

# Chapter 15

## The Mass of The Kilogram and of Signatures

Any national discussion of a metric system conversion in the US public media or in government simply vanished from view after the 1980s. The 1990s and 2000s came and went in metric silence. Pat Naughtin had done what he could to reignite a discussion of metric conversion in the US, but appeared to have little impact. The world of technology had dramatically changed how the world communicated since the era of the 1980s. Pat Naughtin left a body of work on his website, where it was still available for all to access as he had wished. Naughtin bequeathed his *Metrication Leaders Guide* for all to read on his website. At least the metric conversion knowledge he had acquired over his lifetime, would in all likelihood, be preserved somewhere in cyberspace, should it ever be needed to help guide a US metric conversion.

Very few articles appeared calling for the US government to act on metrication. A singular occurrence was when the Editorial Page Editor of *Barron's* offered this viewpoint in 2002:

... there are few places in the economy where the government can actually legislate American efficiency. The system of weights and measures is one of them. Congress can and should convert the country to the metric system.<sup>[1]</sup>

Any mention of the metric system in the popular press, especially by the business press, was minimal in the first decade of the 21st Century. When the metric system was mentioned, it was often from an anti-metric point of view.

On September 26, 2006 the *California Department of Transportation*, which had adopted metric, changed back to Olde English units after

*California Department of Transportation*

*Flex your power!  
Be energy efficient!*

## *Deputy Directive*

*Number:* DD-12-R1

*Refer to  
Director's Policy:* DP-15-R-1  
U.S. Customary  
(English) Units

*Effective Date:* October 2006

*Supersedes:* DD-12 (08-25-93)  
Metrication

**TITLE** International System (Metric) to U.S. Customary System (English) Transition

**POLICY**

The California Department of Transportation (Department) has adopted the use of English units as its preferred system of units and measures. The transition to the English system is to be accomplished efficiently, minimizing impacts on project delivery. Projects on the State Highway System advertised after June 30, 2007, regardless of funding source, shall utilize the English system of units and measures unless granted an exception.

Figure 15.1: Title of memo which announces the 2006 change back to Olde English Units from metric at the *California Department of Transportation*. Effective on 2007-05-30, an exemption must be obtained from the State of California to utilize the metric system.

using metric for ten years. Kevin Herritt was the project manager of the Metric To English Transition at the Division of Design.

The 2008 Elections in the US brought out political commentators, who mostly used the possibility of America becoming metric as a scare tactic. The July 25, 2008 *Wall Street Journal* published an article entitled “Take Me To Your Liter.” The article is a polemic laced with sarcasm which would seem more appropriate in a tabloid paper:<sup>[2]</sup>

The single most disturbing thing we have heard about Barack Obama is this paragraph from a report in the German tabloid Bild, describing the candidate’s workout in a Berlin hotel gym:

He goes and picks up a pair of 16 kilo weights and starts curling them with his left and right arms, 30 repetitions on each side. Then, amazingly, he picks up the 32 kilo weights! Very slowly he lifts them, first 10 curls with his right, then

10 with his left. He breathes deeply in and out and takes a sip of water from his 0,5 litre Evian bottle.

This shows just how far to the left the Democratic Party has lurched since 2004. Back then, the party decisively rejected Howard Dean, an advocate of the metric system, in favor of the “electable” John Kerry\*, who kept any pro-metric sympathies to himself. Now the Dems have nominated someone who actually uses the metric system.

Adherents to the metric cult like to rave about how easy it is to multiply by 10. It’s a familiar enough refrain: “We were only following orders [of magnitude].” . . .

\* The haughty, French-looking Massachusetts Democrat, who by the way served in Vietnam.

The effectiveness of this polemic relied on the ignorance of the American public concerning the fact that Germany became metric in the 19th Century. It would not be possible for candidate Obama to easily avoid using it in a metric country. This was of course not the point, the statements were all made for political impact, and to generate fear that an uncomfortable change might occur should Obama become president.

