



Forming of locally made sheet steels

HH1

Issues and Opportunities

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Slide 1

HH1

Local or locally ?

Holger Heinzel, 29/10/2006

Content

Local material
Process of press forming
Material characterisation
Strain analysis
inForming

Challenges



Aim:

Use local material to produce press formed parts

Steps:

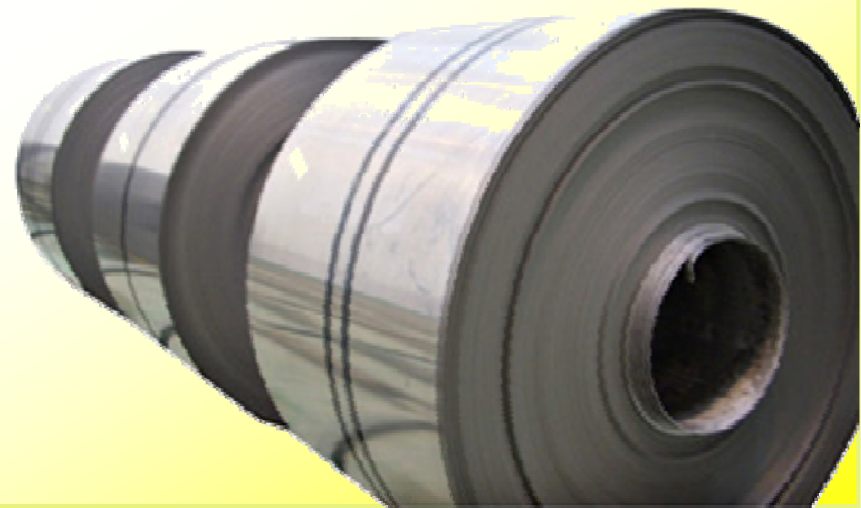
- **Process requirements**
 - Which material parameters are required by the process to achieve acceptable and reliable products
 - Which process parameters are of influence for the material
- **Formability of material**
 - What are the forming limitations of the given material and how can we measure them
 - Influence of coating to forming limitation
- **Interaction between material / process**
 - Surface, Lubrication, Material flow....



The local material

Local sheet material

- Made from black iron sand
- Thickness: ~ 0.3 mm to ~2.0 mm
- Base material: G250 to G550
- Alloying elements: C, P, Mn, S, Si, Al, N
- Coating:
 - Galvanized (Zinc)
 - Zinc/Aluminum
 - Colour

