

3M Science.
Applied to Life.™

Respiratory Protection: Assigned Protection Factors and Fit Testing

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Introduction

- This presentation contains a general overview of certain points regarding use of personal protective equipment, including selected offerings from 3M Company. This slide deck should not be relied upon to make specific decisions. It is not a comprehensive catalog of offerings, nor should it be relied upon as a comprehensive list for PPE use generally, or in any specific situation.
- Local country or regional requirements vary, and employers must always follow applicable laws and regulations. Always consult User Instructions and follow local laws and regulations.
- Information is current as of October 2017, though requirements can change in the future.
- This presentation should not be relied upon in isolation, as the content is often accompanied by additional and/or clarifying information or discussion.
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Agenda

1. Key Respiratory Protection Program Elements
2. Protection Factors
3. Fit Testing
4. Summary

Key Respiratory Protection Program Elements

Occupational Hygiene Process

Anticipate

Recognize

Evaluate

Control



Engineering

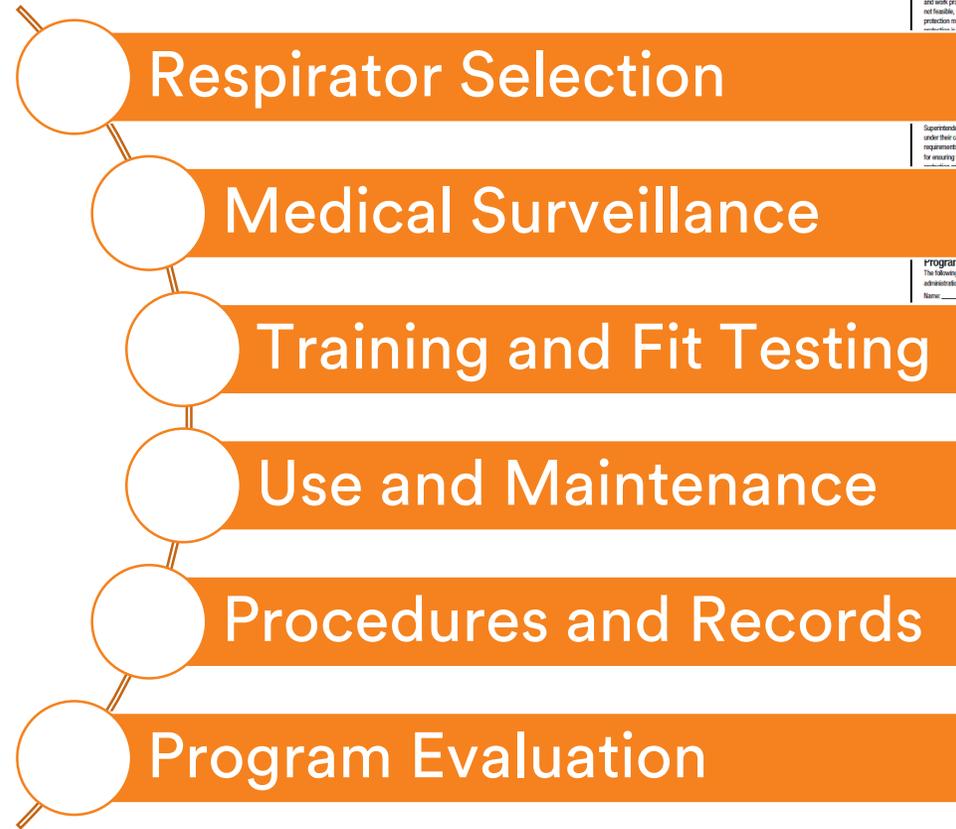
Administrative

Personal Protective
Equipment



Key Elements of Written Respiratory Protection Program

- Requires a Program Administrator
- Specific to a site
- Updated annually



General Procedures, Policy and Responsibility

General
The Occupational Safety and Health Administration (OSHA) General Industry standard for respiratory protection 29 CFR 1910.134 requires that written respiratory protection programs be established by an employer. The following procedures are based on the requirements established by OSHA.

