Particulate Matter:
A brief history, current progress and future development.

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Overview

- Introduction to PM
- History of PM Standards
- PM Test Methodologies

What is PM?

- PM or “Particulate matter," is a complex mixture of extremely small particles including acids (such as nitrates and sulfates), organic chemicals, metals, and soils (such as dust particles).

- EPA’s definition of Particulate Matter:

  - Total Suspended Particles (TSP): is larger than 0.1 micrometers and smaller than 30 micrometers in diameter. (0.1-30µm)

  - Coarse particles : is larger than 2.5 micrometer and smaller than 10 micrometer in diameter. (2.5-10µm)

  - Fine particulate: is 2.5 micrometer in diameter and smaller. (≤ 2.5µm)

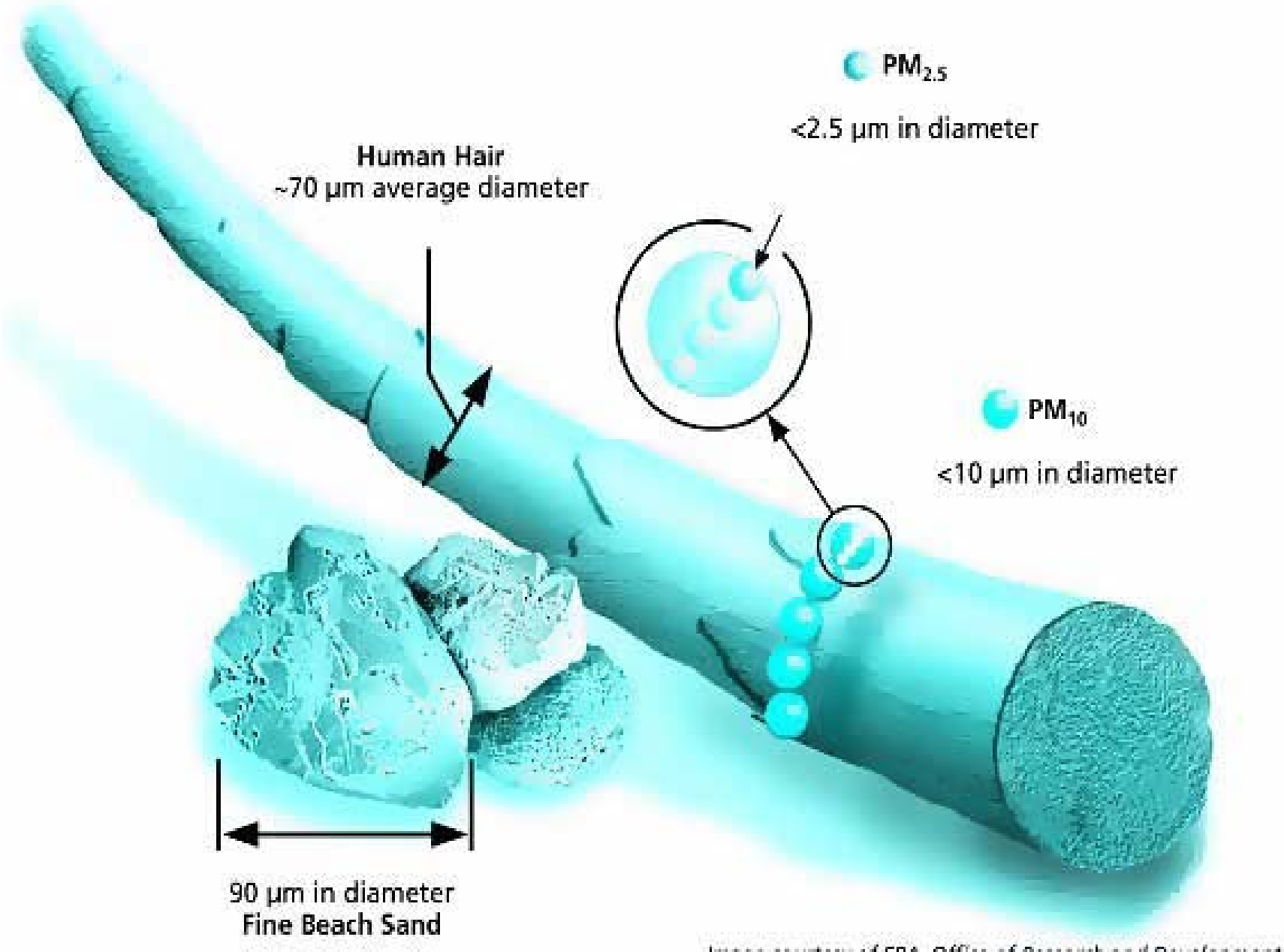
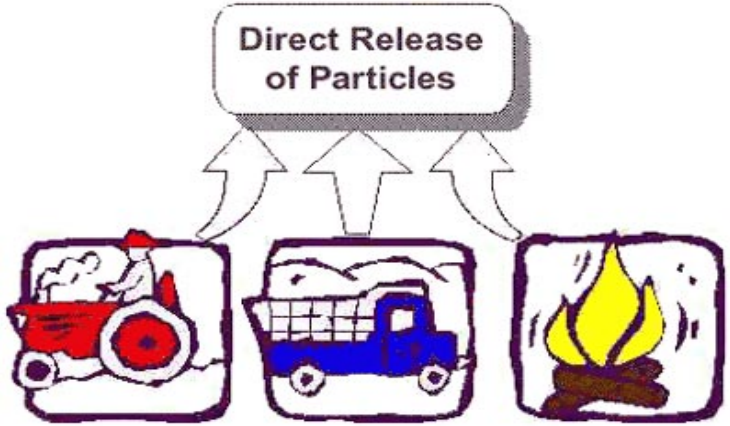


