# Improving the Safety of Chlorine Transporting


Chlorine has wide-scale applications but is also highly toxic and hazardous. High demand for chlorine not only calls for large-scale production but also transportation to usage locations, which requires high level of safety. This article throws light on new technology by Midland, which helps ensure safe completion of chlorine shipments.

Chlorine is a key component in the production of a variety of industrial and consumer products that enhance the health, convenience and comfort of our lives. The largest users of chlorine are companies that make ethylene dichloride and other chlorinated solvents, polyvinyl chloride (PVC) resins and chlorofluorocarbons. It is used in over half of all industrial chemical processes, including 90 per cent of pharmaceuticals and 96 per cent of crop protection chemicals. Chlorine is also used in the manufacturing of plastics, paper, medical devices, automobiles, textiles and household cleaning products. Additionally, chlorine plays an important role in the purification of water. Chlorine also provides a residual level of disinfectant that helps protect treated water. In addition to purifying water, chlorine helps remove tastes and odours, control the growth of slime and algae in pipes and storage tanks, and helps to remove unwanted nitrogen compounds.

**Harmful Effects of Chlorine**

While chlorine helps improve the quality of our everyday lives, it is also highly toxic and considered to be among the most dangerous of hazardous materials. Classified as both a Toxic Inhalation Hazard (TIH) and a Poison Inhalation Hazard (PIH), chlorine gas becomes extremely dangerous when released into the air. Small doses of chlorine gas are detectable with measuring devices in concentrations as low as 0.2 parts per million (ppm), and by smell at 1 ppm. Even in these small doses, chlorine can irritate the eyes, skin and respiratory system. If inhaled at high concentrations, at or above 40 ppm, chlorine begins to break down in the lungs to form hydrochloric acid (HCL) that burns lung tissue, causing pulmonary edema and essentially causing drowning as liquid floods the lungs.

Although the risk of exposure depends on how close a person is to the release, chlorine spreads easily when caught in the wind. When this occurs, it has the potential to endanger a large population of the general public. In addition, chlorine can be harmful to the environment. It is especially dangerous to organisms living in water and in soil. Once released, chlorine begins to immediately react with other chemicals. Ultimately, the consequences of a release depend on the source, the surrounding terrain and meteorological conditions. The source is determined by the quantity of material released and the duration of a release. Meteorological conditions and the surroundings influence the dispersion of the gas and the duration of exposure. These conditions include the amount of moisture in the air, wind direction and speed, amount of sunlight, terrain and temperature.

**Risks of Transporting Chlorine**

While it is a naturally occurring element, large-scale production of chlorine takes place all over the world because of its high demand. While the majority of chlorine is used directly at the production site, transporting it to additional usage locations is common. Ultimately, transporting chlorine from production facilities to usage locations adds up to millions of miles in transportation each year. Chlorine is most commonly transported on tank trucks or rail tank cars in specially designed pressurised tank containers. Generally made and lined with different types of steel, these containers are designed to carry a few pounds up to several tonnes of chlorine at any given time. Tank cars utilise a pressure plate with the fittings, valve system and a cylindrical protective housing at the top. This means that all loading and unloading of the commodity is

*Midland Manufacturing's Enhanced Fittings Package for use with chlorine*

done through the protective housing at the top of the tank.

Chlorine releases that occur during transport (including loading and unloading) can happen either in an accident by mechanical failure or by operator error. Any unintentional release that does not involve an accident has been termed 'Non-Accident Releases' (NARs). NARs consist of leaks, splashes and other releases from improperly secured or malfunctioning valves, fittings and tank shells, and also include releases from pressure relief devices. Most NARs happen during the loading and unloading process when human interaction is occurring. When this happens, it is usually the result of an incorrect connection between the hose connection and the tank valve. In addition, the hose that connects to the valve for loading and unloading can leak or even break. When these incidents occur, secondary protection equipment must be used to help prevent personnel from exposure.

Once chlorine has been loaded into a tank car and begins traveling down the road or rail, there usually is no one watching the tank to ensure the valves are performing correctly and a leak is not occurring. For this reason, it is imperative that the valve system can be trusted to operate properly and holds the chlorine inside the tank. Once in transport, there is always the potential for a derailment or a truck roll over. When this occurs, since all the fittings and valves are located on the top of the tank car, the angle valves and pressure relief valve run the risk of being sheared off. When this occurs, chorine gas will inevitably be released into the atmosphere.

**Improving Chlorine Transport**

Recently, the chemical and transport industries have made significant improvements to help minimise the risk of transporting chlorine, including improvements to rail car equipment and transportation regulations. For example, a major change in regulation is occurring industry-wide, requiring extra protection when transporting any TIH or PIH commodity. These new regulations, set forth by the Association of American Railroads (AAR), call for an increase in top protection on the tank car. To address these regulations, industry professionals have two options. The first option is to install more physical protection, like a jacket or shield, to cover the loading equipment. This helps ensure the entire area cannot be sheared off or damaged in the event of an accident. The second option is to install an upgraded valve system that has been designed with the primary seals at or below the surface of the pressure plate. These new valve systems not only reduce the risk of product loss to the atmosphere in the event the fittings are damaged during an accident, but also have been designed with additional sealing to reduce the amount of NARs.

Midland Manufacturing, Skokie, Illinois, USA, recently worked with a number of shippers, rail car builders, leasing companies and regulatory agencies to develop its new Enhanced Fittings Package, which has been designed with the primary seals at or below the surface of the pressure plate. The Enhanced Fittings Package includes Midland's A-14378-ML-VL Pressure Relief Valve, 9100-CS Pressure Plate, A-180-ML-TG Check Valve and A-718-S-HC Angle Valve. When Midland first introduced the Enhanced Fittings Package in 2009, it was installed onto 25 rail cars and tested for over a two-year period.

Since then, these cars have traveled over 220 trips and over 250,000 miles, including loading and unloading. To date, no leaks or failures have occurred. This is due to corrosion-resistant materials – including Hastelloy® C, Stellite 21, Monel® and Inconel® X750 – that have been proven to better withstand all of the operating environments typically found in the transportation of chlorine. One of the most significant benefits to utilising the Fittings Package is that it offers triple sealing protection. This means that it has been designed with three points of sealing – the check valve, the angle valve at its seat and the plug on the angle valve. So essentially, there has to be three failures in the system for a leak to occur. This is a dramatic improvement over other valve systems that feature only one point of sealing. Unlike on previous valve systems where the angle valve was used as the primary seal point, there is a check valve as the primary seal, which allows the angle valve to experience less wear and tear over time because it no longer has vapours constantly in contact with it. Additionally, an additional layer of protection has been added on the check valve, with a seal chamber, located between the seat and the commodity.

In addition, with improved characteristics for loading and unloading tank cars, the Package has been designed to be used with increased-diameter protective housings; and can utilise current load-rack configurations or change to vertical loading and unloading. The pressure relief valve and angle valves can be removed for testing and maintenance without cleaning the car. There is also no need to remove the pressure plate and inspect the check valve because all the internal components can be removed through the pressure plate.

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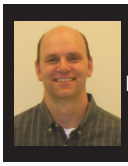
**Conclusion**

While chlorine is an essential part of the industrial and consumer products that enhance our everyday lives, it is essential to remember that it is still a very toxic chemical. Improving the equipment used during transport of chlorine can go along way in helping to ensure that personnel, the general public and the environment are protected against potential chlorine releases. ■



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