UC 149-2

UNION CARBIDE

INTERNAL CORRESPONDENCE

CHEMICALS AND PLASTICS • SOUTH CHARLESTON PLANT [illegible] SOUTH CHARLESTON, W. VA.

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Subject Proposed Work Practice for Control of VCM Fugitive Emissions

Attached is the beginning of a Proposed Work Practice for Control of VCM Fugitive Emissions. The following sections are rough outlined and need authorship:

IX. Maintenance of Equipment

X. Sampling

XI. Detection of Leaks

Volunteers will be cheerfully accepted. Comments and changes to the other pieces are also acceptable.

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RNWJr./pm
Attachment

ENVIRONMENTAL PROTECTION WORK PRACTICE ~~STANDARD~~ GUIDELINE FOR THE CONTROL OF FUGITIVE EMISSIONS IN THE MANUFACTURE OF VINYL CHLORIDE AND POLYVINYL CHLORIDE

I. Scope and Application

This standard applies to process piping and equipment in vinyl ~~chloride~~ service used for the manufacture of vinyl chloride or polyvinyl chloride.

II. Purpose

The purpose of this work practice is to establish standards and procedures which will substantially eliminate fugitive emissions from equipment and piping in vinyl chloride service.

III. Definitions

(a) "Fugitive emissions" are emissions for which which are unaccounted for in all other source estimates and data is not available to rigorously estimate the magnitude of these emissions.

(b) "Vinyl chloride plant" includes any plant which produces vinyl chloride by any process.

(c) "Polyvinyl chloride plant" includes any plant where vinyl chloride alone or in combination with other materials is polymerized.

(d) "Slip gauge" means a gauge which has a probe that moves through the gas/liquid interface in a storage or transfer vessel and indicates the level of vinyl chloride in the vessel by the physical state of the material the gauge discharges.

(e) "Inprocess wastewater" means any water which, during manufacturing or processing, comes into direct contact with vinyl chloride or polyvinyl chloride or results from the production or use of any raw material, intermediate product, finished product, by-product, or waste product containing vinyl chloride or polyvinyl chloride but which has not been discharged to a wastewater treatment process or discharged untreated as wastewater.

Here in concentrator this def - excludes latex

(f) "In vinyl chloride service" means that a piece of equipment contains or contacts either a liquid that is at least ten percent by weight vinyl chloride or a gas that is at least ten percent by volume vinyl chloride.

IV. Engineering Controls

A. General

1. Process equipment and piping shall meet or be equivalent to the following consensus standards.

   a. Pressure Vessels (>15 psig) - ASME Boiler and Pressure Vessel Code Section VIII Division I.

   b. Pressure Vessels (<15 psig) - American Petroleum Institute 620 - Rules for Design and Construction of Large Welded Low Pressure Storage Tanks.

   c. Atmospheric Pressure Vessels - API 650 Rules for Design and Construction of Welded Steel Tanks for Oil Storage.

   d. Process Piping - American National Standards Institute, Code for Pressure Piping A.N.S.I. B 31.3 Petroleum and Chemical Plant Piping.

2. Process Instrumentation and computer systems shall have alternative or standby power sources that will either permit ~~continued~~ operation or a deliberate shutdown if utility supplies are interrupted.

3. Critical equipment for control or prevention of process emergencies shall remain operative under known emergency conditions.

4. Materials of construction considered hazardous for equipment in vinyl chloride service are copper, zinc, aluminum and alloys containing major fractions of these materials. These should be avoided in construction or maintenance. Most elastomers swell and lose strength in vinyl chloride service; therefore, materials for gasketing or packaging should be selected carefully based on experience or testing.

5. Process equipment and piping layout should permit ready access to valves, pumps, agitators, compressors, relief devices and vents so they may be easily inspected and repaired. The layout should also provide for isolation and vinyl chloride removal from equipment and piping requiring maintenance or inspection.

V. Bulk Shipping Container Loading or Unloading

A. Regulations by Other Agencies - This work practice is intended to supplement other regulations and to minimize vinyl chloride emissions or to eliminate potential emissions. There is no intent to replace regulations by other agencies.

B. General

1. Unloading or loading facilities shall be maintained to minimize vinyl chloride emissions or to eliminate potential emissions. Items to be considered are:

(a) Open ended valves, pipes and hoses are to be blind flanged, blanked or plugged when equipment is in standby condition; i.e., not engaged in operations relating to loading or unloading.

(b) Known leaks or emissions shall be repaired promptly.

(c) Good preventive maintenance procedures shall be followed. For example, valves with packing glands followers that permit no further tightening shall have packing added or be repacked.

(d) Hoses, couplings and coupling gaskets shall be inspected prior to each use and such items showing wear or damage that may lead to vinyl chloride emissions replaced.

(e) Bulk containers in leaking or in known poor condition may not be loaded or unloaded unless there is reason to believe that such operations will lead to lower total atmospheric emissions than holding them for repair.

(f) Bulk containers equipped with slip gauges may be loaded only if an "alternate" gauging system is available or if the gauge is made to discharge into a "bull's eye" sighting device and the gas flowing out of the "bull's eye" is ducted to a suitable control device.

C. Loading

1. Empty containers shall be inspected and records consulted to certify the container is in good condition for loading and shipment. Containers with defects or needing repairs which may cause vinyl chloride emissions may not be loaded.

C. Loading (continued)

2. Gas contained in the empty containers may not contain more than 0.1% oxygen by volume. Containers without positive pressure in the shell should be pressurized with inert gas or vinyl chloride prior to sampling for oxygen. ???

3. Loaded containers shall be valved in and the loading line valves closed. The coupling assembly or hose shall be purged or stripped to a suitable control device until the hose or coupling assembly contains no more than 0.13 FT^3 of vinyl chloride gas at standard temperature and pressure.

4. The loading hoses and/or piping are removed.

5. The container vapor space is sampled and analyzed for oxygen content. If the vapor space contains more than 300 ppm by volume oxygen the container vapor space is purged to a suitable control device until analysis shows the oxygen in the container vapor space is less than 300 ppm.

6. All valved openings to the container shell are capped, blind flanged or plugged.

7. The space in and around the container loading dome are checked for leaks using an approved portable leak detector. If no leaks are found the container is approved for shipment. If leaks are found they must be repaired prior to shipment.

D. Unloading

1. Bulk containers shall be checked for leaks, gauged, and checked for excessive temperature or pressure promptly on receipt. If the shipment is not in "good order" the shipper should be consulted immediately and necessary action taken to handle the problem safely and to minimize potential atmospheric emissions of vinyl chloride. Shipments in "good order" shall be unloaded in normal rotation; i.e., oldest shipments first. FIRST IN - FIRST OUT

2. The plant storage tank level and pressure should be checked to insure the tank will hold the contents of the shipping container without being overfilled or overpressured.

3. With the container properly positioned and locked in place, remove caps or plugs from unloading valves and attach unloading hoses or piping. If container valves show evidence of leakage on removal of caps or plugs, report the faulty valves to the car owner or shipper.

C. Unloading (continued)

4. Unload the container. Check operation of pumps and/or compressors and adjust flow rates to eliminate excessive vibration or unusual noise. Such vibration or noise indicating cavitation may lead to or indicate impending seal failure on these items. A drop in unloading pump discharge pressure indicates the container is empty or the excess flow check on the shipping container has been activated. Shut down the unloading operation and check the storage tank level. If the storage tank level rise is equivalent to the contents of the container then initiate container stripping operations. If the storage tank level indicates the container is not empty then restart the unloading process.

