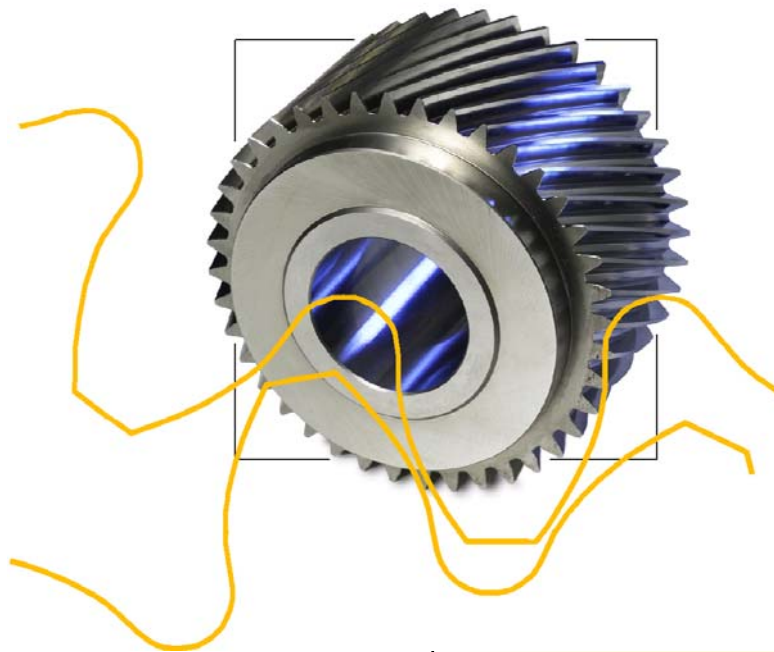
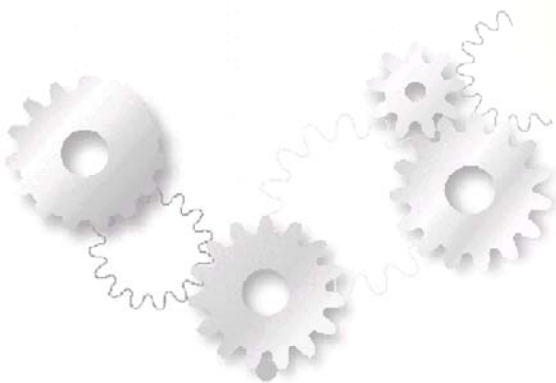




MASTER GEARS for every requirement



*Highest standard
technically perfect*



*pure
perfection*

FRENCO

Master gears for every requirement

Range

To guarantee your customers the high quality products they expect, you need to take quick gear measurements and carry out minutely-detailed functionality inspections. Ultimately, quality assurance is the key to the success – and survival – of every company. But it has to be economical. It has to pay off.



- Quality
- Material
- Geometry
- Coating
- Tip chamfers
- Modifications

That is why FRENCO has now developed a new generation of master gears. Going by the name “**pure perfection**”, they enable you to carry out single and double flank gear rolling inspection as part of an integrated process within production – thus saving you both, time and money.



- Quality
- Material
- Geometry
- Coating
- Tip chamfers
- Modifications



- Quality
- Material
- Geometry
- Coating
- Tip chamfers
- Modifications

Summary

Standard design

Possible versions

DIN Q3	DIN Q4, DIN Q234 (Chaco), AGMA, ISO
Gage steel GS	SX (ASP 23), tool steel TS
DIN 3970 /B	FRENCO L, XL, XXL
without	TIN or CO (only for SX and TS materials)
without	Tip chamfers possible
without	All types and combinations

FRENCO QF	DIN Q4, Agma, ISO
tool steel TS	SX (ASP23)
DIN 3970 /B	FRENCO L, XL, XXL
CO	
tip chamfers	
without	All types and combinations

individual
individual
individual
individual
individual
individual

Design
CHACO
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Major 12

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Regrinding procedure
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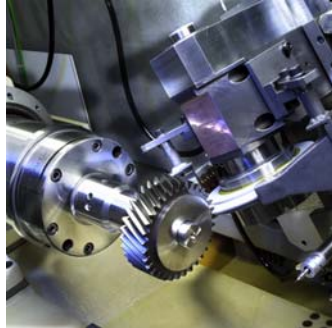


FRENCO

Design CHACO

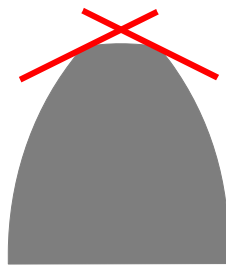
Made to be different-
Maximizing benefits:
CHACO

CHACO =
CHAMFERED COATED



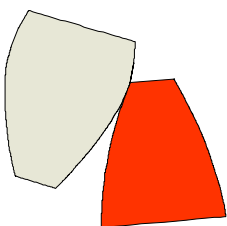
Key benefit:
CHACO is the first master gear with premium quality tip chamfers

They optimize the gearing qualities and prevent from master gear damage.



