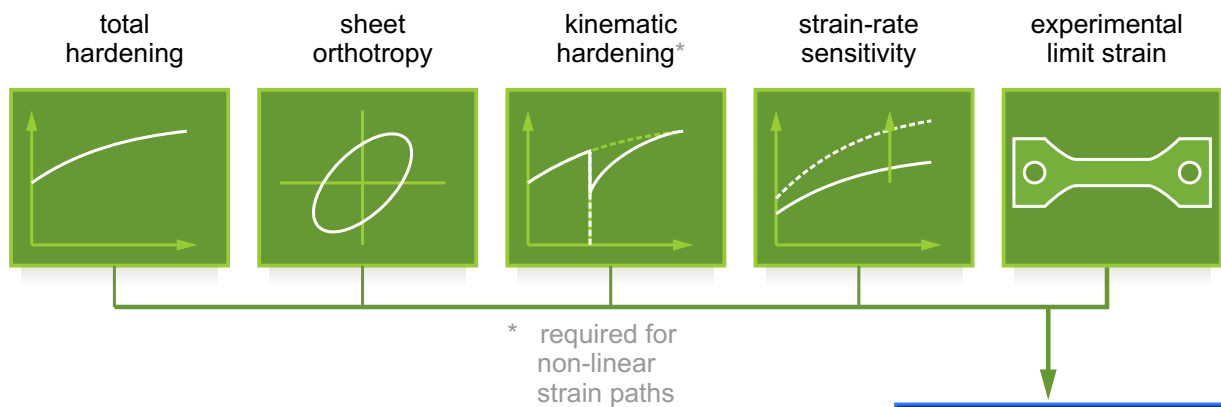


# CrachLab

Version 1.6

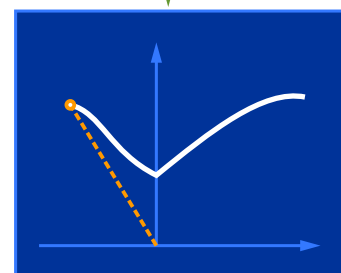
The forming limit curve (FLC) is a standard procedure for evaluating the formability of sheet metals. The experimental determination of such a diagram can be costly. *CrachLab* predicts the FLC with a numerical approach based on the strain-hardening behaviour of the sheet.



## What does CrachLab calculate?

*CrachLab* calculates the forming limit for metal sheets. Previous forming processes and heat treatments are taken into account.

The calibration of forming limit curves with *CrachLab* requires the definition of strain hardening, the strain-rate sensitivity and the sheet orthotropy as well as one experimental limit strain. *CrachLab* may be used as a virtual test laboratory to reduce the number of experiments. Typically, seven differently waisted Nakajima specimens are used; with *CrachLab* you need only standard tensile tests.

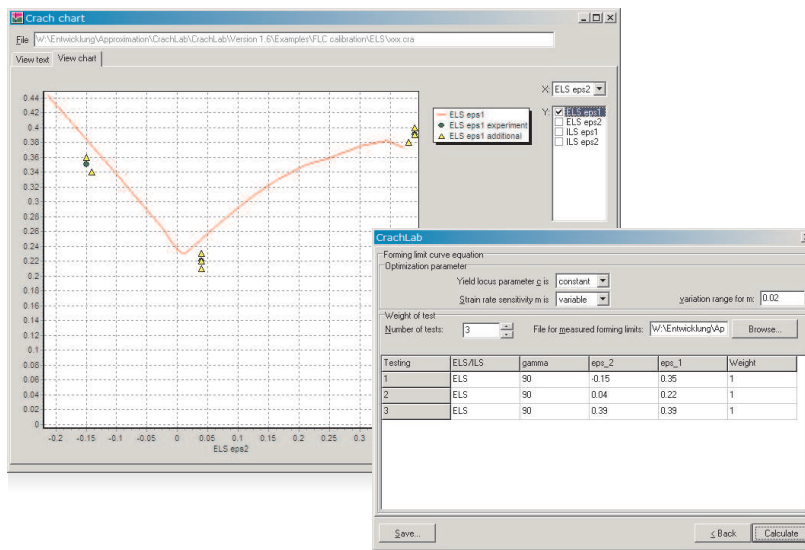


FLD determined by Crach based on plastic behaviour of the material

*CrachLab* can determine the external limit strain (ELS), which is measured on the torn specimen by means of an imprinted measuring grid, as well as the internal limit strain (ILS), which is obtained by extrapolation of the strain over the distance to the fracture. Both methods are regularly used in industry

## Scope of CrachLab

*CrachLab* offers several possible applications. First, it may be used to determine an initial FLC of a sheet without great experimental expenses. This FLC may account for previous deformations with non-linear strain paths. The obtained FLCs are shown graphically and may be used as curve in FE simulations.



Further, the safety factor of a forming process may be calculated. *CrachLab* may also be used as a fitting tool for experimental FLCs with a reduced number of specimen geometries.

An auxiliary module allows to approximate experimental hardening curves from tensile tests with the analytical hardening laws used in *CrachLab* (Swift and Hockett-Sherby).

## Benefits

*CrachLab* allows to determine a forming limit diagram for the evaluation of formability from standard tensile tests. Alternatively, a reduced testing programme may be combined with *CrachLab* to determine FLCs.

*CrachLab* accounts for the physical effects in the sheet; it can therefore be used to predict FLCs where experiments cannot be carried out easily, e.g. at high strain rates or for hot forming.

Further reading:

Gese, H.; Dell, H.:  
*Numerical Prediction of FLC with the Program Crach*. FLC Zürich, March 15 - 16, 2006; IVP, ETH Zürich, Switzerland

FLD calibration with experiments under uniaxial, plane-strain and equibiaxial tension

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