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API ACCIDENT PREVENTION MANUAL
ON
CLEANING PETROLEUM STORAGE TANKS
SECTION "B" - GASOLINE

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CLEANING PETROLEUM STORAGE TANKS

SECTION "B" - GASOLINE

FOREWORD

The purpose of this manual is to aid in preventing accidents during the cleaning of storage tanks that have contained gasoline.

The extensive use of gasoline which has been blended with tetraethyl lead creates certain tank-cleaning problems not associated with other petroleum products. As gasoline is a finished petroleum product, its storage concerns only those persons engaged in distributing operations or in the final refinery preparation of gasoline for distribution. For that reason, and so as not to confuse the problems of cleaning gasoline-storage tanks with those peculiar to crude-oil and unfinished-products tanks, the subject is dealt with separately.

This section contains information of value to supervisors, foremen, and others who are responsible for the safety of gasoline-tank cleaners. It should be useful as a guide for safe practices wherever gasoline-storage tanks are cleaned.

HAZARDS OF TANK CLEANING

General

1. Employees engaged in the cleaning of gasoline-storage tanks may suffer accidental injury as a result of:

- (a) Explosion or fire.
- (b) An excess of gasoline vapor or deficiency of oxygen.
- (c) The presence of toxic liquids, gases, or dusts.

Sources and Causes of Combustion

2. The three elements necessary for combustion are fuel, air (oxygen), and ignition temperature. No combustion can occur without these three essentials.

3. Mixtures of petroleum vapors and air are explosive when they occur within certain limits, called the "lower" and "upper" explosive limits. For gasoline vapors in air these limits are, generally, 1 per cent and 6 per cent by volume. Other vapors may have different limits. Vapor indicators (any make) record the percentage of the lower explosive limit. The toxic range is marked on the percentage scale by the vapor indicator maker.

4. Concentrations of gasoline vapor in air between the foregoing limits are referred to as being within the explosive range because a violent explosion will occur if such a mixture is ignited within a closed space.

5. Mixtures of gasoline vapor and air richer than the upper explosive limit are not combustible, but such a mixture can ignite and burn at points of escape from the tanks such as leaks or manhole openings.

6. Gasoline-storage tanks may contain combustible mixtures at any time depending upon the presence of air and vapor in proper proportions.

7. A combustible mixture is most likely to occur in a tank after it has been opened. Vapors in closed gasoline tanks are generally too rich to ignite.

8. Even after a tank has been freed of vapor, combustible mixtures again may be formed through the admission of vapor or gasoline from some other source, as through an unblanked line or connection, a break in the bottom of the tank, the evolution within the tank of vapor from sludges, sediment, sidewall scale, or oil-soaked wooden structures.

9. One of the most common causes of ignition is an electric spark. Sparks may result from lightning. Other sources of electric sparks are worn or

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covers. "Stray" currents have ignited combustible mixtures. In rare cases sparks may result from the discharge of static electricity which has accumulated on liquid surfaces or on equipment used in the tank-cleaning operations. A tank cleaner may collect static on his person or equipment if he is completely insulated by rubber boots and gloves. A copper rivet through the heel of the rubber boots will provide a ground.

10. Fires have been caused by internal-combustion engines in passing automobiles, trucks, or in other nearby apparatus. Vapors may travel a considerable distance from a tank, ignite, and then flash back.

11. Another cause of ignition during tank cleaning may be heat produced by tools and equipment. Heat may be caused by such operations as cutting, riveting, welding, scraping, chipping, and sand-blasting.

Toxic Liquids, Vapors, and Dusts

12. The cleaning of tanks containing gasoline that has been treated with tetraethyl lead should be given special consideration. Tetraethyl lead is toxic when it enters the body, and it may enter the body through inhalation of vapors or dust, through skin contact, or by way of dirty hands into the mouth.

13. All tanks which have been used for the blending or storage of gasoline treated with tetraethyl lead should be considered as a source of lead hazard throughout the cleaning process, regardless of whether they have been freed of vapors.

14. Poor health, colds, overheating, fatigue, or lowered physical resistance from any source accentuates the above hazards to workmen.

