Portable Hardness Tester

Model No. 3821 & 3822

Combination UCI & Leeb Hardness Tester

Technical Support
(201) 962-8352
www.starrett.com

Specifications: 3821 & 3822

Hardness Range	HRC: 20.3- 68; HRB: 61-85.6 ; HV: 80-1599; HB: 76-618
Scale Selection	Rockwell C (HRC); Rockwell B (HRB); Rockwell A (HRA); Brinell (HB); Vickers (HV); Leeb (HLD) and More!
Tolerance	+/- 3.0% deviation of average from the reference value of the test block with a minimum of 5 tests
Display Type	LCD Color Screen w/Backlight, adjustable brightness
Language Selection	English, German, Chinese, Spanish, etc.
Data Logger	Alpha-Numeric
Data Memory	2000 groups of measured data ; 20 groups of calibration data
Statistical Software	Supplied-can be saved in Word or Excel
Data Output	USB – cable supplied
Power Supply	Rechargeable Lithium Battery: Voltage-4.2V, 4800mAh
Auto Power Off	5 minutes
Recharging Time	Approx. 8 hours
Battery Usage	Approx. 6 hours (no backlight)
Net Weight(base unit)	2lbs (w/probe)
Gross Weight	12 lbs
Unit Dimensions	7.0 x 3.1 x 1.1" (160x80x30mm)
Gross Dimensions	13.7 x 17.7 x 5.9" (350x450x150mm)

QUICK SET UP:

If all your parameters are set, please skip to Page 12 to learn how to take a test.

Do not hesitate to call us for quick set up help.

TECHNICAL SUPPORT!

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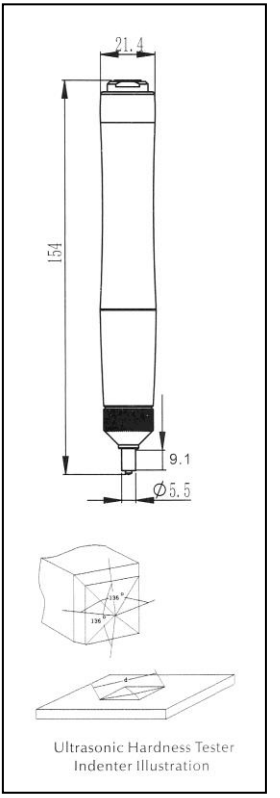
Manual UCI Probe Specifications:

Probe Type/Model	3821	3822
Loading Force	2kg (20N)	5kg (50N)
Probe Diameter	22mm	22mm
Length	154mm	154mm
Oscillating Rod Diameter	2.4mm	3mm
Surface Roughness Requirements *µm=Metric µin= Inch*	Ra<5 µm (Ra<197 µin)	Ra<10 µm (Ra<393 µin)
Min weight of test sample	0.3kg (.66lbs)	0.3kg (.66lbs)
Minimum thickness of sample	2mm (.08”)	2mm (.08”)

Standard Probe Cap

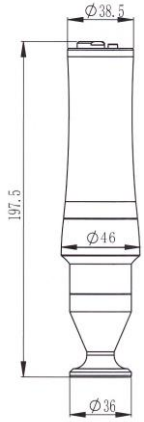
Deep Hole Probe Cap



Ultrasonic Hardness Tester
Indenter Illustration

Motorized UCI Probe Specifications: Special Order Only!

Probe Type			
Loading Force	**.30kg (3N)**	**.80kg (8N)**	**1kgf (10N)**
Probe Diameter	46mm	46mm	46mm
Length	198mm	198mm	198mm
Oscillating Rod Diameter	3.7mm	3.7mm	3.7mm
Surface Roughness Requirements *µm=Metric µin= Inch*	Ra<3.2µm (Ra<125 µin)	Ra<5 µm (Ra<197 µin)	Ra<8 µm (Ra<314 µin)
Min weight of test sample	0.3kg (.66lbs)	0.3kg (.66lbs)	0.3kg (.66lbs)
Minimum thickness of sample	2mm (.08")	2mm (.08")	2mm (.08")



Drawings of Motorized Probe

Indentation Depth (µm)

Hardness	.30kg Motorized	.80kg Motorized	1kg Motorized	2kg Manual	5kg Manual
800HV	4	5	7	10	15
600HV	4	5	8	11	18
500HV	5	6	9	12	19
300HV	6	8	11	16	25
100HV	10	13	19	27	43

Parameter Settings:

Available Scale Selection:

Scales: HRA, HRB, HRC, HRD, HRF, HR15N, HR30N, HR45N, HR15T, HR30T, HR45T, HBW, HBS, HS, MPA

To access the popular hardness scales, press the H button to scroll through each one. If you need to test in a scale not shown on the main display them you need to follow the instructions below:

Press the menu button, scroll down to System Set Up, Press the enter button. Scroll down to SYSTEM RESET.

Press enter button and then press again to enter the "code" **600002**.

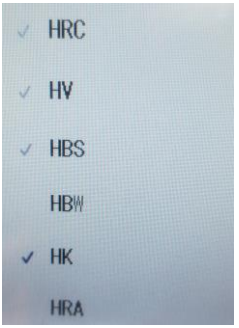
Press the save button to save each number.

