UNIVERSITY OF BATH HEALTH AND SAFETY STANDARD

Safe Use of Nanomaterials

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Aims	The University is committed to ensuring the health, safety and welfare of all staff, students and visitors. In order to achieve this, control measures to prevent and minimise exposure to hazardous substances to as low as reasonably practicable, must be implemented as identified by risk assessment. The potential risk to health and the environment to Nanomaterials is currently relatively unknown and research is being undertaken. Therefore, there is a need to take specific considerations into account during their risk assessment. Exposure to some particulate nanomaterials can occur by ingestion, skin penetration or inhalation, with the resultant adverse effects depending upon the size, dose and toxicity of the nanoparticle. Toxicity investigations indicate that the effects appear to be related to the total surface area of the particles. The exposure potential will be directly related to the structure and form of the nanomaterial. The exposure risk to particles encapsulated in a matrix or strongly adhered to a substrate will be lower than that from 'free' aerosolised, particulate nanomaterials.				
Scope	This document is primarily concerned with the use, storage and disposal of particulate nanomaterials. It does not cover the incidental release of nanomaterials such as those from diesel exhaust and welding fumes. It also does not include other properties of nanomaterials in detail as defined under COSHH. These are covered by the Hazardous Substances Standard which should be implemented in conjunction with the requirements of this document.				
Relevant Legislation	• Health & Safety at Work etc. Act 1974 (HASWA) • The Management of Health & Safety at Work Regulations 1999 (MHSWR) • Control of Substances Hazardous to Health Regulations 2002 (COSHH) • The Dangerous Substances and Explosive Atmospheres Regulations 2002 (DSEAR) • HSE Guidance on Nanotechnology				
Definitions	Nanomaterial (European Commission Recommendation 2011/696/EU) A natural, incidental or manufactured material containing particles, in an unbound state or as an aggregate or agglomerate and where, for 50% or more of the particles in the number size distribution, one or more external dimensions is in the size range 1 nm - 100 nm. In specific cases and where warranted by concerns for the environment, health, safety or competitiveness the number size distribution threshold of 50% may be replaced by a threshold between 1 and 50%. By derogation, fullerenes, graphene flakes and single wall carbon nanotubes with one or more external dimensions below 1 nm should be considered as nanomaterials.				
	Nanoparticle A Nano-object with all three dimensions in the nanoscale				
	Nano-object A material with one, two or three external dimensions in the nanoscale				

	Nanoscale Size range from approximately 1 nm to 100 nm
	Nanotube A hollow nanofibre
	Nanofibre A nano-object with two similar external dimensions in the nanoscale and the third dimension being significantly larger.
	High Aspect Ratio Nanomaterials (HARNs) Fibrous nanomaterials where the length is many times the width such as certain types of carbon nanotubes, nanorods or nanowires. Research shows there is sufficient evidence to suggest that HARNs which have the same characteristics (diameter, length and biopersistance) as pathogenic fibres, such as asbestos, are likely to have similar pathology. Therefore, more robust control measures need to be considered when assessing the risk from these types of nanomaterials.
	Precautionary Principle There is no universally accepted definition of the precautionary principle. The purpose of the Precautionary Principle is to create an impetus to take a decision notwithstanding scientific uncertainty about the nature and extent of the risk, i.e. to avoid 'paralysis by analysis' by removing excuses for inaction on the grounds of scientific uncertainty. Applying the Precautionary Principle is essentially a matter of making assumptions to establish credible scenarios, and then using standard procedures of risk assessment and management to inform decisions on how to address the hazard.
	Local Exhaust Ventilation (LEV) An engineering control system used to reduce exposure to airborne hazardous substances such as dust, mist, fume, vapour or gas in a workplace by capturing and extracting the hazardous substance at the source of the emission.
	Personal Protective Equipment (PPE) Equipment that will protect the user against health or safety risks at work. It can include items such as safety helmets, gloves, eye protection, high-visibility clothing, safety footwear and safety harnesses. It also includes respiratory protective equipment (RPE).
Responsibility for implementation	Heads of Departments Supervisors/Managers/Principal Investigators Technical/Teaching Staff
Training availability:	Induction and on the job training with records held by Departments

Standard to meet:		**Accountability**	**Reference documents and more information**
1.	Identify work with Nanomaterials (see definition)	Head of Department/ Principal Investigator	https://www.hse.gov.uk/nanotechnology/
2.	Notify SHEW of proposed new nanomaterial work and supply a copy of the risk assessment for review prior to work commencing.	Principal Investigator/ User	https://www.hse.gov.uk/nanotechnology/
3.	Ensure the risk assessment justifies the use of nanomaterials (where cannot be eliminated) and takes into account their specific properties: - minimise amount of material handled/stored (includes bulk material purchased) - minimise potential for airborne release - minimise number of persons exposed	Supervisors/ Managers	Working Safely with Nanomaterials in Research and Development Particulate Nano-Material Control Measures Selection Flowchart p40 of above document.

