RESPIRATORY PROTECTIVE EQUIPMENT PROGRAM

TNCL-OHS-SOP- 0017

Approvals:

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Definitions:

Respiratory Protective Equipment (RPE)	Is a particular type of personal protective equipment (PPE) designed to protect the wearer from breathing in harmful substances or from oxygen-deficient atmospheres when other controls are either not possible or insufficient on their own
Assigned Protective Factor	In simple terms, this is the ratio of hazardous substances outside the RPE to the amount inside the RPE.

Abbreviations

RPE	Respiratory Protective Equipment
APF	Assigned Protective Factor
QNFT	Quantitative Fit Testing
ERT	Emergency Response Team
SDS	Safety Data Sheet
QLFT	Qualitative Fit Testing
QNFF	Quantitative Fit Factor
CNP	Controlled Negative Pressure
SCBA	Self-Contained Breathing Apparatus
Co	Challenge Concentration Outside
Ci	Challenge Concentration Inside

Scope

The Respiratory Protective Equipment program will cover all employees, both TNCL and the contractors, who will be exposed to airborne hazards, of which controlling the exposure of means was not sufficient.

The program will also cover the employees who are exposed to airborne hazards, of which the exposure cannot be sufficiently quantified to conclude it is below the minimum exposure limit.

Cost of the program

The program cost from procurement of the fit testing machine and its consumables, procurement of the respirators, maintenance, replacement and training will be from the General manager's budget. This will reduce administrative challenges and, therefore, the sustainability of the program.

Legislation

The Occupational Health and Safety Act of Tanzania, 2003, states in section ' 60. Every factory or workplace where activities carried out involve Risk hazardous processes or hazardous equipment or use of hazardous chemical substances, likely to result in adverse health effects to people or serious damage to property or environment in case of accidents, the employer shall ensure that -

(a) risk assessment annually or any other time when the need for the

risk assessment deemed necessary is done by an approved inspection authority;

(b) evidence of the risk assessment is furnished to the Chief Inspector or an inspector when requested.

61.-(I) In any factory or workplace which is in connection with any process carried on, there are given off any dust or fumes or other impurities of such a character, and to such extent, as to be likely to be injurious or offensive to the persons employed or any substantial quantity of dust or fumes of any kind, the employer shall ensure that -

(a) all practicable measures are being taken to protect the persons employed against inhalation of the dust or fume, or other impurity and to prevent it from accumulating in any workroom.

Therefore, having an RPE program in the workplace is a statutory requirement after considering the risks identified during the baseline HIRA.

Rationale

During the baseline risk assessment, the employees were classified from Group A to H. There were some groups of employees whose exposure to airborne hazards could not be sufficiently quantified, and the available control measures were insufficient to conclude that the exposure would be below the minimum exposure limit.

Therefore there is a need to have an RPE program, and the exposed employees will be under the medical surveillance program and will also be under the RPE program until the exposure is sufficiently controlled with the other means apart of RPE.

Hazards Identification, Risk Assessment and Risk Control

The Respiratory Protective Equipment Program will be implemented as part of the hierarchy of control of risk at the workplace. The program will always be preceded by the HIRA, and should the airborne exposure couldn't be controlled by other means, for example, elimination, substitution, engineering and administrative controls, then the use of Respirators will be rationalised. This program will not act as a substitute for appropriate occupational health principles for controlling occupational risks.

Who will be covered under the RPE program

The following groups of employees will be covered under the RPE programs due to their exposure to airborne hazardous substances at the workplace:

- Clinic personnel
- Painters
- Welders
- Masons
- Vector control officers
- Drillers and driller assistants
- Geotechnicians
- Electricians
- Plumbers
- Carpenters
- The risk assessment will identify other groups.
- ERT team

The Respiratory Protective Equipment (RPE)

The basics of RPE

Some of the working activities and working environment might expose employees to airborne hazardous materials. These may range from airborne biological hazards such as Mycobacterium Tuberculosis and measles and airborne hazardous chemical agents, which may be in the form of solid, liquid or gaseous form.

