



**Occupational  
Safety and Health  
Administration**

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# **Process Safety Management for Explosives and Pyrotechnics Manufacturing**



### **Occupational Safety and Health Act of 1970**

“To assure safe and healthful working conditions for working men and women; by authorizing enforcement of the standards developed under the Act; by assisting and encouraging the States in their efforts to assure safe and healthful working conditions; by providing for research, information, education, and training in the field of occupational safety and health.”

This guidance document is not a standard or regulation, and it creates no new legal obligations. It contains recommendations as well as descriptions of mandatory safety and health standards. The recommendations are advisory in nature, informational in content, and are intended to assist employers in providing a safe and healthful workplace. The *Occupational Safety and Health Act* requires employers to comply with safety and health standards and regulations promulgated by OSHA or by a state with an OSHA-approved state plan. In addition, the Act’s General Duty Clause, Section 5(a)(1), requires employers to provide their employees with a workplace free from recognized hazards likely to cause death or serious physical harm.

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# Process Safety Management for Explosives and Pyrotechnics Manufacturing

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U.S. Department of Labor  
Occupational Safety and Health Administration

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U.S. Department of Labor

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## Purpose

This document does not cover the entire Process Safety Management (PSM) standard, but only focuses on aspects of the standard particularly relevant to explosives and pyrotechnic manufacturers. OSHA's standard on Explosives and Blasting Agents, 29 CFR 1910.109, provides a definition of explosives and pyrotechnics. For a full compliance guide to PSM, please refer to [OSHA 3132](#)<sup>1</sup> or the full text of the standard at [www.osha.gov](http://www.osha.gov).<sup>2</sup> Although all elements of the PSM standard apply to a PSM-covered explosives and pyrotechnics manufacturer, the following elements of the standard are particularly relevant to hazards associated with explosives and pyrotechnics manufacturers:

- Process Safety Information (PSI)
- Process Hazards Analysis (PHA)
- Operating Procedures
- Training
- Mechanical Integrity (MI)

PSM is critically important to facilities that manufacture explosives and pyrotechnics. The required safety programs will help prevent fires, explosions, and other major incidents. Compliance with the PSM standard will help ensure that employees, contractors, facility visitors, and emergency responders are safe from hazards. Compliance will also benefit employers by minimizing damage to facility equipment and neighboring structures. All explosives should be handled with care.

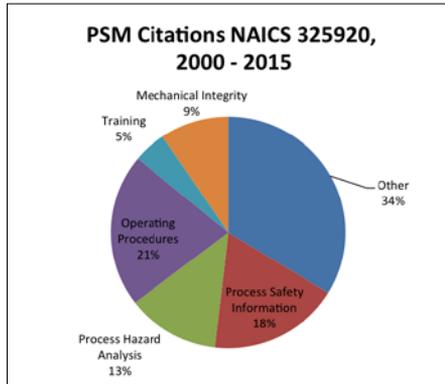
Explosives are chemicals compounds, mixtures or devices that will detonate or deflagrate when supplied with sufficient initiating energy. Furthermore, explosives do not distinguish between initiating energy supplied accidentally or deliberately. Those who handle and use explosive materials in the manufacturing process must prevent exposure of the material to accidental sources of initiating energy.

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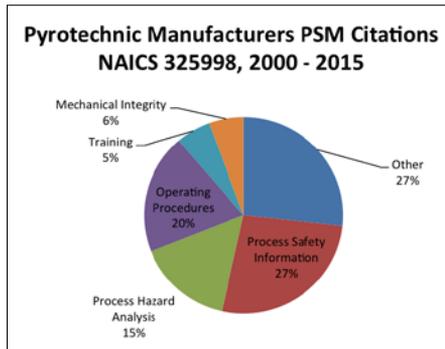
1. [www.osha.gov/Publications/osha3132.pdf](http://www.osha.gov/Publications/osha3132.pdf)

2. [www.osha.gov/pls/oshaweb/owadisp.show\\_document?p\\_table=STANDARDS&p\\_id=9760](http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=9760)

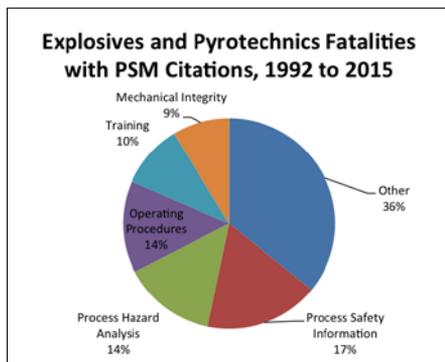
The first two graphs shown below represent citations recorded as the result of OSHA PSM inspections conducted from 2000 to 2015 for Explosives Manufacturers under the North American Industry Classification System (NAICS) code 325920 and Pyrotechnics Manufacturing information extracted from NAICS code 325998. The graphs illustrate the percentages of citations for specific PSM elements as they appear in the Department of Labor Enforcement database.



Between 1992 and 2015, OSHA issued citations in 10 fatality cases (associated with a total of 19 fatalities). The following graph shows percentages of citations for specific PSM elements. The data, was taken from OSHA’s IMIS (or OIS) database.



