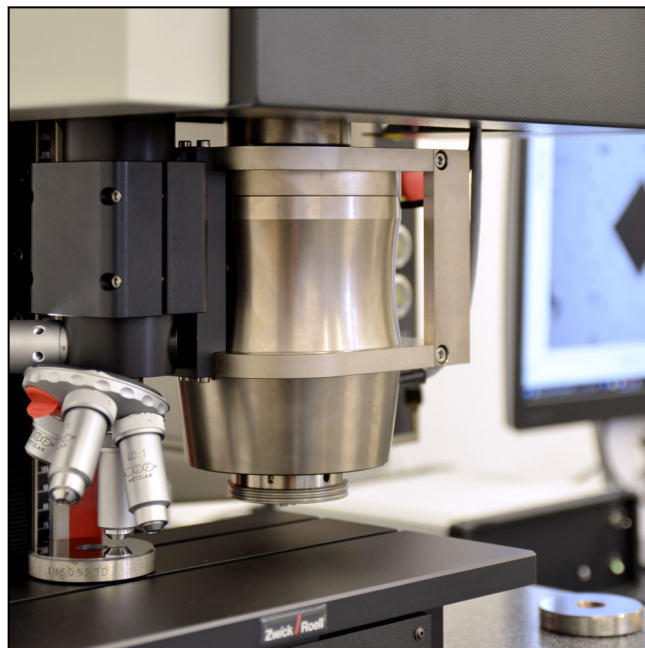


## Product Information

### Universal Hardness Testing Machine ZHU/zwickiLine+

CTA: 142888 142890



#### Applications

Overall the hardness measuring head covers all hardness tests employing indentation measurement, including:

- Martens hardness HM, instrumented indentation test
- Rockwell hardness scales A to K, N, T, plus HMR5/250
- Rockwell hardness scales R, L, M, E, K,  $\alpha$
- ball indentation hardness (for plastics)
- Vickers depth measurement HVT
- Brinell depth measurement HBT

Instrumented hardness testing for determination of the Martens hardness HM of metals is standardized in EN ISO 14577-1. The purpose of this standard is to define a universal hardness scale. This scale covers all hardness grades from thermoplastic films to very hard metals, enabling improved comparability of material behavior.

The force-indentation depth curve and different sequences of the loading process allow more comprehensive description of mechanical material properties, including:

- plastic and elastic portions of the indentation energy
- Martens hardness HM
- volume hardness HMs
- indentation hardness  $H_{IT}$
- elastic indentation modulus  $E_{IT}$
- creep behavior
- creep relaxation behavior

#### Advantages and features

The core components of this precision measuring system are the innovative hardness measuring head, the zwickiLine+ hardness testing machine with state-of-the-art testControl II measurement and control electronics and the intelligent testing software testXpert hardness edition. An add-on unit with measurement optics is optionally available for optical hardness testing methods.

- The combination of a zwickiLine+ with the hardness measuring head and testing software testXpert hardness edition results in an innovative test system with a wide range of applications.
- Universal application with fully automatic test sequence for practically any hardness testing method, regardless of material.
- Automatic display of force-indentation-depth curve regardless of method, for comprehensive materials characterization in instrumented indentation test to ISO 14577.
- Multiple use as a hardness testing machine and/ or as a testing machine for tensile, compression & bending tests.
- High operating comfort with changing test conditions due to fast and precise AC drive and large test area, e.g. for different specimen sizes.
- Versatile result presentation: single and statistical values, graphics, on-screen display, and test reports can be varied as required.

## Product Information

### Universal Hardness Testing Machine ZHU/zwickiLine+

#### Optics add-on unit

An optics add-on unit has been developed for the hardness measuring head. This unit consists of a measuring microscope with up to four lenses and a linear displacement unit which allows position changes between measuring microscope and load unit, avoiding the need for movement of components under test. The Optics add-on unit for the hardness measuring head is essential for "optical" hardness testing methods (Vickers, Knoop, Brinell).

Optical methods in combination with Optics add-on unit:

- Vickers HV to ISO 6507 / ASTM E384
- Brinell HB to ISO 6506 / ASTM E10
- Knoop HK to ISO 4545 / ASTM E384

This configuration transforms the ZHU2.5/Z2.5 into the most versatile hardness testing machine in the world. As well as the indentation-depth methods referred to above, Vickers, Knoop and Brinell hardness can be performed in accordance with standards using an optical measuring microscope. The combination of Optics add-on unit and hardness measuring head channeled through the intelligence of testXpert gives rise to outstanding characteristics.

