Science of Safety

Systems for the Use of PPE as a Control

NZOHS CES 2019

3M

What is Occupational Hygiene (OH) ? What do OH's do?

The AIOH defines occupational hygiene as:

> *"the art and science dedicated to the Anticipation, Recognition, Evaluation, Communication and Control of environmental hazards in, or arising from, the workplace that can result in injury, illness, impairment, or affect the well-being of workers and members of the community".*

- OH's use science and engineering to measure the extent of worker exposure, and to design and implement appropriate control strategies to prevent ill health caused by the working environment.

- Good occupational hygiene benefits workers and industry alike, resulting in:
  - Improved worker health and increased life expectancy;
  - Reduction in the number of people who leave employment early through injury or illness;
  - Lower social and health care costs as well as maximising worker potential; and
  - More efficient working processes with technological improvements and increased productivity.

Source: https://www.aioh.org.au/

NZ WORK HEALTH AND SAFETY LAW

HEALTH AND SAFETY AT WORK ACT 2015 (HSWA)

LEGALLY BINDING

HEALTH AND SAFETY REGULATIONS

Expand on health and safety duties in HSWA.

Set standards for managing certain risks and hazards.

Health and Safety at Work (General Risk and Workplace Management) Regulations 2016

- *Requirements relating to haz. subs., exposure monitoring, first aid, health and safety at work, health monitoring, PPE etc.*

Health and Safety in Employment Regulations 1995

- *Requirements relating to noise, machinery, working at height, scaffolding, excavation etc.*

LEGALLY BINDING

SAFE WORK INSTRUMENTS (SWIs)

Set out technical rules in relation to matters covered by regulations for e.g., Hazardous Substances

Approved by the Minister.

LEGALLY BINDING

Source: https://worksafe.govt.nz/

Risk management

Under the HSWA Act 2015, risks to health and safety must be eliminated so far as is reasonably practicable. If a risk can't be eliminated, it must be minimised so far as is reasonably practicable. Regulations 5 to 8 in the GRWM 2016 apply when managing particular risks to health and safety, as specified in the regulations.

Risks to health and safety arise from people being exposed to hazards (anything that can cause harm). Risk has two components – the likelihood that it will occur and the consequences (degree of harm) if it happens.

Whoever creates the risk manages the risk. HSWA 2015 requires health and safety work risks to be managed. This means consideration of the potential work-related health conditions as well as the injuries that could occur. Health conditions include both physical and psychological, acute and long term illnesses.

Other Duties of PCBU Relating to PPE

(1) A PCBU must ensure that any personal protective equipment provided by the PCBU under regulation 15(2), or that is provided by the worker under regulation 16(1), is—

(a) selected to minimise risks to health and safety, including by ensuring that the equipment is—

(i) suitable, having regard to the nature of the work and any hazard associated with the work; and

(ii) a suitable size and fit and reasonably comfortable for the worker who is to wear or use it; and

(b) maintained, repaired, or replaced so that it continues to minimise risk to the worker who uses it, including by ensuring that the equipment is—

(i) clean and hygienic; and

(ii) in good working order; and

(c) worn or used by the worker, so far as is reasonably practicable; and

(d) compatible with any other personal protective equipment that is required to be worn or used by the worker.

(2) In addition, the PCBU must, in accordance with regulation 9, provide the worker with information about, and training and instruction in,—

(a) the proper wearing or use of personal protective equipment; and

(b) the storage and maintenance of personal protective equipment.

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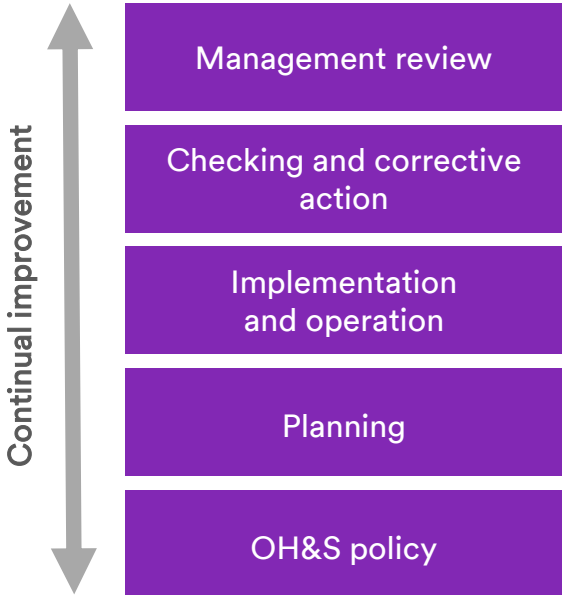
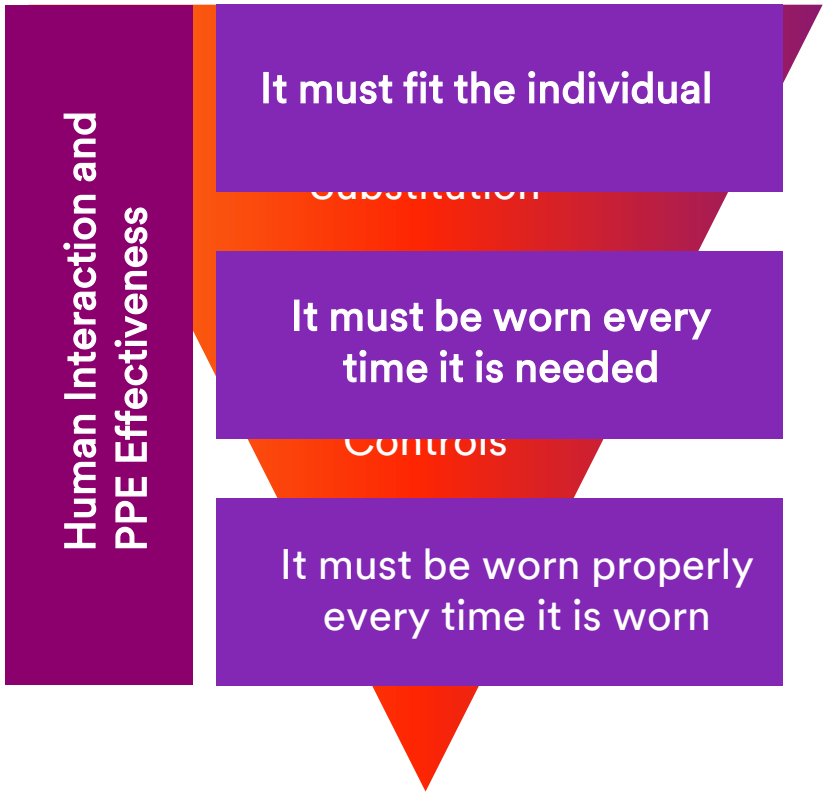
Source: http://www.legislation.govt.nz/regulation/public/2016/0013/latest/resultsin.aspx?search=sw_096be8ed816cbecc_personal+protective+equipment_25_se&p=1

Risk Management Framework



Hierarchy Of Control



NIOSH Workplace Safety and Health Topic, CDC Hierarchy of Controls, www.cdc.gov/niosh/topics/hierarchy

Compliance

Before choosing personal protective equipment, the employer is required to assess whether the personal protective equipment intended for use satisfies the requirements of relevant AS/NZS compliance standards.

For example, for RPE:

AS/NZS 1715 *Selection, Use and Maintenance of Respiratory Equipment* – includes information on RPE selection, issuing, fit testing, training and maintenance.

AS/NZS 1716 *Respiratory Protective Devices* – includes information on the various types of respirator available.

This assessment involves:

(a) an analysis and assessment of risks which cannot be avoided by other means;

(b) the definition of the characteristics which personal protective equipment must have in order to be effective against the risks, taking into account any risks which this equipment itself may create;

(c) comparison of the characteristics of the personal protective equipment available with the characteristics referred to in (b).

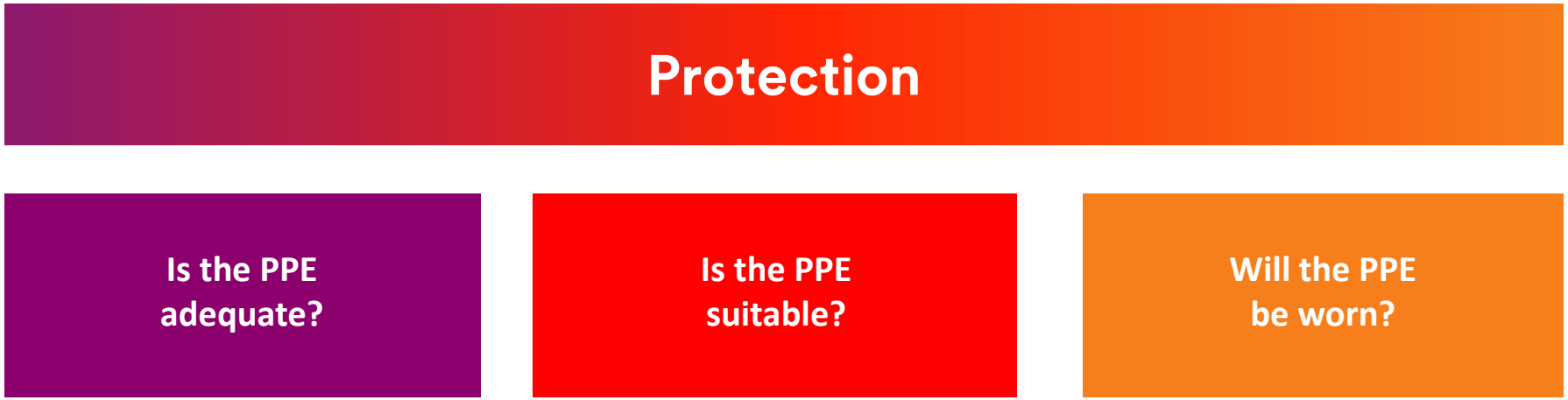
The assessment shall be reviewed if any changes are made to any of its elements.

PPE assessed should:

(1) reduce exposure to a potential harm to as low as is reasonably practicable, and to a level needed to protect workers' or others' health,

(2) be right for the wearer and the work they do

Compliance


Protection
Is the PPE adequate?
Is the PPE suitable?
Will the PPE be worn?

Compliance


ID the Hazard
Implement Controls
If PPE required, select the correct protecting PPE
Make sure the PPE is suitable

Science of Safety Approach

Selection

- Comfort
- Compatibility
- Ease of use

Training and Use

- Training

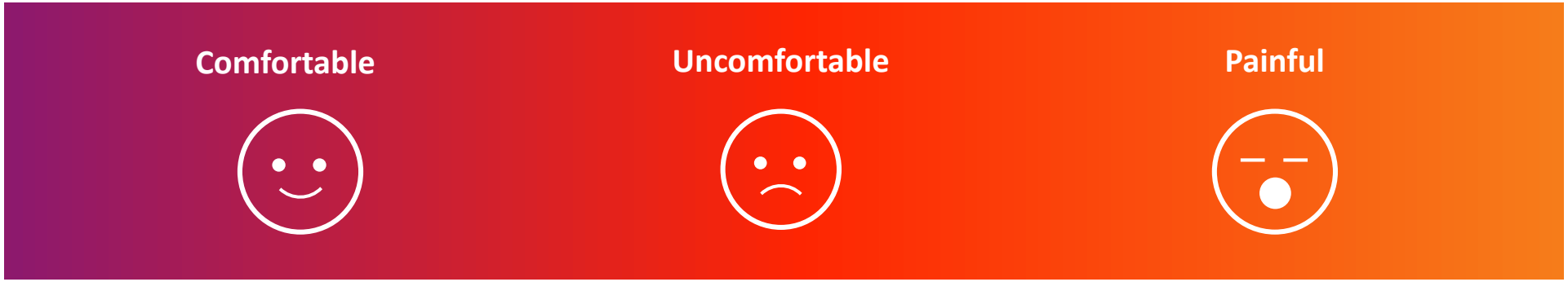
Fit Validation

- Fit
- Fit Validation

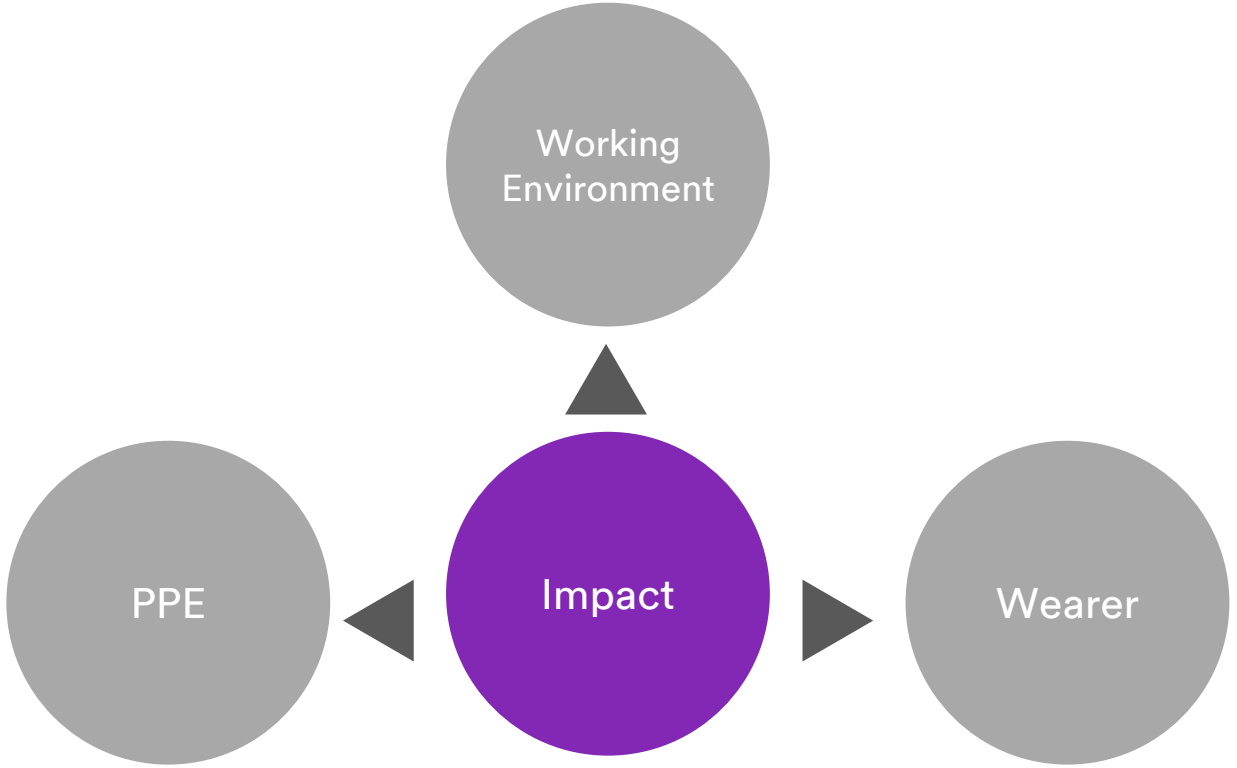
- Behavioural Considerations
- PPE Management Systems

PPE Comfort

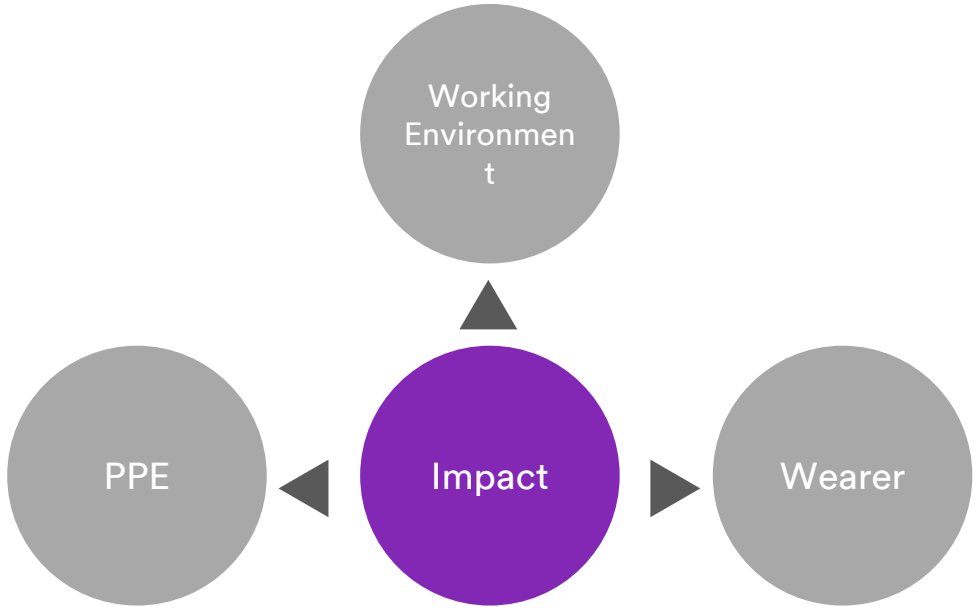
The three different phases of comfort



Aspects of comfort



Impact upon comfort



- Physiological impact
  - Physical stress
    - Elevated body temperature
    - Increased sweating
    - Fatigue
  - Injury
- Psychological impact
  - Emotional stress
    - Isolation
    - Anxiety
    - Discomfort
    - Dissatisfaction

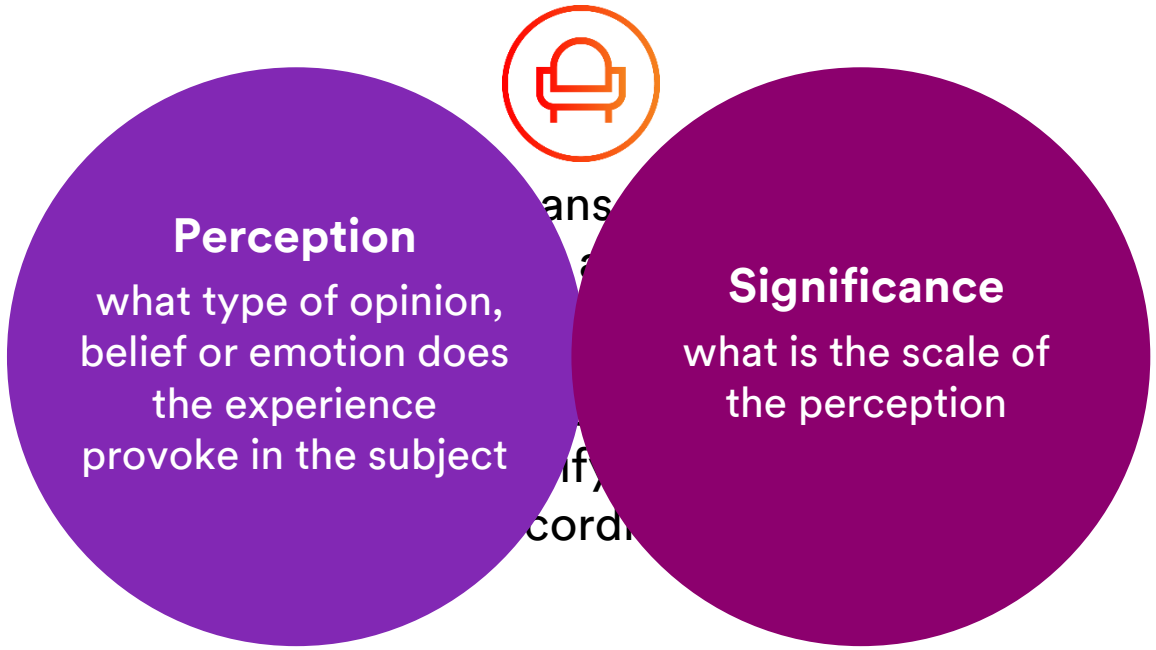
Physiological impact

Physiological impacts of uncomfortable or painful PPE upon the wearer of PPE can be wide and varied.

