

*8th International Forging Conference/Brasil  
(24th Senafor)*

Some ideas about simulation:

The possible gap between what simulation systems could do for you and what you do with simulation systems

*G. H. Arfmann, M. Twickler  
AE Arfmann Engineering, CPM GmbH, Germany*

21st of October 2004

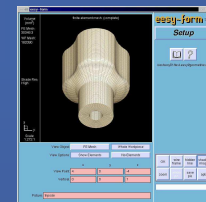


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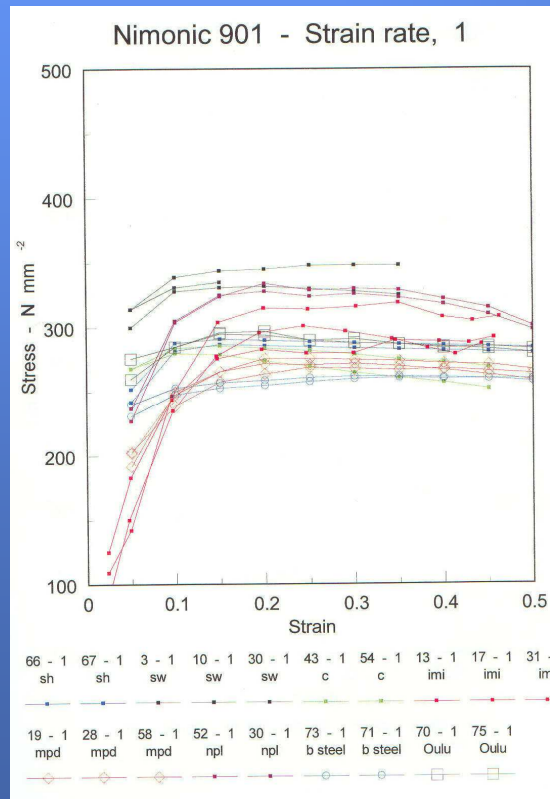
## Some ideas about simulation.....

- Availability of reliable data (material, friction, physical properties)
- Designing of cold forming process (process and tool design)
- Avoiding of failures
  - cracking of the part (in two pieces)
  - failure of a punch
  - folding at the part
  - pre-stressing-system design
- Prediction of microstructure
- 3D or 2D ? What is the right choice?
- Administration of data



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Some ideas about simulation.....



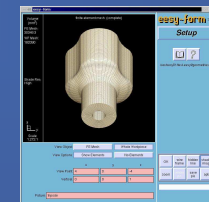
- Correct material data

Yield-Stress-Strain curve

Quality

Source

Documentation

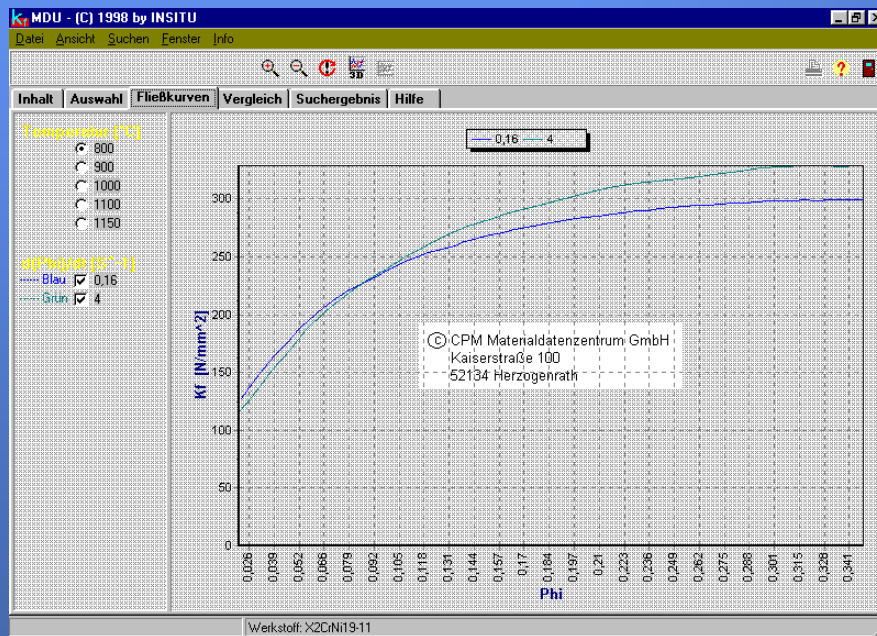


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Some ideas about simulation....

- Correct material data

Yield-Stress-Strain  
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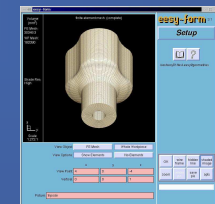
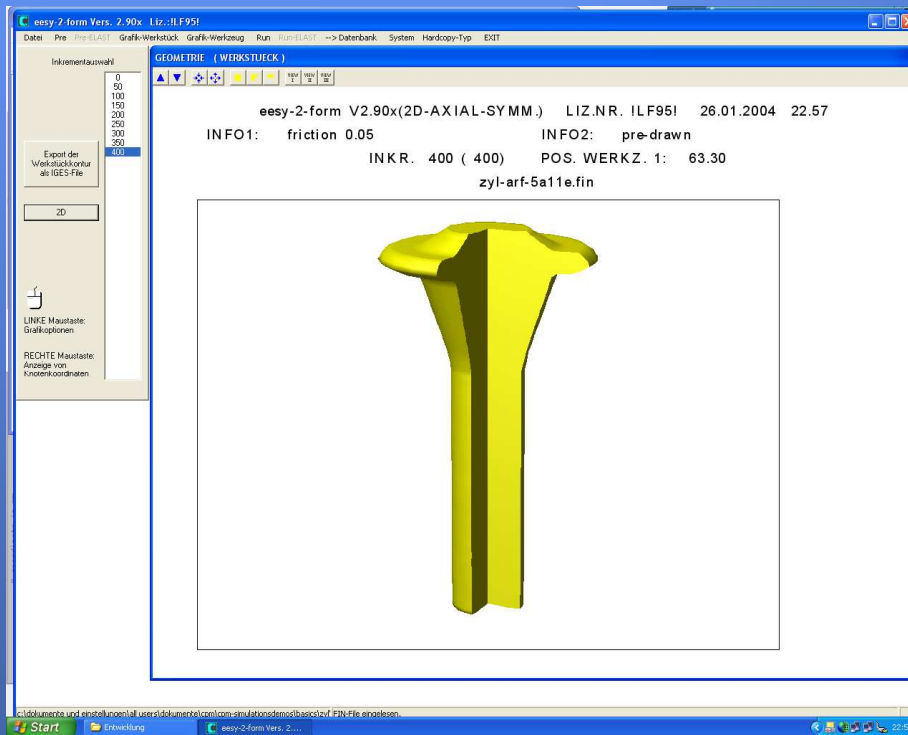
- boundary conditions

Correct friction and temperature?

Influence on

- correct material flow
- correct load

$\mu=0.05$ , temp.= 25°C,  
pre-drawing



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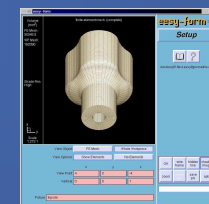
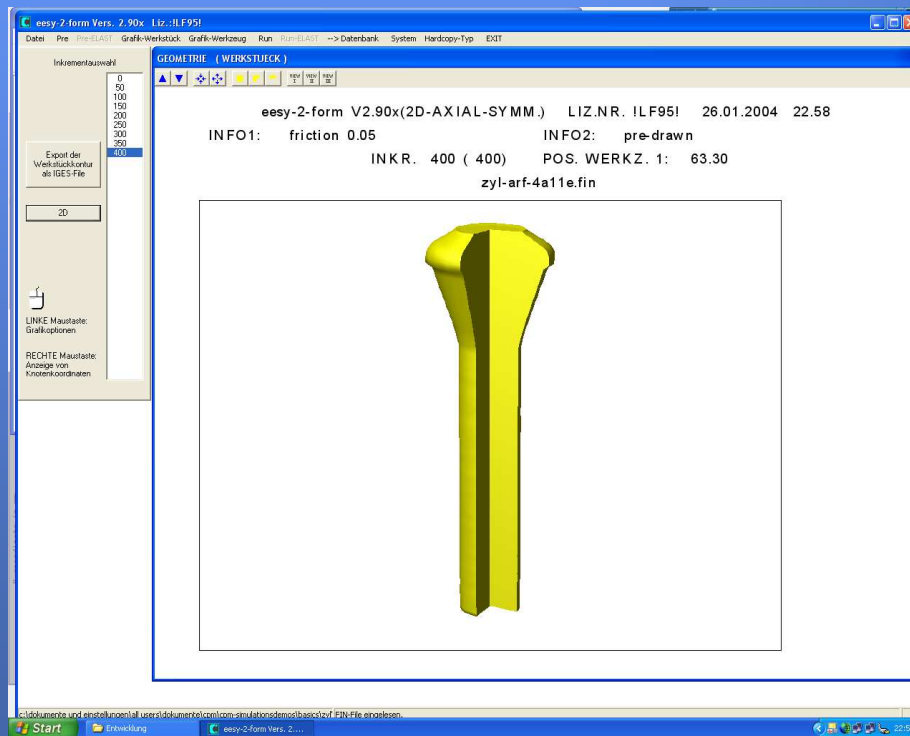
- boundary conditions

Adaptation of friction and temperature

Influence on

- correct material flow
- correct load

$\mu=0.05$ , temp.= 80°C, pre-drawing



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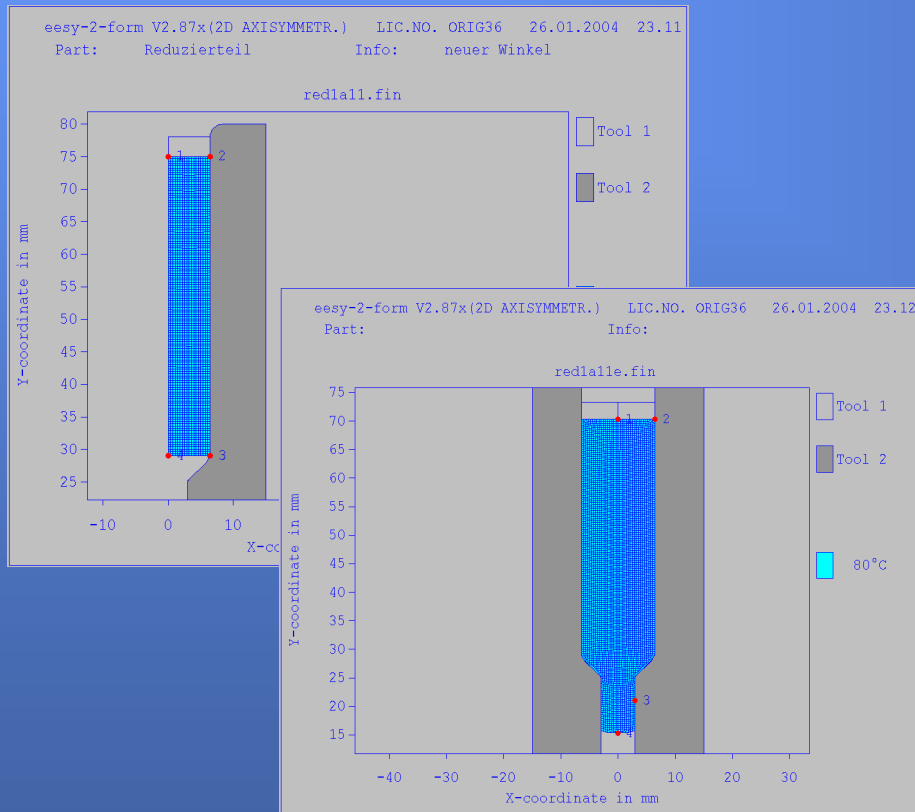
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Some ideas about simulation....

