

Introduction



Introduction

This second edition reflects the work practice changes required by the Occupational Safety and Health Standard published October 4, 1974, in the Federal Register. The procedures recommended in this manual follow the work practice guidelines adopted for PPG plants producing vinyl chloride monomer. Of course, some PPG practices may not be applicable to individual customer operations.

The Chemical Division of PPG Industries manufactures vinyl chloride monomer at Lake Charles, Louisiana, and at Guayanilla, Puerto Rico. The combined capacity of these two facilities is rated at 900 million pounds per year. This capacity makes PPG a major supplier of vinyl chloride monomer to producers of polyvinyl chloride resins. PPG is also a major supplier of percarbonate polymerization initiators used in the manufacture of polyvinyl chloride. The following pages show PPG's large-scale commitment to vinyl chloride monomer production.

ASI 000013637

Commitment

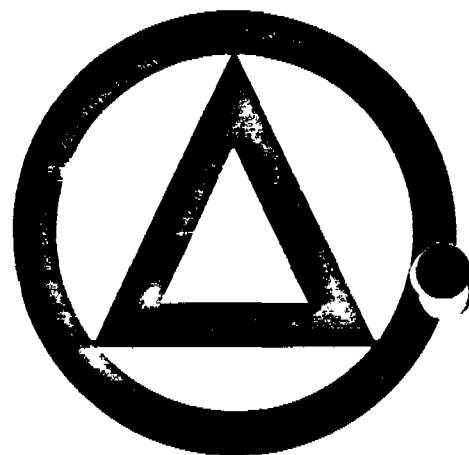
PPG's Commitment To Vinyl Chloride Monomer Production

In 1969, PPG expanded its Lake Charles, Louisiana vinyl chloride plant and, in 1971, built a Puerto Rican plant that greatly expanded PPG's capacity for producing chlorine and vinyl chloride monomer. Built at the same time nearby in Puerto Rico was an olefins plant half-owned by PPG. Its annual capacity includes one billion pounds of ethylene, which PPG combines with chlorine to produce vinyl chloride monomer.

A new large tanker, the S.S. Puerto Rican, transports refrigerated vinyl chloride monomer to a terminal at Paulsboro, New Jersey. There vinyl chloride monomer is stored under refrigeration and shipped to customers in tank cars and in a fleet of dedicated tank trucks. PPG can also ship vinyl chloride monomer at ambient temperatures by barge and ocean-going ships as well as by pipeline.

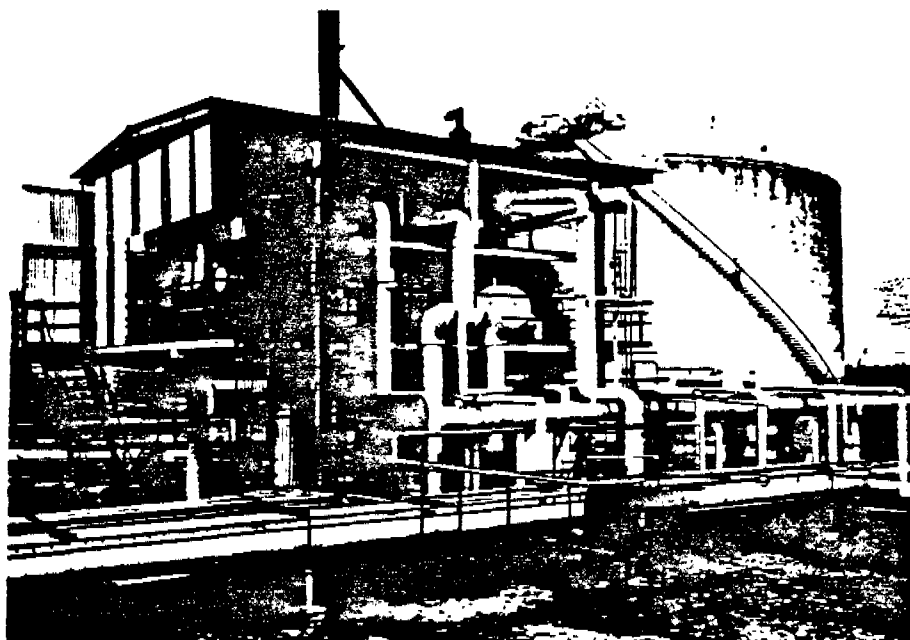
PPG produces vinyl chloride monomer by an oxyhydrochlorination process and holds more than 400 domestic and foreign patents on this technology. PPG developed the process in the early 1950s and commercialized it in the early 1960s.

Related to PPG's vinyl chloride monomer is its production of vinylidene chloride monomer.





At the PPG plant in Guayanilla, Puerto Rico, the company's modern 34,000-ton chemical tanker, S.S. Puerto Rico, receives a load of vinyl chloride monomer that will travel under refrigeration to Paulsboro, New Jersey.



In the foreground is the refrigeration unit of a vinyl chloride monomer storage tank at the Paulsboro, New Jersey terminal. This is the

nation's largest terminal for vinyl chloride monomer and the world's largest for refrigerated vinyl chloride monomer.



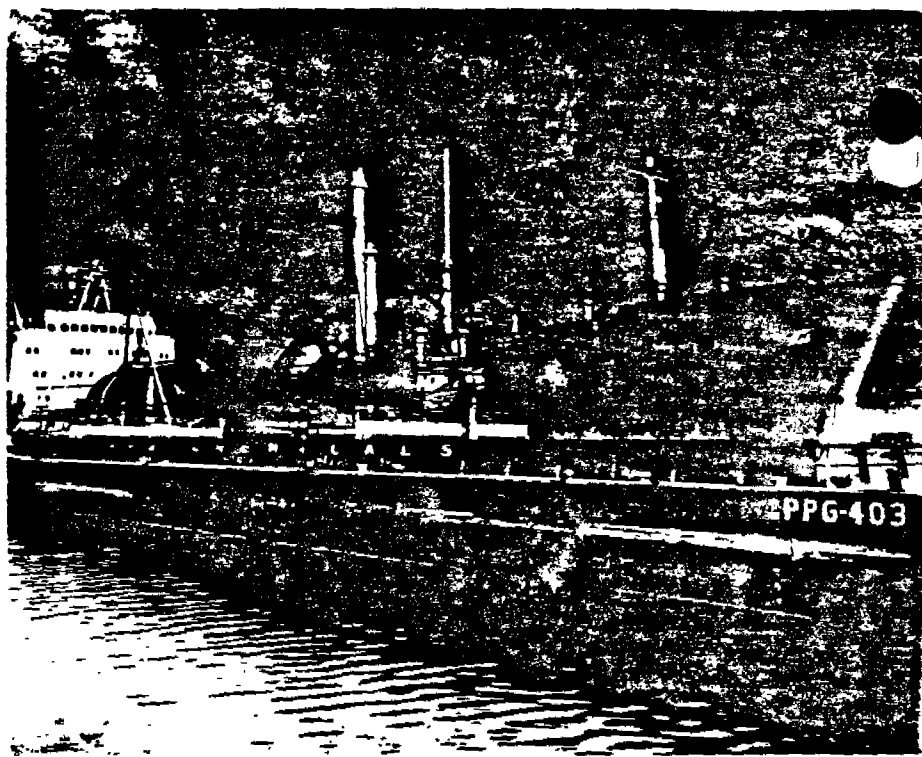
Tank truck is being loaded with 20 tons of liquid vinyl chloride monomer under pressure.

PPG offers the East Coast's first tank truck deliveries of vinyl chloride monomer. The

Paulsboro terminal can store 53.3 million pounds of the monomer.



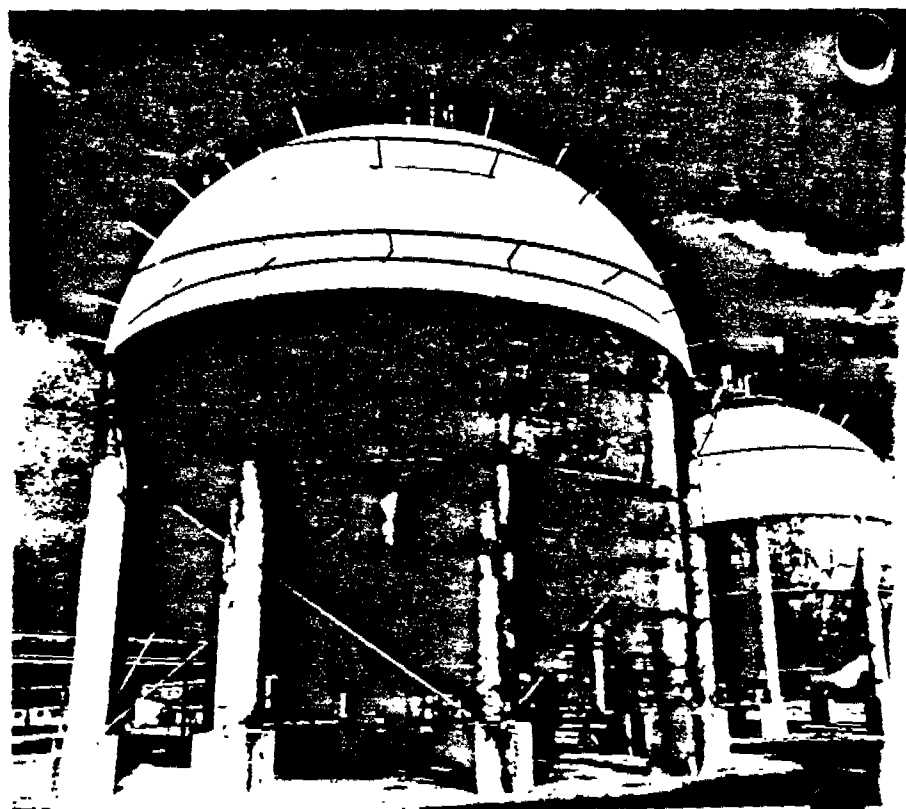
At PPG's Lake Charles, Louisiana plant, a tank car is being loaded with liquid vinyl chloride monomer under pressure. PPG has a fleet of tank cars dedicated to vinyl chloride service.



