Universal & productive Hobbing Machine

LC 180 / 280 (DC)

LIEBHERR

20% Performance boost

LC 180/ 280 (DC)

Workpiece:

– Max. Ø 280 mm

– Module: up to 6 mm

Main Market:

– Automotive Industry

– Supplier

– Job Shopper

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Universal & flexible for every application

Hobbing

Worm wheel hobbing

Stack machining

Skive Hobbing

Advantages

- Optimized stiffness of the machine bed with FE Analysis model
- Thermo-symmetrical machine design for constant high quality
- Safe and problem-free removal of chips
- Wet and dry processing
- High flexibility for different processes:
  - Gears, shafts, worm gears
  - Cluster gearing
  - Skiving
- Positioned/ Oriented gear teeth
- Hook-ready machine with compact floor space suitable for straightforward implementation
- Hand or machine, internal crane loading

Siemens Sinumerik ONE

Control cabinet with machine controls "Siemens Sinumerik ONE“

SinumerikOne, Control with integrated PLC in control cabinet, in connection with SIEMENS drive technology.

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Work area

- Large box guideway for best damping properties
- Perfect chip removal
- Highest thermal stability
- Capped off work area
- Perfect and ergonomic accessibility to the machine table.

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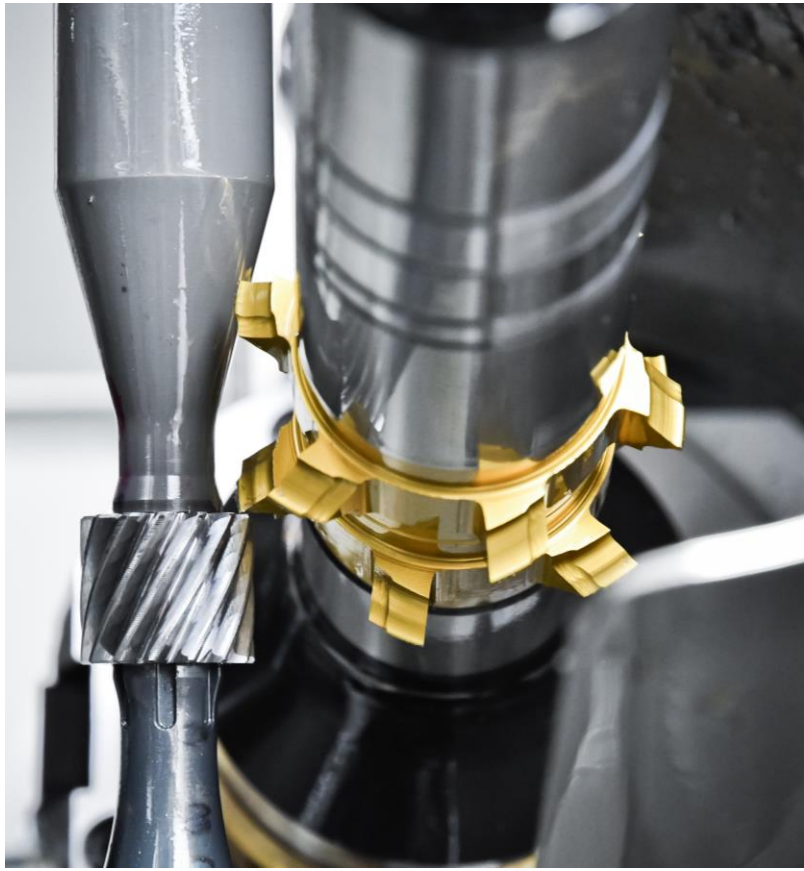
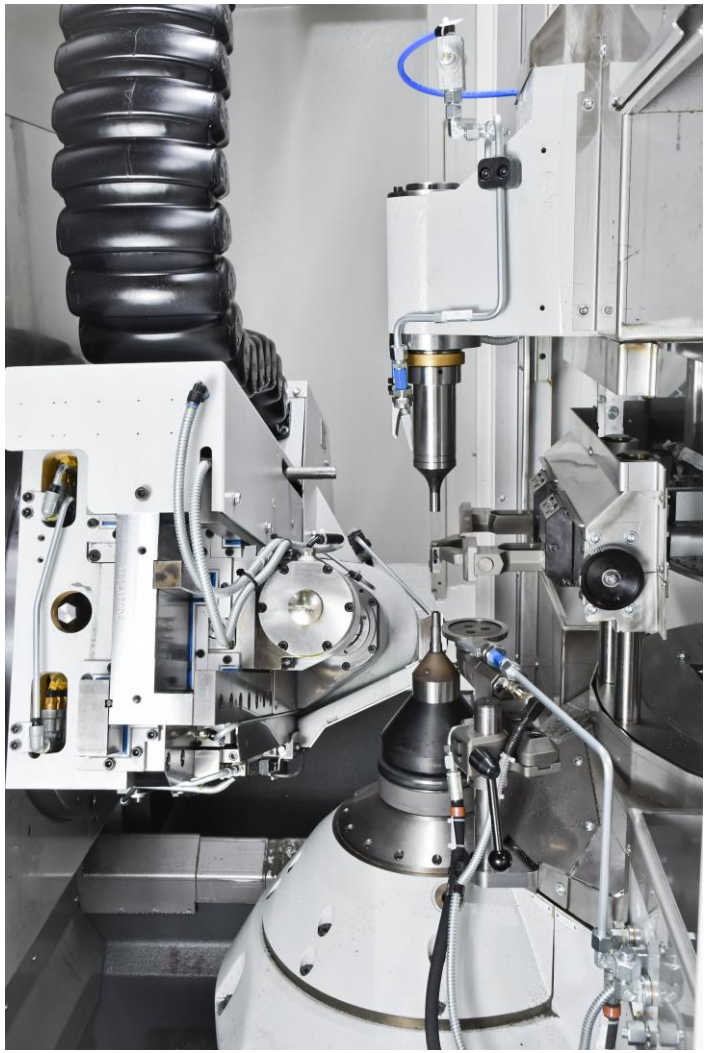
Impressions work area

Impressions work areas



Stack machining LC 180/280

LC 180 DC - small gears hobbing and time parallel chamfering



Dry Machining

Dry Hobbing Package

Stainless steel cladding to prevent temperature effects

The LC 180/280 machines are designed for dry cutting but can easily be equipped for wet machining.

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M/C Design

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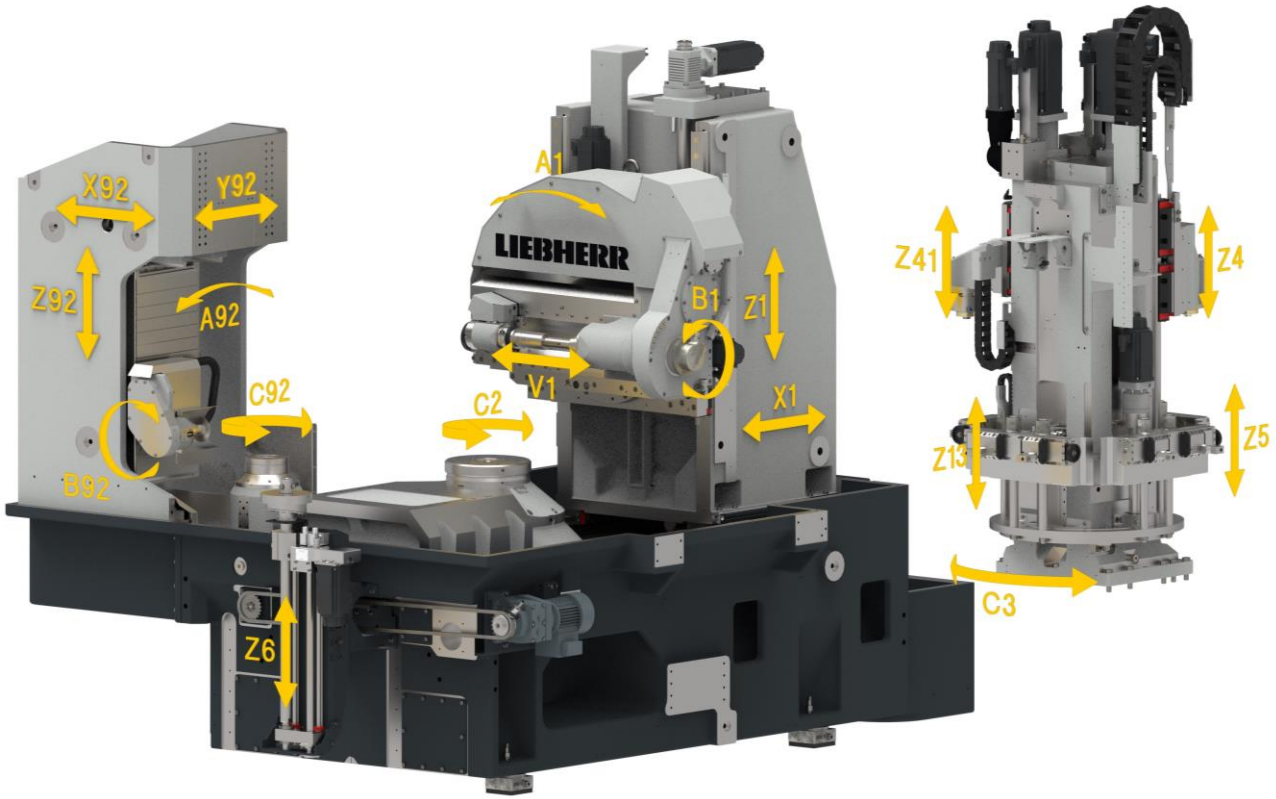
LC 180/ 280 DC Machine Design



- Liebherr Machines are
  - compact
  - fast
  - reliable
  - Competitively priced
  - Closed Oil-circulation loop in the machine bed assure an extremely uniform temperature distribution
  - thermal stability
  - high workpiece quality
- higher hob and table speeds
- reliable removal of the hot chips
- comfortable maintenance

A1 – Swivel motion of tool

B1 - Rotary movement of tool

C2 - Rotary movement of workpiece

V1 - Tangential movement of tool

X1 - Radial movement of spindle slide

Z1 - Axial Travel of grinding head

C3 - Rotary movement of ring loader

Z4 - Vertical movement of counter column

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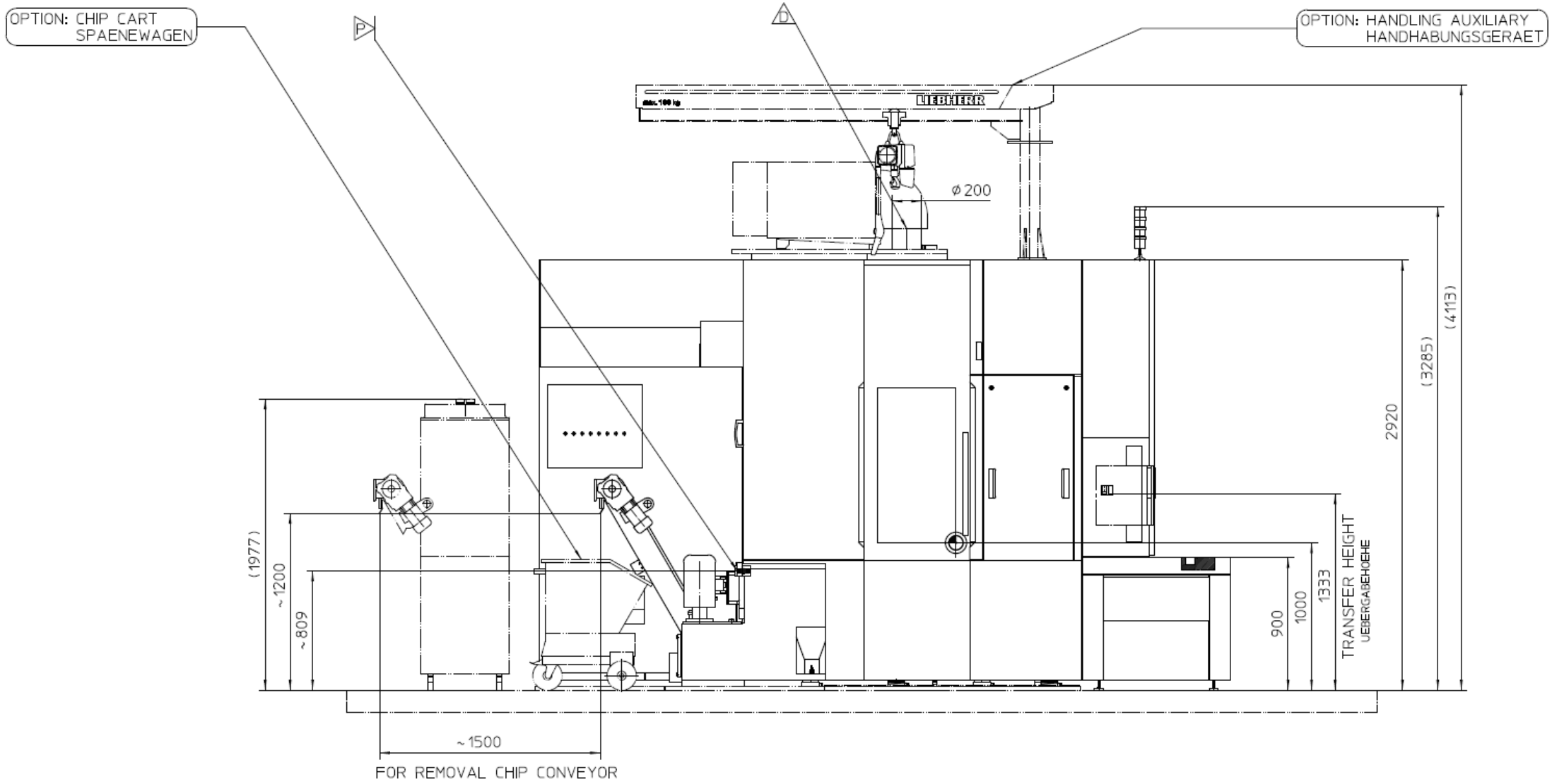
Machine Dimensions LC 180 / 280 DC



