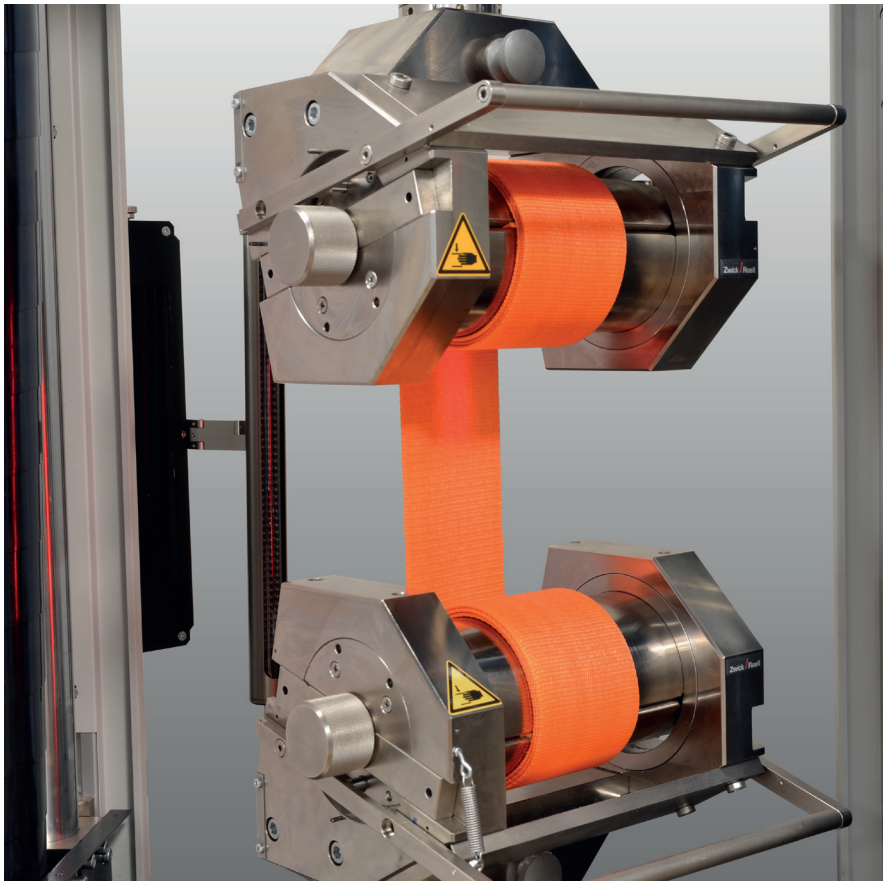
Zwick / Roell

Testing Machines and Testing Systems for Textile Materials





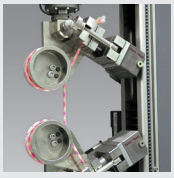



BB 415.1.03.18

Intelligent Testing

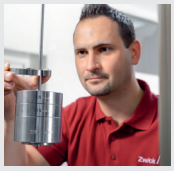
Zwick / Roell

1 The ZwickRoell Group



2 Textile Applications

3 Products



1 The ZwickRoell Group

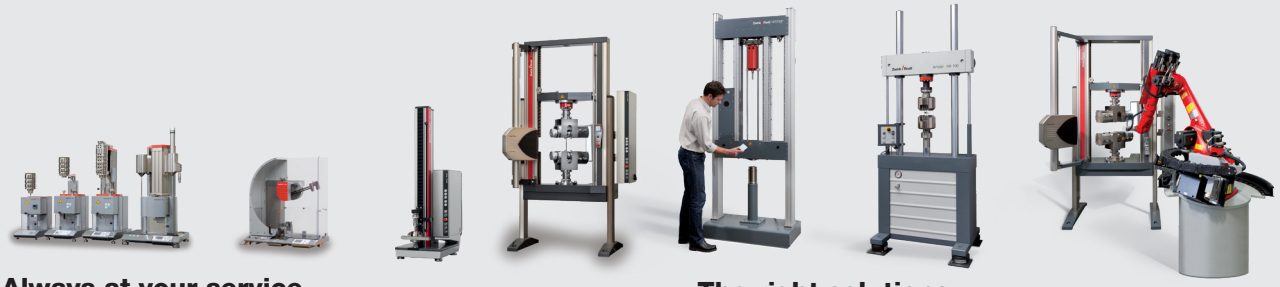
1.1 ZwickRoell—Passion and expertise

Our company philosophy is founded on a passionate commitment to our customers. We work hard to ensure customer satisfaction by having over a third of our employees engaged in service and support.

As a family-owned company with a tradition stretching back 160 years, we place great value on honesty and fairness. Over the years an ethos of close collaboration based on mutual trust between our partners, suppliers and customers has evolved, something that we all value highly.

Fig.1: Innovation Center at ZwickRoell's headquarters in Ulm, Germany

1.2 The basis of a successful partnership: innovative employees, innovative products!



Always at your service

Over 1,100 people are employed at our headquarters in Ulm, Germany. Many of them have been with us for years—decades even. Their knowledge, ability and commitment are what lies behind the worldwide success of the ZwickRoell Group.

We are present in over 50 countries around the world.

The right solutions

Whether for static materials testing or the various forms of fatigue testing—we have the right solutions. We offer products for hardness testing as well as instruments for impact testing and for melt index determination.

And for that rare occasion when we don't have a solution to fit, our experts will find one—from the smallest customization to a fully automated testing system or a test bench for special purposes.

1.3 Reliable test results

Reliable test results are a fundamental and hot topic in materials testing. With each materials and components test we ask the same questions:

Is the value obtained accurate? Are the results repeatable? Are these results comparable to other measurements? Is it possible to trace who did what, when and how? Does the measuring equipment meet the required standards and specifications?

ZwickRoell's machine and software solutions provide accuracy, repeatability and reproducibility, as well as complete traceability of test results.

Fig.1: Reliable test results with machine and software solutions from ZwickRoell

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2 Textile applications

2.1 Tests on threads and single/plied yarns

2.1.1 Tensile test on sewing thread as per EN ISO 2062

Tensile tests on sewing threads are performed to EN ISO 2062. The example shown here features screw grips and strain measurement via crosshead travel. The test is displayed in a typical force-strain diagram.

2.1.2 Tensile test on aramid yarn as per EN 12562

Tensile tests on aramid yarns are carried out in accordance with EN 12562. Capstan grips are used in order to avoid jaw breaks.

The grips' 180° load-reduction curve allows a defined grip-to-grip separation to be assumed during the test, eliminating the need for direct extension measurement during the test. Use of a load-reduction curve decreases the tensile force before end clamping. The specimen is held securely and jaw breaks are avoided. Failure then occurs within the free grip-to-grip separation, rather than on the load-reduction curves or in the clamped area.

For higher measurement accuracy, use of an optical extensometer is preferable. A mechanical measuring system can only be used if there is no risk of damage at specimen break.

2.1.3 Elastic behavior of elastomeric yarn as per DIN 53835-2/3

Tests in accordance with this standard are used to assess the elastic behavior of monofilaments of elastomeric yarns by repeated application of tensile loads between constant extension limits. This

Fig.1. Tensile test on sewing yarn

Fig. 2. Tensile test on aramid yarn

standard is applicable to all elastomeric filament yarns that have more than 300% elongation.

Tests on elastomeric yarns are not performed up to break, but between defined strain limits.

The test is displayed in a typical force-strain diagram and elongation is measured via crosshead travel.

2.1.4 Tensile test on two-ply yarn as per EN ISO 2062

For testing two-ply yarns to EN ISO 2062 pneumatic capstan grips are used. Elongation is measured via crosshead travel. Tests are displayed in a typical force-strain diagram.

The load-reduction curve allows a defined grip-to-grip separation to be assumed during the test, eliminating the need for direct extension measurement during the test.

Use of a load-reduction curve decreases the tensile force before end clamping.

The specimen is held securely and jaw breaks are avoided.

2.1.5 Tensile test on multi-filament yarn as per EN ISO 2062

The smooth texture of multi-filament yarn, together with its tendency to twist, places increased demands on the test arrangement. In this case the material is held in rope grips and elongation is measured via an optical extensometer because the crosshead travel cannot be used as a reference value for the strain. The standard applicable to this test is EN ISO 2062. With these specimen grips the gripping force is generated by looping and additional screw, wedge or hydraulic end clamping. The tensile force is reduced to a large extent by friction achieved through multiple turns around the load-reduction roller. Roller diameters between 30 mm and 250 mm are used, depending on the material.

2.1.6 Tensile test on single filaments as per ISO 11566

Tests on single-filament specimens as per ISO 11566 are carried out on individual fibers from a carbon multi-filament yarn from a fabric or a staple fiber.

The specimen is held in the spring-loaded grips with the aid of a paper frame, as shown here. The single filaments are very small and extremely sensitive to clamping. The paper frame, to which the filament is attached, is therefore used as reinforcement. Before the test the paper frame is cut through and the test is then started very low forces, in the 0.04 N - 5 N range, may arise. Elongation is measured via crosshead travel.

2.1.7 Tensile test on rovings

In the test shown here the roving material is clamped in 270° capstan grips and tested up to break. Tests are displayed in a typical force-travel diagram.

2.1.8 Tensile test using double capstan grips

With this deflection principle a force differential occurs over two stages, allowing specimen failure within the gauge length with no jaw breaks.

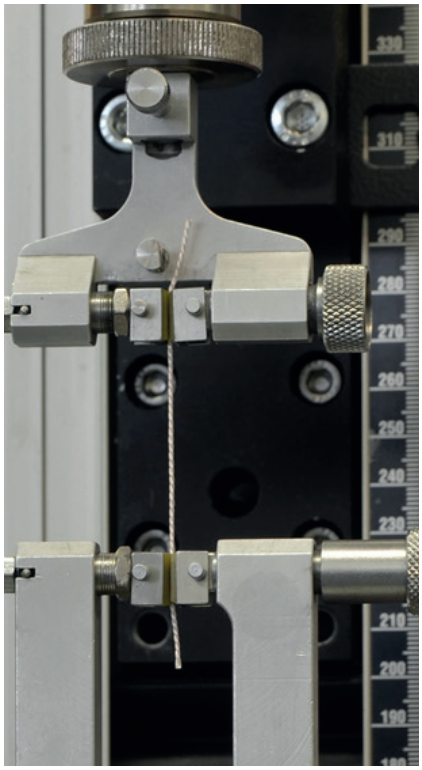


Fig.1. Elastic behavior of elastomeric yarn

Fig.2. Tensile test on two-ply yarn

Zwick / Roell

With the double capstan grips the specimen is laid in a loop over the roller connected to the load cell. It is then led over a second roller, then over a third, height-adjustable roller.

