Legal Compliance of Paint Mix Room in Car Manufacturing Plant
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Abstract:
Car manufacturing plant has multiple processes and using multiple energy sources like mechanical, electrical, hydraulic, chemical, pneumatic and water. Employees are working under all above environment. So they are having more working hazards. How was controlled working hazard? And safe work practices? That’s why I choose a car manufacturing plant. It has main hazard of this plant is paint shop. In a car manufacturing plant, paint shop has a full of chemical process. It is a very high risk & very hazardous area. In Paint Mix Room (PMR) is the heart of the paint shop, it is a critical & very high risk process were done. In order to strengthen the requirements of PMR study was recommended suitable control measures.

1. INTRODUCTION

1.1 STORAGE OF CHEMICALS AND SOLVENTS:
The State of Delaware enacted a Hazardous Chemical Information Act in July, 1985. This act provides students and employees access to information regarding hazardous chemicals to which they may be exposed either during their normal employment activities or during emergency situations. Be sure that you read The Safety Department “Hazardous Material Safety Manual” and that you receive “Right To Know” training before using any laboratory facility.

Labeling:
• Label all chemicals in the laboratory with permanent labels. The label includes the primary hazard associated with the chemical (e.g., flammable, toxic), the full chemical name, manufacturer and date opened.
• Triple rinse chemical reagent, salt and solvent bottles before discarding in the broken glass container, even if the bottle is intact. Recycle brown glass bottles after the triple rinse by removing the label or crossing out the chemical name and warning with a black marker.

Protective Equipment:
• Wear face shields and rubber gloves when concentrated acids are poured. Wear personal protective equipment (PPE) when any highly reactive or toxic chemicals are handled, such as elemental sodium or cyanide. The Chemical Hygiene Plan requires that appropriate PPE is used when handling toxic chemicals, carcinogens, reproductive toxins or chemicals with unknown toxicity.
• Use the Hyper CPC Stacks database on the Macintosh Lab file server to help you select the best make and model of gloves and protective clothing to meet a challenge from a specific solvent or toxic chemical.

Barrier:
• You may need engineering controls in addition to a fume hood to keep a barrier between you and the process. These include closed reactor or gas control systems of glass or stainless steel, glove bags, glove boxes, steel or polycarbonate barricades.
• Use a laboratory hood as an engineering control with flammable solvents, toxic gases and chemicals, reproductive toxins or known or suspect carcinogens. It may be recalled that the best ventilating efficiency is attained with the hood sash closed. Keeping all items 6 inches behind the sash line and minimizing the quantity of equipment within the hood area will greatly improve its exhaust effect. The operating condition of a hood should be determined before the hood is put to use; be certain that the Magnehelic gage shows a positive reading before the hood is used. In case the hood is not operational, close the hood sash, call Plant Operations at extension 1141 and notify the lab coordinator immediately.

Storage:
• All chemicals must be organized and stored on shelves or in cabinets where they will not be knocked over. One way to organize chemicals is to store organics by number of Carbon atoms (not by alpha sort) and separate from inorganics, which should be stored in alphabetical order.

Flammable solvents:
Properties of flammable liquids:
Flash Point: Temperature at which the vapor pressure is sufficient to form an ignitable vapor mixture with the air.

Ignition Temperature: Minimum temperature required to cause self-sustained combustion.

Classification:

Table 1.1 Classifications

<table>
<thead>
<tr>
<th>S.NO</th>
<th>CLASSES OF LIQUID</th>
<th>FLASH POINT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Class I A</td>
<td>below 73°F and below 100°F</td>
</tr>
<tr>
<td>2.</td>
<td>Class I B</td>
<td>Below 73°F and above 100°F</td>
</tr>
<tr>
<td>3.</td>
<td>Class I C</td>
<td>between 73°F to 100°F</td>
</tr>
<tr>
<td>4.</td>
<td>Class II</td>
<td>between 100°F to 140°F</td>
</tr>
<tr>
<td>5.</td>
<td>Class III A</td>
<td>between 140°F to 200°F</td>
</tr>
<tr>
<td>6.</td>
<td>Class III B</td>
<td>above 200°F</td>
</tr>
</tbody>
</table>
The maximum allowable size of flammable liquid containers (NFPA 30):

Table 1.2 the maximum allowable size of flammable liquid containers

<table>
<thead>
<tr>
<th>FLAMMABILITY CLASS:</th>
<th>IA</th>
<th>IB</th>
<th>IC</th>
<th>IIC</th>
<th>IIIC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glass/plastic</td>
<td>1 pt</td>
<td>1 qt</td>
<td>1 gal</td>
<td>1 gal</td>
<td>1 gal</td>
</tr>
<tr>
<td>Tinplate can</td>
<td>1 gal</td>
<td>5 gal</td>
<td>5 gal</td>
<td>5 gal</td>
<td>5 gal</td>
</tr>
<tr>
<td>Safety cans</td>
<td>2 gal</td>
<td>5 gal</td>
<td>5 gal</td>
<td>5 gal</td>
<td>5 gal</td>
</tr>
</tbody>
</table>

REACTIVE CHEMICAL HAZARDS:
- Untrained individuals (Engineers doing Chemistry) attempting organic synthesis and other reactions, who are not absolutely confident of the stability or toxicity of their intermediate products and end products must always seek advice from knowledgeable colleagues or from the literature before proceeding. (Example: nitromethane will detonate at its critical temperature).
- Your procedures require a laboratory hazard review if you plan to use pyrophoric (chemicals that ignite on exposure to air), shock sensitive materials (asides and other nitrogen-containing materials) and potentially exothermic reactions.

