DIP TANKS, FLOW COATERS AND ROLL COATERS

Table of Contents

List of Figures

List of Tables

1.0 SCOPE

This data sheet includes loss prevention guidance on processes where materials are coated by immersion in tanks of ignitable liquid or by closely related processes. It includes roll coating and flow coating. Information is also provided on specific coating operations such as electrostatic detearing, electrophoresis, asphalt saturators, and wave soldering.

The data sheet does not include loss prevention guidance for metal cleaning, oil quenching, or spray painting operations. For information on these processes, see Data Sheet 7-97, *Metal Cleaning*; Data Sheet 7-41, *Heat Treating of Materials Using Oil Quenching and Molten Salt Baths*; and Data Sheet 7-27, *Spray Application of Flammable and Combustible Materials*, respectively. General information on the prevention of and protection against fires and explosions in occupancies handling, processing, and transferring ignitable liquid is presented in Data Sheet 7-32, *Ignitable Liquid Operations*.

1.1 Changes

February 2025. Interim revision. Recommendations associated with Trichloroethylene have been made obsolete.

1.2 Superseded Information

Data Sheet 7-18, *Asphalt Saturators*, is superseded by this document (DS 7-9), which now contains information on asphalt saturators.

2.0 LOSS PREVENTION RECOMMENDATIONS

2.1 Introduction

Use FM Approved equipment, materials, and services whenever they are applicable. For a list of products and services that are FM Approved, see the *Approval Guide*, an online resource of FM Approvals.

2.1.1 Ignitable Liquid Hazard Scenario

Recommendations for passive and active fire protection features in this data sheet vary depending on the severity of the potential fire hazard. The consequences of a dip tank fire are dependent on a number of factors, including the following:

- Quantity and type of ignitable liquid involved
- Exposed surface area of the dip tank
- Use conditions (e.g., temperature)
- Equipment arrangement (e.g., open, closed, automatic closing covers, etc.)
- Equipment location
- Equipment construction

The intent of this data sheet is to limit the amount of ignitable liquid that can become involved in a fire. In evaluating the hazard associated with a dip tank, the starting point is the exposed surface area of the dip tank. The severity of a dip tank fire is directly proportional to the surface area of the liquid. As such, the surface area and corresponding fire severity will be minimized if the ignitable liquid can be contained within the dip tank. A small dip tank that is properly designed (e.g., noncombustible equipment, piping, etc.) will present a minimal fire hazard due to the small surface area of the tank.

A tank with a larger surface area will result in an increased fire hazard, although damage can still be limited if overflow from the tank can be prevented. Safeguards such as overflow drains, emergency bottom drains, or automatic closing covers may be provided for the equipment, designed to contain the liquid within the tank and piping systems. Damage to adjacent equipment will be minimized, while automatic sprinklers will limit damage to the building.

Regardless of the dip tank size, if safeguards are not provided to confine the liquid to the equipment, the potential exists for the liquid to be released into a room and a subsequent fire to extend well beyond the dip tank area. The fire size will grow exponentially, and the potential exists for a large fire that will operate all exposed sprinklers. Any equipment that is exposed to the burning pool will be damaged. However, if overflow from the tank is accounted for by designing the surrounding area as an ignitable liquid occupancy in accordance with Data Sheet 7-32, *Ignitable Liquid Operations*, damage may be effectively limited. The includes containment and emergency drainage for the room area to limit the ignitable liquid fire exposure to the rest of the building and properly designed automatic sprinkler protection that accounts for the larger pool fire outside of the dip tank.

2.2 Construction and Location

2.2.1 Locate and arrange dip tanks and drain boards, as well as flow-coating and roll-coating operations, in accordance with the recommendations in Data Sheet 7-32, *Ignitable Liquid Operations*.

2.2.2 Construct all dip tanks, drainboards, and salvage tanks of noncombustible material on supports of heavy metal, reinforced concrete, or masonry.

2.2.3 Locate salvage and separator tanks in accordance with Data Sheet 7-88, *Ignitable Liquid Storage Tanks*, for outdoor tanks, and Data Sheet 7-32, *Ignitable Liquid Operations*, for indoor tanks. Figure 2 depicts an arrangement where the tank is buried.

2.2.4 Design, locate, and arrange dip tanks and associated equipment, piping, and storage tanks so they are protected from physical damage:

A. Locate equipment so the potential for vehicle impact damage is eliminated.

B. Provide noncombustible equipment and piping materials with high resistance to mechanical damage.

C. Locate piping overhead or in covered trenches in the floor.

2.2.5 If an ignitable liquid is heated or sprayed as part of a dipping or coating process, evaluate equipment or room explosion hazards in accordance with the recommendations in Data Sheet 7-32, *Ignitable Liquid Operations*.

2.2.6 Do not locate dip tanks and drainboards in below-grade locations. When below-grade installations are unavoidable, provide adequate access for manual firefighting efforts as coordinated with the local fire service.

2.2.7 Avoid pits, narrow spaces, pockets, and trenches where vapor may accumulate in the vicinity of dip tanks, such as beneath or around the sides of tanks.

2.2.8 Provide a tight floor cutoff around tanks that extend through a floor into the story below.

2.2.9 Arrange the top of any dip tank to be at least 6 in. (150 mm) above the floor of the room in which it is located. Where this arrangement is not provided, install a 6 in. (150 mm) noncombustible curb or lip secured to the building floor surface around the perimeter of the tank.

2.2.10 Containment and Emergency Drainage

Containment and emergency drainage will limit the surface area of an ignitable liquid pool fire, as well as the corresponding fire size and severity. A dip tank designed to contain the liquid within the tank and piping systems will limit the fire size. However, a spill on the floor outside of the tank could result in a much larger fire. If safeguards are not provided to confine the liquid to the equipment, containment and emergency drainage for the room area is necessary.

2.2.10.1 Design the equipment to contain the liquid within the system. Dip tanks that are provided with one or more of the design features or safeguards listed in Table 2.2..10.1 are not expected to create a pool outside the equipment footprint, provided any automatic filling operations are properly arranged and no other sources of ignitable liquid release exist in the area.

