

TESTING

DYNAMIC MATERIAL CHARACTERIZATION

SPLIT HOPKINSON PRESSURE BAR (SHPB)

Split Hopkinson Pressure Bar testing is a widely used method to evaluate high strain rate material properties. The SHPB apparatus at Mentis Sciences is currently used for compressive testing and is adaptable to tensile, shear, and torsion tests.

Mentis has modified its SHPB apparatus to create a Split Bar Water Jet Generator (SBWJG) that can produce water jets with velocities of 1000 m/s for simulating hydrometeor impacts to evaluate rain erosion coatings.

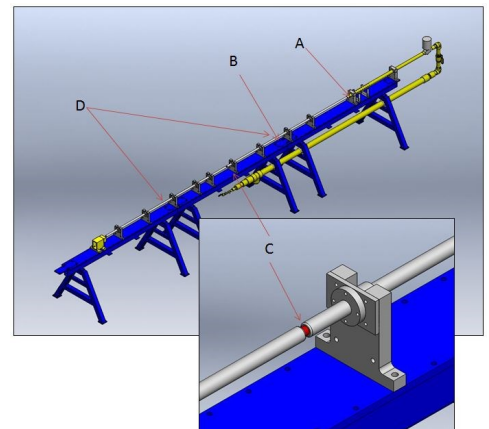
HOW A SHPB APPARATUS WORKS

- A) High pressure gas gun fires a "striker bar" into an "incident bar."
- B) Impact of bars creates a pulse stress wave that propagates down the incident bar, this is measured with a strain gage bonded to the incident bar.
- C) Pulse reaches specimen, which has an impedance mismatch with incident bar. A portion of the stress wave is transmitted throughout the specimen, plastically deforming it, before its transmitted into a "transmitter bar" which also has a strain gage. The other portion of the stress wave is reflected back down the incident bar, where the reflected wave is measured again.

Data reduction utilizes both the incident and transmitted strain gage signals to calculate the resultant stress, strain, and strain rate in the test specimen.

SHPB VITAL STATISTICS

- Capable of testing wide range of materials (plastics to aluminum)
- Strain rates of 100 - 10,000 strain/sec
- Output data reduced to strain, stress, and strain-rate. Modulus at elevated rates can be calculated.
- Typical specimen size is 1/2" diameter by 1/2" in length.



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HOW A SHPB APPARATUS WORKS

At Mentis we are always innovating to produce new radome and nosecone materials and coatings. One problem that we have faced was to find a satisfactory screening method to evaluate potential new materials for their rain erosion performance in a timely and cost effective manner. This challenge led us to the development of the Split Bar Water Jet Generator (SBWJG). The SBWJG is a modified version of the SHPB test apparatus where a liquid layer replaces the test Specimen. Water jets up to 1000m/s have been achieved with a jet duration of approximately 0.0005 seconds.

- A) High pressure gas gun fires a specially shaped "striker bar" into an aluminum "incident bar."
- B) A short-duration pulse wave is generated from the impact and travels down the incident bar towards a water layer, which is sandwiched between the aluminum incident bar and a steel "transmitter bar." The aluminum/water and water/steel impedance mismatches are very high. As a result, the pulse wave generates extremely high pressures in the water layer.
- C) The pressurized water escapes through a nozzle at very high speeds, where it impacts a specimen.

SBWJG VITAL STATISTICS

- Develop Water Jet from 300 m/s up to 1000m/s to simulate hydrometeor impact
- Jet Duration is typically 0.0005 seconds
- Fast turnaround – Up to 50 tests can be conducted in a day
- Angle between the water jet and test specimen is adjustable to simulate various angles of attack.
- Tests recorded with high speed digital video for analysis

