



THE CHLORINE INSTITUTE

Pamphlet 150

*Recommended Practices
For Handling Hydrochloric
Acid in Bulk Highway
Transports*

Edition 4



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1. INTRODUCTION

1.1 SCOPE

This pamphlet provides guidelines, recommended practices and other useful information for the safe shipping, handling (including loading and unloading) and receiving of hydrochloric acid in bulk highway transports. It represents a compendium of Institute membership experience as of the date of publication. It is particularly critical for receivers of hydrochloric acid bulk highway transports to be intimately familiar with the guidance provided in this pamphlet to help prevent the accidental mixing of hydrochloric acid with incompatible materials which can result in incidents having significant consequences, including severe injuries and/or damage to property.

1.2 CHLORINE INSTITUTE STEWARDSHIP PROGRAM

The Chlorine Institute exists to support the chlor-alkali industry in advancing safe, secure, environmentally compatible, and sustainable production, distribution, and use of its mission chemicals¹.

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

1.3 DEFINITIONS AND ACRONYMS

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

ACGIH	American Conference of Governmental Industrial Hygienists
AEGL	Acute Exposure Guidelines
Air Padding	The addition of clean, dry, oil free compressed air in order to increase system pressure in the cargo tank for unloading
ASME	American Society of Mechanical Engineers
CANUTEC	Canadian Transport Emergency Centre
Cargo Tank	Any tank permanently attached to or forming a part of any motor vehicle or any bulk liquid or compressed gas packaging not permanently attached to any motor vehicle which by reason of its size, construction or attachment to a motor vehicle, is loaded or unloaded without being removed from motor vehicle

¹ *CI's mission chemicals: chlorine, sodium and potassium hydroxides, sodium hypochlorite, the distribution of vinyl chloride monomer (VCM), and the distribution and use of hydrogen chloride.

CDL	Commercial Driver's License
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act (U.S.)
CFR	Code of Federal Regulations
CHEMTREC®	Chemical Transportation Emergency Center
CIAC	Chemistry Industry Association of Canada, formerly Canadian Chemical Producers' Association
CPVC	Chlorinated Polyvinyl Chloride
CSA	Canadian Standards Association
DOL	Department of Labor (U.S.)
DOT	Department of Transportation (U.S.)
E2 Plan	Environmental Emergency Plan (Canada)
E2 Regulation	Environmental Emergency Regulations (Canada)
EPA	Environmental Protection Agency (U.S.)
ERPG	Emergency Response Planning Guideline
FMCSA	Federal Motor Carrier Safety Administration
FMCSR	DOT Motor Carrier Safety Regulations
FRP	Fiberglass Reinforced Plastic
GVW	Gross Vehicle Weight
HCl	Hydrochloric Acid
HMR	Hazardous Materials Regulations of the DOT
IBCs	Intermediate Bulk Containers
IDLH	Immediately Dangerous to Life and Health
Institute	The Chlorine Institute
Marking	Application of stencil or decal
MAWP	Maximum Allowable Working Pressure

Motor Vehicle	A vehicle, machine, tractor, trailer, or semi-trailer, or any combination thereof, propelled or drawn by mechanical power and used upon the highways in the transportation of passengers or property
NIOSH	National Institute for Occupational Safety and Health (U.S.)
NOM's	(Or Normas) Normas Oficiales Mexicanas ("Official Mexican Standards")
NTTC	National Tank Truck Carriers, Inc.
OEM	Original Equipment Manager
OSHA	Occupational Safety and Health Administration (U.S.)
PEL	Permissible Exposure Limit
PHMSA	Pipeline and Hazardous Materials Safety Administration (U.S.)
PRD	Pressure Relief Device - Self reclosing valve or non-reclosing vent with rupture disc, designed to prevent rise of internal pressure in excess of a specified value, due to exposure to abnormal conditions
psig	Pounds per square inch gauge
PTFE	Polytetrafluoroethylene
PVC	Polyvinyl Chloride
RMP	Risk Management Plan
RQ	Reportable Quantity
SDS	Safety Data Sheet
TC	Transport Canada
TDG	Transportation of Dangerous Goods (Canada)
TLV	Threshold Limit Value
Transfer Site	Any facility where product is loaded and/or unloaded

1.4 SAFETY PROGRAMS

Every site handling hydrochloric acid should have an ongoing safety program. Periodic training sessions and safety inspections must be conducted in accord with DOT and OSHA regulations or equivalent Canadian or Mexican requirements. Special attention should be directed to appropriate emergency procedures and to equipment available for use in an emergency. Additional information on safety programs is available from the Institute and from hydrochloric acid 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 changes in the recommendations contained herein. Appropriate steps should be taken to ensure that the information is current when used. These recommendations should not be confused 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 19, 2020.

1.7 REVISIONS

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

1.7.1 Significant Revisions in Current Edition

Significant revisions in Edition 4 of this pamphlet include:

- New title and scope to encompass Intermediate Bulk Containers (IBCs) guidelines;
- Added references to IBCs throughout the document, including a new Appendix G on IBC safe handling (Section 2 and Appendix G);
- Added information on toxicological properties and exposures guidelines (Section 2);
- Added recommendations specific to the prevention of accidental mixing (Section 2.3 and 8.4);
- Enhanced guidance on spill containment equipment (Section 2.8);
- Updated regulatory and industry standards (Section 3);
- Updated and clarified cargo tank description information (Section 4);
- Updated and added new guidance on personnel qualification (Section 5);

- Updated and enhanced section on receiving and spotting (Section 6);
- Updated and enhanced pre- and post-transfer inspection steps for loading and unloading (Sections 7 and 8);
- Updated guidance on monitoring during unloading (Section 8.9);
- Updated transportation incident data and best practice guidance (Section 10);
- Updated and added new guidance on emergency response considerations (Section 11);
- Added caustic potash neutralizing quantities to Table 11.1 (Section 11);
- Added new appendix on Fiberglass Reinforced Plastic (FRP) cargo tank inspection special considerations (Appendix H);
- Reorganized appendices for consistency with other CI pamphlets; and
- Minor updates throughout.

1.8 REPRODUCTION

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

2. **GENERAL INFORMATION**

2.1 PRODUCT DATA - HYDROCHLORIC ACID

Chlorohydric acid, aqueous hydrogen chloride and muriatic acid are synonyms for hydrochloric acid. This pamphlet will use the term “hydrochloric acid” to refer to this substance.

Hydrochloric acid is an important and widely used chemical but possesses highly corrosive and hazardous properties. Personnel handling hydrochloric acid should be thoroughly familiar with the chemical and physical properties, health hazards and appropriate first aid procedures (See Appendices A through E). Safety Data Sheets are available from hydrochloric acid suppliers. Training is required under OSHA and DOT regulations or equivalent Canadian regulations (see Section 3).

2.2 HYDROCHLORIC ACID IN TRANSPORTATION

Hydrochloric acid is classified for transportation by DOT and TC as Class 8 (corrosive material). Various types of specialized containers are suitable for hydrochloric acid shipments, including cargo tanks and intermediate bulk containers (IBCs) transported by highway. This pamphlet will primarily address cargo tank shipments. However, guidance on the safe handling of IBCs can be found in Appendix G.

Due to the corrosive nature of hydrochloric acid, cargo tanks are usually rubber-lined steel, fiberglass reinforced plastic (FRP) lined steel, or FRP cargo tanks. Solutions of hydrochloric acid most generally shipped are 20° Baumé (31.45% HCl), 22° Baumé (35.21% HCl) and 23° Baumé (37.14% HCl). Other concentrations are shipped for specific purposes.

2.3 REACTIVITY AND COMPATIBILITY

Hydrochloric acid is a strong acid. It will react rapidly and sometimes violently with metal oxides, some organic compounds and alkaline materials (e.g. caustic soda). Poisonous gas can be generated by reaction with hypochlorites, sulfides and cyanides. Most reactions with hydrochloric acid will also generate heat which might cause boiling and splattering when improperly handled.

The accidental mixing of hydrochloric acid with incompatible chemicals may cause dangerous conditions that could result in severe injury (or even death under certain conditions) and damage to property or the environment. Common locations where accidental mixing can occur include, but are not limited to, containment systems and drains, sinks unloading piping and storage areas/tanks.

In addition, hydrochloric acid will react with most metals, thereby generating flammable hydrogen gas. Neither hazardous decomposition nor polymerization will occur with hydrochloric acid.

2.4 TOXICOLOGICAL PROPERTIES

HCl is a liquid at atmospheric pressure. It is very irritating to the skin, eyes, and mucosal surfaces. It can cause serious burns. High or prolonged inhalation exposures may cause delayed pulmonary edema with cough, chest discomfort, and difficulty in breathing. Contact with liquid can damage the eyes. Prolonged overexposure can cause dental erosion. Ingestion may cause severe acid burns of the mouth, throat, esophagus, and stomach with burning pain of the mouth, throat, chest, and abdomen. Gross exposure may cause death.

2.5 EXPOSURE GUIDELINES

The OSHA Permissible Exposure Limit (PEL) and ACGIH TLV exposure limits for HCl are 5 ppm (or 7 mg/m³ and 7.5 mg/m³, respectively). These are the ceiling values that should not be exceeded during any part of the work exposure without the appropriate PPE.

NIOSH's Immediately Dangerous to Life or Health Concentration (IDLH) limit is 100 ppm. The odor threshold for HCl is 0.2 - 0.8 ppm and 5-10 ppm will cause physical discomfort.

The Emergency Response Planning Guideline (ERPG) exposure guidelines for a 1-hour exposure period of hydrochloric acid are:

Table 2.1 Emergency Response Planning Guidelines (ERPG) for HCl (1-hour exposure)

ERPG-1	3 ppm	Mild health effects
ERPG-2	20 ppm	Serious health effects
ERPG-3	100 ppm	Life-threatening health effects

Acute exposure guidelines (AEGL) for hydrochloric acid are as follows:

Table 2.2 Acute Exposure Guidelines (AEGL) for HCl

Exposure Period	AEGL-1	AEGL-2	AEGL-3
10 minutes	1.8 ppm	100 ppm	620 ppm
30 minutes	1.8 ppm	43 ppm	210 ppm
60 minutes	1.8 ppm	22 ppm	100 ppm
4 hours	1.8 ppm	11 ppm	26 ppm
8 hours	1.8 ppm	11 ppm	26 ppm

2.6 OTHER HANDLING AND STORAGE CONSIDERATIONS

Some heat of dilution is generated when hydrochloric acid is mixed with water. Proper handling procedures must be followed to prevent overheating of the diluted solution. **ALWAYS ADD ACID TO WATER** while providing agitation, **NEVER ADD WATER TO ACID**.

2.7 PERSONAL PROTECTION INFORMATION

Handling hydrochloric acid requires adequate personal protective equipment to protect the user against hazards. This topic is explained in the Occupational Safety and Health Standard 29 CFR 1910.132 through 1910.136 (12.4). These regulations should be incorporated into a training program provided to all personnel involved in product handling. Proper personal protective equipment (which may include hard hat, respiratory protective device, chemical splash goggles, full-face shield, acid impervious gloves, boots, jacket, pants, and apron) should be worn when handling hydrochloric acid. Safety showers and eye wash facilities should be located in the immediate work area and tested on a regular basis. Detailed requirements for personal protective equipment should be established on a site-specific basis. Additional information about protective equipment for handling chlor-alkali chemicals can be found in CI Pamphlet 65 (12.1).

2.8 SPILL PREVENTION PROGRAM

All bulk transfer facilities should have a documented spill prevention and containment program for handling hydrochloric acid. Consideration must be given to the containment of hydrochloric acid leaks and spills to comply with applicable federal, state, provincial and local regulations.

Each transfer facility should decide what emergency response equipment is needed for their facility and what training is required to deploy the equipment.

Equipment that may be needed includes:

- Absorbent pads or pillow to absorb spills.
- Polyethylene sheeting to contain spills.
- Catch pans/pails.
- Transfer connections such as dry-type quick disconnect couplings and four-bolt flange connections.
- Bleed valves to completely empty all liquid product from hoses and piping.

Part of the planning for actions necessary to respond to a spill includes obtaining advice from the supplier and training with local fire departments and others.

2.9 RELATED INFORMATION AND PUBLICATIONS

For related physical properties, handling, storage, protective equipment and training aids, the reader should refer to the appendices and Section 12.

3. **REGULATORY REQUIREMENTS**

3.1 DOT REGULATIONS

The U.S. DOT regulates the acceptance and transportation of hazardous materials in the United States. DOT's Pipeline and Hazardous Materials Safety Administration (PHMSA) and Federal Motor Carrier Safety Administration (FMCSA) regulate the transportation of hydrochloric acid by highway in the PHMSA's Hazardous Materials Regulations (also referred to as the HMR) are found in Title 49 CFR Parts 171-180 (12.2.1). Because hydrochloric acid is a hazardous material, it is imperative that personnel involved in any aspect of handling, packaging and/or transportation of hydrochloric acid are knowledgeable of the regulatory requirements pertaining to hydrochloric acid.

These regulations also include requirements intended to enhance the security of hazardous materials in transportation by including a security component in employee training programs and developing and implementing security plans. FMCSA serves as the enforcer of hazardous materials transportation by highway. Relevant publications, including regulations and interpretations, are readily available for reference through the agency website (12.2).

3.2 EPA REGULATIONS

Personnel involved in transfer operations for hydrochloric acid should be aware of the regulatory requirements for spills and/or other emissions. Title 40 CFR should be reviewed for specific federal requirements. EPA currently requires producers, users and consumers who have in process quantities of hydrochloric acid (37% or greater strength and 15,000 lbs. or more) to have a Risk Management Program in place and file a "Risk Management Plan" (RMP) (12.3.1).

3.3 OSHA (DOL) REGULATIONS

Title 29 of the Code of Federal Regulations (CFR), Part 1910, contains workplace health and safety regulations developed and enforced by the Occupational Safety and Health Administration (OSHA) under a delegation of authority from the Department of Labor (DOL). These regulations include minimum standards for the safe handling, storage and use of hazardous materials. Title 29 CFR 1910.176 regulates material handling and storage, 29 CFR 1910.120 regulates the emergency response to hazardous substance releases and 29 CFR Part 1910 Subpart I regulates personal protective equipment (12.4.1).

3.4 CANADIAN REGULATIONS

Transport Canada's regulations for the Transportation of Dangerous Goods (TDG) parallel the DOT requirements in most respects. The Canadian regulations can be found online on Transport Canada's website under Transportation of Dangerous Goods (Act and Regulations). Relevant sections in the TDG regulations include Part 2 Classification, Part 3 Documentation, Part 4 Safety Marks, Part 5 Means of Containment, Part 6 Training, Part 7 ERAP, Part 8 Reporting, and Part 9 Road.

The TDG regulations include, by reference, various standards, published by agencies such as the Canadian Standards Association (CSA) and the Canadian General Standards Board (CGSB). Two such references are CSA B620 and CSA B621. CSA B621, titled "Selection and Use of Highway Tanks, Portable Tanks, Cargo Compartments and Containers for the Transportation of Dangerous Goods", outlines the requirements for the selection and use, handling, filling, and unloading of highway tanks, TC portable tanks, and other large containers when they are used for the transportation of dangerous goods of Classes 3, 4, 5, 6.1, 8, and 9. CSA-B620, "Highway Tanks and Portable Tanks for the Transportation of Dangerous Goods", is the CSA standard for the design, construction, certification, assembly, modification, repair, testing, inspection and periodic retesting, maintenance, and identification of tanks other than intermediate bulk containers or tubes. This Standard also applies to the hose assemblies used to load or off-load dangerous goods.

For transportation of tank cars containing hydrochloric acid (Packing Group II) within Canada, an Emergency Response Assistance Plan (ERAP) approved by Transport Canada is required. See Part 7 of the TDG Regulations for more details (12.5).

Environment Canada's Environmental Emergency Regulations, or E2 Regulations, lists Hydrochloric Acid I in Schedule 1 Part 2, Substances Hazardous When Inhaled. If a facility has the charge, management or control of a listed substance at or above the threshold quantity or is at a quantity greater than zero and is stored in a container that has a maximum capacity equal to or exceeding the threshold quantity, Environment Canada requires that the facility prepare, implement and test an Environmental Emergency Plan (E2 Plan).

3.5 MEXICAN REGULATIONS

The Normas Oficiales Mexicanas ("Official Mexican Standards"), often referred to as Normas or NOM's, supports the Mexican Hazardous Materials Land Transportation Regulation. The Mexican Secretariat for Communications and Transport is responsible for publishing and applying the NOM's. The Mexican NOM's are generally consistent with those of the United Nations recommendations on the Transport of Dangerous Goods (UN Recommendations) and TC and DOT regulations.

3.6 OTHER REGULATIONS

In addition to federal regulations, state, provincial and/or local regulations might also affect the operations. The reader is cautioned to check for applicable state, provincial and/or local rules and regulations.

