NEWAGE®
HMV-2 Microhardness Testing System

The HMV-2 Series is designed for measuring the hardness of small parts and metallic structures used in precision equipment, processed surface layers, and metal plating layers. The HMV-2 Series is ideal for metallographic research and product quality control. It features an intuitive LCD touchscreen operator interface combined with an excellent optical system with a minimum unit of diagonal length measurement of 0.01 μm for extremely high accuracy.

The HMV-2 offers two modes of testing. The standard testing modes lets you setup your test for fast, efficient hardness testing based on only a test load and test duration period. However, the serial testing modes lets you generate a batch of indentations and then measure the diagonal length of those indentations.

The HMV-2 includes a variety of analysis functions including statistical calculations and data editing, hardness conversion and data output in tabular or graphical representations.

The HMV-2 Series can be operated as a standalone system or combined with our C.A.M.S.™ computer-assisted microhardness testing measurement software.

Features
- Modular, scaleable architecture
- Touchscreen operation
- Operate as standalone system or with our C.A.M.S. System
- Measurement Modes
  - Vickers Hardness (HV)
  - Knoop Hardness (HK)
  - Brinell Hardness (HB)
  - Triangle Pyramid Hardness (HT)
  - Direct Length Reading (L)
- Nine (9) Load Settings
- Adjustable Load Times
- C.A.M.S. Functionality options:
  - Manual or automatic on-screen impression measurement
  - Manual or motorized positioning tables in one or two axis
  - Built-in statistical process control
  - Manual or automatic traverses
  - Image capture
  - Test block verification
  - Image analysis of metallurgical structure
  - Auto focusing
  - Auto or manual case depth
  - Grain Sizing
  - Crack length analysis

Shown: HMV-2 Tester with X-Y stage

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AMETEK® | **Newage®** *Hardness Testing*

HMV-2 Series Operation

Touchscreen Operation

The HMV-2 Series operates using a touchscreen display panel that controls primary tester operations and setup. The displays are dynamic and change based on the operation being performed, and provide the user with information for that operation only. This leads to intuitive decision making since only logical options are presented to the user.

Indenters

Four types of indenters may be used for Vickers hardness (HV), Knoop hardness (HK), Brinell hardness (HB) and triangular pyramid hardness (HT). Length reading (HL) is also available as a length reading function.

You select from one of the indenters installed on the tester. The number of readings for your test will depend on the type of indenter and the shape of the test sample surface. When the test sample is not flat, the test impression will be irregularly shaped. A correction factor must be used corresponding to the shape of the test material. When the test sample shape is preset, the HMV-2 tester will automatically apply the correction factor. You may specify the sample shape as flat, cylindrical or spherical.

Optical System

The optical head for the HMV-2 Series consists of an eyepiece, index knob and index positioner. The spacing of the index displayed in the visual field seen through the eyepiece may be adjusted using the index knob. The index positioner is used to adjust the position of the indexes without changing the index spacing.

Although the HMV-2 Series uses a direct load method, the optical system is extremely simple. The optical system is used to set the measurement position and test sample surface height, then it measures the indentation. With a combination of the 10X eyepiece and 40X objective lens, the standard optical system functions as a 400X microscope. Optional objective lens with magnifications of 20X, 50X and 100X are also available.

Two lenses may be used simultaneously on your HMV-2 tester. When an indentation is too small to be measured at a magnification of 40X, the lens can be changed to an optional 10X objective for measurement. The lenses may change automatically if the HMV-2 Series is fitted with the electric turret.

Test Sample X-Y Stage

The test sample stage can be adjusted manually and may be equipped with a variety of optional vise fixtures or self-leveling vise fixtures. Key specifications for the X-Y stage are:

- Elevation Distance   60mm
- Surface Area   120 x 120mm
- Fine Adjustment Range   25mm
- - Minimum graduation   0.1mm

Shown: Optional self-leveling vise fixture

Tolerances

Upper and lower limit values may be used for determining the tolerance (pass or fail) for your sample. If the measured value is within the range defined by your upper and lower limits, "OK" will display on your result display. "NG" for "no good" will display when the result falls outside your tolerance limits.

Load Duration Time

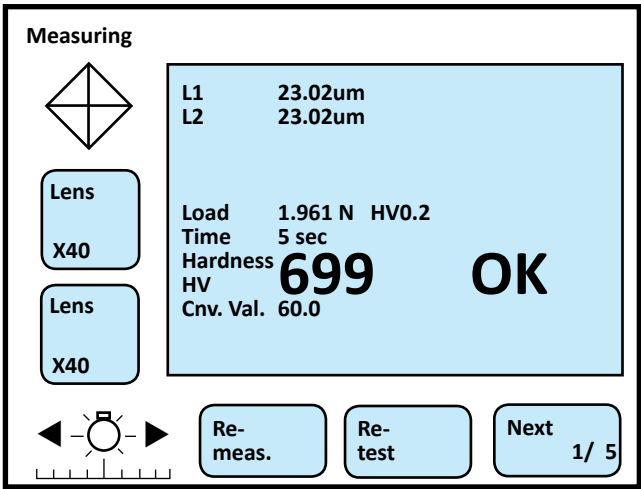Load durations may be configured from 5 to 999 seconds.

