LIMITED DISTRIBUTION

REMINGTON ARMS COMPANY, INC.

RESEARCH DEPARTMENT

FIRST QUARTER PROGRESS REPORT - 1983

March 1983

DISTRIBUTION

J.P. McAndrews
E.F. Barrett
E. Hooton, Jr.
G.L. Ehrens
R.A. Partnoy
C.T. Wagner
C.A. Riley
D.M. Condon
W.H. Coleman, II
R.L. Hall
P.S. Hebert
C.B. Work
R.J. Iverson-Lake City

NOTE: Please destroy this report when it has served your needs.

REF:nw

HIGHLIGHTS

FIREARMS RESEARCH	Page No.
• Five styling samples of the Model 870 Restyle, to be introduced in 1985, are undergoing Marketing evaluation.	4
• Styling samples have been completed and development testing continues on a new family of shotguns to replace the Model 1100 and 870.	4
• Initial drawings are being evaluated on a 20 Gauge Parker shotgun.	4
• A prototype of the Model 700 Lightweight which will replace the Model 700 Classic has been completed.	5
• Model 7400 .223 Carbine prototypes and preliminary economics have been reviewed by Marketing. Primary emphasis is now being placed on development of a 10 shot magazine box.	5
• Prototypes of the XP-100 in .223 and 7mm-08 caliber will be complete in April.	5
• Cost estimates are being prepared for the Model 700 Classic in 250-3000 Savage and .338 Win. Magnum caliber.	6
• Model 870/1100 Waterfowl prototypes will be completed by May 1.	6
• Efforts are proceeding to solve floor plate opening and stock cracking problems encountered on the Model Seven Lightweight rifle.	6
• A third production run of powder metal pole pieces has been held because of poor magnetic properties as determined by new test techniques.	7
• A modified 410 stainless steel has been developed with impressive wear resistant properties. In a related program, addition of less than 10% WC to HD-1000 and HD-2108 enhanced mechanical properties.	7

HIGHLIGHTS - Cont'd

Page No.

AMMUNITION RESEARCH

- Semi-works 3" LVRC bodies for the new 1-7/8 oz. "Premier" load were machine headed and primed, hand loaded, and tested. Product was acceptable. A machine confirmation AH&P and loading run is in progress. Progress is continuing on all other shotshell gauges. 8

- Hand load ballistics were confirmed for "Premier" 12 Ga. 3" 1-7/8 oz. load in LVRC body. Tests are underway. 8

- 270 caliber Sierra bullets were grooved on a prototype grooving unit installed on a duplex loader and demonstrated good accuracy. 9

- Experimental domed primer cup shotshell primers with both 1024 and fuelless mixture are indicating superior performance in hand loaded target shotshell testing vs. Federal 209 and Remington 117XA primers. 9

- ABC battery cup tooling to increase flash hole area is being fabricated; fuelless mixture shows promise of reducing battery cup failures. 10

- The Center Fire Modernization Committee was reestablished to develop an implementation strategy. Marketing, Lonoke, R&D, Business Services, Corporate Engineering, and ER&DD are represented. Preliminary results will be presented in April. Status of the prototype machines is reviewed. 10

FIREARMS MODERNIZATION

- The Engineering Department has completed the CCE & VGA estimates for the prototype and production Receiver Flexible Machining projects. Project economics will now be generated and presented to Remington management along with the current plans for prototype and production facilities. 12

FIREARMS MODERNIZATION - Cont'd.

- The Heian CNC router for long stock inletting has been installed at Ilion. Two Heian technicians are currently assisting with machine set-up and check-out. Machine accuracy will be confirmed before Trial and Pilot operations begin. Production is scheduled to begin on the Model Seven in May. 12

- Quality problems discovered in the initial Trial & Pilot testing of the DeVilbiss atomizers have forced production to continue using the old Graco guns. Du Pont Service Representatives, were on plant 3/8-9 to assist in implementing a testing program. A possible cause for the quality problems was discovered and additional testing has been planned in April to confirm the results. 13

- The following assemblies have been selected for inclusion in the initial Small Metal Components Assembly System; shotgun breech bolt, common trigger, M/700-7 trigger housing, and shotgun carrier. 13

  EDL is currently fabricating prototype assembly stations for economic and technical evaluation. Preliminary testing is scheduled to begin in April.