The media continued to fan the flames of fear. When Al Franken was elected as Senator from Minnesota, CNN’s John Freehery lamented: “The metric system is the kind of thing that you can expect from the 60–vote filibuster-proof majority Democrats now have in the United States Senate.”<sup>[3]</sup>

The constant problems that weights and measurement miscommunication caused in trade between the US and the metric world continued silently in the background, and seldom made it into the US press. In 2002, Woodland California businessman Carlos Zambello, manager of *The Wild Rice Exchange*, sold a shipment of rice to a customer in Japan. Zambello quoted the rice at 39 cents per pound. The Japanese business thought Carlos had quoted it as 39 cents per Kilogram. With 2.2 pounds in a Kilogram, the actual price was 81 cents per Kilogram. Zambello wanted to do business with them in the future, and marked his rice down to cost. Both parties lost money and the representative had to explain to her boss in Japan how this mishap occurred.<sup>[4]</sup>

Mistakes like these do not occur between countries other than the US, because they are all metric. Clinging to Olde English measures promotes a very negative view of America and Americans. In 2010, a

Baltic businessman offered some pointers to his fellow citizens on how to do business with Americans. He points out that Americans are rather geographically arrogant, and feel they need to know little about the world beyond their border. The author then relates the steps it takes to move a bushel of grain from the US to his country:<sup>[5]</sup>

This arrogance extends to weights and measures. While some American companies use the metric system, most do not. It is crazy not to. I worked in commodity trading for 20 years and these are the calculations you made:

1. You bought grain from farmers in bushels — a bushel of corn is 56 lbs (25 kilos).
2. You shipped the corn by railroad to a port or a barge loading point. U.S. railroads charge by 100 weight (100 pounds or 45 kilos) or short tons (2,000 pounds or 900 kilos).
3. Ocean shipping is calculated in long tons (2,240 pounds or 1,000 kilos).
4. Sales overseas are calculated in metric tons

All these transactions could have been accomplished in Kilograms, without bushels, hundred weights, long tons, or short tons, with far, far, less of a chance of an error. The use of metric tons rather than the proper term Megagrams is an example of poor international use of the metric system. The ton is a pre-metric unit.

Following the 2008 US election, four years passed, and the Obama Administration remained silent on the issue of US metrication. Barack Obama was re-elected in November of 2012. President Obama, and his administration had not addressed metric in his first term, and appeared well on their way to ignoring it in their second.

On December 31, 2012 a *We The People* petition was launched on the whitehouse.gov website, by R.C. from South Pasadena, CA. The text of his petition is:

WE PETITION THE OBAMA ADMINISTRATION TO:

**Make the Metric system the standard in the United States,  
instead of the Imperial system.**

The United States is one of the few countries left in the world who still have not converted to using the Metric System as a standardized system of measurement. Instead of going along with what the rest of the world uses, we stubbornly still adhere to using the imprecise Imperial Unit - despite the fact that practically every other country that we interact with uses Metric.

Why should we convert to using the Metric System? Because it's superior, less convoluted - everything is ordered in units of tens, while the chaotic arrangement of the Imperial System slows things down for us - not only in terms of education, but also businesses, science, foreign relations, and daily life.

Created: Dec 31, 2012

Issues: Education, Science and Space Policy

The petition attracted almost 50 000 signatures, which is twice the number of signatures needed for a mandatory Whitehouse response on the issue. On the Friday before Memorial Day weekend, a response was posted:

Official National Institute of Standards and Technology  
Response to Make the Metric system the standard in the  
United States, instead of the Imperial system.

Supporting American Choices on Measurement

By Patrick D. Gallagher

Thanks for your petition.

Theres a lot of history here. Right after the Civil War, President Andrew Johnson signed legislation that made it "lawful throughout the United States of America to employ the weights and measures of the metric system in all contracts, dealings or court proceedings." In 1875, the United States was one of the original 17 nations to sign the Treaty of the Metre. Since the 1890s, U.S. customary units (the mile, pound, teaspoon, etc.) have all been defined in terms of their metric equivalent.

So contrary to what many people may think, the U.S. uses the metric system now to define all basic units used in commerce and trade. At the same time, if the metric system and U.S. customary system are languages of measurement, then the United States is truly a bilingual nation.

We measure distance in miles, but fiber optic cable diameter in millimeters. We weigh deli products in pounds, but medicine in milligrams. We buy gasoline by the gallon, but soda comes in liter-size bottles. We parcel property in acres, but remote sensing satellites map the Earth in square meters.

While many countries mandate the use of the metric system by law, the U.S. Congress has repeatedly passed laws that encourage voluntary adoption of the metric system. We use a mixture of metric and customary units depending on the context. We also have a long tradition of voluntary standards and our bilingual system of measurement is part of that tradition.

The Commerce Department's National Institute of Standards and Technology (NIST), the agency I direct, was specifically tasked by Congress to help businesses and federal agencies adopt use of metric units.

