HDPE DUAL CONTAINMENT PIPING SYSTEMS COMPREHENSIVE TESTING GUIDELINES

1. INTRODUCTION

ISCO Industries, Inc. has developed specifications for many HDPE dual contained piping system projects. Our specification guidelines have been used as a guide for commercial, industrial, municipal, Superfund, Corp of Engineers, DOD, and DOE projects. Our systems are handling hydrocarbons, acids, bases, and chlorinated compounds over a wide range of temperatures in gravity and force main applications.

Every system is different. Each engineer must give sufficient thought to their system's testing procedure. These guidelines are intended to give an overall view of the applicable guidelines that we recommend for testing of Dual Containment HDPE Piping Systems. Many specifying organizations, like the Corp of Engineers, refer to ASTM standards. ASTM F2164 is a specification for hydrostatic field leak testing of polyethylene (PE) pressure piping systems. The procedures and safety considerations included in this standard should be followed. Unfortunately, this standard (and most HDPE manufacturers' testing guidelines) are for single wall piping systems. Since no standard currently exists for testing dual containment piping systems, we have used ASTM F2164 as a starting point for our test guidelines. A comprehensive copy of the standard is available for purchase from ASTM International.

2. GENERAL CONSIDERATIONS

2.1 Containment Testing - In dual containment piping systems the inner (carrier) pipe is the system's actual "pipe line" that performs the fluid transmission function of the dual contained piping. The outer (containment) pipe is the means by which the carrier can be leak detected as well as providing secondary containment. The "secondary containment" function of the containment piping is actually a bonus. The regulatory thrust for dual containment comes from the need to detect leaks in the primary vessel, the carrier pipe. The containment pipe creates a controlled environment, the annular space, around the carrier pipe that allows the carrier to be leak detected by looking for a "change" in that controlled environment. This is an important consideration for these types of systems. The integrity of the annular space must be demonstrated by a pressure test, but the test medium for the annular space should not contaminate that space with a material that can confuse the leak detection capability of the system. For this reason, water is not a good test medium for the annular space of dual containment systems. Even in a fuel system, a leak in the containment can introduce water into the system. If water is used in testing the annular space, the system must be dried or the integrity of the containment cannot be assured. Thus, an air pressure test is our recommendation for the annular space of these types of systems so that the annulus maintains a clean and dry condition.

The problem with air testing relates to the compressibility of gases and stored kinetic energy. A pressure surge of six times the gauge pressure is possible with compressed air and care must be taken to prevent an unsafe test condition. If an SDR 17 system was being tested at 150 psi air, and a surge occurred, 900 psi is possible and damage would occur to the system and persons around the pipe. We recommend a very low pressure air test for the containment annular space.

2.1.1 Air Test Acceptability - Why is a low pressure air test acceptable? A low pressure test does not give a real indication of the tensile strength of the containment weld. The simultaneous welding procedure allows us to perform both pipe welds concurrently with a high degree of confidence. This affects the testing logic of our system in a very positive way. In our welding procedure, the containment acts as a "guide" for the carrier piping weld, making the carrier piping hydrostatic test a strong indicator of the strength of the containment weld. By using a low pressure air test, we are not testing the strength of the containment weld - the carrier hydrostatic test accomplishes this. We are checking the integrity of the entire containment system.

2.1.2 Special Containment Fittings - Annular access ports and low point drains for the containment piping are important fittings that do not occur in single wall piping systems. These fittings greatly facilitate the testing and in many dual containment systems are the only way to test the annular space. They should be included in any dual containment piping system for many reasons - not all are associated with testing. Careful thought should be given to the location of these fittings in the system.

2.2 Carrier Testing - There are two basic types of pipeline flows: Gravity and pressure (force mains). Both systems require testing. The difference in procedure for these two HDPE systems has to do with the use of different fittings and tie-ins to structures. For example, in a gravity system often the pipe is open to a manhole, reducing the pressure capability of the system. Fittings are another limiting factor in gravity (and pressure) systems. In gravity systems, the use of wyes, crosses, and other fabricated structures may limit the pressure capability of the system. As with any piping system, the pressure rating of the system is only as high as the lowest rated component in the system.

2.2.1 Gravity - In gravity systems, the carrier testing is usually accomplished by using a low pressure test consisting of a column of water providing a liquid head pressure in the system, or a low pressure air test. This accommodates the use of many traditional gravity profile fittings such as wyes, crosses, etc.

2.2.2 Force Main - Pressure systems can be tested at higher pressures than the actual working pressure of the system. Normal HDPE pressure test guidelines are for a test of 1.5 times the rated pressure of the piping. In the example of a DR 11 pipe that is rated at 200 psi, the pressure test can be as high as 300 psi (at ambient temperature).

However, the same constraint applies in regard to system components as applies to gravity systems. The pressure rating of the system is only as high as the lowest rated component in the system. It is important to know the types of fittings and their rated pressure for any dual containment piping system.

2.2.3 Fittings - Molded fittings versus fabricated fittings. Some competing systems claim that molded fittings are "superior" to fabricated fittings, implying a lack of quality or an inherent weakness. Fabricated fittings are just as strong as molded fittings when properly made. Some require pressure derating and some do not. Fittings that are fabricated from saddle fusion fittings with saddle-fusion welding have the same pressure as comparable molded fittings. In the case of a mitered fabricated fitting there is a derating requirement. Otherwise, integral reinforcement is required to maintain the rating. Reinforcement is also the reason that molded fittings have equal pressure rating to the pipe - the wall thickness at areas of high stress concentration is greater than the pipe's. We will provide the most cost-effective fitting that meets the application's needs, based on accepted engineering best practices and HDPE manufacturing techniques.