Policy
It is the policy of this company to provide its employees with a safe and healthful work environment. The guidelines in this program are designed to help reduce employee exposure to occupational air contaminants and organ deficiency. The primary objective is to prevent excessive exposure to these contaminants. This is accomplished as far as feasible by accepted engineering and work practice control measures. When effective engineering controls are not feasible, or while they are being implemented or evaluated, respiratory protection may be required to achieve the goal. In these situations, respiratory protection shall be provided at no cost to the employees.

Responsibilities
It is the responsibility of management to determine what specific applications respiratory protective equipment. Management must also ensure that respiratory protective equipment to meet the needs of each area. Employees must be provided with adequate training and equipment.

Supervisory
Supervisors of each area are responsible for ensuring that all personnel under their control are completely knowledgeable of the respiratory protection requirements for the areas in which they work. They are also responsible for ensuring that their subordinates comply with all facets of this respiratory protection program, including respirator inspection and maintenance. They are also responsible for enforcing disciplinary procedures for employees who do not comply with respiratory program requirements.

Employee
It is the responsibility of each employee to have an awareness of the respiratory protection requirements for their work areas (as explained by management) and to use respiratory protection as required. It is the responsibility of each employee to follow proper instructions and to maintain the respirator in good and operable condition.

Program Administration
The following individual has full and complete responsibility for the administration of the respiratory protection program:

Name: _____
Title: _____
Department: _____
Signature: _____
Date: _____

This individual has the authority to act on any and all matters relating to the operation and administration of the respiratory protection program. All employees, operating departments, and service departments will cooperate to the fullest extent. This person is referred to as the Respiratory Protection Program Administrator in this program.

The following individual is responsible for reviewing or conducting an assessment of the respiratory hazard, developing working procedures for the program, maintaining records, and conducting program evaluations.

Name: _____
Title: _____
Department: _____
Signature: _____
Date: _____

The following individual is responsible for contaminant identification, including technical support, air sampling or laboratory analysis.

Name: _____
Title: _____
Department: _____
Signature: _____
Date: _____

The following individual is responsible for evaluating the health of company employees via a comprehensive medical and health history.

Name: _____
Title: _____
Department: _____
Signature: _____
Date: _____

The following individual is responsible for directing and coordinating engineering projects which are directly related to respiratory protection.

Name: _____
Title: _____
Department: _____
Signature: _____
Date: _____

The following individual is responsible for selection, issuing, testing of all respirators used in the company, including fit testing.

Name: _____
Title: _____
Department: _____
Signature: _____
Date: _____

This program will be effective on _____.

3M™ Administrative Respiratory Protection Program

Respirator Selection Documentation

STEP 1: Respiratory Hazard Identification

- Contaminant(s): _____
- Physical State(s): _____
- Concentration: _____
- PEL: _____
- OSHA: _____
- ACGIH: _____
- NIOSH: _____
- Other: _____

STEP 2: Hazard Analysis

- Permissible Exposure Limit: _____
- Protection Factor Required: _____
- Skin Absorption/Irritation: _____
- Eye Irritation: _____
- Flaming Properties: _____
- Color Threshold: _____
- Basal/Throat Irritation: _____

STEP 3: Respirator Type Required

- Minimum Acceptable: _____
- Alternative (optional): _____

STEP 4: Specific Selections

- EELR Concentration: _____
- Lower Flammable Limit: _____
- Service Life Information: _____
- Chemical Cartridge Changeout Time: _____

Qualitative Fit Test Record

Name: _____ Date: ____/____/____ (Month / Day / Year)

Respirator: _____ Size: _____

Employee ID/SSN: _____

Respiratory Hazards Encountered: _____

Sensitivity Test

• Isopropyl Alcohol (Breathable Oil): Pass Fail NA

• Saccharin #19: Pass Fail NA

• Silver Ammon #19: Pass Fail NA

• Instant Smoke: Pass Fail NA

Fit Test Agent:

• Isopropyl Alcohol: Pass Fail NA

• Saccharin: Pass Fail NA

• Silver Ammon: Pass Fail NA

• Instant Smoke: Pass Fail NA

Filter/Cartridge:

