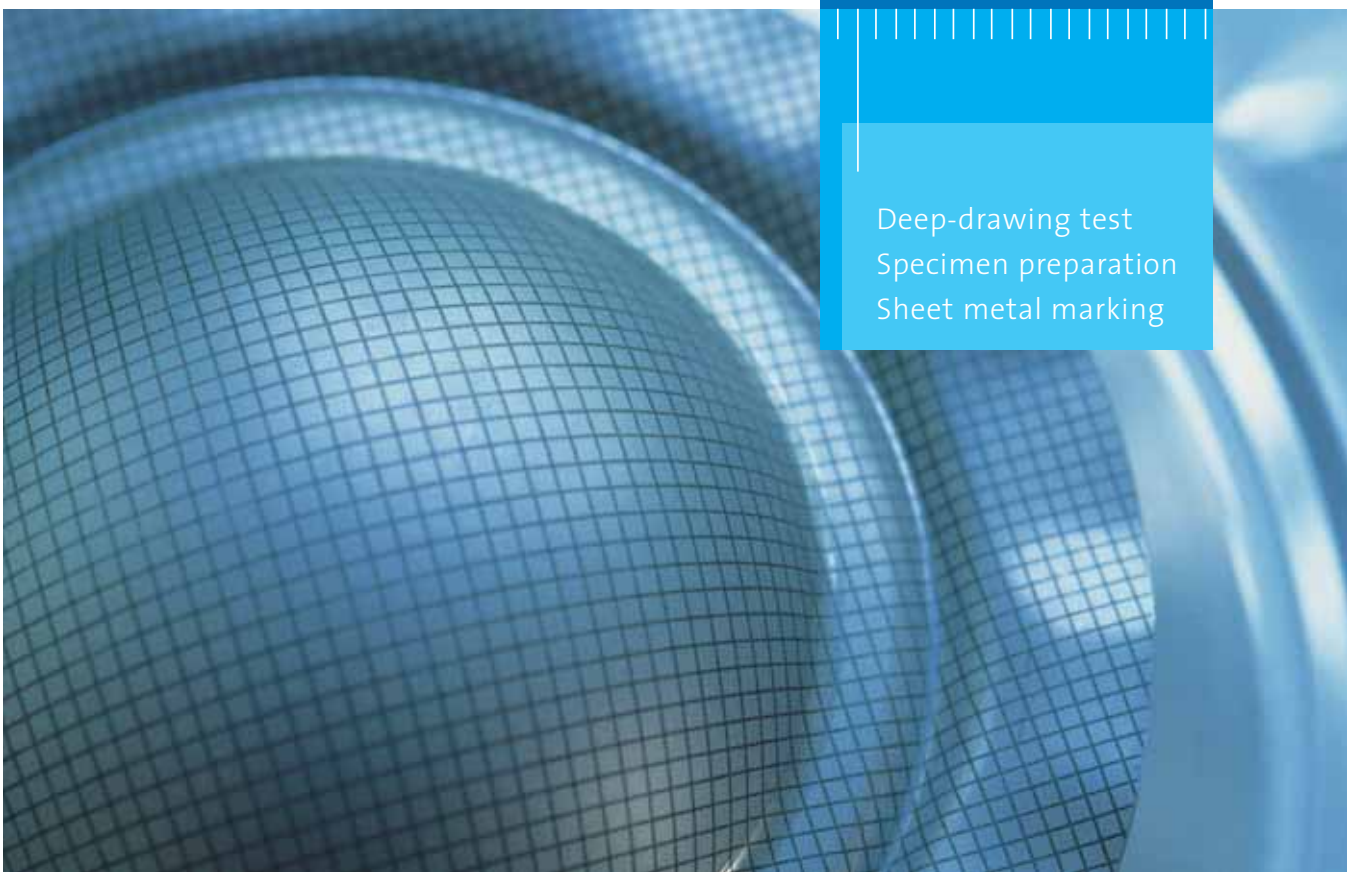
testing equipment for quality management

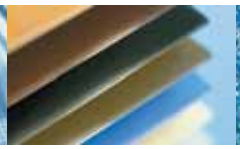
SHEET METAL TESTING



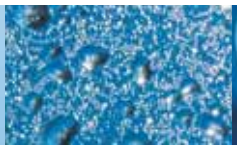
Deep-drawing test
Specimen preparation
Sheet metal marking

