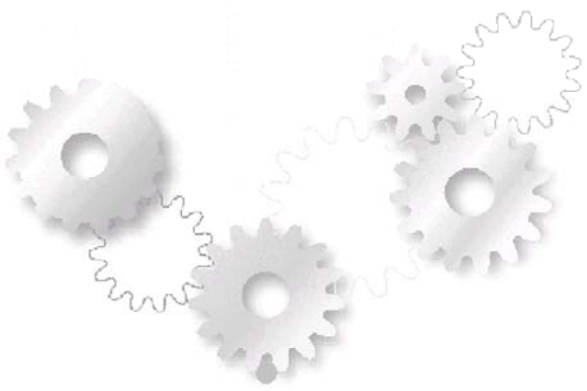
Double flank gear roll inspection machines

The simple functional inspection



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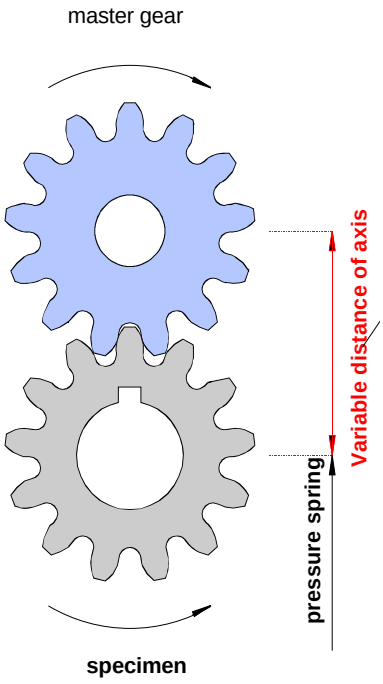
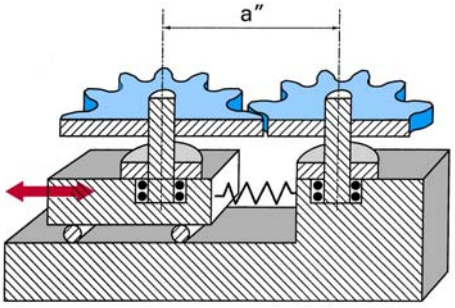
URM-WZ –-e- 11/07

Function

The double flank gear roll inspection is a simple method to test the functional accuracy easily and quickly. The resulat is the sum of of all given deviations. No matter which deviation the specimen has, the double flank gear roll inspection will detect it. The result of the double flank gear roll inspection is a summery error. That means, that it is not possible to determine the single errors causing the deviation. If the detected summary errors are within tolerance, it is assumed that also the single errors are within tolerance. If the deviation detected by the roll inspection is too big, the cause study is the operator's job or the specimen has to be measured by a machine which is able to determine single deviations..

FRENCO double flank gear roll inspection machines are fully developed and high-quality products.





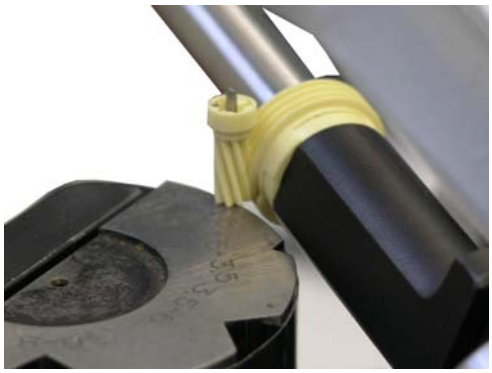
Measurement setup for the double flank gear roll inspection:

Two gears are rolled off together free from backlash.

Measurement of geometries

worms

spur gear



pinion and worm

pinion and gear

oil pump gear

helical gears

Types of roll inspection machines

ZWP

Contents

ZWP 06 (896)

ZWP 14 (894)

ZWP 18 (898)

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Features

	ZWP 06 (896)		ZWP 14 (894)		ZWP 18 (898)	
	single end	between tips	single end	between tips	single end	between tips
Distance of axis	12 – 80 mm	12 – 80 mm	45 – 170 mm	45 – 170 mm	45 – 175 mm	45 – 175 mm
Distance of axis with adaptor for small distance of axis	1 mm	1 mm	15 mm	15 mm	15 mm	15 mm
Max. diameter of specimen with steady center attachment 3	80 mm	80 mm	400 mm	160 mm 310 mm	200 mm	160 mm 310 mm
Max. diameter of specimen with extension adaptor					300 mm	-
Center height size 1 **Center height size 2** **Center height size 3**	-	40–100	-	60 – 220 220 - 360 0 - 420	-	60 – 200 220 - 360 0 - 420
Range for height adjustable single end mounting	possible with limits	-	-	-	200	-
2. steady center attachment	no		yes		yes	
Adjustment of measuring force	0 – 5 N		possible with limits		0 – 20 N	
Optional scale out of glas	yes		yes		yes	
Optional sensor for corrections of deviations of master gears	on request		yes		on request	
Range of application	small workpieces and plastic gears		big workpieces; solid for shop floor use		medium-sized workpieces; suitable for inspection laboratories	
Motor drive	standard		optional		standard	
Manual operation	-		yes		-	
Motor drive with 2. steady center attchment	-		-		yes	
Manual operation with 2. steady center attachment	-		yes		-	

Other sizes are available on request.

ZWP 06 (896)

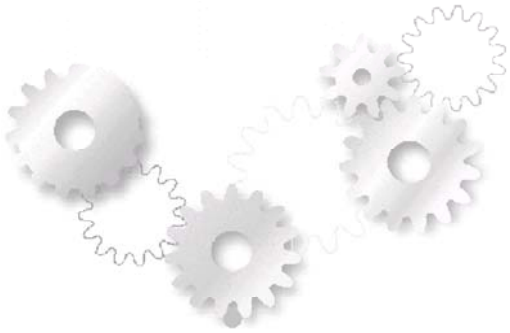
The universal measuring machine for the double flank gear rolling inspection

The double flank gear rolling inspection machine is specially designed for small specimens. It is also very well suitable for plastic gears. The measuring force can be lowered up to zero. The sophisticated design is extraordinarily precise and sensitive, as it is necessary for the measurement of small specimens.

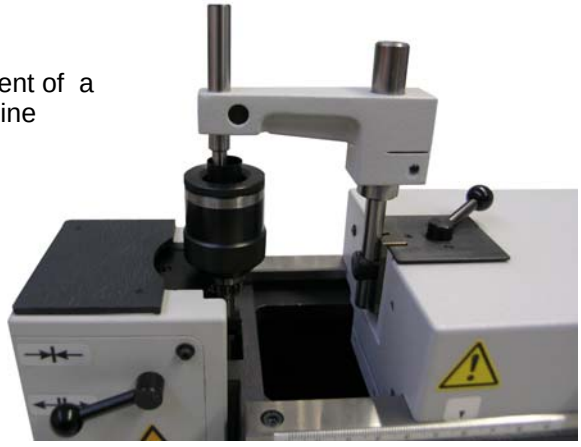
The sequence of measurement is motor driven by default. Therefore the motor drive FMC-light as most reasonable possibility is at least necessary.

Measurement of a plastic gear

A manifold accessory nearly leaves nothing to be desired.

