

CDR

Technical Reference and Operating Manual

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Introduction 1

1.1 Safety information

The CDR is designed and tested according to EN DIN 61 010 Part 1, March 1994, "Safety requirements for electric measuring, control and laboratory equipment", and was technically in perfectly safe and faultless condition when leaving the manufacturing works.

In order to maintain this condition and to ensure a safe operation, it is absolutely necessary that you read the following safety information before putting the instrument into operation.



Attention:

**The CDR is an instrument for materials testing.
Any use for medical applications or other purposes
is not permitted!**

**The instrument may only be used in industrial
environments.**

Batteries

The CDR can be operated with AAA-sized AIMn cells or rechargeable NiCads and NiMH batteries.

NiCads or NiMH batteries can not be charged within the instrument. They must be charged with a specifically approved external battery charger.

For information on how to properly handle the batteries, please refer to chapter 4 *Maintenance and care*.

Software

According to the present state of the art, software is never completely free from errors.

Before using any software-controlled test equipment, you should ensure that the required functions operate perfectly as intended.

If you have any questions about the use of your Clark Instrument test equipment, please contact your local Clark Instrument representative.

1.2 About this manual

In the following section you will learn how to use this manual. Please read through these instructions carefully to operate all functions of the CDR quickly and reliably.

This will enable you to take full advantage of the instrument's capabilities. Also, you will avoid any incorrect test results due to malfunctions or operating errors. Such incorrect test results may cause personal injuries or material damages.

Important information

Even if you should be familiar with hardness testing methods, please review the information in the chapters 1.4, 1.5 and 7.

In chapter 1.4, you will find important limitations and prerequisites for hardness testing in general (training, knowledge of the specific technical test requirements and limits, choice of the appropriate test equipment).

In chapter 1.5, you will find complete information about hardness testing using the CDR that must always be followed to ensure correct measurement results.

Chapter 7 describes the rebound hardness testing method.

1.3 Layout and presentation in this manual

To make it easier for you to use this manual, all operating steps, notes, etc. are always presented in the same way. This will help you find individual pieces of information quickly.

Attention and note symbols

Attention:

The **Attention** symbol indicates peculiarities and special aspects in the operation which could affect the accuracy of the results.

Note:

Note contains e.g. references to other chapters or special recommendations for a function.

Listings

Listings are presented in the following form:

- Variant A
- Variant B
- ...

Operating steps

Operating steps appear as shown in the following example:

- Position the CDR vertically to the surface to be tested.
- Use your thumb to press the release button.

1.4 Prerequisites for hardness testing

This operating manual contains all essential information on how to operate the CDR. In addition, there are a number of factors which affect the results. A description of these factors would go beyond the scope of an operating manual. The following list therefore contains only the three most important conditions:

- operator training
- knowledge of special technical test requirements and limits
- choice of the appropriate test equipment



Attention:

Lack of knowledge of the above-mentioned subjects may lead to incorrect test results and thus have unforeseeable consequences.

Operator training

The reliable and safe operation of a hardness testing device requires a proper training in the field of materials testing.

A proper training comprises for example adequate knowledge of:

- hardness testing on metallic materials,
- effects due to material properties, especially due to the microstructure, on hardness testing and on the corresponding choice of the appropriate hardness tester,
- limits relating to the use of conversion of different hardness values such as Vickers, Rockwell and Brinell,
- effects of surface finish on the hardness value,
- effects of the test load on the determined hardness value.

Technical test requirements

Every hardness test is subject to specific technical test requirements. The most important ones are :

- definition of the scope of test
- choice of the appropriate test method
- consideration of material properties
- determination of limits for evaluation

Choice of the appropriate test equipment

It is the task of those with overall responsibility for testing to ensure that the inspector is fully informed about the technical test requirements. Moreover, a clear and thorough interpretation of the corresponding test specifications is absolutely necessary.

Information about test methods and test specifications may be obtained, for example, from various institutions, industrial enterprises and authorities.

1.5 Clark Instrument CDR

The Clark Instrument CDR is a handy and easy-to-use rebound hardness tester enabling the user to carry out tests quickly and effortlessly.