Sheet metal testing

Surface testing



Corrosion testing

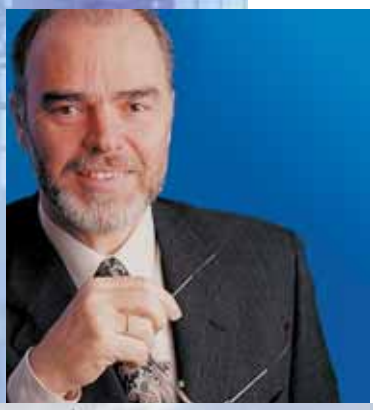


Materias testing

ERICHSEN
since 1910

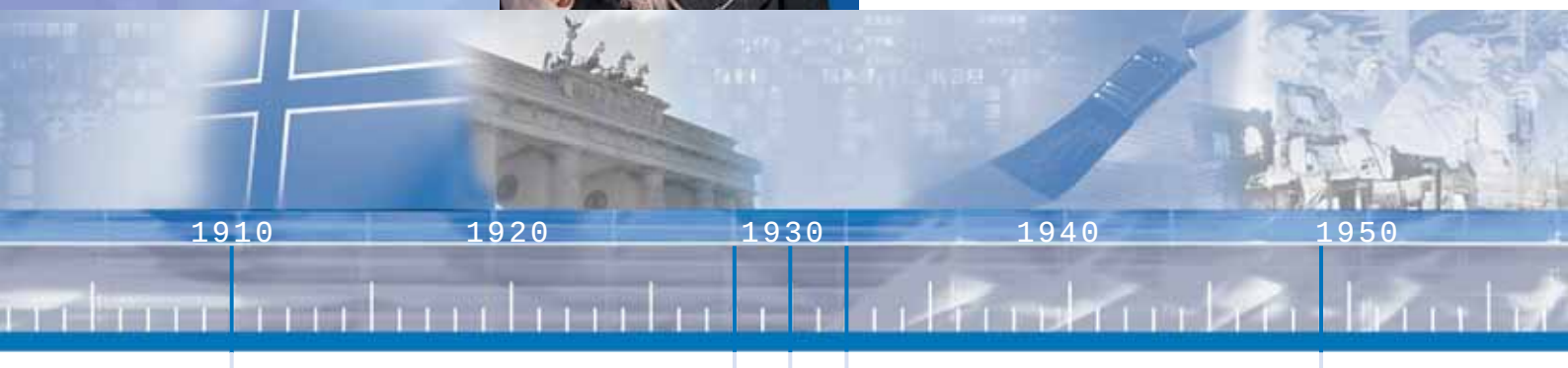
ERICHSEN -

The absolute reliability of your test results is our top priority. All our research, planning, development, construction and production is geared to achieving this objective – not only in the past, but today and in the future.



Björn Erichsen

Björn Erichsen



1910

It was probably true Viking spirit and the urge for discovery that impelled the engineer A.M. Erichsen from Porsgrunn/Norway to settle and set up business in Berlin-Reinickendorf. His first invention, a water-cooled ingot mould which to this day constitutes one of the most frequently used casting processes for semi-finished products in the foundry industry, enabled him to secure the financial position of his company. A.M. Erichsen's next invention – the cupping test – was just as significant. This was the very first test method for determining the quality grade of sheet and strip metal.

This test procedure was initially patented, but has since been adopted by all industrial countries within the framework of the International Standards Organisation (ISO). Just as temperatures are measured throughout the world in Celsius or Fahrenheit, the standard for sheet metal quality is the ERICHSEN deep-drawing index.

1928

A.M. Erichsen set up his first small factory in Teltow near Berlin. Research and experiments led to many further inventions.

1930

the German State Chemico-Technical Institute successfully applied the ERICHSEN deep-drawing method to measure the elasticity and adhesive properties of paints and lacquers. The results were so convincing that the procedure has since been adopted by the paint industry all over the world.

1932

the inventive Norseman A.M. Erichsen introduced tools for cupping test dies to the market, without which the batch production of deep-drawn parts made of sheet metal would hardly have been possible. Numerous innovations and improvements followed. A.M. Erichsen not only possessed a forward-looking inventive urge, he was also talented in commercial matters and soon enjoyed international renown. Satisfied customers were evidence of the quality of his products.

the name means commitment.

As the world's leading manufacturer of sheet metal testing machines, we ensure that our experience and knowledge is incorporated into the development of all our products.

The result is perfected, innovative machines with excellent longterm stability which need only a minimum of maintenance. Our products meet global requirements on testing technology and exceed international demands on accuracy. The ERICHSEN Manufacturer's Certificate M (conforming to DIN 55 350, Section 18) is our response to the control of inspection, measuring and test equipment required by DIN EN ISO 9000.

All our standard test equipment can be supplied with this certification which ensures full traceability through product identification. The functions and measured values of the basic machine are checked using calibrated measuring equipment and are documented in an inspection report. It is also possible to have used deep-drawing tools reworked and recertified by us.

We will be delighted to advise you in our modern show rooms where you can convince yourself of our competence. Consult us in all questions concerning testing – especially if you need customized solutions.

