Zwick / Roell

Testing systems

Testing Machines and Systems for building materials









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This catalogue provides an overview of devices, machines and systems of the Zwick Roell AG for the testing of building materials in the corresponding industries, research and development, test institutes and training centers. This is only a part of the extensive product portfolio of the Zwick Roell AG.

The Zwick Roell Group – More than a century of experience in materials testing

Mechanical-technological testing is the oldest discipline of materials testing. As early as in the 15th and 16th century, Leonardo da Vinci and Galileo Galilei were already considering the flexural stressing and the elastic behavior of materials. In the course of time further know-ledge was obtained. In the middle of the 18th century the first testing machines finally appeared in France.

Since the middle of the 19th century the company Amsler (formerly in Schaffhausen, Switzerland) has been involved in materials testing and the company Roell & Korthaus since 1920. Since 1937 Zwick has been building devices, machines and systems for mechanical-technological materials testing. Long before that time, i.e. in 1876, Prof. Seger had already founded a chemical laboratory as a scientific-technological consulting company for the industry of nonmetallic minerals. During the 20th century, the present company Toni Technik has developed from these fundamentals and is now considered a leading expert for test systems for building materials. Excellent performances were also supplied by the company MFL (Mohr & Federhaff) – a company that was founded in 1870. By the way, Carl Benz was one of the employees.

Since 1992, these companies have formed the Zwick/Roell company group.

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Photos front cover: Bilfinger Berger, chronos reportagen, DYWIDAG, HOCHTIEF, Toni Technik

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In July 2001, the Zwick Roell company group was converted into a stock corporation: the Zwick Roell AG. Part of this stock corporation are the companies Zwick, Roell Amsler, Toni Technik, Indentec Ltd. and Acmel Labo. These companies supply an extensive program for materials, component, and functional tests – from the manually operated hardness tester up to a complex test system for the process-accompanying application. Since May 2002, Acmel Labo, French manufacturer of laboratory devices for the cement, gypsum and lime industry is also part of the Zwick Roell AG.

Headquarters of Zwick Roell AG and Zwick GmbH & Co. KG at Ulm, Germany

Zwick has many years of experience, combined with a multitude of supplied systems. This experience is continuously supplemented by the constant communication with our users. On this solid basis, the company supplies a wide range of high-performance products – from the economical standard machine up to special versions and designs for special test jobs. Modern mechanics, high-performance electronics and the application-oriented software are the prerequisite for the versatility and the high ”intelligence“ of these modern testing machines and systems. However, the services of the Zwick Roell AG go far beyond the supply of products. Already in 1994 the company received the certification according to DIN EN ISO 9001 and thus guarantees a consistently high product and service quality. With accredited calibration laboratories, the companies of the Zwick Roell AG are in addition entitled to verify and to calibrate test systems and to document that with internationally recognized certificates.


Roell Amsler GmbH & Co. KG at Gottmadingen, Germany


Toni Technik GmbH at Berlin, Germany

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Modern building materials – a large spectrum of materials, properties and textures

Modern building materials consist of many different raw materials as for example natural and artificial minerals, plastics, wood or metals and they are offered in various types of products: as powder, masses, bulk goods, foils, plates, stones and form elements or prefabricated components, as for example wall elements, supports, stairs, etc. They are used for the preparation of foundations, walls and ceilings, for the protection and for the optical presentation of areas and surfaces, for the sealing of joints and surfaces or for cold and heat insulation. They are used for the construction of buildings of various sizes and functions, for traffic routes such as roads, bridges or even dams.

During production, storage, transport and particularly as finished building all building materials are subject to mechanical stress, i.e. they are subject to the pressure caused by the earth, water and wind and the parts of the building located above, to the forces of gravity and the motility of man and machines, impacts released by earthquakes or by shifts resp. the sliding of different earth bottom layers in the underground.

There is hardly any other field of technology in which the well-being and safety of many people are so much dependent on the reliable and safe function and stability of such buildings. Therefore, the properties of the building materials used have to be studied carefully and tested accordingly. Standards and guidelines define the composition and properties of the most different building materials. The test standards specify how these properties are to be tested. The table “Test standards and testing machines” includes essential test standards for building materials and refers to the suitable testing instruments and machines.

Strength and deformation

Strength and deformation play a central role in the testing of building materials. For this reason the testing technology predominantly deals with the testing of these properties. Special criterions have to be considered; they depend on the building materials in question and the specimens or components manufactured out of them.

Binders – Products with extremely different test requirements

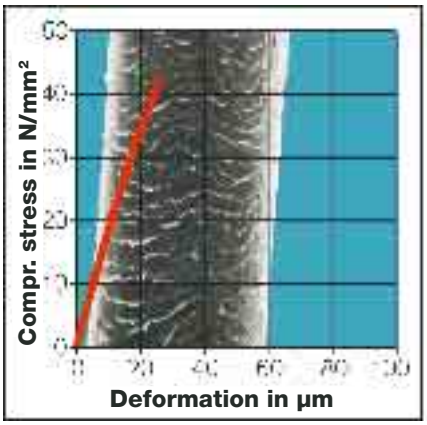
All types of hydraulic and non-hydraulic binders and mixtures are classified under this term. Priority, also set up by the testing machines and devices, is given to cement, the basic material of the majority of binders. This also includes all types of mortar (gypsum mortar, lime mortar and cement mortar) including ready-mixed mortar or dry mortar resp. and adhesives on a mineral or partially mineral basis. For the testing of the adhesive strength resp. of the adhesive shear strength of tiling adhesives special testing devices are used. The determination of the modulus of elasticity (Young’s modulus) revealing the influence of mineral or synthetic fibres on the compressive and bending strength, becomes more and more important (see also product information “Testing machines for plastics and elastomers”

Concrete – A building material which makes particularly high demands on testing technology

The strength of concrete is between 20 and 50 N/mm² and can amount up to 200 N/mm² for high-strength and fibre-reinforced variants. Since concrete is a very brittle material, its strain at break is located in a tenth percent range. These are – referred to the heights of the cube or cylinder-shaped compression specimens – deformations of a few hundredths of a millimeter only; not more than the thickness of a hair! This is considerably less than the elastic deformation of the testing machine’s load frame. The modulus of elasticity of concrete is between 15,000 and 45,000 N/mm² (depending on the hardened cement paste, volume of the hardened cement paste and aggregate and, if necessary, on the reinforcement by fibres etc.).

Specimen shapes and dimensions

Concrete has a heterogeneous structure, which requires large specimens. These are either cubes with an equal length of edges of 100, 150, 200 or 300 mm or



Compressive stress-deformation curve of a concrete specimen compared to the thickness of a human hair

(drilling) cylinders with a diameter of 100, 150, 200 and 300 mm and double their respective diameter.

Test load and test load distribution

The large specimens require large test loads, usually a test load from 600 to 6,000 kN.

The test load distribution over the entire (large) compression surface of the specimen is a substantial aspect for the test results, i.e. whether test results with a limited range of variation correspond to the actual strength of concrete or if considerably lower values with a large range of variation are output.

Due to the high rigidity and the low deformability even slight unevenness (roughs, grooves, impurities etc.) of the compression surfaces, the bending of the compression platens or unsymmetrical deformations of the machine frame (angular position of the compression platens) lead to locally different compressive stresses and to a premature break when having reached the peak of load application. The reduction in force during the first crack leads to an immediate elastic resilience of the load frame and accelerates the break process.

Different load application speeds or speeds changing under load application will also influence the test results.

Such influences lead to uncertain test results with a range of variation being more than 20 % below the actual strength. The actual strength of concrete is not reached.

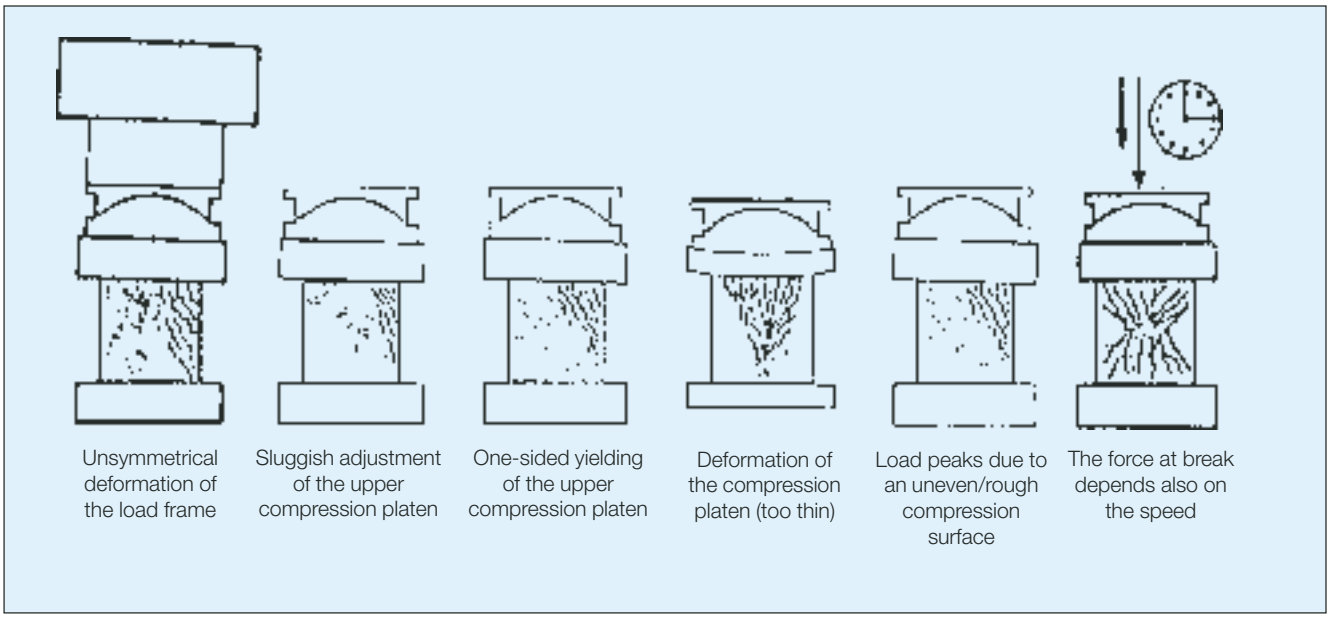
These influences can be limited decisively by taking the following measures:

a) The load frames of the testing machines must have high longitudinal and transverse rigidities so that unsymmetrical elastic deformations are negligible even if the specimen is not inserted exactly centrically for example.