EXAMPLE: 6, ,0, ,0, , etc. Press when done.

See Screen shot below. Use arrows to scroll to scale choice and press . You will see a check mark once its saved. If you want to remove a set scale from the main screen then press when the highlighted check mark is on the scale to be deleted.

Press to remove from list. Once all scales are chosen you must press . Say YES when prompted. Continue to press the MENU button to go to the main menu or on to the main testing screen.

Scale selection can be changed anytime in the main testing screen by pressing the H button. This will toggle through your preselected scales.



TEST SETUP MENU

Press  MENU, Test setup is already highlighted. Press  to see paramaters.

HARDNESS SCALE: Choose hardness scale for your application
Follow instructions shown on Page 4.

TEST NUMBER: ***Testing for Average (Min/Max)***

While in Test Set up, scroll down to Test Number. Press  enter button and a 3-digit number will appear on the display. Use your 4-arrow buttons to change the value to the desired number of tests you want to take before seeing the avaerage and Min/Max. Press  Enter button to save and return to test setup screen.

TOLERANCE +/- : ***("Batch Mode" must be ON for this parameter to be adjusted)***
This feature will notify you with a beep and color change to red when either limit has been reached while testing.

While in Test Set up, scroll down to TOLERANCE. Press  enter button and the screen will show **UP** with a value and **DOWN** with a value. UP is your upper limit setting and DOWN is your lower limit setting. Use Up or Down arrow buttons to chose up or down. That value will turn Red. Use the left and right arrows to adjust the numbers to your desired values. Press  to save and choose YES when prompted.

BATCH MODE: ***Testing for average***
If you want the PHT-6000 to display average, min/max then turn Batch mode off. If you just want to take tests and don't need average then choose ON.

TEST TIME: ***This is similar to "dwell" time on Rockwell and brinell hardness testers.***
This feature allows you to set "dwell" time from 1-5 seconds. Generally the lighter load the lower the setting should be.
Example: Rockwell C scale uses a very heavy load(150kg) so this setting should be somewhere from 3-5S. HR15T scale uses a very light load 15kg) so the seting should be somewhere between 1-3. Test this out to see what time works best for your application.

Press  to enter Test Time. Use arrow buttons to choose a value between 1-5(seconds). Press  to save and return to test set up menu.

Hardness STANDARD:
This parameter allows you to change from American standard **ASTM** to international standards. This feature alows the user to be sure that the conversions are correct according to their countries specifications.
In other words, The U.S follows ASTM standards for hardness testing. If you choose ASTM as your standard then all test results will be done according to ASTM's latest conversions for UCI hardness testing.
If you choose DIN then the conversions will be done acording to European standards. GB/T is the standard used throughout China.

Press  to enter Standards. Use arrow buttons to choose the standard for your application. Press  to save and return to test set up menu.

IMPACT DIRECTION*: For use with Leeb impact devices only*
This feature will allow the gauge to automatically compensate for tesing in positions other than straight down (90°).

Press  to enter Impact Direction. Use the 4-arrow buttons to choose the position you will be testing in. Press  to save and return to test set up menu.

MATERIAL: (Leeb only) *Allows user to select material being tested*
This feature allows the use to select the material of your particular application.

Choose the material closest to actual metal. Press  to enter Material. Use arrow buttons to choose your material. Press  to save and return to test set up menu.

Calibration/MAT: (UCI only) This will show the name of the calibration that was last used.

SYSTEM SET UP MENU

Press the  MENU button and scroll down to System Setup. Press  ENTER button to enter this parameter.

SOUND:

Press  to choose if you want the sound to be on or off. Make your choice and press  to save.

BATTERY:
This feature allows you either use the battery saver mode or turn it off. With battery saver on the unit will power off after 5 minutes of non use. In the off position, you will have to power the unit off manually.

BACKLIGHT:
This feature allows you to adjust the brightness of the screen.

Press the button to enter this parameter and use the up and down arrow buttons to increase or decrease the numeric value on the display. Numbers 1 thru 8 with 8 being the brightest. Press when done to retun to the System Setup menu.

DATE & TIME:

Press the button to enter this paramter.
Use the left and right arrow buttons to scroll through the numeric choices and then use the up and down arrow buttong to increase or decrease the numbers.

Press to sabve and return to the system setup menu.

LANGUAGE:

Press the button to enter this parameter.
IMPORTANT!
Its not advisable to change this to another language as it will be difficult to navigate thru the menu system if you arent familiar with the chosen language.
The 3821 & 3822's will be automatically set to English at the factory.

RESET ALL: ***(Password Protected)***
This function allows the user to change parameters such as visible hardness scales, delete all saved parameters, return to the original factory settings, and calibrate to Leeb test blocks.

Restore Factory Setting: *See Warning below!*

Press the button to enter this parameter, Press then input Password **666666** and press . Now press the save button and you will be prompted to say YES. Press the button to say yes and begin the resetting process. Press Menu button to return to the main menu once complete.
WARNING! This procedure will delate all saved data and/or calibrations

Calibration for Leeb Testing:
The D impact device must be plugged in and "Leeb" should be selected in the Probe Selection on the main Menu screen.

