TECHNICAL BULLETIN – TB233

UNDERSTANDING PRODUCT PERFORMANCE DATA UNITS

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INTRODUCTION & SCOPE

When doing an examination of datasheets, we sometimes find a mixture of different units and measurements which mean the same thing, and this leads to confusion. Sometimes the people who create the datasheets use obscure versions of units to create an impression for a 'marketing edge'.

There is also the problem that some countries do not use metric or System Internationale (SI) units, which then have to be converted over to SI for Australia and New Zealand usage. This is true for materials from the US, and to a lesser extent the UK which formally converted to metric in 2009.

This bulletin gives some examples to make comparisons easier.

STRENGTH UNITS

The most common items that a reader might want to look at on a datasheet are the strength properties, such as tensile (strain or stretching), compressive (stress - crushing) or flexural (bending) strength.

The SI derived unit for this type of property is the Newton (N) and values are commonly shown as kN meaning thousands of Newtons of *force*.

However, this is an absolute value and does not take the sample size into account, so the results are usually shown as a *pressure* in Pascals (kPa/MPa) or N/mm^2 instead which is defined as force applied over a specified unit area.

This table shows some equivalent units that may be seen:

SI Unit	SI Pressure equivalent	Non-standard units	Imperial PSI	Imperial PSF	Imperial TSI
1 N/mm^2	1 MPa	10 kg/cm^2	145 $lbs/inch^2$	20885 lb/ft^2	0.07 $tons/inch^2$

Ardex Australia uses the first two SI units for strength properties of materials.
For example, the compressive strength of Ardex K15 = 30MPa or 30N/mm^2 or 4350psi.

DEFLECTION OR ELONGATION

The deflection measurements are either shown as a movement value in millimetres (deflection in unstable tiles or flexural break) or as a percentage of a gauge length (i.e. tensile testing of a membrane).

The gauge length is the start length of a sample between the test machine jaws.

Deflection (X,Y,Z)	Percent Elongation
mm (millimetres)	For example 100mm gauge and 5mm stretching = 5% elongation

Membranes are quoted as percent elongation (i.e. >300%) which means that at test unbonded membrane samples stretch at least 3 times the gauge length at failure.

Elasticity is defined as Stress / Strain or Break load / deflection at failure. The derived units are in Pa normally.

VOLUME

This is a unit which seems to cause a lot of confusion. Volume is measured in litres or cubic metres (for example concrete).

The older Imperial/US units are sometimes encountered as well, and it needs to be recognised that British Imperial are not always the same as the American versions.

1 litre = 1000ml (1000 millilitres) = 1000cm^3 (cc) (1000 cubic centimetres)	
1 cubic metre (1m^3) = 1000 litres = 220 UK gallons = 264 US gallons = 35ft^3 = 1.31yd^3	
1 US pint = 2.11 litres	1 UK pint = 1.76 litres
1 US gallon = 3.79 litres	1 UK gallon = 4.55 litres
1 US quart = 2 US pints = 1.7 UK pints = 0.95 litres	1ml = 0.034 US oz = 0.035 UK oz (ounce)
1 UK quart = 2 UK pints = 2.4 US pints = 1.13 litres	1 inch^3 = 16.4ml = 16.4cm^3 (cc)

DENSITY

There are two common ways of expressing density, a weight per unit volume (absolute density) or referred back to water and called Specific Gravity or SG.

The logic behind SG was derived by Archimedes, and in its current usage relies on the fact that 1m^3 / 1000litres of fresh water weighs 1000kg. However, this can be done with Imperial units as well. The methodology involves the object being immersed in water, and the volume/weight of water displaced is equal to item volume, which then can be used with the measured weight to determine the density.

The SI derived unit for density is kg per cubic metre (kg/m^3). This example is water.

SI Unit	Specific gravity (SG)	Imperial PSI / PSF
1000kg/m^3	1.0	1000kg/m^3 = 0.36lbs/inch^3
		1000kg/m^3 = 62.4lbs/ft^3

Ardex K15 has a density of ~2000kg/m^3 or an SG of 2 mixed.

TEMPERATURE

It is not common these days to encounter temperature expressed in Fahrenheit, however sometimes materials from the US or UK use this measure. The SI derived unit is the degree Celsius.

There is no direct correlation because the way these measures were defined originally was very different. The conversions are done thusly,

C^0 to F^0 = (C^0 x 9 ÷ 5) + 32 or C^0 x 1.8 + 32

F^0 to C^0 = (F^0 – 32) x 5 ÷ 9 or (F^0 – 32) x 0.56

DIMENSIONS

The basic units are the metric metre and Imperial foot (US & UK only). In the case of metres the subdivisions are based on the SI prefixes which are in multiples of 10s. The smaller Imperial units are based on multiples of 3, 6 or 12 (12 inches = 1 foot, 36 inches or 3 feet = 1 yard).

1 metre (m) = 100cm = 1000mm = 39.4 inches = 3.28ft = 1.09yds	
$1m^2 = 10000cm^2 = 10^6mm^2 = 1550in^2 = 10.8ft^2 = 1.19yds^2$	
1 inch = 2.54cm = 25.4mm	1 ft = 30.5cm = 305mm
1mm = 0.039" = 0.0039ft	1mm = 1000µm = 39.4mil (39 thousandths of an inch)

Membrane and some coating thicknesses are measured in millimetre (mm) or micron (µm) where 1 mm = 1000µm. In US literature the expression Mils is commonly used, which is a thousandth of an inch.

AREA

Although not a common measure in the construction industry, some very large buildings may in fact be described in units of ground area, rather than in square metres.

The derived metric unit is the hectare (ha) which is $10000m^2$ and the Imperial equivalent is the Acre which is equivalent to ~$4000m^2$ ($4840yds^2$ or $43560ft^2$).

PARTS OR RATIOS

The mixing usage of parts can be either volume or weight and the instructions will normally specify which it means. When done as a volume this usually means that some type of measuring vessel (e.g. a water jug) is being used, whereas by weight has to be physically measured on a balance.

Caution needs to be exercised trying convert one method to the other unless the absolute or bulk densities are known. For example, 1 litre of WPM001 does not weigh 1kg, and 1 litre of K15 powder out of the bag weighs around 1.2-1.4kg depending on how compacted it has become.

Ratios are the same as parts in this case.

METRIC PREFIXES

The following show the metric prefixes in common use.

Prefix	Symbol	10^n	Decimal	Name
giga	G	10^9	1000000000	Billion (US) thousand million
mega	M	10^6	1000000	million
kilo	k	10^3	1000	thousand
hecto	h	10^2	100	hundred
deca	da	10^1	10	ten
deci	d	10^{-1}	0.1	tenth
centi	c	10^{-2}	0.01	hundredth
milli	m	10^{-3}	0.001	thousandth
micro	µ	10^{-6}	0.000001	millionth

The US expression Mil is a combination of the Latin prefix for a 1000th and inches. Micrometre is also called micron.

IMPORTANT
This Technical Bulletin provides guideline information only and is not intended to be interpreted as a general specification for the application/installation of the products described. Since each project potentially differs in exposure/condition specific recommendations may vary from the information contained herein. For recommendations for specific applications/installations contact your nearest Ardex Australia Office.

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