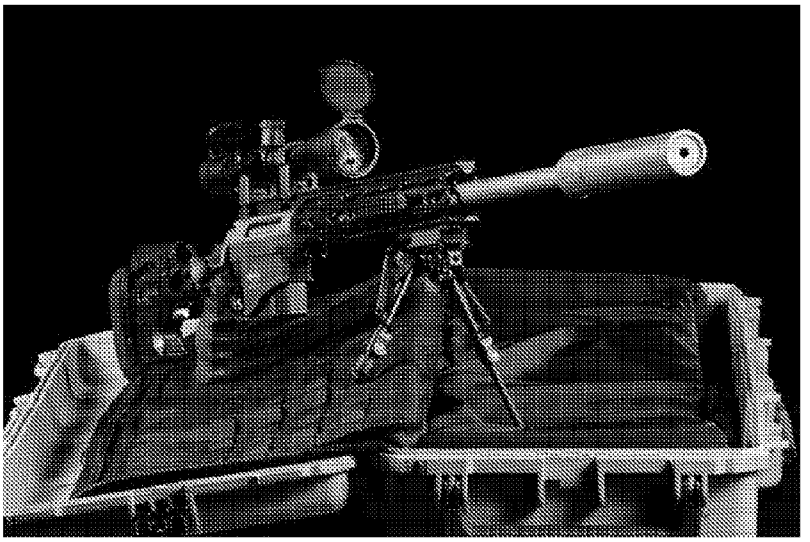
Remington MILITARY PRODUCTS DIVISION

# New Sniper Weapon System

## Design Status as of 09/07/08



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## Purpose

Since the 5 June, 2008 submission of two NSWS prototype rifles to the U.S. Army, Remington has continued to develop and evolve the platform, improving many of the shortcomings found in the initial samples. As mentioned in the submittal documentation, Remington is dedicated to refining the NSWS to a level that exceeds the requirements set forth by the United States Armed Forces to ensure they are provided with the most sophisticated weapons system available. In order to ensure the fulfillment of this objective, Remington has assigned the necessary resources capable of reacting quickly to any and all feedback extracted from those evaluating the rifles at Ft. Bragg, independent consultants, and government agencies.

In an effort to demonstrate our continual development, a short design status update has been compiled. To ease in illustrating the changes and/or improvements, a copy of the Exceptions/Known Issues section from the original submittal documentation is included below. After each item within the section, the red text represents the current item's status. Additional notes and comments regarding the design's status follow the Exceptions/Known Issues section.

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# Exceptions/Known Issues and Anticipated Resolutions

## Magazines

Due to the short development time associated with the program, the prototype magazines have just begun to arrive. Testing on the initial samples has yielded unfavorable results. The included magazines allow single loading or feeding of two rounds at most. The material and heat treatment is insufficient, causing the feed lips to easily deform and fail to retain the rounds and/or present them in the proper orientation to the bolt face when feeding. This also applies to the floor plate retention. The vendor has, to date, failed to produce magazines that comply to the design specifications and is presently fabricating new magazines with improvements for the heat treat, material, and geometry. As soon as improved magazines become available, they will be forwarded for replacement with the submitted rifles.

Replacement five round magazines were submitted based upon a vendor sampling from 16 July, 2008. These magazines incorporated a reduction in feed lip length of approximately .300", allowing the round to release sooner for more reliable stripping. Also, the heat treat was improved, stabilizing the geometry by preventing any non-elastic deformation. The last change incorporated the addition of a spacer to allow the feeding of CIP length ammunition without binding on the guide ribs. To accommodate rounds longer than CIP and up to 4.0" OAL, the insert can be removed.

Another iteration of the five round magazine has been received. These samples improved the round presentation to the bolt face, increasing the contact height from .100" to .140". This lessens the chance of the case head dropping below the bolt face during feeding prior to exiting the release point of the feed lips. Additionally, a one degree incline has also been incorporated into the lip geometry to present the round with an upward attitude to the feed ramp. A sample of 50 magazines is presently due and additional magazines will be submitted upon receipt. At present, the ten

round magazine is still in development by the vendor and no samples have been tested.