- Recent tests conducted by Remington personnel at the vendor's facility were favorable utilizing both urethane and polyester finishes. Additional testing is being scheduled in May to continue process development, determine the economic potential, and address the toxicity question. 13

- The Serial Number Recording System Phase II project was approved in January. Detailed system performance specifications are currently being prepared with plant assistance to insure optimum production compatibility. Upon completion, Purchasing will request a requote from the SNRS vendor, Computer Identics Corporation. 14

FIREARMS

Model 870 Restyle

The Model 870 pump shotgun is being upgraded with new styling and mechanical features for 1985. Mechanical changes include the use of the Model 1100 barrel (long extension), Model 1100 sight line, and new magazine cap retention system. Specifications include 12 Gauge, 3" chamber only, medium gloss wood finish and cut checkering.

Five styling samples depicting options for new stock, fore-end, rib, and receiver contours have been assembled. These are currently undergoing Marketing evaluation.

Model 111/871 Shotgun Development

A new autoloading and slide action shotgun is being developed as a replacement for the Model 1100's and Model 870's, respectively. Objectives include decreased weight, increased reliability, and reduced manufacturing costs.

The design currently being developed involves the use of a novel rocker arm locking system, improved barrel contour, stainless steel magazine tube, orifice selector/choke tubes, and improved carrier latch system. Four samples will be completed by April 30 for preliminary design testing. Nine styling samples have been completed which depict options for stock and fore-end design, checkering pattern, and receiver/vent rib contours.

A design alternative being explored is the use of an aluminum receiver to achieve a weight reduction of approximately one pound. Prototype aluminum receivers have been successfully tested up to 10,000 Magnum rounds.

Parker Double Barrel Shotgun

Reintroduction of the classic Parker side-by-side shotgun is being considered. Arrangements are proceeding to complete one VH Grade 12 Gauge Parker by May 1983.

A partial set of drawings on a 20 Gauge Parker have been received. These drawings are undergoing engineering evaluation. Once the remaining drawings have been received, they will be cost estimated by Process Engineering.

Bolt Action Rifle Development

Two new rifles are included in the bolt action program to replace the Model 700 Classic and the BDL. The replacement for the Classic will be called the Model 700 Lightweight and is planned for 1985 introduction. The replacement for the BDL is currently scheduled for 1986 introduction. Both rifles will feature a stock designed by Bob Emmons and a lightweight barrel contour. The BDL replacement will include other distinctive styling changes, such as an octagonal receiver with integral scope mounts. Functional improvements to the BDL will include a rotary magazine box for more reliable feeding, fully enclosed claw type extractor for added strength, no bind-easy lift bolt for smoother action, receiver with heavier — integral recoil lug for added stability, a redundant safety switch, and a fully adjustable fire control that does not require removal from the stock.

One Model 700 Lightweight has been assembled for review with Marketing. Parts list and drawings have been completed with the exception of the stock which will be completed in June.

Model 7400/7600 Centerfire Rifles

Model guns illustrating the newest design options and preliminary economics for the .223 Carbine have been reviewed by Marketing. Agreement has been reached on the stock and fore-end design with the final barrel configuration yet to be determined. The stock and fore-end will reflect the present contour with a toned down finish and birch wood. Marketing feedback has shifted design emphasis from the 4 shot box to one with a ten-round capacity. Specifications for the preferred design include a magazine release on the box and no bolt release. Preliminary layouts have been completed and final drawings for two designs will be completed by June. Test rifles are being built to reflect the latest design opitons.

XP-100 in .223 and 7mm-08 Caliber

Marketing has requested the addition of the .223 and 7mm-08 hunting calibers to the XP 100 for 1984.

