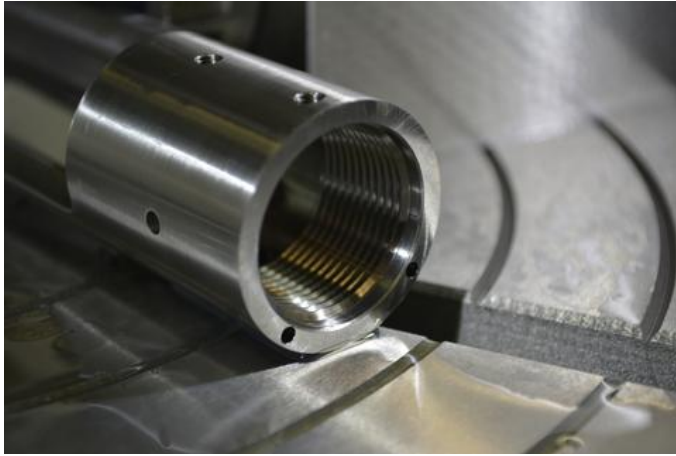


## LRI Tier-One Receiver Blueprinting for The Remington Model 700



*LRI Tier-One Accurized Remington M700 Receiver*

- **Background:**

The process of “Blueprinting” an action can be one of the most challenging types of machine work presented to a gunsmith. The margin for error is very small due to the cascading effect(s) on mating components. Historically, this kind of work is performed on a manual lathe. The action is positioned to rotate parallel and concentric to the machine’s spindle bore.

Existing features are then machined (with a minimalist strategy) so that the critical dimensions are altered (again, minimally) to bring the receiver into more favorable tolerances. The problem we saw with this process early on is that it is near impossible to standardize dimensions. One receiver may clean up at “X” where’s another requires “X+Y”.

The latest trend of tooling companies/gunsmiths selling and using mandrel guided taps and form cutters attempts to duplicate the same kind of work. It does so while ignoring almost all fundamental machining principles. LRI views these products and processes as a scam that preys upon uneducated shooters who have never been exposed to machining basics. A tap, no matter how sharp or well made, will **never** correct a positional error. Taps follow the path of least resistance. In this case, all that ends up happening are the threads get made larger and maybe a bit shinier. Correcting a potential position error is simply not possible because too much of the tool is in contact with the part.

In 2003 LRI began to explore the feasibility of doing “blueprinting” type receiver and bolt work using CNC machining centers. The intent was to improve the overall quality while also taking advantage of consolidated work holding. CNC machinery has the ability to access multiple sides of the receiver in a single setup. This only serves to improve the overall quality.

Additional advantages are that automated machines can do things that are just not practical to attempt by hand.

- **Step one; Single Stroke Diamond Honing:**

When blueprinting an action, the receiver bore is the “center of the earth.” Ensuring it is straight, round, taper free, and of good surface finish, is vital.

Reaming has been the historical means of doing this. While it works it also creates some unique challenges to solve from a machining perspective. Honing is the better answer as it’s a very precise means of bringing a cylindrical body to precise dimensions. (A cylinder in a car’s engine for instance) On a receiver, this is not an easy thing to do because the hole is not completely round. The raceway features of an action present act as a “tooth” that attempts to rip the abrasive stones from the hone’s mandrel.



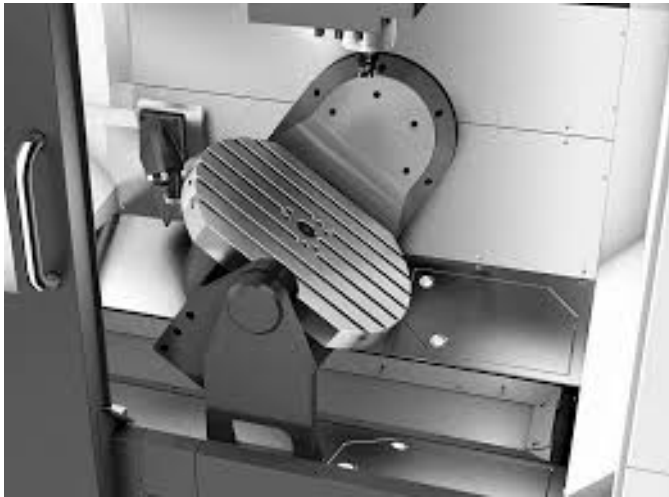
***LRI's Exclusive Single Stroke Diamond Honing process***

The solution was to have custom made tooling that would qualify the bore while also managing the raceway features common to bolt action receivers. Single stroke diamond honing solves this.