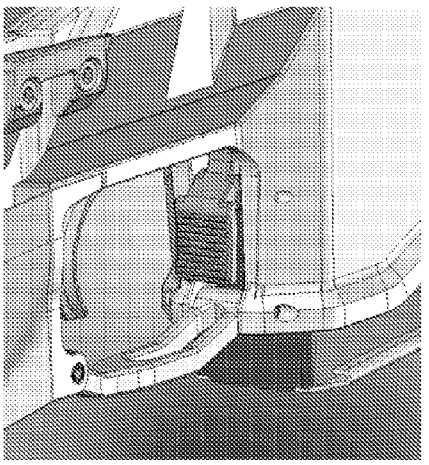
**Stock and Fore End Assembly**

1) Assembly/Disassembly. Present disassembly/assembly of the action to the stock and fore end to the receiver requires the removal of eight socket head cap screws of various sizes. Future generations of the stock will have an access hole in the grip plate for the rear action screw which will reduce this operation to four socket head cap screws of the same size.

Assembly and disassembly of the action to the stock and fore end now requires the removal of only four ¼"-28 socket head cap screws and requires only a 3/16" allen wrench. These changes were present in the stock sample sent for evaluation on 30 July, 2008.

2) Magazine Release. The magazine release is aluminum. The next version will be steel to prevent wear when working in conjunction with hardened magazines.

The magazine release has been changed to hardened steel. Also, the width of the release has been increased and serrations added to improve ergonomics. See the picture below.



Picture 1. Magazine Release and Stock Catch Insert

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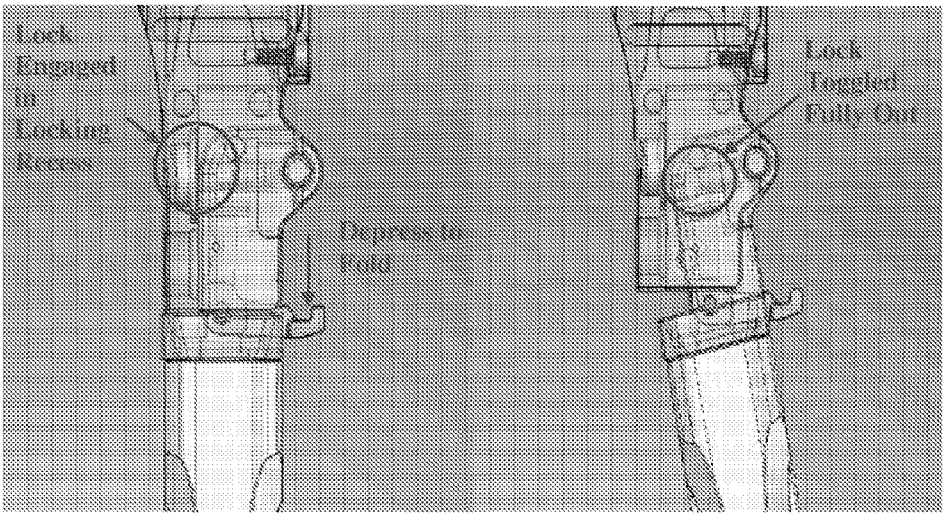
3) Stock Folding Mechanisms. When folded, the butt stock latches with a steel catch into a notch on the aluminum lower receiver. Again to prevent wear, this notch will be a hardened steel insert.

The addition of the hardened steel insert is complete and was also present in the most recent stock sample. It can be seen in the upper left corner of Picture 1 above.

The stock folding mechanism has exhibited some loosening during continuous use. In an effort to minimize any relaxing of the fit, the stock vendor has redesigned the latch assembly. The assembly has also been simplified to help make operation more intuitive to the end user. Pictures 2-5 below show the new mechanism during function.

