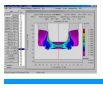
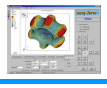
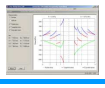




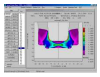
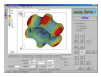


# *Simulation of Cold Forging*

## *- examples of applications from around the world -*

*Dr. Gerhard H. Arfmann*
*CPM GmbH, Herzogenrath*

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Prozeß- und Materialtechnik

## CV Dr. Arfmann

| | | | |
|---|---|---|---|
| Till | 1974 | High School at Kreisgymnasium Halle, Halle Westfalen, Germany | |
| 1976 - | 1981 | Electrical Engineering at Aachen University of Technology , Aachen, Germany | |
| 1977 - | 1983 | Mechanical Engineering at Aachen Universtiy of Technology, Aachen, Germany | |
| 1984 - | 1990 | Research at Institute of Metal Forming at University of Technology Aachen, Germany | |
| Since | 1990 | CEO of CPM GmbH, Herzogenrath, Germany | |
| Academic Degrees: | 1981 | Dipl.-Ing. | (Electr. Eng.) |
| | 1983 | Dipl.-Ing. | (Mech. Eng.) |
| | 1999 | Dr.-Ing. | (Met. Forming) |
| Memberships | VDEh | Association of Steel making Engineers | |
| | VDE | Association of Electric Engineers | |
| | ICFG | International Cold Forging Group | |
| | DSV | German Fastener Association (via CPM GmbH) | |
| | GCFG | German Cold Forging Group (via CPM GmbH) | |

## History and Business of CPM GmbH

| | |
|---|---|
| *1997* | *Founded in 1987 by Professors and Engineers of Aachen University of Technology as part time business in Aachen* |
| *1990* | *Moving the company to Herzogenrath and run it as full time business* |
| *1992* | *Management buyout by Dr. Arfmann and Dr. Twickler* |
| *1990-2000* | *Intensive Extending of the business in Europe , Brazil and India* |
| *2000 ff.* | *Extension of business to Asia* |
| *2004* | *First Activities in China* |
| *Simulation Sales Agencies:* | *Japan, Korea, Taiwan, China, SE Asia, India, Turkey, Russia, UK, France, Spain, Italy, Brazil, Argentina, (Mexico)* |
| *Focus of business:* | *Research, Consulting, Simulation* |
| *Customers/Partners:* | *Companies from Hot and Cold Forging Machine, Tool , Material and other Suppliers to Forging Industry Universities* |



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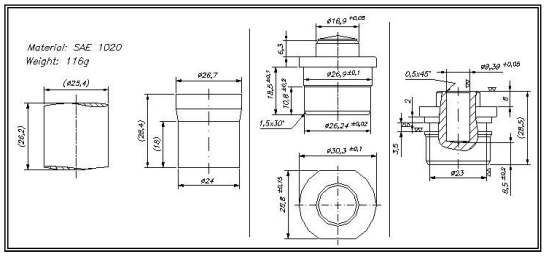
***20 Years of simulation in Cold forming-***
***What are the standard applications in industry?***

- ***Process design***
- ***Geometrical failure***
- ***Material flow***
- ***Tool design***
- ***Tool failure***

# *Production of a shock absorber*




**Conventional process**



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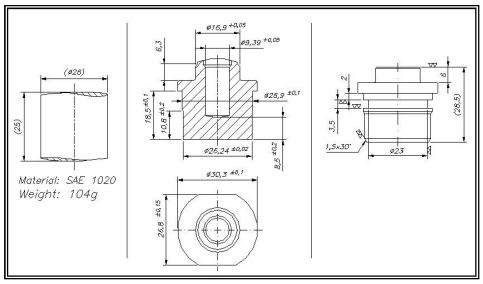
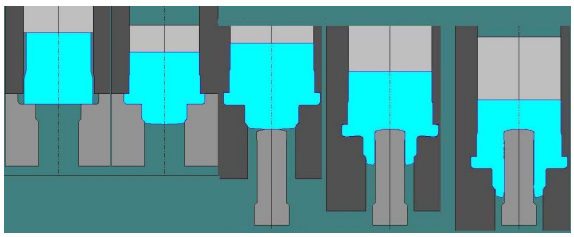
# *Production of a shock absorber*




