



TAR (Test Accuracy Ratio) Calculator — Instruction Guide

The TAR Calculator divides a DUT's $\pm$ tolerance by the $\pm$ accuracy of the standard, shows the ratio truncated to two decimals, and places it against the legacy 4:1 rule.

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1. Purpose and application

Use this calculator to compute a test accuracy ratio (TAR) at one test point and to learn what the legacy 4:1 rule did and did not say.

TAR compares two specifications: the DUT's tolerance half-width and the standard's accuracy half-width. MIL-STD-45662A (1988) sub-clause 5.2 limited the collective uncertainty of the standards to 25 percent of the acceptable tolerance. That is a 4:1 ratio. MIL-STD-45662A was cancelled in 1995.

Typical uses:

- A quick screen when choosing a standard for a test point.
- Reading old procedures, contracts or audit records that state a 4:1 TAR.
- Teaching why accuracy ratios gave way to uncertainty ratios.

The calculator takes no measured value, so it never decides whether an item conforms. Every card carries a notice that begins: "TAR is a legacy rule of thumb, not an accepted method for conformity decisions today."

TAR or TUR? A standard's accuracy specification is not the uncertainty of the calibration. It leaves out repeatability, resolution, environment and the method, and it usually states no coverage probability. When you have a 95 % expanded uncertainty for the calibration process, use a TUR calculator instead:

You have	Use
A tolerance and the standard's accuracy specification only	TAR Calculator (this guide)
A tolerance and a 95 % expanded uncertainty	TUR Calculator (Simplified)
A tolerance, an expanded uncertainty and the in-tolerance probability (EOPR), or a need for a guard band	TUR Calculator (Full ANSI/NCSL Z540.3)
A measured value to accept or reject against a tolerance	Decision Rules & Guard Band Calculator

2. Standards basis

The 4:1 threshold comes from a canceled military standard; the unit factors come from NIST SP 811; the TUR pointer comes from Z540.3.

Standard	What the calculator takes from it
MIL-STD-45662A (1 August 1988), sub-clause 5.2 "Adequacy of measurement standards"	The 4:1 threshold: collective uncertainty of the standards not to exceed 25 percent of the acceptable tolerance. Canceled in 1995. Taught as history and as a quick screen.
ANSI/NCSL Z540.3-2006, sub-clause 3.11 (TUR) and 5.3 b), with its Handbook	The modern comparison the card points to. Withdrawn as an active standard in October 2020; still widely specified by contract.
NIST SP 811 (2008), Appendix B	The conversion factors used when the two values are in different units of one domain.
ISO/IEC 17025:2017, 7.11.2	The requirement that calculation software be validated before use and after changes is applied in MT-VAL-TAR-002.

3. How the calculator ensures accurate results

Code computes every number on the card; the language model only explains it. The form text is parsed and checked, the ratio is computed from the typed decimals, unit factors come from their SP 811 definitions, and display rules never round a ratio up into a better band. The model receives the finished values in a block marked as verified and authoritative, and its prompt forbids it to recompute, re-round or dispute any of them. The card, PDF, Word and spreadsheet exports all take their strings from one presentation function.

MT-VAL-TAR-002 Rev B (18 October 2026, production commit 5cbb347) found 0 mismatches over 12,000 random cases against an independent exact-arithmetic Python reference: 5,414 meets, 3,733 below and 2,853 exceeds. All 9 specification known answers, all 6 edge and rejection cases and all live tests on mettutor.ai (card and PDF) passed. The method is described in the white paper [Deterministic Computation in AI-Assisted Metrology](#) (Racen, 2026).

4. Input fields

The form has seven fields: five always required and two that become required when exactly one value is a percentage.

