



THE CHLORINE INSTITUTE

Pamphlet 49

*Recommended Practices
for Handling Chlorine
Bulk Highway Transports*

Edition 9



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1. INTRODUCTION

1.1 SCOPE

This pamphlet provides guidelines, recommended practices and other useful information for the safe shipping, receiving, testing and handling of cargo tank motor vehicles and portable tanks used to transport chlorine by highway. It represents a compendium of Institute membership experience as of the date of publication.

1.2 CHLORINE INSTITUTE STEWARDSHIP PROGRAM

The Chlorine Institute, Inc. exists to support the chlor-alkali industry and serve the public by fostering continuous improvements to safety and the protection of human health and the environment connected with the production, distribution and use of chlorine, sodium and potassium hydroxides, and sodium hypochlorite: and the distribution and use of hydrogen chloride. This support extends to giving continued attention to the security of chlorine handling operations.

Chlorine Institute members are committed to adopting CI's safety and stewardship initiatives, including pamphlets, checklists, and incident sharing, that will assist members in achieving measurable improvement. For more information on the Institute's stewardship program, visit CI's website at www.chlorineinstitute.org.

1.3 DEFINITIONS

In this pamphlet, the following meanings apply unless otherwise noted:

cargo tank	any tank permanently attached to or forming a part of any motor vehicle or any bulk liquid or compressed gas packaging not permanently attached to any motor vehicle which by reason of its size, construction or attachment to a motor vehicle, is loaded or unloaded without being removed from the motor vehicle. This does not include a portable tank.
cargo tank motor vehicle	a motor vehicle with one or more cargo tanks permanently attached to or forming an integral part of the motor vehicle (49 CFR 171.8)
carrier	a person engaged in the transportation of passengers or property as a common, contract or private carrier
CCPA	Canadian Chemical Producers Association
CFR	Code of Federal Regulations
chlorine	dry chlorine (either liquid or gas)

DCE	Design certifying engineer
dry air or nitrogen	air or nitrogen dried to a dew point of -40°F (-40°C) or below measured at the operating pressure
DOT	U.S. Department of Transportation
DHS	U.S. Department of Homeland Security
FMCSA	Federal Motor Carrier Safety Administration
filling density	the percent ratio of the weight of gas in the tank to the weight of water that the tank will hold (49 CFR 173.315)
Institute	The Chlorine Institute, Inc.
kPa	kilopascal(s)
motor vehicle	a vehicle, machine, tractor, trailer or semi-trailer, or any combination thereof, propelled or drawn by mechanical power and used upon the highways in the transportation of passengers or property (49 CFR 171.8)
NPSH	Net Positive Suction Head
NTTC	National Tank Truck Carriers, Inc.
PHMSA	Pipeline and Hazardous Materials Safety Administration
TC	Transport Canada
TSA	Transportation Security Administration
portable tank	a bulk packaging (except a cylinder having a water capacity of 1000 lbs or less) designed primarily to be loaded onto or on, or temporarily attached to a transport vehicle or ship and equipped with skids, mounting, or accessories to facilitate handling of the tank by mechanical means. It does not include a cargo tank, tank car, multi-unit tank car tank, or trailer carrying 3AX, 3AAX, or 3T cylinders (49 CFR 171.8)
psig	pounds per square inch gauge
tank	the chlorine containing vessel which conforms to MC 331, MC 330, or DOT 51

1.4 DISCLAIMER

The information in this pamphlet is drawn from sources believed to be reliable. The Institute and its members, jointly and severally, make no guarantee and assume no liability in connection with any of this information. Moreover, it should not be assumed that every acceptable procedure is included or that special circumstances may not warrant modified or additional procedures. The user should be aware that changing technology or regulations may require a change in the recommendations herein. Appropriate steps should be taken to ensure the information is current when used. These suggestions should not be confused with federal, state, provincial, municipal or insurance requirements, or with national safety codes.

1.5 APPROVAL

The Institute's Transportation Issue Team approved Edition 9 of this pamphlet on January 15, 2009.

1.6 REVISIONS

Suggestions for revision should be directed to the Secretary of the Institute.

1.7 REPRODUCTION

The contents of this pamphlet are not to be copied for publication, in whole or in part, without prior Institute permission.

2. **GENERAL INFORMATION**

2.1 CHLORINE IN COMMERCE

Chlorine is classified for transportation by the DOT as a Class 2, Division 2.3 poison gas with a subsidiary corrosive hazard. In Canada, chlorine is classified by TC as a Class 2, Division 2.3 poison gas with a secondary classification of Class 5, Division 5.1 oxidizer. The classification in Mexico is the same as in Canada. The United Nations identification for chlorine is U.N. 1017. New chlorine cargo tanks must be constructed in accordance with specification MC 331. Existing MC 330 specification cargo tanks are also authorized for the carriage of chlorine provided the tank was marked or certified before May 15, 1967. Chlorine may also be carried in a Specification 51 portable tank.

2.2 RELATED PUBLICATIONS

For additional information on the physical properties of chlorine, cargo handling, personal protective equipment and cargo tank motor vehicle and portable tank related items, the reader should refer to Section 14.

A source of information for shippers and carriers with guidance on day-to-day operational concerns with tank truck transportation of chemicals is the Inter-Industry Bulk Chemical Highway Safety Task Force Recommendations published by the American Chemistry Council and NTTCC.

Sources of security guidance include The Chlorine Institute Security Management Plan for Transportation and On-Site Storage and Use of Chlorine Cylinders, Ton Containers and Cargo Tanks, and the American Trucking Association Sample Hazmat Transportation Security Plan (Reference 14.6.2).

3. EMERGENCY RESPONSE

3.1 EMERGENCY PLANNING

Facilities and Transfer Sites

All personnel responsible for transfer operations should be completely familiar with the facility's emergency plan for handling spills and leaks of product.

Transportation

The DOT has specific training requirements applicable to the handling of hazardous materials. Shippers must familiarize themselves with these requirements. In particular, DOT requires each operator of a cargo tank motor vehicle to have written procedures for all delivery operations. The procedures must describe the emergency discharge control features. For chlorine cargo tanks, this includes the parameters within which the excess flow valves will function to shut down cargo flow in the event there is a complete separation of the cargo transfer hose. Reference is made to 49 CFR 177.840(I) (Reference 14.2.1).

CHLOREP

The Chlorine Emergency Plan (CHLOREP) is an industry-wide program established by the Institute to improve the speed and effectiveness of response to chlorine emergencies in the United States and Canada. Under this plan the United States and Canada have been divided into regional sectors where chlorine emergency teams from producing, packager and consuming plants are on a 24-hour alert to handle potential or actual chlorine emergencies. During a chlorine emergency, any carrier, customer, or civil authority can obtain basic emergency information and be put in contact with the closest chlorine emergency group by phoning an emergency dispatch agency.

3.2 CHEMTREC AND CANUTEC

For transportation-related incidents in the U.S., one should utilize CHEMTREC, the Chemical Transportation Emergency Center in Arlington, VA, as the dispatch agency. CHEMTREC operates around-the-clock, 24 hours-a-day, seven days-a-week to receive direct-dial, toll-free calls from any point in the United States and Canada at 1-800-424-9300 (800-262-8200 for all other calls). CHEMTREC provides immediate advice for those at the scene of emergencies, then, if the emergency involves chlorine, promptly contacts the designated CHLOREP team, the shipper and others as required.

Registration with CHEMTREC is provided through the American Chemistry Council. In Canada, one should utilize CANUTEC, the Canadian Transport Emergency Centre in Ottawa as the dispatch agency. Their telephone number is 613-996-6666 (call collect). CANUTEC, administered by TC, operates in a similar manner to CHEMTREC.

3.3 EMERGENCY KITS AND RESPONSE TRAINING

Leaks that may occur in chlorine tanks usually involve the angle valves or pressure relief device and can be controlled with the Institute's Emergency Kit C. Over 2000 of these and earlier kits are in existence throughout the United States and Canada. These kits should be on site or readily available where tanks are in storage or in use. Each chlorine motor vehicle must carry an emergency kit.

The driver of the motor vehicle and shipper/receiver response personnel must be trained to properly apply this kit in emergency situations. A useful introduction to training for a chlorine emergency is found in The Chlorine Institute's DVD "Chlorine Emergencies: An Overview for First Responders".

3.4 PERSONAL PROTECTIVE EQUIPMENT

DOT regulations specify that chlorine tank motor vehicles be shipped with a gas mask approved for chlorine service. In the U.S. all respiratory equipment and maintenance thereof must comply with OSHA standards. Since it is unlikely the concentration of chlorine present in an emergency situation can be adequately monitored, it is recommended that a self contained breathing apparatus (SCBA) with a full face piece with at least 20 minutes of air operated in the positive pressure mode be carried on the motor vehicle. Institute recommendations on a suitable respiratory protection program are contained in CI Pamphlet 65. The driver of the vehicle must be trained in and familiar with all respiratory protection furnished. SCBA should also be available at loading and unloading sites.

3.5 REPORTING OF RELEASE

Chlorine is identified as hazardous substances in Table 302.4 - *List of Hazardous Substances and Reportable Quantities* of 40 CFR 302.4. CERCLA requires immediate notification of a release equal to or in excess of the reportable quantity while in transportation or at shipping or receiving facilities when not in transportation. The reportable quantity of chlorine is 10 pounds (4.54 Kg). Should a reportable release occur in the U.S., the law requires the National Response Center (1-800-424-8802) to be immediately notified. Incidents that occur in transportation also require reporting to DOT in a 5800 report. In Canada appropriate provincial response authorities must be immediately advised of a chlorine release of any quantity. State, provincial and local laws may require reporting to the appropriate state and/or local environmental agencies at lower thresholds or of any quantity.

4. REGULATORY REQUIREMENTS AND GUIDANCE FOR SAFETY AND SECURITY

4.1 DOT REGULATIONS

The DOT regulates the acceptance and transportation of hazardous materials including the specifications for shipping containers. As chlorine is a hazardous material, it is imperative that personnel involved in any aspect of handling, packaging and/or transportation of chlorine are knowledgeable of the regulatory requirements pertaining to chlorine. DOT regulations include requirements for plans to address security risks related to transportation of hazardous materials including chlorine. Publications should be readily available for reference. For ordering information, see Section 14.

Title 49 CFR details all of the requirements for hazardous material transportation in the United States. Pertinent sections in the DOT regulations in Title 49 CFR that cover many of the requirements relating to chlorine cargo tanks are identified below. Once a chlorine tank has been removed from the motor vehicle, it is no longer a cargo tank as defined by DOT and is not regulated under the [DOT Hazardous Material Regulations 49 CFR Parts 171 – 180.](#)

Part 107	General registration requirements
Part 171.8	Definitions and abbreviations
Part 171.15	Immediate notice of certain hazardous materials incidents
Part 171.16	Detailed hazardous materials incident reports
Part 172.101	Hazardous materials table
Part 172.102	Special provisions
Part 172.200	Applicability (shipping papers)
Part 172.201	General entries (shipping papers)
Part 172.202	Description of hazardous materials on shipping papers
Part 172.203	Additional description requirements (shipping papers)
Part 172.204	Shipper's certification
Part 172.302	General marking requirements for bulk packaging
Part 172.313	Poisonous hazardous materials
Part 172.326	Portable tanks
Part 172.328	Cargo tanks (marking)
Parts 172.500-519	Placarding
Part 172.540	POISON GAS placard

Part 172.555	Poison inhalation hazard placard
Parts 172.600-604	Subpart G emergency response information
Parts 172.700-704	Subpart H - Training
Parts 172.800-804	Subpart I – Security Plans
Part 173.32	Qualification, maintenance and use of portable tanks
Part 173.33	Qualification, maintenance and use of cargo tanks
Part 173.315	Compressed gases in cargo tanks and portable tanks
Part 177.800	Purpose and scope of this part and responsibility for compliance and training (carriage by public highway)
Part 177.816	Driver training
Part 177.817	Shipping papers
Part 177.834	General Requirements (Loading and Unloading)
Part 177.840	Class 2 (gases) materials (Loading and Unloading)
Part 178.245	Specification 51 (portable tank)
Part 178.320	General requirements applicable to all DOT specifications
Part 178.337	Cargo tank specification MC 331
Parts 180.401-417	Qualification and maintenance of cargo tanks
Part 180.415	Test and inspection markings
Part 397	Transportation of hazardous materials: driving and parking rules
Part 383	Commercial driver's license standard; requirements and penalties
Part 387	Minimum levels of financial responsibility of motor carriers
Part 389	Rule making procedures - Federal motor carrier safety regulations
Part 390	Federal Motor Carrier Safety Regulations: General
Part 391	Qualifications of drivers
Part 392	Driving of motor vehicles
Part 393	Parts and accessories necessary for safe operation
Part 394	Notification and reporting of accidents
Part 395	Hours of service of drivers

Part 396	Inspection, repair and maintenance
Part 397	Transportation of hazardous materials; driving and parking rule
Part 399	Employee safety and health standards

4.2 TSA VOLUNTARY MEASURES

TSA has developed voluntary Security Action Items which have been made available to those involved in the shipment of certain Security Sensitive Hazardous Materials. These measures should be considered in concert with industry guidance by those who load, transport, store incidental to transport or unload Security Sensitive Hazardous Materials including chlorine.

4.3 EPA REGULATIONS

In the United States, when chlorine is used for disinfection of drinking water, waste water and swimming pools it is considered to be a fungicide and is subject to EPA regulations issued under the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA). The EPA regulations, found in 40 CFR Subchapter E and in particular 40 CFR 156, require shipper registration with EPA and appropriate labeling (Reference 14.4).

4.4 OSHA REGULATIONS

The OSHA occupational safety and health standards are found in Title 29 CFR Part 1910. Title 29 CFR 1910 regulates material handling and storage, 29CFR 1910 regulates process safety management, 29 CFR 1910 regulates the emergency response to hazardous substance releases and 29 CFR subpart I regulates personal protective equipment. (Reference 14.5)

4.5 CANADA REGULATIONS

The Canadian regulations for the Transportation of Dangerous Goods (TDG) parallel DOT requirements in most respects. The Canadian regulations can be found in the Canadian Transportation of Dangerous Goods Act and Regulations. These regulations include, by reference, various standards and specifications found in Canadian Standards Association (CSA) publications and in Canadian General Standards Board (CGSB) publications. There are also provincial regulations specific to each province (Reference 14.3).

4.6 MEXICO REGULATIONS

The Normas Oficiales de Mexico (Official Mexican Standards), often referred to as Normas or NOMs, support the Mexican Hazardous Materials Land Transportation Regulation. The Mexican Secretariat for Communications and Transport is responsible for publishing and applying the NOMs. The Mexican NOMs are fairly consistent with those of the United Nations Recommendations on the Transport of Dangerous Goods (UN Recommendations) and TC and DOT regulations.

4.7 LOCAL REQUIREMENTS

In addition to federal requirements, state, provisional or local requirements might affect these operations. The reader is cautioned to check applicable codes.

5. **TANK DESCRIPTION**

5.1 SIZE AND TYPE

Chlorine cargo tanks and portable tanks in North America range in chlorine capacity from 9 to 22 tons. Tanks can be mounted in ISO frames, custom trailer mounts or be permanently mounted on or part of truck or trailer assemblies. There are many trailer assemblies that conform to DOT MC 331 specification. Figures 5.1 through 5.4 give outline drawings with approximate dimensions for several types of units.

5.2 INSULATION

Insulation for chlorine tanks is four inches minimum of cork board, or four inches of polyurethane foam or at least two inches of 4-pound per cubic foot (minimum) density ceramic fiber covered by two inches of glass fiber. The insulation is covered with a carbon steel or stainless steel jacket. A protective coating is applied to the exterior surface of the tank and to the inside surface of the steel jacket. The jacket is flashed around all openings so as to be weather tight.

5.3 TANK ARRANGEMENT AND EQUIPMENT

Manway Arrangements

All tanks are equipped with manway arrangements in accordance with CI Drawing 137. The manway cover, all standard valves, studs and gaskets are detailed in pertinent Institute drawings. This arrangement facilitates the use of the Institute's Emergency Kit C. Maintenance pamphlets are available for all standard valves.

Angle Valves

Most cargo tanks are equipped with four 1 inch manual angle valves. Reference is made to 49 CFR 178.337-9 (b)(8) (Reference 14.2.1). Effective October 1, 2008 in addition to valves designed per CI Drawing 104, valves meeting CI Pamphlet 166, Section 3 performance standards may be utilized without a special permit. The two angle valves on the longitudinal center line of the tank are for liquid discharge.

The two valves on the transverse center line are connected to the vapor space. The liquid valves are each equipped with 1.25-inch (31.75 mm) diameter eduction pipes extending to the bottom of the tank for unloading of the contents. (**NOTE:** angle valves should be capped when not in use)

Excess Flow Valve

Each eduction pipe is equipped with an excess flow valve having a maximum operating flow rate of 7,000 lbs (3175.2 kg) of liquid chlorine per hour (See CI Drawing 101). Vapor valves must be equipped with excess flow valves per CI Drawing 106. Reference is made to 49 CFR 178.337-8(b) (Reference 14.2.1). Other excess flow valve arrangements may be used with a DOT special permit.

Cargo Tank
Trailer Mount (DOT MC-331)

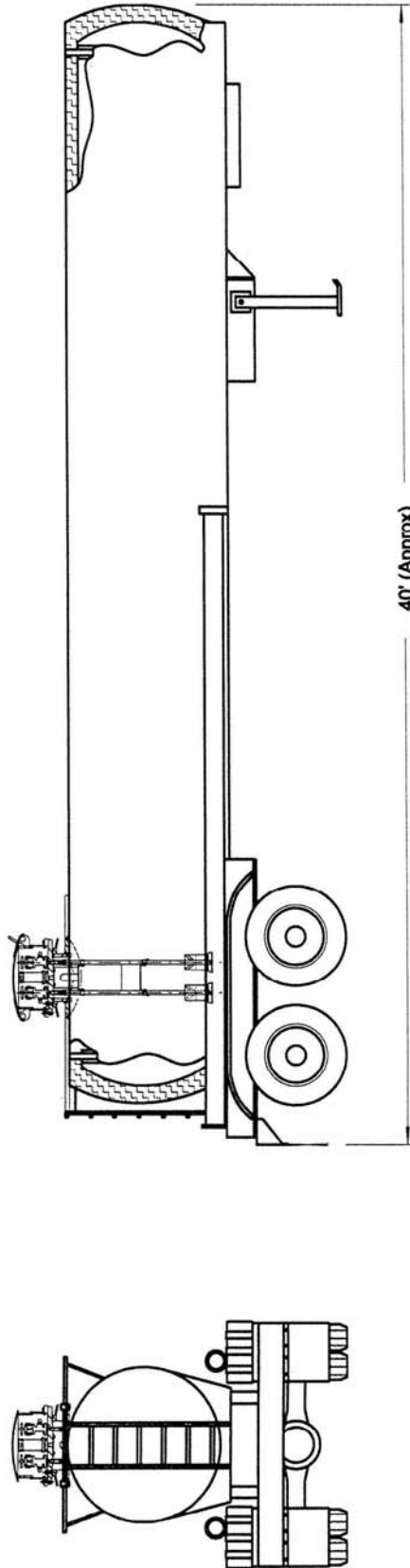


Fig. 5-1

Cargo Tank
Chassis Mount (DOT MC-331)

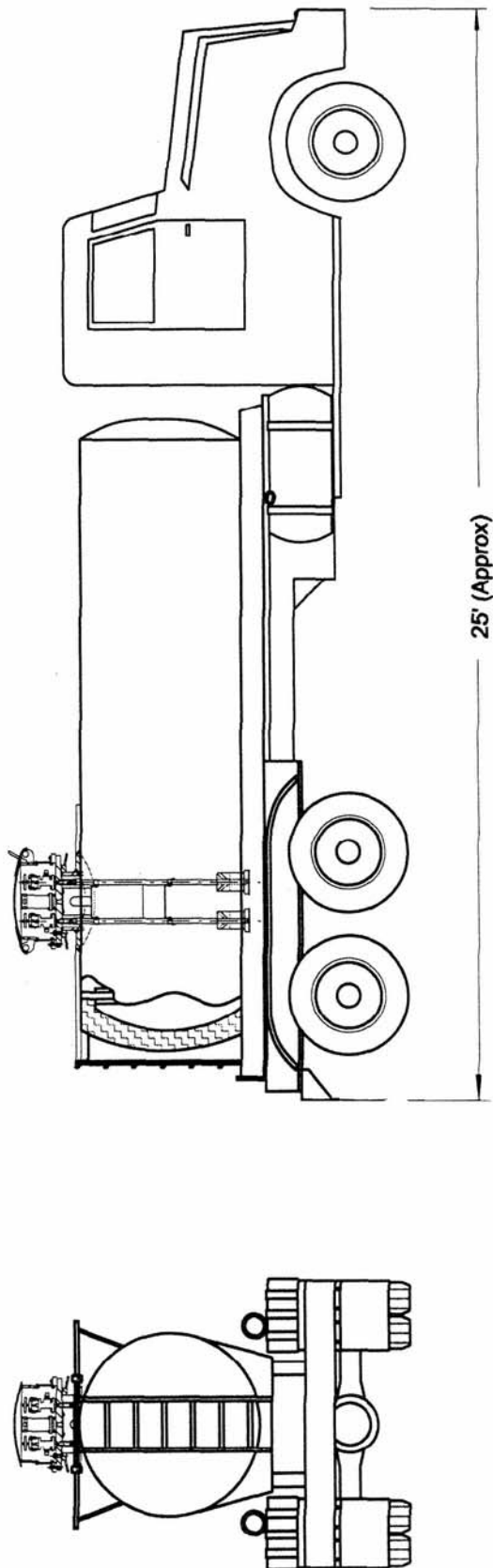


Fig. 5-2

Cargo Tank
Demountable (DOT MC-331)

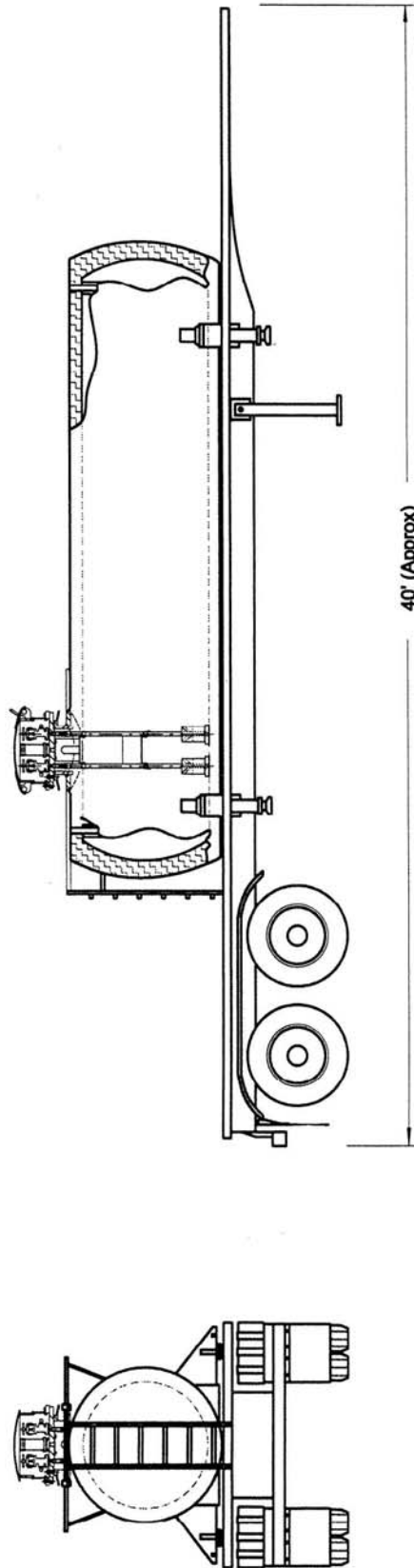
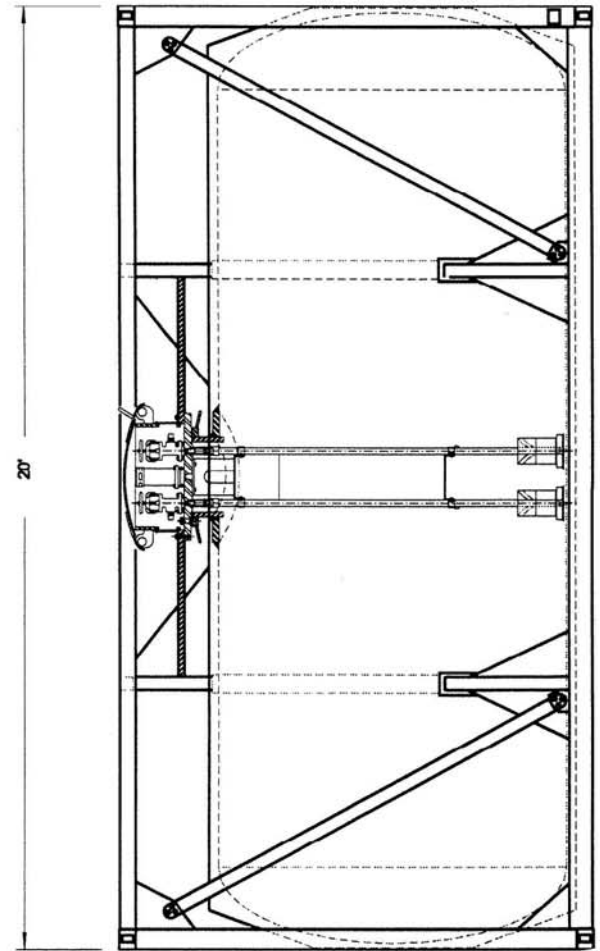
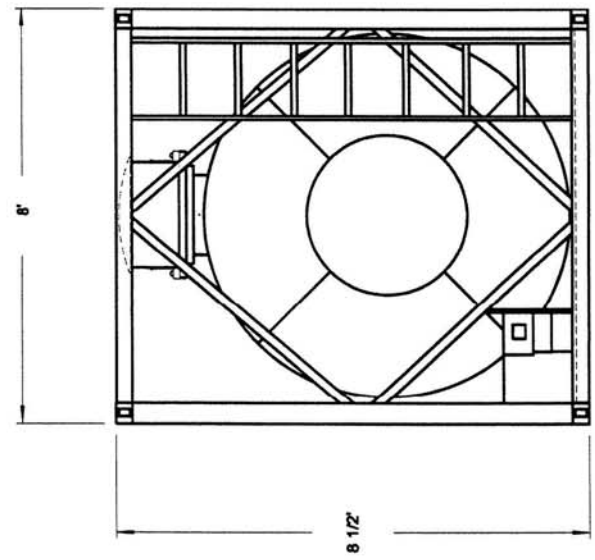
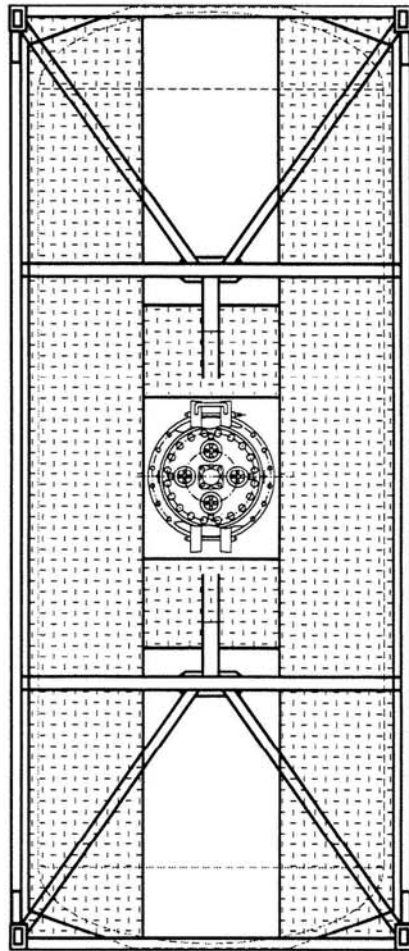


Fig. 5-3

Portable Tank (DOT 51)

Fig. 5-4



Pressure Relief Device

Each tank is equipped with a pressure relief device located in the center of the manway cover. Other authorized pressure relief devices can be used. The device is set to discharge at 225 psig (1551 kPa). See CI Drawings H-50155 (elastomeric seat design) and H-51970 (metallic seat design).

Accessories

Trucks and trailers may carry transfer hoses in specially designed racks that ensure hose integrity and dry chlorine transfer (note: transfer hoses should be plugged at both ends when not in use). All chlorine tank haulers carry the Chlorine Institute's Emergency Kit C or a similar kit to facilitate emergency response. Personal protection equipment is also carried (See Section 3.4). Some trucks and trailers are fitted with compressors and air dryers for use during loading or unloading.

6. OPERATORS OF TANK MOTOR VEHICLES

6.1 DRIVER QUALIFICATIONS

In order for a driver to be considered qualified for transporting chlorine the driver must:

- Successfully complete a DOT required medical evaluation. Evaluation to be per DOT established criteria
- Have considerable and varied driving experience
- Be properly licensed for the size and class of the vehicle to be driven including all appropriate endorsements for the cargo carried
- Have basic familiarity with the construction of the chlorine tank and fittings on the manway assembly
- Be able to inspect the tank and manway fittings and identify any discrepancies
- Be properly trained to respond to an emergency in transit, and be provided with proper notification procedures

- Pass a DOT-required initial employment drug test and be enrolled in a proper DOT - required random drug and alcohol testing program
- Have training in the company's security plan which includes all applicable components of the of the Chlorine Institute Security Management Plan for the Transportation and On-Site Storage and Use of Chlorine Cylinders, Ton Containers and Cargo Tanks and meets the requirements of 49CFR 172.800

6.2 DRIVER TRAINING

On a periodic basis, the vehicle owner or authorized agent should schedule a formalized chlorine driver training program for all involved drivers with at least one annual refresher. Training must be administered by qualified personnel in the following specific areas:

- Physical and chemical characteristics of chlorine
- General construction and features of the tank including inspection techniques and proper completion of a daily vehicle inspection report
- Tank manway details (e.g. locking devices, bolts, side access ports and access means to the manway)
- Making and breaking connections and chlorine transferring operation
- Detection and location of leaks
- Use of a positive pressure, self-contained breathing apparatus with full face piece
- Emergency procedures, contacts and reporting
- General precautions (i.e. weight shifting and stopping distance)
- Personal protective equipment
- DOT-required hazmat employee training (every 3 years)
- Security Training in the company transportation security plan.

The following is a listing of the mandatory training requirements contained in Title 49 CFR:

Part 172.700	Purpose and scope
Part 172.704	Training requirements
Part 177.800	Purpose and scope and responsibility for compliance and training

Part 177.816	Driver training
Part 383.23	Commercial driver's license
Part 387.9	Financial responsibility, minimum levels (Motor Carriers)
Part 390	Federal Motor Carrier Safety Regulations: General
Part 391.11	Qualifications of drivers
Part 392	Driving of motor vehicles
Part 393	Parts and accessories necessary for safe operation
Part 395	Hours of service of drivers
Part 396	Inspection repair and maintenance
Part 379	Transportation of hazardous materials: driving and parking rules
Part 399	Employee safety and health standards

6.3 CARRIER QUALIFICATIONS

As an alternative to utilizing the shipper's own drivers, "for hire"/contract carriers may be selected to haul liquid chlorine. It is recommended that such carriers be pre-approved to meet a shipper's qualification standard and only those carriers should be utilized thereafter. Examples of carrier qualification requirements are:

- Proof of the minimum insurance required
- Copies of operating authority
- Pass a facility equipment/questionnaire or a driver training inspection/questionnaire
- Copy of DOT safety rating
- Transportation Security Plan per 49 CFR 172.800
- Hazardous Material Safety Permit
- Latest motor carrier safety survey
- In Canada, a CCPA carrier evaluation criteria system is in effect

6.4 U.S. DOT HAZARDOUS MATERIALS REGISTRATION PROGRAM

Under DOT regulations found in 49 CFR 107.601 - 107.620, a person who offers or transports certain quantities or types of hazardous materials must register annually with DOT. This includes chlorine carried in MC 330, MC 331 and Specification 51 tanks. To register, the DOT Form F 5800.2 must be completed and sent to the U.S. Department of Transportation Hazardous Materials Registration, P.O. Box 70985, Charlotte, NC 28272-0985. The registration requires an annual fee. The DOT will issue a registration number each year after payment.

7. **LOADING\UNLOADING\FACILITY ISSUES**

7.1 TANK PRESSURE

Conditions of loading and padding must be such that when the temperature of the chlorine increases, pressure in the tank will not approach the pressure relief device setting.

Temperature/Pressure Relationships

Chlorine in a tank is a liquefied gas under pressure. The tank always contains some non-condensable gases in addition to the chlorine vapor. These gases may or may not be in equilibrium with the chlorine. The total pressure in the tank is the sum of the partial pressure of the chlorine and the partial pressure of the non-condensables. Because of a lack of equilibrium, it is not possible to calculate the exact pressure by means of gas laws.

The partial pressure of the chlorine is a function of its temperature. The partial pressure of the non-condensables is a function of the molecular weight of such gases, the volume of the vapor space and the gas temperature.

The following pressure limits apply:

Specifications	Pressure Relief Device (<i>Start-to-Discharge</i>)	Limiting Pressure
MC-330/331 and DOT 51	225 psig (1551 kPa)	225 psig (1551 kPa) at 105°F (40.5°C)

Chlorine vapor pressure at various temperatures is shown below in Table 7-1.

Table 7-1. Vapor Pressure of Chlorine

Temperature		Vapor Pressure		Temperature		Vapor Pressure	
°F	°C	psig	kPa	°F	°C	psig	kPa
0	-18	13.8	95	60	16	70.9	489
10	-12	20.3	140	70	21	85.5	589
20	-7	27.8	192	80	27	101.8	701
30	-1	36.6	252	90	32	119.9	826
40	4	46.6	321	100	38	140.1	965
50	10	58.0	400	105	41	151.3	1042

Loading Pad Limit

The final tank pressure after padding should not exceed the maximum values shown on CI Drawing 201. This curve can be used for padding prior to shipment or padding to make a transfer.

Unloading Pad Air Pressure

Unloading pad air pressure should be the minimum consistent with the process needs. The limits contained in CI Drawing 201 and the cargo tank certification (See Section 7.9) should be observed. For additional information see section 7.5.

Pressure Developed During Transloading

If padding is used to transfer chlorine between two tanks or between a tank and a tank car, care must be taken to ensure excess inert gas does not result in an over pressure situation.

7.2 CHLORINE TRANSFER METHODS

Inert Gas Padding

The vapor pressure of chlorine at various temperatures is given in Table 7-1. If more pressure is needed to unload the tank, padding of the tank may be necessary. See Section 7.5 for more information. Dry air is commonly used; however, other suitable inert gases, such as nitrogen can be used. To minimize need for padding, consideration should be given to the following:

- reducing the pressure at the point of consumption
- reducing the pressure drop in the piping system
- housing the tank in a warm shed (This is helpful where extremely cold weather is encountered.)

Pumping

Pumps are typically used to load tanks in large producing locations. Unloading using pumps is generally impractical due to NPSH requirements of commercially available pumps.

Chlorine Padding (Recompression)

Some carriers and some owners of stationary storage systems use chlorine compressors to compress vapor in the fixed storage for use as pad gases to remove liquid from the transport tank. This is acceptable if the system is designed to exclude moisture entry from ambient air leakage and adequate inert gas is always available in the system. If there is inadequate inert vapor in the fixed storage tank, the transfer compressor will compress a gas that is mostly chlorine. If temperatures are low in the transport tank, the chlorine gas from the compressor will liquefy, possibly overfilling the transport tank rather than increasing the pressure to pad the liquid out.

7.3 CHLORINE DELIVERY

It is quite common for the chlorine tank to be directly connected to the consuming process. When utilizing this method the unloading of a chlorine tank may take place over an extended period of time. Chlorine can also be unloaded into fixed storage containers for future transfer to the process.

Choice is generally based on relative risk of multiple transfers and additional equipment versus reliability of unloading connections. For additional information see CI Pamphlet 5.

7.4 EVACUATION AND ABSORPTION SYSTEM

At a minimum, an evacuation or absorption system should be provided to remove chlorine contained in transfer lines prior to disconnect. Additional safeguards may be justified based on local risk analysis.

7.5 UNLOADING AND PADDING PRECAUTIONS

Even small amounts of moisture can cause corrosion to tank equipment and to the user's piping and handling system. Chlorine and oil will react to produce contaminants and, under certain conditions, the reaction might occur with violent force. For these reasons, it is essential that air used for padding be free from oil and foreign matter and dried to a dew point of -40°F (-40°C) or below measured at the operating pressure.

Moisture Content

To make sure that no moisture is entering the chlorine system, the moisture content of padding air should be tested each time a tank is connected for padding. This is easily done with a commercial dew point tester. Draining of the water trap and filter in the air line should not be overlooked and should be on a scheduled periodic maintenance program.

Separate System

Padding air should not be taken from the plant air system, but, ideally, should come from an independent air compressor used solely for this purpose. Unless safeguards are taken, in a common system a heavy demand for air elsewhere could lower the overall system pressure below the tank pressure. Chlorine could then feed back into the air system with probable damage to equipment and danger to personnel.

Air Padding

A suitable air compressor and an ASME Code receiver equipped with a pressure gauge, a safety valve, a drain valve and automatic pressure controls should be used. An after-cooler and a trap or filter should be provided to remove condensed moisture and entrained oil to reduce the load on the dryer. A filter should also be installed which is designed specifically for oil removal. See CI Drawing 119 for a typical installation. Table 7.2 shows the air flow required at tank pressures for various unloading rates.

Air Dryers

Commercial regenerative type dryers using activated alumina or silica gel as the desiccant are recommended and can be obtained with any degree of refinement from manual to fully-automatic control. If continuous operation is desired, dual units are necessary. For required capacity, see Tables 7-2 and 7-3.

Shipper or Receiver Air Padding

When the required unloading pressure is lower than the vapor pressure of chlorine at ambient temperatures and the pressure due to air is required only during the initial unloading period while the chlorine is relatively cold, the shipper may add air pressure prior to shipment. If the pressure in the tank is not sufficient when received or throughout unloading, the receiver should notify the shipper.

Table 7-2. Continuous Air Flow Requirements for Padding¹				
Unloading Rate	Std. Cubic Feet per Minute (SCFM) of Air Required			
lbs/hour of chlorine	ft³/minute		m³/second	
	P=125 psig	P=100 psig	P=862 kPa	P=684 kPa
7,500	10.00	7.5	.00472	.00354
6,000	8.00	6.0	.00378	.00283
4,000	5.33	4.0	.00252	.00189
1,000	1.33	1.0	.00063	.00047

$$\bullet \quad \text{SCFM Air} = \frac{\text{lbs/hr of chlorine} \times (P - 25)}{75,000}$$

$$\bullet \quad P = \text{total pressure in tank (psig)}$$

Table 7-3. Air Quantity Requirements for Padding¹				
Nominal Chlorine Capacity	Total Air Required (SCFM)			
	ft³/minute		m³/second	
	P=125 psig	P=100 psig	P=862 kPa	P=684 kPa
16 short tons (14.5 metric tons)	3,070	2,300	1.449	1.086
22 short tons (20 metric tons)	4,224	3,168	1.994	1.495

$$\bullet \quad \text{ft}^3 \text{ of air} = \text{tons of chlorine} \times 1.92 \times (P - 25) \quad \bullet \quad P = \text{total pressure in tank (psig)}$$

7.6 OVER PRESSURE PREVENTION

To minimize the increased hazards accompanying air padding, pressures should be kept as low as possible. In any case, the total pressure (the vapor pressure of the chlorine plus the pressure of the air pad) should not exceed the pressures indicated on the appropriate curves on CI Drawing 201.

Atmospheric heat entering the tank will raise the temperature of the liquid chlorine and increase its vapor pressure. The heat will also cause the liquid to expand thus reducing the vapor space with resulting increase in the air pressure.

¹ Requirements are based on the assumption that no air dissolves in the chlorine and an average chlorine temperature in the tank of 18°F (-7.8°C). Corresponding vapor pressure is 24.7 psig (170 kPa). Higher temperatures will require less air. The standard cubic foot is measured at 68°F (20°C) and 1 atm.

The combined effects of expansion of the liquid and increase in its vapor pressure may increase the total pressure enough to open the pressure relief device.

For example, if a full tank at 33°F is padded from the vapor pressure of 40 psig (276 kPa) to a total pressure of 125 psig (862 kPa) and is then allowed to warm up to 88°F, the combined effects of the expansion of the liquid chlorine and increase in its vapor pressure will raise the total pressure above 225 psig (1551 kPa) and a pressure relief device set at that pressure will open.

It is especially important to prevent buildup of excessive pressure over periods when chlorine is not being withdrawn such as nights, weekends, plant vacation periods or shutdowns. Such tanks should be inspected routinely for leaks and excessive pressure. If necessary, excessive pressure should be vented to a recovery system.

7.7 OTHER EQUIPMENT

For loading operations either a direct reading scale or the ability to load from a weighed feed tank followed by a check scale is required. The filling density must not exceed 125%.

7.8 EMERGENCY SHUT-OFF

49 CFR 173.315(n) (2) specifies requirements for emergency shutdown to shut off the flow of product within 20 seconds of an unintentional release caused by separation of a liquid delivery hose. Excess flow valves should not be relied upon as the only means of mitigating a hose or piping failure during chlorine transfer. CI Pamphlet 57, *Emergency Shut-Off Systems for Bulk Transfer of Chlorine* outlines CI recommended practices for emergency protection against major chlorine spills during chlorine transfers involving chlorine tank handling systems. The pamphlet illustrates one emergency shut-off system that will quickly bring a release situation under control. The system described in CI Pamphlet 57 provides the means to shut down the flow of chlorine from the cargo tank by isolating both sides of the cargo transfer hose. Use of an emergency shut-off system that meets the standards in CI Pamphlet 57 is recommended during the loading or unloading of a chlorine cargo tank. Use of a proper hose suitable for the transfer of chlorine as recommended in CI Pamphlet 6 should be part of the transfer system.

7.9 CARGO TANK CERTIFICATION

DOT regulations (49 CFR 173.315(n)(2)) (Reference 14.2.1) require a cargo tank motor vehicle carrying liquefied compressed gases including chlorine to be certified by a Design Certifying Engineer (DCE) that there is a means to automatically shut off the flow of product during unloading without human intervention (a passive system) within 20 seconds of an unintentional release caused by the complete separation of a liquid delivery hose.

The Chlorine Institute has obtained certification, based on the cargo tank's excess flow valves (see 5.3.3), for the chlorine cargo tank unloading system. Copies of the certifications are included in Appendix B. The certified cargo tank unloading systems consist of the following:

- Six foot length of 1¼ inch schedule 80 education pipe inside the cargo tank
- Up to an 18 inch length of one inch schedule 80 pipe nipple
- An automatic isolation valve, which may not be on all systems, consisting of a ball or plug valve of nominal one inch diameter, in the fully opened position with a Cv of at least 44
- A chlorine transfer hose meeting the standards of CI Pamphlet 6 with a nominal one inch diameter and a maximum length of 25 feet, and
- One of the following excess flow valve and angle valve combinations:
 - An excess flow valve as per CI Drawing 101 (7,000 lb/hr) and an angle valve as per CI Drawing 104; or
 - An excess flow valve as per CI Drawing 101 (7,000 lb/hr) and an angle valve as per Midland Manufacturing Corp Drawing A-713-ML; or
 - An excess flow valve as per Midland Manufacturing Corp Drawing A-120-ML (32,000 lb/hr of water) and an angle valve as per Midland Manufacturing Corp Drawing A-713-ML

Unloading operations must be conducted within the limitations set by the DCE certification as follows:

- The pressure in the cargo tank during unloading must be at least 20 psig for systems with CI Drawing 101 (7,000 lb/hr) excess flow valves. For systems with Midland Manufacturing Corp Drawing A-120-ML (32,000 lb/hr of water) excess flow valves, the pressure in the cargo tank during unloading must be as specified in the DCE certification (see Appendix B) which bases the required pressure on the length of the cargo hose and varies between 50 psig and 103 psig

- The angle valve and the other valves in the system must be in the fully opened position during unloading
- The cargo transfer hose can be no more than 42 inches above the angle valve opening; and
- The excess flow valves must be properly maintained and meet all manufacturer's design specifications

7.10 NITROGEN TRICHLORIDE - HAZARD AWARENESS

The presence of nitrogen trichloride in liquid chlorine is the suspected cause of explosions that have occurred, although infrequently, in chlorine systems including chlorine transportation containers. Nitrogen trichloride is formed from nitrogen that enters the system during the chlorine production process. CI Pamphlet 152 provides methods for the detection, prevention and destruction of nitrogen trichloride. Bulk shipping containers (barge tanks, tank cars and cargo tanks) should not be unloaded in the gas phase. If present, nitrogen trichloride will concentrate in the liquid phase because of nitrogen trichloride's higher boiling point. Due to the relatively large amount of chlorine in the bulk container, the nitrogen trichloride in the liquid phase could concentrate to dangerous levels if only gases are removed.

8. **RESPONSIBILITIES**

8.1 LOADING FACILITY RESPONSIBILITIES

It is recommended that the loading facility ensure to the extent practicable the tank complies with all current tank regulations and applicable recommendations contained in this pamphlet, and that a satisfactory pre-loading inspection is made prior to loading. The loading facility should ensure that:

- The tank and vehicle meet the applicable DOT and TC specifications, including chlorine requirements
- The pressure relief device is within required test dates
- No piping or hoses have been left attached to the angle valves
- The tank is checked for a current specification plate and for test and inspection markings
- The angle valves comply with regulations pertaining to testing
- The transfer hoses are compatible with chlorine and no moisture is present (See CI Pamphlet 6 for recommendations on transfer hoses)
- The filling density requirements are not exceeded

- The tank's manway arrangement is correct
- Responsibility is taken if the tank is left on the premises
- The tank is loaded in a safe area properly equipped to handle any emergency
- Safe access to the manway area by safe steps, platforms, drop bridges or guard rails has been provided
- Flexible connections, valves, emergency shutoff devices have been provided. Reference is made to CI Pamphlets 6 and 57
- An evacuation or absorption system or other means of purging connecting lines to prevent releases of chlorine into the atmosphere after shutoff and during disconnection is provided
- The padding system meets the appropriate standards
- Good lighting for night and inclement weather operations has been provided
- Emergency equipment has been provided
- Access is restricted to authorized persons
- Shipping documents and placarding are prepared for the shipment of the tank

8.2 CARRIER RESPONSIBILITIES

The carrier should ensure that:

- The tank and pressure relief device meet appropriate DOT and TC specifications, including chlorine transportation requirements
- The motor vehicle is equipped with an Emergency Kit C and an SCBA
- The gross vehicle weight is not exceeded
- Shipping papers, placards and other required documentation are furnished
- The tank's manway arrangement is correct
- There is a safe delivery and placement of the chlorine tank

- Markings are consistent with maintaining the gross vehicle weight below the local maximum
- The driver is fully qualified
- There is proper support for tanks that remain at the unloading facility

8.3 UNLOADING FACILITY RESPONSIBILITIES

The unloading facility should ensure that:

- Responsibility is taken if the tank is left on the premises
- The tank is unloaded in a safe area properly equipped to handle any emergency
- Safe access to the manway area by safe steps, platforms, drop bridges or guard rails is provided
- Flexible connections, valves, emergency shut-off devices are provided. Reference is made to CI Pamphlets 6 and 57
- An evacuation or absorption system or other means of purging connecting lines to prevent releases of chlorine into the atmosphere after shutoff and during disconnection is provided
- The padding system meets the appropriate standards. See Section 7
- Good lighting for night and inclement weather operations is provided
- Access is restricted to authorized persons
- Shipping documents and placarding are prepared for the return of tank to the supplier

9. **RECEIVING AND SPOTTING CHLORINE TANKS**

When a cargo tank motor vehicle arrives at a facility, and before it is at the transfer site, it should be ascertained that it is the proper carrier with a carrier's bill of lading authorized for the shipment of the tank to be loaded or unloaded.

The carrier furnishing the tank and/or motor unit is responsible for safe delivery to and positioning of the tank at the transfer destination. Proper positioning of the tank for transfer must be done for safety considerations. The unit should be on firm ground or supports, and out of the path of other vehicles. When the tank is spotted at the transfer rack, the driver should shut off the engine, set hand brakes and chock the wheels.

A recommended practice is obtaining keys from the driver or placing a “transfer in progress” sign on the tractor windshield. It is recommended the driver not be permitted to remain in the cab during the transfer operations (See Section 10.5 regarding monitoring of monitoring of loading/unloading).

If the tractor is to be withdrawn, the trailer support should be placed on a firm surface capable of supporting the unit. An extra nose support under the fifth wheel plate should be used.

Drivers should be instructed on emergency evacuation procedures. Precautions should be taken to prevent unauthorized movement of the tank.

10. TANK LOADING PROCEDURES

10.1 GENERAL

When loading a chlorine tank, the safety aspects of the operation should be uppermost in the minds of loading personnel. The loader must verify that proper spotting and receiving procedures have been completed before beginning transfer operations.

Proper personal protective equipment should be worn during the transfer operation (See CI Pamphlet 65). Safety showers and eye wash facilities should be immediately available.

The reader's attention is drawn to 49 CFR 177.834(i) covering the attendance requirements during the loading operation. Development of attendance procedures should take these rules into account.

10.2 TANK INSPECTION CHECKLIST

An inspection checklist should be used for all aspects of the loading operation. It should include all recommendations contained in this pamphlet plus any company procedures or special requirements specific to each facility. The checklist documents that the proper loading and securement procedures have been completed. The checklist should be retained for an appropriate period of time.

The pre-load portion of the checklist should at a minimum include:

- Determination that the proper tank has been supplied
- Check of the tank for DOT/TC specification plate. A tank that does not have one should not be loaded

- Inspection of the running gear, safety appliances, marking and other pertinent items. The purpose of this portion of the inspection is to identify all defects in the tank motor vehicle before loading any chlorine. All tank fittings should be checked to verify they are properly secured to the manway cover
- Inspection of angle valves to ensure they are closed
- An inspection for proper securement of all components and fittings. This could be verified by a pressure test
- Confirmation the tank is properly stenciled and placarded
- Verify location of C-Kit and SCBAs
- Verify Kingpin support in place if needed, brakes are set and wheels chocked

10.3 LOADING CONSIDERATIONS

Connections

The manway cover of chlorine tanks recently hydrostatically tested should receive particular attention to ensure that the gasket joint is leak proof.

Chlorine tank angle valves are equipped with a one inch pipe plug closure secured to the valve body. This plug should be tightly in place when the tank is received and located for loading. Before any connection is made all piping should be clean, dry, and free of oil. Refer to CI Pamphlet 6.

A nipple made from one inch schedule 80 carbon steel, about 15 inches long, threaded at both ends should be tightly screwed into the tank valve outlet.

The threads on the nipple should be standard NPT, sharp, clean and prepared with an appropriate sealant that is non reactive with chlorine. Care should be taken when tightening the nipple to prevent undue strain on the valve. A flexible transfer hose, per recommendations contained in Appendix A of CI Pamphlet 6 or a flexible copper loop, per CI Drawing 118, should be provided between the nipple and the permanent piping to compensate for the change in elevation of the tank during loading. A valve arrangement incorporating fail safe features, mounted as close as possible to the tank angle valve, is recommended. A chlorine pressure gauge, protected with a suitable diaphragm, with a range of twice the operating pressure, should be mounted at the beginning of the permanent piping. A second valve arrangement incorporating fail safe features should be mounted on the permanent piping feeding the chlorine to process. Use of an emergency shut-off system that meets the standards in CI Pamphlet 57 is recommended during the loading of a chlorine cargo tank.

Teflon tape (T-tape) can be an effective lubricant/sealant of threaded pipe and plug connections to tank car angle valves if it is applied correctly. If the tape is incorrectly applied to these connections, it can be sucked into the internal components of the car's angle valves if the car is pulled under a vacuum during its preparation for loading, thereby preventing these valves from being able to be completely closed. To properly apply Teflon tape to a pipe nipple or a pipe plug to be installed in an angle valve, use a thick grade of tape, i.e., one that meets Military Specification MIL-T-27730A or General Services Administration Commercial Item Description (CID) A-A-58092, and do not wrap the tape past the first thread at the end of the pipe nipple or valve plug.

Weight of Chlorine Tank

The weight of the chlorine tank with all chocks and loading connections in place should be determined and recorded. This weight should be used as the initial tare weight for filling. This procedure prevents overloading.

If it is necessary to interrupt the loading operation before the tank is completely filled, the connected weight of the partly loaded tank should be determined and recorded before disconnecting and the weight of chlorine already loaded should be calculated. When the tank is reconnected, the new connected weight of the tank should be recorded and the loading completed so that the total weight of chlorine loaded meets the required level of accuracy.

The weight of chlorine in a tank must not exceed 125% of the weight of water the tank will hold. This is defined as the filling density. It is absolutely vital to always comply with this limit. Exceeding this limit will result in an unsafe container and possible discharge of chlorine from the unit. In addition, state or provincial axle and gross load limits must not be exceeded.

Cargo tanks must be weighed either during or before and promptly after each loading to be certain that the maximum load limit was not exceeded. If loading is done on a scale, flexible filling lines must be used to ensure accurate weighing. Weights must be noted on shipping documents.

Tank Pressure

The final tank pressure should not exceed the maximum values shown on CI Drawing 201. If the tank pressure is excessive when loading is complete, the tank should be vented to a recovery system until the proper pressure is obtained.

The minimum pressure in a loaded tank when offered for shipment must be at least 20 psig for cargo tanks with the CI Drawing 101 (7,000 lb/hr) excess flow valve and 50 psig for cargo tanks with the Midland Manufacturing Corp Drawing A-120-ML (32,000 lb/hr of water).

This will ensure there will be sufficient flow to close the excess flow valves if an angle valve is broken off.

Conditions of loading and padding must be such that when the temperature of the chlorine increases, pressure in the tank will not approach the pressure relief device setting. Reference is made to Section 7.

10.4 LEAK TEST

DOT requirements state in 49 CFR 173.315(o) that “prior to each loading, the cargo tank must be inspected and the angle valves and gasket joints must be examined and tested at a pressure of not less than 50 psig to determine that they are not leaking and are in proper condition for transportation.” Ways to meet this requirement include documenting a leak test of at least 50 psig on a return tank prior to depressurization, and adding a small amount of chlorine at the loading rack and padding with dry air to 50 psig followed by a leak test.

A squeeze bottle containing 26° Baumé aqua ammonia (ammonium hydroxide) solution can be used to detect a minor release or leak. A white cloud will form if a leak is present. To avoid corrosion, ammonia solution should not be directly sprayed onto connections. Any efforts to detect the source of a leak should be carried out with full consideration for potential hazards.

10.5 MONITORING THE LOADING

DOT (49 CFR 177.834(i)) and TC (CSA Std B622) regulations require a cargo tank to be attended by a qualified person at all times during loading. The person attending the loading must be alert and be within 25 feet of the tank. A qualified person is one that has been made aware of the hazards of chlorine and the procedures to be followed in an emergency, is authorized to move the cargo tank and has the means to do so.

10.6 LEAKS DURING LOADING

Leaks in Connections and Piping

Chlorine piping systems should be pressure tested at regular intervals according to Institute recommendations (See CI Pamphlet 6). All chlorine piping systems should be inspected at regular intervals for signs of leakage, internal or external corrosion, insulation failure or support problems. If a chlorine leak should occur in equipment or piping, the chlorine transfer should be stopped immediately, the pressure relieved and the necessary repairs made. When the leak has been located and the faulty equipment repaired, loading may be resumed.

Leaks at Fittings

Leaks around the angle valve stems can usually be stopped by tightening the packing gland nuts. If this does not stop the leak, the angle valve should be closed. Only if a valve leak cannot be stopped by corrective measures should the Emergency Kit C be used. If the pressure relief device must be capped, regular monitoring must be established. A DOT special permit is required to move a trailer outside a facility with a C-Kit installed.

10.7 DISCONNECTING

As soon as it is determined that the tank is loaded, the liquid valves should be closed first and the loading line emptied before any other valves in the discharge system are closed. The loading line should then be purged, evacuated and disconnected. This should be done with care being sure the line has been cleared. **CAUTION:** It is imperative that no chlorine be released upon disconnection. Appropriate personal protective equipment should be worn when disconnecting lines that have contained chlorine. Reference is made to CI Pamphlet 65. Never trap liquid chlorine in the discharge line between valves, since extremely high pressure can develop from an increase in the temperature of the chlorine. This pressure may lead to hydrostatic rupture of the line.

Adequate back flow protection should be utilized to prevent chlorine contamination of the padding system. The ends of loading lines and angle valves should be capped/plugged to prevent moisture contamination.

10.8 PRERELEASE CHECK

- Inspect angle valves to ensure they are closed
- Check for leaks using aqua ammonia as soon as all connections have been secured, valves closed and outlet plugs installed wrench-tight
- Close and secure the protective housing cover
- Remove chocks
- Prepare shipping papers
- Ensure the tank pressure is recorded

11. TANK UNLOADING PROCEDURES

11.1 GENERAL

When unloading a chlorine tank the safety aspects of the operation should be uppermost in the minds of unloading personnel. Before beginning transfer operations, the unloader must verify proper spotting and unloading procedures have been followed and a cargo tank safety check, which includes the discharge system and the cargo transfer hose, has been completed. The pressure in the cargo tank must be at or above that needed to ensure operation of the excess flow valves if there were a complete separation of the cargo transfer hose.

Reference is made to Section 7.9. Proper personal protective equipment should be worn during the transfer operation, see CI Pamphlet 65. Safety showers and eyewash facilities should be readily available. In addition all suppliers' recommendations should be followed during product transfer. The reader's attention is drawn to 49 CFR 177.834(i) covering the attendance requirements during the unloading operation. Development of attendance requirements should take these rules into account.

11.2 TANK INSPECTION CHECKLIST

An inspection checklist should be used for all aspects of the unloading operation. It should include all recommendations contained in this pamphlet plus any company procedures or special requirements specific to each facility. The checklist documents that the proper unloading and securement procedures have been completed. The checklist should be retained for an appropriate period of time.

The checklist for procedures to be followed after spotting the unit should at a minimum include:

- Verification that the tank is loaded with chlorine by careful inspection of the bill of lading, the vehicle number, commodity marking and placards
- Inspection of the running gear, safety appliances, marking (including stenciling), placarding and other pertinent items. The purpose of this portion of the inspection is to identify all defects in the tank motor vehicle before unloading any chlorine
- Verification that the tank security has been maintained. (Protective housing cover seal or driver assurance)
- Opening the housing cover and inspecting the manway fittings for evidence of a leak

- Verification that the receiving tank has sufficient capacity to receive the chlorine to be transferred
- Verification that the angle valve is fully closed before removing the angle valve plug
- A FIFRA label approved by the EPA if the tank is to be unloaded at water or sewage treatment facilities in the U.S.
- A check of the discharge system and the cargo transfer hose
- Verify location of C-Kit and SCBAs
- Verify Kingpin support in place if needed, brakes are set and wheels chocked

11.3 UNLOADING CONSIDERATIONS

Connections

Chlorine tank angle valves are equipped with a one inch pipe plug closure secured to the valve body. This plug should be tightly in place when the tank is received and located for unloading. Before any connection is made all piping should be clean, dry, and free of oil. Refer to CI Pamphlet 6.

A nipple made from one inch schedule 80 carbon steel, about 15 inches long, threaded at both ends should be tightly screwed into the tank valve outlet. The threads on the nipple should be standard NPT, sharp and clean and prepared with an appropriate sealant that is non reactive with chlorine. Care should be taken when tightening the nipple to prevent undue strain on the valve. A flexible transfer hose, per recommendations contained in Appendix A of CI Pamphlet 6 or a flexible copper loop, per CI Drawing 118, should be provided between the nipple and the permanent piping to compensate for the rise of the tank during unloading.

Teflon tape (T-tape) can be an effective lubricant/sealant of threaded pipe and plug connections to tank car angle valves if it is applied correctly. If the tape is incorrectly applied to these connections, it can be sucked into the internal components of the car's angle valves if the car is pulled under a vacuum during its preparation for loading, thereby preventing these valves from being able to be completely closed. To properly apply Teflon tape to a pipe nipple or a pipe plug to be installed in an angle valve, use a thick grade of tape, i.e., one that meets Military Specification MIL-T-27730A or General Services Administration Commercial Item Description (CID) A-A-58092, and do not wrap the tape past the first thread at the end of the pipe nipple or valve plug.

A valve arrangement incorporating fail safe features, mounted as close as possible to the tank angle valve, is recommended. A chlorine pressure gauge, protected with a suitable diaphragm, with a range of twice the operating pressure, should be mounted at the beginning of the permanent piping. A second valve arrangement incorporating fail safe features should be mounted on the permanent piping feeding the chlorine to process.

Use of a proper transfer hose suitable for the transfer of chlorine as recommended in CI Pamphlet 6 should be part of the transfer system. Use of an emergency shut-off system that meets the standards in CI Pamphlet 57 is recommended during the unloading of a chlorine cargo tank. An emergency shut-off arrangement as described in CI Pamphlet 57 is required for the unloading of all chlorine cargo tanks.

It is advisable, after all connections are made, to allow a small amount of chlorine gas into the system. Each connection, valve packing and flange should then be checked for leaks. If a leak is found, it must be corrected before allowing more chlorine into the line.

A squeeze bottle containing 26° Baumé aqua ammonia (ammonium hydroxide) solution can be used to detect a minor release or leak. A white cloud will form if a leak is present. To avoid corrosion, ammonia solution should not be directly sprayed onto connections. Any efforts to detect the source of a leak should be carried out with full consideration for potential hazards.

Opening Angle Valves

Each angle valve opening on the chlorine tank is equipped with an excess flow valve. The tank liquid angle valve must be opened slowly until it is completely opened and left fully open. If opened rapidly, the excess flow valve may close and flow will not occur. The angle valves should not be opened remotely without a qualified person in attendance.

Line Pressurization

While slowly opening the tank liquid angle valve, the pressure gauge located at the beginning of the permanent piping should be observed. A rise in pressure indicates there is liquid flow. The line valve should be in a closed position at this point. As soon as the gauge indicates a steady pressure, the tank liquid angle valve should be opened fully. As soon as the valve is completely open, the same procedure should be followed at the line valve, that is, it should be opened slowly until the liquid chlorine completely fills the line to process.

CAUTION: If liquid chlorine is trapped between two valves, extremely high pressure can develop upon increase in the temperature of the chlorine. Refer to CI Pamphlet 6.

Excess Flow Valve Unseating

Chlorine tanks are equipped with excess flow valves under all angle valves. The excess flow valve consists of a rising ball or plug which blocks the flow when the rate of flow exceeds a predetermined value. It does not respond to tank pressure alone.

It is designed to close automatically against the flow of chlorine if the angle valve is broken off or if there is a complete separation of the cargo transfer hose. If there is a leak of lesser magnitude, the emergency shut down system described in CI Pamphlet 57 can be used to stop the flow of chlorine. There may be times, due to opening the angle valve too rapidly or due to unusually high flow rates, the excess flow valve will close.

If this occurs, close the angle valve on the tank and leave it closed until the metal ball or plug in the excess flow valve drops back into place. A noticeable click will be heard when the ball or plug drops. If the ball or plug does not drop a connection can be made to the other liquid valve on the tank. The supplier should be consulted if neither of these two methods is successful.

11.4 MONITORING THE UNLOADING

DOT (49 CFR 177.834(i)) and TC (CSA Std. B622) regulations require a cargo tank to be attended by a qualified person at all times during unloading. The person attending the unloading must be alert, have an unobstructed view of the tank and cargo transfer hose and be within 25 feet of the tank. A qualified person is one that has been made aware of the hazards of chlorine and the procedures to be followed in an emergency, is authorized to move the cargo tank and has the means to do so.

11.5 LEAKS DURING UNLOADING

Leaks in Connections and Piping

Chlorine piping systems should be pressure tested at regular intervals according to Institute recommendations (See CI Pamphlet 6). All chlorine piping systems should be inspected at regular intervals for signs of leakage, internal or external corrosion, insulation failure or support problems. If a chlorine leak should occur in equipment or piping, the chlorine transfer should be stopped immediately by closing the tank angle valve, the pressure relieved and the necessary repairs made. When the leak has been located and the faulty equipment repaired, unloading may be resumed.

Leaks at Fittings

Leaks around the angle valve stems can usually be stopped by tightening the packing gland nuts. If this does not stop the leak, the angle valve should be closed. Only if a valve leak cannot be stopped by corrective measures should the Emergency Kit C be used. If the pressure relief device must be capped, regular monitoring must be established. The shipper should be advised of the problem as soon as possible.

11.6 DETERMINING AMOUNT OF CHLORINE UNLOADED

Where chlorine tanks cannot be unloaded on scales, and reliable direct gauging devices are not readily available, the most common practice for estimating the quantity of chlorine remaining in the tank is from the consumption records on the quantity removed. When a sharp drop in tank pressure occurs, unloading is normally complete. The contents must be unloaded to the maximum extent practicable.

11.7 DISCONNECTING

As soon as it is determined that the tank is as empty as possible, the liquid angle valves should be closed first and the discharge line emptied before any other valves in the discharge system are closed. The unloading lines should then be purged, evacuated and disconnected. This should be done with care being sure the line or lines have been cleared.

CAUTION: It is imperative that no chlorine be released upon disconnection. Appropriate personal protective equipment should be worn when disconnecting lines that have contained chlorine. Reference is made to CI Pamphlet 65. Never trap liquid chlorine in the discharge line between valves, since extremely high pressure can develop from an increase in the temperature of the chlorine. This pressure may lead to hydrostatic rupture of the line.

11.8 PRERELEASE CHECK

1. Inspect angle valves to ensure they are closed
2. Check for leaks using aqua ammonia as soon as all connections have been secured, valves closed and outlet plugs installed wrench-tight
3. Close and secure the protective housing cover
4. Remove chocks
5. Prepare shipping papers

12. **MAINTENANCE REQUIREMENTS**

12.1 GENERAL REQUIREMENTS

As with all hazardous material transport containers, chlorine tanks must be maintained in a safe working condition. Therefore, it is essential all scheduled tests and inspections be carried out with great diligence and care.

12.2 DAILY INSPECTION AND MAINTENANCE

Pre-trip vehicle condition reports are required to be completed by the driver at the beginning of the daily run. This inspection should disclose any obvious deficiencies.

Post trip vehicle condition reports should disclose any problems or deficiencies uncovered during the day's operation.

Inspections must be conducted on the vehicle at the completion of the day's work and any necessary deficiencies corrected before the unit resumes service on the public highways. Records must be kept and be available for reference during future scheduled maintenance events to assure that a uniform and cohesive flow of information is available to future inspectors. Specific DOT requirements for inspection, repair and maintenance can be found in 49 CFR Part 396.

12.3 PERIODIC MAINTENANCE

Careful and thorough vehicle maintenance should be performed on a fixed schedule as dictated by operating conditions and environment. For example, colder climates may cause maintenance problems such as corrosion due to road salting, spring and tire failure due to potholes caused by frozen roadways, etc. Each vehicle should be subjected to a thorough visual inspection on at least a quarterly basis.

Angle valves should be reconditioned at regular intervals. Before installation, each angle valve must be tested for leakage at not less than 225 psig using dry air or inert gas (49 CFR 178.337-9(b)(8)).

12.4 HOSE AND FITTING MAINTENANCE

Procedures for maintenance, testing and inspection of hoses should be set by each facility based on experience, equipment use and regulatory requirements in 49 CFR 180.407 and 416. Cargo transfer hoses carried on the tank must be properly purged and capped, to prevent the ingress of moisture, and secured in a safe, proper manner.

All hoses should be of the appropriate construction and comply with recommendations found in CI Pamphlet 6, Appendix A.

Hoses shall be carefully inspected prior to and after each use to assure none of the following conditions exist: damage to the hose cover that exposes the reinforcement; damaged, slipping or excessively worn hose couplings; or loose coupling assemblies.

Each hose must be marked with a unique identification number and maximum working pressure.

12.5 TESTS AND INSPECTIONS

Title 49 CFR Part 180 contains the requirements for maintenance, use, inspection, repair, retest and qualification of cargo tanks. Report and record retention requirements can be found in 49 CFR 180.417.

Any required weld repairs, as described in 49 CFR 180.413, may only be accomplished by a repair shop awarded a National Board "R" Stamp.

The following is a summary of chlorine cargo tank tests and inspections. Reference is made to 49 CFR 180.407 and 416 for the specific requirements for these tests and inspections.

Test/Inspection Type	Required
• Cargo Tank External Visual Inspection	Every year (V)
• Cargo Tank Internal Visual Inspection (The visual inspection is part of the required pressure test.)	Every two years
• Cargo Tank Leakage Test	Every two years (K)
• Cargo Tank Pressure Test (The hydrostatic test method should be used to conduct the pressure test.)	Every two years (P)
• Cargo Tank Thickness Test (recommended)	Every two years
• Removal of Upper Coupler (At each pressure test)	Every two years
• Pressure Relief Device	At each Pressure Test
• Transfer Hose Inspection	Monthly
• Transfer Hose Leakage Test (Hose assembly must be marked with month and year of most recent leakage test.)	Annually
• Transfer Hose Pressure Test (Test to a minimum of 120 percent of the hose maximum working pressure and permanently mark with the month and year of test.)	New or repaired hoses
• Cargo Piping Inspection	Monthly

Thickness testing is required every two years for cargo tanks carrying materials corrosive to the tank. Specifically, liquid chlorine is not corrosive to steel. However, certain conditions can cause chlorine to become corrosive to steel, such as the introduction of moisture. Furthermore, as the exterior surface of tank envelope is masked by the insulation and jacketing, there exists the potential for corrosion on this surface which will not be revealed without the jacket removal. It is for these reasons the practice of performing a thickness test every two years is recommended.

Upon satisfactory completion of test/inspection events, the tester must place a legend denoting the month/year of the test followed with the letter signifying the type of test performed (e.g. **6/00 P** for a pressure test performed during June 2000). This legend must be permanently affixed near the specification plate in characters or anywhere on the front head, not less than 1¹/₄ inches high. Legends are not required to be displayed noting the removal, testing, inspection and reinstallation of pressure relief devices or upper coupler assemblies, but records of these events must be available for review (49 CFR 180.415).

Every chlorine tank must have a legible DOT specification plate securely attached to the frame or shell at the front of the unit. Adjacent to this plate the legend **NQT** (for tanks of non-quenched and tempered steel) must be displayed in characters not less than two inches high.

Records demonstrating completion of tests and inspections must be maintained at the tank's terminal, or at a permitted regional, central, or terminal office according to DOT rules in Part 180.417. Records must be immediately available for review and must be completed and signed by the authorized inspector or tester. Only facilities expressly registered with the DOT and possessing a registration number may grant inspector or tester authorization using criteria established by the DOT. For minimum qualifications for inspectors or testers, see 49 CFR 180.409.

12.6 RECORDS AND CONTROL

It is important to keep complete records of different operations related to the safe handling transfer of chlorine tanks. Logs should be kept relative to tank and valve testing. Outgoing and incoming inspection reports of full and empty tanks should be maintained for at least one year.

Records documenting the test and inspection of cargo transfer hoses must be kept. (49 CFR 180.416(f)(3)).

13. **TRANSPORTATION**

13.1 ROUTE PLAN

Managements of the parties operating the chlorine tank and the consignee should approve the proposed route. It is advisable to include experienced transportation personnel in this decision.

A high level of communication and confidence-building should be attained with affected authorities for emergency preparedness, familiarity with equipment and, possibly, for joint emergency response drills. **Routing of chlorine tank motor vehicles must fully comply with all federal, state local and/or provincial laws, standards or guidelines.** Actions for various alert levels as outlined in the CI Cylinder, Ton and Cargo Plan should be reviewed.

13.2 MARKING AND PLACARDING OF TANKS

DOT regulations require very specific marking and placarding on the chlorine tanks (CI Drawing 168).

Marking requirements

- **CHLORINE** must be printed in 2-inch (50 mm) letters on each side and end (49 CFR 172.328(b))
- **INHALATION HAZARD** must be printed in 2-inch (50 mm) letters on two opposing sides if these words do not appear on the placard (49 CFR 172.313(a) and 172.302(b))
- **NQT** must be printed in 2-inch (50 mm) letters on MC 330 or MC 331 near the specification plate (172.328(c))
- The pressure relief device must be permanently marked with the following:
 - a) The start-to-discharge pressure
 - b) The actual rate of discharge of the device in cubic feet per minute of air at 60°F (15.6°C) and at atmospheric pressure
 - c) The manufacturer's name and catalog number (49 CFR 173.315(i))
- All tank inlets and outlets, except pressure relief devices, must be marked to designate whether they communicate with vapor or liquid (49 CFR 178.337-9(c))
- Each tank must be durably and legibly marked, in English, with the date (month and year) and the type of test or inspection performed. The date must be readily identifiable with the applicable test or inspection. The marking must be in letters and numbers at least 1.25-inches (32-mm) high, on the tank shell near the specification plate or anywhere on the front head

The type of test or inspection may be abbreviated as follows:

V = External Visual Inspection and Test

I = Internal Visual Inspection

P = Pressure Retest

K = Leakage Test

T = Thickness Test

For example, the marking **10-00 P, V** would indicate that in October 2000 the tank received and passed the prescribed pressure retest and the external visual inspection and test (49 CFR 180.415(a)(b)).

Placarding requirements

DOT placarding is required on each side and each end of the tank, for any quantity of hazardous material (49 CFR 172.504, 506, 514 and 540). Placards alert persons to the potential dangers associated with hazardous materials contained within tanks.

Placards also guide emergency personnel who respond to incidents involving hazardous materials. At the time of pamphlet issue DOT allowed several methods of placarding. The reader is cautioned to ensure placarding meets DOT and TC regulations.

13.3 TRANSPORTATION INCIDENTS/ACCIDENTS

Chlorine Leak

At first indication of a leak in transit, the driver should quickly determine the nature of the leak. If at all possible, the vehicle should be driven to an isolated area for a complete inspection. The emergency plan should be activated. Where possible, the driver should stay on the scene to assist emergency response personnel. All other persons should be kept away from the affected area. The location of a leak can usually be detected by the reaction of aqua ammonia vapor with the escaping chlorine. See 10.4 for information on testing for leaks.

The Institute's Emergency Kit C contains devices to stop leaks from the angle valves and the pressure relief device, as well as leaks between the valves and the manway cover. Respiratory equipment is not included in the kit. DOT regulations require respiratory equipment to be on board the motor vehicle during transportation.

Never use water on a chlorine leak. Chlorine is only slightly soluble in water, and the corrosive action of chlorine and water will make a leak worse.

Fire

In the event of fire, the vehicle should be removed from the fire zone immediately. If it cannot be moved, the driver should advise the emergency response personnel that the container should be kept cool by applying water. Although non-flammable, chlorine will react vigorously with most metals (including steel) at high temperatures.

Collision

In the event of a minor collision not affecting the safety of the chlorine tank, normal procedures for reporting any traffic accident should be followed. In the event of a collision that damages the chlorine tank, or the running gear of the chlorine tank, even if no leak has developed, the driver should contact the shipper. If a chlorine leak develops or the potential for a leak is present, the emergency plan should be activated.

Reports

When transporting chlorine in tanks, all carriers in local, intrastate or international commerce must comply with DOT Part 394 "Notification, Reporting and Recording of Accidents", and DOT 171.15 "Immediate notice of certain hazardous material incidents".

14. REFERENCES

14.1 INSTITUTE PUBLICATIONS

<u>Pamphlet & Drawing #</u>	<u>Title</u>
1	<i>Chlorine Basics</i> , ed. 7; Pamphlet 1; The Chlorine Institute: Arlington, VA, 2008 .
5	<i>Bulk Storage of Liquid Chlorine</i> , ed. 7; Pamphlet 5; The Chlorine Institute: Arlington, VA, 2005 .
6	<i>Piping Systems for Dry Chlorine</i> , ed. 15; Pamphlet 6; The Chlorine Institute: Arlington, VA, 2005 .
57	<i>Emergency Shut-Off Systems for Bulk Transfer of Chlorine</i> , ed. 5; Pamphlet 57; The Chlorine Institute: Arlington, VA, 2009 .
65	<i>Personal Protective Equipment for Chlor-Alkali Chemicals</i> , ed. 5; Pamphlet 65; The Chlorine Institute: Arlington, VA, 2008 .
73	<i>Atmospheric Monitoring Equipment for Chlorine</i> , ed. 7; Pamphlet 73; The Chlorine Institute: Arlington, VA, 2003 .
95	<i>Gaskets for Chlorine Service</i> , ed. 4; Pamphlet 95; The Chlorine Institute: Arlington, VA, 2008 .
152	<i>Safe Handling of Chlorine Containing Nitrogen Trichloride</i> , ed. 2; Pamphlet 152; The Chlorine Institute, Arlington, VA, 2005 .

<u>Pamphlet & Drawing #</u>	<u>Title</u>
IB/C	IB/C Instruction Booklet: Chlorine Institute Emergency Kit "C" for Chlorine Tank Cars and Tank Trucks, ed. 8-R1; Pamphlet IB/C; The Chlorine Institute: Arlington, VA, 2006 .
DWG-101	<i>Excess Flow Valve with Removable Seat - 7000 lbs/hr</i> , Drawing; DWG 101-7; The Chlorine Institute: Arlington, VA, 1993 .
DWG-102	<i>Studs, Nuts and Gaskets for Chlorine Tank Manway Covers and Valves</i> , Drawing; DWG 102-11; The Chlorine Institute: Arlington, VA, 2006 .
DWG-103	<i>Manway Cover for Chlorine Tank Cars and Cargo Tanks</i> , Drawing; DWG 103-8; The Chlorine Institute: Arlington, VA, 2001 .
DWG-104	<i>Standard Chlorine Angle Valve Assembly</i> , Drawing; DWG 104-9; The Chlorine Institute: Arlington, VA, 2002 .
DWG-105	<i>Standard Chlorine Angle Valve Parts</i> , Drawing; DWG 105-10 (two sheets); The Chlorine Institute: Arlington, VA, 2002 .
DWG-106	<i>Excess Flow Valve with Removable Gasket</i> , Drawing; DWG 106-6; The Chlorine Institute: Arlington, VA, 1993 .
DWG-118	<i>Chlorine Tank Car Unloading Connection</i> , Drawing; DWG 118-4; The Chlorine Institute: Arlington, VA, 1991 .
DWG-119	<i>Chlorine Tank Car Air Padding</i> , Drawing; DWG 119-3; The Chlorine Institute: Arlington, VA, 1993 .
DWG-137	<i>Typical Manway Arrangement - Chlorine Cargo Tank</i> , Drawing; DWG 137-5; The Chlorine Institute: Arlington, VA, 1996 .
DWG-168	<i>Chlorine Cargo Tank Marking and Placarding</i> , Drawing; DWG 168-5; The Chlorine Institute: Arlington, VA, 1998 .
DWG-201	<i>Maximum Internal Tank Pressure for Padding Chlorine Bulk Transports</i> , Drawing; DWG 201-3; The Chlorine Institute: Arlington, VA, 2001 .
DWG-H-51970	<i>Pressure Relief Device for Chlorine Service - Metallic Seat Design</i> , Styles 1 ½ JQ 225 and 1 ½ JQ 375, Drawing; H-51970-F; Anderson Greenwood Crosby: Wrentham, MA, 1996 .
DWG-H-50155	<i>Pressure Relief Device for Chlorine Service - Elastomeric Seat Seal Design</i> , Styles 1 ½ JQ 375, Drawing; H-50155-H; Anderson Greenwood Crosby: Wrentham, MA, 1996 .
Security	Security Management Plan for Transportation and On-Site Storage and Use of Chlorine Cylinders, Ton Containers and Cargo Tanks

14.2 DOT REGULATIONS

- 14.2.1 *Hazardous Materials Regulations*. Department of Transportation. 49 CFR Parts 170-178. U.S. Government Printing Office: Washington, DC, (revised annually).
- 14.2.2 *Federal Motor Carrier Safety Regulations*. Department of Transportation. 49 CFR Parts 386-399. U.S. Government Printing Office: Washington, DC, (revised annually).

14.3 CANADIAN REGULATIONS

- 14.3.1 *Canadian Transportation of Dangerous Goods in Clear Language*; ICC International Compliance Center Ltd: Mississauga, Ontario, **2008**.
- 14.3.2 *Highway Tanks and Portable Tanks for the Transportation of Dangerous Goods*; CSA B620; Canadian Standards Association: Mississauga, Ontario, **2009**.
- 14.3.3 *Selection and Use of Highway Tanks, Multiunit Tank Car Tanks, and Portable Tanks for the Transportation of Dangerous Goods Class 2, by Road*; CSA B622; Canadian Standards Association: Mississauga, Ontario, **2009**.

14.4 EPA REGULATIONS

Code of Federal Regulations. Title 40. Part 150. Office of the Federal Register National Archives and Records Administration. U.S. Government Printing Office: Washington, DC, (revised annually).

14.5 OSHA REGULATIONS

Code of Federal Regulations. Title 29. Part 1910. Office of the Federal Register National Archives and Records Administration. U.S. Government Printing Office: Washington, DC, (revised annually).

"OSHA Standard Method for Determination of Respiratory Protection Program Acceptability"

14.6 OTHER PUBLICATIONS

- 14.6.1 *Inter-Industry Bulk Chemical Highway Safety Task Force Manual of Recommendations*; The American Chemistry Council: Arlington, VA, and National Tank Truck Carriers: Alexandria, VA **1996**.
- 14.6.2 American Trucking Association Sample Hazmat Transportation Security Plan (5/31/03)

For further assistance and information on items referenced, contact:

American Chemistry Council
1300 Wilson Boulevard
Arlington, VA 22209
703-741-5000
703-741-6000 (Fax)
www.americanchemistry.com

Canadian Chemical Producers Association
350 Sparks Street
Suite 805
Ottawa, Ontario K1R 7S8 (Canada)
613-237-6215
613-237-4061 (Fax)
www.ccpa.ca

Government of Canada Publications
Ottawa, Ontario K1A 0S5 (Canada)
1-800-635-7943
www.publications.gc.ca

Canadian Standards Association
5060 Spectrum Way
Mississauga, Ontario L4W 5N6 (Canada)
416-747-4000
416-747-4044 (standard purchases)
416-747-4149 (Fax)
www.csa.ca

International Compliance Center Ltd.
205 Matheson Boulevard, East, Unit 7
Mississauga, Ontario L4Z 1X8 (Canada)
416-890-7227
416-890-7070 (Fax)
www.thecompliancecenter.com

National Tank Truck Carriers, Inc.
950 North Glebe Road, Suite 520
Arlington, VA 22203
703-838-1960
703-684-5753 (Fax)
www.tanktruck.org

Superintendent of Documents
Government Printing Office
732 North Capitol Street, NW
Washington, DC 20401
202-512-0000
www.access.gpo.gov

The Chlorine Institute, Inc.
1300 Wilson Boulevard
Arlington, VA 22209
703-741-5760
703-741-6068 (Fax)
www.chlorineinstitute.org

APPENDIX A

PAMPHLET 49 CHECKLIST

This checklist is designed to emphasize major topics for someone who has already read and understood the pamphlet. Taking recommendations from this list without understanding related topics can lead to inappropriate conclusions.

Place a check mark (✓) in the appropriate box below:

Yes	No	N/A		
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	1. Are personnel familiar with facility and transfer site emergency plans?	{3.1.1}
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	2. Are Emergency Kit C and SCBA carried on chlorine motor vehicles?	{3.3, 3.4}
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	3. Are personnel trained in regulatory requirements for chlorine?	{4.1}
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4. Has shipper registered with EPA and are tanks properly labeled when chlorine is to be used in FIFRA regulated application?	{4.2}
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	5. Do chlorine tanks meet all governmental specifications and Chlorine Institute recommendations?	{5.1.-5.3.5}
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	6. Are drivers properly qualified and preapproved prior to transporting chlorine?	{6.3}
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	7. Are carriers properly qualified and preapproved prior to transporting chlorine?	{6.3}
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	8. Are the shipper and carrier registered under the US DOT Hazardous Materials Registration Program?	{6.4}
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	9. Are conditions during loading and padding such that tank pressure will not approach the relief device setting?	{7.1}
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	10. Is air, used for unloading and padding, free from oil and foreign matter, dried at or below specified dew point and tested using a commercial dew point tester?	{7.5}
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	11. Does the loading facility comply with the responsibilities outlined in CI Pamphlet 49?	{8.1}
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	12. Does the carrier comply with the responsibilities outlined in CI Pamphlet 49?	{8.2}

Yes	No	N/A		
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	13. Does the unloading facility comply with the responsibilities outlined in CI Pamphlet 49?	{8.3}
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	14. Is an inspection checklist used for all aspects of the loading operation?	{10.2}
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	15. Is an inspection checklist used for all aspects of the unloading operation?	{11.2}
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	16. Is a qualified person in attendance at all times during cargo tank unloading to meet governmental requirements?	{11.4}
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	17. Are chlorine tanks maintained and tested per governmental requirements?	{12.5}
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	18. Are records maintained consistent with governmental regulations?	{12.6}
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	19. Are chlorine tanks marked and placarded per governmental requirements?	{13.2}
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	20. Is a transportation security plan as specified by 49 CFR 172.800 in place?	{14.2.1}
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	21. Are training records in place to document that employees are trained to the security plan?	{14.3.2}

REMINDER:

Users of this checklist should document exceptions to the recommendations contained in this pamphlet.

APPENDIX B

Cargo Tank Certifications

CARSON ENGINEERING

P.O. Box 2969 • Renton, WA 98056 • (425) 235-7551 • Fax (425) 277-5780 • E-MAIL - carengr@nwrain.com

CHLORINE CARGO TANK UNLOADING SYSTEM CERTIFICATION

(A) Summary

This document is the Design Certifying Engineer certification of the design for the means to provide for a passive shut-down of the chlorine cargo tank unloading system within twenty seconds of an unintentional release caused by a complete separation of a liquid delivery hose as required by U.S. Department of Transportation regulations in Title 49 CFR 173.315 (n)(2), published on May 24, 1999 (64 FR 28029).

(B) Description of the Chlorine Cargo Tank Unloading System

A chlorine cargo tank unloading system consists of a closed loop process involving liquid and gaseous chlorine consisting of liquid chlorine flow through -

- a) Six foot length of 1½-inch schedule 80 education pipe inside the cargo tank.
- b) An excess flow valve as per The Chlorine Institute, Inc. Drawing 101 (7,000 lb/hr)
- c) An angle valve assembly as per The Chlorine Institute, Inc. Drawing 104.
- d) Up to 18-inches length of one inch schedule 80 pipe nipple.
- e) An automatic isolation valve. This valve, which may not be on all systems, consists of a ball or plug valve of nominal one-inch diameter. This valve, in the fully opened position, has a Cv of at least 44.
- f) A chlorine transfer hose with a nominal one-inch diameter with a maximum length of 25 feet.

(C) Certification

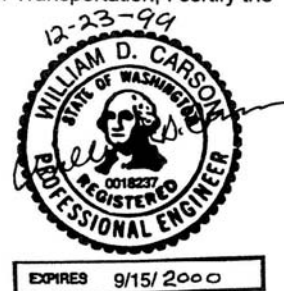
I have reviewed technical information and performed volumetric flow calculations pertaining to the chlorine cargo tank unloading system as described above and found the chlorine cargo tank transfer system, as described above, meets the design requirements of Title 49 CFR 173.315 (n)(2), that is, the system's excess flow valves will shut-down the flow of chlorine cargo within twenty seconds of an unintentional release caused by a complete separation of a liquid delivery hose, under the following conditions:

- a) The pressure in the cargo tank is at least 20 psig;
- b) The angle valve and the other valves in the system are in the fully opened position;
- c) The cargo transfer hose is no more than 42 inches above the angle valve opening; and
- d) The excess flow valves are properly maintained and meet the manufacturer's design specifications.

As a Design Certifying Engineer registered with the U.S. Department of Transportation, I certify the above to be true and correct.

Signed:

William D. Carson, DOT Certification ID #CT8063



**CARSON
ENGINEERING**

P.O. Box 2969 • Renton, WA 98056 • (425) 235-7551 • Fax (425) 277-5780 • E-MAIL - carengr@nwrain.com

CHLORINE CARGO TANK UNLOADING SYSTEM CERTIFICATION**(A) Summary**

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(B) Description of the Chlorine Cargo Tank Unloading System

A chlorine cargo tank unloading system consists of a closed loop process involving liquid and gaseous chlorine consisting of liquid chlorine flow through

- a) Six foot length of 1½-inch schedule 80 education pipe inside the cargo tank.
- b) An excess flow valve as per Midland Manufacturing Corp. A-120-ML.
- c) An angle valve assembly as per Midland Manufacturing Corp. Model A-713-ML.
- d) Up to 18-inches length of one inch schedule 80 pipe nipple.
- e) An automatic isolation valve. This valve, which may not be on all systems, consists of a ball or plug valve of nominal one-inch diameter. This valve, in the fully opened position, has a Cv of at least 44.
- f) A chlorine transfer hose with a nominal one-inch diameter with variable length (see below).

(C) Certification

I have reviewed technical information and performed volumetric flow calculations pertaining to the chlorine cargo tank unloading system as described above and found the chlorine cargo tank transfer system, as described above, meets the design requirements of Title 49 CFR 173.315 (n)(2), that is, the system's excess flow valves will shut-down the flow of chlorine cargo within twenty seconds of an unintentional release caused by a complete separation of a liquid delivery hose, under the following conditions:

- a) The pressure in the cargo tank is variable dependent on hose length:

Hose Length	Minimum Tank Pressure
10 ft	50 psig
15 ft	68 psig
20 ft	85 psig
25 ft	103 psig

- b) The angle valve and the other valves in the system are in the fully opened position;
- c) The cargo transfer hose is no more than 42 inches above the angle valve opening; and
- d) The excess flow valves are properly maintained and meet the manufacturer's design specifications.

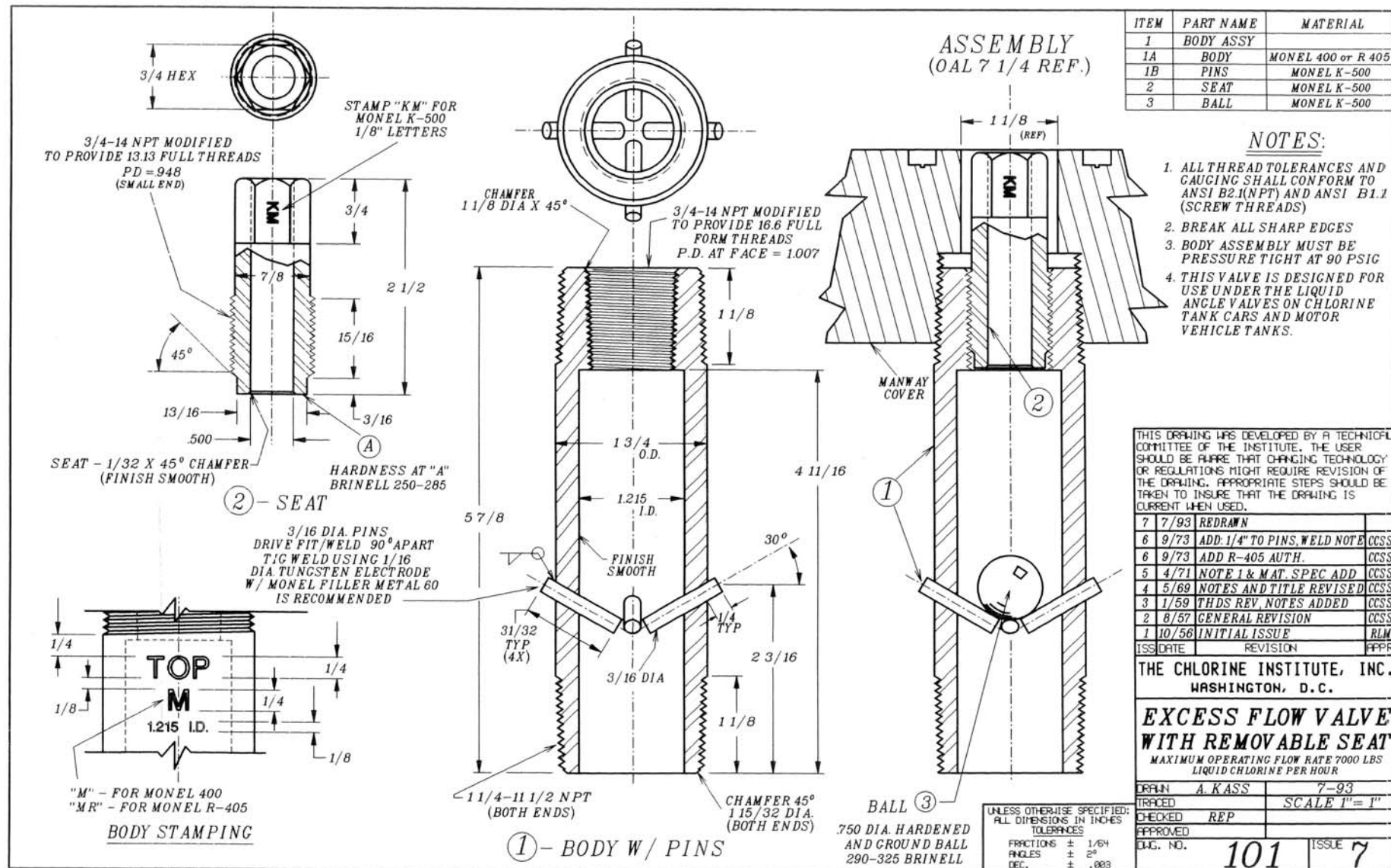
As a Design Certifying Engineer registered with the U.S. Department of Transportation, I certify the above to be true and correct.

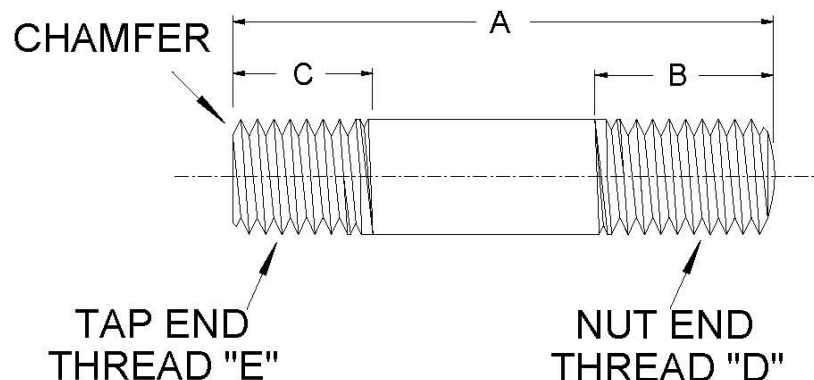
Signed:

William D. Carson DOT Certification ID #CT8063



DRAWINGS





ITEM	PART	USE
1	STUD	Tank car and cargo tank pressure relief device (1 1/2 JQ)
2	STUD	Standard angle valve and tank car protective housing. (see NOTE 7)
2A	STUD	Alternate angle valve. (see NOTE 7)
3	STUD	Tank car and cargo tank manway cover.
4	GASKET	Angle valve, pressure relief device (1 1/2 JQ)
5	GASKET	Tank car and cargo tank manway cover.
6	NUT	Angle valve, pressure relief device (1 1/2 and 4JQ) tank car and cargo tank protective housing.
7	NUT	Tank car and cargo tank manway cover.
8	GASKET	Tank barge pressure relief device (4JQ)
9	STUD	Tank barge pressure relief device (4JQ)

STUDS

DIM.	ITEM 1	ITEM 2	ITEM 2A	ITEM 3	ITEM 9	CLASS OR TOL.
A	3 3/4	3	2 5/8	4 1/2	4 1/8	+1/16,-0
B	2 3/8	1 5/8	1 1/4	2 3/4	1 3/8	+0,-1/16
C	7/8	7/8	7/8	1 1/4	1	+0,-1/16
D	3/4-10 UNC	3/4-10 UNC	3/4-10 UNC	1 1/8-7 UNC	3/4-10 UNC	2A
E	3/4-10 UNC	3/4-10 UNC	3/4-10 UNC	1 1/8-7 UNC	3/4-10 UNC	3A

ITEM 6 - 3/4-10 UNC-2B (1 1/4 ACROSS FLATS)

ITEM 7 - 1 1/8-7 UNC-2B (1 13/16 ACROSS FLATS)

Material shall conform to ASTM A320 Grade L7 specifications including impact testing.

NOTES:

- Dimensions in inches unless noted.
- Screw thread tolerance and gaging shall conform to ANSI B1.1.
- Dimensions "B" and "C" include 1 to 1-1/4 imperfect threads.
- Lock washers not permitted.
- Cargo tank parts are identical to tank car parts.
- Place grade mark "L7" on nut end of stud.
- The valve supplier should be consulted for the proper stud dimensions.

GASKETS

DIM	ITEM 4	ITEM 5	ITEM 8
OD	2 1/4	20 1/4	6 3/16
ID	1 1/2	19 1/4	5 3/16
THICK	1/8	1/8	1/8

MATERIAL: Per gasket material section in pamphlet 95

NUTS

Nuts shall be heavy series, semifinished hexagon type in conformance with ANSI B18.22 & ASTM A194

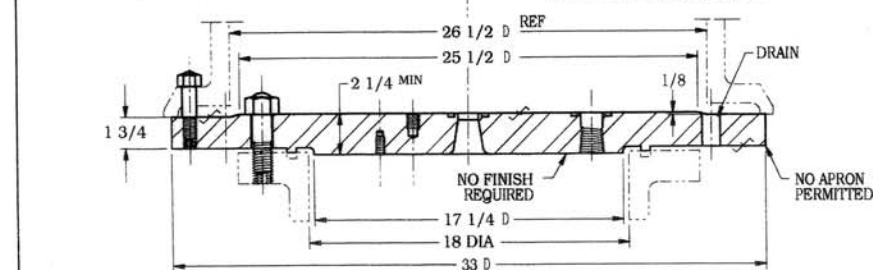
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11	10/06	ADDED "2A", REVISED NOTES	
10	1/01	CLARIFIED USE & MAT. NOTES	STC
9	7/93	REDRAWN	
8	8/83	CORRECT DIM "C", ITEM 2 & 9	
7	9/82	ADD NOTE 6	STC
6		GASKET SPEC UPDATED	CCSS
5	9/76	ITEMS 1-3, DIM. A, B & C REV.	
4	11/62	4JQ STUDS, 8C GASKET ADDED	CCSS
3	5/58	GENERAL REVISIONS	CCSS
2	1/58	THREADS REVISED TO UNC	CCSS
1	2/57	ISSUED	RLM
ISS DATE		REVISION	APPR

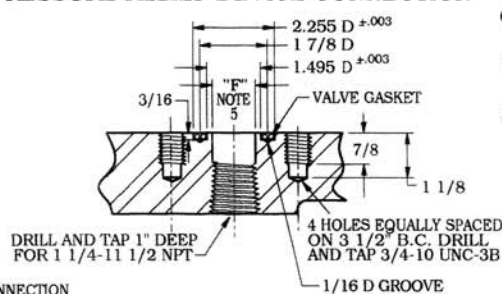
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WASHINGTON, D.C.

STUDS, NUTS & GASKETS FOR
CHLORINE TANK
MANWAY COVERS & VALVES

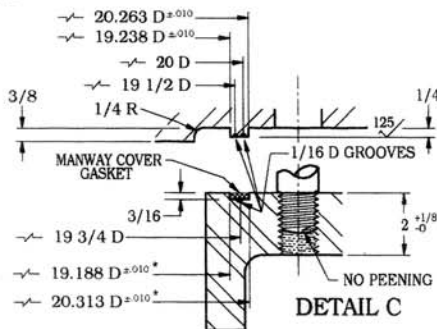
DRAWN	A. KASS	7-93
TRACED		
CHECKED	REP	
APPROVED		
DWG. NO.	102	ISSUE 11



SEE DETAIL "C" FOR TONGUE AND GROOVE DIMENSIONS



DETAIL B - ANGLE VALVE CONN.



JOINT BETWEEN MANWAY
COVER AND NOZZLE

NOTE: * NEW CONSTRUCTION OR REPAIR INCLUDING
FULL FILL OF GROOVE WITH WELDING:
±.010 - AS MACHINED
±.035 - AS CAR COMPLETED

UNLESS OTHERWISE SPECIFIED		
ALL DIMENSIONS IN INCHES		
<u>TOLERANCES</u>		
FRACTIONS	±	1/64
ANGLES	±	2°
DEC.	±	.005

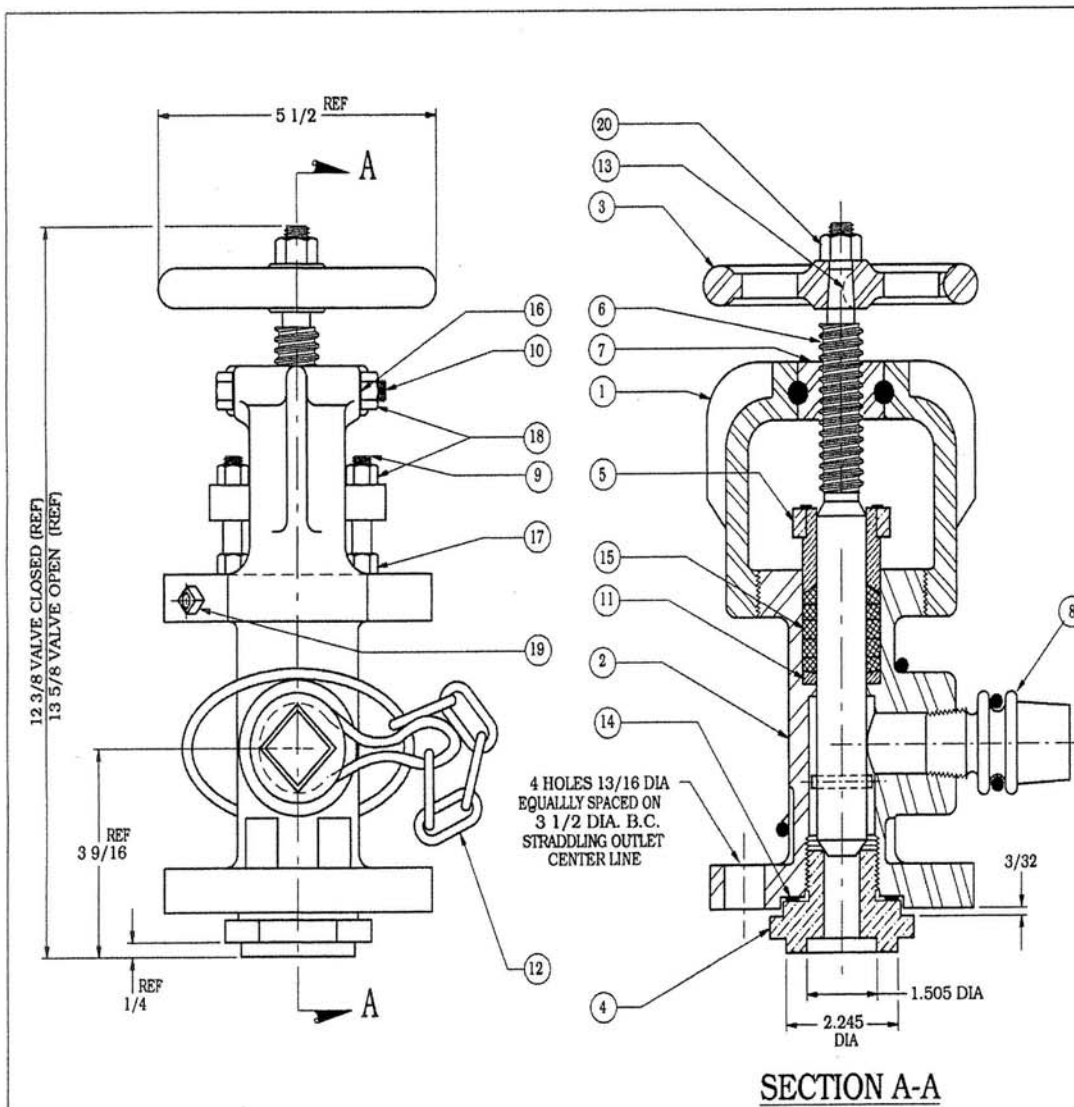
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8	1/01	ADDED TOLERANCING NOTE	STC
7	11/96	ADDED TOLERANCING	
6	11/93	REDRAW	
5	9/77	"MIN" ADDED TO THICKNESS DIM.	CCSS
4	9/71	DET. 8 & NOTES REVISED	CCSS
3	1/58	REMOVE NOTE 5-EDITORIAL REV	CCSS
2	6/57	HOUSING STUD DRILLING	CCSS
1	3/57	INITIAL RELEASE	CCSS
ISS	DATE	REVISION	APPR

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MANWAY COVER FOR
CHLORINE TANK CARS
AND CARGO TANKS
18" MANWAY

DRAWN	A. KASS	11-93
TRACED		SCALE = 1" = 6"
CHECKED	REP	
APPROVED		
DATE, NO.	103	ISSUE 8



ITEM	NAME OF PART	QTY	MAT
1	YOKE	1	STL
2	BODY	1	STL
3	HANDWHEEL	1	IRON
4	SEAT	1	MONEL
5	PACKING GLAND ASSY.	1	MONEL
6	STEM ASSY.	1	MONEL
7	YOKE BUSHING	1	STL
8	PLUG	1	STL
9	PACKING GLAND STUD	2	STL
10	BUSHING BOLT	2	STL
11	PACKING RETAINER	1	MONEL
12	PLUG CHAIN/CABLE ASSY.	1	STL
13	WOODRUFF KEY #606	1	STL
14	SEAT GASKET	1	NOTE 2
15	PACKING RING SET	5/7	DWG. 105
16	BUSHING LOCKWASHER	2	STL
17	GLAND STUD JAM NUT	2	STL
18	NUT	4	STL
19	SET SCREW	2	STL
20	HANDWHEEL NUT	1	STL

NOTES:

1. Nuts shall be steel American Std. Heavy series semi-finished, hex type.
2. Gasket material may be 2-3% antimony lead, compressed asbestos sheet to Fed spec HH-P-48B or Garkock 8810.
3. See Dwg. 102 for mounting studs, gasket details and specifications.
4. See Dwg. 105 for details of design and material including alternatives.
5. See Dwg. 190 for condemning limits.

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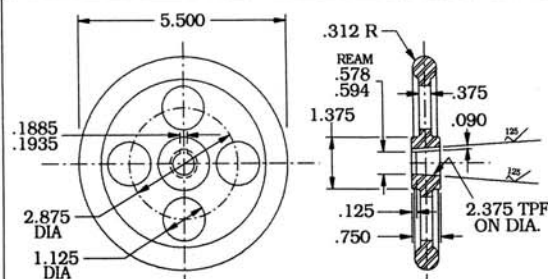
9	4/02	EDITED NOTE 2	STC
8	12/97	MODIFY ITEMS: 7, 12, & 17	STC
7	7/83	REDRAW	STC
6	12/82	13 5/8 WAS 12 5/8	STC
5	9/72	REDRAWN - VALVE ASSY.	CCSS
4	5/58	STUD & STEM REVISED	CCSS
3	1/58	GENERAL REVISIONS	CCSS
2	6/57	PLUG CHAIN REVISED	CCSS
1	5/57	INITIAL RELEASE	CCSS
ISS	DATE	REVISION	APPR

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STANDARD CHLORINE ANGLE VALVE ASSEMBLY

DRAWN	A. KASS	7-93
TRACED		SCALE = NONE
CHECKED	MEL	
APPROVED		
DWG. NO.	104	ISSUE 9

UNLESS OTHERWISE SPECIFIED:
ALL DIMENSIONS IN INCHES
TOLERANCES
FRACTIONS $\pm 1/64$
ANGLES $\pm 2^\circ$
DEC. $\pm .003$



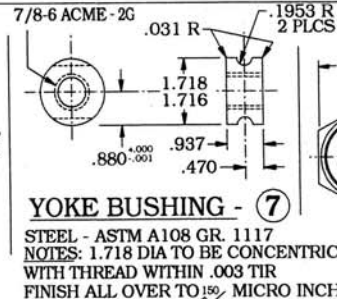
HAND WHEEL - ③

GRAY IRON - ASTM A-126 CL.B
ASTM A-576 GR 1030 - FORGED



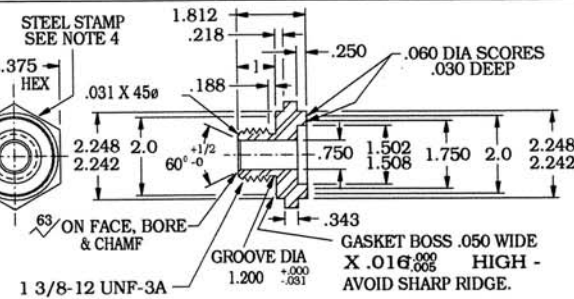
PACKING RETAINER

MONEL - ASTM B164 UNS NO 4400
HASTELLOY - C-22 ASTM B574
UNS NO 6022
NOTE: FINISH ALL OVER TO
DIA'S CONCENTRIC WITHIN .003



YOKE BUSHING - ⑦

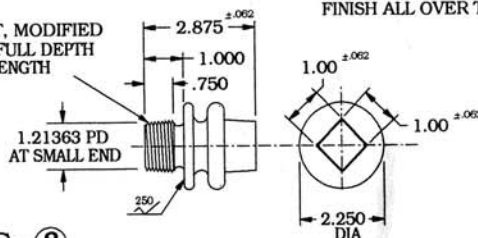
STEEL - ASTM A108 GR. 1117
NOTES: 1.718 DIA TO BE CONCENTRIC
WITH THREAD WITHIN .003 TIR
FINISH ALL OVER TO .003 MICRO INCH



SEAT - ④

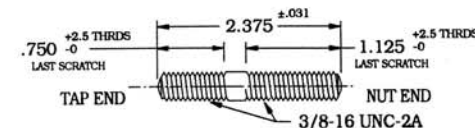
HOT ROLLED MONEL - ASTM B164 UNS NO 4400
COLD ROLLED MONEL - ASTM B164 UNS NO 4405
HASTELLOY C-22 ASTM B574 UNS NO 6022
NOTE: ALL DIA'S & THREADS TO BE CONCENTRIC
TO .75 DIA TO WITHIN .003 TIR

1-11 1/2 NPT, MODIFIED
TO PROVIDE FULL DEPTH
FOR ENTIRE LENGTH



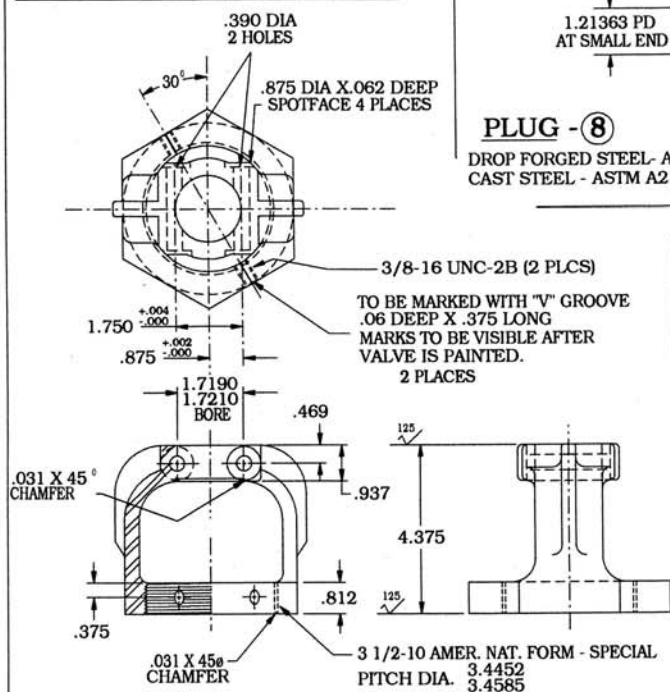
PLUG - ⑧

DROP FORGED STEEL - ASTM A576 GR. 1117, 1118 OR 1120
CAST STEEL - ASTM A216 GR. WCB OR A27 GR. 70-36



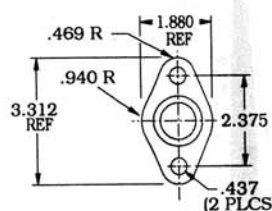
PACKING GLAND STUD - ⑨

STEEL - ASTM A307 GR. A
(2X SCALE)



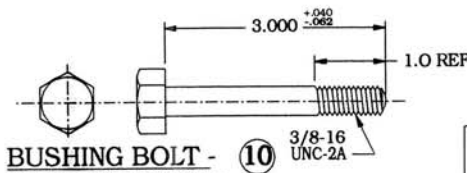
YOKE - ①

CAST STEEL - AAR M201 GR. B
ASTM A216 GR. WCB
ASTM A27 GR. 70-36



PACKING GLAND - ⑤

GLAND - INVESTMENT CAST MONEL - ASTM A494 GRM35-1



BUSHING BOLT - ⑩

STEEL - ASTM A307 GR. A
(2X SCALE)

UNLESS OTHERWISE SPECIFIED:
ALL DIMENSIONS IN INCHES
TOLERANCES
DIMENSIONS ± .015
ANGLES ± 2°

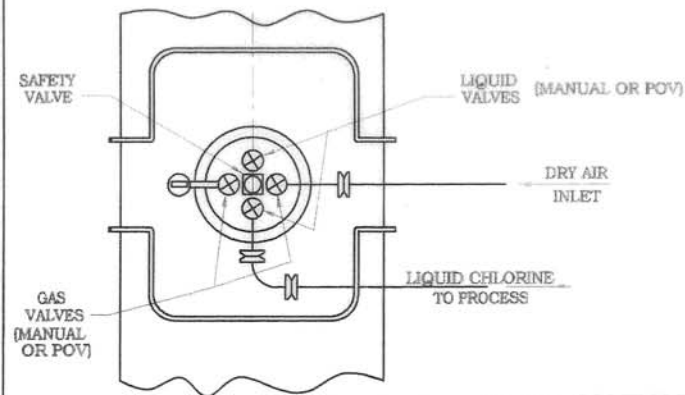
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STANDARD CHLORINE ANGLE VALVE PARTS

(SHEET 2 of 2)

DRAWN	A. KASS	8-93
TRACED		SCALE = 1" = 3"
CHECKED	MEL	
APPROVED		
DWG. NO.	105-2	ISSUE 10

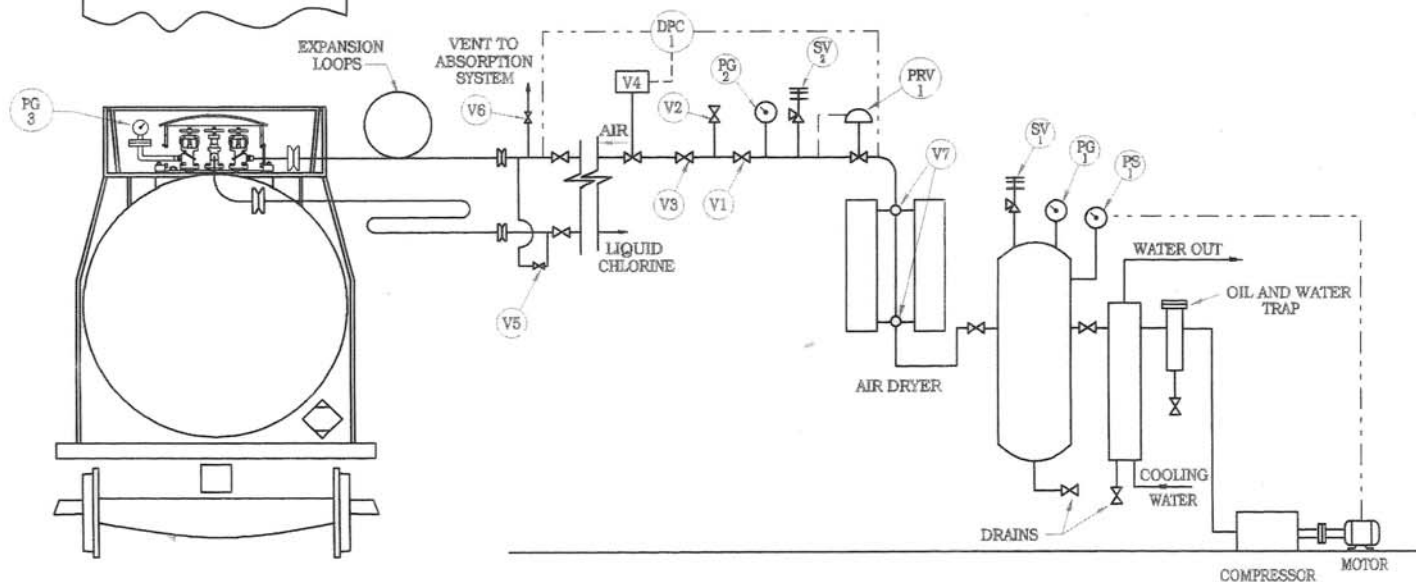


LIST OF VALVES AND GAGES

DPC-1	DIFFERENTIAL PRESSURE CONTROLLER - SEE NOTE 2
PG-1	PRESSURE GAGE- RANGE 150% MAX. READING
PG-2	PRESSURE GAGE- RANGE 150% MAX. READING
PG-3	PRESSURE GAGE WITH GAGE PROTECTOR
PRV-1	PRESSURE REDUCING VALVE
PS-1	PRESSURE SWITCH - SET 15 PSI ABOVE PRV-1
SV-1	SAFETY VALVE - SET 40 PSI ABOVE PRV-1
SV-2	SAFETY VALVE - SET 15 PSI ABOVE PRV-1
V-1	BLOCK VALVE
V-2	VENT AND AIR SAMPLE VALVE
V-3	BLOCK VALVE
V-4	VALVE OPERATED BY DPC-1
V-5	BY-PASS VALVE
V-6	VENT VALVE
V-7	AIR DRYER MULTIPORT CYCLE VALVES

NOTES:

- PS-1 IS SET AT 15 PSI ABOVE REDUCING VALVE DISCHARGE PRESSURE AND CONTROLS THE COMPRESSOR MOTOR. SOME USERS INSTALL A SECOND PRESSURE SWITCH ON THE RECEIVER TO INITIATE AN ALARM IF THIS PRESSURE IS NOT MAINTAINED.
- DPC-1 IS SET TO OPEN V-4 ONLY IF THE PRESSURE AT THE DRYER OUTLET IS 10 TO 15 PSI ABOVE THE CAR PRESSURE.
- CONTINUOUS ON LINE DEWPOINT MEASUREMENT FOR COMPRESSED AIR SYSTEMS IS RECOMMENDED.
- ENSURE AN OILFREE COMPRESSOR OPERATION WITH NO CARRYOVER TO AIR.
- FOR EMERGENCY SHUT-OFF RECOMMENDATIONS, SEE INSTITUTE PAMPHLET #57.



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6		
5		
4		
3		
2	8/93 REDRAW	STC
1	5/61 INITIAL RELEASE	CCSS
ISS DATE	REVISION	APP

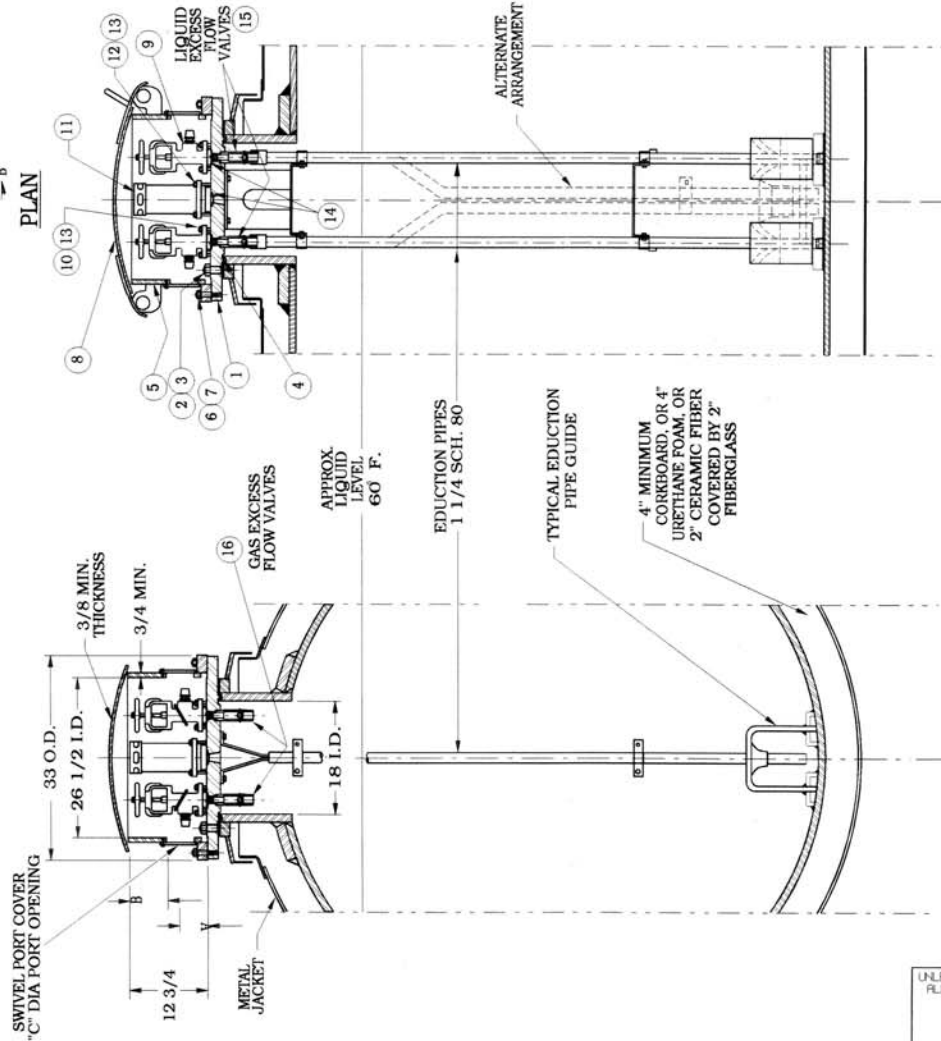
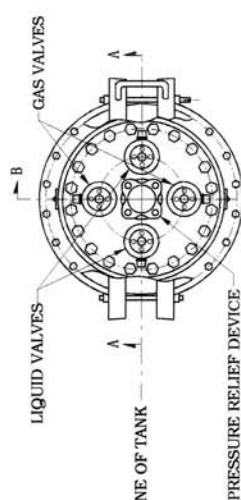
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WASHINGTON, D.C.

CHLORINE TANK CAR AIR PADDING

DRAWN	A. KASS	8-93
TRACED		SCALE = NONE
CHECKED	MEL	
APPROVED		
DWG. NO.	119	ISSUE 3

NOTE: NEW CONSTRUCTION TO BE +1/8"
FOR PORT OPENINGS

PREFERRED	
A	4"
B	7"
C	3 1/2"



SECTION A-A

SECTION B-B

ITEM	NAME OF PART	QTY	DWG
1	MANWAY COVER	1	103
2	MANWAY COVER STUD	20	102
3	MANWAY COVER NUT	20	102
4	MANWAY COVER GASKET	1	102
5	PROTECTIVE HOUSING	1	
6	PROTECTIVE HOUSING STUD	20	102
7	PROTECTIVE HOUSING NUT	20	102
8	PROTECTIVE HOUSING COVER	1	
9	ANGLE VALVE - 1"	4	104
10	ANGLE VALVE STUD	16	102
11	PRESSURE RELIEF DEVICE (1 1/2" Q225)	1	H 51970
12	PRESSURE RELIEF DEVICE STUD	4	102
13	VALVE NUT	20	102
14	VALVE GASKET	5	102
15	LIQUID EXCESS FLOW VALVE	2	101
16	GAS EXCESS FLOW VALVE	2	106

NOTES:

1. CLAMPING ARRANGEMENTS FOR EDUCTION PIPES VARY.
2. DOT REGULATIONS REQUIRE EXCESS FLOW VALVES UNDER ALL ANGLE VALVES.

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6		
5	11/96 ADOPTED PRD NOMENCLATURE	
4	7/93 REDRAW	
3	9/82 REV. INSULATION NOTE	STC
2	9/71 REDRAWN- ADD NOTES & DIM	CCSS
1	11/62 INITIAL RELEASE	CCSS
ISS DATE	REVISION	APPR

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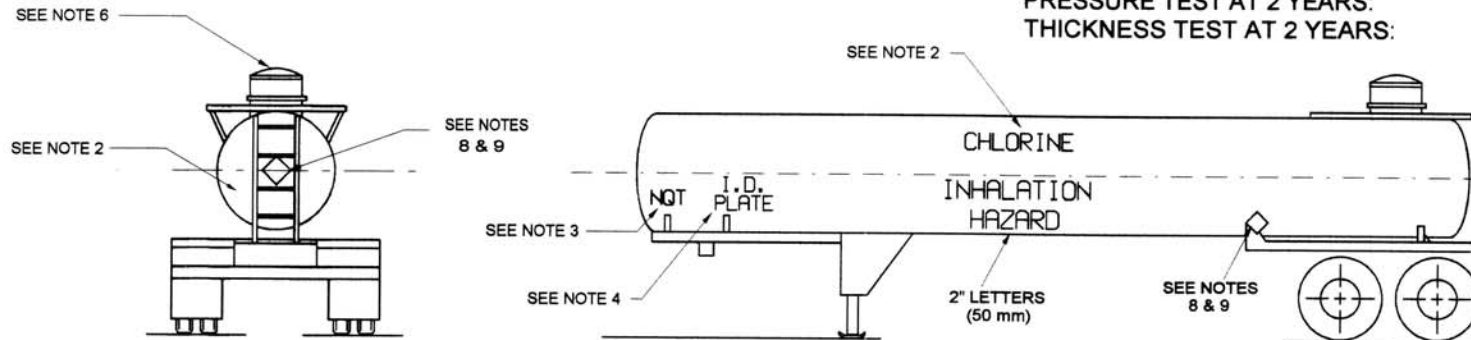
TYPICAL MANWAY ARRANGEMENT CHLORINE CARGO TANK

DRAWN	A. KASS	7-93
TRACED		SCALE = 1" = NONE
CHECKED	REP	
APPROVED		
DWG. NO.	137	ISSUE 5

UNLESS OTHERWISE SPECIFIED:
ALL DIMENSIONS IN INCHES
TOLERANCES
FRACTIONS ± 1/64
ANGLES ± 2°
DEC. ± .003

TEST AND INSPECTION STENCILS (NOTE 7)

EXTERNAL VISUAL INSP. AT 1 YEAR: (MO - YR) V
INTERNAL VISUAL INSP. AT 2 YEARS: (MO - YR) I
LEAKAGE TEST AT 2 YEARS: (MO - YR) K
PRESSURE TEST AT 2 YEARS: (MO - YR) P
THICKNESS TEST AT 2 YEARS: (MO - YR) T



NOTES:

- DOT REQUIREMENTS FOR MARKING CHLORINE CARGO TANKS (INCLUDING STENCILING AND STAMPING) ARE ILLUSTRATED FOR GUIDANCE. FOR STATE, PROVINCIAL AND LOCAL ADDITIONAL REQUIREMENTS, IT IS ASSUMED THAT SHIPPERS AND CARRIERS WILL INVESTIGATE WITH SUCH REGULATORY AGENCIES.
- PER DOT 172.328(b) THE WORD CHLORINE MUST BE DISPLAYED ON EACH END AND SIDE IN LETTERS AT LEAST 2 INCHES (50 MILLIMETERS) HIGH.
- PER DOT 172.328(c) NQT (TO INDICATE CONSTRUCTION OF OTHER THAN QUENCHED AND TEMPERED STEEL) MUST BE DURABLY MARKED IN LETTERS AT LEAST 2" HIGH IN THE AREA ADJACENT TO THE IDENTIFICATION PLATE.
- PER DOT 178.337-17, A NON-CORROSIVE METAL PLATE MUST BE PERMANENTLY AFFIXED ON THE LEFT SIDE (RIGHT SIDE FOR TRAILERS CONSTRUCTED BEFORE 7-1-85) NEAR THE FRONT OF THE CARGO TANK IN A PLACE READILY ACCESSIBLE FOR INSPECTION AND MAINTAINED LEGIBLE. THE FORMED LETTERS, IN CHARACTERS AT LEAST 3/8" HIGH, MUST INCLUDE THE FOLLOWING IN ADDITION TO THAT REQUIRED BY THE ASME CODE:

VEHICLE MANUFACTURER
VEHICAL MANUFACTURER'S SERIAL NUMBER
DOT SPECIFICATION NUMBER MC-331 (OR ICC MC-330)
VESSEL MATERIAL SPECIFICATION NUMBER
WATER CAPACITY IN POUNDS (SEE DOT 173.315 (a) TABLE-NOTE 1)
ORIGINAL TEST DATE

EACH INSULATED TANK MUST HAVE AN ADDITIONAL PLATE SIMILAR TO THE ABOVE AFFIXED TO THE JACKET AT THE LOCATION SPECIFIED ABOVE.

- PER DOT 173.315(i)(13), THE PRESSURE RELIEF DEVICE ON A CHLORINE CARGO TANK MUST CONFORM TO THE STANDARD OF THE CHLORINE INSTITUTE, INC. TYPE 1-1/2 JQ 225. THE PRESSURE RELIEF DEVICE MUST BE PERMANENTLY MARKED WITH THE START TO DISCHARGE PRESSURE, THE ACTUAL RATE OF DISCHARGE OF THE DEVICE IN CUBIC FEET PER MINUTE OF AIR AT 60 DEG F AND ATMOSPHERIC PRESSURE, THE MANUFACTURER'S NAME AND CATALOG NUMBER. ALL OF THIS SHOULD BE ON THE NAMEPLATE ATTACHED TO THE PRESSURE RELIEF DEVICE.
- PER DOT 178.337-9(c), ALL TANK OUTLETS AND INLETS (EXCEPT PRESSURE RELIEF DEVICES) MUST BE MARKED TO DESIGNATE WHETHER THEY COMMUNICATE WITH VAPOR OR LIQUID.
- PER DOT 180.415, THE DATE OF THE LAST TESTS AND INSPECTIONS OF THE CARGO TANK SHALL BE IN LETTERS NOT LESS THAN 1-1/4" HIGH NEAR THE METAL CERTIFICATION PLATE OR ON THE FRONT HEAD. (SEE DOT 180.407(c) TABLE FOR FREQUENCIES) ALTHOUGH NOT REQUIRED THE INSTITUTE RECOMMENDS A THICKNESS TEST EVERY 2 YEARS. THE PRESSURE TEST INCLUDES EITHER REPLACEMENT OR TESTING OF THE PRESSURE RELIEF DEVICE, A VISUAL INSPECTION AND A HYDROSTATIC TEST.
- PER DOT 172.504, 172.506, 172.514 AND 172.540 SHIPPER SHALL PLACARD TANK ON EACH SIDE AND END WITH 10 3/4 INCH POISON GAS PLACARD.
- PER DOT 172.332 CHLORINE IDENTIFICATION NUMBER (1017) MUST BE SHOWN ON PLACARDS IN 3 1/2 INCH HIGH LETTERS OR ON SEPARATE ORANGE PANEL IN 4 INCH HIGH LETTERS ON EACH SIDE AND END.
- PER DOT 172.313, THE WORDS "INHALATION HAZARD" ARE NOT REQUIRED IF THEY APPEAR ON THE PLACARD.

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6		
5	10/98	CHANGE NOTES
4	7/93	REDRAW
3	1/89	CORRECTED PLACEMENT-SIDE VIEW
2	9/84	UPDATE
1	3/73	INITIAL RELEASE
ISS DATE	REVISION	APPR

THE CHLORINE INSTITUTE, INC.
WASHINGTON, D.C.

CHLORINE CARGO TANK MARKING AND PLACARDING

DRAWN	A. KASS	7-93
TRACED		
CHECKED	REP	
APPROVED		
CHG. NO.	168	ISSUE 5

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6		
5		
4		
3	1/01 REORIENT AXIS	STC
2	6/91 REDRAW	
1	8/62 INITIAL RELEASE	CCSS
ISSUITE	REVISION	FFFF

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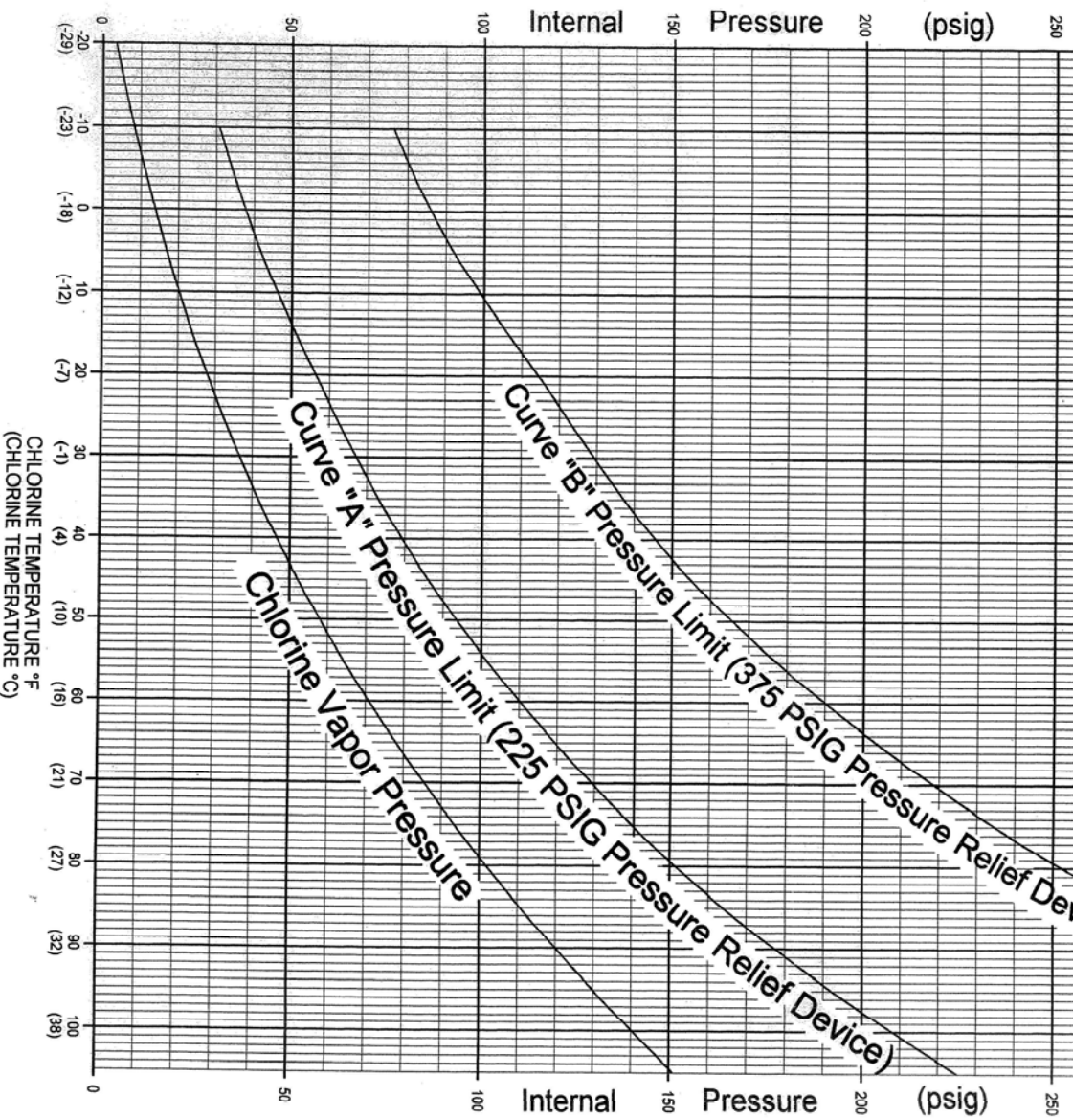
**MAXIMUM INTERNAL TANK
PRESSURE FOR PADDING
CHLORINE BULK TRANSPORTS**

DESIGN	A. KASS	9-91
CHECKED	REP	ISSUE 3
APPROVED		
DWG. NO.	201	ISSUE 3

CURVE DATA			
TEMP.	WAPOR PRESSURE	CURVE A	CURVE B
° F	PSIG	PSIG	PSIG
-10	8.29	30.8	76.5
0	13.81	37.7	86.2
+20	27.84	56.4	114.4
40	46.58	79.3	145.7
60	70.91	110.2	190.1
80	101.76	151.5	252.3
100	140.20	208.0	344.8
105	151.0	225.0	375.0

CURVE A - TANKS EQUIPPED WITH 225 PSIG
PRESSURE RELIEF DEVICE

CURVE B - TANKS EQUIPPED WITH 375 PSIG
PRESSURE RELIEF DEVICE





1300 Wilson Boulevard « Suite 525 « Arlington, VA 22209
Telephone: (703) 894-4140 « Fax: (703) 894-4130
Email: pubs@CL2.com « Website: www.chlorineinstitute.org
Technical inquiries: techsvc@cl2.com

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