	- minimise exposure time - other hazardous properties i.e. toxic, carcinogen, mutagen - Identification of appropriate control measures; LEV and PPE		
4.	Implement a sensible precautionary approach to risk management of nanomaterials due to the uncertain or not clearly defined toxicology particularly for exposure via inhalation, ingestion, or absorption.	Supervisors/ Managers	Risk management in detail - Nanotechnology - HSE
5.	Notified risk assessments are reviewed and agreed by the University technical expert prior to any new work with nanomaterials being started.	SHEW	
6.	Apply stricter risk management of control for HARNs (see definition) - Robust justification for use - minimise likelihood of becoming airborne (keep wet/damp) - Fully enclose process (when aerosol intentionally generated i.e. use of glovebox) - Provide RPE for emergencies (minimum assigned protection factor APF40)	Supervisors/ Managers	
7.	Ensure users are trained in the particular hazards and control measures required when working with nanomaterials.	Supervisors/ Managers	http://www.hse.gov.uk/pubns/books/hsg272.htm
8.	Where ≥1g particulate material is to be handled ensure this is carried out in appropriate **ducted** containment with **HP14 HEPA** filters installed. Examples of appropriate containment: - fume cupboard - containment cabinet - Class I or III microbiological safety cabinet (class II not suitable because they re-circulate up to 70% of their air inside the cabinet and are only specified to a containment level of 10^{-5})	Supervisors/ Managers	Working Safely with Nanomaterials in Research and Development Pages 21- 23
9.	Where <1g particulate material is to be handled; use of a recirculating HEPA filtered containment or microbiological safety cabinet may be used in the absence of hazardous vapours or gases if external venting is not reasonably practicable. This must be justified by risk assessment and agreed with the University technical expert/SHEW.	Users	Working Safely with Nanomaterials in Research and Development Page 23
10.	When the nanomaterial is combustible, for example many carbon based or metallic materials, assess whether the way it is to be processed or the quantities handled could create a fire or explosion risk in accordance with the DSEAR Regulations.	Users	http://www.hse.gov.uk/pubns/books/l138.htm
11.	Identify appropriate clean-up and waste disposal procedures - wet wiping; DO NOT brush or use compressed air - only use a dedicated HEPA filtered vacuum - waste should be considered hazardous (unless it can be demonstrated otherwise)	Users	

Generic Risk Assessment

Risk Assessment Title: Handling of Nanomaterials	Date reviewed: June 2023	Review Date: June 2026
Overview/Description of Activity: Any use, handling, storage or disposal of nanomaterials as defined by the European Commission (see Nanomaterials Standard). This risk assessment only covers the hazards associated with hazardous properties of nanomaterials and not the toxicology of the material itself. This should be covered in the associated COSHH assessment. NB: This risk assessment assumes that a justification has already been made that nanomaterials need to be used for the work activity.	**Duration/Frequency of Activity**: All work with nanomaterials regardless of duration and frequency should be risk assessed due to the uncertainty regarding their health impact. Projects can be short term, one-off activities or longer term research projects.	
Location of Activity: University of Bath facilities	**Generic or Specific Assessment:** Generic assessment to be used as a basis for producing specific task based assessments for individual projects.	

#	Hazard(s) identified	Who might be affected and how	Existing controls & measures	Severity (a)	Likelihood (b)	Risk Rating (a x b)	Additional control/action required
1	Handling of particulate nanomaterials ≥1g or carrying out a machining process which could generate airborne particles	All persons in the vicinity of the activity exposed to airborne particulate via inhalation potentially leading to respiratory disease/illness	• As a minimum, this activity must be carried out in HEPA HP14 filtered ducted containment • Minimise material becoming airborne by using in solution/matrix where practicable • Minimise number of persons who could be exposed by restricting access to work area • Minimise time of exposure	4	2	8	

