



TO ▶ **EMEA Sales Management**  
FROM ▶ **K. Holvoet, Product Engineer**

DATE ▶ **February 18, 2011**

SUBJECT ▶ **Oxygen Diffusion in Hydronic Systems**

You have received a customer request for information on oxygen diffusion characteristics of Victaulic couplings. Victaulic's elastomer gaskets are encased in an impermeable metallic housing and not open to the atmosphere. We have conducted testing and found a grooved system using Victaulic couplings demonstrates oxygen diffusion characteristics equivalent to other metallic systems in preventing the diffusion of oxygen into a hydronic heating system.

### **Diffusion**

Oxygen in a heating system can cause corrosion of piping, pumps, boilers and other components. Oxygen diffusion is the ability of oxygen molecules to pass through a material due to the material's molecular structure and a difference in the partial pressure of oxygen on each side of the material. Diffusion does not depend on system pressure, but on the partial pressure of the oxygen molecules across the permeable membrane so under the right conditions atmospheric oxygen can enter a piping system filled with pressurized water.

Metal pipes (i.e. carbon steel, stainless steel, copper, aluminum, and ductile iron) are not permeable. The customer's claim is that the joining method (threading, flanging, and grooving) may allow for oxygen diffusion.

### **Victaulic Couplings**



The mechanical Victaulic joint, or coupling, is comprised of four elements: the grooved pipe, the gasket, the coupling housings, and the nuts and bolts. The pipe groove is made by cold forming or machining a groove into the end of a pipe. The key section of the coupling housing engages the groove when the bolts and nuts are tightened. In the installed state the coupling housings encase the gasket in impermeable metal.

We recommend our coupling with Grade "E" and "EHP" EPDM gaskets for chilled, condenser, heating and domestic water systems.

As the first grooved coupling manufacturer to use EPDM material, we have more than thirty years of experience in developing and improving the gasket compound, it's processing and our test methods. Victaulic is the only grooved product supplier to design and manufacture its gaskets in-house and we control all phases of gasket development to ensure a product of the highest quality and performance.

Victaulic grooved couplings have provided many successful years of reliable service in HVAC applications, including hot (hydronic) heating, boiler piping systems, dual temperature systems, cooling and chilled water systems. Victaulic couplings are durable and designed to last the life of the piping system. Victaulic has never been made aware of any type of system failing from accelerated corrosion due to using Victaulic grooved mechanical pipe couplings.

Victaulic couplings in heating and cooling systems are used with impermeable carbon steel pipe, the gasket is encased in impermeable metal, and the surface area of the gasket material within the couplings is negligible compared with the total pipe surface area. However, to satisfy customer concerns, tests were performed to identify any oxygen diffusion/permeability through Victaulic couplings

## **The test**

### 1. Test Program



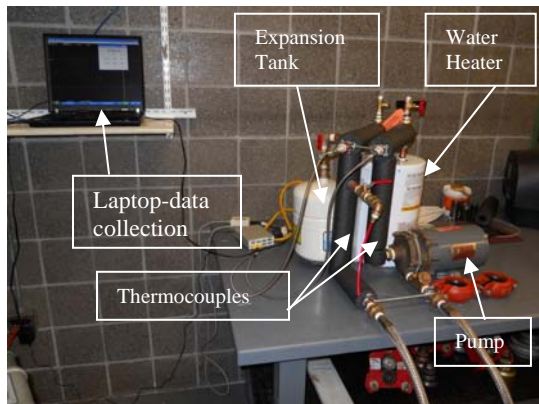
Picture 1  
Piping Layout

A test simulating a hydronic heating system was developed. Dissolved oxygen in the water was continuously measured on both welded and grooved systems in which 40°C water continuously circulated.

For both systems, the piping layout consisted of 2 inch (60.3 mm) carbon steel (schedule 40) pipe with a total length of 20 feet (6.096 m). In the mechanically joined system the grooved piping and elbows were connected with a total of 10 Victaulic couplings, 5 Style 107 QuickVic Rigid Coupling and 5 Style 177 QuickVic Flexible Couplings with EHP gaskets (picture 1)

A water heater and pump were connected to the closed loop systems to circulate and heat the water in the piping (picture 2).

A dissolved oxygen meter/probe was inserted in the systems to provide a continuous reading of the dissolved oxygen in the hot water (picture 3).



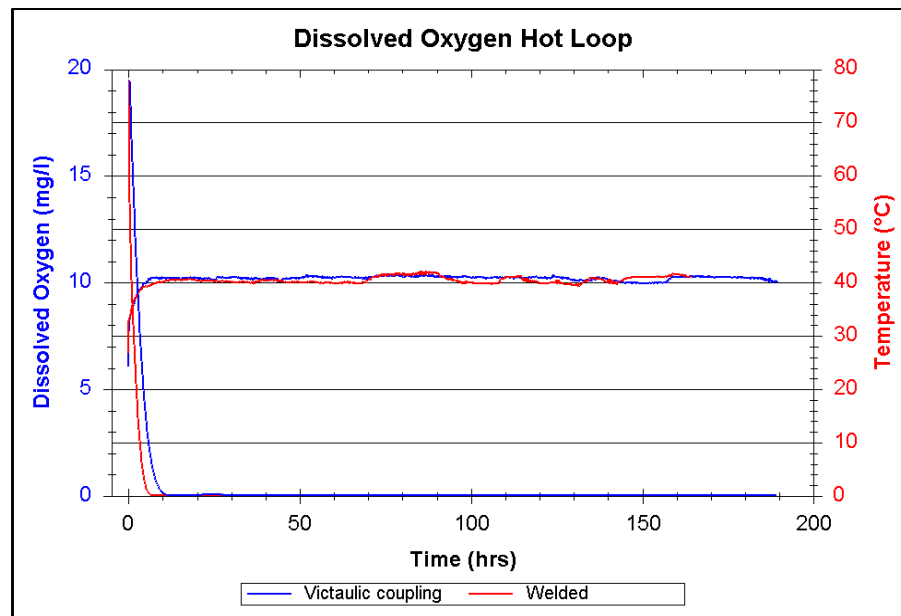
Picture 2  
Test layout



Picture 3  
Oxygen probe

Fresh tap water of 20°C was introduced in the piping systems and was heated to and maintained at 40°C during the test.

## 2. Results



The above graph shows the dissolved oxygen data for the piping loops over time. The temperature was maintained at 40°C during the complete test. When cold fresh water 20°C was first introduced into the loop, the dissolved oxygen level was at its highest, but dropped to zero for both systems in less than ten hours. The oxygen depletion is expected and caused by a reaction between the metal ions of the carbon steel pipe and the oxygen in the water. As shown on the graph, once the oxygen level was depleted, it remained to a level below detection limits during the next eight days, when the test was ended, for both grooved and welded systems.

### 3. Conclusions

Based on the results it can be concluded that a grooved system using Victaulic couplings demonstrates oxygen diffusion characteristics equivalent to other metallic systems. In both systems, the oxygen was depleted in less than ten hours and the level for both systems remained at a level below detection limits for the duration of the test.

Victaulic couplings do not contribute to oxygen concentrations in a hydronic heating system.

KDH: mfw