Folding




Picture 2. Latch Operation - Fold




Picture 3. Beginning to Fold

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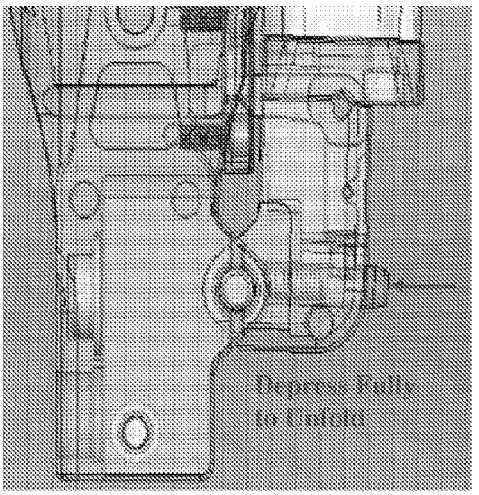
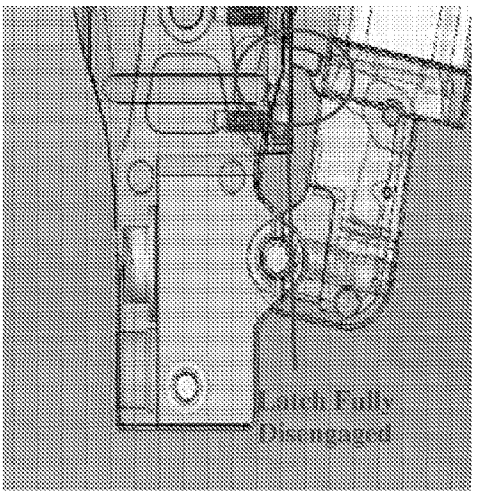
Unfolding




Picture 4. Latch Operation - Unfold




Picture 5. Beginning to Unfold

4) Magazine Release Stop. The stop for the magazine release is a hardened dowel, separately inserted into the lower receiver. The change here will see the magazine well opening lowered to stop the release's rotation, eliminating the dowel.

This issue was corrected and demonstrated in the most recent sample.

5) Sling Swivel Pocket. The rear sling swivel pocket is meant to accept a hardened steel push-button sling swivel. The pocket is in the aluminum lower receiver and wear may be an issue. The next version will have a hardened insert to lessen the wear chances.

This issue was corrected and demonstrated in the most recent sample.


6) Recoil Lug. The recoil lug has been fabricated out of pre-hard material and has a Rockwell hardness of Rc 32. No issues have been observed around this but in an effort to anticipate any problems, the material will change to AISI 4140 and heat treated to a Rockwell hardness of Rc 37-42, increasing the strength of the part.

This issue was corrected and demonstrated in the most recent sample.

7) Monolithic Rail. The monolithic rail prevents re-barreling without removal of the optics platform. Splitting the fore end rail and the receiver rail while maintaining the alignment and 20 MOA grade can potentially solve this problem. This correction will only be pursued if it is seen as a problem by those evaluating the system.

By removing the six screws attaching the monolithic rail to the hand guard, the primary optics can remain in place while removing the hand guard, allowing access to the barrel nut for barrel removal.

This method was field tested with excellent results. A 20" barrel and a 27" barrel were alternately fired a single shot at a time with a total of six barrel changes and two respective groups. Each barrel shot into its respective group and both measured approximately 1 MOA, indicating very little shift when changing barrels and removing optics could be deemed unnecessary. If using a particularly long scope the rear two screws on the monolithic rail may be covered by the objective. A future test will be performed to determine if the system can operate with the front four screws only, possibly eliminating the rear two and simplifying assembly/disassembly.

**Action Assembly**

1) Bolt/Receiver Interface. The bolt presently can bind when operating in a non-linear fashion due to the diametrical relationship between the guide path in the receiver and the bolt body diameter. The guide path has been inadvertently oversized beyond acceptable tolerancing while the bolt bodies are near the minimum allowable tolerance. Excess clearance between these parts amplifies the binding when a side load is applied. Also,


the bolt head ways and bolt body guide paths have been EDM'ed into the receivers, leaving a coarse surface finish. Future versions will have the diametrical relationship corrected as well as the surfaces polished.

