



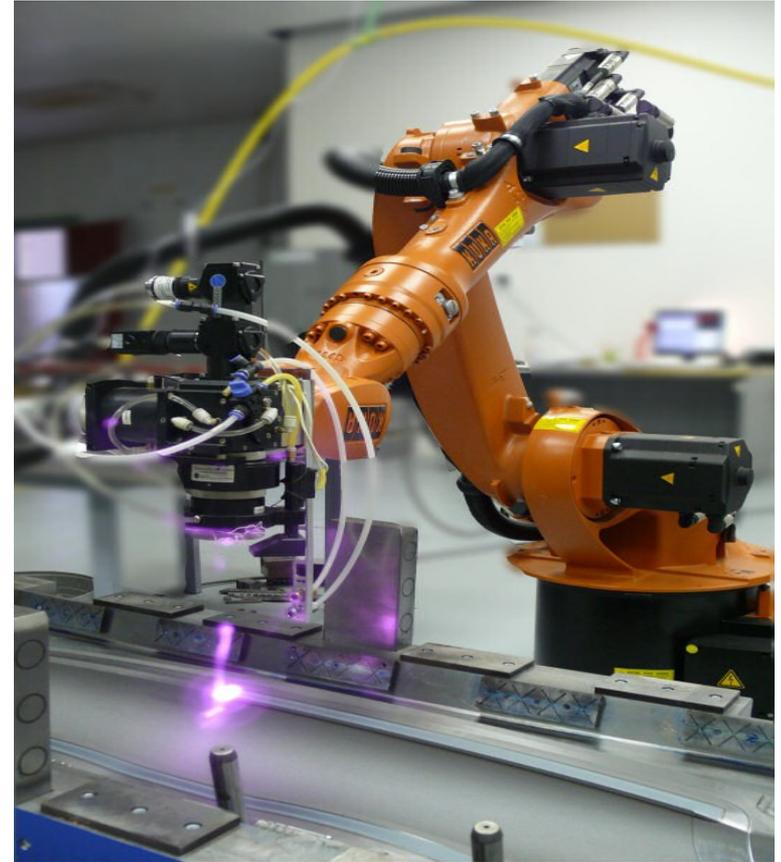
**FACULTY OF MECHANICAL
ENGINEERING**
UNIVERSITY
OF WEST BOHEMIA

WEAR OF LASER SURFACE HARDENED STEELS

**RESULTS PUBLISHED IN THE PRESENTATION WERE
OBTAINED IN THE SGS-2013-083 PROJECT**

Overview

- 1) Laser surface hardening
- 2) Goal of the presentation
- 3) Overlap zone
- 4) Wear tests and materials
- 5) **Pin-on-Disk test**
- 6) **Cyclic impact test**
- 7) Conclusion



Laser Line ($P_{max}=4$ kW), Kuka 16 HA [1]

Goal of the presentation



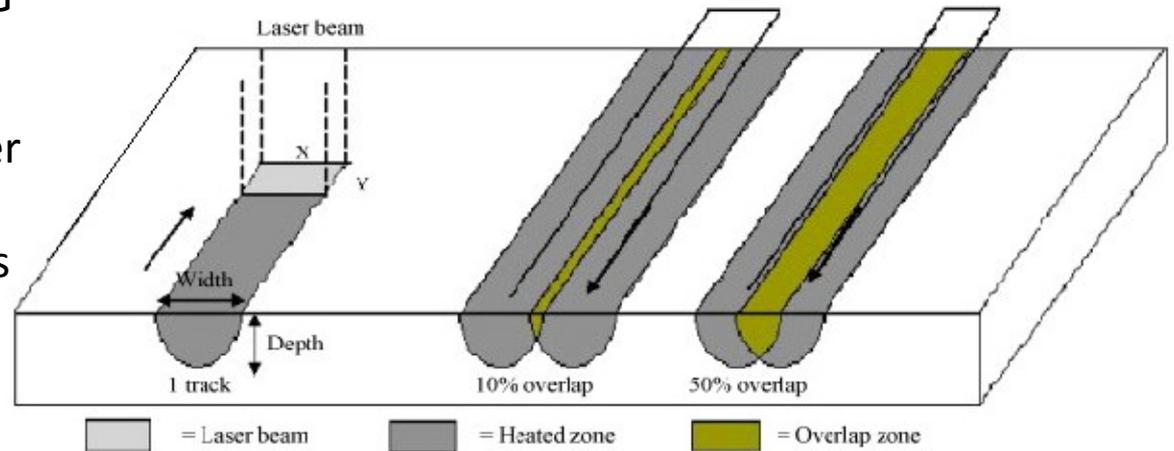
???