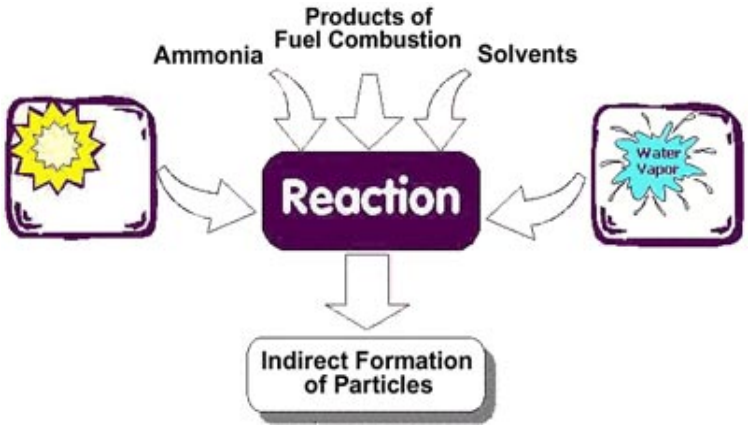
Image courtesy of EPA, Office of Research and Development

Where does PM come from?

Primary PM Emissions



Secondary PM Emissions



- Some PM is directly emitted by a wide variety of different sources including agriculture, industry and mother nature …
- While other PM is formed in complicated chemical reactions in the atmosphere

Why is PM a concern?

- Fine particles are easily inhaled deep into the lungs where they may accumulate, react, or be absorbed.

- Scientific studies have linked particle pollution, especially fine particles, with a series of significant health problems especially for people with heart or lung diseases, children and older adults.

Examples of Health Issues

- Increased respiratory symptoms, such as irritation of the airways, coughing, or difficulty breathing.
- Decreased lung function, aggravated asthma and the development of chronic bronchitis.
- An increase in irregular heartbeat and nonfatal heart attacks, even premature death in people with heart or lung disease.
- However, even if you are healthy, you may experience temporary symptoms from exposure to elevated levels of particle pollution.

History of PM Standards

- 1971 – EPA issued the first National Ambient Air Quality Standards for Total Suspended Particles (TSP).
- 1987 – EPA revised the standards and replaced TSP with PM_{10} (targeting particles <10um).
- 1997 – EPA revised the standards and included $PM_{2.5}$ (targeting particles <2.5 um).
- 1997 – Several industry and organizations including some state governments challenged EPA's standards in the U.S. Court Appeals for the D.C. Circuit.
- 2001 – The U.S. Supreme Court upheld EPA's authority under the CAA to set standards and clarified that EPA cannot consider cost in setting standards. Remanded several issues to the appellate court.

History of PM Standards continued…

- 2002 – The District Court rejected all remaining legal challenges to EPA's 1997 standards for $PM_{2.5}$.
- 2004 – EPA designated 39 areas as not meeting the standards for $PM_{2.5}$.
- 2005 – EPA proposes a rule to implement 1997 $PM_{2.5}$ NAAQS including revisions to NSR program. ("$PM_{2.5}$ Implementation Rule")
- 2007 – EPA finalizes $PM_{2.5}$ Implementation Rule and proposes $PM_{2.5}$ NSR Rule to include Increments, Significant Impact Levels (SILS) and Significant Monitoring Calculation (SMC).
- 2008 – May, EPA promulgates another $PM_{2.5}$ NSR rule for delegated States effective July 15th, 2008.