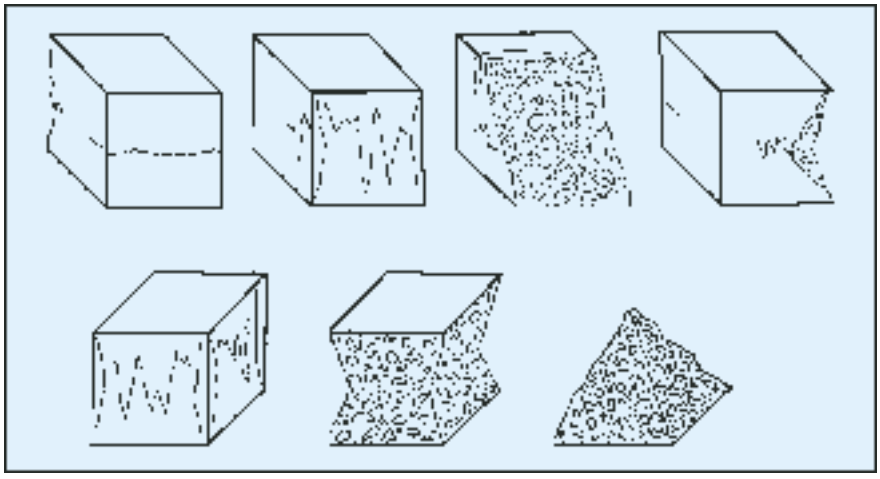
b) The compression platens must be extremely rigid, the surfaces must be hardened (³ 55 HRC) and polished (average peak-to-valley height £ 0,0016 mm, flatness deviation £ 0.03 mm over 250 mm).

c) The upper compression platen must be positioned in a way that it sits allover close to the specimen and without lateral offset (center of rotation on a level with the compression surface) when approaching the specimen, but with the test load increasing the angular position must not change any further.

d) Due to the very small deformations of the specimens, the speed of load application is subject to a force-dependent control and must therefore be reproducible.



Different causes for a nonuniform load application on the specimen



Specimen after the test with nonuniform (top) and uniform (bottom) stress distribution

In this way the test data dispersions can be reduced to values below 1% and the actual strength of the concrete can finally be determined. The type of load application used is revealed on the specimen's break graphs.

A so-called strain cylinder test is carried out to test and to prove the efficiency of these measures. This test has been developed particularly for compression testing machines for concrete (max. test load > 1200 kN). It is part of the European test standards resp. of the national supplementary sheets. All compression testing machines from Toni Technik are tested accordingly prior to their delivery. For this purpose, a correspondingly adapted strain cylinder has also been developed for the compression testing machines for cement, mortar etc. (max. test load 100 – 1200 kN).

Ceramic building materials

Another spectrum of products are ordinary and fine ceramic materials. The most important materials are shown in the following table.

Special building materials

The particularly large variety of special building materials in Central Europe continues growing on a global level due to internationally active manufacturers of building materials. For the majority of these building materials the standard testing machines can be used requiring none or only slight adaptations. This applies mainly to

- porous concrete (beam elements and cube specimens)
- calcareous sandstones (small and large sizes)
- refractory material (masses and stones, see also "ceramic building materials")
- insulating bricks (lining with bricks) and heat insulating materials (see also our product information („Testing machines for textile materials")

Testing machines for building materials for various test jobs

The different properties of the building materials and the specimens, components, parts and textures made of them require testing machines with accordingly adapted performance profiles.

The Universal Testing Machines from Zwick available as standard machines are, as is explained by the term itself, universally usable machines. Large test areas and test travels, exchangeable test tools and test data transducers enable the testing of specimens, components and parts with different shapes, dimensions and properties.

The Strength Testing Machines from ToniTechnik perfectly meet the specific requirements of standardized compression and bending tests of specimens made of mineral building materials such as mortar, cement and concrete. This means that e.g. load frame, compression platens and drive system fulfill the special requirements of the concrete testing – also advantageous for the mortar and cement testing – or that combinations of compression and bending testing machines allow a quick change of the test method without prior retrofitting.

Since the high-frequency pulsators from Roell Amsler use the resonance principle, they only need very little energy for the testing of the fatigue strength of specimens made of reinforced concrete, steel mesh fabrics or wire mesh. In addition to that only relatively short test times are required (less than 3 hours for 2 million load changes at 200 Hz) because the tests are carried out at the highest permissible test frequencies.

To meet the requirements of particular applications, the testing machines from Zwick, Toni Technik and Roell Amsler may be modified, components may be combined or job-specific special testing machines may be developed. An example for that are the clamping scales planned and manufactured to a large extent by Zwick provided

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with servohydraulic units and test cylinders by Roell Amsler. The expert knowledge and the practical experiences of these companies and of the users take effect. For all those machines, the universal test software *testXpert*® from Zwick can be used.

In addition to these machines which are predominantly used for the strength tests, Toni Technik also supplies auxiliary means, devices, machines and facilities for test laboratories for building materials (see catalogue "Global Testing" from Toni Technik). Roell Amsler additionally supplies servohydraulic universal testing machines, pendulum impact testers and drop impact testers for dynamic tests and Zwick supplies hardness testers and machines for metals, plastics, rubber, gypsum and bitumen.

Testing machines for binders and concrete
(Cement, mortar, action of additives and admixtures as chemicals, metallurgical sand, gravels etc.)

Specimen types: Cubes, cylinders, prism, beams, cores, tubes, pipes, stones, elements, textures

Task	Testing means or test method	Acmel Labo	Roell Amsler	Toni Technik	Zwick
Specimen preparation	Mixer, specimen shapes, bench jolters, Storing in humid and wet atmosphere	-	-	✓	-
Specimen characterization	Particle size distrib. curve, grinding fineness Blaine value, particle size determ. with laser	✓	-	✓	-
Determination of the setting	Vicat test, calorimeter	✓	✓	✓	-
Determination of the climatic and chemical stability	CDF installation, climatic chamber	-	-	✓	-
determination of strength and deformation	Compressive and bending testing machines,	-	(✓)	✓	(✓)
	strong floors and special testing machines	-	-	-	✓
	Dynamic testing machines	-	✓	-	-
Determination of fatique strength	Fatique and creep testing machines	-	✓	-	-
Determination of other characteristic features	Determ. of free lime, titrations, chem. analysis, degree of whiteness, X-ray phase analysis	-	-	✓	-

Testing machines for ceramic building materials

Type of ceramics	Properties to be determined	Roell Amsler	Toni Technik	Zwick
Fine ceramics				
• Glazes	Hardness, surface, adhesion, chem. stability	-	✓	✓
• Porcelain	Compressive and bending strength	-	-	✓
• Household ceramics	Compr. and bend. strength, Young´s mod., surface	-	-	✓
• Tiles	Compressive and bending strength	-	✓	✓
• Laboratory ceramics	Compressive and bending strength, surface chem. stability	-	✓	✓
Ordinary ceramics				
• Tubes, pipes	Compressive strength of vertex	-	✓	-
• Bricks	Compressive strength	-	✓	-
• Roof tiles	Compressive and bending strength	-	✓	✓
• Refractory	Compressive and bending strength	-	✓	✓
• Tiles	Compressive and bending strength, abrrasion resistance, surface	-	✓	✓

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Type of ceramics	Properties to be determined	Roell Amsler	Toni Technik	Zwick
Special ceramics				
• Oxide ceramics	Powder characterization, bending and shear strength, Young´s modulus, impact resistance, dynamic behaviour	-	✓	✓
• Non-oxide ceramics	Powder characterization, bending and shear strength, Young´s modulus	-	✓	✓
• Glass ceramics	Powder characterization, bending and shear strength, Young´s modulus	-	✓	✓
• Composites	Powder characterization, bending and shear strength, Young´s modulus	✓	✓	✓

The company Identec offers hardness tests in accordance with international standards.

Testing machines for special building materials

Type of special building material	Properties to be determined	Roell Amsler	Toni Technik	Zwick
• Porous concrete, incl. reinforced products	Tensile, compressive and bending strength	-	✓	✓
• Calcareous sandstones	Compressive strength	-	✓	-
• Refractory materials	Compr. and bending strength, Young´s modulus	-	✓	✓
• Insulating bricks	Tensile, compressive and bending strength	-	✓	✓
• Heat insulting materials[1)]	Tensile, compressive and bending strength	-	✓	✓
• Natural stones	Compressive strength	-	✓	-
• Natural building materials	Strength and ductility, workability, grain sizes	-	✓	✓
• Bitumen, asphalt	Ductility, workability, tensile, compr. and bending strength, abrasion resistance, Young´s modulus	(✓)	✓	(✓)
• Glass	Compr. and bending strength, dynamic behaviour	(✓)	(✓)	✓

[1)] See also product information „Testing machines and systems for textile materials“

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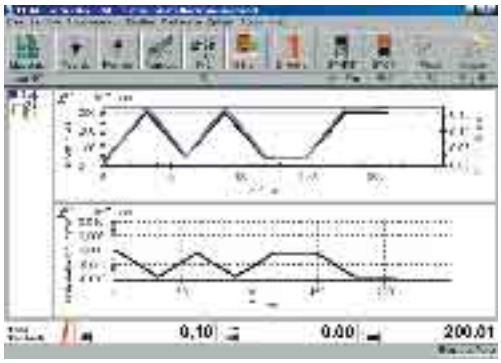
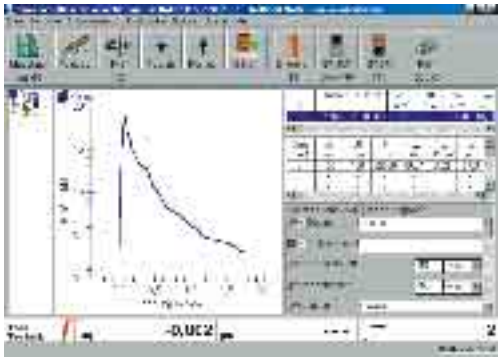
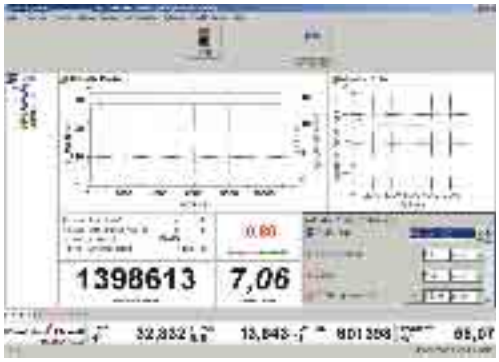
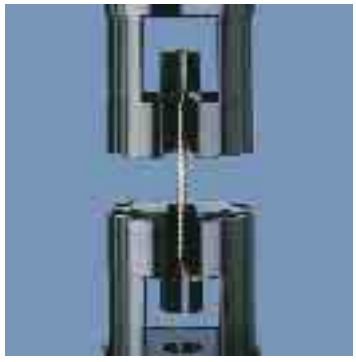
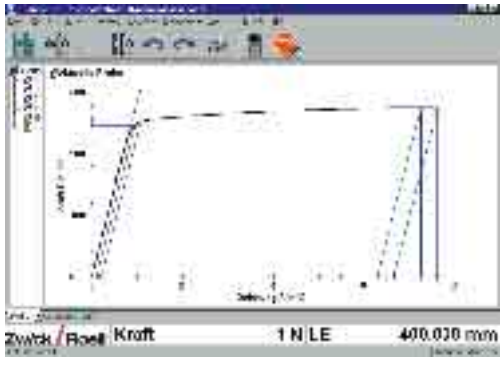
Application	test-curve in *testXpert*®	Example of mounting
Concrete Standard: ISO 6784, DIN 1048 Type of test: Determination of Young´s modulus, Compression test Material: Concrete Extensometer: 0712.002 Test speed: 0,5 N/mm²s *testXpert*®: T0510.351		
Standard: DBV code of pract. Air-placed concrete Type of test: 4-Point-bending test Material: Fibre reinforced concrete Extensometer: 0728 Test speed: Acc. to DBV code of pract. *testXpert*®: T0510.351		
Steel wire for the reinforcement of concrete Standard: DIN 488 Type of test: Altern. tensile test Material: Steel wire for the reinf. of concrete Grips: Special grips for steel wires Test frequency: 80 Hz *testXpert*®: B06942000		
Strands Standard: DIN EN 10138 Type of test: Tensile test Material: Strand Grips: Hydraulic grips withdual clamping system *testXpert*®: B069008		

