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REMINGTON ARMS COMPANY
RESEARCH DEPARTMENT
THIRD QUARTER PROGRESS REPORT - 1981
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HIGHLIGHTS

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• Experimental runs of new unibody 12 gauge shotshell process product made on the production prototype machine and 20 gauge Semi-works product have been successfully headed and primed on plant equipment.	1
Installation of the Bridgeport production system is on schedule for fourth quarter 1981 start-up.	
• A primer basics program has been outlined aimed at optimizing primer performance.	3
• Four shotshell samples including 12, 16, 20 gauge and .410 bore have been loaded using two variations of the integral anvil battery cup primer. Ballistics and normal gun function and casualty results were satisfactory for each sample. Research is working with Production and Marketing to identify a specific product and quantity to be loaded as part of the unannounced introduction program.	3
• An extended range shotshell informational project is scheduled for submission in October to define objectives, responsibilities, preliminary economics, etc.	4
• A sample of the extended range center fire ammunition has been experimentally loaded and evaluated for down-range ballistics. Satisfactory results were obtained for this 30-06 Spfd cartridge using Sierra 160 grain Spitzer boat-tail bullets and a new powder: HRP-85, formulated by Hercules.	5
• A satisfactory experimental run of TLX priming mixture in rim fire shells was completed; preparations are being made for a Trial and Pilot run.	5
• A reduction in velocity in the "Viper" ("Scorpion") rim fire product from 1440 fps to 1410 fps allows use of a standard powder. An experimental run is to be made by October 1.	5

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AMMUNITION

New Unibody Shotshell Process

The new unibody shotshell process is being developed to overcome the inherent disadvantages of the present RXP® process. The unibody construction will be extended to all gauges, and gives Remington the opportunity to have a single process for all shotshell bodies.

The Bridgeport plant and Research successfully processed 30,000 of the 250,000 12 gauge bodies made on the Production prototype machine in Wilmington through a Triplex assemble, head and prime machine. No problems were encountered and all specifications were met. A Trial and Pilot run on the Bridgeport body former is scheduled for November. Upon installation of the Rotary Cam machine in Bridgeport, product is expected to be even better due to improved punch cooling and heatset temperature control.

The practicality of a deep skive, which substantially increases the reloading life of the new unibody, has been demonstrated on Production equipment with over one million skived without any machine problems.

Semi-works product of both 20 gauge lengths were successfully headed and primed on a Production Simplex assemble, head and prime machine. Both target and high base caps were used. Subsequent loading of high base S Mag loads on the PETERS® loader was only partially successful due to a high incidence of misfolded crimps. The cause is felt to be misalignment of the star crimp station on the loader possibly aggravated by the deep skive experimental tooling. Load fit and ballistics were acceptable, and another loading will be attempted, probably on a Simplex loader.

Continuing development on 8 gauge has presented more of a challenge than anticipated. A balance between primer bore, rim fill, wall thickness, and work ratio has caused more iterations in tooling than anticipated. Outside shell body diameter has been increased to accommodate the needed balance. An experimental run on Semi-works equipment is scheduled for October.

Preliminary tooling for 28 gauge on Semi-works equipment is 95% complete. Shop and machine change parts for all subsequent gauges have been specified.

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Body Shotshell Process (Cont'd.)

The full-scale prototype production equipment system, capable of producing one-piece shotshell bodies in all gauges at a rate of 960 parts per minute, has been successfully tested for overall functionality at ETL. Equipment has been delivered to the Bridgeport plant with installation scheduled for completion by the end of October. Initial production of 12 gauge is expected in fourth quarter, 1981.

Process and Body Cut-off Study

DuPont and ETL is investigating two areas of resolving body cut-off problem. The first area is to determine if internal heat treating of the shell can be reduced to a proper process. Samples of shells treated by various techniques have been submitted for evaluation.

The second area of work is to determine the cause of fish-tail and develop methods of minimizing their frequency. The result will be reduced scrap but it would allow an increase in work ratio which would improve the body cut-off percentage. Using Energy Dispersive X-ray Analysis, ETL determined that shells contain chlorine and/or silicon and these elements were found in the surrounding material. Bridgeport PE&C's analysis of residue on a filter screen cleaned at Berringer by pyrolysis also indicates a high level of silicon. The source of this element is residual catalyst in the surrounding material. The particles in the shell containing the residue are in excess of 50 μ in size and probably can be filtered out and it appears that some are being filtered out currently. According to ETL our filter should be able to trap 100 μ particles. Finer filtration will be evaluated. It may require cartridge area filters or continuous screen filtration to make it acceptable.

