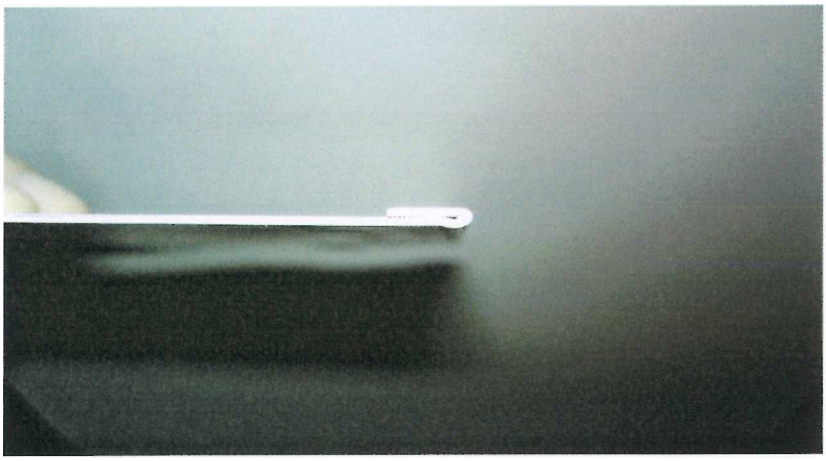
SENTRIGARD
METAL SYSTEMS
TECHNICAL BULLETIN

BENDING METAL

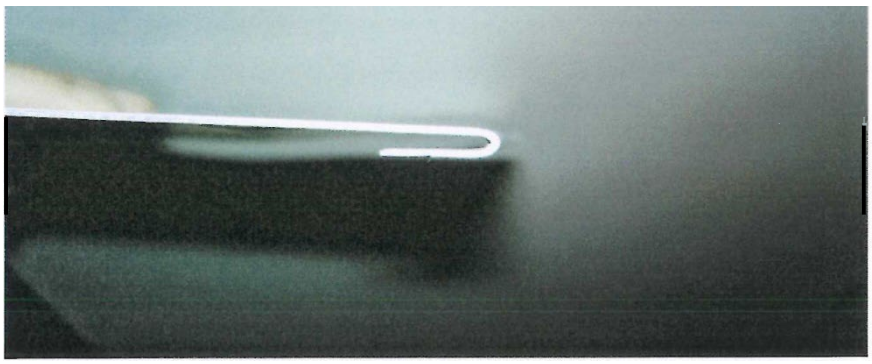
Introducing a hem onto architectural metals to avoid damage to the coating utilizes.4T-Bend testing per ASTM D 4145, Test results show no damage to the coating with a 2T Bend. The 2T refers to the sample being hemmed or bent around 2 thicknesses of the material being used, which means it will appear as an open hem, or the panel is hemmed multiple times until it incorporates 2 thicknesses of the material, please see ASTM Standard attached.

The picture below shows a 0 (zero)T Bend, which is simply the material bent tight around itself.



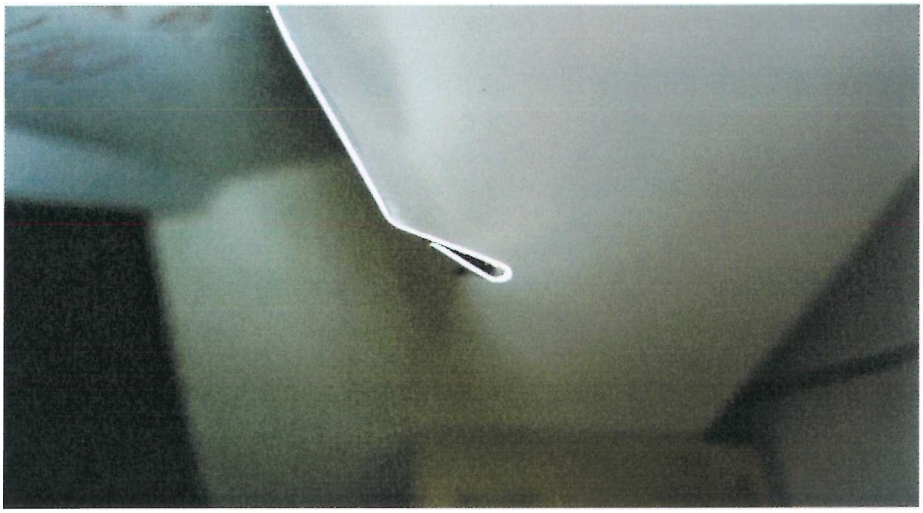
This bend is too tight and most likely will damage the coating. In this case, the coating is damaged.

