

File.

TEST & MEASUREMENT LAB REPORT

REPORT NUMBER:
MODEL(S): Remington & Competitive Bolt Action Rifles
GAGE/ON CALIBER: .243 Win., 30-06, 7mm Rem.Mag., 25-06
REPORT TITLE: Bolt Action Competitive Arms Test

DATE: September 18, 1981
W.O. NUMBER: G-0309
PART NAME:
PART NUMBER:
DRAWING ALTERATION:
RAMAC NUMBER:

TEST TYPE: 1. ☐ DEPT. 98 OPERATIONS
2. ☒ PHOTO LAB OPERATIONS
3. ☒ STRENGTH TESTS
4. ☒ FUNCTION TESTS
5. ☒ ACCURACY
6. ☒ MEASUREMENTS
7. ☒ ENDURANCE TESTS
8. ☐ ENVIRONMENTAL TESTS
9. ☐ AMMUNITION TESTING & EVALUATION
10. ☒ VISUAL EVALUATION

PROCESS TYPE:
MATERIAL(S):
DESIGNER OR ENGINEER:

ABSTRACT:

Distribution:

C.B. Workman
J.W. Brooks
J.R. Snedeker

Request Date: April 23, 1981
Start Date: April 23, 1981
Completion Date: September 14, 1981

I N D E X

	<u>Page</u>
Test Abstract	1 - 3
Report Text	4
I. Packaging Evaluation	4 - 5
II. Visual Inspection	5 - 7
III. Manufacturers Selling Points	8 - 11
IV. Customer Selection	12
V. Preliminary Measurements	13
VI. Lock Time	13
VII. Accuracy	14 - 15
VIII. Field Cycle Test	15 - 21
IX. Endurance	22 - 28
Appendix A	Calculations
Appendix B	Photographs
Appendix C	Data Sheets
Appendix D	Instruction Manuals

REMINGTON ARMS COMPANY, INC.
Firearms Research Division

September 18, 1981

TO: J. R. SNEDEKER
FROM: C. J. SWEET
SUBJECT: BOLT ACTION COMPETITIVE ARMS TEST

ABSTRACT

A total of twenty-five Competitive and Remington Bolt Action Rifles were subjected to numerous tests and measurements for evaluation purposes. They include:

Packaging Evaluation	Preliminary Measurements
Visual Inspection	Lock Time
Price Comparison	Accuracy
Customer Selection	Field Cycle Test
	Endurance

Strength Test
Engineering Sample

The test guns consist of:

- 5 - Brownings M-BBR
- 5 - Remingtons M700
- 5 - Rugers M77
- 5 - Smith & Wessons M1500
- 5 - Winchesters M70XTR

Each competitive rifle was purchased from Creekside Gun Shop (Holcumb, New York) and the M700 rifles were selected randomly from the Ilion Plant warehouse.

SCOPE OF TEST

To thoroughly evaluate each competitor's model to determine "what sells the rifle" and to compare the differences and/or similarities among the rifles.

TEST RESULTS

A brief synopsis is given for each mode of the test. Refer to the Report Text for more detailed accounts.

To: J.R.Snedeker
From: C.J.Sweet
Bolt Action Competitive Arms Test

9-18-81
-2-

Packaging

Each carton was reviewed by L.Ferreira, Purchasing Agent in charge of packing materials for Remington Arms. After careful examination of each pack, he rated them in this order:

- | | | |
|----|----------------|---|
| 1. | Browning | Most costly, but offers the best protection |
| 2. | Winchester | Strong pack, reusable |
| 3. | Remington | Certified for shipment, but with outer sleeve |
| 4. | Smith & Wesson | Adequate protection, potential end damage |
| 5. | Ruger | Adequate protection, not reusable. |

Visual Inspection

Major Defects:

- | | | |
|---|-------------------------|--|
| • | Browning BBR | Open grain, and dents in finish. Some rust pits on the barrels. |
| • | Remington M700 | Some bubbles in the finish. Poor color on bolt heads, barrels and sight bases. |
| • | Ruger M77 | One stock was cracked 3" at the fore end tip, others dented and scratched. Polishing marks evident on the barrels, some rust and finish chipping away. |
| • | Smith & Wesson
M1500 | Open grain and ripple in finish. Polishing marks on the barrels and receivers - dull appearance. |
| • | Winchester | Poor color matches between receiver and barrels. The checking - diamonds are flat - light scratches in wood finish. |

Manufacturers Selling Points

- | | | |
|---|-------------------------|---|
| • | Browning BBR | Short throw 60° bolt, anti-warp fore end and one grade outstanding. |
| • | Remington M700 | Strongest action ever designed - 3 rings of steel, and an anti-rust bolt. |
| • | Ruger M77 | Hand checkering, patented bedding and a quick release floor plate. |
| • | Smith & Wesson
M1500 | Bolt body has relief ports to allow gas to escape, receivers are machined from a single piece of forged steel for maximum strength. |
| • | Winchester
M70XTR | A three position safety and high strength and durability from machined steel components. |

To: J.R.Snedeker
From: C.J.Sweet
Bolt Action Competitive Arms Test

9-18-81
-3-

Customers Selection

Thirty one people were individually asked to rate the rifles for visual appearance only. The results were:

1. Browning BBR
2. Remington M700 ADL
3. Ruger M77
4. Winchester M 70XTR
5. Smith & Wesson M1500

Preliminary Measurements

Every rifle met Remington's standards except for bore & groove measurements. Browning, Smith & Wesson and Winchester had some 4-groove barrels. We were unable to measure this because we can only measure 6 groove barrels with our gages.