Number of Tests

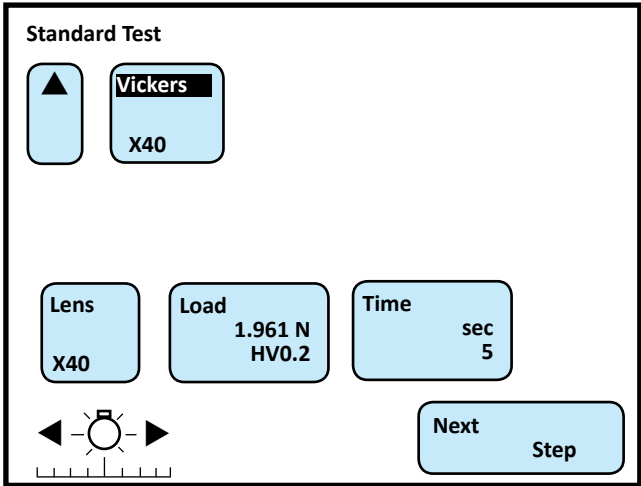You may specify the number of tests to be performed from 1 to 256 times.

Load Settings

Up to nine (9) load setting may be selected:

- 98.07mN (HV0.01)
- 245.2mN (HV0.025)
- 490.3mN (HV0.05)
- 980.7mN (HV0.1)
- 1.961 N (HV0.2)
- 2.942 N (HV0.3)

Shown: Measurement Dsplay for 2 Readings

Shown: Test Condition Setup Display for Simple Tests

- 4.903 N (HV0.5)
- 9.807 N (HV1)
- 19.614 N (HV2)

Hardness Conversion

Test results may be converted from Vickers hardness into other hardness scales. Converted results are displays as "Cnv. Val. xx.x".

The available hardness conversion values are:

- No conversion
- Rockwell A
- Rockwell C
- Rockwell D
- Rockwell 15-N
- Rockwell 30-N
- Rockwell 45-N
- Brinell
- Shore
- Tensile Strength

Shown: Test Condition Setup Display for Standard Tests

Lamp Output Adjustment

The halogen lamp can be adjusted to increase/decrease the brightness of the optical head field of view. Press the arrow key on the display to adjust the brightness.

Test Load v. Hardness Correction

You may also correct to compensate for differences due to visual variations between hardness variations due to the size of the test load. Correction may also be used to compensate for difference when the sample is measured by the Vickers method and by the Knoop method.

Data Output

The HMV-2 Series may be connected directly to a printer for outputting data. The HMV-2 display can also show tabular results, graphical results, including data plotting and histograms, and statistical results. The prince must be ESC/P code compatible.

Comprehensive reporting can be accomplished directly from your HMV-2 Series to a serial data or parallel printer. The report format headers are:

Header	Description of Transmission
SA	Sample No.
NA	Sample Name
ME	Memo
MO	Test Mode
CO	Correction Factor
SU	Surface Shape
LN	No. of Tests (1 to 256)
LO	Load (10 to 2000 gf)
TI	Load Duration (5 to 999 sec)
LM	Upper Limit Tolerance
LX	Lower Limit Tolerance
DI	Surface Diameter (0.01 to 1000.0mm)

Statistical Results include the following:

- Average
- Standard deviation
- Coefficient of variation
- Maximum value
- Minimum value
- Number of passes results
- Number of failed results

```
****  CONDITIONS  ****

Date              10-01-01  12:00      Condition File No.     - -
Sample Name       HMV0700             Sample No.             344-04110-09
Mode              Single              Correct                0.00
Indenter          Vickers             Number of Readings     2
Number of Tests   5                   Read Lens              X40
Test Load         1.961 N (HV0.2)     Time                   5 sec
Surface           Flat
Limit Minimum     1.0                 Limit Maximum          1000.0
Remarks           HMV-2

No.      HV        Length1    Length2         HRC      Judge
 1       699       23.02      23.02           60.0     OK
 2       704       22.95      22.95           60.3     OK
 3       704       22.95      22.95           60.3     OK
 4       707       22.95      22.84           60.4     OK
 5       711       22.84      22.84           60.6     OK

Mean Value               705
Standard deviation       4.42
Coefficient of variation 0.63
Minimum value            699
Maximum value            711
Number of OK data          5
Number of NG data          0
```

Shown: Printer output example

HVM-2 Series with C.A.M.S. System

The NEWAGE® HMV-2 with C.A.M.S System is a modular and cost-effective solution for applications requiring advanced microhardness testing functionality such as complex case depth traverses. The HMV-2 with C.A.M.S System starts with a Newage HMV-2 microhardness tester with video camera, combined with our software, personal computer and any required accessories, such as a motorized X-Y-Z axis positioning table.