The next picture shown below is an open hem, where at least two thicknesses of material would fit into the open hem. This would be a 2T Bend, which the test report shows no damage to the coating.



Conclusion: A correct 180° degree bend, or hem, must have enough room in the hem for two thicknesses of material, or the metal must be bent around itself 2x (times) to create a 2T Bend. The sample above has no damage to the coating.

Please review the photo below showing a "tear drop" hem. Notice that at the hem edge there is enough room for 2 thicknesses of the material. This is the identifier that shows the 2T Bend as required.



If there are any questions, please contact Sentrigard Technical Services.

Designation: D 4145-83 (Reapproved 1996t

Standard Test Method for Coating Flexibility of Prepainted Sheet[1]

This standard is issued under the fixed designation D 4145; 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 **(E)** indicates an editorial change since the last revision or reapproval.

ε[1] Norn-Keywords and the unit of measurement statement were added editorially in January 1996.

1. Scope

1.1 This test method describes a procedure for determining the flexibility and adhesion of organic coatings (paints) on metallic substrates that are deformed by bending when the sheet is fabricated into building panels or other products.
without fracturing and with no excessive grain development.

1.2 The values stated in inch-pound units are to be regarded as the standard. The values given in parentheses are for information only.

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 acceptability of regulatory limitations prior ,to use.

2. Terminology

2.1 Definitions of Terms Specific to This Standard:

2.1.1 *T-bend-a* description of the severity of a bend in terms of the thickness (T) of the sheet to which the coating has been applied; *as used in this test method,* the T-bend rating is the minimum number of thicknesses of metal around which the coated sheet is bent (Fig. 1), or if bent around a die, the number of thicknesses of metal equivalent to the diameter of the die to achieve no fracture or removal of the coating.

3. Summary of Test Method

3.1 Pre-painted panels are bent 180° around progressively more thicknesses of metal or larger diameter dies, the end point being when failures no longer occur. The panels are examined at low magnification (5 to 10x) after each bend for fracture of the coating (cracking) and, for loss of adhesion pickoff, by means of a tape pull-off test.

4. Significance and Use

4.1 Organic coatings on precoated sheet are subjected to stresses when fabricated into products by roll forming, brake bending, or other deformation processes. These stresses can exceed the flexibility or adhesive strength of the coating,

The metal substrate must be capable of passing this te

[1] This test method is under the jurisdiction of ASTM Committee D-1 on Paint and Related Coatings, Materials, and Applications and is the direct responsibility of Subcommittee D01.53 on Factory-Precoated Strip Metal.

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Note I-The above bends are expanded for clarity. They are actually flat against themselves in the test.

FIG. 1 T-Bend Test In Which the Coated Specimen Is Bent Around Itself

resulting in fracture of the coating, exposing the substrate, or loss of adhesion to the substrate. This test is a means of evaluating the ability of a coating system to withstand the stresses of fabrication.

4.2 The bend direction, whether the axis of bend is across or along the rolling diameter of the metal, and the temperature of the specimen when it is bent affect the results of this test and should be agreed upon between the supplier and the user.2

Apparatus

4.3 A means of holding one end of the specimen rigidly while making the bend is needed. A bench vise with smooth jaws or with smooth inserts, preferably of a soft metal to avoid damage to the coating, has been found to be satisfactory.

4.4 If the metal is not bent around itself as in Fig. 1, a series of bending dies with smoothly rounded ends may be used as guides around which the specimen is bent (Fig. 2).

[2] Scotch Brand #61O tape manufactured by 3M Co., St. Paul, MN or equivalent, or as agreed upon between the supplier and the user.

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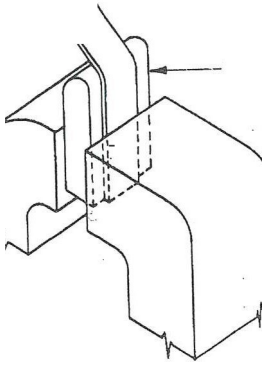

FIG. 2 T-Bend Test Using a Die Around Which the Specimen is Bent

4.5 *Magnifier,* capable of 5 to 10x magnification for examining the specimen for coating fracture and pickoff after testing. A stereomicroscope has been found useful for this purpose.

5. Procedure

6.1 *Bending the Coated Specimen Around Itself.*

6.1.1 The coated specimen shall be at least 2 in. (50 mm) across the bend direction, by a length sufficient to make the required number of bends. A 2 by 6-in. (50 by 150-mm) size is convenient. The specimen shall be at ±2°F of the temperature agreed on.