The NIST Metric Program provides manufacturers and exporters with the information about the metric system they need to sell U.S. goods abroad. And it helps distribute resources for educators who are teaching the metric system in their classrooms. That responsibility is growing as more students look to careers in science, technology, engineering, and math, where metric is universal.

Since the 1970s, all American schools have taught the metric system. Many federal agencies use metric routinely, and the U.S. military does so almost exclusively. Moreover, since Congress updated the Fair Packaging and Labeling Act in 1992, most consumer products in this country are labeled in both metric and U.S. customary units. So-called dual-unit labeling has helped consumers become familiar with using metric units.

NIST is currently working to make it possible for manu-

facturers to label their products with metric units only (.pdf) if they choose to do so because it will reduce their costs or improve their international competitiveness.

Ultimately, the use of metric in this country is a choice and we would encourage Americans to continue to make the best choice for themselves and for the purpose at hand and to continue to learn how to move seamlessly between both systems.

In our voluntary system, it is the consumers who have the power to make this choice. So if you like, “speak” metric at home by setting your digital scales to kilograms and your thermometers to Celsius. Cook in metric with liters and grams and set your GPS to kilometers.

We were thrilled to see this petition from “We the People” succeed. Feedback like this from consumers shows everyone from policy makers to businesses how important having this choice is to Americans.

So choose to live your life in metric if you want, and thank you for signing on.

*Patrick D. Gallagher is Under Secretary of Commerce for Standards and Technology and Director, National Institute of Standards and Technology*

This response was offered on the Friday before a major US holiday, which is the typical timing used to bury any possible media interest.

The website *Gizmodo* was quick to comment on the NIST Directors petition response on May 24, 2013:<sup>[6]</sup>

The White House ends the response by saying ‘choose to live your life in metric if you want’. Basically, do whatever you want because the US will never officially change to the metric system.

On August 27, 2013 *Discovery News* reacted to the electronic epistle offered by Dr. Gallagher by epitomizing his statement in response the metric system thus:<sup>[7]</sup>

We as Americans can choose to live our lives as metric. Essentially living as a bilingual family using celsius at home and Fahrenheit at school and work—that’s dumb.

David Wogan, writing for *Scientific American*, published a blog on August 20, 2013, entitled: “You know what the rest of the world has figured out? The metric system. Its time the US got on board” which ended:

While speaking in metric at home is encouraged, I disagree with Mr. Gallaghers statement that being bilingual in the unit system sense is good – its unnecessary. We need a national standard – not a choice – if we want to speak the language of science.

The latest attempt by members of the public to petition their government to switch to the metric system had a low number of signatures by historical standards, but they were gathered in a very short time period. Once again the request was ignored by the executive branch.

This exchange demonstrated two aspects of the metric discussion which are perennial in the US. The first is that anti-metric people frame metrication as a social change, and not a technical one. The farrago of Olde English units used in America are often called US Customary Units. They are marketed as a social custom, which must be preserved it is argued. The second is that the anti-metric voices frame metric as a system needed only by scientists—which doesn’t include them. The *Scientific American* blogger attached the metric system to science, rather than describing it as a system which has been designed for everyone. This immediately allows metric conversion to become an issue which is unpopular because of the long time anti-intellectual culture nurtured in the US, and appears to only increase its influence.

In 2013, the head of US Metrication, Elizabeth Gentry of NIST, was given an award for her metrication work. It was described in a press release:

Ms. Gentry was selected in recognition of her exceptional leadership as metric program coordinator with the National Institute of Standards and Technology, Department of Commerce. Ms. Gentry serves as the nations focal point for voluntary conversion to the metric system. She led an effort to persuade states to amend their laws and regulations to permit manufacturers and retailers to voluntarily use metric

units on their packaging. At the same time she worked to ensure the laws of other countries to continue allowing current U.S. labeling while the transition occurs.

The irony is that the transition to metric has been a non-occurrence for about 150 years. The argument for the allowance of metric-only labeling on packaging in all 50 states, and then waiting for Market Darwinism to jump start metric is essentially the same argument made in 1866, and more forcefully by the chairman of the 1921 metric hearings who stated that “the great law or science of commerce ought to adjust it.” What was ignored, yet again, was the Australian experience. In his monograph *Metrication in Australia*, Kevin Wilks offers this assessment:

In hindsight, the early conversion of quantity statements on packaged goods and changes in package sizes had little impact on public education due largely to the universal existence of the supermarket method of marketing, in which packages were selected by the customer by visual size rather than by quantity name in either imperial or metric.

