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NASA TECH BRIEF

Automatic, Computerized Testing of Bolts

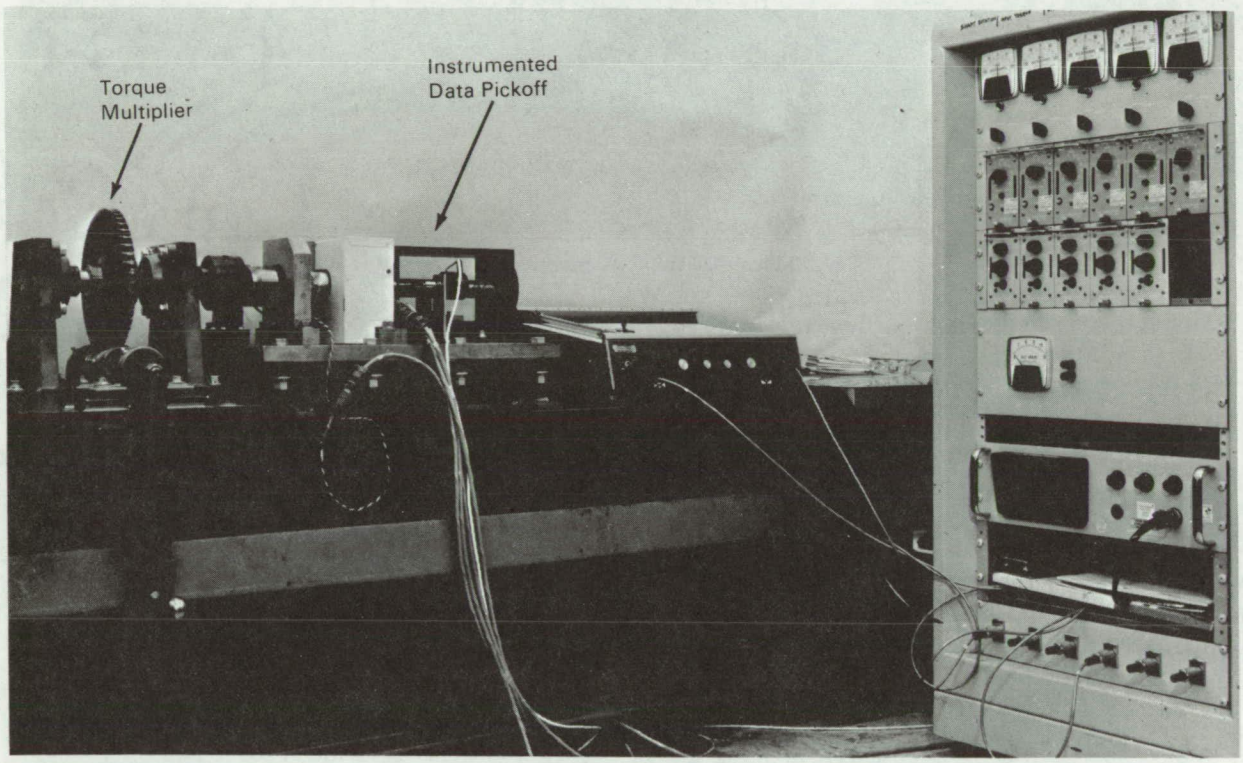

Figure 1. Test-Apparatus Bolt Clamp

A novel computerized system for testing bolts with various platings, lubricants, nuts, and tightening procedures produces five rows of data, printed in report form, more rapidly than three are produced by older systems.

Most commercial bolt-testers are hydraulic, with limited, visual readout. The nuts must be turned and the turns marked by hand. The purpose in developing this new, automatic, computerized system (Fig. 1) was to determine the best combination of plating, lubrication, nut type, and tightening procedure for both a reliably tensioned fastener and an identifiable and reproducible level of tension. With this system, 200 fasteners can be tested, and the results processed and summarized, within one month. The bolt elongation and the shank torque are measured, and the data is delivered in the form of a printed report.

