PIPING SYSTEMS

FOR

DRY CHLORINE

Edition 10,

March 1979

CHLORINE INSTITUTE PAMPHLET 6

The Chlorine Institute, Inc., 342 Madison Ave., New York, N Y. 10017. Additional copies of this pamphlet are available at nominal cost.

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1. INTRODUCTION

1.1 SCOPE

This publication is intended to provide useful information concerning chlorine pipine systems. The requirements of chlorine producing plants and of processing plants using large piping or reactors have not been considered. It lists selected pipe, valves and fittings suitable for use with dry chlorine in either the liquid or gaseous phase, at temperatures between -20°F and +300°F. (See §3.1) Users should select suitable equipment for their purpose on sound engineering principles. (See §1.3).

The Chlorine Institute does not approve, rate, certify, or endorse any product or construction except for certain equipment used in transportation. In each such case, there is an approved Chlorine Institute drawing. Manufacturers of equipment which does not comply in every respect with such drawings are not authorized to use the Chlorine Institute name in advertising.

To properly fit the detailed scope outlined above, the former title of this pamphlet "Piping and Equipment for use with Dry Chlorine" has been changed to "Piping Systems for Dry Chlorine" beginning with Edition 9.

1.2 DEFINITIONS

In this pamphlet the following meanings apply unless otherwise noted:

ANSI means American National Standards Institute, Inc.

ASME means American Society of Mechanical Engineers

ASTM means American Society for Testing and Materials

CWP means cold working pressure

Chlorine means elemental chlorine, liquid or gaseous, and dry, as defined in the Institute's Chlorine Manual

Institute means The Chlorine Institute, Inc.

NGO means national gas outlet thread

NGT means national gas taper thread

NPT means American standard taper pipe thread

OD means outside diameter

OS&Y means outside screw and yoke

PSI means pounds per square inch gage

SAE means Society of Automotive Engineers

SCFM means standard cubic feet per minute (60°F and 14.7 PSIA)

1.3 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 procedure. The user should be aware that changing technology or regulations may require a change in the recommendations herein. Appropriate steps should be taken to insure that the information is current when used. These suggestions should not be confused with federal, state, provincial, municipal or insurance requirements, or with national safety codes.

1.4. APPROVAL

The Institute's Committee on Container Specifications and Safety approved Edition 10 of this pamphlet at a meeting held on February 6, 1979.

1.5 REVISIONS

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

1.6 REPRODUCTION

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

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2. GENERAL

2.1 PRECAUTIONS

Chlorine is a hazardous material. It exists as a liquid or gas under pressure. It is toxic For general precautions in chlorine handling, the reader should refer to the Institute's Chlorine Manual. In particular, care must be taken to assure that all piping is thoroughly purged of chlorine before welding. Chlorine can support combustion of carbon steel.

2.2 CERTIFICATION

Manufacturers or suppliers must certify to the user, when requested, that their product is suitable for chlorine in the specified service.

2.3 MATERIALS

2.3.1 In general, steel piping is recommended for handling dry chlorine. Fine grain practice carbon steel pipe such as ASTM A587 can be cold bent but ordinary carbon steel pipe should be normalized after bending. To insure rigidity and to provide increased protection from outside abuse, pipe of 3/4" nominal size or larger should be used. Non-ferrous and non-metallic tubing and fittings of appropriate size, see §3.7 and §3.8, may also be used. Ordinary forms of grey iron or malleable iron fittings and general purpose valves are not recommended for chlorine service. Porcelain valves must not be used. Ductile iron per ASTM A 395 may be used for pressure reducing valves, ball and plug valves and strainers designed for chlorine gas service only.

2.3.2 Where reference is made to specific materials, other materials may be used provided the user has evidence that the alternate materials are equal or better in the intended service.

2.3.3 Screwed and socket weld joints are recommended for sizes up to 1-1/2". Butt weld and flanged joints are recommended for all sizes.

3. RECOMMENDED PIPING AND COMPONENT EQUIPMENT

3.1 GENERAL

This section provides a minimal specification for the components of piping systems. The Institute believes that these materials are available and are suitable for the service shown. Other materials may be used (see §2.3.2). All parts of this pamphlet should be consulted before deciding on the components of a piping system. Paragraphs 3.2 and 3.3 are organized according to operating temperatures. During certain periods, temperatures may differ.

It has always been an objective of this pamphlet to offer practical suggestions in the selection of material suited for the expected service. It should be borne in mind that all recommended materials must make some compromise to accord with operating conditions and with the possible corrosive nature of chlorine particularly when moisture unintentionally enters the system.

Temperatures below -20°F may be encountered in chlorine systems and below this temperature some metals become brittle. ASTM A333 (with grades specific to the expected temperature) and with corresponding fittings has been recommended but availability has become limited. Stainless steels of the 300 series have useful properties for low temperature service but are subject to stress corrosion cracking particularly in the presence of moisture at ambient or elevated temperatures. The recommendations of this edition of Pamphlet No. 6 for materials other than ordinary carbon steel should be regarded as applying only to the special conditions indicated.

3.2 SERVICE: Chlorine Gas, -20F to 300F, vacuum to 150 PSI
SYSTEM: Class 150, carbon steel, screwed, welded and/or flanged

3.2.1 Pipe: Carbon steel - 3/4" through 1-1/2" SCH 80, ASTM A 106 Grade A or B, or ASTM A 587
2" through 6" SCH 40, ASTM A 53 Grade A or B, Type E or S.

