

# RESPIRATOR FIT TEST STANDARD COMPARISON – EXTENDED VERSION

## OSHA 1910.134, HSE INDG 479 AND ISO 16975-3



APPLICATION NOTE RFT-038 (A4-EN)

The PortaCount® Respirator Fit Tester and the FitPro™ Ultra Software provide support for many fit test protocols. This document will compare in detail the three most common standards and regulations, the US OSHA protocol, the British Fit2Fit protocol (HSE INDG 479 and the corresponding Fit2Fit companion) and the ISO 16975-3 protocol. In addition to the legacy OSHA protocol, the two shortened modified CNC protocols are added to the comparison.

As the three standards/regulations are very extensive, the comparison presented here is very detailed. For a brief overview of the main differences and similarities, the Application Note RFT-037 “Respirator Fit Test Protocol Comparison - Summary” is suitable.

The table below compares fit testing methods, respirator guidance, requirements for fit testing, fit test preparation, how to conduct the fit test (protocol) and the fit test result for each standard/regulation. If some aspects do not appear in a protocol, the field is marked with a "/". Empty fields in OSHA's modified protocols mean that there is no deviation from the normal protocol, the deviations appear only in the “conducting the fit test” section. The abbreviations used by the standards and regulations are explained at the end of the table.



		US – OSHA Protocol (OSHA 29CFR1910.134)		UK – Fit2Fit Protocol (HSE INDG 479)	ISO 16975-3 Protocol
		Ambient aerosol CNC protocol	Modified for half/ full-face respirators	Modified for filtering facepieces	
<b>General</b>					
<b>Aim of fit testing</b>	/			<p>Aim of fit testing is to</p> <ul style="list-style-type: none"> <li>- Check whether a particular model and size of tight-fitting face mask fits the wearer's facial features and seals sufficiently;</li> <li>- Identify unsuitable respirators which should not be used.</li> </ul>	<p>Aim of fit testing – regarding a specific make, model, and size of a respiratory protective device (RPD) – is to</p> <ul style="list-style-type: none"> <li>- Verify that the tight-fitting RPD fits the wearer by evaluating the seal effectiveness between the wearer's face and the respiratory interface;</li> <li>- Validate that the wearer knows how to properly inspect, don and doff the RPD and perform a fit check.</li> </ul>
<b>Classification of fit testing</b>	Fit testing is part of the respiratory protection program.			Fit testing is part of the initial selection process of the respiratory protective equipment (RPE).	Fit testing is only one element of a complete but essential component of an effective RPD program.
<b>Relationship to seal check</b>	<p>The user seal check must be carried out every time the employees put on a respirator.</p> <p>The user seal check has, therefore, to be performed in preparation for, and not as a substitute for, a fit test.</p>			<p>The wearer-seal check is part of the process before the fit test and is not a substitute for it.</p> <p>The pre-use wearer-seal check has to be performed each time before wearing a fit-tested respirator and before entering the hazardous area.</p>	The seal check is one step in the fit test procedure.
<b>Date of fit testing</b>	<p>Fit test shall be conducted</p> <ul style="list-style-type: none"> <li>- Prior to initial use;</li> <li>- Anytime a different respirator (size, style, model, or brand) is used;</li> <li>- At least annually thereafter;</li> <li>- Additionally, if physical conditions change (examples: Facial scars, dental changes, cosmetic surgery, or an obvious change in body weight);</li> <li>- If the employee communicates that the fit of the respirator is not acceptable</li> </ul>			<p>Fit test should be performed</p> <ul style="list-style-type: none"> <li>- As part of RPE's initial selection;</li> <li>- Every time the type, size, model or material of the RPE is changed;</li> <li>- If the wearer's circumstances change which could affect the fit of the RPE; e.g.: <ul style="list-style-type: none"> <li>o Weight loss or gain;</li> <li>o Extensive dental work;</li> <li>o Any changes in the face (scars, moles, signs of ageing, etc.) in the area of face seal;</li> <li>o facial piercings;</li> <li>o Introduction or alteration of other (PPE) worn on the head;</li> </ul> </li> <li>- Every two years as recommended</li> </ul>	<p>Fit test shall be carried out</p> <ul style="list-style-type: none"> <li>- Before using the RPD the first time;</li> <li>- If using a different respiratory interface (RI) (size, style, model, material or make);</li> <li>- Annually as recommended (national/local regulations may require periodic repetition).</li> <li>- If a change has occurred in an individual that may affect the RI seal, such as: <ul style="list-style-type: none"> <li>o Significant change in body weight;</li> <li>o Facial changes in the area of the seal (e.g. scarring, facial surgery);</li> <li>o Dental changes;</li> <li>o Discomfort of the wearer</li> </ul> </li> </ul>

