Safe Operation of Inland Bulk Plants

API PUBLICATION 2008 THIRD EDITION, NOVEMBER 1976

> American Petroleum Institute 2101 L Street, Northwest Washington, D.C. 20037

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Fire and Safety Coordination

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> American Petroleum Institute





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FOREWORD

This publication describes the basic principles of safety and fire protection in the operation of bulk plants for the purpose of preventing fire losses, personal injury and property damage.

This publication is intended for use at inland bulk plants where petroleum products are normally received by tank vehicle, tank cars or pipeline, and distributed by tank truck. These plants are an important link in the distribution of petroleum products. Many of these plants are operated by companies with refining or distributing facilities; however more are independently operated businesses. Although the suggestions herein apply to either case, they are not intended to replace individual company procedures. Distributors also may find it advantageous to avail themselves of the guidance and experience of their suppliers.

This is a recommended practice for operation and is not intended to outline standards for design or construction, as such standards are covered in other publications.

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This publication was prepared by the Marketing and Transportation Safety Subcommittee of the Institute's Committee on Safety and Fire Protection in cooperation with the Marketing Department's Operations and Engineering Committee. It replaces Accident Prevention Manual No. 8: *Safe Practices in Bulk Plant Operations*, second edition, March 1955. It is hoped that through this publication the petroleum industry's excellent accident and fire records may be maintained or improved.

SAFE OPERATION OF INLAND BULK PLANTS

1 GENERAL BULK PLANT SAFETY

1.1 Introduction

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Even though bulk plants handle flammable and combustible petroleum products, the fire frequency-rate for bulk plants is typically lower than that of any other commercial establishments.

The safety of plant employees, protection of the public from injury, and the protection of the plant from damage by fire loss are obvious essentials to successful bulk plant operation.

Safety is achieved only by the effective participation and interest of all personnel associated with the plant. Each person is rewarded with freedom from injury, suffering, and loss of time and income. Preservation of the plant through the prevention of fire ensures continuity of its service to the community, a place of employment and an enhancement of public goodwill.

Operating procedures should be developed to prevent spills, personal injuries and fires along with contingency plans to deal with emergencies. These procedures and plans should be reviewed periodically with, and observed by, all employees and reviewed with the local fire department.

1.2 Fundamentals of fire

The bulk plant operator should be familiar with the more likely causes of bulk plant fires.

Before a fire can occur, three elements must be present:

a) fuel in vapor form;

b) air (oxygen) in sufficient quantity to support combustion;

c) a source of ignition.

Because of the volatility of many of the liquids handled and the small amount of vapor in air needed to be flammable (e.g., for gasoline, approximately one to seven percent by volume), fuel vapor may occasionally be present at bulk plants in sufficient quantity to be flammable. Therefore, it is important to control all sources of ignition in plant areas where such vapor-air mixtures are likely to be present.

1.3 Ignition control

When volatile flammable liquids are exposed to air, flammable vapor-air mixtures can be formed; therefore, uncontrolled releases of such vapor to the atmosphere should be prevented.

Leaks: Tanks, valves, pumps, flanges, etc., which contain flammable liquids should be frequently inspected and maintained in leak-free condition to ensure that vapor is not released.

Spills: Any spilled product should be collected in a slop tank, or pass through a filter or separator so the product will not enter public ditches, sewers or waterways. Environmental regulations should be consulted before a spill occurs to determine the appropriate means to handle spilled product as well as any reporting requirements.

Cleaning solvents: Gasoline is a motor fuel—not a cleaning solvent. Never use gasoline for cleaning. The manufacturer's instructions and warning labels should be followed when using cleaning materials.

Smoking: Smoking should not be permitted except in designated safe locations. NO SMOKING signs should be posted in known hazardous areas, such as loading, unloading, pumping, tank areas and warehouses.

Matches and lighters: 'Strike anywhere' matches and lighters that do not require two separate actions to operate should not be permitted in the plant.

Open flames and fires: Open flames, fires or welding should not be permitted in the plant, except when authorized for maintenance and construction. Such work must be closely supervised and controlled. A written hot work permit or check list system can be an effective means of ensuring proper communications and understanding among operating and maintenance personnel, and to ensure that there is a clear understanding of responsibilities before any hot work is started.

Power equipment: Many types of power equipment, such as internal combustion engines, electric hand tools, and the like, are possible sources of ignition and should not be used where flammable vapor-air mixtures are present.

Heating equipment: Where heating equipment is provided, it should be of a type without an ignition source or so located that it will not serve as an ignition source for leaks or spills.

