Florida Method of Test
for
PREDICTING THE CRACK FREE SERVICE LIFE of HDPE CORRUGATED PIPES

Designation, FM 5-573

1. SCOPE

1.1 This test method is used to predict the crack free service life of high-density polyethylene (HDPE) corrugated pipes in view of Florida DOT 100-year design service life requirement.

1.2 This test utilizes data obtained from a test method that was designed to evaluate the stress crack resistance (SCR) of corrugated pipes. The SCR test methods for junction and longitudinal profiles of the pipe are described in ***FM 5-572, Procedures B and C***, respectively.

1.3 The SCR tests for junction and longitudinal profiles shall be performed at a minimum of two elevated temperatures and two stress levels in a water incubation environment.

1.4 The SCR test data obtained from the elevated temperatures are shifted to a lower site specific temperature using the rate process method equation, as shown in Eq. (1).

$$\log t = A + \frac{B}{T} + \frac{C \log S}{T} \qquad (1)$$

where:

t= time, hr
T= Absolute temperature, K (K = ^{o}C + 273)
S= Applied stress, psi, and
A, B, C= constants

2. REFERENCED DOCUMENTS

2.1 ASTM Standards:

D1600 Terminology for Abbreviated Terms Relating to Plastics

D2837 Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products

2.2 FDOT Documents:

FM 5-572 Test Method for Determining Stress Crack Resistance of HDPE Corrugated Pipes.

2.3 ISO Standards

ISO 9080 Plastics piping and ducting systems – Determination of long-term hydrostatic strength of thermoplastics materials in pipe form by extrapolation

3. STRESS CRACK RESISTANCE (SCR) TEST

3.1 The SCR test shall be performed according to ***FM 5-572***.

3.1.1 Procedure B uses pipe junction specimens

3.1.2 Procedure C uses specimens consisting of longitudinal profiles, such as a vent-hole or mold line

3.2 The applied stresses at different test temperatures are shown in Table 1.

Note 1: Tests performed at stresses higher than the defined values may enter into the transition region of the ductile-brittle curve thereby yielding a longer failure time than that of the lower stress. Details of the ductile-brittle transition can be found in **ASTM D5397**.

3.3 Five specimens are tested at each stress level.

Table 1 – Applied Stresses at Different Test Temperatures

Test Temperature (^{o}C)	Applied Stresses (psi)
70	650
80	650, 450

4. PREDICTION PROCEDURE

4.1 The average temperature of 23^{o}C shall be used as the general site temperature in service life prediction analysis.

4.2 To determine the brittle failure performance, solve for the three coefficients (*A, B* and *C*) of the rate process method equation, Eq. (1), using all 15 data points (5*3 = 15). A least squares multi-variable linear regression method is applied to calculate the three coefficients.

4.3 Using Eq. (1) to generate a failure curve at a temperature of 23^{o}C (296 K).

4.4 Use ***ISO 9080 Annex A*** to determine the 97.5% lower confidence curve from which the failure time at 500 psi should be greater than 100 yr. (876,000 hr).

Note 2: The “SCR Service Life Prediction Program” can be obtained from Florida Department of Transportation.

5. REPORTING RESULTS

The test report shall include the following information:

5.1 All details necessary for complete identification of the material tested (***AASHTO M 294*** cell class).

5.2 Present all of the data in both table and graphic forms. The format of the table is shown in Table 2. The graphic form shall be presented by plotting the logarithm of applied stress versus the logarithm of the failure time at each of the tested temperatures and stresses.

5.3 Report the three coefficient values, *A, B* and *C.*

5.4 Report the predicted failure time with 97.5% lower confidence at 23°C and 500psi.

Table 2 – Recommend Data Record Template

<table>
<tr><th>Test Temperature (°C)</th><th>Applied Stress (psi)</th><th>Average Thickness (in)</th><th>Applied Load (lb)</th><th>Failure Time (hr)</th><th>Average Failure Time (hr)</th></tr>
<tr><td rowspan="5">80</td><td rowspan="5">650</td><td></td><td></td><td></td><td rowspan="5"></td></tr>
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