Norn I-A triangle-shaped specimen (Fig. 3) has been found convenient for making T-bend tests. This shape 1·eaves a portion of each bend exposed for later examination and for a permanent record.

6.1.2 Secure about 0.5 to 0.75 in. (13 to 20 mm) of one end of the specimen in a vise or holding jig as shown in Fig. 1. Bend the free end of the specimen 90° in a smooth and uniform manner so that the coating is on the outside of the specimen after it is bent.

Note I-The above bends are expanded for clarity. They are at against themselves in the test.

FIG. 3 Triangular Specimen for T-Bend Test

Continue to bend the specimen until the bent end can be inserted in the jaws of the vise. Tighten the vise to complete the 180° bend, which is called an OT bend. Take care to tighten the vise sufficiently so that the apex of the bend is as flat as can be reasonably achieved.

6.1.3 Examine the bend using a hand lens or low-power microscope for cracks in the coating.

6.1.4 Apply pressure-sensitive tape[2] along the bend. Rub the tape flat; then, holding the specimen firmly, remove the tape with a rapid movement at an angle of 180° to the bend surface. Examine the tape for coating removed from the surface of the specimen (that is, pickoff). In the case of a coated steel specimen (for example, galvanized steel), examine the .tape to determine whether pickoff is between the organic coating and the metallic surface or between the metallic coating and the base steel.

6.1.5 Secure the bent end of the specimen in the vise and bend the free end 90°. Continue to bend the free end around the first (OT) bend to complete a 180° bend, and tighten in the vise as before. This makes a 1T bend (Fig. 1). Examine under magnification and by taping for cracking and pickoff, as with the OT bend.

6.1.6 Repeat this procedure, making a 2T, 3T, etc., bends until no cracking or pickoff occurs.

6.2 Bending the Coated Specimen Around a Die:

6.2.1 The coated specimen shall be at least 2 in. (50 mm) across the bend direction.

6.2.2 Secure the specimen and bending die in a vise or holding jig (Fig. 2). Bend the specimen 180° around the die in a smooth and uniform manner.

6.2.3 Examine the bend for cracking as in 6.1.4 and for loss of adhesion as in 6.1.5.

5.1 Express the T-bend to no cracking or no pickoff as the number of thicknesses around which the metal is being bent equal to the thickness of the die.

6. Report

6.1 Report the following information:

7. L1 Identification of the material, such as coil number and location within the coil if the sample was coated on a coil line, .

6.1.2 The coating system, coating thickness, and application and cure conditions,

6.1.3 The temperature at which the specimen is bent,

6.1.4 The bend direction-whether across or along the rolling direction of the sheet,

6.1.5 The minimum T-bend to no paint fracture, and

6.1.6 The minimum T-bend to no pickoff.

6.2.4 **8. Precision** [3]

8.1 On the basis of an interlaboratory study of this test method, in which two operators in each of five laboratories tested panels coated with paints of different flexibility and adhesion, the standard deviation was found to be:

dtandard Deviation

	Aluminum	Galvanized Steel
T-bend to no fracture	0.55	1.33
T-bend to no pickoff	0.76	2.09

8.2 Based on these standard deviations, the following criteria should be used to judge the acceptability of results at the 95% confidence level:

8.2.1 *Repeatability-Measurements* obtained by two operators in a single laboratory should be considered suspect if they differ by more than:

[3] Supporting data are available from ASTM Headquarters. Request RR:D01-1034.

	Aluminum	Galvanized Steel
T-bend to no fracture	0.4	1.8
T-bend to no pickoff	0.9	3.3

8.2.2 *Reproducibility-Two* measurements obtained in c: different laboratories, each the mean of measurements made two operators within a laboratory, should be considered susp, if they differ by more than:

	Aluminum	Galvanized Steel
T-bend to no fracture	2.5	10.1
T-bend to no pickoff	1.8	10.6

7 Keywords

9.1 coating flexibility; prepainted sheet; T-bend flexibility

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CERTIFIED LABORATORY TEST REPORT

FLEXIBILITY – T-BEND

TEST PROCEDURES:	**T-BEND PER ASTM D 4145**
PRODUCT TESTED:	**FLUROPON®**
SUBSTRATE:	**HDG, GALVALUME AND ALUMINUM**
TEST RESULTS:	**T-BEND = 2T**
LOCATION:	**THE SHERWIN-WILLIAMS COMPANY FT. MYERS, FLORIDA, USA**

Marlene Garrow 05/30/2019
Marlene Garrow Date
Group Leader

Alexander J. Nicol 5/30/19
Alexander J. Nicol Date
Notary Public