Inspection of spur gears by a double-flank rolling method

GEAR INSPECTION MACHINES FOR SPUR GEARS

GTS 100/200/300/400

Geartec.cz, Czech Republic, 2014

Inspection of spur gears by a double-flank rolling method

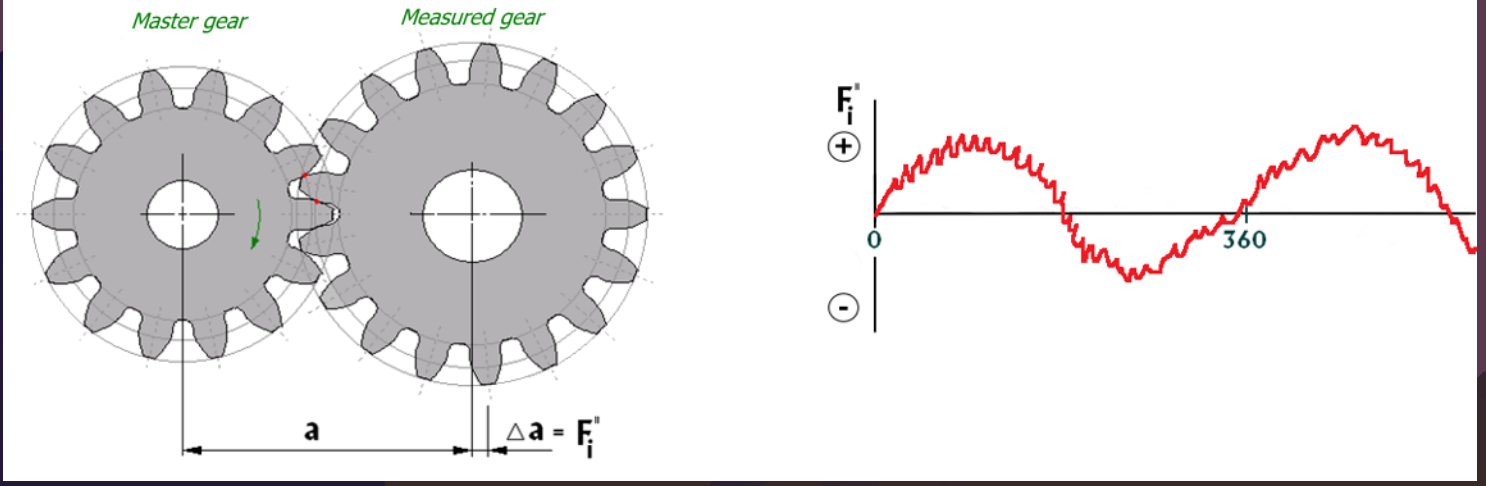
MANUFACTURING REQUIREMENTS

- Quality grade according to DIN Standard
- Guaranteed tooth backlash
- Low running noise / long life-span
- Influence of assembly accuracy
- Localization of tooth nicks
- Quick and inexpensive measurement
- 100% inspection of all gears, suitable for mass production

This is all where our machine of double-flank rolling can help you.

MEASURING PRINCIPLE

- Tooth errors cause fluctuation of axis distance
- Left and right flank are measured simultaneously
- Constant force in radial direction
- Measuring accuracy is better than 1μm
- Deviations according to: DIN, ISO, AGMA, JIS, JGMA a BS



Inspection of spur gears by a double-flank rolling method

MACHINES CAN MEASURE

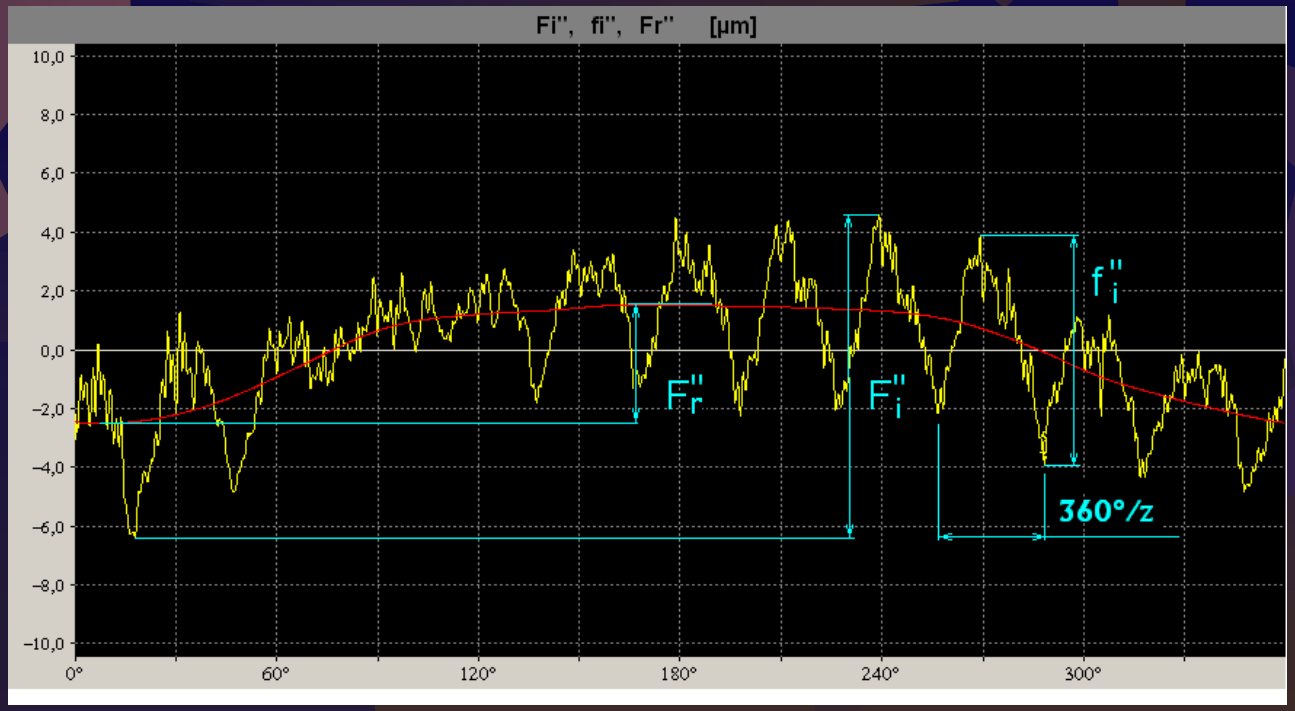
Standards: DIN, ISO, AGMA, BS, JGMA, JIS and/or in-company requirements

Double-flank deviations

- F_i'' - Total composite error
- f_i'' - Tooth to tooth error
- F_r'' - Radial runout

Other measurable deviations

- j - Backlash
- A_a - Fluctuation of axis distance
- M_z - Measure over teeth
- M_{dk} - Measure over pins



Inspection of spur gears by a double-flank rolling method

RANGE OF GTS MACHINES, VARIATIONS

- **GTS 100** – machine for measuring of spur gears, max. diameter 100 mm
- **GTS 200** – machine for measuring of spur gears, max. diameter 200 mm
- **GTS 300** – machine for measuring of spur gears, max. diameter 300 mm
- **GTS 400** – machine for measuring of spur gears, max. diameter 400 mm

- **Machines with mechanical drive** – inspection by a dial
- **Machines with motor drives**– inspection and evaluation by a GEARTEC software
- **Clamping fleetingly or between centers**
- **Clamping by a specially designed clamping fixtures** – construction is based on a customer demand
- Setting of measuring force and measuring speed is objective

Inspection of spur gears by a double-flank rolling method

MACHINE PARAMETERS GTS RANGE

	GTS 100	GTS 200	GTS 300	GTS 400
Diameter of measured gear, max. /mm/	100	200	300	400
Axis distance, min. /mm/	15	45	75	100
Gear length clamped between centers, max. /mm/	100	300	500	700
Weight of measured gear, max. /kg/	0,5	3	5	10
Measuring speed, max. (machines with motor drive) /rev./min^{-1}/	20	10	10	5
Measuring force, max. /N/	8	20	30	50
Total measuring accuracy /µm/	0,5	1	1	1,5

MEASURING REPORT (HEADER)

Measured gear data

Customer,s logo

Double flank roll testing

Drawing No.: 7 719 625_K46

geartec.cz

Gear A		A-Freilauf	Gear B		B-Primär	Part No.	150
Number of teeth	z	60	Number of teeth	z	46	Contract No.	
Module	m	1,900	Module	m	2,150	Machine No.	
Pressure angle	α	20°00'00"	Pressure angle	α	16°00'00"	Date	29.2.2012 16:17
Helix angle	β	+00°00'00"	Helix angle	β	+00°00'00"	Checked by	NN
Gear Position	l_A	55,000 mm	Gear Position	l_B	310,000 mm	Note	Abnahme

EVALUATION OF MEASURED DATA

Allowed values
according to DIN 3963

Measuring Parameters			A	Allowed	B	A	Measured	B
Total composite error	F_i''	[µm]		28,0	32,0		33,5	12,1
Tooth to tooth error	f_i''	[µm]		12,0	14,0		8,8	5,3
Mean value	$f_{i,m}''$	[µm]					2,2	1,1
Runout	F_r''	[µm]		40,0	40,0		27,2	11,1
Centre distance deviation	$A''_{ai} \div A''_{ae}$	[mm]		0,000÷0,000	0,000÷0,000		95,175÷95,209	93,636÷93,648
Measurement over teeth	M_z	[mm]		38,178÷38,201/7	30,404÷30,424/5		38,184	30,405
Roundness - Bearing A-B	R	[µm]		10,0	10,0		1,3	1,9
Eccentricity - Bearing A-B	e	[µm]		10,0	10,0		6,9	1,7

Ver. 1.3.0.0

Measured values

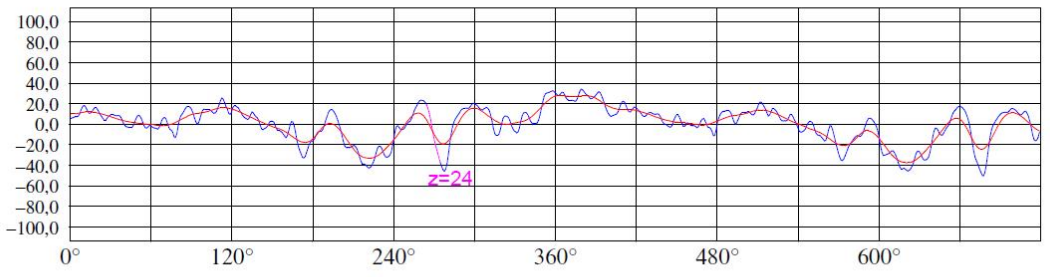
MEASUIRING REPORTS

Inspection of spur gears by a double-flank rolling method

Double flank roll testing, Spur gears — geartec.cz, s.r.o.

Test gear		TG	Master gear		MG	Part No.	
Number of teeth	z	30	Number of teeth	z	60	Contract No.	
Module	m	0,80000	Measuring speed		5 rpm (L)	Machine No.	
Pressure angle	α	20°00'00"	Runout compensation master gear		---	Date	2.6.2014 13:17
Helix angle	β	+00°00'00"	Centre distance	a"		Checked by	
Face width	b	0,000 mm	Measuring force		5 Oz	Note	

Fi", fi", Fr" - [µm]



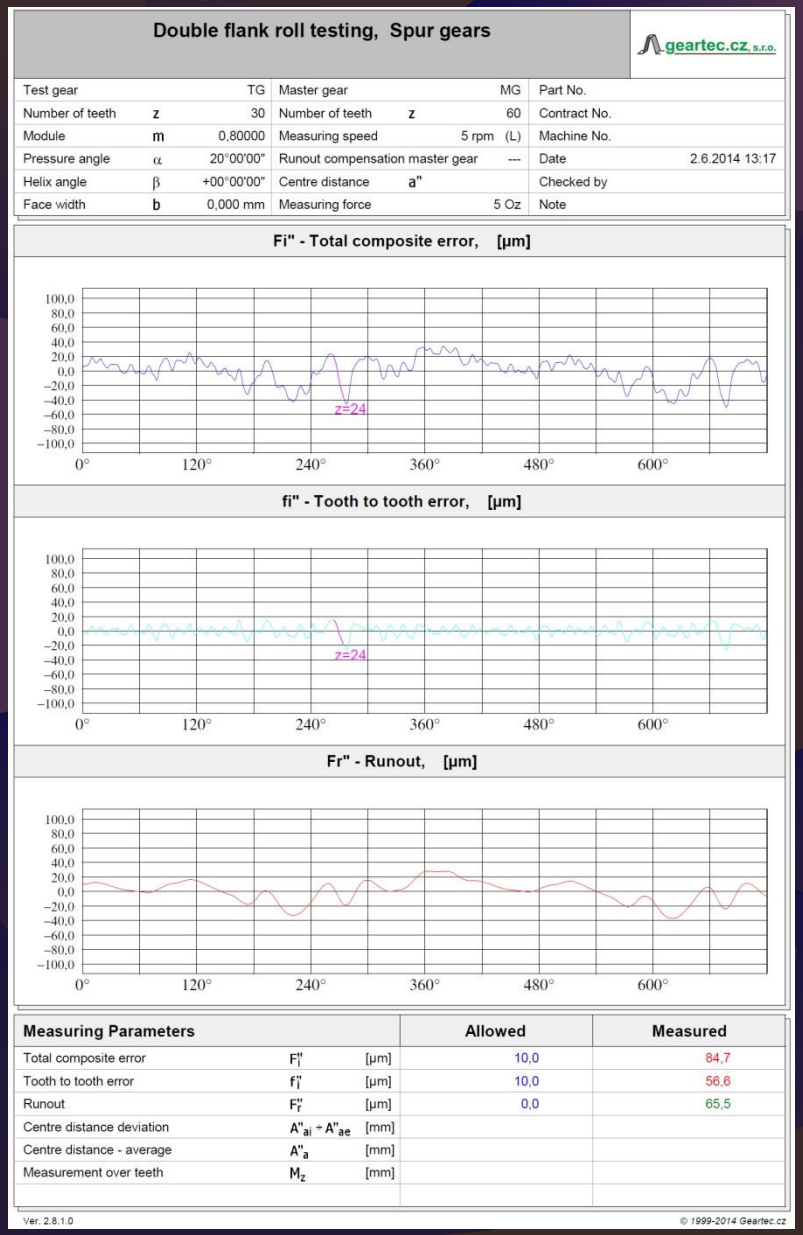
Measuring Parameters			Allowed	Measured
Total composite error	F_i''	[µm]	10,0	84,7
Tooth to tooth error	f_i''	[µm]	10,0	56,6
Runout	F_r''	[µm]	0,0	65,5
Centre distance deviation	$A''_{ai} \div A''_{ae}$	[mm]		
Centre distance - average	A''_a	[mm]		
Measurement over teeth	M_z	[mm]		

Ver. 2.8.1.0

- Deviations F_i'' / f_i'' / F_r'' depicted in one diagram including highlighted tooth with the worst local f_i'' deviation.