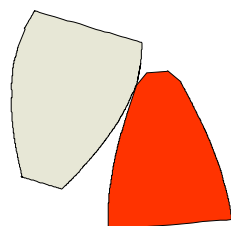
Standard:

Measurement with sharp edges at tooth tip



CHACO:

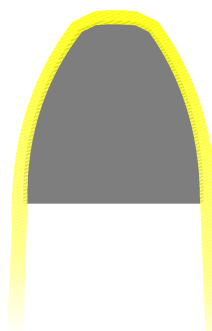
Tip chamfer as safety buffer for reliable measurements



Key benefit:
CHACO offers protection against wear

The tool steel with innovative coatings setting new standards to the concept of value-for-money. At the same time the quality of CHACO master gears convinces in the long run: Wear –e.g. caused by sliding friction- is reduced to a minimum.

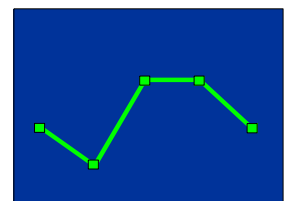
Wear performance has never been better; corrosion protection is guaranteed. The intervals of your wear inspection are extremely extended.



Key benefit:
CHACO master gears now provide manufacturing tolerances that make sense.

The manufacturing tolerances of the new generation of CHACO master gears correspond to the real demands on master gears.

CHACO tolerances have deliberately been selected with DIN standards in mind.



Quality

The qualities of master gears are normally defined by DIN 3962. This standard is not very suitable for master gears. As nothing else is available, the smallest manufacturable tolerance class DIN Q3 is used. DIN Q3 is the smallest manufacturable quality, because deviations of profile variations cannot be manufactured any better. By the way of contrast other variations could be tolerated closer.

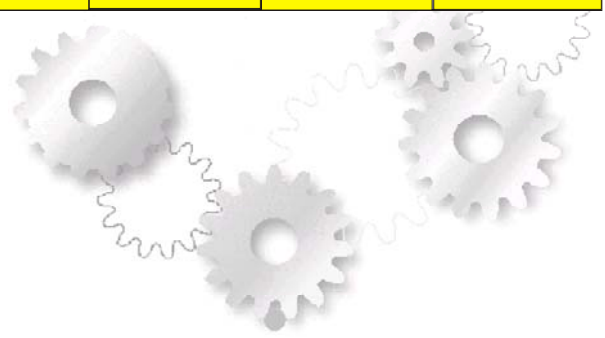
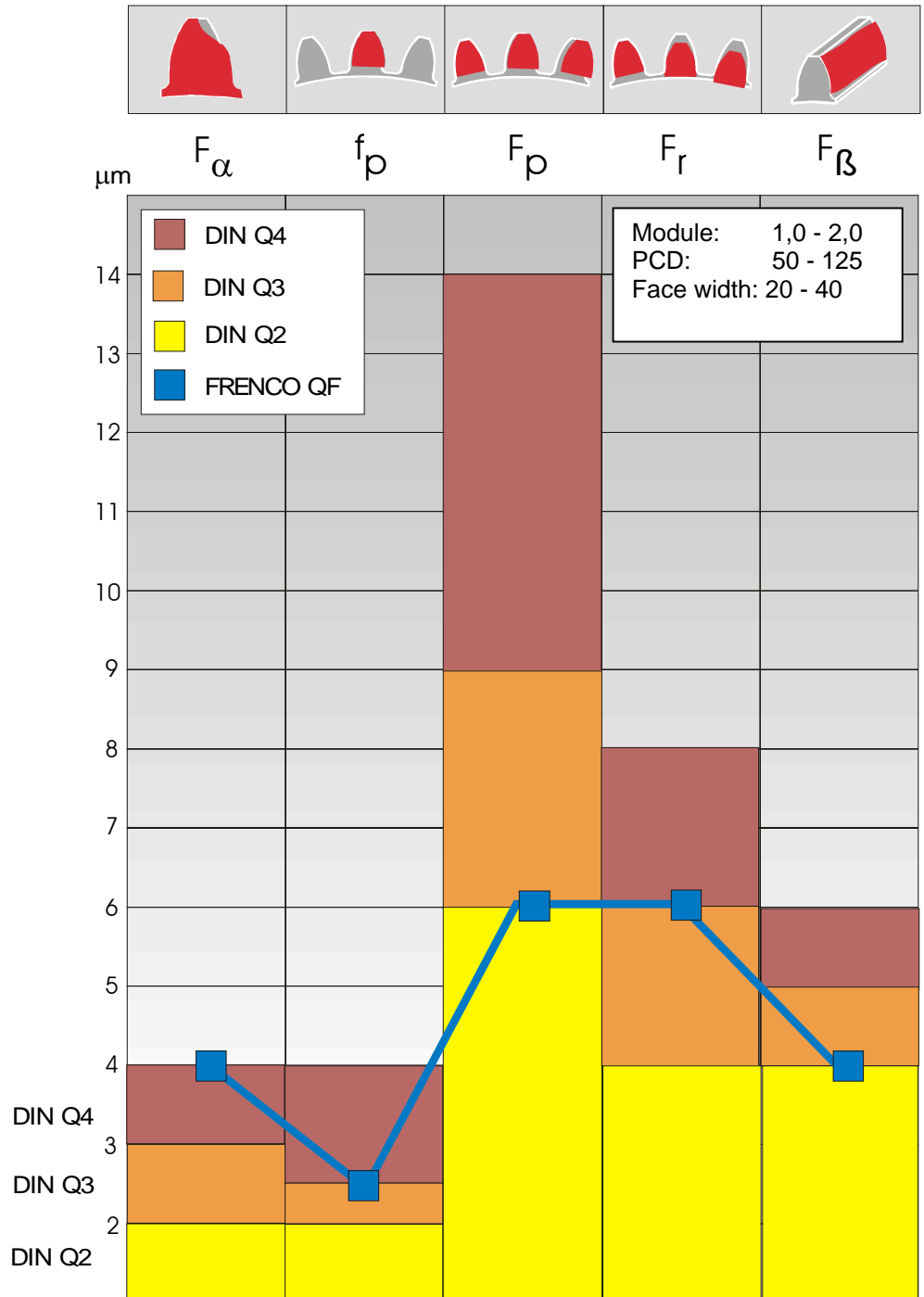
FRENCO supplies master gears according to:

DIN Q3

DIN Q4

Or as FRENCO QF

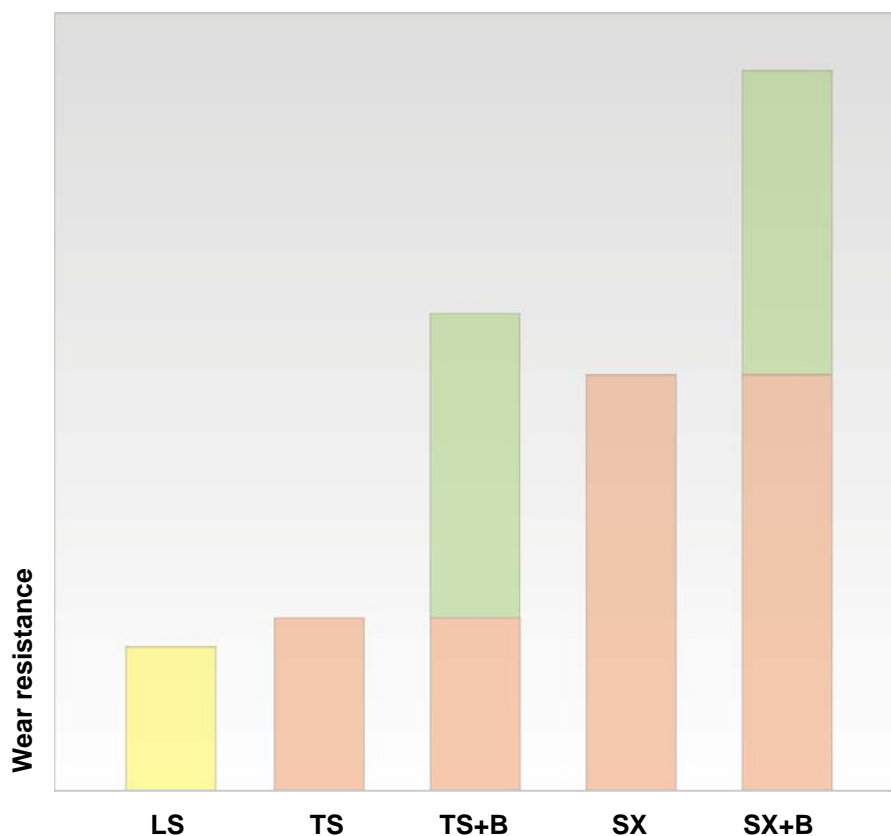
The quality FRENCO QF is especially recommended for coated master gears.