3.2.2 Screwed Construction - through 1-1/2" nom. pipe size
Fittings: Screwed, 3000 lb - ANSI B16.11; Forged carbon steel - see ASTM A 105.
Thread Dope: PTFE tape or paste; litharge and glycerin (results in a threaded joint that cannot be taken apart)
Unions: Screwed, 3000 lb - ANSI B16.11, Forged carbon steel - ASTM A 105.
Alternate through 1" size: Flange unions, screwed, 1500 lb two-bolt oval type, tongue and groove, forged carbon steel - ASTM A 105.
Valves, Gas:
Globe type, 800 lb, screwed, forged steel (see §3.4)
Ball type, 300 lb, screwed, cast steel (see §3.5)
Plug type, 300 lb, screwed, ductile iron (see §3.6)

3.2.3 Socket Welded Construction - through 1-1/2" nom. pipe size
Fittings: Socket weld, 3000 lb, Forged steel, ASTM A 105.
Flanges: Socket weld, Class 150, Forged steel, ASTM A 105 or 1500 lb, two or four-bolt oval type
Gaskets: See welded or flanged construction

3.2.4 Welded and/or Flanged Construction - through 6" nom. pipe size
Butt Weld Fittings: Carbon steel, same schedule as pipe, ASTM A 234 Grade WPB.
Flanges: Class 150-ANSI 16.5, 1/16" raised face, forged carbon steel - ASTM A 105, slip-on type suggested for pipe and weld neck for fittings.
Gaskets: High temperature compressed asbestos, ring type, per Federal Spec HH-P 46E
Thickness - 1/16" for pipe sizes to 1-1/2" Nom.
1/8" for pipe sizes 2" and larger
For tongue and groove flanges: Chemical lead, 2 - 4% antimony, 1/8" thick or asbestos specification per HH-P 46E.
Gasket Dope: None permitted.
Bolts and Nuts: Heavy hex, carbon steel per ASTM A 307 Gr B.
Dimensions - Bolts-ANSI B18.2.1; Nuts B18.2.2
Threads per ANSI B 1.1 - Bolts - Class 2A Fit; Nuts - Class 2B Fit.
Valves: Globe type, Class 150, flanged, cast steel (see §3.4)
Ball type, Class 150, flanged, ductile iron or cast steel (see §3.5)
Plug type, Class 150, flanged, ductile iron (see §3.6)

3.3 SERVICE: Chlorine gas or liquid, -20F to 300F, vacuum to 300 PSI
SYSTEM: Class 300, carbon steel, screwed, welded and/or flanged

3.3.1 Pipe: Carbon Steel
3/4" through 1-1/2" SCH 80, ASTM A 106 Grade A or B.
2" through 6" SCH 80, ASTM A 53 Grade A or B, type S.

3.3.2 Screwed Construction - through 1-1/2" nom. pipe size
Fittings: Screwed, 3000 lb - ANSI B16.11; Forged carbon steel ASTM A 105.
Thread Dope: PTFE tape or paste; litharge and glycerin (results in a threaded joint that cannot be taken apart)
Unions: Screwed, 3000 lb - ANSI B16.11, Forged carbon steel ASTM A 105.
Alternate through 1" size: flange unions, screwed, 1500 lb two-bolt oval type, tongue and groove, forged carbon steel ASTM A 105.
Valves, Liquid or Gas:
Globe type, 800 lb, screwed, forged steel (see §3.4)
Ball type, 300 lb, screwed, cast steel (see §3.5)
Plug type, 300 lb, screwed, ductile iron (see §3.6)

3.3.3 Socket Welded Construction - through 1-1/2" nom. pipe size
Fittings: Socket weld, 3000 lb, forged steel, ASTM A 105.
Flanges: Socket weld, Class 300, forged steel, ASTM A 105 or 1500 lb two or four-bolt oval type
Gaskets: See welded or flanged construction.

3.3.4 Welded and/or Flanged Construction - through 6" nom. pipe size
Butt Weld Fittings: carbon steel, same schedule as pipe, ASTM A 234 Grade WPB.
Flanges: Class 300 ANSI B16.5, 1/16" raised face, forged carbon steel - ASTM A 105, slip-on type suggested for pipe and weld neck for fittings.
Gaskets: High temperature compressed asbestos, ring type, per Federal Spec HH-P 46E
Thickness - 1/16" for pipe sizes to 1-1/2" Nom.
1/8" for pipe sizes 2" and larger
For tongue and groove flanges: Chemical lead, 2 - 4% antimony, 1/8" thick or asbestos specification per HH-P 46E.
Gasket Dope: None permitted
Bolts and Nuts: Heavy hex, carbon steel per ASTM A 307 Gr. B.
Dimensions - Bolts-ANSI B18.21; Nuts B18.2.2
Threads per ANSI B 1.1 - Bolts - Class 2A Fit; Nuts - Class 2B Fit.
Valves, Liquid or Gas:
Globe type, Class 300, Flanged, Cast Steel (see §3.4)
Ball type, Class 300, Flanged, Cast Steel (see §3.5)
Plug type, Class 300, Flanged, Cast Steel (see §3.6)

3.4 GLOBE VALVES - (See §3.1 through §3.3 for recommendations based on service conditions) - To be cleaned for chlorine service by the manufacturer.

3.4.1 Screwed, 800 lb
Body - Forged steel per ASTM A 105
Bonnet - Flanged, OS&Y
Stem - Hastelloy C
Disc - Monel
Seat - Monel ring
Packing - PTFE impregnated asbestos

3.4.2 Flanged, Class 150 or Class 300
Body - Cast steel per ASTM A 216, Grade WCB
Bonnet - Flanged, OS&Y
Stem - Hastelloy C
Disc - Monel, plug type
Seat - Monel ring
Packing - PTFE impregnated asbestos

3.5 BALL VALVES -(See §3.1 through §3.3 for recommendations based on service conditions) - To be cleaned for chlorine service by the manufacturer.