Comparison of the graphs illustrates the similarity in percentages of the PSM elements cited as a result of OSHA inspections whether or not the inspections were performed as a result of a reported fatality. OSHA believes that this comparison implies that a better understanding



of the major elements of PSM, particularly those elements most frequently cited, would improve compliance and prevent fatalities in explosives and pyrotechnics manufacturing.

PSM elements complement the **cardinal principle for explosive safety: expose the minimum number of people to the smallest quantity of explosives for the shortest period consistent with the operation being conducted**. This principle is stated in many industry explosives safety standards and referenced in government publications such as: DoD Instruction 4145.26; NASA Standard 8719.12; AFMAN 91-2015; Army Pamphlet p385-64; and in commercially-available explosives safety training. Successfully implementing this principle means establishing personnel limits and devising methods to reduce the number of people exposed, the time of exposure, and the quantity of material that could be involved in a single incident.

Explosives and pyrotechnics manufacturing is an inherently hazardous process. Failure to properly recognize unsafe conditions and to take steps to mitigate the hazards can result in unexpected circumstances that can, and do, result in injury or death. Below are some examples of incidents that resulted from PSM non-compliance.

#### **Ultratec Fireworks Manufacturing (02/06/15): 2 Fatalities**

An explosion occurred at a fireworks manufacturing facility, which resulted in two fatalities. The investigation identified several problems including housekeeping of hazardous materials (that were susceptible to friction heat and pressure), structural failure, and a failure to have code-required separation distances between buildings. Inspectors also found that employees had no formal fireworks safety training and no annual refresher training.

#### **Kilgore Flares Company LLC (02/25/14): 1 Fatality**

On February 22, 2014, an employee was working in a Mix Room. He was cleaning a residual composition that had adhered to surfaces of the mix bowl and mix wheel. As the employee removed the residual, the composition ignited and exploded. The investigation identified noncompliance in process safety information, process hazard analysis and

operating procedures. The employee suffered severe burns on multiple areas of his body and was transported to a hospital, where he received medical treatment and burn therapy, but died from his injuries.

**Black Mag (05/14/10): 2 Fatalities**

On May 14, 2010, an explosion occurred at a synthetic gunpowder manufacturing facility. Instead of implementing existing engineering and administrative controls, two employees and the plant supervisor hand fed a gunpowder substitute (Black Mag powder) into operating equipment. Additionally, the employer did not implement remote starting procedures, safe distancing, isolated stations, and barriers or shielding for the process of manufacturing explosive powder. The two employees died of injuries from the explosion.

**Olin Corporation, Winchester Division (11/24/2008): 1 Injury**

On November 24, 2008, an employee at an explosives manufacturing facility was sweeping up primers (small metal cups of explosive) into a dustpan. As the employee started to lift the dustpan, a few primers dropped and exploded upward. The employee's face, torso, shoulders, neck and head were injured, burned, and she was hospitalized. A safe job procedure was developed for the job but not for cleanup. The job involved a PSM-covered process, but no PHA was developed for the cleanup task.

**American Ordnance LLC, Iowa Army Ammunition Plant (6/12/2006): 2 Fatalities**

On June 12, 2006, two employees were handling a shaped charge of high explosives on a cart. These employees were conducting a wet density test involving a shaped charge. During the test an explosion occurred, killing both employees. The investigation determined that violations of PSM requirements for process hazard analysis, operating procedures, training, pre-startup safety review and performance of compliance audits contributed to the fatalities.

## **Sierra Chemical Co. (01/07/98): 4 Fatalities**

On January 7, 1998, four employees were about to begin work in the production room at Sierra Chemical's Kean Canyon explosives manufacturing facility when two large blasts involving over 40,000 lbs. of explosives devastated the facility. All four employees were killed. The facility melted, mixed, and poured cast boosters in two separate production areas using large heated stainless steel melting and mixing kettles. The production room had been in service for less than four months and had several substantial changes compared to the old production area, including kettles heated by steam as opposed to hot water and direct drive mechanical agitation instead of hydraulic agitation. Possible causes of the explosions included raw material contamination, a cold start, or static ignition. The investigation resulted in citations for violations of the Employee Participation, Process Safety Information, Process Hazard Analysis, Operating Procedures, Training, Pre-startup Safety Review, Mechanical Integrity, and Management of Change provisions of the PSM standard.

## **Applicability**

Employers who manufacture explosives<sup>3</sup> and pyrotechnics<sup>4</sup> must comply with PSM (see 29 CFR 1910.109(k)).

OSHA considers the manufacturing of explosives to mean: mixing, blending, extruding, synthesizing, assembling, disassembling and other activities involved in the making of

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3. The term "explosive" is defined in 29 CFR 1910.109, Explosives and Blasting Agents, paragraph (a)(3):

Explosive — any chemical compound, mixture, or device, the primary or common purpose of which is to function by explosion, i.e., with substantially instantaneous release of gas and heat, unless such compound, mixture, or device is otherwise specifically classified by the U.S. Department of Transportation; see 49 CFR Chapter I. The term "explosives" shall include all material which is classified as Class A, Class B, and Class C explosives by the U.S. Department of Transportation, and includes, but is not limited to dynamite, black powder, pellet powders, initiating explosives, blasting caps, electric blasting caps, safety fuse, fuse lighters, fuse igniters, squibs, cordeau detonant fuse, instantaneous fuse, igniter cord, igniters, small arms ammunition, small arms ammunition primers, smokeless propellant, cartridges for propellant-actuated power devices, and cartridges for industrial guns. Commercial explosives are those explosives which are intended to be used in commercial or industrial operations.