15. Vapor from gasoline, if breathed in strong concentrations, produces an excitement stage leading to unconsciousness, a reaction similar to that produced by ether or chloroform. Rest and fresh air may correct this condition within a few hours, but all physical reactions resulting from gasoline

16. Atmosphere (air) within a tank which registers within the "unsafe range" (more than 14 per cent to 20 per cent of the lower explosive limit) on the vapor indicator is considered unsafe for breathing even for a short period of time.

Oxygen Deficiency

17. Normal air contains about 21 per cent oxygen. Air which contains less than 16 per cent oxygen may not long sustain life. Tanks which contain high concentrations of gasoline vapor are also deficient in oxygen. Air within a closed tank, even though it has been cleaned previously, may have become deficient in oxygen due to rusting (oxidization) of the metal of the tank. To avoid suffocation, employees should not enter such a tank without fresh-air masks, until it has been ventilated thoroughly.

Other Sources of Injury

18. In addition to injuries resulting from fires or explosions, toxic conditions or asphyxiation, employees may receive injuries from other causes.

Some are:

- (a) Failure to use personal protective equipment.
- (b) Failure of protective equipment.
- (c) A discharge of steam or gasoline into a tank while employees are at work.
- (d) Dropping of swing line.
- (e) Objects dropped or falling from upper part of tank.
- (f) Employees falling from scaffolding, stairways, or ladders.
- (g) Employees falling from or through roof of tank.
- (h) Tripping over hose lines, or other objects.
- (i) Slipping on tank floors.

- (l) Structural failure of tank or its appurtenances.
- (m) Failure to use goggles during riveting, or during cutting of rivets, scale scraping, sand-blasting, spreading of sawdust, and the like.
- (n) Insufficient light.

CLEANING METHODS

19. By planning and vigilance, employees engaged in the cleaning of gasoline-storage tanks may avoid accidental injury or property damage resulting from fire or explosion, from the presence of gasoline vapors, from a deficiency of oxygen, from the presence of toxic materials, or from the misuse of equipment.

20. The removal of vapors and the elimination of fire and explosion sources are extremely important. If impractical to remove the vapors, protective equipment and extreme precautionary measures should be applied.

21. Tanks which have contained gasoline treated with tetraethyl lead and have not been thoroughly cleaned should be entered only by a person wearing a blower-type or positive-pressure airline hose mask. This applies not only to tank cleaners, but to all others who go into the tank for any purpose.

22. Inspection of each tank by a competent person, coupled with a definite training program for the tank-cleaning personnel, reduces the chance of injury resulting from poor judgment, error, and misuse of equipment.

23. The supervisor of the tank-cleaning operation should ascertain how long the tank has been in service, the approximate amount of gasoline and sediment in the tank, and the physical condition of the tank itself. He should determine whether it is necessary to gas-free the tank or if the tank should be cleaned with vapor present.

24. Sources of ignition should be removed from the surrounding area. Consideration should be given to wind and weather conditions. Work should not be

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could create a hazard. Work should not be started if an electrical storm is threatening or in progress. Matches should not be carried.

Cleaning Tanks - Not Vapor-free

25. At small bulk-marketing plants facilities for cleaning gasoline-storage tanks are very limited. In many locations water is not available for floating out gasoline or for washing the tank walls; also the disposal problem may create difficulties. The cleaning may only require the removal of a small amount of rust or scale from the bottom of the tank. In such cases it may be more practicable to clean the tank without removing the vapors. There is also a method of cleaning without emptying the tank of product. This consists of taking suction on product and sediment at the bottom of the tank, circulating through a filter, and returning the cleaned product to the tank. Cleaning a tank without first removing the product and vapor calls for extreme precaution and full knowledge of proper procedure.

26. The tank should be pumped out or drained of gasoline to the lowest possible point. A thorough inspection of the area surrounding the tank should be made to remove all possible sources of ignition.

27. If the tank is equipped with a bottom manhole, employees equipped with rubber gloves and rubber boots, fresh-air hose masks, life lines, and proper clothing (in the event the tank has contained leaded gasoline) may enter the tank through the manhole (with suitable scrapers, brooms, shovels, buckets, and the like) and complete the job in as short a time as possible. Employees within the tank should be under constant observation from the outside, and sufficient help should be available for rescue work in case of emergency.

28. If the tank has only a top manhole, a ladder is placed in the manhole and securely braced. Employees equipped as in paragraph 27 above enter the tank and complete the work.

