

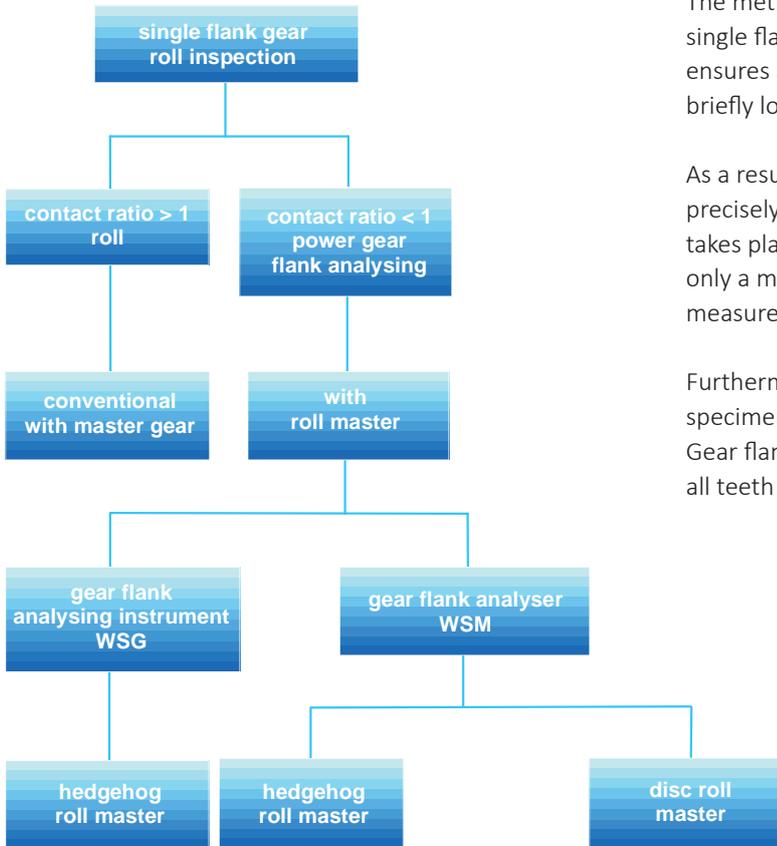
## Gear Flank Analyser

Evaluation of the total gear geometry

  
*pure  
perfection*

**FRENCO**

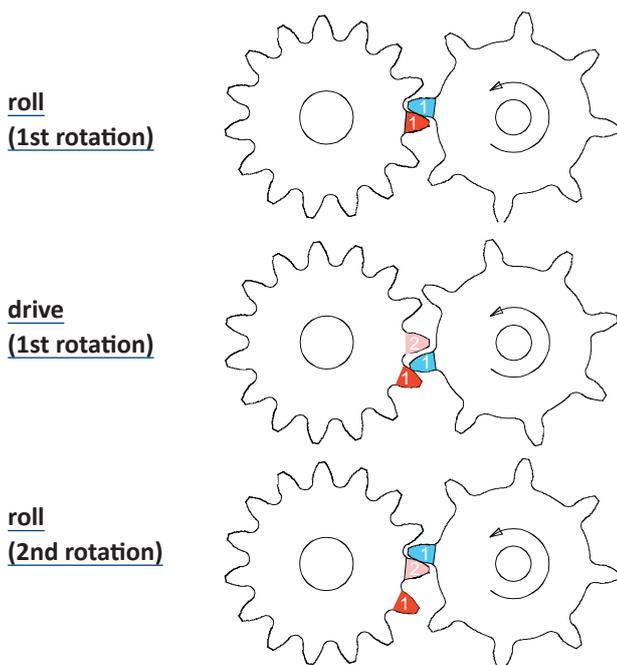
# General Information



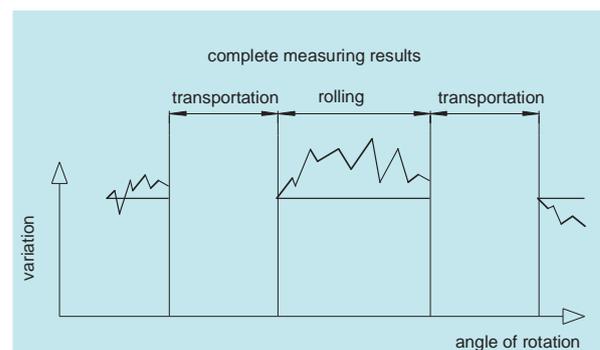
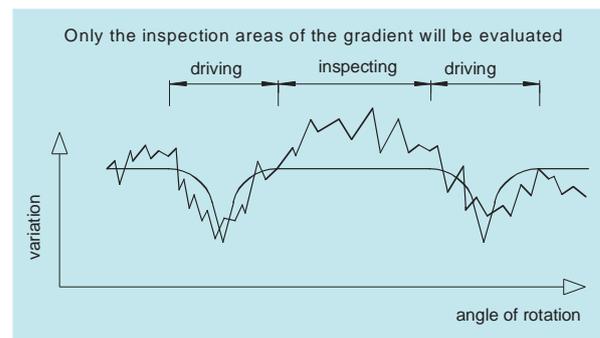
The method of gear flank analysing is based on the single flank gear test. A specially designed roll master ensures a contact ratio of less than one. Thus the gears briefly loose contact in-between two adjacent teeth.

As a result, the specimens' deviations can be assigned precisely to the tooth number. The actual measurement takes place during the rolling process. The driving path is only a means of transportation and is irrelevant for the measurement.

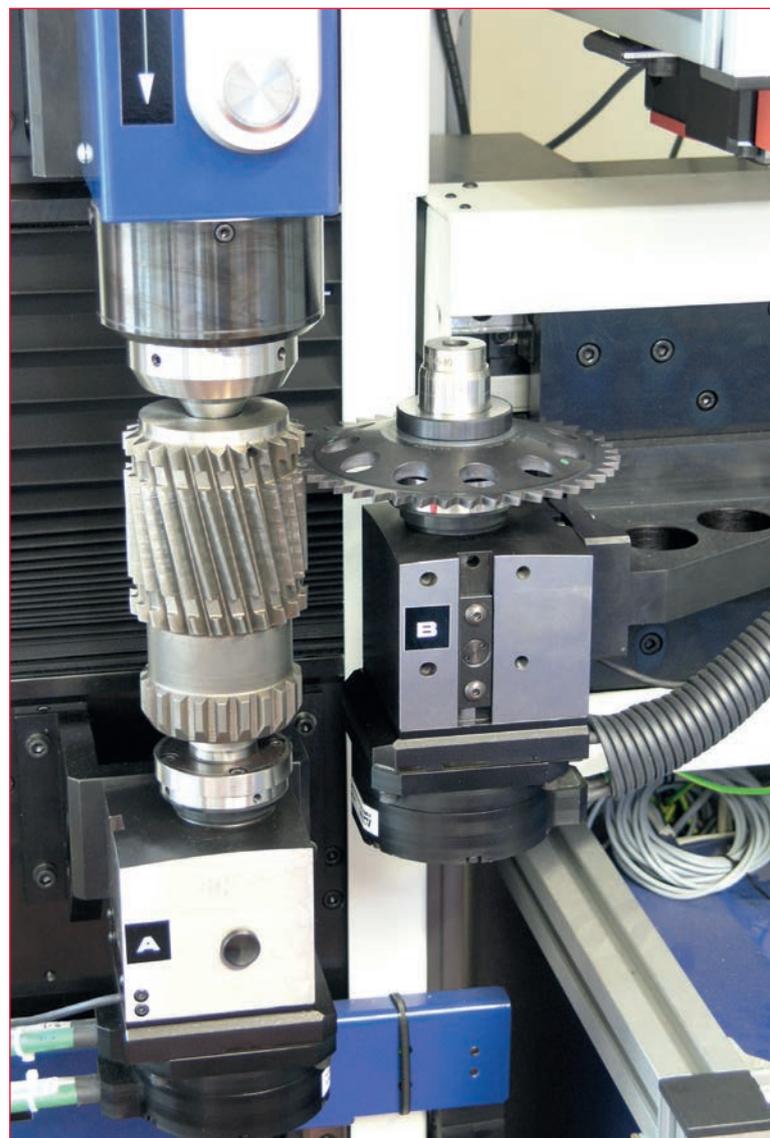
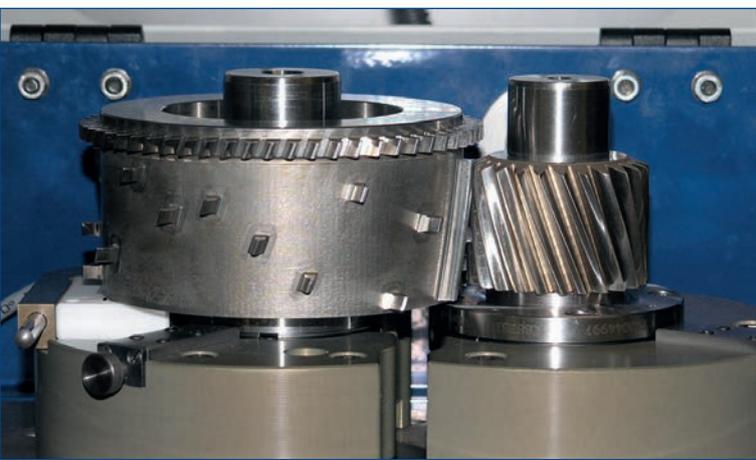
Furthermore, the roll master is designed to measure the specimen in more than 13 independent planes. In short: Gear flank analysing conducts an individual error test of all teeth in several planes.