- Design of a cold forming process

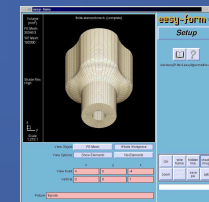
Simulation of an extrusion

Material flow



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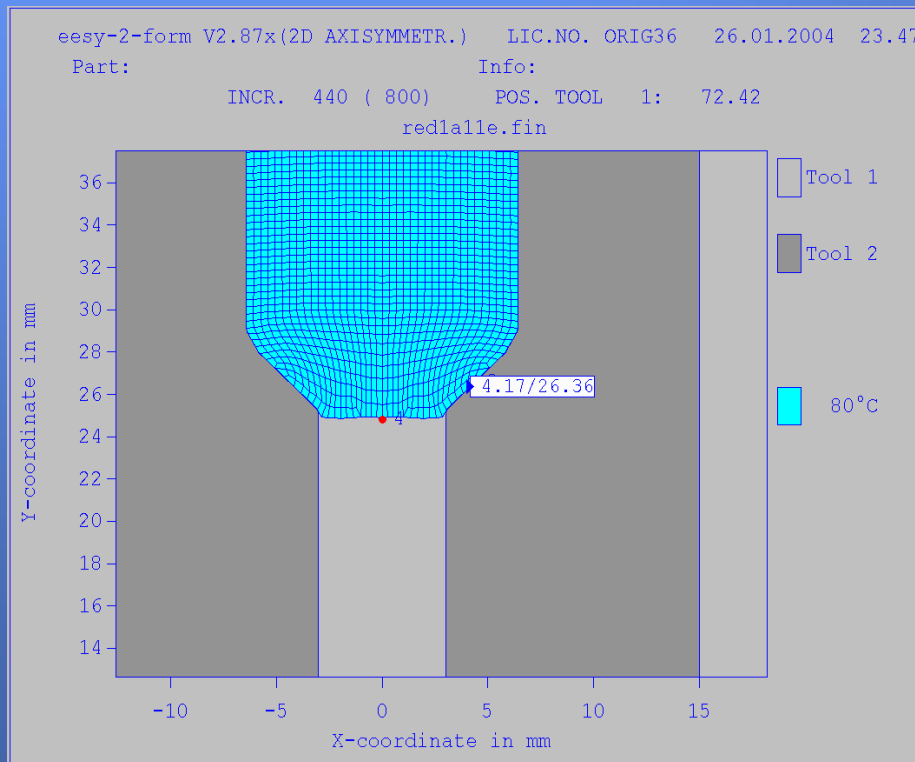
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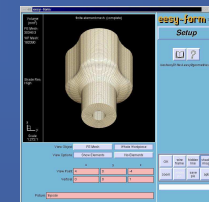


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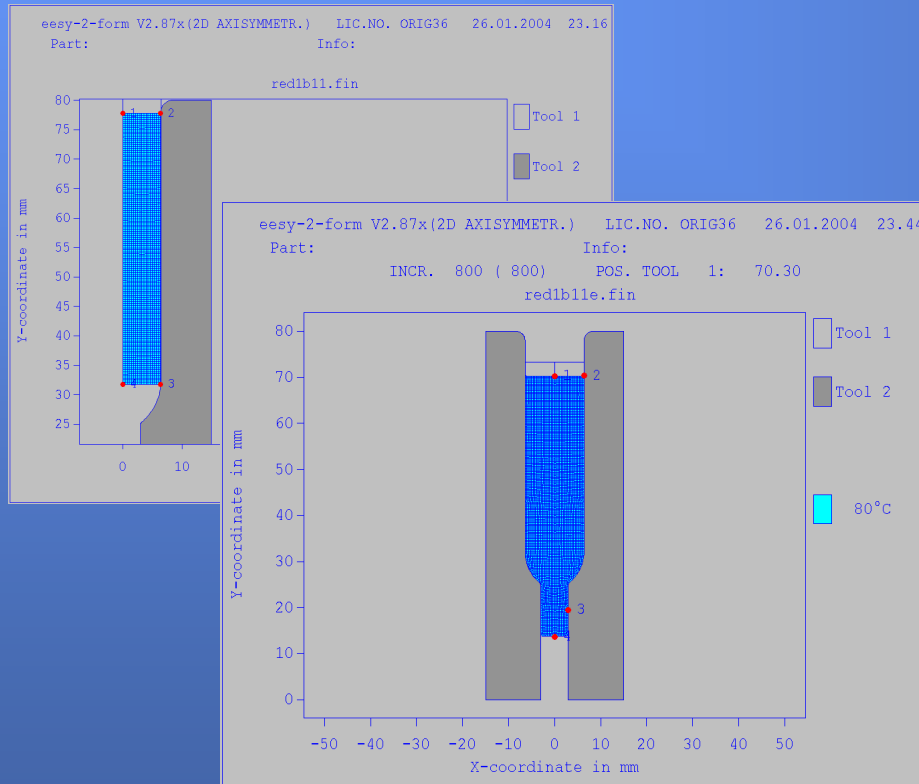
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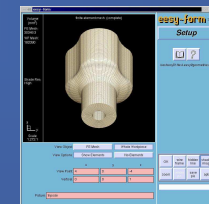
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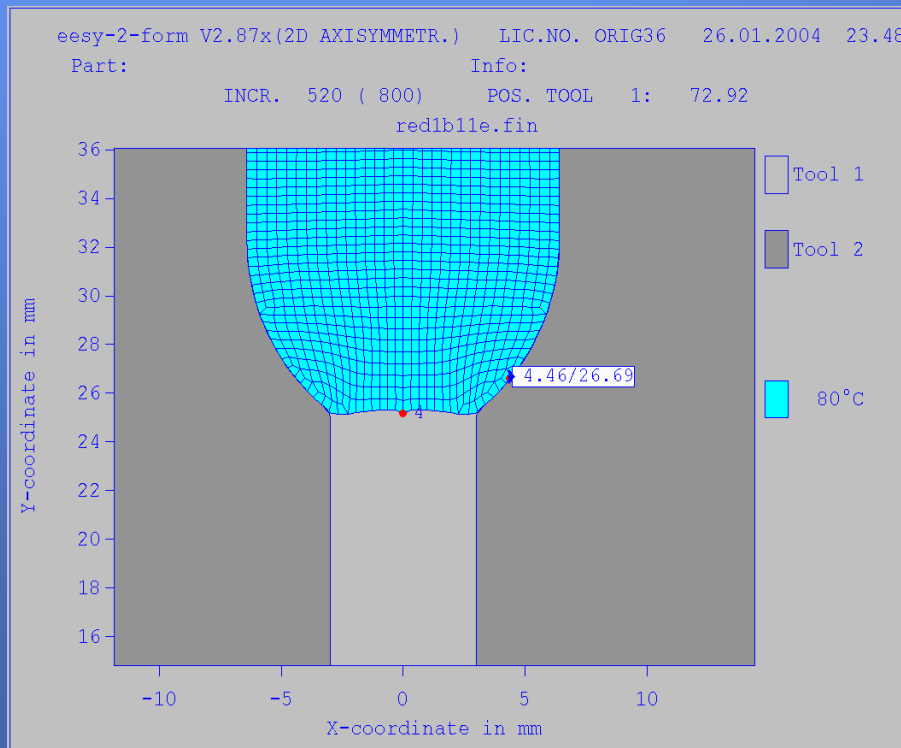
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Some ideas about simulation....

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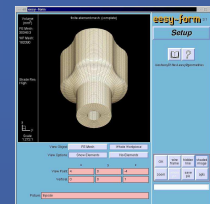


Simulation of an extrusion

Material flow  
**CPM**

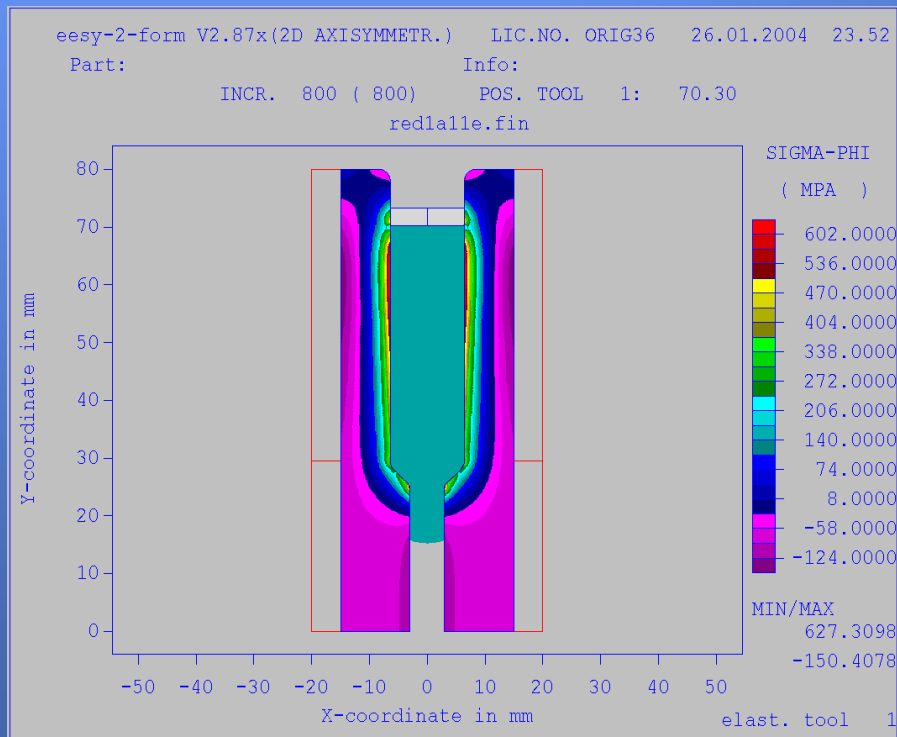
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Some ideas about simulation....



- Design of a cold forming process

Tool design

Stress in the die  
without pre-stressing

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Some ideas about simulation.....

Software Brigitte Königs, D-41061 Mönchengladbach, Gneisenaustr.3 **MatriA3.4**

D1  mm

D2  mm

D3  mm

D4  mm

Pi  N/mm<sup>2</sup>

S1  0/00

S1  mm

S2  0/00

S2  mm

Fügefolge  von Außen nach Innen

CPM D-52134 Herzogenrath Kaiserstr.100 Fugendruck Ps1 = 937 N/mm<sup>2</sup>  
Fugendruck Ps2 = 382 N/mm<sup>2</sup>

Atmung D1 f(Pi) = 0,053 mm  
Verengung D1 f(S1+S2) = 0,046 mm Datum 26.01.2004 Time 23:56:03

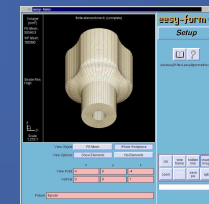
Bemerkung

OK Ende Grafik S-Opt D-Opt D3-Opt Print Werkstoff Oberfläche

	<Ps2	<Ps1	<Pi=Innendruck	Innenring	Mitterring	Außenring
	S2	S1	Sprache	D1	D2	D3 D4
<b>Schweers-Dreiringsystem</b>						
	Innenring		Mitterring	Außenring		
Werkstoffbenennung	G55		X40CrMoV51	X40CrMoV51		
Werkstoffnummer			1.2344	1.2344		
Poissonsche-Zahl	0,25		0,28	0,28		
E-Modul kN/mm <sup>2</sup>	450		216	216		
Anlaßtemperatur °C			520	600		
Streckgrenze N/mm <sup>2</sup>			1850	1470		
Bruchfestigkeit N/mm <sup>2</sup>			2050	1670		
Vergleichsspannung N/mm <sup>2</sup>	1298			1665	1323	
Tangentialspannung N/mm <sup>2</sup>	0			728	941	
				Zug	Zug	

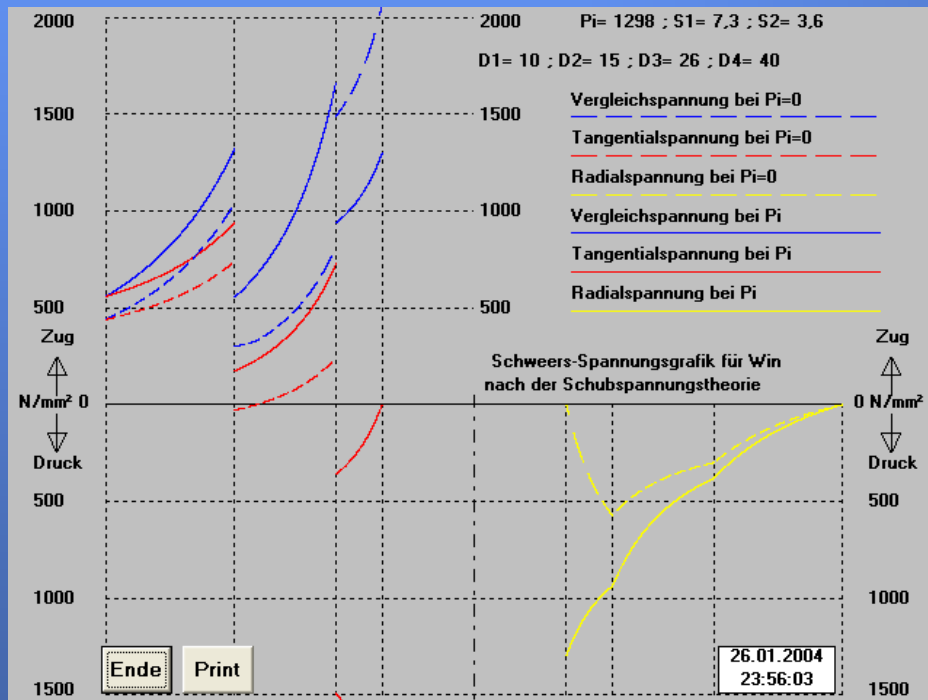
- Design of a cold forming process

Tool design  
Design of a multi-ring pre-stressing-system



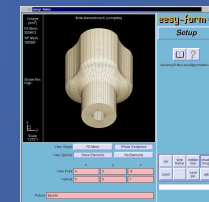
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- Design of a cold forming process

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Some ideas about simulation.....