Following deflection of the double thread a defined pre-tension weight is attached. During this phase all three rollers can be moved to compensate for the change in length caused by the attachment of the pre-tension weight. The three lengths are adjusted to the material being tested.

This results in frictional forces between the rollers and the specimen, which gently reduce the tensile force prior to end clamping (specimen grip), ensuring that the specimen is gripped securely and prevents the jaws from breaking.

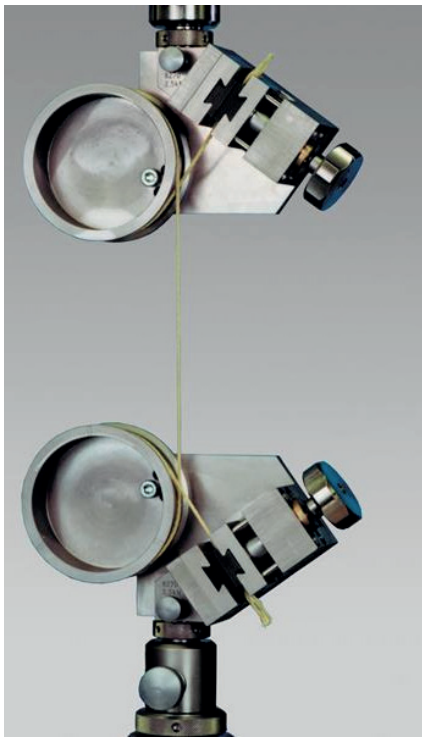


Fig.1. Tensile test on multi-filament yarn

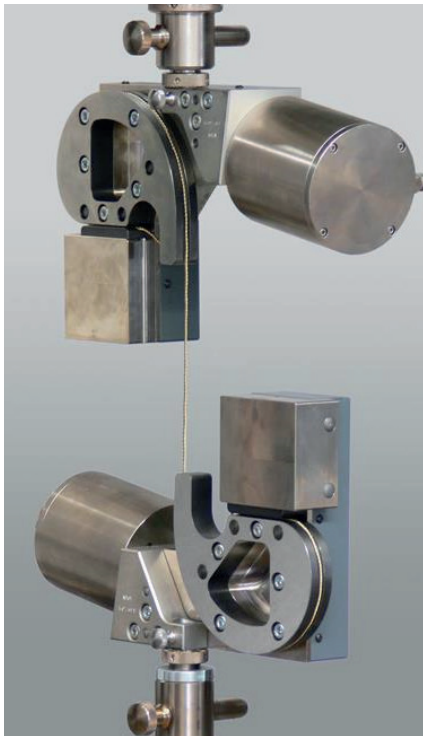


Fig.2. Tensile test on rovings

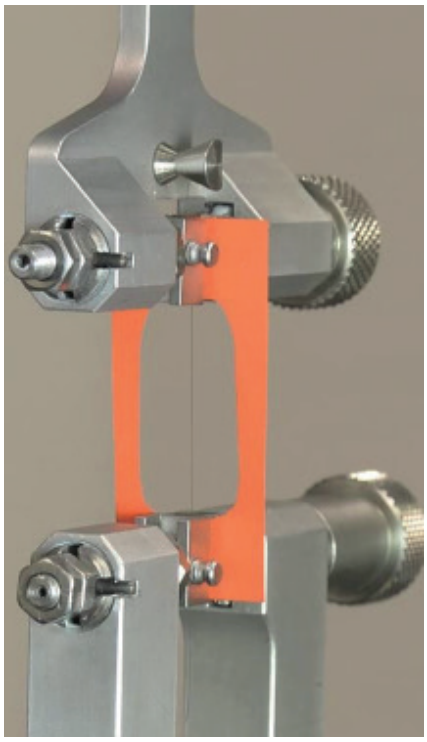


Fig.3. Tensile test on monofilaments

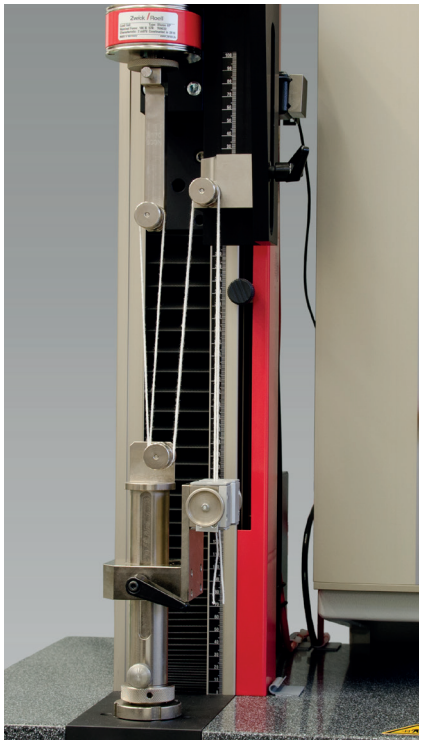
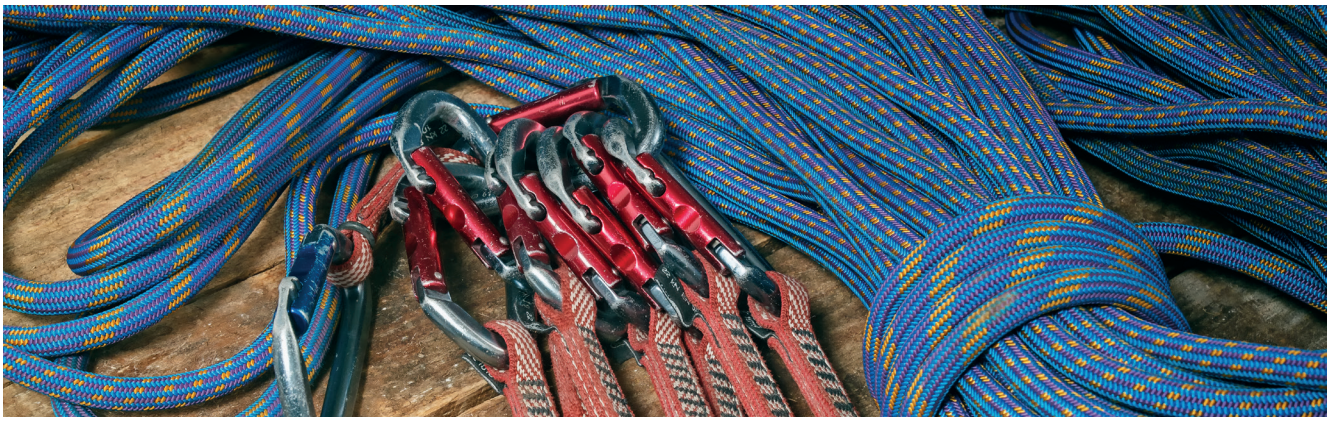


Fig.4. Double capstan grips



2.2 Tests on straps belts, ropes and cordage

2.2.1 Tensile test on ropes as per EN ISO 2307

Testing ropes calls for a certain level of expertise. Untwisting of the rope during clamping should be prevented or at least kept to a minimum.

Specimen insertion using a winding principle is fast, convenient and easy on the specimen. The specimen material is clamped at the end only, making this principle suitable even for highly sensitive surfaces. The specimen is centered automatically by means of a guide groove, while tensile stress on the specimen is reduced by friction on the load reduction roller. The ends are clamped mechanically via a screw, a wedge or a hydraulic gripping unit.

Due to the energy released when the rope breaks a non-contact optical long-travel measuring system is required. Crosshead travel cannot be defined sufficiently accurately to provide a reference quantity for strain.

2.2.2 Tensile test on belts as per EN 1492

Safety-belt manufacturers and OEMs appreciate the advantages of ZwickRoell testing systems when it comes to determining the strength of their safety-belt products (with or without buckle). This tensile test requires special specimen grips and an impact-resistant safety housing.

In another test the release force of the belt buckle (unloaded and under tensile loading) is determined. In this test the specimen is rolled up in the roller grips, thereby holding itself in place. Rolling the specimen material around the rollers causes it to clamp itself firmly due to the frictional contact.

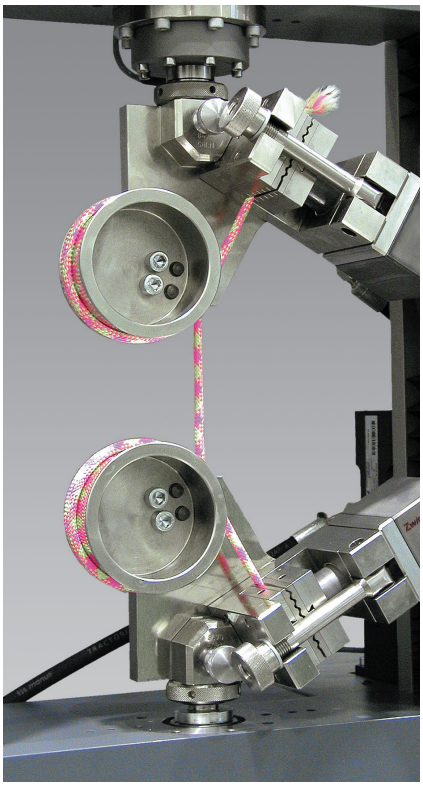


Fig.1. Tensile test on ropes

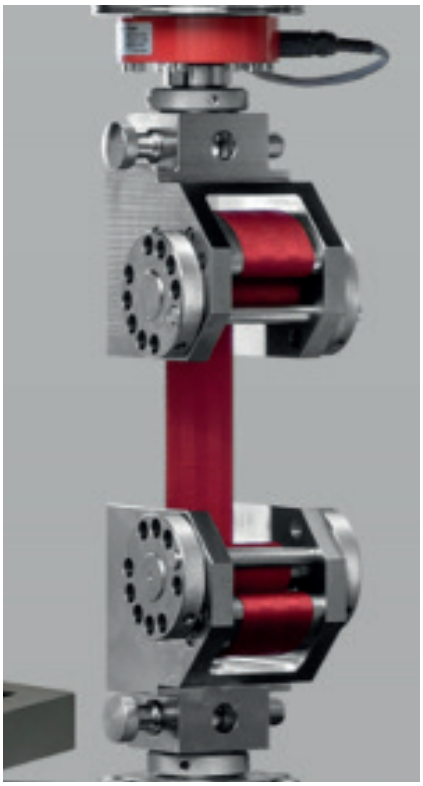


Fig. 2. Tensile test on belts

Alternatively, capstan grips are also used for belts and straps. These allow specimens to be clamped quickly and easily and are also used for thin, clamping-sensitive materials to avoid jaw breaks or specimen slippage during tensile tests. Use of a load-reduction curve allows the tensile force to be decreased before end clamping. The test can be performed in accordance with the standard. The specimen should break in the free clamping length and not in the deflectors.