Norwegian vessel has taken on a cargo tank of liquid vinyl chloride monomer under pressure from the PPG plant in Lake Charles, Louisiana. PPG loads ships with up to six million pounds of monomer.



Barge holding cargo tanks of liquid vinyl chloride monomer under pressure is being loaded at the PPG plant in Lake Charles, Louisiana. From there, the barge can travel up the Mississippi and Ohio rivers. A barge can hold four million pounds of monomer.



Storage spheres at PPG's Lake Charles, Louisiana plant hold thousands of gallons each of liquid vinyl chloride monomer under pressure. Horizontal storage tanks at right serve as quality control tanks.

Proposals

ASI 000013641



Properties

Chemical Names:

Vinyl chloride, vinyl chloride monomer, chloroethylene, chloroethene

Chemical Formula: CH₂CHCl

Molecular Weight: 62.5

Description:

At ordinary temperatures and pressures, vinyl chloride is a colorless gas with a mild, sweet odor. But as supplied in tank cars and trucks under pressure, it is a liquid. Vinyl chloride is highly volatile and its vapor is extremely flammable. Containers are labeled "cancer-suspect agent."

Boiling Point, °C —13.8
°F +7.0

Freezing Point, °C —153.7
°F —245

Flash Point, open cup, °C —78
°F —108.4

Explosive Limits, volume %
in air at 25°C (77°F) 3.6 to 33

Autoignition Temperature, °C 472
°F 882

Critical Temperature, °C 158.4
°F 317

Critical Pressure, psia 775
Vapor Density, air = 1 2.15

Solubility,
water in monomer at 25°C
(77°F), weight % 0.11

Solubility

Vinyl chloride is relatively insoluble in water but soluble in most organic solvents.

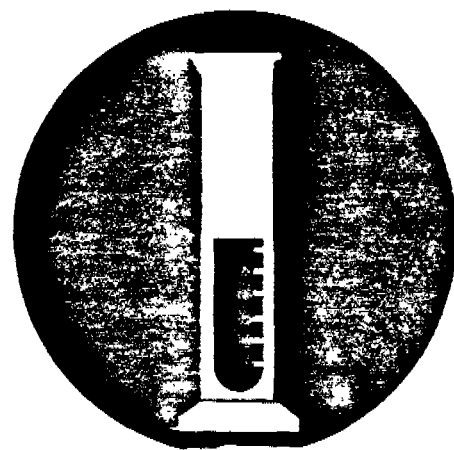
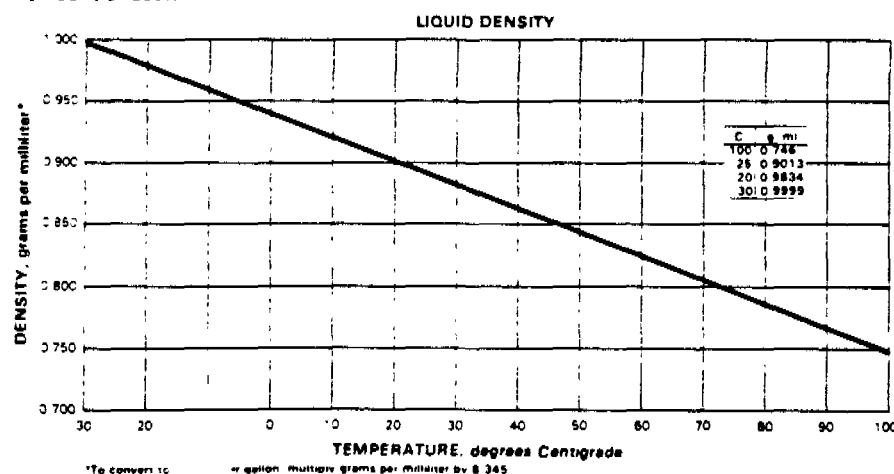
Reactivity

Vinyl chloride polymerizes exothermically in the presence of light, air, oxygen or catalysts. Heat alone will not initiate polymerization. Vinyl chloride is thermally stable to quite high temperatures. Although peroxide formation due to air exposure is a slow reaction, certain peroxide products are shock-sensitive. Vinyl chloride is noncorrosive to metals when dry at normal ambient temperatures, but water at elevated temperatures accelerates corrosion. The double bond behaves as in other unsaturated compounds. The chlorine atom is relatively inactive and is more stable than in saturated or allylic compounds.

Specification and Typical Analysis:

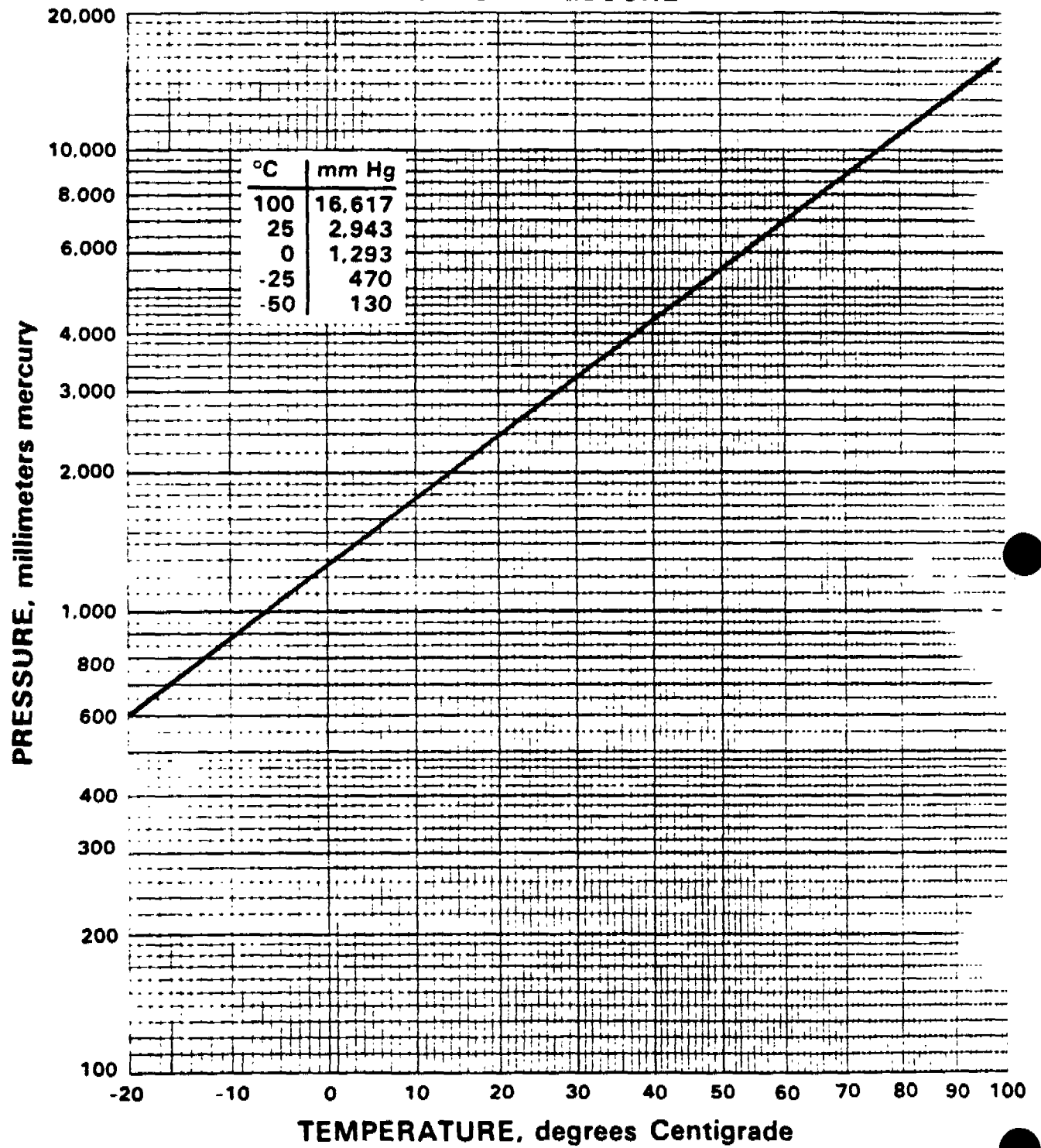
	<i>Specification</i>	<i>Typical Analysis</i>
Appearance	clear, free of suspended matter	clear, free of suspended matter
Color	colorless, water-white	colorless, water-white
Acidity, as HCl, ppm	5 maximum	<1
Iron, as Fe, ppm (filtered sample)	0.5 maximum	0.1
Nonvolatile residue, weight %	0.05 maximum	0.0003
Water, ppm	100 maximum	34
Sulfur, as SO ₂ , ppm	3 maximum	<1
Acetaldehyde, ppm	5 maximum	<1
Acetylene, ppm	2 maximum*	<1

*This maximum is an industry standard; however, the PPG product contains no detectable amount of acetylene.



