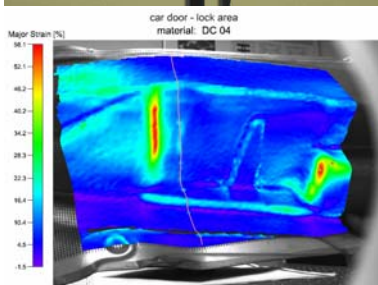
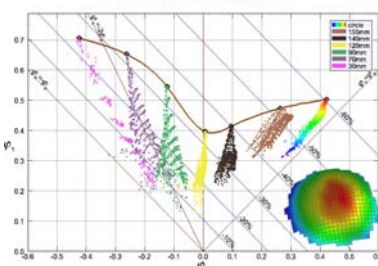


# AutoGrid<sup>®</sup> vario

## Highest flexibility for component analysis and in-process materials testing



Forming Limit Diagram



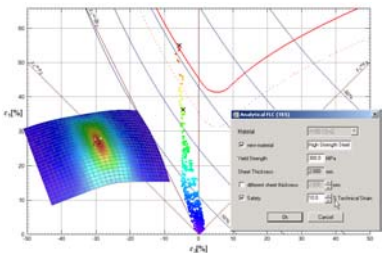
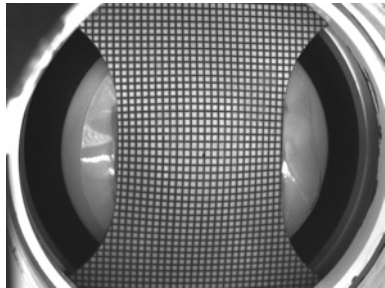
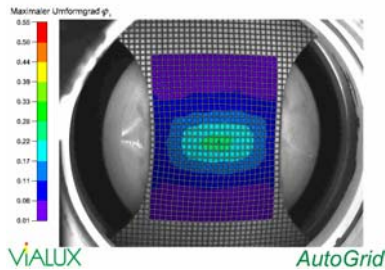
The *AutoGrid<sup>®</sup>* product family enables for strain analysis on samples and components in sheet metal industry. The new *AutoGrid<sup>®</sup> vario* has been designed to meet our customers needs for highest flexibility in the optical setup, measurement volume and local resolution. The direct, fast, and accurate measurement is based upon the automatic evaluation of grid patterns that consist of electrochemically-marked orthogonal lines spaced 1-5 mm. The system is able to determine a field of strain values in the range of 0.5 % to more than 100 % without any unambiguity. The *AutoGrid<sup>®</sup>* systems proved well suited for a variety of applications in deep drawing and hydroforming as well as for different materials including aluminium alloys, stainless steel and fibre reinforced composites.

The *AutoGrid<sup>®</sup> vario* is fitted with an in-process facility, i.e. an extension that allows the recording of deformations and strains during a forming process. This type of operation facilitates the measurement of forming limit curves (FLC) if the pre-calibrated measuring head is mounted on a sheet metal testing machine (Erichsen or others). All four cameras observing the specimen from different perspective views are exactly synchronized and the image sequences are recorded with a rate of up to 15 x 4 frames per second. Electronic shuttering is combined with the progressive scanning mode of the cameras with variable exposure time to avoid any blur or disturbance due to the object motion. Employing latest digital camera technology *AutoGrid<sup>®</sup> vario* provides 5.7 million pixel per recording. In case of the standard testing velocity of 1-2 mm/s, a punch depth resolution of less than 0.1 mm can be achieved. In many practical cases some lower frame rates can be chosen. The length of the sequence recorded fulfils all practical requirement by appropriate memory configuration of the notebook PC used.

In addition, the in-process facility supports the data acquisition of signals from the testing machine. Measuring data, e. g. of path and force pictures in the sequence and the recording can be controlled automatically by corresponding thresholds.

After the test, the whole sequence of image ensembles is stored in memory and may be inspected immediately or saved to disk for further analyses if desired. The sequence can be displayed step by step, zoomed and also connected to force/path data in order to identify the moment and the location where the critical necking occurred first.

The results of a specimen for the forming limit diagram are available about 5 min after the test run. A variety of stress conditions is required for a complete forming limit curve. They are generated by differently shaped specimens and, using *AutoGrid<sup>®</sup> vario*, all the results can be conveniently combined in



one diagram to define the points of a FLC interactively. Polygon or spline functions can be used for interpolation. Data export is given by ASCII format.

ViALUX provides a fast and accurate tool for the determination of forming limit curves (FLCs) of sheet metal materials. Directly connected to the testing machine, the system gives precise access to the maximum strain value just *before* necking and subsequent cracking occurs. Comfortable software allows to create FLCs from a set of specimens very effectively. Furthermore, the customer have the option to create free editable FLD reports for documentation. Of course, *AutoGrid® vario* can also be used e.g. for bulge or tensile tests.

The unsurpassed performance allows for materials testing and component analysis with one system, which makes *AutoGrid® vario* the ideal solution for quality assurance purposes in sheet metal industry.

Contact:  
E

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### Specifications

- Measuring head:** 4 progressive scanning CCD cameras 1392 (H) x 1040 (V) active pixel with f=8,16 25 mm high quality measuring lenses; PC connection and power supply via a single 4 m cable using the firewire interface; convenient transport box, weight: 8 kg
- Computer:** brand mark first class laptop PC with worldwide service, incl. laptop case (alternatively midi tower PC and TFT monitor on demand)
- Environment:** temperature: operating 10 ... 35° C, non-operating: -40 ... +70° C  
humidity: 20%...93% non-condensing
- Software:** Microsoft Windows XP Professional  
full compatibility with Microsoft Office applications and other standard software
- Measuring volume:** about 500\*400\*200 mm<sup>3</sup> per image set (other volumes on demand)
- Field of data:** up to 12.000 measured points per single measurement;  
combined measurements without size limitation
- Calibration:** fixed optical setup maintaining long term calibration;  
automated, robust self-calibration procedure (3 min) using certified calibration gauge
- Measuring time:** 3-5 min for a complete analysis of one image set
- Recording:** max. 15 frames per second
- Results:** 3D shape: coordinates x,y,z [mm] at grid line crossing points; engineering strain  $\epsilon$  [%], true strain  $\phi$ , v.Mises equivalent strain, thinning [%], thickness [mm]

**Accuracy (rms):**

field of view [mm <sup>3</sup> ]	grid [mm]	Points per image set	$\Delta x$ [mm]	$\Delta y$ [mm]	$\Delta z$ [mm]	$\Delta \epsilon$
500*400*200	2.0	> 12.000	0.01	0.01	0.02	0.5 %
500*400*200	3.0	> 9.000	0.01	0.01	0.02	0.3 %
500*400*200	5.0	> 6.000	0.01	0.01	0.02	0.1 %

- Graphs:** 3D surface display using original object grid for direct result mapping to object color encoded presentation of strain and thickness as texture on the 3D object  
2D data profiles along user defined curves  
forming limit diagram (FLD) with various FLC's and auxiliary lines  
interactive tool for the creation of FLC's from strain data sets  
free editable FLD reports

- Export:** graphs: printer, clipboard, \*.bmp, \*.tif, \*.png, \*.jpg, \*.gif, \*.ps, \*.eps  
data: ASCII, AutoForm, Pam-Stamp, \*.stl, AutoCAD