- Minor irritation all the way through to a major physical injury
- Tiredness and fatigue
- Increased sweating / heart rate, through to heat stress and heat exhaustion
- Productivity loss

Psychological impact

Psychological impact

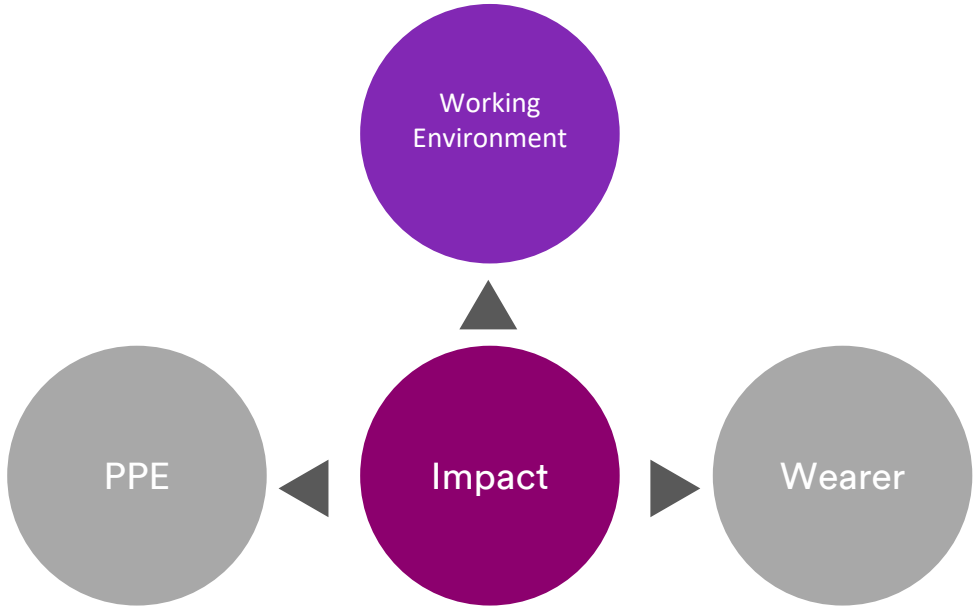


Psychological impact

Comfort is classically broken down by psychologists into four elements, which we can apply to the field of PPE comfort:

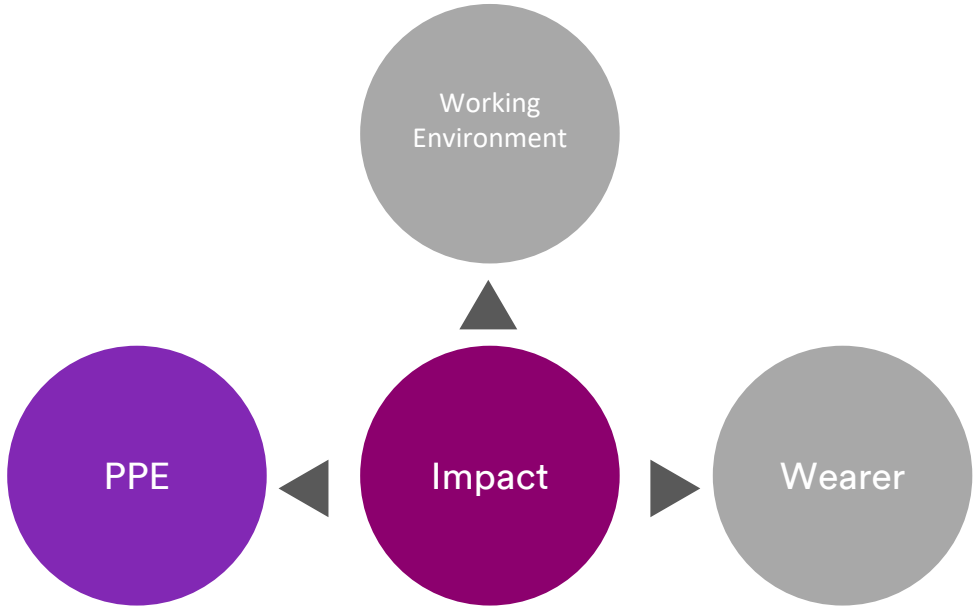
1. Personalisation → PPE: sizing, adjustment and familiarity
2. Freedom of action → PPE: the ability to move and conduct work
3. Space → PPE: correct sizing, claustrophobia, isolation (limited communication)
4. Warmth → PPE: thermal management, not too cold, not too hot.

Impact upon Working Environment



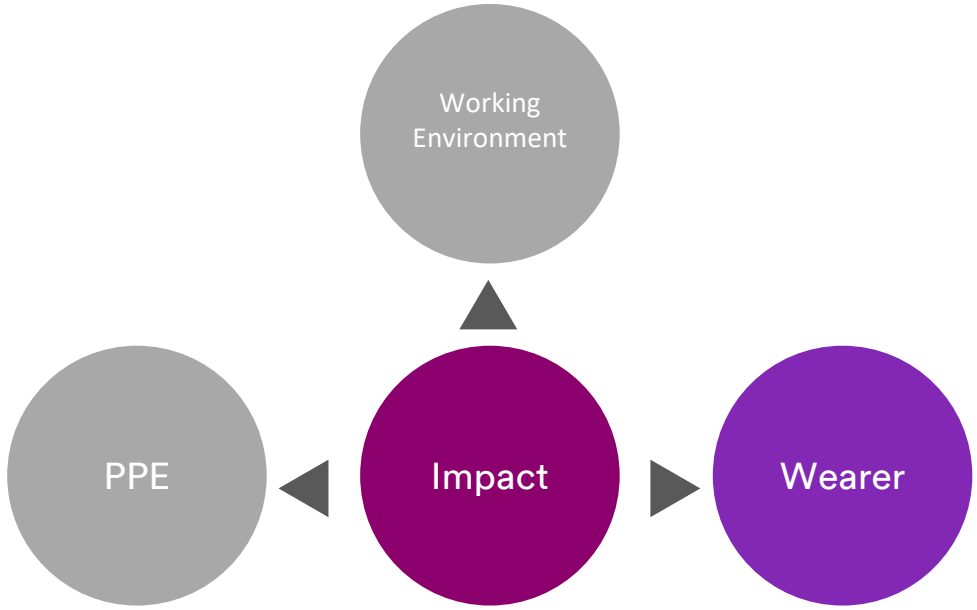
- Ambient temperature
- Radiant temperature
- Humidity
- Light levels
- Wind / draughts
- Noise
- Communication
- Vibration
- Confined space
- Working at height

Impact upon PPE



- Weight
- Balance
- Tightness
- Security
- Size
- Materials
- Pressure points
- Field of vision
- Thermal insulation properties
- Moisture permeation/barrier properties

Impact upon Wearer



- Comfort is subjective
- Wearers are all anatomically different
- Wearers have different physical attributes and levels of fitness
- Some wearers wear a single item of PPE, others wear multiple items in combination
- Wearers conduct different tasks, have different levels of physical exertion and wear their PPE for different durations

Why is comfort important?

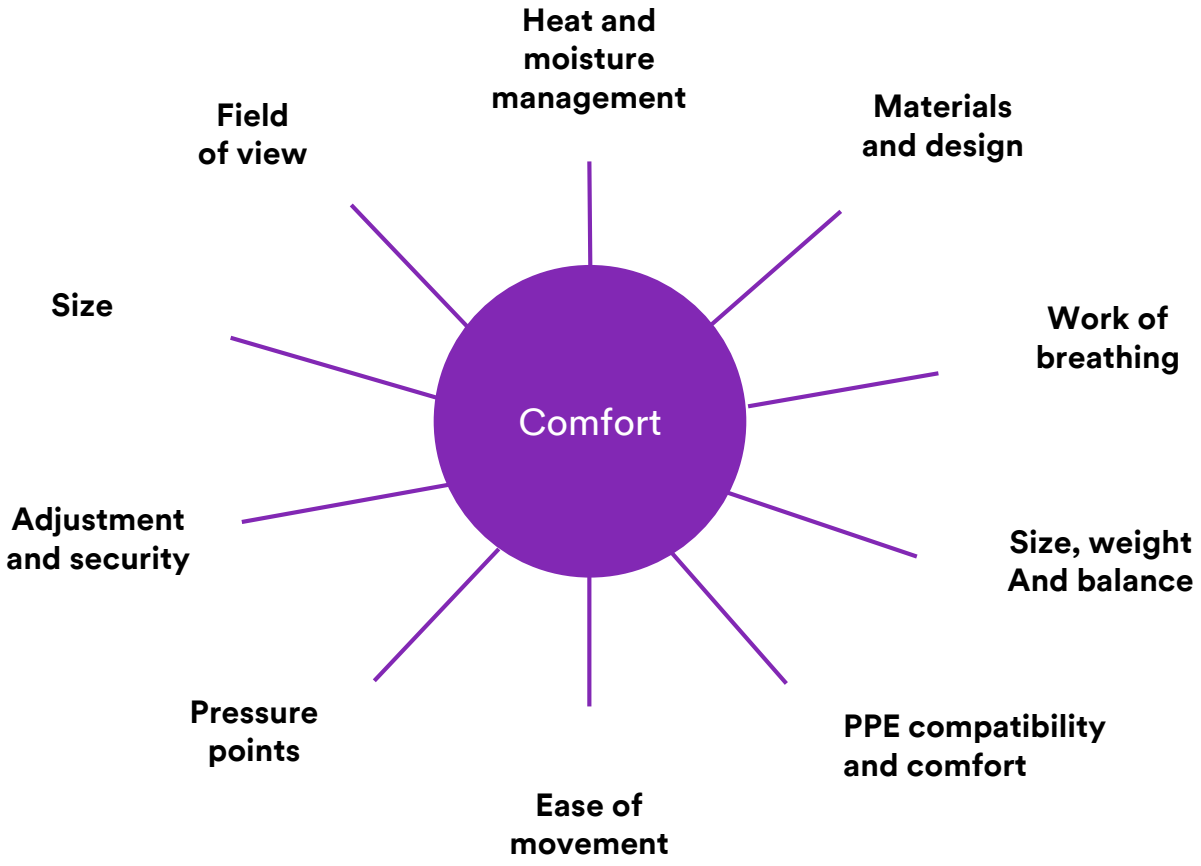
Users and specifiers frequently agree that protection and comfort are the two most important features when selecting PPE.

Items of PPE that are not sufficiently comfortable may not be worn properly, if at all, significantly reducing the protection that they provide.

The protection that an item of PPE provides, over a working shift, can drop dramatically when a it is not used during periods of exposure, even for a short period of time.

For example, if an FFP2 respirator is removed for 10 % of the time - the equivalent of just 48 minutes in an 8 hour shift - the actual protection factor is almost halved.

Aspects of comfort



Heat and moisture management
(respiratory)

The Problem

- Exhaled breathe is naturally warmed and humidified.
- Tight-fitting respirators will temporarily contain this exhaled air to lesser or greater extents, depending upon their type, design and features, resulting in the temperature humidity levels inside of mask being raised.
- Studies have shown that wearing a filtering facepiece respirator can result in increased heat stress of up to 7.5°C.
- The skin on the face is highly sensitive to temperature, further heightening perceptions with respirators.

Considerations

- Exhalation valves – not all are as good as each other!
- Low breathing resistance filter material
- Powered or Supplied Air systems
- Adjustable flow rates in Systems

Heat and moisture management
(body)

Different materials used in PPE will have different characteristics:

- Thermal insulation
- Moisture vapour transmission

The Problem

- Once the skin becomes saturated with unevaporated sweat, the skin will feel uncomfortable and clammy. Clothing and fabrics of the PPE may then stick to skin, further leading to perception of discomfort and reduced heat and sweat loss.
- For certain items of PPE sweat may lead to items of PPE becoming stuck to the skin or alternatively may act almost as a lubricant leading to the PPE becoming loose or insecurely fitted.

Considerations

- Materials / fabric
- Selecting the right level of protection against hazards
- Sweat bands
- Comfort pads

Materials and design

Skin Sensitives

- Pressure
- Sweat
- Temperature
- Feel of materials

Work of breathing

- Wearing a tight-fitting, negative pressure respirator requires the wearer to inhale the filter and exhale through the filter and/or exhalation valve.
- The easier it is to both inhale and exhale, particularly when working hard, the more comfortable the respirator will likely be.
- This will require some effort, which can result in fatigue.
- The ‘work of breathing’ is defined as the total work conducted by the body to inhale and exhale one complete respiratory cycle.

Work of breathing

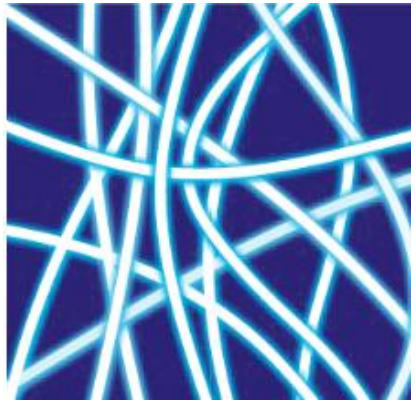


Illustration showing density of common competitive electrostatically charged filter media

Illustration showing open structure of 3M AEM filter media

Size, weight and balance

PPE needs to be lightweight and perhaps more importantly well balanced when worn to avoid rubbing and movement during use.

Larger items of PPE worn upon the head particularly need to be designed with weight and balance in mind, as the muscles of the neck and shoulders can readily fatigue.

PPE Compatibility

Wearing different items of PPE can lead to issues with compatibility and comfort – items that simply don't work well together, limiting the protection that they afford or making one of other uncomfortable or impractical to wear.

Ease of movement

PPE can easily restrict movement

Consider

- All aspects of work – including at extremes of use
- Consider ease of movement and comfort at rest periods
- Think about avoiding introducing further hazards, e.g. trip hazards

Pressure Points

The head and face and other parts of the body have a number of areas where bones are covered by little fleshy skin. These areas can be very sensitive to pressure.

- Nose and nose-bridge, cheek bones, temples and parts of the skull.
- Hips, elbows, spine

PPE items should ideally avoid making contact with these areas, or the product should be designed to minimise the resultant pressure on these areas.

Adjustment and security

Comfort

Security

Size

Improperly sized PPE may limit the protection provided and at very least cause comfort issues.

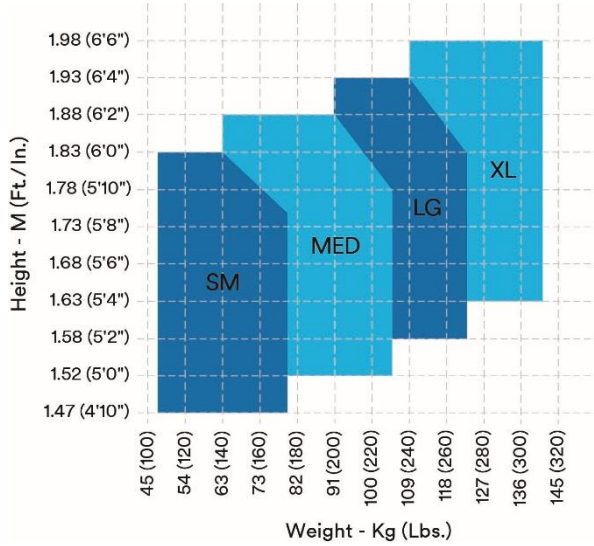
Over-sized products can:

- potentially snag,
- get caught or hang loose

Under-sized products can:

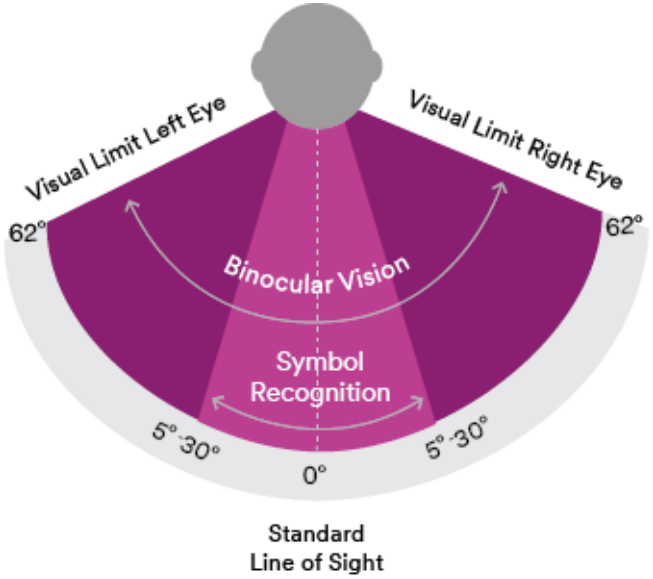
- restrict movement,
- create pressure

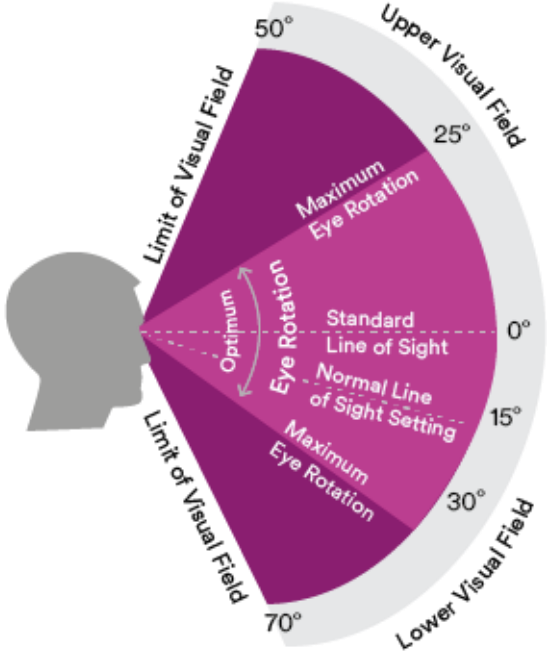
Wearers of PPE are all different shapes and sizes.



	Height		Chest	
S	64–67 in	164 – 170 cm	33–36 in	84–92 cm
S	66–69 in	167 – 176 cm	36–39 in	92–100 cm
L	69–71 in	174 – 181 cm	39–43 in	100–108 cm
XL	70–74 in	179 – 187cm	43–45 in	108–115 cm
XXL	73–76 in	186 – 194 cm	45–49 in	115–124 cm
3XL	76–78 in	194 – 200 cm	49–52 in	124–132 cm
4XL	78–81 in	200 – 206 cm	52–55 in	132–140 cm

Field of view





PPE Compatibility

What is PPE Compatibility?

- Many industries have a complex range of hazards that may be area or task specific.
- This can often lead to a need for multiple types of PPE
  - Each product is designed and tested on its own to ensure that it offers adequate protection.
  - But what happens when that product is used in combination with other items of PPE?
  - Where do the different items of PPE interact with each other and what effect does this have?
- Understanding PPE compatibility is taking this interaction into account to ensure that the PPE functions effectively and is compliant with appropriate legislation

Why should I be concerned by PPE Compatibility?

Loss of Protection

Can you think of scenarios where protection may be reduced?

Can you think of scenarios where fit is effected?

Can you think of scenarios where a PPE becomes unusable?

Reduction in Comfort

Poor PPE compatibility can lead to a reduction in user comfort

Comfort and compatibility are often the main reason given for not wearing PPE

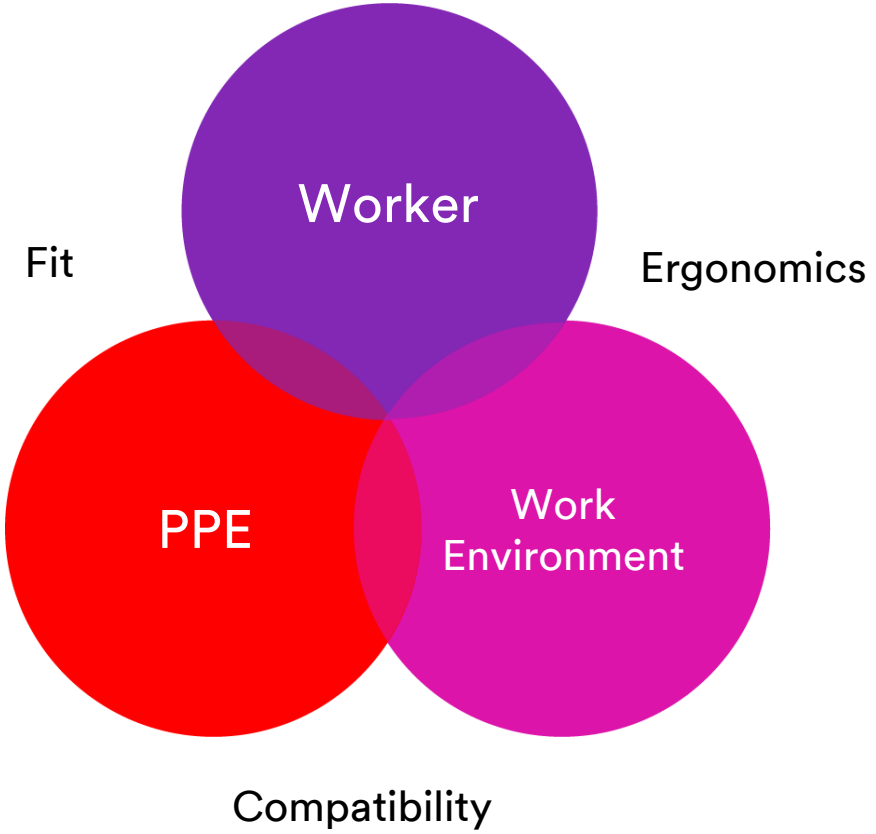
In a survey conducted of 226 construction workers carried out by 3M UK:

75% said making PPE more comfortable would increase compliance

41% said making PPE compatible with other PPE would increase compliance

3M

Where do Compatibility issues arise?



