

# What is metrication?

Pat Naughtin

Metrication is the process of upgrading from any of the many and various old pre-metric measurement methods to the modern metric system, which is technically known as The International System of Units (SI).

Metrication began in France in the 1790s and then spread rapidly to all other nations in the world. Gradually, through the 1800s, the metric system replaced all of the numerous old historical weighing and measuring methods. By 1900, almost all nations had passed laws that accepted the metric system for use in trade, and during the late 1800s this usually translated into widespread use of the metric system by the public.

The metric system is now used by all of the world's people in all nations. The philosopher, Condorcet, proved to be correct when, in 1791, he described the original metric system as:

*For all people; for all time.*

As examples, the USA has allowed metric measuring units since 1866, and the UK since 1873. Liberia and Myanmar are the only nations that have not yet passed specific metric laws but the metric system is used in both of those countries every day.

Only in France, Japan, the United Kingdom, and the United States of America has there been any significant opposition to metrication, the main objections being based on history, tradition, aesthetics, economic conjecture, and a personal distaste for foreign ideas.

In France and Japan the opposition faded as soon as people regularly used the metric system. This left only two nations, the UK and the USA, with citizens who have difficulty accepting the reality of worldwide metrication.

For example, while the world automotive industry 'went metric' in the 1970s, the anti-metric lobbyists in the UK and the USA still insist, in the 21st century, that the all-metric cars, whether made in the UK and the USA or imported, have mph written on their speedometer, ml written on their odometers; and psi written on their tyres.

While the anti-metric people protest, the rest of us simply:

*get with it; get over it; and get on with it!*

Opposition to the metric system sometimes leads to quite odd results. In the USA, since the Mendenhall Order in 1893, all old measures such as yards and pounds have been legally and officially defined by the USA in terms of the metric system. The USA yard was defined as: 1 yard = 3600/3937 metre, or 1 inch = 25.400 050 8 millimetres. In the same year, 1893, the Congress of the USA defeated a measure to adopt the metric system. As suggested by Mark Twain (Samuel Langhorne Clemens 1835/1910):

*Denial ain't just a river in Egypt.*

## Metrication process

The common processes that governments use in upgrading from traditional measurement methods to the metric system are:

- ◇ Direct metrication
- ◇ Phased metrication
- ◇ Metric conversion

## **Direct metrication**

Direct metrication is rapid, smooth, and economical. Direct metrication was used by India in the early 1960s. The Indian approach was to simultaneously outlaw the use of all old pre-metric measurements, to rewrite and to reissue all government publications and laws, and to change education curricula to metric. India's metrication upgrade lasted from 1960 April 1, when metric became legal, to 1962 April 1, when all the old pre-metric measures systems were banned for use in trade. The Indian model was extremely successful and it was successfully copied by several other nations. Direct metrication was used by the Australian construction industry to 'go metric' in a single year, and direct metrication was used by the world automotive industry to 'go metric' in the 1970s.

## **Phased metrication**

Phased metrication is slow, painful, and expensive. Phased metrication involves passing laws that permit the use of metric units in parallel with old measures. This is then followed, on a parliamentary and political timescale, by slowly banning all of the old pre-metric measures. I will use 3 phased metric examples in the order that they 'went metric': the USA, the UK, and Japan.

### **USA**

The USA has been using a phased metrication policy since President Andrew Johnson signed the Kassen Act (1866 July 28). This Act declared it lawful throughout the USA to '*employ the weights and measures of the metric system*'. The USA is still going through its process of phased metrication in 2006 — 140 years later — and still counting.

### **UK**

The United Kingdom permitted the use of the metric system in 1873, but little progress was made until pro-metric laws were passed whenever UK politicians saw a chance to do so (the major Weights and Measures Acts in the UK were in 1963, 1976, and 1985).

However, despite huge efforts, anti-metric lobbyists in the UK were only able to gain exceptions in four areas: miles, yards, feet and inches for road signs; pints for beer and cider; acres for farmland; and troy ounces for gold and silver.

All other measurements in the UK are now fully metric.

### **Japan**

Japan chose phased metrication and their changeover was painfully slow, with bitter political and personal disputes, and expensive.