## Measurement with contact ratio less than 1



# Measuring Tasks



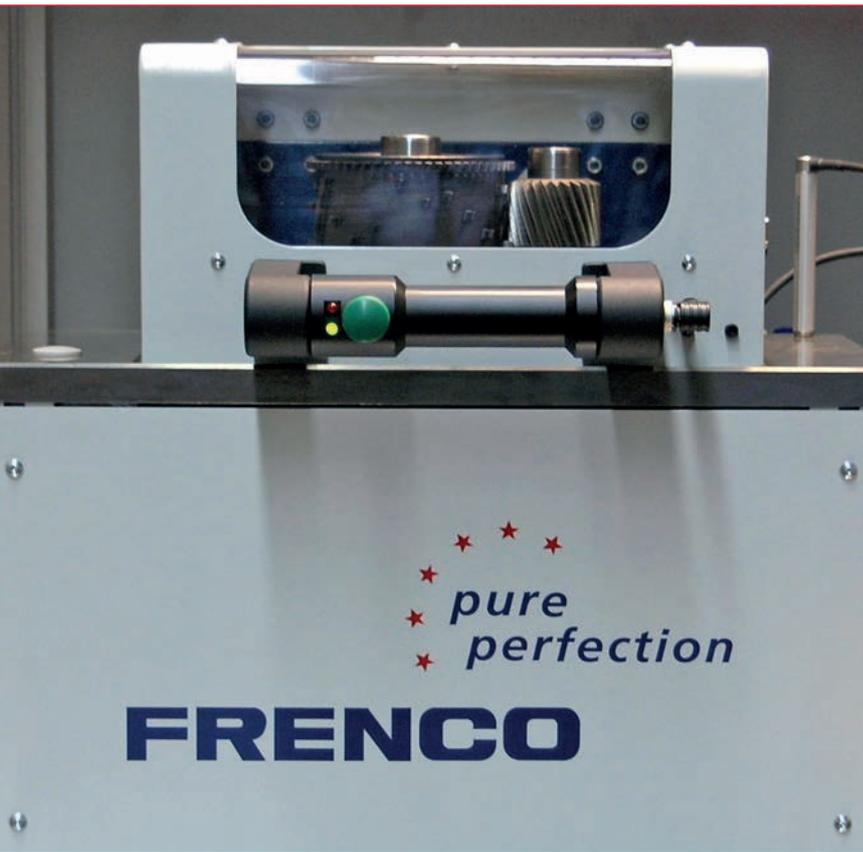
Depending on the number of teeth and the device, the entire gear profile can be scanned within 3 to 13 minutes. It is possible to evaluate a large number of other parameters, besides the usual parameters, such as profile, pitch and runout, with the measuring time remaining the same.

Gear flank analysing measuring allows an extensive and still efficient quality evaluation.

The machines are designed for use in production and may replace the inspection in a measuring room. Whenever there is an error, the reaction time is extremely short. The gear flank analysing machines only render their full contribution when high volumes and consistent gear geometries are measured.

The number of measurement amounts to 60-100 per day and machine.

# Gear Flank Analyser WSG



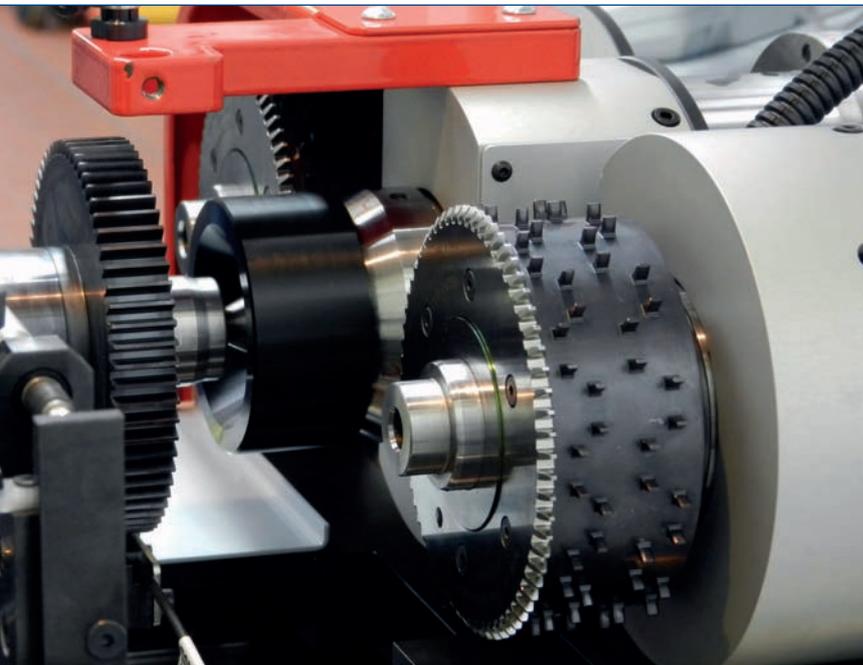
Gear flank analysing machines WSG use hedgehog roll masters. These are master gears with tooth segments that are adapted to the gear geometry to be measured.

Due to the segments' vertical offset it is possible to evaluate the workpiece geometry in several planes.

This ensures that the profiles of all tooth flanks are detected in several planes, which enables a calculation of the tooth traces.



Hedgehog roll master



Gear flank analyser with double spindle:  
cuts measuring time by half

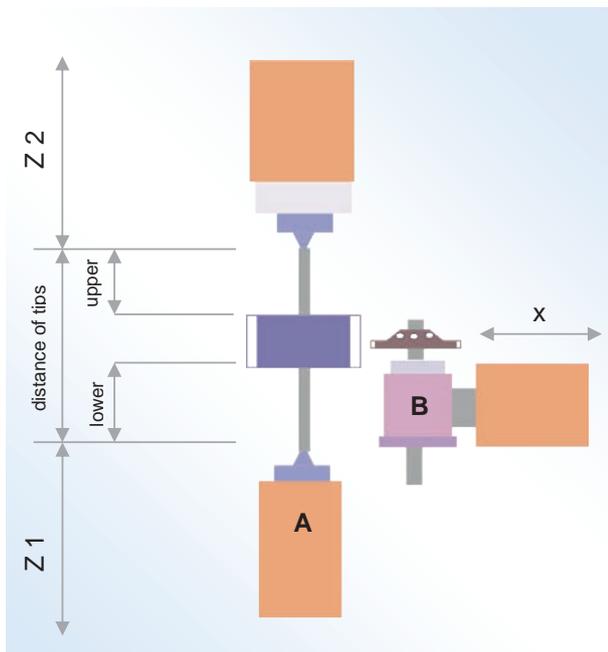
# Gear Flank Analyser WSM

Gear flank analysing is based on the principle of the single flank gear roll inspection and the roll master is adjusted to the gear profile to be inspected. Two rotations of the master complete the inspection of the set plane of the workpiece. Rotary axis A of the workpiece and rotary axis B of the roll master are electrically connected. Simultaneous movement of axis Z1 and axis Z2 enables measurements in as many planes as necessary.

The tip centre distance and the position of the gear profile to be inspected are logged in the inspection plan and automatically controlled during the process.

The x axis controls the centre distance and is positioned automatically.

Depending on the workpiece, the measurement in 10 planes takes about 4 minutes.



- A = axis of rotation of the workpiece
- B = axis of rotation of the disc scanning master
- Z1 = upper centre position
- Z2 = lower centre position
- X = centre distance



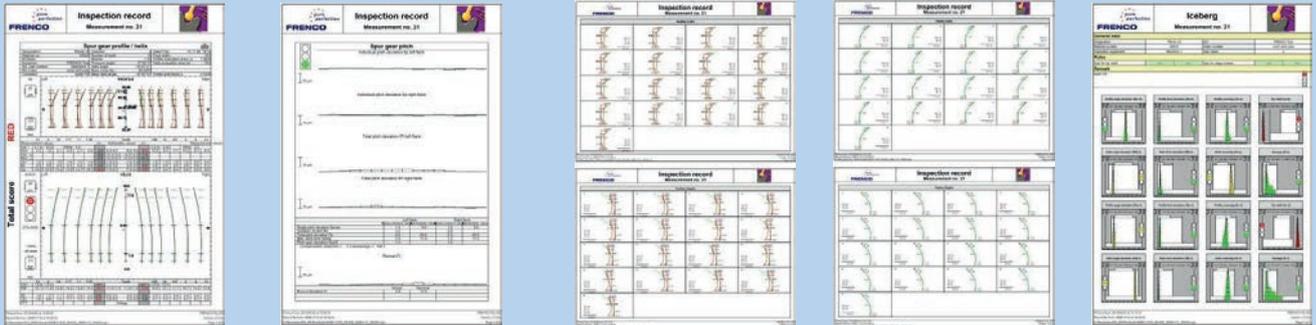
disc gear flank analysing master

# Methods of Evaluation

The latest version of the evaluation software supports various graphic charts and evaluations - including unique and basically new assessments for the completely detected tooth flanks.

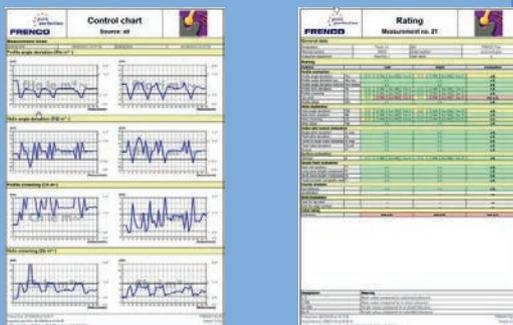
Standard evaluation of profile, helix (of four teeth), pitch and runout plus profile and helix of all teeth, detecting the worst tooth. All important values are clearly displayed in various charts.