Lock Time

Of the five competitors rifles measured (30-06 Cal.) the Remington M700 has the fastest lock time of 3.29 ms.

Accuracy

The Remington M700 rifles used in the test performed better than the other competitors, in all three calibers shot (243, 30-06, 7mm Mag.). Even after 1000 rds. of endurance the Remington M700s remained in group size specs, and outshot the competitors rifles.

Field Cycle Test

Every model experienced functional problems during the field test. Also, two Remington M700s, one Winchester M 700XTR and one Browning BBR rifle were removed from test because of breakages or functional problems.

Endurance

No serious problems were encountered with any of the rifles during endurance testing. The malfunction rates are low and they consist mostly of:

- Stem low malfunctions
- Shell jumps mag. malfunctions

Engineering Sample & Strength Test

These will be covered in separate reports.

CJS:T

REPORT TEXT

I. PACKAGING EVALUATION

This evaluation was conducted by L.Ferreira, Purchasing Agent in charge of packing materials for Remington Arms. All the packages were inspected as received from the gun shop. The three major criteria that Mr. Ferreira based his observations on were:

- How well the rifle is protected in the carton.
- How well the carton is made.
- Reusability of the carton.

This was his report:

Browning BBR Pack

- A full telescope box, with a full styrofoam tray and pad.
- The rifle is protected in a polyethylene linen bag.
- Good molding job on the tray.
- Full protection offered.
- Reusability is adequate, but the pack is without certification.

Estimated Cost: \$2.00 each for box and materials.

Remington M700 Pack

- A five panel folded corrugated box with styrofoam inserts.
- Certified for shipment with a protected outer sleeve.
- Reusability - Excellent.

Estimated Cost: \$.60 each for box and materials.

Ruger M77 Pack

- A fold-up corrugated container with cardboard inserts.
- Protection is adequate, and the carton is certified to ship as is (no outer sleeve required).
- The carton is not reusable for shipment without additional protection.

Estimated Cost: \$.30 to \$.40 each for box and materials.

Smith & Wesson M1500 Pack

- A full styrofoam tray with a cardboard sleeve.
- The rifle is protected in a polyethylene liner bag.
- Protection is adequate but if the end styrofoam breaks away the gun will be exposed.
- The sleeve marks up easily (blue ink comes off).
- The carton is reusable, but must be covered with a corrugated tube.
- The carton is not certified for shipment.

Estimated Cost: \$1.50 each for box and materials.

Winchester M70XTR Pack

- The carton is made of 100 lb. "B" flute cardboard and it is certified for shipping.
- Oil treated paper is used to wrap the rifle to prevent rust.
- There were many loose cardboard pieces in the carton.
- Reusability - Good.

Estimated Cost: \$.90 each for box and materials.

II. VISUAL INSPECTION

The twenty-five rifles were visually inspected in the Test Lab. They were reviewed by four members of the Test & Measurement Lab (J.H.Hennings, R.E.Nightingale, S.R.Franz and C.J.Sweet), and one member from the Quality Control Department (J.Mroz). Each man critiqued the twenty-five rifles, while sharing comments with the other members. Following is a summary of those critiques per manufacturer and model.

Browning BBR

Wood

- The bolt head dents the stock when it is retracted fully.
- Heavy scratches on the stocks.
- Overruns and underruns on the checkering.
- Poor sanding - ripples along the entire stock.
- Traces of yellow crayon on some of the checkering.
- Large knots were repaired; poor job.
- Poor fit of butt plates, on two rifles.
- Finish is chipping away behind the safety switch.
- Some dirt found under the finish around the bolt handle slots.

Metal

- Rust pits found on two receivers.
- Heavy scratches found on two floor plates.
- Bad polishing mark around the lower port area.
- Excellent color match between barrel and receiver.
- Good color and finish on all trigger guards (includes the inside bow of the guard).
- Color mismatch between trigger guards and floor plates (floor plates are darker).
- The inletting is good between barrel and receiver to the wood.

II. Remington M700 (ADL-BDL)

Wood

- All bolt handle cuts are rough, full of debris and poorly finished.
- Crushed checkering on the right side of a pistol grip on one ADL rifle.
- Finish and wood is chipping away on some of the stocks, primarily around the grip caps and where the sling strap screws are located.
- All the brass stock reinforcement pins are eggshaped.
- Small dents and scratches were recorded on three of the rifles (superficial).
- All of the stocks have a nice glossy finish.
- Good inletting of the stocks to the barrels.

