Kalibrierschein / Calibration Certificate

erstellt durch das Kalibrierlaboratorium

issued by the calibration laboratory

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Deutsche Akkreditierungsstelle D-K-15199-01-00

Kalibrierzeichen *Calibration mark*	004711
	D-K-15199-01-00
	2019-12

Gegenstand *Object*	**IC-Normal B für Profil, Flankenlinie, Teilung, Rundlauf und MdK**
Hersteller *Manufacturer*	**FRENCO GmbH** **Jakob-Baier-Straße 3** **90518 Altdorf**
Typ *Type*	**d = 84 mm; ß = 0°**
Z. B. Serien- oder Prüfmittel-Nr. *Serial number*	**04711 02 01 07**
Kunden- oder Eigentümerdaten *Customer*	-
Auftragsnummer *Order No.*	**20209999**
Anzahl der Seiten des Kalibrierscheines *Number of pages of the certificate*	**7**
Datum der Kalibrierung *Date of calibration*	**12.08.2020**

Dieser Kalibrierschein dokumentiert die metrologische Rückführbarkeit auf nationale Normale zur Darstellung der Einheiten in Übereinstimmung mit dem Internationalen Einheitensystem (SI).
Die DAkkS ist Unterzeichner der multilateralen Übereinkommen der European co-operation for Accreditation (EA) und der International Laboratory Accreditation Cooperation (ILAC) zur gegenseitigen Anerkennung der Kalibrierscheine.
Für die Einhaltung einer angemessenen Frist zur Wiederholung der Kalibrierung ist der Benutzer verantwortlich.

This calibration certificate documents the metrological traceability to national standards, which realize the units of measurement according to the International System of Units (SI).
The DAkkS is signatory to the multilateral agreements of the European co-operation for Accreditation (EA) and of the International Laboratory Accreditation Cooperation (ILAC) for the mutual recognition of calibration certificates.
The user is obliged to have the object recalibrated at appropriate intervals.

Datum der Ausstellung *Date of issue*	Freigabe des Kalibrierscheins durch *Approval of the certificate of calibration by*	Bearbeiter *Person in charge*
14.08.2020	Dipl. –Ing. (FH) J. Kühl	G. Werner

These pages of the calibration certificate have been translated from the German original. In case of any doubts or disputes, please refer to the German certificate.

1. Profile and helix trace

1.1 Calibration method

The gear artefact was calibrated on a gear inspection device whose deviations were determined via a measuring task specific calibration with PTB calibrated artefacts in order to correct the measured values for F_{α}; $f_{H\alpha}$ as well as F_{β} and $f_{H\beta}$ (PTB: National Metrology Institute of Germany).

1.2 Measurement conditions

The reference axis was determined during the calibration of the gear artefact through the centres of 2 circles.
These circles were located 23.0mm (upwards) and 148.0mm (downwards) from the measuring plane on the surface area of 2 cylinders with a diameter of 58.0mm.

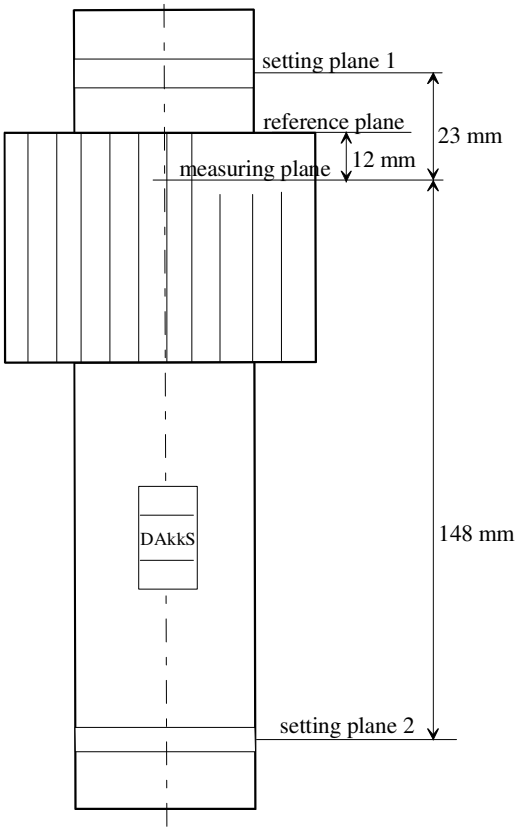

Figure 1: Position of the reference plane and the measuring plan

The reference plane of the artefact is the end face of the gear where the teeth are marked (Figure 1). The regression lines were laid through the graphs in accordance with the method of the smallest error square sum.

The helix inspections were carried out in the transverse plane on the measuring cylinder d_M = 84.000 mm in the right-hand flank position (unfiltered) with a probe ball diameter of 1.5 mm. The evaluation area of the helix trace L_{β} was situated symmetrically to the centre of the facewidth.

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The involute areas from root to tip were touched in the measuring planes, during profile inspection. Calibration was carried out in the right-hand flank position (unfiltered). The probe ball diameter was 1.5 mm.

Used gear data and evaluation areas

Helix angle ß [°]	Number of teeth	module m_n [mm]	pressure-angle α [°]	Base circle diameter d_b [mm]	Root rolling length L_f [mm]	Tip rolling length L_a [mm]	Profile inspection area L_α [mm]	Helix inspection area [mm]	Evaluation area for $f_{h\beta}$ [mm]
0	42	2.0000	17.5000	80.1122	9.2	18.2	9.0	60.0	48.0

1.3 Ambient temperatures

The room temperature in which the inspections were carried out was between 20.0°C and 20.2°C

1.4 Measurement results

The measurement results are shown in the table below. They are mean values taken from several inspections.