5. Vendor's instructions regarding empty cars varies; however, in lieu of specific instructions pump the container pressure down to five psig with the unloading compressor and valve in the container. Continue to evacuate or purge the unloading hoses or piping until the vinyl chloride contained in the unloading hose or coupling assemble is not more than the permissable volume. Close in the hose or coupling with valves and shut down the unloading compressor.

6. Remove the unloading pipelines or hoses from the container.

7. Cap or plug all the container unloading valve openings.

VI. Rotary Pump, Agitator and Compressor Seals

General - Seals on rotary pumps, agitators and compressors in vinyl chloride service must not only minimize emissions to the air but they must also have an acceptable life expectancy and have safe guards to control hazards or failure. Items to consider in rotary seals are:

A. Selection of a seal type is defined by the EPA Vinyl Chloride Standard, the equipment to be sealed and the vendor who provides the best service. Seals are custom installations; therefore, there is generally no interchangeability of service or parts. The most important item in seal selection is the specification of proper materials of construction. Failure of the secondary static seal materials, i.e. "O" rings or soft packing, is a major cause of seal outage.

B. Installation of a seal involves these important criteria:

1. Lateral or axial movement of the shaft to be sealed should be less than 0.005 inches.

2. Radial movement of the shaft to be sealed should be less than 0.003 inches. Rotate the shaft with indicator attached to check for straightness. Proper balance of the rotor and shaft assembly is, of course, necessary.

3. Stuffing box face and bore should be checked for alignment and concentricity. Serious faults must be corrected.

4. Instructions from the seal vendor should be followed explicitly regarding the seal.

5. Seals being a precision item, are usually installed on the equipment item in a machine shop and unless the equipment is handled with care and not subjected to shock, to strains and to misalignment, the seal will be inoperative or irreparably damaged before it is placed in service.

6. The completed seal installation must provide for lubrication of the seal faces, cooling of the seal and for the addition of purge fluid on the withdrawal of leaking vinyl chloride to a control system.

C. Seal operation requires consideration of these items:

1. Accessory equipment noted in item B6 must be fully operational before the seal is operated.

2. Misalignment of the sealed equipment is to be avoided. Piping strains and temperature changes are particularly troublesome.

3. Excessive vibration arising from foreign matter lodged in the impellor, restricted suction ports, restricted discharge or impending bearing failure should be corrected promptly.

4. Seals on equipment in standby condition should be rotated by hand weekly or placed in service periodically.

5. Provision should be made to maintain lubricant or seal fluid pressures under all conditions; i.e., pressure tanks, accumulators or standby supply systems. Even a brief loss of this pressure will probably cause seal failure.

D. Monitoring seal performance is carried out in several fashions.

1. For systems with pressurized purge fluids evidence of excessive purge fluid flow via flow indicator or pressure tank level is adequate reason to repair the seal.

2. For systems where space between the seals is ducted to a control system, excessive flow indication is reason to repair the seal.

3. Preventive maintenance records are valuable tools in forecasting seal repairs.

4. Seal repair schedules based upon vinyl chloride leak detection in the ambient air is <u>not</u> recommended.

5. Canned or so called sealless pumps must have provision for monitoring the electrical side of the can for vinyl chloride gas. (A vent valve in the electrical conduit between the EYS fitting and the pump could provide access.)

VII. Reciprocating Pump and Compressor Seals

Seals on reciprocating pumps and compressors in vinyl chloride service must minimize emissions to the ambient air, require minimal maintenance and have an acceptable life expectancy. Items to consider in reciprocating pump and compressor seals are:

A. Selection of seal material should be based on experience and vendors recommendations. The material falls into three general categories; metallic packing for clean lubricated service such as compressors, soft packing for non-lubricated compressor glands and pumps and semi-metallic packing for severe service. All must be installed as specified in 40 CFR Part 61 Subpart F with pressurized sealing fluid between two seals or by ducting the between seal pressure to a control device.

B. Installation of reciprocating rod seals involves these criteria:

1. The reciprocating rod must be free of appreciable wear and move through the stuffing box with no evidence of misalignment or bending. To insure this situation bearings, pistons and cylinders must be well maintained.

2. Reciprocating rod mechanical packing is classified in three functional types as follows:

a. Floating packing includes piston rings and segmented rod packing. These rings or segments work in grooves, usually individual, and are energized by springs.

Metallic, carbon or other rigid rings are installed in two-ring sets in a packing case on a compressor. For purge gas systems the highest pressure is at the purge gas tap on the packing case; thus, the packing sets should be oriented pressure wise from that point and lubricant added here if required. Best service is obtained if the rod and packing are renewed simultaneously.

b. Automatic packing is fabricated in cup, flange, U cups, V ring and O ring shapes and is energized by the fluid pressure in the stuffing box. These packings are precision molded sets for each stuffing box application. For vinyl chloride service one set would be installed in the bottom of the stuffing box followed by a lantern ring. A second

set would then be installed under the gland follower. The pressure orientation of the bottom set would depend upon the sealing fluid and/or lubricant system. Venting the lantern ring to a control system and operating the packing without lubricant is not desirable. Automatic packing works extremely well when properly fitted on an unworn rod.

C. Compression packing consists of lubricated, braided or molded rings made up of fiber, graphite, plastic, metal or elastomers. A number of rings are placed in a stuffing box and the seal achieved by compressing the rings with the gland follower. The installation is similar to that described for automatic packing except the packing is installed by individual ring rather than a complete set. Two or three rings are put in the stuffing box followed by the lantern ring. Additional rings are placed on top the lantern ring and the whole compressed by the gland follower. Compression packing is widely used and very poorly understood. For critical vinyl chloride service precision cut, beveled rings should be used for each stuffing box, the reciprocating rod should be unworn and the lantern ring located at the purge fluid port. Operation of reciprocating rod seals is not greatly different than for rotary joint seals. Some items to be noted are:

1. Purge and/or lubricant systems must be fully operative when the equipment is in service.

2. Provision should be made to maintain purge and/or lubricant pressure under all emergency conditions. A brief loss of pressure will not cause failure unless there is reverse flow in the purge system.

3. Packing systems should be broken in carefully under the direction of a skilled person. Too much or too little gland pressure can shorten packing life considerably.

4. In vinyl chloride service compression and automatic packings should be completely replaced when failure is indicated.

D. Monitoring reciprocating seal performance is carried out as follows:

1. Systems with pressurized purge fluid systems having evidence of abnormal purge fluid flow should be repaired.

2. Systems with vent from seals to a control system should be repaired when vent flow is abnormal.

3. Floating packing systems, i.e., compressor rod packing should be overhauled at least annually.

4. Evidence of external VCM leakage should be taken as indication of need for emergency repair. It is also indicative of poor maintenance procedures in this critical service; i.e., good maintenance permits no detectable leaks.

VIII. Emergency Relief Devices

The possibilities of excess pressure development exists in every chemical process plant. It is important to understand how overpressure can develop, what may be the eventual results and equipment to control or to prevent excess pressure emergencies. Excessive pressure can develop from an explosion, a chemical reaction, positive displacement pumps and compressors, fire around the equipment, a controller malfunction or a host of other related and unrelated situations. In the case of vinyl chloride the requirement that emissions be eliminated or be minimized is an additional parameter to be considered.

Items in planning emergency relief systems are:

A. An integrated emergency plan that not only provides for each equipment item but also provides for protection of the entire plant. Emergency situations for each equipment item must be reviewed and the emergency relief devices selected to protect the equipment with a high degree of confidence. The relief devices must be installed so as not to endanger personnel or other equipment when they function. While this discussion is limited to emergency relief devices, control systems should be checked to be sure control valves assume a safe position when the power supply is interrupted. General rules for emergency relief devices are contained in the A.S.M.E. Boiler and Pressure Vessel Code Section VIII for unfired pressure vessels and Section I for power boilers. The A.P.I.'s Recommended Practice for the Design and Construction of Pressure-Relieving Systems in References is also a valuable reference.

