NC Employees Workplace Program Requirements for
Safety and Health

Flammable and Combustible Liquids

Scope

Flammable and combustible liquids are used in everyday operations. Flammable and combustible liquids require careful handling. Mixing and using these liquids, smoking, and using electrical equipment around them add to the hazards.

This safety requirement and procedure presents guidelines for the safe use, and storage of flammable and combustible liquids. It presents training provisions, a discussion on health hazards and on the flammable and combustible liquids classification system. Additionally, this safety requirement and procedure presents information on the typical uses of flammable and combustible liquids, storage requirements, and disposal details.

This safety requirement and procedure affects State employees who are exposed to the hazards associated with flammable and combustible liquids.

Background

This safety requirement and procedure is established in accordance with Occupational Safety and Health Administration for General Industry 29 CFR (1910.106), the Occupational Safety and Health Standards for the Construction Industry (29 CFR 1926.152), and the National Fire Protection Association, NFPA 30.

Requirement

It is the requirement of the State to provide a place of employment that is free from recognized hazards that cause or are likely to cause death or serious physical harm to employees or the public. Therefore, flammable and combustible liquids will always be handled in a careful manner to minimize fire and explosion hazards. When these hazards exist that cannot be eliminated, the engineering practices, administrative practices, safe work practices, Personal Protective Equipment (PPE) and proper training regarding Flammable and Combustible Liquids will be implemented. These measures will be implemented to minimize those hazards to ensure the safety of employees and the public.

Definitions

**Barrel:** A container holding 42 U.S. gallons.

**Boiling Point:** The boiling point of a liquid at a pressure of 14.7 pounds per square inch absolute (p.s.i.a.) or, if boiling point is unavailable, the 10 percent point of a distillation may be used as the boiling point of a liquid.

**Closed Container:** A container sealed by means of a lid or other device such that neither liquid nor vapor will escape at ordinary temperatures.

**Fire Area:** An area of a building separated from the remainder of the building by construction which has a fire resistance of at least 1 hour and having communicating openings properly protected by an assembly which has a fire resistance of at least 1 hour.
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**Flashpoint:** The minimum temperature at which a liquid gives off vapor within a test vessel in sufficient concentration to form an ignitable mixture with air near the surface of the liquid.

**Liquid:** Any material which has fluidity greater than that of 300 penetration asphalt when tested which includes both flammable and combustible liquids.

**Combustible Liquids:** Any liquid having a flashpoint at or above 100°F. Combustibles are divided into two classes as follows:

- Class II Liquids will include those with flashpoints at or above 100°F and below 140°F or higher, except any mixture having components with flashpoints of 200°F or higher, the volume of which make up 99 percent or more of the total volume of the mixture.

- Class III Liquids will include those with flashpoints at or above 140°F. And below 200°F, except any mixture having components with flashpoints of 200°F or higher, the total volume of which make up 99 percent or more of the total volume of the mixture.

- Class IIIB Liquids will include those with flashpoints at or above 200°F.

**Flammable Liquids:** Any liquid having a flashpoint below 100°F except a mixture having components with flashpoints of 100°F, or higher, the total of which make up 99 percent or more of the total volume of the mixture. Flammable Liquids are divided into three classes as follows:

- Class 1A includes liquids having flashpoints below 73°F and having a boiling point below 100°F.

- Class 1B includes liquids having flashpoints below 73°F and having boiling points at or above 100°F.

- Class 1C includes liquids having flashpoints at or above 73°F and having boiling points below 100°F.

A liquid which in a pure state or as commercially produced or transported will vigorously polymerize, decompose, condense, or will become self-reactive under conditions of shocks, pressure, or temperature.

**Portable Tank:** A closed container having a liquid capacity over 60 U.S. gallons and not intended for fixed installation.

**Pressure Vessel:** A storage tank or vessel which has been designed to operate at pressures above 15 p.s.i.

**Protection From Exposure:** Adequate fire protection for structures on property adjacent to tanks, where there are employees of the establishment.

**Safety Can:** An approved container of not more than 5 gallons capacity, having a spring-closing lid and spout cover and so designed that it will relieve internal pressure when subjected to fire exposure.
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**Vapor Pressure:** The pressure measured in pounds per square inch (absolute) exerted by a volatile liquid as determined by the “Standard Method of Test for Vapor Pressure of Petroleum Products.”