4. **CARGO TANK DESCRIPTION**

4.1 CARGO TANK SPECIFICATIONS

The specifications for the cargo tanks that may be used to carry hydrochloric acid are found in 49 CFR 173.242. The current design specifications for hydrochloric acid cargo tanks are DOT 407 and DOT 412 which are found in 49 CFR 178.320 and 178.345 through 178.348 inclusive. DOT cargo tanks built to earlier design specifications MC 304, MC 307, MC 311 and MC 312 may still be used.

Hydrochloric acid is also commonly transported in fiberglass reinforced plastic (FRP) cargo tanks. At the time Edition 4 of this pamphlet was published, cargo tanks constructed of FRP are not authorized under DOT regulations. However, many FRP designs have been authorized under certain DOT special permits, including SP-9166, SP-10878, SP-11903, SP-12516, SP-14275, SP-14277, SP-14779 and SP-15552. The tank manufacturers are the grantees of these special permits. It is the responsibility of the shipper to ensure that each FRP cargo tank driver has a copy of the respective special permit and the shipping papers are identified appropriately.

The Canadian specifications for cargo tanks are found in CSA B620 and B621 (12.5).

The "wetted area" of parts of the tank which may come in contact with the lading must be compatible with the lading. These parts include:

- Tank shell (including heads)
- Interior lining

- Gasket material
- Valves and covers
- Seats and seals

Many factors should be considered when selecting a material for these tanks; such as volume to be transported, strength of solution, climate, and the expected life of the material. All handling equipment at the transfer site must also be compatible with hydrochloric acid. Certificates of Compliance and ASME form U-A1 data reports for cargo tanks must be maintained and available at the carrier's principal or designated headquarters.

4.2 CARGO TANK SIZES

Hydrochloric acid is transported in cargo tanks containing quantities up to 6,500 gallons. With the density of hydrochloric acid solutions being 9.69 to 9.79 lbs/gal (U.S.), the load level becomes significant. Free movement of a less-than-full liquid load can cause problems such as:

- | | |
|------------|--|
| surging | a longitudinal shift of liquid and weight from back to front and front to back. This presents the greatest hazard when the brakes are applied to slow or stop the moving vehicle. |
| side shift | a sideways shift of liquid and weight from the normal position to one side, so that the center of gravity of the vessel moves from side to side. The greatest hazard from side shift is the increased possibility of rollover while cornering. |

A combination of these effects can be expected to some degree in all shipments with increasing effects when less-than-full loads are transported.

The control of unstabilizing effects can be achieved by:

- Use of appropriately sized vessels in relation to the liquid volume ordered
- Use of baffled or compartmented tanks
- Training drivers to anticipate and safely handle these effects, including maneuvering at lower speeds

4.3 MARKING AND PLACARDING OF CARGO TANKS

4.3.1 Marking

The product identification number (UN 1789 for hydrochloric acid) must be marked on each side and each end of the cargo tank (49 CFR 172.302, 172.328, and 172.332) (12.2). The product identification number may be included on the placard. Each cargo tank must be durably and legibly marked, in English, with the date (month and year) and the type of test or inspection performed. The date must be readily identifiable with the applicable test or inspection. The marking must be in letters and numbers at least 1.25 inches (32mm) high, on the tank shell near the specification plate or anywhere on the front head. The type of test or inspection may be abbreviated as follows:

V	=	External Visual Inspection and Test
I	=	Internal Visual Inspection
P	=	Pressure Retest
K	=	Leakage Test
L	=	Lining (if present)
T	=	Thickness Testing

For example, the marking 10-18 P, V would indicate that in October 2018 the tank received and passed the prescribed pressure retest and the external visual inspection and test (49 CFR 180.415) (12.2.1).

4.3.2 Placarding Requirements

For any quantity of hydrochloric acid in a cargo tank, a corrosive placard is required on each side and each end of the tank. Placards alert persons to the potential dangers associated with hazardous materials contained in the cargo tank. Placards also guide emergency personnel who respond to incidents involving hazardous materials (49 CFR 172.558).

4.4 CARGO TANK FITTINGS

A typical hydrochloric acid cargo tank has provisions for top product transfer. Some cargo tanks are outfitted for bottom discharge. The primary control valves and air supply valves are described in the following paragraphs.

4.4.1 Pressure and Vacuum Relief

Each DOT 412 and 407 hydrochloric acid cargo tank must be equipped to relieve pressure and vacuum conditions. The pressure and vacuum relief system must be designed to operate and have sufficient capacity to prevent cargo tank rupture or collapse due to pressure changes resulting from loading, unloading, or heating or cooling of the lading.

All cargo tanks built in accordance with DOT specification 407 and 412 must be equipped with remote self-closing devices. Reference is made to 49 CFR 178.345-10. Older cargo tanks (MC 312) are not required to be equipped with a vacuum relief valve.

4.4.2 Top Fitting Arrangements

The top fittings typically consist of a fill hole, top unloading valve, air/vent pad valve and the relief system mentioned in Section 4.4.1.

Fill Hole - A typical fill hole is a seven to ten-inch opening with a hinged and bolted cover. Covers are designed with sufficient strength and hold-down clamps to safely contain the cargo tank contents in an overturn. The covers must be secured and fully bolted down before transporting any product.

Product Unloading Valve for top unloaders - The unloading valve is mounted directly to the tank above a dip tube that extends to a sump in the bottom of the tank. Butterfly valves are typically used for this service but other valves for chemical service are permitted.

Air Inlet Valve - An air inlet valve is mounted directly to the tank. It is usually one inch in size and of a butterfly design, although other designs and sizes are in use.

Vapor Vent Valve - allows vapor to exit the tank during transfer. This valve could also serve as an air inlet device.

Rollover protection is located around appurtenances to help reduce damage (leak) in an incident.

Relief valve should be mounted in center of cargo tank to avoid surge induced failures.

4.5 INTERIOR LININGS

Steel or aluminum cargo tanks in hydrochloric acid service must have an interior lining that is compatible with hydrochloric acid. It is recommended the user consult with the various coating and lining manufacturers for specific recommendations based upon the user's operations, product and temperatures limitations. Examples of lining materials used include rubber, such as chlorobutyl and selected fluoropolymers.

4.6 GASKET MATERIALS

The gasket materials chosen for cargo tank use must be compatible with hydrochloric acid. Some suitable materials for gaskets are PTFE, natural rubber, Viton®, neoprene rubber, ethylene-propylene rubber or vinyl materials. It is the shipper's responsibility to verify the material compatibility before use in hydrochloric acid service.

5. **TRAINING AND QUALIFICATION**

5.1 GENERAL REQUIREMENTS

The DOT and TC have specific training requirements applicable to handling of hazardous materials. Shippers and drivers of hazardous materials must familiarize themselves with these requirements (see 49 CFR 172.700 and 172.704). Such training must include:

- General awareness training.
- Function-specific training.

- Safety training.
- Security-awareness training.
- In-depth security training (when applicable).

A variety of training aids such as DVD's, online content, booklets, etc. are available from the Institute and commercial suppliers. These can be beneficial when properly selected and applied in the program.

Several training sessions are generally better than one long session. Seasonal weather problems can be discussed at appropriate times. Safety review, defensive driving techniques and review of the procedures are good topics to cover on an annual basis. Driver training courses are offered by agencies and many organizations can supply excellent training.

5.2 DRIVER QUALIFICATIONS

In the United States, the driver of a hydrochloric acid cargo tank and the driver of a truck shipping IBC's with combined volume of > 1,000 gallons must have DOT-qualified with a Commercial Driver's License (CDL) with a Hazardous Material Endorsement and Tank Endorsement. Requirements for obtaining a CDL and Hazardous Materials Endorsement can be found in 49 CFR Part 383. Minimum qualifications for persons who drive commercial motor vehicles can be found in 49 CFR Part 391. Every commercial motor vehicle must be operated in accordance with the laws, ordinances, and regulations of the jurisdiction in which it is being operated.

Applicable federal rules for operating in the United States can be found at 49 CFR Parts 392 thru 397.

In Canada, the driver of a hydrochloric acid cargo tank must have a provincial driver's license and Transportation of Dangerous Goods (TDG) training certificate. Applicable federal rules for operating in Canada can be found in the Transportation of Dangerous Goods Regulations (12.5).

5.3 DRIVER TRAINING

The driver should have a basic familiarity with the features of the cargo tank and the fittings so that he can inspect the vehicle, including the closures and fittings. It is essential that the driver understands the nature of his cargo and be trained in the use of emergency devices and equipment on the truck. The driver must know how to handle an emergency in transit, including correct phone contacts and required written reports to DOT, state, provincial and local authorities. To ensure proper driver training, the vehicle owner or his authorized agent should have a formalized training program which documents on-going driver training for all involved drivers. DOT requires recurrent training at least every three years. Driver training must be administered by qualified personnel in the following specific areas:

- General construction and features of authorized cargo tanks.
- Cargo tank details (e.g. manhole covers, locking devices and access to top fittings).

- Specific details and locations of discharge and safety valves and proper operation of all valves.
- How to detect leaks and safety precautions to observe.
- Driving rules.
- General driving precautions (e.g. surging, weight shifting, stopping distances, etc.).
- OSHA's Hazard Communication Standard (29 CFR 1910.120).
- Selection, use and care of personal protective equipment (e.g. eye and face protection, gloves, protective clothing, and boots).
- Use and care of emergency response equipment.
- Product transfer operations and procedures.
- Applicable customer rules and requirements.

To ensure competency, it is strongly recommended that refresher training on these topics be given at least annually.

OSHA requires that training on respiratory protection be conducted annually (29 CFR 1910.134(k)). To have an effective and compliant respiratory protection program, the carrier must ensure that the following are completed:

- Annual medical evaluation for each person authorized to wear a respirator.
- Annual training on proper use and care.
- Annual fit testing of each different respirator that the driver will or may wear.

In order to prepare the driver to respond in the event of a transportation emergency, drivers must receive initial and annual refresher training on emergency response (29 CFR 1910.120) to at least the First Responder Level.

5.4 CARRIER QUALIFICATIONS

As an alternative to utilizing a shipper's private fleet, contract carriers may be selected to transport hydrochloric acid. It is recommended that such carriers be pre-approved to ensure that they meet the shipper's minimum qualification standards and that only qualified carriers be used. Examples of carrier qualification requirements include:

- Proof of minimum insurance coverage including the financial responsibility requirements of 49 CFR Part 387.
- Copy of operating authority.
- A completed facility equipment questionnaire and a driver training inspection questionnaire.

- Proof of proper driver licensing and identification.
- Copy of DOT safety rating.
- Copy of Motor Carrier Safety and Performance Data.
- Hazardous Material Safety Permit.
- Latest motor carrier safety survey.
- Copy of written training program and driver training records.

In Canada, a CIAC carrier evaluation criteria system is in effect. Carriers that transport in Canada are required to obtain a permit from each province that they intend to transport dangerous goods through.

6. RECEIVING AND SPOTTING HYDROCHLORIC ACID TANK MOTOR VEHICLES

It is recommended that an unloading checklist be used prior to unloading a cargo tank. The checklist should include verifying the correct product is being delivered via checking the shipping description, seal numbers, UN number and placards. Ensure they are all matching, and that the receiving tank has sufficient capacity to accept the quantity being delivered. The checklist should also include a double check of the connection point for the delivery.

Prior to loading operations, cleaning certificates should be verified if a cargo tank is empty and clean. If the tank contains residue product (previously unloaded but not clean), a document certifying the last product loading should be available and verified to avoid potential mixing of incompatible materials.

The driver should be instructed to spot the vehicle for the pre-load/pre-unload inspection (this may or may not be at the loading/unloading area).

Finally, once the truck is properly spotted, the brakes should be set, trailer wheels chocked and the vehicle can be turned off (if engine power is not required). Ensure the truck is properly secured to prevent accidental movement during the transfer operation. The loader/unloader should follow normal transfer procedures as outlined by company procedures.

7. HYDROCHLORIC ACID CARGO TANK LOADING

7.1 GENERAL

When loading hydrochloric acid cargo tanks, the safety aspects of the operation should be foremost in the minds of loading personnel. The loaders must verify that proper spotting and receiving processes have been properly completed before beginning transfer operations.

Proper personal protective equipment (e.g. hard hat, respiratory protection, chemical splash goggles, full-face shield, acid impervious gloves, boots, jacket, and pants) should be worn during the transfer operation. A safety shower and eye wash system must be located in the immediate work area (See 29 CFR 1910.151 (c)) and be tested on a routine basis and before each product transfer. Supplier recommendations should be followed during any product transfer. Note: Safety shower standards are found in ANSI Z358.1.

7.2 PRE-LOAD INSPECTION CHECKLIST

An inspection checklist should be used for all aspects of the loading operation. The checklist should include all recommendations contained in this pamphlet plus any special requirements specific to each plant. The purpose of the pre-load inspection is to identify problems and ensure all safety measures are in place before loading. The pre-load portion of the checklist should at a minimum include:

- a. The location of the nearest safety showers and eyewash verified with the loading operator and activated to verify water flow.
- b. Determination that the proper cargo tank has been supplied.
- c. A check of the cargo tank for a DOT/TC specification plate to determine the compatibility of the material of construction or lining for use in hydrochloric acid service. A cargo tank that does not have a DOT/TC specification plate should not be loaded.
- d. Confirmation that the cargo tank test dates on the specification plate or appropriate location are current and that the material to be loaded will not exceed the temperature, weight and density limits.
- e. A check that there is a written certification or documentation stating whether the trailer has been cleaned or identifying the last contained product.
- f. A check to ensure that only compatible materials are loaded into compartmented tank trucks.
- g. An inspection of the running gear, safety appliances, markings and placarding.
- h. Verification that all cargo tank fittings not used during loading are closed tightly to prevent any leakage.
- i. Verification that the unloading valves are closed tightly to prevent an accidental discharge.

j. Visual inspections as follows:

- Top and bottom fittings, including the manway and its cover, for corrosion, deterioration, damage, signs of product leakage, and loose, missing, bent or damaged hardware.
 - Manway cover gaskets, product hoses and hose gaskets for excessive wear, cracks, damage, deformities, etc.
 - Tank interior for lining condition, cleanliness and any heel.
 - Stop Work Authority should be used if any problems are found. Report any problems to supervisor so problem can be corrected prior to commencing the transfer operation.
- k. Verification that the cargo tank has been depressurized prior to opening the manway to the interior of the tank. Prior to inspecting the interior of the tank, the tank needs to be depressurized to allow for the manway to be safely opened.
- l. Perform a lining integrity test at the frequency recommended by your company and in accordance with DOT requirements to determine the condition of a rubber lined cargo tank (Refer to CI Pamphlet 98, specifically the appendix entitled 'Rubber Lining Integrity Testing Guidelines for Carbon Steel Vessels Containing HCl' (12.1)). A record of all conductivity tests should be maintained to assist in determining when the rubber lining should be replaced.

Because of the risk of contamination or reactivity of cargo tank contents, if a liquid heel is discovered during the pre-load inspections, appropriate facility procedures must be followed.

7.3 VENTING OF CARGO TANK

Cargo tanks must be properly vented before transfer operations may begin. Connect the vent hose to the vent connection on the cargo tank and vent any pressure. Vent gas should be collected in accordance with facility procedures.

7.4 PRODUCT TRANSFER

After the pre-load inspection is complete and the cargo tank is found acceptable, make sure the scrubber vent is connected to the cargo tank. Verify the scrubber is operating properly and any cargo tank pressure has been vented to the scrubber. Once the pre-load inspection and venting has been completed product transfer can begin. Four corrosive placards (UN1789 for hydrochloric acid) should be applied to the cargo tank whenever acid or acid residue is present in the tank.

It is recommended the following be included in procedures for loading a hydrochloric acid cargo tank:

- a. Determine the amount of product to be loaded.
- b. Ensure all outlet valves are closed.

- c. Ensure the loading line is secured to prevent movement. Product surge through the piping could cause the loading line to “jump” and cause a product release.
- d. When loading is done on a scale, flexible filling lines must be used to ensure accurate weighing.
- e. When ready to transfer, open product valve, engage transfer pump and begin product flow.
- f. During the transfer process, periodically inspect the cargo tank to ensure there is no leakage. If leakage is detected, immediately stop the transfer and determine cause of leak. Ensure defect has been corrected prior to continuing with transfer.
- g. Fill the tank to the proper level following established plant procedures, ensuring the cargo tank’s volume and weight capacity are not exceeded. This is defined as the load limit, and consists of both the design capacity of the tank, and the gross vehicle weight (GVW) of the power unit. Exceeding this limit may result in an unsafe condition. In addition, state or provincial axle and gross load limits must not be exceeded.
- h. Secure all the valves, valve plugs, valve caps and the manway cover using a properly sized wrench. All fittings should be tool tight.

7.5 LEAK CHECKING

Periodically during the transfer process, inspect the cargo tank to ensure there is no leakage. If leakage is detected, immediately stop the transfer and locate the source of the leak before proceeding. Provision must be made to assure the proper volume is introduced into the cargo tank by utilizing a weigh scale, meter, level probe or other similar device.