2. COMPANY OVERVIEW

Ford India Private Limited began production in 1926 as a subsidiary of the Ford Motor Company of Canada. Ford increased its interest to 72% in March 1998 and renamed the company Ford India Private Limited since its entry in India in 1995, Ford has invested more than US$ 2 billion to expand its manufacturing facilities and sales & service footprint to meet the demand in one of the world's fastest-growing auto markets. Ford India’s integrated manufacturing facility at Maraimalai Nagar, near Chennai, produces its award-winning range of products including the Ford Eco Sport and all-new Ford Endeavour. As part of its overall commitment, Ford inaugurated its US$ 1 billion state-of-the-art integrated manufacturing facility in Sanand, Gujarat in March 2015. With Sanand being operational, Ford India has doubled its annual installed manufacturing capacity to 610,000 engines and 440,000 vehicles. The sub-four-meter compact sedan, Ford Aspire, became the first car to roll out from the new Ford Sanand plant. The plant also manufactures Next-Gen Figo hatchback.

2.1. COMPANY PROCESS:

Figure. 2.2: company process

1. Blanking
2. Stamping
3. Body Shop
4. Paint Shop
5. Trim Chassis & Final
7. Paint Mix Room
8. Solvent Storage Area

COMPANY PROCESS IN IMAGES:

Figure 2.3 Company Process in Image

2.1.1. PAINT SHOP:

The objective of painting is to form a coating film on the surface of an object in order to protect the object and give a fine appearance. Painting may also have other special functions. There are various types of painting methods, and spray painting is currently used in many types of industrial painting.

Figure 2.4 Paint Shop

In the painting operation, various types of painting methods are used according to the shape, size, quality, and quantity of the object(s) to be painted. The “transfer efficiency” differs, in other words, the ratio of the quantity of the coated film formed on the object to the quantity of the paint sludge generated from overspray differs according to the differences in these operational conditions.
2.1.2. PAINT MIX ROOM:
The amount of flammable or combustible liquid stored in the paint mixing room must be within the following limits.

- Paint mixing rooms within 6’ of the spray area may contain up to two (2) litres per square foot of enclosure floor area but may not exceed 60 litres.
- Paint mixing rooms further than 6’ from the spray area may contain up to two (2) litres per square foot of enclosure floor area but may not exceed 300 litres.

2.1.3. PAINT MIXING ROOM (PMR) PROCESS & SOLVENT STORAGE AREA:

Paint Mix Rooms are engineered for two distinct purposes; to control contamination, and to remove harmful fumes during the mixing process. This allows for a higher quality finish and a safe work environment, which is vital to the success of your business. GFS offers Paint Mix Rooms in multiple configurations and they can be connected to certain types of paint booths for direct entry.

What are flammable and combustible liquids?
Flammable and combustible liquids are liquids that can burn. They are classified, or grouped, as either flammable or combustible by their flashpoints. Generally speaking, flammable liquids will ignite (catch on fire) and burn easily at normal working temperatures. Combustible liquids have the ability to burn at temperatures that are usually above working temperatures. There are several specific technical criteria and test methods for identifying flammable and combustible liquids. Under the Workplace Hazardous Materials Information System (WHMIS) 1988, flammable liquids have a flashpoint below 37.8°C (100°F). Combustible liquids have a flashpoint at or above 37.8°C (100°F) and below 93.3°C (200°F). Flammable and combustible liquids are present in almost every workplace. Fuels and many common products like solvents, thinners, cleaners, adhesives, paints, waxes and polishes may be flammable or combustible liquids. Everyone who works with these liquids must be aware of their hazards.
LIST OF CHEMICALS USED AT PAINT MIX ROOM:

<table>
<thead>
<tr>
<th>S.NO</th>
<th>CHEMICAL NAME</th>
<th>FLASH POINT</th>
<th>CHEMICAL CLASSES</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>THINNER T - 829</td>
<td>15°C</td>
<td>A</td>
</tr>
<tr>
<td>2</td>
<td>WHITE PRIMER - 3 Wet High Solids</td>
<td>23°C</td>
<td>A</td>
</tr>
<tr>
<td>3</td>
<td>DCT DIAMOND WHITE BASECOAT</td>
<td>17.22°C</td>
<td>A</td>
</tr>
<tr>
<td>4</td>
<td>HIGH BARE REPAIR PRIMER - DXP 1928</td>
<td>20°C</td>
<td>A</td>
</tr>
<tr>
<td>5</td>
<td>3 WET HS BC KINETIC BLUE</td>
<td>18.89°C</td>
<td>A</td>
</tr>
<tr>
<td>6</td>
<td>MEDIUM GREY PRIMER - 3 Wet High Solids</td>
<td>23°C</td>
<td>A</td>
</tr>
<tr>
<td>7</td>
<td>WIPING SOLVENT CLEAR</td>
<td>-18 to 23°C</td>
<td>A</td>
</tr>
<tr>
<td>8</td>
<td>3 WET HS BC SUNSET</td>
<td>23 to 37.8°C</td>
<td>B</td>
</tr>
<tr>
<td>9</td>
<td>TMAC - 8000 - 3 Wet High Solids Clear Coat</td>
<td>25°C</td>
<td>B</td>
</tr>
<tr>
<td>10</td>
<td>ED TOUCH UP THINNER</td>
<td>24°C</td>
<td>B</td>
</tr>
<tr>
<td>11</td>
<td>3 WET HS BC GOLDEN BRONZE</td>
<td>23 to 37.8°C</td>
<td>B</td>
</tr>
<tr>
<td>12</td>
<td>METALLIC BC PANTHER BLOCK</td>
<td>24°C</td>
<td>B</td>
</tr>
<tr>
<td>13</td>
<td>3 WET HS BC SMOKE</td>
<td>23 to 37.8°C</td>
<td>B</td>
</tr>
<tr>
<td>14</td>
<td>BUTYL GLYCOL ACETATE</td>
<td>74 to 83°C</td>
<td>C</td>
</tr>
<tr>
<td>15</td>
<td>FLOW CONTROLLER NT</td>
<td>37.8°C</td>
<td>B</td>
</tr>
<tr>
<td>16</td>
<td>METALLIC BC XSC 2431 MOONDUST</td>
<td>24°C</td>
<td>B</td>
</tr>
<tr>
<td>17</td>
<td>THINNER T - 765</td>
<td>24°C</td>
<td>B</td>
</tr>
<tr>
<td>18</td>
<td>THINNER T - 831</td>
<td>38°C</td>
<td>B</td>
</tr>
<tr>
<td>19</td>
<td>THINNER T - 830</td>
<td>27°C</td>
<td>B</td>
</tr>
</tbody>
</table>