  - SIP approved NSR States may continue with surrogate PM_{10} and do not need to account for condensable PM until January 2011.

Testing PM in the 90's

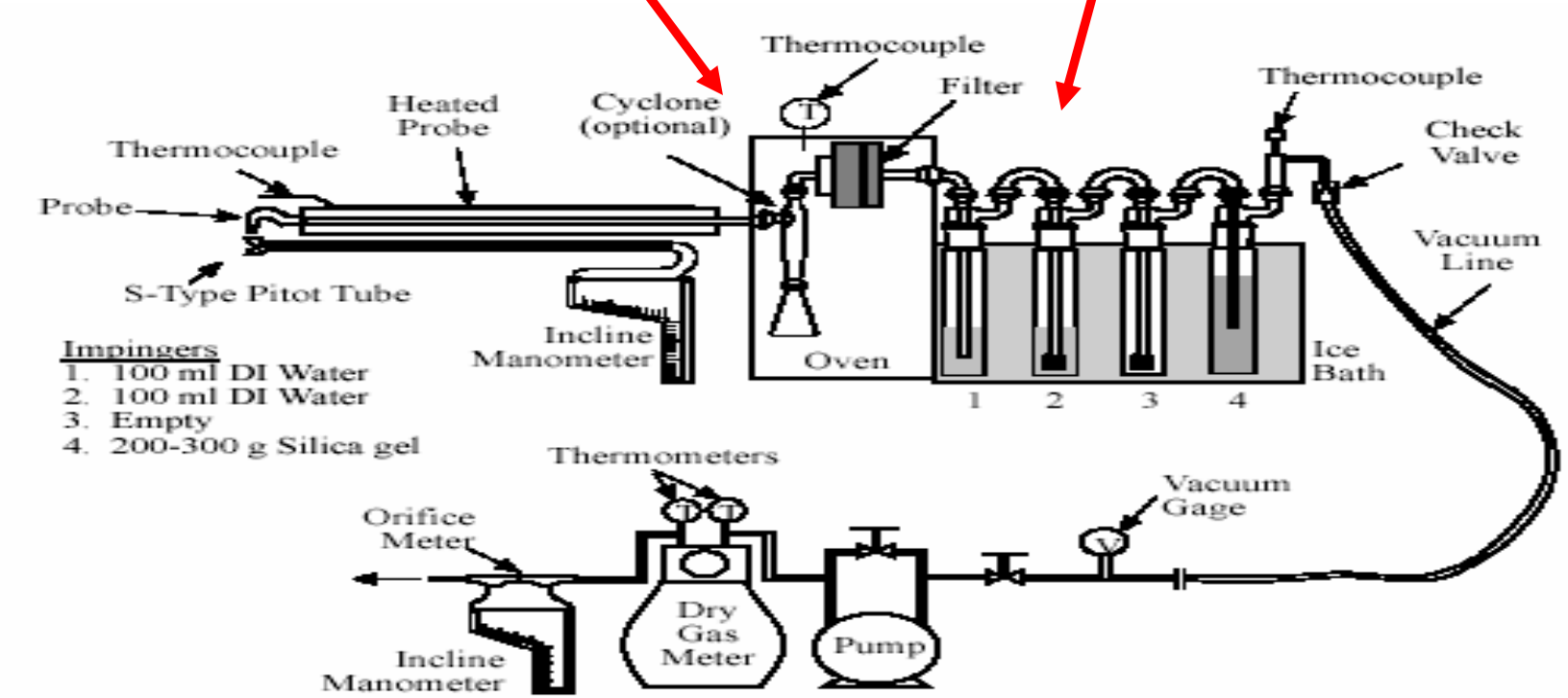
- Use Method 5 for filterable and Method 202 for condensable due to simplicity.
- Generally acceptable for PM (including PM_{10}) because Method 5 filter collects PM down to 0.3µg in size and so long as the total amount of PM collected was less than the permit requirements there was no issue.
- Started to notice trend in Method 202 with poor repeatability and high results that vary depending on the application.
- Much of the PM data provided to state agencies for PM_{10} during the 90's was total suspended particulate (TSP).

How is PM measured from the stack?