**Single stage process**

# *Production of a shock absorber*



**Simulation of the single stage process**



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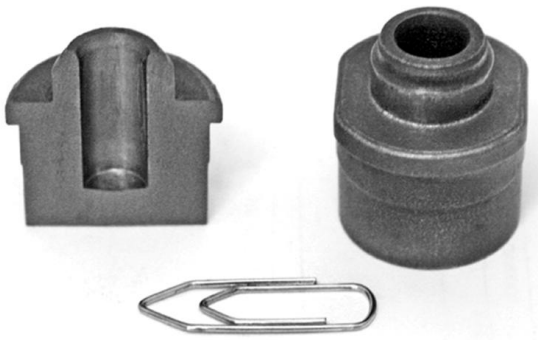
# *Production of a shock absorber*



**Simulation of the single stage process**

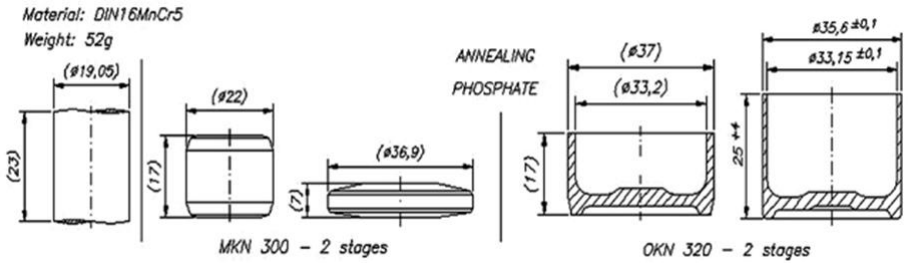
# *Simulation of a „cross“*


**Test of new processes**





# *Simulation of a „valve tappet“*




**Traditional process**

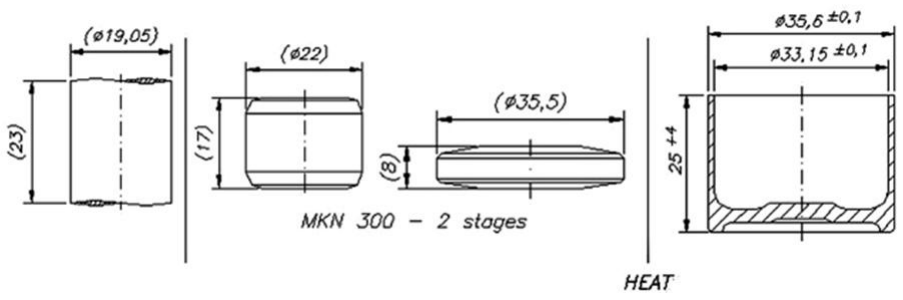
# *Simulation of a „valve tappet“*

**Traditional process**





# *Simulation of a „valve tappet“*




**New process**

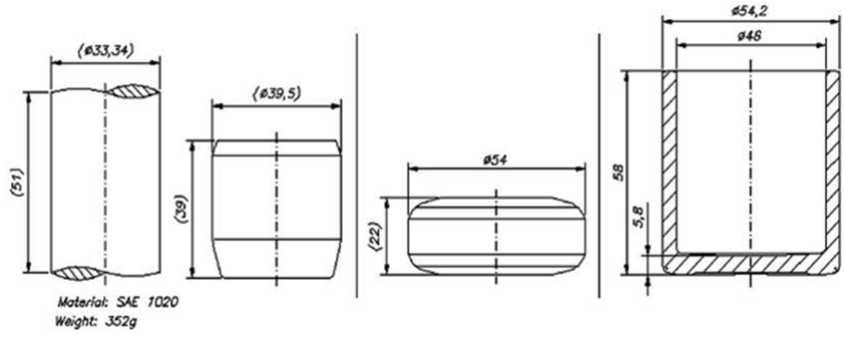
# *Simulation of a „valve tappet“*

**New process**



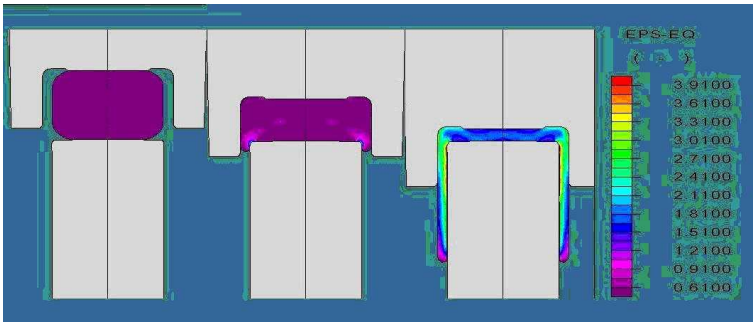


# *Simulation of a „Brake Pisten“*




**traditionell process**

# *Simulation of a „Brake Pisten“*

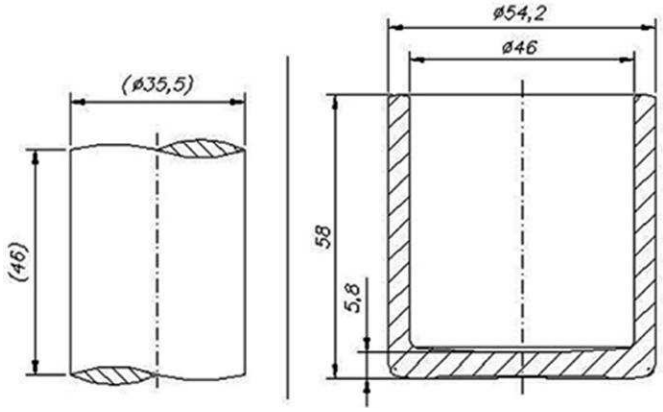