ISO 9001
BUREAU VERITAS
Certification

1949

Following the turmoils of the war and the loss of his company, A.M. Erichsen resolved to start up again in the west of Germany. His best partner – his son, Dr.-Ing. Per F. Erichsen – had studied mechanical engineering in Hanover, graduated at the Metallurgical Institute of the Technical High School in Aachen, and did his doctorate at the Coal Research Institute of Dortmund. Establishing the new company proved difficult – without machines, tools, or construction drawings – in a factory kitchen of the ironworks in Sundwig. Ideas and determination were the order of the day – initially the parts were made externally and assembled by themselves. The modern factory we operate today is located not far away.

1975

Björn Erichsen joined the company after completing his technical and business management studies at the Polytechnic in Munich and at the George Washington University in the U.S.A.. After taking over from his father – who entered well-earned retirement from the active management of the business in 1977 and died in 1988 – he is now the third generation to lead this company which has long since gained international renown. Under his management the range of instruments has been expanded, primarily by the addition of modern, non-destructive measuring devices for surface engineering applications.

1998

The decision was made to incorporate tensile and pressure testing machines, hydraulic and electronic load and pressure cells, as well as calibration equipment with extreme measuring accuracy into the production programme – reverting to the field of mechanical metrology earlier controlled by the company. Support was provided by a group of competent former employees from ERICHSEN Wuppertal whose knowledge and experience in conjunction with great insight into the latest in the field of hardware and software has resulted in a wide range of modern products.

2016

In the course of 100 years the extensive Erichsen product range has been built up based on the technical fields of metrology and test engineering. ERICHSEN pays stringent attention that their machines and equipment comply both with the testing regulations of national and international standards and with the acceptance terms of the industrial sector. These provide the basis for global understanding between the manufacturer and the user wherever the quality of raw materials, semi-finished and finished products is concerned. Design precision, perfect function and absolute fulfilment of purpose: these attributes have top priority at ERICHSEN.

Deep Drawing Tests. Sp

Test machines for all types of sheet metal forming. Dependable tests ensure efficient production.

International Standards

ERICHSEN cupping test		ERICHSEN deep-drawing cup test
DIN EN ISO 20482	JIS Z–2247	ISO 11 531
NF A 03–602	JIS Z-7729	DIN EN 1669
NF A 03–652	UNE 7080	JIS Z–2249
ASTM E643–09	GOST 10 510	GB/T 15825
IS 10175	GB 4156–84	

The following two test methods provide only some insight into the wide variety of tests that can be conducted with our test machines. Customized solutions to meet our customers' requirements are challenges which we face with confidence.

One of the best known test methods for sheet metal worldwide - patented as early as 1913 by the founder of our company - is the ERICHSEN Cupping Test. To conduct this test, a sheet metal specimen is clamped between a blank holder and a die and then dented (deep-drawn) with a hardened spherical punch.

ecimen Preparation. Sheet Metal Marking.

The following pages contain brief descriptions of our products intended for use in sheet metal testing. We will be pleased to provide you with detailed technical information on request. Please contact us directly:

Tel. +49 (0) 23 72–96 83–0
Fax. +49 (0) 23 72–64 30
info@erichsen.de
www.erichsen.de

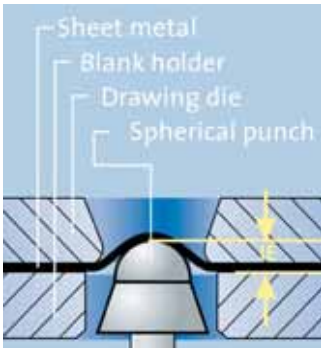
ERICHSEN universal sheet metal testing machines – equipped with the appropriate tools and/or accessories – are suitable for conducting a wide range of tests related to metal forming:

- Cupping test acc. to Olsen or Persoz
- Square cup test
- Bore expanding test acc. to ISO/TS 16630
- Deep-drawing cup test acc. to Swift
- Fukui test
- Engelhardt test
- LDH test
- FLC determination acc. to ISO/WD 12004 Nakazima Test and Marciniak Test
- Tests with drawing speeds up to 30m/min
- Deep-drawing test with hot drawing equipment up to 550 °C
- Bulge test
- Reverse drawing
- Precision blanking test
- Lubricant testing
- Tube expanding test acc. to DIN 50 135
- Ring expanding test acc. to DIN 50 137/ISO 16630
- Cupping test on tailored blanks
- ERICHSEN cupping test on lacquered sheet metal acc. to DIN ISO 1520.