2.2.3 Adhesion test to determine the adhesive strength between constitutive elements as per EN ISO 252

The adhesion test allows the adhesive strength of laminated structures such as conveyor belts to be determined. The material specimen is prepared in accordance with EN ISO 252. At one end of the specimen (cut lengthwise) the first ply is removed, then clamped in the specimen grips. Basic test conditions conform to ISO 36. It can be used for all types of conveyor belting with the exception of belts containing steel cord reinforcement, and textile-reinforced belts with a full-thickness tensile strength of less than 160 N/mm.

2.2.4 Tensile test on conveyor belts as per EN ISO 283

The standard used, EN ISO 283, specifies a test method to determine the breaking strength, elongation at break and elongation at reference load of textile conveyor belts at full thickness. A specimen cut from the full thickness of the conveyor belt is elongated using a tensile testing machine until it ruptures. High, individually tailored gripping forces are required to hold the specimen. Hydraulic grips with suitable jaw inserts are used for this. An elongation measuring system is required to ensure accurate measurement; a mechanical system can only be used if there is no risk of damage at specimen break.

Fig. 2. Adhesion test to determine the adhesive strength between constitutive elements

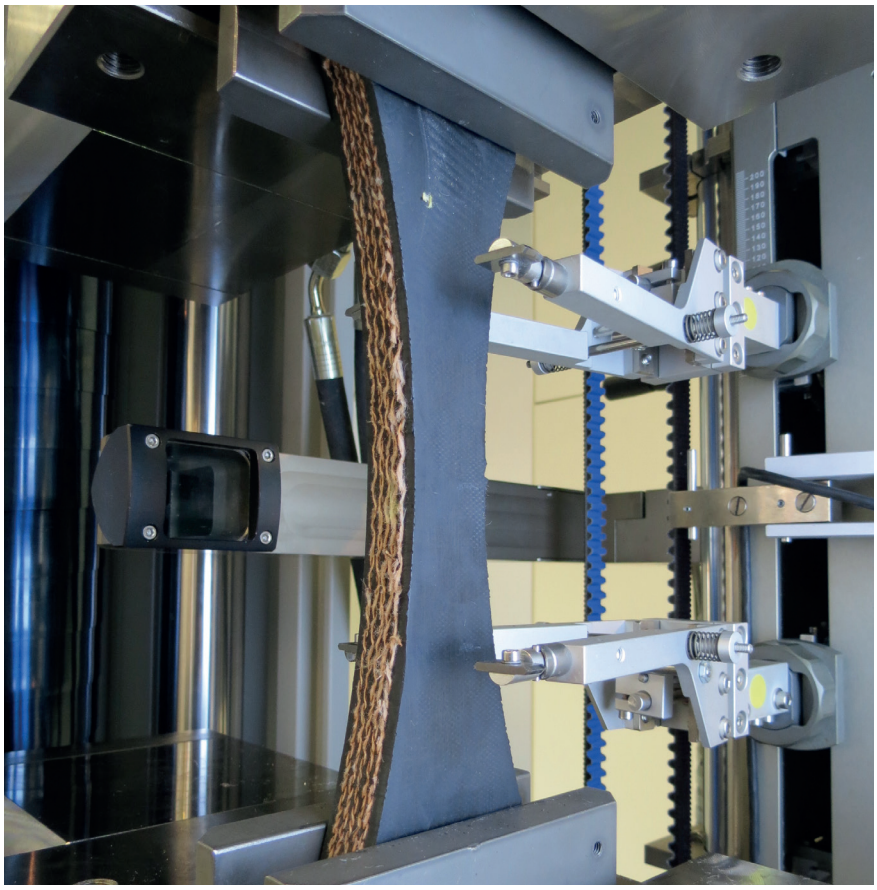


Fig. 1. Tensile test on conveyor belt

2.3 Tests on textile fabrics, coated textiles and geotextiles

2.3.1 Tensile test on textile fabrics as per EN ISO 13934-1

In tests to EN ISO 13934-1, 50 mm wide strip specimens are tested once in the warp direction and once in the weft direction, both in a standard atmosphere and in a wet state. Due to the surface properties of the most commonly used types of fabric, pneumatic grips are generally employed. The standard requires determination of maximum force and elongation at maximum force. Elongation at maximum tensile force is measured via crosshead travel.

The test method described here applies primarily to woven textiles, but can also be used for other fabrics. It generally cannot be used for woven elastic fabrics, geotextiles, nonwovens, coated fabrics, textile-glass woven fabrics and fabrics made from carbon fibers or polyolefin tape yarns.

Specimens used for testing must display no folds or creases, selvages or areas which are not representative of the fabric. For greater measuring accuracy an optical extension measuring system can be used; this is not subject to influence by the clamping system. A mechanical measuring system can only be used if there is no risk of damage at specimen break.

Fig. 1. Tensile test on textile fabrics

Where jaw breaks or slippage cannot be prevented when using flat-faced jaws, capstan grips have proved to be suitable. Elongation measurement must be carried out with an optical extension measuring system because the crosshead travel reference value for the strain cannot be precisely defined.

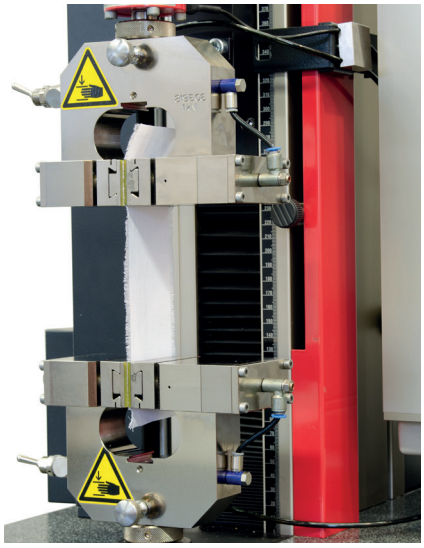


Fig. 2. Tensile test

2.3.2 Tear growth tests on textiles to EN ISO 13937-2 and EN ISO 9073-4

Specially cut specimens are used for tear tests. Tests to EN ISO 9073-4 are performed on trapezoidal specimens.
It should particularly be noted that very wide jaws are used. Pneumatic grips are preferred here, as these grip uniformly and provide re-adjustment.

For tests to EN ISO 13937-2, so-called "trouser" specimens are prepared and tested. The tear force measured is the force applied parallel to the cut; the fabric tears in the direction of the applied force. The use of pneumatic grips is advisable.

2.3.3 Tests as per Marks & Spencer

One important attribute with regard to processing textile fabrics is seam slippage resistance.

The example here concerns the support for test P12 as developed by Marks & Spencer for testing the seam slippage resistance of clothing fabrics. This standard defines the determination of the resistance of the thread systems in a clothing fabric to displacement in the vicinity of the seam, as caused by the sewing yarns. Marks & Spencer tests are precisely defined and must not be modified. We are authorized suppliers of testing equipment for the following Marks & Spencer tests:

P11, P12, P12A, P12B, P13, P13A, P14, P14A, P15 Part 1 and P15A

2.3.4 Bursting strength to ISO 3303 Method A

Bursting strength is the resistance of a ring-clamped specimen to a uniformly distributed increasing compression load applied from one side up to rupture.

This property is determined on plastic or rubber-coated fabrics in accordance with ISO 3303 Method A, using a suitable materials testing machine with ring clamps and steel ball.

Fig. 1. Tear growth test on textiles

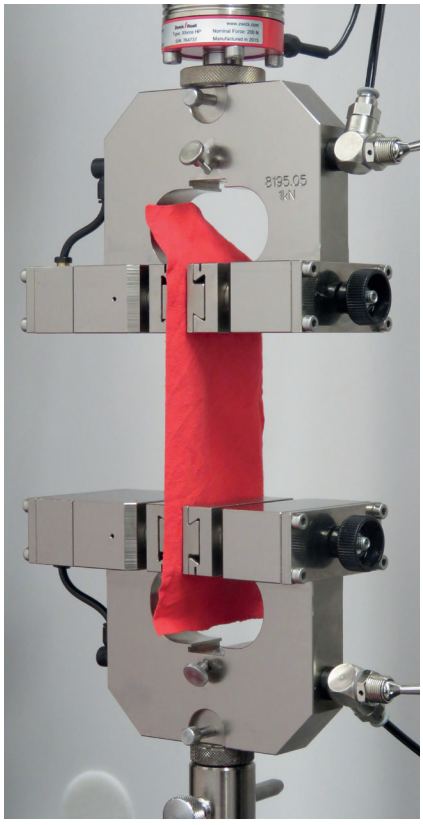


Fig. 2. Tensile test as per Marks & Spencer

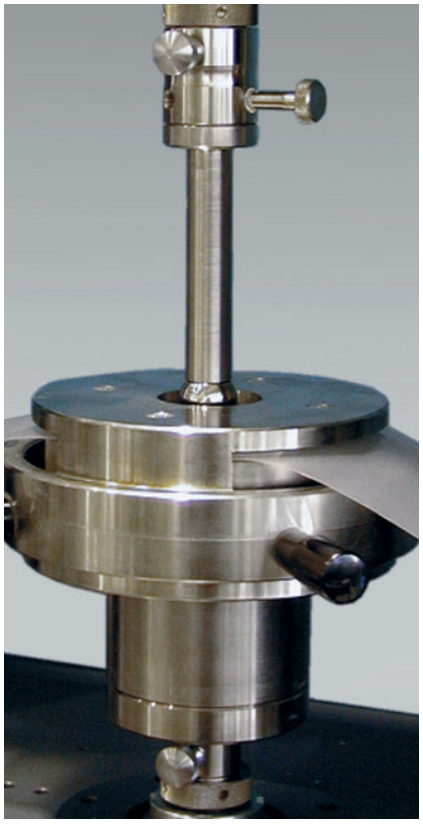


Fig. 3. Bursting strength

2.3.5 Tensile test on geogrids and non-woven geotextiles to EN ISO 10319

Tensile test on geogrids and geotextiles using an optical travel measuring system and pneumatic grips as per EN ISO 10319. The key feature of this method of determining the tensile strength of textiles is the width of the specimens.

In the basic test using this method the specimen width (200 mm) is greater than the grip-to-grip separation (100 mm). This is because nonwoven geotextiles have a tendency to contract (“neck down”) under tensile loading at right angles to the load direction The greater width reduces the contraction effect and provides a relationship closer to expected fabric behavior in the field.

An optical travel measuring system is often used here due to the high energies which may sometimes be released at break.
A mechanical measuring system can only be used if there is no risk of damage at specimen break. Alternatively, hydraulic grips must be used where high forces are involved.

2.3.6 Static puncture test (CBR test) to EN ISO 12236

EN ISO 12236 describes a method for determining the puncture resistance of geotextiles and related products by measuring the force required to push a flat-ended plunger through the specimen.

The specimen is clamped between two steel rings, with hydraulic end clamping.