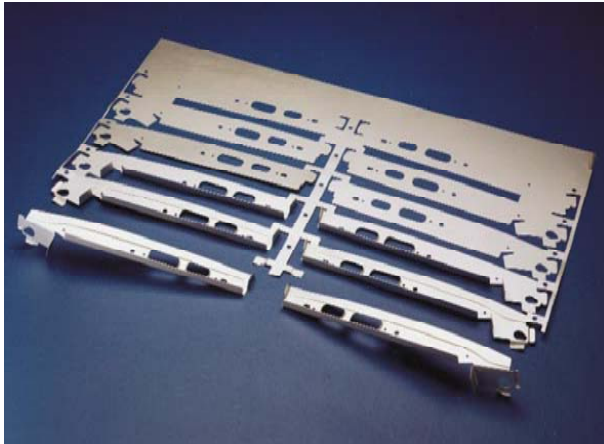




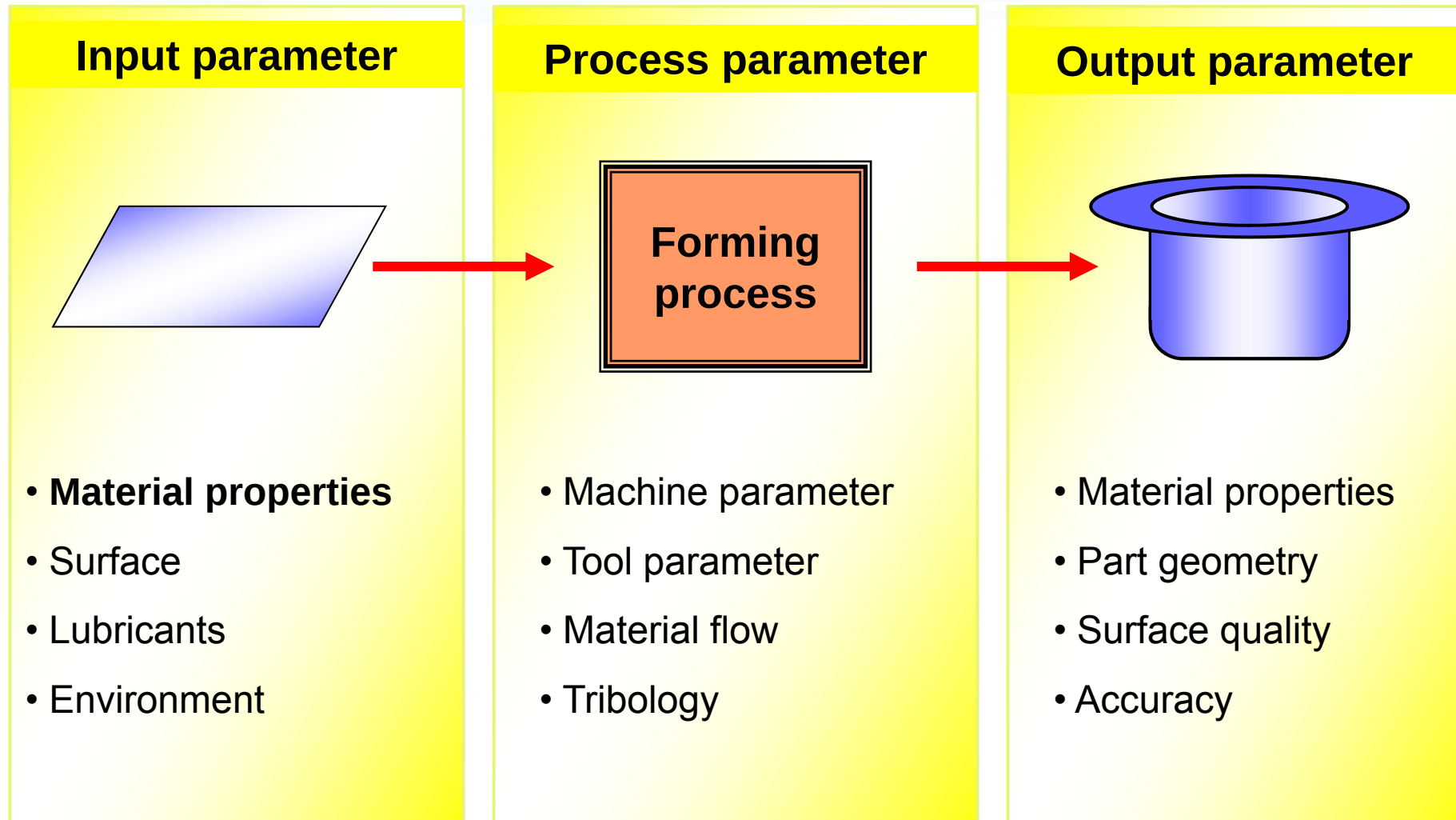
Process of press forming

Press forming

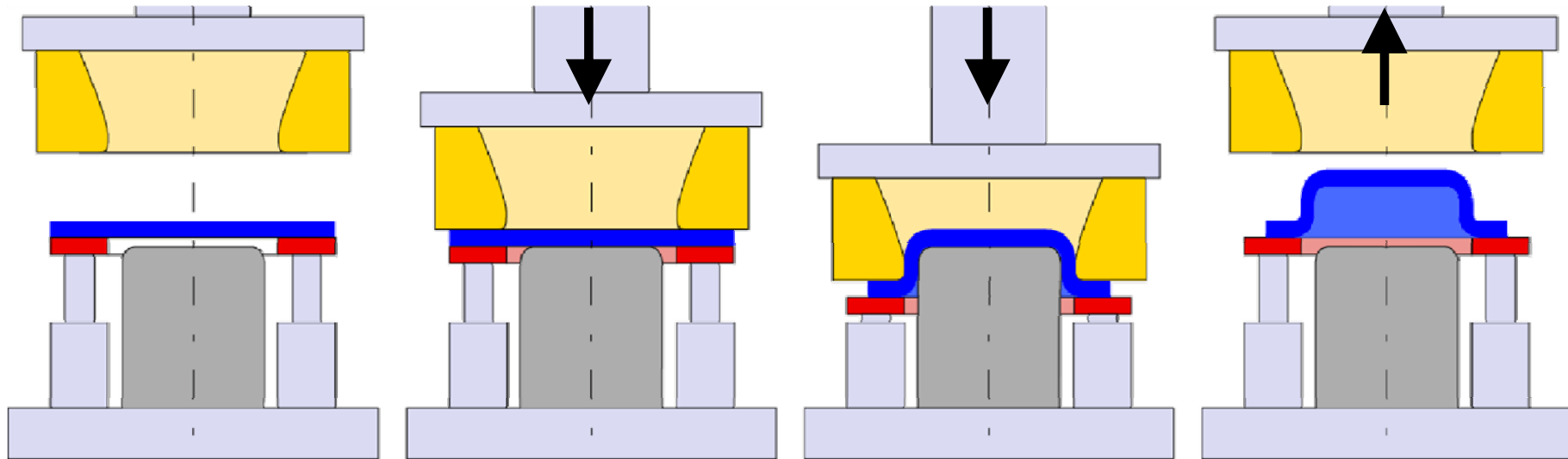
part samples



Forming process



Deep drawing



Tool is in the
open position

Load new blank

Start process

Closing of the
tool

High speed

Low force

Forming of the
shape

Blankholder to
prevent wrinkles