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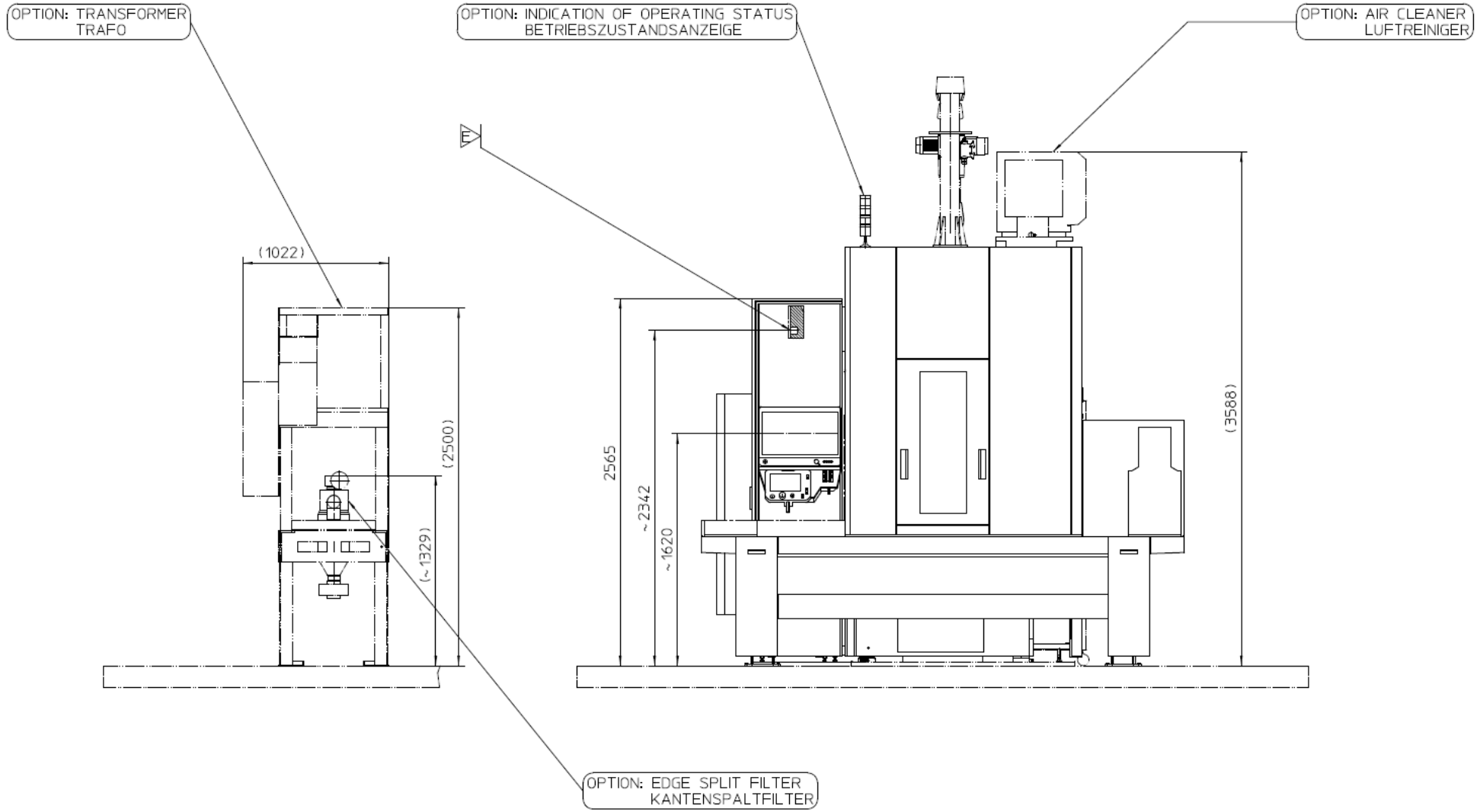
Machine Dimensions LC 180 / 280 DC



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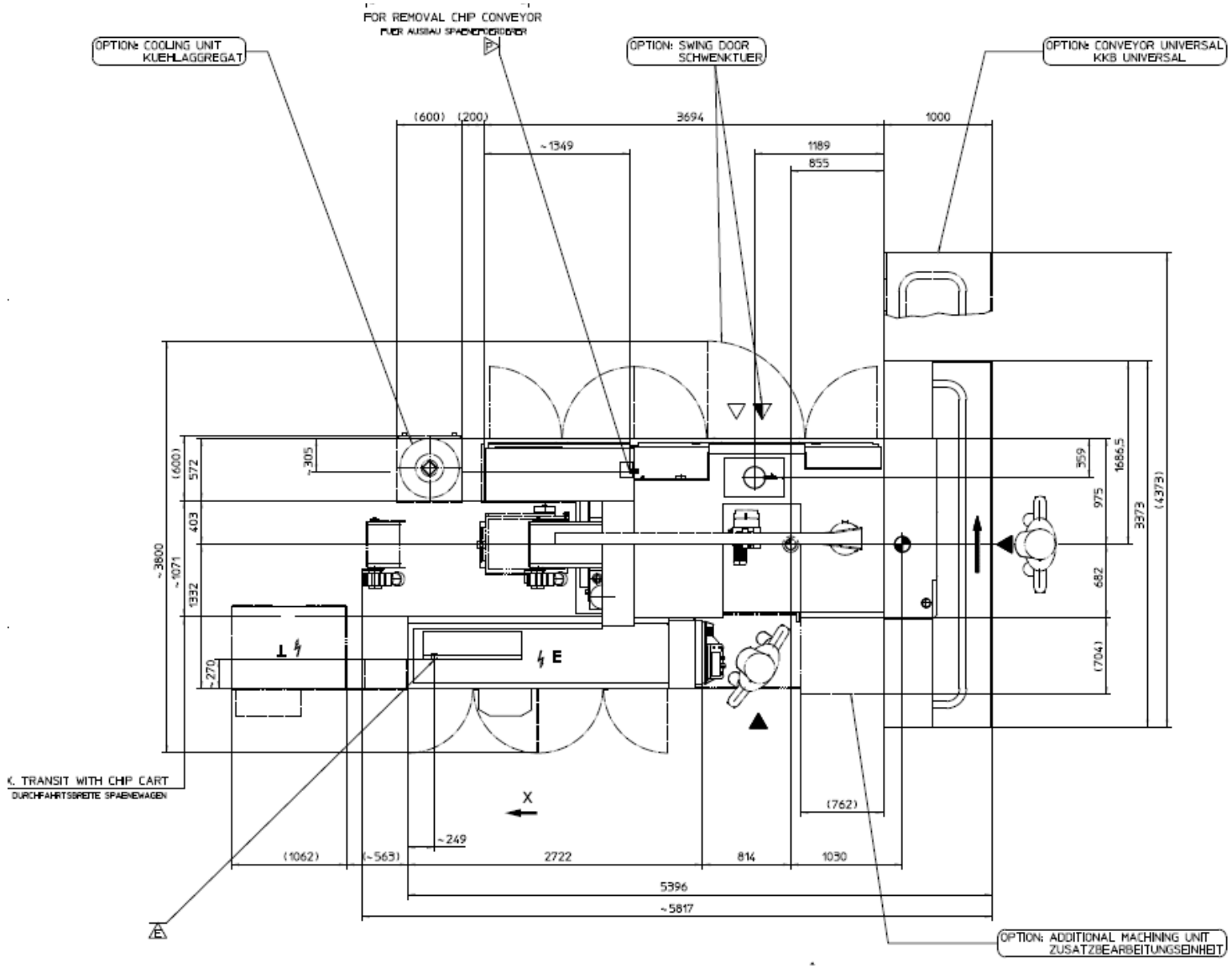
Machine Layout LC 180/ 280



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Hobbing Heads

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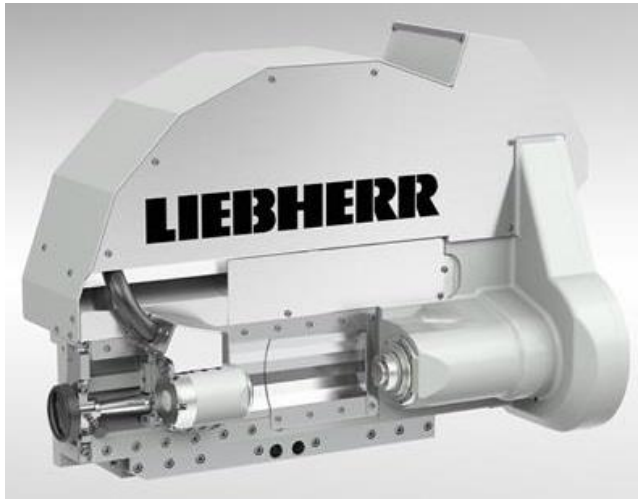
Gear driven Hob Head HH150

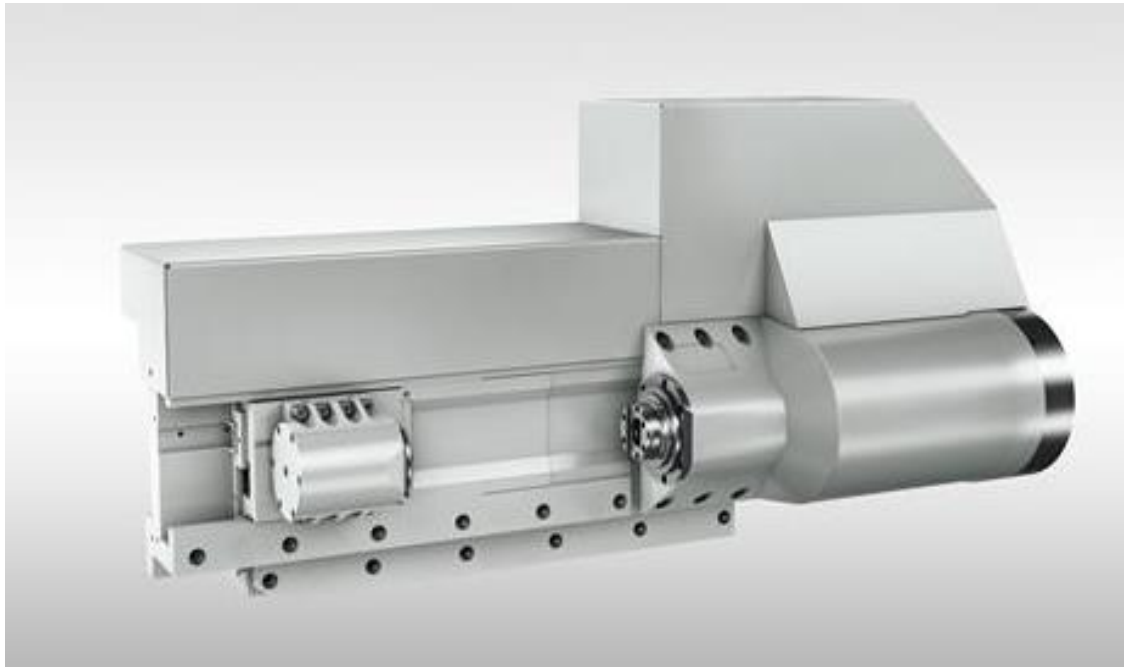
	HH 150
tool interface	Collet
max. hob diameter	150 mm
shift travel	200 mm
power	13,2 kW
speed	2250 1/min / i=4
max. module	6mm



Hobbing Head HH150

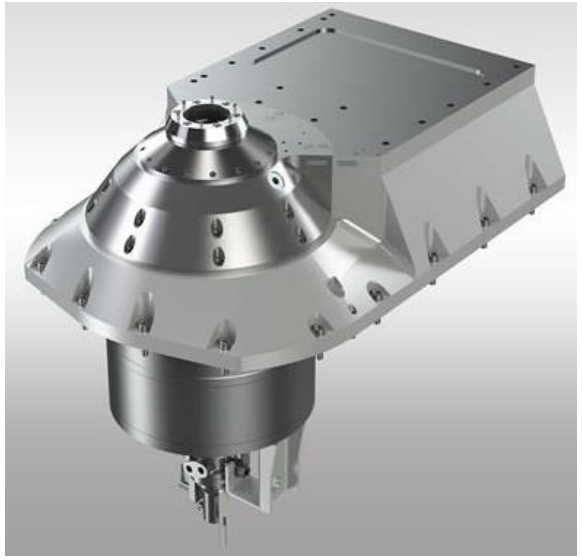
Direct driven Hob Head HH100 D

	HH 100 D (New)
tool interface	clamping collet Ø 32mm
max. hob diameter	100 mm (former 90 mm)
shift travel	180 mm
power	23 kW
speed	6.000 rpm
max. module	4 mm (former 3 mm)