MEASUIRNG REPORTS

Inspection of spur gears by a double-flank rolling method



Double flank roll testing, Spur gears

geartec.cz, s.r.o.

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Helix angle	β	+00°00'00"	Centre distance	a"		Checked by	
Face width	b	0,000 mm	Measuring force		5 Oz	Note	

Fi" - Total composite error, [µm]

fi" - Tooth to tooth error, [µm]

Fr" - Runout, [µm]

Measuring Parameters			Allowed	Measured
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Centre distance - average	A''_a	[mm]		
Measurement over teeth	M_z	[mm]		

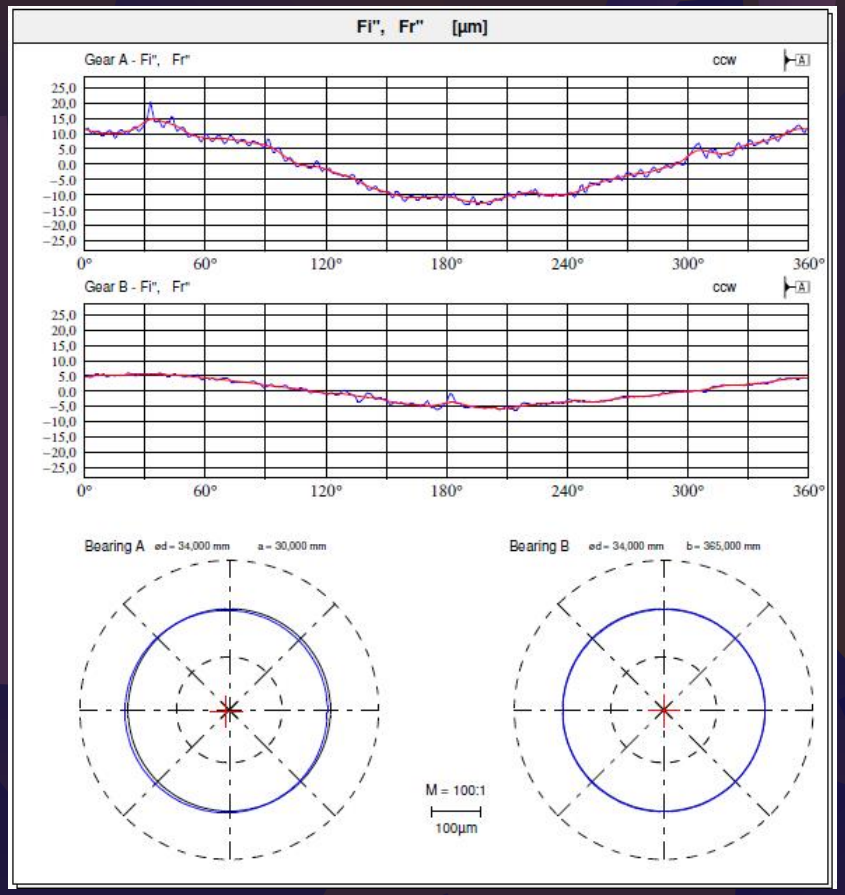
Ver. 2.8.1.0

- Separately depicted following deviations: F_i'' / f_i'' / F_r''
- Fluctuation of centre distance can be optionally measured
- Measurement over teeth can also be optionally measured

Geartec.cz, Czech Republic, 2014

Inspection of spur gears by a double-flank rolling method

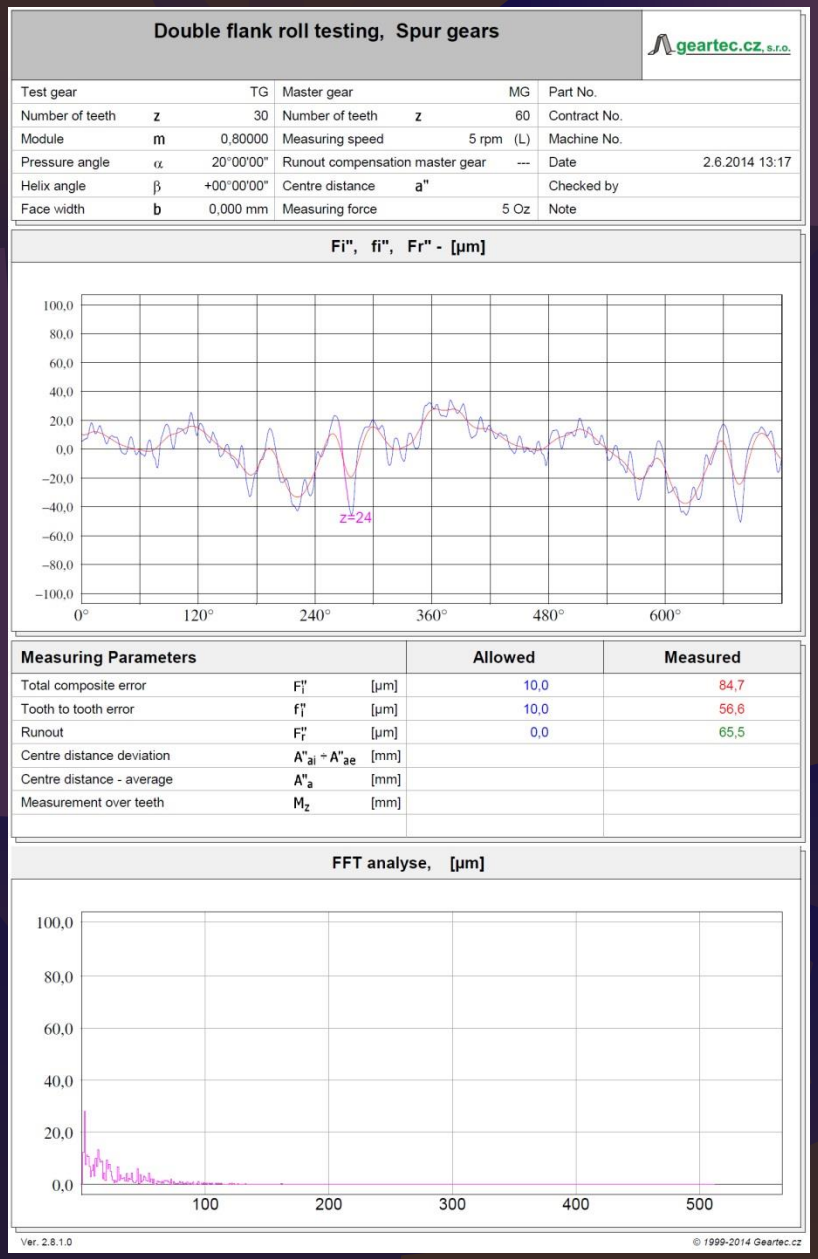
MEASURING REPORT



- Elimination of bearings inaccuracy
- Simultaneous measuring of several gears on one shaft
- Quality of bearing surface depicted (eccentricity and roundness)
- Quality evaluation related to the axis of rotation and/or bearing axis.

Inspection of spur gears by a double-flank rolling method

MEASURING REPORT



Double flank roll testing, Spur gears

geartec.cz, s.r.o.

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Helix angle	β	+00°00'00"	Centre distance	a"		Checked by	
Face width	b	0,000 mm	Measuring force		5 Oz	Note	

Fi", fi", Fr" - [µm]

Measuring Parameters			Allowed	Measured
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Centre distance - average	A''_a	[mm]		
Measurement over teeth	M_z	[mm]		

FFT analyse, [µm]

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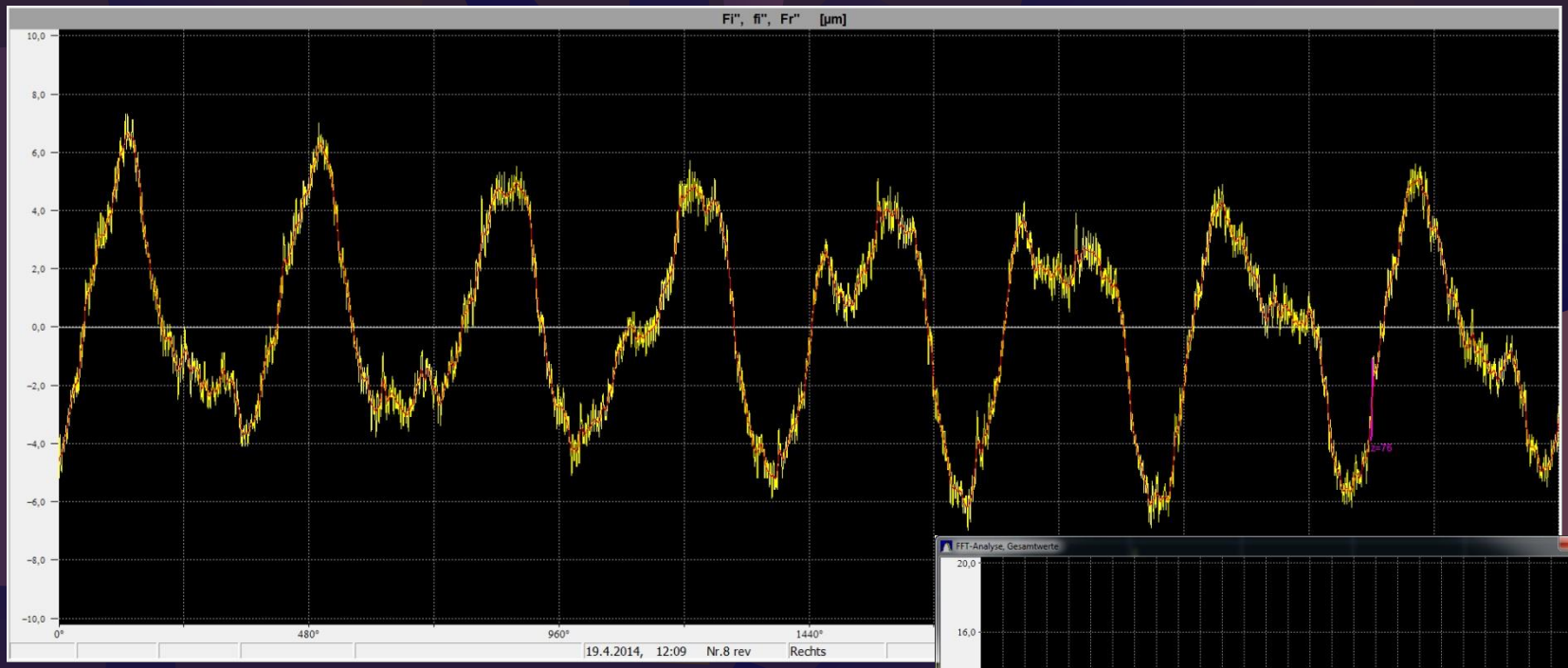
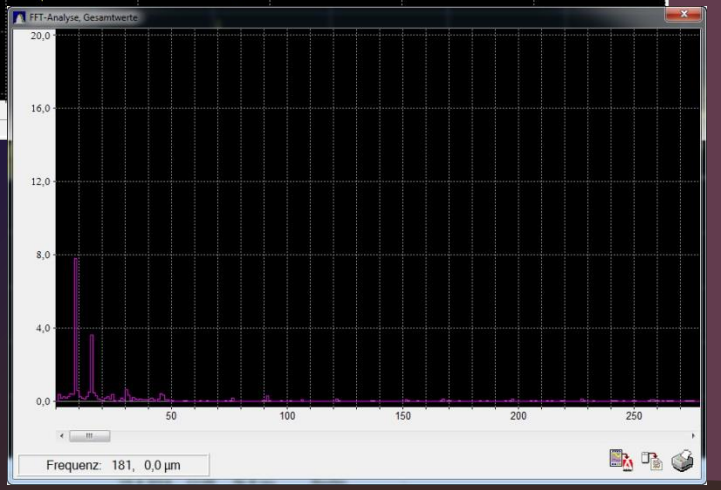
- FTT – analysis of measured signal
- Detection of error influences
- Production process diagnosis
- Used tool quality analysis
- Used clamping fixture quality analysis

