Welcome

DISCOVER
WHAT IS BEHIND

TECHNOLOGY DAYS
HORN **2015**

Technical presentation:
Grooving and parting off stainless materials

Speaker: Chris Foschaar

Agenda

- **Focus: Stainless steels**
  - Use, properties, categorization, machining process, cutting edge requirements, geometry requirements
- **Machining examples based on various tool solutions**
  - Sleeve – Toolholder with clamping finger cooling
  - Ring – Burr-free parting off and appropriate coating system
  - Gearshaft – Insert with internal cooling
  - Valve seat – Cartridge system 845

Stainless steels

Usage

Industrial: Tanks, exhaust systems, screw connections, fittings, etc.

Domestic: Pots, knives, lamps, sinks, etc.

Construction: Structures, facades, roof coverings, swimming pools, etc.

Medical: Screws, plates, operating tools, etc.

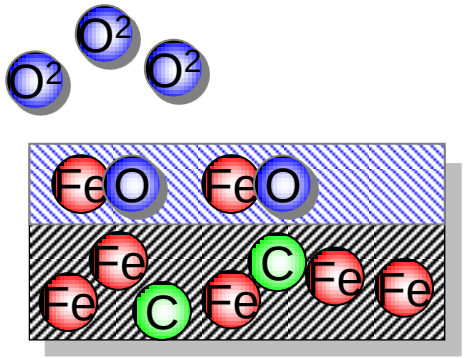
Main features:

Corrosion resistance, mechanical toughness, durability, hygiene, aesthetic appeal, appearance, etc.

Stainless steels

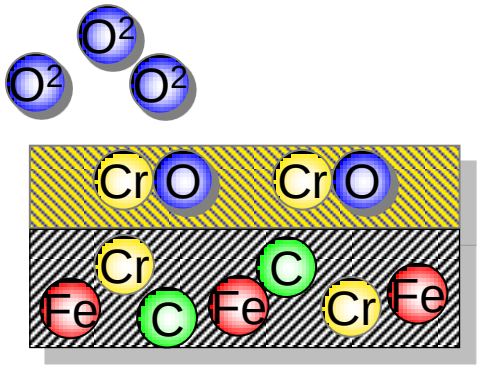
Properties – Corrosion resistance

Carbon steel



Free iron atoms combine with oxygen to form iron oxide (rust).

Stainless steel



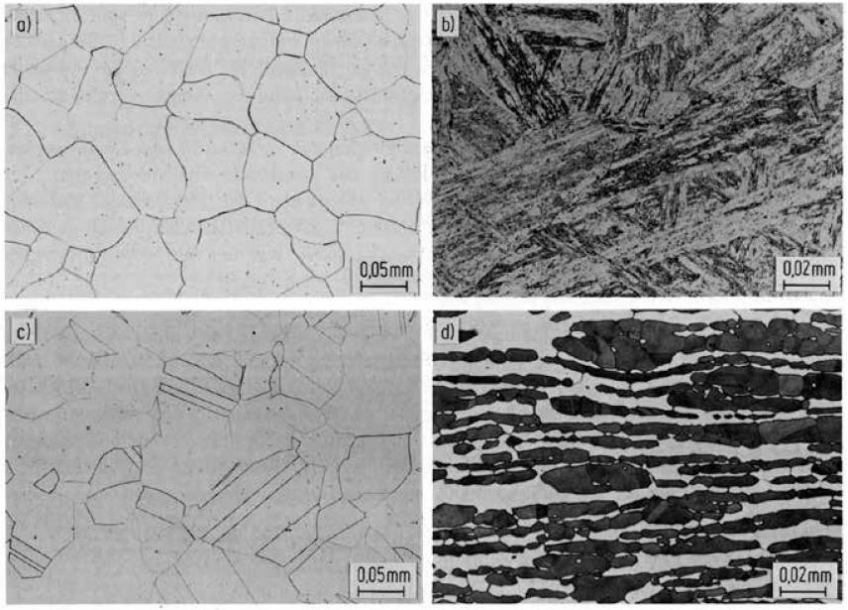
Free chromium atoms combine with oxygen to form chromium oxide (passive layer).

