



INTER-OFFICE CORRESPONDENCE

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Subject: VCM Shipping Manual

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Attached is a proposed VCM shipping manual section for:

- 1) Regulations
- 2) Work Practice Guidelines

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Attachment

cc: F. C. Dehn

FEDERAL REGULATIONS

OVERVIEW

Several agencies of the Federal government have issued regulations impacting upon the loading and shipping of vinyl chloride monomer. These regulations take several forms.

1. Personal Protection. Regulations are published by OSHA and the Coast Guard for protection of the individual against the suspected carcinogenic nature of vinyl chloride monomer. These regulations specify the limits of workplace vinyl chloride, the use of respiratory protection, the establishment of regulated areas, the posting of signs and so on.
2. Environmental Protection. Regulations have been proposed by EPA for limiting the amount of VCM which escapes into the atmosphere as a result of loading operations.
3. Public Protection. Regulations are published by DOT and the Coast Guard regarding container specifications, container loading and gaging, placarding and labeling of containers, and safety related loading procedures applicable to a flammable compressed gas.

The regulatory wording of the actual text of appropriate regulations is the authority on requirements to be followed during the loading procedure. The following section is an overview and summary of the applicable regulations, published as a general guideline to be followed in handling and loading vinyl chloride.

VINYL CHLORIDE HANDLING
HAZARDS AND GUIDELINES

This section of the manual will consist of three parts:

1. Summary of vinyl chloride hazards
2. Summary of Work Practice Guidelines
3. Summary of Handling and Loading Practices

(NOTE: These are extracted from the Vinyl Manual. Part three is to be restructured as loading practices rather than unloading.)

Fire and explosion

Vinyl chloride vapor is extremely flammable. Its explosive limits are between 3.6 and 33% by volume in air. Sufficient ventilation and the elimination of ignition sources are mandatory in areas where vapor concentrations may reach a flammable level. When a tank car is unloaded, both the car tank and the unloading pump must be electrically grounded.

The major products of combustion include toxic and corrosive hydrogen chloride as well as carbon monoxide and carbon dioxide. Under certain conditions traces of phosgene may be produced. The main sources of danger to personnel result from carbon monoxide and from the extensive formation of hydrogen chloride gas, as well as from any unburned vinyl chloride vapor. Since a major combustion product is hydrogen chloride, any time its pungent odor is detected the area should be evacuated. Only persons properly protected should enter the area. Vinyl chloride vapor does not have any warning properties at low levels.

Carbon dioxide or dry chemical agents extinguish small fires effectively, but no extinguisher is known for large fires. Streams of water cannot extinguish a liquid vinyl chloride fire because the monomer does not mix with water and will float on top. Water may be sprayed to cool equipment, however. If the source of the vinyl chloride monomer leak has not been closed off, do not attempt to extinguish a large fire because hot metal can reignite an unburned vapor cloud. No one without proper protective respiratory equipment should enter an area where there has been a fire until the area has been thoroughly ventilated and checked to make sure the monomer concentration is below the level required by the Occupational Safety and Health Standard.

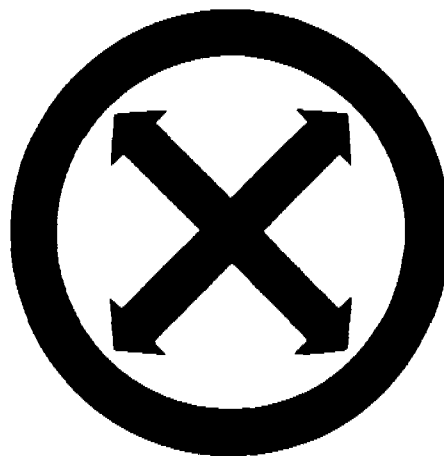
Chemical reactions

Contamination of uninhibited vinyl chloride monomer may catalyze polymerization, which is highly exothermic, or cause decomposition, which liberates toxic hydrogen chloride gas. The high purity of vinyl chloride must be maintained in shipment, transfer and storage.

Exposure to oxygen, air or sunlight can also catalyze polymerization. Peroxides may also form.

Toxicity

The Occupational Safety and Health Standard on exposure to vinyl chloride published October 4, 1974, says: "Based on the demonstrated evidence of vinyl chloride monomer's carcinogenicity in three animal species (rats, mice and hamsters), and the substantial probability that vinyl chloride monomer had been the causal agent in the cases of liver angiosarcoma found in workers both here and abroad, OSHA . . . published a comprehensive proposal . . . to protect employees from hazards of exposure to vinyl chloride monomer."



Stated in this OSHA standard is the following "Permissible exposure limit" scheduled to become effective April 1, 1975.

(1) No employee may be exposed to vinyl chloride at concentrations greater than 1 ppm (part per million by volume) averaged over any 8-hour period, and

(2) No employee may be exposed to vinyl chloride at concentrations greater than 5 ppm averaged over any period not exceeding 15 minutes

(3) No employee may be exposed to vinyl chloride by direct contact with liquid vinyl chloride

In cases where these limits of exposure are exceeded, the wearing of respirators will be mandatory for workers beginning April 1, 1976. Until then, the wearing of respirators is discretionary for exposures under 25 ppm

Besides the suspected carcinogenicity, vinyl chloride monomer vapor can produce immediate symptoms in persons exposed to high concentrations.

The odor of vinyl chloride monomer is sweetish and the sense of smell can not be relied upon as a warning. High vapor concentrations may cause lung irritation, can cause dizziness and anesthesia, and may do other bodily damage in ways not yet ascertained. In all cases of overexposure, immediately remove the affected individual to fresh air and obtain medical attention.

Liquid vinyl chloride monomer may cause frostbite because it evaporates so fast. If a polymerization inhibitor is included, it may cause local skin burns. However, most vinyl chloride monomer shipped today is not inhibited.

Workers should wear eye protection and protective clothing to prevent skin contact with the liquid. If vinyl chloride gets on clothing or shoes, they should be removed immediately. If vinyl chloride contacts the skin, wash immediately with soap and water. If vinyl chloride contacts the eyes, the eyes should be washed immediately and thoroughly with water for at least 15 minutes. Get medical attention.



Workers should wear protective clothing and eye protection when unloading shipments. Whether or not respiratory protection is used, and what type, depends on the concentration of vinyl chloride monomer vapor.

Guidelines

Work Practice Guidelines

PPG Industries has work practice guidelines used at its own plants to reduce exposure to vinyl chloride monomer during manufacture, storage and loading. Portions of the guidelines are reproduced here. Of course, some PPG practices may not be applicable to individual customer operations. Copies of the PPG work practice guidelines are available from the technical service staff of PPG Industries' Chemical Division.

Copies of the OSHA standard, "Exposure to Vinyl Chloride," are also available on request. Users of vinyl chloride monomer should observe the requirements of the appropriate regulatory agencies.

I. Labeling and Posting

A. Signs

1. Entrances to the regulated areas* shall be prominently posted with legible signs bearing the following:

**DANGER!
CANCER-SUSPECT AGENT AREA
AUTHORIZED PERSONNEL ONLY**

2. Areas where hazardous operations are performed or where an emergency currently exists shall be posted with legible signs bearing the following:

**CANCER-SUSPECT AGENT
IN THIS AREA
PROTECTIVE EQUIPMENT
REQUIRED
AUTHORIZED PERSONNEL ONLY**

B. Labels for Monomer Containers

Vinyl chloride monomer in containers or vessels located outside the regulated area shall be labeled as follows:

VINYL CHLORIDE

**DANGER!
EXTREMELY FLAMMABLE
LIQUID AND GAS
UNDER PRESSURE
CANCER-SUSPECT AGENT
HARMFUL IF INHALED
MAY POLYMERIZE VIOLENTLY
UNDER FIRE CONDITIONS OR
LOSS OR REMOVAL OF INHIBITOR**

Keep away from heat, sparks and open flame.