In line with the market trend towards increasing automation and reduced operator influence in hardness

testing, the add-on unit with measuring microscope has been motorized. Making the indentation, swiveling the measuring microscope into place and optical measurement of the indentation are all fully automatic operations.

The testXpert Master and Standard Test Programs developed for the hardness measuring head allow Martens hardness testing, together with Rockwell and ball indentation hardness, as well as HVT and HBT. The Master Test Program can be expanded to include Vickers, Knoop and Brinell hardness tests, while hardness traverse tests with automatic indentation measurement and focusing are also possible.

#### Extended application range

In addition to the classical methods of hardness testing (Vickers, Rockwell, Brinell) and to the instrumented indentation test, the following applications are also possible thanks to zwickiLine+:

- Fully automatic Vickers and Rockwell hardness traverse tests (Jominy end-quench test, Vickers tests on ceramics)
- Ball indentation on plastics
- Cyclic tests on paper or ceramics
- Materials testing in general (e.g. tensile/compression tests)

CTA: 202872 202873



ZHU/zwickiLine+ with the option second test area



3-point-bending test on plastics

## Product Information

### Universal Hardness Testing Machine ZHU/zwickiLine+

#### Technical data

#### zwickiLine+ hardness testing machines with testControl II

Type	Z2.5 TN+	
Item No.	1044260	
Test load $F_{max}$	2.5	kN
<b>Test area</b>		
Test area height <sup>1)</sup>	675	mm
Test area depth	105	mm
Test area width	No limitation	
<b>Load frame</b>		
Height	1289	mm
Width	585	mm
Depth	707	mm
Weight, approx. <sup>2)</sup>	132	kg
Paint finish	A6-C31, RAL 7021 und RAL 3038	
Ambient temperature	+10 ... +35	°C
Relative humidity (non-condensing)	20 ... 90	%
Average noise level at $v_{max}$ measured in 1 m distance to the front side of machine	64	dB(A)
Conformity	ISO 9000 and CE	
<b>Drive system</b>		
Driving power	500	W
Motor	AC servo motor	
Control, set value preselection	Digital	
Crosshead speed $v_{min}$ ... $v_{max}$	0.0005 ... 3000 <sup>3)</sup>	mm/min
Drive travel resolution	0.95	nm
Positioning repeatability (without reversal of direction)	±2	µm
Controller	Adaptive	
Cycle time	1000	Hz
<b>Power input specifications</b>		
Version	1	kW
Power supply	230	V, 1Ph/N/PE
Permissible voltage fluctuation	±10	%
Power consumption (full load), approx.	2.3	kVA
Power frequency	50/60	Hz

1) Inclusive add-on unit "Optics". The dimensions of the x-y tables are not considered.

2) based on typical accessories

3) Values apply to machines with closed safety door and closed safety guard in automatic mode and to machines without safety device and/or without safety guard. For machines with the safety door and/or safety guard open, the speed is reduced to 600 mm/min.

## Product Information

### Universal Hardness Testing Machine ZHU/zwickiLine+

#### Hardness measuring head

For installation in a hardness testing machine with increased resolution, continuous force application, measurement of force and indentation depth, suitable in principle for all test methods featuring indentation depth measurement, e.g. Martens hardness test (EN ISO 14577-1, macro method)

Item No.	1044205	1044204	
Resolution	0.002	0.002	µm
Test load, max. (Fmax)	0.2	2.5	kN
Upper connection	Ø 20	Ø 20	mm
Lower compression platen	Ø 138	Ø 138	mm
Load cell	0.002 ... 0.2	0.005 ... 2.5	kN
Extensometer, digital	max. 4 mm, increased resolution 0.002 µm	max. 4 mm, increased resolution 0.002 µm	

Required:

- indenter
- sensor foot
- testXpert hardness edition testing software
- 1x INC module for connecting the hardness measuring head to testControl II (Item No. 046637)

#### Sensor feet for hardness measuring head (1x required)

The various indenters are mounted on the hardness measuring heads via sensor feet. Here you can differentiate between normal and so-called quick-change sensor feet. When using a quick-change sensor feet 1x the quick-change device (item number 320845) is required, which then remains in the hardness measuring head when changing between different indenters. See also the example configuration.