The HMV-2 with C.A.M.S System uses a video camera connected to a personal computer to view and optically measure test impressions made by a microhardness tester. The software and camera operate independently from the tester they are connected to. The personal computer does not need to control any of the mechanical or electronic functions of the tester, although the software may be setup to control the tester and any associated accessories such as a motorized positioning table.

The C.A.M.S System software complements the advanced video capabilities of the system by providing comprehensive test setup tools, including intelligent prompts and menus that guide the user through the test configuration process- from basic microhardness testing to sophisticated case depth profiling. Test configuration is intuitive and information is presented in a logical, step-by-step sequence. A variety of testing attributes are presented for your testing. Configuration is as simple as selecting options from a list. There is minimal text entry.

Once the test setup is configured, the C.A.M.S System provides the user with a variety of on-screen navigation tools. For example, on-screen navigation with motorized positioning lets you select from four ways to direct movement of the test sample using an X-Y table. Navigation can use the computer mouse or a virtual joystick controlled from the computer display. Directional arrows on the display allow you to jog the position of the sample by 1µ (0.001mm) increments- ideal for stepping through traverse positions. Operators can be prompted during the test to enter specific information about the current test process. When the automatic measurement function is used, operator influence is eliminated.

The C.A.M.S System's on-screen analysis is exceptional. A comprehensive display shows your hardness results, converted values and tolerances at a glance. You can measure total case depth in standard or full screen viewing mode or perform detailed image analysis such as grain sizing or crack length. Operators can even orient the traverse direction to each test part, on the screen, and within seconds. Viewing the impression and

positive positioning of the filars from the displayed image is much easier and faster than having to use an eye piece.

The C.A.M.S System supplies comprehensive data management tools and report generation capabilities. A variety of standard report formats are provided. Operators can capture images of the impression, plot overlays or multiple case curves for comparison, perform statistical calculations and general tabular and graphical reports- quickly and easily.

Configuration

Test Setup

The C.A.M.S System software is file-based. All setup parameters such as hardness sale, tolerance limits, part information, etc. are created and saved with the individual file. Files are created in a .csv format. Each new file has a set of attributes that define the test file. These attributes include:

- Part Number
- Part Name
- Spec Order
- Heat Number

- Load Number
- Furnace Number
- Lab Number

You also have the ability to add "comments" to further define the test setup file.

### Scale Selection and Conversion

During test setup you configure a primary and secondary scale. The primary scale is normally HRC. The secondary scale is any scale you would like to be able to convert your hardness result to. A menu is provided for scale setup.

Averaging

Averaging allows you to save averaged results for a group of tests rather than the results of each and every individual test result. You may specify the number of results that comprise a Group for which the averaging is performed. Options for averaging include: use all results, eliminate the highest and
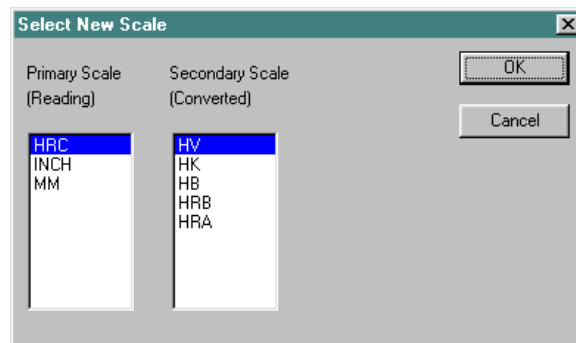
Shown: Select your primary and secondary scale. Results will be displayed in the primary scale. Conversions may be made to your secondary scales.
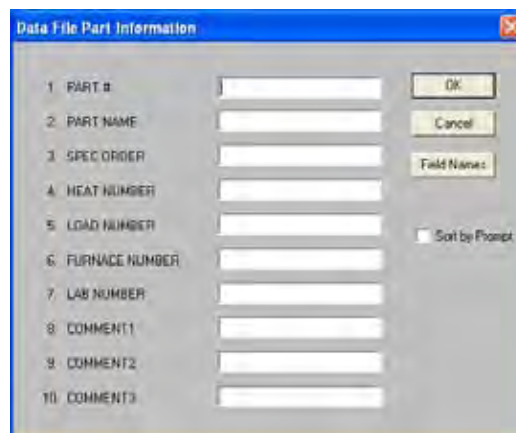
Shown: Intelligent prompts, menus, dialog boxes and list of values are intuitive and help make configuration and setup easy.