Materials

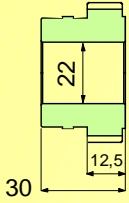
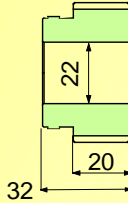
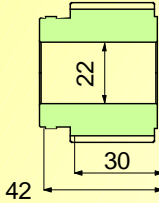
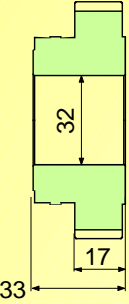
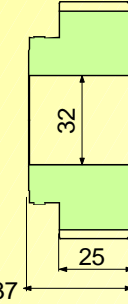
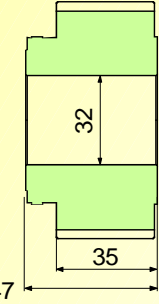
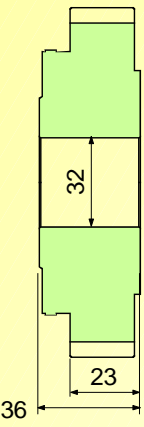
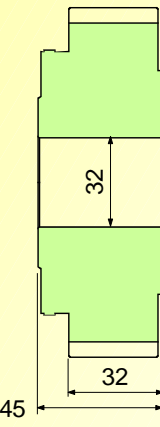
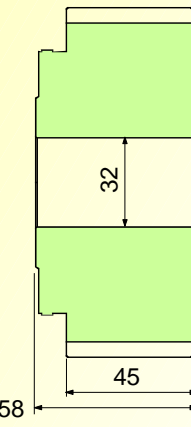
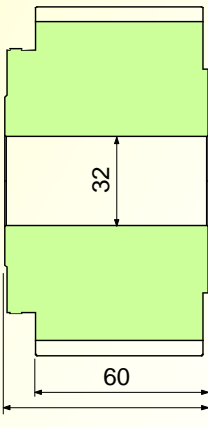
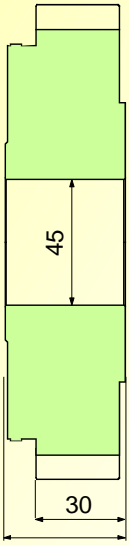
Material	coatable	% C	% V	% Cr	% Mo	HRC
Gage steel LS	no	1,0	0,1	0,6		60-62
High-speed tool steel TS	yes	1,0	0,3	9	2,5	61-63
Powder steel SX	yes	1,4	4	4		63-65

As basic material for master gears various types of steel are available. Wear resistance increases from LS through TS to SX. In addition, the types TS and SX are coatable. For normal requirements, TS+B (TS coated) is the best value for money. SX+B offers ultimate wear resistance for the highest demands in high-volume production.

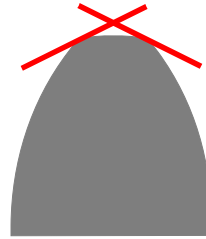


External Geometries

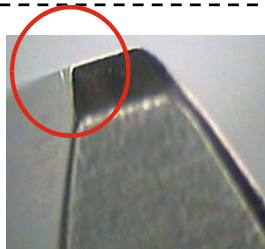
DIN 3970 prescribes the external geometries for master gears. The tooth width of master gears should usually be a little larger than that of the workpiece. This can mean that a master gear with a DIN-defined tooth width can be too narrow. In addition to DIN widths, FRENCO offers the widths L, XL and XXL as standard. Of course, other widths, bore diameters and drivers are also possible as special designs.

Size	DIN	L	XL	XXL
1				
2				
3				
4				

Tip Chamfers



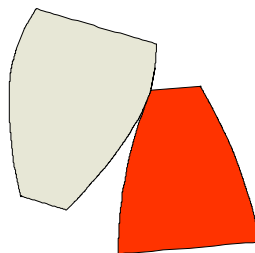
Tip chamfers improve running characteristics and protect the master gear against damage. For not being ascertainable during the wear measurement, these damages are very dangerous.



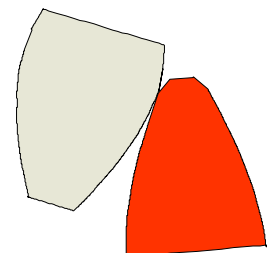
Without tip chamfer



With tip chamfer

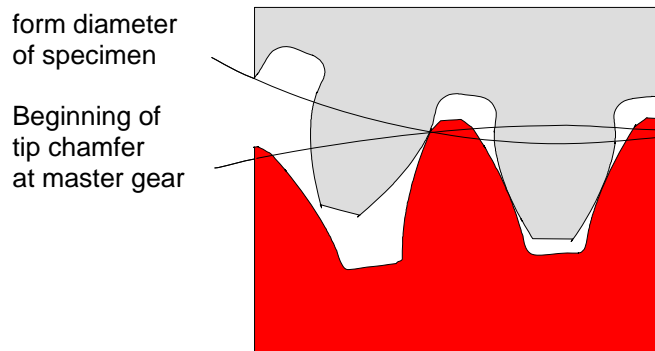


The sharp edge of the tip diameter touches first while the flank contact is running in.



