Anti-Metric?

You already use it more than you think!

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The United States has been in the process of converting to the metric system (called *metrication*) for over 20 years. In the mid-1970s, most British Commonwealth countries made the metric transition, leaving the United States in the company of other officially nonmetric countries such as Liberia and Myanmar (Burma). In fact, the US is the *only* industrialized nation not predominantly using metric. Even Britain is largely metric, but still uses miles on road signs and pints for beer. Closer links to the European Union have caused Britain to adopt metric much faster than the US.

So why are we not metric?

The reason we are not metric is a combination of limited opposition and a much larger portion of apathy. The fact that metric is not the "native" measurement system for most Americans breeds resistance. Some people refuse to change, mainly out of fear of the unknown. But that fear can be overcome with a better understanding of the simplicity of the metric system, a system that is much easier to use than our existing hodgepodge of units.

The apathy part comes from those who may know the benefits of metric measurement, but are unwilling to take steps toward that goal. They want someone else to change first. In this article we'll see how many products and services are already metric or have changed to metric in recent years. Because of these, we are more familiar with metric units than we may realize.

When most of us encounter metric units, it's often through conversion factors between inch-pound and metric units. Conversion factors, such as 3.28 feet per meter, only serve to cloud the simplicity of the metric system, where conversions between units use factors of 10. Dual units, however, are only a temporary inconvenience, since if we were fully metric, we would not be converting between metric and inch-pound units and would not encounter such odd conversions. This is a major advantage of having one unit system throughout the world.

The benefits of the metric system

The metric system is a decimal system, like our monetary system. In fact, the US pioneered decimal coinage in 1786. All other currencies in the world are now decimal. In Great Britain, the former system consisting of pounds sterling, shillings, pence, and farthings was abandoned in 1971. Now the British use a pound unit of currency that is divided into 100 pence. In the late 1960s and early 1970s all other countries using the former British system changed to decimal currencies as well, leaving behind the days of nondecimal monetary systems. The last country, Nigeria, changed in 1973.

In 1996, the Canadian Stock Exchange was decimalized, and the US stock exchanges are finally going decimal soon after the year 2000. As an intermediate step toward that goal, stock prices are now quoted in sixteenths, or 6.25 cent increments, down from eighths, or 12.5 cents. The switch to decimal trading will bring the US in line with the rest of the world's major exchanges.

Some people may argue the benefits of base 2 (binary) and base 12 (duodecimal) systems for measurement, as opposed to decimal. However, neither of these matches the world's existing decimal counting system, and would thereby suffer a major disadvantage if

used with decimal coinage and decimal measurement systems.

The metric system is more universal and international than the common units most Americans use. And we know well that amateur radio is an international hobby. Far more people use metric than not. When we talk on the air to anyone outside the US, do we expect them to understand our measurements in miles, feet, and inches, or our temperatures in degrees Fahrenheit?

In fact, the US is the only industrialized nation that still uses Fahrenheit in weather reports for surface temperatures. Upper air temperatures have always been measured and reported in degrees Celsius worldwide. And, as of July 1996, the international standard code for hourly and special surface weather observations (METAR) now uses degrees Celsius for the temperature and dewpoint fields.

The metric system is based on the idea of one base unit for all similar types of measurements, such as the meter for length. The meter can be subdivided into decimal parts by using prefixes, arriving at centimeters, millimeters, and micrometers. Or the kilo prefix can be applied to arrive at kilometers for larger distances. These units are factors of 10, 100, or 1000 different, and lengths can be converted in scale merely by moving the decimal marker. No need for numerous units for length such as inches, feet, yards, rods, and (statute and nautical) miles, where the conversion factors between units are all different. The units we use are not as well known as some people claim they are. Quick, what's the definition of an acre?