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<b>General (cont.)</b>					
<b>Fit test report</b>	<p>The employer shall keep a record of the fit tests performed on an employee until the next test. The report contains:</p> <ul style="list-style-type: none"> <li>- The name or identification of the employee tested;</li> <li>- Type of fit test performed;</li> <li>- Specific make, model, style, and size of respirator tested;</li> <li>- Date of test; and</li> <li>- The pass/fail results for QLFTs or the fit factor and strip chart recording or other recording of the test results for QNFTs</li> </ul>			<p>For the fit test, a report/certificate should be issued that should contain:</p> <ul style="list-style-type: none"> <li>- The name of the person being fit tested;</li> <li>- The respirator’s make, model, material and size;</li> <li>- The type of filters that were fitted to the respirator;</li> <li>- The presence or absence of goggles;</li> <li>- The make and model of any PPE and/or RPE accessory;</li> <li>- Whether the respirator used was the subject-issued, a company-provided or a test respirator;</li> <li>- The fit test exercises performed;</li> <li>- The fit test method;</li> <li>- For QNFT, the measured individual fit factors and the overall fit factor;</li> <li>- The pass level;</li> <li>- The fit test result (Pass or Fail);</li> <li>- The test date;</li> <li>- Personal details of who conducted the test, name of company, address, etc.</li> </ul> <p>The report should be available to the employee and accessible to supervisory authorities.</p> <p>The report should be retained for at least five years and include adjustments to the fit test protocol.</p> <p>Best practice is also to record the next test date.</p> <p>Personal information will be subject to data protection regulation.</p> <p>If applicable, the fit test report should also include the following:</p> <ul style="list-style-type: none"> <li>- The condition of the wearer's respirator;</li> <li>- If the wearer needed any help in donning and performing the wearer seal check</li> <li>- How many retests were required to achieve a passing score and the reasons therefore;</li> <li>- The equipment serial number or other identifier of the equipment used in the fit test</li> </ul>	<p>Fit-test records shall be maintained and include:</p> <ul style="list-style-type: none"> <li>- Test date;</li> <li>- Identification and name of employer/company of the fit test operator;</li> <li>- Name of the person conducting the fit test;</li> <li>- Information clearly identifying the RI (make, model, size, and material);</li> <li>- Information clearly identifying all other potentially affecting PPE (e.g., eyewear);</li> <li>- The fit test method used;</li> <li>- Pass/fail criteria;</li> <li>- Results: Pass/fail, fit factors, or other generated information</li> <li>- Corrective action in the event of a failed fit test;</li> <li>- Overall fit factor achieved;</li> <li>- Pass level used in the test;</li> <li>- Serial number or other identifier test instruments;</li> <li>- Any additional information deemed pertinent by the RPD program administrator</li> </ul>
<b>Employer's obligation</b>	<p>The employer shall</p> <ul style="list-style-type: none"> <li>- Be responsible to establish and maintain a respiratory protection program;</li> <li>- Ensure that an appropriate fit test is taken by employees using a tight-fitting respirator;</li> <li>- Provide the employee a medical evaluation on whether an employee can use a respirator before having him/her take a fit test or to wear the respirator on the job</li> </ul>			<p>The employer bears the costs.</p>	<p>The employer has to have an RPD Program Administrator who is responsible for the evaluation and verification of the operators' training and qualifications.</p>

