

IMERC Fact Sheet

Mercury Use in Measuring Devices

This Fact Sheet summarizes the use of mercury in devices that conduct some form of measurement, including barometers, thermometers, manometers, blood pressure cuffs, and others. It includes information on the total amount of mercury in all of these products that were sold in the U.S. in 2001, 2004, 2007, 2010, and 2013.

The information in the Fact Sheet is based on data submitted to the state members of the [Interstate Mercury Education and Reduction Clearinghouse \(IMERC\)](#) including Connecticut, Louisiana, Maine, Massachusetts, New Hampshire, New York, Rhode Island, and Vermont. The data is available online through the [IMERC Mercury-Added Products Database](#).

Types of Mercury Measuring Devices

As the only metal that is liquid at room temperature, mercury expands and contracts evenly with temperature and pressure changes. These characteristics have made mercury useful in devices used for measuring temperature and pressure, including those described below.

Barometers measure atmospheric pressure. They can be stand-alone devices or attached to the wall. Mercury barometers consist of a glass tube that is closed at one end, with a mercury-filled reservoir at the base. Often, one end of the tube is open to the atmosphere so that the elemental mercury is exposed to air. The mercury rises and falls with changes in atmospheric pressure.



Close-up of a Mercury-Filled Barometer; Source: NEWMOA

Flow Meters measure the flow of gas, water, air, and steam. They are often used in water treatment, sewage plants, power stations, and other industrial applications. Some industrial settings may still have mercury flow meters in use; however, IMERC's research has found that new flow meters, including digital and ball-actuated flow meters are manufactured without mercury. For more information on older, legacy flow meters, visit:

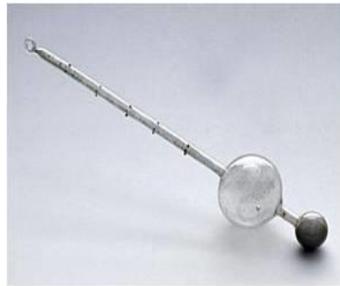
www.newmoa.org/prevention/mercury/projects/legacy/measdev.cfm#fm.



Mercury Flow Meters; Source: Purdue University

Hydrometers measure the specific gravity of liquids. Mercury was often used in hydrometers as a weight. Some schools and laboratories may still have mercury hydrometers in use; however, IMERC's research has found that mercury hydrometers are no longer manufactured and sold as new in the U.S. Non-mercury hydrometers that use lead ballast as a weight are sold. For more information on the legacy hydrometers, visit:

www.newmoa.org/prevention/mercury/projects/legacy/measdev.cfm#h.



Mercury Bulb Hydrometer; Source: NEWMOA

Manometers measure the difference in the pressure of a gas or liquid. Mercury manometers are generally U-shaped glass or plastic tubes containing elemental mercury with one end of the tube closed and the other open to the atmosphere. The difference in the levels of mercury in each side of the tube indicates the pressure of the substance being measured. Manometers are frequently used to measure air pressure within air ducts or compressed air lines. Mercury manometers were commonly used in milking systems to measure the pressure of the vacuum line that transports the milk from the cow's udders to the cooling tank (e.g., dairy manometer). Non-mercury manometers that display the vacuum pressure on a dial or digital display are now commonly used. For more information on the legacy manometers, visit:

www.newmoa.org/prevention/mercury/projects/legacy/measdev.cfm#dm.



Mercury Dairy Manometer; Source: Cuoco & Cormier Engineering

Psychrometers and Hygrometers are instruments used for measuring humidity. They contain two mercury thermometers, a “dry bulb,” or ordinary thermometer, and a “wet bulb” thermometer, which is kept constantly wet. In both hygrometers and psychrometers, the humidity is determined by comparing the difference in the temperatures shown by the two thermometers. These devices function similarly, but the names differ due to the applications in which they are used. For example, a sling psychrometer is a specific type of psychrometer encased in a swiveling mechanism that is swung around rapidly to record an accurate reading for relative humidity. Some schools and laboratories may still have mercury psychrometers and hygrometers in use; however, IMERC’s research has found that these devices are no longer manufactured and sold as new in the U.S. For more information on legacy psychrometers and hygrometers, visit: www.newmoa.org/prevention/mercury/projects/legacy/measdev.cfm#handp.



