Commonly Used Technologies by Performance Specifications

Performance Specification	Pollutant	QA Procedure	Technology	Description
PS-1	Opacity	Procedure 3	Transmissometry	Transmissometry is the measurement of the amount of light that can be transmitted through a stack exhaust. The intensity of the light is attenuated by scattering and absorption by particulate matter in the stack exhaust. The amount of attenuation is measured as percent opacity, and is a function of the amount, type and distribution of particulate matter in the stack gas.
PS-2	SO2 and NOx	Procedure 1	SO2 – Pulsed Fluorescence NOx - Chemiluminescence	Pulsed Fluorescence uses the property of SO_2 molecules to absorb ultraviolet (UV) light and become excited at one wavelength, then decay to a lower energy state emitting UV light at a different wavelength, the measured emitted light corresponding to the concentration of SO2 in the sample gas. The pulsing of the UV source lamp allows the analyzer to use both the light and dark phases of the pulsed light to continuously detect and correct for electronic noise, and to measure lower pollutant concentrations. A Chemiluminescence analyzer uses the light-emitting chemical reaction of NO and analyzer-generated ozone to measure the concentration of the NO in a gas sample. A successive measurement of the NO, plus NO converted from the NO2 in the sample, gives a total NOx measurement; the difference between the two measurements is equal to the NO2 concentration in the sample.

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PS-3	O_2 and CO_2	Procedure 1	O_2 –zirconium oxide, paramagnetic CO_2 – non-dispersive infrared (NDIR)	A Zirconium oxide O_2 analyzer is an electrochemical cell which is porous to O_2 when heated to high temperature, allowing the O_2 to pass from the high concentration side (reference) to low concentration side (sample) and generating a voltage proportional to the difference in O_2 concentrations. In a Paramagnetic O_2 analyzer, a sample gas containing oxygen is drawn into two parallel sample paths, one passing through a magnetic field and one not. The oxygen is attracted into the magnetic field path, with the rest of the sample being split between the two paths, and the difference between the two measured gas flow rates is proportional to the O_2 content of the sample. Non-dispersive Infrared (NDIR) is a type of infrared (IR) absorption spectroscopy using parallel sample and reference (non-absorbing) cells. It is one of the most commonly used IR methods. The IR light is filtered for a specific wavelength that is absorbed by CO_2, and the difference in intensity of that specific IR wavelength after passing through each of the two cells is proportional to the CO_2 concentration in the sample gas.
PS-4, 4A and 4B	CO (CO and O_2 for PS-4B)	Procedure 1	Gas Filter Correlation	The Gas Filter Correlation (GFC) method is similar to NDIR, but instead of two parallel cells it uses a rotating filter wheel. One side of the wheel contains a high concentration of the gas of interest (to absorb all that wavelength before the sample gas) and the other side containing a neutral gas that will partially absorb all wavelengths equally. The light beam passes through the rotating wheel resulting in a beam of alternating spectrum which passes through a sample of the gas

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				being measured. The difference in the amount of absorbance of the alternating light is proportional to the gas concentration.
PS-5	TRS		Gas Chromatography Pulsed Fluorescence	Gas Chromatography (GC) uses an inert carrier gas to transport the sample through a capillary column and separates the chemical constituents in the sample by their relative affinity for the column material. The constituents come off, or elute, from the column at different retention times, based on their specific chemical properties, and are measured by the chosen detector type, usually a Flame Photometric Detector (FPD) or Thermal-conductivity Detector (TCD) for H2S measurement. See PS-2 above
PS-6	Flow Rate		Pitot tube, Ultrasonic	Pitot tubes use the differential pressure between the measurements of total pressure and the static pressure at a point in the stack to calculate the stack gas velocity and volumetric flowrate. An Ultrasonic flowmeter uses a pair of transmitter/receivers mounted on opposite side of the stack, with one upstream from the other. The signal is alternated between them, sending it in the direction of stack gas flow, where it is speeded up, and then against the direction of flow, where it is slowed down. The difference in the time between the two signals is proportional to the stack gas velocity.