4. Pyrotechnics are defined in 29 CFR 1910.109(a)(10):

Pyrotechnics — any combustible or explosive compositions or manufactured articles designed and prepared for the purpose of producing audible or visible effects, and are commonly referred to as fireworks.

a chemical compound, mixture or device which is intended to explode. Unlike other highly hazardous chemicals (HHC) covered by PSM, explosive materials do not have a listed threshold quantity. If any quantity of explosives is manufactured as discussed above, then the manufacturing process is covered by the PSM standard.<sup>5</sup>

Activities that are conducted in a separate, non-production research or test area or facility and do not have the potential to cause or contribute to a release or interfere with mitigating the consequences of a catastrophic release from the explosive manufacturing process are not covered by the PSM standard, but are still covered by §1910.109. These include:

- product testing and analysis which is not part of any in-production sampling and testing of the explosive manufacturing process;
- chemical and physical property analysis of explosives and propellants and pyrotechnics formulations;
- scale-up research chemical formulations to develop production quantity formulations;
- analysis of age tests conducted on finished products;
- failure analysis tests conducted on pre-manufactured or finished products;
- x-raying;
- quality assurance testing (not including the extraction of samples from an active explosive manufacturing [production] process);
- evaluating environmental effects, such as hot, cold, jolt, jumble, drop, vibration, high altitude, salt, and fog; and
- assembly of engineering research and development models.

The Department of Transportation (DOT) maintains a classification scheme for explosive materials. Prior to October 1, 1991, DOT's classifications were designated as Explosives A, B, C, or Blasting Agents. These designations

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5. The information from this paragraph and the next come from the February 4, 1998 Letter to Frank A. White, Vice President, Organization Resources Counselors, Inc., [www.osha.gov/pls/oshaweb/owadis.show\\_document?p\\_table=INTERPRETATIONS&p\\_id=22524](http://www.osha.gov/pls/oshaweb/owadis.show_document?p_table=INTERPRETATIONS&p_id=22524)

are still used in OSHA’s current definition of explosives.<sup>6</sup> After October 1991, DOT re-designated its explosives categories, and now listed as Hazard Class 1 materials, which are divided into six divisions to note the principal hazard of the explosive. The definition of each division can be found in 49 CFR 173.50.<sup>7</sup> The chart below illustrates the comparison between the old and new DOT classification system, which may be used in determining whether an explosive classified under DOT’s current scheme falls within OSHA’s definition of explosive:

<b>Current Classification</b>	<b>Prior DOT Classification</b>
Division 1.1	Class A Explosives
Division 1.2	Class A or Class B Explosives
Division 1.3	Class B Explosives
Division 1.4	Class C Explosives
Division 1.5	Blasting Agents
Division 1.6	No Applicable Hazard Class

## **Process Safety Information**

Employers are required to compile written process safety information (PSI) about highly hazardous chemicals and process equipment for all PSM covered processes. Process Safety Information (PSI) is the information necessary for implementation of all other aspects of PSM. The compilation of written process safety information will help the employer and the workers involved in operating the process to identify and understand the hazards involved in their processes. Process safety information must include information on the hazards of the highly hazardous materials used or produced by the process, information on the technology of the process, and information on the equipment used in the process.

6. See footnote 5 above.

7. [www.gpo.gov/fdsys/granule/CFR-2011-title49-vol2/CFR-2011-title49-vol2-sec173-52/content-detail.html](http://www.gpo.gov/fdsys/granule/CFR-2011-title49-vol2/CFR-2011-title49-vol2-sec173-52/content-detail.html).

## **Information on Highly Hazardous Chemicals**

PSM requires that explosives and pyrotechnics manufacturers compile information on toxicity, permissible exposure limits, physical data, reactivity data, corrosivity data, thermal and chemical stability data, and hazardous effects associated with inadvertent mixing of materials that may occur. Unlike other highly hazardous chemicals (HHC) covered by PSM, explosive materials do not have a listed threshold quantity. If any quantity of explosives is manufactured as discussed above, then the manufacturing process is covered by the PSM standard.

OSHA's Hazard Communication standard (HCS), 29 CFR 1910.1200 requires manufacturers to provide chemical information on their products in safety data sheets (SDS). SDSs must provide information on a number of specific characteristics which may be used to identify and understand the hazards posed by hazardous chemicals used in the explosives manufacturing process. It should be noted that some SDSs may not contain specific important explosives material handling information such as minimum humidity needed and minimum ignition energy.

## **Information on Process Technology**

Information on the technology of the process must include at least the following:

- Diagrams (Block or Process Flow) – an example of which is shown in non-mandatory Appendix B of the PSM standard
- Process chemistry
- Maximum intended inventory
- Safe upper and lower process limits for such items as temperatures, pressures, flows or compositions, and
- An evaluation of the consequences of deviations, including those affecting the safety and health of employees that could occur if operating beyond the established process limits.

