Fatigue strength of pressformed steel body parts

1. Introduction

2. Experimental results

3. Fatigue analysis without taking the pressforming in account

4. Fatigue analysis taking the pressforming in account

5. Conclusion

Fatigue strength of pressformed steel body parts

Introduction

During pressforming the material properties change

- material becomes thinner

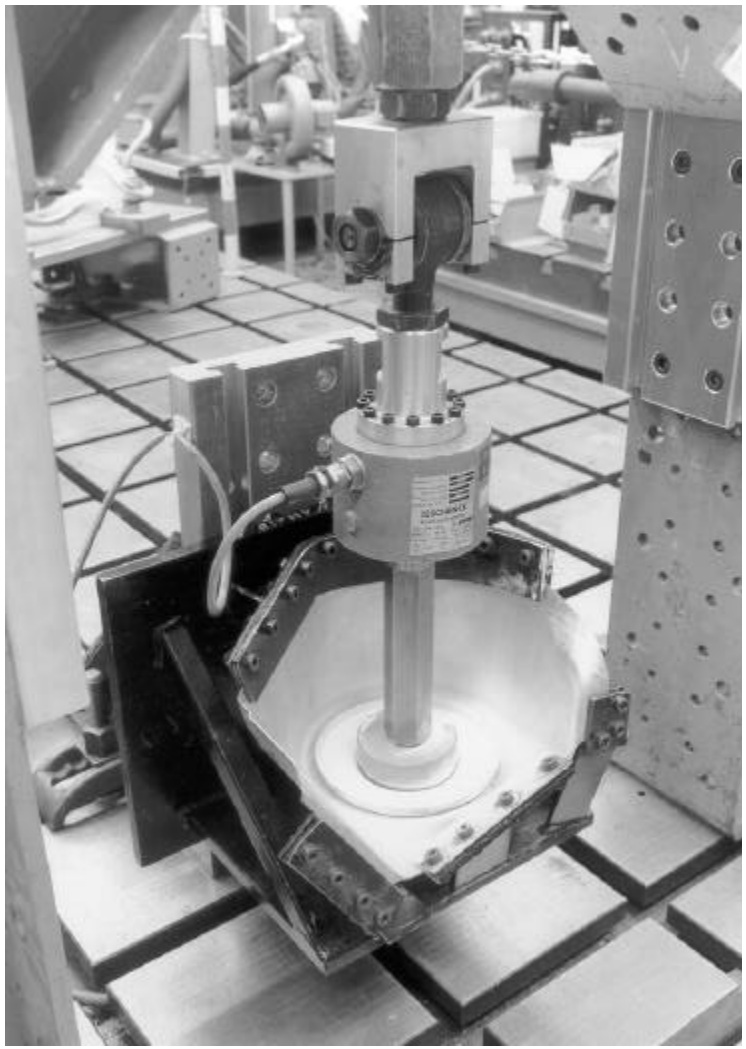
- material hardness increases, increased fatigue strength

- residual stresses

Usually the FE and fatigue analysis does‘nt take these effects in account

In this presentation the first two effects are considered in the FE and fatigue analysis

Fatigue strength of pressformed steel body parts
Test rig



Fatigue strength of pressformed steel body parts

Location of crack

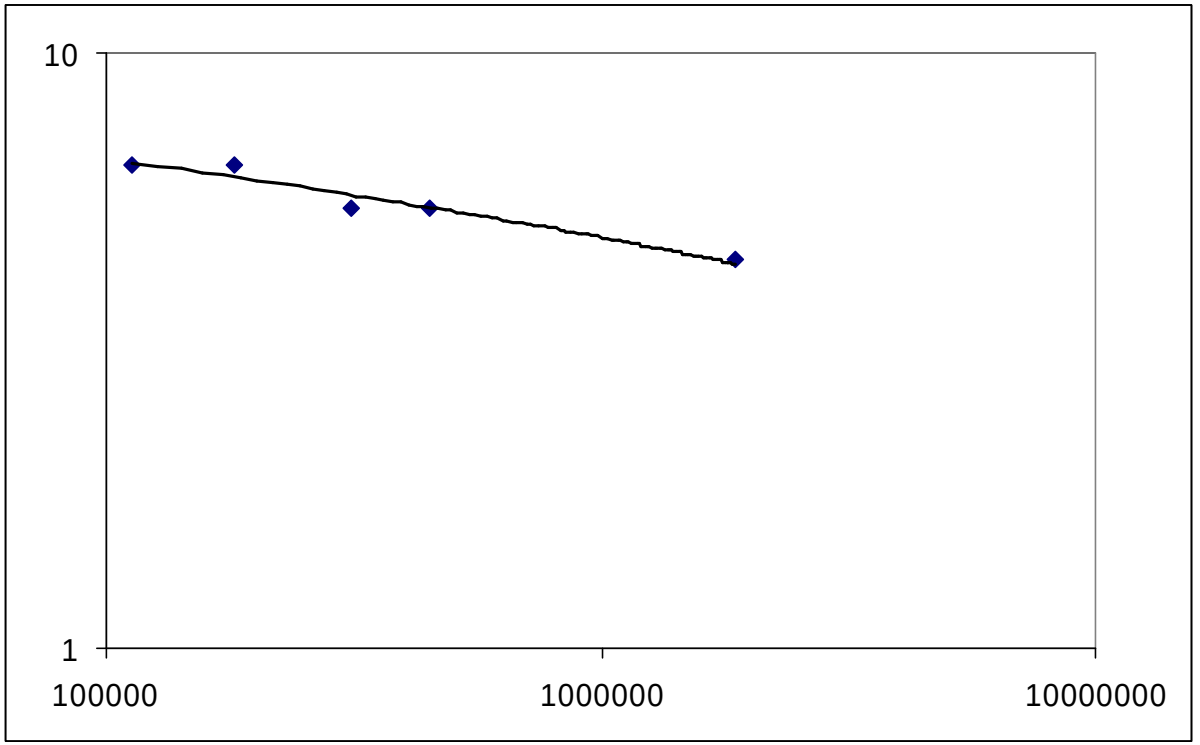
Fatigue strength of pressformed steel body parts

Number of cycles

part	Fmin (kN)	Fmax (kN)	cycles first crack	cycles break down
1	-0.5	-9.5	1864000	2619208
2	-0.5	-11.5	450000	488003
3	-0.5	-11.5	----	339076
4	-0.5	-13.5	182912	187944
5	-0.5	-13.5	112584	114399