3. PETROLEUM ACT 1934 & PETROLEUM RULES 2002

3.1. PETROLEUM ACT 1934

- Approval of containers:
  - Containers exceeding one liter in capacity for petroleum Class A and five liters in capacity for petroleum Class B or petroleum class C shall be of a type approved by the Chief Controller.
  - Where the approval of the Chief Controller is sought to a type of container not previously approved, an application together with copies of drawings thereof to scale showing the design, materials to be used, the method of construction and capacity of the container together with two samples containers and a fee of rupees one thousand for scrutiny shall be submitted to the Chief Controller.
  - Nothing in sub-rules (1) and (2) shall apply to containers in the possession of the Defense forces of the Union.

- Containers for petroleum Class A:
  - Containers for petroleum Class A shall be constructed of tinned, galvanized or externally rust proofed sheet iron or steel and are of a type approved by the Chief Controller:
  - The containers shall be so constructed and secured as not to be liable except under circumstances of gross negligence or extraordinary accident to become defective, leaky or insecure in transit and they shall be kept in proper repair.
  - The containers shall have well-made filling aperture which shall be fitted with well-fitting and secure airtight screw plugs or screw caps or other caps.
  - The capacity of any container, other than those approved by the Chief Controller for specific purposes, shall not exceed 300 liters.
  - An air space of not less than 5 percent of its capacity shall be kept in each container.
  - The container shall bear a stamped, embossed or painted warning exhibiting inconspicuous characters the words “Petrol” or “Motor Spirit” or an equivalent warning of the highly inflammable nature of the petroleum.
  - Nothing in sub-rules (1), (3), (4), (5), (6) and (7), shall apply to containers in the possession of the defense Forces of the Union.

- Containers for petroleum Class B and Class C:
  - Containers for petroleum class B or petroleum class C shall be constructed of steel or iron and are of a type approved by the Chief Controller.
  - An air space of not less than 5 percent of its capacity shall be kept in each container for petroleum Class B and not less than 3 percent of its capacity in each container for petroleum Class C.
  - Nothing in this rule shall apply to containers in the possession of the Defense Forces of the Union.

3.2. THE PETROLEUM RULES, 2002

3.2.1. STORAGE OF PETROLEUM REQUIRING LICENCE

- License for storage:
  - Save as provided in sections 7, 8 and 9 of the Act, no person shall store petroleum except under and in accordance with a license granted under these rules. Provided that no license shall be necessary.-
  - For the storage of petroleum in well-head tanks; or
  - For the storage of petroleum as transit cargo within the limits of a port subject to such conditions as may be specified by the Conservator.

Precautions against fire

- No person shall smoke in any installation, storage shed or service station saves in places specifically authorized by the licensing authority for the purpose.
• No person shall carry matches, fuses or other appliances capable of producing ignition or explosion in any installation or storage shed, which is used for the storage of petroleum.
• No fire, furnace or other source of heat or light capable of igniting inflammable vapor shall be allowed in any installation, storage shed or service station save in places specially authorized by the licensing authority for the purpose.
• An adequate number of portable dry chemical powders or any other fire extinguisher capable of extinguishing oil fires shall always be kept in every storage shed and small class B or C installations at strategic point and all persons employed at such locations shall be conversant with the use of such fire extinguishers.
• Scale of fire fighting provided in other areas of installation should be as per the requirement given in OISD Standard -117 for all installations approved by the Chief Controller after publication of the original standard OISD-117. For Installations existing prior to the publication of this standard the firefighting facilities shall be improved to the extent feasible (keeping this standard in mind) and approved by the Chief Controller.

Supervision of operations within an installation, service station or storage shed
All operations within an installation, service station or storage shed shall be conducted under supervision of an experienced responsible agent or supervisor who is conversant with the terms and conditions of the license held for the installation, service station or storage shed as the case may be and those persons should have proper safety training.

Cleanliness of installation, service station or storage shed:
The ground in the interior of an installation or service station and the protected areas surrounding any installation, service station or storage shed shall be kept clean and free from all vegetation, waste material and rubbish.

Drainage
• All enclosures surrounding above ground tanks in an installation shall be provided with proper drainage facilities in such a way that no water is allowed to accumulate in the enclosures.
• No part of the enclosure referred to in sub-rule (1) shall be below the level of the surrounding ground within the protected area.
• Where drainage is affected by means of a pipe, the pipe shall be fitted with a valve which is capable of being operated from the outside of the enclosure or with any other arrangements approved in writing by the Chief Controller.
• All valves and other opening for draining off water shall be kept closed except when water is being drained off.
• The nature of the drainage arrangements and the position of all openings and valves therein shall be shown in the plan submitted with the application for a license.

Exclusion of unauthorized persons
• The protected area surrounding every installation and storage shed shall be surrounded by a wall or fence of at least 1.8 meters in height.
• In case of service station 1.2 meter high boundary wall or fence on sides other than the drive way shall be provided.
• Precautions shall be taken to prevent unauthorized persons from having access to any storage shed or installation.

Petroleum only to be stored
No installation, service station or storage shed shall, without permission in writing from the Chief Controller is used for any purpose other than the storage and distribution of petroleum and for purpose directly connected there with.