Customers of MATEX PM would like to know whether the wear rate of laser-hardened steel is the same as or higher than that of induction-hardened steel

???

LASER SURFACE HARDENING

- ✓ Minimized distortion
- ✓ High quality of hardened layer
- ✓ High process speed
- ✓ Processing of complex shapes
- ✓ No surface cracks
- ✓ Environment-friendliness



- ✗ Distinct transitional area
- ✗ Relatively low depth of hardened layer

Laser surface hardening [2]

Overlap Zone

Why Study the Overlap Area?

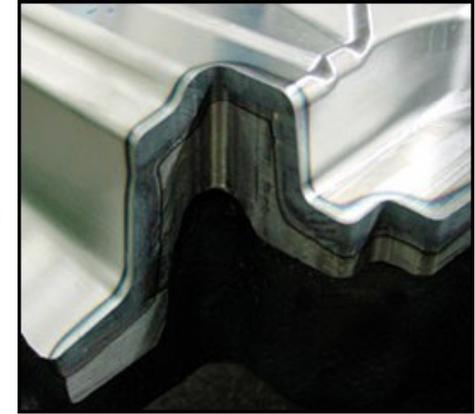
- Different type and **rate** of wear
- May lead to a high wear difference between overlap and laser track areas

Could we affect an overlap area?

- ✓ 1) Overlap zones are not always necessary
- ✓ 2) In most cases, overlap is not used in functional areas
- ✗ 3) Sometimes we cannot control the overlap



Differences in wear rates !!!



Mould for automotive industry [3]



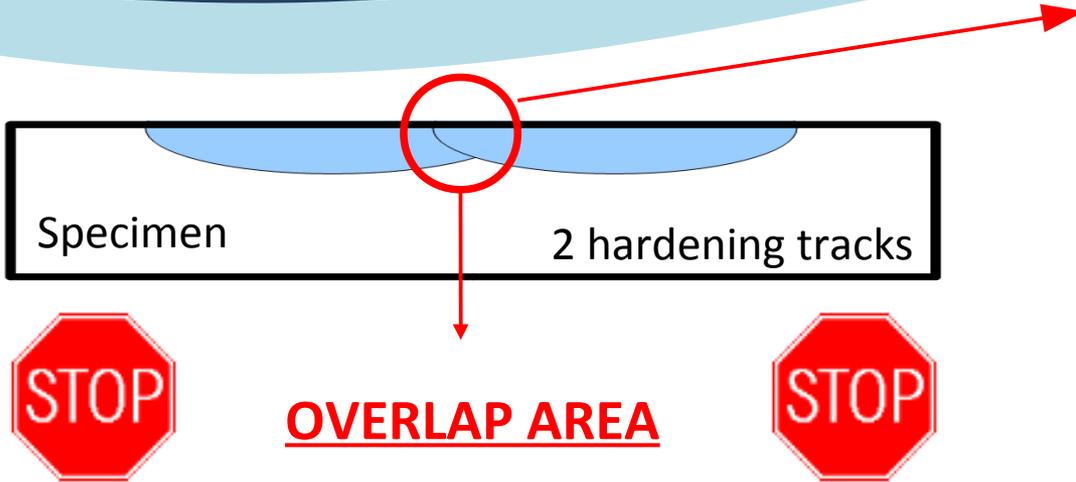
Cogwheel



gear pinion [4]

