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An American National Standard

Standard Practice for
Drafting Impact Test Requirements In Thermoplastic Pipe And Fittings Standards[1]

This standard is issued under the fixed designation F 725; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

ϵ1 NOTE—Section X1.1 was editorially revised in March 2008.

1. Scope

1.1 This practice describes a procedure for setting up impact test requirements on the basis of test data obtained by Test Method D 2444.

1.2 This practice is applicable to thermoplastic pipe and fittings.

1.3 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:* [2]

D 2444 Test Method for Determination of the Impact Resistance of Thermoplastic Pipe and Fittings by Means of a Tup (Falling Weight)

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *binomial probability equation*—the equation that defines the chance for exactly *r* specimens to pass, when *n* are tested, given *p*, the chance that a single specimen chosen at random will pass. It is expressed as follows:

$$_rP_n = \frac{n!}{r!(n-r)!}p^r(1-p)^{n-r} \tag{1}$$

NOTE 1—The factorial of zero is one.

3.1.2 *binomial test*—a test that has only two possible results (for example, pass or fail, heads or tails, true or false).

3.1.3 *mean strength*—the average strength of the total population (see Note 2).

3.1.4 *OC curve (operating characteristic curve)*— a graph that illustrates the chance of success or failure when a given specification format is employed, given any quality level from 0 to 1 (0 to 100 % passing in the lot from which test specimens are selected).

3.1.5 *probability graph paper*—commercially available graph paper that provides straight-line plots when the distribution of attributes is normal. —commercially available graph paper that provides straight-line plots when the distribution of attributes is normal. For a discussion on the use of proability graph paper, see Test Method D 2444 Appendix X2.

3.1.6 *specification format*—the rules set forth by the test requirement, including the number of specimens to be tested and the minimum acceptable number of passes.

3.1.7 *standard deviation*—a statistical term that relates to the size of the expected variation in test results.

NOTE 2—The terms "mean," "normal distribution," and "standard deviation" are dealt with in elementary statistics textbooks.

4. Summary of Practice

4.1 Round-robin tests of representative pipe and fittings specimens are performed to identify the energy levels at which 90 % or more of the specimens in acceptable lots will pass. A preferred test format is listed. The B-tup and the V-block holder, and room-temperature conditioning and tests are preferred choices.

5. Significance and Use

5.1 This practice is used for drafting impact test specification requirements, and it presupposes no special familiarity with statistical methods. It provides for specification values that will pass acceptable lots with a high degree of certainty. The impact test requirement is intended to discriminate between acceptable materials and manufacturing methods and those which are not; it is not a simulated service test.

6. Procedure

6.1 Test thermoplastic pipe or fittings specimens in accordance with Test Method D 2444, and plot the test results on probability graph paper.

6.2 It will be clear, from the ~~usual~~probability paper plot, that the energy level where 98 % or 99 % of all specimens would pass will be low. On the one hand, when the test format requires that five of five, or six of six, or nine or ten of ten tested shall pass, or the lot rejected, then the specified energy levels must correspond to these levels (see Fig. 1, the operating characteristic (OC) curve for the "nine or ten of ten" test format). On the other hand, five of five, six of six, and nine or ten of ten tests at low energy levels will not screen marginal or poor lots effectively. (~~s~~See Fig. 1 again).

6.3 A format which will accept reliably when 90 % or more of the specimens in acceptable lots would pass, and reject reliably when 60 % or fewer would pass, is as follows:

6.3.1 "X.X Test ten specimens. When nine or ten pass, accept the lot. When six or fewer pass, reject the lot. When seven or eight pass, test ten additional specimens. When 17 or more of 20 pass, accept the lot. When 13 or fewer of 20 pass, reject the lot. When 14, 15, or 16 pass, test 20 additional specimens. When 32 or more of 40 pass, accept the lot. When 31 or fewer pass, reject the lot."

6.3.2 The OC curve for this format is illustrated in Fig. 2.

6.4 *Specimen Length*—The pipe specimen length should be 6 in. (150 mm) ± ¼ in. (6mm).

6.5 *Choice of Tup and Holder*—The B tup is preferred. It provides a good compromise between energy concentration in the specimen (and therefore reduced test energy levels), and resistance to damage in service. The V-block holder is preferred for pipe specimens; it provides for greater energy concentration, and for failures in a range of thin-walled specimens which would merely flatten on the flat-plate holder.

6.6 *Test Conditions*—Room-temperature tests are preferred. They can be performed by the manufacturer on a timely basis, so that the size of questionable or defective inventories is minimized. Binomial tests are relatively crude, unless large numbers of specimens are subjected to test. The expense and inconvenience of low-temperature conditioning render it a poor choice (study Fig. 1 together with a data plot performed in accordance with Test Method D 2444to fully grasp the merits of this statement).

7. Multiple-Product Standards

7.1 Many thermoplastic pipe and fittings specifications list large numbers of products. Test Method D 2444requires that at least 100 test specimens shall be employed for each single test run in order that the impact properties can be measured with useful
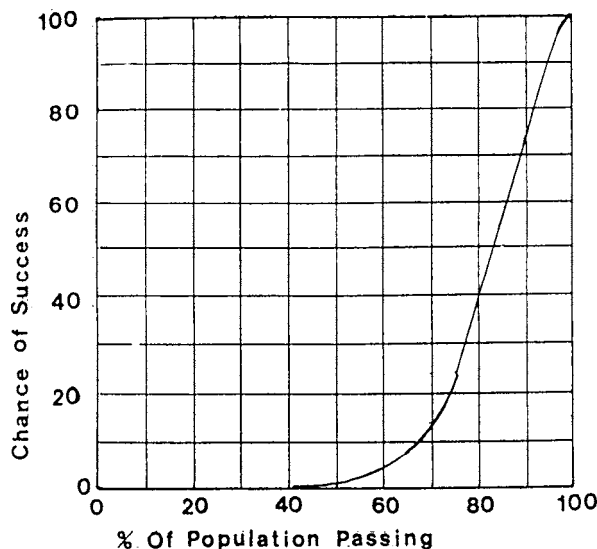

FIG. 1 O.C. Curve for Nine or Ten of Ten

2