Lap Shear Strength of Adhesively Bonded Metal Specimens – ASTM D 1002

Application Report

Introduction

The strength of adhesive bonds depends greatly upon the conditions under which the bonding process is carried out. Therefore, variations in this process lead to variations in the accuracy of the results acquired from strength tests of these bonds. It is the responsibility of the manufacturer to prepare samples in accordance with the ASTM standard. However, once this work is done, an Instron® universal testing system is ideal for completing high quality testing and providing accurate results.

Test Configuration and Sample Preparation

The ASTM standard specifies that "the testing machine shall conform to the requirements of Practices E 4." For this test the Instron 5569 electromechanical test frame was configured with a 50 kN load cell and 30 kN capacity mechanical wedge action grips with coarse serrated faces. The standard further specifies that "the long axis of the test specimen coincide with the direction of applied pull through the center line of the grip assembly." In order to insure that the load be applied in exactly the same direction as the center line, spacers were inserted into the grips and clamped very tightly to prevent slipping. Normally, over-tightening the grip faces causes jaw breaks but because the adhesive is expected to break at a much lower load than the metal this consideration may be overlooked. For a detailed image of the gripping point see Figure 1. The test was run at a crosshead speed of 1.3 mm/min until failure. See Figure 2 for a view immediately following the test.

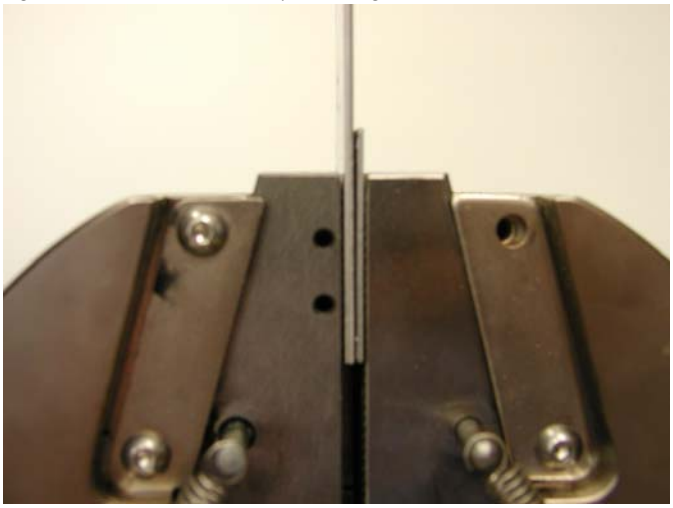

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Figure 1:
Close-up of test configuration. Note the spacer within the grip faces used to properly align the specimen.

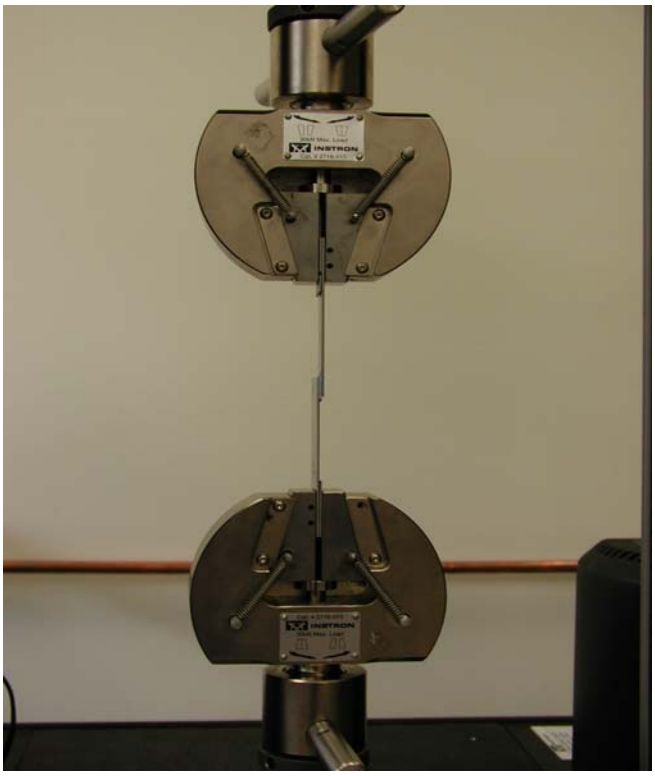

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Figure 2:
Specimen immediately after adhesive failure.

Results

The results confirm that the Instron test frame and software are more than adequate to complete testing following ASTM D 1002. The accompanying graph (Figure 3) and results table (Table 1) exhibit the required results.

Though this test used the 30 kN wedge action grips accompanied by spacers, other test configurations are acceptable and, sometimes, are preferable. Most notably, screw action grips or pneumatic side action grips that can be manually offset obviate the need for spacers. The elimination of spacers is more precise and could potentially improve results by reducing any slippage. Should spacers be used it is recommended that they be bonded to the specimen using the same adhesive and bonding process (over a larger surface area than the joint of interest) to maintain continuity throughout the specimen. However, if slipping is eliminated and the same process is used throughout testing, it is acceptable testing procedure because the "test method is comparative."

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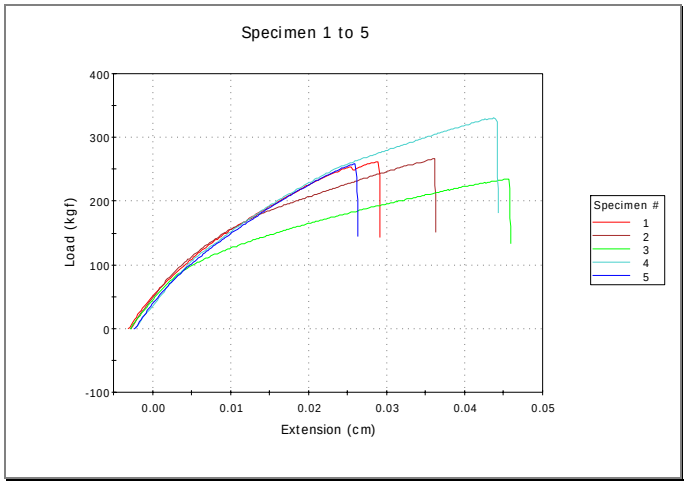

Figure 3:
Load vs. extension data for five specimens.

Specimen #	Overlap Length (cm)	Load at Break (kgf)	Stress at Break (kfg/cm^2)
1	1.39	240.23	68.04
2	1.33	266.59	78.92
3	1.29	235.20	71.78
4	1.36	324.44	93.92
5	1.32	238.18	71.04
Mean	1.34	260.93	76.74
S.D.	0.04	37.66	10.40

Table 1:
Results for five specimens.

Configuration Table

Catalog Number	Configuration Options	Description
5569	Frame	Dual column, table mounted test frame
2525-802	Load cell	50 kN capacity
2716-015	Grips	30 kN mechanical wedge action
2703-151	Faces	Jaw faces for flats, coarse serrated
2410-400	Software	Bluehill® 2

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