IMPROVED AIR SAMPLING SYSTEM

RELATED APPLICATIONS

[0001] This application claims priority from ~~is a continuation- in-part of~~ U.S. Application Serial No. 12/723,095, filed March 12, 2010, ~~which claims the benefit of~~ U.S. Provisional Application Serial No. 61/305,669, filed February 18, 2010, ~~and which is a continuation-in-part of~~ U.S. Application Serial No. ~~12/402,738~~12/843.571, filed ~~March 12, 2009~~July 26, 2010, ~~which is a continuation-in-part of U.S. Application Serial No. 12/068,483, filed February 7, 2008~~and PCT/US2011/025021 filed February 16, 2011, the entire disclosures of which are hereby incorporated by reference.

BACKGROUND OF THE INVENTION

Field of the Invention

[0002] The present invention relates to devices and methods for collecting air samples in indoor environments. In particular, the present invention relates to devices and methods for collecting, processing, and analyzing air samples in clean rooms and electronically and automatically controlling and calibrating the sampling equipment from a single, central location.

Description of the Related Art

[0003] Clean rooms found in manufacturing, research, and other facilities are typically classified into two broad categories based on the static air pressure inside the rooms relative to atmospheric pressure and/or based on the air pressure in spaces adjacent the clean rooms. A positive air pressure room is maintained at an absolute air pressure greater than atmospheric pressure, greater than the air pressure in spaces adjacent the clean room, or both. The positive air pressure in such rooms is provided by pumping filtered and/or conditioned air into the rooms and controlling the flow of air out of the rooms. The adjacent spaces, which may be manufacturing facilities or offices, are typically maintained at or close to atmospheric pressure by heating, ventilation, and

volume accuracy and precision are important at multiple locations in a clean room. Accordingly, there is a need for an air sampling system and method that has a flow rate accuracy better than ±30%, a digital flow switch, and simultaneous multi-location sampling.

[0014] In addition, none of the prior art devices provide the degree of control, monitoring, reporting, modularity, and remote operation required in the modern clean room. For example, none of the prior art devices and air sampling methods described above utilizes multiple air sampling devices with inline digital flow switches at each air sampling device to separately and simultaneously measure the air flow realized at each individual air sampling device. Nor do any of the prior art devices and air sampling methods described above provide the ability to simultaneously monitor and control a variable number of air sampling devices placed at different locations in a clean room from a single, central location that is remote from the air sampling devices. Accordingly, there is also a need for an air sampling system and method that allows the user to separately and simultaneously measure, monitor, and control varying numbers of air sampling devices from a single, central location.

SUMMARY AND OBJECTS OF THE INVENTION

[0015] A~~n air sampling/monitoring~~ system and method in accordance with the present invention, for sampling air at multiple locations in a controlled environment, ~~overcomes at least the shortcomings of the prior art discussed above by~~ provide~~sing~~ two or more air sampling devices at different locations within the controlled environment. A controller is provided at a location outside of the controlled environment and in separate air flow communication with each of the two or more air sampling devices via separate first vacuum tubes, the controller having a manifold configured to separately control a rate of air flow from the two or more air sampling devices to the controller via each of the separate first vacuum tubes and to selectively direct the air flow from each of the separate first vacuum tubes to one or more

second vacuum tubes. A vacuum source is provided at a location outside the controlled environment and in air flow communication with the controller via the one or more second vacuum tubes, the vacuum source providing suction and being controlled by the controller to generate the air flow through each of the first vacuum tubes. And, a flow switch for each of the two or more air sampling devices is provided at a location between a corresponding air sampling device and the vacuum source, each of the flow switches being configured to separately measure and control the rate of air flow through a corresponding first vacuum tube. An alarm is automatically activated at a location inside the controlled environment by one or more of the flow switches when the rate of air flow measured at one or more of the flow switches deviates from a desired value by a predetermined amount.

[0016] With those and other ~~objects,~~ advantages, and features of the invention that may become hereinafter apparent, the nature of the invention may be more clearly understood by reference to the following detailed description of the invention, the appended claims and to the several drawings attached herein.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017] Many aspects of the present invention can be better understood with reference to the following drawings, which are part of the specification and represent preferred embodiments of the present invention. The components in the drawings are not necessarily to scale, emphasis instead being placed upon illustrating the principles of the present invention. And, in the drawings, like reference numerals designate corresponding parts throughout the several views.

[0018] **FIG. 1** is a schematic diagram of an exemplary facility having a clean room therein according one aspect of the present invention;

[0019] **FIG. 2** is a schematic diagram of an air sampling/monitoring system for use in the clean