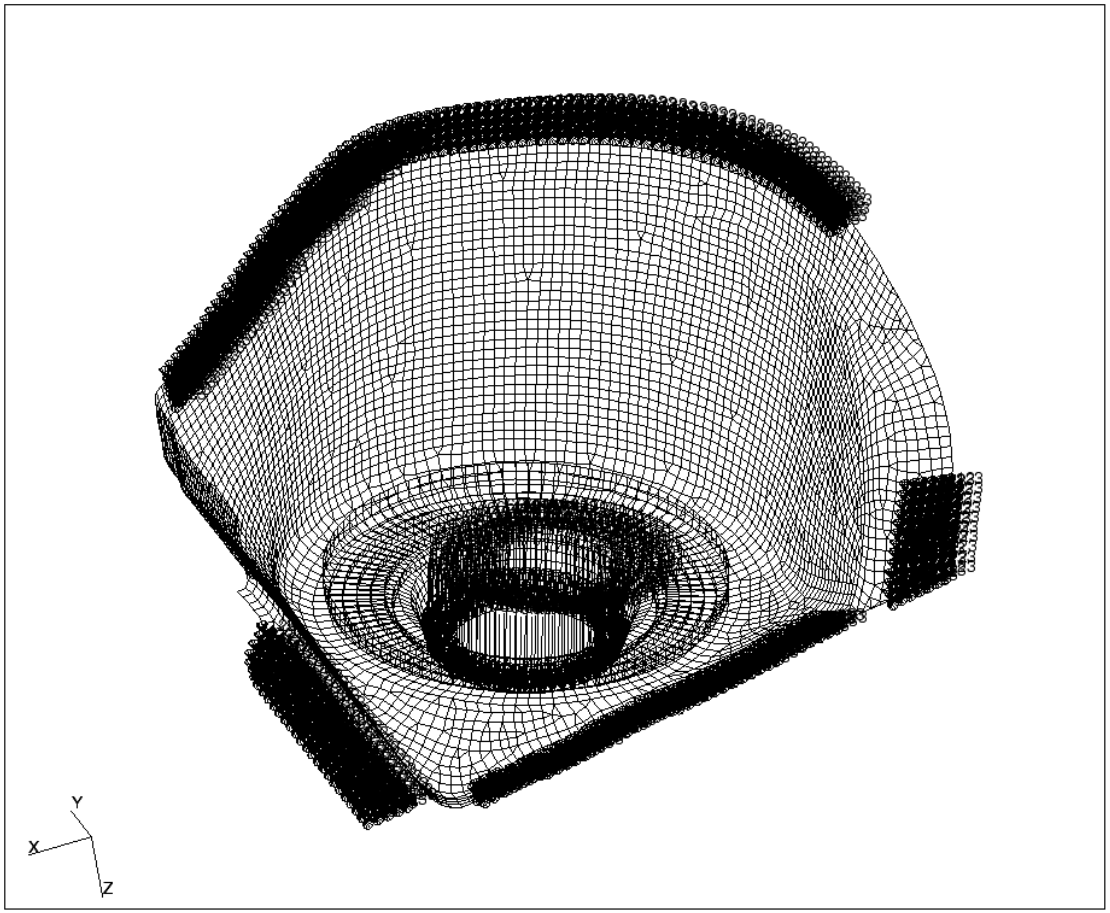
Fatigue strength of pressformed steel body parts

S-n curve



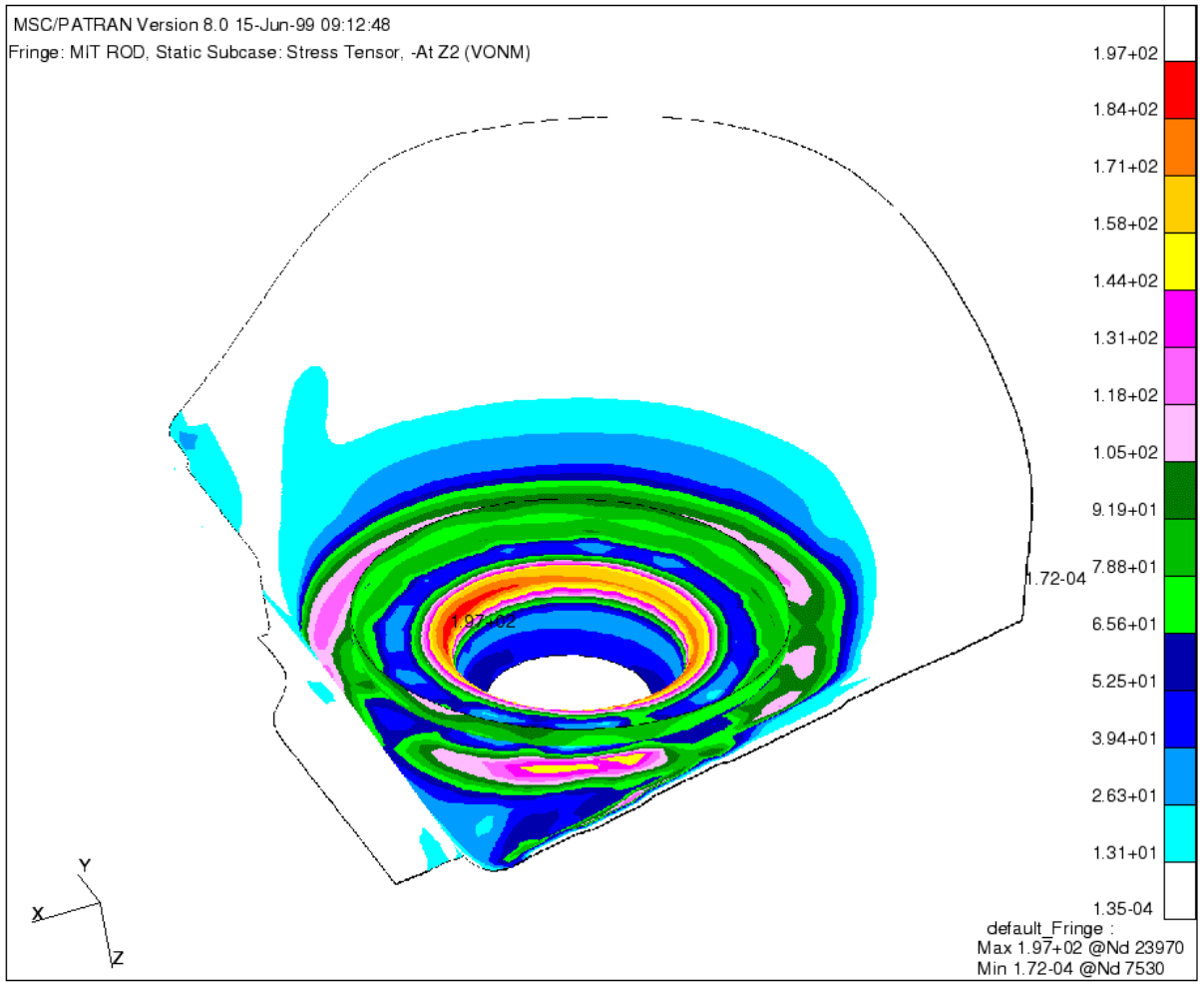
Fatigue strength of pressformed steel body parts