High force

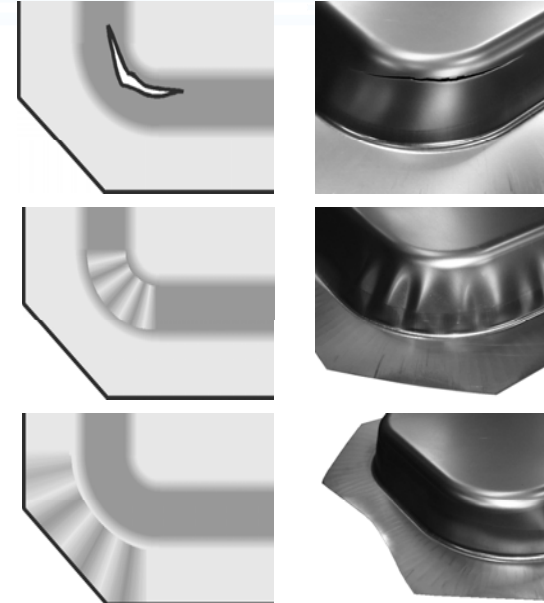
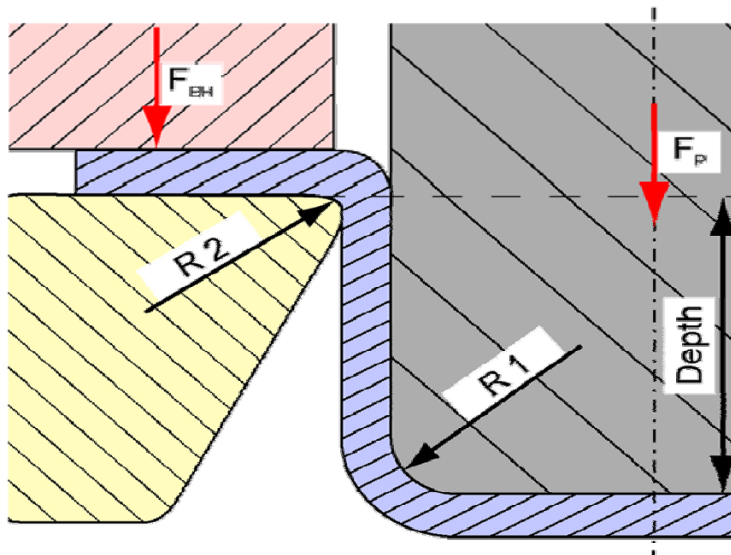
Opening of the
tool

Eject pressed
part

Process parameter

of influence to the forming result

- Punch and Die radii
- Punch-to-die-clearance
- Restraint of material flow
- Press speed



Errors

- Wrinkles
- Cracks
- Buckling
- Excessive thinning



Material characterization

Formability...