Table 2.2.10.1. Design Options to Contain Ignitable Liquid within a Dip Tank

Closed-Cup Flash Point, Liquid Type	*Design Options*
Any	Provide automatic closing covers and at least 6 in. (150mm) of freeboard on the tank or equipment. Design thecovers in accordance with Section 2.5.5. Provide emergency bottom drains to prevent overflowby quickly removing the exposed ignitable liquid fromthe equipment and fire area. Design the emergencybottom drains in accordance with Section 2.5.8.
>200°F (93°C) Or Very high flash Point (VHFP) and heated above 150°F (65°C) and/orpumped Or Water miscible Depending on the surface area of the dip tank, a high heat release rate fire on the exposed pool surface may occur. However, the freeboard in the tank will act as local containment and keep the burning liquid confined to the equipment. If the sprinklers are designed to extinguish thepool fire, the scenario will be limited to the single piece ofequipment.	Design the sprinkler protection at the ceiling and/ orunder any obstructions (e.g., exhaust hoods, processenclosures, etc.) to extinguish the fire (refer to DataSheet 7-32, *Ignitable Liquid Operations*). In addition,provide enough freeboard to contain the sprinklerdischarge for the duration of the fire.
<200°F (93°C)	Provide a special protection system over the equipment. Design the system in accordance with Section 2.4.2. In addition, provide enough freeboard to contain the sprinkler discharge for the duration of the fire.
Specific gravity >1	Provide at least 1 in. (25 mm) of freeboard.
VHFP/Unpumped	Additional containment and emergency drainage features are unnecessary.

2.2.10.2 Where the features listed in Table 1 are not provided to confine the liquid to the equipment in the event of a fire, or other sources of ignitable liquid release exist in the area, provide containment and emergency drainage (or an alternative to emergency drainage) in the room or building in accordance with Data Sheet 7-32, *Ignitable Liquid Operations.* Design the containment and emergency drainage in accordance with Data Sheet 7-83, *Drainage and Containment Systems for Ignitable Liquids.*

2.2.10.3 The containment and emergency drainage options listed in Sections 2.2.10.1 and 2.2.10.2 are not necessary for dip tanks with less than 20 ft^2 (1.9 m^2) of exposed surface and a minimum of 6 in. (150 mm) of freeboard.

2.2.11 Provide noncombustible hoods over asphalt saturators, or a noncombustible enclosure around asphalt saturator operations, to prevent lint and asphalt deposits from collecting on building surfaces.

2.2.12 Design and arrange electrostatic detearing operations in accordance with recommendations for electrostatic spraying operations in Data Sheet 7-27, *Spray Application of Flammable and Combustible Materials.*

2.2.13 Design and arrange ovens or dryers associated with dipping operations in accordance with Data Sheet 6-9, *Industrial Ovens and Dryers*.

2.2.14 Where parts are cleaned prior to dipping or coating operations, design and arrange the cleaning systems in accordance with Data Sheet 7-97, *Metal Cleaning*.

2.3 Occupancy

2.3.1 General

2.3.1.1 Install ventilation systems in accordance with Data Sheet 7-32, *Ignitable Liquid Operations*, designed to confine, dilute, and remove the maximum amount of flammable vapor released from dip tanks, drainboards, pits, and freshly coated work during normal operations.

2.3.1.2 Maintain housekeeping in the vicinity of dip tanks and drainboards, keeping the area free of both combustible stock and debris. Keep hoods and ducts clean.

2.3.1.3 Keep waste materials (e.g., rags) in FM Approved waste cans, and empty them at least daily.

2.3.1.4 Develop and implement a housekeeping audit program completed at least semi-annually. Ensure plant management reviews audit reports and takes action to promptly address any identified issues.

2.3.2 Flow Coating

2.3.2.1 Provide positive mechanical ventilation in the amount of 10,000 ft^3 (283 m^3) of fresh air at 70°F (21°C) for each gallon (4 L) of solvent evaporated within the flow coater and drip tunnel. Balance the ventilation so that flammable vapor concentrations exceeding 25% of their lower explosive limit will be confined to within 2 ft (0.6 m) of the freshly coated work and the bottom of the drip tunnel.

2.3.2.2 Interlock the ventilation to shut down the paint supply pump and sound an alarm whenever the fans are stopped.

2.3.3 Asphalt Saturators

2.3.3.1 Use felt paper containing a minimum of easily ignitable impurities. Do not use felt paper made with low-grade, mixed waste paper. This can be verified by lack of “sparking” or flaring in the felt as it contacts hot asphalt.

2.3.4 Wave Solder

2.3.4.1 Use noncombustible equipment and ductwork for exhaust.

2.3.4.2 Where flexible connections are needed, use metallic flex ducts.

2.4 Protection

2.4.1 Room Protection

2.4.1.1 Provide automatic sprinkler protection over all dip tanks, drainboards, flow-coating operations, and roll-coating operations.

2.4.1.2 Design and install the sprinkler protection in accordance with Data Sheet 7-32, *Ignitable Liquid Operations*, based on the flash point of the ignitable liquids in use.

2.4.1.2.1 In cases where the ignitable liquid in use has a flash point greater than or equal to 200°F (93°C), and the sprinkler protection is designed to extinguish the pool fire, use the exposed liquid surface of the dip tank to determine the sprinkler operating area as long as the equipment is arranged to prevent the release of the liquid into the room.

2.4.1.3 In addition to sprinklers at the ceiling, provide automatic sprinklers under any obstruction that exceeds 3 ft (0.9 m) in width or diameter and 10 ft^2 (0.9 m^2) in area (e.g., under dip tanks, under exhaust hoods, inside process enclosures containing dipping operations, etc.), and in all enclosures.

2.4.1.4 Protect detearing operations in accordance with recommendations for electrostatic spraying operations in Data Sheet 7-27, *Spray Application of Flammable and Combustible Materials.*

2.4.1.5 Protect cleaning operations in accordance with Data Sheet 7-97, *Metal Cleaning*.

2.4.1.6 Protect ovens or dryers associated with dipping operations in accordance with Data Sheet 6-9, *Industrial Ovens and Dryers*.

2.4.1.7 Provide automatic sprinkler protection in all ductwork where deposits of condensed vapor may accumulate, in accordance with the recommendations in Data Sheet 7-78, *Industrial Exhaust Systems*.

2.4.1.8 Interlock the heating system to shut down in the event of sprinkler system operation.

2.4.2 Equipment Protection

2.4.2.1 Automatic sprinkler protection may be supplemented with an FM Approved fixed special protection system in accordance with Data Sheet 7-32, *Ignitable Liquid Operations*, to limit fire damage or as an alternative to an emergency drainage system (either within the room or locally over the dip tank).