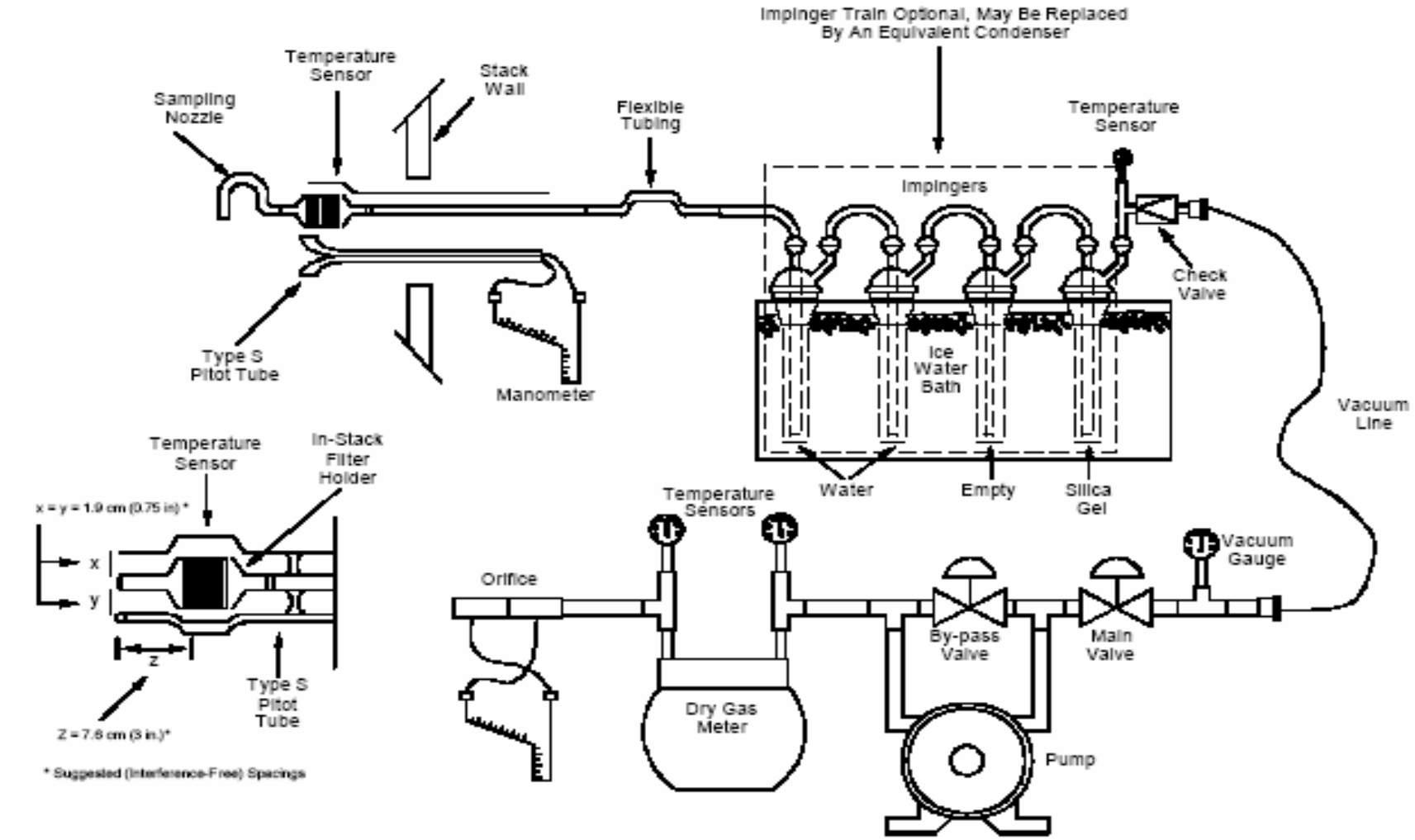
Theoretical Principle ⇨ $PM_{Total} = PM_{Filterable} + PM_{Condensable}$

Front Half = EPA Method 5
(Filterable PM)

Back Half = EPA Method 202
(Condensable)



Method 17 Sample Train



What's wrong with RM202

- Interference – SOx, NOx and Ammonia "weighable" artifacts.
- Matrix Effect – (air chemistry vs. water chemistry) similar to interference with the production of "weighable" artifacts.
- Precision – EPA studies reported an acceptable precision of 23% (laboratory studies), real world stack experience (field studies) reports 20-80% (as % RSD).
- Accuracy – nobody knows, no true standards available for comparison.
- Indiscriminate errors – beaker weighs 160,000 mg, PM can weight 1 – 10 mg.

What's wrong with RM202 continued..

