



Energetic Materials Management Plan

**Radiological and Environmental Management
Purdue Energetics Research Center
Adopted: August 2021**

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1. Purpose

This program will cover all energetic material used in research at Purdue University. Energetic material includes explosives, propellants, pyrotechnics, and any other material, purchased or synthesized, with a high energy density.

The possession, storage, and use of energetic materials at Purdue University is governed by US Bureau of Alcohol, Tobacco, and Firearms (ATF); the US Department of Transportation (USDOT); and university policy. The United States Attorney General updates the list of listed/classified ATF explosives annually. The annual list of explosive materials list is available on the Federal Register's *Commerce in Explosives; 2021 Annual List of Explosive Materials* website. In addition to the list, any unclassified, created or material with similar energetic properties is also applicable to this plan.

Purdue University must remain compliant with regulations of the ATF for obtaining, storing, documenting, and utilizing listed/classified energetic materials. The University must also adhere to USDOT regulations for hazardous materials transport. Failure to comply with these regulations may result in regulatory fines, use curtailment, or disciplinary action.

2. Scope and Application

This program applies to all personnel associated with Purdue University West Lafayette who will be working with or managing energetic materials.

Representatives from Purdue Environmental Health and Public Safety (EHPS) and Purdue Energetics Research Center (PERC) will meet periodically to discuss safety, research, regulatory concerns, and update standard operating procedures. The roles of each group as it pertains to energetic materials will be outlined in this document.

2.1 Radiological and Environmental Management

Radiological and Environmental Management (REM) is responsible for conducting safety inspections of laboratories, including those areas with energetic material storage. REM will determine amount limits for laboratories with assistance of subject matter experts (e.g., PERC Faculty, Research Engineers, Scientists, etc.). Information on REM inspections is available in Section 10.

REM is responsible for the safe and compliant delivery of energetic materials to approved key custodians from the bulk storage magazines, as well as safe and compliant off-site shipments. REM will maintain the documentation, permits, etc. necessary to transport and ship energetic materials.

2.2 Purdue Energetics Research Center

Purdue Energetics Research Center (PERC) is responsible for managing energetic material in Purdue University research spaces and ensuring compliance with all requirements set forth by REM. PERC will develop and enforce policies that align with federal, state, and university regulations, laws, and policies. PERC must provide regular, informal inspections of their facilities and equipment; know the current legal and University requirements concerning energetic material; determine the required levels of personal protective equipment; and ensure that facilities and training for use of energetic material are adequate.

PERC will maintain ATF compliant inventories of energetics material in research spaces that will be available to REM. PERC will be responsible for onboarding any new researchers working with energetic material and notifying REM of any changes to researchers or energetic material on campus. PERC will ensure that all researchers have been trained appropriately before working with energetic materials and that all appropriate records are kept by the research groups.

2.3 Laboratory Supervisors and Principal Investigators

Laboratory supervisors and principal investigators (PI) are responsible for energetic material use in the laboratory. It is the PI's responsibility to determine laboratory-specific protocols, safe practices, and to ensure compliance with appropriate federal, state, and university regulations, laws, and policies. PERC staff should be used as a resource when determining these protocols. Researchers must notify and seek approval from PERC if energetic material in any quantity will be obtained or transferred from any source. The PI is responsible for safe and compliant possession of material and for making appropriate and timely arrangements with PERC and REM. The PI is also responsible for maintaining all documentation, including but not limited to inventories, training records, and hazard assessments. These records must be available to PERC and REM for inspection.

2.4 Laboratory Staff

Laboratory staff are all people who will be working in the lab space. This includes but is not limited to staff scientists, staff engineers, postdoctoral researchers, graduate researchers, undergraduate researchers, and visiting scholars. Staff are responsible for planning and conducting each operation in accordance with recognized safe energetic material procedures. Staff must only perform tasks that they are trained to perform. Staff should be knowledgeable about procedures in the lab and safety resources that are available and must immediately report any safety incidents or concerns to the PI, PERC staff, and/or REM as appropriate.

3. Training

Training is required for all personnel working with energetic materials. The following must be complete before working with energetic materials.

