Answer KEYWORDS

Exam in Modern Manufacturing Processes MPR 033

Date: 2009-10-19

Time: 14.00-18.00

Examiner: Gustav Holmqvist, tel. 5026, 0709-393275

Credit list: Will be sent out by e-mail **2009-11-09**

Checking: Checking of your exams can be made 2009-11-11, 12.30-13.15, place to be announced.

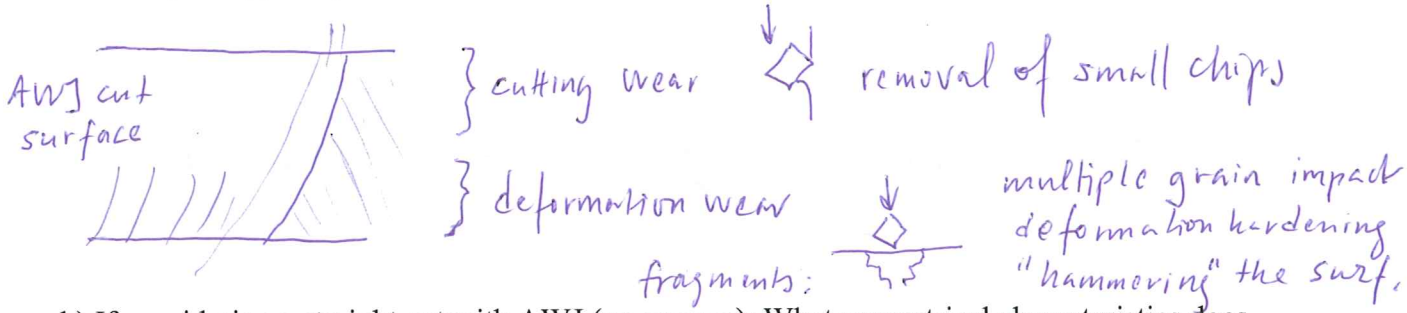
Grading Fail: 0-19,5p, 3: 20-29,5p, 4: 30-39,5p, 5: 40-50p

(Extra points based on your group assignment report will be added to your exam result)

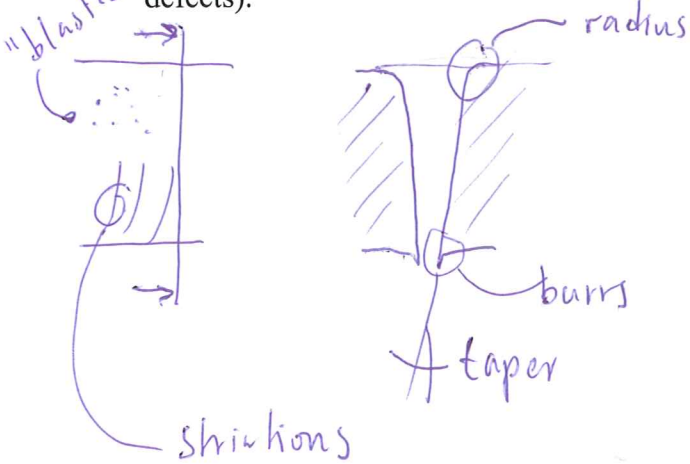
Unconventional machining methods

1. Abrasive Waterjet Cutting (5p)

a) AWJ cut surfaces are a result of the different wear mechanisms. Describe these and point out were they are typically found on a surface. (2 p)



b) If considering a straight cut with AWJ (no corners); What geometrical characteristics does the surface have on the micro and macro scale? Relate to question 1a but also include geometrical defects in your answer. Make appropriate sketches. (Note: Not the corner-type defects). (3 p)



At least three must be well described

2. Laser and Plasma cutting (6p)

a) Make a general comparison between laser and plasma cutting concerning: applications, edge quality, economy and some other factor of your own choice. (4 p)

	Laser	Plasma
Appl.	t = 0-15mm, mild steel...	t = 10-50, stainless steel...
Edge	Rel good, some striations, HAZ	worse in general, more HAZ
Economy	High invest, consummables = gas	Lower invest. Consum. depend on type
Envir	Some fumes from thermal proc.	High noise, Gas & fumes

b) Lasers and Plasma uses gases in the processes. Discuss briefly the different uses of gases in the two processes. (2 p)

Plasma-gas: Can be air (producing the plasma)
Can be just single gas but often have dual gas.
Secondary for shielding (and cool.) H_2 CO_2

Laser
Active for steel O_2 ⇒ exothermic
Shield gases N_2 Ar. For both protect and blow away

3. Chemical machining (4p)

a) Describe Photo-chemical machining. Describe the steps in making a part. Make appropriate sketches. (3 p)

Ch 8-II
Fig 3.10 + some text

b) Why does this process (PCM) exist? What applications are there? (1 p)

Fine patterns in thin sheet without burrs
(Can be used for μ-machining)

Metal forming

4. Roll forming (5p)

a) Describe roll forming, it's function and give some typical application. (2p)

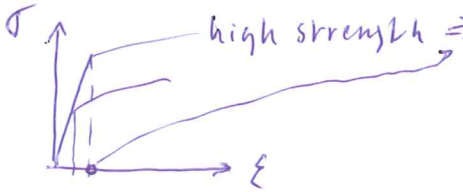
Succesive passes through pairs of rolls
Fig 81 in Ch 2-I, For beams

b) Why do you get *springback* in roll forming? You may also describe for bending. (2p)

Residual elastic deformation, fig 59.

