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Get the ~~Lead~~ Mercury Out!!

By Val Miller

Regulatory Issues

Devices containing mercury are used in many facets of our lives. Entire measurement and control systems have been developed around items that contain mercury in some form. From the mercury-wetted relay contacts in automobiles and instrumentation control circuits, to oral thermometers and blood pressure sphygmomanometers that have been essential components of our healthcare system, the use of mercury has maintained a vital place in our lives. Now, due to health and environmental hazards related to the use of mercury and its escape into the environment, efforts are being made through legislation to control and eliminate the use of devices containing mercury in the United States.

In the 2003 NCWM State Laboratory Program Workload Survey, State laboratories were asked if their state had enacted legislation or rules restricting the use of mercury-containing devices. Of the thirty respondents, only three answered that their state was working to restrict the use of mercury-containing devices. Today, a significant number of states have adopted, or are working on, legislation that will limit or prohibit the sale and use of devices containing mercury, though most current legislation has a provision to allow an exemption where replacement is not technically or economically feasible. These restrictions include mercury-in-glass thermometers.

Background on Thermometry Standards

Thermometers containing mercury are typically considered among the most accurate and stable temperature-measuring devices available for *general* temperature measurements. Because they are basically passive devices, they have been relatively inexpensive to purchase and their relatively long recalibration cycles make them a very economical means of accurate temperature measurement. The American Society for Testing and Materials (ASTM) has developed a documentary standard, ASTM E1, for the design, manufacture and testing of mercury-in-glass thermometers covering a temperature range of -80 °C to 405 °C (-112 °F to 766.4 °F). Many industries, including those regulated by USDA, FDA, API and U.S. Pharmacopeia, have developed testing methods, or use ASTM-developed methods, that are based on the use of ASTM E1 thermometers. In fact, a recent search of the ASTM standards database revealed that 839 other ASTM standards reference ASTM E1 in some form.

Use of Mercury Thermometers

On the surface, it would seem a simple matter to replace mercury thermometers with electronic devices, as thermocouple and resistance thermometry technology has developed to an accuracy level capable of meeting or exceeding that of mercury-in-glass thermometers. So what is the problem?

ASTM and other standards development bodies have developed testing processes based on the specific operating characteristics of the measuring devices specified in the

documentary standard that describes a test. Because many of these testing processes have qualitative measurement results, the result is dependent on the laboratory's ability to obtain repeatable measurements when using that process. The thermal component of the process can be very critical to the measurement result. Each style of thermometer has a different response to temperature change, with some responding more quickly than others. Because the process depends on the device response, users of these testing processes cannot deviate from the use of the specified measuring device without risking the validity of their measurements. After making a change to the procedure such as would be required for mercury-free thermometers, validation of the process and accreditation of the laboratory's measurement results may take years.

Some, but not all, testing processes have already been developed and validated allowing the use of both mercury-in-glass thermometers as well as other types of thermometers. For those processes, use of mercury-free thermometers is quite acceptable and the legal restrictions on the sale of mercury thermometers will simply mean that any mercury thermometers now in use will eventually be replaced with acceptable alternative thermometers and all will be well. However, if alternative thermometers have not been specified, there may be legal issues if a regulatory body like FDA requires a certain ASTM process that has not been validated using an alternative thermometer. If a testing laboratory reports that they used the required process, but used an alternative thermometer, the results may be deemed unreliable. For instance, a specified procedure requires, during the heating of a material, that a mixing process is started at 200 °C so that a specific reaction occurs, but this procedure has only been validated with mercury-in-glass thermometers. If the laboratory uses a bead thermistor to measure the temperature, there can be no certainty that the correct reaction took place because the bead thermistor has a different thermal response than the mercury-in-glass thermometer. Because the test procedure was not followed exactly, test results should not be reported stating that the specified procedure was followed.

Increased costs will likely result from the restrictions on mercury thermometers. Currently, most equivalent electronic thermometers, having similar accuracy and readability, are more expensive to purchase than their mercury-containing counterpart. And, since they are no longer passive devices, more frequent calibration will be required adding to the cost of operations. One permissible reason to apply for an exemption to the ban on mercury-containing devices is increased costs, but no criteria for economical feasibility have been developed. What is affordable for one organization may not be for another. More work is required to better define economic feasibility.

I recently participated in a teleconference call coordinated by Interstate Mercury Education & Reduction Clearinghouse (IMERC) to discuss an exemption application that was submitted to the State of Connecticut by a thermometer manufacturer for the sale of mercury-in-glass thermometers manufactured to ASTM Standard E1. Connecticut has enacted legislation prohibiting the sale of most devices containing mercury. Included in their legislation, however, is the possibility of obtaining an exemption when a technically or economically feasible substitute for a mercury thermometer is not available or a Federal health or safety requirement exists. During that conference call it quickly became

apparent that there is a growing movement by state environmental departments to restrict or prohibit the sale of mercury-containing devices. This was demonstrated by what seemed to be the general consensus of the State participants that since there are other devices capable of measuring and controlling temperature, March 2006 Page 3 there should be no issues with using electronic devices or liquid-in-glass thermometers using liquids other than mercury in place of mercury-in-glass thermometers. As of this writing in mid-February, the application for exemption in Connecticut is still pending.

Your Role in the Change

One action item resulted from the teleconference call: each state member of IMERC is to issue a letter to the various standards development bodies to make them aware of the coming restrictions on mercury-containing devices and encourage them to begin the process of converting existing methods or developing new methods, using alternative devices and standards. This conversion process will take some time and will require the expenditure of significant resources by everyone involved in developing the alternative processes. As most standards development organizations are based on the work of volunteers, you can help in this effort to ensure testing procedures are properly updated in a timely manner. Remember the World Wars I and II posters that said, "Uncle Sam Needs YOU!"? Maybe we should rework that slogan to say, "Your standards development body needs YOU!"

Changes are coming to the portions of our measurement world that rely on devices containing mercury. At least eleven states are restricting the sale or use of items containing mercury. Your state may be next. ***Now*** is the time to begin preparing for the time when your mercury-containing measuring instruments can no longer be used or replaced, as it is likely any exemptions issued by a state will have a defined expiration date after which an alternative must be used. Contact your standards writing bodies, ASTM, ANSI, NCWM, FDA, USP, etc., and encourage them to speed up the process of developing alternatives to measuring instruments containing mercury.

One caution however—some alternatives currently being suggested for temperature instruments will themselves be environmental hazards requiring special disposal procedures and controlled waste streams. Be sure to fully investigate options and identify all environmental issues before adopting replacement instruments so that one hazardous material is not replaced by another.

Volunteer your time and services to develop updated standards to replace the ones that now require mercury-in-glass thermometers. *You can make a difference and you need to start now!*