Valve design shall insure that excess pressure in the ball and body cavity of closed valve will relieve spontaneously toward the direction of high pressure. This relief may be accomplished by providing a relief hole in the ball or in the body, bypassing the upstream seat, or by the use of cavity pressure relieving seats. If relieving device is directional, the valve body must be supplied with indicator noting the direction of pressure tightness.

Valve stem seals shall be externally adjustable to stop stem leakage. The stem shall be such as to prevent accidental removal while the valve is in service. The valve shall be provided with a port position indicator.

Manufacturers shall test each valve for seat tightness. Each seat in every pressure relieving seat valve or the seat opposite the relief hole in a one-way valve must be tested. There shall be no leakage in one minute at 80 PSI at a temperature of 65°F to 75°F.

Manufacturers shall test a representative sample of each size and model valve for seat relief. Pressure introduced into the valve cavity must relieve at pressure indicated below:

Class 150 and 300, through 3" size - maximum of 5 times CWP rating
Greater than Class 300 or over 3" size - maximum of 2.5 times CWP rating

Relief is to be measured at a temperature of 65°F to 75°F with no pressure on either side of the valve and is that pressure at which a steady stream of bubbles at a minimum rate of one per 15 seconds issues from the valve cavity.

3.5.1 Screwed, 150 lb or 300 lb
Body - Cast steel per ASTM A 216 Grade WCB
Ball and Stem - Monel or Hastelloy C
Seat - reinforced PTFE
Seals - PTFE

3.5.2 Flanged, Class 150
Body - Cast ductile iron per ASTM A 395 or cast steel per ASTM A 216 Grade WCB
Ball and Stem - Monel or Hastelloy C
Seat - reinforced PTFE
Seals - PTFE

3.5.3 Flanged, Class 300
Body - Cast steel per ASTM A 216 Grade WCB
Ball and Stem - Monel or Hastelloy C
Seat - reinforced PTFE
Seals - PTFE

3.6 PLUG VALVES -(See §3.1 through §3.3 for recommendations based on service conditions) - To be cleaned for chlorine service by the manufacturer.

Valve design shall insure that excess pressure in the plug and body cavity of closed valve will relieve spontaneously toward the direction of high pressure.

Valve stem seats shall be externally adjustable to stop stem leakage. The stem shall be such as to prevent accidental removal while the valve is in service.

3.6.1 Screwed, 300 lb
Body - Cast ductile iron per ASTM A 395 or Cast steel per ASTM A 216, Grade WCB
Sleeve - PTFE
Plug and Stem - Monel
Seals - PTFE

3.6.2 Flanged, Class 150
Body - Cast ductile iron per ASTM A 395 or Cast steel per ASTM A 216, Grade WCB
Sleeve - PTFE
Plug and Stem - Monel
Seals - PTFE

3.7 NON-FERROUS METAL CONSTRUCTION

At ordinary temperatures, chlorine reacts vigorously with many common materials such as aluminum, titanium and tin (see Chlorine Manual). Where flexible connections are required

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between cylinders or ton containers and rigid piping systems, copper and copper alloy construction may be used. Because of the reaction between chlorine and tin, brazing alloys containing tin should not be used. For additional protection against external corrosion, cadmium plating is recommended.

3.7.1 Copper Tubing

Seamless copper water tube per ASTM B 88 in the annealed state with Type K wall thickness or heavier is recommended.

3.7.2 Fittings for Copper Tubing

Where tubing terminates at standard chlorine cylinder or ton container valves, adapters shown on Institute Drawing 130, brazed to the tubing, are recommended.

For other applications, flareless type fittings in monel or solder type fittings in wrought copper are recommended. Lead based solder must not be used. Gasketed type connections are preferred where connections are to be broken frequently. Flared type fittings are not recommended.

For chlorine tank car unloading connectors, refer to Dwg. 118.

For small union connection standards, refer to Dwg. 171.

3.8 PLASTIC CONSTRUCTION

As with virtually all hydrocarbon based materials, most plastics will react chemically with chlorine. This reaction can be dangerous, even explosive. Only a few highly halogenated plastics such as PTFE, polyvinylidene fluoride (Kynar ®)*, and ethylene chlorotrifluoroethylene (Halar ®)* possess adequate chemical properties to be useful in chlorine service. For some limited purposes polyvinyl chloride, chlorinated polyvinyl chloride, acrylonitrile butadiene styrene, polyethylene, and polypropylene are used. See 3.8.1 and 3.8.2. Plastics should be used only as specified by a designer experienced in the handling of chlorine or as recommended by the manufacturer of the chlorine handling equipment.

3.8.1 Pipe and Fittings

Chlorine gas only, 30" Hg vacuum to 6 PSI pressure:

For 130°F max, schedule 40 PVC (polyvinyl chloride) with solvent cemented joints (schedule 80 with screwed joints) may be used.

For 212°F max, CPVC (chlorinated polyvinyl chloride) pipe or fiber glass reinforced pipe fabricated from a resin specifically recommended by the producer of that resin as suitable for chlorine service may be used.

3.8.2 Tubing and Fittings

For chlorine gas only, vacuum service, 130°F max, polyethylene tubing, 1/16" wall thickness and up to 5/8" OD with compression type fittings may be used.

3.9 SPECIAL PURPOSE VALVES

The valves, drawings of which are cited in this section, are designed for chlorine transportation containers and have been approved for such service. They are frequently used in chlorine piping systems.