Compatibility as a Regulatory Concern

Lets Consider how Compatibility may cause problems for regulated products

- Claimed Compatibility
- End User Alterations
- Multiple Items of PPE
- Compatibility across Manufacturers

Compatibility Problem Areas

Temple Area

PPE

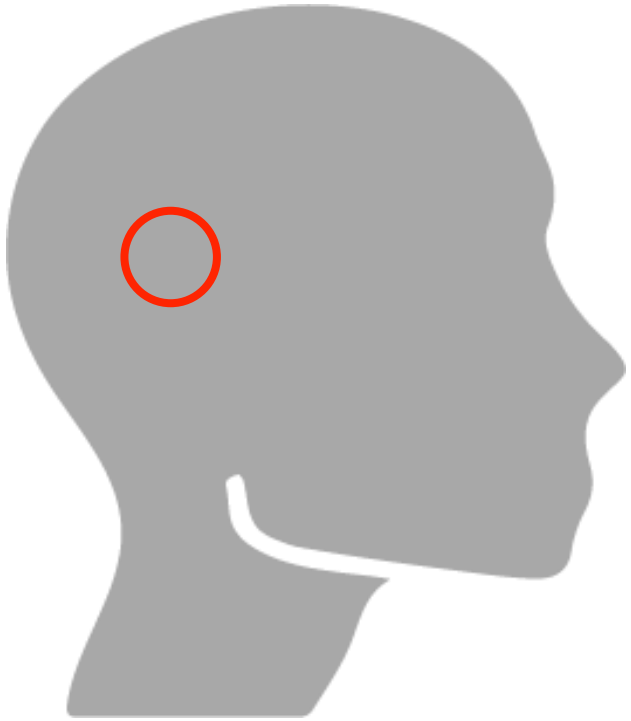
- Eyewear arms (safety or prescription)
- Ear Muff cushions
- Helmet and Visor headbands
- Respirator Straps
- Coverall hoods

Functionality Problems

- Eyewear potentially displaced
- Ear muff attenuation reduced
- Helmet/Visor less stable

Comfort Problems

- Increased pressure on Temple



Compatibility Problem Areas

Nose Bridge

PPE

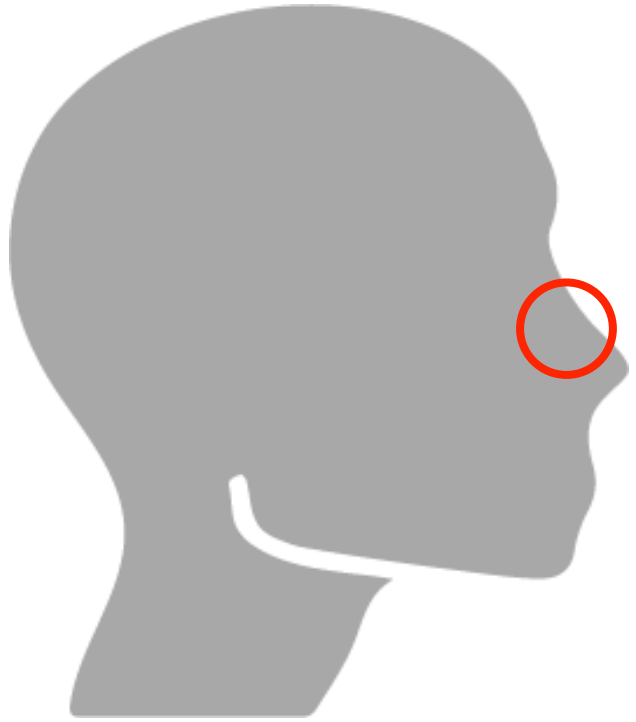
- Disposable and Reusable Respirators
- Eyewear (Safety and Prescription)

Functionality Problems

- Eyewear potentially displaced
- Respirator Fit effected
- Eyewear potentially Fogs

Comfort Problems

- Increased pressure on Nose



Compatibility Problem Areas

Crown of the head

PPE

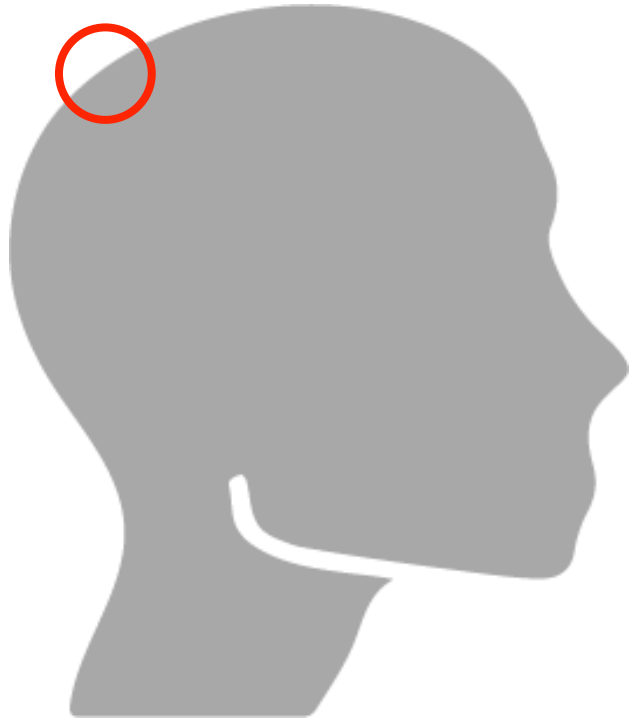
- Disposable/Reusable Respirator Straps
- Safety Helmet Suspension
- Earmuff headbands

Functionality Problems

- Eyewear potentially displaced
- Respirator Fit effected
- Safety Helmet unstable

Comfort Problems

- Increased pressure on Crown of the head
- Discomfort due to poor balance



Compatibility Problem Areas

Forehead

PPE

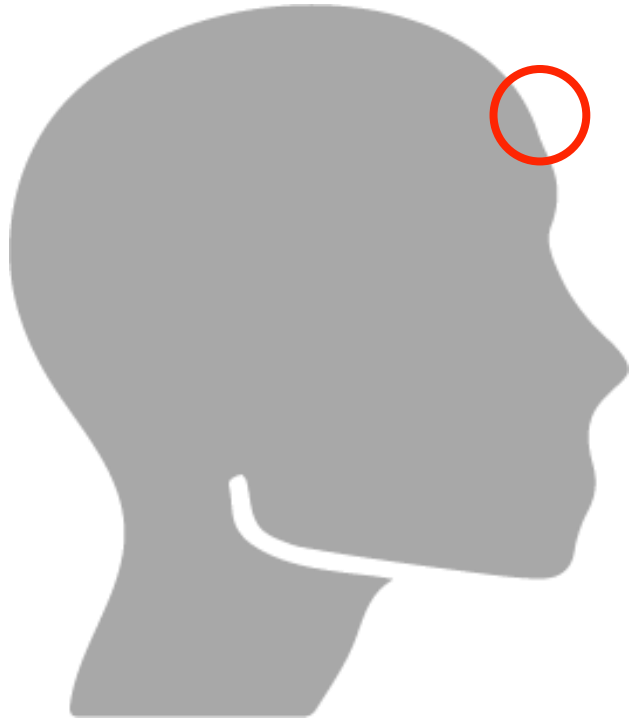
- Full Face Respirators
- Faceshields
- Safety Helmets
- Coverall Hoods

Functionality Problems

- Faceshield potentially displaced
- Respirator Fit effected
- Safety Helmet unstable
- Gaps in Coverage

Comfort Problems

- Increased pressure forehead
- Discomfort due to poor balance



Compatibility Problem Areas

In Front of face

PPE

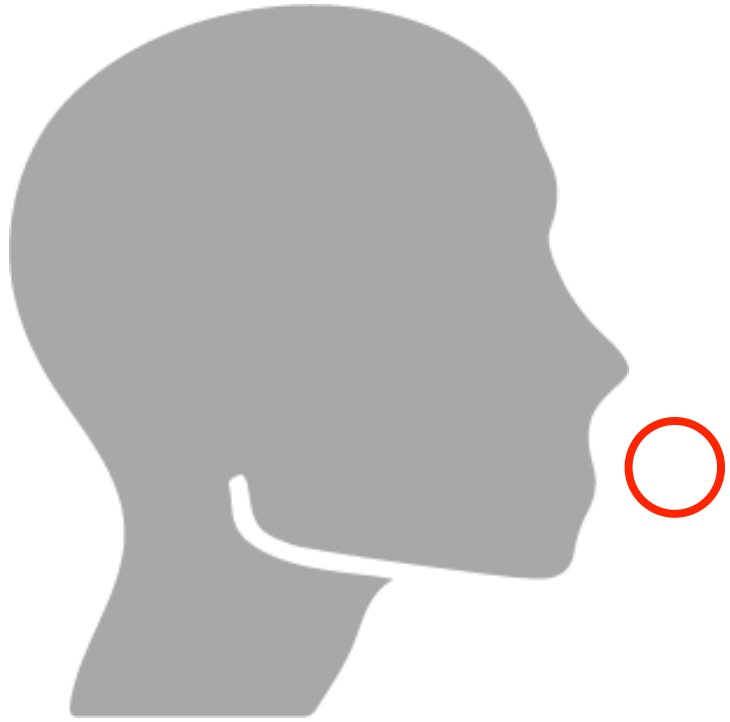
- Respirators
- Faceshields
- Communications devices

Functionality Problems

- Faceshield potentially displaced
- Respirator Fit effected
- Faceshield Fogs
- Communication problems

Comfort Problems

- Increased pressure on
  Nose bridge or forehead
- Discomfort due to poor balance



Compatibility Problem Areas

Neck Area

PPE

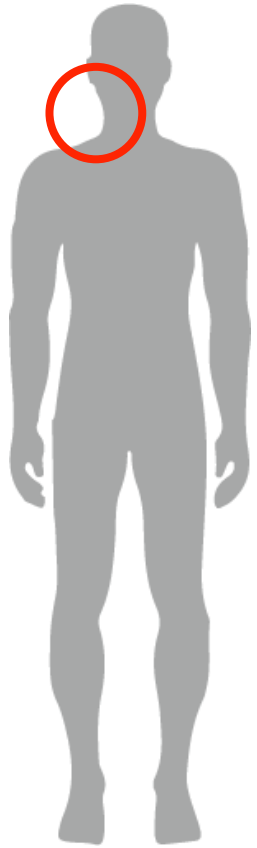
- Coverall and protective clothing
- Powered air Hoods

Functionality Problems

- Donning and Doffing issues
- Coveralls interfering with fit of hood
- Coveralls interfering with Air supply to hood
- Coverage gaps

Comfort Problems

- Rubbing, Abrasion
- Thermal Stress



Compatibility Problem Areas

Body Area

PPE

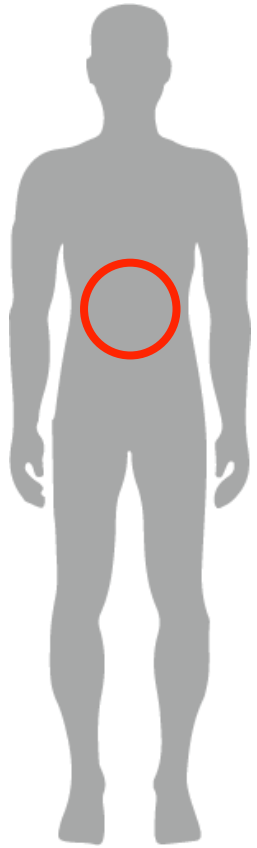
- Coverall And protective clothing
- Reflective Clothing
- Fall Protection Harnesses
- Powered and Supplied Air respirators

Functionality Problems

- Donning and Doffing issues
- Visibility reduced
- Equipment worn too loosely
- Equipment worn too tightly

Comfort Problems

- Heat Stress/Sweating
- Ergonomic problems



Compatibility Problem Areas

Wrist Area

PPE

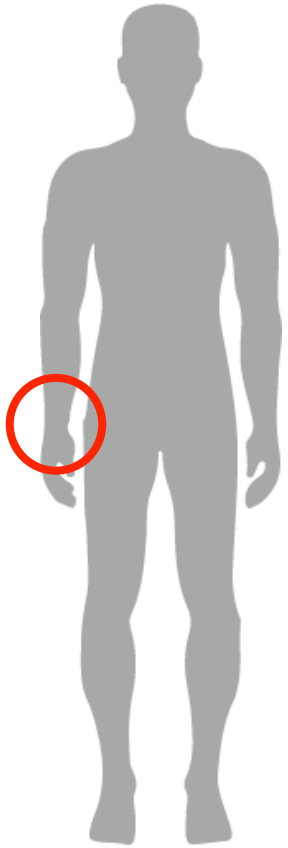
- Gloves
- Coverall And protective clothing

Functionality Problems

- Gaps in coverage
- Donning and Doffing issues

Comfort Problems

- Heat stress
- Sweating



Compatibility Problem Areas

Ankle Area

PPE

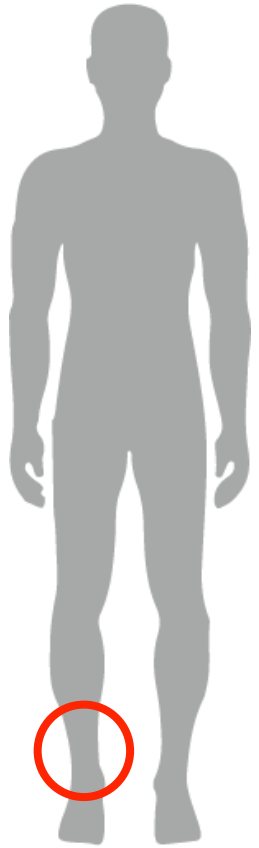
- Shoes
- Overboots
- Coverall and protective

Functionality Problems

- Gaps in coverage
- Donning and Doffing issues

Comfort Problems

- Heat stress
- Sweating



Addressing Compatibility Problems

Product Design

Products can be designed to minimise compatibility issues whilst maintaining performance

User Selection and Assessment

If integrated solutions are not available it is possible to carry out user assessments and trials to identify potential problems

Product Design Solutions

Products designed to reduce specific issue

- Low profile temple arms
- Eyewear without temple arms
- Neckband earmuffs

Designed interaction points

- Specified connection points
- Helmet attached earmuffs
- Helmet attached visors /welding shields
- Integrated Eyewear

Single product offering multiple types of protection

- Powered Air helmets (respiratory + face + head protection)
- Hi-Vis Harnesses

Products designed to reduce specific issue

3M™ Securefit™ with 3M™ PELTOR™ X Series Earmuffs

- The Low Profile temple arms of the 3M™ Securefit™ SF400 safety eyewear are designed for comfort and for compatibility when worn in combination with the 3M™ Peltor™ X-Series Earmuffs
- Securefit™ SF400 safety eyewear and Peltor™ X4A (headband) Earmuffs were tested in accordance with EN24869-1 (Sound attenuation of hearing protectors)

Less than 3dB Reduction in attenuation

Products designed to reduce specific issue

3M™ PELTOR™ Optime™ Earmuffs

- 3M PELTOR have sold Neckband earmuffs for a number of years
- Products such as the H505B neckband earmuff have been designed to address interference issues that occur between a welding shield and hearing protection
- The neckband and scalloped cup shape are specifically designed to allow the wearer appropriate hearing protection whilst wearing welding shields with a large area of coverage

Designed interaction points

3M™ Industrial Safety Helmets and accessories

- The Industrial Safety Helmet has for a long time been established as the ‘workhorse’ of the neck-up PPE family
- It has been designed to carry other safety items for a number of years.
- Hearing protection with a helmet attachment is one of the few areas where compatibility is standardised and regulated (covered in AS/NZS 1270:2002)
- Alternative helmet combinations are required to pass tests for comparative attenuation as well as sizing and adjustability

Always ensure that you are offering approved and certified combinations to offer the customer the necessary protection

Designed interaction points

3M™ Industrial Safety Helmets and accessories

- Face Protection is often large, cumbersome and difficult to use in combination with other PPE
- Designing Face protection to work in combination with Head Protection and Hearing Protection requires control over the interaction between each item
- All PPE needs to be carried but not all PPE is needed at the same time – designing interactions that allow visors or earmuffs to be opened or closed independently and easily is of importance

Designed interaction points

3M™ Speedglas™ QR Quick Release

- In order to make head protection easier for certain task based roles, it is necessary to offer solutions that give the user flexibility.
- The 3M™ Speedglas™ QR means the welder no longer has to compromise between welding helmet and safety helmet.
- The wearer can use a welding helmet in combination with his industrial safety helmet without needing to wear the welding helmet at all times.

Single product offering multiple types of protection

3M™ Versaflo™ Powered Air helmets

What do you do when you require multiple types of protection and have to select from too many products or can't make the combination you've selected work? What if you also need respiratory protection?

The 3M™ Versaflo™ M-Series Headtops incorporate lightweight, intuitive and well-balanced design with integrated protection from a range of respiratory, head and eye hazards, with offerings for hearing protection, neck and shoulder coverage and soon communication solutions.

User Selection and Assessment

Always carry out product trials based on working environment

- Preferably in work environment where appropriate

Ensure new products to be introduced are assessed alongside all other PPE and equipment to be used

- Fit testing for respirators or hearing protection in the mode worn

  i.e. with safety glasses, head protection

Preference should be given to solutions designed to work together where available

Training and engagement with the work force will help raise awareness before complacency or non-compliance sets in

Use & Maintenance of personal protective equipment

What do we mean by use and maintenance?

- Ease of putting on (donning) and removal (doffing)
- Storage – before & after usage
- How do I know when to replace the product?
- Consumable & accessories
- Cleaning & disinfection
- Shelf life
- Record keeping

Refer to: Regulations 17(1) and (2): Other duties of PCBU relating to personal protective equipment

Donning and doffing

Take the time to adjust the PPE to suit the wearer

Think about where donning and doffing should happen

- Put the PPE on and ensure properly set up before entering the hazardous area
- Where should contaminated PPE be removed?

Train wearers in correct donning and doffing procedures

Give extra attention with doffing procedures where there is risk of the hazard transferring during removal.

Storage – before, during and after use

- If not stored correctly PPE could become contaminated by hazards e.g. dust, contaminated surfaces, UV exposure, rain etc.
- Consider potential health effects of using contaminated PPE e.g. adverse skin reaction, hygiene issues, potential biological hazards etc.

- Design of PPE can determine how easily contaminants can be trapped within PPE or cause material damage.
- Always follow manufacturer's guidance for storage

Shelf life and Service life

Difficult to give a simple answer as there are numerous factors affecting service life, for example:-

- Level & type of hazard
- Temperature & relative humidity
- Physical nature of work & breathing rate of wearer
- How it has been stored and maintained

How can I tell when to replace the product?

- Often rely on sensory platform in the case of gas & vapour respirators e.g. ability to smell
- Physical signs of damage or product no longer serviceable
- Disposable PPE discarded at the end of the shift or sooner if damaged or dirty
- New technological approach to help manage service life. For example:
  - Service life software for estimating breakthrough time for gas & vapour filters
  - Visual indicators resulting in colour change

Consumables and Accessories

Some re-usable PPE is supported with some replaceable components and accessories to enhance the life of the product and / or improve wearer comfort

Examples of consumable include:

- Respirator filters
- Breathing tubes
- Hygiene kits
  (cushions and inserts) for earmuffs

Examples of accessories

- Helmet chin straps
- Earmuff cushion sweat pads

Cleaning and Disinfection

- Affects all re-usable PPE from hygiene viewpoint
  – particularly products used by visitors

Outline maintenance plan for overall serviceability

- How often?
- What parts should be replaced?
- Post maintenance testing of complete reassembled product

- Implication of using product in extremely hazardous environment
  e.g. radiological, nuclear, biological etc.
- Provision for suitable disinfection programme where product is used in extremely hazardous environment

Record Keeping

- Covers all aspects of PPE ranging from correct selection & usage, service and maintenance
  - Creating an inspection, repair and destruction schedule for the PPE.
- Applies to all PPE – including disposable products
- Helps ensure the wearer is appropriately trained and adequately protected
- Can be potentially invaluable in defending court cases

Behavioural Considerations

Behavioural Safety ‘Definition’

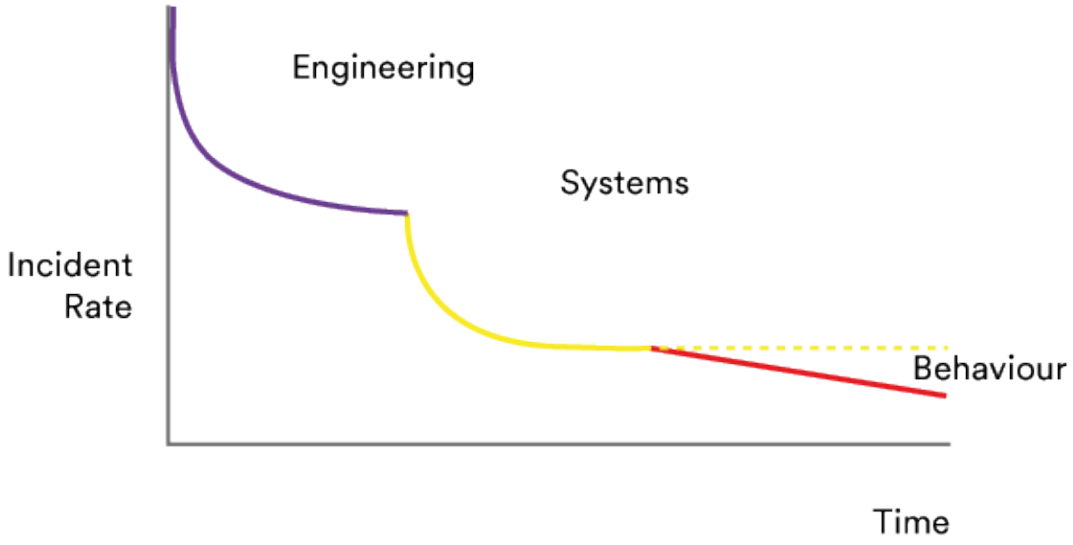
Behavioural Safety uses **techniques and tools** to alter the way a person behaves in, and thinks about, their work place.

