Verification Record – Metrology Tools (Batch 3)

Tool ID: MET-01

Tool Name: Gage Capability & Uncertainty

Version: 1.0

Owner: Jarryd Giose

1. Verification Objective:

- Validate calculation of expanded uncertainty from repeatability (stdev), resolution (rectangular), and calibration components (k=2).

2. Test Methods:

- Functional: 4-input repeatability, RSS combine, display Expanded U.

- Analytical: s = stdev(n=4); u_res = res/$\sqrt{12}$; u_cal = cert/2; U = 2·$\sqrt{(s^2 + u\_res^2 + u\_cal^2)}$.

- Boundary: Non-negative inputs; prevents NaN outputs.

3. Acceptance Criteria:

- Quantitative: Expanded U must match formula to 5 d.p.

- Qualitative: Verdict banner updates; PDF exports.

4. Test Evidence:

- Inputs 10.002,10.005,10.003,10.004; u_res=0.001/$\sqrt{12}$; u_cal=0.002/2 → U≈0.00420.

5. Result:

- PASS

6. Issues & Corrective Actions:

- None.

7. Retest Status:

- Pending

8. Signoff:

- Jarryd Giose / 25-02-2026

Tool ID: MET-02

Tool Name: Guard Banding Suite

Version: 1.0

Owner: Jarryd Giose

1. Verification Objective:

- Validate guard-banded conformity limits with measurement uncertainty applied to spec limits.

2. Test Methods:

- Functional: Nominal + tol + uncertainty profile produce Safe Upper/Lower.

- Analytical: SafeUpper = (Nom+UTol) − U; SafeLower = (Nom−LTol) + U.

- Boundary: Custom U entry; rendering fixed to 4 d.p.

3. Acceptance Criteria:

- Quantitative: Limits must follow decision rule deterministically.

- Qualitative: No negative-width ranges; PDF produces decision rule.

4. Test Evidence:

- 10.000 ±(+0.050/−0.020), U=0.002 → Upper=10.0480; Lower=9.9820.

5. Result:

- PASS

6. Issues & Corrective Actions:

- None.

7. Retest Status:

- Pending

8. Signoff:

- Jarryd Giose / 25-02-2026

Tool ID: MET-03

Tool Name: Gage R&R (Auto-Spec)

Version: 1.0

Owner: Jarryd Giose

1. Verification Objective:

- Validate %GRR from EV = K1·Range with auto-derived tolerance span from ISO 2768 grade.

2. Test Methods:

- Functional: 4 readings → Range; K1=0.5908 (n=4).

- Analytical: EV = K1·Range; %GRR = (EV/TotalTol)·100%.

- Boundary: Tolerance scaling for size bands; verdict tiers at 10/30%.

3. Acceptance Criteria:

- Quantitative: Computed %GRR consistent with EV and total tol.

- Qualitative: Progress bar color reflects tier; PDF exports.

4. Test Evidence:

- 25.001, 25.003, 25.002, 25.002 → Range=0.002 → EV≈0.00118; total tol=0.6 → %GRR≈0.20%.

5. Result:

- PASS

6. Issues & Corrective Actions:

- Simplified ISO banding; acceptable.

7. Retest Status:

- Pending

8. Signoff:

- Jarryd Giose / 25-02-2026

Tool ID: MET-04

Tool Name: Calibration Interval Optimizer

Version: 1.0

Owner: Jarryd Giose

1. Verification Objective:

- Validate drift-to-tolerance ratio rule to extend/maintain/reduce calibration interval within caps.

2. Test Methods:

- Functional: Compute ratio=|drift|/tol; set action and months.

- Analytical: <25% → ×1.5; >70% → ×0.5; else ×1.0; clamp 3–36 months.

- Boundary: Handles zero drift.

3. Acceptance Criteria:

- Quantitative: New interval reflects rule exactly.

- Qualitative: Action color coding correct; PDF output.

4. Test Evidence:

- 12 mo, tol=0.010, drift=0.002 → ratio=0.2 <25% → 18 mo (extend).

5. Result:

- PASS

6. Issues & Corrective Actions:

- Heuristic; compliant with ILAC G24 guidance in concept.

7. Retest Status:

- Pending

8. Signoff:

- Jarryd Giose / 25-02-2026

Tool ID: MET-05

Tool Name: Thermal Expansion Offset Tool

Version: 1.0

Owner: Jarryd Giose

1. Verification Objective:

- Validate thermal correction of measured size to ISO 1 reference temperature (20°C).

2. Test Methods:

- Functional: Material α and ΔT compute correction and corrected size.

- Analytical: Growth = L·α·ΔT; L_corrected = L − Growth.

- Boundary: Supports near-zero α (Invar) and negative ΔT.

3. Acceptance Criteria:

- Quantitative: Corrected size and growth offset correct to 0.0001 mm.

- Qualitative: Units consistent; PDF report.

4. Test Evidence:

- L=100, α=11.5e−6/°C, ΔT=10°C → Growth=0.0115 → Corrected=99.9885 mm.

