Zwick / Roell

Testing systems

Testing of plastics and rubber









FP 269 2.0408

Intelligent Testing

Zwick / Roell

This catalogue provides an overview of testing instruments, machines, and systems of the Zwick Roell AG for use in the plastics and rubber industry and in the corresponding research and test institutes and training centers.

This is only a part of the extensive overall program of the Zwick Roell AG.

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Picture sources, front page: BASF AG, Bayer AG, Continental AG, Solvay SA, Recaro GmbH & Co. KG, BIG-Spielwarenfabrik

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The Zwick Roell AG – more than a century of experience in materials testing

Mechanical-technological testing is one of the oldest disciplines 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 elastic behaviour of materials. In the course of time further knowledge was obtained. In the middle of the 18th century the first testing machines finally appeared in France.

Since 1920 the company Roell & Korthaus was involved in the materials testing business. In 1937 Zwick built its first testing machines and systems for mechanical testing of materials, and many years prior to that in 1876, a Professor Seger had founded a chemical laboratory as part of a scientific technological consulting company for non-metallic materials. During the 20th century the present company, Toni Technik, has evolved from these origins and is now considered a leading expert in test systems for building materials. MFL (Mohr & Federhaff) – a company that was founded in 1870 – became part of the Zwick Roell group and interestingly, Carl Benz (of Mercedes Benz fame) was one of their employees.

Since 1992, these companies have formed the Zwick Roell group, and in July 2001, the company group was converted into a stock corporation: the Zwick Roell AG. Part of this stock corporation are the companies Zwick, Toni Technik, Indentec Ltd., and since may 2002 Acmel Labo. These companies supply an extensive program for materials, component, and functional tests – from the manually operated hardness tester up to complex robotic test systems for the twenty-four-seven production control.

By acquisition of the German company GTM (2007) and the Austrian company Messphysik (2006) the know-how of the Zwick Roell AG in the field of force and elongation measurement has been safed and enriched.

Zwick has many years of experience, combined with a multitude of supplied systems, and this experience is continuously supplemented by constant communication with customers. On this solid base the company supplies a wide range of high-performance products – from the economical standard quality control machine up to customised solutions designs for specific test requirements. 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.

The services of the Zwick Roell AG go far beyond the supply of products. In 1994 the company received its certification ISO 9001 accredited helping to guarantee a consistently high product and service quality. With its accredited calibration laboratories, the companies of the Zwick Roell AG are able to verify and calibrate test systems and to issue internationally recognized certificates.

The headquarter of the Zwick Roell AG and the Zwick GmbH & Co. KG at Ulm, Germany

Zwick / Roell

Plastics and rubbers- development, structure and properties

Plastics

In 1861, the first polymeric plastic was patented for Alexander Parkes under the name Parkesine. It was a kind of celluloid then patented by Hyatt in 1870, and in 1908, Bakeland and Lebach made the chemistry of phenolic resins more transparent. Bakeland then discovered Bakelite, the first plastic to be broadly used, whilst Hermann Staudinger described the structure of polymeric materials as macromolecules and thus discovered the basis of macromolecular chemistry. Ziegler and Natta worked on the polymerization of ethylene. On this basis, Montedison produced polypropylene in 1957 for the first time.

Today, the most important raw material is petroleum which – decomposed in its elements – supplies the basic material of plastics. These molecules are linked to large chains: the polymers. When talking about plastics one can imagine a mass of molecule chains. Depending on how these chains are linked to each other, different groups of plastic will result:

Thermoplastics

The molecule chains are linear and branched. Very often a large portion of spaghetti is taken as example. At ambient temperature, thermoplastics are often hard or even brittle. When heated, the material softens or is given plasticity because the molecule chains slide past each other more easily. Thermoplastics are the largest group of plastics. The four most important thermoplastics are PE, PP, PVC and PS.

Thermosetting plastics
(thermohardening plastics)

The molecule chains of thermosetting plastics are linked more closely. The cross-links are thermally not soluble, so thermosetting plastics do not melt. The classical thermosetting plastic material is Bakelite, found in early telephones and of many other commodities. Modern materials are unsaturated polyester, linked polyurethanes and epoxy resins.

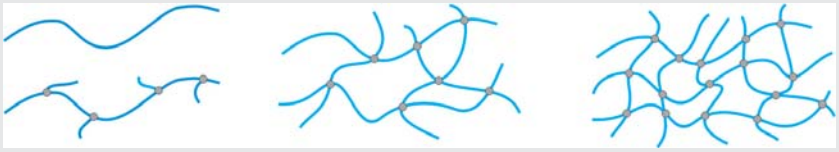
Elastomers

Elastomers are polymers which are built up of macromolecules and which are three-dimensionally cross-linked. The elastic rubberlike properties of these materials are the result of the cross-link of single polymer chains (vulcanization). In modern usage, elastomers are therefore also called rubber.

Testing of plastics

CAMPUS® (Computer Aided Material Preselection by Uniform Standards) supplies tested values for mechanical, thermal, electrical and process-specific properties of almost every type of plastics. The list of rheological, mechanical, thermal, electrical and other properties to be tested are standardized in ISO 10350 (single point data). Many material properties required as construction data are standardized in ISO 11403 (multipoint data). ISO 17282 provides details for design data.

See: www.campusplastics.com

Thermoplastic materials	Elastomers	Thermosetting materials
Structure of the molecule chains		
Simple chains or shrub-type ramifications	Wide-range cross-linked	Closely cross-linked in all directions
		
Properties		
• Quite soft • Deformable under temperature • Deformation process is repeatable	• Molecular structure similiar to a fishing net • swellable • rubber-like elasticity	• Hard and brittle • Temperature-resistant • Non-deformable • Non-meltable
Types of plastics		
Polyethylene (PE) Polystyrene (PS) Polyamide (PA) Polyester	Rubber Silicone Polyurethane	Epoxy resins Polyester resins Phenolic resins Polyurethane

Structure of plastics

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Rubbers

When the Spanish conquerors came to Mexico and South America in the beginning of the 16th century, they saw Indians playing with a strange bouncing ball. The Indians called the material of the ball « Ca hu chu » (crying tree). Today we call this Latex-tree Hervea brasiliensis.

More than 200 years later, rubber was used in Europe as well. In 1770, the English minister Priestley was credited with the discovery of the use of rubber as an eraser.

Finally, in the 19th century, people discovered the precious properties of rubber: its waterproofing and elasticity. Rubber mixed with turpentine oil was used to manufacture bags, hot-water bags and life buoys. In 1824 the first braces and suspenders were manufactured. The rain coats that were available at that time were hard as stone in winter and sticky in the summer.

In 1844, Charles Goodyear patented his revolutionary discovery. For many years he had been experimenting with rubber, and one day, some rubber mixed with sulfur dropped onto a hot stove. During carbonization, the grey, raw rubber turned into a smooth and solid material with good properties. Goodyear had discovered the vulcanization process.
At that time, the demand for rubber was exclusively covered by supplies from the Brazilian rain forest. Brazil held the monopoly and suspiciously watched that no seeds of the tree were taken to other countries. In 1876, the English adventurer Sir Wickham smuggled rubber seeds to London, and the resultant seedlings were sent to India where they could be planted on English plantations. In 1880, Asian rubber was sold on the world market for the first time. Today, the world economy gets 3.5 million tons a year from the plantations all over the world.

Synthetic rubber

As early as 1826 Michael Faraday discovered the chemical structure of rubber, and in 1909, the German chemist Fritz Hofmann was the first to patent the production process of synthetic rubber. After World War I, the patent was expropriated and the production was discontinued.
In 1930, America began large-scale manufacture of synthetic rubber and – since they had lost their plantations due to Japan's entry into war – they built up huge production capacities of 840,000 t by 1945.

The rubber industry strongly depends on the availability of petroleum, and as a result about 70 % of the world requirements are manufactured synthetically.

There are about 20 different types of synthetic rubber, many of them with special properties. Just as natural rubber, they consist of long molecule chains creating a convoluted network. For vulcanization, the chains are provided with cross-links. Classical example is the sulfur vulcanization of natural rubber. The number of cross-links determines the properties of rubber: soft rubber with a few links, hard rubber with many links.

Overview of rubber

Short sign	Designation	Application examples
NR	Natural Rubber	Medical gloves, latex, blending component for synthetic rubber
SBR	Styrene Butadiene Rubber (originally "Buna – S")	All-purpose rubber, tire industry
CR	Polychloropren Rubber	Contact adhesives, conveyor belts, sealings, hoses
IIR	Isobutene-Isoprene (Butyl) Rubber	Sealings, membranes, cable insulations
EPDM	Ethylene-Propylene-Diene Monomer	Roof and pond foils, sealings in automotive industry
NBR	Nitrile Butadiene Rubber	Oil and fuel resistant sealings, membranes, hoses
SI/MQ/ PMQ/ VMQ	Silicone Rubber	Sealings for freezers, stoves, window and cabin sealings of airplanes.
FPM	Fluorocarbon Rubber	Sealings, moulded parts, hoses with a high temperature and chemical resistance, belts
PUR	Polyurethane	Foams

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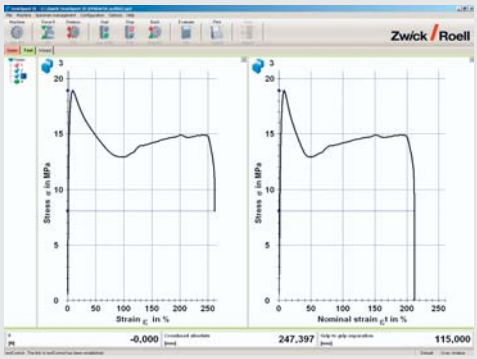
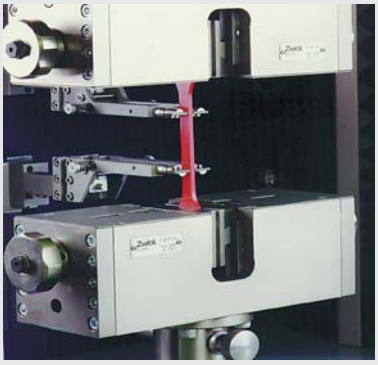
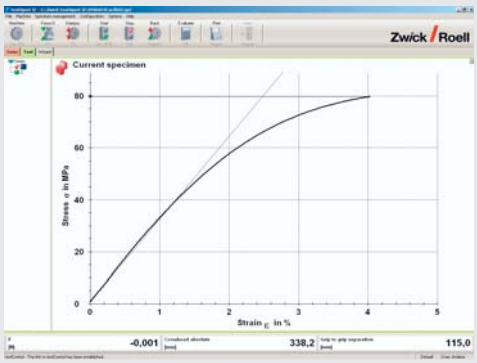
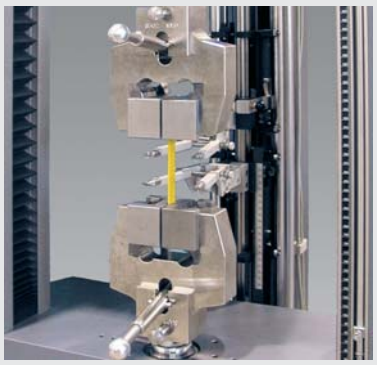
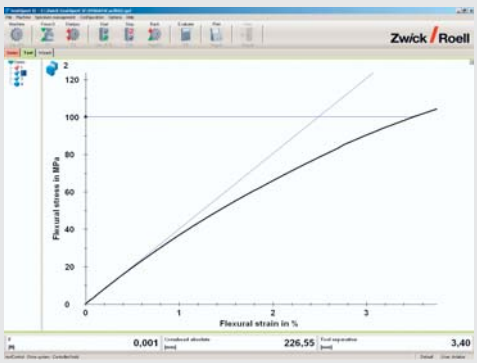
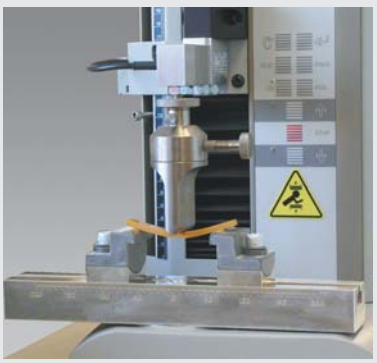
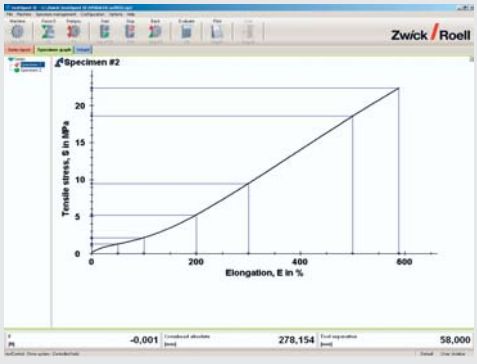
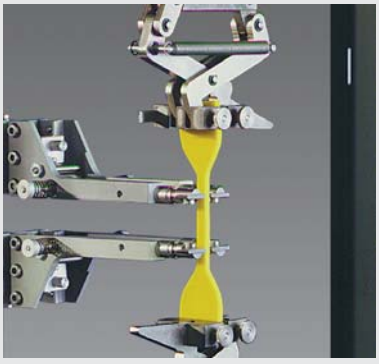
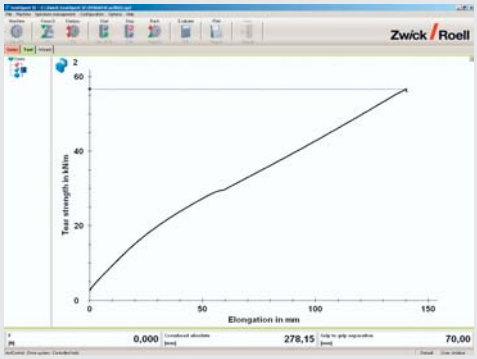
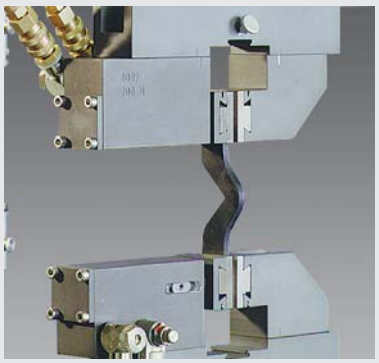
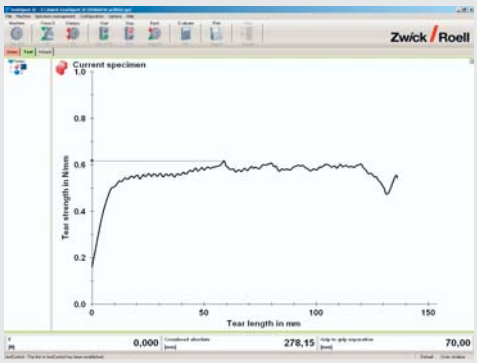
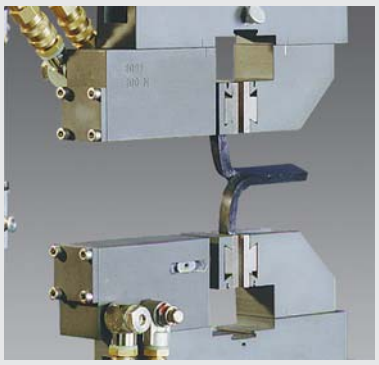
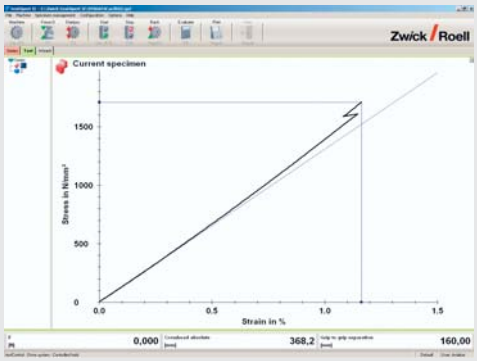
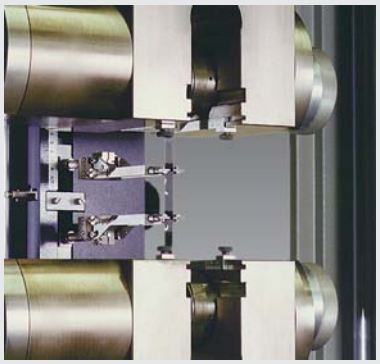
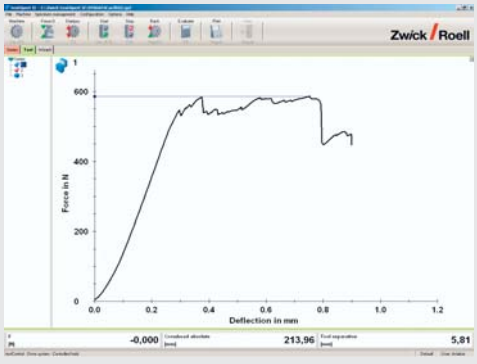
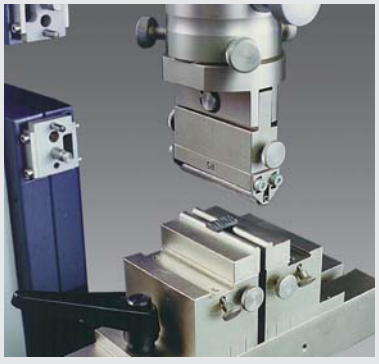
Application	test-curve in *testXpert*® II	Example of mounting
Thermoplastic and thermosetting materials Standard: ISO 527-2 Type: tensile Material: semi-rigid plastic Grips: wedge-screw Extensometer: multiXtens Test speed: 1 mm/min, 50 mm/min		
Standard: ISO 527-2 Type: tensile Material: rigid plastic Grips: wedge Extensometer: Macro Test speed: 1 mm/min, 50 mm/min		
Standard: ISO 178 Type: flexural (3-point) Material: rigid plastic Grips: flexural tool Extensometer: crosshead monitor Test speed: 2 mm/min, 50 mm/min		
Rubbers and elastomers Standard: ISO 37 Type: tensile Material: PIB dumbbell Grips: pincer Extensometer: mechanical long travel Test speed: 500 mm/min		

Application	test-curve in *testXpert*® II	Example of mounting
Rubbers and elastomers Standard: ISO 34-1 Type: tear test Material: SBR Specimen: angle Grips: pneumatic Extensometer: crosshead monitor Test speed: 500 mm/min		
Standard: ISO 34-1 Type: tear test Material: SBR Specimen: trouser Grips: pneumatic Extensometer: crosshead monitor Test speed: 500 mm/min		
Fibre reinforced composites Standard: ISO 527-4 Type: tensile Material: CRP Specimen: type 3 Grips: hydraulic Extensometer: Macro Test speed: 2 mm/min		
Standard: ISO 14130 Type: interlaminar shear Material: CRP Grips: flexural device Extensometer: crosshead monitor Test speed: 1 mm/min		

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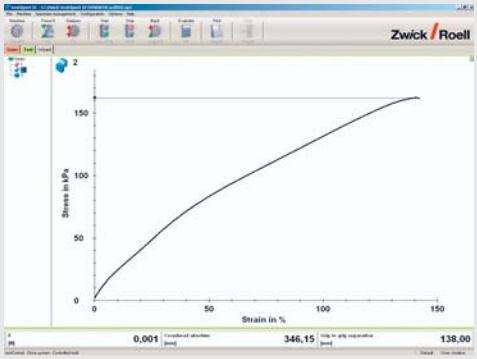
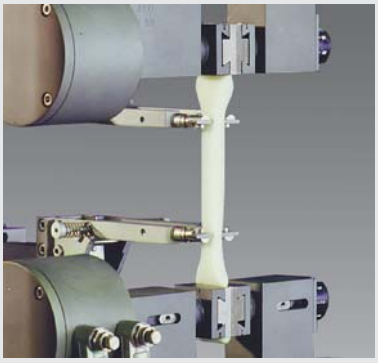
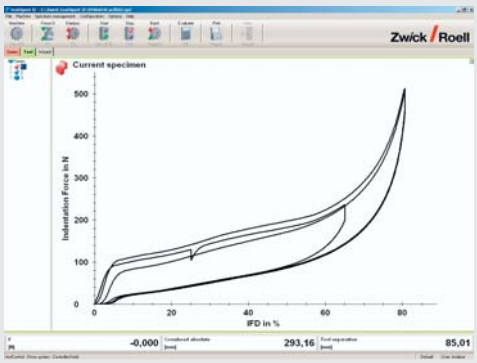
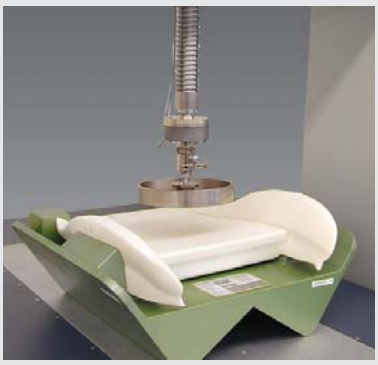
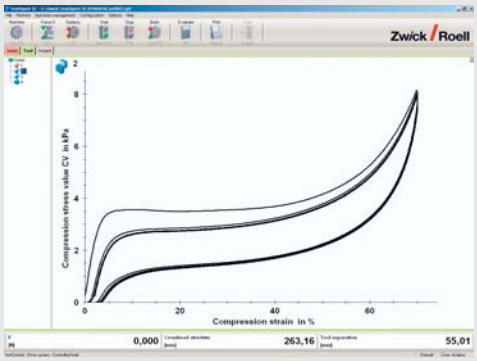
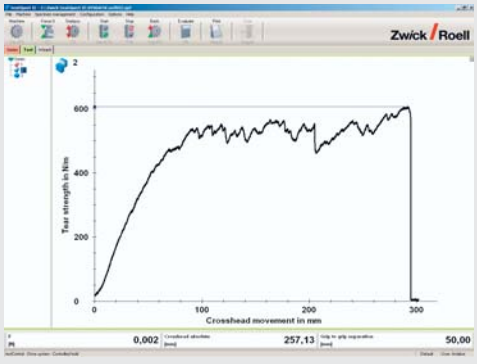
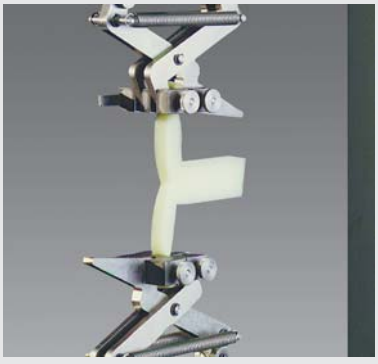
Application	test-curve in *testXpert*® II	Example of mounting
Flexible cellular plastics Standard: ISO 1798 Type: tensile Material: PUR Grips: pneumatic Extensometer: mechanical long travel Test speed: 500 mm/min		
Standard: ASTM D 3574 - B1 Type: indentation hardness Material: PUR Grips: indentor Extensometer: crosshead monitor Test speed: 48 mm/min		
Standard: ISO 3386 Type: compression properties Material: PUR Grips: compression plates Extensometer: crosshead monitor Test speed: 50 mm/min		
Standard: ISO 8067 Type: tear test Material: PUR Specimen: trouser Grips: pincer Extensometer: crosshead monitor Test speed: 50 mm/min		

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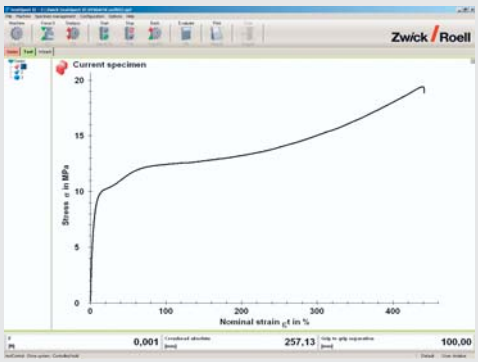
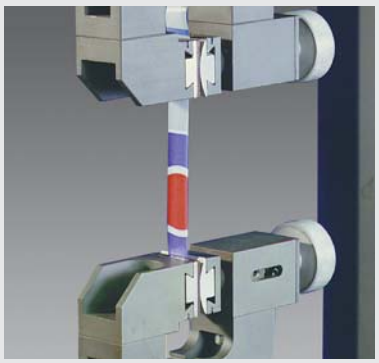
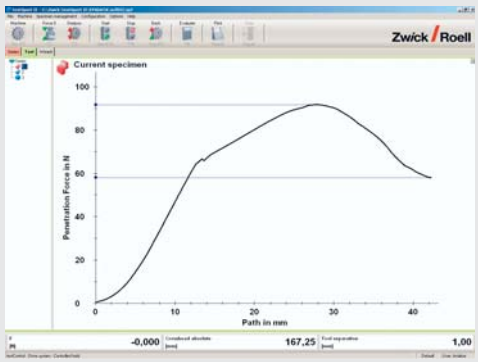
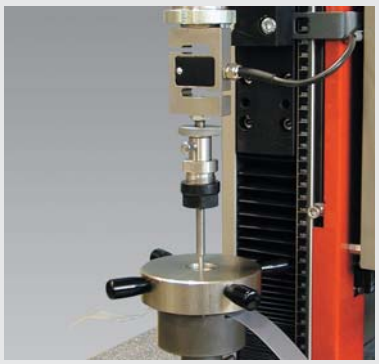
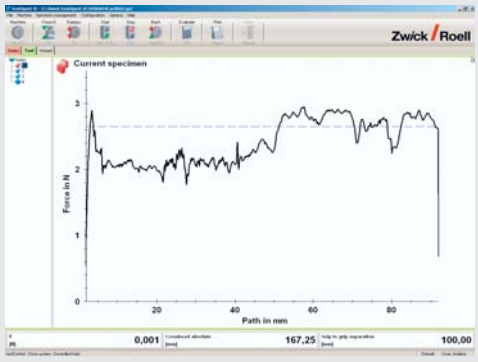
Application	test-curve in *testXpert*® II	Example of mounting
Thin sheeting and plastic film Standard: ISO 527-3 Type: tensile Material: PVC film Specimen: strip, 10mm large Grips: screw Extensometer: crosshead monitor Test speed: 100 mm/min		
Standard: EN 14477 Type: puncture test Material: PE film Grips: test device Extensometer: crosshead monitor Test speed: 100 mm/min		
Adhesives and sealings Standard: ISO 4578 Type: 90° peel test Material: tape Grips: test device Extensometer: crosshead monitor Test speed: 100 mm/min		
Standard: customer specific Type: opening of sealing Material: food packages Grips: special device Extensometer: crosshead monitor Test speed: 100 mm/min		

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Sample Preparation

Injection molding and compression molding

To characterize thermoplastic and thermosetting materials, specimens are made by injection or direct compression molding. The applied processing parameters such as pressure, temperature and shear-rate strongly influence the materials behavior.
Thermosetting materials:
- Compression molding (ISO 295)
- Injection molding (ISO 10724-1)

Thermoplastic materials:
- Compression molding (ISO 293)
- Injection molding (ISO 294, part 1-4)

Multipurpose specimen, ISO 3167

The local shear-rate during processing is influenced by the shape of the specimen. This means that the results of specimens with different shapes are not normally comparable.
For this reason a multipurpose specimen has been defined in ISO 3167, which is to be used for a variety of different tests such as tensile, compression, flexure, creep, hardness and impact.