Machine Table

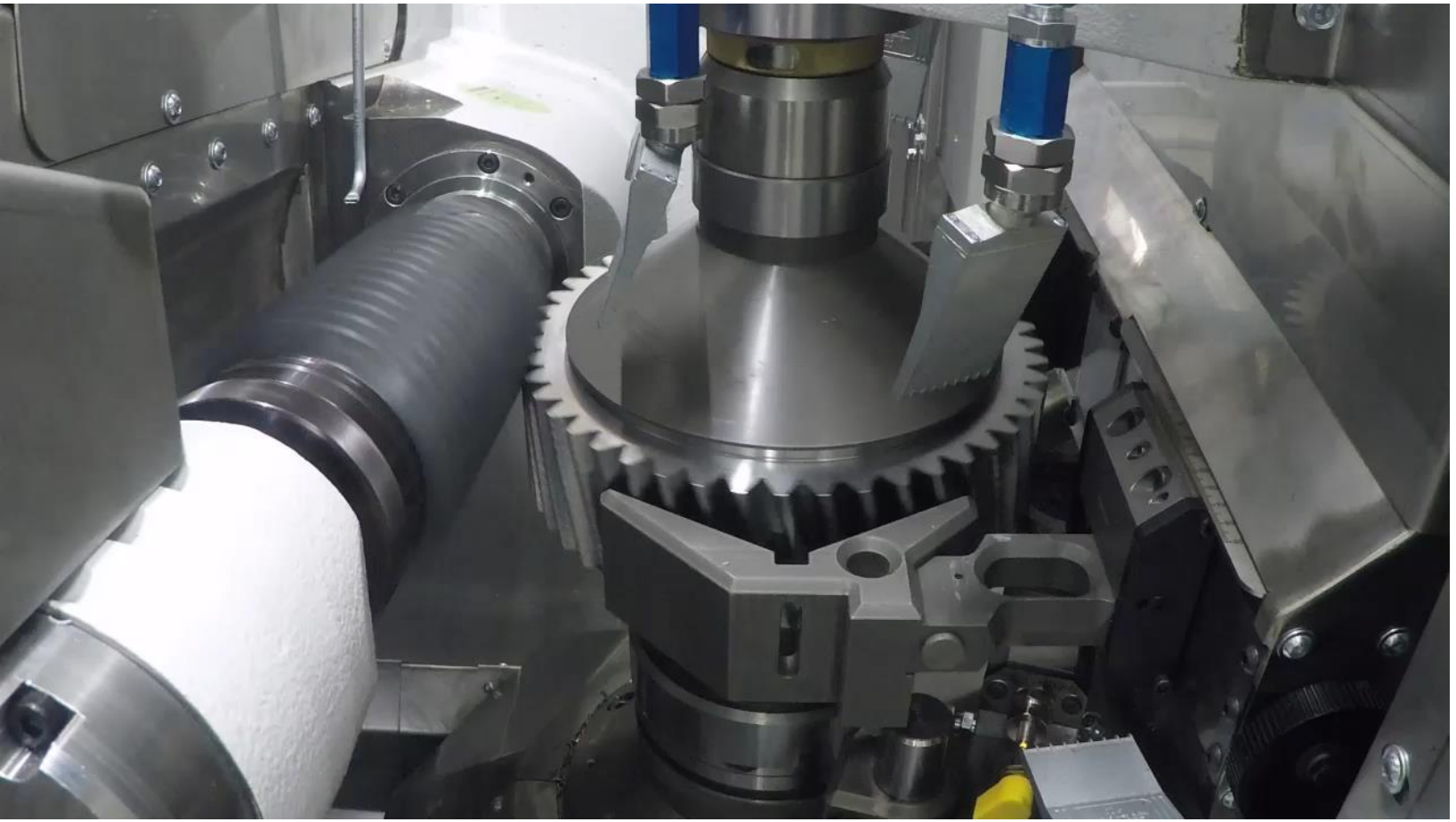
Hob Table	T-250
Drive	Gear Drive
Drive power (kW)	5,8
Gear ratio	12
Speed (rpm)	250
Table plate diameter (mm)	145
Table interface	Short taper KG 5



Hob Table	T-800 D
Drive	Direct Drive
Speed (rpm)	800
Table plate diameter (mm)	145
Table interface	Short taper KG 5

Universal Ringloader LC 180/ 280 DC

Loading and Unloading



- Max. workpiece diameter Ø 280 mm
- Highest flexibility for large diameter range
- Clamping Force 13 kN
- Workpiece weight of up to 15 kg
- Traveling distance:

  - 450 mm (Standard)
- Chip-to-Chip-time < 6 seconds
- NC-lowering stroke
- Quick Gripper Change

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Fixture quick changeover

Hydraulic clamping device

Clamping cylinder inside machine table.
Clamping pressure manually adjustable for clamping force up to 33 kN.

Second pressure level for unclamping of fixture for fixture quick change.

Clamping travel monitoring via displacement transducer.

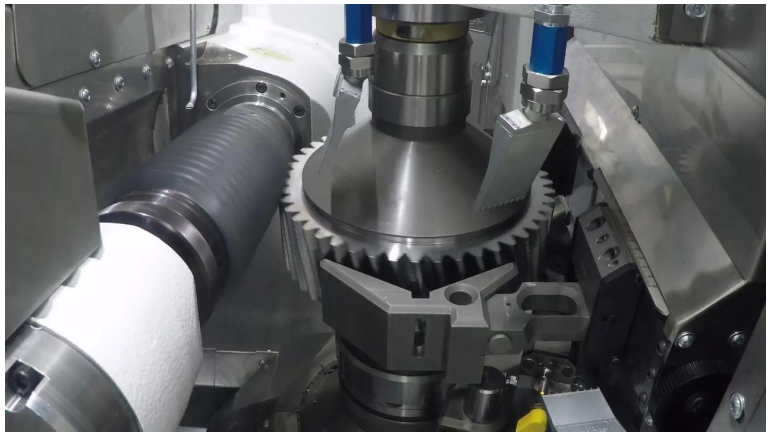
Benefit:

- No tools necessary
- Quick changeover

Universal Ringloader

Internal Automation

- Max. workpiece diameter Ø 280 mm
- Highest flexibility for large diameter range
- Clamping Force 13 kN
- Workpiece weight of up to 25 kg
- Travel distance: 450 mm (Standard)
- Chip-to-Chip-time < 6 seconds
- NC-lowering stroke 220 mm
- Quick Gripper Change



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Deburring & time parallel chamfering

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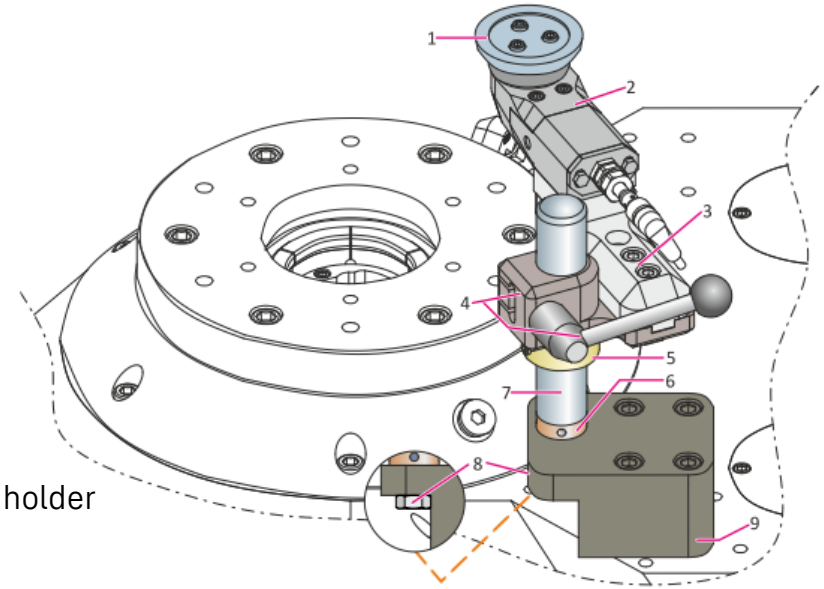
Rough Deburring



- Deburring disk
- Deburring disk holder
- Slide
- Holder with clamping lever
- Adjusting ring (height adjustment)
- Adjusting ring (shaft incline)
- Shaft
- Hexagon screw
- Console

Positioning the coarse deburring disk on the workpiece

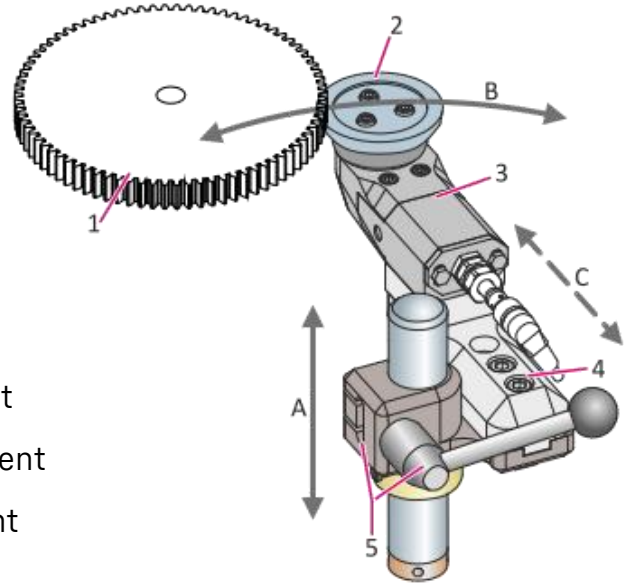
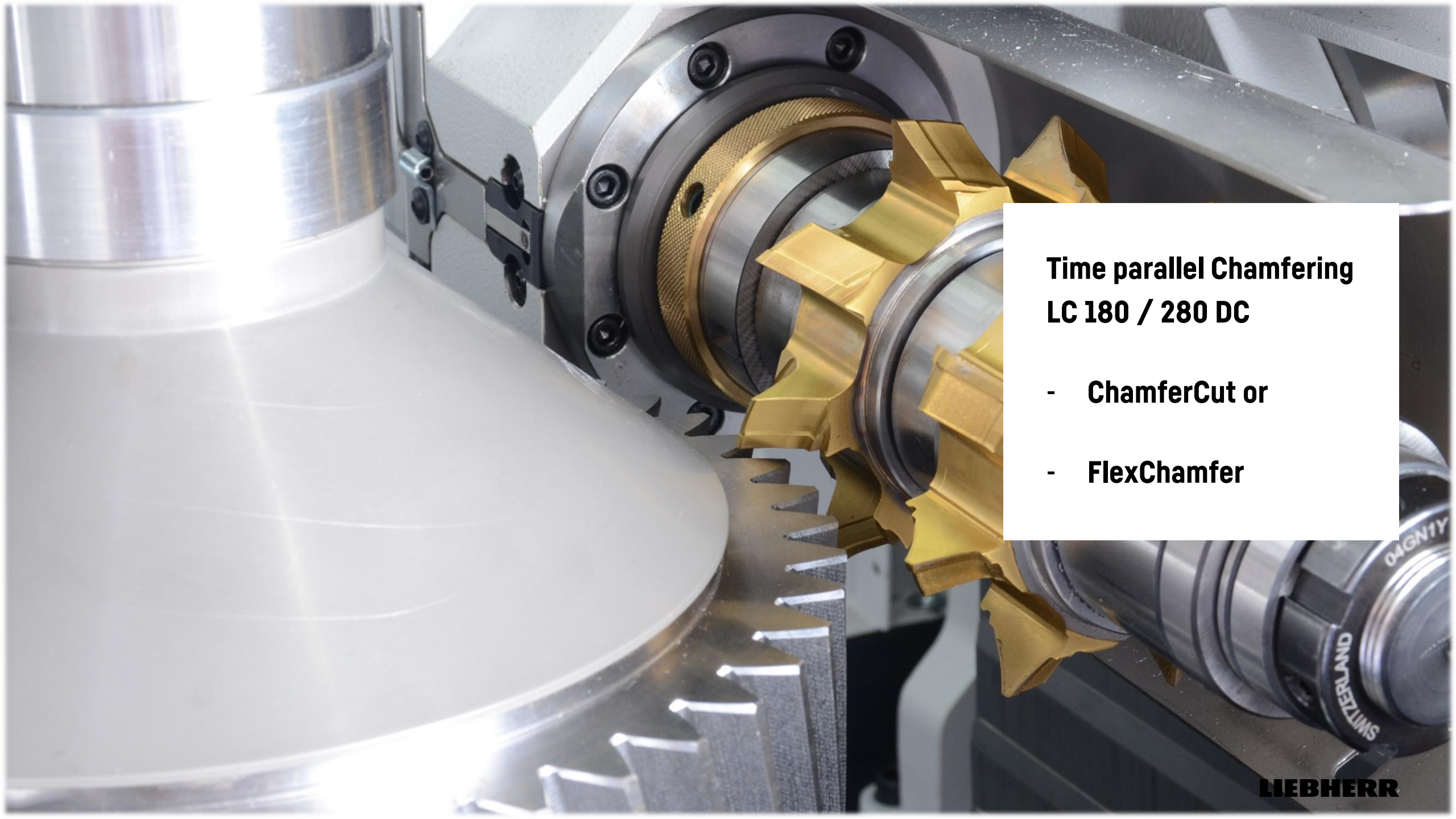


Fig. 6-4: Positioning the coarse deburring disk (example image)

- A Height adjustment
- B Swiveling movement
- C Length adjustment
- 1 Workpiece
- 2 Deburring disk
- 3 Deburring disk holder
- 4 Slide
- 5 Holder with clamping lever