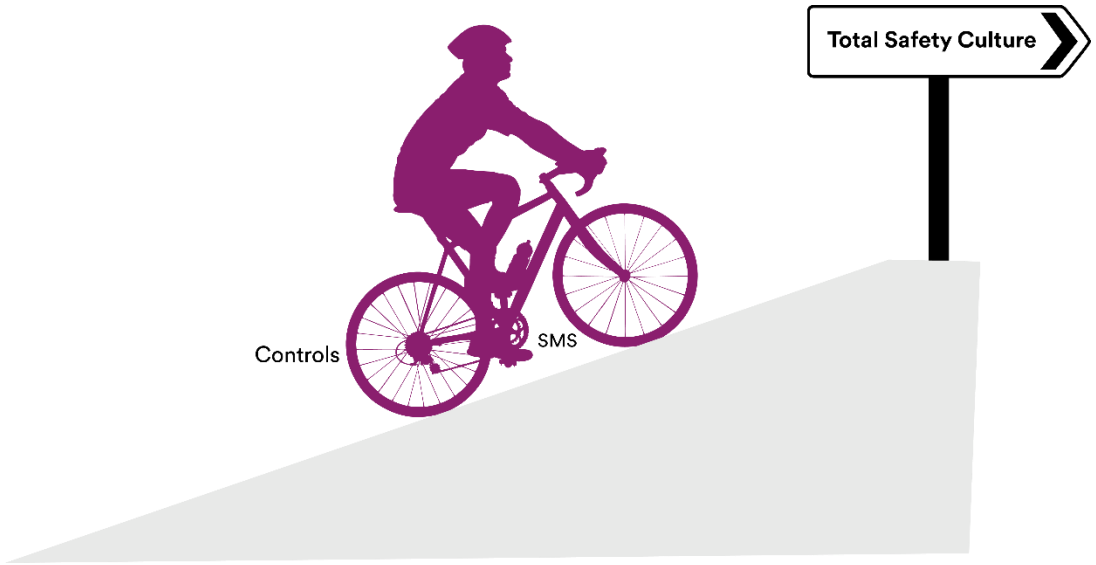
Development of a culture where every individual actively embodies safety in all that they do; there is a shared understanding and appreciation **across all levels of the organisation** that doing things safely is the **ONLY** way they do things.

Behavioural safety is the human element that is crucial to effective safety management systems.

Often described as ‘winning hearts and minds’.

What is Behavioural Safety?





Human Behaviour is key

Gather Data

- The reason will always be valid to the individual, even if it does not resonate with you!

- Gather as many ‘voices’ and thoughts as you can from YOUR workplace. This will allow you to tailor your programme to your employees’ needs

Why do people wear their PPE incorrectly?

Training related	Product related
Lack of understanding Error/Misunderstanding Bravado Defiance	Difficulty doing the task Difficulty communicating Discomfort

Record keeping

Training related	Product related
The Need for Protection	Product Selection
Limitations of Use	Trial PPE
Use Credible Trainers	Consider all Stakeholders
Use Obs & F'back Output	Questionnaires Task Analysis
Less Obvious risks: Time	Employee Led Task Forces

How else can compliance be improved?

Discussions so far have been very carrot-like.

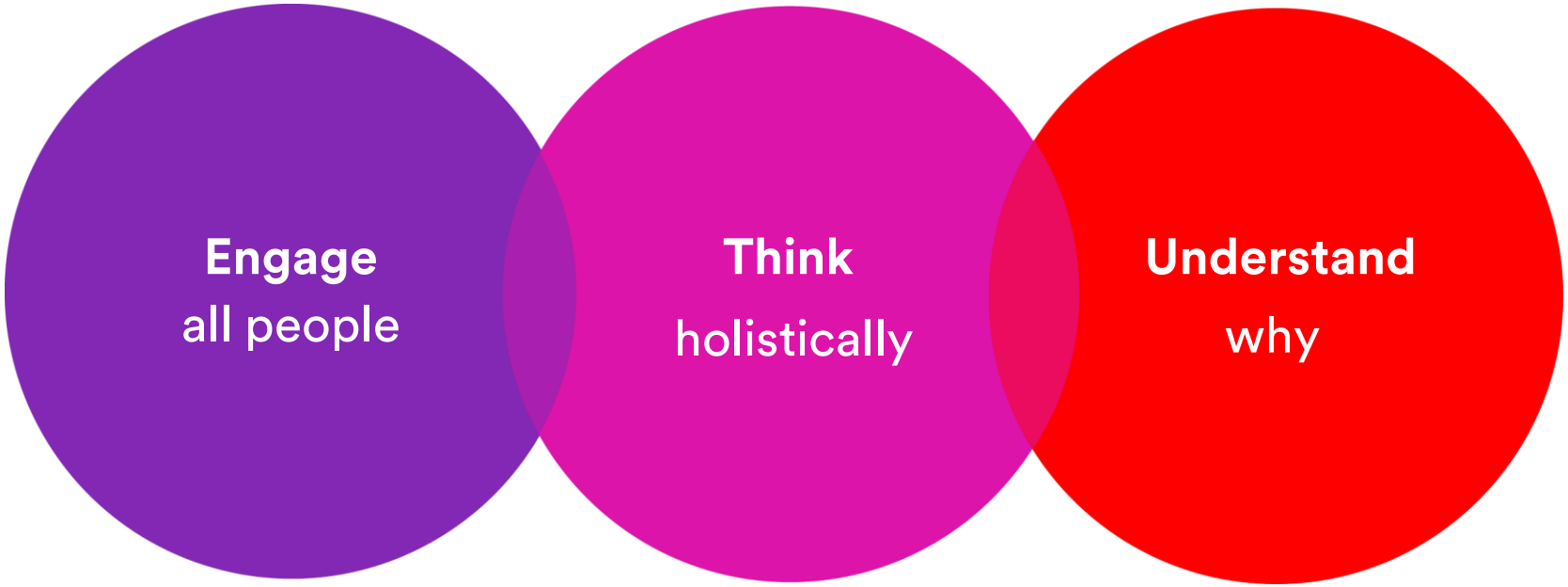
V

S

- Celebrating safety milestones (with caution)
- Rewarding good practice (divides opinion)

- Part of employment contract
- Disciplinary action

Behavioural Safety Summary



Training

Why train on the use of PPE?

Health and Safety at Work (General Risk and Workplace Management) *Regulations 2016*, s.9 (1b (ii)) : Duty to provide information, supervision, training, and instruction & s.17 (2a & b): Other duties of PCBU relating to personal protective equipment

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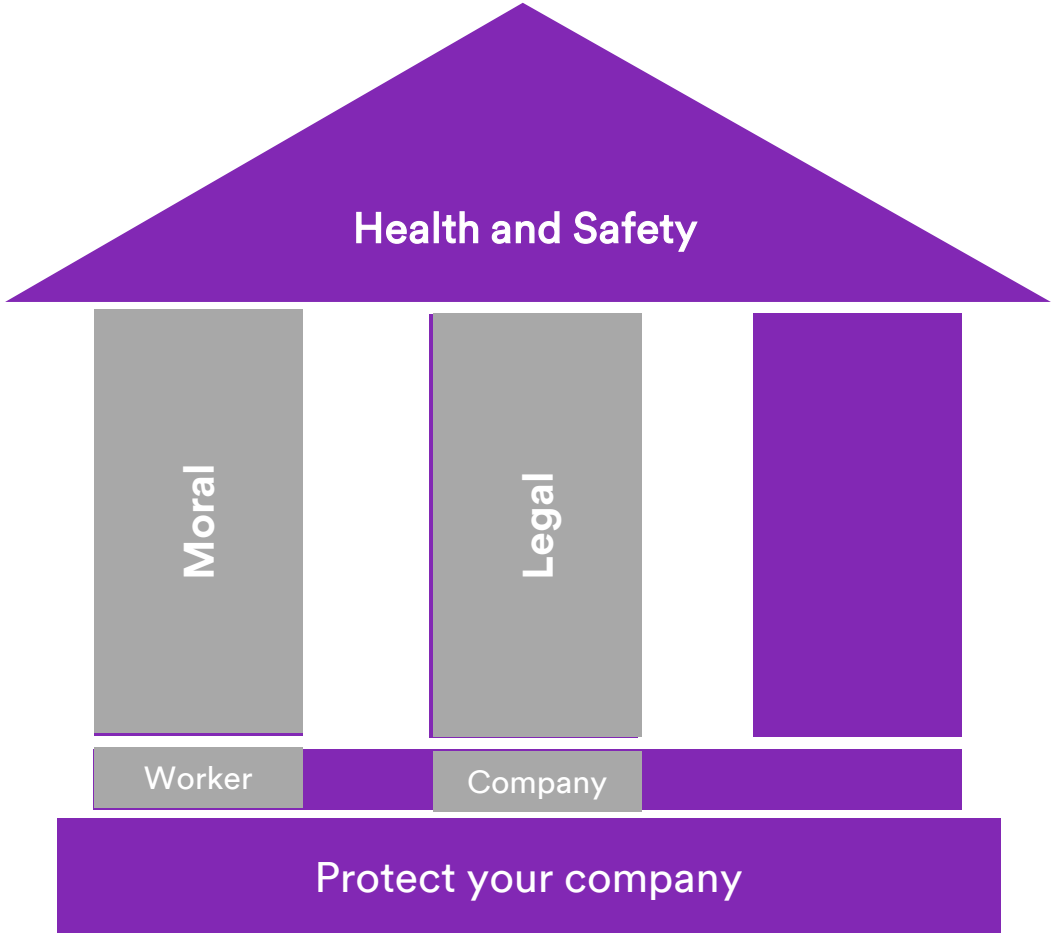

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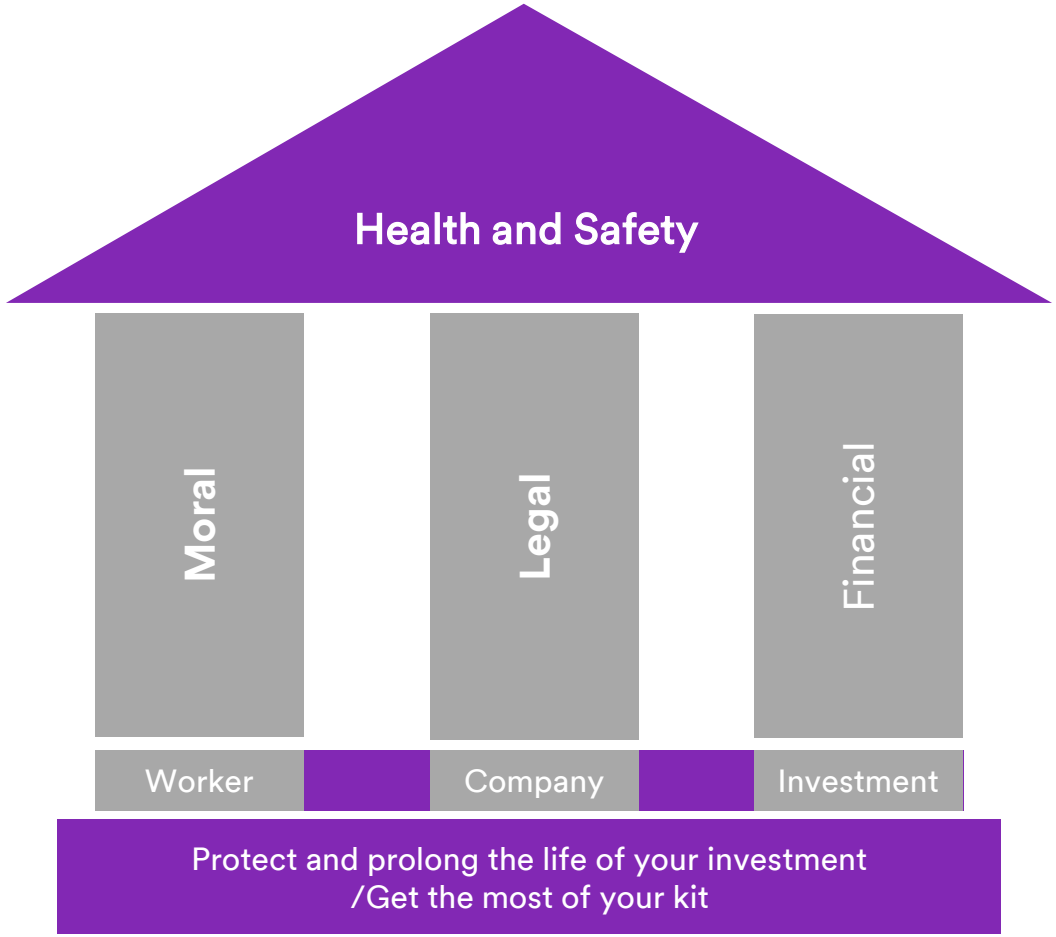

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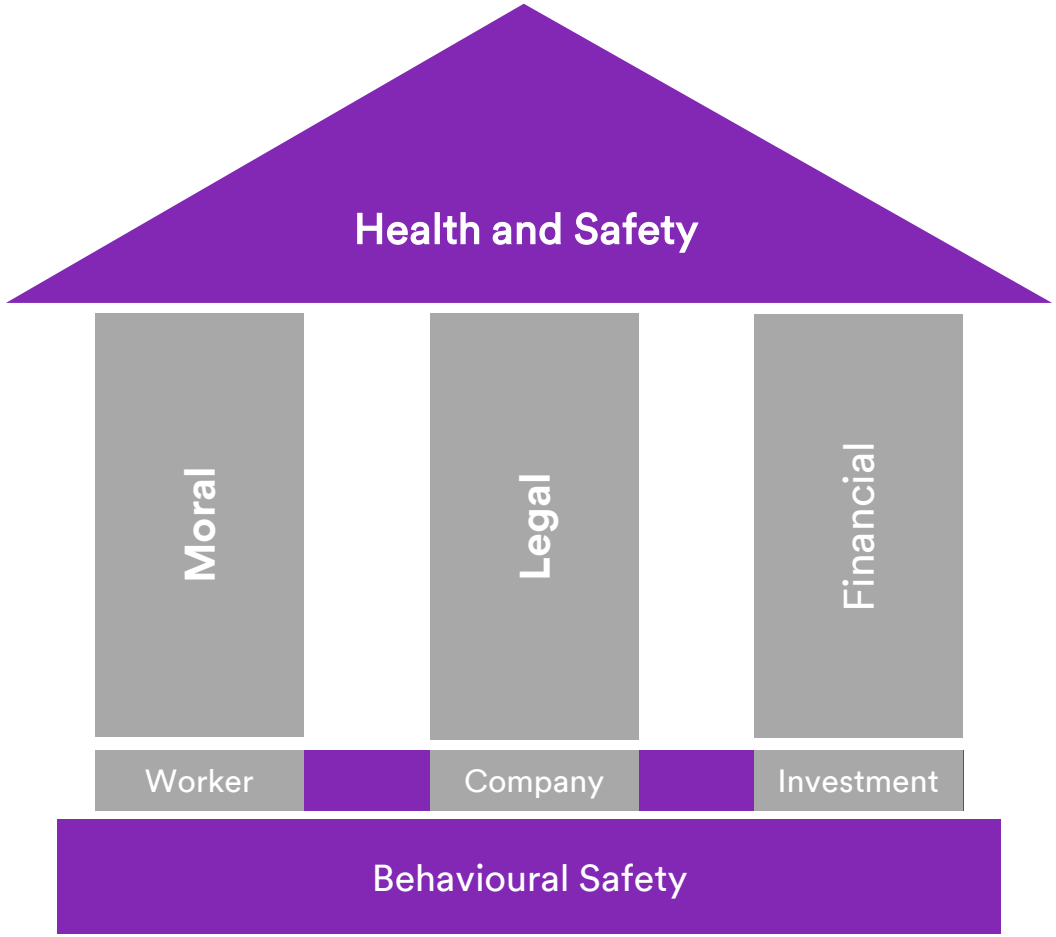

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What Should be Included on a Training Programme?

Need

- The need for protection and when to wear the PPE
- What ‘it’ is, i.e. not just ‘wear an ear plug’, but what type of ear plug
- Limitations of Use

How to use

- How to use it
- How to put it on and remove it
- How to ensure it is correctly fitted

Care and Maintenance

- How to store it (between use and between shifts)
- How to maintain it

Logistics

- How to dispose of waste / contaminated PPE
- How to order and get replacements
- Where to find it

3M

Additional Training Considerations

Use Observation and Feedback Output

Use Credible Trainers

Less Obvious Risks: ↑ Time

Consider methods of communicating the info

Formal classroom, e-learning, induction

Additional Training Considerations

Consider frequency of refreshing information

Consider learning style of the audience – visual, audio, learning through action

Consider reminders and positioning/location of information – posters, etc etc

Overcome ‘Defiance ‘ – mentoring / coaching

Anticipatory Regret – real stories / ‘case studies’

Fit

What is Fit?

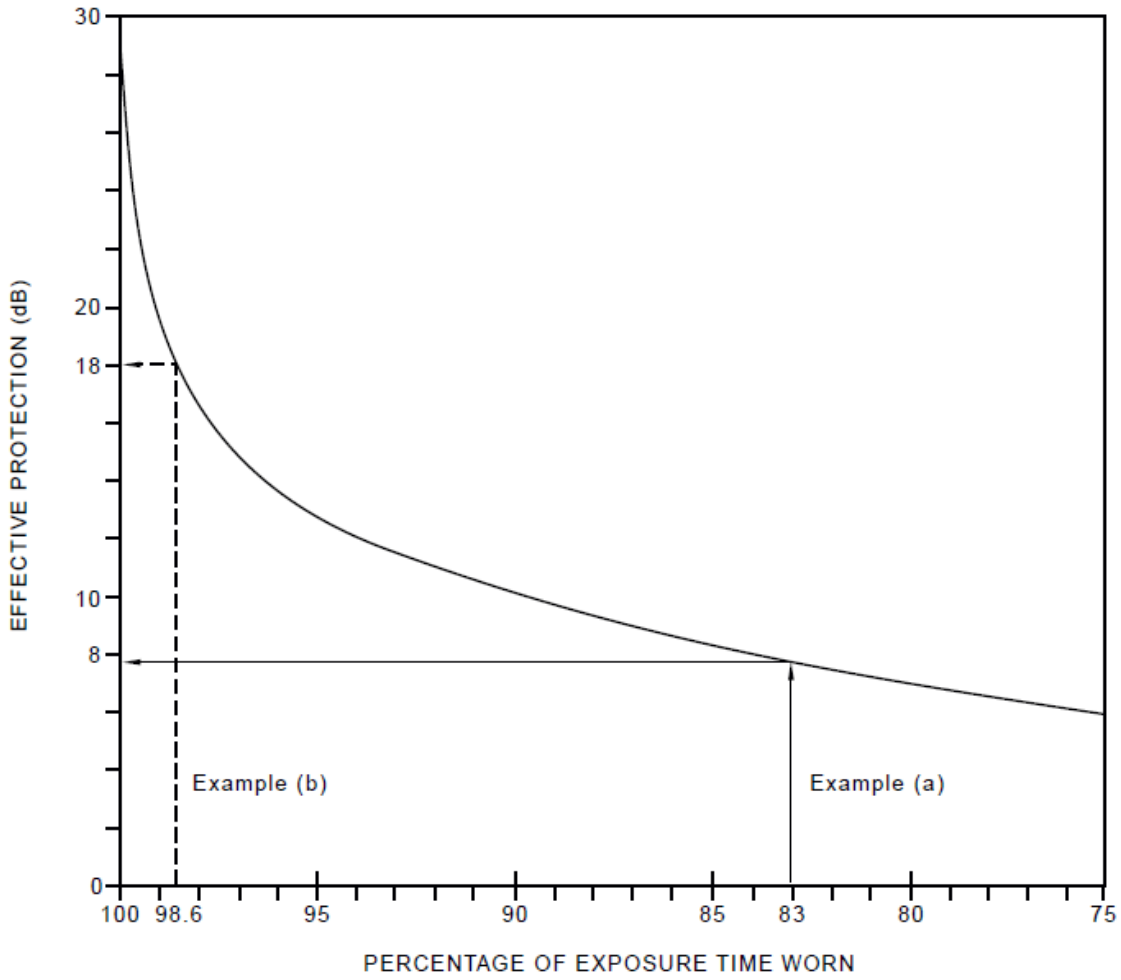
- How well an item of PPE fits the individual wearer
- Helps determine how well the wearer is protected from given hazard(s)

- Many factors affect fit, for example:
  - Whether the wearer has followed manufacturer user instructions?
  - Wearer clean shaven (for tight fitting respirators)?
  - Presence of facial jewellery
  - Individual's size and shape
  - Clothing
  - Other PPE

Importance of Fit

- Incorrectly fitted PPE results in significant reduction in protection
- For example, incorrectly rolled foam earplugs can lead to significant reduction in actual level of attenuation.
  - Similar effects to non-wear time
  - Effects may be greater for higher protection devices
  - Consider for example, non-wear time in the AS/NZS 1269.3 as shown in Figure 1.