Australia had already shown that *mandatory* metric only packaging had proved completely ineffective, yet this snake oil is perennially sold by Market Darwinists as the hope for the future for metric in the US.

The worst aspect of this press release is that Ms. Gentry was praised for keeping the rest of the world from refusing our products because they do not conform with those of the rest of the world. Protecting the use of ancient pre-scientific measurement values on our products, is seen to be a great accomplishment. It is clear that the current culture in government is simply hostile to the metric system, and proudly so.

In August of 2014, John Bemelmans Marciano had his book *Whatever Happened to the Metric System?: How America Kept Its Feet* published by Bloomsbury USA. Marciano’s book contains little about the metric system, and reads like dilettante sociology. While one would suspect this book to be about why the US does not use the metric system, the majority of the book is a historical digression. About one-quarter of the book is dedicated to the horrors of the French Revolution and metric is charged as an accessory to the horrors involved.

Marciano does not mention John Wilkins as the creator of the metric system, even though this information is readily available, and any

serious modern history would include it. John Wilkins did not create the system in a vacuum, William Brouncker and Christiaan Huygens collaborated. Marciano is clearly aware of the seconds pendulum as a candidate standard, but remains silent on the controversy surrounding the choice of the Earth over the seconds pendulum.

The book contains only a minute amount of information about the modern metric system or SI. It spends a considerable amount of time on spelling reform, and Melvil Dewey (1851-1931), esperanto, base ten time, calendar reform, money, and anything that the author finds to be a combination of red herring and albatross to place around the neck of the metric system. He then uses them to tarnish the metric system with guilt by association, no matter how tenuous that association might be. The absence of any discussion of actual numerical representation and discussion is deafening.

Marciano quotes Tom Wolfe: “NASA had gone to the moon on inches and pounds and had never considered any other system.” This statement is quite incorrect. The computers on the Apollo spacecraft performed all their computations in metric. The outputs were converted into US medieval units.

The success of rational, democratic metrication in Australia is completely avoided with the statement that it was a: “relatively straightforward project.”

The only book published in the 21st century on the metric system in the United States, simply pontificates against the metric system, without any actual content. The book *Whatever Happened to the Metric System?* is simply a vacuous anti-metric polemic. It would also be a portent.

On June 4th 2015, Former US Senator (D-RI), and Governor of Rhode Island, Lincoln Chafee, announced he would be running for President of the United States. In his announcement speech, Chafee addressed a number of important issues such as infrastructure, climate change and education. Chafee reminded the public that he voted against the resolution for the Iraq war during the George W. Bush administration. The newly announced candidate argued for a renewal of the United Nations, and the elimination of diplomatic posts going to the highest bidder. He asserted we will abide by the Geneva Conventions, and not torture prisoners. Chafee called for allowing Edward Snowden to come home to the US. Chafee continued with a long list of important issues. Then *fourteen minutes* into his speech the candidate stated:

Earlier I said let's be bold. Here's a bold embrace of internationalism. Let's join the rest of the world and go metric. I happen to live in Canada and they completed the process. Believe me it's easy. It doesn't take long before 34 degrees is hot. Only Myanmar, Liberia and The United States aren't metric and it will help our economy.

The press took note of Lincoln Chafee's proposal for a metric United States, and that became the tagline for his speech. Suggesting a metric America was proof certain that he is indeed a far-out, non-serious fringe candidate. Chafee is incorrect that Canada has transitioned to metric, they still do all their housing construction in Imperial. They have a metric veneer covering an Imperial interior and live in a metric purgatory. England is far more metric than Canada. He was indeed bold when using a temperature example, which has the least amount of utility as an example of metric superiority. Indicating he lives outside of the US in Canada, and is now running for President of the United States, only welds metric and foreign together, yet one more time.

*The Daily Show with Jon Stewart* reached around two million viewers each night in 2015. Stewart skewered Lincoln Chafee and his metric proposal the same night:

Jon Stewart: Alright Chafs, hit us with your Hillary crushing vision for America.

Video of Chafee: Here's a bold embrace of internationalism. Let's join the rest of the world and go metric.

[Audience Laughter] Stewart blankly stares at the camera.