Press  Menu button and scroll down to System Set Up and press  . Scroll down to System Reset and press  . The password screen is now displayed.

Enter password 123456. (1,  , 2,  ,3, etc.)

Press  . Press the  button to go to the Leeb Calibration screen.

Take 5 tests on your leeb test block. The average will be displayed in the TEST line. The value shown in the Normal line is red and is the value you must change to match the value shown on your test block. Use the Left or right arrow buttons to change the numbers. Press  when complete.

Press  MENUto return to main testing screen.

MEMORY SETUP:

Auto-Save:
This features allows you to automatically save each test group.
Example; if you have the unit set to give an average after 5 tests, the 3821/3822 will automatically save this group once the average has been displayed.
If you have the Auto-save turned off then you will need to manually save each testing group. Press  to enter this parameter. Use Up or Down arrow button to choose On or Off. Press  Menu to save.

View Saved Data:
This feature allows you to view all of the saved test groups.
Press  to enter this parameter. Use the Up or down arrow buttons to scroll thru to groups that you want to view. Press the  button to view all test information for that group. Press the right arrow button to view next page of results. Press  Menu to return to View save data screen. Press  MENU to return to memory setup screen.

Data Send:
This feature lets you leave the output feature on or off depending upon your desire to print via USB or Bluetooth.

Press  to enter this parameter. Use the Up or down arrow buttons to choose On or Off. Press the  button to save

Delete Group: ***Deletes individual saved groups***

Press  to enter this parameter. Use the Up or down arrow buttons to scroll to the group you want to delete. Press  to check off the group. Press the  button to delete. You will be prompted Yes or No. Press left/right arrow to choose. Press  to save and return to the group view.

Press  menu to return to memory setup screen.

Delete All: ***Deletes all saved groups***

Press the  to enter this parameter.

You will be prompted Yes or No. use left/right arrow button to choose. Press  to say yes and all saved groups will be deleted.

DATA OUTPUT

Bluetooth/USB:
This allows you to choose your output method.

Press  to enter this parameter. Press Up or down arrow buytton to choose either Bluetooth or USB output. Press  to save.

Connect Bluetooth:

Press  to enter this parameter. The 3821/3822 will automatically search for the Bluetooth signal.

Print Selection:

Press  to enter this parameter. Use up or down arrow buttons to scroll through saved groups. Press  to check off the group or groups that you want to print. Press  button to print.

Print All:

Press to enter this parameter. You will be prompted to say Yes or No. Use left/right arrow button to choose and press to print all saved groups.

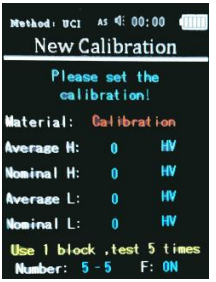
PROBE SELECTION:

Press to enter this parameter. You have 3 choices.
UCI-MP = Motorized probe
UCI-HP = Hand held Probe
Leeb = Impact Device D or DL

Use down arrow button to scroll down to your probe type and press to save and return to the main menu.

CALIBRATION: ***New Calibrations for UCI only***

Press MENU button. Scroll down to CALIBRATION. Press the button. Scroll down to New Calibration. Press . See the screen shot below.



Calibration will be shown in red. Press to enter the alpha/numeric display. This is where you can name your own calibration. Scroll through alpha/numerals and press save button to choose. Press buttons as shown below

EXAMPLE: Enter your own calibration name HRC Steel. (H, , R, ,C, etc.)

Once complete press the button to save the name and return to calibration screen. The next step is to set the hardness scale that you want to calibrate in.

Press the H button to toggle through the available scales until the proper scale is shown on the display.
Press the down arrow button and the "0" on **Nominal H** will be shown in red. Press the button to enter alpha/numeral page. Scroll to the numeric value shown on your test block. Enter as shown below:

EXAMPLE: Enter the numeric value on your test block as shown(43.6).

(4, , 3, , ., 6,etc.)

Once value is chosen, press the button to return to the calibration page.

Once these parameters are set, press the button to begin with the calibration process. The display will *show "Please test times to get an average value".*
Take 5 tests on your test block. You will see the test counter count down and once the 5th test is completed you will see 'Complete" flash on the top of the display. You will be asked to "SAVE Calibration". Press right arrow button for yes and then hit the Enter button.

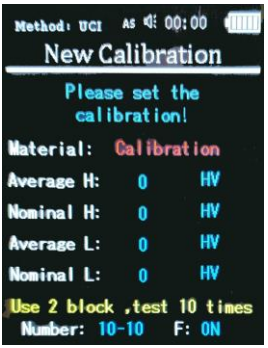
You will be brought back to the Menu screen. Press the to return to the manin testing screen.
Once this step has been completed you must now go back into the menu and set your new calibration. Press the Menu button.

Scroll down to "Calibration". Press . Then press again to enter "Calibration List". Scroll down to the calibration that you desire and Press the button and **"Set Success"** will pop up on the display. Press to accept and then hit the Menu button twice to return to the main testing screen.

Test Block Calibration using 2-Test Blocks:

Press MENU button. Scroll down to CALIBRATION. Press the button. Scroll down to New Calibration. Press . See the screen shot below.