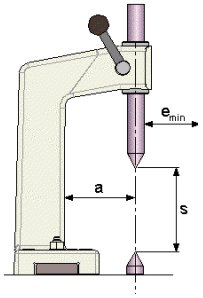


Measurement of a internal spline



Accessories

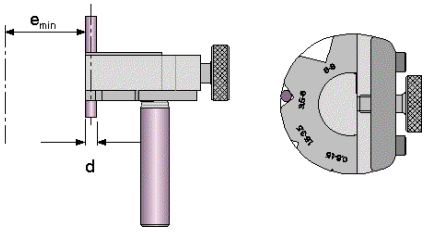
steady center attachment
only to mount the master gear



s = 40 - 100 mm
a = 40 mm
e_{min} = 12 - 80 mm

---

adaptor for small distances of axis
only to mount the workpiece

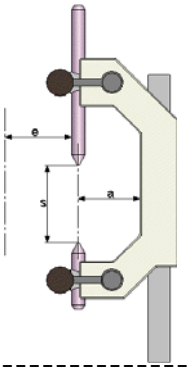


d = 0,6 - 8 mm

e_{min} = 1 mm

---

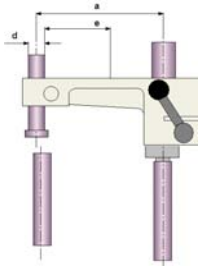
center fixture
only to mount the workpiece



s = 15 – 50 mm
a = 20 mm
e_{min} = 12 - 50 mm

---

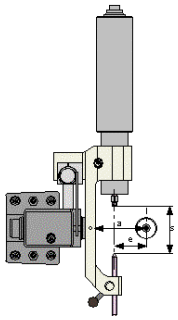
fixture for internal gears and splines



d = 8 mm
a = 48 mm
e = 60 mm

---

pivoting fixture



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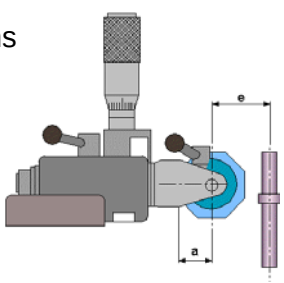
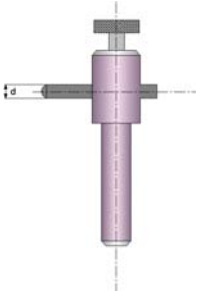
clamping arbor for worms

e = 0 - 50 mm
a = 16 mm



clamping arbor for bevel gears



ZWP 14 (894)

Simple, robust, designed for shop-floor use

The ZWP 14 (old designation 896) is the most robust double flank gear roll inspection machine of this serial.

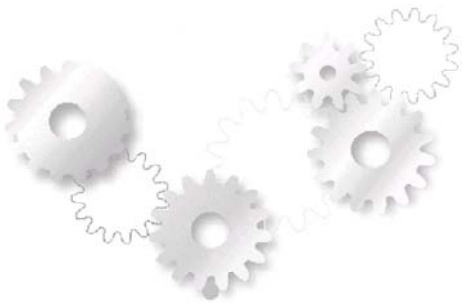
This machine can be driven as well manually as by motor. The distance of axis can be chosen manually by dint of a adjustable adaptor disc.

The results of the measurement are displayed on a dial indicator. The analysis with our MEG 32 is only possible, if the machine is equipped with a motor drive

The manifold accessory allows a individual customization. Moreover individual solutions for your special needs are possible.

ZWP 14 with steady center attachment

Single end mountig

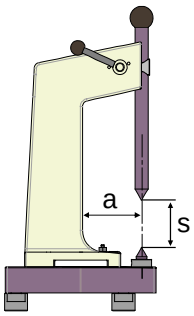


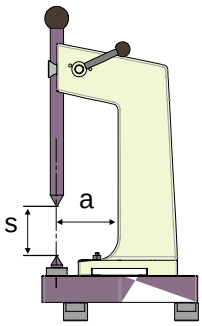
Measurement of worm gears with an according adaptor (accessory)

Accessories

steady center attachment size 1

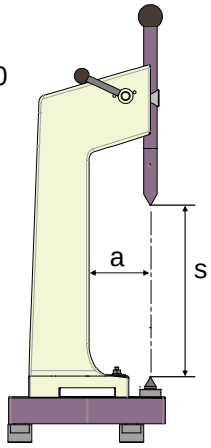
s=60-200
a=80





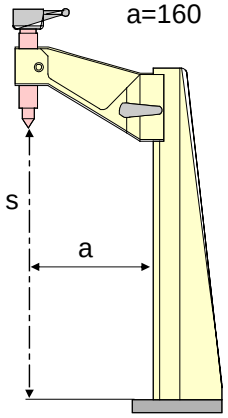
steady center attachment size 2

s=220-360
a=80

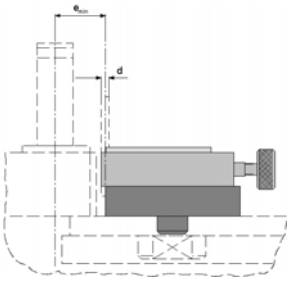


steady center attachment size 3

s=0-420
a=160

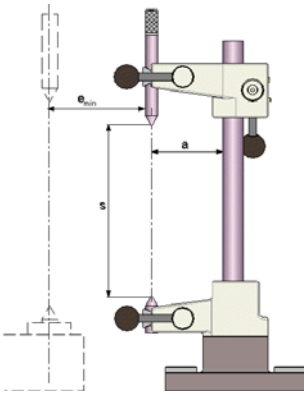


adaptor for small distances of axis
only to mount the workpiece



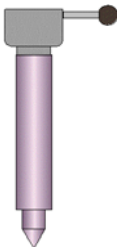
e_{min} = 22 mm

center fixture
only to mount the workpiece

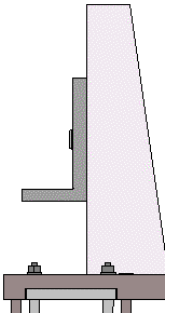


s = 0 - 140 mm
a = 45 mm
e_{min} = 22 mm

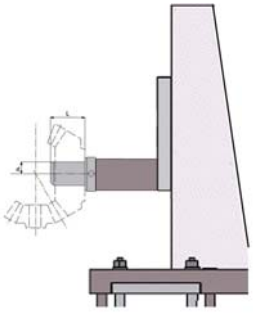
Adjustable tip for steady center attachment



Adaptor for the measurement of worms



Adaptor with recording head for bevel gears



ZWP 18 (898)

Highest precision and comfortable handling

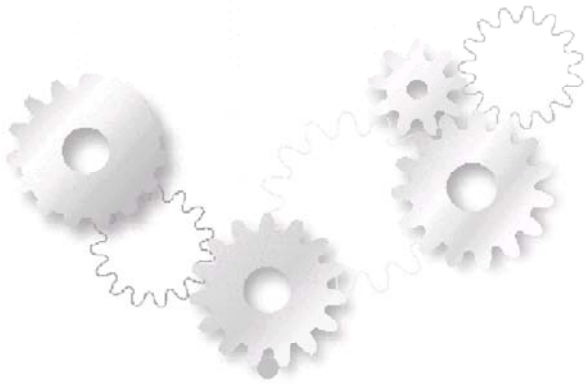
The high quality ZWP 18 (previous 898) features a filigree setup and thus allows high precision measurements.

The distance of axis can be easily and quickly changed by adjusting the measuring carriage with a hand-wheel. The adjustable sleeves enable a simple and comfortable selection of the height of wheels to be rolled. It is no problem to equip the machine with many accessories.

The motor drive is already integrated. To ensure highest precision the measuring carriage is mounted on very smooth running guideways.

Pinion with master gear

Single end mounting for the workpiece. Left side: steady center attachment to mount the master gear (accessory)



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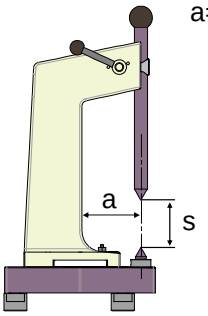
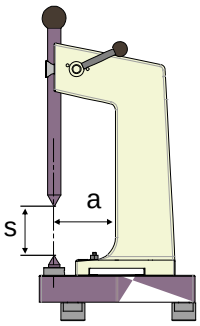
Accessories

steady center attachment size 1

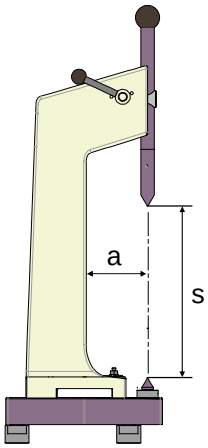
s=60-200
a=80





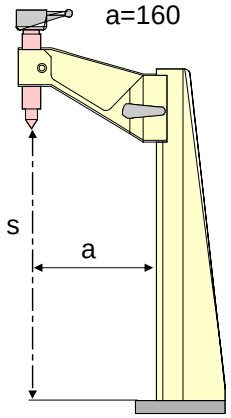
steady center attachment size 2

s=220-360
a=80



steady center attachment size 3

s=0-400
a=160



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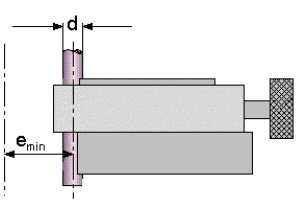
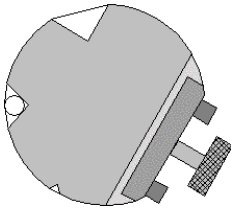
adaptor for small distances of axis
only to mount the workpiece





d = 1 - 16 mm

e_{min} = 15 mm

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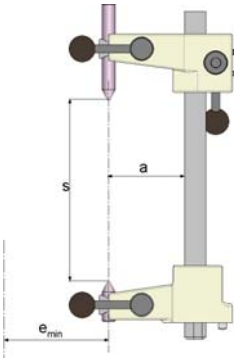
center fixture
only to mount the workpiece



s = 0 – 140 mm
a = 45 mm
e_{min} = 15 mm

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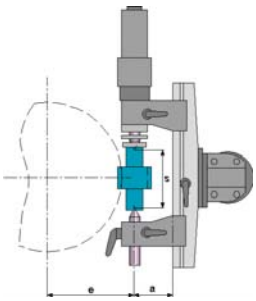
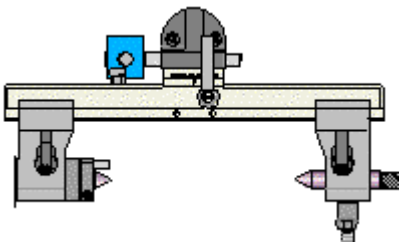
pivoting fixture for worms and worm gears.



