An experimental study on respirator penetration testing by sodium flame and aerosol photometer methods

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According to EN143-2000, two kinds of methods are used for respirator penetration testing, Sodium Flame (also Flame Photometer) and Aerosol Photometer (also Laser Photometer) methods.

In China, Sodium Flame method has been successfully used for the filtration efficiency (100 percent minus penetration) testing of HEPA filter and HEPA filter media for thirty years. In November 2006, Model KZNJ-1 tester is invented by Tsinghua University of China on basis of Sodium Flame aerosol measurement technology. In USA, one tester has been developed for the testing of respirator filtration efficiency which is based on the principle of Aerosol Photometer aerosol measurement technology and named TSI 8130 (TSI Incorporated, St. Paul, MN, USA).

In improved Model KZNJ-1 tester, which is different from previous design (Jiang et al., 2006), the NaCl aerosol shall be generated from 1% solution of NaCl, the atomizer is composed of one Collision Type nozzle and works at a pressure of 2.6 bar. The particle size distributions which are measured by TSI SMPS3936L22 (TSI Incorporated, St. Paul, MN, USA) are shown in Figure 1.

Figure 1. Particle size distribution of NaCl aerosol.

19 pieces of media are tested at 14.2 cm/s of face velocity (flow rate is 85 l/min, filtration area is 100 cm²) by one KZNJ-1 tester and two TSI 8130 testers. The experimental results of KZNJ-1 and TSI 8130 are given in Figure 2.

The results show the penetrations have well consistent between KZNJ-1 and TSI 8130 for the media whose penetrations are higher than 0.01%.

Figure 2. Results comparison of media penetration which are tested by KZNJ-1 and TSI 8130.

Others media are tested at different face velocities (from 1 cm/s to 16.7 cm/s) by one KZNJ-1 tester and one TSI 8130 tester. The experimental data are given in Figure 3.

Figure 3. Results comparison of media penetration which are tested by KZNJ-1 and TSI 8130.

From the experimental data, for the media whose penetrations are lower than 0.01%, the accuracy of TSI 8130 is lower. All of the experimental results show the good agreement with those described in EN143.
