Pergamon

J. Aerosol Sci. Vol. 28, Suppl. 1, pp. S677–S678, 1997

Printed in Great Britain

PII:S0021-8502(97)00387-X

0021-8502/97 $17.00+0.00

Simplified Test Method to Evaluate Personal Aerosol Samplers

O. Witschger*, K. Willeke, S.A. Grinshpun, V. Aizenberg

Aerosol Research and Exposure Assessment Laboratory,Department of Environmental Health, University of Cincinnati, Cincinnati, OH 45267-0056, USA.

and

J. Smith and P.A. Baron

U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, 4676 Columbia Parkway, Cincinnati, OH 45226-1998, USA

* Present address: Aerosol Physics and Metrology Laboratory, IPSN/DPEA/SERAC, CEA-Saclay, F-91191 Gif sur Yvette, Cedex, France

KEYWORDS

Simplified test method, performance testing, personal aerosol samplers, wind tunnel.

INTRODUCTION

The performance evaluation of a personal aerosol sampler for the inhalable aerosol fraction (CEN, 1993; ISO, 1995) requires laboratory tests on a full-size manikin with particles up to at least 90 μm in aerodynamic diameter and wind speeds of 50 cm/s and higher (CEN, 1996). A recent collaborative study of CEN protocols for performance testing of workplace aerosol samplers (Kenny et al., 1997) clearly shows the difficulty of testing personal samplers in a large cross-section wind tunnel. The present study was initiated to simplify and reduce the cost of the suggested protocol.

SIMPLIFIED TEST METHOD

The simplified test method consists of mounting several personal aerosol samplers of the same design on a static simplified torso instead of a full-size rotating manikin, as shown in Fig. 1A and B. The simplified torso consists of a rectangular three-dimensional body with rounded corners (33 cm wide, 20 cm high, 20 cm deep) to simulate the sampler's attachment to the human body. To reduce the number of experiments, the simplified torso was designed so that the personal sampler under investigation can be tested during the same run with the same aerosol and wind conditions in all three principal sampling orientations: facing the wind, 90° to the wind and in the wake of the manikin, as shown in Fig. 1C and E. Thus, a sampler is attached in the center of each vertical face of the simplified torso, as shown in Fig. 1D and F.

EXPERIMENTAL SETUP AND PROCEDURES

The laboratory evaluation of the simplified test method was conducted in two parts. The first part was an air flow study by carrying out flow pattern visualization and three-dimensional air velocity measurements around the test bodies (full-size torso and simplified torso) for the different sampling orientations. In the second part, the aerosol sampling efficiency of a commercially available personal aerosol sampler was compared when mounted on either of the two test bodies. Tests were performed in a large cross-section wind tunnel located at the NIOSH in Cincinnati.

RESULTS

The air flow approaching a sampler mounted on a manikin depends on its location on the chest, symmetry of the full-size torso and position of the arms. The magnitude and direction of the air flow near the sampler mounted on the simplified torso were found to be comparable to the ones near the sampler mounted on the full-size torso, as shown by the air streamlines in Fig. 1. The 3.5 l/min GSP personal aerosol sampler gives similar sampling efficiency for both test bodies when measured in the three sampling regimes at air velocities of 50 cm/s and 200 cm/s with particle of 70 μm aerodynamic diameter.

The advantage of the simplified test method is that fewer measurements need to be made and a smaller, less expensive wind tunnel can be used for the testing.

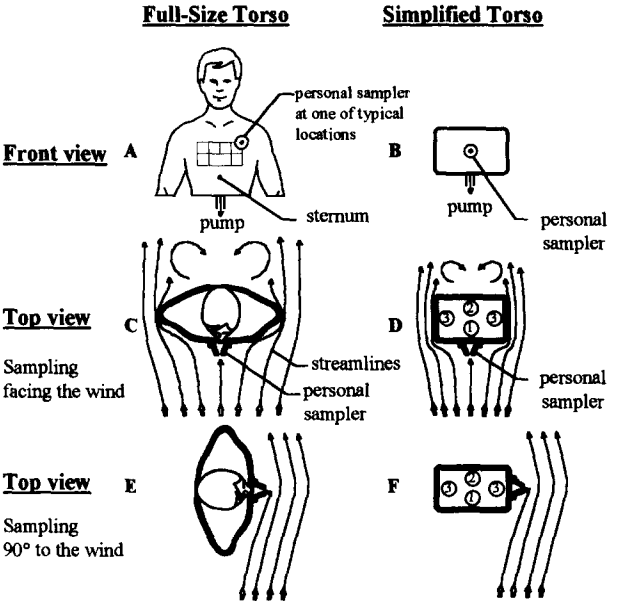

Fig. 1: Test bodies, sampling locations and flow pattern for typical body orientations

REFERENCES

CEN (Comité Européen de Normalisation) (1993) Workplace atmospheres - Size fraction definitions for measurements of airborne particles in the workplace, *CEN standard EN 481, CEN, Brussels.*

CEN (Comité Européen de Normalisation) (1996) Workplace atmospheres - Assessment of performances of instruments for measurement of airborne particles. *CEN/TC137, N171, CEN, Brussels.*

ISO (International Organization for Standardization) (1995) Air quality - Particle size fraction definitions for health-related sampling. *ISO standard 7708, International Organization for Standardization, Geneva.*

Kenny, L.C., Aitken, R., Chalmers, C., Fabriès, J.F., Gonzales-Fernandez, E., Kromhout, H., Lidén, G., Mark, D., Riediger, G., Prodi, V. (1997) Outcome of a collaborative European study of personal inhalable aerosol sampler performance. *Ann. Occup. Hyg. in press.*