Containers
Chlorine is packaged in containers as a liquefied gas under pressure, resulting in the container having both a liquid phase and a gas phase. When removing gas from a container, heat is needed to vaporize the liquid. Liquid absorbs heat from the surrounding liquid until the liquid temperature is lower than the surrounding air. Then heat is absorbed through the container walls from the surrounding air. This heat absorption has a cooling effect on the container. When the container cools to the dewpoint of the air, the moisture in the air condenses on the container's outside walls. As cooling continues, the moisture freezes, insulates the container and inhibits heat transfer to the liquid, reducing the rate of vaporization.

Circulating air can have a significant effect on increasing the withdrawal rate. Air circulation is an important factor in achieving dependable and continuous withdrawal of gaseous chlorine from cylinders and ton containers. Other factors that govern withdrawal rates include air temperature, container wall thickness, humidity, and volume of liquid chlorine remaining.

CAUTION: Never apply heat directly to a chlorine cylinder or ton container. (See bulletin 010.3220)

Dimensions and Weights of Cylinders and Ton Containers*

<table>
<thead>
<tr>
<th>Container Type</th>
<th>Net Capacity</th>
<th>Weight Empty</th>
<th>Outside Diameter</th>
<th>Overall Height</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>lbs.</td>
<td>kg</td>
<td>lbs.</td>
<td>kg</td>
</tr>
<tr>
<td>Cylinder</td>
<td>100</td>
<td>45</td>
<td>63-115</td>
<td>29-52</td>
</tr>
<tr>
<td>Cylinder</td>
<td>150</td>
<td>68</td>
<td>85-140</td>
<td>39-64</td>
</tr>
<tr>
<td>Ton</td>
<td>2000</td>
<td>907</td>
<td>1300-1650</td>
<td>590-748</td>
</tr>
</tbody>
</table>

Notes:
1. Weight includes protection hood and valve(s)
2. Height to top of valve protection hood; height to center line of valve outlet from the valve base, is approximately 3-1/2" (89 mm) less.
3. The threads for the standard Chlorine Institute valve are not standard pipe threads but are special straight threads. Thread designation is 1.030"-14NGO-RH-EXT.
4. Every cylinder valve is equipped with a fusible metal plug. The plug is designed to melt at 158°F-162°F (70°C-74°C). The purpose is to relieve the cylinder pressure during conditions of high temperature, preventing explosion. U.S. ton containers are fitted with three (3) fusible plugs in each end of the container.

Typical Dimensions and Weights for Tank Cars*

<table>
<thead>
<tr>
<th>Net Weight</th>
<th>Length Over Car Strikers</th>
<th>Overall Height</th>
<th>Height to Valve Outlet</th>
<th>Extreme Widths</th>
<th>Weight Empty lbs</th>
<th>Weight Loaded lbs</th>
</tr>
</thead>
<tbody>
<tr>
<td>16 ton</td>
<td>32’ 2”-33’ 3”</td>
<td>10’ 5”-33’ 3”</td>
<td>9’ 3”-1’-0”</td>
<td>9’ 2”-9’ 6 1/2”</td>
<td>42,000-51,000</td>
<td>74,000-83,000</td>
</tr>
<tr>
<td>30 ton</td>
<td>33’ 10”-35’ 11 1/2”</td>
<td>12’ 4 1/2”-13’ 7”</td>
<td>11’ 3”-11’ 9”</td>
<td>9’ 3”- 10’ 2”</td>
<td>55,000-65,000</td>
<td>115,000-125,000</td>
</tr>
<tr>
<td>55 ton</td>
<td>29’ 9”-43’ 0”</td>
<td>14’ 3”-15’ 1”</td>
<td>12’ 6”-13’ 4”</td>
<td>9’ 3”-10’ 7 1/2”</td>
<td>57,000-94,000</td>
<td>167,000-204,000</td>
</tr>
<tr>
<td>85 ton</td>
<td>43’ 7”-50’ 0”</td>
<td>14’ 11”-15’ 1”</td>
<td>13’ 2”-13’ 4”</td>
<td>10’ 5”-10’ 6 1/2”</td>
<td>79,700-90,100</td>
<td>250,300-260,100</td>
</tr>
<tr>
<td>90 ton</td>
<td>45’ 8”-47” 2”</td>
<td>14’ 11”-15’ 1”</td>
<td>13’ 2”-13’ 4”</td>
<td>10’ 5”-10’ 6 1/2”</td>
<td>81,900-82,900</td>
<td>261,900-263,000</td>
</tr>
</tbody>
</table>

1. Dimensions and weights are typical. For complete details, contact your local supplier.

* Source: The Chlorine Manual
Storage Requirements/Handling Equipment

Storage
It is common practice to have at least one chlorine gas cylinder in reserve for each one in use. Storage areas should be maintained at a minimum temperature of 60°F (11°C). Cylinders should never be stored in direct sunlight, and all cylinders should be secured with safety chains.

For systems using more than five operational cylinders, a switchover system or a change to ton containers should be considered.

To monitor the amount of chlorine used, single or dual cylinder scales are normally used with gas cylinder installations. Platform type scales may be used for systems requiring more than two cylinders.

Handling of 150 lb. chlorine gas cylinders is accomplished by using a specially designed chlorine cylinder hand truck. The cylinder should be chained to the hand truck to prevent accidental tipping and subsequent cylinder or valve damage.