7.5.1 Leaks in Connections and Piping

Piping systems should be tested, inspected and maintained in accordance with manufacturer recommendations. This should include inspections at regular intervals for signs of leakage, internal or external corrosion, insulation failure or support problems. If a leak should occur in equipment or piping, the transfer should be stopped immediately by closing the source of hydrochloric acid to the tank, closing the valves, and the load lines de-pressurized so the necessary repairs can be made. When the leak has been located and the faulty equipment repaired and leak tested, loading may be resumed.

7.5.2 Leaks in Fittings

Leaks around the valve stems can usually be stopped by tightening the valve’s packing gland nuts or packing screw. If this does not stop the leak, the product valve should be closed and necessary repairs made.

7.6 MONITORING CARGO TANK LOADING

DOT (49 CFR 177.834(i)) and TC (CSA Standard B622) regulations require a cargo tank to be attended at all times during loading (12.2.1 and 12.2.2). DOT regulations require that attendance during loading must be achieved by one of three ways, as long as certain criteria are met:

- A qualified person who is within 25 feet (in walking distance) of the cargo tank, must be alert and have an unobstructed view of the cargo tank and delivery hose to the maximum extent practicable;
- A qualified person observes by means of video cameras and monitors, or other instrumentation and signaling systems, located at a remote-control station; or
- Hoses used for loading are equipped with cable-connected wedges, plungers or flapper valves located at each end of the hose that are able to stop the flow of product within one second without human intervention in the event of a hose failure.

Transport Canada only allows attendance of loading to be achieved by a qualified person attending the loading within 150 feet of the tank and within 25 feet of the transfer hose.

7.7 POST-LOAD INSPECTION CHECKLIST

The post-load inspection checklist should, at a minimum, include the following:

- a. Verification that all proper components and fittings are in place and secured.
- b. Verification the cargo tank motor vehicle is not overweight.
- c. Application of seals, product information tags or other information required by regulation and the facility.
- d. Washing off of any product residue from the cargo tank following established plant procedures.
- e. Confirmation the cargo tank is properly marked and placarded.
- f. Confirmation the cargo tank has a security seal(s) in place if required by company policy.
- g. Confirmation the manway covers are securely fastened, and all other openings are securely closed and tightened before transit.
- h. Ensure the proper SDS accompanies the shipping papers.
- i. A visual inspection of the cargo tank, including all fittings and fitting connections, for leakage (liquid or vapor) or mechanical problems.
- j. A check that proper shipping papers have been prepared and have been given to the driver and are located on the door pocket or driver's seat.

- k. Completion of the cargo tank inspection checklist report and a release of the tank for shipment.

8. HYDROCHLORIC ACID CARGO TANK UNLOADING

8.1 GENERAL

When unloading hydrochloric acid cargo tanks the safety aspects of the operation should be foremost in the minds of personnel. The unloader must verify that the requirements for receiving and spotting processes have been properly completed before beginning transfer operations.

Proper personal protective equipment (e.g. hard hat, respiratory protection, chemical splash goggles, full-face shield, acid impervious gloves, boots, jacket, pants and apron) should be worn during the transfer operation. The level of personal protective equipment may vary depending on the exposure risk. A safety shower and eye wash system must be located in the immediate work area (See 29 CFR 1910.151 (c)) and be tested on a routine basis and before product transfers are started. Supplier recommendations should be followed during any product transfer. Note: Safety shower standards are found in ANSI Z358.1.

8.2 TANK MOTOR VEHICLE 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 special requirements specific to each facility. The checklist documents that the proper unloading and securement procedures have been completed. It is essential that all site equipment such as pumps, lines, valves, and air systems are compatible with hydrochloric acid in design and materials of construction.

8.3 CARRIER RESPONSIBILITY

Shipping papers and other required documentation must be delivered to a responsible authority before unloading. A signed delivery receipt should be obtained before the motor carrier leaves the area.

8.4 PRODUCT VERIFICATION AND SAMPLING

Following established company procedures, verify the content of the cargo tank is hydrochloric acid.

Steps should be taken to avoid the accidental mixing of hydrochloric acid with incompatible materials, which can result in significant consequences (as noted in Section 2.3). Verify that the cargo tank is connected to the correct unloading lines and that hydrochloric acid will be unloaded into the correct receiving tank. Appropriate marking should be in place and legible. If proper connections or markings are not in place, STOP and contact your supervisor for direction before proceeding. Additional guidance on preventing accidental mixing incidents can be found in CI's video "Accidental Mixing: Dangers, Incidents and Prevention during Chemical Delivery" (12.1).

8.5 RECEIVER RESPONSIBILITY

The motor vehicle driver is responsible for working with the receiver to hook up and begin the unloading process. Prior to unloading:

- a. Specific procedures should be reviewed with the driver.
- b. Product should be verified by paperwork and sampled where required.
- c. Verify level of storage tank and ensure it has sufficient empty volume (ullage) to receive the shipment. If unable to verify, STOP and contact your supervisor for direction before proceeding.
- d. Appropriate connections in storage or process tanks are in place and verified. Appropriate marking should be in place and legible. If proper connections or markings are not in place, STOP and contact your supervisor for direction before proceeding.
- e. Unloading hoses and fittings should be inspected for proper condition and compatibility with hydrochloric acid.
- f. Grounding cables should be connected to trailer if required by plant procedures.
- g. Proper personal protective equipment (e.g. hard hat, respiratory protection, chemical splash goggles, full-face shield, acid impervious gloves, boots, jacket, and pants) should be worn.
- h. The location of the nearest safety showers and eyewash are verified with the delivery driver and activated to verify water flow.
- i. The tank venting system should be connected and operating properly.
- j. In preparation for unloading, relieve any pressure in the cargo tank through the air inlet valve when so equipped or by slowly loosening the bolts on the safety vent assembly flange or the fill hole cover. Vent gases should be collected in accordance with plant procedures.

The receiver must take responsibility for the operation and safety of a tank motor vehicle left on their premises. It is important that the tank be unloaded in a safe area properly equipped to handle any emergency that might occur.

Access to top fittings on the cargo tank should be provided by safe steps, platforms or drop-bridges. Guard rails for the protection of personnel must meet OSHA standards. If air padding is used for unloading, the air must be clean and properly regulated not to exceed the tank maximum working pressure. Emergency shutoff equipment is recommended on all product lines. If operations are to be carried on during darkness or in inclement weather, proper lighting must be provided during unloading. Available emergency equipment should include fire extinguisher, spill containment equipment, self-contained breathing apparatus and a full acid suit.

8.6 STATIONARY STORAGE

Storage tanks used to receive hydrochloric acid from cargo tanks must be properly constructed and capable of containing the incoming shipment. The storage tank must be equipped with properly maintained valving, pressure and vacuum relieving devices and provided with a reliable level measuring device to prevent overfilling. Appropriate spill containment should be provided. The storage tanks should be vented to a scrubber in accordance with plant operating practices.

8.7 UNLOADING SYSTEMS

Hydrochloric acid cargo tanks may be unloaded by pump, pressure padding, or in some cases, by gravity. Typical air padding unloading arrangements are shown in Figure 8.1. Pump unloading is the preferred method of transfer. When unloading by pressure padding, a positive pressure is typically applied to the cargo tank to force the product out of the cargo tank through the eduction pipe. Be certain that the fill hole cover is secured before applying any pressure. Unloading pressure in the cargo tank must not exceed its pressure relief device rating.

The relief device pressure rating or maximum allowable working pressure (MAWP) is clearly identified on the trailer specification plate of the cargo tank. In most cases, 20 psig should be sufficient.

Use a suitable air compressor equipped with a pressure gauge, a pressure relief valve and automatic pressure controls. A filter should be provided to remove entrained oil, condensed moisture and rust particles. Air from a tractor or highway power unit can be utilized for padding provided that it is clean, pressure-controlled and used only when the unit is parked and not operating on the highway. An air supply at the receiving or delivery point may be used for padding, provided that it is clean and pressure-controlled. Regulated air supply from one of the above sources should be connected to the air inlet nozzle on the cargo tank.

Internal and external (primary & secondary) valves should be opened prior to padding tanker with air when delivering into a top load tank. Internal (primary) valve should be opened prior to padding tanker with air when delivering into a bottom unload tank. The external (secondary) valve should be opened slowly after air pressure inside the tanker is sufficient to overcome the head pressure inside the storage tank.

It is important that pressure be relieved to the extent practicable before disconnecting any fittings on the cargo tank and before releasing the cargo tank for return shipment.

CAUTION: Special receiving tank design considerations are required when using positive pressure unloading, to handle pressure surge when the tank goes empty (See Appendix F).

Product transfer can also be accomplished by pumping. Care should be taken not to pull a vacuum on the cargo tank. To prevent cargo tank failure and possible collapse, the tank must be properly vented to allow air to displace the volume of liquid being transferred. Ensure that hoses are empty prior to disconnecting.

8.7.1 Unloading Hoses

Unloading hoses are commonly 2-inch diameter rubber chemical hoses. The fittings should be rubber-lined or other suitable material 4-bolt flanges. Plastic (PVC/CPVC) quick-coupler or camlock fittings are not recommended as these fittings are more likely to fail, particularly in cold-weather conditions. Hoses should be properly supported to avoid kinks or weak spots to prevent excessive weight on the hose connection. See section 9.4 for additional information on hose maintenance.

AIR PRESSURE SYSTEM FOR UNLOADING

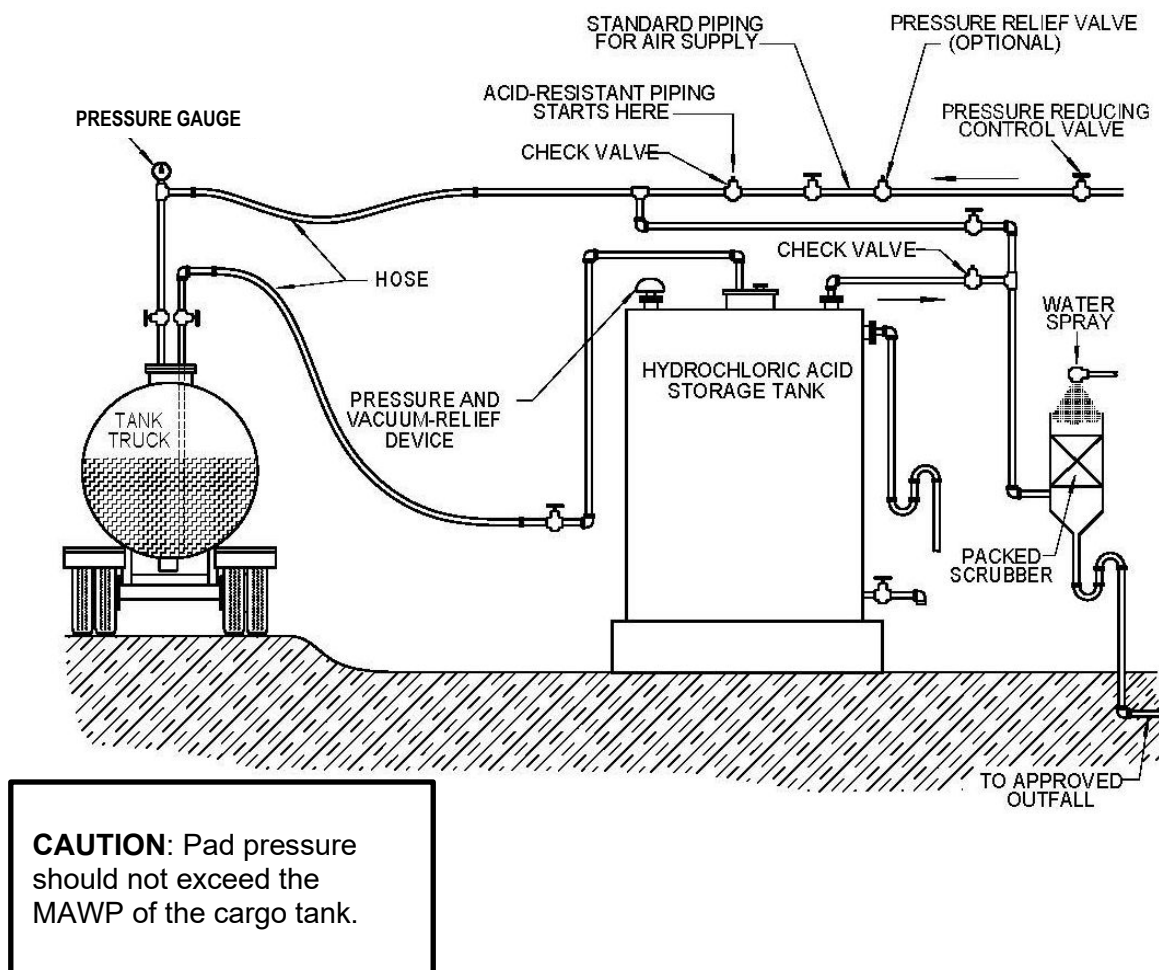


Figure 8.1

8.8 LEAK CHECKING

Periodically during the transfer process, inspect the cargo tank to ensure there is no leakage. If leakage is detected, immediately stop the transfer and locate the source of the leak before proceeding. Provision must be made to assure the proper volume is introduced into the cargo tank by utilizing a weigh scale, meter, level probe or other similar device.

8.8.1 Leaks in Connections and Piping

Piping systems should be tested, inspected and maintained in accordance with manufacturer recommendations. This should include inspections at regular intervals for signs of leakage, internal or external corrosion, insulation failure or support problems. If a leak should occur in equipment or piping, the transfer should be stopped immediately by closing the source of hydrochloric acid to the tank, closing the valves, and the load lines de-pressurized so the necessary repairs can be made. When the leak has been located and the faulty equipment repaired and leak tested, unloading may be resumed.

8.8.2 Leaks in Fittings

Leaks around the valve stems can usually be stopped by tightening the valve's packing gland nuts or packing screw. If this does not stop the leak, the product valve should be closed and necessary repairs made.

8.9 MONITORING CARGO TANK UNLOADING

DOT (49 CFR 177.834(i)) and TC (CSA Standard B622) regulations require a cargo tank to be attended at all times during unloading (12.2.1 and 12.5.2). DOT regulations require that attendance during loading must be achieved by one of three ways, as long as certain criteria are met:

- A qualified person who is within 25 feet (in walking distance) of the cargo tank, must be alert and have an unobstructed view of the cargo tank and delivery hose to the maximum extent practicable;
- A qualified person observes by means of video cameras and monitors, or other instrumentation and signaling systems, located at a remote-control station; or
- Hoses used for unloading are equipped with cable-connected wedges, plungers or flapper valves located at each end of the hose that are able to stop the flow of product within one second without human intervention in the event of a hose failure.

Transport Canada only allows attendance of unloading to be achieved by a qualified person attending the unloading within 150 feet of the tank and within 25 feet of the transfer hose.

9. MAINTENANCE REQUIREMENTS

9.1 GENERAL REQUIREMENTS

As with all hazardous material transport containers, hydrochloric acid cargo tanks must be maintained in safe operating condition. This includes the basic tank structure, running gear, valves, piping, safety equipment and auxiliary equipment. Special considerations for FRP cargo tanks can be found in Appendix H.

9.2 DAILY INSPECTION AND MAINTENANCE

Pre-trip vehicle condition reports are required to be completed by the driver. This inspection should disclose obvious conditions requiring maintenance.

Post-trip vehicle condition reports should disclose any problems or conditions requiring maintenance that were found during that day of operations.

Inspections by knowledgeable personnel should be made whenever a driver's condition report indicates a problem or deficiency and periodically as needed to ensure safety and full compliance with regulations and good operating practices.

Preventive and corrective maintenance should be performed and recorded as needed to maintain the entire motor vehicle and its related equipment in safe condition to protect the driver, receiver, highway travelers, and the environment.

9.3 PERIODIC MAINTENANCE

Standard vehicle maintenance should be accomplished on a proper schedule and recorded. Special attention should be given to the maintenance of the brake system and tires. Cargo tank equipment inspection and maintenance should be done on an established schedule to assure the safe condition and operation of all valves, piping, manhole covers and hold-down devices, vents, air padding systems and clean-out openings and caps.

9.4 HOSE AND FITTING MAINTENANCE

Hoses should be properly selected and equipped with fittings and gaskets to ensure the safe transfer of the hydrochloric acid. An inspection schedule should be carefully followed to detect problems and potential failure before they occur. Hoses should be hydrostatically tested at 150% of working pressure at least annually and tagged with test date and pressure. Hydrochloric acid hoses in regular service should be removed from service as evidenced by general wear or poor condition or as specified by the company's policy.

9.5 TESTS AND INSPECTIONS

Title 49 CFR Part 180 contains the requirements for maintenance, use, inspection, repair, retest, and requalification of cargo tanks. Report and record retention requirements can be found in 49 CFR 180.417. Testing requirements in Canada are similar, see CSA B620 (12.5.2).

Any required weld repairs, as described in 49 CFR 180.413, may only be accomplished by a repair shop awarded a National Board “R” Stamp. Then a repair or replacement of the rubber lining might be required.