The Custom Shop is building prototype barreled actions in .308, .223, and 7mm-08 caliber using the Model Seven Lightweight barrel, which is required for these larger cartridges. XP-100 nylon stocks are being modified to take the Model Seven barrel contour. The .308 caliber prototypes will be used during April to test the strength of the modified stock. If satisfactory, the .223 and 7mm-08 calibers will be function and accuracy tested by early May. If a new stock is required, we will consider purchasing a fiberglass stock and redesigning the present stock.

Model 700 Classic in .338 Win. Mag. and 250-3000 Savage Calibers

Two calibers, .338 Win. Mag. and 250-3000 Savage, are being considered as the 1984 limited production offering in the Model 700 Classic rifle.

The .338 Magnum caliber will require a new barrel blank, mandrels, and gauges. Prototypes of the 250-3000 Savage, using a 10 in. twist barrel, will be completed in April. If accuracy testing is not satisfactory, new mandrels will be required and new models will be built. Estimates of cost to develop and produce both models are being prepared.

Model 870/1100 Waterfowl Shotguns in 12 Ga.

Marketing has requested a special Waterfowl shotgun in 12 Gauge with 3" Magnum vent rib barrel that will have rust resistant and non-reflective surfaces for introduction in 1984. A prototype will be ready by May 1st.

Model Seven Floor Plate and Stock Difficulties

When Trial and Pilot testing of the Model Seven in .308 caliber began, floor plate cover opening was encountered and several stocks cracked. Subsequent additional testing revealed that the same problem existed in the smaller calibers but to a lesser extent.

Heat treating the trigger guard combined with altering the rear mounting tab arrangement has eliminated all floor plate openings on the .243, 6mm, and .222 caliber rifles. The .308 and 7mm-08 still experienced an unsatisfactory 1-2% opening rate. We are making floor plate base and cover assemblies from thicker material and will have parts tested by May 1st in .308 caliber rifles.

A reinforcing screw was added to the stock and 75 stocks were endurance tested to 3,000 rounds each. All testing was done with .308 caliber rifles using cartridges with 175 grain and 200 grain bullets. One of the stocks developed a small crack, at 500 rounds, behind the recoil lug on the inside surface but it did not propagate to the outside surface of the stock. The rest of the stocks were satisfactory.

Testing and Certification of Magnetic Powder Metal Components

Magnetic pole pieces are used in matrix printers to form a character when an appropriate set of them are energized by signals from a computer. The speed of response and the impact force are important variables. In order to verify that a part is magnetically correct, a procedure has been established for measuring these variables.

A third production run of pole pieces was required because of poor magnetic properties. Preliminary investigation indicates that there are no cracks in the parts, which suggest that pressing techniques have improved. The problem may lie with improper sintering and annealing.

Work is continuing at the Experimental Station to improve the reproducibility of sintering Fe-Si magnetic alloys.

Wear Resistant Powder Metal Alloys

The objective of this program is to make wear resistant components by the powder metallurgy route. Several approaches are being followed.

410 stainless steel powder has been modified with additions of Mo, Ni, P, and C. A series of vacuum sintering experiments have produced the following encouraging results:

- transverse rupture stress - 130,000 psi
- hardness - R_C 48-52
- Shrinkage - .055 in/in

In a different application, various amounts of TiC and WC are added to Remington materials HD-1000 and HD-2108 to determine the effect on wear resistance. Initial testing indicates that the powders used were too fine. Additions of less than 10% WC were beneficial, but additions of TiC, at any level, deteriorated the mechanical properties.

AMMUNITION

Unibody Shotshell Process

"12 Gauge" large volume Semi-works bodies, machine headed and primed and hand loaded, successfully passed casualty tests in the 3" 1-7/8 oz. "Premier" load. A confirmation Assemble Head and Prime (AH&P) and machine loading and testing run is in progress.

"20 Gauge" product has been successfully run on the production machine. Design for a 3" body is complete. Evaluation will follow startup of the production body former in May.