B. Emergency relief devices are classified as follows:

1. Relief valves are automatic relieving devices actuated by the pressure upstream of the valve and which opens proportionately to the pressure in excess of the set pressure. These valves are found on liquid systems such as positive displacement pumps. If the valve bonnet is leak tight, the valve may relieve back into the process at a lower pressure point. The valve will probably not leak through at less than 90% of set pressure for steady conditions and 75% of set pressure for pulsing pressure.

2. Safety valves are automatic relieving devices actuated by the static pressure upstream of the valve and which opens fully when the set pressure is exceeded

Safety valves are used for steam, gas or vapor service. Safety valves should be operative at 90% or less of set pressure. Variations of this safety valve are:

a. Balanced valves as opposed to conventional valves are not seriously affected by variation in the back pressure.

b. Bellows sealed valves are used where the valve blows down into a closed system and bonnet leakage is undesirable.

c. Valve seats and disks may be hard faced and ground metal, a resilient O ring seat and metal disk or a combination of metal and resilient seat with metal discs. The single seat valves usually start leaking at 90% of set pressure while the combination seated valves do not leak until 95% of the set pressure is exceeded.

3. Rupture disks are then diaphragms (metal, nonmetallic or plastic) held between special flanges and designed to burst at a predetermined pressure. Each bursting requires the installation of a new disk. It is applicable to all steam, gas, vapor and liquid systems but is susceptible to premature failure from corrosion, metal fatigue and poor installation. Rupture disks in small sizes (less than four inches) do not perform reliably at set pressures below 50 psig. Types of rupture disks are:

a. Standard prebulged rupture disk with or without vacuum support. The bulge is in the direction of the vent. Standard disks should be operated at 70% or less of set pressure.

b. Reverse buckling rupture disk is bulged toward the pressure. On over pressure the reverse bulge snaps against knife edges to fracture the disk. These disks are more precise as to set pressure than the conventional and may be operated at 90% or less of set pressure.

c. Reverse buckling scored rupture disk is similar to "b" but contains no knife edges. The disk is prescored to insure rupture. This disk is precise on set pressure, may be operated at 90% or less of set pressure and imposes no obstructions in the vent line as is the case of the knife edges in "b".

4. Hand vent valves are an important part of the emergency relief system where polymerization reactions are involved. Judicious use of hand vents, particularly in anticipation of a problem, will avoid emergency situations or certainly reduce their severity.

   The Environmental Protection Agency has limited emergency relief devices in vinyl chloride service to the following systems:

   a. Safety relief valves that vent back to a lower pressure part of the process or to a vent control device.

   b. Safety relief valves with a rupture disk installed between the relief valve and the vessel to be relieved to the air.

   c. Safety relief valves with a combination metal and O ring sealed seat on vessels relieving to the air.

   d. Rupture disks along on vessels relieving to the air.

   e. Hand vent valves or reactors that vent to the air.

   For all relief devices except "e" it is desirable to have shut off valves in the system so that the automatic relief device may be serviced or be isolated in the event of a malfunction. Purge connections should be located between the shut off valve or valves and the safety device so that vinyl chloride pressure can be relieved to a control system prior to servicing the device.

   Monitoring for leaks and maintenance of relief devices should follow this general plan:

   a. Safety relief valves venting to process or to a vent control device require monitoring for external leakage each time the valve is serviced or piping is opened. Annual cleaning and testing of the valve is recommended.

   b. Safety relief valves in series with a rupture disk require monitoring for external leakage each time the valve is serviced, the rupture disk replaced or the piping is opened. In

addition, if the space between the relief valve and the rupture disk is vented to the air this vent must be monitored at least weekly. If the space is not vented then a pressure alarm system or a pressure check at least daily is needed. The relief valve should be cleaned, repaired and reset to bubble free at 85% of set pressure on an annual basis. The rupture disk should be replaced annually. If either or both are activated then immediate service is indicated.

C. Safety relief valves with combination metal and O ring sealed seats are to be monitored for external leaks each time the valve is serviced or the piping is opened. The relief valve is to be cleaned, repaired, O ring seals replaced and reset to bubble free at 90% of set pressure on an annual basis or whenever it is activated.

D. Rupture disks are to be replaced annually or whenever they burst, whichever date comes first. Rupture disks must be installed and the bolts torqued in strict compliance with the vendor's instructions.

E. Records of safety relief valve servicing and rupture disk replacement are to be maintained. Service intervals are to be adjusted, shortened or lengthened if the records justify the change.

F. Servicing a safety relief valve shall consist of a thorough cleaning, replacing corroded or worn parts, replacing gaskets and O rings, lapping the seat and disk if metal-to-metal seating is required, resetting the the valve set pressure using a precision gauge, reseating the disk and seat after popping and testing for leaks to bubble tightness.

G. Vessel nozzles are to be inspected and cleaned if need be each time the vessel is cleaned or the relief device is serviced.

IX. Maintenance of Equipment in Vinyl Chloride Service

A. List of equipment in vinyl chloride service and locations.

B. Standard operating procedure for opening equipment for cleaning and maintenance. (See attached)

C. Standardized maintenance procedures.

1. Blend all open end valves or lines.

2. Clean all flange faces and install new gaskets and bolts.

3. Replace valves in poor condition.

4. Repack valves with follower all the way up.

5. Equipment to be returned to service shall be purged and pressure tested with inert gas at its normal operating pressure. All piping joints are to be tested with soapy water or a sonic leak detector and leaks repaired.

6. Equipment returned to vinyl chloride service shall be checked for internal leaks with a portable leak detector.

D. Reliability maintenance program.

1. Equipment and pipelines shall be inspected externally at least annually and written inspection reports filed.

2. Equipment and piping shall be internally inspected and hydrostability tested on a regular basis such as three-year intervals for process equipment and longer for storage systems.

3. Mechanical equipment files are to be maintained.

4. Equipment repair, inspection and testing shall be done on a schedule with written feedback.

IX. MAINTENANCE OF EQUIPMENT IN VINYL CHLORIDE SERVICE

Preparation for the Job

The inherently hazardous nature of vessel entry is increased by the flammability and toxicity of vinyl chloride and by the possibility of the presence of peroxide residues in a vessel that has contained vinyl chloride. Only experienced and trained workers should be assigned this duty and then only under the direct supervision of an experienced foreman. All work should be done in compliance with an adequate vessel entry procedure that provides for training, the use of suitable protective equipment, health safeguards and a written checklist or work practice guideline for each step.

Preparation of the Tank or Equipment

The Environmental Protection Agency regulation (40 CFR Part 61 Sub-part F) on vinyl chloride has sharply restricted the allowable emissions to the environment from vessel openings. Vessels over 25-gallon capacity are allowed to release no more than 2% of the vessel volume as vinyl chloride vapor or 25 gallons upon opening, whichever is greater. Reactors are limited to twenty pounds of vapor per million pounds of product. Therefore, special control methods must be used.

Any liquid vinyl chloride should be transferred to another suitable vessel insofar as possible. The remaining heel should then be evacuated or allowed to evaporate to a lower pressure system which leads eventually to a recovery or emission abatement system capable of moving the final effluent to less than ten parts per million concentration of vinyl chloride. The model method recommended by EPA is to use water to displace the vapor to a recovery or abatement system. The water so used becomes contaminated and must be stripped to less than ten ppm vinyl chloride concentration before release to the environment. Alternate methods are repeated evacuation and repressurization with an inert gas or continual purging with inert gas or steam with the exhaust gas being treated by recovery or abatement equipment in either case. When the vinyl chloride content has been reduced to less than 2% of the standard volume of the vessel or 25 gallons it may be opened to the atmosphere and further action is not regulated by EPA, but OSHA rules still apply. (See 40 CFR Part 61, Sub-part F).