Production



Quality control charts can be selected separately for all attributes depending on the processing machine. An overview of all evaluations is given.

Evaluation



Function

Topographical evaluation of the measurement results, Fast Fourier Transform (FFT) analysis for roll distance and acceleration (per measurement and FFT history) and calculated measurement results of a single flank gear rolling inspection are displayed.

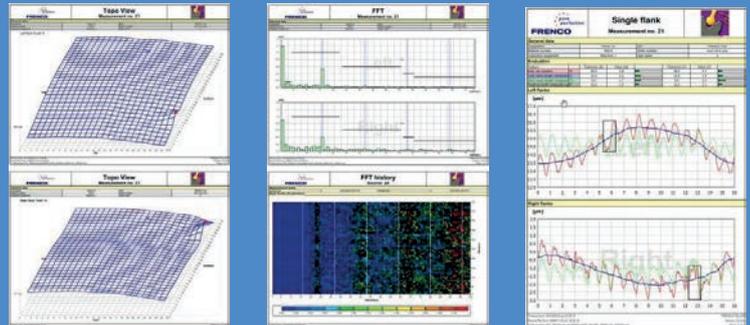
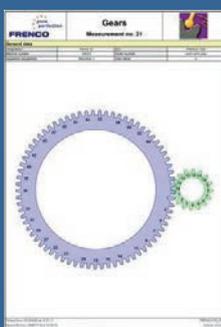


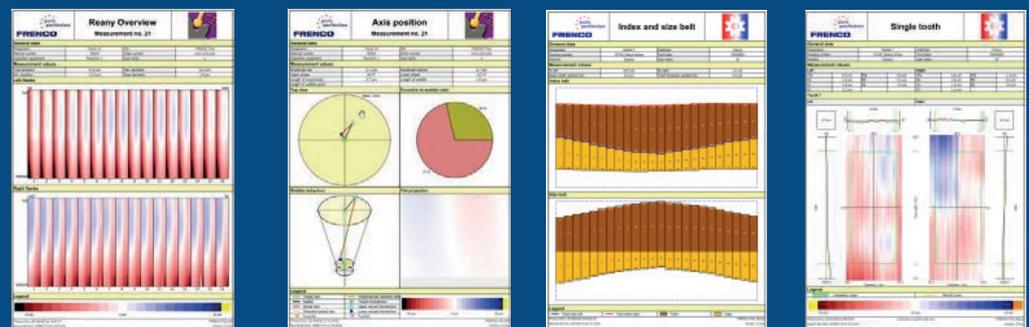
Illustration of the tooth position

REANY analysis of the measurement results represented by various charts and illustrations e.g. Reany Overview, position of axis and pitch. The software includes a correction of the axis.

Localisation



Reany

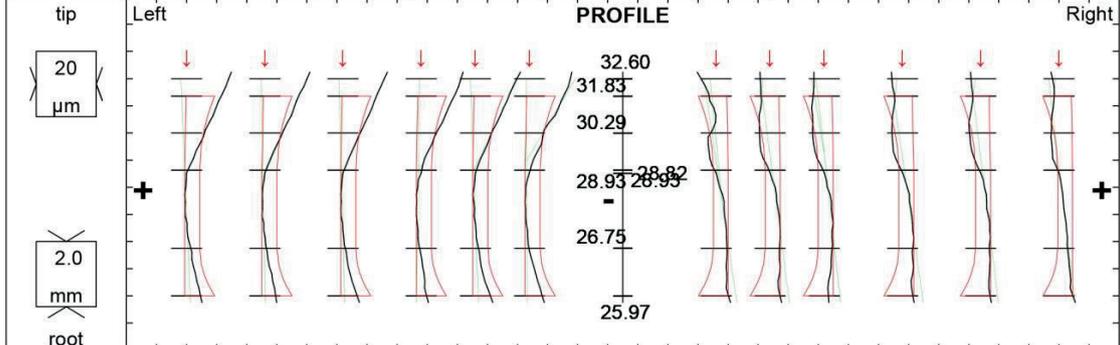


This evaluation is available for both, gear flank analyser and all-teeth measurement on coordinate measuring machines.



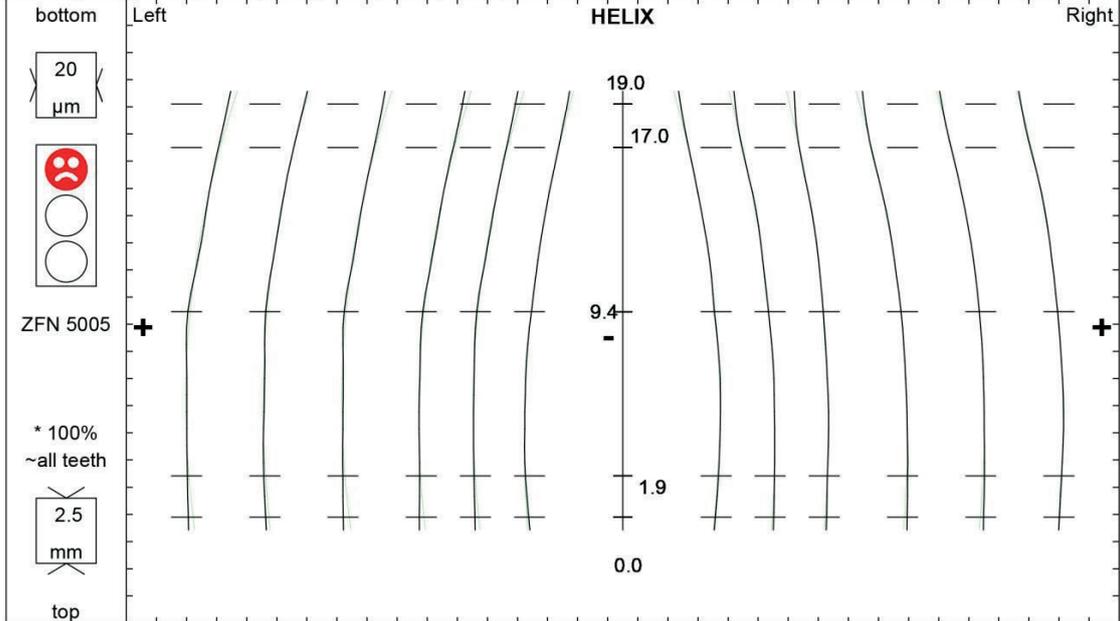
Spur gear profile / helix			
Designation:	Planet 16	Operator	a
Material no.:	50523	Number of teeth:	16
M-Sheet:		Module:	1.59
Customer	FRENCO Test	Pressure angle:	17°30' 0"
Act. part number:	Maschine 1	Helix angle:	-19°47'21"
Wz index:	wm2 em3 poly	Base circle dia.:	25.6357
Comment:	kontrl FR	Base helix angle:	-18°50'16"
		Profile shift factor x:	0.5330

