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NIDEC MACHINE TOOL CORPORATION

Ein Mehrprozess-Maschinenkonzept für die Endbearbeitung von Innenverzahnungen

A multi-process machine concept for internal gear finishing

Aachen Forum on Gear Production, Aachen

Presenter: Adrianos Georgoussis

Momo Sakakibara, Adrianos Georgoussis

12-13. November 2025

Gliederung · *Agenda*

1. Herstellungskette von Innenverzahnung
   Manufacturing chain for internal gears

2. Ausgewählte Ergebnisse mit Nidec ZI-Series
   Exemplary results with Nidec ZI-Series

3. Weichschleifen von Innenverzahnungen
   Soft grinding of internal gears

Herstellung von Innenverzahnungen
Manufacturing of internal gears

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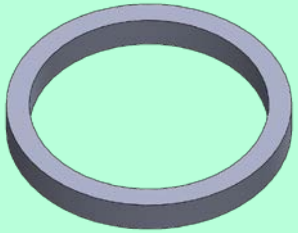
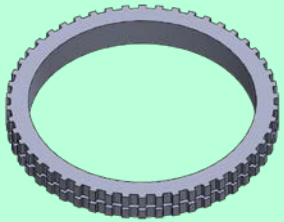
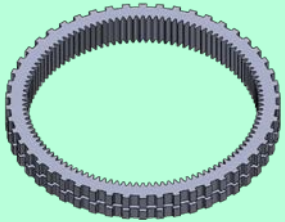
Drehen
Lathe

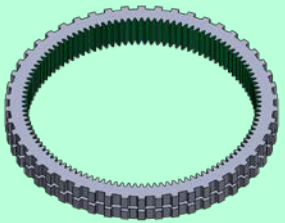
5-Achs Bearbeitung
5-Axes Machining

Zahnbearbeitung · *Gear machining*









Nidec Machine Tools Group

Nidec TAKISAWA

Nidec OKK

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Ergebnisse zum Innenwälzschälen
Internal gear skiving results

