Analytical Gas Systems for Vehicle Emissions Monitoring

Market Application Publication

Background:

Vehicle Emissions Monitoring (VEM) plays a significant role in compliance with environmental regulations to reduce air pollution. Testing vehicle exhaust and evaporative emissions requires a number of analytical instruments that determine concentrations of:

- Hydrocarbons
- Carbon Monoxide (CO)
- Nitrogen Oxides (NO_x)
- Particulates
- Sulfur Oxide (SO_x)
- Volatile Organic Compounds (VOC)

The Environmental Protection Agency (EPA) specifies the emissions monitoring procedures for all vehicle classes including heavy- and light-duty automotive, marine, locomotive, and recreation. Typically, a VEM lab may require Zero Air, Nitrogen, and a Hydrogen/Methane mixture for the instruments' calibration, curtain, and fuel gases. Detailed within the Code of Federal Regulations (CFR) Title 40 Part 1065, Engine-Testing Procedures, are the purity requirements for these analytical gases. Consistent and reliable results are an inherent requirement for any test method. Parker Balston Analytical Gas Systems (AGS) are dependable, safe, and efficient, making them the premium supply choice for VEM analytical gases.

Features and benefits:

Quality engineering and dedication to premier customer service ensures that the Parker generators meet or exceed testing purity and production needs. Application and Technical Service Engineers tailor each system to the specific requirements of the VEM laboratory and provide continued support throughout the generators' operation. The Parker Balston Analytical Gas Systems provide VEM laboratories with the following features and benefits:

- Produces high-purity analytical gases from ordinary compressed air
- Removes CO_2, CO, NO_x, SO_X, THC, and H_2 to sub ppm levels
- Each system tested and certified for compliance to gas purity specifications
- Low electrical power consumption and minimal maintenance
- Safe and efficient systems that produce gas based upon consumption
- Eliminates acquisition, transport, and installation of cumbersome and hazardous gas tanks
- Reliable operation prevents lost production time and interrupted data collection through continuous quality gas supply
- Compact design that saves laboratory space

Contact Information:

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Application:

The first major push for vehicle emissions monitoring arose from the Environmental Protection Agency's (EPA) Clean Air Act of 1970. This set a national goal to provide unpolluted air for all, and ultimately established a foundation for government and private industry pollution control. Due to development and urban sprawl, the original goal of the Clean Air Act has yet to be accomplished. In fact, travel by personal vehicle has more than doubled since the origin of the regulation and thus induces stricter pollution guidelines. Consequently, as allowable emissions from new vehicles become more stringent, so does the need for accurate analysis.

The present day act now requires that all engines, road and non-road, abide by clean air regulations. This encompasses all vehicle classes including, light- and heavy-duty automotive, marine, locomotive and recreational. Furthermore, all such polluting machinery is subject to much tighter tailpipe standards than previously required. Vehicle manufacturers must acquire certification from the EPA by following strict vehicle emissions monitoring (VEM) procedures. Testing is used to determine tailpipe and evaporative pollutants during vehicle operation, as well as while parked and refueling.

Tail pipe emissions are often analyzed by first capturing a sample of the exhaust in a dilution bag. Furthermore, evaporative emissions are of concern because hydrocarbon pollutants are released when gasoline vaporizes from the engine due to hot running temperatures and ambient conditions. Fuel tank vapors are also released during refueling. For these circumstances, manufacturers conduct EPA guided procedures with Sealed Housing for Evaporative Determination (SHED).

