# DROPKINSON BAR:

## A NEW EXPERIMENTAL APPARATUS FOR INTERMEDIATE-RATE MATERIAL CHARACTERIZATION

Sandia National Laboratories

**Patent Pending**
**Technology Readiness Level: 5**
*Key elements have been demonstrated in relevant environments*

Sandia National Laboratories has developed an experimental apparatus that is capable of obtaining intermediate-rate stress-strain data of materials that have previously been unavailable due to a lack of instrument precision. Combining a quasi-static testing frame and conventional split Hopkinson bar tests, Sandia's Dropkinson Bar allows for full-suite reliable and precise material characterization without a gap of strain rates. The Dropkinson Bar apparatus can achieve intermediate strain rates ranging from 101 to 102s-1 and provides in-depth insight into the material response transition between quasi-static and dynamic testing.

The Dropkinson Bar apparatus consists of a vertical Hopkinson bar and a drop table. When released, a cylindrical steel impactor attached to the bottom of the drop table carriage strikes an impact plate through a specially designed pulse shaper, to which several guide rods are applied as a means of ensuring the impact plate moves downward with a minimal bending effect. A tensile specimen is threaded into a hole located between the guide rods and the edge of the impact plate and is connected to the end of the Hopkinson bar. Strain gauges along the Hopkinson bar and a high-frequency-response laser extensometer provide load history and displacement on the tensile specimen, which can then be used to calculate the specimen stress, strain rate, and strain histories, as well as subsequent stress-strain response.

Sandia's Dropkinson Bar apparatus can provide an in-depth understanding of material behavior under a broader range of mechanical environments than traditional testing devices. Its innovative design allows for the collection of exceptionally precise data for materials that have previously been untestable and can become a useful tool in the characterization for a variety of materials.

## TECHNICAL BENEFITS

- High reliability and precision
- Capable of obtaining tensile stress-strain response of materials at intermediate strain rates ranging from $10^1$ to $10^2 s^{-1}$
- Provides in-depth investigation of material response transition between quasi-static and dynamic testing
- Can be operated independently as a drop table or Hopkinson Bar

## INDUSTRIES & APPLICATIONS

- Structural engineering
- Mechanical engineering
- Automotive applications

ip.sandia.gov
ip@sandia.gov

U.S. DEPARTMENT OF ENERGY | NNSA National Nuclear Security Administration

*Sandia National Laboratories is a multimission laboratory managed and operated by National Technology and Engineering Solutions of Sandia, LLC, a wholly owned subsidiary of Honeywell International, Inc., for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-NA0003525. SAND2017-6914 M*