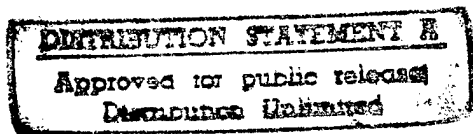


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NOTICE

The above identified patent application is available for licensing. Requests for information should be addressed to:



OFFICE OF NAVAL RESEARCH
DEPARTMENT OF THE NAVY
CODE OCCC3
ARLINGTON VA 22217-5660

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1 Navy Case No. 77648

2 ADHESIVE SHEAR STRENGTH TEST APPARATUS

3
4 STATEMENT OF GOVERNMENT INTEREST

5 The invention described herein may be manufactured and used
6 by or for the Government of the United States of America for
7 governmental purposes without the payment of any royalties
8 thereon or therefore.

9
10 BACKGROUND OF THE INVENTION

11 (1) Field of the Invention

12 The present invention relates to testing adhesives and more
13 particularly to testing adhesive strength in pure shear.

14 (2) Description of the Prior Art

15 In designing an adhesively bonded joint, it is necessary to
16 determine the bonding strength of the proposed adhesive.
17 Standardized test methods have been developed for testing the
18 shear strength of adhesives, such as American Society for Testing
19 and Materials tests, D3164-92a, "Strength Properties of
20 Adhesively Bonded Plastic Lap-Shear Sandwich Joints in Shear by
21 Tension Loading" and D3165-95, "Strength Properties of Adhesives
22 in Shear by Tension Loading of Single-Lap-Joint Laminated
23 Assemblies". Though these test methods are useful in determining
24 comparative shear strength data, both tests utilize lap joints.
25 In these tests, adhesive is placed between two overlapping plates

1 and tension is applied to the ends of the plates furthest from
2 the joint such that a shearing force is applied to the adhesive.
3 However, bending forces are also introduced into the adhesive
4 joint due to the lapped arrangement of the joint and the
5 resulting offset in the tensile loading. The use of doublers, or
6 offset plates, may be required to prevent bending failure of the
7 adhesive joint. Further, the thickness of the lap-joint is
8 difficult to control in that higher viscosity adhesives would
9 typically result in a thicker joint. The lack of control leads
10 to variability in test results from one specimen to the next.

11 12 SUMMARY OF THE INVENTION

13 Accordingly, it is a general purpose and object of the
14 present invention to provide an apparatus for testing adhesive
15 shear strength which subjects the adhesive bond to pure shear.

16 Another object is to provide an adhesive shear strength test
17 providing greater control of bond, or adhesive thickness. A
18 further object is to provide an adhesive shear strength test
19 having less statistical variation between similar specimens.

20 These objects are accomplished with the present invention by
21 providing new rod-shaped test samples to replace the lapped
22 plates of previous test methods. A bore and a counterbore of
23 slightly larger diameter are drilled into the end of the first
24 rod. The second rod has a diameter essentially equal to the
25 diameter of the bore. Adhesive is placed in the bore and

1 counterbore of the first rod and the second rod is then placed
2 into the bore, extending out of the counterbore, thus forming a
3 cylindrical adhesive joint between the rods at the counterbore.
4 The difference in diameter between the bore and the counterbore
5 determines the thickness of the adhesive bonding the two rods.
6 An axial tensile force is applied at the ends of the rods
7 furthest from the joint, putting the joint into shear. Since the
8 tension is axial, no bending is induced in the adhesive joint.
9 The rods can be fabricated of metal such that they can be reused
10 by burning off old adhesive in a furnace. Further, the rods and
11 the drilled bore and counterbore can be accurately machined such
12 that bond thickness does not vary between tests of different
13 adhesives. Additionally, a number of rods can be fabricated with
14 differing counterbore diameters which provide test data for a
15 range of adhesive thicknesses resulting in a strength to
16 thickness curve for the adhesive tested.

17 18 BRIEF DESCRIPTION OF THE DRAWINGS

19 A more complete understanding of the invention and many of
20 the attendant advantages thereto will be readily appreciated as
21 the same becomes better understood by reference to the following
22 detailed description when considered in conjunction with the
23 accompanying drawings wherein:

1 FIG. 1 shows a cross section of a first rod used in forming
2 the test sample for the adhesive shear strength test of the
3 present invention;

4 FIG. 2 shows a cross section of a second rod used in forming
5 the test sample; and

6 FIG. 3 shows a cross section of the rods in an assembled
7 position for the adhesive shear strength test of the present
8 invention.

9
10 DESCRIPTION OF THE PREFERRED EMBODIMENT

11 Referring now to FIG. 1, holder rod 10 is shown in cross
12 section. Holder rod 10 is cylindrical in shape having a bore 12
13 reamed along the longitudinal axis X-X at end 10a of holder rod
14 10. Bore 12 has a diameter "d". Counterbore 14, having a
15 diameter larger than "d" is also reamed into the end 10a of
16 holder rod 10. A tension eye 16 is drilled through holder rod 10
17 at opposite end 10b, transverse to axis X-X. Referring now to
18 FIG. 2, insert rod 18 is shown in cross section. Insert rod 18
19 is also cylindrical in shape, having a diameter essentially equal
20 to diameter "d" of bore 12. A second tension eye 20 is drilled
21 through insert rod 18 at one end, transverse to longitudinal axis
22 Y-Y of insert rod 18.

