Technical Principles and Practices of Fire Prevention

Module Industrial

MODULE OBJECTIVES

The students will be able to:

- *Identify industrial occupancies and their subclasses.*
- *Identify and classify the major fire and life safety issues in industrial occupancies.*
- *Identify and define flammable and combustible liquids.*
- *Identify the basic properties of hazardous materials.*
- *Identify the principles of safe storage, handling, use, and separation of hazardous materials.*
- *Identify recognized methods for warning labels and placarding for hazardous materials.*
- *Identify the differences between corrosives, reactives, and toxic materials.*
- *Identify the availability of resource materials for use when conducting inspections at industrial occupancies.*
- *Given a list of hazardous processes or materials, identify the storage, handling, use, and separation requirements as identified by their adopted code.*

DEFINITION OF INDUSTRIAL OCCUPANCY

Industrial occupancies range from the very basic to the very technical in the area of code enforcement. This module introduces some of the fundamental uses and hazards of industrial occupancies. Before conducting an industrial occupancy inspection, inspectors need additional training and extensive supervised field work in industrial code enforcement.

NFPA Definition

The National Fire Protection Association (NFPA) 101, *Life Safety Code* defines an industrial occupancy as "any building, portion of a building, or group of buildings used for the manufacture, assembly, service, mixing, packaging, finishing, repair, treatment, or other processing of goods or commodities by a variety of operations or processes."

Industrial occupancies are subclassified in NFPA 101, *Life Safety Code*, into three usage types: general, incidental high hazard, and high hazard. Operations in general industrial occupancies involve low or ordinary hazard materials, processes, or contents--usually with a high density of employees. Examples of general industrial occupancies include

- electronic and metal fabrication operations;
- textile mills;
- automobile assembly operations;
- steel mills; and
- clothing manufacturing operations.

Incidental (special purpose) high-hazard industrial occupancies are buildings designed for and suitable only for particular types of operations, usually with a low density of employees. Examples of incidental high-hazard industrial occupancies include

- paint spray booths;
- flammable liquid storage rooms in low- or ordinary-hazard occupancies; and
- plastics fabrication/forming.

High-hazard industrial occupancies are those having high-hazard materials, processes, or contents. Examples of high-hazard industrial occupancies include

- paint and chemical plants;
- explosives manufacturing plants;

- aerosol can filling facilities;
- grain or other combustible dust-handling operations; and
- any operation involving extensive quantities of flammable or hazardous material.

The model codes may have slight variations in the definition of "industrial occupancies." Check your local code.

INDUSTRIAL FIRE HAZARD IDENTIFICATION

Four Categories of Fire Hazards

There are generally four categories of fire hazards in industrial occupancies (per NFPA):

- sources of ignition;
- combustibility;
- structural fire hazards; and
- hazards to personnel.

Initiation of combustion occurs when a heat source heats a fuel. It is the goal of the inspection process to separate fuels from heat sources when possible. With the exception of some metals, minerals, and water, most common materials will ignite and burn.

The combustibility of common materials is the second category of fire hazard. Some combustibles burn faster than others, and the burn rate depends on form. In industrial occupancies, there could be wood shavings rather than solid pieces.

Two features constitute structural fire hazards. First are conditions that promote fire spread, which include a lack of proper fire separations, unprotected vertical openings, unprotected horizontal and/or vertical openings for conveyor systems, and large, undivided open areas without separations. The second includes conditions that contribute to structural failure: a lack of fire resistance protection for structural supports, walls, frames, and floor/ceiling supports; the removal of fire resistance protection for columns, beams, and girders; and the presence of heavy process machinery and equipment that adds to the structural load.

The fourth category of fire hazards, hazards to personnel, is also the primary concern. Means of egress for occupants depend on the number of exits, exit capacities, exit arrangement, and exit construction.

Inspection Goals

The inspection process should identify, reduce, or eliminate hazards. This helps control fire and fire spread, and limits losses. Inspectors must develop expertise in, and knowledge of, what to inspect to ensure that these circumstances are not hazards to life or property. The inspector should take the appropriate steps to reduce or eliminate the hazards.

Methods to Identify Hazards

Identification of hazards is one of the most difficult tasks encountered by an inspector. Inspectors identify hazards during plan review, design review, through observation, and on inspections. Experience increases the tools available to identify hazards, and the lack of experience is often the new inspector's shortcoming. This shortcoming points out the need for inspectors to conduct research by reviewing building information related to what type of processes are being conducted, and determining the type of hazards that can be associated with the processes.

Hazards in Industrial Occupancies

These hazards fall into two major groups.

General Hazards

The inspector must inspect for general hazards during all inspections. These include

- housekeeping;
- control of smoking materials;
- maintenance of exiting systems; and
- maintenance of electrical equipment.

Specific Hazards

Some specific hazards found in industrial occupancies include (not an all-inclusive list)

- flammable and combustible liquids;
- compressed gases;
- storage, handling, and use of other hazardous materials;
- welding and cutting operations;
- dust-producing operations;

- woodworking operations;
- operations requiring conveyor systems;
- industrial ovens--high temperatures; and
- spraying and dipping operations.

Fire Hazards in Industrial Occupancies

The inspector must consider many factors when conducting a fire inspection in an industrial occupancy. The following is only a partial list.

