HONESTY IN FIT TESTING
WHY AEROSOL FIT TESTING IS THE MOST POPULAR AND TRUSTED QUANTITATIVE FIT TEST METHOD

When it comes to respirator fit testing, deciding what technology to use is a critical decision. Unfortunately, not all technologies were made equal - or even advertised accurately.

TIME NEEDED:

It has been suggested that the CNP REDON Protocol, as used by the OHD Quantifit fit tester is significantly faster than the Aerosol method. In fact OHD advertises “1-3 minute respirator fit testing”, but just how true is this statement? It’s not even close. Below we see the OSHA approved procedures for the REDON protocol:

Exercises	Exercise Procedure	Measurement Procedure
Facing Forward	Stand and breathe normally, without talking, for 30 seconds.	Face forward, while holding breath for 10 seconds.
Bending Over	Bend at the waist, as if going to touch his or her toes, for 30 seconds.	Face parallel to the floor, while holding breath for 10 seconds
Head Shaking	For about three seconds, shake head back and forth vigorously several times while shouting.	Face forward, while holding breath for 10 seconds.
REDON 1	Remove the respirator mask, loosen all facepiece straps, and then redon the respirator mask.	Face forward, while holding breath for 10 seconds.
REDON 2	Remove the respirator mask, loosen all facepiece straps, and then redon the respirator mask again.	Face forward, while holding breath for 10 seconds.

Table A-1. – CNP REDON Quantitative Fit Testing Protocol, as found in OSHA 1910.134 Appendix A.

When you consider that the first two exercises in the fit test take a minimum of 1 minute and 20 seconds to complete, and the last 2 exercises require the fit test subject to remove the mask completely, loosen all the mask straps fully, and then redon properly, it's easy to see that it would be **impossible to achieve the times as advertised by OHD**. The problem is that many CNP users are taught to cheat their way through a fit test by not performing the first two 30 second exercise procedures and by not removing the mask completely and loosening all the straps as instructed by OSHA.
When the time needed to perform a CNP REDON fit test is compared with that of the Aerosol fit test, it is clear that any difference is negligible. For more detailed information on the true time needed to perform a fit test refer to the TSI application note RFT-008.

References:

1. Occupational Safety and Health Administration (OSHA). U.S. Department of Labor. 29 CFR 1910.134, 2004.

SIMULATING WORK CONDITIONS:

The CNP method, specifically as utilized by the OHD Quantifit, advertises the ability to simulate actual work conditions by changing the assumed breath rate depending on the characteristic of the fit test subject. However these selectable challenge pressures are **static** pressures and, as is obvious to all, a living person breathes, which means the in-mask pressure varies continuously, and this cannot be accounted for in the CNP method. In addition to this, there is no way to really know which condition to select for each individual on the OHD, so **the only thing you know for sure is that the selected in-mask pressure is wrong**.

Another consideration is when the actual testing, or measurement, of the fit factor occurs. The CNP method requires the person to perform the fit test exercise, and then remain completely motionless, holding their breath while the leak rate is being measured. In fact, here are the specific instructions the fit test subject is required to be trained on and to follow in order to complete the fit testing process:

- Take a breath and hold it, keeping mouth closed
- Keep mouth closed (**do not swallow or move mouth or tongue**)
- Do not exhale any air through nose
- Do not make head or facial movements. Sit or stand as still as possible in the position as instructed.

Anyone who has donned a full face respirator for any length of time will easily understand the amount of pressure and strain such requirements will put on a person's ability to breath, and on their pulmonary system.

The aerosol technology does not need to "simulate" such conditions, as the fit factor measured is done under conditions that really exist, such as while the fit test subject is moving and breathing. The aerosol technology will measure fit factors as these variations occur, making it a dynamic method of measurement. **The CNP method only measures during a static pose**, so unless the person being fit tested doesn't breathe or move during their work hours, you must ask yourself how can this be an accurate simulation?

ACCURACY:

It's obviously very important to make sure you are utilizing an accurate method of measurement when determining Fit Factors. The Aerosol technology measures an actual Fit Factor with a high degree of accuracy and repeatability, while **the CNP does NOT measure a fit factor at all, it only extrapolates or assumes one**. The CNP method extrapolates a fit factor by measuring the leak rate, and then assuming a breath flow rate for each individual, the problem with that is that the breath rate of the fit test subject cannot be accurately guessed. The assumption made by the CNP method to determine an estimated fit factor introduces errors in the range of (-39%) to (+93%) for men and (-21%) to (+58%) for women. There is nothing you can do mathematically to improve an inherently uncertain guess.
It has also been stated that the CNP method can be calibrated back to a NIST primary standard, which is not wholly accurate. The measurement of the leak rate can be traced to a NIST primary standard, however the Fit Factor, that which is critical to the health of the worker, cannot and the inherent inaccuracy of the extrapolated fit factor mentioned above still applies.

Aerosol-based fit testers, like the TSI PortaCount® Pro/Pro+ measure fit factor directly by making a concentration measurement both inside and outside the mask while the test subject simultaneously moves and breathes. The dynamic in-mask pressure and breathing rate are "as occurs" for each individual. With the PortaCount, any errors that affect both the C_{out} and C_{in} measurements automatically cancel out when the fit factor is calculated, thus making them irrelevant. There are no artificial conditions, assumptions or estimations involved in the calculation of a PortaCount fit factor.

References:

1. Wallaart, J.C.: A Study of the Relationship between Heart Rate and Minute Breathing Volume at Various Levels of Work Demonstrating the Spread between Individuals in a Group and the Implications in Industry. Presented at ISRP Conf. Amsterdam (1997). http://www.sea.com.au/docs/papers/isrpjw2.pdf

2. Berndtsson G.: Peak Inhalation Air Flow and Minute Volumes Measured in a Bicycle Ergometer Test, J. Int. Soc. Resp. Prot., 21:21-30 (2004)

3. Kaufman, J., Hastings, S.: Respiratory Demand During Rigorous Physical Work in a Chemical Protective Ensemble, Journal of Occupational and Environmental Hygiene, Vol 2, No 2, (Feb 2005)

4. Janssen, L.L.: Interpretation of Inhalation Airflow Measurements for Respirator Design and Testing, J. Int. Soc. Resp. Prot., 22 : 122- 141 (2005)

APPROPRIATE CHALLENGE AGENTS:

It has been wrongly assumed by some that there is a discrepancy between Aerosol particulate penetration into the mask, and Vapor/Gas penetration into the mask, with the result being to question whether the Aerosol method of fit testing could measure a leak that only vapor could penetrate. The fact is, that Vapors penetrate the mask the same as Aerosol particulate do, and studies have shown that when comparing the two challenge agents, aerosol particulate versus vapor/gas, they compare very well.[1]
It has been further assumed by CNP methods that air is the best challenge agent, but studies have shown that this simply isn't true. **In fact the CNP method has been openly questioned by various safety and regulatory boards** because it measures the exhalation valve leak during the measurement, which is unrealistic as compared to actual respirator usage.

References:

3. Gardner, P., Hofacre, K., Richardson, A.: Comparison of Simulated Respirator Fit Factors Using Aerosol and Vapor

Challenges,
Journal of Occupational and Environmental Hygiene, Vol 1, No 29-38, (Jan 2004)