ASI 000013643

VAPOR PRESSURE



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Fir 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.

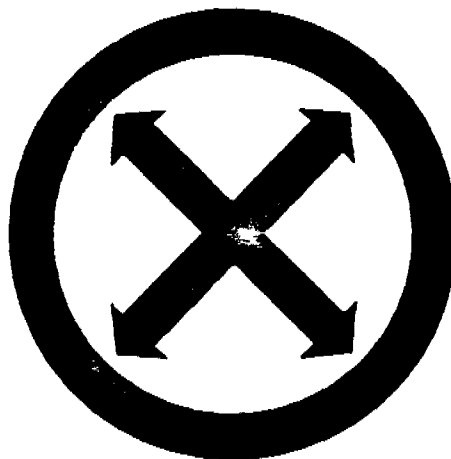
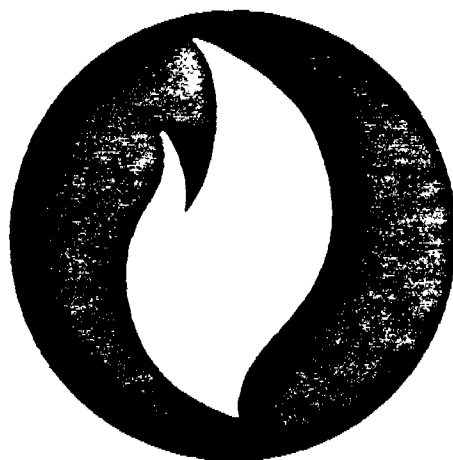
Chemical reactions

Contamination of uninhibited vinyl chloride monomer may catalyze polymerization, which is highly exothermic, or cause decomposition which liberates toxic hydrogen 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 (rat, 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 cannot 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 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**

*"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 vessels, respiratory protection shall be worn at all times. Where the concentration of vinyl chloride monomer inside the vessel has been purged below 25 ppm, and there is adequate oxygen content to support life, an approved chemical canister mask shall be worn. Where 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.



ASI 000013649

and
Union

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

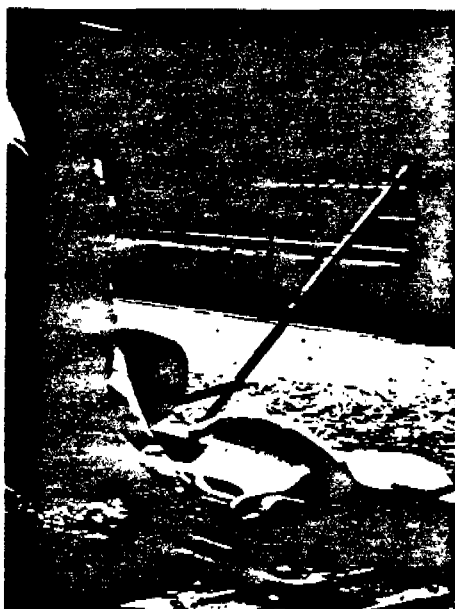
Spot tank car accurately on level track. Set car brakes and block wheels with standard rail clamps. Unless car is protected by a closed and locked switch or gate, attach a derail to open end of track. Place caution signs complying with DOT regulations on track or car to give warning to persons approaching 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.

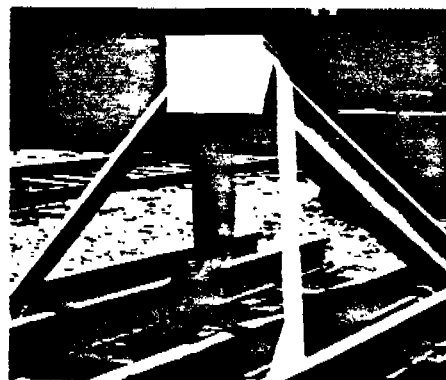
Workmen unloading shipments should wear goggles and protective clothing, that is, garments suited to the particular situation and probable extent of exposure.

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 check 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.

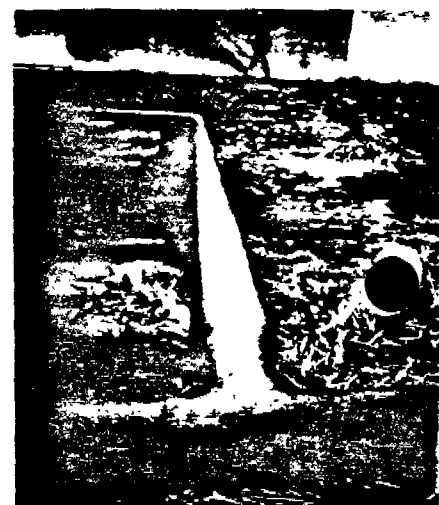
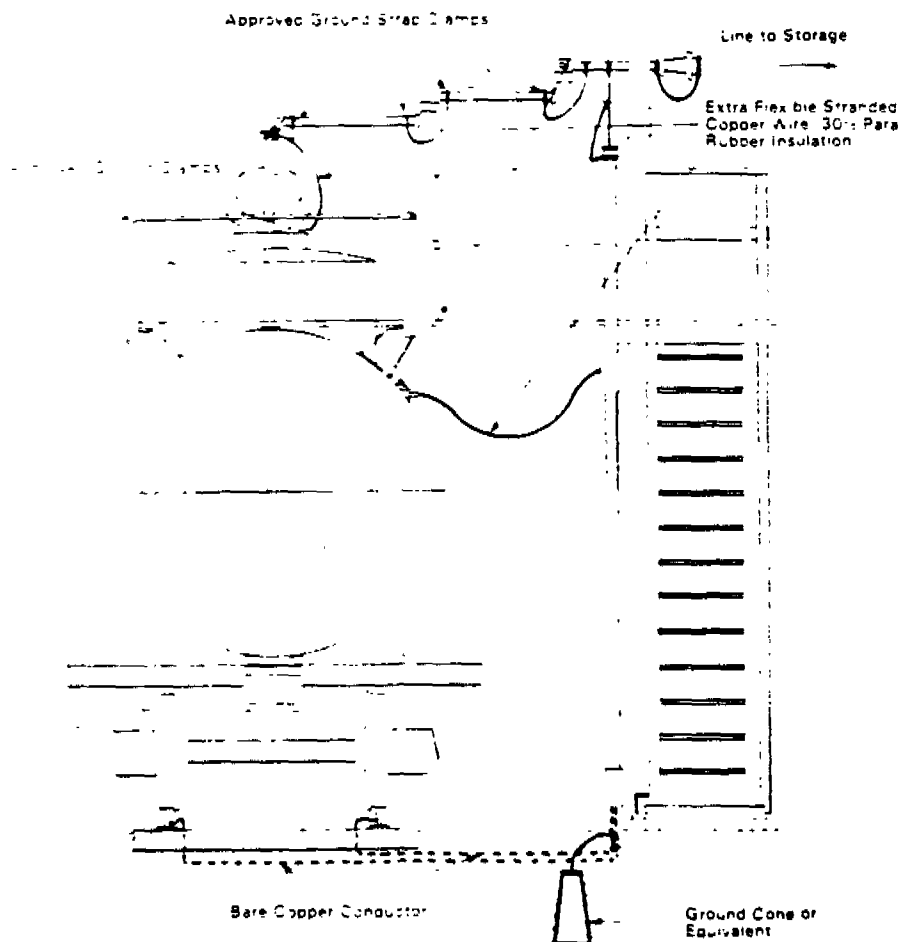


Ground the tank car before unloading.



Flanged joints should be bonded by jumper cables.

Grounding Arrangement



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.

