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Considerations For Selecting The Correct Respiratory Protective Equipment For Work With Pathogenic Micro-organisms

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Introduction

The personal protective equipment is intended to be used or worn by the worker to protect against the risks that might threaten his safety and health at work. The respiratory protective equipment (RPE) such as masks and respirator is therefore mainly personal protective equipment intended for people who are in contact with contaminated air by providing full insulation from the atmosphere and by filtering airborne particles. In contaminated air, respiratory hazards can include airborne contaminants such as pathogenic micro-organisms, dusts, mists, fumes, and gases. For contained use activities, both aspects, worker protection and environmental protection, should be taken into account.

It is important to notice that RPE should be used only after all other reasonably practicable measures to prevent or control inhalation exposure are taken. Respirators are also used for emergency work or temporary failure of controls, and for infrequent exposure, such as during maintenance work.

The decision tree hereunder provides a support tool that leads to the decision about whether or not to wear suitable respiratory protective equipment in the event of exposure to infectious aerosols during the contained use of pathogens.

If the decision to wear a RPE is taken, it is important to select the suitable type of RPE. The most representative RPE is presented in the table below.

Method

The use and the selection of a RPE depend on the hazards to which the worker is exposed; it also depends on the work environment, the type of manipulation and the characteristics and limitations of the biosafety equipment itself.

Therefore, the processes should begin with a risk assessment. The risk coefficient (RC) is an important parameter of the risk assessment. It represents the relationship between the concentration of the contaminant measured in the environment and the permissible exposure value (PEV) below which the majority of individuals should not suffer from symptoms during exposure to non-infectious bioaerosols. However, no PEV has been set for infectious aerosols, thereby the risk assessment must be based on a qualitative approach. Thus qualitative criteria to be considered are

1) the nature of the biological hazard (risk group of the micro-organism, its concentration, size, virulence, the mode of transmission…),
2) the type of manipulation (aerosolisation, possibility of inhalation, work with animal…),
3) the available safety equipment (biosafety cabinet, filtered cage for infected animals…) and
4) the engineering control of the workplace (ventilation, HEPA filtration, negative pressure…).

Conclusion

The use and the selection of a respiratory protection start with an exposure assessment.

The strict application of good laboratory practices, adequate engineering control and the use of biosafety equipment must first be implemented because they can often avoid the use of RPE.

The presented decision tree provides a helpful, effective and practical support for lab workers to assess the risk of the manipulation and to make a choice between the different types of RPE.

