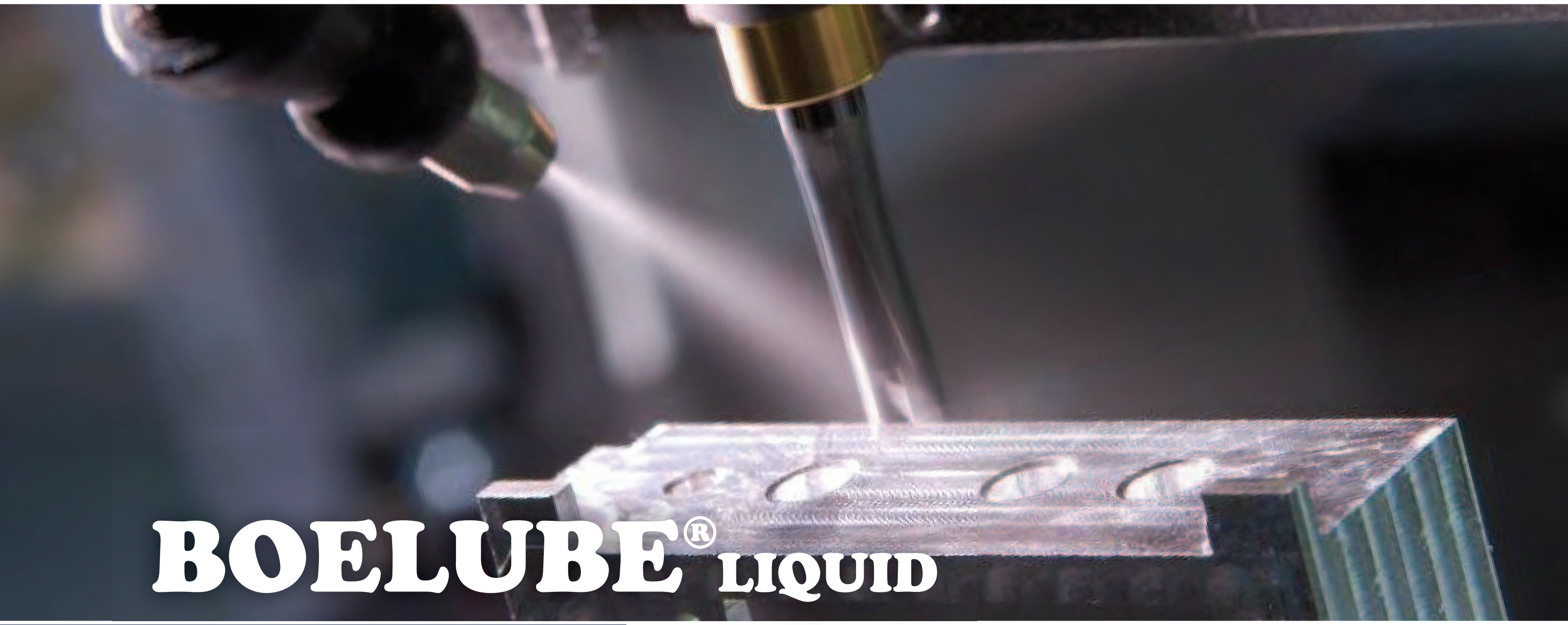
# BOELUBE®

A BOEING DEVELOPED LUBRICANT



# BOELUBE® LIQUID

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# Boelube® Liquid for Drilling

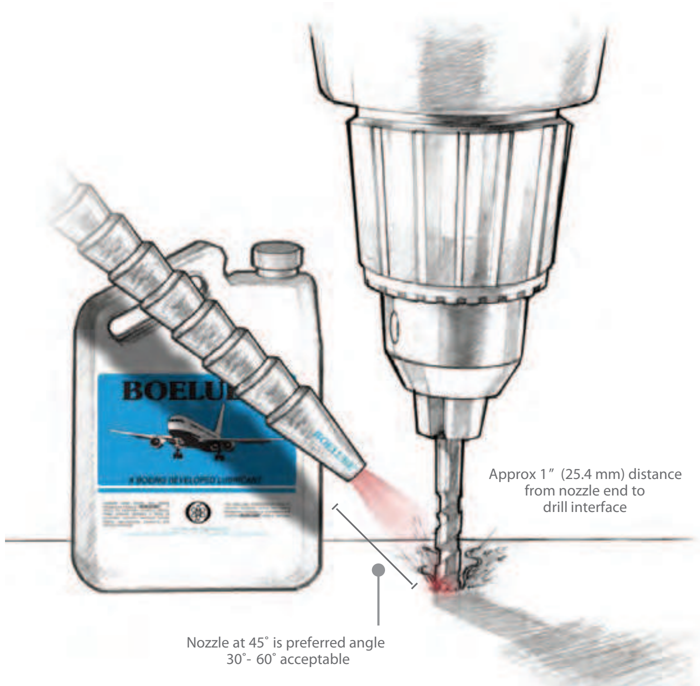
**Save time and money while being environmentally responsible.**

