Fit Testing with Controlled Negative Pressure

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What is a Fit Test?

The use of a protocol to evaluate the fit of a respirator on an individual

Verifies training and identifies the specific make, model, style, and size of respirator best suited for each employee

Why Fit Test?

- Protect the health of employees
- Ensure employees are trained on their mask and risk
- Provide employees peace of mind
- Required by:
  - OSHA 29 CFR 1910.134
  - ANSI Z88.10 – 2010
  - ISO 16975 – 2017

When Should A Fit Test Be Carried Out?

- As part of the initial selection
- Where an untested facepiece is already in use.

When Should A Repeat Fit Test Be Conducted?

- When the wearer:
  - Loses or gains significant weight (+/- 20lbs or 9kg)
  - Undergoes any substantial dental work
  - Develops any facial changes (scars, moles, etc.) around the faceseal area
- At the regulated time interval (typically annually)

Medical Clearance

- Respirators place extra physical stress on the user
- To ensure you are healthy enough to wear a respirator, a medical evaluation is typically required by a physician

Fit testing training

- All employees must be trained on the proper use and requirements
  - Awareness of hazards
  - Inspects respirator
  - Knowledge of donning and doffing respirator
  - Performs wearer seal check

Wearer Seal Checks

Positive Pressure Check

Negative Pressure Check

Quantitative Check

Qualitative Fit Testing (QLFT)

Subjective, Pass/Fail test that relies on the employee's response to an agent to detect leakage

- Current typical methods:
  - Isoamyl Acetate
  - Saccharin
  - Bitrex
  - Irritant Smoke

If the presence of the test agent is detected inside the mask, the respirator fit is considered to be inadequate

Only be used to fit test negative pressure air-purifying respirators that require a fit factor of 100 or less (typically half mask)

Quantitative Fit Testing (QNFT)

- Objective; Uses a machine to measure leakage into the mask
- Provides a numerical value of the fit called a fit factor
- Three methods accepted by OSHA:
  - Controlled Negative Pressure
  - Ambient Aerosol Condensation Nuclei Counter (CNC)
  - Generated aerosol
- Can be used for any tight fitting respirator

Two Most Common Methods of QNFT

CNP

- OHD Quantifit
- Air is the challenge agent
- Uses a Controlled Negative Pressure to directly measure respirator leakage
- Precisely measures leak rate (in cc/min) by determining the amount of air that leaks into the respirator during the fit test

Ambient Aerosol CNC

- TSI PortaCount or Accutec AccuFIT 9000
- Aerosols are the challenge agent
- Carried out by probing the facepiece and calculating the ratio of external particles to the particles in the mask
- Aerosol can be artificially created for testing if natural particle counts are too low

QLFT

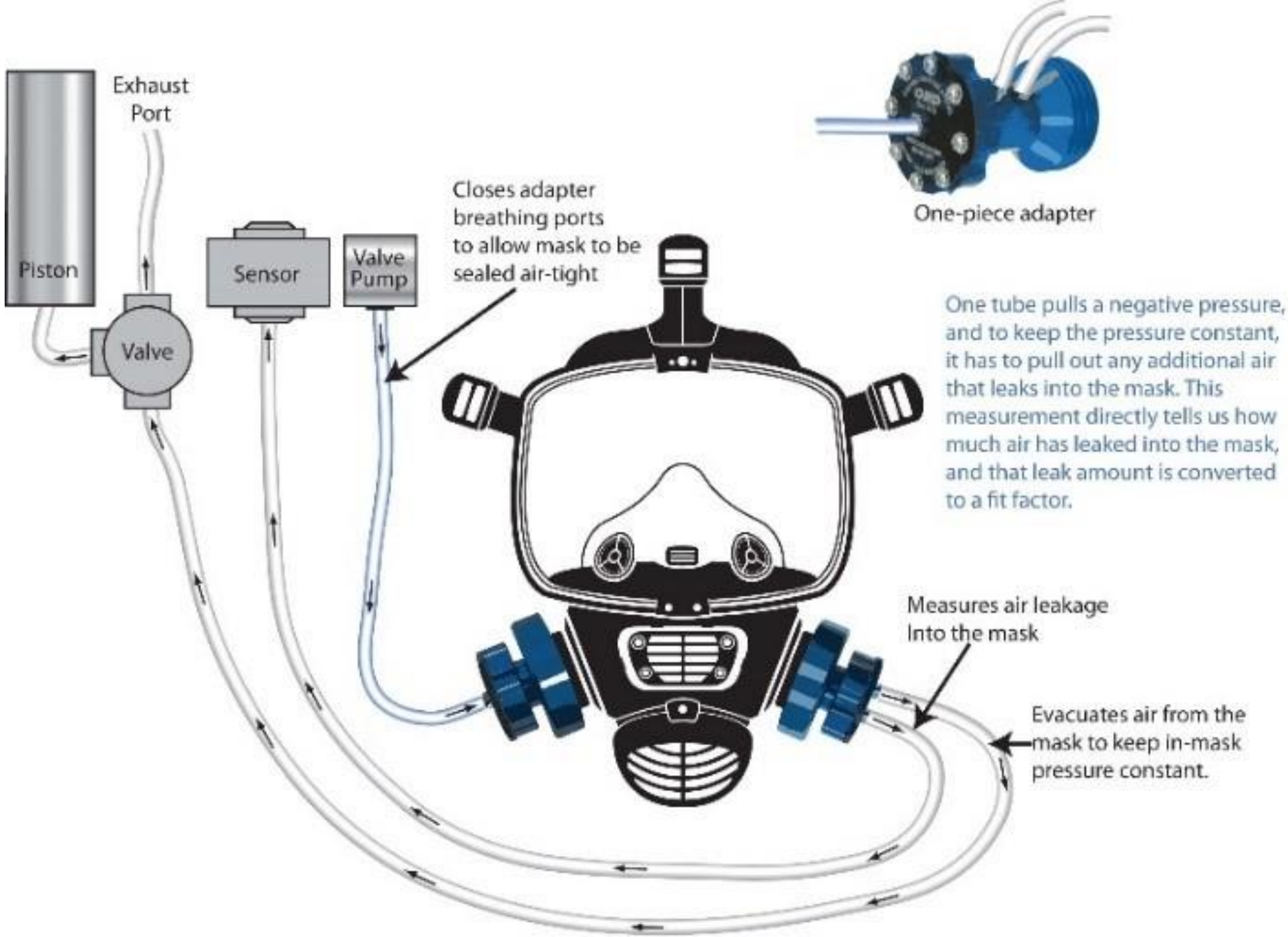
- Inexpensive
- Low maintenance
- Imprecise
- Subjective
- Subject to cheating
- Slow