### Solutions provided via honing:

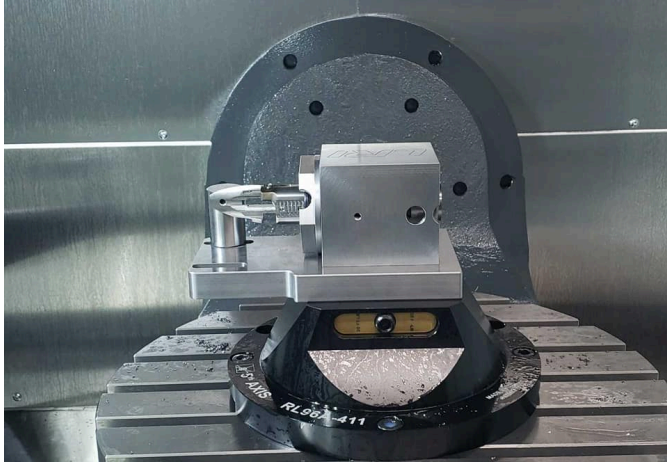
- Single stroke diamond hones deliver a straight & round ID bore
- Honing creates a well-defined datum point for all subsequent work
- Honing delivers a superior internal bore surface finish
- Honing offers flexibility for sizing the bore for proper bolt clearance/function when applying finishes/coatings (Cerakote, Duracoat, etc.)
- Exceptionally good control of the process provides excellent repeatability and therefore standardizes the finished product

- **The Future: True live 5 axis machining:**



### ***LRI's 5 axis blueprinting process; an industry exclusive!***

In 2019 LRI took this entire process a step further with *True live 5 axis CNC receiver blueprinting!* We are **the industry first** to do this! We began this ambitious effort in 2003 by pioneering the process with conventional 3 axis machines. Our new capability allows us to fixture a part, electronically probe all critical features, align to the spindle, and present multiple sides in an almost endless variety of ways with only **one setup**. The result is exceptionally accurate machining that delivers predictable and consistent quality faster than ever previously possible by **anyone** in the custom gun industry. A receiver that begins life as a "production grade" part can now enjoy the same kind of features and detail work once considered exclusive to custom bolt actions.



This kind of work has historically been very labor intensive and time consuming. We can now process receivers in minutes instead of hours and days.

[Video of M700 Receiver Blueprinting](#)

#### Work Detail:



- ***Barrel Tennon Threads:***

LRI does not merely “clean up” an existing action thread by machining until it shows evidence of material removal across the circumference. The issue with this is that gunsmiths end up

“chasing” a variety of unknown, unqualified values when fitting a barrel. Thread size for fitting the barrel literally becomes a **guess**. A run of actions done this way may all coexist in a range of  $-0.0"/+0.015"$  depending on how much was removed. While not impossible to do, one must be experienced in how to determine the actual ID thread's major diameter so that the barrel threads may be sized appropriately. Additionally, there is no practical means to predict the proper pitch diameters and percentages of thread flank engagement between the receiver and the barrel.

To do so properly requires experience. Unfortunately, obtaining this experience often results in an alarming (EXPENSIVE) amount of scrap parts or receivers that are “made to work.” This is because nothing is standardized and very few end users have the resources/skillsets required to qualify the work afterward.

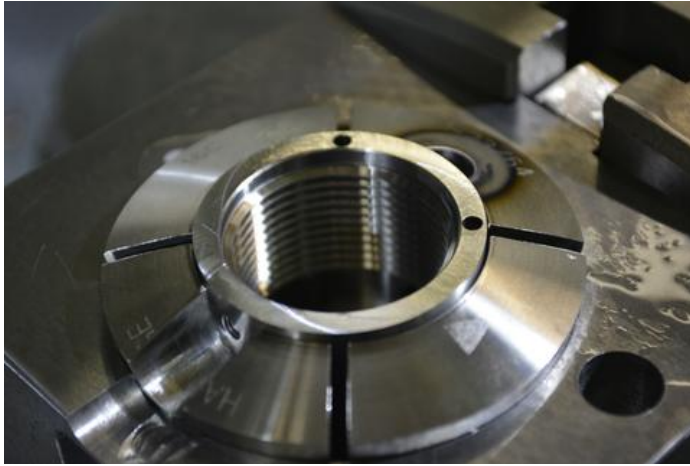
LRI **solved** this. We conducted a case study long ago to document the envelope of positional errors typical of a production M700/M70 receiver thread. Once a baseline was established, we literally created our own thread pitch: 1.085"x16tpi. To fully vet the process, we had custom gauging made by West Port Tool and Gauging. Using the same mathematical calculations used for determining conventional thread sizes, the result is a machined thread feature that is both **traceable and repeatable**.