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Methods of fit testing	2 – Qualitative fit test (QLFT) & Quantitative fit test (QNFT)			2 – Qualitative fit testing (QLFT) & Quantitative fit testing (QNFT)	Use of a challenge agent 2 – Qualitative fit test (QLFT) & Quantitative fit test (QNFT)
<b>QLFT</b>	QLFT is a pass/fail fit test for evaluating the adequacy of the respirator based on the response of the person being tested to the test agent. It may be used for fit testing of air-filtering negative pressure respirators only, which must meet a fit factor of 100 or less.			QLFT is a pass/fail test designed to detect a bitter- or sweet-tasting aerosol that is introduced as a test agent, making the test based on a subjective assessment by the wearer. For QLFT, disposable and reusable masks are suitable, but not full-face masks.  It is important that the fit test is performed by a fit tester who is competent in the use of this method.	QLFT is a pass/fail test method that requires sensory detection of a challenge agent in a localized test atmosphere, in a special enclosure, for assessing the adequacy of the RPD fit. QLFT shall be used for respirators with RFF of 100 or less, only.  QLFF means the qualitative estimate of the minimum fit of a given tight-fitting RPD to a given person. The result of the fit test, for example, if passed, is that the challenge agent was not detected.
<b>QNFT</b>	QNFT assesses the adequacy of respirator fit by measuring the amount of leakage in the respirator numerically. Generated aerosol, ambient aerosol (CNC) or controlled negative pressure (CNP) method can be used for this purpose.			QNFT assesses how well a respirator seals against the wearer's face through a numerical measure, the QNFF. Ambient particle counting (APC) or controlled negative pressure can be used for this.  QNFT is suitable for disposable and reusable half masks and full-face masks.	QNFT is a test method in which special measuring instruments output a numerical value, the fit factor (QNFF), to evaluate the fit and seal leakage of the RPD on the face of a given individual. Three different methods have proven effective for QNFT.
<b>Generated Aerosol</b>	In the GA method, a non-hazardous test aerosol is generated in a test chamber by an aerosol generation and dilution system and the generated particles are measured by it.			/	An aerosol is introduced into a leak test chamber as a challenge agent and the concentration inside and outside the RPD is measured with an instrument. From the ratio of the two concentrations, the QNFF is calculated as follows:  $QNFF = \frac{C_{out}}{C_{in}}$ <i>with</i> C <sub>out</sub> as aerosol concentration outside the RI; C <sub>in</sub> as aerosol concentration inside the RI.
<b>CNC / APC</b>	The CNC method quantifies the respirator fit with ambient aerosol as the test agent and a measuring instrument: condensation nuclei counter.			In the APC method, ambient air (normal room air) or a generated aerosol is used as a test challenge and a particle counter is used to measure the concentration inside and outside the facepiece. During this process, the wearer performs a series of specified exercises. The ratio of the two measured concentrations is the QNFF  $QNFF = \frac{C_o}{C_i}$ where C <sub>o</sub> is the concentration outside and C <sub>i</sub> the concentration inside the facepiece.	CNC counters determine the number concentration of particles by counting individual particles, usually from ambient air in the fit test. In the QNFT, this is used to measure the concentration of the test aerosol outside the respirator (around the head and shoulders) (C <sub>out</sub> ) and inside (C <sub>in</sub> ). During this process, the person being tested performs a series of exercises that stress the face/neck seal as much as possible, similar to the way movements in the workplace do.  The fit factor can be calculated from the two measured concentrations:  $QNFF = \frac{C_{out}}{C_{in}}$
<b>CNP</b>	The CNP method is used to measure the volumetric leak rate and is based on the exhaust of air from a temporarily sealed respirator. The purpose is to create and maintain a constant negative pressure inside the facepiece.			The QNFF is calculated as the ratio of the inspiratory flow rate (IFR) to the mean leakage flow rate (LFR) measured at the end of each test exercise:  $QNFF = \frac{IFR}{LFR}$	In the CNP fit test, air is used as the test medium. The air discharge rate required to keep the in-RP pressure constant is measured. In this process, the air inlets are closed and operating speeds are simulated by selecting negative inlet pressures during the tests. The measured air discharge rate provides a direct measure of air leakage.  The QNFF is calculated from the ratio of the inspiratory flow rate and the mean leakage flow rate measured at the end of each test exercise:  $CNP_{QNFF} = \frac{IFR}{LFR}$

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<b>Respirators</b>	Any respirator with a negative or positive pressure tight-fitting facepiece			All tight-fitting respirators	All tight-fitting respirators, <u>except</u> escape-only RPD
<b>Types of respirators</b>	<i>(see above)</i>			The tight-fitting respirators that must be fit tested include: - Disposable half masks - Reusable half and full-face masks - Powered half and full-face masks - Constant flow airline BA – half and full-face masks - Fresh air hose BA – half and full-face mask - Demand valve BA – half and full-face mask - Escape BA – Full-face masks	<i>(see above)</i>
<b>Choice of fit test method</b>	When choosing the fit test method, it should be noted that air-filtering negative pressure respirators that have a required fit factor of 100 or less are the only respirators for which QLFT may be used.			When selecting the fit test method, it should be noted that only half masks can be tested with QLFT and CNP is only suitable for elastomeric but not disposable masks. APC, on the other hand, can be used for all types.	When choosing the fit test method, it is important to note that respirators in protection classes 1-3 with an RFF of 100 or less are the only ones for which QLFT shall be used. QNFT, on the other hand, is possible for all protection classes (1-6).
<b>Requirements for fit testing</b>					
<b>Requirements for the tested person</b>	<ul style="list-style-type: none"> <li>- The person being fit tested shall have no hair growth – like stubble beard growth, beard, mustache or sideburns – between skin and sealing surface.</li> <li>- Furthermore, the person being fit tested shall wear any applicable safety equipment which could affect the fit of the respirator during actual use of the respirator.</li> <li>- The person being tested should have received formal training according to the respiratory protection program</li> </ul>			The person being fit tested should <ul style="list-style-type: none"> <li>- Be clean shaven on the face or in the area of the face seal within 8 hours before the start of the work shift;</li> <li>- Be trained in the correct donning of the respirator so that they can do this without any assistance;</li> <li>- Wear any other PPE that could potentially interfere with the fit of the facepiece;</li> <li>- Not have eaten anything, drunk anything (except still, unflavoured water), smoked or chewed gum in the last 30 minutes when using QLFT;</li> <li>- Not have smoked in the last hour and should not have eaten or drunk anything (except fresh water) in the last approximately 15 minutes when using APC.</li> </ul>	The person being fit tested shall <ul style="list-style-type: none"> <li>- Be trained to have the required level of competence and to know the purpose and procedure of the fit test;</li> <li>- With respect to the RPD, be able to perform <ul style="list-style-type: none"> <li>o A proper inspection to determine integrity impairments <i>and</i></li> <li>o Proper donning (positioning on the face and adjustment of straps), as well as a wearer-seal check;</li> </ul> </li> <li>- Be free of hair (shaved within 24 h, preferably 12 h), jewelry, or other clothing in the area of the RI sealing surface, but wear any PPE and/or RPD accessories that could interfere with the seal;</li> <li>- Not have smoked in the 30 minutes when using CNC.</li> </ul>

