NASM1312-16
STANDARD PRACTICE

FASTENER TEST METHODS

METHOD 16

CLAMPING FORCE FOR INSTALLATION

FORMED FASTENERS

THE INITIAL RELEASE OF THIS DOCUMENT SUPERSEDES MIL-STD-1312-16A

DESIGNATION FOR THIS TEST METHOD REMAINS MIL-STD-1312-16

LIST OF CURRENT SHEETS									
NO.	1	2	3	4	5	6	7	8	9
REV.	NEW	NEW	NEW	NEW	NEW	NEW	NEW	NEW	NEW

FSC 53GP

APPROVAL DATE AUGUST 1997

NATIONAL AEROSPACE STANDARD

FORWORD

This standard sets forth a standard test method for determining the induced axial load (clamping force) for installation formed fasteners after installation.

APPROVAL DATE AUGUST1997

NATIONAL AEROSPACE STANDARD

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FIGURES

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1. SCOPE

1.1 Applicability. This test method provides a standardized method for determining the induced axial load (clamping force) for multiple-piece installation formed fasteners after installation and is not limited by configuration or size.

2. REFERENCED DOCUMENTS

2.1 Government documents.

2.1.1 Specifications, standards and handbooks. The following specifications, standards and handbooks form a part of this specification to the extent specified herein. Unless otherwise specified, the issues of these documents should be those listed in the issue of the Department of Defense Index of Specifications and Standards (DoDISS) and the supplement thereto, cited in the solicitation.

SPECIFICATION

MILITARY

MIL-STD-45662 Calibration System Requirements

(Copies of specifications, standards and handbooks are available from the Naval Publications and Printing Service, Standardization Documents Ordering Desk , Bldg. 4D, 700 Robbins Ave., Philadelphia, PA 1911-5094).

2.2 Other publications. The following document(s) forms a part of this specification to the extent specified herein. Unless otherwise specified, the issues of the documents which are DOD adopted shall be those listed in the issue of the DoDISS specified in the solicitation. Unless otherwise specified, the issues of the documents not listed in the DoDISS shall be the issue of the nongovernment documents which are current on the date of the solicitation.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM E4 Standard Methods of Verification of Testing Machines

ASTM E74 Calibration of Force-Measuring Instruments for Varying the Load Indication of Testing Machines

(Application for copies should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.)

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI B46.1 Surface Texture (Surface Roughness, Waviness and Lay)

(Application for copies should be addressed to the American National Standards Institute, 1430 Broadway, New York, NY, 10018)

3. DEFINITIONS Not applicable.

4. GENERAL REQUIREMENTS

4.1 Test apparatus.

4.1.1 Load cell method.

4.1.1.1 Load cell. The load cell used shall have been calibrated on a calibrated testing machine in accordance with MIL-STD-45662. A clamping force value that is repeatable and directly comparable for most fastener types can be determined by measuring the strain induced in a fastener by use of strain gages. The accuracy of the measurement of the clamping force depends upon proper alignment of strain gages, the rigidity of the structure and the squareness of the structure faces contacting the fastener. This method, however, necessitates clearance for strain gages in hole preparation, extremely delicate gage application when used with smaller diameter fasteners, and much time for instrumentation and test. These disadvantages eliminat its use with some fasteners, such as hole filling type, and make it impractical as a convenient, easily obtainable test (see figure 1).

4.1.1.2 Amplifying and recording equipment. Applicable equipment suitable for the purpose and of suitable accuracy shall be used.

4.1.1.3 System accuracy and repeatability. The overall system, consisting of the load cell and the amplifying and recording equipment shall be accurate within 2 percent. The load repeatability must be within 5 percent.

4.1.2 Paddle or split shim method. These methods also indirectly measure the fastener clamping force. In either method, a tensile load is applied and the joint pulled until the joint is "unclamped." The clamping load is defined as the "unclamping" load required on the joint to enable small shims to be removed or a paddle to be rotated. This test is very convenient and can be quickly accomplished, however, it has many disadvantages. The results obtained are affected by coefficient of friction in the joint, load differences used to remove the shims or rotate the paddle and angular misalignment of the "unclamping load. The results obtained from this test tend to be higher than the "actual" clamping force mainly due to bending from any misaligned loading (see figure 2).