23 Referring now additionally to FIG. 3, there is shown a cross
24 sectional view of rods 10 and 18 assembled for testing. The end
25 of insert rod furthest from second tension eye 20 is inserted

1 into bore 12 of holder rod 10 and seated against base 12a of bore
2 12 (shown in FIG. 1), such that the axes X-X and Y-Y of rods 10
3 and 18, respectively, are aligned. In preparing the rods for
4 testing, adhesive 22 is first placed into bore 12 and counterbore
5 14 of holder rod 10. When insert rod 18 is placed within bore
6 10, adhesive 22 fills the space between insert rod 18 and
7 counterbore 14, creating a uniformly thick, cylindrical adhesive
8 bond between holder rod 10 and insert rod 18. Using tension eyes
9 16 and 20, a tensile load is applied along axes X-X and Y-Y,
10 trying to pull insert rod 18 from within bore 12, which puts
11 adhesive 22 into pure shear. In the preferred embodiment shown,
12 an adhesive reservoir 24 is formed at base 12a by drilling
13 further along axis X-X. A drain tap 26 is drilled into holder
14 rod 10 transverse to axis X-X to intersect reservoir 24. When
15 insert rod 18 is placed into bore 12 and counterbore 14, excess
16 adhesive is allowed to flow through reservoir 24 and out drain
17 tap 26. This allows full engagement of the insertion rod into
18 the bore. The adhesive can also be flushed from drain tap 26 and
19 reservoir 24 to prevent an adhesive bond at the end of the
20 insertion rod along the direction of base 12a of bore 12. Teflon
21 tape 28 is also applied to the end of insertion rod 18 to further
22 prevent the formation of a bond. This will ensure that shear
23 strength measurements are not influenced by a bond which would be
24 subjected to a tensile load.

1 What has thus been described is an adhesive shear strength
2 test apparatus having a cylindrical adhesive bond between test
3 specimens which is subjected to pure shear. The test specimens
4 are two cylindrical rods. One rod has a bore and counterbore
5 reamed into one end along its longitudinal axis. The other rod
6 has a diameter equal to the diameter of the bore. The adhesive
7 to be tested is placed within the bore and counterbore and the
8 smaller diameter rod is inserted into the bore. The adhesive
9 fills the space between the smaller rod and the counterbore,
10 creating a uniform, cylindrical layer of adhesive between the
11 exterior surface of the smaller rod and the inner surface of the
12 counterbore. When the adhesive cures, the assembly is subjected
13 to a tensile load along its longitudinal axis tending to pull the
14 inserted rod from the bore such that the adhesive is subjected to
15 a pure shear load. The rods can be machined to tight tolerances
16 to provide consistent adhesive thicknesses from test to test.
17 Additionally, a number of test specimens can be fabricated with
18 differing counterbore diameters to test the effect of adhesive
19 thickness on shear strength. By fabricating the test specimens
20 of metal, the adhesive can be baked off by placing the assembly
21 in an oven, allowing the specimens to be used again.

22 Obviously many modifications and variations of the present
23 invention may become apparent in light of the above teachings.
24 For example, the method of applying the tensile load can be
25 varied to suit the testing apparatus so long as the load is

1 applied axially. In the preferred embodiment, pins are placed
2 through tension eyes drilled through the rods. However, eyes
3 could be screwed into the ends of the rods, or a flange could be
4 attached to provide a grip for a pulling device, or the rods may
5 simply be gripped at their ends and pulled apart. Also, the
6 preferred embodiment contemplates using mild steel rods but the
7 rods may be fabricated of any suitable material which could be
8 drilled as indicated.

9 In light of the above, it is therefore understood that
10 the invention may be
11 practiced otherwise than as specifically described.

2
3 ADHESIVE SHEAR STRENGTH TEST APPARATUS

4
5 ABSTRACT OF THE DISCLOSURE

6 An apparatus for testing adhesive shear strength having a
7 cylindrical adhesive bond between test specimens which is
8 subjected to pure shear. The test specimens are two cylindrical
9 rods. One rod has a bore and counterbore reamed into one end
10 along its longitudinal axis. The other rod has a diameter
11 essentially equal to the diameter of the bore. The adhesive to
12 be tested is placed within the bore and counterbore and the
13 smaller diameter rod is inserted into and seated at the base of
14 the bore. The adhesive fills the space between the smaller rod
15 and the counterbore, creating a uniform, cylindrical layer of
16 adhesive between the exterior surface of the smaller rod and the
17 inner surface of the counterbore. When the adhesive cures, the
18 assembly is subjected to a tensile load along its longitudinal
19 axis, tending to pull the inserted rod from the bore and
20 subjecting the cylindrical adhesive bond to a pure shear load.