Field	Required	Format or options	What it means (the form's help text)
Unit domain	Yes	23 physical domains, or Other (same unit on both values)	The physical quantity of the values. Temperature means a temperature difference: a tolerance or an uncertainty in temperature is an interval, so °C and K are equal steps and °F and °R are 5/9 K. Choose "Other (same unit on both values)" for anything not listed, such as %RH, dB, ppm, counts or digits: you type one unit, both values must use it, and nothing is converted.
DUT tolerance (half-width)	Yes	Positive number only; example 0.5	The DUT's $\pm$ tolerance at this test point, i.e. half the tolerance span, as a number only: choose its unit next to it. For asymmetric limits, enter half the total span. For a percentage, enter the percent here and choose % as the unit.
DUT tolerance unit	Yes	Units of the chosen domain, or %; typed text under Other	Unit of the DUT tolerance, or % for a percentage.
Standard accuracy (half-width)	Yes	Positive number only; example 0.1	The standard's $\pm$ accuracy specification at this test point, as a number only. If more than one standard contributes, enter their combined accuracy as your procedure defines it. For a percentage, enter the percent and choose % as the unit. In another unit of the same domain than the DUT tolerance, it is converted exactly into the DUT unit.
Standard accuracy unit	Yes	Units of the chosen domain, or %; typed text under Other	Unit of the standard accuracy, or % for a percentage.
Reference value (nominal / reading / full scale)	Only when exactly one value is a %	Non-zero number only; example 100	Needed only when exactly one of the two values is a percentage: the value that percentage applies to, as a number only; choose its unit next to it. Leave blank if neither or both are percentages. In another unit than the one it is compared with, it is converted exactly.

Field	Required	Format or options	What it means (the form's help text)
Reference value unit	Whenever a reference value is needed	Units of the chosen domain; % is not offered	Unit of the reference value (not %). Required whenever a reference value is needed.

Every value field takes a bare number with a period as the decimal mark. A unit typed into a value field, such as "1 V", is refused; choose the unit in its own list.

4.1 Unit domain

The domain sets which units the three unit lists offer. The options, in form order: Voltage, Current, Resistance, Capacitance, Inductance, Conductance, Electric charge, Pressure, Temperature, Torque, Force, Mass, Length, Time, Frequency, Angle, Rotational speed, Area, Volume, Energy, Power, Magnetic flux density, Magnetic flux, and Other (same unit on both values). Section 5 lists the units in each.

- **Temperature.** A tolerance or an accuracy in temperature is an interval. °C and K are equal steps; °F and °R are 5/9 K. No offset is ever applied.
- **Other (same unit on both values).** For anything not listed, such as %RH, dB, ppm, counts or digits. The unit fields become free text. You type one unit, both values must use it, and nothing is converted.

4.2 Unit fields and the % option

The DUT tolerance unit, Standard accuracy unit and Reference value unit fields depend on the Unit domain. Each lists that domain's units; the first two also offer %. The Reference value unit never offers %, because it is the unit the percentage applies to.

4.3 Percentages and the reference value

The calculator has four input paths:

DUT tolerance	Standard accuracy	Reference value	What the calculator does
Absolute	Absolute	Not used	Converts the standard accuracy into the DUT unit if needed, then divides.
Absolute	%	Required	Standard accuracy = $p/100 \times \text{reference value} $, in the DUT unit. The reference value is converted into the DUT unit first if needed.
%	Absolute	Required	DUT tolerance = $p/100 \times \text{reference value} $. The reference unit becomes the working unit; the standard accuracy converts into it.
%	%	Ignored	TAR = $p(\text{DUT}) / p(\text{std})$. Both are taken as percentages of the same value; the ratio has no unit.

The reference value is whatever the percentage specification is written against: the nominal, the reading, or the full scale. Enter the value that matches each specification. A % of reading and a % of full scale on the same instrument give different absolute values. When both values are percentages but of different bases (one of reading, one of full scale), convert one to an absolute value before you enter it.

5. Units and unit conversion

The DUT side sets the working unit, and only the other side is converted with the SP 811 factor (exact, except the tabulated inHg factors and factors involving π) and always shown rounded up.