Even though no petroleum vapor is involved, stoves and furnaces may cause a fire unless they are properly installed, equipped and maintained so that no fire from overheating will result. Heater rooms should be kept neat and orderly, and should not be used for storage.

Electrical equipment: Electrical systems improperly installed or incorrectly sized can be sources of ignition. Electrical equipment, as well as circuits and fuses, should be properly maintained and should comply with Chapter 6 of NFPA No. 30 and the National Electrical Code NFPA No. 70.

Spontaneous combustion: Rags, clothing or other absorbent material, which have become soaked with oil base paint, vegetable or animal oils, are potentials for spontaneous combustion. These materials should be placed in a metal container with a metal lid or a cover. These containers should be emptied frequently to minimize the hazard.

Rubbish: Combustible rubbish, such as waste paper, packing materials, etc., are ready fuels for fire. Covered metal containers should be provided or such materials isolated until they are properly removed from the plant.

Other fire sources: Frequently, fires endangering a bulk plant originate on adjacent properties. These fires may spread from their source in dry grass, weeds and rubbish to petroleum storage and handling areas. Good housekeeping, including control of grass and weeds, especially along the fenced perimeter, will minimize the spread of outside fires into the plant property.

Static electricity: Liquid petroleum products in motion generate static electrical charges which may be a source of ignition under certain conditions. Proper use and maintenance of bonding devices, and the control of switch loading practices (loading of low vapor pressure products such as diesel fuel into a tank compartment which previously contained gasoline) will reduce this hazard. For precautions against electrostatic ignitions, see the section on *Precautions Against Electrostatic Ignitions* in this publication.

1.4 Fire control procedure

Usually there are a limited number of employees at a bulk plant. Regardless of the size of the plant however, each employee including drivers, should be trained to perform the following:

a) Stop the flow of all products, i.e., close valves and shut down pumps. A prior knowledge of the operation and location of all tanks, vents, valves, emergency controls, etc., will avoid delay and error.

b) Alert all persons who are in the plant.

c) Summon the nearest available fire department. The telephone number of the local fire department and other emergency numbers should be posted at each plant telephone. (Local fire department personnel should be familiar with the plant layout and emergency controls and have a predeveloped firefighting plan.)

- d) Use available fire-extinguishing equipment.
- e) Remove trucks unless it is unsafe to do so.

1.5 Personnel safety

Freedom from injury can be achieved only when each individual does his part by observing correct work procedures. Safety is an obligation that cannot be accomplished on a 'fix-it-tomorrow' or 'take-a-chance-this time' basis.

Records indicate that most personal injuries in bulk plants occur while employees are handling bulk product containers and packages in a warehouse, while they are servicing equipment, or while they are engaged in loading/unloading operations. Such injuries usually result from falls, falling objects, strains, striking against or being caught between objects, contact with petroleum products and fire. Fire can result in injury to employees, fire fighters or the public.

Falls: Severe injuries can be caused by improperly

maintained walking/working surfaces; slippery conditions; ladders which are unsafe or improperly used; or by using boxes, chairs and other makeshift platforms to reach overhead objects. Falls are frequently caused by poor housekeeping, such as tools, equipment and debris that are left on walking/working surfaces. These may be very difficult to see in a poorly illuminated environment. Personnel should be encouraged to correct these unsafe conditions, and to report those that cannot be resolved immediately. Additionally, personnel should be trained to compensate for unavoidable hazards when they exist such as ice, snow, etc.

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Hand tools: Hand tools may be a source of injury. The following are a few safety suggestions relative to the use of such equipment:

a) Use the proper type and size tool for the specific job. The right tool readily available discourages the use of improper tools. Certain bulk plant jobs require the use of special tools, such as bung wrenches, drum carts, trucks, skids, etc. Where needed, employees should be instructed in their proper use.

b) Defective tools should never be used. They should be repaired or replaced immediately.

c) Tools should be kept clean and stored in an orderly manner. A good tools board assists workers to find a tool quickly and vividly indicates tools that are missing. All tools should be handled with care.

d) Equipment such as rakes, hoes, shovels and other yard tools should be stored in a designated place where they will not subject personnel to injury.

e) Tools such as crowbars and track jacks should be securely placed in racks.

Lifting: To lift heavy objects the following should be considered:

a) Ascertain that the object can be lifted without difficulty.

b) Get a firm, comfortable stance on a level surface, if possible, before attempting the lift.

c) Bend the knees and lift naturally. This method

keeps the spine in its natural configuration thereby reducing the possibility of back injury.

d) Turning, twisting or moving can precipitate an injury while lifting or lowering an object.

e) Never try to lift heavy objects that exceed your lifting abilities.

f) Exhibitions of weightlifting are out of place on the job.