"16 Gauge" machine headed, hand loaded product testing resulted in partial head cutoffs after storage at elevated temperatures. This problem is attributed to wad fit at a point coincident with the mouth of the cap in a loaded round. The length of taper in the shell wall will be shortened to relieve this wad fit problem.

"410 bore" product redesigned to produce a tapered wall shows good promise. The new body has 15% greater tensile strength than the standard SP product. Bent bodies are almost nonexistent. Further testing is in progress.

"Premier" Shotshell

Production non-magnum products with hard, Cu plated shot have passed all acceptance testing and are in the warehouse.

The magnum products are currently in various stages of development. They are, beginning with the heaviest payload:

- 12 Ga. 3" 1-7/8 oz. shot
- 12 Ga. 3" 1-5/8 oz. shot
- 12 Ga. 2-3/4" 1-1/2 oz. shot
- 20 Ga. 3" 1-1/4 oz. shot
- 20 Ga. 2-3/4" 1-1/8 oz. shot

The 1-7/8 oz. load will use the 3" large volume Rotary Cam body. A powder and heavy pellet primer have been identified that yield acceptable ballistics at test temperatures and process control limit extremes. An experimental AH&P and loading run is underway to confirm the shotshell body integrity and load ballistics. Similar efforts are planned for the 1-5/8 oz. load.

The 1-1/2 oz. load is an existing product with the exception of hard shot. Tests showed, however, that current primers were no longer

"Premier" Shotshell - Cont'd.

acceptable (very low, cold temperature pressures). The most significant effect appears to be low pellet weight primers that are unable to consistently ignite the slower burning magnum powders. Production and ARD have been working on a joint development effort to identify a powder/primer combination that yields acceptable ballistics. Several candidate powders have been identified with heavier pellet primers. Production has scheduled a machine loading for mid-April.

The 20 gauge 2-3/4" and 3" products have been demonstrated in hand loads only and are awaiting product from the rotary cam machine.

"Premier" Center Fire Ammunition

Remington plans to introduce "Premier" Center Fire products using purchased boattail bullets. Load development, bullet cannelluring, and bullet feeding are areas requiring development effort. Introduction of this product in selected loads is scheduled for 1984.

A prototype bullet groover was installed on a duplex loader and tested with the 270 Win. load. Using the 130 gr. PSPBT bullet and 4350 powder, an accuracy of 1.1" was obtained. Good bullet appearance was maintained and velocity, pressure, and bullet pull were within specification. Similar results had been obtained earlier with the 30-06 and 308 Win. cartridges using Sierra 165 gr. PSPBT bullets. Difficulties were encountered with the 6mm/243 bullet. Bulging on either side of the groove creates a gauging problem. Minimal grooving may be acceptable.

Marketing recently implied that Hornady boattail bullets are an acceptable substitute for the Sierra bullets presently being tested providing their accuracy in plant loaded rounds is comparable to Federal Premium. Hornady can supply cannelured bullets and these will be tested to evaluate the potential to eliminate Remington's need to cannelure at loading.

Shotshell Primer Basics

The objective of this program is to develop a shotshell primer which will equal or surpass competitive primers from a performance standpoint and to develop basic interrelationships between major variables in primer design.

An experimental run of primers with domed primer cups and quarter hard anvils, and charged with both 1024 and fuelless mixtures has been completed. Target loads were machine primed and loaded at Lonoke and are ready for testing.

Shotshell Primer Basics - Cont'd.

Testing of hand primed and hand loaded target rounds indicated the cleaner burning, less violent fuelless mix primers equalled Federal in sensitivity and were superior in piercing resistance while the 1024 charged primers had superior sensitivity and were approximately equal in piercing resistance. Experimental run primers exhibit substantially improved piercing performance when compared with the present Remington 117XA target load primers charged with 1024 mixture.

The fuelless mixture continues to show ignition and ballistic performance equal to 1024 mixture when charged to a pellet weight about 10% over the 1024 mixture.

