

## GUN BARREL HONING SYSTEM HITS BULLSEYE FOR PAC-NOR

*HONING MACHINE OUTSHOTS HAND LAPPING IN MANUFACTURE OF PRECISION RIFLE BARRELS*

Manufacturing precision rifle barrels has always been something of an art that involves hand lapping of the bore surface twice, before and after the rifling profile is cut or swaged in by a rifling button. In fact, a bright, hand-lapped bore is considered one of the hallmarks of a precision rifle barrel, despite the inherent variations from

that is head and shoulders above lapping, within two to three millionths of an inch end-to-end when it's really dialed in," he said. "This, in turn, improves the consistency of the rifling process by minimizing variation in the depth of the grooves. We still finish lap after rifling, but it's easier because we just polish off the fine crosshatch finish that may be left after honing and rifling."

Pac-Nor Barreling is a true custom manufacturer catering to bolt-action rifle shooters. The company's principle markets are law enforcement, military, competitive shooters and hunters. Started in 1984 by avid shooter and company President Chris Dichter, Pac-Nor is now in its second generation under his son, Casey. In addition to barrel manufacturing, the shop will install the barrel on a customer's action, or add features such as muzzle brakes or fluting on bolts and barrels etc.

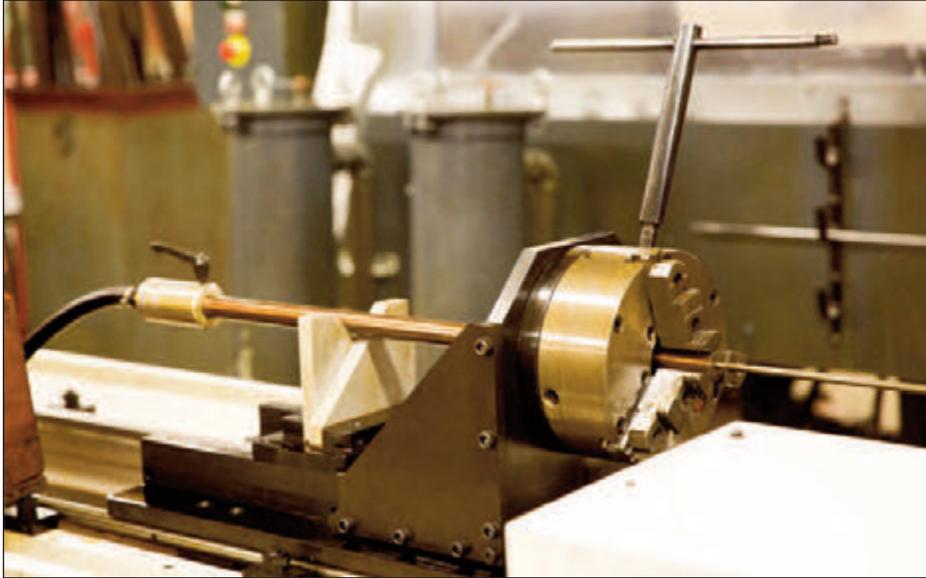
The shop runs two shifts per day. A day shift of ten people produces 30-40 custom barrels of different calibers in 416R stainless or chrome-moly steel. A night shift of three people produces one type of barrel – about 50 AR-15 barrels per day for a rifle OEM.

Pac-Nor's process starts with cutting and facing premium bar stock, followed by gun drilling on four Pratt & Whitney twin-spindle machines and an Eldorado CNC twin spindle. After reaming, the barrels are gaged for size. Depending on the condition of the reamer, 0.0004" to 0.0007" of material is left in the bore. This must be manually lapped out or honed out to final size for rifling. "Everyone who works here has done hand lapping," said Dichter. "It's an unpleasant job, particularly if the reamer is starting to get dull. Lapping  
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manual work done by people who get bored and tired from the monotonous chore. Pac-Nor Barreling, Inc. set its sights on this issue more than a year ago and hit the X-ring with the newly developed Sunnen HTE honing machine. The machine has all but eliminated Pac-Nor's pre-rifling lap, which is the more difficult and time consuming of the two laps. Pac-Nor is also producing as many custom barrels as ever, but with a slightly smaller staff. "Our objectives with the hone were to build a better product with less labor, and the honing machine has exceeded my expectations," said Pac-Nor Production Manager Casey Dichter. "The hone produces a consistency in bore diameter



Pac-Nor Production Manager Casey Dichter says the Sunnen hone produces a consistency in bore diameter that is head and shoulders above lapping. The machine has all but eliminated the standard pre-rifling lap.



