

HIGHLIGHTS

FIREARMS

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- Two 3" Magnum XSG shotguns have been endurance tested to 10,000 rounds with no major parts breakage. 6
- Research continues to work with Production and vendors to reduce gallery rejects with the M/7400-7600 center fire rifles. Recent 30-06 and .308 caliber gallery rates have been below 5% 6
- A total of 57 seismic guns have been shipped against MAPCO's purchase order. 7
- Model 870 Competition Trap shotgun receivers with a small crack at the rear of the ejection port have been found in the field. Testing indicates maximum bolt receiver tolerances and holding back on the fore-end during shooting causes the highest stresses in the receivers. 9
- Upgraded Model 700 ADL/BDL's and an A grade model have been delivered to Marketing for review. Non-formed, no bind followers and scope mount ring final design and testing will be completed in January 1982. 8
- A production trial and pilot of the ASEA manipulator 10 is in process with the robot rough polishing approximately 80 - M/7400 receivers a day.
- A quote has been received for a thermal extraction 11 system for injection molding powder metals. A Plans and Estimates work order is being prepared to authorize purchase of the system prior to project approval.

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September 1981

REMINGTON ARMS COMPANY
RESEARCH AND DEVELOPMENT

THIRD QUARTER PROGRESS REPORT - 1981

AMMUNITION

New Shotshell Unibody Process

A new high-productivity process for producing one-piece plastic shotshell bodies is in the final stages of check out. The full-scale production equipment system, capable of producing one-piece shotshell bodies in all gauges at a rate of 960 parts per minute, has been checked out and function tested successfully at EDL. The equipment has been delivered to the Bridgeport plant with installation scheduled for completion at the end of October. Initial production of 12 gauge bodies is expected in fourth quarter, 1981.

30,000 of the 250,000 12 gauge bodies produced during the function trials at EDL have been successfully processed through a triplex assemble, head and prime machine. No problems were encountered, and all product specifications were satisfied.

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.

20 gauge bodies produced on the semiworks unibody process 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 judged 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 scheduled.

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 semiworks equipment is scheduled in October.

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Polymer Process and Shotshell Reloading Life

With the assistance of ETL, we are exploring two approaches to improved reloading life of our shotshells. The first approach seeks a practical production process for heat treating the internal plastic surface of a shotshell. Heat treatment is known to produce an amorphous skin which is resistant to crack propagation and subsequent separation of the shell wall.

The second approach is to determine the cause of contamination (fish eyes) and develop methods of minimizing its frequency. One obvious result will be reduced scrap. More importantly, reduced contamination would allow increased orientation of plastic, and therefore a higher strength body which would be more resistant to failure.

Using Energy Dispersive X-ray Analysis, ETL determined that fisheyes contain chlorine and/or silicon and these elements are not found in the surrounding material. Bridgeport's analysis of residue on a filter screen cleaned at Berringer by probable source of this element is residual catalyst in the virgin material. The particles in the shell containing the silicon are in excess of 50 μ in size and probably can be filtered out. 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 extended area filters or continuous screen filtration to make it practical.

Dimensional uniformity is an additional area of exploration. ETL has noticed non-uniform extrudate emerging from their capillary 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 whether this same dimensional non-uniformity is occurring in our pipe but tests will be attempted to determine this.

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

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 as 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 of 5074 mix was loaded into 12, 16, and 20 gauge product and satisfactory 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 published. Ilion gallery testing with the 12 gauge product is continuing with 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.

Extended Range Shotshell

Marketing has proposed a line of shotshell products featuring plated shot in all loads, fluff in all Magnum loads, and harder shot in all Express loads and most field loads. The product line would be marketed with advertising emphasis on the "Extended Range" performance of the line.

Extended Range Shotshell - Cont'd

The primary technical questions to be resolved are: The most economical method of plating shot, the most economical method of obtaining hard shot in larger shot sizes, methods of fluff charging small shot sizes and a primer for the 1-7/8 magnum load.

Production has been requested to provide cost information for a project to be submitted in the 4Q.