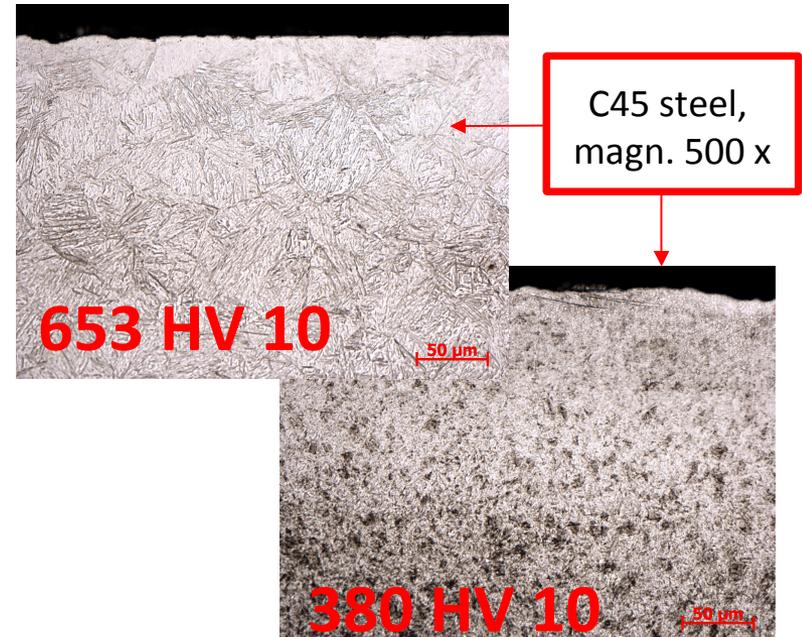
Overlap zone

C45 steel, magnification 50 x



Fracture,
C45 steel,
magn. 10x

Fracture,
C45 steel,
magn. 500x



Wear Tests

Pin-on-Disk test [5]

1) PIN-ON-DISK TEST

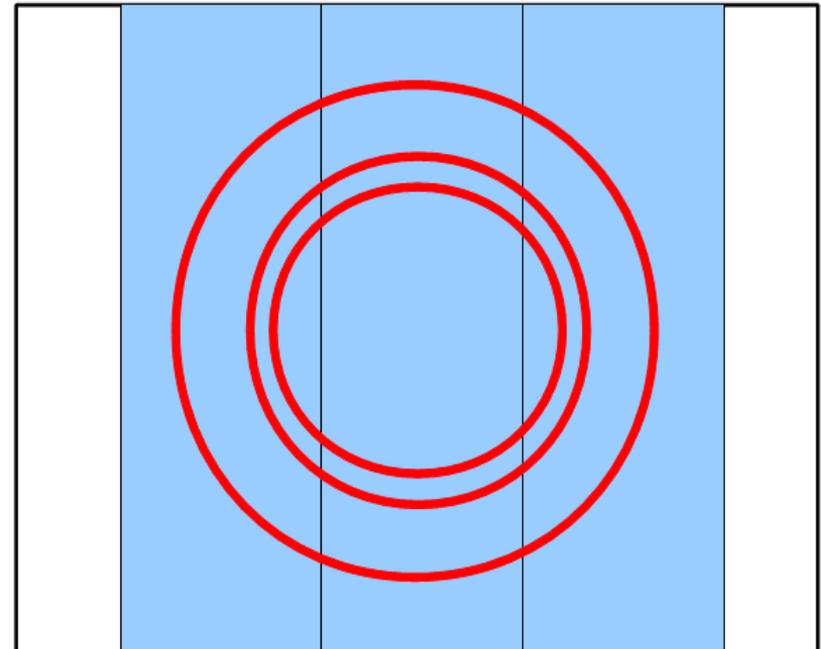
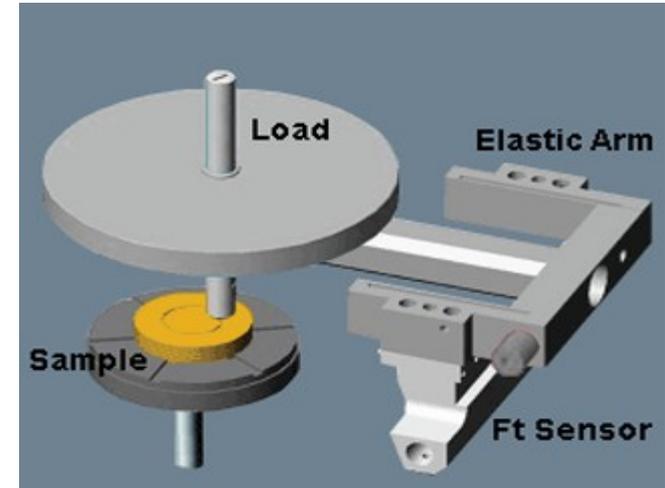
Aim of the test

- 1) **Compare the wear behaviour** of the laser track area and the overlap zone
- 2) Compare the wear of laser-hardened and induction-hardened materials

