

# Use of Speech Transmission Index (STI) for Voice Intelligibility Testing of Respiratory Protection Devices and Proposed Measurement Method

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The voice intelligibility of respiratory protection devices is a key metric of communication effectiveness. The current test standard in the respiratory protection field is the Modified Rhyme Test (MRT) standardized under 42 CFR, part 84, subpart G, section 84.63(a)(c)(d). The MRT is a modified version of the Fairbanks Rhyme Test developed in the 1960's. The method is widely known to be both cumbersome and time consuming to perform. The test utilizes human subjects (typically an arrangement of 'speakers' and 'listeners') to assess the speech characteristics of a respiratory protection device. As with all human subject testing, the results are highly dependent on the subjects used. In the Modified Rhyme Test for instance the results can be highly influenced by a speaker's accent, enunciation, cadence, sound pressure level, etc., as well as the listeners' hearing ability. While all efforts are made to minimize these effects they cannot be eliminated completely. These discrepancies lead to testing that is highly subjective with lower than desired repeatability and reproducibility.

Speech Transmission Index (STI) testing is a quantitative and objective method of speech transmission quality in the presence of ambient (pink) noise and calculated from the Modulation Transfer Function using the signal-to-noise ratios per octave band with weightings. An alternate testing method using a variation of the STI method proposed by the National Fire Protection Agency in NFPA 1981: Standard on Open-Circuit Self-Contained Breathing Apparatus (SCBA for Emergency Services for the 2013 Edition) is studied for its highly repeatable and reproducible results. Since the STI method does not require any human subjects it eliminates the variability caused by differences in their speaking and/or hearing abilities.

An evaluation of the repeatability and reproducibility of respiratory protective device performance utilizing the method proposed by the NFPA was undertaken. The study further evaluates a new method for assessing 'best in class' voice intelligibility performance of respiratory protection devices via a full 360 degree intelligibility profile. The current standard MRT test only takes into account the anterior direction of the speaker. Similarly, the NFPA 1981 2013 Edition draft standard proposes only an anterior direction; however it does take into account various speaker-listener separations. The new STI method proposed places higher weighting on the anterior speaking directions but also provides scoring for lateral and posterior directions thus an omni-directional voice intelligibility profile score of the respiratory protection devices is created.