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Occupational Health Programs Manual – Chapter 23

Nanomaterials Health and Safety w/Change 2 (9/30/2015)

Approved by: QS/Chief, Safety and Health Division

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NASA - Glenn Research Center
Cleveland, OH 44135

Change Record

Revision	Effective Date	Expiration Date	GRC25, Change Request #	Description
B	2/9/2012	2/9/2017	305	Biannual Review
1	4/14/2014	2/9/2017	N/A	Administrative change to add front cover and change history log to comply with NPR 1400.1, added "The GRC shall follow the requirements of NPR 1800.1C" in Section 4.0 Policy.
2	9/30/2015	2/9/2017	N/A	Administrative change to remove hyperlinks.

***Include all information for each revision. Do not remove old revision data. Add new rows to table when space runs out by pressing the tab key in the last row, far right column.*

Contents

Chapter 23—Nanomaterials Health and Safety

NOTE: *The current version of this chapter is maintained and approved by the Safety and Health Division (SHeD). The last revision date of this chapter was February 2012. The current version is located on the Glenn Research Center intranet within the BMS Library. Approved by Chief of Safety and Health Division.*

1.0 PURPOSE

This chapter describes the interim NASA Glenn Research Center (GRC) Nanomaterials Program and establishes the minimum requirements to reduce the risk of occupational illness resulting from exposure to nanomaterials. To minimize exposure to as low as reasonably achievable for employees working with nanomaterials, priority will be given to the use of safe laboratory procedures and work practices, and engineering controls, such as source control, local exhaust ventilation, high-efficiency particulate air (HEPA) filtration, and personal protective equipment (PPE).

2.0 APPLICABILITY

The chapter is applicable to all personnel at GRC, including but not limited to civil servants, contractor personnel, tenants, and students who work with nanomaterials.

3.0 BACKGROUND

Nanotechnology and nanomaterials hold significant promise for technological advancements. Nanomaterials are important because they exhibit unique chemical and physical properties. Based upon current and ongoing research, it is surmised that the nanocharacteristics of size, shape, surface area, charge, chemical properties, solubility, and agglomeration may contribute to the interaction of these materials with biological systems. At this time, the human health impacts are not fully understood; however, the National Institute for Occupational Safety and Health (NIOSH) advises the use of precautionary measures. Health risks are based on how much and how long a person is exposed to a material, the toxicity of the material, the biopersistance of the material in the body, and individual characteristics of the person. The most common exposure route is via inhalation; nanomaterials may be deposited to a greater extent than larger particles in the lower portions of the respiratory tract. Ingestion is also considered a potential route of exposure and can be attributed to hand contamination with the subsequent transfer to the mouth. Some studies suggest that nanomaterials may enter the body via penetration through the skin, mucus membranes, and eyes. Once in the body, nanomaterials may translocate to other organs.

4.0 POLICY

It is GRC's policy to provide a safe and healthful workplace, which complies with NASA Headquarters, Federal, State, and local regulations and applicable national consensus standards. This policy will be achieved through compliance with Safety and Health Division (SHeD) programs and procedures. The GRC shall follow the requirements of NPR 1800.1C.

5.0 RESPONSIBILITIES

All employees and their supervisors shall be cognizant of the Nanomaterials Health and Safety Program and conform to its requirements.

Specific responsibilities are as follows:

5.1 Safety and Health Division, Senior Industrial Hygienist (IH) shall:

- Administers, maintains, and exercises surveillance of this program, including but not limited to managing chemicals, assessing workareas, reviewing standard operating procedures (SOP), recommending controls, conducting sampling, and providing training and hazard assessment reports

5.2 Medical Director, Occupational Medical Services

- Provides medical evaluations and surveillance as required

5.3 Facilities Division shall

- Notifies the senior industrial hygienist of facility space utilization of nanomaterial use laboratories
- Considers control aspects in engineering design and ensures safe work practices for maintenance activities involving nanomaterial use laboratories and facilities
- Provides disposal recommendations and advice concerning pollution issues of The Toxic Substances Control Act (TSCA) and any issues related to related to, air, water, or soil.

5.4 Researchers/Operations Personnel shall

- Complete Nanomaterials Usage Survey Form GRC–235
- Develop written SOP that include an exposure control plan with site-specific safety practices for nanomaterials; include the plan in the chemical hygiene laboratory SOP or as an SOP in the safety permit process where applicable
- Attend required training
- Notify chemical management of new material usage for inventory updates
- Ensure that materials be used in accordance with the GRC Hazard Communication Policy
- See http://smad-ext.grc.nasa.gov/shed/pub/ohpm/ohpm20.pdf Label materials properly
- Create material safety data sheets MSDS for newly developed nanomaterials
- Maintain MSDS
- Use appropriate controls and follow PPE program procedures
- Ensure that materials be disposed of properly
- Assist FE with the development of a pre-manufacture notice to the Environmental Protection Agency (EPA) for any TSCA-defined “chemical substances” not on the TSCA inventory

5.5 Supervisors shall

- Identify employees and recommend employees for nanomaterial training
- Request nanomaterials hazard evaluations
- Enforce the use of engineering and administrative controls, including PPE

6.0 REQUIREMENTS

This document specifies the procedures to reduce and control exposure to nanomaterials. Copies of this program are maintained by SHeD and are available online.