Even though there is no threshold quantity requirement applicable for explosive material in a PSM-covered manufacturing process, employers should still consider minimizing the volume of explosive material on site to minimize the hazard during the manufacturing process. For example, NASA Standard 8719.12, *Safety Standard for Explosives, Propellants, and Pyrotechnics*,<sup>8</sup> recommends that the determination of the limits for explosive materials operations be the result of a careful analysis of all facts, including operation timing; transportation methods; size of the items; explosive, chemical and physical characteristics of the materials; building layout; and facilities design. The standard further recommends that limits should be established for each operation, rather than one building or total workplace capacity.

## **Information on the Process Equipment**

For some explosives or pyrotechnics manufacturing facilities, the amount of process equipment that exists in the facility may be minimal. OSHA recognizes that the complexity of processes within the explosives and pyrotechnics manufacturing industry vary, and range from pure chemical processes to simplified mechanical processes. Nevertheless, facilities must collect information on covered process equipment. Employers are required to collect equipment information on materials of construction, applicable piping and instrument diagrams (P&IDs), electrical classifications, relief system design and design basis, ventilation system designs, and safety systems. Facilities in which the processes are purely mechanical (not chemical) without piping, typically will not have P&IDs. However, all process facilities with a fire suppression system must have a P&ID for that system. For facilities using “off-the-shelf” or customized “in-house” designs, the manufacturer of the components will provide most, if not all, of this information. Components or equipment of unknown origin, cannot satisfy the Quality Assurance provision of 1910.119(j) (6)(iii) and are prohibited in explosives or pyrotechnic manufacturing processes. However, employers may bring

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8. [www.hq.nasa.gov/office/codeq/doctree/NASASTD871912.pdf](http://www.hq.nasa.gov/office/codeq/doctree/NASASTD871912.pdf)

this type of equipment into compliance by performing their own assessment to ensure that maintenance materials, spare parts and equipment are suitable for the process application for which they will be used. This may require the employer to perform a fitness for service, or similar, assessment. Questions on applicability of specific PSM requirements pertaining to unique situations should be referred to OSHA's Directorate of Enforcement Programs or the appropriate OSHA Consultation Program Office.

Employers must also document that equipment complies with recognized and generally accepted good engineering practices (RAGAGEP). For more information on OSHA's interpretation of RAGAGEP, see OSHA's Memorandum, *RAGAGEP in Process Safety Management*.<sup>9</sup> There are many potential sources of RAGAGEP pertaining to explosives and pyrotechnics manufacturing, some of which are provided here.

One example, the *Department of Defense (DoD) Standard for Ammunition and Explosives Safety, DoD 6055.09-STD, (DoD 6055.09-STD)*<sup>10</sup> provides guidance for employers to consider when developing internal standards that can be applied to engineering design criteria for facilities and operations conducted within those facilities. The criteria are then used to select equipment, shielding, engineering controls, and protective clothing for personnel.

Another example of RAGAGEP is *National Fire Protection Association (NFPA) 495, Explosive Materials Code*. It provides a table showing the minimum intraline (intraplant) (ILD or ILP) separation distances for Division 1.1 or 1.2 explosives. This code is intended to provide reasonable safety in the manufacture, storage, transportation, and use of explosive materials. Another potential source of RAGAGEP, *NFPA 1124, Code for the Manufacture, Transportation, and Storage, of Fireworks and Pyrotechnic Articles* establishes reasonable minimum fire and life safety requirements for the manufacture, transportation, and storage of fireworks, pyrotechnic articles,

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9. [www.osha.gov/pls/oshaweb/owadisp.show\\_document?p\\_table=INTERPRETATIONS&p\\_id=30785](http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=INTERPRETATIONS&p_id=30785)  
10. [uxoinfo.com/blogcfc/client/enclosures/DOD6055-09-STD\\_21Aug\\_09.pdf](http://uxoinfo.com/blogcfc/client/enclosures/DOD6055-09-STD_21Aug_09.pdf)

and any component(s) thereof containing pyrotechnic or explosive compositions. This code also addresses process building, construction, and working surfaces.

Other examples of potential sources of RAGAGEP for explosive and pyrotechnic manufacturing include:

- **NFPA 70, *National Electrical Code***

This code is intended to be used for the design and use of heating, lighting and electrical equipment in any area where fireworks, fireworks components, or flammable liquids are or can be present.

- **NFPA 77, *Recommended Practice on Static Electricity***

This recommended practice offers guidance on identifying, evaluating, and controlling static electric hazards for purposes of preventing fires and explosions.

- **NFPA 499, *Recommended Practice for the Classification of Combustible Dusts and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas***

This recommended practice presents criteria to determine ignitability hazards in chemical process areas where combustible dusts are produced, processed, or handled to assist in the selection of electrical systems and equipment for safe use in Class II hazardous (classified) locations.

- **Institute of the Makers of Explosives, IME SLP-3, *Suggested Code of Regulations for the Manufacture, Transportation, Storage, Sale, Possession and Use of Explosive Materials***

Among other topics, this code focuses on the purity of raw materials obtained for the purpose of manufacturing explosives. These include: foreign objects in raw materials; use of substitute raw materials; specific handling requirements for raw materials; impact by tools or equipment; impingement; friction; sparking; and static discharge. The document further states that the raw materials may contain impurities that could

create an impact or friction hazard and lists recommended procedures that could be used to prevent these hazardous foreign objects from entering the manufacturing process.