- ***Best*** (only) Available Methodology (BAM) for Condensable Particulate Matter- RM202.
- EPA Recognized CPM concerns and suggested industry develop consensus based methods (EPA funding issues).
- EPA expected policy to drive technology with the $PM_{2.5}$ Implementation Rule in the year 2005.

What's been done with RM202

- To address concerns over these issues, EPA received resources to evaluate the interference in Method 202 and to explore modifications to improve this method.
- Through a collaboration with several stakeholders, EPA evaluated M202 and a modified method John Richards (JR202) also known as the Dry Impinger Method.

4 Phases:

- Phase 1 – Laboratory Testing: 
- Phase 2 – Field Testing: 
- Phase 3 – Validation: In Process
- Phase 4 – Emission Factors: TBD

Modified M202/Dry Method Impinger Method Update

- May 13, 2008 – Ron Myers (EPA) updates Modified M202.
- Objective: one method, one result (for all applications).
- The method is placed on the EPA Website under Other Test Methods (OTM).

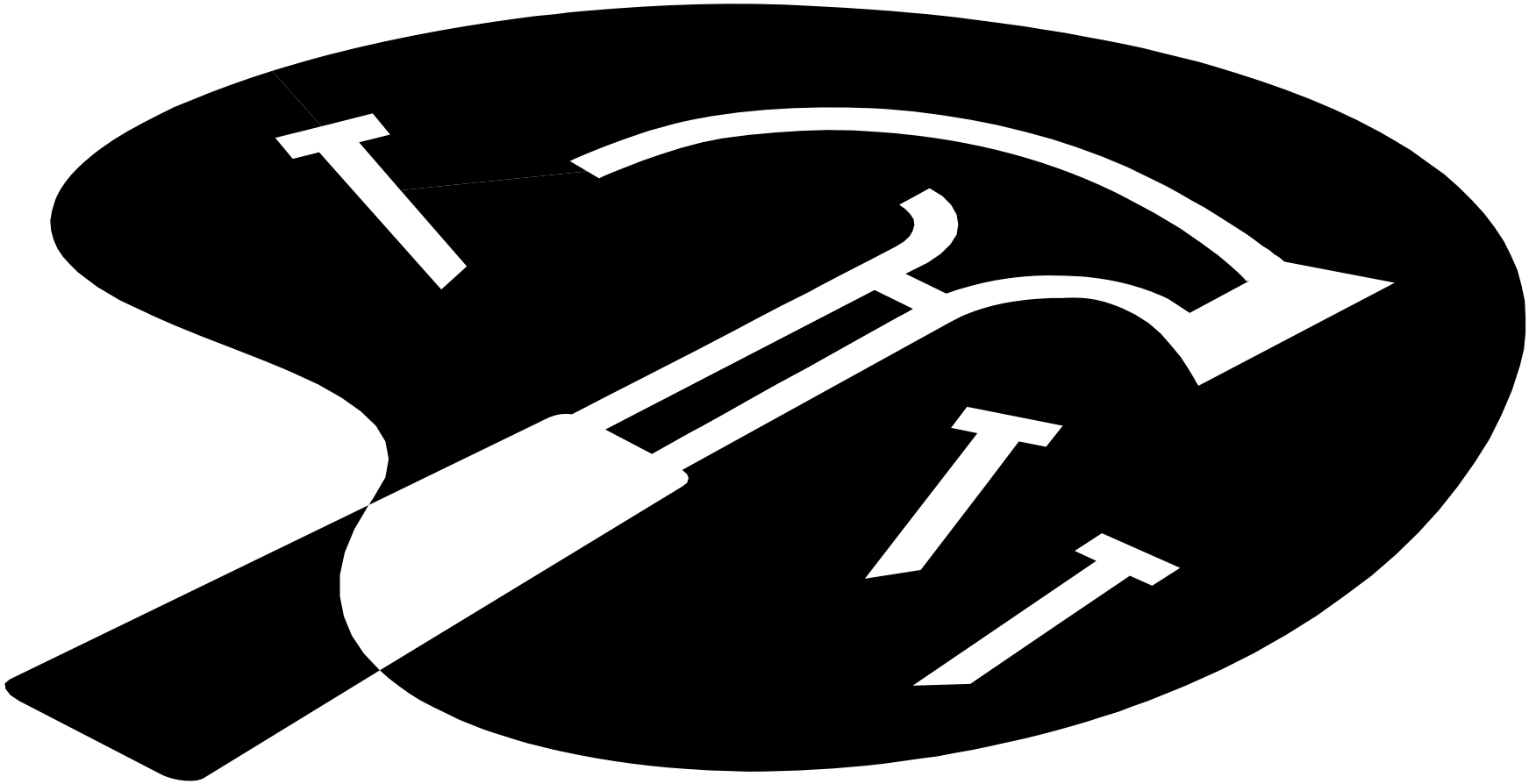
  - OTM-28 : http://www.epa.gov/ttn/emc/prelim/otm28.pdf