Machining

For testing semi-finished and finished parts it is generally required to know the materials characteristics after having achieved its final shape.
The specimens are then machined in accordance to ISO 2818 or other material-specific standards.
Specimens made of softer materials (e.g. hardness of less than 85 Shore A), especially rubber, elastomers, soft plastics, and specimens made of thin sheet and film are manufactured relatively easily with cutting presses and special cutting tools. Higher hardness values reduce the life of the cutting dies.
In particular, the thicker and harder the specimen is, the more difficult it is to cut. These materials have to be machined by milling, sawing, planing or blanking.

Single or double notches for impact specimen are easily milled by using the Zwick notch cutter ZNO

Zwick notch cutter ZNO

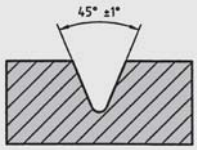
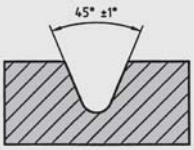
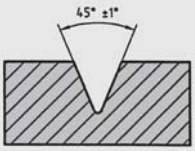
The Zwick ZNO notch milling machine is used to notch plastic specimens in accordance with standards ASTM D 256, ASTM D 6110, ISO 179, ISO 180 and ISO 8256 (Charpy and Izod tests).

Advantages and features

- Steplessly adjustable cutting speed and feed rate
- Manual setting of residual width by means of fine screw adjustment
- Acrylic safety hood
- Use of interchangeable specimen magazines
- Quick-clamping device for magazines
- Single-tooth polycrystalline diamond milling cutter for optimal notching results
- Connection for external compressed air or nitrogen for specimen cooling
- Option: Digital measuring station for residual width.

Standard	Spezimen size (LxBxH)
ISO179-1	80 x 10 x 4
ISO180	80 x 10 x 4
ISO8256-1	80 x 10 x 6
ASTM D 256	2.5 x 0.5 x 0.125...0.5
ASTM D 6110	5.0 x 0.5 x 0.125...0.5
ISO179-1 (historic)	50 x 6 x 4
DIN53435 (Dynstat)	15 x 10 x 1.2...4.6

All dimensions in [mm]

Standard	Shape A	Shape B	Shape C
ISO179-1	single or double notch	single or double notch	single or double notch
ISO180	single notch	single notch	-
ISO8256-1	double notch	-	-
ASTM D 256	single notch	-	-
ASTM D 6110	single notch	-	-
Sketch			
Radius of notch root	0.25 mm ± 0.05 mm	1.00 mm ± 0.05 mm	0.10 mm ± 0.02 mm

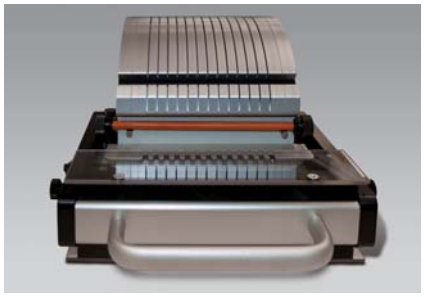
Strip cutter for plastics film

Parallel strip-type specimen for tensile tests are taken from a sheet material with a straight and notch-free cut.

This strip-cutter allows strips to be cut from a sheet of about 180 mm by 300 mm (7” by 12”), fixed on the cutting drum.

Specimen dimensions
Length: approx. 230 mm
Width: 10 or 15 mm
Thickness: 5 to 900 µm

Strip cutter dimensions
L x W x H: 420 x 290 x 240 mm
Weight: approx. 29 kg



The Strip cutter allows sampling of up to 10 strip-type specimen in one single cutting movement. The cutting edges are perfectly straight, parallel and notch free.

Zwick cutting presses and tools

Zwick offers a wide range of cutting devices for both standardized and special specimen shapes. A list of the most common types is shown in the following tables.

The cutting tool consists of 11 blades, allowing all strips to be cut in a single operation.

Advantages of cutting devices:
- Quick and easy changing of cutting dies
- Mechanical specimen ejecting system (minimising the risk of injury from the sharp cutting edges)
- Possibility to sharpen the cutting die several times
- Cutting die and ejecter are two modular parts so that the cutting die is available as a separate spare part.

Cutting presses

Reference	H04.7101[1)]	ZCP020	H02.7108
Application	circular specim.	all shapes	all shapes
Max. applicable load	5 kN	20 kN	35 kN
Push rod stroke	25 mm	41 mm	30 mm
Max. distance push rod-table	65 mm	155 mm	70 mm
Adjustment of push rod stroke	12 mm	25 mm	-
Adjustment of table elevation	-	-	70 mm
Projection	46 mm	125 mm	110 mm
Anvil table	swiveling	250 x 250 mm	350 x 215 mm
Compressed air supply	-	-	6 bar
Net weight	40 kg	55 kg	75 kg

[1)] Cutting dies can be used for ring-shaped specimen up to a diameter of 80 mm, square-shaped specimen up to 75 mm and rectangular and dumbbell shaped specimens up to a size of 160 x 30 mm

Excentric cutting press 7101 with ring centering device for circular specimens

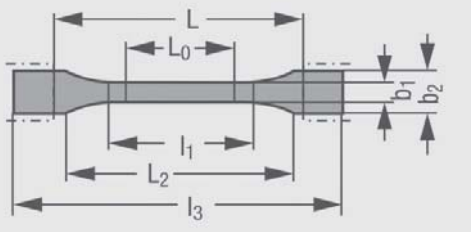
Knee-lever cutting press ZCP020 for all specimen shapes

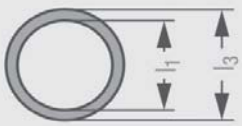
Pneumatic cutting press 7108 for all specimen shapes

Zwick / Roell

Specimen shapes, specimen dimensions and cutting dies

Note: The item numbers in the following tables have to be prefixed by H06.710





L_0 - gauge length
L - distance between grips
l_1 - length of narrow parallel-sided portion or inner diameter
L_2 (l_e) - distance between broad parallel-sided portions
l_3 - overall length or outer diameter
b_1 - width of narrow portion
b_2 - width at ends
h - thickness

Thermoplastic and thermosetting materials

Standard	Type	Application	l_3 mm	l_1 mm	b_2 mm	b_1 mm	h mm	L_0 mm	L mm	Shape	Cutting die/ spare die[1]
ISO 3167	A	Injection moulded multipurpose specimen	≥150 (170)	80±2	20±0.2	10±0.2	4.0±0.2	-	-		B.089 / 090[2]
ISO 3167	B	Compr. moulded or machined multipurpose specimen	≥150	60±0.5	20±0.2	10±0.2	4.0±0.2	-	-		B.019 / 020
ISO 527-2	1A	Injection moulded specimen (preferred shape)	≥150	80±2	20±0.2	10±0.2	4.0±0.2 (preferred)	50±0.5	115		B.089 / 090[2]
ISO 527-2	1B	Compression moulded or machined specimen (preferred shape)	≥150	60±0.5	20±0.2	10±0.2	4.0±0.2 (preferred)	50±0.5	l_2+5[3] l_2=106...120		B.019 / 020
ISO 527-2	1BA	Specimen proportional 1:2 to type 1B	≥75	30±0.5	10±0.5	5±0.5	≥2	25±0.5	l_2[3]+2[3] l_2=58±2		B.201 / 202
ISO 527-2	1BB	Specimen proportional 1:5 to type 1B	≥30	12±0.5	4±0.2	2±0.2	≥2	10±0.2	l_2+5[3] l_2=23±2		B.153 / 154
ISO 527-2	5A	Specimen identical to ISO 37 type 2 similiar to ISO 527-3 type 5	≥75	25±1	12.5±1	4±0.1	≥2	20±0.5	50±2		B.005 / 006
ISO 527-2	5B	Specimen identical to ISO 37 type 4 similiar to ISO 527-3 type 5	≥35	12±0.5	6±0.5	2±0.1	≥1	10±0.2	20±2		B.083 / 084
ASTM D 638	I	Preferred specimen for rigid plastics	≥165	57±0.5	19+6.4	13±0.5	3.2±0.4	50±0.25	115±5		B.155 / 156
ASTM D 638	II	Preferred if type 1 does not break in the narrow section	≥183	57±0.5	19+6.4	6±0.5	3.2±0.4	50±0.25	135±5		B.157 / 158
ASTM D 638	III	for thickness > 7 mm (rigid and non-rigid plastics)	≥246	57±0.5	29+6.4	19±0.5	7...14	50±0.25	115±5		B.057 / 058
ASTM D 638	V	Smaller specimen taken from parts or semi-products	≥63.5	9.53	9.53+3.1	3.18±0.5	3.2±0.4	7.62	25.4±5		B.161 / 162
ASTM D 638	V	For comparison between rigid and non-rigid platics (similiar to ISO 37 type 1)	≥115	33±0.5	19+6.4	6±0.05	3.2±0.4	25±0.13	65±5		B.159 / 160
ASTM D 638	M-I	Preferred metric size for rigid and semi-rigid plastics	≥150	60±0.5	20±0.5	10±0.5	<10	50±0.25	115±5		B.019 / 020
ASTM D 638	M-III	Smaller metric size to M-I	≥60	10±0.5	10±0.5	2.5±0.5	<4	7.5±0.2	25±5		B.165 / 166
ASTM D 638	M-II	Metric size for non-rigid materials	≥115	33±0.5	25±0.5	6±0.5	<4	25±0.5	80±5		B.009 / 010
ISO 178		flexural properties (center part of ISO 3167 specimen)	≥80		10±0.2	4 (preferred)					machined

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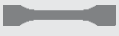
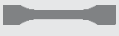
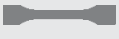
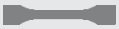
Standard	Type	Application	l_3 inch	l_1 inch	b_2 inch	b_1 inch	h inch	L_0 inch	L inch	Shape	Cutting die/ spare die[1]
ASTM D 638	I	Preferred specimen for rigid plastics	≥6.5	2.25	≥0.75	0.5	0.13±0.02	2	4.5		B.167 / 168
ASTM D 638	II	Preferred if type 1 does not break in the narrow section	≥7.2	2.25	≥0.75	0.25	0.13±0.02	2	5.3		B.061 / 062
ASTM D 638	III	For specimen thickness >7 mm (rigid and non-rigid plastics)	≥9.7	2.25	≥1.13	0.75	0.28/0.55	2	4.5		B.057 / 058
ASTM D 638	V	Smaller specimen taken from parts or semi-products	≥2.5	0.375	≥0.375	0.125	0.32±0.02	0.3	1		B.161 / 162
ASTM D 638	IV	For comparison between rigid and non-rigid plastics (similiar to ISO 37, type 1)	≥4.5	1.3	≥0.75	0.25	0.32±0.02	1	2.5		B.163 / 164

Rubbers and elastomers

Standard	Type	Application	l_3 mm	l_1 mm	b_2 mm	b_1 mm	h mm	L_0 mm	L mm	Shape	Cutting die/ spare die[1]
ISO 37	1	Preferred size	≥115	33±2	25±1	6+0.4	2±0.2	25±0.5	-		B.009 / 010
ISO 37	1A	Smaller size	100	20+2	25±1	5±0.1	2±0.2	20±0.5	-		B.187/188
ISO 37	2	Smaller preferred size	≥75	25±1	12.5±1	4±0.1	2±0.2	20±0.5	-		B.005 / 006
ISO 37	3	Smaller size	≥50	16±1	8.5±0.5	4±0.1	2±0.2	10±0.5	-		B.121 / 122
ISO 37	4	Very small size	≥35	12±0.5	6±0.5	2±0.1	1±0.1	10±0.5	-		B.083 / 084
DIN 53504	S1	Larger size	115	33±2	25±1	6+0.4	2±0.2	25	-		B.009 / 010
DIN 53504	S2	Preferred size	75	25±1	12.5±1	4±0.1	2±0.2	20	-		B.005 / 006
DIN 53504	S3a	Smaller size	50	16	8.5	4	2±0.2	10	-		B.121 / 122
DIN 53504	S3	Very small size	35	12±0.5	6±0.5	2±0.05	1±0.1	10	-		B.083 / 084
ASTM D 412	C	Preferred size	≥115	33	25±1	6+0.05	1.3...3.3	25±0.25	-		B.009 / 010
ASTM D 412	A	Possible size	≥140	59±2	25±1	12+0.05	1.3...3.3	50±0.5	-		B.145 / 146
ASTM D 412	B	Possible size	≥40	59±2	25±1	6+0.05	1.3...3.3	50±0.5	-		B.143 / 144
ASTM D 412	D	Possible size	≥100	33±2	16±1	3+0.05	1.3...3.3	25±0.25	-		B.123 / 124
ASTM D 412	E	Possible size	≥125	59±2	16±1	3+0.05	1.3...3.3	50±0.5	-		B.147 / 148
ASTM D 412	F	Possible size	≥125	59±2	16±1	6+0.05	1.3...3.3	50±0.5	-		B.149 / 150
ISO 37	A	Normal size	52.6	44.6±0.2			4±0.2	152.7	-		C.003 / 004 + C.099 / 100
ISO 37	B	Small size	10	8±0.1			1±0.1	28.26	-		C.065 / 066 + C.119 / 120
DIN 53504	R1	Preferred size	52.6	44.6			4±0.2	152.7	-		C.003 / 004 + C.099 / 100
DIN 53504	R2	Small size	44.6	36.6			4±0.2	127.5	-		C.005 / 006 + C.007 / 008
ASTM D 412	1	Preferred size	17.9	15.9			1...3.3	50	-		C.121 / 122 + C.123 / 124
ASTM D 412	2	Larger size	35.8	31.8			1...3.3	100	-		C.125 / 126 + C.127 / 128
ISO 34-1	A	Tear test, trouser preferred size	≥100	-	15±1	-	2±0.2	-	-		D.007 / 008
ISO 34-1 and ASTM D 624	B C	and Tear test, angle without nick	≥100	-	19±0.05	12.7±0.05	2±0.2	-	-		D.001 / 002
ISO 34-1 and ASTM D 624	C B	and Tear test, Crescend without nick	≥110	-	25±0.5	10.5±0.05	2±0.2	-	-		D.029 / 030
ASTM D 624		cutting die A	42	-	-	10.2	-	-	-		D.033 / 034

[1] Cutting is only possible for specimen showing a hardness less than 85 Shore A. Harder materials shall be machined by use of milling machines or other convenient machinery acc. to ISO 2818.

[2] This specimen shape is specially designed for moulding. Cut specimens do not correspond to any standard.

[3] Value indicates the upper and lower tolerances..

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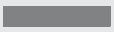
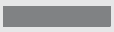
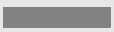
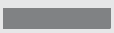
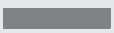
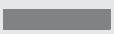
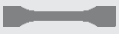
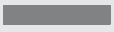
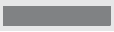
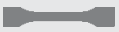
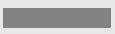
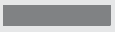
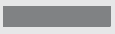
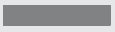
Flexible cellular polymeric materials (soft foams)

Standard	Type	Application	l_3 mm	l_1 mm	b_2 mm	b_1 mm	h mm	L_0 mm	L mm	Shape	Cutting die/ spare die[1]
ISO 1798		Tensile specimen	152	55	25	13	10...15	25/50	-		B.015 / 016
ASTM D 3574 - E		Tensile specimen	139.7	34.9	25.4	6.4	12.5±1.5	20/25			B.039 / 040
ISO 8067		Tear strength, method A	125±25		25±1		25±1				D.093 / 094
		Tear strength, method B	≥100	19	12.7		-				D.001 / 002
ASTM D 3574 - F		Tear resistance test	152.4		25.4		25.4				D.081 / 082

Thin sheetings and films

Standard	Type	Application	l_3 mm	l_1 mm	b_2 mm	b_1 mm	h mm	L_0 mm	L mm	Shape	Cutting die/ spare die[1]
ISO 527-3	2	Recommended shape.	≤150			10	≤1	50±0.5	100±5		A.149 / 150
		Strip taken with any	≤150			12	≤1	50±0.5	100±5		A.121 / 122
		kind of cutting device.	≤150			13	≤1	50±0.5	100±5		A.123 / 124
		L_0 may be reduced	≤150			15	≤1	50±0.5	100±5		A.125 / 126
		to 50 mm for high	≤150			20	≤1	50±0.5	100±5		A.079 / 080
		elongations	≤150			25	≤1	50±0.5	100±5		A.127 / 128
ISO 527-3	5	Specimen shape for	≥115	33±2	25±1	6 ±0.4	≤1	25±0.25	80±5		B.009 / 010 or
		quality and control purpose									B.125 / 126
											(130 mm long)
ISO 527-3	1B	Specimen shape for	≥150	60±0.5	20±0.5	10±0.2	≤1	50±0.5	115±5		B.019 / 020
		quality and control purpose									
ISO 527-3	4	Specimen shape for	≥152	50±0.5	38	25.4±0.1	≤1	50±0.5	73.4		B.085 / 086
		thin sheets									
ASTM D 882		Strip for quality control	≥150			5...25.4	≤1	100	100		on request
		Strip für modulus measuring	≥300			5...25.4	≤1	250	250		on request

Reinforced plastic composites

Standard	Type	Application	l_3 mm	l_1 mm	b_2 mm	b_1 mm	h mm	L_0 mm	L mm	Shape
ISO 527-4	1B	Preferred for isotropic and	≥150	60±0.5	20±0.2	10±0.2	4.0±0.2	50±0.5	115	
		orthotropic reinforced								
		composites and for								
ISO 527-4	2	multidirectional and	≥250		25±0.5		2...10	50±1	150±1	
					oder 50±0.5					
ISO 527-4	3	fibre-reinforced materials	≥250		25±0.5		2...10	50±1	136	
					oder 50±0.5					
ISO 527-5	A	Unidirectional fibre-reinforced	250		15±0.5		1±0.2	50±1	136	
		plastic composites, longitudinal								
ISO 527-5	B	For transverse direction	250		25±0.5		2±0.2	50±1	136	

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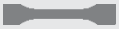
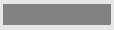
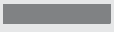
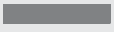
Plastic piping

Standard	Type	Application	l_3 mm	l_1 mm	b_2 mm	b_1 mm	h mm	L_0 mm	L mm	Shape	Cutting die/ spare die[1)]
PVC-Pipes											
ISO 6259-2	1	Machined specimen	≥115	33±2	≥15	6+0.4	wall thickness	25±1	80±5		
ISO 6259-2	2	By cutting die produced specimen	≥115	33±2	25±1	6+0.4	wall thickness	25±1	80±5		B009 / 010
Polyolefin pipes (PE, PP)											
ISO 6259-3	1	Wall thickness >5 mm (similiar ISO 527-2, type 1B)	≥115	60±0.5	20±0.2	10±0.2	wall thickness	50±0.5	115±0.5		
ISO 6259-3	2	Wall thickness ≤5 mm (similiar ISO 37, type 1)	≥115	33±2	25±1	6+0.4	wall thickness	25±1	80±5		B009 / 010
ISO 6259-3	3	Wall thickness >12 mm	≥250	25±1	100±3	25±1	wall thickness	20±1	165±5		

Specimen for pendulum impact tests

Standard	Type	Application	l_3 mm	l_1 mm	b_2 mm	b_1 mm	h mm	L_0 mm	L mm	Shape	Cutting die/ spare die[1)]
ISO 179-1	1	Charpy (from multipurpose specimen)	80±2	-	-	10±0.2	4±0.2	62+0.5 (preferred)			only molding or machining
ISO 179-1	2	Charpy, materials exhibiting interlaminar shear	25 x h	-	-	10 or 15	3 (preferred)	20 x h			-
	3		(11 or 13) x h		-	10 or 15	3 (preferred)	(6 or 8) x h			-
ASTM D 6110	-	Charpy, notched specimen	127 (5“)	63.5 (2.5“)	-	12.7 (1“)	3...12.7 6.36...12.7 (preferred)	101.6±0.5 (4“)			molded or pressed
ISO 180	1	Izod (from multipurpose specimen)	80±2	-	-	10±0.2	4±0.2	-			-
ASTM D 256	-	Izod, notched specimen	63.5±2 (2.5“)	-	-	12.7±0.2 (0.5“)	3...12.7 6.35...12.7 (preferred)	31.8±1 (1.25“)			-
ASTM D 4812	-	Cantilever Beam Impact (unnotched)	63.5 (2.5“)	-	-	12.7 (0.5“)	3.17 ±0.13 (preferred)	-			-
ASTM D 4508	-	Chip impact (small specimen)	19.05 (0.75“)	-	-	12.7 (0.5“)	1.02...3.175 (0.04“...0.125“)		-		-
DIN 53435	-	Dynstat impact (small specimen)	15 ±1	-	-	10 ±0.5	1.2...4.5	-			
ISO 8256	1	Tensile impact, notched type	80±2	30±2	10±0.5	6±0.2		-			D.095 / 096
	2	Tensile impact	60±1	25±2	10±0.2	3±0.05		10±0.2			D.101 / 102
	3	Tensile impact	80±2	30±2	15±0.5	10±0.5		10±0.2			D.103 / 104
	4	Tensile impact	60±1	25±2	10±0.2	3±0.1		-			D.097 / 098
	5	Tensile impact	80±2	50±0.5	15±0.5	5±0.5		10±0.2			D.105 / 106
ASTM	S	Tensile impact	63.5	25.4	9.53/12.7	3.18±0.03	3.2	-			D.087 / 088
D 1822M	L	Tensile impact	63.5 (2.5“)	25.4 (1“)	9.53/12.7	3.18±0.03 (0.125“)	3.2 (0.125“)	-			D.090 / 100

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Dimension measurement

The reproducibility of test results is significantly influenced by accurate and reproducible measurement of the specimen dimensions.

Methods for determining the relevant dimensions are defined in Standards.

Vernier calliper

Vernier callipers can be used to determine dimensions of ≥ 30 mm on plastics and rubbers (see ISO 178, ISO 4648, ASTM D 3767, DIN 53534), and dimensions ≥ 10 mm of rigid cellular plastics (DIN 53570)

Digital micrometers with ratchet

Micrometers, able to generate a constant measuring force, are suitable for dimensions ≥ 0.25 mm of rigid and semi-rigid plastics.

Both vernier callipers and micrometers can be connected via RS232 interface to the PC. Multiplexers for 2, 3 or 6 measurement devices are also available.

Dead weight thickness gauges

are used to measure the dimensions of rubbers, elastomers, non-rigid plastics, flexible cellular plastics, thin sheetings and plastic films.

As the surface pressure applied on the test piece by the thickness gauge is important for accurate measurement, the testing Standards fix the shape and surface-area of contacting surfaces such as the pressure foot and the anvil as well as the weight to be applied. Various contact elements can be used with the same device.

A choice of standards and contact elements is shown on the next page.