s = 0 - 150 mm
a = 40 mm
e = 0 - 80 mm
w = ±45°



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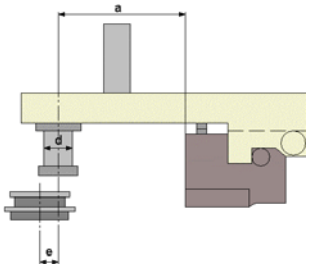
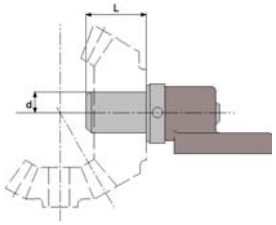
fixture for master gears with internal gears.

d = 8/16/22/32 mm
a = 65 mm
e = 0 - 85 mm



fixture for bevel gears



d = 8 - 10 mm
L = 20 mm
d = 10 - 15 mm
L = 25 mm
d = 15 - 20 mm
L = 35 mm

Evaluation

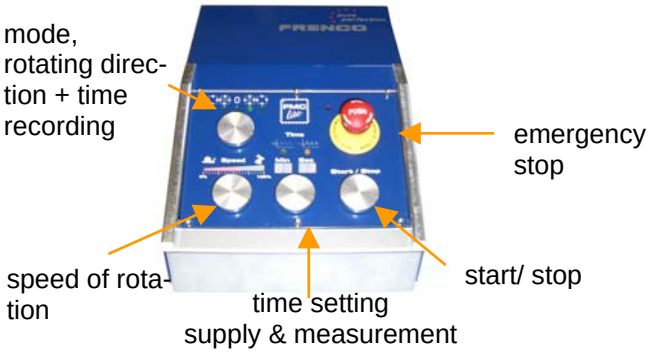
Dial indicator
for manual measurement and evaluation

Measuring probe

analogue for external printer

digital for FMC and FGI

Motor drive FMC

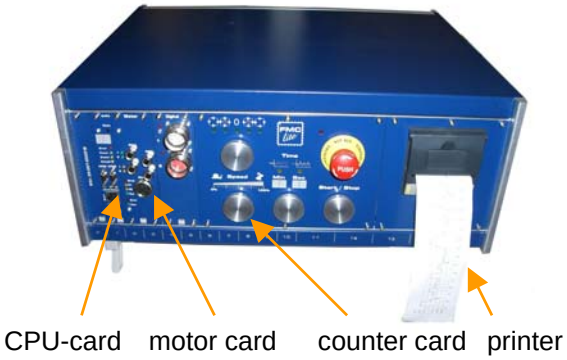


FGI-lite

features:

- MEG measuring electronics basis
- motor drive FMC
- printer

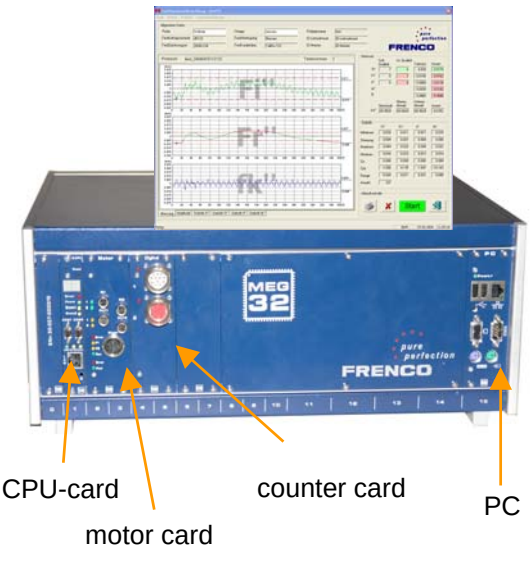
The measurement of the distance of axis is not possible.



FGI-Pro

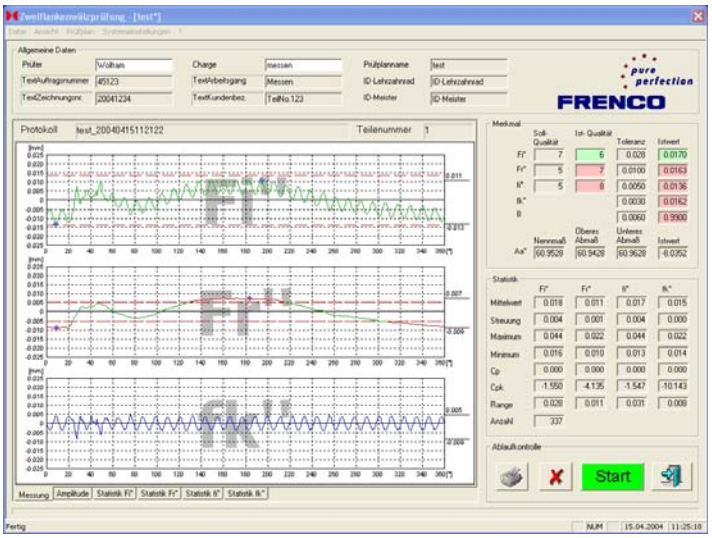
features:

- measuring electronics MEG 32
- simple and effective handling
- flexible configuration
- measuring software windows
- data exchange via Ethernet
- modular setup with 19" cards
- integrated PC



Software: FRENCO Gear Inspector FGI-Pro

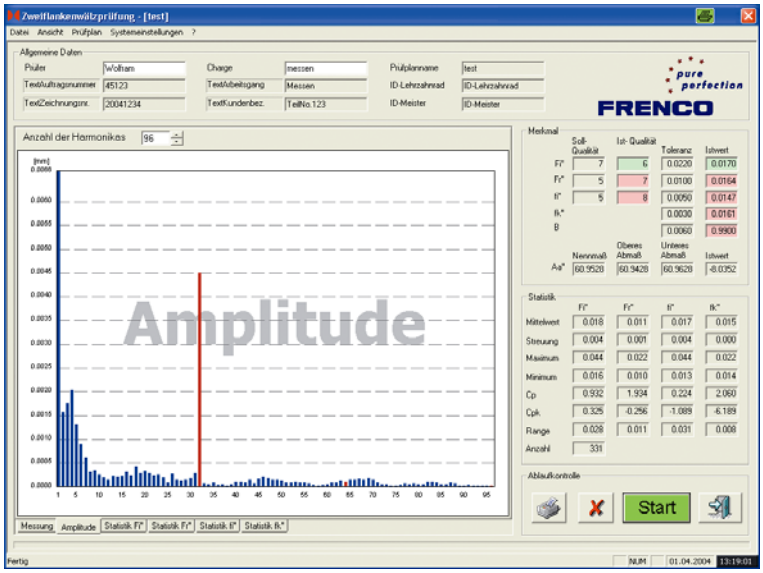
This software has been developed by FRENCO software specialists. Customers' wishes have always been being integrated. The contact persons for your individual requirements are direct at FRENCO.



- ✓ Results are displayed immediately after the measurement: **workpiece ok/ not ok**
- ✓ Gear roll variations, tooth to tooth composite deviations, composite runout deviations and the short wave part are determined
- ✓ statistical evaluations
- ✓ qs-STAT-port
- ✓ frequency spectrum FFT
- ✓ online recording
- ✓ circular point out
- ✓ multi lingual

We recommend this software for all double flank gear roll inspection machines. The advantages will convince you.

