IFA
Institut für Arbeitsschutz der
Deutschen Gesetzlichen Unfallversicherung

“MUST“ – A tool for the determination of measurement uncertainty and more

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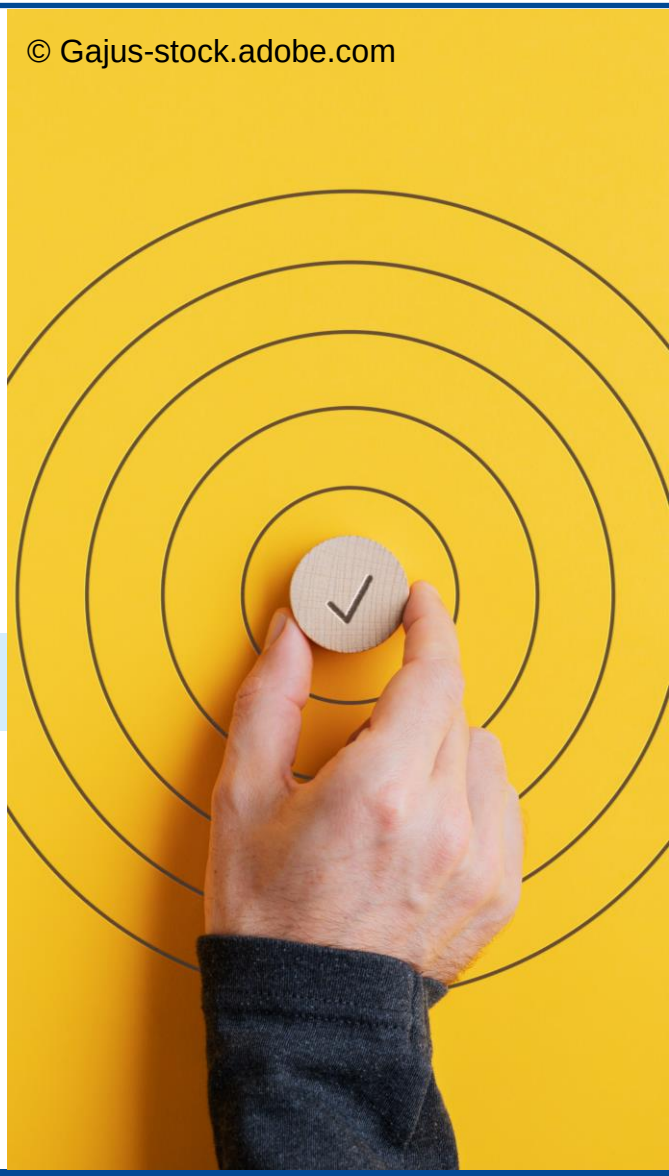
What is measurement uncertainty? Why do we need it?

- True value is unknown
- Measurement value is an estimate influenced by factors
- The uncertainty:
  - parameter associated with the result to a measurement
  - characterized by the variance contributed to a measurement parameter



Why do we need measurement uncertainty?

- Customer request
- Legal regulation (comparison to OELV)
- Accreditation (ISO 17025)
- Comparison with other laboratories and improvement of the measurement method

Standards, Regulations and Sources

- **ISO/IEC Guide 98-3 Uncertainty of measurement – Part 3: Guide to the expression of uncertainty in measurement (GUM)**
- EN 482:2021 Workplace exposure – Procedures for the determination of the concentration of chemical agents – basic performance requirements
- ISO 20581:2016 Workplace air – General requirements for the performance of procedures for the measurement of chemical agents
- ISO 21832:2020 Workplace air – Metals and metalloids in airborne particles – Requirements for evaluation of measuring procedures
- ISO 22065:2021 Workplace air – Gases and vapours – Requirements for evaluation of measuring procedures using pumped samplers
- ISO 23861: Workplace air - Chemical agent present as a mixture of airborne particles and vapour - Requirements for evaluation of measuring procedures

