Remington Arms Company Inc.
RESEARCH & DEVELOPMENT TECHNICAL CENTER
315 WEST RING ROAD
ELIZABETHTOWN, KY 42701

Remington Arms Company, Inc.

Test Report – Design Acceptance Test

M/710 Centerfire Rifle

.30-06 Sprg.

(PART A)

January 2001

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Remington Arms Company, Inc

Test Report – Design Acceptance Test

January 2000

M/710 Centerfire Rifle

Caliber: 30-06 Sprg.

ABSTRACT:

This Report covers the results of the Design Acceptance Testing procedures performed on the Remington M/710 Centerfire Rifle during the time period from April 2000 to October 2000 at the Remington Arms Company, Inc., Research & Development Technical Center located at Elizabethtown, KY.

This Testing Program was organized around the goal of determining if this new product met design specifications. Several "information only" tests were also conducted during the same test program for the purpose of evaluating the products under extreme conditions.

The following general grouping of test procedures were used to determine product capability.

1. *– Headspace and Proof Checks*
2. *– Initial Inspections, Tests and Measurements*
3. *– Weights, Lengths and Gun Characteristics*
4. *– Firearms Measurements*
5. *Functional / Endurance Testing*
6. *Accuracy*
7. *Environmental Tests*
8. *Abusive Testing*

After reviewing the entire series of DAT tests and the data for each of the individual tests, the Research Test Lab and the Research Design Group has concluded that this product did not fully meet the design requirements as set forth by the Test Plan. The design is approved for Trial & Pilot production and testing with the understanding that the issues raised by the Design Acceptance testing will be addressed during the Trial & Pilot phase of testing prior to release for shipment.

Report Prepared By:

*J. R. Snedeker*________________________________ */ 04 January 2001.*

INTRODUCTION

The Model 710, Centerfire Rifle is a new product line for the Remington Arms Company designed to be an economical alternative for the Bolt Action Centerfire rifle customer.

This report will review and summarize the results of various Design Acceptance Tests (DAT #1 & #2) conducted during the time period April 2000 and October 2000 at the Remington Arms Company, Inc., Research & Development Technical Center located in Elizabethtown, KY.

Due to the extensive nature of the testing that embodied this new product it was determined that this report would consist of two parts. Part A (this document) presents a brief explanation of each of the individual tests that were a part of the overall test plan, along with a brief review of the results for that particular test. Part B consists of 2 large binders and contains the raw data, tabulated results and additional individual test reports associated with the test program. It is more extensive in both volume and detail and is intended to give the reader an in-depth look at each of those same tests. It gives details such as the flow charts for the DAT test plan, copies of the individual test requests and the reports and/or the data that was generated during the completion of a particular test. Part B locates in one place all of the pertinent information that is summarized in Part A.

Part B is divided into two parts. B.1 contains the information pertinent to Phase I of the test program and B.2 contains the information pertinent to Phase II of the test program along with copies of additional supplementary tests that were not part of the original test plan.

For easy reference and consistency, the same section numbering scheme is used in Part A and in Part B.

As a result of testing for DAT # 1 certain problems were identified and needed correction before testing continued. Design changes were made and the second test program was started (DAT # 2). Additional problems were identified as testing continued and the decision was made to correct identified problems and conduct a ten-gun post DAT test. At the completion of this test there were still issues that needed to be resolved. Given the time schedule for introduction, the decision was made to move directly to Trial & Pilot testing where proposed design changes would be incorporated into the T&P samples and the Trial & Pilot testing would confirm the design as well as the production process.

The following is a partial listing of the open issues still to be resolved by the Trial & Pilot Testing:

- Bolt Handle Braze failures
- Followers sticking in magazine boxes.
- Inconsistent Bolt Stop Detent
- Bolt Closing Force high

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1.0 PURPOSE & SCOPE OF TEST PROGRAM

1.1 PURPOSE

The purpose of this series of tests was to determine if the Model 710 Centerfire Rifle would perform as designed and meet the established function and safety criteria proposed by the Research & Development Firearms Design Group.

1.2 SCOPE

This report covers the testing of the Remington Model 710 Centerfire in .30-06 Win. caliber only.

2.0 EXECUTIVE SUMMARY

This section of the report is a summary of the test work accomplished through two Phases of Design Acceptance Testing (DAT) for Remington's new Model 710 Centerfire Rifle (plus a ten gun post-DAT test.) The testing and associated design development improvements were completed during the time period of April 2000 and October 2000. Due to the unavailability of synthetic stocks at start of DAT testing the test plan was divided into two Phases. For Phase I testing (Rifles A1-A15) three aluminum stocks were available for test. Those tests or measurements that would be affected by the use of the aluminum stocks such as weight or measurement of recoil were postponed until Phase II testing.

During Part B.2, Phase II, DAT # 1 testing (Rifles B1-B30) with synthetic stocks several problems were identified, addressed with design changes and resubmitted for test under the designation of Part B.2, Phase II, DAT # 2 (Rifles C1- C30). The results of this testing indicated the need for a ten-gun post-DAT test. The following table lists the results of the most recent of each of these three test series, Phase II, DAT #1, DAT #2 and the ten-gun post-DAT test. Where problems were still unresolved the decision was made to wait on the results of Trial & Pilot Testing where the most recent design changes would be incorporated into the design and process.

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2.1 TEST SUMMARY TABLE

The following Table lists the individual test procedures that were completed during the DAT series and the Final Status of each by individual category. Note: Final Status is listed as "Passed", "Acceptable", "For Information" or "..Did Not Meet Specifications".

Passed = those characteristics for which a specification or criteria was required to be met.

Acceptable = those for which specific criteria have not been clearly established.

For Information = those characteristics without specific criteria and which were taken to provide data to establish expected product design levels.

Did Not Meet Specifications = those characteristics for which criteria or specifications were established but not met by the submitted sample.

TEST PROCEDURE	Phase I Status	PHASE II DAT 1, DAT 2 OR POST- DAT Status	Final Status
3.1 INITIAL INSPECTIONS, TESTS & MEASUREMENTS			
3.1.1 Headspace & Proof Testing			
3.1.1.1 TLW0010A – Measure Headspace	Completed	Completed	**Passed**
3.1.1.2 TLW0010B - Proof Test	Completed	Completed	**Passed**
3.1.1.3 TLW0010C – Re-Measure Headspace Proof Test	Completed	Completed	**Passed**
3.1.2 Forces			
3.1.2.1 TLW0010D – Firing Pin Indent	Completed	Completed	**Did not meet S.A.A.M.I. Specifications**
3.1.2.2 TLW0010E – Sear/Trigger Engagement & Sear Lift	Completed	Completed	**Did not meet all Specifications**

3.1.2.3 TLW0010F – Trigger Pull Forces	Completed	Completed	**Re-adjusted to meet Specifications**
3.1.2.4 TLW0010G – Safe On/Off Forces	Completed	Completed	**Passed**
3.1.2.5 TLW0010H – Bolt Lift and Bolt Closing Forces	Completed	Completed	**For Information Only**
3.1.2.6 TLW0010I – Magazine Spring Forces	Completed	Completed	**For Information Only**
3.1.2.7 TLW0010J – Recoil Force	Not Tested	Completed	**For Information Only**
3.1.2.8 TLW0010K – Lock Time	Completed	Not Tested	**For Information Only**
3.1.2.9 TLW0010AZ – Firing Pin Head to Sear Engagement	Not Tested	Completed	**Passed**
3.1.3 Weights of Major Components			
3.1.3.1 TLW0010L – Overall Weight	Not Tested	Completed	**For Information Only**
3.1.3.2 TLW0010M – Weight of Stock Assembly	Not Tested	Completed	**For Information Only**
3.1.3.3 TLW0010N – Weight of Barrel Assembly	Not Tested	Completed	**For Information Only**
3.1.3.4 TLW0010O – Weight of Bolt Assembly	Not Tested	Completed	**For Information Only**
3.1.4 Lengths of Major Components			
3.1.4.1 TLW0010P – Overall Length	Not Tested	Completed	**Acceptable**
3.1.4.2 TLW0010Q – Barrel Length	Completed	Completed	**Passed**
3.1.4.3 TLW0010R – Length of Pull	Not Tested	Completed	**Acceptable**
3.1.5 Gun Characteristics			
3.1.5.1 TLW0010S – Balance Point	Not Tested	Completed	**For Information**
3.1.5.2 TLW0010T – Drop and Cast	Not Tested	Completed	**Acceptable**

3.1.5.3 TLW0010U – 40 lb. Trigger Pull Test	Not Tested	Completed	**Passed**
3.1.6 Firearms Measurements			
3.1.6.1 TLW0010V – Chamber Cast	Completed	Completed	**Did not meet all Specifications**
3.1.6.2 TLW0010W – Bore Diameter	Completed	Completed	**Some bore diameters oversize**
3.1.6.3 TLW0010X – Groove Diameter	Completed	Completed	**Some groove diameters over max. dimension.**
3.1.6.4 TLW0010Y – Twist Rate (.30-06)	Completed	Completed	**Passed**
3.1.6.5 TLW0010Z – Magazine Capacity Test	Completed	Completed	**Passed**
3.2 FUNCTION & ENDURANCE TESTING			
3.2.1 Function & Endurance Testing			
3.2.1.1 TLW0010AA – Basic Jack Function Test	Completed	Completed	**Average Malf. Rate 1.35% - Passed**
3.2.1.2 TLW0010AB – Basic Shoulder Function Test	Completed	Completed	**Average Malf. Rate 0.17% - Passed**
3.2.1.3 TLW0010AC – Extended Function & Endurance Test	Completed	Completed	**Acceptable**
3.2.1.4 TLW0010AD – Clean Rifles and Inspect	Completed	Completed	**For Information**
3.2.1.5 TLW0010AE – Dry Cycle to 5000 Cycles	Completed	Completed	**Acceptable**
3.3 ACCURACY			
3.3.1 Accuracy & POI Testing			
3.3.1.1 TLW0010AF – Point of Impact	Not Done	Completed	**Acceptable**
3.3.1.2 TLW0010AG – Group Size at 100 Yards	Completed	Completed	**Acceptable**
3.4 ENVIRONMENTAL TESTING			

