GMP 12
Good Measurement Practice
for
Standard Operating Procedure Selection

Good laboratory practices, use of proper standards and equipment, and selection of standard operating procedures are essential for providing calibration results with accurate and traceable values with appropriate and suitable uncertainties. The following matrix recommends SOPs based on the parameter, type of calibration items, and level of uncertainty needed.

Table 1. Procedure Selection Table.

Parameter or Documentary Standard[1]	Calibration Item	Recommended SOP
Mass (NISTIR 6969 and NISTIR 5672)		
	Railroad test cars	SOP 27, Railroad Test Cars using a Master Track Scale
HB 105-8	Weight carts	SOP 33, Calibration of Weight Carts (References SOP 4 and SOP 7)
HB 105-1, Class F ASTM, OIML	Class F Class 5, 6, 7 Class M_1, M_2, M_3 e.g., 10 kg to 250 kg (≥ 500 lb) cast iron 1 mg to 5 kg (1 µlb to 10 lb) stainless steel	SOP 8, Modified Substitution - may be used if expanded uncertainty is less than 1/3 of the tolerance SOP 7, Single Substitution - to be used, as a minimum, if conditions given for SOP 8 cannot be met NOTE: Balances and standards must be selected properly for these conditions to be met.
ASTM, OIML	Class 3, 4 (P) Class F_1, F_2 e.g., 1 kg kit, 100 g kit	SOP 7, Single Substitution - may be used if expanded uncertainty is less than 1/3 of the tolerance. If uncertainty is greater than 1/3 of the tolerance, then use SOP 4. SOP 4, Double Substitution - to be used for buoyancy corrections and if expanded uncertainty is less than 1/3 of the tolerance NOTE: Balances and standards must be selected properly for these conditions to be met.
ASTM, OIML	Class 1, 2 (S, S-1) Class E_2 When used for balance calibration	SOP 5, 3-1 Weighing Design (preferred) SOP 4, Double Substitution - to be used for buoyancy corrections and if expanded uncertainty is less than 1/3 of the tolerance
ASTM, OIML	Class 000, 00, 0, 1 (S) Class E_1 When used as laboratory standards	Weighing Designs per NIST Technical Note (TN) 952, TN 844, NISTIR 5672, SOP 28, with appropriate check standards; SOP 5, 3-1 Weighing Design (optional)

[1] See Table 2 for complete Titles for the Documentary Standard references used in Table 1.

Volume (NISTIR 7383)		
HB 105-2	Glass flasks	SOP 14, Gravimetric Calibration of Volumetric Standards Using an Electronic Balance SOP 16, Calibration of Measuring Flasks Volume Transfer Method (acceptable)
HB 105-3	20 L test measures (5 gal or 10 gal)	Preferred: SOP 19, Calibration of Graduated Neck-Type Metal Provers (Volume Transfer Method) is preferred. When temperature instability is observed during the calibration process, SOP 19 must be used. SOP 31, Scale Plate Calibration for Volumetric Field Standards SOP 18, Calibration of Graduated Neck-Type Metal Volumetric Field Standards Using a Slicker-Plate Type Standard, may be used if temperature stability and limits are acceptable (single delivery from slicker plate type standard; for glass standards use SOP 19.
HB 105-3	Large graduated neck type provers - used for meter verification	SOP 19, Calibration of Graduated Neck-Type Metal Provers (Volume Transfer Method) SOP 31, Scale Plate Calibration for Volumetric Field Standards
HB 105-4	LPG provers	SOP 21, Calibration of LPG Provers SOP 31, Scale Plate Calibration for Volumetric Field Standards
HB 105-7	Compact Displacement Prover (Small Volume Provers)	SOP 26, Gravimetric Calibration of Dynamic Volumetric Systems used as Standards
	Laboratory standards Glassware: burets, pipettes, flasks	SOP 14, Gravimetric Calibration of Volumetric Standards Using an Electronic Balance
	Laboratory standards Laboratory slicker plate standards	SOP 14, Gravimetric Calibration of Volumetric Standards Using an Electronic Balance
	Micropipettes	SOP 14, Gravimetric Calibration of Volumetric Standards Using an Electronic Balance
HB 105-3	Large graduated neck type provers - used as laboratory standards	SOP 19, Calibration of Graduated Neck-Type Metal Provers (Volume Transfer Method) OR SOP 14, Gravimetric Calibration of Volumetric Standards Using an Electronic Balance SOP 31, Scale Plate Calibration for Volumetric Field Standards

Length (NISTIR 8028)		
	Tapes	SOP 11, Bench Method (lower uncertainties) OR SOP 12, Tape to Tape
	Rigid Rules	SOP 10, Rigid Rule
	Pi Tapes	SOP 23, Pi Tape Calibration
Liquid-in-Glass Thermometers		
HB 105-6	Field standards for weights and measures	SOP 25 (unpublished)
Timing Devices		
HB 105-5	Field standards for weights and measures	SOP 24 (unpublished)
Traffic Speed Gun Tuning Forks		
	For enforcement official use	SOP 22 (unpublished)
Measurement Assurance		
All Process Measurement Assurance	SOP 30	Use of process measurement assurance programs
Mass	SOP 5, 28	Use of check standards in procedure TN 952, TN 844, NISTIR 5672
Mass	SOP 4, 6, 7, 8	SOP 9
Length	SOP 10, 11, 12, 23	Redundancy built into procedures with replicate measurements
Volume	SOP 13, 14, 15, 16, 18, 19, 21, 26	SOP 17, laboratory check standards OR SOP 20, standard deviation charts and range charts
Temperature	SOP 25	Use of check standards in procedure (SOP 30, SOP 17)
Uncertainty		
All parameters	All SOPs	SOP 29, Calculation of Uncertainty Note: Each SOP for calibration procedures includes a detailed uncertainty budget table template identifying common components to be included.

Table 2. Documentary Standard References.

Documentary Standard Number	Title	Latest Revision Date
105-1	Specifications and Tolerances for Field Standard Weights (NIST Class F)	2019
105-2	Specifications and Tolerances for Field Standard Measuring Flasks	1996
105-3	Specifications and Tolerances for Graduated Neck Type Volumetric Field Standards	2010
105-4	Specifications and Tolerances for Liquefied Petroleum Gas and Anhydrous Ammonia Liquid Volumetric Provers	2016
105-5	Specifications and Tolerances for Field Standard Stopwatches	1997
105-6	Specifications and Tolerances for Thermometers	1997
105-7	Specifications and Tolerances for Dynamic Small Volume Provers	1997
105-8	Specifications and Tolerances for Field Standard Weight Carts	2019
ASTM E617	Standard Specification for Laboratory Weights and Precision Mass Standards	2018
OIML R111	Weights of classes E_1, E_2, F_1, F_2, M_1, $M_{1–2}$, M_2, $M_{2–3}$ and M_3 Part 1: Metrological and technical requirements	2004