- American Pyrotechnics Association (APA) Standard 87-1. American Pyrotechnics Standard 87-1, *Standard for Construction and Approval for Transportation of Fireworks, Novelties, and Theatrical Pyrotechnics*.

## Process Hazard Analysis

A process hazard analysis is an organized and systematic effort to identify and analyze the significance of potential hazards associated with the processing and handling of highly hazardous chemicals. A PHA team must be comprised of personnel that are knowledgeable in engineering and process operations, and at least one person familiar with the process being evaluated, and at least one person knowledgeable in the specific process hazard analysis methodology being used. The team analyzes potential causes and consequences of fires and explosions. The team conducting the PHA must make recommendations for additional safeguards to adequately control identified hazards or to mitigate their effects. Safeguards may include inherently safer or passive approaches to hazard control, or suggesting new engineering controls or administrative controls.

Failure to properly perform a PHA, or failing to address findings and recommendations, can have catastrophic consequences as evidenced by the fatalities and injuries cited in the incidents described at the beginning of this document. The PHA relating to explosives and pyrotechnics may include such topics as: inherent chemical and physical properties of specific explosives and/or explosive compounds, quantity distance requirements, building design, human factors, and prior incident reports.

An example of a hazard analysis technique, again citing DoD 6055.09-STD, describes a risk assessment process that is performed on new or modified operations and facilities within

the U.S. DoD. The assessment takes into consideration factors of explosives initiation sensitivity, quantity of materials, heat output, rate of burn, potential ignition and initiation sources, protection capabilities of shields, various types of clothing, fire protection systems and personnel exposure.

Small businesses may contact OSHA's On-site Consultation services to help further determine their worksite hazards. To obtain free consultation services, go to OSHA's On-site Consultation webpage at: [www.osha.gov/consultation](http://www.osha.gov/consultation) or call 1-800-321-OSHA (6742) and press number 4.

PHAs must be reviewed every five years to ensure that they are still consistent with the current process.

## **Operating Procedures**

Employers are required to develop and implement written operating procedures that provide clear instructions for safely conducting activities involved in each covered process consistent with the process safety information. Operating procedures must provide clear instructions not only to specify the steps for normal operations, but also for upset conditions, temporary operations, start-up, and emergency shutdown. Important safety information that includes the basic hazards encountered or that could be encountered in the process must also be addressed in the operating procedures. For instance, identification of hazard areas and limitations on the number of authorized personnel in the hazard area will ensure that the minimum numbers of personnel are exposed to the hazard.

There have been a number of incidents involving explosives processing equipment, piping, ventilation systems, and similar systems that the employer incorrectly believed to be free of explosives contamination. Explosives and pyrotechnics manufacturers should be aware of this hazard and the importance of explosive decontamination prior to doing any facility maintenance or equipment installation work in an explosive processing facility. Although the PSM standard requires the employer to annually certify that operating

procedures are current and adequate, it is recommended that the date of the operating procedure(s) be checked prior to each use to verify that only the most current version of the operating procedure is being used before proceeding. However, the procedures must be available to all operators, and be accurate and current.

The importance of thorough written procedures cannot be overstressed. During inspections, OSHA Compliance Officers have discovered that some employers did not have written procedures available for a process. Some employers also did not have emergency shutdown procedures for operations or equipment, normal shutdown procedures, emergency operations, quality control for raw materials and the control of hazardous chemical inventory levels, or accessibility to procedures for employees working in or maintaining the process, all of which are potential violations of the standard.

Quality control must also be included in the operating procedures. This entails verifying that the raw materials comply with approved and documented material specifications provided by the purchaser for manufacturing explosives that enter into the process from external suppliers. An example of this concept is found in IME SLP-3 which states: "Raw materials, demilitarized explosives, and reworked materials used in the manufacturing processes shall not contain foreign objects that might create an impact or friction hazard."

NFPA 495 lists specific topics for explosives manufacturers to consider when developing explosives manufacturing procedures such as when to empty waste containers, and how to manage the collection of spilled materials, disposal, storage, and/or open burning of contaminated materials or explosive waste (in accordance with Federal/State/Local authority having jurisdiction). Manufacturers should also consider how to dispose of contaminated materials, reuse of shipping containers, and establish when non-routine maintenance and repair work may be performed. Ignition source control (smoking, flame-producing devices, portable electrical and electronic equipment, static electricity control, hazards of

electromagnetic radiation to both ordnance and personnel), clothing care, prohibited accessories, and housekeeping should also be considered. Specifics on the approach to be used for these individual topics should be addressed in the PHA using appropriately approved standards and analyses.

## **Training**

Employers must provide initial and refresher training to every employee involved in operating a PSM-covered process. Training must cover process-specific safety and health hazards, operating procedures, safe work practices, and emergency shutdown procedures. The level of training may vary for each employee. All employees, including maintenance and contractor employees involved with explosives and pyrotechnics manufacturing, need to fully understand the safety and health hazards of the materials and processes they work with so they can protect themselves and their fellow employees. Proper training ensures adequate understanding of standard procedures, operational parameters, care and maintenance of equipment, and emergency procedures, including detection methods for the presence or release of hazardous material in the work area, familiarity with emergency warning signals and actions to take in the event that the warning signal is activated.

