



Standards Topics

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Coating Thickness Measurement

This column is prompted by several telephone calls I recently received on the subject of coating thickness measurement. Apparently, a number of people are not comfortable with the SI metric coating thickness dimensions used in ASTM, ISO and many company specifications. They grew-up in the "inch" world of mils, thous, and tenths. With the arrival of ISO 9000 certification, they are in a panic to understand SI metric.

ASTM committee B08 began introducing dual dimension thickness

designations more than 30 years ago. At that time, the inch dimension was given first, followed by the metric dimension in parentheses. In 1973, the B08 Committee, aware of the increased usage of SI metric in the world, undertook to lead the U.S. metal finishing industry into the use of SI metric dimensioning.

A Metrication Section was formed with Fielding Ogburn as chairman. Members of the committee were Boris Joffe, George DiBari, Fred Lowenheim, Bill Harding, Bill

Polleys and myself. Starting in 1975, SI metric dimensions became the primary and only unit in ASTM plating standards; they already were the dimension unit in ISO standards. Many company specifications followed suit. A number of articles were written and published in *Plating and Surface Finishing*, *Metal Finishing* and *Product Finishing*. Talks were given at AESF Branch meetings. The effort culminated with the publication of *Guidelines for Metrication in the Field of Electrodeposition and Related Process* in July 1976. It is re-published every year in *ASTM Standards*, Volume 01.05.

How Do You Say "μ"?

Not withstanding all of that effort, we apparently neglected to provide some sort of guidance concerning the names of the SI metric units and their pronunciation. One caller asked: How many 'you ems' in 25 mils?" He had mistaken the Greek letter "μ" (pronounced "mew") for the English letter "u." The combination "μm" is the symbol for the micrometer, the basic unit for expressing coating thickness. The micrometer is equal to 1/1000th of a millimeter. It is synonymous with the term "micron," which is not a recognized SI metric unit, and is no longer used.

I am not going to address the conversion factors here. These can be obtained from the *ASTM Guide to Metrication*.

Listed in Table 1 are the terms and symbols for those quantities that are of special significance to electrodeposition. Tables 2 and 3 compare inch system values with SI metric values, and should help in the learning process. O

Table 1

Comparison of SI Units/Symbols with Alternative Units/Symbols

Quantity	SI Unit	Symbol	Alternative Units	Symbol
Coating thickness	micrometer	μm		
Coating mass	gram per square meter	g/m ²	milligram per square centimeter	mg/cm ²
Current density	ampere per square meter	A/m ²	ampere per square decimeter	A/dm ²
Quantity of electricity	coulomb (ampere-second)	C	ampere-hour ampere-minute	A h A min
Volume	cubic meter	m ³	liter	L
	cubic centimeter	cm ³	milliliter	mL
Mass concentration	kilogram per cubic meter	kg/m ³	gram per liter	g/L
Volume concentration	cubic centimeter per cubic meter	cm ³ /m ³	cubic centimeter per liter	cm ³ /L
Stress (internal pressure)	megapascal	MPa		
Temperature	kelvin	K	degree Celsius	°C

Table 2
Comparison of Inch With Millimeter, Micrometer & Nanometer

Inch	Millimeter (mm)	Micrometer (μ m)	Nanometer (nm)	Trade Term
1.000 000 000	25.400 000 000	25 400.000 000 000	25 400 000.000 000 000	1000 mil
0.100 000 000	2.540 000 000	2 540.000 000 000	2 540 000.000 000 000	100 mil
0.010 000 000	0.254 000 000	254.000 000 000	254 000.000 000 000	10 mil
0.001 000 000	0.025 400 000	25.400 000 000	25 400.000 000 000	1 mil 1 thou
0.000 100 000	0.002 540 000	2.540 000 000	2 540.000 000 000	1 tenth 100 millionths 100 micro-inches
0.000 050 000	0.001 270 000	1.270 000 000	1 270.000 000 000	50 millionths 50 micro-inches
0.000 040 000	0.001 016 000	1.016 000 000	1 016.000 000 000	40 millionths 40 micro-inches
0.000 030 000	0.000 762 000	0.762 000 000	762.000 000 000	30 millionths 30 micro-inches
0.000 020 000	0.000 508 000	0.508 000 000	508.000 000 000	20 millionths 20 micro-inches
0.000 010 000	0.000 254 000	0.254 000 000	254.000 000 000	10 millionths 10 micro-inches
0.000 004 000	0.000 101 600	0.101 600 000	101.600 000 000	4 millionths 4 micro-inches
0.000 001 000	0.000 025 400	0.025 400 000	25.400 000 000	1 millionth 1 micro-inch
0.000 000 100	0.000 002 540	0.002 540 000	2.540 000 000	100 billionths
0.000 000 010	0.000 000 254	0.000 254 000	0.254 000 000	10 billionths
0.000 000 001	0.000 000 025	0.000 025 400	0.025 400 000	1 billionth

Table 3
Comparison of Millimeter With Micrometer, Nanometer, Micro-inch & Mil

Millimeter (mm)	Micrometer (μ m)	Nanometer (nm)	Micro-inch (μ -in.)	Mil	Trade Term
1.000 000	1 000.000	1 000 000.000	39 370.079	39.370 079	1 millimeter
0.100 000	100.000	100 000.000	3 937.008	3.937 008	100 micrometer
0.010 000	10.000	10 000.000	393.700	0.393 700	10 micrometers
0.001 000	1.000	1 000.000	39.370	0.039 370	1 micrometer
0.000 100	0.100	100.000	3.937	0.003 937	100 nanometers
0.000 010	0.010	10.000	0.394	0.000 394	10 nanometers
0.000 001	0.001	1.000	0.039	0.000 039	1 nanometer