3.4.1 Temperature & Humidity Testing			
3.4.1.1 TLW0010AH – Hot Function Test	Completed	Completed	**Acceptable**
3.4.1.2 TLW0010AI – Cold Function Test	Completed	Completed	**Acceptable**
3.4.1.3 TLW0010AJ – Thermal Cycle Test	Completed	Not Tested	**Acceptable**
3.4.1.4 TLW0010AK – Heat & Humidity Test	Completed	Not Tested	**Acceptable**
3.4.2. Debris Testing			
3.4.2.1 TLW0010AL – Dynamic Sand & Dust Test	Completed	Completed	**Acceptable**
3.4.2.2 TLW0010AM – Static Sand & Dust Test	Completed	Completed	**Acceptable**
3.4.2.3 TLW0010AN – Field Debris Test	Issues	Completed	**Acceptable**
3.4.3 Misc. Tests			
3.4.3.1 TLW0010AO – Rain Test	Completed	Completed	**Acceptable**
3.4.3.2 TLW0010AP – Solvent Test	Completed	Not Tested	**Acceptable**
3.5 ABUSIVE TESTING			
3.5.1 Impact Testing			
3.5.1.1 TLW0010AQ – SAAMI Drop Testing	Not Tested	Completed	**Passed**
3.5.1.2 TLW0010AR – SAAMI Jar-Off Testing	Not Tested	Completed	**Passed**
3.5.1.3 TLW0010AS – SAAMI Rotation Testing	Not Tested	Completed	**Passed**
3.5.1.4 TLW0010AT – Extended SAAMI Jar-Off Testing	Not Tested	Completed	**Information Only**
3.5.1.5 TLW0010AU – Extended SAAMI Rotation Test	Not Tested	Completed	**Information Only**
3.5.1.6 TLW0010AV – Extended SAAMI Drop Test	Not Tested	Completed	**Information Only**
3.5.2 Intentional Abuse			
3.5.2.1 TLW0010AW – Pierced Primer Test	Completed	Not Tested	**Acceptable**
3.5.2.2 TLW0010AX – High Pressure Test	Completed	Not Tested	**Acceptable**
3.5.2.3 TLW0010AY – Obstructed Bore Test	Completed	Not Tested	**Acceptable**

3.0 DATA SUMMARY

3.1 INITIAL INSPECTIONS, TESTS & MEASUREMENTS

3.1.1 Headspace & Proof Testing

3.1.1.1 TLW0010A – Measure Headspace

Headspace for this firearm is the distance between the face of the bolt and the point of contact on the shoulder of the chamber. Excessive headspace can result in an unsupported shell case allowing the case to stretch and potentially rupture and thereby dump high pressure gas into the breech area. This pressure can potentially cause damage to the firearm and/or shooter. Headspace dimensions are clearly specified by both Remington and S.A.A.M.I.. Remington specifications for centerfire rifles require that headspace not exceed "min." chamber +.009".

For rifles A-1 to A-15 (Phase I) and rifles B-1 to B-30 (Phase II) all of the rifles were in the range of min. to min. +. 004 prior to proof testing. *(See Section TLW0010A; B.1 & B.2.)*

3.1.1.2 TLW0010B – Proof Test

The proof test requires that a firearm be subjected to at least one round that generates a substantially higher chamber pressure than that which it is expected to be subjected to during normal use with standard ammunition. Prior to and immediately after a proof round is fired the rifle is examined for any indications of damage due to excessive pressure.

Inspection of all rifles, both Phase I and Phase II, after proof did not exhibit indications of damage due to high pressure for bolts, locking surfaces, chambers or other components. *(See Section TLW0010B; B.1 & B.2.)*

3.1.1.3 TLW0010C – Re-Measure Headspace after Proof Test

After proof, headspace is again measured on each firearm. All rifles must remain under the min.+.009" limit. In addition, there is a requirement of the test plan that no headspace measurement can be greater than .002" from the pre-proof measurement. All rifles tested met this criterion. *(See Section TLW0010C; B.1 & B.2)*

3.1.2 Forces

3.1.2.1 TLW0010D – Firing Pin Indent

Firing Pin Indent is measured to insure that there is sufficient energy available when the firing pin impacts the cartridge primer to initiate ignition. The depth of the firing pin indent should be at least 0.017" "…in order to insure against misfires chargeable to the firearm…" (Ref. S.A.A.M.I. Technical Committee Manual, Vol. VII Centerfire Rifle, Section 7-50.03)

The test lab uses the average of three trials to determine the value of each rifle's indent. For Phase I rifles (A1-A15) , the mean of all 15 rifles was 0.01887". The minimum value for this sample was 0.01770" and the maximum value was 0.01970".

For Phase II, the mean of all thirty rifles was 0.01722". However, in this sample there were 10 rifles that measured less than 0.017". The minimum value observed was 0.015". There are currently no known plans to change the design to address this discrepancy relative to the recommended S.A.A.M.I. standard. It should be noted that no misfires occurred during DAT testing that could be attributed to the rifle. *(See Section TLW0010E; B.1 & B.2.)*

3.1.2.2 TLW0010E – Sear/Trigger Engagement and Sear Lift

The amount of engagement (or overlap) of the Sear Safety Cam and the Trigger connector is required to be 0.020" to 0.025" with the bolt in the fully closed and locked position. In addition, the required amount of lift for the Sear Safety Cam when the safety in placed in the "Fire" must be a minimum of 0.006" and a maximum of 0.018". For these values, the test lab uses the average of three trials.

Phase I measurements revealed that the mean for Sear/Trigger Engagement was 0.02265" with a minimum value of 0.01773" and a maximum value of 0.02870". There were two values below the minimum specification of 0.020" and two values above the maximum specification value of 0.025". For the Sear Lift specification the mean of the fifteen samples was 0.00959" with a minimum value of 0.00727" and a maximum value of 0.01137".

Phase II measurement for the mean of the thirty samples for Sear/Trigger Engagement was 0.02419" with a minimum value of 0.01990" and a maximum value of 0.02750". There was one value below the minimum specification of 0.020" and four values above the specification of 0.025". For the Sear Lift specification the mean of the thirty samples was 0.01596" with a minimum value of 0.01140" and a maximum value of 0.01870". There was one value in the sample that was greater than the upper specification of 0.018". There were no values below the lower specification of 0.006". *(See Section TLW0010E; B.1 & B.2)*

3.1.2.3 TLW0010F – Trigger Pull Forces

Trigger pull is the force required to manually operate the trigger and release the firing pin and is measured in accordance to S.A.A.M.I. (Ref. S.A.A.M.I. Technical Committee Manual, Vol. VII Centerfire Rifle, Section 7-150.01-note that S.A.A.M.I. sets only a minimum trigger pull of 3.0 lb.) and Remington standard test procedures. The placement of the spring scale force gauge was in the center of the finger radius of the trigger and the direction of pull was horizontal and parallel to the long axis of the barrel bore. Three trials were made on each sample rifle and the average used as the final value of the trigger pull force. <u>The Remington specifications established for this product are a minimum trigger pull of 4.0 lb. and a maximum of 5.0 lb</u>. Trigger pull forces were re-adjusted to this specification prior to the continuation of testing if found to be above or below the specified limits. Trigger pulls were taken both with the actions in the stocks and independent of the stocks. *(See Section TLW0010F; B.2)*

For Phase I one of the fifteen samples averaged 3.982 lb. . All other Phase I samples were between 4.0 lb. and 5.0 lb. . *(See Section TLW0010F; B.1)*

For Phase II rifles four rifles were over the 5.0 lb. limit and were re-adjusted to the specified limits. One rifle was found to be at 2.0 lb. (measured as assembled in the stock) which was under the S.A.M.M.I. recommended minimum and was re-adjusted up to above the 4.0 lb. Remington limit. *(See Section TLW0010F; B.2)*

3.1.2.4 TLW0010G – Safe On/Off Forces

The amount of force required to move the Safety from the "On-Safe" position to the "Fire" position and the force required to move the Safety from the "Fire" position to the "On-Safe" position. The first requirement is a S.A.A.M.I. specification (Ref. S.A.A.M.I. Technical Committee Manual, Vol. VII Centerfire Rifle, Section 7-130.01) and specifies that the firearms with a manual safety have a force of at least 1 lb. to move the safety from the "safe" position to the "fire" position. All sample rifles measured in both Phase I & II met this requirement. The second specification was taken for information only.

Phase I sample rifles averaged 4.084 lb. for "Safe-On" to "Fire" position force and 3.1615 lb. for "Fire" to "Safe-On" position force.