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Test devices for cement, gypsum and lime

Automatic VICAT Needle Apparatus

Apparatus to determine the setting time on up to 8 specimens irrespective from each other. The time of begin and end of the setting process of cement, gypsum or mortar is measured. The penetration depth of the Vicat needle into the specimen is measured, evaluated and saved according to 3 different methods. The measurements may be carried out in any order at any of the 8 available spots thus making optimum use of the specimen surface but considering the conditions set by the different standards.

Automatic VICAT Needle Apparatus

Le Chatelier Water Bath

Device to determine the stability of cement which may change when expanding during hydration. For this purpose up to 16 specimen bars can be stored in a bath of boiling water or water vapor. The heating cycle – e.g. heating up to 100ºC within 30 min and keeping this temperature constant for more than 3 h – is regulated automatically and with a high accuracy (accurate to 0.1ºC). Setting time and setting temperature may vary according to the requirements in question.

Easy and safe handling.

Automatic Blaine Apparatus

Apparatus to determine the specific surface of cement and other powdered materials. The time required by a certain air volume to penetrate a powder bed is measured in accordance with EN 196-6.
Measurement, test sequence control and evaluation are automatically performed.

Free Lime Determination Device

Device to determine the concentration of free lime in cement or cement clinker. For this purpose the conductivity of a cement solution in hot glycol is measured.

The menu-guided test sequence allows an easy and safe handling and short test times. The test results are available more quickly compared to other methods, thus allowing also a quicker correction of the furnace operation and the burning process.

Le Chatelier Water Bath

Automatic Blaine Apparatus

Free Lime Determination Device

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High frequency testing machines

Vibrophore HFP 5100

The quality of reinforcement bars and steel tendons is vital for the safety and stability of buildings. Thus the durability of reinforcement bars has to be tested according to standard ENV 10080 for diameters between 5 and 40 mm through 2 million load cycles at frequency ranges between 1 and 200 Hz.

Vibrophores are particularly suitable for these kinds of tests. In comparison to servo hydraulic testing systems vibrophores provide the following advantages:

- Very low energy consumption due to resonance drive
- No additional cooling or hydraulics necessary
- Virtually maintenance free system; no abrasion parts
- Short test sequences due to high test frequencies, thus high specimen throughput
- Low cost of operation

Reinforcement bars are fixed in special grippings. Three adapted clamping jaws press against the ends of the specimens with anti-fatigue bolts to transmit the tension forces. The ends of the specimen that might be demaged by the clamping can be moulded into metal tubes to avoid brakage due to clamping. Hydraulic grips allow quick and easy clamping and releasing of the specimens. VibroWin® is a user friendly testing software with a graphic user interface. It controls and monitors the tests and acquires, stores and evaluates the test values. The VibroWin® controller is compatible with *testXpert*® testing software which provides features such as freely configurable user interface, creating of standards, or graphic as well as tabular display of test values and results.

Besides fatigue testing of steel, the Amsler Vibrophore series 5100 can also be used for testing of non-iron metals, thermosetting plastics and ceramics. Depending on the respective testing accessories and tools the specimens and components can be subject to tension, bending or torsion tests. Another application of the vibrophore are mechanical fracturing tests.

High gripping force already acting at the beginning of the gripping action prevents a partial ”slippage“ of the specimen. This can lead to a ”piling up of the force“ at the beginning of the clamping and can thus release a premature break.

Clamping for reinforcement bars

Max. test load, kN	50/400
Max. preload force of clamping jaws, kN	ca. 520
Max. press capacity of clamping jaws, kN	ca. 840

Specimens of reinforcement bars with clamping jaws

Specimen before clamping

Vibrophore Amsler HFP 400

High frequency testing machines

Series/Type	Amsler HFP 50	Amsler HFP 100-250	Amsler HFP 400
Load frame nominal force, kN	50	100 - 250	400
Range of frequency, Hz	35 to 300	35 to 300	35 to 300
Max. force amplitude, kN	± 25	± 50 - 125	± 200
Frequency steps	5	5	5
Max. power consumption, kVA	5	5	5

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Specimen preparation

The most important and maybe the most decisive part for the testing of binders is the standard-conforming, reproducible preparation and production of specimens. For this reason, the corresponding devices and auxiliary means are subject to strict quality standards regarding accuracy and user-friendliness. Standard devices for the specimen preparation are to be found in the catalogue Global Testing from Toni Technik. Example for an innovative solution in this field is the

Mortar mixer *ToniMIX*

The automatic mixing process can be programmed in accordance with the specification of different standards. Its special features are

- automatic sand and water supply facility,
- safe mixing guaranteed by a high precision of the component parts,
- clear glass door with safety switch,
- standard dust exhaust facility and
- specially robust long-life construction.

Testing of binders

Automatic needle testers *ToniSET* Compact and *ToniSET* Expert

The setting behaviour is a decisive, technological factor for the processing of binders and is usually determined manually with the Vicat needle tester during time-consuming tests.

In the course of the user-oriented development of building materials with permanently new special properties, the number of these tests is increasing constantly and thus becomes an important economic factor. The traditional characteristic values “begin of setting” and “end of setting” are decisive factors for an extensive evaluation of the setting behaviour. For the product development of binders, retarders and accelerators it is of particular importance to save time by means of a fully automatic test performance. The consequent observance of defined environmental conditions (temperature, humidity of air) are

Automatic needle tester *ToniSET* Compact

further crucial advantages of the automated measuring method with *ToniSET*. Several specimens are tested fully automatically with both devices, optionally at a defined humidity of air or under water. The advantage of the underwater test, which seems to gain more and more ground as alternative method for the standards (EN and ASTM), is that the environmental conditions are reproducible in the best possible way.

Mortar mixer *ToniMIX*

Automatic needle tester *ToniSET* Expert

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Both variants are controlled by a MS Windows-based software whereby individual test intervals may be selected for each specimen. The current setting condition of the different specimens can be read in the corresponding program windows at any time. The moments of time for the beginning, resp. the end of setting are automatically calculated in accord. with the specifications set up after comparison measurements.

Heat flow-differential-calorimeter *ToniCAL* cement, mortar and concrete

All devices are used to determine the setting heat of hydraulic building materials. For this purpose, the microprocessor continuously records the generation of heat (Joule/gram) in dependence on time. Whereas for *ToniCAL* cement a quantity of 10 grams is sufficient due to the homogeneous, pulverized materials, *ToniCAL* mortar needs a quantity of about 70 to 140g and *ToniCAL* concrete finally works - due to the very coarse-grained and very inhomogeneous fresh concrete mixture - with a specimen shape and quantity that corresponds to a concrete cylinder with a diameter of 150 mm and a height of 300 mm (about 5.3 litres).

Each one of the devices consists of a control unit with temperature controller, amplifier, temperature display and processor interface as well as a separate, heat-insulated calorimeter block containing the measuring cylinders for the material to be tested and an inert sample, the measuring chains from a variety of thermosensors adjacent to the cylinders and a source of heat. *ToniCAL* cement is additionally equipped with a device for the subsequent dosing of additives.

The released hydration heat (Joule/mass x time) can be represented in tabular form or graphically as instantaneous or cumulative value either during the measurement or after the termination of the test. The high measuring accuracy and reproducibility guarantee a safe and reliable evaluation of the generation of heat and of the influence of additives.

Heat-flow differential calorimeter *ToniCAL* concrete

Automatic Blaine apparatus *ToniPERM* (Type 6565)

The specific surface according to Blaine is an indirect measure for the grain size and has a decisive influence on the strength values of cement. Therefore, an exact, simple and quick determination is of decisive importance already during the production process (in the cement mill).

ToniPERM is an automated, microprocessor-controlled Blaine device and particularly suitable for the quick determination of operating characteristic values. It consists of a microprocessor control unit (similar to *ToniTROL*) and a measuring tower, optionally with one or two measuring cells.

The powdered material to be tested is compressed to a defined volume in the enlarged measuring cell (according to Dyckerhoff). After having placed the measuring cell(s) onto the measuring tower and after having entered the test-specific specimen data, the test is carried out and evaluated fully automatically. The Blaine-value is calculated out of the single values of a preselected number of tests and, if necessary, out of two measuring cells.

Automatic Blaine apparatus *ToniPERM*

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Compression and bending testing machines

Servohydraulic Compression and bending testing machines from ToniTechnik are predominantly used to determine the compressive and the bending strength of specimens and components made of mineral materials such as mortar, cement, gypsum or concrete. Other building materials such as porous concrete, calcareous sandstone, bricks, insulating bricks and refractory materials are also regularly tested with products from Toni Technik. Depending on the type of machine and the equipment, it is also possible to determine deformation-dependent properties as e.g. the Young's modulus of elasticity and the deformation at breaking point or to acquire and evaluate the entire stress (strength) – deformation curve (graphs). The control and evaluation software testXpert has drastically extended the spectrum of test evaluation.

The machines are designed to meet the special requirements of relatively large variety of specimen and components made of mostly inhomogeneous and brittle materials. They are combined acc. to the specific applications from a modular system consisting of the following components:

- load frame for compression and bending tests,
- measurement and control system,
- servohydraulic station and
- displacement and deformation transducer

Load frames

For compression tests very often larger test loads are required than for bending tests (factor 2 to 15). The changing of load cells and test tools (compression platens, bending tools) is, due to the considerable weight of the compression platens, only usual for small loads up to 100 kN . For this reason, the load frames are mostly designed for compression or bending tests; test cylinder, load cell and test tools are firmly mounted.

