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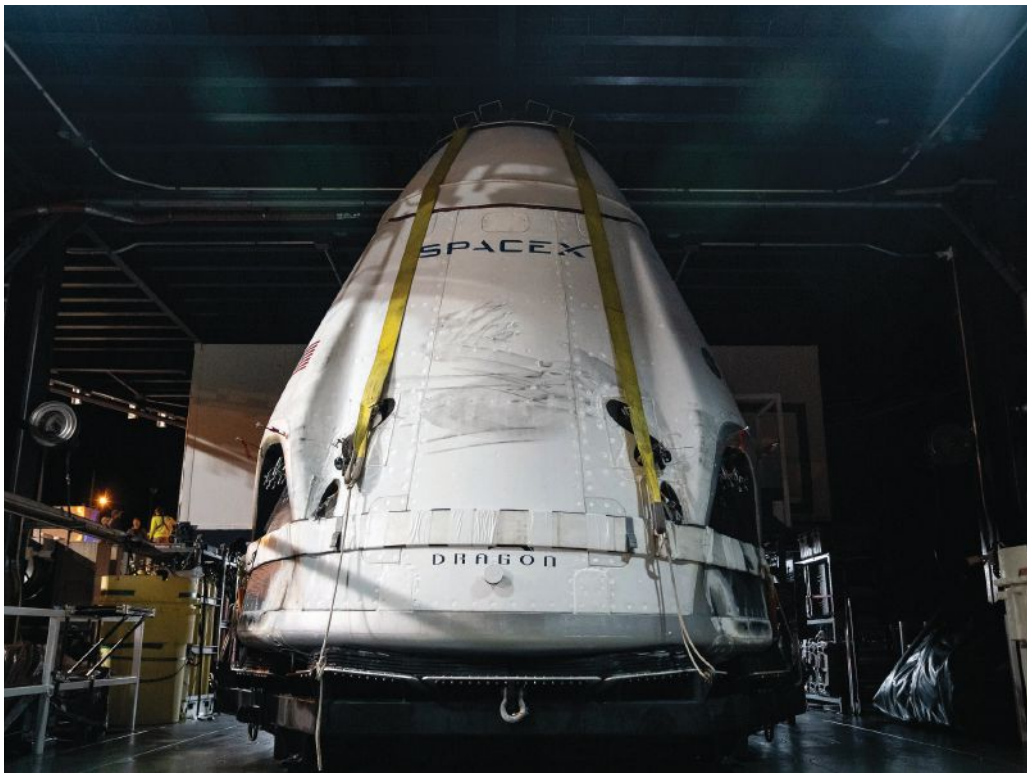


# NASA survivability test paves way for launching astronauts from U.S. soil

BY AMEER MIKHAIL, WILLIAM D. BRYANT AND TEDDY SEDALOR

The **Survivability Technical Committee** promotes air and spacecraft survivability as a design discipline that includes such factors as crashworthiness, combat and reparability.

▲ **A SpaceX Crew Dragon** capsule is offloaded from the company's recovery ship at Port Canaveral in Florida after the uncrewed in-flight abort test.
SpaceX

NASA and SpaceX launched a Falcon 9 rocket in January to **test the flight abort system of SpaceX's Crew Dragon** capsule as part of NASA's Commercial Crew program, which has developed spacecraft and launch vehicles to carry crews to low-Earth orbit and the International Space Station. The test validated that the crew and capsule would be protected if the flight needs to be aborted at launch or a few minutes after that. The test flight was aborted 85 seconds after launch. The capsule, which had mannequins but no crew members, splashed down in the Atlantic Ocean nine minutes after launch and was recovered within 32 kilometers east of the Florida coast. The test was the last major hurdle for SpaceX before the Dragon design was approved to carry humans to the ISS. NASA astronauts Bob Behnken and Doug Hurley were launched to the ISS in a reusable Crew Dragon capsule in May for a 64-day mission that included four spacewalks to make repairs. The astronauts returned to Earth in the capsule, splashing down in the Gulf of Mexico in August. Data from that flight cleared the way for the November launch of four astronauts in the Crew-1 operational mission.

Within the military aircraft discipline of survivability from traditional combat threats (ballistics and fire), **a new cyber threat/weapon** considered is the in-flight commanded malfunctions of the aircraft internal computer operations that are running the aircraft systems (e.g., control surfaces, engines, stability, weapons delivery). William Bryant and Robert E. Ball analyzed and formulated this new threat over the past few years and introduced it in the Spring and Summer 2020 issues of the Journal of Aircraft Survivability as an extension of the traditional kinetic energy impact threats (projectiles and missiles). This cyber threat analysis extension follows the same probabilistic approach/methodology of the "hit/kill" survivability analysis for the traditional threats.

From January to March, the U.S. Army Combat Capabilities Development Command Aviation and Missile Center studied and tested the effectiveness of **aircraft lighter-weight, spaced composite armor** (two panels with space/gap in between) against impacting projectiles. Researchers carried out performance characterization for the projectiles' impact speed, impact angle and other parameters. The findings will help in **designing more survivable lighter-weight fuselage and wing structures** for both rotary and fixed-wing aircrafts.

For aircraft composite wing and fuel tank structures, Northrop Grumman started studying a new development concerning the **replacement of fasteners in the composites by bonded composite joints**. Bonded joints produce a distributed stress field and eliminate the fastener bearing stress. However, a drawback for the bonded joint is its lower impact and pullout strengths. Researchers plan to investigate the bonded joint effectiveness against a hydraulic ram event resulting from the high-pressure outcome from the impact of a penetrator projectile with a fuel tank. This high pressure can cause delamination or separation in the bonded joint. ★

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