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<b>Requirements for fit testing (cont.)</b>					
<b>Requirements for the person carrying out the test</b>	The person who carries out the fit test shall be able to properly perform the calibration of the equipment as well as the tests. This includes ensuring proper working order of the instruments, detecting invalid tests and calculating the fit factor.			<p>The person who carries out the fit test should have received adequate instructions/training in and demonstrate adequate knowledge of the following areas:</p> <ul style="list-style-type: none"> <li>- Selection of appropriate and suitable RPE and its examination;</li> <li>- Recognizing poor maintenance and poor fit of RPE;</li> <li>- Correct donning and performing a pre-use wearer-seal check;</li> <li>- Knowing factors that affect the fit of the facepiece or the result of the fit test;</li> <li>- Applicability and purpose of fit testing and fit test exercises;</li> <li>- Facepiece and equipment preparation and diagnostic testing and knowing the capabilities and limitations of the equipment;</li> <li>- Differences between the two methods (QNFT &amp; QLFT), their use, and how to properly perform the methods;</li> <li>- Preventing and correcting problems that occur during the fit test;</li> <li>- Interpreting the results of fit tests;</li> <li>- Understand the differences between fit factor, work place protection factor (WPF), assigned protection factor (APF), and nominal protection factor (NPF);</li> <li>- Knowing the HSE ACOPs and guidance that deal with fit testing of RPE</li> </ul> <p>The competence in these areas can be demonstrated by a Fit2Fit certificate.</p>	<p>The person who carries out the fit test shall be competent in the way that he/she demonstrate</p> <ul style="list-style-type: none"> <li>- Familiarity with the fit test and RPD handling sections of the RPD program;</li> <li>- Knowledge of the RPD used for fit testing by <ul style="list-style-type: none"> <li>o Having a basic understanding of the selection;</li> <li>o Identifying components and their function and different brands/ models/ styles/ sizes;</li> <li>o Being able to demonstrate inspection, cleaning and maintenance;</li> <li>o Being able to discuss the possibilities and limitations of RPDs with regard to the fit test;</li> <li>o Performing and evaluating the correct donning and doffing, as well as the wearer-seal check;</li> </ul> </li> <li>- Practical and theoretical knowledge as well as suitable and sufficient experience of the fit test methods by <ul style="list-style-type: none"> <li>o Being trained appropriately and demonstrating the correct application;</li> <li>o Being able to explain the purpose and procedure of fit testing, as well as the possibilities and limitations of the method;</li> <li>o Identification of indications of faulty fit test results;</li> <li>o Demonstration of knowledge of the health and safety hazards associated with the used chemicals and/or equipment;</li> </ul> </li> <li>- Capability of setting up the fit test equipment and monitoring its operation by: <ul style="list-style-type: none"> <li>o Selecting the correct RPD filters and preparing, inspecting and testing the fit test equipment and materials for functionality;</li> <li>o Identifying potential problems with the equipment and assembling it correctly (using/placing probes and adapters correctly QNFT);</li> </ul> </li> <li>- Capability of conducting the fit test <ul style="list-style-type: none"> <li>o Recognizing interference concerns and thus properly assessing when to conduct a fit test and when to refuse;</li> <li>o Explaining the purpose and procedures of fit testing to the person being tested;</li> <li>o Observing the correct donning procedure (without assistance) and whether the seal check according to the manufacturer's instructions and the fit test are performed correctly;</li> <li>o Evaluating and recording the results and explaining them to the wearer;</li> <li>o Cleaning and disinfecting the RPD according to the manufacturer's instructions, removing all adapters and reattaching valves as necessary;</li> </ul> </li> <li>- Can identify probable causes of fit test failures.</li> </ul>
<b>Medical Conditions</b>	<ul style="list-style-type: none"> <li>- A written recommendation from the PLHCP, regarding the employee's ability to use the respirator, shall be obtained by the employer.</li> <li>- If the employee experiences breathing difficulties during the Fit Test, he/she shall be referred to a physician or other licensed health care professional.</li> </ul>			<ul style="list-style-type: none"> <li>- That there are no medical conditions that prevent the use of the respirator is something the employer has to be sure of.</li> <li>- If a wearer is able to wear the respirator but is medically unable to perform all of the exercises in the fit test, changes can be made to the protocol, which should be recorded.</li> </ul>	Fit testing takes place after completion of health surveillance, in which the person being tested shall have received medical clearance to wear the RPD.