You can use the CDR to carry out measurements anywhere and in any direction; the direction does not have to be set in advance.

The CDR is mainly suitable

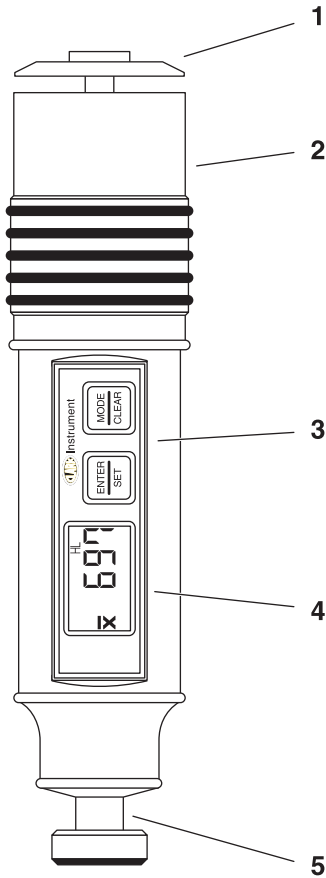
- for measuring the hardness of low-alloy or unalloyed steels,
- for measuring the hardness of high-alloy steels,
- for measuring the hardness of nonferrous metals.

The CDR operates according to the rebound method (according to ASTM standard A 956). In this method, an impact body is impelled against the test surface by spring force.

Impact and rebound speeds are measured in non-contact mode and the hardness value is calculated on the basis of these two measurements. The hardness value is immediately displayed. Apart from this, a high reproducibility of the test results is ensured.

The CDR has only two operating keys to carry out all functions.

The large display indicates the current single value or the statistical average of a measurement set, depending on the selected mode.



- 1 Release button
- 2 Loading tube
- 3 Operating keys
- 4 Display
- 5 Impact device with test attachment

1.6 Important information about hardness testing using the CDR

The following section contains a summary of the most important technical test requirements that you always have to observe in order to obtain reliable and reproducible measurement results.

Test material

Surfaces must be free from any impurities (oil, dust, rust, etc.). Rough surfaces lead to a greater variation of the single values.

Test objects having a mass of at least 5 kgs can be tested without any additional supports; objects weighing less require a support to which they have to be tightly coupled. Please use large, inflexible and rigid metal supports for this purpose.

The test objects should have a minimum wall thickness of 20 mm.

Attention:

A yielding or springiness of the test objects may lead to measuring errors! Please also refer to chapter 7.3.

The rebound method

The rebound method is a dynamic method with a very high reproducibility of the measurements. The rebound method does not replace the classical Brinell hardness testing or other standardized methods, but rather complements them.

The remaining energy of an impact body is measured after rebounding from the material surface. Please observe that the loss of energy is also effected by the material's mechanical properties, i.e. mainly on its modulus of elasticity or Young's modulus.

The direct comparison with results obtained from standardized hardness measurements on specific materials is therefore important for the evaluation of the measuring accuracy of the rebound method.

 **Attention:**

It is absolutely necessary that you set your CDR to the appropriate material group before testing (ref. chapter 3.4).

The material group for low-alloy or unalloyed steel is defined as default setting in the instrument.

Please also read chapter 7 on the rebound method.

 **Attention:**

You should not carry out hardness measurements twice at the same test position, otherwise faulty measurements are possible due to the surface hardening. The distance between the test positions should be at least 3 mm.

Conversion of hardness values

The conversion of the HL value determined according to the rebound method into standard hardness scales is carried out on the basis of defined conversion tables depending on the material group.

The conversion into tensile strength values is made according to DIN 50150 on the basis of the HB values.

You should carry out conversions only

- if the specified test method cannot be applied (for example because there is no suitable instrument available),
- if it's not possible to section the part to perform the specified test method.

Please observe the limitations regarding the conversion into DIN 50150.

 **Attention:**

Any illegal or unacceptable conversions may lead to grave errors in the interpretation of measurement results.

Scope of supply and accessories **2**

This chapter informs you about the scope of supply in our standard package and the accessories available for the CDR.