Calibration will be shown in red. Press  to enter the alpha/numeric display. This is where you can name your own calibration. Scroll through alpha/numerals and press  button to choose each value. Once complete press the  button to save the name and return to calibration screen.
The next step is to set the hardness scale that you want to calibrate in. Press the "SC" button to toggle through the visible scales until the scale is showing on the display. Press the down arrow button to enter the **nominal high** value for your calibration block(s). Press the down arrow button and the "0" on **Nominal H** will be shown in red. Press the  button to enter alpha/numeral page. Scroll to the numeric value shown on your test block and press the  button to choose. Continue until you have the value shown at the top of the page. Once value is chosen, press the  button to return to the calibration page. Press the down arrow button again and the "0" of Nominal L will be shown in red. Press the  button to enter alpha/numerals page. Scroll to the numeric value and repeat instructions as shown above. Once value is chosen, press the  button to return to the calibration page.
Press the "Right arrow button and the screen will show Use 2 Blocks, Test 10 Times.



Once these parameters are set, press the  button to begin with the calibration process. The display will *show "Please test times to get an average value".*
Take 5 tests on your LOW value test block. You will see the test counter count down and once the 5th test is completed you must now take 5 tests on your HIGH value test block. At this time you will see 'Complete" flash on the top of the display. Now its time to enter in the values shown on your test blocks.
Press the Down arrow button until the Nominal H "0" is highlighted in Red. Press the  button to open the alpha/numeric screen.

Scroll to the numeric value shown on your test block and press the button to choose each number/symbol/letter.

Example: if your test block value is 46.3HRC then scroll down to the 4 and press the button. Scroll to the number 6 and hit the button. Scroll to the "." And press the button. Scroll to the number 3 and hit the button. Top of the page will show 46.3

Continue until you have the value shown at the top of the page. Once value is chosen, press the button to return to the calibration page. Press the down arrow button again and the "0" of Nominal L will be shown in red. Press the button to enter alpha/numerals page. Scroll to the numeric value and repeat instructions as shown above. Once value is chosen, press the button to return to the calibration page

You will be asked to "SAVE Calibration". Press right arrow button for yes and then hit the button.

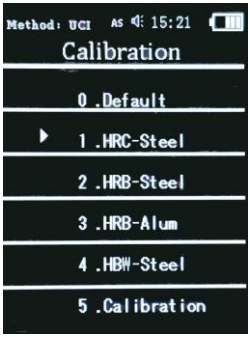
You will be brought back to the main testing screen.

Once this step has been completed you must now go back into the menu and set the new calibration. Press the Menu button.

Scroll down to "Calibration". Press . Press again to enter "Calibration List". Scroll down to the calibration that you desire and Press the button and "Set Success" will pop up on the display. Press to accept and then hit the Menu button twice to return to the main testing screen. Begin Testing.

CHOOSING STORED CALIBRATIONS:

Press MENU button. Scroll down to Calibration. Press . Scroll down to Calibration List. Press . Here you will see all of the calibrations that are stored in your unit.



Scroll down to the calibration that meets your application and press the button to choose. The display will show SET SUCCESS. Press the button to accept. Press the to return to the main testing screen. You will now see the new calibration shown at the top of the display.

DELETING STORED CALIBRATION:

Press MENU button. Scroll down to Calibration. Press . Scroll down to Calibration List. Press . Scroll to any stored calibration and press the H button. You will be asked if you want to delete. Press right arrow button to say YES and then press to delete the calibration.

Parameters are all set; Begin testing

Taking a Test:

Attach the probe to the base unit using the supplied heavy duty cable. The 90° end of the cable attaches to the top of the probe. Power the unit on using switch on the left side of the unit. Check the display to make sure all parameters are set properly.

Manual Probe:(hand held)

Hold probe in a tight fist. Press the probe straight down flat on the surface of your part and hold steady until the unit beeps and gives the hardness value on the display. Immediately lift the probe off the part. Be sure to use the proper amount of force when pressing the probe down. This is an important part of the procedure to obtain proper results.

Continue testing for average. This procedure may take a few minutes of practice but should come to you easily after taking tests on the supplied calibration block.

Motorized Probe:

This probe will give you the most repeatable results since it eliminates the need to apply proper force.

Place the probe flat on the surface of your part. The bottom of the probe is magnetized to help stay put on flat surfaces. Press the red button on top of the probe to sart the test. Wait for test result on the display before lifting it up and taking another test.

Do not hesitate to call us for quick set up help.

TECHNICAL SUPPORT!

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3821/3822 Instructions for Software Configuration

1) Prepare the Device.

