

Technical Data Bulletin

An Introduction to Tight-Fitting Respirator Fit Testing

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The Technical Data Bulletin is intended to be relevant to employers and respirator wearers in Europe, the Middle East and Africa. This document particularly highlights fit testing practises in the USA and UK – check your local requirements for respirator fit testing.

Introduction

Do you know if your workers are wearing tight-fitting respirators that actually fit them?

Tight-fitting respirators must seal to the wearer's face in order to provide expected protection. If there is a leak, they may be exposed to harmful airborne contaminants. Fit testing is required by law in many different countries around the world and is being increasingly adopted by companies as best practice even where there is not a mandatory requirement to fit test.

What is fit testing?

A respirator fit test can be defined (1) as:

"...a method for checking that a tight-fitting facepiece matches the person's facial features and seals adequately to the wearer's face. It will also help to identify unsuitable facepieces which should not be used."

Why fit testing?

A good fit means the respiratory protective device (RPD) will seal to your skin. A respirator can only provide respiratory protection to the wearer when air passes through the filter. Air will take the path of least resistance, so if there isn't a good seal, some of the contaminated the air will go around rather than through the respirator – and therefore lessen the protection.

Every wearer's face is different in shape, size and features. Tight-fitting respirators are also available in a wide range of shapes, styles, materials and sizes. Unfortunately, there is no single tight-fitting respirator that can be expected to fit every possible wearer. Therefore, the fit of a respirator is personal, individual and unique to each wearer. The only way to know if a respirator can provide an adequate seal to a worker is to fit test each respirator-wearer combination.

Fit testing as part of your respiratory protection program

Implementing an effective respiratory protection program should be a methodical and documented process. All programs should start with an exposure and risk assessment to determine the level of adequate respiratory protection required. After this, the focus is the selection and fit testing of a respiratory protective device that is suitable for both the workplace and the worker. A suitable tight-fitting RPD needs to be compatible with others items of PPE, be comfortable to wear and importantly fit the worker. In some countries, a mandatory medical evaluation may be required prior to fit testing. Finally, the entire program should be documented, particularly worker training in the use, limitations, maintenance and fitting of the respirator completes the process.

Fit testing is a key part of a workplace respiratory protection program. Obviously, a fit test gives an assessment of how well the respirator fits the worker. But a fit test also helps with the assessment of the respirator's comfort, compatibility with other PPE and overall suitability for the wearer, along with being an ideal training opportunity for the worker on the use and correct fitting of the product.

What type of RPE should be fit tested?

Any tight-fitting facepiece should be fit tested. These include filtering facepiece respirators (disposable respirators, commonly referred to as 'dust masks'), half-masks with filters and full-face masks with filters. Any tight-fitting facepiece or mask that is connected to powered or supplied air system should also be fit tested; this includes tight-fitting face masks used with turbos, breathable compressed air or self-contained breathing apparatus.

Only respirators that rely upon positive air flow through a loose-fitting headtop do not require face fit testing. Such products may be selected for a variety of reasons, which may include the need for higher protection levels, worker facial hair that may affect the seal of a tight fitting respirator, worker comfort and the need for a single item of PPE that offers combined protection from other hazards.

Fit test methods and regulations

Most respirator fit test methods rely upon the worker wearing the respirator in an atmosphere containing a harmless aerosol, with the amount of the aerosol entering inside of the respirator due to face seal leakage being assessed either qualitatively or quantitatively.

Around the world there are several interpretations of how fit testing should actually be implemented. These fit test regulations specify the minimum pass levels, repeat test frequency, type and number of simulated workplace exercises to be conducted and other requirements within the fit test method.

All of the regulations and methods have significant commonality, and in most cases are derived from the methods and regulations first implemented in the USA.

Fit test methods

Fit test methods can be defined as being either qualitative (QLFT) or quantitative (QNFT):

Qualitative (QLFT)

Qualitative fit testing is subjective, requiring the wearer to provide input to the fit test. The predominant methods use either a Saccharine or Bitrex® test solution, sprayed into an over hood, which the respirator wearer decides if they can taste whilst conducting a number of fit test exercises. If the test solution is not tasted during the fit test, then the test is deemed a pass (with an assumed fit factor of 100 for the respirator).

Qualitative methods can be used to fit test filtering facepieces and half-masks (with particulate or combination filters) only. Qualitative methods may be suitable for full face masks according to some fit test regulations and only in certain circumstances.