Shown: Case depth menus guide users through the setup process.

lowest result, eliminate the furthest result from the average, and eliminate if the standard deviation exceeds a user-defined value.

Tolerances
You may set tolerances for your test to provide warnings and indications on individual test results. Tolerance settings include: low tolerance limit, low tolerance warning, high tolerance limit and high tolerance warning. Tolerance limits can be set to produce an audible alarm and they can be setup to require the operator to acknowledge the tolerance condition.

Test Parameters
Menus are provided for selecting the load, time-at-load and the magnification for your camera. Loads are presented in both gf and N units of measure. Load time is presented in 5 second increments. Magnification is from 40X to 100X in 10X increments.

Round Correction
When the test setup load is greater than 1000 kgf a round correction factor may be specified. When selected, a prompt for round correction will be displayed after each test. Options are available for spherical and cylindrical specimens as well as concave and convex.

Operation
On-screen Navigation Tools
C.A.M.S System operators frequently comment on the system's exceptional user friendliness. The on-screen navigational tools are intuitive and easy-to-use. As an example, a right click of the mouse automatically positions the sample from the cursor position to the center of the display- ideal for centering impressions, selecting a test position, or for just navigating across the display.

The on-screen arrow control keys can be used to jog the sample's position or stepping through traverse positions. You can select standard jog increments in metric or imperial units. Metric increments can be set as small as 1μ. You can even define your own increments. Additionally, tools such as the virtual joystick allow the operator to navigate around the surface of the sample quickly and controlling both speed and direction. Using predefined traverse sequences, the operator can automatically move around the test sample to preview test positions in a "dry run" mode, or perform the actual testing making measures of the test positions. You can have a user-defined Home position so you always have a reference position. Options such as automatic focus are useful when

making large traverses because the avoid repeated focus adjustment.
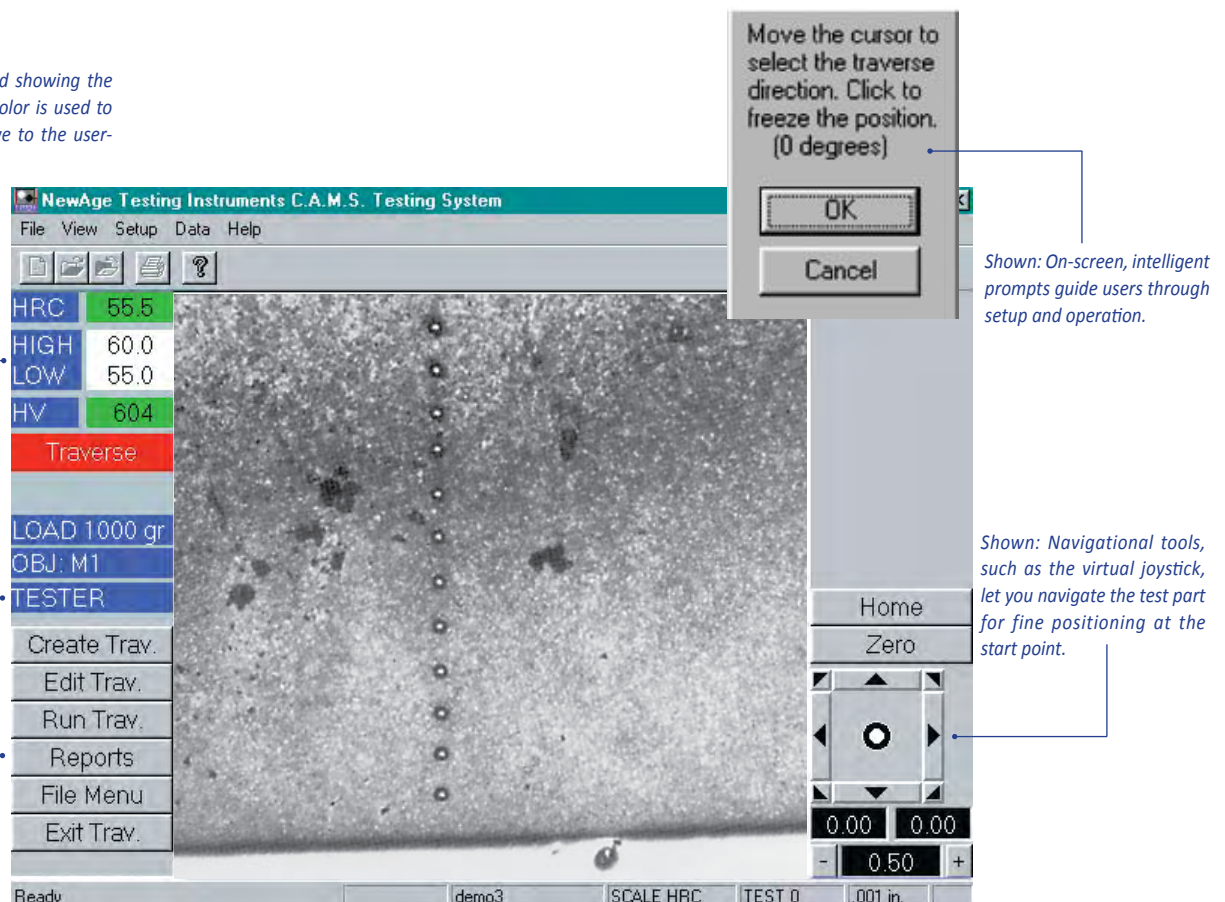
Inch/Millimeter Scale
This function requires the Inch/Millimeter optional add-on. If "inch" or "mm" is selected as the scale during a test setup, the tester will allow the operator to measure distances at any angle.