6.1 Nanomaterials Usage Survey

All GRC personnel currently engaged in research, manufacture, and operations involving nanomaterials shall complete the SHeD Nanomaterials Usage Survey form GRC-235, which is available from the GRC LTID C forms site. Submit the survey to the SHeD operations team at MS 6–4 for review.

6.2 Develop Standard Operating Procedure

Users shall develop a SOP with exposure control considerations for nanomaterial use as part of a safety permit. Users shall develop a laboratory SOP with exposure control considerations for nanomaterial use in a chemical laboratory. The senior IH of the operations team will review the SOP/LSOP and exposure controls, conduct a site visit, and make additional recommendations if needed.

6.3 Permissible Exposure Limits

There are very limited permissible exposure limits for engineered nanomaterials. Most of these limits are based on specific chemical constituents or on total dust calculated as a mass by volume, which may or may not be a suitable measure as indices of exposure. Limits will be reviewed prior to sampling for the specific type of nanomaterial under evaluation.

6.4 Engineering Controls

To the extent feasible, priority shall be given to reducing employee exposure by using engineering controls: local exhaust ventilation and enclosures such as glove boxes for activities involving nanomaterials; HEPA filtration of ventilation systems is most desirable.

6.5 Safe Work Practices

- Standard Operating Procedures and Exposure Control Considerations
    - The following are examples of tasks that nanomaterial users shallconsider for control (i.e., control against exposure via inhalation, ingestion, and penetration via the skin or eyes).
    - Handling liquids that contain nanomaterials: use appropriate gloves
    - Performing liquid operations that generate aerosols: use enclosures, local exhaust ventilation
    - Generating gas-phase aerosols: use enclosed systems
    - Handling powders: use enclosed or local exhaust ventilation systems
    - Performing maintenance tasks: inform maintenance of hazard on workorder, so that work procedure may be developed through the GRC Health and Safety Plan process
    - Cleaning dust collection systems: use an approved Health and Safety Plan
    - Machining, grinding, sanding products with nanomaterials: use enclosures, local exhaust ventilation

- Work involving nanomaterials shall be planned to control and prevent employee exposure and the contamination of work surfaces and equipment.

- Facility and equipment work surfaces shall be cleaned of contamination at the end of the task or shift by good housekeeping practices, including HEPA vacuuming and wet wiping.

    – Wet wipes will be bagged so as not to re-aerosolize products.

    – Dry sweeping is prohibited.

    – Compressed air hose for cleaning is prohibited.

    – Sticky mats may be used for areas outside nano material dry powder operations

- Personal protective equipment may be necessary and will include the following:

    – Gloves, chemical protective-type as appropriate for the specific material: always rinse off gloves once they are exposed to nanomaterials.
    – Laboratory coats, disposable lab coat or coverall as appropriate: contaminated disposable clothing shall be containerized and disposed of properly.
    – Safety eyewear, such as safety glasses with side shields, chemical goggles, and/or face shield as appropriate

    – Respiratory protection may be necessary: all respirator users shall conform to the requirements of the GRC Respiratory Protection Program. At a minimum, respirator filtration will provide HEPA capability. An elastomeric respirator properly fit tested is recommended as the best type. The IH

will help to select the most appropriate type for the specific application. See http://smad-ext.grc.nasa.gov/shed/pub/ohpm/ohpm4-respir.pdf

- Dust collection systems should include HEPA filtration.
- Foods shall not be stored or consumed in areas where nanomaterials are handled.
- Hand washing is required before eating, drinking, smoking, and leaving work.

6.6 Safety Issues: Fire, Explosion, Catalytic Reactions

- Although not fully known, nanomaterials may pose a risk of fire, explosion, and/or catalytic reaction because of the surface area and their unique properties. Physical hazards must be considered prior to use of nanomaterials.

6.7 Spills

- Small-scale material spills shall be cleaned up by using the appropriate PPE. Approaches to cleaning up these spills include the use of HEPA-filtered vacuum cleaners, wetting powders complete with surfactant, wetted cloths, and the application of absorbent materials.
- Large-scale material spills shall be reported to security (9-1-1).

