

Deutsche Akkreditierungsstelle GmbH

Annex to the Accreditation Certificate D-K-20427-01-00 according to DIN EN ISO/IEC 17025:2018

Valid from: 18.03.2020

Date of issue: 18.03.2020

Holder of certificate:

OPTOLUTION Messtechnik GmbH
Gewerbestraße 18, 79539 Lörrach

Calibration in the fields:

Thermodynamic quantities

- Thermal energy**
- Heat meters ^{a)}

Fluid quantities

- Liquid flow rate ^{a)}

^{a)} only on-site calibration

Abbreviations used: see last page

The certificate together with its annex reflects the status at the time of the date of issue. The current status of the scope of accreditation can be found in the database of accredited bodies of Deutsche Akkreditierungsstelle GmbH.
<https://www.dakks.de/en/content/accredited-bodies-dakks>

Annex to the accreditation certificate D-K-20427-01-00

On-site Calibration

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement ¹⁾	Remarks
Heat meters Flow sensors as part of heat meters and cooling meters: volume flow rate	20 m ³ /h to 30000 m ³ /h	LDV segment method Profile class „fully developed“ Profile coefficient: $0 \leq K_P \leq 1.0$ Asymmetry coefficient: $0 \leq K_A \leq 0.2$ Turbulence coefficient: $0.5 \leq K_{Tu} \leq 1.5$ Level of profile overlap: $K_D \geq 80\%$	0.7 %	Provision of optical access in empty unpressurised pipes or filled pressurised pipes Fluid temperature: 5 °C to 150 °C
	20 m ³ /h to 30000 m ³ /h	LDV segment method Profile class „symmetric“ (Profile coefficient · Asymmetry coefficient): $0 \leq (K_P \cdot K_A) \leq 1.0$ Turbulence coefficient: $0.5 \leq K_{Tu} \leq 1.5$ Level of profile overlap: $K_D \geq 85\%$	1.4 %	volumetric flow velocity of fluid: ≥ 0.3 m/s
	20 m ³ /h to 30000 m ³ /h	LDV segment method Profile class „slightly disturbed“ Profile coefficient: $0 \leq K_P \leq 9$ Asymmetry coefficient: $0 \leq K_A \leq 0.5$ Turbulence coefficient: $1.2 \leq K_{Tu} \leq 3.5$ Level of profile overlap: $K_D \geq 90\%$	2.3 %	
	20 m ³ /h to 30000 m ³ /h	LDV segment method Profile class „highly turbulent“ Profile coefficient: $1 \leq K_P \leq 12$ Asymmetry coefficient: $0 \leq K_A \leq 0.5$ Turbulence coefficient: $1.4 \leq K_{Tu} \leq 5.8$ Level of profile overlap: $K_D \geq 95\%$	2.7 %	
	20 m ³ /h to 30000 m ³ /h	LDV segment method Profile class „highly asymmetric“ Profile coefficient: $2 \leq K_P \leq 11$ Asymmetry coefficient: $0.5 \leq K_A \leq 5$ Turbulence coefficient: $1.4 \leq K_{Tu} \leq 6$ Level of profile overlap: $K_D \geq 95\%$	4.2 %	

¹⁾ The expanded uncertainties according to EA-4/02 M:2013 are part of CMC and are the best measurement uncertainties within accreditation. They have a coverage probability of approximately 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.

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On-site Calibration
Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement ¹⁾	Remarks
Liquid flow rate volume flow rate of flowing water	20 m ³ /h to 30000 m ³ /h	LDV segment method Profil class „fully developed“ Profile coefficient: $0 \leq K_p \leq 1.0$ Asymmetry coefficient: $0 \leq K_A \leq 0.2$ Turbulence coefficient: $0.5 \leq K_{Tu} \leq 1.5$ Level of profile overlap: $K_D \geq 80 \%$	0.7 %	Provision of optical access in empty unpressurised pipes or filled pressurised pipes Fluid temperature: 5 °C to 150 °C
	20 m ³ /h to 30000 m ³ /h	LDV segment method Profil class „symmetric“ (Profile coefficient · Asymmetry coefficient): $0 \leq K_p \cdot K_A \leq 1.0$ Turbulence coefficient: $0.5 \leq K_{Tu} \leq 1.5$ Level of profile overlap: $K_D \geq 85 \%$	1.4 %	volumetric flow velocity of fluid: ≥ 0.3 m/s
	20 m ³ /h to 30000 m ³ /h	LDV segment method Profil class „slightly disturbed“ Profile coefficient: $0 \leq K_p \leq 9$ Asymmetry coefficient: $0 \leq K_A \leq 0.5$ Turbulence coefficient: $1.2 \leq K_{Tu} \leq 3.5$ Level of profile overlap: $K_D \geq 90 \%$	2.3 %	
	20 m ³ /h to 30000 m ³ /h	LDV segment method Profil class „highly turbulent“ Profile coefficient: $1 \leq K_p \leq 12$ Asymmetry coefficient: $0 \leq K_A \leq 0.5$ Turbulence coefficient: $1.4 \leq K_{Tu} \leq 5.8$ Level of profile overlap: $K_D \geq 95 \%$	2.7 %	
	20 m ³ /h to 30000 m ³ /h	LDV segment method Profil class „highly asymmetric“ Profile coefficient: $2 \leq K_p \leq 11$ Asymmetry coefficient: $0.5 \leq K_A \leq 5$ Turbulence coefficient: $1.4 \leq K_{Tu} \leq 6$ Level of profile overlap: $K_D \geq 95 \%$	4.2 %	

Abbreviations used:

CMC Calibration and measurement capabilities
 LDV Laser doppler velocimetry

¹⁾ The expanded uncertainties according to EA-4/02 M:2013 are part of CMC and are the best measurement uncertainties within accreditation. They have a coverage probability of approximately 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.