The ERICHSEN-production range:

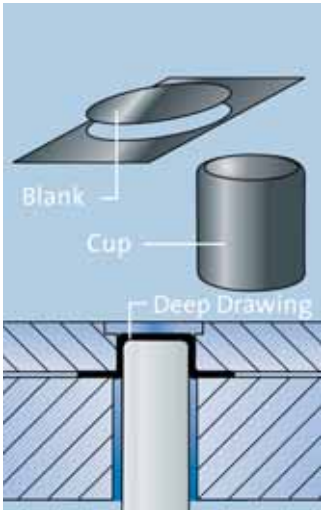
Machines for testing the forming properties of coating materials | Viscometers and consistency measuring instruments | Density measuring devices | Equipment for determining the electrical properties of paints | Devices for ascertaining grain size and pigment dispersion | Instruments for determining opacity | Devices for producing films of defined thickness | Instruments for testing drying properties | Film thickness gauges | Flexibility testers | Adhesion testers | Instruments for testing adhesives | Impact resistance testers | Hardness testers | Abrasion resistance and scrubbability testers | Instruments for conducting chalking tests | Gloss measuring devices | Densimeters | Equipment for corrosion and weathering tests | Film applicators for printing ink | Special testing instruments | Torque measuring equipment | Calibrating equipment | Force and pressure gauges | Tensile and pressure testing machines | Deep Drawing test | Equipment for specimen preparation | Sheet metal marking

Cupping Test



procedure is continued at a prescribed speed until it results in a fine, continuous crack in the sheet metal. The displacement of the spherical punch till cracking occurs is known as the cupping index >>IE<<, and represents a significant quality attribute of the tested sheet metal. This fast, cost-effective testing method is just as suitable for use inincoming inspection as for in-process controls – and that without any lengthy specimen preparation.

Deep Drawing Cup Test



The Deep-drawing Cup Test is a method of testing sheet metal by which a circular plate (blank) is stamped from a strip of sheet metal and then formed into a cup using a drawing die and a drawing punch. The greatest possible ratio between the blank and the drawing punch diameter, which just permits the faultless production of a cup, is called the Limiting Drawing Ratio »ßmax « and is a quality attribute for the forming abilities of the sheet metal material. The ears, which form as a result of the flow properties of the material are undesirable because they necessitate rework on drawn parts when they occur in practice. Here again, it is possible to determine the best suited sheet material for the intended forming process by means of the deep-drawing cup test.

Model 100

Simple hand-operated Sheet Metal Testing Machine

Recommended for use in factories and workshops where a low rate of metal forming is carried out on thin material. As a useful accessory, an attachable microscope with illumination is available making the detection of the cracks much easier.

The blank holder force of 10 kN conforming to the standards, is applied by means of saucer springs. The deep-drawing index is displayed on an electro-mechanic pulse counter with a resolution of 0.1 mm.

Drawing force:	max. 30 kN	Test:	ERICHSEN cupping test
Blank holder force:	10 kN		Sheet thickness: 0.1 – 1.5 mm

Also suitable for testing materials of less than 0.1 mm thickness.

Model 111

Electro-hydraulic Cupping Tester with Automatic Test Sequence

This easy-to-handle cupping test machine is intended for fast incoming inspection and quality control on sheet and strip metals. Because of its sturdy construction this machine is particularly suitable for in-process testing.

Designed as a compact benchtop model, this testing machine requires a minimum of space. The slanting arrangement of the test cylinder enables the user to remain seated whilst observing the test. The blank holder force and the drawing speed required for the execution of tests conforming to the standards, are set automatically by actuating the start button. Afterwards the deep-drawing test is also performed automatically.

The deep-drawing index is shown on a digital display (resolution 0.1 mm). As the testing machine works automatically and also stops automatically at specimen failure, it is possible to delay this procedure by a potentiometer. This is particularly necessary for an objective assessment of the crack when testing thicker sheet metals.

A special microscope is an optional accessory which enhances this procedure.

Drawing force:	max. 45 kN	Test:	ERICHSEN cupping test
Blank holder force:	10 kN		Sheet thickness: 0.1 – 2.0 mm

Model 102

Electro-hydraulic Sheet Metal Testing Machine with Automatic Test Sequence

Suitable for the medium sheet thikness range and favoured by manufacturers of sheet metal for convenient use in fast quality control. The advance movement of the drawing punch is stopped automatically at specimen failure and the relevant deep-drawing index is shown digitally on an electronic counter (resolution: 0.1 mm). As an option, a data acquisition system with PC is available for the modified ERICHSEN cupping test. When equipped with a special microscope with illumination, the testing machine is also suitable to assess the quality of coated sheet metals.

Drawing force:	max. 60 kN	Test:	ERICHSEN cupping test
Blank holder force:	max. 12 kN		Sheet thickness: 0.1 – 3.5 mm
			Bore expanding test
			Sheet thickness: 0.2 – 1.5 mm

Model 134

Electro-hydraulically driven Sheet Metal Testing Machine with Automatic Controls

Particularly recommendable for manufacturers and workers of sheet metal wherever constant testing is required. Enables all deep-drawing tests specified in national and international standards, to be conducted fully automatically. Customized tests can also be carried out using the appropriate test tools. The test cylinder is equipped with three working pistons like models 142/145/146, so that blanking, clamping of the blank, deep-drawing and ejecting of the cup are effected in one single operation. For recording force-displacement diagrams and for further data acquisition the testing machine can be provided with analogue outputs for drawing force, blank holder force and drawing punch stroke.