Domain	Units offered (symbol)
Voltage	MV, kV, V, mV, μ V, nV, pV
Current	kA, A, mA, μ A, nA, pA
Resistance	T Ω , G Ω , M Ω , k Ω , Ω , m Ω , $\mu\Omega$
Capacitance	F, mF, μ F, nF, pF
Inductance	H, mH, μ H, nH
Conductance	S, mS, μ S, nS
Electric charge	C, mC, μ C, nC, pC
Pressure	Pa, mPa, μ Pa, kPa, MPa, GPa, bar, mbar, psi, atm, Torr, mTorr, mmHg (conventional), inHg (60 °F), inHg (32 °F)
Temperature	K, mK, °C, °F, °R
Torque	N·m, N·cm, mN·m, μ N·m, kN·m, lbf·ft, lbf·in, ozf·in
Force	N, mN, μ N, kN, MN, dyn, lbf, ozf, kgf
Mass	kg, g, mg, μ g, ng, t, lb, oz, gr, slug
Length	m, cm, mm, μ m, nm, pm, km, in, ft, yd, mi, mil (0.001 in), nmi
Time	s, ms, μ s, ns, ps, min, h, d
Frequency	Hz, mHz, kHz, MHz, GHz
Angle	rad, °, mrad, ', ", gon
Rotational speed	r/min, r/s, rad/s
Area	m ² , cm ² , mm ² , in ² , ft ² , yd ² , acre, ha
Volume	L, mL, μ L, m ³ , cm ³ , gal (US), liq qt, liq pt, fl oz, in ³ , ft ³
Energy	J, mJ, μ J, kJ, MJ, cal (IT), cal (thermochemical), kcal (IT), kcal (thermochemical), W·h, kW·h, Btu (IT), ft·lbf

Domain	Units offered (symbol)
Power	W, mW, μ W, nW, pW, kW, MW, hp (550 ft·lbf/s), hp (electric), hp (metric), Btu (IT)/h
Magnetic flux density	T, mT, μ T, nT, G (gauss)
Magnetic flux	Wb, mWb, μ Wb, Mx

The form shows each unit as its name with the symbol, for example "millivolt (mV)". The DUT tolerance unit and Standard accuracy unit lists add %.

How conversion works.

1. **Working unit.** The DUT tolerance unit is the working unit. When the DUT tolerance is a %, the reference value unit is the working unit.
2. **What converts.** The standard accuracy converts into the working unit. When the standard accuracy is a %, the reference value converts into the DUT unit first, and the percentage is then applied.
3. **The factor.** Most factors are built as exact fractions from the unit definitions in NIST SP 811 Appendix B: 1 in = 0.0254 m, 1 lb = 0.45359237 kg, $g(n) = 9.80665 \text{ m/s}^2$, 1 atm = 101 325 Pa, and so on. The two inHg units use SP 811's tabulated values. Angle and rotational-speed factors that involve π are computed in double precision unless π cancels.
4. **The displayed value.** The converted value is rounded up to N significant figures, where N = entered significant figures + 3, at most 7. An exact short result, such as 2.5 mV to 0.0025 V, is shown as is. The ratio uses the unrounded converted value.
5. **The record.** The card adds Unit Conversion rows and a note such as "Standard accuracy 2.5 mV converted to 0.0025 V ($\times 0.001$, exact)".

Torque and energy are separate domains. Pound-force foot (lbf·ft) is a torque and foot pound-force (ft·lbf) is an energy; neither converts into the other. Under Other, nothing converts: both values must carry the identical typed unit.

