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FUEL ECONOMY MEASUREMENT

This patent pending design combines our high speed, high performance exhaust flow meter with a re-designed CO/CO² gas analyzer and packages them into an integrated system, providing accurate, real-time fuel economy measurements using the carbon balance method.

Sample handling is integrated into the system, with an internal sample probe, heated filter, Nafion dryer, and coalescing filter. The dried and filtered sample then passes through a non-dispersive infra-red analyzer for measurement of CO, CO² and HC. An optional paramagnetic oxygen sensor completes the gas analysis. The system is easily controlled through an intuitive graphical touch screen on the electronics module, or through the optional host software via a USB, serial, or Ethernet connection. Mass flow, mass emissions and fuel economy values can be monitored live, along with exhaust pressure and temperature. The system accomodates standard flow tube sizes from 1" through 6" diameters, and is also scalable, enabling custom sizes upon request.

The MAE-FEM was designed to measure exhaust flow, CO and CO², both on-board and in the test cell. The system is comprised of a high performance flow meter, and a Non-Dispersive Infra-Red (NDIR) gas analyzer, with the following features and benefits:

High Speed Sampling: The FEM internally samples the differential pressure channels at up to 5 kHz, accounting for every pressure pulse from an engine, from idle to maximum rpm. Standard output rate is 1 Hz.

Sample Handling: Sample probe, heated filter, coalescing filter and Nafion dryer are integrated into the tube electronics. An additional Nafion dryer is included in the FEM control module.

Embedded Calibration: Calibration coefficients embedded in the flow tube electronics are automatically recognized on connection. Therefore, tubes of varying sizes can be interchanged with one control module.

Multiple Tube Sizes: Eight flow tube sizes accommodate engines from less than 0.8L displacement up to 24L.

Back Purge: A software controlled back purge pump is included in the flow tube assembly, along with solenoids that route high pressure air backward through the pitot tube, purging contaminants and any condensation in the pressure lines. No dismantling is required.

Auto Zero: With a single software command, internal solenoids open the pressure sensors to ambient air, allowing fast and easy zeroing while the engine is still operating.

Graphical Panel Display: Monitor live data, adjust settings on the fly, and easily perform basic functions such as zero, span and purge, directly from the analyzer front panel's full color touch screen.

MAE-EFM-HS TUBE ASSEMBLIES

A tube assembly must be used in conjunction with the FEM electronics. Each tube assembly is a rugged metal construction. The calibration coefficients for each tube are embedded in the flow tube electronics, which are automatically recognized on connection. Therefore, tubes of varying sizes can be interchanged with one control module. The tube itself contains a sample probe, heated filter, coalescing filter and Nafion dryer. The tube connecting harness then delivers the dried and filtered sample to the FEM electronics module for analysis.

MAE-FEM

ISO 9001 REGISTERED FIRM

MUSTANG ADVANCED ENGINEERING

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MAE-FEM SYSTEM SPECIFICATIONS

Power	12 VDC nominal (10.5 – 14.5 VDC); 110 VAC or 220 VAC
Storage temperature	Dry –40 to 60 °C ambient
Operating temperature	0 to 45 °C ambient
Dimensions	43.6cm x 30.8cm x 9.1cm (WxDxH)
Weight*	10 kg
Data transmission	RS232, Ethernet, USB
Electromagnetic interference and susceptibility	CE Standards: IEC 61326: 2002-2
Exhaust temperature range	-5 to 700 °C standard construction
Exhaust temperature accuracy	± 1% of reading or ±2°C, whichever is greater
Flow measurement linearity	< 1.0% of full scale
Flow measurement accuracy	±2% of reading or ±0.5% of full scale, whichever is greater

*NOTE: Weight is for electronics module only. Tube assembly weight is dependent on exhaust tube size.

CO, CO², AND HC ANALYZER SPECIFICATIONS (NDIR)

Gas	CO	CO2	HC
Range of measurement	0 – 8 %	0 – 20 %	0 – 2,000 ppm hexane 0 – 4,000 ppm propane
Accuracy	± 3% of reading or 50 ppm, whichever is greater	± 3% of reading or ±0.1%, whichever is greater	± 3% of reading or 4.0 ppm C_6, whichever is greater
Resolution	10 ppm	0.01%	1 ppm C_6
Linearity	Intercept ≤ 0.5 % of range. 0.990 ≤ Slope ≤ 1.01 SEE ≤ 1.0 % of range r2 ≥ 0.998		
Repeatability	±2 % of reading or 20 ppm, whichever is greater	±2% of reading or ± 0.05%, whichever is greater	± 2 % of reading or 2.0 ppmC6, whichever is greater
Noise	± 20 ppm	± 0.02%	± 1 ppm C_6
Span drift (over 8 hours)	± 2% of reading or 20 ppm, whichever is greater	± 2% of reading or 0.1%, whichever is greater	± 2% of reading or 2.0 ppm C_6, whichever is greater
Zero drift (over 2 hours)	± 0.005% (50 ppm)	± 0.1%	± 4 ppm C_6
Response time	T90 ≤ 3 seconds	T90 ≤ 3 seconds	T90 ≤ 3 seconds
Data rate	1 Hz	1 Hz	1 Hz
Flow rate	2 lpm (nominal)	2 lpm (nominal)	2 lpm (nominal)

O² ANALYZER (PARAMAGNETIC)

Range of measurement	0 to 100 %
Accuracy	±0.1 % oxygen
Resolution	0.1 %
Linearity	±0.1 % oxygen
Repeatability	±0.1% oxygen
Noise	±0.1 % oxygen
Span drift	±1.0 % of reading or ±0.5 % Oxygen whichever is greater
Response time	T10 toT90 < 2.5 seconds at 200ml/min
Flow rate	0.5 to 3 lpm

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