- Avoiding of failures

Production of a spark plug

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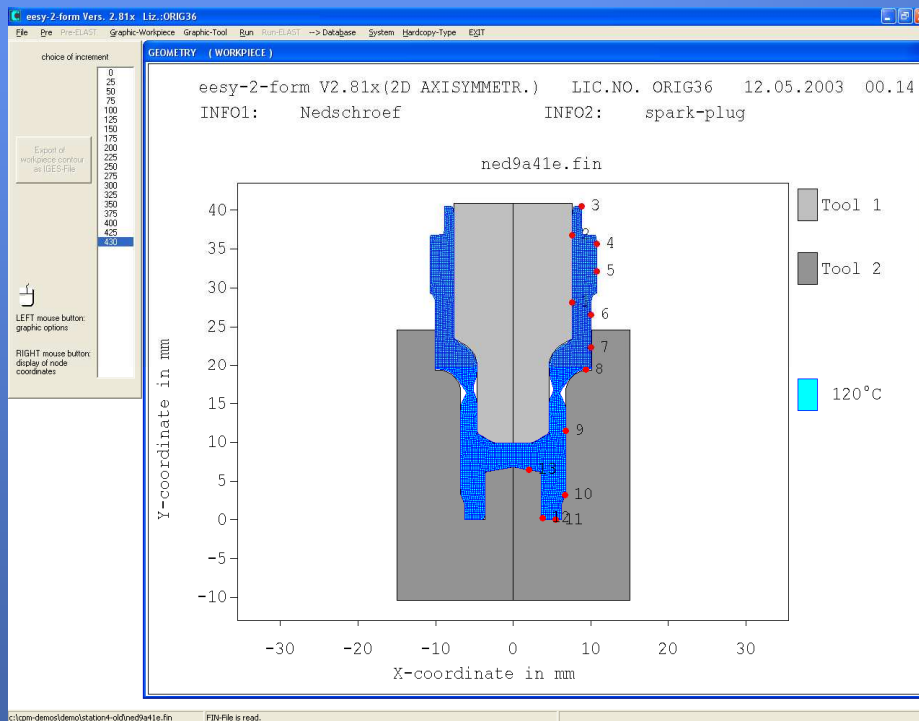
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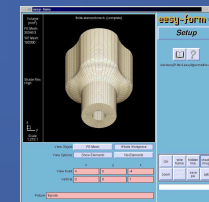
Production of a spark plug

Cracking of the part (in two pieces) because of wrong adjustment



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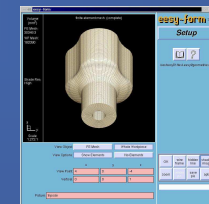
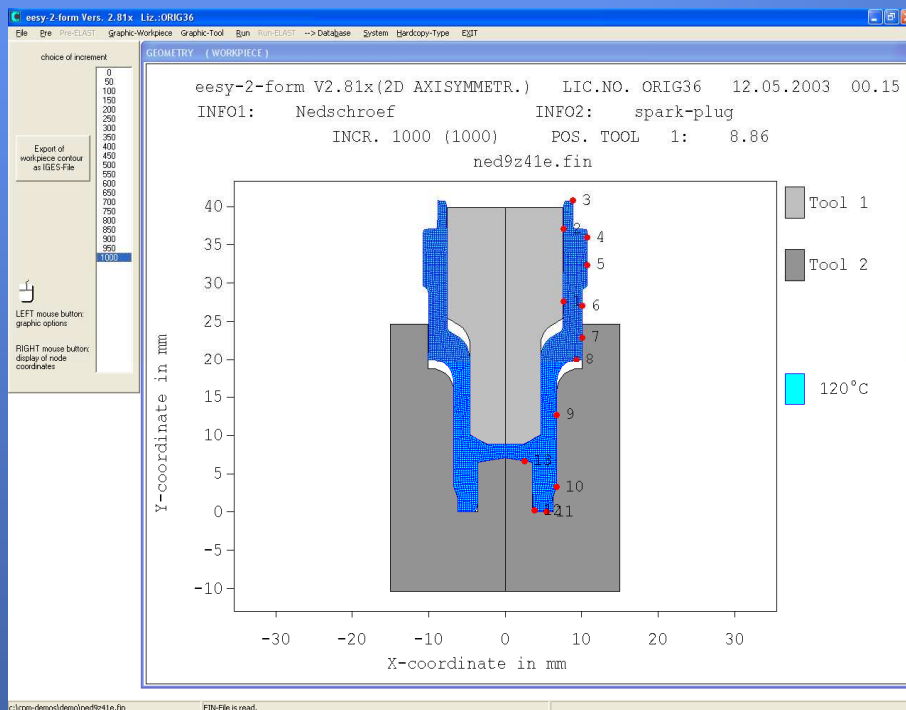
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Some ideas about simulation....

- Avoiding of failures

Production of a spark plug

Correct adjustment





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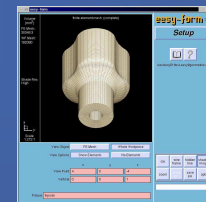
Some ideas about simulation.....



- Avoiding of failures

Failure of a punch

Bad pre-form design



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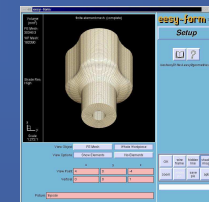
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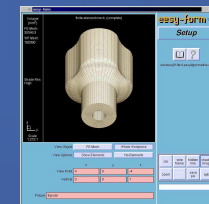
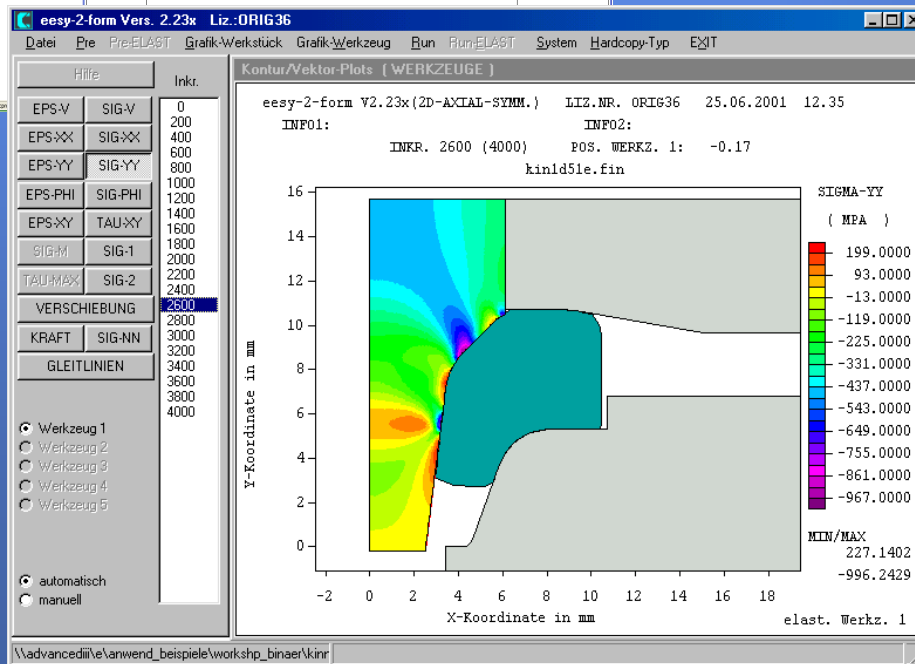
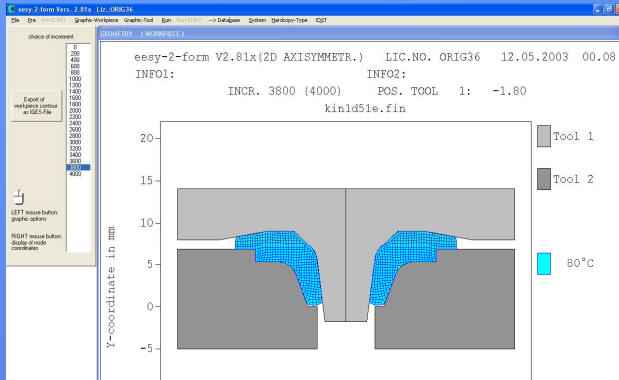
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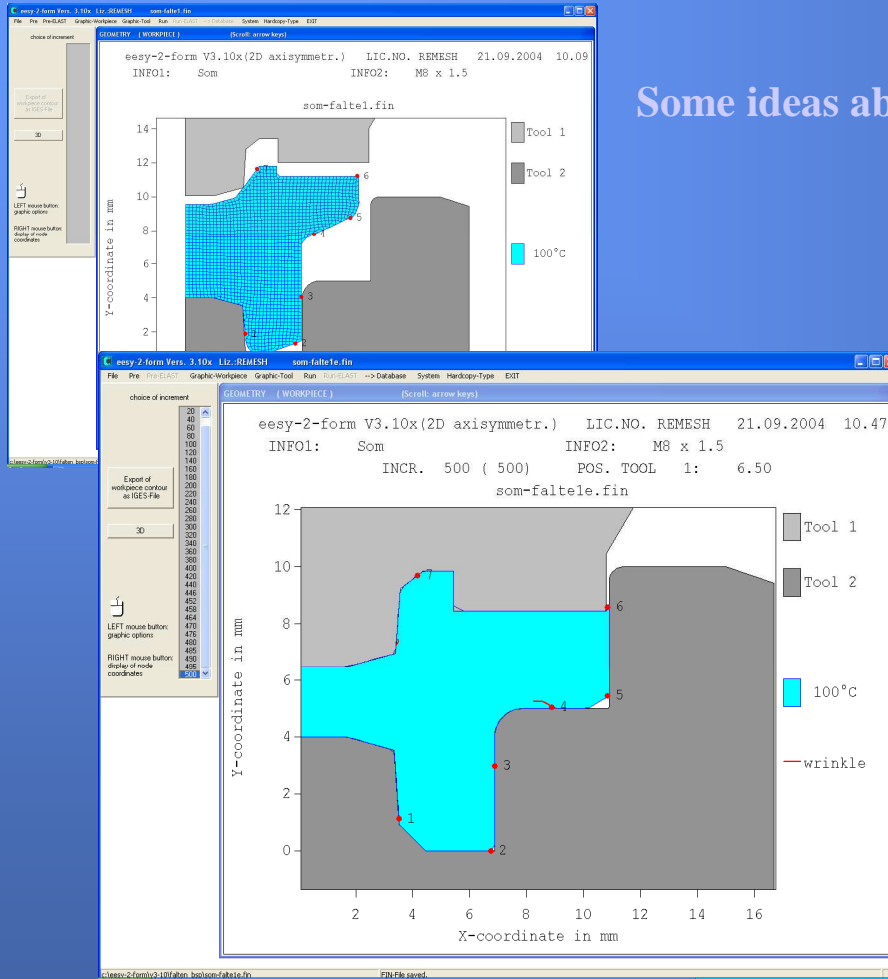


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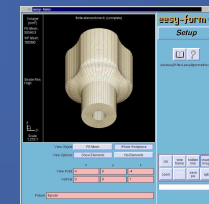
- Avoiding of failures

Folding at the part surface



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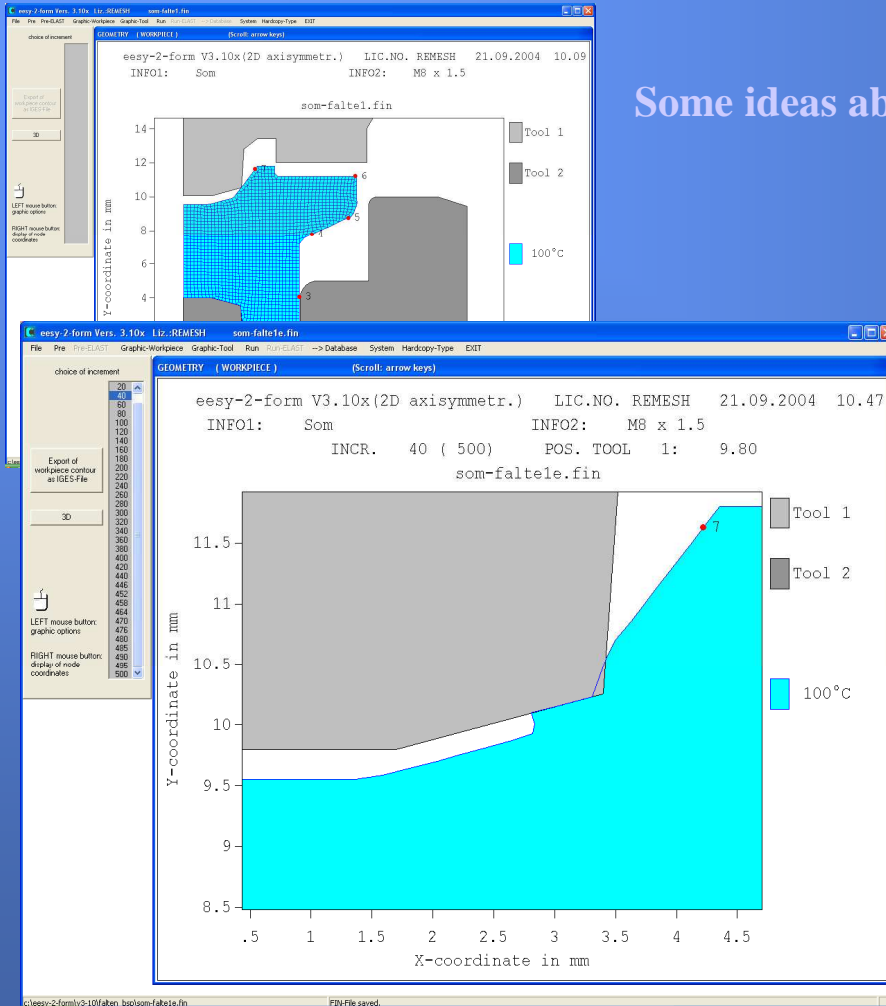
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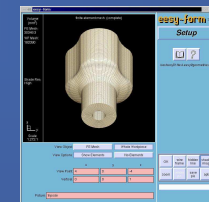
Folding at the part surface