Automatic Focus
Requires the Automatic Focus add-on, when running traverses and making tests, the automatic focus functions works automatically when the "Prefocus" option is selected. Auto focus may also be controlled manually. The auto focus may be setup for coarse or fine focus.

Advanced Imaging
When the Image Capture option is selected, the SAVE function will permit you to capture the camera image without the program controls or buttons appearing. The image is saved as a .bmp file. The image may be magnified using the magnification controls (1X, 2X).

Shown: Test results are displayed showing the primary and secondary scale. Color is used to indicate the result status relative to the user-defined tolerance criterion.

Shown: Setup status indication shows your currently configured testing attributes.

Shown: On-screen softkeys are used for traverse setup, operation and reporting.

Shown: On-screen, intelligent prompts guide users through setup and operation.

Shown: Navigational tools, such as the virtual joystick, let you navigate the test part for fine positioning at the start point.

Shown: The main results display provides a variety of on-screen information and navigation tools.

Manual Traverse Option

During the traverse test routine and while the tests are being made, the operator is prompted to move to the origin and select the test direction and to rotate the turret to each point in sequence. Once all tests have been made, the operator is taken back through the same sequence of positions in order to read the impression diameters with prompting for each coordinate position.

Automatic Traverse Setup

You can setup an automatic traverse test when the C.A.M.S. System has the optional automatic traverse and motorized X-Y table options. During setup, the user creates the test file and includes attributes such as traverse direction. Individual test points are also located on the displayed image by positioning the cursor in the traverse layout grid. Staggered traverses may also be created if the operator needs to position tests closer than the minimum allowable distance for a given load.

Multiple Traverse Mode

Operators may set up a second, third or additional traverse allowing multiple traverses to be performed. Up to 24 traverses may be configured as part of one procedure. The operator may also select a specific traverse within a multiple traverse procedure.

Effective Case Depth

The operator is prompted to enter the effective case hardness values to calculate the case depth. Up to three case hardness values may be entered for each test file. Each value may have its own effective case depth distance tolerance. Surface test and Core test values may also be established with an "offset" value that determines the distance from the traverse origin and with related hardness tolerances. Case Hardness setup options include User Defined, Nitride Case, Eht Case, Rht Case and Nht Case. The Eht, Rht and Nht Cases all calculate the case depths per ISO and DIN specifications.
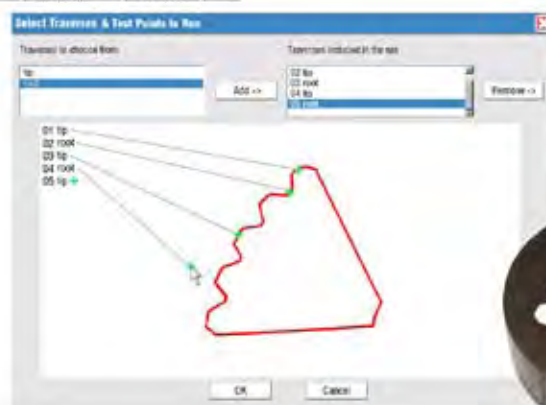
Mapping