Phase II sample rifles averaged 2.538 lb. for "Safe-On" to "Fire" position force and 5.757 lb. for "Fire" to "Safe-On" position force. *(See TLW0010G; B.1 & B.2)*

3.1.2.5 TLW0010H – Bolt Lift and bolt closing Forces

The force that was required to open the bolt and the force required to close the bolt were determined for each designated sample. Both forces were taken with chamber empty and then repeated, this time with a new dummy round in the chamber. There is not a specification for these characteristics and the readings were taken for information only. See Table following. *(See TLW0010H; B.1 & B.2)*

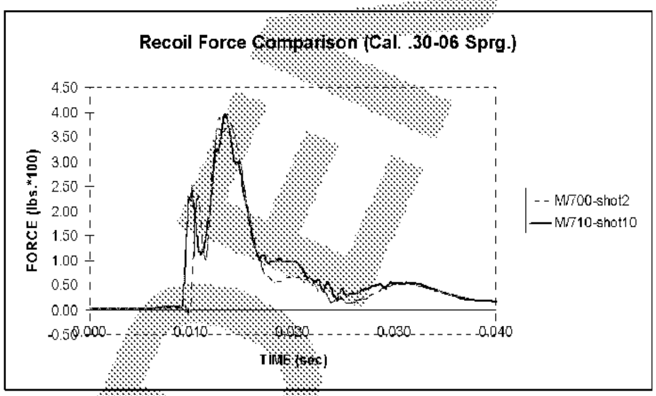
	PHASE I (n = 10)		PHASE II (n = 9)	
	OPEN FORCE	CLOSING FORCE	OPEN FORCE	CLOSING FORCE
EMPTY CHAMBER	6.250	3.013	3.320	2.730
ROUND CHAMBERED	6.529	3.482	Not Measured	Not Measured

3.1.2.6 TLW0010I – Magazine Spring Force

The force required to depress the magazine follower in the magazine box when pushing the follower down a distance of 1.0 inches (after an initial 0.2" depression) was measured during both phases. There is not currently an established specification for this characteristic but design requested that the measurement be made to gather information for possible future use. An average of three trials was made on each sample. Two sets of measurements were made for each test phase, the first at the 0.2" position and the second at the 1.0" position. *(See TLW0010H; B.1 & B.2)*

PHASE I (n = 3)		PHASE II (n = 10)	
0.2" Position	1.0" Position	0.2" Position	1.0" Position
1.88 lb.	3.28 lb.	1.90 lb.	2.98 lb.

3.1.2.7 TLW0010J – Recoil Force



During Phase II a measurement of recoil force was made to compare the Model 710 with a Model 700 firing .30-06 ammunition. Statistical analysis of the data using ANOVA procedures indicates that there is a statistically significant difference (at the 95% confidence interval) for both the peak force measurement and the area under the force time curve. While the data indicates a statistical difference, from a practical point of view the differences are insignificant. The difference of approximately 8-9 lb. in peak values is unlikely to be discerned by most shooters as being a difference in recoil. Studies done in 1948 (see Remington Progress Report AB-48-31, prepared by F.G. DuPont) indicated that "...a minimum difference of 20 lbs. in maximum shoulder force *(i.e. peak force)* between guns is indicated as being required for reliable discrimination by the shooter." (Page 2 of ref. cited above.) In addition, the above reference states "Subjective recoil sensation is found to correlate well with maximum shoulder force." (Page 2.) *(See TLW0010J; B.2)*

3.1.2.8 TLW0010K – Lock Time

Lock time was measured during Phase I only. The average of three trials on each sample was used for the measurement of lock times. Average lock time was 2.89 ms with a minimum of 2.74 ms and a maximum value of 3.09 ms. *(See Section TLW0010K; B.1)*

3.1.2.9 TLW0010AZ – Firing Pin Head to Sear Engagement

An important characteristic identified by Design as important to proper function of this model is the relationship of the firing pin head to the sear safety cam. Design has determined that the minimum acceptable engagement must be equal to or greater than 0.060". This characteristic was measured during Phase II only. The data measured on all thirty sample rifles indicated a mean value of 0.071" with a minimum value observed at 0.065" and a maximum value at 0.077". *(See TLW0010AZ; B.2)*

3.1.3 Weights of Major Components

3.1.3.1 TLW0010L – Overall Weight

Weights of the product and weights of various major sub-assemblies are considered to be important parts of the product description. Of the weights measured, Overall Weight of the product is the most important relative to customer perception and acceptance and in the case of overall weight are generally listed in the catalog. Customers generally want a hunting rifle to be as light as practical for carrying into the field.

Ten Phase II sample rifles were weighed as complete rifle systems (without the scope included and without the magazine box installed.) The magazine boxes would normally have been included in the weight of the complete assembly but were unavailable for weighing due to other testing requirements on the boxes at the time. Note that the weight of a magazine box is approximately 0.215 lb. The average weight of the rifle was measured at 6.894 lb. The 95% confidence interval was calculated at 6.886 lb. to 6.903 lb.. The average weight of a comparable Model 700 is approximately 7-3/8 lb. (e.g. the Model 700 ADL Synthetic, 22", Long Action.) *(See Section TLW0010L; B.2)*

3.1.3.2 TLW0010M – Weight of Stock Assembly

The weight of the stock averaged 2.346 lb.. The 95% confidence interval is 2.342 lb. to 2.349 lb.. The stock is approximately 34% of the complete assembly. *(See Section TLW0010M; B.2)*

3.1.3.3 TLW0010N – Weight of Barrel Assembly

The weight of the barrel assembly averaged 3.854 lb.. The 95% confidence interval is 3.847. lb. to 3.861 lb.. The barrel assembly is approximately 56% of the complete assembly. *(See Section TLW0010N; B.2)*

3.1.3.4 TLW0010O – Weight of Bolt assembly

The weight of the bolt assembly averaged 0.654. lb.. The 95% confidence interval is 0.654 lb. to 0.655 lb.. The bolt assembly is approximately 9.5% of the complete assembly. *(See Section TLW0010O; B.2)*

3.1.4 Lengths of Major Components

3.1.4.1 TLW0010P – Overall Length

As with weights, some basic lengths are considered to be important parts of the product description. Of the lengths measured, overall length, barrel length and length of pull is generally listed in the catalog. (Ref. S.A.A.M.I. Technical Committee Manual, Vol. VII Centerfire Rifle, Section 7-40.01and Section 7-40.02). Overall Length averaged 41.769 inches. The 95% confidence interval is 41.747 to 41.790 inches. *(See Section TLW0010P; B.2)*

3.1.4.2 TLW0010Q – Barrel Length

In addition to being listed in the catalog there is a legal requirement that must be met for barrel length. There is a minimum barrel length established by law of 18". (Ref. S.A.A.M.I. Technical Committee Manual, Vol. VII Centerfire Rifle, Section 7-40.01). The rifles in the test sample all measured 22". *(See Section TLW0010Q; B.2)*

3.1.4.3 TLW0010R – Length of Pull

Length of Pull is part of the product description and is listed in the catalog. Average Length of Pull was 13.248 inches with the 95% confidence interval of 13.241 to 13.255 inches. *(See Section TLW0010R; B.2)*

3.1.5 Gun Characteristics

3.1.5.1 TLW0010S – Balance Point

The balance point (as measured from the muzzle) is determined for the primary purpose of setting up the required S.A.A.M.I. drop testing. (Ref. S.A.A.M.I. Technical Committee Manual, Vol. VII Centerfire Rifle, Section 7-95.02). For this Phase II sample the average location of the balance point was 21.9 inches from the muzzle. *(See Section TLW0010S; B.2)*

3.1.5.2 TLW0010T – Drop at Heel and Comb

Drop at Heel and Comb is listed in the catalog and is part of the product description. Drop at the Heel averaged 1.402 inches as measured from the bore. Drop at the Comb averaged 1.297 inches. *(See Section TLW0010T: B.2)*

3.1.5.3 TLW0010U – 40 lb. Trigger Pull Test

This test is specified by S.A.A.M.I. as a test of the safety operation. Per S.A.A.M.I. "The mechanical operation of the safety should not be impaired as a result of the application of a 40 lb. (18.1 kg) force to the trigger in any direction with the safety in the 'on' or 'safe' position." (Ref. S.A.A.M.I. Technical Committee Manual, Vol. VII Centerfire Rifle, Section 7-130.01). The test plan stated the 40-lb. force limit as 50 lb. in error and the tester performed the test using a 50-lb. force. In spite of this error the following before and after characteristics were determined.

	Trigger Pull (lb.)	**Trigger Engagement (in.)**	**Trigger Gap (in.)**	**Fire during Safe Release**	**Fire after Trigger Pull**
Before	4.92	0.0280	0.165	-	-
After	4.91	0.0287	0.133	No	Yes

There was not a significant difference for either Trigger Pull or Trigger Engagement between the before or after application of the 50 lb. load. There was however a significant difference between the before and after Trigger Gap as measured between the rear of the trigger and the trigger guard bow. This was most likely due to the bending of the trigger when the 50 lb. load was applied. The post-test of safety release followed by pulling the trigger did not result in any failures of the firecontrol to function properly.

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```
          One-way Analysis of Variance - 40 lb. Safety test -
        Trigger Gap ( distance from rear of trigger to trigger bow)
    Before application of 50 lb. load vs. After application of 50 lb. load.

