Flowmeters Are the & quot;Eyes & quot; of Medical Devices During Heart Recovery

Erik J. Rosaen

Flowmeters are typically found in machinery and equipment not usually associated with medical devices. However, two companies have determined how they can be used in a circulatory support system that is beneficial during heart recovery. This article highlights the advantages realized with the implementation of flowmeters in this circulatory system.

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Flowmeters—instruments that measure the flow rate or quantity of a liquid or gas passing through them—have proven their capabilities in countless applications of process monitoring and control, but treatment of acute heart failure is a dramatic departure from their usual use. Manufacturing facilities, power plants, mines, chemical centers, and water treatment operations are just a few of the businesses relying on flowmeters for monitoring water, coolants, corrosives, lubricating oil, compressed air, nitrogen, hydrogen, natural gas, carbon dioxide, and numerous other fluids and gases.

Today a major manufacturer of circulatory support systems is employing flowmeters as the "eyes" of patient-support devices that pump blood to reduce the heart's workload until it recovers.

Abiomed Inc. has specified FlowStream mass flowmeters from Universal Flow Monitors for its iPulse Circulatory Support System console and AB5000 Portable Circulatory Support Driver, two powerful tools for achieving heart recovery. The iPulse is the only combination console on the market with the capability of providing heart recovery support to patients in mild to severe acute heart failure and drives multiple circulatory support disposables, including Abiomed's intra-aortic balloon pump and two Abiomed ventricular assist devices (VADs).

The iPulse console is responsible for controlling the pumping action of the AB5000

Ventricle. The ventricle acts in place of the failing heart, supporting the required level of blood flow to meet a patient's clinical needs.

Each console is equipped with two FlowStream mass flowmeters (one each for the left and right sides of the console) that drive air pulses to and from the VAD's blood pumps. The flowmeters are connected inline with the blood pumps and function as the "eyes" into the state of the pumps. The airflow signal is analyzed, and the correct timing is calculated for exactly when to fill and empty the blood pumps.

Universal Flow Monitors supplies Abiomed with custom-designed FlowStream flowmeters that operate on the Laminar Flow Element differential pressure principle. The air's flow rate is determined by measuring the pressure drop across an internal restriction, known as Laminar Flow Element. The restriction is designed so that the air molecules are forced into moving in parallel paths along the entire length of the passage for the entire range of operation of the device. The relationship between pressure drop and flow is linear.

The flowmeters use an absolute pressure sensor along with a temperature sensor to compensate for density variations of the gas. When combined with the differential pressure (volumetric flow) output, the mass flow rate of the air can be determined.

Bidirectionality is an important operating feature of the flowmeters. The FlowStream units can measure air flow accurately and with repeatability for flow in each direction. Flow range is -50 SLPM (standard liters per minute) to +50 SLPM in both the forward and reverse directions. This bidirectional capability is central to the flowmeters' work in driving air pulses both to and from the blood pumps.

The FlowStream flowmeters have a wide dynamic operating range while simultaneously providing a high-fidelity signal at very low flow levels. They also provide high reliability, sensor stability, and very low drift that eliminates the need to tare (re-zero) the flowmeter frequently.

Another factor in the successful customer/supplier working relationship has been Universal Flow Monitors' ability to meet Abiomed's stringent demands for reliability.

Universal and Abiomed have worked together to make product modifications to Abiomed specifications and achieve critical needs in the mission of heart recovery.

Online

For additional information on the technologies and products discussed in this article, see *MDT* online at www.mdtmag.com [2] and the following websites:

www.flowmeters.com [3]
www.abiomed.com [4]

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