Inspection of spur gears by a double-flank rolling method

MASTER GEAR ERROR ELIMINATION

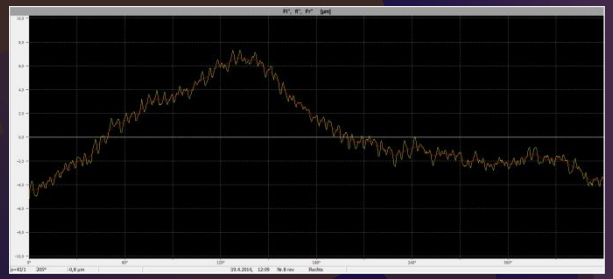
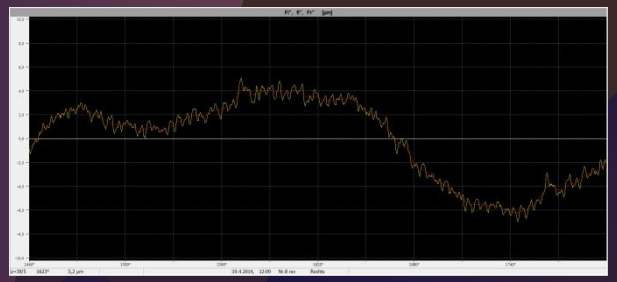
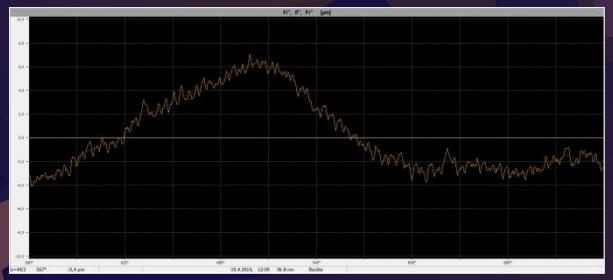
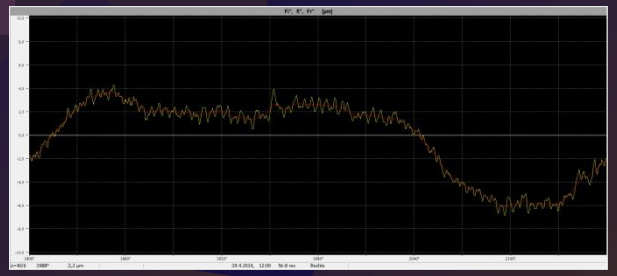
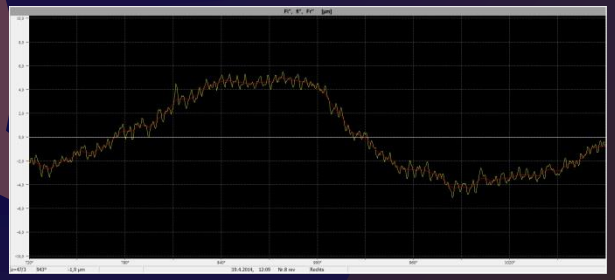
- for much demanding accuracy of measuring; quality of measured gear is close to the quality of master gear

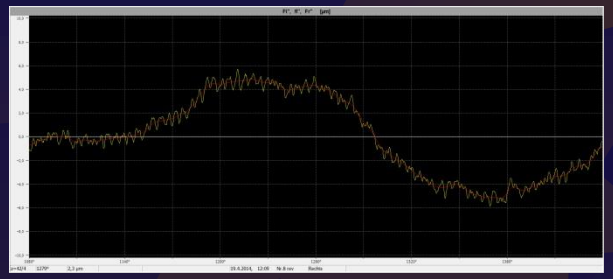
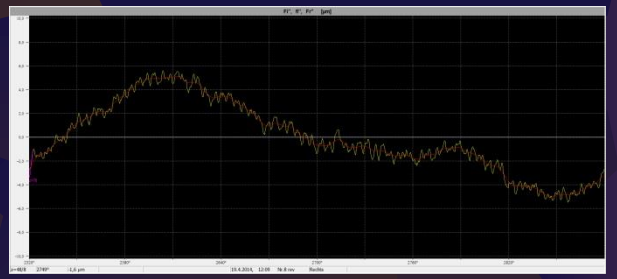




8 revolutions of measured gear without master gear error cancellation

Inspection of spur gears by a double-flank rolling method

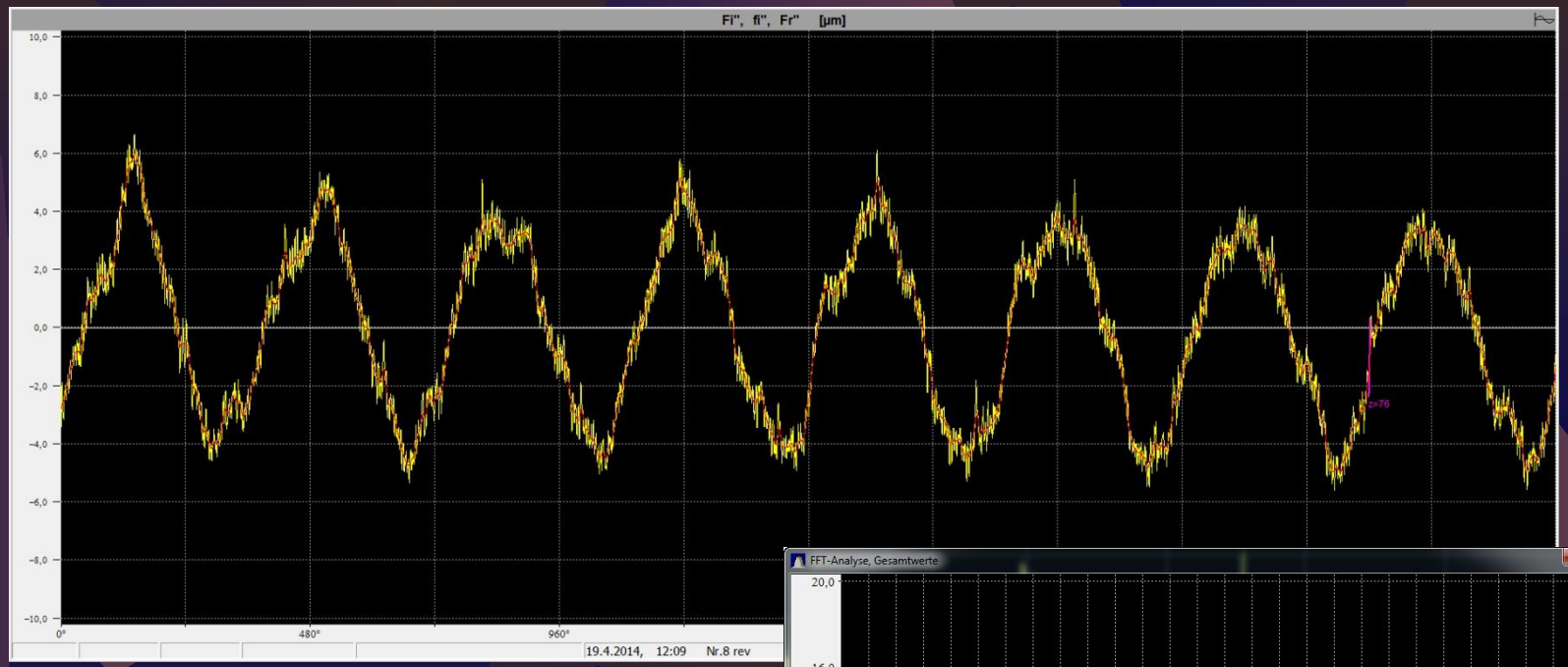






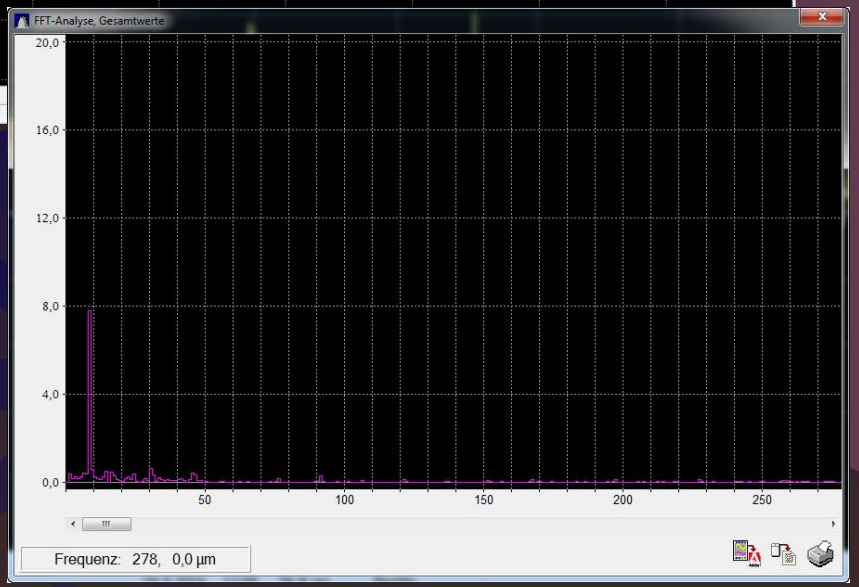



Why is each revolution different? It is caused by the master gear error.

Inspection of spur gears by a double-flank rolling method

MASTER GEAR ERROR ELIMINATION

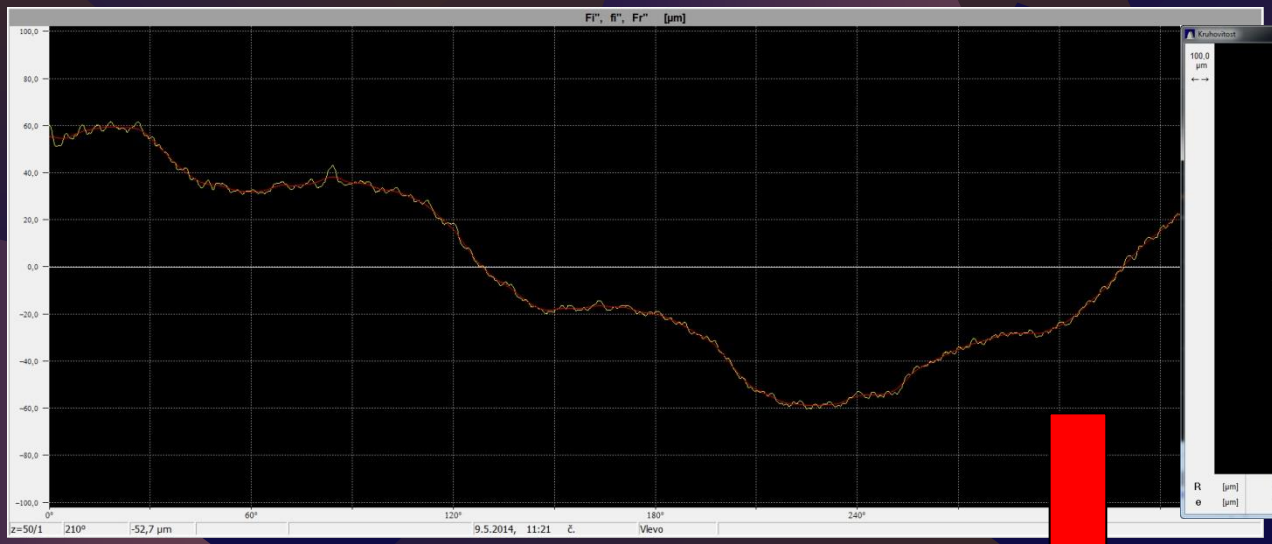


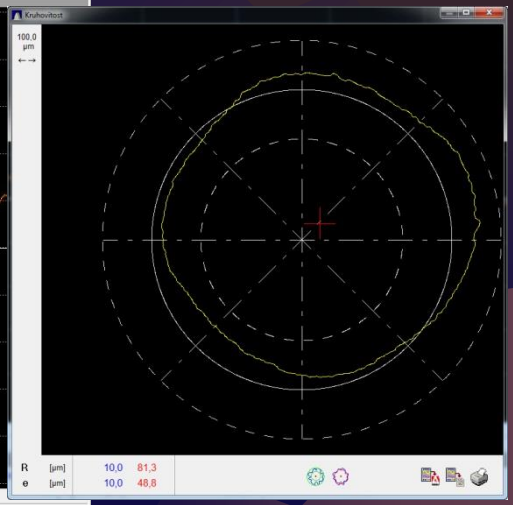


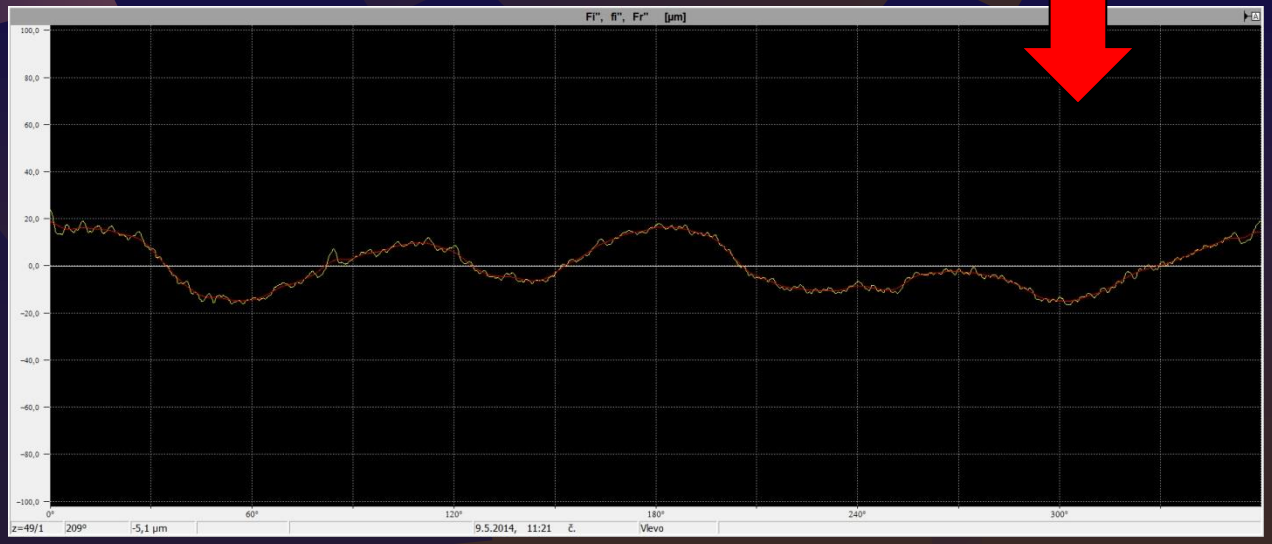
8 revolutions of measured gear with master gear error cancellation based on FFT analysis.