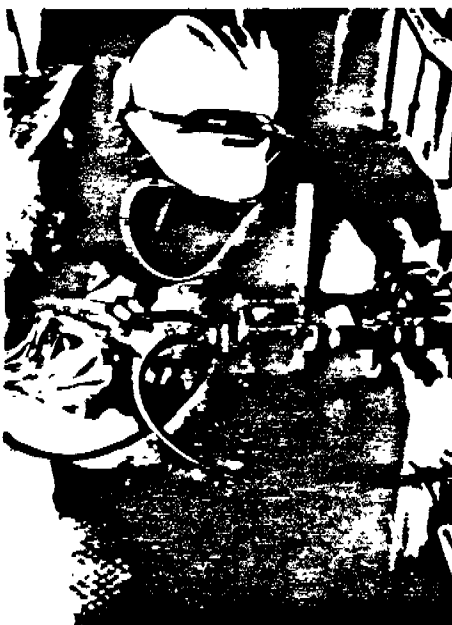
Check storage-tank level to make sure there is sufficient room for the car's contents. The PPG tank car is equipped with a gage rod assembly (see diagram of tank car fittings below) for measuring the level of vinyl chloride.

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 2-inch opening to obtain the temperature of the vinyl chloride when desired.

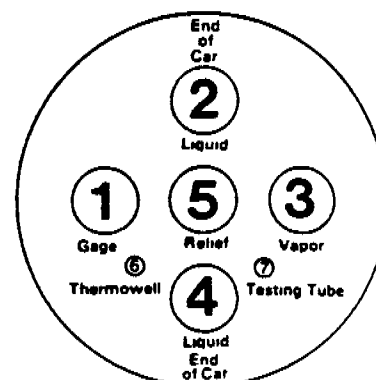


Bull's-eye sighting device permits observing liquid without exposure to vapor.



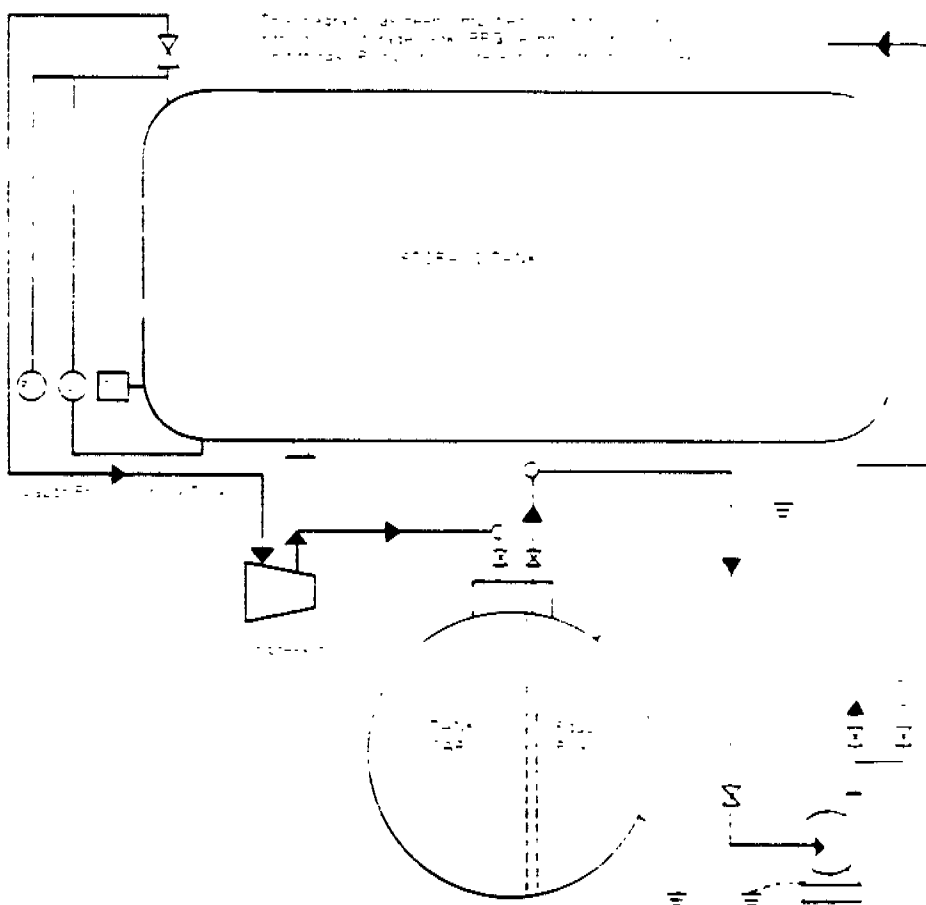
Measure level of vinyl chloride monomer liquid in tank car with gage rod assembly

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

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 96% of the water weight capacity of the tank. Vinyl chloride vapor occupies a 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.

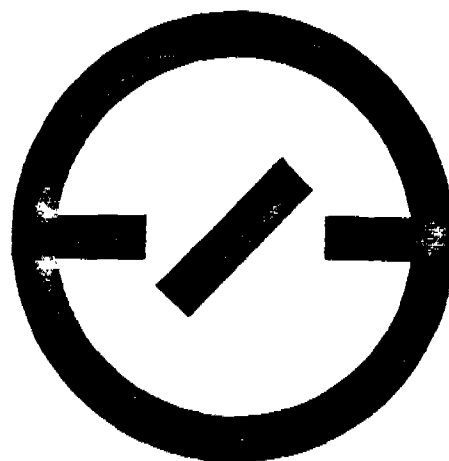
Checking Unloading Progress

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.

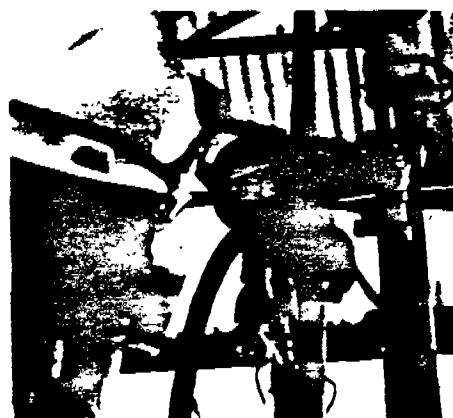
Do not allow tank car to stand with unloading connections attached after unloading has been completed. Remove all lines from the car and disconnect grounding wires.

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.



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 1- 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. The tank trucks have a net weight of 40,000 pounds corresponding to a nominal capacity of 5,200 gallons. The trucks are unloaded on either side from the bottom near 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" strong enough under the front. Don't rely on the support wheels and the load. Set the brakes and chock the wheels.

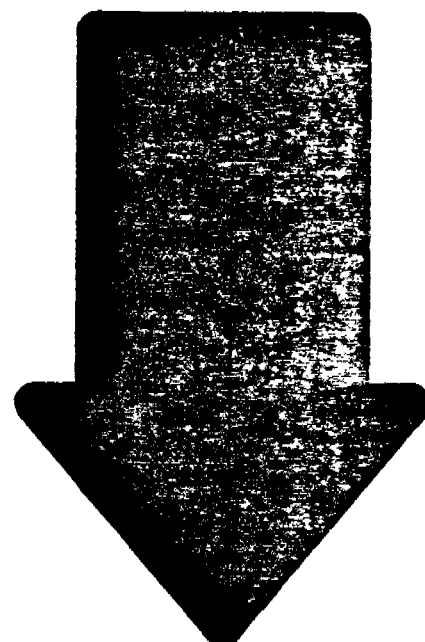
Locate the vinyl chloride truck so as to protect it from collision with a passing vehicle. Allow no vehicular traffic in the area until unloading is completed. If this cannot be done, minimize and control traffic by temporary roadblocks.



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.

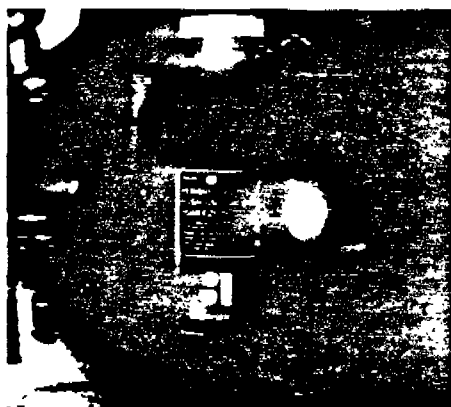
Inspect the pump, vapor line and liquid line hoses or flexible-joint piping for any defects including leaks.



Ground the 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.

