Deutsche Akkreditierungsstelle GmbH

Annex to the Accreditation Certificate D-K-15199-01-00 according to DIN EN ISO/IEC 17025:2005

Period of validity: 15.09.2016 to 14.09.2021 Date of issue: 15.09.2016

Holder of certificate:

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

Head: Dipl.-Ing. (FH) Jan Kühl
Deputy: Jürgen Stellwag

Accredited as calibration laboratory since: 17.04.2000

Calibrations in the fields:

Dimensional quantities

Length

- **Gear quantities**

Abbreviations used: see last page

Permanent Laboratory

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Best measurement capability [1)]	Remarks
Length				
Gear quantities Involute artefact	Base diameter: d_b Evaluation range: L_α	Substitution measuring with gear devices:		External gears
F_α $f_{H\alpha}$ $f_{f\alpha}$	30 mm ≤ d_b ≤ 50 mm 10 mm ≤ L_α ≤ 16 mm	Correction of F_α,$f_{H\alpha}$ by comparision against involute artefact with	1.8 µm 1.4 µm 1.0 µm	Symbols according to ISO 1328-1:2013
F_α $f_{H\alpha}$ $f_{f\alpha}$	25 mm ≤ d_b ≤ 60 mm 7 mm ≤ L_α ≤ 18 mm	d_b = 40 mm L_α = 13 mm	2.0 µm 1.8 µm 1.0 µm	Evaluation according to guidelines
F_α $f_{H\alpha}$ $f_{f\alpha}$	80 mm ≤ d_b ≤ 120 mm 14 mm ≤ L_α ≤ 42 mm	Correction of F_α,$f_{H\alpha}$ by comparision against involute artefact with d_b = 93.96 mm L_α = 37 mm or with d_b = 100 mm L_α = 37 mm	1.4 µm 1.0 µm 0.9 µm	VDI/VDE 2607:2000 VDI/VDE 2612:2000
F_α $f_{H\alpha}$ $f_{f\alpha}$	60 mm ≤ d_b ≤ 130 mm 8 mm ≤ L_α ≤ 48 mm		1.7 µm 1.4 µm 0.9 µm	
F_α $f_{H\alpha}$ $f_{f\alpha}$	60 mm ≤ d_b ≤ 130 mm 20 mm ≤ L_α ≤ 53 mm		1.8 µm 1.5 µm 1.0 µm	
F_α $f_{H\alpha}$ $f_{f\alpha}$	8 mm ≤ d_b ≤ 150 mm L_α ≤ 74 mm	Measurement without correction; traceability proved by involute artefact with d_b = 100 mm, L_α = 37 mm or with d_b = 93.96 mm L_α = 37 mm	2.1 µm 1.8 µm 0.9 µm	

[1)] The best measurement capabilities are stated according to DAkkS-DKD-3 (EA-4/02). These are expanded uncertainties of measurement with a coverage probability of 95% and have a coverage factor of $k = 2$ unless stated otherwise. Uncertainties without unit are relative uncertainties referring to the measurement value unless stated otherwise.

