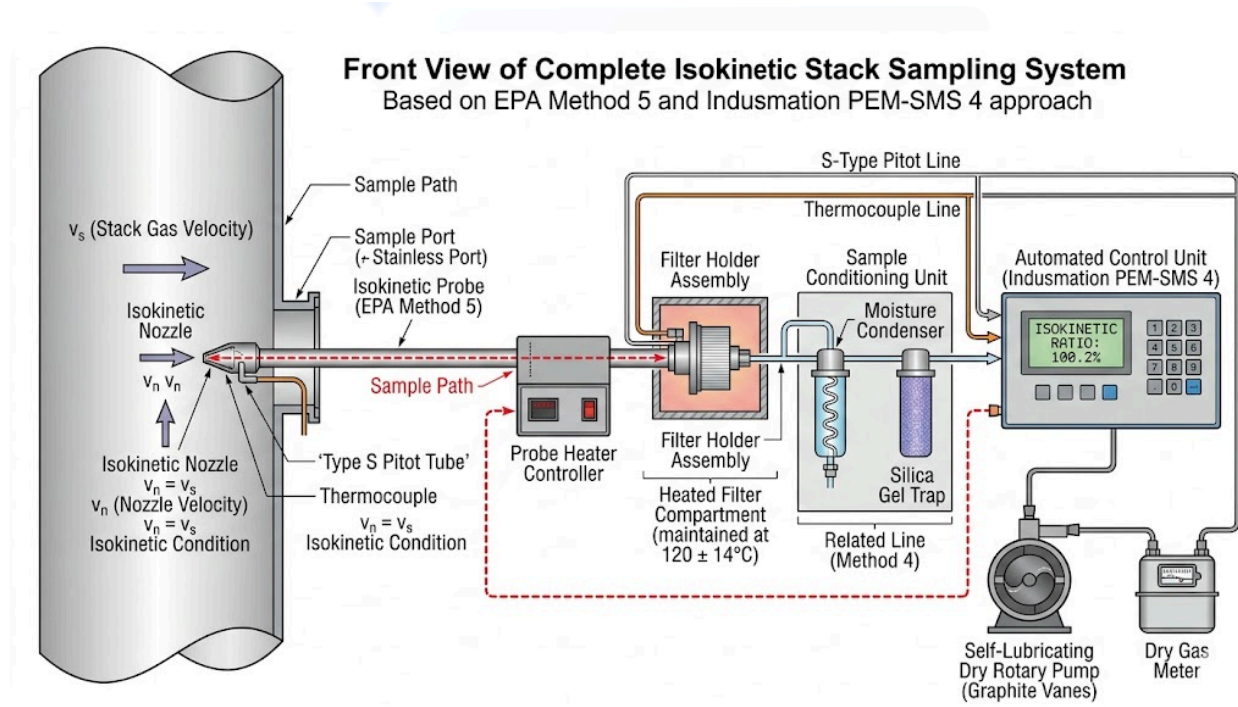


White Paper: Bridging the Compliance Gap

Methodology-Specific Isokinetic Kits for Advanced Emission Monitoring



The Global Imperative for Precise Monitoring

The industrial landscape in emerging markets is undergoing a regulatory transformation. As nations in Southeast Asia, Africa, and Latin America align with international environmental benchmarks, the demand for high-precision, automated sampling has escalated. Traditional manual sampling is often hampered by high human error rates and the complex logistical challenge of procuring specialized individual components. This paper explores how Indusmation's methodology-specific kits, centered on the **Automatic Isokinetic Stack Monitoring System Model PEM-SMS 4**, provide an "unpack-and-run" solution that ensures rigorous compliance with US EPA standards.

The Science of Representative Sampling

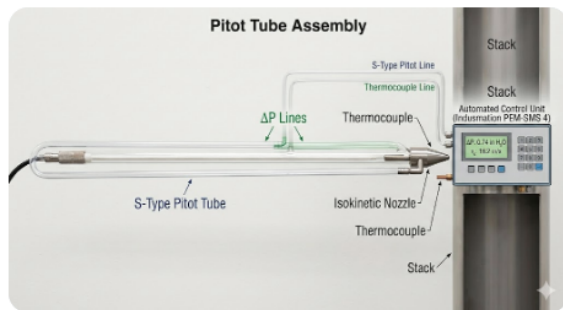
The validity of stack measurement rests on the **isokinetic principle**: sample withdrawal

velocity (v_n) must exactly match the stack gas velocity (v_s) at the sampling point.