Analysis of Variance
Source     DF        SS        MS        F        P
Factor      1 0.0045761 0.0045761   122.35    0.000
Error      16 0.0005984 0.0000374
Total      17 0.0051745
                                 Individual 95% CIs For Mean
                                 Based on Pooled StDev
Level       N      Mean     StDev  ---+---------+---------+---------+---
trig gap    9   0.16478   0.00233                            (--*---)
trig gap    9   0.13289   0.00833  (---*--)
                                   ---+---------+---------+---------+---
Pooled StDev =  0.00612             0.132     0.144     0.156     0.168
```

- NOTE * N missing = 2

3.1.6 Firearms Measurements

3.1.6.1 TLW0010V – Chamber Cast

Casts of the chamber were made using Cerrosafe™. Five chamber dimensions were surveyed using the casts and the 30" optical comparator for measurements.

Chamber Dimensions (LB-153)

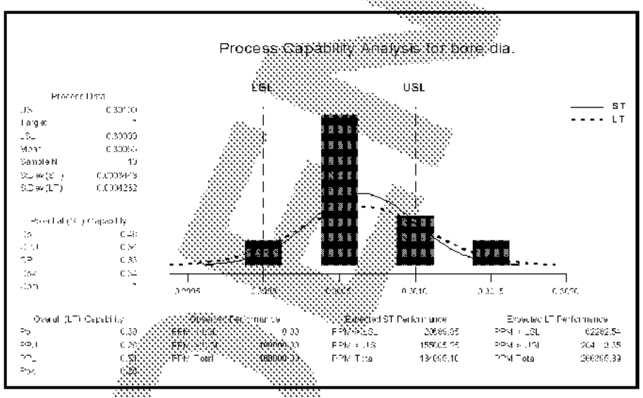
Rifle	.4728/.4708 (1.)	.4440/.4425 (1.)	34 deg. 30"	.3424/.3404 (1.)	.3105/.3095 (1.)
B-1	.4694	.4430	34.09	.3435	.3086
B-2	.4692	.4440	34.67	.3441	.3103
B-3	.4704	.4434	34.40	.3446	.3085
B-4	.4709	.4442	34.33	.3441	.3101
B-5	.4695	.4430	34.26	.3424	.3096
B-6	.4704	.4432	34.50	.3436	.3096
B-7	.4668	.4432	34.59	.3436	.3099
B-8	.4707	.4448	34.59	.3444	.3100
B-9	.4701	.4448	34.58	.3445	.3099
B-10	.4704	.4447	34.53	.3447	.3108
Average	**.4698**	**.4438**	**34.45**	**.3440**	**.3097**
Max.	**.4709**	**.4448**	**34.67**	**.3447**	**.3108**
Min.	**.4668**	**.4430**	**34.09**	**.3424**	**.3085**
St. Dev.	**0.0012**	**.0008**	**0.18**	**.0007**	**.0007**

Notes:
1. Dimensions could not be taken from Breech Face datum. Do not compare to specification.

Dimensions taken using this method indicated that there were several firearms in the sample that did not meet specifications. After investigation it is probable that the measurements that are indicated as being out of tolerance were due to measurement error due to the lack of a physical reference to the bolt face which could not be located using only the castings. Longitudinal specifications as listed on the drawing are taken from the bolt face and are used to determine the location for taking the diameters listed above. This issue was discussed with production. Production stated that their review of the tooling indicated that the dimensions for the chamber were correct. This, along with the lack of performance problems during testing with the firearms that could be assigned to the chamber, would suggest that the measurements taken using the cast method are probably in error and that the measurements of the production tooling are a better overall measure of the chamber dimensions. *(See Section TLW0010V; B.2)*

3.1.6.2 TLW0010W – Bore Diameter

Bore diameter was measured and found to average .3007" against a specification of .300"/.301". *(See Section TLW0010W; B.2)*



3.1.6.3 TLW0010X – Groove Diameter

Groove diameter was found to be near the max end of the tolerance with two of the ten samples over the maximum tolerance limit. This information was relayed to Production where the tooling was reviewed and the rifling buttons were modified. Average groove diameter was calculated at .3090, which is right on the maximum tolerance limit of 0.309 to 0.308 inches. The minimum value was 0.3085" and the maximum value was 0.3099". See Graph next page>

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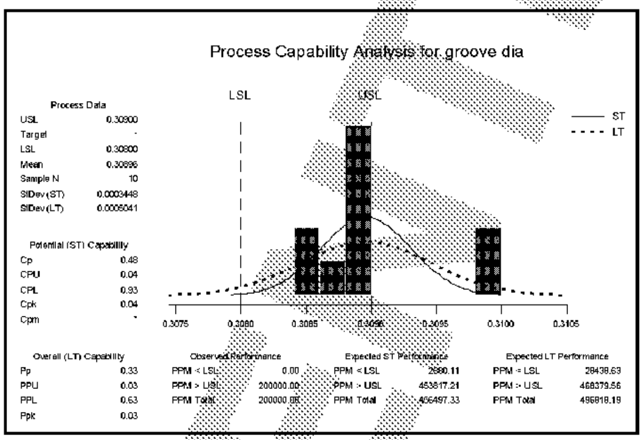
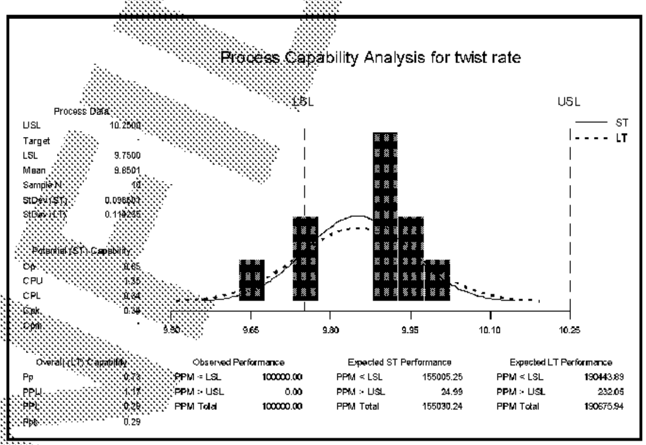


3.1.6.4 TLW0010Y – Twist Rate (.30-06)



3.1.6.5 TLW0010Z – Magazine Capacity Test

Rifles with the magazine fully loaded must be able to be inserted into firearm with the bolt closed and in the locked position. The Model 710 must be able to accept 4 rounds in the magazine and with the bolt closed be able to insert and lock the magazine into the magazine well of the receiver. For this test, three different magazine boxes were tried in each of the ten sample rifles.

With the exception of test rifle B5 all boxes were loaded and locked in the receiver with 4 rounds loaded in the magazine box. On rifle B5 the bolt handle broke on closing the bolt and the rifle was eliminated from this test.

3.2 FUNCTION & ENDURANCE TESTING

3.2.1 Function & Endurance Testing

3.2.1.1 TLW0010AA – Basic Jack Function Test (to 200 Rounds)

MALFUNCTIONS BY RIFLE

RIFLE	TOTAL RDS SHOT	TOTAL MALFUNCTIONS	AVERAGE MALF RATE
B-11	200	15	7.5%
B-12	200	3	1.5%
B-13	200	6	3.0%
B-14	200	0	0.0%
B-15	200	0	0.0%
B-16	200	1	0.5%
B-17	200	0	0.0%
B-18	200	1	0.5%
B-19	200	0	0.0%
B-20	200	1	0.5%
TOTAL	**2000**	**27**	**1.35%**

MALFUNCTIONS BY AMMUNITION TYPE

AMMUNITION TYPE	TOTAL RDS SHOT	TOTAL MALFUNCTIONS	AVERAGE MALF. RATE
REM R30065 180 GR.	400	1	0.3%
REM R30067 220 GR.	400	1	0.3%
UMC L30062 150 GR.	400	7	1.8%
REM PRT3006B 165 GR.	400	7	1.8%

REM R30063 150 GR.	400	11	2.8%
TOTAL	**2000**	**27**	**1.35%**

MALFUNCTIONS BY MALFUNCTION TYPE

MALFUNCTION	TOTAL RDS SHOT	TOTAL MALFUNCTIONS	AVERAGE MALF RATE
STEM LOW	2000	24	1.2%
BOLT OVERRIDE	2000	2	0.1%
FAIL TO EJECT	2000	1	0.1%
TOTAL	**2000**	**27**	**1.35%**

To get an early picture of the product's functional capability, a 200 round per rifle jack function test was conducted. Five bullet types were used. 40 rounds of each in each rifle to evaluate the potential for feeding problems. The test was conducted in the test jacks with the "belly-protectors" in place and fully closed for each shot. All malfunctions and any unusual behavior were noted on the data forms. To be acceptable the overall average of all sample rifles should be at or below 2-% malfunction rate. Up to one rifle from the sample of ten may be removed from the averaging process if it has an excessive malfunction rate relative to the remaining group of nine samples. If this had occurred the rifle would have been investigated by engineering to determine the probable source of the problem and engineering would have provided written documentation for possible inclusion in the DAT report. Test criteria allowed for no major mechanical failures in the test sample. Major mechanical failures are defined as those failures that cannot easily be repaired with simple tools and/or readily available replacement parts. At the conclusion of this test the firearms were carefully examined for signs of excessive wear, with special attention paid to the plastic components.

The major problem experienced during this test was related to the magazine box. Two problems, possibly related, were noted. First, the boxes failed at the assembly welds (see picture below) and second, the boxes were continually deformed by being bowed out at the front of the box by rounds impacting the box. This required that the boxes be pounded back into shape to continue the function testing. There were also dents in the front of the magazine boxes from the bullet points. (See picture below.)

Testing was done on the boxes to determine weld strength. (See reports in the Appendices on weld strength testing.) Corrections were made to the production welding process to address this problem and welding strength re-testing was performed to confirm improved status.

To address the problem of deformation a "dimple" was added on the front surface of the box to reinforce the box.

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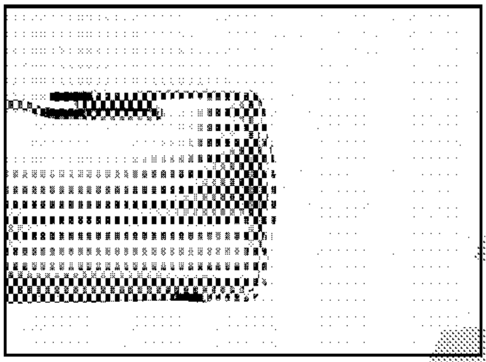
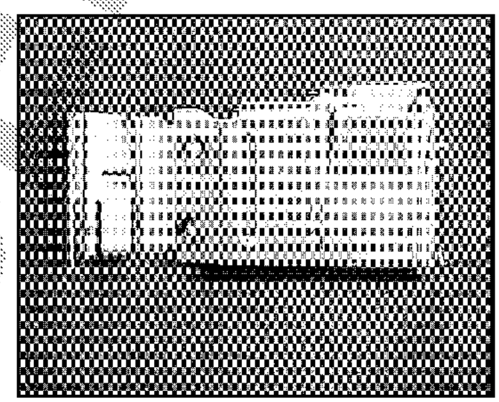
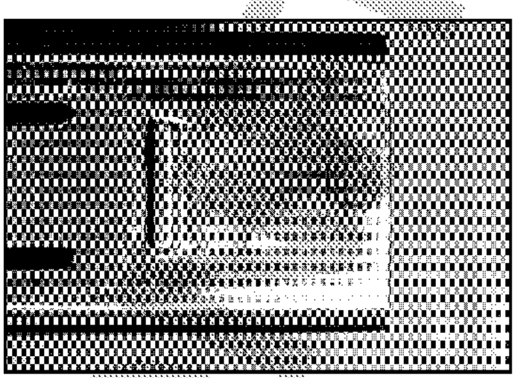


Magazine Box showing deformation at front of box. Note also the separated sides of the box where the welds failed.

Magazine Box, opened at front to show weld spot areas where weld failures occurred. This picture is a production box that was tested in the R&D Metallurgical Lab.