Description	ArticleNumber
Sensor foot for following indenters: Vickers pyramid, Knoop diamond pyramid, Berkovich pyramid, hard metal ball, Ø 1 mm, Ø 2.5 mm, Ø 5 mm, Ø 1/8" (3.175 mm), Ø 1/16" (1.5875 mm) and steel ball, Ø 5 mm	<b>318063</b>
Sensor foot for indenter for Rockwell hardness test (diamond, Ø 1/2", Ø 1/4")	<b>319410</b>
Quick-change device For the use of quick-change sensor feet	<b>320845</b>
Quick-change sensor foot For use with Vickers, Berkovich and Knoop diamond pyramid indenter, hard metal ball Ø 1 mm, Ø 2.5 mm, Ø 5 mm, Ø 1/8", Ø 1/16" and steel ball Ø 5 mm	<b>320847</b>
Quick-change sensor foot For use with Rockwell indenter (Diamond, Ø 1/2", Ø 1/4")	<b>320849</b>

#### Indenters

Indenter as per hardness test method	Item No.
Rockwell, with diamond cone, 120°	319408
Rockwell, with hard metal ball, 1/4" (6.35 mm)	320863
Rockwell, with hard metal ball, 1/2" (12.7 mm)	320890
Rockwell, with hard metal ball, 1/8" (3.175 mm)	320861
Rockwell, with hard metal ball, 1/16" (1.587 mm)	320859
Vickers, with pyramidal diamond point 136°	318061
Knoop, with diamond pyramid to Knoop, 172° 30'/130°	318845

## Product Information

### Universal Hardness Testing Machine ZHU/zwickiLine+

Indenter as per hardness test method	Item No.
Brinell, with hard metal ball, 1 mm	320900
Brinell, with hard metal ball, 2.5 mm	320896
Brinell, with hard metal ball 5 mm	320894
Ball indentation, with steel ball, 5 mm	320902

#### "Optics" add-on unit for hardness measuring head

Description	ArticleNumber
<b>"Optics" add-on unit</b> in conjunction with hardness measuring head (testControl II), including <b>manual</b> displacement unit for installation in a zwickiLine+ hardness testing machine. Includes 1.4-megapixel GigE camera, LED illumination (incl. power supply unit, 230 V) and software licenses.	<b>1044206</b>
<b>Required:</b> objective lenses	<b>see below</b>
powerful graphics card for optical hardness test methods <sup>1)</sup>	<b>075270</b>
<b>"Optics" add-on unit</b> in conjunction with hardness measuring head (testControl II), including <b>motorized</b> displacement unit for installation in a zwickiLine+ hardness testing machine. Includes 1.4-megapixel GigE camera, LED illumination (incl. power supply unit, 230 V) and software licenses.	<b>1044207</b>
<b>Required:</b> objective lenses	<b>see below</b>
powerful graphics card for optical hardness test methods <sup>1)</sup>	<b>075270</b>
motorized X-Y table	<b>see above</b>
<b>Video adapter</b> (interchangeable; option for "Optics" add-on unit) with low individual magnification for connecting the GigE camera to hardness measuring microscopes. The field of view shown on the screen is expanded by a factor of approximately 2.	<b>320406</b>

<sup>1)</sup> Compatibility of the PC card is guaranteed only in conjunction with PCs from ZwickRoell's range with Windows 10. In the case of use of customer's own PC, this must be sent to ZwickRoell in the event of an order.

#### Lenses

Item No.	1075268	1075269	1075270	1075271	1075272	
Inherent magnification	5 : 1	10 : 1	20 : 1	40 : 1	60 : 1	
Horizontal field of view, max., standard version	1760	880	440	220	147	µm <sup>1)2)</sup>
Vertical field of view, max., standard version	1320	660	330	165	110	µm <sup>1)2)</sup>
Resolution, standard version	1.5	0.8	0.4	0.2	0.13	µm/pixels
Horizontal field of view, max., optional version (item no. 320406)	2720	1360	680	340	227	µm <sup>3)4)</sup>
Vertical field of view, max., optional version (item no. 320406)	2040	1020	510	255	171	µm <sup>3)4)</sup>
Resolution, optional version	2.3	1.2	0.6	0.3	0.2	µm/pixels

<sup>1)</sup> A video adapter with a high level of inherent magnification is integrated in the standard version in the measurement microscope in front of the GigE camera.

<sup>2)</sup> The permissible measurement ranges are described in detail in the corresponding standards. For example, according to DIN EN ISO 6507-2, in order to achieve a resolution of 0.2 µm (d < 40 µm) or 0.5% of d (d ≥ 40 µm), a Vickers indentation must equal at least 1/3 of the vertical field of view.

