

# Selection of proven risk management measures (RMMs) to control the exposure to ENMs

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Current knowledge on the effectiveness of personal protective equipment (PPE) and technical measures against nanomaterials is still scarce. However, a number of initiatives, including EU funded research projects and studies from research organizations across the scientific community are starting to appear.

This work presents experimental data on the effectiveness of respiratory protective equipment, chemical protective gloves, protective clothes, and local exhaustive ventilation (LEV) systems to control the exposure to ENMs in occupational settings.

New experimental data on the protection factors achieved under representative exposure scenarios, as well as recommendations for the design of PPE and engineering controls will be presented.

The experimental studies were conducted by means of standard operation procedures (SOPs) developed on the basis of current EN standards, and recommended approaches retrieved from peer reviewed publications.

Concerning PPE, the data retrieved showed that Full and Half Mask Respirators provided adequate performance levels of filtration efficiency against NMs (figure 1). Total inward leakage (TIL) ratios determined in relevant studies suggest that face seal leakage, and not filter penetration, is a key parameter to be considered when working with ENMs.

In the case of protective gloves, performance depends strongly on the material of the glove, and although

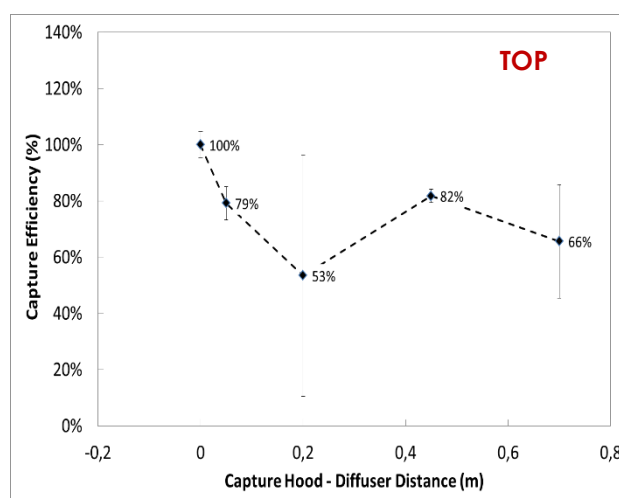
generally there are no pores in their surface, some small defects or gaps can be enough to offer a way in to the glove.

Finally, the performance of LEV systems showed a decrease in efficiency when the distance from the source increases from 0 to 65 cm. With a vertically positioned hood efficiency decreases gradually at 5 cm and drops significantly at 20 cm. At 45 cm a more or less similar efficiency is measured compared with 5 cm efficiency (figure 2).

Figures

RPD	Specifications	Measures	Standard Efficiency	Protection (NMs)	Reference particle
Filters	P2 Filter	Efficiency	94 %	99.83 %	NaCl
	P3 Filter	Efficiency	99.95 %	99.97 %	NaCl
Half Mask	New Mask P3 Filter	Efficiency	99.95%	99.47 ± 0.83 %	NaCl
	Aged Mask P3 Filter	Efficiency	99.95%	99.77 ± 0.29 %	NaCl
Full Mask	New Mask P3 Filter	Efficiency	99.95%	99.73 ± 0.25 %	NaCl
	Aged Mask P3 Filter	Efficiency	99.95%	99.78 ± 0.16 %	NaCl
FFP	FFP1	Efficiency	80%	75.63 %	NaCl
	FFP3 (Model a)	Efficiency	99%	99.77 ± 0.29 %	NaCl
	FFP3 (Model b)	Efficiency	99%	95.63 ± 4.39 %	NaCl

**Figure 1:** Effectiveness of common RPE when dealing with ENMs.



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**Figure 2:** Capture efficiency of LEV systems

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