Basic requirements to measurement uncertainty

According to EN 482 and ISO 20581

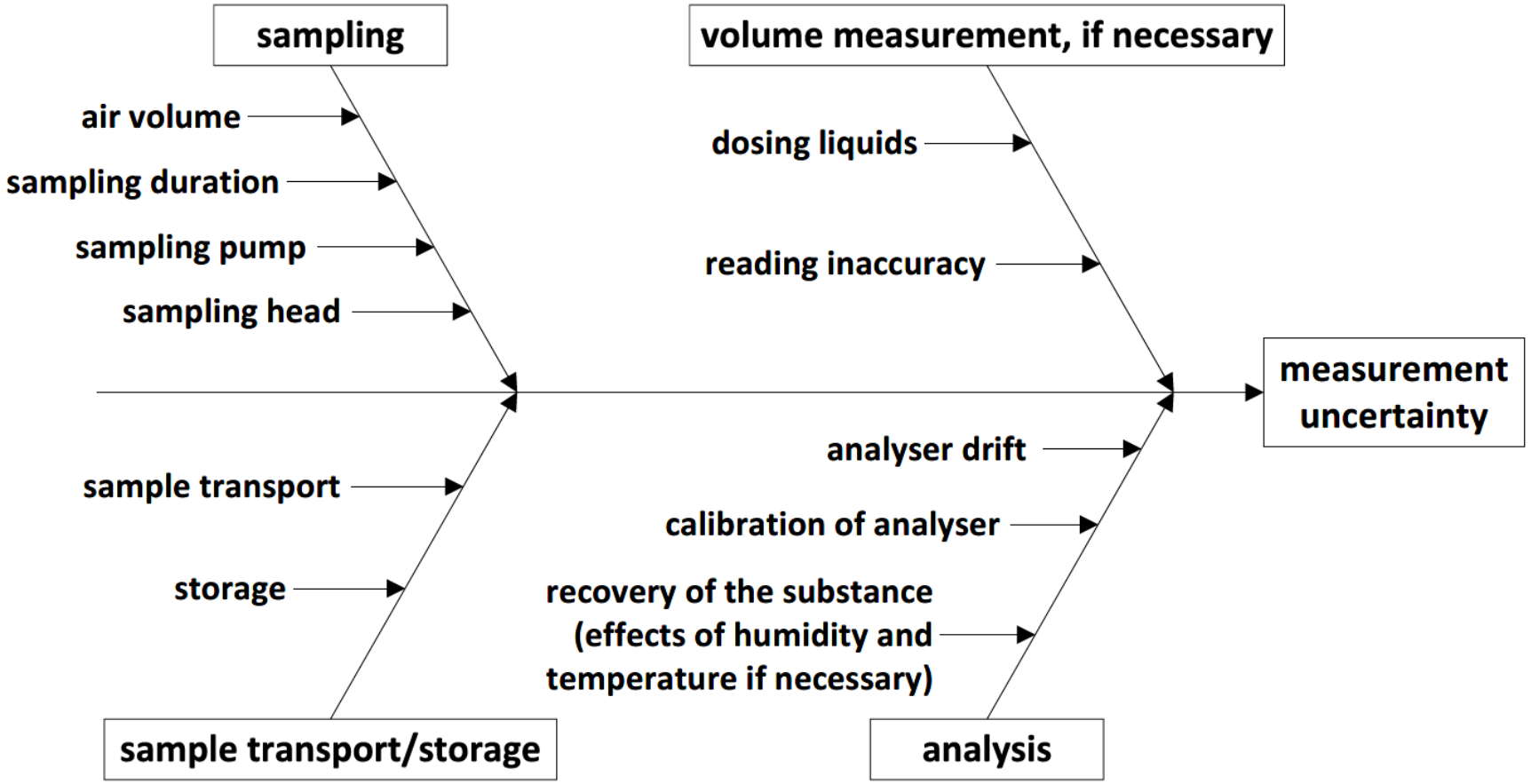
Minimum measuring ranges

- Health-based limit values (shift average): 0.1 – 2 LV
- Risk-based limit values (in Germany): 0.2 AK (acceptable risk) – 2 TK (tolerable risk)

Expanded measurement uncertainty (U) for the measurement method:

- U ≤ 50 % 0.1 – 0.5 LV (0.2 AK – 1 AK)
- U ≤ 30 % 0.5 – 2 LV (1 AK – 2 TK)
- U ≤ 50 % for mixtures of particles and vapor

What data is required?



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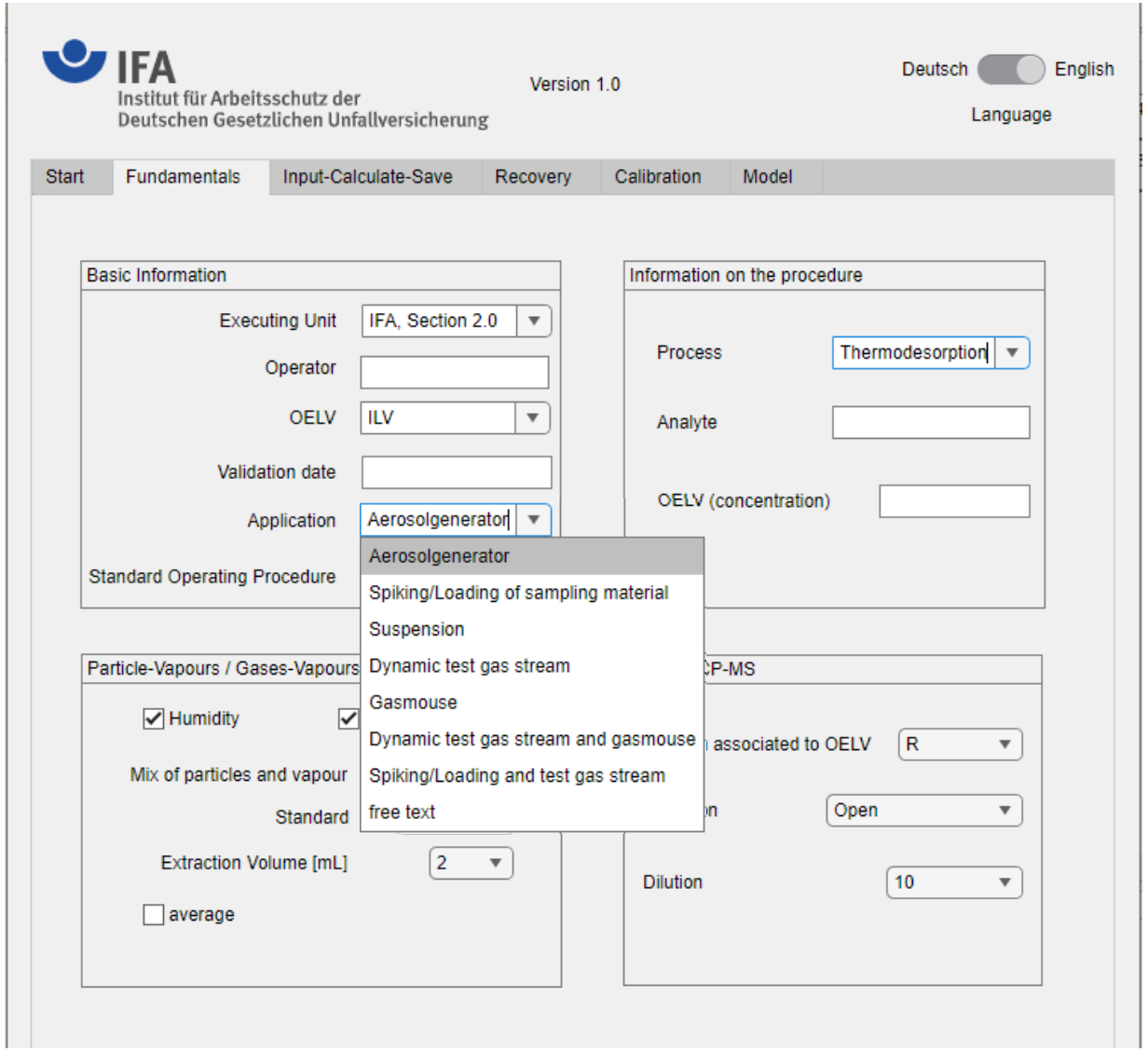
Basic Information