-Power on the Device

-Navigate Main Menu->Probe Selection: Set probe type to Leeb or UCI-HP, (for our example, select UCI-HP)

-Navigate Main Menu-> Test Setup -> Batch Mode: Set Batch model on/off to "ON"

-Navigate Main Menu-> Memory Setup-> Auto-save: Set Auto save to "ON"

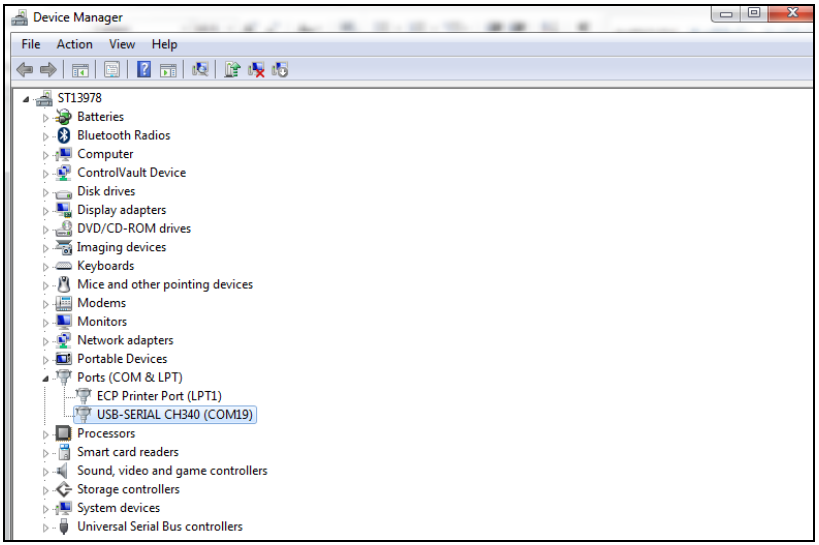
-Navigate Main Menu-> Data Output-> Bluetooth/USB: Set Bluetooth/USB to "USB"

2) Configure Device to PC.

-Connect Device to the PC using the USB cable.

-Navigate to your Device Manager on your PC. Locate the COM number for CH-340, for example COM19 (see below picture).

-If no COM number is displayed, this typically means that you did not install the software.



3) Configure Device to Software.

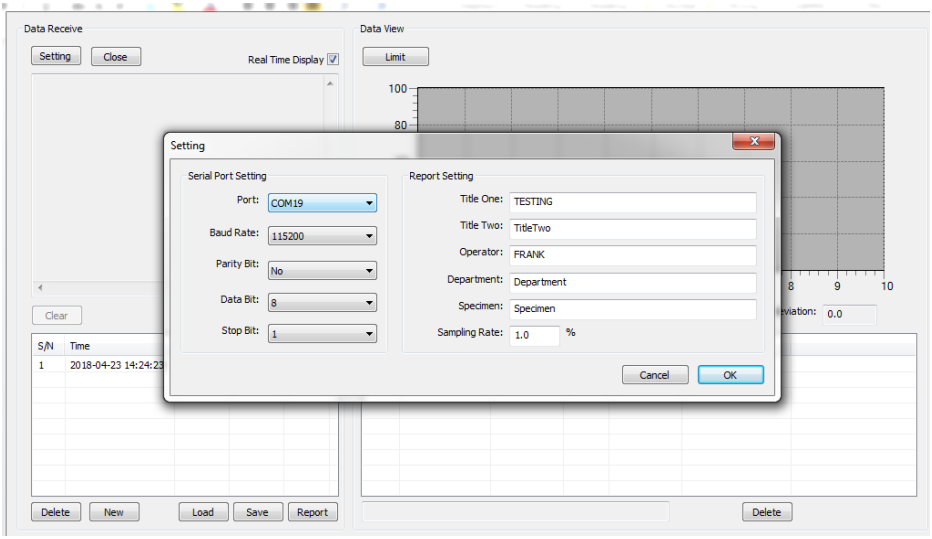
-Open the software

-Select "Setting," then select the corresponding COM number (COM19 in our example).

-Confirm the Serial Port Settings are set as per below.

-Set the appropriate "Report Settings," then click OK.

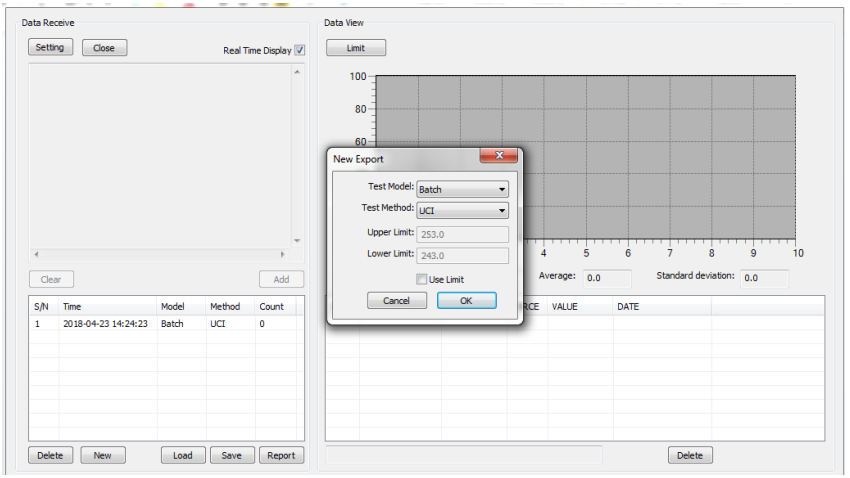
-Click OPEN on top left of the software interface.