Figure 1: Reduction in the effective protection provided by high grade HP with decreased wearing time in a given noise environment



Source: AS/NZS 1269.3:2005 *Occupational Noise Management – Part 3: Hearing Protector Program*

How can we Overcome Fit Issues?

- Ergonomically better designed products providing improved fit and enhance wearer comfort
- Regular training for workers
- Development and use of innovative tool kits to help train and educate, for example:
  - Training videos & posters
  - Clear & concise user instructions
  - Engaging and interactive fit checking/fit testing devices

Assessing Fit

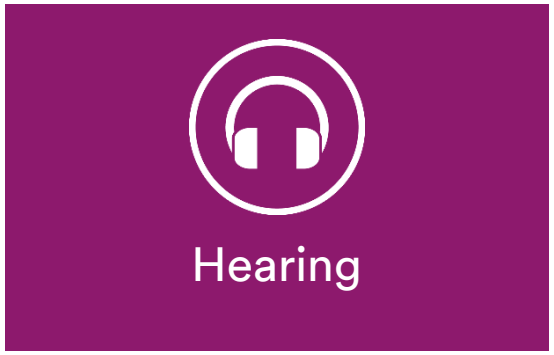
There are methods to validate fit, which we will deal with in the fit validation section, but even in the absence of such methods there are simple steps that can taken to assess the fit by the wearer.

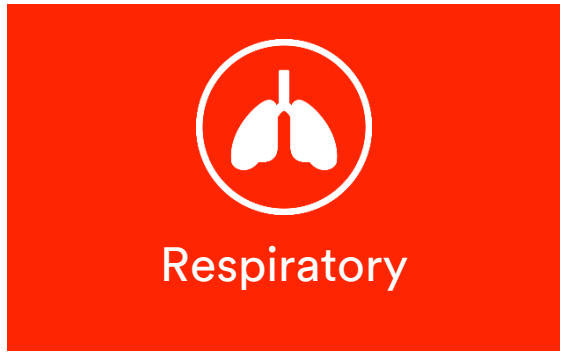
Consider the following examples where the product size is normally indicated on the packaging but the wearer can assess how well the product fits the individual.

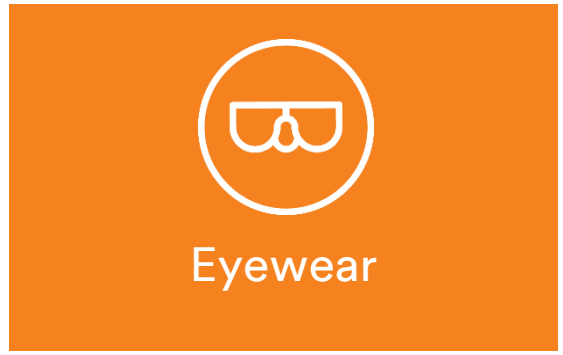
- Coverall – check for overall length and fit
- Safety harnesses - must form a snug fit for comfort and protection
- Safety Gloves and shoes – as in the case of other products, safety gloves and shoes must fit the individual wearer comfortably so that the product is worn for the entire duration of the period

Fit Validation

Fit Validation







How can Fit Validation Help Fit Issues?

- Key element of workplace protection programme
- Gives an assessment of how well a given PPE fits the worker
- Also an assessment of comfort, compatibility and overall suitability for the wearer
- Ideal training opportunity for the worker on the use and correct fitting of PPE
- Globally, several interpretation of how fit validation should actually be implemented
- Two key methods are qualitative and quantitative

What's Behind Fit Validation?

- No one single design and size fit every wearer
- Wide range of ethnic population workforce around the world
- Wearers have different anatomical facial features i.e. shape of nose, orbital area of the eye, ear canal etc.

- 'Real World' studies suggest significant difference between field measurement and laboratory controlled testing
- May be required by law in some countries
- Company practice
- Best practice

Why Validate your PPE?

Every wearer is different – different shape of nose, ear canal, orbital area of eye etc.

Confidence in performance – some ‘real-world’ studies suggest significant difference in performance between field and lab data

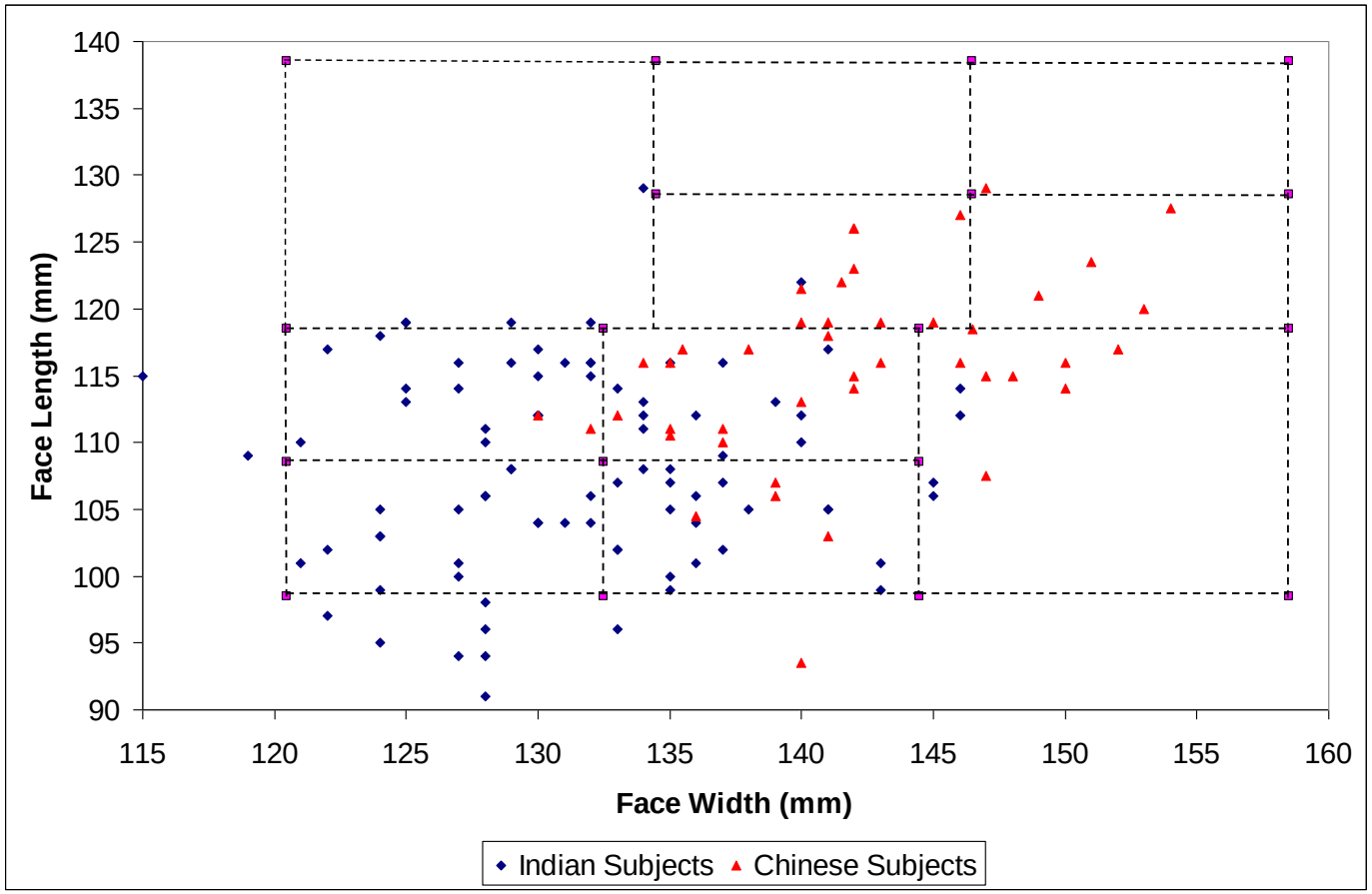
Confirm your choice

Comply with regulations - may be required by law in some countries

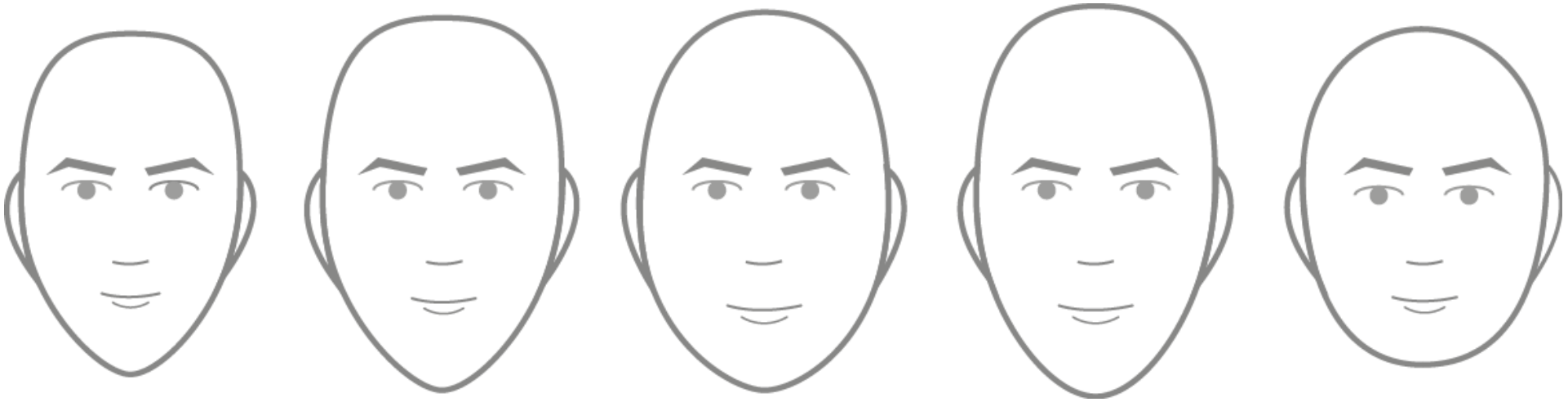
Training on correct use

Science of Fit: Design for People

Example of Distribution of Face Size by Nationality



Ethnic diversity challenge



a) small

b) medium

c) large

d) long/narrow

e) short/wide

What is the difference between Fit Check and Fit test?

Fit check

- Conducted by the employee/wearer each time they put on PPE
- Good practice that gives an indication that the PPE is positioned correctly on the wearer
- Responsibility remains with the employee
- Shows crude fitting errors
- Guidance provided in User Instructions

Fit test

- Test that must be conducted each time a new model of PPE is selected
- AS/NZS1715 doesn't require fit test administrators to be certified, just to know how to conduct a test, recognize invalid tests, and properly clean and maintain equipment
- Can be carried out in-house by a competent person, manufacturer, supplier or service provider.
- Employers responsibility

Aims of Fit Test

- Helps optimise product and size selection
- Means of measuring effectiveness of PPE on an individual
- Train and motivate the wearer
- Lead to enhancement of worker protection and thus reduce ill health
- Match the correct product to the hazard and wearer
- Improve compliance and wearer motivation

When do you Fit Test?

- Initial selection of PPE
- Change of PPE model or brand
  - Different size, style, model or make of respirator used.
- As part of routine health surveillance
- As a result of physiological or anatomical changes e.g. facial characteristics, rapid weight changes
- Mandated by regulatory or company health & safety policies

Fit testing is required by Australian New Zealand Standard AS/NZS1715 before a user wears a respirator on the job, and should be assessed **at least annually**.

Global Fit test Standards
Respiratory protection

AS/NZS 1715:2009

- Evolved over many years / decades
- Requires annual refit testing
- Qualitative fit testing
- Quantitative fit testing
- Different Exercises
- Medical examination is a prerequisite

HSE 282/28 (UK)

- Based extensively on OSHA 1910
- No time-based refit test requirement
- Qualitative fit testing
- Quantitative fit testing
- Different exercises
- Different sampling durations
- Pass each and every exercise
- Exercises conducted at elevated work rates

OSHA 1910.134 (USA)

- Evolved over many years / decades
- OSHA: Requires annual refit testing
- Qualitative fit testing
- Quantitative fit testing
- Medical examination is a prerequisite

ISO 16975-3

- Based on ANSI Z88.10
- 'OSHA with some changes'
- ISO Protection Classes and Protection Levels
- Requires annual refit testing
- Qualitative fit testing
- Quantitative fit testing

Fit Testing Standards Hearing Protection

- European Guidance Document EN 458:2016 & Canadian Standard CSA Z94.2 “*Hearing protection devices Performance, Selection, Care, and Use”* - Section 13 “Field Attenuation Estimation Systems (FAES).”
- Fit testing encouraged as a way of improving field performance of hearing protectors, training purposes and variability.
- Applicable to all types of hearing protectors

Fit Testing Methods

Qualitative

- Provides simple PASS / FAIL based on wearer's subjective assessment or limited objective measurement e.g. pressure leak test for some custom moulded earplugs
- Wearer decides whether the PPE fits or not based upon taste / smell for filtering respirators, for example

Quantitative

- Provides quantifiable information and generates numerical value which can be interpreted in the light of workplace hazards
- Selecting the right level of protection against hazards

Tight Fitting RPE

Purpose: to determine the appropriate respirator style and size for the individual wearer

- Qualitative fit testing (QLFT) or
  Quantitative fit-testing (QNFT)

Repeat annually, or earlier if facial scarring, dental surgery, excessive weight loss or gain, or any other change occurs in the employee's physical condition that could affect fit

Hearing - E·A·Rfit Validation

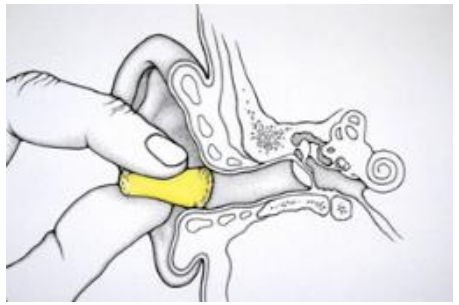
Fast (8 seconds/ear) measurement of real-ear attenuation. Test frequencies 125Hz to 8kHz

Microphones inside and outside the ear measure sound pressure levels and give a Personal Attenuation Rating (PAR).

E-A-Rfit version 5

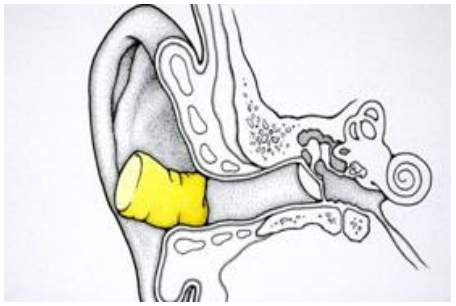
- Updated hardware and software.
- Dual ear measurements.
- Validated with large range of 3M earplugs and the new 3M Peltor X Series earmuffs.

Hearing – Importance of Fit

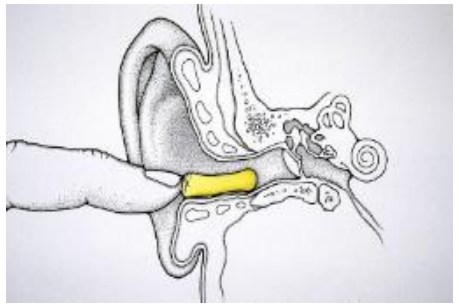


Inadequate roll down

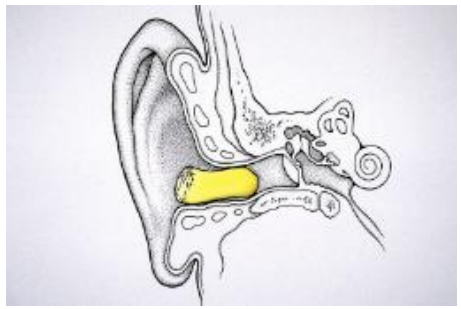
No Roll Down



Result: poor attenuation



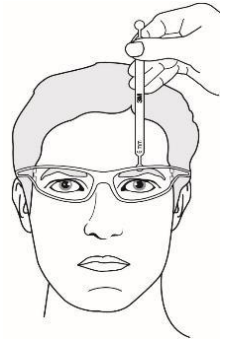
Adequate roll down



Full insertion

Result: good attenuation

Workplace Eye Protection Fitting



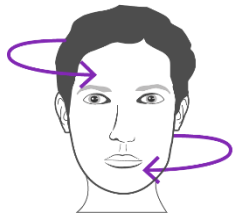
Gaps

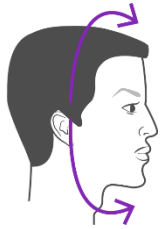
View

Fit

Coverage

Security





3M Science. Applied to Life.™

Respiratory

Respiratory Protection Program

When respiratory protection is required as per AS/NZS 1715 Standard, a written respiratory protection program should be established. That means the designated program administrator must oversee the following:

1. Assessment of exposure to airborne contaminants.
2. Selection of appropriate respirators.
3. Evaluation of employees' health to make sure they can wear a respirator.
4. Fit-testing and training of employees regularly.
5. Inspection, repair, cleaning, storage and replacement of respirators as needed.
6. Review of the program periodically to make sure it's being run properly.
7. Keeping a written record of all of the above.

1. Exposure Assessment

Employers are required to evaluate respiratory hazards in the work place.
Assessment can help employers understand:

- Exposure levels, and whether they're acceptable or unacceptable.
- Effective ways to control exposure.
- Which types of respirators (if any) can help provide the right protection for your workers.

ASSESSMENT

Should be conducted:

- periodically, and/or when changes in the workplace are introduced that could result in new exposures — such as a change in equipment, process, products or control measures.

RECORDS

Records of all exposure assessments are needed for the written respiratory program.

2. Respirator Selection

- Respirators shall conform to the requirements of AS/NZS 1716*.
- Respirators must be selected according to the assigned protection factor (APF), which is the workplace level of respiratory protection that a respirator or class of respirators is expected to provide to employees when the employer implements a continuing, effective respiratory protection program.
- Another consideration is maximum use concentration (MUC), which is the maximum concentration a worker can be expected to be protected from using the chosen respirator. Multiplying the APF by the workplace exposure standard (WES) gives you the MUC for a respirator; it should be less than the IDLH levels for that hazard.

WES X APF = MUC

Ensure:

- Respirators selected are appropriate for the type of hazard.
- Selection of appropriate protection to filter out hazard ie types of respirators, filters and cartridges for workplace airborne contaminants (particles, gases, vapours or other hazards)
- Respirators are compatible with any other personal protective equipment (PPE) and other relevant workplace and user factors e.g. hot environment, health conditions, confined work spaces etc.

Types of Respirators

There are two main kinds of respirators:

- Air-purifying respirators, which use filters, cartridges or canisters to remove contaminants from the air you breathe.
- Atmosphere-supplying respirators, which provide you with clean air from an uncontaminated source.

RECORDS:

Documentation of respirator selection and justification needed for written Respiratory Program

AS/NZS 1715 Assigned Protection Factors

Increasing Protection Factor

APF 100+

PAPR with Full face and P3
Supplied Air with full face

APF 100

Full face with P3

APF 50

Full face with P2
PAPR with loose fitting head tops

APF 10

Disposable and Half Face

3M

Refer AS/NZS 1715 for full table

3. Medical Assessment

Wearing a respirator can put an extra burden on the body. Employees with certain medical conditions affecting the heart or lungs could risk injury or death if they wear a respirator on the job.

AS/NZS 1715:2009 section 6.1 Medical Assessment:

> *"Persons who are routinely required to wear respirators should have an initial medial assessment prior to use to determine if they are able to wear respirators."*

AS/NZS 1715 requirements section 7:

Further medical assessment may be required when there is a change in circumstances that may affect the workers ability to wear the RPE. Re-evaluation is also necessary if:

- A worker reports signs or symptoms that may affect his/her ability to use a respirator.
- A supervisor or respiratory program administrator decides it is.
- Information arises during fit testing or program evaluation indicating a need.
- Workplace conditions change

  -for example, if more exertion is required, temperatures change, or bulkier protective clothing is introduced.

RECORDS:

Documentation of medical evaluations needed for written Respiratory Program

4. Fit Testing

Tight-fitting respirators can only provide expected protection if they fit correctly, so fit-testing each employee is critical.

Tight-fitting respirators must seal to the wearer's face in order to provide expected protection. This includes disposable respirators (also called "filtering facepieces"). Fit testing is required by AS/NZS1715 before a user wears a respirator on the job, and should be assessed at least annually.

There are two kinds of tests, and AS/NZS 1715 specifies which can be used depending on the respirator type.

Qualitative Fit Test (QLFT)

- Pass/fail and relies on the employee's senses
- QLFTs may be used to fit-test:
  - All disposable and reusable half-facepiece respirators, whether used in negative or positive pressure mode but particle filters must be used when the test is conducted.

Quantitative Fit Test (QNFT) uses an instrument to measure leakage around the face seal and produces a numerical result called a "fit factor."

- QNFT can be used to fit-test any type of tight-fitting respirator. A fit factor of at least 100 is required for half-mask respirators and a minimum fit factor of 1000 for a full facepiece negative pressure respirator.

RECORDS:

List of specific fit test procedures & employee fit test records are required for the written Respiratory Program

Fit Testing – Two Principle Methods

Qualitative fit test QLFT

Suitable for DR and RR half masks

Quantitative fit test QNFT

Suitable for DR*, RR half and full face

- Not Controlled Negative Pressure methods (CNP)

(a test that creates a vacuum by temporarily cutting off air).