Building design or construction failure. Is the building designed for the industrial use currently in operation? Oftentimes, a nonhazardous business will vacate a building only to be replaced by a hazardous or high-hazard operation. Inspectors must check to ensure that construction standards are consistent with current use. It also is important to check on storage, handling, or other processes now in place that may require the installation of a new fire protection system in these existing buildings. The change in use may require a change in construction type. Does the new use comply with current construction requirements?

A new process initiated in an existing building may require fire separation from other areas. A change to a high-hazard use may not comply with the adopted building code where separations are required, upgrade to a higher construction standard is mandated, or where fire protection system requirements are not complied with.

Operational error. Make sure the personnel follow all mechanical or operational procedures. Are the transfer procedures for hazardous materials adhered to? Human beings can become complacent when they are performing what **they** view as routine tasks. But, all too often, this leads to accidents, injury, death, and/or serious fires.

Equipment failure or malfunction. Although not always caught readily by the human eye, telltale signs of potential equipment failure include frayed, worn, or deteriorating electrical wires, a buildup of oil or grease, general uncleanliness, or poor housekeeping. If you see these signs, discuss the hazard potential with the business owner or representative.

Procedural deficiencies. Similar to operational error, this category involves following prescribed steps in a process. These steps generally are established to ensure a safe process. If you find steps are not being followed, bring this to the attention of the business representative.

Maintenance weaknesses. This category is tied to equipment failure. Ask if the business has a scheduled maintenance program. Mechanical equipment will last only so long before it needs to be maintained, checked, and serviced. Encourage business owners to establish and follow prescribed maintenance schedules.

Insufficient supervision of training. Proper supervision and training are essential to safe industrial operations. Discuss the benefits of ongoing training programs, and encourage business owners to have them, particularly in the area of safety. Discuss the value of appropriate levels of supervision which help to ensure adherence to safety procedures, following procedural and maintenance guidelines.

Natural phenomena. An inspector cannot control nature but can affect operations in areas subject to natural disasters such as earthquakes, floods, high winds, lightning, and heavy snow loads. Is equipment secured or positioned to minimize hazards in an earthquake? Is earthquake bracing in place for fire protection (fire sprinklers) equipment? Have measures been taken to mitigate the potential of the other natural phenomena mentioned above, especially in regions where they are commonplace? Is the facility in a flood-prone area? It's important that inspectors know the potential natural disasters common in their area and what steps the codes have taken to provide a margin of safety in the event of their occurrence.

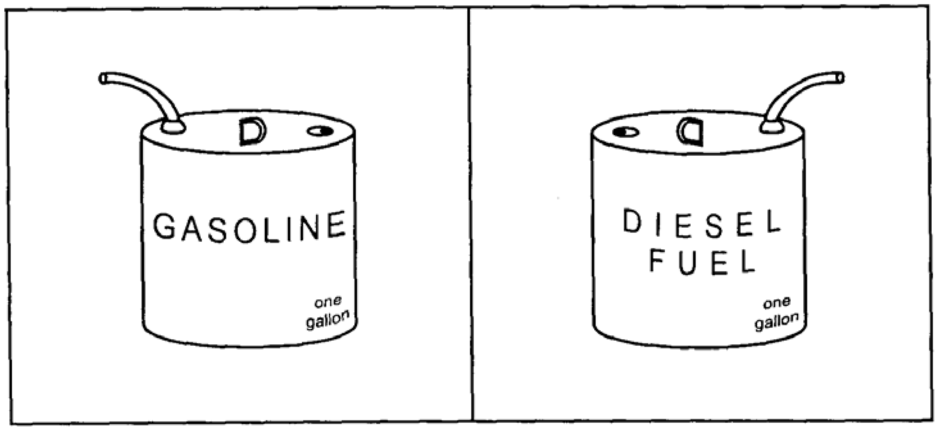
Environmental conditions. This covers a wide range of issues. Is the disposal of waste products safe? Are gas fumes properly vented, and are they safe entering the environment? Are watersheds protected from contamination? Is water runoff properly disposed of and not allowed to go into ponds or streams? Is this runoff nonflammable and environmentally safe?

As can be seen by this discussion, industrial occupancies can produce an abundance of hazards. The inspector must be careful and conscientious in evaluating each process and its potential hazard(s) as related to the protection of life and property.

FLAMMABLE AND COMBUSTIBLE LIQUIDS

Overview

The use of flammable and combustible liquids produced by chemical and petrochemical companies is increasing rapidly. Inspectors will find these liquids daily in all types of occupancies. With the recent conservation and shortage of energy sources, both industry and the general public are using alternate sources. Gasoline and fuel oil are the most common and widely used examples of flammable and combustible liquids. There are many other flammable and combustible liquids, some of which have names that give no indication of the hazards or characteristics of the liquid. Along with the flammable hazard, some liquids also may pose additional hazards, such as being unstable (reactive) or toxic. The storage and handling of these types of liquids will require special attention and precautions.



Two petroleum products
But gasoline, at normal temperatures, is
Extremely dangerous (flammable). Diesel
Fuel will not easily ignite under
The same conditions.

Generally the methods of controlling the fire hazards associated with flammable and combustible liquids are containing the liquid and vapors, and minimizing the exposure of the liquid to air.