- Information on validation / person / date
- Type of OELV
- Application

Extraction/Thermodesorption or Metals with ICP-MS



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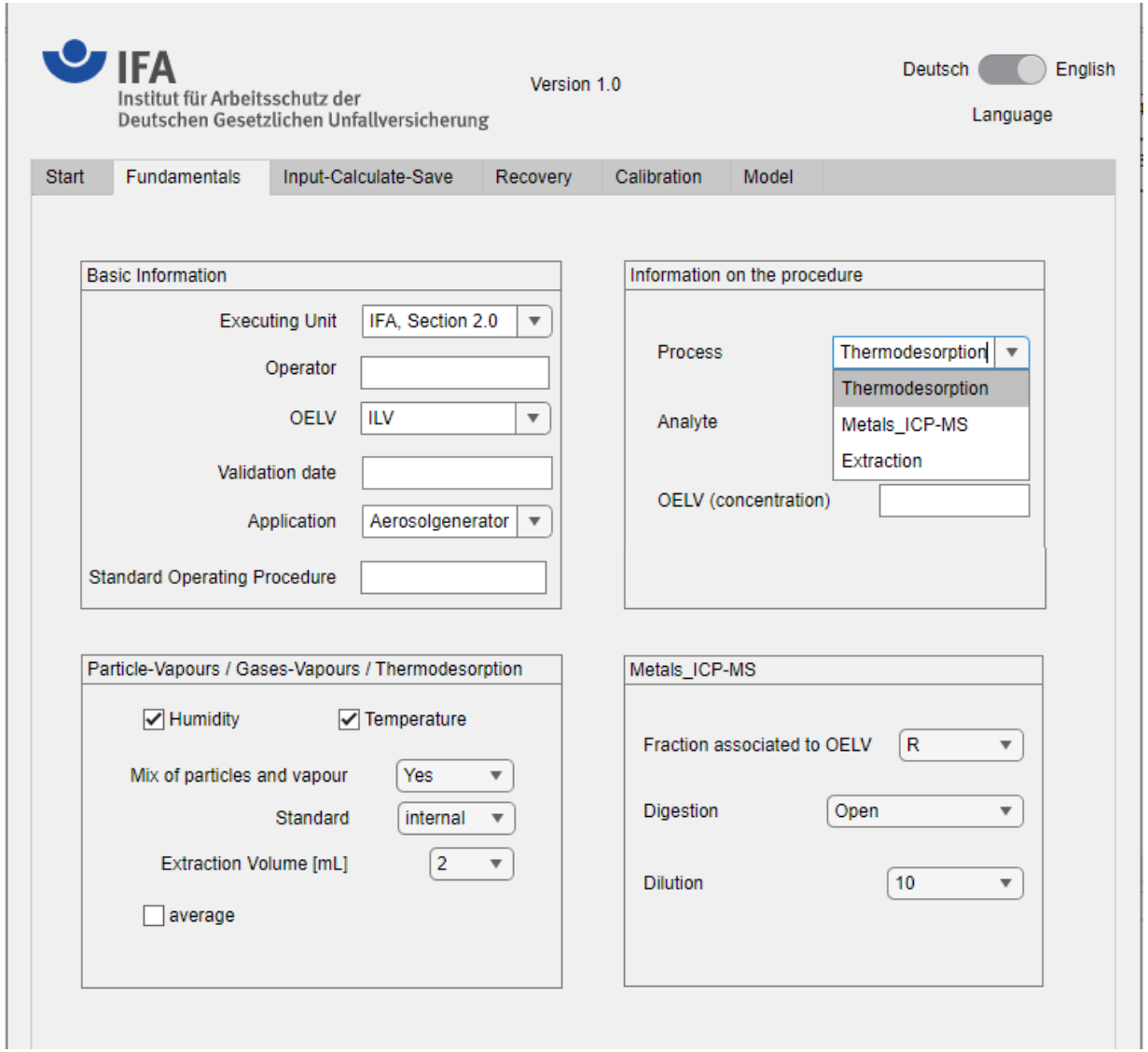
Basic Information

Procedure / Method

- Method (3 different types to chose from)
- Analyte (documentation)
- OELV (documentation)

- Depending on method
- Extraction: humidity/temperature if necessary; volume
- Metals: sampling head, digestion method, dilution factor