RED

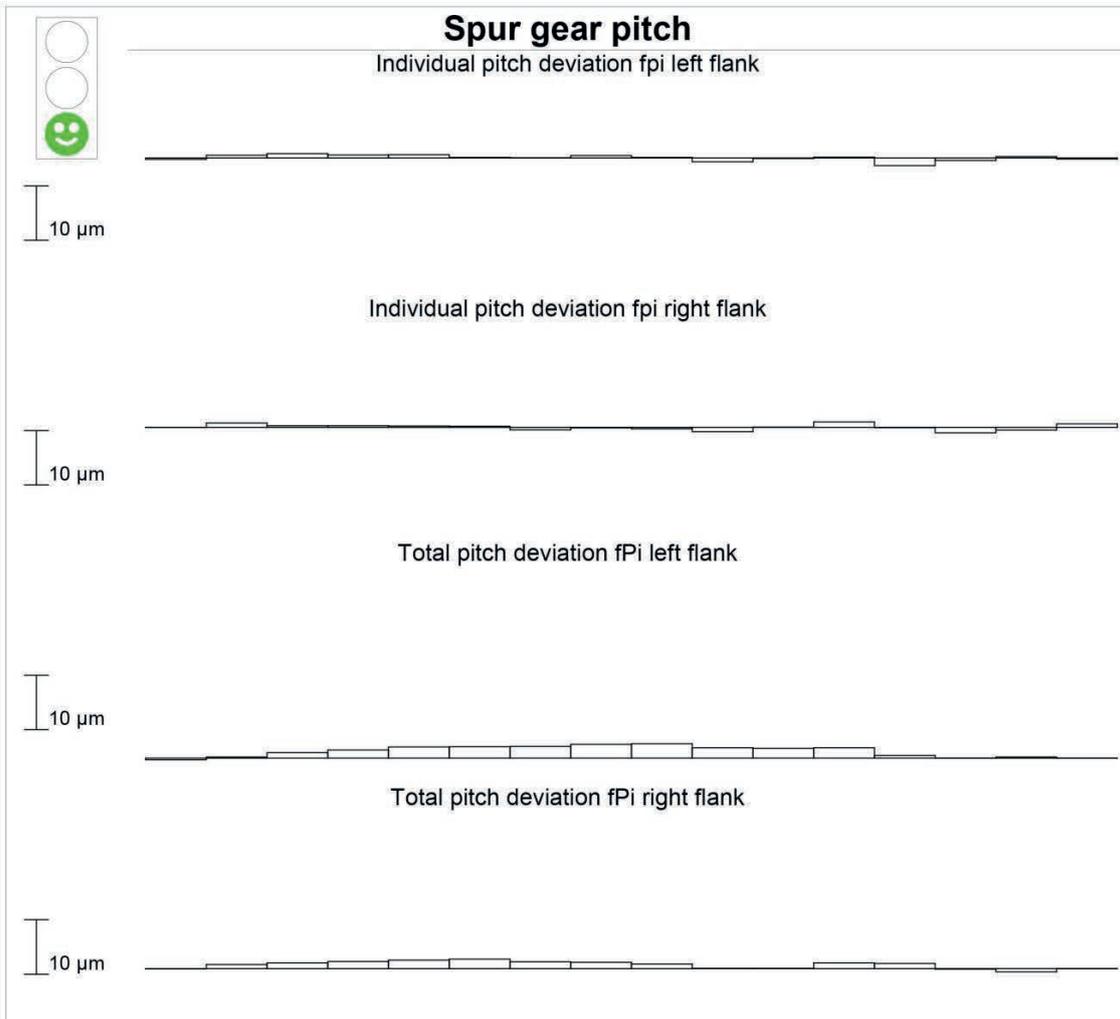


Measurement values	Admissible values												Measurement values														
$f\alpha^*_{\sim}$	2.7 (0 / 8.0)						$m_{\sim}$						$m_{\sim}$	2.2 (0 / 8.0)				$Rf\alpha^*$	0.8					$Rf\alpha^*$	3.2		
$fH\alpha^*$	3.3	1.5	2.1	-0.8	2.7	0.6	2.0	-9.0/9.0	-9.0/9.0	-9.5	-10.5	-9.4	-7.7	-10.2	-8.7	-8.5											
$fH\alpha^*_o$							-0.9	-12.0/12.0	-12.0/12.0	-7.0																	
$fH\alpha^*_u$							-0.0	-12.0/12.0	-12.0/12.0	-10.3																	
$Ch^*$	1.2	1.2	1.0	1.4	1.0	1.4	1.3	-1.0/2.0	-1.0/2.0	1.1	1.2	1.3	1.5	1.2	0.9	0.4											
$ff\alpha$	0.4	0.4	0.4	0.5	0.6	0.6	0.4	0.0/3.0	0.0/3.0	0.5	0.5	0.5	0.5	0.4	0.6	0.3											
Ca	-14.6	-14.5	-14.4	-14.6	-14.7	-16.3	-14.4	-7.0/-2.0	-7.0/-2.0	0.6	-4.0	0.4	-0.4	0.8	0.8	0.9											

Total score



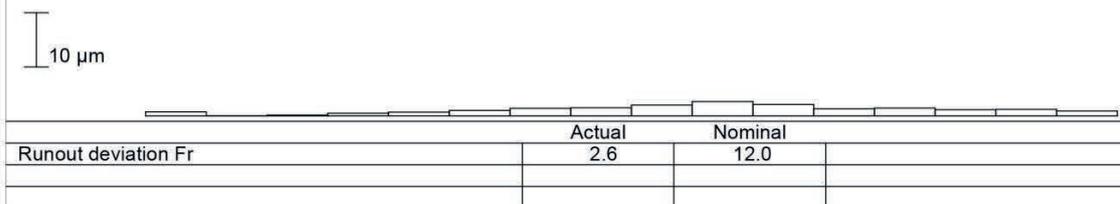
Measurement values	Admissible values												Measurement values														
$f\sigma\beta^*_{\sim}$	1.9 (0 / 12.0)						$m_{\sim}$						$m_{\sim}$	2.5 (0 / 12.0)													
$fH\beta^*$	-13.1	-11.9	-12.6	-14.2	-13.6	-14.3	-12.7	-11.0/11.0	-11.0/11.0	13.9	12.8	13.1	11.7	14.7	13.2	12.9											
$ff\beta$	1.4	1.0	1.1	0.9	0.8	0.3	0.8	0.0/2.0	0.0/2.0	0.4	0.5	0.5	0.4	0.4	0.4	0.4											
$Cb^*$	7.6	6.6	7.4	7.1	7.0	5.7	6.9	2.0/6.0	2.0/6.0	5.8	6.1	5.4	5.3	6.2	6.3	5.9											
FFT								WWeg																			

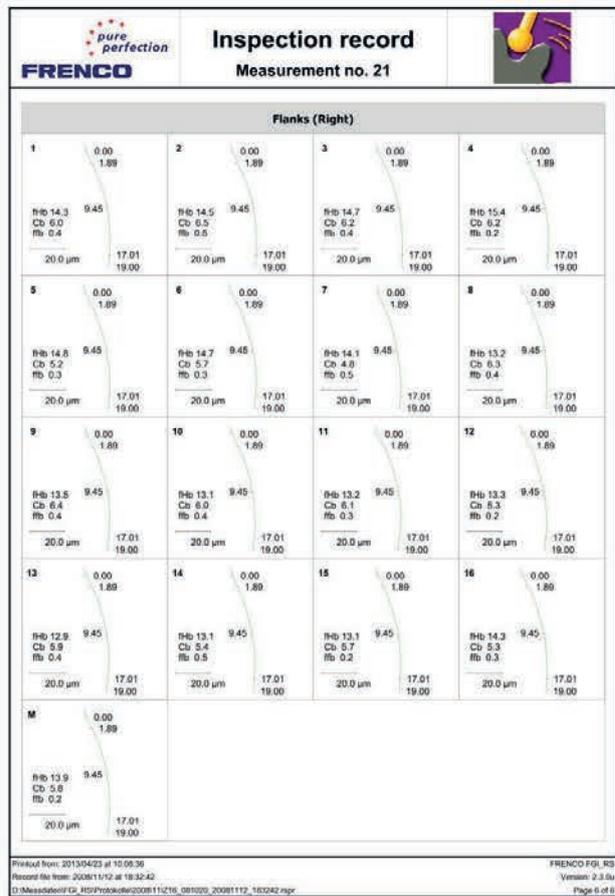
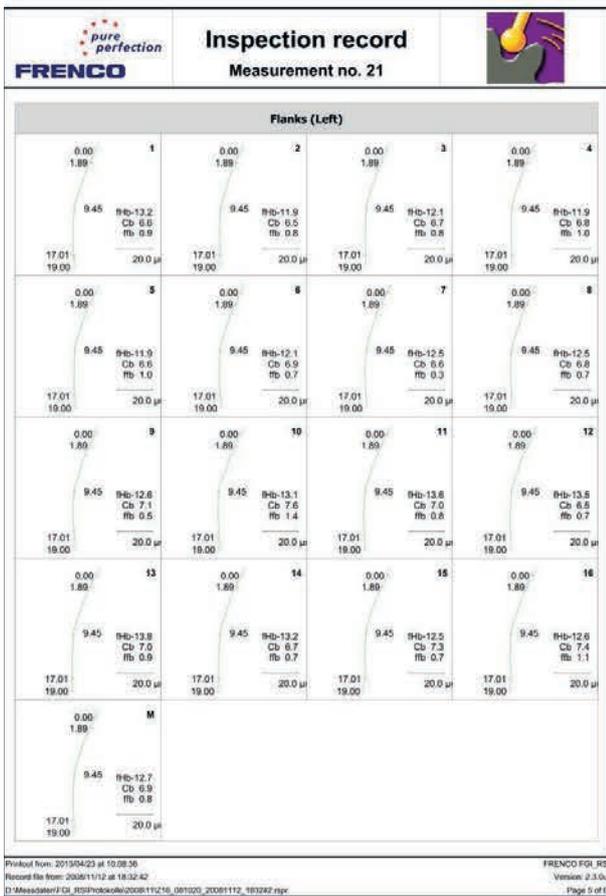


	Left flank		Right flank	
	Measurement value	Admissible value	Measurement value	Admissible value
Single pitch deviation $f_{pmax}$	1.4	9.0	1.0	9.0
Variation of pitch $R_s$	2.2		2.0	
Total pitch deviation $F_p$	2.9	28.0	2.3	28.0
Max. pitch error $f_{umax}$	1.5	11.0	1.2	11.0
Pitch span deviation $F_{pz/8}$	1.4		1.0	

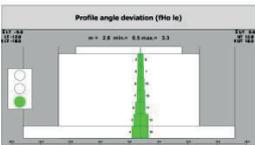
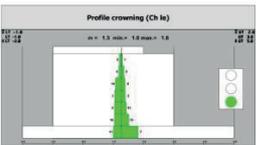
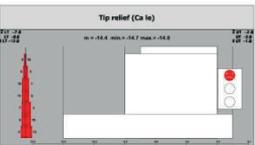
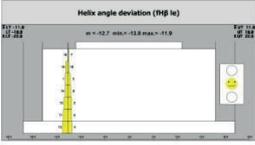
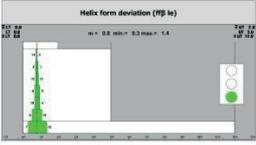
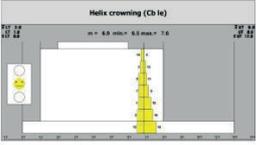
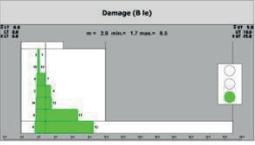
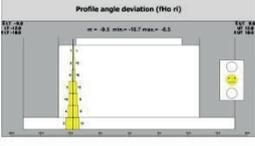
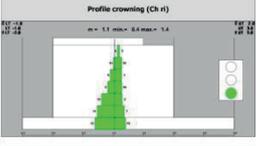
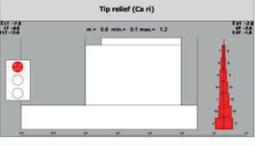
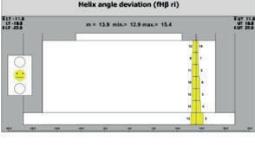
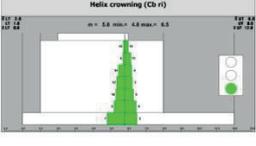
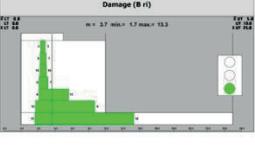
Compensation ampl(mm) = 3.3 phase(degr) = 168.1