Peroxide residues should be assumed to exist if the vessel has contained recovered vinyl chloride or if there has been any possibility that oxygen and moisture have been present.

Preparation of the Tank or Equipment (continued)

Sufficient 10% sodium hydroxide should be added to cover any solid deposits in the lower section of the vessel and this should remain in contact for three to six hours. This time may be shortened to two hours if the temperature can be raised above 60°C (145°F). This should be done before an attempt is made to disconnect any lines on the bottom of the vessel to avoid detonation of this sensitive material. Care should be taken in handling, removing and disposing of this solution to prevent caustic burns. Refer to the MCA Data Sheet Number SD-9 on sodium hydroxide for recommended precautionary measures.

All process piping should be disconnected, slip blanket or blinded so that there is no opportunity of process materials or utilities re-entering the vessel. Local regulations regarding the method of installing blinds should be followed. It is not sufficient to valve off these lines or to only insert blinds in the line. An open section should exist between the vessel and the line if there is any question as to the integrity of the blinds.

As soon as the vessel is open to the atmosphere, positive ventilation should be applied to remove the remaining vinyl chloride vapor. Sources of ignition should be eliminated from the work area until tests show that the concentration throughout the area and inside the vessel are well below the flammable limits. Care should be taken that all dead spots are eliminated and that the exhaust gases are dispersed adequately.

All persons in the work area during the vessel preparation steps should be equipped with impermeable clothing until one is assured that no liquid vinyl chloride remains in the vessel or its associated piping and should wear suitable NIOSH/MESA approved air-supplied respirators until tests have shown that the vinyl chloride concentration has been reduced to the point where other methods of protection are adequate.

After adequate dispersion of vinyl chloride vapors the interior of the vessel should be washed as free as possible of wall fouling or loose debris to prevent desorption of vinyl chloride back into the work atmosphere.

Vessel Entry

General [Consult OSHA Regulations 1910.1017(h)]

A written work permit must be prepared before tank preparation and entry. It must describe work procedures to be used, hazards which may be encountered and procedures and equipment

Vessel Entry (continued)

General (continued)

to be used to protect against these hazards. The permit must be prepared, reviewed and signed by the supervisor to whom the tank is assigned after he has satisfied himself that tank entry and repair work can be done safely and applicable regulations met.

As a minimum this permit procedure must assure that proper protective equipment is used, mechanical and electrical lockout procedures followed, the vessel atmosphere has been tested, and adequate rescue capabilities are available. A new authorization or permit is required at each shift change.

Special ventilation providing a continuous supply of fresh air is required during the entire time personnel are inside the tank.

It is preferable that vapors be exhausted from the bottom of the tank with fresh air being admitted at the top. In the case of the tanks having a top opening only this can be accomplished by extending a flexible air duct to the bottom of the tank. Care must be taken to avoid recycling exhaust gases into the tank.

During the course of the work, frequent tests should be made to determine that the atmosphere in the tank is being maintained within the safe range. This precaution is necessary because residues not completely removed by washing may recontaminate the tank atmosphere.

If flammable vapors are detected over 10% of the LEL, the cleaning process should be repeated until the tank or vessel is free of vapor. The air should also be tested for oxygen content.

The electrical supply to any agitation within the vessel, and to any moving equipment nearby shall be locked out in the off position according to local codes and the key kept in the possession of the man inside the vessel or his foreman. The starting switch should be activated to be sure the proper circuit has been deactivated. The switch may also be disabled by a rod or lock in the "off" position, although this should not be the only lockout protection.

Danger signs should be prominently placed to indicate when workmen are in the tank.

Vessel Entry (continued)

No one should enter a tank or vessel that does not have a manhole opening large enough to admit him while wearing his safety harness, life line and respiratory protective equipment. It should be ascertained that the tank or vessel can be left by the original entrance. In some cases, it is advisable to have a block and tackle positioned on a tripod or otherwise fastened above the manhole.

No one should enter a tank or confined space until a work permit has been signed by an authorized person indicating that the area has been tested and found to be safe. Before directing men to enter a tank, an inspection of the interior should be made by the foreman who should be equipped with a positive pressure (or continuous flow) air line mask or self-contained breathing apparatus, together with rescue harness and life line. Another person should be on guard during the inspection.

Workers entering vessels should wear boots or rubbers over safety shoes, eye protection, hard hat and a NIOSH/MESA approved supplied air respirator. Impermeable clothing is needed if the walls are fouled with polymer. A wrist harness and safety line are also required and at least one other person similarly equipped for vessel entry should be stationed at the entrance of the vessel at all times. At least one other employee must be within audible hailing distance at all times.

All ladders, scaffolds or other large equipment shall be tied off properly and secured to prevent slipping or falling during the work assignment. Care must be taken to avoid tangling of air hoses and rescue lines with other equipment.

Any lights or electrically powered tools shall be inspected for proper insulation and grounding, and local codes shall be followed in regard to the permissible voltage to be used inside vessels. Refer to 29 CFR 1910.309 (OSHA regulation).

Emergency Rescue

It is essential that one or more attandants be present at the point of entry whenever another person is in the tank, depending upon the mechanical aids provided for removing a man from the tank. If work is being done in an isolated area, arrangements should be made to have additional assistants available at all times. Each person entering a tank should wear an approved safety harness or wristlets with a rope attached. An individual rope must be provided at the manhole cover for each person.

Emergency Rescue (continued)

Additional supplied-air respirators (hose mask) or self-contained breathing apparatus, together with rescue harness and life-line should always be located outside the tank entrance for rescue purposes regardless of the type of respiratory equipment or air supply which is provided for employees inside the tank. The air intake of the hose mask should be kept in an uncontaminated area.

Under no circumstances should a rescuer enter a tank to remove a victim of overexposure without proper respiratory protection (canister respirators are not proper equipment), a safety harness and an attached life line or before he has summoned additicnal assistance.

If a workman is overcome be fumes, he should be removed to fresh air immediately. Artificial respiration should be applied if breathing has stopped and a physician or ambulance summoned at once.

An injured worker should leave the vessel under his own power if possible, but if not he may be assisted by the attendent lifting on the rescue line or by means of the block and tackle. Only as a last resort should one person try to carry another up a ladder or out of a manway. Victims of a fall who have a suspected back or neck injury should only be moved in a basket litter.

Refer to Section 4 for treatment of overexposure to vinyl chloride.

Cleaning and Repairs

No repairs should be attempted until the vessel has been completely freed of polymer and peroxide residues. Care should be taken to avoid any exposure to vinyl chloride that may be entrapped in the solids. Protective foot, head and hand covering shall be required as a minimum, in addition to the previously recommended air-supplied respirators, while engaged in cleaning.

Any burning or welding may cause the formation of hydrogen chloride due to the decomposition of polymer. Adequate respiratory protection shall be used and sufficient ventilation is supplied to compensate for the oxygen demand of the welding operation.

No burning, welding, grinding or other operation that provides a potential source of ignition shall be allowed until

a hot-work permit has been issued by a responsible supervisor who has determined that the work can be done safely. Both the conditions in the work area and the possibility of flammable vapor from adjacent areas must be considered. Continued testing of the work space must be done as described in Section 10.3.3.