2.4.2.2 A fixed water spray system may be installed over the dip tank to limit fire damage. Design the system in accordance with Data Sheet 4-1, *Fixed Water Spray Systems for Fire Protection*.

2.4.2.3 Where a special protection system is installed locally over the equipment as supplemental protection to automatic sprinklers, cover the dip tank, drainboard, and any other areas where fire might spread because of the presence of ignitable liquid.

2.4.2.4 Automatically actuate special protection systems using FM Approved flame and/or heat detectors that are compatible with the extinguishing system and arranged in accordance with Data Sheet 5-48, *Automatic Fire Detectors*. Ensure the detection devices will provide fire detection at least as fast as a quick response sprinkler.

2.4.2.5 Provide capability for remote manual activation of special protection systems from an area that will be accessible during a fire.

2.4.2.6 Where a special protection system is installed, interlock the heating system and all ventilating fans for the dip tank and drain board to shut down immediately upon operation of the system.

2.5 Equipment and Processes

2.5.1 Design ignitable liquid piping and transfer systems in accordance with the recommendations in Data Sheet 7-32, *Ignitable Liquid Operations.* Provide automatic safeguards and interlocks arranged to shut down all ignitable liquid flow in and to the impacted building or room in the event of a fire.

2.5.2 Store all ignitable liquid in accordance with the recommendations in Data Sheet 7-29, *Ignitable Liquid Storage in Portable Containers*.

2.5.3 If supplies of ignitable liquid must be maintained for dispensing in the vicinity of dip tanks, restrict the quantity to the amount necessary for operations during one shift, and not more than 70 gal (265 L).

2.5.4 Use FM Approved ignitable liquid storage cabinets (also referred to as flammable liquid storage cabinets) for storing small quantities of ignitable liquid (e.g., the small quantities of flux used in wave soldering operations). Additional information on FM Approved storage cabinets is provided in Data Sheet 7-32, *Ignitable Liquid Operations*.

2.5.5 Provide automatic-closing covers on all dip tanks (see Figure 2.5.5.), except where automatic operation is not possible due to conveyors, hoists, suspended work, or excessive tank surface areas. If properly installed and maintained, automatic-closing covers will extinguish dip tank fires by the exclusion of air and, at the same time, practically eliminate the possibility of overflow.

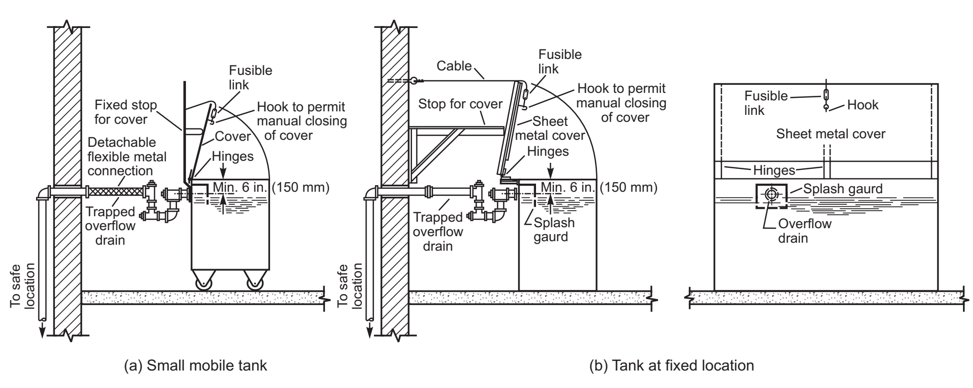


Fig. 2.5.5. Dip tanks with automatic covers

2.5.6 Provide high liquid level switches for automatic filling operations to prevent overflow of the tank. Provide a high liquid level switch a maximum of 2 in. (51 mm) below the lip of the tank, arranged to sound an alarm. Provide a second switch at a higher level designed to shut down all ignitable liquid flow to the tank.

2.5.6.1 Tanks with properly designed overflow drains do not need a second liquid level switch arranged to shut down filling. A high liquid level alarm is still needed to ensure operators are alerted.

2.5.7 Route process piping, building roof drains, and similar items away from open dip tanks.

2.5.8 Overflow Pipes

2.5.8.1 Route overflow pipes back to the source of supply or to a point of safe discharge such as a salvage or separator tank.

2.5.8.2 Locate the center line of the overflow connection at least 6 in. (150 mm) below the top of the tank.

2.5.8.3 Provide traps so discharged ignitable liquid will not continue to burn at the collection point. Keep the traps sealed with liquid to prevent passage of vapor.

2.5.8.4 Size the piping to prevent tank overflow from ceiling sprinkler discharge, water-spray nozzles, and other fixed fire protection systems. Refer to the recommendations for catch basins and horizontal discharge piping design in Data Sheet 7-83, *Drainage and Containment Systems for Ignitable Liquids*, to determine the necessary capacity of the overflow drains.

2.5.8.5 Provide fittings and ports to facilitate inspection and cleaning.

2.5.8.6 Install a sheet metal guard where necessary to prevent splashing into the overflow pipe, but arranged so the liquid may flow unobstructed into the overflow pipe.

2.5.8.7 In cases where the material in the dip tank has a melting point above 70°F (21°C), the use of overflow drains may not work as intended due to the material solidifying in the drainage pipe.

2.5.9 Emergency Bottom Drains

2.5.9.1 Pipe emergency bottom drains back to the source of supply or to a point of safe discharge such as a salvage or separator tank.

2.5.9.2 Design the emergency bottom drain pipe sizes in accordance with the recommendations for floor drains in Data Sheet 7-83, *Drainage and Containment Systems for Ignitable Liquids*.

2.5.9.3 Where the bottom drain is not arranged for gravity flow, provide an automatically operated pump to empty the dip tank. Arrange the pump as follows:

A. Interlock the pump to operate simultaneously with the opening of the bottom drain valve.

B. Locate the pump and electrical supply to the pump away from the potential fire area.

C. Provide a means for manual operation of the bottom drain valve from a safe location.

2.5.9.4 Actuate the bottom drain valve independently of any automatic special protection systems. Operation of the bottom-drain valve may be by a fusible link having a temperature rating higher than that of a fixed-temperature fire detection device actuating the fire protection system or suitable electrical control from a water-flow alarm on the sprinkler system. If fusible links are used, center them over the dip tank on a spacing not exceeding that of sprinklers in the building.

