
59.8 59.8 59.8 59.8 59.8	59.8	0.0
SCALE HRC		
59.8 59.8 59.9 59.9 59.8		
59.9 59.9 59.8	59.8	0.1

## SECTION 11: INDENTRON DATAVIEW INSTRUCTIONS

1. Open DataView software. Ensure to connect USS key as it contains software license.
2. Select "Comm. Setup". Under mode, select "Online".
3. Select "Comm. Setup". Select "Communication Settings".
4. Communication Setup window will appear.
5. Select Communications Port (COM1).
6. Set as follows: Baud Rate to 9600. Data size 8. Parity-None. Handshake-None . Data Field-0. Select OK.
7. On Hardness Tester press Menu key until RS232 appears.
8. Under RS232 mode press up arrow until finding "testXpert".
9. Place sample on flat anvil. Take machine to preload stage. Allow machine to complete test.
10. Lower sample away from diamond indenter.
11. Hardness value will appear on DataView software.

## SECTION 12: ROUTINE MAINTENANCE

The machine has been designed, as far as possible, so that the effect of normal wear and tear does not influence the machines performance. As a result the need for routine maintenance has been kept to an absolute minimum.

The overriding requirement is that the indenters are handled very carefully, and are stored in a safe place when not in use. The Rockwell diamond indenter is the most vulnerable, and a spare indenter should always be available.

A damaged ball will also give spurious answers, and, if in doubt the ball should be changed.

It is extremely important that the support anvil is clean, flat, and free from marks and bruises. This requirement also applies to the surfaces of the test blocks, especially the under surface they should be meticulously clean. It is necessary that product ion test specimens are properly supported, to prevent any movement during the loading cycle.

The main leadscrew should be lubricated periodically by applying just a few drops of light machine oil. Access to the leadscrew can be obtained by first removing the anvil and bellows. Slacken the collar at the top of the bellows using a 2.5mm Allen key and then lower the bellows. After lubrication, run the leadscrew up and down a few times to distribute the oil. DO NOT OVER LUBRICATE. Refit the bellows by the reverse procedure.



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