**Runout  $F_r$**





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<b>General data</b>										
Designation	Planet 16	IGV	FRENCO Test							
Material number	50523	Order number	wm2 em3 poly							
Inspection equipment	Maschine 1	User name	a							
<b>Rating</b>										
		<b>Left</b>			<b>Right</b>			<b>Evaluation</b>		
<b>Profile evaluation</b>										
Profile angle deviation	fHc	x/x	x/Mb	Ew/Mb	Ew/E	x/x	x/Mb	Ew/Mb	Ew/E	o.k.
Profile angle deviation top	fHc top	o.k.								
Profile angle deviation bottom	fHc bottom	o.k.								
Profile form deviation	fFa	x/x	x/Mb	Ew/Mb	Ew/E	x/x	x/Mb	Ew/Mb	Ew/E	o.k.
Profile crowning	Ch	x/x	x/Mb	Ew/Mb	Ew/E	x/x	x/Mb	Ew/Mb	Ew/E	o.k.
Tip relief	Ca	x/x	x/Mb	Ew/Mb	Ew/E	x/x	x/Mb	Ew/Mb	Ew/E	not o.k.
Profile range	foa	o.k.								
<b>Helix evaluation</b>										
Helix angle deviation	fHβ	x/x	x/Mb	Ew/Mb	Ew/E	x/x	x/Mb	Ew/Mb	Ew/E	o.k.
Helix form deviation	fHβ	x/x	x/Mb	Ew/Mb	Ew/E	x/x	x/Mb	Ew/Mb	Ew/E	o.k.
Helix crowning	Cb	x/x	x/Mb	Ew/Mb	Ew/E	x/x	x/Mb	Ew/Mb	Ew/E	o.k.
Helix range	foβ	o.k.								
<b>Index and runout evaluation</b>										
Single pitch deviation	fp max	o.k.								
Total pitch deviation	Fp	o.k.								
Tooth to tooth index deviation	fu max	o.k.								
Total index deviation	Fp z/8	o.k.								
Runout	Fr	o.k.								
<b>Surface evaluation</b>										
Damage	B	x/x	x/Mb	Ew/Mb	Ew/E	x/x	x/Mb	Ew/Mb	Ew/E	o.k.
<b>Single flank evaluation</b>										
Gear roll variation	F1	o.k.								
Long wave-length component	F1	o.k.								
Short wave-length component	Fk	o.k.								
Tooth-to-tooth composite variation	F1	o.k.								
<b>Fourier analysis</b>										
Roll distance		o.k.								
Acceleration		---								
<b>Rule evaluation</b>										
Rule for tip relief		---								
Rule for edge contact		---								
<b>Total rating</b>										
Evaluation		not o.k.			not o.k.			not o.k.		
<b>Designation</b>		<b>Meaning</b>								
x/x		Mean value compared to restricted tolerance								
x/Mb		Mean value compared to m sheet tolerance								
Ew/Mb		Single values compared to m sheet tolerance								
Ew/E		Single values compared to extended tolerance								
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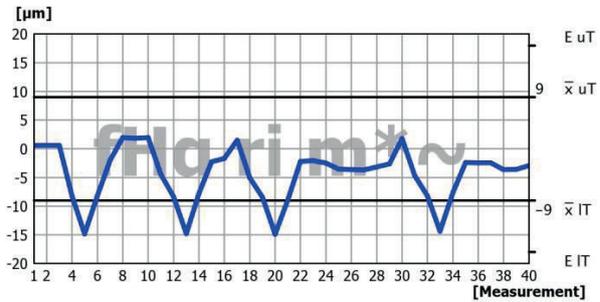
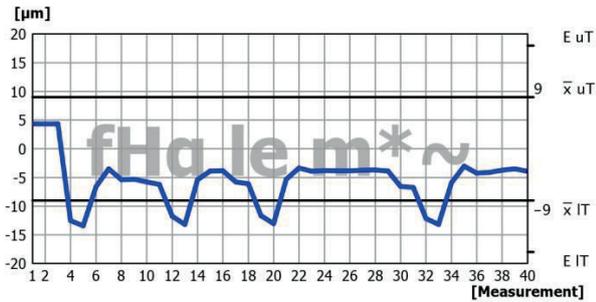
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<b>General data</b>							
Designation	Planet 16	IGV	FRENCO Test				
Material number	50523	Order number	wm2 em3 poly				
Inspection equipment	Maschine 1	User name	a				
<b>Rules</b>							
Rule for tip relief		o.k.	o.k.	Rule for edge contact		o.k.	o.k.
<b>Remark</b>							
kontri FR <span style="float: right;">● ○</span>							
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						Version: 2.3.0u	
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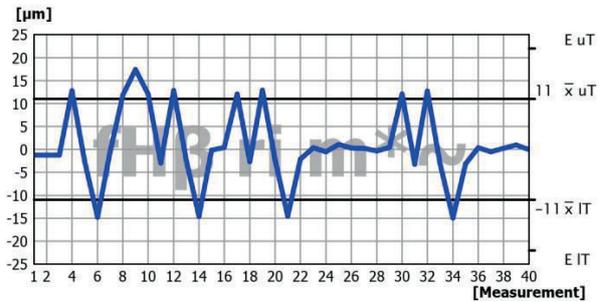
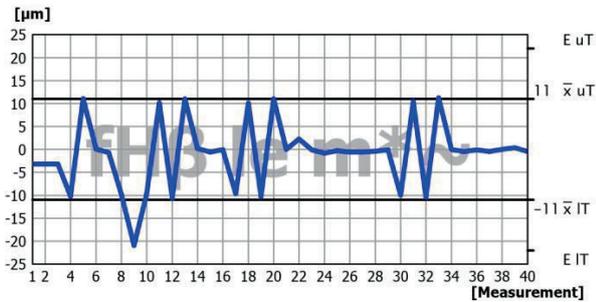
## Measurement times

Starting time	08/04/2011 13:47:02	Ending time	02/28/2013 13:37:55
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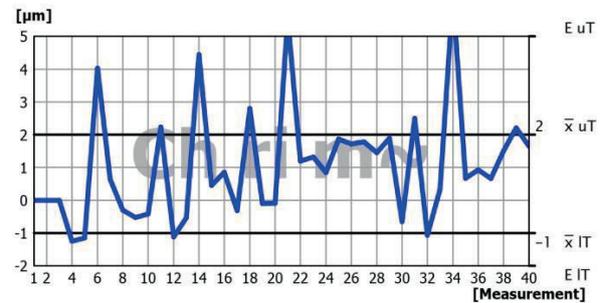
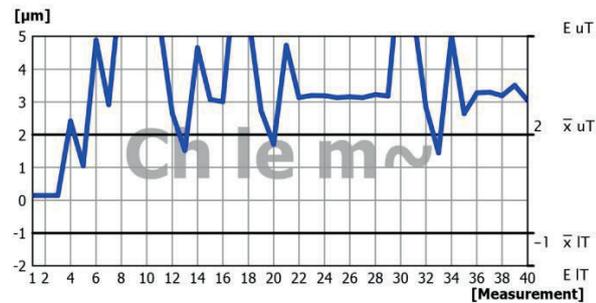
## Profile angle deviation (fHa m\*~)



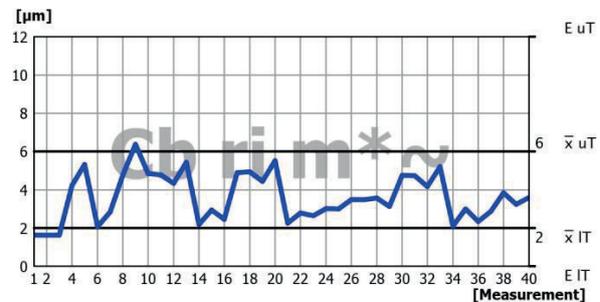
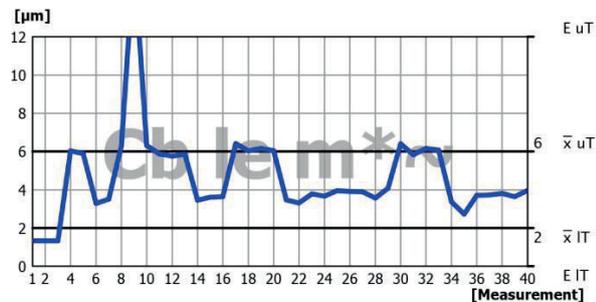
## Helix angle deviation (fHβ m\*~)



