



Comparative Test Program for Pipeline Rock Shield Methods

Introduction

The purpose of this test program is to determine the relative resistance of pipeline rock shields to impact from falling stones and their effectiveness in protecting coated pipes. This program closely follows the methods set forth in ASTM G13-89, *Standard Test Method for Impact Resistance of Pipeline Coatings (Limestone Drop Test)*. This test method however, is intended to evaluate pipeline “coatings” that protect the pipe and not rockshields that protect the coatings. It was therefore deemed appropriate to alter the test to better replicate actual in-service conditions of a rockshield. This essentially meant increasing the severity of the impact by increasing both the weight and the size of stones used in the test. Specifically, the test, as conducted on the various rock shields, deviates from ASTM G13 as noted below.

Test Procedure

Specimen

Test specimens were prepared by coating ¼” x 12” x 12” carbon steel plates with a nominal 16 mil coating of factory applied 3M fusion bonded epoxy per the manufacturers instructions. This differs from ASTM G13 as 4” or 6” diameter coated pipe is specified. The use of a flat plate specimen would likely increase the severity of the test by eliminating glancing impacts to the specimen. The coated metal plates were then covered with various rockshield materials prior to testing. One specimen was left unprotected for “select fill” testing.

Test Apparatus

The test apparatus used was essentially the same as that shown in Figure 1 of ASTM G13. A hopper, sized sufficiently large to hold the stones, was supported 6’-0” above the test specimen. A slide gate was used to release the stones, allowing them to free-fall onto the test specimen.

Stones used in the test consist of hard, angular shaped limestone in the following sizes: 1.5”, 3”, 4” and 6”.

In the case of the “select fill” specimen a mixture of aggregate was used consisting of (50% sand, 48% ½ ” washed pebbles, 2% 1-½ ” stones).

Procedure

All tests were performed at room temperature. The rock shield protected specimens were subjected to as many as 10 impact tests for each size stone described above. Each test consisted of releasing 50 pounds of stone from the holding hopper and allowing them to free-fall onto the specimen, supported 6’-0” below. Tests began with the smallest size stone. If no visible breaks were found after 10 impact tests (drops), the

next larger size stone was selected and testing resumed. Testing progressed through the larger stones until visible breaks were found in the coating.

A test was also performed using "select fill" on a specimen protected only by the epoxy coating. As "select fill" is sometimes used in lieu of a rock shield, data was collected for this method as well.

The number of impact tests and the size stone was noted at point of failure; failure defined as 2 or more visible breaks in the pipe coating.

Results

Polyethylene Mesh:

(3/16" thick open grid network mesh)

5 drops of 1.5" stones - no visible breaks in coating

1 drop of 3" stones - multiple holidays (failures)

Polyurethane Foam w/ Polyethylene backing:

(1/2" nominal thickness, 0.012" PE backing with 3/16" diameter perforations, 1" on center)

5 drops of 1.5" stones - no visible breaks in coating

1 drop of 3" stones - multiple holidays (failures)

Polyvinyl Chloride:

(3/8" – 9.5 mm thick Tuff-N-Nuff Rockshield)

10 drops of 1.5" stones - no visible breaks in coating

10 drops of 3" stones - no visible breaks in coating

10 drops of 4" stones - no visible breaks in coating

3 drops of 6" stones - 2 holidays (failures)

(1/4" – 6.35 mm thick Tuff-N-Nuff Rockshield)

10 drops of 1.5" stones - no visible breaks in coating

10 drops of 3" stones - no visible breaks in coating

4 drops of 4" stones - 2 holidays (failures)

Select Fill: A 50 lb mixture consisting of:

50% sand

48% 1/2" washed pebbles

2% 1-1/2" stones

The select fill test consisted of a single drop of the "select fill" mixture onto an unprotected test specimen.

1 drop of mixture - multiple holidays (failures)