All load frames in the 2, 3 or 4 column version for compression tests have an extreme longitudinal and transverse rigidity to minimize an unsymmetrical deformation also for slightly eccentric load transmissions. On request the

ToniNORM load frames for compression and bending testing

Compression load frame from 200 up to 1,000 kN (from 2,000 up to 6,000 kN see table page 22)

Series/type	2020.0200	2020.0300	2020.0400	2020.0600	2020.1000
• Max. load, kN	200	300	400	600	1,000
• Working area width, mm	250	250	320	320	320
• Pressure plates diameter, mm	180	180	220	220	220
• Pressure plates distance, mm	225	225	225	225	225
* optional, mm	340/540	340/540	340/540	340/540	340/540
• Piston stroke, mm	100	100	100	100	100

Series/type	2060.0010	2060.0020	2060.0050	2065.0020	2070.0100 2070.0200	2075.0200 2075.0300
• Max. load, kN	10	20	50	20	100/200	200/300
• Working area width, mm	155	280	280	315	1,200	840 x 250
bending support and edge						
* Length, mm	60	250	250	250	500	220
* Diameter, mm	10	10	10	10	20	20
• Support distance, fixed, mm	100					
variable, mm	-	70 - 400	70 - 400	70 - 210	100 - 900	70 - 700
• Dim. of pressure plates, mm	40 x 40	Ø 180	Ø 180			
(Option) mm	40 x 62.5			Ø 180	Ø 180	Ø 180
• Piston stroke, mm	30	200	200	200	250	100
• Vertical distance						
* for bending device, mm	55	0 - 120	0 - 120	0 - 120	0 - 250	100 - 20
* for pressure plates, mm	50	60 - 260	60 - 260	60 - 260	284.5 - 534.5	125 - 225

Zwick / Roell

compression platens are designed to meet the requirements of the "Strain cylinder test" according to DIN 51 302-2 "Materials testing machines – Additional requirements for compression testing machines for building materials".

Load cells

The test load is optionally measured with strain gauge load cells or by means of an oil pressure gauge. The load cells are mounted above the upper compression platen, resp. the bending die and the oil pressure gauge is mounted at the test cylinder. The measuring range according to DIN EN ISO 7500-1, class covers the range from 1 % to 100 % of the nominal load.

Measurement and control system *ToniTROL*

ToniTROL is designed for the efficient and economic compression and bending test on building materials. This system is used for the test data acquistion, processing and display, for the monitoring and control of the test sequence and for the test speed control. The measurement and control electronics is located in a compact housing in a space-saving manner. For the Stand Alone operation (without PC) a function-specific keyboard and a 4-line, large sized LCD-display are integrated in the ergonomically slightly inclined front side.

Special features of *ToniTROL*:

- Easy, menu-guided operation
- Up to 3 different load frames (for tensile, compression and/or flexure) are connectable with automatic, program-controlled changeover and adaptation of parameters, calibration factors etc.
- Test speed control in dependence on the test load (standard), displacement or deformation (option), may also be changed during the test
- Displacement measurement with test load-dependent correction of the machine deformation (option in the "stand alone" – mode and with *testXpert*®)
- Many different test programs, easy to operate, for compression and bending tests, cyclic(al) and stepped test sequences, for the determination of the Young's modulus of elasticity, for the individual programming of test sequences etc. are available in RAM.
- The break detection can be generously adapted with different break parameters acc . to different rigidity of the building material in question
- 100 Test sequences (with index) can be saved
- Additional possibility to connect two further deformation sensors (e.g. for the measurement of the Young's modulus)

Measurement and control system *ToniTROL*

- Printer and ASCII-keyboard
- Barcode reader for the identification of marked specimens
- Scales, caliper gauges or specimen measurement station for the acquisition of the weight and the specimen dimensions
- Personal-Computer (PC) with test software *testXpert*®

Hydraulic station

The *ToniNORM* Powerbox includes all units for the provision of the hydraulic and electrical capacities (power supply units, pump, oil tank, control valves etc.). It is available in different types (see table Powerbox).

ToniNORM Powerboxes (examples)

Series/type	2010.010	2010.020	2010.030	2011	2012
• Pump capacity, l/mm	1.4	2.1/3.7	4.2	1.4	1.4
• Max. working pressure, bar	450	450	450	450	450
• Type of control (B = Bypass, Z = Afflux)	B or Z	B or Z	B or Z	B	B or Z
• No. of connectable load frames	3	3	3	2	1
• Working table width, mm (heigth 900 mm, depth 550 mm)	1,200	1,200	1,200	700	700
• Max. power consumption, kVA	1.5	3	3	1.5	1.5
• Weight, kg	approx. 280	approx. 300	approx. 300	approx. 210	approx. 210

Zwick / Roell

All the corresponding units are integrated in one working table. This table is at the same time used for some models as a support table for the measurement and control system *ToniTROL* and for the testing frame combination *ToniPRAX* for example.

The load application speed can be controlled alternatively in 2 ways:

Bypass control

With the bypass control, the piston movement is controlled via the backflow of the pressure oil to the tank. This means that only the actually required amount of pressure is built up in the cylinder. Due to the minimum power loss the oil does not need to be cooled. With a servo valve integrated in the Powerbox, all the connected load frames can be operated. For this reason this type of control is particularly economic and has a long life.

Afflux control

With this control system, the oil supply to the cylinder is controlled. The servovalve is always under pressure. The higher losses of power for some applications requires an oil cooling. Each load frame connected to a common Powerbox needs its own servo valve adapted to the corresponding power requirement and directly located at the cylinder. The advantages of this type of control are, for example, minimum reaction times and high control accuracies, which are particularly needed for research and development tasks.

Deformation transducer for the determination of the Young´s modulus

Displacement and deformation transducer

The following transducer systems for the determination of the specimen deformation with corresponding measurement electronics and software can be connected to *ToniTROL*:

- piston displacement transducer
- transducer for the measurement of the separation between the compression platens
- transducer for the measurement of the specimen deflection
- transducer for the time-synchronous measurement of the longitudinal and transverse strain for the determination of the Young's modulus of elasticity.

With these transducers, the test speed can also be regulated in dependence on the displacement or the deformation resp. So even after the reduction in force after the incipient crack, the test may be continued at a constant speed in order to measure the adhesive strength of steel fibres in the concrete.

Deformation transducer for the PCI-cube test

Configurations of the testing machines

Job-specific testing machines and systems are created with the above mentioned modules, thus offering many different solutions: from the pragmatic single-purpose testing machine for the standard quality control via testing machine combinations for the simple and quick change between compression and bending tests up to the demanding testing system for research jobs.

ToniPRAX

is a compact testing machine combination for standard tests in the laboratory for binders.

TONICOMP V

is the optimised cement testing machine with an integrated pneumatic unit for sample centering and safety cage movement.

ToniNORM

is a modular system which can be freely combined and which is suitable for the efficient and economic testing of the strength of building materials of any type. Load frames for the compressive and bending strength with a test load capacity

Transducer for measuring the bending deformation

Zwick / Roell

from 10 to 10,000 kN may, according to the test job in question, be combined to universal multipurpose testing systems. Thus, tests with extremely different test loads from the bending test on light mortar up to the compressive strength test on high-performance concrete can be carried out.

Compression testing systems *ToniTOP*

The tasks of materials testing institutes and research laboratories make particularly high demands on compression testing machines. This applies to the variability of the test area dimensions, the longitudinal and transverse rigidity of load frames, the accuracy and dynamics of the measurement and control system and the entire test software. Test frequencies of up to 3-5 Hz can be realized with the systems mentioned here.

The stress/strain behaviour after the maximum compressive strain (graph) is a decisive criterion for high performance concrete, steel fibre concrete etc. Such kind of

ToniPRAX with *ToniNORM* 3000 and specimen measuring device for cube tests

Single-purpose test machine *ToniPACT* III

Configuration	Special features	Max. force Compr.	Bending	Measur. and contr. system	Options
ToniPRAX[1] Serie 1.540	Efficient single-purpose test plant for satndard prisms and cubes	300 kN	10 kN	*ToniTrol testXpert*®	Measurement of Young´s modulus
ToniNORM Serie 2.020 + 2.060	Modular construction system for the versatile building mat. laboratory	200 kN up to 1,000 kN	10 kN up to 50 kN	*ToniTrol testXpert*®	Various tools, e. g. for the measurement of Young´s modulus and deflection
ToniCOMP V Serie 2.024	For the rational testing of large series	200 kN or 300 kN	10 kN	*ToniTrol testXpert*®	Sample centering device and waste disposal included in the standard configuration
ToniFLEX Serie 2.220	High-end multi-purpose system with flexible workind areas, especially for research and development	200 kN up to 1,000 kN	20 kN up to 100 kN	*ToniTROL testXpert*®	Flexible and individual additional options for hardware and software; also user-specific solutions

[1] For simple, construction site orientated testing, there are also manually controlled machines with analog display available (see Catalogue “GLOBAL TESTING“)

Zwick / Roell

tests can only be carried out if the load frame is extremely rigid, its drive system is controlled in dependence on the displacement or even on the deformation and if this control is reacting very quickly. Such tests are however not only carried out on standardized specimens, but also on larger components (e.g. complete wall elements). For this purpose, a vertically adjustable test area is required.

ToniFLEX and *ToniVERSAL*

These product lines include load frames for a maximum test load capacity of up to 600 kN which are equipped with an individually adjustable crosshead. They combine a high flexibility with an extensive universal range of application. In nowadays that test plants have been largely modernized as many have been delivered in the 80´s already with *ToniTRO*L and *testXpert*®.

Compression testing machine *ToniTOP*

Compression testing machines with compact frame
Major application field: Quality control

Series/type	*ToniPACT*		*ToniNORM*		*ToniNORM*	
• Form of construction	2091		2031		2041	
• Type[1)]	single		combi		combi	
• Max. load, kN	2,000	3,000	3,000	4,000	5,000	6,000
• Working ares width, mm	355	355	355/400	450	540	540
• Pressure plates dimensions, mm	Ø 300	Ø 300	Ø300	320 x 520	420 x 520	420 x 520
* optional, mm	320 x 520	320 x 520	320 x 520	380 x 520		
• Pressure plates distance, mm	340[2)]	340[2)]	340	340	340	
• Piston stroke, mm	65	65	65/200	100/200	100/200	
• Max. deformation, mm	1.0	1.0	1.0	0.8	0.85	1.0

[1)] Single: available as single compression testing machine only; Combi: can be combined with all other *ToniNORM* load frames and *ToniNORM Powerboxes* (up to three load frames to one Powerbox)
[2)] Adjustable with auxiliary plates

Zwick / Roell

ToniLAB

These are complete ergonomic laboratory units consisting of functional units with simple and complex laboratory workbenches. They are adapted to the individual requirements of the testing laboratory in question considering ergonomic and functional aspects.