Keep container closed.

Use with adequate ventilation.

Avoid breathing vapor.

Avoid contact with skin.

Keep cylinder out of sun and away from heat.

Container should be grounded when being emptied.

Never drop cylinder.

FIRST AID: If inhaled, remove to fresh air. If not breathing give artificial respiration, preferably mouth-to-mouth. If breathing is difficult, give oxygen. Call a physician.

IN CASE OF:

Fire—Use water spray, dry chemical, or carbon dioxide.

Spill or Leak—For small spills, evacuate area and permit to evaporate. For large spills or leaks, evacuate area.

Dike or flush to ground and let evaporate. Do not flush to sewer because of explosion hazard. Wear suitable respiratory protection.

C. Waste Material

Waste material removed from regulated area in closed containers for disposal shall have the following label:

**WASTE MATERIAL
DANGER!
MAY CONTAIN
VINYL CHLORIDE MONOMER
EXTREMELY FLAMMABLE
VINYL CHLORIDE IS
A CANCER-SUSPECT AGENT**

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*"Regulated area" means an area where vinyl chloride concentrations are in excess of the permissible exposure limit.

D. Equipment

Process equipment, materials and clothing contaminated with vinyl chloride monomer shall not be removed from a regulated area unless it has been purged or placed in closed containers bearing the following legend:

DANGER!
CONTAMINATED WITH
VINYL CHLORIDE MONOMER
CANCER-SUSPECT AGENT

II. Appraisal of Employees

Each employee working in a regulated area shall be apprised of all known hazards, the consequences of over-exposure, appropriate emergency procedures, proper conditions for safe use and precautions to prevent exposure to vinyl chloride monomer. Each plant shall have prepared an operations manual detailing procedures for performing the work which contains specific safe work practices. These practices shall not contain inherent steps that result in exposure of the employee.

III. Medical

Medical surveillance shall be required or made available to workers covered by this Work Practice Guideline no less frequently than every 12 months. For employees who have worked over 10 years, this period shall be every six months. This medical program shall be considered the practical minimum and these examinations should be reviewed every three years for revisions and supplemental testing where indicated.

IV. Personal Protective Equipment and Clothing

A. Respiratory Protection

1. General

When the limits of exposure prescribed on page 13 under Toxicity cannot be met by limiting the concentration of vinyl chloride monomer in the work environment through feasible engineering means, the plant must establish and enforce a program of respiratory protection detailing the required protection of each job classification.

2. Non-Routine Operations

The requirements set forth in this section shall apply for non-routine operations such as brief exposure to concentrations as a result of maintenance or repair activities, emergency situations, or other short-time, non-standard work routines. A respiratory protection program meeting the general requirements outlined in the American National Standard, Practices for Respiratory Protection, Z88.2-1969 shall be established and enforced. This program shall include instructions on the selection, fitting, use, testing for leakage, cleaning and maintenance of the respiratory protective device.

3. Vessel Cleaning, Draining, Charging or Maintenance

a. Where employees are engaged in cleaning, charging or maintenance inside vessel, respiratory protection shall be worn if times where the concentration of vinyl chloride monomer inside the vessel has been purged below 25 ppm, there is adequate oxygen content to support life, an approved chemical canister mask shall be worn. When the concentration of vinyl chloride monomer inside the vessel is below 10 ppm, a chemical cartridge respirator, which provides a service life of at least 1 hour, can be worn in lieu of the canister mask.

b. Where the concentration of vinyl chloride monomer cannot be brought below 25 ppm, the employees shall wear a demand or continuous flow or self-contained respirator (Type C per OSHA standard page 35897)

c. Employees making the first break into a process line, storage line or vessel that contained or contains vinyl chloride monomer shall wear respiratory protection appropriate to protect the employee from exposure to vinyl chloride monomer.

4. Routine Operations

a. Workers loading or unloading tank cars, tank trucks, barges, ships, filling cylinders and other such similar operations where the facility does not have a closed system for vapor equalization, shall wear Type C respiratory protection during the above-mentioned operations.

b. Where there are loading and unloading operations which incorporate equalization lines, Type C respirators shall be located in the immediate area and worn in the event of spillage, leaks or emergencies. Only those employees properly protected with Type C respiratory protection shall attempt to correct an upset condition or emergency.

c. Employees engaged in loading, unloading and production shall have on their person a chemical cartridge respirator to be used for escape purposes.

d. Employees who collect samples for quality control purposes shall wear respiratory protection consisting of a chemical cartridge(s) type during the period when the sample is inserted and removed from the sampling line. Respiratory protection consisting of a chemical cartridge type shall be worn when gate and globe valves are operated.

e. Employees who monitor the workplace air shall have available appropriate respiratory protection in the event of leaks in equipment. These employees shall wear the respiratory protection when levels being measured exceed the permissible limit.



Self-contained breathing apparatus.



B. Clothing

1) Protective gloves, footwear or foot coverings, and protective head covering and protective eye wear shall be provided for use in regulated areas. This protective equipment shall be worn during maintenance and cleaning operations on or inside previously purged vessels, pipes, pumps and valves not removed from the regulated area.

2) For vessel cleaning, maintenance and changing charges, protective clothing shall be worn to prevent skin contact with liquid vinyl chloride monomer or other materials containing vinyl chloride monomer.

3) Employees making a break into a closed system line which contains or contained vinyl chloride monomer or other materials containing vinyl chloride monomer shall wear protective clothing.

V. Work Practices

A. Emergency Procedures

Specific emergency procedures shall be prescribed. The procedures shall be readily available, in writing, to the employees. The employees shall be familiarized with these procedures, and trained and rehearsed in their application.

B. Engineering Procedures

An engineering review procedure shall be established to incorporate design changes where feasible to minimize sources of vinyl chloride monomer vapors from processes, loading, unloading operations and maintenance procedures that contribute to employee exposures. Where local exhaust ventilation is used, it shall be designed and maintained to prevent the accumulation of or recirculation of vinyl chloride monomer vapor into a non-regulated area. Sample collection ports shall be so designed that during the sample collection period, the sample container is part of a closed loop system. Valves shall be located as close as practical to the end of the disconnecting line. Valves shall be located where their frequent closings are necessary to isolate equipment. Valves shall be made of high-quality type to prevent leakage of vinyl chloride monomer or liquid streams containing vinyl chloride monomer.

Blow-down and purge lines from equipment shall be designed to return to the process or to discharge to a point remote from employees' work location.

C. Laboratory Procedures

1) All quality control testing and analyses shall be performed in a laboratory equipped with a chemical laboratory hood having a capture velocity adequate to collect vinyl chloride monomer vapors under conditions prevailing in the laboratory. The discharge from the laboratory hood shall be designed so that vinyl chloride vapors do not reenter other non-regulated areas.

2) All full sample containers (bombs) shall be stored inside the laboratory hood pending analysis. Sample bombs empty or practically empty of liquid shall not be stored in the laboratory unless the storage space is properly ventilated and under negative pressure. Sample bombs may be stored outside the laboratory building provided the storage location meets safety requirements.