Contact with petroleum products: Skin irritation may result from prolonged contact with most petroleum products. Contaminated clothing should be removed as soon as possible and the affected part of the body washed thoroughly with soap and water.

Clothing soaked with gasoline or a similar flammable liquid should be removed before the wearer enters a room where a source of ignition may be present. Such clothing should be hung outside in the air for the vapor to evaporate, or be placed in a covered metal container and not worn again until it has been laundered.

Breathing petroleum vapors: The inhalation of petroleum vapors (depending upon their concentration and the duration of exposure) may result in intoxication, unconsciousness, or possibly death from asphyxiation.

Enclosed spaces such as tanks or tank cars should be entered only by properly trained persons. Such persons should be equipped with protective respiratory equipment which provides an independent air supply unless the tank has been tested and found to have sufficient oxygen and to be free of toxic vapor in concentration above the Threshold Limit Value (TLV). Entry into enclosed spaces which are not lead-free requires appropriate personal protective clothing and respiratory equipment. Such work should be in accordance with API Publication 2015, *Cleaning Petroleum Storage Tanks* or API RP 2015A, *Guide for Controlling the Lead Hazard Associated with Tank Entry and Cleaning*, or API RP 2013, *Cleaning Mobile Tanks in Flammable or Combustible Liquid Service*, whichever is applicable.

1.6 Personal protective equipment

The use of approved personal protective equipment should be required when it is necessary to achieve the desired protection. Safety shoes, eye and face protection, and garments which are compatible with their normal day-to-day work assignments are considered personal protective equipment.

2 YARD SAFETY

2.1 Vehicle parking

A clearly marked vehicle parking area, as remote as practical from operating areas, is desireable.

2.2 Drum storage

Material stored outside should be safely and neatly arranged. Drums should not be stored under or around tanks. Drum storage areas should be protected from access by unauthorized persons. All empty drums should have their bungs in place. Leakers should be disposed of to prevent oil creating a potential slipping or fire hazard. Lighting should be adequate to ensure safety of personnel working at night.

2.3 Weed and grass control

The application of a commercial weed killer may be advisable where mowing is impractical; however, some of these products may be toxic to both humans and animals and should only be applied in accordance with manufacturer's instructions. Power mowers should never be operated in a hydrocarbon vapor atmosphere or near a product spill.

2.4 Fences and gates

Fences and gates with locking devices are desirable for keeping unauthorized persons from entering and causing damage to plant property, possible injury or theft.

2.5 Drainage

Adequate drainage should be provided in the yard. Ditches and sewers should be kept in repair and free of obstruction. Every effort should be made to prevent any petroleum product from reaching public drainage systems or waterways. Environmental regulations should be consulted to determine the appropriate means to handle plant drainage.

2.6 Walkways and driveways

Walkways should be free and clear of obstacles, and crossovers provided over piping where employee crossings are a normal part of the work assignment. These facilities should be inspected frequently and kept in repair. Driveways should be kept in good condition and holes filled to prevent falls or vehicular accidents. It may be necessary to provide guards, rails or posts where equipment is exposed to vehicular traffic.

3 WAREHOUSE SAFETY

3.1 Doors, passageways and windows

Warehouses should be maintained in first-class repair at all times. Broken window panes should be replaced to prevent personal injury and weather damage to stored material. Doors should be kept in satisfactory repair and free of obstructions; defective hinges, hangers or tracks may cause personal injury and impede exiting in emergencies.

Doorways, aisles and passageways should be kept clear. A clear space should be maintained around fireprotection or fire-fighting equipment. The location of fire-fighting equipment should be distinctively marked. Fire doors, if provided, should be maintained so they will operate automatically in the event of fire. Fusible links on the fire doors should not be painted.

3.2 Floors and stairways

Floors, loading platforms and stairways should be kept free of oil, grease and other slippery materials, projecting nails, splinters, and worn or weak spots. Broken planking and floor members should be repaired immediately. Supporting timbers or structural members should be inspected regularly. Floor loading limits must not be exceeded. Snow or ice should be removed promptly.

Holes or breaks in concrete floors should be patched to prevent falls or injuries. Floor areas in which drums are stored and in which hand trucks are used should be as level as possible.

3.3 Packaged stocks

All packages should be stacked so that they will not fall. While cases are being opened, care should be exercised to avoid injury from nails, splinters, bands or flying particles. Protruding nails should be removed. Small packages should not be stored on top of drums. Products in glass bottles or aerosol cans should not be exposed to direct sunlight or other source of heat, and should be stored in such a way that they will not be broken or ruptured. Cases should be stacked securely. Pallets or mechanical aids are desirable for placing cases in high stacks. Stacks of palletized cases should have freestanding stability. High stacks of packages should be crosstied for stability. If cases are to be moved by lift truck, the operator's vision should not be blocked. Pallets used in storing and handling packages and drums should be kept in good repair, and should be of correct size and type to safely handle the load.