(Avoid with fully plastic def.)

c) Is there an advantage or a disadvantage in using high-strength steels with the respect to springback in roll forming? Explain briefly. (1p)



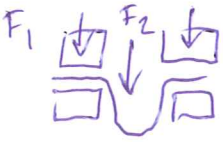
high strength ⇒ more elastic ⇒ more springback.

But: Also ok to discuss that in roll forming there are flanges etc that are "slightly" deformed ⇒ more problems in Low strength

5. Drawing – wrinkles (4p)

a) Explain *why* and *where* wrinkling occurs in drawing. Explain also how wrinkles are *avoided* (2,5p)

See Lab!



Too Low F_1

Avoid: Higher F_1

Material deformed inwards in to die:

can wrinkle.

b) In a forming limit diagram, try to point out where (approximately) wrinkles might occur. (Draw your own in the answer paper). (1,5 p)

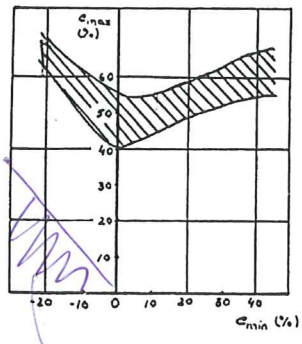


Figure: Example of FLD.

wrinkles (e_{min} too negative while e_{max} quite small)

6. Hydroforming (4p)

a) What main process parameters are there in hydroforming? Name and describe at least three. (1,5 p)

Pressure: Provides forming and calibration in cavities

Axial force: Provides sealing and is correlated to the position

Horizontal path: Position of the axial cylinder

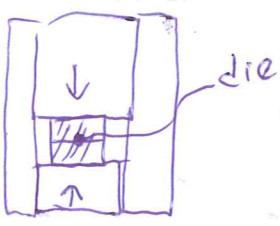
b) What is crash-forming (or crush forming) in hydroforming? (1 p)

Fitting tube in die

c) In the literature is discussed a cost aspect of the so called clamping force. What is the clamping force and what is the "problem" in economical terms? Clue: how is the clamping force normally provided today? (1,5 p)

Ch 3-II 2.4 Equipment

Today large presses are used for this purpose (they are not active in forming).



Metal Cutting

7. Grinding (5p)

a) Name and explain at least three characteristic properties of a grinding wheel. The properties should be among those found in the designation (coding) of a grinding wheel. (3 p)

3 of
- Bond type
- Abr type ....
- Grain size
- Grade
- Structure

Explain (see literature)

b) Higher temperatures arise in grinding than other metal cutting processes – why? (1 p)

High degree of losses in plowing and rubbing (and small chip thickness)

d) What negative effects do high temperatures have? At least two effects should be mentioned and *very briefly* explained/discussed. (1 p)

2 of
- Tempering : Softening
- Burning : Oxidation or cracking, ..
- Residual stresses : Temperature change and gradients

8. Metal Cutting Fluids (5p)

a) What are the general functions (or motivations) of a cutting fluid? Name at least three and explain at least two. (3 p)

Prevent tool, workpiece and machine from overheat.
Increase tool life : Lower T ⇒ Mechanisms for wear goes slower.
Improve surface finish: Better lubrication, less BUE
Evacuate chips : Flush away from machining zone

b) How well can MQL provide for these functions? Are they "functioning" in the same way, worse or not at all? Compare to ordinary cutting fluid application. (2 p)

Lab!

Generally worse
No or small cooling
Lubrication ⇒ Effect on tool life & surface
chip evacuation: (Less) some, by the air.

9. High-Speed Machining (5p)

a) Explain why thinner walls are possible to machine with HSM in for instance Aluminium. (2,5p)

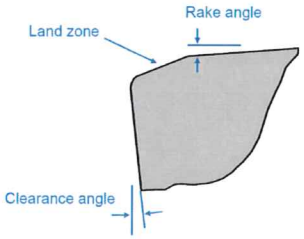
Smaller chip thickness, but material removal rate can be kept high through high v_c
Small chip ⇒ lower force on part & tool.

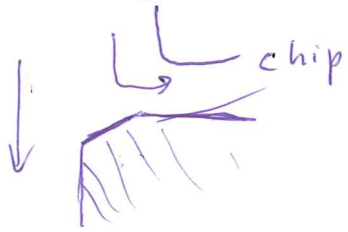
b) *How* and *why* can the process chain for producing dies in hardened steel be changed with HSM? What is the advantage of HSM? (2,5p)

No EDM and machining directly in hardened material.
Saves on nr. of steps and set-up times and tooling for EDM.
⇒ Saves time in design changes and new product releases.

10 Metal cutting tools (3p)

The picture in below shows the edge of a cutting insert.





a) Why is an edge made in this way – why is there a land zone? Is there any negative effect of this geometry? (2p)

Strengthening the edge
(There is actually also an effect on chip contact length ⇒ +)
Forces can be higher due to a rake angle that gets more neg.)

b) For what insert material (or materials) would you expect to find this type of geometry?

Brittle materials, Ceramics, CBN..
(Example = from lecture = CBN) (1p)

11. Surface Topography (4p)

a) What are the general advantages of using a 3D-measurement instead of a 2D measurement? (2p)

- Statistics : More data
- Functions are in 3D
- Visualisation : Images...

b) Explain the use of filtering in surface topography characterization. Which three surface characteristics do you typically want to distinguish? (2p)

Form
Waviness
Roughness
} different wavelengths
are filtered out chosing cut off