NFPA 495 contains examples of minimum training recommendations. It states that persons handling explosive materials or working in operating buildings shall be trained in the following areas:

- The physical and health hazards of the explosive materials to be manufactured
- The operational activities involved in processing explosive materials, and these activities include instructions for emergencies that are anticipated in the manufacturing process
- The operating rules applicable to the materials in the manufacturing process
- Plans for emergency procedures in the event of a fire or explosion

Another example, contained in IME SLP-25, *Explosives Manufacturing and Processing Guideline to Safety Training*, recommends a set of topics that should be covered in the training plan. These recommendations include instruction on:

- safety requirements
- control and emergency procedures
- personal protective clothing and equipment
- personnel and explosives limits
- equipment design, inspection and maintenance
- location and sequence of operations
- housekeeping procedures
- other topics that employees or management believe should be covered

## **Mechanical Integrity**

Mechanical Integrity requires explosives and pyrotechnic manufacturers to implement rigorous and systematic written procedures that ensure that all critical process components are properly designed, tested, inspected, repaired, and maintained. OSHA currently requires that employers have a mechanical integrity program for pressure vessels and storage tanks, piping systems (including components such as valves), relief and venting systems, emergency shutdown systems, controls, and pumps. However, OSHA recommends that employers identify and include all other equipment which interfaces with explosive material and used in the process in the mechanical integrity program, and not just those items currently required by PSM standard.

A mechanical integrity program includes identifying applicable equipment, training of maintenance personnel, inspection and testing, and maintenance of critical safety equipment.

A starting point for creating a mechanical integrity programs is listing all equipment, instruments, and components that must be considered. In many cases, the equipment that is part of the MI program will have inspection and testing recommendations from the manufacturer. If the covered equipment does not

have any MI related manufacturers recommendations, then employers should look for applicable codes/standards or industry best practices. Inspections and tests must follow Recognized and Generally Accepted Good Engineering Practices (RAGAGEP), and inspection and test frequency must be consistent with manufacturer's recommendations and good engineering practices, or more frequently if indicated by operating experience.

If employers and employees are completely unfamiliar with these RAGAGEP references, consultation with a professional engineer is advised. Local fire officials may also be used as a point of reference for appropriate fire codes.

Each inspection and test that has been performed to verify current equipment integrity must be documented. This documentation serves as proof of compliance, and the records can also be used to assess trends in longer-term equipment degradation which is then used to determine if inspection and testing frequencies should be adjusted. Maintenance and inspection programs should include equipment used to move explosive materials, visual and electrical inspections of the lightning protection system, response time tests of the deluge system, area warning system tests, and building grounding system checks.

Any deficiencies identified during inspections and tests must be addressed before further use, or in a safe and timely manner when actions are taken to assure safe operation pending repairs. When equipment is determined to be deficient, a management of change (MOC) procedure must be established and implemented prior to continuing operation of the deficient equipment outside of established operating limits. The MOC procedure must include a determination of the safety and health impacts of continued operation of the deficient equipment.

The final element of mechanical integrity programs is quality assurance. PSM-covered facilities must ensure that equipment for newly constructed operations is suitable for the intended

application and that equipment in existing processes is properly installed and consistent with design specifications. Quality assurance requirements also apply to maintenance materials and spare parts to ensure compatibility with the equipment and the process.

An example of actions needed for a mechanical integrity program are noted in IME SLP-3, which recommends that a daily visual inspection be made of the mixing, conveying and electrical equipment to determine that such equipment is in good operating condition. This inspection could include checks of current equipment maintenance or integrity (if equipment is tagged with that information), any noted damage, or a review of the maintenance records if there is uncertainty about the specific equipment. Instructions for actions to be taken in the event that equipment is found to be out of compliance with operational specifications should be provided. The standard requires employers to correct deficiencies in equipment that are outside acceptable limits (defined by the PSI) before further use or in a safe and timely manner when necessary means are taken to assure safe operation.

## **APPENDIX A: Related Publications**

These publications are not incorporated by reference into the PSM standard but can provide informative assistance to consider when implementing the PSM program.

Explosives and Blasting Agents Standard, Title 29, Code of Federal Regulations (CFR) Part 1910.109, 36 FR 10553-10562).

This contains the actual text of the rule. (A single free copy of the above materials can be obtained from the OSHA Publications Office, Room N3101, Washington, DC 20210, (202) 523-9667).

U.S. Government Publications. U.S. Government Publishing Office, Washington, DC 20402.[?]

Publication ATF P 5400.7 (9/07), *Federal Explosive Law and Regulations*, U.S. Bureau of Alcohol, Tobacco, Firearms, and Explosives.

Title 18, United States Code, Chapter 40, "*Importation, Manufacture, Distribution and Storage of Explosive Materials.*"

Title 27, Code of Federal Regulations, Part 555, "*Table of Distances for Low Explosives,*" U.S. Bureau of Alcohol, Tobacco, Firearms, and Explosives.