Flammable and combustible liquid fire and explosion prevention measures embrace one or more of the following techniques: exclusion of sources of ignition, exclusion of air, keeping the liquid in closed containers or systems, ventilation to prevent the accumulation of vapors within the flammable range, and use of an atmosphere of inert gas instead of air.

Of all the hazardous materials, flammable and combustible liquids are probably of the greatest concern. They are not more dangerous than explosives or toxic gases, but they are found more frequently in a wider variety of occupancies and comprise more of the emergency calls received by the fire department. Fire codes address the requirements for the safe storage, handling, and use of these liquids in more detail.

Classifications

In determining the physical and fire characteristics of a flammable or combustible liquid, the following material is helpful:

- NFPA 321, *Standard on Basic Classification of Flammable and Combustible Liquids*.
- NFPA 30, *Flammable and Combustible Liquids Code*.
- The inspector always should use his/her sources in connection with the local fire code.

A gas is a substance that has a vapor pressure of 40 psia (pounds per square inch absolute) or more at 100°F (37.8°C). A flammable liquid is a substance having a flashpoint below 100°F, a vapor pressure below 40 psia (2,068.6mm), and a specified fluidity or viscosity. Examples are acetylene, butane, and hydrogen.

A solid is a substance with less fluidity, more viscosity, and little mobility. If it sinks in a liquid, it's a solid.

Flammable liquid is a term that designates any liquid having a flashpoint below 100°F. Flammable liquids will ignite at normal temperatures. This makes them more dangerous.

Combustible liquid is a term used to designate any liquid having a flashpoint at or above 100°F. Refer to the Storage Module of this course for further information for classification of both flammable and combustible liquid.

Many chemicals are solids at 100°F or above, and therefore are classified as solids. When heated, the solids become liquids, giving off flammable vapors, and flashpoints can be determined. When in a liquid state, these solids should be treated as liquids with similar flashpoints. These solids include paste waxes and polishes. The flashpoint and amount of liquid in the material will determine the degree of hazard.

The intent of this classification system is to divide liquids that burn into three categories. It is anticipated that, in most areas, the indoor temperature could reach 100°F at some time during the year; therefore, all liquids with flashpoints below 100°F are Class I liquids. In some areas, the ambient temperature could exceed 100°F, so only a moderate degree of heating would be required to heat the liquid to its flashpoint. Based on this, an arbitrary division of 100°F to 140°F was established for liquids with this flashpoint. These are known as Class II liquids. Liquids with flashpoints above 140°F would require considerable heating from a source other than ambient temperature before ignition could occur, and they have been identified as Class III liquids. All the model fire codes use this classification except the Standard Fire Code (SBCCI). This code does not separate Class III liquids into Class IIIA and IIIB. It uses only the Class III designation and defines it as a liquid with a flashpoint at or above

140°F and below 200°F. In determining fire prevention code requirements, it is important to remember that **it is the vapor** of a flammable or combustible liquid, rather than the liquid itself, which will burn or explode.

The violence of flammable vapor explosions also varies. It will depend on the concentration and nature of the vapor, as well as the quantity of the vapor-air mixture and type of enclosure containing the mixture.

Flashpoint, commonly accepted as one of the most important measures of the relative hazard of flammable and combustible liquids, is by no means the only factor in evaluating the hazard. The ignition temperature, flammable range, rate of evaporation, reactivity when contaminated or exposed to heat, density, and rate of diffusion of the vapor also have a bearing. The flashpoint and other factors that determine the relative susceptibility of a flammable or combustible liquid to ignition have comparatively little influence on its burning characteristics after the fire has burned for a short time.

Most of the violations concerning flammable and combustible liquids will occur with improper storage. This includes storage of excessive quantities, improper or unsafe storage containers, and improper handling or misuse of the liquid.

Regulations

Usually the codes require a permit for the storage, handling, or use of flammable and combustible liquids exceeding a given amount. The permit helps control where, when, and by whom liquids are stored, handled, and used.

There are also Federal regulations that govern the use of flammable and combustible liquids.

- Title 16, *Code of Federal Regulations*, Part 1500.43(a). Implementation of Federal Hazardous Substance Labeling Act.

- Title 29, *Code of Federal Regulations*, Part 1910. Implementation of Occupational Safety and Health Act (OSHA).

- Title 40, *Code of Federal Regulations*, Part 280. US-EPA underground storage tank system rules.

- Title 49, *Code of Federal Regulations*, Part 173. US-DOT flammable and combustible liquids definitions.

Inspection Considerations for Flammable and Combustible Liquids

The codes address design, construction, and fabrication requirements for atmospheric, low pressure, and pressure vessels. They specify requirements for aboveground tanks (outside) which include minimum distance from property lines, public ways, nearest important building, and spacing between tanks and water. The type of tank and protection is a condition that affects the distance requirements.

The codes also specify requirements for the construction and venting of portable containers, maximum allowable sizes for containers and portable tanks, and requirements for capacity and construction of storage cabinets.

Codes note special requirements for the rooms used for storage. These include requirements for maximum amounts of materials stored depending on the fire-resistive enclosure, fixed fire protection systems in the room, doorsill heights, ventilation, and electrical wiring and equipment. Codes also limit amounts of the liquids permitted outside of a storage cabinet or room, depending on the type of occupancy, and specify requirements for outside storage locations, drainage, maximum amount of liquid in each pile, distances between piles, property lines, and public ways.