Material characterisation with regards to forming operations

... depends on
the deformation process

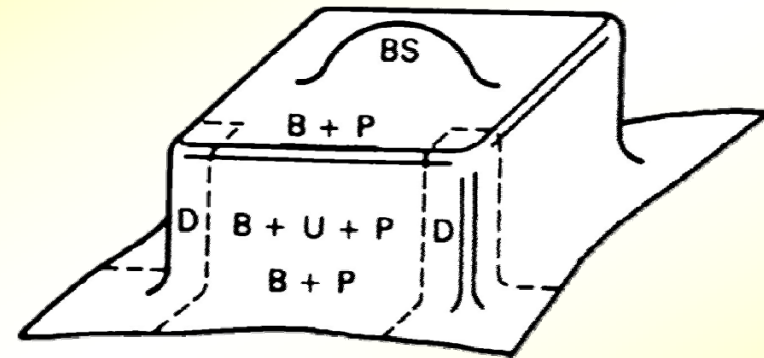
bending [B]

biaxial stretching [BS]

drawing [D]

plane-strain stretching [P]

unbending [U]



... is not a material property

... of material can change with conditions

... is a combination of different tests results

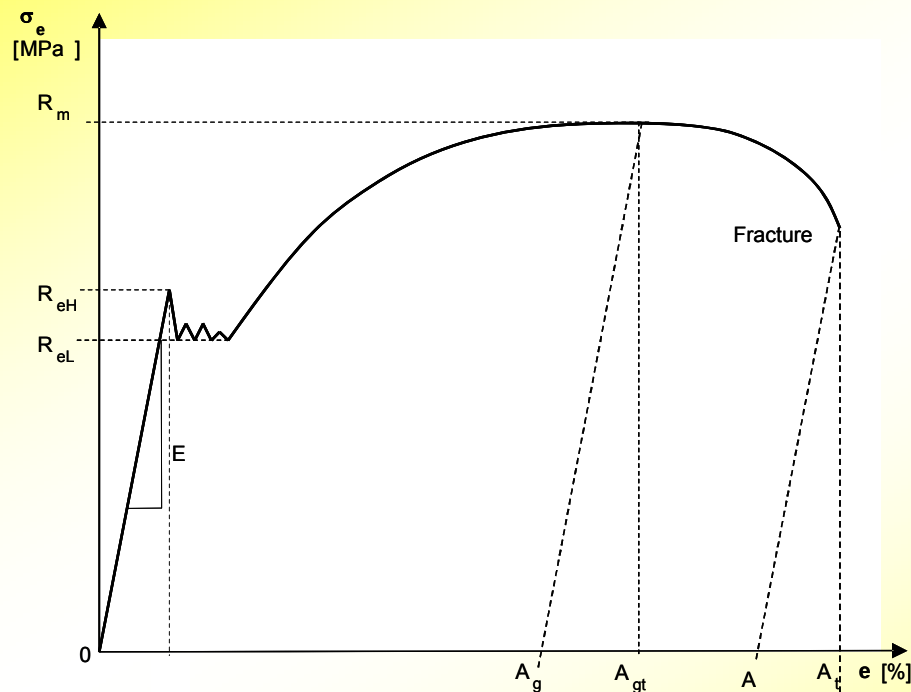
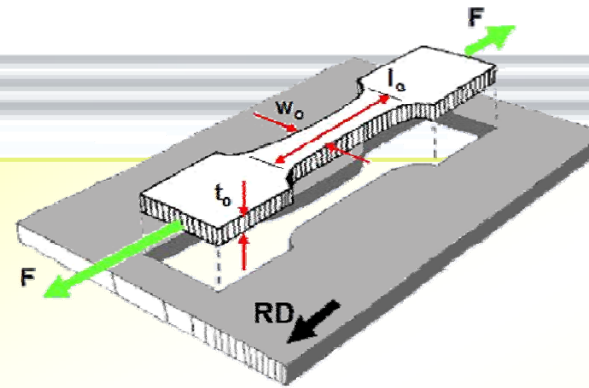
Aim:

Complete description of forming limitations of the material !