Test conditions

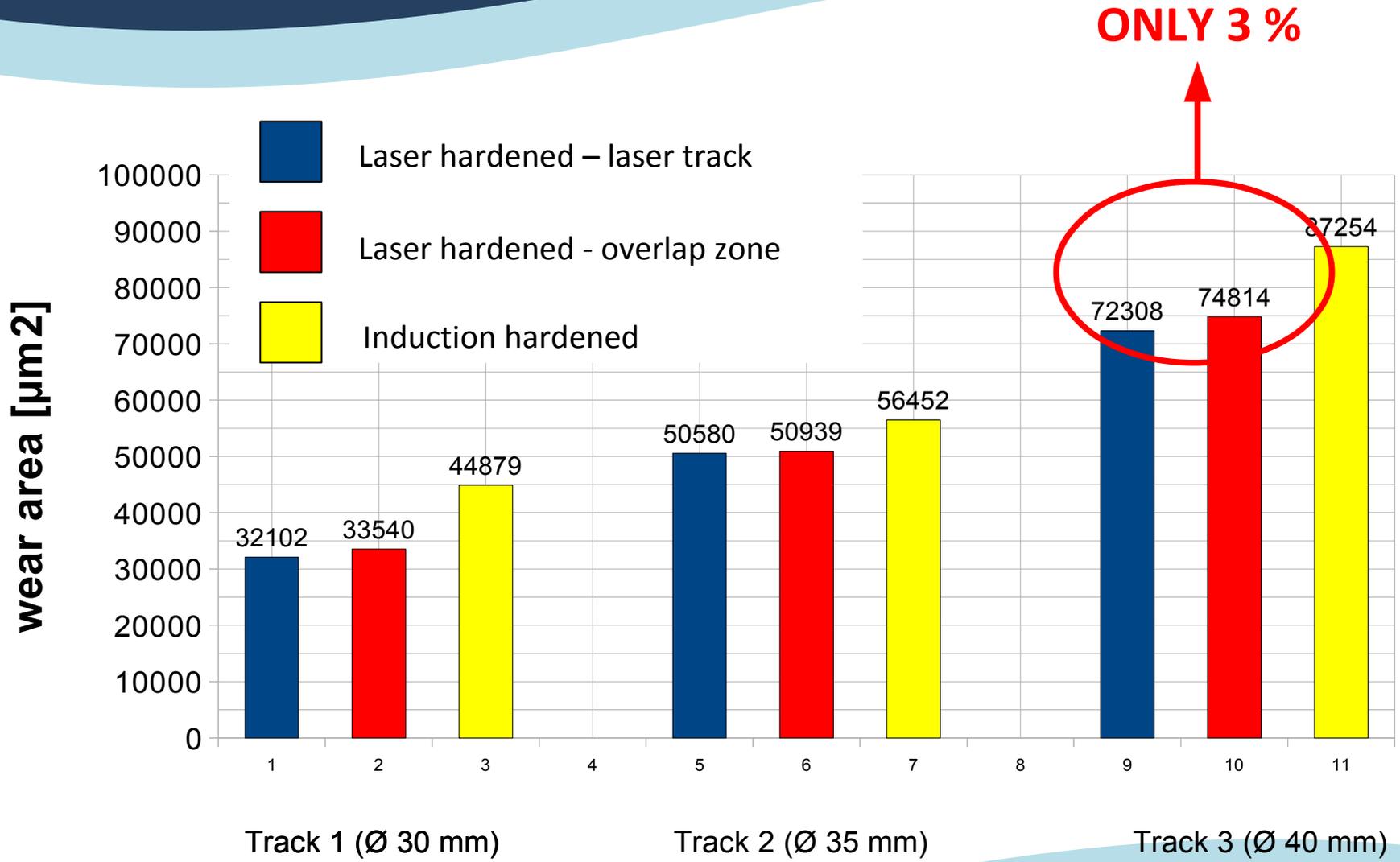
- 42CrMo4 steel (ČSN 15 142)
- Hardness after laser surface hardening: **55 HRC**
- Number of cycles: 100 000
- PIN material: Al₂O₃