2.5.9.5 In cases where the material in the dip tank has a melting point above 70°F (21°C), the use of bottom drains may not work as intended due to the material solidifying in the drainage pipe.

2.5.10 Salvage Tanks

2.5.10.1 Discharge overflow pipes and emergency bottom drains to a storage location for recovery of ignitable liquid and waste water treatment.

2.5.10.2 Size emergency drainage system impounding basins or collection facilities to hold the total drainage system discharge for the duration of the sprinkler operation.

2.5.10.3 Design and locate salvage or separator tanks in accordance with Data Sheet 7-88, *Ignitable Liquid Storage Tanks*, including the following:

A. Provide pipe connections and vents for salvage and separator tanks in accordance with Figure 2.5.10.3 Terminate vent lines outside the building.

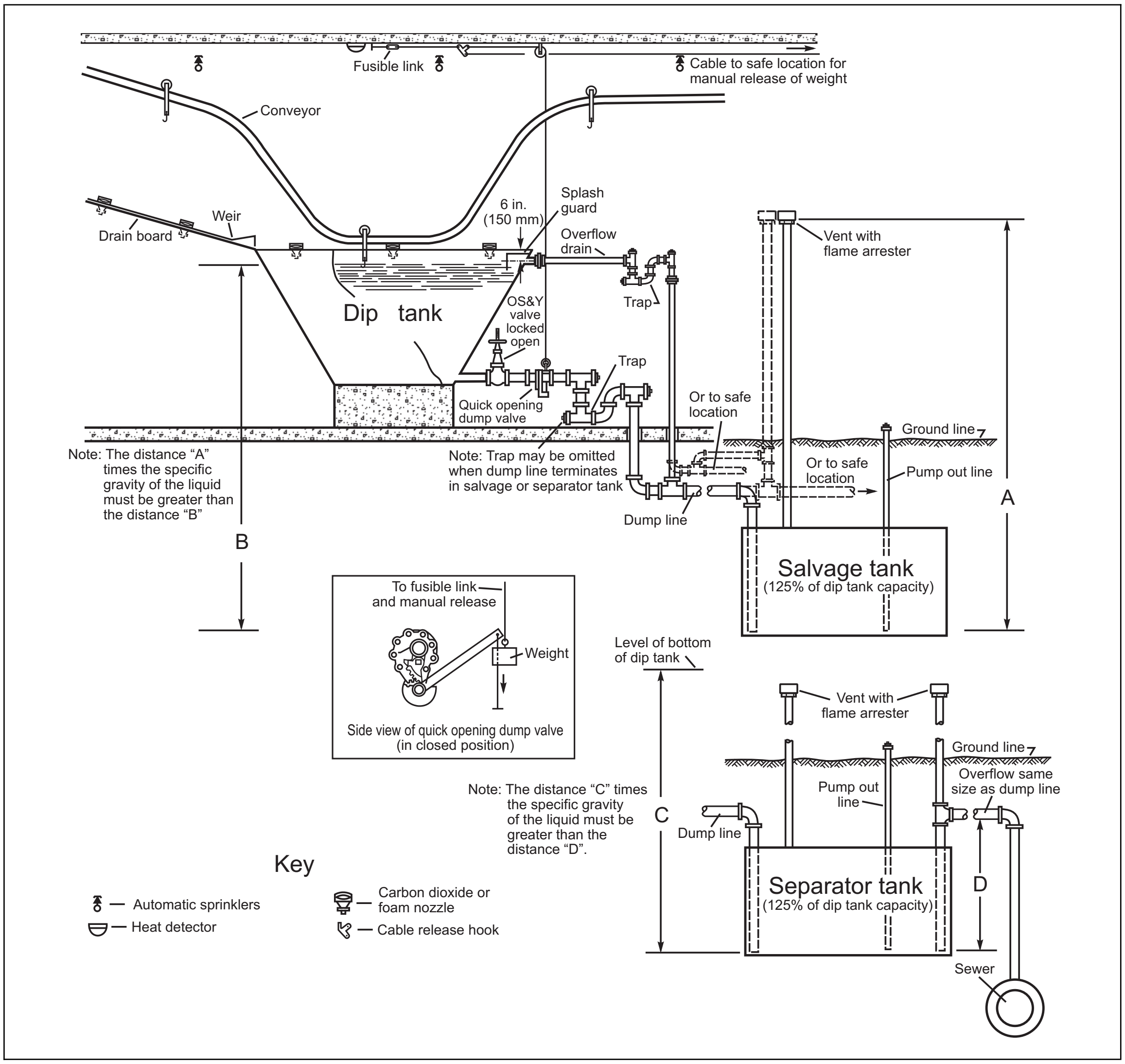


Fig. 2.5.10.3. Typical dip-tank installation

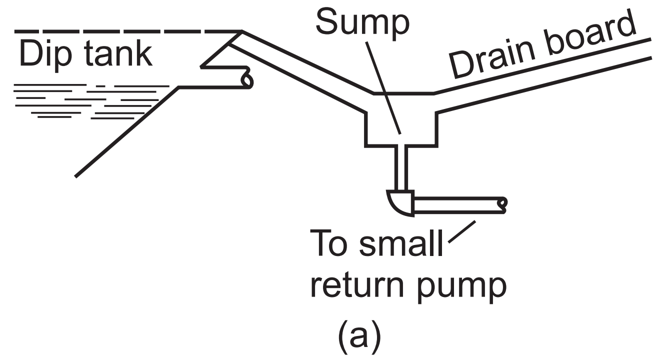
B. Equip the vent on the salvage or separator tank with a flame arrester.

C. Provide an overflow pipe from the salvage or separator tank to a safe location (see Figure 2.5.10.3).

D. Provide a normally locked open valve in the bottom drain line between the dip tank and the quick-opening valve (see Figure 2.5.10.3), and install a plugged tee immediately after the quick-opening valve. By closing the valve, the automatic operation of the quick-opening valve may be tested without discharging the contents of the dip tank. By removing the plug, the interior of the quick-opening valve is readily accessible for cleaning. For accessibility, install plugged tees at the trap and bends in the drain line.