FE-mesh, boundary conditions, loads



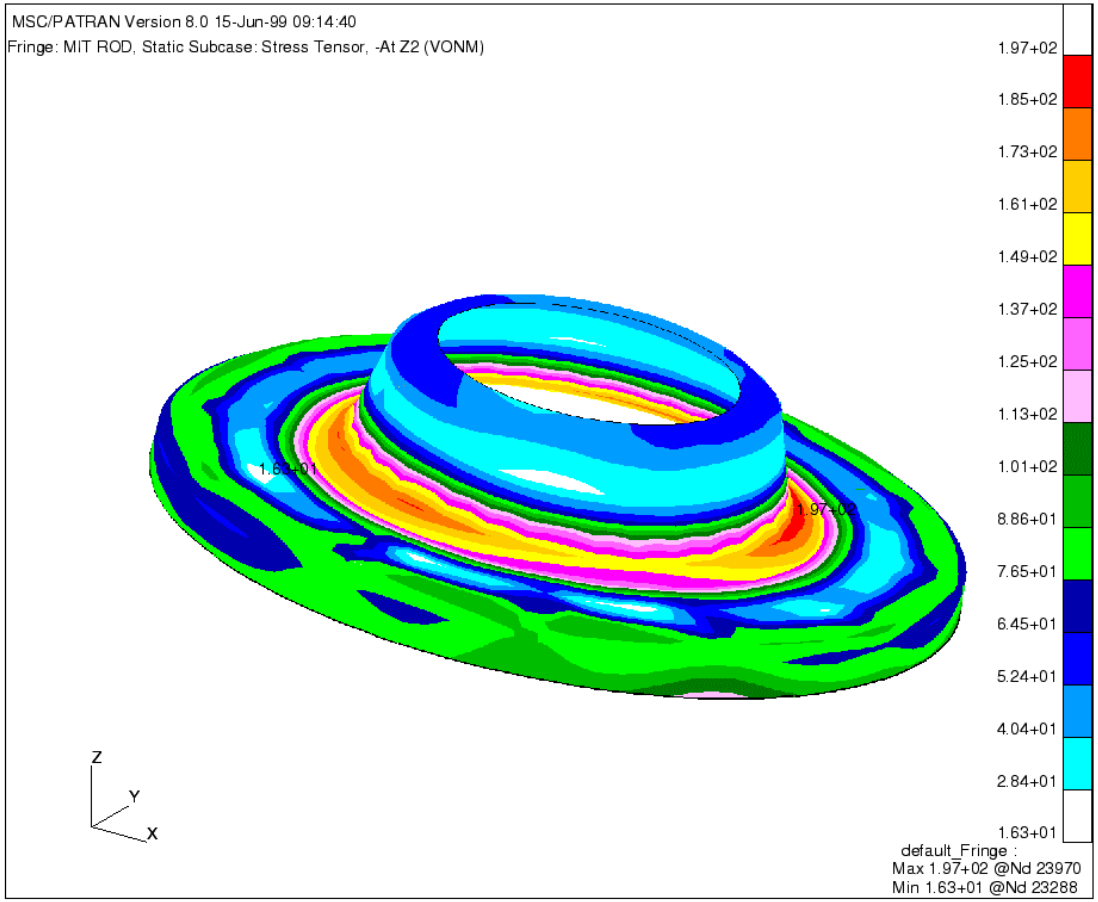
Fatigue strength of pressformed steel body parts

Von Mises stresses, pressforming not considered



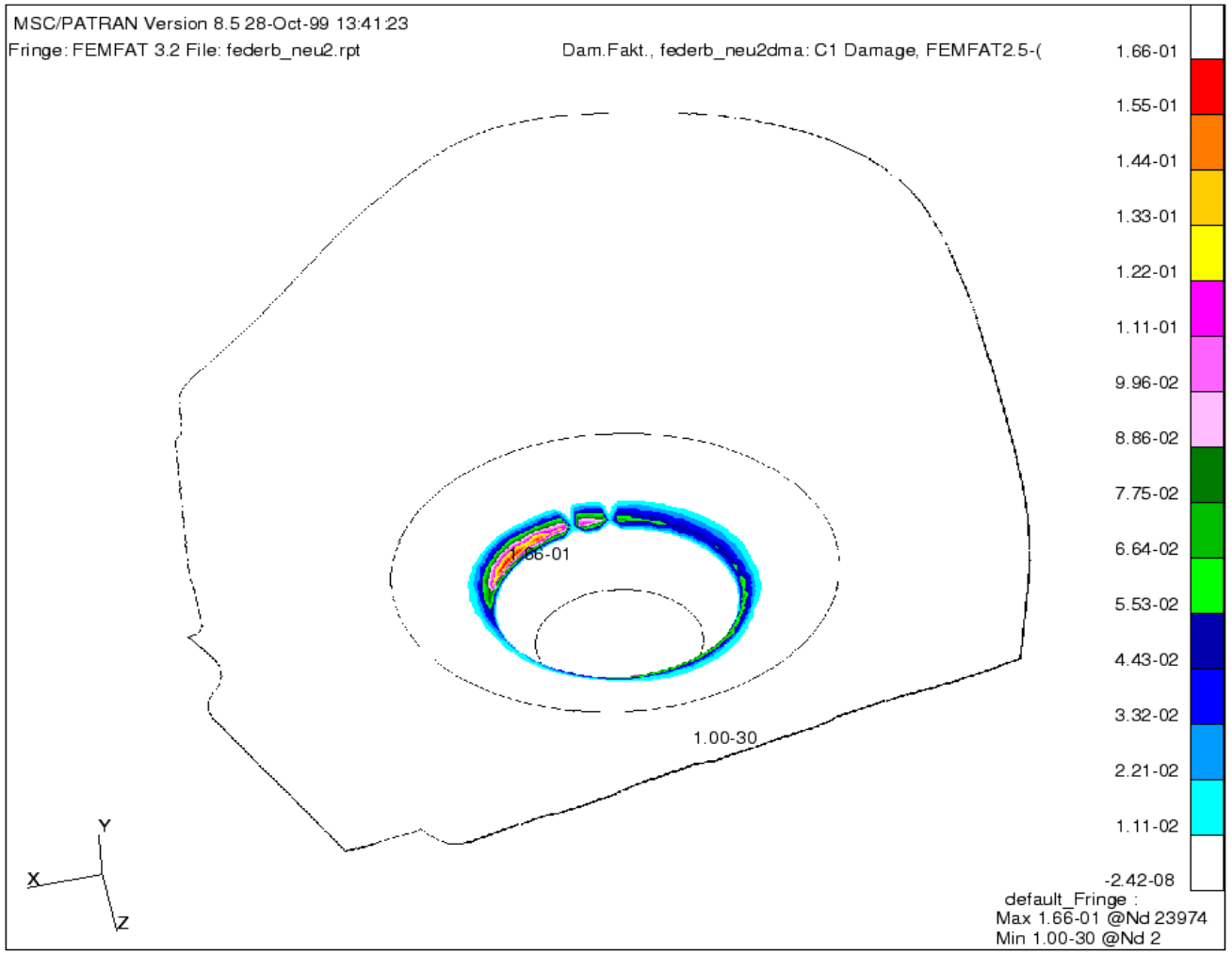
Fatigue strength of pressformed steel body parts