Codes spell out normal and emergency relief venting for fire exposure requirements to prevent the development of a vacuum or overpressurization during the filling or unloading of tanks. Venting also is required for tanks to prevent the excessive internal pressure caused by exposure fires.

The codes note dikes and drainage requirements for tanks that may endanger important facilities, adjoining property, or waterways by accidentally discharging their liquids. Either drainage areas or firewalls are acceptable to meet those requirements. Tanks in diked areas also are required to be subdivided by drainage channels or intermediate curbs to prevent spills from endangering adjacent tanks within the diked area.

The codes specify requirements for the location of underground tanks in relation to the nearest building foundation and property line as well as the depth and cover, corrosion protection, and venting installations.

Codes discuss present requirements for tanks permitted inside buildings under special conditions. Special venting, fire protection, piping arrangements, and control valves also are listed.

Codes note special requirements for supports, foundations, and anchorage for tanks, and for fire prevention or fire protection requirements for tanks that are supported above the foundation.

Other special requirements listed in the codes are for anchoring of tanks that may be subject to flooding. In locations where flammable vapors may be present, precautions must be taken to eliminate or control ignition sources.

Codes cover requirements for methods of transfer, as well as drainage and ventilation requirements, and bonding. Requirements for the location and distances from tanks, property lines, and buildings are noted as are special fire control equipment requirements. Requirements for electrical bonding and grounding are spelled out, along with filling controls, ignition sources, and drainage requirements.

Other requirements in the codes note the proper type of explosive-proof equipment, fixtures, and wiring. The class of liquid, location, and distance from the activity determine the requirements.

Last, codes specify requirements for the type of nozzles, dispensing units, dispensing locations, special controls, emergency shutoffs, attendance, or supervision of dispensing as well.

COMPRESSED GAS CYLINDERS--INDUSTRIAL GASES

Overview

Most fire inspectors will have major contacts with gases that are considered hazardous materials. Gases, in themselves, are not dangerous. It is the use to which a gas is put and how it is handled that determine whether or not that gas is hazardous. Improperly used, gases can be responsible for major disasters. Chemical properties of a gas are a primary fire protection concern, as they reflect the ability of a gas to react chemically with other materials (or with itself) to produce potentially hazardous quantities of heat or reaction products, as well as physiological effects hazardous to humans. The hazards of gases confined in their containers basically reflect their tendency to expand when heated. When the gas is confined, heating results in an increase in pressure, which can result in gas release or cause container failure.

Containers can fail from flame impingement, that is, an exposure fire due to loss in strength of the material from which the container is fabricated. When storing compressed gas cylinders, it is critical to separate fuel cylinders from oxygen cylinders. Different codes have different requirements, and inspectors need to check local codes.

Gases Defined

In order to deal effectively with the great number and variety of gases in commerce or the environment, it is advantageous to establish certain classifications for gases. These classifications recognize certain "common denominators" reflecting the chemical and physical properties of gases and their primary uses.

- **Compressed gas** exists at normal temperature inside its container solely in the gaseous state under pressure. (Example: hydrogen.) Compressed gases may be toxic, flammable, corrosive, oxidizing, etc. Release of a gas for any reason may have a detrimental effect on life and/or property.

- **Liquefied gas** exists at normal temperature inside its container partly in the liquid state and partly in the gaseous state, and under pressure, as long as any liquid remains in the container. (Example: liquefied petroleum gas (LPG).)

- **Cryogenic gas** exists as a liquefied gas in its container at temperatures far below normal atmospheric temperatures, usually slightly above its boiling point at normal temperature and pressure (NTP). (Example: liquid oxygen.)

One can subdivide the three gas groupings even further.

- **Flammable gas** will burn in normal concentrations of oxygen in the air. (Example: acetylene.)

- **Nonflammable gas** will not burn in any concentration of air or oxygen. (Example: nitrogen.) Some nonflammable gases will support combustion and are referred to as "oxidizers." (Example: oxygen.)

- **Reactive gas** will react with other materials or by itself (with the production of potentially hazardous quantities of heat or reaction products). (Example: fluorine.)

- **Toxic gas** presents a serious life hazard if released into the atmosphere; gases that are poisonous or irritating when inhaled or contacted. (Example: chlorine.)

Storage of Compressed Gases

The Model Fire Codes and NFPA Standards have varying requirements for the storage of different types of compressed gases. The general requirements noted by these different codes and standards address the following:

- Separate flammable and nonflammable gases.
- Separate oxygen cylinders from flammable cylinders, at least 20 feet or provide a wall separation with a minimum 30-minute fire resistive rating.
- Properly marked and stored upright.
- Chained or secured with valve protection.
- Separate from flammable or hazardous materials or processes.
- Outside storage.
- Specific distances required from property lines based on type and amount of storage.

Compressed gases also are found in medical applications such as hospitals, doctor/dentist's offices, and veterinary offices.

OTHER INDUSTRIAL OCCUPANCY HAZARDS AND PROCESSES

Many industrial processes are potential hazards; the inspector needs to consider this during inspections.

Welding and Cutting

Welding and cutting have inherent risks due to open flame and sparks. These operations must be done in a safe area. The codes generally specify when and what type of firefighting equipment must be available during welding and cutting operations. They may require as little as a fire extinguisher, or as much as charged and manned hoselines. Permits usually are required. Housekeeping in the areas is very important. Most codes require a fire watch during welding and/or cutting operations, and for at least 30 minutes after operations are complete.