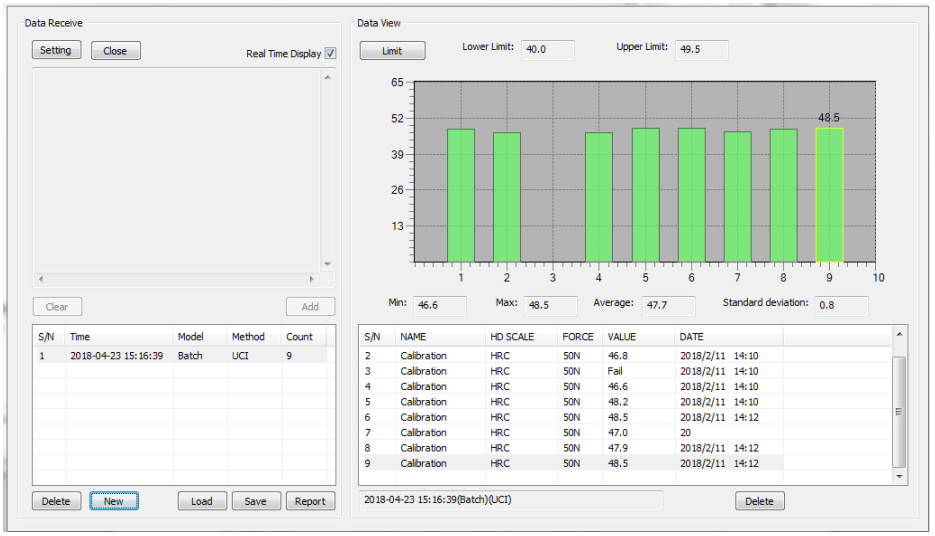


NOTE: If the software does not open, execute file vcredist_x86(sp1). You can find this file in the software folder.

5) Create a new batch of data.

-Select “NEW.”
- Match “NEW EXPORT” settings to the Device and the test limitations.
-Set (BATCH/AVERAGE) and (UCI/LEEB).
-Click “OK”
-Toggle “REAL TIME DISPLAY” as required. If this is not selected, you must select “ADD” at the end of the measurement group.
-Select “REPORT” to export data as .xls
-The data file can be saved by clicking “SAVE.” It will be saved as an .hdb file type and can be reopened with the software.


Data Receive
Setting
Close
Real Time Display
Clear
Add
S/N
Time
Model
Method
Count
1
2018-04-23 14:24:23
Batch
UCI
0
Delete
New
Load
Save
Report
Data View
Limit
100
80
60
New Export
Test Model:
Batch
Test Method:
UCI
Upper Limit:
253.0
Lower Limit:
243.0
Use Limit
Cancel
OK
4
5
6
7
8
9
10
Average:
0.0
Standard deviation:
0.0
VALUE
DATE
Delete


Data Receive
Setting
Close
Real Time Display
Clear
Add
S/N
Time
Model
Method
Count
1
2018-04-23 15:16:39
Batch
UCI
9
Delete
New
Load
Save
Report
Data View
Limit
Lower Limit:
40.0
Upper Limit:
49.5
65
52
39
26
13
48.5
1
2
3
4
5
6
7
8
9
10
Min:
46.6
Max:
48.5
Average:
47.7
Standard deviation:
0.8
S/N
NAME
HD SCALE
FORCE
VALUE
DATE
2
Calibration
HRC
50N
46.8
2018/2/11 14:10
3
Calibration
HRC
50N
Fail
2018/2/11 14:10
4
Calibration
HRC
50N
46.6
2018/2/11 14:10
5
Calibration
HRC
50N
48.2
2018/2/11 14:10
6
Calibration
HRC
50N
48.5
2018/2/11 14:12
7
Calibration
HRC
50N
47.0
20
8
Calibration
HRC
50N
47.9
2018/2/11 14:12
9
Calibration
HRC
50N
48.5
2018/2/11 14:12
2018-04-23 15:16:39(Batch)(UCI)
Delete

Approximate Hardness Conversion Numbers for Non-Austenitic Steels (Rockwell C Hardness Range)[a]