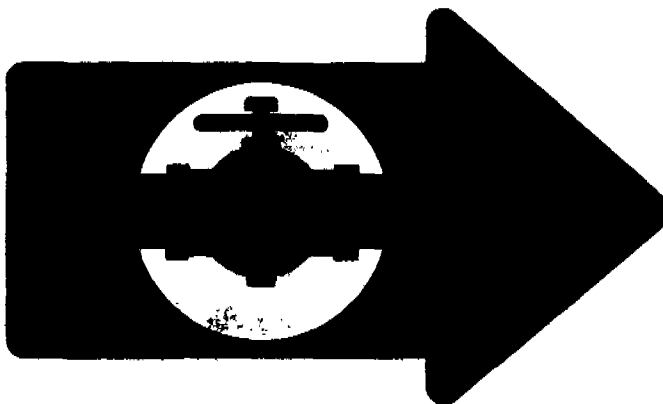
3) Analytical test instruments such as a gas chromatograph, that are located inside the laboratory but outside the laboratory hood, shall have their purge and bypass lines discharge into the laboratory hood.

4) All quality control sampling containers (bombs) shall be periodically checked to assure the integrity of the valves and for leakage. Screw caps shall be provided for all sample bombs and used when the bomb is not in service.

5) No glassware containing vinyl chloride shall be removed from the laboratory hood.

D. General Housekeeping

1) To prevent airborne contamination and accidental skin contact with vinyl chloride monomer, emphasis shall be placed upon periodic inspection, prompt repair of equipment and leaks, and proper handling, storage and disposal of materials.



- 2) An initial air monitoring survey and atmospheric sampling tests shall be made in accordance with applicable standards. There shall be periodic tests for leaks at pumps, valves and flanges and for emission of vinyl chloride monomer. The frequency of these tests shall be such to insure the integrity of equipment and adherence to proper work practices.

- 3) For waste material and contaminated equipment handling, see Section I (C) and (D) on Labeling and Posting.

E. Special Precautions

- Vinyl chloride monomer is a gas at ambient temperatures. Therefore, waste materials, equipment and other sources of the monomer in closed containers shall not be placed in areas of excessive temperature or sunlight where buildup of internal pressure may result in rupture of the container, fire or explosion.

F. Vessel Entry

- 1) A vessel entry procedure shall be developed. Employees shall be familiarized with the procedure in writing, and shall be trained and rehearsed in the techniques provided for in the procedure.
- 2) Atmospheres within the vessel shall be purged to where vinyl chloride monomer contained therein is below 25 ppm and the oxygen content contained therein is sufficient for supporting life. Where either the vinyl chloride monomer concentration cannot be reduced below 25 ppm or where there is insufficient oxygen or where other toxic materials may be present in concentrations dangerous to life, an air-supplied respirator (Type C) and protective clothing, as stated in Section IV of this Work Practice Guideline, shall be provided by the plant and used by the employee. In vessels which have been purged to below 25 ppm, respiratory protection outlined in Section IVA3 shall apply.
- 3) All piping to and from the vessel shall be blanked or otherwise isolated prior to entry.

G. Blow-Down Procedure

Whenever any equipment which contains or contained vinyl chloride monomer is to be purged or blown-down, there shall be a written procedure established to prevent the worker from being exposed. This can be accomplished by returning the blow-down stream to the process through equalizing lines or locating the discharge point remote from the employee. If these systems are not feasible, Section IV of this Guideline shall be followed.

H. Tank Car, Tank Truck, Barge and Ship Loading and Unloading

Each unloading line and each vapor equalizing line shall be equipped with vent connections permitting, at the completion of unloading, pressure to be vented, and the hose purged with an inert gas back to the process or to a remote point from which employee exposure will not result.

VI. Sanitation

A. General

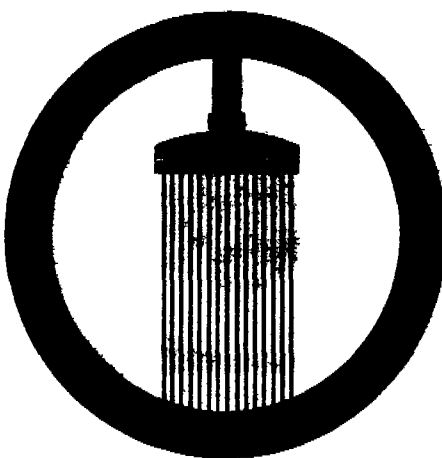
Storage or consumption of food, storage or use of containers of beverages, application of cosmetics or smoking are prohibited in regulated areas.

B. Showers and Hand-Washing Facilities

Showers, hand-washing facilities, and soap and water shall be available to all vinyl chloride workers.

C. Clothing

Clothing saturated with vinyl chloride monomer or with other process streams containing vinyl chloride monomer shall be promptly removed and replaced with uncontaminated clothing.



VII. Monitoring and Record-Keeping Requirements

A. Workplace Areas

1) Concentrations of vinyl chloride monomer in the regulated area shall be monitored at strategic sampling points. Adequate summary records of these concentrations shall be maintained and held available for inspection for a period of 30 years.

2) a. Sampling frequency and patterns shall be adequate to represent the regulated area environment and to demonstrate proper work practices and the integrity of the equipment.

b. Vessel environments shall be periodically monitored at frequent intervals for vinyl chloride monomer concentrations during the times they are occupied by an employee. Summary records of these measurements shall be maintained for 30 years.

3) Where the manufacturing process is located out-of-doors, a sampling station should be located downwind of the operations. Multiple sampling points may be necessary.

B. Personal Monitoring

1) Sampling shall be of such frequency and pattern as to represent levels of exposure of employees to vinyl chloride monomer. Provisions set forth in the OSHA standard for vinyl chloride monomer shall be followed. Summary records shall be maintained for 30 years for all sample schedules to include the sampling data, analytical methods, type of respiratory protection in use (if applicable) and the concentrations of vinyl chloride monomer. Job summary records shall be maintained so that they may be classified by employee.

2) Each worker shall have access to the sample results as they pertain to his occupational exposure.

3) Within ten working days after monitoring which discloses that any employee has been exposed, each such employee shall be notified in writing of the results of the exposure measurement. An evaluation of the incident shall be made and corrective action outlined.

Handling and Unloading

In many handling and unloading steps, there are potential points of exposure to vinyl chloride monomer. Consult with the technical service staff of PPG Industries' Chemical Division regarding where monomer unloading exposure points may be in your plant. Check also for other exposure points that are peculiar to individual plant operations.

Handling spills and leaks

If the concentration of vinyl chloride vapor in air exceeds 3.6% by volume, the lower limit of the explosive range, persons should not enter area of spill or leak except for a rescue.

Take care of a leak or spill immediately. Shut off or remove any possible source of ignition. Keep people away and do not permit smoking. Handle small spills by evacuating the area and letting the liquid evaporate. Dike the liquid from a large spill and let it evaporate. Do not flush vinyl chloride into a sewer because it may create an explosion hazard. Spilled vinyl chloride should not be deliberately ignited.

Invisible leaks can be detected by using a soap solution or by instruments; never use a halide lamp because of the fire and explosion hazards. If it can be done without personal risk, shut off a leak.

Persons taking care of a leak or spill, or making a rescue, should use self-contained or air-supplied breathing apparatus and should wear spark-proof shoes and use spark-proof tools.

A person contacted by vinyl chloride liquid should take a bath promptly and discard contaminated clothing and shoes.

Unloading tank cars

If tank car valves are defective or leaking, do NOT unload. Telephone the PPG Chemicals plant at Lake Charles, Louisiana, 318-882-1200.