The following is a summary of tests and inspections for hydrochloric acid cargo tanks:

DOT Code	Description	Frequency	Applicable Tanks
V	External Visual Inspection	1 year	All
I	Internal Visual Inspection	1 year	All
L	Lining Inspection	1 year	All
K	Leakage Testing	1 year	All
P	Pressure Testing	5 years	Insulated and lined, also tanks with no manholes
T	Thickness Testing	2 years	All unlined

The tank should be subjected to hydrostatic or pneumatic pressure during the pressure test. See 49 CFR 180.407 for the specific requirements for the above-listed test and inspections.

Upon satisfactory completion of the test/inspection events, the tester must place a legend denoting the month/year of the test followed with the letter signifying the type of test performed (e.g. 6/18 P for a pressure test performed during June 2018). This legend must be permanently affixed near the tank specification plate or anywhere on the front head in characters no less than 1¹/₄ inches (32 mm) in height. A legend is not required denoting the removal of the upper coupler device, but records of this event must be available for review (49 CFR 180.415).

Hydrochloric acid cargo tanks must be equipped with a legible specification plate denoting the MC or DOT specification type, the date of manufacture, the maximum allowable working pressure, cargo capacity, and other pertinent information.

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

Testing requirements in Canada are similar, see CSA B620 (12.5.2).

10. REDUCING RELEASES

10.1 GENERAL

Any unintended release of hazardous materials that occurs during transportation in the United States is required to be reported by carriers and shippers on DOT 5800.1 report forms which are recorded in a DOT database. This database is publicly available and can be queried to retrieve information on any and all incidents reported to DOT:

<https://hazmatonline.phmsa.dot.gov/IncidentReportsSearch/Welcome.aspx>.

10.2 REVIEW OF DOT 5800 DATA

CI's Transportation Issue Team frequently reviews transportation incidents involving CI mission chemicals from the DOT incident report database. The issue team reviews the data to identify cause trends and make recommendations for equipment and process improvements to enhance the safe transportation of CI mission chemicals. In particular, CI focuses on reducing incidents that can be more easily addressed by shippers. A summary of the total number of hydrochloric acid cargo tank incidents from 2014 through 2018 can be found in Figure 10.1.

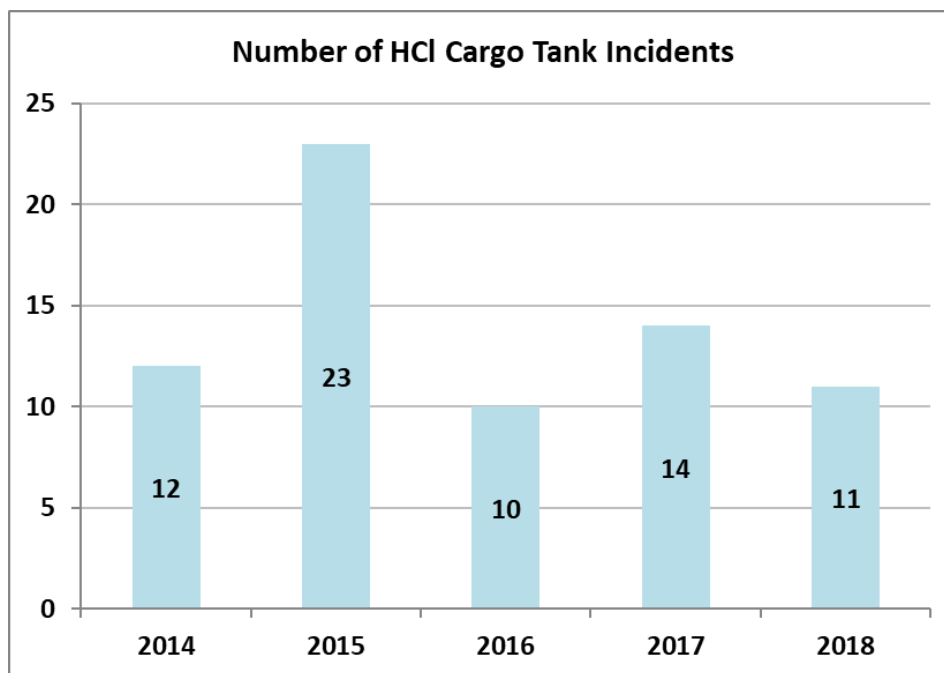


Figure 10.1 Hydrochloric Acid Cargo Tank Incidents 2014-2018

Further data on the causes and sources of hydrochloric acid cargo tank releases during 2014-2018 can be found in Figure 12.2. This chart reflects a wide range of causes and sources, most of which involve hose or connection failures and various issues with the valves and fittings, such as loose closures and damaged or defective parts. For more updated incident data, contact CI at info@cl2.com.

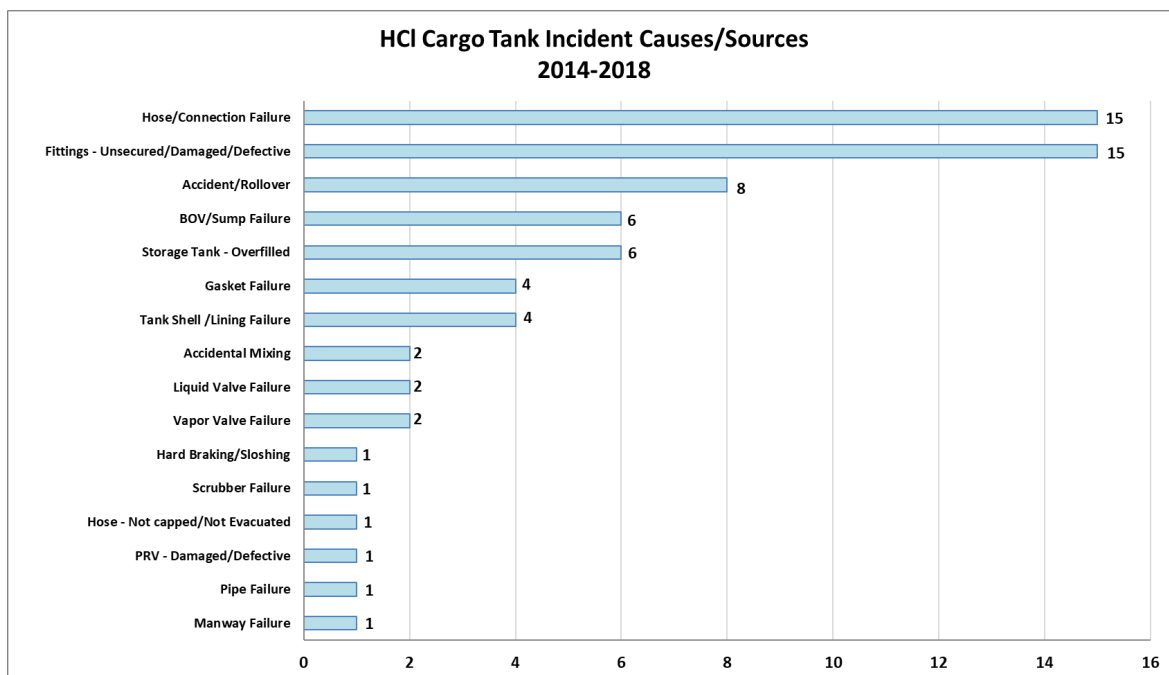


Figure 10.2 Causes/Sources of HCl Cargo Tank Releases 2014-2018

10.3 BEST PRACTICES TO REDUCE TRANSPORTATION INCIDENTS

The following are some industry best practices that CI member companies have been employing to reduce incidents. These best practices include:

- Use a formal procedure (e.g. checklist) that requires the driver and/or facility personnel to verify elements included in Section 7, *Hydrochloric Acid Cargo Tank Loading*.
- Choose the most appropriate gasket, based on the strength of HCl being transported.
- Use a reclosing pressure relief device of appropriate materials of construction instead of non-reclosing pressure relief device (i.e., rupture discs). A reclosing pressure relief device will reclose after relieving excess pressure within the cargo tank. In addition, a reclosing pressure relief device will eliminate certain aspects of human error, such as using a rupture disc incompatible with the HCl, using a rupture disc with an incorrect burst (rupture) pressure, or improper installation.
- Ensure the proper orientation of a rupture disc in a non-reclosing pressure relief device and follow the Original Equipment Manufacturer (OEM) installation instructions.
- Ensure the surge suppression device is in place and not broken.
- Prior to offering the cargo tank into transportation, thoroughly inspect the non-reclosing pressure relief device assembly and both sides of the rupture disc by removing the disc from the holder.
- Ensuring all fittings, including the PRD, valves, closures, fasteners, washers and gaskets, are in good condition, properly secured, and all valves are closed prior to offering the cargo tank into transportation.
- Conducting a post-load or post-unload leak check to inspect for leakage of vapor or liquid at loading/unloading lines and top loading hatch.
- Ensuring sufficient outage when loading a cargo tank.
- As a receiver, inspect the hoses used to unload HCl.
- Ensure sufficient capacity in the receiving storage tank when unloading a cargo tank.
- Verify and re-verify that the receiving tank being filled is the same product being unloaded from the cargo tank. **NOTE:** If the receiving tank does not have appropriate product labels, it is recommended that product delivery does not take place. Accidental mixing of incompatible products can result in a serious incident that potentially involves injuries.

11. EMERGENCY RESPONSE

11.1 GENERAL

All facilities handling hydrochloric acid should maintain an emergency response plan to address potential releases. The plan should include an emergency contact system to notify local, state, provincial and federal authorities, site evacuation and control plans, and medical support preplanning. The Institute also provides specific recommendations concerning emergency response plans in CI Pamphlet 64 (12.1). This section provides additional recommendations of an HCl emergency response plan.

11.2 EMERGENCY PLANNING AND TRAINING

11.2.1 General

All personnel responsible for transfer operations should be completely familiar with the site emergency plan for handling spills and leaks of product. Refer to Section 11.2.2. for training recommendations. Each site should have proper emergency response equipment immediately accessible to help limit the size and consequences of an incident (see Section 11.3).

A facility's emergency contingency plans should be current and in place for all areas of hydrochloric acid handling and transportation. These plans should identify hazards and include systems for accident/incident prevention, and mechanisms for minimizing loss and damage resulting from accidents/incidents. Copies of the plan should be on file as required by regulation. Registration with the American Chemistry Council is necessary if notification of CHEMTREC is part of the emergency plan. Refer to Section 3.2 for Risk Management Plan (RMP) applicability.

In Canada, an Emergency Response Assistance Plan (ERAP) registered with Transport Canada is required for shipment or import of hydrochloric acid in quantities that exceed the limits referred to in Schedule 1 of the Transportation of Dangerous Goods (TDG) Regulations. Part 7 of the TDG Regulations specifically details the requirements and approval process for an ERAP.

11.2.2 Training

Personnel responding to HCl emergencies, should as a minimum, review the following regulations and standards concerning level of training for emergency response personnel:

- OSHA HAZWOPER Standard, 29 CFR 1910.120
- OSHA PPE and respiratory protection standard, 29 CFR 1014.134
- NFPA Standard 472, Chapter 6, Specialist Employee Category

All responding personnel should be persons with experience and detailed knowledge of HCl properties and safe handling. All should review the following at regular intervals:

- Use of leak-mitigation techniques;
- Use of respiratory protection and chemical protective suits; and
- Use of other emergency equipment potentially used at the incident scene.

Drills are strongly recommended to check awareness of emergency procedures. It is also recommended that local fire responders and hazmat teams participate in drills with local emergency responders and in conjunction with the local emergency planning committees.

11.3 EMERGENCY EQUIPMENT

11.3.1 Special Equipment

Specialized emergency equipment may be necessary depending on the severity of the incident. Sites should consider the following when evaluating their equipment for suitability in an HCl emergency:

1. Equipment suitable for test pressures up to 200 psig
2. Equipment suitable for high or low ambient temperatures, particularly when working with plastics susceptible to brittle fracture at cold temperatures.

Each site should develop a list of additional equipment needed to handle an HCl emergency, including:

- Personal Protective Equipment
- Valves, gauges, piping, hoses, bolts, fittings, etc. capping kits, banding, patching equipment
- Pumps
- Scrubbing equipment
- Temperature measuring equipment
- Pressure measuring equipment
- HCl exposure monitoring equipment

The following is a sample list of special equipment a facility may consider keeping on hand for emergency response purposes (not intended to be an all-inclusive or exhaustive list):

Satellite telephone	2-way Radios
Air monitoring equipment, multi meter or colorimetric tubes	Zip Patches, various wooden plugs and rubber bungs.
Spill Containment tray/pool/pail/ hammock, leak diverter funnel & tarp	Magnetic Patching
Hydrochloric Acid Transferring Fittings Kit: CPVC, FRP, or Polypropylene, rated for 200psi. Elbows and extra isolation valves.	Portable Air Compressor, c/w air hoses
PVC Dip Tubes, in threaded 3' lengths	Garden hoses for wash down
2" Chemical Transfer Hoses	pH test kit
2" Diaphragm Pump, compatible diaphragm	Alkaline material such as soda ash or ag lime
1" Diaphragm pump	Plastic drums with lids
Centrifugal pump (gas), Ryton® or compatible casing	Additional compatible camlock fittings such as polypropylene, PVC, or FRP
2" Peristaltic Pump (gas), Teflon tube	Truck Fittings Kit, "T"s, elbows, male/female camlocks, extra isolation valves and blowback fittings
1" Jet Pump, CPVC	Flares and road markers
Diaphragm gauges to 200 psi	Conductivity meter
HCl eductor/ sparger system	SCBA, dependent on vapor cloud
1" Transfer Hoses, for eductor	"Vetter" Leak Sealing device (optional)

11.3.2 PPE

Emergency personnel should wear respiratory protection appropriate for the spill size and environment. This includes protective clothing, as well as either a full-face air purifying respirator or a self-contained breathing apparatus. Some releases could even require the use of totally encapsulating (Level A) chemical protective suits. Refer to CI Pamphlet 65 for more details (14.1).

The following PPE is recommended to be readily available in responders' PPE kit bags for an HCL emergency:

- Compatible chemical suit (Level A or B) (rubber, PVC, or Gore-Tex).
- HCl compatible boots and gloves.
- Hard hat.
- Safety glasses, chemical goggles, and face shield.
- Full or half-face respirator with approved acid gas/organic vapor cartridge.

11.3.3 Related Published Materials

The following list of HCl related literature should be made available to personnel at the emergency scene:

1. Supplier's HCl Safety Data Sheet (SDS)
2. HCl Medical Management Guideline for Acute Chemical Exposure – produced by U.S. Department of health, ATSDR.
3. CI Pamphlet 65
4. CI Pamphlet 150 (this pamphlet)
5. CI's Hydrochloric Acid Release Fact Sheet

11.4 ACTION AT THE EMERGENCY

11.4.1 Initial Action

The emergency response team leader must work with the Incident Commander to make an immediate appraisal of the situation. Initial action should involve discussions with other concerned personnel, including government agencies, to provide expertise in handling the emergency, e.g. preventing damage to the container during abnormal handling.

The team leader must establish whether or not an HCl leak is present, determine its severity, and evaluate whether or not a leak may develop. Some leaks of HCl are visible depending on acid strength and environmental conditions. Small leaks may be located by a number of methods, but most often by visual or odor detection. Vapor from a 5-30% aqua ammonia (10.3 – 61.7% ammonium hydroxide solution) will develop a dense white vapor upon exposure to even a small amount of HCl. Do not apply aqua ammonia liquid directly to the leaking equipment as this might increase corrosion. Moist pH paper, litmus paper and detector tubes will also indicate leaks. Detector tubes have an advantage in that they may indicate concentrations.

At first indication of a leak in transit the cargo tank must be isolated. The vehicle should be pulled off the road and the cargo tank moved to a safe location. The driver should ascertain the problem from a safe distance and take appropriate actions. If help is required, the emergency plan should be activated. Written procedures or instructions from the emergency response guidebook should be followed. Telephone numbers for the hydrochloric acid supplier and CHEMTREC or CANUTEC should be included in the emergency plan. Where possible, the driver should stay on the scene to assist emergency response personnel in assessing the severity of the incident for determination of the need for response action.

When a leak is present, the use of a finely divided water spray, like that from a fog nozzle, can be employed to reduce downwind concentration of HCl vapor. Care should be taken not to spray water directly at the point of the leak. Water run-off must be contained and properly disposed of. If a leak is in the piping system, the first response should be to stop the flow of liquid. Diverting the leaking product to a scrubbing medium such as water will minimize the amount of HCl released to the environment.

All surfaces that come in contact with the HCl liquid or fumes must be decontaminated as quickly as possible to prevent exposure to personnel and/or corrosion of equipment. Clean-up personnel should wear personal protective equipment possibly including respiratory protection. Refer to CI Pamphlet 65 for more details (12.1).

11.4.2 Damage Assessment

A good damage assessment is very important as it should determine how the damaged cargo tank will be handled. An appropriate cargo tank damage assessment expert should get to the scene as early as possible. Damage assessment experts and product specialists will closely examine the tank for dents, cracking, gouges, loss of lining integrity, and other damage to determine what course of action can be taken.