6. Calculation method

TAR is the DUT tolerance half-width divided by the standard accuracy half-width, both in the working unit.

$$\mathrm{TAR} = \frac{T}{A}$$

T is the DUT tolerance half-width and A the standard accuracy half-width. A value entered as a percentage p of a reference value R becomes:

$$T = \frac{p_{\mathrm{DUT}}}{100} R \quad \text{or} \quad A = \frac{p_{\mathrm{std}}}{100} R$$

When both values are percentages, the reference cancels:

$$\mathrm{TAR} = \frac{p_{\mathrm{DUT}}}{p_{\mathrm{std}}}$$

The band is decided on the unrounded ratio, with a relative tolerance of 10^{-12} at each boundary:

$$\text{band} = \begin{cases} \text{Meets legacy 4:1 rule} & \text{if } \mathrm{TAR} \geq 4 \\ \text{Below legacy 4:1 rule} & \text{if } 1 \leq \mathrm{TAR} < 4 \\ \text{Standard accuracy exceeds DUT tolerance} & \text{if } \mathrm{TAR} < 1 \end{cases}$$

The tolerance exists because the ratio itself is computed in double precision. A ratio that is exactly 4 by its decimals but computes as 3.999999999999996 is treated as 4. Unit factors are exact fractions, except the two tabulated inHg factors and factors involving π , which are computed in double precision. The percentage products used for display are exact.

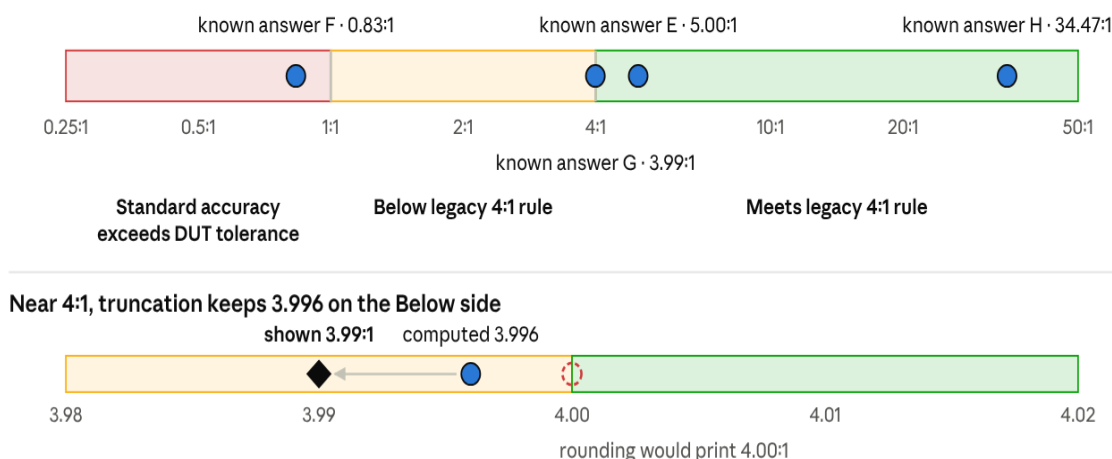
Display rules. Each rule keeps the card from looking better than the computation.

Quantity	Rule	Why
TAR	Truncated to 2 decimals, shown as "x.xx:1"	A ratio is never rounded up into a better band. 3.996 shows as 3.99:1, not 4.00:1.
DUT tolerance derived from a %	Rounded down to 4 significant figures	The numerator never looks larger than computed.
Standard accuracy derived from a %	Rounded up to 4 significant figures	The denominator never looks smaller than computed.
Standard accuracy or reference value converted from another unit	Rounded up to N = entered s.f. + 3 (at most 7)	Same reason; an exact short result is shown as is.
Values entered directly in the working unit	Shown as typed	No rounding is needed.

Truncation matters at the 4:1 line. Rounding 3.996 to two decimals would print 4.00:1 next to the word "Below", or invite a reader to call it 4:1. Truncation prints 3.99:1, which agrees with the band. The rounded inputs work the same way: dividing the displayed DUT tolerance by the displayed standard accuracy never gives a larger ratio than the computed one.

The band is decided on the unrounded TAR; the display is truncated

TAR on a log scale, with four known answers from MT-VAL-TAR-002 Rev B



TAR bands on a log scale · zoom at 4:1

Figure 1. The three bands with known answers E, F, G and H from MT-VAL-TAR-002 Rev B. The lower strip shows known answer G: the computed 3.996 is truncated to 3.99:1 and stays in the Below band; rounding would print 4.00:1.

