QUANTITATIVE VS. QUALITATIVE FIT TESTING

Why quantitative testing is the most secure and efficient method for fit testing tight-fitting respirators

11th HIS International Conference (HIS 2018):
Arena & Convention Centre (ACC), Liverpool, United Kingdom
November 26-28, 2018

Maxine Dolloway[1], Nicolas Kirch[2], Josh Schulze[3]

[1]TSI Instruments Ltd., Stirling Road, Cressex Business Park, High Wycombe, HP12 3ST, UK
[2]TSI GmbH, Neuköllner Str. 4, 52068 Aachen, Germany
[3] TSI Inc., 500 Cardigan Road, 55126 Shoreview, MN, USA

Contact: maxine.dolloway@tsi.com

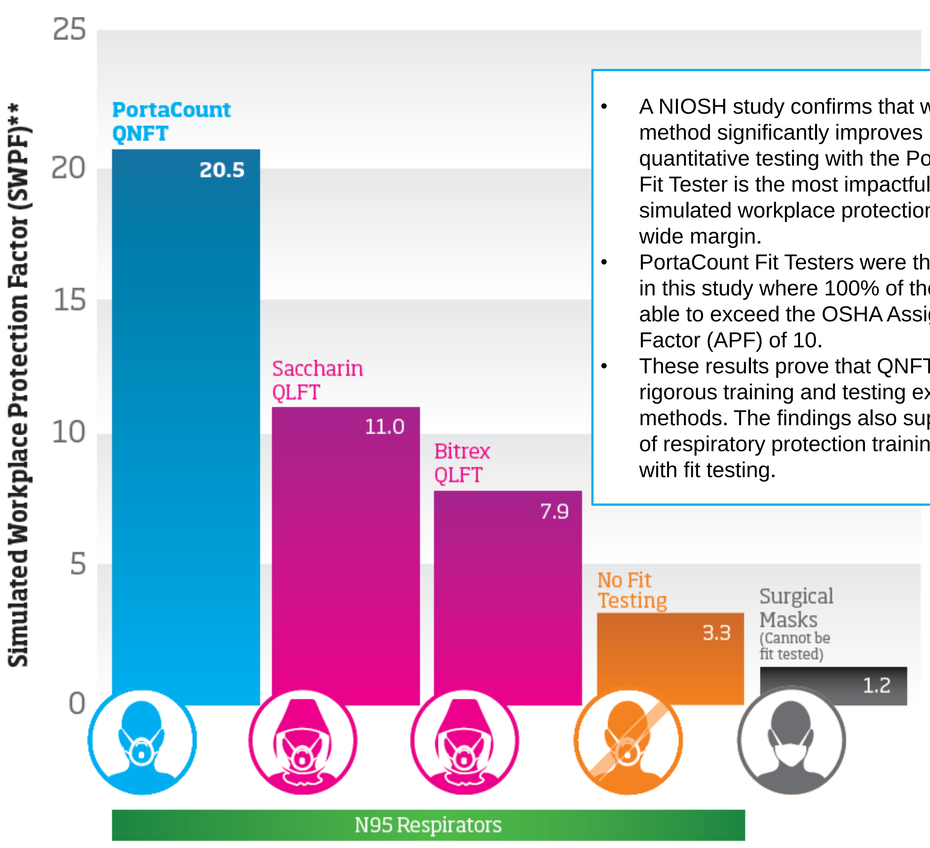
Introduction to Respirator Fit Testing

- Respirator fit testing is a key component of any respiratory protection programme, protecting staff from airborne hazards.
- Anyone who has to wear a tight fitting respirator is required by HSE 282/28 to perform respirator fit testing.
- Reasons for fit testing:
    - Respirators fit to a specific individual – as respirators and humans come in various shapes and sizes, an unsatisfactory seal / barrier may unknowingly exist. This could allow excessive leakage of airborne contaminants into the wearer's breathing zone.
    - Proper donning and wearing of respirators – The fit test challenges the test subject to see if they know how to don and doff the respirator properly, without assistance.
    - To determine the Fit Factor of that particular model make and size of respirator for the test individual
- A Fit Factor is a number that is the direct result of a quantitative respirator fit test. It is a measurement made by an instrument during a simulation of workplace activities (the exercises). It is expressed as the challenge aerosol concentration outside the respirator divided by the challenge aerosol concentration that leaks inside the respirator during a fit test.
- $Fit\ Factor = \frac{C_{OUT}}{C_{IN}}$

Quantitative (QNFT) versus Qualitative (QLFT) Fit Testing

- Two basic types of fit tests: Quantitative Fit Testing (QNFT) and Qualitative Fit Testing (QLFT)
    - QLFT is a low cost, subjective pass/fail test that exposes the respirator wearer to a chemical stimulant (while donning a test hood) that can only be detected if the respirator leaks.
    - Multiple challenges exist for QLFT, including operator error, operator fatigue, subjective results and recordkeeping challenges
    - QNFT measures the challenge agent leakage into the respirator without dependence on a test subject's voluntary or involuntary response to the challenge agent
    - The instrumentation is typically capable of measuring Fit Factors of between 1 - 10,000 and higher
- HSE standards and regulations permit the use of either QLFT or QNFT for half-face respirators. When full-face respirators are used, HSE requires a quantitative fit test (QNFT) with a minimum fit factor of 2000.
- There are four types of QLFT currently accepted by HSE: Isoamyl Acetate, Sodium Saccharin, Bitrex, and Irritant Smoke.

