





Some Notes on TANK CLEANING METHODS and Procedure for Tanks which have contained LEADED GASOLINE

1. INTRODUCTION

(a) Object

This booklet has been prepared with the object of creating a better understanding of the lead hazards, as distinct from other hazards, encountered in the cleaning of storage tanks which have contained leaded gasoline.

Regulations governing the cleaning, scaling and repairing of tanks which have contained leaded gasoline have been issued by The Associated Ethyl Co. Ltd, and these regulations must be read in conjunction with the subject matter of this booklet.

(b) Nature and Source of Hazard

Organic compounds of lead, whether in liquid, solid or vapour form are highly poisonous.

Tetraethyl lead is an important example of this type of compound. It can be absorbed into the human system either by the inhalation of its vapour, by skin contact, or through the mouth, with serious or even fatal results.

It should be realized that the nature and symptoms of organic lead poisoning are quite different from inorganic lead poisoning or plumbism. As an example, a tumblerful of tetraethyl lead completely evaporated in a 4,000 ton storage tank will produce an atmosphere which may be fatal after an hour's exposure.

After removal of the gasoline from a tank which is to be cleaned, the main dangers to persons entering the tank arise from:

- (i) Sludge on the tank bottom;
- (ii) Rust scale on the inside surfaces; and
- (iii) Residual gasoline vapours.

(i) During storage of lead-treated gasoline, small quantities of organic lead are deposited on the bottom of the tank and remain in suspension in the sludge on the tank bottom. This sludge will vary in depth according to the amount of water present and the degree of irregularity of the tank bottom, and will consist generally of water, rust and scale, tetraethyl lead and its

decomposition products. Any agitation of the sludge can increase the volatilization of lead compounds and thus make the air in the tank dangerous to breathe. Sludge which has been removed from a tank is still dangerous to handle, even when wet, and precautions must be taken to avoid exposure to vapours emanating from it.

(ii) Rust scale on the inside surfaces of a tank contains traces of lead, and inhalation of dust from this scale must be avoided.

(iii) The residual vapours in the tank are both asphyxiating and poisonous and should not be breathed in any circumstances.

Any tank which has at any time contained leaded gasoline, and has not been thoroughly cleaned thereafter, may present serious danger of lead exposure, irrespective of size and type of tank, frequency of cleaning, geographical location, length of service, etc. If the tank is not thoroughly cleaned this danger will persist even if a different product, such as fuel oil, is subsequently stored.

Even when all sludge and loose scale have been removed, and the tank has been thoroughly ventilated and gas-freed, a hazard still remains, namely that repair work, involving the application of heat, may result in the volatilization of lead compounds still present on the surface of the metal and particularly in hidden crevices.

2. RESPONSIBILITY

It is recommended that the Chief Engineer be responsible for the whole tank cleaning operation, and no work should be commenced without his written authority and instructions.

3. PLANNING THE WORK

The whole operation should be planned by the Chief Engineer who should satisfy himself on the following points:

(a) Method of Cleaning

Certain alternative methods for the removal of sludge will be described later, and the decision

as to which will be employed must be based on conditions at the site, equipment available and the allowable time during which the tank may be out of service.

(b) Selection of Workmen

A competent foreman, familiar with the regulations and understanding the hazards involved, should first be chosen. He must then satisfy himself that each man in the tank cleaning crew has read and understood the regulations.

(c) Medical Examination

Experience has shown that certain diseases and disabilities can make the wearing of protective equipment unduly onerous. It is recommended, therefore, that before being selected for tank cleaning, workmen be medically examined to ensure that they are in good health and not suffering from any disability which might seriously interfere with their work. If this be done, and the proper precautions observed, there will be no injury to health from the lead hazard during tank cleaning. As a general precaution, no man who has a perforated ear-drum should be employed in a tank which has not been completely gas-freed, as it is possible for a person so afflicted to breathe gasoline vapours through the ears.

(d) Clothing and Protective Equipment

All protective clothing and safety equipment must be carefully inspected by the foreman, who must satisfy himself that it is in first-class condition before work commences.

The tank should not be entered (even for a short period) until it has been thoroughly ventilated and all residual vapours and sludge removed, unless the person concerned is adequately protected against skin contact with the sludge, and has an air supply which is completely independent of the air in the tank. This can only be assured by:

- (i) Wearing protective clothing as set out in Section I.A. of the Associated Ethyl Company's Tank Cleaning Regulations; and
- (ii) Using a positive-pressure full face-piece air-line mask with hoses and blower.

