

sure block, at the lower end of the piston shaft. This specimen is pressed down against the other specimen, which is mounted in a recess in another block, denoted the slip block, that can be moved horizontally but not vertically. The slip block is driven in reciprocating horizontal motion by an electrodynamic vibration exciter outside the pressure vessel. The armature of the electrodynamic exciter is connected to the slip block via a horizontal shaft that extends into the pressure vessel via a second shaft seal. The reciprocating horizontal motion can be chosen to be random with a flat spectrum over the frequency range of 10 Hz to 1 kHz, or to be sinu-

soidal at any peak-to-peak amplitude up to 0.8 in. (≈ 2 cm) and fixed or varying frequency up to 1 kHz.

The temperatures of the specimen and of the vessel are measured by thermocouples. A digital video camera mounted outside the pressure vessel is aimed into the vessel through a sapphire window, with its focus fixed on the interface between the two specimens. A position transducer monitors the displacement of the pneumatic-cylinder shaft. The pressure in the vessel is also monitored. During a test, the output of the video camera, the temperatures, and the pneumatic-shaft displacement are monitored and recorded. The test is contin-

ued for a predetermined amount of time (typically, 10 minutes) or until either (1) the output of the position transducer shows a sudden change indicative of degradation of either or both specimens, (2) ignition or another significant reaction is observed, or (3) pressure in the vessel increases beyond a pre-set level that triggers an automatic shutdown.

This work was done by Eddie Davis of Marshall Space Flight Center, Bill Howard of Qualis Corp., and Stephen Herald of Integrated Concepts & Research Corp. For further information, contact Sammy Nabors, MSFC Commercialization Assistance Lead, at sammy.a.nabors@nasa.gov. Refer to MFS-32613-1.

Small-Bolt Torque-Tension Tester

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Current torque-tension measurement techniques involve using load washers as the force measuring transducer. The disadvantage of load washers is that they are too large to be used with fasteners smaller than about size #8. The device described here measures the torque-tension relationship for fasteners as small as #0.

The small-bolt tester consists of a plate of high-strength steel into which three miniature load cells are recessed. The depth of the recess is sized so that the three load cells can be shimmed, the optimum height depending upon the test hardware. The three miniature load cells are arranged in an equilateral triangular configuration with the test bolt aligned with the centroid of the three. This is a kinematic arrangement. The three load

cells define a plane and since the test bolt interfaces at the centroid of the three load cells, each load cell reacts 1/3 of the total bolt preload. Because of this, only one of the three load cells is really required with the other two being redundant. Having the additional load cells adds redundancy and confidence to the system. The signals from the three miniature load cells are read by three individual force-measurement indicators.

The test bolt interfaces to a unique bushing that is recessed from the opposite side from the load cells. The replaceable bushings used in the device allow the system to test with the appropriate in service materials if required. The deep recess (or counterbore) allows for testing of bolts that are as short as 0.38-in. (≈ 10 -mm).

The outside diameter of the bushing is threaded to interface with the threaded recessed hole. There is a hole in the center of the bushing where the test bolt passes through. The bushing material and hole size can be customized to replicate actual in-service hardware. This is important to account for the different friction coefficients at the interfaces.

As a test bolt is tightened, the bolt analyzer continually monitors and records both the torque and preload until the target preload is reached. The data are stored digitally, which allows for easy data analysis.

This work was done by Alan J. Posey of Goddard Space Flight Center. Further information is contained in a TSP (see page 1). GSC-15718-1