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All drums and other package goods in storage should be kept tightly sealed at all times. Drums and packages should be handled in such a manner that breakage or leakage will be minimized. If leakage does occur, the damaged container should be removed from the storage area for repair or disposal, and any fire or slipping hazard should be eliminated immediately.

When a drum is to be moved by hand, it is important to ascertain whether it is full, partly full or empty. Painful injuries have occurred from failure to take this precaution. A proper lifting technique is important for the upending of drums. Developing momentum in the early part of the lift will help carry the drum to the upright position. Drum lifters provide additional leverage and should be used.

To avoid having fingers mashed when a drum is being rolled, hands should not grasp the chimes; the drums should be pushed with the hands near the rolling rims. A drum should never be rolled with the feet.

In many instances the handling of drums is done mechanically. Powered equipment is used in large warehouses, whereas hand trucks and drain stands are used in smaller warehouses. Special equipment has been developed for upending drums; but, if used on drums of unusual shape, extra precaution is required.

3.4 Van and boxcar unloading

Vans should be chocked immediately after spotting at the loading dock. Loads may shift while in transit causing packages to fall when a door is opened. It is therefore advisable for the person opening the door of a van or boxcar to stand to one side and open the door slowly. A dockboard should be securely anchored between the loading dock and the van or car.

3.5 Truck loading—package goods

Trucks should not be overloaded. All packages should be stacked so they may be moved or handled easily when unloading. On tank trucks, drums and cases should be placed only in the package compartments provided, firmly secured to prevent shifting or falling, and arranged so the first one loaded is the last one unloaded.

3.6 Filling portable containers

Care should be exercised in the filling of portable containers with flammable liquids in order to avoid spills which could cause a fire. Filling with flammable liquids should not be done inside the warehouse, except in areas designed and ventilated for such an operation (see Flammable and Combustible Liquids Code NFPA No. 30). Prior to filling, the area should be checked to determine that there are no sources of ignition. Any spills should be cleaned up immediately. In order to prevent accumulation of static charges from flowing petroleum products, metallic contact should be maintained between the filling nozzle and the can, drum or container being filled. As an alternative the container can be placed on a metal surface which is electrically bonded to the nozzle or fill piping, or a bond provided between the nozzle and container (see API RP 2003 Protection Against Ignitions Arising Out of Static, Lightning and Stray Currents.)

4 GARAGE SAFETY

Garage doors should be opened before engines are started to avoid hazards of carbon monoxide unless engine exhaust outlets are connected to a vent system. Proper housekeeping is very important. Oil, grease and other foreign substances should be cleaned from the floor immediately. No flammable liquids other than those in the vehicle's fuel tank or tank truck itself should be stored in the garage.

If hot work is to be done, the atmosphere in the area should be vapor-free. The work location should be remote from any possible flammable vapor. Adequate ventilation is essential. Mechanical ventilation may be desirable if such work is done on a regular basis. If repairs involve welding or cutting on the cargo tank, all compartments, double-bulkheads and similar spaces, and piping should be emptied and made vapor-free. Such work should be performed in accordance with API RP 2013.

5 PUMPS

Frequently, pumps are located in or near tank areas or at loading racks. Pumps may be in the open or sheltered by a roof. Good housekeeping and adequate drainage should be maintained in the area. Motor controls should be identified and so located as to allow remote shutdown in the event of a fire or accident.

If the pumps are installed in a pump house, adequate ventilation is essential. This building should be for pumps only and not for storage or other work purposes. Blocking of floor-level ventilators should be prohibited.

To avoid intermixing of different classes of products, e.g., gasoline and kerosine, separate pumps should be assigned for such class of product and each pump should be properly identified.

Pumps should be kept free of leaks and adequately maintained. If a small leak or drip should develop, a drip pan should be provided until the pump can be repaired. The pan should be emptied frequently. Repairs should be made as soon as feasible.

A fixed guard should be installed around drive shafts, pump gears, clutches or belt drives.

Electric motors, wiring and controls should be maintained in safe condition. Motors should be electrically grounded and be of a type approved for the classification of area where they will operate.

5.1 Piping and valves

Separate piping should be provided for each class of product to prevent the possibility of intermixing highand low-flash-point products, or leaded and unleaded gasoline. Where manifolds are used the pumps and piping which handle low-flash-point products should not be cross-connected with others that handle high-flashpoint products.