**General Provisions**

This section details the provisions of this safety requirement and procedure with each provision discussed in a separate subsection. These provisions are:

- Training
- Health Hazards
- Classification
- General Safety Requirements
- Uses
- Storage
- Disposal

**Training**

Employees who work with flammable and combustible liquids shall be trained at the time of initial employment or assignment. Refresher training shall be provided at the discretion of the supervisor.

**Health Hazards**

Flammable and combustible liquids create health hazards when inhaled or when they contact skin. Intoxication and other acute and chronic conditions may result from breathing vapors of flammable liquids. Irritation results from the solvent action that these liquids have on the skin’s natural oils and tissue. Vapors from flammable and combustible liquids are generally heavier than air. They will flow into pits, tank openings, confined areas, and low places where they may displace oxygen and contaminate the normal air, causing toxic and explosive atmospheres.

Oxygen deficiency may also occur in closed containers, such as a tank that has been closed for a long time and in which rusting has consumed the oxygen. Confined spaces should be tested for toxic and flammable atmosphere and oxygen levels. See 29 CFR 1910.146, Confined Space Entry, for additional details.

**Classification**

The National Fire Protection Association (NFPA) developed a classification system for flammable liquids and combustible liquids that uses flash point, vapor pressure and anticipated ambient temperature conditions.

The flash point of a liquid is the lowest temperature at which the vapor pressure of the liquid is just sufficient to produce a flammable mixture at the lower limit of flammability.

Vapor pressure is a property of a liquid in a closed container. The atmosphere above the liquid is a mixture of air and vapors of the liquid.
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The temperature at which the flash point and boiling point occurs also is used to determine the NFPA classification of a liquid. The following charts illustrate the classification of liquids based upon flash and boiling points.

### Flammable Liquids Classification

<table>
<thead>
<tr>
<th>Flash Points Ranges</th>
<th>Boiling Point Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Less than 73°F)</td>
<td>(Less than 100°F)</td>
</tr>
<tr>
<td>(Greater than)</td>
<td>(Greater than)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Classification</th>
<th>Flash Points</th>
<th>Boiling Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>IA</td>
<td>Less than</td>
<td>Less than</td>
</tr>
<tr>
<td>IB</td>
<td>Greater than</td>
<td>Greater than</td>
</tr>
<tr>
<td>IC</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Combustible Liquids Classification

<table>
<thead>
<tr>
<th>Flash Points Ranges</th>
<th>Boiling Point Ranges</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Less than 100°F)</td>
<td>(Less than 140°F)</td>
</tr>
<tr>
<td>(Greater than)</td>
<td>(Greater than 200°F)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Classification</th>
<th>Flash Points</th>
<th>Boiling Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>II</td>
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<td></td>
</tr>
<tr>
<td>III</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IIIIB</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### General Safety Requirements

Flammable and combustible liquids require careful handling. General safety requirements to minimize flammable and combustible liquids hazards include:

- Preventing dangerous mixtures
- Not smoking
- Avoiding static electricity

**Preventing dangerous mixtures** of flammable and combustible liquids is important to minimize fire and explosion hazards. Identify fill openings, discharge openings, and control valves on equipment containing flammable and combustible liquids by colors or labels, or both. Mark each tank with the name of the product or otherwise identify it. Keep lines from tanks of different types and classes of products separated.

Use a portable approved container for handling flammable liquids in quantities up to 5 gallons. Clearly identify the containers with lettering or a color code.

**Not smoking** in a building or area where flammable and combustible liquids are stored, handled, or used minimizes fire and explosion hazards.

Employees should not smoke or carry strike-anywhere matches, lighters, and other spark-producing devices when inside a flammable and combustible liquid storage building. The size of the restricted area will depend on the type of products handled, the design of the
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building, local codes, and local conditions. No Smoking (see figure 1) signs must be conspicuously posted in buildings and areas where smoking is prohibited.

Avoiding static electricity minimizes fire and explosion hazards caused by spark discharges. Static electricity is generated by the contact and separation of dissimilar material. For example, static electricity is generated when a fluid flows through a pipe or from an opening into a tank.

A static spark poses great danger where a flammable vapor may be present in the air, such as at the outlet of a flammable liquids container, and around a tank truck’s fill opening or barrel bunghole. When a difference in electrical potential is present, a spark between two bodies can occur because there is not a good electrical-conductive path between them.

To prevent static electricity, bonding and grounding of flammable and combustible containers must be done. Bonding eliminates the static charge potential between two or more containers. Grounding eliminates the static difference between a container and the earth.