Tip chamfers serve to break this edge so that no damage can arise on the master gear.

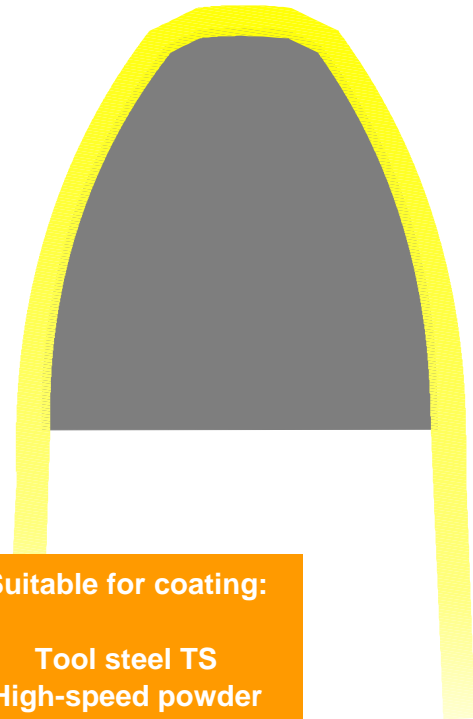
The beginning of the tip chamfer on the master gear has got the identical tolerance as the major diameter without chamfer.



Coatings

Coatings protect the surface against wear. The coating is much more harder than any steel and also more resistant of wear. At the same time, the layer is a rust protection.

As the coating process has to be carried out at a high temperature, the base material to be coated must be suitable.



Suitable for coating:

Tool steel TS
High-speed powder
steel SX (ASP 23)

uncoated



Coating hardness:
HV 1800

TIN coated

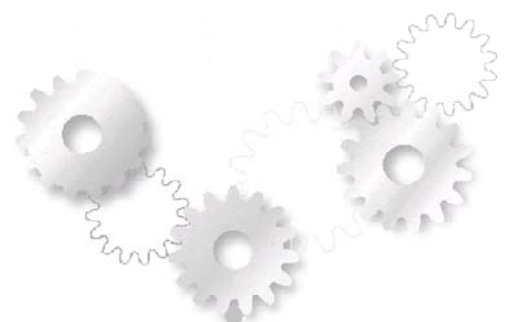


Beschichtungshärte:
HV 1800

CO coated



Coating hardness
HV 3000



Modifications

Modifications are the desired deviations of profile or helix from the ideal shape.

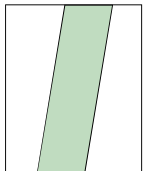
In the case of master gears, this is usually accomplished as an adaptation of the specimen modifications.

Modifications can be symmetric or asymmetric in relation to the left or right tooth.

helix modifications Cb

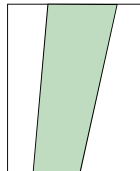
angle modification

$$C_b = h$$



symmetric

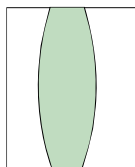
$$C_b = H$$



asymmetric

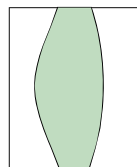
form modification

$$C_b = b$$



symmetric

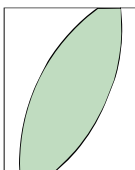
$$C_b = B$$



asymmetric

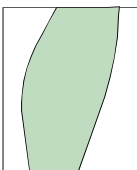
combined modifications

$$C_b = hb$$



symmetric

$$C_b = HB$$

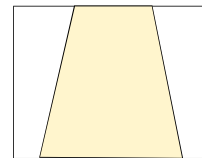


asymmetric

profile modifications Ca

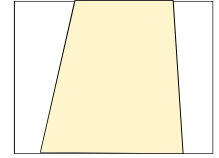
angle modification

$$C_a = h$$



symmetric

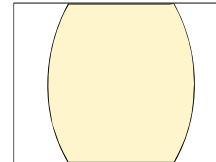
$$C_a = H$$



asymmetric

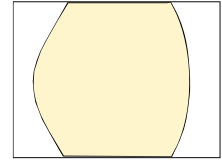
form modification

$$C_a = b$$



symmetric

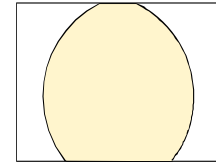
$$C_a = B$$



asymmetric

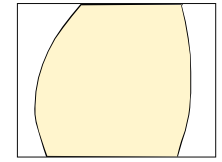
combined modifications

$$C_a = hb$$



symmetric

$$C_a = HB$$



asymmetric

Nearly all modifications and their combinations are possible.