Modified M202/Dry Method Impinger Method Update continued…

Next Steps:

- Work Group Closure – Circulate throughout agency to the Regional Offices, Office of Research and Development, Legal, Informational Officer, then to Office of Management Budget (OMB) by late June early July 2008.
- Ron Myers (EPA) expects management approval by August 2008.
- OMB has 90 days to look at the proposed rule and make comments. OMB then looks at preamble language to determine cost to industry, effect on human health, etc.
- Through management approval once again before finalization.
- Signature for Proposal anticipated (optimistically) by November 2008.

The Quick Fix...(OTM-28 & OTM-27)



Other Test Methods (OTM-28) Modified M202

Back Half or Condensable Fraction (Dry Impinger Method)

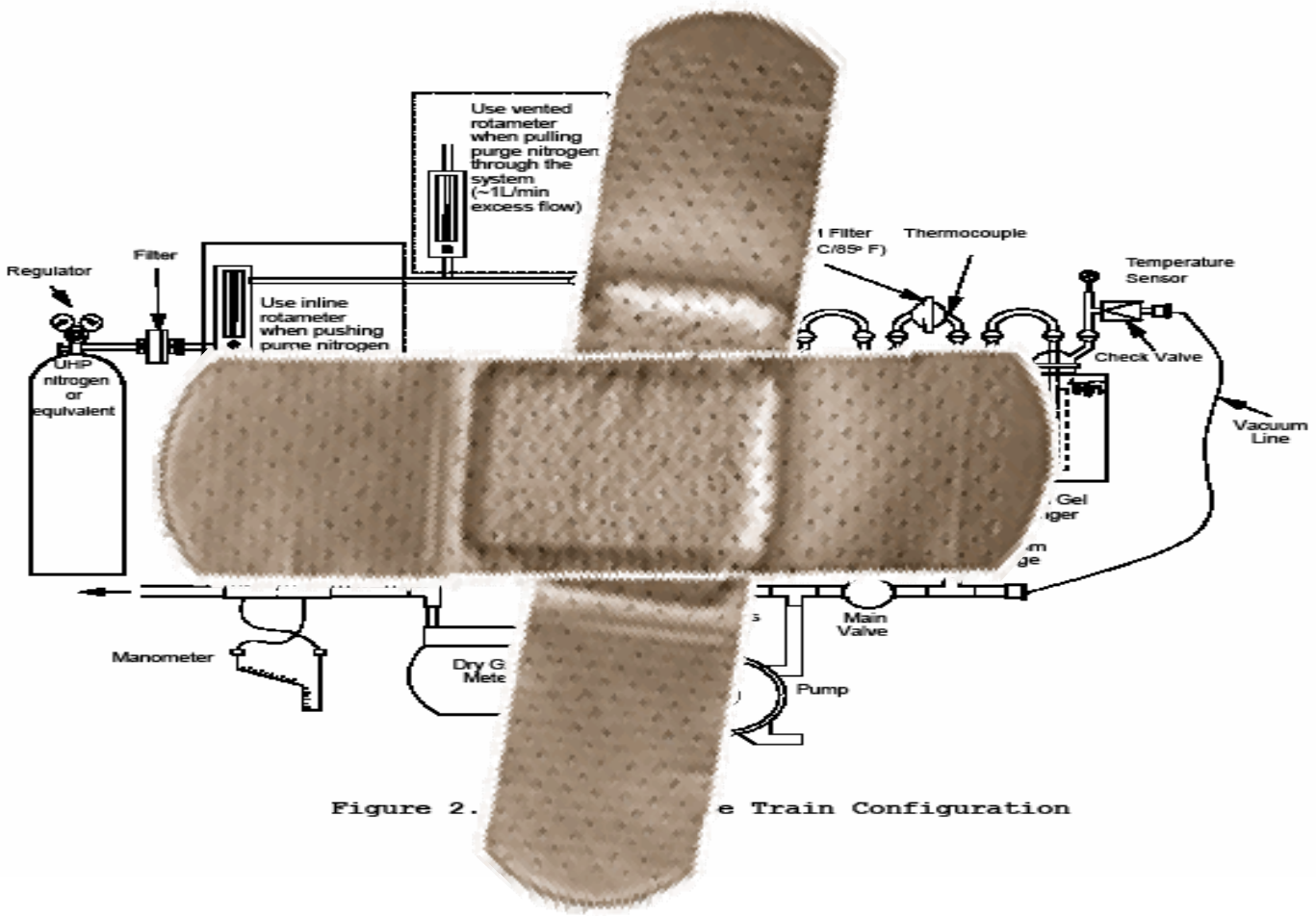
- Measures condensable particulate matter (CPM) from stationary sources after filterable particulate has been removed.

