Meaning

A set of units is consistent if all conversion ratios have a magnitude of 1.0. This means that

$$(1.0 \text{ force unit}) = (1.0 \text{ mass unit})(1.0 \text{ acceleration unit})$$

$$(1.0 \text{ acceleration unit}) = \frac{(1.0 \text{ length unit})}{(1.0 \text{ time unit})^2}$$

$$(1.0 \text{ power unit}) = \frac{(1.0 \text{ work unit})}{(1.0 \text{ time unit})} = \frac{(1.0 \text{ energy unit})}{(1.0 \text{ time unit})}$$

$$(1.0 \text{ density unit}) = \frac{(1.0 \text{ mass unit})}{(1.0 \text{ length unit})^3}$$

$$(1.0 \text{ pressure unit}) = \frac{(1.0 \text{ force unit})}{(1.0 \text{ length unit})^2}$$

for all conversion ratios that are used to express dimensions.

Rationale

If you do not use consistent units, you may end up in "unit conversion hell." If you use consistent units, calculations will be

- faster and simpler
- clearer
- more accurate (less chance of error)

Examples

* The newton, meter, and pascal are consistent because each number in the conversion ratio is 1.0:

$$(1.0 \text{ Pa}) = \frac{(1.0 \text{ N})}{(1.0 \text{ m})^2}$$

* The newton, meter, and kilopascal (kPa) are inconsistent because the number 1000 appears in the conversion ratio:

$$(1.0 \text{ kPa}) = \frac{(1000 \text{ N})}{(1.0 \text{ m})^2}$$

* The pound-mass, pound-force, and ft/s^2 are inconsistent because the number 32 appears in the conversion ratio:

$$(1.0 \text{ lbf}) = (1.0 \text{ lbm})\left(32.2 \text{ ft/s}^2\right)$$

Connections

* Best practice : convert to consistent units when you define your problem (under "situation"). Select either (a) SI units or (b) traditional units.

* Best practice: learn to easily work in both SI and traditional units because both systems are widely used.

* Best practice: convert your answer so it follows standard practice. For example, pressure in SI is most often expressed in kPa (not Pa). For example, power is traditional units is expressed in hp (not ft•lbf/s).

* Consistent units in SI and Traditional (not all units are shown).

	mass	length	time	force	pressure	power	density	energy
SI	kg	m	s	N	Pa	W	kg/m^3	J
Traditional	slug	ft	s	lbf	psf = lbf/ft^2	ft•lbf/s	slug/ft^3	ft-lbf