Reference	Range	Resolution
W40031	150 mm	0.01 mm
W40038	500 mm	0.01 mm

Reference	W40032
Range:	0 to 25 mm
Contact surface, shape:	circular/flat
Contact surface diameter:	6.35 mm
Measuring force:	5 to 10 N
Display resolution:	0.001 mm

Reference	THICK GA.000	THICK GA.H00
Range:	12 mm	12 mm
Resolution:	1 µm	0.2 µm
Anvil dia.:	50 mm	50 mm
Connection:	Multiplexer	RS 232

Digital vernier calliper (Ref. W40031)

Digital hand micrometer (Ref. W40032)

Dead weight thickness gauge providing a constant measuring force (DM-THICKGA.00 + DM-PLASTFOI.S00)

Requirements of standards for measurements by use of a micrometer or an automatic cross-section measuring device

Standard	Material	Test type	Measurement of	Reading req.
ISO 527-1	Rigid and semi-rigid plastics	Tensile	Thickness, width	≤0.020 mm
ASTM D 638	Rigid and semi-rigid plastics	Tensile	Thickness, width	≤0.025 mm
ISO 178	Rigid and semi-rigid plastics	Flexural	Thickness, width	≤0.010 mm
ASTM D 790	Rigid and semi-rigid plastics	Flexural	Thickness, width	≤0.010 mm
ASTM D 374	Plastic sheet and film	General	Thickness >0,25mm	≤0.010 mm
ISO 1923	Rigid cellular plastics	General	Dimensions ≤10 mm	≤0.05 mm

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Requirements of standards – Measurement carried out by use of dead weight thickness gauges

Standard	Material	Test-type	Specimen	Measure-ment of	Pressure-foot, shape	Pressure-foot, diam. mm	Anvil diam. mm	Contact pressure kPa	Contact force N	Reso-lution mm	Recomm. contact elem. Reference
ISO 37	Rubber	Tensile	Dumbbell	Width	(nominal distance between cutting edges)						
	Rubber	Tensile	Ring	Thickness	circul./flat	(same device as for dumbbell test pieces)					
		Tensile	Ring	Rad. Width	2 cylinders						on request
ISO 4648/	Rubber/	Tensile	1 / (S1)	Thickn.<30	circul./flat	10	>10	10±2	0.562	0.001	
DIN 53534	IRHD<35	Tensile	2 / (S2)	Thickn.<30	circul./flat	10	>10	10±2	0.388	0.001	
		Tensile	3 / (S3a)	Thickn.<30	circul./flat	10	>10	10±2	0.388	0.001	
		Tensile	4 / (S3)*)	Thickn.<30	circul./flat	10	>10	10±2	0.201	0.001	
			larger								
			specimen*)	Thickn.<30	circul./flat	6	>6	10±2	0.282	0.001	DM-
	IRHD≥35	Tensile	1 / (S1)	Thickn.<30	circul./flat	10	>10	22±5	1.236	0.001	ELASTOM.S00
		Tensile	2 / (S2)	Thickn.<30	circul./flat	10	>10	22±5	0.853	0.001	
		Tensile	3 / (S3a)	Thickn.<30	circul./flat	10	>10	22±5	0.853	0.001	
		Tensile	4 / (S3)	Thickn.<30	circul./flat	10	>10	22±5	0.441	0.001	
			larger								
			specimen	Thickn.<30	circul./flat	6	>6	22±2	0.622	0.001	
ASTM D412/	Rubber/	Tensile	Dumbbell	Thickn.≤30	circul./flat	3...10	35	10±2	-	0.001	
ASTM D3767	IRHD≤35	Tensile	Dumbbell	Width	(nominal distance between cutting edges)						
	IRHD>35	Tensile	Dumbbell	Thickn.≤30	circul./flat	3...10	≥35	22±5	-	0.001	DM-
	IRHD≤35	Tensile	Ring	Thickn.≤30	circul./flat	3...10	≥35	10±2	-	0.001	ELASTOM.S00
	IRHD>35	Tensile	Ring	Thickn.≤30	circul./flat	3...10	≥35	22±5	-	0.001	
	alle IRHD	Tensile	Ring	Rad. width	2 cylinders	15.5±0.5 (length 12mm)					on request
ASTM D374	Shore A	General	All types	Thickness	circul./flat	6.35±0.25	≥50	26±4	-	0.002	on request
	30 to 80			0.76...6.35							
ASTM D3767	Rubber	Compr.		Thickness	spherical	9.5...10			0.8±0.1	-	on request
		set plot				(Spheric rad. 12.5±0.1)					
ISO 527-1	Non-rigid	Tensile	Dumbbell	Thickness	circul./flat	-	-	20±3	-	0.02	DM-
	plastics	Tensile	Dumbbell	Width	circul./flat	-	-	20±3	-	0.1	PLASTFOI.S00
ASTM D 638	Non-rigid	Tensile	Dumbbell	Thickness	circul./flat	6.35±0.025		>6.4	25±2.5	-	on request
	plastics	Tensile	Dumbbell	Width	circul./flat	6.35±0.025		>6.4	25±2.5	-	-
		Tensile	Large spec.	Thickness	circul./flat	15.88±0.08		>6	25±2.5	-	-
ISO 527-3/	Sheet &	Tensile	Strip &	Thickness	circul./flat	2.5...10	2.5...10		0.5...1	-0.001	DM-
ISO 4593	film	Tensile	Dumbbell	≥10 µm							PLASTFOI.S00
		Tensile		Width	(nominal distance between cutting edges)						
ASTM D882	Sheet &	Tensile	Strip &	Thickness	circul./flat	25...55	3...13	≥51		0.0025	DM-
	film		Dumbbell	≥0,025...to 0,25							PLASTFOI.S00
ASTM D374	Sheet &	General	All types	Thickness	circul./flat	25...55	3...13	≥51		0.002	DM-
	film			≥0,025...0,25							PLASTFOI.S00
ISO 1923/	Cellular	General	All types	Dimensions	circul./flat	35.7	>36	0.1±0.01	-	0.05	on request
DIN 53570	plastics			≥10 mm							

*) Measurement only with thickness gauge DM-THICKGA.H00

Remark: Standards for elastomers and rubbers generally require the median of 3 measurements.
Standards for plastics generally require the average of 3 measurements.
Standards for cellular plastics generally require the average of 5 measurements.

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Automatic cross-section measurement device

Automatic cross-section measurement devices are used for fast, comfortable and reproducible measurement of specimen thickness, width or diameter on rigid and semi-rigid plastics.

The operator places the specimen into the measurement device where one or several measurements can be carried out. By this method, the influence of the operator on the specimen dimension measurement is eliminated.

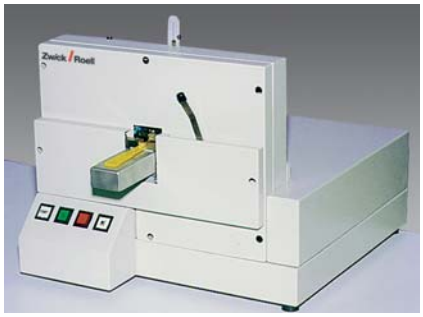
Reference	066998.00.00
Shoulder width, max:	40 mm
Parallel length, min:	60 mm
Specimen length, min:	100 mm
Thickness, range:	0.1 to 20 mm
Thickness, contact foot:	spherical
Width/diameter, range:	6.0 to 40 mm
Width, contact foot shope:	flat, Ø 1 mm
Resolution:	0.001 mm
Accuracy (gauge block):	± 0.003 mm
PC-Connection:	RS 232
including certified gauge block.	

Measurement of cross section by weight

This method is used for the cross-section determination of rubber and elastomer ring specimens as well as for strip specimens of very thin (≤ 10 µm) or embossed plastic film.

Available balances

Reference	2.01.00	W4002- 2.02.00	3.01.00
Meas. range	≤51 g	≤101 g	≤151 g
Resolution	0.1 mg	0.1 mg	1 mg
PC-connec.	RS232	RS232	RS232
Power supply	220 V	220 V	220 V



Automatic cross-section measuring device (Ref. 066998.00.00)

Determination of ambient density according to ISO 1183, DIN 53479-A

The method consists of weighing the material in air and in distilled water, normally at ambient temperature. The kit consists of weighing mechanism and a thermometer. A suitable balance is needed.

Digital balance and kit for the determination of density, gravimetric method, (4106.69)

Material testing machines

Zwick produces material testing machines with capacities up to 6000 kN and sometimes more. For plastic materials and rubbers most of the standard tests are covered by forces up to 20 kN.

Typical fields of application

Loads up to 1 kN
- Tensile and tear tests on rubbers, non-rigid plastics, thin sheets and film, cellular plastics
- Creep and flexural tests on rigid and semi-rigid plastics
- Peel resistance of adhesives

Loads up to 10 kN
- Indentation hardness and compression tests on cellular plastics

Loads up to 20 kN
- Tensile, compression, creep and shear tests on rigid and semi-rigid plastics

Loads higher than 20 kN
- Tensile and compression properties of reinforced plastic composites
- Compression properties of plastic piping as well as other plastic and rubber parts

Basic concept

In order to be able to offer the best machine for each requirement, Zwick's comprehensive product range includes three machine versions for static materials testing, each of them offering different equipment, performance and expansion capabilities:

Zwick / Roell

- The **ProLine** is particularly suitable for functional tests on component parts as well as for standard materials tests. A broad range of standard accessories provides comprehensive testing capability at an affordable price.

- The **zwicki-Line** consists of top-quality space-saving testing machines. These simple-to-use and easy-to-transport single column machines have been designed for test forces up to a maximum of 5 kN.

- The **Allround-Line** is the flagship-range of testing equipment offering the highest level of technical sophistication and future expansion possibilities.

Measurement and control system

The fundamental component for any testing machine is the measurement and control system. Its design and scope of capabilities determine which drive system it can regulate, which measurement system it is connected to and which functions can be controlled.

The *testControl* controller offers highest technical performance and long range return of investment through the use of the latest technologies and highest quality standards. Notable characteristics of the electronics are:

- Chronologically-synchronized test data recording with high resolution and measurement frequency
- Sampling of input signal at 320 kHz
- 500 Hz real-time processing of the test data for monitoring and event oriented control of the test sequence and for safety limits. (e.g. speed change upon reaching the yield or proof stress limit)
- Adaptive control for precise and reproducible speeds and positions

testControl and hence the testing machine, is operated by using a PC and the test software *testXpert*® II. The system is easy to configure and upgrade for almost any diverse application as well as extremely flexible and easy to operate.

The optional stand-alone variant offers simple, direct operation of the testing machine without a PC, using a colour display, a key pad and a few, intuitive function keys. A printer can be connected to output the test results.

Components testing with ProLine:
Determination of the stiffness of window frames

Materials testing:
Tensile test according to ISO 527-2

Zwick / Roell

Load frames

Different load frame versions are available for test loads up to 2000 kN as standard. Special applications can be developed and manufactured, for example, load frames in horizontal posi-tion suitable for the testing of long ropes.

Table-top testing machines, ProLine

The load frames of the ProLine are designed with twin lead screws and 2 round steel columns ensuring precise guidance of the moving crosshead. The integrated protec-tion of lead screws and guide columns aids reliable testing even for very brittle materials.

Table-top testing machines, zwicki-Line

These single column load frames are designed with very rigid aluminium high-precision extruded profiles. The working area is freely accessible from 3 sides. It only requires limited bench space and fits on most laboratory tables. Due to its low weight, it is easy to transport.

zwicki-Line load frames and drives

Series	Z0.5	Z1.0	Z2.5	Z5.0
• Max. test load [kN]	0.5	1.0	2.5	5.0
• Work space height				
* short [mm]	570	570	573	-
* normal [mm]	1070	1070	1073	1030
* high [mm]	1370	1373	1373	-
• Work space width [mm]	∞	∞	∞	∞
• Work space depth [mm]	100	100	100	100
• Max. crosshead speed [mm/min]	2000/3000	2000	1000	600
• Crosshead travel resolution [µm]	0.2453	0.2265	0.0996	0.0399
• Max. power consumption, kVA	0.44	0.44	0.44	0.44

zwicki-Line materials testing machines for materials and components testing

Around-Line Z010 equipped for tensile testing

Zwick / Roell

Table-top and floor standing models, Allround-Line

The table-top version is constructed using two aluminium, high-precision extruded profiles (patented design). They are light, very rigid and serve simultaneously as lead-screw guides 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.

A unique development by Zwick allows all table top load frames with two columns to be equipped with legs to allow them to stand on the floor and position the working area at an optimum height for the operator. This allows a comfortable seated operation with complete freedom for leg movement thus making the testing system suitable for wheelchair users.

The **floor standing models** are equipped with hard-chrome plated steel guiding columns and high precision and backlash-free ball screws. The crossheads of these loadframes can be arranged in different ways, so that the lower, upper, or both workspaces can be utilized.

All load frames with an electromechanical drive system can be equipped with a second working area. This allows a fast and convenient work station and can eliminate the need for the operator to change tooling and operator.

Allround-Line Z050 in an extended version for testing tensile characteristics and ring stiffness on plastic pipes

Allround-Line Z100 equipped with pneumatic grips and Macro extensometer

Zwick / Roell

Loadframes for testing soft foams

Specific loadframes are available to test large foam parts such as seat cushions, matresses etc.

The C-frame

With this type of loadframe lateral tables can be raised on both sides in order to get a large anvil surface. Optionally, this frame can be equipped by a sliding-support which is useful for testing large matresses. In the test area the table is perforated with holes to allow rapid air escape during indentation tests, as described in many ISO, ASTM standards and automotive specifications.

The test space is accessible from three sides to allow a very practical and fast operation. By use of adaptors, this load frame can be used for tensile and tear testing as well.

Lower testing platform

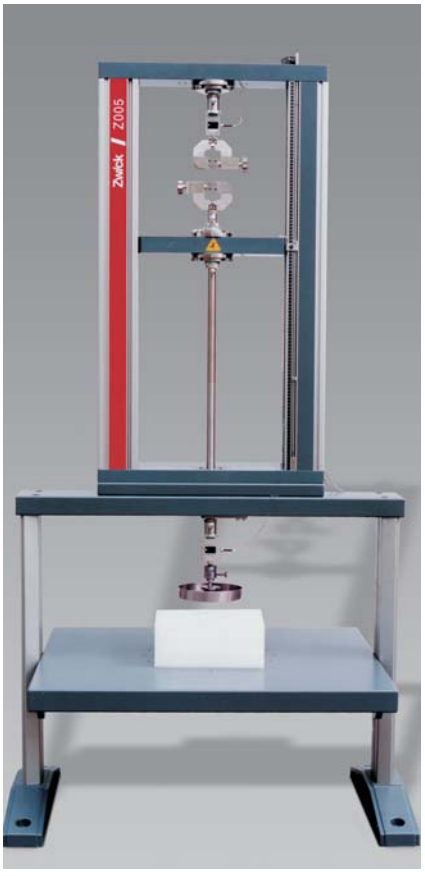
Several types of standard loadframes can be equipped with a lower testing platform (see below right) that allows testing of larger foam parts, but maintains the functionality of the load frame itself.

Constant load pounding machine

This machine type is equipped with a high-speed electromechanical drive system to generate the constant load pounding frequency required by the testing standards. In addition, this machine can also be used for static compression and indentation hardness tests.

This machine can be used for constant load pounding tests as well as for static compression and indentation hardness

The C-frame is used for compression and indentation hardness tests of large foam parts



Testing of larger parts can be performed in the optional lower testing platform

Zwick / Roell

ProLine Load Frames and Drives

Tabletop Testing Machines

Series	Z005	Z010	Z020	Z030	Z050[1]	Z100
• Max. test load [kN]	5	10	20	30	50	100
• Work space height						
* shortened [mm]	570	-	-	-	-	-
* normal [mm]	1070	1050	1050	1370	1370	1360
* increased [mm]	-	-	-	-	-	-
• Work space width [mm]	440	440	440	440	440	640
• Work space depth [mm]	∞	∞	∞	∞	∞	∞
• Max. crosshead speed [mm/min]	500	1000	500	300	180/600[1]	300
• Crosshead travel resolution [µm]	0.039	0.038	0.018	0.012	0.007/0.016[1]	0.008
• Max. power consumption, kVA	0.8	0.8	0.8	0.8	0.8/3[1]	3

[1] This testing machine is available in two electronics variations. The first value is for the standard electronics, the second for *testControl*.

Allround-Line Load Frames and Drives

Tabletop Testing Machines

Series	Z005	Z010	Z020	Z030	Z050	Z100	Z150
• Max. test load [kN]	5	10	20	30	50	100	150
• Work space height							
* normal [mm] [2]	1045/1025	1045/1025	1045/1025	-	-	-	-
* increased [mm] [2]	1445/1425	1445/1425	1445/1425	1355/1325	1355/1325	1355	1535
* extra high [mm] [2]	1795/1785	1795/1785	1795/1785	1755/1725	1755/1725	1755	-
• Work space width							
* normal [mm]	440	440	440	440	440	-	-
* widened [mm]	640	640	640	640	640	640	640
• Work space depth [mm]	∞	∞	∞	∞	∞	∞	∞
• Max. crosshead speed [mm/min]	3000	2000	1000/2000[3]	1000	600	750/1500[3]	900
• Crosshead travel resolution [µm]	0.0410	0.0272	0.0136/0.0543[3]	0.0271	0.0163	0.0207	0.0123
• Max. power consumption, kVA	2	1.9	2.1/2.6[3]	2.3	2.3	4/6[3]	5.5

Floor-standing Testing Machines

Series	Z050	Z100	Z150	Z250	Z300	Z400	Z600
• Max. test load [kN]	50	100	150	250	300	400	600
• Work space height[mm]	1825/1760[2]	1825/1760[2]	1715/1655[2]	1715/1655[2];	1800 1360[4]	1800	1940
• Work space width							
* normal [mm]	630	630	630	630	630	630	740
* widened [mm]	1030	1030	1030	1030	-	-	-
• Work space depth [mm]	∞	∞	∞	∞	∞	∞	∞
• Max. crosshead speed [mm/min]	1000/2000[3]	500/1000[3]	900	600	250	250	200
• Crosshead travel resolution [µm]	0.0270	0.0136	0.0123	0.0082	0.031	0.031	0.025
• Max. power consumption, kVA	4/5[3]	4/5[3]	5.5	6	7/13[5]	7/13[5]	20/26[5]

[2] The second value is for the model with the widened work space [3] Depending on selected drive and its power
[4] The last value is for a cost effective special model limited to one work space [5] Higher power consumption applies for hydraulic grips

Zwick / Roell

testXpert® II – Intelligent and Reliable, the New Software Generation for Materials Testing

Zwick Roell has set new standards with *testXpert*® for intelligent materials testing software. Unlike other software, Zwick has standardized *testXpert*® for all of its applications, no matter whether static or dynamic tests – so you spend less time learning to handle software and more time conducting tests. With *testXpert*® II, you benefit from over 80 years of testing experience and from over 10,000 successful installations worldwide.

Some Significant Benefits of *testXpert*® II

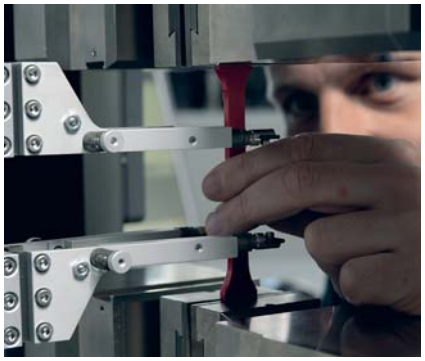
Ingeniously simple – *testXpert*® II is organized so that you can operate it intuitively. Expressive symbols and a clear menu structure enable quick familiarization. The menu bar is set up according to the needs of the user, making working with *testXpert*® II ingeniously simple.

Intelligent – Wizards help you to set up or change test procedures and test reports. Should you have any questions, the extensive context sensitive online help feature will quickly deliver the answer.

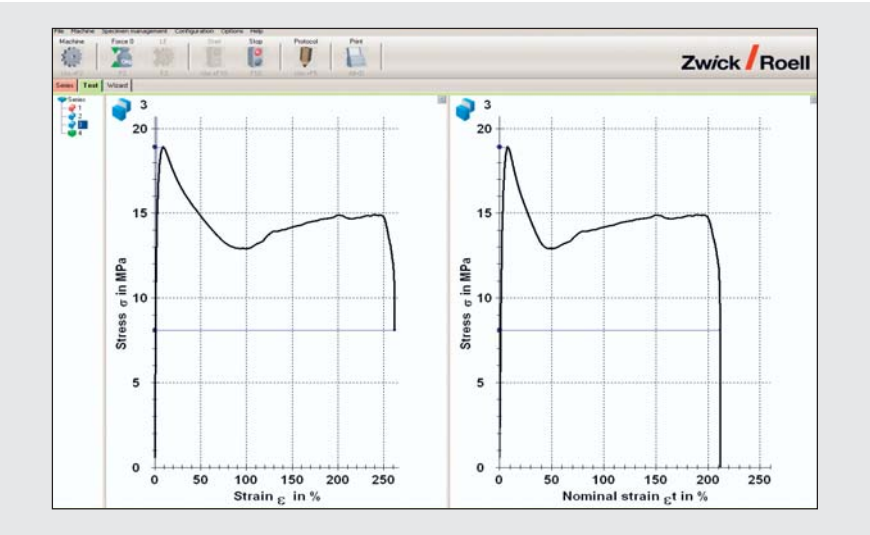
Modular design – means that specific testing solutions meet your particular requirements. Additional testing capabilities can be added as needed.

Compatible with your hardware – Zwick *testXpert*® II is compatible with all commercially available PCs and laptops without the need for an additional interface card! This means it is easy to switch system computers or even to develop test methods or perform analyses in the office at your convenience. You always have access to your test data.

Online language swapping – Needless to say, you can have *testXpert*® II in your language of choice. *testXpert*® II speaks more than one language – all you need to do is click the mouse in order to change the language online. Language swapping is a function which can be changed at any time, e.g., when generating the test report. Flexible *testXpert*® II language swapping offers international teams not only language-neutral operation of their testing machine but also considerably simplified communication.



Industry-oriented terminology and data export capability – And *testXpert*® II not only uses your language but it also adopts your technical terminology. For example, symbols or variables that are specific to your industry (e.g., metals, plastics, rubber) are implemented throughout the software. This provides more relevant meaningful information for your testing application. Today's quality assurance standards necessitate that the test results may be exported to a company's central laboratory database. So we have created *testXpert*® II to communicate reliably with your IT system by providing flexible interfaces and MS Office integration by means of Object Linking Editing (OLE).



Comparison of measured and nominal strain during a tensile test acc. ISO 527-2

Select Test Standard

In *testXpert*® II you find the right standard for every test. Just select the desired test program. All parameters are preconfigured to standard. You can of course adjust these if you wish.

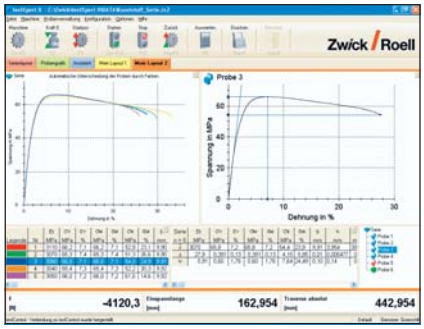
Test

The individual data are displayed on the monitor – online as part of the test procedure. You can follow the test procedure live. If desired you can also incorporate an exactly synchronized video recording.

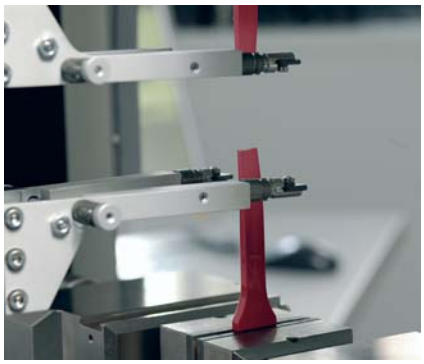
The results are already calculated during the test so that the test procedure can be eventmanaged, e.g., by speed change after determining the E-modulus or the yield point. Only in this manner can the test be performed quickly and according to standard.

Evaluation of Test Results

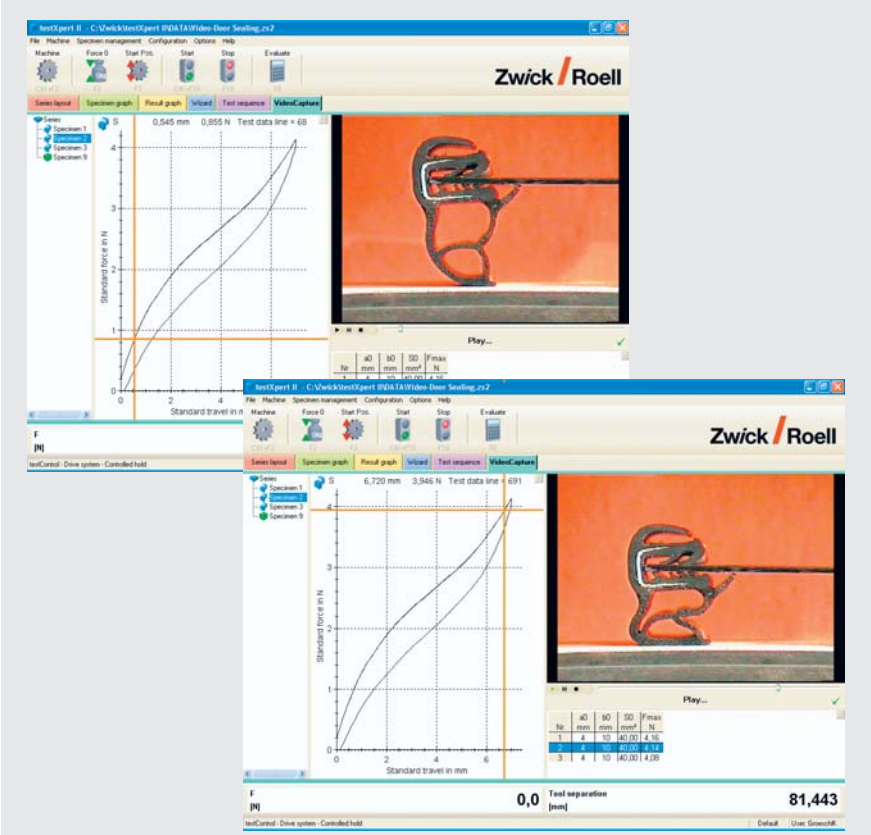
In *testXpert*® II you can create many different screen layouts according to your needs. For example: With other graphs, various representations of the testing curves, tables and additional statistics. With one click you can switch between the various layouts, thus changing the representation of your test results.