### **1.085"x16 thread gauge**

The peripheral features such as the height between the lug abutments and the receiver ring face are preserved to the OEM 1.150" linear distance. The internal thread diameter is sized for the 1.085"x16 minor diameter (1.009") to further ensure concentricity with the receiver bore centerline. Because we use **one tool** to do all three of these features, tolerance stacking is **eliminated**. The addition of the “Higbee cut” is a small detail item we add to the lead thread of the receiver. Its sole purpose is to eliminate the risk of tear/galling the lead thread of the receiver ring.

Doing so gives the gunsmith a single standard to finish the barrel to and this equates to barreling becoming as easy as any marquee level custom action. In some cases, were better than the aftermarket.



#### ***Completed receiver ring with pinned recoil lug positioning holes***

Another powerful advantage of 5 axis positioning is that multiple machining operations can be consolidated into one setup. The use of modern probing routines ensures positions and coordinates are known prior to a tool ever contacting the part. LRI manufactures recoil lugs in house designed specifically to fit our modified receivers. Pinning the lug ensures repeatability when installing new barrels into bedded stocks. The lug always times the same so that fitment issues are avoided.

- **Scope base hole enlargement/alignment:**

The upgrade to larger 8-40 optic base holes is a process that has been traditionally done with vice work in a manual mill.

- **Helically bored and thread milled 8-40 Optic Base Holes**

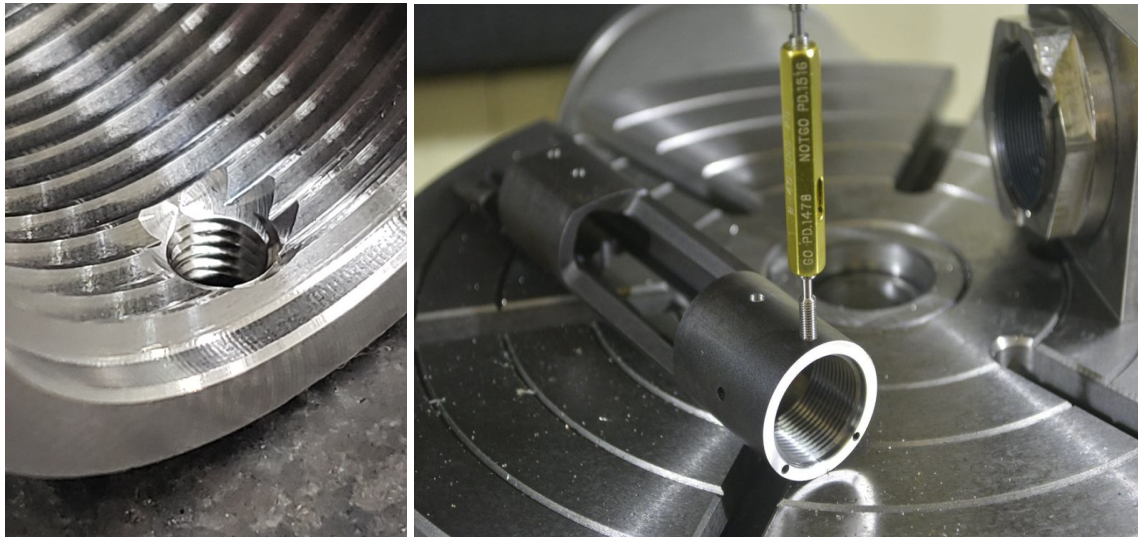
Here, we simply probe qualified features on the action to locate where the holes *should* go, then we interpolate (bore) the existing holes and machine threads with the same thread milling process used on the receiver ring. Any potential location errors in the original holes are corrected.