Inspection of spur gears by a double-flank rolling method

MEASURING AND CANCELLATION OF CLAMPING INACCURACY



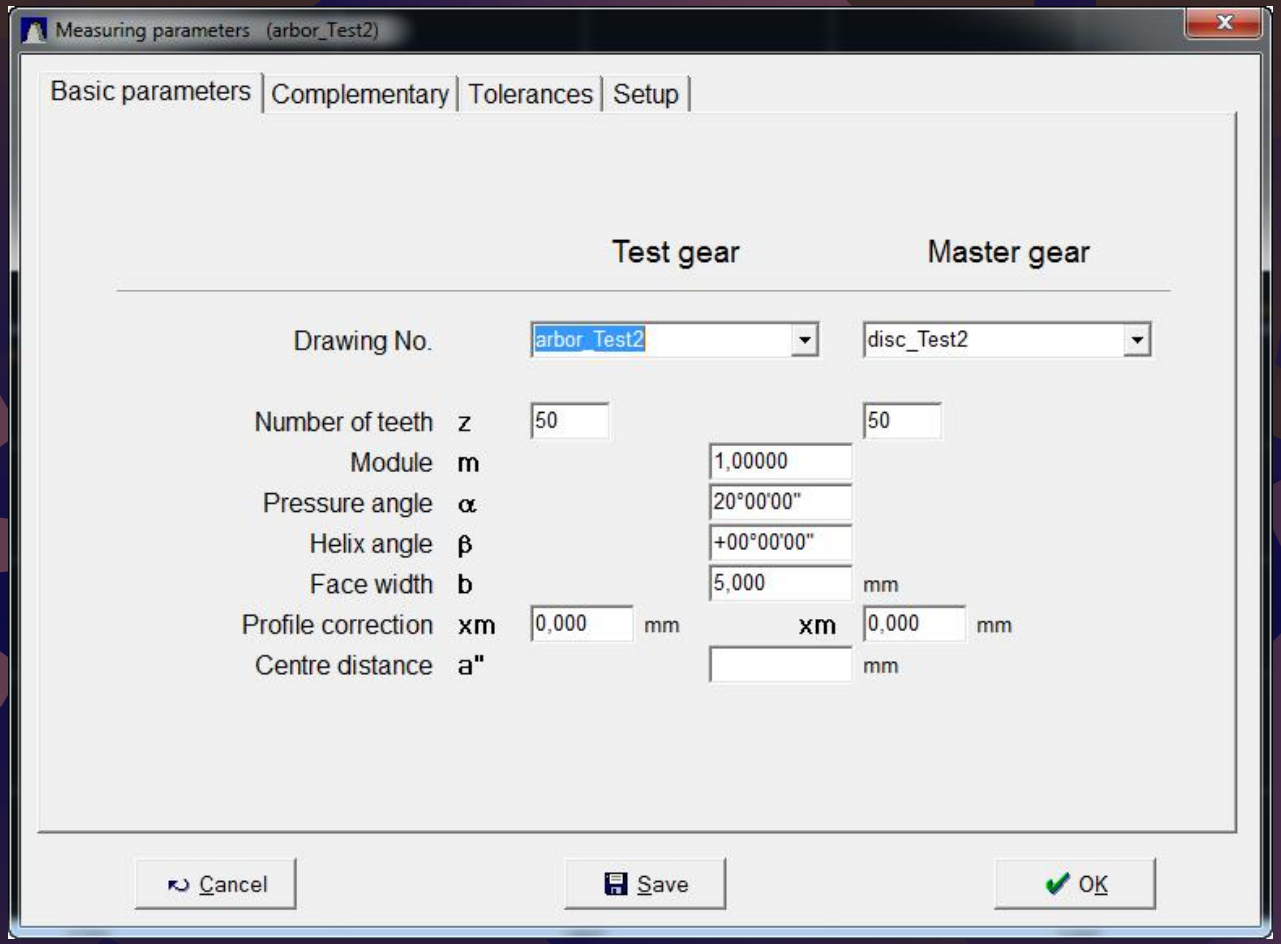




Inaccuracy of clamping cancelled

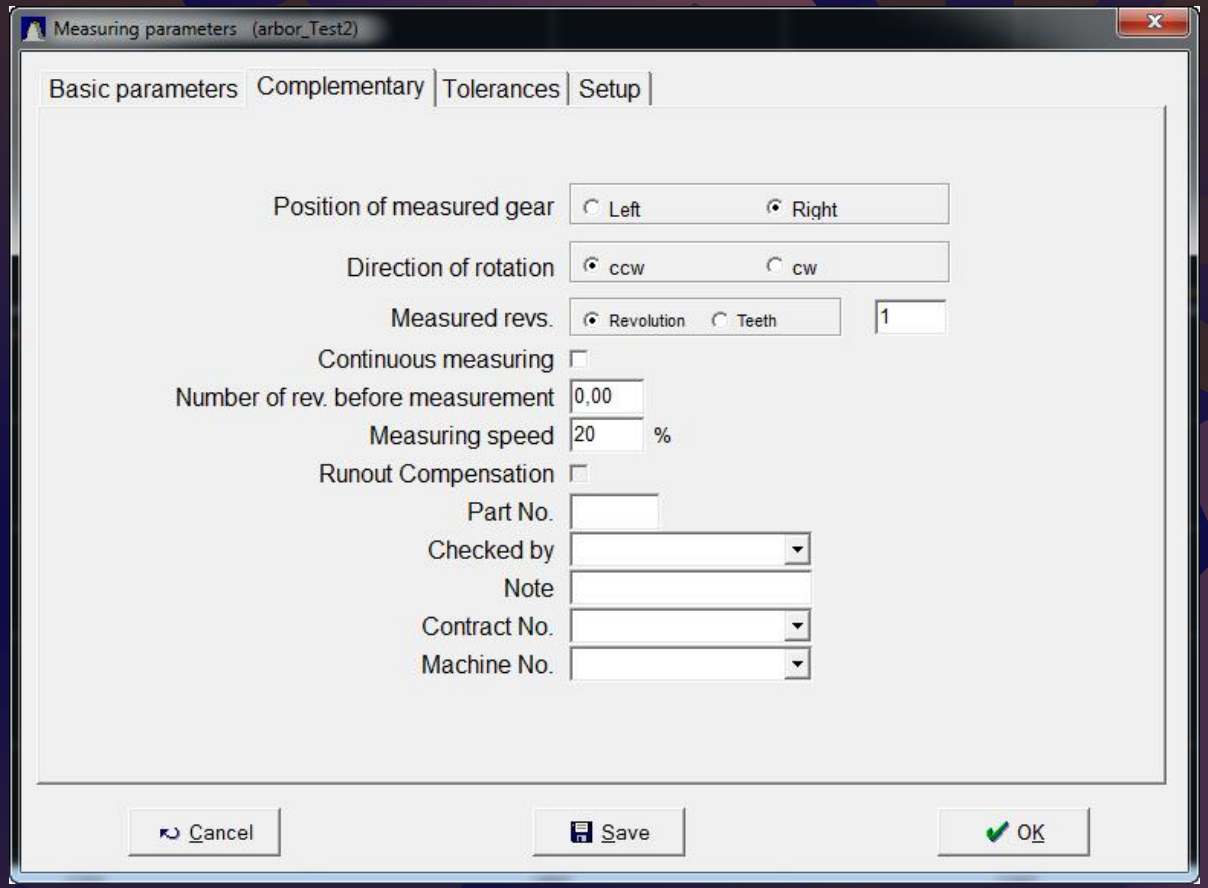
Geartec.cz, Czech Republic, 2014

BASIC PARAMETERS



- Measuring software is user-friendly and does not require any special PC knowledge. It can communicate in many languages and runs under Microsoft Windows software.
- Intuitive work environment

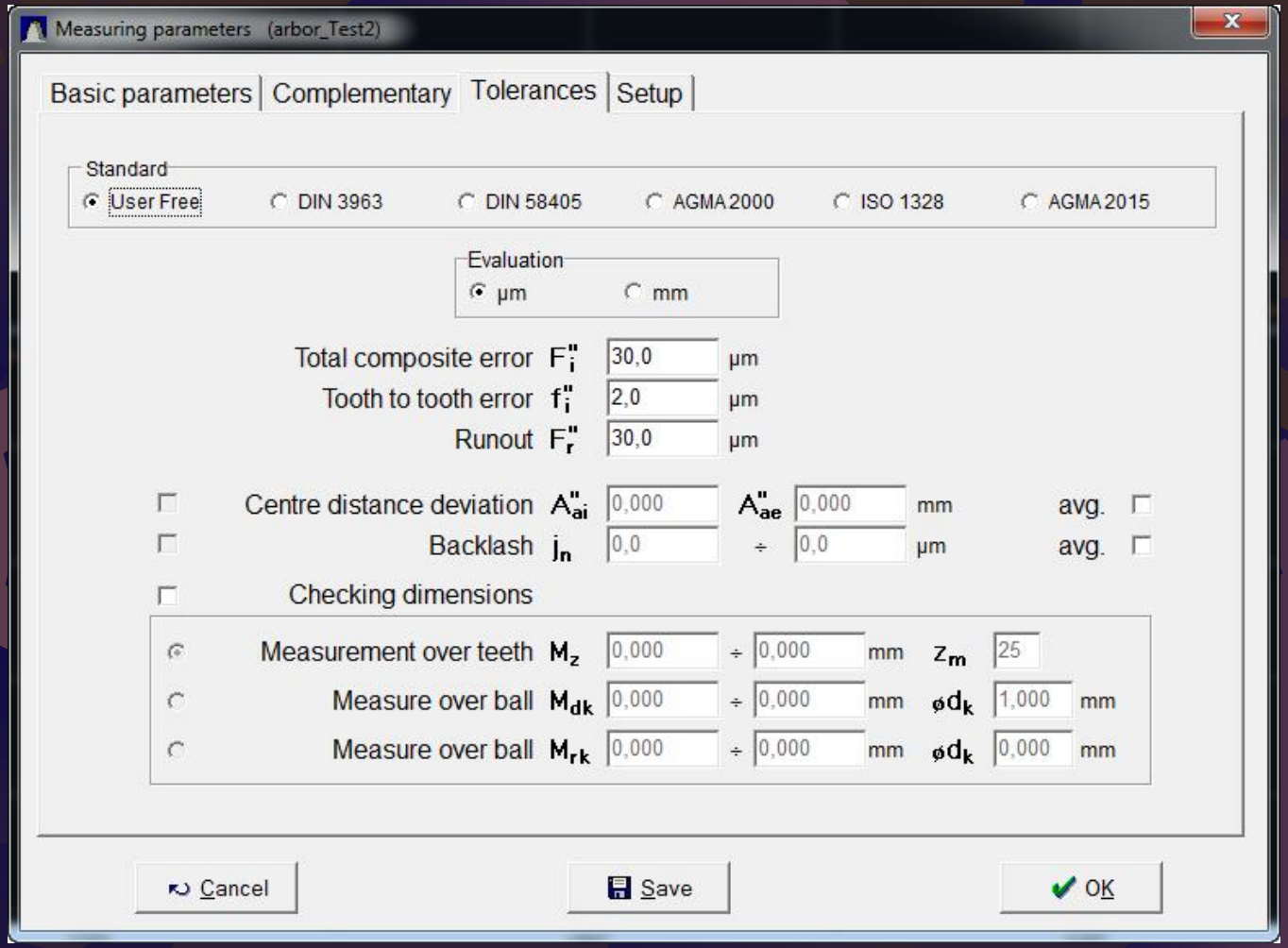
COMPLEMENTARY PARAMETERS



- Description of a measuring cycle is optionally adjustable
- Complementary parameters
- Data of production