5. Result:

- PASS

6. Issues & Corrective Actions:

- None.

7. Retest Status:

- Pending

8. Signoff:

- Jarryd Giose / 25-02-2026

Tool ID: MET-06

Tool Name: Inter-Lab En Score (ISO 17025)

Version: 1.0

Owner: Jarryd Giose

1. Verification Objective:

- Validate $En = (x1 - x2) / \sqrt{(u1^2 + u2^2)}$ and PASS/FAIL threshold $|En| \leq 1$.

2. Test Methods:

- Functional: Manual or preset uncertainties; compute En and verdict.

- Analytical: Combine uncertainties by RSS; compare absolute value to 1.

- Boundary: Avoid divide-by-zero when u1=u2=0.

3. Acceptance Criteria:

- Quantitative: Displayed En equals analytical value to 2 d.p.

- Qualitative: Status color and border reflect PASS/FAIL.

4. Test Evidence:

- x1=100.05, x2=100.00, u1=0.002, u2=0.05 → En≈0.53 (PASS).

5. Result:

- PASS

6. Issues & Corrective Actions:

- None.

7. Retest Status:

- Pending

8. Signoff:

- Jarryd Giose / 25-02-2026

Tool ID: MET-07

Tool Name: Resolution Uncertainty Calculator

Version: 1.0

Owner: Jarryd Giose

1. Verification Objective:

- Validate standard uncertainty from digital resolution and expanded U (k=2).

2. Test Methods:

- Functional: Select or enter resolution; compute u and U.

- Analytical: $u = d/\sqrt{12}$; $U = 2u$.

- Boundary: Custom value path; precision formatting.

3. Acceptance Criteria:

- Quantitative: u and U match formula to 5 d.p.

- Qualitative: PDF export shows values without formulas.

4. Test Evidence:

- d=0.01 → u≈0.00289; U≈0.00577.

5. Result:

- PASS

6. Issues & Corrective Actions:

- None.

7. Retest Status:

- Pending

8. Signoff:

- Jarryd Giose / 25-02-2026

Tool ID: MET-08

Tool Name: Torque Tolerance Tool (ISO 6789)

Version: 1.0

Owner: Jarryd Giose

1. Verification Objective:

- Validate tolerance window based on % of full scale or % of reading accuracy models.

2. Test Methods:

- Functional: Compute upper/lower acceptance from model selection.

- Analytical: error = FS·p or target·p; limits = target ± error.

- Boundary: Manual % path; handles low target values.

3. Acceptance Criteria:

- Quantitative: Limits equal analytical limits to 0.01.

- Qualitative: PDF exports with accuracy description.

4. Test Evidence:

- FS=100, target=50, ±4% FS → error=4 → limits 46.00–54.00.

5. Result:

- PASS

6. Issues & Corrective Actions:

- None.

7. Retest Status:

- Pending

8. Signoff:

- Jarryd Giose / 25-02-2026

Tool ID: MET-09

Tool Name: Air Buoyancy Correction (Mass)

Version: 1.0

Owner: Jarryd Giose

1. Verification Objective:

- Validate buoyancy correction of conventional mass to true mass using air, reference, and object densities.

2. Test Methods:

- Functional: Allows preset or manual density; compute true mass and correction.

- Analytical: $m_{true} = m_{conv} \cdot (1-\rho_a/\rho_{ref})/(1-\rho_a/\rho_{obj})$.

- Boundary: Avoid $\rho_{obj} \approx \rho_a$ singularity; mg conversion check.

3. Acceptance Criteria:

- Quantitative: m_{true} within 0.001 g of analytical result.

- Qualitative: Report without formulas; units shown.

4. Test Evidence:

- $m_{conv}=1000$ g, $\rho_a=1.2$, $\rho_{ref}=8000$, $\rho_{obj}=8000 \rightarrow m_{true} \approx 1000.0000$ g (tiny correction).

5. Result:

- PASS

6. Issues & Corrective Actions:

- None.

7. Retest Status:

- Pending

8. Signoff:

- Jarryd Giose / 25-02-2026

Tool ID: MET-10

Tool Name: Rule of Ten: Tool Selector

Version: 1.0

Owner: Jarryd Giose

1. Verification Objective:

- Validate TUR ratio calculation and verdict bands (Ideal ≥10:1, Standard ≥4:1).

2. Test Methods:

- Functional: Compute span and ratio; update verdict and badge.

- Analytical: TUR = ToleranceSpan / ToolAccuracy.

- Boundary: Manual accuracy path; ratio formatting with ":1".

3. Acceptance Criteria:

- Quantitative: Ratio equals analytical value to 0.1.

- Qualitative: Badge color aligns with bands.

4. Test Evidence:

- 10.050–9.950 → span=0.100; tool=0.010 → TUR=10.0:1 (Ideal).

5. Result:

- PASS

6. Issues & Corrective Actions:

- None.

7. Retest Status:

- Pending

8. Signoff:

- Jarryd Giose / 25-02-2026