Dust-Producing Operations

Because finely divided particles ignite easily, dust contributes to rapid fire spread. In industrial situations where dust production is a problem, housekeeping is extremely important. Dust collection systems help mitigate problems, but they must be well maintained and kept clean. Machinery should be approved (i.e., Underwriters Laboratories (UL)).

Woodworking Operations

Woodworking operations have hazards similar to those in dust-producing operations. The machinery should be approved and well maintained. Housekeeping helps control sawdust. Sawdust collectors help mitigate the hazards.

Conveyor Systems

Conveyor systems present the greatest hazard if the carried material is combustible or if the belt itself is combustible. Conveyor systems need inspection regularly. Heat-producing operations such as cutting and welding or discharge from kilns, ovens, or furnaces often are associated with conveyors. Fire protection systems for conveyors limit the amount of heat in the system and include sprinklers and fire doors.

A significant problem with conveyor systems is their penetration of walls, especially separation walls, both horizontal and vertical. Although required by the codes for most applications, automatic system shutoffs that activate during fire events often are omitted or are inoperative. Without these built-in safety systems, fires in conveyors can build and spread very rapidly.

Industrial Ovens

Industrial ovens generally operate at or below 1,400°F (760°C), although some go even higher. Some examples include bakery ovens, which operate up to 1,400°F, and coke ovens, which operate above 2,000°F (1,093.3°C). Housekeeping in and around ovens is essential. There must be proper venting for heat and explosion and frequent inspections. Operating controls also need regular testing.

Ovens that involve flammable or combustible processes in buildings protected by automatic fire sprinklers may be required to have internal (oven) fire sprinkler protection. NFPA 86, *Standard for Ovens and Furnaces*, is a recognized reference for these requirements.

Spraying and Dipping Operations

Spraying and dipping operations produce fine flammable particles or vapors. Because of the inherent hazards of these operations, automatic fire extinguishing systems may be required. Ventilation is essential. These operations must include protected electrical systems with spark arresters or containment, and self-closing dip pans or trays. Housekeeping is essential to control liquids and vapor buildup.

Application of flammable finishes by spray process is more hazardous than brush application because of the volume of flammable liquids used, the method of application and drying, and the foundation of flammable residue, which in some cases may be subject to spontaneous heating.

The water wash booth helps minimize overspray deposits in exhaust ducts and reduce air pollution. Water wash booths employ a water spray curtain to separate the excess overspray. Water collects the residue and carries it to a tank from which it is later removed as a sludge. Water spray booths generally require the same protection as other booths, although the hazard in the exhaust ducts is reduced materially.

In exhaust air filter booths, filters help collect the overspray. An air velocity over the open face of the spray booth cannot be less than 100 linear feet per minute.

HAZARDOUS MATERIALS

Overview

Hazardous materials are processed, stored, handled, and transported. At each step in the life cycle of these materials different hazards appear.

First, someone manufactures the material and then ships it to a facility closer to their point of end use. Here it often gets stored and/or transferred to smaller containers for distribution and sale. Finally, hazardous materials may be totally consumed, or waste may be generated for disposal (used motor oil, nuclear fuel core, etc.). This illustrates the need for code enforcement initiatives at various levels in your community.

The following list separates code actions into functional areas:

- manufacturing of hazardous materials;
- transfer and storage;
- distribution and/or retail sales; and
- end-user.

Before you can work methodically toward the solution of the problem by using the proper code requirement, you must recognize that a hazard exists. Your jurisdiction may not have code requirements for some of the hazardous materials. Become totally familiar with your jurisdiction's codes and with what types of materials the codes address. No community is exempt from the use of hazardous materials or the threat such use may present.

The purpose of the inspection is to identify what hazardous materials are being used, and their properties. This can be the most challenging task. Next determine what units of the material are allowed for storage and actual use. Areas for the production or processing of hazardous materials must be identified, and control for protection of the material must be in place.

Inspection Considerations

Ensure adequate safety precautions as required by codes for amounts of material in the area, making sure, for example, that there is adequate venting, properly classified and maintained electrical equipment, and that wiring is in good condition. When inspecting production and process areas for hazardous materials, identify processes or operations that are hazardous. Be sure they have proper controls and that the protection is appropriate to the hazard. Hazardous materials should not exceed the amounts necessary for one day or for one shift's use. Use your judgment. There may be no established standards.

Your inspection should cover the basics of fire prevention:

- good maintenance of areas and equipment;
- good housekeeping practices;
- developed and understood safety plan;
- separation of incompatible materials or processes;
- remote storage of materials, if necessary; and
- correct markings for hazardous materials.

Trade secrets are common in industry. Management must trust you to hold information for inspection purposes only. You may need to sign a pledge of confidentiality.

Hazardous materials can create serious hazardous conditions for employees, visitors, or anyone in the area of the plant or process. The purpose of an industrial occupancy hazardous materials inspection is to identify these hazardous materials. Codes specify the limits of hazardous material amounts at a facility and in actual use. The inspection should verify that only the necessary amounts are present.

