

## *The Highest Perforating Standards in the Industry Today*

Jet Research Center originated and introduced jet perforating to the energy industry, forever changing the way oil and gas are produced. And what made JRC the leader in perforating technology then continues today at JRC's Explosive Products Center in Alvarado, Texas. Located on over 800 acres (3.25 km<sup>2</sup>) in North Central Texas, JRC's Explosive Products Center is a fully integrated research, engineering, testing, and manufacturing plant that produces advanced perforating systems and specialty explosive devices for the oilfield, including shaped charge perforators, RF-protected detonators, tubing and casing cutters, and severing tools.

### Research and Engineering

Our premier technical staff includes a balance of engineers, designers, and technicians, who are among the most knowledgeable experts in the perforating industry. Their backgrounds range from doctoral and masters level engineers to highly skilled explosive technicians, some with over 25 years experience. The latest techniques and equipment are used in our design work including sophisticated hydrocodes, such as DYNA-2D and CTH, that model the high strain-rate deformations of materials subjected to explosive loading. In addition to the hydrocodes, we have analytical computer programs that predict the response of structures to explosive impulse loads.



Jet Research's Explosive Products Center in Alvarado, Texas.

For predicting the state properties of reacting explosives and their resulting detonation products, we use the CHEETAH code, a well-recognized equation-of-state program in the explosive industry.

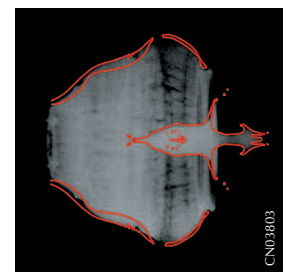
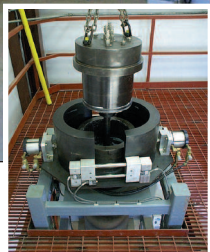
### Testing

- **Perforation Flow Laboratory** provides a means to measure the flow or injection characteristics of a perforation tunnel created by a shaped charge. This allows design engineers to tailor shaped charge performance to optimize well productivity. The flow laboratory is able to handle a wide range of test conditions and materials, including hard rocks and fully unconsolidated formations with permeabilities ranging from 0.001 to 2.0 Darcy.

- **Flash X-Ray Equipment** allows us to study the details of explosive events in nanosecond resolution. This helps us improve the performance of both new and existing shaped charge designs by analyzing the charge initiation process, detonation wave propagation, liner collapse, jet formation, jet stretching, formation penetration, and debris characteristics. All the information and data gathered with the flash X-ray is put to work building



Perforation flow laboratory



Flash X-ray with superimposed hydrocode prediction

into every JRC charge the reliability and performance you expect in the field.

- **API 19B Testing Facilities** are available for conducting Section 1, Section 2, Section 3 and Section 4 tests as described in the RP-43 document.
- **Firing Chambers and Shooting Bunkers** are available for testing a wide range of devices ranging from less than one gram of explosive to over 25 pounds. Scaled tests to simulate even larger shots can be configured.
- **Pressure Vessels and Thermal Ovens** are available to test explosive components and systems to conditions up to 30,000 psi (207 MPa) and 500°F (260°C). High-speed multi-channel oscilloscopes, piezoelectric pins, ballistic pressure transducers, and other specialty instrumentation is routinely used to conduct diagnostic experiments on explosive components and systems.
- **Shooting Pond** is used for conducting underwater test shots and for verifying gun survival in fluid.
- **Air Shot Test Enclosure** is a specially designed test pit for conducting full-length gun survivability shots in air.

## Manufacturing

In the manufacturing process, the emphasis on quality and consistency has resulted in a continual progression toward automation. This produces a more accurate and consistent charge, while at the same time providing a more cost-effective and safer production process.

- **High quality metal powders** are blended and tested to extend perforator performance and storage life.



State-of-the-art laser tubular cutting technology

- **Spinning and vibrating sub-presses** are used with computerized hydraulic pressing systems to fabricate powdered metal liners.
- **High purity explosive powders** are tested for melting point, flow characteristics, and moisture content.
- **Computer controlled electronic powder weigh stations** are integrated into the automated charge presses to ensure accurate and consistent measures of explosive powder for each charge.
- **State-of-the-art laser tubular cutting technology**
- **World class perforating hardware machining center**
- **OSHA VPP Merit plant status** - the first explosive manufacturer in the USA to gain this certification.

Visit our website at [www.jetresearch.com](http://www.jetresearch.com).

JRC is ISO 9001, ISO 14001, OHSAS 18001, ISO RC 14001 and  
OSHA VPP STAR Certified



Sales of Jet Research products will be in accord solely with the terms and conditions contained in the contract between Jet Research and the customer that is applicable to the sale.