3. TESTING PROCEDURE GUIDELINES

3.1 General Requirements - In below ground applications, piping does not have to be completely buried to be tested, but bends, reduced pressure rated fittings, and components should be buried or restrained. Ideally, all welds and flange connections should be visible to check for leaks. In above ground installations, all piping should be restrained before testing.

All personnel should be aware testing is being conducted, and only required personnel for the test should be in the test area for the duration of the test. *THE CONTRACTOR SHOULD BE MADE AWARE OF THE IMPORTANCE OF SAFE TESTING PROCEDURES FOR THIS MATERIAL.*

3.2 Carrier Piping Hydrostatic Force Main Testing - HDPE can withstand up to 2 times the rated pressure of HDPE piping components created by pressure surges and other transient events such as water hammer. Hydrostatic test pressure should not exceed EITHER 1.5 times the pressure rating of the HDPE piping components OR test pressure rating of lowest-rated component in the system.

In ASTM F2164, Section 9 **Hydrostatic Test Procedure** states that the pipe test section is filled slowly and purged of all air. The test section and the test liquid are then allowed to achieve equilibrium before the pipe is gradually pressurized to the required test pressure and held for the required test length.

Note: As an example, if DR 11 pipe is being tested for 200 psi service, and 1.5 times the operating pressure is the desired test, then the pressure on the pipe would be 300 psi. After

the initial test pressurization period, makeup water can be added to the pipe system. If there are no visual or detected leaks and the pressure drop is within 5% of test pressure at the completion of the final phase period, then the pipeline passes the test.

In addition to the pressure test, the annular access ports and/or the low point drains should be checked for evidence of leakage. If no water is found in the leak detection ports and the test pressure is attained, then the pipe will have passed the required pressure test.

3.3 Containment Annular Space Testing - It is recommended that the carrier pipe should be brought up to and held at the system test pressure while the containment piping is being tested. This prevents any possibility of damage to thin wall carrier pipes or erroneous pressure test results from compression of the carrier piping due to the external pressure differential.

Based on the lowest pressure rated fitting or component in the system, an air pressure of no higher than 10 psi should be used. As stated in section 2.1, hydrostatic testing is not allowed. Because of the expansive nature of air as a gas, once pressure stabilizes, the test begins and lasts for 10 minutes. If no significant pressure drop is noted, the pipe has passed the test. Longer duration is not recommended due to section 3.4.

3.4 Temperature Driven Pressure Fluctuations - Remember that pressure drop during the test can occur due to temperature fluctuations as well as due to pressure expansion, especially for air test of containment pipes exposed to the sun. As the temperature increases, the gauge pressure is expected to decrease. If there are no visual leaks or significant pressure drops during the final test period, then the pipeline passes the test.

Preferably, the preparations for the pressure test are usually made the day before, in the afternoon. The actual test is conducted the next morning, then the pressure release, the dewatering, and the clean-up done after lunch.

4. CAUTIONARY NOTES FOR PRESSURE TESTING

4.1 General - This document attempts to provide a comprehensive overview of systems testing in dual contained HDPE piping. Attention should be taken by the designer, and especially by the installer, to assure that safe testing conditions exist on the job site before, during, and after the testing.

ALWAYS use sufficient caution when releasing the test pressures. Test pressures should be released gradually and in a controlled manner.

4.2 Air Testing - HDPE manufacturers do not recommend air testing of pipe at high pressures. While some polyethylene piping can pass air tests greater than 10 psi, there is great possible danger to those conducting the test. The danger is related to the compressibility of air as a gas, see above.

A typical water hammer surge pressure in worst case might be three times the average pressure. Thus a 200 psi test pressure on DR 11 pipe could possibly result in a surge equal to 600 psi. Since the 1 minute burst pressure on SDR 11 HDPE pipe is usually 800 psi or higher, there is little danger of failure.

For air, a hammer (surge) of six times the average pressure is possible. This means that an improperly conducted air test on DR 11 pipe requiring 200 psi air could possibly see 1200 psi. There is no doubt that the pipe would fail under this test condition. If someone were hurt during a high pressure air test, then ISCO Industries would not be liable.

In the event that a dual contained system requires higher air test pressures, those procedures and precautions must come from the owner/designer, who accepts all liability for potential damages to both the piping system and its surroundings.

4.3 Hydrostatic Testing - Purge all air from the carrier pipeline. Trapped air can make achieving a consistent pressure reading difficult as it will absorb into the water at higher pressure, affecting the volume of test medium in the pipe.

The pipe should be restrained or covered to prevent possible violent and dangerous movement. The installer or testing contractor must use sufficient care and caution during testing to prevent dangerous conditions from existing in the testing procedure.

ISCO Industries, Inc. has taken every effort to check the accuracy and standards used in the preparation of these sample specifications. ISCO does not guarantee or warranty piping installations, nor their final design. Sample specifications are to be used as a guide to assist engineers and owners of piping systems. Sample specifications do not cover all situations or applications. These specifications are not intended to provide installation training or instructions.

Since every job is different, a trained professional engineer should be used to determine the needs of a particular job.

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