

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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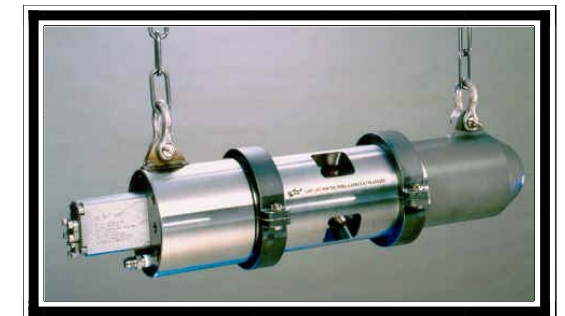
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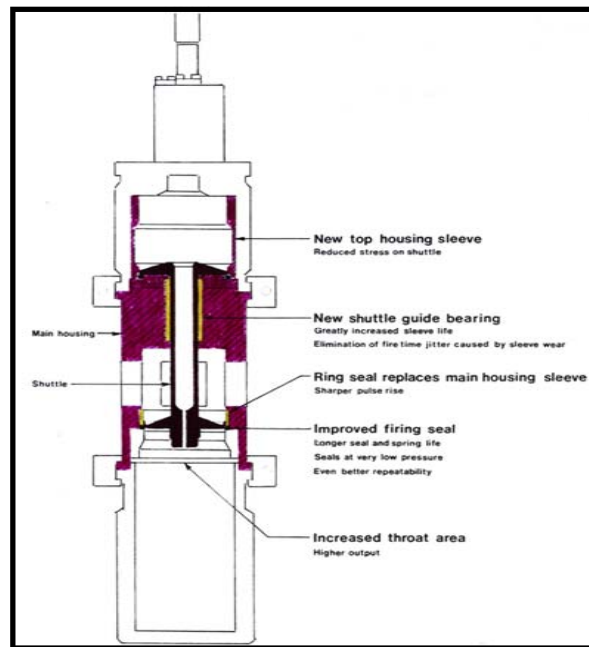
The Long-Life™ Air Gun



Long-Life™ Technology Solution

During the early 1990s, the marine seismic industry began to develop larger and substantially more complex multi-streamer vessels capable of efficiently acquiring vast amounts of 3D seismic data. Bolt Technology Corporation introduced the *Long-Life™* Air Gun in 1991, in response to demands by seismic contractors for a stable and reliable energy source that would match the efficiency of these vessels. The *Long-Life™* design has resulted in air guns that consistently produce 750,000 or more trouble-free shots before requiring significant maintenance. In addition the *Long-Life™* Air Gun does not require lubrication of any kind, making it the only environmentally clean marine seismic source.

Since March of 1993 Bolt Technology Corporation has sold in excess of 8,600 *Long-Life™* Air Guns, which equates to more than two thirds of the Western World's seismic fleet. The following diagram illustrates the principal features of the *Long-Life™* Air Gun.

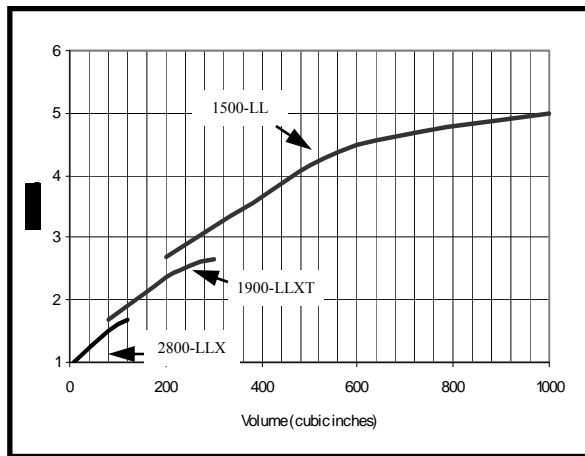


▲ 1500-LL *Long-Life™* Air Gun

The *Long-Life™* Air Gun is available both as a completely new gun or as an upgrade kit for conventional 1500CT and 1900CT Bolt Air Guns.

High Acoustic Output

A combination of increased throat area and improved shuttle speed has resulted in a significant improvement over conventional Bolt Air Guns in both peak output and peak-to-bubble ratio. The following graph illustrates peak output vs. chamber volume for Bolt *Long-Life™* Air Guns, measured through an Out-128 Hz filter.



▲ Peak Output vs. Volume (Out-128 Hz Filter)

The *Long-Life™* Air Gun is available in three models spanning volumes from 5 in³ to 1,500 in³.

2800-LLX

The 2800-LLX Air Gun is designed for volumes ranging from 5 in³ to 120 in³. The gun is very light-weight, and is ideally suited for shallow water source vessels with limited deck space. For maximum energy output, it can be easily configured in 2-gun and 3-gun cluster elements.



▲ 2800-LLX Air Gun



1900-LLXT

The 1900-LLXT Air Gun is designed for volumes ranging from 10 in³ to 380 in³, and life tested at 3,000 psi. The gun is extremely versatile, and is sufficiently light-weight for shallow draught vessels while powerful enough for blue-water seismic surveys.



▲ 1900-LLXT Air Gun

1500-LL

Due to its large throat area, the 1500-LL Air Gun is capable of generating very high peak output with the excellent low-frequency content associated with large chamber volumes. Using heavy-duty cluster spreader bars, it is possible to configure cluster elements in excess of 1,000 in³ without sacrificing peak output.



▲ 1500-LL Air Gun

The 1500-LL Air Gun produces the highest peak output over the largest range of chamber volumes. The gun can be configured with chamber volumes ranging in size from 40 in³ to 1,500 in³. Large chamber sizes require heavy duty towing frames to withstand the shock generated by the gun.

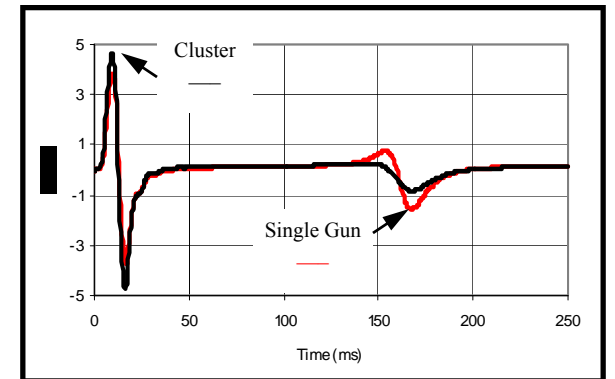
1500-LL 2-Gun Cluster

The preceding graph illustrating Peak Output vs. Volume for Bolt Air Guns clearly shows the effect of throat limitation on output. For each model of Air Gun, there is a volume limit beyond which the normal increase in output with volume is diminished.



▲ 2-Gun Cluster Frame (2 x 300 in³)

A solution to this problem is found in Bolt's heavy-duty cluster spreader bar assembly. The increase in peak output for the 2-gun cluster compared to a single 600 in³ is shown in the following far-field signatures.



▲ Single 600 in³ vs. 2 x 300 in³ cluster

The far-field signature clearly shows the 20% improvement in efficiency that results from a 2-gun cluster compared with a single 600 in³ air gun.

Carefully engineered and thoroughly tested, Bolt's *Long-Life™* Air Gun has proven to be the marine seismic industry's most reliable source for a decade.