2.5.11 Drainboards

2.5.11.1 Arrange drainboards so water from sprinklers and hose streams cannot flow into the dip tank in appreciable quantities. Suggested arrangements are shown in Figure 2.5.11.1.



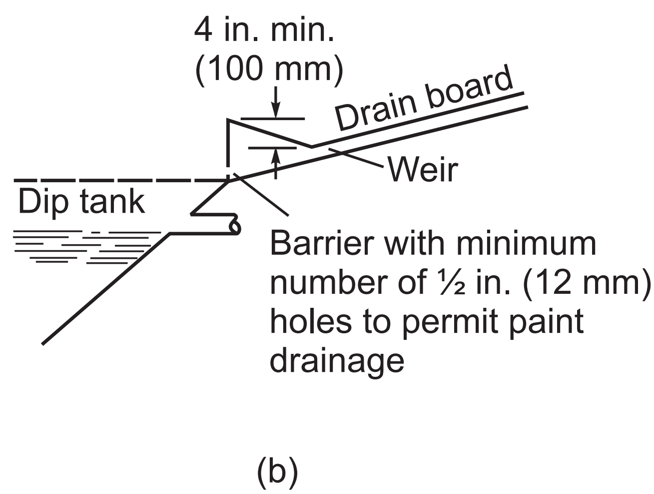


Fig. 2.5.11.1. Arrangement of drainboards to prevent sprinkler discharge from entering dip tank

2.5.11.2 Arrange large drainboards so the drippings will flow into a special sump from which they may be returned to the dip tank by a small pump.

2.5.11.3 Provide a barrier between the tank and drainboard with a sufficient number of 1/2 in. (12 mm) holes to permit drippings to drain to the tank, and arrange the sides of the drainboard to form a weir (Figure 2.5.11.1) for the discharge of sprinkler water in amounts larger than the normal liquid flow. Locate the top of the barrier at least 4 in. (100 mm) above the low point of the weir.

2.5.12 Agitators and Conveyors

2.5.12.1 Arrange motors that drive recirculating pumps or agitators to shut down automatically in the event of fire. These motors may be interlocked with the operation of automatic fire protection system.

2.5.12.2 Interlock the conveyor drive with any mechanical exhaust ventilating system so the conveyor cannot move unless the ventilating fan is operating. Interlock the conveyor drive with the automatic fire protection system so the conveyor will immediately stop whenever the system operates. Avoid locating conveyor motor drives, take-up mechanisms, and similar devices in the immediate vicinity of the dip tanks.

2.5.13 Heated Ignitable Liquids

The temperature of ignitable liquid in a dip tank is sometimes raised by the direct application of heat to the tank, circulation of the liquid through tubes in a combustion chamber, or immersion of preheated materials.

2.5.13.1 In addition to the general recommendations in Sections 2.5.1 through 2.5.12, provide the following features where ignitable liquid is heated:

A. Heat equipment using steam, hot water, organic heat transfer fluid (see Data Sheet 7-99, *Heat Transfer Fluid Systems*) or other means not requiring an open flame.

B. Where heaters are separate from the tank, arrange the pump used to supply the liquid to the tank to shut down if the return pump fails (see Figure 2.5.13.1).

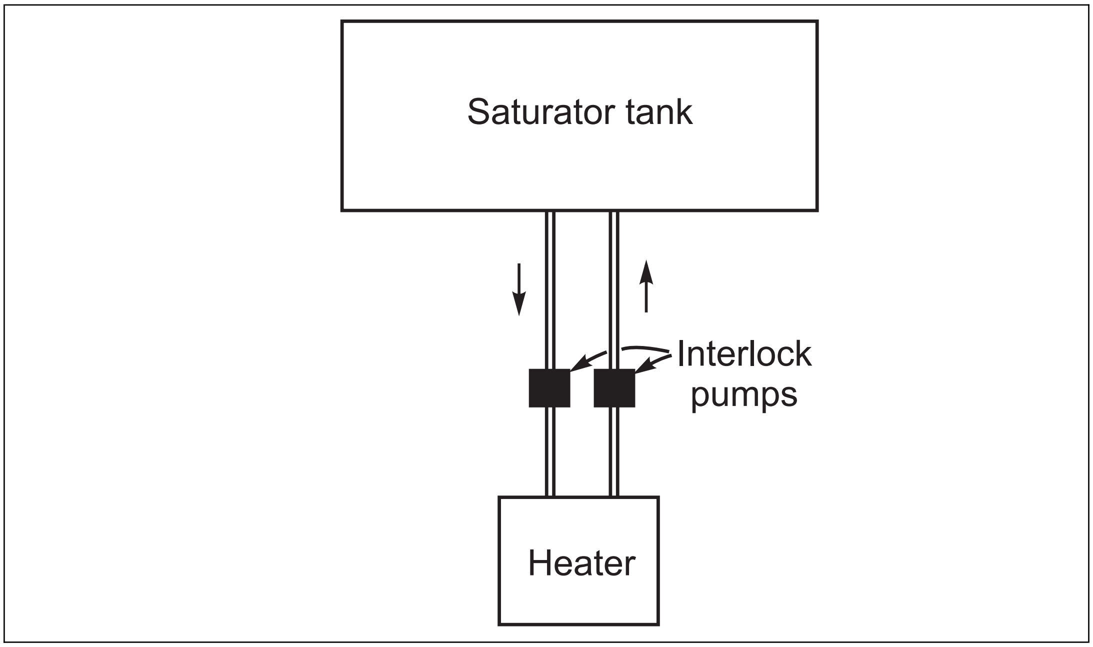


Fig. 2.5.13.1. Plan view of piping arrangement where heater is separate from saturator (not to scale).

C. Provide agitation or recirculation pumps interlocked with the heater to ensure uniform temperatures throughout a tank when electric strip heaters are used.

D. On all heating systems, provide automatic temperature controls to maintain the liquid at desired working temperature, and at least 50°F (28°C) below the flash point of the ignitable liquid. Interlock the controls to provide an audible alarm and shut down the equipment, and prevent starting the heating system before the tank agitator or recirculation pump is in operation. Design automatic controls to shut down on loss of operating electrical or air supply.