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Gear Data

m_n = 1.25 mm
z = -85 -
a_n = 20 °
β = 20 ° LH
q = 90 µm
JIS SCM415
DIN 20MnCr5

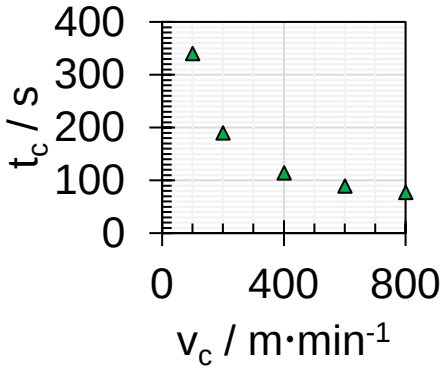
Tool Data

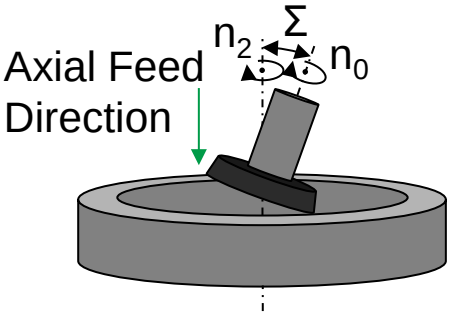
z = 47 -
d_a = 60 mm

Process Data

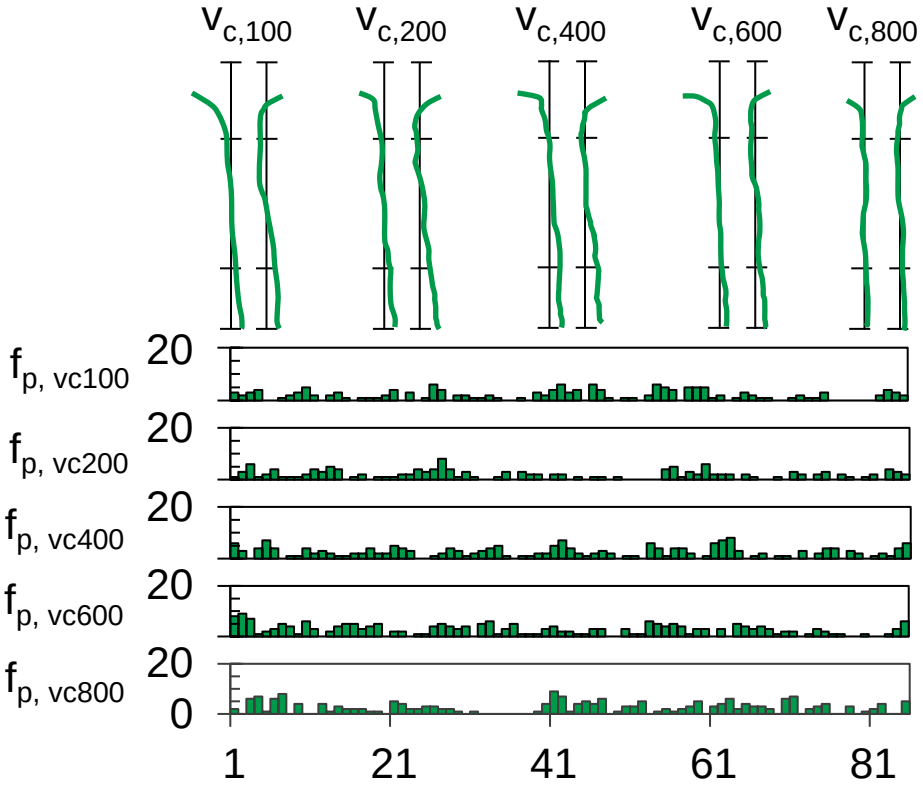
Σ = 20 °

Testing plan





Profile



Ergebnisse zum Innenwälzschleifen

Internal gear grinding results

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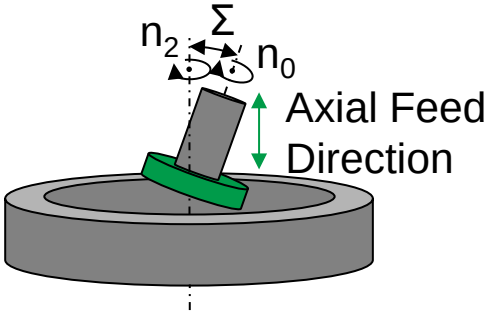
Gear Data

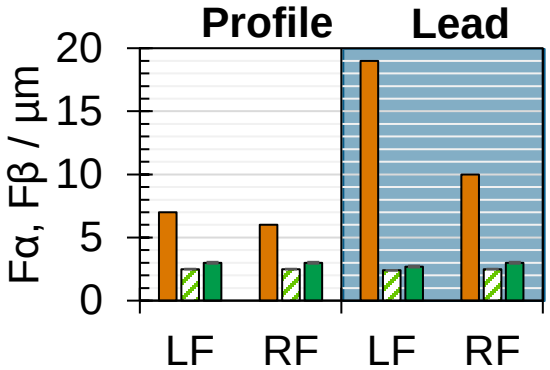
m_n	= 1.25	mm
z	= -85	-
a_n	= 20	°
β	= 20	° LH
q	= 90	µm