For processing the test results *testXpert*® II offers a variety of tools: e.g., the report editor for creating an individual test report, or various export possibilities, e.g., in Excel or Word.



Synchronized video recording – *testXpert*® II offers you an image-for-image, perfectly synchronized video recording of your test. You can interpret the measuring curve of the test efficiently with the help of the recorded image changes of the specimen. You can record the test procedure with a video camera or an USB webcam. And *testXpert*® II saves the recorded images synchronized with the measuring data. The visual recording shows, for example, when, how, and where the specimen necks, buckles, or changes colors. The alterations in specimen dimensions can be measured exactly from the captured images. In addition, before the test, you can determine which events images should be recorded for: such as the point in a cycle when compression switches over into tensile stress. Afterwards you can print out these pictures or integrate them into the test report. Thanks to the synchronized video recording, the test procedure can be recalled or compared at any later time.

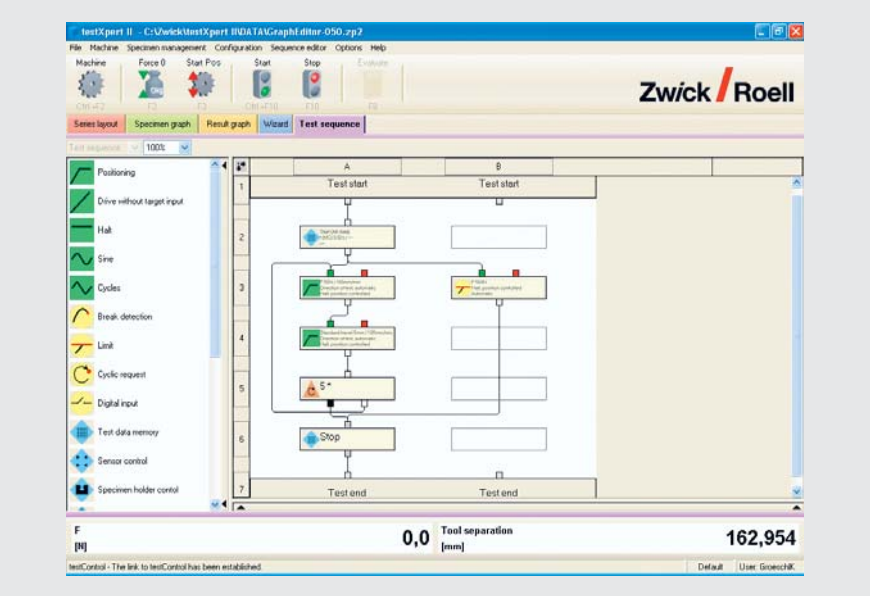


The video pictures and the data curves are exactly synchronized with each other. The measured data points and specimen behaviour are then easily compared

A representation of a material's tensile strength over a period of days

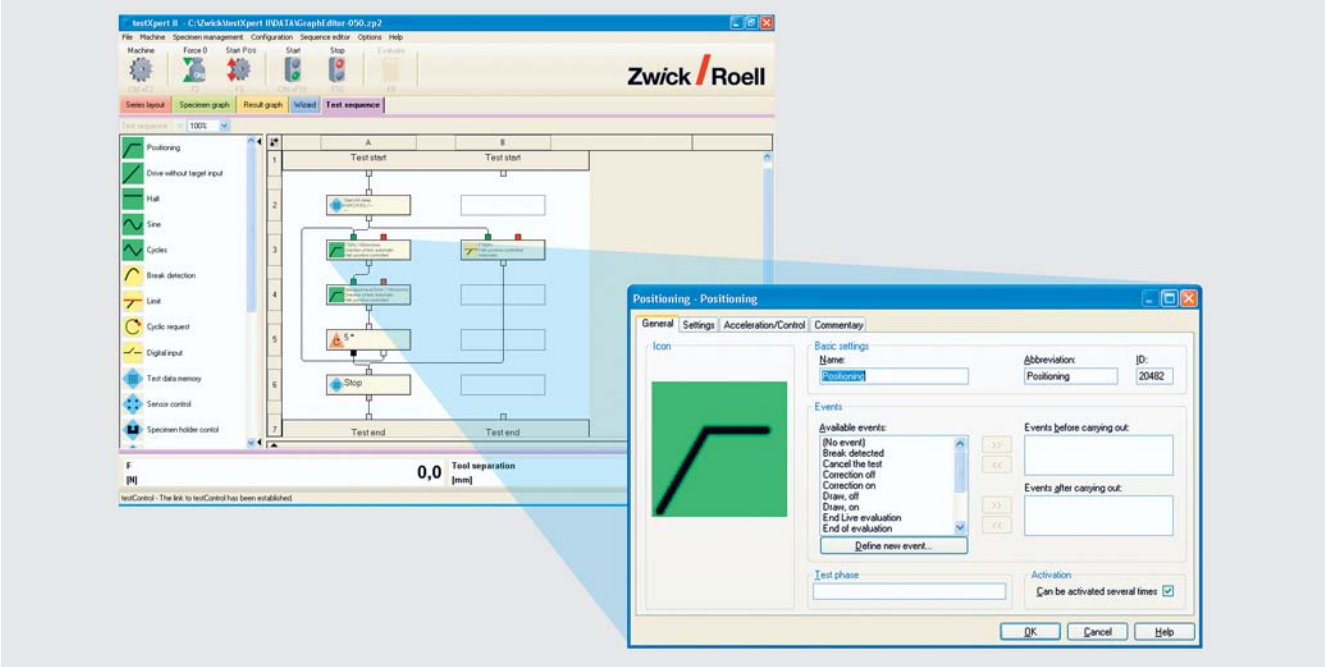
***testXpert*® II LIMS** – Only *testXpert*® II offers these features: an integrated Laboratory Information Management System (LIMS). A powerful database is available to administer your test results in order to create and archive long-term statistics and reports. All data acquired by *testXpert*® II are available from any testing system in your company.

Graphical Sequence Editor – The *testXpert*® II Graphical Sequence Editor offers all the freedom you could possibly hope for. It enables you to design test procedures of any kind individually, by combining test events, parameters and results exactly as you require. The intelligent construction of the graphical-user interface allows the editor to make your work easy. You do not require any programming knowledge: The graphic user interface makes for quick familiarization with the functionality. The integrated simulation mode offers you safety: It analyzes the test procedure you have created incorporating a virtual testing machine, with different specimen behaviour (e.g. spring, plastic, metal, etc.). You thus filter out errors from the test procedure in the early stages, and all this without destroying a single specimen.



An example of a graphical sequence editor program

Example: You want to cycle between two steps (such as load levels) within a test sequence. Use the mouse to select the module of the first step and drag and drop it into the sequence. Decide the parameters for the first step. Proceed accordingly with the second step. You can enter the number of loops in the loop module underneath it, and then reconnect it to the beginning. At the same time, a limit can be monitored during this process. Once again, very simply, by selecting the respective limit module.



The program sequence is illustrated. Details for each step may be shown and changed by clicking on the respective boxes.

Zwick / Roell

Intelligent Load cells

Load cells are available for accurate load measurement of forces from 0.04 N onwards. They offer the following advantages in conjunction with the digital measurement electronics:

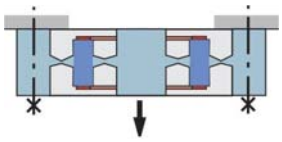
- Automatic identification and acquisition of all setting and calibration parameters via sensor plug. An exchange of the load cells neither requires a calibration nor a modification of the setting data.
- Automatic zero-point and sensitivity balancing
- Temperature compensation
- High measurement frequency
- Very high test data resolution
- Accuracy:
  Class 1 (1 % of reading)
  from 0.2 to 120 % of full scale load
  (1 to 100 % in the case of load cells smaller than 500 N).
  Class 0.5 (0.5 % of reading) from 1 % to 100 % of full scale load.
- Overload protection
- Manufacturer's test certificate to certify the factory calibration

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

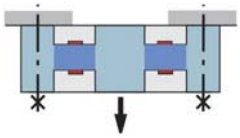
Types and recommendations for their use

Depending on the test, the accuracy of the load cells and other features are important. For use with temperature devices, these are the temperature sensitivity of zero-point and measured value. During compression and flexural tests, transverse forces and moments may occur which should not falsify the force value in an inadmissible way and which should not damage the load cell. For this reason, Zwick offers different types of load cells.

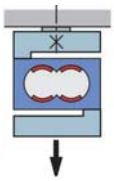
- Load cell type ring-torsion
  The body of this circular load cell is a bending ring with ring-shaped strain gauges on the face sides. It is very insensitive to excentric load applications and overloads.



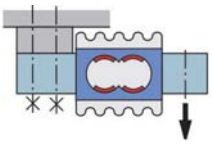
- Load cell type ring-spokes
  The outer and the inner ring of this load cell are linked by spokes on which the strain gages are applied to. This load cell is relatively insensitive to excentric load applications.



- Load cell type S-beam
  The body of this flat, S-shaped load cell is a double beam. It is relatively sensitive to excentric load applications.



- Load cell type beam bar
  This load cell consists of a double beam-shaped body. The centrically acting test load is traversed laterally and transmitted to the crosshead of the testing machine. Therefore it is quite sensitive to excentric load applications.



Note:
The measurement body of the load cell is illustrated in dark blue and the strain gauges applied onto them are illustrated in red.

Type/test conditions	RT	RS	SB	BB
Tension force with axial load application	+ + +	+ + +	+ + +	+ + +
Compressive force with safe axial load application	+ + +	+ +	+ +	+ +
Compressive force with excentric load application	+ + +	- [1]	- [2]	- [2]
Bending tests	+ + +	+ +	+ +	+ +
Extended temperature range	+ + +	+ +	+ +	+ +
Creep tests	+ + +	+ +	+ +	+ +
Axial alignment under load	+ + +	+ + +	+ +	+

[1] Limited measuring accuracy
[2] Risk of destruction

Load cell with sensor plug, type ring-torsion

Zwick / Roell

Specimen Grips and Tooling

Specimen grips for tensile, creep and cyclic tests

Zwick offers a large product range of specimen grips in various designs, test load ranges and test temperatures to cover the wide range of applications for the plastics and rubber testing (see table “selection criteria for specimen grips”).

The specific range of application of a specimen grip depends on the operating principle and the maximum permissible test load. For tests inside a temperature or climatic chamber, the temperature range is another important factor.

Force transfer between specimen and specimen grips

The clamping principle defines the type of force transfer between specimen and specimen grips. Most grips are named according to their clamping principle.

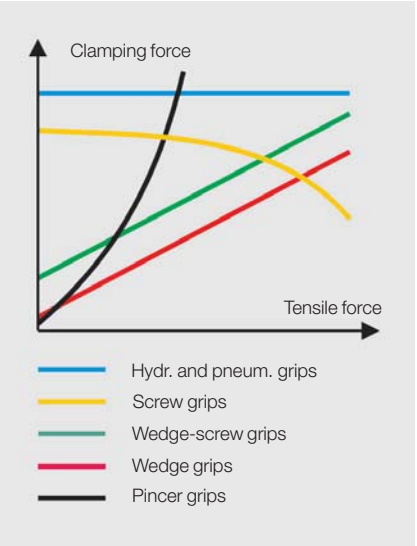
For the majority of specimens, the test load can only be transferred by a force-holding gripping principle, i.e. friction. The frictional force between specimen ends and gripping jaws of the specimen grips must always be greater than the test load. The required gripping forces acting vertically to the test load are generated externally (e.g. by means of pneumatic pressure) or are generated mechanically from the test load (e.g. by means of sliding wedges).

In order to avoid specimen break within the grips – particularly for gripping-sensitive and flexible specimens (plastic films, strips, monofilaments) – the test load is slightly reduced by a frictional force applied by wrapping around prior to gripping. For this purpose, the specimen ends are wound onto cam plates and are subsequently clamped.

For rubber ring specimens, the force is transferred according to the form-fitting gripping principle. They are wound over pulleys.

Gripping force

For specimen grips with an external gripping force application, e.g. hydraulic, motorized, pneumatic, the set gripping force is effective during the entire test. When testing thick and soft specimens, specimen material may flow out of the gripping range (slip) during load application causing a reduction of the specimen thickness. When using hydraulic or pneumatic specimen grips, the gripping force remains constant because the pressure generator maintains the oil or compressed air pressure. When using screw grips, the gripping pressure is reduced in accordance to the rigidity and the resilience of the specimen grip.



Dependence of the clamping force on the test load for different types of specimen grips

Due to the high gripping force of these specimen grips, specimen material is “pushed” out of the gripping range while closing the grips. The specimen is compressed and may be damaged. This effect can be avoided by activating the machine drive during the closure of the clamps. (“Zero-Force-Regulation”).

In case of self-clamping grips, the initially low gripping force increases in relation to the acting tensile force and the function principle of the grips (Wedge, pincer, etc.).

Gripping surfaces

The frictional force depends not only on the gripping force, but also on the coefficient of friction of the contacting surfaces. For this reason, exchangeable gripping jaws or jaw faces with different surface types (shape, surface structure, material etc.) are availalable for many specimen grips.

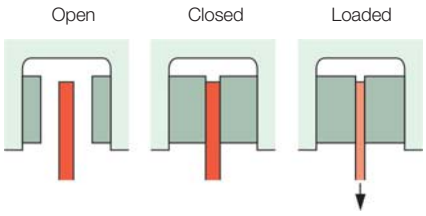
Gripping travel and opening width

Specimen grips with an external gripping force application have a long gripping travel and consequently a large opening width. This means an easy specimen feed even when testing thicker specimens. Exchangeable gripping jaws for different specimen thicknesses are not required.

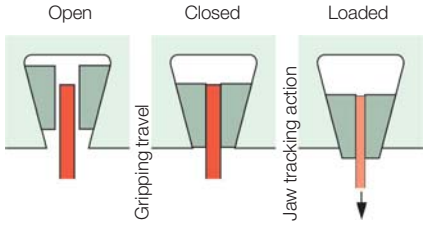
When using self-clamping grips, each change of the gripping travel causes a larger displacement of the jaws in. Therefore, gripping travel, opening width and thus the range of specimen thicknesses and thickness variations are limited for these types of specimen grips. Differently thick gripping jaws might be required to cope with different thickness ranges.

Gripping jaw tracking action

During the test, the specimen thickness may be reduced in proportion to the increase in test load; this is particularly the case when testing thick and soft specimens. This change in thickness has to be compensated by an additional gripping travel. For self-clamping grips, the gripping jaws are moved towards the center of the specimen. This gripping jaw tracking action which is considerably greater than the changing thickness of the specimen (for wedge grips with a wedge angle of 15 degrees, a change in thickness of 0.1 mm causes a gripping jaw tracking action of about 1 mm at both ends of the specimen!) results in a corresponding error of the indirect extension measurement for the determination of the nominal strain.



Gripping process for specimen grips with external load application (long gripping travel, no gripping jaw tracking action)



Gripping process for increasing force wedge grips (short gripping travel, large gripping jaw tracking action)

Handling and control

The opening and closing of the specimen grips for low test loads is mostly done via lever or handwheel.

When using specimen grips for higher test loads and frequent operation, the manual operation can be very tiring for the operator. In this case hydraulic, pneumatic or motorized grips which are operated via push buttons or foot switch are a good solution. In case of semi-automatic operations, the user only has to close the specimen grips. Depending on the specimen dimensions, it is even possible to set the hydraulic or pneumatic pressure – and thus the gripping force – automatically. The opening is done automatically after the specimen break.

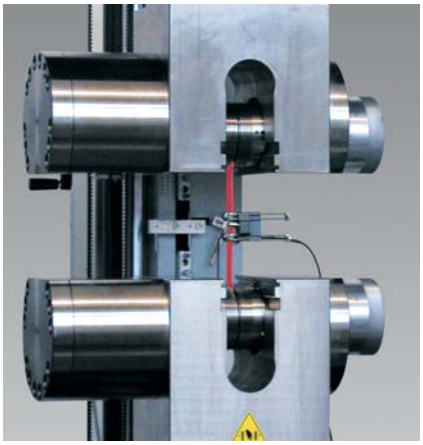
Types of specimen holders

Hydraulic grips

These universall grips are predominantly used for average and high test loads. The gripping force is applied via direct acting hydraulic cylinder. The grips are available in two versions:

- One manually adjustable and one hydraulic operated grip jaw so shear tests with an excentric gripping can also be performed.
- Symmetrical jaw closing

The required hydraulic energy is supplied by a hydraulic unit (see photo: hydraulic grips).



Hydraulic grips

Pneumatic grips

Pneumatic grips

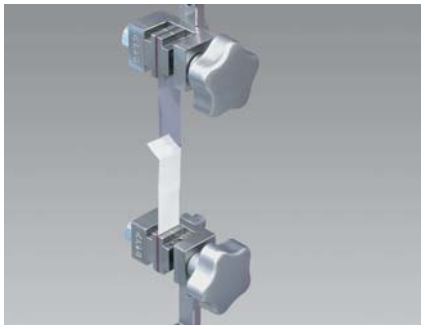
Depending on the clamping force required, these grips incorporate direct acting pneumatic cylinders or apply the clamping force via al lever system. They are mainly used for low and average test loads.

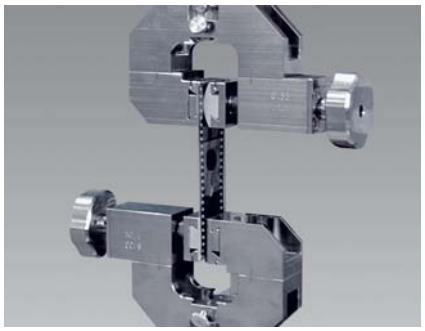
Versions with single or double-sided closing gripping jaws are available. The required pneumatic energy is mostly supplied by the in-house compressed air ductwork system (see photo: pneumatic grips).

Zwick / Roell

Screw grips

One gripping jaw is operated manually via screw drive. The other gripping jaw can be set in fixed steps, steplessly or may be permanently fixed.

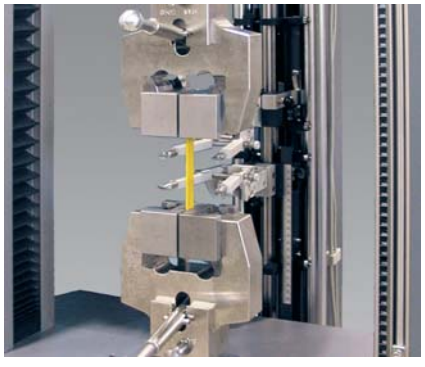




Screw grips

Wedge grips

Two wedges actuated manually via lever are pressed against the specimen at a low preload generated by a spring. The wedges cause an increasing force effect. I.e., the gripping force increases with the increase in tensile force.

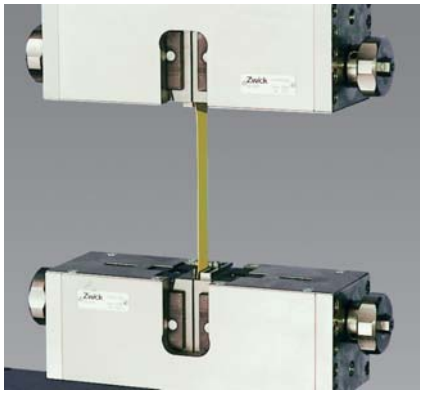


Wedge grips

Wedge-screw grips

These specimen grips are a combination of screw and wedge grips. With the screw drive, the gripping jaws are closed and opened – and the initial gripping force is generated. If the clamp is closed, the wedges generate the increasing force effect.

Optionally, the screw drive can either be driven by motor, be controlled manually via push buttons or externally by electronic/PC.



Wedge-Screw grips

Spring loaded grips

These grips are particularly suitable for tests at very low forces. The mass of the specimen grip is of particular importance here: Its weight is compared to the nominal force of the connected load cell so small that its load measuring range is not restricted.

The gripping force is generated by a spring with adjustable spring force. Thus, sensitive materials can be tested by using a predefined and constant gripping force.

Pincer grips

This pincer-type specimen grip also has the increasing force principle. The initial gripping force is applied by a prestressed spring. The pincer principle generates a gripping force which increases exponentially to the tensile force. It is particularly suitable for tensile specimens made of soft, highly extensible rubber and elastomers which become extremely strong prior to the specimen break.

Pincer grips

Spring loaded grips

Zwick / Roell

Selection criteria for specimen grips

Features Specimen grips (Function principle)	Hydraulic-	Pneumatic-	Spring loaded	Wedge-	Screw-	Wedge-screw	Pincer-	Toggle-	Ring testing
Load range (max. load)									
Min. size, kN	10	0.02	0.02	2.5	0.02	0.5	0.5	0.3	2.5
Max. size, kN	250	100	0.05	250	50	250	10	2.5	2.5
Temperature range									
Lower limit, °C	-70	-70	-15	-70	-70	-40	-40	-15	-40
Upper limit, °C	+250	+250	+80	+250	+250	+250	+250	+80	+150
Main range of application									
Sheets, strips		•	•		•			•	
tapes	•	•			•				
Monofilament	•	•		•					
Strings, ropes		•			•				
Dumbbells	•	•		•	•	•	•		
Rings									•

Tooling for the determination of compressive properties of flexible cellular materials

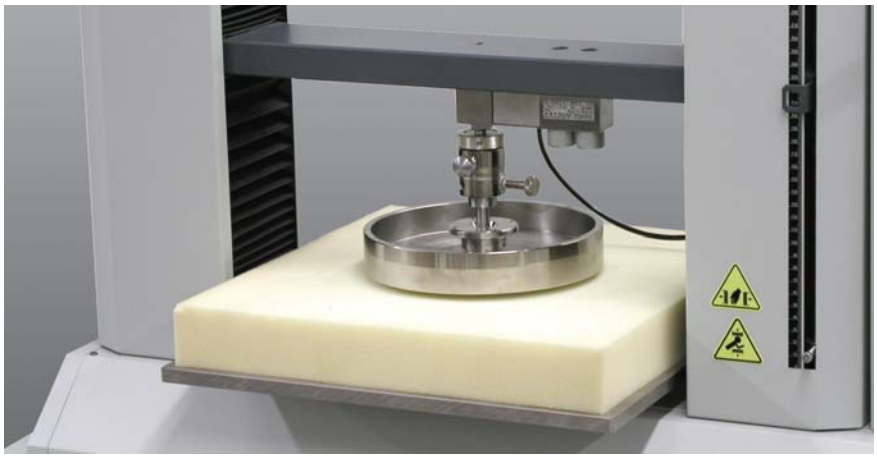
Depending on the standard in question, square specimens with an edge length of 50 or 100 mm are tested. The lower, perforated compression platen must be larger than the specimen's cross-section. It is therefore available in different sizes.

The table plate of the materials testing machine Z005 and Z010 with C-frame is designed as compression platen. The upper, non-perforated compression platen is rigidly fixed.

Tooling for the determination of the indentation hardness

This test is also carried out on flexible cellular materials. The upper compression platen however has a spherical seating. It has a diameter of 203 mm. The lower compression platen must be perforated.

Determination of the compression properties



Determination of the indentation hardness

Zwick / Roell

Tooling for flexural tests

Flexure tests are carried out with specimens of different dimensions on thermoset and thermoplastic materials, composites etc. and in accordance with different standards. Accordingly, there is a large number of components the test unit in question can be comprised of:

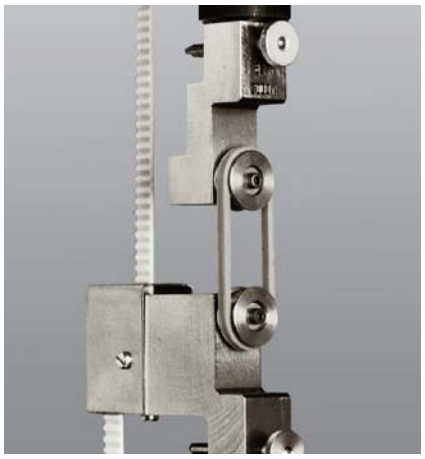
- Tables for 3-point and 4-point flexure tests with manual or motorized setting of the support span and for different test load levels
- Flexure die with different flexure die radii
- Flexure supports with different support radii and with fixed or rotatable bearing

Ring testing device

The rubber rings are wrapped around two pulleys with defined diameters. One pulley is turned synchronously to the crosshead movement.