Metal

- Poor polish and color on all the bolt plugs.
- Polishing marks are evident on all the barrels.
- Two barrels have traces of GFM hammer marks on them.
- Poor color on all the barrel lugs. They look dull compared to the barrel and receiver finishes.
- Poor color on all the sight bases. They also have a "rough finish" look to them.
- Good polish and color on the floor plates and trigger guards.

Ruger M77

Wood

- The fore end tip of the varmint rifle is cracked 3".
- Heavy scratches were found on three stocks.
- All bolt handle cuts have torn grain, wood burns, and gouging.
- Poor fill and stain on all stocks.
- Two rifles have a white plastic strand hanging out from the insert on the grip cap.
- The recoil pads do not fit tight to the stocks on some of the rifles (gaps).
- Good inletting for barrel fit.

Metal

- Rust pits were found on some of the bolts, barrels and receivers.
- A deep $\frac{1}{2}$ " scratch, 6" from the muzzle end on one rifle.
- The finish is wearing off on two receivers at the tang area near the safety switches.
- Polishing marks are noticeable the full length of the barrels.
- Poor finish on the trigger guards and floor plates - very dull; doesn't match the receiver and barrel.

II. Smith & Wesson M1500

Wood

- The stocks are full of open grain and sanding ripples.
- Some deep scratches are on two stocks.
- The finish is cracked at the pistol grip area on one rifle.
- Dents to the stock are being caused by the sling strap swivels, that are shipped assembled to the rifles.
- The finish is chipping around the butt plates.
- Poor fit of the white spacers to the stock - excessive margins.
- Dirty recoil pad on the magnum rifle.

Metal

- Poor color match between receivers and barrels.
- Polishing marks give the barrels and the receivers a dull appearance.
- The bolt sleeves (bolt plugs) are purple in color.
- The blend between the jewel and black color of the bolt is irregular (compared to Remington).
- Dust in the finish on two floor plates.

Winchester M70XTR

Wood

- Some open grain.
- The diamonds are flat on the checkering.
- Some of the bolt handle slots are rough.
- Some small dents and scratches are noticeable on the stocks.
- There is a lack of stain on some of the butt stock edges.
- Finish is chipping away around the white spacers.
- Two of the actions set deeper into the stocks compared to the other Winchester rifles.
- There is good inletting on all the rifles - the space is even on both sides of the barrels and receivers.

Metal

- The receivers are glossy, but the barrels are dull.
- Some trigger guards are pitted.
- Poor blend between the jewel and color of the bolt.
- Polishing marks on the receivers.

Photographs of some of the imperfections found are in Appendix B.

III. MANUFACTURERS' SELLING POINTS

Manufacturers' selling points are advertisements found in the 1981 gun catalogs from each individual gun company. This is what a prospective buyer might read before his purchase:

Browning BBR

"Hammer Forged Accuracy" - to produce flawless rifling and guarantee a straight bore.

"Supersmooth, Short Throw, Lightning Bolt Action" - 60° throw faster to operate.

"The Larger Diameter Bolt and Fluted Surface" - reduce wobble and friction.

"Plunger Type Ejector" - eliminated the need for a weakening ejector groove in the bolt head.

"Anti-Warp Forearm" - an aluminum channel 1/8" thick and 8" long is inlaid into the barrel channel.

"Free Floating Barrel" - very minimal clearance between the barrel and the barrel bed is possible because the anti-warp aluminum channel provides enough rigidity to prevent forearm warpage from "spoiling" the float.

"Adjustable Trigger" - 3 to 6 lbs., the trigger is grooved for better finger control.

"Dual Safety Indicators" - a switch and a visual indicator.

"Ready for a Scope" - no open sights.

"Standard & Magnum Calibers"

"Scissors Magazine Spring for Smooth Feeding" - the spring more evenly distributes pressure on the magazine follower than the common leaf spring. The follower won't tip down.

"Convenient Hinged Floor Plate with Detachable Magazine" - A hinged floor plate swings down for easy loading, and a removable magazine for reloading, spare magazine for quick loading, or safety reasons.

"One Grade Outstanding" - No other grades of wood are available, just a single piece of select grade American walnut cut to the lines of a Monte Carlo Sporter with a full pistol grip and high cheekpiece.

Price: \$429.95 Suggest Retail List Price

III. Remington M700

"No other centerfire rifles in their class are more ruggedly built, more rigorously inspected."

"Each one is precision machined, hand assembled and individually test fired."

"It's all done right here in the United States of America."

"Clearly, it's one of the strongest ever designed. A bolt face, barrel, and receiver surround the cartridge head with three rings of solid steel."

"No single extractor cut to weaken it."

"The receiver is machined from a single billet of Ordnance-quality steel, then vibra-honed for smooth functioning."

"Every 700 also has a polished anti-bind bolt."

"Wide choice of calibers and styles."

"Hand applied Du Pont RK-W finish."