Most Americans do not realize that the metric system was made legal for all purposes in the US in 1866. Then, in 1893 our common inch-pound units were first defined and standardized in terms of metric units, which are regarded as the fundamental and internationally-accepted standards of length, mass, etc. Much later, in 1958, the definition of the inch was finally standardized *worldwide* as 25.4 millimeters exactly. Previously the definition of the inch varied among the major inch-using countries: the US, Great Britain, and Canada. The difference was enough to cause confusion, inefficiencies, and difficulties during World War II in attempts to interchange various precision products.

The pound and the gallon are also defined in terms of metric units (the kilogram and the liter) by US law, but to a larger number of significant figures than the inch. Before the metric system came along, there were numerous standards for most inch-pound units. These units varied greatly in some cases, causing problems in daily commerce. This problem still exists for some units, such as the foot, where the international foot (based on the standard 25.4 mm inch) and the survey foot (based on an older definition of the inch used by the US, which differs by 2 parts in 10^6) are both still in wide use.

This leaves us with two definitions of the mile, one based on the international foot and the other based on the survey foot. Although this may not seem like a big difference, it causes the two definitions of a mile to differ by about one-eighth of an inch, or 100 miles to differ by over one foot!

How we already use the metric system

Don't think that the metric system is strange. We use metric units in many ways now—possibly in many more ways than we realize.

The electrical units we currently use are part of the metric system. The ampere is a base unit in SI (the International System of Units). Other electrical units such as volt, watt, joule, ohm, farad, and henry are all derived metric units (combinations of base and/or other derived units).

Amateurs also use meters, centimeters, and millimeters for wavelengths. We have frequency allocations on the 160 meter through 23 centimeter bands. For higher frequencies we generally speak in terms of megahertz and gigahertz frequencies, which are metric units for multiples of cycles per second.

When building a dipole antenna, why struggle with the formula in feet? When using the formula in meters, the half-wave antenna length relates nicely to the radio wavelength. For example, on the 20 meter band, the half-wavelength is approximately 10 meters long, a more logical solution than converted to 33 feet. And for a vertical ground-plane antenna, the length is approximately one-quarter of the radio wavelength. For the 10 meter band, the quarter-wave antenna length is approximately two and a half meters,

You Be the Judge
(answers at bottom)

Question A: Which column would you rather add?
(The two sums are the same.)

1 yard 2 feet 3-1/4 inches
1 foot 11-3/16 inches
2 feet 5-1/2 inches
3 yards 1 foot 6-5/8 inches

1.607 meters
0.589 meters
0.749 meters
3.216 meters

Question B: A room measures 15 feet, 3-3/4 inches by 21 feet, 7-1/2 inches (4.667 m by 6.591 m). What is its floor area in square yards?
What is its floor area in square meters?

Question C: In designing a calendar, you wish to divide an area of 7-1/4 inches by 11 inches (184 mm by 279 mm) into 35 rectangles (that is, you wish to divide 7-1/4 inches by 5 and to divide 11 inches by 7). What are the dimensions of each rectangle in inches? What are the dimensions of each rectangle in millimeters?

Answer A: 6 yards, 2 feet, 2-9/16 inches, or 6.161 meters
Answer B: 36.79 square yards, or 30.76 square meters
Answer C: 1-29/64 inches by 1-37/64 inches, or 36.8 millimeters by 39.9 millimeters

again more logically related to the wavelength than when converted to eight feet.

Amateurs use kilograms for satellite mass (weight) and kilometers for satellite orbits. Kilometers are also used for best terrestrial distances for VHF, UHF, and microwave contacts—and how about low-noise amplifiers used for satellite reception? Such receivers are rated by temperatures in kelvins, an SI unit equal in size to the degree Celsius (the metric scale used for everyday temperatures), but on a scale with the zero point at absolute zero of temperature rather than at the freezing/melting point of water.

Surface mount chips are making the transition away from inch-based pin spacings to millimeter-based contact spacings. And many new electronic connectors use millimeter pin spacings.