Pulley diameter:

ISO 37:	22.3/4 mm
DIN 53504:	22.3/18.3 mm
ASTM D 412:	4.75 mm



Ring testing device

Flexure tool according to ISO 178

Celanese compression test fixture

This test fixture, standardized in ISO 14126, prEN 2850, DIN 65380 and former versions of ASTM D 3410, is designed for compression tests on long fibre reinforced composites. The test fixture is placed in between two compression platens, and the compression deformation can be measured by strain gages or special extensometry. Various jaw inserts and wedges are available to comply with various specimen dimensions and geometries.

Classic Celanese test fixture

Hydraulic composites compression test fixture, HCCF

Zwick offers a new and innovative hydraulic compression test fixture for testing of large numbers of specimen.

Advantages are:

- Time saving, resulting from the improved specimen handling compared to traditional Celanese or ITTRI test fixtures.
- The bending influences during the clamping process are virtually eliminated.
- This test fixture complies with various test standards as well as different specimen geometries.

The test is carried out with reference to the procedures in ISO 14126, prEN 2850, DIN 65380 and QVA-Z10-46-38, with the advantage that the following speci-men dimensions can be tested:

Specimen width:	6.35 to 35 mm
Specimen thickness:	up to 6.6 mm
Clamp distance:	up to 35 mm
Length of clamps:	65 mm each

The compression fixture can be used in shear loading mode, in end loading mode or in a mixed mode combining both.

The hydraulic compression test fixture HCCF allows rapid testing

Zwick / Roell

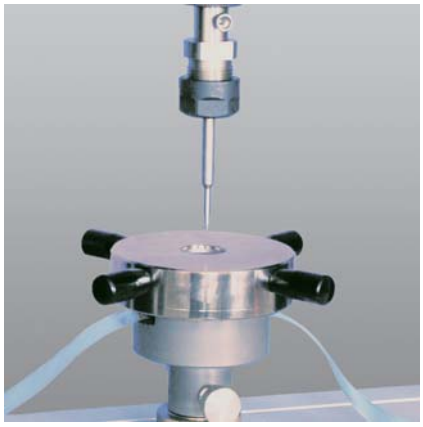
Unit for 90° peel tests

For the determination of adhesive forces e.g. on glued joints, sealings, adhesive tapes etc., the specimen is applied to a rigid base material and is then peeled off at a constant angle of 90°. The peeling force is measured and evaluated.

90° peel test unit

Puncture test device

For tests on packaging foils, the specimen, clamped in the lower specimen holder is penetrated by an exchangeable indentor. The puncture force is measured and evaluated.



Puncture test device acc. to EN 14477

Toggle grips

These grips are particularly suitable for thin, strip-shaped plastic films. Its ends are wrapped around round bolts (functioning as cam plates) by 180 degrees. These round bolts are acting at the same time as a gripping jaw actuated by the tensile force.

Toggle grips

Equipment for the determination of the coefficients of friction (COF)

Unit for the determination of the coefficients of friction

For the determination of the static and dynamic coefficient of friction, the specimen is clamped on a horizontal mirror glass table and a defined weight is put onto it. This weight is pulled over the specimen via a deflection pulley. This tensile force is measured and evaluated.

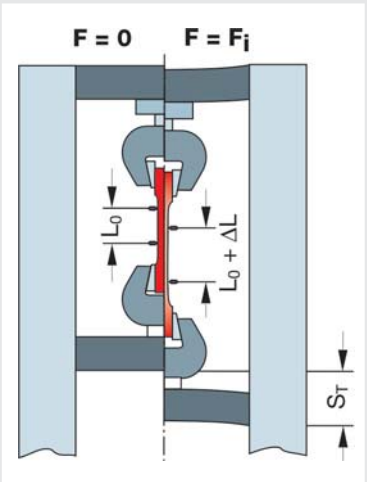
Zwick / Roell

Extensometers

In tensile tests the extension versus the tensile force has to be measured; in special cases the reduction in width also has to be measured. In flexure tests, the measured quantity is the deflection. Different specimen shapes and dimensions, material properties (strength, rigidity, extensibility etc.) and material characteristics to be determined, measuring accuracies etc. require different extensometers.

Crosshead travel monitor

Each Zwick standard or allround materials testing machine is equipped with a standard digital crosshead travel monitor. Its measuring signal is primarily used to measure the current value for the position and speed control of the drive system. It is however also used for the indirect extension measurement as for example for the determination of the nominal strain in accordance to ISO 527 (determination of the tensile properties of plastics).



With the crosshead travel S_T (indirect extension measurement) not only the extension ΔL of the gauge length L_0 is measured, but also the deformation of the testing machine and specimen parts outside the gauge length.

This indirect measurement is suitable for many compression, indentation hardness, flexure, tear and shear tests, and also for tensile tests on ring and strip-shaped specimens made of materials with a high elongation.

However, for tests on dumbbell specimens for the determination of the tensile modulus and other extension-dependent characteristic values in a deformation range up to the yield point, the standards require the direct extension measurement. (Remark: For the acquisition of single-point-data in the framework of ISO 10350-1, only strains up to 50 % are relevant.)

Analogue clip-on extensometers

(clip-on, manual)

The resolution of these extensometers that can be attached manually or automatically (option) to the specimen, is extremely high, but the test travel is relatively short. Therefore they are predominantly used for the high-precision determination of tensile modules and Poisson's ratio (ISO 527-1) on rigid and reinforced plastics – measuring at the same time the extension and the reduction in width.

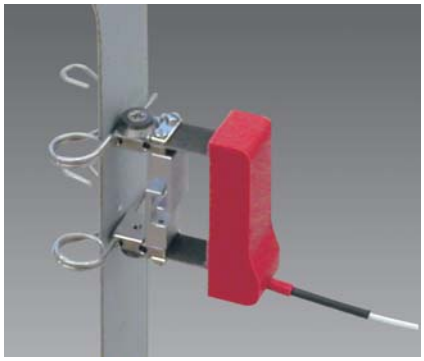
Advantages of the extension measurement:

- High-resolution measurement of the tensile modulus according to ISO 527-1 and ASTM D 638
- Resolution better than 0.02 µm at a test travel of ±2 mm
- Optional counterbalancing (compensation of the extensometer weight)
- Used at ambient temperature or at a temperature range from -70 °C to +220 °C

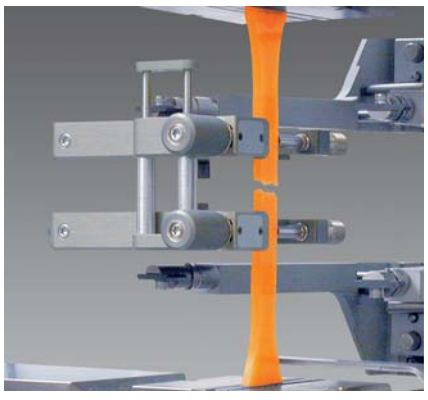
Advantages for the reduction-in-width measurement:

- Determination of Poisson´s ratio on fibre-reinforced composites according to ISO 527-1
- Resolution better than 0.01 µm at a test travel of ±4 mm
- Choice of different measuring pins for adaptation to the specimen dimensions

Analogue clip-on extensometer



Analogue clip-on extensometer



Analogue reduction-in-width monitor

Zwick / Roell

Digital clip-on extensometers

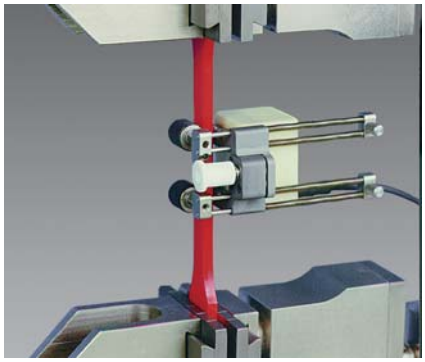
These extensometers are manually attached to the specimens and have a high resolution and a relatively long test travel. Therefore, they can be used for the precise determination of the tensile modulus and the yield point according to ISO 527-1 and ASTM D 638 on rigid and semi-rigid plastics. When testing rigid plastics showing a low extension, even the elongation at max. force and the elongation at break may be determined.

Advantages:
- Measuring range until beyond the yield point
- High-resolution determination of the modulus according to ISO 527-1 and ASTM D 638
- Suitable for tensile, compression and creep tests
- Attaches directly to the specimen
- Measurement up to specimen break without removing the extensometer
- Also available as reduction-in-width monitor and as biaxial system

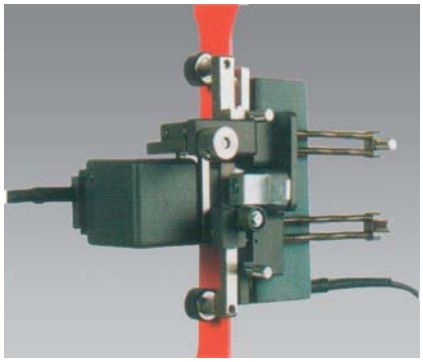
Macro extensometer

This digital extensometer is used for tensile, compression, flexure and cyclic tests on plastics, composites and rigid cellular plastics showing small to medium extensions. It is also useful for thin sheet, plastic films and flexible cellular plastics if optical measuring methods are not required.

Advantages:
- Automatic setting of the gauge length
- Automatic attachment and detaching of the sensor arms
- Low drag forces of the sensor arms
- Deformation measurement up to specimen break without detaching the sensor arms (rotatable knife edges)
- Crosshead contact/collision protection
- Exchangeable sensor arms for tensile, compression and flexure tests
- Suitable for measurements in temperature chambers
- Suitable for the determination of the modulus according to ISO 527-1 and ASTM D 638



Digital clip-on extensometer



Bi-axial digital extensometer

The Macro-extensometer covers all standard requirements for a wide range of plastics

Digital clip-on extensometers

	Usual variant	Extended variant	Reduction-in width	Bi-axial extensometer
Measuring system	Digital	Digital	Digital	Digital
Measuring range				
Tensile, mm	13.5 / 8.5 mm	40 / 35 mm	-	40 / 35 mm
Compression, mm	0.2 / 5.2 mm	0.2 / 5.2 mm	-	0.2 / 5.2 mm
Width, mm	-	-	1.5 / 11.5	1.5 / 11.5
Gauge length, mm	20/25/30/ 50*/80* 25.4/50.8	50/55/65/70/80* 85*/100*/105 50.8	-	80
Specimen width, mm	-	-	10 / 20	10 / 20
Temperature range, °C	10 ... 35	10 ... 35	10 ... 35	10 ... 35
Resolution, µm	0.1	0.1	0.1	0.1
Accuracy (ISO 9513)	Class 0.5	Class 0.5	Class 0.5	Class 0.5

* with extension parts

Zwick / Roell

multiXtens extensometer

Fully automatic, multifunctional and high-resolution digital extension measurement system for tensile, compression, flexure and creep tests as well as for cyclic tests on materials which have low to high extensions, e.g. all kinds of plastics, foams, thin sheet and plastic films, composites, rubber and elastomers which do not wrap around the sensor arms in case of failure.

Advantages:
- Easy-to-use technology
- Automatic gauge length setting
- Automatic attachment
- Automatic centering between the specimen grips
- Very low drag force
- Deformation measurement until specimen break without detaching the sensor arms
- Crosshead crash protection
- Exchangeable sensor arms for tensile, compression and flexure tests
- Suitable for measurements in temperature chambers
- Suitable for the determination of the modulus according to ISO 527-1 and ASTM D 638

The multiXtens-extensometer combines high-resolution and long-stroke measurement

optiXtens extensometer

Fully automatic high-resolution, optical extensometer using the Laser Speckle method. It is used for tensile, compression and creep tests as well as for cyclic tests on non-transparent materials with low to high extensions both at ambient temperature and in connection with temperature chambers.

Advantages:
- Direct measuring optical system which does not require measurement marks
- Easy-to-operate
- No influence of drag forces
- Secure and accurate deformation measurement until specimen break
- Particularly suitable for measurements in temperature chambers
- Suitable for the determination of the modulus according to ISO 527-1 and ASTM D 638, also in temperature chambers

The optiXtens measures the extension without specimen marking

videoXtens extensometer

Contact-free high-resolution extensometer for tensile and compression tests on all kinds of plastics, rubber, composites, sheets and plastic films. Resolution and measuring range can be easily adapted to the prevailing test conditions by selecting suitable easy-to-change objectives.

Advantages:
- Adaptable to various materials and test conditions
- Optical, contact-free measuring system for the testing of plastic films on dumbbell specimens according to ISO 527-3
- Suitable for the determination of the modulus according to ASTM D 638
- Secure and accurate extension measurement until specimen break.
- Automatic gauge length recognition
- Suitable for measurements in temperature chambers through a heated glass window.

The videoXtens is adapted to the test by selecting suitable field of view

Zwick / Roell

Mechanical long-travel extensometer

It is designed for the measurement of higher extensions on plastics, rubber and elastomers, cellular materials, plastic film and thin sheet with maximum forces greater than approx. 20 N. A rigid and non-sensitive system which is particularly suitable for the testing of rubber and elastomer specimens showing a tendency to wrap around the sensor arms after specimen break.

Advantages:
- Robust, digital and easy-to-use technology
- Particularly developed for tests on elastomers and rubber
- Measurement until specimen break without detaching the sensor arms (rotatable knife edges)
- Self-identifying sensor plug
- Exchangeable sensor arms
- Suitable for measurements in temperature chambers

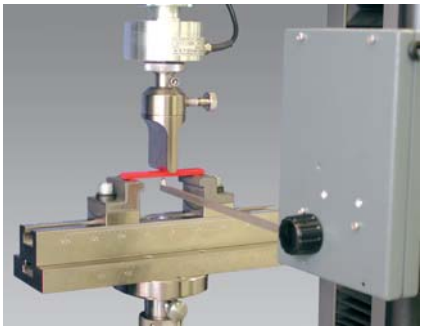
Optical long-travel extensometer

Contact-free, digital extensometer for tensile tests on rubber, elastomers, flexible cellular materials, thin sheet and plastic film at ambient temperature and in temperature chambers through a heatable window.

Advantages:
- Proven, easy-to-use measurement system for high elongation materials
- Secure and accurate measurement until specimen break
- Self-identifying sensor plug
- No influence of drag forces
- Suitable for measurements in temperature chambers through a heated glass window.

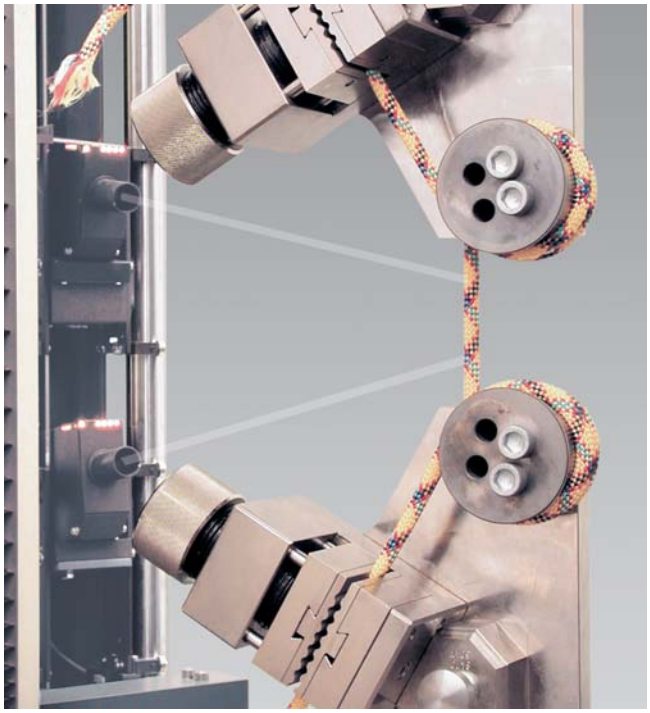
Transducers for 3-point flexure tests according to ISO 178, ASTM D 790 and ISO 14125

With this simple and easy-to-use mechanical transducer, deflection is directly measured below the specimen. The sensor arm is attached manually or automatically (option) to the specimen.



The 3-point flexure transducer has been developed particularly for this test

The mechanical long-travel-extensometer is designed for measurements on rubber and plastics.



The optical long-travel-extensometer allows a contact-free measurement of the specimen marks attached on the specimen

Zwick / Roell

Extensometer, technical data

	Macro	multiXtens	optiXtens	videoXtens[1]	Mechan. long travel	Optical long travel	Laser
Measuring system	Digital	Digital[2]	Laser-Speckle	Image processing	Digital	Digital	Rotating laser
Measuring range, mm	min. 75 max. 160	700 – L_0	500 – L_0	50...200 (field of view)	1000 – L_0	1000 – L_0	approx. 400
Resolution, µm	0.12...0.6	0.02...0.04	0.1	1	5	5	12
Accuracy (ISO 9513)	Class 1	Class 0.5/1[4]	Class 0.5	Class 1	1% or 0.01 mm[3]	1% or 0.03 mm[3]	Grade B (ISO 5893)
Gauge length, mm	10 to 100/205	≥5	≥10	≥5	10...1000	10...900	≥10 (tensile) ≥20 (compr.)
Drag force, N	≤0.050	≤0.015	none	none	≤0.20	none	none
Motorized sensor arm attach.	Optional	yes	yes	-	yes	yes	-
Autom. pre-set of L_0	Optional	yes	yes	-	yes	yes	-

[1] Data for 25 mm-lens, [2] 2 measuring ranges, [3] whatever is greater, [4] dependent on the feelerarm length

Indications for the choice of extensometers and deformation transducers

Application		Extensometer type											
Test results	Standard	Reduct.-in -width transducer (anal.)	Analogue clip-on extensometer	Incremental clip-on extensometer	Macro	multiXtens	optiXtens	Opt. long stroke extensometer	Mech. long stroke extensometer	Laser-extensometer	videoXtens[1]	3-pt flexural transducer	Crosshead travel monitor
Poissons ratio	ISO 527	•	-	-	-	•	-	-	-	-	-	-	-
Tensile modulus	ISO 527	-	•	•	•	•	•	-	-	-	•	-	-
Compr. modulus	ISO 604	-	•	•	•	•	•	-	-	-	-	•	-
Flexural modulus	ISO 178	-	-	-	•	•	-	-	-	-	-	•	x
Tensile creep modulus	ISO 899-1	-	•	•	•	•	•	-	-	-	•	-	-
Flexural creep modulus	ISO 899-2	-	-	-	•	•	-	-	-	-	-	•	x
3,5% flexural strain	ISO 178	-	-	-	•	•	-	-	-	-	-	•	x
Deflection at break	ISO 178	-	-	-	•	•	-	-	-	-	-	•	x
Strain at yield point	ISO 527	-	-	o	•	•	•	•	•	-	•	-	-
	ISO 37	-	-	-	•	•	•	•	•	•	o	-	-
Stress at X% strain	ISO 527	-	-	o	•	•	•	•	•	-	•	-	-
	ISO 37	-	-	-	o	•	•	•	•	•	•	-	-
Strain at max. force.	ISO 527	-	-	o	o	•	•	•	•	-	•	-	-
	ISO 37	-	-	-	o	•	•	•	•	•	•	-	-
Strain at max. force, strips	ISO 527-3	-	-	-	o	•	•	•	•	-	•	-	•
Strain at break	ISO 527	-	-	o	o	•	•	•	•	-	•	-	-
	ISO 37	-	-	-	o	•	•	•	•	•	•	-	-
Strain at break, strips	ISO 527-3	-	-	-	o	•	•	•	•	-	•	-	•
Nominal strain	ISO 527	-	-	-	-	-	-	-	-	-	-	-	•
	ISO 604	-	-	-	-	-	-	-	-	-	-	-	•

[1] = The lenses of the video extensometer can not be changed while testing
o = Only useful if the strain does not exeed the range of the extensometer
x = Measurements using the crosshead displacement show lower results due to the system deformation and contact pressure on the specimen
• = Convenient system

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Testing in Hot and Cold Conditions

Many types of plastic and rubber materials significantly change their mechanical properties depending on the temperature. For some thermoplastic materials it is known that the modulus value can change about 3 to 4 % for 1°K.

According to the longterm use of materials, especially in automotive and aeronautic industries, it is very important to know the behavior of materials in different environmental conditions.

Temperature chamber, optiXtens extensometer and pneumatic grips mounted in a material testing machine Z005

Temperature chambers

Zwick temperature chambers show the following characteristics:

- Aperture for extensometer sensor arms on the rear left side (except for chambers without cooling)
- Digital temperature control unit with display for actual value and set value.
- Illumination inside the chamber
- Front door with insulated window
- Removable segments for moving the chamber back without removing the grips
- Insulating and electrical design meet the CE requirements for safety

Available options

Several options are available according to the specification of the testing machine and the needs in the laboratory.

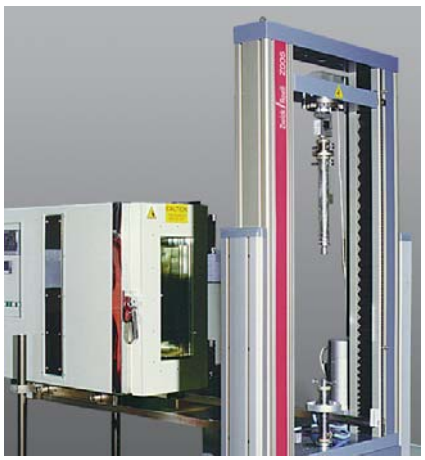
- heatable optical glass insert when using optical extensometers
- guiding rails or trolley to move the chamber out of the test area
- temperature measurement and control by *testXpert*® software via RS 232 interface
- direct temperature measurement and control on the specimen
- liquid nitrogen tank, 100 litres, with pressure device, control valve, filling level indicator and security device.

Zwick / Roell

Temperature chambers

Use with		Table top and floor standing load frames			Only for floor standing load frames	
Height		usual	extended	extended	usual	extended
Width		usual	usual	usual	extended	extended
Dimensions (external / internal)						
Height, mm		650 / 500	850 / 700	1050 / 900	800 / 650	1000 / 850
Width, mm		400 / 255	400 / 255	400 / 255	600 / 450	600 / 450
Depth, mm		840 / 360	840 / 360	840 / 360	1044 / 542	1044 / 542
Power supply		230 V / 3 kVA	230 V / 3 kVA	230 V / 3 kVA	400 V / 4 kVA	400 V / 4 kVA
Type of cooling	**Temp. °C** [2]	**Reference**	**Reference**	**Reference**	**Reference**	**Reference**
No cooling	amb. /+250	B091260 [1]	B091265 [1]	-	-	-
CO_2	-60 /+250	W91251	W91256	-	W91117	W91118
N_2	-80 /+250	W91250	W91255	W91270	W91122	W91123

[1] Without opening for mechanical or optical extensometers, without removal sliders
[2] Zwick supplies further temperature-ranges on request



Temperature chambers are usually mounted on guide rails

Segments for removing the chamber without removing the grips

The controller and the opening for extensometers on the rear left side

Refrigeration by liquid nitrogen (LN_2) or carbon dioxide (CO_2)

This type of cooling is advantageous if required from time to time only. The cooling effect is generated by vaporizing the liquid nitrogen or carbon dioxide. Even if these gases are non-toxic, a sufficient ventilation of the test laboratory is absolutely neccessary.

The consumption depends on the size of the chamber and its capacity.

For standard applications the consumption values are as follows:

Temperature	–20 °C	–80 °C
LN_2, l/h	appr. 10	appr. 20
CO_2, kg/h	appr. 20	appr. 40

The consumption costs for CO_2 are usually higher than for LN_2.

The optional 100 litres LN_2 tank is sufficient for several hours of tests.

Nitrogen connector: 3/8" Whitworth

Optical extension measurement in a temperature chamber

Zwick / Roell

Automatic Specimen Feeding

Automatic specimen feeding systems are mainly used for the efficient testing of very large series, especially in research centers where statistically safe results are needed.

Specimen feeding systems are available in different task-specific designs for plastic and rubber testing. (see table below)

They are designed for executing different test-types alternatively, i.e. tensile and flexural, as well as testing alternatively different materials, i.e. thermoplastics and cellular materials.

Benefits of automatic testing

- user-independent test results
- improved reproducibility
- more test capacity as the systems can run “ghost-shifts” during the night and weekends
- one-task handling systems are very simple to operate by different users
- good/bad sorting of broken specimen
- magazine filling is possible while the system is running
- manually controlled tests are also possible
- simply adapted and expanded to specific requirements
- short pay back time

“roboTest B”

This compact system allows testing of smaller batches in a fully automatic mode. In addition, the testing machine can easily be operated in manual mode if required.

This robotic testers can perform flexural as well as tensile tests.

