

# **3-Dimensional Shape Analysis of Commercial Half-facepiece Respirators for Koreans: Statistical approaches**

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This study was performed to identify design deficiencies of the facepieces of commercial half-mask respirators, and to suggest a new three-dimensional (3D) fit test panel, constructed based on 3D facial data, for respirator fit testing using statistical software program (SAS software package). Three dimensional surface data were obtained using a 3D laser scanner; facial data from a group of 102 volunteers (70 males and 32 females) and surface data from the 4 half-mask respirators chosen, 2 from foreign-import and 2 from domestic products. The collected digitalized data were used for shape analysis utilizing the Procrustes algorithm. In addition, quantitative fit tests were performed using a PortaCount 8020 (TSI, U.S.A.). Fit factors, with geometric means of 102.0 and 318.7 from foreign imports and 44.6 and 47.0 from domestic brands, respectively, were statistically significantly different between genders, among respirator brands. A stepwise regression analysis of the facial shape information, denoted by the stand-off distances between the surfaces of a respirator and the face on each landmark, and the length information expressed as the differences between a respirator and the face length (diff-LNTH) showed that fit factors were either affected by the shape information or by the length information data, but not both. These design deficiencies, as well as shape information of Korean faces, should be taken into consideration for the design of future half-mask respirators.