## Profile crowning (Ch m~)



## Helix crowning (Cb m\*~)





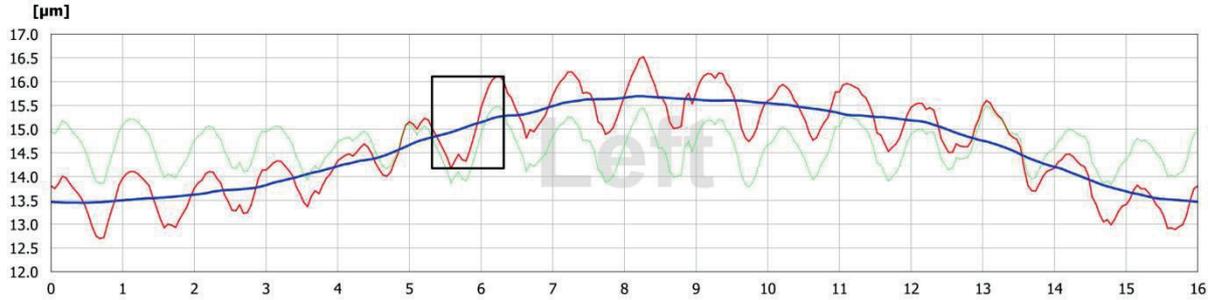
**General data**

Designation	Planet 16	IGV	FRENCO Test
Material number	50523	Order number	wm2 em3 poly
Inspection equipment	Maschine 1	User name	a

**Evaluation**

Feature		Tolerance (le)	Value (le)		Tolerance (ri)	Value (ri)	
Gear roll variation	Fi	28.0	3.8		28.0	3.7	
Long wave-length component	Fl	12.0	2.2		12.0	1.9	
Short wave-length component	Fk	9.0	1.7		9.0	2.4	
Tooth-to-tooth composite variation	Ft	16.0	1.9		16.0	2.1	

**Left flanks**



**Right flanks**



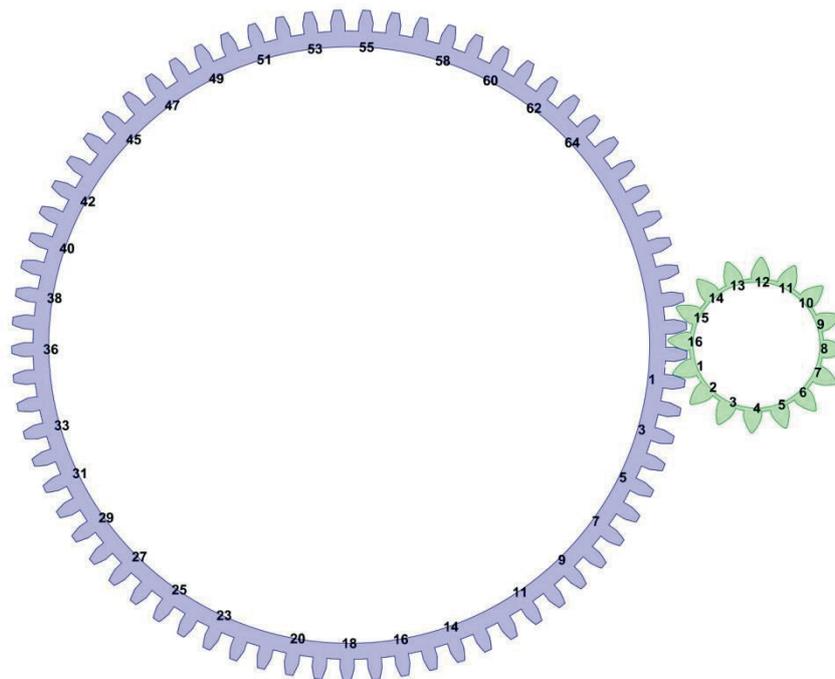
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FRENCO FGI\_RS  
Version: 2.3.0u  
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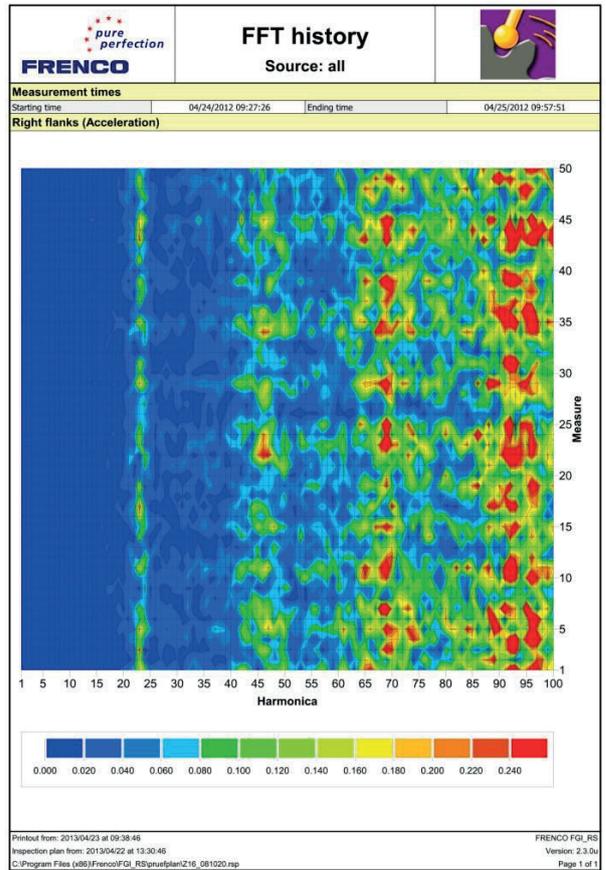
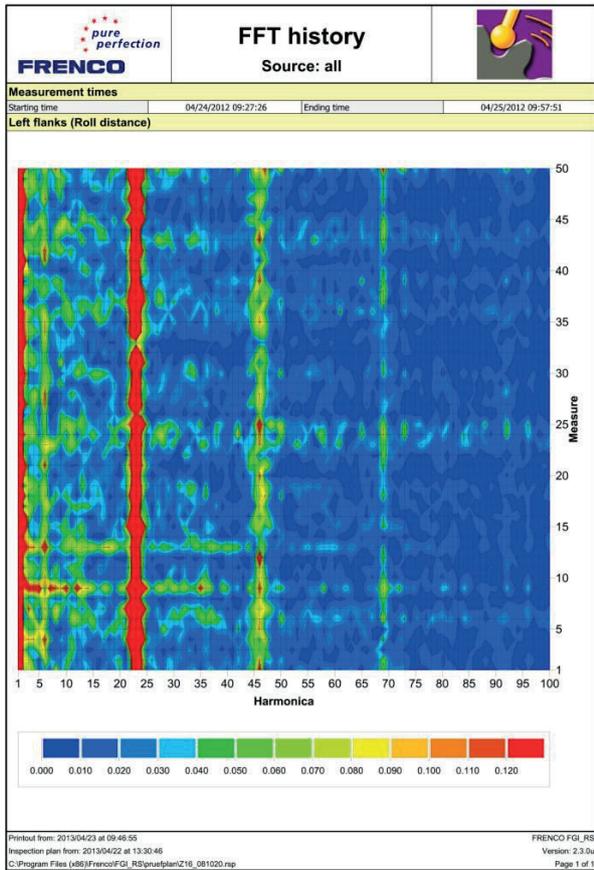
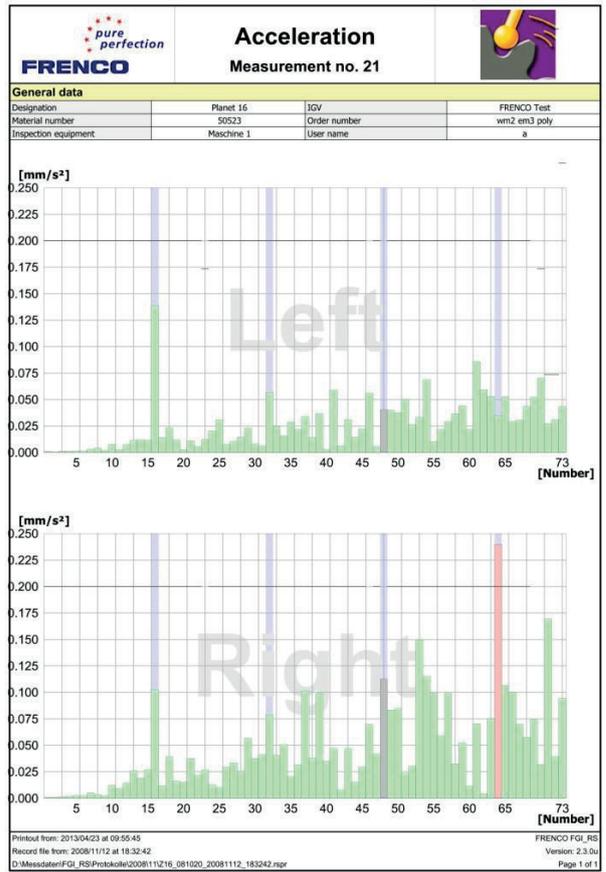
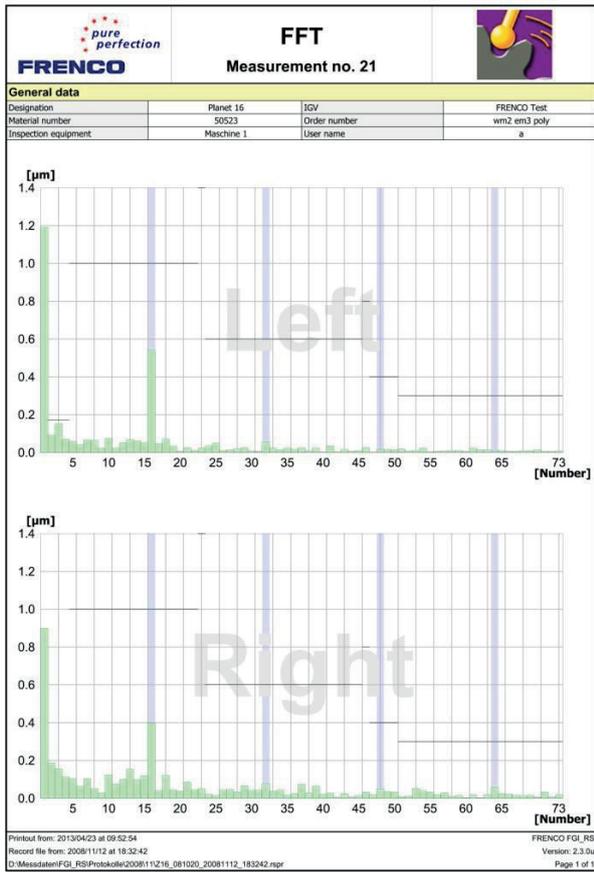
**General data**