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<b>Requirements for fit testing (cont.)</b>					
<b>Requirements for the respirator</b>	If tight-fitting respirators and tight-fitting powered air-purifying respirators are subjected to a fit test, it shall be performed in the negative pressure mode. This shall be accomplished by: - Using suitable filters or an identical negative pressure respirator with the same sealing surfaces for QLFT; - Allowing for QNFT to sample air from inside the facepiece in the user's breathing zone, midway between the nose and mouth, by installing a permanent sampling probe on a replacement facepiece or by using a sampling adapter. A NIOSH approved filter has to be installed.			- The respirator for the fit test can be either the wearer's (individually assigned), a test facepiece (same class and size), or a spare facepiece with the same sealing surface (and same materials, headgear, breathing resistance). - The respirator used must be visually inspected and should be clean and disinfected. The respirators are equipped with a P3 filter and has to be used in the negative pressure mode.	- The respirator used in the fit test should, to the extent possible, be representative of that used in the workplace. - It shall be properly inspected, tested for proper function, and maintained. - The respirator shall be equipped with particle filters (particle class F3, F4 or F5) suitable for the test method, which may differ from those used in the workplace, and adapters. - It is tested in negative pressure mode regardless of the operating mode.
<b>NOTE</b> For using the PortaCount® Respirator Fit Tester, a NIOSH series 100 or P3 filter has to be fitted to the respirator.					
<b>Requirements for fit test equipment</b>	- The employer must ensure that the equipment is kept clean, maintained and calibrated. - For the CNC method, the PortaCount® Respirator Fit Tester is the measuring instrument.			- The fit testing equipment should have been checked by the fit tester for good condition and stability, and should have undergone pre-use testing and calibration. - Records of maintenance, calibration and pre-use testing should be retained. - If FFP1 and FFP2 masks are tested with the equipment, additional material may be required.	- Generally, fit testing equipment shall be maintained in a clean and sanitary condition according to the manufacturer's instructions. - The equipment for the CNC method consists of o The CNC counting instrument, which shall have passed all required pre-use checks, o Recommended filters for diagnostic testing and other recommended consumables and o The RPD's equipped with probes or fit test sampling adapters as well as RPD particle filters (particle filter class F3, F4 or F5).
<b>Fit test environment</b>	The environment has to be appropriate.			The environment for fit testing should be safe and clean, with privacy to some degree and an appropriate concentration of particles in the ambient air ( <i>see below</i> ).	/
<b>Fit test preparation</b>					
<b>QNFT – CNC / APC</b>					
<b>Communication</b>	- The fit test steps and their responsibilities shall be communicated to the test subject. - Information about the request to select the respirator that provides the best fit shall be provided.			Everything should be explained to the wearer by the fit tester and safety instructions should be given.	The purpose and procedures of fit testing, including a description of the test exercises, shall be communicated to the person being tested so that he or she understands the purpose of the test, the determination of the specific model and size of RI that will provide an adequate fit.
<b>Choice of the respirator</b>	- The test subject shall be given the opportunity to select from a sufficient number of respirator models and sizes, the respirator that is acceptable to and properly fits the user. - In doing so, the subject shall be instructed to hold the selected respirator in front of the face so that those with an obvious poor fit can be discarded.			/	- Selection should take place on the basis of wearing comfort, the results of the wearer seal check, and personal preference. - Wearer acceptance is influenced by breathing resistance, visual and communication impairment, and RPD weight.
<b>Training in donning</b>	The donning of the respirator shall be demonstrated to the subject prior to the selection process.			The fit tester will provide training to the wearer if needed, but donning for the fit test has to be done without counseling.	The person being tested is instructed to put on the RPD as trained.
<b>Wearing the respirator</b>	The most comfortable mask is put on and worn for at least five minutes so that comfort can be assessed, taking certain aspects into account.			/	- If an RPD is being worn for the first time or if the model or brand has been changed, then the RPD shall be worn for approximately five minutes to evaluate comfort. During this time, adjustments may be made or if unacceptable, the RPD may be changed. - Before starting the test, each wearer must be allowed sufficient time (up to one minute) to breathe so that particles are removed.
<b>Fit test equipment</b>	Following the manufacturer's instructions for operating the PortaCount® Respirator Fit Tester and performing the test.			/	To set up the instrument to perform the required fit test exercise protocol, the manufacturer's instructions are followed.