Time parallel Chamfering
LC 180 / 280 DC

- ChamferCut or
- FlexChamfer

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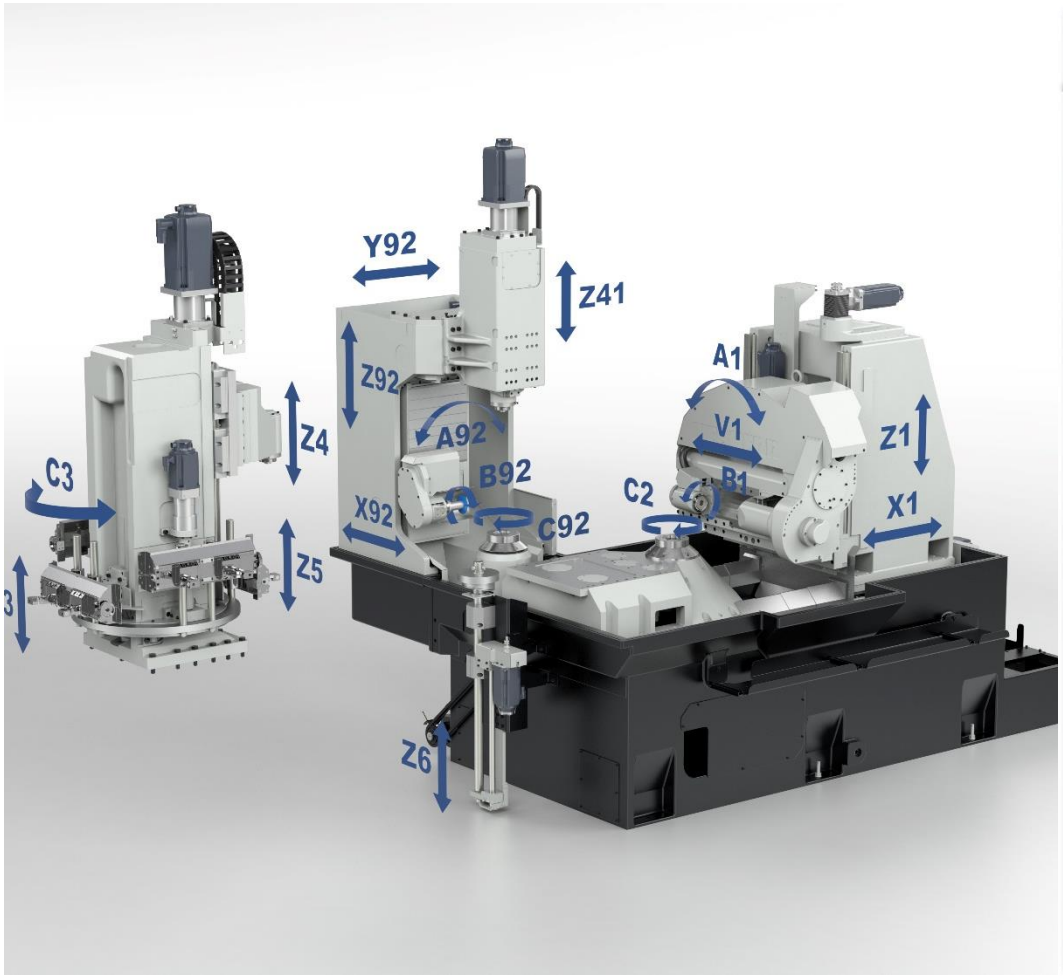
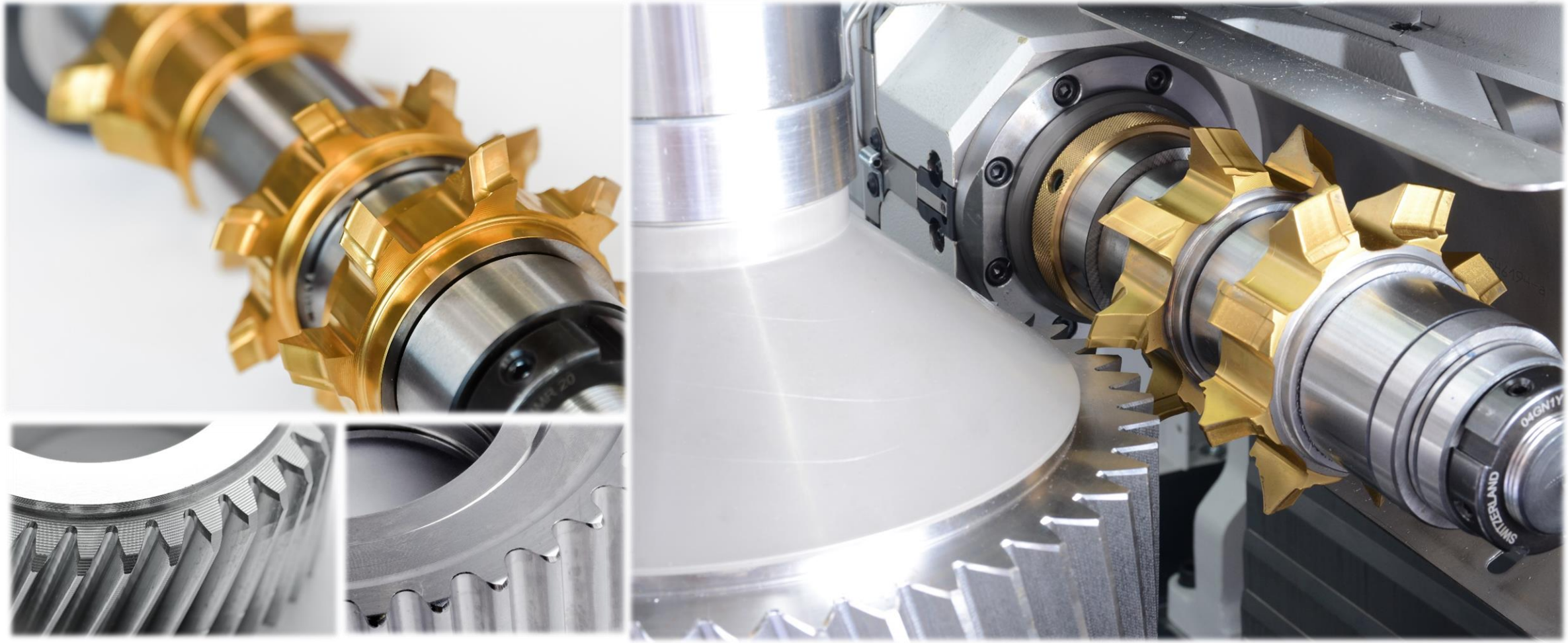
LC 180 / 280 DC with integrated ChamferCut Unit



ChamferCut - perfect for highly productive & efficient production



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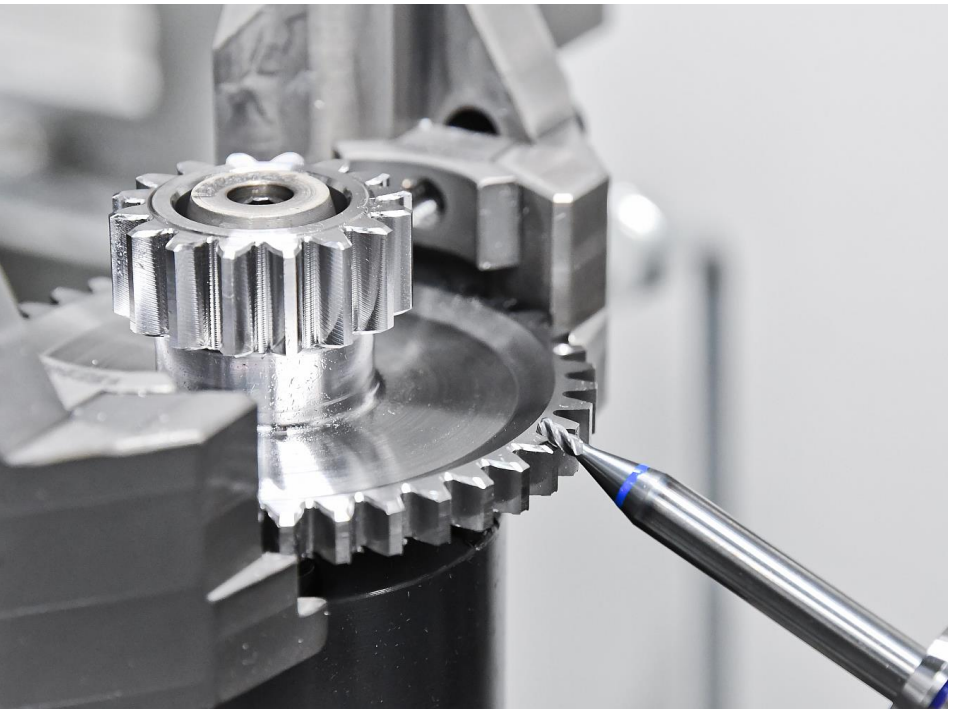
Integrated ChamferCut Unit – optimized chip removal



FlexChamfer - new chamfering technology

FlexChamfer Highlights

- Time parallel process
- Flexible and universal
- Precise chamfer geometry
- Repeatability
- For external and internal gears
- Especially with regard to interference contours
- Easy NC corrections
- Use of stock end mills

FlexChamfer Website

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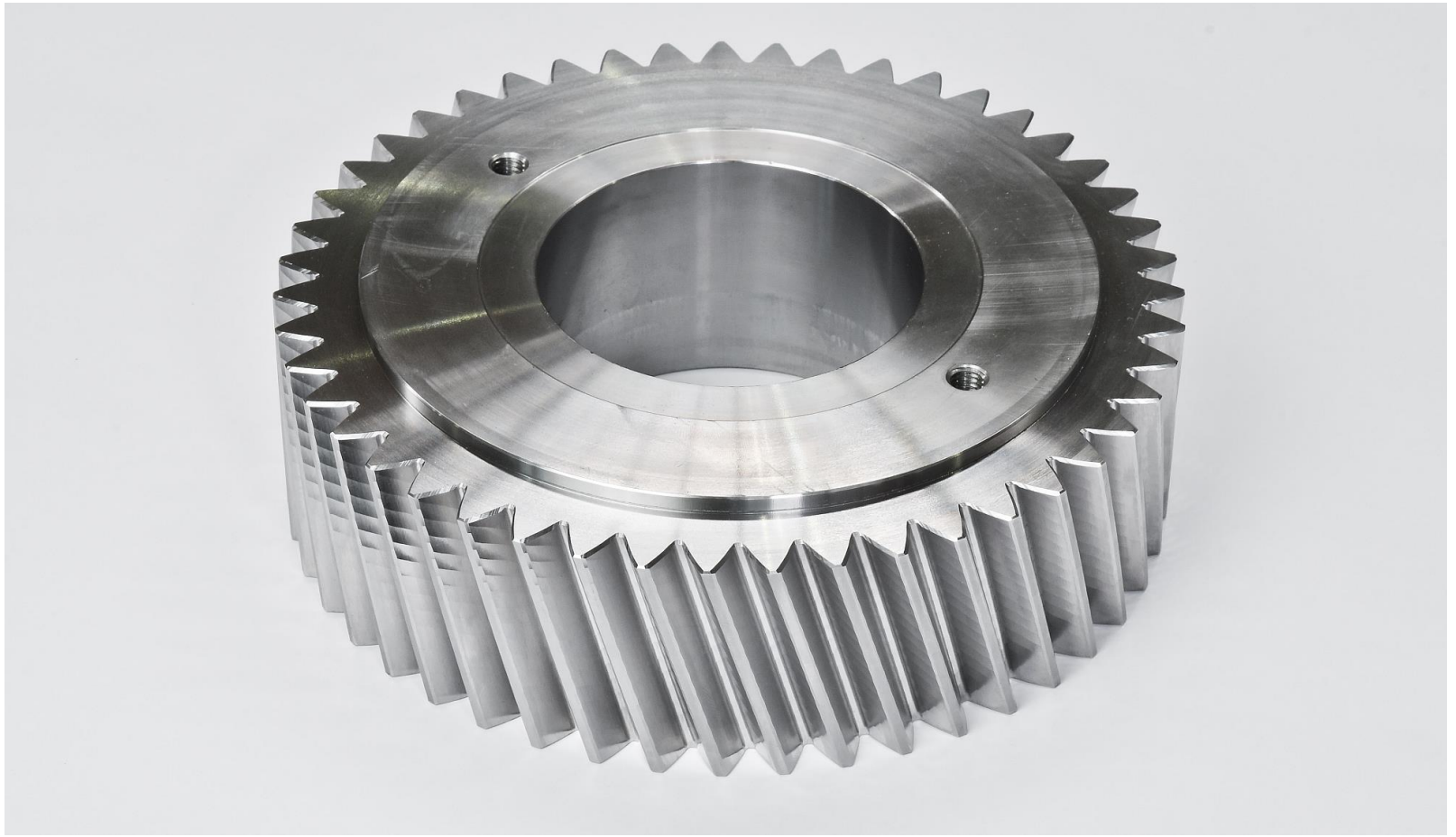
Application example – Industrial gear



Application example – Industrial gear

Industrial gear

Workpiece

– Module	4.5 mm
– Number of teeth	47
– Pressure angle	24°
– Helix angle	-16°
– Tip diameter	234.0 mm
– Tooth width	65.0 mm
– Material	20MnCr5
– Tensile strength	530 N/mm²
– Pre-grind hobbing	

Gear hobbing – MC90 hob

Gear hobbing (technology) – Industrial gear

Tool

– Type of tool	Hob
– Substrate	MC90
– Outside diameter	100 mm
– Number of starts	1
– Number of gashes	15
– Toothed length	220 mm

Machine

- LC 280 DC
- Ring loader

Workpiece

– Module	4.5 mm
– Number of teeth	47
– Pressure angle	24°
– Helix angle	-16°
– Tip diameter	234.0 mm
– Gear width	65.0 mm

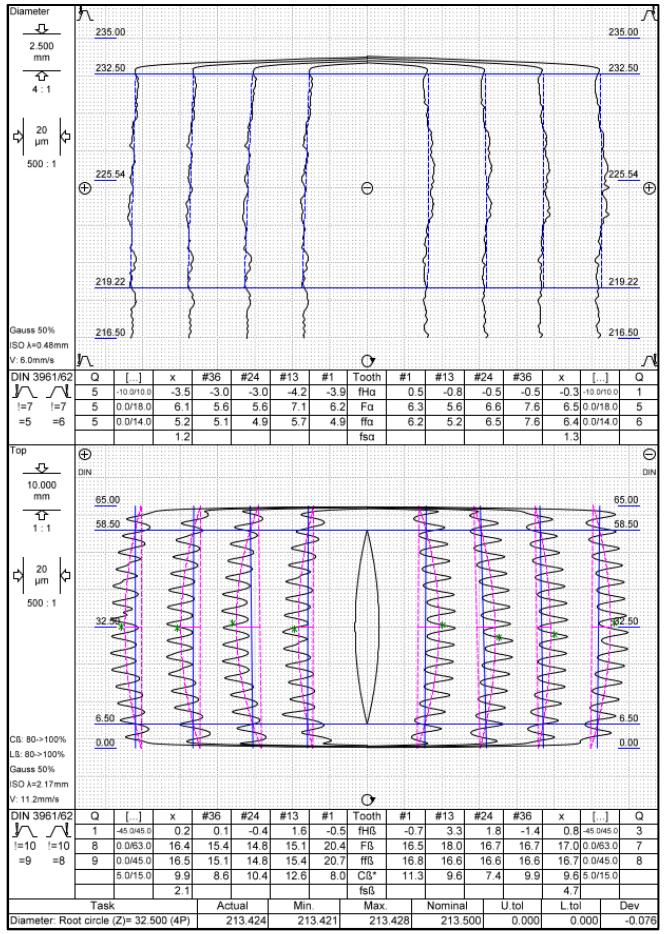
Technology

– Number of cuts		2
– Cutting speed	▽	220 m/min
	▽▽▽	260 m/min
– Axial feed	▽	4.5 mm/WR
	▽▽▽	-4.5 mm/WR
– Cutting medium		Dry