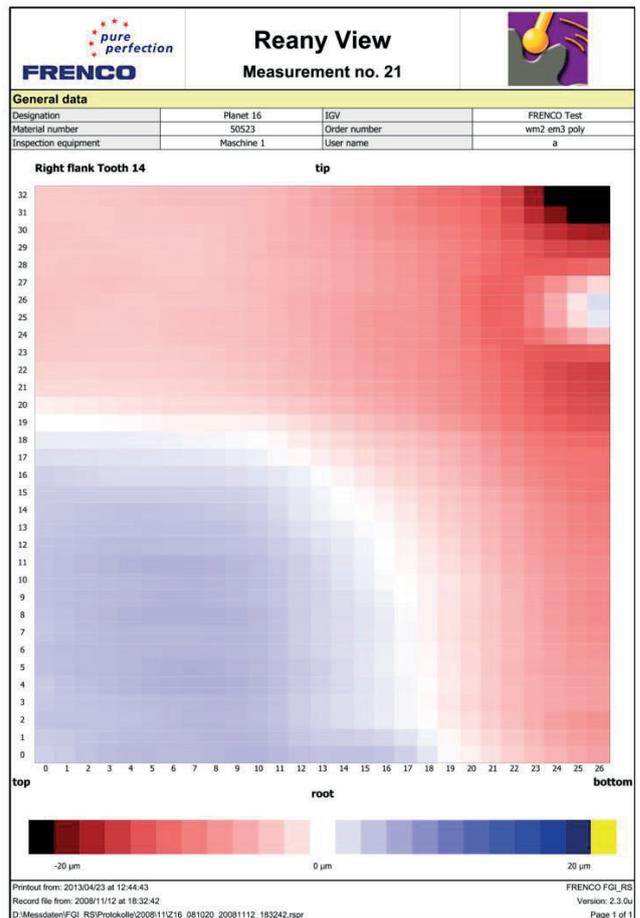
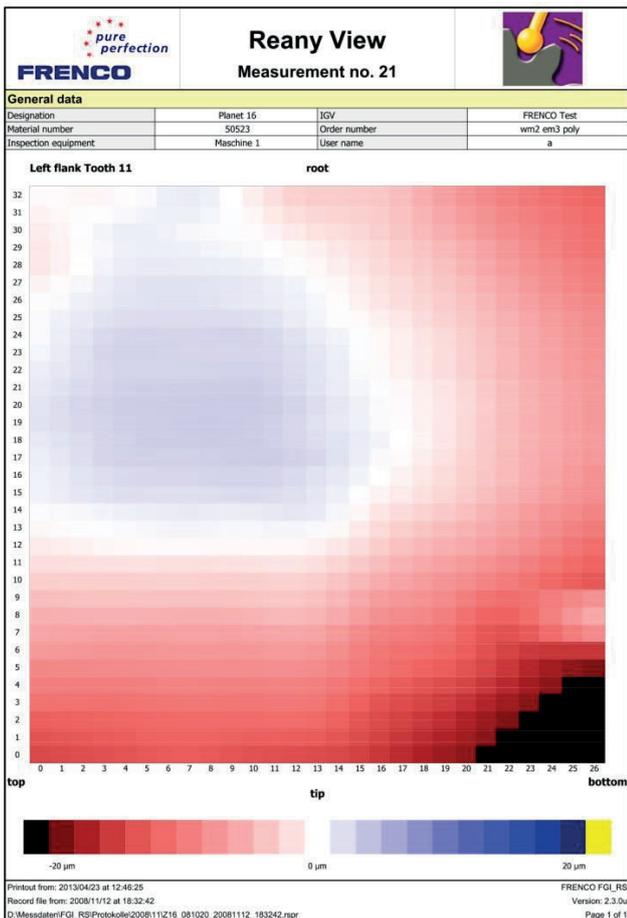
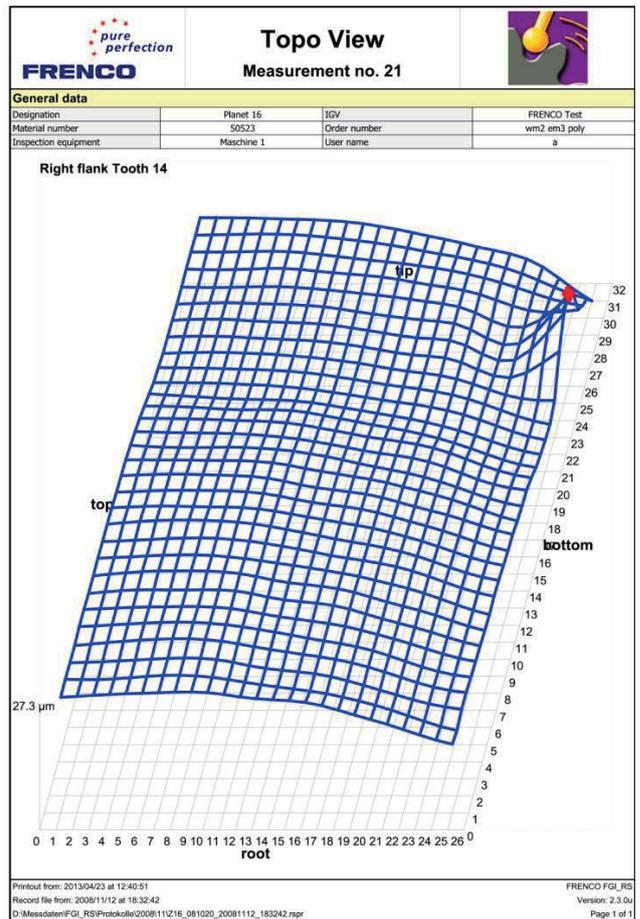
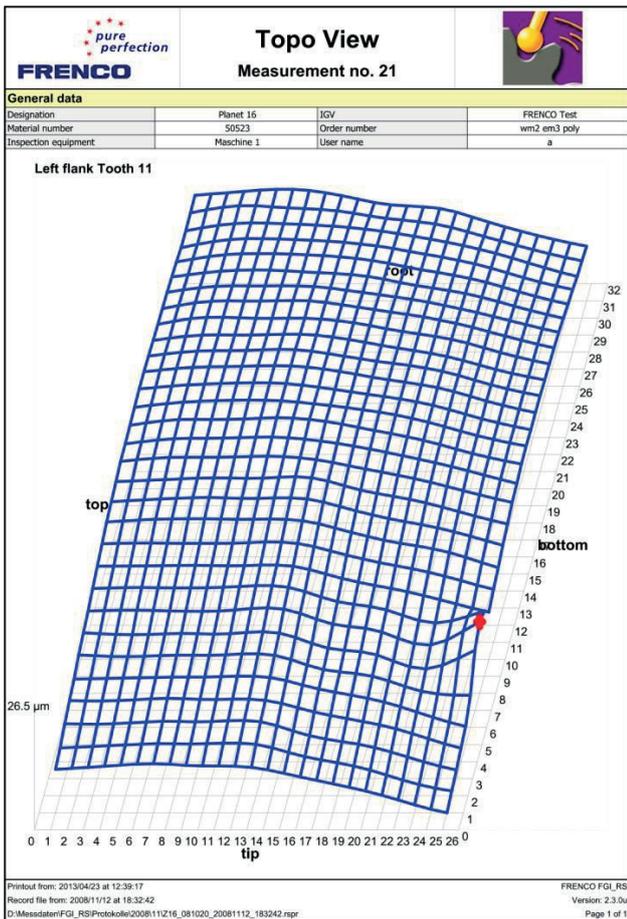
Designation	Planet 16	IGV	FRENCO Test
Material number	50523	Order number	wm2 em3 poly
Inspection equipment	Maschine 1	User name	a