Also available from us: A computer with statistics programme for ERICHSEN deep-drawing indices as well as for recording force-displacement diagrams during the deep-drawing cup test.

Drawing force:	max. 120 kN
Blank holder force:	max. 45 kN
Blanking force:	max. 200 kN
Drawing punch ø:	max. 33 mm
Blank ø:	max. 80 mm

Test:
ERICHSEN cupping test
Sheet thickness: 0.1 – 4.0 mm
Deep-drawing cup test
Sheet thickness: 0.2 – 2.5 mm
Bore expanding test
Sheet thickness: 0.2 – 2.0 mm

Model 142- 20/40 Basic

Universal Sheet Metal Testing Machine with Automatic Test Sequence

A versatile testing machine for the medium to upper performance class (200 or 400 kN), which is used for applications in the field of the accompanying process control as well as in research and development of new materials. The machine is driven electro-hydraulically; the test sequence can be controlled either automatically or manually. The blanking press is integrated into the test head; infinitely variable control of drawing speed and blank holder force, independent of load. Digital display of drawing force, blank holder force and drawing punch stroke with peak value indication. Analogue outputs enable force-displacement diagrams to be recorded.

	142–20 Basic		142–40 Basic	
Drawing force:	max. 200 kN		max. 400 kN	
Blank holder force:	max. 100 kN		max. 225 kN	
Blanking force:	max. 250 kN		max. 600 kN	
Drawing punch ø:	max. 50 mm		max. 75 mm	
Blank ø:	120 mm		120 mm	
Test:				
ERICHSEN cupping test	Sheet thickness:	0.1 – 5.0 mm	Sheet thickness:	0.1 – 5.0 mm
Deep-drawing cup test	Sheet thickness:	0.2 – 3.0 mm	Sheet thickness:	0.2 – 6.0 mm
Bore expanding test	Sheet thickness:	0.2 – 6.0 mm	Sheet thickness:	0.2 – 6.0 mm
FLC test	with drawing punch diameter up to 100 mm		with drawing punch diameter up to 100 mm	
Bulge test	for a bulge diameter up to 100 mm		for a bulge diameter up to 100 mm	

Special tests:

Square cupping test, determination of the forming limit curves (FLC), LDH test, bulge test, lubricant test, deep-drawing test with hot drawing equipment up to 550 °C, Fukui test, Olsen, Swift

Model 142- 20/40

Universal Sheet Metal Testing Machine with Automatic Test Sequence

A versatile testing machine for the medium to upper performance class (200 or 400 kN), which is used for applications in the field of the accompanying process control as well as in research and development of new materials. The machine is driven electro-hydraulically; the test sequence can be controlled either automatically or manually. The blanking press is integrated into the test head; infinitely variable control of drawing speed and blank holder force, independent of load. Digital display of drawing force, blank holder force and drawing punch stroke with peak value indication. Analogue outputs enable force-displacement diagrams to be recorded.

As a further option, the control of the machine and of all important test parameters as well as the evaluation of the measurements can be effected by means of a PC.

	142–20	
Drawing force:	max. 200 kN	
Blank holder force:	max. 100 kN	
Blanking force:	max. 250 kN	
Drawing punch ø:	max. 50 mm	
Blank ø:	120 mm	
Test:		
ERICHSEN cupping test	Sheet thickness:	0.1 – 5.0 mm
Deep-drawing cup test	Sheet thickness:	0.2 – 3.0 mm
Bore expanding test	Sheet thickness:	0.2 – 3.0 mm
FLC test	with drawing punch diameter up to 100 mm	
Bulge test	for a bulge diameter up to 100 mm	

Special tests:

Square cupping test, determination of the forming limit curves (FLC), LDH test, bulge test, lubricant test, deep-drawing test with hot drawing equipment up to 550 °C, high-speed deep-drawing test, Fukui test, Olsen, Swift, reverse drawing, precision blanking test, hardness test, tensile test.

	142–40	
Drawing force:	max. 400 kN	
Blank holder force:	max. 225 kN	
Blanking force:	max. 600 kN	
Drawing punch ø:	max. 75 mm	
Blank ø:	120 mm	
Test:		
ERICHSEN cupping test	Sheet thickness:	0.1 – 5.0 mm
Deep-drawing cup test	Sheet thickness:	0.2 – 6.0 mm
Bore expanding test	Sheet thickness:	0.2 – 3.0 mm
FLC test	with drawing punch diameter up to 100 mm	
Bulge test	for a bulge diameter up to 100 mm	

Special tests:

Square cupping test, determination of the forming limit curves (FLC), LDH test, bulge test, lubricant test, deep-drawing test with hot drawing equipment up to 550 °C, high-speed deep-drawing test, Fukui test, Olsen, Swift, reverse drawing, precision blanking test, hardness test, tensile test.