Quantitative (QNFT)

A quantitative fit test (QNFT) is an objective method that can be used to fit-test most tight-fitting respirators. It involves using an instrument to measure leakage around the face seal and produces a numerical result called a "fit factor." There are several QNFT methods, however the most commonly used method is condensation nuclei counter (CNC) using a TSI® PortaCount®. This machine uses the principle of 'ambient particle counting' – it measures the concentration of both the ambient aerosol and the particles inside of the mask being tested.

The ratio of the concentration of ambient particles to particles inside of the mask is called the Fit Factor (FF). {Note: FF is not be confused with respirator protection factors such as nominal protection factor (NPF) or assigned protection factor (APF) that may be used to predict reduction of inhalation exposure.} The PortaCount will record the measured fit factor throughout the fit test, as well as control other aspects of the

test, including record keeping. Another method for quantitative fit testing reusable respirators is the OHD Quantifit® which uses controlled negative pressure.

Fit test regulations

There are many countries that currently have fit testing guidance, laws or regulations for tight-fitting respirators (for simplicity, we will call these all 'regulations' in this document). Across Europe, there is growing interest in the topic of fit testing and the implementation of fit testing regulations. But, there is currently no European, nor International standard for RPE fit testing, the only recognized fit testing regulation published and mandatory implemented within Europe being the UK's HSE 282/28 (1). The lack of at least a European standard may be interpreted as leaving a void of guidance and direction for many employers wishing to implement fit testing. It is important to note that in countries where there is no mandatory fit testing regulation, 3M recommend that employers follow recognized regulations, methods and guidance from other countries, such as the UK's HSE 282/28 or the USA's OSHA 1910.134 (2). See ** Qualitative fit testing may be used for full facepieces used in positive or negative pressure mode. However, for negative pressure full facepiece respirators, the assigned protection factor must be reduced to 10 instead of 50.

Table 1 for a comparison of fit test method suitability by product type and minimum fit factor requirements.

OSHA 1910.134

OSHA 29 CFR 1910.134 specifies all of the elements for implementing a respiratory protection program, including both the fit test regulations and methods (protocols). Key elements include:

- Mandatory annual refit testing.
- Wide range of permissible Qualitative fit testing methods, including Saccharine and Bitrex taste methods
- Quantitative fit testing
 - 8 different fit test exercises, includes a 15 second 'grimace'
 - The 'overall fit factor' from a fit test must exceed the required minimum fit factor for the test to be deemed to be a pass.
- Wearer medical examination is a prerequisite to fit testing
- Qualitative methods can be used for full face mask if they are used in positive pressure mode, OR if they are used in negative pressure mode but an APF of 10 is adequate. Note, that if a full face mask with an APF of 50 is needed, then a quantitative fit test must be used

HSE 282/28

HSE 282/28 was implemented by the UK Health and Safety Executive over a decade ago, making fit testing of tight-fitting respirators mandatory. This document provides best practice fit test methods for demonstrating compliance. There are a number of key differences between HSE 282/28 and OSHA 1910.134:

- No mandatory refit test requirement (unless required by other applicable regulations)
- Permissible Qualitative fit testing methods are Saccharine and Bitrex taste methods
- Quantitative fit testing
 - 7 different fit test exercises, excludes a 15 second 'grimace'
 - Longer in mask sampling times for the TSI PortaCount method
 - The fit factor calculated from each fit test exercise and the 'overall fit factor' must exceed the required minimum fit factor for the test to be deemed to be a pass.
 - Fit test exercises, with the exception of bending over, are conducted at elevated work rates (walking, stepping, static cycling)

- No mandatory requirement to complete a wearer medical examination prior to fit testing

	Qualitative (Saccharine / Bitrex taste)	Quantitative – Ambient Particle Counting (TSI PortaCount)		Quantitative – Controlled Negative Pressure (OHD Quantifit)	
	Suitability	Suitability	Minimum Fit Factor	Suitability	Minimum Fit Factor
Filtering facepiece	HSE: Yes OSHA: Yes	Yes	HSE: 100* OSHA: 100	No	n/a
Half mask	HSE: Yes OSHA: Yes	Yes	HSE: 100 OSHA: 100	Yes	HSE: 100 OSHA: 100
Full face mask	HSE: No OSHA: Yes**	Yes	HSE: 2000 OSHA: 500	Yes	HSE: 2000 OSHA: 500

* FFP1 filtering facepiece can only be, and FFP2 filtering facepiece respirator should ideally be fit tested using the TSI PortaCount Pro+ or if the N95 Companion is employed.