All repairs to a vessel must be done in accordance with the appropriate ASME codes.

Careful attention should be given to the condition of nozzles and flanges, especially those bearing the safety relief devices. All residues and buildup should be removed while the vessel is open.

X. Samples from Equipment in Vinyl Chloride Service

A. List of samples and locations.

B. Standard operating procedure for each type of sample.

C. Disposal of samples.

XI. Detection of Leaks and Elimination of Leaks from Equipment in Vinyl Chloride Service

A. Fixed Monitoring System Operating Procedure

B. Portable Monitoring Operating Procedure

C. Recordkeeping

D. Standardized Leak Program Submitted to EPA

VINYL LEAKS

OBJECTIVE:

To stop the escape of vinyl chloride from a tank, vessel or line and prevent employee exposure.

WHY IS THE OPERATION PERFORMED:

[illegible] and prevent any employee from accidently

WHEN IS THE OPERATION PERFORMED:

Whenever a vinyl leak is detected.

WHO PERFORMS THE OPERATION:

The operator designated by the foreman or "A" operator.

HOW THE OPERATION IS PERFORMED:

1. The intent of this procedure is to cover any problems dealing with a vinyl chloride leak not already covered by procedure and should in no way interfere with any other adopted procedure.

2. Once a leak is visually observed or sensed by the monitoring system the "A" operator should be notified. If the leak appears sizeable and will require more than just simply tightening a flange - the foreman should be notified.

3. Seal off the area with a saw horse, rope, tape, etc. to prevent any employee from entering the area.

4. The operator or operators chosen to correct the leak must put on the necessary respiratory and body protective equipment.

5 If the leak involves a reactor containing a batch and the leak cannot be stopped, follow the procedure for batch transfer due to equipment failure.

6. If the leak involves a relief valve that has lifted and will not reset properly, the vessel involved must be emptied and purged free of vinyl before removing valve for repair.

7. If the leak involves a gasket, tightening down on the gasket may be all that is necessary. If gasket replacement is required than the line or vessel involved must be emptied and purged of vinyl before proceeding with the replacement.

8. If the leak involves a cocked flange, Do Not attempt to correct the problem by tightening down on flange, instead, empty the line or vessel involved, purge it free of vinyl, then make the necessary repairs.

9. If the leak involves a leaky valve, closing the valve off properly may be all that is required. Installing a plug or blind flange on the valve may also correct the problem. If valve replacement is necessary the line or vessel must be emptied and purged of vinyl before proceeding with replacement.

10. If the leak involves a pump seal, shut off the pump, valve off pump intake and discharge. The line and pump must be emptied and if possible steamed before turning over to maintenance for repair.

11. After the leak has been corrected, the area will be monitored until vinyl exposure levels are within permissible limits. Only after the area passes the monitoring check can it be made available to all other employees.

KEY POINTS TO REMEMBER:

1. Once a leak is detected notify the necessary people. (A operator and foreman.)

2. Respiratory and body protective equipment must be worn by those entering the area.

3. Seal off the area to prevent other employees from becoming exposed.

4. Make the necessary repairs as quickly as possible.

5. The area involved will remain sealed off until constant monitoring reveals the area to be safe.

PREPARED BY: [signature] APPROVED: [signature]
Technical
[signature]
Production
[signature]
Safety

bak

COLORITE 019027

VCM LEAK DETECTION PROGRAM

OBJECTIVE:

To establish a uniform procedure and schedule to follow in detecting and eliminating vinyl chloride leaks.

WHY THE OPERATION IS PERFORMED:

To detect a VCM leak and expedite the correction of such leaks.

WHEN THE OPERATION IS PERFORMED:

Routinely during normal operating conditions and supplemented by scheduled leak detection patrols every eight (8) hours.

WHO PERFORMS THE OPERATION:

Personnel who have been thoroughly trained in the plant monitoring system and plant leak detection program, will perform the scheduled monitoring patrols and the operating personnel of each department, subject to the vinyl chloride leak detection program, will be responsible for the routine monitoring patrols.

HOW THE OPERATION IS PERFORMED:

Scheduled Monitoring Patrols

1. At the beginning of each calendar day the leak patrol person will obtain a set of blank VCM leak detection forms.

2. This form covers a twenty four (24) hour period (12 midnite to 12 midnite) and each patrol person will be responsible for filling out that portion of the form involving his shift.

3. Scheduled monitoring patrols are to be conducted on a once/shift basis. This meas that each crew will be responsible for making one (1) monitoring patrol per shift.

4. The designated patrol person will secure the portable hydro carbon detector (be sure the detector has been properly calibrated) and, at the designated time proceed to the first vinyl chloride monitoring location, Poly I motor control center. This location contains the monitoring units and point printouts for Polymerization Building I, first and second floors.

5. Inspect the monitoring unit printout charts, indicate on the form any individual point printout above twenty/five (25) ppm. or any four (4) concecutive point printout readings ten (10) ppm. above the background level for that area. Readings of this nature or level, for definition, will constitute the existance of a leak. If by this definition no leak is detected, indicate so by placing a check in the appropriate column for that point.

Vinyl chloride background levels for the various areas of plant I and plant II have been determined and listed below:

A. Polymerization Building I
   1) First floor - 5 ppm
   2) Second floor - 5 ppm
   3) Recovery Room - 8 ppm

B. Polymerization Building II
   1) First floor - 10 ppm
   2) Second floor - 6 ppm
   3) Third floor - 5 ppm
   4) Fourth floor - 5 ppm
   5) Fifth floor - 5 ppm

6. The monitoring system may indicate a leak that has been corrected by the operting personnel prior to the inspection round. This can be determined by one of two ways: 1) If a leak has been indicated on the printout chart and then followed by a normal level printout, 2) If a leak involves a most recent printout and by placing that monitoring point on hold a normal level printout should be obtained.

   In these situations patrol personnel must make an inquiry with the foreman or operating personnel to determine the origin and corrective steps that were taken to eliminate the leak. This information must be obtained from the "Vinyl Chloride Detection and Elimination" log book for that area.

7. If a leak is indicated with the fixed monitor system proceed with the portable hydrocarbon unit to the point location.

8. Using the portable hydrocarbon unit monitor the area in question to determine the origin and exact location of the vinyl chloride monomer leak or leaks.

9. Once the exact location and/or equipment has been determined, fill in the appropriate section on the vinyl chloride leak detection form and place a leak detection I.D. tag on the source noting the I.D. tag control number on the leak detection form.

10. After placing the vinyl chloride leak detection I.D. tag on the source, immediately notify the shift foreman and advise him of the location and details of the findings. It is the shifts foreman's responsibility to see that the necessary steps are taken to expedite the corrective action required to correct and eliminate the leak.

11. The shift foreman, after instituting the necessary action to correct or eliminate the leak per seperate procedure, will fill in the required information on the lower section of the leak detection I. D. tag and return it to the Safety Department for examination and filing.

12. The patrol person will then proceed to the second and third vinyl chloride monitoring locations. The second vinyl chloride monitor is located in the maintenance building and contains the monitoring unit and point printouts for the tank farm. The third vinyl chloride monitor is located in the Polymerization Building II motor control center and contains the monitoring unit and point printouts for the entire Polymerization Building II. Complete the inspection patrol of the second and third locations by following steps five (5) thru ten (10) as outline above.

13. After completing the inspection and filling out the appropriate sections of the vinyl chloride leak detection form, forward the form to the designated personnel on the oncoming shift. The completed form must be returned to the Safety Department for examination and filing.