Inspection of spur gears by a double-flank rolling method

DEVIATIONS

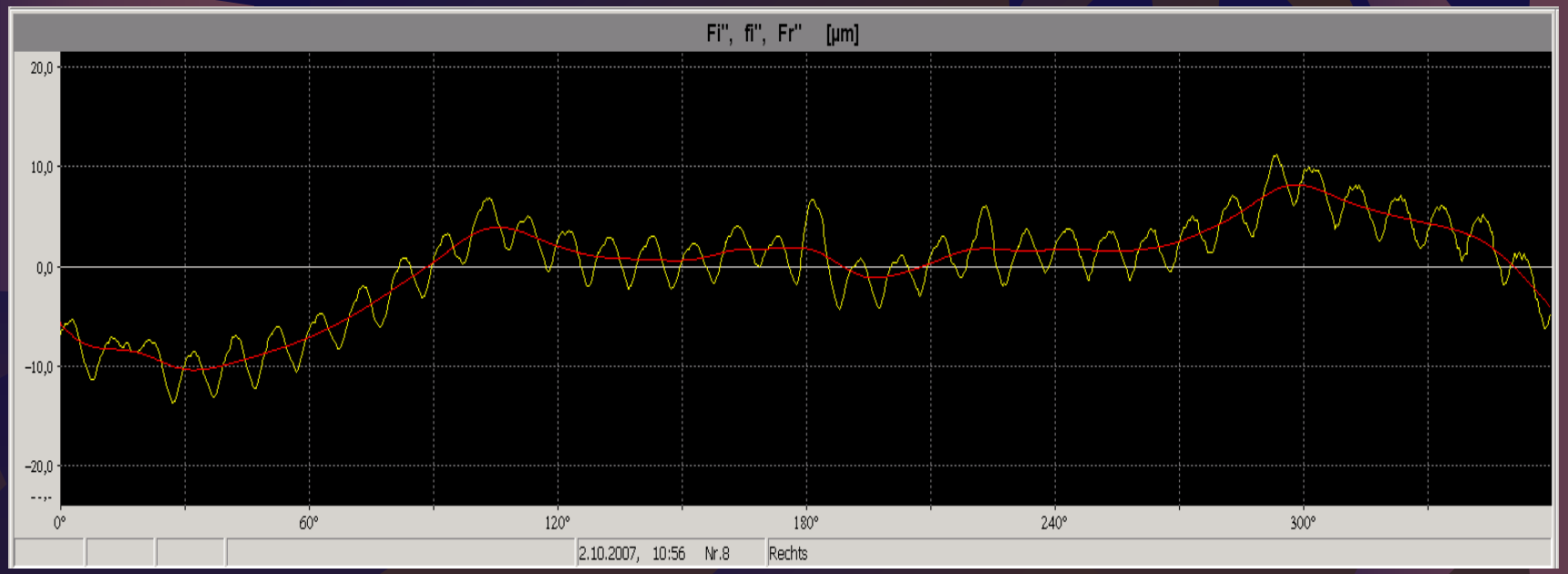


- A wide spectrum of available standards for evaluation
- Optional choice of measured deviations

EXAMPLE 1 : GOOD RESULTS

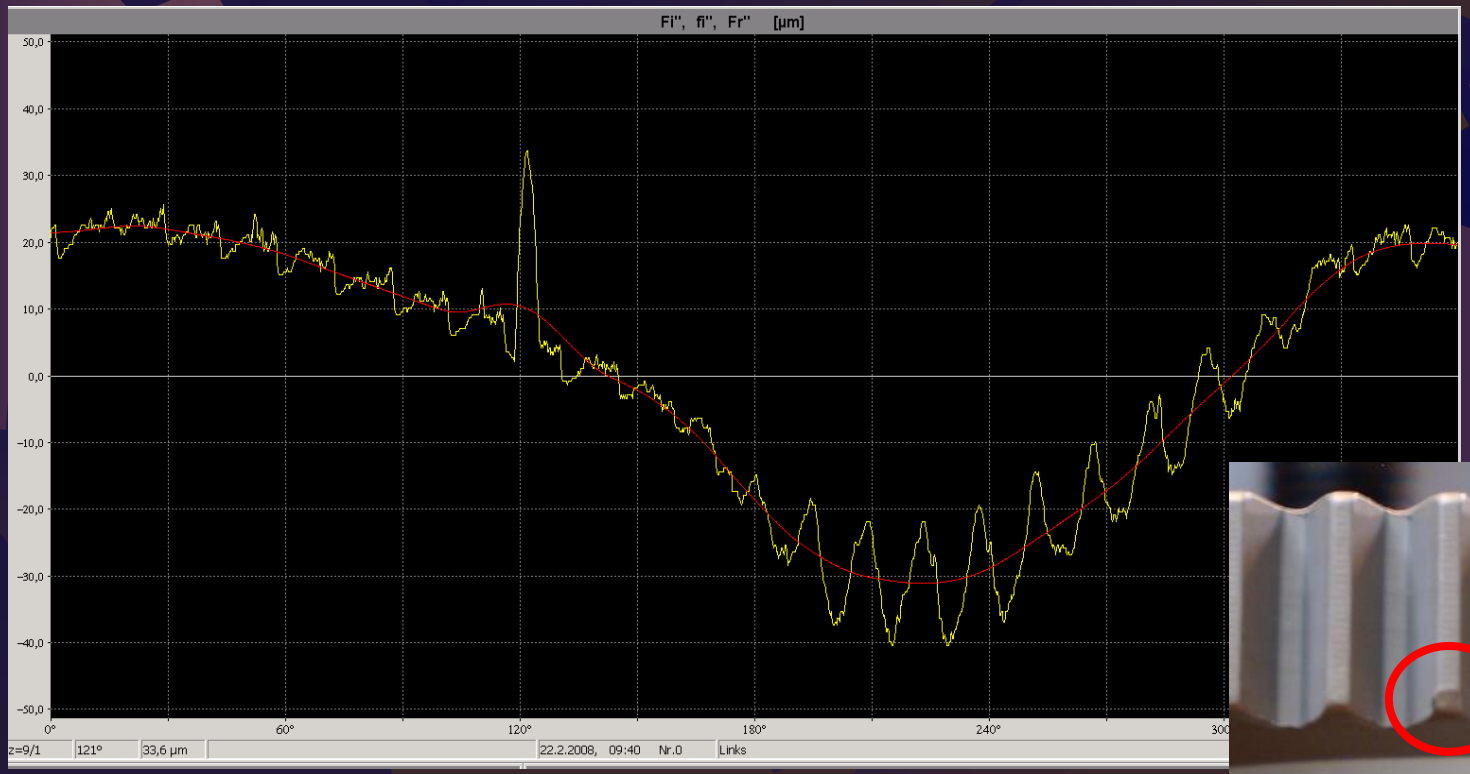
Double flank chart, gear with 36 teeth

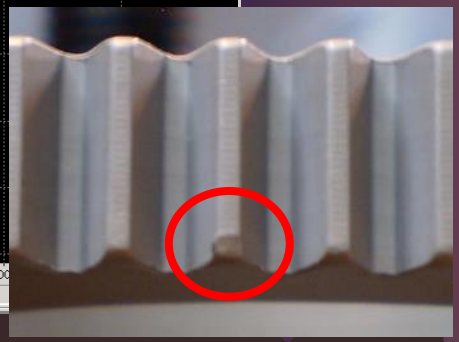
- Radial runout about 0,010 mm
- Visible meshing of individual teeth
- One tooth in the middle of chart is little thicker



EXAMPLE 2: TOOTH NICK

- Tooth No.9 is damaged on tip
- Gear with axial runout
- After measuring, the gear automatically rotates to the damaged area

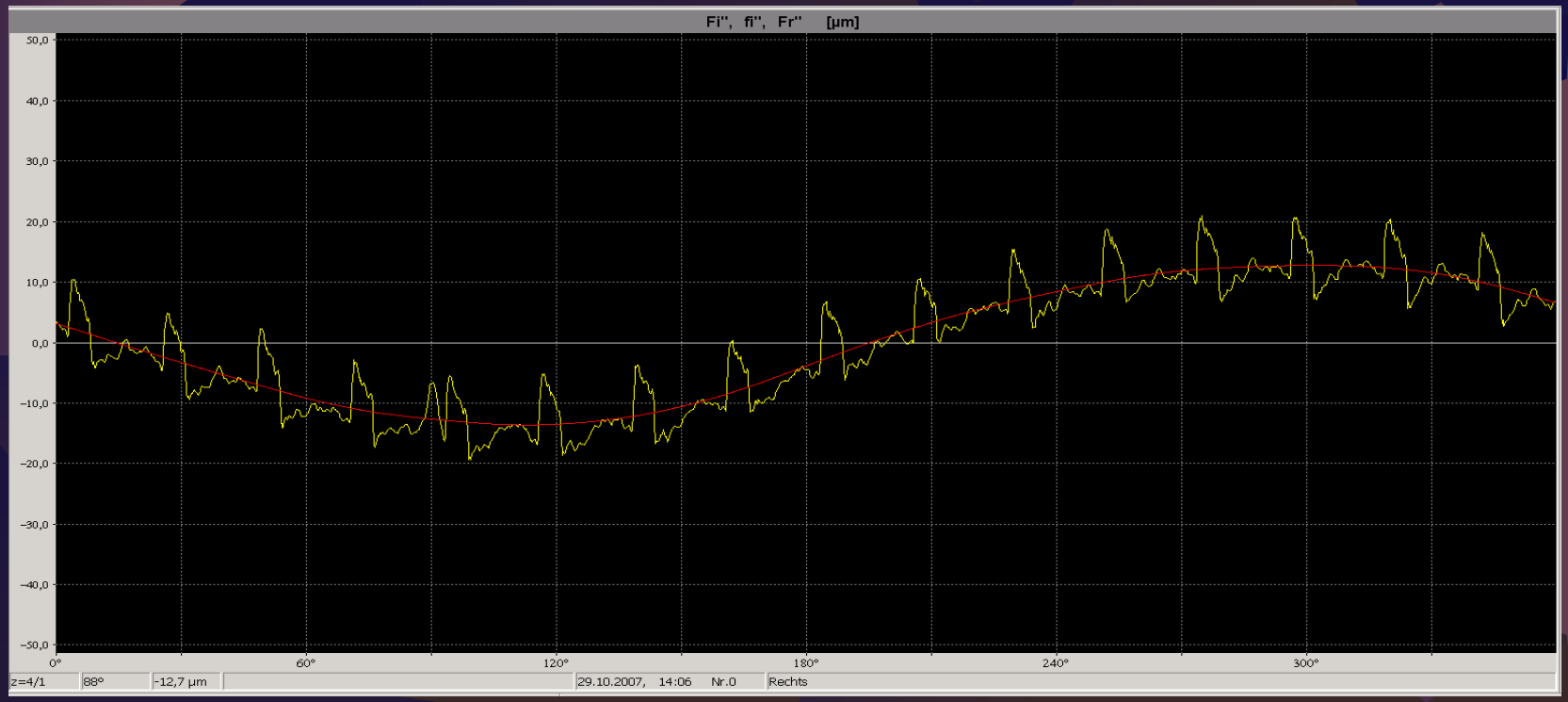




EXAMPLE 3: LOW QUALITY GEARING

Double flank chart, gear with 16 teeth

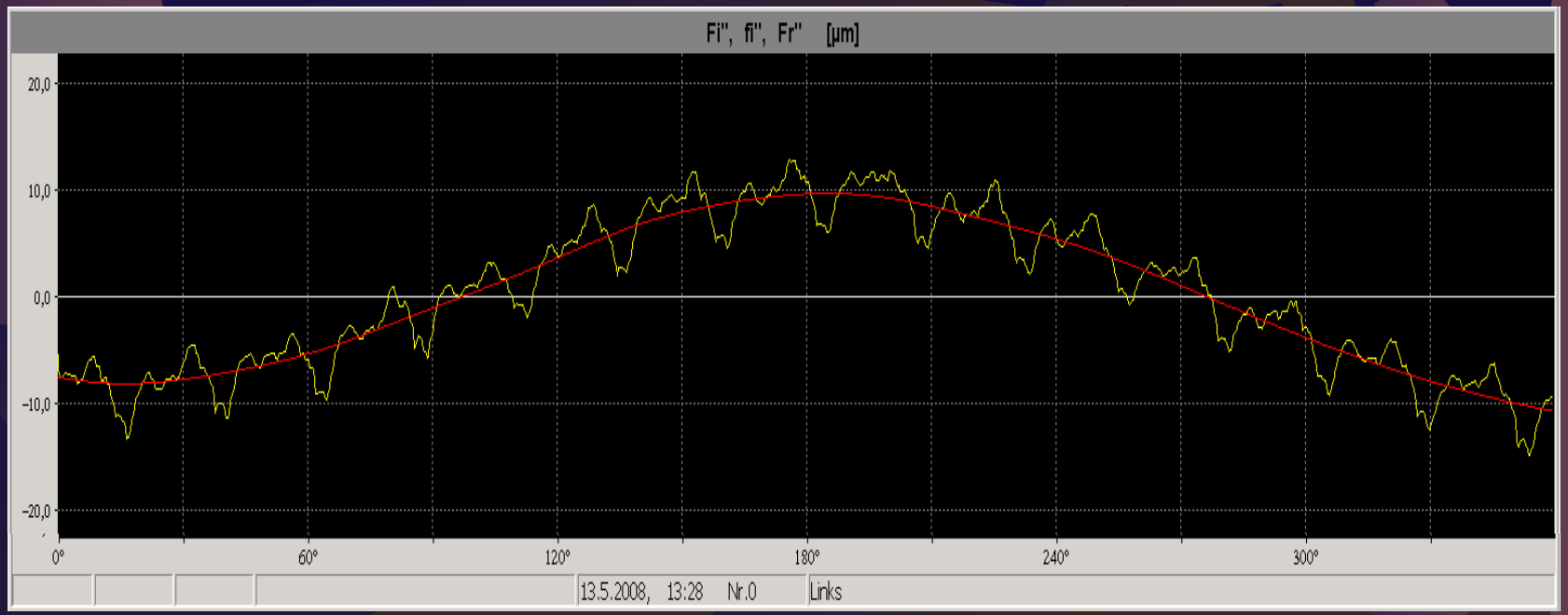
- Wrong pressure angle
- Tooth No. 5 is damaged or dirty