• Organic Vapor Cartridge: Pass Fail NA

• Particulate Filter: Pass Fail NA

• 100 Level Particulate: Pass Fail NA

Comments: _____

Fit Test Requested Before: _____ Test Conductor: _____ Employee Signature: _____

3M's *Internal/Global* Respiratory Protection Plan

3M Global Safety & Health Plan Overview

As required by the 3M Safety & Health Policy, the 3M Global Safety & Health Plan (GSHP) provides a management system to address safety and health risks and compliance obligations applicable to each company location. It applies to all 3M locations worldwide and provides an overview of the various safety and health elements required.

While the GSHP covers the most common safety and health risks, it is not inclusive of all risks. It is implicit in this plan that locations understand and manage their risks and comply with all applicable local government regulations.

All locations are required to complete an annual self-assessment of the elements that apply to them. Detailed requirements for implementing the GSHP are documented in the GSHP Self-Assessment User Guide available through the EHS Work Center. See the *EHS Management System User Guide* for detailed instructions on completing and submitting the annual self-assessment.

The elements of the GSHP are as follows:

1.1 Location Safety and Health Plan Description

A written location-specific Safety and Health Plan designed to manage the facility's safety and health risks is required. The plan shall document the management systems and procedures for implementing each applicable element of the Global Safety and Health Plan.

1.1.1 Leadership Attributes

Leadership Attributes describe how Site Leadership integrates EHS performance into each



3M Respiratory Protection Manual

Version 3



3M's Global Respiratory Protection Manual*

“This manual supports the program and provides enough information for Respiratory Protection Program Administrators to develop, implement, and maintain the program at their facilities. It provides guidance on **developing the written program and assistance in selecting appropriate respiratory protection, conducting training, fit testing, and respirator medical evaluations, appropriate recordkeeping, and regular program evaluations.** This manual also provides assistance for making choices related to the program, as well as discussions of implications of those choices.

The manual will identify **minimum requirements, and good practices.** Ensure that you are also **following local regulations** for respirator selection and use.”

*3M's internal plan for 3M employees

Based on US OSHA Regulations

3M's Global Respiratory Protection Program Key Elements*

“The Global Safety and Health Plan requires that all 3M facilities where respirators are used develop a respiratory protection program. The program includes the following requirements:

- * Determine the need for the use of respirators through documented **exposure assessments** and if respirators are being used voluntarily.
- * If respirator use (required or voluntary) is determined, a qualified **Respiratory Protection** professional has the authority to effectively manage the program.
- * Develop a **written program** that outlines where and how respirators are used and by whom. See Appendix A: Sample Respiratory Protection Program for an example of a written program.
- * Annually **evaluate the program** to determine if it meets these general requirements.

- Sets clear program direction
- Allows for local requirements
- Have not set global Protection Factors

*Choose respirators that adequately **protect employees** and meet 3M and local requirements.

*Conduct respirator **medical evaluations** for all employees who wear respirators.

* Conduct **annual training** for employees required to wear respirators.

* Use respirators under voluntary use with access to **information** about

* Conduct **annual fit testing** for employees required to wear respirators, using fit-testing protocols that are recognized and approved.

* Develop **cartridge/filter change schedules** for air purifying respirator uses.

* Establish **procedures** for inspection, care, storage, cleaning, sanitizing, and maintenance of respirators.”

Based on US OSHA Regulations

*3M's internal plan for 3M employees

3M Respiratory Protection Program

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RPE Program Administrator

An individual who is qualified by appropriate training or experience *that is commensurate with the complexity of the program* to oversee