1. Safety of Energetic Materials
2. Lab Safety Fundamentals or Hazard Communication training (annual refresher required)
3. Energetic Material Management Plan Awareness Certification (see Appendix D)
4. Export Control – RCR Training (if required by the research project)

Additional training is required for more specific procedures, equipment, etc. PERC staff will determine any additional training required and who may receive it. Labs should have a procedure in place to ensure those working with energetic material are trusted and competent. Each procedure and equipment should have a list of approved users maintained by the lab and made available to the PERC Safety Officer.

4. Hazard Identification

Energetic materials can present explosive hazards and must be handled with appropriate care. Energetic materials may have other hazards, such as toxicity and corrosivity. All samples must be labeled and easily identifiable. Appendix A contains an example of a labeling method. Another method can be used but must be written into an SOP for the laboratory that is easily accessible to all working in the lab, PERC staff, and REM inspectors. Labels should be legible, dated, and should identify the owner of the agent. If codes, acronyms, formulae, or abbreviations are used, post a legend/key near the inside of the entrance to the room.

A hazard assessment must be performed, and certification must be kept on record for all procedures involving energetic material and for any new material being used. Certification of Hazard Assessment forms are available on REM's website (see Appendix D). Hazard assessments should be performed regularly or anytime conditions change to ensure that the best possible controls are being used.

5. Engineering Controls and Personal Protective Equipment

Engineering controls are the most effective means of hazard control and should be implemented first and in conjunction with PPE. The appropriate engineering controls will be determined by the hazard assessment based on the material, the amount, the type of research being done, etc. If an experiment is being scaled up or changed in any way, a new hazard assessment must be performed to determine if the necessary engineering controls or PPE requirements have changed.

PPE requirements may vary by laboratory or type of research done. At minimum, gloves and safety glasses should be worn when handling energetic material. PPE should be evaluated for each situation. Enhanced PPE is recommended after an experiment if the stability of the material is unknown. Energetic material work should be done remotely whenever possible.

6. Handling

Appropriate procedures and safety measures will be in place for energetic material work as determined by PERC faculty and staff. All work must comply with relevant ATF, USDOT, EPA, and OSHA regulations. The amount of energetic material stored at a location should be kept to a minimum. Maximum amounts per location will be determined by REM and PERC and communicated to laboratory staff at each location.

Laboratory staff must log all receipt, transfer, and consumption of energetic material in the inventory log for their location. Inventory logs must contain all information on the form in Appendix B but can be in any format. When removing material from a larger storage container, the amount being returned to the magazine should be weighed and recorded to ensure an accurate inventory.

Energetic waste should be kept to a minimum. Every effort must be made to safely consume all energetic material during the research.

7. Movement, Storage, Security

7.1 Movement

7.1.1 Obtaining Material

To obtain energetic material in any quantity from Purdue's bulk storage magazines, a PERC technical staff member (research engineer, research scientist, etc.) must send a request to REM giving at least 24-hour notice. Material can only be delivered to an approved key custodian and must be logged in at the new location before REM leaves the site. Requests should include the following information:

- The Principal Investigator (PI) involved in the request
- Material requested: specific chemical name and common name, if available
- Amount requested
- Location for delivery (laboratory building and room number)

If receiving material from an off-campus location or vendor, upon ordering the material, the researcher must send a notice to REM including the following information:

- The Principal Investigator (PI) associated with the material

- Material received: specific chemical name and common name, if available
- Amount received
- Location of material storage (laboratory building and room number)

REM will manage the transport of energetic material deliveries to either the lab or the bulk storage magazines. As much notice as possible should be given to REM to prepare appropriately.

7.1.2 Moving Material On-Campus

Small samples of energetic material can be moved on foot by researchers per Section 5.14 of the Purdue University's Chemical Hygiene Plan (CHP). Movement of larger amounts on campus or any amount of material from Zucrow to the main campus should be coordinated with a PERC staff member or REM. PERC Staff members must be trained to transport energetic material per the CHP and the Energetic Material Transport and Deliveries SOP. Limits, container requirements and vehicle requirements will be set in the Energetic Material Transport and Deliveries SOP and will be updated as needed by REM and PERC.