- wear profile was measured in Palacký university in Olomouc



Sample hardened by laser

Pin-on-Disk Test Results



Wear tests

2) CYCLIC IMPACT TEST

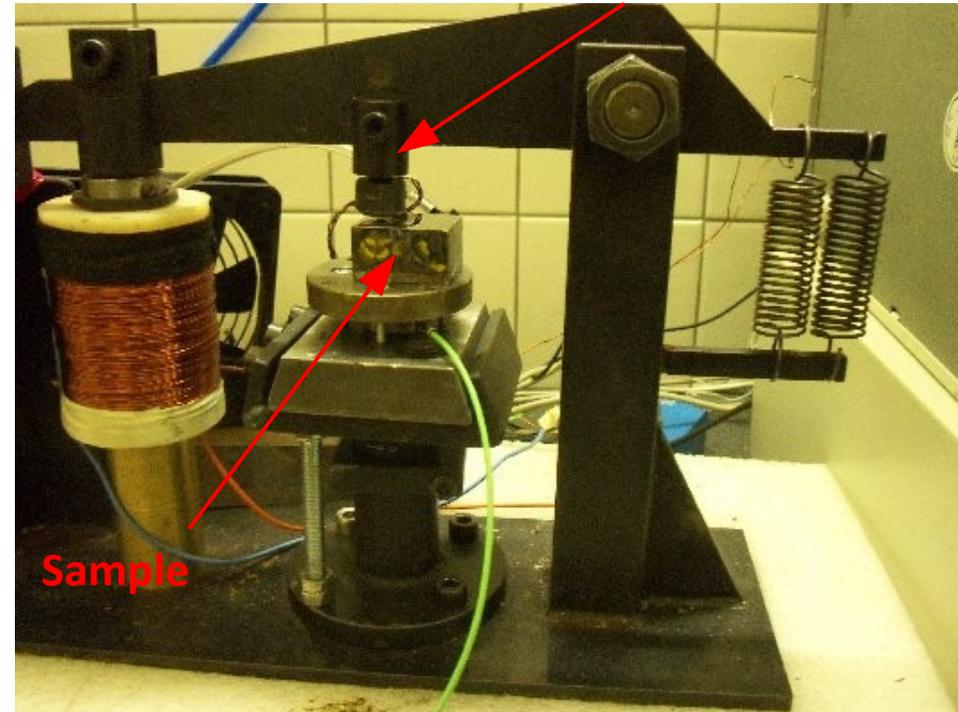
Aim of test

- 1) Compare the wear of laser-hardened surface and induction-hardened surface

Test conditions

- Materials
 - 1.2379 (ČSN 41 9573)
 - 1) soft-annealed
 - 2) quenched and tempered
 - 1.6582 (ČSN 41 6343)
 - 1) quenched and tempered
- Number of cycles = 100 000
- $F = 400 \text{ N}$
- 6 impact craters were created in each specimen
- Crater area was measured
- An arithmetic characteristic of the wear area was obtained
- 1.6582 and 1.2379 steels were used