However, the manufacturing demands rise sharply for asymmetrical helix modifications Cb in particular.

Special Pressure Angles

The tolerances specified in DIN 3962 only apply to a pressure angle of 20°.

If smaller pressure angles are used, the quality requirements for the total permissible profile and runout deviation increases

An agreement is required according to the new series of standards DIN 23961-23963, which are currently on the way (see DIN 23961, page 3,1.).

The Franco standard envisages the following agreement:

The runout deviation arises from deviations in roundness and coaxiality. The contribution of roundness deviations will have an above-average effect for pressure angles lower than 20°. The values specified in DIN 3962 will, therefore, be raised proportionally.

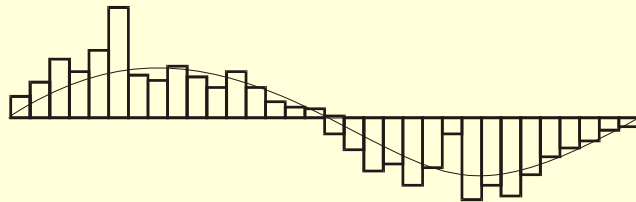
Relevant information were given in DIN 3962 – 1952. Unfortunately, this information disappeared with the revision of this standard in later editions.

Assuming that the contributions of roundness deviation and coaxiality deviation are distributed equally, the tolerance of the roundness deviation increases if the pressure angle is smaller than 20° and is determined by the formula:

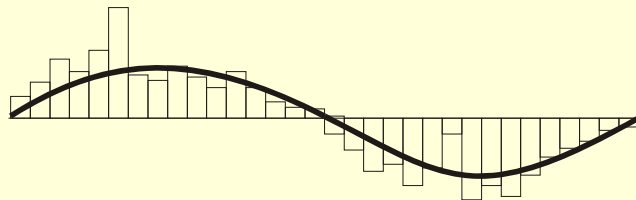
$$\alpha < 20^\circ \text{ bis } 15^\circ : F_\alpha = \text{standard} + 0,001 \text{ mm}$$

$$\alpha < 15^\circ \text{ bis } 10^\circ : F_\alpha = \text{standard} + 0,002 \text{ mm}$$

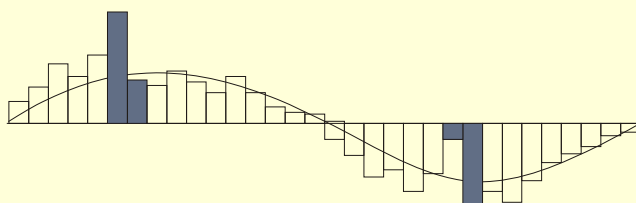
example of runout deviation



contribution of coaxiality deviation



contribution of roundness deviation



$$Fr = Fr_{\text{standard}} \times (0,5 + 0,5 \times \tan(20^\circ) / \tan(\alpha^\circ))$$

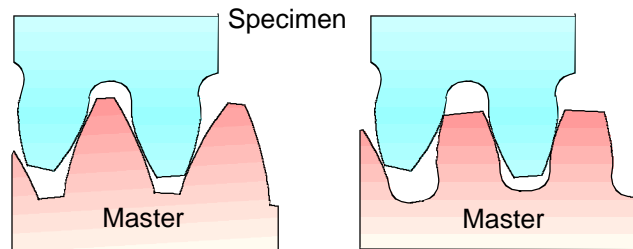
simplified by reduction:

$$Fr = Fr_{\text{standard}} \times 0,5 \times (1 + \tan(20^\circ) / \tan(\alpha^\circ))$$

Major diameter

The calculation of the tooth thickness and the diameter of master gears is made –depending on the order- in three different ways: N (=strictly to standard), S (= fits one special specimen), M (= fits more special specimens). According to the used method of calculation the major diameter varies as listed opposite.

The manufacturing tolerance of the major diameter tried to reach is $\pm 0,025$ mm. A difference from the design may appear if the major diameter is adjusted to the tooth thickness (because the tolerance of tooth thickness aimed by the design has not been reached).



The function of both masters is ensured if their major diameter and their tooth thickness fit exactly together

- N** The major diameter is defined by the standard as long as the master gear is ordered according to the standard and not to fit one or more specimens.
- S** The major diameter is calculated in a way, which enables the master gear rolling down exactly to the form diameter. If this major diameter is theoretically or practically not possible or if the major diameter has not a tolerance of at least $0,15 \times m$ to the root of the specimen, the tooth thickness will be adjusted. In case of not being possible to solve the problem by changing the tooth thickness, the number of teeth will be increased.
- M** For every specimen a master gear with a fitting major diameter is calculated, which rolls down exactly to the form diameter. The smallest of all major diameters of the calculated master gears is chosen as specification in the design. That means that the major diameter of the master gear rolls down to the form diameter of that specimen with the biggest form diameter. At all other specimens the tooth flank is not rolled down to the form diameter. If the form diameter of the specimen is below the base circle diameter (BCD), the major diameter will be calculated in such a way, that it will roll down to the BCD.