Front of Magazine Box showing the small dents due to the impact of the bullet nose on the front of the box.

3.2.1.2 TLW0010AB – Basic Shoulder Function Test

		Rifle Malfunctions			Magazine Box Related		
Rifle	**Rounds**	**Stem Low**	**Bolt Override**	**F.T.E.**	**Broken Mag. Box**	**Mag. Box Falls Apart**	**Bolt Stop Failure**
B-11	100			1	6	1	5
B-12	100				1		3
B-13	50				1		1
B-14	50				1		
B-15	50						
B-16	50				1		
B-17	50						1
B-18	50				2		
B-19	50				1		
B-20	50						
Total	**600**	**0**	**0**	**1**	**13**	**1**	**10**

OVERALL MALF. RATE = 2.00% - NOTE: Does not include Broken Mag. Boxes (Spot Weld Failure)
OVERALL MALF. RATE = 0.33% - NOTE: Does not include Broken Mag. Boxes (Spot Weld Failure) or Bolt Stop Failure
OVERALL MALF. RATE = 0.17% - NOTE: Only Feeding related malfunctions.

NOTE: BOLT VERY STIFF WHEN CLOSING THE BOLT AND CHAMBERING A ROUND.
DURING TESTING THERE WERE MANY PROBLEMS WITH THE MAG. BOX HOUSINGS COMING APART AT THE SPOT WELD.
SOME OF THE MALFUNCTIONS MAY BE ATTRIBUTED TO THE MAG. BOX WELD ISSUE.

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FEEDING MALFUNCTIONS (F.T.E.) BY AMMUNITION TYPE

	TOTAL ROUNDS	TOTAL RIFLE	AVERAGE
RIFLE	SHOT	MALFUNCTIONS	,MALFUNCTION RATE
REM R30065 180 GR.	120	1	0.8%
REM R30067 220 GR.	120	0	0.0%
UMC L30062 150 GR.	120	0	0.0%
REM PRT3006B 165 GR.	120	0	0.0%
REM R30063 150 GR.	120	0	0.0%
TOTAL	600	1	0.17%

MALFUNCTIONS BY TYPE

	TOTAL ROUNDS	TOTAL RIFLE	AVERAGE
MALFUNCTION	SHOT	MALFUNCTIONS	,MALFUNCTION RATE
STEM LOW	600	0	0.0%
BOLT OVERIDE	600	0	0.0%
F.T.E.	600	1	0.2%
TOTAL	600	0	0.17%

To get a quick picture of the product's functional capability from the perspective of the customer, a 100 OR 50 round per rifle shoulder function test was conducted to evaluate the potential for feeding problems. The malfunctions that occur when shooting from the shoulder may be different from those noted in the test jack due to shooter reactions to recoil that can potentially affect round position in the magazine box. The test was conducted in the long range while shooting from a standing position. Twenty (20) rounds (or 10 rounds in some rifles) of each of five (5) different bullet types were shot in each sample rifle.

As can be observed from the tables above, the majority of problems noted during the shoulder test were with the magazine box. The same problems experienced in the jack-shooting test were observed during this test.

Discounting the magazine box related problems only one malfunction was observed that was related to the rifle itself giving an overall malfunction rate of 0.17%

3.2.1.3 TLW0010AC – Extended Function & Endurance

The Extended Function/Endurance Test was shot to accomplish two purposes. The first purpose was to determine an estimate of the product's expected malfunction rate over an extended period of shooting.

The second purpose was to determine both the estimated life of individual components as well as the expected life of the entire product as a system. For purposes of definition, a component failure was defined as one that prevented (or potentially could prevent) the firearm from functioning as intended. These are failures that can be fixed relatively easily by the simple replacement of a part such as could be done by the gun owner using only simple household tools.

System failures were defined as failures of a major nature, the extent of which would require specialized tooling or methods to repair not normally available to the average gun owner. Such a repair would be most likely made by a qualified gunsmith or by return to the factory. Examples include broken bolt handles and broken firing pins.

The following table lists, by rifle, rounds shot, malfunctions experienced and occurrences of magazine box problems.

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RIFLE	TOTAL ENDURANCE ROUNDS	FAIL TO EJECT	STEM LOW	STEM HIGH	BOLT OVERIDE	FAIL TO FEED	STRAIGHTEN BOX	BOX BOTTOM DETACHES	DOESN'T LATCH
B-11	**10,000**	4	83		1	1	3	1	3
B-12	**5,000**	14	1				4		
B-13	**5,000**	7	6		2		3	5	2
B-14	**1,000**	1			1		3		
B-15	**2,000**	6					3		
B-16	**2,000**	12	4				13		
B-17	**2,000**	3	1	1			12		
B-18	**1,000**		4				11	1	
B-19	**1,000**	20					11	1	
B-20	**1,000**	2	1				12		
TOTAL	**30,000**	**69**	**100**	**1**	**4**	**1**	**75**	**8**	**5**
MALFUNCTION %		**0.23%**	**0.33%**	**0.003%**	**0.01%**	**0.003%**	**0.25%**	**0.03%**	**0.02%**

BROKEN PARTS – ENDURANCE TEST

B-14	Bolt Handle braze failed during inspection
B-12	Firing Pin broke at 1,496 rounds in thread area (replaced with pin from B-14 (1,320 rounds)
B-12	One ear on bolt Plug broken off. Noticed at 3,000 round inspection level.

General comments:

Rifles B-11, B-12 and B-13: Bolt Stop would not work 100% of the time at approximately the 3,000 round level. Shimmed Stock to fix.

Rifle B-13: Number of FTE's reported may be low. Chronic FTE malfunctions noted at 4,400 rounds.

3.2.1.4 TLW0010AD – Clean Rifles and Inspect

3.2.1.5 TLW0010AE – Dry Cycle to 5000 Cycles

One of the purposes of this test was to evaluate the reliability of the ISS system as installed on the Model 710. Five ISS units were tested using a Remington designed dry cycling machine. Each unit was cycled 5000 times. At the completion of the cycles one unit was selected for testing with an additional 5000 cycles.

Peak torque force was measured for both the lock and unlock functions of each unit and compared at zero cycles and at 5000 cycles (and at 10,000 cycles for unit B-6). The peak torque force required to lock and unlock the units averaged approximately 30% less after the 5000 cycles were completed vs. the level at the start.

At the completion of the test the units were disassembled to facilitate visual examination. It was noted that while wear was evident on the parts "...the parts did not appear worn out."

The following two charts were taken from the report authored by B.Rages – "Model 710 ISS Dry Cycle" dated 10/24/00. This report can be found in its entirety in part B.2 *(See Section TLW0010AE; B.2)*

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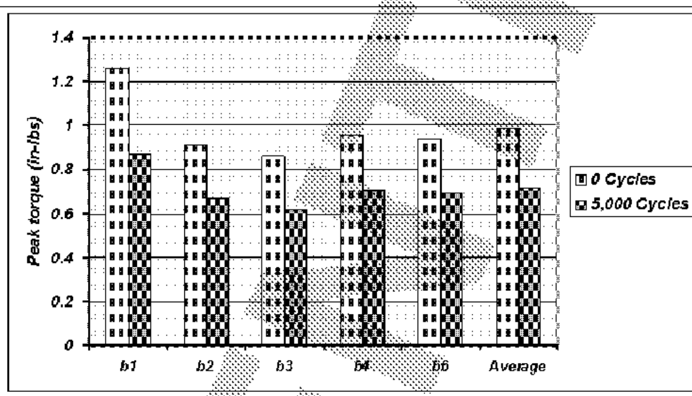


Figure 3. Peak locking torque, before and after 5,000 cycles, average of two measurements.

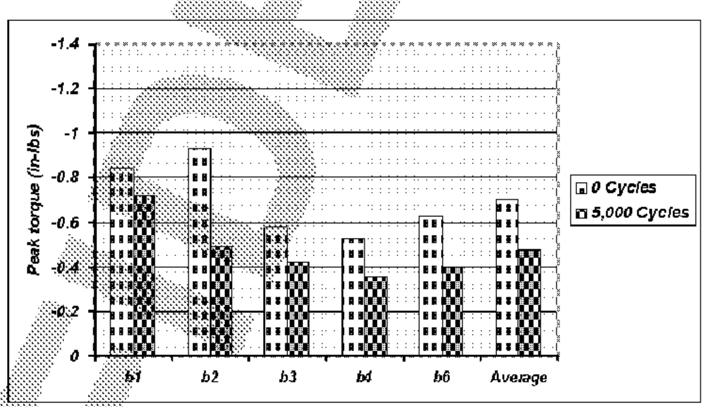


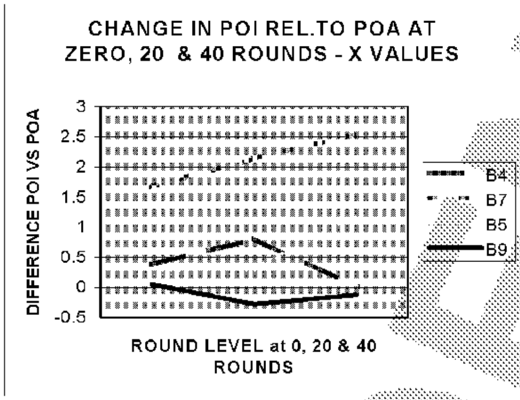
Figure 4. Unlocking torque, before and after 5,000 cycles, average of two measurements.

3.3 ACCURACY TESTING

3.3.1 Accuracy & POI Testing

3.3.1.1 TLW0010AF – Point of Impact

This test was conducted to determine if the Scope system supplied with the M/710 would remain "stable" and maintain scope settings after live firing. Two charts are shown below show the change in Point of Impact (POI) vs. Point of Aim (POA) for four Model 710 rifles over a forty round test.



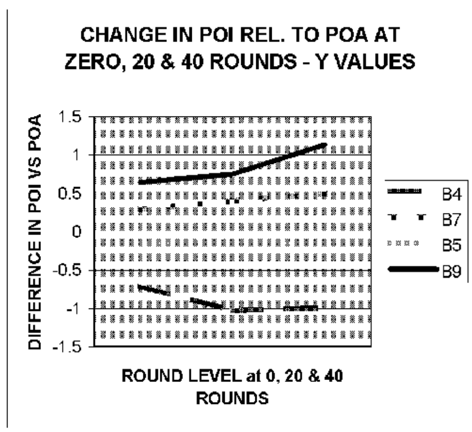
X	ROUND LEVEL 0	20	40
B4	0.38	0.81	0.004
B7	1.67	2.14	2.55
B5	0.23	0.29	1.22
B9	0.05	-0.28	-0.12

The first chart gives the changes relative to the "X" values on the target paper.

The second chart shows the changes relative to the "Y" values on the target.

Y	ROUND LEVEL 0	20	40
B4	-0.71	-1.03	-0.99
B7	0.29	0.4	0.5
B5	-0.21	-0.04	-0.23
B9	0.64	0.75	1.13

Note that Rifles B-4 and B-7 were shot using two Bushnell scopes and Rifles B-5 and B-9 were shot using two Tasco scopes. Ammunition used was Remington R30064, 180 gr. Range was 100 yards.



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One-way Analysis of Variance - POI VS. POA - CHANGE FROM ZERO ROUNDS TO 20 ROUNDS TO 40 ROUNDS.

MODEL 710 - PHASE II TEST
PROJECT 241095
TLW0323
10 OCTOBER 2000

Analysis of Variance - X VALUES

Source	DF	SS	MS	F	P
Factor	2	0.22	0.11	0.10	0.902
Error	9	9.51	1.06		
Total	11	9.73			