These test methods may be used for Quality Assurance comparative testing or for comparative testing of different design installation formed fasteners. These test methods shall not be used to obtain data determing actual clamp-up loads of installation formed fasteners. Due to the differences in test methods (and equipment), methods defined herein shall not be used for verification of paddle or split shim test results accomplished by other sources.

4.1.3 Test fixtures. Test fixtures shall meet all of the following requirements. Typical test fixtures are shown on figures 1 and 2.

4.1.3.1 Hole features. The fixture hole shall be chamfered to provide clearance for the head to shank fillet of the fastener. Also, the hole shall be countersunk when flush head fasteners are to be tested.

4.1.3.2 Load direction. The fixture shall be capable of applying an axial tensile load through the centerline of the fastener, within ±0.005, by means of suitable supporting fixtures.

4.1.4 Testing machine. The testing machine shall be capable of applying a tensile load at a controllable rate. The calibration system for the machine shall conform to the requirements of MIL-STD-45662. Its accuracy shall be verified every 6 months by a method complying with ASTM E4, using a calibration device which shall have been calibrated in accordance with ASTM E74 not more than 2 years prior to its use.

5. DETAIL REQUIREMENTS

5.1 Test procedures.

5.1.1 Assembly. The assembly to be tested shall be assembled in the appropriate fixture as shown on figures 1 and 2. Other fixtures of equal or superior accuracy may be used and shall be fully described in the report. The fastener shall be installed (pulled, driven, etc.) partially or completely, as required by the installation procedure, and the induced load clamping force read from the load indicating instrument or dial. Unless otherwise required, the fasteners shall be installed in the as-delivered condition. When deviations are requested (degreasing, application of specific lubricants, sealing compounds, etc.), detailed information specifying applied procedure shall be included in the test report.

5.1.2 Grip length. Fasteners having a specific grip range shall be tested in such grip conditions as required by the applicable procurement specification or document. In any case, however, fasteners having a grip length less than twice the nominal diameter need not be tested.

5.1.3 Number of tests. Unless otherwise specified, not less than five clamping force tests of each fastener size and type in minimum and maximum grip, shall be performed.

5.1.4 Load rate. Unless otherwise specified, the loading rate shall be in accordance with Table I.

TABLE I Loading rate.

Loading rates pounds /minute ± 10 percent	
Nominal Diameter (inch)	Preload Rate
5/32 (.156)	300
3/16 (.188)	456
1/4 (.250)	800
5/16 (.313)	1,200
3/8 (.375)	1,800
7/16 (.438)	2,250
1/2 (.500)	2,950