It describes

- accessories included in the scope of supply of our standard package
- recommended accessories
- spare parts requirements

2.1 Scope of supply

Product name	Description	Order no.
CDR	<p>CDR –Portable hardness tester according to the rebound method with an integrated impact device D and digital display of the measured value in HV, HB, HRB, HRC, HS, HL or N/mm²</p> <p>consisting of:</p> <p>Basic instrument CDR</p> <p>Operating manual English</p> <p>Quick Reference Guide English</p> <p>Transport case</p> <p>Cleaning brush</p> <p>2 AIMn batteries (type AAA)</p> <p>Test attachment dia. 13.5 mm</p>	062-035-425

Product name	Description	Order no.
CDR Plus	<p data-bbox="584 206 1139 359">CDR –Portable hardness tester according to the rebound method with an integrated impact device D and digital display of the measured value in HV, HB, HRB, HRC, HS, HL or N/mm², including hardness reference block</p> <p data-bbox="584 389 743 412">consisting of:</p> <ul data-bbox="584 442 954 847" style="list-style-type: none"><li data-bbox="584 442 842 464">Basic instrument CDR<li data-bbox="584 495 884 517">Hardness reference block<li data-bbox="584 547 884 570">Operating manual English<li data-bbox="584 600 954 622">Quick Reference Guide English<li data-bbox="584 652 759 675">Transport case<li data-bbox="584 705 759 728">Cleaning brush<li data-bbox="584 758 916 780">2 AIMn batteries (type AAA)<li data-bbox="584 810 932 833">Test attachment dia. 13.5 mm	062-035-426

2.2 Recommended accessories

Product name	Description	Order no.
Dyna 41	1 set (5 pieces) of test attachments for cylindrical surfaces	081-034-536
Dyna 42	1 set (5 pieces) test attachments for spherical surfaces	081-034-539

2.3 Spare parts requirements

Product name	Description	Order no.
	Hardness reference block	083-035-371
	Cleaning brush for impact device D	081-034-420
	Standard test attachment for impact device D	081-034-312
	Test attachment for impact device D, dia. 13.5 mm	081-034-656
	Impact body D	081-034-443

Operation **3**

3.1 Preparation

Inserting batteries

You can operate the CDR with AAA-sized AlMn batteries or rechargeable NiCd or NiMH batteries. You need 2 pieces of each. AlMn batteries are recommended for the longest operating time.

- Open the cover of the battery compartment.
- Insert the batteries while observing the correct polarity as shown in the battery compartment.
- Replace the lid and snap the cover back in place. The lock must perceptibly snap in.

Notes:

Remove the batteries from the instrument if you're not going to use it for a longer period of time!

Used or defective batteries are special waste and must be disposed of according to the legal requirements!

The following icon indicates the battery voltage is getting too low:



In this case, exchange the batteries immediately. The CDR automatically switches off if the battery voltage is too weak to ensure reliable operation. It may happen that the instrument cannot be switched on again without battery exchange.

Note:

If you remove the batteries from the instrument for more than about 3 minutes, the last settings are lost (e.g. measurement mode and hardness scale).

You will find more information about batteries in chapter 5.1.

3.2 Fundamental principles of operation

Display and keys

The display consists of the following areas:

1 Average

If you have selected the measurement set mode, the icon for average value is displayed.

2 Battery

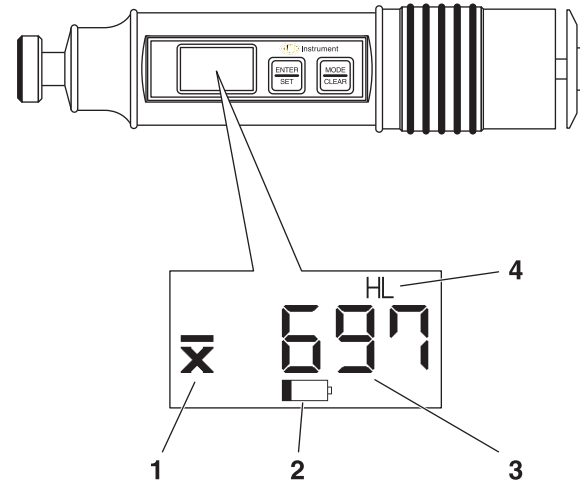
The battery voltage icon flashes to indicate that the batteries require replacement.