"Receiver drilled and tapped for scope mounts and receiver sights."

"Centerfire barrels are made of special Remington steel."

"Equipped with sights that are fully adjustable and removable."

"The safety switch on each M700 is a fast, positive thumb-type. Left hand models have a left hand safety switch."

Price:	ADL - \$334.95	BDL Var. \$419.95
		BDL Maq. \$419.95

Ruger M77

- Hand checkering
- Patented Bedding System
- Quick Release Floor Plate
- Sliding Tang Safety
- Rubber Butt Pad
- Scope Mount Bases
- Sporting Sights Optional

Price:	M77R, 77ST, 77R	-	\$325.00	Suggested Retail List Price
	M77 Varmint		\$341.25	" " " "

III. Smith & Wesson M1500

"A conveniently located thumb safety securely locks the trigger but allows the bolt to be opened for quick, safe inspection and unloading."

"Hand rubbed smoothness of select American walnut."

"Two action lengths, short & long." [There is no varmint barrel.]

"Twin locking lugs ride in a three rail design for smooth, easy, non-binding bolt operation and travel."

"The bolt body has three relief ports to allow gas to escape downward through the magazine box in the unlikely event of a cartridge case rupture."

"Receivers are machined from a single piece of forged steel for maximum strength, and drilled and tapped for scope mounts."

"The trigger group has a crisp let-off with minimum overtravel."

"A hinged floor plate on both action lengths that makes unloading safe, fast and simple."

"Straighter stocks, with less drop at the heel. The result is faster sight alignment and most important, a straighter recoil for minimum muzzle jump."

"S&W's brilliant, durable finish protects and maintains the stability of the wood through seasons of changing weather."

Deluxe Version: *"Skip line hand checkering"*
"Engine turned bolt"
"Monte Carlo comb & cheekpiece is crafted from American Walnut"
"Ventilated pad softens recoil on magnum models"
"Swivel post and quick detachable swivels"
"An inlaid S&W seal on the pistol grip cap"

Standard Version: *"A hooded ramp 'gold bead' front sight and a fully adjustable broad vee, round notch rear sight puts you on target"*
"Eighteen line hand checkering"
"Posts are installed for your favorite swivels and sling"

M1500 Standard:	\$334.95	with Recoil Pad	\$349.95
M1500 Deluxe:	\$379.95	" " "	\$394.95

III. Winchester M70XTR

"Balancing and handling characteristics are superb"

"Trigger pull is crisp"

"The matched bolt, receiver and barrel are assembled and tested as an integral system for each rifle to assure precise chambering and accuracy"

"The anti-bind bolt is precision-slotted to provide smooth, sure functioning in any field situation"

"One piece Monte Carlo stock with cheekpiece"

"Fine cut checkering"

"American walnut stock is protected by a tough, high lustre finish"

"Engine turned bolt"

"High strength and durability from machined steel components"

"Three position safety"

"Receiver is drilled and tapped for a scope"

"Hooded front sight and improved adjustable Winchester rear sight"

"Detachable sling swivels"

"Stainless steel magazine follower"

"Hinged floor plate made of steel"

M70XTR Standard	\$412.00
M70XTR Varmint	\$433.00
M70XTR Magnum	\$428.00

IV. *CUSTOMER SELECTION

The purpose: To determine which manufacturer's rifle is selected, to rate over the competition, for visual appearance only. The five manufacturer's rifles were placed on a vertical board in alphabetical order to achieve a display-like atmosphere (Fig. No. 1). Studio lights assisted in highlighting the visual appearances. Thirty employees were selected randomly to rate the rifles for appearance only. They weren't allowed to handle the rifles, and they all stood approximately six feet in front of the board. A descending rating system was used with number one being the first choice. A point system was used to rate the rifles:

<u>Position</u>	<u>Points</u>
1	5
2	4
3	3
4	2
5	1

Fig. No. 1

The results:

Browning BBR	118 pts.	No. 1
Remington M700 ADL	101 "	No. 2
Ruger M77	84 "	No. 3
Winchester M70XTR	83 "	No. 4
Smith & Wesson M1500	64 "	No. 5

A complete breakdown is in Appendix C, Data Sheet No. 1

*All models were the standard models, with exception of the Browning BBR, since it only comes in one grade.

V. PRELIMINARY MEASUREMENTS

The preliminary measurements recorded on the twenty-five rifles were within Remington Standards. Complete data sheets with all the recorded measurements is found in Appendix C, Data Sheet Nos. 2, 3, 4, 5, & 6.

Included on these data sheets are:

Headspace	Center of Gravity
Firing Pin Indent	Bolt Open Forces
Trigger Pull	Bore & Groove
Safe ON-OFF	Twist
Weight & Length	Safety Check
Chamber Cast Measurements	

The groove measurements taken on the barrels are incomplete because many of the barrels are four groove. The air gauges we currently have in the plant can only measure six groove barrels. The four grooved rifles are:

- Browning BBR - 3 rifles, all 30-06 Cal.
- Smith & Wesson M1500 - all five rifles
- Winchester M70XTR - 3 rifles, all 30-06 Cal.