Men so equipped should see that they have a clear path of escape in the event of an accident

or damage to their breathing apparatus. They should make a mental note of any mechanical hazards which exist, such as roof supports, and should immediately tell the foreman if they become affected by heat or other cause. If, at any time during the cleaning operations their clothing becomes soaked with sludge, they must immediately leave the tank, bathe and put on clean clothes.

Hoses for air masks have a limited life. They should always be tested before use. If, while testing, or later when in use in a tank, a distinctive odour, such as gasoline, is detected, the user should leave the tank at once and find the cause and remedy it, or get a new hose. Hose connections should have gaskets and all fittings should be tested to withstand, without damage or leaking, any twisting or flexing strains which can be expected when dragging hoses inside a tank.

The intake of the air blower should be placed to windward of the tank opening so that only fresh uncontaminated air will be supplied to the men inside the tank.

(e) Mechanical Equipment

All equipment which will be required for the work, such as fire hoses, fire pumps, sludge pumps, ejectors and hand tools should be examined by the foreman who should satisfy himself that all mechanical equipment is in good running order before work commences.

(f) Provision of Sludge Pits

The foreman should see that suitable pits for the burial of sludge, rust and scale are provided. They should be of sufficient capacity to take all the material removed from the tank and should be located where they are not likely to be disturbed at a later date.

Authority to commence work inside the tank should not be given by the Chief Engineer until all the above considerations have been satisfied.

4. MANHOLE COVERS

The job of removing the manhole covers from a tank which is about to be cleaned, can present a significant hazard due to the escape of lead and gasoline vapours through the openings. It is important, therefore, that the men undertaking this work be protected against

these vapours while they are close to the manholes. Canister masks, such as used in "Ethyl" fluid mixing plants will give sufficient protection in this regard, *provided the men do not enter the tank or put their heads through the manholes.*

If it is decided to ventilate the tank at this stage reference should be made to Section 7 where methods of ventilation are described.

5. REMOVAL OF SLUDGE

There are several ways of removing sludge from a tank, and the foreman should be fully instructed in the method to be employed.

(a) Facilities at Tank

The experience of some companies is that substantial saving in time and much greater convenience in cleaning tanks can be effected by removing one complete plate from the bottom strake of the tank, thus leaving a large opening through which sludge can be flushed by means of high-pressure water hoses. This method has the advantage of easy entry and exit, better light and ventilation, and almost eliminates the need to handle the sludge. However, before adopting this method, the tank design should be investigated to see that the structure is not weakened by the removal of a plate. Fig. 1 shows the opening provided when a plate has been removed in this way. Figs 2 and 3 illustrate the added convenience and improved illumination.

The ideal type of tank from the cleaning point of view is one with an opening or drain at the lowest point in the tank bottom, but even in the case of tanks to which such outlets have been fitted, the advantages to be gained by removing one or more of the plates from the bottom strake would fully justify this procedure.

Obviously, the best time to fit a drainage outlet is during the construction of the tank, but it is possible to install a similar drain as a field modification to an existing tank, as shown in Fig. 4. Once such a drain has been fitted, the greater part of the sludge and loose scale can be removed before entering, thus greatly reducing the lead hazard. Where there is no suitable drainage outlet from the tank, the use of a portable pump or an ejector is desirable for removing the bulk of the sludge, in order to reduce the length of time that the men would have to

remain in the tank. When a pump is used for this work, care should be taken subsequently, to clean all parts contaminated by sludge. When an ejector is used, large quantities of water are required, but this has the advantage of reducing the lead concentration in the effluent which, after passing through an interceptor, can be discharged into any convenient drainage system.

(b) Water Flushing Method

The safest way to remove sludge from a tank is to do the work entirely from the outside; no person actually entering the tank until the sludge and loose scale have been removed. In many cases this can be done and, when carried out effectively, it has the advantage of reducing to a large extent the risk of exposure to lead for the men concerned. The water flushing method necessitates the use of high pressure water (80—100 p.s.i.), fire hoses, and a suitable pump or ejector for removing the sludge and water from the tank. (Where there is a clean-out sump or bottom drain in the tank no pump or ejector is required). A suitable ejector is illustrated in Fig. 5.