Prior approval of specifications and plans of premises proposed to be licensed
• Every person desiring to obtain a license to import and store petroleum in Form XIV, Form XV, Form XVI or in Special Form, as the case may be, shall submit to the licensing authority an application along with-
• Specification and plans drawn to scale in duplicate clearly indicating.
• The manner in which the provisions prescribed in these rules will be complied with;
• The premises proposed to be licensed, the area of which shall be distinctly colored or otherwise marked.
• The surroundings and all protected works lying within 100 meters of the edge of all facilities which are proposed to be licensed;
• The position, capacity, materials of construction and ground and elevation view of all storage tanks, enclosures around tanks, all valves, filling and discharge points, vent pipes, dip pipes, storage and filling sheds, pumps, fire-fighting and all other building and facilities forming part of the premises proposed to be licensed;
• The areas reserved for different class of petroleum including petroleum exempted under section 11 of the Act; and
• A scrutiny fee of rupees four hundred paid in the manner specified in rule 13.
• If the Chief Controller, after scrutiny of the specification and plans and after making such enquiries as he deems fit, is satisfied that petroleum may be stored in the premises proposed to be licensed, he shall return to the applicant one copy each of the specifications and plans signed by him conveying his sanction subject to such conditions as he may specify.

Pumping
No internal combustion engine or electric motor in an installation shall be used for driving pumps for pumping petroleum save in a pump house or pumping area specially constructed for the purpose and approved by the Chief Controller.

3.2.2, STORAGE OF PETROLEUM CLASS “C” NOT REQUIRING A LICENSE
• Application:
• The provisions of this chapter shall apply to petroleum Class C stored otherwise than under a license as provided in section 7 of the Act but shall not apply to petroleum Class C in the possession of the Defense Forces of the Union.
• The provisions of Chapter V shall not apply to petroleum Class C permitted to be stored without a license under section 7 of the Act.
• Restriction of Storage:
Petroleum Class C shall not be stored together with any other class of petroleum except under and in accordance with a license granted under these rules.
• Storage of exempted Petroleum Class C in bulk:
Petroleum Class C in bulk shall be stored in a tank constructed of iron or steel or any other material approved in writing by the Chief Controller.
The tank referred to in sub-rule (1) shall be properly designed and erected and the tank with all its fittings shall be so constructed and maintained as to prevent any leakage of petroleum.

All tanks of capacity exceeding 5,000 liters for the storage of petroleum Class C shall be surrounded by an enclosure wall or placed inside a pit, so constructed and maintained as to be able to contain without leakage the maximum quantity of petroleum capable of being contained in largest tank within such enclosure or pit.

A drainage pipe with a valve capable of being actuated from outside the enclosure shall be provided in the enclosure or pit referred to in sub-rule (3) and the valve shall be kept closed.

A distance of not less than 1.5 meters shall be kept clear between protected works and the edge of such enclosure wall or pit.

**Storage of Petroleum Class C in non-bulk:**

Petroleum Class C which is not in bulk shall, if the quantity at any one time exceeds 2,500 liters be stored in a storage shed of which either:

- The doorways and openings shall be built up to a height of 30 centimeters above the floor, or
- The floor shall be sunk to a depth of 30 centimeters.

**Prior report of storage of Petroleum Class C:**

Every person intending to store petroleum Class C in quantity exceeding 5,000 liters otherwise than under a license shall submit the following to the Chief Controller before commencing storage-

- Plans drawn to scale of the storage facilities showing compliance of rule 138 and site plan of the storage premises and surroundings up to 100 meters identifying the locations of premises; and
- A scrutiny fee of rupees five hundred.

### 3.3. FACTORIES ACT AND RULES:

**Storage of flammable liquids:**

The quantity of flammable liquids in any work room shall be the minimum required for the process or processes carried on in such room. Flammable liquids shall be stored in suitable containers with close fitting covers.

Provided that not more than 20 liters of flammable liquids having a flash point of 21 degrees centigrade or less shall be kept or stored in any work room.

Flammable liquids shall be stored in closed containers and in limited quantities in well ventilated rooms of fire resisting construction which are isolated from the remainder of the building by fire walls and self-closing fire doors.

Large quantities of such liquids shall be stored in isolated adequately ventilated building of fire resisting construction which is isolated from the remainder of the building by fire walls and self-closing fire doors.

Effective steps shall be taken to prevent leakage of such liquids into basements, sumps or drains and to confine any escaping liquid within safe limits.

**Accumulation of flammable dust, gas fume or vapor in air or flammable waste material on the floors:**

Effective steps shall be taken for removal or prevention of the accumulation in the air of flammable dust, gas, fume or vapor to an extent which is likely to be dangerous.

No waste material of a flammable nature shall be permitted to accumulate on the floors and shall be removed at least once in a day or shift, and more often, when possible. Such materials shall be placed in suitable metal containers with covers wherever possible.

**Fire exits:**

"horizontal exit" means an arrangement which allows alternative egress from a floor area to another floor at or near the same level in an adjoining building or an adjoining part of the same building with adequate separation; and

"Travel distance" means the distance an occupant has to travel to reach an exit.

An exit may be a doorway, corridor, passageway to an external stairway or to a verandah or to an internal stairway segregated from the rest of building by fire resisting walls which shall provide continuous and protected means of egress to the exterior of a building to an exterior open space. An exit may also include a horizontal exit leading to an adjoining building at the same level.

Lifts, escalators and revolving doors shall not be considered as exits for the purpose of this sub-rule.

In every room of a factory exits sufficient to permit safe escape of the occupants in case of fire or other emergency shall be provided which shall be free of any obstruction. The exits shall be clearly visible and suitably illuminated with suitable arrangement, whatever artificial lighting is to be adopted for this purpose, to maintain the required illumination in case of failure of the normal source of electric supply.