3.9.1 Ton Container & Cylinder Valve

Design and Material - See Dwgs 110, 112 and 113

3.9.2 Tank Car Angle Valve

Design and Material - See Dwgs 104 and 105

3.9.3 Safety Relief Valves

3.9.3.1 For transportation equipment
Design and Material - See Dwgs H-51970-A and H-50155-B

3.9.3.2 Standard construction
To be used in combination with a breaking pin assembly or rupture disc.

Construction - Angle body, closed bonnet, screwed cap over adjusting screw

*Note: These are registered trademarks of Pennwalt Corp. and Allied Chemical, respectively.

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A - DESIGN, CONSTRUCTION AND TESTING

Chlorine (tank car)(cargo tank)(tank barge) transfer hose to the following specifications:

1. Application Data:
   Length _____
   Inside Diameter _____
   End Connections _____

2. Design and Construction:

2.1 Design Pressure. Hose shall be designed for a bursting pressure of not less than five times the maximum safety relief valve setting of the tank with which it is used. Minimum design pressure shall be 375 psig for tank car or cargo tank service and 300 psig for barge service.

2.2 Hose. The hose shall be corrugated from a seamless or butt welded tube. It shall have annular or helical corrugations and shall be of one continuous length.

2.3 Braid. The braid shall be of diamond lay or basket weave and shall be permanently attached at both ends by welding.

2.4 End Fitings. Both ends of assembly shall terminate with Schedule 80 pipe nipples which shall be permanently attached to assembly by welding or brazing. Flanges may be welded, brazed or threaded to nipples. Van Stone lap joints may also be used.

2.5 Wrench Pads. Hex wrench pads made from steel or malleable iron shall be permanently attached to pipe nipples by welding.

2.6 Physical Protection. Hose assembly shall be provided with one of the following:

2.6.1 Spiral Guard. The hose shall be provided with a stainless steel spiral guard for the full length of hose. Spiral guard shall be permanetly attached to ferrules by welding. Spiral guard shall be 1/4"x 3/32" Type 304 stainless steel flat wire or strip helically wound around the braided hose. Maximum spacing between each spiral shall be 3/4".

2.6.2 Stainless Steel Casing. The hose shall be provided with a loosely wound Type 302 stainless steel interlocked casing for the full length of hose. Casing shall be permanently attached to the ferrules by welding.

2.7 Alloys. Hose, braid and pipe nipples and ferrules shall be Monel 400.

2.8 Welding. Welding or brazing shall be in accordance with either paragraph 2.8.1 or 2.8.2 below and shall be performed by welders or brazors qualified per Section IX of the A.S.M.E. Boiler and Pressure Vessel Code.

2.8.1 Welding shall be done by the tungsten-inert gas shielded arc method using Monel 60 filler wire for the hose, braid and fitting welds and INCO 82 or INCO 92 filler wire to weld wrench pads to pipe nipples and spiral guard or stainless steel casing to ferrules.

2.8.2 All joints shall be nicro-brazed per A.M.S. 4779 using nickel welding rod.

2.9 Internal plastic coatings or liners are not recommended.

2.10 External coatings of neoprene or other elastomers are not recommended since these hide evidence of small leaks.

3. Testing.

3.1 Prototype Test. A prototype hose assembly of three feet minimum length representative of all lengths of that diameter & fitting construction shall withstand a hydrostatic test pressure of at least five times the design pressure without bursting or otherwise breaking at any seam or joint. The hose temperature during this prototype test shall duplicate the marked minimum service temperature. Any assembly so tested shall not be subsequently used in transfer service and shall be scrapped. If any detail of design or fabrication technique is changed, a new prototype shall be so tested.

3.2 Production Pressure Test. Each hose assembly shall be hydrostatically tested at ambient temperature to a pressure not less than twice its maximum working pressure nor more than two-fifths its bursting pressure.

3.3 Gas Pressure Test. Hose assembly shall withstand a Gas Pressure Test with helium or nitrogen under water at twice the minimum design pressure.

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4 Marking:
A nameplate or equivalent showing the following shall be permanently attached to each hose.

Manufacturer _____
Maximum Working Pressure _____ psig
Hydrostatic Test Pressure _____ psig
Minimum Service Temperature _____ °F
Complies with Chlorine Institute Dwg. 135-2

5. Preparation for Delivery:

5.1 Cleaning. After all inspection and testing, assembly shall be cleaned sufficiently to remove hydorcarbons and other contaminants which may react with chlorine. Assembly shall be thoroughly dried after cleaning by drying in oven at approximately 300°F or by purging with dry, oil-free air or nitrogen having a dew point of minus 40°F or lower.

5.2 End Seals. Both ends of assembly shall be suitably capped with plastic or elastomeric caps to prevent entry of contaminants during shipment.

B - INSTALLATION AND MAINTENANCE
The following paragraphs do NOT form part of recommended purchase specification.

1 Installation:

1.1 A chlorine type ball valve is recommended for the container end of the hose. This valve protects the hose from internal contamination by moisture in the air when the hose is disconnected from the chlorine container. Protection by plugging or capping is an acceptable alternative.

1.2 The fixed end of the hose should be attached to vertical piping so the hose will hang vertically when not in use. As an alternate, a boom may be used to provide support for the weight of the hoses when they are not in use.

1.3 Use two wrenches to make up threaded fittings to avoid torqueing. Place holding wrench on pipe fittings only, never on braided section. Make up fixed flanges first on assemblies containing fixed and floating flanges.

1.4 A hose should be in one plane only. Compound bends which induce torque, i.e. - twisting, should be avoided. Recommended centerline bend radii or offsets should not be exceeded Use two or more men on long or heavy assemblies to prevent hose distortion.