Tensile testing

(uniaxial)

- Basis for defining mechanical properties of materials
- Highly standardised (AS, ISO,...)

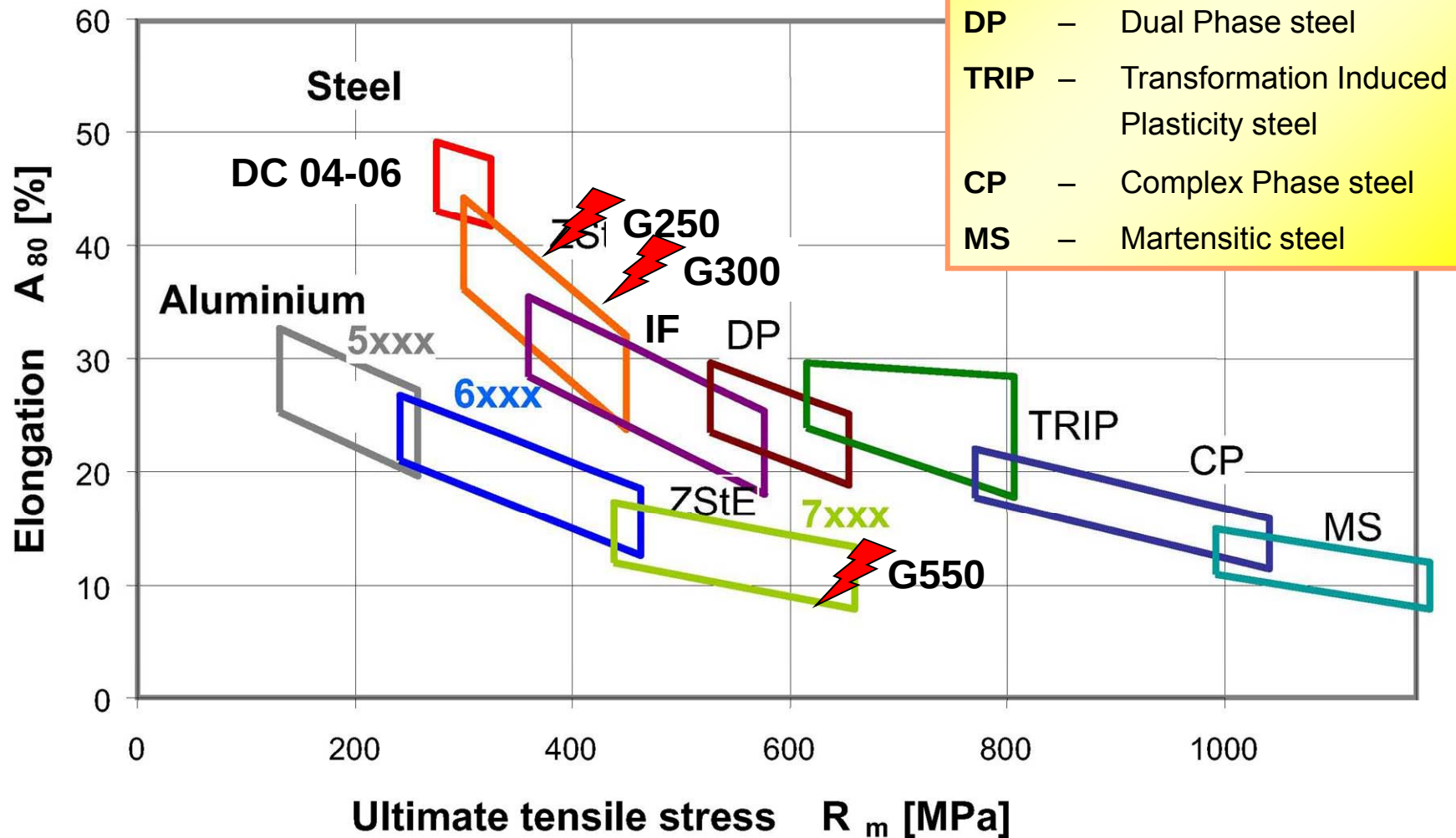


Results

- Young's Modulus E
- Yield strength
- Tensile strength UTS
- Uniform elongation
- **Total elongation**
- **Strain Hardening exponent n**
- **Plastic strain ratio r**
- Normal anisotropy r_m
- Planar anisotropy Δr