Respirator Protection Factors

Respiratory Protection Selection

Hazard Assessment

Measure concentration

Compare to OEL

Determine minimum PF

Select air source of cartridge

Select respirator type

Assess work area and demands

Evaluate respirator & PPE

Determine worker acceptance

Select Respirator

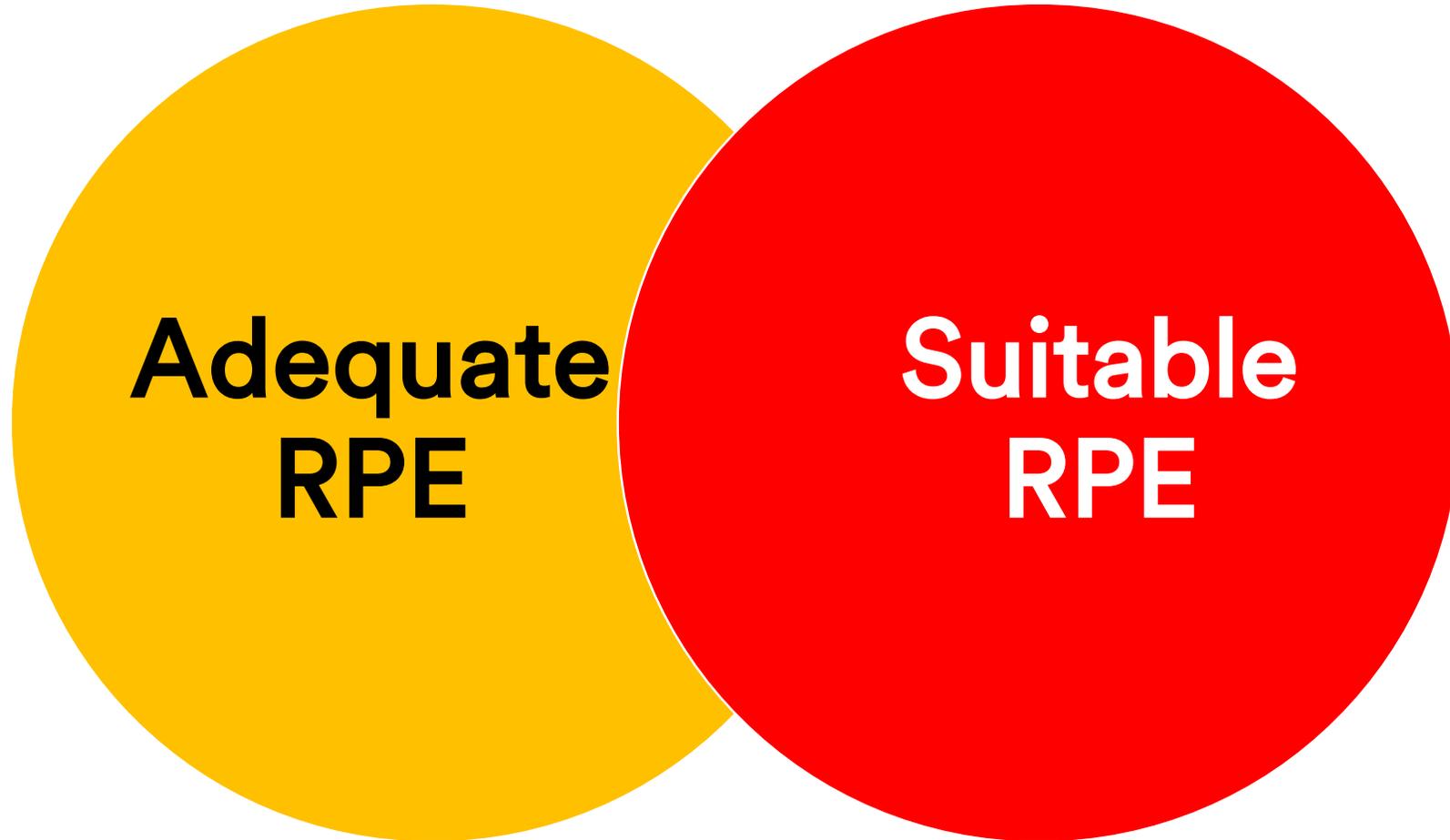


OEL = Occupational Exposure Limit

PF = Protection Factor

PPE = Personal Protective Equipment

Respirator selection



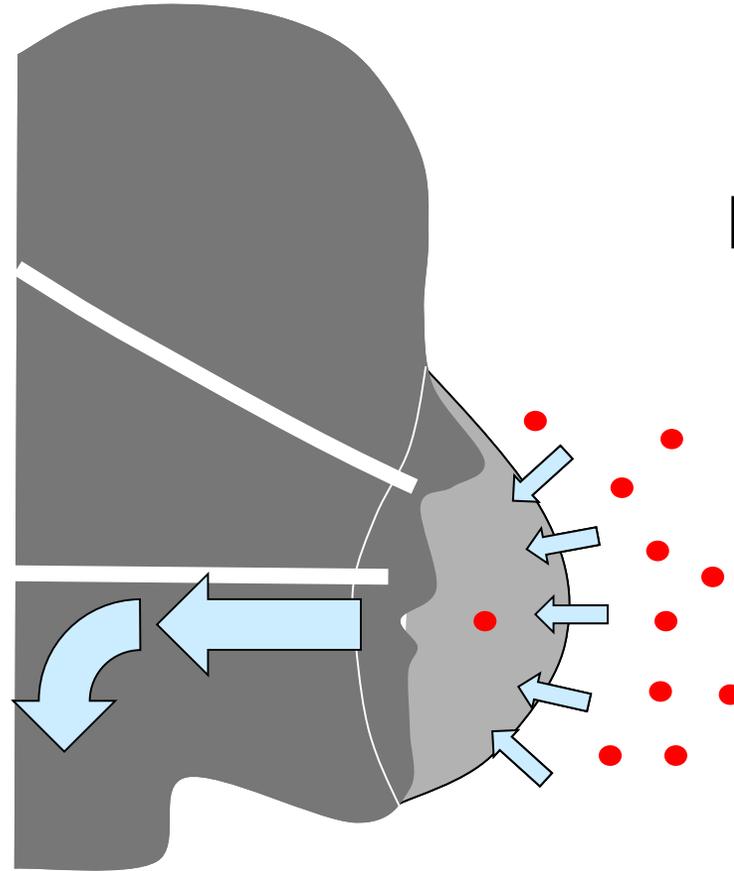
RPE = Respiratory Protective Equipment

Protection Factor