2. Maintenance:

2.1 Hose is a non-reparable item and should be replaced if following conditions are noted:-
a. Leakage.
b. Frayed or worn braid.
c. Ballooned or bunched braid.
d. Hose elongation or deformation
e. Corrosion.

2.2 When hoses are retested, hose should be properly supported. Rated test pressures should not be exceeded. USCG Regulation 151.04-5(h) requires that "Cargo hose stored on board the vessel --- shall be inspected every 2 years . The inspection shall consist of a visual examination and a hydrostatic test of 1-1/2 times the maximum pressure to which the hose may be subjected. The date of the most recent inspection and the test pressure shall be stenciled or otherwise marked on the hose".

This drawing was developed by a technical committee of the Institute. The user should be aware that changing technology or regulations might require revision of the drawing. Appropriate steps should be taken to insure that the drawing is current when used.

ISS.	DATE	REVISION	APPR.
3	2/4/73	REV 2.4, 2.8 AND 3.1	CCS-S
2	7/25/72	REVISED 2.1, 2.8, 3.1, 3.3 & 3.4	CCS-S

THE CHLORINE INSTITUTE, INC.
NEW YORK, N. Y.

RECOMMENDED SPECIFICATIONS
FOR
CHLORINE TRANSFER HOSE

DRAWN SJL	
TRACED	
CHECKED	
APPROVED CC 3.3 6/24/69	
DWG. NO. 135	ISSUE 3

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Connections - Inlet flange - Class 300
- Outlet flange - Class 150 or 300

Materials - Body - cast carbon steel
- Nozzle, Disc Adjusting ring, Nozzle ring, Spindle Guide - Hastelloy "C" or Monel
- Spring - steel, nickel plated

3.9.3.3 "O" Ring Seat Seal Construction
Safety relief valves complying with §3.9.3.2 but equipped with "O" ring seat seals of Viton may be used without a breaking pin or rupture disc.

3.9.3.4 Safety relief valves of other designs are acceptable provided that the materials used are compatible with chlorine and that their design and installation meet the general requirements of the ASME Boiler and Pressure Vessel Code Division 1, Section VIII.

3.9.4 Excess Flow Valves

Size & Design	1-1/4" - Per Dwg. 101 (Max. operating liquid flow rate 7,000 lbs/hr) 1-1/4" - Per Dwg. 106 (Used in chlorine gas only) 1-1/4" - Per Dwg. 114 (Max. operating liquid flow rate 15,000 lbs/hr) 2" x 2-1/2" Per Dwg. 162 (Max. operating liquid flow rate 30,000 lbs/hr) 1-1/4" - Per Dwg. 163 (Max. operating liquid flow rate 11,000 lbs/hr)
Material	See drawings

3.9.5 Check Valves

Spring loaded or gravity operated check valves are not recommended for chlorine service. Power operated control valves with suitable instrumentation should be used.

3.10 RUPTURE DISCS

Connections	Up to 1-1/2" - screwed, socket weld or flanged 2" and up - flanged or butt weld
Flange Rating	To conform to the design class of the piping system. (See §3.1 - §3.3)
Materials	Flanges - forged carbon steel Disc - silver, tantalum, impervious graphite
Design	Considerable margin between operating pressures and rated burst pressure of disc should be provided. Operating pressures exceeding 70% of disc pressure may cause premature failures. Vacuum supports should be used where necessary. Note: Impervious graphite discs should not be used in conjunction with safety relief valves.

3.11 INSTRUMENTS

3.11.1 When pressure measuring systems are isolated from chlorine by a liquid filled system, the recommended filling fluid is a polymer of trifluorovinylchloride of appropriate viscosity (e.g. Fluorolube ®)*

3.11.2 Pressure Gages & Pressure Switches

3.11.2.1 Diaphragm sealed type

Line Connections	Screwed or flanged
Materials	Seal, upper body - steel Seal, lower body - steel or monel Diaphragm - Monel, silver or tantalum
Pressure Range	Twice operating pressure

3.11.2.2 Direct Reading Type

Line Connections	Screwed or flanged
Materials	Bourdon tube - Monel
Pressure Range	Twice operating pressure

*Note: This is a registered trademark of Hooker Chemicals & Plastics Corp.

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4. PIPING LAYOUT

4.1 GENERAL

Piping arrangements should be as simple as possible with a minimum number of joints. Piping systems should be well supported and adequately sloped. Low spots should have openings for drainage. Suitable allowance should be provided for pipe expansion due to changes in temperature. Shut-off valves at the end of a line, or valves at intermediate points in a long line, provide a means of isolating serious leaks. See also §4.2.

4.2 LIQUID EXPANSION PROTECTION

Liquid chlorine has a very high coefficient of thermal expansion. If liquid chlorine is trapped between two closed valves and then warms up in the sun or because of other conditions, very high pressures can develop. These pressures may be sufficient to cause rupture of some portion of the system and the release of the trapped chlorine.

Such rupture can be prevented by a suitably designed and installed expansion chamber. In deciding whether an expansion chamber is desirable, one should give consideration to the quantity of chlorine involved, the nature of possible personnel exposure if rupture occurs, and to damage to equipment. Two suitable designs for expansion chambers are shown on Drawing No. 136. Both incorporate a rupture disc and receiver chamber together with a pressure indicator or alarm switch set to function if rupture occurs. Rupture discs should be temporarily removed when hydrostatic testing.

Alternate A incorporates an expansion chamber ahead of the rupture disc. This device should be installed at the high point in the line so that noncondensible gases can collect in the chamber and provide a cushion for some expansion before rupture occurs. The valve between the primary chamber and the rupture disc permits changing the rupture disc while the product line is in service but this valve must always be left in the open position.