## Product Information

### Universal Hardness Testing Machine ZHU/zwickiLine+

- 3) In the optional version an interchangeable video adapter with a low level of inherent magnification can be integrated in the measurement microscope in front of the GigE camera. In contrast to the standard version, it expands the field of view. This is absolutely necessary for the Brinell hardness test.
- 4) According to DIN EN ISO 6506-1/2, select the degree of load so that  $0.24 \cdot D < \text{indentation diameter} < 0.6 \cdot D$ . The remaining indentation diameter is thus within the following limits:  
 1-mm ball:  $0.240 \text{ mm} < \text{indentation diameter} < 0.6 \text{ mm}$   
 2.5-mm ball:  $0.6 \text{ mm} < \text{indentation diameter} < 1.5 \text{ mm}$   
 5-mm ball:  $1.2 \text{ mm} < \text{indentation diameter} < 3 \text{ mm}$   
 The measurement device should have a scale of 0.5% of d.

#### X-Y tables (adapter plate required when using X-Y table)

Type	Force, max. (Fmax) [kN]	Table dimensions [mm]	Distance of travel [mm]	Included in delivery	Item No.
X-Y table, manually	2.5	130 x 130	25 x 25	Micrometer screws, manual	357720
X-Y table, manually	2.5	130 x 130	25 x 25	<ul style="list-style-type: none"> <li>Micrometer screws</li> <li>Digital display</li> <li>Position transfer via RS232</li> </ul>	357722
X-Y table, manually	0.5	135 x 135	50 x 50	<ul style="list-style-type: none"> <li>Micrometer screws</li> </ul>	353448
X-Y table, manually	0.5	135 x 135	25 x 25	<ul style="list-style-type: none"> <li>Micrometer screws</li> <li>Digital display</li> <li>Position transfer via RS232</li> </ul>	353449
X-Y table, motorized	0.5	350 x 192	100 x 50	Control by PC via RS232 interface with testXpert	018130
X-Y table, motorized	0.5	400 x 192	150 x 50	Control by PC via RS232 interface with testXpert	018134
X-Y table, motorized	2.5	350 x 192	100 x 50	Control by PC via RS232 interface with testXpert	016316

#### Testing software *testXpert*<sup>®</sup> hardness edition

Description	ArticleNumber
testXpert basic program for zwickiLine hardness testers, German	<b>056151</b>
testXpert basic program for zwickiLine hardness testers, English	<b>056153</b>
Master Test Program for ZHU/zwickiLine hardness testers, German <ul style="list-style-type: none"> <li>Hardness testing methods using depth measurement: instrumented indentation test to ISO 14577-1, Rockwell hardness to ISO 6508-1, ball indentation hardness to ISO 2039-1, methods HVT &amp; HBT (not standardized), with cyclic loading (staircase, steps and constant cycles)</li> <li>Including following options: optical hardness test methods (Vickers, Knoop, Brinell), hardness traverse, auto-measurement, autofocus, X-Y table software integration</li> </ul>	<b>319222</b>
Master Test Program for ZHU/zwickiLine hardness testers, as 319222, English	<b>319224</b>
Master Test Program for ZHU/zwickiLine hardness testers, as 319222, 2nd licence	<b>354634</b>
Master Test Program for ZHU/zwickiLine hardness testers, as 319224, 2nd licence (English)	<b>354832</b>

## Product Information

### Universal Hardness Testing Machine ZHU/zwickiLine+

#### Data processing software InspectorX

To simulate stress-strain curves of metals from cyclic indentation tests, the InspectorX software and the stress-strain curve module are required in addition to the testXpert Master test program (and further options).

Description	ArticleNumber
Data processing software InspectorX - Software for the analysis of force indentation depth curves measured with the ZHU/zwicki+ according to ISO 14577 including comprehensive export functions, special analysis and correction functions ( <i>available in German or English</i> )	<b>1063064</b>
InspectorX in version 5.3 • Delivery of InspectorX will be in version 5.3	<b>1102288</b>
InspectorX in version 5.14 • Delivery of InspectorX will be in version 5.14	<b>1093308</b>
Software option materials data base for ZHN • Comprehensive collection of materials data about Young's modulus, Poisson's ratio, density, yield strength, tensile strength, thermal expansion and more (over 630 datasets) • Suitable for use in InspectorX <sup>1)</sup>	<b>1018405</b>
Stress-Strain-Curve Module - Module for the calculation of stress-strain curves of metals from indentations with spherical indenters and the use of a neural network	<b>1016458</b>

<sup>1)</sup> Please always add to specification in quotation/order (= 0 Euro)