

## XVIII. SHOP NOTES

### A. MOCK METRIC IS FUN AND USEFUL TOO

"Four" is a magic number for students, engineers, and scientists in every field in which problems involve comparison or conversion of linear measures expressed in English and metric systems.

There is no obvious compatibility between meters equal to 39.37008 inches and inches equal to 0.0254 meter; one familiar with either may find frustration in the other. I have extrapolated that if my English ancestors who made the inch equal to the width of a man's thumb had been foresighted enough to also legislate a man's thumb equal to the fortieth part of a meter, the whole course of history could have been happier!

Nevertheless, we can enjoy a great deal of convenience by imagining the happy ratio. We can say with some degree of truth that a meter is forty inches, and we can imagine the forty-inch meter divided and subdivided into the usual metric units. This is to imagine a linear metric system whose units are a bit longer than standard units; a bit so small that for many practical purposes it may be ignored, yet known exactly so that it may be accounted for for other purposes. This is the happy-ratio, first-approximation, pseudometric system that I call "mock metric."

In mock metric, "4" is a magic number:

40 inches = 1 meter	1 inch = $\frac{1}{40}$ meter
4 inches = 1 decimeter	1 inch = $\frac{1}{4}$ decimeter
0.4 inch = 1 centimeter	1 inch = $\frac{10}{4}$ = 2.5 centimeters
0.04 inch = 1 millimeter	1 inch = $\frac{100}{4}$ = 25 millimeters
0.004 inch = 100 microns	1 inch = $\frac{100,000}{4}$ = 25,000 microns.

Any decimal-inch expression can be divided by 4 on mere inspection; the quotient is its mock-metric equivalent in decimeters and may be converted to any other mock-metric unit by shifting the decimal point. For example,

$$\begin{aligned} 7/8 \text{ in.} &= 0.875 \text{ in.} = \frac{0.875}{4} = 0.21875 \text{ dm} \\ &= 2.1875 \text{ cm} \\ &= 21.875 \text{ mm} \\ &= 21,875 \mu. \end{aligned}$$

In mock metric, "3" is a magic number too, but only for dealing with measurements expressed in feet. One need not multiply feet by 12 to obtain inches to be divided by 4;

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multiplying feet by 3 gives the same result expressed in mock decimeters.

For example,

$$\begin{aligned} 10 \text{ ft} &= 10 \times 3 = 30 \text{ dm} \\ &= 3 \text{ m} \end{aligned}$$

or

$$\begin{aligned} 5 \text{ ft } 9 \text{ in.} &= 5.75 \text{ ft} = 5.75 \times 3 = 17.25 \text{ dm} \\ &= 172.5 \text{ cm} \end{aligned}$$

and

$$\begin{aligned} 3 \text{ ft } 4 \frac{1}{2} \text{ in.} &= 3 \text{ ft } 4.5 \text{ in.} = 3 \times 3 + \frac{4.5}{4} = 9 + 1.125 \\ &= 10.125 \text{ dm.} \end{aligned}$$

These mock-metric expressions so easily obtained are known to be not exact standard metric statements. A feeling for the degree of inexactness is needed for judgment as to whether or not it may be ignored in a given situation. And exact knowledge of the order of the inexactness is needed wherever the inexactness is to be accounted for. Both derive most logically, I think, from considerations of the 1000 standard millimeters that make a standard meter and the 1000 mock millimeters that make a mock meter. Since

$$40 \text{ inches} = 40 \times 25.4 = 1016 \text{ standard millimeters}$$

and

$$40 \text{ inches} = 40 \times 25 = 1000 \text{ mock millimeters,}$$

it follows that

$$1000 \text{ any mock units} = 1016 \text{ similar standard units.}$$

The order of the inexactness of this first approximation that I call mock metric is 16 parts in 1000 or 1.6 per cent. Obviously, if 1.6 per cent of itself is added to any mock-metric figure, the sum will be the exact standard metric equivalent.

But an easier trick may be to make a second approximation by adding to a mock-metric figure one-sixth of 10 per cent ( $1/6 \cdot 10$  per cent) of itself.

For example,

$$1 \text{ inch} = \frac{1.000}{4} = 0.25 \text{ (mock metric or first approximation)}$$

$$1 \text{ inch} = 0.2500 + \frac{0.025}{6} = 0.25416 \text{ (second approximation).}$$

But we know that

$$1 \text{ inch} = 0.25400 \text{ standard metric exactly.}$$

Thus it is seen that the inexactness remaining in the second approximation is

reduced to 16 parts in 25,000, which is less than 0.1 per cent and, I think, of approximately the same order as the inexactness of our knowledge of the earth's circumference!

For practical purposes then, in circumstances for which a 1.6 per cent error is not significant or meaningful, the first approximation serves. In more stringent circumstances in which 1.6 per cent may be significant but 0.1 per cent not meaningful, the second approximation serves.

Unusual circumstances that require accuracy better than 1 part in 1000 justify the exact computation instead of the second approximation. And there is no easier way to make the exact computation than to multiply the mock-metric figure by 1.016.

Exact conversion formulas are:

$$\text{meters} = \left( \frac{\text{inches}}{4} \right) 1.016 \text{ standard metric}$$

$$\text{feet} = (3 \times \text{feet}) 1.016 \text{ standard metric}$$

$$\text{feet and inches} = \left( 3 \times \text{feet} + \frac{\text{inches}}{4} \right) 1.016 \text{ standard metric.}$$

The whole philosophy of mock metric is reversible, of course. Any standard metric dimension multiplied by 4 produces a figure that is a first approximation of equivalent inches, or, if divided by 3, a first approximation of equivalent feet, either of which is exactly 101.6 per cent of the exact equivalent. We may divide the first approximation by 1.016 to obtain the exact equivalent, or reduce the first approximation by  $1/6$  - 10 per cent of itself to obtain the second approximation, with certain knowledge that the remaining error will not be as much as 0.1 per cent.

The decimal point is the same problem in mock metric as in standard metric. In any case, it requires attention to ensure cranking out answers having an error factor of less than 10!

Mock metric defies Parkinson's Law. It is for the man in a hurry, for mental calculation, for solution by inspection, for the fun of empathy with the work you do!

Would you like to see an actual mock-metric scale? Just take any decimal-inch scale and you have it in your hands. Every 0.4-in. interval is a mock centimeter, every 0.040-in. interval a mock millimeter. Only the legend has been arranged to read in terms of inches!

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