The five characteristics selected for measurement

(continued overleaf)

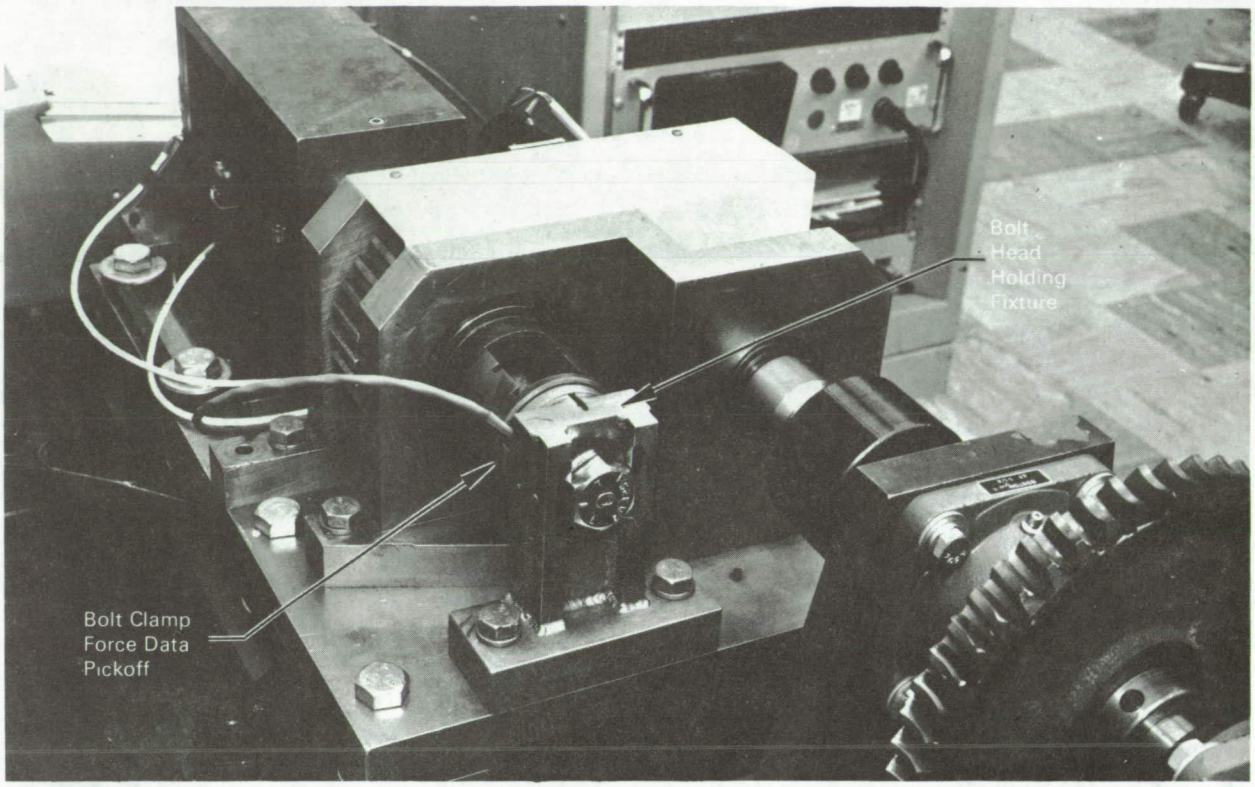

Fig. 2. Close-Up to the Apparatus Pickoff

are: (1) input torque and (2) nut rotation (to determine their relationship to the bolt clamping force); (3) bolt clamping force (the basis of the study); (4) bolt shank twist (to evaluate the torsion variations with different platings and lubricants); and (5) bolt elongation (to evaluate its relationship to clamping force).

The test apparatus is comprised of an input-torque multiplying device and an instrumented data-pickoff fixture (Fig. 2). The torque multiplier consists of a worm shaft and gear, with a ratio motor. The fixture holds the head of the bolt and allows the nut to be turned without interfering with the pickoff.

Input torque is measured by a strain-gage bridge fixed to the input shaft of the fixture. The number of partial rotations of the nut is measured by a ten-turn potentiometer driven by the input shaft. Clamping force is measured by a Lockheed force washer installed in a fixture holding the bolt head. Bolt twist is measured by a strain-gage beam mounted on the fixture, and deflected by a cam mounted on a threaded shaft. The threads engage the end of the bolt that protrudes through the nut. Bolt elongation is measured by a strain-gage beam deflection caused by the linear motion of the threaded shaft.

All transducer signals are fed into bridge-supply/bridge-completion modules and then to dc amplifiers. Amplifier signals are fed through a multiconductor data link to a computer. The data are compiled, and stress and strain calculations are typed in report form. Visual analog recorders furnish continuous data read-out for real-time checking during the tests, or for later back-checking.

Note:

Requests for further information may be directed to:

Technology Utilization Officer
NASA Pasadena Office
4800 Oak Grove Drive
Pasadena, California 91103
Reference: TSP70-10657

Patent status:

No patent action is contemplated by NASA.

Source: V. B. Lobb, F. W. Stoller, and J. Carlucci, Jr., of Caltech/JPL under contract to NASA Pasadena Office (NPO-11090)