[ABS30]

Contact Interaction and Air Flow Characteristics between Respirators and Headforms

Jingzhou (James) Yang[1], Zhipeng Lei[1], and Ziqing Zhuang[2]

(1) Human-Centric Design Research Laboratory, Department of Mechanical Engineering, Texas Tech University
(2) National Institute for Occupational Safety and Health, National Personal Protective Technology Laboratory

Assessment of respirator comfort and fit is critical for respirator designers, users, and standards developers. This presentation summarizes a simulation study of contact interaction and air flow characteristics between six respirators and five headforms of different sizes. Contact interaction was simulated using LS-DYNA software. The headform model contained a skin layer, muscle layer, fat tissue layer, and bone layer. Each headform was divided into five parts (two areas for cheeks, one area for the upper forehead, and one area for the chin, and one area for the back side of head). Each respirator model was made of two layers (an inner form layer and outer soft layer) with two straps. The simulation process had two stages for each respirator/headform combination. The first stage was to wrap the straps around the back of the headform and pull the respirator away from the face. The second stage was to release the respirator so that the respirator moved towards the face. Different strap forces and contact interactions were generated between the respirators and the headforms. Meanwhile, contact pressures on the interface of the respirators and headforms were measured to validate the simulation results. A real-time surface pressure mapping system was used to record the pressures at 16 locations. The experimental results matched the simulation results very well. Based on the final contact scenario, air flow characteristics were studied using the computational fluid dynamics (CFD) software, Fluent. The CFD simulation clearly showed where the leakages were. The air flow stream lines during exhalation and inhalation indicated leakage locations which coincided with areas having low contact pressures.