Factor by which the respirator will reduce your exposure when properly used



Protection Factor Example



Protection Factor = 10

Data driven decisions

Workplace
exposures

Occupational
Exposure
Limits

Protection
Factor

$\frac{\text{Concentration}}{\text{OEL}} = \text{Hazard Ratio}$

$\text{Hazard Ratio} \leq \text{Protection Factor}$

Need for control measures

$$\text{Hazard Ratio} = \frac{\text{Exposure}}{\text{OEL}}$$

Exposure level : 40mg/m³

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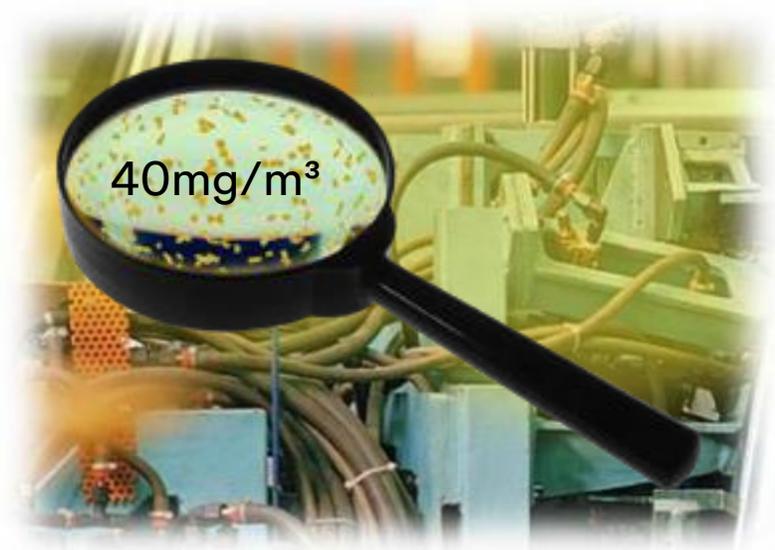
OEL: 5mg/m³