Look at many other examples of metric usage that surround us:

In photography, we have 28-, 35-, and 70-millimeter (IMAX) width film. Lens and filter sizes are given in millimeters, as are eyeglass lenses and glasses frames. Stamps and stamp collecting supplies are measured in millimeters. Almost all pharmaceuticals and vitamins come in grams, milligrams, and micrograms. Many cosmetic containers are in rounded metric sizes. Most garden seeds are packaged in grams or milligrams. All food packages are required to have the net weight statement in both metric and non-metric units, and an increasing number of them are coming in rounded metric sizes. Nutrition fact labels on food packages show the mass of fat and other constituents in grams. Liquor and wine are bottled and sold in milliliters and liters exclusively.

Nearly all automobiles, trucks, motorcycles, and bicycles are now built using metric standards and components. The same is true for farm and construction equipment. Skis and snowboards are measured in centimeters, and soaring and sail planes use metric measurements for most applications. Olympic events are measured in metric units. Running race distances are mostly in kilometers, as are cross-country ski trails, rowing events, and most track and field events.

Those 3-1/2-inch computer diskettes are actually 90 millimeters in diameter, and compact videotapes are eight millimeters wide. CDs and DVDs have metric diameters as well. Light bulb power is measured in watts and light output in lumens. Mechanical pencil lead comes in 0.5 and 0.7 millimeter widths. Wallpaper often comes in five- and 10-meter lengths and metric widths. Construction adhesive and caulk are now packaged in 300 milliliter tubes. Several brands of dental floss come in metric (50 m and 100 m) lengths, as do all cigarettes. Luggage weight for international flights is measured in kilograms. And you thought metric units were only used outside the US! (Oh ... and don't forget your metric tool set!)

The metric system is not dead in America. After our initial steps toward metric in the 1970s, there has been some delay, but progress is currently being made in the areas of federally-funded road and building construction. The US is considering allowing metric-only labels on products to accommodate the export of those products to Europe, whereas dual labeling is presently required on all consumer products in the US.

Arguments for converting

Often we don't realize how much more difficult we make simple arithmetic problems by *not* using metric units. Our educational system spends numerous hours teaching our collection of units, fractions, and the conversion factors we need with these units. How many needless conversions are required to solve a problem like: There is a container four feet 11-13/16 inches tall, five feet 5-3/4 inches wide, and eight feet 3-3/8 inches long. How many gallons does it hold?

Or try this one: There is a field one mile 64 chains two rods three feet three inches by two miles 50 chains one rod two feet five inches. How big is the field in acres? Or how big is the field in square feet? Many of us do not even know the definition of a chain or a rod!

It is much simpler to solve these problems using the metric system, rather than with our nondecimal inch-pound units.

Also, *what if* we were already a metric country and people understood it, and *then* someone suggested that we change to new-fangled inch-pound units. That is when people would say: "What! You mean we should adopt a system where the ratios between the units are 12, 3, 1760, and 5280 for common lengths alone?!" Or: "You mean we need to use fractions!" Or even: "You mean we should measure temperature and put the freezing point of water at 32, and put the zero point at a place that has little or no meaning?" They would also say that this or that new unit is too small or too large, a common argument when converting to metric. Most people would think that such a proposal to change away from the metric system to a less logical system was absurd, and it is, because we don't see any countries doing that.

For more information

The metric system has been around since the late 1700s and in its modern SI form since 1960. Yet some Americans may not realize that most of the world uses metric. That's partly because our news media conveniently convert measurements in the foreign news, shielding us from metric usage that is prevalent in the world. Anyone who travels outside the US soon realizes that our nonmetric units are not used in other countries. On the other hand, much of the world either speaks or understands our English language, a trend that cannot be denied. Would it not be much simpler if the whole world spoke one language (but that's another story) and used one measurement system (metric)?

Many details on the metric system and its proper use are not included in this article. The US Metric Association (USMA) maintains a Web site which contains a wealth of information on the metric system, references to metric standards documents, as well as current information on the status of the metrication in the US. The URL is: [http://lamar.colostate.edu/~hillger/] or [http://www.metric.org].

The USMA also publishes a bimonthly newsletter titled *Metric Today*. 73