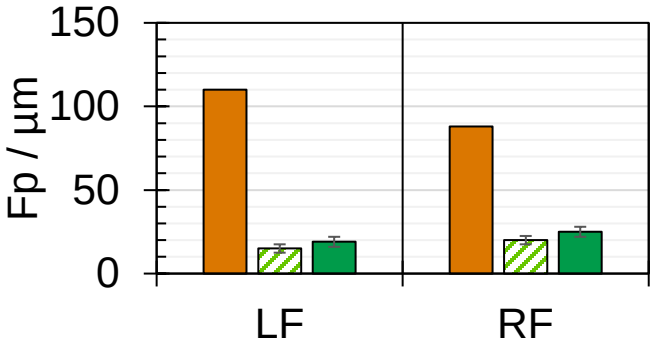
HRC 58 - 63

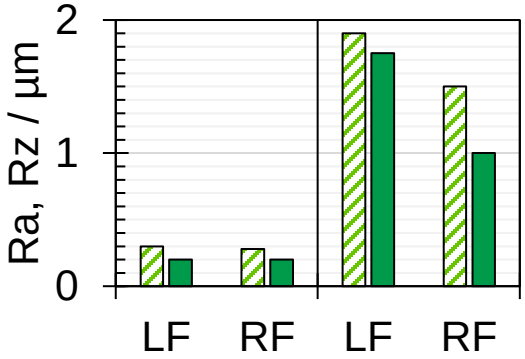
JIS SCM415

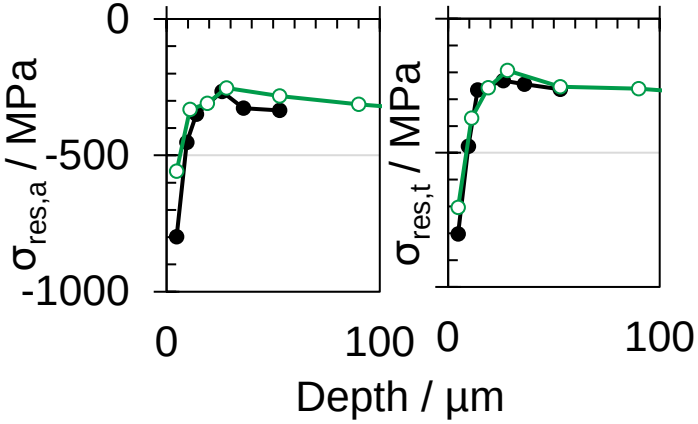
DIN 20MnCr5











- Before Grinding
- After Grinding (Focus: Tool life)
- After Grinding (Focus: Cycle Time)
- Internal Generating Grinding
- Profile Grinding