Extended Range Center Fire Ammunition

Similarly marketing has proposed a line of eight popular center fire ammunition products featuring boattail bullets for superior accuracy in an "Extended Range" line.

The 30-06 caliber loading run using a Sierra 160 grain Spitzer boattail bullet has been 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 rim fire 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 rim fire product.

"Viper" (Previously "Scorpion") Rim Fire Cartridge

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

The major development involves definition of a powder which will develop the desired ballistics and be compatible with the rim fire 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 Du Pont 8159 powder.

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"Viper" (Previously "Scorpion") Rim Fire Cartridge - Cont'd

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

Shell - standard long with "U" headstamp
Powder - Du Pont 8159
Bullet - 36 grain, solid nose, truncated cone
copper plate, single knurl, standard lead
knife and crimp
Velocity-1380 \pm 47 fps control
Accuracy-2.72" @ 10C' 5-10 shot groups

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.

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 per 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.

FIREARMS

XSG/XPG Shotguns

Two 3" Magnum XSG shotguns have been endurance tested to 10,000 rounds with no major parts breakage. Four M/1100 control samples failed at 2,850; 3,000; 5,385; and 6,600 rounds respectively. Endurance testing of the XSG's is continuing.

Component parts for the twenty-five model guns scheduled for assembly in November are 40% complete.

Fabrication of components for an XSG pump shotgun has been started and is 30% complete. Latches similar to the M/870 are designed and will be ordered.

One XSG having the new design feed system has been assembled and function tested. This system is scheduled for endurance testing. Development work is continuing.

A prototype gun with the pressure vent gas system has functioned reliably on light target loads and 3" Magnum loads with satisfactory bolt velocities. Other models are being made. Alternate designs and combinations of action springs, spring preloads, and orifice sizes are being evaluated.

A variety of styling combinations are being prepared for evaluation.

Model 7400 Autoloading and Model 7600 Slide Action Center Fire Rifles

Research continues to work with Production and vendors to reduce gallery rejects. Recent 30-06 and .308 caliber gallery rates have been below 5%.

One magazine box gauge has been delivered to the vendor. A vendor's sample of magazines to the gauge is expected by December 30. A companion gauge is being used by Production to check and modify boxes in the current inventory.

A second field test of eight 25-06 and eight 7mm-08 caliber rifles is scheduled. Drawings are being prepared for estimating and transmittal.

Ten M/7400's in the .223 caliber will be assembled by October 30 for testing (minus magazine boxes). Magazine box components (5 shot) are on order and are expected by November 30.

Aluminum M/7400 receivers are being processed and should be assembled into rifles by October 30.

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Bolt Action Carbine

A short, lightweight centerfire rifle (carbine) is being developed to replace the discontinued Model 600.

Field test stocks have been received from Fajen. They have been finished with Model III and are now being checkered. Caliber 7mm-08 actions have been completed. Eleven field test models will be assembled, proofed, and tested in October. Five field test models with the improved metal finish on the barrel, receiver, bolt handle, bolt plug, trigger guard, and floor plate will be completed in November.

One model of the latest design and finish has been shown to Marketing for review.

We have requested costs for sample stamped followers that will have the no-bind feature. Present lead time is six months.

Model 979 Seismic Gun

The seismic gun is an adaptation of the Remington kiln gun. Development of the gun, which is used in geological studies, has been a joint venture by Firearms Research, Ammunition Research, and MAPCO. All guns produced to date have been converted kiln guns, with Ilion replacing the conventional breech block with an electrically actuated design for simultaneous firing of multiple guns.

MAPCO has ordered 87 guns to be shipped in 1981. A total of 57 guns have been shipped against that order, and 20 additional guns are in process.

A draft of the operator's manual is awaiting approval by Marketing.

1982 Model 870 and 1100 Ducks Unlimited Shotguns

This will be the second year of a four year program that started in 1981.

Model requirements have been defined and prototype models have been built and furnished to Marketing for review. Prints have been furnished to Process Engineering for cost estimating.