The Sunnen hone secures the barrel blank in a 3-jaw chuck, with honing oil pumped into one end while the tool works from the opposite end. Sunnen's specialized Long Bore Tool uses metal-bond diamond or CBN superabrasives to quickly remove reamer marks, waviness, tight spots and other imperfections left by upstream processes.

may take 10 to 45 minutes, depending on the caliber of the barrel. We tried to shorten this, but when chatter marks get 'ironed' into the surface by the rifling button, the finish lap is even longer and more difficult, so there is no advantage. With lapping, too, there is potential for variation, simply because it's a manual process. Lapping can also be a production limiter and in our region we have a very small labor force to draw on when we want to grow."

The company had explored honing in the nineties, but re-visited the idea when Sunnen introduced its HTE honing machine in 2014. The HTE is a horizontal machine that can hone small-bore rifle barrels, with a diameter range of 0.150" to 0.790" (4-20 mm), and lengths up to 60" (1,524 mm). Designed specifically for long small bores, the machine features an extremely sensitive drive and tool feed system that provide maximum protection against tool overload/breakage. Tool specific force limits and run settings are stored in the touch-screen PC control, allowing the system to sense tight sections in the bore and correct them automatically.

Sunnen also developed a new Long-Bore Tool (LBT) designed to take on

industry's most difficult honing challenges in small bores of .17 caliber rifle barrels. The tool quickly removes reamer marks, waviness, tight spots and other imperfections left by upstream processes. The LBT utilizes metal-bond diamond or CBN superabrasives for high productivity, long life and fast cycle times. Precision-machined of through-hardened tool steel, the LBT can produce bore accuracies of 0.000027" (0.0006 mm) for diameter, roundness, and taper – from first part to last.

Honing is an ideal replacement for hand lapping barrel blanks before rifling. It quickly removes reamer scratches and surface waviness without labor-intensive hand lapping. A typical 600-grit abrasive can produce a 6-10 microinch Ra (0.15 to 0.25  $\mu\text{m}$ ) finish in a reamed barrel blank. By producing a consistent bore diameter ( $\pm 0.0001$ " or less), parallelism, roundness and surface finish end to end, honing yields more consistent performance from rifling buttons and cutters, resulting in a constant



At Pac-Nor, barrel blanks are stress relieved in a tempering furnace after honing and rifling. The parts are inspected and gaged at various stages during manufacture.

groove depth. The ideal bore geometry reduces distortion of the bullet shape for improved gyroscopic stability in flight.

"We are currently honing about 80 percent of what we make and will do more as we acquire the tools in different  
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**Maverick McCourt prepares to install a rifle barrel on a receiver using Pac-Nor's barrel press.**

calibers," said Dichter. "We have learned the quality of our reaming now does not need to be as critical because we have the hone. Although there is a tradeoff in cycle time and abrasive cost for additional honing, we are still able to run our reamers two to three times longer than when we lapped alone. With a hand lap, the time and effort increase when the reamer is getting dull."

After honing, the barrel is inspected again before rifling with a pull-button. Pac-Nor makes its own Accu-Twist carbide rifling buttons and can provide different rifling styles, including polygonal, per the customer's choice. A button is attached to a rod and the rod is pulled through the barrel. The company's hydraulic rifling machine utilizes a CNC machined twist bar with a helix angle that matches the twist rate requested by the customer. The final twist rate is confirmed afterward using a Barrel-Scan electro-optical twist measurement system

The barrel is then stress relieved in a tempering furnace, followed by contouring of the outer shape and final, finish lapping of the bore. "During the finish lap, you can

really tell the difference between a bore that was honed before rifling and one that was lapped," said Dichter. "You can easily sense any remaining tight or loose spots in the bore. The diameter uniformity and roundness of the honed bore are superb. The lap also feels different in a honed bore."