Spotting Car

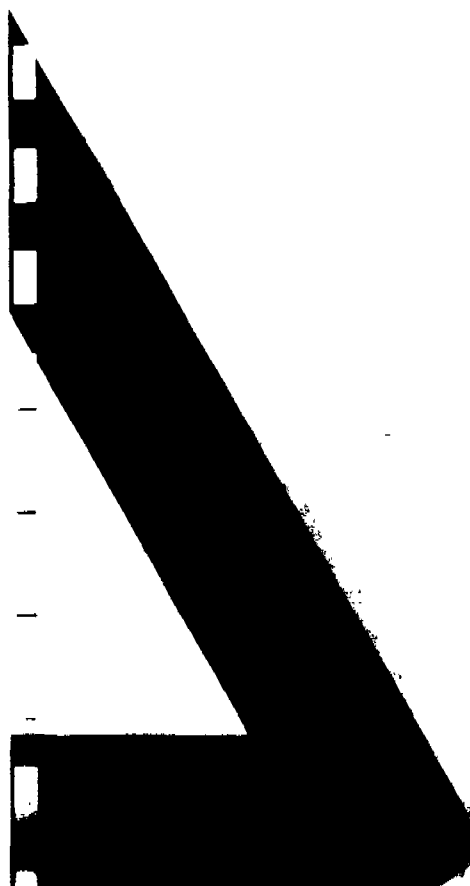
Spot tank car accurately on level track. Set car brakes and block wheels with standard rail clamps. Unless car is protected by a closed and locked switch or gate, attach a derail to open end of track. Place caution signs complying with DOT regulations on track or car to give warning to persons approaching car from open end(s) of siding. The signs and derail must be left in place until after car is unloaded and disconnected.

PPG tank cars are equipped only for top unloading. The car type is DOT Class 112A-340W. The cars have a net weight capacity of 180,000 pounds corresponding to a nominal capacity of 26,000 gallons.

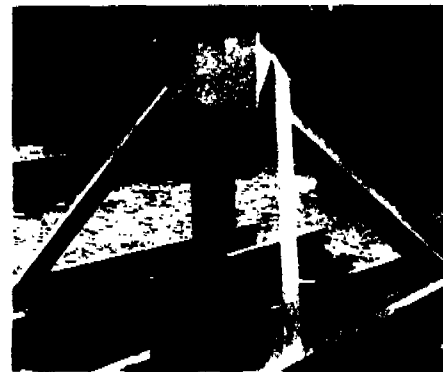
Workmen unloading shipments should wear goggles and protective clothing; that is, garments suited to the particular situation and probable extent of exposure.

If unloading procedures—particularly connecting, disconnecting and sampling—release vinyl chloride vapors in the work area, workmen should use proper respiratory protection (see page 15, PPG Work Practice Guidelines, Section IVA2).

The car should not be left unattended while being unloaded.



Tank car warning and derail.



Tank car stop.



Wheel chock for tank cars.

Preventing Ignition

Static electricity must be dissipated to minimize the fire hazard. Connect grounding wire between the car tank and the unloading line. (See grounding arrangement diagram below.) Also, the car tank should be grounded as well as the rail under the tank car. Flanged joints in piping should be bonded by jumper cables. Welded pipe connections are preferable. Use a commercial meter for checking ground integrity.

All wiring and electrical equipment should be explosion-proof, Class 1, Group D. No flame- or spark-producing devices or smoking by personnel must be allowed in the area.

Follow federal, local and insurance regulations. A fire hose should be available to cool the car tank and surrounding equipment in case of fire.

Additional information appears in Manual Sheet TC-4 on "Unloading Flammable Liquids from Tank Cars," published by the Manufacturing Chemists Association, 1825 Connecticut Avenue, N.W., Washington, D.C. 20009.



Ground the tank car before unloading.



Flanged joints should be bonded by jumper cables.

Grounding Arrangement

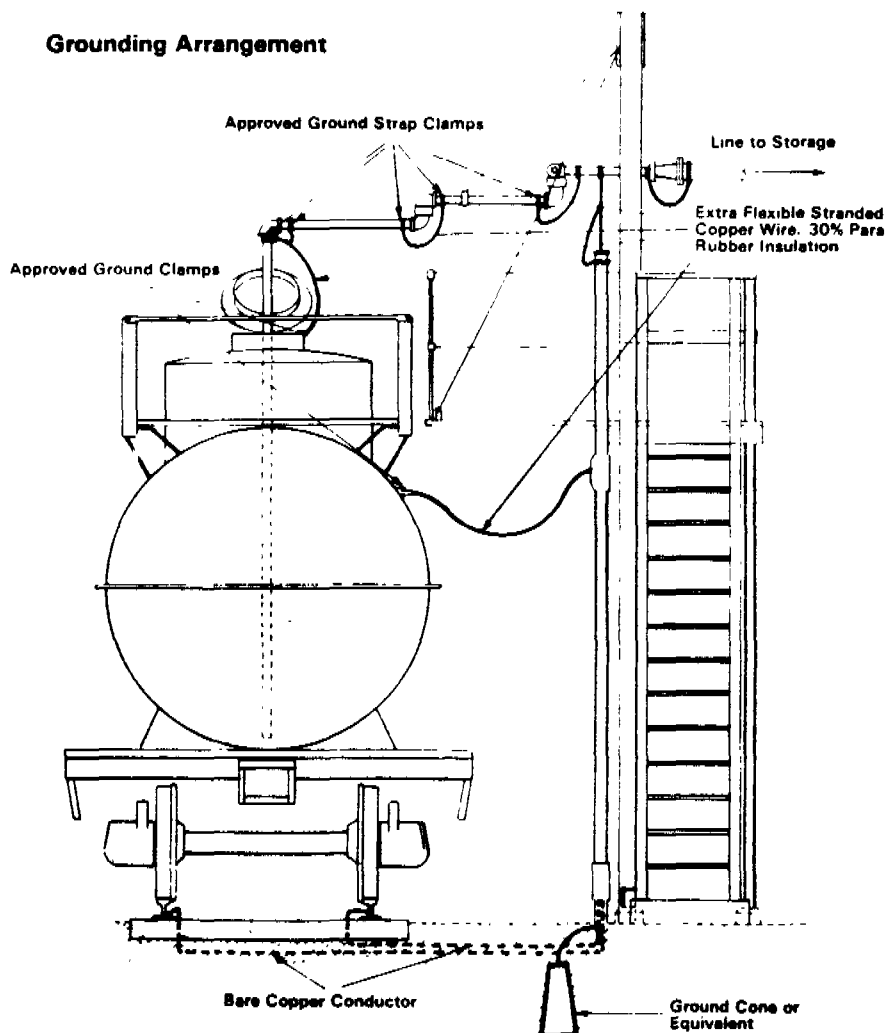


Diagram courtesy Manufacturing Chemists Association



Welded pipe connections are preferred for dissipating static electricity.



Check for ground integrity.

Check Before Unloading

Check all car valves to make sure they are closed. Check valves on the piping from storage tank to process to make sure they are closed. Check the vinyl chloride monomer concentration to make sure there are no invisible leaks from valves. Wear respiratory protection if there is any leakage. Take care of leak as recommended on page 19.

Check storage-tank level to make sure there is sufficient room for the car's contents. The PPG tank car is equipped with a gage rod assembly (see diagram of tank car fittings below) for measuring the level of vinyl chloride.

To prevent exposure of workers to vinyl chloride monomer vapor, this procedure has been modified by connecting a "bull's-eye" sighting device to the end of the gage rod. It permits observing liquid vinyl chloride monomer in a system that is closed at the inspection site. The gas flowing out the bull's-eye is piped into the recovery system.

A 2-inch valve is installed vertically on the vapor padding connection and two 3-inch valves on the liquid unloading outlets, which are over education pipes. Users may reduce the vapor line valve to 1 inch providing vapor flow is sufficient to maintain positive pressure near the end of unloading. Both liquid outlets can be used to speed unloading if desired.

The vapor padding connection should be vented to the vapor at the top of the storage tank (see unloading diagram).