- For sources whose temperatures are **below 85°F**, a Method 17 with a Teflon membrane filter is required. The filter is not weighed but extracted using de-ionized water and Methylene Chloride in a sonication bath. Measurement of the back-half (condensable) is not necessary.

- For temperatures **above 85°F**, the filterable particulate (front-half) is collected using a Method 5, 17, 201A or OTM-027 with the following additions:
  - Method 23 type condenser after the front half filterable PM has been removed.
  - A secondary CPM filter is placed between the second and third dry impingers.
  - A long stem impinger insert to perform post run Nitrogen purge.

- Revised Method posted on EPA website:
  http://www.epa.gov/ttn/emc/prelim/otm28.pdf
  EPA accepting comments until June 27th, 2008.

Other Test Methods (OTM-28)



Other Test Methods (OTM-27)

Front Half or Filterable Fraction

- Updated filterable PM_{10} and$PM_{2.5}$ test method. OTM-27 is a reformatted and edited version of Conditional Test Method (CTM) 40.

- OTM-27 is used for the determination of filterable particulate matter only. If stack gas temperatures exceed 85°F, and Total Particulate Matter (TPM) is to be measured, this method must be combined with procedures found in OTM-28 (Dry Impinger Method) or you may continue to use the existing Method 202 for measuring CPM.

- Revised Method posted on EPA website:
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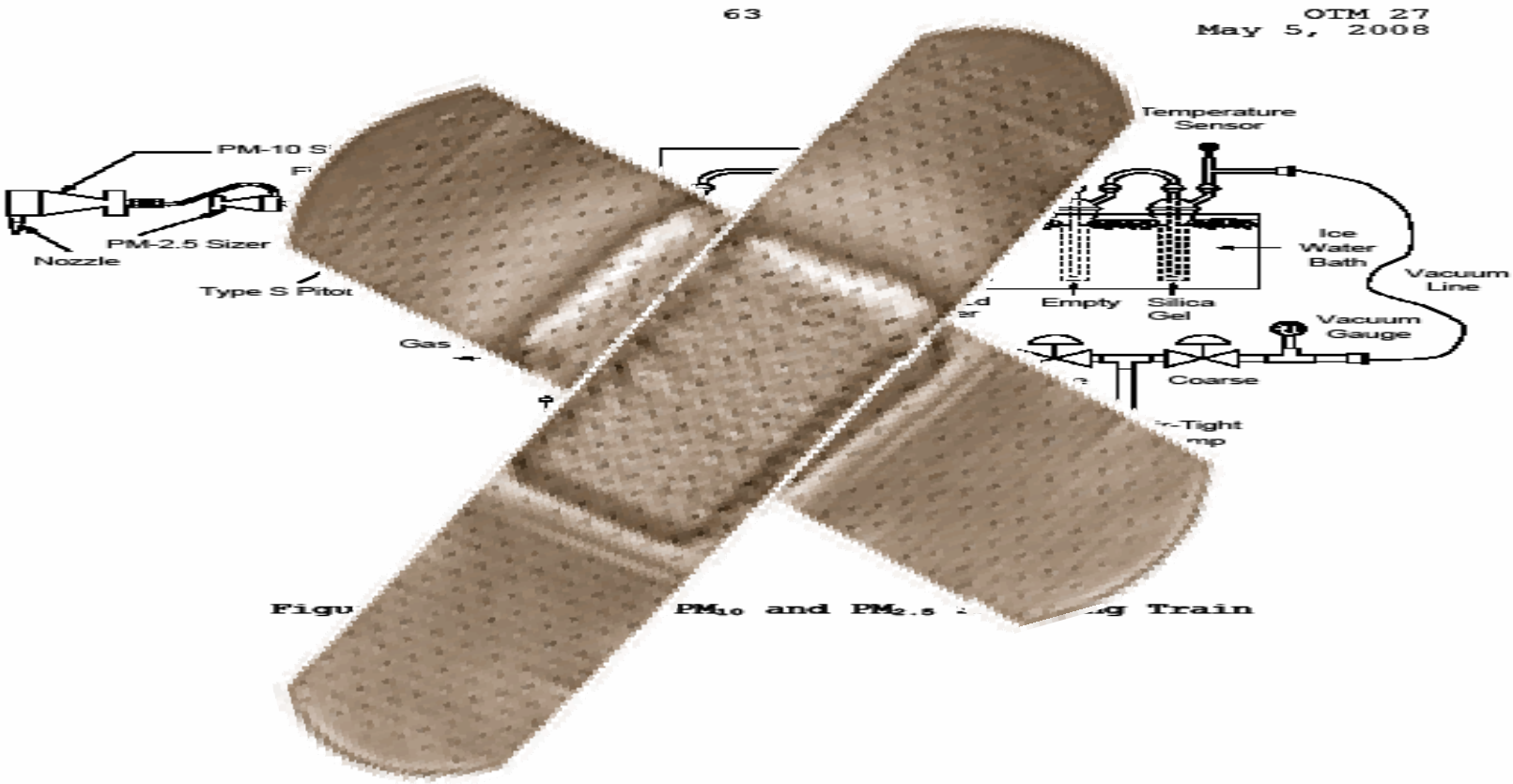
Other Test Methods (OTM-27) Revised CTM040