The water is directed through the manholes to flush the rigging, walls, and floor. At the same time, the pump or ejector is operated to draw out the water-sludge mixture. The process of flushing and ejecting is continued until all possible loose material has been removed from the tank. Usually this takes from one to six hours, depending upon the size of the tank and the amount and nature of the sludge, but in general, the flushing is continued until the water leaving the tank is as clean as the in-going water.

If the men operating the hoses from outside the tank detect gasoline or other vapours they should immediately put on their gas-masks.

With large tanks, it may be necessary for men wearing air-line masks to enter in order to direct the hoses so as to remove sludge from certain areas difficult of access. In such cases, it is preferable to remove as much as possible of the sludge and loose material by operating the hoses from the outside before sending men in to complete the flushing operation. This has the benefit of proportionately reducing the lead hazard.

The sludge should be discharged into a drain leading to a previously prepared pit of sufficient capacity to hold all the sludge in the tank. A

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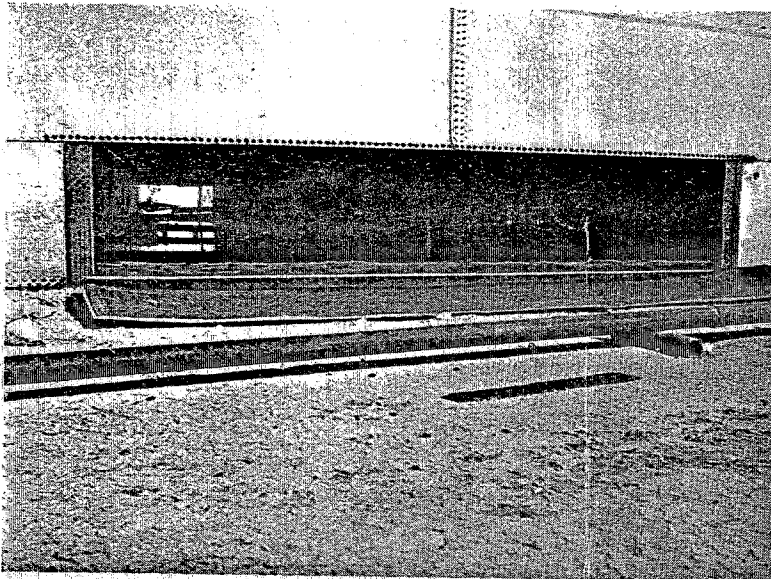