- **Front hole inner chamfer**

There are two types of gunsmiths; *“Those who have stuck a barrel and those who will.”* It’s a feeling that will burn a hole through your stomach. Often, the front optic base hole on an



action is the culprit. The base hole interfacing with the receiver threads tends to behave like a thread die. Material is peeled off the thread flanks of the barrel with little room for the swarf resulting in seizure of the thread which is an expensive consequence. LRI has taken measures to solve this problem by machining a chamfered edge on the inner thread ring. The tool clearances the two features while also machining a radius at the thread interruption. It does nothing for accuracy however it does go a long way to ensure parts do not cannibalize each other during the assembly/tear down process. This is a very critical feature for shooters using quick change/multiple barrel setups.



#### ***Front base hole chamfer and gauged 8-40 base holes***

The Boring and thread milling process avoids location errors from tools following the existing features the way a drill and tap does. Boring is on a modern machining center is a very, very reliable means of correcting a hole's positional error. Inspection is again performed using certified gauging.

In summary, the modernization of this process produces a finished part that exceeds practical abilities of conventional gunsmithing practices. LRI's process parallels many of the same manufacturing techniques used by higher-level custom action companies. Our cues come from the world of aerospace, auto racing, and medical components manufacturing.

Additionally, we also offer the full gamut of peripheral work such as fluting, TIG'd handles, knob installs, etc...

- **Summary of Advantages with LRI's CNC receiver accurizing:**

- Reduction in tool library all but eliminates tolerance stacking
- Consolidated machining operations improves dimensioning accuracy
- Exceptional Parallelism between bolt and receiver lug surfaces through tool package consolidation
- Use of a "Higbee" lead thread to eliminate the risk of a torn or galled thread
- Avoidance of part distortion from "point contact" type work holding
- Taper free receiver ring threads with use of thread milling tool paths
- Standardization of receiver threads with traceable/qualified gauging
- Misaligned optic base holes corrected
- Superior surface finish with proprietary work holding, aerospace quality machining, and tooling
- Streamlined production via consolidated programming for barrel fitting
- Pinned recoil lug positioning for repeatable clocking during assembly
- Scalable to meet demand increases
- Available for Short, Long actions in any bolt face configuration, material, or hand dominance
- Fastest rotation in the industry. In/out in a few days vs weeks/months.

- **Accessory and upgrade work:**

With fundamental issues solved, the door can now open to exploring add on features. LRI's external side release is a popular upgrade. We make our own releases in house with the commitment to solving multiple problems. 1<sup>st</sup>, we designed the parts as a system to ensure that impact energy is channeled directly from the release to the receiver when bolt comes to full extraction length. The pin is merely used to keep the assembly together. 2<sup>nd</sup>, the release is made as wide as practically possible to distribute energy over a broader surface. 3<sup>rd</sup>, they are made from carefully heat-treated material, so they last, while *not* peening the lug surface of the bolt head from thousands of cycles. Last, they are elegantly machined with clean, ergonomic edges that present and function well.





### ***LRI External Bolt Release***

- **Bolt work:**

Bolt work was the next problem to solve. In 2016 we migrated away from using a lathe for bolt work and switched to CNC machining centers. In a single setup we can access all critical surfaces and machine them to identical, repeatable, and predictable dimensional values. When combined with our receivers, it makes barreling an almost “plug and play” effort. No more chasing tenon lengths, head space values, or breech clearance variances. Improvements such as M16 extractors, dual ejectors, fluting, and bushing of firing pins becomes a seamless transition because of our proprietary rapid setup and palletized fixturing. The work simply flows from one station to the next, yet never leaves the actual fixture.

This may sound too good to be true and we thought so as well, but our high-volume clients have served to fully vet this process and we’ve been doing it successfully for years.

The goal again is to maximize the action’s potential and deliver a high quality product that allows you to focus on shooting.

We also offer the full gamut of peripheral features such as fluting, TIG’d handles, knob installs, etc...

- **Summary of Advantages with LRI's 5 axis CNC bolt accurizing:**

- Reduction in tool library all but eliminates tolerance stacking
- Consolidated machining operations improves dimensioning accuracy
- Exceptional Parallelism between bolt and receiver lug surfaces through tool package consolidation
- Avoidance of part distortion from "point contact" work holding
- Superior surface finish with proprietary work holding, aerospace quality machining, and tooling
- Streamlined production via consolidated programming
- Scalable to meet demand increases
- Available for Short, Long actions in any bolt face configuration, material, or hand dominance
- Fastest rotation in the industry. In/out in a few days vs weeks/months.