	Brinell Hardness Number[c]			Rockwell		Superficial Rockwell Number			
Rockwell C 150kgf (HRC)	Vickers (HV)	10-mm Standard ball 3000kgf (HBS)	10-mm Carbide ball 3000kgf (HBW)	Knoop 500-gf and Over (HK)	A Scale 60 kgf (HRA)	D Scale 100kgf (HRD)	15-N Scale 15-kgf (HR15N)	30-N Scale 30-kgf (HR30N)	45-N Scale 45-kgf (HR45N)	Scleroscope Hardness[b]
68	940	...	...	920	85.6	76.9	93.2	84.4	75.4	97.3
67	900	...	...	895	85.0	76.1	92.9	83.6	74.2	95.0
66	865	...	...	870	84.5	75.4	92.5	82.8	73.3	92.7
65	832	...	(739)	846	83.9	74.5	92.2	81.9	72.0	90.6
64	800	...	(722)	822	83.4	73.8	91.8	81.1	71.0	88.5
63	772	...	(705)	799	82.8	73.0	91.4	80.1	69.9	86.5
62	746	...	(688)	776	82.3	72.2	91.1	79.3	68.8	84.5
61	720	...	(670)	754	81.8	71.5	90.7	78.4	67.7	82.6
60	697	...	(654)	732	81.2	70.7	90.2	77.5	66.6	80.8
59	674	...	634	710	80.7	69.9	89.8	76.6	65.5	79.0
58	653	...	615	690	80.1	69.2	89.3	75.7	64.3	77.3
57	633	...	595	670	79.6	68.5	88.9	74.8	63.2	75.6
56	613	...	577	650	79.0	67.7	88.3	73.9	62.0	74.0
55	595	...	560	630	78.5	66.9	87.9	73.0	60.9	72.4
54	577	...	543	612	78.0	66.1	87.4	72.0	59.8	70.9
53	560	...	525	594	77.4	65.4	86.9	71.2	58.6	69.4
52	544	(500)	512	576	76.8	64.6	86.4	70.2	57.4	67.9
51	528	(487)	496	558	76.3	63.8	85.9	69.4	56.1	66.5
50	513	(475)	481	542	75.9	63.1	85.5	68.5	55.0	65.1
49	498	(464)	469	526	75.2	62.1	85.0	67.6	53.8	63.7
48	484	451	455	510	74.7	61.4	84.5	66.7	52.5	62.4
47	471	442	443	495	74.1	60.8	83.9	65.8	51.4	61.1
46	458	432	432	480	73.6	60.0	83.5	64.8	50.3	59.8
45	446	421	421	466	73.1	59.2	83.0	64.0	49.0	58.5
44	434	409	409	452	72.5	58.5	82.5	63.1	47.8	57.3
43	423	400	400	438	72.0	57.7	82.0	62.2	46.7	56.1
42	412	390	390	426	71.5	56.9	81.5	61.3	45.5	54.9
41	402	381	381	414	70.9	56.2	80.9	60.4	44.3	53.7
40	392	371	371	402	70.4	55.4	80.4	59.5	43.1	52.6
39	382	362	362	391	69.9	54.6	79.9	58.6	41.9	51.5
38	372	353	353	380	69.4	53.8	79.4	57.7	40.8	50.4
37	363	344	344	370	68.9	53.1	78.8	56.8	39.6	49.3
36	354	336	336	360	68.4	52.3	78.3	55.9	38.4	48.2
35	345	327	327	351	67.9	51.5	77.7	55.0	37.2	47.1
34	336	319	319	342	67.4	50.8	77.2	54.2	36.1	46.1
33	327	311	311	334	66.8	50.0	76.6	53.3	34.9	45.1
32	318	301	301	326	66.3	49.2	76.1	52.1	33.7	44.1
31	310	294	294	318	65.8	48.4	75.6	51.3	32.5	43.1
30	302	286	286	311	65.3	47.7	75.0	50.4	31.3	42.2
29	294	279	279	304	64.8	47.0	74.5	49.5	30.1	41.3
28	286	271	271	297	64.3	46.1	73.9	48.6	28.9	40.4
27	279	264	264	290	63.8	45.2	73.3	47.7	27.8	39.5
26	272	258	258	284	63.3	44.6	72.8	46.8	26.7	38.7
25	266	253	253	278	62.8	43.8	72.2	45.9	25.5	37.8
24	260	247	247	272	62.4	43.1	71.6	45.0	24.3	37.0
23	254	243	243	266	62.0	42.1	71.0	44.0	23.1	36.3
22	248	237	237	261	61.5	41.6	70.5	43.2	22.0	35.5
21	243	231	231	256	61.0	40.9	69.9	42.3	20.7	34.8
20	238	226	226	251	60.5	40.1	69.4	41.5	19.6	34.2

Approximate Hardness Conversion Numbers for Non-Austenitic Steels (Rockwell B Hardness Range)