The Future of PM testing… Where do we go from here...?

- EPA is moving forward on finalizing the test methodology for air dilution sampling.

- Air Dilution:
  - Eliminates matrix effect.
  (air chemistry vs. air chemistry)

  - Allows better correlation between ambient air monitoring station data to source emission test data.

- Still under development:
  - CTM039: EPA
  - WK8124: ASTM

Air Dilution CTM039

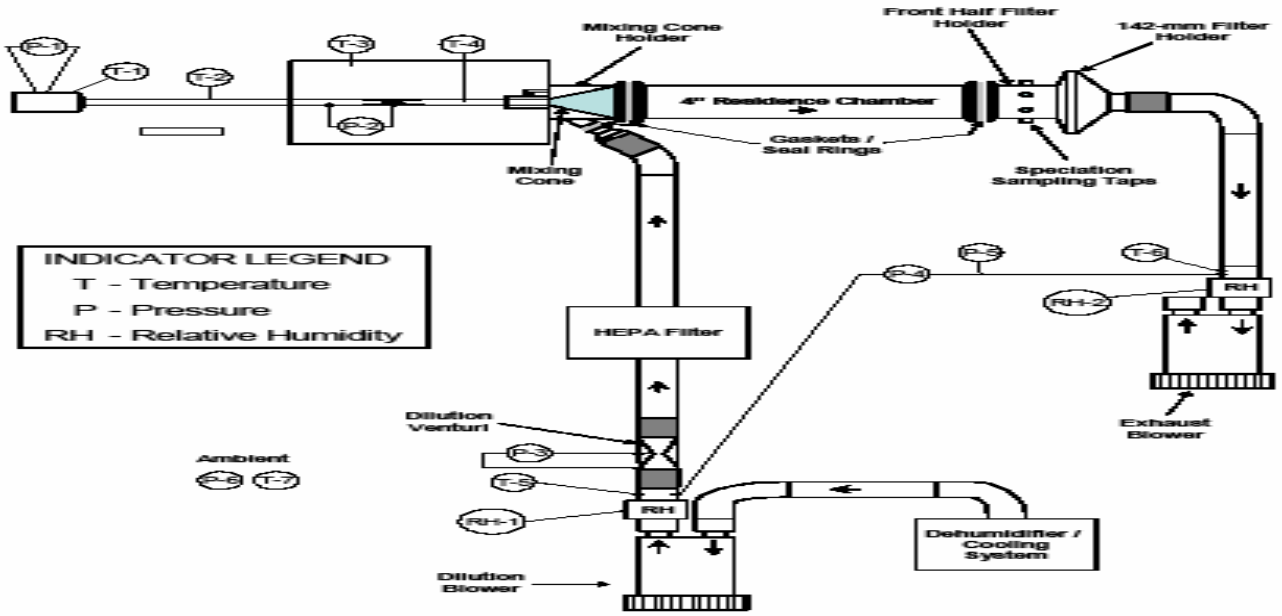


Figure 2. FPM-DST Pressure and Sensor Lines Layout.

Questions?