Times

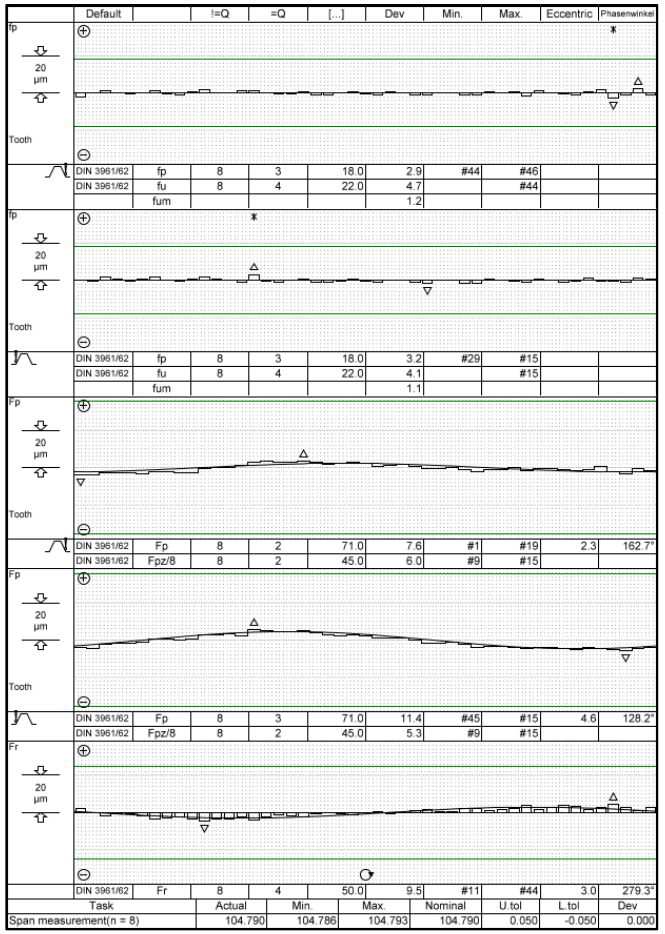
– Cutting time	1.70/1.03 min
– Idle time	0.15 min
– **Cycle time**	**2.88 min**
– *Chamfering*	*2.47 min*

Gear quality – Industrial gear



DIN 3961/62	Q	[...]	x	#36	#24	#13	#1	Tooth	#1	#13	#24	#36	x	[...]	Q
!=7 !=7	5	-10.0/10.0	-3.5	-3.0	-3.0	-4.2	-3.9	fHα	0.5	-0.8	-0.5	-0.5	-0.3	-10.0/10.0	1
=5 =6	5	0.0/18.0	6.1	5.6	5.6	7.1	6.2	Fα	6.3	5.6	6.6	7.6	6.5	0.0/18.0	5
	5	0.0/14.0	5.2	5.1	4.9	5.7	4.9	ffα	6.2	5.2	6.5	7.6	6.4	0.0/14.0	6
			1.2					fsα					1.3		
!=10 !=10	1	-45.0/45.0	0.2	0.1	-0.4	1.6	-0.5	fHß	-0.7	3.3	1.8	-1.4	0.8	-45.0/45.0	3
=9 =8	8	0.0/63.0	16.4	15.4	14.8	15.1	20.4	Fß	16.5	18.0	16.7	16.7	17.0	0.0/63.0	7
	9	0.0/45.0	16.5	15.1	14.8	15.4	20.7	ffß	16.8	16.6	16.6	16.6	16.7	0.0/45.0	8
		5.0/15.0	9.9	8.6	10.4	12.6	8.0	Cß*	11.3	9.6	7.4	9.9	9.6	5.0/15.0	
			2.1					fsß					4.7		

Task	Actual	Min.	Max.	Nominal	U.tol	L.tol	Dev
Diameter: Root circle (Z)= 32.500 (4P)	213.424	213.421	213.428	213.500	0.000	0.000	-0.076



DIN 3961/62									
DIN 3961/62	fp	8	3	18.0	2.9	#44	#46		
DIN 3961/62	fu	8	4	22.0	4.7		#44		
	fum				1.2				
DIN 3961/62	fp	8	3	18.0	3.2	#29	#15		
DIN 3961/62	fu	8	4	22.0	4.1		#15		
	fum				1.1				
DIN 3961/62	Fp	8	2	71.0	7.6	#1	#19	2.3	162.7°
DIN 3961/62	Fpz/8	8	2	45.0	6.0	#9	#15		
DIN 3961/62	Fp	8	3	71.0	11.4	#45	#15	4.6	128.2°
DIN 3961/62	Fpz/8	8	2	45.0	5.3	#9	#15		
DIN 3961/62	Fr	8	4	50.0	9.5	#11	#44	3.0	279.3°

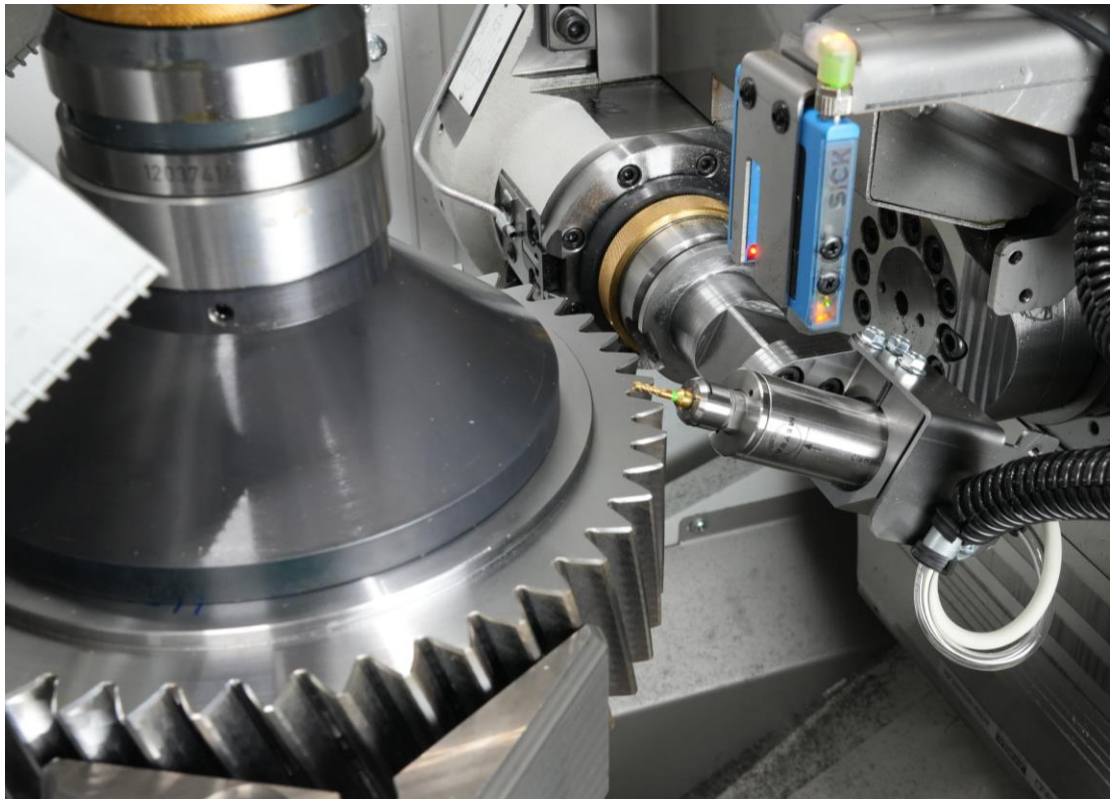
Task	Actual	Min.	Max.	Nominal	U.tol	L.tol	Dev
Span measurement(n = 8)	104.790	104.786	104.793	104.790	0.050	-0.050	0.000

Quality

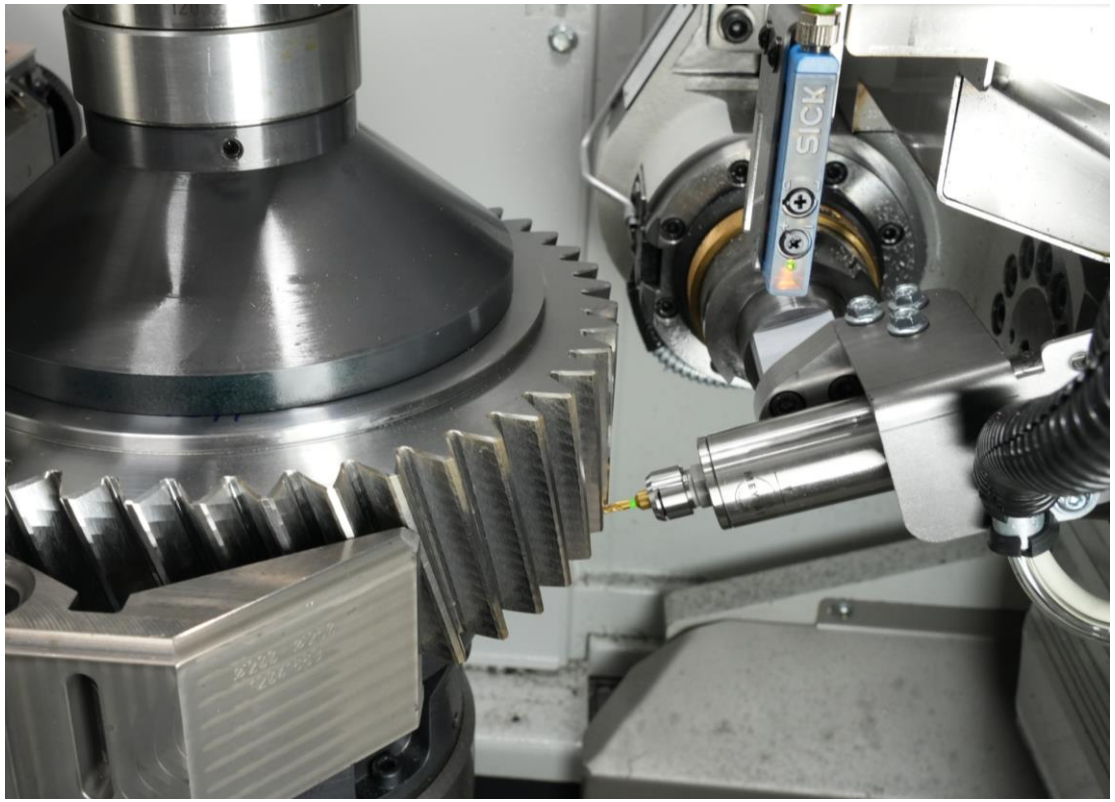
– fHα	DIN 5
– Fα	DIN 5
– ffα	DIN 6
– fHβ	DIN 3
– Fβ	DIN 8
– ffβ	DIN 9
– fp max	DIN 3
– fu max	DIN 4
– Fp	DIN 3
– Fr	DIN 4

FlexChamfer – Gear hobbing and chamfering time-parallel

industrial gear (top)



industrial gear (bottom)



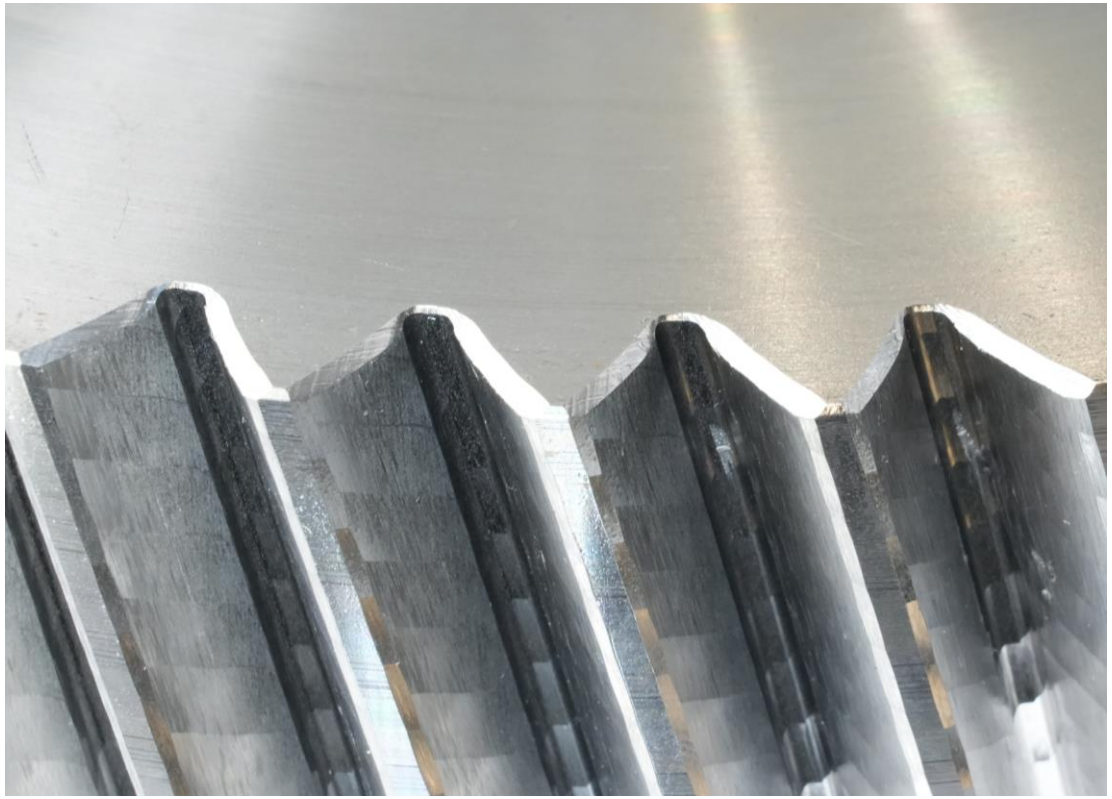
/// **CNC-controlled and flexible chamfering simultaneously to gear cutting**