Mercury Sling Psychrometer; Source: Wikipedia

Pyrometers measure the temperature of extremely hot materials and are primarily used in foundry applications. Mercury is contained in the temperature-sensing device. Some manufacturers may still have mercury pyrometers in use; however, IMERC’s research has found that mercury pyrometers are no longer manufactured and sold as new in the U.S. New non-mercury pyrometers are either digital or optical. For more information on legacy pyrometers, visit: www.newmoa.org/prevention/mercury/projects/legacy/measdev.cfm#py.

Sphygmomanometers are a type of mercury manometer that is used for measuring blood pressure. Sphygmomanometers measure both maximum arterial pressure, when the heart beats and sends blood through the arteries, and minimum pressure, when the heart relaxes and fills with blood again. Mercury is contained inside a plastic or glass tube. The sphygmomanometer may be hand-held (i.e., portable), wall-mounted, or mobile.



Portable Sphygmomanometer
Source: NEWMOA



Wall-mounted Sphygmomanometer
Source: Sargent-Welch



Mobile Sphygmomanometer
Source: Sargent-Welch

Strain Gauges measure forearm blood flow, or arterial inflow, using a technique called strain gauge plethysmography. Mercury is contained in a fine rubber tube, which is placed around the forearm. The gauge measures the increase in forearm circumference as pressure is applied. These products are not common, and only one manufacturer has informed the IMERC-member states that they manufacture mercury strain gauges. Therefore, they are included in the “other” category in Table 2. Non-mercury strain gauge alternatives include indium-gallium strain gauges. For more information on legacy gauges, visit:

www.newmoa.org/prevention/mercury/projects/legacy/healthcare.cfm#sg.



Mercury Strain Gauges for Leg
Source: D.E. Hokanson Inc.



Mercury Strain Gauge for Digits (fingers and toes)
Source: D.E. Hokanson Inc.

Thermohydrometers are a specific type of hydrometer that contains a mercury thermometer for measuring the temperature and density of liquids. These products are not common, and only one manufacturer has notified the IMERC-member states that they manufacture mercury thermohydrometers. Therefore, they are included in the “other” category in Table 2.

Thermometers measure temperature. Mercury thermometers contain mercury encased in a thin plastic or glass tube. The mercury level rises and falls with changes in the temperature. Thermometers are used in a variety of industrial, laboratory, and commercial applications.



Mercury Lab Thermometers; Source: Sargent-Welch

Table 1 presents the average amount of mercury in each type of measuring device. Manufacturers, importers, and distributors of mercury-added products report the amount of mercury used as an exact number or as a range.

Table 1: Amount of Mercury in Measuring Devices	
Component or Product	Amount of Mercury in Individual Component or Product (grams)
Flow meters	Up to 5,000 (up to 175+ ounces)
Barometers	400 – 620 (up to 22 ounces)
Sphygmomanometers	50 – 140 (up to 5 ounces)
Manometers	30 – 75 (up to 2.5 ounces)
Pyrometers	5 – 10 (less than 0.5 ounces)
Hygrometers/Psychrometers	3 – 7 (less than 0.5 ounces)
Thermometers	0.5 – 50 (up to ~ 2 ounces)
Hydrometers	Less than 1 (less than 0.25 ounces)

[Note: 1 gram of mercury = 0.035 ounces. All numbers are rounded to the nearest whole number.]

Mercury Use in Measuring Devices

Table 2 presents the total amount of mercury sold in measuring devices in 2001, 2004, 2007, 2010, and 2013.¹ Twenty-two manufacturers of these devices have submitted Mercury-added Product Notification Forms to IMERC-member states for one or more reporting years. However, at least 13 companies have since phased out their use of mercury, and therefore, no longer report to IMERC. As of December 2015, five companies have not yet submitted required data; and one manufacturer submitted 2013 data that had not done so for previous reporting periods. In total, seven companies correctly submitted their 2013 notification reports.