Generation



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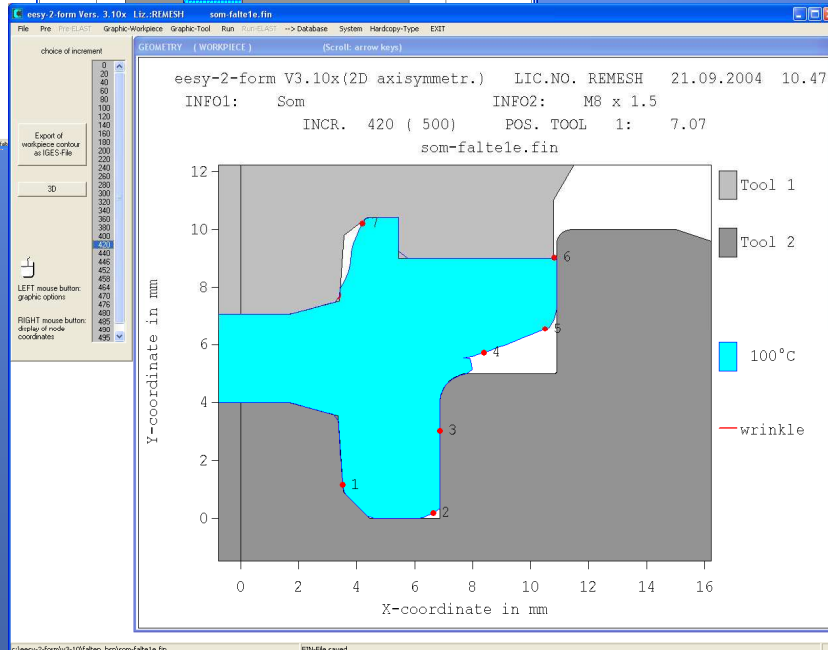
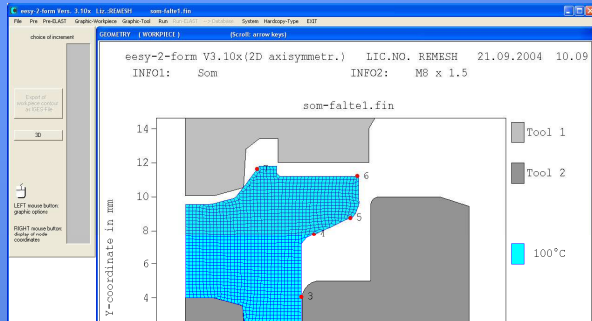
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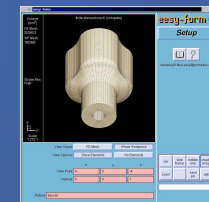
Folding at the part  
Surface

Generation



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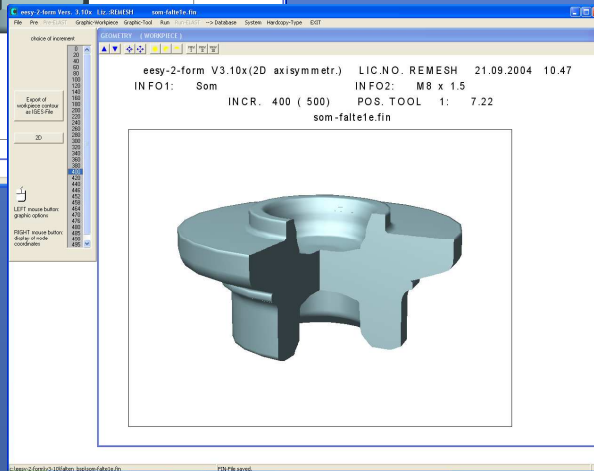
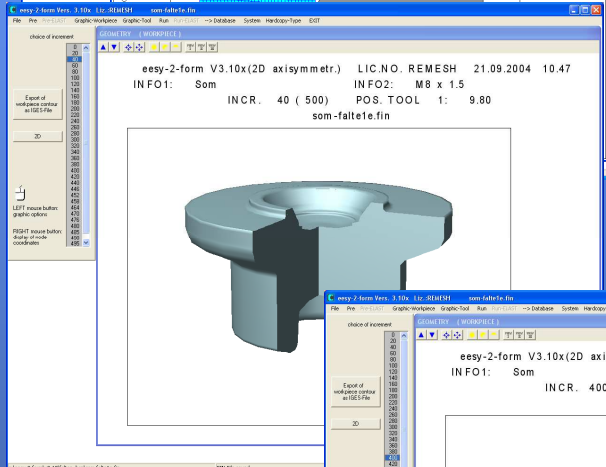
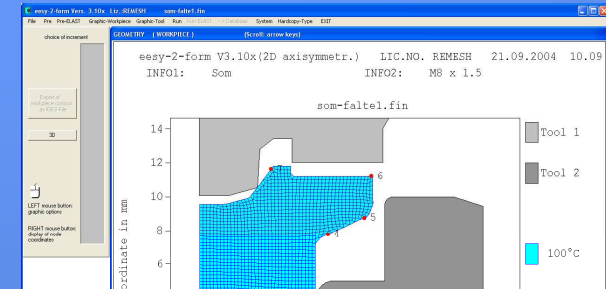
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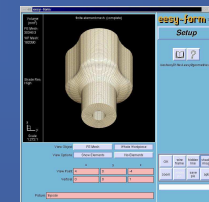
## Folding at the part surface

## Generation



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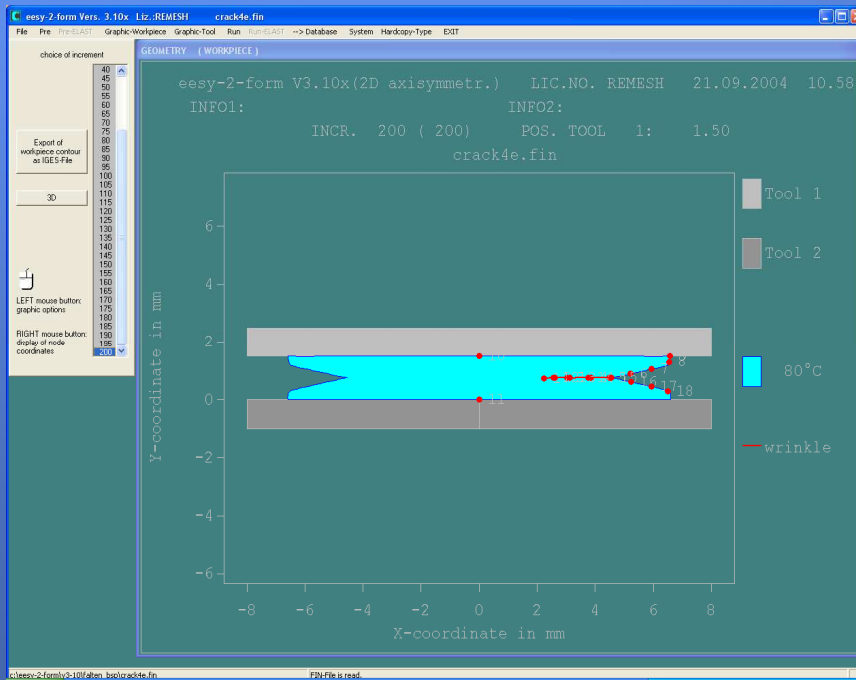


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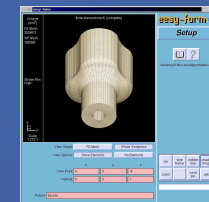
- Avoiding of failures

Generation of a fold



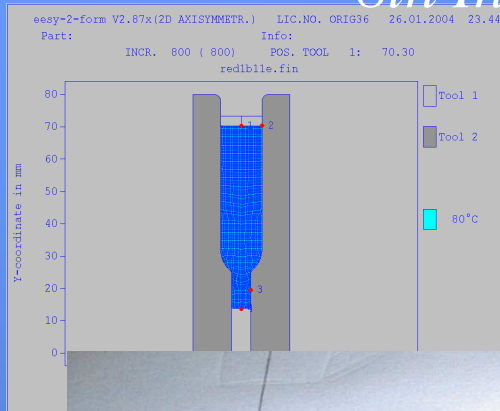
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Some ideas about simulation....

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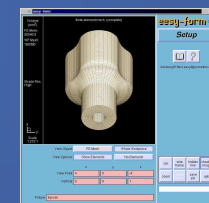


Splitting of a die due to high stresses

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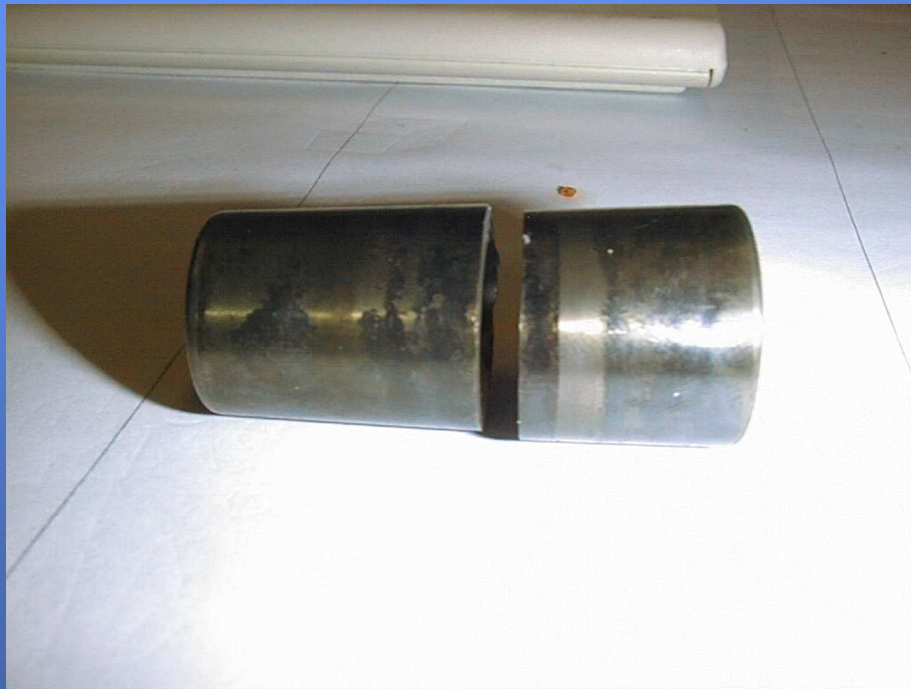
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**CPM**



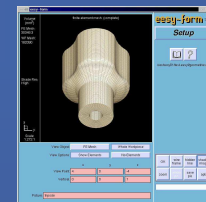
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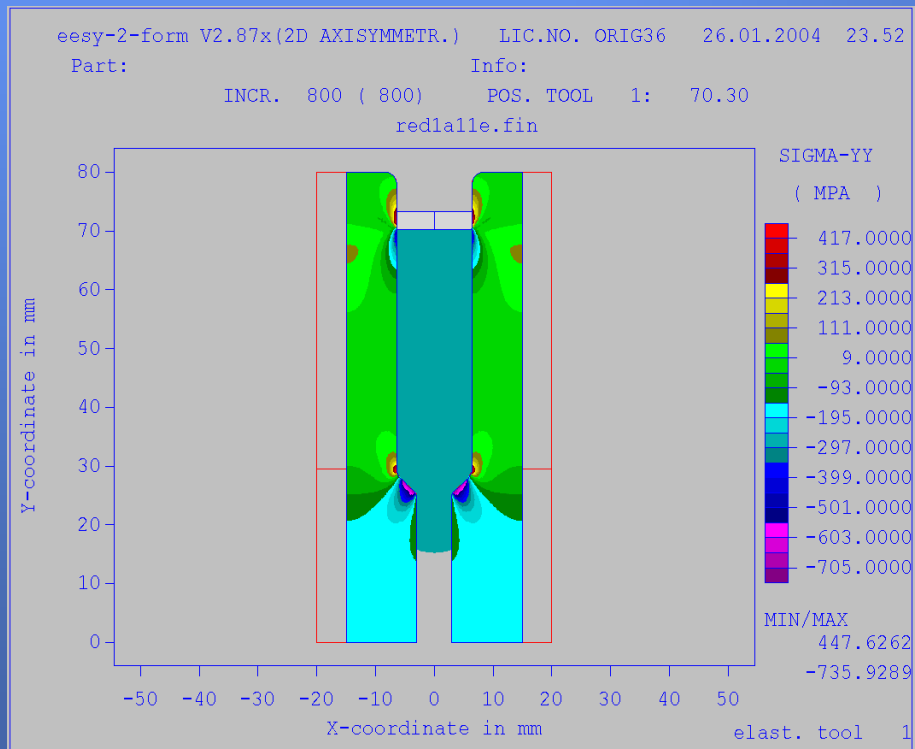
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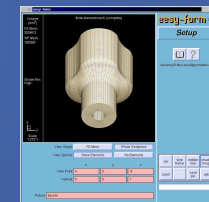


