Proposed Total Inward Leakage Testing in NIOSH Certification Benchmark Testing

William Newcomb

NIOSH/NPPTL PUBLIC MEETING
June 26, 2007

Total Inward Leakage Program

Benchmark Tests
- 57 Filtering Facepiece Respirators
- 43 Elastomeric Half-Mask Respirators
- 1 Quarter-Mask Respirator
- Entire panel of 25 Subjects per model
- Three donnings per respirator per subject
- 8250 Fit Factor data points
Total Inward Leakage Program

\[ TIL = \frac{100}{FF} \]

Assume that the measured Fit Factor (FF) \( \approx \) Protection factor (not Assigned Protection Factor [APF])

- A TIL of 1% \( \approx \) Protection factor of 100
- A TIL of 5% \( \approx \) Protection factor of 20
- A TIL of 10% \( \approx \) Protection factor of 10
- A TIL of 20% \( \approx \) Protection factor of 5

---

Total Inward Leakage Program

TIL Test Results: 101 Respirator Models

- Percentage of models that achieve penetration less than \( P_c \) for 19 of 25 subjects:
  - 60%
  - 48%
  - 10%
  - 5%

Penetration Criteria, \( P_c \)

PF=1000  PF=100  PF=10  PF=1
Total Inward Leaksage Program

TIL Test Results: Elastomeric vs. Filtering Facepiece

Percentage of Models that Achieve Penetration less than Pc for 15 of 25 Subjects

- 100%
- 90%
- 80%
- 70%
- 60%
- 50%
- 40%
- 30%
- 20%
- 10%
- 0%

Penetration Criteria, \( P_C \)

- Elastomeric
- Filtering-Facepiece

Total Inward Leakage Program

Data Anomalies

- No primary ambient sample
- Missing last in-mask sample
- Other switching errors
- Low ambient concentrations
Total Inward Leakage Program

Typical Data Plot

Abnormal Data Plot
Failed to take initial ambient sample

To correct this switching error, the second ambient measurement was used to replace the first
Total Inward Leakage Program

Abnormal Data Plot
Failed to take final in-mask sample

To correct this switching error, the fit factor was calculated without the last in-mask (normal breathing) sample.

Total Inward Leakage Program

Abnormal Data Plot
Failed to take middle ambient sample

To correct this switching error, the prior and subsequent ambient measurements were used to replace the averages.
Total Inward Leakage Program

Comparison of Corrected and Uncorrected Data

TIL Test Results Corrected for Valving Error

- Summary of Data Review
  - Data was corrected where applicable
  - Uncorrectable data not used
  - Corrections did not significantly change the results
Data Availability

- Data will be made available to those Manufacturers who wish to review their data

Total Inward Leakage Program

- Summary of TIL Benchmark Results
  - A wide variation exists between the overall fitting characteristics of half-mask respirators
  - Statistical difference was observed between elastomeric half-mask TIL and filtering facepiece TIL, but there is overlap

- Conclusion
  - A TIL performance requirement as part of respirator certification is necessary
  - With the tested respirators, it should be easier for a potential wearer to obtain the OSHA required Fit Factor during a fit test with an elastomeric half-mask than with a filtering facepiece
Quality Partnerships
Enhance Worker Safety & Health

Disclaimer: The findings and conclusions in this presentation have not been formally disseminated by the National Institute for Occupational Safety and Health and should not be construed to represent any agency determination or policy.

Thank you

Visit NPPTL at: http://www.cdc.gov/niosh/npptl/default.html