The mapping function makes it easier for the operator to locate the beginning points for traverses when multiple traverses are carried out on one sample. If mapping is enabled, mapping starts after the operator selects which of the multiple traverses to include in the particular test sequence. The system prompts the operator whether to map the test sample. If mapping is required, the system rotates to low power and then directs the operator to clock on the edge to the right or left of the center of the screen using the mouse. The system proceeds to track the perimeter of the sample, create a red outline of the sample until the operator locks again. Next, the operator is requested to locate the position of the traverses. When the traverse testing is initiated, the system will automatically position the sample near the starting pint for each traverse. The operator only needs to exactly position the traverse origins and proceed with the testing.
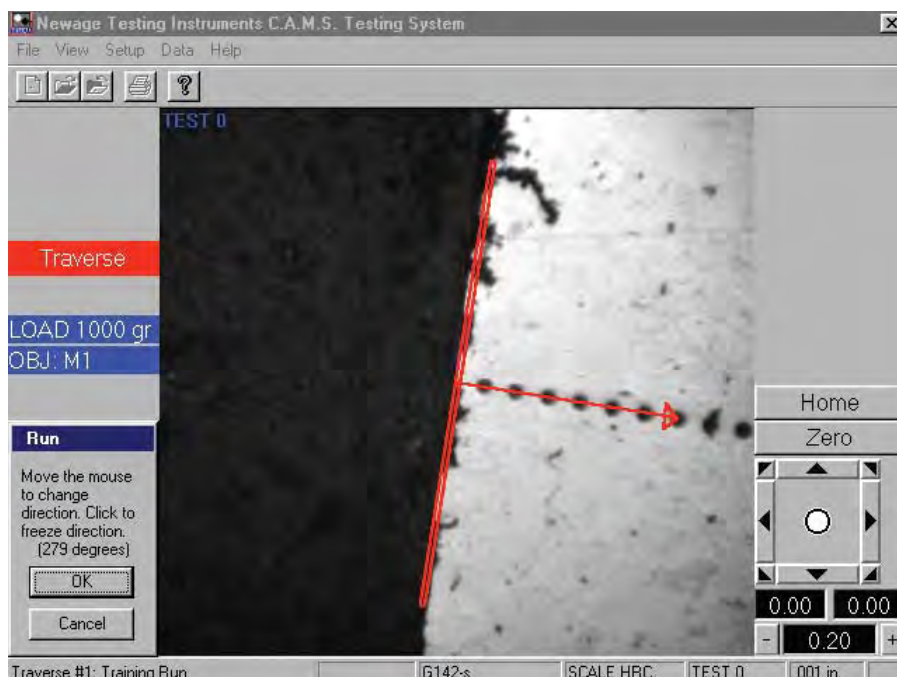
Shown: Performing a traverse is as simple as identifying your points and direction..
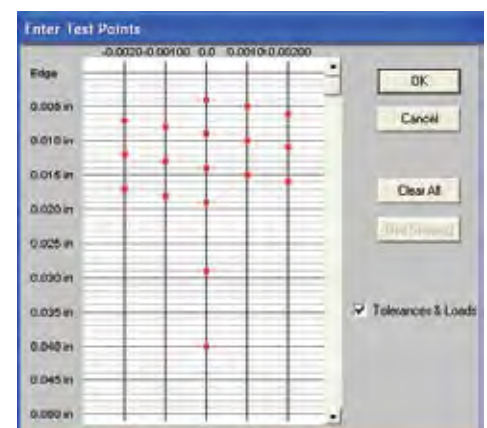
Shown: Using predefined traverse sequences, the operator can automatically move around the test sample to preview test positions in a "dry run" or "simulated" mode, or perform the actual testing.

Shown: Mapping lets your track the perimeter of your sample and helps locate the beginning points for traverses when multiple traverses are being performed on a sample.

Data Management and Reporting

The HMV-2 Series with C.A.M.S. System features an assortment of reports and dsiplay views that help analyze your test data. There are seven different views that can be accessed via a menu: X-Bar and R Chart, Histogram, History Data, Tile, Auto Tile, Tool Bar and Status Bar.

A report view shows the data from the current test file as well as the associated histogram and X Bar/R Chart.

An on-screen statistics display shows a comprehensive statistical report for a range of user-defined results.