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<b>Fit test preparation (cont.)</b> <span style="float: right;">QNFT – CNC / APC</span>					
<b>Sample probe</b>	The sample is taken from inside the mask by a special sampling device installed on the respirator mask.			<ul style="list-style-type: none"> <li>- The use of suitable fit test adapters is required.</li> <li>- Disposable connectors must be used for disposable masks and if no adapter is available for half and full face masks, a permanent connector can be used.</li> <li>- It is always important that the sample tubing is not blocked, twisted or obstructed in any way and that the positioning and weight of the probe does not interfere with the facepiece.</li> </ul>	For sampling, the sampling hose is connected to the instrument and to the respirator via a sampling adapter.
<b>Positioning sample probe</b>	The sample probe, as permanent sampling probe on a replacement facepiece or as sampling adapter, shall be installed to sample air from inside the facepiece in the user's breathing zone, midway between the nose and mouth.			<ul style="list-style-type: none"> <li>- The sampling probe is placed in the breathing zone of the wearer, near the face midway between the nose and mouth.</li> <li>- There has to be no physical partition or isolation of the sample probe from the mouth and nose region.</li> <li>- For disposable masks with an exhalation valve, the connector should be placed to the side of the valve.</li> </ul>	<ul style="list-style-type: none"> <li>- The sample is taken from the area between the mouth and nose, close to the face.</li> <li>- There should be no physical separation from this area and the specimen should therefore extend into the RPD cavity, while not being blocked by the face.</li> </ul>
<b>Ambient conditions</b>				<ul style="list-style-type: none"> <li>- Ambient challenge concentrations of 3000 particles/cm<sup>3</sup> for disposable and reusable half masks or 10,000 particles/cm<sup>3</sup> for full face masks reduces the probability of false fails.</li> <li>- An aerosol generator or burning candle or similar can be used to achieve this recommended minimum particle count.</li> </ul>	/
<b>NOTE</b>	/				/
Please follow the TSI® recommendations for using the PortaCount® Respirator Fit Tester.					
<b>Conducting the fit test</b> <span style="float: right;">QNFT – CNC / APC</span>					
<b>Tasks of the fit test operator</b>	<ul style="list-style-type: none"> <li>- The fit test operator shall interview the wearer about the comfort of the respirator after completion of the exercise protocol.</li> <li>- The operator has to observe the wearer and inform him/her about the result.</li> </ul>			<ul style="list-style-type: none"> <li>- The fit test operator observes the wearer throughout, watching for proper execution and movements that may cause leakage.</li> <li>- The safety of the wearer should be ensured.</li> <li>- Coughing or sneezing may result in a need to repeat the test.</li> <li>- Upon completion of the test, inform the wearer of the results and, if the fit is poor due to inadequate training, the employer too.</li> </ul>	- The fit test operator observes the donning process, wearer seal check and the whole fit test procedure.
<b>Fit test equipment</b>	<ul style="list-style-type: none"> <li>- The overall fit factor is calculated by the PortaCount® Respirator Fit Tester after the measurements have been automatically completed.</li> <li>- The "Passed" or "Failed" message indicates the (non-) success of the test.</li> <li>- Since the pass level is user programmable, the fit test operator shall check this.</li> </ul>			/	<ul style="list-style-type: none"> <li>- The fit test cycle of the instrument is started and during this cycle the particle concentration of the test environment and within the RPD is measured.</li> <li>- After all exercises have been performed as described, the fit test is complete.</li> </ul>
<b>Number of fit test exercises</b>	8	4	4	7	7
<b>Duration of each exercise</b>	With the exception of the grimace exercise, which is performed for 15 seconds, the test exercises must be performed for one minute each.	<ul style="list-style-type: none"> <li>- Each exercise has to be performed for 30 seconds.</li> <li>- But because of ambient sampling the first exercise has to be done for 50 seconds and the last one for 39 seconds.</li> </ul>	<ul style="list-style-type: none"> <li>- Each exercise has to be performed for 30 seconds.</li> <li>- But because of ambient sampling the first exercise has to be done for 50 seconds and the last one for 39 seconds.</li> </ul>	<ul style="list-style-type: none"> <li>- Exercises should be performed for at least one minute.</li> <li>- However, the sampling time for QNFT should also be at least one minute, making the total exercise time (sampling + purging + environmental sampling time) longer than one minute.</li> </ul>	<ul style="list-style-type: none"> <li>- Each exercise shall be practiced for at least one minute.</li> <li>- However, for QNFT, the in-mask sample period should be at least one minute.</li> </ul>
<b>1. Exercise</b> <i>exact quote</i>	Normal breathing: In a normal standing position, without talking, the subject shall breathe normally.	Bending over: The test subject shall bend at the waist, as if going to touch his/her toes for 50 seconds and inhale 2 times at the bottom.	Bending over: The test subject shall bend at the waist, as if going to touch his/her toes for 50 seconds and inhale 2 times at the bottom.	Normal breathing: The wearer should breathe normally with no head movements or talking.	Normal breathing: In a normal standing position, without talking, the subject shall breathe normally.



