Mechanics

Stability-Augmentation Devices for Miniature Aircraft
Passive mechanical devices help miniature aircraft fly in adverse weather.

Langley Research Center, Hampton, Virginia

Non-aerodynamic mechanical devices are under consideration as means to augment the stability of miniature autonomous and remotely controlled aircraft. Such aircraft can be used for diverse purposes, including military reconnaissance, radio communications, and safety-related monitoring of wide areas. The need for stability-augmentation devices arises because adverse meteorological conditions generally affect smaller aircraft more strongly than they affect larger aircraft: Miniature aircraft often become uncontrollable under conditions that would not be considered severe enough to warrant grounding of larger aircraft. The need for the stability-augmentation devices to be non-aerodynamic arises because there is no known way to create controlled aerodynamic forces sufficient to counteract the uncontrollable meteorological forces on miniature aircraft.

A stability-augmentation device of the type under consideration includes a mass pod (a counterweight) at the outer end of a telescoping shaft, plus associated equipment to support the operation of the aircraft. The telescoping shaft and mass pod are stowed in the rear of the aircraft. When deployed, they extend below the aircraft.

Optionally, an antenna for radio communication can be integrated into the shaft.

At the time of writing this article, the deployment of the telescoping shaft and mass pod was characterized as passive and automatic, but information about the deployment mechanism(s) was not available. The feasibility of this stability-augmentation concept was demonstrated in flights of hand-launched prototype aircraft.

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Tool Measures Depths of Defects on a Case Tang Joint
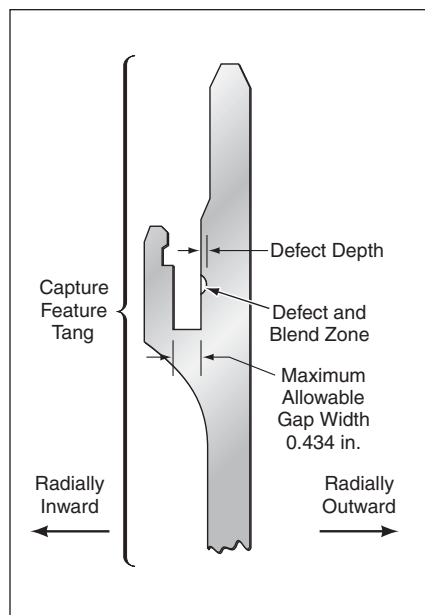### Precise measurements can be made consistently.

Marshall Space Flight Center, Alabama

A special-purpose tool has been developed for measuring the depths of defects on an O-ring seal surface. The surface lies in a specially shaped ringlike fitting, called a "capture feature tang," located on an end of a cylindrical segment of a case that contains a solid-fuel booster-rocket motor for launching a space shuttle. The capture feature tang is a part of a tang-and-clevis, O-ring joint between the case segment and a similar, adjacent cylindrical case segment. When the segments are joined, the tang makes an interference fit with the clevis and squeezes the O-ring at the side of the gap.

The critical surface in question is an O-ring sealing surface. The defects on this surface can include pits and gouges that must be mitigated by grinding their edges to make them blend smoothly into the surrounding undamaged surface. Measurement of the depths of these defects (see figure) is necessary to ensure against grinding away so much material that the local width of the gap would exceed the maximum allowable value for adequate O-ring squeeze for sealing.

The tool includes four index bearings that ride circumferentially along the interference-fit surface (the inner gap surfaces), plus two additional index bearings that ride along the tip of the capture feature. The four-bearing indexing design enables the tool to ride over interference-fit, fretting defects without adverse effect on the accuracy of measurements. The tool is secured to the case joint by use of two pincher bearings, which ride on the inner-diameter surface of the capture feature. The pincher bearings are connected to spring-loaded handles that apply a radial clamping force. The tool is attached to the joint by squeezing the spring-loaded handles, lowering the device in position, then releasing the handles.

The base of the tool contains a battery compartment and a miniature krypton inspection light. The light is essential for visual inspections inside the gap.

The tool includes a measurement probe on a slide mechanism that enables motion of the probe along the cylindrical axis. There is also an adjustment mechanism for alignment of the slide mechanism with the datum plane established by the four index bearings. The slide is actuated by turning a thumb wheel connected to a spur-gear shaft that, in turn, drives a rack gear, which is mounted on a housing that is part of the probe.

The probe housing, machined from piece of aluminum, contains a dial indicator, a rocker arm, and an engagement-cable release mechanism. The

The **Depth of a Defect** on the sealing surface of the capture feature tang is what one seeks to measure.

Labels in figure: Capture Feature Tang; Defect Depth; Defect and Blend Zone; Maximum Allowable Gap Width 0.434 in.; Radially Inward; Radially Outward

dial indicator includes a plunger oriented perpendicularly to its bezel. The plunger is spring-loaded and is positioned to push against one end of the rocker arm. The other end of the rocker arm extends into the gap down to the sealing surface of interest, and is fitted with a sharpened contact tip for access to the deepest portions of pit defects. To prevent inadvertent scratching of the sealing surface by the contact tip during circumferential or longitudinal motion of the tool, a spring mechanism keeps the arm retracted except when a technician actuates the cable-release mechanism to press the tip into contact with the surface.

The tool includes a longitudinal-position dial indicator, which, as its name suggests, shows the longitudinal position of the contact tip of the measurement probe. The spring-loaded plunger of this indicator rests against a bar on the slide mechanism.

The tool is accompanied by a calibration block in the form of a precisely machined sector simulating a nominal capture feature tang. For storage and transport, the tool is indexed onto the block, then the tool-and-block assembly is placed in a lightweight carrying case with a transparent top.