The following activities may expose an employee to airborne hazardous substances:

- Cutting a material such as stone or wood;
- Using a product containing volatile solvents;
- Handling a dusty powder;
- Welding stainless steel.
- Attending patients
- Plumbing works
- Working in confined spaces where the oxygen content is low

The RPEs are designed to protect the wearer from a variety of hazards, suit a variety of work

situations and match the specific requirements of the wearer. RPEs are available in different sizes to allow for the facial differences of workers, gender, ethnicity, build and many other factors. **This means that one size of facepiece will not fit everyone.**
The RPEs should be suitable and adequate:

- Adequate – It is **right for the hazard** and reduces exposure to the level required to protect the wearer's health.
- Suitable – It is **right for the wearer,** task and environment, such that the wearer can work freely and without additional risks due to the RPE.

Types of RPEs

There are two main types of RPEs:

- Respirators (filtering devices)
- Breathing apparatus

Respirators (filtering devices) use filters to remove contaminants from the air being breathed in. They can be either:

- Non-powered respirators – relying on the wearer's breathing to draw air through the filter; or
- Powered respirators – use a motor to pass air through the filter to give a supply of clean air.

The breathing apparatus needs a supply of breathing-quality air from an independent source (e.g. air cylinder or air compressor)

Respirators and BA are available in a range of styles, divided into two main groups:

- **Tight-fitting facepieces (often referred to as masks):** rely on having a good seal on the wearer's face. These are available as both non-powered and powered respirators and BA. A fit face test should be carried out to ensure the RPE can protect the wearer.
- **Loose-fitting facepieces** rely on enough clean air being provided to the wearer to prevent contaminant leaking in (only available as powered respirators or BA). Examples are hoods, helmets, visors, blouses and suits.

RPE filters

A key component of any respirator is the filter. Filters are available for solid or liquid particles, vapours and gases. They can be an intrinsic part of the device or come as a separate filter so they can be changed on a reusable respirator. It is vital that you choose the correct filter, which will be effective against the hazard.

Breathing apparatus

There are different types, but all will supply air from an independent source, such as a compressed air cylinder or air compressor; it can be used against a range of airborne hazards and in different atmospheres.

RPE that will be currently used onsite

Clinic personnel:

N95 Respirators – For Mycobacterium Tuberculosis or when handling a patient with other airborne diseases, i.e., measles, varicella or when doing any aerosol-generating procedure.

When dealing with Ebola, a Powered Air Purifying Respirator (PAPR) with a hood and full-face shield must be used.

ERT officers and when working in confined spaces

During the act of fire fighting or when working in confined spaces, SCBA should be used.

Full-face respirators with filters will with filters (canisters) should be used when dealing with hazardous chemical exposure incidents.

The employee who will be working in confined spaces may use air-supplied respirators or SCBA.

Vector control officers:

During the indoor residual spraying, fogging and fumigation, the employees should use the Powered Air Supplied Respirator or SCBA. The non-powered respirators can also be used if it's full or half-face with special filters (Black canisters) specific for pesticide exposure.

Welders

The welders, at a minimum, should use FFP3 half-face respirator with filters. As per the manufacturer's instructions, specific respirators should be used if they are working with specific alloys.

Painters

Currently, we don't have the spray painters onsite. In the ongoing painting work, the main exposures are epoxy resins and solvents; therefore half, face respirators with canisters/filters will be used.

Drillers, carpenters, drillers assistants and exposure to non-toxic dust

The recommended respirator is an FFP2 mask or N95 mask.

Plumbers

Depending on where they will be working, they might need an N95 respirator, SCBA or air-supplied respirator. They should always be in touch with the occupational health team and should go to work in the sewage tanks, confined space areas etc.

Procurement of the respirators

All respirators must meet either or both European standards (CE marked) or NIOSH/OSHA-USA standards. No respirator will be accepted onsite if it doesn't meet the above standards.