The test is normally performed on dry specimens conditioned in the specified atmosphere and is applicable to most types of product, but not to materials with apertures greater than 10 mm.

2.3.7 Tensile test on woven textile glass fabrics to ISO 4606

In the example shown here tests are being carried out on woven textile glass fabrics. This international standard specifies the method for determining the tensile breaking force and elongation at break of frayed strips of woven textile glass fabrics. The method is applicable to unimpregnated textile glass fabrics and to textile glass fabrics impregnated with stiffening materials, but not to fabrics coated with plastics or elastomers.

In accordance with ISO 4606, 50 mm wide strips are here being tested up to failure in both the warp and weft directions. Pneumatic grips are used in view of the high gripping forces required to enable the specimen to be clamped in accordance with the standard. Specimens used for testing must display no folds or creases, selvages or areas which are not representative of the fabric.

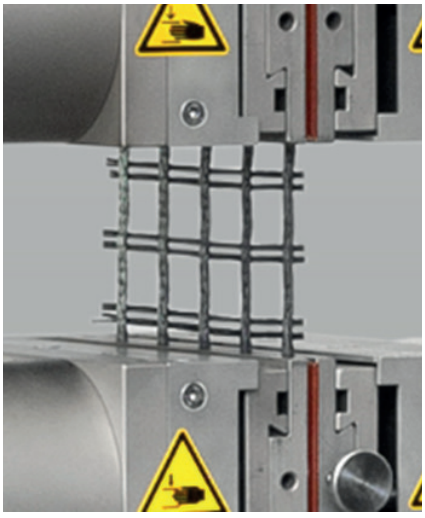


Fig. 1. Tensile test on geogrid

Fig. 2. Static puncture test (CBR test)

Fig. 3. Tensile test on woven textile glass fabric

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2.4 Testing finished textile products

2.4.1 Tensile test on press studs to BS 4162

In the application shown here the basic closing force of press studs and the pull-out force of buttons are being tested to BS 4162.

The test arrangement used consists of two parts:

- holding-down clamp
- a form of locking tongs.

The upper press-stud is pressed on by hand. The upper part of the press stud is gripped in the locking tongs.

A tensile test is then carried out to determine the maximum force of the press-stud fastening. The result is shown in a typical force-travel diagram.

2.4.2 Tensile test on soft toys as per EN 71

EN 71 defines methods and requirements for testing the mechanical and physical properties of toys.

As illustrated in the example below, the strength and seam attachments of soft toy appendages are tested. A device with a circular aperture into which the toy can be inserted is used, as in the example here. The opening is designed so that it is not possible for the soft toy to be drawn through it during the test. In this case simple screw grips are being used to hold the soft toy or its appendages.

Available from ZwickRoell is a variety of holding-down clamps, tools and specimen grips for a wide range of testing situations.

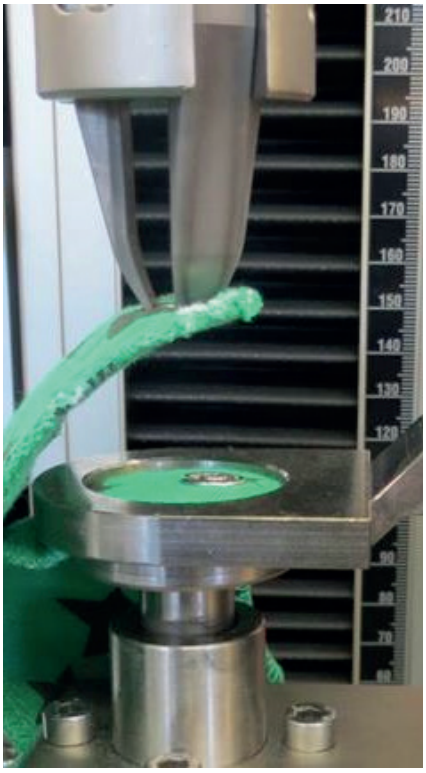

Fig. 1. Tensile test on press-studs

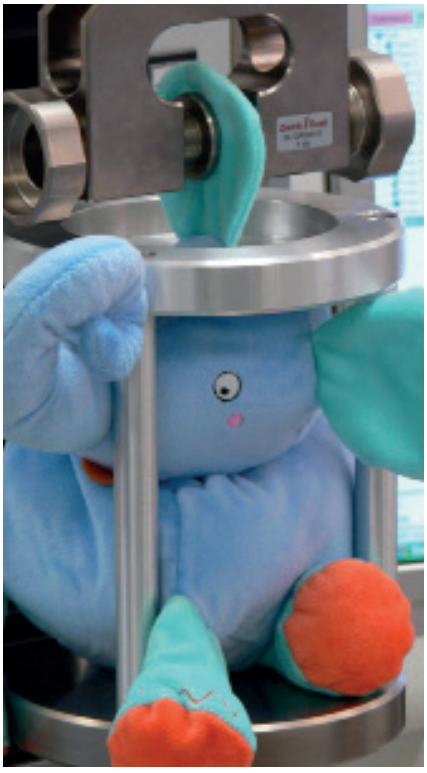

Fig. 2. Tensile test on soft toys

2.4.3 Tensile test on zip fasteners to BS 3084

BS 3084 covers a large variety of different types of slide (zip) fasteners, together with a wide range of testing situations and requirements.

In the example shown the properties of a plastic zip fastener are being tested. The textile part of the fastener is held so that the slider can rest on it correctly.

A tensile test is then performed at right angles to the zip fastener and continues until the fastener or the slider fails. The maximum force is determined and is shown in a typical force-travel diagram.

2.4.4 Tensile test on sling/belt connections to EN 1492

Sling/belt connections in the form of loops, knots or eyes must be tested for their safety-related forces and properties.

In the example shown here the maximum force acting on the seam stitching, the safety loop or the conveyor belt is being determined. For this the conveyor belt is rolled up and held using roller grips. The eye is clamped in pneumatic grips on the opposite side.
The force-travel diagram is recorded via the crosshead. No additional measuring system is required for this.

