



Technology Focus: Test & Measurement

⚙️ Simulator for Testing Spacecraft Separation Devices

Marshall Space Flight Center, Alabama

A report describes the main features of a system for testing pyrotechnic and mechanical devices used to separate spacecraft and modules of spacecraft during flight. The system includes a spacecraft simulator [also denoted a large mobility base (LMB)] equipped with air thrusters, sensors, and data-acquisition equipment. The spacecraft simulator floats on air bearings over an epoxy-covered concrete floor. This free-flotation arrangement enables simulation of motion in outer

space in three degrees of freedom: translation along two orthogonal horizontal axes and rotation about a vertical axis. The system also includes a static stand. In one application, the system was used to test a bolt-retraction system (BRS) intended for separation of the lifting-body and deorbit-propulsion stages of the X-38 spacecraft. The LMB was connected via the BRS to the static stand, then pyrotechnic devices that actuate the BRS were fired. The separation distance and

acceleration were measured. The report cites a document, not yet published at the time of reporting the information for this article, that is said to present additional detailed information.

This work was done by Nick Johnston, Joe Gaines, and Tom Bryan of Marshall Space Flight Center. For further information, contact Sammy Nabors, MSFC Commercialization Assistance Lead, at sammy.a.nabors@nasa.gov. Refer to MFS-31907.

⚙️ Apparatus for Hot Impact Testing of Material Specimens

It is not necessary to cool and reheat the furnace between tests.

John H. Glenn Research Center, Cleveland, Ohio

An apparatus for positioning and holding material specimens is a major subsystem of a system for impact testing of the specimens at temperatures up to 1,500 °C. This apparatus and the rest of the system are designed especially for

hot impact testing of advanced ceramics, composites, and coating materials.

The apparatus includes a retaining fixture on a rotating stage on a vertically movable cross support driven by a linear actuator. These components are located below

a furnace wherein the hot impact tests are performed (see Figure 1). In preparation for a test, a specimen is mounted on the retaining fixture, then the cross support is moved upward to raise the specimen, through an opening in the bottom of the

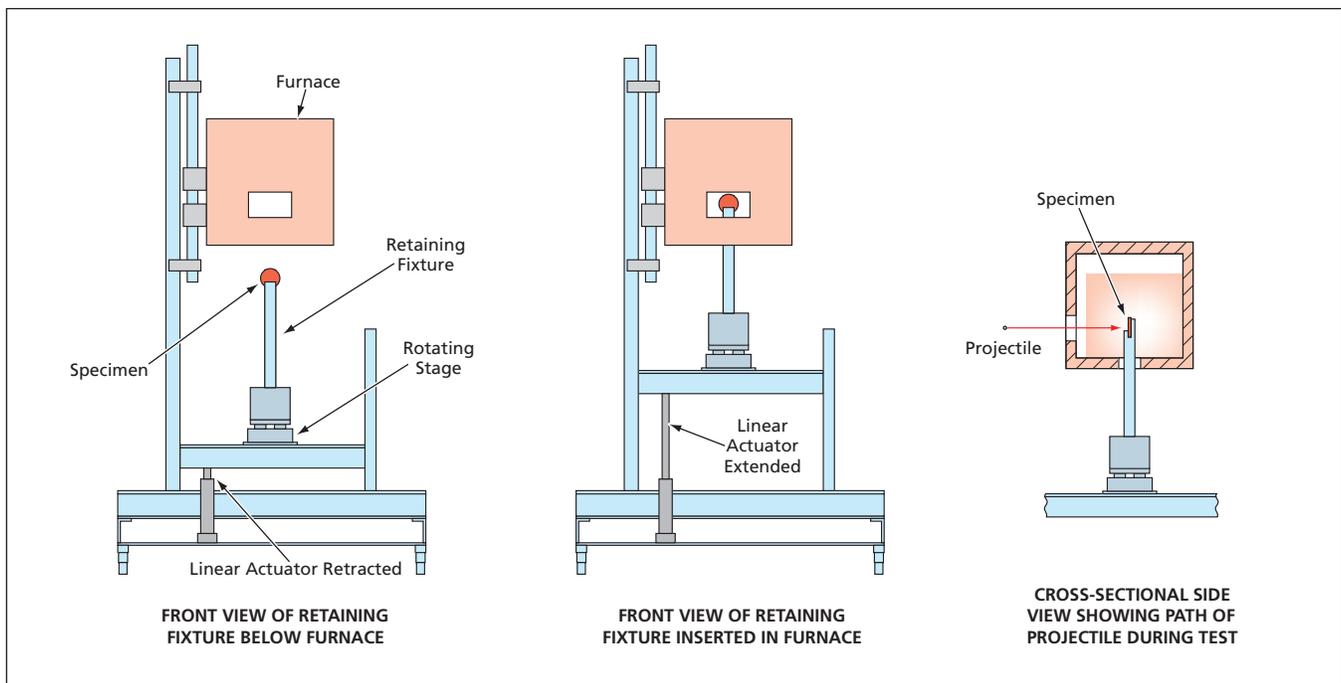


Figure 1. The Retaining Fixture and Specimen are raised into the furnace, wherein the specimen is heated and subjected to impact by a projectile.

furnace, to the test position inside the furnace. On one side of the furnace there is another, relatively small opening on a direct line to the specimen. Once the specimen has become heated to the test temperature, the test is performed by using an instrumented external pressurized-gas-driven gun to shoot a projectile through the side opening at the specimen.