¹ More detailed information on the 2001 and 2004 data can be found in the report, *Trends in Mercury Use in Products: Summary of the IMERC Mercury-added Products Database*, June 2008.

(www.newmoa.org/prevention/mercury/imerc/pubs/reports.cfm)

The 2007 data is taken from a NEWMOA presentation, *Trends in Mercury Use in Products: Analysis of the IMERC Mercury-added Products Database*, November 17, 2009.

(www.newmoa.org/prevention/mercury/conferences/sciandpolicy/presentations/Wienert_Session3B.pdf)

As shown in Table 1, the 2013 data analysis includes data from 12 companies. The five companies that did not report for 2013 are included in the 2013 analysis, even though their mercury contributions are estimates based on the data reported in the previous triennial year. It is also important to note that the one “new” reporter is included only in the 2013 total presented below and not incorporated into the previous reporting cycles.

Table 2: Total Mercury Sold in Measuring Devices (pounds)					
Product	2001	2004	2007	2010	2013
Barometers	353	234	0	0	0
Manometers ²	1,936	2,545	0	0	0
Sphygmomanometers	4,305	2,219	1,657	974	1,060
Thermometers	3,634	1,089	598	555	546
Psychrometers and Other Measuring Equipment	4	3	2	1	0.98
TOTAL	10,232 (5.12 tons)	6,090 (3.05 tons)	2,257 (1.13 tons)	1,530 (0.77 tons)	1,607 (0.80 tons)
<i>Number of companies included in analysis</i>	<i>21 companies</i>	<i>20 companies</i>	<i>14 companies</i>	<i>12 companies</i>	<i>12 companies</i>

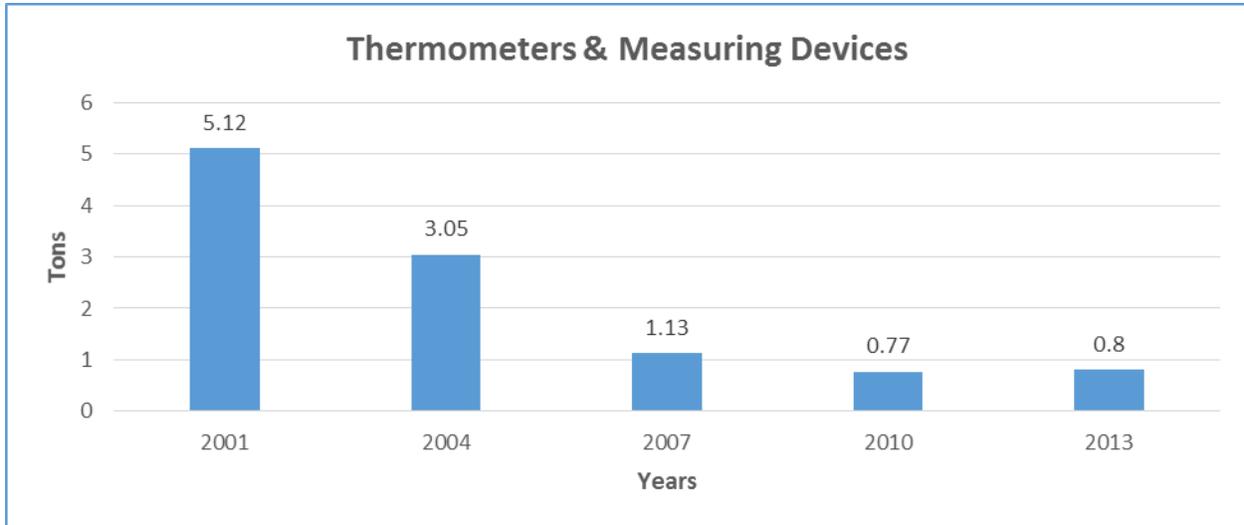
[Note: 453.6 grams = 1 pound; 2,000 pounds = 1 ton. All numbers are rounded to the nearest whole number.]