#### 3.3.1. HANDLING & STORAGE:

Flammable and combustible liquids are present in nearly every workplace. Gasoline, diesel fuel, and many common products like solvents, thinners, cleaners, adhesives, paints, and polishes may be flammable or combustible. Flammable and combustible liquids play a part in our lifestyle. However, if used or stored improperly, serious fires and death may occur. This article discusses flammable and combustible liquid terminology, handling, and storage practices. The applicable standard is 29 CFR 1910.106–Flammable Liquids, which is based upon the 1969 version of 30 Flammable and
Combustible Liquids Code. However, it is important to note that in 2012, in response to revised Hazard Communication standard (due to incorporation of the Globally Harmonized System [GHS]), revised 29 CFR 1910.106. The title of 29 CFR 1910.106 has been changed from “Flammable and Combustible Liquids to “Flammable Liquids.” One significant change is the revised regulation lists liquids as “categories” rather than “classes.” However, the 2012 Edition of 30 has not been revised to reflect GHS guidelines. For instance, 30 continues to use the term flammable and combustible liquid and refer to “classes” of liquids. If you are covered by, you must comply with 29 CFR 1910.106 – Flammable Liquids. As a best practice, however, it is recommended that you review both 1910.106 as well as 30 and comply with the standard providing the highest level of protection.

**Terminology**

A review of the properties and hazards of flammable and combustible liquids is in order.

**Auto ignition Temperature:**

The auto ignition temperature is the lowest temperature at which a liquid will ignite without an external ignition source. While most flammable and combustible liquids have auto ignition temperatures in the range of 500°F to 1000°F, some have very low auto ignition temperatures. For example, ethyl ether has an auto ignition temperature of 356°F, and its vapors have been ignited by heated surfaces.

- **Flashpoint:** This is the minimum temperature of a liquid at which sufficient vapor is given off to form an ignitable mixture with the air, either near the surface of the liquid or within the vessel used.
- **Fire Point:** The fire point is the lowest temperature at which a liquid will ignite and achieve sustained burning when exposed to a test flame.
- **Vapor Pressure:** Pressure, measured in pounds per square inch–absolute exerted by a liquid.
- **Combustible Liquid (per30):** A combustible liquid has a flashpoint at or above 100°F.
- **Grounding and Bonding:** When flammable and combustible liquids travel through a pipe or through the air, static charges are accumulated. Grounding and bonding is necessary during the transfer of flammable liquids that have a flashpoint below 100°F to prevent a static spark from igniting the flammable vapors. An example of grounding and bonding is illustrated.

![Grounding and Bonding Diagram](image)

**Figure 5.3.1(a) Grounding and Bonding**

- **Container:** Any vessel with a capacity of 60 liters or less that is used for transporting or storing liquids is referred to as a “container”.
- **Portable Tank:** Any closed vessel having a liquid capacity of 60 liters and not intended for fixed installation is called a “portable tank”.

- **Safety Can:** A safety can is a listed container with a capacity of no more than 5 liters that has a spring-closing lid and spout cover and is designed to safely relieve internal pressure when exposed to fire.
- **Flammable Storage Cabinet:** A “flammable storage cabinet” is a listed storage cabinet designed in accordance. Such a cabinet is designed and constructed to limit the internal temperature to no more than 325°F from the center of the cabinet to within 1 inch of the top of the cabinet when subjected to a 10-minute fire test.
- **Fire Area:** A “fire area” is an area of a building separated from the remainder of the building by special construction. This area has a fire resistance of at least 1 hour and has all communicating openings properly protected by an assembly that also has a fire resistance rating of at least 1 hour.
- **Storage:** Storage of flammable and combustible liquids is usually a necessity. Whenever flammable and combustible liquids are stored improperly, however, they become a significant fire hazard. For instance, 29 CFR 1910.106 has established the following storage practices to ensure flammable liquids are not stored in excessive quantities.
- **Flammable Storage Cabinets:** When I teach courses on flammable and combustible liquids, I am repeatedly asked the question: “Are we required to vent the bung on a flammable storage cabinet?” It does not require bungs to be vented. In addition, in a correspondence to Mr. Mark E. Graham dated March 28, 1978 provided a formal position concerning the issue of venting flammable storage cabinets. “The vents for flammable liquids storage cabinets are not required or even recommended by our Flammable and Combustible Liquids Code 30.”

- “The fittings are sometimes provided by the manufacturers due to the fact that, in a few locations in the country, local ordinances require such vents to be provided. Therefore, the manufacturer plug these vents which can be removed in those few areas where such venting is required”.

Unless a municipality or other government agency specifically requires the bung to be vented, venting is not required, nor is it recommended.

**Handling Liquids at Point of Final Use**

To understand flammable liquids it is important to know that it is the vapor, not the liquid that burns. For instance, explosions routinely occur when mechanics drain a gasoline tank and mistakenly assume it is safe to commence repairs involving welding and/or brazing on the tank. Although the tank is empty, its vapor space contains gasoline vapors. If the vapor concentration is within the explosive range and a source of ignition is introduced, an explosion will likely occur. The following work practices must be followed when handling flammable and combustible liquids:

- **Flammable liquids with a flashpoint below 100° F** must be kept in covered containers when not in use.
- **Flammable liquids must be stored only in acceptable containers.**
- **Grounding and bonding must be utilized when transferring flammable liquids with a flashpoint below 100° F.**
- **Locations where flammable vapor-air mixtures may exist** must have electrical wiring installed according to the requirements of 29 CFR 1910 Subpart S (Electrical):
- **Flammable vapor-air mixtures may exist under normal conditions:** Class I Division I.
• Flammable vapor-air mixtures may exist under abnormal conditions: Class I Division II
• Where flammable or combustible liquids are used or handled, except in closed containers, means shall be provided to dispose of leaked or spilled liquid promptly and safely.
• Flammable or combustible liquids shall be drawn from or transferred into vessels, containers, or portable tanks within a building by one of the following methods:
  • Through a closed piping system
  • From safety cans
  • By means of a device drawing through the top
  • From containers or portable tanks by gravity through an approved self-closing valve
• Transfer operations must be provided with adequate ventilation. Sources of ignition are not permitted in areas where flammable vapors may travel.
• Transferring liquids by means of air pressure on the container or portable tanks is prohibited. This type of transfer may result in an overpressure that could exceed what the container or tank is designed to withstand. In addition, a flammable atmosphere could be created within the container or tank. This atmosphere would be particularly sensitive to ignition because of the increased pressure.