The procedures to be followed during the RPE program

HIRA

The Risk assessment that indicates exposure to airborne hazardous materials must be present. This will indicate not only the presence of airborne hazardous substances but also in what physical form; gaseous/vapour, liquid or solid. Also, the HIRA should indicate the route of exposure and the available control measures. Finally, the HIRA should indicate who is exposed and be able to at least quantify the exposure semi-quantitatively. If there are any employees who previously suffered occupational disease due to the exposure or currently the employee is presenting with symptoms, all of these must be captured.

Exposure assessment

The exposure identified in the HIRA must be quantified quantitatively. If the exposure is at or above the occupational exposure limit, the employee will be under medical surveillance and also will be under the REP program. If the airborne hazardous chemical agent is carcinogenic, allergic, or an airborne biological substance, the employee will again be put under medical surveillance. The exposure assessment will only be accepted if a certified occupational hygienist or technologist conducts it, and the samples should be analysed in an internationally accredited laboratory.

Risk mitigation

Before instituting the RPE program, exposure to airborne hazardous chemical agents must either be prevented or, if it's not reasonably practicable, it must be controlled. The control measures must follow the hierarchy of control principles. The usage of RPE should be the last resort and not the main control measure.

Deciding on the type of respirator to be used

The decision on what type of respirator should be used is mainly guided by adequacy factors and suitability factors. The adequacy factors are explained in the decision tree and the

figures below. It is important to take into consideration the Assigned Protective Factor of the respirator (APF).

There are only a few number ratings used, so RPE APFs will be either: 4; 10; 20; 40; 200 or 2000. When calculating the protection factor, **always** an APF above the calculated value will be used. Does the SDS provide advice on the required APF?

Table 1: Example of a calculation to find the required APF:

Substance – Toluene (a common solvent)

- Measured airborne toluene concentration:
  350 ppm (parts per million) within an eight-hour time-weighted average (TWA).
- Toluene WEL: 50 ppm (from EH40).
- Required APF to reduce to WEL = 350/50 = 7.

Select RPE device with an APF above the required protection factor. In this case an APF of 10 will be required.

Figure 1: The decision tree for choosing the type of RPE.