Approximately 5.12 tons of mercury contained in measuring devices was sold in 2001, decreasing to 0.80 tons in 2013, or by about 84 percent. Almost all of the sub-categories of measuring devices have shown some decline over the years, with barometers and manometers having the most significant decrease with a 100 percent reduction in use. Mercury use in thermometers decreased 85 percent – from 3,634 pounds in 2001 to 546 pounds in 2013. And the instruments included in the “other” category (e.g., hydrometers, psychrometers, and strain gauges) show an overall reduction of 76 percent.

Sphygmomanometers show a slight increase in 2013 from 2010 but it must be noted that data for this product category is incomplete. Out of the two known companies that manufacture this type of product, only one has provided notification for 2013, so the reporting rate is at 50 percent. As noted in the “Data Caveats” section on page 9-10, in the absence of any reported data IMERC assumes the 2013 total for the missing reporter is the same as their most recent reporting year, which in this case was 2010 (unless they have confirmed a phase-out).

² It is important to note that although no mercury-added manometers were sold in the U.S. in 2007, 2010, or 2013, one company, Scientific Glass & Instruments, continues to manufacture and sell the manometer glass tubing without supplying the elemental mercury with the product. It is unknown if the persons that purchase this manometer tubing are filling it with elemental mercury, or substituting the mercury with another liquid.

IMERC considers the reporting rate for thermometers to be approximately 71 percent; while the “psychrometers and other equipment” category is 100 percent (i.e., the same company has consistently reported to IMERC since 2001).



Since 2001, many states have passed legislation banning the use and sale of mercury-added thermometers and other measuring devices, and that is partly why the data sets for these categories are inconsistent. This is because companies that do not sell their products into the Notification states (because of the sales bans) are not required to report to IMERC. The only IMERC-member state that currently allows the sale of mercury-added thermometers is Massachusetts. As of 2012, none of the states that require Notification allow the sale of sphygmomanometers (without an exemption). If more states restrict the sale of these products, mercury use in this product category will likely further decline.

Phase-Outs & Bans on the Sale of Mercury Measuring Devices

The following IMERC-member states currently have [restrictions on the sale and/or distribution of mercury-containing thermometers and other measuring devices](#): Connecticut, Louisiana, Maine, Massachusetts, Michigan, Minnesota, New Hampshire, New Jersey, New York, Rhode Island, Vermont, and Washington.

The state of Connecticut has mercury content restrictions that ban the sale of products containing more than 100 milligrams (mg) of mercury (i.e., 0.1 gram or 0.004 ounces). Louisiana and Rhode Island have even stricter bans, starting at products with more than 10 mg of mercury. As noted in Table 1 (page 5), the mercury content in all identified measuring devices exceeds these amounts. Therefore, their sale is restricted in these three states. In addition, all three of these states explicitly prohibit the sale of the dairy manometers, fever thermometers, and other thermometers.

Other IMERC-member states have different definitions for “measuring devices” and identify specific products for which this category applies. Table 3 summarizes these bans.

Table 3: Bans on Mercury Measuring Devices – By IMERC State												
Product	CT	LA	ME	MA	MI	MN	NH	NJ	NY	RI	VT	WA
Barometers	*	*	✓	✓		✓	✓		✓	*	✓	
Bougie Tubes	*	*	✓	✓	✓	✓	✓		✓	*	✓	
Dairy Manometers	✓	✓	✓			✓	✓		✓	✓	✓	
Esophageal Dilators	*	*	✓	✓	✓	✓	✓		✓	*	✓	
Feeding Tubes	*	*				✓				*		
Fever Thermometers	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Flow Meters	*	*	✓	✓		✓	✓		✓	*	✓	
Gastro-intestinal Tubes	*	*	✓	✓	✓	✓	✓		✓	*	✓	
Hydrometers	*	*	✓	✓		✓	✓		✓	*	✓	
Hygrometers	*	*	✓	✓		✓	✓		✓	*	✓	
Manometers (Other)	*	*	✓	✓		✓	✓		✓	*	✓	
Psychrometers	*	*	✓	✓		✓	✓		✓	*	✓	
Pyrometers	*	*	✓	✓		✓	✓		✓	*	✓	
Sphygmo-manometers	*	*	✓	✓	✓	✓	✓		✓	*	✓	✓
Thermometers (Laboratory)	✓	✓	✓		✓	✓	✓		✓	✓	✓	✓

