

The U.S. EPA/NIST Program to Phase-Out Mercury-in-Glass Thermometers Used in Industrial and Laboratory Applications

Dawn Cross, Wyatt Miller, and Gregory F. Strouse

National Institute of Standards and Technology

Gaithersburg, MD 20899 USA

dawn.cross@nist.gov



Abstract

In 2006, the Quicksilver Caucus, a coalition of State environmental associations, requested that United States government agencies and standards organizations collaborate together to reduce the industrial and laboratory use of Hg thermometers.

- ASTM International found over 850 standards with references to Hg thermometers.
- NIST and the EPA are providing science-based support to assist in the transition of ASTM standards to allow for the use of alternative thermometers

As part of that support, the EPA and NIST completed a pilot study to phase out the use of Hg thermometers in petroleum field activities

- A NIST developed protocol to compare Hg and alternative thermometers was implemented at two petroleum product distribution terminals
- Observations from these tests provided valuable information for understanding measurement differences encountered in the field

Outcomes from the EPA and NIST work

Web-based user-friendly guidelines

- Replacement of Mercury Thermometers
- Selecting Alternatives to Mercury-Filled Thermometers
- Verification Methods to Alternatives to Mercury-Filled Thermometers, Including Research on Ice and Steam Points
- Non-Mercury Thermometers for Validating Autoclave Operating Temperatures
- What is Traceability?

Web-based videos

- Alternative Thermometers
- Ice Melting Point
- Steam Point
- Traceability



Alternative thermometer testing

- Intrinsically-safe alternative thermometers field tested at two Refined Product Terminals (RTPs)



Notes and Disclaimer:

- thanks to those companies who donated thermometers (analog and digital) for this work
- any commercial products identified in this poster does not constitute endorsement by NIST

Field Testing at Refined Product Terminals

- Phase I** Repeatability of thermometers at NIST
- Phase II** Field testing of protocol and thermometers
- Phase III** "Closing-the-Loop" Measurements at NIST

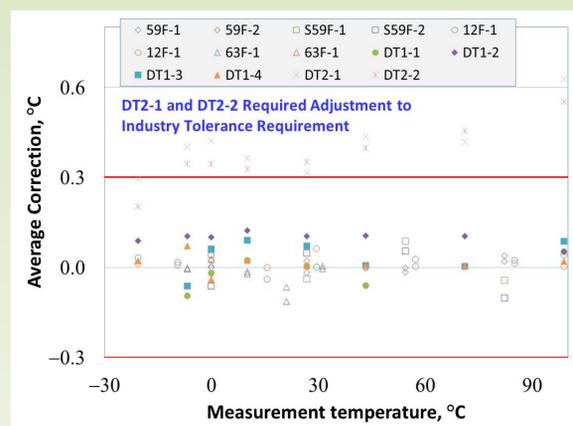
Phase I: Alternative Thermometers

Thermometer Type	Thermometer Designation	Range and Graduation/Resolution
Hg	59F-1, 59F-2	0 F to 180 F in 1 F
Hg	12F-1, 12F-2	-5 F to 215 F in 1 F
Hg	63F-1, 63F-2	8 F to 89 F in 0.2 F
Organic	S59F-1, S59F-2	0 F to 180 F in 1 F
Digital	DT1-1	-10 C to 188 C in 0.1 C
Digital	DT1-2	-40 C to 204 C in 0.1 C
Digital	DT1-3	-10 C to 188 C in 0.1 C
Digital	DT1-4	-40 C to 204 C in 0.1 C
Digital	DT2-1, DT2-2	-50 F to 400 F in 0.1 F

Repeatability testing protocol performed at NIST

- Thermometers cycled through full calibration cycle 3 times
- Measurements performed by two NIST metrologists
- Temperature range of -21 C to 99 C

Phase I: NIST Laboratory Results



Phase II: Field Testing of Protocol and Thermometers

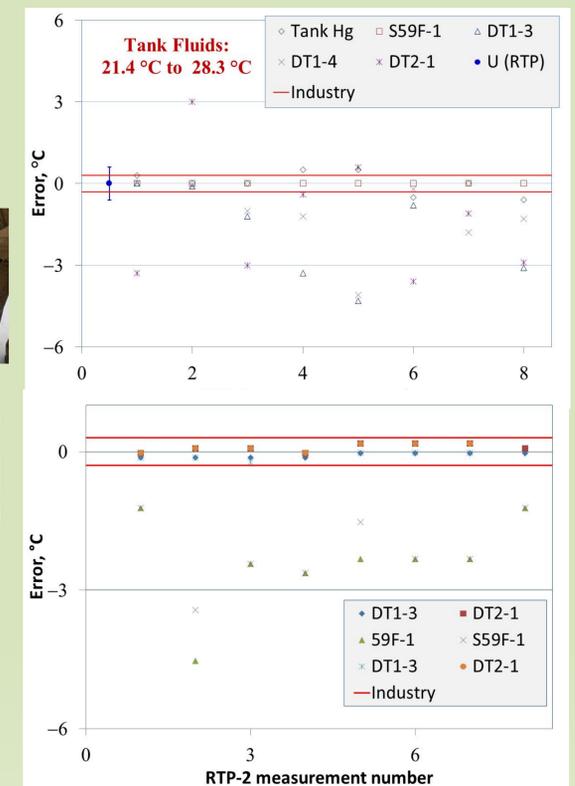
Protocol to field-test thermometers at RTPs

- Measurement instructions and data-collection worksheets
 - 8 measurement sets performed once per week
- Feasibility of different technicians measuring several thermometers
- Survivability of transfer standards (e.g. thermometers)
- Different measurement conditions
 - Time of day / night
 - Gasoline and Ethanol
 - Weather conditions

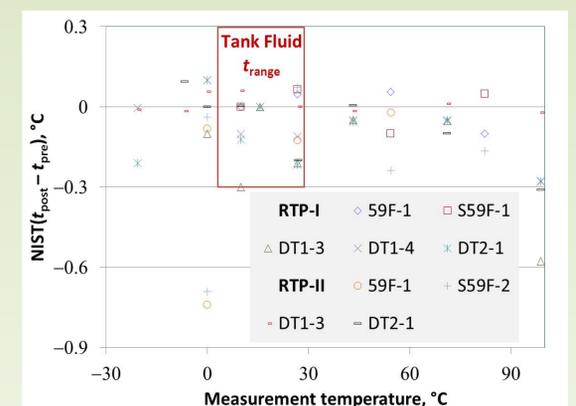


Thermometers Tested at RTPs	
Hg	59F
Organic	S59F
Digital	DT1-3, DT1-4, DT2-1

Phase II: Results from RTP-1 and RTP-2



Phase III: "Closing-the-Loop" Measurements at NIST



Notes From the Field

Thermometer field measurements needs improvement

- Analog Thermometers
 - RTP-1: ±0.6 C field measurement resolution
 - RTP-2: Drain time only 5 minutes for Organics
- Digital Thermometers
 - RTP-1: results reflect staff training issues
 - RTP-2: results reflect NIST & EPA metrologists capabilities

Digital thermometer manufacturers need to solve various issues

- Ergonomics, EMI, Training tutorials – online videos