Ball Stud and Socket Assembly Test Procedure–SAE J193a

SAE Recommended Practice
Completely Revised April 1979

THIS IS A PREPRINT WHICH IS SUBJECT TO REVISIONS AND CORRECTIONS. THE FINAL VERSION WILL APPEAR IN THE 1980 EDITION OF THE SAE HANDBOOK.

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LAND SEA AIR SPACE

PREPRINT

The ϕ symbol is for the convenience of the user in locating areas where technical revisions have been made to the previous issue of the report. If the symbol is next to the report title, it indicates a complete revision of the report.

ϕ BALL STUD AND SOCKET ASSEMBLY TEST PROCEDURE—SAE J193a

SAE Recommended Practice

Report of Ball Stud and Tie Rod Socket Committee approved August 1970 and completely revised April 1979.

1. Scope—The purpose of this test procedure is to provide a uniform method of testing ball stud and socket assemblies to determine their functional characteristics. This procedure is an extension of the dimensional recommendations for ball studs as used in integral socket assemblies. All tests, except ball stud yield, may be run using complete integral assemblies representing the application.

2. Objective—To provide adequate testing format to ensure that the parts will meet functional requirements of the individual application.

3. Test Procedures—The test procedures cover the following characteristics:

3.1 Ball stud to socket rotating and oscillating torque.
3.2 Ball stud to socket axial end movement.
3.3 Ball stud to socket cam out strength.
3.4 Ball stud and socket assembly fatigue and wear test.
3.5 Ball stud yield load.

4. Objectives and Test Procedures

4.1 Ball Stud to Socket Rotating and Oscillating Torque

4.1.1 Objective—To ensure desired rotating and oscillating torque is obtained.

4.1.2 Procedure—The assembly should be clamped at an area away from the socket to prevent addition of external clamping pressures which may affect torque readings.

4.1.2.1 Breakaway Torque—Assemblies should be filled with specified application lubricant when it is required.

For some designs and applications it is necessary to store the assembly (with lubricant) for 48 h without movement prior to test to ascertain the cold flow characteristics of the materials and congelation effect of the selected lubricant on breakaway torque.

The torque is read with a torque device with gradual application of a rotating force.

Breakaway torque values may be varied to suit the application.

4.1.2.2 Rotating or Oscillating Torque—Assemblies should be filled with specified application lubricant when it is required.

Rotate stud a minimum of five complete revolutions to minimize congelation and other factors prior to recording torque.

The torque is read with a torque device while the stud is being revolved or oscillated at approximately 5 r/min.

Rotating and oscillating torque values may be varied to suit the application.

4.2 Ball Stud to Socket Axial End Movement

4.2.1 Objective—To determine end movement measurement.

4.2.2 Procedure

4.2.2.1 Spring Loaded Type—For axial movement the following is commonly used. The stud should be set perpendicular to the socket. Socket should be supported on the bottom of assembly. A force is applied to the stud (less nut) and the axial movement of the stud is noted and recorded. (Fig. 1A depicts typical fixture.)

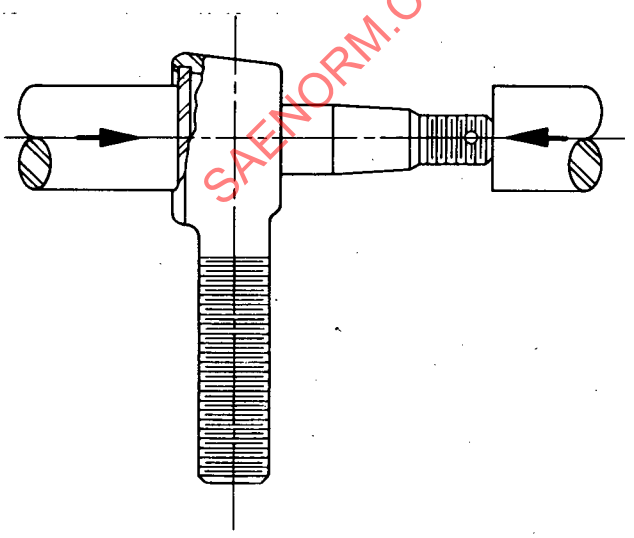

FIG. 1A

Note: Ensure that the top of the stud is flat at the contact point of force (grind if necessary).

4.2.2.2 All Other Types of Socket Assemblies—With the shank of the socket assembly clamped to prevent squeezing of socket and the stud, pull upward. After the movement of the stud is noted and recorded, the operation is repeated with a force pushing downward. Fig. 1B depicts a typical fixture.

4.3 Ball Stud to Socket Cam Out Strength

4.3.1 Objective—To determine retention of the ball stud in the socket at angular positions and to determine the angle of separation.

4.3.2 Procedure—The ball stud and socket assemblies should be mounted in a tensile test machine with the test specimen stud held in a fixture which permits unrestricted angular travel. Fig. 2 depicts a typical fixture.