Analysis of the emissions for different pollutants is conducted using multiple high-precision analytical instruments. VEM laboratories often employ modular racks with flexible instrument configurations to suit their particular analysis needs. A single rack can hold up to five analyzers that are able to measure as many as ten different constituents. For a typical bench manufacturer, the analytical methods for detection of common pollutants may include:

- CO, CO2: non-dispersive Infrared method (NDIR)
- NO/NOx: chemi-luminescence detection (CLD), heated, vacuum-type
- THC: flame ionization detection (FID), heated
- O2: magneto-pneumatic detection (MPD)

The analytical instruments typically require Zero Air, high-purity Nitrogen, and a Hydrogen/Methane mixture. Depending upon the bench configuration and test procedure requirements, a significant amount of Zero Air and/or Nitrogen is used for calibration and purging. Purging sample bags is also a common use for such gases. Ultimately, the need for accurate analysis to abide by stringent regulations is what drives the need for consistent supply of Zero Air and high-purity Nitrogen. High pressure tanks from commercial suppliers are a common source, however, many users have benefited from converting to the in-house generation method.

Parker Balston Analytical Gas Systems for VEM applications provides significant advantages over cylinder supply in safety, convenience, quality, environmental impact, and cost. The high volume consumption that is typical for VEM laboratories often requires a blast proof room dedicated to storing multiple six packs of high pressure gas cylinders. In-house analytical gas generation eliminates the need for this extra space and the risks associated with replenishing gas supply.

When an in house generator is employed, only a small amount of the gas is present at a low pressure (relative to cylinder pressure) at a given time, and the gas is ported directly to the analyzer. The gas system is sized to the needs of the lab and only supplies based upon consumption. In contrast, a number of serious hazards exist when gas is supplied by a tank. There is a significant hazard and the possibility of injury or damage during the transportation and installation of a gas tank. A standard cylinder is quite heavy and can become a guided missile if the valve is compromised during transport.

Replacing cumbersome tanks also poses an issue with convenience and test data integrity. With an in-house generator, gas is supplied continuously, on 24 hour/7 day a week basis, if necessary, and without any user interaction other than minimal routine

annual maintenance. In contrast, cylinders require the user to pay close attention to the tank level and replace it regularly. The use of finite cylinders in the high-volume consumption environment, that is typical to VEM, lends itself quite easily to interruption of test data collection. Additionally, uncertain tank gas quality is a major concern for testing that requires a high degree of precision. As influenced by EPA, the very nature of VEM is to detect low pollutant levels in order to meet strict regulations. Unlike cylinder supply, Parker Balston Gas Systems can ensure uninterrupted data collection with reliable baseline readings.

Another important aspect of an in-house generator is the economic benefit compared to the use of gas tanks. The running cost of operation of the generator is extremely low and requires only compressed air and electricity. In contrast, the cost for using gas from tanks includes contractual agreements, capital cost (blast proof rooms, steel piping), and the time involved maintaining inventory. In fact, for VEM applications, a payback period of two years or less is not uncommon.

Finally, gas generators eradicate the need to transport cylinders between the point of filling, to the user's site, and back for recharging. Such deliveries require a considerable expenditure of energy due to the cylinders' weight. In fact, quantifiable findings support this advantage as seen in the following case study.

Case Study:

An essential capability of any major auto manufacturer is the vehicle emissions monitoring (VEM) laboratory. The Assistant Manager of a Power Train & Emissions Research and Development department* is very pleased with the operation of his lab's Zero Air and Hydrogen generators. Parker HPZA-18000, AGS-200NA, and an upstream hydrocarbon scrubber supply high-quality gases daily to numerous analyzers. The instruments analyze sample emissions obtained in sealed housings for evaporative determination (SHED). These chambers include variable volume variable temperature (VVVT), and onboard refueling vapor recovery (ORVR) testing. In addition to the standard analytical generation system benefits, the customer has noted the following in electing to use generators instead of gas cylinders:

- Considerable reduction in supply costs incurred by ordering and delivery of cylinders
- Less than three year return on generator investment
- Increased testing efficiency through eliminating gas supply delays
- Hassle-free and consistent supply of Hydrogen and Zero Air that meets or exceeds analytical gas requirements specified by government agencies
- Aide in acquiring facility LEED certification through the significant reduction in emissions caused by cylinder delivery; an estimated savings of 180 gallons of diesel fuel and 3995lbs, or two Tons of CO_2 gases.