Since the initial submittal, additional actions have been fabricated. Because of a programming issue with the vendor, the first five actions experienced the same oversized condition as the two submitted to the Army. An additional four receivers were made with an attempt to better control the problem dimensions. The five "oversized" receivers function properly but exhibit the bolt binding and "chatter" just as the two Army samples. A few methods are currently in process to attempt to lessen the dimensional concerns:

1) Honing of the EDM finish and polishing the bolt head produced a significant improvement in surface finish. All receivers from this point forward will receive this treatment. It is recommended that the Army receivers also have this operation performed to them if possible.

2) A hard chrome finish is scheduled to be applied to a receiver on 11 September, 2008. This process adds material thickness in the bolt guide paths, essentially filling in the oversized dimensions to the point of near compliance. Also, the hard chrome coats the titanium with a very smooth and hard (HRc 60) finish. Both decrease friction and galling common with titanium.

3) Based upon the dimensional inspection data from the submittal actions, two oversized bolt bodies and bolt heads were made for the Army. Because the submittal actions were not available for precise fitting, it is unknown whether or not they will perform as intended. Using similarly oversized actions, the oversized assemblies did lessen (not eliminate) the bolt binding and chatter. Due to the variations in receiver dimensions throughout the length of the part, some receivers, despite being oversized, did not accept the similarly oversized bolt components. Additional fitting would be required. The Flat Dark Earth PVD coating (addressed separately below) has shown to increase friction rather than reduce as intended. Therefore, the two samples have only received the E-Ni-Teflon coating process.

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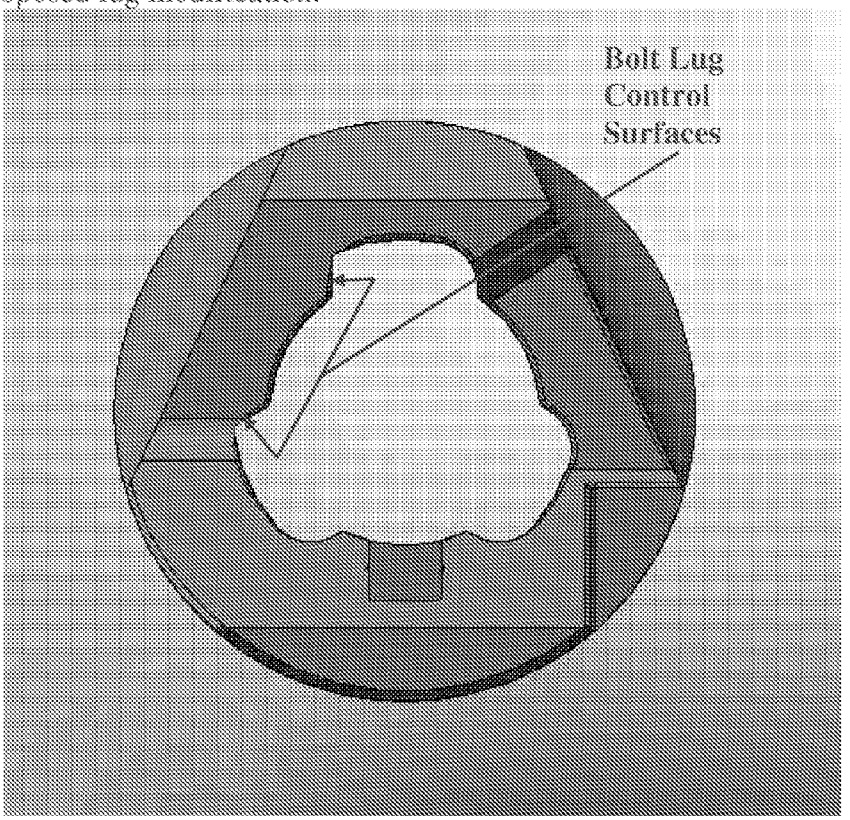
Besides the aforementioned paths for the oversized receivers, additional avenues of improvement are being pursued to better the design as a whole. The four receivers manufactured to tolerance control the bolt and bolt head better than the oversized receivers but some evidence of chatter and binding exists. Applying the polishing and honing operation, coupled with the proper coating, should increasingly lessen the problem. However, even further reduction to the point of elimination of the issue theoretically can be achieved when including a slight change in lug geometry to the improvement matrix. The change will increase the contact surface area in the two directions of operation, providing flat and dimensionally controlled bearing areas for the bolt lugs. As this change requires the removal of material, present receivers can be modified to test the concept. Only the fabrication of new bolt heads will be necessary. Picture 6 below illustrates the proposed lug modification.