Inspection Process

When making an inspection of an industrial occupancy with hazardous materials, take your time. Use all the available reference sources (code books, hazardous materials guides, and MSDS). Research carefully and thoroughly. At the time of the inspection there usually is not an emergency, so get it right the first time and use good judgment. Identify the hazard and its properties by referencing the required information found in the Materials Safety Data Sheet (MSDS) available at the site.

Classification of Hazardous Materials

Hazardous materials are classified in the following ways.

Oxidizers provide oxygen for combustion. Examples include nitrates, nitrites, chlorates, chlorites, and peroxides.

Combustible chemicals give off toxic gases when heated. Examples include carbon black, lamp black, sulfur, and organic peroxides.

Unstable chemicals spontaneously polymerize, decompose, or otherwise react with themselves in the presence of a catalytic material. These chemicals deserve special attention in storage and handling. They can be decomposed by heat, shock, or friction, depending on the chemical and the temperature.

Water- and air-reactive chemicals react and produce significant amounts of heat when exposed to water or air. Examples include alkalies (caustics), anhydrides, carbides, phosphorus, and hydrides.

Corrosive chemicals have a destructive effect on living tissue and are usually strong oxidizing agents. Examples include inorganic acids (such as hydrochloric acid, hydrofluoric acid, and sulfuric acid) and halogens (such as bromine, chlorine, and fluorine).

Radioactive materials have both explosive and fire hazards. They emit radiation at various levels. Industrial radioactive materials include X-rays, krypton 85, plutonium 238, and uranium 238.

Toxic chemicals present a life hazard in fire. These materials can cause serious injury or death when small quantities are inhaled, ingested, or absorbed through the skin. Examples include alkaloids, antimony compounds, arsenates, and aresenites.

Code Requirement References

The four model fire codes have specific sections that address various types of hazardous materials. In addition, the National Fire Protection

Association (NFPA) publishes standards, adopted by reference within the fire codes, that address requirements for hazardous materials (e.g., NFPA 30, *Flammable and Combustible Liquids Code*; NFPA 58, *Standard for the Storage and Handling of Liquefied Petroleum Gases*). Another reference source is the *North American Emergency Response Guide Book.* Make sure that you have checked what your jurisdiction uses.

The Superfund Amendments and Reauthorization Act of 1986 (SARA Title III), the Federal regulation, was enacted October 17, 1986. It covers requirements for emergency planning and the community's right to know related to hazardous materials. The regulation applies to all communities regardless of what other code or regulation they have adopted. This regulation requires a plan that includes the following:

- identification of facilities and extremely hazardous substances transportation routes;
- emergency response procedures, on site and off site;
- designation of a community coordinator and facility coordinator(s) to implement the plan;
- emergency notification procedures;
- methods for determining the occurrence of a release and the probable affected area and population;
- description of community and industry emergency equipment and facilities and the identity of persons responsible for them;
- evacuation plans;
- description and schedules of a training program for emergency response personnel; and
- methods and schedules for exercising emergency response plans.

Minimum plan elements are emergency evacuation routes and procedures; procedures for shutdown of critical operations; procedures to account for all employees after evacuation; rescue and medical duties, if necessary; means of reporting fires and other emergencies; and identification of persons who can provide information and explanation of the plan.

Any facility that produces, uses, or stores any of the listed hazardous materials in quantities greater than its listed threshold, is subject to emergency planning.

The plan requires that copies of the MSDS be submitted to:

- Local Emergency Planning Committee (LEPC);
- State Emergency Response Commission (SERC); and
- local fire department.

Response agencies need to receive MSDS. The MSDS contains information about chemical composition, physical and chemical properties, health and safety hazards, emergency response, and waste disposal of material.

MSDS must show

- name, address and telephone number;
- chemical and trade name;
- health and hazard data;
- hazardous ingredients;
- fire and explosive information;
- precaution and protective information;
- physical and reactivity data;
- environmental information; and
- may include recommendations for storage and handling.

Required emergency notification that includes

- the chemical name;
- an indication of whether the substance is extremely hazardous;
- an estimate of the quantity released into the environment;
- the time and duration of the release;
- the medium into which the release occurred;
- any known or anticipated acute or chronic health risks associated with the emergency, and (where appropriate) advice regarding medical attention necessary for exposed individuals;
- proper precautions, such as evacuation; and
- name and telephone number of contact person.

Authorities must develop and implement an emergency response plan to handle anticipated onsite emergencies prior to the start of hazardous waste operations. Emergency response activities to all other hazardous waste operations shall follow an emergency response plan meeting the requirements of the following:

- pre-emergency planning;
- personnel roles, lines of authority, training, and communication;
- emergency recognition and prevention;
- safe distances and places of refuge;
- site security and control;
- evacuation routes and procedures;
- decontamination;
- emergency medical treatment and first aid;
- emergency alerting and response procedures;

- critique of response and followup; and
- personal protective equipment (PPE) and emergency equipment.

The employer shall develop an emergency response plan for onsite and offsite emergencies that address, as a minimum, the following:

- location and storage of hazardous materials;
- location of onsite emergency firefighting and spill cleanup equipment;
- diagram of complete sewer system;
- water system, showing fire hydrant and water main locations and sizes;
- copy of hazardous materials management plan (where required);
- building floor plan where required by the code official;
- personnel list--key personnel knowledgeable of safe procedures, with phone numbers; and
- inventory of hazardous materials with average or maximum daily quantities allowed.

