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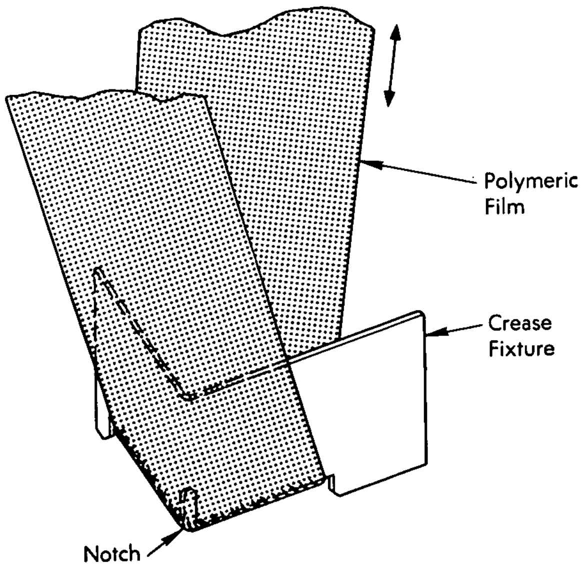
# Micro-Scale Crease-and-Fold Apparatus

## The problem:

To evaluate the crease-and-fold resistance of polymeric films in the presence of small amounts of highly reactive fluids. In particular, the evaluation was to involve the severe three-corner creases experienced by propellant expulsion bladders in spacecraft; moreover, it was desired that results should be comparable with those obtained from a large, table-size three-corner crease tester.




## The solution:

A micro-scale crease-and-fold test apparatus based on the use of a fixture which produces a three-corner crease on a strip of polymeric film while it is immersed in a small volume of reactive fluid.

## How it's done:

The crease fixture shown in the diagram is mounted on the end of a rod supported by a nickel-plated circular plate which acts as a support for all mechanical components of the test apparatus and also serves as the lid for a small bell jar or heavy-wall "test tube" of large diameter; hermetic seal between glass and the metal lid is effected by an O-ring of inert material, and the assembly is maintained integral by suitable clamps. The shaft of a variable-speed motor passes through a polytetrafluoroethylene O-ring rotary seal in the nickel-plated lid and drives a crank mechanism that imparts reciprocating motion to a drive pulley. A narrow band of 0.127-mm nickel foil is fixed to the pulley at one point and the test sample strip is fastened by clamps to the ends of the nickel foil; thus, the reciprocating action of the pulley causes the test strip to slide back and forth over the crease fixture. A spring-plunger tension gage interposed between one end of the nickel foil band and the test sample insures smooth operation and prevents undue tension when motion of the test sample is abruptly reversed.

The test sample strip is forced to comply with the shape of the crease fixture by the tension exerted by the spring-plunger tension gage; thus, a three-corner crease is formed. However, since the test sample strip is forcibly slid back and forth, the three-corner crease is made to travel along a line 5 to 7 cm long, and when the sample fails, a pinhole will be formed on the line. Pinholes are detected by a spark probe consisting of a wire (insulated by quartz tubing) attached to a 10,000-volt, 30-mA neon-sign transformer. Since the fixture defines the position of the three-corner crease at all times, it is possible to place the probe at a

(continued overleaf)

point where a pinhole can be detected almost at the time it is formed; the pinhole allows more current to flow through the probe to ground, as is readily indicated by a milliammeter. Appropriate insulating terminals in the lid of the test apparatus provide the means for activating the probe while it is in place within the bell jar. Of course, when reactive fluids are in the test apparatus, the spark probe cannot be turned on; in these instances, the crease test is allowed to run for a few cycles while a reactive fluid is present, and then the fluid is removed prior to the spark test. For convenience in removing fluids, a port is included in the lid of the test apparatus; fluids are best removed by evaporation under vacuum.

A 75-mm bell jar which can hold 200 ml of test fluid is ordinarily used for inert liquids like the Freons (often used for low-temperature tests). A smaller jar, holding about 10 ml of test fluid, is used to immerse the crease fixture whenever there is likelihood of violent interaction between sample and fluid; since the test apparatus can be run unattended for a given number of cycles and the fluid removed by evacuation, the reactivity of sample and fluid poses no hazards to the operator.

## Notes:

1. The glass vessel enclosing the crease fixture can be immersed in hot or cold baths for tests at prescribed temperatures. As constructed, the glass vessel can withstand 276 $kN/m^2$ (40 psia); however,a metal vessel and an appropriate method for maintaining closure of the lid can provide an operational environment at considerably higher pressures.
2. The angles of the defining surfaces of the crease fixture have been selected so that the results of the micro-scale apparatus are in statistical compliance with the results obtained from a large table-model crease tester. Other angles may be used to provide creases which are more or less rigorous.
3. Requests for further information may be directed to:

   Technology Utilization Officer
   NASA Pasadena Office
   4800 Oak Grove Drive
   Pasadena, California 91103
   Reference: TSP72-10552

## Patent status:

NASA has decided not to apply for a patent.

Source: Raffaele F. Muraca and
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