Note: There was no reference made in any of the three manufacturer's literature or their catalogs stating that the barrels are four groove.

VI. LOCK TIME

Lock time was measured on five rifles consisting of one model from each manufacturer. The results are:

Remington M700	3.29 Msec.
Browning BBR	3.38 Msec.
Smith & Wesson M1500	3.81 Msec.
Winchester M70XTR	4.00 Msec.
Ruger M77	4.19 Msec.

Each of the above numbers is the mean of ten individual measurements per rifle. Refer to Appendix C, Data Sheet No. 7.

VII. ACCURACY

The purpose of this test was to determine what effect, if any, the number of fired rounds on the rifle barrel have on its accuracy performance.

Three calibers from each manufacturer were shot for accuracy. They consist of:

- Browning BBR 30-06 Cal., *25-06 Cal. and 7mm Rem. Mag. Cal.
 *A 25-06 Cal. was used because they do not manufacture a 243 Win. Cal. rifle.
- Remington M700 30-06 Cal. ADL Grade, 243 Win. Var. BDL Grade, and a 7mm Rem. Mag. Cal. BDL Grade.
- Ruger M77 30-06 Cal., 243 Win. Var., and a 7mm Rem. Mag. Cal.
- Smith & Wesson 30-06 Cal., 243 Win. (Varmint barrel not made), and a 7mm Rem. Mag. Cal.

All the accuracy was shot from the 100 yard bench, using a 10X power scope (indoor range). The same ammunition code was used at each round level. Remington M40 XBs were used to verify that the factory lots of ammunition used were satisfactory for accuracy testing. This same procedure was used before the start of the first group fired:

- Wire brush all barrels with Hoppes' solvent and patch thoroughly.
- Air cool between each group.
- Shoot one warmer before each group.

The results are in Appendix C, Data Sheet No. 8 titled "Accuracy Summary Sheet". There is no accuracy data for the Winchester M70XTR 7mm Rem. Mag. at the 500 and 1000 round levels due to bolt related problems. This will be covered in detail in the Endurance Section of this report, under Breakages.

VII. Four of the competitors' rifles experienced accuracy problems at various round levels. When compared to the Remington Specs, the,

Winchester M/70XTR - 243 Win.Var. shot a group size of 1.8" at the 500 rd. level. This is .4" above our specs.

Smith & Wesson M/1500 - 7mm Rem.Mag. shot a group size of 2.9" at the zero round level. This is .2" above the Remington specs.

Ruger M/77 - 243 Win.Var. shot 1.6" at the zero round level. This is .1" over Remington specs. Also, the Ruger 7mm Rem.Mag. shot a group size of 3.9" at the 500 round level. This is 1.2" above Remington specs.

VIII. FIELD CYCLE TEST

The purpose of the field cycle test was to evaluate the function of each rifle when shot from the shoulder with Remington and competitive ammunition.

All twenty-five rifles were subjected to an 85 round test with Remington, Winchester and Federal ammunition. (All bullet weights were used.) Before any live firing took place, each man would load his rifle and then live unload it. Upon completion of this, he would reload the rifle and fire five rounds. He'd then move to another rifle, keeping a rotation going, so that each man fired every rifle in the test. The rifles were air cooled after every ten rounds. The testing took place at the Ilion Fish and Game Club 100 yard range.

This segment of the report is divided into three sections:

1. Breakages
2. Malfunctions
3. Remarks and Adjustments

VIII. Breakages

Two breakages were recorded during the field cycle test.

They were:

- Remington M/700 BDL - 30-06 Cal. - Ser.No. B6263104

After 55 fired rounds, the floor plate latch spring broke. This allowed the floor plate to open up and dump the unfired cartridges in the magazine to the ground. Without the spring the floor plate would not stay closed when the rifle was fired. The spring broke at the front hoop. (Refer to Fig. 2) The spring was replaced and the test was completed on the rifle.

Fig. No. 2

- Browning BBR - 30-06 Cal. - Ser.No. 01105RP117

After 10 fired rounds the rifle was removed from testing. The cartridges would not feed from the magazine. The reason was that the front takedown screw on the trigger guard would not tighten completely. This allowed the floor plate to drop at the rear (Fig. No. 3) and prevent the cartridges from feeding.

Fig. No. 3

VIII. Browning BBR Continued

The bolt would ride over the top of the cartridges. The rifle was taken apart and examined. An improperly factory installed spring escutcheon that the screw screwed into was the cause of the feeding problem. The spring escutcheon was halfway out of the hole and the wood around the hole was chipping away. The Model Shop tried to repair it, but they were unable to do so. (Figs. No. 4 & 5)

Fig. No. 4

Fig. No. 5

VIII. Malfunctions

The malfunction rates recorded on the rifles in the Field Cycle Test are low with exception of the Browning BBR that was pulled from testing due to the escutcheon breakage. The malfunction type and rates are:

• Browning BBR

<u>Cal.</u>	<u>Ser.No.</u>		<u>Malfunction</u>	<u>Rate</u>
30-06	01105RP117	*6	Fail to Feed	60% in 10 rds.
30-06	04030RP117	1	Fail to Feed	1.2% in 85 rds.
30-06	01101RP117		None	0% in 85 rds.
25-06	10075RP117	4	Light Indents	4.7% in 85 rds.
7mm Rem.Mag	09143RP117	<u>1</u>	Stem High	<u>1.2%</u> in 85 rds.
Five Rifle Total		12		3.4% in 350 rds.