The display report is provided for each test result. If multiple traverses are setup under a traverse specification, then two pages will be reported for each curve.
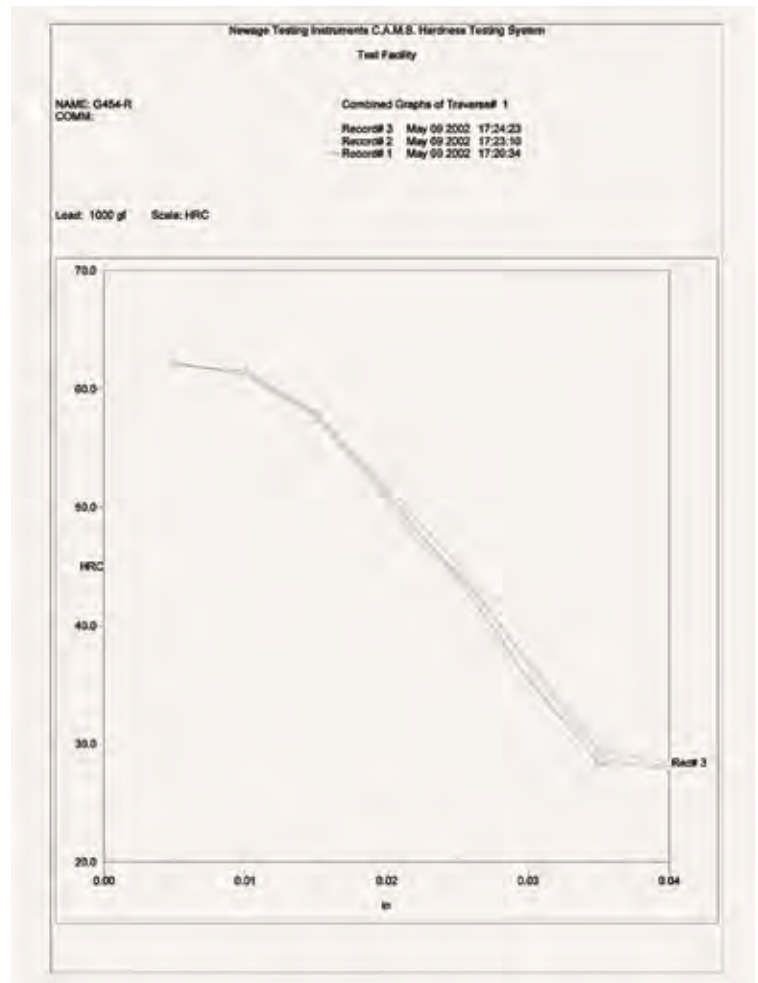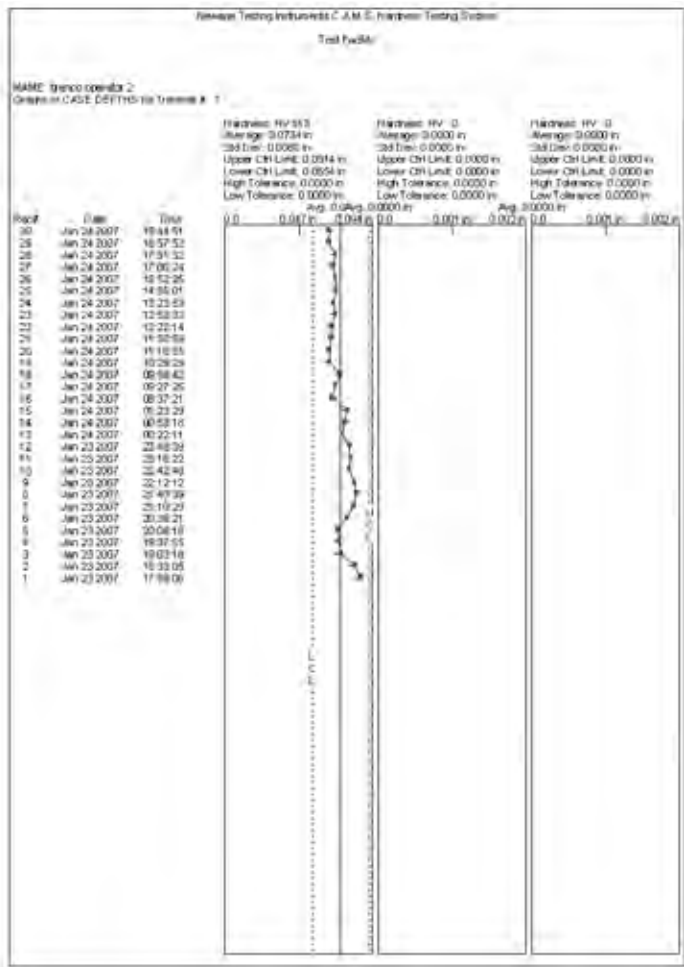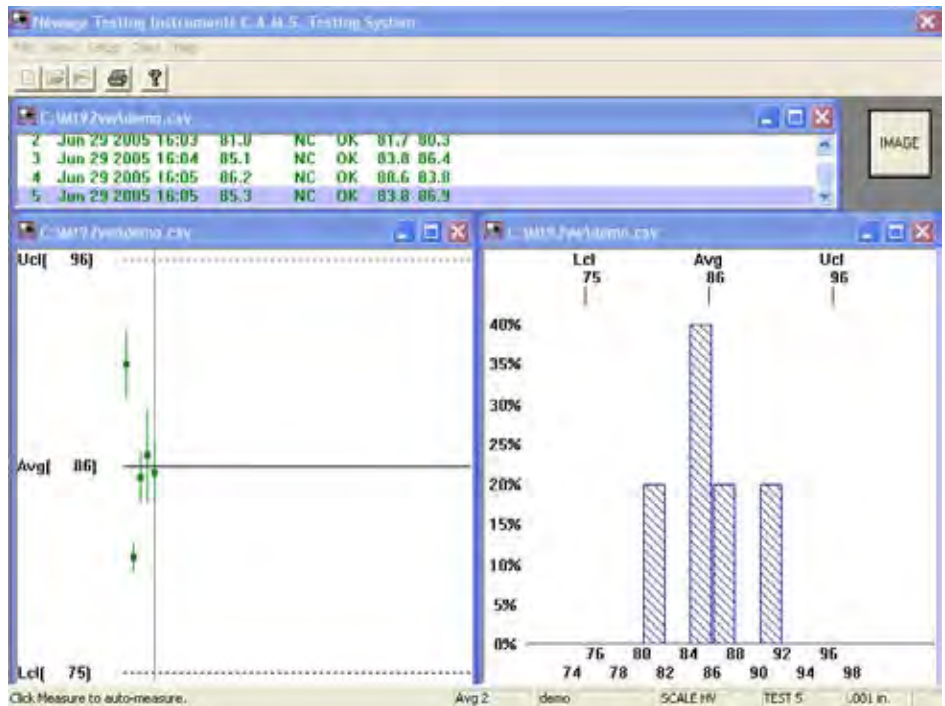
Shown: A wide array of reports are available and we can help customize report formats for your specific requirements. Operators can enter comments within a report, capture images in .bmp formats, and plot overlays for graphical comparisons.