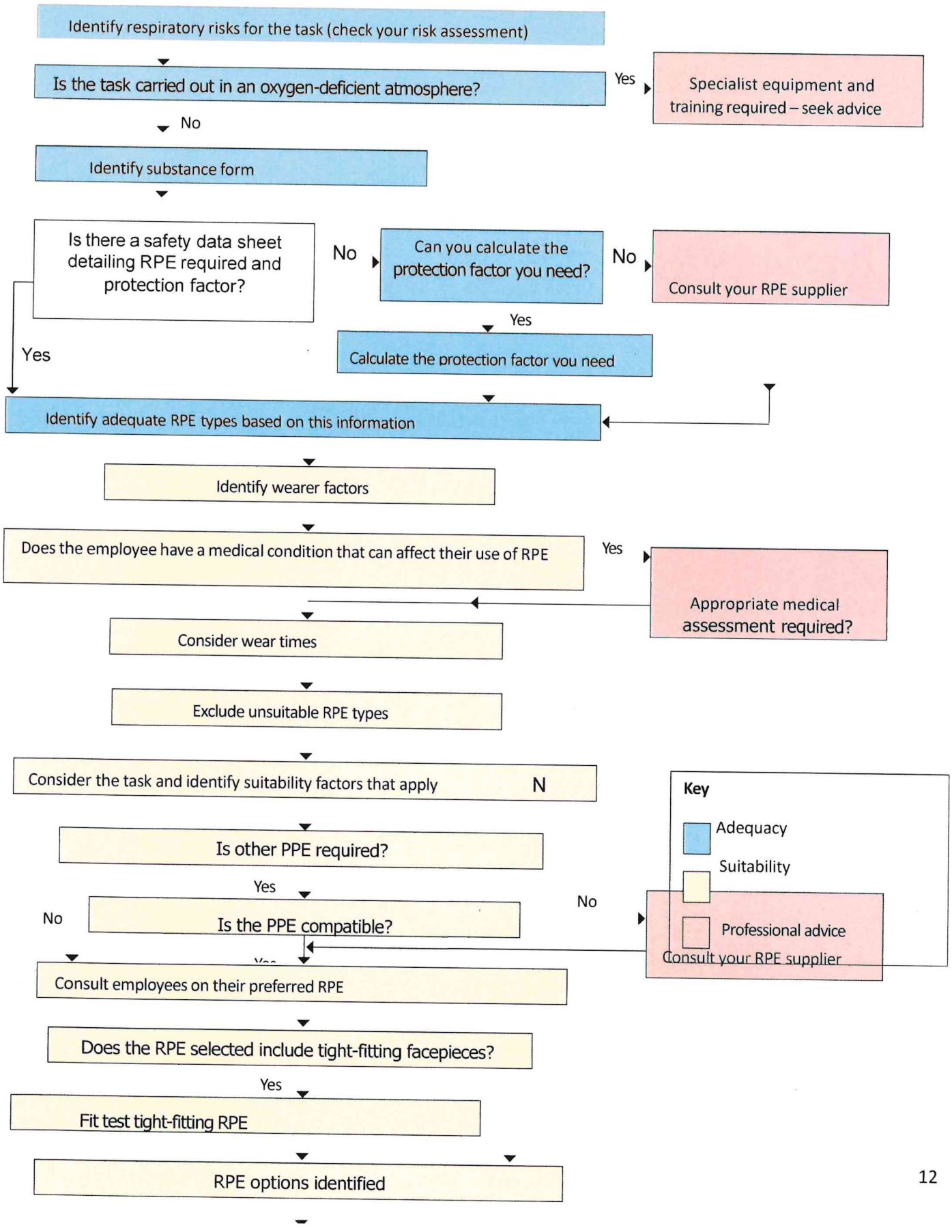

Table 2: RPE types and characteristics

Adequacy/suitability	Respirators						
RPE type							
	Disposable half mask – particle filter*	Reusable half mask – particle filter	Reusable half mask – gas/ vapour filter	Full face mask – particle filter	Full face mask – gas/vapour filter	Powered mask	Powered hoods/helmets
Effective for particles	✔	✔	✘	✔	✘	✔ **	✔ **
Effective for gas/vapour	✘	✘	✔	✘	✔	✔ **	✔ **
Continuous wear time	Less than 1 hr	Less than 1 hr	Less than 1 hr	Less than 1 hr	Less than 1 hr	More than 1 hr	More than 1 hr
APF4 types	✔	✔	✘	✔	✘	✘	✘
APF10 types	✔	✔	✔	✔	✘	✔	✔
APF20 types	✔	✔	✘	✘	✔	✔	✔
APF40 types	✘	✘	✘	✔	✘	✔	✔
APF200 types	✘	✘	✘	✘	✘	✘	✘
APF2000 types	✘	✘	✘	✘	✘	✘	✘

* Sometimes referred to as a filtering facepiece or orinasal respirator.

** Only protects against particles or gas/vapour when the appropriate filter is fitted.

Table 2: RPE types and characteristics continue.