Expansion chambers should be constructed in accordance with Section VIII of the ASME Code for Unfired Pressure Vessels. (Small vessels are exempted from certain Code requirements)

4.3 CONDENSATION

Condensation or reliquefaction of chlorine may occur in chlorine gas lines which pass through areas where the temperature is below the temperature pressure equilibrium indicated in the vapor pressure curve. Where adequate superheat is not provided by a vaporizer or by reducing the pressure with a pressure reducing valve, the line should be traced and insulated. Surface temperature of the chlorine pipe should not be allowed to exceed 250°F.

5. PREPARATION FOR USE

5.1 CLEANING

All portions of chlorine systems must be cleaned before use because chlorine can react violently with cutting oil, grease, and other foreign materials. Carbon tetrachloride is recommended as a cleaning solvent. CAUTION: Excess exposure to carbon tetrachloride and most other chlorinated solvents presents a toxic risk. Caution must be exercised using the most effective combination of engineering controls, work practices and personal protection that will provide minimum exposure. Cleaning must not be done with hydrocarbons or alcohols because residual solvent may react with chlorine. Any equipment received in an oily condition should be dismantled and cleaned before use.

5.2 HYDROSTATIC TESTING

Chlorine piping should be hydrostatically tested to 1.5 times the maximum pressure to which the system may be subjected. Pressure gages, relief valves and other components which may be damaged should be removed and openings blocked off prior to testing. It is essential that chlorine systems be thoroughly dried (see §5.3) prior to being put into service.

There are some circumstances under which such drying cannot be accomplished after hydrostatic testing with water. If such drying is impractical and if the equipment and components comply in all other respects with the provisions of Institute Pamphlet No. 6, hydrostatic testing may be omitted and the equipment thoroughly cleaned, tested and prepared for service as in applicable parts of §5.3 and §5.4.

5.3 DRYING

During construction, moisture may enter the system from the atmosphere or other sources. For this reason, pipe lines must always be dried before use. This can be done by passing steam through the lines from the high end until the lines are thoroughly heated. While steaming allow condensate and foreign matter to drain out. The steam supply then should be disconnected and all the pockets and low spots in the line drained. While the line is still warm dry air, having a dew point of -40°F or below, should be blown through the line until it is dry. This may require an extended period of time.

If steam and dry air are not available, special care must be taken in cleaning sections of pipe and other equipment before assembly, and careful inspection is necessary as construction proceeds. The final system should be purged with dry cylinder air or nitrogen.

5.4 GAS TESTING

After drying, the system should be pressurized to 150 PSI with dry air or nitrogen and tested for leaks by application of soapy water to the outside of joints. Chlorine gas gradually may then be introduced and the system tested for leaks as described below. Never attempt to repair leaks by welding until all chlorine has been purged from the system. When detectable leaks have been repaired, the line should be retested at the service pressure.

5.5 FINDING LEAKS

The location of a leak in a chlorine containing system can usually be detected by the reaction of ammonia vapor with the escaping chlorine. The reaction is a dense white cloud. The most convenient way to use ammonia for this purpose is to direct the vapor from a plastic squeeze bottle containing aqua ammonia at the suspected leak. Do not squirt liquid aqua ammonia on pipe and fittings.

Any efforts to detect the source of a leak should be carried out with full consideration for potential hazards. Appropriate protective equipment must be used.

6. REFERENCES

6.1 ANSI STANDARDS

ANSI B1.1 - 1974	Unified Inch Screw Threads
ANSI B2.1 - 1968	Pipe Threads (Except Dryseal)
ANSI B16.5 - 1977	Steel Pipe Flanges and Flanged Fittings
ANSI B16.11 - 1973	Forged Steel Fittings, Socket Welding & Threaded
ANSI B16.34 - 1973	Steel Butt-Welding End Fittings
ANSI B18.2.1 - 1972	Square and Hex Bolts and Screws
ANSI B18.2.2 - 1972	Square and Hex Nuts
ANSI B31.3 - 1976	Chemical Plant and Petroleum Refinery Piping
ANSI B57.1 - 1977	Compressed Gas Cylinder Valve Outlet & Inlet Connections
ANSI W3.1 - 1973	Mild Steel Covered Arc-Welding Electrodes
ANSI W3.2 - 1973	Iron and Steel Gas Welding Rods

6.2 ASTM SPECIFICATIONS

A 53	Welded and Seamless Steel Pipe
A 105	Forgings, Carbon Steel, for Piping Components
A 106	Seamless Carbon Steel Pipe for High-Temperature Service
A 181	Forged or Rolled Steel Pipe Flanges, Forged Fittings, and Valves and Parts for General Service
A 182	Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service
A 194	Carbon and Alloy Steel Nuts for Bolts for High Pressure and High-Temperature Service
A 197	Cupola Malleable Iron
A 216	Carbon Steel Castings Suitable for Fusion Welding for High-Pressure and High-Temperature Service
A 234	Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures
A 307	Carbon Steel Externally and Internally Threaded Standard Fasteners

A 320	Alloy Steel Bolting Materials for Low-Temperature Service Ferritic Steel - "L" Grades only
A 322	Hot-Rolled Alloy Steel Bars
A 333	Seamless and Welded Steel Pipe for Low-Temperature Service
A 350	Forgings, Carbon and Low Alloy Steel, Requiring Notch Toughness Testing for Piping Components
A 352	Ferritic Steel Castings for Pressure-Containing Parts Suitable for Low-Temperature Service
A 354	Quenched and Tempered Alloy Steel Bolts, Studs and other Externally Threaded Fasteners
A 395	Ferritic Ductile Iron Pressure Retaining Costings for Use at Elevated Temperatures
A 587	Electric-Welded Low-Carbon Steel Pipe for the Chemical Industry
B 88	Seamless Copper Water Tube

