

# Safety Advisory

## Chlorine Transfer Hose Failure

U.S. Chemical Safety and Hazard Investigation Board



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### Key Message

Chlorine handlers using nonmetallic-lined chlorine transfer hoses should ensure that these hoses are constructed with the appropriate structural braiding layer, either PVDF monofilament material or Hastelloy C-276.

### Introduction

The U.S. Chemical Safety and Hazard Investigation Board (CSB) is issuing this Safety Advisory to inform users of chlorine of the importance of using chlorine transfer hoses (CTH) with the proper material of construction and of the need for end user positive identification of hoses. This Advisory is a preliminary product of the investigation into an August 14, 2002, chlorine release at DPC Enterprises in Festus, Missouri. CSB will publish a detailed report on the incident at the conclusion of the investigation. However, this Advisory is being issued at this time so that other chlorine handlers can take appropriate safety precautions.

### Background

CTHs with a nonmetallic<sup>1</sup> inner core such as Teflon are more tolerant of moisture. However, this inner core is subject to permeation by chlorine molecules. The Chlorine Institute recommends that hoses constructed with such an inner lining “have a structural layer braid of polyvinylidene fluoride (PVDF) monofilament material or a structural braid of Hastelloy C-276.”<sup>2</sup> If the braid is not composed of the recommended material, permeating chlorine molecules could potentially attack the braid layer and weaken the structural integrity of the hose.

### The Incident

On August 14, 2002, a 1-inch CTH used in a railcar offloading operation at DPC Enterprises in Festus, Missouri, catastrophically ruptured and initiated a sequence of events that led to the release of 48,000 pounds of chlorine into neighboring areas. The material of construction of the ruptured hose was incorrect.

<sup>1</sup> Most plastics react chemically with chlorine because of their hydrocarbon structural makeup. This reactivity is avoided with some plastics in which fluorine atoms have been substituted into the hydrocarbon molecule.

<sup>2</sup> Piping Systems for Dry Chlorine, Pamphlet #6, edition 14, December 1998. Structural braid provides mechanical reinforcement for pressure containment.

DPC corporate headquarters ordered several CTHs from a hose distributor<sup>3</sup> for railcar offloading operations at its chlorine repackaging facilities in Festus and Sweetwater, Texas. The distributor fabricated bulk CTH hose with Schedule 80 Monel 400 end fittings and a high-density polyethylene spiral guard. Three hoses were shipped directly to the Festus facility from the distributor; two were put into service on June 15, 2002. The hose involved in the incident failed after 59 days in service.

Shipping documentation<sup>4</sup> indicated that the CTHs were constructed of a convoluted Teflon-inner liner and Hastelloy C-276 structural braid layer. DPC has no testing capabilities to verify materials of construction; they depend on documentation from the distributor and visual inspection.

The ruptured hose was tested after the incident. Test results indicated that the hose was constructed of a 316 L stainless-steel structural braid layer,<sup>5</sup> and thus did not follow Chlorine Institute recommendations for nonmetallic-lined hoses.

CSB has not yet determined the point in the supply chain<sup>6</sup> where the mix-up in the order could have occurred. However, CSB is issuing this Safety Advisory as a precaution to other users of nonmetallic-lined chlorine transfer hoses.

## **Information Resources**

CSB contracted with a third party to analyze segments of 316 L and Hastelloy C-276 structural braid layer hoses with X-ray fluorescence (XRF) nondestructive testing. This test method provided positive materials identification (PMI) of the hose braid layer.

The following are resources for additional information on materials testing and chlorine systems:

American Society for Nondestructive Testing  
P.O. Box 28518  
1711 Arlingate Lane  
Columbus, OH 43228  
Phone (800) 222-2768  
[http:// www.asnt.org](http://www.asnt.org)

ASTM (formerly known as American Society for Testing and Materials)  
100 Barr Harbor Drive  
P.O. Box C700  
West Conshohocken, PA 19428-2959  
Phone (610) 832-9585  
[http:// www.astm.org](http://www.astm.org)

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<sup>3</sup> The distributor purchases bulk quantities of raw hose (inner-liner plus structural braiding) from a hose manufacturer and then fabricates the hose according to customer requirements.

<sup>4</sup> The hose pressure test certification, work order with bill of materials, invoice, and shipping certification from the distributor.

<sup>5</sup> The 316 L stainless-steel structural braid layer and Hastelloy C-276 braid cannot be distinguished through visual inspection. The distributor did not perform a positive materials identification (PMI) test on the bulk hose upon receipt from the hose manufacturer or on the fabricated hoses before shipment. DPC did not perform a PMI test on the hoses upon receipt or prior to installation.

<sup>6</sup> DPC, Hose distributor, and Hose Manufacturer.

*The Chlorine Institute has published several pamphlets of interest, including:*

Piping Systems for Dry Chlorine, Pamphlet #6, edition 14, December 1998 (Appendix A provides recommendations for chlorine transfer hoses.)

The Chlorine Institute, Inc.  
1300 Wilson Boulevard  
Arlington, VA 22209  
Phone (703) 741-5760  
[http:// www.cl2.com](http://www.cl2.com)

**For more information.....**

Contact the U.S. Chemical Safety and Hazard Investigation Board at (202) 261-7600  
Monday – Friday, 9:00 a.m. to 5 p.m. EST

Please notify CSB as soon as possible if your facility determines that a chlorine transfer hose has been misidentified or if you have experienced chlorine transfer hose failures due to incorrect hose material of construction.

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## Notice

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