Fig. 1

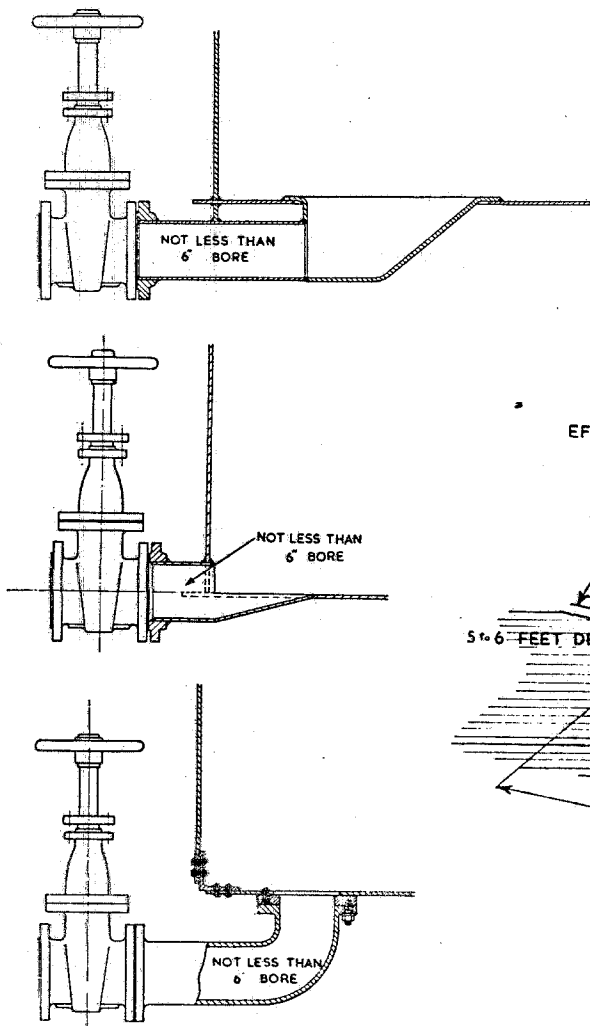


Fig. 4. Alternative drainage outlets

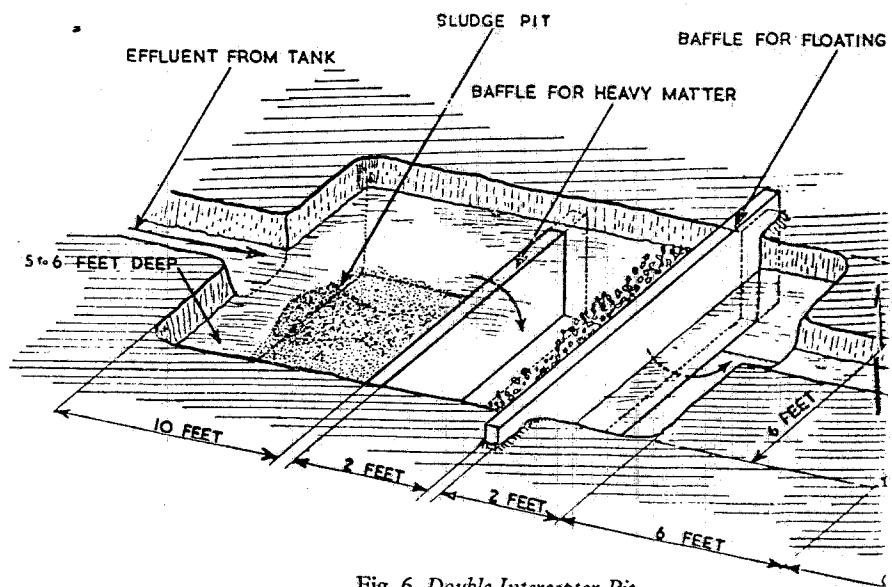


Fig. 6. Double Interceptor Pit

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Fig. 2

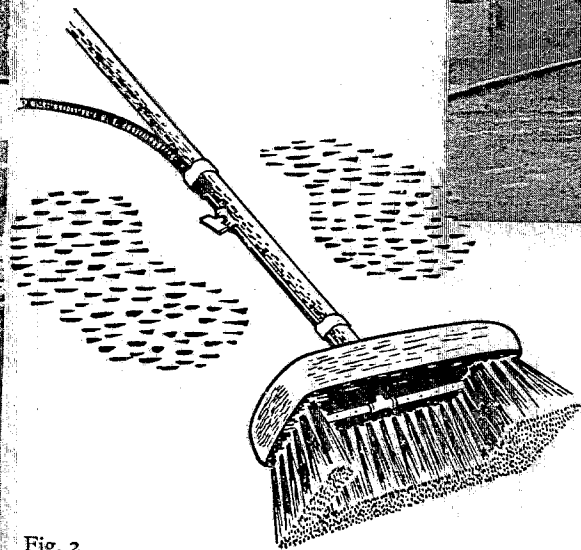


Fig. 7. Broom with water connection

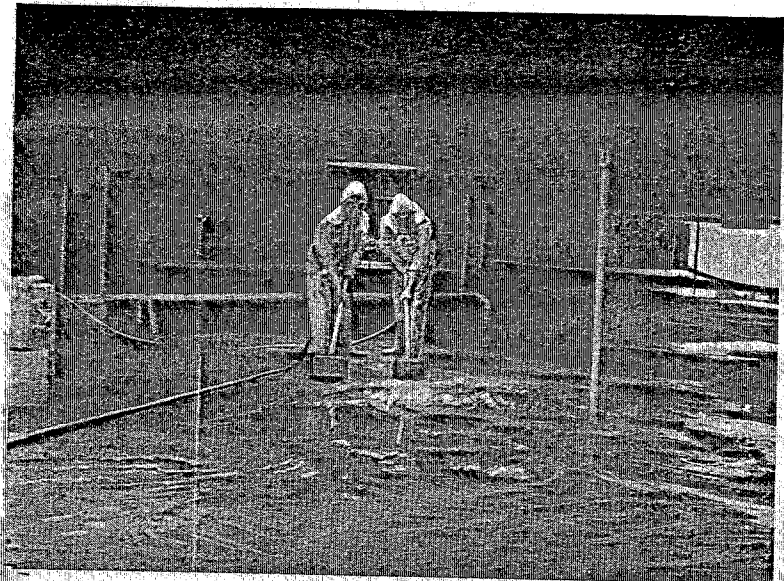


Fig. 3

E FOR FLOATING MATTER

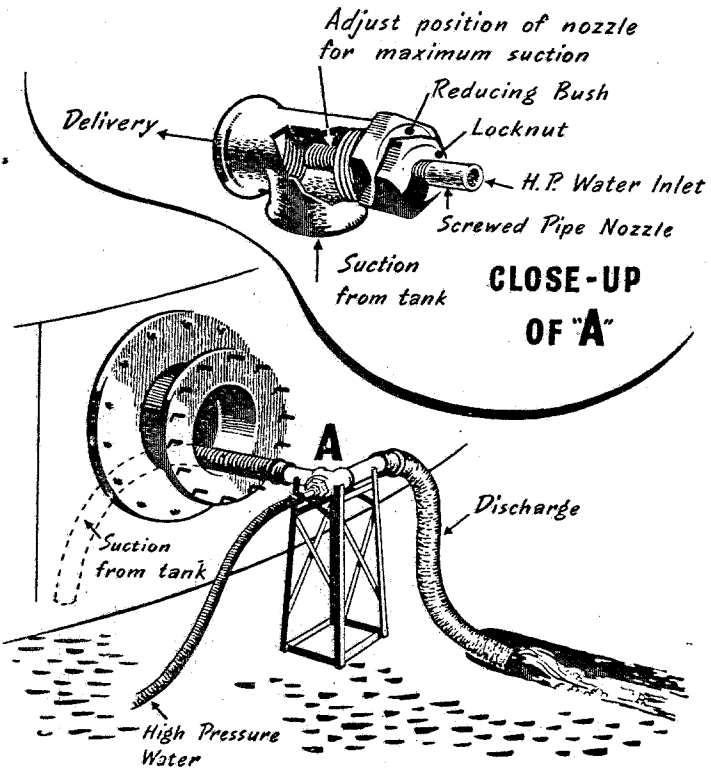
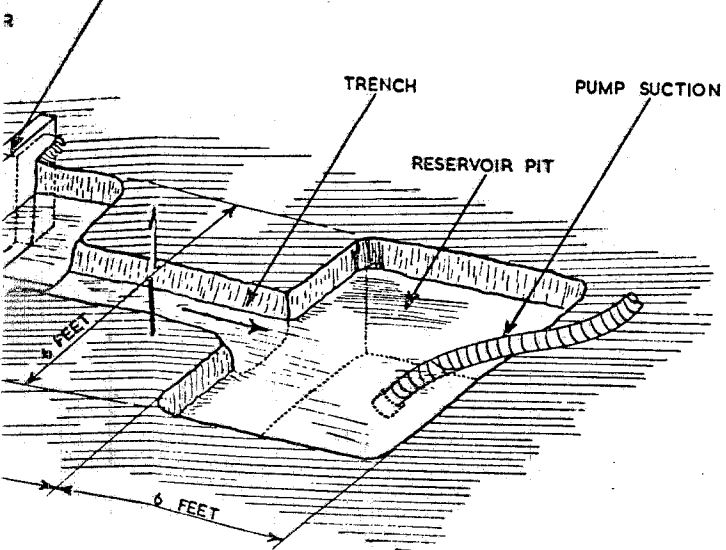


Fig. 5. Water-sludge ejector

drain should be led from the pit to carry away the surplus water used in flushing. When this operation has been completed the sludge-pit should be filled in and its location marked, to ensure that the buried sludge will not subsequently be disturbed. Sufficient time should be allowed for all surplus water to percolate away before the sludge-pit is backfilled. A minimum earth cover of three feet should be allowed. In certain cases it may be possible to flush the sludge and water through a drain into the sea, but this will depend upon local regulations regarding disposal of effluents from factories and plants.

The foregoing is a general procedure for tank cleaning which will involve the men in the absolute minimum of exposure to toxic vapours, but necessitates the use of a large quantity of water to flush out the sludge. In certain cases it is not practical to have a large volume of water running to waste, because either there is insufficient water available, or the tank bottoms are so close to the natural ground water-level that there is inadequate drainage. In such cases it is still possible to use the flushing method by constructing a double interceptor pit consisting of two pits or holes connected by a trench as shown in Fig. 6. A baffle should be so placed that any gasoline or oily substances floating on the surface of the water will be prevented from passing between the two pits while still permitting the flow of water from one pit to the other. Another baffle to prevent solid materials passing between the pits will also be required.