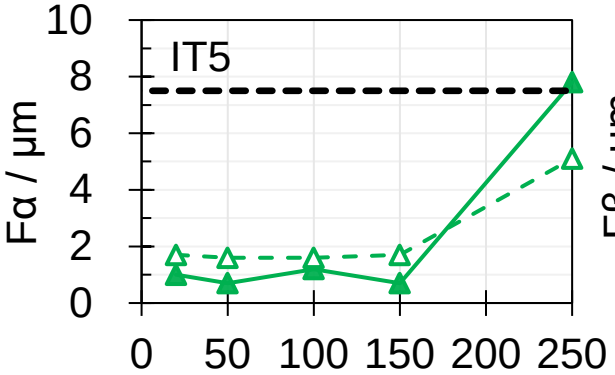
Ergebnisse zum Innenwälzpolieren

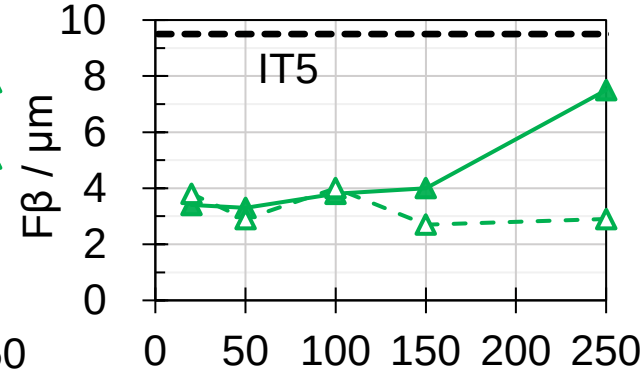
Internal gear polishing results

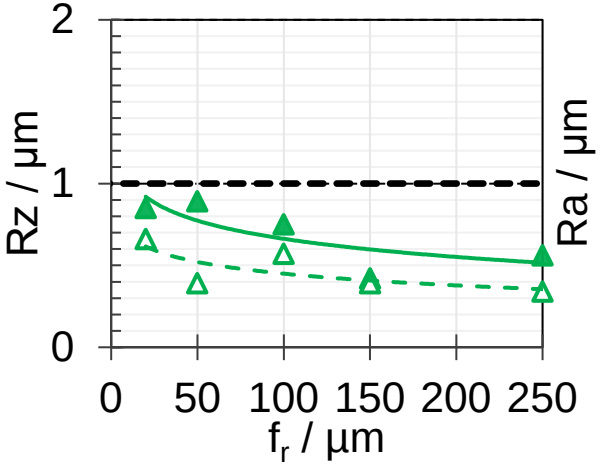
Gear Data

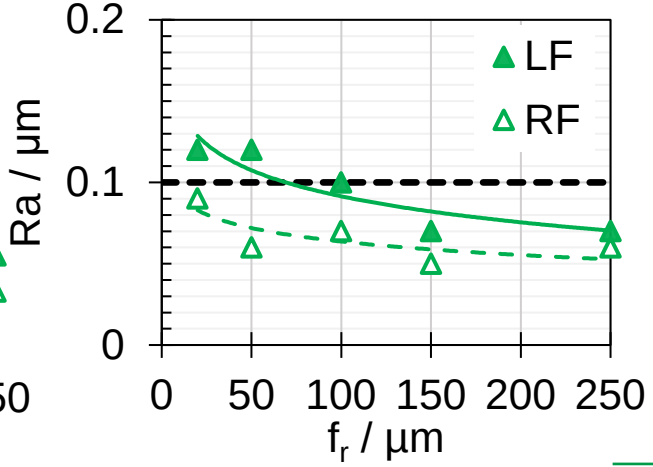
m_n = 1.25 mm
z = -85 -
a_n = 20 °
β = 20 ° LH

HRC 58 - 63
JIS SCM415
DIN 20MnCr5









Ergebnisse zum Außenwälzschleifen mit der Nidec ZI-Serie

External generating gear grinding results with the ZI-Series

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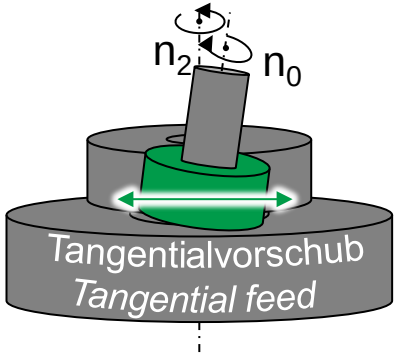
Gear Data

m_n = 1.6 mm
z = 22 -
a_n = 21 °
β = 25 ° LH
q = 0.13 mm
HRC 58 - 63
JIS SCM415
DIN 15CrMo5



Tool Data

z = 67 -
d_a = 120 mm
Noritake
CZ 120 V 700P

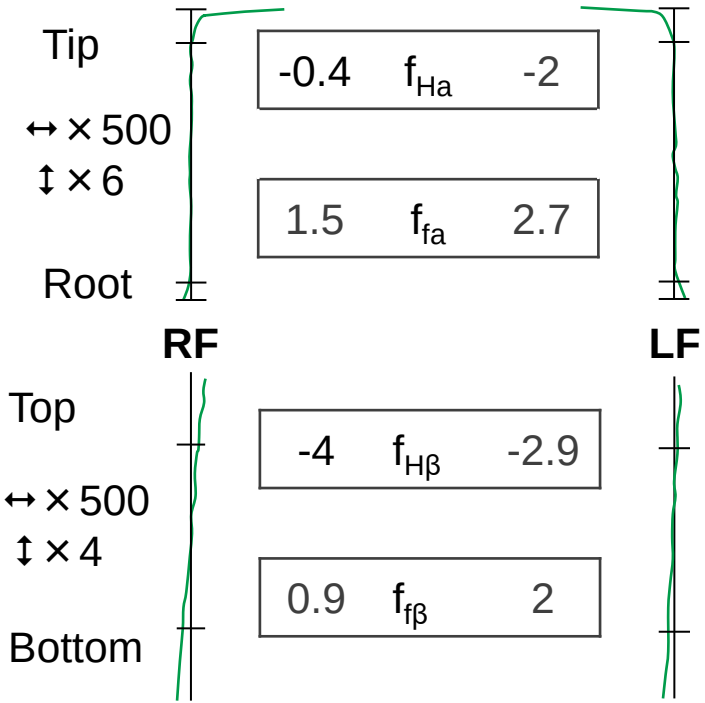
Dress Data

n = 300 rpm
v_f = 4.6 mm/min

Process Data

n = 5500 rpm
v_f = 5.3 mm/min
N = 6 -
Σ = 5 °
ZI20A - G

Average of all measured flanks



Verfügbare Prozesse in der ZI-Serie
ZI-Series Process availability

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	Innenverzahnung *Internal gear*	Außenverzahnung *External gear*
Schleifen *Grinding*	✓	✓
Polieren *Polishing*	◑	◔
Wälzschälen *Skiving*	◕	◑
Honen *Honing*	◌	◌