6.1-6.7 Verification processes -GRC235 reviews and assessment reports, laboratory safety inspections and safety permit reviews.

6.8 Disposal

Contact FE Waste Management for the disposal of substance-specific nanomaterials.

6.9 Training

Employees working with nanomaterials shall be trained in the current health-based research, potential routes of exposure, safe work practices, sampling limitations and types, proper use of PPE, engineering controls, emergency response procedures for spills, and disposal recommendations.

Training is provided by SHeD and through the System for Administration, Training, Educational Resources for NASA (SATERN).

6.9 Verification- SATERN records review, audits, self assessment

6.10 Recordkeeping

In accordance with the requirements of the 29 CFR 1910.20 Occupational Safety Health Administration (OSHA) Access to Employee Exposure and Medical Records, both medical and industrial hygiene records will be made available to affected employees or their representatives.

7.0 RECORDS

- NASA GRC Nanomaterials Usage Survey C–235, SOP
- Exposure assessments and reports
- Training records are maintained by HCDD

8.0 REFERENCES

Document number	Document name
National Institute for Occupational Safety and Health	Approaches to Safe Nanotechnology, 2009 http://www.cdc.gov/niosh/docs/2009-125/pdfs/2009-125.pdf

National Institute for Occupational Safety and Health	Progress Toward Safe Nanotechnology in the Workplace, 2010 http://www.cdc.gov/niosh/docs/2010-104/pdfs/2010-104.pdf
International Council on Nanotechnology	Review of Safety Practices in the Nanotechnology Industry, November 13, 2006 http://icon.rice.edu/projects.cfm?doc_id=4388
NASA Ames Research Center	Nanomaterials Safety and Health Guideline, http://server-mpo.arc.nasa.gov/Services/CDMSDocs/Centers/ARC/Dirs/APR/APR1700.1C50.html
Nanotoxicology Chapter 4.6	NASA NPR 1800.1C

APPENDIX A.—DEFINITIONS AND ACRONYMS

Agglomerate.—Group of particles held together by weak forces including van der Waals, electrostatic, and surface tension

Environmental Protection Agency (EPA)

Glenn Research Center (GRC)

High-efficiency particulate air filter (HEPA).—Filter that removes 0.3-µm-diameter particles with 99.97 percent or greater efficiency. The selection of the 0.3-um diameter as the standard challenge diameter is based on the fact that most particulate filters are least efficient at this diameter and more effectively remove particles that are both smaller and larger in diameter. NIOSH is reviewing HEPA efficiency for nanomaterials, and there is evidence that this may be effective at filtering nanosized materials.

Laboratory Standard Operating Procedure (LSOP)

Material safety data sheets (MSDS)

Nanomaterial.—Material defined as having at least one dimension in the range of 1 to 100 nanometers

National Institute for Occupational Safety and Health (NIOSH)

Occupational Safety Health Administration (OSHA)

Personal protective equipment (PPE)

Plum Brook Station (PBS)

Safety and Health Division (SHeD)

Senior industrial hygienist (IH)

Standard operating procedures (SOP)

System for Administration, Training, Educational Resources for NASA (SATERN)

Translocation.—Act, process, or instance of changing location or position

The Toxic Substances Control Act (TSCA)

APPENDIX B.—NASA GRC NANOMATERIALS USAGE SURVEY

Appendix 1

NASA GRC Nanomaterials Usage Survey

Researcher Name: _____ Survey Form Completion Date: _____

Org Code: _____ Phone: _____ Building: _____ Room: _____

Nanomaterials Use Location: _____ Lab Phone: _____ Building: _____ Room: _____

List other employees working with this material in the space:

_____

_____

Safety Permit # (If applicable): _____

Lab SOP# (If applicable): _____

Research Project Name: _____

List all nanomaterials used in this location.				
Date	Material Used	Activity	MSDS Available Yes or No	Physical Form *Powder Solution Composite*

Questions:

1. Do you use a ventilation hood? _____ Hood ID#? _____ Glove box? _____
2. Do you use PPE? _____ Garment type: _____ Glove type: _____ Respirator: _____
   - If a respirator is worn, please specify type and cartridges:

   _____
3. Eyewear type: _____ Other: _____
4. If you identified solution in table above, please specify solvent type: _____
5. Are nanomaterials created in the lab? _____
6. Are nanomaterials purchased or provided by other site? Please specify. _____

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For each material, complete the following:				
Material	Total Qty > 1 gram Yes or No	How often used per week, month, year	Time during use, Specify minutes or hours	#Employees

OHB - IH Internal

Review by: _____ Date: _____

Follow-up sampling recommended? _____ Type needed: _____

Other comments:

Return form via interoffice mail to Luz Jeziorowski at MS: 6-4

NASA C-235 (Rev. 6-2008)