

# Exam in Manufacturing Processes MPR 034

- Date:** 2011-10-19
- Time:** 14.00-18.00
- Examiner:** Gustav Holmqvist, tel. 5026, 0709-393275  
Will visit the exam about 15.00 and 16.30.
- Ass. Devices:** Approved calculator, pen, pencil, eraser, ruler, and written dictionary.
- Credit list:** Will be sent out by e-mail 2011-11-09
- Checking:** Checking of your exams can be made 2011-11-14, 12.30-13.15, Room Gamma in the study hall.
- Grading** Fail: 0-19,5p, 3: 20-29,5p, 4: 30-39,5p, 5: 40-50p

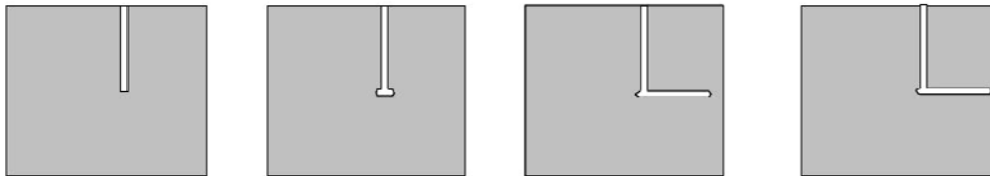
*General instructions: For full point you must make clear that you have understood the meaning of your answer. You must show the teacher that you have understood the question and its answer. Write detailed answers and motivate and explain yourself. Write clearly and readable. Do not use ink pen. Good Luck!*

---

## Unconventional machining methods

### 1. Abrasive Waterjet Cutting (5p)

- a. In below figure is shown two geometrical defects of an AWJ cut part. Point them out and explain in detail how they have occurred. (3 p)



- b. Mention two other geometrical (not corner defects, not surface topography) defects that an AWJ cut surface typically exhibits. (1 p)

- c. Mention and very briefly explain a method or way to overcome one of the defects you mentioned in question b. (1 p)

### 2. Laser cutting (4p)

- a. Laser light needs to be transferred from the source to the cutting head. How is that made? Mention two major types of laser sources that use different methods for the light transfer. How and why are they different? How does this affect the automation solution? (2 p)

- b. Why is the cutting speed for laser cutting typically much higher in ordinary mild steel than it is for cutting in stainless steels? Explain! (2p)

## **Metal forming**

### **3. Deep drawing (6 p)**

- a. What is a forming limit diagram? Explain how the diagram is made as well as how it is used. Start with pointing out what you find on the x- and y-axis. (4 p)
- b. Explain how and why the lubrication affects the LDR in deep drawing. (2 p)

### **4. High-strength materials and formability (3 p)**

Light weight products can mean using more high strength materials. Point out and briefly explain two important disadvantages of high strength materials from a formability point of view. (Note: Do not confuse formability with high press forces).

### **5. Hydroforming (4p)**

- What conventional process chain does hydroforming “compete” with? (How would a hydroformed part be made with conventional technologies?)
- Compare and point out the main advantages and disadvantages of hydroforming compared to the conventional solution. Explain each point briefly.

## **Metal Cutting**

### **6. Grinding and hard turning (6p)**

- a. The resulting surface from grinding is much dependent on how worn the grinding wheel is. Explain:
- How will grinding wheels and abrasive wear?
  - How does the abrasive act on the surface? How does a ground surface look like?
  - Correlate the first two points: How will the surface change as abrasives wear?
- (4p)
- b. Briefly compare hard turning to grinding. Point out the difference on how the surface is produced. Also comment briefly on energy consumption and flexibility/set-up time for the two processes. (2 p)

### **7. Metal Cutting Fluids (5p)**

- a. Why is heat created in metal cutting? There are several causes for the heat generation. Explain by making a figure of where the heat is generated. (2 p)
- b. When and why can dry cutting (no cutting fluid at all) make sense? Exemplify! (2 p)
- c. Why might dry cutting not be an economical way to machine parts in ordinary turning of steel for example? Give some comment on whether you therefore think dry cutting is a sustainable solution. (1 p)

## 8. High-Speed Machining (4p)

- a. Why is safety (for operators etc) a problematic question in HSM? What measures are typically taken in HSM to avoid problems? (2p)
- b. Some factors mentioned in the literature on HSM and computer numerical control (CNC) are: “Data transfer speed”, “NURBS”, and “Look-ahead function”. Select two of these and briefly explain what they mean and why they are important in HSM (2p)

## 9. Metal cutting - Micro machining (3p)

- a. One can say that the material properties are of more importance in micro machining. What “type” of material properties is that, and why is it important? (2p)
- b. Give some other example of factor where micro machining is different than conventional metal cutting. (1p)

## Joining

### 10 Soldering (3p)

When soldering electronics components to PCB:s fluxes can be added in different ways. Describe how and when flux is added in:

- hand soldering
- wave soldering
- surface mount technology (mechanised)

You must show *when* the flux is added with respect to the soldering.

### 11. Clinching compared to spot welding (3p)

The literature gives in total 9 advantages for clinching. Mention at least three where clinching has an advantage over spot welding. Also mention three other advantages. *Very briefly* explain each point.

### 12. Surface Topography (4p)

- a. A machined surface typically contains three features: Roughness, waviness and form error. How are these three features typically produced? Use grinding, turning or milling as an example. (2 p)
- b. How can one in practice distinguish these three features? Your answer should for full scoring include the term “cut-off”. (2 p)