The thermowell dome fitting covers a closed system filled with antifreeze. A thermometer can be inserted in the 1/4-inch opening to obtain the temperature of the vinyl chloride when desired.

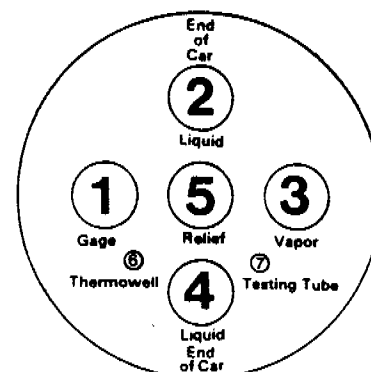


"Bull's-eye" sighting device permits observing liquid without exposure to vapor



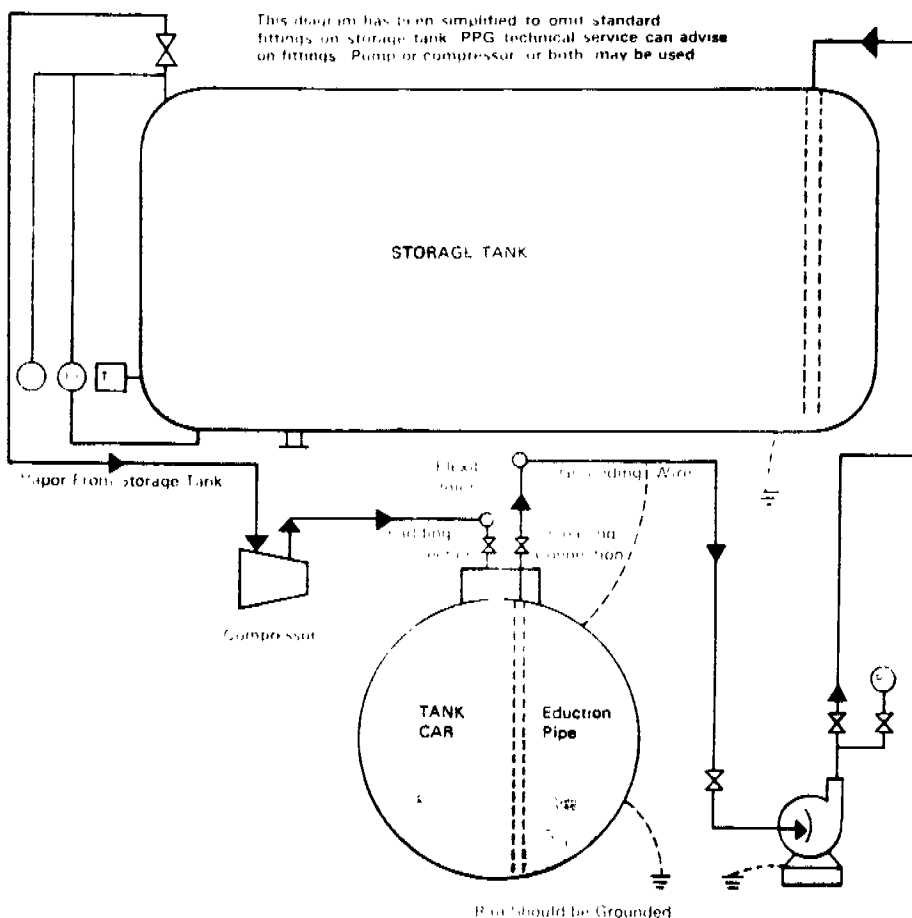
Measure level of vinyl chloride monomer liquid in tank car with gage rod assembly.

Vinyl Chloride Monomer Tank Car Dome Fittings



- 1 Gage rod assembly
- 2 Liquid unloading valve
- 3 Vapor padding valve
- 4 Liquid unloading valve
- 5 Safety relief valve
- 6 Thermowell
- 7 Testing tube

Tank Car Unloading Station For Vinyl Chloride Monomer



RANGE Full vacuum to 50 psig
RANGE -50°F to 150°F

SL 090393

Sampling

Check contents of tank car by sampling before unloading to verify that contents of car are vinyl chloride and meet required specifications.

Samples are taken in **stainless steel** pressure bombs that meet the requirements of DOT Regulation 3B-400 and are dedicated to vinyl chloride service.

All pipe connections and valves at the sampling point should be as close together as possible to minimize the quantity of vinyl chloride monomer that must be vented before removing the sample bomb from the system.

The pipe leading from the sampling bomb is part of a closed loop system. It is connected to a common vent manifold leading to the refrigerated recovery system or to the stack system. If this cannot be done, an alternative is to discharge the vent line no less than 12 feet from the operator, who should have room to stay upwind no matter what the wind direction may be. A suitable breathing device must be used during sampling if measurements of vinyl chloride monomer concentration have indicated that exposure is possible.

An alternative arrangement has piping and valves for two evacuated sampling bombs: one for collecting the sample, the other for collecting the bleed-off.

The operator should wear long sleeves and gloves to protect him from possible contact with residual liquid vinyl chloride monomer when he removes the bomb from the sampling position.

Liquid samples should be taken only through the gage rod assembly fitting.

1. Remove hood from gage rod assembly.

2. While holding rod, release latch.

CAUTION: When releasing latch, do not stand directly over rod because the car vapor pressure could make the rod rise rapidly once the latch is released.

3. Set rod to desired level in car.

In the center of the other fittings is a spring-loaded, safety relief valve set at 280 psig.



Connecting sample bomb.

Pressurizing Car

PPG ships tank cars of vinyl chloride filled with liquid up to no more than 86% of the water weight capacity of the tank. Vinyl chloride vapor occupies the space above the liquid. Air or oxygen must not be introduced during unloading or storage to prevent formation of a flammable mixture or premature polymerization. Purge all lines thoroughly with nitrogen before hooking up. Use nitrogen with a maximum of 10 ppm oxygen. Nitrogen purging can be minimized by sealing the line and alternately pressurizing with nitrogen and bleeding off the nitrogen to a remote location or to a recovery system or incinerator.

Remove the threaded pipe plugs on the liquid and gas valves cautiously and connect the liquid unloading line and the vapor padding line (see unloading diagram). The vapor pressure is needed to prime the centrifugal forwarding pump, if one is used. To reduce pressure drop, locate the pump as close to the tank car as possible. Some installations have a compressor on the vapor line from the storage tank in addition to the pump. In warm climates, a compressor may be used alone without a pump, but in cold weather a pump is usually needed—with or without the compressor—to facilitate unloading. The vapor pressure used for padding should not exceed 225 psig. Never apply heat to accelerate the unloading of a vinyl chloride tank car.

To obtain flexibility in the unloading system, either stainless steel hose or steel pipe with flexible joints can be used. The flow of vinyl chloride from the tank car should be regulated by a valve in the transfer line. If the discharge rate suddenly becomes too great, an excess flow check valve in the tank car will close. To re-open this valve, close the unloading connection valve until the pressure is equalized.

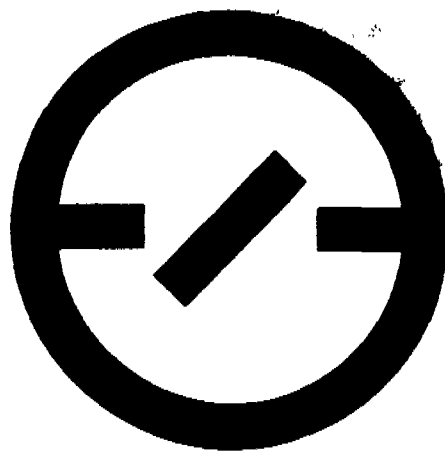
Checking Unloading Progress

Start unloading by slowly opening the vapor padding connection valve to the car. If it is necessary to discontinue unloading for any reason, close all valves tightly and disconnect all unloading connections.