**Pac-Nor cuts and faces premium bar stock, then gun drills on one of five twin-spindle machines, followed by reaming of the blanks. This rack of barrel blanks awaits completion.**

In competitive shooting where winning scores may be separated by thousandths of an inch, a few millionths of an inch improvement in the uniformity of a Pac-Nor barrel may make a big difference for a skilled shooter.



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### SUNNEN PRODUCTS COMPANY

#### St. Louis, MO - USA

World Headquarters

Phone 1.314.781.2100

Fax 1.314.781.2268

Toll Free 1.800.325.3670

Email [sunnen@sunnen.com](mailto:sunnen@sunnen.com)  
[www.sunnen.com](http://www.sunnen.com)

### SUNNEN AG

#### Ennetaach - Switzerland

Phone +41 71 649 33 33

Fax +41 71 649 33 34

Email [sales@sunnen.eu](mailto:sales@sunnen.eu)  
[www.sunnen.eu](http://www.sunnen.eu)

### SUNNEN ITALIA S.R.L.

#### Arese - Italy

Phone +39 02 383417 1

Fax +39 02 38341750

Email [sunnen@sunnenitalia.com](mailto:sunnen@sunnenitalia.com)  
[www.sunnenitalia.COM](http://www.sunnenitalia.COM)

### SUNNEN SAS

#### Saclay - France

Phone +33 1 69 30 0000

Fax +33 1 69 30 1111

Email [info@sunnen.fr](mailto:info@sunnen.fr)  
[www.sunnen.fr](http://www.sunnen.fr)

### SUNNEN BENELUX BVBA

#### Kontich - Belgium

Phone +32 3 880 28 00

Fax +32 3 844 39 01

Email [info@sunnen.be](mailto:info@sunnen.be)  
[www.sunnen.be](http://www.sunnen.be)

### SUNNEN PRODUCTS LTD.

#### Hempstead Herts - United Kingdom

Phone +44 1442 393939

Fax +44 1442 391212

Email [hemel@sunnen.co.uk](mailto:hemel@sunnen.co.uk)  
[www.sunnen.co.uk](http://www.sunnen.co.uk)

### SUNNEN DO BRASIL LTDA.

#### São Paulo - Brasil

Phone +55 11 4177 3824

Fax +55 11 4362 3083

Email [sunnen@sunnen.com.br](mailto:sunnen@sunnen.com.br)  
[www.sunnen.com.br](http://www.sunnen.com.br)

### SUNNEN POLSKA SP. Z.O.O.

#### Warszawa - Poland

Phone +48 22 814 34 29

Fax +48 22 814 34 28

Email [sunnen@sunnen.pl](mailto:sunnen@sunnen.pl)  
[www.sunnen.pl](http://www.sunnen.pl)

### SUNNEN RUS LLC

#### Moscow - Russia

Phone +7 495 258 43 43

Fax +7 495 258 91 75

Email [sunnen@sunnen-russia.ru](mailto:sunnen@sunnen-russia.ru)  
[www.sunnen.ru](http://www.sunnen.ru)

### SUNNEN S.R.O

#### Strakonice - Czech Republic

Phone +420 383 376 317

Fax +420 383 376 316

Email [sunnen@sunnen.cz](mailto:sunnen@sunnen.cz)  
[www.sunnen.cz](http://www.sunnen.cz)

### SHANGHAI SUNNEN MECHANICAL CO. LTD.

#### Shanghai - China

Phone +86 21 58133990

Fax +86 21 58132299

Email [shsunnen@sunnensh.com](mailto:shsunnen@sunnensh.com)  
[www.sunnensh.com](http://www.sunnensh.com)