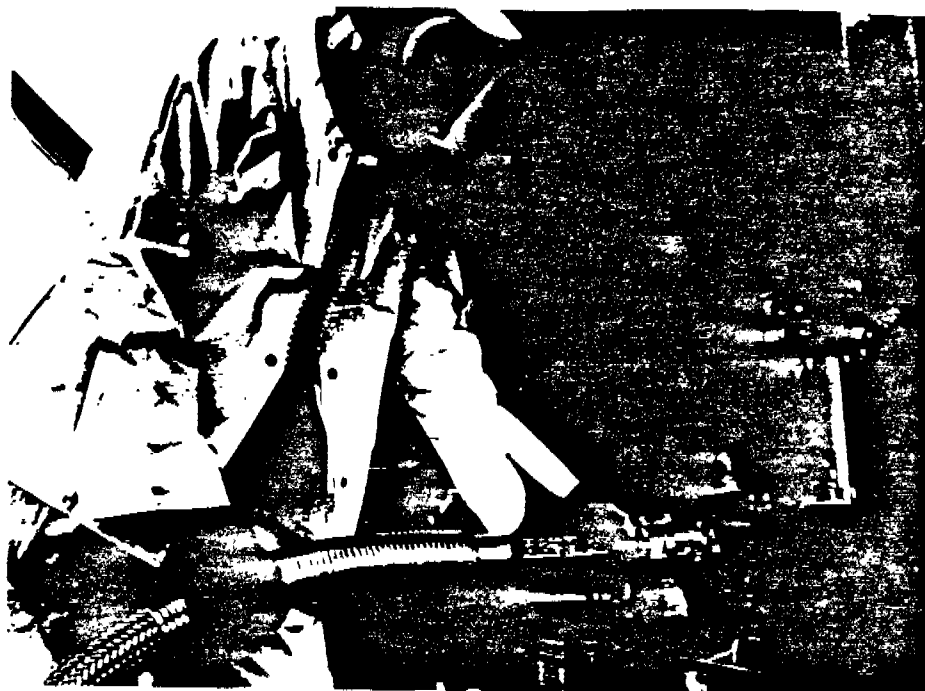
Unloading Vinyl Chloride Monomer From Tank Truck

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.

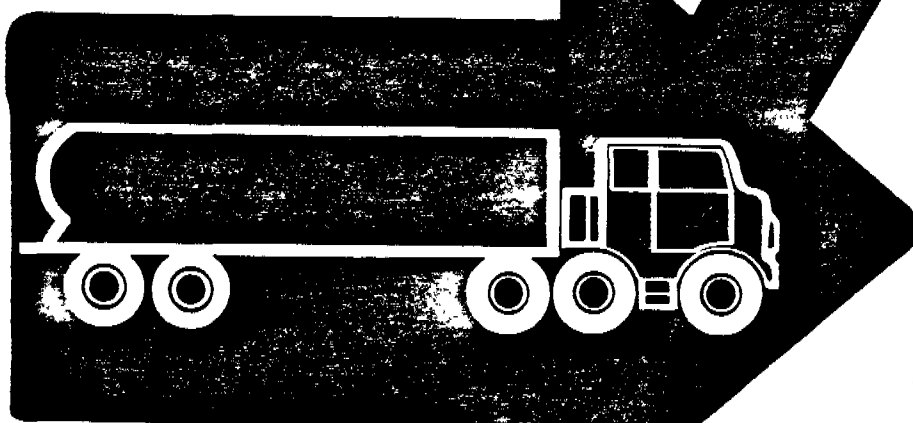
A short spool piece at the end of the hose should always remain with the hose. Do not substitute a different piping section for it. The spool piece is purposely short to minimize its air content and avoid the need for nitrogen purging. All emptied sections of the system should be clean, dry, and free 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.



Unloading Procedure

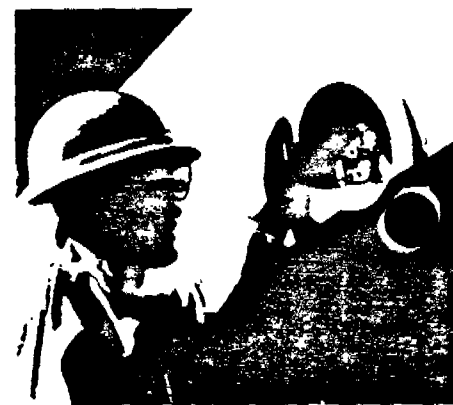
1. Hook up the coupling of the liquid line and ground it. Make sure the closure is tight and the spool piece bleed valve is closed.
2. The coupling of the vapor padding line has already been hooked up and grounded. Open valve from vapor space on storage tank.
3. Slowly open the truck and hose valves 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.



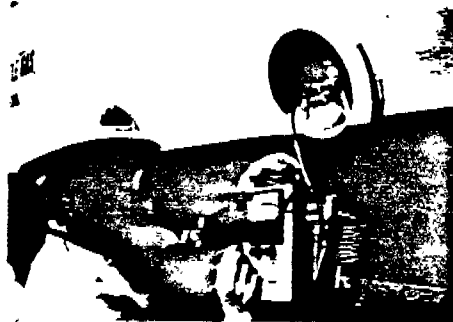
Lever opens and closes internal valve to provide an alternate means of controlling liquid flow from tank truck.



Check pressure on emptied tank truck to make sure at least 10 psig of vinyl chloride vapor 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 1 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.

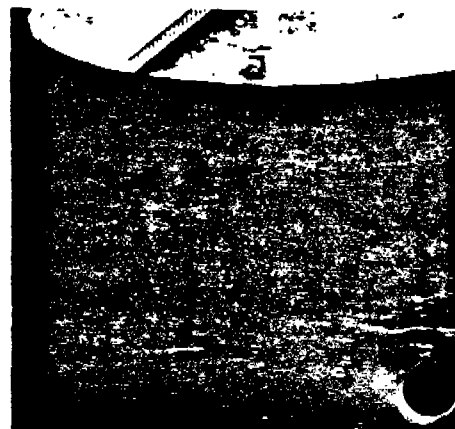
To take care of spilled liquid in the event of a tank rupture, adequate dikes and drainage should be constructed (see photo).

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.

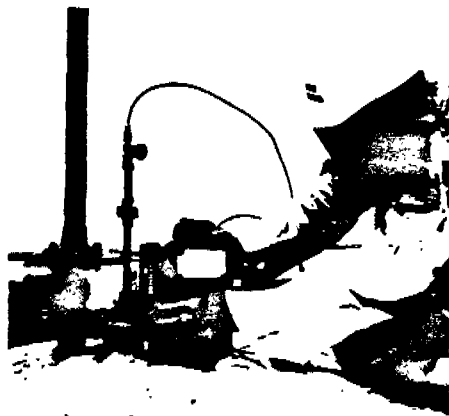
Since it is impossible to condense 100% of the vinyl chloride monomer vapor, the inert gas stream from the refrigeration unit will contain some vinyl chloride monomer.



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.

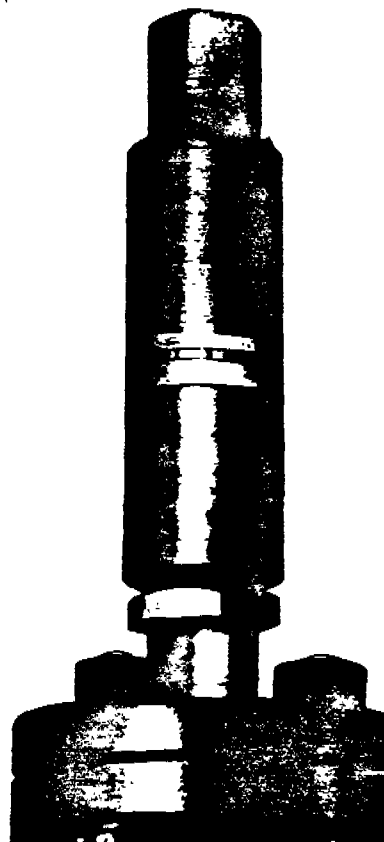
To prevent the buildup of static electricity, pipe connections should preferably be welded. If flanged connections are used, they should be bonded with jumper cables.

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

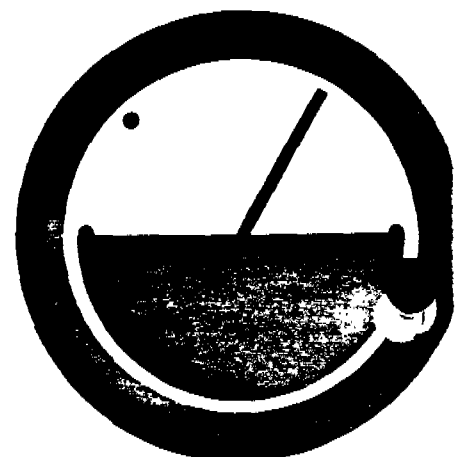
Equipment for determining concentrations of vinyl chloride monomer vapor in workplace air can be divided into three classes: (1) personal, (2) fixed area and (3) portable area monitoring.

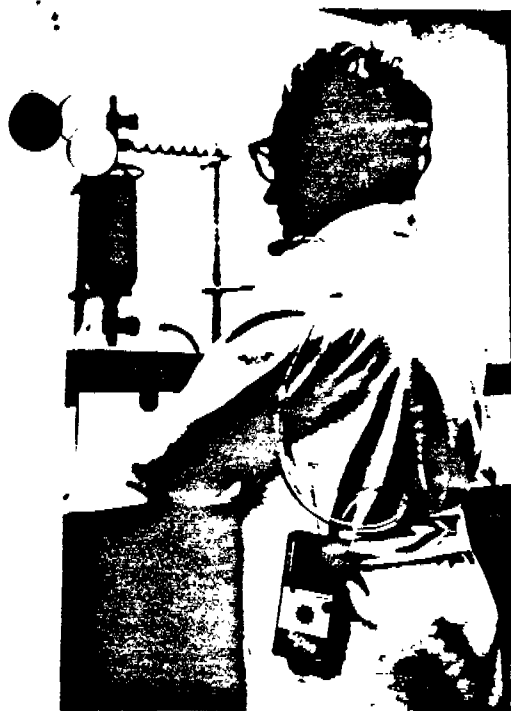
1. In the method that NIOSH (National Institute for Occupational Safety and Health) has been using for personal monitoring, air from the worker's breathing zone is drawn through a tube that can be clipped to his shirt collar. Suction comes from a battery-operated pump that can fit into his shirt pocket 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 air through long tubes ending at several 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.