Jon Stewart: The time has come America, to switch to centimeters. [Audience Laughter] And why use cars when we can relax and exercise by travelling only by recumbent bicycle. Wait where's everybody going I haven't passed around my homemade .. blondies yet. Why would you launch your campaign by invoking one of Jimmy Carter's most notable non-hostage related failures?!

Video of Chafee: Only Myanmar, Liberia and The United States aren't metric...

Jon Stewart: You want to be our president and yet you don't know we don't give two shits about other countries? Or...or if I may, to put that in metric terms, point oh two millifeces.

Not all the coverage was negative. NBC News, on their website, had the headline: *A Case for Litter-Ship: Advocates Cheer Lincoln Chafee's Metric Proposal*. CNN had *Lincoln Chafee: Go bold, go metric*. CNN also published a blog by John Bemelmans Marciano entitled *No, America Shouldn't Go Metric*, where Marciano asserts:

The only reason for us to switch is exactly the one Chafee brings up – that it would be “good for our international reputation.” Yet beyond this being of questionable logic – would it really net enough good PR to justify the billions in dollars it would cost us to convert? – there is the underlying notion that it is bad for us to be out step with the rest of the world.

Marciano is either an incredibly poor researcher or willfully ignorant of the advantages to construction, medical practice, and everyday life, metrication would provide. He also states *without any reference of any sort*, that it would take billions of dollars to convert to metric. This was asserted by anti-metric persons in Australia, and proofed to be illusory. Marciano invoked truthiness as his proof, and in the contemporary US, this is far more effective than a scientific dissertation, as it is based on emotion, which everyone can understand.

Lincoln Chafee dropped out of the U.S. Presidential race on October 23, 2015. CNN had the headline: “Lincoln Chafee Drops Out Of The Democratic Presidential Primary” with the subtitle: “Farewell to dreams of the metric system becoming a campaign issue.”

*Esquire* interviewed Chafee in October of 2016, just before the election. He had this to say about his metric proposal:

**Looking back on the primary, are there things you wish you did better?**

I guess the big mistake—I went back and forth on including the metric system angle. I was just crossing my

fingers there would be some intellectual approach to the various proposals I put out in my announcement speech, which kind of covered the gamut, from ending capital punishment, to bringing Edward Snowden home. Also, I was for TPP. Unfortunately, my crossed fingers didn't work, and it just turned into more of a joke about metric, not "let's look at the bigger picture." I think, and it's a trend, there's just less of a Walter Cronkite, I call it, approach to the news. It's entertainment. Donald Trump, early on, said: I'm just going to push every possible emotional button I can. I don't care! And he crushed the nomination.

**The metric system seems like it works everywhere else.**

Canada had it. And I was there when they were doing the transition to it. It's no big deal!

**It could be our undercurrent of anti-European sentiment.**

Yup. I was saying, should I put it in or not? My wife said, no, it will be misunderstood. And she was right.

In June of 2019 *Fox News* personality Tucker Carlson went after the metric system:

Almost every nation on Earth has fallen under the yoke of tyranny—the metric system, From Beijing to Buenos Aires, from Lusaka to London, the people of the world have been forced to measure their environment in millimeters and kilograms. The United States is the only major country that has resisted, but we have no reason to be ashamed for using feet and pounds. So says *New Criterion* editor James Panero.

James Panero, had earlier penned an anti-metric article titled *Be a Leader, Not a Litter* in the *Wall Street Journal*. The article enlists every common metric system misconception of the last 100 years, so-much-so, that its prose creak. Panero is an art critic, with a background in the classics, and art, who sees himself as a "A preeminent voice of

American cultural conservatism.” World Metrology Day had stimulated his cultural hackles, producing the vacuous sarcasm found in his article. The only recent metric news had been the decision to finally define the Kilogram in terms of natural phenomena, rather than an artifact. The Kilogram is now tied to Planck’s constant which Panero opines:

With the European Union being cut down to size, can we hope for a return to British imperial units, which the U.K. was forced to abandon after it joined? A pints a pound, the world around, and it beats walking the Planck.

In the United States, the metric system became simply a culture war talking point for the right, and a non-existent one on the left. The phrase “A Pint’s a Pound the World Around” originated with a 19th century organization, the International Institute, who wrote a song in 1883, with the same title, A Pints a Pound the World Around, which contains these lyrics:

For the Anglo-Saxon race shall rule  
The earth from shore to shore  
Then down with every ‘‘metric’’ scheme  
Taught by the foreign school

A perfect inch, a perfect pint.  
The Anglos honest pound  
Shall hold their place upon the earth  
Till Times last trump shall sound!