**traditionell process**



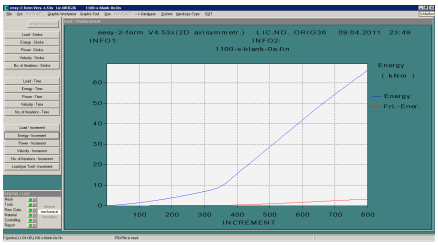


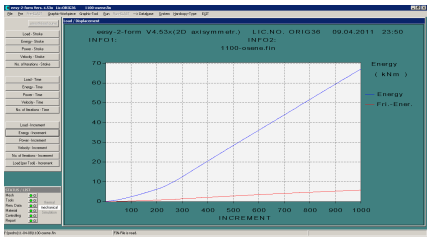
# *Simulation of a „Brake Piston“*




**new process – osen-**

## *Simulation of a „Brake Piston“*




**Comparison – work needed**



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## *Simulation of a „Brake Piston“*

Since both processes need the same work (besides small differences in friction etc) the Osen process requires less load.

The Osen process requires about 180 to while the backward extrusion requires 450 to.

**Comparison – work needed**

# *Production of an „inner race“*

**Inner race – process developement**



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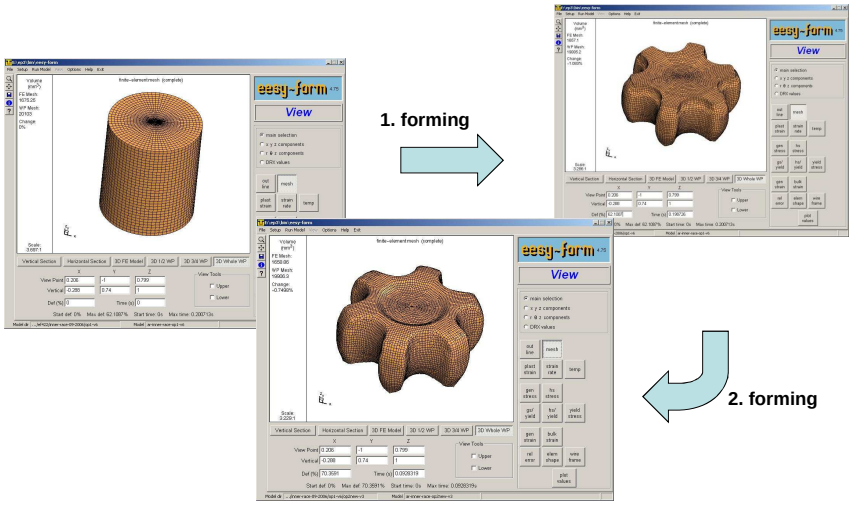
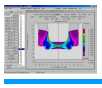
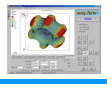
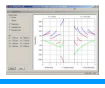
# *Production of an „inner race“*



