Group	Name	Neptun code	Date

Material Selection
report

Project

Bevel gear

Dimension: 45 mm diameter

Loads & requirements: wear load at the teeth surface
bending load at the teeth's bottom
moderate impact dynamic load

Service parameters: -

Production: medium series

Fig. 1. Picture of bevel gears [1]

Part/tool

- *Short description:*

  Bevel gears are gears where the axes of the two shafts intersect and the tooth-bearing faces of the gears themselves are conically shaped. Bevel gears are most often mounted on shafts that are 90 degrees apart, but can be designed to work at other angles as well. The pitch surface of bevel gears is a cone [1].

- *Selection criteria:*
    - Surface should be hard
    - Core should be tough and bear fatigue
    - Medium series mean that a better material with higher price can also be chosen

Selected material

- *Type:* case hardening steel
- *Material* DIN: 16 MnCr5
  AISI: SAE 5115
  EN: 1.7131
- *Description:*

Case hardening steel with medium strength. The carburized surface will provide a hard, wear resistant layer on the top of the teeth, while the core has appropriate toughness for dynamic loading. Hardness of the surface is approximately 60 HRC [3].

- *Standards:*

  EN 10084 : 2008 Case hardening steels. Technical delivery conditions.

  EN 10132 - 2 : 2000 Cold rolled narrow steel strip for heat treatment. Technical delivery conditions. Case hardening steels.

- *Chemical composition* [4]:

Chemical elements	C	Si max.	Mn	P max.	S	Cr
w%	0,14-0,19	0,40	1,00-1,30	0,035	≤ 0,035	0,80 – 1,10
Permissible deviation	± 0,02	+ 0,03	± 0,05	+ 0,005	+ 0,005	± 0,05

Processing technology steps and parameters

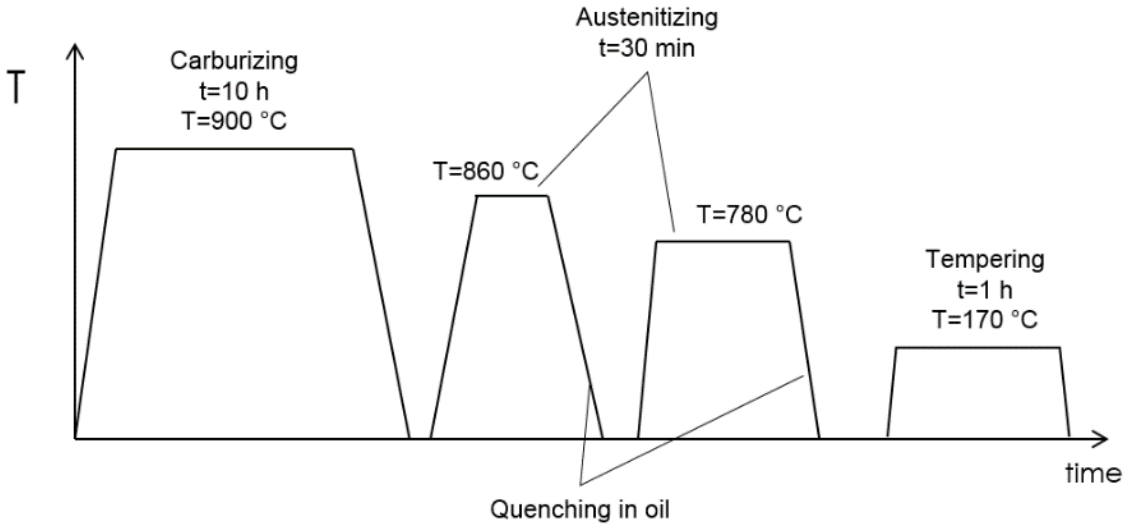
1.) Cutting, parting

2.) Closed die forging, cutting of the flash
parameters: forging temperature: 1100 °C

3.) Machining

4.) Heat threating
steps:
a. carburizing in solid medium (charcoal)
at 900 ºC for 10 hours and cooling on air in the case

b. core hardening: austenitizing at 860 ºC for 30 min. and quenching in oil
c. case hardening: austenitizing at 780 ºC for 30 min. and quenching in oil
d. tempering at 170 ºC for 1 h (approx. 60 HRC).



5.) Finishing (grinding)

References

[1] Picture https://5.imimg.com/data5/RX/SK/MY-3730100/straight-bevel-gears-500x500.jpg
[2] Bevel gear https://en.wikipedia.org/wiki/Bevel_gear
[3] Surface hardening (case-hardening) https://www.tec-science.com/material-science/heat-treatment-steel/surface-hardening-case-hardening/
[4] Chemical composition http://www.bebonchina.com/Industry-news/16MnCr516MnCr5-Chemical-composition16MnCr5-steel-grades.html