3 Measured value

The measured hardness value (or the statistical average with measurement sets) is shown in large digits in the middle of the display. This area also applies to other text displays when selecting default settings, and for error codes.

4 Hardness scale

The selected hardness scale is displayed in the area above or below the measured value.



The CDR has two keys which you can use to carry out all functions. Each activates several different functions, depending on the current mode of the instrument.



Key ENTER/SET

Mode	Function
Instrument off	Switch-on
Single measurement	None
Measurement set	Start new measurement set
Setting	Set selected parameter



Key MODE/CLEAR

Mode	Function
Instrument off	Switch-on
Single measurement	None
Measurement set	Display and delete last value
Setting	Apply setting and select the next parameter

How to handle the impact device

Ensure the use of the appropriate test attachment for your application.

- Press either key to switch the instrument on.
- Place the CDR with the test attachment on a flat surface.
- Load the impact device by pressing the blue cylinder down to the end stop and then moving it slowly back to the initial position.
- Place the CDR vertically on the test surface.
- Use your thumb to press the release button.

The measured value (or the statistical average) is digitally displayed:



Attention:

Do not load the impact device at the actual test location but (due to surface hardening) at another location (e.g. table or another part of the test object). After that, place it at a new test position for another measurement.

Do not perform two measurements at the same test location, otherwise measuring errors may occur due to surface hardening effects. Maintain a minimum spacing of 3 mm.

The loading tube should not be pushed in (loading tube must be at the farthest stop) when releasing for measurement.

Test attachments Dyna 41 and Dyna 42

The test attachments Dyna 41 and Dyna 42, which you use for a better positioning on curved surfaces, have a special geometry for use on cylindrical surfaces or spherical surfaces (ref. chapter 2).

3.3 Hardness measurement

If you intend to measure on low-alloy or unalloyed steels, no adjustment to the instrument setting is required because the CDR is set to this material group as default setting.

When measuring on high-alloy steels as well as on other materials, such as nonferrous metals, you have to select the required material group before carrying out the measurement.

Switch-on

– Briefly press either key to switch the CDR on.

Immediately after activating, the instrument carries out a self-test and displays the installed software version (e.g. 100 for software version 1.00) on the display. After that, the CDR is ready for measurement.

Switch-off

The CDR is automatically switched off if not used for approx. 1 minute (single value) resp. for approx. 3 minutes (measurement set).

This limits unnecessary battery drain to extend the operating time.

Note:

When switching off, the displayed reading (or the complete set with measurement sets) is deleted, the selected settings are retained.

If you remove the batteries from the instrument, the individual settings are lost after about 3 minutes (e.g. measurement mode and hardness scale).

Carrying out a measurement

- Check that the test attachment is suitable and that the required settings (e.g. hardness scale) are selected.
- Position the CDR and carry out the measurement. The measured values are digitally displayed.

Closing a measurement set

If you use measurement sets, you can close a measurement set at any time and start a new set. The previous measured values stored for the calculation and their displayed arithmetic mean are deleted.

- Press the ENTER/SET key. The actual average value flashes.
- Press the ENTER/SET key a second time to close the current measurement set and to delete the stored values. The display indicates **0** as a current reading.

Deleting measured values

If you are using measurement sets, you can delete the most recent reading at any time to remove an erroneous measurement from the statistical average.

- Press the MODE/CLEAR key for about 2 seconds. The last value measured flashes.
- Press the MODE/CLEAR key a second time to delete the value. The measured value is deleted and the average is automatically recalculated.
- You can repeat the procedure to sequence through the readings deleting each until all measured values are deleted.

Note:

As long as the display is flashing, you can abort the deletion.

- Briefly press the ENTER/SET key to cancel the process of deleting.