Typical materials

used in the automotive industry



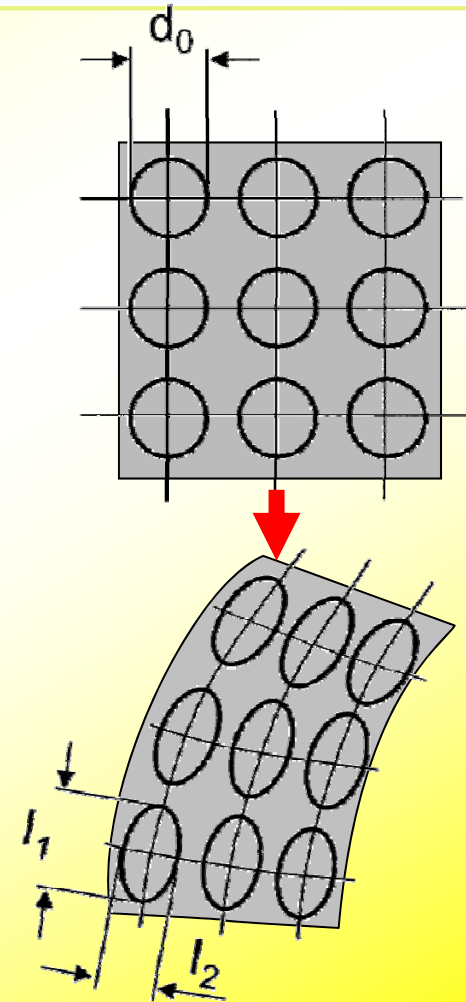
Strain analysis

principals

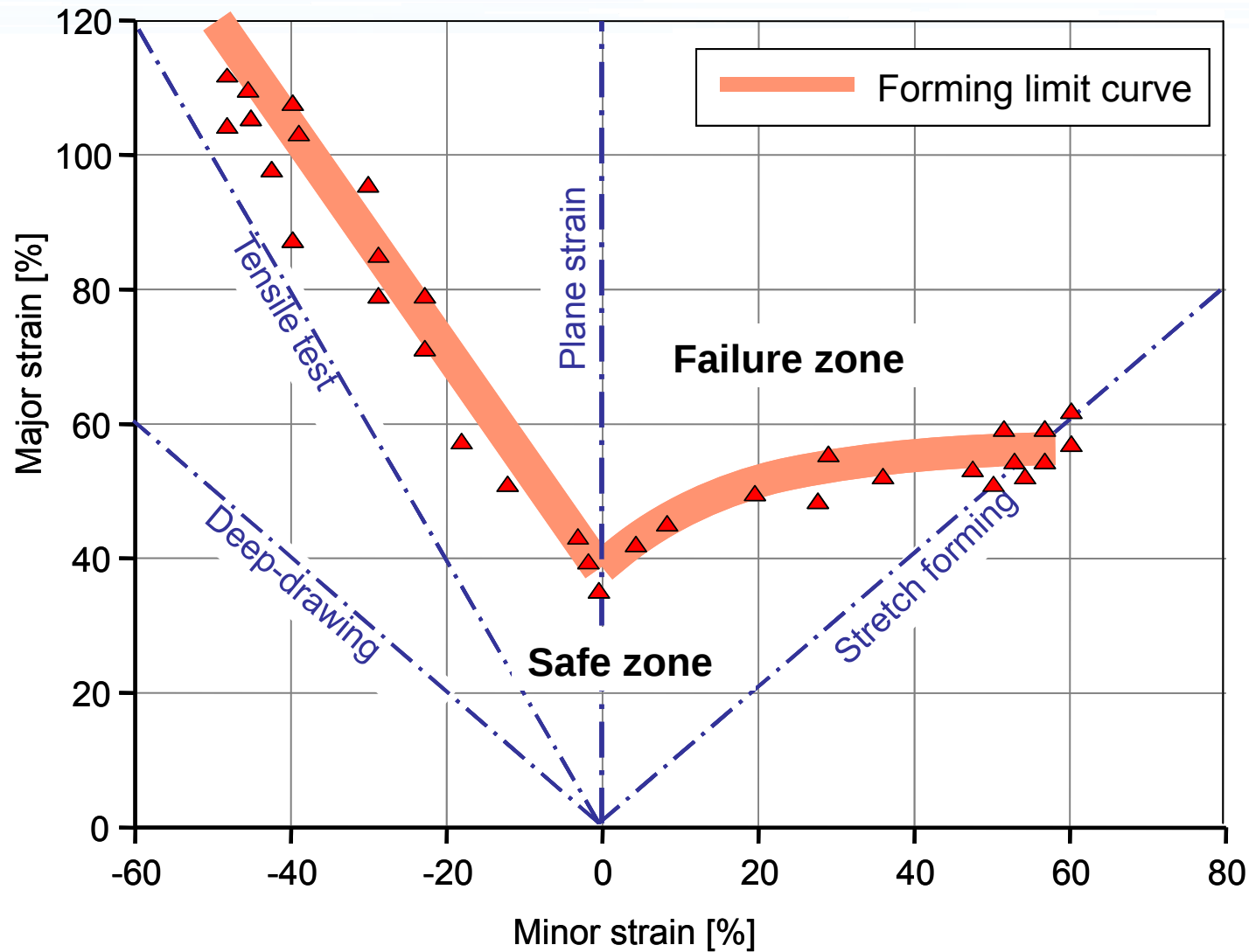
Based on Forming Limit Diagram (FLD) and Forming Limit Curve (FLC)

