



Gun Barrel Honing

A New Approach to Accuracy



Executive Summary

Honing is an abrasive machining process that is the "best kept secret" at many leading gun barrel producers, whether the end product is a fine sniper rifle, a police service pistol or an aircraft cannon. Simply put, honing produces a more accurate barrel – a better overall product – for lower cost.

Honing improves barrel performance by producing more uniform and controlled bore geometry, size and surface finish. Honing improves straightness, cylindricity, and roundness. It corrects taper, bow, barrel shape, tight spots and other geometric errors better than reaming. It's ideal for correcting bore geometry after stress relieving. And it consistently produces surface finish to specifications. With its "self-sharpening" abrasive tooling, honing eliminates "tool condition" and "wear" as a manufacturing variable.

Honing is used before rifling, and sometimes afterward. Whether the rifling is produced with a cutter, button, broach or hammer forging, its advantages apply equally. And unlike lapping, honing is a true production process – fast, low-cost, highly consistent, easily automated, and requires no special skills or "touch."

Leading defense contractors and commercial gun/barrel makers use Sunnen honing systems, including Sabre Defence Ind., Glock, Colt, Savage Arms, Kolar Arms, General Dynamics, Anshütz, Sigarms, Bulldog Barrels, Feddersen Inc., Briley Manufacturing, Marine Corp. Logistics Base, Stag Arms, and North American Arms. The follow article provides details.



Application Summary – Gun Barrels



Sunnen Products Company has '*cracked the code*' for production of Gun Barrels! The production process for gun barrels has remained relatively unchanged for many years, although technology advancements in honing have yielded drastic improvements in production cycle times, geometric bore quality, and surface finish in recent years at several manufacturers. New developments in honing tooling, abrasives, and machines have in many cases eliminated the manual lapping process used to finish barrels. Improved size control and surface finish by incorporating a honing step prior to button rifling improves the consistency of the rifling operation, resulting in consistent rifling depth and twist throughout the bore, end-to-end! Honing can also be performed after rifling if desired.

A gun barrel must withstand pressures up to 60,000 psi (4136 bars) during weapon discharge. The steel chosen must be able to withstand this type of loading on a repetitive basis. Most gun barrels are made from chrome / molybdenum alloy steels (4140, EN19) or certain types of stainless steels (416). The chrome moly steels are more popular choices for hunting and military weapons because they can be blackened easily. Stainless steel barrels are popular with target shooters because the barrels can be made with highly accurate bores and have a long service life. *No matter the composition*, all steel alloys can be honed with the proper choice of abrasive and honing coolant. By choosing the honing stone bond and grit size properly, any imaginable surface finish requirement can be achieved!

Creating the gun barrel bore is normally done on gun drilling equipment using specially designed gun drill tools made from tungsten carbide. The barrel is normally rotated opposite the drill as the drill is forced into the steel at an average rate of 1 inch (25mm) per minute. Coolant is fed under high pressure (1000 psi / 69 bars) down the drill through a small hole in the tool shank. The coolant flushes the chips out of the bore through a flute cut into the outside of the gun drill tool shank. Several flutes are used on larger diameter tools. Drilling is normally followed by reaming. Reaming is used to more accurately control the size of the bore after gun



drilling. Honing after reaming removes .002" - .004" (50 – 100 microns) stock. Honing controls the final diameter and bore geometry even more precisely than reaming and creates a consistent surface finish in the bore. For surface finishes below 16 $\mu\text{in Ra}$ (.4 micron) roughing and finish honing steps are used. Rifling results are more uniform and consistent due to the precise size control from honing. The honing crosshatch surface texture also provides lubrication to the rifle button as it travels the length of the bore. Honing can also be used after the rifling step to polish and remove burrs. The honing process vastly improves the rifling process regardless of whether the rifle is cut, buttoned or hammer forged. The same honing benefits apply in all cases.

SABRE DEFENCE INDUSTRIES

50 Caliber Browning M2 & M3 Machine Gun Barrel Application



In the 50 caliber machine gun barrel application, the manufacturer's main goal is to improve the precision of the barrel during test firing. The army's spec for test firing performance for a 10 round burst is to hit within an 8" (203 mm) circle at 100' (30.5 m). The honing process improved the precision from a 7" (178 mm) circle down to a 4" (102 mm) circle! The barrels performed so well that tank gunners began to request the Sabre Defence barrels by name! The gunners could tell immediately after shooting whether a barrel had the precision or not.

The M3 aircraft machine gun barrel is a lighter version of the M2 machine gun barrel. Both barrels start out from slightly different grades of alloy steel, with extra vanadium to increase life. The 45" (1143 mm) long by 2.625" (66.7 mm) diameter steel blank for the barrel weighs 73 lb (33 kg). This blank is heat treated and then drilled to a diameter of 0.490" (12.45 mm). The chamber end of the blank is drilled to a larger diameter to accept a stellite insert. Gun drilling is followed by reaming to control the diameter to a size of ± 0.001 " (30 microns). After a stress relieving operation, the bore diameter changes and the roundness and straightness become worse. Honing is used after the stress relief operation to correct the bore size and geometry to well within the Military Specifications. The honing machine has an automatic plug gauge that



gauges the bore after every honing stroke, controlling the size, roundness, and straightness to well within .0005" (13 microns). Honing stock removal typically runs about .002 - .004" (50 – 100 microns). The barrel ID changes caused by the subsequent button rifling and chrome plating steps are held well within the overall tolerance allowed.

The lapping process this manufacturer used prior to the adoption of honing cannot control the size as accurately as honing and produces about one bore per hour, compared to 10 – 12 bores per hour with the Sunnen honing process! The Sunnen honing process reduces the labor required *by 55 minutes per bore*. At a labor cost of \$50/hour, this equates to a savings of \$45.83 per bore. With production quantities of up to 1200 barrels per month, **annual savings from the honing operation can approach \$660,000 per year!** And the savings produces barrels that the **tank gunners ask for by name!** This is truly a "Win – Win" situation for the manufacturer and the armed services!

Summary



Gun barrel applications come in a wide variety of sizes, lengths, and tolerance requirements. Long rifle bores and short pistol bores benefit from the honing process – even paintball gun barrels. Large cannon barrels and mortar tubes are also commonly honed to improve accuracy. Honing is applied to all materials from Alnico to Zinc! Gun barrels processed on Sunnen Honing systems have achieved higher precision on the shooting range. Better production quality and lower costs are the result. Sunnen Products Company has the solution!



Sunnen Products Company – for accuracy measured in millionths

Sunnen Products Company is the world's largest vertically integrated producer of honing machines, abrasives, tooling and coolants. A leading supplier of technology for the gun and barrel making industries, the company was founded in 1924 in the U.S. by Joseph Sunnen, a man who was truly "ahead of his time" in many ways. His initial creative genius was geared toward the repair of automotive engines to improve the productivity of the automotive repair shops of his era. Over the ensuing years Joe sought to improve the performance of industrial products using the honing process. This work led to the development of honing tools, gages, machines, and processes capable of yielding bore accuracies of ten millionths of an inch ($\frac{1}{4}$ micron), in a production environment!

With more than 700 employees worldwide and global Sales & Service through 50 distributors, Sunnen has become a leader in fully automated flexible honing systems for medium to high-volume production. Standard products are also available from the extensive Sunnen Honing Supplies catalog for high, medium and low-volume production. With manufacturing control of its own abrasives, tooling, coolants and machinery, Sunnen Products Company is ideally positioned to offer "*the best total solution*" to its customers. No matter what the production requirements, Sunnen has a honing solution that is right for you – *all from one supplier!*