Gear and Spline Inspection  
according to certified standards  
Gear and spline  
technology with service
Deutsche Akkreditierungsstelle GmbH

Entrusted according to Section 8 subsection 1 AkkStelleG in connection with Section 1 subsection 1 AkkStelleGBV
Signatory to the Multilateral Agreements of
EA, ILAC and IAF for Mutual Recognition

Accreditation

The Deutsche Akkreditierungsstelle GmbH attests that the calibration laboratory

Frenco GmbH, Verzahnungstechnik, Messtechnik
Jakob-Baier-Straße 3, 90518 Altdorf

is competent under the terms of DIN EN ISO/IEC 17025:2005 to carry out calibrations in the following fields:

Dimensional Quantities
  - Length
  - Gear Quantities

The accreditation certificate shall only apply in connection with the notice of accreditation of 07.03.2012 with the accreditation number D-K-15199-01 and is valid until 06.03.2017. It comprises the cover sheet, the reverse side of the cover sheet and the following annex with a total of 4 pages.

Registration number of the certificate: D-K-15199-01-00

Braunschweig, 07.03.2012

Dr. Michael Hoff
Head of Division

This document is a translation. The definitive version is the original German accreditation.
General information

For everything concerning gear and spline measuring FRENCO is the first address in Germany. With our equipment we are able to measure nearly all kinds of gear. A constant room temperature and top qualified employees guarantee highest precision. The traceability to PTB certified artefacts ensure a reliable appreciation of the measuring results. The FRENCO calibration laboratory has been accredited according to EN ISO/IEC 17025 (Registry No. D-K-15199-01-00) by the „Deutsche Akkreditierungsstelle“.

Now FRENCO is authorized to do a complete calibration of gears and spurs – You get the DKD calibration with the smallest uncertainty in Germany.
The program

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Wear measurement

Scope of services

All kinds of measuring instruments and measuring equipment for internal and external gears and splines like gages, master gears, one flank taper arbor, instruments for size inspection and others are tested. The standard wear measurement according to the directive VDL2618 sheet 1 includes the below listed services:

- Checking the delivered number of pieces
- Cleaning
- Demagnetisation
- Optical check on damages
- Determination of the gear and spline according to an existing drawing or
- Determination of the gear and spline data by dint of standards or
- Creation of a drawing (additional charge)
- Remedy of small defects at the gear and spline
- Size inspection of the gear and spline by hand with Abbe-length measuring instrument or length measuring comparator
- Inspection of form like profile and helix trace pitch and runout on our measuring machines
- Issue of an inspection certificate in english or german language
- Electronic archiving of the measuring results at FRENCO
- Availability of measuring results online at www.frenco.de
- New marking (additional charge)
- Check of gage-design according to a workpiece (if required)
- Packing in a rust protective foil

Note: If the wear measurement has to be aborted due to a size being out of tolerance, costs will be reduced accordingly.

Delivery time

The delivery time is about 2 weeks after the arrival of the objects to be tested at FRENCO. The delivery time can be shortened down to 3 working days in accordance with the above mentioned persons (additional charge). The delivery time for DAkkS-calibrations is 10 weeks after the arrival at FRENCO. Shorter delivery time on request.

Documentation

For each measured object a inspection certificate is issued, which contains:

- the object data, the specified and the actual size and the final appreciation on the front page
- depending on the scope of the order the diagrammed measuring results of the inspection machines with profile and helix trace, pitch and runout on the inner pages
- an index of the used abbreviations, the traceability and the measuring uncertainty on the back page.

Delivery

We ask you to send the measuring instruments for FRENCO free of charge in a for measuring instruments reasonable packing. The delivery from FRENCO back to you is carried out by a parcel service (on request by one of your choice).
Inspection of parts

The gear and spline on workpieces can be inspected in different ways:

- inspection of the individual form on the measuring machine (profile, helix trace, pitch, runout)
- double flank gear rolling inspection on a FRENCO double flank gear rolling inspection machine. Thereby it is mandatory to provide the proper master gear.

Within the individual form inspection as well external and internal gears and splines as involute, serration and stright sided gears and splines can be measured.

- Max. diameter of the workpieces: 400mm (worm gears 260mm)
- Max. length of workpieces: 650mm
- Max. vertical measuring range: 500mm
- Min. module: 0.3 (0.2 external gears and splines)

Additional measurements:

- Position of functional faces (circles, cylinder, plane faces etc.) referring to the axis of spline
- Topography of singular teeth, by measuring multiple profiles per tooth
- Roughness and contour measurements
Every customer can retrieve the certificate for all wear inspections and inspections of parts calibrated by FRENCO from our homepage as pdf-file. A detailed description can be found on our homepage www.frenco.de.

