Total Inward Leakage Project Update

The objective of this project is to establish total inward leakage (TIL) laboratory test capability and performance requirements for respirator certification. The inward leakage of a respirator is determined by measuring the concentration of a challenge aerosol outside of the respirator as well as the concentration within the breathing zone. Respirator fit testing normally considers face seal leakage. Total inward leakage defines a protective level achieved by a respirator when the contributions of all leakage paths are considered. The TIL is defined as the ratio of the external concentration to the breathing-zone concentration. While the total inward leakage testing performed under laboratory conditions is not expected to reflect expected actual field level PPE performance, it does represent a criterion for performance that will influence PPE design and performance.

The project is initially addressing the performance requirement for half-mask respirators, including elastomeric and filtering facepiece styles. Other classes of respirators will be incorporated into the program following completion of the half-mask project. TIL testing is intended to quantify the ability of respirators to fit individuals having a defined range of facial dimensions, and can not replace individual fit testing to assure the respirator fits the individual user.

The TIL performance requirements will be based on the performance of the current respirators in the class. The performance requirements will be based on the state of the art respirator performance, accounting for differences between laboratory test conditions and workplace conditions. The TIL test will use a panel of subjects with a range of facial dimensions, and the respirators will be tested for performance to those sizes specified by the respirator manufacturer. The exercises used to stress the facepiece-to-face seal will be similar to those identified in the OSHA respiratory protection standard.

The project to develop a half-mask respirator TIL program consists of five components:

- **Develop respirator TIL requirements and test protocol**

The TSI PortaCount ® Plus was selected as the test instrument to measure the respirators' inward leakage, based on NIOSH fit testing research. NPPTL has also established a panel of human test subjects with facial dimensions representing the range found within the U.S. workforce. The seal between the facepiece and the wearer's face generally accounts for the largest portion of the inward leakage. Therefore, an exercise protocol designed to stress that seal has been developed for

use in this project. This protocol is similar to the fit test exercise protocols specified in the OSHA respiratory protection standards found at 29 CFR 1910.134.

- **Establish a TIL test facility**

NPPTL has purchased four TSI PortaCount® Plus units and established a test facility for conducting the TIL testing. This test facility has been used to conduct the benchmark testing for the half-mask class of respirators.

- **Benchmark and consistency testing**

NPPTL has completed testing of 101 models of half-mask respirators on the panel of test subjects to establish a database of half-mask performance capabilities in the proposed laboratory test protocol. The results of these tests will be analyzed, and used to determine the state-of-the-art performance capabilities of the half-mask class of respirators. The proposed performance criteria for half-mask respirators will be determined based on those capacities.

- **Peer Review**

A peer review team composed of manufacturers, users, as well as experts from academia and government was identified and formed. The team has conducted reviews of the initial TIL concept for the performance requirements and test protocol. The team conducted peer reviews in April, July, and October 2004 and January 2005. Another peer review is anticipated for January 2007.

- **Public Meetings**

The concepts for the TIL program for half-mask respirators have been presented for discussion at public meetings in June and September 2004. The concepts presented at these public meetings are found at: http://www.cdc.gov/niosh/npptl/standardsdev/til/