• Remington M-700

30-06 ADL	B6303850		None	0% in 85 rds.
30-06 ADL	B6275032		None	0% in 85 rds.
30-06 BDL	B6263104	1	Floor Plate Spg.Breakage	1.2% in 85 rds.
243 Var.BDL	B6270650		None	0% in 85 rds.
7mm Rem.Mag	B6245077	<u>3</u>	Shell Jump Mag	<u>3.5%</u> in 85 rds.
Five Rifle Total		4		0.9% in 425 rds.

• Ruger M-77

30-06	74-28970		None	0% in 85 rds.
30-06	73-95020		None	0% in 85 rds.
30-06	73-80410		None	0% in 85 rds.
243 Var.	74-00086		None	0% in 85 rds.
7mm Rem.Mag	74-24449		None	<u>0%</u> in 85 rds.
Five Rifle Total			None	0% in 425 rds.

• Smith & Wesson M-1500

30-06	PN00852		None	0% in 85 rds.
30-06	PN01129	1	Stem Low	2.4% in 85 rds.
		1	Stem High	
30-06	PN00825		None	0% in 85 rds.
243	PN11952		None	0% in 85 rds.
7mm Rem.Mag	PN02081	<u>1</u>	Stem High	<u>1.2%</u> in 85 rds.
Five Rifle Total		3		0.7% in 425 rds.

• Winchester M-70XTR

30-06	G1374180		None	0% in 85 rds.
30-06	G1430481		None	0% in 85 rds.
30-06	G1366675		None	0% in 85 rds.
243 Var.	G1396213		None	0% in 85 rds.
7mm Rem.Mag	G1390274		None	<u>0%</u> in 85 rds.
Five Rifle Total			None	0% in 425 rds.

*Pulled from test (escutcheon breakage)

VIII. Malfunctions Continued

Field Cycle Test

Overall Malfunction Rates:

Browning BBR	3.4% in 350 rds. (Includes rifle pulled from test)
Remington M-700	0.9% in 425 rds.
Ruger M-77	0% in 425 rds.
Smith & Wesson M-1500	0.7% in 425 rds.
Winchester M-70XTR	0% in 425 rds.

Remarks and Adjustments

There are several remarks and adjustments which resulted from the field cycle test.

- Browning BBR

It was very difficult to load the magazines. The instructions received with the rifle recommend loading the rifle in this manner:

LOADING THE RIFLE

CAUTION: WHENEVER LOADING YOUR RIFLE, BE SURE THE MUZZLE IS POINTED IN A SAFE DIRECTION.

The new Browning bolt action rifle utilizes a unique detachable box magazine. The capacity of the magazine is four rounds (three rounds for Magnum calibers). Another round may be carried in the chamber, providing a total rifle capacity of five rounds (four rounds for Magnum calibers). The rifle may be loaded with the magazine in place. Simply open the bolt and push the cartridges down into the magazine. Close the bolt and put the safety "ON SAFE."

LOADING WITH MAGAZINE ATTACHED TO FLOORPLATE

To ready the rifle for loading, hold the rifle in a natural position with the barrel angled down toward the ground. The bolt may be either open or in a closed position. (If the bolt is in the closed position, be sure the safety is "ON SAFE.") Hold the rifle with either hand at the forearm. Depress the magazine latch in front of the trigger guard with the index finger of your free hand, and allow the hinged floorplate-magazine unit to swing downward.

Four rounds may now be inserted into the magazine (three in the Magnum models). Lay a round on top of the follower and press it down with your thumb until it is retained in the magazine. Care should be exercised in positioning each cartridge so that its base is flush with the rear of the magazine. If the nose of a cartridge protrudes beyond the front of the magazine, it could cause feeding problems or interfere with the closing of the magazine floorplate. (See Figure 5.)



After loading the magazine, swing the floorplate upwards until it is retained by the magazine latch. The bolt may be cycled at any time you wish to load the chamber. Slide the thumb safety to the rear to place the loaded rifle "ON SAFE."

The magazine-floorplate unit may be opened at any time to refill the magazine to capacity.

VIII. Remarks and Adjustments Continued

- Browning BBR Continued

The shooters found it difficult to load the rifle as the recommended procedure shows. They were dropping shells, they found it difficult to load the fourth round, and one shooter even pinched his finger at the hinge point of the floor plate. If you load the magazine in this manner, but leave the bolt open, another problem arises. In order to close the floor plate with four shells in the magazine, a great deal of pressure to swing it up is required. On occasion, the first shell in the magazine box would pop out the port during the closing of the floor plate.