E. Provide a high-temperature limit switch independent of operating temperature controls. Set the limit switch slightly higher than the normal operating temperature and at least 50°F (28°C) below the flash point of the ignitable liquid. Interlock the switch to provide an audible alarm, shut down the heating system, and, if not in operation, start up oil recirculation or agitation. A dual-contact limit switch may be used, arranged to actuate the alarm prior to the other operations.

F. Provide a low-liquid-level interlock arranged to sound an alarm and shut down the heating system in the event the liquid level is below safe limits.

G. Interlock the heating system to shut down in the event of sprinkler or special protection system operation.

2.6 Operation and Maintenance

2.6.1 Provide a substantial, tight-fitting, noncombustible cover for all dip tanks, except those that are equipped with automatic-closing covers or are emptied by draining into a salvage or storage tank when not in use. Keep all covers closed whenever the tanks are not in use.

2.6.2 Keep work-supporting carriers free of combustible deposits (e.g., paint) by periodic cleaning. Provide nonferrous scraping tools for removing combustible accumulations.

2.6.3 Make a thorough weekly inspection of all dip tank facilities, including covers, overflow pipe inlet and discharge, bottom drain valve, electric wiring and equipment, ventilating fans, and all protection equipment.

2.6.4 Correct any defects noted on weekly inspections, including repair of any identified sources of leakage. Do not use equipment under unsafe conditions.

2.6.5 Develop and implement a formal operator audit procedure to ensure compliance with established standard operating and emergency response procedures. Conduct these audits at least semi-annually.

2.6.6 Test all system safety interlocks in accordance with manufacturer recommendations or at least quarterly. Maintain records of these tests.

2.6.7 Implement a management of change program. Have a full review of all planned changes conducted by qualified loss prevention consultants, as well as other authorities having jurisdiction, before the project begins.

2.7 Ignition Source Control

2.7.1 Control all ignition sources in accordance with the recommendations in Data Sheet 7-32, *Ignitable Liquid Operations*.

2.7.2 In roll-coating operations, adequately ground all rotating parts, install static collectors wherever the material leaves a rotating part, and maintain a relative humidity of 50% to 75% at all times.

2.7.3 Provide the following in electrophoresis operations:

A. Provide NEMA Type 2 enclosures for electrical equipment that is within 10 ft (3 m) of the operation. General Purpose enclosures are acceptable beyond 10 ft (3 m). See Data Sheet 5-1, *Electrical Equipment in Hazardous Locations*, for definitions of NEMA enclosures. The approximate international equivalent to a NEMA Type 2 enclosure is an IP11 enclosure per IEC 60529, *Degrees of Protection Provided by Enclosures (IP Code).*

B. Provide the means to manually ground the high-voltage system during cleaning periods and production shutdowns.

C. Establish and maintain ample clearance between electrodes and grounded work or other grounded objects. Clearance should be at least twice the possible sparking distance.

D. Provide an electronic sensitivity control or similar device arranged to automatically shut down the process if the work or other objects move too close to electrodes.

3.0 SUPPORT FOR RECOMMENDATIONS

3.1 Flow Coating

Paint is frequently applied to surfaces by flow coating. In this process, the liquid is pumped to nozzles that direct it against the work. The excess is collected in a trough or sump from which it is either returned to a supply tank or recirculated directly to the nozzles by the pump. The nozzles are located in a sheet metal enclosure having openings through which the work enters and leaves. The flooding section of the equipment is followed by an enclosed drip tunnel. In determining occupancy and protection, the sump is considered to be the dip tank. The floors of the flooding section and drip tunnel are considered to be the drainboard area

3.2 Roll Coating

Fabric and paper are often coated by passing them either directly through a tank or trough containing ignitable liquid or over the surface of a roller that revolves partially submerged in the liquid. Very low flash point solvents used for roll coating are subject to flash fires involving large quantities of freshly coated material. For printing, see Data Sheet 7-96, *Printing Plants.*

3.3 Electrostatic Detearing

In flow coating or dipping, there is a tendency to accumulate excess coating material at the drain-off points. These tear drops, or fatty edges, not only affect the finish, but the heavy accumulations cannot be baked to satisfactory hardness without overbaking the thinner coatings. Electrostatic detearing frees the article of excess material so the work is uniformly coated and can be baked to an acceptable finish.

The work is mounted on a grounded conveyor, dipped in the usual manner, and then passed over a drainboard. After air drying, it is carried over a metal detearing grid (Figure 3.3) connected to the high-voltage negative terminal of a power pack consisting of a transformer and rectifier. An electrostatic field is established between the high-voltage grid and the grounded (positive) work. The excess coating material at the drain-off points is repelled from the work and attracted by the detearing grid.