Check valves should be provided in filling lines at the tank car or truck unloading connection to prevent backflow. Identification of lines and equipment is necessary to avoid the intermixing of products or the accidental discharge of the wrong product. Identification of product lines, valves, equipment and tanks, by use of product name tags, tank numbers, color codes or a combination of these methods, may be desirable. Color coding, where used, should follow nationally accepted coding or that of the supplying company.

The piping layout should include valves located at the rack and at other remote points in the lines to permit individual cut-off of product flow to the rack in the event of an emergency. In addition, every pipe entering a tank below the liquid level should have a steel valve as close as possible to the tank. These tank valves should be closed at any time the plant is unattended. Such valves should be constructed or marked to clearly indicate whether the valve is open or closed. In addition, each loading downspout or hose should be equipped with a self-closing valve or automatic flow control device. Selfclosing valves should never be blocked or tied open. (...)

A regular painting schedule will prevent above-ground piping from rusting and improve its appearance. Bridges or steps should be provided over above-ground piping to avoid falls, and to eliminate any strain that might weaken the connections and result in piping leaks.

5.2 Change of service

If the service of a tank is changed, the tank and lines should be cleaned and flushed thoroughly in accordance with API-RP 2015. Consideration should also be given to any needed improvements while the tank is out of service.

5.3 Maintenance and repair

A high standard of maintenance and repair should be achieved to minimize leakage and other potential hazards. An experienced and qualified mechanic should be used to repair the plant piping system. Leaks from loose connections at unions or flanged joints usually can be stopped by tightening the union or the bolts in the flanges. Uneven or excessive tightening should be avoided. Tightening the packing gland or replacing packing will usually correct stuffing box leaks.

NEVER USE AN OPEN FLAME OR TORCH TO THAW FROZEN PIPING OR VALVES. Heated sand, or blankets or burlap soaked in hot water, may be effectively used for this purpose.

6 STORAGE TANKS

6.1 Foundations or supports

Tank foundations or supports for vertical or horizontal tanks should be inspected regularly for corrosion, spalling, cracking or settling, and if necessary, should be repaired promptly. Insufficient or uneven supports may subject a tank to excessive strain and cause buckling. Piping connected to such a tank may fail and result in loss of product. Tanks installed at grade level should be kept free of any dirt accumulation against the shell of the tank. Washouts under and at the edge of a tank or foundation should be filled in and the dirt tamped into place. Above-ground piping should be properly supported (with noncombustible material) and should not rest on the ground.

6.2 Drainage and dikes

Where possible, tank areas should be drained or sloped so that any overflow or escape of product will flow away from the tanks to a safe area. Dikes should be maintained in good condition. Drain lines for the diked area which penetrate a dike wall should be sealed to prevent leakage around the line. Valves should be kept closed except when actually in use and be located outside the dike. If a siphon is used instead of a drain valve, the siphon should be raised when it is not in use. Water should not be allowed to accumulate in the dike area. It should be drawn off, after which the drain valve should be closed or the siphon raised.

There should be adequate provision to prevent a petroleum product from reaching public drains, sewers or waterways. Environmental regulations should be consulted to determine the specific requirements applicable.

6.3 Tank stairs and walkways

Stairs, walkways, bridges, ladders, platforms and handrails, conforming to applicable regulations should be maintained in safe condition. Damaged parts should be repaired or replaced immediately. Oil, snow and ice should be removed promptly.

6.4 Tank fittings and appurtenances

The discs and seats of both vacuum and pressure ports of vent valves on storage tanks require periodic inspection and thorough cleaning. More frequent inspection is required during freezing weather. Vents should be protected against paint spray while tanks are being painted.

It is generally agreed by those knowledgeable in petroleum safety that flame arresters do not offer additional protection to a tank equipped with conservation pressure-vacuum-type vents nor to a tank equipped with open vents when storing a product with a flash point above 38°C (100°F), such as kerosine. Where flame arresters are installed, frequent inspection is required to ensure that they function properly and are clean. If frost blocks the arrester, venting will be restricted which may result in damage to the tank.

Therefore, it may be advisable to remove the flamearrester banks in winter months.

Tank valves should be closed when the tank is not in operation, empty or idle. The water-draw off valve should be kept closed and locked when not in actual use. Gage hatches should be closed except when gaging is in progress.

When an internal valve is used on a storage tank, regular testing is recommended to ensure that the valve is in operating condition and that it will close automatically if the tank is exposed to fire.

6.5 Tank maintenance and repair

A leaking tank should be taken out of service and repaired as soon as possible. Only competent personnel should repair the tank or replace the tank valves.