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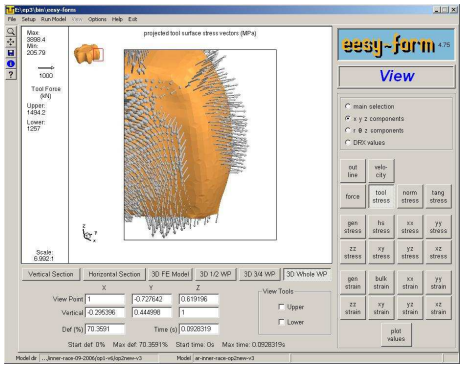
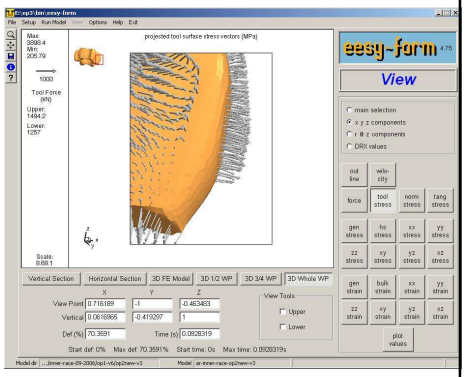
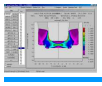
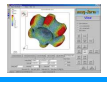
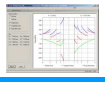
# *Production of an „inner race“*




**No sufficient filling (normal pressure on surface)**



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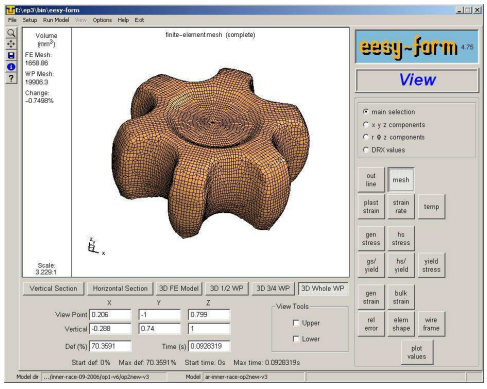
# *Production of an „inner race“*




