The JASPER gas gun chamber.

Introduction

In 1992, the President of the United States placed a moratorium on underground nuclear weapons testing. In order to maintain a safe, secure and effective stockpile, the U.S. Department of Energy has replaced weapons testing with a combination of actinide or special nuclear material experiments, highly accurate physics modeling, more mature theories describing weapon physics and improved computational power. Among these experimental methods is the JASPER Facility, located at the NNSS. JASPER plays an integral role in the certification of the nation's nuclear weapons stockpile by providing a method to generate and measure data pertaining to the properties of materials at high shock pressures, temperatures and strain rates. These extreme laboratory conditions approximate those experienced in nuclear weapons. Data from the experiments are used to determine material equation of state and to validate computer models of material response for weapons applications. Experiment results are used for code refinement, which permit better predictive capability and ensuring confidence in the U.S. nuclear stockpile.

NEVADA NATIONAL NNSS SECURITY SITE

Stockpile Stewardship

Joint Actinide Shock Physics Experimental Research Facility (JASPER)

Background

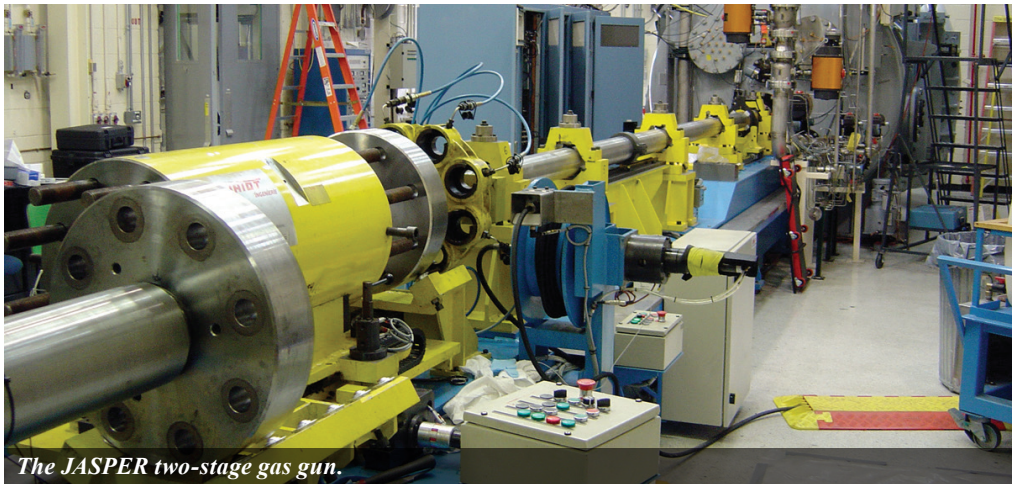
The JASPER Facility is a multi-organizational research facility hosting Lawrence Livermore National Laboratory (LLNL), Los Alamos National Laboratory, and Sandia National Laboratories. LLNL maintains the responsibility for experimental program management and physics definition. Nevada National Security Site manages the facility operations; engineering; experiment fielding and data capture; diagnostic development and deployment; and health and safety.

How It Works

The JASPER two-stage gas gun is use to explore surrogate materials and plutonium performance while safely containing nuclear material with experiments supporting Stockpile Stewardship.

The basic concept of the two-stage gas gun is to propel a projectile at a highly consistent velocity ranging from two kilometers per second (km/s) to eight km/s. The JASPER gas gun is specifically designed to conduct research using plutonium and surrogate materials as targets.

The two-stage gas gun consists of a first-stage breech containing gunpowder and a pump tube filled with a light gas such as hydrogen, helium or nitrogen; and a second-stage evacuated barrel for guiding the high-velocity projectile to a target possibly containing radioactive material. Hot gases from the burning propellant drive a piston down the pump tube, compressing the gas that is in front of the piston. At approximately 10,000 pound-force per square inch, the gas breaks a rupture valve and enters the narrow barrel, propelling the projectile that is housed in the barrel toward the target.

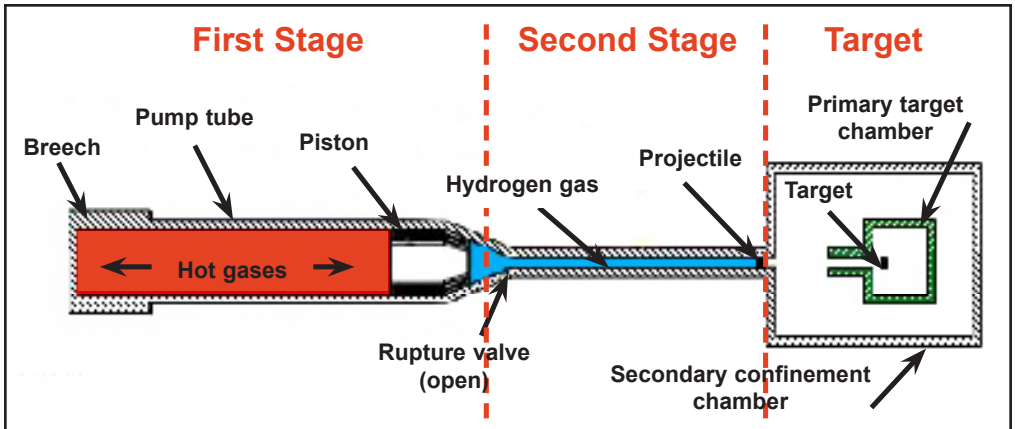


The JASPER two-stage gas gun.

When the projectile hits the target, it produces a high-pressure shock wave. In a fraction of a microsecond, the shock wave reverberates through the target. Diagnostic equipment measures the properties of the shocked material inside the target during this extremely brief period. In addition to shocks, recent methods are used to more gradually exert pressure on samples to study different pathways to high-pressure behavior. The target is contained within the primary containment chamber and disintegrated by the impact of the projectile via an explosively-driven, fastclosing cylindrical valve. A second confinement chamber protects workers as a safety precaution in the unlikely event that the primary confinement system fails. The data from these experiments are used by the national laboratories to further refine the computer codes used to certify the U.S. nuclear stockpile.

Conclusion

Because of the well-controlled environment of the gas gun, JASPER provides scientists with more precise data than can be obtained from conventional, high-explosive experiments. Nested confinement systems assure that radioactive materials are not released into the gas gun building or the environment after target impact.



A diagram of the JASPER two-stage gas gun.

National Nuclear Security Administration

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