Effect of strain rate on the mechanical properties of materials

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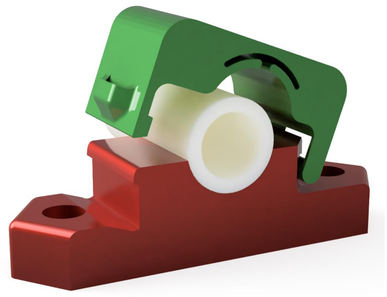
VYSOKÉ UČENÍ TECHNICKÉ V BRNĚ FAKULTA STROJNÍHO INŽENÝRSTVÍ

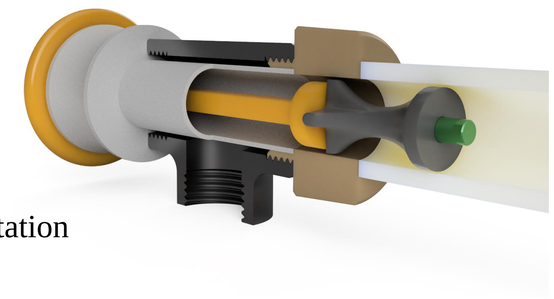
Dynamic material testing

- Impact speeds:
  - up to 100 m/s - SHPB & SHTB
  - up to 300 m/s - Taylor Anvil Test
  - up to 250 m/s - Symmetric TAT
- Strain rates:
  - up to 10^4 s^{-1} - SHPB & SHTB
  - up to 10^5 s^{-1} - Taylor Anvil Test
  - up to 10^4 s^{-1} - Symmetric TAT
- Testing at increased temperatures
- Application of results:
  - material models for simulations
  - stress-strain curves
- Unique laboratory in the Czech Republic and worldwide

Device development

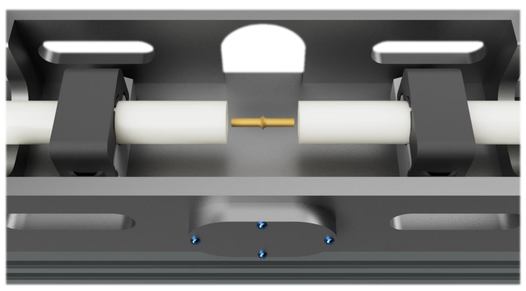
- Propulsion
  - air compressor
- Firing control
  - timing switch
  - solenoid valve
- Construction
  - support frame
  - main profile
  - impact box
- Features
  - quick-release holders
  - precise specimen loading
  - high-speed camera implementation





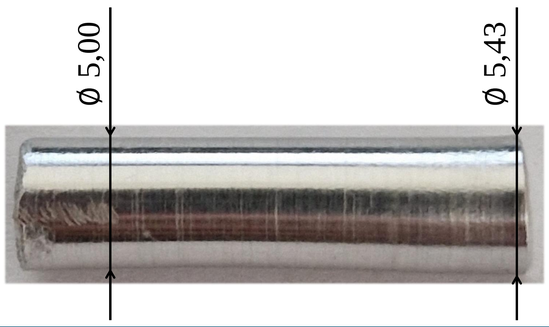
Constructed device

- Overall length – 5 meters
- Barrel length – 2,2 meters
- Max sample diameter
  17 millimeters



Material tests – aluminum

- Sample diameter – 5 mm
- Sample length – 25 mm
- Concentricity within 0,1 mm
- Impact speed – 220 m/s
- Testing device capabilities



Material tests – spruce wood

- Sample diameter – 10 mm
- Sample length – 20 mm
- Impact speeds – 175 ~ 235 m/s
- Natural moisture

Impact speed = 235 m/s

Impact speed = 175 m/s

Conclusions and future activities

- First ideally symmetric Taylor Anvil Test device
- Organic material tests
- Repeatability of testing
- Enhancement of laboratory capabilities
- Improvement of speed measurement
- Implementation of a high-speed camera
- Testing at increased temperatures