

Bolt's worldwide leadership as a supplier of seismic energy sources has been maintained by an on-going commitment to research and development. Bolt Technology Corporation prides itself in a long tradition of service to our customers.

The company's commitment to service and excellence is demonstrated by extensive quality control procedures and tests. In addition to in-plant inspection, Bolt maintains an extensive test facility where each marine, land and bore-hole air gun is rigorously tested under conditions which simulate actual applications.



▲ Aerial View of Bolt's Test Facility

Bolt is committed to being the premiere supplier of seismic energy sources for geophysical exploration.



▲ Bubble Venting from a 9000 in³ Air Gun at 10 m. depth

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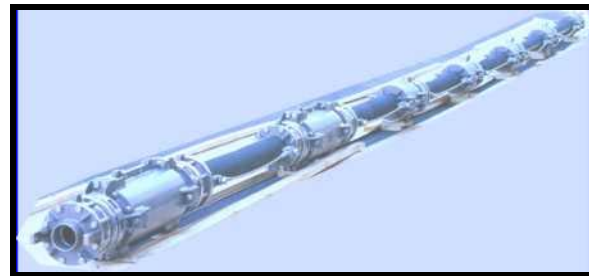


Annular Port Air Gun



The Next Generation of Air Guns

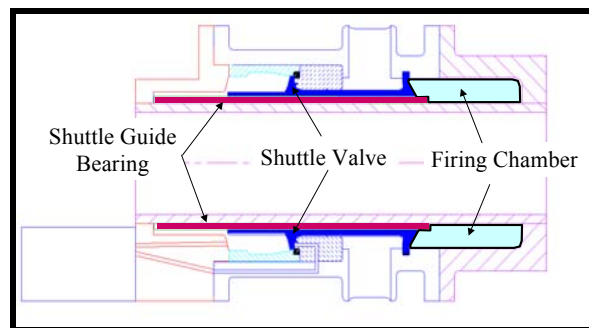
The Annular Port Air Gun is a new design for a marine air gun that provides significant improvements in both the operating efficiency and acoustic output of marine seismic source arrays. The principal feature of the Annular Port Air Gun design is an annulus containing the air chamber and shuttle valve surrounding a hollow passage through which air supply hoses and electrical control cables are routed.



▲ Annular Port Gun Sub-Array

The new air gun design features a number of advantages:

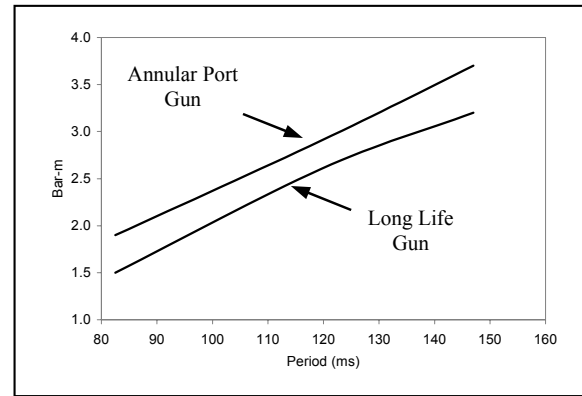
- Gun plates, air manifolds, and exposed air hose and electrical cable jumpers are eliminated.
- Air fittings and electrical connectors are protected from the effects of the air blast.
- Less drag results from smaller sub-array profiles.
- Towing symmetry results in less energetic gun movements.
- Bubble geometry results in increased acoustic output per unit volume of air.



▲ Cross Section Annular Port Air Gun

Improved Acoustic Output

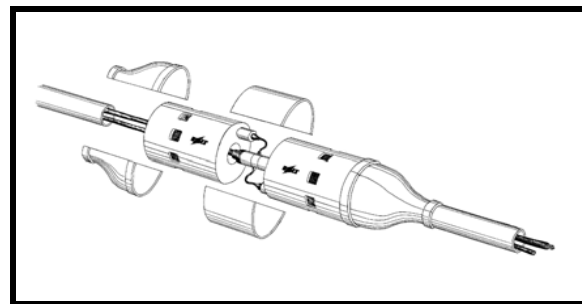
The improvement in peak output is attributable to the increased surface area of the toroidal bubble compared to the spherically shaped bubble generated by a conventional 4-port air gun.



▲ Peak Output vs. Bubble Period

Linear Cluster Elements

The annular configuration of the new air gun also permits the use of simplified multi-gun arrays that generate less towing drag. Linear air gun clusters replace horizontal or vertical clusters found in conventional source arrays.