ABC Primer

The ABC (integral anvil) battery cup has the potential of significantly reducing costs through automation and improving quality through assured anvil positioning.

Tooling to increase the flash hole area to reduce battery cup failures is being fabricated and is scheduled for delivery May 1st. New anvil point fluting tools and flash hole blanking tools are required.

Testing with fuelless mixture, which eliminates breech flash, shows a significant reduction in primer casualties when compared with 1024 mixture. Testing of mixtures produced with basic lead styphnate rather than our normal lead styphnate shows further reduction in casualties is possible.

Center Fire Modernization

The status of the Prototype Project has been thoroughly reviewed along with the projected business needs related to that endeavor. The Committee has formulated a strategy to implement those phases of the original project which are most beneficial to the immediate needs of our center fire operation. The criteria used to establish priorities for this strategy are:

- Maximum cash flow in the near future
- Product enhancements which generate higher sales

Work continues on the prototype machines as follows:

Bullet Assembly:

Wire feed system modifications have resulted in improved feed reliability, better lead weight control, and elimination of product appearance problems (stripes). Pre-lubricated and dried jackets have solved

Center Fire Modernization - Cont'd.

Bullet Assembly: - Cont'd.

the feeder problem which were experienced when using wet jackets. Equipment has been turned over for plant testing.

Jacket Draw:

Project work is complete. Performance monitoring will continue.

Header:

A mechanism has been added to keep the two streams of components separated for control purposes. The focus is now on getting this equipment qualified for production use.

Turret Trim/Headturn:

The turret trim and headturn machines were run uncoupled for 8 hours and achieved efficiencies of 79%. A decision was made to relocate the machines in closer proximity for the plant Trial and Pilot run and subsequent production operation.

Anneal/Taper/Anneal:

System checkout continues; with component handling, body anneal, and mouth anneal giving good initial results. Small quantities of shells were successfully processed through the entire system, including automatic lubrication. A continuous run should occur in April.

Loader:

The electrical/electronic installation checkout is complete. Means of installing a production and downtime monitor are being investigated. Mechanical checkout will begin as soon as installation is complete.

Progressive Shell Draw:

Development of 30-06 tooling is complete. Redesign of .357 Magnum tooling to the new Lonoke heavy-wall shell specification is in progress.

FIREARMS MODERNIZATION

Receiver Flexible Manufacturing System

To insure the rapid development of this manufacturing technology, management has approved Preliminary Design and Estimate (P&E) funding of $600M. The P&E scope includes the design and construction cost estimate for a prototype system project and authorizes the Engineering Department to order limiting hardware.

The prototype project scope will include a demonstration of all critical system technology including, the machine and fixturing, tooling and tool support, the inspection and material handling concepts and the computer communication system required to tie these components together. The prototype project is scheduled to be ready for authorization in April.

The Engineering Department has recently completed the CCE & VGA estimates for the prototype and production projects and presented the results for Remington review. Project economics will now be generated and presented to Remington management along with the current plans for prototype and production facility projects.

Wood Shop Flexible Manufacturing System

Conceptual long range modernization plans for the Wood Shop include a flexible machining system (FMS) for machining and sanding. Engineering work has been initiated to develop a CNC work station capable of carving stocks to closer tolerances. With closer carving tolerances it is anticipated stock sanding, which is presently done by hand, can also be performed on a CNC station.

The modernization study of the Wood Shop brought to light two cost reduction proposals that have been spun off into separate projects to provide earlier benefits.

1. CNC Long Stock Inletter

The Heian machine has been recently delivered and installed at Ilion. Two Heian technicians are currently assisting Remington with machine set-up and check-out. Machine accuracy will be confirmed before Trial and Pilot operations begin. Production is scheduled to begin on the M/7 stock in May.

Wood Shop Flexible Manufacturing System - Cont'd.