6.3 FEDERAL SPECIFICATIONS

HH-P-46E - Compressed Asbestos Sheet Packing

6.4 OTHERS

SAE Handbook Supplement 150 - 1971 Edition - Tube, Pipe, Hose and Lubrication Fittings

6.5 INSTITUTE

6.5.1 Pamphlets

1 - Chlorine Manual
5 - Facilities and Operating Procedures for Chlorine Storage
9 - Chlorine Vaporizing Equipment
60 - Chlorine Pipelines

6.5.2 Drawings

101 - Excess Flow Valve with Removable Seat - 7,000 lbs per Hour

102 - Studs, Nuts and Gaskets for Chlorine Tank Manway Covers & Valves

104 - Standard Chlorine Angle Valve Assembly

105 - Standard Chlorine Angle Valve Parts

106 - Excess Flow Valve with Removable Basket

110 - Valve for Chlorine Cylinders and Ton Containers - Assembly

111 - 3/4" and 1" Fusible Plug for Chlorine Ton Containers

112 - Valve & Fusible Plug for Chlorine Cylinders & Ton Containers - Spec. & Gen. Notes

113 - Valve for Chlorine Cylinders and Ton Containers - Parts

114 - Excess Flow Valve with Removable Seat - 15,000 lbs per Hour

118 - Chlorine Tank Car Unloading Connections (attached)

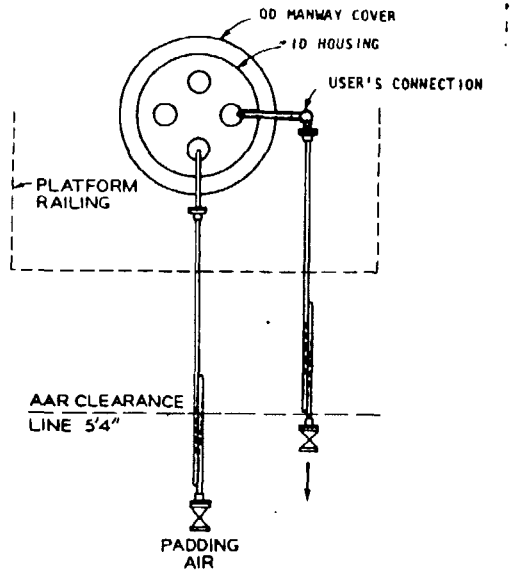
135 - Recommended Specifications for Chlorine Transfer Hose (attached)

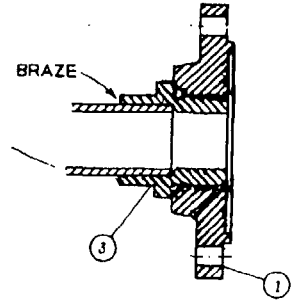
136 - Chlorine Expansion Chambers (attached)

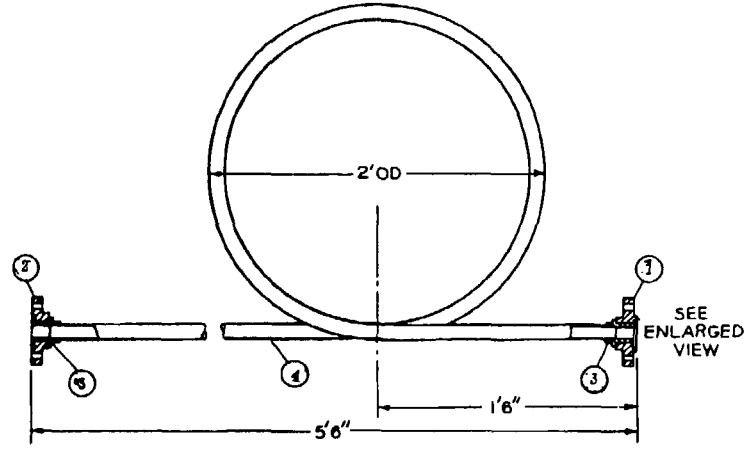
162 - Excess Flow Valve with Removable Seat - 30,000 lbs per Hour

163 - Excess Flow Valve with Removable Seat - 11,000 lbs per Hour

171 - Small Union Connection







ITEM	NAME OF PART	MAT'L
1	FLANGE, 1", SCREWED CLASS 300-ANSI B16.5 LARGE TONGUE	FORGED STEEL ASTM A 105
2	FLANGE, 1", SCREWED CLASS 300-ANSI B16.5 LARGE GROOVE	FORGED STEEL ASTM A 105
3	ADAPTER, SOLDER JOINT, ANNEALED, (1-1/8" OD TUBE TO 1" MALE NPT)	WROUGHT COPPER ASTM B 75
4	TUBING, 1" STD SIZE, TYPE K, ANNEALED (1-1/8" OD x .065" WALL)	COPPER ASTM B 88

NOTES:

1. USE OF FORGED STEEL TWO BOLT OVAL FLANGES ACCEPTABLE.
2. JOINTS SHOULD BE MADE WITH A BRAZING ALLOY CONTAINING NO TIN.

ISS.	DATE	REVISION	APPR
2	9/1/77	Update B/g; Delete det user's conn	CCSS
1	5/19/76		CCSS

THE CHLORINE INSTITUTE, INC.
NEW YORK, N.Y

CHLORINE TANK CAR UNLOADING CONNECTIONS

DRAWN		
TRACED		
CHECKED	MR	
APPROVED	CCSS	Issue 2 - 6/23/77
DWG NO.	118	ISSUE 2

This drawing was developed by a technical committee of the Institute. The user should be aware that changing technology or regulations might require revision of the drawing. Appropriate steps should be taken to insure that the drawing is current when used.