**No sufficient filling (normal pressure on surface)**

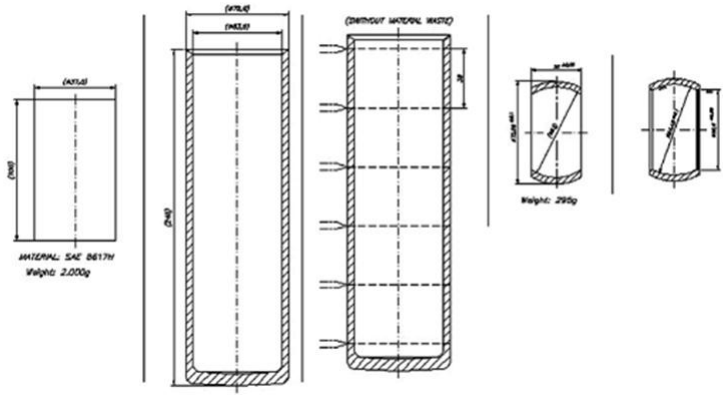
# Production of Cages

**Product**



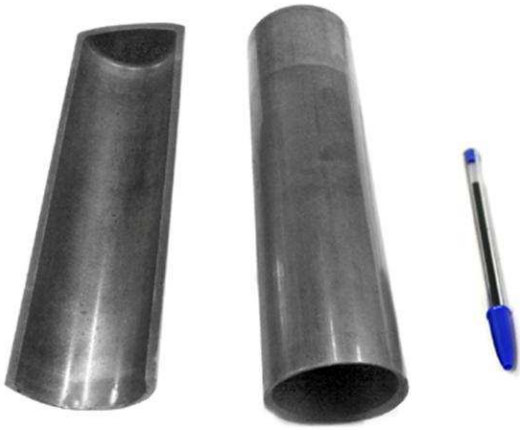


# Production of Cages



**New process using „osen“ technology**

## *Production of Cages*



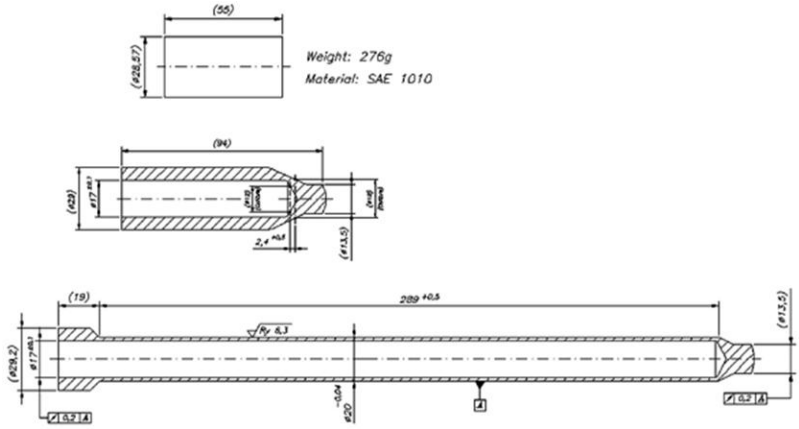
**New process using „osen“ technology**





## *Production of a shock absorber body*

# Production of a shock absorber body

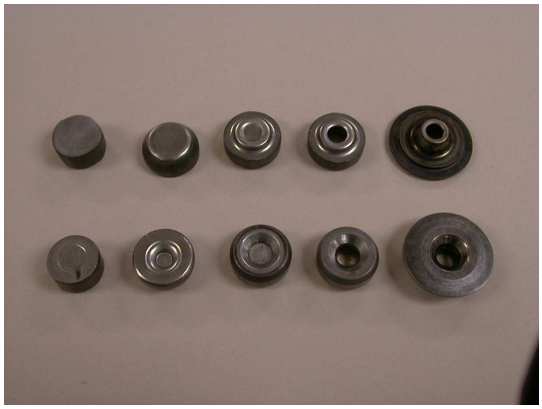



**New process using „osen“ technology**





# Production of valve spring retainers



**Progression to produce a retainer**

# *Production of valve spring retainers*

**Premature tool failure**



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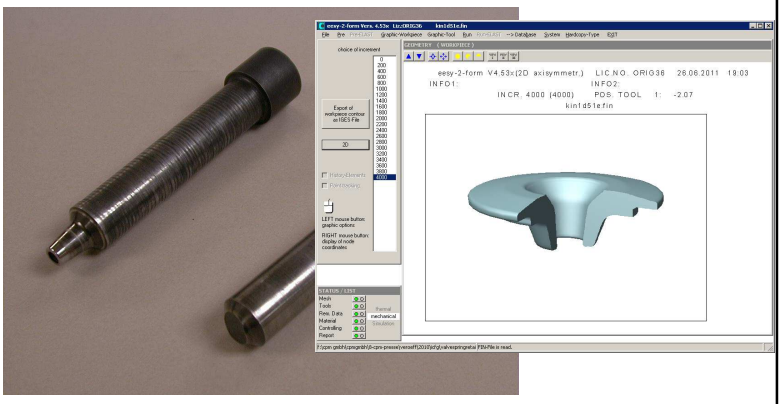
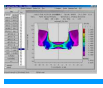
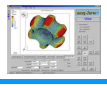
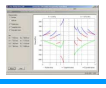
# *Production of valve spring retainers*