Fig. 1. Tensile test on zip fasteners

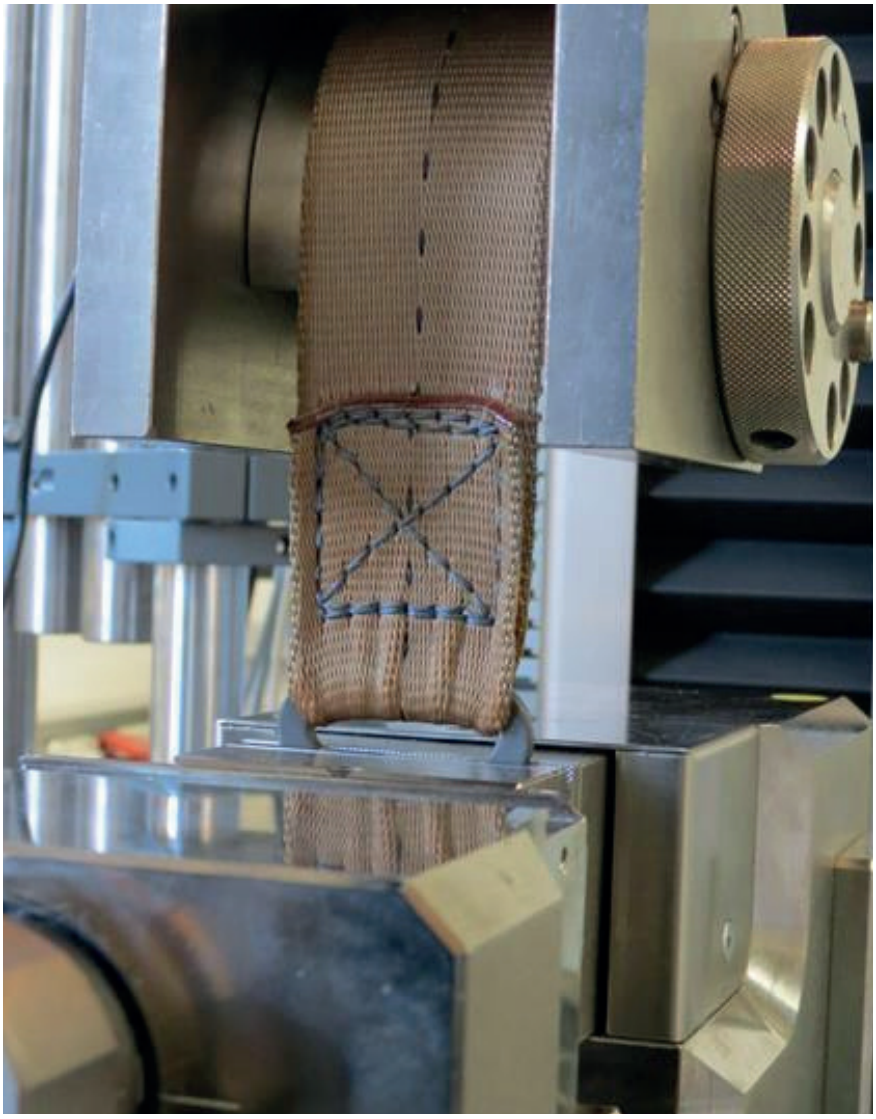

Fig. 2. Tensile test on belt connections

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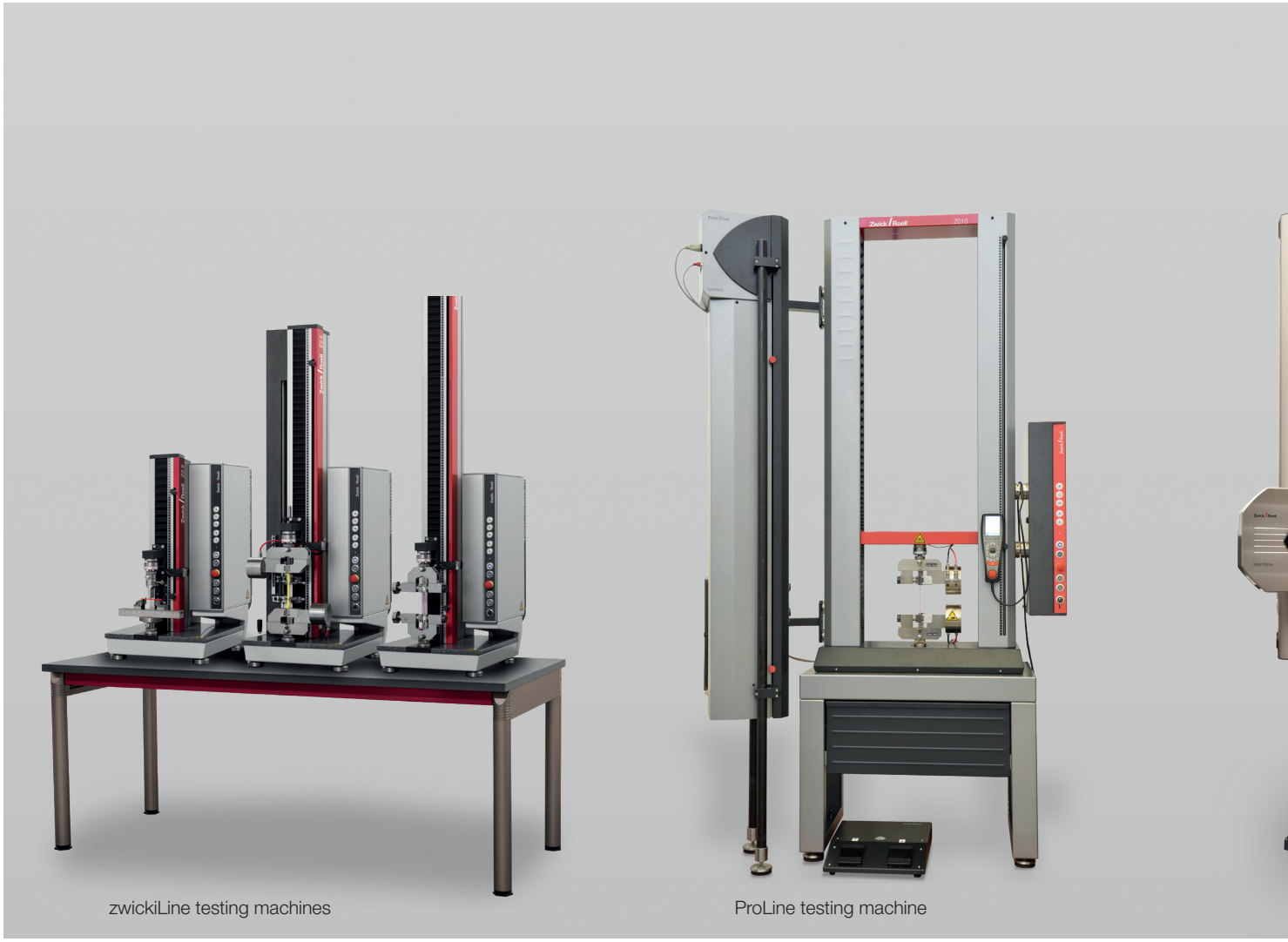
3 Products and services

3.1 Testing machines for quasi-static applications

The ZwickRoell Group is the world's leading supplier of static materials testing machines, developed by our experts for use in demanding testing situations and in a wide range of applications. Our static testing machines have been specifically designed for tensile, compression and flexure tests, together with shear and torsion tests, making them ideal for use in the most demanding materials and component testing situations. Our five testing machine ranges in the 200 N to 2,500 kN force range offer a wide choice of test strokes and speeds, with high-quality load frames combined with intelligent drive systems. All systems feature simple, flexible integration of load cells, specimen grips and extensometers. The static testing machine is the classic testing solution for reliable validation of characteristic values of materials and components.

zwickiLine
Included in our testing machines rated up to 5 kN is the single-column zwickiLine, which offers a powerful, flexible testing solution for a wide range of materials and components. This materials testing machine is equally ideal for research and development and for routine quality assurance testing. A wide range of equipment options enables zwickiLine to be used for tests on plastics, rubber, metals, composites, paper, board, textiles, foams and components.



zwickiLine testing machines

ProLine testing machine

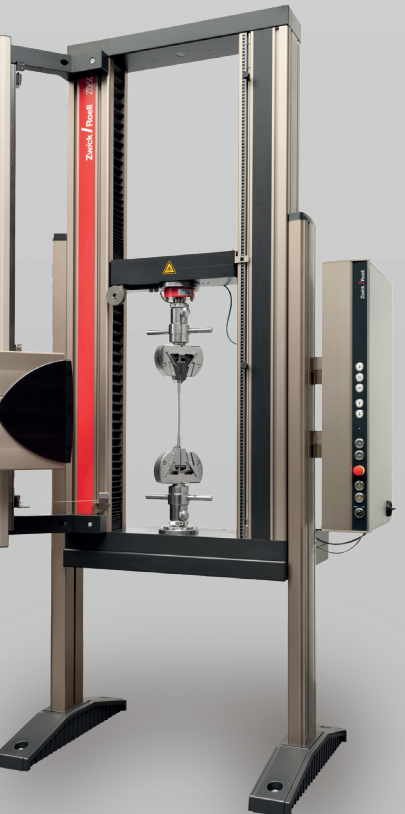
Zwick / Roell

ProLine
The ProLine series was developed primarily for standardized tests on materials and components in the force range up to 100 kN. These materials testing machines are quick and easy to operate in combination with the intuitive testXpert III testing software.

AllroundLine
The new AllroundLine can be used for applications from all fields and is equally ideal for quality control testing and demanding research projects. These materials testing machines are available from a force range of 5 kN. Depending on requirements and force range, there is a choice between profile-framed and column-type machines.

High-capacity testing machines
Our high-capacity testing machines were developed for testing materials and components which call for high test loads. Test tools for lower test forces expand the range of use and are easily attached.

Our standard product range covers several load frame versions in a force range from 330 kN to 2,500 kN Force application can be electromechanical or hydraulic. For higher force ranges, customized solutions featuring hydraulic high-capacity testing machines are available. Our high-capacity testing machines offer high levels of stiffness, robustness, flexibility and reliability.



AllroundLine testing machine

AllroundLine testing machine

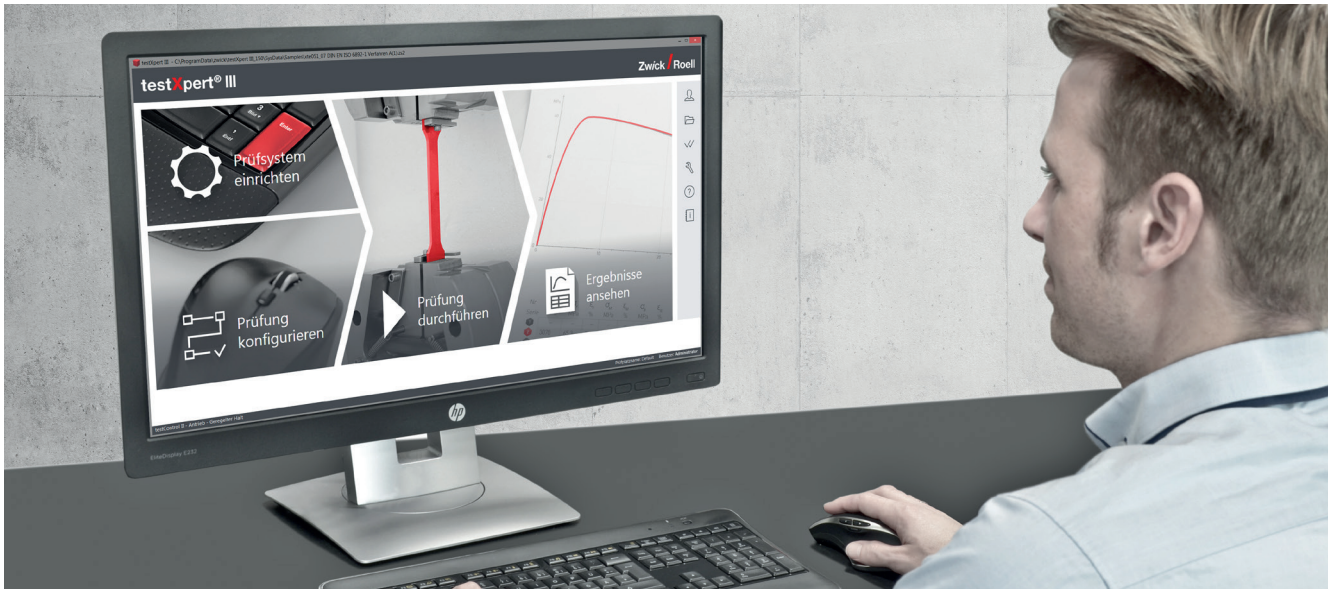


Fig. 1. Workflow related to working processes: administrator's view, with full functionality - www.testXpert.de

3.2 testXpert® III testing software

Intuitive and workflow-based from the very start!
testXpert III is the result of close collaboration with users in materials testing and the experience gained from over 30,000 successful testXpert installations. With its intuitive, structured operation, testXpert III is easy to use right from the start. Informative icons and clear visual linking of related items assist the user, while reducing mouse movement and clicks.

A workflow aligned to your operating processes

- Set up testing system – configure all machine-related settings for your testing application.
- Configure test – set all test-related parameters, such as selecting results with the intelligent wizard.
- Run test – fast, easy navigation through the entire test sequence.
  View results – verify all test data, also in secure mode.

Intelligent user management allows you to define user roles or import user roles direct from Windows accounts via LDAP. The user can focus on the task at hand right from the start and avoid input errors. testXpert III is workflow-based throughout, keeping training time to a minimum and enabling efficient, reliable testing.

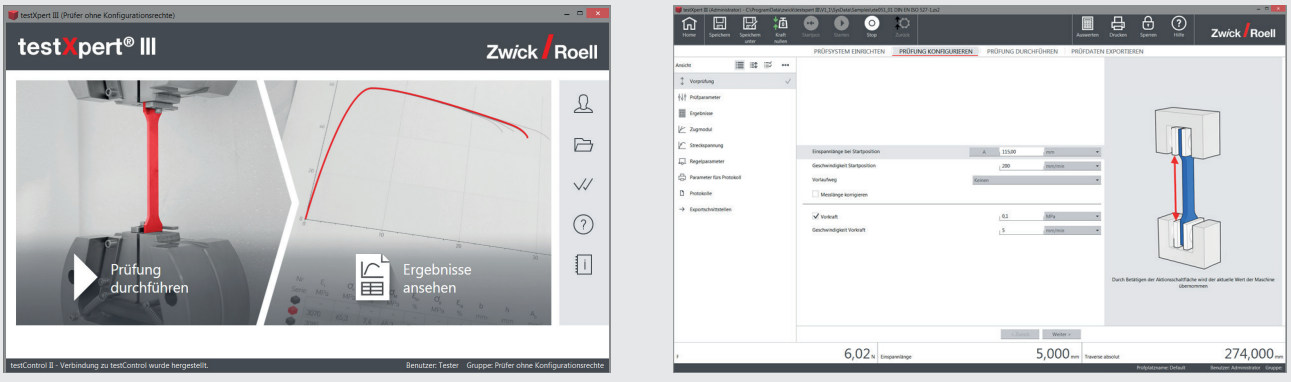


Fig. 2. View optimized for the tester (left); intelligent wizard for test configuration (right)

Unique System Configuration Builder software concept
System Configuration Builder allows you to preset and save all relevant testing system and safety settings such as crosshead position, tool separation or sensor configuration in a freely definable system configuration. The saved system configuration checks the connected sensors; the test can only be started when the parameters match the presets, ensuring exactly repeatable test conditions.

