

FLC Probe

**Testing Machine with
programmable logic
controller
(PLC)**

**Bulge/
FLC Tester
Model 161**

**Proportioning control
of blank holder force
and drawing speed**



**Universal User Software
for control, adjustment,
documentation and filing of
measuring data
as option**

testing equipment for quality management

ERICHSEN

Technical Description

**Bulge/FLC Tester to
carry out the hydraulic
Cupping Test**

Product

The **Bulge/FLC Tester, Model 161**, is an electro-hydraulic testing machine to carry out the hydraulic cupping test on all ferrous and non-ferrous metals.

Specimens up to a size of 400 x 650 mm can be tested.

In addition to the actual hydraulic forming process the design of the machine also allows the use of ball punches (FLC) up to a diameter of 100 to 195 mm.



The Bulge Test

A diagrammatic section of the bulge test device which is used in the Bulge/FLC Tester is shown in Fig. 1. The test panel (2) is clamped between the drawing die (1) and the blank holder (3). The chamber underneath the test panel is filled with special oil (4). The test panel is frictionless deformed into a bulge by means of the drawing piston (5) which moves upwards pressing the oil against the sheet metal. The thicker the sheet metal and the higher the tensile strength, the greater is the drawing force needed to deform the test panel.

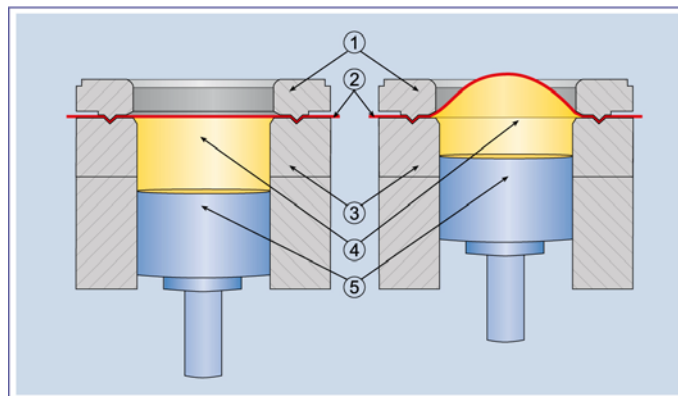


Fig. 1

The FLC Test

For the determination of the forming limit curves (FLC) in accordance with ISO 12004 the Nakazima test is described.

The principle of the Nakazima Test is based on the deformation of sheet metal blanks of different geometries using a hemispherical drawing punch until fracture occurs (Fig. 2). By varying the specimen width, different deep draw and stretch forming conditions occur on the sheet metal surface. The characteristic, maximum strain values achievable (prior to failure) of the different shapes of specimens are determined, and thus define the forming limit curve of a material.

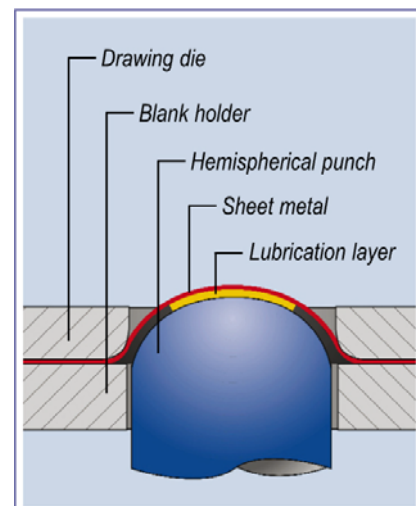


Fig. 2

Description

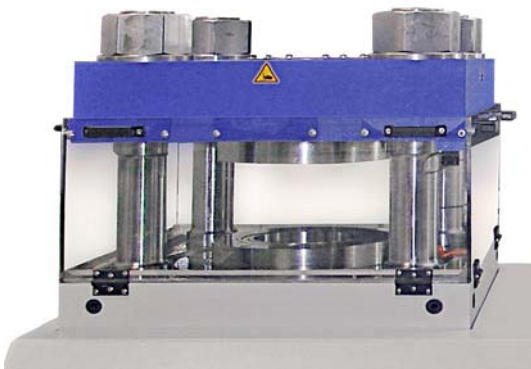
The hydraulic cylinder, the hydraulic aggregate as well as the control devices are housed within the body of the machine.

The four-column frame with integrated test tool, allows the test of specimens up to a size of 400 x 650 mm.

The **Bulge-/FLC Tester, Model 161**, with programmable logic controller (PLC) is provided with a maximum drawing force (bulge force) of 1,000 kN . The bulge diameter is 200 mm. The control of the maximum drawing speed is effected via a proportional distribution valve with pressure balance. The blank holder force of max. 1,000 kN is infinitely variable and is controlled by a proportional pressure regulating valve. The clamping stroke is 180 mm.