EXAMPLE 4: LOW QUALITY GEARING

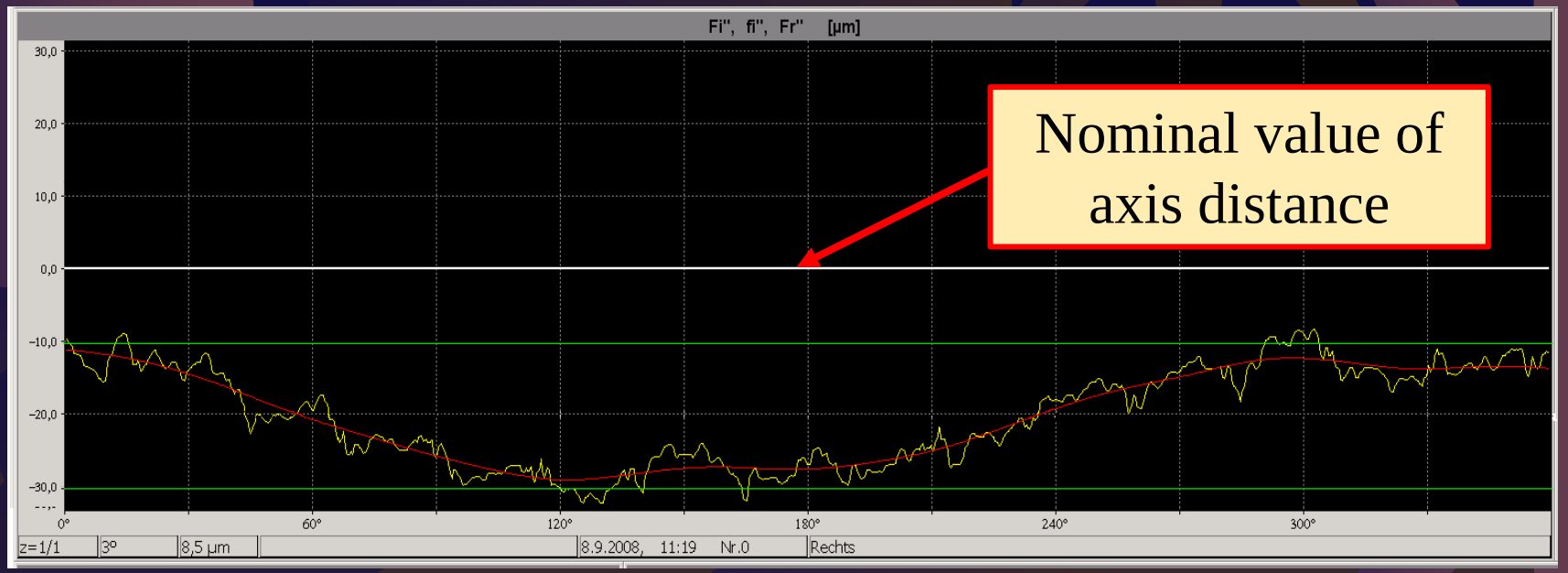
Double flank chart, gear with 15 teeth

- Radial runout
- Teeth with inaccuracy of profile caused by a hobbing machine

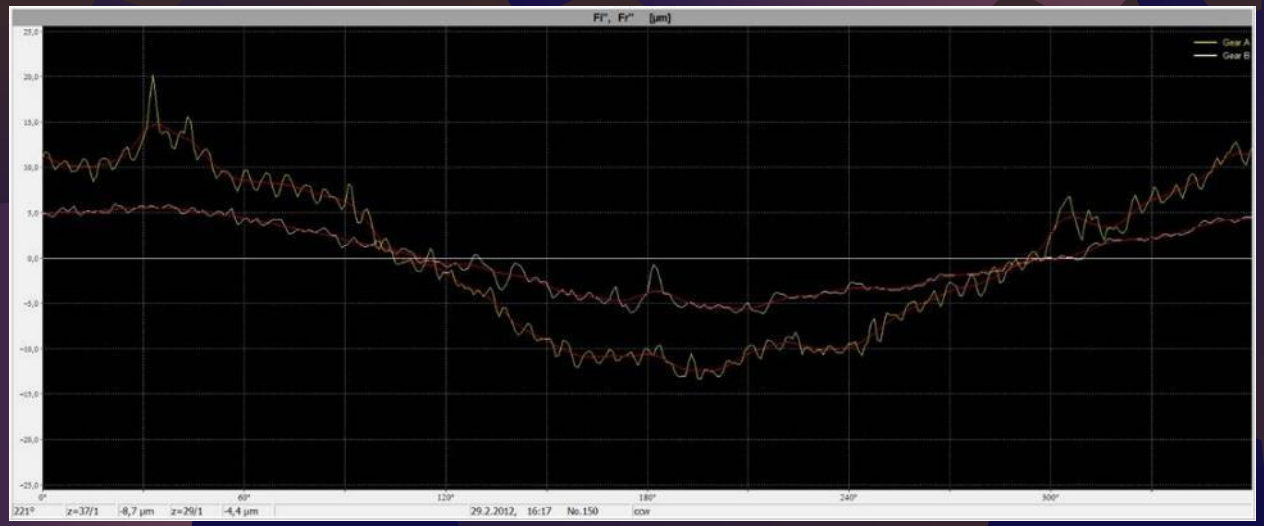


EXAMPLE 5: MEASURING OF BACKLASH

- Axis distance is related to the nominal value
- Calculation of measurement over tooth M_z
- Calculation of measurement over pins (balls) M_{rk} , M_{dk}



EXAMPLE 6: BEARINGS RUNOUT

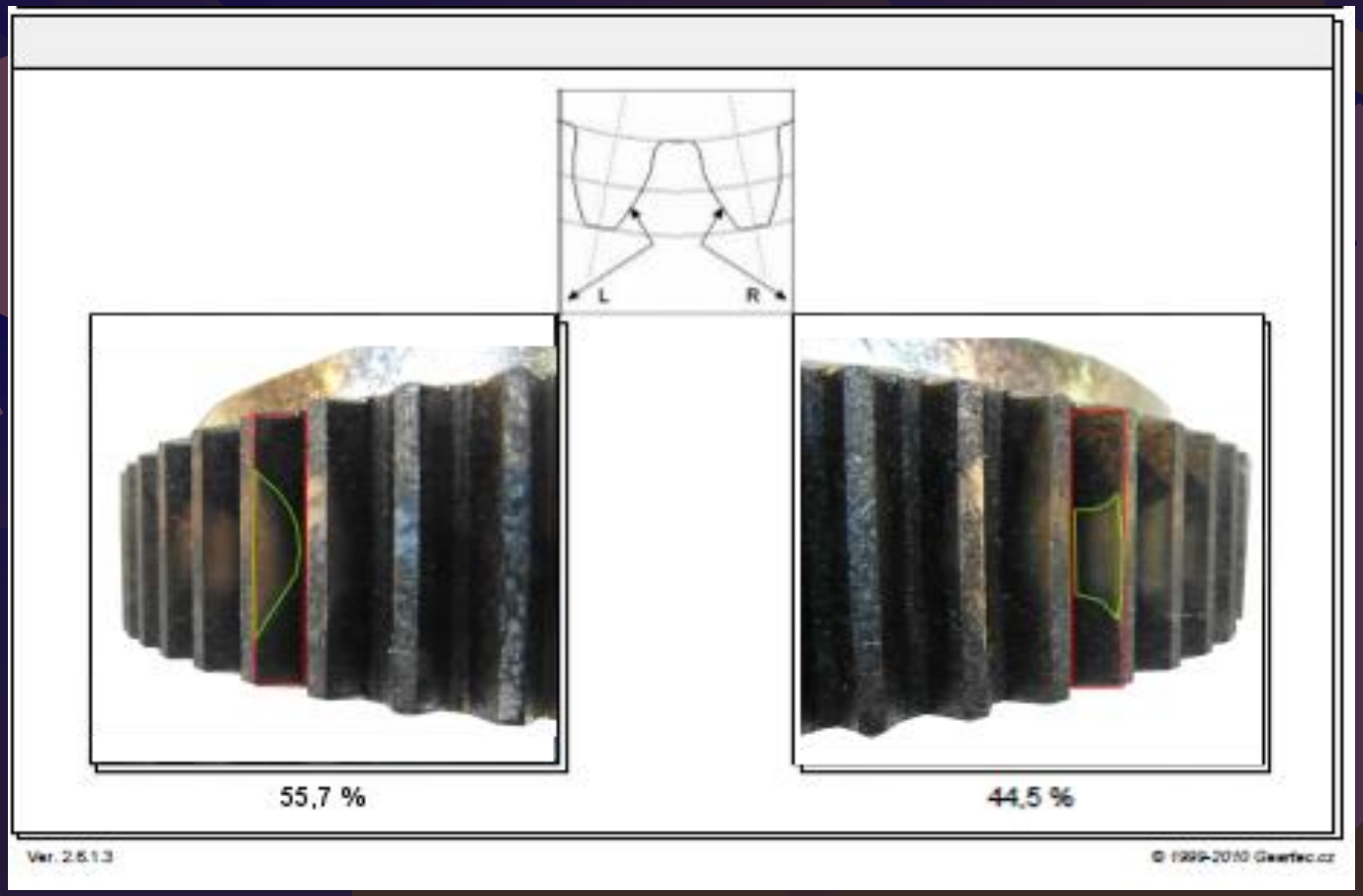


Measured quality of gears – clamped between centers

Quality of gears after bearings runout elimination

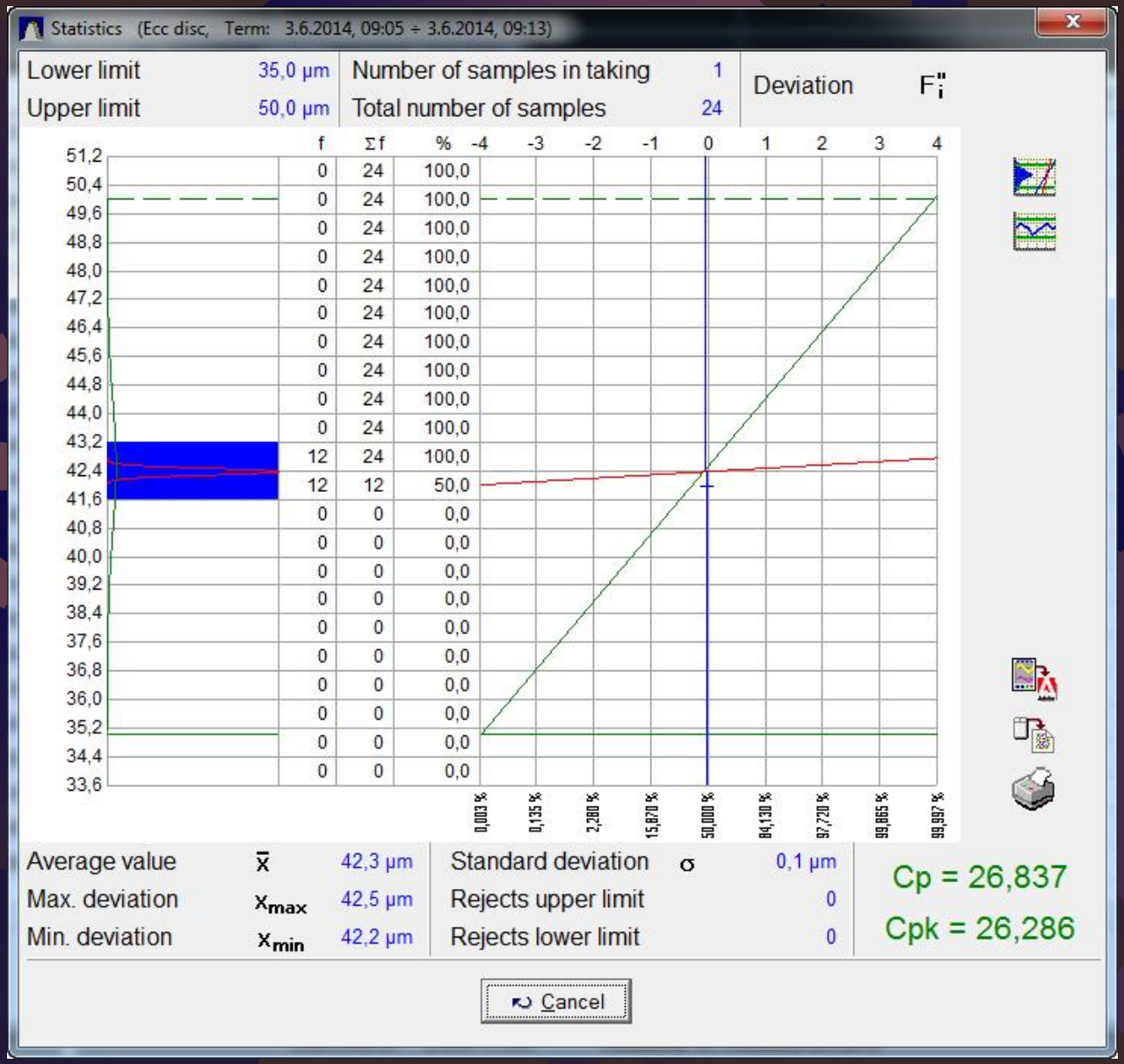
EXAMPLE 7: CONTACT PATTERN

- Quality of contact pattern is shown in % of the total area of tooth
- Photos are automatically saved with measured data into a databank