3.4 Selecting instrument settings

Setup mode

You can set various parameters for your work with the CDR. To do this, change over to the setup mode first.

- If necessary, press one of the two keys to switch the instrument on.
- Press the two keys simultaneously to select the setup mode.

The first setup parameter is displayed:

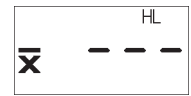


- Press the MODE/CLEAR key to activate the next parameter. After the last parameter, the instrument exits the setup mode and returns to the measurement display.

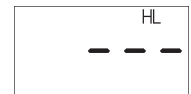
Measurement mode and display of measured values

You can choose between single measurements and measurement sets. In the case of single measurements, the current individual value is displayed. Selecting measurement sets, the arithmetic mean calculated on the basis of consecutive readings is displayed.

Setting options:



Measurement set with average display



Single measurement

- Activate setup mode and select the parameter **S/A** with the MODE/CLEAR key.
- Press the ENTER/SET key in order to change the current setting.
- Press the MODE/CLEAR key to confirm the selected setting. Press the key again to exit the setup mode and return to the measurement mode.

Material group

If you intend to carry out measurements on high-alloy steels or on other materials, such as nonferrous metals, you must set the CDR to the required material.

Choose the appropriate material from the 9 material groups stored in the CDR.

Setting options:

- St** Low-alloy/unalloyed steel and cast steel
- ASt** Tool steel
- SSt** Corrosion-resistant steel
- GCI** Gray cast iron
- NCI** Nodular graphite cast iron
- AL** Aluminum cast alloys
- brS** Brass
- brZ** Bronze
- Cu** Wrought copper alloys

- Press the two keys simultaneously to select the setup mode.
- Select the parameter **MAt** with the MODE/CLEAR key.
- Press the ENTER/SET key to change the current setting.
- Use the MODE/CLEAR key to confirm the selected setting, and press the key again, if necessary, to go to the measurement mode.

Hardness scale

In the default setting, the measurement result is displayed as HL(D) value (Leeb's hardness according to the rebound hardness testing method). You can select another hardness scale if required.

Setting options:

HS	Shore
HB	Brinell
HRB	Rockwell B
HRC	Rockwell C
HL(D)	Leeb D
HV	Vickers
N/mm²	Tensile strength

- Press the ENTER/SET key to change the current setting.
- Use the MODE/CLEAR key to confirm the selected setting, and press the key again, if necessary, to go to the measurement mode.

The selected new hardness scale is shown in the display in the area above or below the measured value.

- Press the two keys simultaneously to select the setup mode.
- Select the parameter **SCAL** with the MODE/CLEAR key.

Conversion

The CDR provides various conversion options. The conversions according to DIN 50150 and ASTM E140 only apply to the material group St (steel and cast steel) (please refer to overview of conversion ranges in chapter 7.2).

Setting options:

dynA Dyna-specific

din DIN 50150

E140 ASTM E140

- Press the two keys simultaneously to select the setup mode.
- Select the parameter **Con** with the MODE/CLEAR key.
- Press the ENTER/SET key to change the current setting.
- Use the MODE/CLEAR key to confirm the selected setting, and press the key again, if necessary, to go to the measurement mode.

Maintenance and care 4

4.1 Care

Caring for the instrument

Prevent dust and dirt from collecting in the guide tube of the impact device.

Clean the instrument and the accessory parts only by means of a dry cloth.



Don't use water for cleaning! The CDR is neither water-tight nor humidity-proof.

Don't use solvents! The paint coating and the plastic parts may become brittle or be damaged.

Caring for rechargeable batteries

The capacity and service life of batteries mainly depend on proper handling. You should therefore observe the following tips when using rechargeable batteries:

- before the initial start-up,
- after a storage period of 3 months or longer,
- after frequent partial discharge.

Charging the batteries

NiMH batteries or NiCads can be charged using only a specifically approved external battery charger. Read the operating manual of the battery charger and pay special attention to the safety precautions recommended there.

How to handle alkaline batteries

As improper handling or misuse of batteries may cause damages to the instrument, please observe the following recommendations:

- Only use leak-proof batteries!
- Remove the batteries from the instrument if you're not planning to use it for extended periods of time!