The **Bulge-/FLC Tester, Model 161**, is equipped with analogue outputs for data acquisition when using an own evaluation systems. The captured data of drawing force and blank holder force can be processed in this way by a separate evaluation unit.

For safety reasons the test area of the **Bulge-/FLC Tester, Model 161**, is provided with high-rigidity, transparent protective lids. The Testing Machine can only be started, when all protective lids are closed and thus it is no longer possible to reach into the tool area.



Purpose and Application

The operation of the **Bulge-/FLC Tester, Model 161**, is most simple. After the specimen has been placed into the test head, the hydraulic system is started with the help of a push button whereupon in the first instance the test panel is clamped tightly. Thereafter the drawing piston moves upwards and presses the quantity of oil that is located between the piston and the test panel, into the direction of the test panel so that the specimen is formed into a spherical bulge.

The automatic crack detection can be activated by using the "crack" switch.

At specimen failure the drawing piston is stopped by way of the crack detection automatism and returns into its starting position. Since the crack detection automatism acts on a retrograde signal, it is possible that the sheet metal panel tested does not yet show a fracture, especially in the case of thick material. With the help of a time lag relay the switching-off can be delayed until the fracture occurs.



The acquisition and evaluation of the measuring points on the bulge surface can be carried out during the drawing process by an measuring device (optional), Ord.-No. 0193.01.32.

Using a measuring sensor placed onto the specimen, and with a maximum measuring distance of 100 mm the particular height of the cup can be captured in an analogue manner, displayed digitally on the control panel and then processed via an analogue output.

Equipment to enable further Tests

Facility for Measurement of the Bulge Height
with analogue data acquisition, digital display as well as analogue output.

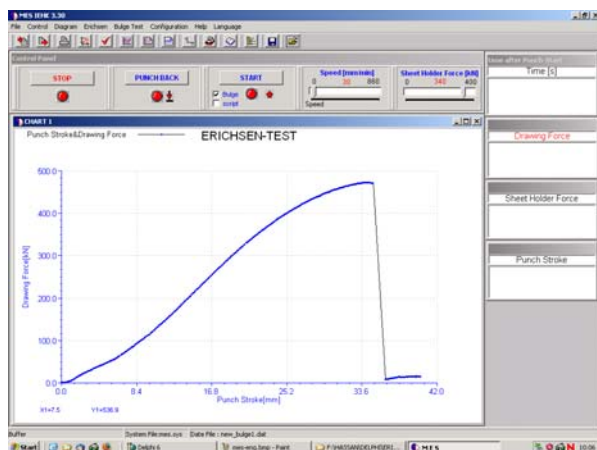
Facility for Measurement of Bulge Oil Pressure
with analogue data acquisition, digital display as well as analogue output.

Universal User Software

for control, adjustment, documentation and filing of measuring data of the Sheet Metal Testing Machine. Software for recording of force/time-dependency diagrams like drawing force and blank holder force. Creation of scripts (test sequences); presetting of freely selectable parameters such as drawing and blank holder force as well as drawing speed. The measuring system integrated in the Sheet Metal Testing Machine is designed in a modular system with analogue and digital inputs and outputs. Hereby drawing force and blank holder force are acquired. The data are exchanged with the PC via a USB connection. This programme enables to create and evaluate test sequences for the bulge and FLC test.

If the Testing Machine is equipped with the optional facilities "Device for measuring the bulge height" (Ord.-No. 0193.01.32) and/or "Device for measuring the bulge pressure" (Ord.-No. 0821.01,32), these signals can also be displayed, recorded and evaluated.

The scope of supply includes PC, VDU and printer.



Technical Data

Bulge dia., max.:	200 mm
Ball punch dia.:	100 - 195 mm
Drawing force, max.:	1,000 kN
Drawing speed:	0 - 200 mm/min
Blank holder force (infinitely variable up to):	1,000 kN
Clamping stroke:	180 mm
Dimensions (WxHxD):	approx. 1800 x 1100 x 1400 mm
Net weight:	approx. 4000 kg
Mains supply:	400 V, 50 Hz
Connected load:	13 kW

Order Information

Ord.-No.	Product-Description
0078.01.31	Bulge/FLC Tester, Model 161

Accessories

Ord.-No.	Product-Description
	For additional functions and tests:
0193.01.32	Unit for Measurement of the Bulge Height
0821.01.32	Unit for Measurement of the Bulge Pressure
0838.01.32	Universal User Software
0194.01.32	Ball Punch (FLC), for one particular diameter in the range from 100 to 150 mm (please state required dia. when ordering)
0195.01.32	Ball Punch (FLC), for one particular diameter in the range from 151 to 195 mm (please state required dia. when ordering)
0765.03.32	Oil/Water Cooling System for use at increased ambient temperatures

For further information please refer to our Price List No. 161/E.

The right of technical modifications is reserved.
TBE 161 – IV/2009