***M16 extractors/Dual Ejector upgrade available for .390, .450, .480, .545, and .590 case head diameters***

- **M16 Extractor and dual ejector upgrade:**

Our M16 extractors are also made in house and fully heat treated. Our process for installation is radically different from the industry standard of machining the bolt nose and gluing the bushing. LRI's bushings are *threaded* into the nose of the bolt and soldered using magnetic induction. ***Flame heat is never used.*** The risk of compromising the heat treatment of the bolt head is eliminated. Threading the insert combined with solder ensures a trouble-free installation for the life of the firearm. Our extractors are "gender specific" (L/R handed) and when installed with our optional dual ejector upgrade, provide the most reliable extraction/ejection functions available for the M700 action.

### ***-More on dual ejectors:***

The most common issue with an oem bolt being fitted with an extractor design like the M16 is that the ejection angle of the cartridge becomes nearly vertical. With the use of modern optics what often happens is the spent case hits the bottom of the scope and bounces right back into the loading port. Adding the second ejector pin restores the angle to nearly horizontal making for flawless function. Concerns of heavy bolt closure are solved by simply trimming a few coils of the ejector springs. It restores the bolt manipulation to normal while still providing plenty of “punt” to get the spent case out of the rifle.

- **Keyed scope base lugs (clip slotting):**

This process began with the United States Marine Corps during one of the revisions to the M40 weapon system. Basically, the screws holding the base to the receiver no longer pull double duty by having to manage recoil and abuse. The optic base is keyed to the receiver body so that any/all impact energy is transferred directly between the two parts. This process has been done by several companies spanning over a quarter century.

LRI has made small improvements to the process by modifying the rear bridge features to also capture the sides of the base. This was never part of the original design and we make no claims as to being “period correct”. Our intent is to offer the absolute most robust means of securing the base to the receiver. The original process used the existing clip slot made by Remington for the use of top feeding, external stripper clips. These clips depended upon small angled hole like pockets to position the stripper for loading the internal magazine. The slots for the clips are no longer applicable because the scope base prevents a top feeding stripper clip from ever being used. Because of this we’ve eliminated the operation.

What we have done is preserve and improve upon the eye catching “double radius” feature on the ejection port. Original prints from Remington have been obtained that show additional work being done to the ejection port of the receiver opposite of the port floor. A narrow flat feature is extended, and a portion of the raceway is cleared as well. These are details that we preserve with our setup as it does improve the overall appearance to the upgrade. Last, we gave up on sourcing outside vendors for the bases as the standard has evolved over time and no one now seems to have “the one”. Instead, they are all private label versions of the original. LRI began making its own bases in 2013. The added benefit to this is that we also offer versions for the long action M700. Keeping the parts and the process in house gives us total control on the outcome and ensures your clients get the best result. Our bases are made from aerospace certified, forged 7075 T651 aircraft billet aluminum for maximum strength and weight reduction.





- **Optional/Additional receiver services:**

The menu of options we offer for the M700 action expand further with services designed to solve specific issues known to exist.

- M16 Extractor installation for both R and L handed actions in any bolt face configuration
- Bushed striker pin installation
- Timed/TIG welded bolt handle
- Skeletonized bolt handle
- Bolt fluting in a broad variety of patterns/styles
- Faceted bolt shrouds
- External Side bolt release installation
- M40 type keyed optic base installation (Commonly called “clip slotting”)
- AI-AW magazine box modification
- Extended magazine box fitting
- Modified loading ports for increased COAL ammunition
- TIG welding groove feature found on SS actions to improve bedding performance
- Installation of heat-treated thread insert for tactical bolt knob installation
- Dual ejector installation for M16 extractor upgrade (R&L handed)

- **You are in good hands**

To date, LRI has Blueprinted over **9,000** receivers since the spring of 2009. The process has been refined and tuned to deliver very predictable results with sterling quality machine work. We take immense pride in that we have successfully campaigned the largest internet “Group Buy Special” for *6 consecutive years* on the Sniper’s Hide Forum. It is tailored specifically to this type of work and targets some of the industry’s most discriminating clients.

LRI’s services are retained by 4 major metropolitan Police SWAT Teams, International Security and Risk Management firms, municipal law enforcement, and others. In addition, we have sponsored/assisted multiple national, international, and Olympic athletes with their shooting careers. Our dealership network is global with over 200 businesses worldwide retaining our services. We are the premiere state-of-the-art facility in world for custom gunmaking. Our exceptional staff and work ethic is backed with the best customer service offered in the custom rifle industry.

“Remember, Men will bet their lives on the work you do.”

*-Phillip Newsom, Engineer for Pratt and Whitney*