```
                                   Individual 95% CIs For Mean
                                   Based on Pooled StDev
Level       N      Mean     StDev  --------+---------+---------+--------
ZERO RDS    4     0.582     0.737   (-------------*--------------)
20 ROUND    4     0.740     1.034     (-------------*--------------)
40 ROUND    4     0.913     1.247       (-------------*--------------)
                                   --------+---------+---------+--------
Pooled StDev =    1.028                  0.00      0.80      1.60
```

One-way Analysis of Variance - Y VALUES

Analysis of Variance

Source	DF	SS	MS	F	P
Factor	2	0.023	0.011	0.02	0.981
Error	9	5.343	0.594		
Total	11	5.366			

```
                                   Individual 95% CIs For Mean
                                   Based on Pooled StDev
Level       N      Mean     StDev  --------+---------+---------+--------
ZERO RDS    4    0.0025    0.5893   (----------------*----------------)
20 ROUND    4    0.0200    0.7710   (----------------*-----------------)
40 ROUND    4    0.1025    0.9161     (----------------*----------------)
                                   --------+---------+---------+--------
Pooled StDev =   0.7705                 -0.50      0.00      0.50
```

The Analysis of Variance above indicates that there is not a statistically significant difference between the zero and 20 round and 40 round levels for either the "X" or "Y" values for the differences between the Point of Impact vs. the Point of Aim for the four rifles. The average difference between the "X" values at the zero round level and the 40 round level is approximately 1/3 inch. The average difference for the comparable "Y" values is approximately 1/10 inch.

3.3.1.2 TLW0010AG – Group Size at 100 Yards

One hundred-yard accuracy testing was completed utilizing standard factory ammunition. The test consisted of three, 5-shot groups. Rifles were cooled after every group. Each firearm was cleaned and fired with five fouling shots prior to beginning the accuracy work-up. Group sizes were measured from actual targets and recorded. The same code of ammunition and same type of ammunition was used for all group size test shots. The standard for Average group sizes was set at ≤ 2.7" at 100 yards.

	BUSHNELL SCOPE		TASCO SCOPE	
Rounds	**B-4**	**B-7**	**B-5**	**B-9**
0	1.417	1.379	1.527	1.545
20	1.368	1.370	1.259	1.444
40	1.567	1.659	1.650	1.258

All group sizes were under the 2.7" minimum. The overall average for all rifles over the 40 round test was calculated to be 1.4157 inches. There was not a statistically significant difference in terms of group size between the rifles using the Bushnell scope and the rifles using the Tasco scope.

The technician stated that the scope was a factor in testing. In the opinion of the technician groups would have been tighter with a higher quality scopes with thinner cross hairs.

3.4 ENVIRONMENTAL TESTING

3.4.1 Temperature & Humidity Testing

3.4.1.1 TLW0010AH – Hot Function Test

The purpose of this test was an evaluation of the effects of extreme high temperature on the functional performance of the product such as would be experienced if the firearm were to be stored in a vehicle such as a truck on a hot summer day with the windows closed. Under such conditions, temperatures could be expected to approach or exceed 120°F. The rifle used in this test was pre-heated to 120°F for 14 hours then shot with 20 rounds at which time the rifle was returned to the chamber for two hours to return the firearm to the test temperature. This cycle was repeated 4 more cycles of twenty rounds each until a total of 100 rounds were shot through the rifle. No malfunctions were experienced.

3.4.1.2 TLW0010AI – Cold Function Test

This test evaluates the effect of extreme low temperature on the function of the product. This test simulates storage in a vehicle during cold weather or carrying the firearm into the field during winter weather. The test rifle was pre-conditioned at -20°F for at least six hours. Every two hours thereafter twenty rounds were fired in the rifle. Between cycles the rifle was re-cooled for two hours.

The first round was a misfire. On the 23rd & 89th round the bolt would not close. The precise reason for these malfunctions was indeterminate.

3.4.1.3 TLW0010AJ – Thermal Cycle Test

This test evaluates the effects of large temperature changes due to expansion and contraction differentials of metallic and non-metallic components used in the Model 710. The sample rifle was alternately cycled between a temperature of 120°F and -20°F for three cycles. Time at each temperature was at least 24 hours. At the completion of the three complete cycles the rifle was allowed to return to ambient temperature for at least six hours. At that time 100 rounds of ammunition were fired in the rifle after which the rifle was examined for any obvious signs that thermal cycling had affected the component parts such as cracking or material creep. Rifle A-11 was used for this test and no problems were noted after the completion of the 100 round test. This test was completed during Phase I and was not repeated during Phase II. *(See Section TLW0010AJ; B.1)*

3.4.1.4 TLW0010AK – Heat & Humidity Test

This test evaluates the potential effects of high heat and humidity on the function of the product such as might be found in a tropical environment. The subject rifle was placed in a large environmental test chamber for a minimum of six hours. The temperature in the chamber was set at 100°F with a relative humidity of 80-90%. After the six-hour storage time the rifle was shot 20 rounds at two hour intervals until 100 rounds total were expended in the rifle.

TIME	ROUNDS FIRED	CHAMBER TEMP.	HUMIDITY	COMMENTS
8:00	20	99°F	97 %	Bolt very stiff to operate
10:00	20	101°F	95 %	Bolt very stiff to operate
12:00	20	99°F	94 %	Bolt very stiff to operate
2:00	20	101°F	100 %	Bolt very stiff to operate
4:00	20	102°F	98 %	Bolt very stiff to operate

No other problems were noted. *(See Section TLW0010AK; B.1)*

3.4.2 Debris Testing

As part of the evaluation of the design three types of abusive tests were included in the DAT, all involving the introduction of foreign material by various means to determine the potential effects of dirt, dust and debris on the function and reliability of the product. The following is a summary report of the testing performed during DAT Phase II related to the results of various debris tests that were performed on the Model 710. For sake of completeness the report is included below exactly as written at the time:

M/710 DAT Phase II
Debris Test Summary
(10/4/00 - Franz)
(Updated: 10/12/00 - Danner)
(Updated: 10/30/00 - Franz)

Introduction:

As part of the original M/710 Design Acceptance Test Plan a series of Abusive Tests were scheduled to be run. This document only summarizes those tests performed during Phase II DAT dealing with Debris. More specifically this document will outline the chronology of events dealing with these tests, what tests were run and when followed by a brief description of test results. You must refer to the specific test in question for more detailed information. As originally planned a single test gun (B-22, Serial. No. **71001278**) was identified that would be used for the three different Debris Tests. These tests are listed below.

Test Title	Test Lab Work Request No.
1. Dynamic Sand & Dust	TLW0010AL
2. Static Sand & Dust	TLW0010AM
3. Field Debris	TLW0010AN

The specific procedures for each of these three tests are documented in the M/710 Design Acceptance Test (DAT #1) Test Plan, Model 710, New Centerfire Rifle, and Revision #2 dated 3/31/00. Gun B-22 was one of ten guns received on Sept. 9th. This gun had Preliminary Measurements taken on the 9th followed by magnaflux of the bolt head on the 11th.

Chronology of Events:

- A Dynamic Sand & Dust Test was run on 9/16/00. Nothing unusual reported by the technicians.
- A Field Debris Test was run on 9/16/00. During this test the first two rounds were fired without incident. On the 3rd round the technicians reported that the gun fired while pushing the Safety from the "On" to the "Off" position. The test was stopped at this time. The gun was disassembled and a small particle was observed between the engagement screw and the trigger.
- It was noted that the procedures for both the Dynamic Sand & Dust and Field Debris Tests were not followed exactly as documented in the Test Plan. The three main procedural differences noted were:
-
    1. The Safety was cycled from "On" to "Off" after every shot was fired. The Test Plan specifically calls out cycling the Safety every 5 shots.
    2. The 10-lb. test procedure was not run in either case as spelled out in the plan.
    3. Only 5 rounds were fired in either test, however the test Plan calls for 20.
- The Field Debris Test was rerun on 9/27/00 per procedure defined in the test plan. The same two technicians were asked to run the test. An attempt was made to fire 20 rounds of ammunition. Seventeen of the 20 rounds were actually fired during the test. A total of four malfunctions occurred. The first malfunction was a Fail-to-Fire that was either a Follow-Down or an obstructed firing pin/firing pin head/Sear. The second through fourth malfunctions were feeding related (1 Fail-to-Feed from Magazine and 2 Stem-Lows). At no time during this test did an inadvertent discharge occur. The gun was again torn down, cleaned, lubricated with trigger pull and engagement reset.
- The Static Sand & Dust was run on 9/29/00. After application of the sand & dust debris the firearm would not fire. Five attempts were made to pull the trigger. At no time did the gun fire. In addition the firing pin did not fall. A new round was fed before the trigger was pulled for each of the five attempts. On the first attempt the trigger did not move. The bolt lift was easy when opening the bolt to cycle the second round, further evidence that the firing pin did not fall. On the second attempt the trigger moved slightly. On each of the three remaining attempts the bolt lift was easy when opened after the trigger was pulled. Trigger movement increased on each successive attempt but not enough to fire the gun. The test was stopped at this time since the gun would not function.