7.1.3 Moving Material Off Campus

REM Hazardous Materials Shipping must manage all outgoing shipments of hazardous materials. REM maintains the appropriate permits to ship energetic material under DOT-SP-8451. Compliant packaging must be provided by the researcher.

Material that cannot be shipped using DOT-SP-8451 will require an approved third-party vendor to transport the material. DOT-SP-8451 should be used whenever possible to ship material.

Contact REM Hazardous Materials Shipping (hazmatshipping@purdue.edu) with questions and clarification on what can be shipped.

7.2 Storage

The following storage requirements must be in place in the lab before beginning work with energetic materials if material will be kept on site. REM will not deliver energetic material until these are in place.

- Type 2 storage magazine is present in the laboratory to store the material.
- The magazine must be cabled by a braided steel cable, at least 3/8", to an anchor point. The anchor point can be a laser table. If a laser table is not present, the anchor point must be drilled into the floor or concrete wall. The anchor should be hardened steel, at least 3/8". This cable must secure the magazine with a lock of equal to or greater strength than the requirements of 27 CFR § 555.208(b)(4).

- The magazine must be secured with a lock of equal to or greater strength than the requirements of 27 CFR § 555.208(b)(4).
- Every key to the magazine must be in a lock box or with a trained individual. The lock box must be a combination lock bolted to the wall or to another immovable object in the lab. REM and PERC must be supplied with access to the magazine at any time.

Only energetic material should be stored in the magazine. If multiple types of energetic material are stored in a single magazine, they must be compatible.

7.3 Security

Energetic material work should only be done in a secure location. Access must be limited to only trained and authorized individuals.

8. Incident Response

When an incident occurs, immediately evacuate the area and ensure others are aware of the incident. If there is currently or an imminent threat of a fire, pull the nearest fire alarm station to evacuate the building and dial 911. You should never try to fight a fire involving energetic material. If personnel have become exposed and need medical assistance, dial 911.

It is imperative to inform first responders of any energetic material in a location they are entering. Purdue University Police Department (PUPD) and Purdue University Fire Department (PUFD) are both aware of the areas that have energetic materials, but as much information as possible should be provided if there is an incident.

Within 24 hours, once any immediate danger has been mitigated, an incident investigation must occur. A First Report of Injury/Supervisors Incident Investigation and/or Near-Miss form (see Appendix D) must be completed and shared with the PERC Safety Officer. If there was an injury, regardless of severity, a First Report of Injury must be completed by the supervisor and submitted to REM.

8.1 Emergency Numbers

All Emergencies	9-1-1
Radiological and Environmental Management (REM)	765-494-6371
PUPD Non-Emergency	765-494-8221
PUFD Non-Emergency	765-494-6919

9. Reference and Regulations

This plan was developed through collaboration with PERC and Environmental Health and Public Safety (EHPS). Information and requirements in this plan are supported by Purdue University

policies, a memo available upon request from EHPS and using work practices, and compliance obligations from various agencies such as DOT, ATF, EPA the Department of Defense, Department of Energy.

10. Inspections

Radiological and Environmental Management (REM) will inspect energetic use facilities for the following at least annually:

- Security of the lab space
- Documentation review, such as signage, SOPs, hazard assessments
- Identification of appropriate storage location, specifically an appropriate magazine and lock box
- Limits for energetic material
- Identification and documentation of proper training in the use of energetic materials
- Identification of inventory record keeping (see Appendix B).

Following an inspection, REM will specify what was inspected and generate an inspection report. The inspection report will notate issues and provide recommendations, as well as give a timeline to correct those issues. If notated issues are not corrected in a timely manner, the office of the Executive Vice President for Research and Partnerships (EVPRP) will be informed and will determine appropriate actions(s), if necessary. REM maintains copies of inspection records and submits completed inspection forms to the PI, PERC, and the Senior Director of EHPS.