** Qualitative fit testing may be used for full facepieces used in positive or negative pressure mode. However, for negative pressure full facepiece respirators, the assigned protection factor must be reduced to 10 instead of 50.

Table 1 - Suitability of fit test method by product type and minimum Fit Factor requirements

Respirator stability and fit test exercises

A key part of a fit test is to determine the respirator's ability to retain its seal when the worker is in motion. That's why test subjects are told to go through several standardized exercises that are meant to put the seal of the tight-fitting respirator under stress, as part of testing. The most common exercises used in protocols are as follows:

- Normal breathing
- Deep breathing
- Turning head from side to side (inhaling at the extremes)
- Moving head up and down (inhaling when looking up)
- Reading / talking aloud
- Grimace*¹
- Bending over at the waist²
- Normal breathing

¹Grimace features in OSHA 1910.134 Quantitative fit testing methods only (excluded from HSE 282/28) – duration is 15 seconds, sampling within the mask is discarded for final fit factor calculation.

²May be substituted for jogging on the spot in OSHA 1910.134 if the fit test method setup does not permit bending over at the waist.

When conduct a fit test?

A fit test must be conducted whenever there is a new wearer and tight-fitting facepiece combination, for example a new worker or a change to a new type, brand or model of tight-fitting respirator. A fit test must also be conducted should some characteristic of the wearer or the product change that may affect the seal upon the face, for example when any facial changes occur that could affect fit, such as significant weight fluctuation, skin scarring or dental work.

Some national fit testing regulations, industry specific national regulations or employer's health and safety policies require that fit testing be repeated on a regular basis, for example:

- At least annually in the USA according to OSHA 1910.134 (2)
- At least annually in the UK Asbestos industry according to the Control of Asbestos Regulations (CAR) 2006 (3).

Importance of fit

Incorrectly fitted respirators may not achieve a reliable seal to the wearer's face and may be uncomfortable possibly leading to workers not wearing the respirator during all periods of exposure.

There are many factors that affect the fit of tight-fitting respirators.

- Donning procedure: everything from putting the respirator on the right way up through to the correct position and tension adjustment of the headbands, proper formation of the noseclip (if fitted).
- Facial hair: look out for hair under the face seal, beard growth / stubble, forward hairlines (full face masks) and big sideburns. Beards, mustaches, or even stubble interfere with the seal of a tight-fitting respirator. Workers must be clean-shaven in any area of the face and neck where the respirator comes into contact with the face. This rule applies not only for the day of fit testing, but for any day when a tight-fitting respirator is worn in the workplace.
- Other contaminants: anything that can interfere with the seal to the face, includes hair, cosmetics, sweat, facial jewellery, foreign bodies within the mask and facial hair.
- Face shape and size: extremes of face size (length and width of face) and well as very angular or very round faces can cause issue with fit.
- Facial features: prominent facial features can also cause some issues such as cleft chins, scars on the face sealing area, depressions around the temple / cheekbones, unusual chin profiles (chiselled features), unusual nose shapes (very large or very flat).

User Seal Check: An Essential Everyday Test

Employees wearing tight-fitting respiratory protection should perform a seal check each time they put on their respirator (including before a fit test). A fit test ensures that the respirator is able to fit and provide a secure seal, but a user seal check ensures that it's being worn right each time – a quick way of identifying errors in fitting and certain faults with the respirator. Users can either perform a positive-pressure or negative-pressure seal check, as detailed in the manufacturer's user instructions:

- A positive-pressure check means blocking the exhalation valve on a half or full facepiece respirator or covering the respirator surface on a filtering facepiece, usually by using your hands, and trying to breathe out. If slight pressure builds up, that means the seal is adequate. Note that exhalation valves on filtering facepieces are not designed to be blocked, so this method is not viable for valved filtering facepieces.
- A negative-pressure check involves blocking the intake valves or filters on a half or full facepiece respirator or covering the respirator surface on a filtering facepiece, typically using your hands and trying to breathe in. If no air enters, the seal is adequate. See the product User Instructions for more details.