LIEBHERR
LC 280 DC
LIEBHERR

FlexChamfer – Chamfer formation (form)

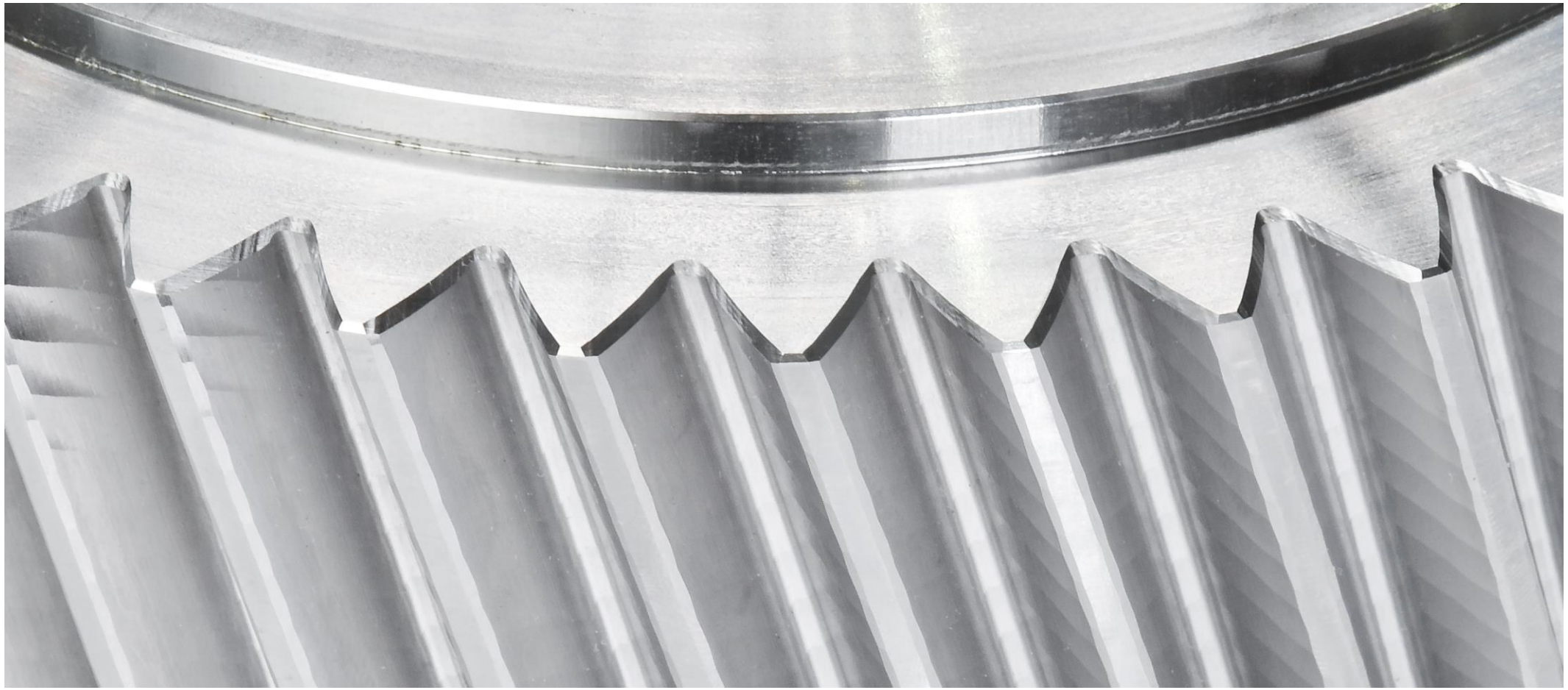
industrial gear (top)

industrial gear (bottom)



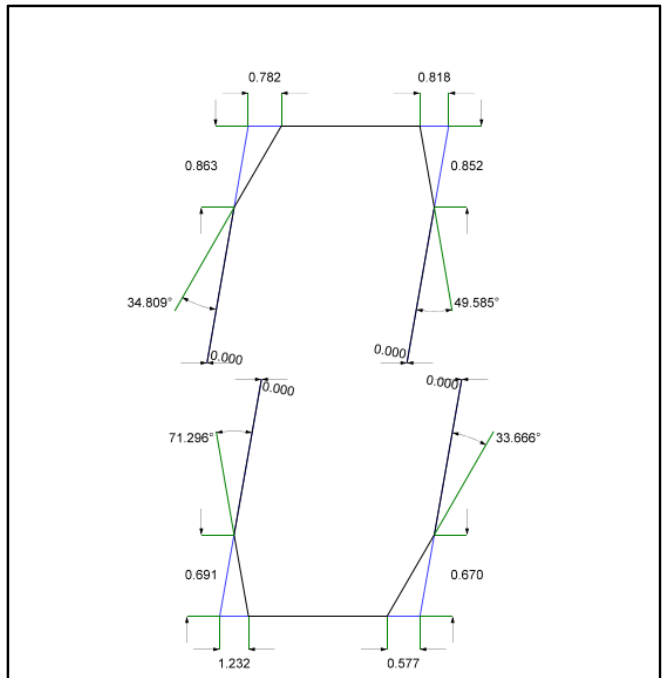
/// **precise and flexible chamfering including face taper with standard tools**

FlexChamfer – Chamfer formation (form)



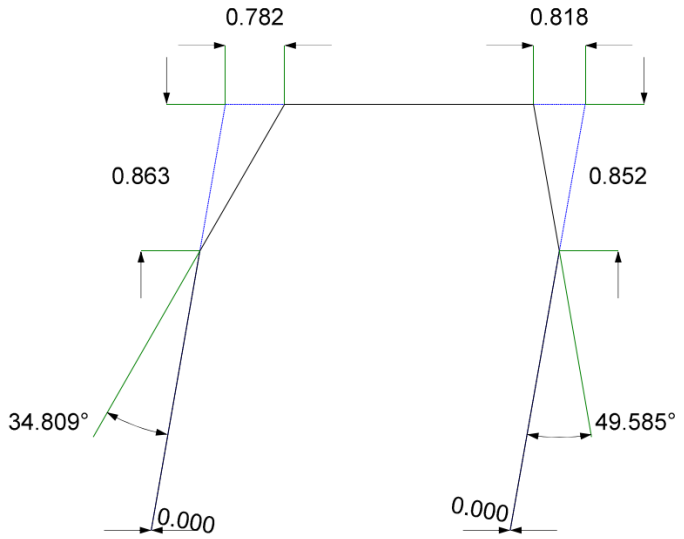
/// precise and flexible chamfering including face taper with standard tools

Chamfer formation (size) – Industrial gear



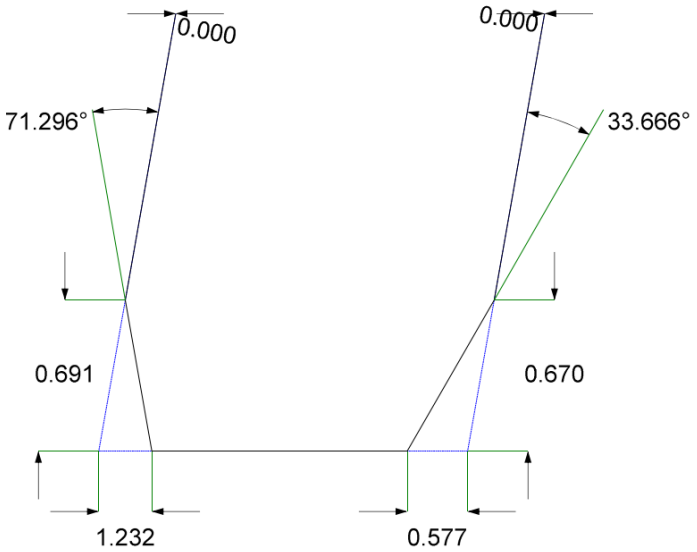
Task	Actual			Nominal	U.tol	L.tol	Dev
Chamfer: Width (Left-Top)	0.863			0.850	0.300	-0.300	0.013
Chamfer: Depth	0.782			0.850	0.300	-0.300	-0.068
Chamfer: Angle	34.809			37.000	5.000	-5.000	-2.191
Chamfer: Width (Right-Top)	0.852			0.850	0.300	-0.300	0.002
Chamfer: Depth	0.818			0.850	0.300	-0.300	-0.032
Chamfer: Angle	49.585			53.000	5.000	-5.000	-3.415
Chamfer: Width (Right-Bottom)	0.670			0.700	0.300	-0.300	-0.030
Chamfer: Depth	0.577			0.600	0.300	-0.300	-0.023
Chamfer: Angle	33.666			31.000	5.000	-5.000	2.666
Chamfer: Width (Left-Bottom)	0.691			0.700	0.300	-0.300	-0.009
Chamfer: Depth	1.232			1.200	0.300	-0.300	0.032
Chamfer: Angle	71.296			73.000	5.000	-5.000	-1.704

top



Task	Actual	Nominal	U.tol	L.tol
Chamfer: Width (Left-Top)	0.863	0.850	0.300	-0.300
Chamfer: Depth	0.782	0.850	0.300	-0.300
Chamfer: Angle	34.809	37.000	5.000	-5.000
Chamfer: Width (Right-Top)	0.852	0.850	0.300	-0.300
Chamfer: Depth	0.818	0.850	0.300	-0.300
Chamfer: Angle	49.585	53.000	5.000	-5.000