Attention:

Never attempt to charge AIMn batteries (explosion hazard)!



Note:

Used or defective batteries are special waste and must be disposed of according to the legal requirements!

To protect the environment, please use storage batteries whenever possible!

4.2 Maintenance

The instrument requires basically no maintenance work.



Attention:

Any repair work may only be carried out by authorized Clark Instrument Service personnel.

Impact device

The impact device must be cleaned after approx. 1,000 measurements or in the case of incorrect measured values.

- Unscrew the test attachment and remove the impact body from the guide tube.
- Clean the test attachment, impact body and test tip using a dry cloth.
- Clean the inside of the guide tube using the cleaning brush.



Attention:

Never use oil to clean the impact device!

Function check and troubleshooting **5**

5.1 Checking the function

Please check the functioning of the impact device and hardness tester by measuring the HL(D) hardness value on the hardness reference block before using the instrument for the first time, and afterwards from time to time (always after 1,000 impacts at the latest).

- Take the hardness reference block from the case and place it on a solid base support.
- Carry out 3 to 5 measurements on the hardness reference block. Ensure that the spacing between the measurement locations is a minimum of 3 mm.
- Read the average and compare it with the reference value of the hardness reference block.

In the case of larger deviations, the tungsten-carbide ball functioning as a spherical test tip must be replaced.

5.2 Troubleshooting

When turned on, the CDR carries out an automatic system self-test. In addition, the CDR's self-monitoring function is active during the operation.

If system errors or operating errors should occur, they are displayed by a corresponding error code (e.g. E 0.1).

Error codes

Code	Cause	Action
E 0.0	Internal error in the EPROM/RAM	Remove the batteries and re-insert them after approx. 1 minute. Switch the instrument on; if the error occurs again, contact your nearest Clark Instrument Service department.
E 0.1	Battery voltage is too low	Exchange the batteries.
E 0.2	Error with self-test	Switch the instrument on again; if the error occurs again, contact your nearest Clark Instrument Service department.
E 1.0	Evaluation error, impossible to carry out a correct evaluation of the measurement.	Carry out the measurement once again. If necessary, clean the impact device.
E 1.1	Evaluation of the measurement is not yet complete.	Please carry out the measurement again.
OFL/UFL	Overflow/Underflow Out of range for the selected hardness scale	Select another hardness scale

Technical data **6**

Technical data

Housing

Setup	Miniaturized processor-controlled rebound hardness tester. Impact device with integrated electronics.
Battery compartment	2 AAA cells, lid with snap-in lock
Dimensions (dia. xL)	approx. 38 x170 mm / 1.5 x6.7 in
Weight	approx. 200 g / 0.4 lb.
Impact energy	approx. 12 Nmm
Impact device	D (for all materials enabling testing)
Switch-on	press of a key
Switch-off	automatic switch-off after approx. 1 min (single measurement mode) / 3 min (measurement set with average display)

Display and keypad

Display	LCD, display of the hardness value via 4 seven-segments, status indicators
Keypad	Membrane keypad with 2 click keys

Power supply and operating time

Batteries	2 xsize AAA cells. AlMn or rechargeable with NiCad or NiMH, (external charging only).
Operating time	> 4,000 measurements
Battery charge indicator	Low-Batt indicator, hardware switch-off with undervoltage.

Ambient conditions

Operation	-10 °C to +50 °C / 14 °F to 122 °F
Storage	-20 °C to +70 °C / -4 °F to 150 °F
Rel. humidity of air	10 to 80 % (no condensation allowed, moisture condensation excluded)
Vibration resistance	5 g (5 to 150 Hz, half-sine)
Shock resistance	11 g (11 ms, sine)

Technical data

Evaluation

Measured quantity	Characteristic of the induced coil voltage, determination of the hardness value according to $HL = V1/V2 \times 1000$
Data buffer	Battery-backed RAM memory. With loss of battery voltage the data and set values are lost after 3 minutes.
Measurement uncertainty	+ 4 HL of the average (5 measurements) from reference value of the hardness reference plate (0.5 % at 800 HL)
Statistics	Average
Conversion	according to DIN, ASTM, Dyna
Conversion scales and resolution	HL (1.0) HV (1.0) HB (1.0) HS (0.1) HRC (0.1) HRB (0.1) N/mm ² (5.0)
Material groups	please see page 7-4
Conversion ranges	please see page 7-5

The rebound hardness testing method **7**

7.1 The hardness testing method

In the following section, you will find some helpful information about the hardness testing method of the CDR.

