

Izhmash Biathlon Rifle Barrel Replacement



Dave Anana

Background

Eden Anana had a very good biathlon shooting record this winter, despite her age and size, the eleven year old out-performed most adults on the 45 mm prone targets. However, during several races inexplicable missed targets surfaced despite excellent zero period validation. We were driven to identify and rectify those conditions on her Izhmash 7-3 rifle.

We chose the 7-3 because of its reasonable price, straightforward design, robust components, and simple dry fire mechanism. It was popular with entry level athletes and biathlon clubs. But at the IBU Cup, World Cup and Olympic levels they were rare. Interestingly more than 80% of Russia's World Cup Biathlon Team, home of Izhmash rifle manufacturer, placed their trust in the German manufactured Anschutz rifle.

Stories of inconsistent bullet impact and group size degradation in cold conditions, though unverified by controlled tests, seemed to shadow these weapons. We wondered if these concerns were justified, applicable to her rifle, and how they could be reconciled.

Mr. Gene Econ, who has decades of high power and small bore competition experience, referred us to a highly regarded barrel manufacturer in Portland, Oregon. Unfortunately, very little information was available about his record, capabilities, operation, or skills. The only hints of his craftsmanship were scant and scattered chat room conversations; none proving comprehensive.

Barrel Manufacture and Installation

Program Kick-Off - With trust in the recommendation, we committed to the upgrade of one 7-3 and one 7-4 Izhmash to machined rifle barrels. Full payment initiated the activity with two weeks scheduled for barrel manufacture and another three weeks for installation, fitment and verification. Delivery of all accessories was mandated to facilitate validation tests.

Barrel Blank Selection - For the biathlon application a barrel blank material of 4140 chromium molybdenum steel was selected for its machinability, durability, and strength. The use of 416R stainless steel offered advantages but additional material cost and manufacturing steps would not translate into real world benefits. Despite its name 416R stainless was not completely rust resistant, especially in the bore when not maintained. Cleaning without caution may result in scratches to the bore.

Bore Drilling - A colossal gun drill utilized a purpose built drill bit in conjunction with oil under extremely high pressure to create the initial bore through the barrel blank. Of critical importance was maintaining concentricity of the hole along the blank's axis, minimizing deflection along its entire length, evacuating machining chips from the bore, and ensuring a consistent diameter throughout. No fewer than 50-gallons of a special oil circulated through the apparatus to facilitate the critical and tedious operation.

May 3, 2013

Izhmash Biathlon Rifle Barrel Replacement



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Bore Reaming - The reaming process brought the drilled bore to its final diameter and provided a smooth finish. A very fine cross hatch pattern was also introduced to mitigate the negative effects of bullet lubricants.

Rifling – Lands were created using custom tools that were designed and manufactured in-house. The rifling button was drawn through the bore leaving clearly defined lands at a twist rate optimized for 22 Long Rifle cartridges.

Bore Lapping – Each barrel was lapped to remove machine marks, ensure dimensional uniformity over the barrel length and to finish the bore.

Contour Cutting – The barrel's exterior profile was machined on a CNC lathe.

Heat Treatment - Barrels were then bathed with an inert gas mixture in kiln which was also designed and fabricated in-house. Temperature profiles, durations and cooling periods were carefully controlled to attain desired martensite, austenite, and grain boundary properties. The heat treatment process used in manufacture exceeded all US military requirements. This critical step ensured all residual stresses inherent to the blank materials, processing prior to receipt and processing as described above were eliminated. These barrels were “dead”.

Bore Straightness Validation – The inspection step ensure bored straightness, diameter and other critical features were not affected during heat treat.

Barrel Facing and Crowning – Both the breech and muzzle were faced to ensure surfaces were orthogonal to the bore. In addition an 11° crown was applied to the muzzle. These machined barrels were 2.00-inches longer than the original for better off-hand stability.

Barrel Fluting – A total of six 0.100-inches (depth) by 0.250-inches (width) flutes were cut along the barrel's length in a CNC machining center. The removed material resulted in a nominal overall weight reduction compared to the units replaced. The minimum barrel wall thickness of 0.170-inches exceeded all performance parameters for 22 Long Rifle bullets as well as the NATO 5.56 used by the US Military. Fluting provides greater barrel rigidity for a given weight than its non-fluted counterpart.

Barrel Chambering - The breech was chambered for 22 Long Rifle cartridges in a drilling operation. An optimized feed ramp was incorporated to mitigate bullet damage and/or deformation when loaded from a magazine.