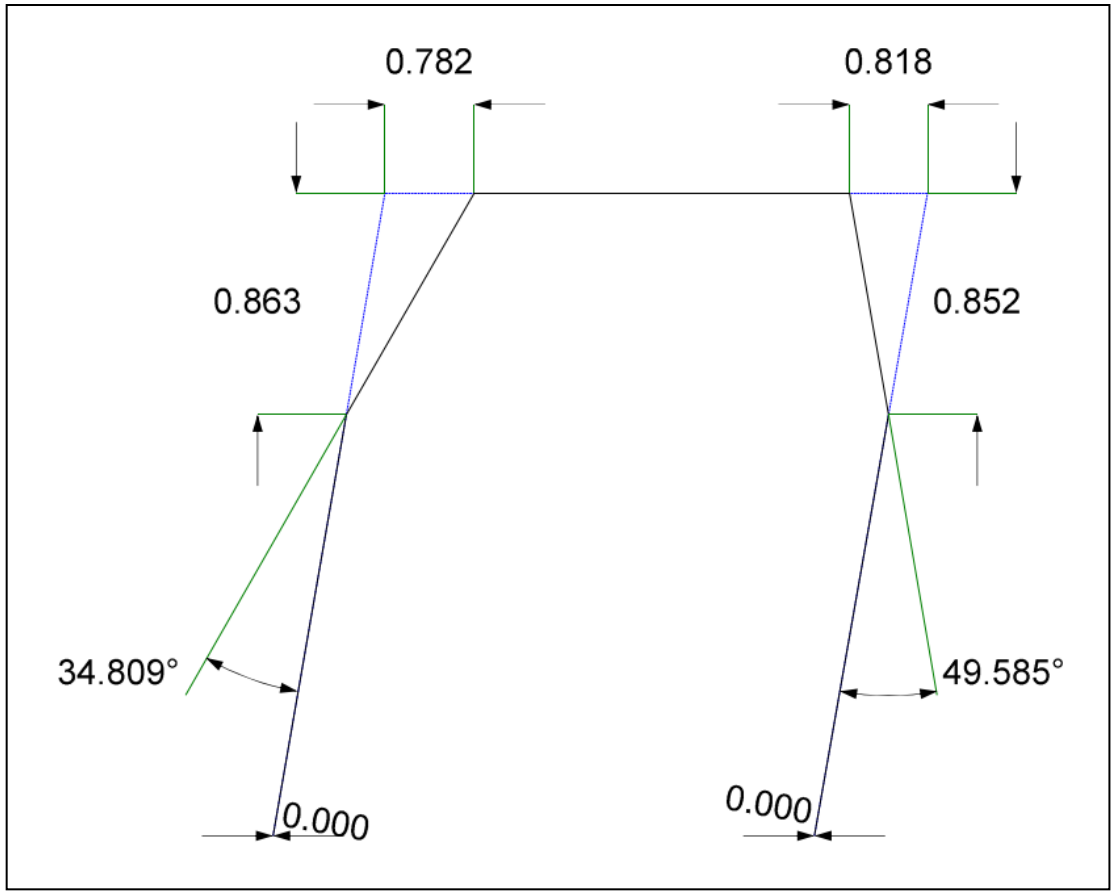
bottom



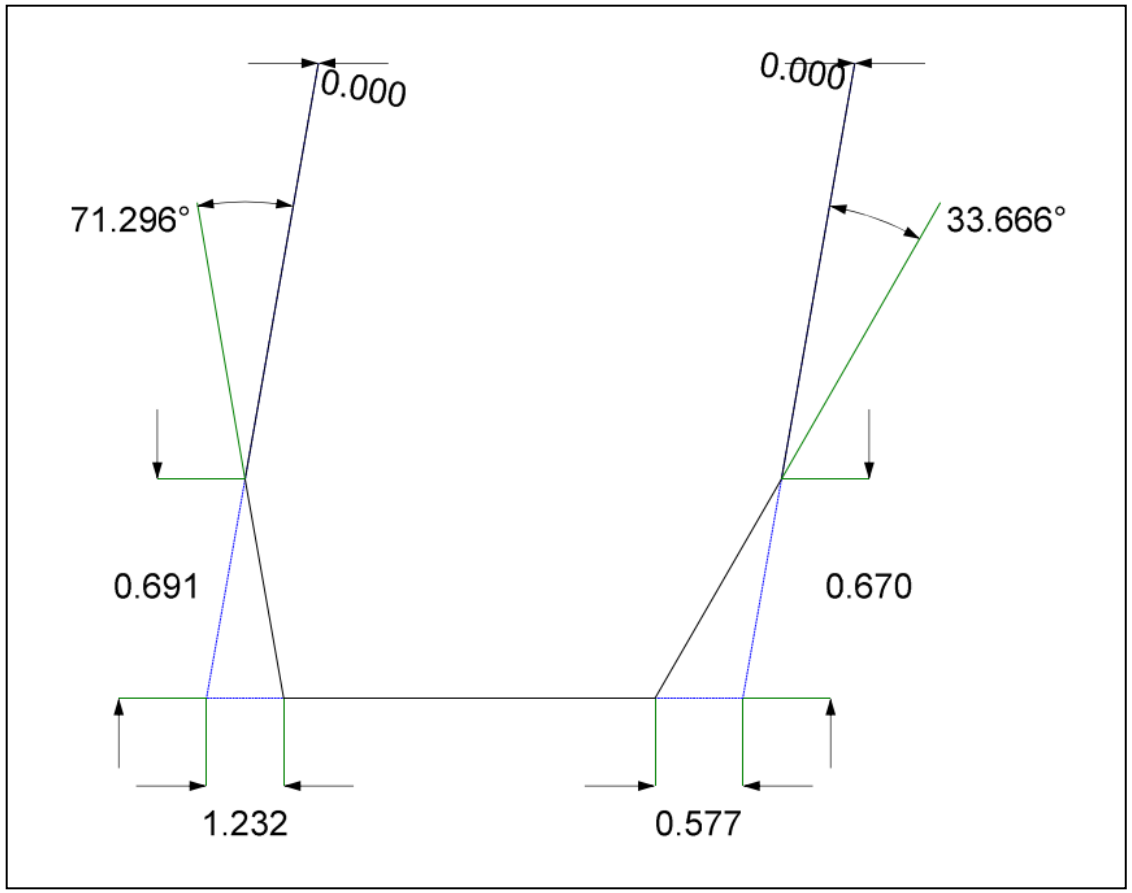
Task	Actual	Nominal	U.tol	L.tol
Chamfer: Width (Right-Bottom)	0.670	0.700	0.300	-0.300
Chamfer: Depth	0.577	0.600	0.300	-0.300
Chamfer: Angle	33.666	31.000	5.000	-5.000
Chamfer: Width (Left-Bottom)	0.691	0.700	0.300	-0.300
Chamfer: Depth	1.232	1.200	0.300	-0.300
Chamfer: Angle	71.296	73.000	5.000	-5.000

Chamfer formation (size)

top



bottom



FlexChamfer - the new simultaneous chamfering technology

- Flexible solution especially for external gears with interference contours or internal gears
- Consistent chamfer width from tip to the root
- Time parallel chamfering for hobbing, shaping or skiving
- Generation of variable chamfer shapes with CNC technology
- Use of standard end mills (stock tools)

Workpieces leave the machine burr-free with a defined chamfer. This is unique!

Control panel and user interface

LHStation LHMobile

New Liebherr Panel

- **Flexible mount** for cabinet integration or installation on an external bracket
(depending on machine type)

- 8 **freely configurable buttons or key-switches** for custom-extensions

- **Context-sensitive display** of PLC/NC keys and machine/program states

- Portable **handheld terminal** as a **standard** component

LHStation

LHMobile

- New GUI surface LHGearTec

- 24“ **Touch Monitor**

- 2 **USB Ports** for flexible data Import Export

- **Reduced tactile switches** (NC-Start/Stop, hand wheel) for fast access

- **Tactile numeric block** for fast input of tool und workpiece data

- **Cable-based transmission** for maximized safety

LHStation LHMobile

New Liebherr Panel

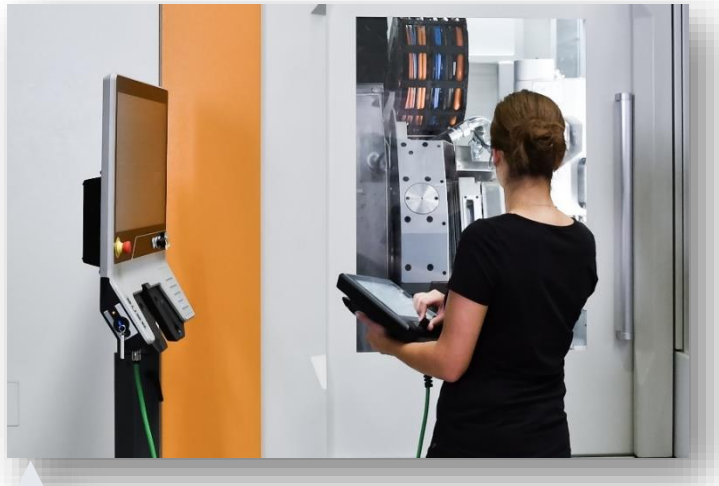
LHStation

LHMobile

- Standardized **Operation Mode Switch** (EKS) with RFID chips for fast mode selection and user authentication

Impressions

LC 280 DC



LGG 280

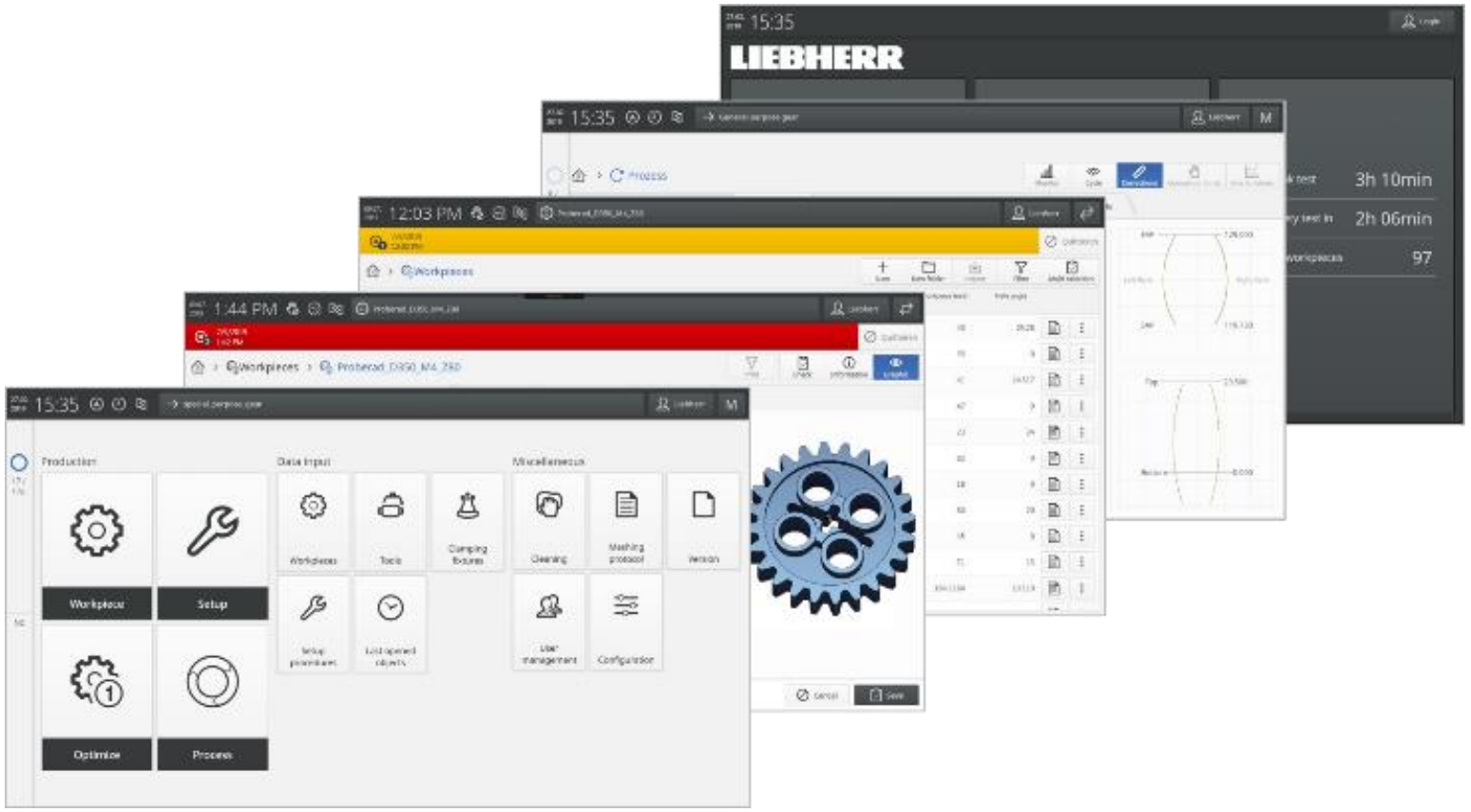
Customer benefits

The most important highlights for your start with new user ergonomics:

- Large main screen with 24" Multi-Touch
- Tactile numeric keypad for fast input of tool and workpiece data
- Mobile handheld terminal with 10" Multi-Touch as standard
- Context-sensitive views such as PLC/NC keys and program statuses
- Reduced hardware key field for high clarity
- Wired signal transmission for maximum safety
- Standardized mode selector with RFID-based user recognition
- Eight buttons or key switches, freely configurable to customer requirements
- Two USB ports for flexible data import/export

/// It is not only more innovative, but also more intuitive, ergonomic and powerful

The new programming system from Liebherr



- Quick access to the last changed parameters.
- Ergonomically optimized operating areas for workpiece and tool input
- Import and Export of workpiece and tool geometries in GDE format (Gear Data Exchange)
- Measured value transfer via GDE communication between measuring machine and gear cutting machine
- Improved 3D visualization and process display
- Available for Hobbing, Grinding Shaping and Skiving
- Possibility to integrate Siemens cycles for drilling, milling and turning operations
- "Digital-Twin": Offline Programming System for work preparation
- Support of tool changers

08
Industrie 4.0

LIEBHERR

01
Protocols & Interfaces
Data Profiles
LHWebPlatform

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Architecture

LHMachineInfo
- Dashboard
- Logic Editor

LHSignalInfo
- Data Visualization

LHReportInfo
- Generate Reports

LHWebPlatform

Factory Connection (e.g. MES)

Protocols & Interfaces

OPC UA | MT Connect | Profibus/Profinet | umati | MQTT | Custom

Data Profile Packages

Basic

Monitoring
- Signal Light
- Alarm Number
- Feed Override
- ...

Production (incl. Basic)

Production Optimization
- Program Status
- Oper./Production Time
- Machine Status
- ...

Process (incl. Basic & Production)

Process Optimization
- Axis Movement
- Power / Torque / Load
- Travel Time
- ...

Customized

Custom Extension

02
Closed Loop (GDE)

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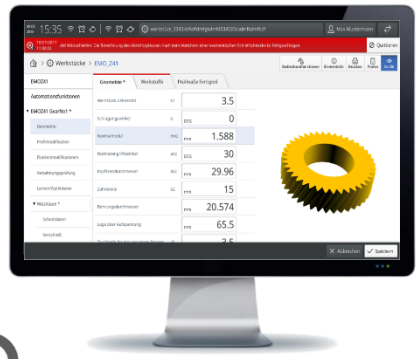
Possible procedure per GDE