* Although these products are not specifically called out in the law, they contain an amount of mercury greater than allowed by the states of CT, LA, and RI (noted in the paragraph above).

Additional states that restrict the sale of one or more types of mercury-added measuring devices include: California, Illinois, Indiana, Maryland, Nebraska, Ohio, Oregon, and Wisconsin. In response to all of these mercury product bans and phase-outs, many companies have ceased manufacturing mercury-added measuring devices and/or stopped selling these products to these states.

Non-Mercury Alternatives

There are non-mercury alternatives that may be suitable for replacing traditional mercury-added measuring devices. Many factors should be considered when switching to a non-mercury

measuring device, including the costs, availability, and product effectiveness. Table 4 lists the non-mercury alternatives to common measuring devices.

Table 4: Alternatives to Mercury Measuring Devices	
Component or Product	Non-Mercury Alternative(s)
Barometer	Aneroid, digital, eco-celli liquid-gas silicon
Flow Meter	Digital, ball-actuated
Hydrometer	Lead and non-lead ballast hydrometers
Hygrometer	Spirit-filled glass bulb, digital, aneroid
Manometer	U-shaped tubes using any colored liquid, digital
Pyrometer	Optical, digital
Psychrometer	Spirit-filled glass bulb, digital
Sphygmomanometer	Aneroid, digital
Strain Gauge	Indium-gallium filled
Thermometer	Alcohol or mineral spirit-filled glass bulb, digital

IMERC’s research has found that many mercury-added measuring devices, including flow meters, hydrometers, hygrometers, psychrometers, and pyrometers, are no longer manufactured or sold in the U.S. These products are considered “legacy products” and may be used, re-sold as used products, or stored in homes or businesses. For more information on these and other legacy measuring devices, visit: www.newmoa.org/prevention/mercury/projects/legacy/measdev.cfm.

For more information about the non-mercury alternatives for measuring devices found in schools, visit: www.newmoa.org/prevention/mercury/schools/MercuryAlternativesReport.pdf.

Data Caveats

A number of important caveats must be considered when reviewing the data summarized in this Fact Sheet:

- The information may not represent the entire universe of mercury-added measuring devices sold in the U.S. The IMERC-member states continuously receive new information from mercury-added product manufacturers, and as a result, the data presented in this Fact Sheet may underestimate the total amount of mercury sold in this product category.
- In contrast, the data presented in this Fact Sheet may overestimate the total amount of mercury sold in this product category. In some cases, manufacturers supplied data for earlier reporting years but are out of compliance for one or more years. Rather than assuming that this non-reporting is a result of a company phasing-out its mercury-added measuring devices, IMERC takes a more conservative approach and assumes that the mercury total for non-reporters for 2013 is the same as its most recently reported year.

- The Notification requirement only applies to manufacturers and distributors of mercury-added measuring devices that are allowed to sell into one or more of the IMERC Notification States: Connecticut, Louisiana, Maine, Massachusetts, New Hampshire, New York, Rhode Island, and Vermont.
- The information summarizes mercury use in measuring devices sold nationwide since 2001. It does not include products sold prior to January 1, 2001 or exported outside of the U.S., or products sold in-between triennial reporting years.
- Reported data includes only mercury that is used in the product, and does not include mercury emitted during mining, manufacturing, or other points in the product's life cycle.