Inspection

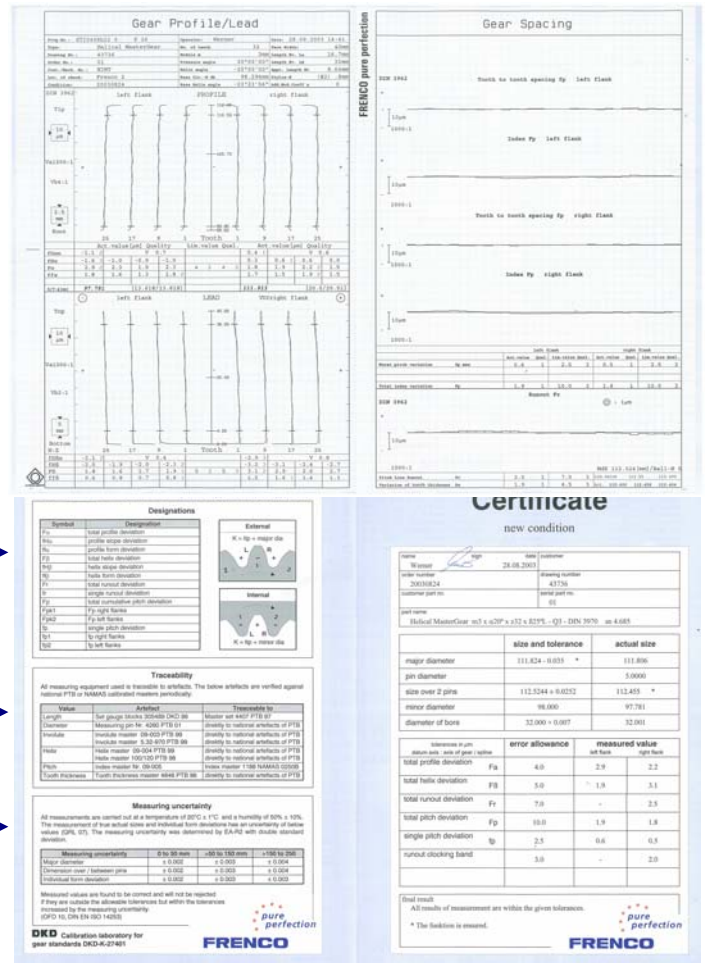
The Inspection of master gears contains the measurement of the total profile, the total helix, the total runout, the total pitch and the single pitch deviation on a high precision inspection machine. Additionally the bore and the major diameter are measured.

Due to the very small tolerances, master gears are not rejected until the tolerance is exceeded by the measuring uncertainty. This principle is also used for the wear inspection to make sure that functional master gears are not rejected because of the measuring uncertainty.

Master gears will slowly wear during their usage. That's why it is necessary to check them periodically. This wear inspection has to be made on the same conditions as the inspection of a master gear in new condition, provided that the allowed single deviations may arise to the limit of the next worse quality. The inspection during the usage should be made in intervals of 25% of the estimated service life.

FRENCO offers the **wear inspections** of master gears.