	US – OSHA Protocol (OSHA 29CFR1910.134)			UK – Fit2Fit Protocol (HSE INDG 479)	ISO 16975-3 Protocol
	Ambient aerosol CNC protocol	Modified for half/full-face respirators	Modified for filtering facepieces		
<b>Conducting the fit test (cont.)</b>					
<b>QNFT – CNC / APC</b>					
<b>2. Exercise</b> <i>exact quote</i>	Deep breathing: In a normal standing position, the subject shall breathe slowly and deeply, taking caution so as not to hyperventilate.	Jogging-in-Place: The test subject shall jog in place comfortably for 30 seconds.	Talking: The test subject shall talk out loud slowly and loud enough so as to be heard clearly by the test conductor for 30 seconds. He/she will either read from a prepared text such as the Rainbow Passage, count backward from 100, or recite a memorized poem or song.	Deep breathing: The wearer should breathe slowly and deeply, taking care not to hyperventilate.	Deep breathing: In a normal standing position, the subject shall breathe slowly and deeply, taking caution so as not to hyperventilate.
<b>3. Exercise</b> <i>exact quote</i>	Turning head side to side: Standing in place, the subject shall slowly turn his/her head from side to side between the extreme positions on each side. The head shall be held at each extreme momentarily so the subject can inhale at each side.	Head Side-to-Side: The test subject shall stand in place, slowly turning his/her head from side to side for 30 seconds and inhale 2 times at each extreme.	Head Side-to-Side: The test subject shall stand in place, slowly turning his/her head from side to side for 30 seconds and inhale 2 times at each extreme.	Turning head side to side: The wearer should slowly turn their head from side to side between the extreme positions on each side (approximately 15-20 times per minute). The head shall be held at each extreme momentarily so the wearer can inhale at each side.	Turning head side to side: Standing or sitting, the subject shall slowly turn his/her head from side to side between the extreme positions on each side. The head shall be held at each extreme momentarily so the subject can inhale at each side. Exhalation shall take place through the return movement of the head.
<b>4. Exercise</b> <i>exact quote</i>	Moving head up and down: Standing in place, the subject shall slowly move his/her head up and down. The subject shall be instructed to inhale in the up position (i.e., when looking toward the ceiling).	Head Up-and-Down: The test subject shall stand in place, slowly moving his/her head up and down for 39 seconds and inhale 2 times at each extreme.	Head Up-and-Down: The test subject shall stand in place, slowly moving his/her head up and down for 39 seconds and inhale 2 times at each extreme.	Moving head up and down: The wearer should slowly move their head up and down (approximately 15–20 times per minute). The wearer should be instructed to inhale in the up position (i.e., when looking toward the ceiling).	Moving head up and down: Standing in place, the subject shall slowly move his/her head up and down. The subject shall be instructed to inhale in the up and down positions. Exhalation shall take place through the return movement of the head.
<b>5. Exercise</b> <i>exact quote</i>	Talking: The subject shall talk out loud slowly and loud enough so as to be heard clearly by the test conductor. The subject can read from a prepared text such as the Rainbow Passage, count backward from 100, or recite a memorized poem or song.	/	/	Talking: The wearer should talk slowly and loudly enough to be heard clearly by the fit tester. The wearer should read from a standard reading passage or count down from 100.	Talking: The subject shall talk slowly and loud enough so as to be heard clearly by the fit-test operator. The subject can read from a prepared text, count backward from 100 or recite a memorized poem.
<b>6. Exercise</b> <i>exact quote</i>	Grimace: The test subject shall grimace by smiling or frowning.	/	/	/	/
<b>7. Exercise</b> <i>exact quote</i>	Bending over: The subject shall bend at the waist as if he/she were to touch his/her toes. Jogging in place shall be substituted for this exercise in those test environments that do not permit bending over at the waist.	/	/	Bending over: From a normal standing position, the wearer should bend at the waist as if to touch their toes and then return to an upright position. Repeat approximately 10–15 times throughout the duration of the exercise.	Bending over: The wearer shall bend at the waist as if to touch their toes and return to an upright position. This shall be repeated. Jogging in place shall be substituted for this exercise when using test equipment that do not permit bending over at the waist.
<b>8. Exercise</b>	Normal breathing: Same as exercise 1	/	/	Normal breathing: Same as exercise 1	Normal breathing: Same as exercise 1
<b>During the exercises</b>	/	/	/	While performing the exercises above (with the exception of the "bending over" exercise) the wearer: - Rides an exercise bike; - Runs on a treadmill; or - Performs stepping exercises.	/
<b>Exercise: Talking out loud</b>	Rainbow Passage	/	Rainbow Passage	Preferred: Rainbow Passage	/
<b>Fit test result</b>					
<b>Significance of fit test result</b>	- The respirator has to be still comfortable after the test. - The fit test is passed if the overall fit factor is equal to or greater than the required minimum fit factor.			- The fit test is passed if the fit factor for each exercise is equal to or greater than the required minimum fit factor. - The result of the fit test is only valid for the specific make, model and size of mask worn during the test. - A fit factor with a value greater than 100,000 may indicate a problem with the application.	- Adjustment of the RPD after the start of the fit test shall not be made, as any adjustment will result in invalidity and the need to repeat the test. - The fit test is passed if the overall fit factor is equal to or greater than the required minimum fit factor.