Routine Monitoring Patrols

It will be the responsibility of all operating personnel, including the shift foreman, to participate in the routine detection and elimination of all vinyl chloride leaks. Although a formal scheduled patrol has been established solely for the purpose of detecting vinyl chloride monomer leaks, it is the intent of the routine monitoring patrols to expedite the elimination of such leaks. Therefore, during the normal operation of the plant, all personnel should take steps to eliminate any condition that may create a leak and be continuously on the alert to the existence of a leak.

Shift Foreman Guidelines

1. During the shift foremans normal routine patrols of the various operating areas in the plant, he will periodically check the vinyl chloride monitoring printout charts to determine the existence of any vinyl chloride monomer leak.

2. If a leak, as defined in steps five (5) and six (6) of the scheduled monitoring patrol section, is detected he should proceed to the suspected leak area with the portable hydrocarbon detector unit and determine the exact origin and location of the leak or leaks.

3. Once the exact location and/or equipment involved in the leak has been determined, proceed with the necessary steps to expedite the corrective action required to correct and eliminate the leak.

4. After the corrective action steps have been instituted to correct or eliminate the leak an entry must be made in the "Vinyl Chloride Leak Detection and Elimination" log book giving a complete description of the equipment and/or location of the leak and the corrective action steps implimented to

eliminate the leak. A log book for this purpose is located in each of the polymerization control rooms. The log for Polymerization I will also cover the necessary entries for the tank farm.

OPERATING PERSONNEL GUIDELINES:

The operating personnel of each department, subject to the vinyl chloride leak detection program, being in the operating area for a larger percentage of the time, are first of all normally in the ideal position to prevent leaks from occuring and secondly are in a position whereas immediate steps can be instituted, once a leak has been detected or observed, to correct or eliminate such a leak.

1. Many vinyl chloride leaks and emissions can be eliminated by adhereing to established company standard operating procedures. In those instances where a specific company procedure does not apply the operator in charge should use descretion in what course of action to take in the prevention of vinyl chloride leaks and emissions and if necessary should contact the shift foreman to determine the correct procedure to be followed.

2. Operating personnel must constantly be on the alert for signs or indications of the existence of a vinyl chloride leak.

   a. The stationary vinyl chloride monitoring unit will alert operating personnel by an audible and visual alarm of the presence of vinyl chloride in the atmosphere.

   b. The presence of frost on valves, flanges, and pump seals.

   c. The sound of pressure escaping from a line or vessel.

   d. The sight of a vinyl chloride cloud or vapors.

   e. The smell of any unusual odor.

The existence of any of the above conditions may indicate a vinyl chloride leak and must be investigated and if necessary, corrected and recorded by following steps three (3) and four (4) as outlined under the routine monitoring patrols, shift foreman's guidelines.

KEY POINTS TO REMEMBER:

1. A leak is defined as four (4) consecutive point printout readings ten (10) ppm above the background level for that area, or any individual point printout reading above twenty-five ppm.

2. It is important that the proper forms be completed and turned in on a timely basis.

3. The leak detection record must include a brief statement explaining the location, cause, date, time and action taken to eliminate the leak.

4. The leak detection I.D. tag must not be removed from the leak source until the leak has been eliminated.

5. The appropriate respirator, per OSHA standard 1910.1017, must be worn while investigating and correcting leaks.

6. Be sure portable hydrocarbon detector unit is properly calibrated before starting leak detection patrols.

7. The use of the portable hydrocarbon detector unit is restricted to personnel trained in its use.

All personnel involved in the vinyl chloride leak detection program are reminded that occasionally a situation may develop that is not specifically covered by a standard operating procedure, which if not properly handled, may cause the release of vinyl chloride into the work area and atmosphere. Therefore, all employees should keep in mind that it is of the utmost importance to handle every situation in a manner that will prevent this from occuring and to expedite the necessary corrective steps to correct a condition, once a release has occured.

LEAK ELIMINATION PROCEDURE

OBJECTIVE:

To stop the escape of vinyl chloride from a tank, vessel or line and prevent employee exposure.

WHY IS THE OPERATION PERFORMED:

To correct the vinyl leak and prevent any employee from accidently entering the area.

WHEN IS THE OPERATION PERFORMED:

Whenever a vinyl leak is detected.

WHO PERFORMS THE OPERATION:

The operator designated by the foreman or "A" operator.

HOW THE OPERATION IS PERFORMED:

1. The intent of this procedure is to cover any problems dealing with a vinyl chloride leak not already covered by procedure and should in no way interfere with any other adopted procedure.

2. Once a leak is visually observed or sensed by the monitoring system the "A" operator should be notified. If the leak appears sizeable and will require more than just simply tightening a flange the foreman should be notified.

3. Seal off the area with a saw horse, rope, tape, etc. to prevent any employee from entering the area.

4. The operator or operators chosen to correct the leak must put on the necessary respiratory and body protective equipment when necessary.

5. If the leak involves a reactor containing a batch and the leak cannot be stopped, follow the procedure for batch transfer due to equipment failure.

6. If the leak involves a relief valve that has lifted and will not reset properly, the vessel involved must be emptied and purged free of vinyl before removing valve for repair.

7. If the leak involves a gasket, tightening down on the gasket may be all that is necessary. If gasket replacement is required than the line or vessel involved must be emptied and purged of vinyl before proceeding with the replacement.

8. If the leak involves a cocked flange, Do Not attempt to correct the problem by tightening down on flange, Instead, empty the line or vessel involved, purge it free of vinyl, then make the necessary repairs.

9. If the leak involves a leaky valve, closing the valve off properly may be all that is required. Installing a plug or blind flange on the valve may also correct the problem. If valve replacement is necessary the line or vessel must be emptied and purged of vinyl before proceeding with replacement.

10. If the leak involves a pump seal, shut the pump off immediately, valve off the pump intake and discharge. The line and pump must be purged free of vinyl before turning over to maintenance for repair.

11. After the leak has been corrected, the area will be monitored until vinyl exposure levels are within permissible limits. Only after the area passes the monitoring check can it be made available.

KEY POINTS TO REMEMBER:

1. Once a leak is detected notify the necessary people. (A operator and foreman.)

2. Respiratory and necessary body protective equipment must be worn by those entering the area.

3. Seal off the area to prevent other employees from becoming exposed.

4. Make the necessary repairs as quickly as possible.

5. The area involved will remain sealed off until constant monitoring reveals the area to be safe.

VCM MONITORING EQUIPMENT MAINTENANCE PROGRAM

OBJECTIVE:

To establish a reliable preventive maintenance program for all fixed and portable monitoring units used in the detection of vinyl chloride leaks and emissions.

WHY THE OPERATION IS PERFORMED:

...mate calibration of these units and to ...d releases of vinyl chloride.

WHEN THE OPERATION IS PERFORMED:

On a daily basis each unit must be inspected and properly calibrated, cylinders and charts should be replaced as needed.

A routine preventative maintenance inspection of each unit will be performed on a weekly basis or whenever necessitated by a malfunction in the operation of the monitoring equipment.

WHO PERFORMS THE OPERATIONS:

Authorized maintenance personnel who have been thoroughly trained and who are capable of making such repairs, services or calibrations as required.

HOW THE OPERATION IS PERFORMED:

Miran Monitoring Systems

1. On a pre-determined date and time the authorized maintenance personnel involved will obtain a set of monitoring system P.M. forms from the maintenance office and proceed to monitoring unit No. 1. This form must be filled out and returned to the maintenance office upon completion of all listed items.

2. Inspect the strip chart and ink pad, install a new chart or ink pad as required.

3. Proceed to check the analyzer for zero drift, change the carbon canister as required.

4. Check the alarm functions, set in high signal on the analyzer. Check all channels for proper high and low alarms locally. Lock the high signal in on all channels by placing the analyzer in the hold position and check all audio and visual remote alarms.

