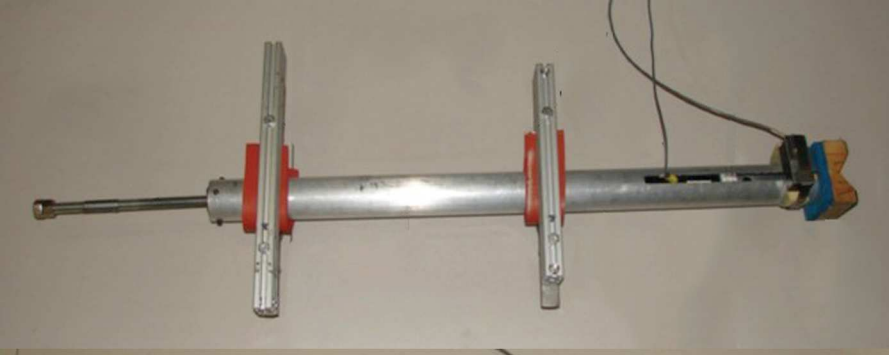


National Aeronautics and
Space Administration

Manufacturing

A Portable Impactor Device

Lightweight instrument for investigating structural response

NASA's Langley Research Center has developed a portable device to simulate low-velocity impacts on a material or structure. As composite materials are highly susceptible to damage caused by low-velocity impact, they must be designed and evaluated for structural integrity after these types of impacts. The NASA impactors design comprises an exterior tube, an instrumented projectile, a spring to propel the projectile, a spring compression device, a release pin, a wooden spacer/ locator block, and an optical sensor.The tube can be handheld or rigidly mounted at any angle such that the impact response can be evaluated at specific positions on the test article. In the current configuration, impact energies between 4 and 40 J (between about 3 and 30 ft-lbs) can be obtained. Researchers designed a fully functioning prototype for the NASA Engineering and Safety Centers (NESCs) Composite Crew Module (CCM) program for damage tolerance testing. Both the impact force history and projectile velocity are captured during operation.

BENEFITS

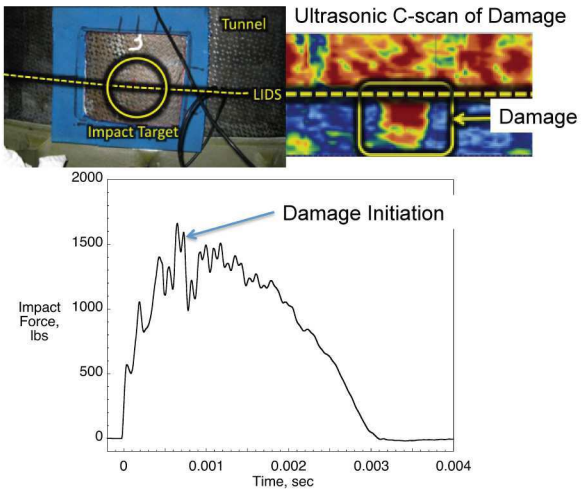
- Portable - can be handheld or clamped into position.
- Lightweight - weighs approximately 15 lbs.
- Controlled uses a spring rather than gravity to propel projectile.
- Variable is not dependent on specimen size or orientation.
- Adaptable - spring can be changed to reach desired impact energies.
- Easy to use - has a straightforward design.
- Proven - has been prototyped and tested in various NASA and U.S. Army applications.

technology solution

THE TECHNOLOGY

The NASA impactor is a fully portable device that propels an instrumented projectile so that it impacts a vehicle, structural component, or test specimen. The device includes a projectile inside an exterior tube. The projectile itself contains a commercial load cell designed to obtain the dynamic force response during the impact event. Furthermore, a digital oscilloscope and optical sensor are combined to measure the velocity just prior to impact so that the impact energy of the projectile onto the test surface can be calculated. In the current configuration, impacts with energies between 4 and 40 J (between about 3 and 30 ft-lbs) are obtainable, and could be adjusted by changing the spring to one with a different spring constant. The tube can be handheld or rigidly mounted at any angle such that the impact response can be evaluated at specified positions throughout the test article. The impactor device is primarily designed for use on composite structures to investigate the structural response from a low-velocity impact, as composite materials are highly susceptible to damage from low-velocity impacts where the damage may not be visible but results in great loss of strength. If the damage cannot be detected visually, it can be seen through nondestructive testing (ultrasonic, flash thermography or X-ray). However, the device may also be used on structures to evaluate and tune structural health monitoring systems.

The technology has been designed, prototyped, and implemented in four military or government programs for impact testing on metallic and composite structures, including a helicopter roof in 2013. The cost of the parts for the prototype was approximately $9,000. Production costs are expected to be lower.



Example of a 25 ft-lb (~34 J) impact on the tunnel area of NASAs CCM and resulting damage

APPLICATIONS

The technology has several potential applications:

- Aerospace - investigating impact damage resistance or tolerance of small coupons or large structures
- Aviation - testing structural health of existing vehicles
- Automotive - assessing durability and damage tolerance of metallic or composite parts

PUBLICATIONS

Patent Pending

More Information

National Aeronautics and Space Administration

The Technology Gateway

Langley Research Center

Mail Stop 151
Hampton, VA 23681
757.864.1178
LARC-DL-technologygateway@mail.nasa.gov

http://technology.nasa.gov/

www.nasa.gov

NP-2014-09-1268-HQ

NASA's Technology Transfer Program pursues the widest possible applications of agency technology to benefit US citizens. Through partnerships and licensing agreements with industry, the program ensures that NASA's investments in pioneering research find secondary uses that benefit the economy, create jobs, and improve quality of life.

LAR-18411-1