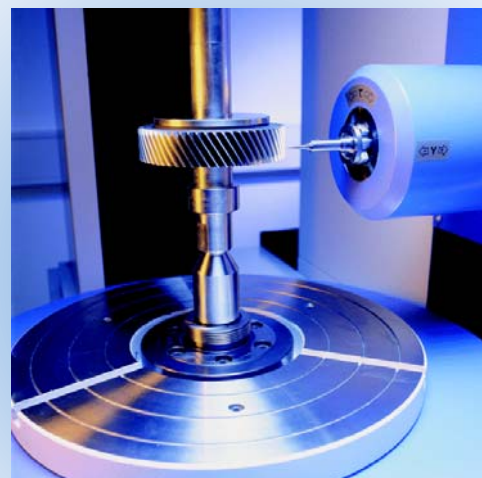
FRENCO Certificate



Designation

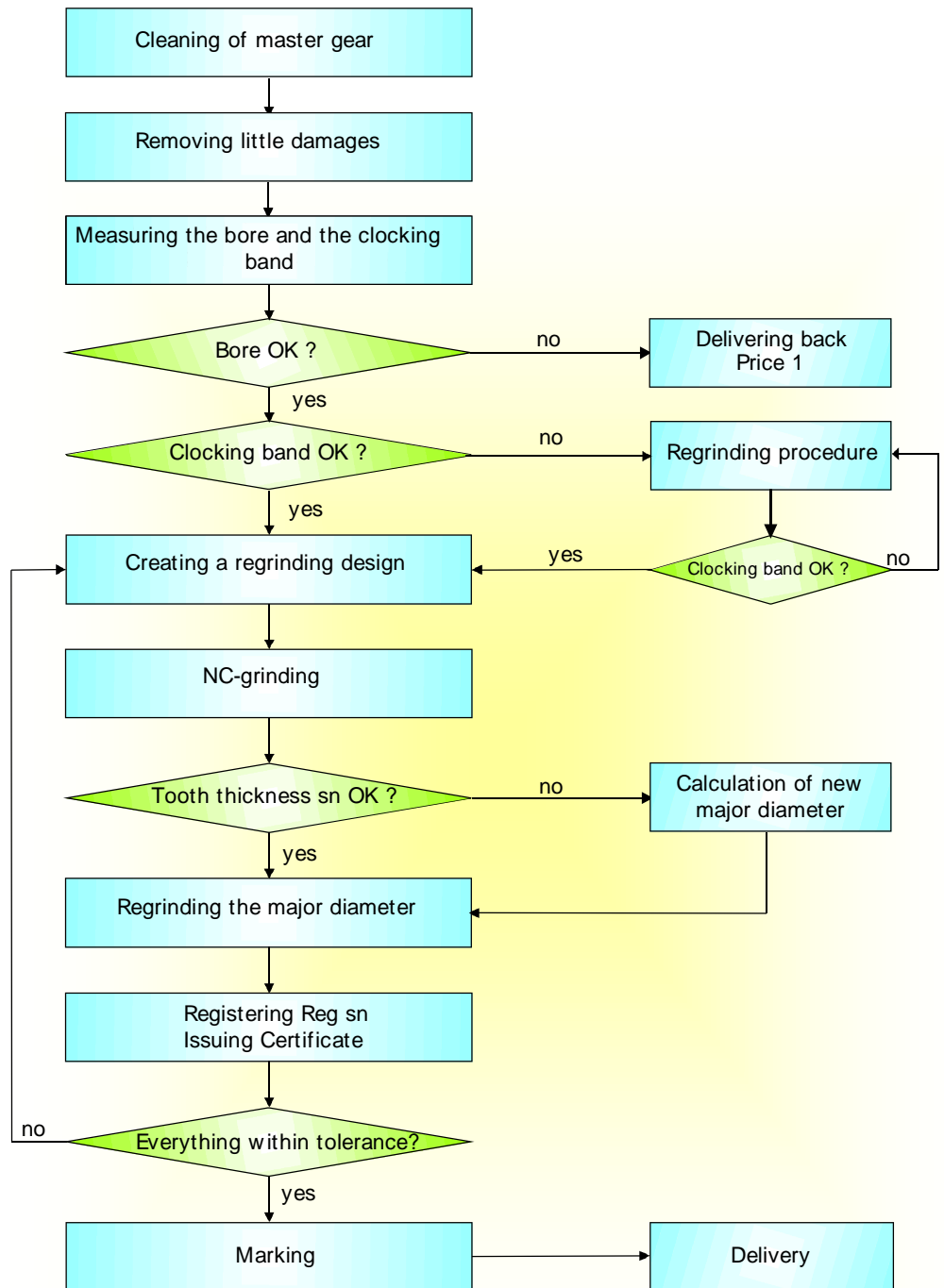
Traceability

Measuring uncertainty



Regrinding Procedure

Master gears wear during their usage. Often worn master gears can be reground. This service is offered by FRENCO. Detailed information about the procedure are available on request. FRENCO suggests the following tolerances of wear:
One quality level for total runout and total pitch deviation.
Two quality levels for total profile, total helix and single pitch deviation.

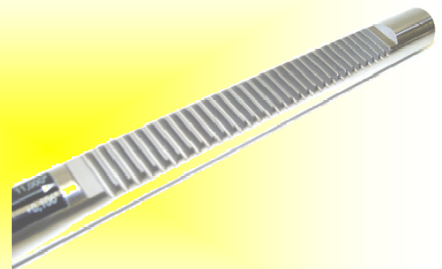


Versions

Nearly every wish for special features can be fulfilled.

Just ask **FRENCO!**

Master racks



Master worms



Master ring gears



FRENCO Product Lines



Gear and spline high precision

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



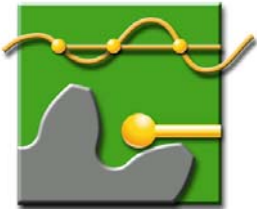
Instruments for size inspection Series V

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



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