Title 49, Code of Federal Regulations, Parts 100–199, "*Hazardous Materials Regulations,*" U.S. Department of Transportation.

Department of Defense, DoD 6055.09-STD, *DOD Ammunition and Explosives Safety Standards*, latest edition.

Department of Defense, DoD 4145.26-M, *DOD Contractors Safety Manual for Ammunition and Explosives*

OSHA Instruction CPL 02-01-053, *Compliance Policy for Manufacture, Storage, Sale, Handling, Use and Display of Pyrotechnics.*

National Aeronautics and Space Administration, NASA-STD-8719.12, *Safety Standard for Explosives, Propellants, and Pyrotechnics*, latest edition.

NFPA 70, *National Electrical Code*, latest edition.

NFPA 77, *Recommended Practice on Static Electricity*

NFPA 101, *Life Safety Code*, latest edition.

NFPA 495, *Explosive Materials Code*, latest edition.

NFPA 499, *Recommended Practice for the Classification of Combustible Dusts and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas*

NFPA 1124, *Code for the Manufacture, Transportation, and Storage, of Fireworks and Pyrotechnic Articles*, latest edition.

NFPA 5000, *Building Construction and Safety Code*, latest edition.

IME Publication. Institute of Makers of Explosives, 1120 19<sup>th</sup> St., NW, Suite 310, Washington, DC 20036-3605. Additional documents can be downloaded from IME's website at [www.ime.org](http://www.ime.org).

IME Safety Library Publication No. 3, "*Suggested Code of Regulations for the Manufacture, Transportation, Storage, Sale, Possession and Use of Explosive Materials.*"

IME Safety Library Publication No. 25, "Explosives Manufacturing and Processing Guideline to Safety Training."

APA Standard 87-1. American Pyrotechnics Standard 87-1, *Standard for Construction and Approval for Transportation of Fireworks, Novelties, and Theatrical Pyrotechnics.*

## **APPENDIX B: Frequently Asked Questions**

This appendix documents a PSM-related question that explosives and pyrotechnics manufacturers commonly ask of OSHA. This question is meant to provide a helpful response that will help with PSM Compliance.

**What are OSHA's requirements for fireworks?** OSHA **Instruction CPL 02-01-53**<sup>11</sup> provides compliance policy for manufacture, storage, safe handling, use and display of fireworks. Because the Bureau of Alcohol, Tobacco and Firearms has regulations addressing working conditions associated with the storage of explosives, OSHA's storage requirements for explosives at §1910.109(c) are preempted under section 4(b)(1) of the OSH Act.

OSHA's PSM standard applies to the manufacture of fireworks, and CPL 02-01-53 sets out OSHA's other applicable requirements. Explosive materials that are staged for active use in the manufacturing or assembly process are not considered to be in "storage", and may be covered by the PSM standard.

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11. [www.osha.gov/sites/default/files/enforcement/directives/CPL\\_02-01-053.pdf](http://www.osha.gov/sites/default/files/enforcement/directives/CPL_02-01-053.pdf)

## **Workers' Rights**

Under federal law, workers are entitled to working conditions that do not pose a risk of serious harm.

For more information on how to assure a safe and healthful workplace, see [OSHA's Workers page](#).

## **OSHA Assistance, Services and Programs**

OSHA has a great deal of information to assist employers in complying with their responsibilities under OSHA law. Several OSHA programs and services can help employers identify and correct job hazards, as well as improve their safety and health program.

### **Establishing a Safety and Health Program**

Safety and health programs are systems that can substantially reduce the number and severity of workplace injuries and illnesses, while reducing costs to employers.

Visit [www.osha.gov/shpguidelines](http://www.osha.gov/shpguidelines) for more information.

### **Compliance Assistance Specialists**

OSHA Compliance assistance specialists can provide information to employers and workers about OSHA standards, short educational programs on specific hazards or OSHA rights and responsibilities, and information on additional compliance assistance resources.

Visit [www.osha.gov/dcsp/compliance\\_assistance/cas.html](http://www.osha.gov/dcsp/compliance_assistance/cas.html) or call 1-800-321-OSHA (6742) to contact your local OSHA office.

### **Free On-site Safety and Health Consultation Services for Small Business**

OSHA's On-site Consultation Program offers free and confidential advice to small and medium-sized businesses in all states across the country, with priority given to high-hazard worksites. On-site consultation services are separate from enforcement and do not result in penalties or citations.

For more information or to find the local On-site Consultation office in your state, visit [www.osha.gov/consultation](http://www.osha.gov/consultation), or call 1-800-321-OSHA (6742).

Under the consultation program, certain exemplary employers may request participation in OSHA's **Safety and Health Achievement Recognition Program (SHARP)**. Worksites that receive SHARP recognition are exempt from programmed inspections during the period that the SHARP certification is valid.

## **Cooperative Programs**

OSHA offers cooperative programs under which businesses, labor groups and other organizations can work cooperatively with OSHA. To find out more about any of the following programs, visit [www.osha.gov/cooperativeprograms](http://www.osha.gov/cooperativeprograms).