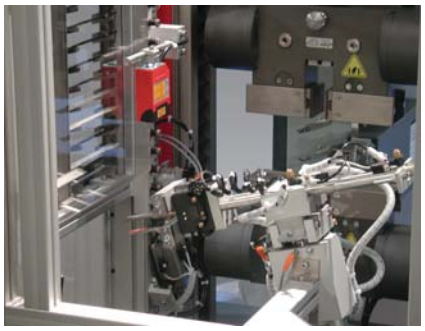
The “roboTest B“ tester can switch from tensile to flexural tests.

Specimen feeding systems

System		roboTest	A	B	F	L	L(Ring)	P	R	I
N° of storage places, standard			5 to 20	5 to 20	100 to 200	150 to 450	50 / 300	100 to 400	up to 200	up to 25
Test	Tensile		●	●	●	●	●	●	●	-
	Compression		-	-	-	-	-	●	●	-
	Flexural		-	●	-	●	-	●	●	-
	Tear		-	-	●	-	-	●	●	-
	Creep		●	●	-	●	-	●	●	-
	Charpy/Izod		-	-	-	-	-	-	●	●
	Multiaxial impact		-	-	-	-	-	-	●	-
	Hardness		-	-	-	●	-	-	●	-
Material	Plastic film, sheetings		-	-	●	-	-	-	-	-
	Flexible materials		-	-	●	-	-	-	●	-
	Rigid and semi-rigid plastics		●	●	●	●	-	●	●	●
	Composites		●	●	●	●	-	●	●	●
	Foam		-	-	-	-	-	●	●	-
	Rings (Rubber)		-	-	-	-	●	-	-	-
Specimen dimensions, mm										
	Shoulder or strip width		6 to 25	6 to 25	10 to 50	6 to 25	-	all	all	max. 10
	Thickness		max. 15	max. 15	max. 5	max. 15	4 to 6	all	max. 10	max. 10
	Over-all length		max.260	max.260	max. 350	max. 260	-	max. 350	max. 350	max. 55
Options										
	Thickness measurement		-	-	-	●	●	●	●	●
	Cross-section measurement		-	-	-	●	-	●	●	-
	Barcode identification		●	●	●	●	-	●	●	●
	Temperature chamber		-	-	-	-	-	-	●	●

Zwick / Roell

“roboTest A”



“roboTest A” - up to 20 specimens can be loaded into the magazine.

The “roboTest A” system inserts the tensile test specimen into the testing machine and means that the operator effort is minimized and the statistical scatter of test results is greatly reduced.

“roboTest F”

“roboTest F” is perfect for testing flexible specimens, i.e. plastic film.

The “roboTest F” is a two-axis system with a rotating clip carrier for holding the specimens. The clips are positioned outside the gauge length to avoid damage to the specimen.

In many cases the broken specimen can be returned to the magazine after testing.

“roboTest L”

Variant of “roboTest L” for testing of ring-type rubber specimen

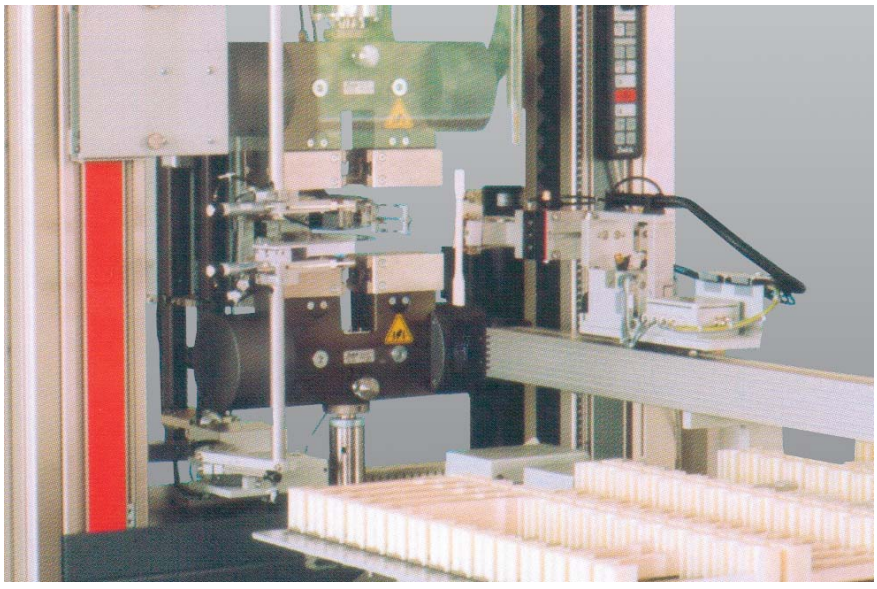
The “roboTest L” tester uses pneumatic or pincer grips for testing materials such as thermosets and thermoplastic materials, composites, rubbers, elastomers and cellular materials. It has been designed for tests on tensile, flexural and angle tear specimens.

The fully functional unit comprises options for a barcode reader, specimen magazine, multi-axis handling system, and automatic cross section or width measurement.

A variant of the “roboTest L”is designed for testing ring-type rubber specimens. A thickness measurement station measuring at three positions is then included.

“roboTest P”

This system is used when larger specimens, for example compression specimens of cellular plastics need to be tested in addition. This product covers the range of the “roboTest L” but includes more storage space for specimens and additional options such as an instrumented ball indentation hardness tester.



“roboTest L“ for tensile and flexural tests: High storage capacity for testpieces to run the system overnight or at the weekend.

Zwick / Roell

“roboTest R”

“roboTest R”: The illustrated system integrates tensile, flexural, and Izod testing.

This product is based on an industrial robot with high flexibility and positioning accuracy.

It is currently used for more complex processes such as testing in above or below ambient conditions using a temperature chamber.

The “roboTest R” can integrate several tests into one sequence. For example running tensile, flexural, hardness and impact tests in parallel within the same system.

“roboTest I”

For pendulum impact tests, pre-testing conditions such as specimen temperature as well as automated feeding of the specimen in to the impact tester can easily be carried out with the “robotest I”.

Tests according to the Charpy method can be performed, and depending of the type of cooling, temperatures down to -60°C or even -180°C can be achieved.

Additional applications

Zwick supplies a vast range of robotic equipment for materials testing:

- Izod and Charpy including temperature devices
- Hardness testers
- Notching of Charpy and Izod specimens
- Component testing

“roboTest I”: Charpy impact testing with a large temperature range.

Zwick / Roell

Servohydraulic Testing Machines

Field of Application

Servohydraulic testing machines are used extensively for universal dynamic testing, and materials testing applications requiring very accurate measurement and control.

Typical applications

- Dynamic analysis and characterisation of rubber mountings, airsprings and elastomer dampers
- Characterisation of plastics, fibre reinforced and composite materials
- Durability testing of synthetic materials and components
- Dynamic peel and separation tests on bonded materials and adhesive tapes

Unique Features

Zwick universal servohydraulic testing machines combine structural rigidity with precise alignment to guarantee test data of the highest possible integrity.

All load frames boast smooth hard chromium plated columns, friction clamped by one-piece cross heads producing a structural platform of exceptional stiffness and rigidity with infinite fatigue life at rated capacity.

The testing machines are equipped with high performance fatigue rated servo-hydraulic actuators, available with hydrostatic bearings or polymer based plain bearings. Displacement transducers are mounted concentrically inside the actuator body. Machines are matched with hydraulic power units and servovalves to ensure application specific performance and efficiency.

Load Frames

- Type HA
  The actuator is semi-integrated into the lower crosshead. Hydraulic adjustment and clamping of the upper crosshead are available on all models.

- Type HB
  The actuator is mounted in the upper crosshead. The HB design proves a flexible test space for optimal specimen mounting possibilities. Hydraulic adjustment and clamping of the upper crosshead are available on all models.

Servo-hydraulic testing machine
Amsler HC 5 for testing rubber mountings

- Type HC
  These tabletop test machines are designed to be of a lightweight construction, with very high frame stiffness. The actuator is mounted in the upper crosshead resulting in a versatile frame, which can be tailored to customer requirements. Hydraulic upper crosshead adjustment is optional. The optional T-slotted table allows easy mounting of components.

Measurement and control

Unrivalled performance is offered using the HydroWin 96xx controller series

- 10 kHz closed loop control and data acquisition
- 19 bit A/D conversion with real time linearisation
- Real-time derive channels MIMICS advanced adaptive control for non-linear test applications
- Environmental control
- Multi-channel control
- Adaptive controller for non-linear applications
- 32 bit function generator

Servo-hydraulic testing machines
standard designs[1)]

Model[2)]	HC	HB	HA
• Construction form	table top	floor standing	floor standing
• Nominal force, kN	5 – 25	50 – 1000	50 – 500
• Testing stroke, mm	100	100 / 250 / 400	100 / 250
• Specimen length, mm	100 – 700	100 – 1100	250 – 1500
• Hydraulic power pack			
* System pressure, bar	210 / 280	210 / 280	210 / 280
* Throughput, l/min	5 – 23	8 – 270	8 – 270
• Max. power consumption, kVA	4.2 – 11	6.6 – 230	6.6 – 230

[1)] Load frames can be supplied for higher forces, different dimensions and testing strokes
[2)] Piston located below (HA) or above (HB, HC) the working area

Zwick / Roell

High Speed Testing Machines

High-speed testing machines are used especially for high-rate puncture impact and other materials tests requiring high testing speeds.

High-Speed Testing Machines Standard models*

Model	Amsler HTM			
	2512	2520	5012	5020
• Rated force, kN	25	25	50	50
• Speed, m/s	12	20	12	20

* Other sizes and speeds available upon request.

Examples of applications:

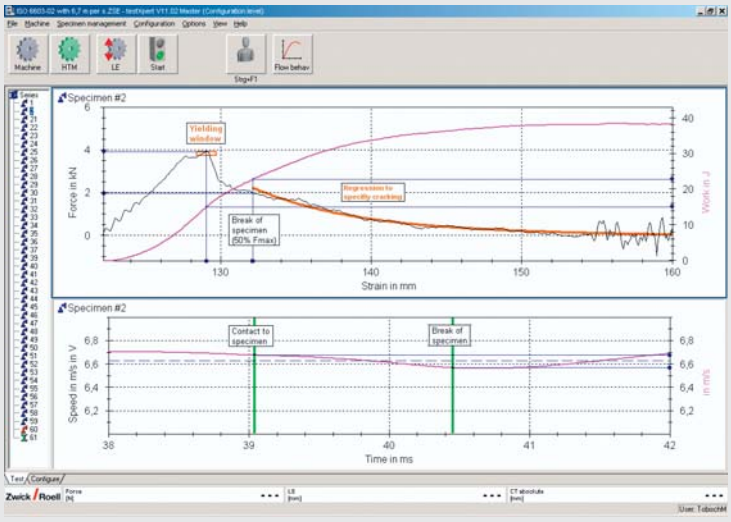
- Instrumented multiaxial impact tests according to ISO 6603-2 and ASTM D 3763
- Determination of tensile properties at high strain rates, ISO/DIS 18872
- Instrumented impact tests on semi-finished products and components

Characteristic features:

- Design as two or four column single test area load frame
- Hydraulic or mechanical clamping and adjustment of the upper crosshead
- Built-in working cylinder
- Fixed lower crosshead to be used as a clamping table
- Loading unit in shock absorbing construction to reduce vibration or shock transmission to the floor
- Double operation cylinder for tensile of compression loading
- Piston without sealing rings
- Double-sided hydraulic end-position damping of the piston
- Optional kit for transforming the high-speed testing machine into a servo hydraulic-dynamic testing machine for cyclic or monotonic quasi-static tests.

Testing in hot and cold conditions

High speed testing machines can be used in a large temperature range. (see chapter Temperature chambers)



testXpert® shows all relevant data of an instrumented puncture impact test

High-speed testing machine equipped for multiaxial impact tests

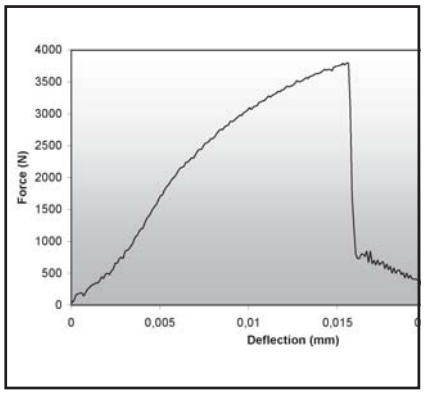
Zwick / Roell

Falling weight testers

Falling weight testers are used to determine the dynamic behavior of materials within a limited speed range from about 3 m/s. The following tests can be performed with the instrumented Falling weight tester HIT230F:

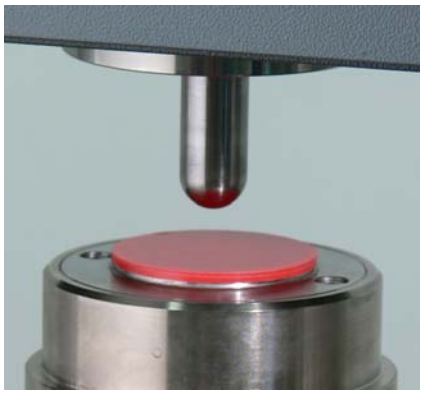
- Multiaxial impact tests according to ISO 6603-2, ISO 7765-2, and ASTM D 3763 at ambient and non-ambient conditions.

The drop height of 1 m allows impact speeds of up to 4.43 m/s.



High resolution and natural frequency provide outstanding force signal quality.

Instrumented multiaxial impact test



Specimens are pneumatically clamped for the multiaxial impact tests.

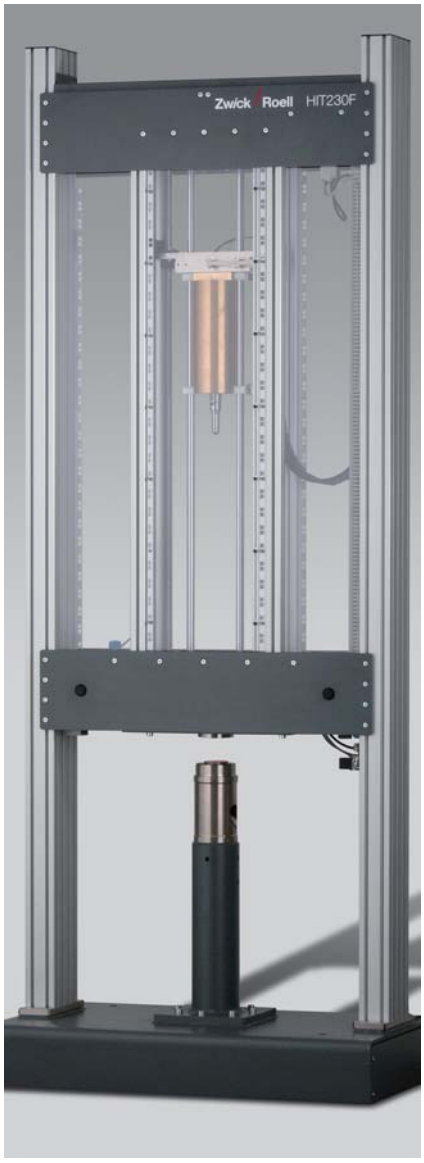
The plate-type specimens to be tested are held with a pneumatic clamping device and then impacted by an instrumented tup of standardized diameter with hemispherical tup insert.

Depending on the standard, different tups and clamping rings are available. During the test the load-time signal is measured. The force-travel signal as well as the energy consumed during impact can be calculated from this data by the software. The potential energy of the falling weight tester must be at least 2.78 times larger than the consumed energy to ensure that the speed-drop during impact remains less than 20% as required by most standards.

Test specimen can be cooled in a cooling box and then tested within 4 to 5 seconds due to the good accessibility.

Technical Data:

Maximum Energy	230 J
Drop height:	0.1 to 1 m
Falling weight	23 kg
Load signal resolution	16bit
Elect. connection	85 to 132 VAC 170 to 264 VAC
Power	500 W



The instrumented Falling weight tester HIT 230 F is fast and simple to operate.

Zwick / Roell

Pendulum Impact Testers

HIT pendulum impact testers are powerful instruments, designed to meet the exact specifications of international standards in every respect. These instruments are the ultimate in reliability for both research and quality control.

ISO 13802 compliant
The base of the tester is made of vibration damping cast iron. It is fully compliant to the Standards regarding the frame-pendulum mass ratio. Three heavy duty levelling feet ensure solid installation as well as levelling capability.

Pendulum Recognition
Each installed pendulum is automatically recognized by the electronics to ensure that the correct pendulum is used for each test.

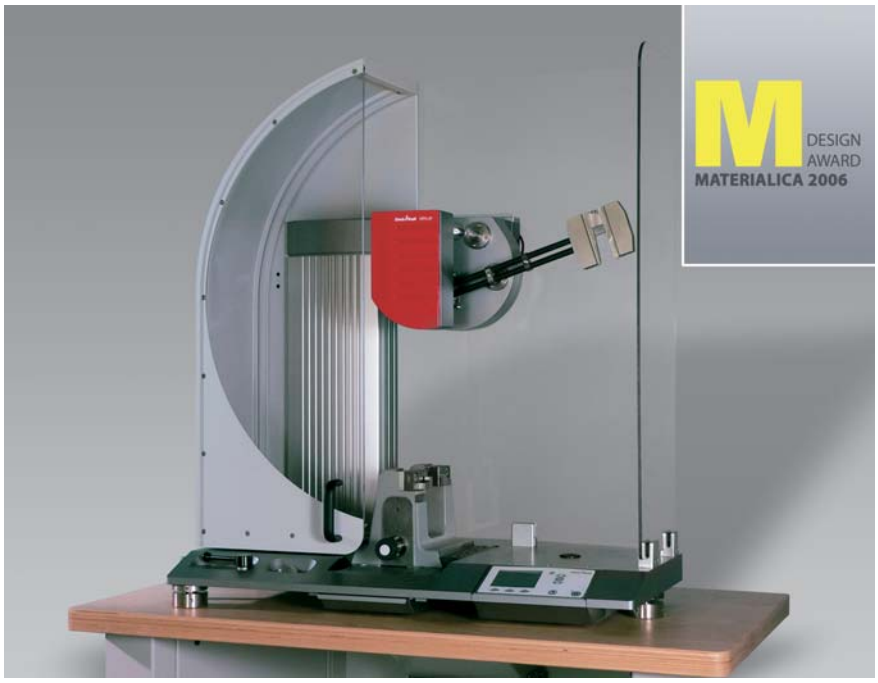
Ergonomic design
All important operating elements such as keyboard, brake, release lever and display are all within easy reach of the operator.

Pendulum change without tools
Each pendulum is equipped with a quick change unit. Changing of pendulums can be carried out quickly without special tools.

Pendulum Impact Tester HIT5P for testing according to ISO standards.

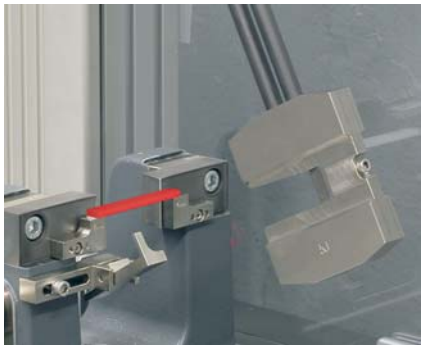
Universal Pendulum Impact Tester HIT 50 P with CE-conforming safety housing and motorized pendulum lift.

Changing test method
The vices for the different methods are securely guided and clamped with dovetail grooves. Whilst enabling the tester to be quickly setup for each type of test, it also guarantees a perfect connection between the support and the frame of the impact tester.



The universal Pendulum Impact Tester HIT5.5P can perform Charpy, Izod, Tensile Impact and Dynstat impact tests according to ISO, ASTM and DIN standards.

Zwick / Roell



Charpy test

Izod test

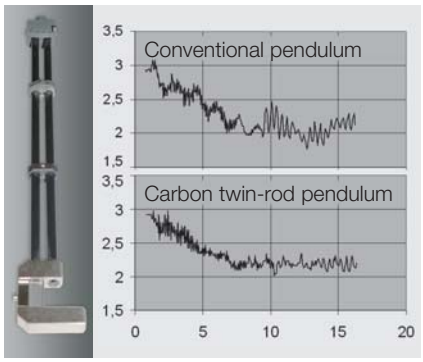
Tensile-impact test ISO method A

Dynstat test

Standard requirements					HIT 5 P		HIT 5.5 P		HIT 25 P		HIT 50 P	
Method	Standard	Pendulum energy J	Pendulum energy ft lbf	Velocity at impact m/s	Stand Alone	PC	Stand Alone	PC	Stand Alone	PC	Stand Alone	PC
Charpy	ISO 179	0.5	0.37		•	•	•	•	•	•	•	•
		1	0.74		•	•	•	•	•	•	•	•
		2	1.48	2.9 m/s	•	•	•	•	•	•	•	•
		4	2.95	(±10%)	•	•	•	•	•	•	•	•
		5	3.69		•	•	•	•	•	•	•	•
		7.5	5.53		-	-	-	-	•	•	•	•
		15	11.1	3.8 m/s	-	-	-	-	•	•	•	•
		25	18.4	(±10%)	-	-	-	-	•	•	•	•
		50	36.9		-	-	-	-	-	-	•	•
	ASTM D 6110	0.5	0.37	approx.	-	-	•	•	•	•	•	•
		1	0.74	3.46 m/s	-	-	•	•	•	•	•	•
		2.7	2		-	-	•	•	•	•	•	•
		5.4	4		-	-	•	•	•	•	•	•
		10.8	8	(Height of fall:	-	-	-	-	•	•	•	•
		21.6	16	610±2 mm)	-	-	-	-	•	•	•	•
Izod and „Unnotched cantilever beam impact“	ISO 180	1.0	0.74		-	-	•	•	•	•	•	•
		2.75	2.03	3.5 m/s	-	-	•	•	•	•	•	•
		5.5	4.06	(±10%)	-	-	•	•	•	•	•	•
		11	8.11		-	-	-	-	•	•	•	•
		22	16.2		-	-	-	-	•	•	•	•
	ASTM D 256 / D 4812	1.0	0.74	approx.	-	-	•	•	•	•	•	•
		2.75	2.03	3.46 m/s	-	-	•	•	•	•	•	•
		5.5	4.06		-	-	•	•	•	•	•	•
		11	8.11	(Height of fall:	-	-	-	-	•	•	•	•
		22	16.2	610±2 mm)	-	-	-	-	•	•	•	•
Tensile impact	ISO 8256 – method A	2,0	1.48	2.9 m/s	•	•	•	•	•	•	•	•
		4.0	2.95	(±10%)	•	•	•	•	•	•	•	•
		7.5	5.53		-	-	-	-	•	•	•	•
		15.0	11.1	3.8 m/s	-	-	-	-	•	•	•	•
		25.0	18.4	(±10%)	-	-	-	-	•	•	•	•
		50.0	36.9		-	-	-	-	-	-	•	•
Tensile impact – „tensile-in-head“ method	ISO 8256 – method B	2.0	1.48	2.9 m/s	-	-	•	•	•	•	•	•
		4.0	2.95	(±10%)	-	-	•	•	•	•	•	•
		7.5	5.53		-	-	-	-	•	•	•	•
		15.0	11.1	3.8 m/s	-	-	-	-	•	•	•	•
		25.0	18.4	(±10%)	-	-	-	-	•	•	•	•
		50.0	36.9		-	-	-	-	-	-	•	•
	ASTM D 1822	2.7	2	approx.	-	-	•	•	•	•	•	•
		5.4	4	3.46 m/s	-	-	•	•	•	•	•	•
		10.8	8	(Height of fall:	-	-	-	-	•	•	•	•
		21.6	16	610±2 mm)	-	-	-	-	•	•	•	•
Dynstat	DIN 53435	0.2	0.15		-	-	-	-	-	-	-	-
		0.5	0.37	2.2±0.1 m/s	-	-	•	•	•	•	•	•
		1.0	0.74		-	-	•	•	•	•	•	•
		2.0	1.48		-	-	•	•	•	•	•	•
		4.0	2.96		-	-	•	•	•	•	•	•

Zwick / Roell

Virtually vibration free
A new innovation features twin carbon rods of carbon for the pendulum. This provides high stiffness in the direction of impact and concentrates the pendulum mass at the impact point. Compared to traditional single-rod, metal pendulums and compound-type pendulums, the energy loss due to resonant oscillations at impact is considerably reduced.



The twin carbon rod pendulum minimizes energy losses.

Precise specimen supports
The specimen supports are precision-ground components ensuring that every radius and relief groove conforms exactly to the standards.

Accreditation for "authoritative" tests
A HIT Pendulum Impact tester has been verified as an example in all details by the German MPA-NRW in order to prove its ability to obtain the accreditation for authoritative tests. In Germany this is the highest level that any instrument can obtain.


Prüfdatum: 2006-08-21 bis 2006-08-24

1. Prüfergebnis

Das Pendelschlagwerk wurde gemäß DIN EN ISO 13802 und DIN EN ISO 180 geprüft und kalibriert.
Es entspricht den Anforderungen der genannten Normen und kann für maßgebliche Versuche mit dem Arbeitsvermögen

2,75 J
5,5 J

verwendet werden.