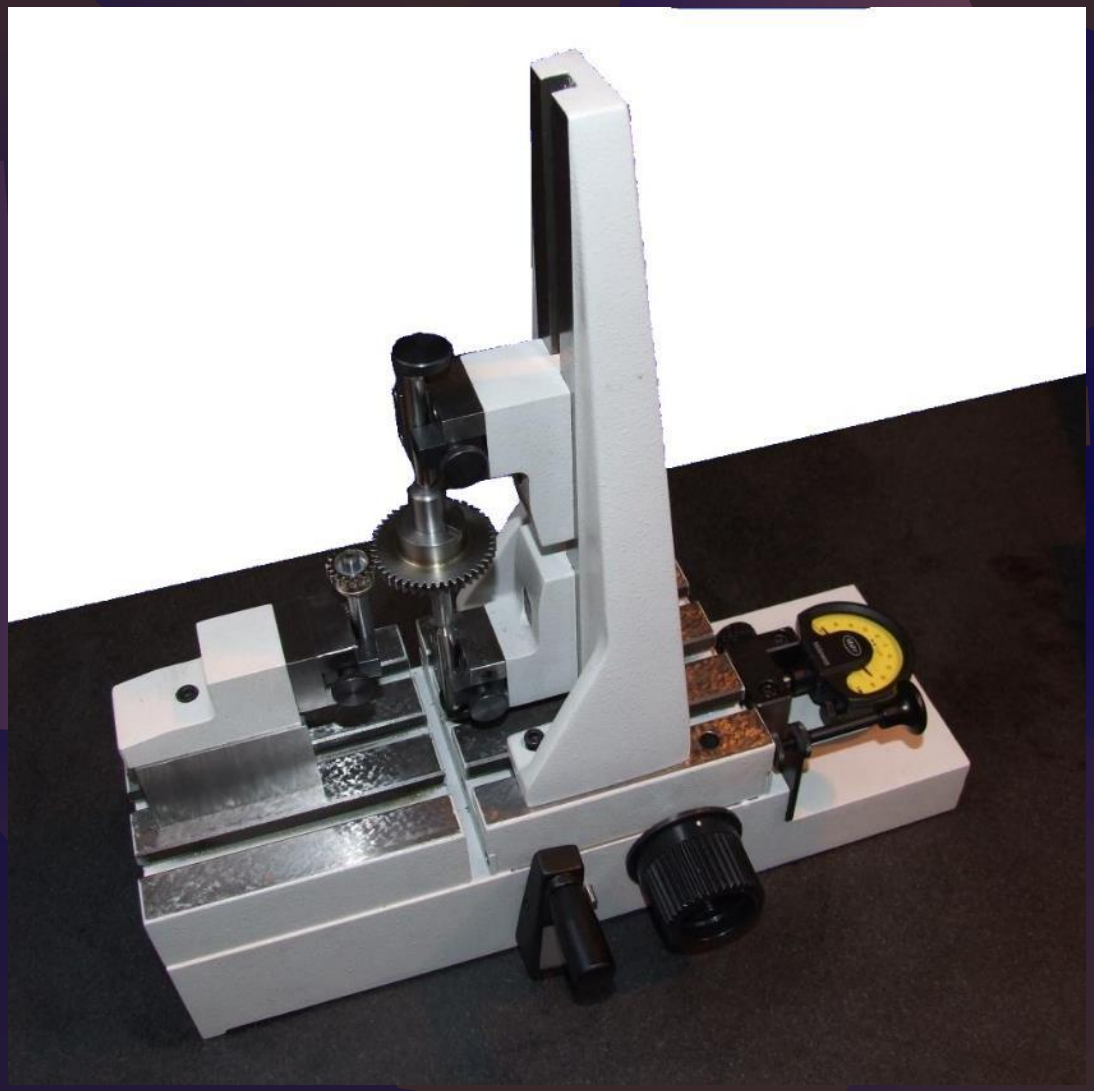


STATISTICAL EVALUATION

Inspection of spur gears by a double-flank rolling method

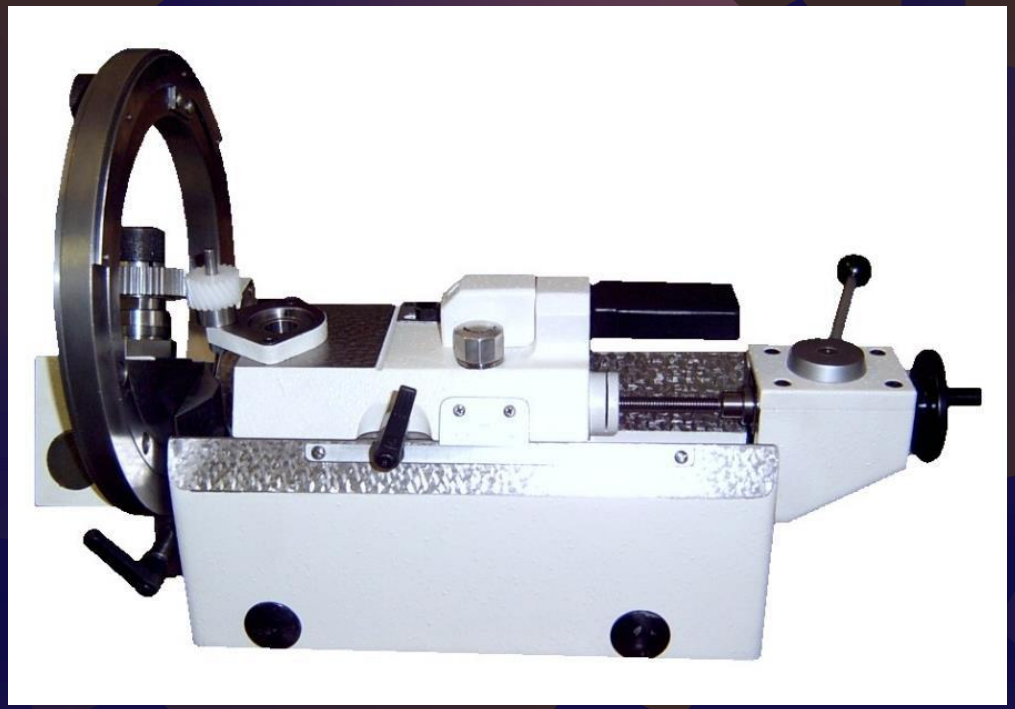


GTS100 MECHANICAL MACHINE



- Master gear on an arbor is clamped between centers
- Measured gear is clamped fleetingly, clamping diameter is optional up to app. 20 mm

MODERNIZED MACHINE GM



- Master gear is clamped fleetingly, clamping diameter 12,7 mm
- Measured gear is clamped fleetingly, clamping diameter is optional up to app. 20 mm
- Special version with a tilt unit enabling measuring of helical gear with a spur master gear..

GTS100 MACHINE

- Master gear is clamped fleetingly, clamping diameter 12,7 mm
- Measured gear is clamped fleetingly, clamping diameter is optional up to app. 20 mm
- Including a controlling computer and Geartec SW

GTS200 MACHINE

- Both master gear and measure gear is clamped between centers
- With motor drive
- Including a controlling computer and Geartec SW

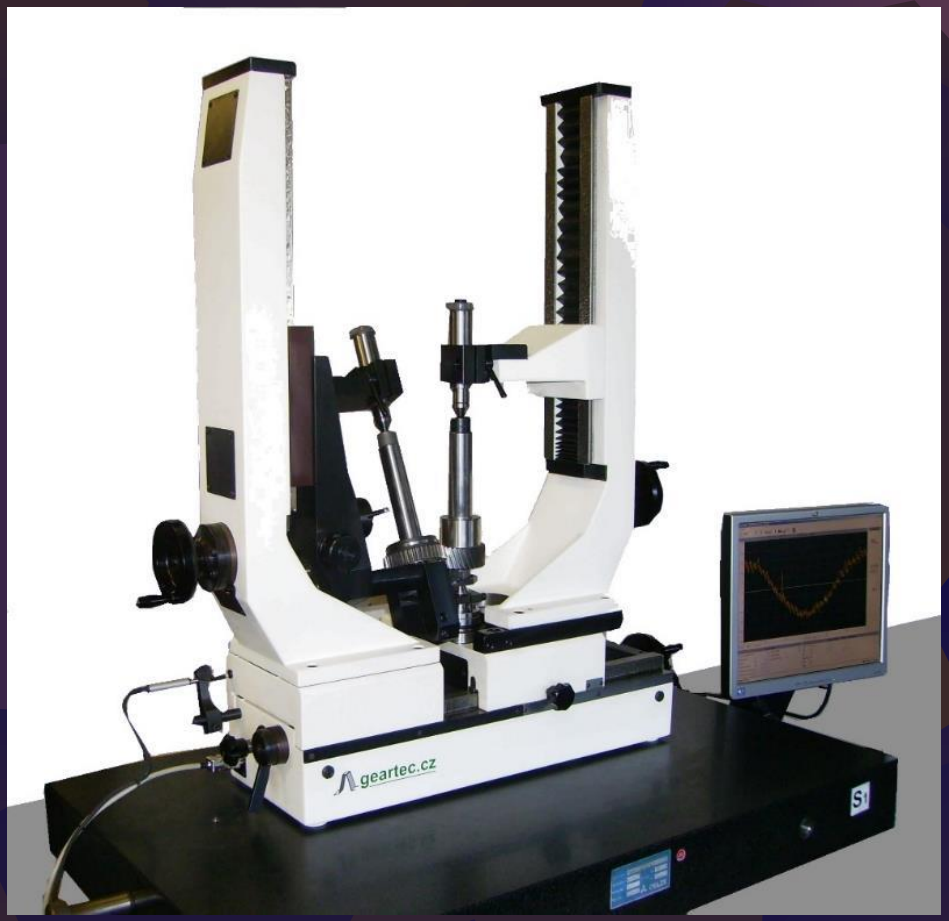
GTS200 MACHINE

- Version for measuring of rack
- Pinion with a motor drive
- Suitable for both left and right control
- Including a controlling computer and Geartec SW

GTS200 MACHINE

- Master gear is clamped fleetingly, clamping diameter 30 mm
- Measured gear is clamped fleetingly by a special clamping fixture
- Including a controlling computer and Geartec SW

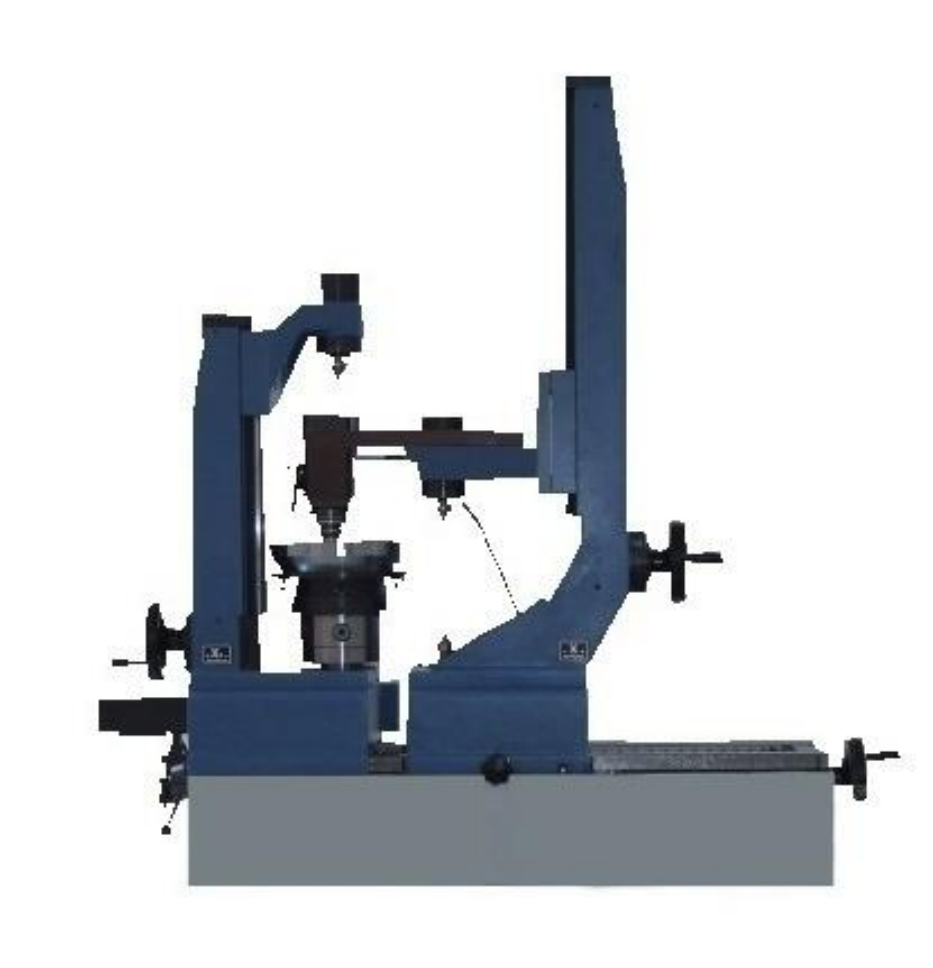
GTS200 MACHINE



- Rotary axis with a motor drive
- Master gear on an arbor clamped between centers
- A tilt head enables measuring of helical gear with a spur master gear
- Including a controlling computer and Geartec SW