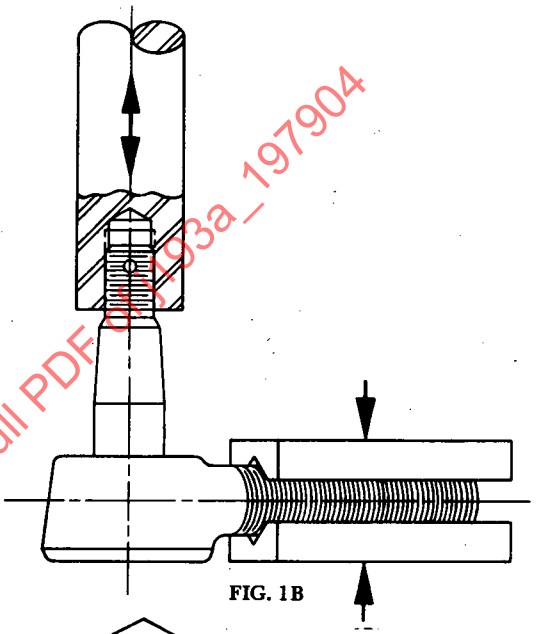

FIG. 1B

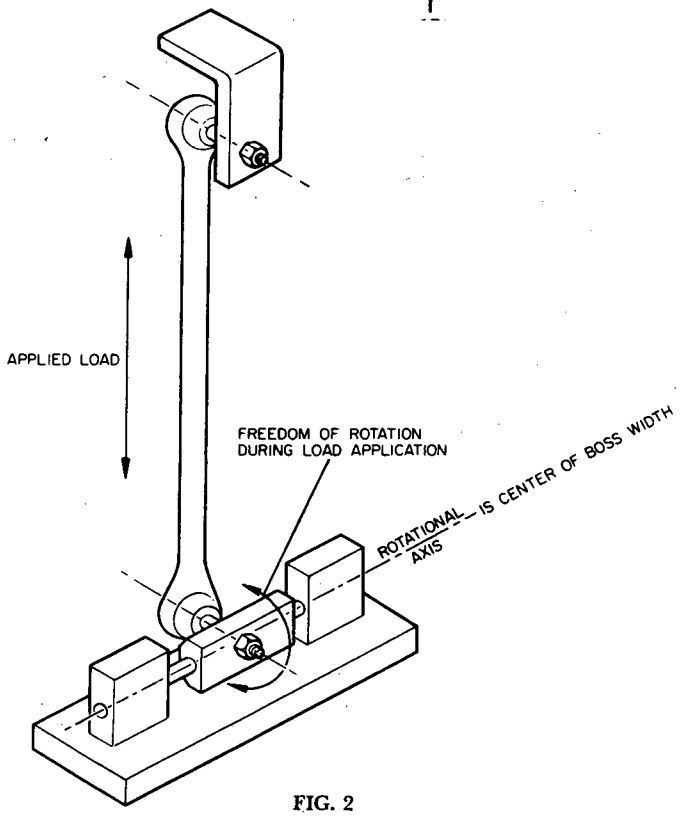

FIG. 2

A tensile load is applied to the assembly parallel to the normal load direction when the test stud is in full angular travel. The test is repeated with a new sample, using a compression load. The maximum load and angle induced prior to separating the stud from the socket is recorded.

4.4 Ball Stud and Socket Assembly Fatigue and Wear Test

4.4.1 Objective—To determine fatigue and wear characteristics of ball stud and socket assemblies.

4.4.2 Procedure—Use socket assemblies which have been tested according to paragraphs 4.1 and 4.2 and found acceptable. Socket assemblies should be filled with recommended lubricant when required in the application. Socket assemblies should be installed, with seals when required, in a fixture by placing the taper shank in the mating tapered hole with the retaining nut torqued to design specification. For each type to be tested, the ball stud and socket assemblies may be cut and threaded to suit the test machine. Securely clamp the link in a manner to achieve the required motions. The following are typical motions which may be used: Refer to Fig. 3.

1. Angular Oscillation—±20 deg in a plane parallel to the link centerline at 60 c/min.
2. Angular Rotation—±40 deg measured about the ball stud shank centerline at 32 c/min.
3. Load—Alternating designated tension and compression load at 60 c/min.

Load application angle may be varied to suit the application. The socket assemblies are then tested to required angles, frequencies, and load applications concurrently and completed in two phases.

Note: When actual use dictates, other application loads, angles, and frequencies may be substituted for above.

4.4.2.1 Phase I Test: Peak Load—To correlate the cycle life with the maximum operating load to which the assembly will be subjected in its actual application.

The cycle life varies for each type of application and environment; therefore, a program loading procedure for the specific application is required to establish load and cycle life required for this test.

In the absence of complete program loading data, and to provide a basis for standardized testing of the assembly, 7500 cycles is a reasonable cycle life for this test.