Appendices

Appendix A: Sample Labeling

Appendix B: Magazine Inventory Log (Example)

Appendix C: Annual Inventory Log (Example)

Appendix D: Awareness Certification and Other Related Forms

Appendix E: Summary of Changes

Appendix A: Sample Labeling

Purdue Explosive	Main HE Component		Production or Modified		Serial Number
Use "PX" abbreviation.	Largest HE percentage by mass.	Has something been done to the material since it was shipped to us (e.g., sieving or re-crystallization)?		Sequential 4-digit Number	
PX-	01	HMX	01	Recrystallized	####
	02	RDX	02	Mechanical Impact Modification	
	03	PETN	03	Any particle size selection technique	
	04	TATB	04	3D Printed Sample	
	05	SMX	05	Pressed sample	
	06	DAFF	06	Mixed with polymer and cured	
	07	High Nitrogen	07		
	08	Cocystal	08		
	09	CL-20	09		
	10	Comp-B	10		
	11	TNT			
	12	Fox-7			
	13	Ammonium Nitrate			
	14	NTO			
	15	TNAZ			

Note: This numbering system is designed to provide containers with specific serial numbers. It is not intended for similar pieces stored in the same container to get individual serial numbers. For example: If pressing (20) 6mm cube PBX-9501 samples those would all share the same explosives reference number. Each cube would not need its own number so long as they are stored in the same container (e.g., the fourth container of HMX based PBX-9501 that has been pressed into pellets should be "PX-01-05-0004").

Appendix B: Magazine Inventory Log (Example)



EMMPMIL

Magazine Inventory Log

Research Record of ATF Regulated Material
27 CFR 555.127

Principal Investigator:		Graduate Student:	
Building:		Room:	
Storage Type:		Storage Location:	
Product Name:		Manufacturer:	
Date Code:	Production Code:	UN #:	Hazard Class:

Date	Quantity In	Quantity Out	Remaining Chemical

Created: March 12, 2022

Appendix C: Annual Inventory Log (Example)



EMMPAIL

Annual Inventory Log

Annual Report of ATF Regulated Material

Principal Investigator:	Building:	Room:
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Product Name	Manufacturer	Quantity	Storage Location

Created: March 12, 2022

Appendix D: Awareness Certification and Other Related Forms

Energetic Materials Management Plan Awareness Certification

- DocuSign with electronic signature.
 - <https://na2.docusign.net/Member/PowerFormSigning.aspx?PowerFormId=4794eabe-829f-452c-b4dd-a7815b8e8c37&env=na2&acct=9ad6adfd-6804-409b-91bc-173cbee909f9&v=2>
 - You will need to enter you name and Purdue email as well as your PI's or supervisor's. You can save a signed copy for yourself after submitting the form.
- Standalone PDF for completing and signing by hand.
 - <https://www.purdue.edu/ehps/rem/documents/forms/emmpac.pdf>

Magazine Inventory Log

- <https://www.purdue.edu/ehps/rem/documents/forms/emmpmil.pdf>

Annual Inventory Log

- <https://www.purdue.edu/ehps/rem/documents/forms/emmpail.pdf>

First Report of Injury/Supervisors Incident Investigation

Contact REM for most current version.

Hazard Assessment

Hazard assessment is a requirement of the Purdue Personal Protective Equipment (PPE) Policy. There are 3 versions of Certification of Hazard Assessment forms accessible from the REM Forms webpage (<https://www.purdue.edu/ehps/rem/forms/allforms.html>).

- Location: <https://www.purdue.edu/ehps/rem/documents/forms/A3CertL.doc>
 - Location template that must be edited to cover hazards in your location. <https://www.purdue.edu/ehps/rem/documents/forms/HazAsTmp.doc>
- Position/Task: <https://www.purdue.edu/ehps/rem/documents/forms/A2CertPT.doc>
- Single Task: <https://www.purdue.edu/ehps/rem/documents/forms/A1CertST.doc>

Near Miss Investigation

Contact REM for most current version.

Appendix E: Summary of Changes

August 5, 2022

1. Section 6, 2nd paragraph, 1st sentence: Changed from “... *transfer, consumption, and destruction of energetic material ...*” to “... *transfer, and consumption of energetic material ...*”