5. Check the unit calibration with a certified vinyl chloride gas and air standard. The PPM value of standard gas used, and any corrections made to the analyzer must be listed on the monitoring system P.M. form. Indicate on the strip chart the time and date each calibration check is made.

6. Proceed to each monitoring point location and inspect each point for filter restrictions, cracked or obstructions in sample lines, etc.

7. After completing the necessary functions on unit no. 1 proceed to complete steps three (3) thru seven (7) on the second, third and forth units. Unit no. 2 is also located in the motor control center of Poly I and controls the monitoring points for Poly I, first floor. Unit no. 3 located in the maintenance building controls the tank farm monitoring points and unit no. 4 located alongside the "S" dryer panel board controls the slurry tanks, "S" warehouse and "S" dryer monitoring points.

Arcas Monitoring System

1. The Arcas monitoring unit is located in the Poly II motor control center and controls the fixed monitoring points for all of Poly II.

2. Inspect the printout chart and inking tape, replace as required.

3. Open the cabinet door housing the printout chart and check for any blown fuses in the alarm modules. Shut the alarm system off while replacing these fuses.

4. Using the standard gas provided, check the units calibration, make adjustments accordingly and indicate on the printout chart the time and date of calibration. Fill in the required information on the P.M. form.

5. Semi-weekly record the analyzer output on the Leads and Northrup chart provided. Attach the strip chart and printout calibration sample to the P.M. form and return to maintenance office.

6. Check all gas lines for leaks, use liquid leak detector.

7. Check the audible and visual alarms on all floors.

8. Inspect each monitoring point for filter restriction and deterioration, replace as required.

Portable Century Meters

1. The portable Century meters will be stored in the safety equipment storeroom, and on a scheduled weekly basis will be turned over to the maintenance department for a general maintenance inspection.

2. Upon receiving the Century unit, the maintenance department will clean or replace the inlet and exhaust filters.

3. Turn the instrument on and check the high and low gain, adjust accordingly.

4. Disassemble the detector assembly and clean.

5. Fill the hydrogen fuel cylinders. (Should maintain in a full condition.)

6. Calibrate with a known vinyl chloride standard gas mixture.

7. When the maintenance inspection is completed, the unit must be returned to the Safety Department for distribution.

KEY POINTS TO REMEMBER:

1. Standard gases used in calibrating the vinyl chloride monitoring systems will consist of a vinyl chloride and nitrogen gas mixture and must be of a concentration equal to the concentration of a leak as defined.

2. All calibrations made on the fixed monitoring units must be recorded with the time and date on the printout charts.

3. Printout charts removed from the fixed monitoring units must be clearly marked with the location, time and date of removal. (Ex. Poly I, first floor, 9:00 a.m. 10/22/76) All charts must be turned over to the Safety Department for examination and filing.

4. For those instances when problems arise with monitoring equipment and are not covered in this procedure, refer back to the manufacture's operating manual.

XII. EMPLOYEE TRAINING AND JOB SAFETY

Employee Education and Training

The supervisor should be thoroughly familiar with the contents of this data sheet, the Occupational Safety and Health Administration Standard for Vinyl Chloride (29CFR §1910.1017) and the Environmental Protection Agency's National Emission Standard for Vinyl Chloride (Part 61 Chapter I Title 40 CFR Subpart F) before undertaking any training of the employees who are engaged in handling or processing of vinyl chloride. Vinyl chloride handling and use are strictly regulated by many governmental agencies but the regulations issued by OSHA and EPA directly affect the content of any training program for vinyl chloride workers. The supervisor should also seek supplementary information and assistance. One recommended reference is the MCA Case Histories to learn of accidents and injuries that have occurred while handling or processing vinyl chloride. If the services of a safety specialist are avialable, the supervisor should consult with him before finalizing a safety review of his operations involving vinyl chloride.

The Occupational Safety and Health Administration Standard for Vinyl Chloride requires that each employee engaged in vinyl chloride or polyvinyl chloride operations shall be provided training in a program including:

(a) Nature of the health hazards of vinyl chloride exposure.

(b) Specific operations which could result in exposure to vinyl chloride in excess of the permissible exposure limit and necessary protective steps.

(c) Purpose, proper use and limitations of the respiratory protective devices.

(d) Fire hazard and acute toxicity of vinyl chloride and necessary protective steps.

(e) Purpose and description of the monitoring program.

(f) Purpose and description of the medical surveillance program.

(g) Emergency procedures.

(h) Specific information to aid the employee in recognition of conditions which may result in the release of vinyl chloride.

(i) A review of the OSHA standard for vinyl chloride. This review must be undertaken annually as well as at the employee's first training period.

The Environmental Protection Agency National Emission Standard for Vinyl Chloride requires that Standard Operating Procedures be prepared and implemented for:

(a) Loading and unloading line emission control.

(b) Slip gauge emission control.

(c) Manual venting of gases.

(d) Opening equipment emission control.

(e) Sample taking, handling and disposition.

(f) Leak detection and elimination.

The employee training program should include the following:

(a) Process chemistry and objectives.

(b) Basic process equipment and operating techniques.

(c) Properties and safe handling procedures for the materials involved.

(d) Detailed study of the process and process operation.

(e) Standard operating procedures for the various plant jobs.

(f) Modifications and additions to meet the foregoing EPA and OSHA requirements.

The supervisor should periodically review equipment, materials and procedures in current use. For maximum effectiveness, this review should include the participation or input from selected representatives of operations, maintenance, technical and other related activities. The results and recommendations from this review should be incorporated into employee training programs, standard operating procedures and equipment changes or revisions. All chemical processes and plants, particularly those working with reactive hazardous materials should be updated based on changes in process, changes in materials, past experience and new information.

All significant hazards should be explained together with the precautions to be followed in the standard operating procedures. For example, if eye protection is required while taking a sample, the standard operating procedure should read "Wear splash goggles and sample still number 000". This type of instruction is preferable to requiring that a sample be taken in one part of the standard operating procedure and requiring that goggles be worn in another part.

If there are extremely critical steps in the process where, for example, overcharge of catalyst may cause an uncontrollable reaction, consideration should be given to making these supervisory checkpoints. In a similar vein, if certain process variables are not or cannot be maintained within prescribed limits then the plant or process step should immediately be shut down and the supervisor consulted.

Complete standard operating procedures with safety information are essential to train new employees, to provide guidance for older employees and to demonstrate compliance in certain regulatory agencies. An error by an untrained employee is often regarded as negligence on the employer's part by the courts and by regulatory agencies.

Personal Protective Equipment

Availability and Use

Personal protective equipment is not an adequate substitute for good safe working conditions, adequate ventilation and intelligent conduct on the part of employees working with vinyl chloride. It is, however, in many instances the only practical means of protecting the worker, particularly in emergency situations.

The Standard for Vinyl Chloride specifically requires engineering and work practice controls to limit exposure to vinyl chloride to the permissable limit to the extent feasible. Where these controls are not sufficient to reduce exposure to the permissable exposure limits, a written program shall be established and implemented to reduce employee exposure to the permissable limits or to the greatest extent feasible.

Protective Clothing

Clothing and gloves made of rubber or impervious material should be worn to protect the body skin from accidental contact with liquid vinyl chloride where applicable.

Protective garments are required for employees who are engaged in hazardous operations such as cleaning polyvinyl chloride residue on vessel walls. These garments shall be selected for the operation and possible exposure conditions when liquid vinyl chloride is not involved.

All protective garments shall be provided clean and dry for each use.