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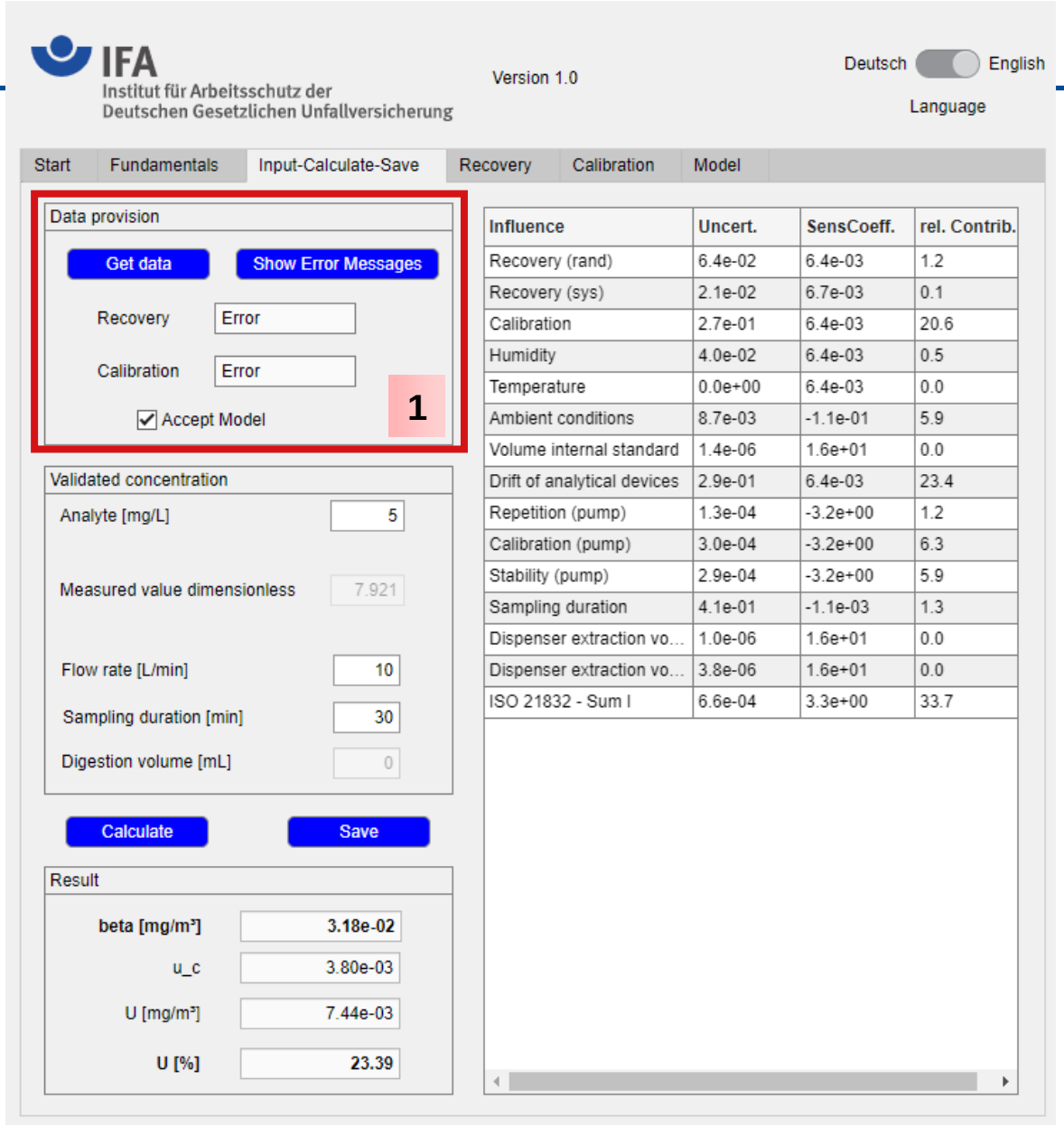
1 Data provision

- Load data

Influence factors

Concentration

Result of calculation



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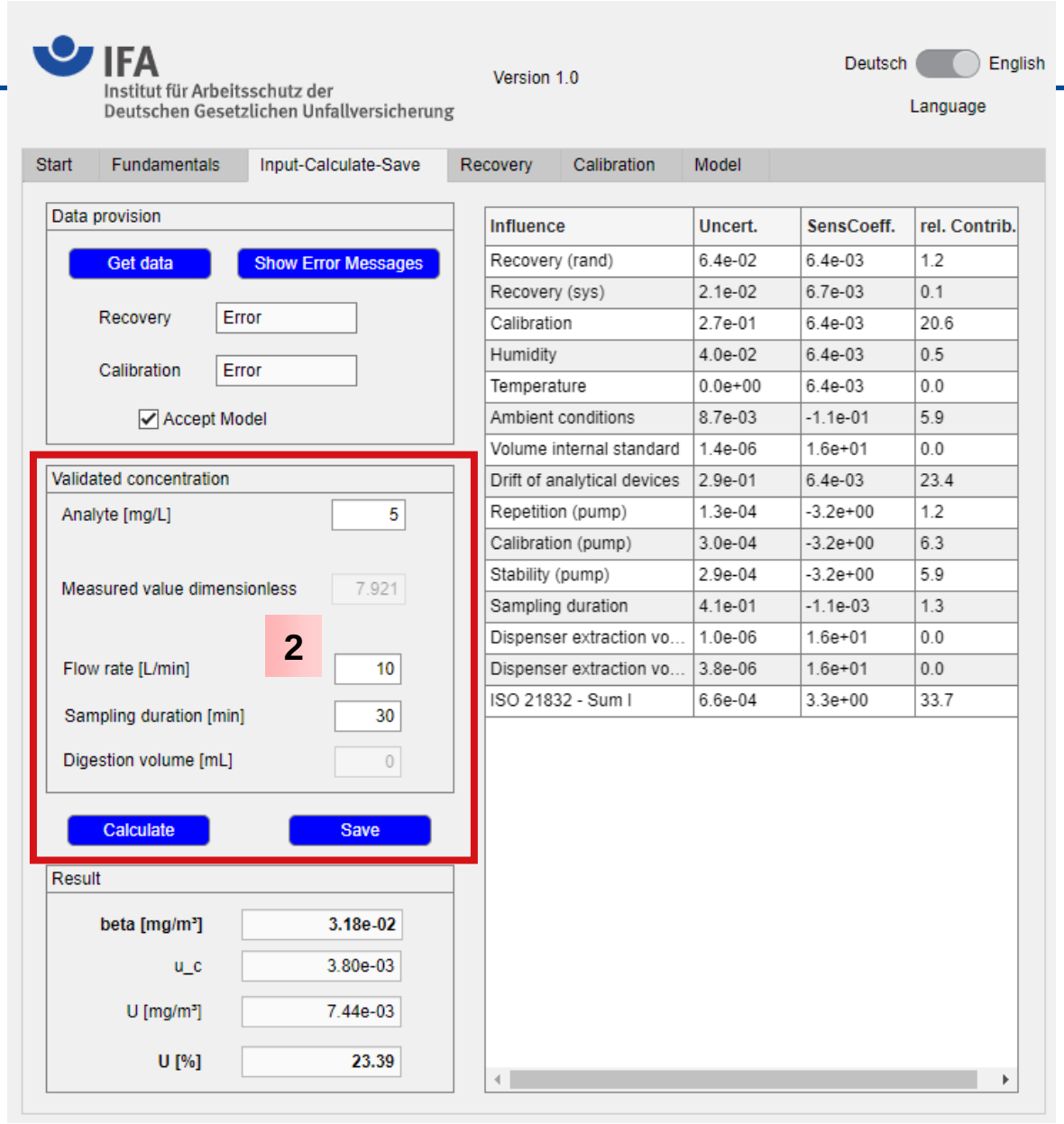
Data provision