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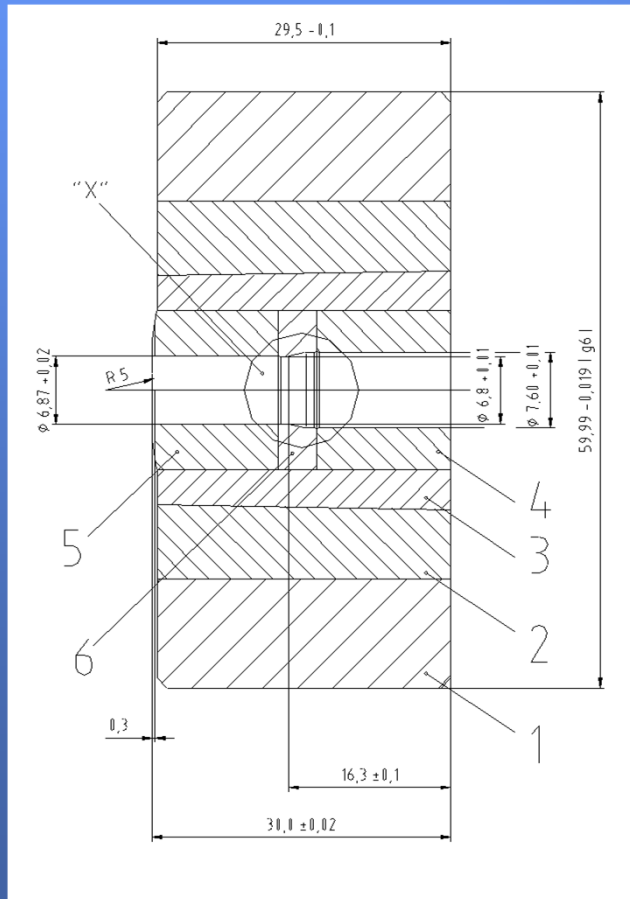
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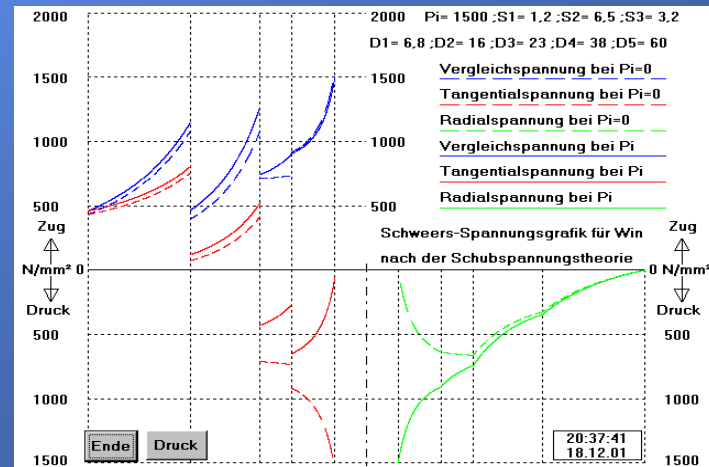


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Some ideas about simulation....



- Avoiding of failures



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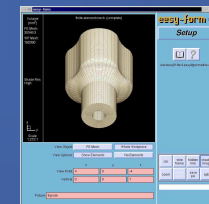
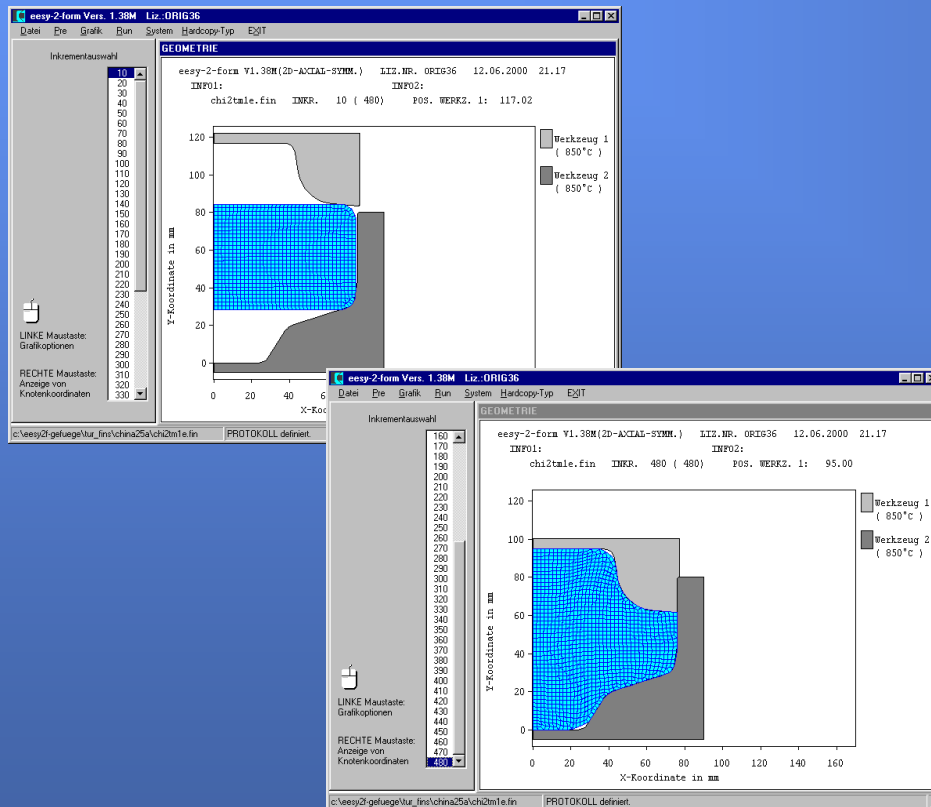


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Some ideas about simulation....

- Prediction of microstructure
- Correct consideration of boundary conditions:
  - Temperature
  - Machine
  - Material
  - .....



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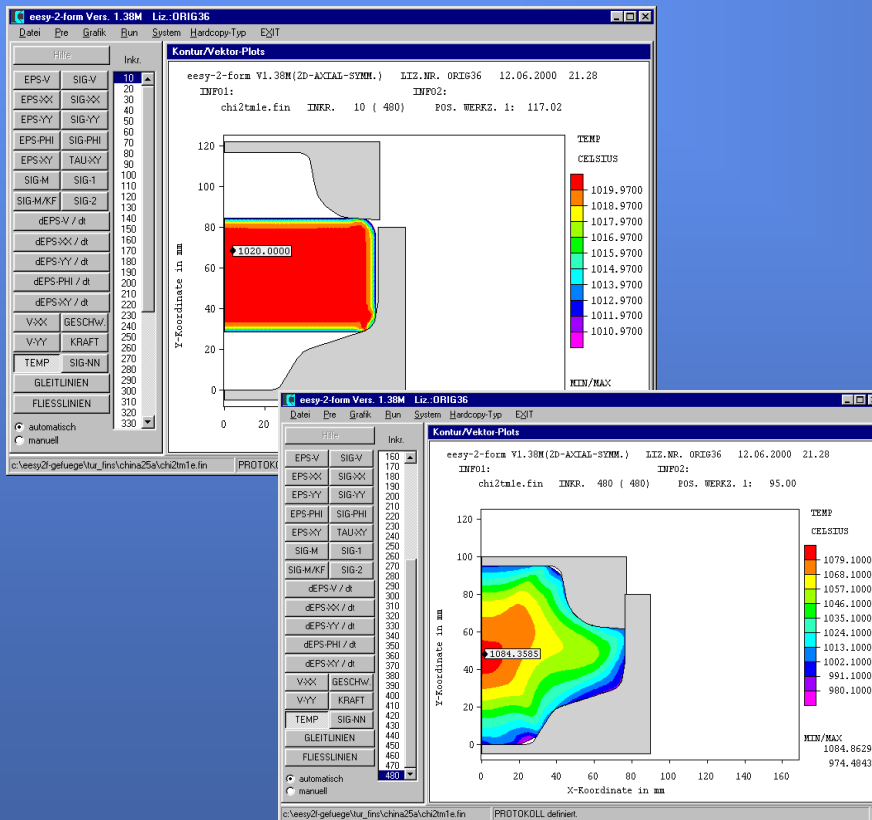
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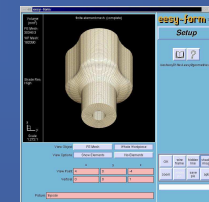
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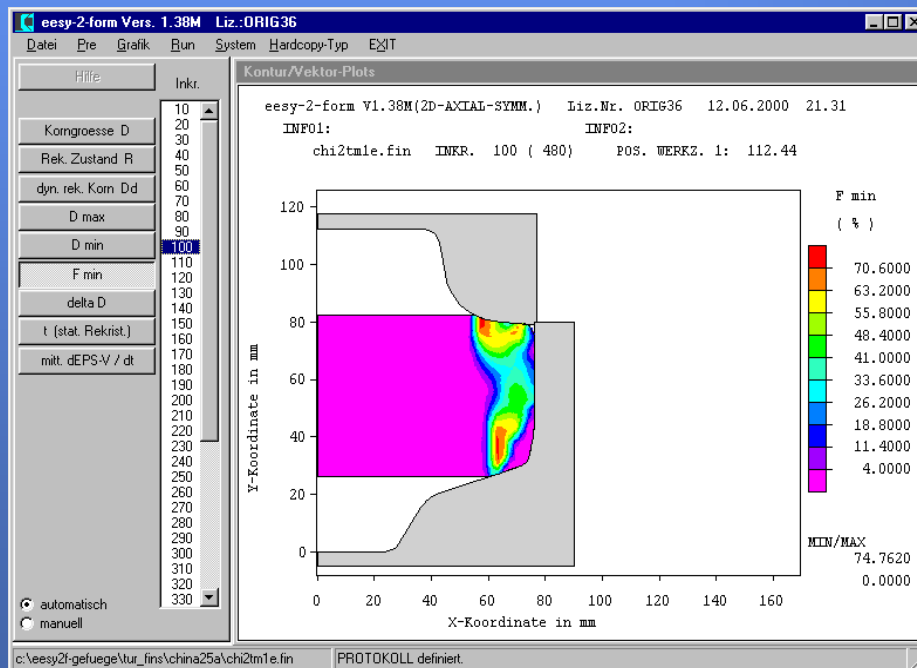
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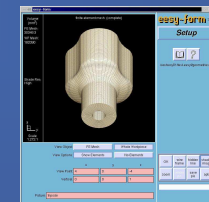
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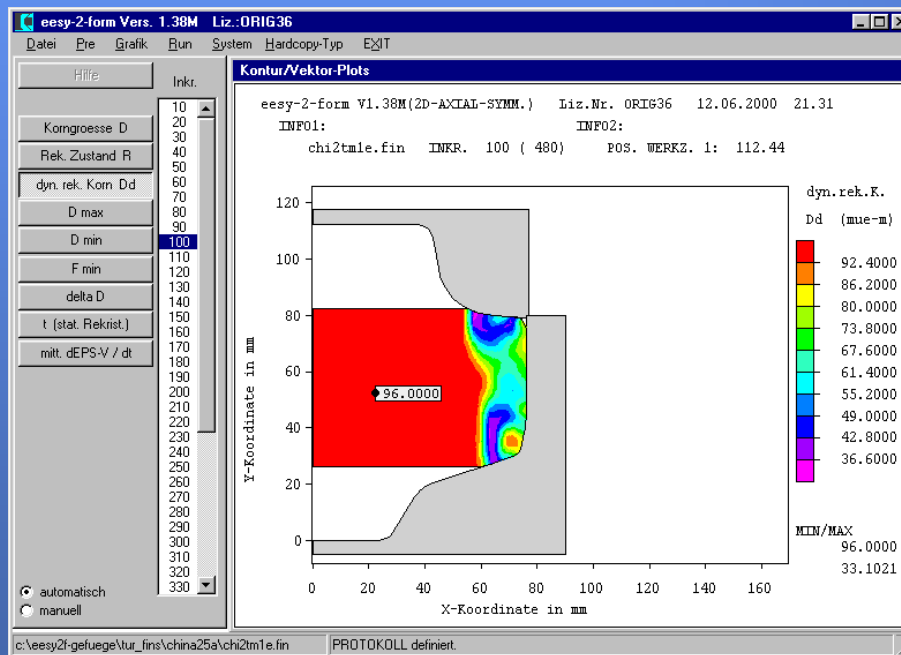
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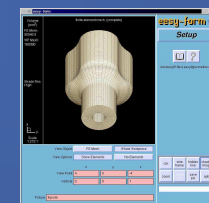
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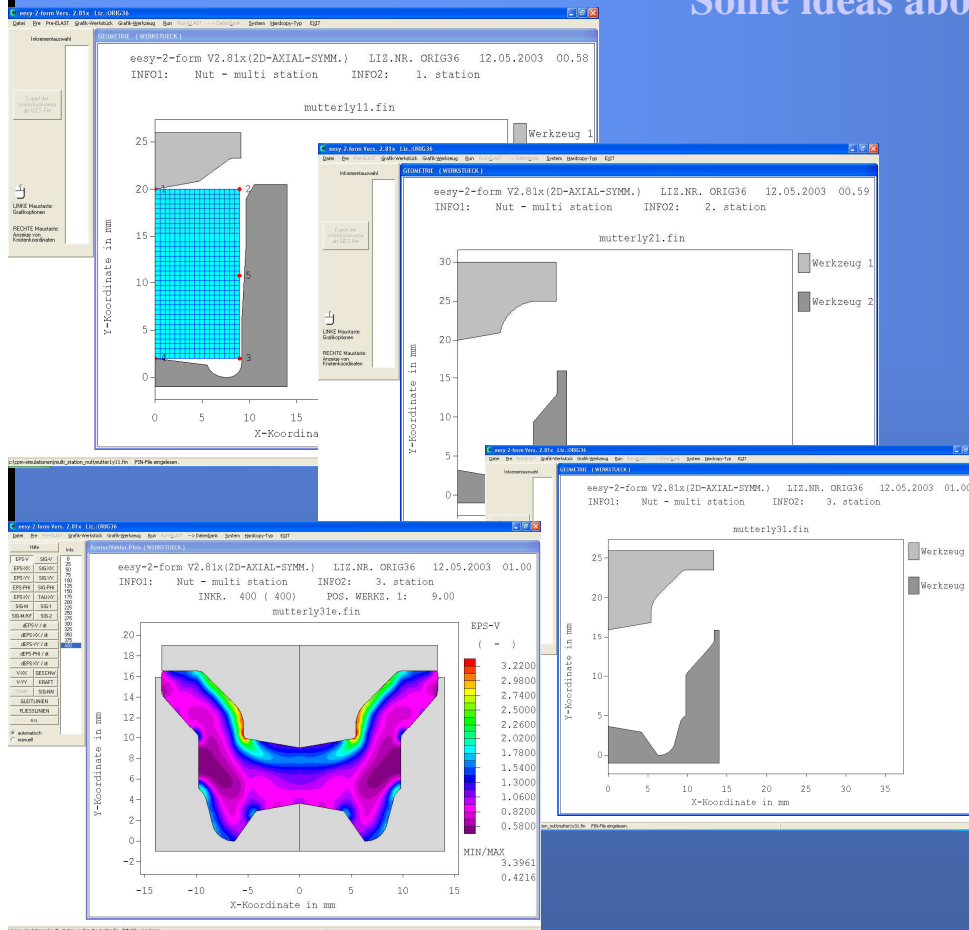
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Some ideas about simulation....