Dortmund, den 2006-08-24

Im Auftrag

gez. Ohlrich, Nowaczyk
MPA-Prüfingenieure

MPA NRW.

Dieses Prüfzeugnis gilt als Nachweis der Prüfmittelüberwachung nach DIN EN ISO 9001.
Die Laboratorien des MPA NRW sind nach DIN EN ISO/IEC 17025 akkreditiert.

The HIT5.5P Pendulum Impact Tester has been accredited for "authoritative" tests by the German Materials Testing Institute MPA-NRW.

Powerful PC-Software *testXpert*® II (Option)
By connecting the Pendulum Impact Tester to a PC via a USB interface, and using *testXpert*® II software, the highest level of comfortable operation, reporting, and data administration become possible. A separate RS232 interface is available to connect directly to existing LIMS systems.

Low-wear disc brake (Option)
The optional disc brake allows the pendulum to be stopped smoothly.

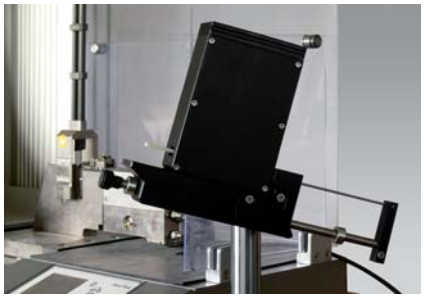
Instrumentation (Option)
For determination of the force-displacement-time behavior, load sensors and a high-speed measurement system are used. This allows comfortable yet detailed fracture mechanics analysis in the R&D environment, or routine and automatic recognition of brittle-ductile transitions when using the system for quality assurance.

Testing at low temperatures (Option)
The easiest way to perform tests at low temperatures is by cooling the specimen in a normal cooling box.

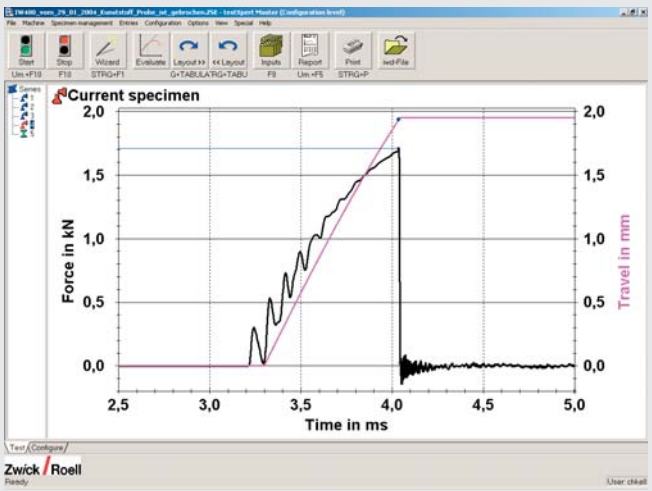
To reduce temperature variations during a test sequence, specially designed and insulated specimen magazines allow a series of specimens to be brought close to the impact tester. This magazine is then placed on a specimen dispenser that allows to the operator to take the specimens out one-by-one and to place them into, or on, the supports for testing. Testing can be carried out within approx. 3 seconds after removing them from the magazine.

An optional digital thermometer is available to monitor the temperature within the magazine.

For testing very high specimen throughput, we recommend our range of roboTest solutions.

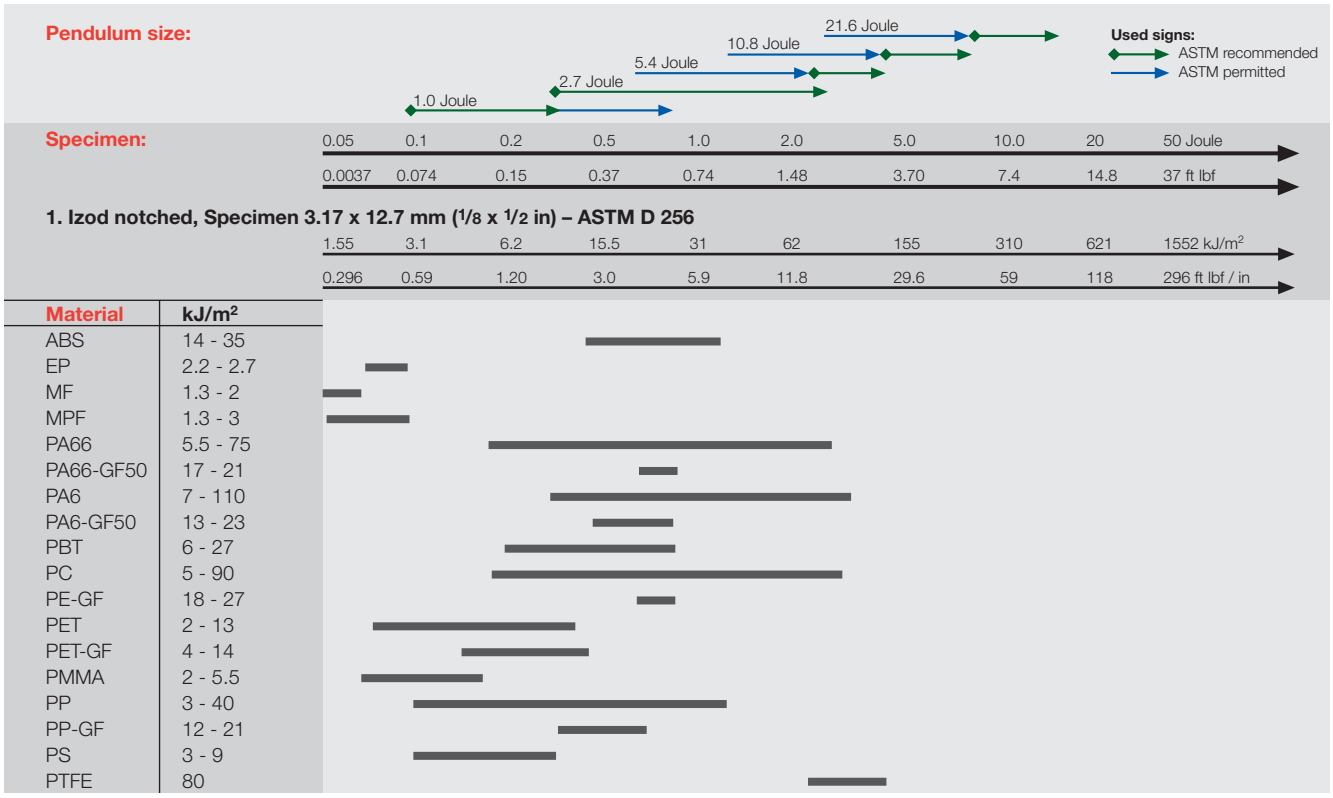


Specimen dispenser and magazine for low temperature testing.



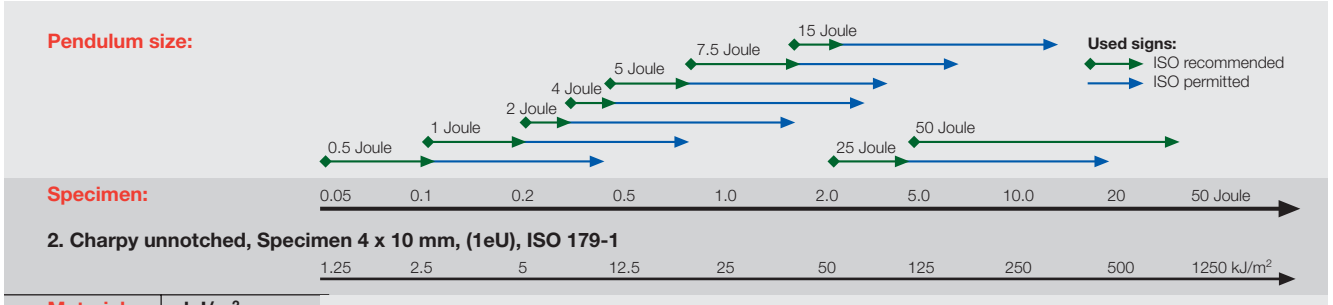
Instrumentation allows the acquisition of the force-time and travel information.

Zwick / Roell



Material	kJ/m²
ABS	14 - 35
EP	2.2 - 2.7
MF	1.3 - 2
MPF	1.3 - 3
PA66	5.5 - 75
PA66-GF50	17 - 21
PA6	7 - 110
PA6-GF50	13 - 23
PBT	6 - 27
PC	5 - 90
PE-GF	18 - 27
PET	2 - 13
PET-GF	4 - 14
PMMA	2 - 5.5
PP	3 - 40
PP-GF	12 - 21
PS	3 - 9
PTFE	80

Indicated values for Izod impact resilience according to ASTM standard are only valid for specimen cross-sections 1/8“ x 1/2“ (3.17 x 12.7 mm).



Material	kJ/m²
ABS	20 - 80
EP	4 - 9
MF	7 - 9
MPF	7 - 9
PA66	150
PA66-GF20	50 - 95
PA6-GF	90 - 100
PBT	25 - 300
PC	70 - 310
PE	not specified
PET	25 - 70
PET-GF	30 - 60
PMMA	16 - 80
POM	150 - 320
PP	50 - 120
PS	8 - 160

Indicated values for Charpy impact resilience are only valid for unnotched specimen, 10 x 4 mm.

Zwick / Roell

Extrusion plastometers

Melt flow plastometers deliver standard values of melt mass-flow rate (MFR) and melt volume-flow rate (MVR) of thermoplastic materials under specified conditions of temperature and load.

The standards ISO 1133 and ASTM D 1238 describe these tests for many different materials, whilst ASTM D 3364 defines a specific method for testing PVC.

The new draft standard ISO/CD 1133-2 prepares the description of a method for time-history dependent and moisture sensitive materials, such as PA, PET and PBT that requires specific pre-conditioning of the samples and higher technical demands on the plastometers.

Method A:
Cutting of extrudates with constant time intervals, followed by weighing with an analytical scale. The result is the MFR value presented in g/10min.

Method B:
Measurement of piston travel and time during the test. The result is the volume extruded through the standard die per unit of time, presented as the MVR value in cm^3/10 min.

Method C (according to ASTM):
Measurements with a "half-size die". The method is used for polyolefins showing high flow rates. The procedure is identical to method B.

Method D (according to ASTM):
Measurement as for method B, but under different loads within one barrel filling. A specific automatic load-change unit is needed, see 4106.200.

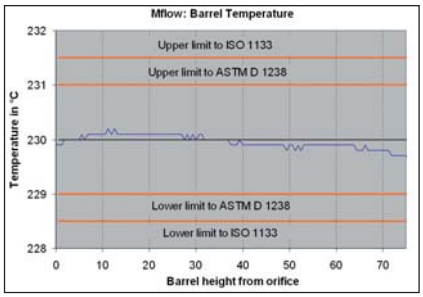
MFR and MVR values can be converted using a known melt density.

Modular plastometer Mflow for comfortable MFR and MVR measurements. Here shown with optional separation shield, piston travel transducer, automatic weight release system and PC software control.

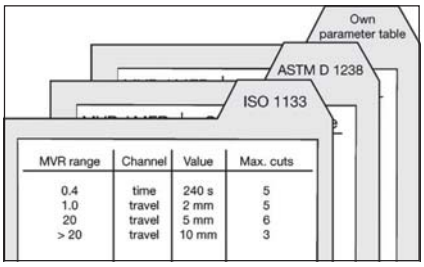
Modular Plastometer Mflow

In the basic version, this plastometer is equipped for MFR measurements according to method A. By adding options such as a piston travel transducer, the instrument is able to measure MVR as well. It then uses the unique "Adaptive Parameter Control (APC)" function which enables auto programming of the test procedure for all flow rates. This relieves the operator from estimating the flow rate in order to find the best fitting parameters. The plastometer can automatically find the best fitting parameters and apply them to each test.

Advantages:
- Very high temperature accuracy
- Adaptive Parameter Control (APC)
- Modular and extendable design
- Stand-alone operation capabilities
- Comfortable PC control using *testXpert*® II software
- Automatic air bubble recognition and exclusion
- Large range of accessories



Precise temperature control developed for the testing of PA, PBT and PET.



From the first test "Adaptive Parameter Control", (APC) enables each test to be performed with optimum parameters in real time.

Zwick / Roell

Cflow: Simple to use plastometer for the determination of the MFR value (Analytical balance required)

Die release system

Filament cutter with nozzle plug

Compact Plastometer, Cflow

The Cflow plastometers are exclusively designed for MFR determination according to method A. The instrument is equipped with a precise temperature control, simplified purging function via the die release system, manual or motorized filament cutting option, and an optional nozzle plug for testing very fluid melts.

All standardized weights up to 21.6 kg are available fort he Cflow model. For frequent tests with weights larger than 5 kg we recommend the use of the Mflow model including the automatic weight lift option.

Zwick 4106 – the melt flow plastometer complying with methods A, B, C and D

The plastometer 4106 covers the complete application range defined throughout the standards.

The instrument is equipped with an automatic weight change unit, specifically developed for QA/QC. In multi-stage tests, the weights can be freely changed from high to low or vice versa. Measuring time and travel can be individually programmed for each load step.

Advantages:

- Automatic weight release
- Automatic weight change
- Integrated piston travel transducer
- High temperature accuracy
- Stand-alone operation capability
- Comfortable PC control by using *testXpert*® software
- Good accessibility for cleaning
- Automatic results calculation
- Pre-programmable switch-on time.

Extrusion plastometer Zwick 4106.200 with automatic weight change unit. Upper right: the basic version with manual weights.

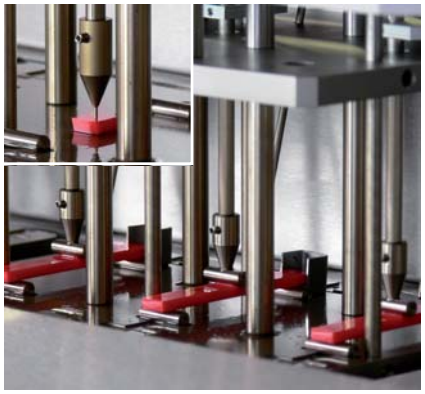
Zwick / Roell

Heat distortion temperature under load and Vicat softening temperature, HDT and VST

Heat Deflection Temperature (HDT)
of thermoplastics, hard rubber, fibre reinforced and filled hardening plastics, according to ISO 75 parts 1 to 3 and ASTM D 648 Method B

Vicat Softening Temperature (VST)
of thermoplastics, according to ISO 306 and ASTM D 1525

Creep test characteristics
under flexural loading



Upper: Vicat softening temperature, VST,
Lower: HDT, heat deflection temperature.

HDT/Vicat Standard series

HDT/Vicat Standard instruments have been designed especially for incoming goods inspection, quality assurance, and for education and training purposes. Versions with up to 6 measurement stations are available. Programming of the test sequences and setup of test results presentation are comfortably performed when using a connected PC and testXpert® II (Option).

Functions, elements and interfaces

- Test temperatures up to 250°C or 300°C according to model
- Built-in microprocessor-controller for temperature control
- Easy-to-read display
- Safety thermostat
- Electronic bath level monitoring with instruments up to 300 °C
- Test control and data acquisition via PC with testXpert® II (2 RS232-Interfaces required in PC)
- Integrated compensation in PC mode for the thermal expansion of the measurement stations
- Manual immersion of the testing stations
- Manual placing of test weights
- Manual or solenoid valve controlled water-cooling according to model.
- Connection for external chillers

PC-controlled test sequence

As soon as the heat transfer liquid has reached the starting temperature, the specimens are placed in the measurement stations and are manually lowered into the bath. The next step is to manually position the weights as indicated in the standard and to start the test sequence on the PC.

The travel transducers are zeroed after an indicated creep time under load. Then the heating is started with a preset and controlled heating rate.

As soon as the test is over, the heating will be switched off. Cooling of the heat transfer liquid will then be automatically switched on by the PC-software or manually by the operator.

Standard model HDT/Vicat 3-250 S: Measurements up to 250°C, 1 to 3 measurement stations, with PC connection.

The instrument HDT/Vicat 6-300 S is equipped with a solenoid valve for enhanced control of cooling. It can be equipped with 1 to 6 measurement stations.

Zwick / Roell

Technical data	Vicat-Standard	Vicat-Allround	Vicat-Dry
Accuracy at 250 °C	± 0.5 °C	± 0.5 °C	± 0.5 °C
Spatial distribution	± 0.1 °C	± 0.2 °C	± 0.2 °C
Resolution	0.1 °C	0.1 °C	0.1 °C
Heating rates	50 to120 K/h (all)		
Accuracy, displacement	± 0.01 mm	± 0.01 mm	± 0.01 mm
Voltage	230 to 240 V	230 V	230 V
Frequency	50 to 60 Hz	50 Hz	50 Hz
Power	2000 W	3000 W	3000 W

HDT/Vicat Allround

The Allround series instruments are equipped with a motor driven lift for the measurement stations. This permits the stations to be immersed into the liquid using an automatic sequence and to lift them again after the liquid has been cooled back to ambient temperature.

Furthermore, all instruments are equipped with an automatically controlled cooling unit. Depending on the model this can be a simple cooling hose or an oil-water heat exchanger for fast and powerful cooling.

Functions, elements and interfaces

- Integrated PLC controller for temperature control and data acquisition
- Cooling sequence controlled by solenoid-valve
- Motor driven immersion of the measurement stations.
- Manual placement of weights
- Safety thermostat
- Electronic bath level monitoring
- Test control and data acquisition via PC with testXpert® II
- Integrated compensation for the thermal expansion of the measurement stations

Vicat-Dry

ISO 306 (Vicat Softening Temperature) describes the contact heat transfer method that is used by this instrument. Round robin tests have shown that, for several materials, the results obtained are statistically identical to results obtained with the liquid heat transfer method working with an oil bath.

No more annoying oil fumes!
Vicat-Dry instruments are very comfortable to operate. They are often used in R&D environments, but also in incoming goods inspection and quality control. The oil-free measurement principle ensures clean operation without odours. The whole test sequence runs in automatic mode. All parameters can comfortably be set in *testXpert*® II.

Specimen dimensions max:
10 by 6.5 by 10 mm

The HDT/Vicat 3-300 A is equipped with an integrated water-oil heat exchanger for fast cooling of the heat transfer liquid.

The Allround model HDT/Vicat 6-300 A is fitted with a motorised station lift that allows the whole test to be run automatically.

The Vicat 6-300 D works according to the contact heat transfer method without oil. The test is performed in a metal heating block equipped with 6 measurement stations.

The HDT/Vicat 6-300 A is equipped with up to 6 stations. The whole test sequence can run in PC-controlled automatic mode.

Zwick / Roell

Rebound Resilience Tester Zwick 5109

The device also known as “Schob Pendulum” is perfectly suitable for investigating the rebound resilience on rubber, elastomers and flexible cellular materials in accordance to the following standards:

- ISO 4662, DIN 53512, ASTM D 1054 method B: Rebound resilience of rubber and elastomers
- DIN 13014, DIN 53573: Rebound resilience of flexible cellular materials

Specimen shapes

Rubber and elastomers are tested in form of circular or square plates from 28 to 50 mm. The specimen thickness should not exceed 15 mm. Flexible cellular materials are tested by taking square specimens 80 x 80 mm with a thickness of 50 mm.

Technical Data

Order no.:	Zwick 5109
Pendulum length:	200.4 mm
Release angle:	90°
Impact velocity:	1.98 m/s
Electr. connection:	100...240 V 50...60 Hz

Pendulum acc. to ISO 4662, ASTM D 1054 and DIN 53512

Impact energy:	0.5 J
Pendulum mass:	252 g
Shape of impact fin:	hemisphere
Diameter:	15 mm
Application:	rubber, elastomers

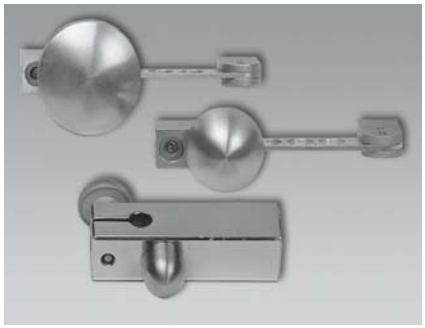
Pendulum acc. to DIN 13014

Impact energy	0.196 J
Pendulum mass	101g
Shape of impact fin:	hemisphere
Diameter:	30 mm
Application:	mattresses

Options

Electrically heatable specimen fixtures (Ambient to 100 °C)

Rebound resilience tester Zwick 5109 with digital display



Pendulums for different types of tests

Zwick / Roell

Abrasion tester

The abrasion tester conforms with the standard ISO 4649. It is used to evaluate the resistance of rubbers and elastomers to frictional wear.

The method compares the wear of an unknown test piece to that of a known material.

A sheet of abrasive paper is attached on the drum. The specimen is placed into a specimen holder, which enables the sample to move laterally and to rotate during the test. The necessary load is applied by a dead weight to the test-piece. The result is given by weighing the test piece before and after the test.

Technical data

Sample diameter:	16 mm
Sample height:	6 ... 16 mm
Loading forces:	2.5/5/7.5/10 N/ 12.5/15N
Lateral movement:	4.2mm/revolut.
Sample rotation:	0.9 rpm
Abrasion path:	40 m
Abrasion speed:	19.2 m/min
Drum diameter:	150 mm
Drum length:	460 mm

Accessories and options

- Abrasive sheet
- Sheet of rubber comparison sample (for approx. 100 samples)
- Circular cutting tool for use with a drilling machine
- Additional weights for loading forces 12.5 / 15 / 17.5 and 20 N
- Drum cleaning unit
- Precision balance (see chapter: dimension measurement)

Abrasion tester Zwick 6103

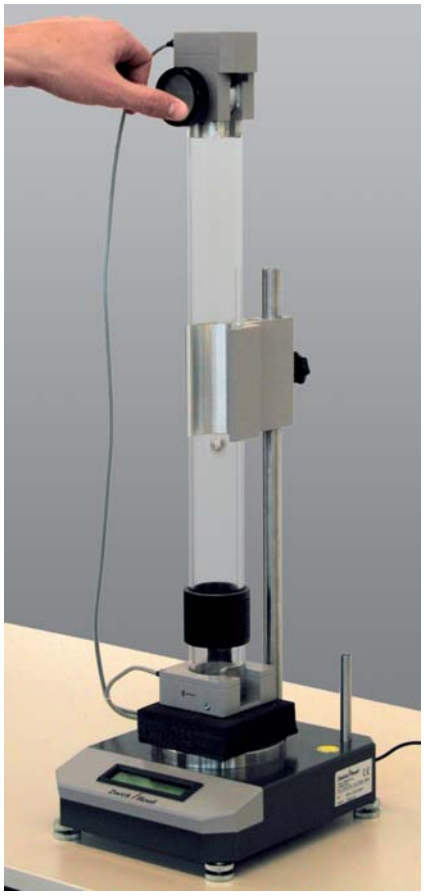
Ball-type rebound resilience tester

This microcomputer controlled instrument is designed for the determination of the rebound resilience of soft foam materials according to ISO 8307 and ASTM D 3574.

A steel ball with a diameter of 16 mm is precisely released by a magnet and drops from a height of 500 mm on the surface of the test-piece. By means of a triple beam light barrier the rebound height of the ball is then measured.

Technical data:

Drop height	500 mm
Ball release	by magnet
Tube, inside diam.	40 mm
Measurement	light barrier
Statistics	Median and single values
PC connection	RS 232
Electrical connect.	115V/60 Hz and 230V/50…60 Hz



Ball-type rebound resilience tester for soft foam materials

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Hardness testers and hardness testing machines

In general, hardness is defined as the resistance of a material against the penetration of a specified indentor. Since hardness is not directly measurable, it is determined from other measurement variables such as penetration depth or penetration force. The determination of reproducible and comparable measurement values requires defined conditions, e.g. the shape and dimensions of the indentor and the force acting on it. The different conditions and requirements for practical application resulted in different hardness test methods.

Application ranges

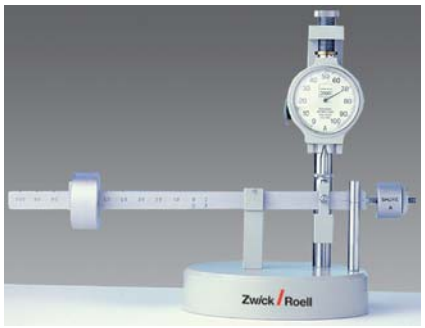
Method	Hardness
Barcol, EN 59 ASTM D 2583	0 - 100
Shore A ISO 868	10 - 90
IRHD smooth ISO 48	10 -40
IRHD normal ISO 48	40 -98
Shore D ISO 868	30 - 90
Ball indentation hardness ISO 2039	8,6 - 467

Shore A and Shore D durometers

These hardness testers, using a spring-loaded indentor of two different shapes according to the definition of Shore A and Shore D, are available with analog display, optionally also with drag pointer indicating the maximum hardness value, as well as digital display and microprocessor for the data storage, statistical evaluation, printout and data transfer to a PC.