Picture 6. Proposed Bolt Lug Control Surface





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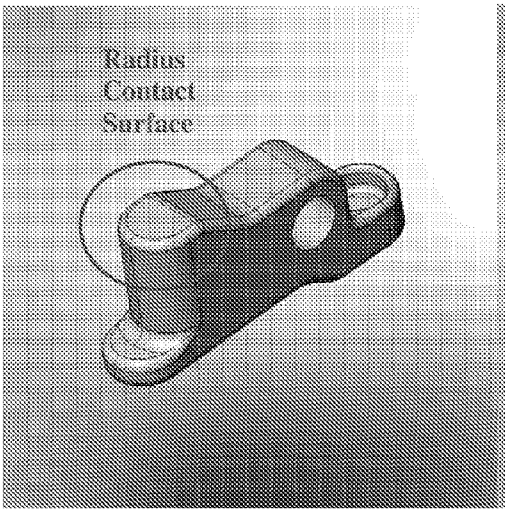
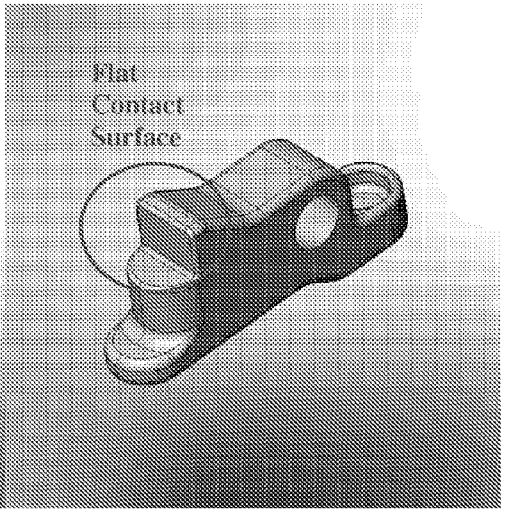
2) Bolt Release. The bolt release is held in place via a hardened dowel, making removal difficult. To correct this, the next generation receivers will have a tapped hole to accommodate a threaded pin to retain the bolt release.

The receivers have been tapped with a #5-40 thread to retain the bolt release. Threading the receiver gives positive retention along with serviceability. An alternate hardened pin of .125" in diameter has been designed as a separate solution. The pin is headed to prevent over insertion and ease of removal.

Through testing, the radius on the lug contact area of the bolt release was found to cause deformation to the corresponding lug on the bolt head when operated forcefully. To alleviate this issue, the radius has been replaced with a flat so point contact between the parts no longer exists. The load is then distributed evenly across the lug and the bolt release, minimizing deformation. See Pictures 7 and 8 below.




Picture 7. Old Bolt Release




Picture 8. New Bolt Release

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3) Safety Arms. The safety arms have been welded together, heat treated, and colored to work with the NSWS receiver. Because of time, stamping the part as intended as well as a plating operation was not performed. No issues should occur with the prototype parts, but the next revision will be processed fully.

Prototype safeties on hand have performed as intended to date. However, production safeties will be fully processed as stated.

4) Barrel Nuts. Two of the four holes on both barrel nuts measure under the desired .250" needed to fit the assembly wrench. Future versions will have this corrected.

This issue has been corrected. When changing barrels with the primary optics remaining installed, four spanner holes proved to be less than optimal for wrench placement. Four additional holes will be added to the nut to bring the total to eight with placements at 12:00, 1:30, 3:00, 4:30, 6:00, 7:30, 9:00, and 10:30 positions.