The damage assessment will help determine:

- Is the cargo tank safe to be lifted or moved to another location in the incident area?
- Is the cargo tank damage sufficient enough to be concerned about vessel integrity? This will most likely then require a transload.
- Can the cargo tank be safely moved to another HCl producer or consumer location or nearby industrial facility for unloading or controlled venting?
- When applicable, response actions must be expedited if lining integrity is compromised.

NOTE: Damaged and/or leaking cargo tanks may be moved in an emergency under certain conditions to ensure public safety. See 49 CFR 177.823 for details (12.2).

11.4.3 Mitigation Methods

An effort should be made to identify the leak source and evaluate methods to stop or minimize the leak. Temporary methods may be used until a permanent solution is found. This will minimize the amount of product released to the environment. If water is used for vapor mitigation the liquid will be acidic and must be contained. The following includes suggested mitigation techniques.

1. Hole in tank (vapor space leak)

- a. Patch or plug hole, if this can be done safely (various style and sizes of magnetic patches have been used successfully).
- b. Consider scrubbing vapors, if the hole cannot be patched or plugged safely or if pressure reduction is beneficial.
- c. Determine how to handle cargo tank after patching/plugging.

NOTE: Special considerations may be needed for FRP tanks. Caution should be given when strapping a patch. Magnetic patches will not be effective on FRP tanks.

2. Hole in tank (liquid leak) – **NOTE:** The leaking tank may be under partial vacuum, and, therefore, opening one of the tank's valves could equalize pressure inside and outside the tank leading to an increase in the leak rate.

- a. Set up containment, if possible.
- b. Consider locating an empty vessel for transferring contents.
- c. Estimate the amount of product remaining in the tank.
- d. Patch or plug hole, if this can be done safely (various style and sizes of magnetic patches have been used successfully).
- e. Determine how to handle the cargo tank after patching/plugging – likely a field transfer may need to occur.

NOTE: Special considerations may be needed for FRP tanks. Caution should be given when strapping a patch. Magnetic patches will not be effective on FRP tanks.

3. Valve and Fittings Leaks (through the flange)

- a. Determine location of leak. Vent any accumulated pressure to stop the leak. Consider the need for vapor management.
- b. Visually inspect flanges and bolts.
- c. Tighten flange bolts.
- d. Inspect for leak.
- e. Retighten flange bolts, if necessary.
- f. If still leaking,
 - i. Replace the leaking component and/or gasket.
 - ii. Determine if epoxy, lead wool, or a magnetic patch can be used to stop the leak.

4. Valve Leak (through the valve)

- a. Cycle the valve to clean the sealing surface.
- b. Check for leak and install or replace blind flange and gasket, if present or necessary.
- c. Move cargo tank to secure location.
- d. Reduce pressure in the cargo tank by vapor scrubbing, etc.

5. Pressure Relief Device Leak – A leaking PRD that has vented/leaking is typically an indication that either the cargo tank over pressured and relieved through the PRD, experienced liquid momentum surge, or the device has been compromised and not sealing correctly.

- a. Replace PRD, if damaged and/or not operating as designed
- b. Consider the need for vapor management

6. Damaged but not leaking

- a. Determine the internal tank pressure and volume of contents, if possible
- b. Determine if the cargo tank can be safely moved. If the cargo tank must be handled in place, evaluate options to reduce the pressure and/or transload.

7. Fire in Transit

In the event of a fire, the vehicle should be removed from the fire zone immediately, if it can be done without undue risk. If it cannot be moved the driver should advise the emergency response personnel that the container should be kept cool by applying water to the cargo tank, however, the product itself will not burn.

8. Collision

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

11.5 TRANSLOADING

An empty HCl cargo tank will be required at the incident scene. Transfer of the liquid product contained in the cargo tank can be accomplished by either pumping the HCl from the damaged tank or by using air to 'pad' the contents of the damaged tank into the receiving tank. A thorough damage assessment must be completed prior to attempting a pressure transfer of product from a damaged cargo tank. Related scrubbing and neutralization guidance can be found in Section 11.6. Consult the shipper for transloading operations.

Key points to remember for transloading:

- 1. Be sure materials of construction of the transloading equipment are compatible with the chemicals being handled.
- 2. Understand the acceptable temperature ranges and chemical compatibility for gaskets and materials used.

3. Be sure to secure and stabilize all equipment prior to transloading.
4. If scrubbing into water, remember that the water is becoming acidic.
5. Remember that a significant temperature rise will occur in the neutralizing or scrubbing solution.
6. Ensure adequate neutralizing/scrubbing medium is available. Ensure adequate neutralizing chemical is available in the solution, if used.
7. Consider sampling and analyzing the neutralizing/scrubbing solution to determine the concentration of the remaining neutralizing media.
8. Ensure there is the capability to purge and clear transfer lines once transloading is complete.

11.6 SCRUBBING HCL IN THE FIELD

The need to scrub HCl vapor from the cargo tank may be needed when:

1. Cargo tank movement is delayed and cargo tank has major damage or is leaking.
2. Making a field transfer of HCl to another container.

HCl vapors can be readily scrubbed using water or a mildly alkaline solution made from lime, soda ash or caustic soda; a minimum of 150 gallons of water or solution should be on hand. An existing process scrubber (within the plant) or a temporary scrubber (in the field) may be utilized or. Depending on the type of leak and if the cargo tank is located within a plant, the user may be able to use the product in their normal process, which will minimize the amount of product that will require treatment.

Consult the shipper if use of an alkaline solution is being considered. Some complications, such as salt buildup, may cause other issues. Compatible hose or piping can be used to direct the fumes from the cargo tank into the water or solution; having a diffuser or a sparger in the drum will provide good contact between the HCl and water and improved scrubber efficiency. The following precautions need to be considered when scrubbing HCl vapors:

1. Be aware that a high flow rate of HCl vapor to the scrubber may go through the scrubber to the atmosphere.
2. Be aware that scrubbing HCl vapors in water or an alkaline solution will generate heat as the HCl is absorbed in the liquid medium; this may result in the scrubbing vessel becoming hot to the touch, etc.

Table 11.1 below provides quantities of commonly used alkaline chemicals needed for neutralizing HCl based on laboratory conditions and perfect mixing. Excess quantities are recommended to achieve complete neutralization during a response.

Table 11.1
Quantities of Various Alkaline Materials Required to
Neutralize 100 Gallons of Hydrochloric Acid

Hydrochloric Acid			Neutralizing Chemicals						
Acid Concen- -tration Wt.% HCl	Specific Gravity Solution	Actual Pounds of Acid per 100 Gals.	CaO Quicklime Lbs.	Ca(OH) ₂ Lime Lbs.	Na ₂ CO ₃ Anhydrous Soda Ash Lbs.	50% NaOH Liquid Caustic Soda Lbs.	NaOH Flake Caustic Soda Lbs.	45% KOH Liquid Caustic Potash Lbs.	50% KOH Liquid Caustic Potash Lbs.
0.1	USE 1.000	.837	.644	.852	1.27	1.836	.918	2.86	2.58
0.2	USE 1.000	1.674	1.28	1.70	2.54	3.672	1.836	5.72	5.15
0.3	USE 1.000	2.511	1.93	2.52	3.81	5.50	2.75	8.59	7.73
0.4	USE 1.000	3.35	2.58	3.41	5.08	7.34	3.67	11.46	10.31
0.5	USE 1.0015	4.19	3.19	4.22	6.35	9.18	4.59	14.33	12.90
0.6	USE 1.0015	5.02	3.86	5.11	7.62	11.02	5.51	17.17	15.45
0.7	USE 1.0015	5.86	4.51	5.93	8.89	12.86	6.43	20.04	18.03
0.8	USE 1.0015	6.70	5.15	6.82	10.16	14.68	7.34	22.91	20.62
0.9	USE 1.0015	7.53	5.79	7.63	11.43	16.52	8.26	25.75	23.17
1.0	1.0032	8.37	6.44	8.52	12.7	18.36	9.18	28.62	25.76
2.0	1.0082	16.83	12.94	17.12	24.6	36.96	18.48	57.55	51.80
3.0	1.0131	25.41	19.54	25.79	37.0	55.70	27.85	86.89	78.20
4.0	1.0181	33.99	26.14	34.53	49.3	74.4	37.2	116.23	104.61
5.0	1.0230	42.73	32.86	43.42	62.0	93.6	46.8	146.12	131.50
6.0	1.0279	51.47	39.56	52.31	74.6	112.8	56.4	176.00	158.40
10.0	1.0474	87.41	67.22	88.92	126.8	191.4	95.7	298.90	269.01
20.0	1.0980	183.3	141	186	267	402	201	626.80	564.12
25.0	1.1261	234.8	179	237	339	512	256	802.90	722.61
30.0	1.1526	288.4	221	293	419	632	316	986.19	887.57
35.0	1.1778	343.8	264	348	498	752	376	1175.63	1058.07

11.7 CHEMTREC AND CANUTEC

For transportation related incidents in the U.S., one should utilize CHEMTREC, the Chemical Transportation Emergency Center in Falls Church, VA as the dispatch agency. CHEMTREC operates around-the-clock, 24 hours a day, seven days a week to receive toll-free calls from any point in the continental United States and Canada at 1-800-424-9300 (outside the United States and Canada call 703-527-3887; collect calls are accepted). CHEMTREC provides immediate advice for those at the scene of emergencies, and then promptly contacts the shipper and others as required. Registration with CHEMTREC is provided through the American Chemistry Council.

In Canada, CANUTEC, the Canadian Transport Emergency Centre in Ottawa should be used as the dispatch agency. The telephone number is 1-888-226-8832 or 613-996-6666 (call collect). CANUTEC, administered by Transport Canada, operates in a similar manner to CHEMTREC.

11.8 REPORTING OF INCIDENTS AND RELEASES

11.8.1 Federal Reporting Requirements

Hydrochloric acid is identified as a hazardous substance 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 (RQ). The reportable quantity of hydrochloric acid is currently 5,000 pounds (2270 Kg) on a 100% hydrochloric acid basis. For example, a 20° Baumé (31.45%) solution reportable quantity release would be approximately 15,900 pounds or 1,650 gallons of solution. A 22° Baumé (35.21%) solution reportable quantity release would be approximately 14,200 pounds or 1,480 gallons of solution.

Should the reportable release occur in the U.S., the law requires these agencies be notified:

1. National Response Center 1-800-424-8802
2. State Emergency Response Commission/Agency
3. Local Emergency Planning Committee

The U.S. DOT requires an immediate notification by telephone of certain hazardous materials transportation incidents (49 CFR 171.15) and a written report using DOT Form F 5800.1 for certain incidents including all those requiring an immediate notification (49 CFR 171.16) (14.2). See Section 12 for additional details on incidents reported to DOT.

In Canada, if a release exceeds five kilograms or five liters from a means of containment, the person in possession of the dangerous goods at the time of the release must make an immediate report to:

- a. the appropriate provincial authority;
- b. the person's employer;
- c. the consignor of the dangerous goods;
- d. for a road vehicle, the owner, lessee or charterer of the road vehicle.

Refer to Part 8 (8.1 Section 5) of the TDG Regulations for a table of the appropriate provincial authorities

In most cases, the initial report will be by telephone for expediency with a follow-up written report. It is suggested that the following information be given during the telephone report:

- a. Name of company involved
- b. Name of caller
- c. Release location
- d. Chemical released (Shipping name and UN Number)

- e. A description of the means of containment
- f. Date, time and duration of release
- g. Release quantity estimate
- h. Information as to whether or not the release is continuing or has stopped
- i. The medium or media into which the release occurred (air, water, land)
- j. Any known or anticipated acute or chronic health risks associated with the emergency and, where appropriate, advice regarding medical attention for exposed individuals. Health Hazard Data and First Aid information from the current hydrochloric acid SDS may be utilized
- k. Precautions taken as a result of the release, including evacuation/sheltering
- l. Wind speed and direction, and
- m. Name and telephone number of person to contact for further information.

If any agency notified has emergency response capabilities and/or responsibilities, they should also be informed of any assistance needed. A written follow-up emergency notice is required after a release. This document should:

- a. Set forth and update the verbal information given previously
- b. Discuss actions taken to respond to and contain the release
- c. Discuss any known or anticipated acute or chronic health risks associated with release
- d. Where appropriate, give advice regarding medical attention for exposed individuals

It is suggested, but not required, that the final report list the cause and corrective actions, with a timetable if appropriate. If the report is mailed, it is recommended to be sent by certified mail, return receipt requested.

For Canadian follow-up reporting requirements, refer to Part 8 (Section 8.3) of the Transportation of Dangerous Goods Regulations.

11.8.2 State Reporting Requirements

State reporting requirements vary, but usually include the State Emergency Response Commission/Agency. Immediate notification is usually required as follows:

- 1. State environmental department or environmentally responsible agency. This may be more than one agency.
- 2. State police.

11.8.3 Local Reporting Requirements

In addition to reporting immediately to the Local Emergency Planning Committee, notification may be required to the following:

1. Town or city leadership
2. Local police or sheriff
3. Local fire department(s)
4. Local health department

12. REFERENCES

12.1 CHLORINE INSTITUTE REFERENCES

The following publications are specifically referenced in CI Pamphlet #. The latest editions of CI publications may be obtained at:

<http://www.chlorineinstitute.org/>.

<u>Pamphlet & VIDEO #</u>	<u>Title</u>
64	<i>Emergency Response Plans for Chlor-Alkali, Sodium Hypochlorite, and Hydrogen Chloride Facilities</i> ; ed. 8; Pamphlet 64; The Chlorine Institute: Arlington, VA, 2020 .
65	<i>Personal Protective Equipment for Chlor-Alkali Chemicals</i> ; ed. 6; Pamphlet 65; The Chlorine Institute: Arlington, VA, 2015 .
98	<i>Recommended Practices for Handling Hydrochloric Acid in Tank Cars</i> , ed. 5; Pamphlet 98; The Chlorine Institute: Arlington, VA, 2019 .
163	<i>Hydrochloric Acid Storage and Piping Systems</i> , ed. 4; Pamphlet 163; The Chlorine Institute: Arlington, VA, 2017 .
ACCIMIX-VIDEO	<i>Accidental Mixing Video</i> , ed. 1; ACCIMIX-VIDEO; The Chlorine Institute: Arlington, VA, 2018 .
HCL-VIDEO	<i>Handling Hydrochloric Acid Safely</i> ; ed. 2; HCL-VIDEO; The Chlorine Institute: Arlington, VA, 2015 .

12.2 DOT REGULATIONS

- 12.2.1 *Code of Federal Regulations*. Title 49. Parts 100-199 (49 CFR). Office of the Federal Register National Archives and Records Administration. U.S. Government Printing Ofc: Washington, DC, (revised annually). Website: <http://www.gpoaccess.gov/cfr/index.html>.
- 12.2.2 *Emergency Response Guidebook (ERG2012)*. Pipeline and Hazardous Materials Safety Administration. U.S. Department of Transportation: Washington, DC, (revised every four years).

12.3 EPA REGULATIONS

- 12.3.1 *Code of Federal Regulations*. Title 40. Part 150 (29 CFR). Office of the Federal Register National Archives and Records Administration. U.S. Government Printing Office: Washington, DC, (revised annually).

12.4 OSHA REGULATIONS

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

12.5 TC REGULATIONS

- 12.5.1 *Guide to Canadian Transportation of Dangerous Goods Act and Regulations*, mini version; ICC International Compliance Center Ltd: Mississauga, Ontario, (revised periodically).
- 12.5.2 *Highway Tanks and Portable Tanks for the Transportation of Dangerous Goods*; CSA B620; Canadian Standards Association: Toronto, Ontario, (revised periodically).
- 12.5.3 *Selection and Use of Highway Tanks, Portable Tanks, Cargo Compartments and Containers for the Transportation of Dangerous Goods*; CSA B621; Canadian Standards Association: Toronto, Ontario, (revised annually).

12.6 ENVIRONMENT CANADA

- 12.6.1 *Implementation Guidelines for the Environmental Emergency Regulations*, Environment Canada 2011.

12.7 OTHER PUBLICATIONS

- 12.7.1 *Tank Trailer and Tank Container Nomenclature - TTMA Recommended Practice RP No. 36*. Available from Truck Trailer Manufacturers Association, 7001 Heritage Village Plaza, Suite 220, Gainesville, VA 20155

13. TRAINING AIDS

In addition to the references cited in Section 12, the following list is meant to help the reader.

13.1 AUDIO VISUAL PROGRAMS

13.1.1 Lending Library of Audio Visual Training Programs. National Chemical Response and Information Center of the American Chemistry Council, 700 2nd St., NE, Washington, DC.

13.1.2 *HazMat Training Program*. American Trucking Association: Arlington, VA.