Dimensional uniformity is an additional area of exploration. ETL has noticed non-uniform extrudate emerging from their extruder rheometer at shear rates lower than our processing rates. This is at rates substantially lower than the critical shear rates at which stick-slip flows occur. It is unknown if this same dimensional non-uniformity is occurring in our process but tests will be attempted to determine this.

It appears that much of the "surging" that is visible is occurring after the extrudate leaves the extrusion die. It is impossible to tell at this time how much the extruder is contributing to how much is occurring downstream. More complete investigation and testing will be required to determine the contribution of each.

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Polymer Process and Body Cut-off Study (Cont'd.)

The program has not been completely defined yet but should be shortly when more information is available from DuPont. Bridgeport's experience with the Panametrics wall thickness control may also influence the program direction.

Primer Basics

A program has been developed at Bridgeport Research to improve our understanding of the mode of failure of shotshell primers. The program has been divided into two major sections; the three-piece primer (such as the 117XA) and the ABC primer. In the three-piece primer section of the program the major areas of work are:

- Analysis of the Federal #209 primer and preparation of a Technical Data Package that would allow us to produce a duplicate of this primer, if desired. Major elements of the duplication effort would include anvil thickness and material, primer cup grain size and profile, battery cup flash hole diameter, priming mixture ingredients and percentage of ingredients used. A substantial portion of this package is complete.
- Continue to define the parameters required to produce a Remington primer which will be fully competitive from the standpoint of performance. This will include such items as definition of materials including anvil metal that will not require annealing, evaluation of thicker anvil metal, optimum primer cup characteristics, analysis of process tolerances and priming mixture variations and their effect on performance, and a better understanding of the primer piercing mechanism which should lead to improved quality control testing. Similar effort will occur with the ABC primer.

The Primer Basics program has been scheduled on a PERT-type network. This network will be a working plan subject to change and because of this, it will be computerized to assist in making modifications to the program and assist in tracking our performance.

Integral Anvil Battery Cup

The objective of this program is to develop an integral anvil battery cup to reduce primer manufacturing costs, improve consistency of primer quality and provide greater opportunity for process automation. The ABC-202 primer which contains .92 grains

Integral Anvil Battery Cup (Cont'd.)

of 5074 mix was loaded into 12, 16, and 20 gauge product and satisfactorily tested. The ABC-1108 primer which contains .73 grains of 5074 mix was loaded into .410 bore product and satisfactorily tested. A report summarizing the test results at Bridgeport and Lonoke has been written and forwarded to management for review. Ilion gallery testing with the 12 gauge product is continuing; zero misfires from over 55,000 rounds to date.

Future plans include production start-up of the press and die for making promotional load primers on a limited basis beginning in late September. Primer design will be refined through the Primer Basics project in order to achieve target level performance.

Asbestos Elimination

The objective of this program is to eliminate the dry molded asbestos basewad from Remington's shotshell products by conversion to a high density polyethylene component. At the Bridgeport plant, all gauges with the exception of 8, 10, and 12 gauge 3", have been converted and are in production.

A modification to the plant "Versa cutter" machine has now reduced cut slug skewness and length variability and after earlier problems which delayed the planned AH&P run in July, new extruder processing techniques have appeared to improve the large wall thickness variability. Approximately 30,000 special caps with primer prongs and an equal number of cut slugs are now on hand for an upcoming run on the Simplex AH&P to establish the required slug tolerances.

Extended Range Shotshell

Marketing has proposed that basically all shotshell products except target and promotional loads be modified and become the extended range line. Basically the changes will require plated shot in all loads, fluff in all Magnum loads, and harder shot in all Express loads and most field loads. The performance criteria must be established by Marketing.

Economics have been requested from both plants and are required for informational and construction projects which are scheduled for submission in October and December respectively. The primary technical questions to be resolved are developing the most economical method of plating shot, developing the most economical method of obtaining hard shot in larger shot sizes, developing methods of fluff charging small shot sizes and developing a primer for the 1-7/8 Magnum load which will use fluff.

Extended Range Center Fire Ammunition

An extended range concept has been developed for center fire rifle ammunition products which should increase the customer's perceived value of Remington products. Eight popular cartridges are to be introduced containing boattail bullets.

The 30-06 Spfd 160 grain PSPBT experimental loading run has been very beneficial. Feeding problems with boattail bullets were identified and are being resolved. Problems in obtaining the proper bullet pull specification were also identified and several solution alternatives are under evaluation. The finished cartridges loaded with HRP-85 powder performed as well as the Federal Premium sample in both accuracy and down-range ballistics.