- 3D or 2D ? What is the right choice?

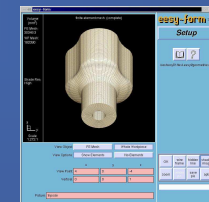
Production of a nut

Automatic simulation of the multi-station process



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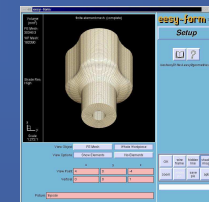
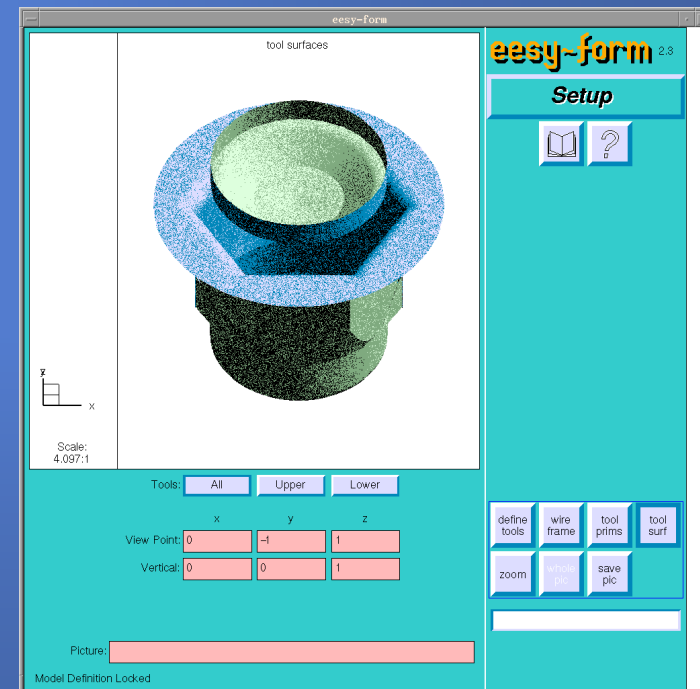
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Production of a nut

Tooling model in 3D



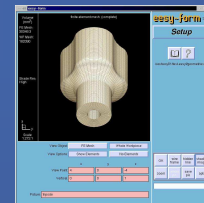
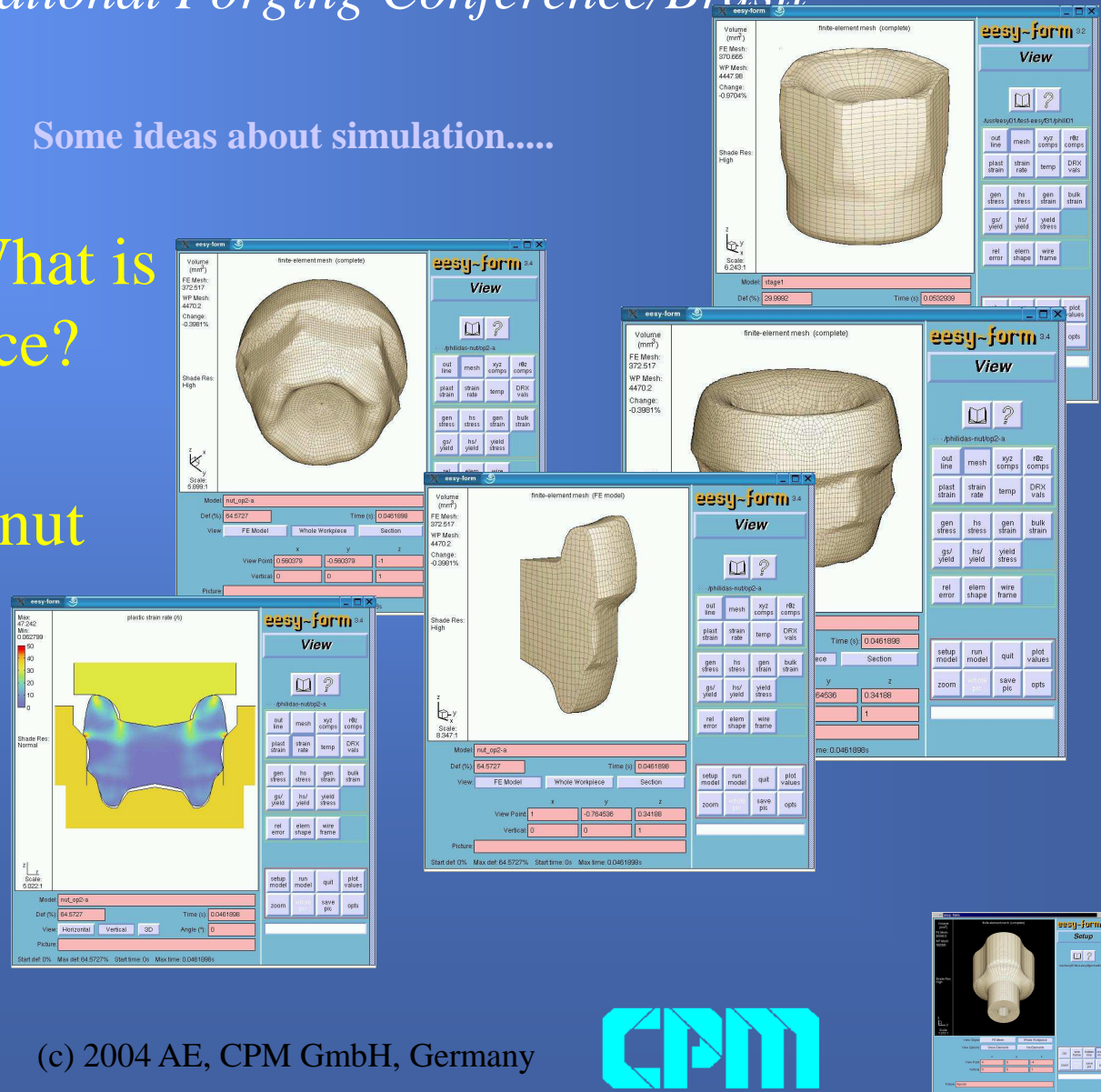
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Some ideas about simulation....

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Production of a nut

Simulation result 3D



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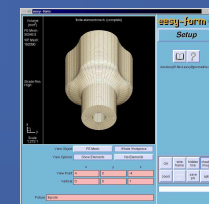
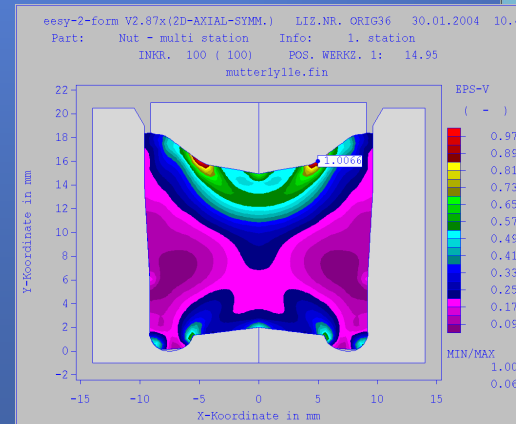
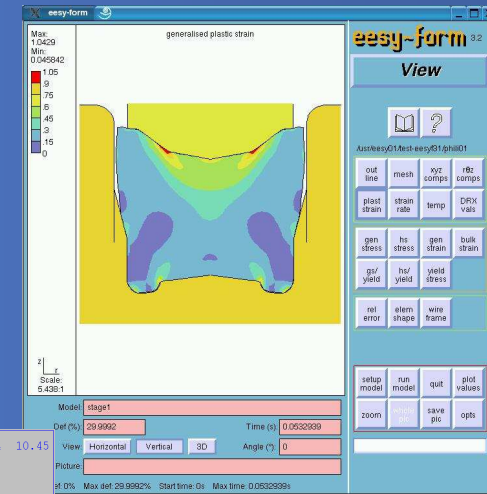
Some ideas about simulation....

- 3D or 2D ? What is the right choice?

## Production of a nut

## Interpretation in cross sections

## 2D-3D



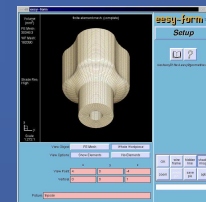
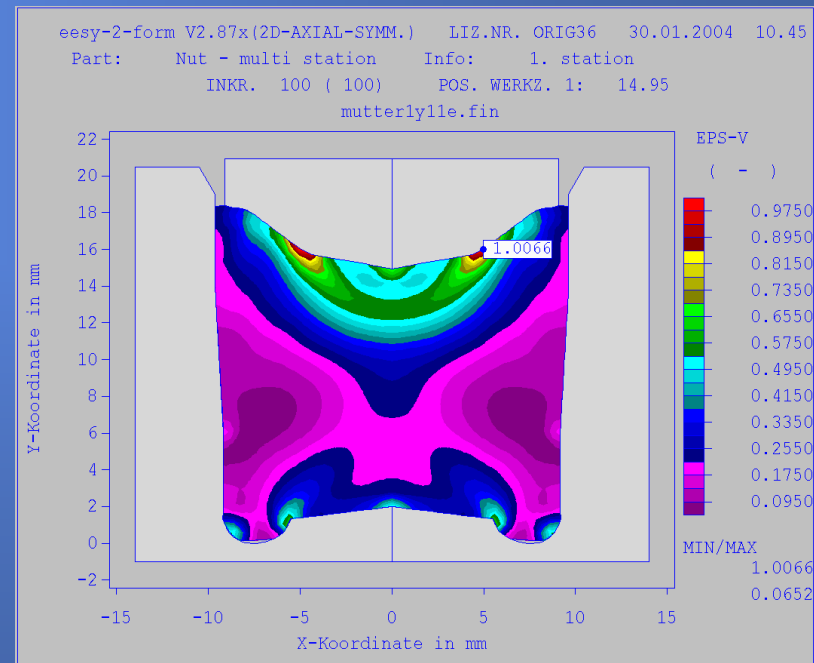
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Some ideas about simulation.....

- 3D or 2D ? What is the right choice?

