True Stress and True Strain from Engineering Values

True stress and true (logarithmic) strain from engineering stress and strain up to necking, and the true fracture strain from the reduction of area.

Method: Constant-volume plastic deformation (Dieter, Mechanical Metallurgy, ch. 8)

Input parameters

Unit system: SI

Parameter	Value	Unit
Engineering stress	400.00	MPa
Engineering strain	10.000	%
Reduction of area at fracture	60.000	%

Calculated results

Parameter	Value	Unit
True stress	440.00	MPa
True strain	9.5310	%
True fracture strain ln(1/(1 − RA))	91.629	%

Notes for this case

- The conversions assume constant volume and uniform strain, so they hold only up to the ultimate tensile strength (start of necking).

Formula and method

$$\sigma_t = \sigma_e(1+\varepsilon_e), \quad \varepsilon_t = \ln(1+\varepsilon_e)$$

$$\varepsilon_f = \ln\frac{1}{1-RA}$$

Variables

σ_e	Engineering stress	Pa
ε_e	Engineering strain	-
RA	Reduction of area at fracture	-
σ_t	True stress	Pa
ε_t	True strain	-
ε_f	True fracture strain ln(1/(1 − RA))	-

Method and standards

With volume constant during plastic flow, the current area is A₀/(1 + ε_e); this holds until necking, after which only the reduction of area gives true strain.

Assumptions and limits

- Uniform deformation, constant volume: valid only up to necking (the uniform elongation). Beyond it the conversion does not apply, although the input range allows larger strains.

References

- Constant-volume plastic deformation (Dieter, Mechanical Metallurgy, ch. 8)

Report details

Report reference	FCC-2CDP-DR1Z (the same inputs always give the same reference)
Generated	17 November 2026, 19:44 UTC
Calculator	True Stress and True Strain from Engineering Values
Method last reviewed	12 November 2026
Software release	FireCAD Calc, release of 17 November 2026
Release checks	3 reference cases of this calculator, computed independently, are checked on every release

Results are for engineering estimation. Verify critical designs against the referenced standards and your own data.

This calculator online

https://calc.firecad.com/materials/properties/true-stress-strain

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.