Ton Containers
It is also common to have at least one reserve ton container for each container in service, with storage space provided for a future shipment. The storage facility should be designed to provide one set of trunnions for each container in use. The trunnions provide spacing support for each ton container along with the ability to position the outlet valves vertically.

The gross weight of the ton container (3,500 lbs/1587 kgs) necessitates special handling equipment. This equipment includes:
- Hoist with trolley rated at 2 tons (4,000 lbs/1815 kgs) [minimum]
- Lifting bar
- Monorail for trolley

Ton container scales are recommended to provide personnel with a continuous read-out of chlorine usage.

Piping
Materials of Construction
All piping installation should be made in accordance with Chlorine Institute Pamphlet #6, “Piping Systems for Dry Chlorine”. For vacuum piping recommendations, reference bulletin 121.3003.

Chlorine gas pressure manifolds should be constructed of 3/4” or 1” diameter Schedule 80 seamless, carbon steel pipe, Grade B, Type S, ASTM A-106. Fittings should be 3/4” or 1” forged steel rated at 3,000 pounds CWP, Grade A-105. PTFE tape, PTFE paste certified for chlorine service or litharge and glycerin is recommended for all threads. Flexible connectors should be of 3/8” O.D. cadmium plated copper tubing. They may be six feet or more in length.

Refer to Figure 1 for pressure drop of 1” and 1-1/2” pipe at various pressures.

Heat Tracing
An alternative to heat tracing would be the placement of a pressure reducing valve prior to long pressure piping runs. The PRV should be set to 40 psig outlet pressure.

Chlorine gas should not be allowed to reliquefy in use. Heat tracing of gas pressure lines should be considered.

The entire length of the chlorine gas pressure manifold should be heat traced with strip heaters to prevent reliquefaction of chlorine gas in the manifold. Pad heaters should also be employed on drip legs to vaporize collected liquid. The number and orientation of the drip legs should be in accordance with bulletin 120.3004.

Note: Never apply direct heat to chlorine cylinders or ton containers. Direct heating of chlorine could result in increased pressure and in the melting of the fusible plug and create a chlorine emergency. All manifolds should be cleaned and pressure tested before installation in accordance with Chlorine Institute recommendations (Pamphlet #6)

Pressure Testing
In preparation for use, all chlorine pressure piping should be pressure tested. Hydrostatic testing of piping requires extensive drying before chlorine introduction.

Prior to testing, cleaning is usually done by flushing with water and then steam cleaning until the lines are thoroughly heated. All lines are dried using air with a dewpoint of -40°F (-40°C) until they are dry. This may require several hours. Follow Chlorine Institute procedures (Pamphlet #6).
Figure 1 - Pressure Drop for Gaseous Chlorine Lines
Valves
Four types of valves are associated with chlorine piping systems:

1. Manifold (header) valves - Used to connect flexible connector to a manifold or a vacuum regulator yoke.
2. Isolating valves - Recommended in gas and liquid systems to isolate a pressurized line. May also keep moisture from the piping system during container changes.
   **Note:** Manifold valves are NOT recommended for liquid systems. Liquid chlorine may become trapped in the flexible connector between the manifold valve and the isolating valve. If the flexible connector should heat up, (i.e. direct sunlight) rupture of the connector could occur.
3. Pressure In-line Valves - Used for general valving functions in a chlorine liquid or gas pressure piping system.
4. Pressure Reducing Valves - Used whenever a potential liquefaction problem exists.

Gas Filters
A chlorine gas line filter is recommended for all chlorine gas pressure lines to remove foreign matter normally encountered within the system. For example, a filter can be placed upstream of a pressure reducing valve to aid removal of contaminants at the valve orifice. Two types of filters are available depending upon the needs of the application:

1. Cast steel Y-type strainer with 40 mesh model screen. (See bulletin 120.3051)
2. Cartridge type filter with replaceable element. (See bulletin 120.3050)

Liquid Chlorine Piping System
Materials of Construction
The liquid chlorine piping should be fabricated from 1" seamless carbon steel pipe, Grade B, Schedule 80, Type S, ASTM A-106. Fittings are 1" forged steel rated 3,000 pounds CWP, Type A-105. Unions should be 1" ammonia flange type with lead gaskets. PTFE tape, PTFE paste certified for chlorine service or litharge and glycerin is recommended on all pipe connections.

Expansion Chambers
Any liquid chlorine piping that can be isolated between two valves must be protected by an expansion chamber. This chamber protects the pipeline from rupture due to an increase in hydrostatic pressure should both valves be closed and the trapped liquid chlorine heated. The expansion chamber should have a volume of at least 20% of the protected line volume.

Note: Chlorine liquid manifolds allow for the coupling of one or more chlorine ton containers to a common header. Chlorine Institute Drawing 183 recommends the correct procedure for manifolding of ton containers on liquid manifolds. (Also see bulletin 115.3003).

Capital Controls standard expansion chamber assembly will protect pipe lengths of 1" Schedule 80 steel pipe, 470 ' (143 m), and 3/4" Schedule 80 steel pipe, 785 ' (239 m). (See bulletin 115.3005)

Expansion chamber rupture disc burst pressure is = 400 psig (27.5 bar). See bulletin 115.3003.

Refer to Figure 2 for pressure drop information for liquid chlorine.
Figure 2 - Pressure Drop for Liquid Chlorine Lines