Tamper-proof test results
testXpert III logs all testing system and system settings, ensuring traceable results. The traceability offered by testXpert III means you always have answers to the question: "When does who do what, why and who is responsible?"

testXpert III guarantees reliable test results and maximum protection for users and the testing system.

Reliable importing & exporting
testXpert III can communicate directly with any IT system. All test-related data is imported quickly and directly from ERP systems, databases or external devices. Data can easily be exported to all your usual evaluation/analysis platforms.

Standard-compliant testing
testXpert III offers over 600 prepared Standard Test Programs, preconfigured to test standard requirements and with integrated results tables and statistics. Standard-compliant testing can start straight away - testXpert III takes care of the rest!

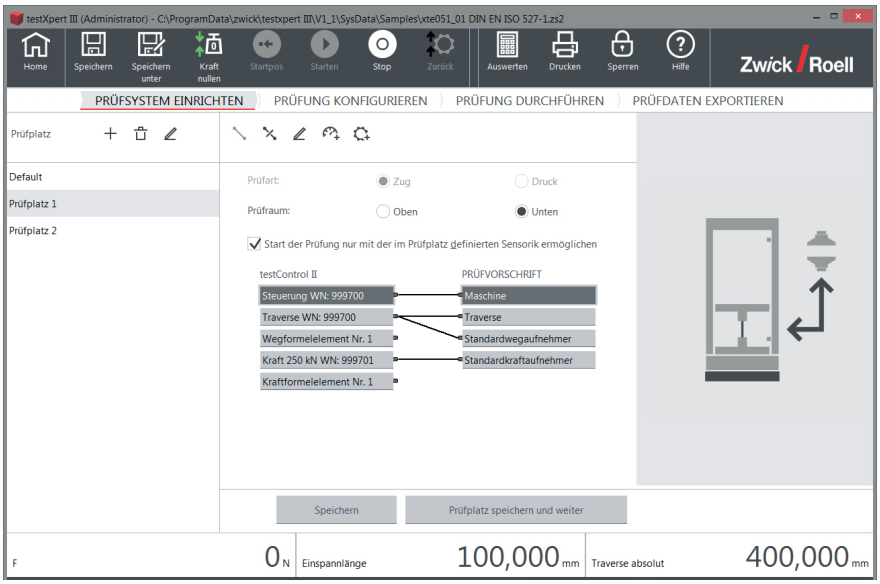


Fig. 1. Following a change of test arrangement, saved test configurations can be re-created and tests can be performed using identical settings.

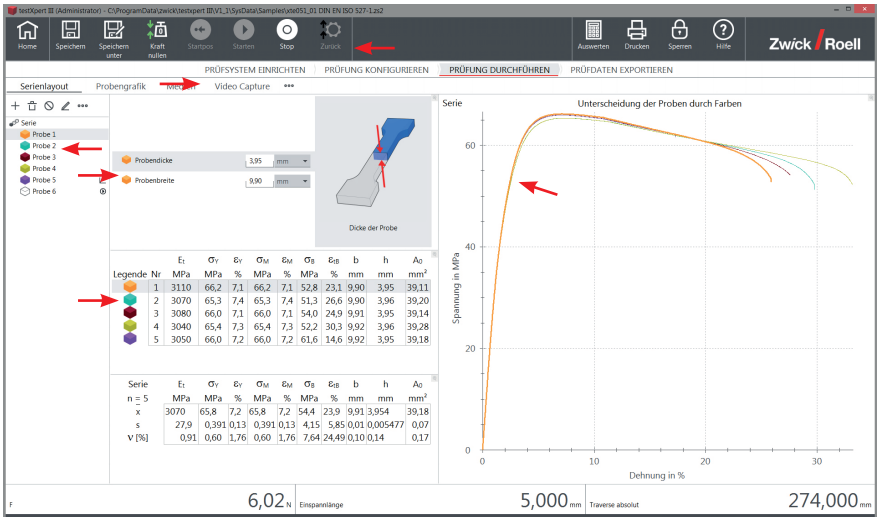


Fig. 2. Clear visual linking of interrelated content, plus structured workflow

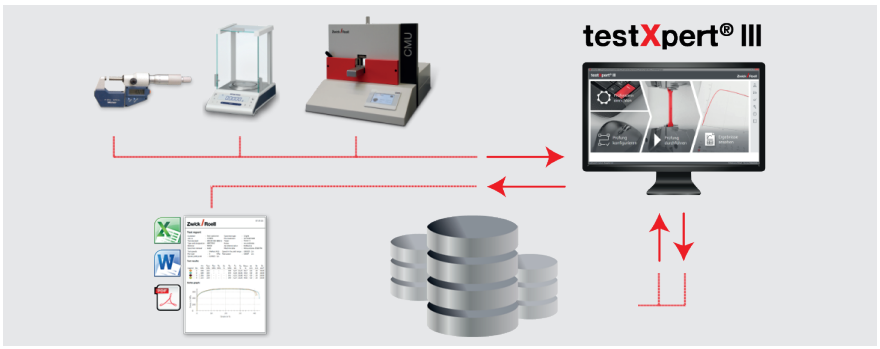


Fig. 3. Simple, reliable interfaces for sharing test results

3.3 Extensometers

ZwickRoell has the widest and most varied range of extensometers for textile testing.

videoXtens
videoXtens uses image processing, allowing high-accuracy non-contact determination of transverse and longitudinal strain.

lightXtens long-travel extensometer
The mechanical long-travel extensometer is used when tensile modulus is not required. Optical version lightXtens is ideal for specimens prone to whipping and for measurements in temperature chambers.

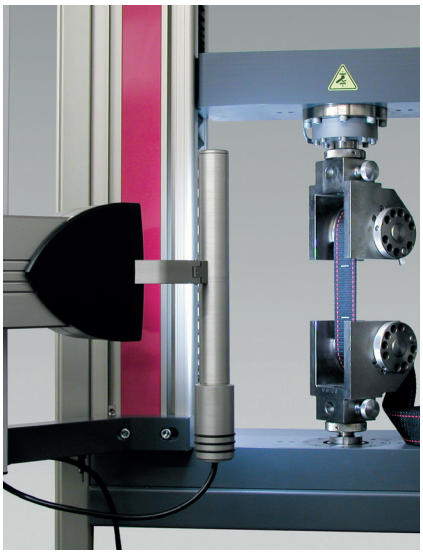


Fig. 1. Extensometers: videoXtens II (left) and lightXtens (right)

3.4 Specimen grips

ZwickRoell's wide range of specimen grips features a variety of designs, test-load ranges and test temperatures, for cutting-edge textile testing solutions.

ZwickRoell has grips to suit all specimen materials and specimen shapes. The range covers the full spectrum of established operating principles for non-positive-clamping grips and positive-clamping grips.

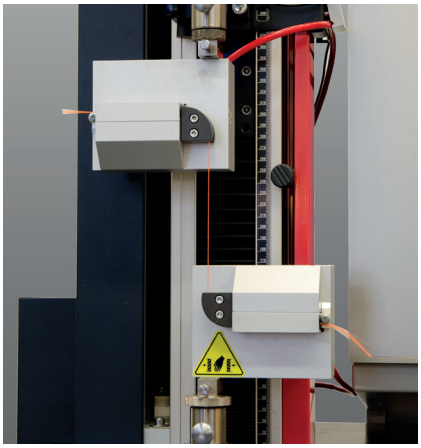


Fig. 2. Capstan grips

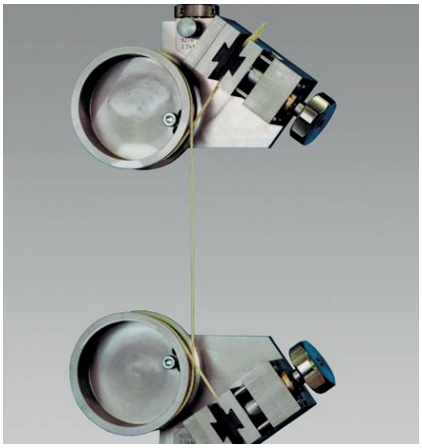


Fig. 4. Rope grips

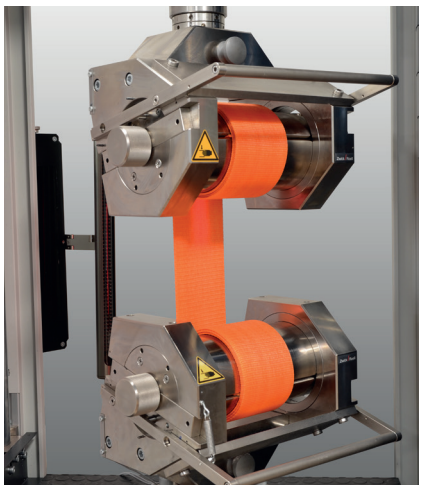


Fig. 3. Roller grips

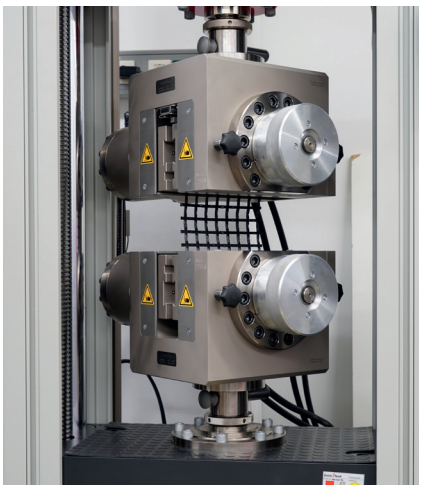


Fig. 5. Hydraulic grips for geotextiles

3.5 Modernization and retrofits for testing machines

RetroLine modernization packages for all makes of materials testing machines

ZwickRoell has already transformed several thousand materials testing machines from over forty different manufacturers into state-of-the-art equipment using proven modernization components such as measurement and control electronics, drive technology and testing software. Modernization packages are available for both electromechanical and servo-hydraulic testing machines, as well as for resonance testing machines and hardness testers.

Modernization takes place either on-site at the customer's premises or if required at ZwickRoell's premises in Ulm, in which case full overhaul, painting and CE marking can be carried out

Benefits offered by modernizations include:

- Spare part availability for a minimum of 10 years
- Use of improved safety components
- Option to retrofit the latest sensors and test tools for a wide range of testing requirements
- Compatibility with current Windows operating systems.

Retrofits

Every year over 3,500 customers upgrade their testing machines using proven ZwickRoell products:

- Load cells - robust and sensitive, highest accuracy class
- Specimen grips and test tools - modular design for flexible, trouble-free retrofitting
- Extensometers - maximum measuring precision, standard-compliant measurement (ISO 9513)
- Safety for operator and machine - retrofitting of safety technology such as safety doors to existing testing systems
- testXpert III - stay up to date at all times; testing software updates and upgrades ensure you always have the latest functions
- Temperature chambers and furnaces - retrofitting of temperature chambers and high-temperature furnaces for up to 1,600°C.