The upgrade of older double flank gear roll inspection machines is possible!



The Fournier spectrum of the measurement is displayed very clearly. The frequency of the teeth is coloured.
Beside that the software provides further features, like a comfortable filing, stistical evaluations, automatic detection of damages, measurement of tooth segments, qs-STAT port, etc.

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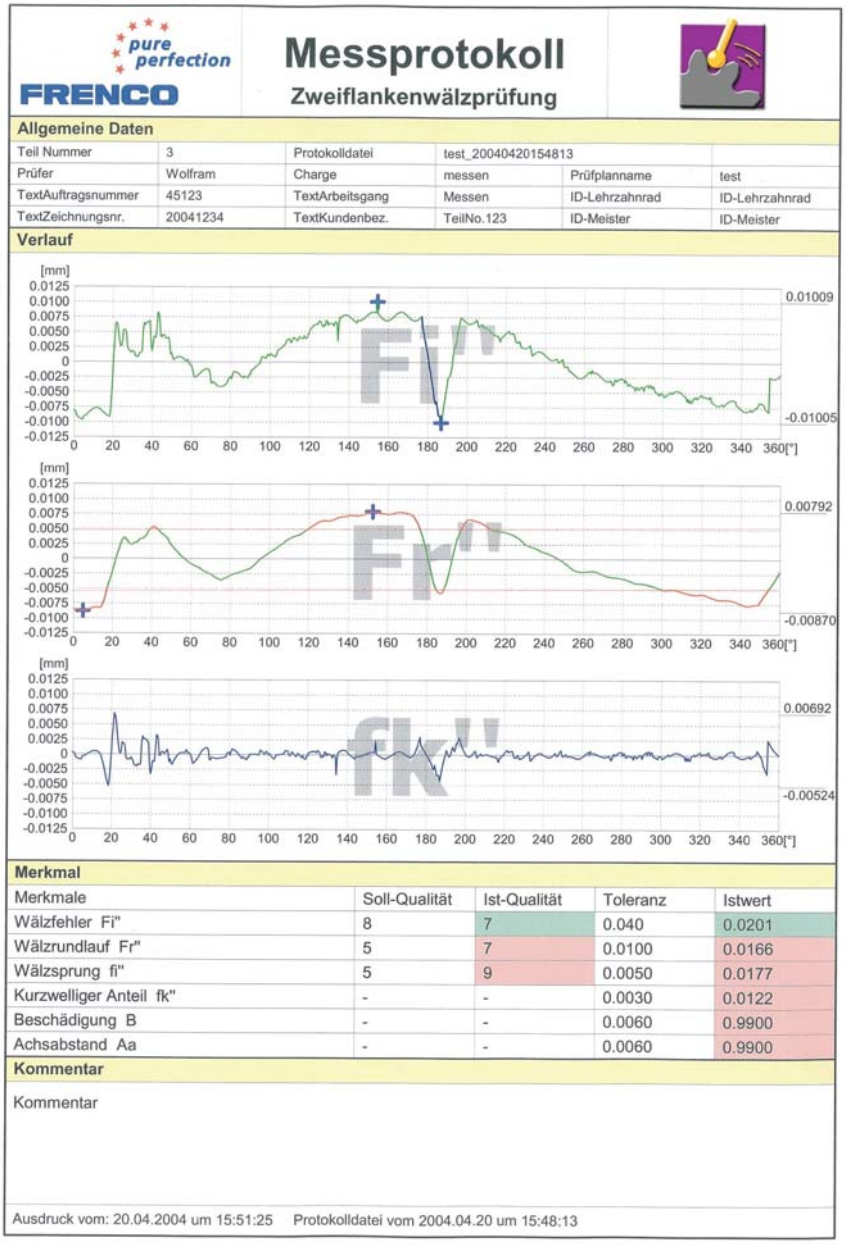


Messprotokoll

Zweiflankenwälzprüfung

Allgemeine Daten

Teil Nummer	3	Protokolldatei	test_20040420154813		
Prüfer	Wolfram	Charge	messen	Prüfplanname	test
TextAuftragsnummer	45123	TextArbeitsgang	Messen	ID-Lehrzahnrad	ID-Lehrzahnrad
TextZeichnungsnr.	20041234	TextKundenbez.	TeilNo.123	ID-Meister	ID-Meister

Verlauf

Merkmal

Merkmale	Soll-Qualität	Ist-Qualität	Toleranz	Istwert
Wälzfehler Fi''	8	7	0.040	0.0201
Wälzrundlauf Fr''	5	7	0.0100	0.0166
Wälzsprung fi''	5	9	0.0050	0.0177
Kurzwelliger Anteil fk''	-	-	0.0030	0.0122
Beschädigung B	-	-	0.0060	0.9900
Achsabstand Aa	-	-	0.0060	0.9900

Kommentar

Kommentar

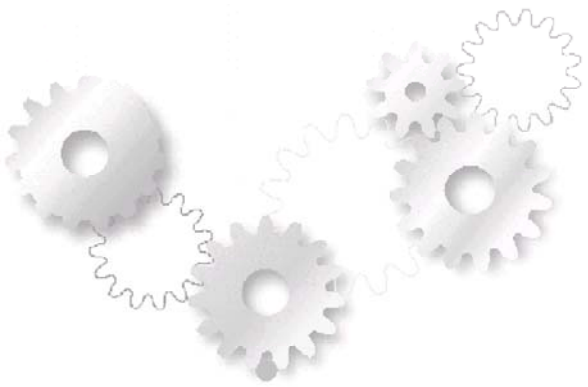
Ausdruck vom: 20.04.2004 um 15:51:25 Protokolldatei vom 2004.04.20 um 15:48:13

Die FRENCO-measuring software FGI-Pro Gear Inspector for the double flank gear roll inspection:

It determines gear roll variations, tooth to tooth composite deviations, composite runout deviations and the short wave part and displays them clearly.
Immediately after the measurement it can be seen whether the gear is acceptable or not.
By the colouring the visual comparison of the actual values and the reference value is made easier.

The software creates a clearly laid out record showing:

- **gear roll variations** Fi'', fi''
- **composite runout deviations** Fr''
- **short wave part** fk''



pure perfection
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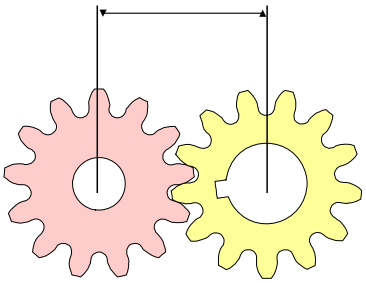
Calibration

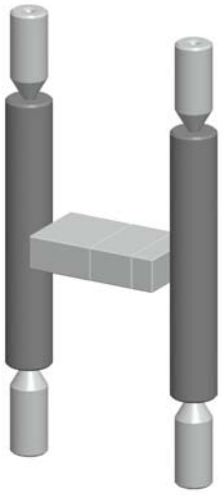
If the actual size of the distance of axis is to be measured, it is necessary to calibrate the machine with known distances of axis. The easiest way to do that is by using shafts, discs and gage blocks.

Nevertheless it is also possible to use 2 master gears (see next page).

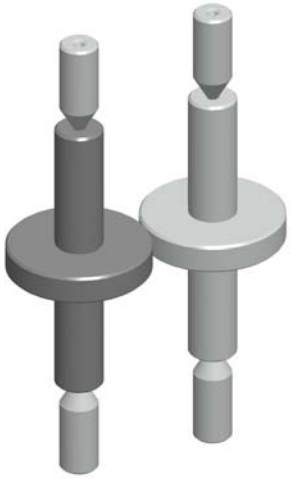
Center distance



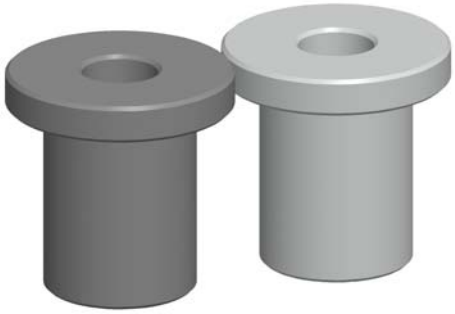
Calibration shaft-gage block-shaft
static



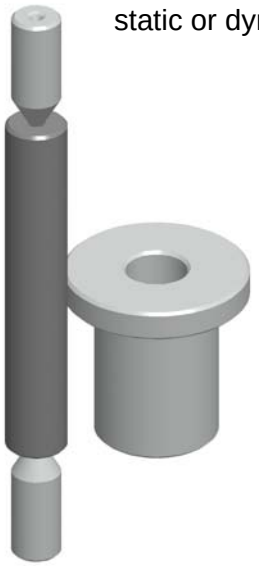
Calibration with discs on shafts
static or dynamic



Calibration disc-disc
static or dynamic



Calibration shaft-disc
static or dynamic



Calibration set MPE

A complete calibration of double flank gear roll inspection machine is possible only with a limit calibration set MPE. Such a set contains 5 master gears:

The reference master gear. It hasn't got any modifications. Tooth No. 1 is marked. With this tooth the other masters are rolled, measured and logged.