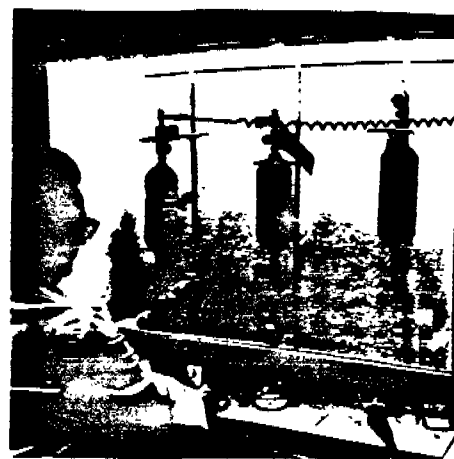


Personal monitoring device traps any vinyl chloride vapor on activated charcoal in tube

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.

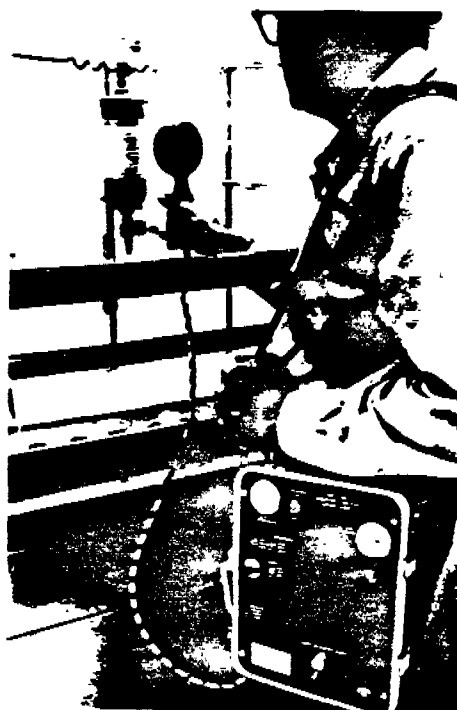
If the chromatograph has a thermal conductivity detecting cell, the exit gas—consisting of vinyl chloride monomer vapor and the carrier gas—should be vented to the hood. However, if the chromatograph has a flame ionization detecting system, the vinyl chloride will be completely burned to form hydrogen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



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



Full-face monitoring device filters air and traps any vinyl chloride gas



Portable area monitoring instrument can also be used for detecting leaks

Analysis

Methods Of Analysis

The following abstracts are taken from the methods of analyses used by PPG Industries' Chemical Division to make the determinations listed under Specification and Typical Analysis on page 9. Copies of the complete methods are available on request from PPG's technical service staff.

Acidity, as HCl

This method involves the determination of the acidity or alkalinity of vinyl chloride monomer by absorption in neutral distilled water and titration of the absorbate to a pH of 7.0 with sodium hydroxide.



Testing for impurities in vinyl chloride monomer with gas chromatograph at PPG plant in Lake Charles, Louisiana.

Iron, as Fe

This method involves the spectrophotometric measurement of the color produced by the ferrous-*o*-phenanthroline complex. The vinyl chloride is allowed to evaporate from an alcohol-acid solution, and the iron is determined on the resulting solution.

Nonvolatile residue

A known weight of vinyl chloride is evaporated to dryness, and the weight of the residue is reported as non-volatile residue.

Water

This method involves the determination of water in vinyl chloride monomer by titration with Karl Fischer reagent. The end point is determined electrometrically utilizing a suitable "dead-stop" titration apparatus.

Sulfur

This method involves the conversion of sulfur in vinyl chloride to sulfate and precipitation as barium sulfate. Barium sulfate is measured turbidimetrically with a spectrophotometer.

Acetaldehyde

The reaction of carbonyl compounds with 2,4-dinitrophenylhydrazine is the basis of the determination of acetaldehyde in vinyl chloride monomer. The reaction takes place under acid conditions in carbonyl-free methanol solvent to form the hydrazone. The addition of a solution of potassium hydroxide produces an intense wine-red color. The absorbance maximum occurs at 480 nm and is measured against a reagent blank.

Purchasing

Purchasing Information

Grades

PPG Industries produces only polymer-grade vinyl chloride monomer.

PPG normally supplies vinyl chloride monomer uninhibited. This eliminates the need for subsequent processing to remove the inhibitor. If required, PPG will add a suitable inhibitor.

Shipping

PPG Industries delivers vinyl chloride monomer by ship, barge, tank car and tank truck. There are three shipping points:

Guayanilla, Puerto Rico
Lake Charles, Louisiana
Paulsboro, New Jersey

The tank trucks hold up to 40,000 pounds of vinyl chloride. Tank car capacity is 180,000-pounds net weight. Ships ordinarily hold up to 6 million pounds and barges up to 4 million pounds.

PPG has a fleet of tank cars for vinyl chloride service only and leases a fleet of tank trucks designed and used only for delivering vinyl chloride.

Tank truck shipments, normally made within a 100-mile radius of Paulsboro, N.J., offer several benefits to customers:

Lower Investment

Frequent deliveries by tank truck permit lower investment in inventoried material both in tank and in transit. Since smaller storage facilities can suffice, less capital need be invested.

Fast Service

Truck deliveries provide fast service on short notice and can supply unusual as well as usual demands.

Savings on Assays and Polymerization Batch Control

The Paulsboro terminal has two huge storage tanks each holding over 26 million pounds of vinyl chloride. Because of these tremendous quantities, the vinyl chloride monomer in these tanks is more homogeneous than material coming from smaller tanks.

Dedicated Drivers

Truck drivers are trained and dedicated for vinyl chloride service. They are safe drivers and maintain good community relations.

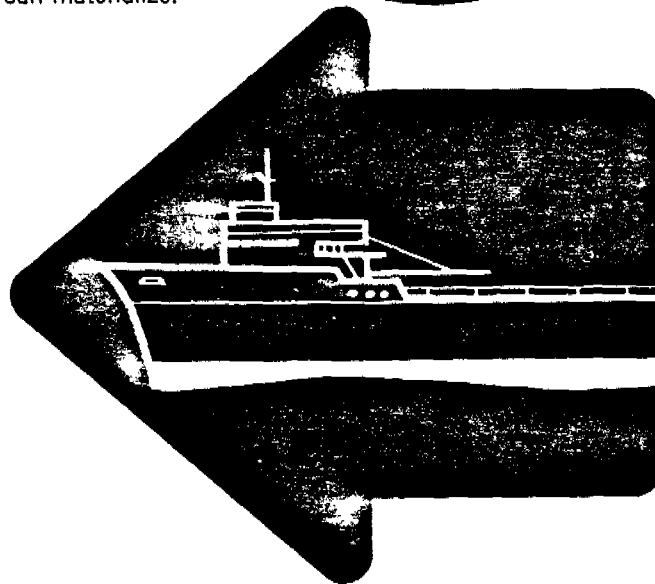
Rail Track Space Savings

Depending on the customer's situation, this advantage too can materialize.

Samples and service

Samples of vinyl chloride monomer are available on special request in returnable laboratory-size steel cylinders holding 5 pounds.

The Pittsburgh-based technical service staff of PPG Industries' Chemical Division is available for consulting on handling, storage and use.

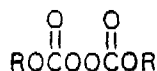


Percarbonate Initiators

Percarbonate Initiators For The Polymerization Of Vinyl Chloride

PPG Industries' Chemical Division supplies a line of peroxydicarbonate initiators for the polymerization of vinyl chloride, ethylene and other unsaturated monomers. These initiators provide free radicals at considerably lower reaction temperatures than most organic peroxide initiators. Because of their high efficiency, the peroxydicarbonates are used by companies that produce most of the annual U.S. output of polyvinyl chloride.

PPG has marketed diisopropyl peroxydicarbonate (IPP) for close to 30 years. Although many users prefer handling solid initiators such as IPP, those who find undiluted liquid initiators or their solutions advantageous can now select di-n-propyl peroxydicarbonate (NPP), di-sec-butyl peroxydicarbonate (SBP) or di-(2-ethylhexyl) peroxydicarbonate (EHP). Peroxydicarbonates have the same general formula:



Advantages that IPP, NPP, SBP and EHP have over other initiators for the production of polyvinyl chloride and other polymers include the capability of the peroxydicarbonates to:

Reduce Time of Batch Runs

Enable fast rate of conversion during the very first hour of reaction and, when the run is terminated, the polymerization rate remains high and constant.