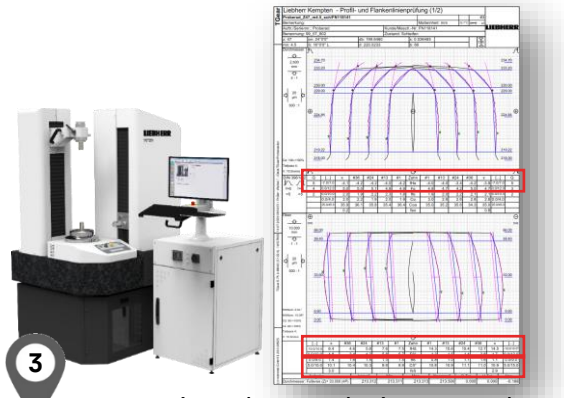


1 LHGearTec as programming system for the workstation preparation

lhgt GDE

2 Load workpiece/tool/clamping and produce.

GDE

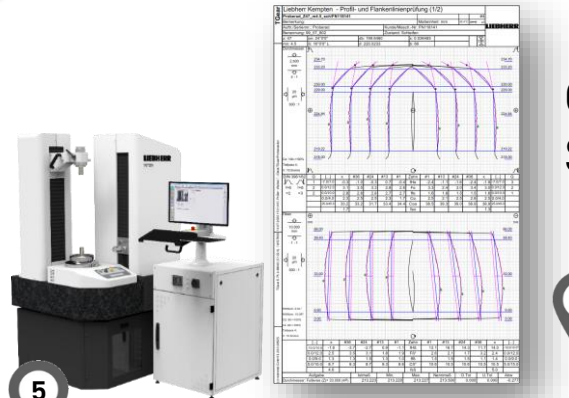


3 Measuring the workpiece on the measuring machine and storing the result via GDE and PDF.

First Part

GDE PDF

4 Open the measured value transfer and carry out correction.



5 Correction part and/or statistical process control in the series.

Correction Part Series

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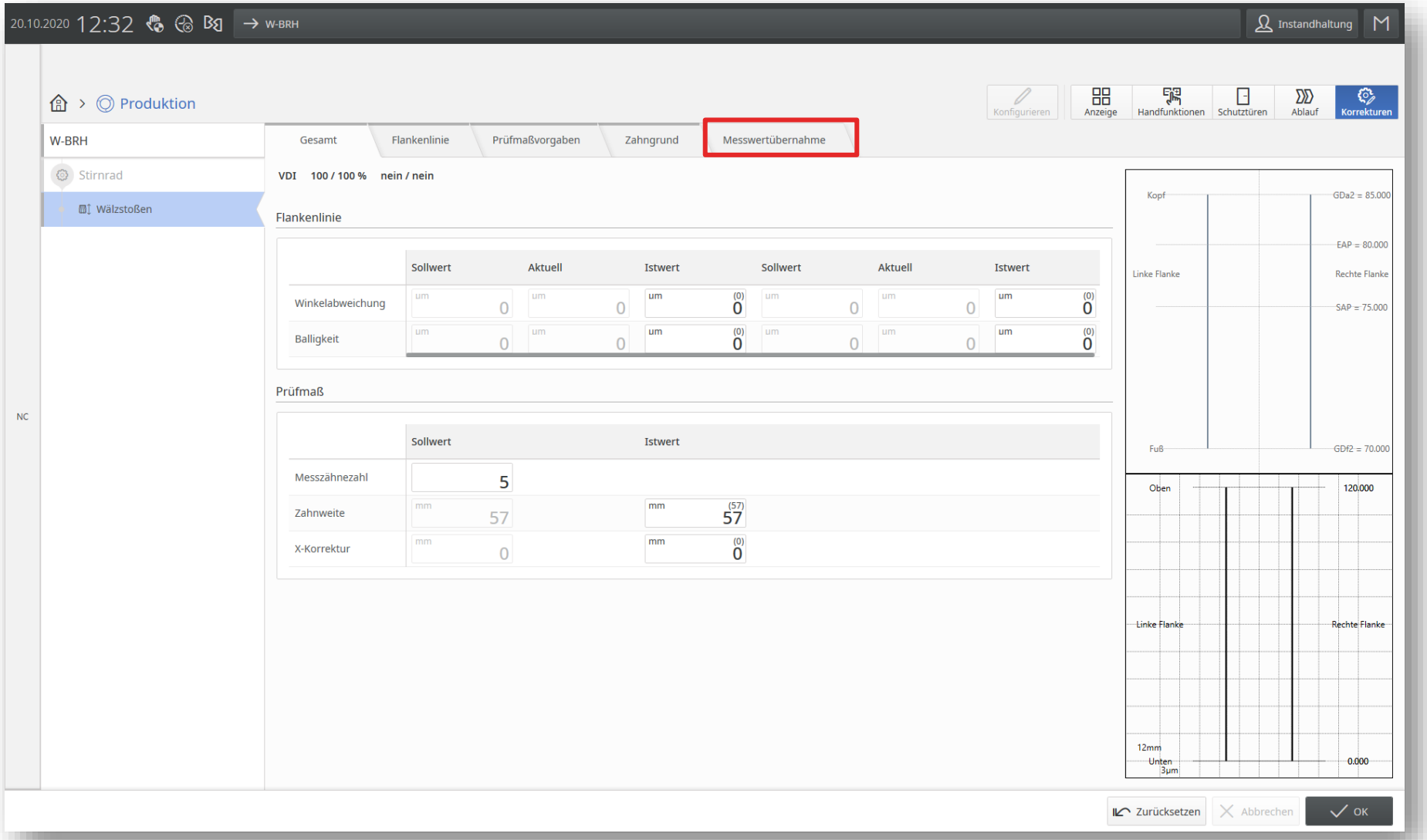
New Tab „Import Measurement Results“



1. There is a new tab at gear cutting machines with the new HMI LHGearTec in the menu „Corrections“.

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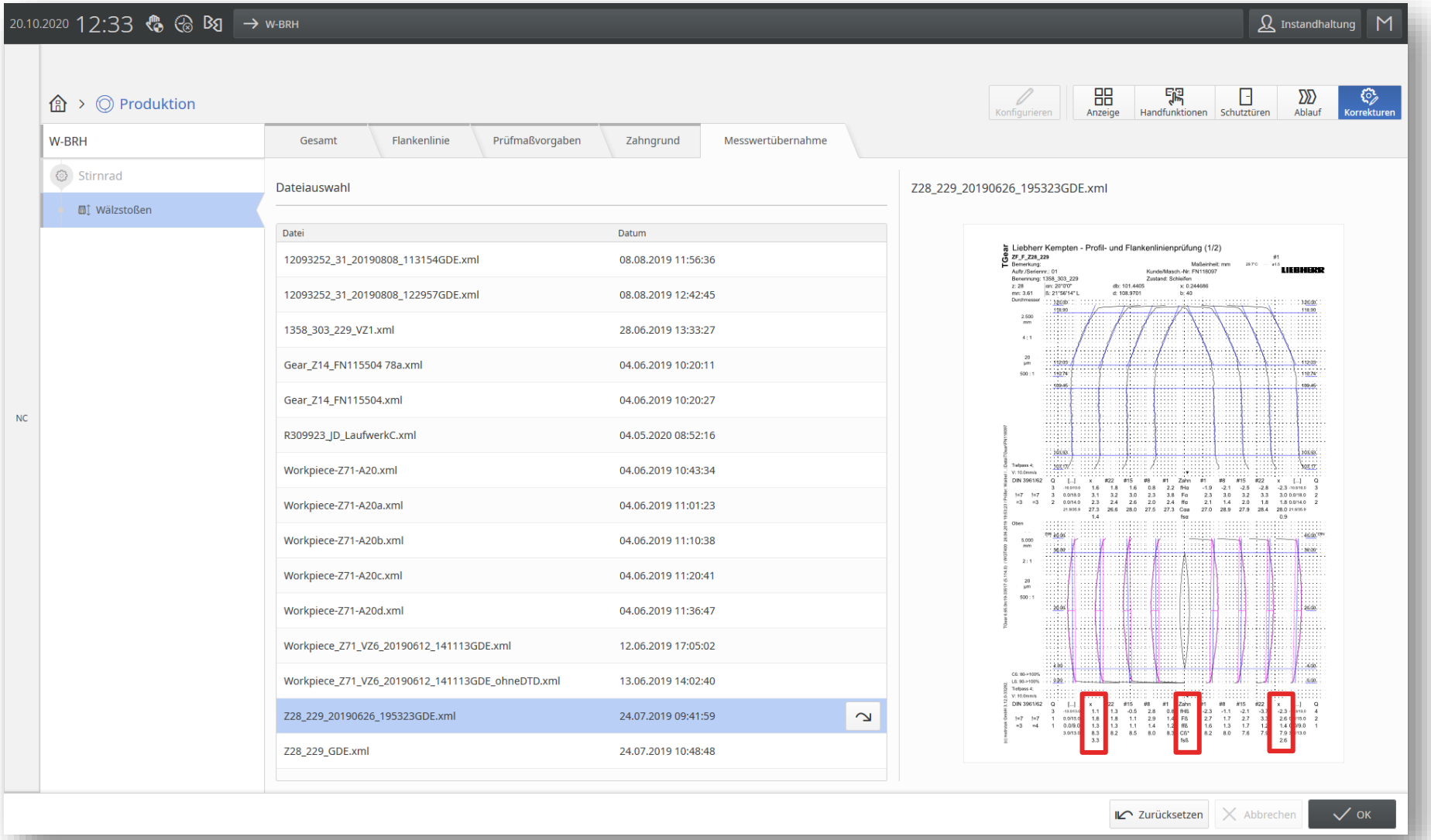
New Tab „Import Measurement Results“



1. In this new tab you can see all the GDE Files on the machine or on a network drive.
2. These GDE files contain the measuring results of the measuring cell.
3. If the GDE files is existing also with the measuring result as a pdf file, the results will be visualized on the side screen.
4. The operator can now decide if he trust these values and can taken over the results in the correction mask.
   e.g. fHa

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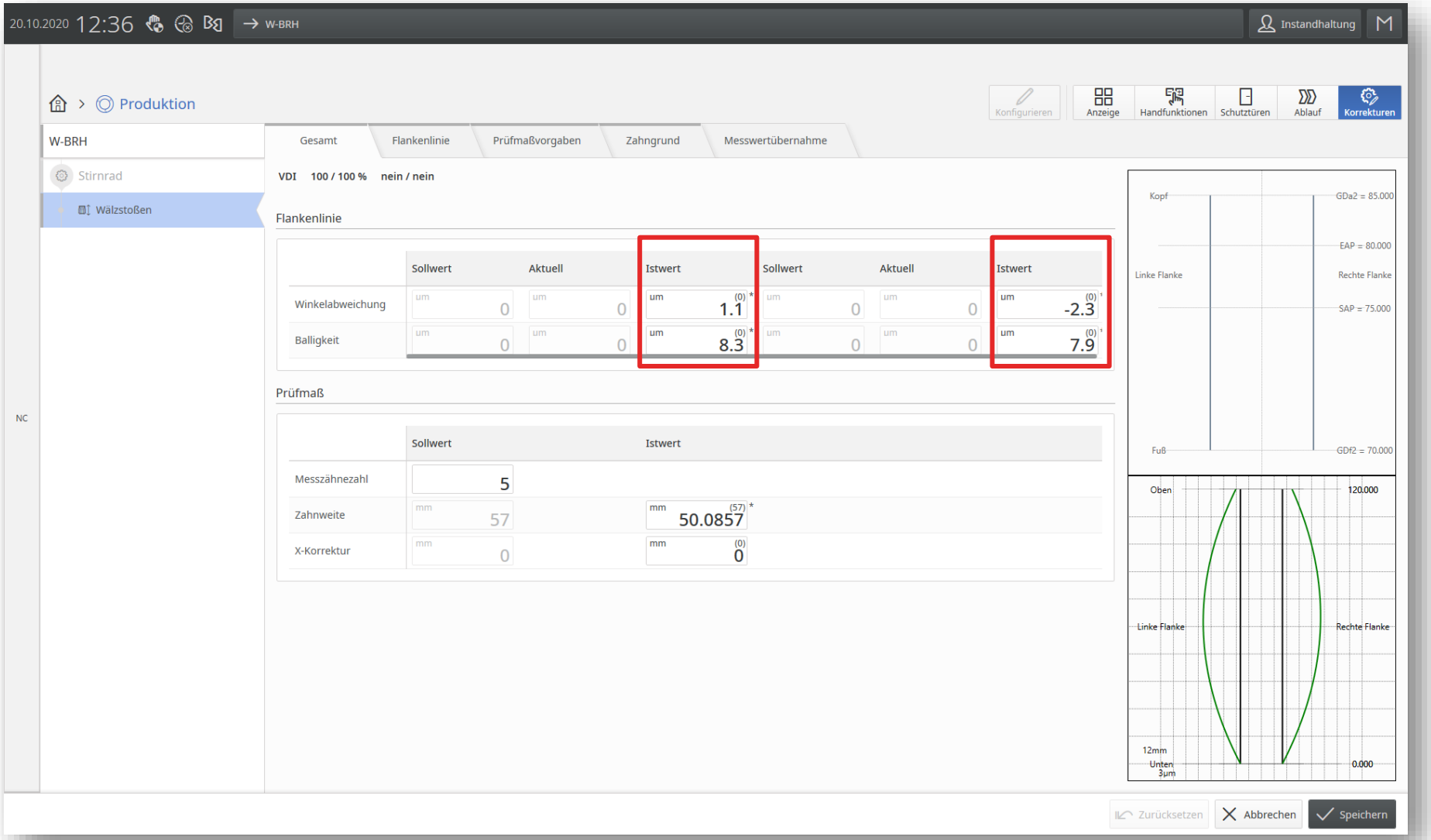
Measuring Results Taken Over



1. In the „Correction“ mask, the transferred measured values are displayed.

2. The worker now also sees the corrections calculated by the machine and can decide which values or corrections he would like to apply.

3. The averaged measurement results are taken from the GDE file for

   a. fHa
   b. fHß
   c. Cß
   d. toothsize

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External Automation Solutions

Plastic Chain Conveyor KKB

- Storage capacity 20 a 15kg / 30 a 10 kg
- Robot-integration as an option
- Optimal fit to the fast integrated Ringloader system (up to part weight 25 kg) for maximum production output

Chain conveyor KSR (LC 180)

- Small intermediate buffer capacity
- Robot-integration as an option
- Optimal fit to the fast integrated Ringloader system
- For workpieces up to 180 mm diameter

or automatic loading with robot

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Maintenance & Ergonomic

Accessibility for quick and easy maintenance

- All maintenance access points are covered with a door and can be easily opened. Each door has additionally a window to check the valves from outside.
- The hydraulic units are also covered with a housing to reduce machining noise in the factory.

- Pneumatic Valves

- Pneumatic Valves

- Covered Hydraulic housing

- Opened doors to the hydraulic unit

Highlights

M/C features
- L-door for good access
- Thermal stable machine bed
- Wet- / dry Hobbing
- High stiffness ensures 1-pass-process for best tool life
- Hook ready for short installation

LH GearTec as Standard
- Touch Interface
- Graphic user support
- Technology support (for speeds & feeds)
- Simulation software to ensure safe and efficient production
- Collision control

Hob Head HH 150
- 13,2 kW Drive Power
- 2.250 rpm spindle speed
- Max. module 6 mm
- Shift travel 200 mm
- Max. hob Ø 150 mm

Plastic chain conveyor
- Storage capacity 20 a 15kg / 30 a 10 kg
- Robot-integration as an option
- Optimal fit to the fast integrated ringloader (up to part weight 25 kg) for maximum production output


Thank
you
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