Bonding and grounding do not eliminate static charges. Bonding equalizes the potential between two containers so that a spark will not occur between them. Grounding will discharge a charged conductive container.

Figure 2 presents how two containers should be bonded during the filling process. Figure 3 grounding configuration for aboveground storage tanks.

Uses

Flammable and combustible liquids are used in a variety of applications in the State. Common uses include:

- Dip tanks
- Drying ovens
- Oil burners
- Cleaning metal parts
- Internal combustion engines
- Spray booths
- Liquefied petroleum gases

When employees use these liquids, they should know and follow the necessary precautions with any of the uses of flammable and combustible liquids. (It should be noted that gasoline should never be used for cleaning parts or starting fires.) Appendix A (Special notes on selected flammable and combustible liquids).

Storage

Storage requirements for flammable and combustible liquids are based on the storage quantity. The table on the following page presents general storage requirements based on capacity.

Flammable and combustible liquids can be stored in a variety of configurations depending upon capacity, use, storage configurations and classification. They include:

- Indoor storage areas
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- Outdoor storage cabinets
- Outdoor storage
- Container and portable tank storage
- Fixed tank storage

**Indoor storage areas** are those areas where the primary function is to store liquids. This includes inside rooms, cut-off rooms, attached buildings, liquid warehouses, and hazardous material storage lockers. These storage areas should be constructed to be fire-resistant per NFPA 30. Additional construction requirements for storage areas are based on the classifications of the stored liquids and whether or not these liquids are dispensed.

**Outdoor storage cabinets** are used to store not more than 120 gallons of Class I, Class II, or Class III liquids. Storage cabinets are designed and constructed to limit the internal temperature at the center of the cabinet. These cabinets can be constructed of either metal or wood and must be marked, “FLAMMABLE-KEEP FIRE AWAY.”

<table>
<thead>
<tr>
<th>Storage Capacity</th>
<th>Storage Container</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 60 gallons</td>
<td>Drums or other containers</td>
</tr>
<tr>
<td>Greater than 60, less than 660 gallons</td>
<td>Portable tanks</td>
</tr>
<tr>
<td>Greater than 660 gallons</td>
<td>Aboveground tanks, underground tanks, inside storage of fixed, and portable tanks</td>
</tr>
</tbody>
</table>

**Outdoor storage** of liquids in containers and portable tanks is permissible in either piles or racks. Appendix B presents outdoor storage requirements for liquids in containers and portable tanks. See NFPA 30 for additional details.

**Container and portable tank storage** should be used for the storage of liquids that do not exceed 60 gallons (containers) and 660 gallons (portable tanks). Appendix C presents the maximum allowable container sizes by classification.

**Fixed tank storage** of liquids is applicable to capacities greater than 660 gallons and includes the following tank configurations:

- Aboveground
- Underground
- Inside storage of liquids in fixed and portable tanks (Storage tank buildings)

Appendix D presents fixed tank installation criteria for all the above fixed tank configurations.

**Disposal**

If uncontaminated flammable and combustible liquids are not to be used they can be:

- Returned to the vendor
- Salvaged for resale
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- Used in some other approved way

If recycling or recovery of used or dirty flammable and combustible liquids is not feasible, then it should be handled by a licensed disposal contractor. Used flammable and combustible liquids are never to be disposed of into the earth or into any water bodies.

**Appendix: Special Notes on Selected Flammable and Combustible Liquids**

Ammonium Nitrate - Ignites when mixed with acetic acid. May react violently or explode with powdered metals.

Ammonium Persulfate - May explode when mixed with aluminum powder. Will explode with sodium peroxide if subjected to crushing (or heating or if a stream of CO2 is passed over it).

Magnesium Nitrate - Oxidant. In contact with easily oxidizable substances may ignite or explode.

Mercuric Nitrate - May explode when heated to decomposition.

Perchloric Acid - Strong oxidant. May explode on contact with organic materials.

Potassium Bromate - Strong oxidant. May react with many substances and cause ignition of combustible materials.

Potassium Chloride - Powerful oxidizing material. May form explosive mixture with easily oxidizable material.

Potassium Nitrate - Oxidizing material. In contact with easily oxidizable material may cause combustion or explosion.

Silver Nitrate - Oxidizing material. Increasing flammability of other oxidizing materials.