Advantageous features of the design and operation of this apparatus include the following:

- All parts of the retaining fixture are made of silicon carbide to withstand high test temperatures.
- The simplest version of the retaining fixture (see Figure 2) includes a tube,

into which are machined tapered slots to accommodate a flat specimen and a side hole for admitting a projectile. (In a more complex version, there are slots for two specimens and two corresponding projectile holes at diametrically opposite locations.) The specimen is held in place by silicon carbide wedges inserted in the tapered gaps remaining between the specimen and the slots.

- Among the alternative versions of the retaining fixture are versions that offer a choice between full support or span support of the specimen. If full support is needed, then one can choose a version having slots wide enough to support not only the specimen but

also a solid backing plate.

- To some extent, by partially enclosing the specimen, the retaining fixture provides some protection of the furnace insulation and heating elements against flying debris from a specimen and projectile. Shielding separate from the retaining fixture can be added in cases in which more protection is needed.
- The rotational stage enables adjustment of the angle of impact — a feature that is desirable for impact testing of vanes under realistic conditions. Alternatively or in addition, if the retaining fixture is of the two-specimen type described above, then the rotational stage can be used to expose both specimens in succession without removing them from the furnace.
- The provision for inserting and removing specimens through the opening in the bottom of the furnace eliminates the need to cool and reheat the furnace between tests, thereby saving substantial amounts of test time.
- When multiple impacts at different positions along a lengthened specimen are required, the retaining fixture can be modified to lengthen the tapered slots and side holes at the additional impact positions, and the linear actuator can be used to place the specimen at the various impact positions. In such a case, the modifications can reduce the shielding effect of the retaining fixture, thereby making it desirable to add separate shielding as mentioned above.

This work was done by Ralph J. Pawlik and Sung R. Choi of Glenn Research Center. Further information is contained in a TSP (see page 1).

Inquiries concerning rights for the commercial use of this invention should be addressed to NASA Glenn Research Center, Innovative Partnerships Office, Attn: Steve Fedor, Mail Stop 4-8, 21000 Brookpark Road, Cleveland, Ohio 44135. Refer to LEW-17610-1.

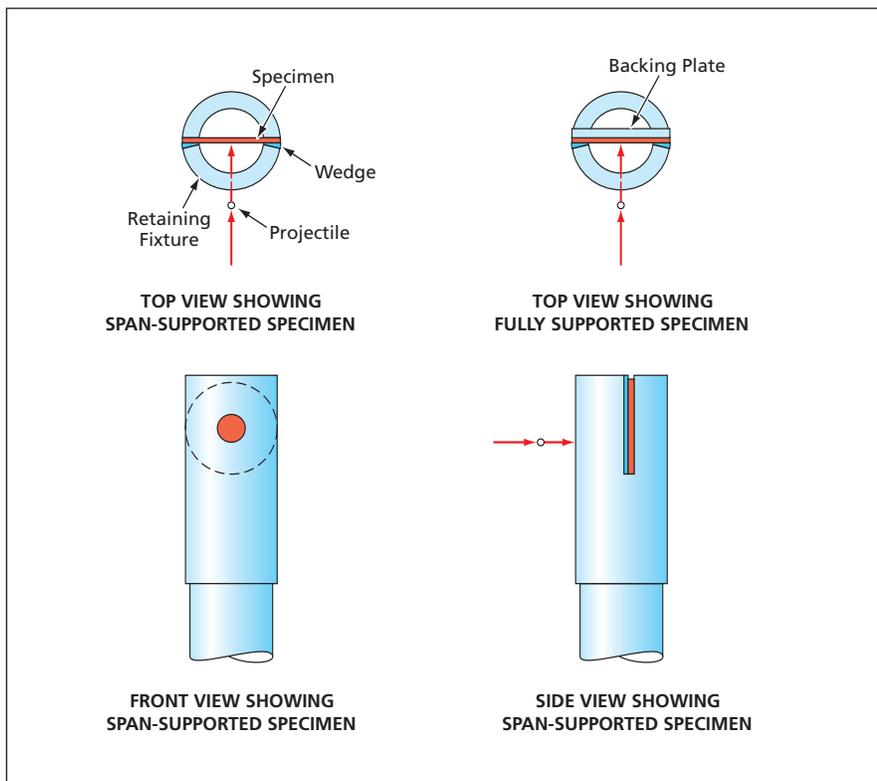


Figure 2. The Specimen Is Held on the Retaining Fixture by means of wedges in tapered slots. The slots can be dimensioned to provide span support of the specimen or to accommodate a backing plate for full support of the specimen.

Instrument for Aircraft-Icing and Cloud-Physics Measurements

Data on cloud water content are deduced from hot-wire power levels.

John H. Glenn Research Center, Cleveland, Ohio

The figure shows a compact, rugged, simple sensor head that is part of an instrumentation system for making measurements to characterize the severity of aircraft-icing conditions and/or to perform research on cloud physics. The quantities that are calculated from

measurement data acquired by this system and that are used to quantify the severity of icing conditions include sizes of cloud water drops, cloud liquid water content (LWC), cloud ice water content (IWC), and cloud total water content (TWC).

The sensor head is mounted on the outside of an aircraft, positioned and oriented to intercept the ambient airflow. The sensor head consists of an open housing that is heated in a controlled manner to keep it free of ice and that contains four hot-wire elements. The hot-wire sens-