3.4. FORD GLOBAL STANDARD:
Flammable Liquid:
A liquid or mixture of liquids that has a closed-cup flash point below 37.8°C (100°F) when tested in accordance with the procedures in 30 or any combustible liquid when in an ambient temperature or when heated above its flash point. For the purposes of this Bulletin, mixtures containing water-miscible liquids such as alcohols in concentrations less than 20% and emulsions containing flammable liquids in concentrations less than 20% are not considered to be flammable liquids.
Combustible Liquid:
Any liquid that has a closed cup flash point higher than 37.8°C (100°F) when tested in accordance with the procedures in 30. For the purposes of this Bulletin, liquids containing water-miscible combustible liquids in concentrations less than 20% or emulsions containing combustible liquids in concentrations less than 20% are not considered to be combustible liquids.
Noncombustible Liquid:
Any liquid that does not have a flash point when tested in accordance with the procedures in 30.
Cut-off Room:
A room that is separated from surrounding areas by fire barrier walls with openings protected
Detached Building:
A building having no common walls with other buildings having different types of occupancies.
Fire Barrier:
A fire resistance rated wall assembly with protected openings, constructed of materials designed to restrict the spread of fire. As used in this document, fire barriers are to be constructed of masonry or concrete.
Flammable Liquid Dispensing or Mixing Room:
A flammable liquid dispensing or storage room is defined as a room where flammable liquids are transferred from one container to another, where open containers are used for mixing, or where the volatile fumes of a flammable liquid are released into the room during operation.
Flammable Liquid Storage Room:
A flammable liquid storage room is defined as a room where the liquid is normally confined within a closed container or piping system, from which escape into the room can only occur through accidental rupture of the container or the system, through abnormal operation of the equipment, or during maintenance operations.
Interior Room:
A room or building section having more than one common wall with other parts of a building that have different types of occupancy.

3.4.1. REQUIREMENTS – MIXING AND DISPENSING ROOMS:
Location and Separation:
Elevation:
Locate flammable liquid mixing and dispensing rooms at or above grade level. Flammable or combustible liquid rooms constructed or renovated after 2000 shall have no other operations or occupancies located below these rooms or buildings.
• The following is the preferred order for separation of flammable liquid mixing and dispensing buildings:
Detached Buildings:
Separate detached flammable liquid mixing or storage buildings from other buildings as required by Bulletin 5.
Attached Buildings:
• Provide a three (3) hour rated fire barrier wall to separate the buildings.
• Brace or reinforce this wall to resist an explosion pressure of 4.8kPa (100 psf).
• Openings in the fire barrier shall be protected by 3-hour rated self-closing fire doors. The doors shall be installed to have pressure resistance equal to or greater than that of the fire barrier.
• The wall shall be sealed (bonded) to the floor to prevent seepage of water and flammable liquids into the adjoining building.
Cut-off Rooms:
• Cut-off rooms shall have at least one outside wall that is provided with explosion venting.
• The cut-off room(s) shall be separated from adjacent areas by 2-hour fire rated walls and 1½-hour doors.
Interior rooms are forbidden for new or renovated flammable liquid mixing or dispensing rooms
Construction:
Roof:
• Install a non-combustible or “Listed or Approved” roofing system.
• Explosion venting roof panels are only allowed in areas where snow loading is not expected, when adequate wall explosion venting is not available, and with written approval from either Corporate Fire Protection Engineering or a National Fire Protection Engineer.
Pressure Relieving Walls (Explosion Venting):
• Provide explosion venting in all flammable liquids mixing and/or dispensing rooms. Explosion venting is generally not required for combustible liquids unless they are heated above their flash points.
• Vent area shall be determined per Factory Mutual Data Sheet 1-44.
• Use lightweight non-combustible wall panels such as corrugated sheet metal, top hung panels, or explosion venting
panels to cover the vent area. Attach explosion relief panels over vent area with fasteners designed to release at a pressure range of 0.95 to 1.4 kPa (20 to 30 psf), depending on local conditions.

- Panels shall have no penetrations such as conduits, pipes, or ducts.
- Panels shall not have any objects such as electric conduit, lighting, or soundproofing panels on either the inside or the outside of the panels.
- Provide tethering cables at the upper corners of the panels designed to restrain the panels, yet still provide explosion relief. Where pedestrian walkways are within 6 m (20 ft.), provide double the number of cables otherwise required.
- Signs reading “Explosion Venting Panel – Do Not Obstruct” and “Keep at Least 15 m (50 ft.)” from this panel shall be installed on panels.
- Other details of explosion venting shall conform to 68.

**Pressure Resistant Walls:**
Where explosion venting is required, construct the non-venting walls as pressure resistant walls. Follow the method in Factory Mutual Data Sheet 1-44 to determine the required pressure resistance. The minimum required pressure resistance shall be 4.8 kPa (100 psf).

**Separation Walls within the Storage and Mixing Area:**
Separate flammable and combustible liquid storage from flammable or combustible liquid mixing and dispensing operations by 2-hour rated fire barrier walls. Communicating openings shall be protected by 1½-hour rated normally closed doors.