Sodium Nitrite - Oxidizing agent. If in contact with easily oxidizable substances, combustion or explosion may result.
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### Appendix B: Outdoor Liquid Storage Requirements

#### Outdoor Liquid Storage in Containers

<table>
<thead>
<tr>
<th>Class</th>
<th>Container Storage - Max per Pile in Gallons</th>
<th>Container Storage - Max per pile in Height (Ft)</th>
<th>Distance Between Piles or Racks (Ft)</th>
<th>Distance to Property Line that is or can be built upon</th>
<th>Distance to Street, Alley, or Public Way</th>
</tr>
</thead>
<tbody>
<tr>
<td>IA</td>
<td>1,100</td>
<td>10</td>
<td>5</td>
<td>50</td>
<td>10</td>
</tr>
<tr>
<td>IB</td>
<td>2,200</td>
<td>12</td>
<td>5</td>
<td>50</td>
<td>10</td>
</tr>
<tr>
<td>IC</td>
<td>4,400</td>
<td>12</td>
<td>5</td>
<td>50</td>
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<tr>
<td>II</td>
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<td>5</td>
<td>10</td>
<td>5</td>
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</table>

#### Outdoor Liquid Storage in Portable Tanks

<table>
<thead>
<tr>
<th>Class</th>
<th>Container Storage - Max per Pile in Gallons</th>
<th>Container Storage - Max per pile in Height (Ft)</th>
<th>Distance Between Piles or Racks (Ft)</th>
<th>Distance to Property Line that is or can be built upon</th>
<th>Distance to Street, Alley, or Public Way</th>
</tr>
</thead>
<tbody>
<tr>
<td>IA</td>
<td>2,200</td>
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<td>5</td>
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<td>IB</td>
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<tr>
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<td>8,800</td>
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<td>5</td>
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</table>

### Appendix C: Maximum Container and Portable Tank Sizes by Classification

<table>
<thead>
<tr>
<th>Container Type</th>
<th>Flammable Liquids</th>
<th>Combustible Liquids</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Class IA</td>
<td>Class IB</td>
</tr>
<tr>
<td>Glass</td>
<td>1 pint</td>
<td>1 quart</td>
</tr>
<tr>
<td>Metal</td>
<td>1 pint</td>
<td>5 gallons</td>
</tr>
<tr>
<td>Approved Plastic</td>
<td>1 pint</td>
<td>5 gallons</td>
</tr>
<tr>
<td>Safety Cans</td>
<td>2 gallons</td>
<td>5 gallons</td>
</tr>
<tr>
<td>Metal Drum</td>
<td>60 gallons</td>
<td>60 gallons</td>
</tr>
<tr>
<td>Metal Portable Tanks</td>
<td>660 gallons</td>
<td>660 gallons</td>
</tr>
<tr>
<td>Polyethylene</td>
<td>1 gallon</td>
<td>5 gallons</td>
</tr>
<tr>
<td>Fibre Drum</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
There are several criteria associated with fixed tank installations. In all of these installations, NFPA 30 should be consulted for further details.

Aboveground storage tanks should meet several criteria in its installation. These criteria include:

- Location
- Spacing
- Control of spillage
- Remote impounding
- Venting
- Emergency relief venting
- Tank openings other than vents
- Abandonment
- Foundations and supports

Underground storage tanks should meet several criteria in their installation. These criteria include:

- Location
- Burial depth and cover
- Corrosion protection
- Vents
- Tank openings other than vents
- Abandonment
- Foundations and supports

Storage tank buildings should also meet several criteria in their installation. These criteria include:

- Location
- Construction
- Ventilation
- Drainage
- Vents
- Tank openings other than vents
- Electrical equipment provisions
- Fire prevention and control measures
- Foundations and supports

Additionally, for areas subject to flooding, more specific provisions are required for all tank storage configurations.
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### Resources

<table>
<thead>
<tr>
<th>Resource</th>
<th>CFR Section</th>
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<tbody>
<tr>
<td>OSHA Standard for General Industry</td>
<td>29 CFR 1910.106</td>
</tr>
<tr>
<td>OSHA Standard for the Construction Industry</td>
<td>29 CFR 1926.152</td>
</tr>
<tr>
<td>National Fire Protection Association</td>
<td>NFPA 30</td>
</tr>
</tbody>
</table>
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Figure 1

No Smoking Sign Examples

![No Smoking Sign Example 1](image1)

![No Smoking Sign Example 2](image2)
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Top of page
Outdoor storage
of liquids in containers

Figure 3