Qualitative Fit Testing (QLFT)

- Used to fit test negative-pressure air purifying respirators as long as they'll only be used in atmospheres where the hazard is at less than 10 times the permissible workplace exposure standard.

- QLFT is Pass/Fail and relies on the user's senses using one of the AS/NZS 1715 accepted test agents:
  - **Isoamyl acetate** (banana smell); only for testing respirators with organic vapor cartridges.
  - **Saccharin** (sweet taste); can test respirators with a particulate filter of any class.
  - **Bitrex®** (bitter taste); can also test respirators with particulate filters of any class

- Test solution is sprayed into a hood while wearer conducts a range of exercises
- The RPE particle filters capture this aerosol
- If there is a leak at the face seal the wearer will taste the aerosol and fail the test
- Reliant upon the wearer's response and sensitivity to the test solution
- An assumed fit factor of 100 is applied to a pass

Quantitative Fit Test QNFT (TSI PortaCount)

- Can be used to fit-test any tight-fitting respirator.
- Employs ‘ambient’ air particles as the challenge
- Involves using an instrument to measure leakage around the face seal and produces a numerical result called a “fit factor.”
- PortaCount counts the particles inside and outside the facepiece while wearer conducts a range of exercises
- Fit factors calculated from the measured particle concentrations:

$$FF = \frac{Conc.\ Particles\ OUTSIDE}{Conc.\ Particles\ INSIDE\ due\ to\ faceseal\ leakage}$$

- **Pass:**
  - DR / Half-mask: FF ≥ 100
  - Full-face mask: FF ≥ 1,000
- Assumes zero filter particle penetration

When to Fit Test

- Initial selection of RPE
- Facepiece not previously tested
- Change of RPE model and/or brand
- Change of facial characteristics
- Company health & safety policy requires it
- *Mandated periodically, e.g. AUS, NZ, USA and Canada, Italy, & UK*

Benefits: RPE Fit Testing

- Selection of respirator based on suitability of the wearer
- Great opportunity to address comfort and PPE compatibility issues

  Great training opportunity to demonstrate to the wearer:
  - They can achieve an acceptable fit
  - How a proper fit feels – so they can repeat it in the workplace
  - That respirators can be effective
  - How and why to use the RPE – facial hair, examination, crucial maintenance, etc.

5. Annual Respirator Training

AS/NZS1715 requires employers to train and fit-test employees who use respiratory protection on the job. Annual training allows for:

- Reinforcing the importance of respiratory protection on site and
- give everyone a refresher course on properly using and caring for their equipment.

Your annual training should include the following:

1. **Identification of Respiratory hazards.**
    - Coverage of gas/vapour and particulate hazards and oxygen deficient atmospheres

2. **Reasons for RPE**
    - Coverage of any applicable regulations, local exposure circumstances and status of engineering controls

3. **RPE Selection**
    - Selection issues like Hazard identification, Assessment of risk and selection of appropriate equipment

4. **Uses and proper fitting**
    - Cover use and fitting issues to ensure RPE is and remains suitable.

5. **Wear time**
    - Stress importance of wearing RPE at all times it is needed.

6. **Limitations of RPE**
    - Discussion on limitations of RPE in use. What it can and can not do to help protect them

7. **Maintenance and storage of RPE**
    - Talk about maintenance and storage of respirators. If your employees are responsible for the maintenance of their own reusable respirators, go over the detailed cleaning, inspection, repair and storage procedures listed in the respirators' instruction manuals.

8. **Program Summary**
    - A summary of the elements of the applicable Respiratory Protection Program

6. Program Evaluation

- Elements of the RPE program should be evaluated on a regular basis, and discussed at regular safety committee meetings.
- Examine the written records to make sure all tests and inspections are up to date.
- Talk to the workers who use respiratory equipment to ensure allocated respirators fulfil their needs, and that they understand and follow procedures for using and maintaining respirators.
- Record evaluations; summarise findings, any deficiencies identified and corrective actions to be taken.

RECORD:

Criteria used to audit the respiratory program & written reports of each evaluation, including corrective actions taken, is required for the written respiratory program.

7. Recordkeeping

- Keeping a written record provides proof of compliance with the regulatory standards to local standards.
- Gives employees a reliable source for information about respiratory protection procedures,
- It's invaluable in helping evaluate the program.

The record should:

- State all the policies and procedures established for your workplace.
- List who is responsible for which parts of the program.
- Contain all the documentation gathered during all of the previous steps.

It takes work and organization to set up and maintain each part of a respiratory protection program.

Requirements may vary by type and level of respiratory hazards employees face, but it's essential for meeting governmental requirements and helping keep your workforce safe.

Respirator Selection – Negative Pressure

Respirators are classified by the type of hazard they protect against, their APF and the specific substance(s) they're approved for.

Negative-pressure respirators rely on the wearer to pull air in through cartridges or filter. This has the potential to put a strain on the wearer, which is why medical evaluations are important and recommended.*

Filtering Facepiece
Disposable respirators, also known as filtering facepieces, are used to help protect against some particulate hazards. They're lightweight and require no maintenance since they're discarded after use.

Reusable
Reusable respirators can be used with particulate filters, gas and vapor cartridges or combination cartridges, which may need to be replaced on a schedule or as needed.

Half-Face
Half-face respirators cover the lower half of the face, including the nose and mouth.

Full-Face
Full-face respirators cover the eyes and much of the face, and can sometimes replace the need for safety glasses.

*As per section 6, Medical and Physical considerations, AS/NZS 1715

Respirator Selection – Positive Pressure

Positive-pressure respirators do the work of pushing air to the respirator headtop or facepiece; they can either be:

- powered-air, using a battery-powered blower to pull air through a filter, or
- supplied-air, bringing clean air through a hose from a source outside of the contaminated work area*

Tight-Fitting
Tight-fitting respirators must be fit-tested when use is required, and users must perform seal checks every time a tight fitting negative pressure respirator – a filtering facepiece or half facepiece respirator - is worn.

Loose-Fitting
Loose-fitting respirators typically have a hood or helmet.

Self-Contained Breathing Apparatus (SCBA)
SCBA is classified as a positive pressure supplied air respirator, but is different from all other respiratory equipment i that the user carries the source of the clean air with them in a tank. This type is mainly used for conditions that are unknown or "immediately dangerous to life or health" (IDLH), such as oxygen-deficient atmospheres, when hazards are so concentrated or so toxic they can't be brought to acceptable levels with other types of respiratory protection, or when you've been unable to definitively record the level of hazard in the workplace.

* refer Appendix A, AS/NZS 1715, requirements for air quality for supplied air respirators.

Cartridge and/or Filter

- *Need to understand types of particulate filters and gas and vapour cartridges to help select the right one.*

As per AS/NZS 1715 there are 3 different classes of particulate filters, P1, P2 and P3.

- Negative Pressure particulate categories are based facepiece coverage.
- All particulate filtering facepieces that cover the nose and mouth area only can achieve only a P1 or P2 classification.
- **P3 classification can ONLY be achieved when worn with a full facepiece.**

Class P1 particulate filters - used against mechanically generated particulates e.g. silica and wood dust.

Class P2 particulate filters - used for protection against mechanically and thermally generated particulates or both e.g. metal fumes.

Class P3 particulate filters - used for protection against highly toxic or highly irritant particulates e.g. beryllium (full facepiece only).

NOTE: certain contaminants may have specific respiratory selection criteria outside this guide e.g. asbestos.

Gas and vapour cartridges categories are distinguished by their filter type and class *.

Commonly used filter types are:

Filter type A = Certain organic vapours (boiling point above 65°C) from solvents such as those in paints & thinners (cartridge label colour = brown)

Filter type B = Acid gases such as chlorine, hydrogen sulfide (sulphide) and sulfur dioxide (cartridge label colour = grey)

Filter type E = Vapours from sulfur dioxide (cartridge colour = yellow)

Filter type ABE = are suitable for both certain organic vapours/acid gases & sulfur dioxide e.g. solvents, chlorine & sulfur dioxide (cartridge label colour = brown, grey & yellow)

Filter type K = ammonia gas (cartridge label colour = green)

Filter type ABEK = are suitable for both certain organic vapours/acid gases, sulfur dioxide and ammonia (cartridge label colour = brown, grey, yellow &green)

* Refer to AS/NZS 1715 for the complete list of filter types and what they are used for.

How to Select Respirators for Your Workplace

Step One: Know your hazard type.

- Select equipment based on whether your work environment contains a particulate hazard (particles such as hazardous dusts or fibers), a gas or vapour hazard (such as solvent vapours or chlorine gas), or both types of hazards.
- If both types of hazards are present, combination cartridges are an option that can filter out both particles and gas or vapours

Step Two: Find out if your workers need respiratory protection.

Compare your exposure levels to the NZ workplace exposure standard (WES), to determine if action is required.

- You can often use values set by other groups, such as the American Conference of Governmental Industrial Hygienists (ACGIH) – if those values are lower than the WES.
- Use same units of measure when comparing measured concetrations toWES ie both expressed in ppm for an eight hour time weighted average (TWA). Measurements may also be in the form of 15-minute short-term exposure limits (STEL) or a ceiling limit (C), which is the absolute limit that should never be exceeded at any time by a worker.

If employee exposure levels are below the WES, then respirators aren't legally required, though you may still want to offer respirators for voluntary use.
If your levels are above the limit, look to reduce exposures through engineering, or administrative controls.

Step Three: Determine level of protection needed.

AS/NZS 1716 tested respirators have an assigned protection factor (APF), which can range from 10 to 100+. For example, APF of 10 means the respirator can protect against exposure levels that are up to 10 times the WES for that hazard.

- To see what level of APF your workplace needs, divide your exposure levels by the exposure limit. (This is called the "hazard ratio.") For instance:

Contaminant exposure level: 500 ppm ÷ WES (of that exposure contaminant): 50 ppm = APF: 10

Refer to your local APF information to help select correct respirator/respiratory combination.

Step Four: Choose a respirator type

Once you know your required APF, narrow down your choices to those respirators that can reduce exposure to below the WES. Consider compatibility with other required protective equipment, such as safety glasses and hard hats, comfort etc

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3M Personal Safety Division

Breathing Apparatus , Escape and Airline

Dean Mitchell Application Engineer EMEA

3M | SCOTT™ Fire & Safety

3M QLFT fit test kits

Two kits are available

- FT-10 Sweet
- FT-30 Bitter

Contents:

- Hood and collar
- Sensitivity nebuliser and solution
- Fit test nebuliser and solution
- Spare jet and cleaning pin
- Instruction book
- Online video and pdf of record card


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Science.
Applied to Life.™
Hearing

Hearing Conservation Program (HCP).

The Australia/New Zealand Standards AS/NZS1269 series provides guidance on managing workplace noise effectively and AS/NZS 1269.3 specifically describes how to conduct an effective hearing protector program.

A HCP as detailed in AS/NZS 1269, is recommended whenever employee time weighted average (TWA) noise exposures are 85 dBA or more

Seven Elements to Hearing Conservation:

- ✓ Measure
- ✓ Control
- ✓ Protect
- ✓ Check
- ✓ Train
- ✓ Record
- ✓ Evaluate

Do You Need A Hearing Conservation Program (HCP)?

In New Zealand employers are required to risk manage noise hazards within the workplace whenever employees have 8-hour time- weighted-average (TWA) noise exposure of 85 dBA or more.

Noise surveys can be simple or complex and may be conducted by people on your health and safety team or by a consultant. There are many different types of noise measurement instruments available depending on the type of noise and the purpose of the survey.

Measure noise to answer key questions such as:

- Is HCP needed?
- Can we control the noise?
- How much hearing protection do we need?

Some indications that noise may be a problem in your workplace include:

- Employees hear ringing or humming in their ears after exposure to loud sounds
- The noise is so loud that employees must shout to be heard by a coworker an arms length away
- Employees notice temporary loss of hearing ability when leaving work

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Measure: Noise Survey

Step 1. Perform a walkaround survey
The purpose is to identify where hazardous noise is present. If noise levels are 85 dBA or more, additional sound surveying is needed.

Step 2. Conduct sound level surveys in noisy areas
A sound level survey is a systematic method for measuring sound pressure levels of specific equipment or tasks, in an area, or near a person.

Types of Sound Level Surveys include:

Basic survey:
- Create noise maps of area sound levels, and determine if a more extensive survey is needed.
- Use results to create a sampling plan; an estimate of how many samples need to be taken to accurately describe the noise levels for each area or job description.

Extensive survey:
- Results are useful to determine worker noise exposures, make hearing protection assignments, and identify who is in or out of the HCP.

Noise control survey:
- Focuses on identifying and prioritizing options for reducing the noise hazard using engineering or administrative controls.

Step 3. Create a noise sampling plan
The results of your basic sound level survey and your observations of how noise fluctuates during the work day can help you develop a plan for how many measurements need to be taken in order to accurately assess the noise exposures in each area and for each task or job description. Generally, more samples are needed when the results of your basic survey are close to the Occupational Exposure Limit (OEL) for noise and when the variability of your noise survey results is high. Fewer samples may be needed if the sound levels in your surveys are well below the OEL and the sound levels are less variable *.

Step 4. Monitor employee noise exposures
Measuring the noise exposure of employees requires averaging the sound levels over time. Noise exposure monitoring is often included as part of an extensive sound survey. The purpose of noise exposure monitoring is to determine a worker's 8-hour time weighted average (TWA) or accumulated noise dose over the work shift (personal noise dose). It is also used to measure how noise varies over time according to the job task.

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* Suggested resources to learn more about sampling strategies for occupational noise exposure: "Quantitative Exposure Data: Interpretation, Decision Making and Statistical Tools" in A Strategy for Assessing and Managing Occupational Exposures, 4th Edition". AIHA Press, 2015. "The Noise Manual, Fifth Edition". AIHA Press 2003

What is Required?

AS/NZS1269.1 suggests:

- A maximum of 5 years between initial and follow-up noise monitoring.

- Employers are required to do supplementary noise surveys whenever there is a change in processes, procedures, or exposure time that may lead to changes in employee noise exposures. Some companies choose to conduct surveys periodically (eg every year or two) to ensure that all exposed employees are included in their hearing conservation programs.

Occupational Noise Exposure

When employee noise exposures meet or exceed the TWA Action Level (AL) of 85 dBA:

- Develop and implement a noise monitoring program
- Design a sampling strategy to identify employees for inclusion in the hearing conservation program (HCP)
- Use representative personal sampling (dosimetry) when workers are highly mobile, noise levels are variable, or there is significant impulse noise
- Set sound measurement equipment to an A-weighting scale, and a “slow” response setting. Use a Type 2 microphone (or better).
- Let employees (or their representatives) observe the monitoring. Inform them of the survey results.
- Permissable Exposure Limit

Know The Limits

AS/NZS1269 and the relevant goverenment regulations set the 8 hour average Exposure Limit at 85 dBA based on a 3 dB exchange rate for calculating noise dose & 140 dBC Peak

Control

Hierarchy of Controls

The concept of a Hierarchy of Controls is well established in occupational health and safety. It is more effective to eliminate or decrease the severity of the hazard than to change the way people work or require workers to wear protective equipment.

Key challenges :

- Constant change of environment
- Variety of equipment
- Variety of applications
- Not always possible to engineer out

Controlling noise:

- The most effective method of reducing noise hazards is to control noise at the source.
- Adopt ‘buy quiet’ policy on site
- Use engineering controls (modify equipment, process or environment) or implementing administrative controls (time workers spend in high noise area).

End result = may reduce the number of employees in a hearing conservation program

Protect

- Hearing protection is necessary when noise cannot be controlled to safe levels.
- Human factors such as attitude, skill, and HPD fit can be as important to the overall success as the hearing protector itself.
- Offer several HPD choices and provide effective training to help increase worker acceptance and proper use of hearing protectors.
- Consider how the hearing protectors affect safety, communication and audibility of critical sounds

What is required?

Provide Hearing Protectors and Training on HPD Use

Employers should make available a “variety of suitable hearing protectors” to all employees who have TWA noise exposures at or above 85 dBA. The HPDs must be provided at no cost to employees and replaced as necessary. Training in the use and care of all hearing protectors needs to be provided.

Ensure Hearing Protection is Worn

Employers must ensure that hearing protectors are worn by employees whose TWA exposure is higher than the 85 dBA TWA limit.

Evaluate HPD Attenuation

The employer must evaluate the HPD attenuation in respect of the specific noise environment in which the protector is being used. HPDs must reduce the employee’s TWA exposure to a level below 85 dBA. Re evaluation of HPD attendution required when noise exposure increases to and HPD provision no longer viable. More effectiive protection must be proveided as necessary.

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See AS/NZS1269 to learn more about hearing conservation requirements.

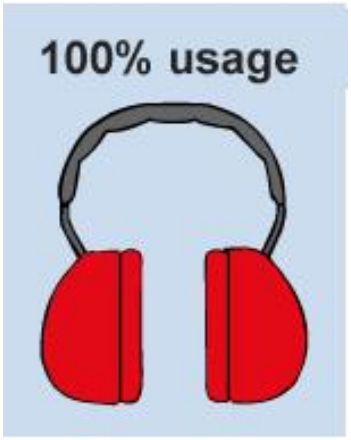
Myth

“Wearing Hearing Protectors Part-Time is Better than Nothing.”

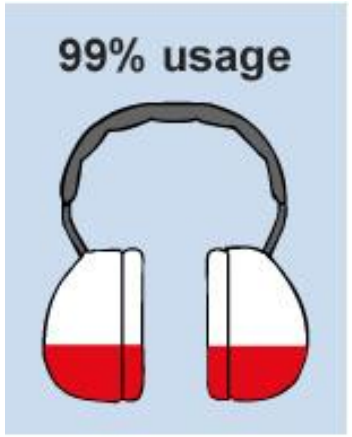
- Your risk of damaging your hearing due to excessive noise increases dramatically after only a few minutes without hearing protection.

- “Partial Protection” very quickly becomes “NO Protection”.

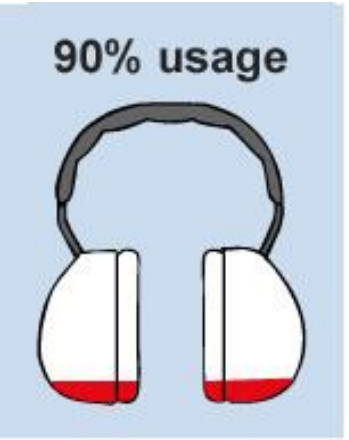
HEARING PROTECTION DEVICES are not effective if they are not worn!!!!



Fitted correctly, protection achieved.



Significantly reduced protection
(1% in 8 hours is ~5 mins
with HPD off)



Virtually No protection
(10% in 8 hours is 48 mins with HPD off)

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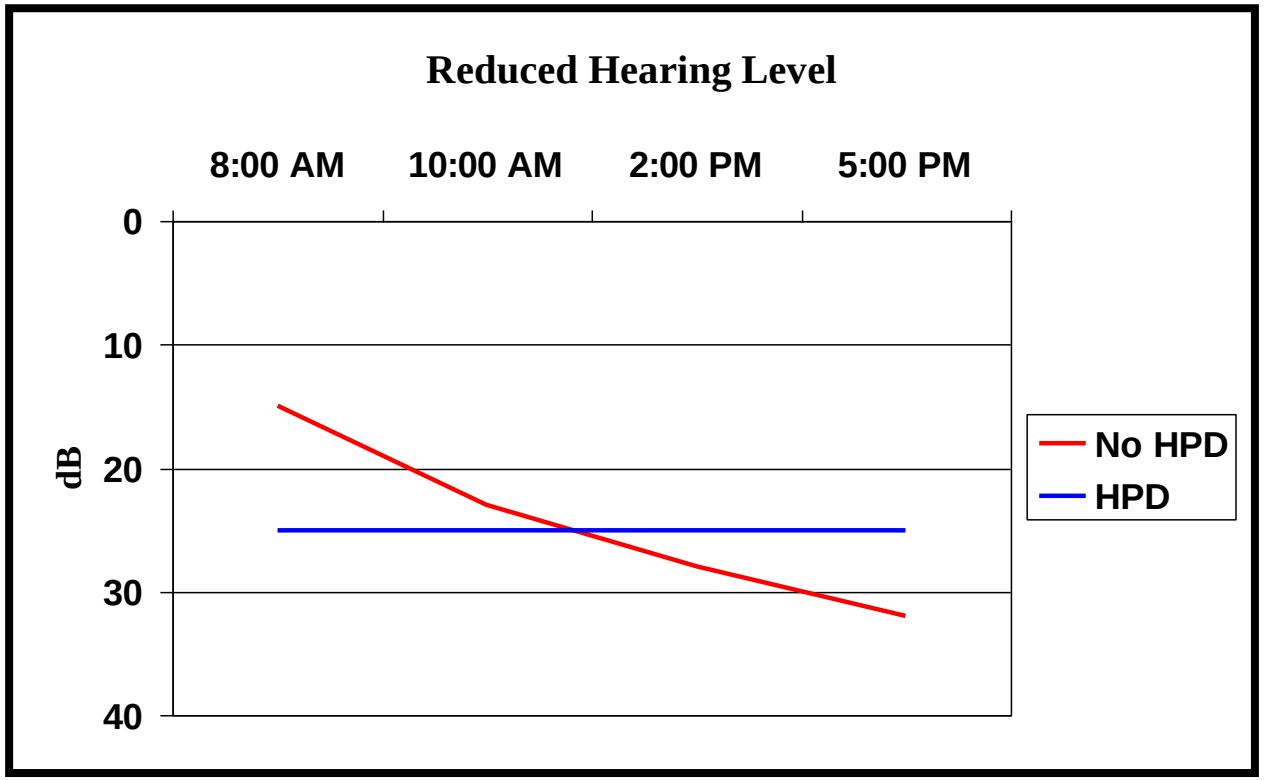
Myth

“Hearing protectors prevent me from hearing important sounds.”