The cleaning of petroleum storage tanks should be performed in accordance with API Publication 2015.

7 RECEIPT OF PRODUCT

7.1 By tank truck (attended receiving plant)

Intermixing of products, overflows and spills must be avoided.

Careful adherence to the following procedures will minimize the possibility of error during product receipt.

a) Plant personnel should compare the carrier's bill of lading with the original order.

b) Each cargo compartment should be checked for volume and content. It may be desirable to take a sample of the contents of each compartment into a clean container, and examine it for color and gravity. The results should be checked with the bill of lading. This sample may also be used for a flash-point test when doubt exists as to the contents of the compartment. (For certain products, such as aviation fuels, regulations require that samples be retained for a stipulated period of time. Any sample that is retained should be tagged or labeled and kept in a safe place.)

c) The receiving tank should be checked and

gaged to avoid product intermixture, as well as to ensure that the tank will hold the quantity of product to be delivered. It is never safe to rely on a paper inventory.

d) The hose should be connected and the valves should be set for delivery to the correct tank. A previous valve setting should never be relied upon.

e) A check should be made for possible leaks in the delivery hose and lines after the product pump has been started. When a truck-mounted pump is being used for delivery and a leak should occur, the truck engine should be shut off immediately. The truck driver or plant personnel should remain in close proximity of the truck until the delivery has been completed.

7.2 By tank truck (driver-attended receiving plant)

Arrangements are sometimes made by agreement between supplier, carrier and receiver for the unloading of trucks during the absence of receiving-plant personnel. The convenience of such an arrangement requires faithful compliance with the procedures. The details of such an arrangement will vary in accordance with the responsibilities assigned to the plant personnel and to the driver. The procedure and responsibilities should be prearranged in writing and uniformly followed.

When setting up a procedure, the following should be considered:

a) The representative of the plant, the carrier and the shipper if concerned, should make a joint inspection of the receiving plant. If night deliveries are contemplated, lighting must be adequate and a night telephone available.

b) An established means of communication is recommended for notifications to and from the driver and for any keys needed.

c) The carrier's driver should be provided with the safety rules and product identification system, which are applicable to the particular receiving plant or company, and should be required to comply with them. Posting of the rules at the plant is desirable.

d) Deliveries should be made only by trained personnel who are thoroughly familiar with the plant. e) The driver should be instructed to contact a plant representative in the event of an emergency or if he is in doubt concerning the proper procedure. Name and telephone number of the representative to be contacted should be readily available. (.)

Based on the above, the following procedure is recommended:

a) The receiving plant should be notified in advance as to the product name, quantity and approximate time of arrival.

b) The driver should be provided with written information concerning the identification and capacity of the receiving tank, identification of product in the tank, valve settings, and if required, the key to the gate and to any locked valves that need to be operated. A layout diagram of the plant's storage area, pumps and valving may also be helpful. Driver-attended deliveries should not necessitate the climbing of ladders on bulk storage tanks.

c) The driver should read the ground level gage to determine if sufficient capacity is available to receive the shipment. In the event ground level gages are not available, it may be necessary for the driver to 'stick' the tank.

d) Valves on tanks not involved in the delivery should be closed and locked.

e) Except for the tank valve, valves and pumps to be used in the delivery may be set in advance if the piping arrangement is such that it is safe to do so. Before pumping starts, the driver should open the tank valve and recheck all connections and valve settings to make certain that the product will be delivered to the correct tank and to prevent overfilling.

f) During the unloading operation the driver must remain in the immediate vicinity of his vehicle and be alert to any indications that the tank will not hold the amount to be delivered, or that tank venting is not operating properly.

g) Upon completion of the delivery, the driver should close all valves, including air bleeder type. He should leave a written record of the delivery. h) Upon reopening the plant, before resuming operations, the plant operator should immediately check the delivery record and gage the tanks for correctness of delivery.

7.3 By railroad tank car

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Careful adherence to the following procedure will minimize error in delivery:

> a) Spotting of cars: Plant personnel should assist the train crew in spotting the car accurately at the unloading header. If it is necessary later to move the car, a 'car mover' tool should be used. Before connecting the pumping equipment, the brakes should be set and the wheel blocked on all cars.

> b) Warning signal: The caution sign reading STOP — TANK CAR CONNECTED or STOP — MEN AT WORK should be placed where any crew coming onto the siding will see it readily. Refer to Hazardous Materials Regulations of the U.S. Department of Transportation for details.