Increase Production

Because batch runs take less time, a much greater annual output of polymer can be produced from the same equipment with peroxydicarbonates.

Make Polymerization Easier to Control

Rate of heat evolution is nearly constant. No large exotherm occurs near end of run as with many polymerization initiators that accelerate reactions near the end. In comparison with other commonly used peroxides, a peroxydicarbonate permits easier termination of a batch polymerization.

Improve Polymer Characteristics

Lower reaction temperatures, linear conversion rates, and less initiator residues are among the factors considered responsible for improving such characteristics as color, electrical resistivity, and stability to ultraviolet light and weathering.

Peroxydicarbonates are powerful oxidizing agents. They are hazardous chemicals shipped under refrigeration and must be stored under refrigeration. Many users prefer handling solid IPP because the heat of fusion provides a safety factor; that is, the solid must melt before it decomposes. Also, pieces that have dropped are easier to pick up and dispose of than liquid spills.

However, other users find the undiluted liquid forms and solutions easier to handle and prefer adding initiator to process volumetrically instead of by weight. Also, NPP, SBP and EHP are more soluble in most of the solvents used to dilute peroxydicarbonate initiators.

More information

Detailed information appears in a 40-page booklet, "Percarbonate Polymerization Initiators," form A-961, available on request.

federal register

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PART II



DEPARTMENT OF LABOR

**Occupational Safety And
Health Administration**

■

EXPOSURE TO VINYL CHLORIDE

**Occupational Safety and
Health Standards**

ASI 000013669

RULES AND REGULATIONS

of the operation or because of an accident in the operation, which would result in an employee exposure in excess of the permissible exposure limit.

(8) "OSHA Area Director" means the Director for the Occupational Safety and Health Administration Area Office having jurisdiction over the geographic area in which the employer's establishment is located.

(9) "Polyvinyl chloride" means polyvinyl chloride homopolymer or copolymer before such is converted to a fabricated product.

(10) "Vinyl chloride" means vinyl chloride monomer.

(c) *Permissible exposure limit.* (1) No employee may be exposed to vinyl chloride at concentrations greater than 1 ppm 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.

(d) *Monitoring.* (1) A program of initial monitoring and measurement shall be undertaken in each establishment to determine if there is any employee exposed, without regard to the use of respirators, in excess of the action level.

(2) Where a determination conducted under paragraph (d)(1) of this section shows any employee exposures, without regard to the use of respirators, in excess of the action level, a program for determining exposures for each such employee shall be established. Such a program:

(i) Shall be repeated at least monthly where any employee is exposed, without regard to the use of respirators, in excess of the permissible exposure limit.

(ii) Shall be repeated not less than quarterly where any employee is exposed, without regard to the use of respirators, in excess of the action level.

(iii) May be discontinued for any employee only when at least two consecutive monitoring determinations, made not less than 5 working days apart, show exposures for that employee at or below the action level.

(3) Whenever there has been a production, process or control change which may result in an increase in the release of vinyl chloride, or the employer has any other reason to suspect that any employee may be exposed in excess of the action level, a determination of employee exposure under paragraph (d)(1) of this section shall be performed.

(4) The method of monitoring and measurement shall have an accuracy (with a confidence level of 95 percent) of not less than plus or minus 50 percent from 0.25 through 0.5 ppm, plus or minus 35 percent from over 0.5 ppm through 1.0 ppm, and plus or minus 25 percent over 1.0 ppm. (Methods meeting these accuracy requirements are available in the "NIOSH Manual of Analytical Methods").

(5) Employees or their designated representatives shall be afforded reasonable

opportunity to observe the monitoring and measuring required by this paragraph.

(e) *Regulated area.* (1) A regulated area shall be established where:

(i) Vinyl chloride or polyvinyl chloride is manufactured, reacted, repackaged, stored, handled or used; and

(ii) Vinyl chloride concentration in excess of the permissible exposure limit.

(2) Access to regulated areas shall be limited to authorized persons. A daily roster shall be made of authorized persons who enter.

(f) *Methods of compliance.* Employee exposures to vinyl chloride shall be controlled to at or below the permissible exposure limit provided in paragraph (c) of this section by engineering, practice, and personal protective devices as follows:

(1) Feasible engineering practice controls shall immediately be used to reduce exposures to at or below the permissible exposure limit.

(2) Wherever feasible engineering practice controls which are instituted immediately are not sufficient to reduce exposures to at or below the permissible exposure limit, they shall nevertheless be used to reduce exposures to the lowest practicable level, and shall be supplemented by respiratory protection in accordance with paragraph (g) of this section. A program shall be established and implemented to reduce exposures to at or below the permissible exposure limit, or to the greatest extent feasible by means of engineering and practice controls, as soon as feasible.

(3) Written plans for such a program shall be developed and furnished upon request for examination and copying to authorized representatives of the Assistant Secretary and the Director. Such plans shall be updated at least every six months.

(g) *Respiratory protection.* Where respiratory protection is required under this section:

(1) The employer shall provide a respirator which meets the requirements of this paragraph and shall assure that the employee uses such respirator, except that until December 31, 1975, wearing of respirators shall be at the discretion of each employee for exposures not in excess of 25 ppm, measured over any 15-minute period. Until December 31, 1975, each employee who chooses not to wear an appropriate respirator shall be informed at least quarterly of the hazards of vinyl chloride and the purpose, use, and limitations of respiratory devices.

(2) Respirators shall be selected among those jointly approved by Mining Enforcement and Safety Administration, Department of the Interior, and the National Institute for Occupational Safety and Health under the provisions of 30 CFR Part 11.

(3) A respiratory protection program meeting the requirements of § 1910.134 shall be established and maintained.

(4) Selection of respirators for vinyl chloride shall be as follows:

§ 1910.93q Vinyl chloride.

(a) *Scope and application.* (1) This section includes requirements for the control of employee exposure to vinyl chloride (chloroethene), Chemical Abstracts Service Registry No. 75015.

(2) This section applies to the manufacture, reaction, packaging, repackaging, storage, handling or use of vinyl chloride or polyvinyl chloride, but does not apply to the handling or use of fabricated products made of polyvinyl chloride.

(3) This section applies to the transportation of vinyl chloride or polyvinyl chloride except to the extent that the Department of Transportation may regulate the hazards covered by this section.

(b) *Definitions.* (1) "Action level" means a concentration of vinyl chloride of 0.5 ppm averaged over an 8-hour work day.

(2) "Assistant Secretary" means the Assistant Secretary of Labor for Occupational Safety and Health, U.S. Department of Labor, or his designee.

(3) "Authorized person" means any person specifically authorized by the employer whose duties require him to enter a regulated area or any person entering such an area as a designated representative of employees for the purpose of exercising an opportunity to observe monitoring and measuring procedures.

(4) "Director" means the Director, National Institute for Occupational Safety and Health, U.S. Department of Health, Education, and Welfare, or his designee.

(5) "Emergency" means any occurrence such as, but not limited to, equipment failure, or operation of a relief device which is likely to, or does, result in massive release of vinyl chloride.

(6) "Fabricated product" means a product made wholly or partly from polyvinyl chloride, and which does not require further processing at temperatures, and for times, sufficient to cause mass melting of the polyvinyl chloride resulting in the release of vinyl chloride.

(7) "Hazardous operation" means any operation, procedure, or activity where a release of either vinyl chloride liquid or gas might be expected as a consequence

RULES AND REGULATIONS

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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) Type C, supplied air respirator continuous flow type, with full or half facepiece, and auxiliary self-contained air supply.
(iii) Not over 100 ppm.....	(A) Combination type C supplied air respirator demand type, with full facepiece, and auxiliary self-contained air supply; or (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.
(iv) 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 4 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 4 hours for concentrations of vinyl chloride up to 25 ppm.
(v) 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 1 hour for concentrations of vinyl chloride up to 10 ppm.

(5) (i) Entry into unknown concentrations or concentrations greater than 36,000 ppm (lower explosive limit) may be made only for purposes of life rescue; and

(ii) Entry into concentrations of less than 36,000 ppm, but greater than 3,600 ppm may be made only for purposes of life rescue, firefighting, or securing equipment so as to prevent a greater hazard from release of vinyl chloride.

(6) Where air-purifying respirators are used:

(i) Air-purifying canisters or cartridges shall be replaced prior to the expiration of their service life or the end of the shift in which they are first used, whichever occurs first, and

(ii) A continuous monitoring and alarm system shall be provided where concentrations of vinyl chloride could reasonably exceed the allowable concentrations for the devices in use. Such system shall be used to alert employees when vinyl chloride concentrations exceed the allowable concentrations for the devices in use.

(7) Apparatus prescribed for higher concentrations may be used for any lower concentration.

(h) *Hazardous operations.* (1) Employees engaged in hazardous operations, including entry of vessels to clean polyvinyl chloride residue from vessel walls, shall be provided and required to wear and use;

(i) Respiratory protection in accordance with paragraphs (c) and (g) of this section; and

(ii) Protective garments to prevent skin contact with liquid vinyl chloride or with polyvinyl chloride residue from vessel walls. The protective garments shall be selected for the operation and its possible exposure conditions.