OSHA requires that those businesses that store, handle, or use hazardous materials have an emergency plan, and that all employees be familiar with the plan.

SUMMARY

Inspection of industrial occupancies requires extensive research to enforce codes properly because these occupancies include such a broad spectrum of materials, many of which are hazardous materials. Furthermore, these occupancies often house unusual processes. The inspector's job is to gain knowledge through research. Take your time and seek the counsel of more experienced inspectors.

Activity IN.1

Identify Types of Industrial Occupancies

Purpose

To differentiate among the various types and subclasses of industrial occupancies based on content hazard classification (subclass).

Directions

1. In small groups, using your adopted code, develop a list of industrial occupancies and the hazardous processes/materials found in these occupancies.

2. Identify the occupancy, process, or material by subclass, using your adopted code.

Example

Operation, Process, or Material	**Occupancy and Subgroup Classification**
Uniform Codes	
Paint spray booth Aircraft repair hangars	Group H, Div. 2 Group H, Div. 5
NFPA 101, *Life Safety Code*	
Paint spray booth Aircraft repair hangars	Incidental (special purpose) high hazard Incidental high hazard

3. The codes are not always succinct on how to categorize the process or material--use your best judgment.

4. Each group will select a spokesperson to report on its results.

5. You will have 40 minutes for this activity.

Activity IN.2

Hazards in Industrial Occupancies

Purpose

To identify the fire and life safety hazards inherent in industrial occupancies.

Directions

1. Working in the same small groups from the previous activity, develop a list of fire and life safety hazards for each of the two industrial occupancies assigned to your group by the instructor. Use an easel pad.

2. Select a spokesperson to report for your group.

3. You have 45 minutes for this activity.

Activity IN.3

Hazard Identification and Enforcement Notice

Purpose

To familiarize you with how to research basic requirements related to flammable liquids in your codes, and how to write code-based inspection notations.

Directions

1. Individually, research, in your code, the specific code section that relates to the issue noted.

2. Discuss your findings with the other members of your group.

3. After your group agrees on the proper code section, draft an inspection notation similar to one you would write on an actual inspection form.

4. Select a spokesperson to present your findings.

5. You have 30 minutes to complete this activity.

Example

Issue: A service station does not have signs posted requiring motors to be shut off during refueling.

Code Section:
Building Officials & Code Administrators International, Inc. (BOCA) Fire Prevention Code F-3206.3 and F-3206.3.1.

Notation:
A motor vehicle engine must be shut off during the fueling process. Warning signs shall be posted visibly in every fuel-dispensing area that indicate "The engine shall be shut off during the refueling process."

Hazard Identification and Enforcement Notice Worksheet

1. During the inspection of a large welding operation, you observe that there is no fire watch. Is this a code violation and, if so, what code section and enforcement notation would you use on your inspection form to remedy this situation?

Code Section(s)	Notation
______________________	______________________
	______________________
	______________________
	______________________

2. While inspecting a service station, you observe that a fuel tank vehicle is filling an underground storage tank. On inspection you cannot locate a fire extinguisher on the vehicle. Is this a code violation, and what section would you cite?

Code Section(s)	Notation
______________________	______________________
	______________________
	______________________
	______________________

3. A service station owner has asked you to provide him/her with the code section requiring monitoring of underground storage tanks. How would you cite this by code section and notation?

Code Section(s)	Notation
______________________	______________________
	______________________
	______________________
	______________________

4. During an inspection of a lumberyard and woodworking plant, you find they have 180,000 board feet of lumber and no permit. Is this a violation and, if so, list the code sections and enforcement notice you would use.

Code Section(s)	Notation
______________________	______________________
	______________________
	______________________
	______________________

5. During an inspection of an industrial occupancy, you observe several compressed gas cylinders unsecured, which could be knocked over easily. What code section would you reference, and what notation would you make on your inspection form to remedy this situation?

Code Section(s)	Notation
______________________	______________________
	______________________
	______________________
	______________________

6. A service station owner has abandoned his/her underground flammable liquids storage tanks. What code section and notation would you use for permit requirements for the removal, abandonment, placing temporarily out of service, or disposal of a flammable or combustible liquid storage tank and piping?

Code Section(s)	Notation
______________________	______________________
	______________________
	______________________
	______________________

7. During an inspection, you observe a LPG container with a 150-gallon water capacity, 3 feet from a building. Is this a code violation and, if so, what code section would you cite, and what enforcement notification would you use to remedy the situation?

Code Section(s)	Notation
______________________	______________________
	______________________
	______________________
	______________________

8. During the inspection of a paint spray booth, you observe electrical equipment that obviously was purchased at a local hardware store. Is this a violation and, if so, what code section and enforcement notation would you use to remedy the situation?

Code Section(s)	Notation
______________________	______________________
	______________________
	______________________
	______________________

9. During the inspection of a service station, you observe that the dispenser nozzles do not have automatic shutoffs. Is this a code violation and, if so, what code section and enforcement notation would you note on your inspection notice?

Code Section(s)	Notation
______________________	______________________
	______________________
	______________________
	______________________

10. You are inspecting an underground flammable liquid storage tank installation that does not have secondary containment. Is it required, and what code section and notation would you make on your inspection notice?