2 Concentration

Parameters of measurement or validation

Influence factors

Result of calculation



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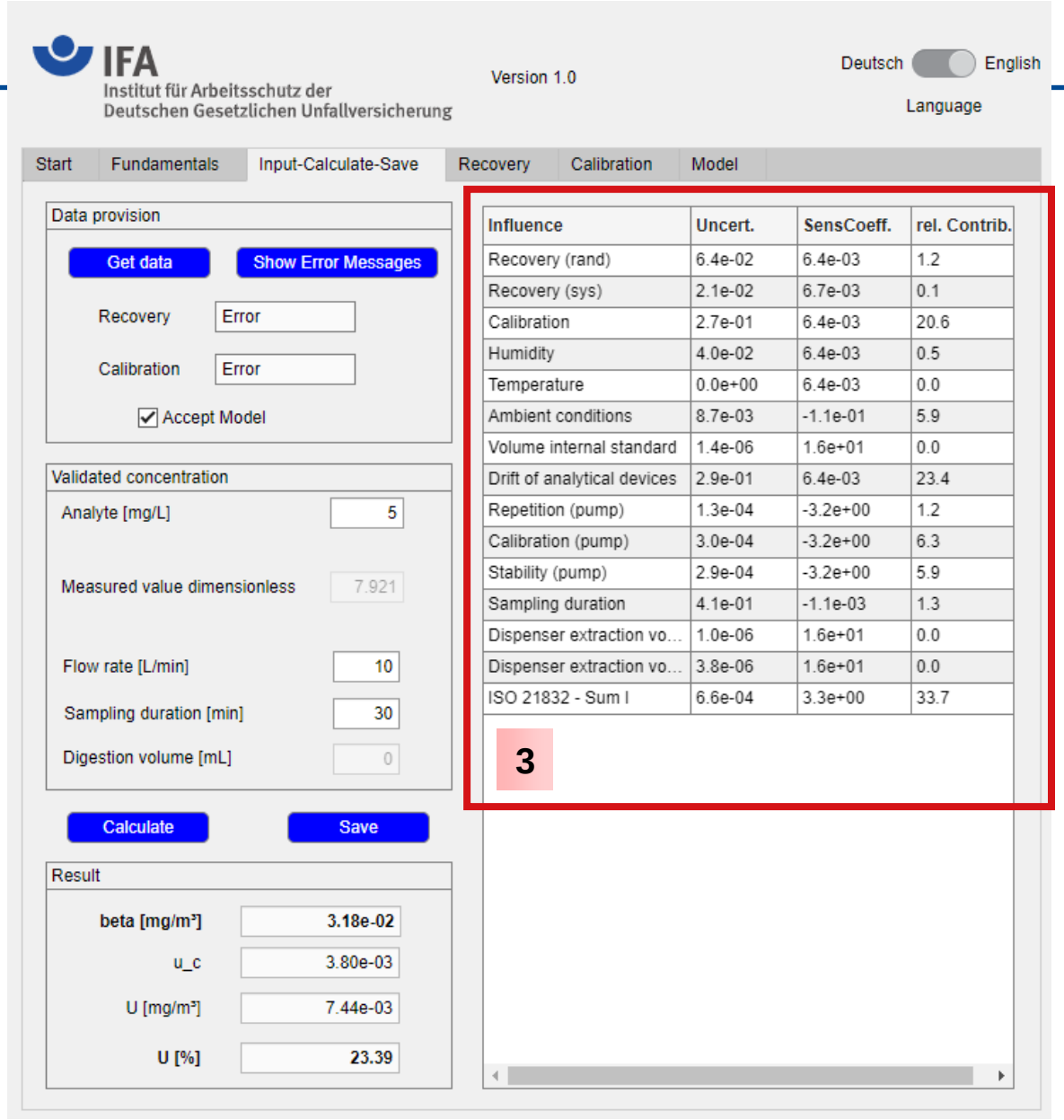
Data provision