Analog Shore A and D hardness tester: Hand-held devices

Analog Shore A hardness tester with test stand



Analog Shore A hardness tester with control unit

Shore A hardness testers are used for non-rigid to semi-rigid plastics and for rubbers and elastomers of a minimum thickness of 6 mm. Plastics showing greater hardness values shall be tested with the Shore D hardness tester or other convenient methods.

Digital Shore hardness tester with integrated electronic unit, installed in a test stand

Test stand for Shore durometers

The manual hardness testers can be mounted into a test stand (additional device) to improve the repeatability of the test method by eliminating operator influences.

Attachable prisms for measurements on printing rollers

An attachable prism facilitates the measurement on drums and printing rollers.

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Control unit

In accordance to the standards, the spring characteristics and the display are to be controlled at regular intervals.

A simple control is obtained by using calibrated rings to verify the displayed value at a defined penetration depth.

For the control of the spring characteristics, a control unit is used.

Further scales according to Shore
Hardness testers according to ASTM D 2240

- with analogue display for Shore B, Shore C, Shore 0 and Shore 00
- with digital display for Shore B, Shore C, Shore 0, Shore 00 and Shore D0.

IRHD Micro Compact Hardness Tester Zwick 3103

This hardness tester is preferably used for O-rings, sealings, machined parts and flexible tubes of rubber, elastomers and plastics with a thickness from 0.5 to 5 mm. Thus, the hardness is determined as penetration at a defined force acting on the ball indentor (0.40 mm diameter).

Standards:
- ISO 48
- DIN 53512-2
- ASTM D 1415
- NF T 46003
- BS 903 part A26

Device configuration:
- Test stand with integrated electronics and LCD display
- Vertically adjustable support table
- Measuring device IHRD micro
- Quick adjustment for series tests

Options:
- Control unit
- Quick centering device for O-rings
- Centering device for rubber hoses
- Magnifying glass
- Manufacturer's test certificate according to DIN 53519-2

Digital IRHD/Shore hardness tester Zwick 3105 digi test

This device is a microprocessor-controlled hardness tester. It can be equipped with different measuring devices and indentors thus covering the following hardness scales

- IRHD-M (micro)
- IRHD-N (normal)
- IRHD-H (hard)
- IHRD-L (soft)
- IHRD-ss (supersoft)
- Shore A and Shore C
- Shore B and Shore D:
- Shore D0 /0 / 00:
- Shore 000

Standards:
- DIN 5305
- DIN 53519 page 1 and 2
- ISO 868
- ASTM D 2240
- ASTM D 1415
- NF T 51123
- NF T 46003
- BS903 part A26

Options:
- Control unit
- Quick centering device for O-rings
- Centering device for rubber hoses
- Magnifying glass with swivel arm
- Precision balances for different measuring ranges

IRHD Micro Compact hardness tester 3103

IHRD/Shore hardness tester 3105 digi test

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Hardness tester 3108 acc. to Pusey & Jones

With this device standardized according to ASTM D 531, the penetration depth of rubber and similar materials (e.g. rubber rollers, standardized blocks) with thicknesses from 13 mm are measured.

Indentor: Ball, diameter 3.175 mm
Loading weight: 1,000 ± 1 g
Reading unit penetration depth: 0.001 mm

Hardness tester 3108 acc. to Pusey & Jones

Barcol hardness tester Zwick 3350

The Barcol method is described in the standards EN 59 and ASTM D 2583. It is used for the testing of harder plastics (e.g. glass fibre reinforced plastics, thermosetting materials, hard thermoplastics).

Indentor: Truncated cone with a cone angle of 26° and a truncated cone surface diameter of 0.157 mm.
Test travel max. 0.76 mm.
The device is supplied with an electronic unit for the display and storage of the test data. A test stand is optionally available.

BARCOL hardness tester

Rockwell hardness tester for scales R, L, M, E, K and α

Ball indentation hardness tester 3106

Ball indentation Hardness tester Zwick 3106

This method according to ISO 2039-1 is used for the testing of rigid plastics and ebonite. The range of application starts at approximately 60 Shore D. The ball indentation hardness may provide values for research, development, quality control and acceptance or rejection according to specification.

With this method, a ball with a diameter of 5 ± 0.02 mm is forced under a specific test load into the surface of a specimen. The penetration depth is measured under load and is related by an equation to the measured hardness in N/mm^2 .

Technical data:

Order no.:	Zwick 3106
Load application:	Weights
Loads:	49 / 132 / 358 / 961 / 1471 N
Pre-loads:	9.8 to 98 N
Standard ball:	5 mm
Further balls:	1.58 ...12.7 mm
Penetration depth measurement:	digital
Resolution:	0.001 mm
Anvil diameter:	25 mm

Further standards using the ball indentation hardness tester:

- ASTM D 785: Rockwell hardness (plastics)
- ISO 6508: Rockwell hardness (metals)
- DIN 1168-2: Hardness of plaster
- DIN 1996: Indentation test method for asphalt
- DIN 51917: Rockwell hardness of carbon materials
- EN 433: Residual indentation (floor coverings)

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Zwick Services

Worldwide Service

Customer satisfaction is a top priority of the Zwick Roell Corporation. With local service organizations in over 50 countries, we help optimize the return on your investment and to ensure the functionality of your testing machine.

Engineering Consulting Services

Changing specifications, new test requirements, or the installation or modification of a test lab can be optimized by consulting experts. Experienced Zwick engineers can advise you in the planning and implementation of such complex projects to meet your exacting requirements.

Demonstration

The decision to purchase a materials testing system and accessories depends on a number of factors. In order to help facilitate this decision, Zwick maintains a fully-equipped Applications Lab to perform trial tests to ensure the selection of the appropriate equipment and accessories.

Pre-Testing

In the course of new, modified, or very complex applications, it is necessary to perform specific tests prior to purchasing or expanding a test system. Zwick's Application Lab is available in conjunction with its numerous ex-perts and extensive selection of machines and fixtures in order to initially verify the testing set-up.

Contract Testing

Whether for new test requirements or tests performed to particular technical specifications, the Zwick Contract Lab provides timely and accurate test results on a contract basis. Please contact us for specific contract testing capabilities and pricing.

Application Technology Seminars

Active collaboration with partners from research and technology qualifies us to impart knowledge in principles of materials testing and expertise within Application Technology Seminars.

Preliminary acceptance

Prior to delivery of your machine, you have the opportunity to conduct a preliminary acceptance checkout at our facility. This will allow you become acquainted with the operation of the machine and confirm the agreed-upon functionality.

Transport

Everything is available from a single source with ZwickService. Upon request, and where applicable, within the scope of initial operation, ZwickService will monitor the complete transport. Beyond that, it is also possible to have the machine transported all the way to the installation site. Convenient and professional. You no longer need to be concerned about the transport at your facility.

Retrofit

Converting the old into new – ZwickService specialists professionally perform the upgrade of your existing materials testing machine, regardless of the original manufacturer. This allows the latest digital control technology and software automation to enhance the performance of your testing system at the fraction of the cost of a new system.

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Installation

ZwickService ensures the optimal installation of your testing machine and accessories based on the experience from several thousand installations. Functional tests performed prior to final acceptance guarantee a successful installation process.

Hardware Overview

Nothing is left to chance during ZwickService test machine commissioning. The on-site commissioning is performed systematically and professionally on a checklist basis, and ensures an optimal utilization of the test hardware.

Software Overview

The introduction is performed following a checklist procedure, using a specific example from the operator's daily practice. The results will be saved for later use. Alternatively, ZwickService offers a two-stage introduction which includes an initial basic overview and a final review at a later date.

Machine Relocation

ZwickService provides for the complete relocation of your testing machine as needed. Our experienced management team takes responsibility for the detailed planning, from the disassembly and transport, through to re-installation of the machine. The machine will be ready for testing at its new location on schedule. Independent of the manufacturer of your testing machine – ZwickService has specially trained and experienced staff for every make or model.

Software Adaptation

Our software engineers have the solid technical expertise from years of experience to quickly deliver programming tailored to your individual needs. The testing requirements are defined in close cooperation and agreement with you and subse-quently carried out according to these specific needs.

Product Training

Zwick maintains a staff of qualified, expert trainers, who have extensive practical experience and who conduct product training courses either at Zwick, or specially customized to be performed at the customer's facility.

Customer Support

The trouble-free performance of your testing machine is of importance to us. Should any unforeseen malfunction occur with the machine's hardware or software, our competent experts at our Hotline will be happy to assist you. If you are not able to speak to someone immediately, we promise to return your call as soon as possible.

Support Desk

Our Support Desk is a cost-saving alternative to on-site visits or training by a service technician. We assist you in questions regarding the operation of hardware and software, adaptation of your test programs or offer further technical support. The extensive application experience enables our service technicians to provide quick and effective solutions to any questions you might have.

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Rentals

Whether for temporary testing requirements or to satisfy a short-term need, ZwickService provides the rental of testing grips. Please contact us for further information about the rental service.

Maintenance

Upon request, ZwickService performs the regularly-required maintenance of machine and accessories as des-cribed in the instruction manual and monitors the maintenance intervals.

Inspection

ZwickService helps reduce downtime significantly by regularly inspecting your test system. The inspection plan documents the condition of the machine, allows immediate exchange of worn parts as needed, and the recommendation of preventive measures.

Repair Work

Should a failure in your materials testing machine occur in spite of thorough inspection and maintenance, one of the many technicians of the ZwickService network is available on short notice. Spare parts, from Zwick's large inventory, will be dispatched within short term.

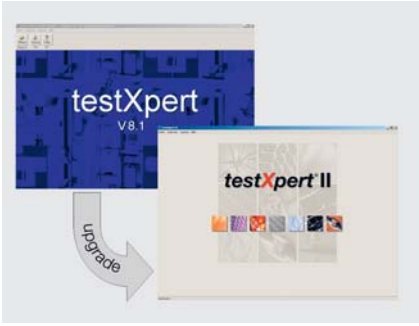
Calibration

ZwickService calibrates your testing machine and testing systems compliant to the current national and international standards, including ISO and ASTM. Zwick has associated calibration laboratories in different countries, all of them accredited in accordance with ISO/IEC 17025. Consequently we are authorized for on-site calibration of testing machines and testing systems according to the relevant standards (DKD, UKAS, COFRAC, A2LA) and to issue the corresponding calibration certificates which are internationally accepted.

Software Upgrade

Upgrade your *testXpert*® software to the latest version. This allows you to take advantage of the most recent developments and the enhanced functionality of *testXpert*®. The latest changes of relevant materials testing standards are also incorporated in the newest *testXpert*® version.

When upgrading your outdated DOS software to the latest Windows tech-nology you can take advantage of improved performance and benefits. With an upgrade from *testXpert*® to *testXpert*® II you benefit from the latest significant developments in application software.



With an update or an upgrade of *testXpert*® Zwick customers are able to take advantage of the latest technology and developments.

[1] DKD: Deutscher Kalibrier-Dienst
[2] UKAS: United Kingdom Accreditation Service
[3] COFRAC: Comité Français d´Accréditation
[4] A2LA: American Association for Laboratory Accredition

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Annex: Overview of standards and test equipment

Subject	Standard	Testing device	Page
Testing equipment: design, verification, accuracy, environmental conditions			
• Tensile, compression and bending machines	ISO 5893, ISO 7500-1, ASTM E 4, ISO 9513, DIN 51220		
• Impact testing machines	ISO 13802, JIS B7756, EN 10045-2, DIN 51230		
• Standard atmospheres for testing	ISO 291, JIS K 7100, ASTM D 618		
• Conditioning and test conditions for rubber	ISO 471, DIN 53500, ASTM D 1349, ASTM D 832		
• Performing of round robin tests	ASTM E 691		
• Temperature devices for rubber testing	ISO 3383		
Sample preparation			
• Injection moulding	ISO 294-1/-2/-3/-4	Injection moulding machine	-
• Compression moulding	ISO 293, ISO 295	Moulding press	-
• Machining	ISO 2818	Cutting press, strip cutter	11
• Rubbers	ISO 4661-1, ASTM D 1485, ASTM D 3183	Cutting press	11
• Multipurpose test specimen for plastics	ISO 3167, JIS K 7139		11
• Test specimen for plastics	ISO 20753		-
• Test specimen for PS	ISO 1622-2		-
Dimension measurement			
• Multipurpose specimen	ISO 527-1, ISO 16012, ASTM D 5947	Micrometer	16
• Thickness of plastic film	ISO 4593, DIN 53370, ASTM D 374, ISO 4591, ASTM E 252	Dead weight thickness gauge, balance	16/18
• Rubbers	ISO 37, ISO 4648, DIN 53504, DIN 53534, ISO 3302, ASTM D 3767,	Dead weight thickness gauge, balance	16/18
• Cellular plastics and rubbers	ISO 1923, DIN 53570	Dead weight thickness gauge, vernier calipper	16
Thermoplastic and thermosetting plastics			
• Tensile properties	ISO 527-1/-2, ASTM D 638, ASTM D 1708, EN 2747	Material testing machine	18
• Poissons ratio	ISO 527, ASTM E 132	Material testing machine	
• Flexural properties (1 point method)	ASTM D 747	Material testing machine	18
• Flexural properties (3 point method)	ISO 178, ASTM D 790, ASTM D 5934	Material testing machine	18
• Flexural properties (4 point method)	ASTM D 6272	Material testing machine	18
• Compression properties	ISO 604, ASTM D 695	Material testing machine	18
• Shear properties	ASTM D 732	Material testing machine	18
• Creep behaviour, tensile	ISO 899-1, ASTM D 2990	Material testing machine	18
• Creep behaviour, flexural (3 point method)	ISO 899-2, ISO 6602	Material testing machine	18
• Creep behaviour, compression	ASTM C 1181	Material testing machine	18
• Dynamic mechanical properties	EN ISO 6721-4/-5/-6, ASTM D 5023, ASTM D 5024, ASTM D 5026, DIN 53442	Servohydraulic testing machine	45
• Fracture toughness	ISO 13586, ASTM E 813	Material testing machine	18
• Barcol hardness	EN 59, ASTM D 2583	Barcol hardness tester	60
• Ball indentation hardness	ISO 2039-1	Ball indentation hardness tester	60
• Rockwell hardness (R, L, M, E, K)	ISO 2039-2, ASTM D 785	hardness tester	60
• Rockwell α hardness	ISO 2039-2, ASTM D 785	hardness tester	60
• Instrumented hardness	ISO 14577-1, DIN 50359-1	Instrumented hardness tester	-
• Shore A- and Shore D-hardness	ISO 868, DIN 53505, ASTM D 2240, ISO 7619-1, ISO 21509	Shore hardness tester	58
• Shore B, C, 0, 00, D0	ASTM D 2240	Shore hardness tester	58

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Subject	Standard	Testing device	Page
Thermoplastic and thermosetting plastics (continuation)			
• Pendulum impact strength, Charpy	ISO 179-1, ASTM D 6110	Pendulum impact tester	48
• Pendulum impact strength, Izod	ISO 180, ASTM D 256, ASTM D 4812	Pendulum impact tester	48
• Pendulum impact strength, tensile	ISO 8256, ASTM D 1822	Pendulum impact tester	48
• Dynstat resilience	DIN 53435	Pendulum impact tester	48
• Impact brittleness temperature	ISO 974	Pendulum impact tester	48
• Instrumented impact strength, Charpy	ISO 179-2	Pendulum impact tester	46, 48
• Falling dart test	ISO 6603-1, ASTM D 5628, ASTM F 736	Falling weight impact tester	47
• High speed impact tests	ISO 6603-2, ASTM D 5420, DIN 53443-2, ASTM D 3763, ASTM D 5628	Falling weight impact tester, High speed testing machine	46 47
• High speed tensile test	ISO / CD 18872	High speed testing machine	46
• Melt index (MFR, MVR, FRR)	ISO 1133, ASTM D 1238, ASTM D 3364	Melt flow Plastometer	52
• Determination of density	ISO 1183-1	Density kit	18
• Vicat softening temperature (VST)	ISO 306, EN 2155-14, JIS K 7206, ASTM D 1525, BSI 2782-meth. 121 C	Vicat VST instrument	54
• Heat Deflection Temperature (HDT)	ISO 75-1/-2/-3, ASTM D 648, BS 2782-meth. 120 C	HDT instrument	54
Rubbers and elastomers			
• Tensile properties	ISO 37, ASTM D 412, DIN 53504	Material testing machine	18
• Tensile, rubber condoms	ISO 4074	Material testing machine	18
• Test methods for rubber threads	ISO 2321, ASTM D 2433	Material testing machine	18
• Tension set	ISO 2285, ASTM D 412	Material testing machine	18
• Compression properties	ISO 7743, ASTM D 575	Material testing machine	18
• Compression set	ISO 815, ASTM D 395, ASTM D 1229	Material testing machine	18
• Tear properties, Graves method	DIN 53515, ASTM D 624, ISO 34	Material testing machine	18
• Tear properties, trouser, angle, crescent	ISO 34-1	Material testing machine	18
• Tear properties, Delft	ISO 34-2	Material testing machine	18
• Adhesion properties	EN 28033, ISO 814, ISO 5600, ISO 5603, ISO 8033, ASTM D 429, ASTM D 1871, ASTM D 413, ISO 813	Material testing machine	18
• Analysis of multi peak traces	ISO 6133	Calculations	
• Shear properties	ISO 1827	Material testing machine	18
• Creep, relaxation	ISO 3384, ISO 8013, DIN 53537, ISO 6914	Material testing machine	18
• Friction properties	ISO 15113	Material testing machine	18
• Visko-elastic properties	ISO 4664, DIN 53513, DIN 53 535	Servohydraulic testing machine	45
• Fatigue	ASTM D 430, ASTM D 4482		
• Test methods for O-rings	ASTM D 1414		
• Requirements for pipe joint seals	EN 681		
• IRHD hardness	ISO 48, ISO 7619, ASTM D 1415, DIN 53519	IRHD hardness tester	59
• Shore A and D hardness	ISO 868, ISO 7619, ASTM D 2240, DIN 53505, ISO 18898	Shore hardness tester	58
• Shore B, C, D0, 00, 000, 000-S, R hardness	ASTM D 2240	Shore hardness tester	58
• Pusey & Jones hardness	ASTM D 531	Pusey & Jones hardness tester	60
• Abrasion resistance	ISO 4649, DIN 53516	Abrasion tester	57
• Rebound resilience	ISO 4662, DIN 53512, ASTM D 1054	Rebound resilience tester	56
• Density	ISO 2781, ASTM D 792, DIN 53479	Density kit	18

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Subject	Standard	Testing device	Page
Rubber or plastic coated fabrics			
• Tensile properties	ISO 1421, ASTM D 751	Material testing machine	18
• Adhesion properties	ISO 36, ISO 4637, ISO 4647, ASTM D 413	Material testing machine	18
• Blocking resistance	ISO 5978, EN 25978	Material testing machine	18
• Tear resistance	ISO 4674, ASTM D 751, DIN 53356	Material testing machine	18
Rigid cellular plastics			
• Test methods	ISO 9054, ISO 7214		-
• Tensile properties	ISO 1926, ASTM D 1623,DIN 53430	Material testing machine	18
• Flexural properties	ISO 1209-1/-2, JIS K 7221	Material testing machine	18
• Shear strength	ISO 1922, DIN 53427	Material testing machine	18
• Compression properties	ISO 844, ASTM D 1621, EN 826	Material testing machine	18
• Compression creep test	ISO 7616, ISO 7850	Material testing machine	18
• Thickness measurement	EN 12431	Material testing machine	18
• Pendulum impact strength	ISO 179	Pendulum impact tester	48
• Density	ISO 845, ASTM D 1622	Balance	18
• Tensile strength perpendicular to faces	EN 1607, DIN 53292	Materials testing machine	18
Flexible cellular polymeric materials			
• Tensile properties	ISO 1798, ASTM D 3574-E	Material testing machine	18
• Compression properties	ISO 3386-1, ISO 3386-2, ASTM D 3574-C, ASTM D 1055	Material testing machine	18
• Indentation properties (hardness)	ISO 2439, DIN 53577, DIN 53579-1 ASTM D 3574-B, ASTM D 3579	Material testing machine	18
• Compression load deflection	ISO 11752	Material testing machine	18
• Tear strength, trouser specimen	ISO 8067, ASTM D 3574-F	Material testing machine	18
• Creep in compression	ISO 10066, ISO 1856	Material testing machine	18
• Rebound resilience	DIN 13014, ISO 8307, ASTM D 3574	Rebound resilience tester	57
• Constant load pounding	ISO 3385		
• Accelerated ageing tests	ISO 2440		
• Dynamic cushioning performance	ISO 4651	Falling weight impact tester	-
• Appearant density	ISO 845, ASTM D 3574-A	Balance	18
Reinforced plastic composites			
• Tensile properties	ISO 527-4/-5, ISO 4899, ISO 14129, ASTM D 3039, ASTM D 3916, ASTM D 5083, DIN 65378, DIN 65466, EN 2561	Material testing machine	18
• Hole opening properties	DIN 65562, ASTM D 5961	Material testing machine	18
• Compression properties	ISO 14126, DIN 65375, DIN 65380, ASTM D 3410, pr EN 2850, ASTM D 695	Material testing machine	18
• Notched compression strength	AITM 1-0008, EN 6036	Materials testing machine	18
• Flexural properties	ISO 14125, ASTM D 4476, DIN 53390	Material testing machine	18
• Interlaminar shear strength	ISO 14130, EN 2377, EN 2563, JIS K 7078, DIN 65148, ASTM D 4475	Material testing machine	18
• Shear strength	ASTM D 5379, ASTM D 3846, ASTM D 3914, DIN 53399-2	Material testing machine	18
• Shear modulus	ISO 14129, ASTM D 3518, JIS K 7079	Material testing machine	18
• Fracture toughness, K_c, G_c (LEFM),J-R	ISO 13586, NASA R.P.1092, ISO 17281, ASTM D 5045, ASTM D 6068, ASTM D 6671, ASTM D 5528	Material testing machine	18
• Fatigue properties	ISO/DIS 13003, ASTM D 3479	Servohydraulic testing machine	18
• Compression After Impact (CAI)	ASTM D 7136, AITM 1-0010, BSS 7260 CRAG method 403	Falling weight tester	47

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Subject	Standard	Testing device	Page
Thin sheetings and films			
• Tensile properties	ISO 527-3, ASTM D 882, ASTM D 5323	Material testing machine	18
• Tear resistance, Graves, angle specimen	ISO 34, DIN 53515	Material testing machine	18
• Tear resistance, trouser specimen	ISO 6383-1, ASTM D 1004, ASTM D 1938	Material testing machine	18
• Tear resistance, trapezoidal specimen	EN 495-2, DIN 53363	Material testing machine	18
• Blocking strength	ISO 11502, DIN 53366, ASTM D 3354	Material testing machine	18
• Puncture tests	EN 14477, ASTM D 5748, ASTM F1306	Material testing machine	18
• Pendulum impact strength, tensile	ISO 8256, ASTM D 1822	Pendulum impact tester	48
• Impact resistance, free falling dart	ISO 7765-1/-2, ASTM D 4272 ASTM D 1709, ASTM D 3763, JIS K 7124 DIN 53373	Falling weight impact tester	47
• Coefficient of friction	ISO 8295, ASTM D 1894, JIS K 7125, DIN 53375	Material testing machine	18
Plastic piping			
• Specifications for pipes	EN 1555, EN 1852		
• Tensile properties	ISO 6259-1/-2/-3, ISO 8521, ISO 8513, ISO 8533, ASTM D 2105, ASTM D 2290, EN 1393, EN 1394	Material testing machine	18
• Compression properties	EN 802, EN 1446, ISO/DIS 4435, DIN 53769-3, ASTM D 2412	Material testing machine	18
• Flexural strength	EN 12100	Material testing machine	18
• Creep test	ISO 7684, EN 761, EN 1862	Material testing machine	18
• Ring stiffness	ISO 9969, ISO 9968, ISO 13967, ISO 10466, ISO 10471, EN 1226, EN 1227, EN 1228, ASTM D 5365	Material testing machine	18
• Cyclic compression test	ASTM D 2143		
• Vicat softening temperature	EN 727	Vicat VST instrument	54
• Impact characteristics	EN 744, EN 1411, EN 12061, ISO 3127, ASTM D 2444, ISO 7628	Falling weight impact tester Pendulum impact tester	47/48
• Melt flow index	ISO 4440-1/-2	Melt flow Plastometer	52
Adhesives			
• Tensile properties (butt joints)	ISO 6922, EN 26922, EN 1940, EN 1941, EN 14410	Material testing machine	18
• Peel resistance	ISO 4578, ISO 8510-1/-2, ISO 11339 EN 1464, EN 1939, EN 28510-1/-2, EN 60454-2	Material testing machine	18
• Contact adhesion	EN 1945		
• Shear strength	ISO 4587, ISO 10123, EN 1465, ISO 11003, ISO 13445, ASTM D 3163, ASTM D 3164	Material testing machine	18
• Bending-shear strength	ISO 15108	Material testing machine	18
• Creep properties	ISO 15109	Material testing machine	18
• Shear impact strength	ISO 9653, EN 29653		
• Fatigue properties	ISO 9664	Servohydraulic testing machine	45
• Resistance to flow	ISO 14678		

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