◔ Machbarkeit bewiesen
Feasibility proven

◕ Umgesetzt in Industrie
Industrial application

◑ Aktiver Verkauf
Marketed Product

✓ Etablierter Prozess
Widespread Application

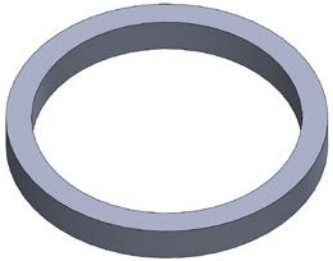
Gliederung · *Agenda*

1. Herstellungskette von Innenverzahnung
   Manufacturing chain for internal gears

2. *Ausgewählte Ergebnisse mit Nidec ZI-Series*
   Exemplary results with Nidec ZI-Series

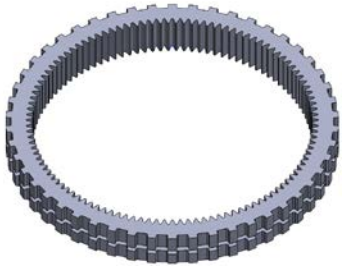
3. Weichschleifen von Innenverzahnungen
   Soft grinding of internal gears

Innenwälzschleifen im weichen Zustand
Internal Soft Gear Grinding

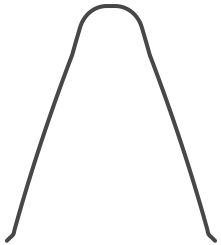


Initial machining operations

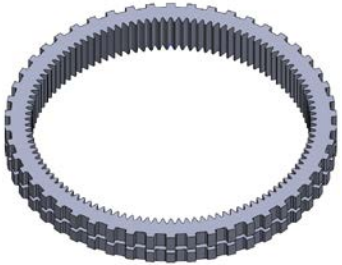
After Hobbing



Gear Skiving



- q = 50µm / Fl.
- d_f = 194,55



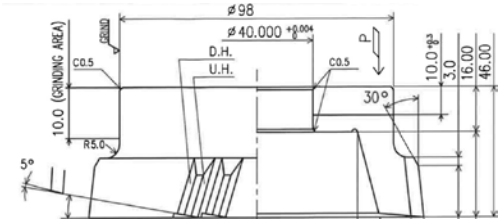
Gear Grinding

- Corundum
- z = 43
- Σ= 30°
- C/T < 120s
- ZI25A
- Qual. < DIN 7

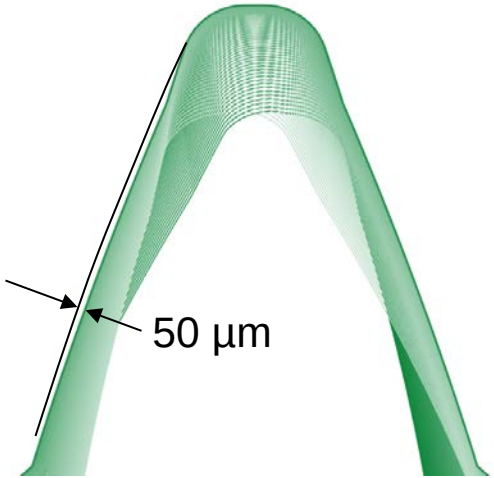
Wälzschälwerkzeug und Schleifsetup
Skiving Tool and Grinding Setup

Werkzeugdaten
Tool Data

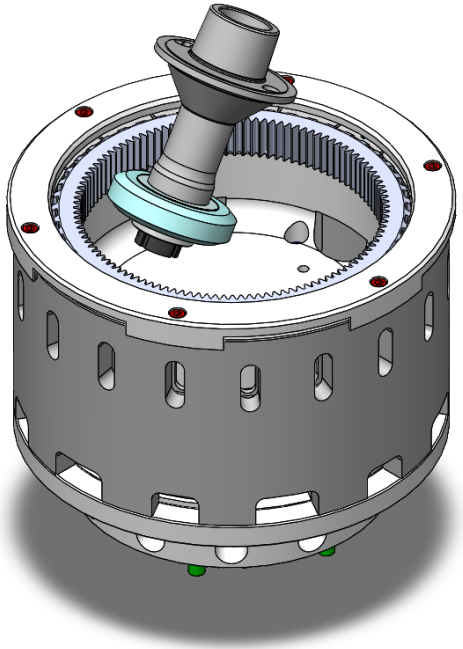
- z_2 = 70 -
- m_n = 1.6 mm
- τ = 5°
- q = 0,05 mm/Fl.
- d_a = 119.864mm
- Σ = 20.346°
- Mat. = GRANMET SK
- Coat= MightyShield Σ