7. Reading the results

The headline gives the TAR and its band in one line; the rows below show each value the ratio was built from.

Headline and band wording. The card shows one of three headlines:

Headline	Band row	What it means
TAR = x.xx:1 — Meets legacy 4:1 rule (MIL-STD-45662A §5.2)	Meets legacy 4:1 rule	The tolerance is at least 4 times the standard accuracy. The arithmetic meets the old default rule. It is not a conformance decision and does not show the device is acceptable.
TAR = x.xx:1 — Below legacy 4:1 rule	Below legacy 4:1 rule	The ratio is at least 1 but less than 4. The old rule allowed documented deviations. No lower ratio, such as 3:1, is offered as a criterion.
TAR = x.xx:1 — Standard accuracy exceeds DUT tolerance	Standard accuracy exceeds DUT tolerance	The standard's accuracy is larger than the tolerance half-width. The standard cannot meaningfully verify this tolerance. Use a more accurate standard or review the tolerance.

The band colours the headline.

Result rows.

Row	Content
TAR	The ratio, truncated to 2 decimals, e.g. 5.00:1
Band	One of the three band phrases above
DUT Tolerance — Value / Unit / Entered	T in the working unit (rounded down to 4 s.f. when derived from a %), its unit, and what you typed (with " %" when only one value is a percentage)
Standard Accuracy — Value / Unit / Entered	A in the working unit (rounded up when derived from a % or converted), its unit, and what you typed (with " %" when only one value is a percentage)
From Percent — Percent / Reference / Reference Unit	Shown only when one value was a %: the percent, the reference value and its unit
Both Percent	Yes when both values were percentages; then both Unit rows read % and the Entered rows show the bare numbers
Unit Scaling — Applied	Always No. Kept for continuity with earlier results; conversions appear in the Unit Conversion rows
Unit Conversion — Field / Entered / Entered Unit / Converted / Unit / Factor / Basis / Note	Shown only when a value was converted. Basis reads exact, tabulated or involves π
Other Unit	Shown only under Other: the one unit both values share

The result also carries the legacy-method disclaimer and a list of findings. A conversion adds the finding "Unit converted: Standard accuracy" or "Unit converted: Reference value"; under Other the finding is "Other domain: no unit conversion". Both are records of what the code did, marked as passed, not judgements.

The PDF, Word, spreadsheet and chat exports carry the same strings as the card. The model-written explanation below the card quotes these values and adds history and context; it is not part of the validated scope.

8. Worked examples

All three results below were copied from runs of the production calculator on the composed form text and checked by hand in exact arithmetic.

Example 1 — Standard accuracy as a percentage (known answer E)

A pressure gauge has a tolerance of ± 0.5 psi at 100 psi. The reference standard is specified at ± 0.1 % of reading. This is known answer E of the TAR specification in MT-VAL-TAR-002 Rev B, also run live as test T4.

Field	Entered
Unit domain	Pressure
DUT tolerance (half-width)	0.5
DUT tolerance unit	psi
Standard accuracy (half-width)	0.1
Standard accuracy unit	%
Reference value (nominal / reading / full scale)	100
Reference value unit	psi

Hand calculation:

1. $A = 0.1/100 \times 100 \text{ psi} = 0.1 \text{ psi}$. Shown rounded up to 4 s.f.: 0.1000 psi.
2. $TAR = 0.5 / 0.1 = 5$ exactly.
3. Truncated to 2 decimals: 5.00:1. $5 \geq 4$, so the band is Meets legacy 4:1 rule.