**Premature tool failure**

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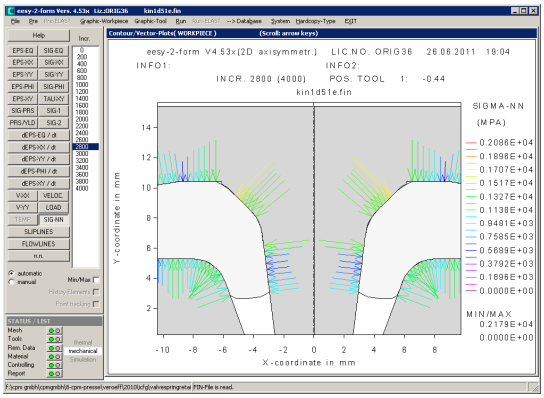
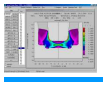
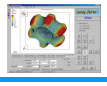
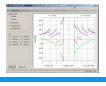
# *Production of valve spring retainers*




**Premature tool failure**



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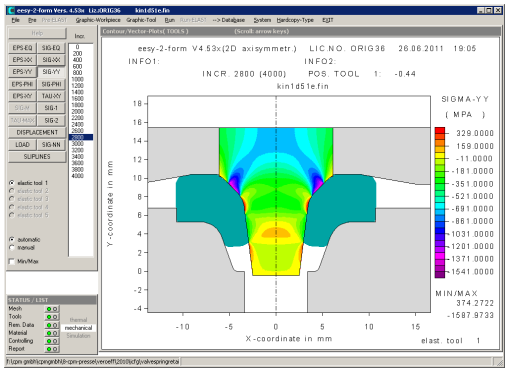
# *Production of valve spring retainers*




**Premature tool failure**

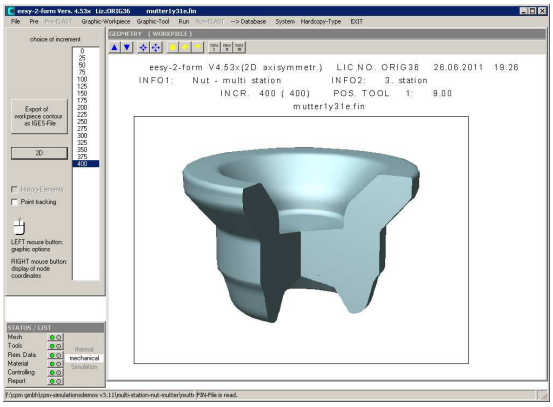
# *Production of valve spring retainers*

**Premature tool failure**



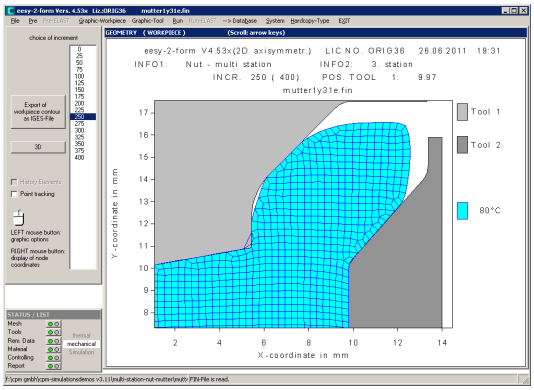


# *Production of a nut*




**Premature tool failure**

# Production of a nut




**Premature tool failure**



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# Production of a nut

**Premature tool failure**

## *Production of a „bolt“*


**Premature tool failure in station 4**



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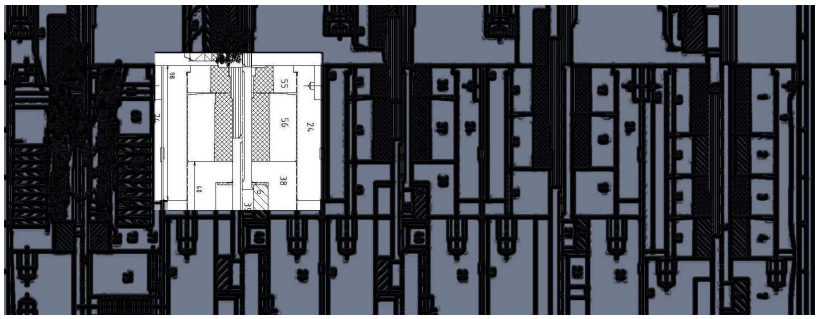
## *Production of a „bolt“*