Von Mises stresses, pressforming not considerd



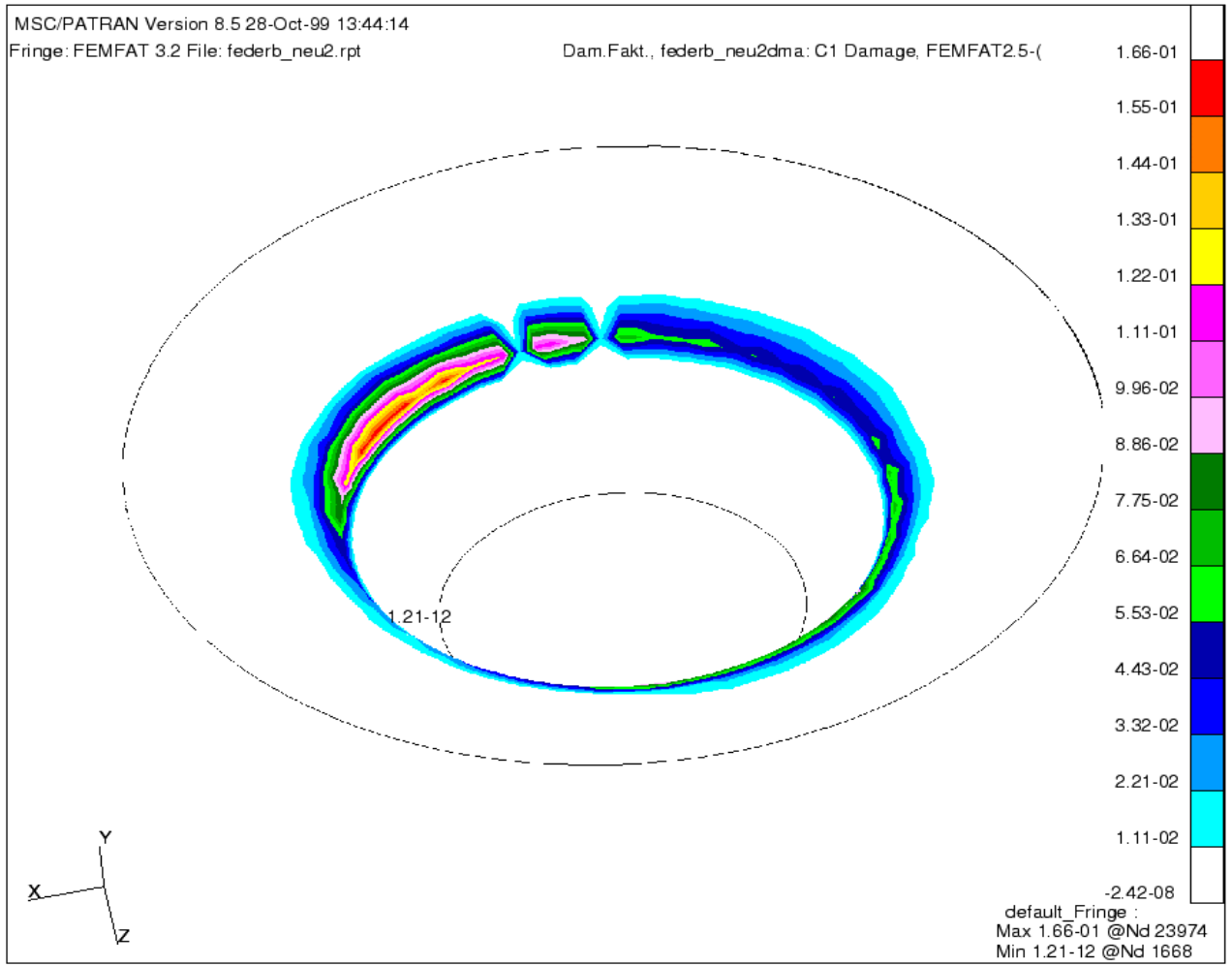
Fatigue strength of pressformed steel body parts

femfat damage plot, pressforming not considerd



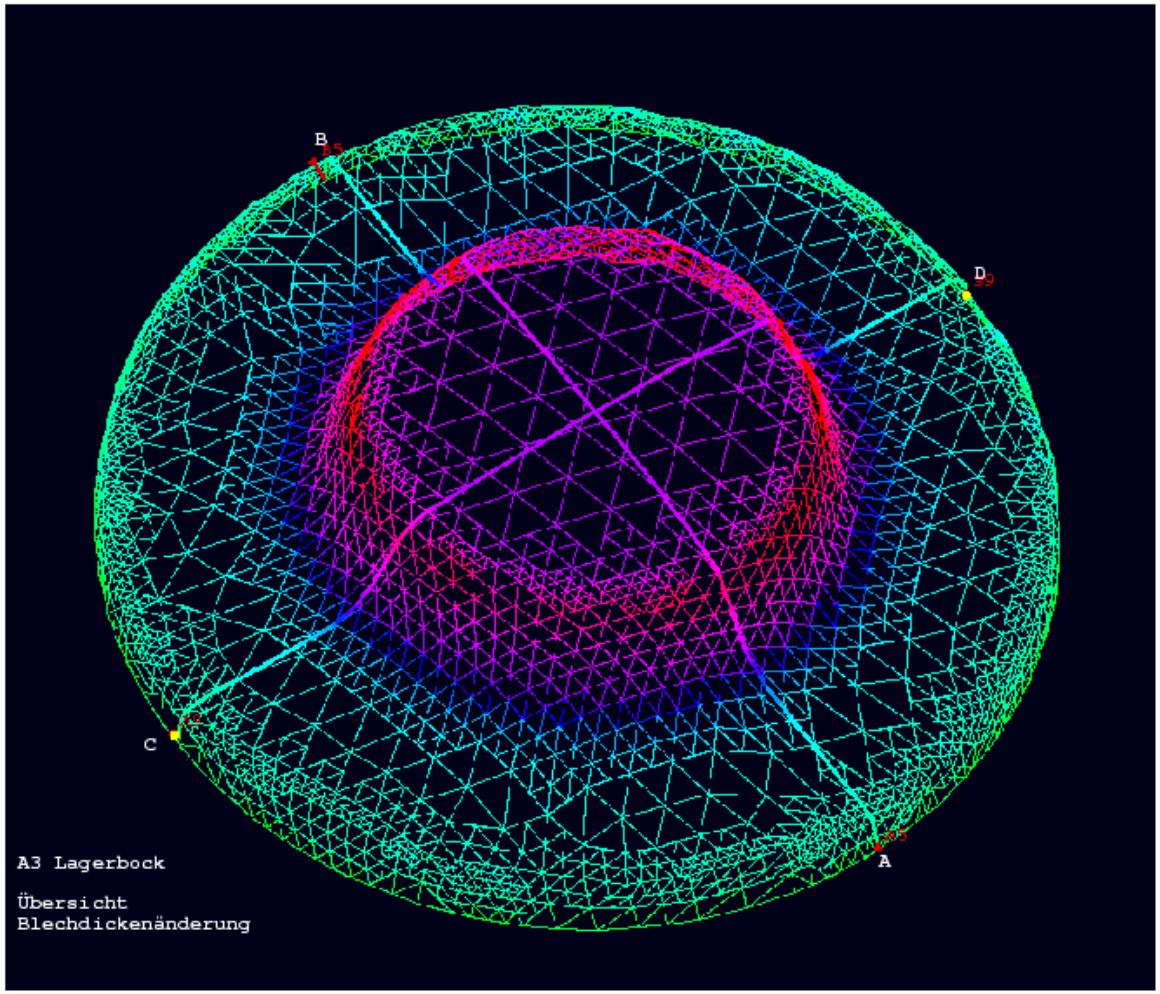
Fatigue strength of pressformed steel body parts