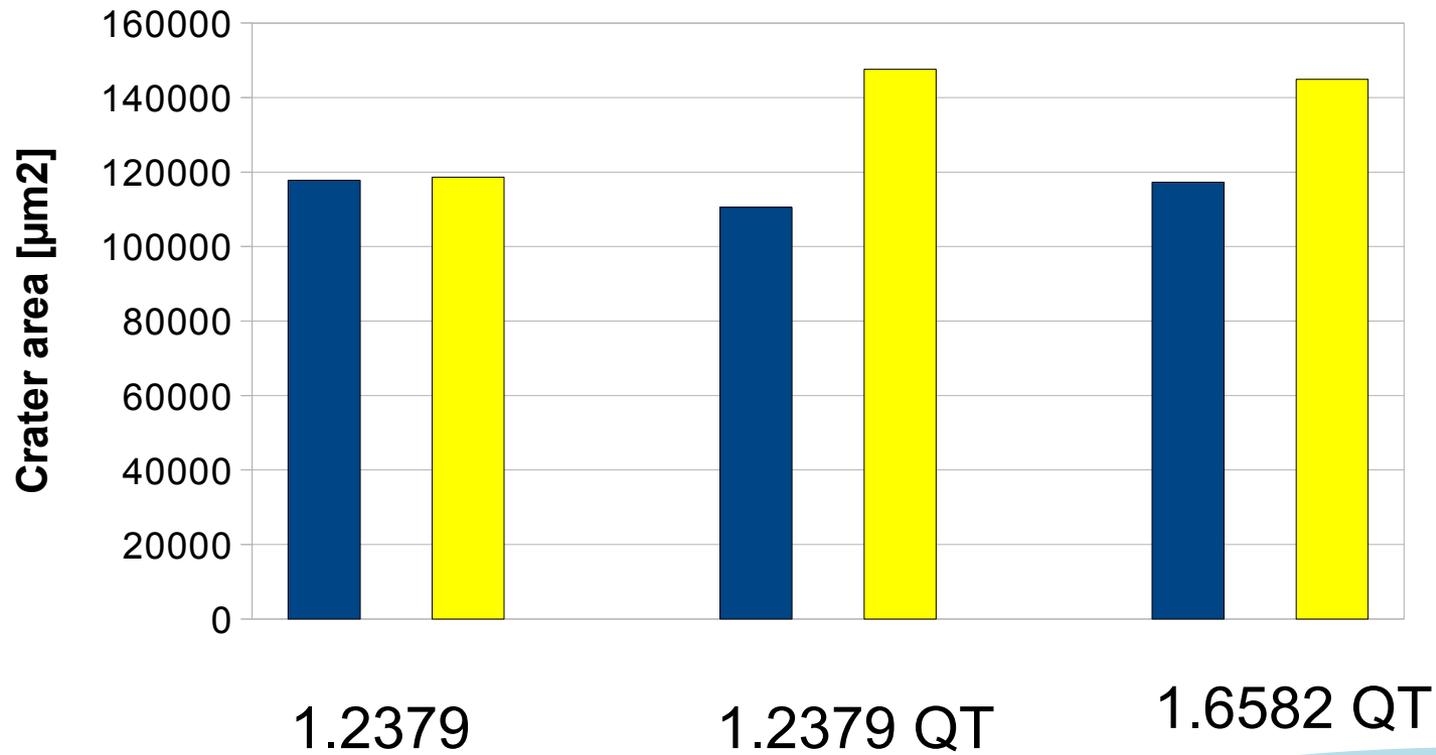
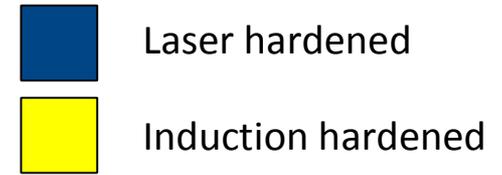
Hammer



Sample

Impact test

Impact test results



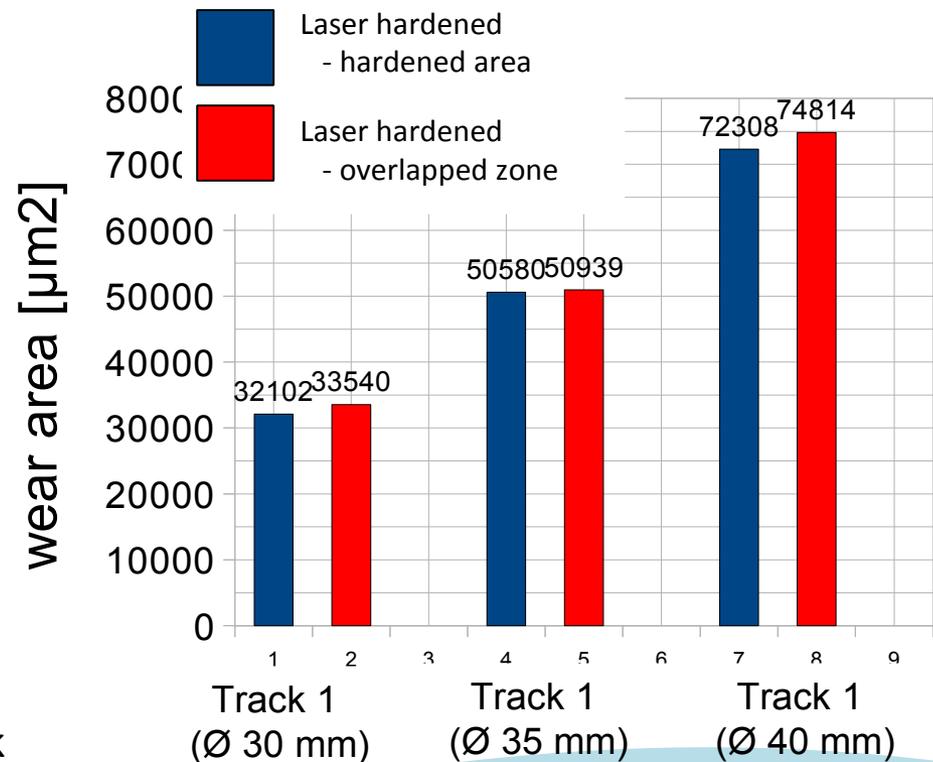
Conclusion

1) DIFFERENCES BETWEEN WEAR OF OVERLAP ZONE AND HARDENED AREA AFTER LASER SURFACE HARDENING (PIN-ON-DISK TEST)

- Average amounts of wear were evaluated for the overlap area and the laser track area
- 42CrMo4 material

Wear tests **have not shown** a **large deviation** in the amount of wear in the overlap area.

