

Hydraulic Apparatus for Mechanical Testing of Nuts

Advantages include mobility and reduced setup time.

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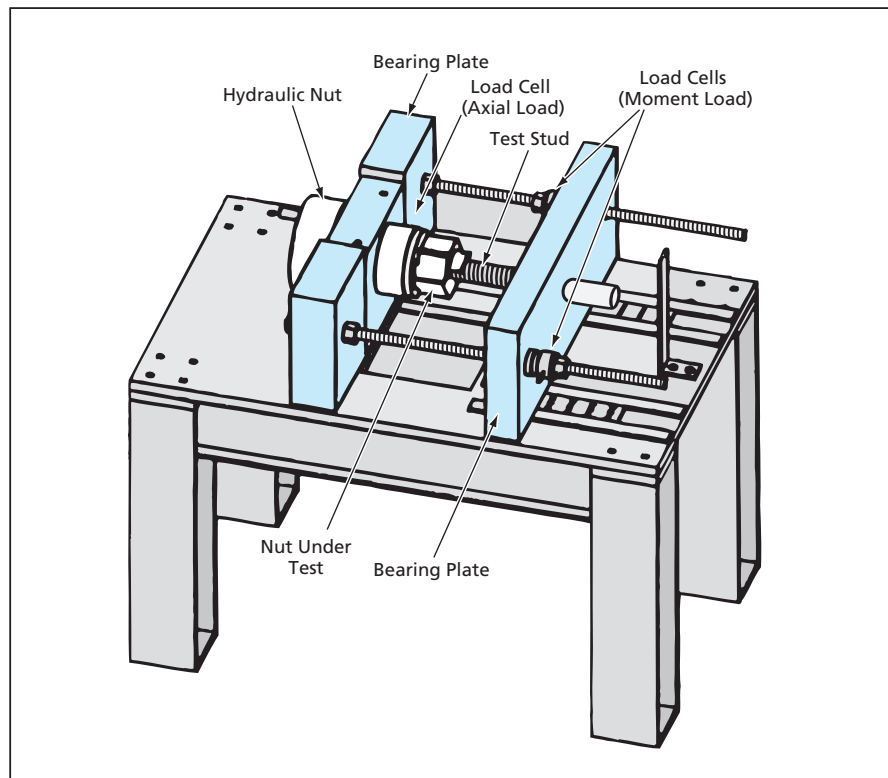
The figure depicts an apparatus for mechanical testing of nuts. In the original application for which the apparatus was developed, the nuts are of a frangible type designed for use with pyrotechnic devices in spacecraft applications in which there are requirements for rapid, one-time separations of structures that are bolted together. The apparatus can also be used to test non-frangible nuts engaged without pyrotechnic devices.

This apparatus was developed to replace prior testing systems that were extremely heavy and immobile and characterized by long setup times (of the order of an hour for each nut to be tested). This apparatus is mobile, and the setup for each test can now be completed in about five minutes.

The apparatus can load a nut under test with a static axial force of as much as 6.8×10^5 lb (3.0 MN) and a static moment of as much as 8.5×10^4 lb-in. (9.6×10^3 N-m) for a predetermined amount of time. In the case of a test of a frangible nut, the pyrotechnic devices can be exploded to break the nut while the load is applied, in which case the breakage of the nut relieves the load. The apparatus can be operated remotely for safety during an explosive test.

The load-generating portion of the apparatus is driven by low-pressure compressed air; the remainder of the apparatus is driven by 110-Vac electricity. From its source, the compressed air is fed to the apparatus through a regulator and a manually operated valve. The regulated compressed air is fed to a pneumatically driven hydraulic pump, which pressurizes oil in a hydraulic cylinder, thereby causing a load to be applied via a hydraulic nut (not to be confused with the nut under test). During operation, the hydraulic pressure is correlated with the applied axial load, which is verified by use of a load cell.

Prior to operation, one end of a test stud (which could be an ordinary



The Hydraulic Unit Applies a Load to the nut under test via the hydraulic nut and the test stud.

threaded rod or bolt) is installed in the hydraulic nut. The other end of the test stud passes through a bearing plate; a load cell is slid onto that end, and then the nut to be tested is threaded onto that end and tightened until the nut and load cell press gently against the bearing plate.

The axial load is applied to the nut under test as the air and hydraulic pressures increase. The manually operated hand valve is closed to isolate the hydraulic pump to hold the load on the test article. A second manually operated valve is used to dump the hydraulic oil back to a reservoir to relieve the load. The maximum axial load is limited by a relief valve on the compressed air source; the maximum load can be changed by adjusting the setting of this valve.

To set up the apparatus to apply a moment load, one adds a second bearing plate, through which the test stud passes with a tight fit. Specific loads can be applied to the second bearing plate by torquing nuts on the all-thread connecting the two bearing plates, at a set distance from the center line of the test stud. These loads are verified by use of load cells. The movement of the second bearing plate creates a bind with the end of the test stud, thereby giving rise to a moment load applied to the nut under test.

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