If you detach the magazine box and load it, you are faced with the same problem as above.

If you load the magazine from the port (such as the Remington) it is very difficult. The magazine sets very low into the stock. The shooters complained that the receiver rails were very sharp when they loaded the rifles in this manner.

- Remington M-700

Every rifle had to be lubricated between the twenty and forty round level. The bolts became very hard to unlock. Moly-Kote GN paste was used as a lubricant. It was applied to the locking lugs and to the cocking cam cut.

At the sixty-two round level the 7mm Rem.Mag. was temporarily pulled from the test. The bolt had to be opened with a plastic hammer for three rounds fired. This occurred on all three ammo. types. The Winchester brass was the hardest to open the bolt on. The shells were scraped up around the diameter just ahead of the belt.

An inspection of the chamber revealed chatter marks at the start of the chamber area just ahead of the belt recess. The chamber was burnished and the rifle was put back in test. This solved the problem. (Fig. No. 6)

VIII. • Remington M-700 Continued

Fig. No. 6

• Ruger M-77

There were no adjustments made on the Rugers.

The only remarks were: "It's very easy to load the magazine. and "The bolt operates smoothly".
(Shooters' quotes)

• Smith & Wesson M-1500

There were some problems with live-unload. The rifles would extract the cartridge, but they would not eject them all the time.

• Winchester M-70XTR

Some action binds; had to lubricate the bolts the same as the Remington M-700s.

IX. ENDURANCE

The purpose for the endurance test is two-fold:

1. To determine what effect, if any, the number of endurance rounds fired on a rifle have on its accuracy. (Covered in Section VII - Accuracy)
2. If any functional difficulties arise in 1000 rounds of endurance.

All the endurance testing took place at the Ilion Fish & Game Club 100 yd. range. All the rifles were shot in the jacks and were cooled after every 20 rounds with an air compressor as the source of air. Bore and chambers were cleaned every 100 rds.

This section is divided into three areas:

1. Breakages
2. Malfunctions
3. Remarks and Adjustments

Breakages

Two breakages occurred during testing. Both breakages occurred to the Winchester M-70XTR - 7mm Rem.Mag.

- Winchester M-70XTR - 7mm Rem.Mag. - Ser.No. G1390274
During the first 120 rds. of endurance, 30 Don't Lock Up malfunctions occurred. They were caused because the bolt would not fully cock. Each time this occurred the shooter would remove the bolt and finish cocking the bolt by hand. (Fig. No. 7)

Fig. No. 7

IX. An investigation of the bolt revealed two probable causes:

- 1) The bolt handle was brazed on .038" out of position. This causes the breech bolt sleeve lock to line up with the notch in the bolt handle in the wrong position, allowing the bolt to not fully cock. (Fig. No. 8)

Fig. No. 8

- 2) The slot in the breech bolt sleeve is .010" oversized. This allows the firing pin head to be sloppy in the slot. This added to the cocking problem. (Fig. No. 9)

Fig. No. 9

- IX. • The second breakage occurred to the new bolt that was purchased for the 7mm Rem.Mag. rifle. When the new bolt was proofed, the bolt was rendered inoperable. The bolt had to be opened with a hammer. The extractor was broken and the extractor slot was bowed out, both sides. (The headspace measured on the new bolt before proof was min. $+.003"$.) (Fig. No. 10)

Fig. No. 10

Two chamber casts were made after the rifle was disassembled. The measurements from the two casts, the actual fired proof round, an unfired factory round and the original chamber measurements taken at zero rounds are compared below.

Fig. No. 11 is the Remington Chamber Drawing, and the figures in red are the SAAMI Recommended Min. Dimension.

Fig. No. 11

IX.

	Measurement Location		
	A	B	C
"O" Rounds Cast	.5150"	.4930"	.3170"
"O" Proof Round	.5140"	.4930"	.3260"
Cast No. 1 (New Bolt)	.5275"	.4990"	.3260"
Cast No. 2 (New Bolt)	.527 "	.4980"	.3250"
Fired Proof Round (New bolt)	.527 "	.4980"	.3240"
Unfired Factory Round	.507"	.4930"	.3130"

Note: There were 225 rounds fired on this rifle between "O" rounds and the proof testing of the new bolt.

The "A" dimension went from .5150" to an avg. .5275". This is an expansion of .0121".

The "B" dimension went from .4930" to an avg. .4983". This is an expansion of .0053".

The "C" dimension went from .3170" to an avg. .3250". This is an expansion of .008".

A careful examination of the barrel revealed that the O.D. of the chamber area expanded .0095". This figure was derived by disassembling an older Winchester M-70 and measuring its O.D. at the chamber area for comparison.

Refer to Appendix A, Data Sheet No. 1, for the calculations.