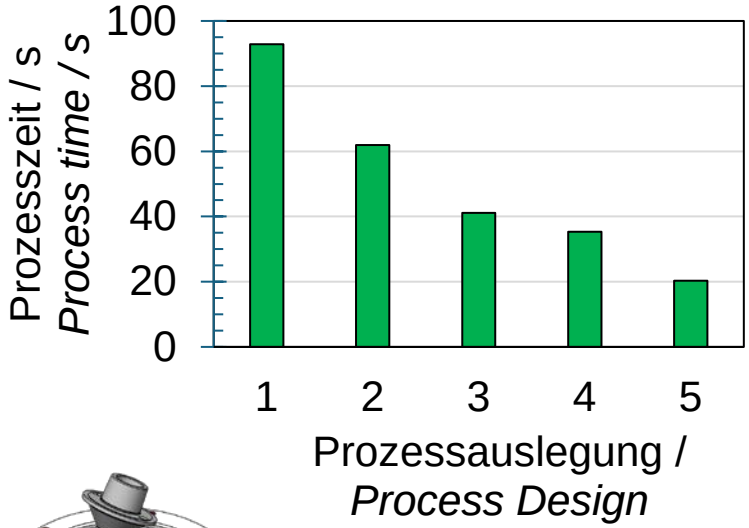
Abwälzdiagramm
Generation Diagramm

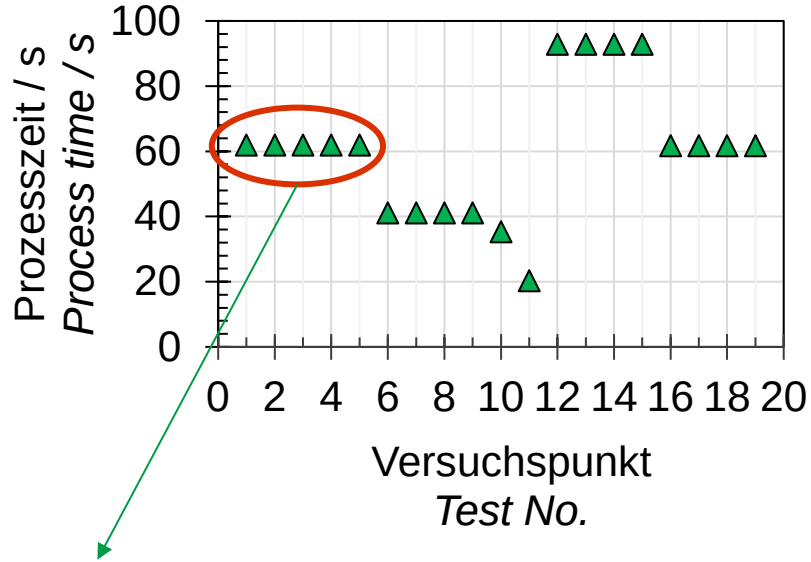


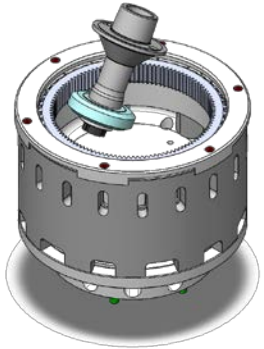
Schleifsetup
Grinding Setup