6. NOTES

6.1 Test report. A test report shall be submitted and shall contain the following data:

a. Fastener description

b. Part number

c. Manufacturer and cage code

d. Fastener material

e. Grip length

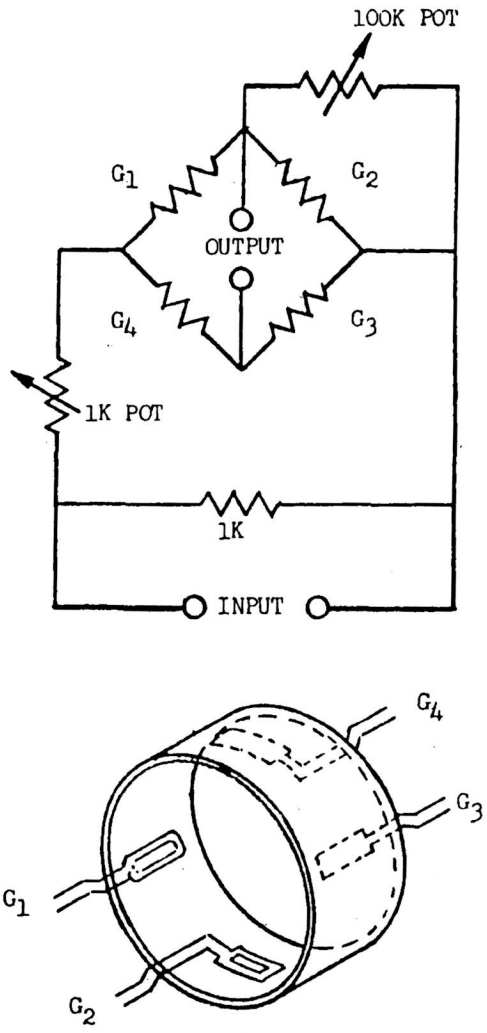
f. Clamping force load

g. Load rate

h. Lot identification

i. Hole sizes

j. Type of equipment used

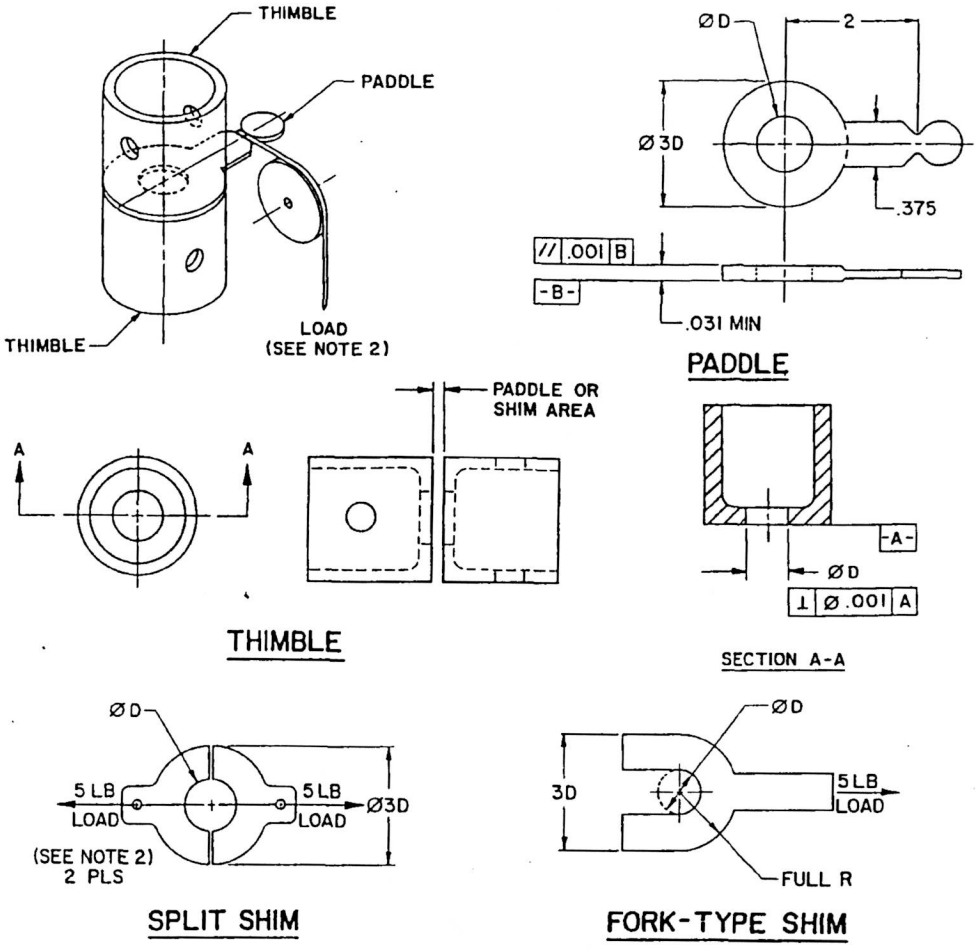


G_1 and G_3 - AXIAL STRAIN GAGES

G_2 and G_4 - CIRCUMFERENTIAL STRAIN GAGES

NOTE: GAGES MAY BE ATTACHED EITHER INSIDE OR OUTSIDE, BUT ALL ON THE SAME SURFACE.

FIGURE 1. Strain gage setup.



NOTES:

1. ALL BEARING SURFACES TO BE 32 MICROINCHES IN ACCORDANCE WITH ANSI B46.1.
2. PADDLE TEST LOAD SHALL BE 1 LB ±.25 LB, SPLIT SHIM TEST LOAD SHALL BE 5 LBS ±.25 LB.
3. A SPLIT SHIM MAY BE USED AS AN OPTION TO THE PADDLE.
4. ALL SURFACES SHALL BE ACCURATE AND CLEAN BEFORE EACH TEST.
5. THIMBLES SHALL BE MADE OF SUFFICIENT WALL THICKNESS TO PERMIT THREADING ON THE O.D.
6. D EQUALS FASTENER MAXIMUM DIAMETER + 0.005 $^{+\ 0.010}_{-\ 0.000}$
7. A FORK-TYPE SHIM MAY BE USED AS AN OPTION TO THE PADDLE OR SPLIT SHIM.

FIGURE 2. Paddle test setup.