Compatibility with other PPE

Prescription and safety spectacles, goggles, face shields, hearing protection, hard hats and coveralls can all compete with a respirator for space upon a wearer's face, head or body. For instance, if a half mask respirator doesn't fit well (especially if it's too large), it can overlap with spectacles. The more that happens, the more fogging can potentially occur on the spectacles.

Adjusting the position of a respirator upon the face to better accommodate spectacles and goggles, or a hard hat or coverall hood affecting the correct positioning of respirator headbands can all interfere with the respirator's seal.

To catch these problems before they happen on the job, any item of PPE that could interfere with the respirator's seal should also be worn during the fit test.

Interpreting fit test passes and fit factor values

A respirator fit test pass means that on that day, in those circumstances, the respirator was shown to be able to provide an adequate seal to the wearer's face. A fit test pass is not a guarantee of adequate respirator fit when the next respirator is worn. Therefore, a tight-fitting respirator should be fitted correctly and in accordance with the manufacturer's instructions, and the wearer must always perform a user seal check (fit check) each time the respirator is fitted.

With quantitative fit tests, there may be a temptation to interpret the Fit Factor values from a fit test, particularly if comparing two or more different models of respirator. With all fit tests, there are a number of product, worker, machine, environmental and fit tester variables that can affect the fit test and the resulting fit factor measured. Therefore, unless the effect of these variables is reduced or eliminated, and the results have been shown to be both scientifically reproducible and repeatable, then caution is advised when comparing fit factor values. Furthermore, little to no correlation has been shown between quantitative fit factors and workplace performance.

It is important to note that provided that the overall (and individual fit test exercise if you are using the HSE 282/28 regulation) fit factor(s) exceed the minimum fit factor requirement, then the fit test has been passed. Then a record of the fit test must be made and stored, and the respirator can be worn by the worker in the workplace.

Who can conduct a fit test?

In theory, anybody can conduct a fit test. Unfortunately though, fit testing is often conducted by people with little or no training or practical experience. The result of a fit test can be greatly influenced by competency of the fit tester and if a fit test is not conducted correctly, the health of the respirator wearer may be put at risk. The UK HSE 282/28 describes in details the requirements for a fit tester to be deemed competent.

Concerns about the competency of some fit testers, lead to the creation of the first fit tester competency assessment scheme. Created by the British Safety Industry Federation (BSiF), the Health and Safety Executive (HSE) and other UK industry stakeholders, the Fit2Fit scheme (4) involves both a written exam and a practical demonstration as part of the competency assessment in line with the requirements of HSE 282/28. Being a Fit2Fit accredited fit tester is not mandatory in the UK. But by being Fit2Fit accredited, fit testers are deemed to be sufficiently demonstrating good practise and compliance with the requirements of HSE 282/28.

HSE 282/28: *To be competent the [fit tester] should have adequate knowledge, and have received adequate instruction and training in the following areas:*

1. *selection of adequate and suitable RPE;*
2. *examination of RPE and the ability to identify poorly maintained facepieces;*
3. *ability to correctly fit a facepiece and perform pre-use fit checks;*
4. *ability to recognise a poor fitting facepiece;*
5. *the purpose and applicability of fit testing; the differences between, and the appropriate use of, quantitative and qualitative fit testing methods;*
6. *the purpose of the fit test exercises;*
7. *preparation of facepieces for fit testing;*
8. *how to carry out diagnostic checks on the facepiece and the fit test equipment;*
9. *capabilities and limitations of the fit test equipment;*
10. *how to perform a correct fit test with the chosen method;*
11. *be aware of and know how to prevent and correct problems during fit testing;*
12. *interpretation of fit test results;*
13. *an understanding of the differences between fit factor, workplace protection factor, assigned protection factor and nominal protection factors; and*
14. *HSE Regulations*

References

1. HSE 282/28 - Fit testing of respiratory protective equipment facepieces. 2012.
2. 29 CFR 1910.134 - OSHA Respiratory Protection Standard.
3. Work with materials containing asbestos. Control of Asbestos Regulations 2006.
4. Fit2Fit. [Online] www.fit2fit.org.

3M Personal Safety Division
West Europe
3M Centre, Cain Road
Bracknell, Berkshire
RG12 8HT
United Kingdom
Office: +44 (0) 1344 858000
www.3M.eu/PPESafety

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