femfat damage plot, pressforming not considerd



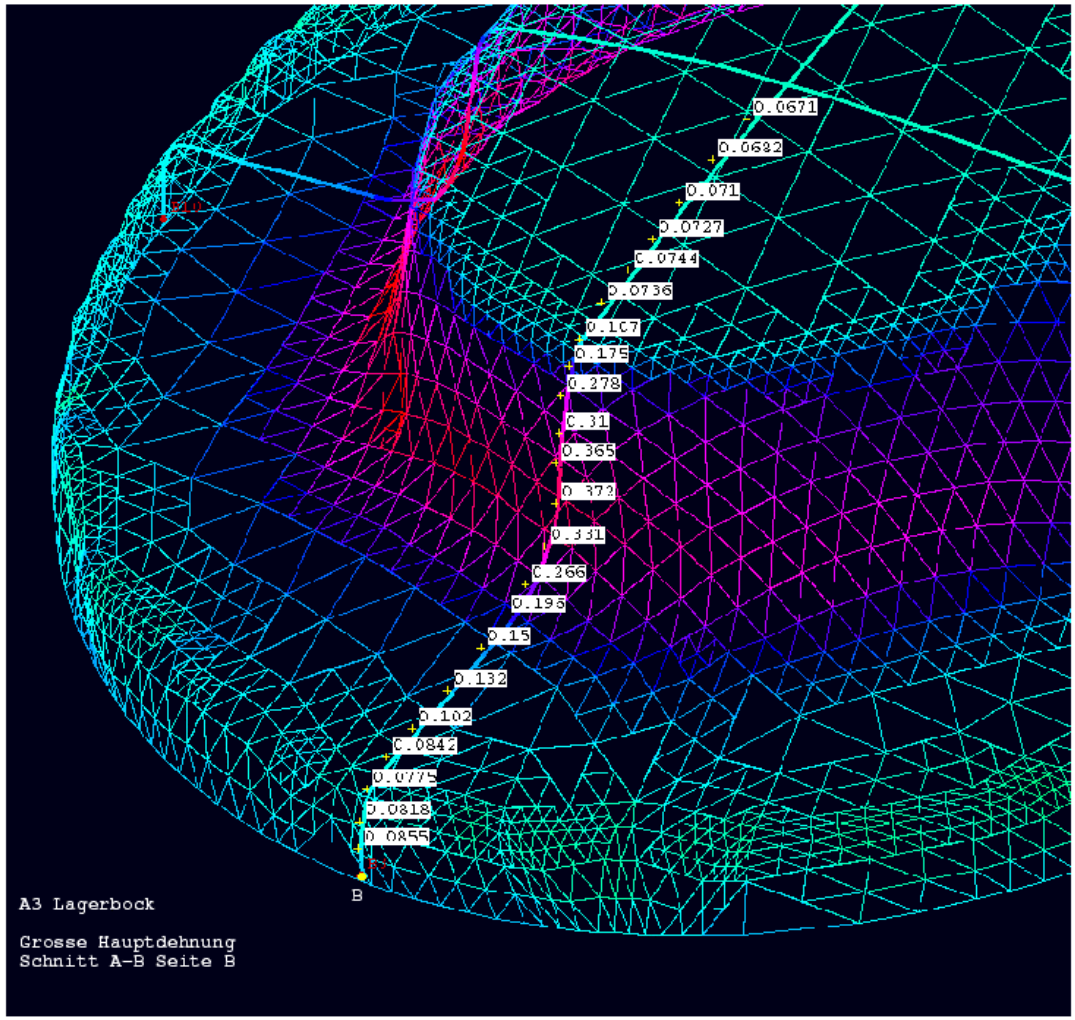
Fatigue strength of pressformed steel body parts

Simulation of pressforming, thickness of part



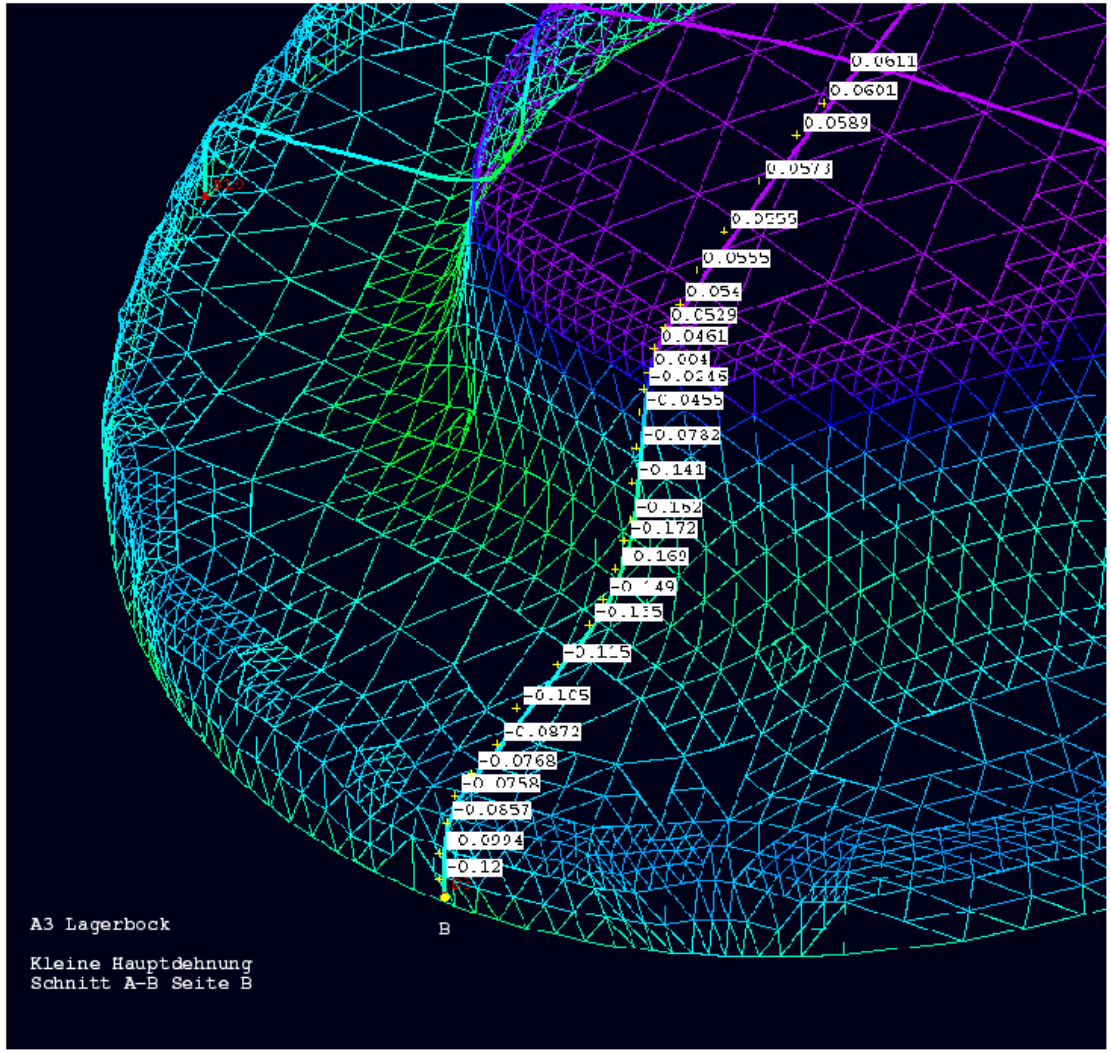
Fatigue strength of pressformed steel body parts