The prototype models include:

- Model 870-12 Ga. 3" Magnum Commemorative Dinner Shotgun
- Model 1100- 28 Ga. Special Dinner Shotgun
- Model 870 - 12 Ga. 3" Magnum Trade Shotgun

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1982 Model 870 and 1100 Ducks Unlimited Shotguns - Cont'd

The Trade gun requires a 32" barrel. Production will provide barrels in October for checking point of impact.

The Commemorative and Special Dinner shotguns are scheduled for warehousing in June 1982, and the Trade shotgun is scheduled for warehousing in December 1982.

Model 870 Ohio State Highway Patrol Anniversary Shotgun

The Ohio State Highway Patrol has requested 1171 Model 870 shotguns with a special rollmark on the receiver for their 50 year anniversary in 1983.

Research purchased a marking roll to see if a two level rollmark would be acceptable. Production samples were satisfactory. A complete gun with rollmarked receiver was accepted by the July Operations Committee. Warehousing of the model is scheduled for December 1981.

Model 700 Upgrade

The Model 700 is Remington's top-of-the-line bolt action center fire rifle. Marketing has developed a new bolt action strategy to meet increasing competition that calls for upgrading the Model 700 ADL and BDL for introduction in 1983, and the addition of an A grade in 1984.

Marketing has defined requirements. Research and Process Engineering have produced an ADL, BDL, and an A model for review. Five more ADL and BDL models each will be ready by the middle of October for a Marketing panel review.

Machined powder metal followers with a no-bind feature will be ready for testing the first week of October. All the calibers in the line must be thoroughly tested with the new follower for feeding malfunctions. Final design and testing will be completed by January 1982.

A one piece scope mount and ring, to be packaged with the rifle is being tested. Additional models are being built for more detailed testing. Final design and testing will be completed in January 1982.

Model 552-572 Bolt Action Rifles with M/870 Pressed Stock and Fore-end

The Model 552-572 BDL stocks are hand sanded with pressed checkering. A proposal was made to use the Model 870 press formed stock in place of the sanded stock as a cost reduction.

Sample guns were presented to Marketing for review. They requested a change in the grip cap and a new checkering pattern on the fore-end. Models have been furnished to Marketing, with these changes, for their review.

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Model 552 Long Rifle Only

Riveted deflectors were pull tested and failed at 80% higher load than current deflectors. The current deflectors showed a tendency to fail catastrophically, coming off completely, while the riveted deflectors remained attached even after the load had peaked.

Pull testing and live fire testing with prototype rivets will be conducted after acquiring these rivets.

The results of function and bolt velocity testing shows that reliable functioning requires terminal bolt velocities higher than 100 inches per second.

The bolt velocity and function tests were conducted using a variety of ammunition, action bar masses, and action spring constants.

Changing only the action spring to the new design produced 80% non-function of 22 longs and 100% non-function of 22 shorts. This modification made the action very difficult to cycle by hand.

Increasing the action bar mass prevented functioning of 22 shorts and 22 longs, without causing problems with 22 long rifles.

Gauging of ejector and extractor clearance cuts was corrected in August. All guns that have blown cases since that time have had the fault traced to a missing machining operation.

Investigation into required web thickness left by the clearance cuts is continuing. A package of information pertinent to this is being prepared to be sent to Wilmington for finite element stress analysis. The package will contain information pertinent to determining stresses in the webs.

Model 870 Competition Trap Shotgun

Model 870 CT receivers with small cracks at the rear of the ejection port were reported at the 1981 Grand American Trap Shoot.

In subsequent tests at Ilion, results of strain gauge and stress coat measurements indicated that shooting the gun while holding the fore-end to the rear (which is frequently done) combined with maximum bolt - receiver clearance causes the highest stress on the receiver at the rear of the ejection port. Further testing also revealed that use of a buffer material (shim) between the bolt and the back of the receiver decreased strain in the port area by 30%.

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Model 870 Competition Trap Shotgun - Cont'd

Competition Trap barrels and receivers are being modified to lengthen the barrel extension and add a support surface in the receiver. In addition, the bolt designed is being revised to add a buffer. These assemblies will be ready for testing in October. At that time, a decision will be made on corrective measures for long and/or short term solutions to the problem.