**Egress:**

**Exits:**
A minimum of two emergency exits, each equipped with an “EXIT” or “EGRESS” sign in the local language,panic hardware, and a manual alarm pull box shall be provided. They shall be located at opposite ends of the flammable liquid mixing and storage area. At least one exit shall lead directly to the exterior.

**Emergency Lighting:**
- Emergency lighting shall be provided for flammable liquid mixing and dispensing rooms and any control rooms associated with the operation.
- Emergency lights shall be classified for use in the hazardous areas where needed. See Sec. III.E.1.
- Lighting should provide a minimum 20 lumen/sq. m (20 lux or 1.9 foot candle) on aisles.

**Liquid Containment:**
- Provide one of the following at all flammable or combustible liquid mixing and dispensing room doorway openings to prevent seepage of water or flammable or combustible liquids to outside the room:
  - A 150 mm (6 inch) curb
  - A 150 mm (6 inch) ramp
  - A trench drain arranged to remove liquids to a safe area or
  - A properly designed scupper system. If using scuppers a curb less than 6 inches can be considered if it meets the rules in the scupper section III.B.
- Floor Drainage:
- Flammable or combustible liquid mixing and storage areas can use common drainage, but trenches from one area cannot feed open trenches in another area. Common piping shall be located underground and not be able to spread open fire from one room to the other by having flow through trenches open to the atmosphere. Each room shall separately drain to outdoors or a treatment center. A properly engineered drainage system is required. Provide one of the following or a combination of the following.
  - Trench Drains:
    - Floors shall be concrete arranged to pitch toward drains. Slope shall be at least 25 mm/3 m (1 in/10 ft.).
    - Stationary drum racks and tanks shall be on concrete pads constructed so they pitch toward the floor drains.
  - The floor drainage system in a flammable liquids storage/mixing room or building shall be designed to remove the automatic sprinkler system discharge plus the contents of the largest container.
  - Trench drains shall not be open to more than one room. If they pass beneath additional room(s), they shall be covered by the floor of the additional room(s).
  - Floor drains shall be trapped and piped to a safe outdoor location such as a separator tank or an industrial waste system (where permissible).

**Scupper:**
- The use of a properly designed wall scupper system is permitted.
- Scuppers shall be located far enough off the floor so the trapped floor area can be considered adequate in volume for environmental containment. In general scuppers should be at least 12 mm (½-inch) off the floor.
- Floor drainage toward scuppers is required. Slope shall be at least 25 mm/3 m (1 in/10 ft.).
- If Scuppers are used then doorways shall have curbing or be located at a height 25 mm (1-in) higher than the scupper to maintain room containment. Trench drains are not permissible at doorways in rooms with scuppers.
- Receiving Area:
  - A receiving area shall be provided so flammable or combustible liquids can be delivered directly to the Flammable or Combustible Liquid Storage area. Transport of flammable or combustible liquids through plant areas or mixing and dispensing rooms is a matter of concern and shall only be approved after a careful risk assessment.
  - If electrical components of dock leveler equipment are below the floor level, the installation shall be listed for a Class I, Division 1 (EU Zone 0).
- Heating and Ventilation:
  - Heat:
  - Building heat and any required heat for ventilation system make-up air shall be from one of the following:
    - Steam
    - Hot Water
    - Indirect hot air from external natural gas fired heating units.
  - Externally Mounted Direct Fired Single Pass Heaters.
  - Ventilation:
  - Provide continuous mechanical ventilation in all flammable liquid mixing and dispensing areas, including all pits or other low level areas in these rooms. Ventilation is generally not required for combustible liquids (flash point above 37.8°C (100°F) unless they are heated above their flash points.

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The exhaust ventilation pickup(s) shall be no more than 150 mm (6 in) and not less than 75 mm (3 in) above the floor level.

Provide an exhaust ventilation rate of at least 1.2 m³/min per m² (4 cfm/ft²) of gross floor area with at least 100% fresh air makeup supply in all mixing and dispensing areas. All of the exhaust shall be taken from low level vents.

Ventilation systems shall be designed to maintain a negative pressure in protected areas relative to adjoining building areas.

An airflow-monitoring device shall supervise the system. Electrical current monitoring or a sail (paddle vane) switch is acceptable.

The airflow monitoring device shall be interlocked to prevent starting the process if ventilation is not operating.

Loss of ventilation shall automatically activate a local alarm and, if possible, send a supervisory signal to the fire alarm panel.

Piping:
- Do not install fluid piping under the plant floor.
- Use Schedule 40 or greater (or equivalent) welded or flanged steel pipe for supply piping or, as an alternate, a listed coupling body with dual swaging rings may be used.
- Keeps supply piping as short and direct as possible?
- Prior to putting fluid supply piping in service, hydrostatically test it at the greater of 10.3 bar (150 psi) or 1.5 times the maximum system operating pressure for one hour with no leakage.

Alternately, test with inert gas (i.e. Nitrogen) at 3.4 bar (50 psi) above the maximum operating pressure of the fuel delivery system. For new systems, prior to introduction of fuel, compressed air can be used for pressure testing. The system shall hold pressure with no loss or with only loss that is due to a drop in ambient temperature.

- Label fuel supply piping with product content and direction of flow. Label fuelpiping using either color coding over the entire length or with product labels every 15 m (50 ft.). Refer to the V2X1-2 paint and color standards for further labeling information. Pipe shall be painted Safety Red.

**Liquid Flow Control Methods:** Prevent uncontrolled discharge of liquids by use of the following:

- Emergency shut-off for pumps
- “Fail-closed” valves such as normally closed solenoids or “dead-man” manual valves.
- Excess flow valves.
- Weighted fusible link valves.

**Electrical:**

“Electrical Standard for Industrial Machinery” shall be used as the basis for installation of electrical equipment. The installation and wiring shall conform to 70, “National Electric Code” with specific reference to Article 500 “Hazardous (Classified) Locations, Classes I, II, and III, Divisions 1 and 2”.