Simulation of pressforming, max plastic strain



Fatigue strength of pressformed steel body parts

Simulation of pressforming, min plastic strain



Fatigue strength of pressformed steel body parts

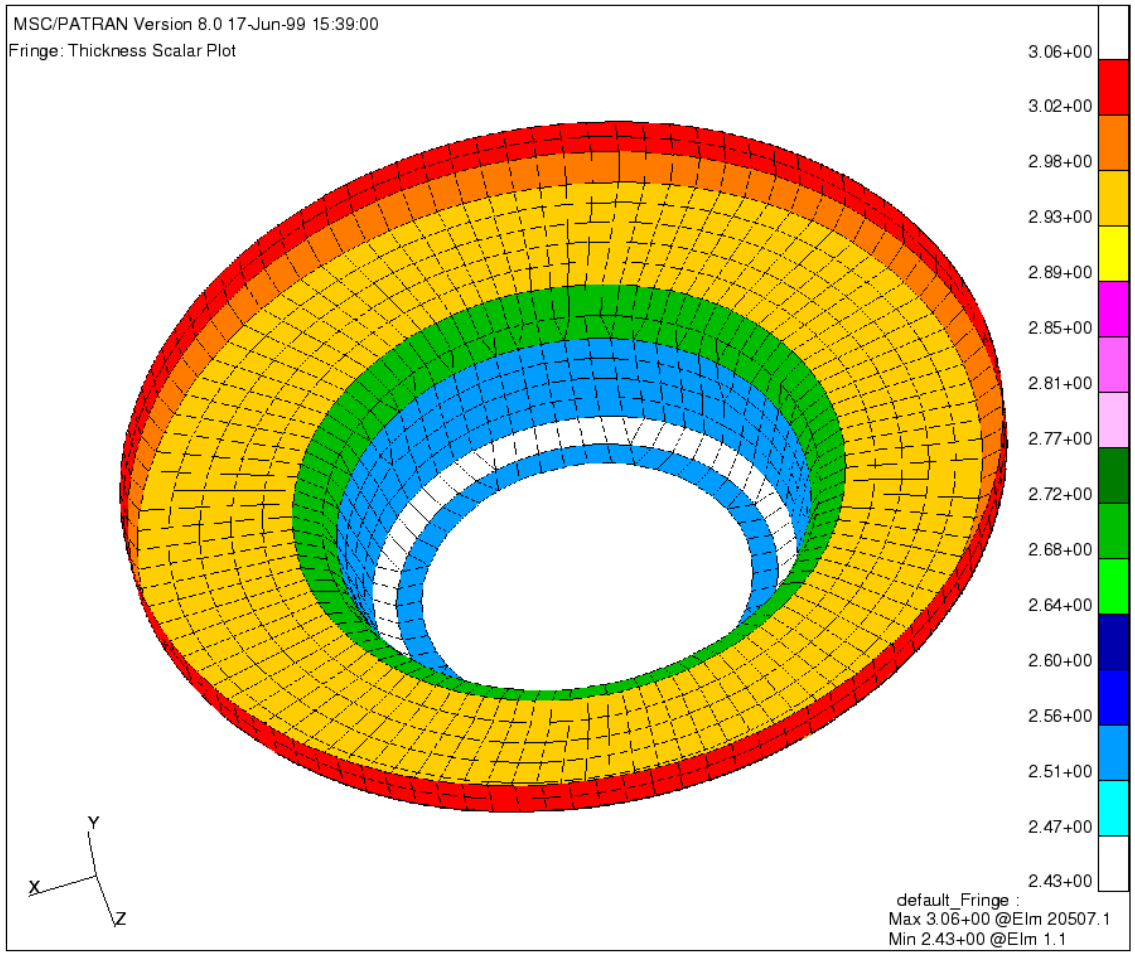
Simulation of pressforming

Values from simulation of pressforming at critical area

thickness:	2,7 mm	instead of 3,0 mm
max plastic strain	0,130	in middle layer
min plastic strain	-0,113	in middle layer

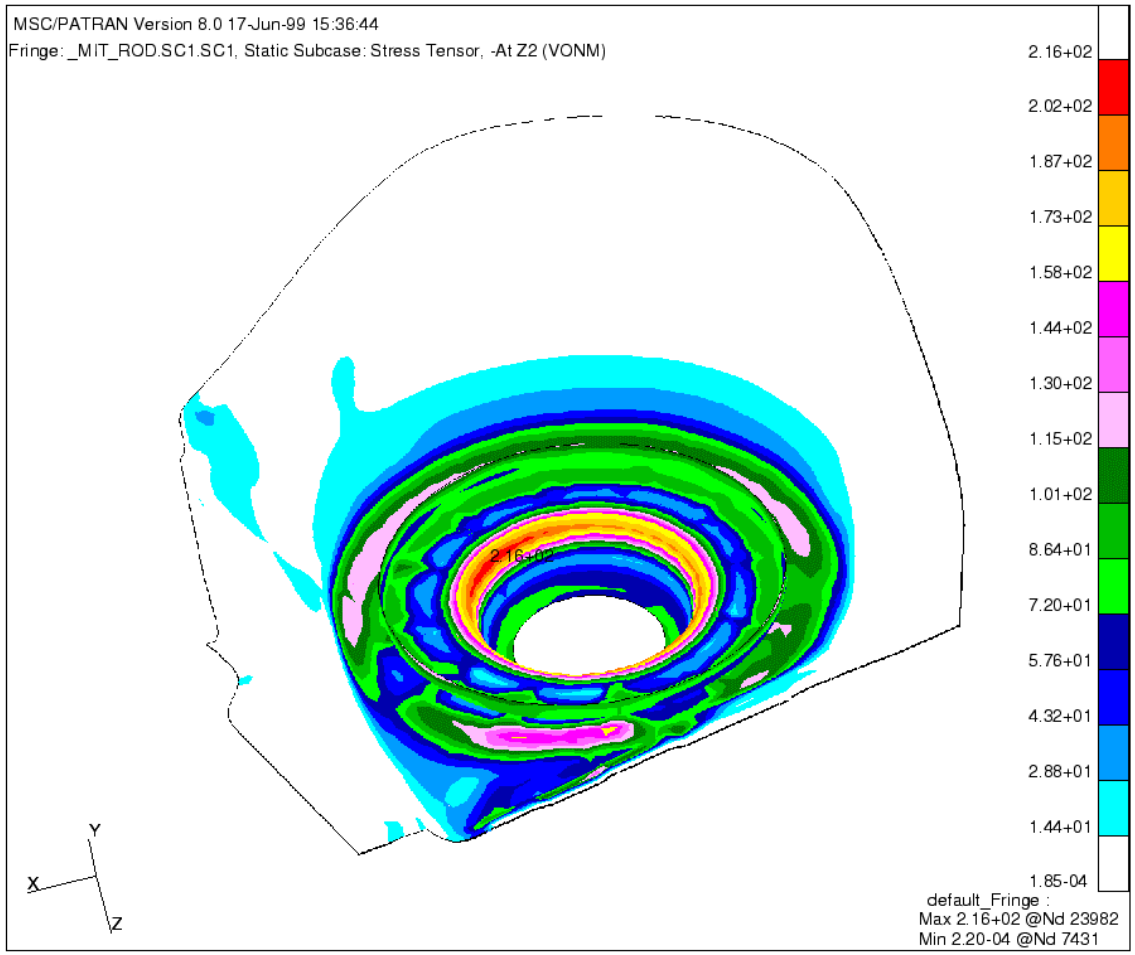
Fatigue strength of pressformed steel body parts