Many instances of highly favorable return on investments have been seen with switching from cylinder gas to generator supply. A further example was seen for a VEM lab in Michigan that was consuming 66 cylinders per year. Upon utilizing Parker Balston Zero Air generator, HPZA-3500, they saw a payback within only eight months.

Another example is with a customer who switched to a Parker Balston Nitrogen generator system.* At one time, their facility was utilizing a single Nitrogen cylinder every 16 hours at a cost of $75.00 each. They saw considerable improvements by implementing a Parker Balston 76-98 Nitrogen generator, NO_x scrubber, and 30 gallon storage tank. Their return on investment was just shy of two years.

These savings are attainable for any vehicle emissions monitoring lab. Parker Balston Sales Applications Engineers are able to assess the appropriate set up with a site visit consultation. The following principal specifications are just a few options for what is available to suit the need of any vehicle emissions monitoring laboratory.

*This customer must remain unnamed due to proprietary reasons typical to vehicle emissions monitoring applications.

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Principal Specifications:

These products were selected for the specific case study gas system. They provide just a sampling of the gas generation system available for any vehicle emissions monitoring laboratory.

	75-83NA, HPZA-3500, HPZA-7000, HPZA-18000, HPZA-30000		76080	AGS-200NA
Max Zero Air Flow Rate	75-83NA	1 lpm		
	HPZA-3500 HPZA-7000 HPZA-18000 HPZA-30000	3.5 lpm 7 lpm 18 lpm 30 lpm		
Outlet Hydrocarbon Concentration (as methane)(1)		<0.05 ppm		
Min/Max Inlet Air Pressure		40 psig/125 psig	60 psig/125 psig	60 psig / 140 psig
Max Inlet Hydrocarbon Concentration (as methane)		100 ppm		
Pressure Drop at Max Flow Rate		4 psig		10 psig
Max Inlet Air Temperature		78°F (25°C)		105°F (40°C)
Inlet/Outlet Ports		1/4" NPT (female)	1/4" NPT (female)	1/2" NPT
Start-up Time for Specified Hydrocarbon Concentration (as methane)		45 minutes		
Electrical Requirements (2)	75-83NA HPZA-3500, HPZA-7000 HPZA-18000, HPZA-30000	120 VAC/60 Hz, 0.5 amps 120 VAC/60 Hz, 2.0amps 120 VAC/60 Hz, 4.0 amps		120 VAC/60 Hz, 0.5 amps
Dimensions	75-83NA	10"w x 3"d x 12"h (25cm x 8cm x 30cm)	15"w x 8"d x 41"h (38cm x 20cm x 104cm)	29"w x 32"d x 76"h (74cm x 81cm x 193cm)
	Other Models	11"w x 13"d x 16"h (27cm x 34cm x 42cm)		
Shipping Weight	75-83NA Other Models	7 lbs.(3 kg) 41 lbs.(19 kg)	29 lbs. (13 kg)	420 lbs. (236 kg)

1 Outlet hydrocarbon concentration (as methane) for models 75-83NA and HPZA-30000 is less than 0.1 ppm.
2 Refer to voltage appendix for electrical and plug configurations for outside North America.

Ordering Information:

System products may vary depending upon specific vehicle emissions laboratory requirements. Contact your local sales applications engineer for analytical gas consultation.

Description	Model Number
Zero Air Generator	75-83NA, HPZA-3500, HPZA-7000, HPZA-18000, HPZA-30000, AGS-200NA
Halogenated Hydrocarbon Scrubber (New)	76080 (Change Frequency: 18 Months)
Maintenance Kit for Model 75-83NA	MK7583
Maintenance Kit for All Other Models	MK7840
Installation Kit for All Models	IK76803
Preventive Maintenance Plan	75-83-PM, HPZA-3500-PM, HPZA-7000-PM, HPZA-18000-PM, HPZA-30000-PM
Extended Support with 24 Month Warranty	75-83-DN2, HPZA-3500-DN2, HPZA-7000-DN2, HPZA-18000-DN2, HPZA-30000-DN2

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