The CDR is an integrated instrument, consisting of impact body, impact device and display unit. The impact body has a tungsten-carbide ball as a spherical test tip, and a permanent magnet for generating a voltage pulse. The impact device has a spring drive for loading and impelling the impact body, and an induction coil for detecting the magnet in the impact body. In rebound hardness testing, the speed variation due to the impact body's collision with the workpiece surface is measured.

To carry out the measurement, the impact energy is set via the spring. The impact body located in the tube of the impact device is impelled against the test surface by means of the release button.

In this process, the impact body's magnet induces a voltage signal in the coil, with the amplitude of this signal being proportional to the impact phase speed (I_p). The impact causes a plastic deformation of the material, and a permanent spherical indentation is

created in the surface. This plastic deformation brings about a loss of energy of the impact body, and consequently leads to a lower speed after the rebound phase (R_p).

The hardness value is calculated from the ratio of these two speeds and displayed as follows:

$$HL = 1000 R_p / I_p$$

please also refer to VDI reports no. 308 (1978).

The speed ratio is determined exactly at the time of the impact/rebound using the special signal processing. The speed ratio is therefore unaffected by the impact direction. As opposed to this, other rebound hardness testers require that the impact direction be predefined in fixed steps (effects of gravitation on the speed ratio) –which is a considerable handicap with frequently changing test positions.

 **Note:**

With CDR, it is not necessary to specify the impact direction.

7.2 Conversion of hardness values

Please observe the following with regard to the conversion of hardness values (ref. DIN 50 150 or ASTM E 140):

Hardness values which are measured according to different methods cannot be converted into one another via generally applicable relations.

The reason for this lies, firstly, in the fact that the penetration behaviour of a material is determined by its stress-deformation behaviour. Secondly, the shape and the material of the indenter, the size of indentation, and consequently the zone measured differ according to the hardness testing method.

You should therefore know that the conversion of hardness values both into one another and into tensile strength values can be inaccurate or unacceptable, depending on the material, its treatment and surface finish.

Indicate hardness values according to the scale determined experimentally with the hardness testing method used (e.g. rebound method in HL).

Only carry out conversions:

- if the specified test method cannot be applied, e.g. because there is no suitable instrument available,
- if it's impossible to take the required samples for the specified test method.

Special aspects related to the conversion in the CDR

In the default setting, the conversion of hardness values into other scales, which you can select on the instrument, is carried out according to the instrument-specific conversion tables; however, you can also carry out a conversion according to DIN 50 150 or ASTM E 140. All limitations mentioned in these standards regarding the conversion apply.

Moreover, please keep in mind that the conversions according to DIN 50 150 and ASTM E 140 (for Rockwell scales) only apply to the material group 1 (low-alloy/unalloyed steel). The instrument-specific conversion is used for other material groups after selecting DIN 50 150 or ASTM E 140.

The CDR provides 9 material groups from which you have to choose the one corresponding to your test material.

Please take into account with the steel material groups that the hardness values situated in the lower hardness ranges (up to approx. 500 HL) are less material-dependent than those in the upper ranges. Please check the calibration of your instrument, in particular if the hardness values in question are situated above 500 HL.

You will find the conversion options available for the individual material groups stored in the CDR in the overview given on the next page. Due to the higher material dependence, converted hardness values show considerably larger differences in the upper hardness ranges.

