Physical Sciences

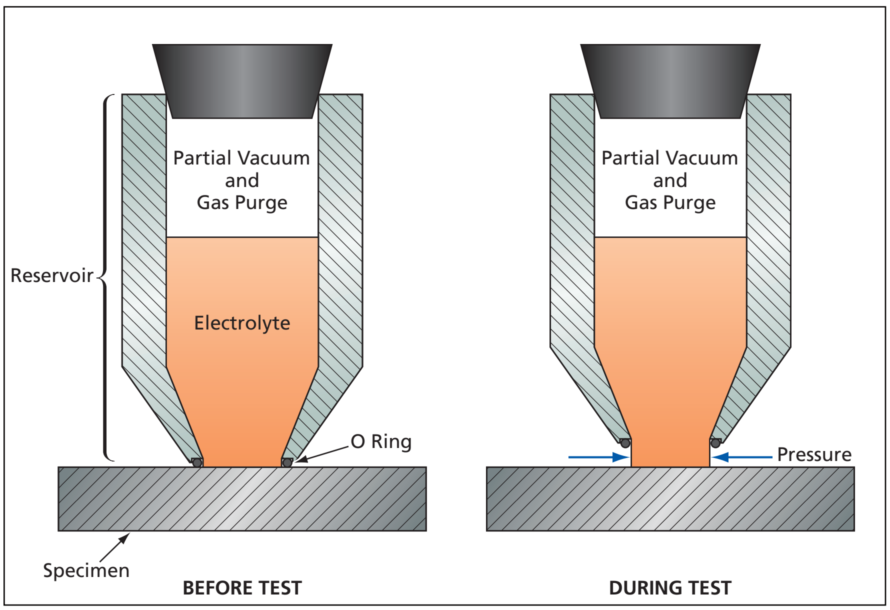
Partial-Vacuum-Gasketed Electrochemical Corrosion Cell

This cell is designed to reduce the incidence of crevice corrosion.

John F. Kennedy Space Center, Florida

An electrochemical cell for making corrosion measurements has been designed to prevent or reduce crevice corrosion, which is a common source of error in prior such cells. In a typical prior corrosion cell, crevice corrosion occurs at an interface between a material specimen, an electrolyte, and a specimen-mounting fixture. Crevice corrosion significantly alters current and voltage responses, thereby generating errors in the determination of both the thermodynamic and kinetic aspects of corrosion.

The present cell (see figure) includes an electrolyte reservoir with O-ring-edged opening at the bottom. In preparation for a test, the reservoir, while empty, is pressed down against a horizontal specimen surface to form an O-ring seal. A purge of air or other suitable gas is begun in the reservoir, and the pressure in the reservoir is regulated to maintain a partial vacuum. While maintaining the purge and partial vacuum, and without opening the interior of the reservoir to the atmosphere, the electrolyte is pumped into the reservoir. The reservoir is then slowly lifted a short distance off the specimen. The level of the partial vacuum is chosen such that the differential pressure is just sufficient to keep the electrolyte from flowing out of the reservoir through the small O-ring/specimen gap. Electrochemical measurements are then made. Because there is no gasket (and, hence, no crevice between the specimen and the gasket), crevice corrosion is unlikely to occur.



Differential Pressure between the atmosphere and the partial vacuum above the reservoir keeps the electrolyte in the reservoir when the reservoir is lifted a short distance off the specimen. The gap between the bottom of the reservoir and the specimen is exaggerated here for clarity.

This cell is easy to operate, uses a relatively small volume (10 to 25 mL) of electrolyte, accommodates specimens of various sizes, does not leave rubber O-ring residues on specimens, is inherently suitable for testing with electrolytes that must be purged with gases, and can easily be cleaned. Simple modifications can be performed to enable use of this cell in special crevice-free corrosion tests — for example, tests for determining critical pitting temperatures.

Inasmuch as the purge gas can quickly diffuse into the electrolyte, careful selection of the purge gas is necessary to ensure reliable results. Water-line corrosion could introduce small errors into some measurements.

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Theodolite Ring Lights

These lights facilitate the use of spherical tooling balls as position references.

Goddard Space Flight Center, Greenbelt, Maryland

Theodolite ring lights have been invented to ease a difficulty encountered in the well-established optical-metrology practice of using highly reflective spherical tooling balls as position references. As described in more detail below, a theodolite ring light is attached to a theodolite or telescope and used to generate a visible target on a tooling ball.

A common technique for aiming an instrument (specifically, a theodolite or an alignment telescope) precisely at the center of a tooling ball involves the use of an autocollimating device. This technique is less than ideal because the reflection from the ball is demagnified by the spherical surface of the ball. The demagnification makes it extremely difficult to resolve the reflection and align it accurately within the cross hairs of the