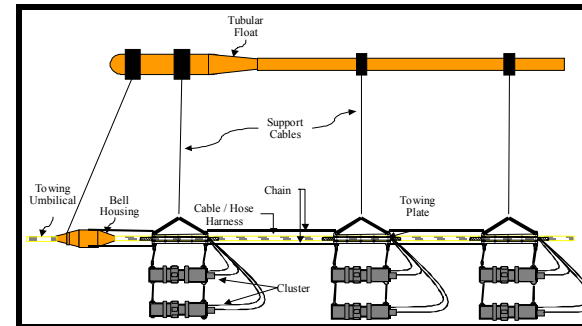
▲ 2-Gun Linear Cluster Element

Arrays comprising Annular Port Air Guns will be easier to deploy and retrieve. Since fragile cables and airlines are protected there will naturally be fewer instances where the array will need to be retrieved for repair. The streamlined profile of the Annular Port Air Gun means these arrays will more effectively withstand the damage sustained by conventional arrays caused by deployment and retrieval.



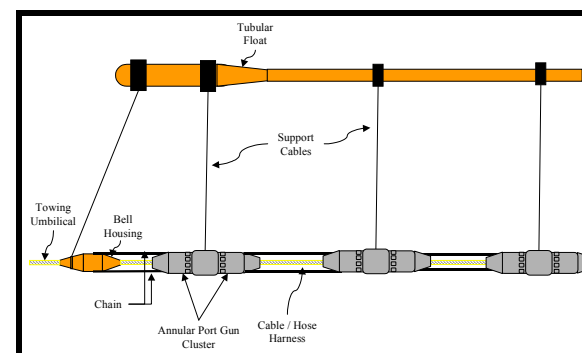
Towing Comparison

Arrays configured with conventional air guns require individual tow plates, airline and electrical jumpers for each gun element. This configuration is cumbersome and exposes the air and electrical jumpers to the energetic air blast from the guns. A typical sub-array configuration comprising conventional air guns is illustrated below.



▲ Conventional Air Gun Sub-Array

Arrays configured with the new Annular Port Air Gun do not require tow plates, cluster spreader bars or exposed air and electrical jumpers. An array of Annular Port Air Guns is shown below configured with linear cluster elements.

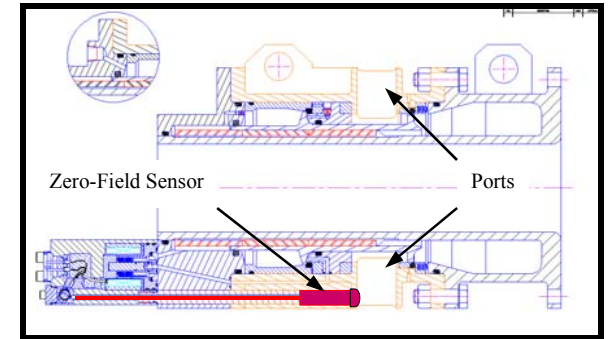


▲ Annular Port Air Gun Sub-Array

The air hose and electrical cables are routed through the core inside the annulus of the gun where they are protected from the effects of the air blast. Steel stress members connect the elements of the sub-array creating a streamlined profile that is easily towed through the water.

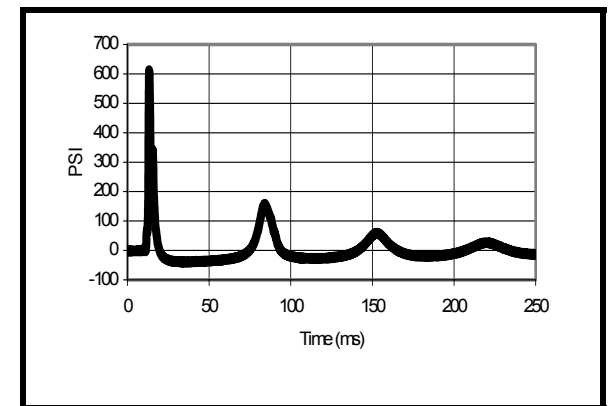
The “Zero-Field” Timing Sensor

An added design feature of the new air gun is the placement of a “zero-field” hydrophone inside the ports of the air gun, which can be used both as a precise time break sensor and as a near field hydrophone.



▲ Location of Zero-Field Sensor

The zero-field sensor measures the pressure field at a position inside the oscillating air bubble. The following display shows the “zero-field” output in psi from an Annular Port Air Gun.



▲ Measured Zero-Field Output—Annular Port Gun

The sharp clearly defined peak measured by the sensor inside the ports is ideally suited for timing air guns within an array. In addition, the sensor can be used as a near-field hydrophone thereby eliminating the need for separate timing sensors and hydrophones.

The Annular Port Air Gun is clearly the marine seismic source of the next generation.

