beam in a meridional plane of the pipe. Receiving optical couplers similar to the transmitting optical couplers are mounted in the same meridional plane at various longitudinal positions on the opposite side of the pipe, approximately facing the transmitting optical coupler along the same slant.

Light collected by each receiving optical coupler is sent, via a multimode fiber-optic cable, to a detector module similar to the reference detector module. The outputs of the photodiodes in each detector module are digitized and processed, similarly to those of the reference detector module, to obtain indications of the amounts of light of each wavelength scattered to the corresponding receiving position. The value for each wavelength at each position is also normalized to the reference laser-power level for that wavelength. From these normalized values, the density and the mass flow rate of the fluid are estimated.

This invention is owned by NASA, and a patent application has been filed. For further information, contact Sammy Nabors, MSFC Commercialization Assistance Lead, at sammy.a.nabors@nasa.gov. Refer to MFS-32031-1.

**Selectable-Tip Corrosion-Testing Electrochemical Cell**

The diameter and average depth of a corrosion pit can be selected.

*John F. Kennedy Space Center, Florida*

The figure depicts aspects of an electrochemical cell for pitting-corrosion tests of material specimens. The cell is designed to generate a region of corrosion having a pit diameter determined by the diameter of a selectable tip. The average depth of corrosion is controlled by the total electric charge passing through the cell in a test. The cell is also designed to produce minimal artifacts associated with crevice corrosion.

There are three selectable tips, having diameters of 0.1 in. (0.254 cm), 0.3 in. (0.762 cm), and 0.6 in. (1.524 cm), respectively. The amount of electric charge needed to generate a corrosion pit having desired average depth \( h \) at a selected diameter \( d \) is given straightforwardly by

\[
Q = \frac{4\pi \rho \rho \pi d^2 h}{(4W)}
\]

\( F \) is the Faraday constant (the charge of one mole of electrons), \( \rho \) is the mass density of the specimen material, and \( W \) is the equivalent weight of the material (the mass of one mole of the material divided by the valence of the material).

This work was done by Janice Lomness and Paul Hintze of Kennedy Space Center. Further information is contained in a TSP (see page 1). KSC-13045

**Piezoelectric Bolt Breakers and Bolt Fatigue Testers**

Safer alternative to spacecraft explosive bolts may accelerate fatigue testing on Earth.

*NASA’s Jet Propulsion Laboratory, Pasadena, California*

A proposed family of devices for inducing fatigue in bolts in order to break the bolts would incorporate piezoelectric actuators into resonant fixtures as in ultrasonic/sonic drills/corers and similar devices described in numerous prior NASA Tech Briefs articles. These devices were originally intended primarily for use as safer, more-reliable, more- versatile alternatives to explosive bolts heretofore used to fasten spacecraft structures that must subsequently be separated from each other quickly on command during flight. On Earth, these devices could be used for accelerated fatigue testing of bolts.

Fatigue theory suggests that a bolt subjected to both a constant-amplitude dynamic (that is, oscillatory) stress and a static tensile stress below the ultimate strength of the bolt material will fail faster than will a bolt subjected to only the dynamic stress. This suggestion would be applied in a device of the proposed type. The device would be designed so that the device and the bolt to be fatigue-tested or broken would be integral parts of an assembly (see figure).