The lines leading from the unloading connection valve and the padding connection valve should be purged with nitrogen so that the vinyl chloride monomer vapor in those lines is transferred to the recovery system.

Check the storage tank frequently to determine when the tank car is almost empty. Completely unload the tank car, it should not be used for storage.

A pressure gage on the unloading line is the best way to indicate when all the liquid has been emptied from the car.



Purging line with nitrogen



Connecting vapor padding line.



Connecting liquid unloading line.

After Car Is Emptied

Stop the forwarding pump. Close the padding connection valve and then the unloading connection valve at the top of the car. After this, close all other valves in the vinyl chloride transfer line.

The lines leading from the unloading connection valve and the padding connection valve should be purged with nitrogen so the vinyl chloride monomer vapor in those lines is transferred to the recovery system.

Check the vinyl chloride monomer concentration to make sure there are no invisible leaks from valves. Wear respiratory protection if there is any leakage. Take care of leak as recommended on page 19.

Do not allow tank car to stand with unloading connections attached after unloading has been completed. Remove all lines from the car and disconnect grounding wires.

Reverse the "DANGEROUS" placard on the car so that it reads "DANGEROUS—EMPTY" (see photo).

IMPORTANT

Leave at least 10 psig of vinyl chloride vapor pressure in the empty tank car being returned after closing and sealing all openings. The pressure is necessary to prevent air from entering the car.

Notify PPG Chemicals immediately if any valves are defective or leaking; telephone the manufacturing plant at Lake Charles, Louisiana 318-882-1200.

TAG VALVE or defective equipment



Leave at least 10 psig of vinyl chloride vapor pressure in the empty tank car.



After tank car is emptied, reverse "DANGEROUS" placard so that it reads "DANGEROUS—EMPTY."

TANK CAR DIMENSIONS

Car	Water Capacity	Length Over Strikers ¹	Overall Height ²	Height to Valve Outlet ²	Extreme Width ³
90-ton	26,000 gal.	50'5"	15'5"	14'1 - 1 1/8"	10'6 1/2"

¹Add 2'7 1/2" for length over center line of coupler knuckles.

²Heights are for empty cars and are measured from top of rail; heights of loaded cars may be as much as 4" less.

³Width over grab irons.

Note: Height to manway platform is 6" to 10" less than height to center line of valve.

TANK TRUCK DIMENSIONS

Overall Length	Height to Top of Relief Valve	Overall Width
48'7"	10'8" approx.	96"

Unloading tank trucks

Tank trucks deliver shipments usually within a 100 mile radius of Paulsboro, N. J. The tank trucks have a net weight capacity of 40,000 pounds corresponding to a nominal capacity of 5,200 gallons. The trucks are unloaded on either side from the bottom rear of the back end. Since the sizes of the liquid line connections (3 inches) and vapor padding connections (2 inches) are the same as for tank cars, any user receiving tank car shipments can take a tank truck shipment so long as the truck can get close enough to the unloading site. If not, a different length of pump suction line or vapor padding line would be needed. Users may reduce the vapor padding connection to 1 inch, providing vapor flow is sufficient to maintain positive pressure near end of unloading.

Personnel should not sit in the cab while unloading, and the unloading should not go unattended. Workers unloading shipments should wear goggles, protective clothing and protective respiratory equipment if needed.

Spotting Truck

Shut off the truck engine. If for some reason the tractor must be separated from the trailer, do this before making any connections and place a "horse" that is strong enough under the front end. Don't rely on the support wheels to hold the load. Set the brakes and chock the wheels.

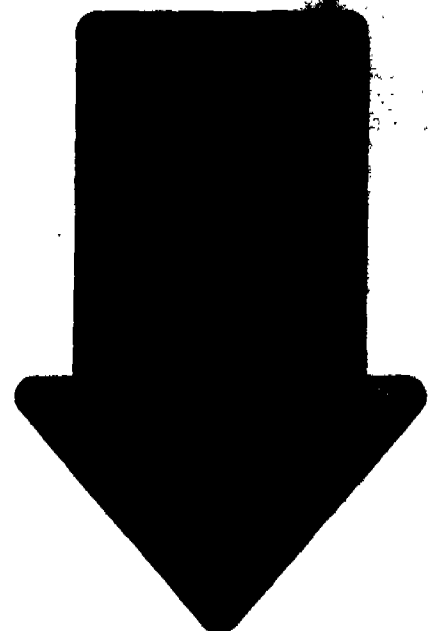
Locate the vinyl chloride truck so as to protect it from collision with a passing vehicle. Allow no vehicular traffic in the area until unloading is completed. If this cannot be done, minimize and control traffic by temporary roadblocks.



Chock the wheels of the tank truck.



In case of emergency while unloading, an internal valve can be shut off by hand levers at the front and back of tank truck.



Preventing Ignition

Static electricity must be dissipated to minimize the fire hazard. Connect a grounding wire between the trailer tank and the unloading line. Also, the truck chassis should be grounded. Flanged joints in the unloading system piping should be bonded by jumper cables. Welded pipe connections are preferable to flanged. Use a commercial meter for checking ground integrity.

All wiring and electrical equipment should be explosion-proof. No flame- or spark-producing devices or smoking by personnel must be allowed in the area.

Follow federal, local and insurance regulations. A fire hose should be available to cool the trailer tank and surrounding equipment in case of fire.

Check Before Unloading

Check all tank truck valves to make sure they are closed, also check valves on the piping from storage tank to process. The valve at the truck end of the liquid line hose should have been closed after the previous delivery. Because liquid vinyl chloride monomer has a high coefficient of expansion, the liquid line to the storage tank should have a safety relief valve no smaller than one inch, preferably located close to the storage tank. Check the storage tank level to make sure there is sufficient room for the truck's contents.

Inspect the pump, vapor line and liquid line hoses or flexible-joint piping for any defects including leaks.



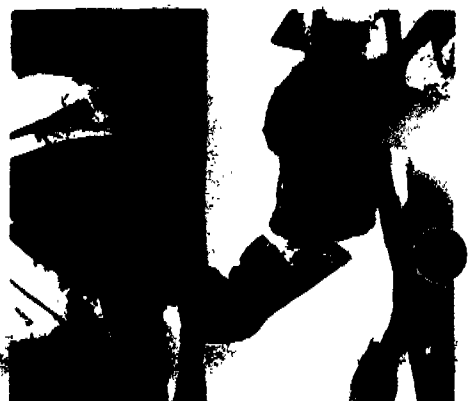
Ground tank truck.



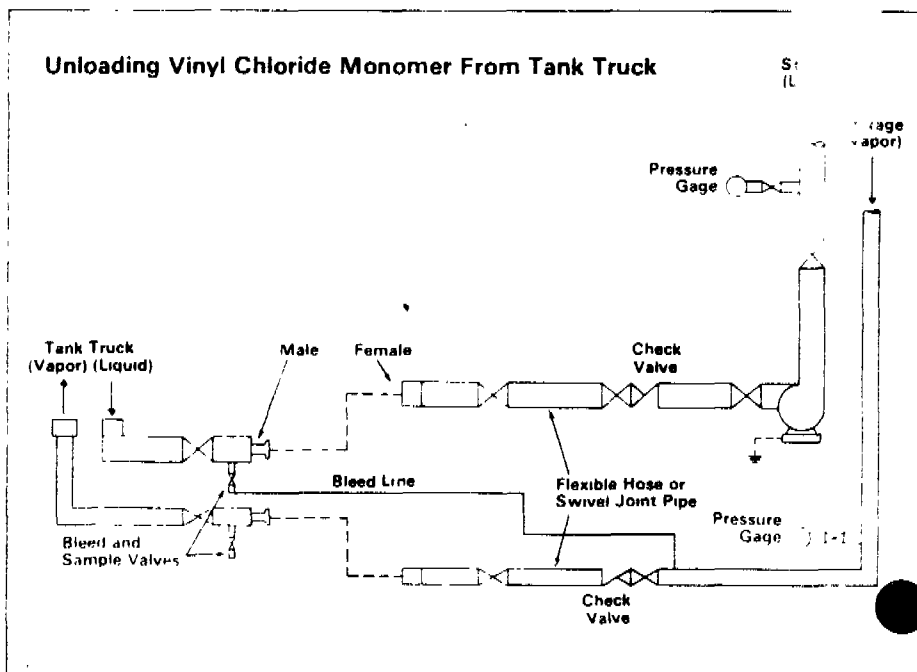
A fire hose and hydrant should be close by in case of fire.