Which have a very obvious appeal to colonialism and racism, and has its origins in the pseudo-scientific notion of the existence of a sacred “pyramid inch.”

On February 22, 2016 CBS *60 Minutes* aired a report that showed laminate flooring manufactured in China, and sold by Lumber Liquidators in the US, had dangerous amounts of formaldehyde outgassing. A scandal ensued and the Center for Disease Control (CDC) issued a report which quantified the expected danger from the measured levels of formaldehyde released into indoor air from the non-compliant flooring.

In some of the calculations CDC scientists made mistakes. They forgot to convert feet to meters. The actual values are 3.3 times higher than government scientists originally calculated. The original CDC report estimated the risk of cancer from product exposure was 2 to 9 cases per 100 000 people. After the correction, the risk range increased to between 6 and 30 cases per 100 000 people.

By the first decade of the Twenty-First Century, the metric system was transparent for 95% of the world's population. It was such a commonplace everyday fact of life for everyone outside of the US, that it was unseen, and undiscussed generally. Like air, it would surround them, remain unnoticed, but be essential for the continued existence of our civilization as we know it. This would be true until 2007, when it was announced that the last artifact used in the metric system, the Kilogram, was discovered to have changed by about 50 micrograms.

The original Kilogram was defined as a weight and not as a mass. Its value was determined using the original meter to form a cube of water. The weight unit of the metric system in 1795 was the gram. This unit was defined using a cubic volume of pure water which was one-hundredth part of a meter (10 mm), at the temperature of melting ice. The gram is a rather small unit, about the weight of a plain chocolate m&m candy, which made it a very difficult quantity to measure and define at that time.

Cubic volume was centimeter based, and difficult to measure, so it was decided to go with a cube which was 1/10 of a meter (100 mm) instead. This is the length known as a decimeter, which is essentially archaic. The new 100 mm (decimeter) cube was utilized, but then another problem was encountered. When water was cooled below about 0.3° C to 0.4° C a small amount of ice would form. Ice has a lower density than water, and as we all know, floats in water. This would have compromised the weight measurement.

Water is most dense when cooled to 3.98° C, which with the limited measurement methods of the time, was defined as 4° C. This would be the temperature of water where the Kilogram would be defined, at its maximum density. In 1799, the weight of a decimeter (100 mm) cube of water was determined, and from this value, a metal prototype was formed with equivalent weight. This new metal weight became the accepted definition of the Kilogram.

The official Kilogram was now an artifact. The artifact was stored

away and treated with all the concern one has for the unique and irreplaceable object that it is. The Kilogram was known as the *kilgrave* for a short period of time. The prototype cylinder of 1799 was replaced with a new metal cylinder in 1889. The new standard is constructed of an alloy of platinum and iridium, which at the time was expected to have the most practicable resistance to chemical reaction and wear. The height and diameter of the new cylindrical standard is about 38.4 mm. To this day, 125 years later, this is *the Kilogram* upon which all other Kilograms are calibrated.

Defining the Kilogram with an artifact, rather than in terms of a scientific phenomenon is known to be problematic. Herbert Arthur Keim in his 1972 book *The Science of Measurement* states:

Unlike the meter and the second, the kilogram has no present referent in nature; it is an arbitrary amount of mass. Today the meter is no longer the distance between marks on a man-made bar, but a stated number of wavelengths of light emitted by Krypton atoms, and the second of time is the duration of a stated number of oscillations of radiation by cesium atoms. It is not impossible that, even before the twentieth century ends, the kilogram also will be redefined, perhaps as a large multiple of the mass of the atom of some designated element. Meanwhile, the prototype cylinder, stored under triple bell jars, remains *the kilogram*. . . .

While we wait for the choice of a more constant mass standard, traces of microscopic film add infinitesimally to the mass of the kilogram, year by year, despite all the many precautions.

Klein's guess as to what might be used to replace the Kilogram was not too far off. He was overly optimistic about how soon the Kilogram might be redefined. We are into the second decade of the 21st, and still there are two competing options. The first is to create a sphere of silicon atoms which is approximately 93.6 mm in diameter and count the number of atom which it contains.