Row	Calculator result
Headline	TAR = 5.00:1 — Meets legacy 4:1 rule (MIL-STD-45662A §5.2)
TAR	5.00:1
Band	Meets legacy 4:1 rule
DUT Tolerance — Value / Unit / Entered	0.5 / psi / 0.5
Standard Accuracy — Value / Unit / Entered	0.1000 / psi / 0.1 %
From Percent — Percent / Reference / Reference Unit	0.1 / 100 / psi
Both Percent	No
Unit Scaling — Applied	No

The standard's accuracy is one fifth of the gauge tolerance, so the legacy 4:1 rule is met. The trailing zeros in 0.1000 show that the value was derived from a percentage and rounded up at 4 significant figures. This does not show that the gauge is in tolerance; it says only that the standard's specification is small relative to the tolerance.

Example 2 — DUT tolerance as % of reading, standard in millivolts

A DMM's 10 V range is specified at $\pm 0.015\%$ of reading, tested at 10.12345 V. The standard is specified at ± 0.3 mV at that point.

Field	Entered
Unit domain	Voltage
DUT tolerance (half-width)	0.015
DUT tolerance unit	%
Standard accuracy (half-width)	0.3
Standard accuracy unit	millivolt (mV)
Reference value (nominal / reading / full scale)	10.12345
Reference value unit	volt (V)

Hand calculation:

1. The DUT tolerance is a %, so the working unit is the reference unit, V.
2. $T = 0.015/100 \times 10.12345 \text{ V} = 0.0015185175 \text{ V}$. Shown rounded down to 4 s.f.: 0.001518 V.
3. $A = 0.3 \text{ mV} \times 0.001 = 0.0003 \text{ V}$ (exact).
4. $TAR = 0.0015185175 / 0.0003 = 5.061725$. Truncated: 5.06:1. The band is Meets legacy 4:1 rule.

Row	Calculator result
Headline	TAR = 5.06:1 — Meets legacy 4:1 rule (MIL-STD-45662A §5.2)
TAR	5.06:1
Band	Meets legacy 4:1 rule
DUT Tolerance — Value / Unit / Entered	0.001518 / V / 0.015 %
From Percent — Percent / Reference / Reference Unit	0.015 / 10.12345 / V
Standard Accuracy — Value / Unit / Entered	0.0003 / V / 0.3
Both Percent	No
Unit Scaling — Applied	No
Unit Conversion — Field / Entered / Entered Unit	Standard accuracy / 0.3 / mV
Unit Conversion — Converted / Unit / Factor / Basis	0.0003 / V / 0.001 / exact

Row	Calculator result
Unit Conversion — Note	Standard accuracy 0.3 mV converted to 0.0003 V (×0.001, exact)

The ratio is computed from the full 0.0015185175 V, not the displayed 0.001518 V. The displayed tolerance is rounded down, so a reader who divides the shown values gets 5.06, never more. Enter the reading as the reference value; a % of reading at a different point gives a different TAR.

Example 3 — Just below 4:1 (known answer G)

A length tolerance of ± 0.3996 mm is checked with a standard of ± 0.1 mm. This is known answer G.

Field	Entered
Unit domain	Length
DUT tolerance (half-width)	0.3996
DUT tolerance unit	millimeter (mm)
Standard accuracy (half-width)	0.1
Standard accuracy unit	millimeter (mm)

Hand calculation:

1. $TAR = 0.3996 / 0.1 = 3.996$.
2. Truncated to 2 decimals: 3.99:1. Rounding would have printed 4.00:1.
3. $3.996 < 4$, so the band is Below legacy 4:1 rule.

Row	Calculator result
Headline	TAR = 3.99:1 — Below legacy 4:1 rule
TAR	3.99:1
Band	Below legacy 4:1 rule
DUT Tolerance — Value / Unit / Entered	0.3996 / mm / 0.3996
Standard Accuracy — Value / Unit / Entered	0.1 / mm / 0.1
Both Percent	No
Unit Scaling — Applied	No

The ratio misses 4:1 by 0.004. Truncation keeps the printed ratio and the band in agreement, so the card cannot be read as "4:1, but below". Under the old rule this point needed a documented deviation or a better standard.