**Premature tool failure in station 4**

## *Production of a „bolt“*

**Premature tool failure in station 4: old layout**



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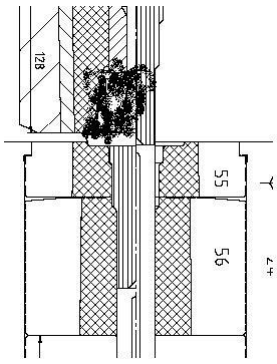
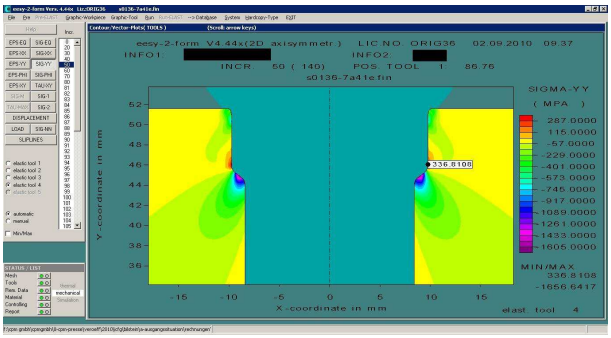
## *Production of a „bolt“*




**Premature tool failure in station 4: old layout**

# *Production of a „bolt“*

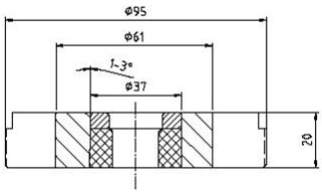



**Premature tool failure in station 4: old layout**



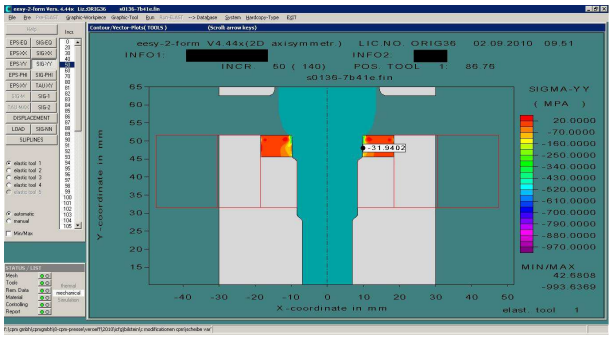


# *Production of a „bolt“*




**Premature tool failure in station 4: new design**

# *Production of a „bolt“*



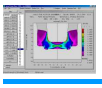
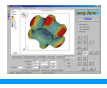
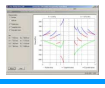

**Premature tool failure in station 4: new design**





# *Production of a bolt - tooling*

**Design of a die**

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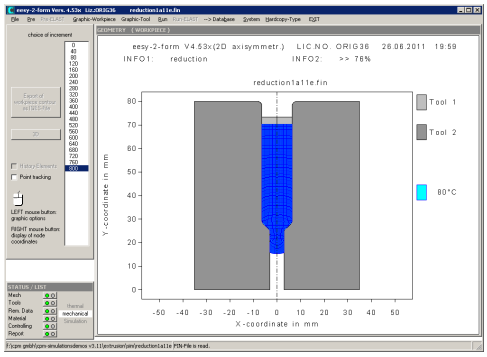
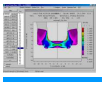
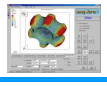
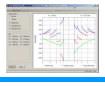
# *Production of a bolt - tooling*




**Design of a die**



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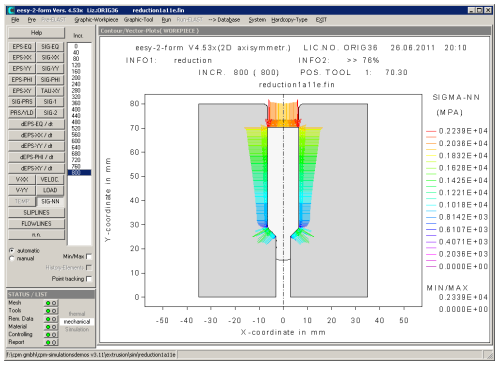
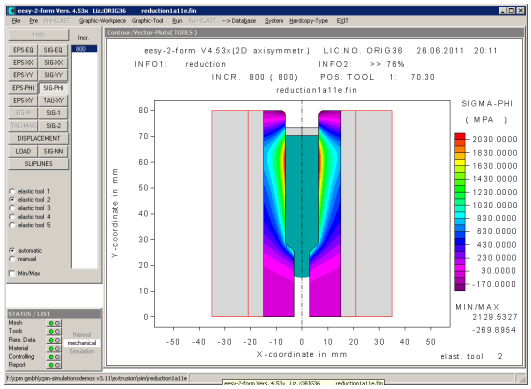
# *Production of a bolt - tooling*