Concentration

3 Influence Factors

- Factors

Result of calculation



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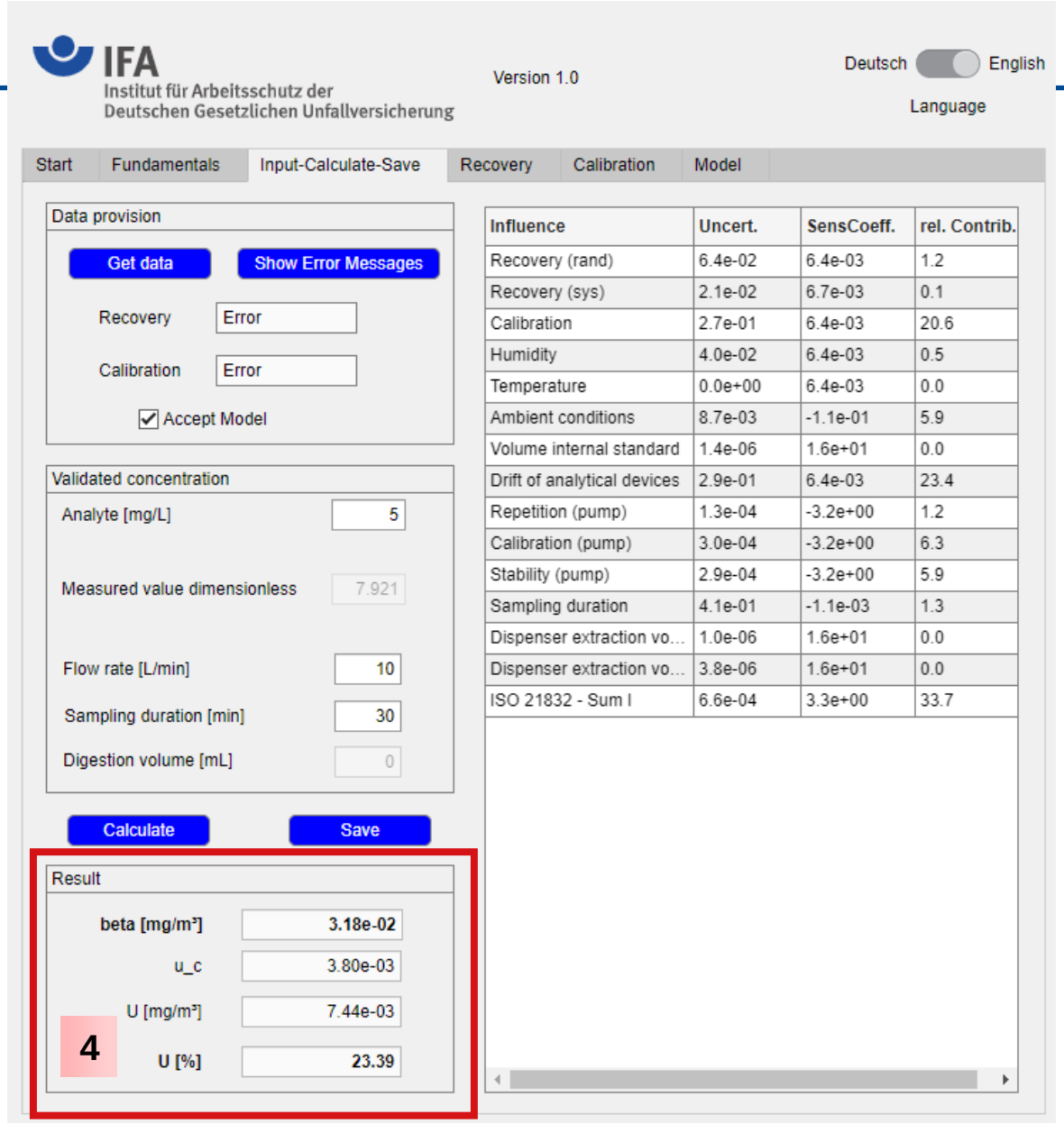
Data provision

Influence factors

Concentration

4 Result of calculation

- *ß:* corrected measuremet value
- *u_c:* combined standard uncertainty
- *U:* expanded measurement uncertainty



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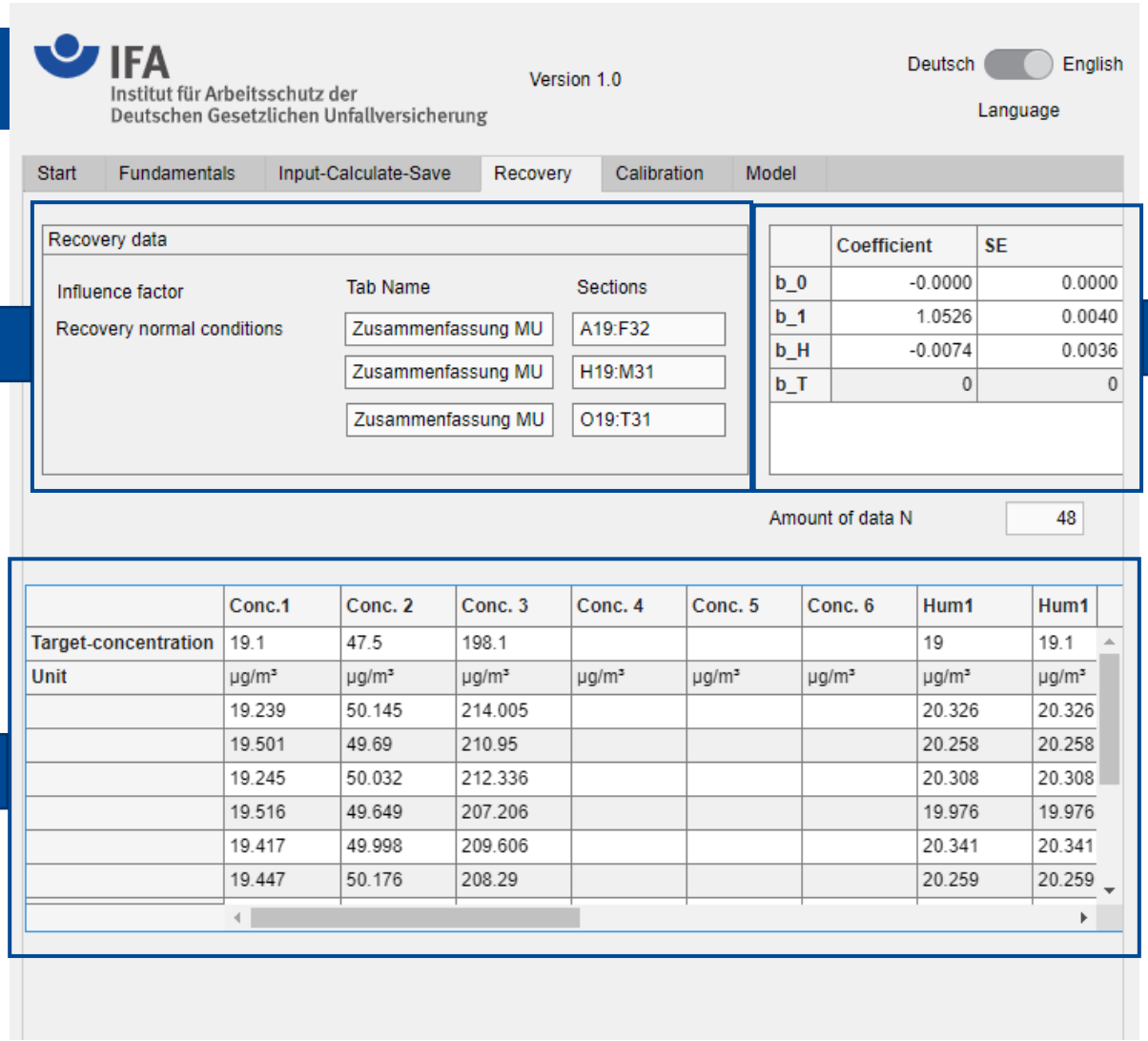
Recovery