QNFT

- More expensive
- Require maintenance
- Precise
- Objective
- Documentation
- Faster

Controlled Negative Pressure

- The OHD Quantifit instrument.
- Uses a Controlled Negative Pressure to directly measure respirator leakage.
- CNP precisely measures leak rate by determining the amount of air that leaks into the respirator during the fit test.
- Air is the challenge agent.


Exhaust Port
Piston
Valve
Sensor
Valve Pump
Closes adapter breathing ports to allow mask to be sealed air-tight
One-piece adapter
One tube pulls a negative pressure, and to keep the pressure constant, it has to pull out any additional air that leaks into the mask. This measurement directly tells us how much air has leaked into the mask, and that leak amount is converted to a fit factor.
Measures air leakage Into the mask
Evacuates air from the mask to keep in-mask pressure constant.

CNP Fit Factor = BR / LR

Where:

BR = inspiratory flow rate associated with CNP challenge pressure (modeled breathing rate);

LR = mean leakage flow rate (leak rate) measured with the head held in a motionless position at the end of each test exercise

CNP: Compute the Fit Factor

Breathing Rate (BR) is expressed in liters/min.

DIVIDED BY

Leak Rate (LR) expressed in cubic centimeter/min

1 cc/min = 0.001 L/min,

So 53.8 L/min = 53,800 cc/min

53,800 cc/min BR / 53.8 cc/min LR = 1,000 Fit Factor

AA Fit Factor = C_{out} / C_{in}

Where:

C_{out} = number concentration of particles in an aerosol sample outside of the respirator in the surrounding ambient air;

C_{in} = number concentration of particles in an aerosol sample inside the respirator

$$\text{Overall Fit Factor} = \frac{N}{[1/FF1 + 1/FF2 + \ldots 1/FFN]}$$

Where:

N = The number of exercises;

FF1 = The fit factor for the first exercise;

FF2 = The fit factor of the second exercise;

FFN = The fit factor of the Nth Exercise.

Harmonic Mean

- A kind of average.
- It is appropriate for situations when the average of rates is desired.
- Tends strongly toward the lowest rates of the list
- Lessens the impact of large outliers
- Worsens the impact of small outliers

Overall fit factor example

- FF = 1000, 500, 750, 1250, 1500
- Formula = N / [1/FF1 + 1/FF2+… 1/FFN]
- 5/[(1/1000)+(1/500)+(1/750)+(1/1250)+(1/1500)]
- Overall fit factor = 862

REDON Protocol

- Step 1 : Facing Forward – for 30 seconds followed by a 10 second measurement
- Step 2 : Bending Over – for 30 seconds followed by a 10 second measurement
- Step 3 : Head Shaking – Vigorous shaking several times while shouting for 3 seconds followed by a 10 second measurement
- Step 4 : REDON 1 – Remove mask loosen straps then redon followed by a 10 second measurement
- Step 5 : REDON 2 – Remove mask loosen straps then redon followed by a 10 second measurement

Questions or Comments?

Thank you!!

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