2. Rotary Bell Atomizers

Review of the wood finishing area indicated that an improvement would result by replacing the present Graco electrostatic spray system with one of the recently developed spray systems. Trials indicate that DeVilbiss rotary bell atomizers for electrostatic spraying would reduce material usage over 40% and increase the finish quality.

Quality problems discovered in the initial Trial & Pilot testing of the DeVilbiss atomizers have forced production to continue using the old Graco guns. G. E. Mulhern and J. G. Kreuer, Du Pont Service Representatives, were on plant 3/8-9 to assist in implementing a testing program. A possible cause for the quality problems was discovered and additional testing has been planned in April to confirm the results. In addition, DeVilbiss Engineers and Service Representatives have been contacted to correct minor problems discovered in the atomizer controls.

Automatic Breech Bolt and Fire Control Assembly

The current shotgun breech bolt assembly process is entirely manual and requires six full time operators to meet production volumes. Remington and EDL have developed a flexible assembly concept based on a robot assisted process. The system will be primarily a programmable robot working with various assembly worktables.

The following assemblies have been selected for inclusion in the initial system; shotgun breech bolt, common trigger, M/700-7 trigger housing, and shotgun carrier.

EDL is currently fabricating prototype assembly stations for economic and technical evaluation. Preliminary testing is scheduled to begin in April.

Ultraviolet Wood Finishing

We are investigating the feasibility of utilizing ultraviolet finishing on all wood products. Ultraviolet finishing is a process in which a specially formulated, high solids finish is sprayed on the wood and cures completely in approximately 30 seconds when exposed to ultraviolet light. Since no hazardous solvents are required for curing, this special finish can be applied much thicker (up to 3X) than our current finishes. This process has been successfully utilized in Europe in the furniture industry for several years but has only recently been introduced in the U. S.

Ultraviolet Wood Finishing - Cont'd.

The main area of conern is the high toxicity of the U. V. finish and whether such a finish could be safely adopted by Remington.

Recent tests conducted at the vendor's facility were favorable utilizing both urethane and polyester finishes. Additional testing is being scheduled in May to continue process development, determine the economic potential, and address the toxicity question.

Potential production applications for the process include; automating the current manual stock fill and pad area by spraying high solids urethanes, one coat spraying of press form stocks, streamlining the current stock repair process for open grain and pit problems and finally base and top coating of all wood products.

Bob Vest of Marshall Laboratory was contacted for assistance in improving Remington's wood finishing processes. Dr. Vest reminded Remington that Du Pont had gone out of the wood finishing business several years ago but he would canvass Marshall Lab for any wood experience and review the possibilities of providing technical assistance.

Serial Number Recording System - Phase II

The Serial Number Recording System (SNRS) is a computerized data collecting and storage system. It uses bar coding technology to efficiently and accurately collect production totals. It has been in operation at the Ilion plant since early 1981.

SNRS - Phase II will expand the current system to include shipping and inventory control. Benefits will include automatic data collection and processing, improved inventory control, and greater shipping record accuracy.

The SNRS - Phase II project was approved in January. Detailed system performance specifications are currently being prepared with plant assistance to insure optimum production compatibility. Upon completion, Purchasing will request a requote from the SNRS vendor, Computer Identics Corporation.

Equipment delivery and software engineering is expected to require approximately five months after the order is placed. System installation is schedule for 4Q'83 with a full system start-up in 1Q'84.

RESEARCH PERSONNEL

REMINGTON ROLL

	Actual 2-28-83	Actual 3-31-83	Forecast 12-31-83
Exempt			
Ammunition Research	17	17	16
Firearms Research	39	39	40
Firearms Modernization	7	7	9
Other	1	1	1
Total Exempt	64	64	66
Nonexempt			
Ammunition Research	12	12	12
Firearms Research	11	12	11
Firearms Modernization	1	1	1
ER&DD	1	1	1
Other	1	1	1
Total Nonexempt	26	27	26
Wage Roll			
Firearms Research	19	19	19
Firearms Modernization	2	2	2
Total Wage Roll	21	21	21
Total Research Department	111	112	113