A fire extinguisher should be close at hand.



Check storage tank level before unloading to make sure there is room for the truck's contents.



Store the hose or flexible arm off the ground on a suitable support. The coupling covers should be in place to keep out dirt and moisture.

The short spool piece at the end of the hose should always remain with the hose. Do not substitute a different piping section for it. The spool piece is purposely short to minimize its air content and avoid the need for nitrogen purging. All emptied sections of the system should be clean, dry and free of air before monomer is introduced. If nitrogen purging is necessary, it can be minimized by sealing the line and alternately pressurizing with nitrogen and bleeding off the nitrogen to a remote location or to a recovery system or incinerator.

If the liquid monomer in the truck is cold, its vapor pressure may be quite low. Hook up the coupling of the vapor padding line and ground it. Make sure the closure is tight. If the vapor pressure in the truck drops below 10 psig, bleed pressure from the storage-tank vapor space into the truck vapor space. Aside from the safety aspects, the storage-tank vapor space must be practically free of oxygen and other contaminants to avoid incurring charges for delaying the truck and purging it after the truck returns.

If a vapor compressor is used in addition to, or instead of, a pump, the compressor must not be capable of delivering over 100 psig. The safety relief valve on the truck is rated at 150 psig.



Hook up the vapor padding line



SL 090399

Unloading Procedure

1. Hook up the coupling of the liquid line and ground it. Make sure the closure is tight and the spool piece bleed valve is closed.
2. The coupling of the vapor padding line has already been hooked up and grounded. Open valve from vapor space on storage tank.
3. Slowly open the truck and hose valves of the liquid line.
4. Start the pump and/or vapor compressor. If the excess flow valve in the truck liquid outlet closes, shut the outlet valve until the pressure is equalized. The flow of vinyl chloride from the truck should be regulated by a valve in the hose line, preferably the valve closest to the storage tank. The truck can be unloaded at a rate up to 350 gallons per minute. Keep a positive pressure on the truck vapor space to avoid the possibility of pulling in air and to prevent pump cavitation.
5. A change in the sound of the pump, as well as a pressure drop on the gage, indicates when the liquid has been completely unloaded from the truck. Do not try to pump out vapor from the truck, because this can produce a vacuum and suck in oxygen from the air. If the vapor pressure in the truck drops below 10 psig, bleed pressure from the storage-tank vapor space into the truck vapor space.



Hook up the liquid unloading line



Lever opens and closes internal valve to provide an alternate means of controlling liquid flow in tank truck.



pressure on emptied tank truck to ensure at least 10 psig of vinyl chloride pressure are left.

After Truck Is Emptied

6. As soon as the liquid has been emptied from the truck, shut down the pump and/or compressor. Close the liquid valves on the truck and on the hose. Carefully bleed vapor from the liquid line spool piece (see diagram on page 26 and photo at right) to the storage-tank vapor space

7. When both liquid and vapor pressures are gone, disconnect the liquid line from the truck and install the blind coupling covers. Shut off the bleed valve on the liquid line spool piece.

8. Likewise, disconnect the vapor line from the truck and install the blind coupling covers. Shut off the bleed valve on the vapor line spool piece. Use respiratory protection.

9. Remove electrical grounds

10. Remove chocks to release the truck.



Check emptied tank truck for oxygen with a portable meter.



Unloading barges and ships

Procedures for unloading vinyl chloride monomer from barge and ship cargo tanks are essentially the same as for unloading tank cars. There is, however, more variation in facilities and conditions at customers' plants that may require modifications of unloading methods and equipment. PPG technical service engineers are available for consultation on particular barge- or ship-unloading problems.

Facilities for unloading barges and ships should have self-contained breathing apparatus available for personnel and instruments for monitoring vinyl chloride vapor concentrations.

Construction materials

Aluminum and its alloys must not be used in equipment to store or handle vinyl chloride because explosive aluminum chloroalkyls can be formed. PPG's vinyl chloride is made from ethylene and contains no detectable amount of acetylene. However, vinyl chloride made from acetylene by an older process contains traces of acetylene that could react with copper or its alloys to form explosive copper acetylides. It is not safe to use such vinyl chloride in processing equipment containing copper or brass.

Carbon steel is the recommended construction material for storage tanks, pumps, valves, fittings and pipe to handle vinyl chloride. Although stainless steel is quite satisfactory, it is not necessary. Cast iron or ductile iron should not be used because equipment fracture or breakage could possibly permit a major spill. Equipment and piping should be able to withstand working pressures of 150 psig. If a system containing vinyl chloride monomer may be closed at any time, it should have duplicate relief valves.

Valves and fittings should be of a type that does not require lubrication. Many lubricants are attacked by vinyl chloride and should not be used. Eccentric-type plug valves are available that tighten further as the seats wear out.

Storage tanks

Vinyl chloride has indefinite storage life and does not polymerize when kept in contact with ferrous materials in the absence of air or oxygen, water, light and excessive heat.

Storage areas should be selected to comply with local codes or authorities. Such organizations as the National Board of Fire Underwriters, the Factory Insurance Association and the National Fire Protection Association provide information about site selection on request.

Locate a vinyl chloride storage tank in a segregated area away from major process units. It should be engineered as a Class I, Group D, Division I area and treated as such. Process units such as furnaces or reactors, which have higher than average fire or explosion hazards, should be situated as far from a vinyl chloride storage tank as practical.

To take care of spilled liquid in the event of a tank rupture, adequate dikes and drainage should be constructed (see photo).

Storage tanks should be constructed of materials recommended above, in accordance with the ASME code for unfired pressure vessels. They should be designed to withstand full vacuum or a working pressure of 100 to 150 psig. However, vapor-recompression or refrigerated storage tanks can be designed for lower pressures. All-welded construction is recommended. Tanks should be painted with white or other heat-reflective paint. The installation should include a water-spray system in case of fire.

To prevent a buildup of static electricity while a tank is being filled, the liquid inlet line should extend to the tank bottom. The stand leg should have a hole in it near the top of the tank as a vacuum breaker that prevents blowback. The tank and filling equipment should be grounded against static electricity and lightning. Resistance to ground should not exceed 25 ohms.



Spray nozzle for cooling outside of storage tank in case of fire.



A dike is needed to contain spilled liquid in case a tank should rupture.

- Liquid outlet lines to process should be equipped with check valves to prevent contamination by backflow.
- Adequately sized pressure-relief valves should be installed on top of a storage tank. To allow for periodic removal and inspection of the valves, they should be installed preferably with a 3-way plug cock in the line that can block off first one, then another valve from the tank.
- Indicators of liquid monomer temperature should be installed near the tank bottom to permit observation from the ground. Vapor pressure gages should be connected to the top of the tank but the indicator should be located near the ground. Tanks should also have a liquid level gage with ground-level readout. The level should not exceed 90% of the tank's capacity.