FE model, pressforming considered



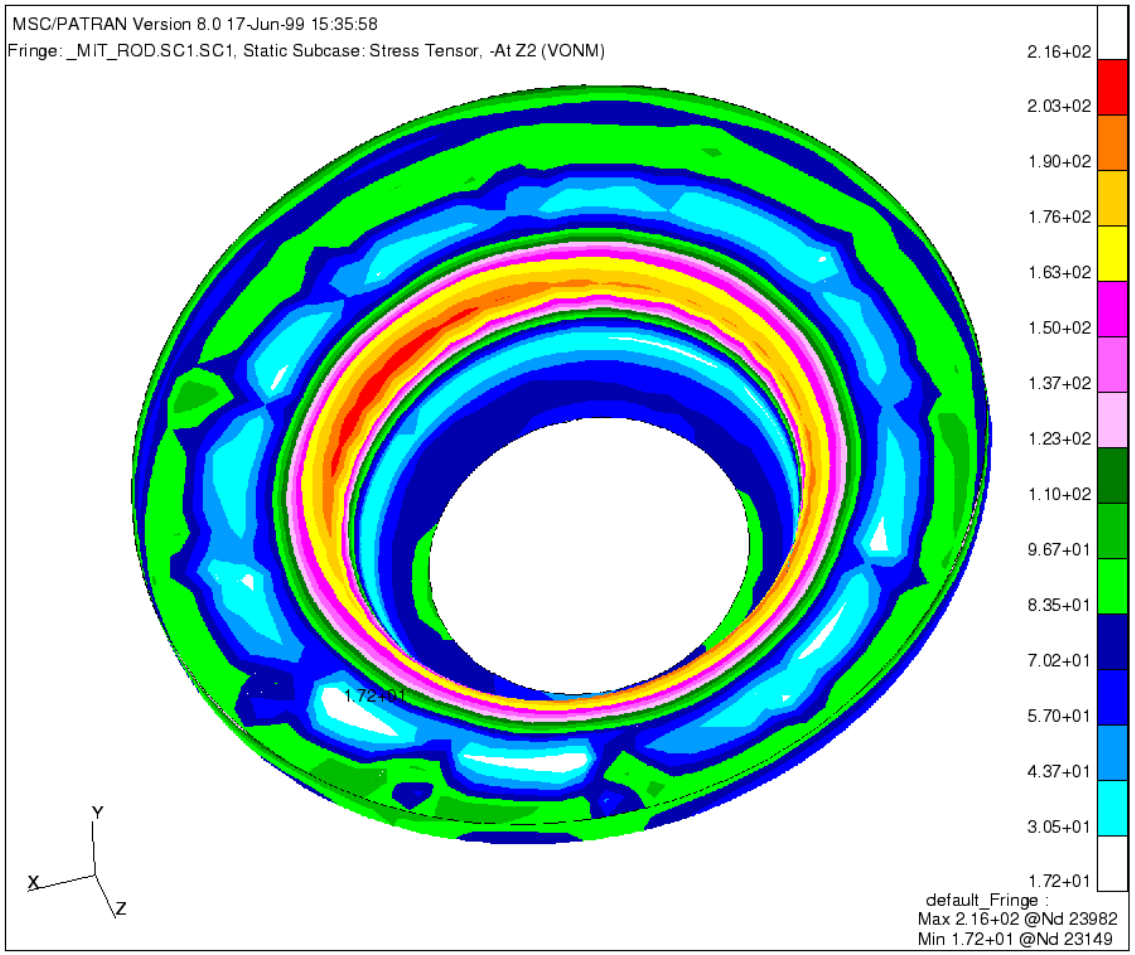
Fatigue strength of pressformed steel body parts

von Mises stresses, pressforming considered



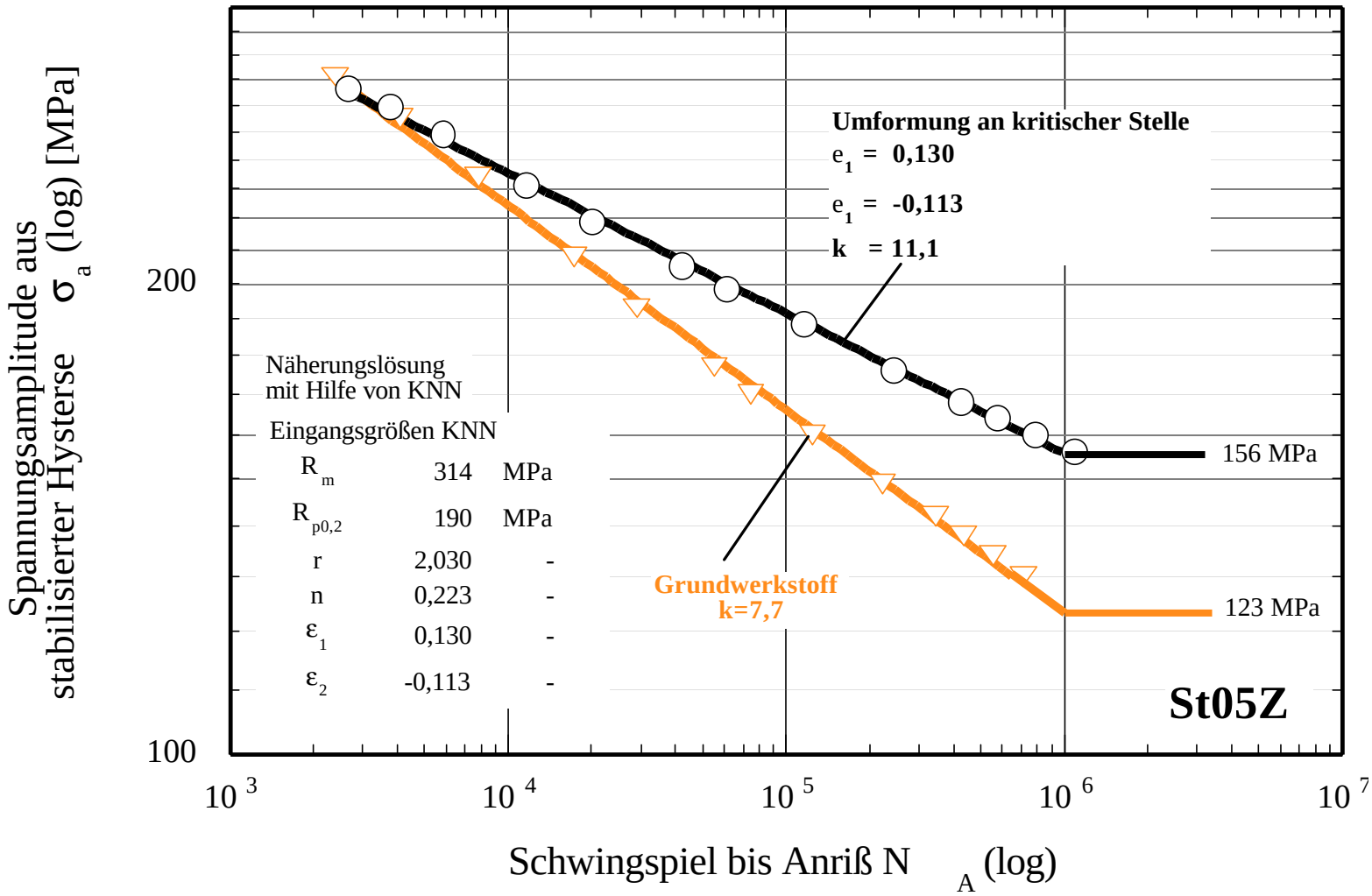
Fatigue strength of pressformed steel body parts