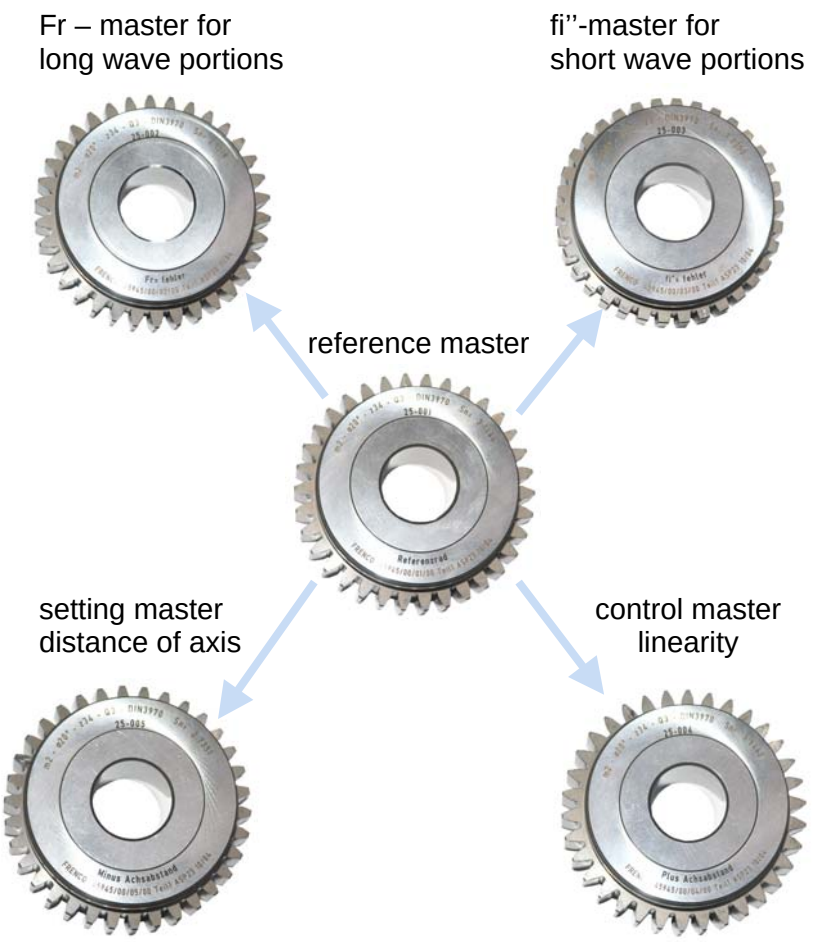
The Fr – master has got a long wave, sinusoidal Fr'' deviation.

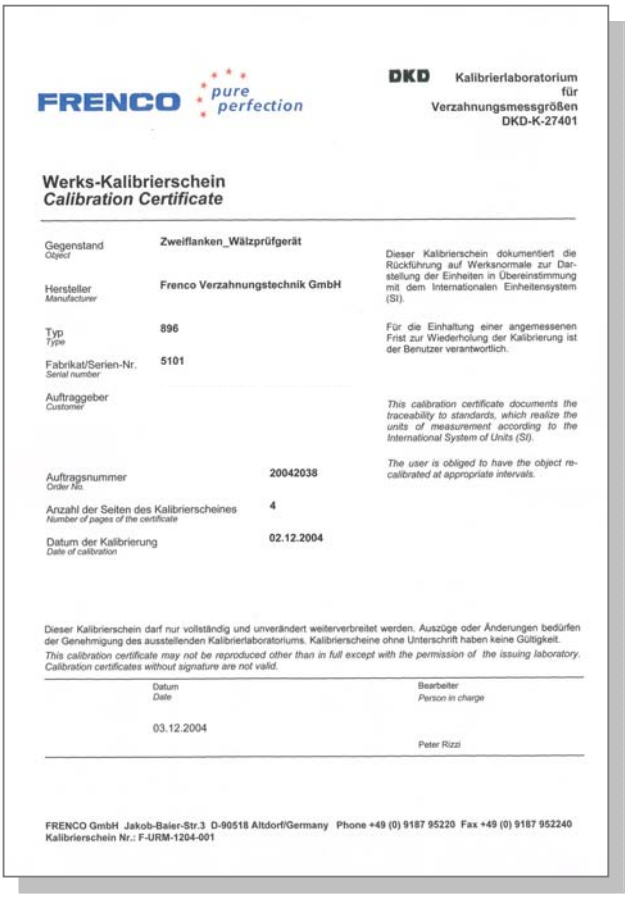
The fi – master has got a variation of tooth thickness, which causes a short wave Fi'' deviation.

With **the setting master distance of axis** the distance of axis is calibrated.

The control master has got an differing tooth thickness from that of the setting master distance of axis. The so appearing deviation of the distance of axis has got a nominal size, which should be congruent to the actual size measured.

After every acceptance, maintenance and service a calibration certificate is issued containing all appearing deviations. This certificate is suitable as basis for the wear inspection, for audits and for certifications.





FRENCO pure perfection

DKD Kalibrierlaboratorium für Verzahnungsmessgrößen DKD-K-27401

Werks-Kalibrierschein
Calibration Certificate

Gegenstand *Object*	Zweiflanken_Wälzprüfgerät
Hersteller *Manufacturer*	Franco Verzahnungstechnik GmbH
Typ *Type*	896
Fabrikat/Serien-Nr. *Serial number*	5101
Auftraggeber *Customer*	
Auftragsnummer *Order No.*	20042038
Anzahl der Seiten des Kalibrierscheines *Number of pages of the certificate*	4
Datum der Kalibrierung *Date of calibration*	02.12.2004

Dieser Kalibrierschein dokumentiert die Rückführung auf Werksnormale zur Darstellung der Einheiten in Übereinstimmung mit dem Internationalen Einheitensystem (SI).

Für die Einhaltung einer angemessenen Frist zur Wiederholung der Kalibrierung ist der Benutzer verantwortlich.

This calibration certificate documents the traceability to standards, which realize the units of measurement according to the International System of Units (SI).

The user is obliged to have the object recalibrated at appropriate intervals.

Dieser Kalibrierschein darf nur vollständig und unverändert weiterverbreitet werden. Auszüge oder Änderungen bedürfen der Genehmigung des ausstellenden Kalibrierlaboratoriums. Kalibrierscheine ohne Unterschrift haben keine Gültigkeit.
This calibration certificate may not be reproduced other than in full except with the permission of the issuing laboratory. Calibration certificates without signature are not valid.