Layout proposals are made on the customer's request in advance free of charge. Standard proposals are available at short term for a low-cost budgeting when planning new units or extensions and/or modernizations.

Compression load frame with adjustable crosshead

(variable height of working area)
Major application field: Multipurpose test tasks, research and development

Series/types	*ToniTOP*			
• Max. load, kN	3,000	4,000	5,000	6,000
• Working area width, mm	450	480	550	610
• Press. plates dimen., mm	320 x 520	420 x 520	420 x 520	420 x 520
* optional, mm	380 x 520	420 x 650	420 x 650	420 x 650
• Max. distance, mm	1,000	1,000	1,000	1,000
* optional, mm	2,000	2,000	2,000	2,000
• Piston stroke, mm	100	100	100	100
• Max. deformation[2], mm,	0.8	0.9	0.9	0.9
• Working pressure, bar	294	303	301	318

[1] Type 1146 with active , type 1160 with passive clamping of the crosshead
[2] For pressure plates distance 500 mm

Bending load frame with adjustable crosshead

Series/types	*ToniVERSAL* type 1229			
• Max. load, kN	25	100	250	400
• Working area width, mm	1,400	1,400	1,550	1,550
• Max. support distance, mm	1,200	1,200	1,250	1,250
* optional, mm	3,000	2,500	2,500	2,500
• Support/edge length, mm	1,250	1,250	1,050	1,050
• Vertical clerance, mm	150 bis 600	150 bis 600	200 bis 600	200 bis 800
• Piston stroke, mm	200	200	200	300

Laboratory *ToniLAB* for rational sample preparation

Zwick / Roell

Strong floors for the testing of large components

For components under a high static load, in particular reinforced supporting frameworks, large tubes, wall elements etc. the test on separately manufactured specimens is not sufficient. Full scale tests 1 : 1 on the finished component are necessary. This requires spacious test systems for usually very high test loads.

The variety of problems for the testing of the totally different components cannot be solved with standard test systems. Usually each component test system requires an individual task-specific project planning. Zwick/Roell has many years of experience and a sound knowledge of application and project planning particularly in this field of application.

For the component test systems both individual test systems and modular systems on the basis of Strong floors with test portals and individual test cylinders are offered.

Individual test systems only cover a limited range of specimens and test jobs. But considering the complexity of testing possibilities they have a favourable price/performance ratio.

For the testing of large components strong floors can be used almost unlimitedly. However, they are definitely a major investment.

Component test system 1000 kN for the testing of supporting frameworks, large tubes etc. with a four-column load frame on an extremely rigid foundation plate made of reinforced concrete.
Technical data:
- clear test area width 2,000 mm (1,000 kN dynamic)
- clearance test area height: 4,000 mm
- max. distance bending supports: 4,000 mm
- total deformation 2 mm (at the load frame center at max. load)

Comparison individual test systems/strong floors

Characteristic feature	Indiv.test system	Strong floor
• Variety of applications	limited	very universal
• Specimen dimensions	limited	very large
• Direction of force application	usually vertical	any
• Multiple point force application	limited	unlimited
• Dynamic testing	limited	unlimited
• Test preparation	simple	extensive
• Project planning costs	average	extremely high
• Investment costs	average	extremely high
• Costs per test	low	very high

Zwick / Roell

Materials Testing Machines

Field of application

Materials testing machines are predominantly used for the determination of the strength and deformation behaviour of specimens and components. For this purpose, tensile, compression, bending or shear tests and with special devices even torsion tests are carried out. Large test areas, test travels, speed and measuring ranges, exchangeable test tools and test data transducers enable tests to be carried out both on small specimens and on compact components, subassemblies and structures. Tailor-made to applications, materials testing machines enable the user to examine the characteristic feature profile of all kinds of materials and material combinations. The spectrum of application and the performance and efficiency of the testing machines are decisively determined by the flexibility of the test software.

Basic concept

The Zwick program includes universal testing machines as tabletop and floor standing designs with different measurement and control systems, load frames, drives and versatile function and supplemen-tary units.

However in order to be able to offer the best machine for each requirement, Zwick has developed a user-related concept. The user can choose among three machine versions, each of them being completely different as to equipment, performance features and also as to the capability of expansion:

- BasicLine
- Standard Line
- Allround Line

The decisive testing machine component is the measurement and control system. Its conception and its scope of performance decide which drive can be controlled, which measurement system can be connected to it and which functions can be controlled with it – and they thus determine the range of appli-cation and the testing machine's capability for future expansion.

The advantages to the user of the three different testing machine versions are as follows:

- The BasicLine is particularly suitable for functional tests on component parts and for the simple materials test.
- The Standard line is ideal to solve simple test jobs reliably. It is a low-cost, sturdy solution which covers many testing needs.
- The Allround line is the basis for a large spectrum of demanding test jobs and can easily be expanded with the requirements becoming more demanding. It is thus a solution that can be relied on for future requirements.

Measurement and control system BasicLine

The electronics taken from existing Zwick machine types guarantees a very high availability and reliability of the test system. The measurement and control electronics is compactly packed in a housing. BasicLine testing machines can be operated in the Stand Alone mode without a PC and they can be operated directly via function keys on the testing machine. As standard it is additionally possible to operate the BasicLine with the test software *testXpert*®, thus profiting from all the advantages of standardized test programs and from the many years of experience on the development sector.

Measurement and control system *testControl*

(for standard and allround version)

By using most recent technologies and by granting highest quality standards *testControl* offers a maximum of technical performance and a long-term investment guarantee. These are the particular features of *testControl*:

- Time-synchronous test data acquisition with high resolution and measuring frequency
- Real-time processing of the test data in a 500 Hz cycle for the monitoring and event-related test sequence control (e.g. speed change when reaching the yield or proof stress) and for safety limit values
- Adaptive control for exactly reproducible speeds and positions
- The measurement and control electronics and the power electronics for the drive system in question are integrated in a housing in a space-saving way. Thus, the usual cabling can be dispensed with.

Materials testing machine BasicLine Z020

Zwick / Roell

The measurement and control system *testControl* is available in 2 variants:

Stand Alone Variant

Easy and reliable operation via coloured display, 10-key keyboard and a few function keys – without PC. A printer may be connected directly for the printout of test results.

PC-Variant

The system may be configured and expanded to cope with the most different applications. PC and user software *testXpert*® make applications very comfortable and extremely flexible.

Load frames

Different load frame versions for test loads up to 2.000 kN are available as standard. For special applications special versions can be developed and manufactured, e.g. load frames in horizontal position suitable for the testing of long steel ropes.

Single-column load frame for table-top testing machines (zwicki)

These load frames are designed with very rigid aluminium high-precision extruded profiles. The working area is freely accessible from 3 sides. Thus, it is ideal for the various tests on small parts and for Zwick hardness testing machines. It only requires a small floor space. Due to its light weight, it is easy to transport.

Two-column load frames for table-top testing machines

The load frames of the BasicLine are designed with 2 round steel columns. The load frames of the Standard and Allround Line are designed with patented aluminium high-precision extruded profiles. They are light, very rigid and serve simultaneously as lead-screw guide and protection. T-shaped grooves on the outer sides allow a simple fitting of accessories as e.g. safety devices without being impeded by the crosshead.

All load frames with two profiles – except for the BasicLine – can be equipped with legs. Advantages are:

- Positioning of the working area to an optimum height for the user
- Comfortable seated operation with absolute freedom for leg movement (also suitable for wheelchair users)

Load frame as floor standing model

In load frames for test loads up to 150 kN patented aluminium high-precision extruded profiles and 2 or 4 hard-chrome plated round steel columns are used as supporting and guide column. For testing machines with a hybrid drive system the stationary piston rods are at the same time used as supporting and guide columns. All load frames with an electro-mechanical drive system may optionally be equipped with a second working area allowing e.g. a rapid change of the test mode without having to change the equipment.

Materials testing machine Z2.5 (zwicki) with *testControl* Stand Alone variant

Materials testing machine Z050 with legs *and testControl* PC variant

Materials testing machine Z100 with *testControl* PC variant

Zwick / Roell

Features of the BasicLine, Standard- and Allround Line

Machine component or funktion	BasicLine	Standard Line	Allround Line
Load frame			
• Type of set-up			
* Table-top machine (nominal force)	500 N to 20 kN	1 kN to 150 kN	1 kN to 150 kN
* Floor stand. machine (nominal force)	-	50 to 2,000 kN	50 kN to 2,000 kN
• Support and guiding columns			
* No. of columns	2	2 or 4	2 or 4
* No. of Aluminium profiles	1 (Z0.5)	1 or 2	1 or 2
• No. of working areas	1	1 or 2	1 or 2
• Expanded design (higher and/or larger)	-	✓	✓
Drive system			
• Elektro-mechanical			
* No. of ball screws	1 or 2	1 or 2	1 or 2
* DC-Motor	✓	only zwicki	only zwicki
* AC-Motor	-	up to 600 kN[1)]	up to 600 kN[1)]
• Servo hydraulic	-	from 400 kN[2)]	from 400 kN
• Hybrid	-	-	from 400 kN
Measurement and control system			
• BasicLine (also usable without PC)	✓	-	-
• *testControl* PC-variant (Standard)	-	✓	✓
testControl Stand Alone variant (Option)	-	optional	optional
Software			
• test software *testXpert*® (with PC)	optional	optional	optional
Transducer			
• Strain gauge load cell	1 (interchangeable)	1 (optional up to 2)	1 (optional up to 3)
• Digital crosshead monitor	integrated	integrated	integrated
• Digital extensometer	-	optional 1	yes (optional up to 3)
• Analogue extensometer	-	optional 1	yes (optional up to 3)
Connection of external systems			
• Digital extensometer	-	✓	✓
• Analogue extensometer	-	✓	✓
• Analogue reduction-in-width monitor	-	✓	✓
• Video Capturing	-	✓	✓
• Switch Contact	-	✓	✓
• Switch Control	-	✓	✓
• Further measurement systems	-	✓	✓
Control of external systems			
• Specimen grips(mot., pneum., hydr.)	-	-	✓
• Extensometer systems	-	semi-automatic	full-automatic
Supplementary units for special applications(optional)			
• Torsion drive	-	-	✓
• Torque transducer	-	-	✓
• Multi-channel force measuring system	-	-	✓
• High-temperature testing equipment	-	(✓)	✓
• Low-temperature testing equipment	-	(✓)	✓

[1)] Without zwicki
[2)] Only SP-matarials testing machine

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Drives

Electro-mechanical drive systems

The basis of all electro-mechanical drive systems are backlash-free and low-friction ball screws and digitally controlled drive systems. They are used with load frames for test loads of up to 600 kN. Together with the digital measurement and control system they have the following advantages:

- Extremely high, stepless speed range
- Very low speeds adjustable (from about 0.5 µm/min on)
- High-precision and exactly reproducible positions and speeds

The testing machines designed with single-column load frames (zwicki and BasicLine) are equipped with low-cost d.c. drives, all the others with particularly low-inertia, brushless three-phase drives.