=

Hazard ratio: 8

Select a respirator with a protection factor ≥ 8

Example



OEL of 5mg/m³

Protection Factor Definition

$$\textit{Protection Factor, } PF = \frac{\text{Concentration of contaminant \textbf{outside}, } C_o}{\text{Concentration of contaminant \textbf{inside}, } C_i}$$

Determined by lab data

Nominal
Protection
Factor (NPF)

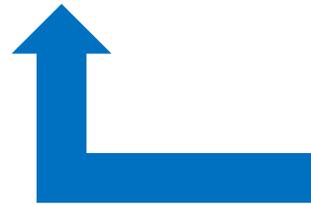
Determined by data sets

Assigned
Protection
Factor (APF)

Types of studies conducted
to obtain data to set APFs

Workplace
Protection Factor
(WPF)

Simulated
Workplace
Protection Factor
(SWPF)



Nominal Protection Factor (NPF)

$$\text{Nominal Protection Factor, } NPF = \frac{100}{TIL_{max}}$$

Laboratory Derived
Value



TIL

NPF calculation example

EN 12491	TIL_{max}	$NPF = \frac{100}{TIL_{max}}$	NPF
TH1	10%	$NPF = \frac{100}{10}$	10
TH2	2%	$NPF = \frac{100}{2}$	50
TH3	0.2%	$NPF = \frac{100}{0.2}$	500

↑
Set in
the
standard

↑
Maximum
value



Assigned Protection Factors (APF)

Level of respiratory protection that can realistically be expected to be achieved in the workplace by 95 % of **adequately trained and supervised** wearers using a properly functioning and correctly fitted RPD and is based on the 5th percentile of the Workplace Protection Factor (WPF) data

Based on
research

EN529:2005 Respiratory protective devices - Recommendations for selection, use, care and maintenance

NPFs and APFs

NPF = Laboratory



APF = Workplace

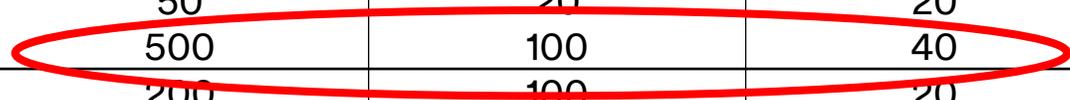


Laboratory and Workplace studies both have benefits and limitations.

EN 529:2005

		NPF	APF (D)	APF (UK)
EN149 (Filtering Facepiece)	FFP1	4	4	4
	FFP2	12	10	10
	FFP3	50	30	20
EN405 (Filtering Half-Mask)	G&V	50	30	10
	P2	12	10	10
	P3	33	30	20
EN140 (Half-mask)	G&V	50	30	10
	P2	12	10	10
	P3	48	30	20
EN136 (Full-Face)	G&V	2000	400	20
	P2	16	10	10
	P3	1000	400	40
EN12941 (Loose-fitting powered)	TH2	50	20	20
	TH3	500	100	40
EN12942 (Tight-fitting powered)	TM2	200	100	20
	TM3	2000	500	40
EN14594 (Supplied air with loose fitting)	1A/1B	10	5	10
	2A/2B	50	20	20
	3A/3B	200	100	40
	4A/4B	2000	100/1000	

US is 25 / 1000



Setting the APFs in the UK; TH3

Table D.1 — Number of individual WPF results for classes of filtering device

Assigned protection factor	Half or quarter mask and filter	Filtering half masks	Full face masks and filter	Power assisted filtering devices incorporating full face masks, half or quarter masks	Powered filtering devices incorporating hoods, helmets or semi-blouses
4	P1:30	FFP1:167	no data	—	—
10	P2:81 Gas:109	FFP2:20	no data	no data	THP1, hoods or helmets: 246 THP2, semi-blouses: 18
20	P3:410	FFP3:62	Gas:7	no data	—
40	—	—	P3:121	TMP3:234	TH3, hoods or helmets: no data semi-blouses: 72