source

regression coefficients

measurement values

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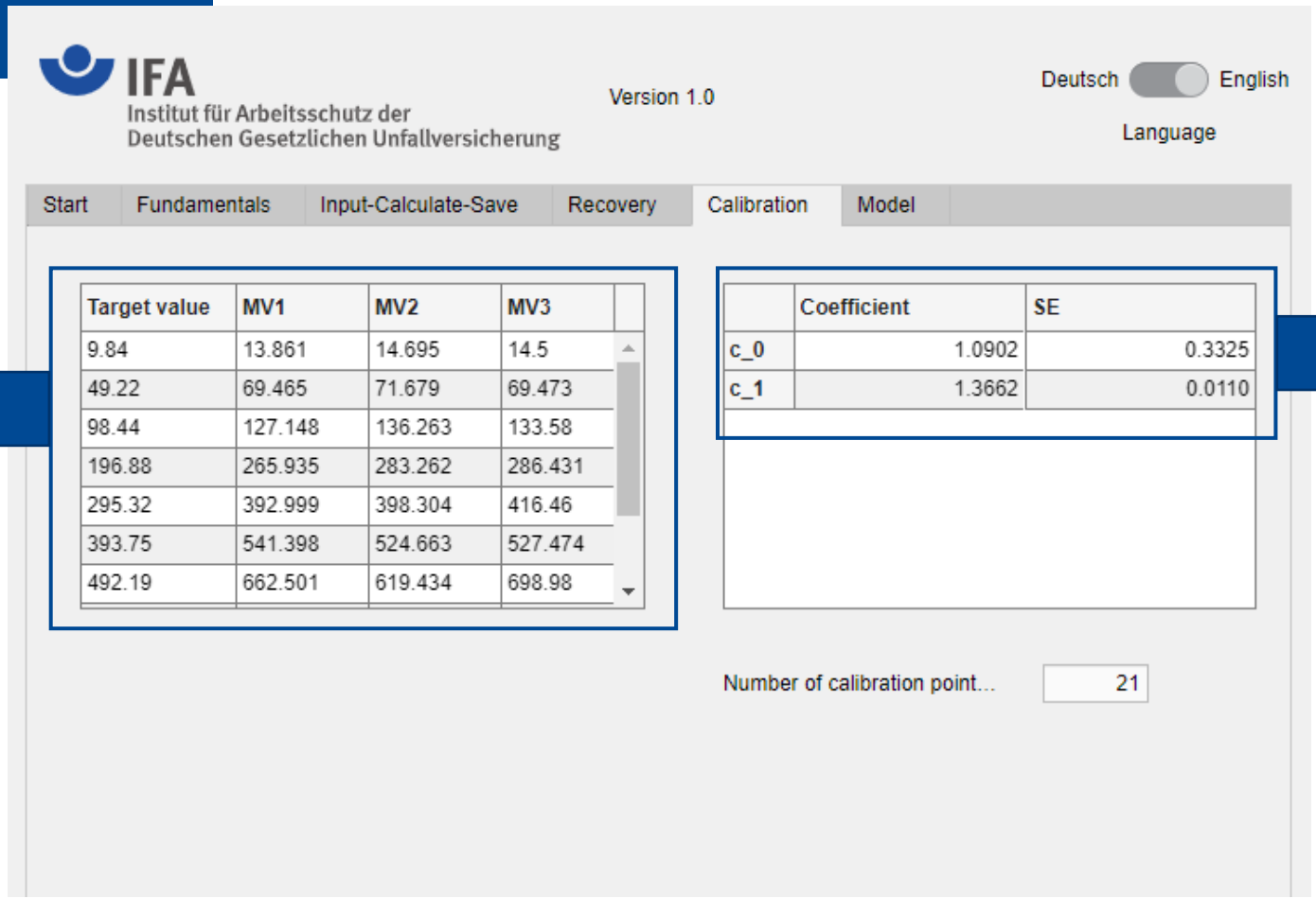
Calibration