Production of a nut

2D Interpretation of strain



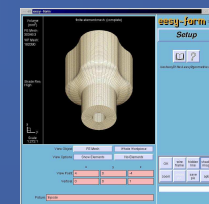
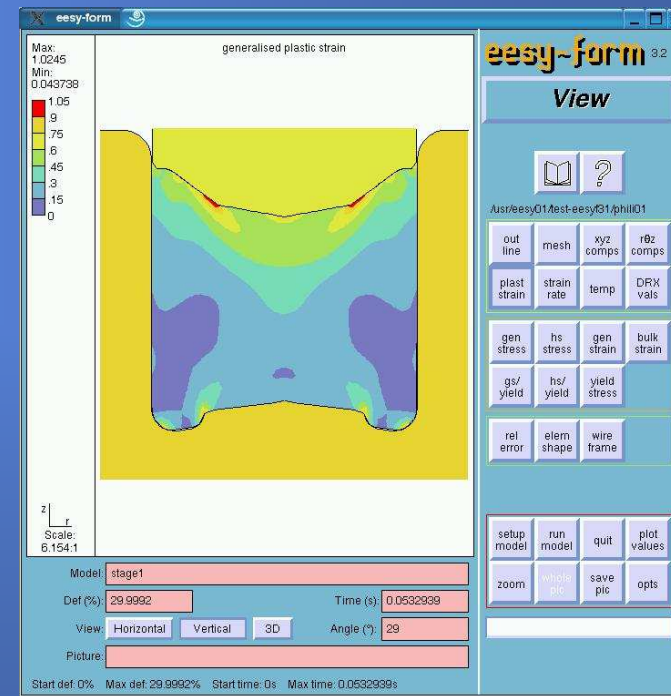
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Some ideas about simulation....

- 3D or 2D ? What is the right choice?

## Production of a nut

### 3D interpretation of strain in cross sections



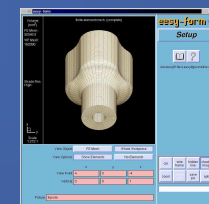
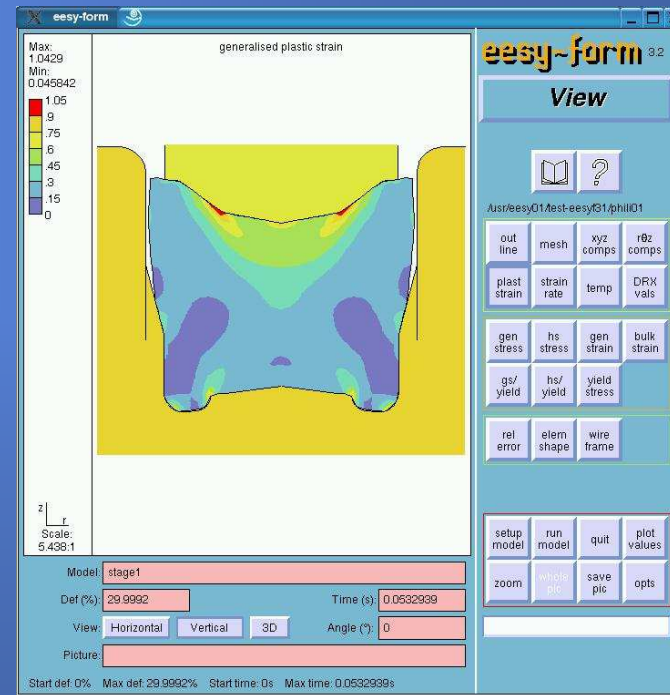
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Some ideas about simulation.....

- 3D or 2D ? What is the right choice?

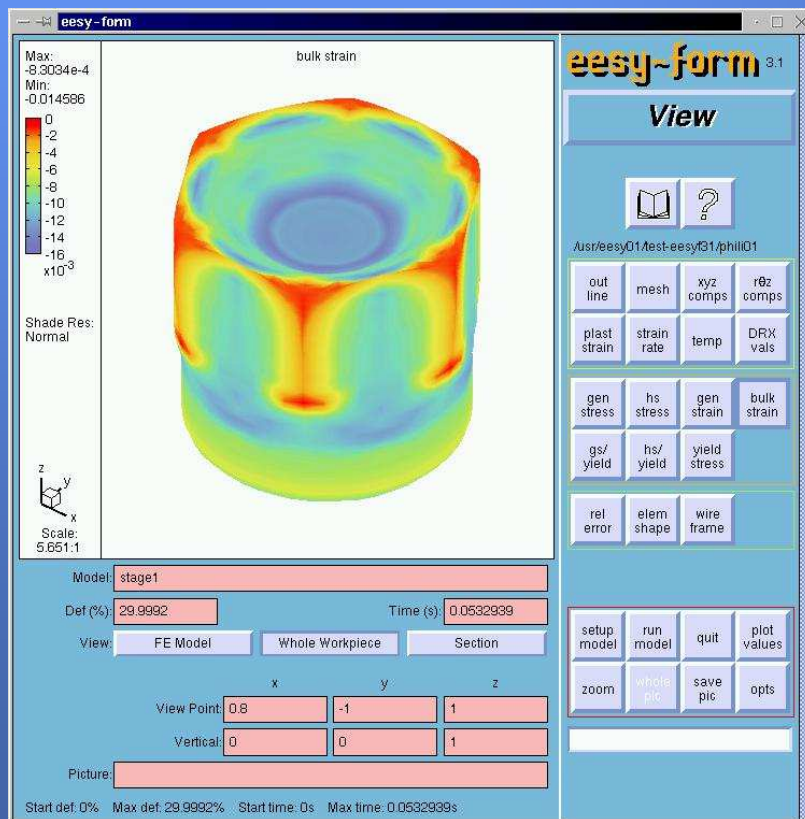
## Production of a nut

3D interpretation of strain in cross sections



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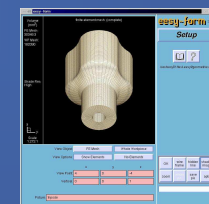
Some ideas about simulation.....



- 3D or 2D ? What is the right choice?

## Production of a nut

### 3 D interpretation of strain on the surface





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Some ideas about simulation.....

- 3D or 2D ? What is the right choice?

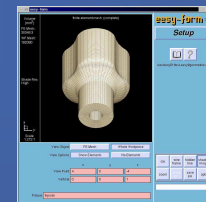
Production of a nut

3 D geometry



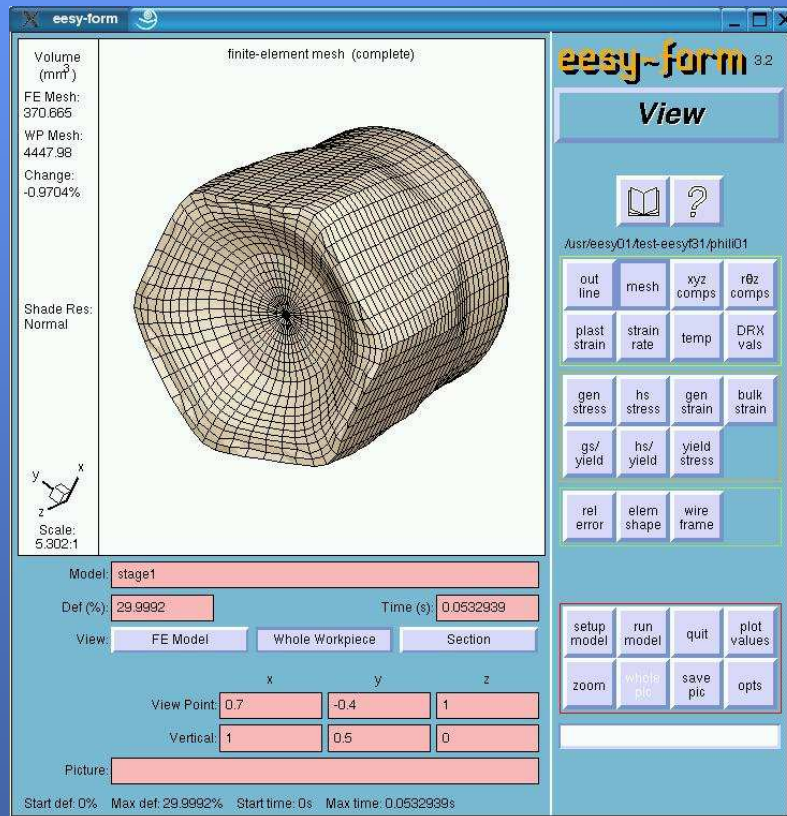
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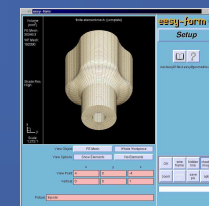
Some ideas about simulation....



- 3D or 2D ? What is the right choice?

## Production of a nut

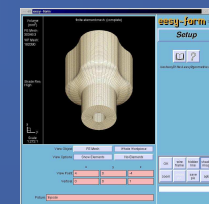
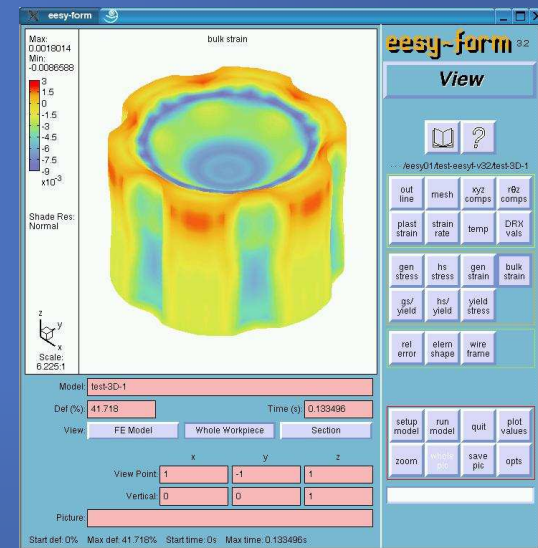
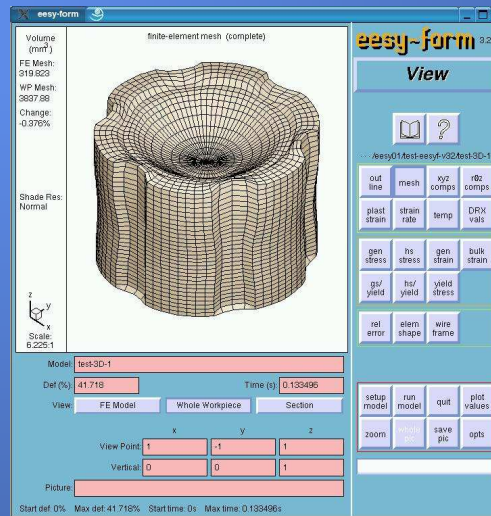
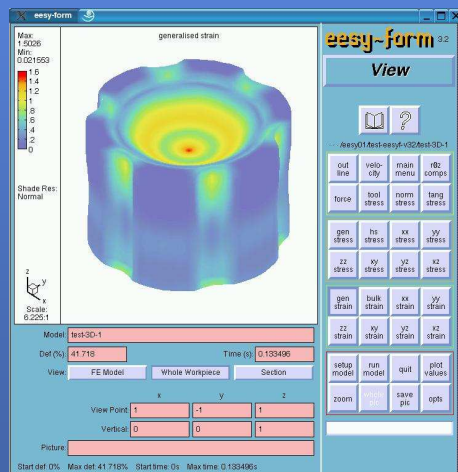
### 3 D geometry in simulation



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Some ideas about simulation....

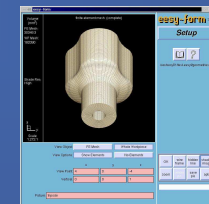
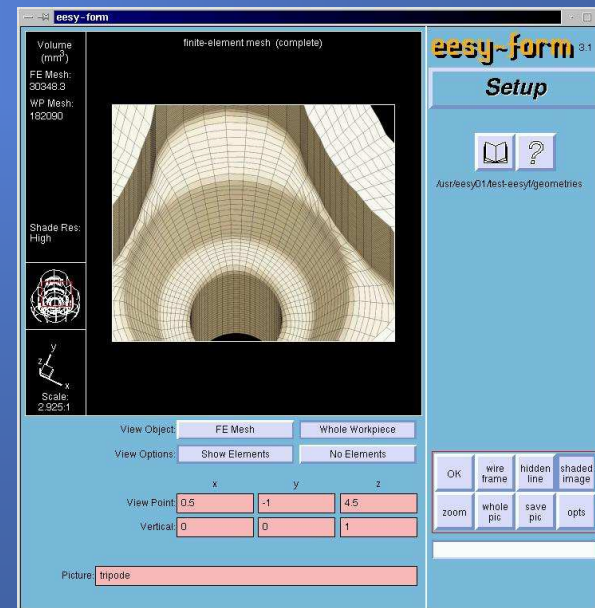
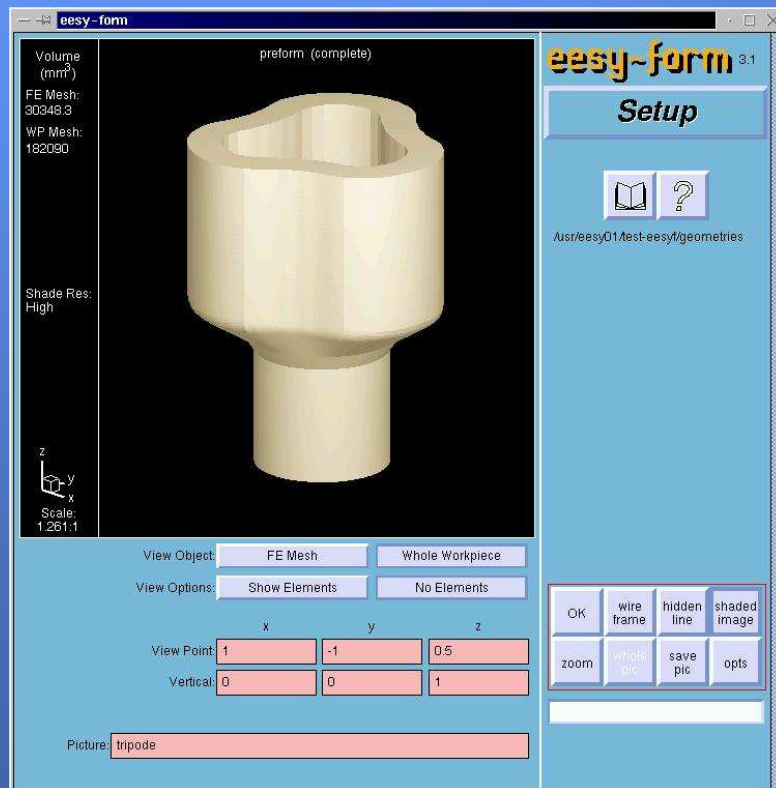
- further 3D applications



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Some ideas about simulation....