Fig. 1. Modernization of a static materials testing machine with testControl II

Fig. 2. Xforce load cells

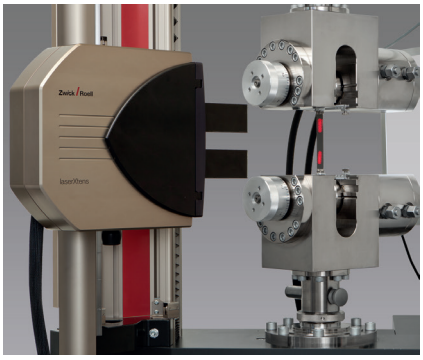


Fig. 3. Specimen grips and extensometers can be retrofitted whenever required

Fig. 4. Temperature chambers can also be retrofitted

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4 ZwickRoell services

4.1 Laboratory for materials and components testing

For companies with a testing requirement but no suitable testing option, ZwickRoell's laboratory for materials and components testing is ready to provide expert assistance.

We can also help out in the event of capacity bottlenecks or perform cross-validation tests. It makes no difference whether just a single test is involved or an entire test series. With the latest technology and modern testing machines, we guarantee fast, standard-compliant testing. Naturally we can also perform tests in accordance with factory standards.

Our laboratories for materials and components testing perform testing services of all kinds, on all static and dynamic materials testing machines.

Fig. 1. Static testing machines and instruments in the ZwickRoell testing laboratory

Fig. 2. The ZwickRoell Academy offers an interesting and wide-ranging training program, for new students and advanced learners alike!

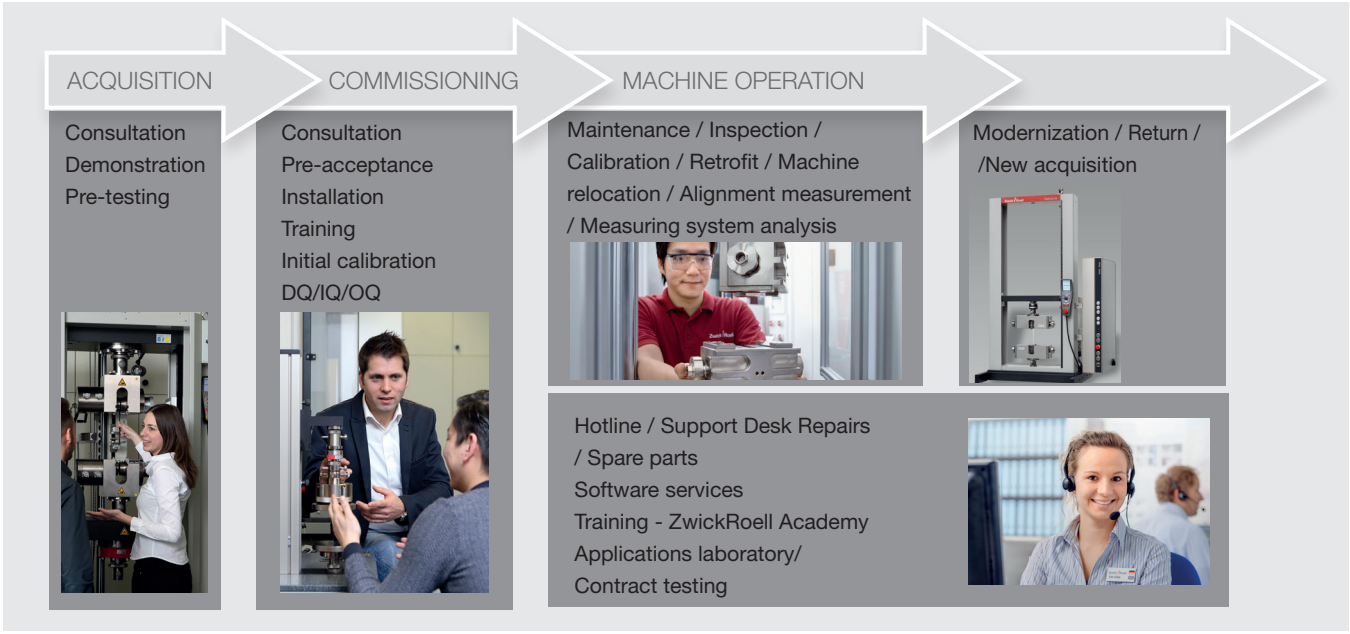

Fig. 1. ZwickRoell provides continuous support throughout the entire life-cycle of materials testing systems.

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5 Test standards and test devices

Contents	Standard	Testing equipment/device
1. Fiber or filament strength		
• Staple fibers, tensile test	EN ISO 5079, ASTM D3822	Fiber strength testing instrument
• Staple fibers, loop tensile test	DIN 53843-2, ASTM D3217a	Fiber strength testing instrument
• Monofilaments, tensile test	EN 13895	Materials testing machine
2. Fiber strength		
• Yarns from packages, tensile test	DIN EN ISO 2062, ASTM D2256	Materials testing machine
• Multifilament yarns	prEN 14621	Materials testing machine etc.
• Yarn skeins, tensile test	ISO 6939, ASTM D1578	Materials testing machine
• Single and plied yarns, knot tensile test	DIN 53842-1	Materials testing machine
• Yarns, loop tensile test	DIN 53843-1	Materials testing machine
• Sewing threads, plied yarns, tensile test and other test methods	ASTM D204	Materials testing machine etc.
3 . Elastic behavior (tensile load)		
• Single and plied elastomeric yarns, repeated application of tensile load between constant extension limits	DIN 53835-2	Materials testing machine
• Single and plied yarns, single application of tensile load between constant extension limits	DIN 53835-3	Materials testing machine
• Single and plied yarns, single application of tensile load between constant force limits	DIN 53835-4	Materials testing machine
• Elastomeric yarns, permanent deformation	ASTM D3106	Materials testing machine
4. Fabric mass per unit area, width and length		
• Fabric, mass per unit area	ASTM D3776	Aids/tools as per standard
• Textile fabrics (except non-wovens), fabric mass per unit area	ISO 3801, EN 12127, EN ISO 5084	Aids as per standard
• Non-wovens, mass per unit area	EN 29073-1, ISO 9073-1	Aids as per standard
• Textile fabrics, width and length	EN 1773, ASTM D3773, ASTM D3774	Aids as per standard
5. Thickness and compression		
• Textile fabrics (except non-wovens), thickness	EN ISO 5084	Thickness tester
• Non-wovens, thickness	EN ISO 9073-2, ASTM D5729	Thickness tester
• Textile fabrics, thickness	ASTM D1777	Thickness tester
• High-loft non wovens, thickness	ASTM D5736	
• Textile fabrics, compression	DIN 53885	Thickness tester

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Contents	Standard	Testing equipment/device
6. Tensile test, strip method		
• Textile fabrics: tensile test, strip method	EN ISO 13934-1	Materials testing machine
• Non-wovens: tensile test, strip method	EN 29073-3, ISO 9073-3	Materials testing machine
• Textile fabrics: tensile test, grab method	EN ISO 13934-2	Materials testing machine
• Textile fabrics: tensile test, strip method	Marks & Spencer P11	Materials testing machine
• Textile fabrics: tensile test, strip method	ASTM D5035	Materials testing machine
• Textile fabrics: tensile test, grab method	ASTM D5034	Materials testing machine
• Textile fabrics: tensile test, strip method, on seams	EN ISO 13935-1	Materials testing machine
• Textile fabrics: tensile test, grab method, on seams	EN ISO 13935-2	Materials testing machine
7. Tear and pull-out characteristics		
• Textile fabrics, tear force of trouser-shaped specimens	EN ISO 13937-2 ASTM D2261	Materials testing machine
• Non-wovens, trouser tear test	DIN 53859-4	Materials testing machine
• Textile fabrics, tear strength, wing procedure	EN ISO 13937-3	Materials testing machine
• Textile fabrics, tear strength, tongue procedure	EN ISO 13937-4	Materials testing machine
• Non-wovens, tear strength, tongue procedure	ASTM D5735	Materials testing machine
• Textile fabrics (except non-wovens), tear strength, trapezoid procedure	DIN 53859-5, ASTM D5587	Materials testing machine
• Non-wovens, tear strength, trapezoid procedure	EN ISO 9073-4 ASTM D5733	Materials testing machine
8. Tensile-elastic behavior		
• Textile fabrics (except knitted fabrics), single tensile load between constant extension limits	DIN 53835-13	Materials testing machine
• Knitted fabrics, single strain between two force limits	DIN 53835-14	Materials testing machine
• Narrow elastic fabrics, static loading	ASTM D5278	Materials testing machine
• Textile fabrics, determination of elasticity, strip test	EN ISO 14704-1	Materials testing machine
• Textile fabrics, determination of elasticity, multiaxial deformation	EN ISO 14704-2	Materials testing machine
• Narrow fabrics, determination of elasticity	EN ISO 14704-3	Materials testing machine
• Elastic fabrics, tension and elongation, loop tension	ASTM D4964	Materials testing machine
• Extension and modulus of elastomeric fabrics and narrow elastics	Marks & Spencer, P14	Materials testing machine
• Extension and modulus of stretch laces	Marks & Spencer, P14A	Materials testing machine
• Elastic properties of fabrics marked Lycra®Soft	Marks & Spencer, P14B	Materials testing machine
• Extension and modulus of bare rubber tapes	Marks & Spencer, P14C	Materials testing machine
• Extension and residual extension of stretch fabrics	Marks & Spencer, P15 Part 1	Materials testing machine