5) Ejectors. The ejector location in the bolt head is not optimal for the most positive ejection. This will be moved outward from the center of the part, tangent of the bolt shroud. Likewise the spring and ejector geometries will be optimized in the next revision.

The ejector position has been moved outward to tangent with the bolt shroud. In theory, this requires less spring load for the same amount of leverage to the cartridge during the ejection cycle. Additional testing is still required though initial testing has been favorable. Various spring rates are slated for testing to optimize the ejection. See Picture 9 below.

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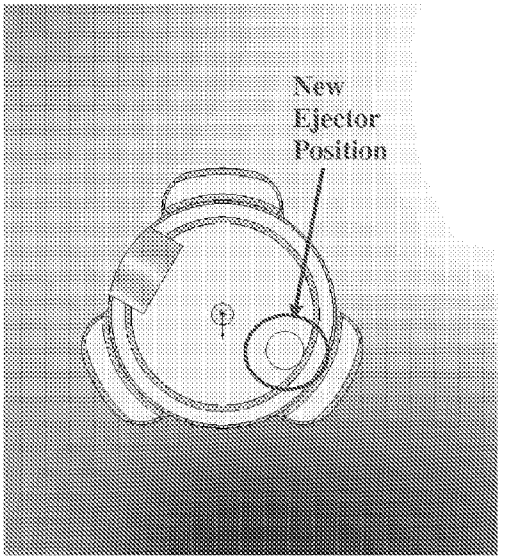


Picture 9. New Ejector Position

6) Extraction. RUAG ammunition has occasionally caused difficult extraction, similar to what would be experienced in a high pressure load. The chambers used in the submitted rifles comply to CIP/SAAMI specifications. Based upon Remington's inspection of the RUAG brass, it was determined that the sidewall hardness at the web of the shell is well below acceptable criteria. This characteristic has been the root cause for extraction difficulties in many weapons. No other manufacturers' ammunition tested has demonstrated this problem and all have shown acceptable case hardness measurements. See Appendix for more detail. In an effort to make the weapon system more tolerant of ammunition variation, the primary extraction cam on the next generation will be improved.

The RUAG ammunition with current production lots has not exhibited this phenomenon. RUAG has indicated a change in their brass processing and quality control. In an effort to further improve the system, the primary extraction cam on the second revision receivers has been increased to engage 0.025" sooner in the unlocking stroke to assist in initial extraction. Additionally, alternate chamber dimensions are being explored that not only assist in extraction by lessening the pressure but improve accuracy as well.

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**Coatings**

Current Coating:

Flat Dark Earth physical vapor deposition (PVD) scratch resistant coating comprised of zirconium nitride. The color is arrived at by adjusting the mixture of reactive gasses during the PVD coating process. This coating exhibits a low coefficient of friction against itself (0.15-0.20) and has friction characteristics similar to hard chrome. It exhibits a hardness of 65HRc and a coating thickness of less than 0.0001". The current coating is semi-porous and does not provide 100% corrosion protection. The corrosion protection it does provide is similar to 400 series stainless steels which will show light rusting during exposure to extreme corrosive environments (salt-fog chamber).

Production Coating:

A version of the Remington TriNyte coating process. This will be the same PVD coating with an underlayer of 0.0002" of high-phosphorus electroless nickel plate. This coating will maintain all the frictional properties as the current coating with a total coating thickness of approximately 0.0003" (Ni + PVD). The electroless Ni underlayer provides complete corrosion protection by encapsulating the substrate material. This coating will exhibit no perceptible corrosion after 72 hours of salt-fog exposure.

Our initial results using the flat-dark earth PVD coating supplied by Ionbond indicate that the frictional properties of the coating do not meet the frictional properties claimed by Ionbond and result in a perceived "roughness" on the surface of the coated parts. This surface finish has not been objectively measured at this time.