In the near dry machining process, BOELUBE® Liquid can be delivered as fine droplets or spray through one or more nozzles positioned accordingly around the cutting tool. Delivering the BOELUBE® Liquid as fine droplets to the cutting edge is necessary in order to reduce friction between the chip, tool, and workpiece, and prevent chips from adhering to the tool cutting edge.

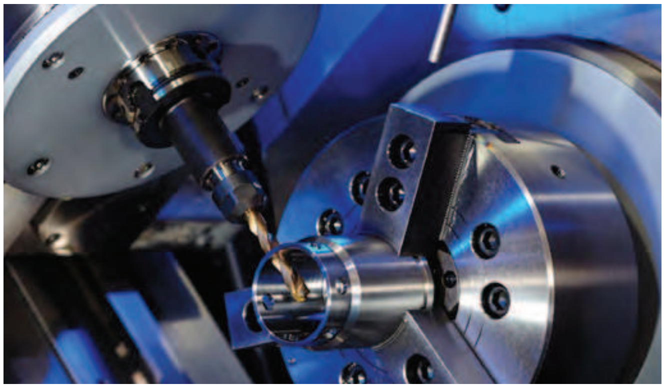
The near dry machining processes using BOELUBE® requires continual reapplication of lubricant to the tool cutting edge and wear surfaces. This can be accomplished externally on shallow drilling, reaming and tapping operations, on milling cutters, and on band and circular saws.

In near dry machining the goal is high efficiency, which is achieved as a result of using a minimal quantity of lubricant. Typical BOELUBE® Liquid usage is about 1 oz (30 ml) per hour of machining time, which is best determined by the particular machining process and workpiece composition. Because minimal quantities are used and consumed for the most part in the machining process, BOELUBE® Liquid produces near dry workpieces and chips with little or no clean-up or related costs and no disposal costs.

Historically, the metalworking industry has used metalworking fluids by flood application in machining operations. But because the costs associated with use, management, and disposal of flood coolants has risen over the years, in part due to increasing federal, state, and local regulations aimed at worker safety and fluid disposal, there has been a growing trend to utilize methods requiring less metalworking fluid to reduce cost, protect the environment, and improve and protect worker health, without sacrificing productivity and quality.




**Using a coaxial supply of compressed air and lubricant to the nozzle, the nozzle directs BOELUBE® lubricant droplets in the compressed air directly to the cutting edge. The compressed air will help move chips from the tool cutting edge as the fine lubricant droplets form a thin film at the point of contact to reduce friction.**



## Reduce Friction with Minimal Clean-up

A metalworking lubricant should impart sufficient lubricity between the tool and the workpiece to cause a significant reduction in friction to occur. BOELUBE® is a technologically advanced lubricant that significantly reduces friction (one of the major elements in generating heat during the material removal process). BOELUBE® Liquid can replace flood type metalworking lubricant in machining operations – being applied by positive displacement lubricant applicator in precise amounts to reduce friction at the interface of the tool cutting edge and workpiece. The reduction of friction at these surfaces minimizes heat generation and concurrent chip weld. Tools retain their cutting edge longer, leading to closer tolerances and prime chip yield.

Near dry machining can be described as a process by which a minimum quantity of lubricant mixed with air is continuously applied to the tool/workpiece interface during the machining operation. The application of near dry machining lubricants, such as BOELUBE®, which for the most part are consumed in the machining process, yield desirable economic, employee, and environmental benefits.