Geartec.cz, Czech Republic, 2014

GTD200 MACHINE



- Rotary axis with a motor drive
- Measuring of internal and external gears
- Including a controlling computer and Geartec SW

Inspection of spur gears by a double-flank rolling method

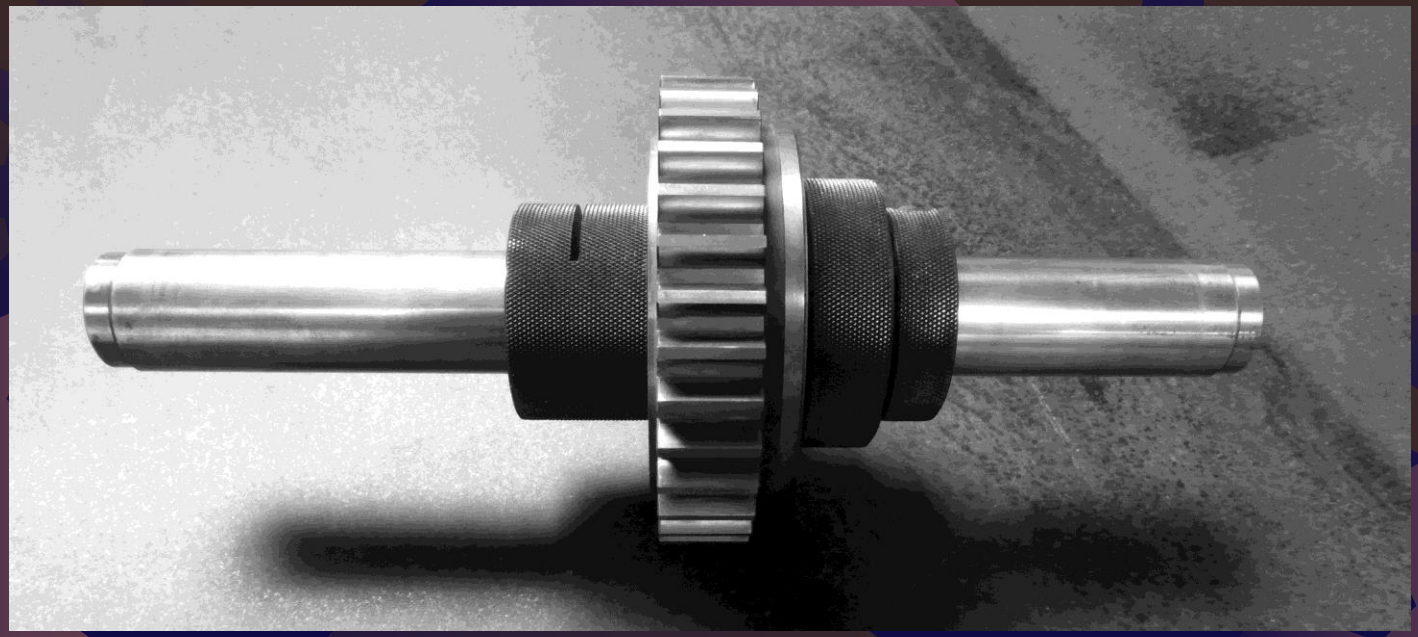
GTS300 MACHINE

- Rotary axis with a motor drive
- Master gear on an arbor clamped between centers
- A tilt head enables measuring of helical gear with a spur master gear
- Including a controlling computer and Geartec SW

GTS400 MACHINE

- Both master gear and measured gear are clamped between centers
- Linear axis with a motor drive
- Including a controlling computer and Geartec SW

MASTER GEAR CLAMPING



- Cylindrical arbor for master gear clamping between centers
- Master gear is vertically adjustable
- Options of clamping arbor diameters: 16, 20 and 30mm
- Arbor is produced in quality IT2
- Clamping accuracy up to 0,003 mm

MASTER GEAR CLAMPING

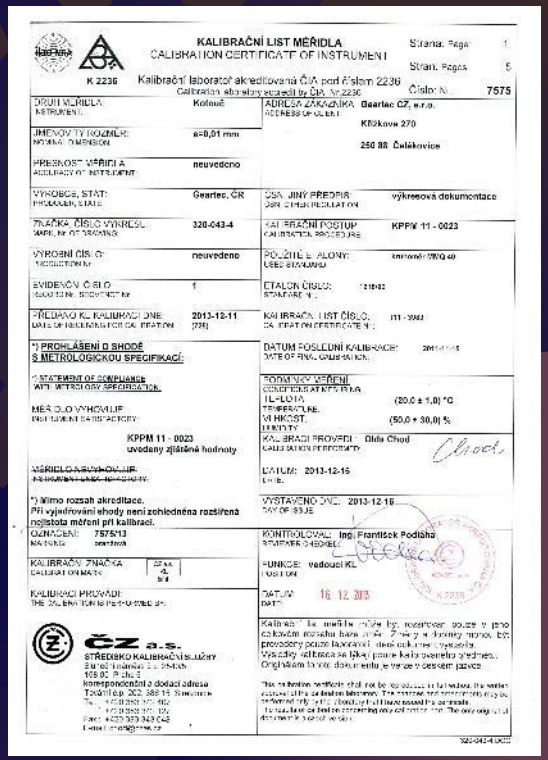
- Clamping fleetingly by an expanding collet
- Standard clamping diameters 20 and 30 mm
- Clamping accuracy up to 0,002 mm

CLAMPING FIXTURES SET

- Fast and easy exchange
- Clamping accuracy in app. 0,002 mm
- Construction based on customer demands

CERTIFIED MEASURING ACCURACY

Inspection of spur gears by a double-flank rolling method



KALIBRAČNÍ LIST MĚŘIDLA
CALIBRATION CERTIFICATE OF INSTRUMENT

K 2236 Kalibrační laboratoř akreditovaná ČIA pod číslem 2236

Číslo: 7575

DRUH MĚŘIDLA: Kotouč

JMENOVITÝ ROZMĚR: a=0,01 mm

PŘESNOST MĚŘIDLA: neuvedeno

VÝROBCE, STÁT: Geartec, ČR

ZNAČKA, ČÍSLO VÝKRESU: 320-043-4

VÝROBNÍ ČÍSLO: neuvedeno

EVIDENČNÍ ČÍSLO: 1

DATUM KALIBRACE: 2013-12-11

ADRESA ZÁKAZNÍKA: Geartec CZ, s.r.o.
Křížkova 270
250 88 Čelákovice

OSA, JINÝ PŘEDPIS: výkresová dokumentace

KALIBRAČNÍ POSTUP: KPPM 11 - 0023

POUŽITÉ ETALONY:

ETALON ČÍSLO:

KALIBRAČNÍ LIST ČÍSLO:

DATUM POSLEDNÍ KALIBRACE:

*) PROHLÁŠENÍ O SHODĚ S METROLOGICKOU SPECIFIKACÍ:

*) STATEMENT OF COMPLIANCE WITH METROLOGY SPECIFICATION:

MĚŘIDLO VYHOVUJE: KPPM 11 - 0023 uvedeny zjištěné hodnoty

*) Mimo rozsah akreditace.
Při vyjadřování shody není zohledněna rozšířená nejistota měření při kalibraci.

OZNAČENÍ: 7575/13

KALIBRAČNÍ ZNAČKA:

KALIBRACI PROVÁDĚL:

PODMÍNKY MĚŘENÍ:
TEPLOTA: (20,0 ± 1,0) °C
VLHKOST: (50,0 ± 30,0) %

KALIBRACI PROVEDL: Ilda Chod

DATUM: 2013-12-16

VYSTAVENO DNE: 2013-12-16

KONTROLOVAL: Ing. František Podišta

FUNKCE: vedoucí KL

DATUM: 16. 12. 2013

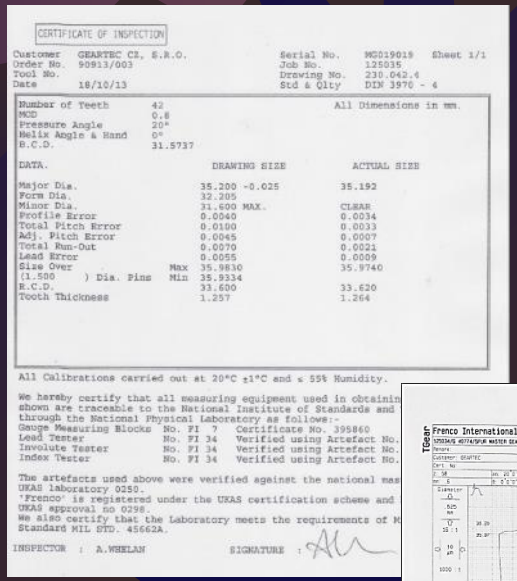
ČZ a.s.
STŘEDISKO KALIBRAČNÍCH SLUŽEB

- Checking with a certified eccentric disc
- Difference in measurements in app. 0,3 μm
- Quality parameters c_m a $c_{mk} \geq 1,33$
- In accordance with international system of quality measuring

Geartec.cz, Czech Republic, 2014

Inspection of spur gears by a double-flank rolling method

MASTER GEARS SET



CERTIFICATE OF INSPECTION

Customer GEARTEC CZ, S.R.O. Serial No. MG019019 Sheet 1/1
Order No. 90913/003 Job No. 125035
Tool No. Drawing No. 230.042.4
Date 18/10/13 Std & Qlty DIN 3970 - 4

Number of Teeth	42	All Dimensions in mm.
MOD	0.8	
Pressure Angle	20°	
Helix Angle & Hand	0°	
B.C.D.	31.5737	

DATA.	DRAWING SIZE	ACTUAL SIZE
Major Dia.	35.200 -0.025	35.192
Form Dia.	32.205	
Minor Dia.	31.600 MAX.	CLEAR
Profile Error	0.0040	0.0034
Total Pitch Error	0.0100	0.0033
Adj. Pitch Error	0.0045	0.0007
Total Run-Out	0.0070	0.0021
Lead Error	0.0055	0.0009
Size Over Max	35.9830	35.9740
(1.500) Dia. Pins Min	35.9334	
M.C.D.	33.600	33.620
Tooth Thickness	1.257	1.264

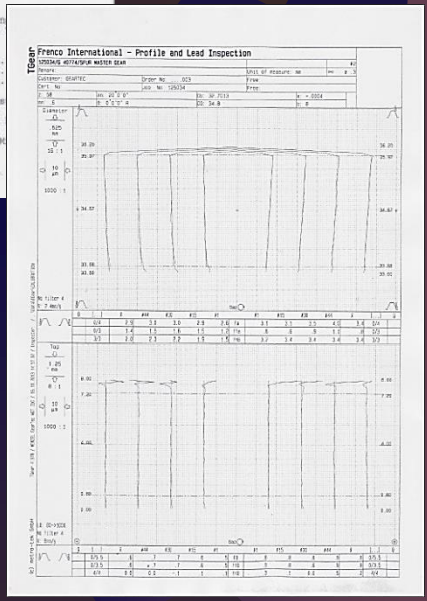
All Calibrations carried out at 20°C ±1°C and ≤ 55% Humidity.

We hereby certify that all measuring equipment used in obtainin
shown are traceable to the National Institute of Standards and
through the National Physical Laboratory as follows:-

Gauge Measuring Blocks	No. FI 7	Certificate No. 395860
Lead Tester	No. FI 34	Verified using Artefact No.
Involute Tester	No. FI 34	Verified using Artefact No.
Index Tester	No. FI 34	Verified using Artefact No.

The artefacts used above were verified against the national mas
UKAS laboratory 0250.
'Frenco' is registered under the UKAS certification scheme and
UKAS approval no 0298.
We also certify that the Laboratory meets the requirements of M
Standard MIL STD. 45662A.

INSPECTOR : A.WHELAN SIGNATURE :



- Parameters of master gears are design for particular measured gears
- We supply with master gears in quality DIN 3-4
- You can design your master gear in a GEAR application by GEARTEC

Inspection of spur gears by a double-flank rolling method

REFERENCE LIST

Germany

ATLANTA ANTRIEBSSYSTEME GmbH & Co.KG
GTS 200 – double flank tester for spur gears

BMW AG – BMW WERK BERLIN
GT 150KW – 2 pieces of double flank tester for automotive crank shafts

EUROTRONIC GmbH
GMS 32 – double flank tester for spur and helical gears

FEINWERK TECHNIK GmbH
GMS 32 – double flank tester for spur and helical gears

GSC SCHWÖRER GmbH
GTS 200 – double flank tester for spur gears

NEUGART GmbH
GMS 32 – double flank tester for spur and helical gears

RINGHOFFER VERZAHNUNGSTECHNIK GmbH
GTS 200 – double flank tester for spur gears

SIEMENS GEARED MOTORS GmbH, WERK TÜBINGEN
GTWG 350 – double flank tester for worm gears

VOGEL ANTRIEBSTECHNIK GmbH
GTS 300 – double flank tester for spur gears

France

CP GEORGES RENAULT S.A.S.
GMS 32 – double flank tester for spur and helical gears

CROUZET AUTOMATISMES
GMS 32 – double flank tester for spur and helical gears

Hungary

ALAS COPCO
GMS 32 – double flank tester for spur and helical gears

Korea

LG INNOTEK
GMS 32 – double flank tester for spur and helical gears

SAMSUNG ELECTRONICS
GMS 32 – double flank tester for spur and helical gears

Sweden

ALAS COPCO
GMS 32 – 3 peices of double flank tester for spur and helical gears

a mnoho dalších

THANK YOU

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250 88 Čelákovice
Czech Republic

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www.geartec.cz