**Classification Requirements – Flammable Liquid Mixing and Dispensing Rooms:**

- Use only electrical equipment that is UL listed for and E.U. (EuropeanUnion) Classified areas as described below and in Figure 1. Classified electrical equipment is generally not required for combustible liquids unless they are heated above their flash points.

- Install only Class I, Division 1, Group D (E.U. Zone 0) electrical equipment within 1.5 m (5 ft.) of any point where flammable liquids are transferred from one container to another or where open containers aroused for mixing.

- Install only Class I, Division 1, Group D (E.U. Zone 0) electrical equipment within all below grade pits and trenches throughout rooms used for mixing or dispensing flammable liquids.

- Install only Class I, Division 2, Group D (E.U. Zone 2) electrical equipment within 1.5 m (5 ft.) of the floor throughout rooms used for mixing or dispensing flammable liquids.

- Ordinary classed switches and equipment may be used if installed more than 1.5 m (5 ft.) above the floor and more than 1.5 m (5 ft.) away from equipment used for mixing or dispensing flammable liquids.

**Bonding and Grounding:**

- Racks, ventilation ducts, hoists, drums, totes, tanks, pails, and other equipment or containers which can develop a static charge shall be bonded and grounded to an earth ground in all mixing and dispensing rooms or buildings.

- Provide a grounded copper buss bar, at 1.2 m (4 ft.) above finished floor level, within the perimeter of the room or building to facilitate the grounding of process equipment and portable containers.


**4.4.2. Fire Control/Suppression Systems:**

- Automatic Sprinkler Protection:
- Install automatic sprinkler protection throughout the mixing and dispensing area.

**Coverage:**

- Special consideration shall be given to the need for sprinkler protection below obstructions. Water is denser than flammable liquids and will sink below the surface of a fire. Therefore, water spray needs to cover all possible burning surfaces.

- Provide ceiling level automatic sprinkler protection throughout flammable liquid mixing and dispensing rooms/buildings and associated pump rooms, tank rooms, mechanical equipment rooms, covered receiving docks, and all similar areas.

- Provide automatic sprinkler protection below bulk storage tanks elevated by legs where the bottom of the tank is 0.6 m (2 ft.) off the floor.

- Provide automatic sprinkler protection below paint line bundles, equipment, and ventilation duct work larger than 1.2 m (4 ft.) wide or anything less than 1.2 m (4 ft.) wide that obstructs the ceiling level sprinkler system.

- Type of System:
- Provide wet pipe automatic sprinkler protection in buildings.

- Provide dry pipe automatic sprinkler protection below outside covered receiving docks or canopies or in other areas subject to freezing temperatures. The dry pipe valve(s) shall be located in an area electrically classed as Ordinary.

- Hose Stations or Hydrants:
- The following apply to indoor areas:
- Locate the fire hose connections so that all areas are accessible from at least two fire hose connections.

- Consider aisles, storage, equipment and conveyor layout and other obstructions when locating hose connections.
Assure that all areas are accessible using no more than 30 m (100 ft.) of hose from each of two connections.

- Special Hazard Systems:
- Contact Corporate Fire Protection Engineering regarding special situations where use of Carbon Dioxide (CO2), Aqueous Film Forming Foam (AFFF-ATC), or other special extinguishing systems may be appropriate.
- 4.4.3. APPROVALS:
- Corporate Fire Protection Engineering or (where applicable) the National Fire Protection Engineer and the local authorities shall be informed of any construction of new 1234yf refrigerant filling operations before construction begins.

Corporate Approvals:
- When requested, submit detailed floor plans with equipment layout, construction, security and fire protection details to Ford Corporate Fire Protection Engineering or the National Fire Protection Engineer for review and approval. Ford Corporate Fire Protection Engineering or the National Fire Protection Engineer may also request a review by the Property Loss Prevention Consultant.
- Local Permits or Approvals (where required):
- Plans and related details shall be submitted to the local Authority Having Jurisdiction (AHJ) if required. Work shall not commence prior to receiving approval from the AHJ. If work starts before receiving approvals, the installing contractor shall be responsible for any required changes.

Final Acceptance:
- Contractor’s certificates for installed systems shall be provided as required by the appropriate Ford Bulletins and/or Standards.
- Where review by the Property Loss Prevention Consultant is required, the appropriate Ford Acceptance form(s) shall be completed. The installing contractor shall provide 10 working days’ notice of required acceptance testing.
- When required, the contractor shall provide 10 working days’ notice of acceptance testing and all documentation needed to obtain the final acceptance by local authorities.
- Since Overall study & references, we have created a standard required of PMR as following Tab (5.1) & created a model checklist of PMR legal compliances as following Tab (6.1).

4. RECOMMENDATION

This project study was carried out in Ford India for to check the legal compliance of Paint Mix Room with respect to the above prepared checklist. The below listed gaps were identified and same needs to be installed for 100% compliance.
- Scupper
- Trench
- Busbar
- Vapour Detector

5. CONCLUSION

By installing the Scupper, Trench, Busbar and Vapour detection system in the PMR makes the environment more safer. It results 100% legal compliance, reduce fire hazard and improves morale of the industry.

6. REFERENCE

[1]. The Petroleum Act, 1934
[2]. The Petroleum Rules, 2002
[3]. The TamilnaduFactories Act, 1948
[4]. The TamilnaduFactories Rules, 1950
[5]. Manufacturing, Storage and Import Hazardous Chemicals Rules 1989
[6]. Ford Bulletin 18.01 Bonding & Grounding
[7]. Ford Bulletin 18.02 Protection of flammable and combustible storage areas
[8]. Ford Bulletin 18.03 Protection of flammable and combustible liquid mixing and dispensing rooms