29. Employees removing manhole covers and working near open manholes should keep on the windward side, and should avoid breathing any vapors which may issue from the tank.

30. In some cases when there is little sediment, the tank may be cleaned by directing a stream of water from a hose through the manhole, and pumping out or draining. As in all other cases, the usual precautions should be taken to keep ignition sources away from the vicinity of the tank. The water hose nozzles should be bonded to the tank to eliminate danger from static electricity.

Cleaning Tanks - Vapor-free

31. If a gasoline tank is to be placed in other service, or if considerable sediment or scale is present, or if extensive repairs are required, the tank should be made vapor-free. This is done by pumping or draining out as much of the gasoline as possible, disconnecting and blanking all gasoline lines, and then ventilating, steaming, or washing the tank until it tests free of vapor. (See paragraphs 40 through 43.)

32. Filling and discharge lines should be disconnected at a point near the tank. A blind flange should be placed over the ends of the disconnected lines so that vapors or gasoline cannot issue from these lines during the cleaning. To isolate the tank, a flanged fitting or valve may be removed from a pipe line. If this is done, both flanges at the point of removal should be blanked off. The flange blanks should be of sufficient thickness to withstand any pressure to which they might be subjected.

Steaming and Ventilating

33. If steam is used to heat the tank, the top manholes should be left closed and the steam should be introduced through a bottom manhole or other connection. Pressure and vacuum vents should be in operating condition or open.

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34. Tests show that a saturation of not less than 40 per cent of steam by volume is required to make the vapor-freeing effective. This should raise the temperature in the tank to approximately 170 deg. F. The amount of steam required depends upon the size of the tank, outside temperature, and the quantity of sludge or sediment present. Alternate heating and cooling causes a tank to "breathe," and thus aids ventilation.

35. Steam entering a tank may generate static electricity and, consequently, may be a source of danger. To reduce this possibility to a minimum, steam should enter the tank at low velocity, and steam and water lines should be bonded to the tank.

36. When the tank has been heated with steam to the highest practicable temperature, the steam should be shut off, and the top and bottom manhole covers should be removed. Air will enter through these openings, and the cooling of the tank will induce an internal circulation and air ventilation.

37. Ordinary ventilation may be used instead of steaming to remove tank vapors. In this case the top and bottom manhole covers should be removed and air allowed to circulate freely through the tank. Ventilation may be accelerated by the use of a wind sail, an eductor-type air mover, a mechanical blower, or other similar device. A fan is most effective for ventilating if used to exhaust vapor from the tank and not to blow fresh air into it. Air movers or fans can be actuated with compressed air, steam, or electric current. If an electric blower is used, it should be of the explosion-resisting type.

38. Local conditions should be considered in determining the position of tank-ventilating equipment. Vapors issuing from the tank should be directed away from possible ignition sources, and in such a manner as to secure the greatest possible diffusion. If a tank is enclosed within a high fire wall, or if there are other possible vapor traps in the vicinity, it may be desirable to exhaust the vapor from a top manhole.

39. Vapor may be present as long as gasoline, sediment, or sludge, remains within the tank. For this reason it is desirable to continue forced ventilation, regardless of vapor tests, until all such material has been removed completely.

Testing for Vapor

40. Tests for vapor are made with a combustible vapor indicator. The person making tests should be thoroughly instructed in handling and reading the indicator instruments. Tests should be made at various points within the tank.

41. Any person entering the tank to make vapor tests should be equipped with a fresh-air hose mask and a life line. He should be under constant observation by one man, and sufficient help should be available to remove him from the tank should he be overcome.

42. Employees may enter the tank without respiratory equipment and remove sediment and scale if the vapor indicator registers within the safe range (less than 14 per cent to 20 per cent of the lower explosive limit). Vapor tests should be repeated at frequent intervals; and, if the indicator shows the presence of vapors within the unsafe range, the employees should leave the tank and not re-enter until it is again gas-free or until they are equipped with fresh-air masks.

43. If the tank has contained leaded gasoline at any time since a previous thorough cleaning, fresh-air masks should be worn until all sediment and sludge have been removed and the bottom, sides, and appurtenances have been completely cleaned of scale and clinging particles, regardless of whether the tank is gas-free.