Stainless steels

Categorization

Ferritic structure
e.g. 1.4511

Austenitic structure
e.g. 1.4301 (V2A)
1.4571 (V4A)



Source: Informationsstelle Edelstahl Rostfrei

Martensitic structure
e.g. 1.4313

Austenitic-ferritic structure
e.g. 1.4462

Stainless steels

Ferritic corrosion-resistant steels

Main alloying component: **Cr**

Use:
Fittings, cladding, apparatus construction, machine elements, silos, tanks and vehicle bodies

Properties:
Good non-cutting forming properties (can be cold-formed), weldable, difficult to machine

Exhaust systems

Source: Informationsstelle Edelstahl Rostfrei

Stainless steels

Martensitic and precipitation-hardening stainless steels

Main alloying component: **Cr, C** (carbon martensite)
or **Ni** (nickel martensite)

Use:
Axles, shafts, screws, surgical instruments, rolling bearings, production materials, springs and cutting tools

Properties:
Can be hardened, easy to machine, limited weld-ability, high strength

Razor blades

Source: Informationsstelle Edelstahl Rostfrei

Stainless steels

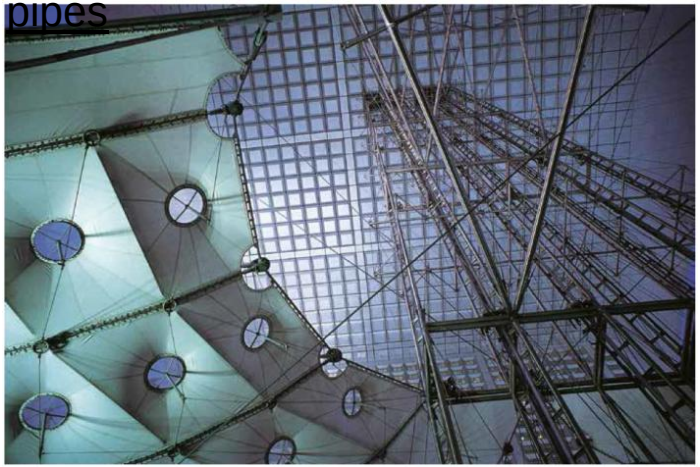
Austenitic-ferritic stainless steels (duplex steels)

Main alloying component: **Cr, Ni, Mo**

<u>Use:</u>
Offshore platforms, aviation industry

<u>Properties:</u>
Weldable, highly corrosion-resistant

<u>Elevator tower made from duplex pipes</u>



Source: Informationsstelle Edelstahl Rostfrei

Stainless steels

Austenitic corrosion-resistant steels

Main alloying component: **Cr, Ni, Mo**, manganese in the case of manganese austenite

<u>Use:</u>
Food, pharmaceutical and cosmetics industries,
chemical apparatus construction, vehicle construction, domestic, surgical instruments and sanitation

<u>Properties:</u>
Can be cold-formed and welded with ease, difficult to machine

<u>Submersible pump</u>

Source: SPECK Pumpen

Geometry requirements

E.g.: 3V geometry with internal cooling

- Low cutting edge rounding
- Small protective chamfer
- Large chipping/relief angle
- Medium chip tapering
- For low to medium feed rates

Stainless steels

Machining example: *Sleeve*

Workpiece:

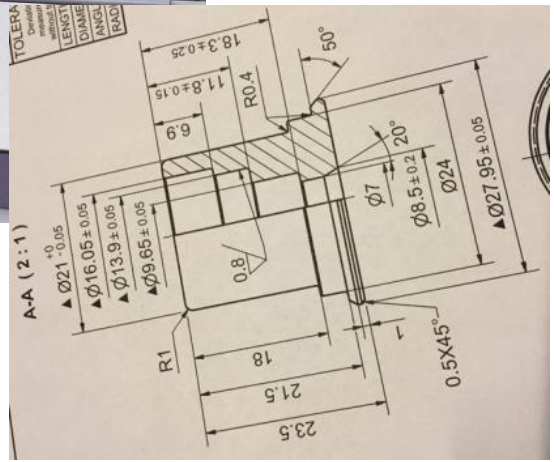
Sleeve from X5CrNi18-10 (1.4301)

R_m = 500-700 N/mm²

Machine:

STAR SR-32J Swiss-type lathe

80 bar, emulsion



Stainless steels

Tool:

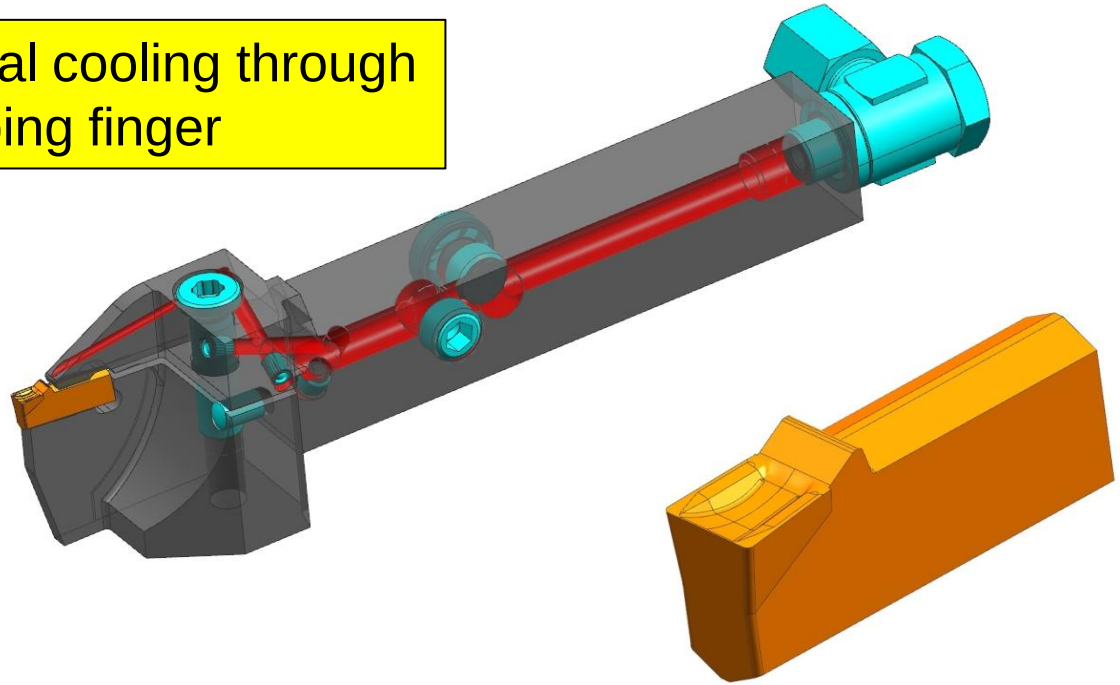
Toolholder:

LH100.1616.0.23.IK

Cutting insert:

S100.0300.3V2 AS45

Internal cooling through clamping finger

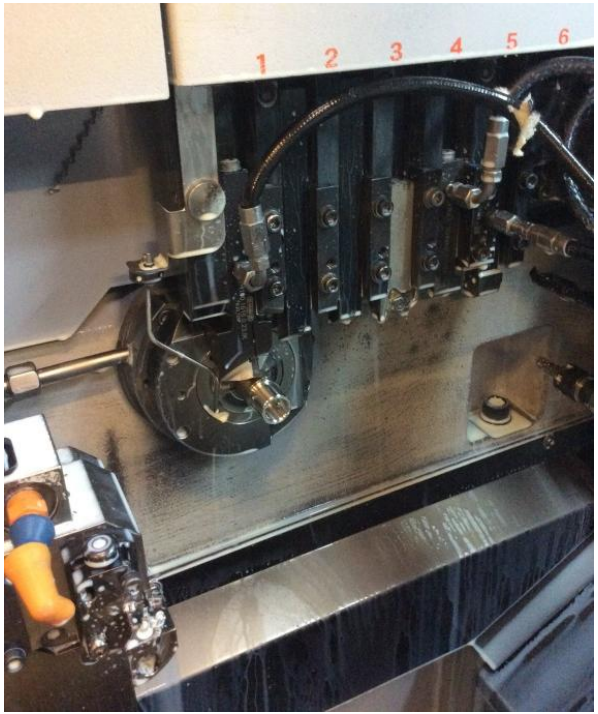


Stainless steels

Cutting data:

v_c = 140 m/min

f = 0.12 mm/rev



Stainless steels

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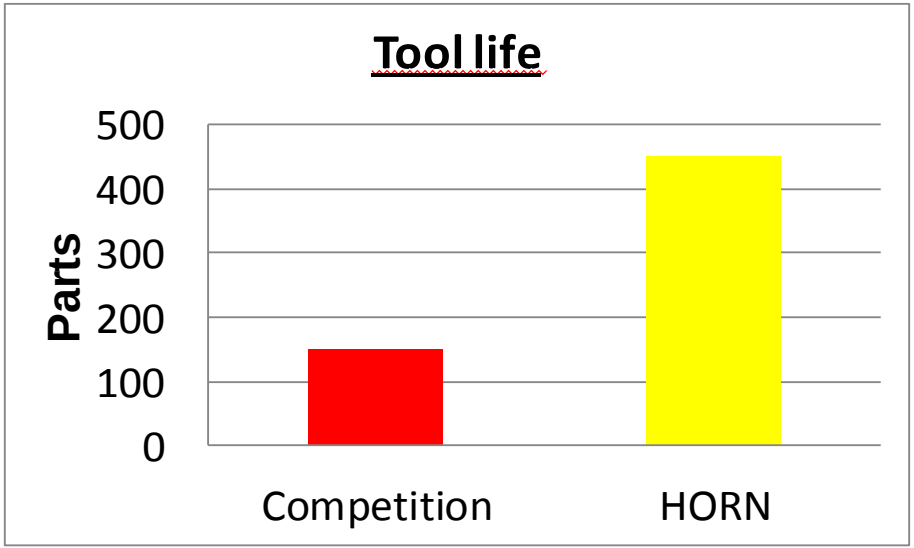
Result:

- Three times the tool life in pieces
- Competition with internal cooling

  max. 150 parts per cutting edge
- HORN with internal cooling

  450 parts per cutting edge



Machining example: *Ring*

Workpiece:

- Ring made of X5CrNi18-10 (1.4301)
- External Ø 32 mm, wall thickness 2 mm
- R_m = 500-700 N/mm²

Challenges:

- Raw material: welded pipe (Tube)
- Extreme batch fluctuations
- Burr-free parting off

Stainless steels

Tools:

Standard indexable insert

R312.0510.00 TN35

→ PH35

Custom insert

114.0020.4646 TN35

→ PH35

Stainless steels

Machine:

Index GB65

Flood cooling with emulsion

Cutting data:

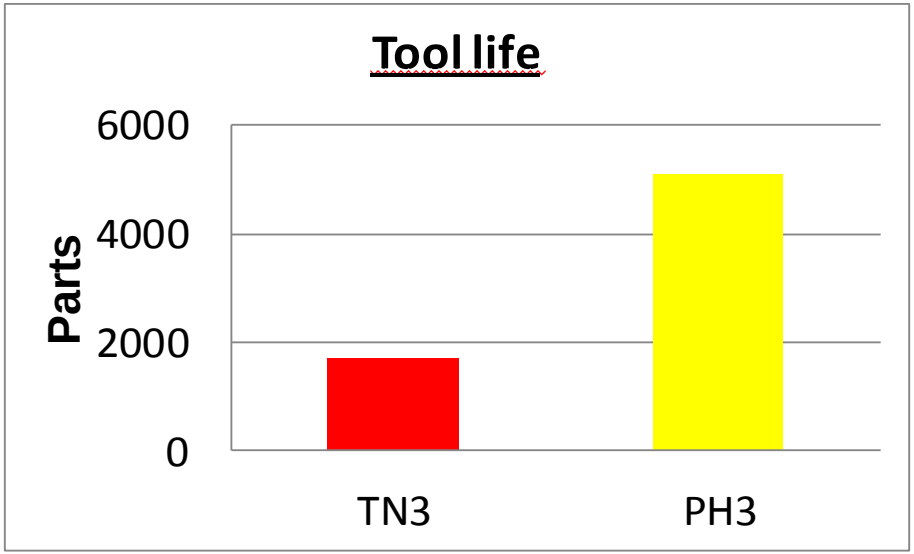
v_c = 150 m/min

f = 0.03 mm/rev

Stainless steels

Result:

- Burr-free components
- Tool life in pieces tripled in comparison to TN35



Stainless steels

Machining example: *Gearshaft*

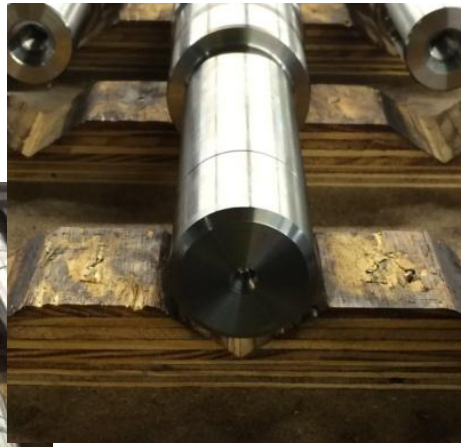
Workpiece:

Gearshaft made of
X2CrNiMo17-12-2 (1.4404)

R_m = 700 N/mm²

Machine:

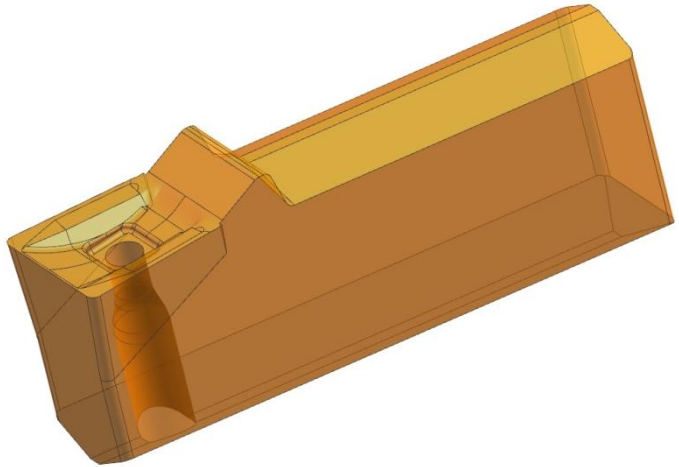
Gildemeister CTX Beta 1250 4A
with VDI40 holder,
25 bar, emulsion



Stainless steels

Complete tool:

Internal cooling through insert



Insert: S100.0300.3V2.IK HP65

Stainless steels

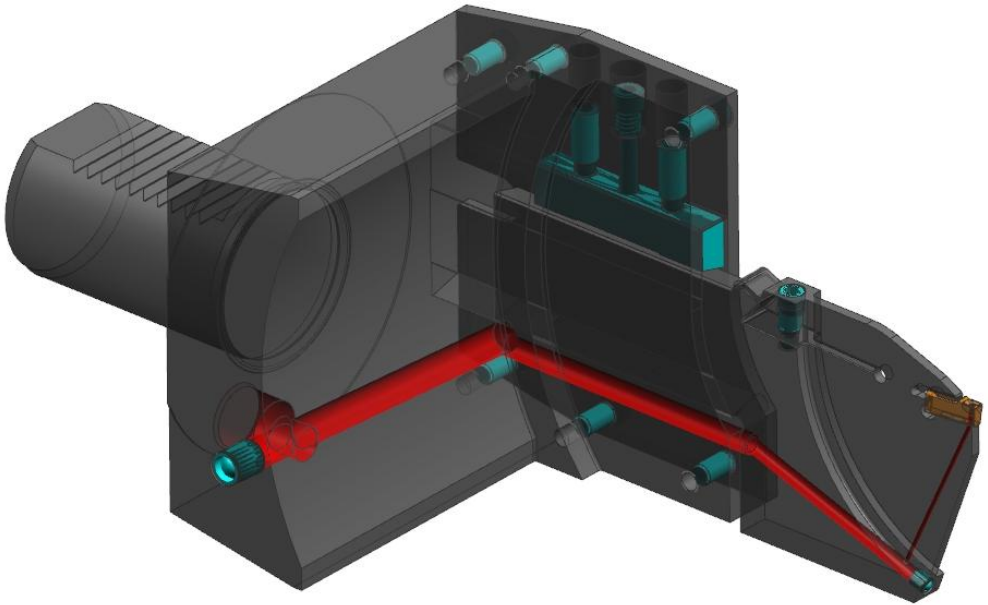
Parting off from Ø 65 mm to 0

Cutting data:

v_c = 130 m/min (n_{max} = 1400 rpm)

f_1 = 0.08 mm/rev up to Ø 3 mm

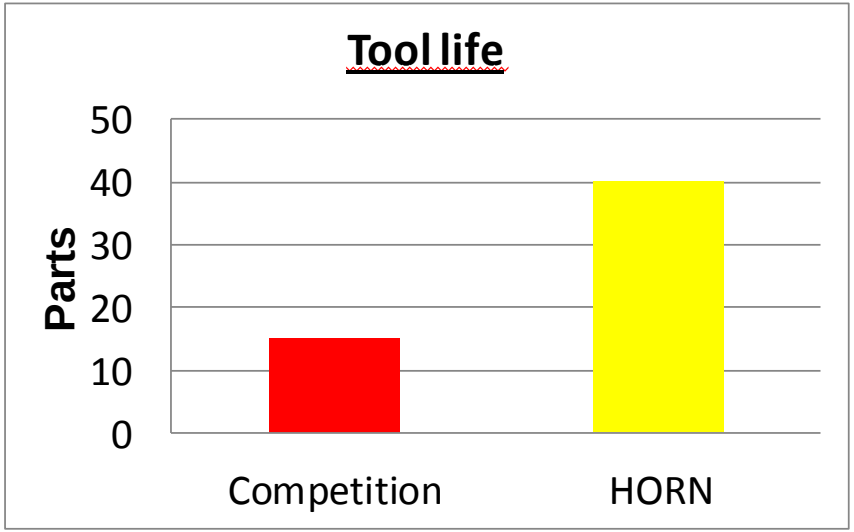
f_2 = 0.02 mm/rev up to X -0.5 mm



Stainless steels

Result:

- **2.7 times tool life in pieces compared with competition**
- Competition: 15 parts per cutting edge
- HORN: 40 parts per cutting edge



Stainless steels

Machining example: *Valve seat*

Workpiece:

Valve seat from X17CrNi16-2 (1.4057)