Modell 145-60 Basic

Universal Sheet Metal Testing Machine with Automatic Test Sequence

A versatile testing machine for the medium to upper performance class, which is used for applications in the field of the accompanying process control as well as in research and development of new materials. The machine is driven electro-hydraulically; the test sequence can be controlled either automatically or manually. The blanking press is integrated into the test head; infinitely variable control of drawing speed and blank holder force, independent of load. Digital display of drawing force, blank holder force and drawing punch stroke with peak value indication. Analogue outputs enable force-displacement diagrams to be recorded.

As a further option, the control of the machine and of all important test parameters as well as the evaluation of the measurements can be effected by means of a PC.

Model 145- 60/100

Universal Sheet Metal Testing Machine for Research and Development

This is the most powerful and versatile sheet metal testing machine of our delivery programme. It is used in research and development of novel, high-strength materials in modern test centres all over the world. Depending on the demand, there are two versions available: with a drawing force of 600 kN or 1,000 kN, including an increased blanking force and blank holder force for blank diameters up to 220 mm. Especially, the FLC and bulge tests often conducted with this machine require high blank holder forces to avoid a possible continue flowing of material. Infinitely variable control of drawing speed and blank holder force, independent of load, by means of proportional valve technique, manually and/or via a PC with suitable software. Digital display of drawing and blank holder forces, drawing speed and drawing punch stroke, each with peak value memory. Hydraulic test head opening for safety and convenience of the user. Additional facility for high speed tests at drawing speeds up to 30 m/min available.

Upon request (option) the testing machine can be connected to a PC with TFT-screen and colour printer by way of a bi-directional interface. The PC controls the machine according to the preset parameters and carries out the acquisition, evaluation, logging and storage of the measuring data.

145–60

Drawing force:	max. 600 kN
Blank holder force:	max. 600 kN
Blanking force:	max. 700 kN
Drawing speed:	approx. 1000 mm/min

Test:

ERICHSEN cupping test
Deep-drawing cup test
Bore expanding test

FLC test	with drawing punch diameter up to 100 mm
Bulge test	for a bulge diameter up to 100 mm

Special tests:

Square cupping test, determination of the forming limit curves (FLC), LDH test, bulge test, lubricant test, deep-drawing test with hot drawing equipment up to 550 °C, high-speed deep-drawing test, Fukui test, Olsen, Swift, reverse drawing, precision blanking test, hardness test, tensile test.

145–100

Drawing force:	max. 1,000 kN
Blank holder force:	max. 1,000 kN
Blanking force:	max. 1,000 kN
Drawing speed:	approx. 1000 mm/min

Test:

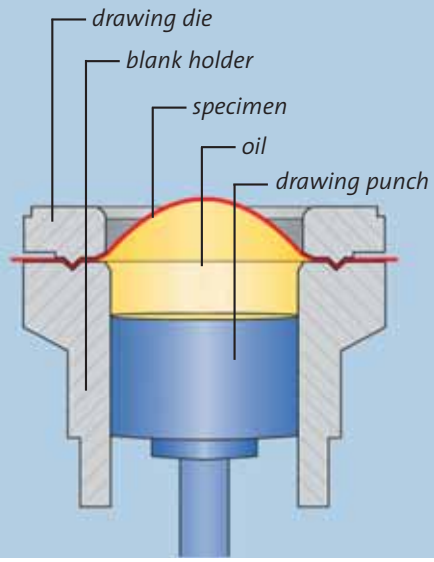
ERICHSEN cupping test
Deep-drawing cup test
Bore expanding test

FLC test	with drawing punch diameter up to 100 mm
Bulge test	for a bulge diameter up to 100 mm

Special tests:

Square cupping test, determination of the forming limit curves (FLC), LDH test, bulge test, lubricant test, deep-drawing test with hot drawing equipment up to 550 °C, high-speed deep-drawing test, Fukui test, Olsen, Swift, reverse drawing, precision blanking test, hardness test, tensile test.

Bulge Test



Bulge Test

Beside the Nakazima test, the bulge test has become more and more important over the last years. The figure shows a diagrammatic view of the testing assembly:

The test panel is fixed between the drawing die and the blank holder. Below the specimen there is a chamber which is filled with oil. The metal sheet is clamped. The drawing punch presses the oil upwards against the test plate and deforms it. The forming process is effected without any friction.

Model 146- 60/100

Universal Sheet Metal Testing Machine for Research, Development and In-process Testing

The special feature of this testing machines is the increased drawing speed of the drawing punch which, in addition to the normal drawing speed range of 0 – 1,200 mm/min can be adjusted, in an infinitely variable manner and independent of load, up to 3,000 mm/min. This is achieved by using a separate oil circuit, fed by a pump with high volumetric displacement. Contrary to the high speed attachment based on a nitrogen accumulator, here a constant drawing speed behaviour is guaranteed over the total displacement of 150 mm. As to the technical design and the options available, including PC control and proportional valve technique, this machines are similar to Models 145. The basic version of the machines includes an oil/water cooling and have a power consumption of 45 kW.