On a comparative basis, near dry machining can yield longer tool life than machining with flood coolant. The lubricity of BOELUBE® that is applied in small quantities is greater than that of high volume, water based flood coolant. Chip removal can be enhanced because a chip saturated in coolant can acquire both added weight and adhesion that make it more difficult to move away. Cleanliness is a major benefit of near dry machining as greatly reduced use of cutting fluid results in both cleaner machines and shops.

## Boelube® Lubricants for Near Dry Machining

One of the earlier uses of near dry machining was in aircraft manufacturing. Freon® gas was used in three distinct areas of the riveting process – drilling, rivet insertion, and rivet-head milling. Because of the undesirable effects of Freon® gas on the ozone layer, Boeing manufacturing research and development engineers introduced an alternative method using BOELUBE® lubricant compositions to efficiently lubricate and cool tools by preventing heat buildup, while greatly reducing the reworking after drilling that had been necessary with Freon® because of exit burrs, oversized holes, and a rough finish on the inside surface of the holes.

BOELUBE® lubricants were used in drilling, reaming, and coldworking of fastener holes in aircraft wing skins; installation of wedge-head lock bolts; lubrication of hand drills; and on machinery that automatically drill rivet holes and install rivets on large sections of airplanes. It was shown that the application of minimal quantities of BOELUBE® lubricant could reduce friction, speed production, increase tool life, and improve surface finish and hole quality in a number of machining operations.

## Cost Savings

Cost savings are derived through longer tool life, better surface finish, increased productivity, reduction in lubricant usage and subsequent cleaning and disposal costs, reduced environmental impact, improved housekeeping, and easier chip handling and recycling.

## Environmentally Non-Hazardous / Worker Friendly

- Manufactured from personal care ingredients, BOELUBE® is non-irritating and biodegradable
- Minimal lubricant usage reduces worker exposure

## Major Benefiits

- BOELUBE® is non-corrosive, non-flammable, chemically stable and free of halogens, heavy metals, sulfur, phosphorus, silicone, petroleum or paraffin wax.
- BOELUBE® does not contain any ingredients considered a hazardous substance by OSHA, WHMIS, IARC, NTP and State Regulatory Lists. Refer to Material Safety Data Sheets for additional information.
- BOELUBE® will not promote dermatitis, provides a high degree of worker safety, and presents a safe effective method to machine various types of materials without special handling, fluid recycling or typical disposal issues.
- BOELUBE® can be removed from surfaces using isopropyl alcohol, denatured alcohol, MEK, or aqueous cleaner.
- BOELUBE® has indefinite shelf life.
- BOELUBE® does not need to be removed prior to heat treat.
- BOELUBE® is in most cases compatible with paints and sealants (though it is highly recommended that compatibility be determined before use).
- BOELUBE® provides superior lubrication when machining or forming the increasingly complex range of materials now being used in Aerospace, and a wide range of other manufacturing industries.

## Machining Processes

Drilling is one of the most widely used machining processes to produce circular holes in metallic and nonmetallic materials.

A drill is a rotary end-cutting tool, with the most common type being the twist drill. The drill, attached to either a stationary machine or hand held, is used to originate or enlarge a hole in a solid material. A drill will have cutting edges and straight or helical grooves or flutes, which allow for movement of chips and cutting fluids. Drill wear is not proportional to the number of holes drilled, but occurs at an accelerated rate.

A reamer is a rotary cutting tool (similar to a drill) with one or more cutting elements, used to enlarge to an exact size and impart a smooth finish to a previously drilled hole. Drilling can be characterized as in a rough form, whereas reaming is the exact form. Reaming is essentially a finishing operation. A reamer can be either straight or tapered.

Milling produces machined surfaces by removing metal or other material using a rotating cutter having a certain number of cutting elements or teeth. A characteristic feature of the milling process is that each tooth of the rotating cutter takes a portion of material in the form of small, individual chips.