Table D.2 — Number of individual WPF results for classes of breathing apparatus

Assigned protection factor	Non self-contained	Self-contained
4	—	—
10	no data	—
20	—	—
40	no data	Negative pressure demand, full mask: 2
100	no data	no data
200	Air line, full suit: 220 Air line, semi-blouse: 64	—
1 000	no data	no data
2 000	no data	no data

“No Data” for full hoods

The numbers above are the total number of workplace protection factor results reviewed by BSI when deriving the current APFs. Where there is no number the APF was derived by comparison with other RPD types or based upon the nominal protection factor. Studies covering 16 types/classes were considered.

EN529:2005 Respiratory protective devices - Recommendations for selection, use, care and maintenance

US OSHA APFs

Footnote 4

Table 1 — Assigned Protection Factors⁵

Type of Respirator ^{1,2}	Quarter Mask	Half Mask	Full Facepiece	Helmet/Hood	Loose-Fitting Facepiece
1. Air-Purifying Respirator	5	10 ³	50	—	—
2. Powered Air-Purifying Respirator (PAPR)	—	50	1,000	25/1,000 ⁴	25
3. Supplied-Air Respirator (SAR) or Airline Respirator					
• Demand mode	—	10	50	—	—
• Continuous flow mode	—	50	1,000	25/1,000 ⁴	25
• Pressure-demand or other positive-pressure mode	—	50	1,000	—	—
4. Self-Contained Breathing Apparatus (SCBA)					
• Demand mode	—	10	50	50	—
• Pressure-demand or other positive-pressure mode (e.g., open/closed circuit)	—	—	10,000	10,000	—

“The employer must have evidence provided by the respirator manufacturer that testing of these respirators demonstrates performance at a level of protection of 1,000 or greater to receive an APF of 1,000.

This level of performance can best be demonstrated by performing a WPF or SWPF study or equivalent testing.

Absent such testing, all other PAPRs and SARs with helmets/hoods are to be treated as loose-fitting facepiece respirators, and receive an APF of 25.”

“Respiratory Protection.” US Code of Federal Regulations. Title 29, Part 1910.134. 2010.

Must have data to claim 1000

NPF 500
UK APF 40
US APF 25



500
40
1000*

*must have data





Table 2 — 3M Hoods and Helmets with APF of 1000

Hood or Helmet Part Number	NIOSH Approved Air Sources	Test Method	APF
BE-10	-Breathe Easy™ -Air-Mate™ -Supplied air	SWPF ¹	1000
BE-10BR	-Breathe Easy™ -Supplied air	SWPF ²	1000
H-410	-TR-300 -GVP -Supplied air	SWPF ⁴ WPF ⁹	1000
H-420	-TR-300 -GVP -Supplied air	WPF ³	1000
H-610	-TR-300 -GVP -Supplied air	SWPF ⁴	1000
L-901 L-905	-TR-300 -GVP -Supplied air	WPF ⁶	1000
	-TR-300		



Which protection factor should you use?

Manufacturer's

Nominal
Protection
Factor (EN)

Assigned
Protection
Factor (FR)

Your
company's
policy

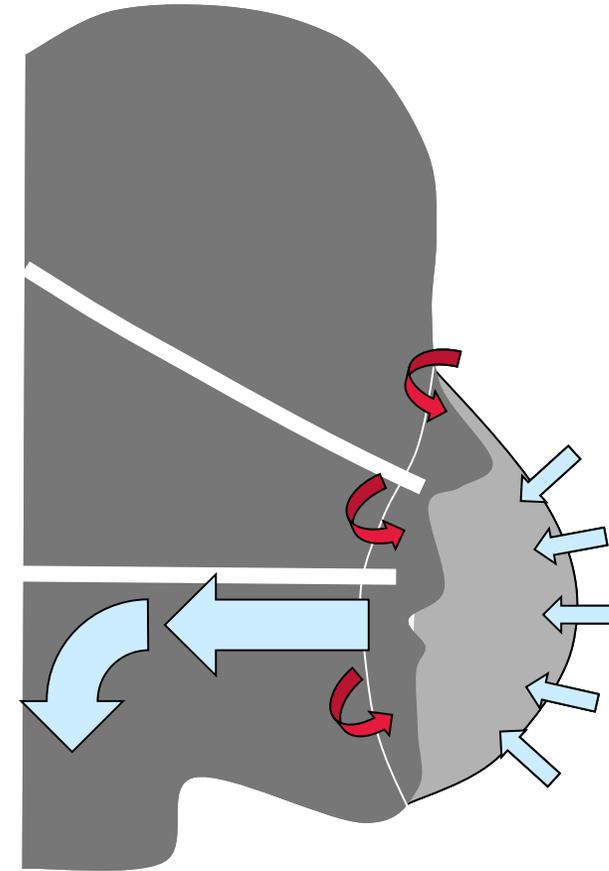
Understand the basis for the protection factor