Versuchsplanung
Design of Experiments



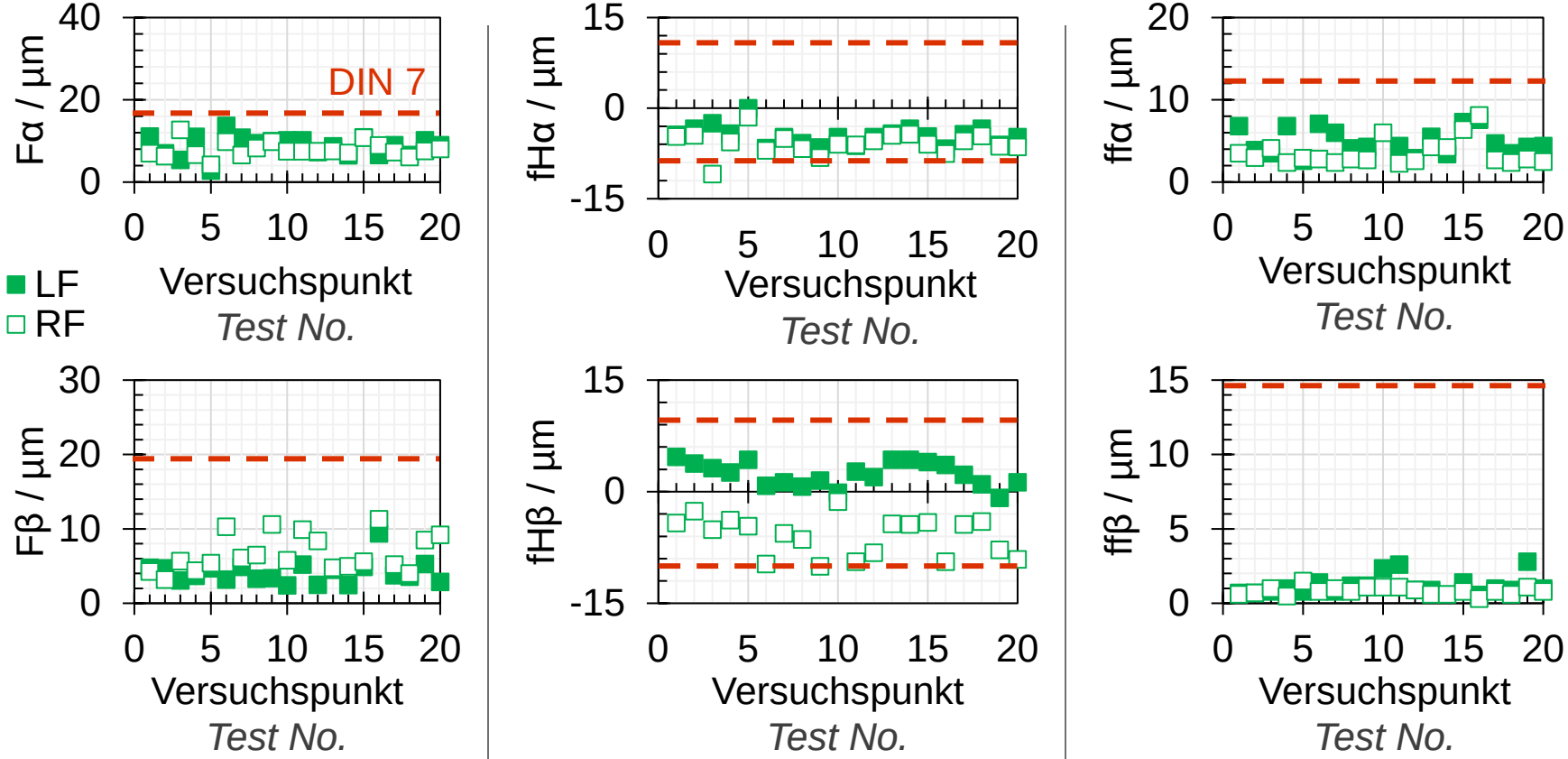




Variation von Prozessparameter und Schleifscheibenspezifikation
Variation of process parameters and tool specifications