Before destroying the paper certificate please save the record ID and the order number. Without these codes the online certificate cannot be retrieved.
The FRENCO calibration laboratory has been accredited according to EN ISO/IEC 17025 (Registry No. D-K-15199-01-00) by the „Deutsche Akkreditierungsstelle“ of all principal features (DKD-K-27401).

Thus not only helical and involute artefacts can be calibrated but also pitch artefacts and gears with pitch, runout and size between measuring circles.

This accreditation is valid for measurement ranges, which are demanded most frequently. For details concerning our range of accreditation see [http://www.dakks.de/en/node/1155](http://www.dakks.de/en/node/1155).

Artefacts not being within this range can be calibrated as working standard calibration.

As result you receive a calibration certificate containing explanations concerning the measuring process, specifications to determine the position of the object to be measured and of course the measuring uncertainty.
... and IC-artefacts

The smallest ascertainable measuring uncertainty depends on the size of the artefact. For DAkkS-calibrations it ranges as follows:

<table>
<thead>
<tr>
<th></th>
<th>U (k=2)</th>
<th>U (k=2)</th>
<th>U (k=2)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Profile</strong></td>
<td>$F_a$: 1.5 - 2.3 \mu m</td>
<td>$f_{ha}$: 1.0 - 2.0 \mu m</td>
<td>$f_{ta}$: 1.0 \mu m</td>
</tr>
<tr>
<td><strong>Helix</strong></td>
<td>$F_b$: 1.7 - 2.3 \mu m</td>
<td>$f_{hb}$: 1.3 - 2.1 \mu m</td>
<td>$f_{tb}$: 1.0 \mu m</td>
</tr>
<tr>
<td><strong>Pitch/runout</strong></td>
<td>$F_p$: 0.7 \mu m</td>
<td>$f_p$: 0.6 \mu m</td>
<td>$F_r$: 1.0 \mu m</td>
</tr>
<tr>
<td><strong>Size over measuring circle</strong></td>
<td>$M_{dk}$: 1.5 – 1.9 \mu m</td>
<td></td>
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</tbody>
</table>
**u\textsubscript{PM} – Certificate for measuring instruments of series V**

On request FRENCO issues an \( u\text{\textsubscript{PM}}\) - certificate for all measuring instruments of the series V (instruments for size inspection). This certificate is laid out according to VDA 5 and contains the measuring uncertainty of the measuring system. That eases the determination of the measuring uncertainty of the inspection process according to VDA 5, because the value of the measuring uncertainty just has to be applied. Moreover characteristic values like \( Q\text{\textsubscript{MS}}, TOL\text{\textsubscript{MIN-UMS}}, C\text{\textsubscript{g}} \) and \( C\text{\textsubscript{gK}} \) which are also an indicator for the quality of your measuring instrument, are listed on the certificate.

**Uncertainty \( U\text{\textsubscript{MS}} \) of the measuring system according to VDA 5**

- \( U_{\text{RE}} \)
- \( U_{\text{CAL}} \)
- \( U_{\text{EVR}} \)
- \( U_{\text{LIN}} \)
- \( U_{\text{REST}} \)
Deviation analysis

The measuring results are digitally filed and can be used in an analysis program for gears and splines. This program features:

- Changes of the position of axis
- Multiple measuring results can be overlaid for comparisons
- Display depending on the tooth thickness
- Correction of the settings of the manufacturing machine (profile grinding)
- Detection of disturbances in the production process,
- Simulation of changes of the datas of gears and splines
- Generation of new data of gear and spline

This analysis program helps to understand correlations, to appreciate disturbances and to detect failure causes. Moreover it features the possibility of a quick change of gear and spline data and many different ways of display them. The most important feature is, that the print of the analysis is like a measuring result and so the user can immediately understand it.
Frenco product range

**High precision gears and splines H**
- Gear and spline gauges
- Master gears, master wheels
- Artefacts, masters
- Punches, dies & electrodes
- Profiled clamping systems
- Gear and spline manufacture

**Rotation measuring systems R**
- Measuring systems with measuring circles
- Multiple inspector
- Gear flank analysing
- Linear gear flank analyser rack
- Gear flank analyser
- Double flank gear roll inspection

**Instruments for size inspection series V**
- Measuring pins and balls
- Gauges, rocking Type
- Gauges with face stop
- Gauges, gear & spline profiles
- Circumferential backlash measuring instrument
- Customized solutions

**Gear & spline inspection P**
- DAkkS- calibration
- Monitoring of inspection equipment
- Workpiece inspections
- Analysis of deviations

**Know-how transfer K**
- Software
- Training, seminars, workshops
- Consulting and calculations
- Literature and documentations
- National and international standards

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