R_m = 950 N/mm²

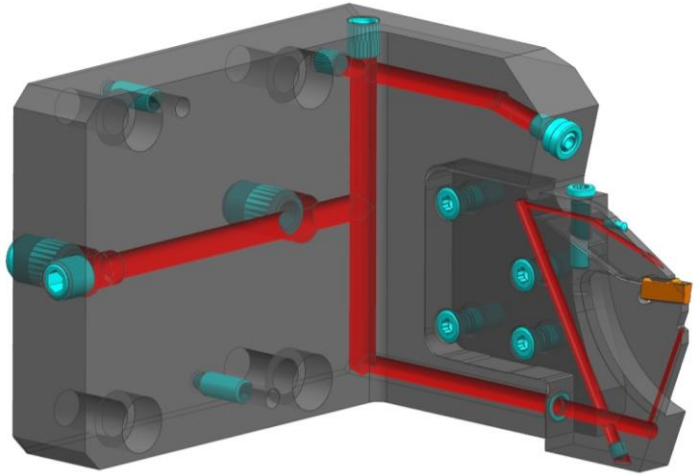
Machine:

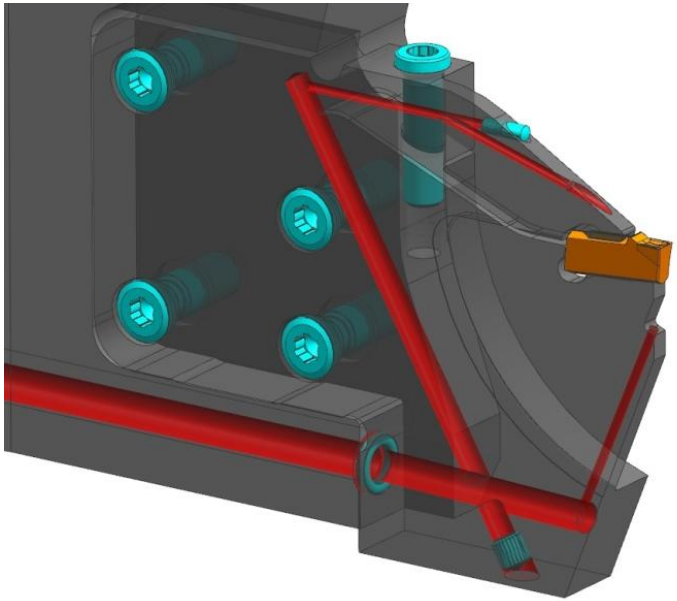
Miyano ABX 64, emulsion

Stainless steels

Complete tool:

Base carrier: 845.0000.0102





Cartridge: LNK100.0845.34.4.73.IK

Insert: S100.0300.3V2 HP65

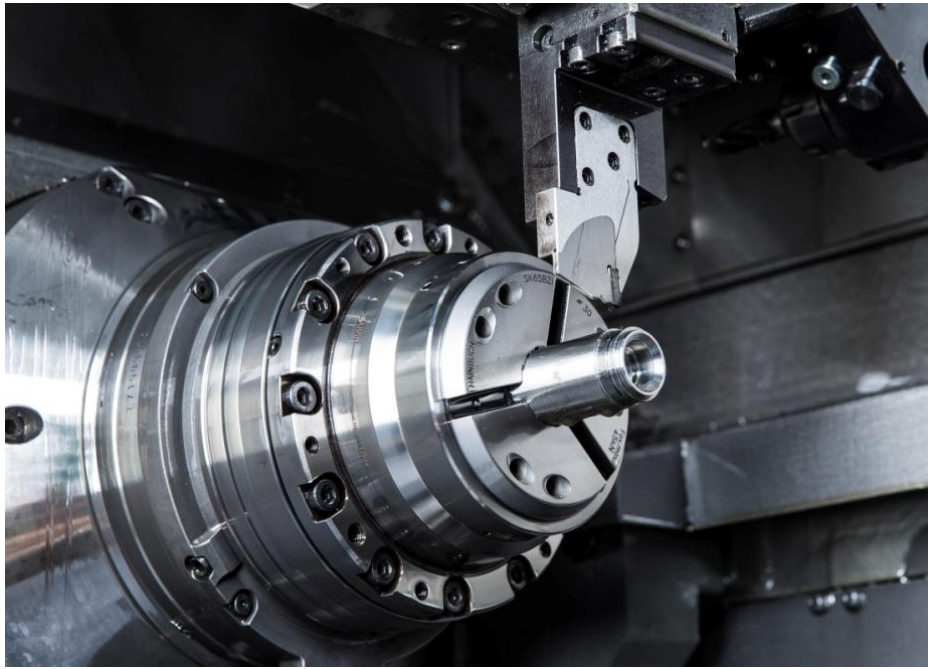
Stainless steels

Parting off Ø 28 mm

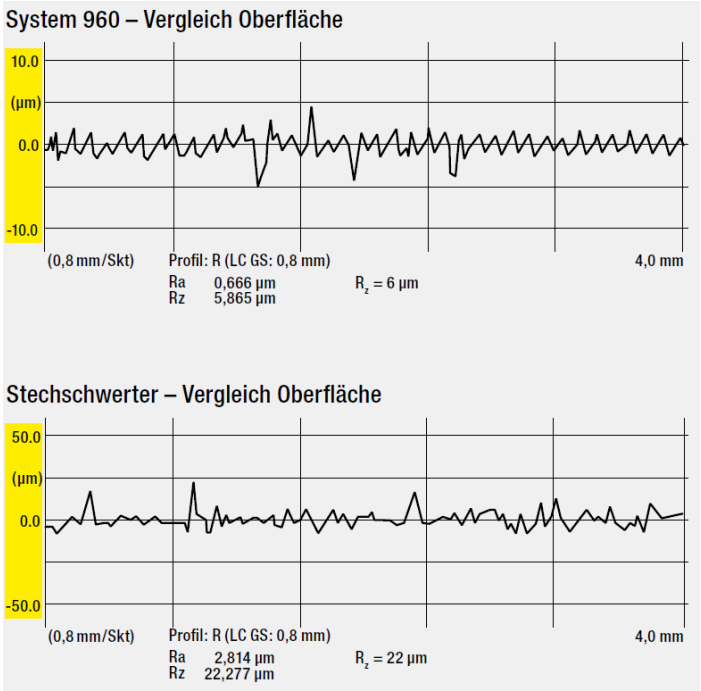
<u>Cutting data:</u>

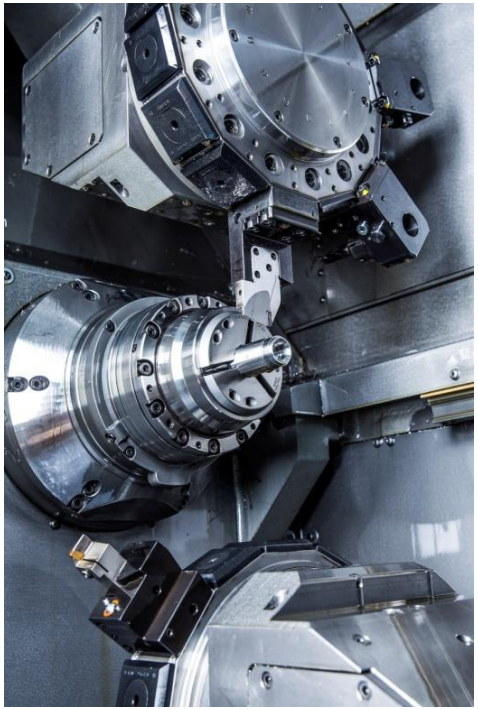
v_c = 170 m/min

f = 0.08 mm/rev



Stainless steels





Summary

- Categorization, properties and machining process of stainless steels
- Machining examples based on various tool systems
  - H100 with internal cooling through clamping finger
  - Special insert 114 – PH3 coating
  - Parting off – S100 with internal cooling – 3V geometry
  - 845 cartridge interface

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Thank you for your attention!