- A new engagement screw was designed by the design team and fabricated for further testing. This screw instead of having a spherical tip had a 60-degree cone shaped tip (see Dwg. B-300448, Alt. D). The full series of Debris tests were rerun to establish performance with this new engagement screw design. All three tests were rerun on 10/3/00. This time two different technicians were assigned to run the tests.
- The same gun, B-22, was torn down, cleaned, lubricated and fitted with the new engagement screw. Trigger pull and engagement were reset.
- During the Field Debris retest with the 60-degree cone shaped engagement screw 2 occurrences of a Fail-to-Fire were encountered. This happened on the 2nd and 8th rounds. During the first Fail-to-Fire trigger movement was detected when the trigger was pulled. No evidence of the firing pin falling was

observed. When the bolt was opened it had a heavy bolt lift, indicating the firing pin was being cocked by the rotation, therefore it was in the fully forward position. On the second Fail-to-Fire no perceivable movement of the trigger was felt when pulled. Again, no movement of the firing pin was detected on this attempt. Bolt lift was again heavy during opening. 18 of the 20 rounds were fired successfully and all steps as outlined in the test procedure were followed. At no time did an inadvertent discharge occur during this test.

- The same gun, B-22, was torn down, cleaned and lubricated. Trigger pull and engagement were reset.
- The Static Sand & Dust Test with the 60 degree cone shaped engagement screw was run next. After application of the sand & dust debris the firearm would not fire. Five attempts were made to pull the trigger. At no time did the gun fire. In addition no evidence of the firing pin falling was detected. This time trigger movement was detected on all five attempts. The bolt opened easily each time the bolt was rotated up, further evidence that the firing pin was in the cocked position. As in the first Static Sand & Dust Test further testing was stopped since the gun would not function. At no time did an inadvertent discharge occur during this test.
- The same gun, B-22, was torn down, cleaned and lubricated. Trigger pull and engagement were reset.
- The Dynamic Sand & Dust Test with the 60 degree cone shaped engagement screw was run last. A total of five malfunctions occurred during this test. The first was a Fail-to-Feed up from the magazine on the second round. The magazine box was removed and the rounds were removed and then reloaded into the box. The round fed ok and fired normally. The next malfunction was a Fail-to-Fire when the trigger was pulled. This occurred on the 3rd round. No evidence of the firing pin failing was detected. Bolt lift was heavy on opening, evidence that the firing pin was in the fully forward or fired position. The 4th and 5th rounds fired normally. The three remaining malfunctions were Stem-Lows that occurred on the 7th, 12th, and 17th rounds, or the 2nd round out of the box in all three cases. In each case the stem was corrected and the round fed and fired. In all a total of 19 of the 20 rounds were fired. At no time did an inadvertent discharge occur during this test.
- Two guns were modified on 10/10/00 to allow for detailed examination of the connector/sear interface. This was accomplished by drilling a "sight hole" through the stock in a location permitting examination of the engagement adjustment hole in the fire control. In addition, the rear plastic portion of the bolt plug was removed to expose the rear of the firing pin head. This interface was modified slightly to allow a custom tool to be threaded into the firing pin head so it could be manipulated manually/separately from the gun and bolt cam.

- Both guns B-4 and B-7 were thoroughly cleaned, the 60 degree cone shaped engagement screw installed, and the fire controls adjusted to nominal engagement and pull criteria.
- Two of the three tests were rerun on 10/11/00. Specifically, these included the Field Debris Test and the Dynamic Sand and Dust Test.
- Gun B-7 (modified as noted above) was selected for the Field Debris Test.
- The firearm was subjected to debris and the test was executed per standard procedure.
- All rounds fired normally with the exception of round #2, which Failed-to-Feed properly from the magazine box.
- At the end of each five round sequence per standard procedure the safety was cycled with the intervening 10-lbs. pull on the trigger. No discharges occurred.
- This completed the Field Debris Test. At no time did an inadvertent discharge occur.
- Gun B-4 (modified as noted above) was selected for the Dynamic Sand and Dust Test.
- The firearm was subjected to the blowing debris in the test box per standard procedure.
- The firearm was removed from the box and relocated to the endurance facility.
- The "primed case" portion of the test successfully passed as indicated by the primed case successfully firing.
- The magazine was loaded with four rounds and inserted into the firearm. It immediately fell out of the gun into the spent round container. The gun was carefully examined and the latch mechanism operated by hand to "free it up". The magazine was shaken in an attempt to remove as much debris as possible from the assembly (At this point the observer considered the magazine status irrelevant to the test). The magazine was reinserted into the firearm.
- The bolt was pushed forward and closed chambering the first round. The magazine was removed and the top round was replaced to bring the magazine content back up to four rounds. The magazine was reinserted into the firearm.
- The safety was moved to the fire state and the trigger pulled. Round fired.
- The bolt was opened and pulled back ejecting the first spent case.
- The bolt was pushed forward in an attempt to chamber the second round. The second round Failed-to-Feed correctly from the magazine box (Stem-Low). The magazine was removed from the firearm along with the second round.

- All rounds were removed from the magazine and then it was disassembled. The components of the magazine were blown clear of debris and then the box was reassembled. All four rounds were reinserted into the magazine.
- The magazine was reinstalled into the firearm and the bolt pushed forward and down to chamber a round. The round was chambered successfully.
- The trigger was pulled – Round did not fire. No motion of the firing pin was detected.
- The firearm and shooting jack assembly was carefully moved backward several inches to expose the "sight hole" added to the stock.
- The sight hole was illuminated via the fiber optic light source obtained from the microscope lab.
- It was clearly evident that the connector was forward and the sear was down.
- It should be further noted that no light could be seen between the sear and connector and that the connector appeared to be resting on the sear.
- The custom firing pin tool was used to pull back on the firing pin head. The sear/connector interface was watched as the head was pulled back.
- After significant movement rearward of the pin the sear began to move up but stopped notably short of allowing the connector to return under the sear. Pulling the head all the way back still did not allow the connector to return under the sear.
- An attempt was made to engage the safety to the safe position while holding back on the firing pin head. Resistance was encountered in attempting to do this so the firing pin was carefully lowered back down to its farthest forward position.
- Another attempt to engage the safety to the safe position while holding back on the firing pin head was made. The connector / sear interface was watched through the sight hole during this process.
- The safety was successfully moved from the fire to safe state although it was significantly more difficult than expected.
- It was observed that the sear was driven forcibly upward by the safety arm.
- Immediately after the sear had risen past the point where the connector could move back under the sear it did so.
- The safety was moved from the safe to the fire position. The trigger was pulled and the round went off as expected. The bolt was opened and pulled back extracting the round.

- The sear / connector interface state was again examined. It was noted that the sear was up and that the connector was under the sear.
- The magazine box was removed (containing the remaining live rounds) and further testing was discontinued.

3.4.2.1 TLW0010AL – Dynamic Sand & Dust Test

See Report above.

3.4.2.2 TLW0010AM – Static Sand & Dust Test

See Report above.

3.4.2.3 TLW0010AN – Field Debris Test

See Report above.

3.4.3 Misc. Tests

3.4.3.1 TLW0010AO – Rain Test

This test is designed to evaluate the product under conditions of inclement weather such as a rain experienced while in the field. The rain was simulated using a chamber to control the application rate. The rate of rainfall was approximately 0.36 inches per square inch per hour (equivalent to a "good steady rain.") The rifle was allowed to remain in the chamber for a test period of six hours. At the end of the rain period and without wiping the rifle dry, the rifle was placed in a shooting jack and a primed case was loaded into the chamber and fired without malfunction.

3.4.3.2 TLW0010AP – Solvent Testing

