



Finnish Institute of
Occupational Health

WHO Guidelines on MNMs

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WHO guideline process

- Evidence-based to increase transparency
- Started with key questions; NOT handbook
- Answers based on systematic reviews of the scientific literature
- Recommendations based on evidence, values, feasibility



Guiding principles

- Precautionary approach
- Hierarchy of controls



Best practices

- Educate and train workers
- Involve workers in risk assessment and control
- Group MNMs into:
 - MNMs with specific toxicity
 - MNMs that are fibres
 - MNMs that are granular biopersistent particles



Recommendations

- Strong : everybody should do this
- Conditional: will probably be adapted according to local context



Recommendations

1. Assess health hazards of MNMs
2. Assess exposure to MNMs
3. Control exposure to MNMs
4. Health surveillance should be in place
5. Training and involvement of workers is needed



1. Assess health hazards

1. Assign hazard classes to all MNMs according to the *Globally Harmonized System* of Classification and Labelling of Chemicals for use in safety data sheets. For a limited number of MNMs this information is made available in these guidelines.
2. Update *safety data sheets with MNM-specific hazard information* or indicate which toxicological end-points did not have adequate testing available.
3. For the respirable fibres and granular biopersistent particles' groups, use the available classification of MNMs for *provisional classification of nanomaterials of the same group*.



Assess Health Hazards: Table 2

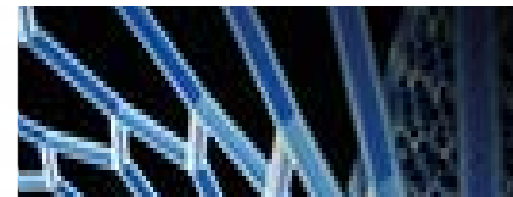
MNM	Acute toxicity	Skin corrosion / irritation	Serious eye damage/eye irritation	Respiratory or skin sensitization	Germ cell mutagenicity	Carcinogenicity	Reproductive toxicity	Specific target organ toxicity (single exposure)	Specific target organ toxicity (repeated exposure)
Fullerene (C ₆₀)	No ^a	No	No	No	No	No data ^b	No data	No data	No
SWCNT	No	No	No	No	Cat 2B ^c (L) ^d	No data IARC ^e 3 (M) ^f	No data	No data	Cat 1 (L)
MWCNT	No	No	Cat 2A (H) ^g	No	Cat 2 (H)	MWCNT-7: Cat 2 (M), IARC 2B Other MWCNTs: IARC 3 (M)	No	No data	Cat 1 (M)
AgNP	No	No	No	Cat 1B (H)	No	No data	No	No data	Cat 1 inhalation (M) Cat 2 oral (M)
AuNP	No data	No data	No data	No data	No data	No data	No data	No data	Cat 1 inhalation (H)
SiO ₂	No	No	No	No	No	No data	No	No data	Cat 2 inhalation (H)
TiO ₂	No	No	No	No	No	No data; IARC 2B	No data	No data	Cat 1 inhalation (H)
CeO ₂	No	No data	No data	No data	No data	No data	No data	No data	Cat 1 inhalation (H)
Dendrimer	No data	No data	No data	No data	No data	No data	No data	No data	No data
Nanoclay	No data	No data	No data	No data	No data	No data	No data	No data	No data
ZnO	No	No	No	No data	No	No data	No	No data	Cat 1 inhalation (M)

2. Assess exposure

1. Assess workers' exposure in workplaces with methods similar to those used for the proposed specific occupational exposure limit (OEL) value of the MNM.
2. Assess whether workplace exposure exceeds a proposed OEL value for the MNM. A list of proposed OEL values is provided in Annex 1 of these guidelines.
3. If specific OELs for MNMs are not available in workplaces, use a stepwise approach for inhalation exposure. For dermal exposure assessment, there was insufficient evidence to recommend one method of dermal exposure assessment over another.



OELs



Category	Study reference	MNM and specs	OEL name	Mass concentr. $\mu\text{g}/\text{m}^3$	Particle concentr. (particle/ml, fibres/cm ³)	Surface concentr. (nm ² /cm ³)	Derivation approach
Inhalation exposure: general MNM approach							
MNM	Guidotti 2010	Particles \leq 2500 nm	BOEL	30	ND	ND	Environmental
MNM	McGarry 2013	Airborne particles from NT processes	PCVs	ND	3 times LBPC for more than 30 minutes	ND	Environmental
Inhalation exposure: categorical MNM approach							
CMAR	BSI 2007	CMAR nanomaterials, NM	BEL	0.1 \times bulk WEL	ND	ND	Bridging
Fibres	AGS 2013	Non-entangled fibrous NM	Acceptance level, respirable fraction	ND	0.01	ND	Bridging/grouping
Fibres	BSI 2007	Fibrous NM	BEL	ND	0.01	ND	Bridging/grouping
Fibres	Stockmann-Juvala 2014	Carbon nanofibres	OEL	ND	0.01	ND	Bridging/grouping

3. Control exposure

1. Focus control of exposure on preventing inhalation exposure with the aim of reducing it as much as possible
 - especially during cleaning and maintenance, collecting material from reaction vessels and feeding MNMs into the production process.
 - In the absence of toxicological information, implement the highest level of controls to prevent workers from any exposure. When more information is available, take a more tailored approach.
2. Use the principle of hierarchy of controls



3. Control exposure

1. Prevent *dermal exposure* by occupational hygiene measures such as surface cleaning and the use of appropriate gloves.
2. When assessment and measurement by a workplace safety expert is not available, *use control banding* for nanomaterials to select exposure control measures in the workplace.



4. Other recommendations

1. Health surveillance: no nano-specific recommendations
2. Worker training and involvement: no nano-specific recommendations. Good training materials available for MNMs. (e.g Kulinowski NIHS US 2011)



Questions for breakouts

- 1 How could these guidelines be utilized in your organization?*
- 2 Which recommendations do you consider most important to be implemented?*
- 3 What is needed most for implementation? (e.g information, expert training, financial support, local OEL)*
- 4 Is the current occupational health infrastructure sufficient to deal with MNM problems?*
- 5 Should there be additional regulation?*



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Thank you!



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