Improvements in Atmosphere Generators Used in Chemical Challenge Testing of Air-Purifying Respirators

C.R. Manning, G.O. Nelson, T.E. Crabtree, and A.R. Piedmont

Assay Technology, Inc., Pleasanton, California, USA

Laboratory data from chemical challenge testing of air purifying respirators (APRs) have been used to estimate service lives for APRs which, in turn, have been used to justify respirator change schedules. The integrity of chemical challenge testing is therefore crucial to the validity of current and future air-purifying respirator programs. A keystone underlying the integrity of any chemical challenge test is the performance of the Atmosphere Generator that is used to provide clean test air, at specified level of moisture (humidity), at a specified temperature, and at a specified flow rate.

With testing of APRs now conducted at upwards of 64 L/min (up to several hundred L/min for PAPRs), the maintenance of accurate flow and humidity regimes in respirator testing is a substantial engineering challenge. Problems encountered in this regard include: (a) non-linearity, and drift in flow control; (b) non-linearity, fluctuations, and drift in humidity control; and (c) system crashes.

In flow control studies, non-linearity was addressed by instituting digital mass flow controllers, while drift was addressed by protecting the flow control unit from external contamination, and the refinement of calibration programs. In humidity studies, non-linearity, fluctuations, and drift were addressed by refinement of the humidity sensor and by calibration programs, respectively. Control of the entire system by a PROM (programmable read-only memory) chip was found to facilitate both calibration and stable operation of the instrument. Further, diagnostic and control programs imbedded in the PROM were found to help prevent the Atmosphere Generator from entering performance regimes that could lead to crashes and/or damage to the equipment.

A summary of instrument performance improvements produced by these investigations and implemented in the Atmosphere Generator will be presented.