Barrel Parkerizing - The barrel exterior was subjected to a zinc phosphate application process to improve wear resistance and inhibit corrosion. The near black finish was very rough in texture as compared to the original barrel.

Barrel Threading - The barrel was threaded a minimum of 2-inches on a lathe to interface with the bushing within the receiver. The attachment method was a contrast to the original clamp and bond configuration.

May 3, 2013

Izhmash Biathlon Rifle Barrel Replacement



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Receiver Threading – The bushing within the receiver was threaded to accommodate installation of the threaded barrel. The original bushing axes on both rifles were not concentric with their respective receivers thereby requiring rework to the case hardened components. No fewer than seven carbide inserts were sacrificed during the corrective phase.

Rear Sight Rail Installation - The rear sight rail on the 7-4 rifle was not located at top-dead-center which drove more rework.

Front Sight Installation - The front sights were removed for installation onto the machined units. Set screw holes were not located for sight location at top-dead-center. The 7-4 barrel set screw hole was only partially drilled; installation was supported primarily through the use of an adhesive compound.

Extractor Groove Machining – Grooves were machined into each side of the breech surface to accommodate the extractor claws. Groove sizes and location varied from rifle to rifle. The left hand side was consistently larger than its right hand counterpart.

Head Spacing - The tolerance between the bolt and barrel faces was adjusted to .003-inches for optimal operation and extraction. Alignment proved to be more critical with an unfired bullet than a spent case.

Barrel-to-Receiver Pinning – Receivers, bushings and barrels were pinned after the extractor grooves were aligned, the desired head spacing achieved and fluted exterior clocked.

Observations and Notes

This modification exposed three significant flaws in the Izhmash rifle design and manufacture:

1. The original barrel-to-receiver attachment clamped 0.5-inches of barrel bearing surface supplemented by 1.5-inches of adhesive. It was not a reliably rigid interface; alignment could be adversely affected by very simple actions like grasping the rifle by its barrel. The condition is easily underestimated as it was neither visible nor obvious.



Izhmash Biathlon Rifle Barrel Replacement



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2. Hammer forged barrels on Izhmash rifles retained localized residual stresses from the manufacturing process. Barrel behavior will be unpredictable when subjected to thermal fluctuations because the metal's grains and boundaries vary along cross section and length. Accuracy and repeatability of a good machined, heat treated barrel will always equal or exceed its low cost, high volume, military oriented hammer forged counterpart.



3. Front and rear sights were not aligned with the bore nor located top-dead-center.

Each Izhmash was built as a stand-alone unit. Drop-in component interchangeability or replacement could not be achieved nor did it appear to be a priority. This may be the direct result of restrictive rifle barrel replacement regulatory oversight in Europe (read very difficult).

Bolt faces were not square to their actions or barrels. In addition to verification by measurement the condition was visually apparent from the bolt-barrel interface top being clean but heavy fouling at bottom revealing propellant gas escapement.

Barrel-receiver attachment for these and other Izhmash biathlon rifles were drilled for but left unpinned, partially drilled but retained by the broken drill bit instead of the intended pin, or simply not drilled.

The benefits of the simple and robust Izhmash biathlon rifle design cannot be overstated. But in its delivery configuration it will never match the shooting performance of its Teutonic rival.

Summary

The described barrel replacements eliminated the three major weaknesses to the Izhmash 7-3 and 7-4 rifles modified in this exercise. On a shooting performance level they are now equal to or better than an Anschutz 1827F rifle in its delivery configuration (read close tolerance and fragile). When accounting for maintenance durability, simplicity and ease of dry fire these modified Izhmash units are easier for training and peak shooting performance.

There is no break-in period. Testing by the manufacturer, using the accessories requested initially, provides the necessary proof. Validation at or below -5°F (-20°C) was not conducted due to time constraints.

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Test results of Eden's 7-3 rifle – Ten shots at 50 feet from a bench rest



Test results of the 7-4 rifle – Five shots at each target from 50 feet off of a bench rest

May 3, 2013

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Mating a machined barrel upgraded Izhmash biathlon rifle to a properly fitted Bear stock are significant steps toward a reliable, well fitting package that will spawn a biathlete's confidence.

John Benjamin is a Master Rifle Barrel Maker! The accomplishments of his customers and the long waiting list for his barrels are testimony to his knowledge, capabilities and skills. In addition to tremendous design and manufacturing abilities his worldly wisdom was captivating.

Despite a decade of reliable service and very good performance my Anschutz 1827FL will be upgraded in August. It may be very good but needs to be great to keep pace with Eden!

May 3, 2013