Hydraulic drive systems

This drive unit is located centrally on the upper fixed crosshead. Thus, the test area lying beneath is easily accessible. A servo or proportional valve regulates the oil flow between the hydraulic unit and the differential cylinder. The oil cushion in the upper pressure area avoids the ”piston jump“ the rams are known for after the specimen break.
The resolution of the piston travel transducer is 1.25 µm (less than 1/400,000 of the max. test travel). The hydraulic drive unit is the most economic solution particularly for large test loads.

Hybrid drive systems

In this patented drive unit, the advantages of the electro-mechanical drive (high precision) are combined with those of the hydraulic drive (high force density). The result is that even cylinders with high forces and long travels can be driven and positioned with an utmost accuracy. According to this principle 2 parallel synchronous cylinders coupled with the moving crosshead can regardless of the load applied be displaced exactly synchronously by following precisely and practically instantaneously the preselected position of an electronic pilot drive unit. The special features of this drive are the following:

- Large test stroke (no adjustment of the fixed crosshead required).
- Comparatively low height of the load frame.

Materials testing machine Z400E

Materials testing machine Z1200H

Load frames and drive systems of the BasicLine

Series	Z0.5	Z005	Z010	Z020
• Type	table top	table top	table top	table top
• Max. load, kN	0.5	5	10	20
• Working area, max.				
* Height, mm	596	561/1,061	1,041	1,041
* Width, mm	no limit	420	420	420
* Depth, mm	99.5	no limit	no limit	no limit
• Max. crosshead speed, mm/min	1,500	500	1,000	500
• Crosshead travel resolution, µm	0.226	0.05	0.09	0.045
• Max. power consumption, kVA	0.4	0.6	0.6	0.6

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Load frames and drive systems of the Standard and Allround Line (with electro-mechanical drive system)

Series	Z1.0	Z2.5	Z005	Z010	Z020	Z030	Z050
• Type	table top	table top	table top	table top	table top	table top	table top
• Max. load, kN	1	2.5	5	10	20	30	50
• Working area							
* Height, short, mm	-	573	-	-	-	-	-
normal, mm	-	1,073	1,058	1,058	1,058	-	-
higher, mm	1,373	1,373	1,458	1,458	1,458	1,380	1,380
higher + larger, mm	-	-	-	1,787	1,787	-	-
* Width, normal, mm	no limit	unbegr.	440	440	440	440	440
larger, mm	-	-	-	640	640	-	-
* Depth, mm	99.5	99.5	no limit	no limit	no limit	no limit	no limit
• Crosshead speed							
* max., mm/min	1,800	800	3,000	2,000	1,000/2,000[1)]	1,000	600
• Crossh. trav. resolution, µm	0.0002	0.0001	0.041	0.027	0.014/0.054	0.027	0.016
• Max. power consum., kVA	0.4	0.4	2/1.9	1.9	2.1/2.6	2.3	2. 3

Series	Z050	Z100	Z100	Z150	Z250	Z400	Z600
• Type	floor stand.	table top	floor stand.	floor stand.	floor stand.	floor stand.	floor stand.
• Max. load, kN	50	100	100	150	250	400	600
• Working area							
* Height, short, mm	-	-	-	-	-	-	-
normal, mm	1,824	-	1,824	1,715	1,715	1,800	1,940
higher, mm	-	-	-	-	-	-	-
higher + larger, mm	1,765	1,360	1,765	1,660	1,660	-	-
* Width, normal, mm	630	640	630	630	630	630	740
larger, mm	1,030	-	1,030	1,030	1,030	-	-
* Depth, mm	no limit	no limit	no limit	no limit	no limit	no limit	no limit
• Crosshead speed							
* max., mm/min	400/2,000[1)]	200/1,500[1)]	200/1,000[1)]	900	600	250	200
• Crossh. trav. resolution, µm	0.027	0.026	0.0136	0.0123	0.0082	0.031	0.025
• Max. power consum., kVA	5	6	5	5.5	6	7/13[2)]	20/26[2)]

[1)] depending on the selected drive system and its power [2)] with hydraulic grips

Load frames and drive systems for high forces (standard types with hydraulic or hybrid drive)

Series	Z400H	Z600H	Z1200H	Z2000H	Z600Y	Z1200Y	Z2000Y
• Max. load, kN	400	600	1,200	2,000	600	1,200	2,000
• Dimensions of load frame							
* Heigth, mm	2,900	3,000	3,500	4,200	2,750	3,147	4,200
* Width, mm	1,020	1,080	1,300	1,400	1,530	1,614	1,870
* Depth, mm	480	500	880	905	788	790	1,100
• Working area							
* max. height, mm	500	500	600	600	1,895	2,300	2,400
* with adjustable crosshead, mm	900	900	1,000	1,000			
* Width, mm	670	670	850	870	790	860	950
* Max. travel , mm	500	500	600	600	850	1,000	1,000
• Travel resolution, µm	1.25	1.25	1.25	1.25	0.05	0.05	0.05
• Max. test speed, mm/min	200	200	200	200	250	250	250
• No. of columns	2	2	4	4	2	2	2
• Max. power consum., kVA	8.5	8.5	15	23	8.5	15	23

Zwick / Roell

Special Metals Testing Machine SP

This testing machine was specially designed for the testing of flat, round and profile specimens made of steel. In addition to tensile tests, it is also possible to carry out compression, bending and folding tests. It has a particularly rigid load frame with a hydraulic central drive on the upper optionally fixed or adjustable crosshead. It is equipped with hydraulically-operated wedge grips as standard. For the test load measurement, electrical load cells are used. The grip separation is measured contact free with a displacement transducer with a resolution of 0.5 µm. In spite of its size the SP machine does not need a special foundation. It is placed on rubber mats directly onto the concrete floor.

Special Metals Testing Machine SP

SP-testing machines with hydraulic drive system

Series	SP400.xx	SP600.xx	SP1000.xx	SP1200.xx	SP1500.xx	SP2000.xx
• Max. load, kN	400	600	1,000	1,200	1,500	2,000
• Working area						
* Height, mm (.00)[1)]	100-600	100-600	120-720	120-720	120-720	120-720
* Height, mm (.01)[2)]	0-800	0-800	0-900	0-1,000	0-1,000	0-1,000
* Width, mm	670	670	700	850	850	850
• Max. travel, mm	500	500	600	600	600	600
• Travel resolution, µm	5	5	5	5	5	5
• Max. test speed, mm/min	250	200	200	200	200	200
• No. of columns	2	2	4	4	4	4
• Max. power consumption, kVA	10	10	18	18	18	30

[1)] with fixed crosshead [2)] with adjustable croshead

Compression testing devices for SP testing machines

Series/type	X070220 -194	X070220 -210	X070220 -226	X070220 -240	X070220 -254	X070220 -268
• Max. load, kN	400	600	1,000	1,200	1,500	2,000
• Diameter, mm	230	230	300	300	300	300

Bending testing divices for SP testing machines

Exampel: support radius 25 mm, support separation 30 to 600 mm, support height 100 mm, flexure fin height 200 mm

Series/type	X070220 -196	X070220 -212	X070220 -228	X070220 -242	X070220 -256	X070220 -270
• Max. load, kN	400	600	1,000	1,200	1,500	2,000
• Bending stamp-Ø, mm[1)]	30,40,50	30,40,50	50	50	50	50

[1)] Separate order items

Zwick / Roell

Test software *testXpert*®

Range of application

testXpert® is the universal Zwick test software for materials, component, and functional testing. It's application range goes from Zwick materials testing machines (for tensile, compression, flexure and functional testing) to hardness testers, pendulum impact testers, extrusion plastometers, automated test systems, etc. right up to the refurbishment of testing machines of a variety of makes and models.

Duties and functions

The essential fields of use of *testXpert*® are:

- verification and re-equipping of the test machine
- preparation of the test or test series
- performance of the test
- evaluation and documentation
- data management
- quality management and
- data exchange between *testXpert*® and other applications (Word, Excel etc.)

testXpert® supports the user for all tasks with software wizards and editors, explanatory pictures and video sequences, situation-specific user tips, warnings, error messages and online help.

Future-oriented concept

The *testXpert*® test software uses the special properties of the object-oriented programming with respect to a clear grouping in tasks and functions. Structure and contents are determined by the Zwick application and software know-how. The *testXpert*® concept is therefore a guarantee for highest flexibility, functional safety as well as simple usability.

The essential characteristic features are:

- uniform basic software for all applications
- modular system for test programs
- user support through software tools

Modular system

The test programs are compiled by Zwick from a selection of several hundred software modules. The modules are sub-divided into classes such as test parameters, test sequence phases, screen views etc. They are continuously updated and expanded with respect to new states of knowledge and necessary supplements. This makes *testXpert*® an intelligent software, and thus enables the realization of test programs strictly to test standards and test programs related to practical applications. Thanks to the numerous possibilities of this system, *testXpert*® can be put to universal use for a wide applicational spectrum and for a variety of testing machines.

Test programs

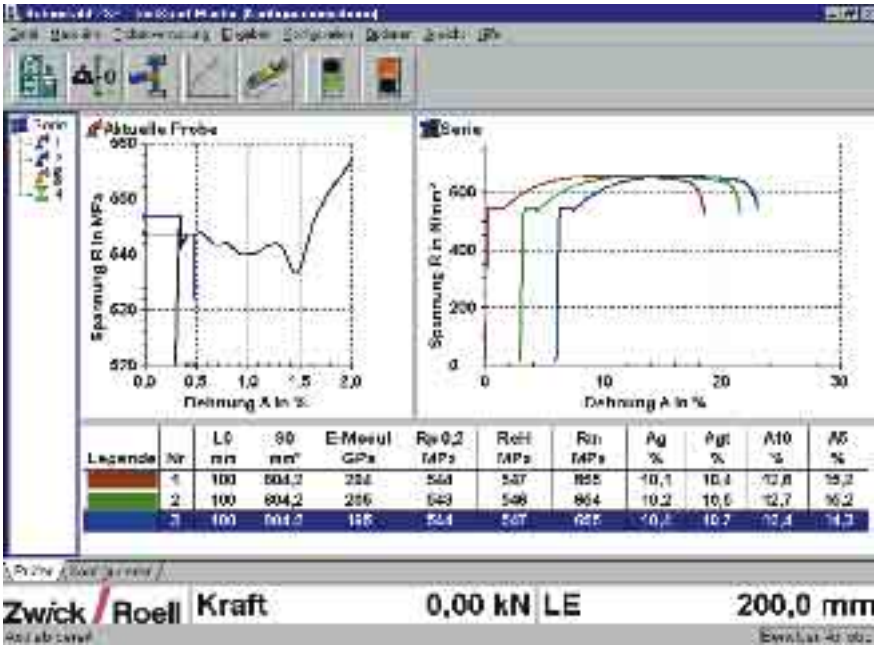
The test programs compiled by Zwick stipulate how tests are to be run. Their basis are selected software modules that are linked to one another and are pre-configured through fixed parameters depending upon the functions required. Thus the user receives from Zwick a "test template" in which only variable parameters must be entered.