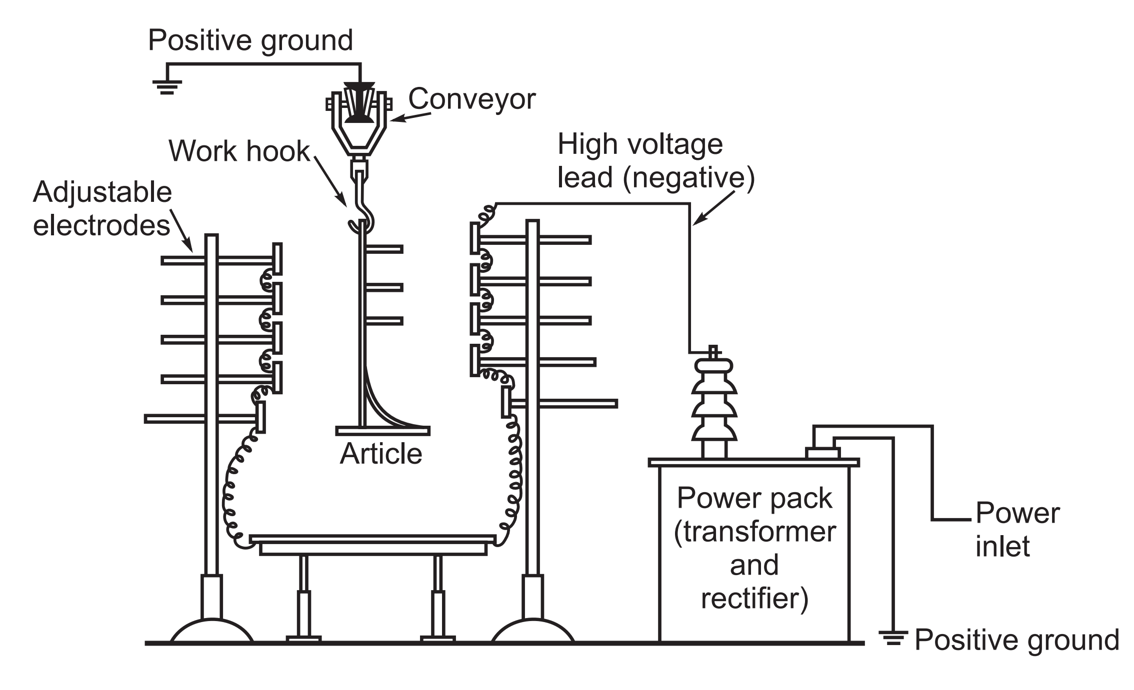


Fig. 3.3. Typical detearing equipment

The power pack is similar to that used for electrostatic spraying, but the unit is smaller and the current and voltage outputs are less. It contains approximately 55 gal (210 L) of transformer oil and provides a pulsating dc output of 85,000 volts with a normal operating current of 200 µA. Current during short circuit conditions is approximately 7 mA. The control unit for the detearing process is similar to that used for the spraying equipment. The detearing grid over which the dipped articles pass consists of metal screens that are removable for cleaning.

A fire hazard is created by the use of electrostatic detearing because electric sparks may occur between the electrodes and the work or surrounding apparatus, introducing an ignition source.

3.4 Electrophoresis

Electrophoresis is the electrical precipitation of paint particles on metal surfaces. It is a colloidal process and is adaptable only for water-based paints that can be electrically charged. Most paints for this use contain rust-inhibitive pigments. The operation is conveyorized and completely automatic. Advantages of this process include uniform deposition of paint, rust inhibition, absence of tears and runs, and economical utilization of paint.

Articles to be coated by this method are first cleaned. They are usually phosphatized to a surface depth of 5 mils (0.13 mm) as well. Phosphatizing is followed by a second cleaning to provide maximum corrosion protection and prevent the carryover of soluble salts into the coating bath. Additional information on cleaning of metal parts can be found in Data Sheet 7-97, *Metal Cleaning*.

The article to be coated is then submerged into a tank containing the paint. The article serves as the positive terminal and the coating tank as the negative terminal in the circuit. Direct electric current flowing through the solution deposits the paint solids uniformly on the submerged article. Power requirements are usually between 50 and 500 volts direct current, with approximately 2 to 3 A/ft^2 (22 to 32 A/m^2) of coated surface.

A final drying in an oven completes the process. Drying time and temperature are determined by the paint composition and the final properties required. Additional information on drying processes is included in Data Sheet 6-9, *Industrial Ovens and Dryers*.

3.5 Asphalt Saturators

An asphalt saturator is used for impregnating paper or fiberglass felt with asphalt in the manufacture of roofing felt and shingles.

A typical saturator is shown in Figure 3.5. Felt paper is made from waste paper or fiberglass, and may contain impurities such as cellophane, plastic, and rubber bands. During the saturating process, the felt is unwound from a roll and passed through a series of presaturator festoons. Normally, molten asphalt is sprayed on one side of the felt as it passes through tach festoon. Excess moisture is removed from the other side of the felt.

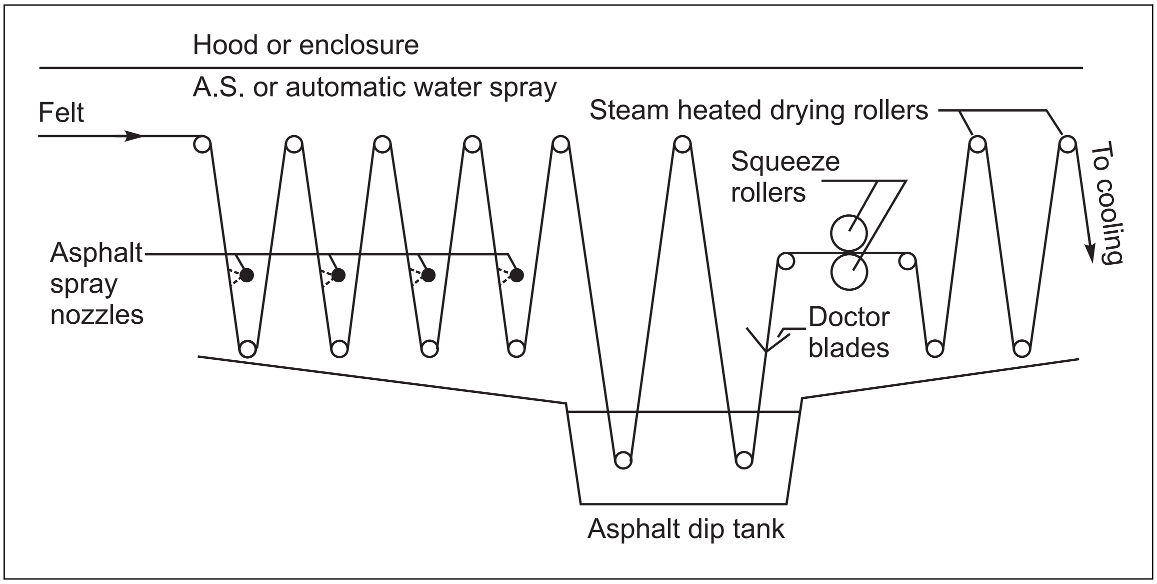


Fig. 3.5. Typical asphalt saturator arrangement (not to scale)

The asphalt is at a temperature between 475°F and 525°F (246°C and 274°C). The flash point range of asphalt is usually between 600°F and 625°F (315°C and 329°C).

After leaving the presaturator festoons, the felt enters a dip tank where it is coated on both sides and saturated. Excess asphalt is removed by means of doctor blades and squeeze rollers.

The felt passes through steam-heated rollers where the asphalt is dried and set in the felt, then passes through more festoons in a cooling section. It may be coated with aggregate, cut, and packaged.

Asphalt saturators using paper are subject to a high frequency of fires. The paper felt is often made using low-grade mixed waste paper, which can contain cellophane wrapping paper. Cellophane wrapping paper often has a coating of cellulose nitrate for waterproofing. Cellulose nitrate has an ignition temperature lower than the asphalt temperature. Often, “sparking” or flaring of particles in the felt can be observed as the felt is contacted by the hot asphalt. These flare-ups are usually extinguished by the spray of asphalt or by dipping the felt into the tank, unless the asphalt is above its flash point. The particles may reignite in the drying stage.