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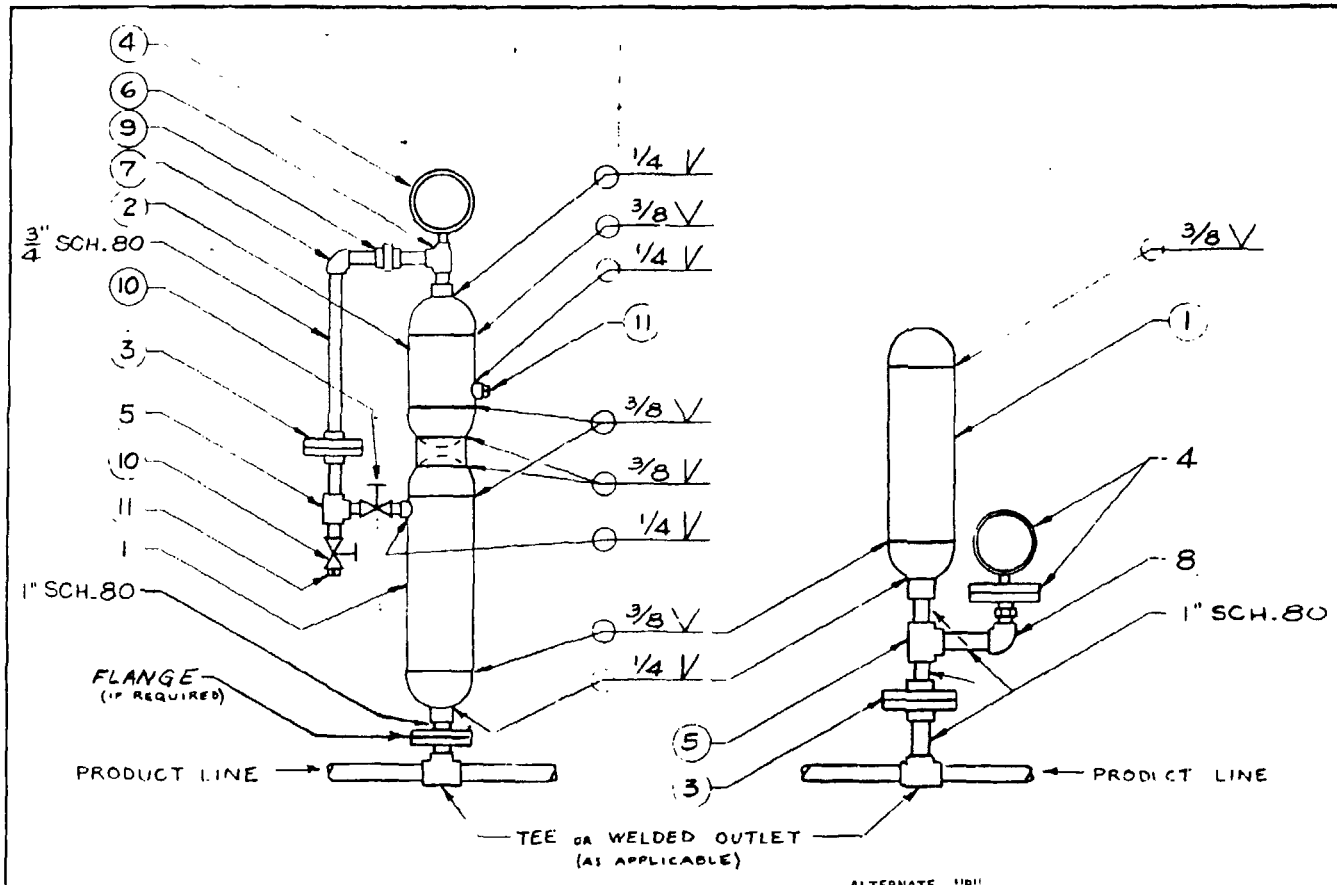

ITEM	NAME OF PART	
1	PRIMARY EXPANSION CHAMBER	[Note 1]
2	SECONDARY EXPANSION CHAMBER	[Note 2]
3	RUPTURE DISC (400 P. S. I.)	[Note 3]
4	PRESSURE INDICATOR OR ALARM SWITCH, 1/2" CONN.	[Note 4]
5	TEE	[Note 5]
6	REDUCING TEE	[Note 5]
7	ELBOW	[Note 5]
8	REDUCING ELBOW	[Note 5]
9	UNION	[Note 5]
10	VALVE	[Note 5]
11	PLUG	[Note 5]

NOTES:

1. CAPACITY - 20% OF LINE VOLUME
2. CAPACITY - 10% OF LINE VOLUME
3. 400 PSI SETTING SUITABLE FOR MANY SYSTEMS. SETTING MUST NOT EXCEED SYSTEM DESIGN PRESSURE
4. LIQUID-FILLED PROTECTIVE DIAPHRAM OPTIONAL
5. FITTINGS SHALL BE FORGED CARBON STEEL, 3000 LB CWP

ISS.	DATE	REVISION	APPR
3	3/1/79	New Note 3, relocate 4 & 5	CCSS
2	9/1/77	PART 4, NOTE 4, & FLANGE WAS UNION	CCSS

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NEW YORK, N.Y.

CHLORINE EXPANSION CHAMBERS

DRAWN	[illegible]	
TRACED		
CHECKED	[illegible]	
APPROVED	[illegible]	Issue 2 - CCSS 6/29/77
DWG. NO.	136	ISSUE 3

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