Solvent testing is performed to insure that commonly used firearms cleaning products, lubricants and other chemicals that might reasonably be expected to come into contact with the product during manufacture or use will not cause damage to the products surface finish or dimensional stability. Tests will be conducted in accordance with ASTM D543-87, which calls for 24-hour immersion in solvents followed by a property evaluation. Hardness or stiffness is the property measured for this test, either quantitatively or qualitatively (where quantitative measurements were impractical). Solvent effects in polymers range from no effect to complete decomposition. Parts that absorb solvents may permanently discolor, crack, craze, or otherwise display failures. The parts also may simply take up solvent when immersed and yield the solvent back when exposed to air with no other property change other than temporary modulus (stiffness) reduction. To support this observation, it is often helpful to separate parts by their amount of solvent uptake, so that the large solvent uptake parts can be more carefully examined.

For the Model 710 Design Acceptance Test a list of synthetic materials used in the product was reviewed. With one exception the synthetic materials used in this design testing were previously completed on the materials when used in other product lines and therefore not repeated for this test. Only the Receiver Insert material was not previously tested it was however similar to the material used in the Bolt Plug and therefore was not tested.

Component	Material Specification	Comments
Magazine Latch	Ultem 1000	Same material as M/597 Magazine Box – Birchwood Casey Gun Scrubber will destroy part.
Bolt Plug	Nylon 6, 6 33% Glass-filled	Note: material changed from original specification of Polypropylene, 15% Glass-filled, Chemically Coupled.
Magazine Box Bottom	Polypropylene, 15% Glass Filled, Chemically Coupled	Same material as M/597 Stock, steel nose insert molded into bolt plug, brass spring retainer ultrasonically welded.
Follower	Polypropylene, 15% Glass Filled, Chemically Coupled	Same material as M/597 Stock, steel nose insert molded into bolt plug, brass spring retainer ultrasonically welded.
Stock	Polypropylene, 15% Glass Filled,	Same material as M/597 Stock, steel

	Chemically Coupled	nose insert molded into bolt plug, brass spring retainer ultrasonically welded.
Receiver Insert	Nylon 6, 6 30% Glass Filled 2% Si, 1% PTFE (Internal Lubricant)	Brass threaded insert ultrasonically welded into receiver insert.

3.5 ABUSIVE TESTING

3.5.1 Impact Testing

3.5.1.1 TLW00104Q – SAAMI Drop Test

This test simulates abusive dropping of a firearm from a vertical distance of 48". There are six orientations used for each rifle:

Barrel vertical, muzzle down,
Barrel vertical, muzzle up,
Barrel horizontal, bottom up,
Barrel horizontal, bottom down,
Barrel horizontal, left side up,
Barrel horizontal, right side up.

A primed case is loaded into the chamber for the drop series. At the completion of the five drops the trigger is pulled firing the primed case to insure that the firearm still functions normally. For this test approximately ½ of the test rifles were dropped with a scope attached to the rifle while the other half of the test rifles were dropped with open sights.

S.A.A.M.I. DROP TEST – PHASE II

	B-24	B-25	B-26	B-27	B-28	B-29	B-30
	OPEN SIGHTS	OPEN SIGHTS	OPEN SIGHTS	SCOPE	SCOPE	SCOPE	SCOPE
Barrel Vertical, Muzzle Up	PASS	PASS	PASS	PASS	PASS	PASS	PASS
Barrel Vertical, Muzzle Down	PASS	PASS	PASS	PASS	PASS	PASS	PASS
Barrel Horizontal, Left side up	PASS	PASS	PASS	PASS	PASS	PASS	PASS
Barrel Horizontal, Right side up	PASS	PASS	PASS	PASS	PASS	PASS	PASS
Barrel Horizontal, Bottom up	PASS	PASS	PASS	PASS	PASS	PASS	PASS
Barrel Horizontal, Top up	PASS	PASS	PASS	PASS	PASS	PASS	PASS

3.5.1.2 TLW0010AR – SAAMI Jar-Off Test

The objective of this test is to simulate abusive impacting (or bumping) of the firearm against a hard surface from a vertical height of 12 inches. The same orientations used for the drop test above are used for this test.

S.A.A.M.I. JAR-OFF TEST - PHASE II

	B-24	B-25	B-26	B-27	B-28	B-29	B-30
	OPEN SIGHTS	OPEN SIGHTS	OPEN SIGHTS	SCOPE	SCOPE	SCOPE	SCOPE
Barrel Vertical, Muzzle Up	PASS	PASS	PASS	PASS	PASS	PASS	PASS
Barrel Vertical, Muzzle Down	PASS	PASS	PASS	PASS	PASS	PASS	PASS
Barrel Horizontal, Left side up	PASS	PASS	PASS	PASS	PASS	PASS	PASS
Barrel Horizontal, Right side up	PASS	PASS	PASS	PASS	PASS	PASS	PASS
Barrel Horizontal, Bottom up	PASS	PASS	PASS	PASS	PASS	PASS	PASS
Barrel Horizontal, Top up	PASS	PASS	PASS	PASS	PASS	PASS	PASS

3.5.1.3 TLW0010AS – SAAMI Rotation Test

This test simulates the effect of a rifle leaning vertically against a wall, tree or other surface and unintentionally falling on one side or the other. There are two orientations used for this test. The rifle is allowed to fall from a vertical position first on one side of the stock then on the other side.

	B-24	**B-25**	**B-26**	**B-27**	**B-28**	**B-29**	**B-30**
	OPEN SIGHTS	**OPEN SIGHTS**	**OPEN SIGHTS**	**SCOPE**	**SCOPE**	**SCOPE**	**SCOPE**
Barrel Vertical; Drop with Left Side Up.	PASS	PASS	PASS	PASS	PASS	PASS	PASS
Barrel Vertical; Drop with Right Side Up.	PASS	PASS	PASS	PASS	PASS	PASS	PASS

3.5.1.4 TLW0010AT – Extended SAAMI Jar-Off Test (for Information only)

This test is similar to the standard SAAMI Jar-Off test but is strictly an internal Remington test and is conducted for information only. The individual rifles are designated at "passing" or "failing" each individual drop and the status recorded. The test guns are dropped from heights of 6", 18"; 24" and 48". The purpose of this test is to gauge the "sensitivity" of the product.

	6"	**18"**	**24"**	**48"**	**Comments**
B-24	PASS	PASS	PASS	FAIL	1 Orientation – Barrel Horizontal; Bottom Down
B-25	PASS	PASS	PASS	PASS	
B-26	PASS	PASS	FAIL	PASS	1 Orientation – Barrel Horizontal; Bottom Up
B-27	PASS	PASS	PASS	PASS	
B-28	PASS	PASS	PASS	FAIL	1 Orientation – Barrel Horizontal; Bottom Down
B-29	PASS	PASS	PASS	PASS	
B-30	PASS	PASS	PASS	PASS	

3.5.1.5 TLW0010AU – Extended SAAMI Rotation Test (for Information only)

This test is similar to the standard SAAMI Rotation test but is strictly an internal Remington test and is conducted for information only; there is no Pass or Fail for the results of the test. The individual rifles are designated at "passing" or "failing" each individual drop and the status recorded. The test guns are dropped first on the left side then on the right side but without the use of the rubber mat used in the other tests. This test was acceptable with no failures noted.

3.5.1.6 TLW0010AV – Extended SAAMI Drop Test: (for Information only)

This test is similar to the standard SAAMI Drop test but is strictly an internal Remington test and is conducted for information only. The individual rifles are designated at "passing" or "failing" each individual drop and the status recorded. The test guns are dropped from heights of 4ft. , 6 ft. and 8 ft. The purpose of this test is to gauge the relative "sensitivity" of the product to severe abuse. Although this test was partially completed, up through a height of 6 ft. Testing was stopped at 6-ft. due to repeated part breakage of scopes, bolt handles and receiver inserts. At no time during this test did any of the rifles fire.

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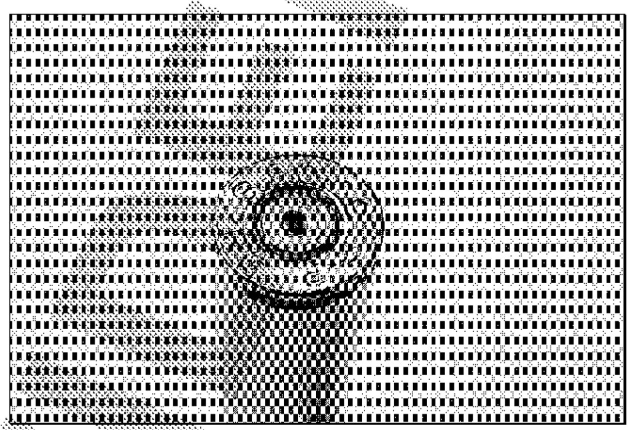
3.5.2 Intentional abuse

3.5.2.1 TLW0010AW – Pierced Primer Test

For this test, a firing pin was altered to make a "wedge-shaped" point. This type of firing pin point usually produces a pierced primer when fired. The purpose of piercing the primer is to allow high-pressure gases to escape into the action and thereby determine the effect of high-pressure gases when dumped into the bolt, magazine box and receiver areas. A standard round of .30-06 ammunition was used for this test. To determine if escaping gas pressure ejects particles that might hit a shooter witness paper is placed just behind the rifle. There were no indications of particles being blown back toward the shooter when this test was conducted.



Pierced Primer Test

3.5.2.2 TLW0010AX – High Pressure Test

This test evaluated the effects of extremely high pressure on the strength of the rifle system. A purpose of this test is to determine the extent of damage that might occur if an individual purposely or accidentally produces a handload that generates a load approximately twice normal factory load pressure. The approximate pressure generated in this test is in the range of 120,000 psi. Although the bolt handle broke off the bolt, the bolt lugs held as did the locking lug area of the receiver. It is believed that the bolt handle was broken during the test when the lanyards used to close the bolt remotely placed excessive stress on the bolt handle during recoil. This stress combined with a poor braze attaching the handle to the bolt resulted in the failure.

There were no other indications of damage to the firearm. No damage to the witness paper was observed.

High Pressure Test

3.5.2.3 TLW0010AY – Obstructed Bore Test

One of the sample rifles had a rifle bullet driven into the bore to a position immediately ahead of the chamber. A standard round (.30-06, 220 gr. factory load) was loaded and fired remotely. All testing was done in the blow-up room using the high-speed video camera and witness paper. Before removing or otherwise disturbing the test samples after blow-up photographs were be taken for the record. After collection and removal of the parts additional photographs of the various individual components were taken for the record. All parts were put in sample bags, boxed and temporarily stored for later review if required.

There was no indication on the witness paper that parts were thrown in the direction of the shooter. The bolt handle broke off from the bolt. Stress from the lanyard and a poor braze joint as noted in the previous test are the probable reason for the failure. The magazine box was blown down from the action and was damaged *(see photos in section TLW0010AY; B.1)*

The shell case was deformed by the high pressure and formed into the extractor shroud area of the bolt. The receiver and barrel experienced no obvious damage.

Obstructed Bore Test