Specifications

Loads
98.07mN, 245.2mN, 490.3mN
1.96N, 2.242N, 4.903N, 9.807N, 19.61N

Outputs
RS-232C
Printer output ESC/P code compatible

Load Device
Automatic Load Change

Power
Single phase 100Vac $\pm$10%, 300VA, 50/60Hz

Load Duration Time
5 to 999 sec (adjust to 1 sec units)

Operating Temperature
41 to 104°F (5 to 40°C)

Indenter
Diamond pyramid, 136° angle between opposing faces

Humidity
0 to 80% non-condensing

Optical Monitor
Objective Lens: 40X
Eyepiece: 10X
Optical path switchable for visual monitoring and photographic recording

Physical Size

W x D x H (mm)	350 x 490 x 515mm
W x D x H (in)	13.8 x 13.3 x 20.3 in
Weight	93 lbs (42 kg)

Test Sample Stage
Surface area: 120 x 120mm

Test Sample Height
100mm maximum above test sample stage
Approx. 140mm deep

Measurement Modes

Vickers Hardness (HV)

$$HV = 0.1891 \ F/d^2$$

where F = Test Load (N)
d = mean of the indentation diagonal length

Knoop Hardness (HK)

$$HK = 1.451 \ F/d^2$$

where F = Test Load (N)
d = Longer diagonal length

Brinell Hardness (HB)

$$HB = 0.102 \ 2F/(\pi D (D - \sqrt{D^2 - d^2}))$$

where F = Test Load (N)
D = Indenter diameter
d = Indentation diameter

Triangle Pyramid Hardness (HT)

$$HT = 0.16007 \ F/d^2$$

where F = Test Load (N)
d = Indentation height

Ordering

HMV-2 Microhardness Testing Systems

Model	Description
MS-HMV2V	HMV-2 Microhardness Tester, Vickers indenter, 10X and 40X objectives
MS-HMV2TV	HMV-2 Microhardness Tester, Vickers indenter, motorized turret, 10X & 40X objectives
MS-HMV2K	HMV-2 Microhardness Tester, Knoop indenter, 10X and 40X objectives
MS-HMV2TV	HMV-2 Microhardness Tester, Knoop indenter, motorized turret, 10X & 40X objectives
MS-HMV2TV-ASW	Complete Auto Traverse System

Accessories

Model	Description
MS-120	Stage Micrometer
MS-120C	Stage Micrometer, certified
MS-101	Slender Sample Attachment, Type 1
MS-201A	Slender Sample Attachment, Type 2
MS-102	Thin Sample Attachment, Type 1
MS-103	Thin Sample Attachment, Type 2
MS-203A	Thin Sample Attachment, Type 3
MS-104	Universal Vise
MS-205	Rotary Stage
MS-106	Self-leveling vise, for mounted samples
MS-107V	Test Block, Vickers, 300 gram 700 value
MS-107K	Test Block, Knoop, 300 gram 700 value
MS-301	Vibration Isolation Pads, set of four (4)
MS-322	Objective lens, 10X
MS-308	Objective lens, 20X
MS-321	Objective lens, 50X
MS-309	Objective lens, 100X
MS-310	Objective lens, 40X, extra long working distance
MS-311	Indenter, Vickers
MS-312	Indenter, Knoop
MS-320	Halogen lamp

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