The biggest difference between amounts of wear in overlap and track zones **was 3 %**.



Conclusion

2) DIFFERENCES BETWEEN WEAR OF LASER SURFACE HARDENING (OVERLAP AND HARDENED AREA) AND INDUCTION HARDENING (PIN-ON-DISK TEST)



Wear tests revealed that the wear rate is much higher in induction-hardened steel than in laser-hardened steel



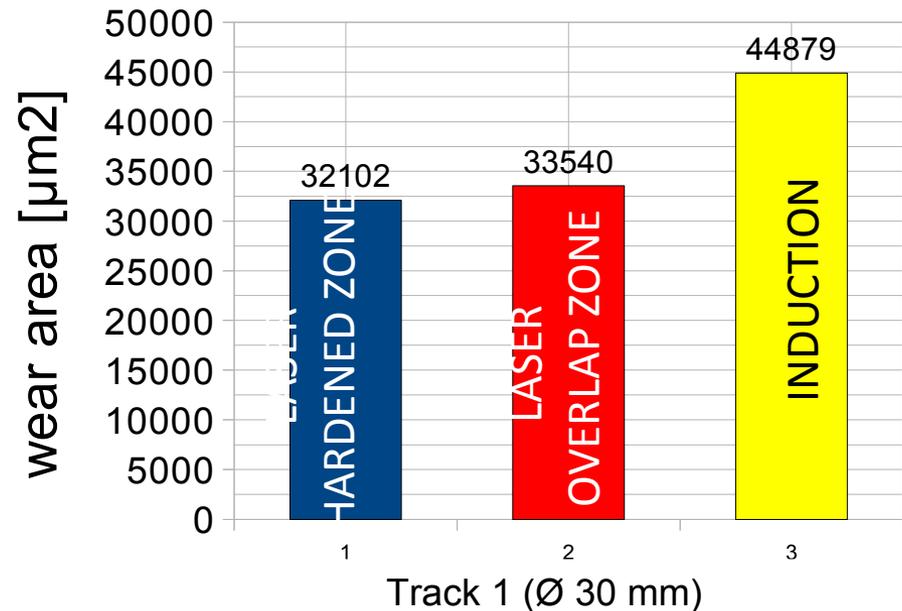
Reduced component life



Need for more frequent replacement in service



Approx. 15% increase in costs

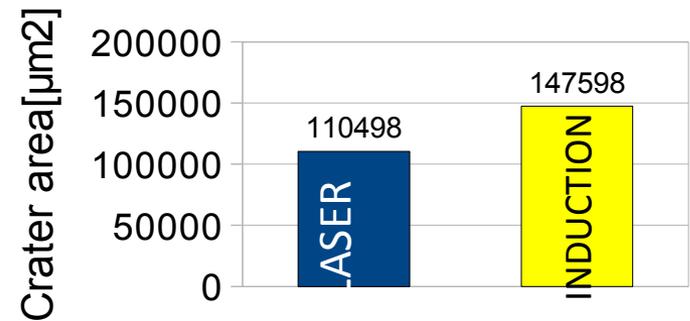


Conclusion

3) DIFFERENCES BETWEEN WEAR OF LASER-HARDENED SURFACE (OVERLAP AND LASER TRACK AREAS) AND INDUCTION-HARDENED SURFACE (IMPACT TEST)



The cyclic impact test revealed considerably higher wear rates under dynamic loading in induction-hardened steel than in laser-hardened steel



1.2379 QT

If you would like to have a lower wear...

LASER



THANK YOU FOR YOUR ATTENTION

LITERATURE

- [1] www.matexpm.com
- [2] www.sciencedirect.com
- [3] www.indiamart.com
- [4] www.mtjgg.com
- [5] www.laserarc.com