Results

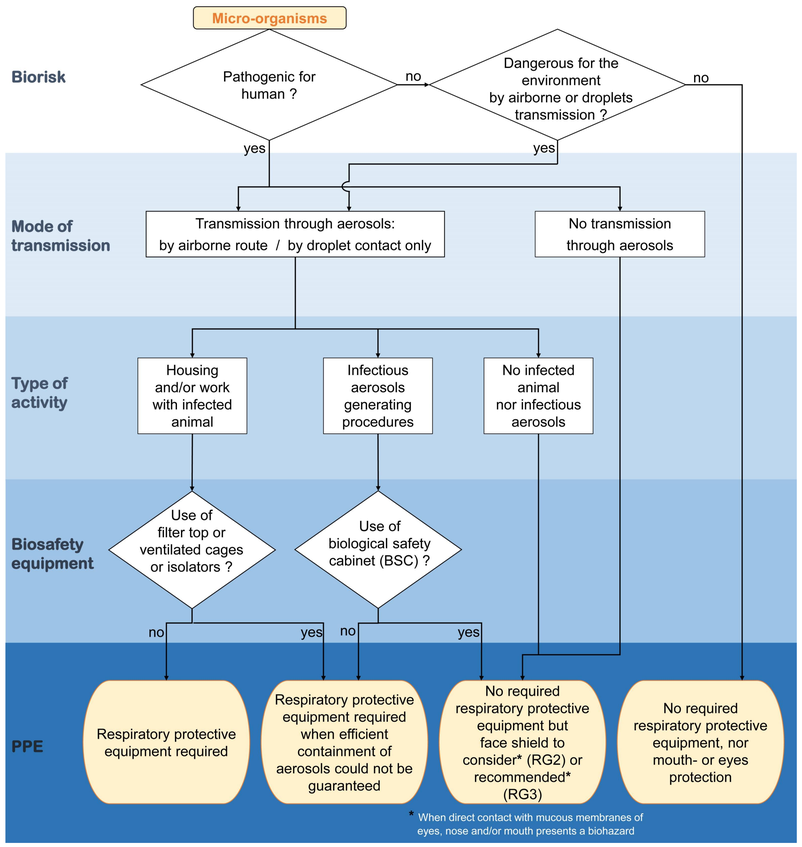


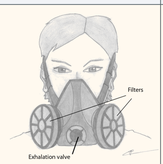
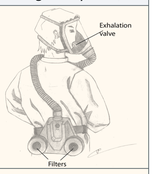
Figure 1: Decision tree on the criteria to determine whether to use a RPE for contained use activities

The choice to wear or not a respiratory protective equipment is easily estimated by the decision tree which resumes the main criteria to be considered for the risk assessment.

There are different types of respirators available in several forms. The two main types of RPE are the air-purifying respirators (APRs), powered or not, that use filters to remove contaminants from the air being breathed in and the supplied-air respirators (SARs) that supply clean air directly to the user from an independent source such as air cylinder or air compressor.

The selection is made following a qualitative approach, considering in addition the knowledge of the assigned protection factor (APF), and the advantages and disadvantages of the respirators. APF is the level of respiratory protection that a respirator is expected to provide to 95% of adequately trained and supervised wearers.

This table is not exhaustive, it presents the most common RPE used during contained use of pathogens.

Type of RPE	*Disposable particulate respirator*	*Half-facepiece respirator*	*Full-facepiece respirator*	*Powered air-purifying respirator with loose-fitting facepiece*	*Powered air-purifying respirator with tight-fitting facepiece*
					
APF (*)	**20** (class FFP3)	**20** (class P3)	**40** (class P3)	**40** (class TH3)	**40** (class TM3)
Main advanta-ges	▪ Lightweight ▪ Maintenance-free ▪ No effect on mobility	▪ Reusable ▪ Low maintenance ▪ No effect on mobility ▪ Wider field of vision than full-facepiece	▪ Reusable ▪ Eyes protection ▪ Low maintenance ▪ No effect on mobility ▪ Better face seal than half-facepiece	▪ Eyes protection ▪ Low breathing resistance → more comfortable ▪ No fit test required ▪ Suitable for beards, correctives glasses	▪ Eyes protection with full-facepiece ▪ Low breathing resistance → more comfortable
Main disadvan-tages	▪ Not reusable → high cost ▪ No eyes protection ▪ Possible inward leakage ▪ Uncomfortable on long wear time	▪ No eyes protection ▪ Possible inward leakage ▪ Uncomfortable on long wear time	▪ Possible inward leakage ▪ Reduced field of vision ▪ Uncomfortable on long wear time	▪ Weight of battery and blower ▪ Awkward for mobility ▪ Cleaning and disinfecting before reuse	▪ Weight of battery and blower ▪ Awkward for mobility ▪ Fit test required ▪ Cleaning and disinfecting before reuse

* According to norm EN 529

Figure 2: characteristics of some RPE

Legislative references:

Directive 89/686/EEC on the approximation of the laws of the Member States relating to the design of personal protective equipment (Belgian transposition as Royal Decree of December 31, 1992 on the placing on the market of personal protective equipment);
Directive 89/656/EEC on the minimum health and safety requirements for the use by workers of personal protective equipment at the workplace (Belgian transposition as Royal Decree of August 7, 1995 on the use of personal protective equipment)
Directive 2000/54/EC on the protection of workers from risks related to exposure to biological agents at work (Belgian transposition as Royal Decision of August 4, 1996 concerning the protection of workers from risks related to exposure to biological agents at work
Directive 2009/41/EC on the contained use of genetically modified micro-organisms (Belgian transposition as a part of the Regional Environmental laws for classified installations)

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