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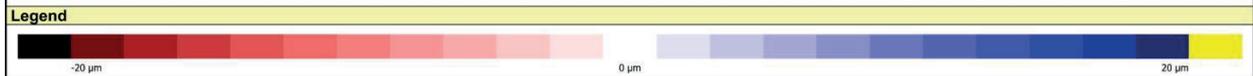
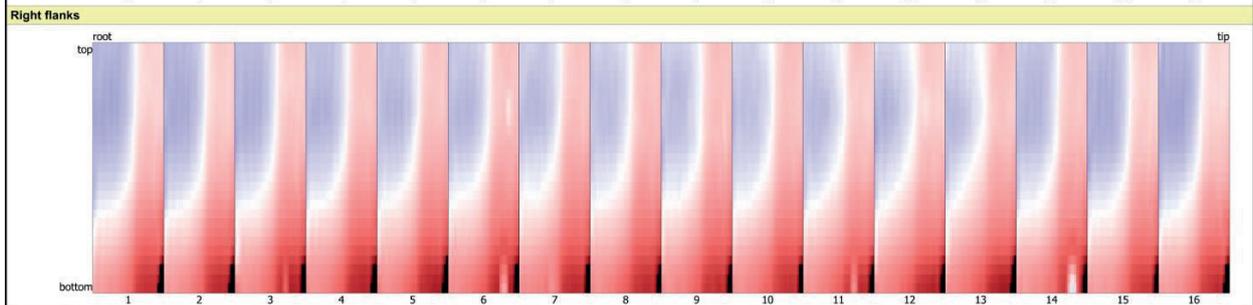
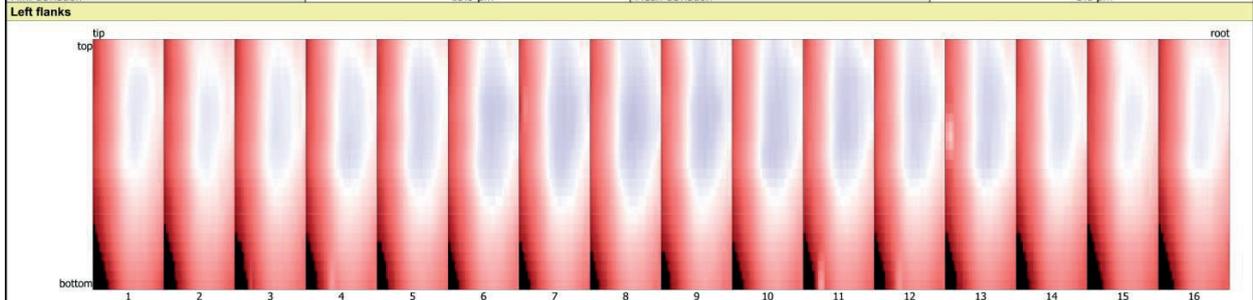
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General data			
Designation	Planet 16	IGV	FRENCO Test
Material number	50523	Order number	wm2 em3 poly
Inspection equipment	Maschine 1	User name	a
Measurement values			
Total deviation	31.6 µm	Max. deviation	16.3 µm
Min. deviation	-15.3 µm	Mean deviation	3.8 µm

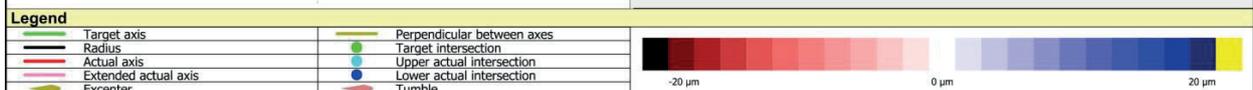
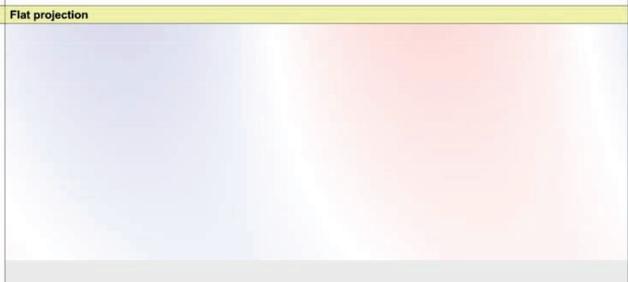
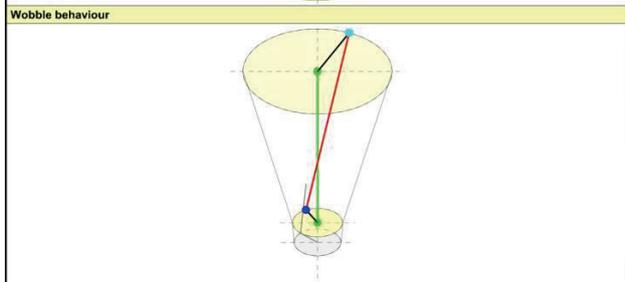
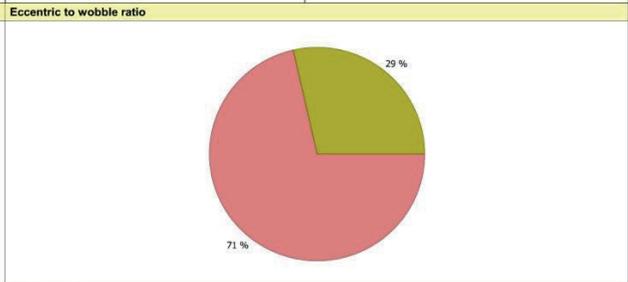
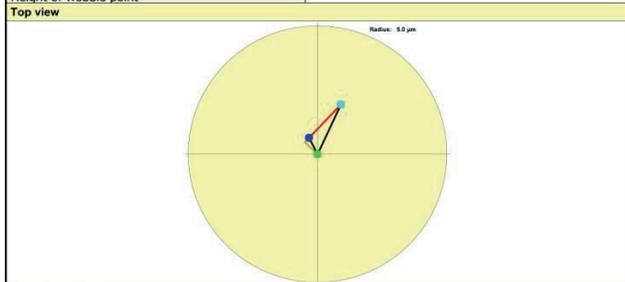


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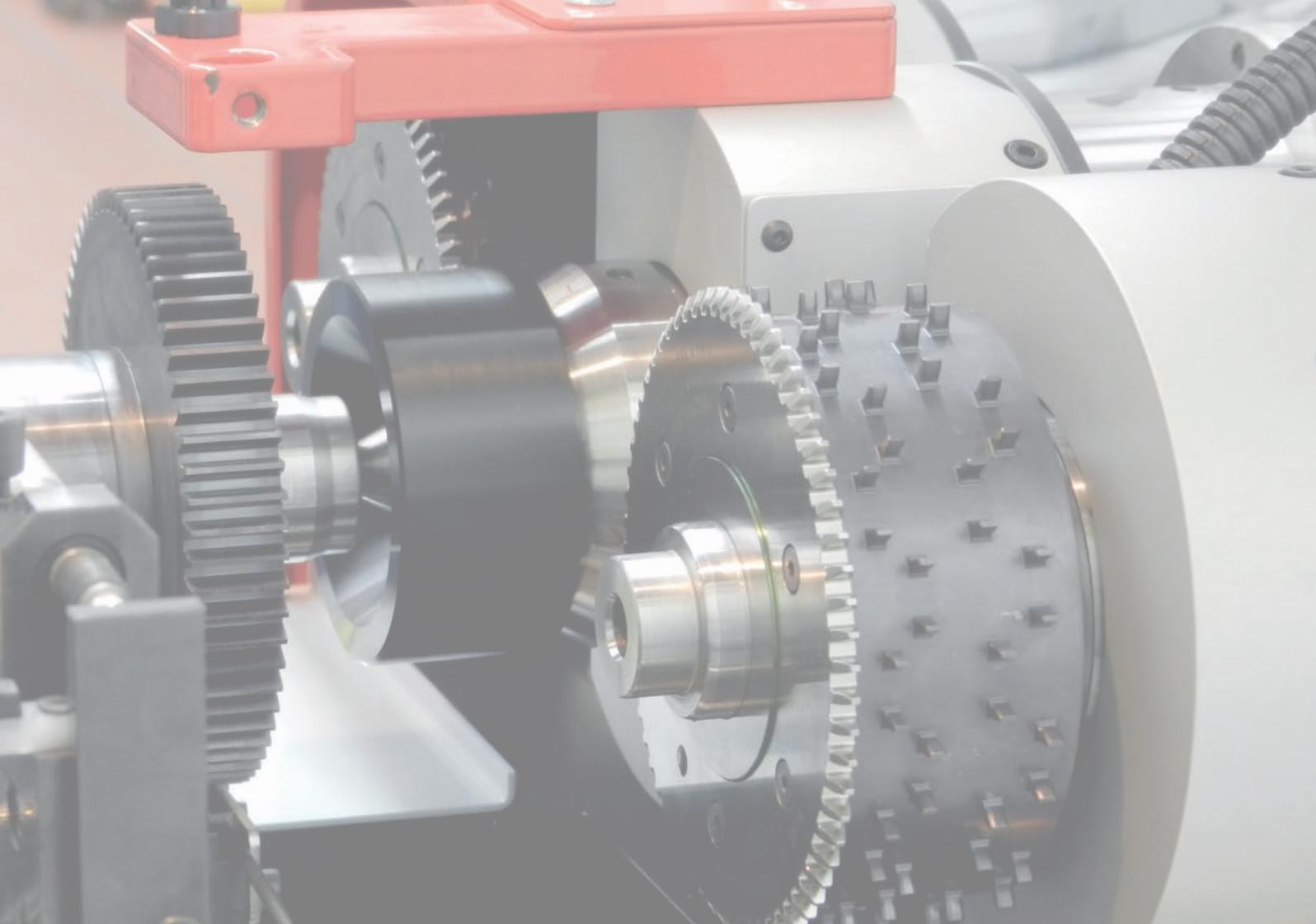


General data			
Designation	Planet 16	IGV	FRENCO Test
Material number	50523	Order number	wm2 em3 poly
Inspection equipment	Maschine 1	User name	a
Measurement values			
Amplitude top	2.1 µm	Amplitude bottom	0.7 µm
Upper phase	64.9°	Lower phase	117.4°
Length of eccentricity	0.7 µm	Length of wobble	1.8 µm
Height of wobble point			



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