To combat this, we propose to use an alternate PVD coating to the interior of the receiver and the exterior of the bolt head and bolt body. This new coating will be black in color and will be comprised of an electroless-Nickel plate underlayer (corrosion protection) with a top-coat of PVD tungsten carbide and amorphous diamond for friction and wear resistance (WCC+DLC → a-C:H:W + a-C:H). The total plate thickness will be in the range of 0.0002"-0.0004". If required, the internal receiver features can be masked and the exterior of the receiver coated with the flat dark earth PVD coating.

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Based on Remington's development experience with titanium and steel component interactions during the function of autoloading firearms, this proposed coating addresses the issue of galling between titanium and steel.

Further development of the flat dark earth PVD coating may yield a better frictional performing coating in the future as development continues of the coating at Ionbond. These advances will be monitored and tested as they become available.

**System Weight**

Current weight of the base rifle with a 27" un-fluted M/24 contour barrel is 16 lbs. The same rifle with a fluted barrel is approximately 15 lbs. Using a similarly contoured 20" barrel gives a weight of 14.6 lbs. Fluting the 20" barrel reduces the weight to 13.9 lbs. Presently, Remington is pursuing research in carbon-fiber wrapped barrels for weight reduction, increased barrel stiffness, and improved heat dissipation characteristics. When using a carbon-fiber wrapped 27" barrel, the weight is reduced further to 12.9 lbs.

Presently, samples of both 27" and 20" barrels are slated for baseline accuracy then will be fluted to reduce weight. Accuracy will then be retested to determine process feasibility within the performance parameters. Optimizing the accuracy with minimal suppressor shift and maximum weight reduction is the obvious objective. In parallel to the aforementioned fluting path, vendor qualification for carbon fiber wrapping of barrels is underway but has yet to be tested for this weapon system.

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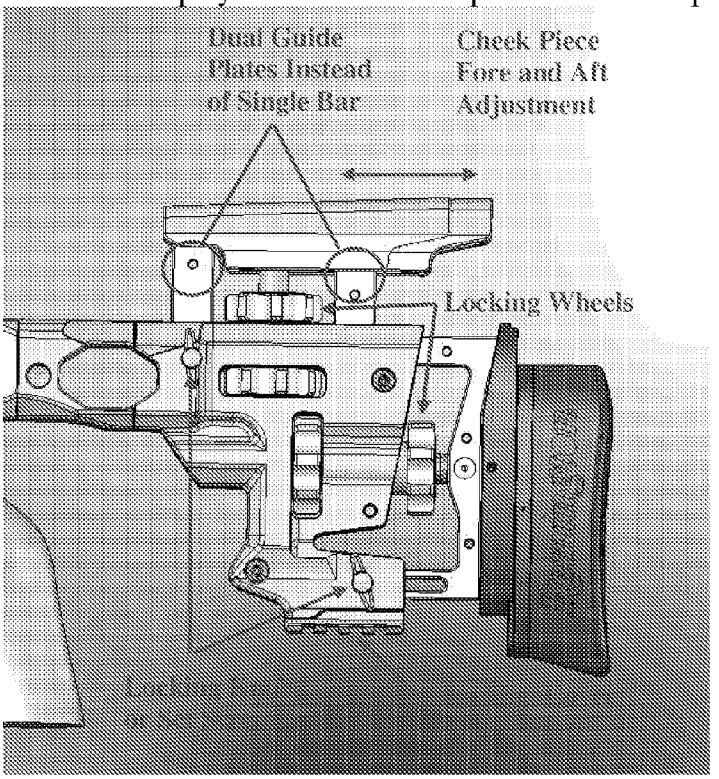
# Additional Design Notes and Comments