### ***Strategic Partnerships and Alliances***

The OSHA Strategic Partnerships (OSP) provide the opportunity for OSHA to partner with employers, workers, professional or trade associations, labor organizations, and/or other interested stakeholders. Through the Alliance Program, OSHA works with groups to develop compliance assistance tools and resources to share with workers and employers, and educate workers and employers about their rights and responsibilities.

### ***Voluntary Protection Programs (VPP)***

The VPP recognize employers and workers in private industry and federal agencies who have implemented effective safety and health management programs and maintain injury and illness rates below the national average for their respective industries.

## **Occupational Safety and Health Training Courses**

The OSHA Training Institute partners with 27 OSHA Training Institute Education Centers at 42 locations throughout the United States to deliver courses on OSHA standards and occupational safety and health topics to thousands of students a year. For more information on training courses, visit [www.osha.gov/otiec](http://www.osha.gov/otiec).

## **OSHA Educational Materials**

OSHA has many types of educational materials to assist employers and workers in finding and preventing workplace hazards.

All OSHA publications are free at [www.osha.gov/publications](http://www.osha.gov/publications) and [www.osha.gov/ebooks](http://www.osha.gov/ebooks). You can also call 1-800-321-OSHA (6742) to order publications.

Employers and safety and health professionals can sign-up for *QuickTakes*, OSHA's free, twice-monthly online newsletter with the latest news about OSHA initiatives and products to assist in finding and preventing workplace hazards. To sign up visit [www.osha.gov/quicktakes](http://www.osha.gov/quicktakes).

# **OSHA Regional Offices**

## **Region I**

Boston Regional Office  
(CT\*, ME, MA, NH, RI, VT\*)  
JFK Federal Building, Room E340  
Boston, MA 02203  
(617) 565-9860 (617) 565-9827 Fax

## **Region II**

New York Regional Office  
(NJ\*, NY\*, PR\*, VI\*)  
201 Varick Street, Room 670  
New York, NY 10014  
(212) 337-2378 (212) 337-2371 Fax

## **Region III**

Philadelphia Regional Office  
(DE, DC, MD\*, PA, VA\*, WV)  
The Curtis Center  
170 S. Independence Mall West  
Suite 740 West  
Philadelphia, PA 19106-3309  
(215) 861-4900 (215) 861-4904 Fax

## **Region IV**

Atlanta Regional Office  
(AL, FL, GA, KY\*, MS, NC\*, SC\*, TN\*)  
61 Forsyth Street, SW, Room 6T50  
Atlanta, GA 30303  
(678) 237-0400 (678) 237-0447 Fax

## **Region V**

Chicago Regional Office  
(IL\*, IN\*, MI\*, MN\*, OH, WI)  
230 South Dearborn Street  
Room 3244  
Chicago, IL 60604  
(312) 353-2220 (312) 353-7774 Fax

## **Region VI**

Dallas Regional Office  
(AR, LA, NM\*, OK, TX)  
525 Griffin Street, Room 602  
Dallas, TX 75202  
(972) 850-4145 (972) 850-4149 Fax  
(972) 850-4150 FSO Fax

## **Region VII**

Kansas City Regional Office  
(IA\*, KS, MO, NE)  
Two Pershing Square Building  
2300 Main Street, Suite 1010  
Kansas City, MO 64108-2416  
(816) 283-8745 (816) 283-0547 Fax

## **Region VIII**

Denver Regional Office  
(CO, MT, ND, SD, UT\*, WY\*)  
Cesar Chavez Memorial Building  
1244 Speer Boulevard, Suite 551  
Denver, CO 80204  
(720) 264-6550 (720) 264-6585 Fax

## **Region IX**

San Francisco Regional Office  
(AZ\*, CA\*, HI\*, NV\*, and American Samoa,  
Guam and the Northern Mariana Islands)  
90 7th Street, Suite 18100  
San Francisco, CA 94103  
(415) 625-2547 (415) 625-2534 Fax

## **Region X**

Seattle Regional Office  
(AK\*, ID, OR\*, WA\*)  
300 Fifth Avenue, Suite 1280  
Seattle, WA 98104  
(206) 757-6700 (206) 757-6705 Fax

\* These states and territories operate their own OSHA-approved job safety and health plans and cover state and local government employees as well as private sector employees. The Connecticut, Illinois, New Jersey, New York and Virgin Islands programs cover public employees only. (Private sector workers in these states are covered by Federal OSHA). States with approved programs must have standards that are identical to, or at least as effective as, the Federal OSHA standards.

Note: To get contact information for OSHA area offices, OSHA-approved state plans and OSHA consultation projects, please visit us online at [www.osha.gov](http://www.osha.gov) or call us at 1-800-321-OSHA (6742).

## How to Contact OSHA

For questions or to get information or advice, to report an emergency, fatality, inpatient hospitalization, amputation, or loss of an eye, or to file a confidential complaint, contact your nearest OSHA office, visit [www.osha.gov](http://www.osha.gov) or call OSHA at 1-800-321-OSHA (6742), TTY 1-877-889-5627.

**For assistance, contact us.  
We are OSHA. We can help.**





U.S. Department of Labor

**For more information:**



**Occupational  
Safety and Health  
Administration**

[www.osha.gov](http://www.osha.gov) (800) 321-OSHA (6742)