(2) Protective garments shall be provided clean and dry for each use.

(i) *Emergency situations.* A written operational plan for emergency situations shall be developed for each facility storing, handling, or otherwise using vinyl chloride as a liquid or compressed gas. Appropriate portions of the plan shall be implemented in the event of an emergency. The plan shall specifically provide that:

(1) Employees engaged in hazardous operations or correcting situations of existing hazardous releases shall be equipped as required in paragraph (h) of this section;

(2) Other employees not so equipped shall evacuate the area and not return until conditions are controlled by the methods required in paragraph (f) of this section and the emergency is abated.

(j) *Training.* Each employee engaged in vinyl chloride or polyvinyl chloride operations shall be provided training in a program relating to the hazards of vinyl chloride and precautions for its safe use.

(1) The program shall include:

(i) The nature of the health hazard from chronic exposure to vinyl chloride including specifically the carcinogenic hazard;

(ii) The specific nature of operations which could result in exposure to vinyl chloride in excess of the permissible limit and necessary protective steps;

(iii) The purpose for, proper use, and limitations of respiratory protective devices;

(iv) The fire hazard and acute toxicity of vinyl chloride, and the necessary protective steps;

(v) The purpose for and a description of the monitoring program;

(vi) The purpose for, and a description of, the medical surveillance program;

(vii) Emergency procedures;

(viii) Specific information to aid the employee in recognition of conditions which may result in the release of vinyl chloride; and

(ix) A review of this standard at the employee's first training and indoctrination program, and annually thereafter.

(2) All materials relating to the program shall be provided upon request to the Assistant Secretary and the Director.

(k) *Medical surveillance.* A program of medical surveillance shall be instituted for each employee exposed, without regard to the use of respirators, to vinyl chloride in excess of the action level. The program shall provide each such employee with an opportunity for examinations and tests in accordance with this paragraph. All medical examinations and procedures shall be performed by or under the supervision of a licensed physician, and shall be provided without cost to the employee.

(i) At the time of initial assignment, or upon institution of medical surveillance;

(i) A general physical examination shall be performed, with specific attention to detecting enlargement of liver, spleen or kidneys, or dysfunction in these organs, and for abnormalities in skin, connective tissues and the pulmonary system (See Appendix A).

(ii) A medical history shall be taken, including the following topics:

(A) Alcohol intake;
(B) Past history of hepatitis;
(C) Work history and past exposure to potential hepatotoxic agents, including drugs and chemicals;
(D) Past history of blood transfusions; and
(E) Past history of hospitalizations.

(iii) A serum specimen shall be obtained and determinations made of:

(A) Total bilirubin;
(B) Alkaline phosphatase;
(C) Serum glutamic oxalacetic transaminase (SGOT);
(D) Serum glutamic pyruvic transaminase (SGPT); and
(E) Gamma glutamyl transpeptidase.

(2) Examinations provided in accordance with this paragraph shall be performed at least:

(i) Every 6 months for each employee who has been employed in vinyl chloride or polyvinyl chloride manufacturing for 10 years or longer; and

(ii) Annually for all other employees.

(3) Each employee exposed to an emergency shall be afforded appropriate medical surveillance.

(4) A statement of each employee's suitability for continued exposure to vinyl chloride including use of protective equipment and respirators, shall be obtained from the examining physician promptly after an examination. A copy of the physician's statement shall be provided each employee.

(5) If any employee's health would be materially impaired by continued exposure, such employee shall be with-

drawn from possible contact with vinyl chloride.

(6) Laboratory analyses for all biological specimens included in medical examinations shall be performed in laboratories licensed under 42 CFR Part 74.

(7) If the examining physician determines that alternative medical examinations to those required by paragraph (k)(1) of this section will provide at least equal assurance of detecting medical conditions pertinent to the exposure to vinyl chloride, the employer may accept such alternative examinations as meeting the requirements of paragraph (k)(1) of this section, if the employer obtains a statement from the examining physician setting forth the alternative examinations and the rationale for substitution. This statement shall be available upon request for examination and copying to authorized representatives of the Assistant Secretary and the Director.

(i) **Signs and labels.** (1) Entrances to regulated areas shall be posted with legible signs bearing the legend:

CANCER-SUSPECT AGENT AREA AUTHORIZED PERSONNEL ONLY

(2) Areas containing hazardous operations or where an emergency currently exists shall be posted with legible signs bearing the legend:

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

(3) Containers of polyvinyl chloride resin waste from reactors or other waste contaminated with vinyl chloride shall be legibly labeled:

**Contaminated with
VINYL CHLORIDE CANCER-SUSPECT AGENT**

(4) Containers of polyvinyl chloride shall be legibly labeled:

**POLYVINYL CHLORIDE (OR TRADE NAME)
Contains
VINYL CHLORIDE
VINYL CHLORIDE IS A CANCER-SUSPECT AGENT**

(5) Containers of vinyl chloride shall be legibly labeled either:

(i) **VINYL CHLORIDE
EXTREMELY FLAMMABLE GAS UNDER PRESSURE
CANCER-SUSPECT AGENT**

or (ii) In accordance with 49 CFR Part 173, Subpart H, with the additional legends:

CANCER-SUSPECT AGENT
applied near the label or placard.
(6) No statement shall appear on or near any required sign, label or instruction

which contradicts or detracts from the effect of, any required warning, information or instruction.

(m) **Records.** (1) All records maintained in accordance with this section shall include the name and social security number of each employee where relevant.

(2) Records of required monitoring and measuring, medical records, and authorized personnel rosters, shall be made and shall be available upon request for examination and copying to authorized representatives of the Assistant Secretary and the Director.

(i) **Monitoring and measuring records shall:**

(A) State the date of such monitoring and measuring and the concentrations determined and identify the instruments and methods used;

(B) Include any additional information necessary to determine individual employee exposures where such exposures are determined by means other than individual monitoring of employees; and

(C) Be maintained for not less than 30 years.

(ii) Authorized personnel rosters shall be maintained for not less than 30 years.

(iii) Medical records shall be maintained for the duration of the employment of each employee plus 20 years, or 30 years, whichever is longer.

(3) In the event that the employer ceases to do business and there is no successor to receive and retain his records for the prescribed period, these records shall be transmitted by registered mail to the Director, and each employee individually notified in writing of this transfer.

(4) Employees or their designated representatives shall be provided access to examine and copy records of required monitoring and measuring.

(5) Former employees shall be provided access to examine and copy required monitoring and measuring records reflecting their own exposures.

(6) Upon written request of any employee, a copy of the medical record of that employee shall be furnished to any physician designated by the employee.

(n) **Reports.** (1) Not later than 1 month after the establishment of a regulated area, the following information shall be reported to the OSHA Area Director. Any changes to such information shall be reported within 15 days.

(i) The address and location of each establishment which has one or more regulated areas; and

(ii) The number of employees in each regulated area during normal operation, including maintenance.

(2) Emergencies, and the facts obtainable at that time, shall be reported within 24 hours to the OSHA Area Director. Upon request of the Area Director, the employer shall submit additional information in writing relevant to the nature and extent of employee exposures and measures taken to prevent future emergencies of similar nature.

(3) Within 10 working days following any monitoring and measuring which discloses that any employee has been exposed, without regard to the use of respirators in excess of the permissible exposure limit, each such employee shall be notified in writing of the results of the exposure measurement and the steps being taken to reduce the exposure to within the permissible exposure limit.

(o) **Effective dates.** (1) Until January 1, 1975, the provisions currently set forth in § 1910.93q of this Part shall apply.

(2) Effective January 1, 1975, the provisions set forth in § 1910.93q of this Part shall apply.

APPENDIX A—SUPPLEMENTARY MEDICAL INFORMATION

When required tests under paragraph (k)(1) of this section show abnormalities, the tests should be repeated as soon as practicable, preferably within 3 to 4 weeks. If tests remain abnormal, consideration should be given to withdrawal of the employee from contact with vinyl chloride, while a more comprehensive examination is made.

Additional tests which may be used:

A. For kidney dysfunction: urine examination for albumin, red blood cells, and exfoliative abnormal cells.

B. Pulmonary system: Forced vital capacity, Forced expiratory volume at 1 second, and chest roentgenogram (posterior-anterior, 14 x 17 inches).

C. Additional serum tests: Lactic acid dehydrogenase, lactic acid dehydrogenase isoenzyme, protein determination, and protein electrophoresis.

D. For a more comprehensive examination on repeated abnormal serum tests: Hepatitis B antigen, and liver scanning.

(Secs. 6 and 8, 84 Stat. 1596, 1599 (29 U.S.C. 655, 657); Secretary of Labor's Order No. 12-71, 36 FR 8754)

Signed at Washington, D.C., this 1st day of October, 1974.

JOHN STENDER,
Assistant Secretary of Labor.

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