Foot Protection

Footwear with built-in steel toe caps are recommended for all industrial operations. For added protection against chemical contact and liquid vinyl chloride, safety footwear or overshoes worn over leather shoes are recommended. It is important to thoroughly clean or discard contaminated footwear.

Eye Protection

Spectacle-type safety glasses meeting ANSI standard 287.1 with metal or plastic frames are recommended as minimum protection against eye injuries from flying particles.

Personal Protective Equipment (continued)

Eye Protection (continued)

When there is danger of splashing or material is under pressure, splash goggles and/or plastic shields (full length, eight-inch minimum) with forehead protection should be worn where complete fact protection is desirable.

Where liquid vinyl chloride is involved or there is likelihood of exposure to vinyl chloride at concentrations exceeding the permissable exposure limit, appropriate respiratory protection is required by OSHA. Use of a full-face piece respirator provides adequate eye protection without supplementary devices.

Respiratory Protection

Where employees are provided or are required to wear respiratory protective devices a respiratory protection program meeting the requirements of OSHA §1910.134 shall be established and maintained. Respirators selected for vinyl chloride shall be as follows:

	Atmospheric Concentration of Vinyl Chloride	Required Apparatus
(i)	Unknown, or above 3,600 ppm. . .	Open-circuit, self-contained breathing apparatus, pressure demand type, with full facepiece.
(ii)	Not over 3,600 ppm	(A) Combination type C supplied air respirator, pressure demand type, with full or half facepiece and auxiliary self-contained air supply; or (B) Combination type C, supplied air respirator continuous flow type, with full or half facepiece, and auxiliary self-contained air supply.
(iii)	Not over 1,000 ppm	Type C, supplied air respirator, continuous flow type with full or half facepiece, helmet or hood.
(iv)	Not over 100 ppm	(A) Combination type C supplied air respirator demand type, with full facepiece and auxiliary self-contained air supply; or

Personal Protective Equipment (continued)

Respiratory Protection (continued)

Atmospheric Concentration of Vinyl Chloride	Required Apparatus
(iv) Not over 100 ppm (continued) . . .	(B) Open-circuit, self-contained breathing apparatus with full facepiece, in demand mode; or (C) Type C supplied air respirator, demand type, with full facepiece.
(v) Not over 25 ppm	(A) A powered air-purifying respirator with hood, helmet, full or half facepiece, and a canister which provides a service life of at least four hours for concentrations of vinyl chloride up to 25 ppm; or (B) Gas mask, front-or back-mounted canister which provides a service life of at least four hours for concentrations of vinyl chloride up to 25 ppm.
(vi) Not over 10 ppm	(A) Combination type C supplied-air respirator, demand type, with half facepiece and auxiliary self-contained air supply; or (B) Type C supplied-air respirator, demand type, with half facepiece; or (C) Any chemical cartridge respirator with an organic vapor cartridge which provides a service life of at least one hour for concentrations of vinyl chloride up to 10 ppm.

Respirators shall be selected from among those jointly approved by NIOSH and MESA under the provisions of 30CFR Part 11.

Employee entry into unknown concentrations of vinyl chloride or concentrations greater than 36,000 ppm may be made only for life rescue. Entry into concentrations ranging from 3,600 to

Personal Protective Equipment (continued)

Respiratory Protection (continued)

36,000 may be made only for life rescue, firefighting or securing equipment so as to prevent a greater hazard.

When air purifying respirators are in use a continuous monitoring and alarm system must be provided when vinyl chloride concentrations may reasonably be expected to exceed the maximum allowable concentration for the devices in use. Such a system shall be used to alert employees that the vinyl chloride concentration exceeds that allowable for the respirator in use.

Where air purifying canisters or cartridges are used they shall be replaced prior to the expiration of their service life or at the end of the work shift in which they were used, whichever occurs first.

Head Protection

Hard hats are recommended for protection from falling objects, overhead liquid leaks and chemical splashes.

Fire Hazards

Vinyl chloride is extremely flammable. Its explosive limits are between 3.6 and 33% by volume in air for the vapor or gas. Vinyl chloride is most often handled as a liquid under pressure; thus, a one-gallon spill of liquid vinyl chloride quickly produces 45 cubic feet of flammable gas which produces over 1,000 cubic feet of explosive gas-air mixture. Vinyl chloride when burning produces carbon monoxide and hydrogen chloride. Burning is usually accompanied by the production of a dense black smoke.

The hazards of vinyl chloride with regard to fire are summarized as follows:

Fire - Vinyl chloride is highly flammable. Vapors from a liquid spill spread quickly.

Explosion - Flammable vapor from a liquid spill if ignited cause a gas explosion hazard indoors, outdoors and sewers. Containers and/or tanks of liquid vinyl chloride may explode due to the heat from a fire.

Health - Contact with liquid may cause burns to skin and eyes. Vapors may cause dizziness or unconciousness. Fire will produce irritating, poisonous gases.

Fire Fighting

Carbon dioxide or dry chemical agents extinguish small fires effectively, but no extinguisher is known to be suitable for large fires. Control of large fires is confined to eliminating the source of fuel and to reducing fire damage by cooling structures and tanks with water spray. Extinguishing a vinyl chloride fire from a major leak source such as a broken pipeline may lead to explosive reignition if all sources of spark and flame are not eliminated.

Some guidelines for major spills or fires are:

Immediate Action

Evacuate area.

Keep upwind. Define and isolate hazard area.

Wear self-contained breathing apparatus and protective clothing.

Eliminate all open flames, flares, smoking and internal combustion engines if there is a vapor cloud.

Fire Fighting (continued)

Followup Action

Let fire burn unless leak or emission can be stopped immediately.

Cool tanks and containers with water from maximum distance until after fire is out. Use unmanned spray systems, monitor nozzles and hoses for major fires. Impound the water to prevent spread of the hazard. Do not let water enter the sewage collection system. Stay clear of tank and container ends. Evacuate immediately in case of a rising noise from venting safety device.

Special Hazards

All persons exposed to vinyl chloride or its combustion products should be checked by a physician. (See Section 4 of this data sheet.)

Entry into fire area after the fire is out should be limited to persons wearing self-contained breathing apparatus until the absence of vinyl chloride, hydrogen chloride and other hazardous gases is confirmed by test.

INSTABILITY AND REACTIVITY HAZARDS AND CONTROLS

Vinyl chloride is a reactive monomer and will undergo addition and polymerization reactions which are characteristic of the ethylenic double bond. Under normal conditions of handling and storage uninhibited vinyl chloride is relatively stable. Vinyl chloride polymerizes exothermally in the presence of light, air, oxygen or free radical initiators to yield polyvinyl chloride. To prevent polymerization in transit or storage it is important that the monomer be protected at all times from contact with air, oxygen, moisture, catalytic impurities and light. Heat along does not initiate hazardous polymerization until temperatures of 250°C or more are reached, though vinyl chloride will become hazy if stored for long periods at temperatures over 20°C indicating that some polymerization does take place.

Vinyl chloride will react with air or oxygen to form vinyl chloride polyperoxide which is shock sensitive and will detonate under some conditions. It will also catalyze polymerization of the monomer. Polyperoxides have been found as a grey-white powdery mass in equipment where vinyl chloride is exposed to small amounts of air or oxygen such as recovery systems for vent gases, etc. When the presence of polyperoxides is suspected, treatment with caustic solutions will usually suffice for their destruction.

To stop polymerization or to prevent polymerization small amounts of phenol, hydroquinones, phenothiazine, tert butyl catechol, isoprene, styrene and styrene derivatives will act as inhibitors or short stops if thoroughly mixed with the vinyl chloride.