How QNFT Increases Staff Safety



- A NIOSH study confirms that while any fit test method significantly improves respirator protection, quantitative testing with the PortaCount® Respirator Fit Tester is the most impactful on disposable mask simulated workplace protection factors (SWPF) by a wide margin.
- PortaCount Fit Testers were the only testing method in this study where 100% of the test subjects were able to exceed the OSHA Assigned Protection Factor (APF) of 10.
- These results prove that QNFT provides a more rigorous training and testing expererience than other methods. The findings also support the importance of respiratory protection training going hand-in-hand with fit testing.

SWPF is the protection provided by a respirator, measured during a laboratory simulation of a workplace environment. A SWPF of 10 means that the air inside the respirator was 10 times cleaner than the air outside.

How QNFT Saves Users Time

Testing time

How long does a QNFT take vs. a QLFT with Saccharin or Bitrex? The OSHA required steps for each method are nearly identical, resulting in similar test times. However, the test itself is only a portion of the total time required.

Exercise / Activity	PortaCount® 8038 Fit Tester (QNFT) Minimum Time (Min:Sec)	Saccharin or Bitrex (QLFT) Minimum Time (Min:Sec)
Threshold Screening Test	N/A	~1:00 – 3:00*
Threshold Test Wear-off Time	N/A	~10:00**
User Respirator Assessment ***	5:00	5:00
One OSHA Compliant Fit Test***	7:15	7:00
Total Testing Time	**12:15**	**23:00 - 25:00**

Note: The listed times do not take into account some necessary preparation activities for each method such as: daily calibration (QNFT), solution preparation (QLFT), test subject data entry or documentation (Both).
* Approximated
** "A Guide to 3M Qualitative Fit Testing," 3M, n.d. Web. 11 Nov. 2016.
*** OSHA Respiratory Protection Standard 29CFR 1910.134 Appendix A.

PortaCount Fit Testers offer many advantages that save time over QLFT.

Exercise / Activity	PortaCount 8038 Fit Tester (QNFT)	Saccharin or Bitrex (QLFT)
Less Prep and Set-up Time	✓	–
Automated Testing Steps	✓	–
Automatically Recorded Test Data	✓	–
Training w/ Real-time Fit Check = Fewer Test Failures	✓	–

Testing experience

It's easy to see the advantages QNFT can offer.

PortaCount Fit Tester (QNFT)	Saccharin or Bitrex (QLFT)
Integrated, automated, step-by-step software test protocol that enables up to two people to be fit tested simultaneously using one computer.	Squeeze Bulb
1 button push, 99% reduction in work, 100% reliable	75-225 nebuliser squeezes per test subject
Know you're protected! • Eliminates error • Enables real-time fit optimsation and training • Eases reporting and record keeping • Minimises operational resources • Eliminates repetitive stresses injuries caused by buld squeezing • HSE-compliant for all respirators including disposables	• Tedious processes • Prone to errors • Increaes need for operational resources • Constant bulb squeezing can cause repetitive stress injuries • Necessitates exposure to unpleasant sensitivity and test solutions • Prone to deceitful test responses • Problems for test subjects with Asthma/Claustrophobia

References

- TSI Inc., Application Note ITI-023, Fit Factors Vs Protection Factors, August, 2012, http://www.tsi.com/uploadedFiles/_Site_Root/Products/Literature/Application_Notes/ITI-023.pdf
- Health and Safety Executive, Operational Circular OC 282/28, Version No 6, April, 2012, http://www.hse.gov.uk/foi/internalops/ocs/200-299/282_28.pdf
- Duling M.G., Lawrence, L.B., Slaven, J.E., Coffey, C.C., [HHS/PHS/CDC/NIOSH], „Simulated Workplace Protection Factors for Half-Facepiece Respiratory Protective Devices." Journal of Occupational and Environmental Hygiene, Vol. 4, No. 6, pp. 420-431, June, 2007
- Quantitative vs. Qualitative Fit Testing, 2016, https://www.tsi.com/uploadedFiles/_Site_Root/Landing_Pages/Landing_Page_Content/QNFT%20vs%20QLFT%20Flyer_US_5001773.pdf
- Introduction To Respirator Fit Testing, November 2015, http://tsi.com/uploadedFiles/_Site_Root/Products/Literature/Application_Notes/iti_070.pdf