

Visualizing Flow Pathways When Overbreathing a Loose-Fitting PAPR

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When blower flow rate is exceeded by inhalation flow rate in a loose-fitting PAPR, outside air is free to leak into the facepiece and be inhaled by the wearer. Pathways taken by this air are critical, because air that enters the facepiece from all directions and fills the dead volume behind the face shield before reaching the mouth or nose will carry with it less inhaled contaminants than will air that enters close to the mouth and flows directly into the mouth. This study was designed to determine the pathway taken by leakage air. Experiments were conducted on a breathing machine headform with a popular loose-fitting PAPR. The PAPR blower was set to deliver its normal flow, and the breathing machine was set to draw more air than the blower delivered. Smoke was generated and introduced into the air outside the facepiece. A video camera recorded all events through the clear face shield of the PAPR. Computer-aided video processing allowed stop action analysis of each frame. It was found that the flow pathway was very preferential toward the mouth. As long as the blower was operating, inhaled volume had to exceed PAPR dead volume before smoke reached the mouth.