There are three variants available for a wide range of requirements:

- Master test programs
- Standard test programs, and
- Customized test programs

International quality standards

To comply with international quality standards, each and every version



testXpert®-Screenshot: Tensile test on steel wire for the reinforcement of concrete with r- and n-value determination

must be transparent, documented and archived for 10 years. The *testXpert*® test software fully meets these requirements and even the particularly strict guidelines of the Good Manufacturing Practices (GMP).

The entire software development process and its components are diligently documented and archived from the source code through to the software tools used, for each and every version. This is valid for each phase from the analysis via the specification, design and implementation up to the test. Conformity to the standard ISO 9000-3 for development of *testXpert*® has been confirmed via audit report no. QM-F-96/1016.

Safety in detail

Windows software is normally used in offices. However, *testXpert*® takes over an additional and especially critical task: monitoring and controlling machines. Machine damage and potential danger to persons must be ruled out. That's why *testXpert*® doesn't use any overlapping windows in the test mode to avoid hiding important displays or key fields.

Automatic acceptance of system data

Different test jobs require different test machines with different and usually, interchangeable components. Their specific properties are characterised by the system data (nominal force, travel, speed range, mounting height, calibration factors, etc.). Organisational data also belong to the above, e.g. the series number or the date of the last calibration.

testXpert® accepts this data automatically directly following the program start

- for the necessary settings
- for the determination of safety limit values
- for the correct measurement signal evaluation

Furthermore *testXpert*® checks whether or not

- the test can be carried out with this configuration
- all settings have been made
- the data have changed for the current test

Simplest operation

Operation is reduced to a one-button operation, i.e. activating the start button, for standard applications. This is possible because *testXpert*® automatically records the test data, and dependent upon this, controls and monitors the test sequence and determines and documents the test results.

Preparation of a test series requires only two steps:

- call-up the test program foreseen for the required application
- input or selection of variable parameters

Optimum user information

All displays necessary for carrying out a test and a test series, can be grouped together in a clear and concise manner in one single screen setting.

- input fields for specimen-specific test parameters
- curve diagram (single or multiple curves)
- tables for test results
- tables for result statistics

Data saving for further use

Depending upon the preselection in the test program, not only all data but also selected result data from a test or test series can be saved. Saving of all data offers the possibility of tracing the origin of the result data up to configuration and settings for the test machine. The standardized measurement data, i.e. the data converted to its basic units can be repeatedly displayed in the simulation mode and can also be evaluated according to other criteria.

Video Capturing

The test software *testXpert*® not only supports the user by means of "Help" videos. It is also possible to carry out multimedia tests by using a video camera and a video-capture card with the video pictures being recorded time-synchronously with the test data.

- With the cursor keys, a "video reticle" can be moved over the test curve and the corresponding picture can be displayed
- The pictures can be captured at a preselected distance of the measuring points or in dependence on the event
- The video can also be played alone, irrespective of testing machine
- Distances between two points and angles between three points, radii, diameters and areas can be measured from the specimen in pictorial representation
- Optionally, the pictures can also be output with dimension lines and test data

Zwick / Roell

Force transducer
(load cells)

Strain gauge load cells are available for nominal load capacities from 5 N up to 2000 kN. Together with the digital measurement electronics they have the following advantages:

- Automatic recognition of all load cell settings, calibration parameters e.c..Therfore the change of load cells is very easy
- Automatic zero and sensitivity alignment
- Compensation of temperature fluctuations
- High measuring frequency
- High test data resolution
- Accuracy of 1% of the displayed value (1 % error limit) from 0.2 to 120 % of the nominal load (1 % to 100 % for load cells with nominal load £ 500 N) and 0.5% of the displayed value (0.5 % error limit) from 1 to 100 % of the nominal load
- Overload protection
- Manufacturer's test certificate to give proof of the works calibration

Load cells with one or two sided mounting studs and self-identifying sensor plugs are available for nominal load capacities from 10 N on.

Specimen grips for tensile tests

Zwick offers a large spectrum of specimen grips in different versions and test load levels to cover the large range of application of metal testing. The following grips are available:

- Wedge grips
- Wedge screw grips
- Pneumatic grips
- Hydraulic grips

Wedge grips

- Simple design, self-gripping
- Adaptable to different specimen dimensions by using different jaw faces
- For large forces with pneumatic actuation

Wedge screw grips

- Adjustable initial clamping force
- Large clamping range suitable for different specimen dimensions

Pneumatic and hydraulic grips

- Increased user comfort for high specimen throughputs
- For tensile, compression and alternating load and safe holding of the specimen also after specimen break
- Large clamping area without having to change the jaws
- Integrated system connection by means of a T-slot change system
- Force control when closing the grips and the jaws
- Optionally available with automatic clamping force adjustment and gentle closing force control

Force transducer with sensor plug

Wedge grips 8405 (50 kN)

Wedge screw grips 8506 (100 kN)

Zwick / Roell

Wedge grips for max. testing forces from 2,5 to 600 kN

Series/type	8201	8302	8303	8402	8403	8502	8509	8520
• Max. testing force, kN	2.5	10	10	50	50	100	250	600
• Max. spec. thickn., mm	10	20	4,5	18	10	6 - 30	16 - 48	16 -48
• Max. spec. diam., mm	-	12-20	-	10 - 18	-	10 - 30	16 - 52	18 - 62
• Max. Clamping surface								
*Width, mm	32	60	30	60	30	60	80	100
*Height, mm	40	50	45	40	77	48	85	100
• Operation (open./clos.)	manual	manual	manual	manual	manual	manual	man./pneum.	pneum.
• Construction height, mm	145	165/175	110	165	196	210	320	400
• Individual weight, kg	1.9	6.5	3	13.5	5	27	70/100	300

Wedge screw grips for testing forces from 0,5 to 250 kN

Series/type	8106	8206	8306	8406	8406	8506	8506	8507
• Max. testing force, kN	0.5	2.5	10	30	50	100	150	250
• Max. spec. thickn., mm	5	10	30	30	30	30	30	64
• Max. spec. diam., mm	30	30	30	30	30	30	30	80
• Max. Clamping surface								
* Width, mm	15	30	60	60	60	60	60	80
* Height, mm	30	60	60/80	60/80	80	80	80	100/120
• Operation (opening/closing)	manual	manual	manual	manual	manual/ motorized	manual/ motorized	manual/ motorized	manual/ motorized
• Construction height, mm	64	110	125	137	146/147	176/177	176/177	252
• Individual weight, kg	0.2	3	15	16	37/50	44/50	42/46	112

Pneumatic grips for testing forces from 1 to 30 kN
(single side closing)

Series/type	8197	8297	8397	8497	8388[1)]
• Max. testing force, kN	1	2,5	5/10	30	5
• Clamp. force at 6 bar, kN	1,7	3,6	9/18	35	5/13
• Max. opening, mm	20	20	24	24	5
• Max. camping surface					
* Width, mm	60	60	60	60	60
* Height, mm	30/50	30/50	50	50	80
• Construction height, mm	95	95	162	175	182
• Individual weight, kg	1.7	2.4	8.2/10	15	6.6/7.5

[1)] with load reduction curve

Pneumatic grips for testing forces from 10 to 100 kN
(double side closing)

Series/type	8397	8497.03	8497.50	8597
• Max. testing force, kN	10	20	50	100
• Clamp. force at 6 bar, kN	27	27	60	120
• Max. opening, mm	25	25	50	30
• Max. camping surface				
* Width, mm	60	60	110	74
* Height, mm	50	50	110	74
• Construction height, mm	208	225	306	341
• Individual weight, kg	14	14	15/53	53

Pneumatic grips 8597 (100 kN)

Zwick / Roell

Hydraulic grips for testing forces from 50 to 2,000 kN

Series/type	8801	8494	8802	8592	8803	8594
• Max. testing force, kN	50	50	100	100	250	250
• Max. clamping force, kN	100	100	255	250	410	410
• Max. hydr. pressure, bar	300	300	300	300	300	480
• Max. spec. thickn., mm	40/59	59	59	59	59	59
• Max. soec. diam., mm	Ø15	Ø15	15/59	15/59	15/59	15/59
• Clamp. surface, width, mm	80/Ø50	Ø50	Ø74	Ø74	Ø74	Ø74
height, mm	70		-	-	-	-
• Type of clamping	single-sided	double-sided	single-sided	double-sided	single-sided	double-sided
• Construction height, mm	205	205	303	303	303	303
• Indiv.idual weight, kg	37	37	70	70	70	70

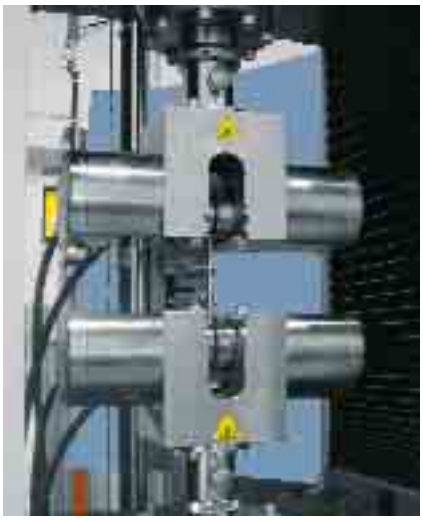
Series/type	8595.03	8595.02	8597.01	8597.02	8598.00	8599.00
• Max. testing force, kN	400	400	600	600	1,200	2,000
• Max. clamping force, kN	590	590	950	950	1,500	3,000
• Max. hydr. pressure, bar	480	480	480	480	480	480
• Max. spec. thickn., mm	80	80	100	100	60	100
• Max. spec. diam., mm	65	65	100	100	60	100
• Clamp. surface, width, mm	65	65	60	60	Ø150	Ø220
height, mm	40	40	80	80	-	-
• Min. gauge length, mm	170	170	220	220	350	500
• Type of clamping	single-sided	double-sided	single-sided	single-sided	double-sided	double-sided
• Construction height, mm	260	260	270	270	470	303
• Indiv.idual weight, kg	130	150	300	330	680	900

Hydraulic grips with dual clamping system

These specimen grips have been developed particularly for the tensile test on high-strength prestressing strands and concrete steel. The tensile force is transmitted from the specimen onto the specimen grips over 2 clamping systems arranged in tandem. So the clamping force is distributed over a longer specimen section and the tensile force is reduced in the specimen grips in two steps. The frequent specimen breaks within the gripping range can thus be avoided.