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Best measurement capability [1)]	Remarks
Gear quantities Helix artefacts	Reference diameter: d Helix angle: β Evaluation range: L_β	Substitution measuring with gear devices:		External gears
F_β $f_{H\beta}$ $f_{f\beta}$	28 mm ≤ d ≤ 36 mm 10° ≤ β ≤ 20° 34 mm ≤ L_β ≤ 46 mm	Correction of F_β, $f_{H\beta}$ by comparision against helix artefact with	1.9 µm 1.6 µm 1.0 µm	Symbols according to ISO 1328-1:2013
F_β $f_{H\beta}$ $f_{f\beta}$	20 mm ≤ d ≤ 45 mm 10° ≤ β ≤ 20° 30 mm ≤ L_β ≤ 50 mm	d = 32 mm β = 15° r+l L_β = 40 mm	2.0 µm 1.8 µm 1.0 µm	Evaluation according to guidelines
F_β $f_{H\beta}$ $f_{f\beta}$	85 mm ≤ d ≤ 125 mm β = 0° 56 mm ≤ L_β ≤ 102 mm	Correction of F_β, $f_{H\beta}$ by comparision against helix artefact with	1.3 µm 0.9 µm 0.9 µm	VDI/VDE 2607:2000 VDI/VDE 2612:2000
F_β $f_{H\beta}$ $f_{f\beta}$	70 mm ≤ d ≤ 135 mm β = 0° 30 mm ≤ L_β ≤ 120 mm	d = 100 mm β = 0° β = 15° r+l β = 30° r+l L_β = 94 mm	1.5 µm 1.1 µm 0.9 µm	
F_β $f_{H\beta}$ $f_{f\beta}$	85 mm ≤ d ≤ 125 mm 10° ≤ β ≤ 20° 56 mm ≤ L_β ≤ 102 mm		1.4 µm 1.0 µm 0.9 µm	
F_β $f_{H\beta}$ $f_{f\beta}$	70 mm ≤ d ≤ 135 mm 7° ≤ β ≤ 23° 46 mm ≤ L_β ≤ 112 mm		1.6 µm 1.3 µm 0.9 µm	
F_β $f_{H\beta}$ $f_{f\beta}$	85 mm ≤ d ≤ 125 mm 25° ≤ β ≤ 35° 56 mm ≤ L_β ≤ 102 mm		1.5 µm 1.2 µm 0.9 µm	
F_β $f_{H\beta}$ $f_{f\beta}$	70 mm ≤ d ≤ 135 mm 23° ≤ β ≤ 37° 46 mm ≤ L_β ≤ 112 mm		1.7 µm 1.4 µm 0.9 µm	
F_β $f_{H\beta}$ $f_{f\beta}$	10 mm ≤ d ≤ 160 mm β = 0° 10 mm ≤ L_β ≤ 130 mm	Measurement without correction; traceability proved by involute artefact with d = 100 mm, L_β = 94 mm β = 0° β = 15° r+l β = 30° r+l	1.5 µm 1.2 µm 0.9 µm	
F_β $f_{H\beta}$ $f_{f\beta}$	10 mm ≤ d ≤ 160 mm 0° ≤ β ≤ 20° 10 mm ≤ L_β ≤ 130 mm		1.7 µm 1.4 µm 0.9 µm	
F_β $f_{H\beta}$ $f_{f\beta}$	10 mm ≤ d ≤ 160 mm 20° ≤ β ≤ 40° 10 mm ≤ L_β ≤ 130 mm		2.0 µm 1.7 µm 0.9 µm	

[1)] The best measurement capabilities are stated according to DAkkS-DKD-3 (EA-4/02). These are expanded uncertainties of measurement with a coverage probability of 95% and have a coverage factor of k = 2 unless stated otherwise. Uncertainties without unit are relative uncertainties referring to the measurement value unless stated otherwise.

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Best measurement capability [1)]	Remarks
Pitch and runout F_P f_P F_r	Reference diamater: d Normal module: M_n 5 mm ≤ d ≤ 350 mm M_n ≥ 0.5	According to „Rosette method“ on gear measuring device. To be carried out according to working instructions of the Laboratory QM	 0.7 µm 0.6 µm 1.0 µm	External gears Symbols according to ISO 1328-1:2013 Evaluation according to guidelines VDI/VDE 2613:2003
Dimension over balls M_{dK}	Dimension over balls: M_{dK} Helix angle: β Normal module: M_n M_{dK} ≤ 240 mm β = 0° M_n ≥ 0.5	Measurement of M_{dK} on length comparator compared to traceable setting standard in accordance with working instructions of the Laboratory QM	1.2 µm	
M_{dK}	M_{dK} ≤ 240 mm β ≥ 0° M_n ≥ 0.5		1.2 µm	

Abbreviations used:

VDI/VDE 2607/2612/2613 VDI-Guideline on gearing

β	Helix angle	F_p	Total pitch error
d	Reference diameter	f_p	Single pitch deviation
d_b	Base diameter	F_r	Runout error
F_α	Total profile deviation	L_α	Profile evaluation range
$f_{f\alpha}$	Profile form deviation	L_β	Helix evaluation range
F_β	Total helix deviation	M_{dK}	Dimension over balls
$f_{f\beta}$	Helix form deviation	M_n	Normal module
$f_{H\beta}$	Helix slope deviation	r+l	Right hand and left hand

[1)] The best measurement capabilities are stated according to DAkkS-DKD-3 (EA-4/02). These are expanded uncertainties of measurement with a coverage probability of 95% and have a coverage factor of $k = 2$ unless stated otherwise. Uncertainties without unit are relative uncertainties referring to the measurement value unless stated otherwise.