The choice of silicon is a practical one as it is the element which has been evaluated, studied and fabricated by the semiconductor industry for decades. The diameter of the sphere would be measured using light interferometry like that used to redefine the meter in terms of wavelengths. The radius of the sphere would be determined to about 300

picometers, which is a measurement on the order of a single layer of atoms. The use of X-rays, allows technicians to determine the spacing between atoms, which is of paramount importance in computing the total number of atoms contained by the sphere.

Unfortunately pure silicon oxidizes, forming an oxide layer of two different varieties, which produces a material variation which is approximately 5-20 atoms thick. This produces an uncertainty which must be addressed to create an accurate standard. This is a problem from which the original Kilogram prototype does not suffer, as platinum and iridium are noble metals which have almost no chemical reactions with the atmosphere.

The other option is known as a Watt-Balance. This is a weighing scale with a single pan. It determines the amount of electrical power required to oppose the weight of a Kilogram under test which has the force of the Earth's gravity acting upon it in the opposite direction. The Watt-Balance relies on a very precise determination of the gravitational constant  $g$ , which has proven to be very problematic to determine, and has one of the largest uncertainties of all the fundamental constants of physics. There are also local variations in  $g$  from changes in water table and other geological shifts.

For better or worse, the difficulties with the Kilogram will bring the metric system back into the consciousness of the American public, for as long as the Kilogram is not yet effectively redefined. Unlike the short term impact of the Mars Climate Orbiter, the Kilogram difficulty will in all likelihood return to the news periodically, as it is of ongoing interest.

On May 25, 2018 *The Daily Observer* of Monrovia Liberia reported that their government pledged a commitment to adopt the metric system. "Commerce and Industry Minister Wilson Tarpeh has said the government is committed to adopting the metric system to promote accountability and transparency in trade."<sup>[8]</sup> The newspaper continued:

... on May 24, [Tarpeh] explained that the government is aware that if it does not adopt the metric system, local manufacturers will find it difficult to benefit from the various ECOWAS trade agreements.

The minister therefore challenged participants at the celebration to develop a policy that will lead the government to adopt the metric system.

In October 22 of 2015 Myanmar announced it would move toward the metric system. By 2017 there was some waffling. As Myanmar is a country that has been torn by civil war for decades, this chaos may preclude a metric change-over for some time. It is quite possible at this point to argue that the United States is the final country on Earth that has not adopted the metric system. It certainly has the largest GDP.

In 2019, the Alcohol and Tobacco Tax and Trade Bureau of the Department of the Treasury proposed adding new values of standard wine and distilled spirit volumes to augment existing ones.<sup>1</sup> This was in response to requests by industry according to the proposal. The addition of 200 mL, 355 mL, 250 mL, 700 mL, 620 mL and 2250 mL are proposed for compatibility with existing international volumes. These requests appear reasonable, but in tandem with this request, is one that proposes that US Olde English labeling be returned, and metric only labeling eliminated. The title of the change is: “Elimination of Certain Standards of Fill for Distilled Spirits; Amendment of Malt Beverage Net Contents Labeling Regulation.”<sup>2</sup> The wording indicates this is to emphasize what they *claim* is already law:

TTB is also proposing to amend the labeling regulations for distilled spirits and malt beverages to specifically provide that distilled spirits may be labeled with the equivalent standard United States (U.S.) measure in addition to the mandatory metric measure, and that malt beverages may be labeled with the equivalent metric measure in addition to the mandatory U.S. measure. Such labeling is currently allowed, but that is not explicitly stated in current regulations. This revision will align the distilled spirits and malt beverage labeling regulations with current policy and also with the wine labeling regulations. The wine labeling regulations state that wine may be labeled with the equivalent standard U.S. measure in addition to the mandatory metric measure.

This is not unlike the Reagan administration reiterating the voluntary nature of metrication in the United States, just to remind people that metric is optional, and the nation is in no danger of metrication, in fact, where metric has been implemented, its use can be reduced.

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<sup>1</sup>Docket No. TTB-2019-0004

<sup>2</sup>Docket No. TTB-2019-0005

2020 Presidential Candidate Tulsi Gabbard was asked about the metric system on November 30, 2019. Her response was “This is not a conversation I’ve ever had with anybody. I think it’s great we’re starting this conversation here today and perhaps we should have this dialog as a country so we the people can make sure our voices are heard on this issue. Thank you for raising that.”