> c) Opening of cars: Before any dome cover or outlet valve is opened, the unloader should hold the pressure relief valve open intermittently to relieve any internal pressure. He should be careful to have a firm footing while he opens the dome cover. He should push on the wrenches or pry bars—NOT pull them—so that if a tool slips, he will fall toward the dome and not off the car.

A check should be made of the volume and contents of the car, as well as the car number. It may be advisable to take a sample of the contents of each car to verify that they contain the proper products.

The receiving tank should be checked and gaged to avoid product intermixture, as well as to ensure that the tank will hold the quantity of product to be delivered.

d) *Tank delivery:* The valves should be set for delivery to the correct tank. A previous valve setting should never be relied upon. If the bottom outlet valve on the tank car is used the unloader should loosen the cap slowly and check for leaks. A bucket should be provided to collect any leakage. If leakage occurs, the cap should be tightened. The outlet valve should be checked by manipulation of the lever in the dome. The procedure of loosening the cap may then be repeated. **NOTE:** In colder climates, water in the cap may freeze. The cap usually can be freed by wrapping hot rags around it. NEVER USE AN OPEN FLAME.

When the leakage is stopped, the cap may be removed and the hose connected. However, if leakage persists or the frozen valve cannot be freed, the cap should be tightened and the car unloaded through the top fittings.

A check should be made for possible leaks in the delivery hose and lines after the product pump has been started. A recheck of the valve setting and a check of the relief vent on the receiving tank will ensure proper operation and delivery of the product to the proper tank.

e) *Supervision:* The unloading operation should be under constant supervision. Unauthorized persons should not be permitted in the vicinity. The plant should never be left unattended while a tank car is connected.

f) Completion of delivery: When the delivery has been completed, the unloader should be certain that the car is empty. The outlet valve should be closed, the hose disconnected and the dome cover replaced and tightened with a suitable bar or wrench. If an outlet valve reducer was used, it should be removed and the valve cap replaced and tightened with a wrench. Shipping cards should be removed and placards should either be removed or reversed if the card is of the reversible type. The caution sign should be removed and the car reported as empty.

8 LOADING OF TANK TRUCKS

The loading rack should be so located that the necessity for close turning or backing of vehicles is avoided or minimized. The piping should be located in such a way that it will not be damaged by vehicles; otherwise it should be protected.

Loading rack operation often involves work above the ground level. Where platforms are provided, stairways and handrails serving the loading rack must comply with applicable regulations and be maintained in good condition. Any surface upon which a person doing the loading walks should be nonskid, or should be coated with nonslip material. Personnel protection also may be provided by adjustable steps, or by walkways or platforms, or grab rails.

Larger loading arms or hoses are usually equipped with devices which make them easy to handle, e.g. counterweights, swing joints, springs and hangers. These devices should be arranged and adjusted so that they will not be damaged by trucks when not in use. In addition, each loading arm or hose used in top loading should be equipped with a self-closing valve or other automatic flow control device. Self-closing valves must never be blocked or tied open.

8.1 Precuations against electrostatic ignitions

This section considers those circumstances where there is a potential for electrostatic discharge in the presence of flammable vapor-air mixtures. The recommendations do not cover those situations in which:

a) Static discharge may occur, but flammable vapor is excluded by gas-freeing or inerting the atmosphere, or when high flash point products are loaded into gas-free tanks.

b) Product handling occurs in a closed system where oxygen is excluded, such as in liquefied petroleum gas (LP-Gas) handling.

c) Flammable vapor may be present, but no mechanism exists for static accumulation and discharge. Included in this category are most situations in which petroleum products (such as most crude oils, residual oils, asphalts including cutbacks) and water-soluble products (such as alcohols) are handled. These products are nonaccumulators of electrostatic charges because of their relatively high electrical conductivity.

8.2 General

Cargo tanks being loaded through open domes, in which flammable vapor is likely to be present, must be electrically bonded to the fill stem, piping or steel loading rack connected to the piping. All metallic parts of the fill pipe assembly should form a continuous electrically conductive path downstream of the point of bond connection. For example, insertion into an open dome of a nonconductive hose equipped with a metal coupling on the outlet should be avoided unless the coupling is bonded to the fill pipe or tank. If bonding is to the rack, it is essential that the piping and the rack be electrically interconnected. Bond wires may be insulated or noninsulated. A noninsulated wire permits ready visual inspection for continuity of bond. Insulated bond wires as well as the entire bond circuit should be electrically tested or inspected periodically for continuity. Bonding should be accomplished prior to opening the dome covers, and maintained in place during the entire loading operation and until the dome covers have been securely closed after loading is completed. Only the dome cover for the compartment to be loaded should be opened; all others should remain closed.