- You can still see with sunglasses and you can still hear with hearing protectors
- Hearing protectors allow you to hear sounds at a more comfortable level
- **Without hearing protectors, your hearing gets worse during the day/work shift.**

HPD Keeps Hearing Constant



Hearing protector fit testing

Recognised as best practice by OSHA, NIOSH, the National Hearing Conservation Association etc . Although it is not a regulatory requirement, it has several benefits, and will help employers meet the requirements to ensure proper initial fitting and supervise the correct use of all hearing protectors.

In a 2014 study, **nearly 30%** of employees in an OSHA-compliant hearing conservation program **were not receiving adequate attenuation for their workplace noise exposures**. (Smith, et. al.). A widely hearing protection attenuation varies among workers, 3M strongly recommends fit testing to verify the attenuation obtained by each employee.

Fit testing systems such as the 3M™ E-A-Rfit™ DualEar™ Validation System are referred to as Field Attenuation Estimation Systems (FAES). The measurement obtained during FAES testing is the Personal Attenuation Rating (PAR). The PAR provides a moment-in-time snapshot of how well the hearing protector is reducing sound for that individual worker. Although hearing protector fit may vary from day to day, fit testing helps to verify that each worker is capable to fitting his/her hearing protectors correctly and obtaining adequate attenuation and that the hearing protector is appropriate for the size and shape of the ear canal or head. Find out more about 3M™ E-A-Rfit™ by clicking here.

Key benefits of HPD fit testing are:

- Identifying at-risk employees who may not be obtaining adequate attenuation
- Training and motivating employees
- Validating the appropriate size and model of HPD for each employee
- Documenting that adequate attenuation is achieved by each employee

Types of Noise Reduction

Hearing Protection Types

Conventional attenuation

- The noise reduction provided by **conventional attenuation devices is the same regardless of the level of the noise.** These are designed to provide the employee with a consistent amount of attenuation throughout the work day.

Level-Dependent attenuation

- The noise reduction provided by **level-dependent hearing protectors varies with the level of the noise**. This type of protector provides more noise reduction at high noise levels and is particularly effective for:
    - *Variable noise conditions:* Helps make it easier for workers to maintain situational awareness without having to remove their hearing protectors.
    - *Impulse noises:* Very short, loud sounds such as the blast of an arc flash or the bang of a pneumatic nail gun. To learn more about hearing protection for impulse noise, read 3M Technical Data Bulletin #234 (PDF, 266.82 KB).

Level-dependent HPDs may be non-electronic (passive) or electronic (active). Electronic level-dependent HPDs feature environmental microphones to pick up low level sounds. The wearer can adjust the volume of the incoming sounds for their preferred listening level.

Uniform attenuation

- Low frequency sounds (bass) are reduced by about the same amount as high frequency sounds (treble) for a more natural sound quality. Originally designed for musicians, these can also be used in occupational hearing conservation. Most uniform attenuation HPDs provide lower noise reduction overall and may be a good choice for employees with lower noise exposures.

Selecting Hearing Protection

If hearing protectors aren't comfortable, easy to use, or they interfere excessively with the ability of workers to hear, the percentage of time that employees wear hearing protection, known as wear time, may decrease. Even the best hearing protectors aren't as likely to be used if they aren't convenient and compatible with the work being done and the clothing & other PPE being worn. Workers not only need to be protected from hazardous loud sounds, but they also often need to be able to hear and communicate on the job.

What to consider:

1. Consider comfort first
    - Pressure
    - Size
    - Softness
    - Weight
    - Temperature
2. Factor in ease of use
    - Hygiene
    - Frequent Insertion & Reuse
    - Storage
    - Compatibility
3. Address Communication Needs
    - You can still hear while wearing hearing protection
    - Without hearing protection, communication in loud noise is poor
    - With hearing protection, communication is often easier
    - With too much hearing protection, communication may be reduced

Hearing Protection Types

In the Ear

Disposable Foam earplugs
The most widely used type of HPD. The soft foam is rolled into a tiny cylinder then inserted into the ear.

Comfortable: Conforms to the unique shape of ear canal
Affordable: Low price per pair
Effective: High noise reduction when worn correctly.

Push-to-Fit earplugs
Soft foam tips with a flexible stem. No need to roll the foam tips before inserting into the ears

Easy to use: Works well for employees who have difficulty rolling and inserting disposable foam earplugs
Convenient: Can be used when hands are dirty or when wearing gloves.
Comfortable: Soft foam conforms to the unique shape of ear canal

Reusable earplugs
Washable earplugs with flexible, elastic flanges attached to a stem.

Less waste: Can be reused many times
Cost effective: Replaced less often for lower cost long term
Convenient: Can be used when hands are dirty or when wearing gloves
Versatile: Material doesn't absorb moisture. Works well in wet conditions or when employees perspire heavily
Moderate attenuation: Allows wearer to hear more sound when high Sound Level Conversion (SLC80) is not needed

Hearing Protection Types

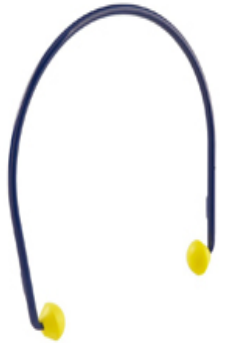
Over the Ear

Earmuffs
Plastic cups attached to an adjustable headband cover the ears to help block out sound. Soft, cushions seal against the side of the wearer's head.

Easy to Use: Most people learn to properly use them with little difficulty
Convenient: Quickly put on and take off hearing protection as needed
Alternative to earplugs: Some people prefer not to, or are unable to, wear earplugs

Banded hearing protectors
Soft foam or elastic tips held in place by a flexible band.

Convenient: Quickly put on and take off hearing protection as needed. Good choice for people who move in and out of noise
Versatile: Wide variety of headband styles and types of ear tips
Moderate attenuation: Allows wearer to hear more sound when a high Sound Level Conversion (SLC80) is not needed



Active (Electronic) Hearing Protectors

Fundamental Electronic Platforms

FUNCTIONS

- Level dependent
- Communication
- Entertainment audio

WEARER MODE

- Over the ear
  - Headband
  - Helmet attached
  - Neckband
  - Foldable band
- In ear

Level dependent function

FUNCTION

- External microphone – signal processing – internal earphone
- Compression function to limit reproduced sound to safe level

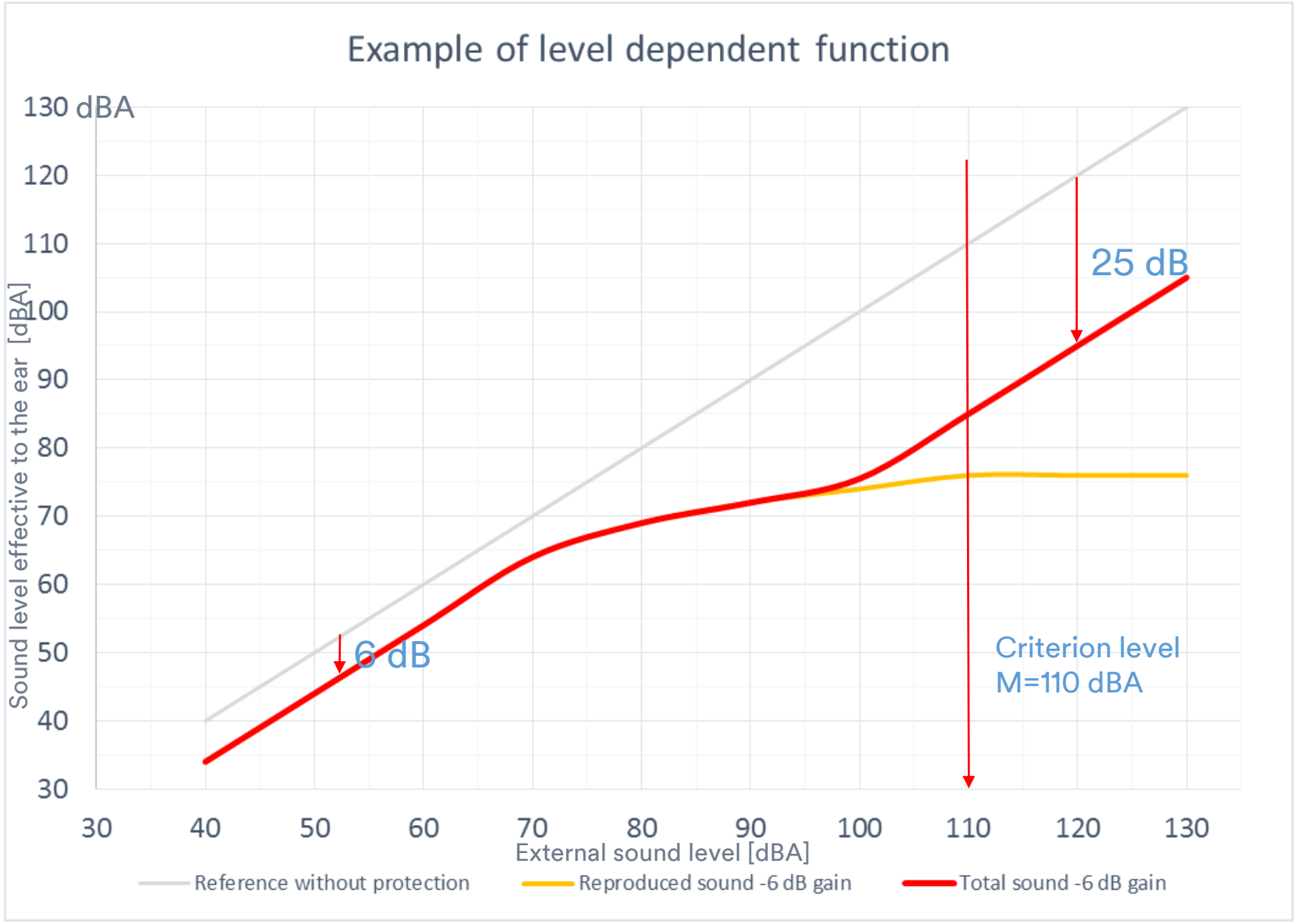
USE

- Provide situational awareness
- Face-to-face communication

LIMITATIONS

- Primarily for intermittent or impulsive noise situations


Microphone
Earphone
Electronics including analog
or digital signal processing


Example of level dependent function
130 dBA
120
110
100
90
80
70
60
50
40
30
Sound level effective to the ear [dBA]
25 dB
6 dB
Criterion level
M=110 dBA
30
40
50
60
70
80
90
100
110
120
130
External sound level [dBA]
Reference without protection
Reproduced sound -6 dB gain
Total sound -6 dB gain

Headsets with built in two-way radio

FUNCTION

- Built in two-way radio
- Voice activated or Push-to-talk
- Noise cancelling microphone
- Licensed and Licence free frequency bands
- Frequency channels for different user groups
- Can operate with other two-way radio systems

USE

- Short or medium range communication in constant noise

Built-in two way radio

Earphone

Noise cancelling microphone

Entertainment audio

FUNCTION

- FM/AM radio receiver
- Bluetooth audio streaming

USE

- Provide entertainment audio at regulated (safe) level
- To enhance motivation and productivity

LIMITATIONS

- Could decrease situational awareness

Product requirement to restrict effective level to the ear to 82 dBA

Use and Care of Hearing Protectors

Always follow the User Instructions provided with the hearing protectors for fitting, cleaning & storage, and replacement of HPDs. In general, replace hearing protectors when they are damaged or no longer provide an effective noise-blocking seal.

Disposable foam earplugs
Uses: Several
Care: Not washable. Replace when dirty, damaged or no longer regain original shape after rolling

Push-to-fit foam earplugs
Uses: Several
Care: Not washable. Replace when dirty, tips detach from stem or tips are no longer soft and pliable

Reusable earplugs
Uses: Many
Care: Washable. Replace when flanges are damaged, torn or are no longer soft and pliable

Earmuffs
Uses: Many
Care: Headband and outside of cups are washable. Foam inserts inside cups are not. Replace bands when: damaged or they no longer provide enough tension to hold cups tightly over ears. Replace cushions and foam inserts: every six months or sooner if they are damaged or are no longer soft and pliable.

Banded hearing protectors
Uses: Many
Care: Bands and reusable tips are washable. Foam tips are not. Replace bands when damaged or they no longer provide enough tension to hold tips tightly in or on ears. Replace tips when they are damaged or are no longer soft and pliable.

Audiometric Testing Program

An audiometric testing program checks the hearing thresholds of workers and tracks them over time.
Objective = to detect changes or shifts in hearing that may signal the beginning stages of noise-induced hearing loss (NIHL).

Identifying the signs and symptoms early enough, allows employers to intervene before the symptoms get worse.

Key Points:

- Routine hearing checks can help detect early symptoms of over-exposure to hazardous noise.
- Effective follow-up for workers with hearing shifts can help prevent permanent noise-induced hearing loss.
- Quality audiometric testing programs rely on consistent procedures, standardized practices, and competent personnel.
- Careful review of hearing test results help determine what follow-up actions are needed and if workplace noise is a factor.
- The audiometric database is a snapshot of the hearing health of the noise-exposed workforce and can be used to identify trends and develop intervention plans.

Purposes of Audiometric Testing

- Checking hearing, through an on-going monitoring program, is the health surveillance part of the hearing loss prevention program (HLPP). When workers are allowed to be in hazardous noise, they should be checked routinely. The purpose of the hearing check is to identify small changes in hearing which may be a symptom of being over-exposed to noise. Workers who show no changes in hearing, in spite of working in hazardous noise, are assumed to be well-protected. However, those who show hearing threshold shifts, need an intervention plan.
- Hearing testing can also be done in order to qualify (or disqualify) a worker from a particular job, if that job has written criteria for hearing. For example, in order to be licensed, an airplane pilot or commercial driver must have good enough hearing to meet the requirements.
- Hearing evaluations can also be performed to determine the cause of the hearing loss for purposes of determining if a hearing loss is work-related.

Train and Motivate Employees to Protect their Hearing on the Job and Elsewhere

Employers may be able to improve the success of their hearing loss prevention efforts by strengthening worker training programs to address not only the KNOWLEDGE of the people involved but also their ATTITUDES and BEHAVIOURS.

KNOWLEDGE:	Understanding how noise can be harmful and how hearing protection and noise controls can reduce the risks
ATTITUDES:	The belief that hearing is valuable and the personal desire to protect it
BEHAVIOURS:	Learning how to protect yourself in noise and consistently practicing those skills

Key Points:

- A strong employee training program can boost the success of your HCP
- Training should address employee knowledge, attitudes and behaviors
- Active learning is one of the keys to training effectiveness

Record

When employers document how and when they implemented each of the elements of a Hearing Loss Prevention Program (HLPP) they may be better prepared to demonstrate compliance with applicable regulations.

Records of noise exposure measurements and hearing test records must be retained for the duration of employment plus 30 years.

Consider keeping other records for the same period of time, including those related to:

- Employee training
- Hearing protector fit testing
- Noise control projects
- Otoscopic results
- Audiometric technician certification

In addition, good records may provide evidence to help an employer accurately track employees' hearing over time and, if necessary, record cases of work-related noise-induced hearing loss in respect of worker compensation claims.

Key Points

- Proper documentation of the steps taken to prevent noise-induced hearing loss (NIHL) benefits both the employer and the noise-exposed worker.
- Complete and accurate records are needed to determine whether Standard Threshold Shifts (STS) are work-related.
- Regulatory agencies require employers to maintain exposure measurement and audiometric test records as part of a HCP and make them available when needed.
- Good recordkeeping makes it easier for employers to evaluate the effectiveness of their Hearing Loss Prevention Program.

Evaluate

Make sure your hearing conservation program is working with regular program evaluations that include employee feedback, responsibility reviews and cost analysis. This will identify trends, magnify problem areas and drive improvement.

Program Audit
A hearing conservation program audit is more in depth than a compliance checklist. This typically involves interviewing members of the management, staff, and workforce. Records can be reviewed in detail and an effort is made to identify if everyday practices are aligned with the company policies and procedures. A “deep dive” program audit can be done by an internal team or may be contracted with an external, subject matter expert.

Tracking Outcome Measures

- Select one or more and track the results over time to identify trends and guide program decisions.
- These measures can be focused on the results of the audiometric database to track occurrences of hearing shift or hearing loss.
- Ideally, the occurrences of hearing shift, or STS, in the noise exposed group of workers should be the same as that of a non-noise exposure population of workers at the same facility.

STS Percentage
To calculate the incidence of STS, divide the number of STS cases by the number of annual tests and multiply the result by 100.

% STS = 100 x (# of STS/ # annual tests)

For example, a company that conducted 200 annual hearing tests found 9 cases of STS. The overall percent STS for the noise-exposed group is 100 x (9/200) or 4.5%. Tracking this number over time can help identify if the STS rate is acceptable and/or stable.

Key Points

- Effective hearing loss prevention programs prevent noise-exposed workers form having standard threshold shifts (STSs).
- Analysis of hearing conservation program records, policies and practices will help employers evaluate the quality of their efforts.
- Regular program evaluation can identify trends, detect gaps, and drive improvement.
- Evaluation can include cost analysis and return on investment (ROI)

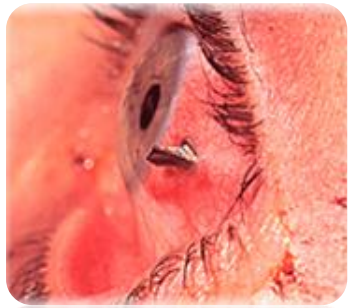
3M Science. Applied to Life.™

Head, Eye & Face Protection

Key Hazards

Eye & Face

- Projectiles – such as concrete, metal, wood, and other objects including staples, nails or shards of broken material
- Chemicals – including dust particles, fumes and splashes
- Radiation – UV, heat or IR, lasers and visible light
- Biological - Infection caused by ocular absorption of certain biological agents (for example hepatitis or HIV)



Head

- Impacts – Falling objects, low ceilings, protruding objects, blunt objects etc.
- Crushing – Caught in collapsing trenches, moving objects/machineray
- Electric Currents – Live hanging conductors
- Metal Splashes – Molten iron splashes, sparks and splatter, burns

3M

Source: https://www.dailymail.co.uk/femail/article-4452070

Eye Protection: NZ Legislation

Employers' responsibilities for eye protection are as follows:

- during hazard assessments of workplace or tasks, giving consideration to eliminating or isolation eye hazards where possible
- considering what type of eye protection is most suitable to minimise the hazard
- providing the appropriate safety eyewear for each task and requiring all employees to wear it.

The most common reasons given by employees for not wearing eye protection include:

- the usual, 'I forgot' or 'I lost them'
- the worker feels or thinks they look silly wearing certain types of eye protection
- the eye protection lens is scratched, dirty, they fog up, or are unserviceable
- the eye protection doesn't fit properly
- the worker gets a headache from wearing the eye protection
- the worker normally wears prescription glasses and didn't have suitable 'over glasses' available.

Source: https://www.standards.govt.nz/touchstone/consumer-safety/2011/sep/safety-eyewear-how-much-are-your-eyes-worth/

Related Standards

- AS/NZS 1337.0(Int):2010 *Personal eye-protection – Eye and face protectors – Vocabulary*
- AS/NZS 1337.1:2010 *Personal eye-protection – Eye and face protectors for occupational applications*
- AS/NZS 1337.4:2004 *Personal eye-protection – Filters and eye-protectors against laser radiation (laser eye-protectors)*
- AS/NZS 1337.5:2004 *Personal eye-protection – Eye-protectors for adjustment work on lasers and laser systems (laser adjustment eye-protectors)*
- AS/NZS 1337.6:2007 *Personal eye-protection – Prescription eye protectors against low and medium impact*
- AS/NZS 1800:1998 *Occupational protective helmets – Selection, care and use*
- AS/NZS 1801:1997 *Occupational protective helmets*
- AS/NZS 4067:2004 *Firefighters' helmets*
- NZS 2264:1970 *Specification for industrial safety helmets (maximum protection)*

Protective Apparel

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Key Questions to Address When Protective Apparel is Required:

1. Physical state of contaminant
2. Form of contaminant (chemical concentration / particle size)
3. Type of exposure & contact with contaminant
4. Length of exposure
5. Working environment (temperature, humidity……)
6. Additional risks (i.e electrostatic charge)

Food Industry

Hazards & Risks

- Workers from the food processing industry can be exposed to splashes from cleaning disinfectants (i.e surface active agents, alcohols, aldehydes, peracetic acid) or refrigerants (i.e Ammonia).
- Employees can also be exposed to biological hazards, such as moulds, yeast, bacteria i.e. Salmonella, Endotoxins and viruses.
- Contamination of the production from human skin, spores and germs also is a key concern in that industry.