9. Refusals and troubleshooting

An input the calculator cannot read without guessing is refused with a card headed "Cannot compute TAR", naming the field and the fix. Every message below was produced by the production calculator.

Message or situation	Cause	What to do
"When exactly one of the two values is a percentage, the value it applies to is required: enter the Reference value (nominal / reading / full scale) and choose its unit"	One value is a % and the reference value is blank	Enter the nominal, reading or full-scale value the % applies to, and its unit.
"Could not find "Reference value unit:". Choose the unit from the list."	The reference value has no unit	Choose the reference value unit.
"The Reference value unit cannot be %: it is the unit the percentage applies to."	% chosen as the reference unit	Choose a unit of the domain.
""Reference value (nominal / reading / full scale)" must not be zero: a percentage of zero is no value."	Reference value 0	Enter the actual reference value. A negative value is accepted and its magnitude is used.
""DUT tolerance (half-width)" value "1,0" uses a comma. Enter decimals with a period, e.g. 0.050."	Comma decimal mark	Use a period: 1.0.
""DUT tolerance (half-width): 1 V" carries the unit "V". Enter the value as a bare number and choose the unit in "DUT tolerance unit""	A unit typed into a value field	Type the number only; pick the unit from its list.
""Standard accuracy (half-width)" must be greater than zero. Found: "0"."	Zero or negative tolerance or accuracy	Enter the $\pm$ half-width as a positive number.
"Enter the standard's $\pm$ accuracy specification (half-width), e.g. "Standard accuracy (half-width): 0.1"."	A required value is missing	Fill in the field named.
""Standard accuracy unit:" must be a Voltage unit: megavolt (MV); kilovolt (kV); volt (V); ...; %."	A unit outside the chosen domain (seen when form text is edited by hand)	Pick a unit from the domain's list, or change the Unit domain.
"Under Other, both values must use the same unit; choose a domain to convert between units. Found "RH" and "%RH"."	Two different typed units under Other	Type the identical unit in both fields, or choose a listed domain so the calculator can convert.

Message or situation	Cause	What to do
"This form has been updated: please reopen the form and submit again (Unit domain is now required)."	Text from the form version before Unit domain existed	Reopen the form and submit again.
TAR is exactly half or double what you expect	One value entered as a full span, the other as a half-width	Enter both as $\pm$ half-widths. For asymmetric limits, enter half the total span.
Both values are %, but of different bases	The calculator assumes both % apply to the same value	Convert one value to an absolute value and enter a reference value.

10. Scope and limitations

The calculator computes one ratio of two specifications at one test point; it is a training and reference tool, not a decision tool.

- **Not an uncertainty ratio.** An accuracy specification omits process contributions and usually states no coverage probability. For a modern comparison, use the TUR calculators.
- **No conformity decision.** No measured value is entered, so no item is accepted or rejected. No guard band or false-acceptance probability is computed; an accuracy specification is not an uncertainty.
- **Fixed 4:1.** MIL-STD-45662A applied 4:1 "unless otherwise specified in the contract". The calculator does not take a contract ratio.
- **Symmetric $\pm$ values only.** One-sided or asymmetric limits must be reduced to a half-width before entry.
- **One combined accuracy.** Several standards must be combined by your procedure before entry.
- **Both-percent case.** Both percentages are taken as percentages of the same value.
- **Other domain.** Units are not checked or recognised; they must simply match.
- **Validated scope.** MT-VAL-TAR-002 Rev B covers every number on the card and in the exports. The explanation written by the language model is outside it.
- **Your laboratory's use.** A laboratory that uses a result in its own work remains responsible for validating that use under ISO/IEC 17025:2017 7.11.

11. References

1. U.S. Department of Defense. MIL-STD-45662A, *Calibration Systems Requirements*, 1 August 1988, sub-clause 5.2. Cancelled in 1995.
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3. NCSL International. *Handbook for the Application of ANSI/NCSL Z540.3-2006*.
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