Method

- Grid is applied to surface of flat steel sheet
- Material is formed to desired shape
- Circles become ellipses
 - longest dimension is major axis
 - shortest dimension is minor axis
- Measure length of axes
- Calculate strain
- Add value pair to Forming limit diagram

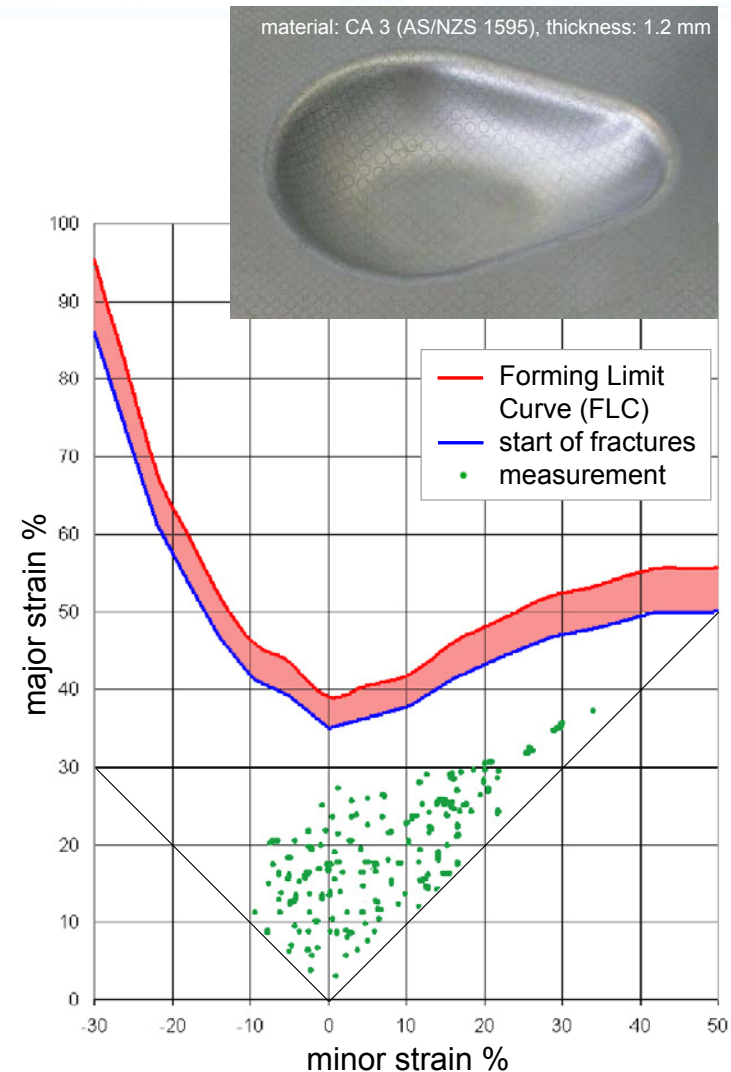


Forming limit diagram



Use of strain analysis

- Analysis and optimisation of the forming process
- Shorter prototype development time
- Quality control of serial parts
- Verification of FE-simulations
- Measurement of sheet thickness (indirect)



informing

Objectives:

- Be research institution for metal forming in NZ
- Support NZ industry in all questions concerning forming of sheet metals
- Develop an industry sector group
- Strengthen position of NZ companies by combined research activities

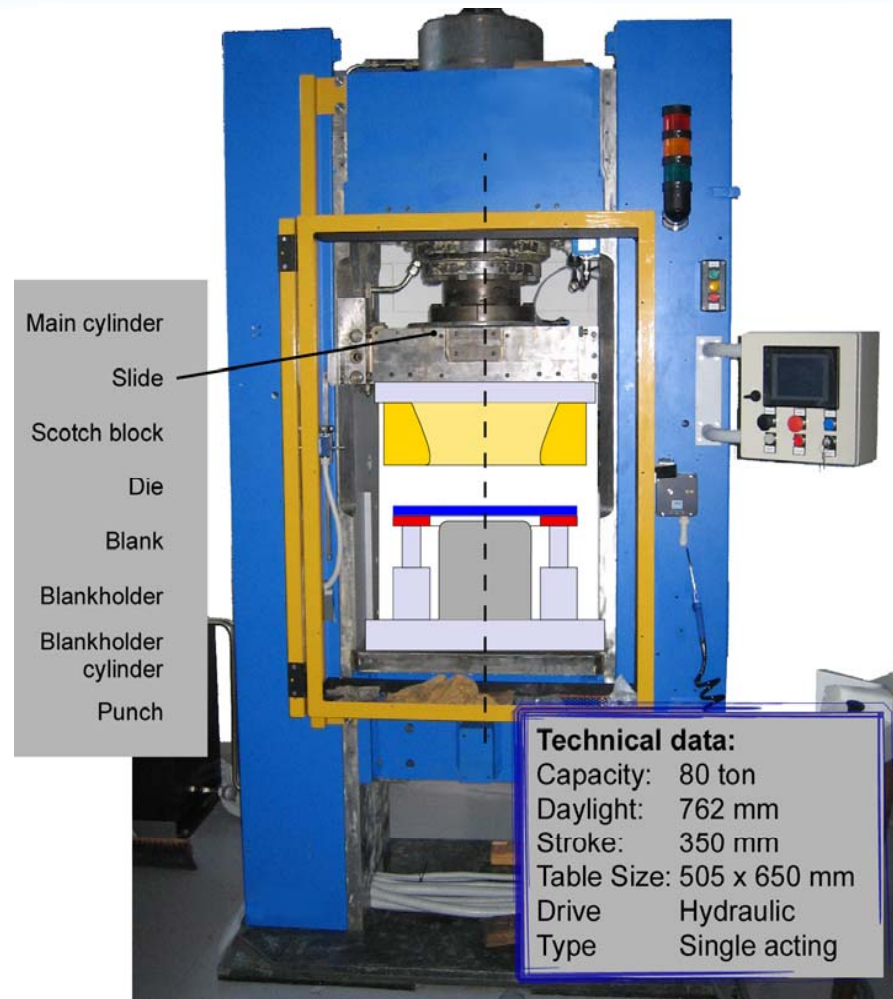
Capabilities:

- Experimental & theoretical analysis of press forming processes
- Experimental & theoretical analysis of roll forming processes
- Analysis of metallurgical composition of materials
- Material characterisation
 - Strain analysis
 - Tensile testing with longitudinal and transversal extensometer

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Thank you

