

# Required Procedures for Respiratory Protection Program

Chapter 296-842 WAC

## Rule

Table 18  
Generated Aerosol Test Procedure

### Important:

- This is a quantitative (QNFT) fit-test procedure.
- In this method, a test aerosol is used to challenge the facepiece seal while aerosol concentrations inside and outside the facepiece are measured during test exercises.
- Special equipment is needed to generate, disperse, detect, and measure test aerosols.

### Test Preparations

1. Test aerosol.
  - Use a particulate, for example, corn oil, polyethylene glycol 400, di-2-ethyl hexyl sebacate, or sodium chloride.
2. Instrumentation.
  - Do **all** the following:
    - Obtain and use aerosol generation, dilution, and measurement systems appropriate for particulates.
    - Use an aerosol-generating instrument that will maintain test concentrations within a 10% variation.
    - Select a sampling instrument that allows for a computer record or strip chart record to be created.
      - The record must show the rise and fall of test agent concentration during each inhalation and exhalation at fit factors of at least 2000.

**Note:**  
Integrators, or computers that integrate the amount of test agent penetration leakage into the respirator for each exercise, may be used if a record of the readings is made.

  - Minimize the time interval between the activity and the recording of the activity so you can clearly connect what you see to what is being recorded. For example, use a small diameter and length of sampling line.
3. Test enclosure.
  - Do **all** the following:
    - Make sure the enclosure is equipped and constructed to effectively:
      - Maintain a uniform concentration of the test agent inside the enclosure. For example, the enclosure must be large enough to allow **all** employees freedom of movement during testing **without** disturbing the test concentration or measurement instrument.
      - Keep the test agent from contaminating the air outside the enclosure. For example, use a HEPA filter to purify exhausted air.
      - Allow the individual conducting the fit test to view the employee during the test.
    - Make sure the tubing used to collect samples from the enclosure **and** respirator is the same material, diameter, **and** length. This makes the effect of aerosol loss caused by deposition in each sample line equal.
    - If sodium chloride is used, relative humidity inside the enclosure must be kept below 50%.



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Table 18 (Continued) Generated Aerosol Test Procedure	
Test Preparation	
<p>4. Prepare test respirators.</p> <ul style="list-style-type: none"> <li>• Do <b>all</b> the following:               <ul style="list-style-type: none"> <li>- Inspect test respirators regularly for missing parts <b>and</b> damage</li> <li>- Keep test respirators in proper working order</li> <li>- Make sure in-mask sampling probes are:                   <ul style="list-style-type: none"> <li>• Designed and installed so the air sample will be drawn from the employee's breathing zone; midway between the nose and mouth</li> <li><b>and</b></li> <li>• The probe extends inside the facepiece at least <math>\frac{1}{4}</math> inch.</li> </ul> </li> <li>- Make sure sampling ports such as probes, or adapters on respirators are constructed and installed so they do <b>not</b>:                   <ul style="list-style-type: none"> <li>• Block air flow into the sampling line</li> <li>• Leak</li> <li>• Interfere with the respirator's fit or performance</li> </ul> </li> </ul> </li> <li>• Have high efficiency particulate air (HEPA) filters OR P100 series filter available.               <ul style="list-style-type: none"> <li>- Replace filters when increased breathing resistance is detected <b>or</b> when the test agent has altered the filter material's integrity.</li> </ul> </li> </ul>	
Test	
<p><b>Important:</b></p> <ul style="list-style-type: none"> <li>• Throughout the test, maintain the employee's exposure to any test agent below the established exposure limit. Exposures allowed must be based on exposure time and exposure limit duration.</li> <li>• If a single peak penetration exceeds 5% for half facepieces <b>or</b> 1% for full facepieces:               <ul style="list-style-type: none"> <li>- Stop the test</li> <li><b>and</b></li> <li>- Have the employee select another respirator for testing.</li> </ul> </li> </ul> <p>5. Have the employee attach filters, put on, adjust, and seal check the respirator.</p> <ul style="list-style-type: none"> <li>• Be sure to crimp the sampling line to avoid pressure leaks during the seal check.</li> <li><b>and</b></li> <li>• Have the employee adjust the respirator straps, without assistance, so the fit is comfortable. Do <b>not</b> over-tighten.</li> </ul> <p>6. <b>Optional Step.</b> To save time conduct a screening test to quickly identify poorly fitting respirators</p> <p><b>Note:</b> You may use a qualitative screening test <b>or</b> an ambient aerosol condensation nuclei counter instrument in the count mode.</p>	



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Table 18 (Continued)  
Generated Aerosol Test Procedure

Test (Continued)

7. Make sure test aerosol concentration is reasonably stable.
  - If a canopy or shower curtain enclosure is used, determine stability of the test aerosol concentration **after** the employee enters the enclosure.
8. Have the employee enter the test enclosure and connect the respirator to the sample lines.
9. Immediately after entering the enclosure measure test aerosol concentration inside the respirator.
  - Make sure the peak penetration does **not** exceed 5% for half facepieces, **or** 1% for full facepieces.
10. Have employee perform the appropriate fit test exercises in Table 19.
  - Do **not** adjust the respirator once exercises begin.
11. Calculate the overall fit factor as specified in Steps 12-13. The fit test is:
  - **Passed** if the minimum fit factor of 100 for half facepieces or 500 for full facepieces is obtained.
  - or**
  - If a passing fit factor is **not** obtained, the test has **failed** and you must have the employee select and test another respirator.

Calculations

Important:

- Do **not** count the grimace exercise measurements during these calculations.
  - Take into account the limitations of instrument detection when determining fit factors.
12. Calculate individual fit factors for **each** exercise by applying the following:
 

Exercise Fit Factor (ffE) =  $\frac{\text{Average test enclosure concentration}}{\text{Test aerosol concentration inside the respirator}}$

    - To determine the average test enclosure concentration use one of the following methods:
      - Arithmetic average of the concentration before and after each test (an average of 2 values per entire test)
      - Arithmetic average of concentration before and after each exercise (an average of 2 values per exercise).
      - True average measured continuously during the respirator sample
    - Determine the test aerosol concentration inside the respirator in one of the following ways:
      - Average peak penetration values. Determine aerosol penetration for each exercise by:
        - Using integrators or computers that calculate the actual test agent penetration
        - or**
        - Average the peak heights shown on the strip chart recording, graph, or by computer integration.
      - Maximum peak penetration. Use strip chart recordings to determine the highest peak penetration for each exercise and use this value.
      - Area under the peaks. Use computerized integration or other appropriate calculations to integrate the area under individual peaks for each exercise.
  13. Using individual exercise fit factors (ffE) calculate the overall fit factor by doing **all** of the following:
    - Convert each exercise fit factor to a penetration value
    - Determine the average penetration value
    - Convert the average penetration value back to a fit factor
    - or**
    - Use this equation to calculate the **overall fit factor**:
 
$$\text{Overall fit factor} = \frac{n}{1/\text{ffE}1 + 1/\text{ffE}2 + 1/\text{ffE}3 + \dots + 1/\text{ffE}n}$$

n = the number of exercises;

ffE1 = The fit factor for the first exercise;

ffE2 = The fit factor for the second exercise;

ffE3 = The fit factor for the third exercise; and

ffEn = the fit factor for the nth exercise