- further 3D applications



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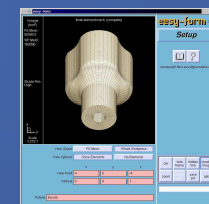
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Some ideas about simulation....

- Administration of data

EXCEL application  
*easy-archiv*

Dateiname (*.FIN)	Anfangszustand	Endzustand	Datum	Kommentar / Bewertung	Werkstoff	Steuerdaten	weitere Angaben
cone_shaft_1e	[Image]	[Image]	2001-09-08	INFO1: Cone Shaft INFO2: Hammer Forging (17 blows) Art der Rechnung - biernisch - mechanisch	2.4668, NiCr 19 NbMo, 900-1150 [°C], 0.1-10 [1/sek], (c) CPM-MDZ	Hammerschmieden mit Gesenkaufbereitung Schläge: 17, Anfangsenergie: Kurbelpresse max. Hub: 0.59800D+03 mm	Ausgangsgeometrie (Vorstufe): Durchmesser: 203,2 mm, Höhe: 330,0 mm, Ausgangstemperatur (Vor): keine
kin1d51e	[Image]	[Image]	2001-09-08	INFO1: INFO2: Art der Rechnung - mechanisch Umgebungstemperatur: 0 °C	1.1033, 34 Cr 4, 20-300 [°C], 0.1-10 [1/sek], (c) CPM-MDZ	Kurbelpresse max. Hub: 0.59800D+03 mm	Anzahl Hübe: Kurbelpresse max. Hub: 0.11000D+03 mm
sleeve_stainless_2e	[Image]	[Image]	2001-09-08	INFO1: INFO2: Art der Rechnung - mechanisch Umgebungstemperatur: 50 °C	1.4567, X 3 CrNiCu 18 9, 20-300 [°C], 0.1-10 [1/sek], (c) CPM-MDZ	Kurbelpresse max. Hub: 0.37100D+03 mm	Ausgangsgeometrie (Vorstufe): Durchmesser: 7,8 mm, Höhe: 7,75 mm
ade-a-11e	[Image]	[Image]	2001-09-08	INFO1: Aile INFO2: 4 station operation Art der Rechnung - mechanisch Umgebungstemperatur: 25 °C	1.1172, Cq 35, 25-300 [°C], 0.1-10 [1/sek], (c) CPM-MDZ	Kurbelpresse max. Hub: 0.37100D+03 mm	Abschnitt Durchmesser: 38,0 mm Länge: 224,5 mm
ade-a-21e	[Image]	[Image]	2001-09-08	INFO1: Aile INFO2: 4 station operation Art der Rechnung - mechanisch Umgebungstemperatur: 25 °C	1.1172, Cq 35, 25-300 [°C], 0.1-10 [1/sek], (c) CPM-MDZ	Kurbelpresse max. Hub: 0.37100D+03 mm	siehe ade-a-11e
ade-a-31e	[Image]	[Image]	2001-09-08	INFO1: Aile INFO2: 4 station operation Art der Rechnung - mechanisch Umgebungstemperatur: 25 °C	1.1172, Cq 35, 25-300 [°C], 0.1-10 [1/sek], (c) CPM-MDZ	Kurbelpresse max. Hub: 0.37100D+03 mm	siehe ade-a-11e
ade-a-41e	[Image]	[Image]	2001-09-08	INFO1: Aile INFO2: 4 station operation Art der Rechnung - mechanisch Umgebungstemperatur: 25 °C	1.1172, Cq 35, 25-300 [°C], 0.1-10 [1/sek], (c) CPM-MDZ	Kurbelpresse max. Hub: 0.37100D+03 mm	siehe ade-a-11e
hotforge_1b11e	[Image]	[Image]	2001-07-19	INFO1: Hot forging INFO2: 1=1100°C, const Art der Rechnung - mechanisch Umgebungstemperatur: 50 °C	unbekanntes Technomaterial bei 1100 [°C]	Kurbelpresse max. Hub: 0.20000D+03 mm	Anzahl Hübe: keine weiteren Angaben



Microsoft Excel - easy-Archive

File Edit View Insert Format Extras Data Window Help

Frage hier eingeben

**easy-Archive (Ver. 2.0)** Aktualisiert am: 10.09.01 14:54:28

Aktualisieren Einstellungen Information

Dateiname (*.FIN)	Anfangszustand	Endzustand	Datum	Kommentar / Bewertung	Werkstoff	Steuerdaten	weitere Angaben
cone_shaft-1e			2001-09-05	INFO1: Cone Shaft INFO2: Hammer Forging (17 blows) Art der Rechnung - thermisch - mechanisch	2.4668, NiCr 19 NbMo, 900-1150 [°C], 0.1-10 [1/sec], (c) CPM- MDZ	Hammerschmieden mit Gesenkaufederung Schlaege: 17 , Anfangsenergie:	Ausgangsgeometrie: Durchmesser: 203,2 mm; Höhe: 330,0 mm; Ausgangstemperatur (vor keine
kin1d51e			2001-09-06	INFO1: INFO2: Art der Rechnung - mechanisch Umgebungstemperatur: 0 °C	1.7033, 34 Cr 4, 20-300 [°C], 0.1-10 [1/sec], (c) CPM-MDZ	Kurbelpresse max. Hub: 0.50800D+03 mm Anzahl Huebe:	
sleeve_stainless_2e			2001-09-06	INFO1: INFO2: Art der Rechnung - mechanisch Umgebungstemperatur: 50 °C	1.4567, X 3 CrNiCu 18 9, 20-300 [°C], 0.1-10 [1/sec] (c) CPM- MDZ	Kurbelpresse max. Hub: 0.11000D+03 mm Anzahl Huebe:	Ausgangsgeometrie (Vorstufe): Durchmesser: 7,8 mm, Höhe: 7,75 mm
axle-a-11e			2001-09-06	INFO1: Axle INFO2: 4 station operation Art der Rechnung - mechanisch Umgebungstemperatur: 25 °C	1.1172, Cq 35, 25-300 [°C], 0.1-10 [1/sec] (c) CPM-MDZ	Kurbelpresse max. Hub: 0.37100D+03 mm Anzahl Huebe:	Abschnitt: Durchmesser: 38,0 mm Länge: 224,5 mm
axle-a-21e			2001-09-06	INFO1: Axle INFO2: 4 station operation Art der Rechnung - mechanisch Umgebungstemperatur: 25 °C	1.1172, Cq 35, 25-300 [°C], 0.1-10 [1/sec] (c) CPM-MDZ	Kurbelpresse max. Hub: 0.37100D+03 mm Anzahl Huebe:	siehe axle-a-11e
axle-a-31e			2001-09-06	INFO1: Axle INFO2: 4 station operation Art der Rechnung - mechanisch Umgebungstemperatur: 25 °C	1.1172, Cq 35, 25-300 [°C], 0.1-10 [1/sec] (c) CPM-MDZ	Kurbelpresse max. Hub: 0.37100D+03 mm Anzahl Huebe:	siehe axle-a-11e
axle-a-41e			2001-09-06	INFO1: Axle INFO2: 4 station operation Art der Rechnung - mechanisch Umgebungstemperatur: 25 °C	1.1172, Cq 35, 25-300 [°C], 0.1-10 [1/sec] (c) CPM-MDZ	Kurbelpresse max. Hub: 0.37100D+03 mm Anzahl Huebe:	siehe axle-a-11e
hotforge-1b11e			2001-07-19	INFO1: Hot forging INFO2: T=1100°C, const. Art der Rechnung - mechanisch Umgebungstemperatur: 50 °C	unbekanntes Testmaterial bei 1100 [°C]	Kurbelpresse max. Hub: 0.20000D+03 mm Anzahl Huebe:	keine weiteren Angaben.

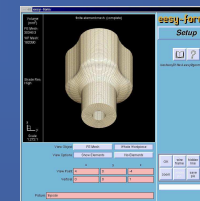
Simulationen

Bereit

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21st of October 2004

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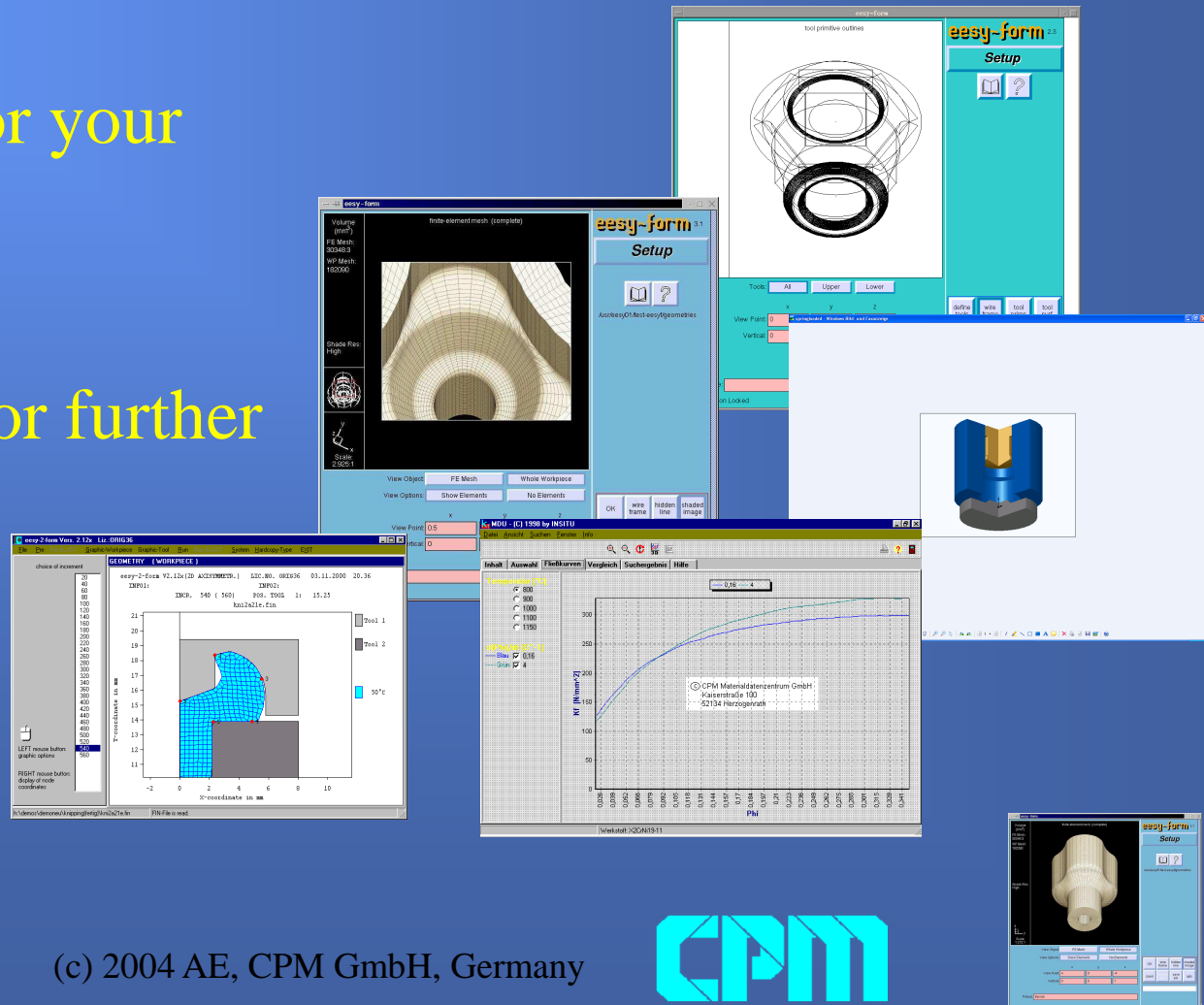


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Some ideas about simulation....

- Thank you for your interest

Pls contact us for further information



21st of October 2004

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