Key activities requiring coveralls

- Cleaning & maintenance of machinery
- Primary process such as reception of live animals, slaughtering & meat processing i.e. defeathering/ skinning, cutting, deboning
- Handling of dairy products, fish, nuts (allergies)
- Vegetable processing
- Slicing, packaging raw and baked goods
- Beverage processing

Products to consider

- Type 5/6 coveralls may offer an effective protection against dusts and low concentration of inorganic chemicals used in this industry. They can also help prevent contamination of production from human skin and germs.
- EN14126 Biohazard protection
- Accessories such as oversleeves, overshoes, mob caps are also commonly used in this industry

Key selection factors

- Protection level
- Comfort
- Linting propensity
- Availability of accessories
- Price
- Food legislation- Commission Directive 2002/72 for plastic food contact materials, 3Ms bags have a symbol advising they are not suitable for food contact. This is specific to the packaging and compliance to packaging standards and not reflective of the product.

PRODUCT SELECTION:


4515


4545


4540+


4532+


4530

Oil Spills & Clean Up

Hazards & Risks

- Total Petroleum Hydrocarbons (TPH) is a mixture of many different chemicals coming from crude oil (e.g Benzene, Toluene, Xylenes). Skin contact with crude oil/TPH can cause rashes, irritation or severe contamination.
- Dispersing agents can also cause dry skin and dermatitis.

Key activities requiring coveralls

- Manual removal of oiled materials
- Manual cutting of oiled vegetation
- Manual sorbent application, boom deployment,, handling and retrieval.
- Pressure washing operations
- Sump & Pump operations
- Load & transfer of oil-saturated plants & animals

News story featuring 3M coveralls being used in clean up operation in a Thailand Oil Spill

Products to consider

- For most on-shore clean up operations, Type 5/6 coveralls may offer appropriate protection against solids and light oil splashes.
- Often type 4 coveralls with taped seams and good organic chemical resistance are suggested for higher exposure to oïl i.e. boom deployment, low-pressure washing (e.g. 3M 4565)
- For high-pressure washing, type 3 coveralls are likely to be more appropriate (e.g. 3M 4570)
- Accessories such as overboots & oversleeves are commonly used

Key selection factors

- Comfort
- Protection against oil
- Availability of accessories

PRODUCT SELECTION:

4520 4532+ 4540+ 4565 4570

Construction

Hazards & Risks

- On construction sites, workers can come into contact with substances such as polyurethane foam, paints & coatings containing solvents and resins, materials containing tar, asbestos.
- Asbestos is still a growing concern, with 600k construction workers in the EU* and 1.3 million in the U.S* exposed annually. Epoxy resins can cause skin irritation and allergic reactions.

Key activities requiring coveralls

- Mixing components: resin and curing agent
- Coatings with epoxy resin for industry flooring or tank equipment
- Working with release oil
- Building redevelopment using materials containing tar
- Painting & coating activities
- Asbestos waste disposal

Products to consider

- For most applications Type 5/6 coveralls will offer appropriate protection against the hazards encountered
- Particle protection for hazardous particles such as asbestos is often a requirement
- Laminates and treated SMS such as the 3M 4532+ can be used for liquid hold out against tar for example

Key selection factors

- Comfort
- Breathability
- Robustness
- Protection against particles
- Protection against solvents and oils
- Price

PRODUCT SELECTION:

4515 4520 4532+ 4540+

Asbestos

Hazards & Risks

- Particles or fibres that penetrate a coverall and reach the wearer can attach to the wearer's skin and hair and be difficult to remove by showering. With time, these particles are shed with the skin and can subsequently be inhaled (« secondary » inhalation).

Key activities requiring coveralls

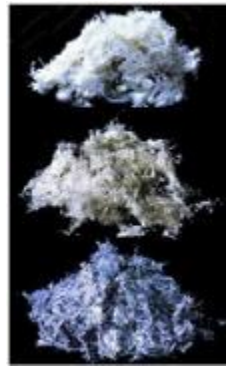
- Site preparation and non-licenced work activities
- Asbestos Removal
- Asbestos waste disposal

Products to consider

- Type 5/6 coverall materials offer an excellent barrier to asbestos fibres.
- For site preparation and non-licenced work activities, type 5/6 SMS coveralls are usually chosen because of comfort and lower price
- For asbestos removal activity, licenced companies tend to select laminated coveralls (type 5/6 or type 4) for the perceived higher barrier efficiency and resistance to water.
- For asbestos removal. 3M recommends type 4 coveralls with overtaped seams for added protection (such as. 3M 4565) .

Key selection factors

- Protection against small sized fibres
- Price (as for any disposable item used in this industry)
- Robustness to avoid cracking in critical points (between legs and arms)
- Fit with Full Facepiece Respirators to avoid sealing tapes to come into contact with skin
- Comfort



PRODUCT SELECTION:

4515 4520 4540+ 4545 4565

Pharmaceutical

Hazards & Risks

- Many organic & inorganic chemicals are used in developing active substances, producing bulk & finished products. Chemicals (sodium hydroxide, ammonia, methylene chloride) are also used for cleaning activities.
- Exposure to chemical liquid and dust can irritate or damage the skin, cause allergic reaction or other severe health effects.
- Products also need protection from particulate and microbiological contamination.
- Electrostatic sparking is an issue in operations where risks of fire or explosions may exist

Key activities requiring coveralls

- Loading / unloading operations (dryers, containers, granulators, filters).
- Separating and transferring liquids
- Mixing solids & liquids in compounding
- Cleanroom
- Biological Hazards

Products to consider

- Type 5/6 coveralls offer a good barrier to dusts from loading and unloading operations or when handling chemical drums. Type 4 coveralls may be more suitable against highly toxic dusts.
- For longer operations in closed rooms, integrated suits with powered or supplied air respirators may be well suited. 3M offers collared models of the core line coveralls for use with repsiratory equipment.
- Type 3 coveralls may be suitable for emergency interventions in case of chemical spills and leaks. (eg. 3M 4570)
- Accessories such as overboots and oversleeves are commonly used
- CE simple garments, lab coats and mob caps are used by plant visitors and workers handling non-hazardous colouring or flavouring agents

Key selection factors

- Protection level,
- Comfort,
- Anti-static
- Mechanical strength
- Linting propensity
- Use of accompanying respiratory equipment

PRODUCT SELECTION:

Agriculture

Hazards & Risks

- Pesticides used in Agriculture can enter the body via skin absorption and cause severe illness or poisoning. Pesticides vary greatly in toxicity, which depends on the formulation.
- Most of the exposure to pesticides is through the skin. Risks arise during preparation and cleaning phases due to exposure to higher concentrations of active ingredients.
- Farmers can also be exposed to viruses from infected animals (see biological hazards)

Key activities requiring coveralls

- Mixing & loading pesticides
- Applying/Spraying pesticides
- Cleaning spraying equipment

Products to consider

- For ground level pesticide applications or handling treated plants, type 5/6 coveralls can, in some cases, provide adequate protection.
- For most pesticide spray applications, type 4 coveralls are recommended (eg. 3M 4565).
- When mixing and loading highly toxic liquid concentrates, or for prolonged exposure to highly toxic spray, type 3_coveralls may be suitable. (eg. 3M 4570)

Key selection factors

- Protection level (CE type)
- Performance against permeation against specific chemicals
- Heat stress
- Comfort

PRODUCT SELECTION:

4565

4570

Biological Hazards

Hazards & Risks

- Recently, there has been an increasing number of incidents involving biological agents.
- Biological agents refers primarily to micro-organisms such as bacteria, viruses and fungi. These substances can be pathogenic, sensitising or toxic.
- Risks arise from direct contact with those agents or from contact with infected people, animals or plants.

Key activities requiring coveralls

- Sewage treatment
- Meat processing
- Health Care
- Farming (crop, dairy, animal)
- Leather industry
- Waste disposal
- Water management
- Clean up of natural distaters
- Health (transmitted diseases)

Products to consider

- For exposure to solid contaminated particles in operations such as inspection, type 5/6 or type 4 coveralls approved to EN14126 may be suitable.
- Type 4_coveralls are commonly used for additional protection against light splashes of contaminated liquids i.e blood (eg. 3M 4565).
- For applications where toxic disinfectants and wet-decontamination of the garment is needed, type 3 coveralls are likely to be needed (eg. 3M 4570)

Key selection factors

- Risk grouping 1-4
- EN14126 Classification
- Fit & convenience
- Heat stress
- Type requirement i.e. taped seams
- Compatibility with complementary PPE

PRODUCT SELECTION:


4510


4545


4565


4570

3M Science. Applied to Life.™

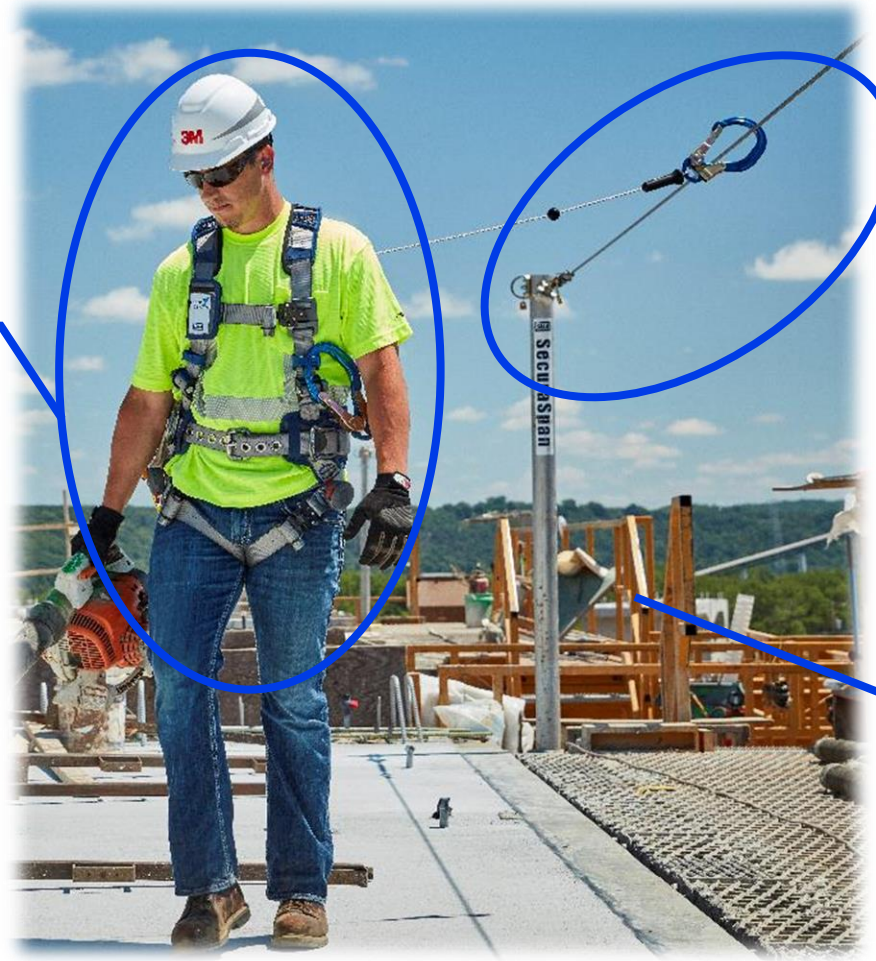
Fall Protection

3M Fall Protection focuses on three main product concepts

Effective fall protection requires a combination of products working together

Personal Fall Protection Equipment

The fundamentals of fall protection that form a complete fall protection system for maximum worker protection



Systems and Structures

Unique solutions – temporary or permanent – that offer a combination of features to fit a particular job.

Expertise Delivery

More than gear: the knowledge and experience to help workers return home safely

3M Fall Protection focuses on three main product concepts

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The fundamentals of fall protection that form a complete fall protection system for maximum worker protection

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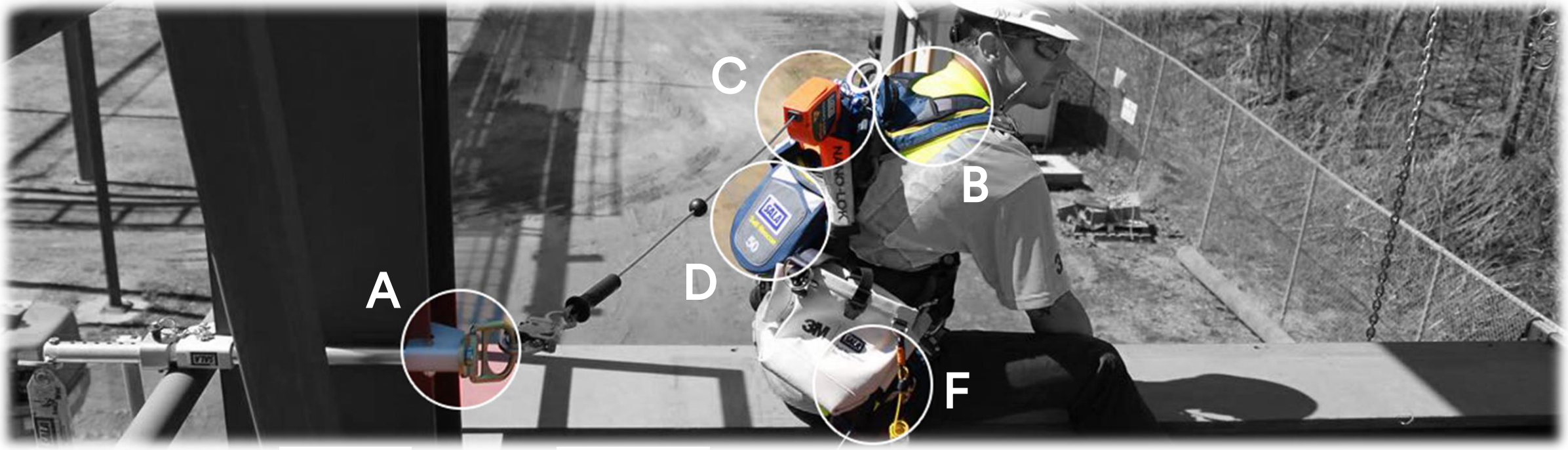
Defining personal fall protection equipment: A-B-C-D-E-F

Each is an important component of a comprehensive fall protection program



A: Anchors

B: Body Support

C: Connectors

D: Descent/ Rescue

E: Education

F: Fall Protection for Tools

3M Fall Protection focuses on three main product concepts

Effective fall protection requires a combination of products working together

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Systems and Structures

Unique solutions – temporary or permanent – that offer a combination of features to fit a particular job.

Expertise Delivery

More than gear: the knowledge and experience to help workers return home safely

Tailoring systems to your needs

When it comes to versatile, reliable fall protection for unique work environments, we will help you every step of the way

Standard design

Custom design

Engineering

Fabrication

Key Considerations:

Anchorage structure type

Lifeline type

Clearance requirements

Number of users

3M Fall Protection focuses on three main product concepts

Effective fall protection requires a combination of products working together

Personal Fall Protection Equipment

The fundamentals of fall protection that form a complete fall protection system for maximum worker protection

Systems and Structures

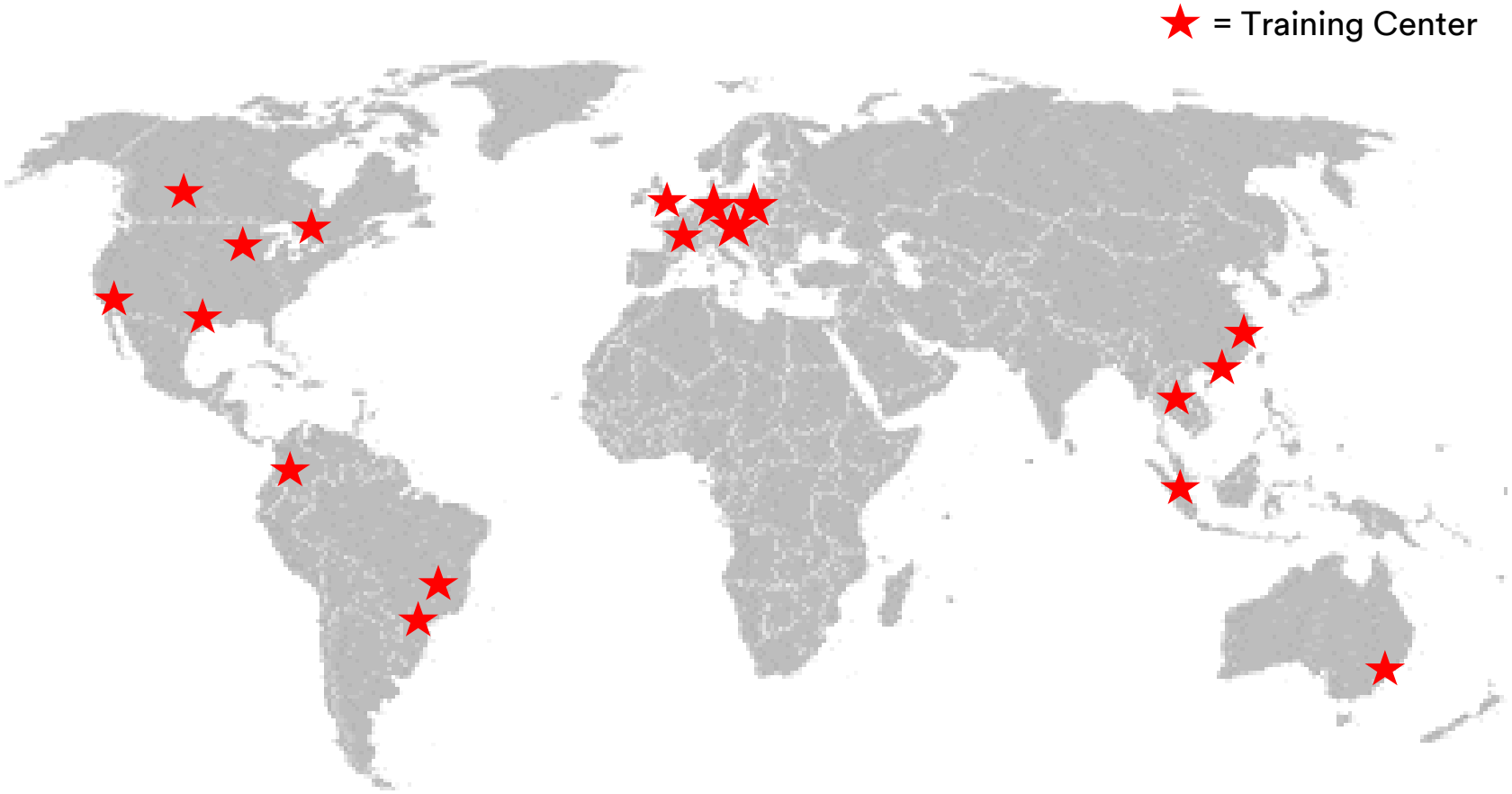
Unique solutions – temporary or permanent – that offer a combination of features to fit a particular job.

Expertise Delivery

More than gear: the knowledge and experience to help workers return home safely

We also offers training and services to help all workers at height and those who employ them

18 Training Centers Worldwide



Course topics include:

- Fall Protection Competent Person
- Confined space entry and rescue
- Fall protection for tools – dropped object competent person
- Wind energy, tower, and industrial rescuer
- High angle rescue
- Rope Access
- Equipment inspector

If you can’t come to us, we can come to you

~ 95 Demonstration vehicles worldwide

Plus, on-site courses:

Whether the safety training is done in your warehouse, drilling derrick, or mine, 3M offers all of its open enrollment courses, as well as many customized courses at your site.

Not only is this often a great cost savings, but the training is tailored to your site and workers, and the hands-on scenarios actually resolve fall protection hazards in and around your facility.

Height Safety- Pillars of Fall Protection

A Anchorages

are a secure point of attachment. Anchorage connectors vary by industry, job, type of installation and structure. They must be able to support the intended loads and provide a sufficient factor of safety for fall arrest.

B Body support

harnesses distribute fall forces over the upper thighs, pelvis, chest and shoulders. They provide a connection point on the worker for the personal fall arrest system.

C Connectors

such as shock-absorbing lanyards or self-retracting lifelines connect a worker's harness to the anchorage.

D Descent and rescue

devices are used to raise or lower a fallen injured worker to safety or retrieve him from a confined space.

E Education

is essential. We offer a variety of training and consultative services to fit your needs.

F Fall protection for tools

helps make work environments safer and more productive by reducing dropped object incidents.

3M Science. Applied to Life.™

Thank you.

Elevate safety to
new heights.

Questions?

Personal Safety Division
Product Portfolios

Hearing Protection

Adv. Hearing Protection

Eyewear

Hard Hats

Face Shields

Fall Protection For Tools

Disposable Respirators

Reusable Respirators

Protective Apparel

SCBA

Welding

Respiratory Protection

Fall Protection

Connected Safety

Gas & Flame Detection

Thermal Imaging