**Pressure on die surface**

## Production of a bolt - tooling




**Tangential stress without pre-stressing**



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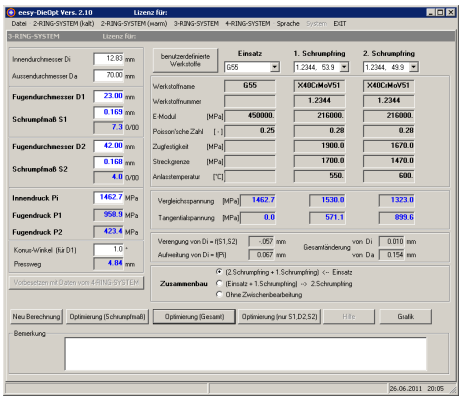
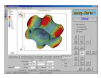
## *Production of a bolt - tooling*




**Pre-stressing system design**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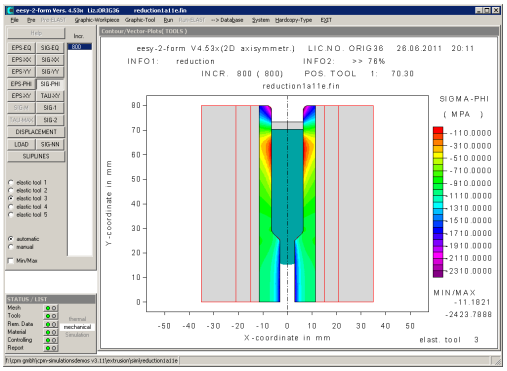
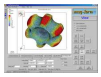
# *Production of a bolt - tooling*




**Tangential stress in the insert (with pre-stressing)**

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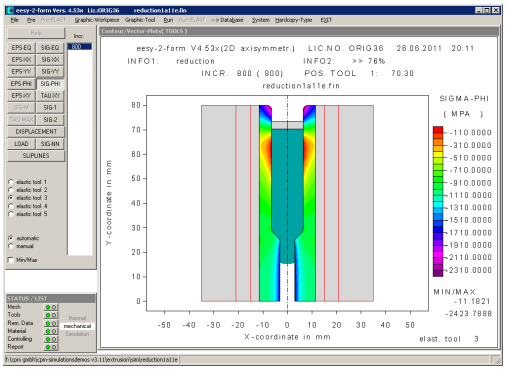
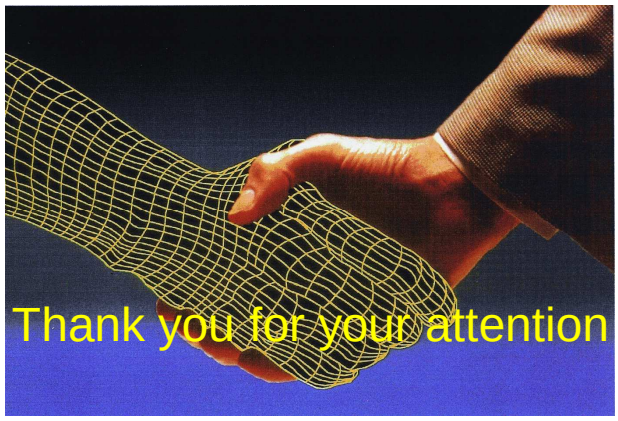
# *Production of a bolt - tooling*




**Tangential stress in the insert (with pre-stressing)**

## *Trust in “eesy” simulation*




**Customers are happy to solve their daily problems with simulation**