The first pit is used as the depository for the effluent from the tank, and the second as a water reservoir. A portable high-pressure pumping unit (such as a fire pump) is required, taking its suction from the reservoir pit, and delivering water to the fire hoses used for flushing the tank interior. It is desirable for the water in the reservoir pit to be as free as possible of suspended matter. The size and type of construction of the pits are governed by the capacity of the tank and the conditions at the site.

(c) Cleaning Without the Use of Water

Where there is no water available for flushing the tank interior it is desirable to pump out as much sludge as possible before men enter the tank to remove the remainder. Brooms, buckets, and possibly a rubber squeegee should then be used to dry up any sludge remaining in pools

caused by the irregularity of the tank bottom. Only non-ferrous equipment should be used for this work, to avoid the danger of explosion. During this cleaning operation every person entering the tank must be equipped with a positive-pressure full face-piece air-line mask and protective clothing, as set out under Section 1A of the Regulations. After the removal of all non-adherent lead deposits and sludge the tank should be gas-freed before commencing any repair or painting operations. If, however, the tank has been cleaned merely for the purpose of changing products, it should not be necessary to proceed further than the elimination of the sludge and non-adherent material on the tank bottom.

(d) Supervision

There is a need for constant supervision by the foreman of all cleaning operations to ensure that men do not remove their air-line masks while inside the tank. These masks can undoubtedly become most uncomfortable, especially at high temperatures. Each face-piece should be thoroughly tested to make certain that only the air from the blower can be breathed. Due to the possibility of the presence of gasoline fumes and air deficient in oxygen, canister masks must never be used in a storage tank which has not been thoroughly cleaned and ventilated.

Supervision is also necessary to ensure that the men engaged on work in leaded gasoline tanks change their clothes and wash before taking any meals, as laid down in Section 1A of the Regulations.

6. DISPOSAL OF SLUDGE

If the tank is cleaned by the water flushing method the sludge will be discharged direct into a pit as already described. Where there is no water available for this method, the sludge must be removed in buckets, or, if a plate has been removed, wheelbarrows may be used for this purpose. All men handling sludge in this manner outside the tank should be equipped with canister type gas-masks until such time as the sludge pit has been back-filled.

The pit should then be marked with a notice, warning that lead sludge has been buried and should not be disturbed. The notice should be numbered and dated to correspond with the point recorded on a map of the installation.

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9. DECONTAMINATION OF AREA AND EQUIPMENT

Upon the completion of the work of removing sludge, rust and scale the foreman should satisfy himself that the following final precautions are observed:

(a) Burial of Sludge

Each sludge pit should be inspected to see that it has been properly back-filled, and that the lead hazard has been completely eliminated. The warning notices should be in place and a record made of the location of the pits. Any area around the tank which has been contaminated should be dug over and the contaminated earth buried.

(b) Mechanical Equipment and Tools

Care should be taken to see that all tools are removed from the tank. These, and any mechanical equipment used, should be thoroughly cleaned before being stored.

(c) Clothing and Protective Equipment

All clothing should be collected and washed at the end of each day's work and at the completion of the job. All rubber equipment, air-line hoses, face-pieces, boots and gloves should be washed and dried immediately after use.

(d) Bathing

All men should change their clothes and bathe at the end of each day's work and when the job is finished.

10. REPAIR OPERATIONS

For the purpose of this booklet, repair operations inside storage tanks, fall within two categories:

- (a) Those which can be undertaken cold;
- (b) Those which involve welding, hot riveting or any operation whereby heat is applied.

(a) Cold repair work inside a tank may create dust, and for this reason the provisions as set out under Paragraph VIII "Removal of rust and scale" are applicable.

(b) For repairs involving hot work, it is important that the parts to be repaired, as well as the areas around those parts which may be heated, be cleaned down to bare metal. The reason for this is that welding, or other hot work, may volatilize solid lead compounds present on the surface of the metal, and thus create a lead hazard.

Tanks which have leaking floor plates must be treated with special care. Any sludge or gasoline which has seeped through the floor into the ground beneath, can be a source of great danger. It is impossible to gas-free the tank and eliminate the lead hazard completely in these cases and, therefore, it is absolutely essential for the men carrying out repair operations to be fully equipped with protective clothing and air-line masks. Until the floor has been repaired it will not be safe for men to enter the tank without wearing protective equipment.