	146–60	146–100
Drawing force:	max. 600 kN	max. 1,000 kN
Blank holder force:	max. 600 kN	max. 1,000 kN
Blanking force:	max. 700 kN	max. 1,000 kN
Drawing speed:	0–3,000 mm/min	0–3,000 mm/min
Test:		
ERICHSEN cupping test		
Deep-drawing cup test		
Bore expanding test		
FLC test	with drawing punch diameter up to 100 mm	
Bulge test	for a bulge diameter up to 100 mm	
Special tests:		

Square cupping test, determination of the forming limit curves (FLC), LDH test, bulge test, lubricant test, deep-drawing test with hot drawing equipment up to 550 °C, high-speed deep-drawing test, Fukui test, Olsen, Swift, reverse drawing, precision blanking test, hardness test, tensile test.

Model 161

Bulge/FLC Tester

It is possible to test specimens up to a size of 400 x 650 mm when conducting the hydraulic deep-drawing test with the Bulge/FLC tester: In addition to the actual hydraulic forming process the construction of this machine also allows the use of ball punches with a diameter up to 200 mm. The maximum drawing force is 2,000 kN. To guarantee an exact reading of the required drawing force even in case of lower forces, they are divided in two measuring ranges. At specimen failure the test can be stopped both manually or automatically. The capture and the evaluation of the measuring points on the surface of the dome can be effected by an optical measuring device during the drawing process. In the basic version the height of the bulge is detected by means of a measuring probe placed on top, the maximum path measured being 100 mm, and displayed digitally.

Drawing force:	max. 2,000 kN	Test:	Bulge/FLC test
Blank holder force:	max. 2,000 kN		
Drawing punch ø:	max. 200 mm		

Model 170

Calibration Set for the Parameters Force and Displacement

Within the scope of quality assurance of a company the inspection of testing equipment in accordance with ISO 9001:2000 of the test instruments used in the laboratory or production is a required element that has to be observed within defined time intervals.

To comply with these requirements our calibration set, model 170, can be applied. It serves to re-calibrate the blank holder and drawing forces as well as the punch stroke of our sheet metal testing machines. The necessary force sensors match with the corresponding machines and are inserted overarm into the test cylinder. When inspecting the punch stroke, measuring probes are placed on top of the test head using appropriate adapters. The parameters force and displacement are displayed digitally.

The accuracy and the retraceability of the inspection chain as required in the standard ISO 9001:2000 is guaranteed by the corresponding manufacturer's certificate.

Force sensors:	50 kN/100 kN/200 kN/500 kN/1000 kN
Accuracy:	< 0,5 %

Model 126 PLUS

Ear Measuring Instrument

For axial measurement of deepdraw cups and raw cans of diameters of 33, 50, 75 or 100 mm at maximum height of 210 mm of deep-draw cups.

The specimen is fastened to the turntable by a chuck and centered by coordinated pins. Measuring is a fully automated process in which the measuring wheel works pneumatically. All real-time processes of the measurement and the automatic test sequence are executed inside the instrument. The analysis of results id executed by PC-Solftawre (part of the scope of supply). The measurements are transferred to a PC via USB interface.

Model 126 C

Ear Measuring Instrument

This instrument is particularly recommended in case of higher test arisings and/or if high demands are made on the determination and evaluation of the earing. The PC connected via a network to the instrument ensures a short measuring time as well as a fully automatic data acquisition and evaluation even for extensive series of measurements. The data evaluation comprises parameters in accordance with DIN EN 1669, standard methods as well as extended, individual calculations, and it yields extensive parameters concerning the anisotropic properties of the basic material.

All measuring data, parameters and accompanying information are filed in the XML format so that a further processing using other programmes is possible at any time.

Diameter of specimen:	20 – 100 mm
Height of specimen:	0 – 210 mm
Accuracy:	± 0,01 mm

Hot-Drawing Device up to 700 ° C

Hot-Drawing Device up to 700 °C

For the evaluation of material properties at elevated temperature, a special tool is required. This hot-drawing device is suitable for performing Nakajima- or Marziniak tests for determining the forming limit curve FLC / FLD.

The tool consists of a heatable cylinder for mounting in the Sheet metal testing machine. The forming tools and the specimen both are heated in the cylinder and formed after reaching the preset temperature. This tool is designed that it is not affecting the hydraulic system of the testing machine. The opening at the top, allows optical observation and evaluation by 3D camera systems such as the "ARAMIS" from GOM or the "AutoGrid In-Process" from VIALUX.

Hot Drawing Equipment

Hot Drawing Equipment up to 550 °C

Extension of the sheet metal testing by using a hot drawing equipment (up to 550 °C). Electrically heatable blank holder plates and drawing dies can be inserted and exchanged easily.