#	Hazard(s) identified	Who might be affected and how	Existing controls & measures	Severity (a)	Likelihood (b)	Risk Rating (a x b)	Additional control/action required
2	Handling of particulate nanomaterials <1g	All persons in the vicinity of the activity exposed to airborne particulate via inhalation potentially leading to respiratory disease/illness	• Minimise material becoming airborne by using in solution/matrix where practicable • Minimise number of persons who could be exposed by restricting access to work area • Minimise time of exposure • Appropriate containment to be justified in risk assessment to reduce the risk to as low as reasonably practicable	3	2	6	
3	Spill of particulate nanomaterial requiring clean-up which could lead to material becoming airborne	All persons in the vicinity of the activity exposed to airborne particulate via inhalation potentially leading to respiratory disease/illness	• Use a damp cloth to minimise generating airborne particulate • If vacuum required then it should be dedicated and HEPA filtered • Compressed air should not be used to move particulate • All waste should be considered hazardous unless it can be demonstrated that it is not	4	2	8	• If the generation of airborne particulate cannot be avoided appropriate RPE (minimum FFP3) should be worn during clean-up

#	Hazard(s) identified	Who might be affected and how	Existing controls & measures	Severity (a)	Likelihood (b)	Risk Rating (a x b)	Additional control/action required
4	Spill of nanomaterial in solution/matrix	Potential for splash in eye or on skin of persons in the vicinity leading to adsorption of hazardous material	• Fume Cupboard sash provides physical barrier against splashes • PPE worn as identified in the COSHH Assessment; as a minimum lab coats, safety glasses and gloves (appropriate for solvent used) • Department procedures and training • Ensure all containers are closed /lidded when not in use	3	2	6	• Where the likelihood of a splash is possible consider the use of a face shield
5	Poor hygiene such as not changing gloves, washing hands when leaving lab area	Spread of nanomaterial outside containment and potential for ingestion of nanomaterial by any person in the department leading to acute illness	• SHEW policy and procedures • Department procedures and training • No eating, drinking etc. within lab areas • Potentially contaminated gloves should not be reused	2	3	6	
6	Incorrect Waste disposal into non-hazardous waste route	Persons collecting waste inadvertently become exposed to hazardous material, particularly as may not be contained or labelled correctly resulting in illness	• COSHH Assessment completed identifying correct waste disposal route • SHEW policy and procedures on hazardous material/waste and Nanomaterials • Department procedures, supervision and training	3	2	6	

#	Hazard(s) identified	Who might be affected and how	Existing controls & measures	Severity (a)	Likelihood (b)	Risk Rating (a x b)	Additional control/action required
7	Handling of High Aspect Ratio Nanomaterials (HARNs)	All persons in the vicinity of the activity repeatedly exposed to airborne particulate via inhalation potentially leading to chronic respiratory disease/illness	• Justification must be made for use of these materials and agreed by Technical Expert/SHEW • Operations where aerosol is intentionally generated (e.g. spraying) must be carried out within a full enclosure such as a glove box • For operations where an aerosol may be produced, appropriate containment must be identified and agreed depending on factors such as amount used, frequency of operation and potential exposure time • Provide appropriate RPE in case of an accidental release of material	4	2	8	

#	Hazard(s) identified	Who might be affected and how	Existing controls & measures	Severity (a)	Likelihood (b)	Risk Rating (a x b)	Additional control/action required
8	Housekeeping activities such as cleaning vessels, tubes after use that contain residual nanomaterial. Cleaning activities could include washing out with water at a sink.	Potential for material to become airborne and persons exposed to airborne particulate via inhalation potentially leading to respiratory disease/illness Potential for splash in eye or on skin of persons in the vicinity leading to adsorption of hazardous material	• Minimise potential for material to become airborne by not allowing it to dry out • Wear appropriate PPE as defined by COSHH assessment • Ensure all areas are thoroughly cleaned of material	2	3	6	

#	Hazard(s) identified	Who might be affected and how	Existing controls & measures	Severity (a)	Likelihood (b)	Risk Rating (a x b)	Additional control/action required
9	Production of airborne combustible nanoparticles such as carbon-based and metal materials from processing creates a dust cloud which could result in a fire or explosion when mixed with air.	All persons in the vicinity of the activity could be exposed to fire/explosion resulting in major injury	• All operations that produce airborne particulate will be carried out in containment which will minimise the spread of fire/contain explosion to an extent • Minimisation of amount of material • Minimise material becoming airborne by dampening where practicable • University fire procedures including presence and use of extinguishers and evacuation • DSEAR assessment to be carried out prior to any work commencing where significant quantities of combustible dust could be produced	5	1	5	

Assessor signature:	Print name:	Date: