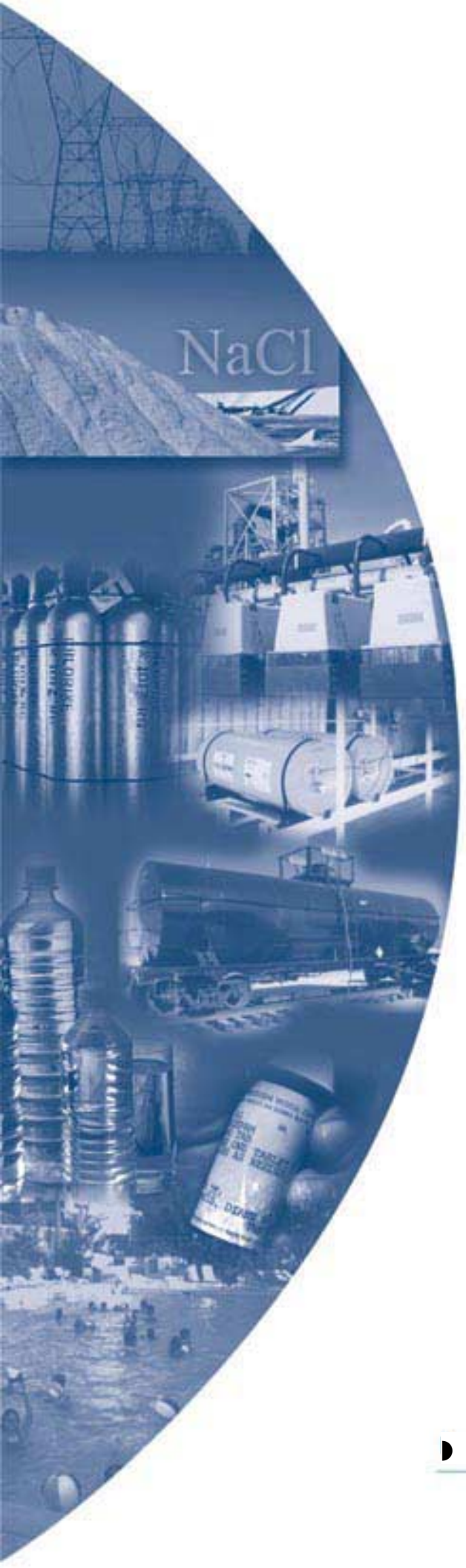

THE CHLORINE INSTITUTE, INC.

Pamphlet 66

Recommended Practices For Handling Chlorine Tank Cars

Edition 4

A LEGACY OF 1924 since SAFETY STEWARDSHIP

December 2007

TABLE OF CONTENTS

1. INTRODUCTION

1.1 SCOPE

This pamphlet provides guidelines, recommended practices and other useful information for the safe handling of chlorine tank cars at loading and unloading facilities. This includes receiving, spotting, loading, unloading, routine maintenance, inspecting, testing and tank qualification. It represents a compendium of Institute membership experience as of the date of publication.

1.2 CHLORINE INSTITUTE STEWARDSHIP PROGRAM

The Chlorine Institute 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 improvements. 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:

AAR	Association of American Railroads
AEI tag	automatic equipment identification tag
ASME	American Society Mechanical Engineers
CFR	Code of Federal Regulations (U.S.)
chlorine	DRY chlorine, either gas or liquid
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act of 1980 (42 U.S.C. 9601 et seq.), also known as the superfund law
DOL	U.S. Department of Labor
DOT	U.S. Department of Transportation

Dry air or nitrogen	air or nitrogen dried to a dew point of -40F (-40C) or below measured at the operating pressure
EPA	U.S. Environmental Protection Agency
FIFRA	Federal Insecticide, Fungicide and Rodenticide Act
FRA	Federal Railroad Administration, U.S. DOT
gas padding	the addition of clean, dry, oil free, compressed air, nitrogen or chlorine in order to increase system pressure
gas purge	the use of clean, dry, oil free, compressed air or nitrogen to displace chlorine, moisture or other contaminants from a tank or system
Institute	The Chlorine Institute, Inc.
marking	A descriptive name, identification number, instruction, caution, weight, specification or UN mark that is required to be applied to the tank car. A marking can be applied with a stencil or decal
NDE	nondestructive examination
OSHA	Occupational Safety and Health Administration, U.S. DOL
POV	Pneumatically operated angle valve
psig	pounds per square inch gage
pressure relief device	A mechanism designed to prevent internal pressure from rising above a predetermined maximum in a pressure vessel
tank car	a tank car tank mounted on or forming part of a rail car structure, including all components necessary and proper for railroad service
sniffing	to remove residual chlorine by pulling a minimum two inches of mercury vacuum on the tank
stencil	a marking applied with paint or a decal
TC	Transport Canada

1.4 SAFETY PROGRAMS

Every site handling chlorine should have an on-going safety program. Periodic training sessions and safety inspections must be conducted in accord with applicable regulations. Special attention should be directed to the appropriateness of emergency procedures and to equipment to be used in an emergency. Additional information on safety programs is available from the Institute and from chlorine suppliers.

1.5 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 insure that the information is current when used. These recommendations should not be confused nor conflict with federal, state, provincial, municipal or insurance requirements, or with national safety codes.

1.6 APPROVAL

The Institute's Transportation Issue Team approved Edition 4 of this pamphlet on March 20, 2007.

1.7 REVISIONS

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

1.8 REPRODUCTION

2. GENERAL INFORMATION

2.1 CHLORINE IN COMMERCE

Chlorine has both a liquid and a gas phase when transported in tank cars. Chlorine is classified for transportation as Class 2.3 (poison gas) with a subsidiary corrosive hazard. In Canada, chlorine has a secondary classification as a Class 5, Division 5.1, oxidizer. The classification in Mexico is the same as that in Canada. The United Nations identification number for chlorine is U.N. 1017. Chlorine tank cars built after July 1, 1996 must meet DOT (or TC) 105J300W or 105J500W requirements. DOT (or TC) 105A300W, 105A500W, 105S300W, 105S500W stenciled cars are being phased out of chlorine service or are being reclassified to J class in order to remain in chlorine service.

DOT regulations under HM-175A (and equivalent Canadian regulations) mandate that the cars that do not meet the 105J classification requirements cannot be used for chlorine (or other Class 2 materials) rail transportation after July 1, 2006. After this date, only DOT (or TC) 105J300W or 105J500W cars will be permitted in chlorine service.

2.2 RELATED INSTITUTE PUBLICATIONS

General information on chlorine including physical properties, packaging, technical data reference can be found in The Chlorine Manual (Reference 13.1.1) Additional information about personal protective equipment can be found in Pamphlet 65 Personal Protective Equipment for Chlor-Alkali Chemicals (Reference 13.1.6). A more comprehensive list is contained in section 13 of this pamphlet.

2.3 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.

Pamphlet 152 Safe Handling of Chlorine Containing Nitrogen Trichloride (Reference 13.1.9) 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.

3. EMERGENCY RESPONSE

3.1 EMERGENCY PLANNING

Facilities and Transfer Sites

All facilities should have an emergency response plan in place. All personnel responsible for transfer operations must be completely familiar with the facility's emergency plan for handling spills and leaks of product.

Transportation

The DOT and TC have specific training requirements applicable to handling of hazardous materials (see 49 CFR Subpart H, 172.700 to 172.704 and the Canadian equivalent). Shippers must familiarize themselves with these requirements and OSHA requirements.

3.2 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 constant alert on a 24-hour basis, to handle threatened or actual chlorine leaks. 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.

3.3 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 (703-527-3887 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.

3.4 EMERGENCY KITS

Leaks that may occur in chlorine tank cars usually involve the angle valves or pressure relief devices and can be controlled with the Institute's Emergency Kit C. An Emergency Kit C should be on site in a location sufficiently away from the tank car so it will be accessible during an emergency. The kit should be inspected frequently to ensure the equipment is ready for use.

3.5 PERSONAL PROTECTIVE EQUIPMENT

Pamphlet 65 (Reference 13.1.6) provides information on personal protective equipment for chlorine. Since it is unlikely the concentration of chlorine present in an emergency situation can be adequately monitored, it is recommended that self contained full face piece breathing apparatus with at least 20 minutes of air operated in the positive pressure mode be on site and readily available.

3.6 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. 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.

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.

4. REGULATORY REQUIREMENTS

4.1 DOT REGULATIONS

The DOT regulates the acceptance and transportation of hazardous materials including the specifications for shipping containers in Title 49 CFR Parts 171-180. Because 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. Publications should be readily available for reference. See Section 13 for ordering information.

4.2 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 Part 156, require shipper registration with EPA and appropriate labeling. (Reference 13.4)

4.3 OSHA REGULATIONS

The OSHA's occupational safety and health standards are found in Title 29 CFR Part 1910. Title 29 CFR regulates material handling and storage, process safety management, the emergency response to hazardous substance releases and personnel protective equipment. (Reference 13.5)

4.4 CANADA REGULATIONS

The Canadian regulations for the Transportation of Dangerous Goods (TDG) parallel the 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, published by agencies such as the Canadian Standards Association (CSA) and the Canadian General Standards Board (CGSB) and particularly with reference to tank cars, CGSB-43.147 (Reference 13.6).

4.5 MEXICO REGULATIONS

The Normas Officiales 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.

4.6 LOCAL REQUIREMENTS

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

5. TANK CAR DESCRIPTION

5.1 SIZE AND TYPE

Tank cars for chlorine use are permitted by regulation to have a maximum capacity of 90 tons (81648 kg) of chlorine. Chlorine tank cars have 55, 85 or 90 ton capacities. Tanks may not be loaded with chlorine in excess of the load limit stenciled on the side of the car (see Section 7.3.1).

Typical Dimensions and Weights of Tank Cars

Typical Dimensions and Weights of Tank Cars

Car	Length Over Strikers(1)	Overall Height(2)	Extreme Width(3)	Height to Valve Outlet (4)	Weight Empty lbs.	Weight Loaded lbs.
55 Ton	29'9"-43'0"	14'3"-15'1"	10'5-1/2"-10'6-1/2"	13'2"-13'7"	57,000-94,000	167,000-204,000
85 Ton	43'7"-50'0"	14'11"-15'1"	10'5-1/2"-10'6-1/2"	13'2"-13'7"	79,000-90,100	249,700-260,100
90 Ton	45'8"-47'2"	14'11"-15'1"	10'5-1/2"-10'6-1/2"	13'2"-13'7"	79,700-83,000	259,700-263,000

Notes: (1) For overall length including both couplers, add approximately 3 feet.

(2) Heights are for empty cars and are measured from top of rail; heights of loaded cars may be reduced as much as two inches.

(3) Width over grab irons.

(4) Height to manway platform is 6 to 10 inches less than height to centerline of valves.

Important: Contact car owner for detailed weight and dimension data.

5.2 SAFETY SYSTEMS

DOT and TC regulations mandate chlorine tank cars be equipped with safety systems that meet the requirements of 49 CFR Part 173 and CGSB-43.147 Section 15. Cars meeting these requirements must be stenciled as 105J300W or 105J500W. The safety systems applicable to chlorine cars include thermal protection systems, insulation systems, tank head puncture resistance systems, coupler vertical restraint systems, and a protective housing as required by regulation.

The following reports document the compliance of commonly used chlorine car safety systems to these requirements:

- "Thermal Insulation Systems Study for the Chlorine Tank Car" (FRA/ORD-85/10), April 1995
- "Evaluation of the Thermal Effectiveness of Urethane Foam and Fiberglass as Insulation Systems for Tank Cars" (FRA/ORD - 87/11), July 1987
- "Chlorine Tank Car Puncture Evaluation" (NTIS DOT/FRA/ORD-92/11), November, 1992.

Insulation System

All chlorine tank cars have insulation covering the tank shell. Insulation for chlorine tank cars must have a thickness of at least two inches of ceramic fiber covered by at least two inches of glass fiber, or four inches minimum thickness of polyurethane foam. Insulation must be covered by a steel jacket of 11 gauge minimum thickness (0.1196 inch nominal thickness). The primary purpose of the insulation system on chlorine tank cars is to protect the tank shell and heads from fire and, to some extent, from other types of accident damage.

5.3 MANWAY ARRANGEMENT FOR TANK CARS

General

All chlorine tank cars should be equipped and assembled with manway arrangements in accord with Drawing 107 (Reference 13.1.17). The manway cover (pressure plate), valves, studs and gaskets are detailed on pertinent Institute drawings. Maintenance manuals should be provided by all valve manufacturers. Tank car valves must be approved by the AAR Tank Car Committee in accord with the requirement of AAR Specification M-1002 (Reference 13.2.1). See Section 13 for a complete listing of publications and drawings.

Angle Valves

Most chlorine tank cars are equipped with four one inch manual angle valves. The two angle valves on the longitudinal center line of the tank car are for liquid transfer. The two valves on the transverse center line are for vapor. Each liquid valve is equipped with a one and one-quarter inch eduction pipe extending to the bottom of the tank for unloading of the contents. All applicable angle valves for use in chlorine service can be found in Pamphlet 166 (Reference 13.1.10) Some chlorine tank cars are equipped with AAR approved pneumatically operated angle (POV) valves in combination with a check valve. The check valve in the POV replaces the excess flow valve under the conventional liquid angle valve.

Excess Flow Valves

Each eduction pipe is equipped with an excess flow valve. An excess flow valve contains a rising ball or plug which blocks the flow when the rate of flow or pressure differential exceeds a predetermined value. These valves are intended to close automatically against outward flow of chlorine if the angle valve is broken off during transit (See 49 CFR 179.100.13(d)) where there would be a sufficient pressure differential to ensure a flow that would activate the excess flow valve. Because excess flow valves may not activate with smaller leaks, excess flow valves must not be depended upon for an emergency shut off during cargo transfers. See Pamphlet 57 *Emergency Shut-Off Systems for Bulk Transfer of Chlorine* (Reference 13.1.4).

Chlorine cars may be equipped with excess flow valves having a maximum operating flow rate of 7,000, 15,000 or 32,000 pounds of liquid chlorine per hour. It is recommended the minimum pressure in a loaded tank car when offered for shipment be 20 psig for tanks equipped with excess flow valves per Drawing 101 (Reference 13.1.12) and 50 psig for excess flow valves per Drawing 114 (Reference 13.1.18). For other excess flow valves, the selection of fittings and minimum pressure should be in accordance with manufacturer's specifications to ensure proper operation.

Pressure Relief Devices

Chlorine tank cars are equipped with a pressure relief device, located in the center of the manway cover (pressure plate), which is set to discharge at 225 psig on tank cars stenciled 105J300W and 375 psig on tank cars stenciled 105J500W. The pressure relief device on a chlorine tank car is a combination device consisting of a breaking pin or rupture disc assembly in combination with a pressure relief valve. .

6. TANK CAR RECEIVING AND SPOTTING

6.1 RAIL SIDING

Chlorine tank cars must be loaded or unloaded on a private track or siding. Derails and a blue flag should be provided for the open end or ends of the siding. A suitable platform should be provided for safe and easy access to the tank car manway area. Special attention must be given to lighting in the area. Even if night operations are not contemplated, effective lighting should be installed as an aid in dealing with possible night emergencies. Emergency lighting should be available in case of power failure.

6.2 SECUREMENT AND PROTECTION OF CAR

Setting Car Brakes

When the tank car has been placed at the desired location on the siding, and before connections to the tank car are made, the hand brake must be set, and the wheels properly chocked. Brake shoes should be in contact with the wheels. A check should be made to ensure the brake is holding.

Placing Derails

During the loading or unloading of a car, measures must be taken to prevent the tank car from being hit or moved by another car or locomotive. This is accomplished by using derails or stops 50 feet or more from both ends of the car. Derails should not be removed for any reason until all cars are disconnected from the loading/unloading rack. If a portable derail is used, it should be properly secured.

Caution Signs/Lights

A tank car positioned for loading or unloading must have caution signs (and/or lights) placed at or near each derail or stop to warn persons approaching the car. Caution signs must remain in place until the operation is completed, all connections removed, and angle valve outlets properly closed with pipe plugs.

6.3 STORAGE OF LOADED CHLORINE TANK CARS

Fully loaded chlorine tank cars, properly prepared for shipment, prior to shipment or following shipment, may be safely used for storage for any period of time not exceeding the next scheduled valve service (Reference 13.1.2).

7. CAR INSPECTION AND PREPARATION PRIOR TO LOADING

7.1 GENERAL

Prior to loading the tank car, there are a number of activities that must take place to ensure the tank car meets all applicable regulations and is ready to receive chlorine. This process starts with an inbound inspection of the car, and could include routine maintenance and repairs and activities related to the qualification of the car.

It is recommended an inspection checklist such as in Appendix B, be used for all aspects of the loading operation. This includes activities from the inbound inspection covered in this section through the post-load inspection covered in Section 8. Checklists will ensure all regulatory requirements, recommendations contained in this pamphlet and company procedures or facility specific requirements are met.

Checklists document that proper loading and securement procedures have been completed and, if necessary, proper corrective actions have been taken. Checklists should be kept following the company's document control policies.

7.2 TANK CAR INBOUND INSPECTION

The purpose of the inbound inspection is to identify all defects in the tank car or items out of regulatory compliance before loading chlorine. The inbound inspection should at a minimum include:

- An inspection of the tank, underframe, running gear, and safety appliances for obvious defects or damage. If damage has not been recorded on a defect card, company procedures should be followed.
- A check of the tank car's markings and stenciling including test and qualification dates to ensure all inspection and maintenance requirements are current.
- A check to determine if there is liquid chlorine in the car. If there is, company procedures should be followed to rectify the situation. Because of the risk of contamination or reactivity, any liquid chlorine should be analyzed before recovery or reuse.
- A check of the valves, housing and fittings.
- A check to verify the car is equipped with AEI tags.
- A check to see if there is a defect card or other defect notification marking.
- Some tank cars may have GPS tracking devices. These devices should be inspected to ensure that they are in working order prior to loading.
- Assure that inspections comply with the site security plan and any applicable regulatory or industry requirements.

7.3 TANK CAR MARKINGS

Tank car marking requirements are found in the AAR Specification M-1002, Appendix C (Reference 13.2.1). Rule 70 in the AAR Field Manual (Reference 13.2.2) also covers tank car marking requirements for lightweight and load limit stencils. Drawing 167 (Reference 13.1.21), included in the back of this pamphlet, shows the proper location, size and content for the tank car markings. All markings must be maintained in a legible condition. The markings needing the most attention at the point of loading are described in the following subsections.

7.3.1 Light Weight and Load Limit

A brief summation of light weight and load limit definitions and their applicability in regard to chlorine tank cars follows:

Light Weight (LT WT) - The total weight of an empty car. Light weight stenciling is to be rounded off to the nearest 100 pounds. (If weight is at an even 50 lbs. - the lower multiple of 100 lbs. is used).

Load Limit (LD LT) - The maximum permissible weight of chlorine that can be loaded into a particular tank car. The load limit is normally the total allowable weight on rails, i.e., gross rail load (See AAR Field Manual Rule 70 (Reference 13.2.2)) minus the stenciled light weight.

In some cases, the car owner must reduce the allowed gross rail load to a value below the maximum to ensure the 90 ton chlorine load limit (or some other limitation) is not exceeded. When this occurs, a “starred” load limit weight is applied. Consult AAR Field Manual - Rule 70 (Reference 13.2.2) for more complete instructions.

Examples of Starred (*) and Non-Starred Load Limits for Chlorine Tank Cars

Normal Maximum Weight on Rail	Actual Maximum	Light Weight	Load Limit
263,000 lbs	261,000 lbs	81,000 lbs	*180,000 lbs
263,000 lbs	262,500 lbs	82,500 lbs	*180,000 lbs
263,000 lbs	263,000 lbs	83,000 lbs	180,000 lbs
263,000 lbs	263,000 lbs	85,000 lbs	178,000 lbs

7.3.2 Marking of Test and Qualification Dates

The test dates and due dates for the tank test or qualification must be marked on the tank car tank and must comply with regulations. Refer to Drawing 167 (Reference 13.1.21)

7.3.3 Commodity Marking

A minimum four inch high marking reading "CHLORINE" must be applied to each side of the tank car as shown on Drawing 167 (Reference 13.1.21). The color must be in a sharp contrast to the color of the tank car.

7.3.4 Inhalation Hazard Marking

Because chlorine has been designated as having a poison-inhalation hazard, a minimum four inch high marking reading "INHALATION HAZARD" must be applied on each side of the tank car as shown on Drawing 167 (Reference 13.1.21).

7.3.5 Excess Flow Valve Stencil

A stencil showing flow rates of the excess flow valves and the minimum shipping pressure should be applied as per Drawing 167 (Reference 13.1.21).

7.3.6 Valve Marking

Valves on tank cars must be marked or tagged as follows. Refer to AAR Specification M-1002, Appendix A (Reference 13.2.1).

- Reclosing Pressure Relief Device - The following markings must be placed on the device or on a plate or plates securely fastened to the device:
    - the name or identifying mark of the manufacturer
    - manufacturer's design or type number
    - set pressure, psig (or psig and kPa)
    - official flow capacity, cubic feet per minute (or cubic feet per minute and cubic meters per second) of air at standard conditions
    - flow rating pressure, psig (or psig and kPa)
    - month and year of manufacture or retest

Note: The AAR requires a serial number on all pressure relief valves built after December 31, 2003.

- Liquid and vapor valves - All valves with a net free flow area of more than ½ square inch (323 square millimeters) must be marked to indicate:
    - the name or identifying mark of the manufacturer
    - manufacturer's design or type number
    - type of trim
    - pressure-temperature limitations

7.4 INSPECTION AND MAINTENANCE OF TANK AND SERVICE EQUIPMENT

It may be determined from the inbound inspection or from company records that the tank car is due for an internal inspection, valve servicing, or service equipment or tank qualification. Tank cars are required to be qualified periodically by an AAR certified facility. Before loading, the stenciled due dates on the car should be checked to ensure the tank car tank, safety systems and service equipment are not overdue for qualification. If the car is due for qualification, arrangements must be made to have the qualification performed by an AAR certified facility. Service equipment has been defined by DOT as the equipment used for filling, sampling, emptying, venting, vacuum relief, heating (if internal to the tank), measuring lading temperature, or measuring the amount of lading in the tank.

In addition to regulatory requirements, companies may have their own maintenance program for service equipment. Before loading, a check should be made to ensure the service equipment has been maintained in accordance with company procedures. The maintenance and installation of service equipment must be performed by an AAR certified or registered facility. Records of valve and pressure relief device replacements must be maintained throughout the qualification period. A pressure leak test, following company procedures, must be conducted after assembly of service equipment to determine if there is leakage between the nozzle flange and the manway cover (pressure plate), and between the manway cover (pressure plate) and service equipment. This test may be conducted using chlorine, dry air or an inert gas.

7.4.1 Internal Tank Inspection

An internal examination of the tank can take place without a person entering the tank. This is not a comprehensive internal examination and can give only limited information on the tank's internal surface condition. It is used to verify the general condition inside the car. It can be done during routine valve changeouts when, with a valve removed and the car under a partial vacuum, a light is inserted into the manway cover (pressure plate) opening and a visual examination made.

A more comprehensive internal inspection occurs when a person enters the tank when the tank is cleaned for a period inspection or for tank qualification. Other circumstances which could lead to an internal examination of the tank include:

- Customer complaint - difficult unloading, out-of-spec chlorine
- Returned car with large heel of chlorine
- Excess flow valve ball or plug missing
- Broken excess flow valve pins
- Corrosion on manway cover (pressure plate) that would prevent proper sealing of the emergency kit hood
- Corroded valve gasket grooves on manway cover (pressure plate).
- Liquid sheen/moisture seen inside tank using drop light through valve opening in manway cover (pressure plate).
- Hole or other defect in eduction pipe
- New or used tank car entering company's chlorine fleet for first time
- Evidence of railroad damage
- Evidence of leak (e.g. green discoloration around seals)
- Problem with pulling vacuum on the car

- Failed leak test
- Sludge in discharge of angle valve
- Car returning from repair shop

Prior to entering a chlorine tank for an internal inspection, residual chlorine must be removed. To accomplish this, conventional sniffing methods should be used. The tank should then be filled with water and washed to remove any remaining chlorine. It is critical to ensure all the liquid chlorine has been removed before water is added. This will prevent the possibility of the formation of hydrochloric acid which could damage the tank. The tank should be completely filled with water to ensure the displacement of any chlorine or inert padding gas.

All facility procedures and OSHA regulations for safe tank entry must be followed. (See 29 CFR 1910.146.) This includes properly securing the tank car, checking the tank atmosphere for oxygen and combustibles, having rescue equipment readily available, and having sufficient backup personnel. A tank entry checklist is recommended. Only properly trained personnel should be involved in tank entry.

Prior to removing the manway assembly, the correct orientation should be marked and the manway assembly tagged with the car number. Prior to the internal inspection, all rust, debris, and visible water should be removed and the tank thoroughly dried using clean dry rags. When conducting the internal inspection, a light beam directed parallel to the walls aids in the detection of pits, cracks and corrosion. If significant problems are found, the tank car owner should be notified.

Before re-installing the manway assembly, the manway nozzle gasket groove should be carefully cleaned with a wire brush and inspected for cuts, corrosion, nicks or damage. If significant defects are noted, the car will have to be shopped for repairs. The manway assembly should be cleaned and all parts inspected for damage including the eduction pipe assembly. The top of the manway cover should be free of pits that could prevent a seal of the Emergency Kit C valve capping hood. If damage is found in the manway cover (pressure plate) gasket sealing surface, the manway cover (pressure plate) should be replaced. A new gasket should be applied. Refer to Drawing 103 (Reference 13.1.14).

New or rebuilt excess flow valves should be installed when necessary. Refer to Drawings 101 (Reference 13.1.12) and 114 (Reference 13.1.18). Excess flow valve seats must be checked for tightness. All studs and nuts should be inspected for corrosion, defects and engagement according to Appendix D of AAR Specification M-1002, Appendix D (Reference 13.2.1). All replacements should conform with Institute Drawing 102 (Reference 13.1.13).

All mounting nuts should be tightened per 7.4.3. After the manway assembly and all valves have been installed, the tank should be dried using dry air or nitrogen and the tank leak tested with dry air.

7.4.2 Removal, Inspection, Reconditioning and Installation of Valves

To permit the removal and replacement of valves without chlorine emission, the internal tank pressure must be reduced to a partial vacuum. Precautions must be taken to prevent moist air from entering the tank. The entry of moisture to the chlorine car during this time is detrimental to the tank shell.

Angle Valves

Angle valves must be removed, examined, reconditioned, retested, and replaced at regular intervals. The frequency of the procedures should be established at each shipping point with consideration to:

- Service equipment qualification
- Prior valve performance history
- Padding air quality
- Loading/unloading frequency
- Other parameters as established by the shipper and end user

Maintenance manuals provided by the valve manufacturer should be reviewed for guidance when reconditioning angle valves.

When valves are removed with the manway cover (pressure plate) and protective housing in place, care must be taken to ensure no damage is incurred from tools used to remove valves and gaskets. A special crow foot wrench can be used to minimize damage potential. Care must be taken to avoid damage to the valve seat tongue and manway cover (pressure plate) groove. To prevent moist air from entering the tank, a soft rubber plug should be immediately installed in the manway cover (pressure plate) valve hole opening. All gaskets should be replaced each time a valve is removed. The manway cover (pressure plate) groove and valve tongue should be inspected and cleaned prior to replacing gaskets. Only proper gasket materials should be used. See Pamphlet 95 (Reference 13.1.8) for material options.

Prior to installation of the angle valve, a check should be made for the presence of excess flow valve balls or plugs under the liquid valves and for the tool tightness of the excess flow valve seat. The tongue and groove surfaces on the manway cover (pressure plate) should be checked. Sealing surfaces must not be scored and should be inspected per 7.4.3. The protection for the valve inlets and the rubber plug from the manway cover (pressure plate) opening must be removed to install the valves. Care must be taken not to damage the valve seat tongue. All mounting nuts should be tightened per 7.4.3.

Excess Flow Valves

When a liquid angle valve is removed from the manway cover (pressure plate) the excess flow valve should be checked. It should be verified that the excess flow valve ball or plug is in place, the valve seat is tool tight and in good condition.

To remove an excess flow valve, the manway assembly must be removed, the braces and clamps loosened or removed, and the excess flow valve unscrewed from the manway cover (pressure plate). Maintenance manuals provided by the valve manufacturer should be reviewed for guidance when reconditioning excess flow valves.

An excess flow valve is installed by screwing the top of the excess flow valve into the manway cover (pressure plate), screwing the eduction pipes onto the excess flow valve, and fastening the braces and clamps. A proper clearance of the eduction pipe to the tank bottom (1 inch, plus 1/4 minus 0 inch is preferred) should be verified. Care should be taken to ensure the excess flow valve pin welds are not damaged by the pipe wrench when removing or installing the excess flow valve.

Pressure Relief Device

If inspection of the pressure relief device indicates there is evidence of leakage or damage, the device should be removed from the car for reconditioning. When the valve is removed, the opening in the manway cover (pressure plate) should be immediately closed with a soft rubber plug until the replacement valve is installed. This will prevent the entry of moist air into the tank. Care must be taken to avoid damage to the valve seat tongue and manway cover (pressure plate) groove. Maintenance manuals provided by the valve manufacturer should be reviewed for guidance when reconditioning pressure relief devices.

If a new or reconditioned pressure relief device is to be installed, the proper device must be used. Cars that are stenciled 105J300W must be equipped with 225 psig devices. Cars that are stenciled 105J500W must be equipped with 375 psig devices.

Care must be taken not to damage the valve seat tongue and manway cover (pressure plate) groove when removing or handling the device. To install the valves, the protection for the valve inlets and the rubber plug from the manway cover (pressure plate) opening must be removed. All mounting nuts should be tightened per 7.4.3

Mounting Studs and Nuts

The proper mounting fasteners can be found in Drawing 102 (Reference 13.1.13)

7.4.3 Torque Guidelines

Flanged and Gasketed Bolted Joints – Torque Recommendations

It is recommended that all applicable federal and AAR guidelines be followed when securing pressure retaining flanged, bolted and gasketed joints on tank cars. It is also recommended that gasket manufacturers' guidelines are followed. All entities securing these joints should have established procedures to ensure safe and reliable tightening. Procedures should include, but not be limited to, the following:

- Ensure clean gasket mating surfaces, free of gouges, corrosion and other defects that exceed one-quarter (1/4) of the gasket thickness. Review thickness and height of tongue and groove.

- Ensure: the gasket is clean, the size and thickness is correct, and it is composed of the correct material. Only gaskets listed for Chlorine service per Pamphlet 95 should be used.

- Ensure that the mating fasteners are free of corrosion, grit, paint or any other debris. Also visually inspect for surface imperfection or defects. Specially coated fasteners should use friction factor associated with that coating (e.g. Teflon® coated fasteners). A light lubricant may be required to ensure a friction factor (k) range common to the industry (see note below). Fastener material should conform to the markings on Drawing 102.

- Some assurance of proper depth and dimensions of internally threaded tapped holes and proper engagement of studs, if applicable, should be made.

- Ensure proper placement and alignment of the gasket prior to assembling the flanges. Flanges should be assembled carefully as to not upset the alignment of the gasket or damage the mating surfaces.

- All nuts should be hand-tightened prior to the use of any mechanical assistance.

- When and only when all nuts are in contact with flange and are hand tight, should tightening begin using, at the minimum, a calibrated torque wrench with sequential values in a cross pattern arrangement per AAR M-1002, Appendix D. Several final rotational and reverse rotational passes are also recommended.

- A final inspection should include that all fastener markings are visible and no nut threads are showing.

- Perform leak testing as prescribed by AAR, and DOT or TC guidelines.

- A retorquing operation may be required based upon experience within each organization, with each procedure and with associated materials.

Typical Torque Ranges:

Joint	Fastener Size	Torque Range
Manway	1-1/8”	400 – 800 ft-lbs.
Pressure Relief Device	¾”	90 – 200 ft-lbs.
Load/Unload Valves	¾”	75 – 200 ft-lbs.

Note: A target torque value should be established based on the specific joint conditions. This should take into consideration the optimum compressive stress for the gasket material and the desired bolt stretch as a percentage of fastener yield stress. The torque values in the above table reflect typical chlorine fittings using lubricated or coated fasteners with k values between .18 and .22. All fasteners in a given fitting should be torqued to a common target torque value.

A proper torque value for any application can only be established by field testing and observation. Torque values that are too low or too high may result in gasket or fastener failure and product leaks.

Halogenated fluorocarbon lubricants identified as completely inert in liquid and gaseous chlorine should be used if this lubricant will come in contact with chlorine.

7.5 NEW CAR INSPECTION

Chlorine tank cars are complex mechanical transportation containers subject to variations in manufacturing. Prior to placing a new tank car in service, a comprehensive internal and external inspection should be made. Gasket and packing material should be inspected. If defects are found or the car does not meet requirements, corrective action must be taken.

Manway Housing Assembly

The manway cover (pressure plate) assembly should be pulled from the car and a complete visual inspection of the tank interior performed. The tank must be completely clean. No rust scale, blast residue, or foreign materials should be present in the car. The interior must be free from visible moisture and/or indications of moisture (rust blush). The valves should be removed and retested prior to reapplication to the manway cover (pressure plate). These valves may be replaced with new, or reconditioned, pretested valves. The excess flow valve assembly (seat, ball and ball retainers) should be inspected at this time. All interior parts of the tank should be inspected for hydrocarbon oil residue from the fabrication process. This inspection can be done using the black light inspection procedures.

Marking and Loading Appurtenances

All marking and loading appurtenances must be inspected to ensure compliance with all AAR, DOT and/or TC requirements. See AAR Specification M-1002 Appendix S for details on loading appurtenances. (Reference 13.2.1) Make certain the start to discharge setting of the pressure relief device agrees with the stenciled pressure.

Certificate of Construction

A copy of the certificate of construction must be kept on file by the car owner.

8. TANK CAR LOADING

8.1 GENERAL

When loading a chlorine tank car, 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 marking and placarding should be confirmed. Proper personal protective equipment should be worn during the transfer operation, see Pamphlet 65 (Reference 13.1.6). Safety showers and eye wash facilities should be available.

A tank car loading record should be prepared for each car. The record should include reporting marks and car number, 3/16" shipping and return shipment security seal identification, light and loaded weights, tank car capacity and the test/qualification dates of the tank and service equipment.

Before a chlorine tank car is loaded, it must comply with AAR, DOT and/or TC requirements and all required inspection, testing and qualification must have been performed.

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 the facility. The checklist documents that the proper loading and securement procedures have been completed. The checklist should be retained as per company policy. Appendix B provides an example of a typical checklist.

8.2 EMERGENCY SHUT-OFF

Excess flow valves can not be relied upon as a means of mitigating a hose or piping failure during chlorine transfer. Pamphlet 57 Emergency Shut-Off Systems for Bulk Transfer of Chlorine (Reference 13.1.4) outlines recommended practices for emergency protection against releases during transfers involving chlorine tank handling systems. The pamphlet illustrates emergency shut-off systems that will quickly bring a release situation under control. Use of an emergency shut-off system that meets the standards in Pamphlet 57 is recommended during the loading of a chlorine tank car. Use of a proper transfer hose suitable for the transfer of chlorine as recommended in Pamphlet 6 (Reference 13.1.3) should be part of the transfer system.

8.3 LOADING CONSIDERATIONS

Before loading is started, the valves and fittings should be pressurized and checked for leaks. The manway cover (pressure plate) of cars recently returned from inspection which required pulling of the manway should receive particular attention to ensure the gasket joint will not leak. If leaks are detected at any time, loading must be discontinued until repairs are made.

Leak tests may be conducted by adding a small amount of chlorine to the tank car at the loading rack and then padding with dry air or nitrogen to a minimum pressure of 50 psig. Vapor from a squeeze bottle containing 10%-30% aqua ammonia (ammonium hydroxide) solution can be used to detect a minor chlorine release or leak. An ammonia inhaler can also be used. 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. Appropriate personal protective equipment must be used.

To prepare a car for loading, a threaded nipple made from one inch schedule 80 carbon steel, about fifteen inches long, 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. 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 thread gage can be used to ensure the acceptability of the threads. The threads should be of a proper length and without wear beyond tolerances to prevent damage to the valve seat or stem area. 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 Pamphlet 6 (Reference 13.1.3) or a flexible copper loop, per Drawing 118 (Reference 13.1.19), should be provided between the nipple and the process piping to compensate for the lowering of the tank during loading. Valve arrangements, incorporating fail safe features as described in Pamphlet 57 (Reference 13.1.4), mounted at the tank car and on the process piping feeding the tank car are recommended.

8.4 LOADING ON A TRACK SCALE

It is recommended chlorine tank cars be loaded on a track scale. The weight of the tank car with all chocks and loading connections in place should be determined and recorded. This weight should be used as the initial scale weight for filling. If the stenciled lightweight is significantly different than the scale weight, the weight discrepancy needs to be resolved prior to commencing with the loading to avoid overloading. If the weight difference is minimal (less than 500 lbs) loading can continue if the higher tare weight value is used as the initial tare weight for filling calculations. This will reduce the chance of overloading the car. If it is necessary to interrupt the loading operation before the car is completely filled, the connected weight of the partly loaded car should be determined and recorded before disconnecting and the weight of chlorine loaded calculated. When the car is reconnected, the connected weight of the car and the chlorine loaded should again be determined. This is to ensure the total weight of chlorine loaded does not exceed the required limit.

The weight of chlorine loaded into a tank must not exceed the load limit stenciled on the tank car. The load limit is calculated using the lowest of the following three factors:

1. 125% of the weight of water the tank will hold. This is defined as the filling density.

2. The weight of chlorine must not exceed 90 tons (See 49 CFR 173.314(c) note 6).

3. Gross rail load must not exceed 263,000 pounds

It is essential to comply with the load limit. Exceeding this limit is contrary to regulations and may result in an unsafe container and possible release of chlorine from the tank.

Periodic maintenance of track scales is of utmost importance. The AAR Scale Handbook (Reference 13.2.3) requires testing of scales at least annually. Frequency of use, presence of errors, or operation of scales in inclement or very cold atmospheric conditions may dictate more frequent tests. Electronic load cells have been known to malfunction in extreme cold temperatures.

The scale pit should be inspected for accumulation of water. Freezing water in the pits can render scales inoperative, potentially causing the overfilling of a tank car.

8.5 TANK PRESSURE

Conditions of loading and padding must be such that when the temperature of the chlorine increases, the chlorine pressure in the tank will stay below approximately 80% of the tank's pressure relief device setting. The final tank pressure when the car is ready to ship should not exceed the maximum values shown on Drawing 201 (Reference 13.1.22). 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.

It is recommended the minimum pressure in a loaded tank car when offered for shipment be 20 psig for tanks equipped with excess flow valves per Drawing 101 (Reference 13.1.12) and 50 psig for tanks equipped with excess flow valves per Drawings 114 (Reference 13.1.18).

For other excess flow valves, the minimum pressure should be in accordance with manufacturer's specifications. Without sufficient internal pressure, there will not be enough flow to close the excess flow valves if an angle valve is broken off.

When padding is needed, clean dry and oil free air or nitrogen padding may be added after the loading operation is complete in order to meet customer unloading requirements or to meet minimum tank pressure needs. Air used should be oil free and dried to a dew point of -40°F (-40°C) or below, measured at the operating pressure. Section 10 contains more information on tank car padding.

When loading is completed, the final connected weight and tank pressure should be recorded.

8.6 LEAKS DURING LOADING

Leaks in Connections and Piping

Chlorine piping systems should be tested, inspected and maintained in accordance with Institute recommendations. Refer to Pamphlet 6 (Reference 13.1.3). This should include inspections 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 source of chlorine to the tank car, tank car angle valves, and the load lines pressure relieved so the necessary repairs can be made. When the leak has been located and the faulty equipment repaired, loading may be resumed.

Tank Car Fitting Leaks

Leaks around the tank car angle valve stems can usually be stopped by tightening the valve's packing gland nuts. If this does not stop the leak, the angle valve should be closed. Only if a tank car valve leak cannot be stopped by corrective measures should the capping devices in the Emergency Kit C be used. If the pressure relief device must be capped, regular monitoring of the tank car's internal pressure must be established.

8.7 DISCONNECTING

As soon as it is determined the tank is loaded, the loading header liquid supply valves should be closed followed by the tank car liquid angle valves and the loading line emptied before any other valves in the system are closed. The loading line should then be purged, evacuated and disconnected. This should be done with care to ensure the line has been cleared and chlorine will not be released upon disconnection. Appropriate personal protective equipment should be worn when disconnecting lines that have contained chlorine. Liquid chlorine should never be trapped in a 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 used to prevent chlorine contamination of the padding system. The ends of loading lines should be tightly capped/plugged to prevent moisture contamination.

8.8 POST LOADING INSPECTION

- Inspect angle valves to ensure they are closed.

- Using aqua ammonia, check for leaks from angle valves with the valves closed and the plugs removed, and from the manway cover (pressure plate) and the pressure relief device. All leaks must be eliminated prior to the release of the tank car.

- Tighten the outlet plugs of all angle valves, wrench tight with a suitable wrench and appropriate thread sealant. 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. Attach warning or instruction tags to angle valves. For valve marking or tagging refer to A7.00 of Appendix A of AAR Specification M-1002 (Reference 13.2.1).

- Close and secure the protective housing cover. A cable seal of not less than 3/16 inch thickness should be applied to the protective housing cover locking pin in such a manner that the pin cannot be removed without breaking the seal. An additional 3/16 inch cable seal for the return movement of the car should be placed inside the protective housing.

- Inspect tank car for defects that make the car unsafe for transportation.

- Check for the proper marking and placarding of the tank car. The placards must be installed in placard holders in four locations on the car.

- Check for a FIFRA label approved by the EPA if the car will be unloaded at water or sewage treatment facilities in the U.S.

- Complete shipping papers.

- Check that the scale ticket is retained and weights are shown on the bill of lading.

- Retain for an appropriate period of time the checklists of the inspection and preparation of the car including receiving, reconditioning, loading and shipping. All corrective actions must be documented.

- Check the tank pressure to ensure it is within the proper limits and that it is recorded.

Refer to 49 CFR 173.31(d) for additional post loading examination items. (Reference 13.3.1)

9. TANK CAR UNLOADING

9.1 GENERAL

Chlorine tank cars are unloaded by increasing the pressure in the vapor space above the liquid to a level sufficient to force the liquid chlorine up the eduction pipes and out the liquid angle valves. If the pressure in the tank car is not sufficient to unload the car when received or throughout unloading, the tank may be padded. If padding is to be used, the unloader should thoroughly review Section 10.

When unloading a chlorine tank the safety aspects of the operation should be uppermost in the minds of unloading personnel. The unloader must verify that proper spotting and unloading procedures have been completed before beginning transfer operations. Proper personal protective equipment should be worn during the transfer operation, see Pamphlet 65 (Reference 13.1.6). Safety showers and eyewash facilities should be available. In addition all suppliers' recommendations should be followed during product transfer.

9.2 TANK CAR 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 proper unloading and securement procedures have been completed. The checklist should be retained for records retention as per company policy. Appendix B provides an example of a typical checklist.

The checklist for procedures to be followed after spotting the tank car should at a minimum include the following items:

- Verify the receiving and spotting procedures in Section 6 have been followed.
- Verify the tank car is loaded with chlorine by careful inspection of the bill of lading or other shipping documents, the reporting marks, the car number, commodity marking, placards and the reported shipping cable seal is intact.
- Open the housing cover and inspecting the manway fittings for evidence of a leak.
- If unloading to a storage tank, verify there is sufficient capacity to receive the chlorine to be transferred.
- Verify the angle valve is fully closed before removing the angle valve plug.
- Verify there is a FIFRA label approved by the EPA if the tank is to be unloaded at water or sewage treatment facilities in the U.S.

9.3 EMERGENCY SHUT-OFF

Excess flow valves can not be relied upon as a means of mitigating a hose or piping failure during chlorine transfer. Pamphlet 57 Emergency Shut-Off Systems for Bulk Transfer of Chlorine (Reference 13.1.4) outlines recommended practices for emergency protection against releases during transfers involving chlorine tank handling systems. The pamphlet illustrates emergency shut-off systems that will quickly bring a release situation under control. Use of an emergency shut-off system that meets the standards in Pamphlet 57 is recommended during the unloading of a chlorine tank car. Use of a proper hose suitable for the transfer of chlorine as recommended in Pamphlet 6 (Reference 13.1.3) should be part of the transfer system.

9.4 CONNECTIONS

Chlorine tank car 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 car is received and spotted for unloading at the facility. Before any connection is made to a chlorine tank car, all piping should be clean, dry, free of oil, and in-test. Refer to Pamphlet 6. (Reference 13.1.3)

To prepare a car for unloading, a threaded nipple made from one inch schedule 80 carbon steel, about fifteen inches long, 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. 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 thread gage can be used to ensure the acceptability of the threads. The threads should be of a proper length to prevent damage to the valve seat or stem area. 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 Pamphlet 6 (Reference 13.1.3) or a flexible copper loop, per Drawing 118 (Reference 13.1.19), should be provided between the nipple and the process piping to compensate for the rise of the car during unloading. Valve arrangements, incorporating fail safe features as described in Pamphlet 57 (Reference 13.1.4), mounted at the tank car and on the process piping feeding the chlorine to the process or to storage are recommended.

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

Vapor from a squeeze bottle containing 10-30% aqua ammonia (ammonium hydroxide) solution can be used to detect a minor chlorine release or leak. An ammonia inhaler can also be used. 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. Appropriate personal protective equipment must be used.

9.5 OPENING ANGLE VALVES

The tank car liquid angle valve should be opened slowly and then left fully open. If it is opened rapidly, the excess flow valve may close and flow will not occur.

9.6 LINE PRESSURIZATION

A differential pressure must be maintained between the chlorine tank car and the system receiving the chlorine. While slowly opening the tank liquid angle valve, the pressure gage 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 gage indicates a steady pressure, the tank liquid angle valve should be opened fully. The line valve should then be opened slowly until the liquid chlorine completely fills the line to the process. The line valve should be opened until the desired flow rate is obtained taking care to ensure the flow does not cause the excess flow valve in the tank car to check.

CAUTION: If liquid chlorine is trapped between two valves, extremely high pressure can develop upon increase in the temperature of the chlorine. Refer to Pamphlet 6 (Reference 13.1.3).

9.7 EXCESS FLOW VALVE UNSEATING

With the exception of those cars equipped with pneumatically operated angle/internal check valve combinations, all chlorine bulk transports are equipped with excess flow valves under the liquid angle valves. 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, the angle valve on the car should be closed and left closed until the metal ball or plug in the excess flow valve drops back into place. A noticeable click will be heard when it drops. If the ball or plug does not drop, a connection can be made to the other liquid valve on the car. The supplier should be consulted if neither of these two methods is successful.

9.8 MONITORING THE UNLOADING

Regulations prior to the issue of HM-223 required that throughout the entire period of unloading, and while the car is connected to the unloading device, the car must be attended by the unloader. CI strongly recommends that although not required in most cases by current DOT regulation it is best practice to provide continuous monitoring of unloading operations. If it is necessary to discontinue unloading a tank car for any reason, all valves must be tightly closed and unloading connections disconnected and plugs installed in the tank car valves. Past correspondence from the DOT indicates that "attending" the unloading includes having an employee physically present at the unloading site, electronic monitoring with remote shut-off equipment, television camera monitoring or by any means by which the tank car is monitored and the flow of chlorine can be stopped if unloading difficulties develop. Shippers/receivers have had successful experience utilizing all of these methods.

A number of regulatory exemptions have been issued by the DOT (SP 12443) to permit tank cars containing chlorine to remain standing with unloading connections attached when product is not being transferred. Special provisions must be followed to meet the terms of the DOT exemption including the designation of an employee responsible for on-site monitoring of the transfer facility.

It is anticipated DOT will soon provide additional clarification on the issue of monitoring the unloading of a tank car. It is the responsibility of each unloading site to ensure all applicable regulations are followed.

9.9 LEAKS DURING UNLOADING

Appropriate PPE per pamphlet 65 should always be used and capping equipment must be readily accessible.

Leaks in Connections and Piping

Chlorine piping systems should be pressure tested at regular intervals according to Institute recommendations. See Pamphlet 6 (Reference 13.1.3). Chlorine piping systems should also 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 car angle valves, and the unloading line pressure relieved so the necessary repairs can be made. When the leak has been located and the faulty equipment repaired, unloading may be resumed.

Fitting Leaks

Leaks around the tank car 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 tank car valve leak cannot be stopped by corrective measures should the capping devices in the Emergency Kit C be used. If the pressure relief device must be capped, regular monitoring of the tank car's internal pressure must be established. The shipper should be advised of the problem as soon as possible.

9.10 DETERMINING AMOUNT OF CHLORINE UNLOADED

Where chlorine tank cars cannot be unloaded on track scales, and reliable direct gauging devices are not readily available, the most common practice for estimating the quantity of chlorine remaining in the car is from the consumption records of the quantity removed. The contents should be unloaded to the maximum extent practicable.

9.11 DISCONNECTING

As soon as it is determined the car is as empty as possible, the liquid chlorine manifold header valves should be closed followed by the tank car liquid angle valves, and the transfer hoses 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 to ensure the line has been cleared and chlorine will not be released upon disconnection. Appropriate respiratory personal protective equipment should be worn when disconnecting lines that have contained chlorine. Liquid chlorine should never be trapped 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. If the car has been padded, the pad gas supply line should be shut-off, evacuated and disconnected.

9.12 PRE-RELEASE CHECK

Inspect angle valves to ensure they are closed.

Using aqua ammonia, check for leaks from angle valves with the valves closed and the plugs removed, and from the manway plate and the pressure relief device. All leaks must be eliminated prior to the release of the tank car.

Tighten the outlet plugs of all angle valves, wrench tight with a suitable wrench and appropriate thread sealant.

Indicate any unusual condition by applying a tag to any of the valves, describing the condition found.

Close and secure the protective housing cover. A cable seal of not less than 3/16 inch thickness should be applied to the protective housing cover locking pin in such a manner that the pin cannot be removed without breaking the seal.

Check for proper marking and placarding of tank car. Placards must be installed in placard holders in four locations on the car.

Complete shipping papers.

Notify the railroad agent that the car is empty.

Refer to 49 CFR 173.31(d) for additional pre-release examination items. (Reference 13.3.1)

10. PRESSURE PADDING

Chlorine tank cars are often unloaded by increasing the pressure in the vapor space above the liquid to a level sufficient to force the liquid chlorine up the eduction pipe and out the liquid angle valves. The process of increasing the pressure in the vapor space is called pressure padding.

10.1 NEED FOR PADDING

The vapor pressure of chlorine at various temperatures is given in Table 10.1. If more pressure is needed to unload the car, padding of the tank may be necessary. Dry air is commonly used, however, dry nitrogen can be used.

To minimize the need for padding, consideration should be given to reducing the pressure at the point of consumption and/or reducing the pressure drop in the piping system.

Table 10-1. Vapor Pressure of Chlorine

Temperature		Vapor Pressure		Temperature		Vapor Pressure	
^{o}F	^{o}C	psig	kPa	^{o}F	^{o}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

10.2 AIR PADDING

10.2.1 Air Quality

Even small amounts of moisture can cause excessive corrosion to tank car equipment and to piping and handling systems. It is essential the air used for padding be free from oil and foreign matter and be dried to a dew point of -40°F (-40°C) or below measured at the operating pressure. Chlorine and oil can react to produce heat and, under certain conditions, the reaction may create a fire.

10.2.2 Moisture Content

To ensure no moisture is entering the chlorine system, the moisture content of padding air should be continuously monitored when the tank car is connected for padding. This is easily done with a commercially available in-line dew point analyzer with alarm. The dew point of the dry air must always be sampled at the operating pressure, not at atmospheric pressure.

10.2.3 ISO Standards for Air Quality

Railcar Padding Compressed Air Quality Specification

With proper filtration, particulates, desiccants, oil, water and vapors can all be removed from the air supply to acceptable levels for chlorine railcar air padding.

The compressed air shall comply with the following ISO Quality Classes:

Component	ISO Class	Standard	Measurement Range
Solid Particles	Class 1	ISO 8573-4	0.1 Micron Maximum Size
Oil, Liquid & Vapor. Total Concentration	Class 1	ISO 8573-2 ISO 8573-5	$\leq$ 0,01 mg/m^3 $\leq$ 0.008 ppm$_{w/w}$
Humidity and Liquid Water. See Note 1	Class 2	ISO 8573-3	$\leq$ - 40°F $\leq$ - 40°C
Note 1: The dew point of the compressed air shall be measured at the operating pressure or a minimum pressure of 100 PSIG.			

10.2.4 Separate Air Padding System

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

If a common plant air supply is used to pad the chlorine cars, a backflow system should be installed with redundant instrumentation and a rigorous process safety review conducted. Figure 10.1 contains a typical design of a backflow system.

10.2.5 Air Padding Compressor

A suitable air compressor and an ASME Code receiver equipped with the appropriate instrumentation such as pressure gages and switches, temperature gages and switches, safety valves, automatic electronic drain valves and automatic pressure controls should be used.

The operating conditions and characteristics of the compressor should be considered when designing the system. For example, operating a typical compressor at 60-70% of maximum design rpms will reduce air outlet temperatures, compressor wear and long term oil carryover.

Table 10.2 shows the air flow required at tank car pressures for various constant unloading rates. Greater compressor capacity will be required when padding a tank car manually rather than automatically. This larger capacity requirement should be taken into consideration when purchasing an air compressor system. Depending on the type of dryer system installed with the compressor, dryer system outlet flow rates may be reduced to 85-90% of the compressor output capacity. This reduction must be considered in the final design. Multiple compressors should be considered for continuous duty.

Special consideration should be given to compressor location. Compressor rooms should be well ventilated. Air inlet filters should be considered to ensure clean air. Silencers should be used to reduce the sound level to acceptable standards. The inlet air supply to the compressor should be drawn from an area that is unlikely to be contaminated with chlorine or other chemical fumes that would quickly corrode and damage the compressor internal components.

10.2.6 After-cooler

An air after-cooler with a moisture and oil trap and electronic drain should be provided to remove condensed moisture and entrained oil. This package will reduce the moisture and oil content to the drying system. An air receiver should be installed upstream of the dryer with an automatic electronic drain to remove additional moisture and oil before the dryer system.

A water after-cooler may be used after careful design including redundant instrumentation and the appropriate process safety review procedures have been followed. Design considerations should anticipate failure of the air/water heat exchanger due to corrosion and loss of air pressure due to compressor failure or power failure. If these two conditions occur at the same time, water will enter the air receiver and dryer system. This will result in a piping system failure including valves, transfer hoses and other equipment.

10.2.7 Air Drying and Treatment Systems

Commercial regenerative type dryers, using activated alumina as the desiccant, are recommended since any oil carryover from the upstream components will be irreversibly absorbed by the activated alumina. The dryers should be fully automatic and may be either of the heatless, electric internal or external heater design. If continuous operation is desired and no down time for repair can be tolerated, dual units are required. The capacity of the dryer should exceed the output capacity of the compressor system so the dryer system is never in an overloaded flow condition. Consideration should be given to the inlet conditions of the air from the compressor with respect to pressure and temperature.

Some manner of indicating the capacity and condition of the activated drying media, such as a dew point monitor should be employed. This indicator should be checked on regular intervals, and the drying media should be replaced as required, according to manufacturer's recommendations.

All dryer packages should include a high efficiency prefilter for removal of water, oil mists and particles with typical removal efficiency of 99.99% at 0.5 micron particle size. The prefilter should include an automatic electronic drain for moisture and oil removal. Commercially available filter housings with built in pressure drop indicators across the filter are useful for scheduling proper maintenance. A particulate after-filter followed by a hydrocarbon vapor filter to remove gaseous hydrocarbon and organic vapors should be installed downstream of the dryer system. If down time can not be tolerated, redundant pre-filters and after-filters should be installed on each dryer installed on the system.

Proper review of commercially available filter housings is required to ensure the correct pressure rating of the bowl and other components. Filter housings with non-metallic filter bowls should include a bowl guard to prevent or reduce the effect of damage caused by a rupture due to an over pressurized condition.

A moisture analyzer shall be installed immediately downstream of the hydrocarbon vapor filter. To maintain correct operating pressure of the dryer system, consideration should be given to the installation of a back pressure regulator downstream of the moisture analyzer. This will maintain the upstream pressure in the dryer regardless of the downstream operating conditions.

Depending on operating procedures or design, the maximum flow rates of the dryer can be exceeded for short periods and the potential for premature desiccant failure can exist. Therefore, a flow orifice or resistor should be considered to increase the life of the desiccant and life of the after-filter.

10.2.8 Backflow Systems

Padding systems should be provided with automatic controls to provide backflow protection to the drying equipment. These controls should be redundant and designed to prevent the backflow of chlorine if one component should fail. The system should provide for easy testing of each component and the materials in potential contact with the chlorine vapor from the tank car should be as recommended by Pamphlet 6 (Reference 13.1.3). Figure 10.1 indicates one method of backflow protection. Other designs may be utilized. It is not the intent of Figure 10.1 to restrict the design of the backflow system. The use of check valve(s) as the sole means to prevent chlorine backflow is not adequate.

10.2.9 Oil Separation and Removal

Consideration should be given to the moisture and oil discharged from the compressors, after-coolers, receivers, and pre-filters of the dryer system. These discharge streams must be collected, the oil separated and collected and the water discharged and treated as required. There are many commercial units designed for this purpose.

10.3 NITROGEN PADDING

Tank cars can be padded with nitrogen in lieu of dry air. However, design considerations need to be given to the source of supply and available pressure. It is recommended the nitrogen be provided from a separate source to prevent contamination of the nitrogen should chlorine backflow into the supply header. Further considerations should be given to lowest ambient temperatures, maximum possible flow rates and highest desired padding pressure. If ambient temperature conditions are low, it is possible for the nitrogen vaporization equipment to supply inadequate pressure to the rail car. This could result in a chlorine backflow. Therefore, it is recommended to supply a backflow system for the nitrogen supply similar to the backflow equipment used in the dry air padding system. With the installation of a backflow system, potential damage to the nitrogen vaporization equipment will be reduced.

If it is necessary to use a common nitrogen supply line to pad the chlorine cars, a backflow system should be installed with redundant instrumentation. See Figure 10.1 for a typical installation. This should only be done after a rigorous process safety review. Since many common nitrogen systems can produce pressures of over 180 psig, controls should be installed to prevent over pressurization of the tank car.

10.4 PADDING PRESSURE CONSIDERATIONS

Temperature/Pressure Relationships

It is necessary to have a thorough understanding of the temperature and pressure relationships of chlorine and ways to prevent over pressurization. Chlorine in tank cars is a liquefied gas under pressure. The tank also 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-condensable gases. Therefore at equilibrium the tank car pressure will always be higher than the vapor pressure of chlorine at the estimated temperature.

Because of a lack of equilibrium, it is not possible to calculate the exact pressure by means of the ideal gas laws. The partial pressure of the chlorine is a function of its temperature. The partial pressure of the non-condensable gas is a function of the molecular weight of such gases, the volume of the vapor space, and the gas temperature.

Over pressure Prevention

Padding procedures should ensure tank car pressures are kept as low as necessary. This will help prevent over pressurization of the tank and subsequent opening of the pressure relief device due to ambient heating. After a tank car is loaded, ambient heat can cause an increase in the temperature of the chlorine resulting in an increase in both chlorine vapor pressure and total pressure in the tank car. Ambient heat will also cause the liquid to expand thus reducing the vapor space with resulting increase in the vapor space pressure. 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 fully loaded car at 33^{o}F (1^{o}C) is padded from the vapor pressure of 40 psig to a total pressure of 125 psig and is then allowed to warm up to 88^{o}F (31^{o}C), the combined effects of expansion of the liquid chlorine and increase in its vapor pressure will raise the total pressure above 225 psig. A pressure relief device set at that pressure will open. To prevent the pressure in the tank from reaching the pressure relief device setting, the total pressure (the vapor pressure of the chlorine plus the pressure of the padding pressure) in the tank car should not exceed the applicable curves on Drawing 201.

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 and shutdowns. Such cars should be inspected routinely for leaks and excessive pressure. If necessary, excessive pressure should be vented to a recovery system.

10.5 PREVENTIVE MAINTENANCE

Air and nitrogen padding systems require a preventive maintenance program to ensure a reliable high quality supply of padding gas.

10.6 FLOW REQUIREMENTS FOR PADDING

Continuous Air/N_2 Flow Requirements for Padding				
Unloading Rate	**Required Air/N_2 Flow**			
lbs/hour of chlorine	ft^3/minute		m^3/second	
	P=125 psig	P=100 psig	P=862 kPa	P=684 kPa
30,000	40.0	30.0	.01888	.01416
15,000	20.0	15.0	.00944	.00708
11,000	14.6	11.0	.00689	.00517
7,500	10.0	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

- SCFM Air/N_2 = $\frac{\text{lbs/hr of chlorine x (P-25)}}{75{,}000}$
- P = total pressure in tank (psig)

Air/N2 Volume Requirements for Padding				
Chlorine Tank Car Capacity	**Total Air/N_2 Required**			
	ft^3		m^3	
	P=125 psig	P=100 psig	P=862 kPa	P=684 kPa
55 ton	10,560	7,920	299	224
85 ton	16,320	12,240	462	347
90 ton	17,280	12,960	489	367

- Ft^3 of air/N_2 = tons of chlorine x 1.92 x (P-25)
- P = total pressure in tank (psig)

11. QUALIFICATION OF TANK CARS

11.1 GENERAL

DOT and TC regulations (49 CFR 180.509 and CAN/CGSB-43.147 Section 25) require all chlorine cars to be qualified using non-destructive testing techniques at an interval of no more than ten years. This replaces the requirement to hydrostatically test chlorine tank cars every two years. Qualification involves the inspection and testing of tank car tanks, service equipment and safety systems. There are record keeping requirements related to the qualification process in 49 CFR 180.517. The qualification of a tank car must be accomplished by a tank car facility approved by the AAR as per AAR Specification M-1002 Appendix B (Reference 13.2.1).

To facilitate the transition to the nondestructive testing requirements from a two year to a ten year interval, DOT has issued a special permit (formerly exemption) and TC issued a Permit which authorizes chlorine tank car owners the use of an alternate testing protocol. Companies wishing to obtain party status to the exemption should contact DOT or TC (See section 11.7).

11.2 QUALIFICATION OF THE TANK CAR

Tank car owners must ensure chlorine tank car are qualified at an interval of no more than ten years. Tank car qualification may only be performed by AAR certified facilities. Qualification is accomplished through the following:

- external and internal visual inspections.
- structural integrity inspections and tests using non-destructive evaluation including dye penetrant, radiography, magnetic particle, ultrasonic, direct or remote visual. Acoustic emissions may be used with a DOT exemption or TC Special Permit.
- tank shell thickness tests.
- safety system inspections including thermal protection systems, insulation, tank head puncture resistance system, coupler vertical restraint system.
- service equipment.

Generally, stub sill and Rule 88-b inspections are done in conjunction with tank car qualification. See 11.8.

11.3 QUALIFICATION OF THE TANK CAR SERVICE EQUIPMENT

The chlorine tank car owner must ensure the service equipment is qualified at an interval of no more than ten years. The chlorine tank car shipper may chose to perform the qualification of the service equipment with the permission of the tank car owner.

Based on past performance of the service equipment, the tank car owner or shipper may determine shorter inspection intervals are necessary to ensure reliability. Angle valves, pressure relief devices, and other service equipment components may be replaced at shorter intervals without changing the service equipment qualification interval or the qualification stencil due date. A leakage pressure test must be conducted when service equipment is replaced. Service equipment replacements, maintenance or qualification may only be performed by AAR certified or registered facilities. Refer to section 12 for additional details.

11.4 PREPARATION OF TANK CAR FOR QUALIFICATION

All liquid chlorine should be removed prior to purging and residual chlorine gas removed by conventional sniffing methods. It is desirable to pull a vacuum down to at least two inches of mercury and air purge the tank to a suitable scrubber (a caustic solution tank) until chlorine can no longer be detected with an aqua ammonia test.

For testing facilities that do not have the capability of pulling a vacuum on the tank, the tank must be air purged to a suitable scrubber until chlorine can no longer be detected with an aqua ammonia test. Caution: Larger amounts of chlorine can be expected when a tank is not degassed by vacuum. Scrubbers must be adequately sized to accommodate this condition in order to prevent a chlorine release.

The interior of the car must be cleaned and suitable for human entry prior to qualification.

Refer to Section 7.4.1 for information related to tank car cleaning.

11.5 TANK CAR PREPARATION AFTER QUALIFICATION AND PRIOR TO LOADING

Upon being returned to the shipper after full qualification, the car should be checked in accordance with the shipper's inspection procedure.

If the qualification of the service equipment has not been completed, it is the responsibility of the Class F and G loading facility to complete the service equipment qualification. Upon completion of the leakage pressure test, the service equipment portion of the qualification stencil should be completed including the completion date, due date stencil and station symbol.

Consideration should be given to weighing the car to verify the light weight stencil.

11.6 TANK CAR QUALIFICATION STENCILING

The tank car qualification stencil must be in accord with AAR Specification M-1002, Appendix C (Reference 13.2.1). The stencil must indicate the qualification data and the next qualification due date. Refer to Drawing 167 (Reference 13.1.21).

Tank cars may display separate station stencil markings when qualifying under 49 CFR 180.509 by two separate tank car facilities. The primary facility will provide all NDE inspection and documentation for service equipment up to installing the product valves and pressure relief devices.

The secondary facility (Class F) will install the product valves or pressure relief devices and complete the service equipment portion of the qualification process and apply its station stencil to the qualified tank car for the service equipment.

11.7 ALTERNATE TANK CAR TESTING PROTOCOL

Because, under the previous regulations, chlorine tank cars were required to be hydrostatically tested every two years, chlorine car owners had only two years after the July 1, 2000 implementation date to qualify their tank cars. To facilitate the transition to the tank and service equipment qualification, 49 CFR 180.509, the DOT and TC issued exemption DOT-SP-11941 and Special Permit SR 5394 that authorizes an alternate testing protocol for chlorine cars.

The exemption/permit allows party companies ten years from the exemption issued date to phase in the qualification of chlorine tank cars. Under the exemption, companies may qualify chlorine cars using a testing protocol that includes a hydrostatic pressure test, a service equipment and safety system inspection, internal visual inspections and thickness test of tank shell and heads. There are special provisions in both the exemption and the Special Permit. The DOT-SP 11941 special provisions are listed below. The special provisions in the Special Permit are similar.

a. Beginning on December 31, 2000, tank cars must be qualified in accordance with 180.509 at a rate such that 50 percent are qualified no later than December 31, 2004 and the remaining cars are qualified no later than December 31, 2008.

b. Annual progress reports must be provided to the FRA.

c. Cars must be marked with the exemption number DOT-SP-11941 and/or SR 5394 and marked with the inspection and test due dates in accordance with AAR Specification M-1002 Appendix C (Reference 13.2.1).

11.8 STUB SILL INSPECTIONS

Tank cars of stub sill design must receive inspections of the stub sill to ensure structural integrity of the sills. Generally, this inspection is due at the time of the tank car qualification. Reference is made to AAR Casualty Prevention Circulars CPC-1094 and CPC-1097. These inspections should be reported to the AAR using Form SS-3.

12. PERSONNEL QUALIFICATION AND FACILITY CERTIFICATION / REGISTRATION

12.1 FACILITY CERTIFICATION AND REGISTRATION

Each facility that performs maintenance on chlorine tank cars must be certified or registered by the AAR to the level of maintenance that will be performed. Facilities in Canada must also register with Transport Canada. Maintenance includes such things as tank and service equipment qualification, repairs, valve rebuilds, valve change-outs, inspections, and tests. The definition of facility classifications are established in AAR Specification M-1002 (Reference 13.2.1).

12.2 QUALITY ASSURANCE PROGRAM

Certified facilities must have a QAP that meets AAR M-1003 (Reference 13.2.4). Registered facilities must have an AAR approved QAP that meets 49 CFR 179.7. The QAP will:

- Ensure the finished product conforms to the applicable specification and regulations.
- Have the means to detect any non-conformities.
- Prevent non-conformities from recurring.
- The QAP for a registered facility must contain the following elements:
    - Statement of authority and responsibility
    - Organizational chart
    - Document control procedures
    - Incoming material inspection and identification program
    - Manufacturing, inspection and test program
    - Monitor and control of processes and product
    - Nonconformance control procedures
- Statement of Applicability of AAR Specification M-1002
- Qualification requirements of NDT personnel
- Inspection and test technique evaluation procedures
- Calibration and measurement of test equipment procedures
- A system for keeping maintenance, inspections, and tests records

12.3 PERSONNEL QUALIFICATIONS

Personnel involved in the maintenance of tank cars must be properly trained and certified. All personnel performing nondestructive testing (NDT) must be qualified for each inspection or test performed per AAR Specification M-1002, Appendix T (Reference 13.2.1). For example, personnel performing the pressure leak test after a service equipment replacement must be certified to at least a level I NDT standard for leak test.

12.4 PERSONNEL TRAINING

Personnel involved in the maintenance, loading, unloading and shipping of chlorine tank cars must be properly trained and tested in accordance with 49 CFR 172.704 and 179.7. These requirements include:

- General Awareness Training
- Function Specific Training
- Safety Training
- Proficiency Testing
- Record Keeping

Records of such training must be maintained while employed and for 90 days after leaving the company. These records include:

- employee name
- the most recent training date
- a description, copy or the location of the training materials used
- the name and address of the person providing the training
- a statement certifying that the employee has been trained and tested

New employees may perform these duties for up to 90 days until training has been documented, but must work under the direct supervision of a properly trained and knowledgeable employee. Recurrent training is required at least every three years.

13. REFERENCES

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13.1.3 Piping Systems for Dry Chlorine, ed. 15; Pamphlet 6; The Chlorine Institute: Arlington, VA, 2005.

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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

Association of American Railroads (AAR)
Transportation Technology Center, Inc.
55500 DOT Road
Pueblo, CO 81001
719-584-0750
719-584-0711 (Fax)
www.aar.org
www.ttci.aar.com

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

Canadian General Standards Board
Place du Portage III, 6B1
11 Laurier Street
Gatineau, Quebec
800-655-2472 or 819-956-0425
819-956-5644 (Fax)
www.pwgsc.gc.ca/cgsb

Canadian Government Publishing
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800-635-7943 or 613-941-5995
613-954-5779 (Fax)
www.publications.pwgsc.gc.ca

Canadian Standards Association
5060 Spectrum Way, Suite 100
Mississauga, Ontario
L4W 5N6 CANADA
416-747-4044 (Sales)
416-747-2510 (Fax)
www.csa.ca

ICC International Compliance
205 Matheson Boulevard E
Mississauga, Ontario
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National Archives and Records Admin.
Director, Office of the Federal Register
800 North Capitol Street, NW, Suite 700
Washington, DC 20001
202-741-6000
202-741-6012 (Fax)
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National Tank Truck Carriers, Inc.
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703-684-5753 (Fax)
www.tanktruck.org

Superintendent of Documents
Government Printing Office
732 North Capitol Street, NW
Washington, DC 20401
202-512-1800 (Sales)
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 - 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			
❒	❒	❒	1.	Are personnel familiar with facility and transfer site emergency plans?	{3.1}
❒	❒	❒	2.	Are Emergency Kit C and SCBA readily available at the transfer site?	{3.4,3.5}
❒	❒	❒	3.	Are personnel trained in regulatory requirements for chlorine?	{4}
❒	❒	❒	4.	Has shipper registered with EPA, and are tanks properly labeled when the chlorine is to be used in FIFRA regulated application?	{4.2, 8.8}
❒	❒	❒	5.	Do chlorine tank cars meet all governmental specifications and Chlorine Institute recommendations?	{5.1-5.3}
❒	❒	❒	6.	Is the tank car properly spotted for loading or unloading?	{6.1, 6.2}
❒	❒	❒	7.	Has the tank car been properly inspected prior to loading?	{7.2}
❒	❒	❒	8.	Does the transfer facility follow the Chlorine Institute's recommendations for emergency shut off?	{8.2, 9.3}
❒	❒	❒	9.	Are conditions during loading and padding such that tank pressure will not approach the relief device setting?	{8.5}
❒	❒	❒	10.	Is air, used for unloading and padding, free from oil and foreign matter and dried to a minimum dew point of -40°F (-40°C)	{10.2}
❒	❒	❒	11.	Have precautions been taken to ensure the tank car is not overloaded?	{8.4, 7.3.1}

Yes	No	N/A			
❒	❒	❒	12.	Is the transfer of chlorine properly monitored?	{9.8}
❒	❒	❒	13.	is an inspection checklist used for all aspects of the loading or unloading operations?	{7.1, 9.2}
❒	❒	❒	14.	Have the proper checks been made after then tank car is loaded or unloaded?	{8.8, 9.12}

REMINDER

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

APPENDIX B
Chlorine Tank Car Loading & Unloading Checklist

Date: _____ Product: _____ T/C No.: _____

Quantity: _____ Track & Spot No.: _____

[OK or ✓] OK [X] UNSATISFACTORY [NA or -] NOT APPLICABLE…

PREPARATION: COMPLETED BY: _____
(Signature)

LOAD	UNLOAD		
		1.	Tank car inspected and no suspicious material found attached or protruding?
		2.	Tank car body inspected to insure there are no major scars or dents?
		3.	All DOT information and stenciling on all sides of tank car is legible and free of graffiti?
		4.	Tank car has springs on all sets of trucks?
		5.	Tank car brake pads in place and in good condition?
		6.	Double shelf coupler on each end of the tank car is free of cracks or other damage?
		7.	The double shelf coupler pin is present and not broken?
		8.	Ladders are secured on both sides of the tank car with no welds cracked or bolts loose?
		9.	All bolts and nuts on the sill steps and grab irons are tight?
		10.	Placard holders are not bent or broken?
		11.	Air hoses are in good condition with no cracks?
		12.	Paint/jacket condition - Good _____ Fair _____ Poor _____

BEFORE LOADING/UNLOADING: COMPLETED BY _____
(Signature)

LOAD	UNLOAD		
		1.	Loader/unloader has successfully completed required training?
		2.	Tank car number agrees with shipping documents? (If not, do not proceed.)
		3.	Capacity checked against amount to load/unload?
		4.	Material in facility tank approved for loading?
		5.	Loading/unloading outage calculated?
		6.	Tank car is correct for product? (Example - DOT 105J500W)
		7.	Hand brakes are set and wheels chocked?
		8.	Visually check safety appliances (ladders, handrails, grab irons) and placard holders?
		9.	Blue flags, blue lights and derails in place?
		10.	Product tags agree with product identification on shipping documents?
		11.	Security seals (if used) are intact and numbers match shipping documents?
		12.	Pressure relief device test up to date?
		13.	No tank car test/inspection dates are past due?
		14.	Grounding cables attached, if appropriate?
		15.	Fall restraint bar/system in place?
		16.	Visually check securement devices (valves, plugs, chains on plugs).

LOAD	UNLOAD	
		17. Valves, pressure plate and pressure relief device inspected for sign of leakage?
		18. OK to load on heel or residue?
		19. Has product been properly identified?
		20. Tank car vented or connected to vacuum/blowdown system?
		21. Loader knowledgeable of procedure to prevent overfilling car?
		22. Verify correct product line is attached to tank car – check line label?
		23. Confirm emergency shutdown system is operational.
		24. Tank car ready to load/unload?
		25. Loading/unloading hoses and fittings inspected for leaks upon beginning transfer?

DURING LOADING/UNLOADING: COMPLETED BY _____
(Signature)

LOAD	UNLOAD	
		1. Tank car fittings observed for leaks – liquid or vapor?
		2. Observe product tank scale and/or tank car scale readings to prevent overfilling.

POST LOADING/UNLOADING: COMPLETED BY _____
(Signature)

LOAD	UNLOAD	
		1. Tank loaded to proper weight?
		2. Product lines removed and secured (closed, capped, plugged)?
		3. Tank car tank pressure-checked for leaks?
		4. Tank car pressure checked and OK?
		5. Vent/blowdown line removed and secured (closed, capped, plugged)?
		6. All valves and plugs properly secured and tool-tight (closed and plugged) – All plugs attached to valves with chains?
		7. Protective housing dome cover closed, pinned and sealed?
		8. Four protective housing outlet covers in closed position?
		9. Product labels/tags/seals in place?
		10. Fall restraint bar/system removed?
		11. '1017' placards applied on all four sides of car?
		12. Ground wire removed?
		13. Derails, blue flags and blue lights removed?
		14. Hand brakes set and chocks left in place for removal by Railroad personnel?

RECORD SEAL NUMBERS:

_____ / _____ / _____ / _____ / _____

_____ / _____ / _____ / _____ / _____

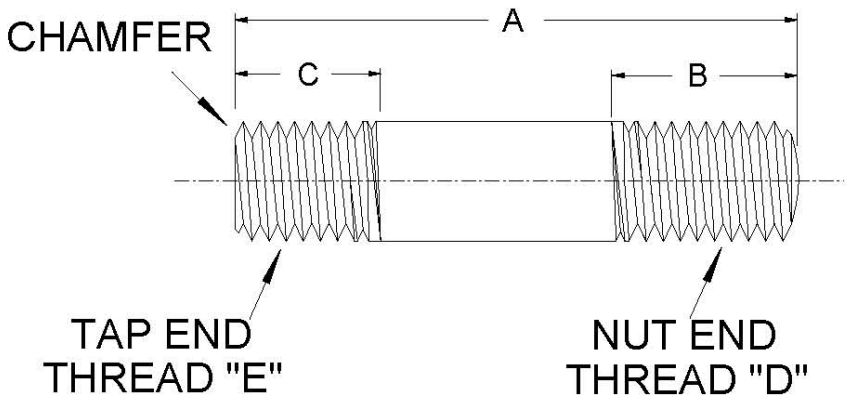
COMMENTS:

_____

_____

Note: The Chlorine Institute recommends a checklist be used for chlorine tank car loading and unloading operations. This sample checklist is an example of the types of information that could be included in such a checklist. Chlorine loading and unloading facilities should use this as a guide in the development of site specific checklists.

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:
1. Dimensions in inches unless noted.
2. Screw thread tolerance and gaging shall conform to ANSI B1.1.
3. Dimensions "B" and "C" include 1 to 1-1/4 imperfect threads.
4. Lock washers not permitted.
5. Cargo tank parts are identical to tank car parts.
6. Place grade mark "L7" on nut end of stud.
7. 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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ISS	DATE	REVISION	APPR
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

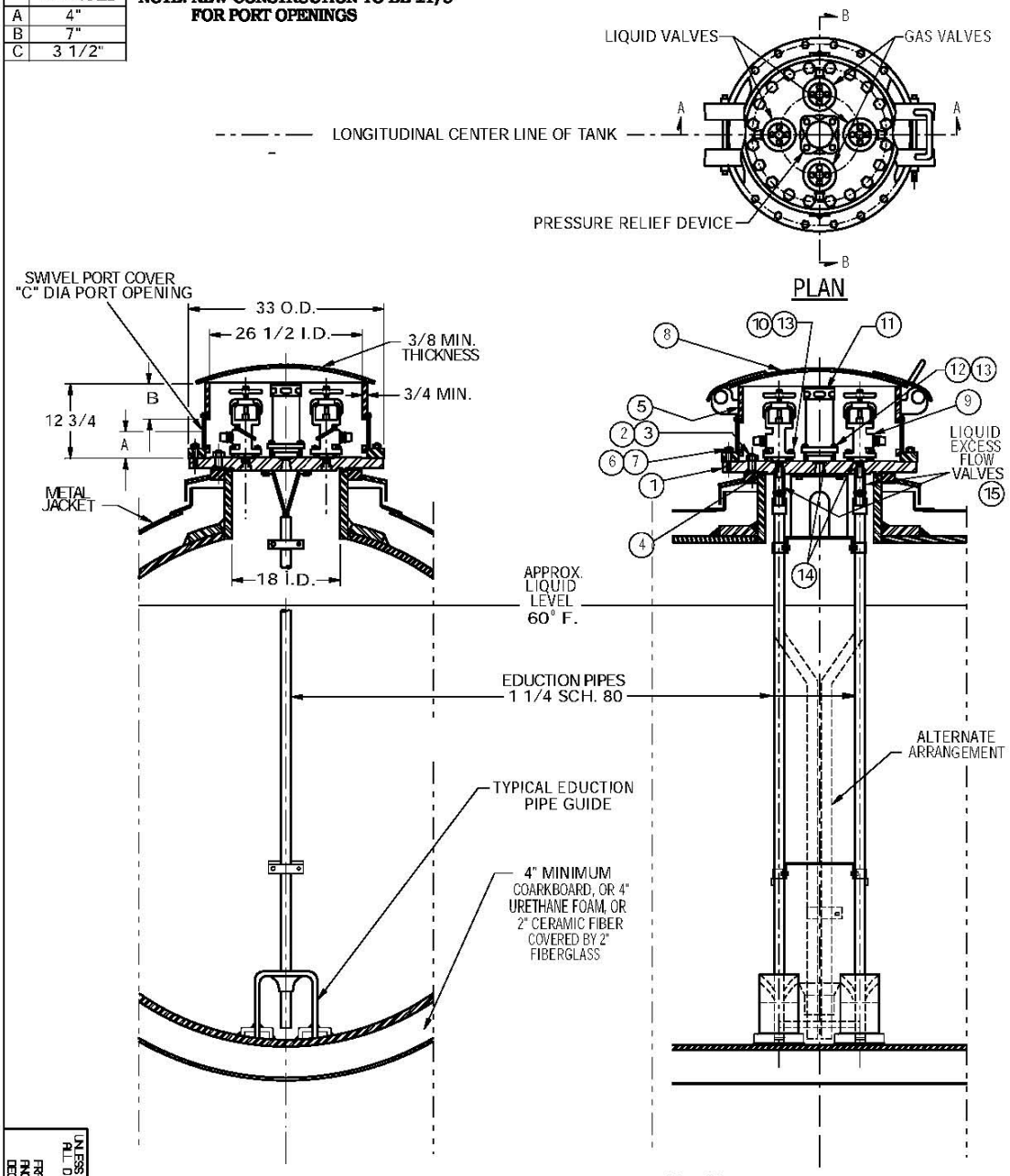
THE CHLORINE INSTITUTE, INC.
WASHINGTON, D.C.

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

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

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

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



NOTES:

1. **Clamping arrangements for eduction pipes vary.**
2. **DOT regulations require excess flow valves under liquid angle valves.**
3. **Some cars are equipped with short nipples under gas valves; some have drop pipes extending to slightly above liquid level.**

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 - SOFT SEAT - METAL SEAT	1	
12	PRESSURE RELIEF DEV.STUD	4	102
13	VALVE NUT	20	102
14	VALVE GASKET	5	102
15	EXCESS FLOW VALVE	2	

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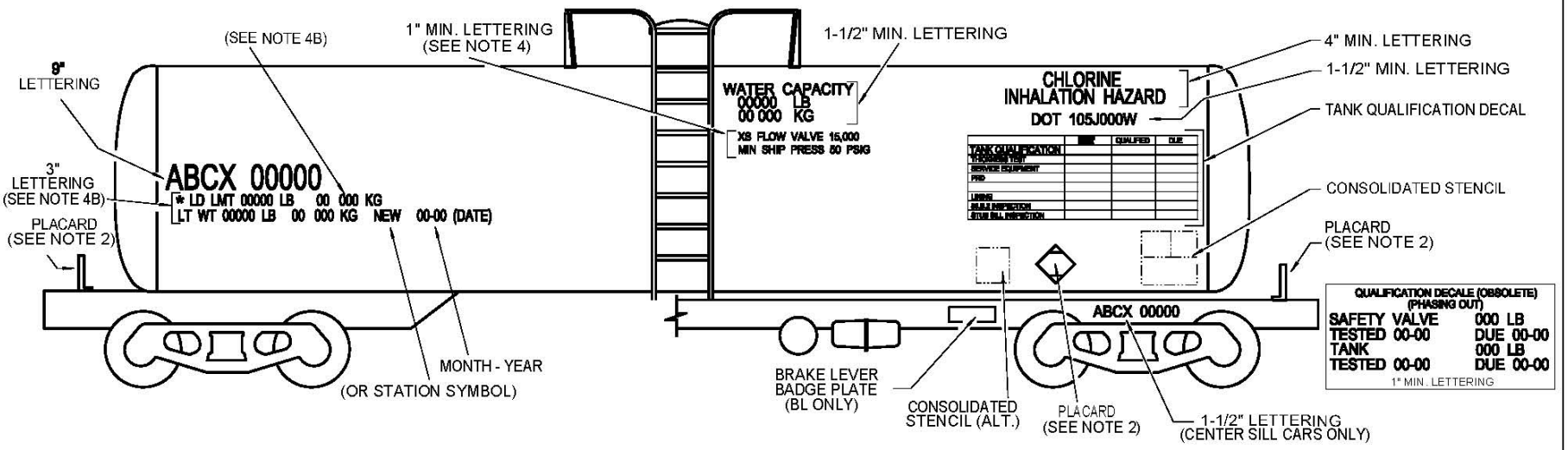
ISS	DATE	REVISION	APPR
9	1/01	**Remove drawing ref's**	STC
8	11/96	**Adopted "PRD" nomenclature**	
7	7/93	**Redrawn**	
6	9/82	**Note 5 & insulation note rev.**	STC
5	9/71	**Redrawn - added dimension**	CCSS
4	2/70	**Redrawn**	CCSS
3	1/62	**Note 4 rev. & add hdg.th.**	CCSS
2	6/59	**Plan view corrected**	CCSS
1	1/59	**Initial release**	CCSS

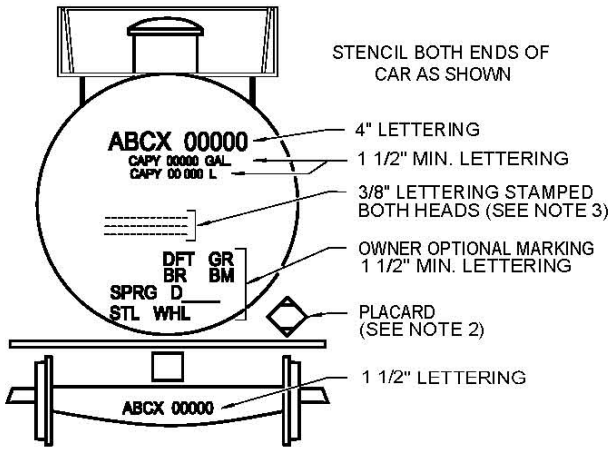
THE CHLORINE INSTITUTE, INC.
WASHINGTON, D.C.

TYPICAL MANWAY ARRANGEMENT CHLORINE TANK CAR

DRAWN	A. KASS	7-93	
TRACED		SCALE = NONE	
CHECKED	REP		
APPROVED			
DWG. NO.	107	ISSUE	9

UNLESS OTHERWISE SPECIFIED:
ALL DIMENSIONS IN INCHES
TOLERANCES
FRACTIONS ± 1/16
ANGLES ± 2°
DEC. ± .005





NOTES:

1. REFER TO THE CURRENT EDITION OF AAR SPECIFICATIONS FOR TANK CARS, APPENDIX C FOR AAR & DOT (TC) REQUIREMENTS FOR MARKING OF TANK CARS INCLUDING STENCILING AND STAMPING.
2. THE CHLORINE PLACARD MUST BE INSTALLED IN METAL PLACARD HOLDERS ON BOTH SIDES AND BOTH ENDS OF CAR AS SHOWN.
3. EACH TANK MUST BE PLAINLY AND PERMANENTLY STAMPED IN LETTERS AND FIGURES AT LEAST 3/8" HIGH INTO THE METAL NEAR THE CENTER OF BOTH OUTSIDE HEADS AS FOLLOWS:

   EXAMPLE OF REQUIRED STAMPING

   SPECIFICATION _ _ _ _ _ _ _ _ _ _ _ DOT-105J500W
   MATERIAL _ _ _ _ _ _ _ _ _ _ _ _ AAR TC 128B
   TANK BUILDER'S INITIALS _ _ _ _ _ _ _ ABC
   DATE OF ORIGINAL TEST _ _ _ _ _ _ _ 00-0000
   CAR ASSEMBLER
   (IF OTHER THAN TANK BUILDER) _ _ _ DEF
   WATER CAPACITY _ _ _ _ _ _ _ _ _ _ _ 00000 LB

4. IN ADDITION TO THAT REQUIRED BY REGULATIONS, THE INSTITUTE'S TECHNICAL COMMITTEES RECOMMEND THAT ADDITIONAL STENCILING BE APPLIED TO CHLORINE TANK CARS AS FOLLOWS:

   A) EXCESS FLOW VALVES - STENCIL AS SHOWN BOTH SIDES OF CAR TO THE RIGHT OF THE LADDER WITH THE MAXIMUM OPERATING FLOW RATE IN POUNDS OF LIQUID CHLORINE PER HOUR AND MINIMUM SHIPPING PRESSURE IN PSIG.

   B) ON A 90-TON CHLORINE CAR, THE LOAD LIMIT SHOULD BE STARRED IF THE LIGHTWEIGHT PLUS 180,000 LB EXCEEDS 263,000 LB.

   C) THE METRIC LOAD LIMIT CONVERSION FOR A 90-TON CHLORINE CAR IS TO THE NEXT LOWER KILOGRAM. THE METRIC LOAD LIMIT CONVERSION FOR CARS SMALLER THAN 90-TON IS TO THE NEAREST 50 KILOGRAMS PER AAR FIELD MANUAL RULE 70.

5. THE INHALATION HAZARD STENCIL MAY BE BELOW (PREFERRED) OR ABOVE THE CHLORINE COMMODITY STENCIL.

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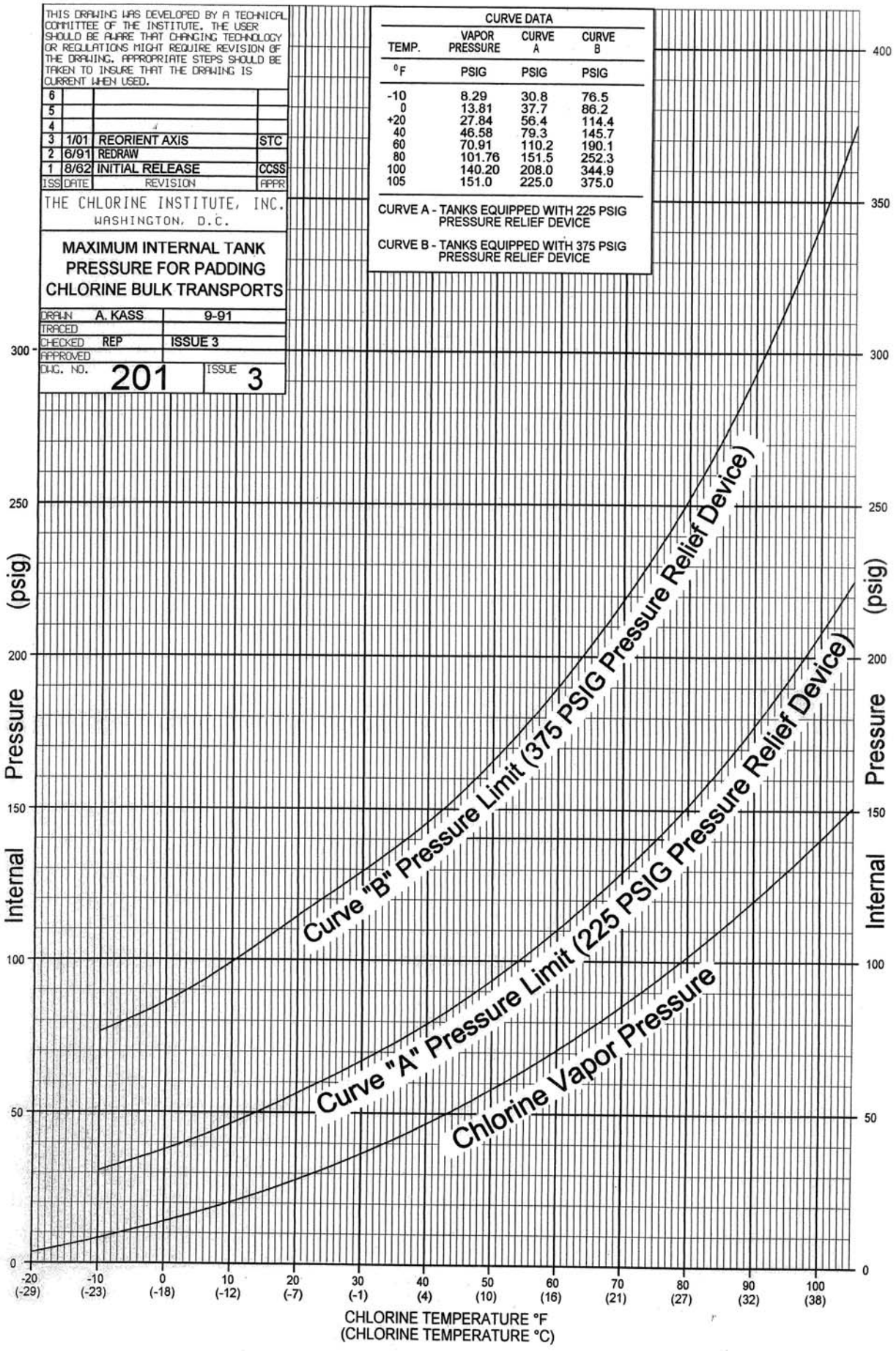
ISS	DATE	REVISION	APPR
5	1/01	NEW QUALIFICATION DECAL	STC
4	7/93	REVISION NOTE "4C", ADD "4D"	STC
3	6/91	REDRAWN, ADD NEW REQ.	STC
2	8/77	UPDATE FIG C-1 REQ.& NOTES	CCSS
1	3/73	ORIGINAL ISSUE	CCSS

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

CHLORINE TANK CAR MARKING

DRAWN	A. KASS	7-93
TRACED		SCALE = NONE
CHECKED	REP	ISSUE 3
APPROVED		
DWG. NO.	167	ISSUE 5


THIS DRAWING WAS DEVELOPED BY A TECHNICAL COMMITTEE OF THE INSTITUTE. THE USER SHOULD BE AWARE THAT CHANGING TECHNOLOGY OR REGULATIONS MIGHT REQUIRE REVISION OF THE DRAWING. APPROPRIATE STEPS SHOULD BE TAKEN TO INSURE THAT THE DRAWING IS CURRENT WHEN USED.
6
5
4
3 1/01 REORIENT AXIS STC
2 6/91 REDRAW
1 8/62 INITIAL RELEASE CCSS
ISS DATE REVISION APPR
THE CHLORINE INSTITUTE, INC.
WASHINGTON, D.C.
MAXIMUM INTERNAL TANK PRESSURE FOR PADDING CHLORINE BULK TRANSPORTS
DRAWN A. KASS 9-91
TRACED
CHECKED REP ISSUE 3
APPROVED
DWG. NO. 201 ISSUE 3
CURVE DATA
TEMP. °F | VAPOR PRESSURE PSIG | CURVE A PSIG | CURVE B 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
100 140.20 208.0 344.9
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
Internal Pressure (psig)
0
50
100
150
200
250
300
350
400
Curve "B" Pressure Limit (375 PSIG Pressure Relief Device)
Curve "A" Pressure Limit (225 PSIG Pressure Relief Device)
Chlorine Vapor Pressure
-20 (-29)
-10 (-23)
0 (-18)
10 (-12)
20 (-7)
30 (-1)
40 (4)
50 (10)
60 (16)
70 (21)
80 (27)
90 (32)
100 (38)
CHLORINE TEMPERATURE °F
(CHLORINE TEMPERATURE °C)