Japan ratified the Convention du Mètre in 1886, and began their phased approach in 1891 but little happened. The government then decided, in 1909, to adopt the units of the British inch-pound system. Japan then had three legally approved measuring methods: traditional units based on the 'shaku' and the 'kan', metric units, and the British inch-ounce measures.

In 1924, the Japanese government decided to adopt the metric system within ten years, but their law also allowed the continued use of other methods as transitional measures. The metrication process was so slow (probably due to dithering between the three measurement methods) that it created considerable public opposition to the metric system.

Japanese metrication experienced a further setback when the country was occupied, in the late 1940s, by military forces from the USA. Japan then experienced a de facto measuring conversion to the customary units of the USA — the Japanese then had four different methods of measurement. The cultural power of the USA is still felt around the world as a result of the measuring language used in film, television, radio, and sports commentaries. When reporters imported from the USA to comment on (say) tennis players from that

country, they choose to use feet, inches, and miles per hour because that is all they know. These commentators seem quite unaware that more than 96 % of the world population prefer to use metric measuring units. Japanese phased metrication is still continuing into the 21st century with sake bottles and tatami mats as examples of hold-outs.

## **Metric conversion**

Metric conversion is so slow that it may never succeed; so bitter that it divides families, industries, institutions, and nations; and so expensive that most nations probably cannot afford it. For example, I estimate that non-metrication in the USA costs over a trillion dollars a year. This is more than twice the annual cost of all military expenditure in the USA. See: '*Costs of non-metrication*' at <http://www.metricationmatters.com/articles>

Metric conversion sounds like it is moving toward the adoption of the metric system when the reverse is nearer to the truth. When people are told that (say) a room is 6 metres long, they ask, 'What's that in feet?' If they are told that there was 15 millimetres of rain during the night, they ask, 'What's that in inches?' Almost all references to metric conversion tables are to change metric units back into old pre-metric measures.

Metric conversion is almost always an attempt to retain the names of old pre-metric measures and to keep the old names the old measures are sometimes redefined using metric units. This has the effect of keeping alive many multiple methods of measurement alongside the metric system. This is usually referred to — erroneously — as dual measurement but it almost always is much more complex than dual measurement.

As an example of the complexity of 'dual' measurements consider the conversion from inches to millimetres in the English speaking nations. In 1958, there were several definitions of the word 'inch'. The UK used the Imperial inch and the Enfield inch; the USA used the customary inch and the survey inch based on the 1893 survey foot; the Canadian inch differed from all four of these, and the Cape inch in South Africa had yet another value. Because of the complexity of all the old pre-metric 'inches', the inch was officially redefined in English speaking nations as exactly 25.4 millimetres (1959 January 1). As metric specialists say:

*Don't duel with dual!*

Metric conversion is essentially about retaining old measuring words simply in an attempt to keep the old words alive. The old measuring words can then remain in use for many years. The obfuscation of measurement words that is inherent in metric conversion might keep the realisation of the truth of metrication away from public attention for many hundreds, perhaps thousands, of years. Remember the cubit is still around in some texts.

## **France — a special case**

Following the failure of phased metrication in France, some French people then chose metric conversion. As an example, they simply took an old word, 'livre' and redefined it as 500 grams (In 1789, there were 12 different livres in France varying from about 344 grams to 519 grams). A similar approach was taken in China with a 500 gram 'jin'; in Denmark with a 500 gram 'pund'; and in the Netherlands they not only redefined the 'pond' as 500 grams but also the 'ons' as 100 grams.

France was a special case because they initially tried phased metrication and when it failed they successfully used direct metrication for most things and metric conversion for some others (You can still hear Parisians ask for 'une livre' of fruit). They passed metric laws in the 1790s and these were universally ignored in favor of the old 'mesures usuelles'. This failure was corrected when the French government finally passed laws favouring direct metrication. The metric system was reinstated as the only measurement system in France from 1840 January 1. French people who did not use metric units were threatened with large fines and severe penalties but few, if any, were charged.

## What holds metrication back?

There are several issues holding back metrication. The main issue is the process that you choose for your metrication. You can choose from direct metrication, phased metrication or metric conversion and the repercussions of each of these decisions are described above.

However, there are also some other issues that will affect any metrication transition whichever process you choose. The main restraining forces involve:

- ◇ dithering,
- ◇ centimetres,
- ◇ hidden metric,
- ◇ power games,
- ◇ habitual cheating.

