Master Examination
„Materials Science of Steel“
Part 2
„Steel Design“
27th Aug. ‘12

Name:

Matriculation number:

<table>
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<tr>
<th>Question</th>
<th>Maximal erreichbare Points:</th>
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<th>Einsicht: (nur neue TeilPoints angeben, <strong>nicht</strong> neue Gesamtpunktzahl pro Question)</th>
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Aufgabe 15  Steel Design – AHSS (Bleck)  4 Points

Using a TTT-diagram, show schematically the hot rolled strip and the cold rolled strip production of a DP-steel. What is the microstructure before cooling? (4P)

Hot rolled

Cold rolled
Aufgabe 16 Steel Design – AHSS (Bleck) 1 Points

In Dual Phase steels, there is usually 5 to 30 vol.-% martensite present in the microstructure. Explain the lower and the upper limit of the martensite content on the base of the mechanical properties. (1P)
Aufgabe 17  Steel Design – AHSS (Bleck)  2 Points

The special properties of TRIP-steels are related to the presence of approximately 10% retained austenite in the microstructure. Explain what it makes possible to have retained austenite present in a 0.2 wt.-% C steel. Is the retained austenite thermodynamically stable? Is it mechanically stable? (2P)
Aufgabe 18  Steel Design – HSS (Kern)  2 Points

Why is the treatment of the crude steel in the secondary metallurgy and especially the treatment of the sulfide shape of great importance for the production of heavy plates? How is the sulfide shape typically modified? (2P)
Aufgabe 19  

Steel Design – HSS (Kern)  

2 Points

Nowadays, there are high requirements on steels for pipelines regarding the resistance against HIC of. What does HIC mean and which aspects shall be considered in the alloying content and the degree of cleanness of the steel grade, in order to obtain high resistance against HIC? How are linepipes typically manufactured? (2P).
Aufgabe 20 Steel Design – HSS (Kern) 1 Points

How are steels for ship constructions manufactured? What yield strengths shall these steels possess? (1P)
Aufgabe 21 Steel Design – HSS (Kern) 4 Points

a) Which physical-metallurgical mechanisms determine the microstructure development during rolling and heat treatment of high-strength structural steels? (2)

b) Which mechanism allows blocking the recrystallization in austenite? (1P.)

c) Name two of usually used alloying elements, which have an effect on the blocking of the recrystallization! (1P)
Aufgabe 22 Steel Design - Creep resistant steels 1.5 Points

Starting from which operation temperature high temperature resistant materials have to be used? What are the physical reasons for this in steels?
Aufgabe 23  Steel Design – Creep resistant steels  0.5 Points

Which method is used to guess the life time of parts under complex mechanical and thermal load? (0.5P)
**Aufgabe 24**  
Steel Design – Creep resistant steels  
2.5 Points

Name the mechanisms which can be used to increase the strength of high-temperature alloys! (2,5P)
Aufgabe 25 Steel Design – Rail Steels (Mu) 2 Points

Talking about rails, there are two factors that determine the lifetime, according to the field of application. Name these two factors, explain what leads to their occurrence and give an example for the fields of application they are used. (2P)
Aufgabe 26  Steel Design – Tube steels  1 Points

Which are the most relevant process steps in the production of longitudinal seam-welded pipes? Name two of them.
Aufgabe 27  Steel Design – Tube Steels  2 Points

What is the first basic processing step used in the production of seamless tubes broadly called? Name three typical processes that use this basic step.
Aufgabe 28  Steel Design – Powerplant steels  1.5 Points

Which chemical element is mainly responsible for oxidation resistance of ferritic/martensitic steels for power plants? (1,5P)
Aufgabe 29  Steel Design – EDDS  3 Points

In cold rolled batch annealed steels the preferred “pancake” microstructure is obtained.

a) What is a pancake-microstructure? (1P)

b) Which process parameters lead to the formation of such microstructure? (2P)