calibration data



regression coefficients

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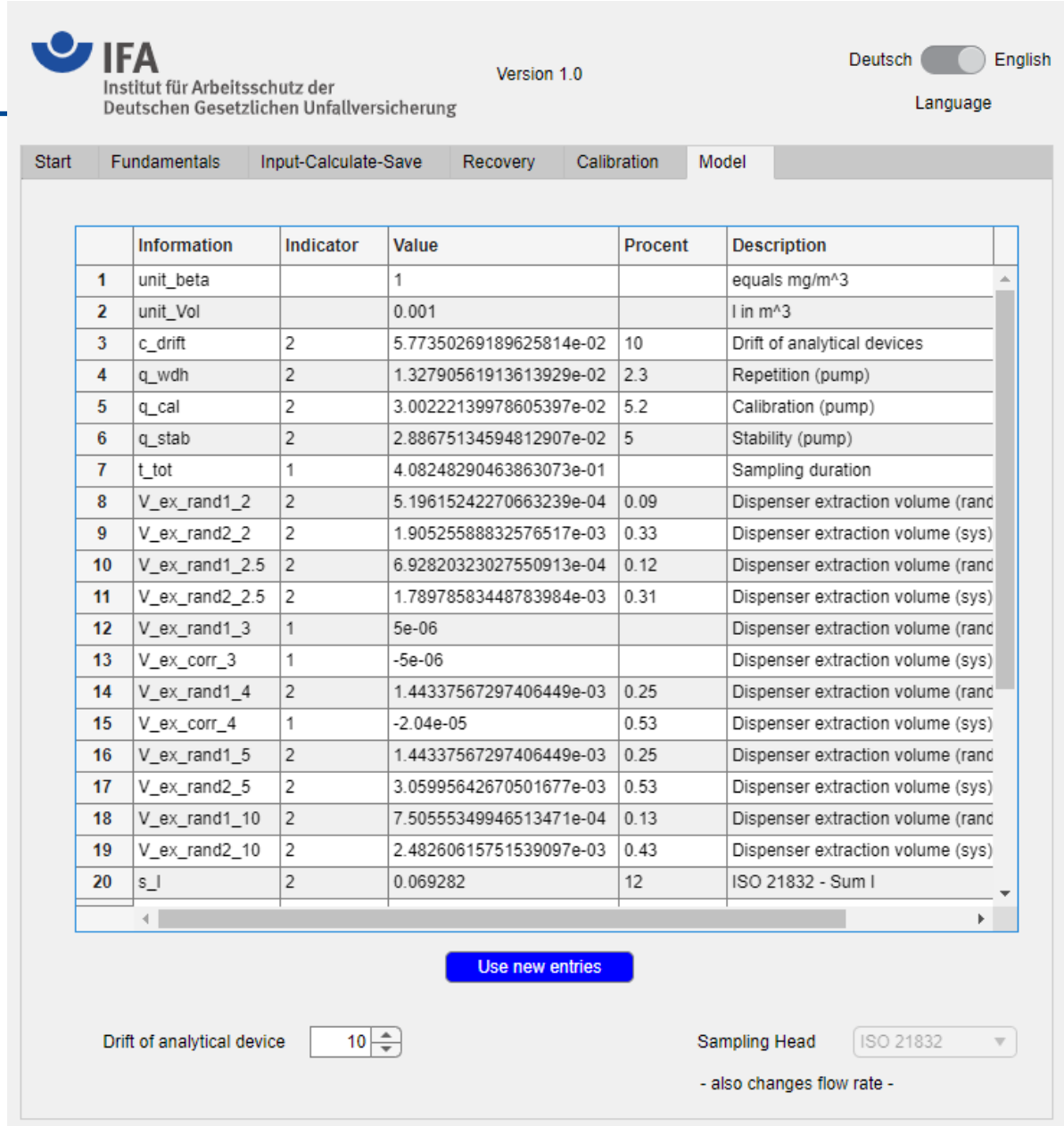
Model Datasheet

- Name of parameter
- Value of uncertainty with sensitivity coefficient
- Percent as given in standards or other sources (changeable)
- Description

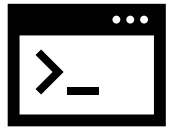


	Information	Indicator	Value	Procent	Description
1	unit_beta		1		equals mg/m^3
2	unit_Vol		0.001		l in m^3
3	c_drift	2	5.77350269189625814e-02	10	Drift of analytical devices
4	q_wdh	2	1.32790561913613929e-02	2.3	Repetition (pump)
5	q_cal	2	3.00222139978605397e-02	5.2	Calibration (pump)
6	q_stab	2	2.88675134594812907e-02	5	Stability (pump)
7	t_tot	1	4.08248290463863073e-01		Sampling duration
8	V_ex_rand1_2	2	5.19615242270663239e-04	0.09	Dispenser extraction volume (ranc
9	V_ex_rand2_2	2	1.90525588832576517e-03	0.33	Dispenser extraction volume (sys)
10	V_ex_rand1_2.5	2	6.92820323027550913e-04	0.12	Dispenser extraction volume (ranc
11	V_ex_rand2_2.5	2	1.78978583448783984e-03	0.31	Dispenser extraction volume (sys)
12	V_ex_rand1_3	1	5e-06		Dispenser extraction volume (ranc
13	V_ex_corr_3	1	-5e-06		Dispenser extraction volume (sys)
14	V_ex_rand1_4	2	1.44337567297406449e-03	0.25	Dispenser extraction volume (ranc
15	V_ex_corr_4	1	-2.04e-05	0.53	Dispenser extraction volume (sys)
16	V_ex_rand1_5	2	1.44337567297406449e-03	0.25	Dispenser extraction volume (ranc
17	V_ex_rand2_5	2	3.05995642670501677e-03	0.53	Dispenser extraction volume (sys)
18	V_ex_rand1_10	2	7.50555349946513471e-04	0.13	Dispenser extraction volume (ranc
19	V_ex_rand2_10	2	2.48260615751539097e-03	0.43	Dispenser extraction volume (sys)
20	s_l	2	0.069282	12	ISO 21832 - Sum l

Required Datafiles

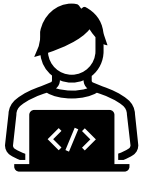
- “MUST” (.exe) can be downloaded from IFA-website for free: https://mustdownload.ifa.dguv.de/

- Download is about 2.5 GB (background: MATLAB runtime environment); folder includes datasheets for validation data



- User manual (GER/ENG) will follow in September 2023 at the website: https://www.dguv.de/ifa/praxishilfen/hazardous-substances/software-must/index.jsp

- Help, Support and questions: must@dguv.de



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Thanks for the attention!