Disposal of Sludge and Sediment

44. Sludge and sediment from tanks that have contained gasoline treated with tetraethyl lead are dangerous to handle, even after they have been

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where they will not be uncovered later.

45. The tank should be swept, and any pools of liquid mopped up. Sawdust or rags may be spread on the tank bottom to absorb the moisture. Any absorbent material used in the mopping-up process should be buried with the sludge.

Repairs

46. If cold repair work is done on a tank and any dust is present, an approved dust respirator or a fresh-air mask may be worn. Dust may be prevented by the wetting down of the inside tank surface. If possible, no such repair work should be done until the tank has been cleaned thoroughly.

47. If repairs involving hot work (welding) are to be made, close attention should be given to every possible source of vapor, even though tests show the tank to be vapor-free. Wooden roof supports may be ignited easily, vapor may enter through leaks in the floor, or vapor pockets may exist in hollow roof-support columns. Wooden columns may be covered with metal sheathing to protect them from sparks.

48. Welding and other hot work in tanks that have contained leaded gasoline should never be done until such tanks have been cleaned thoroughly and all areas that may get hot are down to clean metal.

Personal Protection

49. Acid-resisting gloves and rubber boots should be worn by all tank cleaners.

50. In tanks that have contained leaded gasoline, all employees should wear clean clothing, from the skin out, in addition to gloves and rubber boots. Clothing should be changed (and laundered) and a bath taken every day, either at the end of the day's work or when the job is finished. If at any time clothing gets soaked with sludge, the employee should bathe at once and put on clean

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51. Tools and equipment should be cleaned thoroughly at the end of each day and immediately after a job has been completed.

Masks

52. Fresh-air hose masks, supplied with air by a blower or positive-pressure, should be used by tank cleaners. Canister masks are not recommended for tank-cleaning work inasmuch as they will not properly protect against high concentrations of vapors or oxygen deficiencies.

53. Connections on fresh-air hoses should be inspected frequently and tightened wherever and whenever necessary. Pulling or twisting of hose may loosen the connections while the hose is in use.

54. Hoses for fresh-air masks have a limited life. If an employee notices any odor (as of gasoline) while wearing a mask, he should leave the tank at once and find the cause or get a new hose line.

55. The air blower or hose intake should be placed to windward of the tank opening, so that only fresh uncontaminated air will be supplied to employees.

56. The man operating the blower should stick to his job at all costs, and keep an air supply going to the masks until all persons so equipped are out of the tank and have removed their face pieces.

57. Hoses should be washed with water and should be thoroughly cleaned and dried for storage between jobs.

58. Under no circumstances should an employee remove his mask while he is within the tank.

59. In order to secure a tight fit of the mask or face piece, the user may remove, if necessary, his hat or cap. It is essential that such articles as tobacco and chewing gum be removed from his mouth. After the face piece has been adjusted and tightened, it should be tested for leaks. This is accomplished by bending or crimping the breathing tube and inhaling against the closed tube

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60. Face pieces should be cleaned frequently with soap and water.

61. After each job all parts of masks, including the harness and life lines, should be washed and dried to prevent deterioration and to be ready for re-use. Any repairs or replacement should be made as soon as their need is detected.

Miscellaneous

62. Goggles should be worn during the scraping of scale, cutting of rivets, spreading of sawdust, sand-blasting, and the like, unless the employee is wearing a hose mask. Goggles should be cleaned and sterilized at the end of each job.

63. Clothing, if wet or moistened with gasoline, will irritate the skin and may cause serious discomfort. Vapor also will be given off from clothing which is wet or damp with gasoline, and offers a serious hazard from fire. For these reasons clothing on which gasoline has been spilled should be removed at once, and the skin washed with soap and water.

64. If the hands are frequently wet with gasoline and it is not practicable to wear rubber gloves, the hands may be coated with mutton tallow (anhydrous lanolin).

65. Two or more members of a tank-cleaning crew should know how to perform artificial respiration and ordinary first aid.

66. A tank owner who does not have proper cleaning equipment nor personnel informed on tank-cleaning operations should consult the head of the service department of his gasoline supplier. The Ethyl Gasoline Corporation also supplies a free consulting service for the cleaning of leaded-gasoline tanks. Tank-cleaning contractors who have all the necessary equipment, including experienced crews, can be found in many locations.

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