Analytical Process Systems' SHED Simulator with Integrated Mass Flow Control

Analytical Process Systems of Auburn Hills, Michigan has recently released a compact and portable device for verification of SHED operations. The SHED Simulator is a computer-controlled device that uses a mass flow controller to inject a known quantity of sample gas into a SHED. The timed injections may be performed as a single shot or as multiple shots on an hourly basis for a 24, 48, or 72-hour diurnal test. The injections may vary in length from hour to hour and may also vary in rate with each injection. The actual injection will be within 0.5% of the intended injection on a mass flow basis.

The system is housed in a suitcase type enclosure for ease of portability. Small wheels and a carrying handle will allow for the system to be moved from cell to cell with ease. Weighing just 15 pounds, the case includes storage for detachable external tubing, connectors, solenoid and detachable power cord.

The Microsoft Visual Basic® based application software includes up to 10 pre-built user profiles, which are editable in Notepad. This profile defines the following variables and the software also allows for the detailed information to be entered and logged to the report (please see the APS Specification Sheet for full details):

- Sample gas flow rate (SLPM)
- Sample gas injection Time (either 24, 48, or 72 hours with each hour having its own injection rate)
- Nitrogen purge time (Minutes)
- Sample gas line fill time (Minutes)
- Total number of test cycles

Among the many attributes of the SHED Simulator, are several features based on the integration of Alicat mass flow controllers (MFC) within the Simulator. These features include accuracy, response time, multiple gas measurement, and multiple parameter data.

The Alicat mass flowmeters utilize laminar, or differential pressure measurement, to obtain an accurate reading of the mass flow rate. The principle, known by the Pouiselle Equation, incorporates absolute pressure data, temperature data and differential pressure data with the known temperature versus viscosity curve. These measurements are taken within the laminar flow cavity, where the natural turbulence of a gas flow have been linearized by a series of restrictions and flow separators.

As these measurements are taken directly within the flow stream, the accuracy of the device, ±0.5% full scale, the response to changes in flow (10ms), and the repeatability of ± 0.5% full scale stem from real time measurements. There are no readings based on the characterization of hot wire changes, so no "guesses" based on slope are utilized in the measurements. The Alicat meter also avoids complications and cost of ownership issues associated with the more common thermal technologies, while reducing the power requirements of the device.

The Alicat MFC uses the meter described above, with an integrated proportional valve to affect control of the gas flow rates. The speed of response to a 100% change in required flow rates is 100ms or better. For devices under 10SLPM, the speed of response is typically 50ms or better. Over and undershooting of the commanded setpoint are so slight as to be almost impossible to detect. When the MFC is integrated into a system such as the SHED Simulator, the OEM may incorporate the ratio for control setpoints into their software for transparent functionality by the end user. The Alicat MFC may receive any setpoint within its operating range, and can hold that setpoint for 1 second to any duration of time required by the process. The rapid setpoint cycle abilities of the controller allow for algorithms for specific functions to be programmed by the integrator, such as the SHED Simulator's Nitrogen purge cycle.

Another feature of the Alicat MFC that make it an ideal choice for this portable application rely on the advanced software of the system. Using RS-232 serial communication, the MFC may communicate with any device that has terminal connectivity, including enhanced PDAs. The MFC's internal software allows for a single Alicat device to be preprogrammed for multiple gases. The integrator can then use RS-232 to instruct the MFC to refer to a specific gas calibration per the end user's request. Each gas calibration refers to an independent temperature versus viscosity curve for maximum accuracy.

The Alicat MFC also provides RS-232 data from the discrete temperature (°C) and absolute pressure measurements. These variables, available within a single device, help to reduce the number of components required within the SHED Simulator. This reduction in independent components reduces the manufacturing time and costs, design time, and parts for service by the OEM.

The compact size, low power requirements, accuracy and multi-functionality of the Alicat MFC make it an ideal gas controller for integration into small, compact devices such as Analytical Process Systems' SHED Simulator. Utilizing these features has allowed for the design of a reliable and portable field research tool.

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