The fires may spread rapidly if lint or asphalt condensation is present, especially if it extends beyond the saturator hood.

3.6 Wave Soldering

Wave soldering is an automated process in which electronic components are soldered to printed circuit boards (PCBs). The components are placed on the PCB, and the assembly enters the wave solder machine via a conveyor. It first passes through a fluxing zone, where flux is applied to the PCB, typically in the form of a bath or spray. The PCB then moves through a preheating station to allow the assembly to reach flux activation temperatures. Finally, the assembly passes through the soldering zone, where it is exposed to a bath of solder. A pump is used to produce the waves. As the waves contact the PCB, the components become mechanically and electrically fastened to the board.

Wave soldering presents two primary fire hazards. First, the flux may be an ignitable liquid. The use of water based fluxes is increasing but the flash point of non water based flux materials may be below 50°F (10°C). The quantities of flux used are typically limited (as low as 1 gal [4 L]), but could act as the fuel to cause the initial fire event in a wave solder machine.

The pool of solder also represents a fire hazard. The operating temperature of the solder may be as high as 500°F (260°C). Although high-temperature interlocks are often provided to shut down the equipment, these interlocks can fail. The solder may autoignite, or ignite the flux upon contact with the PCB.

Wave soldering is considered an ignitable liquid operation. Although the wave solder equipment is enclosed, which shields ceiling sprinklers from protecting the interior contents of the equipment, ceiling sprinklers are expected to limit fire damage to the equipment and surrounding area.

4.0 REFERENCES

4.1 FM

Data Sheet 4-1, *FixedWater Spray Systems for Fire Protection*
Data Sheet 4-5, *Portable Extinguishers*
Data Sheet 5-1, *Electrical Equipment in Hazardous (Classified) Locations*
Data Sheet 5-48, *Automatic Fire Detection*
Data Sheet 6-9, *Industrial Ovens and Dryers*
Data Sheet 7-20, *Oil Cookers*
Data Sheet 7-27, *Spray Application of Flammable and Combustible Materials*
Data Sheet 7-29, *Ignitable Liquid Storage in Portable Containers*
Data Sheet 7-32, *Flammable Liquid Operations*
Data Sheet 7-41, *Heat Treating of Materials Using Oil Quenching and Molten Salt Baths*
Data Sheet 7-78, *Industrial Exhaust Systems*
Data Sheet 7-83, *Drainage and Containment Systems for Ignitable Liquids*
Data Sheet 7-88, *Ignitable Liquid Storage Tanks*
Data Sheet 7-96, *Printing Plants*.
Data Sheet 7-97, *Metal Cleaning*

4.2 Other Standards

International Electrotechnical Commission (IEC). *Degrees of Protection Provided by Enclosures* (IP Code). IEC 60529.

APPENDIX A GLOSSARY OF TERMS

Asphalt: A brown to black bituminous substance primarily obtained as a residue in petroleum refining, consisting mainly of high molecular weight hydrocarbons.

Detearing: A process for rapidly removing excess wet coating material from a dipped or coated object or material by passing it through an electrostatic field.

FM Approved: Products and services that have satisfied the criteria for FM Approval. Refer to the *Approval Guide*, an online resource of FM Approvals, for a complete listing of products and services that are FM Approved.

Freshly Coated (Dipped) Work: Work evolving vapor sufficient to reach 25% of the lower flammable (explosive) limit.

Ignitable Liquid: Any liquid or liquid mixture that has a measurable flash point. The hazard of a liquid depends on its ability to sustain combustion or create a flammable vapor-air mixture above its surface. Flash point is one way of understanding if a liquid can create that flammable vapor-air mixture. For a liquid to burn in a pool, it must have a fire point as well as a flash point. Ignitable liquids include flammable liquids, combustible liquids, inflammable liquids, or any other term for a liquid that will burn.

Very high flash point liquid: Liquids that meet the definition specified in Data Sheet 7-32, Section 2.1.3.1.1.

APPENDIX B DOCUMENT REVISION HISTORY

February 2025. Interim revision. Recommendations associated with Trichloroethylene have been made obsolete.

January 2022. Interim Revision. Lowered the flashpoint threshold of very high flashpoint liquids consistent with other ignitable liquid data sheets.

April 2018. Interim revision. Lowered the flash point threshold of very high flash point liquids from 500°F (260°C) to 450°F (232°C) to be consistent with other ignitable liquid data sheets.

July 2013. The following major changes were made:

A. Revised terminology and guidance related to ignitable liquid to provide increased clarity and consistency. This includes the replacement of references to “flammable” and “combustible” liquid with “ignitable” liquid throughout the document.

B. Reorganized the document to provide a format that is consistent with other data sheets.

C. Provided information to assist in evaluating the fire hazard scenario associated with dip tanks, including the need to minimize the surface area of a fire by confining the ignitable liquid within the tank area.

D. Moved information on asphalt saturators from Data Sheet 7-18, *Asphalt Saturators,* to this data sheet (7-9). Data Sheet 7-18 is now obsolete.

E. Added information on wave soldering operations.

F. Eliminated the use of a draft curtain as an alternative to fire-rated cutoffs for dip tank processes.

G. Provided information on protection of piping and equipment from mechanical damage.

H. Updated the recommendations for containment and emergency drainage.

I. Added reference to Data Sheet 7-32, *Ignitable Liquid Operations,* for the appropriate design of piping systems.

J. Revised the sprinkler protection recommendations for areas containing dip tanks.

K. Updated guidance associated with special protection systems for alignment with current technologies and FM Global recommendations.

L. Updated the information on the design of overflow drains and emergency bottom drains based on recent research.

M. Added information related to human factor, ignition source control, and housekeeping.

September 2000. This revision of the document has been reorganized to provide a consistent format. The section on oil cookers has been deleted since they are now covered by Data Sheet 7-20, *Oil Cookers*. Also revised hazardous location electrical equipment classification guidance under 2.5.1 to be consistent with Data Sheet 5-1, *Electrical Equipment in Hazardous (Classified) Locations*, and Data Sheet 7-32, *Flammable Liquid Operations*.