Gabbard’s answer only indicated how little she thinks of this issue, and the question itself. No one else has ever brought it up, this is the first time I’ve ever heard about this. Her “we the people” phrase could only ring hollow for anyone who is a serious metric advocate. The number of signatures for a 2013 We The People metric petition, during the Obama administration, was only met with condescending platitudes, mantled with inclusiveness justification, by the director of the National Institute of Standards and Technology. Gabbard may not have been aware of the brouhaha which occurred when 2016 Presidential candidate Lincoln Chafee had the temerity to suggest we adopt the metric system, and was then pilloried by members of the media for it. If she was, she clearly was prepared to deflect, and offer a vacuous response, expecting never to hear about the subject again.

Surprisingly, the metric system again arose as a topic in the 2020 US presidential election, at an Andrew Yang for president town hall event on January 1st 2020, in Rochester New Hampshire:

Questioner: The politicians and the bureaucrats are on the side of the dummies who don’t know the metric system and are proud of it. So mister make Americans think harder, can we the people of the united states count on President Yang to secure the blessings of the metric system to ourselves and our posterity?

(Audience applauds)

Andrew Yang: I love this question so much. I’m a fan of the metric system,—and you’re not going to believe, well you will (pointing at questioner) but the metric system is actually safer, because when you’re dealing with microdoses of medication for infants, measuring it in ah, milliliters is much more safer than like teaspoons and tablespoons, and you actually can confuse teaspoons and tablespoons and end-up giving people the wrong dosage, so the metric system

would literally save lives every year, so to the extent we could migrate toward the metric system I would love to make it happen. I will say though I think most Americans would resist giving their heights in centimeters or meters because I have no idea what my height is, when they give it in feet and inches I know what they're talking about. That said, that said, the metric system is the world standard there are actually difficulties that arise from us being on a different standard and it would be safer, so thank you sir very wise.

Yang's answer to the question is probably the most informed any politician has given in the history of the US republic. It is rather surprising that a corporate lawyer running for president would be the one able to do so. Once again, the phrase "migrate toward the metric system" was invoked in his answer. This is the same incrementalist and voluntary metric policy that has not worked since it was first advocated in the middle of the 19th century. The answer also indicated that Yang believes people won't change, and will resist, so once again it was a status-quo answer dressed-up with the sound of change, but did not possess any conviction for change. It was true political answer. The answer may have been calibrated to avoid the kerfuffle that Lincoln Chafee precipitated when he directly advocated for a metric switch-over. What is most astonishing is the metric system arising as a campaign question at all in the United States, let alone twice in a single presidential cycle. Yang would not do well in the New Hampshire primary and dropped out of the presidential race on February 11, 2020.

In January of 2017, quite possibly the most anti-science US President ever elected, businessman Donald J. Trump, was inaugurated. Thus far no one has been able to find a single example of President Trump ever making a comment about the metric system.

It seems unlikely that a singular event will occur which prompts the US Government to finally act on a metric switch-over; it has resisted for over 180 years, since the time of John Quincy Adams. The costs of not becoming metric are not obvious to politicians or the public at large. The economic rot which our measurement system produces, will continue. Ignorance will not protect us from the affects of our non-system, but only serve as a psychological anesthetic which masks it. Any actual costs will either be invisible to our collective consciousness, or rationalized as something else. One can only wonder at this point if Liberia and

Myanmar will finally become metric, and the US then become known as the singular exception. This relentless resistance to progressive change does not bode well for the US in general. It may not be until other, unrelated political forces breakdown US intransigence, that metric will also be addressed in turn by The United States of America.



## References

- [1] Dolan, Thomas, G., “Measure for Measure - It’s Time for the United States to Join the World in Using the Metric System,” *Barron’s* November 25, 2002 page 35
- [2] Tarento, James, “Take Me to Your Liter.” *The Wall Street Journal* July 25, 2008
- [3] Freehery, John “Commentary: Franken Victory is Not Funny.” *CNN.com* July 1, 2009
- [4] Gonzales, Anne “Trade Pushes U.S, Especially California, Toward Metrics,” *Metric Today* Vol. 37 No. 1 2002 pg. 1
- [5] Freivalds, John “How To Do Business With Americans,” *Baltic Reports* balticreports.com July 26, 2010
- [6] Casy Chan *The White House Says You Can Use the Metric System If You Want To* 2013-05-24
- [7] *Time To Switch To Metric* 2013-08-27
- [8] Dopoe, Robin, “Govt Pledges Commitment to Adopt Metric System” *The Daily Observer* Monrovia Liberia, May 25 2018

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