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Contents	Standard	Testing equipment/device
• Extension, modulus and residual extension of stretch fabrics	Marks & Spencer, P15A	Materials testing machine
• Stretch fabrics, properties and recovery	Test Method LTD 03	Materials testing machine
• Elastics, load, elongation and recovery	Test Method LTD 06	Materials testing machine
• Bra strap, elongation	Test Method LTD 07	Materials testing machine
9. Slippage resistance		
• Slippage resistance of yarns at a seam in woven fabrics, fixed seam opening method	EN ISO 13936-1	Materials testing machine
Fixed load method	EN ISO 13936-2	Materials testing machine
Needle clamp method	EN ISO 13936-3	Materials testing machine
• Seam slippage	Marks & Spencer P12	Materials testing machine
10. Special seam tests		
• Sam failures in fabrics	ASTM D1683	Materials testing machine
11. Stiffness and recovery from creasing		
• Textile fabrics (except non-wovens), stiffness in bending, cantilever method	DIN 53362	Cantilever instrument
• Non-wovens, bending length	EN ISO 9073-7	Equipment as per standard
• Bending strength, Schlenker method	DIN 53864	Schlenker bending strength tester
• Textiles, determination of recovery from creasing	EN 22313, ISO 2313	Equipment as per standard
• Textiles, determination of crease recovery of wet specimen	DIN 53891-2	Equipment as per standard
12. Adhesion tests		
• Delamination of fusible interlinings from upper fabrics	DIN 54310	Materials testing machine
• Adhesion of rubber to textile fabric	ISO 36	Materials testing machine
• Rubber - adhesion to flexible substrate	ASTM D413	Materials testing machine
13. Bursting tests		
• Hydraulic method	EN ISO 13938-1, ASTM D3786	Bursting pressure tester
• Pneumatic method	EN ISO 13938-2,	Bursting pressure tester
• Ball burst test (CRT method)	ASTM D3787	Materials testing machine
14. Other special test methods for non-wovens		
• Needle tear-out resistance	DIN 54301	Materials testing machine
• Compression elastic behavior	DIN 54305	Materials testing machine
• Standard test methods	ASTM D1117	Materials testing machine etc.
• Non-woven compresses for medical use	EN 1644-1, EN 1644-2	Materials testing machine etc.
• Determination of drape coefficient	EN ISO 9073-9	Equipment as per standard

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Contents	Standard	Testing equipment/device
15. Coated textiles		
• Standard test methods	ASTM D751	Materials testing machine etc.
• Coated and laminated fabrics for architectural use	ASTM D4851, EN 12311	Materials testing machine etc.
• Bonded, fused or laminated apparel fabrics	ASTM D2724	Materials testing machine etc.
• Bending stiffness, cantilever method	DIN 53362	Cantilever stiffness tester
• Tensile test	EN ISO 1421	Materials testing machine
• Tear strength, trapezoidal method	EN 1875-3	Materials testing machine
• Tongue tear and trouser tear	ISO 4674-1	Materials testing machine
• Tear strength	DIN 53356	Materials testing machine
• Blocking resistance	EN 25978, ISO 5978 DIN 53366	Equipment as per standard
• Determination of coating adhesion	EN ISO 2411	Materials testing machine
• Rubber-to-fabric adhesion	ISO 4637	Materials testing machine
• Bursting strength, steel ball and hydraulic methods	ISO 3303	Materials testing machine (Meth. A)
• Bursting strength, steel ball method	EN 12332-1	Materials testing machine
• Bursting strength, hydraulic method	EN 12332-2	Bursting pressure tester
• Low-temperature bending test	ISO 4675, ASTM D2136	Equipment as per standard
• Determination of damage by flexing	EN ISO 7854	Equipment as per standard
16. Floor coverings		
• Textile floor coverings, standard test methods	ASTM D6719	Materials testing machine etc.
• Determination of tuft withdrawal force	ISO 4919	Materials testing machine
• Textile floor coverings, thickness loss	DIN 54316	Materials testing machine
• Textile floor coverings, determination	ISO 11857, ASTM D 3963	Materials testing machine etc.
• of resistance to delamination		
• Textile floor coverings, friability of attached foams	ISO 11858	Materials testing machine etc.
• Textile floor coverings, thickness determination	ISO 1765, DIN 53855	Equipment as per standard
17. Upholstery fabrics		
• Specification and test methods	EN 14465/A1	Materials testing machine etc.
18. Reinforcing textiles		
• Para-aramid multifilament yarns	EN 12562	Materials testing machine
• Para-aramid multifilament yarns	EN 13003-2	Materials testing machine
• Carbon fibre yarns	EN 13002-2	Materials testing machine
• Carbon fibre yarns, tensile properties of resin-impregnated yarn	EN ISO 10618	Materials testing machine
• Continuous-filament carbon and graphite fiber tows and rovings, tensile test	ASTM D4018	Materials testing machine
• Reinforcement fibres for plastics, tensile test	DIN 65382	Materials testing machine
• Tire cord, tire cord fabrics and industrial filament yarns	ASTM D885	Materials testing machine
• Yarns and fabrics used in inflatable items	ASTM D5446	Materials testing machine
• Mats and fabrics, mass per unit area	ISO 3374	Equipment as per standard

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Contents	Standard	Testing equipment/device
19. Textile glass products		
• Textile glass yarns Materials testing machine etc.	EN 12654-2	
• Textile glass yarns Materials testing machine etc.	EN 12971-2	
• Textile glass yarns, tensile test	ISO 3341	Materials testing machine
• Glass fiber strands, yarns and rovings used in reinforced plastics, tensile test	ASTM D2343	Materials testing machine
• Textile glass rovings Materials testing machine etc.	EN 14020-2	
• Textile glass rovings, manufacture of specimens and tensile test on impregnated rovings	EN ISO 9163	Materials testing machine etc.
• Textile glass, wovens, thickness	ISO 4603	Equipment as per standard
• Textile glass mats, thickness and recovery	ISO 3616	Equipment as per standard
• Textile glass fabrics, tensile test	ISO 4606	Materials testing machine
• Textile glass mats, tensile test	ISO 3342	Materials testing machine
20. Geotextiles, geosynthetics		
• Geotextiles, sampling	EN ISO 9862, ASTM D4354	
• Geotextiles, mass per unit area	EN ISO 9864, ASTM D5261	Equipment as per standard
• Geosynthetics, thickness, single layers	EN ISO 9863-1	Thickness tester
• Geotextiles, layer thickness of multi-layer products	EN ISO 9863-2	Thickness tester
• Geotextiles, wide-width tensile test	EN ISO 10319, ASTM D4595, ASTM D6637	Materials testing machine
• Geotextiles, tensile test, grab method	ASTM D4632	Materials testing machine
• Geotextiles, tensile test on joints / seams	EN ISO 10321, ASTM D4884	Materials testing machine
• Geotextiles, geocells, strength of internal structural junctions	EN ISO 13426-1	Materials testing machine
• Geocomposites, strength of internal structural junctions	EN ISO 13426-2	Materials testing machine
• Geotextiles, static puncture test	EN ISO 12236	Materials testing machine
• Geotextiles, geosynthetics, tensile creep	EN ISO 13431, ASTM D5262	Long-term test bench
• Geotextiles, compression creep	EN 1897	Long-term test bench
• Trapezoid tearing strength of geotextiles	ASTM D4533	Materials testing machine
• Geotextilien, cone drop test	EN 918, ISO/DIS 13433	Cone drop tester
• Geomembranes, tensile test on wide strips	ASTM D4885	Materials testing machine
• Geomembranes, tensile test on notched specimens	ASTM D5397	Materials testing machine
• Geomembranes, tensile test pyramid puncture resistance	ASTM D5494	Materials testing machine
• Geosynthetics, pyramid puncture resistance	EN 14574	Equipment as per standard
• Geosynthetics, burst strength	DIN 61551	Bursting pressure tester
• Geotextiles, geomembranes, index puncture resistance	ASTM D4833	Materials testing machine

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Contents	Standard	Testing equipment/device
21. Straps, belts, ropes, cordage		
• Flat woven webbing slings, man-made fibres	EN 1492-1	Materials testing machine etc.
• Webbing, breaking strength and elongation	ASTM D6775	Materials testing machine
• Glass and glass polyester fibre woven tapes	EN 61067-2	Materials testing machine etc.
• Textile conveyor belts, tensile test	EN ISO 283-1	Materials testing machine
• Conveyor belts, adhesion between constitutive elements	EN ISO 252-1	Materials testing machine
• Aircraft equipment, air cargo unit load devices	ISO 8097	Materials testing machine etc.
• Air cargo equipment, restraint straps	ISO 16049	Materials testing machine etc.
• Load restraint, web lashing made of man-made fibres	EN 12195-1	Materials testing machine etc.
• Protective equipment, body harnesses	EN 361	Equipment as per standard
• Protective equipment against falls	EN 364	Materials testing machine etc.
• Mountaineering equipment, tape	EN 565	Materials testing machine etc.
• Mountaineering equipment, harnesses	EN 12277	Materials testing machine etc.
• Mountaineering equipment, accessory cord	EN 564	Materials testing machine etc.
• Mountaineering equipment, slings	EN 566	Materials testing machine etc.
• Dynamic mountaineering ropes,	EN 892	Materials testing machine etc.
• Deck safety harness and safety line for use on recreational craft	EN 1095	Materials testing machine etc.
• Paragliding equipment, harnesses	EN 1651	Materials testing machine etc.
• Fibre ropes	EN ISO 2307	Materials testing machine etc.
• Fibre ropes, splices	DIN 83319	Materials testing machine
• Round or spiral-plaited man-made fibre ropes	DIN 83307	Materials testing machine
• Tow ropes for passenger cars	DIN 76033	Materials testing machine etc.
22. Netting yarns and nets		
• Knot tensile test for netting yarns	DIN 53842-2, ISO 1805	Materials testing machine
• Elongation of netting yarns	ISO 3790	Materials testing machine
• Fishing nets, tensile test on mesh	ISO 1806	Materials testing machine
• Safety nets	EN 1263-1	Materials testing machine etc.
• Air cargo equipment, air/land pallet nets	ISO 4115	Materials testing machine etc.
23. Agricultural yarns and twines		
• Sisal agricultural yarns	EN ISO 5080	Materials testing machine etc.
• Polyolefin agricultural yarns	EN ISO 4167	Materials testing machine etc.
• Sisal twines	EN 12422	Materials testing machine etc.
• Polypropylene twines	EN 12423	Materials testing machine etc.
24. Textile bonding systems		
• Touch and close fasteners	EN 1414	Materials testing machine etc.
• Touch and close fasteners, peel strength	EN 12242	Materials testing machine
• Touch and close fasteners, longitudinal shear strength machine	EN 13780	Materials testing machine
• Slide fasteners, test methods	ASTM D2061, BS 3084	Materials testing machine etc.
• Buttons, test methods	BS 4162, ASTM D4846	Materials testing machine etc..

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Contents	Standard	Testing equipment/device
25. Thermal insulating materials		
• Thermal insulating products for building applications, compression loading	EN 826, ASTM C165	Materials testing machine
• Thermal insulating products for building applications, deformation under specified compressive load and temperature	EN 1605	Materials testing machine
• Thermal insulating products for building applications, compressive creep	EN 1606	Creep test machine
• Thermal insulating products for building applications, tensile test perp. to faces	EN 1607	Materials testing machine
• Thermal insulating products for building applications, tensile test parallel to faces	EN 1608	Materials testing machine
• Thermal insulating products for building applications, bending behavior	EN 12089	Materials testing machine
• Mineral fiber insulating materials, interlaminar tensile strength perpendicular to insulating layer	DIN 52274	Materials testing machine
• Insulated panels, strength	ASTM E1803	Materials testing machine etc.

All standards up to date as at July 2017.

Zwick / Roell

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