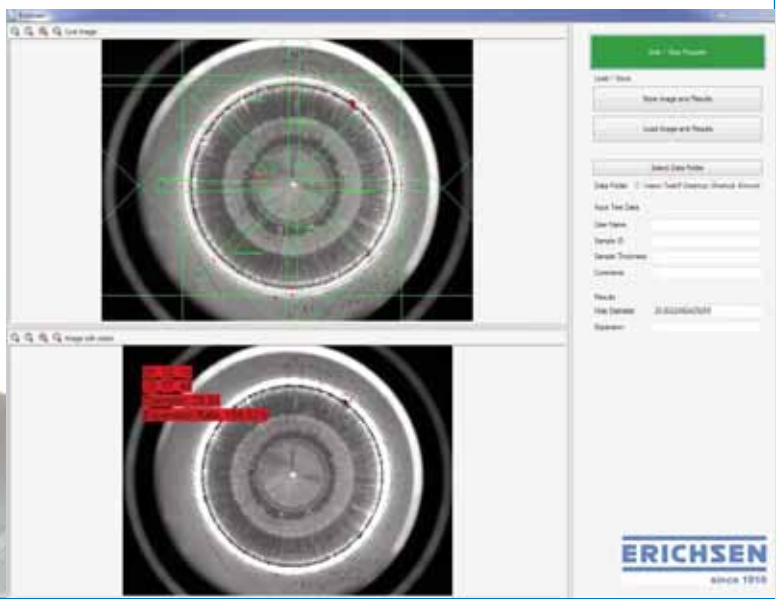
Evaluation

HEXRASCAN

A system for evaluation of hole expansion according to ISO 16630 is the HEXRASCAN (Hole EXpansion RAtio SCAN).

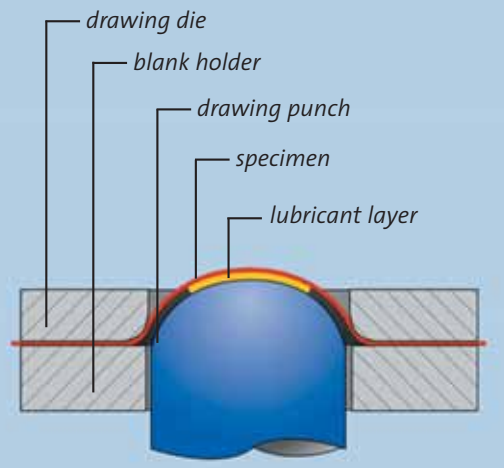
- Automatic - and repeatable crack detection
- Measurement and calculation of the maximum hole expansion ratio
- Automatic storage of measured values, including related images
- Automatic stop the test at the first crack (human intervention is not required)

Using the latest digital camera technology combined with an innovative lighting concept we achieve accurate and reproducible results. The evaluation of the Hole Expansion Ratio is performed automatically with specially developed algorithms for this application.



Nakazima Test

Nakazima Test



Nakazima Test

For the determination of the forming limit curves in accordance with ISO 12004, the Nakazima or the Marciniak test are described. The principle of the Nakazima test (used by up to 90 %) is based on that a hemispherical punch deforms steel sheet billets of different widths until failure.

The maximum characteristic deformations achievable (before failure) of the different shapes of specimens are determined and thus define the forming limit curve of a material.

NOTES

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- Density
- Electrical Properties of Paints
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- Gloss
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- Brightness
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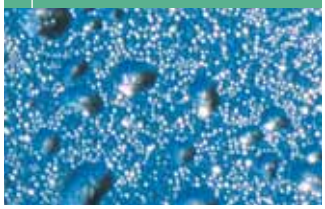

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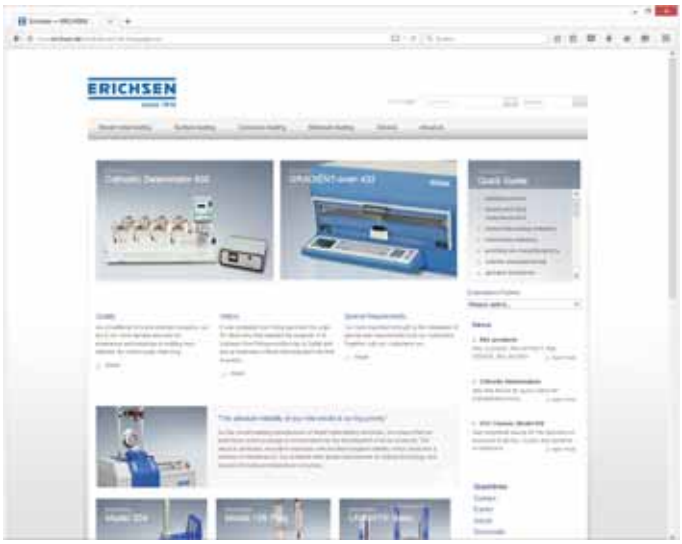

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