4.4.2.2 Phase II Test: Endurance Load—To correlate the cycle life of the assembly for the average load to which the assembly will be subjected in its application and environment, with life in actual use, and to establish the load which provides for extended fatigue and wear life.

The cycle life varies for each type of application and environment; therefore a program loading procedure for the specific application is required to establish load and cycle life required for this test.

In the absence of complete program loading data, and to provide a basis for standardized testing of the assembly, 250 000 cycles is a reasonable cycle life for this test.

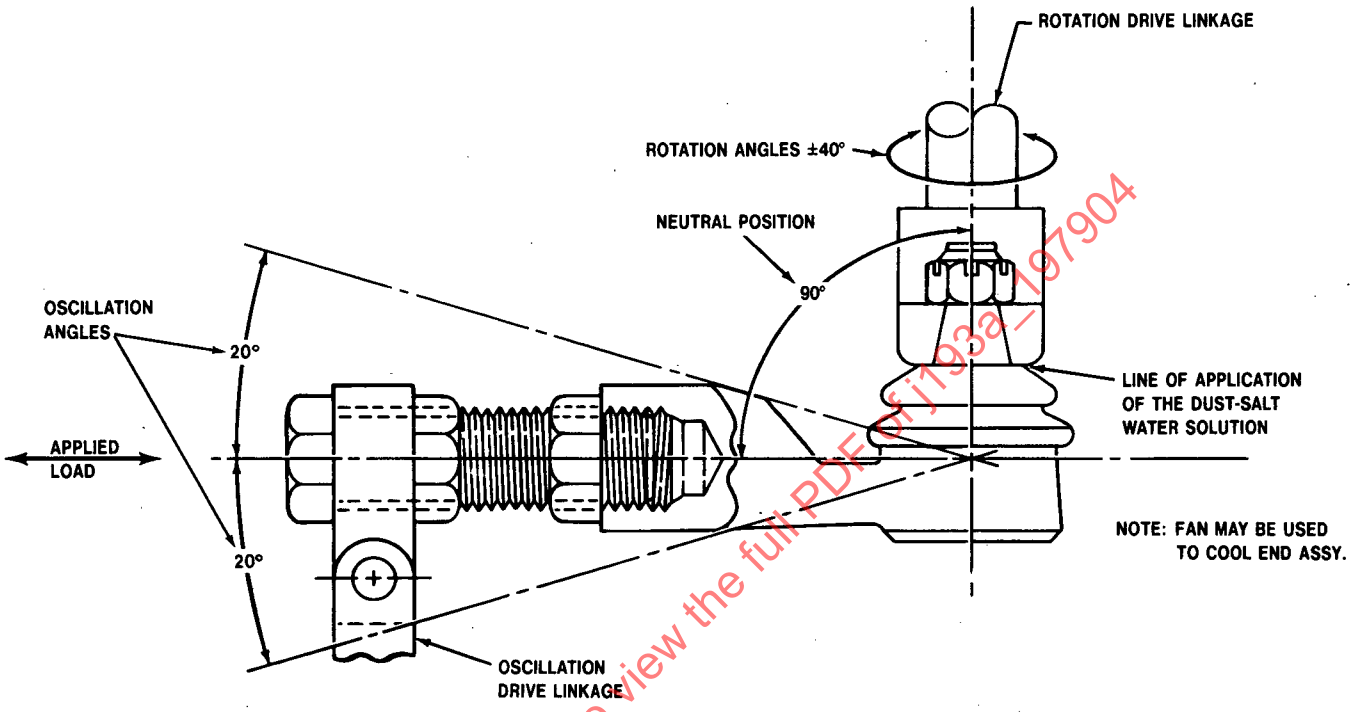

FIG. 3

4.4.2.3 During the Phase I and Phase II tests, artificial cooling may be used where deemed necessary to prevent heat build-up which would not be experienced in the application.

If the application of the ball stud and socket assembly includes environmental contamination, contaminants should be provided to correlate with these conditions in the test. This procedure will determine seal durability and effectiveness.

Typical solutions commonly used are:

1. Ozone atmosphere.
2. Saline and dust—4 L of water, 50% saturated solution of common salt at 21–24°C, and 0.15 kg of SAE air cleaner test dust fine grade. See SAE J426.
3. Steam.

4.4.3 Conditions to be examined at completion of test to determine adequacy for the application:

4.4.3.1 The rotating and oscillating torque condition (see paragraph 4.1).

4.4.3.2 The end movement (see paragraph 4.2).

4.4.3.3 The ball stud should be examined for any surface cracks, determined by a dye check or approved equivalent.

4.4.3.4 The ball stud should be examined for any local yielding, determined by a dimension check.

4.4.3.5 The internal components should be examined for damage.

4.5 Ball Stud Yield Load

4.5.1 Objective—To determine at what load condition the ball stud will take a permanent set without fracture.