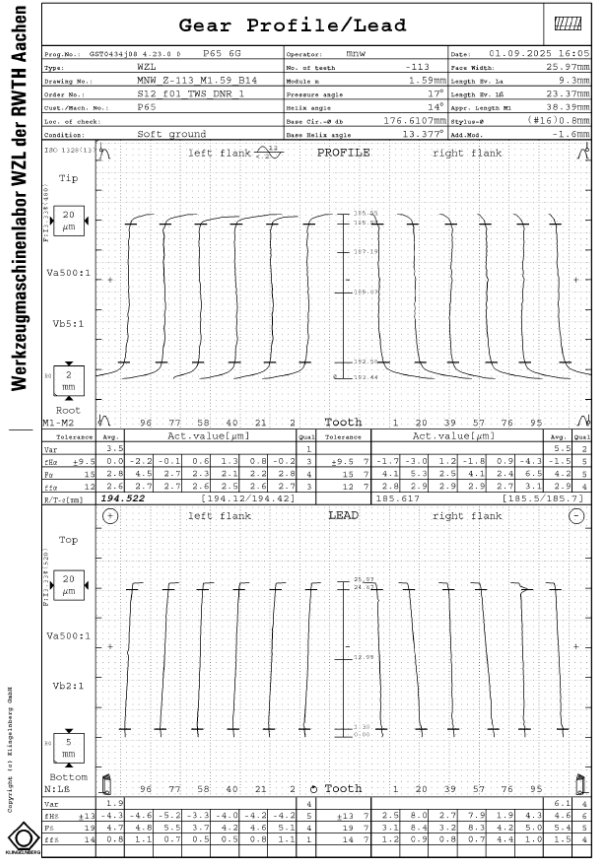
Endbearbeitung – Verzahnungsqualität

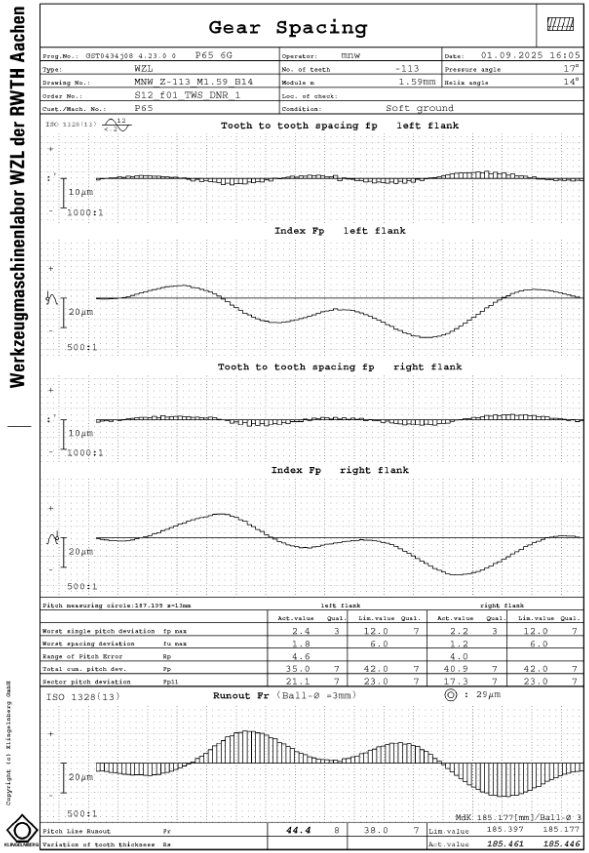
Finish grinding – Gear Quality



Bisher bestes Ergebniss…

Best results so far…





Zwischenfazit
Interim Summary

- **Die ZI-Serie für das Innenwälzschleifen ist von einer Schleifmaschine zu einer Mehrzweck-Plattform für die Verzahnungsfeinbearbeitung entwickelt.**
  Over the last years, the ZI-Series for internal generating grinding has evolved into a multiprocess platform for gear finishing
- **Die ZI-Serie ist für das Innen- und Außenwälzschleifen, -Polieren sowie -Wälzschälen qualifiziert.**
  Internal and external generating grinding, polishing, and gear skiving are now integrated and available within the platform.
- **Der nächste Schritt in der Weiterentwicklung der Plattform wird die Integration des Verzahnungshonens sein. Die entsprechenden Entwicklungsprojekte sind bereits im Gange.**
  The next step in the platform's evolution will be the integration of gear honing. The development projects are already in progress.
- **In Zusammenarbeit mit Schaeffler wurden Versuche zum Weichschleifen von Zahnrädern durchgeführt.**
  In cooperation with Schaeffler, soft gear grinding trials were performed.
- **Die Werkstücke wurden aus der Serienproduktion entnommen, indem ein neues Wälzschälwerkzeug mit Protuberanz eingesetzt und die Schlichtschnitte des Wälzschälprozesses weggelassen wurden.**
  The parts were obtained from series production by introducing a new skiving tool with protuberance and omitting the final skiving finishing cuts.
- **Das Ziel war es, eine Verzahnungsqualität nach DIN 7 zu erreichen, was gelungen ist und unter bestimmten Versuchsbedingungen sogar übertroffen wurde.**
  The target was to achieve a gear quality of DIN 7, which was accomplished and, under certain testing conditions, even surpassed.

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