Metric Eye

For the AgE guy (and gal)

Tony Grift

America loves its English units. Our ancestors divided the land in townships of 6 by 6 miles. An acre is one chain (66 feet) by 10 chains, the strip of land that was once worked by one man. The pound was originally divided into 7,000 grains, which is the product of a prime number (making it divisibly difficult), and a thousand, which indicates a metrication attempt.

We cherished the pound and the ounce, but what if weights or dimensions become really small? We use grams and milligrams, avoiding the headache of using grains or drams. As well, there is a different ounce in use for precious metals. The mil was devised, which amounts to 1/1,000 of an inch.

We came up with gages for almost anything. Most gages were inverted, a small number representing something large. There are gages for strings, steel wire, electrical wire, sheet metal, and shotguns. Drill bits and screws have a numbering system, and nails are measured in pennyweights. There is the bushel, which represents a volume of grain, and firewood is bought by the cord (128 cubic feet). The barrel (sometimes a weight, other times a volume) has more than 10 different values depending on the global location and trade that uses it. The U.S. paper industry specifies the total mass M of a ream of N pages of some size X x Y. This means, one needs to know four values to calculate the (scalar) density (grammage) of the paper.

Finally in 1999, NASA lost a Mars orbiter because one engineering team used metric units while another used English units for a key spacecraft operation. This "human error" cost the American taxpayer 125 million dollars.

The way we have dealt with measurements sounds outdated, a thing of the past. But even today we teach students both systems at best. Recent textbooks on soil and water conservation and food processing are still in English units. Textbooks on power and machinery use a semi-metric approach. Equations are given such that conversion factors still arise. Given, now we have 1,000, 60, and 3.6 instead of 1,714, 33,000, and 375. We tend to express our quantities in "customary units" such as the kW for power. However for torque, some books use N·m where others use kN·m. This semi-metric approach places the *Systeme Internationale* (*SI*) in the same obscurity as the English system. Students will still not try to remember a formula since they have to remember not only the conversion factors but also the customary unit of all quantities.

A unit system exists by virtue of its standards, which are of tremendous scientific and technological importance. This brings up the question as to where the standards are in the English unit system. Who keeps the standard tablespoon, guards the standard pound, and where does the standard horse graze? The truth is there are no English unit standards at all. Instead, they are since 1959 related to the *SI* standards. "The pound (*avoirdupois*) or international pound is the mass unit defined as exactly 0.45359237 kilograms (or 453.59237 grams)." One wonders how the United States can officially adopt *SI* standards but reject the metric system that is founded on them. It is like keeping the pedestal but trashing the statue. Mind the word "international." This might have been true in 1959; however, currently the United States is the only country in the world that still uses the English unit system.

There is no doubt in my mind that the student's intellectual development suffers by using English or both unit systems. They will inadvertently choose between a completely illogical "practical" language that is spoken at home and a refined, simple-to-use "abstract" language that is spoken mostly abroad.

Engineering is essentially applied mathematics and for this reason, apart from an introduction to the *SI* system, textbooks do not need units at all. When all quantities are given in pure *SI* (Speed in m/s, mass in kg), no time and brainpower is wasted on tedious unit conversions. Also, the formulas become so clear that a student will see the underlying concept and may even try to manipulate equations to unveil new concepts. This mathematical approach leads to real understanding rather than blunt regurgitation and a look-up-when-needed mentality.

Metrication means much more than swapping miles for kilometers. It means that we commit to speaking an international language, which will benefit us economically and intellectually. Although the tango is as old as the *avoirdupois* pound, it still takes two.

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