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PS-7	H2S		Gas Chromatography	See PS-5
PS-8	VOC		Flame Ionized Detector	The Flame Ionization Detector (FID) measures the current induced by ions attracted to and hitting a collector plate. The ions are formed by the combustion of organic compounds in a sample gas. A gas sample is extracted from the source through a heated sample line and heated filter to a FID. The FID measures the current, which is directly proportional to the concentration of volatile organic compounds in the sample. Results are reported as volume concentration equivalents of propane.
PS-8A	THC		Flame Ionized Detector	See PS-8
PS-9	GC		Gas Chromatography	See PS-7
PS-11	PM	Procedure 2	Light Scattering, Beta Gauge	A Light Scattering PM CEMS measures the light scattered by the entrained particulate in the stack exhaust, the amount of scattering being proportional to the particulate concentration, and affected by particle size, shape and color. A Beta Gauge PM CEMS uses a beta radiation source and an adhesive filter tape material which collects the PM material at predetermined intervals. The collected PM on the filter tape attenuates the beta radiation, the amount of attenuation being proportional to the mass of collected PM, and independent of particle characteristics. Both PM CEMS require site-specific correlation against manual gravimetric reference method measurements.

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PS-12A	Hg	Procedure 5	Atomic Fluorescence	Mercury sample is extracted from the stack and analyzed using Atomic Fluorescence spectroscopy to measure the concentration of mercury vapor in the sample. When a mercury atom absorbs the energy from a specific UV wavelength, an electron transitions from a stable ground state to an unstable, excited state, and when the UV energy source is removed, the electron returns to its stable state and emits a photon of light.
PS-12B	Hg	Procedure 5	Sorbant Traps; Atomic Fluorescence	Stack exhaust is sampled through a Sorbent Trap system which collects the gaseous elemental and oxidized mercury on the sorbent media. Sorbent traps are sent to the lab, where the mercury sample is extracted from the sorbent and analyzed using Atomic Fluorescence spectroscopy to measure the concentration of mercury vapor in the sample. When a mercury atom absorbs the energy from a specific UV wavelength, an electron transitions from a stable ground state to an unstable, excited state, and when the UV energy source is removed, the electron returns to its stable state and emits a photon of light.
PS-15	FTIR		Fourier Transform Infrared	Fourier Transform Infrared (FTIR) is an analytical technique used to obtain an infrared spectrum of absorption or emission of a gas. An FTIR spectrometer simultaneously collects high-spectral-resolution data over a *wide spectral range*. A Fourier Transform (a mathematical process) is required to convert the raw data into the actual spectrum which is compared to a library of spectra to find a match.

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PS-16	PEMS		Predictive Emissions Monitoring System	Unlike a CEMS which uses sampling and analytical equipment to directly measure specific pollutant concentrations, a Predictive Emissions Monitoring System (PEMS) uses the continuous measurement of selected plant parameters and plant operating conditions with a software-based system of mathematical models to determine the pollutant emissions.
PS-18	HCl	Procedure 6	FTIR, Tunable Diode Laser (TDL), Cavity Ring-Down Spectroscopy (CRDS)	For FTIR, see PS-15 Tunable Diode Laser (TDL) spectroscopy uses the absorbance spectra of target gases and the ability to tune the laser to a specific absorbance wavelength of the gas to measure the gas concentration. It can achieve very low detection limits (ppb) and also it is also possible to determine the temperature, pressure, velocity and mass flux of the gas being measured. It is sometimes used as the light source in Cavity Ring-Down Spectroscopy. In Cavity Ring-Down Spectroscopy (CRDS), the beam from a single-frequency laser diode tuned to the absorbance of the gas being measured enters a cavity defined at least two high reflectivity mirrors with a path length in kilometers, making it extremely sensitive to very low concentrations of the target gas. When the laser is on, the cavity quickly fills with reflected laser light. A photodetector senses the small amount of light leaking through one of the mirrors to produce a signal that is directly proportional to the intensity in the cavity.