Datum *Date*	Bearbeiter *Person in charge*
03.12.2004	Peter Rizzi

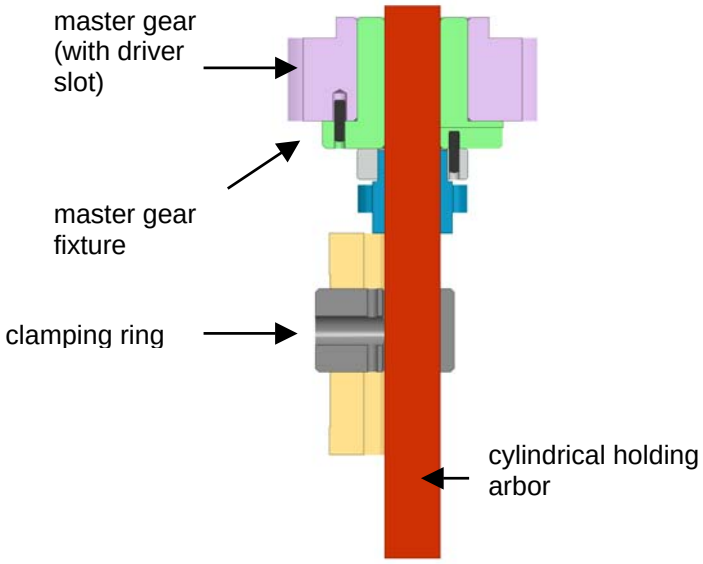
FRENCO GmbH Jakob-Baier-Str.3 D-90518 Altdorf/Germany Phone +49 (0) 9187 95220 Fax +49 (0) 9187 952240
Kalibrierschein Nr.: F-URM-1204-001

Fixtures

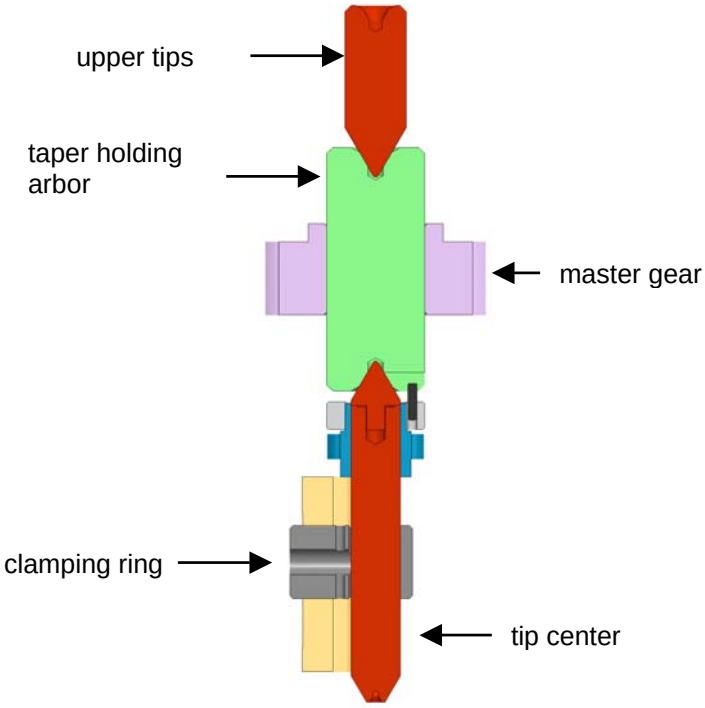
Fixtures for ZWP 06 (896)

for the master gear

Single end mounting

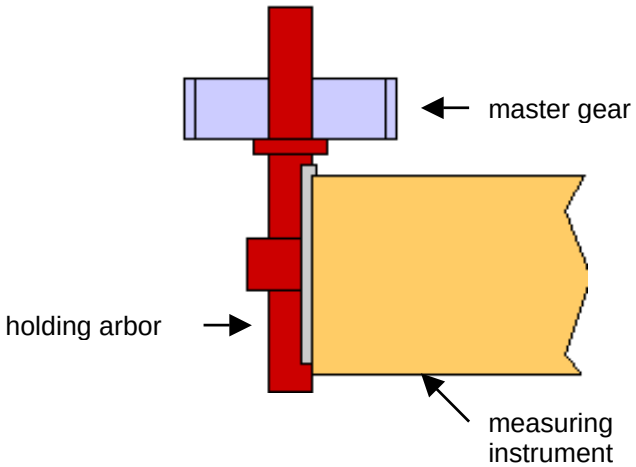


Fixture between tips

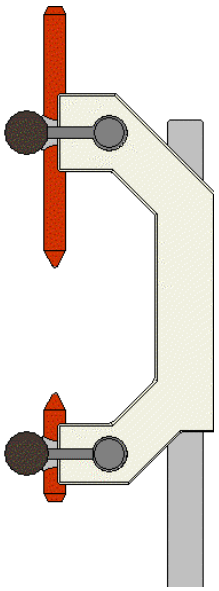


for the workpiece

Single end mounting



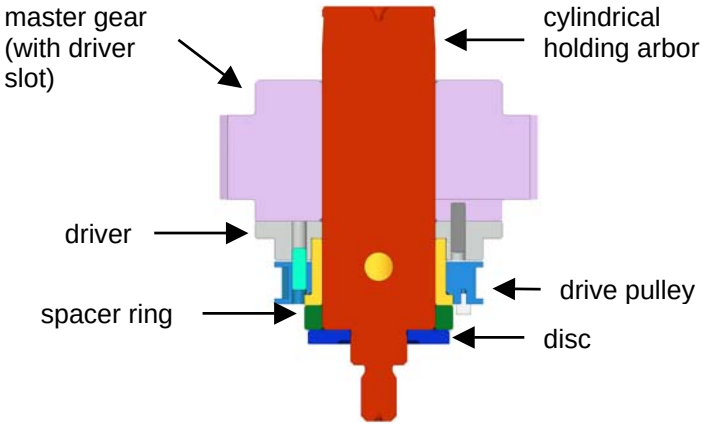
Fixture between tips



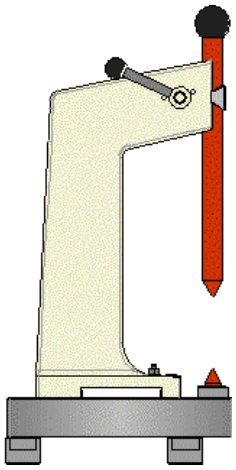
Fixtures for ZWP 14 (894)