### **Dithering**

Dithering occurs when you have to choose between two or more different measures that seem to be equally good choices. Dithering is important enough to be considered as you go through the process of planning for your metrication because dithering can delay your metrication process remarkably.

As an example, think about the competition between the officially recognised metric unit for food energy, kilojoule, and some of the other common measuring words such as, calories, Calories, gram calories, kilocalories, or kilogram calories.

There has been only one official metric unit for measuring food energy since 1889 — kilojoules. As examples, a slice of bread contains about 250 kilojoules of food energy and a sweet biscuit has about 500 kilojoules of food energy. The kilojoule had been accepted as the sole unit for energy internationally since 1889.

However in 1918, 29 years later, Dr Lulu Hunt Peters popularised an alternative word, 'calorie', to describe food energy in the USA. Dr Hunt Peters defined a calorie as the amount of heat needed to heat 4 pounds of water by 1 degree Fahrenheit.

Many attempts were made later to define the word, calorie, in metric terms. But this only led to more confusion as different groups devised different definitions. Like other old pre-metric measures there are now far too many different calories (or Calories or kilocalories) and these have many different names and varying values.

The existence of these seemingly good choices (one accurate, the others popular) means that the debate between them will continue for many generations with nutritionists and dieticians dithering between them. To a measurement specialist there is only one choice, the kilojoule, but I suspect that women's and diet magazines will continue dithering.

You can avoid dithering by adopting a definite measurement policy. As another example, the Australian building construction industry conducted a smooth, rapid, and profitable metric transition using a definite measurement policy that read:

'The Australian Building and Construction Advisory Committee policy is:

*The metric units for linear measurement in building and construction will be the metre (m) and the millimetre (mm), with the kilometre (km) being used where required. This will apply to all sectors of the industry, and the centimetre (cm) shall not be used.'* \*

With these words the Australian Building and Construction Advisory Committee effectively banished centimetres from the building trades in Australia and there was never any chance of individual workers or companies dithering over whether to use centimetres or

millimetres for individual tasks or on individual jobs. They also made it clear that the centimetre should generally not be used, and in particular:

*'... the centimetre should not be used in any calculation and it should never be written down.'* \*

\*Standards Association of Australia 'Metric Handbook, Metric Conversion in Building and Construction 1972

The result of this policy was a smooth, rapid, complete, and profitable metric upgrade without any dithering.

Clearly, measurement policies don't have to be complicated but they do have to exist.

Among many other advantages, this policy also had the immediate effect of removing all references to fractions from building sites. Most other trades, crafts, and professions in Australia followed the example of the building industry, and subsequently followed the building industry's successful metrication upgrade. About 84 % of trades and crafts and professions now routinely use millimetres — and avoid centimetres.

### **centimetres**

Another example of dithering between two measures is in the case of centimetres and inches. When people choose centimetres as their small unit for measuring lengths they usually also bring the full range of skills acquired using the old pre-metric inch.

For example, since inches are divided by fractions then so is the centimetre. The world computer industry chose this approach when they set the defaults for word processors; when you set the defaults to centimetres they are automatically sub-divided into halves and quarters of centimetres despite the fact that one of the reasons for upgrading to the metric system in the 1790s was to get rid of fractions.

People opposed to the metric system sometimes protest about the absence of thirds, which they formerly needed for finding thirds of a shilling, thirds of a foot, or thirds of a yard. It takes them sometime to realise that thirds are rarely necessary in a decimal system. They are simply trying to transport their old skills to the metric units.

Another example is in the textile industry where they use quarter centimetres, quarter metres, thirds of metres, half centimetres, and half metres together with other measures divided by decimal fractions. For people who have trouble with fractions, having both vulgar and decimal fractions makes their lives (at least) doubly difficult.

Most trades and crafts (about 84 % in Australia) choose to use millimetres as their small length measure and by doing so they rid themselves of all fractions; both common or vulgar fractions, as well as decimal fractions. Fractions are simply never used.

It is sometimes difficult to judge the success of metrication efforts when some succeed easily and quickly while others fail slowly amid great cost and difficulty. Reasons for the differences become clearer when you ask: 'Did they choose centimetres or millimetres for their metrication process?' Metrication with millimetres typically takes less than a year; using centimetres can typically take at least 100 years.