Another advantage: The retrofitting of the specimen grips from concrete steel to prestressing strands or vice versa becomes easier and can be realized within a short time.

Hydraulic grips with dual clamping system (for strands e.c.)



Hydraulic grips 8594 (250 kN)

Zwick / Roell

Test tools for compression and bend tests

For the performance of compression and bend tests a multitude of test tools of different versions and dimensions as well as for different test load ranges are available.

The bending supports and dies for the different bending and folding tests are usually exchangeable. The adjustability of the support distance and the free height of the bending supports and dies allow 90° bend tests and bending-folding tests with angles of up to 180°.

Deformation transducers

Extensometers

For the extension measurement, measurement systems with different gauge lengths, test travels and resolutions are available:

- Extensometers with contact measurement for the manual attachment to the specimen
- Extensometers with contact measurement for the manual or automatic attachment of the feelers to the specimen
- Extensometers with non-contact, optical measurement with specimen marks attached on the specimen

The manually attachable, incremental measurement systems can already be used with the testing machines of the standard line.

Motor-driven measurement systems are controlled automatically or by means of a manual control unit. The macro extensometer is particularly suitable for the determination of the proof stress as well as for the uniform elongation and for the strain at break. For the determination of the Young's modulus of elasticity a small test travel and a high resolution should be selected. The long-stroke and the non-contact extensometers, due to their low resolution, are only used for larger gauge lengths.

Reduction in width monitor

For the measurement of the change in width, particularly for the determination of the vertical anisotropy r (r-value) an extension module for the macro extensometer is used. With this module the change in width is measured with a high precision in 2 or 4 resp. in 1 or 4 cross-section levels.

Bending testing device with sliding system

Analogue extensometer
(for manual operating)

Series/type	TC-EXACLEL .001	TC-EXACLEL .002/.003/.004	TC-EXACLEL .005
• Gauge length, mm	25/50	20/10	20/10
• Spec. thickn./diam., mm	28	25	40
• Measurem. travel, mm	25	+2/-1	± 2
• Travel transducer	inductiv	strain gauge	strain gauge

Zwick / Roell

Incremental extensometers

Series/type	TC-EXMACRO	TC-EXLONGS
• Describtion	Macro	Long stroke
• Gauge length, mm	10 to 100/205	10 to 1,000
• Gauge length adjustment	manual or automatic	manual
• Method of attachment	manual or automatic	automatic
• Measurem. travel, mm	80/120/160/75/112,5/150	1,000 – L_0
• Resolution, µm	0.12/0.18/0.24/0.3/0.45/0.6	5

Incremental reduction in width monitor

Series/type	TC-EXMACWD	TC-EXMACWD
• Application with	Macro and long stroke	Macro and long stroke
• Specimen width, mm	10 to 15/20 to 25 (2 steps)	10 to 25 (1 step)
• No. of measurem. levels	2/4	1/4
• Gauge length adjustment	manual	manual
• Method of attachment	manual or automatic	manual or automatic
• Measurem. travel, mm	5	>6
• Resolution, µm	0.02/0.1	0.02/0.1

Macro with reduction in width monitor

Incremental clip-on extensometer
(for manual operation)

Series/type	TC-EXICLEL.001	TC-EXICLEL.002
• Description	Incremental clip-on extensometer	Incremental clip-on extensometer
• Gauge length, mm	20/25/30 (optional 50/80)	50/55/65/70 (optional 80/85/100/105)
• Spec. thickn./diam., mm	20x30 or Ø 20	20x30 or Ø 20
• Measurem. travel, mm	+13.5/-0.2	+40/-0.2
• Resolution, µm	0,1	0,1

Series/type	TC-EXICLWD .001	TC-EXICLBI .001	TC-EXACLWD .001
• Description	Incremental reduction in width monitor	Biaxial incremental clip-on extens.	Strain gauge reduction in width monitor
• Spec. thickness, mm	10 to 20	10 to 20	10/12.5/20/25
• No. of measurem. levels	1	1	2
• Measurem. travel, mm	1.5 to 11.5	1.5 to 11.5	4
• Resolution, µm	0.1	0.1	0.04

Incremental clip-on extensometer

Non-contacting extensometers

Series/type	TC-EXOPTIC	TC-EXLASER	TC-EXVIDEO
• Description	Optical extensometer	Laser-extensometer	Video extensometer
• Gauge length (L_0), mm	10 to 900	10 to 500	5 to 1,000
• Measurem. travel, mm	900 minus L_0	max. 1,000 % to L_0 = 20 mm dep. on resolution	50/100/200/500/1,000,
• Resolution, µm	5	12	0,5/1/2/5/10
• Travel transducer	Incremental	Laserscanner	Video, analogue

Zwick / Roell

ZMART – Zwick Modernization and Retrofit Technology

Modernization package

With the modernization package *ZMART.PRO*® both electro-mechanical and hydraulic materials testing machines of different manufacturers can be upgraded and brought to the most recent state-of-the-art. After a modernization the guaranteed spare parts supply for modernized components, the entire accessory program including extensometers or specimen grips and in particular also the most recent version of the test software *testXpert*® are available.

The decision between the purchase of a new machine and a modernization primarily depends on the value and technical condition of the machine components to be taken over. Due to the fact that in addition to the load frame other components can also be used furthermore, as e.g.: load cell and extensometer, the costs for a modernization remain relatively low compared to the costs incurred in the purchase of a new machine.

The modernization packages are composed of the following components:

- Digital measurement and control electronics
- Test software *testXpert*®
- Maintenance-free AC-drives
- Proportional valves or servo valves and hydraulic units for hydraulic testing machines

Special features or services	*ZMART.PRO*®				
	testControl		Allround (DUPS)		
	M[1)]	H[2)]	M[1)]	H[2)]	I[3)]
Connection to					
• Electro-mechanical testing machines	✓	-	✓	-	-
• Quasi-static hydraulic testing machines	-	✓	-	✓	✓
• Can also be used without Personal Computer (PC)	✓	✓	-	-	-
• Up to 3 hydraulic testing machines	-	-	-	✓	-
Test data acquisition and display					
• Test force and crosshead or piston travel resp.	✓	✓	✓	✓	✓
Connection of:					
• Analog extensometers (inductive)	✓	✓	✓	✓	✓
• Analog extensometers (strain gauge system)	✓	✓	✓	✓	✓
• Incremental extensometers	✓	✓	✓	✓	✓
• several load cells (changeover via *testXpert*®)	✓	✓	✓	✓	✓
Test data storage and processing					
• Display of maximum force and travel when reaching the test end criterion (without PC)	✓	✓	-	-	-
• Optional display of test force or stress, travel and/or deformation or strain (only with PC)	✓	✓	✓	✓	✓
• Output of XY-curves with the coordinates force/stress, travel and/or deformation/strain or test time (only with PC)	✓	✓	✓	✓	✓
• Automatic determination and documentation of materials characteristic data and statistical data (only with PC)	✓	✓	✓	✓	✓
Test sequence and test speed control					
• Automatic recognition of the test end (specimen break, force-travel or time limit value or number of test cycles reached)	✓	✓	✓	✓	-
• Automatic stop at test end or return to start position	✓	✓	✓	✓	-
• Automatic speed changes according to the test program (only with PC)	✓	✓	✓	✓	-
• Test speed control in dependence on the measured force or deformation („closed-loop"-control), only with PC and optional program)	✓	✓	✓	✓	-
Monitoring of safety limit values					
• Test force	✓	✓	✓	✓	-
• Crosshead- resp. piston travel	✓	✓	✓	✓	-

[1)] For electro-mechanical testing machines [2)] For hydraulic testing machines, [3)] Only data aquisition and display

Zwick / Roell

Services

Customer satisfaction is given top priority at Zwick/Roell. Therefore, nearly one third of the employees are active in the service field. Extensive services guarantee the best use possible and a high availability of the supplied testing machines and systems.

Advice and support

Our technically competent and experienced service personnel support the user directly at site or by phone, fax or e-mail. Detailed information may also be looked up in the internet or may be downloaded in case of need.

Maintenance and repair

A service contract with individually agreed service intervals for a careful and thorough maintenance and calibration guarantees the correct and trouble-free operation of the supplied testing machines and systems. Whereby it is not important which manufacturer supplied the testing machine. In case of a malfunction, a service-engineer or – technician is quickly available at site. Modern auxiliary means such as a telediagnostic service via modem allow a quick and exact fault localization at an early stage. Different reaction models guarantee the availability of a technician within the shortest period of time possible.

Calibration service according to ISO 9000

The Zwick/Roell maintenance and calibration service is accredited as DKD[1]-, UKAS[2] or COFRAC[3] calibration laboratory resp. Thus, it is authorized to check the testing machines and systems at the place of installation and to issue DKD or UKAS calibration certificates for the measured quantities force, extension, energy and hardness. These calibration certificates are not only recognized within the European Union, but also in almost every country of the world.

Particular advantage:
The technicians of the calibration service can, on the occasion of their service visit, not only service, adjust and calibrate the Zwick/Roell testing machines and systems, but also the machines and systems of other manufactures. This saves time and costs.

The regular maintenance and calibration of the testing machines is also a prerequisite for a quality management system according to QS-9000 and VDA 6.1.

Hotline – Quick assistance in case of malfunctions

For Zwick/Roell, the perfect functioning of the testing machine is very important. Should, in spite of the high quality standard, any malfunctions occur on the machine or within the software, then competent specialists are available on the free hotline.

Creation and adaptation of test programs

With the test software of the Zwick/Roell Group already many different test programs can be acquired. The test requirements are however not always standardized. Experts will adapt your existing test programs individually or will create a new test program which is tailor-made to comply with your requirements.

Seminars

Studies have shown that more than half of the problems with technical systems are not caused by the technology itself, but rather by the user. A good training of the users helps to avoid troubles and, as a result, to reduce the costs.

The Zwick/Roell seminars inform about theory and practice of the materials and component part testing, the evaluation and the valuation of the test data, test results and the operation and maintenance of the testing devices. These seminars either take place directly at the user's place or at the locations of Zwick/Roell companies or representations.

Support line – Assistance for operation and application

Alternatively to the visit of a seminar or to the service visit of a technician at site, you can talk to our experts on the support line – against charge – whenever you have any questions. They will assist you with the adaptation of the test software, with the creation of test programs, when having questions regarding the operation of the software or the machine and they will give you an application-specific support.

Spare parts

Standard components are mostly available on stock and will be sent to you by courier service on the day of order. Special components, not being carried on stock, will be manufactured "just in time" by means of the latest production technology.

[1]) DKD: Deutscher Kalibrier-Dienst (German Calibration Service)
[2]) UKAS: United Kingdom Accreditation Service
[3]) COFRAC: Comité Francais d´Accreditation

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