**BOELUBE®**

| Product Name | | | Description |
|---|---|---|---|
| 70104 | Appearance | Red Liquid | |
| | Boeing Number | 100A | |
| | Boeing Process Specification | BAC5008 | Application of Lubricants |
| | | BAC5054 | Taper Shank Fastener Installation |
| | | BAC5063 | Fastener Installation in Composite Structures |
| | | BAC5492 | Machining and Cutting Titanium |
| | | BAC5540 | Hole Preparation, Machining, and Grinding of Steels |
| | | BAC5578 | Manufacture of Advanced Carbon Fiber Reinforced Advanced Composite Structure with Toughened Epoxy Systems, +350 F Cure |
| | | BAC5657 | Manufacture of Carbon Fiber Reinforced Composite Structure by Automated Fiber Placement, +350 F Cure Epoxy Systems |
| 70106 | Appearance | Clear Liquid | |
| | Boeing Number | 100F | |
| | Boeing Process Specification | BAC5008 | Application of Lubricants |
| | | BAC5054 | Taper Shank Fastener Installation |
| | | BAC5063 | Fastener Installation in Composite Structures |
| | | BAC5492 | Machining and Cutting Titanium |
| | | BAC5540 | Hole Preparation, Machining, and Grinding of Steels |
| | | BAC5578 | Manufacture of Advanced Carbon Fiber Reinforced Advanced Composite Structure with Toughened Epoxy Systems, +350 F Cure |
| | | BAC5768 | Mandrel Coldworking of Holes in Aluminum |
| | | BAC5657 | Manufacture of Carbon Fiber Reinforced Composite Structure by Automated Fiber Placement, +350 F Cure Epoxy Systems |
| 70305 | Appearance | Pink Hard Paste | |
| | Boeing Number | 50B50A | |
| | Boeing Process Specification | BAC5008 | Application of Lubricants |
| | | BAC5054 | Taper Shank Fastener Installation |
| | | BAC5063 | Fastener Installation in Composite Structures |
| | | BAC5540 | Hole Preparation, Machining, and Grinding of Steels |
| | | BAC5768 | Mandrel Coldworking of Holes in Aluminum |
| 70307 | Appearance | Blue Medium Paste | |
| | Boeing Process Specification | BAC5008 | Application of Lubricants |
| | | BAC5054 | Taper Shank Fastener Installation |
| | | BAC5063 | Fastener Installation in Composite Structures |
| | | BAC5540 | Hole Preparation, Machining, and Grinding of Steels |
| | | BAC5768 | Mandrel Coldworking of Holes in Aluminum |
| 70302 | Appearance | Blue Soft Paste | |
| | Boeing Process Specification | BAC5008 | Application of Lubricants |
| | | BAC5054 | Taper Shank Fastener Installation |
| | | BAC5063 | Fastener Installation in Composite Structures |
| | | BAC5540 | Hole Preparation, Machining, and Grinding of Steels |
| 70200 | Appearance | White Solid | |
| | Boeing Number | 16B4F | |
| | Boeing Process Specification | BAC5008 | Application of Lubricants |
| | | BAC5063 | Fastener Installation in Composite Structures |
| | | BAC5540 | Hole Preparation, Machining, and Grinding of Steels |
| | | BAC5578 | Manufacture of Advanced Carbon Fiber Reinforced Advanced Composite Structure with Toughened Epoxy Systems, +350 F Cure |
| | | BAC5657 | Manufacture of Carbon Fiber Reinforced Composite Structure by Automated Fiber Placement, +350 F Cure Epoxy Systems |
| 70206 | Appearance | White Solid | |
| | Boeing Number | 16B4F | |
| | Boeing Process Specification | BAC5008 | Application of Lubricants |
| | | BAC5063 | Fastener Installation in Composite Structures |
| | | BAC5540 | Hole Preparation, Machining, and Grinding of Steels |
| | | BAC5578 | Manufacture of Advanced Carbon Fiber Reinforced Advanced Composite Structure with Toughened Epoxy Systems, +350 F Cure |
| | | BAC5768 | Mandrel Coldworking of Holes in Aluminum |
| | | BAC5657 | Manufacture of Carbon Fiber Reinforced Composite Structure by Automated Fiber Placement, +350 F Cure Epoxy Systems |
| 70201 | Appearance | Pink Solid | |
| | Boeing Number | 16B1A | |
| | Boeing Process Specification | BAC5578 | Manufacture of Advanced Carbon Fiber Reinforced Advanced Composite Structure with |
| | | BAC5657 | Manufacture of Carbon Fiber Reinforced Composite Structure by Automated Fiber Placement, +350 F Cure Epoxy Systems |