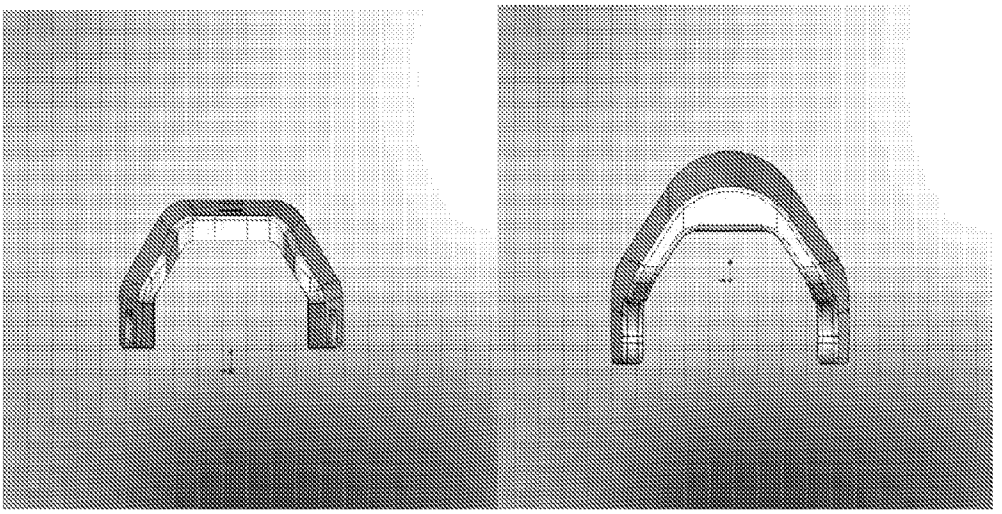
## Stock Assembly

Based upon user feedback, the stability of the cheek piece and butt plate assemblies have come into question. The samples submitted to the Army have locking set screws to help eliminate the play associated with these respective parts. The second generation butt stock did not incorporate the locking set screws but did change the adjustments to allow more precise positional control. When elevated or extended, both the cheek piece and the butt plate move to the point of being noticeable by the shooter. Also, the present stock only has one guide bar coupled with the adjustment bar, allowing both the cheek piece and butt plate to occasionally bind while adjusting. Picture 10 displays several of the improvement concepts.




Picture 10. Butt Stock Improvements

The cheek piece geometry has also been rounded to improve shooter comfort. A coating to protect the cheek piece and the skin of the shooter is being researched and will be applied once a suitable material has been identified. The bare aluminum, while rugged, may prove uncomfortable in extreme cold or hot conditions. Picture 11 below shows the old and new cheek piece profile.



Picture 11. Old and New Cheek Piece Profile Geometry

**Recoil Pad**

To combat the flex of the recoil pad experienced during hard shouldering of the rifle, alternate pads of increased durometer (hardness) have been sampled and can be fitted to the rifle based upon user feedback.

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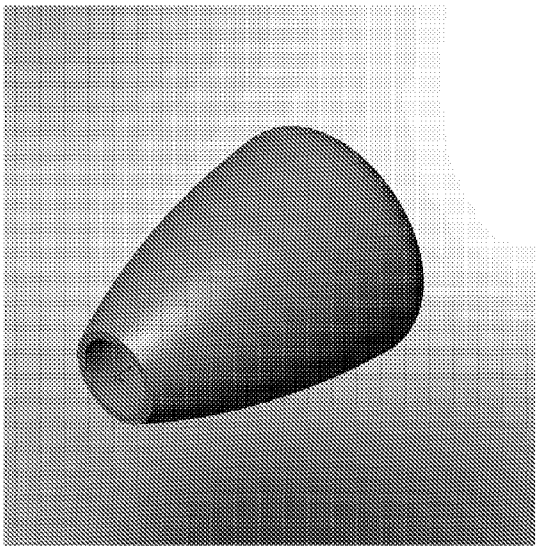
## Rail Cover

The original Army submitted stocks have a detented cover over the accessory rail located on the bottom of the butt stock. This cover was not held to the system sufficient enough to prevent inadvertent removal. The cover was eliminated for the second revision stocks. However, user feedback has suggested that a cover is necessary so a new one is being designed that will screw-lock into place, requiring its removal to be deliberate.

## Bolt Handle Knob

In an effort to give the operator more purchase when manipulating the bolt, the original 1" spherical ball bolt handle knob will be replaced with a conical aluminum knob, fashioned after similarly designed COTS products. This design allows additional gripping surface area while maintaining the ability to be locked by the stock in the folded position. The new knob is shown in Picture 12 below.



Picture 12. New Bolt Handle Knob

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