### **Hidden metric metrication**

Some people choose to use the metric system to gain its positive benefits and then hide their use of the metric system from other people.

For example, when I visited the Kennecott copper mine in Utah, they had a tyre from one of their Caterpillar dump trucks outside the visitor's centre. It was 4 metres in diameter and I checked this with its imprinted dimension of 4.00 that was moulded into the rubber on the tyre. However, on the ground in front of this metric tyre was a sign that read, '13 ft 1-1/2 in'. The company was using a 4 metre tyre but labelling it with old pre-metric

measures presumably because they didn't want the public who visited their 'Public Information Centre' that they were using metric.

I was so intrigued with this deceit that I then traced through the whole copper mining process from mine to market:

- 1 The ore is torn from the mine face using explosives that are calculated in metric units.
- 2 The ore is loaded with loaders that were designed and built in metric units.
- 3 Dump trucks, designed and built by Caterpillar in the USA in metric units using metric fasteners such as metric bolts and metric screws, carry the ore out of the pit.
- 4 The ore is crushed to specific sizes specified in fractions of millimetres or more likely micrometres.
- 5 The separation of the ore from the minerals is done in flotation tanks under the supervision of trained chemical engineers who calculate the processes and the yields in metric units.
- 6 The mineral, in this case mostly pure copper, is then formed into bundles of cathodes of 5000 lb. so that the customers of the Kennecott Mine will not know that they are buying from a metric company.

I think of this process as 'Dumbing down at the door', where companies operate as metric companies internally, and then do whatever they can to hide what they are doing from their clients and the public.

Think of Ford and GM who buy all of their parts on the world market using metric units, design and build vehicles using the metric system, then tell their customers about mph, mpg, and psi simply because of the anti-metric efforts of a government lobbyist – often a long time in the past.

I cannot understand why people choose to use hidden metric. Their motivation is a mystery to me, but I suspect that it has something to do with how people perceive their acceptance by the rest of their community asking things like, 'Will I become a social outcast if I describe a length in millimetres?'

## **Power games**

Some people who are highly skilled in using arithmetic, especially mental arithmetic, encourage conversions between old pre-metric measures and modern metric units because it gives them an opportunity to show off their arithmetic skills, and they can belittle inexperienced students. This is a too-common practice among older engineers, scientists, mathematicians, and teachers.

Sadly, I have observed several professors who have chosen this path. Probably, the best approach to handling these people is to wait for them to retire or die, and to try and isolate them from students before that happy event.

## **Habitual cheating**

In some industries cheating is so endemic, and it has been practised for so long, that many participants in the industry seem to be unaware that they are habitual cheats. Here are several examples. Unfortunately, there are others.

### ***Shoe industry***

Shoes have been sold according to 'size numbers' since, at least the 1300s. A size number was originally the length of a barleycorn, '*chosen from the middle of the ear, full and round*'. But no specification was made as to where the measuring by barleycorns should begin. As a result, most of us can tell a story (or several stories) about shoes we bought as

the 'right size' but that proved within a few days not to fit properly and then they had to be thrown out or given to charity. Probably between 10 % and 20 % of all shoes suffer this fate – a direct profit to the shoe maker.

### ***Beer makers***

Beer makers who sell in containers that measure to the brim of the glass when everyone knows that beer is served with a 'head' of froth. This increases beer sales by about 10 % overall at the expense of the beer drinkers.

### ***Women's clothing***

Many items of women's clothing are sold by size numbers. In this case, there are often no underlying measurements at all. A size 16 this season might become a size 12 next season according to the whimsy of the fashion sales team. Many women have wardrobes containing unused garments bought from these unscrupulous marketers.

### ***Men's clothing***

Makers of men's clothing have discovered the opportunities afforded by dithering between centimetres and inches. They design and make their garments in inches and then sell to the public in size numbers based on 'nominal centimetres'.

### ***Oil industry***

The oil industry tells us the price of oil in 'dollars per barrel' each day. They do not buy oil in barrels; they do not sell oil in barrels; they simply calculate a theoretical oil price based on a theoretical oil barrel of unspecified size – and that never existed – to report to the public. Today's oil price was reportedly close to \$55 per barrel (probably about 35 cents per litre) and, today, I had to pay 109.9 cents per litre at the service station, where I had to serve myself.

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