- **Sub-isokinetic sampling ($v_n < v_s$):**
Gas streamlines diverge, but particles

enter the nozzle due to inertia, leading to a positive bias or overestimation of particulate matter (PM).

- **Super-isokinetic sampling ($v_n > v_s$):** Streamlines converge toward the nozzle, causing larger particles to bypass the inlet and leading to an underestimation of PM concentration.



The **PEM-SMS 4** automates the computational chain, resolving the velocity equation derived from the Bernoulli principle in real-time to adjust flow instantaneously.

Anatomy of the Complete Sampling Train

A reliable isokinetic system depends on the "wet end"—the components in direct contact with flue gas. Indusmation kits provide a modular, integrated sampling train designed for specialized pollutants.

1. The Sampling Probe & Nozzle

The probe acts as the primary interface with the stack. For high-temperature applications or condensable vapors, Indusmation utilizes heated probes with liners made of borosilicate glass, quartz, or stainless steel to prevent sample loss. The nozzle size is

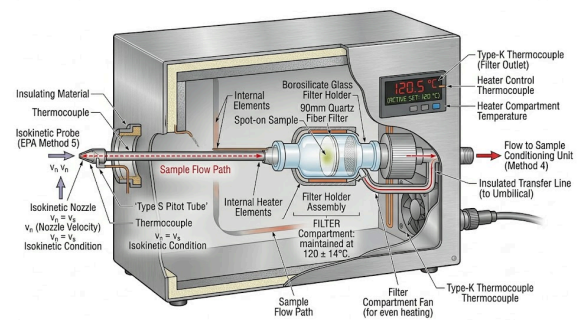
automatically recommended by the PEM-SMS 4 software to optimize the pump's operating range.

2. Pitot Tube & Thermocouple

An S-type Pitot tube is integrated with the probe to measure differential pressure (ΔP). Accompanied by a Type-K thermocouple, these sensors provide the real-time temperature (T_s) and velocity data required for automated flow adjustment.

3. Heated Filter Box

For particulate matter (PM) collection, a heated compartment maintains the filter at a constant temperature (typically $120 \pm 14^\circ\text{C}$). This prevents moisture condensation while ensuring that condensable PM is captured according to EPA Method 5 requirements.



4. The Impinger Train (Sample Conditioning)

A series of glass impingers—typically Greenburg-Smith designs—are used to determine moisture content (B_{ws}) and collect gaseous pollutants.

- **Method 4/5:** Uses water-filled impingers and a final silica gel stage

to protect the pump from moisture.

- **Specialized Methods:** Employs PTFE impingers for corrosive halogens (Method 26A) or nitric acid solutions for metals (Method 29).

The umbilical cord bundles vacuum lines, Pitot lines, and power for heaters into a single protective sheath with push-fit unions for leak-free assembly. This connects the "wet end" to the **PEM-SMS 4 Electronic Control Module**, which utilizes high-speed proportional valves to maintain the isokinetic ratio within the \$100 \pm 10\%\$ tolerance

5. Umbilical Cord & Control Unit

Methodology-Specific Solutions

Method	Target	Technical Requirement & Indusmation Solution
EPA 1 & 2	Velocity/Traverse	Software-calculated traverse points and S-type Pitot integration.
EPA 3 & 4	Gas/Moisture	Integrated sensors for molecular weight and chilled impinger boxes.
EPA 5	Particulate (PM)	Heated probe/filter box kit with borosilicate liners.
EPA 8	H ₂ SO ₄ & SO ₂	Modified impinger train with isopropanol and H ₂ O ₂ reagents.
EPA 29	Multiple Metals	Non-metallic (PTFE/Quartz) components to prevent contamination.

Strategic Recommendation: By adopting automated, methodology-specific kits, industrial partners eliminate the "hidden" costs of manual sampling—such as operator fatigue and math errors—while ensuring a digital audit trail for regulatory transparency.