Adequacy/suitability	Breathing apparatus		
RPE type			
	Fresh air hose	Constant flow airline	Demand valve
Effective for particles	✔	✔	✔
Effective for gas/vapour	✔	✔	✔
Continuous wear time	Unassisted less than 1 hr Assisted/powered more than 1 hr	More than 1 hr	More than 1 hr
APF4 types	✘	✘	✘
APF10 types	✔	✔	✘
APF20 types	✘	✔	✘
APF40 types	✔	✔	✘
APF200 types	✘	✔	✘
APF2000 types	✘	✘	✔

The suitability factors are divided into three groups:

- Wearer factors:
- Task factors:
- Working environment

Table 3: Sustainable factors for the RPE program

Suitability factor	Why	Solution	
Work rate	Higher work rates may increase breathing and sweating, which can affect the performance of some types of RPE. Higher breathing rates can cause contaminants to leak in, and sweating can cause facepieces to slip and leak.	Light work rate	Sedentary work: assembly or sorting of light materials, arm and leg work, drilling. Most RPE would be suitable.
		Medium work rate	Sustained hand and arm work: sawing, planing or chiselling wood, plastering, filing, work with pneumatic breaker, intermittent handling or carrying moderately heavy material, shovelling, sledgehammer work, concrete block laying, pushing or pulling heavily laden hand-cart. Consider more comfortable RPE, such as powered respirators or loose-fitting devices.
		Heavy work rate	Heavy manual work: shovelling or digging, climbing, ramps or ladders. Powered respirators or BA are recommended.
Wear time	Unpowered tight-fitting masks become uncomfortable to wear for long periods, and wearers may be tempted to loosen or remove the RPE.	Wear time more than 1 hr	Using powered RPE with tight-fitting masks or loose-fitting facepieces will help minimise fatigue and discomfort.
Abnormal temperature or humidity	In hot and humid conditions, wearing RPE increases heat stress, sweating and discomfort.	Extreme heat	Using powered respirators or airline BA would help to minimise these problems. Proprietary cooling devices

			are available but consume a lot of compressed air.
	Airflow associated with powered respirators or airline BA can cause chilling effects.	Extreme cold	Proprietary heating devices are available but consume a lot of compressed air.
Facial hair and markings	Affects where a face mask seals to the face and will cause leakage.	Beard, stubble or any hair in the region where a face mask seals Deep cuts or scars, wrinkles, moles, and warts present in the face seal area	Consider the use of loose-fitting facepieces, which do not rely on a tight seal in this region.

Suitability factors	Why	Solution
Spectacles	Spectacles with side arms are incompatible with full face masks as they break the face seal, and they may also interfere with the fit of half masks.	RPE manufacturers can supply special frames which fit inside their masks. It is the responsibility of the employer to find and provide an appropriate solution.
Vision	If you need to see fine details when wearing RPE but don't need to protect the eyes from the airborne hazard, RPE types, which include face protection (full face masks, visors, hoods), may not be ideal because they can be prone to scratching, misting and surface contamination.	Consider half-mask RPE, provide adequate lighting, or choose designs that resist scratching and internal misting. Powered respirators or airline BA are more resistant to misting. Some types include 'tear-off' consumable visors.

Communication	All RPE affects your ability to communicate.	If your work requires clear and precise communication, you should use RPE incorporating proprietary communication devices (ranging from simple speech diaphragms to complex radio intercom systems) or other suitable forms of communication.
Flammable or explosive atmospheres	RPE can be a source of ignition.	If you cannot avoid working in potentially flammable or explosive atmospheres, including oxygen-enriched atmospheres (levels above 21%), you may need to use intrinsically safe, light alloy-free and antistatic RPE.
Use of air power tools	Air jets from power tools (pneumatic or electric) can make RPE valves leak.	Shield tools or seek alternative design. Use RPE designs with valves remote from the tool exhaust location.
	Connecting air-powered tools and your RPE to the same air supply will affect RPE performance.	Ensure that your compressor can supply enough air for both at the same time.
Contact lenses	Wearers may suffer discomfort, or if the lenses are dislodged, the wearer may remove the RPE to replace them while still in the hazardous area.*	Use spectacles (in the mask if necessary) instead.
Mobility	Snagging and damage to trailing hoses. Added bulk of fan units/air cylinders in tight spaces.	Ensure adequate inspection regime and consider other RPE types.