13.2 DRIVER TRAINING AIDS

Materials	Sources/Examples
SDS	Major supplier's SDS
Cargo tank handling	FLI Learning Systems (Princeton, NJ)
Personal protective equipment	CMA Technical Bulletin (10/85)
Driver's Booklet - FMCSR Parts 383, 387 and 390-397	J.J. Keller (Neenah, WI)
Driver's Pocket Guide to Hazardous Materials	J.J. Keller (Neenah, WI)
DOT Emergency Response Guidebook DOT P-5800.4	J.J. Keller (Neenah, WI)
OSHA Hazard Communication Program (site specific)	OSHA Standards
Defensive Driver Training/ Refresher Course #33140-0000	National Safety Council
Emergency/Contingency Plan (site specific)	OSHA Standards

For further assistance and information on items referenced, contact the following organizations:

AMERICAN CHEMISTRY COUNCIL (ACC)

700 2nd Street NE
Washington, DC 20002
Phone: 202-249-7000
www.AmericanChemistry.com

CANADIAN GENERAL STANDARDS BOARD (CGSB)

Place du Portage III, 6B1
11 Laurier Street
Gatineau, Quebec
Phone: 800-655-2472 or 819-956-0425
<http://www.tpsgc-pwgsc.gc.ca/ongc-cgsb/index-eng.html>

CANADIAN STANDARDS ASSOCIATION (CSA)

5060 Spectrum Way, Suite 100
Mississauga, Ontario
L4W 5N6 CANADA
Phone (Sales): 416-747-4044
www.csa.ca

THE CHLORINE INSTITUTE (CI)

1300 Wilson Blvd., Suite 525
Arlington, VA 22209
Phone: 703-894-4140
www.chlorineinstitute.org

ENVIRONMENTAL EMERGENCIES PROGRAM

Environment Canada
351 St. Joseph Boulevard
Gatineau, Quebec, K1A 0H3
Phone: 1-800-668-6767
E-mail: CEPAE2-LCPEUEqc@ec.gc.ca
<https://cepae2-lcpeue.ec.gc.ca>

GOVERNMENT OF CANADA PUBLICATIONS

Publishing and Depository Services
Public Works and Government Services
Ottawa, Ontario K1A 0S5 (Canada)
Phone: 1-800-635-7943
<http://publications.gc.ca>

ICC INTERNATIONAL COMPLIANCE CENTER, INC.

205 Matheson Boulevard E
Mississauga, Ontario
L4Z 1X8 C
Phone (Canada): 888-977-4834
Phone (U.S.): 888-442-9628
www.thecompliancecenter.com

NATIONAL TANK TRUCK CARRIERS, INC.

950 North Glebe Road, Suite #520
Arlington, VA 22203-4183
Phone: 703-838-1960
<http://www.tanktruck.org/>

OFFICE OF THE FEDERAL REGISTER (OFR)

The National Archives and Records
Administration
8601 Adelphi Road
College Park, MD 20740-6001
Phone: 1-866-272-6272
<http://www.archives.gov/federal-register/>

SUPERINTENDENT OF DOCUMENTS

Government Printing Office
732 North Capitol Street, NW
Washington, DC 20401
Phone (Sales): 202-512-1800
<https://www.gpo.gov/>

TRANSPORT CANADA

330 Sparks Street
Ottawa, ON K1A 0N5
Phone (Toll Free): 866-996-9737
Phone (Direct): 613-990-2309
www.tc.gc.ca

APPENDIX A – DATA SHEET

This information provides basic chemical properties and other information based on industry-wide data for the reader's general understanding of the product. Because of the variances in production and shipment methods throughout industry, this information may not necessarily reflect the specific chemical information included in a particular company's product Safety Data Sheet (SDS). Consult your supplier to request an SDS for their product specific information and considerations.

IDENTIFICATION:

Chemical Name: hydrogen chloride solution **Chemical Formula:** HCl
Trade Name: hydrochloric acid **Molecular Weight:** 36.465
Synonyms: chlorohydric acid, muriatic acid

CHEMICAL AND PHYSICAL CHARACTERISTICS:

	20° Bé	22° Bé	23° Bé
Boiling Point	178°F - 183°F 81°C - 84°C	142°F - 146°F 61°C - 63°C	118°F - 125°F 48°C - 52°C
Freezing Point	-49°F -45°C	-26°F -32°C	-17°F -27°C
Vapor Pressure mmHg @ 20°C	25	76	150
Specific Gravity 15.5°C	1.1600	1.1789	1.1885

Solubility in Water: Infinite

Appearance: Colorless to yellowish, clear liquid

Odor: A pungent, suffocating odor

FIRE AND EXPLOSION HAZARDS:

Flash Point: None

Flammable Limits: LFL: N/A; UFL: N/A

Fire and Explosion Hazards: Hydrochloric acid itself is nonflammable. However, a latent fire or explosion hazard exists due to hydrogen gas generation when acid is in contact with metals.

REACTIVITY AND COMPATIBILITY:

Stability (conditions to avoid): Contact with metals may cause generation of flammable concentrations of hydrogen gas.

Incompatibility (materials to avoid): Hydrochloric acid will react rapidly, and sometimes violently, with metal oxides, some organic compounds and alkaline materials (i.e. caustic soda). Also, poison gas can be generated by reaction with hypochlorites, sulfides and cyanides.

Hazardous Decomposition Products: None.

Hazardous Polymerization: Will not occur.

HEALTH HAZARDS:

Eye: May cause pain, lachrymation (tears), and severe irritation with corneal injury which may result in permanent impairment of vision, even blindness.

Skin Contact: Short single exposure may cause severe skin burns.

Ingestion: Ingestion may cause gastrointestinal irritation or ulceration and severe burns to the mouth and throat.

Inhalation: Excessive vapor concentrations are readily attainable and may cause serious adverse effects, even death. Excessive exposure may cause severe irritation and injury to mucous membranes (nose and throat) and lungs.

Systemic and Other Effects: Repeated or prolonged exposure may cause erosion of teeth and bleeding and ulceration of nose, mouth, and gums.

HANDLING AND STORAGE PRECAUTIONS:

Exposure Guidelines: ACGIH TLV and OSHA PEL are 5 ppm ceiling.

Ventilation: Control airborne concentrations below the exposure guidelines. Local exhaust ventilation may be necessary for some operations.

Respiratory Protection: When airborne exposure guidelines and/or comfort levels may be exceeded, use an approved air-purifying respirator. For emergency and other conditions where the exposure guideline may be greatly exceeded, use an approved positive-pressure self-contained breathing apparatus.

Skin Protection: Use protective clothing impervious to acids. Selection of specific items such as acid impervious gloves, coats, pants, boots, aprons, or full-body suits will depend on operations to be performed. Launder contaminated clothing before reuse. Dispose of contaminated leather articles. Safety shower should be located in immediate work area.

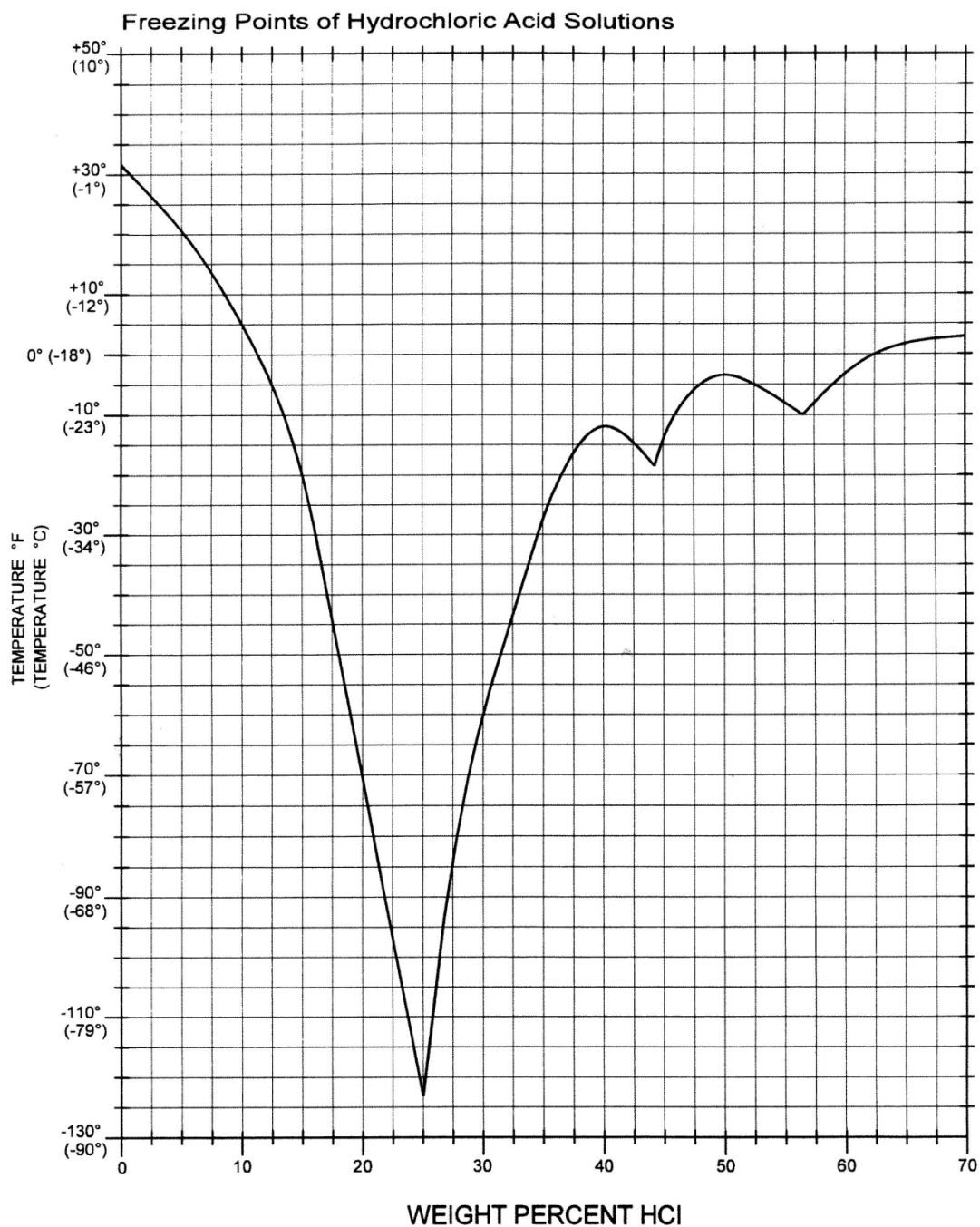
Eye Protection: Use chemical goggles. If vapor exposure causes eye irritation, use a full-face respirator. When splashes are likely, a face shield which allows use of chemical goggles, or full-face respirator should be worn to protect face and eyes. An eyewash facility should be located in the immediate work area and tested on a regular basis.

ADDITIONAL INFORMATION:

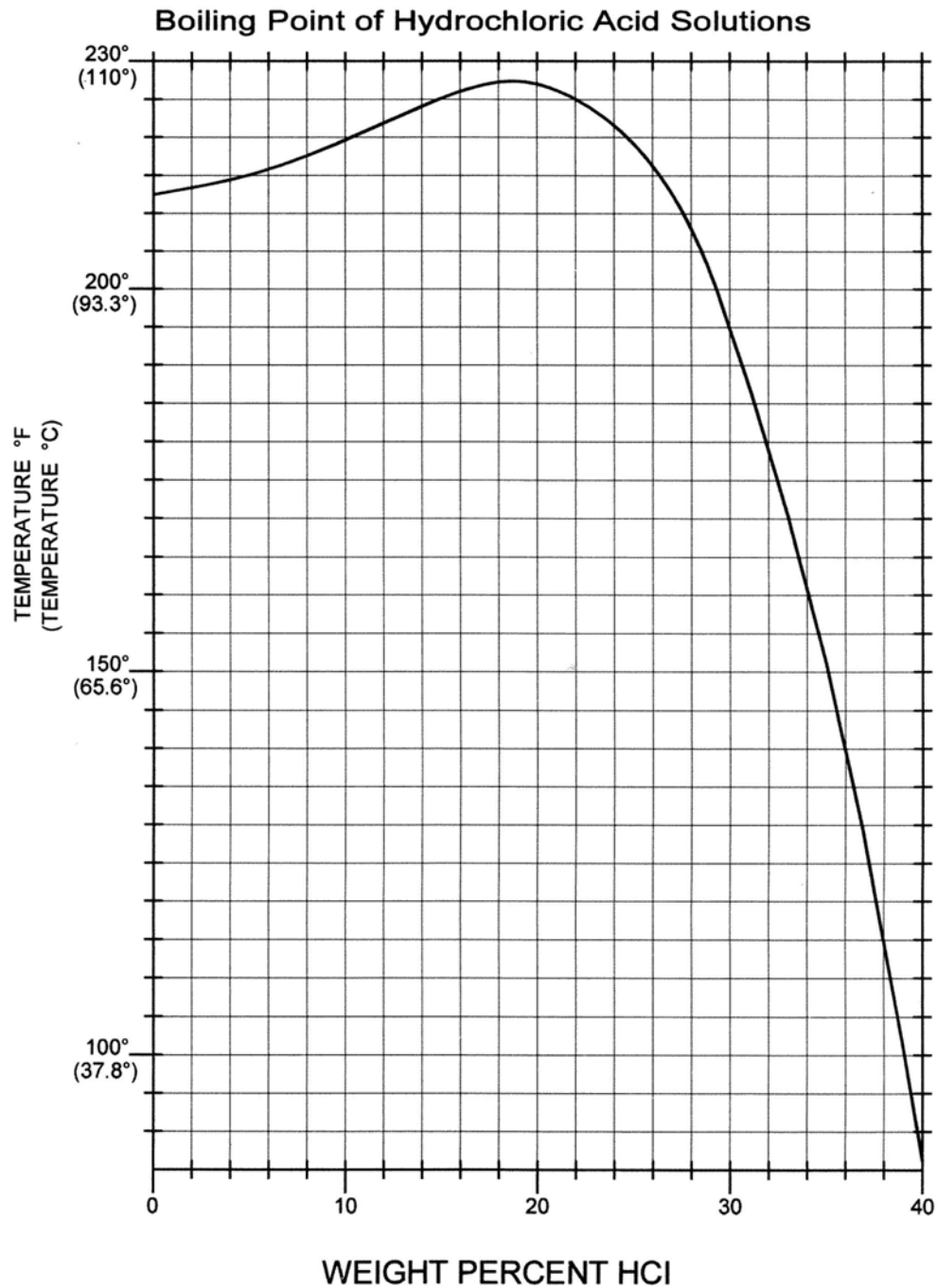
Special Precautions to be Taken in Handling and Storage: Prevent all contact with eyes and skin. Avoid breathing irritating vapors. Avoid hydrochloric acid contact with metals.

Special Precautions for Diluting Hydrochloric Acid Solutions: Always add hydrochloric acid to lukewarm (80-100°F) water.

APPENDIX B – FREEZING POINTS OF HCL SOLUTIONS



APPENDIX C – BOILING POINTS OF HCL SOLUTIONS



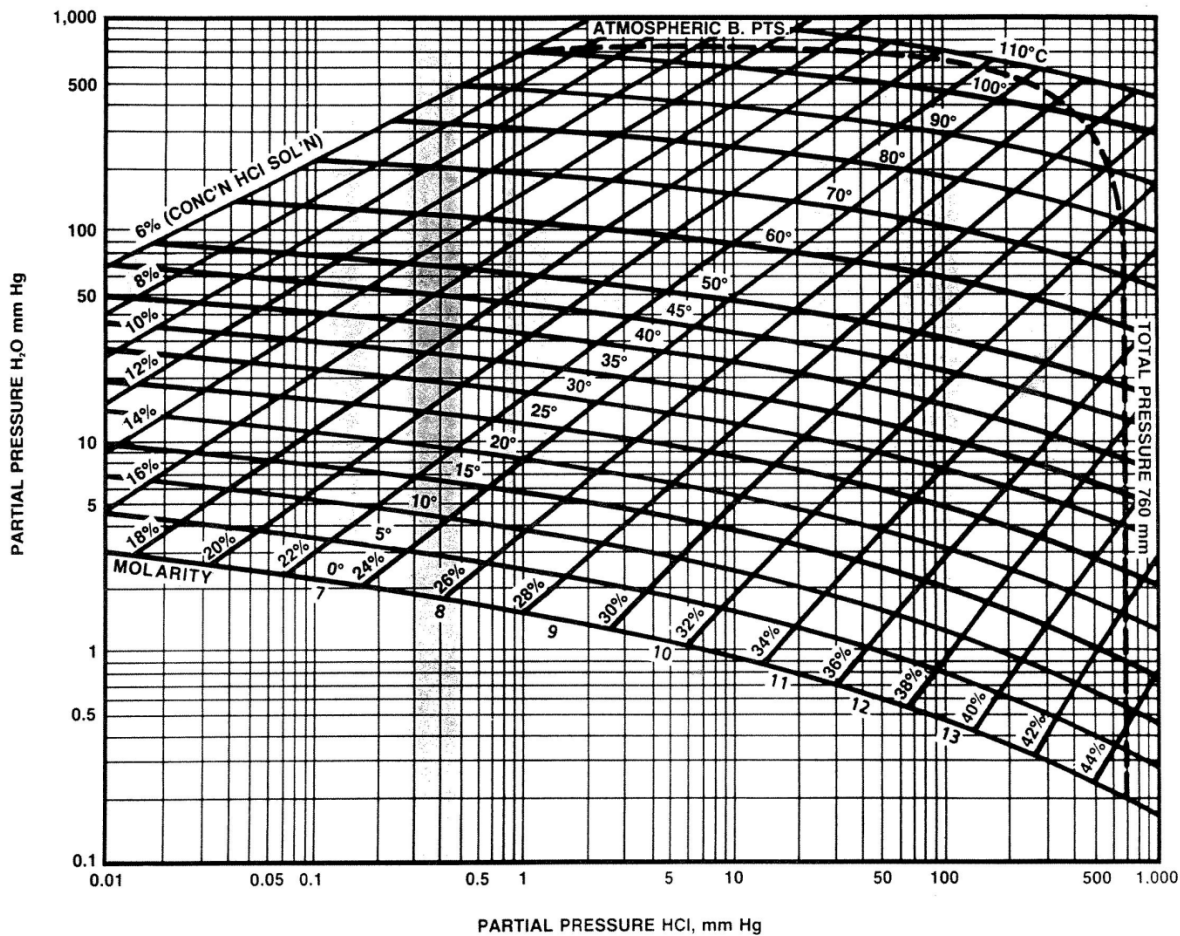
APPENDIX D – SPECIFIC GRAVITY AND DEGREES