				Rockwell		Superficial Rockwell Number		
Rockwell B 100kgf (HRB)	Vickers (HV)	10-mm Standard ball 3000kgf (HBS)	Knoop 500-gf and Over (HK)	A Scale 60 kgf (HRA)	F Scale 60kgf (HRF)	15-T Scale 15-kgf (HR15T)	30-T Scale 30-kgf (HR30T)	45-T Scale 45-kgf (HR45T)
100	240	240	251	61.5	...	93.1	83.1	72.9
99	234	234	246	60.9	...	92.8	82.5	71.9
98	228	228	241	60.2	...	92.5	81.8	70.9
97	222	222	236	59.5	...	92.1	81.1	69.9
96	216	216	231	58.9	...	91.8	80.4	68.9
95	210	210	226	58.3	...	91.5	79.8	67.9
94	205	205	221	57.6	...	91.2	79.1	66.9
93	200	200	216	57.0	...	90.8	78.4	65.9
92	195	195	211	56.4	...	90.5	77.8	64.8
91	190	190	206	55.8	...	90.2	77.1	63.8
90	185	185	201	55.2	...	89.9	76.4	62.8
89	180	180	196	54.6	...	89.5	75.8	61.8
88	176	176	192	54.0	...	89.2	75.1	60.8
87	172	172	188	53.4	...	88.9	74.4	59.8
86	169	169	184	52.8	...	88.6	73.8	58.8
85	165	165	180	52.3	...	88.2	73.1	57.8
84	162	162	176	51.7	...	87.9	72.4	56.8
83	159	159	173	51.1	...	87.6	71.8	55.8
82	156	156	170	50.6	...	87.3	71.1	54.8
81	153	153	167	50.0	...	86.9	70.4	53.8
80	150	150	164	49.5	...	86.6	69.7	52.8
79	147	147	161	48.9	...	86.3	69.1	51.8
78	144	144	158	48.4	...	86.0	68.4	50.8
77	141	141	155	47.9	...	85.6	67.7	49.8
76	139	139	152	47.3	...	85.3	67.1	48.8
75	137	137	150	46.8	99.6	85.0	66.4	47.8
74	135	135	147	46.3	99.1	84.7	65.7	46.8
73	132	132	145	45.8	98.5	84.3	65.1	45.8
72	130	130	143	45.3	98.0	84.0	64.4	44.8
71	127	127	141	44.8	97.4	83.7	63.7	43.8
70	125	125	139	44.3	96.8	83.4	63.1	42.8
69	123	123	137	43.8	96.2	83.0	62.4	41.8
68	121	121	135	43.3	95.6	82.7	61.7	40.8
67	119	119	131	42.8	95.1	82.4	61.0	39.8
66	117	117	129	42.3	94.5	82.1	60.4	38.7
65	116	116	127	41.8	93.9	81.8	59.7	37.7
64	114	114	125	40.9	93.4	81.4	59.0	36.7
63	112	112	124	40.4	92.8	81.1	58.4	35.7
62	110	110	122	40.0	92.2	80.8	57.7	34.7
61	108	108	120	39.5	91.7	80.5	57.0	33.7
60	107	107	118	39.0	91.1	80.1	56.4	32.7
59	106	106	117	38.6	90.5	79.8	55.7	31.7
58	104	104	115	38.1	90.0	79.5	55.0	30.7
57	103	103	114	37.7	89.4	79.2	54.4	29.7
56	101	101	112	37.2	88.8	78.8	53.7	28.7
55	100	100	111	36.8	88.2	78.5	53.0	27.7
...	...	...	110	36.3	87.7	78.2	52.4	26.7
...	...	...	109	35.9	87.1	77.9	51.7	25.7
...	...	...	108	35.5	86.5	77.5	51.0	24.7
...	...	...	107	35.0	86.0	77.2	50.3	23.7
...	...	...	106	34.6	85.4	76.98	49.7	22.7
...	...	...	105	34.1	84.8	76.6	49.0	21.7
...	...	...	104	33.7	84.3	76.2	48.3	20.7
...	...	...	103	33.3	83.7	75.9	47.7	19.7
...	...	...	102	32.9	83.1	75.6	47.0	18.7
...	...	...	101	32.4	82.6	75.3	46.3	17.7
...	...	...	100	32.0	82.0	74.9	45.7	16.7
...	...	...	99	31.6	81.4	74.6	45.0	15.7
...	...	...	98	31.2	80.8	74.3	44.3	14.7
...	...	...	97	30.7	80.3	74.0	43.7	13.6
...	...	...	96	30.3	79.7	73.6	43.0	12.6
...	...	...	95	29.9	79.1	73.3	42.3	11.6
...	...	...	94	29.5	78.6	73.0	41.6	10.6
...	...	...	93	29.1	78.0	72.7	41.0	9.6
...	...	...	92	28.7	77.4	72.3	40.3	8.6
...	...	...	91	28.2	76.9	72.0	39.6	7.6
...	...	...	90	27.8	76.3	71.7	39.0	6.6
...	...	...	89	27.4	75.7	71.4	38.3	5.6
...	...	...	88	27.0	75.2	71.0	37.6	4.6
...	...	...	87	26.6	74.6	70.7	37.0	3.6
...	...	...			74.0	70.4	36.3	2.6

Approximate Leeb (Type D) Hardness Conversion for Non-Austenitic Steels (Rockwell C Hardness Range)[A]

Leeb Hardness, Type D Impact Device (HLD)	Rockwell C Hardness 150kgf (HRC)	Vickers Hardness (HV 10)	Brinell Hardness 10mm Steel Ball 3000kgf (HBS)
828	62	762	(721)
819	61	737	(699)
809	60	711	(675)
800	59	688	(654)
791	58	667	634
782	57	645	614
773	56	625	595
764	55	605	577
755	54	586	559
746	53	568	542
737	52	550	526
729	51	534	511
720	50	517	496
712	49	503	482
703	48	487	467
695	47	473	455
687	46	460	442
679	45	447	430
671	44	434	418
663	43	422	407
655	42	410	395
647	41	398	385
640	40	388	375
632	39	377	365
625	38	368	356
618	37	358	347
611	36	349	338
603	35	339	328
596	34	330	320
590	33	323	313
583	32	314	305
576	31	306	297
570	30	299	291
563	29	291	283
557	28	284	276
551	27	277	270
545	26	271	264
539	25	264	258
533	24	258	252
527	23	251	246
521	22	245	240
516	21	240	235
510	20	234	229