Fit Testing

Respirator function

Goal is to have the air pass through the **filter or cartridge**

If there are **gaps** between the face and the respirator, the air will **leak** around the respirator edge



Why fit test?

Every face is different

- Length, width, nose

Respirators are different

- Shape, straps, etc.

Establishes if a seal is possible

Provides Training



Regulations

Mandatory regulation

- USA, Canada, UK

Fit Testing for tight-fitting RPE used in **Asbestos** abatement industries is mandatory

- France, The Netherlands

Countries considering **new** regulation

- Germany



Top Benefits of Fit Testing

Fit testing leads to enhanced worker **protection** and therefore reduced ill health

Selection of the right size and model for the wearer

- Helps to achieve a good fit and **comfort**

Excellent **training** and awareness tool

PROTECTION

SIZING

COMFORT

TRAINING

When to fit test?

Initial
Use

New
model

Face
changes

Reassess



"I'm a new starter."



"I've just started wearing a respirator."



"I need a different type of respirator."



"I've recently lost a lot of weight."



"I've worn a respirator for some time, but never had a fit test."

What types of RPE should be fit tested?



Any tight fitting facepiece



Including SCBA

Respirators not requiring testing



Respirators that rely on air flow through the headtop and have a loose fit to the face e.g. helmets and hoods – loose fitting



Fit Testing

Have a variety of models available

If fail x 2 → different model

If facial hair → Shave
or
Powered Air Purifying Respirator

One size does NOT fit all

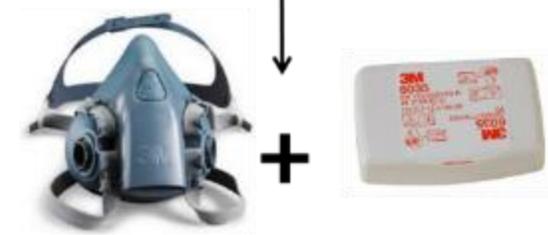
Example



1st



2nd



3rd

Responsibilities

Employer

Implement respirator program

Select suitable RPE

Ensure proper training and use

Ensure good maintenance

Ensure compliance with program

Employee



Clean shaven

Don and use properly

Comply with fit test requirements

Perform exercises

Fit test administrator

- Must be **knowledgeable and experienced** in the methods of fit testing
- Must be **familiar** with the models of respirators they are fitting
- Additionally
 - Helps select adequate size
 - Coaches the wearer in correct fitting and fit checks
 - Recognises and corrects poor fit
 - Maintains, operates and runs the fit test
 - Interprets results
 - Understands the difference between Fit factor and Protection factor



Fit Testing Summary

- Helps ensure that a respirator can offer the expected level of **protection**.
- Matches the respirator to the **individual**.
- It is considered **best practice** in many countries and legally required in several countries.

Fit testing is a powerful training and education tool!

Summary

Achieving protection



The background consists of a complex, abstract pattern of overlapping triangles in various shades of yellow and orange. The triangles vary in size and orientation, creating a dynamic and textured visual effect. The colors range from bright, vibrant yellows to deeper, more saturated oranges, with some areas appearing as lighter, almost white highlights where the triangles overlap.

Thank you