



Standard Test Method for Evaluating Springback of Sheet Metal Using the Demeri Split Ring Test¹

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1. Scope

1.1 This test method provides a means of evaluating the springback behavior of metals in a test that simulates a stretch-draw forming process. The test method can also be used to calibrate computer simulation codes by selecting appropriate control parameters to achieve satisfactory correlation between simulation and test results.

1.2 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

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. Terminology

2.1 Definitions:

2.1.1 *springback*—the difference between the final shape of a part and the shape of the forming die.

2.1.2 *Demeri Split Ring Test*—a test that measures the springback behavior of sheet metal by comparing the diameter of a ring extracted from the wall of a flat bottom cup and the diameter of the same ring split to release residual stresses.

3. Summary of Test Method

3.1 The test method consists of four steps: (1) deep draw a cylindrical cup from a circular blank with a constant clamp or blankholder force, (2) cut a circular ring from the mid-section of the drawn cup, (3) split the ring along a certain direction to release residual stresses caused by the stretch-draw operation, and (4) measure the opening of the ring (springback).

4. Significance and Use

4.1 The formability of materials is affected by springback, the difference between the final shape of a part and the shape

of the die that formed it. Materials having a large amount of springback create difficulties for the die designer and make die rework much more likely and complicated. This can add months and great costs to the achievement of successful dies. While dealing with springback in traditional metals is largely overcome by experience, new metals often have so much springback that they can only be used after much trial and error. The quantification and prediction of the tendency of metals to springback is addressed by this test method.

4.2 The magnitude of the springback is a convolution of the elastic modulus, the flow stress of the metal of interest, the sheet metal thickness and the amount and type of cold work introduced by the forming process. Since the cup forming process contains features of many forming operations, the amount of springback measured by the Demeri split ring test is indicative of the behavior of the metal in many stamping operations.

4.3 The amount of springback that occurs in this test is very large compared to other approaches. This improves measurement accuracy and reduces experimental error in all types of formable metals.

4.4 This test does not require measurement fixtures or any sophisticated profiling equipment for accurate measurement of springback. Conventional length measuring instruments are all that is needed to perform the required measurements.

4.5 This test can be used to rank materials according to their tendency to springback after a forming operation (see Refs **1-3**).² Since springback depends on the sheet thickness, metals should be compared at the same thickness. Experience has shown that the test can also be used in conjunction with an appropriate analysis to predict quantitatively the amount of springback occurring after a forming operation (see Refs **2-9**).

4.6 This test provides a method to compare springback predictions by various numerical simulation codes. Test results can be used to calibrate computer simulation codes by selecting proper control parameters and appropriate material models to achieve satisfactory correlation between simulation and test

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² The boldface numbers in parentheses refer to the list of references at the end of this standard.