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Inspections, Compliance, Enforcement, and Criminal Investigations

The Nation is Going Metric

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WELFARE PUBLIC HEALTH SERVICE

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ITG SUBJECT: THE NATION IS GOING METRIC

INTRODUCTION

The swing to metrics is on in the major U.S. Industries. For example, all four major motor companies are converting to the Metric System of measurement. This does not appear to pose a burden. Everett Baugh, of General Motors, was quoted as saying "Going metric in the Chevette caused no more than a ripple." Pressures for metric products are on the upswing especially in the international markets. Both "hard conversion" and "soft conversion" programs will be found.

"Hard conversion" programs actually package, label, and advertise the product in correct metric sizes (whole SI units) while "soft conversion" programs merely change the labels and use existing size products. From the British experience, "hard conversion" programs are best. The timing to usher out the customary system of measurements in the U.S. is uncertain. This, and additional ITG issues, will focus on metric issues receiving increased attention as the nation goes metric. \a\

HISTORY OF THE METRIC SYSTEM

In 1670, France's Gabriel Mouton proposed a system of measurement that referred to a physical dimension of the earth as its fundamental unit. Previous measurement systems made reference to the human body, i.e., the mile came from the Roman Legion's 1000 paces (mille passus). Mouton chose the distance subtended by a one minute angle of the circle of the earth as the basic dimensional unit, and divided this by powers of ten to get sub-units. Later, the French Academy of Science adopted one ten-millionth of the earth's quadrant as the "metre" meaning simply "a measure." Essentially this system, based on decimal values, is in use throughout the world today.

METRIC LEGISLATION

The Metric System of measurement in the U.S. has been sanctioned officially in 1866 and in 1975. \a\ The passage of the 1866 Act authorized use of metric standards but did not change the American's ways of using the customary system.

Likewise, the Metric Conversion Act of 1975 does not include enforcement powers, or stipulate a conversion time requirement. Some have dubbed this law "both toothless and timeless."

NATIONAL CONVERSION ACT

The 1975 law authorizes a U.S. Metric Board to coordinate the nation's conversion program. Section 3 of the Act states that, "the policy of the United States shall be to coordinate and plan the increasing use of the metric system in the United States and to establish a United States Metric Board to coordinate the voluntary conversion to the metric system." The board is expected to provide a program that offers

flexibility to the various sectors of society in converting to the Metric System by their own schedules and with their own resources.

U.S. METRIC BOARD

The U.S. Metric Board is authorized by the Act to have a chairman and 16 members, each to be appointed by the President with the advice and consent of the Senate. This board is expected to consult with interested groups affected by metric conversion. The board is charged to (a) establish and publicize metrication conversion programs, (b) retain engineering standards, (c) consult with foreign governments on use of the Metric System, (d) encourage public programs of metric information and education, and (e) assist Americans in their use of the Metric System.

METRIC (SI) PREFIXES

An essential feature is the systematic use of prefixes to designate decimal multiples and submultiples of all the units. The prefixes in most common use are:

Multiplication	Factor	Exponent	Prefix	Symbol	Meaning (USA)
1 000 000 000 000 000	10	15	peta	P	one quadrillion times
1 000 000 000 000	10	12	tera	T	one trillion times
1 000 000 000	10	9	giga	G	one billion times
1 000 000	10	6	mega	M	one million times
1 000	10	3	kilo	k	one thousand times
1 00	10	2	hecto	h	one hundred times
1 0	10	1	deka	da	ten times
1	100				one times
0.1	10	(-1)	deci	d	one tenth of
0.01	10	(-2)	centi	c	one hundredth of
0.001	10	(-3)	milli	m	one thousandth of
0.000 001	10	(-6)	micro	mu	one millionth of
0.000 000 001	10	(-9)	nano	n	one billionth of
0.000 000 000 001	10	(-12)	pico	p	one trillionth of
0.000 000 000 000 001	10	(-15)	femto	f	one quadrillionth of

SI SYSTEM

The International System (SI) utilizes standardized nomenclature to reduce confusion from the world's technical literature. The SI system is built from three kinds of units; base, supplementary, and derived units.

Base Units are:

Physical Quantity	Metric Unit	Other Everyday
LENGTH	metre*(m)	millimetre (mm); centimetre (cm); kilometre (km);
MASS	kilogram (kg)	gram (g); metric ton (t);
TIME	second (s)	Same
ELECTRIC CURRENT	Ampere (A)	Same
LUMINOUS INTENSITY	candela ©	Same
AMOUNT OF SUBSTANCE	mole (mol)	Same

Supplementary Units are:

Physical Quantity	Metric Unit	Everyday Unit**\
PLANE ANGLE	radian (rad)	Same (conventional in plane trigonometry). The degree continues to be used also.
SOLID ANGLE	steradian (sr)	Same (conventional in solid geometry)

Derived units stem from multiplication and division of the base or supplementary units, such as:

Physical Quantity	Metric Unit	Other Everyday Units**\
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AREA	Square metre (m ²)	square kilometre (km ²)
VOLUME	cubic metre (m ³)	cubic centimetre (cm ³); Litre (L); millilitre (ml);
VELOCITY	metre/second (m/s)	kilometre/hour (km/h);
DENSITY	kilogram/cubic metre (kg/m ³)	(mg/ml); (g/ml);
PRESSURE	kilopascal (k Pa)	same (or) Newton/square metre (N/m ²)
POWER	Watt (W)	same

COMMON METRIC (SI) CONVERSIONS \#\

Metric Quantity	If You Know	Multiply by	To Get Customary
LENGTH	millimetres	X 0.039	inches
	metres	X 3.281	feet
	metres	X 1.094	yards
	kilometres	X 0.621	miles
AREA	square metres	X 1.196	square yards
	hectares	X 2.471	acres
VOLUME	litres	X 1.057	quarts
	cubic metres	X 1.308	cubic yards
MASS	grams	X 0.035	ounces (avdp)
	kilograms	X 2.205	pounds (avdp)
TEMPERATURE	degrees Celsius	X 9/5 then add 32	degrees Fahrenheit

Customary Quantity	If You Know	Multiply by	To Get Metric
LENGTH	inches	X 25.4	millimetres
	feet	X 0.305	metres
	yards	X 0.914	metres
	miles	X 1.609	kilometres
AREA	square yards	X 0.836	square metres
	acres	X 0.405	hectares
VOLUME	quarts	X 0.946	litres
	cubic yards	X 0.765	cubic metres
MASS	ounces (avdp)	X 28.35	grams
	pounds (avdp)	X 0.454	kilograms
TEMPERATURE	degrees Fahrenheit	X 5/9 subtracting 32)	(after degrees Celsius 32)

The Office of the Associate Commissioner for Compliance (HFC-2) has been designated the official FDA contact and will be on the alert to be of assistance where possible. We also invite your information and queries on metric conversion problems uncovered in the field (301-443-3340).

\a\ Public Law 94-168, The Metric Conversion Act of 1975, was signed by President Ford on Dec. 23, 1975. Copies may be obtained from the Office of Legislative Services (301-443-3150).

*\ Metre or meter? French and English speaking countries, with the exception of the U.S., spell it -re. One argument for the - re is to distinguish between the words mi-cro-metre, a measurement, and mi-crom-eter, a tool for measuring. In the U.S. both spellings are recognized at this time.

**\ See METRIC SYSTEM - Webster's New Collegiate Dictionary (1970 or later editions) for U.S. equivalent units.

\#\ We recommend use of the metric units without conversion; however, this table is handy for quick conversions. The reader is referred to the FDA Inspection Operations Manual, Appendix A, for more extensive units of measure and conversion factors.

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