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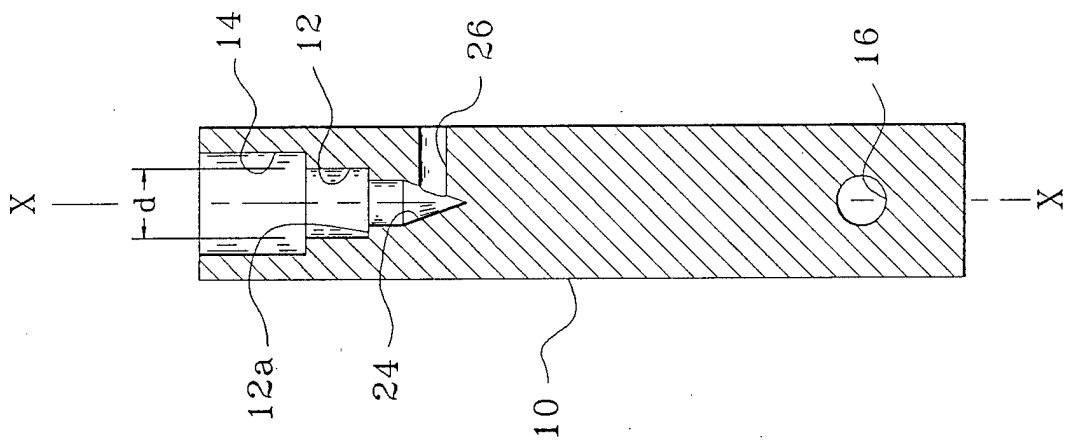


FIG. 1

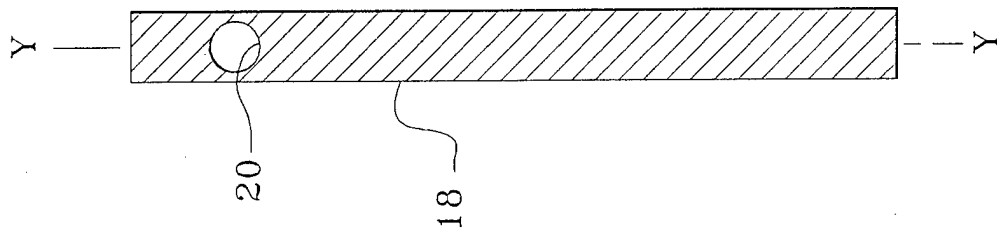


FIG. 2

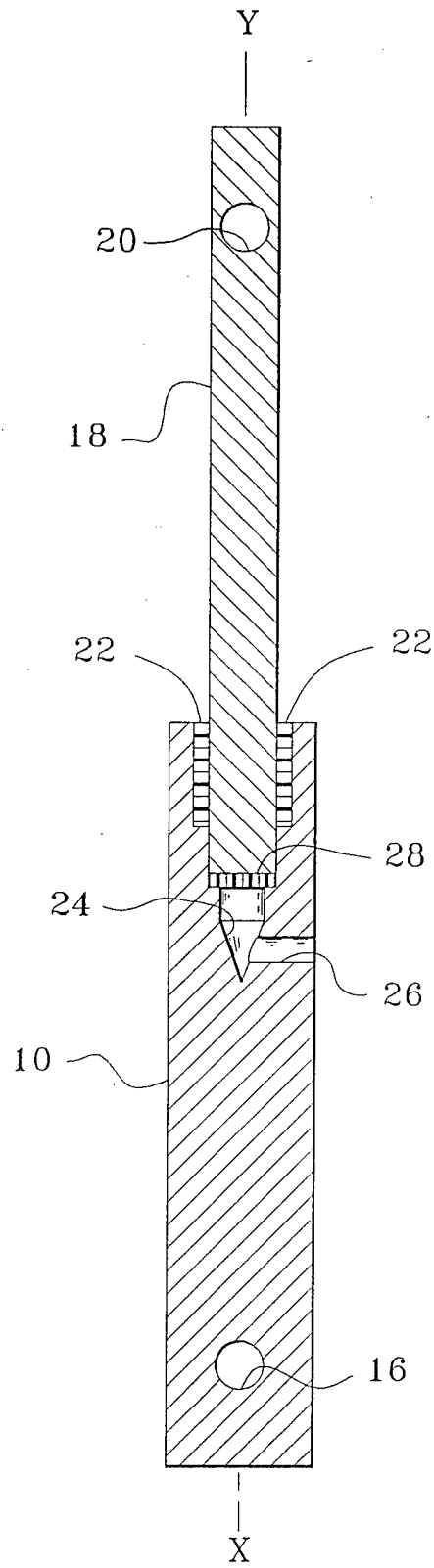


FIG. 3