8.3 Intermediate vapor pressure products and switch loading

An ignition hazard can exist when low-vapor-pressure products are loaded into a cargo tank containing a flammable vapor from a previous load, e.g., fuel oil loaded into a tank which last carried a cargo of gasoline. This is commonly called 'switch loading.' When switch loading is done, or intermediate vapor pressure products such as Jet B are loaded, the procedures described in API Bulletin 1003 or API RP 2003 should be followed.

When switch loading, or loading of intermediate vapor pressure products, the fill pipe should reach as close as possible to the bottom of the tank being loaded and preferably should be in contact with the bottom in order to avoid undue turbulence. However, the down spout should not rest 'full circle' on the bottom. Some companies avoid this possibility by using a down spout with a 45° angle at the end or by using a deflector on the end of the fill pipe. If the fill pipe does not reach the tank bottom the liquid velocity in the fill pipe should be limited to approximately 1 metre/sec (3 fps) until the outlet is submerged. If the fill pipe reaches the bottom of the tank and is kept in continuous contact with it or after the outlet of the fill pipe is covered, the velocity may be increased to approximately 4.5 to 6 metres/sec (15-20 fps).

Where bottom loading is used for 'switch loading', low velocity, splash deflectors or other devices should be used to prevent upward spraying of the product and to minimize surface turbulence.

Filters located between the loading rack and storage tanks may be prolific static generators and 30 seconds relaxation time should be provided between the filter outlet and the fill pipe outlet (see API Bulletin 1003 or API RP 2003).

Metal or conductive objects—such as gage tapes, sample containers and thermometers—should not be lowered into, or suspended in, a compartment while the

compartment is being filled or immediately after cessation of pumping. A waiting period of approximately one minute will generally permit relaxation of the electrostatic charge to a safe level.

Care should be exercised to minimize the possibility of any unbonded object entering a tank. Prior to loading, tanks should be inspected and any unbonded objects removed.

8.4 Loading procedures

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Before loading is started, the following precautions should be taken:

a) Motor and lights of the vehicle should be shut off.

b) Parking brake should be set.

c) No one should be in the cab of the vehicle.

d) Any repairs or adjustments to the vehicle should cease.

e) Vehicle cargo tank outlet valves should be closed, unless required for bottom loading.

f) If bonding is required, the bond wire should be attached to a metal part of the truck tank before a dome cover is opened, and it should not be disconnected until after the loading operation is completed and all dome covers have been secured.

g) A check should be made to determine what product each compartment contained previously. If it previously contained gasoline and now is to be filled with kerosine, diesel fuel or a fuel oil, the tank and piping should be drained thoroughly. Switch loading precautions to prevent electrostatic ignition should be observed. If the compartment previously contained fuel oil, kerosine or diesel fuel and now is to be filled with gasoline, the tank and piping should be drained to avoid contaminating the gasoline. Likewise, if the compartment previously contained leaded gasoline and is to be loaded with unleaded gasoline, the tank and piping should be drained to avoid affecting quality of the unleaded gasoline. If the tank cannot be drained thoroughly, or if the tank is equipped with a pump, meter or wet hose, then flushing of the tank, pump, meter and hose with the product to be loaded will be required. The amount required for flushing should be determined by test and this information provided to the loader. If no established test procedure has been provided, the amount used should be at least twice the capacity of the compartment lines, pump, meter and hose.

During loading, the following precautions should be taken:

a) The loading operation should receive the undivided attention of authorized personnel so that spills may be avoided.

b) The compartment should not be loaded above the level indicated by the appropriate marker to ensure provision for expansion of the product.

c) The dome cover and its gasket should be in first-class condition to ensure that it will remain liquid-tight on the road. The dome cover should be closed tightly after the compartment has been filled.

d) All dome covers should be kept closed when bottom loading. When top loading, only the dome cover of the compartment being loaded should be open.

In the event of an overflow during loading operations, the following precautions should be taken:

a) Loading operations should cease and pumps should be shut off.

b) All loading valves should be closed.

c) The overflow should be removed or flushed away. The overflow should not be flushed into public sewers, ditches or bodies of water where it would increase the hazard or cause contamination.

d) Loading should not be resumed, nor the truck be started until all vapor has dissipated and the liquid cleaned up.

Some system of marking or recording of the product loaded into each compartment should be followed if more than one grade or class of product is hauled in the same load. Hauling low- and high-flash-point products on the same truck should not be done unless an air space (double bulkhead) is provided between compartments. This will avoid contamination of products in case of leakage. Separate truck piping systems, including any truck-mounted pumps, meters and hoses should be provided for each class of product on the same load.

During transit, internal safety (or emergency) valves must be closed.

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