Training

All people involved in the selection, use, storage and maintenance (if required) of RPE require training. An appropriate training programme could cover the following areas:

- Why RPE is needed.
- The hazards, risks and effects of exposure.
- What is RPE being provided?
- How RPE works.
- Why fit testing is required (if relevant).

- How to wear and check the RPE correctly.
- Fit checking before use.
- What maintenance is required and when.
- Where and how it should be cleaned and stored.
- How to report/tackle any problems.
- Employee and employer responsibilities.
- Use and misuse of RPE.
- The wearer needs to be clean-shaven around the face seal to achieve an effective fit when using tight-fitting facepieces.
- Training is a good opportunity to make employees aware of this. If workers have beards or are unable to be clean-shaven, a tight-fitting device will not be suitable, so an appropriate loose-fitting device should be chosen.

The training should be provided by a competent person. The training should be given to every new employee and then annually.

Respirator fit testing

Fit testing is a method for checking that a specific model and size of tight-fitting facepiece matches the wearer's facial features and seals adequately to the wearer's face. It will also help to identify unsuitable facepieces which should not be used.

The performance of tight-fitting facepieces depends on achieving good contact between the wearer's skin and the face seal of the facepiece. People's faces vary significantly in shape and size, so it is unlikely that one particular model or size of RPE facepiece will fit everyone. Inadequate fit will significantly reduce the protection provided to the wearer. Any reduction in protection may lead to immediate or long-term ill health or can even put the RPE wearer's life in danger.

A pre-use wearer-seal check should be carried out each time a fit-tested facepiece is worn and before entering the hazardous environment. This check is to determine whether the wearer has correctly donned a facepiece before entering a contaminated work area. The RPE manufacturer will provide instructions on how to carry it out. Note, however, that a pre-use wearer-seal check is not a substitute for fit testing.

Tight-fitting facepieces (often referred to as masks) rely on having a good seal on the wearer's face. These are available as both non-powered and powered respirators and breathing apparatus (BA) with either a half mask or a full-face mask. Their performance, irrespective of whether they are non-powered (negative pressure), powered or constant-flow airline BA relies heavily on the quality of fit of the facepiece to the wearer's face. An inadequate fit will significantly reduce the protection provided to the wearer.

It is important to know that some pre-existing medical conditions (for example, breathing disorders such as asthma, skin allergies, or even heart problems) may restrict or prevent some workers from wearing any RPE or certain types of RPE. You will need to ensure that workers are fit to wear the selected and required RPE.

Guidance on respiratory protective equipment fit testing 2 Health and Safety Executive Powered or constant-flow airline BA RPE with loose-fitting hoods or helmets do not require fit testing. Tight-fitting,

powered or constant-flow airline BA RPE under positive pressure still requires fit testing, as studies have shown that during heavy exertion, inward leakage is possible.

A fit test should be carried out as part of the initial selection of the RPE. A fit test should be repeated annually or whenever there is a change to the RPE type, size, model or material or whenever there is a change to the circumstances of the wearer that could alter the fit of the RPE; for example:

- Weight loss or gain.
- Substantial dental work.
- any facial changes (scars, moles, effects of ageing etc.) around the face seal area;
- facial piercings.
- Introduction or change in other head-worn personal protective equipment (PPE).

As part of your RPE programme, it is good practice to have a system in place to review when a repeat fit test may be required. For example, face shape will change through ageing alone. There are two basic types of RPE fit testing – qualitative and quantitative.

Qualitative fit testing (QLFT)

Qualitative fit testing (QLFT) is a pass/fail test based on the wearer's subjective assessment of any leakage through the face seal region by detecting the introduction of bitter- or sweet-tasting aerosol as a test agent. QLFT methods are suitable for disposable and reusable half masks; they are not suitable for full-face masks. Although this type of test is based on subjective detection and response by the wearer of the RPE, it is important that it is administered by a fit tester competent in using this method.