Hercules has identified four other powder formulations for these extended range cartridges and efforts are in progress toward their evaluation.

TLX Priming Mixture Process Evaluation

Two experimental runs of TLX mixture were made and charged in the rimfire operation at Bridgeport using NEDOX® coated charging plates and conventional knockout punches (NEDOX is a proprietary coating of nickel and TEFLON® for improved wear and slip characteristics). The NEDOX coated plates appear to improve charging, however six out of seven charging machines ran well with TLX using regular (uncoated) plates. Preparations are presently underway to perform an extensive Trial and Pilot run of TLX primed rimfire product.

"Viper" (Previously "Scorpion") Rimfire Cartridge

The objective of this program is to develop a solid point truncated cone, high performance rimfire cartridge.

The major development involves definition of a powder which will develop the desired ballistics and be compatible with the rimfire autoloaders. Due to continuing problems associated with consistently meeting the 1440 fps goal velocity at acceptable pressure levels, Marketing has agreed to lower the goal velocity to 1410 fps which should be attainable on a day-to-day production basis using DuPont 8159 powder.

An experimental production run is planned for late September and the following specifications will apply.

Shell	-- standard long with "u" headstamp
Powder	-- DuPont 8159
Bullet	-- 36 grain, solid nose, truncated cone copper-plate, single knurl, standard lead knife and crimp
Velocity	-- 1380 ± 47 fps control
Accuracy	-- 2.72" @ 100' 5-10 shot groups

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"Viper" Rimfire Cartridge (Cont'd.)

Meanwhile, Hercules has expressed a desire to continue work on a high performance powder for both the "Yellow Jacket" and "Viper" loads.

357 Remington Maximum 158 Grain SJHP

Ruger has elected to stretch the revolver cylinder an additional 0.2 inches for a total extension of 0.4 inches over the current 357 Magnum cylinder. Limited testing of this effect on the cartridge indicates it can be safely loaded to 50,000 psi with Hercules 2400 powder and will have a vented test barrel muzzle velocity of at least 1700 feet per second.

This change requires fabrication of new test barrels, in progress, and relocation of the cannellure on current .357 caliber 158 grain bullets by either .100 or .200 inches.

Options include leaving the case as is and loading with a bullet having the cannellure relocated .200 inches versus extending the case by 0.100 inches and loading with a bullet having the cannellure relocated .100 inches. The final alternative will be selected based on ballistics, appearance, creep and telescope data.

7mm Bench Rest Remington Case

A satisfactory Final Test Report has been issued by Bridgeport Technical Services for this new case. Lonoke PE&C has completed their Trial and Pilot run. Several tooling modifications were identified and new tools for taper are due in late September.

The Technical Data Package including all tool, gage, and process data has been delivered to Production. Shells for the initial warehouse run are in the draw line. Research will continue to provide assistance on this first run as required.

7mm 140 Grain PSPCL Bullet

A successful experimental assembly run for this bullet, which has a slender nose profile to enhance downrange ballistics, has been conducted. Accuracy and mushroom performance were satisfactory for the 7mm-08 load. An experimental loading run has been scheduled to produce samples for product acceptance testing by Technical Services.

357 Magnum 125 Grain JSP

Components and tools have been made available to Production for an experimental bullet assembly run. It will be conducted during October.

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Center Fire Product Line Simplification

Marketing suggested that the 117 grain bullet for 257 Roberts be discontinued as a single use item. Replacement with two cartridges, 257 Roberts 87 grain PLHP and 100 grain PSPCL, has been proposed. Ballistics and accuracy for the proposed cartridges were excellent, however, overall loaded cartridge length is a problem because of current cannellure location. Research will document their results and forward the information to Marketing and Production for resolution.

1981 Grand American Study

Pressure-time curves were made for this product using an oscilloscope and UR transducer. Comparing these curves with similar data from other shotshell samples indicates the 1981 Grand American product has excessive pressure variations. Preliminary analysis indicates the primers produced higher than normally experienced pressures upon detonation. Further studies are being made to determine what steps should be taken to fine-tune the ignition system for minimum pressure variation.

Automatic 8 Gauge Packer

A new automatic 8 gauge packer has been developed to replace the current hand-packing operation. Operational testing of the plant equipment has been completed and a rate of 160/minute was demonstrated. Plant installation, scheduled to begin in mid-October, will couple the packer with the duplex loader recently converted to 8 gauge loading. The new 8 gauge production equipment should be in production by year-end.