Malfunctions

The malfunction rates recorded for endurance testing are low with exception of the Winchester M-70XTR - 7mm Rem.Mag.. It was removed from endurance testing at the 120 rd. level because of a defective bolt.

<u>Browning BBR</u>	<u>No.of Rds.</u>	<u>Malf.</u>	<u>Rate</u>
30-06 Cal. #0403RP117	0-500	3 - Follower Binds	0.6%
	501-1,000	5 - Stem Lows	1.0%
	1,000	8	0.8%
7mm Rem.Mag #09143RP117	0-500	0	0%
	501-1,000	4 - Stem low	4.4%
	1,000	18 - Shell Jumps Mag	2.2%
Two Rifle Total	2,000	30	3.0%

IX. Malfunctions Continued

<u>Remington M-700</u>	<u>No. of Rds.</u>	<u>Malf.</u>	<u>Rate</u>
30-06 Cal. ADL	0-500	None	0%
#B625032	<u>501-1000</u>	None	0%
	1,000	None	0%
243 Var. BDL	0-500	None	0%
#B6270650	<u>501-1000</u>	None	0%
	1,000	None	0%
7mm Rem. Mag.	0-500	1 - Action Bind	2.2%
#B6245077	<u>501-1000</u>	10 - Shell Jumps Mag.	0%
	1,000	11	1.1%
Three Rifle Total	3,000	11	0.4%
<u>Ruger M-77</u>			
30-06 Cal. #73-95020	0-500	None	0%
	<u>501-1000</u>	1 - Stem Low	0.2%
	1,000	1	0.1%
243 Var. #74-00086	0-500	None	0%
	<u>501-1000</u>	1 - Stem Low	0.2%
	1,000	1	0.1%
7mm Rem. Mag. #74-24449	0-500	None	0%
	<u>501-1000</u>	None	0%
	1,000		0%
Three Rifle Total	3,000	2	0.2%
<u>Smith & Wesson M-1500</u>			
30-06 Cal. #PN01129	0-500	1 - Stem High	0.2%
	<u>501-1000</u>	None	0%
	1,000	1	0.1%
243 Cal. #PN11952	0-500	None	0%
	<u>501-1000</u>	None	0%
	1,000	None	0%
7mm Rem. Mag. #PN02081	0-500	None	0%
	<u>501-1000</u>	None	0%
	1,000	None	0%
Three Rifle Total	3,000	1	0.03%

IX. Malfunctions Continued

<u>Winchester M-70XTR</u>	<u>No. of Rds.</u>	<u>Malf.</u>	<u>Rate</u>
30-06 Cal. #G1430481	0-500	1 - Bolt Override	0.2%
	501-1000	1 - Shell JumpMag.	0.2%
	1,000	2	0.2%
243 Var. #G1396213	0-500	None	0%
	501-1000	None	0%
	1,000	None	0%
7mm Rem. Mag. #G1390274	0-120	30 Don't Lock Ups (Removed from Test)	25%
Three Rifle Total	2,120	32	1.5%

Overall Malfunction Rates for Endurance Testing:

*Browning BBR	3.0%	in 2,000 rds.	(2 rifles)
Remington M-700	0.4%	in 3,000 rds.	(3 rifles)
Ruger M-77	0.2%	in 3,000 rds.	(3 rifles)
Smith & Wesson M-1500	0.03%	in 3,000 rds.	(3 rifles)
Winchester M-70XTR	1.5%	(one rifle out of test) 2,120 rds.	

*Browning doesn't manufacture a 243 Win. Caliber; which is the reason only two rifles were endurance.

Remarks and Adjustments

Browning BBR

- At times, the shooters found it hard to load three shells into the magazine on the 7mm Rem. Magnum. It was hard to close the bolt over the top of the shells in the magazine.
- Lubrication to the bolt lugs was required at the 500 round level due to a bind in the action.
- One 30-06 stock was cracked from the front webbing rearward to the pistol grip. (Fig. No. 12)

Fig. No. 12

IX. Remarks and Adjustments Continued

Remington M-700

- . The only problem with the Remingtons during endurance was that the action had to be lubricated every 50 rds. Hoppes' No. 9 oil was used. The action would lock and unlock very hard. The lubrication was applied to the locking lugs and the cocking cam surface of the bolt.

Ruger M-77

- . At the end of 1000 rds. the 7mm Rem.Mag. caliber rifle stock was cracked clear through at both webs. (Fig.No.13)
- . No lubrication was required on any of the three endurance rifles. They were tested just as they were received.
- . No difficulties in loading or with binding actions.

Smith & Wesson M-1500

- . Lubrication was required on all three rifles at the 600 rd. level. The actions were hard to unlock.
- . The lubrication was applied to the locking lugs (Hoppes' No. 9 oil was used).

Winchester M-70XTR

- . Very easy to load magazine.
- . No lubrication was required, the bolts operated smoothly. (Exception: The 7mm Rem.Mag. rifle that was removed from test due to bolt related problems, explained earlier.)

Note: Supplied in Appendix D is a copy of each instruction manual supplied with each rifle.