Helix

Helix angle ß [°]	Flank number	Helix total deviation $F_ß$ [µm]	Helix angle deviation $f_{Hß}$ [µm]	Helix form deviation $f_{fß}$ [µm]
0	1R	0.7	r 0.4	0.5
0	2L	1.2	r 1.1	0.3

The total helix deviations $F_ß$ and the helix angle deviations $f_{Hß}$, as shown in the table above, have been corrected with the measuring machine deviation as determined in advance. Measurements outside of evaluation range have not been evaluated. Diagrams attached show uncorrected examples (attachment, sheet 1).

Profile

Helix angle ß [°]	Flank number	Profile total deviation $F_α$ [µm]	Profile Base circle deviation $f_{Hα}$ [µm]	Profile form deviation $f_{fα}$ [µm]
0	1R	1.7	-1.2	1.1
0	2L	1.3	0.2	1.3

The total profile deviation $F_α$ and the profile slope deviations $f_{Hα}$ as shown in the table above, have been corrected with the measuring machine deviation as determined in advance. Measurements outside of evaluation range have not been evaluated. Diagrams attached show uncorrected examples (attachment, sheet 1).

1.5 Measurement uncertainty

The following table shows the expanded measurement uncertainties of the above mentioned measurement results.

Helix

Helix angle ß [°]	Measurement uncertainty U of $F_{ß}$ [µm]	Measurement uncertainty U of $f_{Hß}$ [µm]	Measurement uncertainty U of $f_{fß}$ [µm]
0	1.3	1.1	0.7

Profile

Helix angle ß [°]	Measurement uncertainty U of F_{α} [µm]	Measurement uncertainty U of $f_{H\alpha}$ [µm]	Measurement uncertainty U of $f_{f\alpha}$ [µm]
0	1.5	1.4	0.6

The expanded measuring uncertainty as shown above is calculated from the standard measuring uncertainty multiplied by the expansion factor k = 2. It was determined according to DAkkS-DKD-3. The value of the measured variable is within a probability of 95% in the assigned value interval.

2. Pitch and Runout

2.1 Calibration method

Pitch and runout of the gear artefact type B was calibrated on a gear inspection device by using the rosette-procedure. This is an error separation process which is self-traceable.

2.2 Measurement conditions

The reference axis was determined like described under section 1.2. The position of the reference planes and the measuring plan see figure 1.

The pitch inspection were carried out on the measuring cylinder = 84.000 mm with a probe ball diameter of 1.5 mm.

The runout deviations were calculated from the space width of the pitch measuring points considering a ball diameter of 3.500 mm.

2.3 Ambient temperatures

The room temperature in which the inspections were carried out was between 19.9°C and 20.1 °C .

2.4 Measurement results and measurement uncertainty

The following table shows the measurement results and the expanded measurement uncertainties.

	Left flank in µm	Right flank in µm	U in µm
f_p	0.3	0.7	0.6
F_p	0.7	1.4	0.7
F_r	1.5		1.0

Attachment 3 shows the graphic.

The expanded measuring uncertainty as shown above is calculated from the standard measuring uncertainty multiplied by the expansion factor k = 2. It was determined according to EA-4/02 M:2013-3. The value of the measured variable is within a probability of 95% in the assigned value interval.

3. DOB (Dimension over balls)

3.1 Calibration method

The dimension over measuring circles of artefact B was determined with 2 balls on a length measuring device. The measurement was carried out as a differentiation measurement to a DAkkS-calibrated setting mandrel.

3.2 Measurement conditions

The dimension over measuring circle was determined with 2 balls of diameter 3.50060 mm and an Abbe-type length comparator. It was then converted to a ball diameter of 3.50000 mm, to 20.000°C and interpolated to a measuring force of 0N. The distance between the measuring plane and the reference plane is 12mm (figure 1).

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3.3 Measurement results

DOB

Helix angle ß [°]	Gap 1 consisting of flanks no.	Gap 2 consisting of flanks no.	DOB [mm]	Measurement uncertainty U [µm]
0	1R und 2L	22R und 23L	89.0184	1.2

The expanded measuring uncertainty as shown above is calculated from the standard measuring uncertainty multiplied by the expansion factor k = 2. It was determined according to EA-4/02 M:2013-3.The value of the measured variable is within a probability of 95% in the assigned value interval.

3.4 Ambient temperatures

The artefact temperature while inspections were carried out was between 20.1° C and 20.2°C.

4. Standards

All descriptions and evaluations are as per DIN ISO 21771 (2014), VDI/VDE 2607 (2000) and VDI 2613 (2003), the rule of signs as per VDI/VDE 2612 (2018) and the description of the flanks according to VDI 2613 (2003).

5. Recognition of DAkkS calibration certificates abroad

The Deutsche Akkreditierungsstelle GmbH is signatory to the multilateral agreements of the European co-operation for Accreditation (EA) and the International Laboratory Accreditation Cooperation (ILAC) for the mutual recognition of calibration certificates.

Further signatories within and outside Europe are found on the websites of EA (www.european-accreditation.org) and ILAC (www.ilac.org).

6. Traceability

Traceability is guaranteed by following artefacts calibrated by the PTB:

involute	involute artefact	09-012	50571 PTB 16	04.04.2016
helix	helix artefact	09-012	50571 PTB 16	04.04.2016

End of calibration certificate

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