Specific Gravity and Degrees Baumé for HCl Solutions									
Baumé for liquids heavier than water = $145 - \frac{145}{Sp.Gr.}$					Allowance for temperature:				
					At 10 to 15 Bé., 0.025 Bé., or 0.0002 sp. gr. for each F At 15 to 22 Bé., 0.033 Bé., or 0.0003 sp. gr. for each F At 22 to 26 Bé., 0.036 Bé., or 0.00035 sp. gr. for each F				
Degrees Baumé	Specific Gravity 60/60°F	Percent Hydrochloric Acid	Grams HCl Per Liter	Pounds HCl Per Gallon	Degrees Baumé	Specific Gravity 60/60°F	Percent Hydrochloric Acid	Grams HCl Per Liter	Pounds HCl Per Gallon
0.0	1.0 ¹	0.0	0.0	0.0	17.6	1.1381	27.24	310.0	2.58
0.50	1.0032 ²	1.00	10.03	0.0837	17.7	1.1390	27.41	312.0	2.60
1.00	1.0069	1.40	14.096	0.239	17.8	1.1399	27.58	314.0	2.62
2.00	1.0140	2.82	28.6	0.362	17.9	1.1508	27.75	316.0	2.64
3.00	1.0211	4.25	43.4	0.488	18.0	1.1417	27.92	319.0	2.66
4.00	1.0284	5.69	58.5	0.619	18.1	1.1426	28.09	322.0	2.68
5.00	1.0357	7.15	74.1	0.651	18.2	1.1435	28.26	324.0	2.70
5.25	1.0357	7.52	78.0	0.685	18.3	1.1444	28.44	326.0	2.72
5.50	1.0394	7.89	82.0	0.718	18.4	1.1453	28.61	329.0	2.74
5.75	1.0413	8.26	86.0	0.752	18.5	1.1462	28.78	331.0	2.76
6.00	1.0432	8.64	90.0	0.786	18.6	1.1471	28.95	333.0	2.78
6.25	1.0450	9.00	94.1	0.823	18.7	1.1480	29.13	335.0	2.80
6.50	1.0469	9.40	98.4	0.857	18.8	1.1489	29.30	338.0	2.82
6.75	1.0488	9.78	102.6	0.893	18.9	1.1498	29.48	340.0	2.84
7.00	1.0507	10.17	106.9	0.927	19.0	1.1508	29.68	342.0	2.85
7.25	1.0526	10.55	111.0	0.964	19.1	1.1517	29.83	344.0	2.87
7.50	1.0545	10.94	115.4	0.999	19.2	1.1526	30.00	347.0	2.89
7.75	1.0564	11.32	119.6	1.035	19.3	1.1535	30.18	349.0	2.91
8.00	1.0584	11.71	123.9	1.070	19.4	1.1544	30.35	352.0	2.93
8.25	1.0603	12.09	128.2	1.107	19.5	1.1554	30.53	354.0	2.95
8.50	1.0623	12.48	132.6	1.144	19.6	1.1563	30.71	356.0	2.97
8.75	1.0642	12.87	137.0	1.181	19.7	1.1572	30.90	359.0	2.99
9.00	1.0662	13.26	141.4	1.217	19.8	1.1581	31.08	361.0	3.01
9.25	1.0681	13.65	145.8	1.254	19.9	1.1590	31.27	363.0	3.03
9.50	1.0701	14.04	150.2	1.282	20.0	1.1600	31.45	365.0	3.05
9.75	1.0721	14.43	154.7	1.30	20.1	1.1609	31.64	368.0	3.07
10.00	1.0741	14.83	159.4	1.33	20.2	1.1619	31.82	370.0	3.08
10.25	1.0761	15.22	163.8	1.37	20.3	1.1628	32.02	372.0	3.10
10.50	1.0781	15.62	168.4	1.41	20.4	1.1637	32.19	375.0	3.12
10.75	1.0801	16.01	172.9	1.44	20.5	1.1647	32.38	377.0	3.14
11.00	1.0821	16.41	177.6	1.48	20.6	1.1656	32.56	379.0	3.16
11.25	1.0841	16.81	182.2	1.52	20.7	1.1666	32.75	382.0	3.18
11.50	1.0861	17.21	186.9	1.56	20.8	1.1675	32.93	384.0	3.20
11.75	1.0881	17.61	191.6	1.60	20.9	1.1684	33.12	386.0	3.22
12.00	1.0902	18.01	196.4	1.64	21.0	1.1694	33.31	389.0	3.24
12.25	1.0922	18.41	201.1	1.68	21.1	1.1703	33.50	391.0	3.26
12.50	1.0943	18.82	205.9	1.72	21.2	1.1713	33.69	394.0	3.28
12.75	1.0964	19.22	210.7	1.76	21.3	1.1722	33.88	396.0	3.30
13.00	1.0985	19.63	215.6	1.80	21.4	1.1732	34.07	399.0	3.32
13.25	1.1006	20.04	220.6	1.84	21.5	1.1741	34.26	401.0	3.34
13.50	1.1027	20.45	225.5	1.88	21.6	1.1751	34.45	403.0	3.36
13.75	1.1048	20.86	230.4	1.92	21.7	1.1760	34.64	406.0	3.38
14.00	1.1069	21.27	235.5	1.96	21.8	1.1770	34.83	408.0	3.41
14.25	1.1090	21.68	240.4	2.00	21.9	1.1779	35.02	411.0	3.43
14.50	1.1111	22.09	245.5	2.04	22.0	1.1789	35.21	414.0	3.45
14.75	1.1132	22.50	250.5	2.09	22.1	1.1798	35.40	417.0	3.48
15.00	1.1154	22.92	255.6	2.13	22.2	1.1808	35.59	420.0	3.50
15.25	1.1176	23.33	260.7	2.17	22.3	1.1817	35.78	423.0	3.53
15.50	1.1197	23.75	265.9	2.21	22.4	1.1827	35.97	426.0	3.55
15.75	1.1219	24.16	271.0	2.26	22.5	1.1836	36.16	428.0	3.57
16.00	1.1240	24.57	276.0	2.30	22.6	1.1846	36.35	431.0	3.59
16.1	1.1248	24.73	278.0	2.32	22.7	1.1856	36.54	433.0	3.61
16.2	1.1256	24.90	280.0	2.33	22.8	1.1866	36.73	436.0	3.63
16.3	1.1265	25.06	282.0	2.35	22.9	1.1875	36.93	439.0	3.66
16.4	1.1274	25.23	284.0	2.37	23.0	1.1885	37.14	442.0	3.68
16.5	1.1283	25.39	286.0	2.38	23.1	1.1895	37.36	445.0	3.71
16.6	1.1292	25.56	288.0	2.40	23.2	1.1904	37.58	448.0	3.73
16.7	1.1301	25.72	290.0	2.42	23.3	1.1914	37.80	451.0	3.76
16.8	1.1310	25.89	293.0	2.44	23.4	1.1924	38.03	454.0	3.78
16.9	1.1319	26.05	295.0	2.46	23.5	1.1934	38.26	457.0	3.81
17.0	1.1328	26.22	297.0	2.48	23.6	1.1944	38.49	460.0	3.83
17.1	1.1336	26.39	299.0	2.50	23.7	1.1953	38.72	463.0	3.86
17.2	1.1345	26.56	302.0	2.52	23.8	1.1963	38.95	466.0	3.89
17.3	1.1354	26.73	304.0	2.53	23.9	1.1973	39.18	469.0	3.91
17.4	1.1363	26.90	306.0	2.55	24.0	1.1983	39.41	472.0	3.94
17.5	1.1372	27.07	308.0	2.56					

Footnote: ¹Sp. Gr. 15°C/4°C²Sp. Gr. 20°C/4°C

APPENDIX E – VAPOR PRESSURE OF HCL SOLUTIONS

Vapor Pressure of Hydrochloric Acid Solutions



APPENDIX F – HCL INDUSTRY WARNING

Hydrochloric Acid Industry Warning

Air Pressure Unloading Into FRP Tanks

In April 1997, a 5700-gallon fiberglass reinforced plastic (FRP) storage tank containing about 4800 gallons of 31% HCl ruptured during filling, releasing the contents. OSHA and EPA completed a joint accident investigation of this incident and published the report on their Internet website:

www.epa.gov/ceppo/pubs/surpass.pdf

The cause of the failure was determined to be from overpressure of the tank at the end of the unloading process operation. The HCl trailer was being unloaded using 20 psig compressed air. The tank was overpressured due to the air surge from tank trailer at the end of the unloading and limited tank venting caused by a mostly restricted line in the scrubber.

This Industry Warning is to broadly communicate this incident and the potential for overpressuring an FRP storage tank when using air pressure unloading. Other low pressure rated tanks could be subject to the same problem. Hydrochloric acid handling sites should evaluate their storage tank, unloading, and vent systems to be sure that tanks are not exposed to pressures above their design point. Most FRP tanks are low pressure design of around 10 inches of water (about 0.4 psig) and may fail when pressured to only 4-10 psig.

During air pressure unloading, acid enters the tank and displaces the vapor in the tank to the vent scrubber system. This vent rate is low, equal to the trailer unloading rate, about 100 gpm or 13.4 cfm. As the trailer goes empty and the liquid in the line is blown clear, the vapor surge (over 1000 SCFM) will cause a rapid pressure rise in the tank, unless the vent system is sized properly. See the attached chart that estimates the pressure in the tank at various times after the liquid line is cleared as a function of the vent line size and scrubber back pressure. For a tank that is nearly full, has a 3-inch vapor line and a 2-inch unloading line, and has a minimum scrubber back pressure, the pressure in the tank will exceed the tank design (if it is 10 inches of water column) in less than one second. Sites should also recognize at the scrubber back pressure can make a large difference in the pressure on the storage tank during unloading. A typical packed column scrubber exerts very little back pressure however, venting into the bottom of a vessel below a liquid head may exert a back pressure above the tank design in routine venting operations (see details in EPA-OSHA Surpass Chemical accident Investigation).

Listed below are options for avoiding the potential overpressuring of the HCl FRP storage tank:

1. Use a pressure designed storage tank; the pressure rating should be based on the maximum potential pressure during unloading and normal operation.
2. Convert to a closed loop pump unloading operation. This uses a self-priming pump and returns the vapor from the tank to the trailer. This operation does not have the air surge at the end of the unloading.
3. Size the vent system for the large vapor surge at the end of the air unloading. Include any other pressure/vacuum relief system that you may have on the tank.

NOTE: Normal pressure/vacuum relief systems may not have high enough flow capacities to alone handle the vapor surge at the end of an air pressure unloading.

4. Minimize the air pressure used to unload the HCl trailer.
5. Restrict the flow of vapor to the storage tank by partially closing a valve as soon as the trailer goes empty.

NOTE: The industry recommends that trucks/tank cars be fully depressurized before being released back to the supplier.

6. Ensure that your vent lines to the scrubber are completely open and free from obstructions or other restrictions that could reduce vapor flow.
7. Avoid the use of a passive scrubber where the HCl vapor enters the bottom of a partially full vessel of water.
8. Measure the pressure in the tank and interlock the inlet or automatically open a vent valve to the atmosphere.
9. Do not use alkaline neutralizing agents in scrubber. Alkaline solutions can cause salt particulates to form, disturbing the performance of the scrubber. Use only water, which can then be transferred back to the storage tank, provided there are no dilution concerns.

EPA/OSHA accident Investigation recommendations included:

1. Perform hazard analysis when making changes to equipment.
2. Maintain environmental control systems to ensure reliable operation.
3. Develop standard operating procedures for unloading into a storage tank and scrubber maintenance.
4. Reevaluate the EPA's RMP rule for HCl solutions greater than 30% (currently only applies to solutions greater than 37% HCl).

If you have questions about this incident or recommendations on unloading facilities and practices, please contact your HCl supplier.

Modeling of Pressure in a HCl tank at the End of Air Pad Unloading						
Time after Unloading (seconds)	Tank Pressure (psig) 2-inch Water Column Scrubber Back Pressure			Tank Pressure (psig) 16-inch Water Column Scrubber Back Pressure		
	2-inch vent	3-inch vent	4-inch vent	2-inch vent	3-inch vent	4-inch vent
2	1.7	1.3	0.84	1.8	1.5	1.24
5	3.6	2.4	1.25	3.8	2.7	1.68
10	6.0	3.3	1.38	6.1	3.6	1.84
30	9.5	3.9	1.41	9.6	4.3	1.86

Assumptions:

1. Unloading line size is 2 inches, 50 feet of piping, 10-foot elevation increase.
2. Tank trailer air pad pressure is 15-20 psig.
3. All valves to storage tank remain all the way open after unloading is complete.
4. Storage tank is 8000 gallon capacity.
5. Storage tank is 85% full at the end of the unloading.
6. Vent line piping is about 40 feet from the tank to the scrubber.

Scrubber back pressure used is either packed column (2-inch water column back pressure) or a passive scrubber with vapor entering the bottom of a vessel with a liquid head (16 inches of water column back pressure).

APPENDIX G - BEST PRACTICE GUIDANCE FOR THE SAFE HANDLING OF INTERMEDIATE BULK CONTAINERS (IBCS)

The purpose of this document is to provide best practice guidance and other useful information for the safe handling of intermediate bulk containers (IBCs) that distributors should consider in an effort to prevent injury and hazardous materials releases. This guidance will be focused on metal, rigid plastic and composite IBCs used to transport CI mission chemicals, including sodium hydroxide, potassium hydroxide, sodium hypochlorite (bleach) and hydrochloric acid. Refer to CI Pamphlet 65 (12.1) to ensure the appropriate personal protective equipment (PPE) is used when handling these materials.

Please note that the guidance included in this document is general and different considerations may be necessary depending on the material being transported. Specific practices and procedures should be developed on a case-by-case basis based on the company's/facility's own circumstances and conditions.

Transportation Regulatory Requirements

IBCs used to transport hazardous materials must meet certain transportation regulatory requirements in the U.S. and Canada. Following are some of the regulations IBC handlers should understand.

I. U.S. Department of Transportation (DOT)

The DOT regulates the acceptance and transportation of hazardous materials in the United States in Title 49 CFR Parts 100-199 (16.4.1), which are executed by the Pipeline and Hazardous Materials Safety Administration (PHMSA). DOT's hazardous materials regulations (also referred to as the HMR) generally cover package design, construction, inspection, testing, marking and handling. While all regulations relevant to transporting hazardous materials should be reviewed, the following are some specifically related to the transportation of IBCs.

a. Preparation of IBCs for Transport

General requirements for preparing an IBC for transport can be found in 49 CFR 173.35. This section notes when liners should be used for the container. It also provides requirements for filling limits for different packing groups. Special marking and identification requirements specific to IBCs can be found in 49 CFR 178.702-703.

Any IBC (other than a multiwall paper IBC) may be reused. Before an IBC is filled and offered for transport, it must be given an external visual inspection by the person filling the IBC to ensure that (49 CFR 173.35(b)):

- The IBC is free from corrosion, contamination, cracks, cuts or any other defect that presents an unsafe condition; and
- The IBC is marked in accordance with 49 CFR 178.703.

The HMR also provides general requirements for the transport of hazardous materials by highway in 49 CFR Part 177. Some key requirements for preventing IBC incidents during transportation include the securement (49 CFR 177.834(a)) and segregation requirements (49 CFR 177.848).

The regulations require that the materials are segregated on a truck based on their compatibility with other materials and that the packages are secured in a manner that prevent shifting and movement of the packages in order to avoid damage under normal transportation conditions.

b. Packaging Design/Construction

Requirements for specifications and testing of different types of IBCs can be found in 49 CFR Part 178 Subparts N and O. Subpart N provides performance-oriented standards for metal, rigid plastic, composite, fiberwood, wooden and flexible IBCs. Subpart O provides specific design qualification and requalification testing requirements for IBCs with which the manufacturer must comply.

c. Qualification and Maintenance

Requirements for the qualification and maintenance of IBCs can be found in 49 CFR Part 180 Subpart D. This section provides requirements for the periodic retesting and inspection, as well as needed repairs, of IBCs in order to continue authorized transport of an IBC. These requirements are designed to test an IBC in accordance with the applicable requirements in 49 CFR Parts 173 and 178. If an IBC does not meet these requirements, it is no longer authorized for transport.