von Mises stresses, pressforming considered



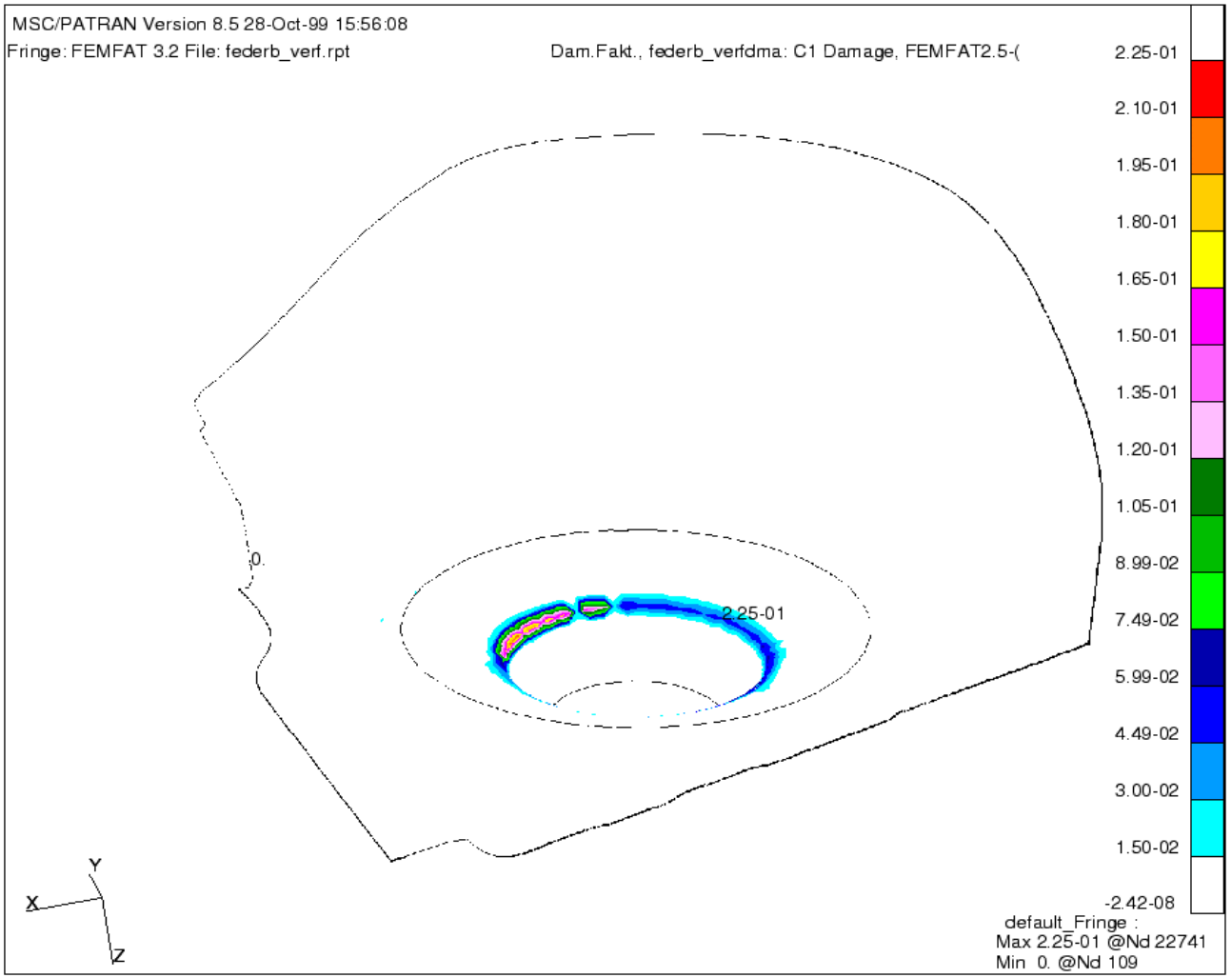
Fatigue strength of pressformed steel body parts

s-n curves not pressformed and pressformed



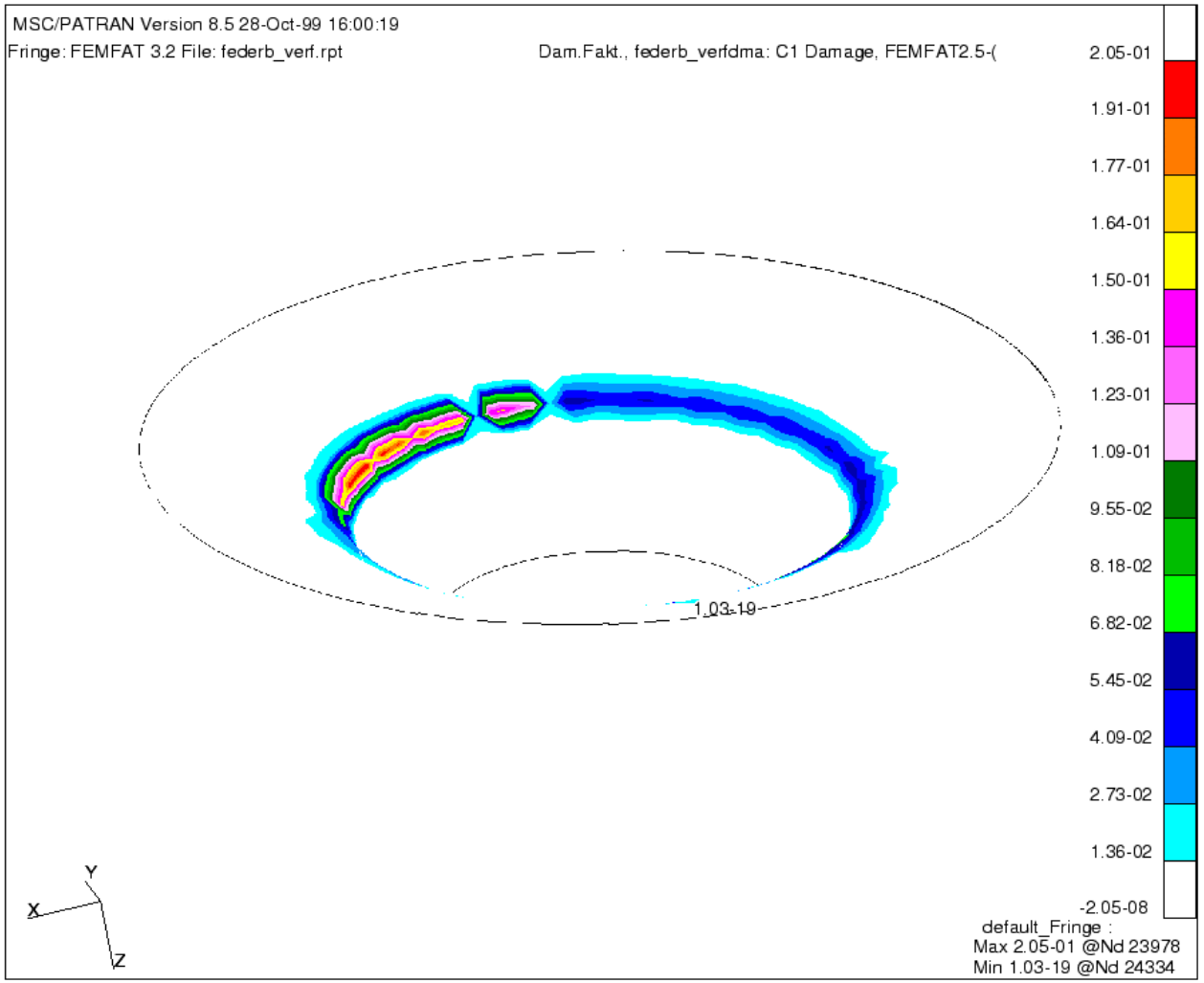
Fatigue strength of pressformed steel body parts

femfat damage plot, pressforming considered



Fatigue strength of pressformed steel body parts

femfat damage plot, pressforming considered



Fatigue strength of pressformed steel body parts

Comparison experiment fatigue analysis

force - 7 +/- 6,5 kN

	cycles first crack
experiment	143502
fatigue analyses no pressforming	602400
fatigue analysis with pressforming	487800

Fatigue strength of pressformed steel body parts

conclusion

The effects of pressforming can be taken in account in the FE and fatigue analysis.

The influence of pressforming does not seem to be high, because the effects are in opposite direction.

For realisation in practice we need:

- automatic transfer of the thickness of the part from the simulation of pressforming to the FE model.

- automatic transfer of the plastic strains from the simulation of pressforming to the fatigue analysis program and there automatic generation of the cyclic material data.