Code Section(s)	Notation
______________________	______________________
	______________________
	______________________
	______________________

Activity IN.4

Developing Emergency Plan Guidelines

Purpose

To help you become familiar with using the DOT *Emergency Response Guide* (ERG).

Directions

1. Individually, using the ERG, provide the information requested for the hazardous materials listed on the following worksheet. In addition, find the section that answers the questions related to information in the ERG.

2. Using the worksheet, prepare your answers and be prepared to discuss your findings with the remainder of the class. Your paper will be turned in and evaluated by the instructor after the discussion.

3. You have 30 minutes to complete this activity. Be prepared to discuss your work.

Hazardous Materials Worksheet

1. Diesel fuel (ID #, guide #(s), and large spill emergency action).

2. Diethyl ether (ID #, guide #, and isolation distance if tank, railcar, or tank truck involved in fire).

3. Sodium nitrate (ID #, guide #, and recommended extinguishing agent).

4. Copper arsenite (ID #, guide #, and large fire emergency action).

5. ID #2278 (name, guide #, and runoff hazard).

6. ID #1076 (name, guide #, and critical health hazard).

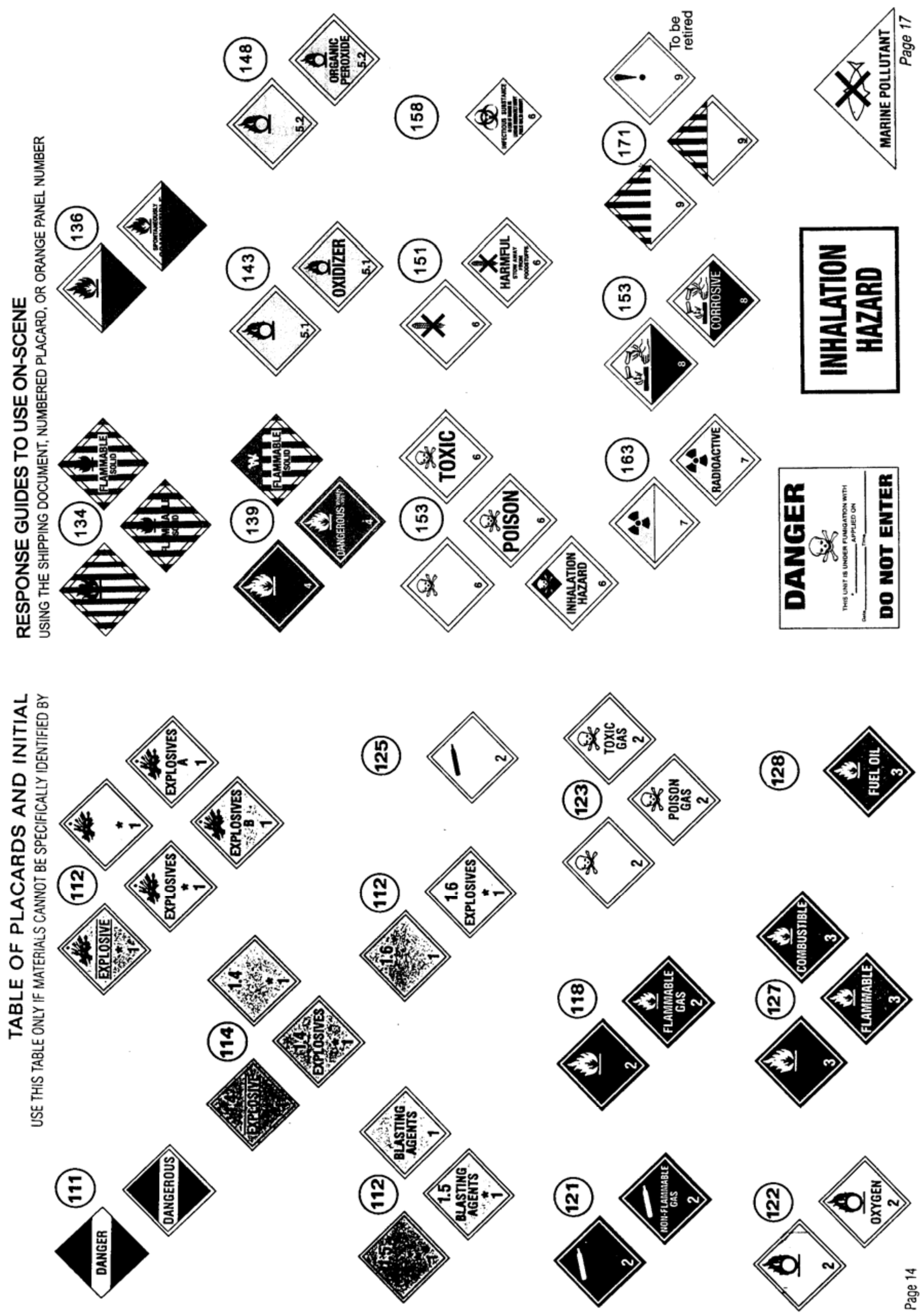
7. ID #1957 (name, guide #, and protective clothing recommendation and cautions).

8. Where is the information that explains the difference between downwind protection distances for day and night?

9. What information is to be provided when calling the National Response Center (NRC), and where is it found?

10. When does the ERG recommend protect-in-place rather than evacuation, and where is the information found?

APPENDIX



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