

Test Exam (total 5 point)

Advanced processing of complex materials

Question 1 (0.25 point):

What are Lueders (Lüders) bands and what is a Cottrell cloud? What is the similarity between these phenomena?

Question 2 (0.25 point):

What is the difficulty with FEM simulations when you encounter a material instability (flow stress goes down with increasing plastic strain) leading to localization of the deformation?

Question 3 (0.25 point):

- a. What is path dependent material behavior?
- b. Explain, based on the stress (path) dependency of ductile fracture, how this can have an influence on a deformation process?

Question 4 (0.25 point):

Why is validation of simulations so important when you develop and implement complex material behavior in a non-linear FEM code and can you say something about the necessary details?

Question 5 (0.25 point):

How do you make a steel corrosion resistant and what are phenomena behind?

Question 6 (0.25 point):

- a. What is mentioned with DACE (Design and Analyses of Computer Experiments), how does DACE work and where is it used for?
- b. What are the different steps in the process of DACE?

Question 7 (0.25 point):

- a. (0.02 point) Draw a FLD (Forming Limit Diagram) curve

- b. (0.03 point) Add the lines in the FLD for tensile, biaxial forming (stretching) and deep drawing

Question 8 (0.75 point):

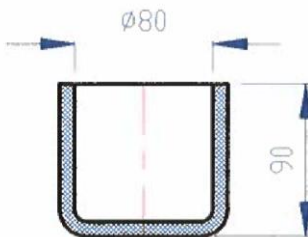
Derive and prove that necking occurs at $\epsilon=n$ during a tensile test based on the Ludwik/Hollemon law: $\sigma=C*\epsilon^n$

With C = specific stress (constant), σ = yield stress, ϵ = strain and n = work hardening coefficient

Question 9 (1.0 point): Design a test scheme, with equidistant plastic strain steps in rolling, based on the combination of rolling and tensile testing up to a plastic strain of 100%

Question 10 (1.5 point): Deep Drawing

- a. (0.03 point) Given a cup with a height of 90 mm and an inner diameter of 80 mm, what is the diameter of the initial blank needed?



- b. (0.02 point) Calculate the drawing ratio
- c. (0.10 point) The thickness of the sheet is 1.5mm. Determine the number of forming stages, each drawing ratio and drawing diameters given the table below:

Max. drawing ratio	Punch diameter / Thickness				$\frac{ds}{s}$	
	24-33	33-53	53-90	90-190	190-400	400-800
1e bew. β_1	2,08-2,00	2,00-1,89	1,89-1,80	1,80-1,72	1,72-1,65	1,65-1,59
2e bew. β_2	1,39-1,34	1,34-1,32	1,32-1,28	1,28-1,26	1,26-1,24	1,24-1,23
3e bew. β_3	1,32-1,28	1,28-1,26	1,26-1,25	1,25-1,24	1,24-1,22	1,22-1,19
4e bew. β_4	1,25-1,22	1,22-1,19	1,19-1,18	1,18-1,16	1,16-1,15	1,15-1,14