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<b>Fit test result (cont.)</b>					
<b>Required minimum fit factors to pass</b>	The required minimum fit factor of tight-fitting half facepieces and tight-fitting full facepieces to pass the fit test is 100 and 500, respectively.			- The required minimum fit factor to pass the fit test is 100 for all disposable (FFP1 with APF 4, FFP2 with APF 10, FFP3 with APF 20) and reusable half masks. - A fit factor of 2,000 must be achieved for full face respirators.	- A minimum fit factor of 100 is required for respirators in protection classes (PC) 1-3. - PC 3-6 respirators must achieve a minimum fit factor of 2,000 using the CNC method and 500 using the CNP method.
<b>Overall fit factor</b>	The overall fit factor is automatically calculated by PortaCount® from the fit factors of the individual exercises using the following formula: $OverallFF = \frac{\text{number of exercises}}{\frac{1}{ff_1} + \dots + \frac{1}{ff_5} + \frac{1}{ff_7} + \frac{1}{ff_8}}$			/	The instrument provides a pass/fail indication and/or an overall fit factor calculated from the following formula, which must be equal to or greater than the required minimum fit factor for the fit test to pass. $QNFF_{overall} = \frac{N}{\frac{1}{QNFF_1} + \frac{1}{QNFF_2} + \dots + \frac{1}{QNFF_n}}$ N is the number of exercises; QNFF <sub>i</sub> is the fit factor for exercise i.
<b>Failed fit test</b>	/			- If a fit test is failed, then the fit of the mask should be checked first. - The mask, filter and equipment are then inspected for defects before the test can be restarted. - A different mask (make, model, or size) should be selected after the second failure.	- If the fit test is failed, the fit of the respirator should be checked. - If the respirator is still considered acceptable by the wearer, the test can be repeated, otherwise the selection process (with seal check) can be repeated. - The fit test should not be repeated more than three times with the same respirator (force-fitting).
<b>Cannot achieve adequate fit</b>	/			If an adequate fit cannot be achieved, an RPE without a tight fit should be selected.	If an adequate make or model of tight-fitting RI cannot be found, RPD alternatives or modification of the model and size of potentially interfering PPE should be considered.

<b>Abkürzungen</b>	
APC	Ambient particle counting
APF	Assigned protection factor
BA	Breathing apparatus
CNC	Condensation nuclei counting
CNP	Controlled negative pressure
FFP	Filtering Facepiece
GA	Generated Aerosol
PC	Protection Class
PLHCP	Physician or other licensed health care professional
PPE	Personal protective equipment
QLFF	Qualitative fit factor
QLFT	Qualitative fit testing
QNFF	Quantitative fit factor
QNFT	Quantitative fit testing
RI	Respiratory interface
RFF	Required fit factor
RPD	Respiratory protective device
RPE	Respiratory protective equipment

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## Disclaimer

This document does not claim to reproduce the protocols and regulations completely. TSI® assumes no responsibility for the complete fulfillment of legal requirements by observing the contents presented herein.

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