Material groups

Code designation Material group

St	Low-alloy/unalloyed steel and cast steel
ASt	Tool steel
SSt	Corrosion-resistant steel
GCI	Gray cast iron
NCI	Nodular graphite cast iron
AL	Aluminum cast alloys
brS	Brass
brZ	Bronze
Cu	Wrought copper alloys

Application ranges of the conversion tables

Conversion mode	Material group	HV	HB	HRB	HRC	HS	N/mm ²
DIN	St	80–1000	80–650	40–106	19–70	30–100	275–2200
ASTM	St	90–1000	90–560	52–102	19–70	30–100	300–2200
Dyna	St	75–1000	75–700	35–100	20–70	30–100	250–2200
	ASt	75–1000			20–70		
	SSt	75–1000	75–700	35–100	20–70		
	GCl		90–350				
	NCI		120–400				
	AL		20–180	10–85			
	brS		40–180	10–95			
	brZ		45–320				
	Cu		45–320				

Measuring range for the default scale HL: 150–1000

7.3 The treatment of test material

In order to obtain reliable and reproducible measurement results, you have to observe a few notes on the quality and treatment of the test material. Therefore, please read the following information.

Surface quality

The surface must be clean, free of oil, grease and dust. The peak-to-valley height or surface roughness should not exceed 10 micrometers.

Curved surfaces

In the case of surfaces showing a radius of curvature < 30 mm (convex or concave), a correspondingly shaped test attachment must be used for a firm and secure positioning of the impact device.

Measurements on small objects

Due to the impact effect of the impact device, vibrations liable to cause a corruption of the measurement results may occur with smaller or more lightweight test objects.

- Objects having a mass less than 2 kgs must always be fixed to the support using couplant so that no vibrations can occur.
- Test objects having a mass between 2 kgs and 5 kgs must be placed on a large metal support (e.g. a table) so that they are not moved or do not start to vibrate by to the impact. If necessary, couple the test objects using a couplant.

Minimum wall thicknesses

Similar problems occur with test objects having small wall thicknesses. Walls, e.g. on tubes, can start to vibrate due to the impact of the impact device in a similar way as the membrane of a drum. This generally results in indicating too low hardness values.

For this reason, we recommend minimum test object wall thicknesses of 20 mm for rebound hardness testing.

7.4 Information about the statistical evaluation

With a corresponding setting, the CDR displays the statistical average (\bar{x}).

Every measurement is subject to a measurement uncertainty. In this connection, the measuring errors consist of the following single errors:

- the basic measurement inaccuracy of the method of measurement used,
- the handling of the probes,
- the preparation of the material to be measured (surface or heat treatment),
- the homogeneity of the material to be measured,
- external influences (contamination, humidity, temperature).

The statistical evaluation is intended to help you to better assess your measurements and to make more reliable decisions on the quality of the material under test.

The average of a measurement set is the more accurate, the more single measurements you carry out. At the same time, however, many single measurements mean that more “outliers” are included. For this reason, the difference between minimum value and maximum value is no reliable yardstick for the evaluation of a measurement set containing more than around 12 measuring points.

The average (\bar{x}) is arithmetically calculated:

$$\bar{x} = \frac{(x_1 + x_2 + x_3 + \dots + x_n)}{n}$$

with

\bar{x} = Average

x = Single measurement

n = Number of measurements

Annex 8

8.1 EU declaration of conformity

The CDR meets the requirements of the following EU directives:

- 89/336/EEC (Electromagnetic compatibility)

The conformity with the requirements of the EU directive 89/336/EEC is proved by the compliance with the following standard specifications

- EN 55011, 12/1998, Class A, Group 2
- EN 50082-2, 02/1996

8.2 Service address

The CDR is manufactured according to state-of-the-art methods using high-quality components. Thorough in-process inspections and a quality management system certified to DIN ISO 9001 ensure an optimum workmanship of the instrument.

Should you nevertheless detect an error or malfunction on your product, please inform the Clark Instrument Service responsible for your products by giving the details (if possible, error number) and a description of the error or malfunction.

If there's anything specific you would like to know about the use, handling, operation and specifications of your instrument, or about our Service Agreement, please contact your local Clark Instrument representative, or the following direct address:

Clark Instrument

24371 Catherine Industrial, Suite 227
Novi, Michigan 48375

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