

Development of an air sampling system for detecting oxygen leaks from the facepiece of a closed circuit self-contained breathing apparatus

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The goal of this work is to develop and validate an oxygen leak detection system for use with a closed circuit self-contained breathing apparatus (CC-SCBA). CC-SCBA operate under a positive pressure closed loop, where carbon dioxide is removed from exhaled air while oxygen and other gases are recovered and recycled. There has been a long standing advisement against the use of such oxygen based closed circuit systems in the presence of high radiant heat or open flame due to concerns over possible user burn injury as a result of leaks in the vicinity of the face piece. Past studies performed at ETL laboratories according to the NFPA 1981 standard have revealed that face piece fit poses the biggest risk for a closed circuit respirator and will most likely be the location for a leak to occur. The system we developed was intended to detect leaks that are emanating from the seal of the face piece with the face using a plenum with sampling ports at intervals located along the periphery of the face piece which suck air to an oxygen analyzer. Leaks were located at the neck, temple and cheek of the facepiece and the changes in percent oxygen in the surrounding air were recorded for leak and no leak conditions. With this approach the oxygen leaks can be sensed directly and independently of size or location. It was found that the proposed system is capable of sampling from the vicinity of the facepiece; however its sensitivity in detecting leaks has not been adequate enough to definitively state if a leak has occurred due to large fluctuations in oxygen detected as a result of a low sample rate and a high dilution factor.