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STATUS: PRODUCT AND PROCESS DEVELOPMENT

21MM Seismic

An electrically fired cartridge, designated as the 21MM Seismic Shell, has been developed for MAPCO for use in seismographic exploration work. The shell requires an electric primer which is being developed and produced at Bridgeport, and a compatible gun and firing system designed at Ilion.

The third quarter production commitments of 50,000 rounds per month were met using Research produced components and dry assemblies. About 400,000 rounds have been produced to date, and 24,000 rounds are currently in the warehouse. It is planned to produce 250,000 loaded rounds in January on production equipment now in start-up. The charging booth was converted to assemble the button, insulator and primer cup; and 170,000 of these assemblies were produced. Design rate of 50,000 assemblies per shift was achieved.

Hob Industries is behind schedule in producing sample components due to the interference of their other production demands. If no substantial progress is shown in their effort by January 1, termination of their contract will be considered. Initial investigation indicates that components can be fabricated on existing plant equipment with new die sets and tooling. Design and fabrication times of the die sets and tooling will be determined prior to any decision to terminate Hob. Sufficient components to meet first quarter 1981 requirements have been produced on research equipment and are on hand.

Shotshell Load and Pack Optimization - Bridgeport Plant

A program to upgrade and optimize the Bridgeport Plant's shotshell load and pack equipment systems is in progress. The scope of work includes the conversion and upgrading of loading machines and packers for added operating flexibility and improved equipment performance. All engineering development and design work is nearing completion. Full program implementation is scheduled for third quarter, 1981.

30 Cal. ACCELERATOR®

Due to excessive sprue lengths on molded polycarbonate sabots, the use of LEXAN® 141 is being considered as a direct replacement for LEXAN® 191. During an experimental molding run at the vendor's plant, this polyethylene-free material totally eliminated the long sprues on molded product. To determine the compatibility of this resin with the single base powder (DuPont 4198) used in the ACCELERATOR® products, testing after severe

30 Cal. ACCELERATOR® (Cont'd.)

environmental storage was conducted. The most recent series of tests which were completed after a six month, 150°F storage period have indicated no detectable degradation of the LEXAN® 141 resin based on test firing and inspection of recovered sabots. Flexure tests of loose sabots stored directly in contact with the 4198 powder at the elevated temperature also showed acceptable results. A series of accuracy tests will be conducted with test and control ammunition stored under severe conditions, and based on those results, recommendations concerning the material change will be developed.

7mm Bench Rest Remington Case

An experimental run to produce the case was completed. Taper-trim of 30,000 cases was accomplished with 15% scrap rate versus 50% predicted. Nine new tools, five new gauges, and a new mouth anneal screw are required for production of this case. A comprehensive product evaluation program has been defined and responsibilities have been assigned. Goal date for completion of all testing and documentation is February, 1981.

7mm Mauser 140 Grain PSP

A second experimental run was conducted to verify that specified pressure and velocity levels could be met. Production start-up for this cartridge is being delayed until pressure reading differences between Process Engineering and Research can be resolved.

7mm 140 Grain PSP Bullet

Upon receipt of the forming dies, experiments were conducted on laboratory equipment to develop proper jacket and core sizes. Ten thousand cores and jackets were subsequently made on production equipment, and Production has been requested to provide machine time to conduct an experimental assembly run.

357 Rem Max 158 Grain SJHP

A case for this cartridge has been developed. It is made in a three-draw process and does not require a stress relief anneal. The case which has a thicker wall construction in the head and body than the standard 357 Magnum product has not split when fired in a handgun at proof pressure. Production has been requested to conduct an experimental loading run. The resulting product will be tested for creep and accuracy in handguns in addition to the normal tests, and a quantity will be made available for Ruger evaluation.

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"Scorpion" Rim Fire Cartridge

Ballistic results from an experimental autoloader run of the "Scorpion" rim fire cartridge indicated that average velocity, using DuPont 8159 propellant, was approximately 30 feet per second below the 1440 ft/sec goal. DuPont, Hercules and Olin were contacted in an attempt to identify a powder with improved ballistic properties. Hercules has agreed to forward three experimental samples of rim fire propellants for preliminary handloading tests. Because of requests by Remington and other rim fire cartridge manufacturers, Hercules is making a concerted effort to increase the efficiency of their rim fire propellants. To date, no propellant samples have been received from DuPont although they have agreed to forward a modified version of 8159. Olin has no propellant available that would be compatible with our high speed equipment. Product evaluation tests on available powders will be conducted in January, 1981.

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