- i. Inspections - Following are some inspection requirements noted in 49 CFR 180.352(b) for metal, rigid plastic and composite IBCs that help prevent releases:
 - External visual inspection:
 - Initially inspect after production, then every 2.5 years starting the date of manufacture or date of repair. Missing or damaged markings, or markings difficult to read, must be restored or returned to original condition. IBC must be inspected for cracks, warpage, corrosion or any other defect that presents an unsafe condition. If any such defects are found, the IBC must be removed from service or repaired.
 - Service equipment (i.e. valves, pressure relief devices) is fully functional and free from damage. Missing, broken or damaged parts must be repaired or replaced.
 - Internal visual inspection:
 - Internally inspect every 5 years for cracks, warpage, corrosion or any other defect that presents an unsafe condition. If any such defects are found, the IBC must be removed from service or repaired.
 - Metal IBCs must be inspected for minimum wall thickness to ensure requirements in 49 CFR 178.705(c)(1)(iv) are met. Metal IBCs not conforming to this section must be removed from service.

- ii. “Retesting” – IBCs must be tested in accordance with the leak-proof test every 2.5 years from the date of manufacture or the date of repair, as required by 49 CFR 180.352. Refer to manufacturer specifications if valves or other components need to be replaced.
- iii. Record Retention – Records for periodic retests, initial and periodic inspections, and tests performed if an IBC has been repaired or remanufactured must be kept by the owner/lessee. Records for periodic tests must be kept at each location where the test was conducted for at least 2.5 years or until the next tests are performed. (49 CFR 180.352(g)).

d. Training

In 49 CFR 172.704, DOT has established training requirements for employees involved in the transportation of hazardous materials, including general awareness, function-specific, safety, and security training. Hazmat employees must receive recurrent training once every three years. Additional requirements for drivers of hazardous materials can be found in 49 CFR 177.816, which also refers to the Federal Motor Carrier Safety Administration’s (FMCSA’s) driver training requirements in 49 CFR Parts 390-397 (16.4.2).

e. Incident Reporting

DOT requires an immediate notification by telephone of certain hazardous materials transportation incidents (49 CFR 171.15) and a written report using DOT Form F 5800.1 for certain incidents including all those requiring an immediate notification (49 CFR 171.16). In general, if an unintended release occurs during the loading, unloading or transport of a hazardous material while the carrier/driver is present, an incident report needs to be submitted to DOT.

II. Transport Canada

Canadian regulations are covered by Transport Canada (TC) in the Transportation of Dangerous Goods Act and Regulations (12.5.1). These regulations include, by reference, various standards and specifications, including Canadian General Standards Board (CGSB) and Canadian Standards Association (CSA) publications. Regulations pertaining specifically to IBCs can be found in CAN/CGSB-43.146, “Design, Manufacture and Use of Intermediate Bulk Containers for the Transportation of Dangerous Goods,” which parallels most of the requirements in the DOT regulations.

Service Life – One of the major differences between U.S. and Canadian regulations is that the Canadian standard establishes a maximum 60-month service life for plastic IBCs, with few exceptions (CAN/CGSB-43.146, Section 13.2.12).

Best Practice Guidance

The following is not an exhaustive list of best practices that IBC handlers should consider. Because of the wide variety of products which IBCs are used to transport, different companies may have different policies and, therefore, different considerations may be needed depending on the product being transported.

I. Useful Service Life

Following are some considerations for maintaining the IBC package material and structure through its useful life.

a. Material Compatibility

It is important to ensure that the hazardous material to be transported in an IBC is compatible with the package's material of construction, as well as service equipment/components (valves, gaskets, etc.). Incompatibility between the hazardous materials and the container material can cause degradation and eventually failure of the IBC. The severity of degradation depends on multiple variables, such as the physical and chemical properties of the material being transported and the frequency at which a single container is refilled. For example, stress-cracking is a particular issue when transporting sodium hypochlorite (bleach) in plastic IBCs.

b. Storage Conditions

The conditions under which IBCs are stored can play a big role in the longevity of an IBCs useful service life. Factors such as climate, storage location, stacking practices should be considered. Following are some specific factors that might be considered.

- i. Extreme temperatures, cold or hot, can severely impact package integrity
- ii. Exposure to sun/UV light may have harmful impacts on plastic IBCs
- iii. Consideration should be given to stacking height. IBC markings will indicate if an IBC is constructed for stacking and if so, the allowable stacking weight limit. Many IBC manufacturers provide recommendation for weight limits. Also, stacking empty IBCs too high could result in an incident causing injuries
- iv. Uneven surfaces should be avoided

c. Dedicated/Restricted Service

To help maintain the package's integrity and extend its useful life, many users will put some of their IBCs into dedicated (or restricted) service to avoid accidental mixing and accelerated degradation of the package. This means that the IBCs are designated to transport only one specific product or similarly classified products that have similar physical and chemical properties. Some users may define this practice within the context of "single-use" containers versus "multi-use" containers.

To provide additional protection for IBCs, some users have also established the practice of only allowing one delivery of the IBC, which may be referred to as "one trip" IBCs, depending on the hazardous material being transported. This means that certain materials are only filled one time for one delivery in a new or remanufactured IBC.

d. Packaging Manufacturer Recommendations

While U.S. DOT regulations do not establish a maximum service life for IBC containers (i.e. maximum number of years an IBC is authorized for use), packaging manufacturers sometimes provide recommendations for maximum use life.

Users of IBCs are encouraged to consult with their packaging manufacturers and, at a minimum, follow their recommendations on maximum use life, if available.

e. Quality Assurance Program

While it is not a specific requirement for IBCs under the regulations, it is helpful to establish a quality assurance program (QAP) to ensure that a certain level of confidence is met with respect to the continued safe use of IBCs. A QAP may contain practices the company uses to achieve compliance with the regulatory requirements for inspections and testing. It may also include procedures for monitoring service experience and recording and investigating failures. Based on service experience and package failure information, a company might establish inspection/maintenance intervals that are more frequent than is required by regulation. A company might also establish maximum use life for different types of IBCs even though it may not be required by regulation. All of these aspects of a QAP can help prevent future incidents.

II. Filling/Discharging Material

Following are a list of considerations that may be taken into account when filling an IBC with product or discharging product from the IBC in order to prevent an incident. Checklists are useful to ensure all steps are taken during inspections before and after filling and discharging material.

a. Pre-Fill Inspection

- i. Verify the test date stamped on the IBC is not overdue (See regulatory requirements above).
- ii. Verify that the IBC, as well as its steel or poly-frame, are in good condition (i.e. no corrosion, contamination, cracks, cuts or other damage) and safe for transport. If damage or defect is discovered, the IBC should be removed from service and inspected further. (See regulatory requirements above).
- iii. Verify that the service equipment and components (i.e. valves, gaskets, caps, relief devices, etc.), as well as hoses and hose connections, are in good condition. If any of this equipment is determined to be in inadequate condition, they should be replaced. (See regulatory requirements above).
- iv. It is crucial to verify that the product to be filled is compatible with the materials of the various components of the container. Issues with incompatibility can cause damage to the IBC and result in an unsafe package.
- v. Verify there is enough capacity in the IBC to fill with the specified amount of material.

- vi. Verify the recommended temperature range for package use and ensure the product to be filled is within this range. Caution should be given when blending or diluting products, because some processes can generate enough heat that can lead to degradation of the container.

- vii. The accidental mixing of incompatible materials can result in a serious incident. Therefore, it is important to confirm that the material being loaded into the IBC is the same as the material that was previously loaded, if the IBC has not yet been washed. The Chlorine Institute has specific guidance on avoiding the accidental mixing of sodium hypochlorite, which can be found here:

<http://www.chlorineinstitute.org/stewardship/sodium-hypochlorite-stewardship.cfm>.

b. Filling

- i. Ensure that there is effective monitoring while filling hazardous materials. This includes ensuring that any monitoring or gauge devices are operating properly.

c. Post-Fill Inspection

- i. Ensure the total amount filled in the IBC does not exceed its maximum filling limit (per 49 CFR 173.35(l)).
- ii. If disconnecting hoses from the process, ensure that all hoses/piping have been evacuated of product and that the air system and/or pumps have been shut down and pressure has been relieved.
- iii. Close per package manufacturer instructions. **NOTE:** DOT requires these instructions be filed at the facility and readily available to employees. DOT inspectors may ask to see the instructions during an inspection.

d. Pre-Discharge Inspection

- i. If unloading the contents of an IBC into a storage tank, verify there is enough available capacity in the storage tank to unload the specified amount.
- ii. Ensure that there is effective monitoring while loading or unloading hazardous materials. This includes ensuring that any monitoring or gauge devices are operating properly.
- iii. The accidental mixing of incompatible materials can result in a serious incident. If product is unloaded from the IBC into a storage tank, confirm that the product is being loaded into the correct storage tank. The Chlorine Institute has specific guidance on avoiding the accidental mixing of sodium hypochlorite, which can be found here:
<http://www.chlorineinstitute.org/stewardship/sodium-hypochlorite-stewardship.cfm>

e. Discharging

- i.* Ensure that there is effective monitoring while discharging hazardous materials. This includes ensuring that any monitoring or gauge devices are operating properly.
- ii.* Sufficient venting is needed when using a vacuum pump or gravity to unload an IBC.
- iii.* The use of pressure padding is generally not recommended for plastic IBCs.

f. Post-Discharge Inspection

- i.* If disconnecting hoses from the process ensure that all hoses/piping have been evacuated of product and that the air system and/or pumps have been shut down and pressure has been relieved.
- ii.* Ensure that transfer hoses have been evacuated and are capped prior to placing back on truck.
- iii.* Close per package manufacturer instructions. **NOTE:** DOT requires these instructions be filed at the facility and readily available to employees. DOT inspectors may ask to see the instructions during an inspection.

III. Truck Loading/Unloading

Following are a list of considerations that may be taken into account when loading IBC onto the truck or offloading from the truck in order to prevent a release.

- a. Forklift/Pallet Jack Handling* – Forklifts and/or pallet jacks are often used for the purposes of loading IBCs onto a truck or offloading IBCs from a truck. Following are a list of considerations specifically related to the use of forklifts and pallet jacks.
 - i.* Ensure that the IBC is centered on the forks.
 - ii.* Only use forklifts and pallets jacks to carry IBCs as they are intended.
 - 1. Do not push IBCs into place with other IBCs on the forklift/pallet jack.
 - 2. With respect to forklifts, in particular, parts other than the forks should not be used to move/shift IBCs into place.
 - iii.* Some forklifts have forks that extend beyond the width of the IBC. For those forklifts, caution should be given to avoid puncturing an adjacent IBC.
 - iv.* Follow facility speed limits and other traffic rules.
 - v.* Avoid unnecessary obstacles, such as slopes and uneven or damaged surfaces.

- vi. Ensure compliance with general requirements and operator training requirements per OSHA regulations for operating forklifts. See 29 CFR 1910.178 (12.2.1).
 - Truck lift gates should not be used for supporting an IBC for a period of time. Lift gates are typically rated to only hold a maximum weight, which the IBC may exceed. Avoiding this will also help prevent an IBC from accidentally falling or being pushed off the lift gate.
 - *Blocking and Bracing* – As noted above, DOT has certain regulatory requirements for securing and segregating IBCs onto a truck. In addition to those requirements, the following may be considered as it relates to securing (or “blocking and bracing”) IBCs on the truck.
 - Ensure that all securement straps/chains/bars, etc. are in good condition, rated for the load being secured, and will work as intended.
 - Avoid overtightening securement straps. If secured too tight, the package could crack.
 - Be careful when pushing IBCs to ensure proper placement. Pushing packages against each other could cause damage to either or both containers. When pushing the package, buckles and other fixtures on the floor may be in the way and can cause damage.
 - Ensure IBC is placed inside the track to provide adequate spacing from objects and materials, such as metal on the wall and metal buckles on the floor that could damage the package during transport.
 - Follow manufacturer recommendations for stacking IBCs (stack testing done in accordance with 49 CFR 178.815). Certain IBCs may not be able to support above a certain load limit. Stacking full IBCs on transport vehicles is not recommended.
 - Particularly when there is less than a full truck load being shipped, maintaining center of gravity on the truck is important. Ensure that the IBCs are placed in a manner that the weight/load displacement is centered to help avoid losing control of the truck due to movement or sloshing of the package contents.
 - Verify the truck axle weight limits are not exceeded.

IV. Delivery

In addition to the considerations listed above for filling/discharging product or loading/unloading the truck, following are a list of considerations, particularly for the driver, related to the delivery and transport of IBCs.

- Verify that all labels/markings/placards on the truck are correct before releasing the shipment.
- Verify shipping papers are correct before releasing the shipment.
- Follow all facility traffic rules.
- Review industry guidance on preventing rollover accidents. DOT developed a rollover prevention video that provides guidance to help avoid these types of accidents (<https://vimeo.com/31563777>).
- Typically DOT does not allow the unloading of material while the IBC is still sitting on the truck. However, many users have applied for a special permit (DOT SP-12412) that allows them to do just that under specific circumstances (i.e. only when materials loaded, if accidentally mixed, would not create an unsafe condition) as long as specific requirements are followed. In order to use this practice, one must apply for “party status” to this special permit. A copy of the special permit and instructions for applying can be found on the DOT website:
- <http://www.phmsa.dot.gov/hazmat/approvals-permits>.

APPENDIX H – FRP CARGO TANK INSPECTION SPECIAL CONSIDERATIONS

The following are a list of special considerations for inspecting fiberglass reinforced plastic (FRP) cargo tanks. This list is not exhaustive, and company policy may require other considerations depending on the product being transported.

1. The DOT-Special Permit (SP) for the cargo tank being used shall be reviewed by the trailer owner and all personnel that will be performing loading/unloading, maintenance, inspections and repairs of the cargo tanks shall be trained in all the provisions of the Special Permit.
2. Facilities performing repair work and inspection on DOT-SP cargo tanks shall hold a CT registration with the Federal Motor Carrier Safety Administration (FMCSA). CT registration must have provisions for each Special Permit of cargo tanks where work is performed.
3. All testing and inspections required for DOT Specification 412 cargo tanks shall be followed except those exempted by the Special Permit.
4. A current copy of the Special Permit must be maintained at each facility where the truck is offered or reoffered for transportation.
5. Visual lining inspections shall be performed in accordance with the manufacturers' application for the special permit and 49 CFR 180.407 (d) and (e).
6. Compatibility of the commodities with the materials of construction shall be confirmed and maintained by the cargo tank owner.
7. Liner repairs shall only be performed after notification and review with the cargo tank manufacturer. It is advisable that pictures are taken and made available to the cargo tank manufacturer, of any areas of concern.
8. Structural repairs shall only be performed by the manufacturer or an authorized service center following written authorization by the manufacturer and according to their written procedures. All repairs should be in accordance with the Special Permit.

APPENDIX I – 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. Is the reactivity and compatibility information from Section 2.3 incorporated into procedures and programs?	{2.3}
☐	☐	☐	2. Does the facility have a Spill Prevention Program in place?	{2.8}
☐	☐	☐	3. Do the emergency plans include notifying CHEMTREC? If so, is the facility registered with the American Chemistry Council?	{11.7}
☐	☐	☐	4. Does the facility's training program for handling hazardous materials and for off-site emergency response comply with DOT or Transport Canada requirements?	{5}
☐	☐	☐	5. Do emergency plans call for notifying the National Response Center of spills greater than or equal to 5,000 pounds of hydrochloric acid?	{11.8}
☐	☐	☐	6. Were the tank truck specifications outlined in Section 4 taken into consideration when specifying HCl tank trucks?	{47.}
☐	☐	☐	7. Are gaskets used on hydrochloric acid cargo tanks compatible with hydrochloric acid?	{4.6}
☐	☐	☐	8. Is the driver of the cargo tank qualified and trained?	{5.1, 5.2}
☐	☐	☐	9. Is a checklist utilized to ensure safe loading and unloading? Recommendations for emergency shut-off during loading?	{7, 8}
☐	☐	☐	10. If required by company policy, are conductivity or resistivity tests performed after completion of the loading?	{7.2}
☐	☐	☐	11. Is the transfer of hydrochloric acid properly monitored?	{7.6, 8.9}
☐	☐	☐	12. Has residue tank truck been shipped in accord with DOT/Transport Canada requirements?	{8.9}

Yes	No	N/A		
☐	☐	☐	13. Are Federal cargo tank inspections and test requirements being met?	{9.5}
☐	☐	☐	14. Are detailed vehicle and equipment maintenance procedures and schedules in place?	{9}
☐	☐	☐	15. Are instrumentation components consistent with Institute recommendations?	{4.4}

REMINDER:

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



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