Before a tank receives vinyl chloride monomer, the tank should be cleaned and purged with a dry inert gas until free of oxygen (see photo). The oxygen content must initially be no more than 1,000 ppm by volume. Check tanks regularly for the presence of polymer. Tanks in vinyl chloride service should not be used to store other materials.

After a storage tank has been placed in operation, follow standard procedures to prevent oxygen from entering. For example, when tank cars or other shipping containers are unloaded, they could vent oxygen back to the storage tank, if their vapor space was of poor quality. The tanks must be inerted to remove oxygen, preferably by alternately pressurizing and depressurizing with nitrogen.

Horizontal cylindrical tanks are used at ambient temperatures to hold up to 50,000 gallons of vinyl chloride; for higher capacities, spheres are preferable.

Although vinyl chloride monomer is sometimes stored as a liquid at atmospheric pressure by means of refrigeration, it is usually stored under pressure. The actual pressure inside a storage tank depends on the ambient temperature (see graph on page 10). For example, between the freezing point of water and 25°C (77°F) the internal vapor pressure varies from 1293 to 2943 millimeters of mercury or from 25 to 57 psig. Therefore, every potential leak site should be checked periodically.

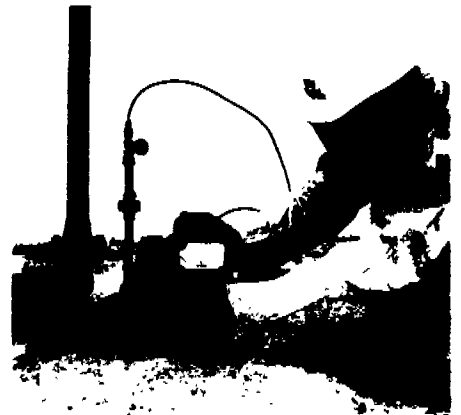
All vessels in the vinyl chloride monomer system should be interconnected by pressure equalization lines, which are connected to a refrigerated vapor-recovery system. The term, "vessels," includes storage tanks, shipping containers and processing equipment. Since it is impossible to condense 100% of the vinyl chloride monomer vapor, the inert gas stream from the refrigeration unit will contain some vinyl chloride monomer.



Sampling storage sphere with continuous loop system.



Reading tank temperature indicator.



Testing storage tank for oxygen with a portable meter.

Transfer lines

To empty a line of vinyl chloride monomer, take care to bleed it off safely either to a condensing system or to a remote location. Then blow out the line with nitrogen. Before any maintenance such as welding is performed on a long transfer line, steaming should be continued for several hours. The line will have to be reamed if polymer has formed.

Relief valves on transfer lines should be vented to the top of a vinyl chloride monomer storage tank.

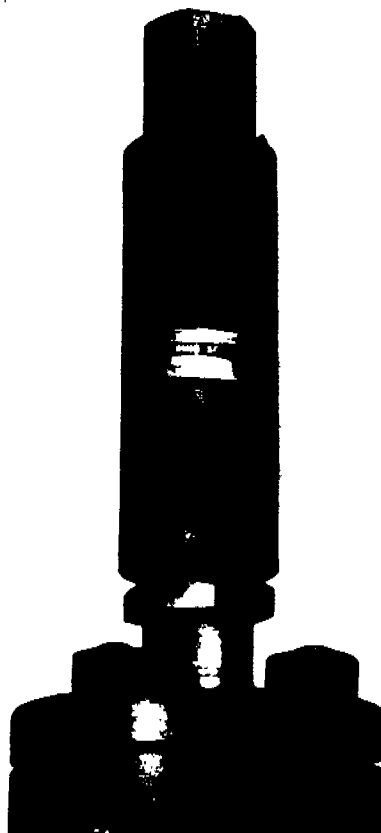
To prevent the buildup of static electricity, pipe connections should preferably be welded. If flanged connections are used, they should be bonded with jumper cables.

Waste disposal

Waste contaminated with vinyl chloride monomer is toxic and a potential fire hazard. The handling of vinyl chloride monomer waste must be done with strict adherence to the OSHA standard, "Exposure to Vinyl Chloride."

Vinyl chloride monomer waste should not be permitted to enter sewers or drains because potentially explosive vapor concentrations can collect.

Waste disposal depends largely on the surroundings, weather and the type of emergency that requires the disposal. Observe all federal, state and local regulations regarding health and pollution.



Relief valve on transfer line is vented to top of storage tank.

Monitoring exposures

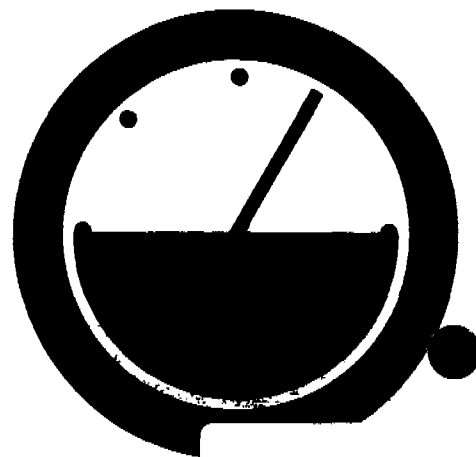
Equipment for determining concentrations of vinyl chloride monomer vapor in workplace air can be divided into three classes: (1) personal, (2) fixed area and (3) portable area monitoring.

1. In the method that NIOSH (National Institute for Occupational Safety and Health) has been using for personal monitoring, air from the worker's breathing zone is drawn through a tube that can be clipped to his shirt collar. Suction comes from a battery-operated pump that can fit into his shirt pocket or over his belt. Activated charcoal in the tube traps the vinyl chloride while the pump runs for 15 minutes. For analysis, the vinyl chloride is removed from the charcoal with carbon disulfide and is subsequently determined on a laboratory gas chromatograph having a flame ionization detector.

An alternative method gaining popularity because of its speed is an air bag strapped to a worker's back. A battery-operated pump attached to his person draws vapor into the bag. Injecting a needle into the bag obtains a sample for gas chromatographic analysis.

2. Fixed area monitoring uses either a gas chromatograph or infrared spectrophotometer. A suction pump near the instrument draws samples through long tubes ending at remote, fixed-site pickup points, commonly ten or twelve points. An automatic programmer provides sequential analyses of the multiple sampling points for cycles such as several minutes each. The instrument can be equipped to sound an alarm when a preset exposure limit is exceeded.

3. Portable instruments are used where fixed area monitoring is impractical. They can also serve for detecting leaks and for making rapid surveys of areas. The various types of portable instruments used include the infrared spectrophotometer, flame ionization instruments, and instruments that measure total hydrocarbons.





Personal monitoring device traps any vinyl chloride vapor on activated charcoal in tube



Personal monitoring device collects air and any vapor in plastic bag.

Reducing Exposure to Vapors in the Laboratory

Store all sample bombs in a rack inside a fume hood. The hood should be large enough to permit doing all analyses without removing sample bombs from hood. Sample lines in and out of the chromatograph sampling valve should be piped to the hood. The "sample in" line is connected to a rotameter to measure sample flow. Thus, chromatographic sampling is carried out without removing sample bombs from hood.

If the chromatograph has a thermal conductivity detecting cell, the exit gas—consisting of vinyl chloride monomer vapor and the carrier gas—should be vented to the hood. However, if the chromatograph has a flame ionization detecting system, the vinyl chloride will be completely burned to form hydrogen chloride and carbon dioxide.



All analyses should be performed without removing sample bombs from hood.



Portable area monitoring instrument can also be used for detecting leaks.