for the master gear

Single end mounting



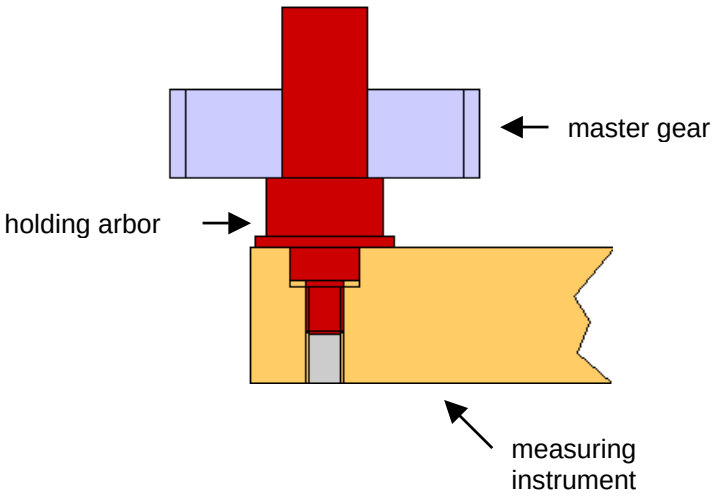
Fixture between tips



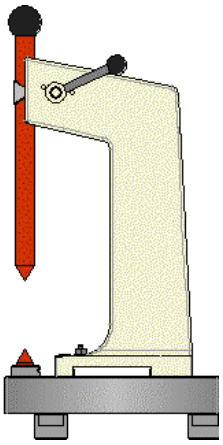
Only available without drive

for the workpiece

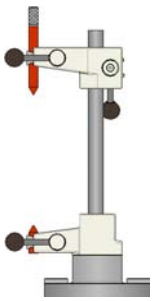
Single end mounting



Fixture between tips



steady center
attachment

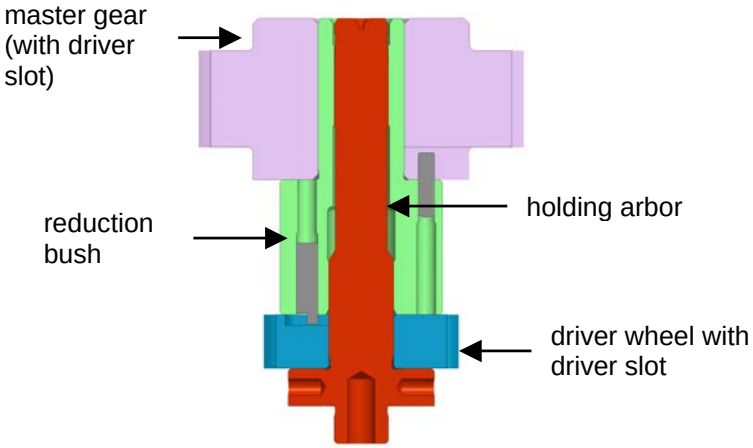


center fixture

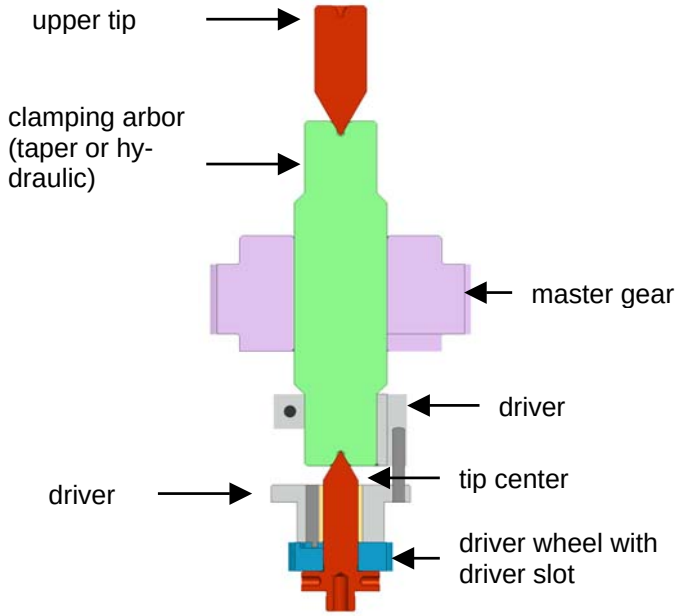
Fixtures for ZWP 18 (898)

for the master gear

Single end mounting

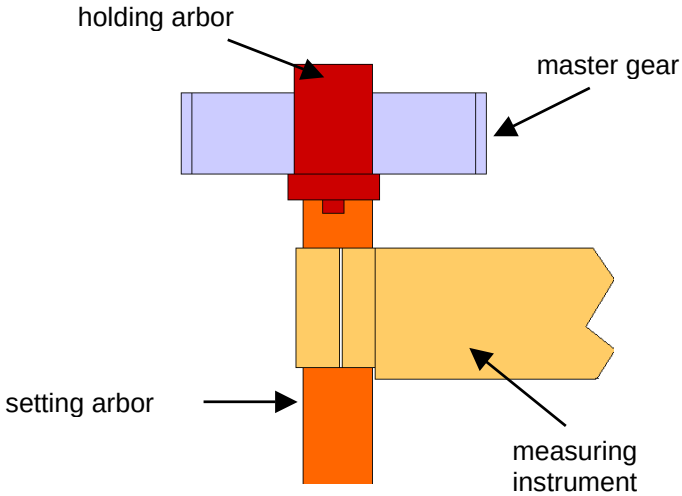


Fixture between tips

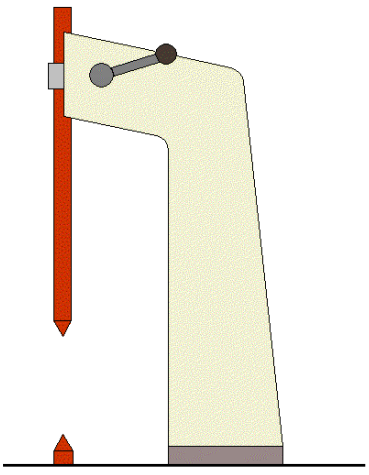


for the workpiece

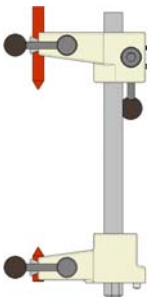
Single end mounting



Fixture between tips



steady center
attachment



center fixture

Correction of deviations of master gears

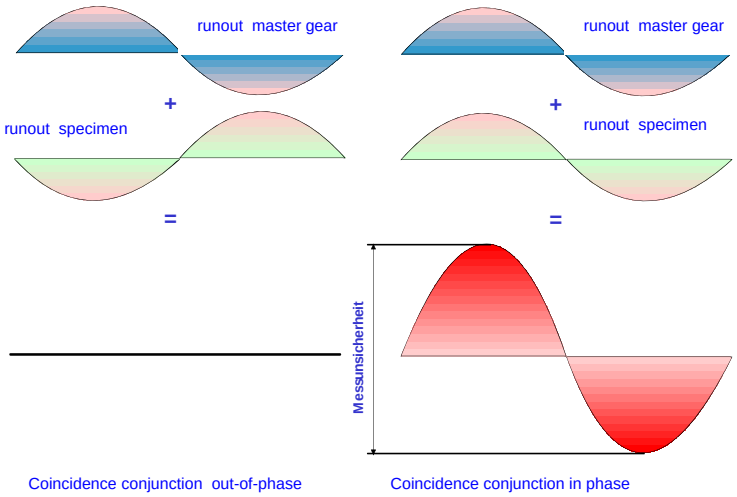
Master gears are manufactured with the same precision as gages, therefore these are high precise parts. However small form variations cannot be avoided. Especially the runout deviation causes a deviation in the double flank gear roll inspection which cannot be disregarded. The actual runout deviation of the master gear is considered in the measuring uncertainty with the double of the value of the runout deviation, because the deviations of the master gear and the workpiece interacts depending on the angular position affirmatively or negatively.

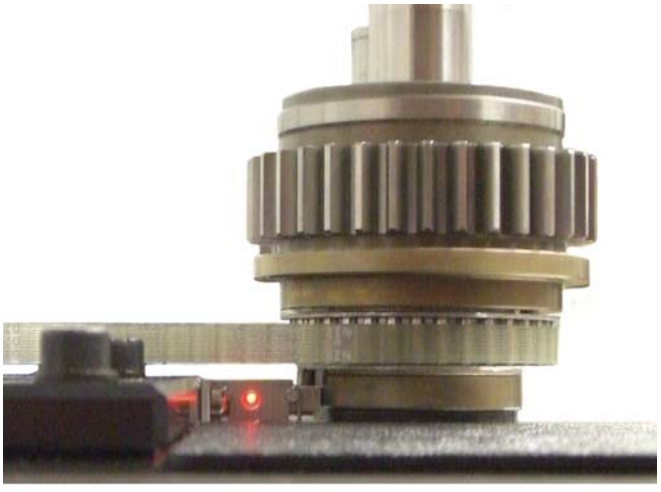
If the runout deviation of master gear is 0,006 mm, the measuring uncertainty raises with 0,012 mm.

This interaction can be minimized by arising the accuracy of the master gear. (e.g. using quality A according to the DIN 3970 (FRENCO QF)). By the application of the correction of deviations of master gears the interaction be avoided nearly completely.

Correction of deviations of master gears:

The master gear or the driver has got a marking for the angular position which is read by a sensor. With a control master fitting to the master gear (number of teeth of the control master and number of teeth of the specimen must not have a common divisor) a correction run with multiple rotations is executed. During this process the correction values are calculated and saved on the electronic. With these calculated values the following measuring results are fully automatically corrected.





Master gears

FRENCO offers a new generation of master gears. **“Pure perfection” in two flank gear roll inspection** – the time and cost saving solution in your production process.

Master gears are available according to standard or in all special variants.

Ask for our detailed brochure about master gears.

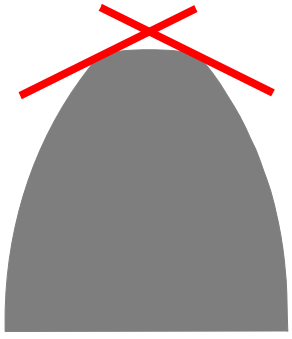
not covered

master worm

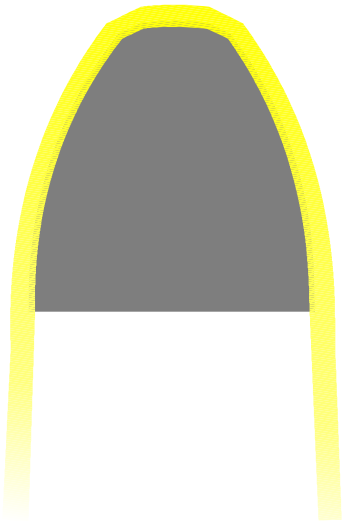
CO-covered

The variant Chaco is very sophisticated:

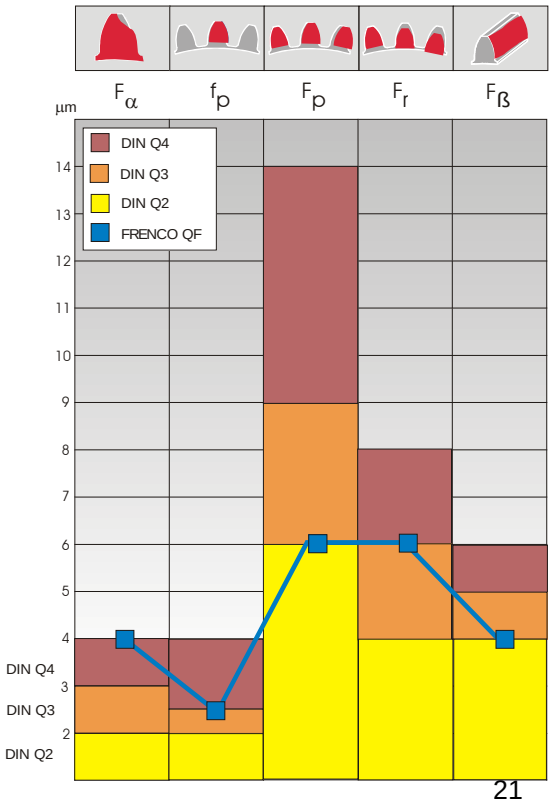
With protecting tip chamfer



With cover wear resistant



With functional tolerances



Method of measurement

Gears transfer rotations and torques. Like all machine components, they are afflicted with production caused deviations.

The challenge to produce a constant quality requires quick and easy inspection methods, which can be smoothly integrated in the production process.

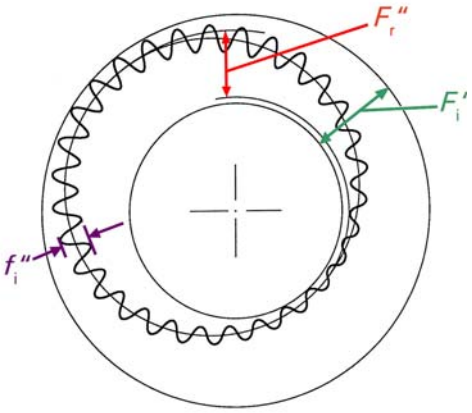
For a precise assessment of the gears' operational behaviour, manufacturers make again use of the well tried double flank gear rolling inspection.

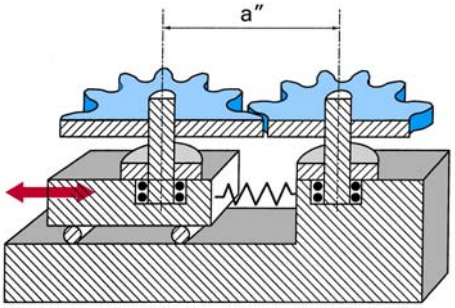
This method enables a quick assessment of gears in terms of total deviations.

Completed with modern evaluation possibilities, PC hard- and software, the double flank gear rolling inspection machines are an important aid for a fast and trouble-free quality control.

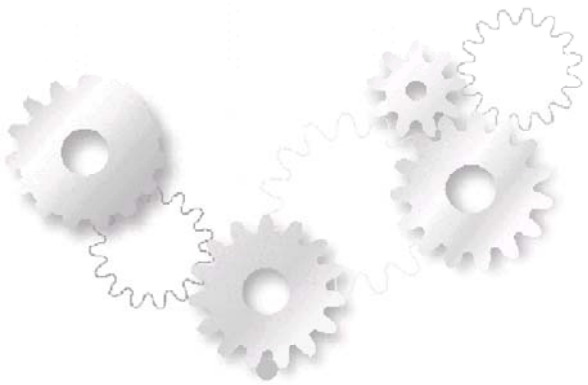
By exhausting the allowed tolerances, the production time can be reduced.

FRENCO double flank gear rolling inspection machines can be used for the measurement of internal and external cylindrical gears and worm gears.





Measuring setup for the double flank gear rolling inspection. During the double flank gear rolling inspection two gears are rolled together free from backlash.



Double flank rolling deviation *F*i“

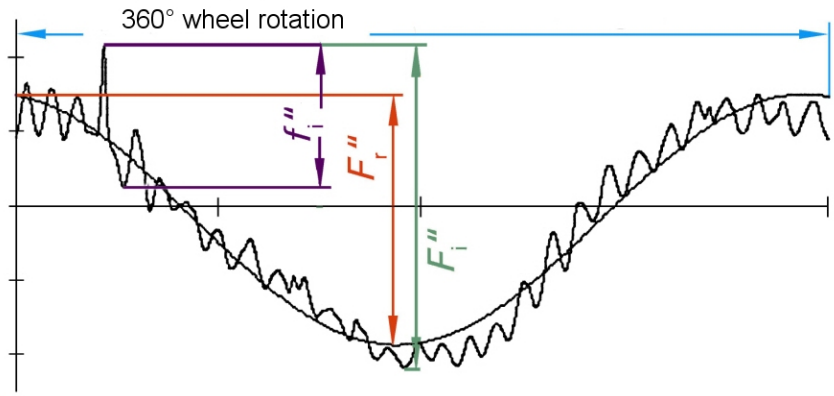
*F*i“ is the difference between the maximum and minimum values of the working center distance, a”, which occurs during a radial (double flank) composite test, when the product gear with its right and left flank simultaneously in tight mesh contact with those of a master gear, is rotated through one complete revolution. (DIN3960/3963)

Double flank rolling tooth-to-tooth deviation *fi*“

fi’’ is the value of the radial composite deviation corresponding to one pitch, 360°/z, during one complete cycle of engagement of all the product gear teeth. (DIN3960/3963)

Radial Runout Fr’’

the value of radial runout of the gear is the difference between the maximum and the minimum radial distance from the gear axis as observed by removing the short-term or undulation pitch deviations and analyzing the long-term sinusoidal wave form.



Display of measurement results

Design

Frenco double flank gear rolling inspection machines employ a virtually frictionless, backlash-free measuring carriage which rides on high-precision roller bearings or parallelogram leaf springs.
This exceptionally sound mechanical design is coupled with a solid and stable machine base for a great accuracy and repeatability of the measurement results. To display the results of measurement electronic evaluation systems like Millitron or Milligraph can be used as well as a PC equipped with our double flank gear rolling inspection software FGI – Frenco Gear Inspector.

Advantages

- Solid, rigid design
- Easy-to-operate, but extremely rigid modular components
- True modular system
- The wide range of available modular elements allows to configure the inspection machine according to the customer wishes and fitted to the specimens and the conditions of inspection.
- Directly variable measuring force
- Quick-change feature of the measuring carriage
- Non-rotating centers and arbors on measurement carriages, setting carriages or machine base. The affect of all possible runout deviation in the holding elements is consequently eliminated. A special driver device activates the gear held on the drive side in the measurement slide.

FRENCO Product Lines

Gear and spline high precision

Spline Gages
Master Gears, master wheels
Artefacts, masters
Profiled tools
Clamping systems
Gear and spline manufacturing

Instruments for size inspection Series V

Ball inserts and pins VRK
Instruments for rocking VA
Instruments with face stop VP
Indicating Gages VM
Variable 3-Disc Gages VD
Customized solutions VS

Rotation Measuring Systems

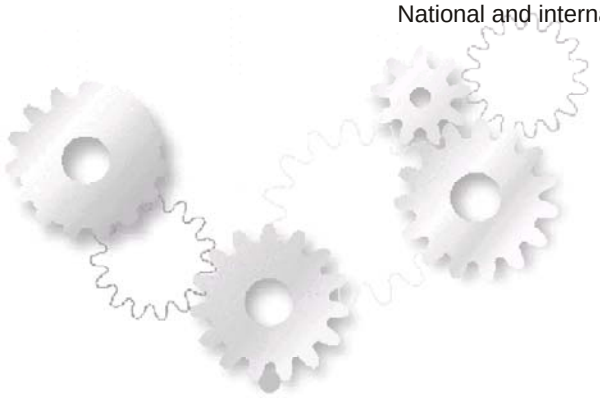
URM - K with balls and pins
URM - R with master wheels
EWP Single flank gear rolling
ZWP Double flank gear rolling
WS Gear Rollscan

Gear and spline inspection

DKD gear calibration
Gage wear inspection
Part inspections
Deviation analysis

Know-how transfer

Software for gear and spline calculating
Training, seminars and workshops
Consulting and calculations
Literature and documents
National and international standards



pure perfection

FRENCO

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