Quantitative fit testing (QNFT)

Quantitative fit testing (QNFT) provides a numerical measure of how well a facepiece seals against a wearer's face; this is called a fit factor. These tests give an objective measure of face fit. QNFT methods are suitable for disposable and reusable half-masks and full-face masks. Examples of QNFT methods are:

- Ambient particle counting.
- Controlled negative pressure (CNP).

The fit factor, which is calculated by the fit test equipment, uses the following formulas:

For the ambient particle counting method, the quantitative fit factor (QNFF) is calculated as the ratio of the two aerosol concentrations measurements as shown in formula (1):

$$QNFF = \frac{Co}{Ci} \qquad (1)$$

Where

Co is the challenge aerosol concentration outside the facepiece.

Ci is the challenge of aerosol concentration inside the facepiece.

For the CNP method, the QNFF is calculated as the ratio of the inspiratory flow rate and the mean leakage flow rate as shown in formula (2):

$$QNFF = \frac{IFR}{LFR} \qquad (2)$$

Where

IFR is the inspiratory flow rate associated with CNP challenge pressure;

LFR is the mean leakage flow rate measured with the head held in a motionless position at the end of each test exercise.

For half masks, the CNP challenge pressure should be 15 mm (0.58 inches) H_2O, and the inspiratory flow rate should be 53.8 litres/min. For full-face masks, the CNP challenge pressure should be 25 mm (1 inch) H_2O, and the inspiratory flow rate should be 55.8 litres/min.

The type of fit test method used depends on the type of RPE to be fit tested. Table 1 shows which fit test methods are applicable.

Table 4: Fit test method selection

Fit testing method				
RPE (type and mask)		Quantitative (QNFT)		Qualitative (QLFT)
		Ambient particle counting	Controlled negative pressure	Taste
Disposable respirator	Half mask	Yes	No	Yes
Reusable respirator	Half mask	Yes	Yes	Yes
	Full-face mask	Yes	Yes	No
Powered respirator	Half mask	Yes	Yes	Yes
	Full-face mask	Yes	Yes	No
Constant flow airline BA	Half mask	Yes	Yes	Yes
	Full-face mask	Yes	Yes	No
Fresh air hose BA	Half mask	Yes	Yes	Yes
	Full-face mask	Yes	Yes	No
Demand valve BA	Half mask	Yes	Yes	Yes
	Full-face mask	Yes	Yes	No
Escape BA	Full-face mask	Yes	Yes	No

If it is not possible for the wearer to obtain an adequate fit with the first choice of the facepiece, you should attempt fit testing using an alternative make, model or size of the tight-fitting facepiece. Where you cannot achieve an adequate fit, you should select another type of RPE that does not rely on a tight-fitting face seal, such as a loose-fitting respirator hood or helmet.

You should record the fit test by means of a report or certificate, which should clearly state whether the result of the fit test was a pass or fail.

The fit test report should be available to the employee and accessible to others, such as enforcement authorities. Collective reports should be available to safety representatives. You should record RPE examinations and tests – and, where appropriate, any repairs made – and retain them for at least five years.

Cleaning and disinfection

There must be a cleaning program for respirators. The respirators should be cleaned and then disinfected before they can be provided to another employee. The supervisors will be responsible for ensuring that all respirators that have been used are properly cleaned and disinfected.

Maintenance and replacement

The rubber seal of the respirators, valves and filters is subject to maintenance and replacement. The maintenance program will be under the engineering team, and should the employee wants to replace the respirator, then the supervisor of the employee's department should be able to provide the employee with the new respirator.

Storage

Each department must provide a room where the RPE that are not in use are stored, and those RPE that are in use are stored. The RPE that are in use and those which are not in use should not be mixed up. No employee will be allowed to take the RPE out of the workplace.

Disposal

The RPE, which is disposable, must be disposed of in the appropriately contained red bins and then be incinerated. The RPE that is not disposable but they are beyond repair should be disposed of under the environmental team consultation.

References

This document was written based on the Health and Safety Guidance (HSG) United Kingdom, HSG 53 and INDG479 (rev1)