ASEA Manipulator

Rifle and shotgun receivers are rough and finish polished by a labor intensive hand process. Project RXI-63 was approved to purchase an ASEA IRb-6 programmable manipulator, and develop it to replace the manual polishing.

Testing in Research has shown that the IRb-6 is at least capable of rough polishing the M/7400 receiver, and may be capable of finish polishing provided some changes are made to the peripheral equipment and prior processing.

A production trial and pilot was started on September 16. The IRb-6 is rough polishing approximately 80 - M/7400 receivers a day. A research engineer is supervising the trial and pilot and is coordinating the efforts of Production, PE&C, and Industrial Engineering to determine the effectiveness of the robot under production conditions. Pending a successful trial and pilot, which should be concluded on October 9, the IRb-6 will be turned over to Production, along with recommendations for extending its use to other rectangular receivers.

Torlon Piston Seal

A new stainless steel stamped piston and high temperature plastic piston seal are being investigated for autoloading shotguns. Implementation of this design into the M/1100 will result in a \$100M annual savings. In addition to the cost improvement, a reduction in gas system corrosion is expected.

Functional testing with the new piston and piston seal has shown the new design to be adequate. Endurance tests with machined Torlon seals went 14,000 rounds before seal breakage occurred. Endurance test, conducted in August, with molded seals were unsatisfactory because of premature failure off all seals tested, at the knit line, opposite the gate. The vendor is in the process of changing the mold to provide a slug well opposite the gate to strengthen the knit line. New samples should be available for testing by October 16.

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Machine Loading Robot System

A system has been proposed for automating existing machine lines, which equips each machine with a pick-and-place mechanism and sufficient storage capacity to make the line operate like a non-synchronous transfer system. It is estimated that, when fully implemented in the Ilion Plant, 10% of the production wage roll work force can be eliminated by these systems, with a resultant manpower savings of over \$3MM.

The designs of the two manipulators required, one each for vertical and horizontal loading applications, are complete, and a project was written in early July to provide funds for a prototype. An engineering estimate for the first phase of implementation (M/7400 breech bolts and bolt carriers) has been forwarded to Industrial Engineering for evaluation.

Further work on this project has been halted pending management review.

Automatic Sanding

White-wood sanding of stocks and fore-ends is a costly, labor intensive process. Also repeatability, from operator to operator, and stock to stock, varies considerably. During the first quarter of 1981, engineers from the Du Pont Engineering Department and Ilion Research undertook a joint development program to build an automatic sanding machine capable of sanding any stock or fore-end, through and including a complex thumb-hole design.

Firearms Research has funded the Engineering Department to build a prototype machine, patterned after the N/C stock checkering machines, and to purchase and interface and HP-85 desk top computer. A preliminary demonstration of the prototype was made in August, using a Model Four fore-end. Additional work has been done since that demonstration to complete the computer software and develop sanding tools.

Futher work on this project has been halted pending management review.

Injection Mold Powder Metals and Ceramics

Manufacturing parts from near net-shape blanks can provide a significant savings in material and labor costs. Conventional processes such as forging and investment casting produce blanks that are fairly expensive and still require some secondary operations. Conventional powder metallurgy will provide blanks of near net-shape at a reasonable cost, but at a sacrifice in physical properties and surface appearance. Parmatech Corp. has developed a process for injection molding

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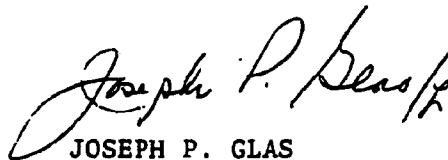
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Injection Mold Powder Metals and Ceramics - Cont'd

very fine powders to produce close tolerance parts with near wrought material properties, at a cost between conventional powder metallurgy and investment casting. Remington has obtained a non-exclusive license from Parmatech to use the process to make parts for commercial markets.

A Research semi-works facility with thermal extraction capability for metals is expected to be in place in the first quarter of 1982. Solvent extraction equipment will follow in the third quarter of 1982, and ceramic capabilities during the first quarter of 1983.

A quote has been received from Witec California, Inc., for a thermalextraction system. A Plans and Estimates work order is being prepared to authorize purchase of the system prior to project approval.



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