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M/710 Development Status

Overall the development is progressing as scheduled. Eight engineering evaluation test (EET) actions were assembled and are currently in test. EET is typically the first evaluation of representative firearms, providing a complete system analysis versus individual sub-assembly evaluations. Based on the observations and functional performance of the EET actions, design improvements/corrections are implemented for the subsequent design acceptance testing (DAT).

EET Observations/Issues:

During the assembly and testing of EET actions the following issues were noted and will require correction for DAT.

Receiver Insert Assembly

- Bolt Clearance Diameter undersize -- Vendor to build new core at their expense.
- Side Plate assembly pins -- Intended to be press fit into receiver insert, but due to forces acting on the side plate, the pins would not hold. Replaced with screws and nuts to hold assembly together for EET. DAT will have redesigned rivets to capture side plate and receiver insert.
- Safety Pivot pin -- Same issue as side plate pins, intended press fit did not withstand forces, replaced with screw and nut for EET. For DAT pin redesigned to incorporate M/700 snap retaining ring to maintain assembly.
- Trigger Adjustment Screw Pockets -- Molded as slot with side plate to cover and retain the screws. Design change to slot depth to reduce loading of side plate pins. Tool alteration required by vendor, at Remingtons expense.
- Safety Detent -- Redesign required due to non-positive "snap" to safe and fire locations. Prototypes received and shipped for heat treatment. Fallback option is current M/700 component design.
- Receiver Interference Band -- There is a band at the rear of the receiver insert that is of greater diameter than the outside diameter of the receiver insert. This band is intended to provide the interference fit between the insert and the receiver. At the current level of interference, the receiver insert can be easily removed from the receiver. A design change to increase the interference has been issued to the vendor. Alteration required at Remingtons expense.

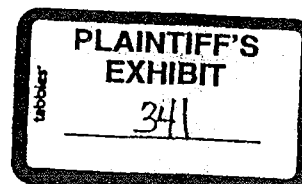
Barrel Assembly

As previously noted, minor improvements to the barrel assembly pressing fixture are required to improve radial alignment of the barrel and receiver. Due to slight misalignment in a few of the EET actions, interference of the trigger assembly and the stock has been noted. In extreme conditions, upon dry firing of the action prior to shooting, the sear stuck in the fired or down position, causing a follow down on the next cycle of the bolt assembly. Alterations were performed to the stocks to eliminate the interference. Corrections to the barrel assembly fixture will be required for DAT assembly.

Magazine Box Assembly

In general the magazines are functioning as desired. The rounds load and feed as desired. At this point in the testing only the 125 grain and 180 grain loads have been test fired. Slight modification of the latch surface of the box was required to ensure the box assembly would remain latched during firing. A design improvement to more positively latch the magazine will be implemented for DAT. In an attempt to minimize the cost of the magazine box development, rapid prototyped followers and box bottoms were purchased. The parts produced by rapid prototyping are dimensionally correct but the material is fairly brittle. During testing, numerous followers and box bottoms have cracked/failed. The intent for DAT is to have as designed molded synthetic followers and box bottoms. There have been occasions during testing where the tabs of

Michael D. J. Scher
Staff Engineer



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the magazine shell (stamped sheet metal) that retain the box bottom deform due to excessive loading during firing. Review of this issue will be required and potentially heat treatment of the magazine shell may be required.

Bolt Assembly

The locking lug geometry of the bolt and barrel dictate that the camming surface, for smooth lock up of the bolt assembly, be machined into the bolt head. In the M700, the cam surface is machined into the receiver. The cam surface as designed and prototyped for EET does not produce a smooth lock up of the bolt assembly. A forward "push" of the bolt handle is required prior to rotation of the bolt assembly into the locked position. Redesign of the cam surface has been completed and a single sample ordered to verify performance. DAT bolt assemblies will include improved cam surfaces.

Design Acceptance Test (DAT)

The objective of Design Acceptance Testing is to verify the performance of the design relative to the design intent. In most instances the DAT has been completed prior to initialization of the process development segment of a new product introduction. The M710 program was presented as more of a process development function than a design oriented program due to the basic bolt action design and targeted manufactured cost. The main objective of the M710 program is a bolt action rifle manufactured at a cost of \$103 and a Jan. 2000 introduction. To meet the Jan. 2000 deadline, a non-standard development schedule was required. As presented during the Feb. 1999 program review, the DAT portion of the M710 program was to include as many production manufactured components as possible. The DAT component procurement was to begin in Feb. 1999 and continue through DAT firearm assembly scheduled for June 25, 1999, with DAT to begin June 28, 1999. At this point in the program, it will not be possible to acquire production processed components; therefore, DAT will be reconfigured as follows.

DAT Rev. #1

By July 15, 1999, R&D will prototype 15 actions (rifled barrel blanks to be provided by Hion). The objective of this test will be to verify the corrections/improvements required as a result of the EET.

DAT Rev. #2

This test will be the "formal" DAT as presented in Feb. 1999. Manufacturing will be required to produce as many of the components for this test as reasonably possible, based on vended component delivery. The timeline will have to be generated by Manufacturing, with the Jan. 2000 introduction as a requirement. Assuming DAT Rev. #1 validates the design, DAT Rev. #2 should verify the manufacturability of the components, allowing the production Trial and Pilot (T&P) to follow closely behind.

Marketing Samples

Additional components to provide limited samples for Marketing analysis/catalog photography will be ordered with the DAT Rev. #1 components.

As stated in the opening paragraph, the program is proceeding fairly well. Although there is still a lot of testing to be completed, the guns are functioning as intended. At this time, there does not appear to be any "show stoppers" from a design standpoint. All of the design improvements/corrections noted to date should easily be completed and implemented prior to DAT Rev. #1. Assuming successful results of DAT Rev. #1, timing of DAT Rev. #2 will dictate our ability to meet the Jan. 2000 introduction date.

Michael D. Koenig
Staff Engineer

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M/710 Design Acceptance Test (DAT) Objectives and Specifications

The test plan as developed by the Test Lab for the M/710 DAT has been broken down into six categories, with sub categories for each. This document will provide the particular objective for each category/sub-category, special considerations, and specific pass/fail criteria. Upon approval of the test plan by the Firearms Director, Test Lab Director, and Test Lab Manager the testing will begin.

The M/710 product offering has been developed and designed around an economic big game hunting rifle. Based on the design principles of a non-replaceable barrel and synthetic receiver insert, this product has a finite life expectancy. Therefore, the test plan endurance expectations and pass/fail criteria have been established accordingly.

The six categories specified by the Test Plan are:

- Measurements
- Function
- Endurance Testing
- Environmental
- Accuracy and Group Size
- Intentional Abuse

Objectives and Specifications:

Measurements

The measurement category involves verification of the basic aspects of the incoming product to be gauged against the product specifications. Included in the "aspects" are static measurements for model drawing verification, dynamic measurements for functional verification, and proof testing for preliminary strength qualification. The following criteria are established as the pass/fail limits for each of the individual measurements as included in each sub-category. Several dynamic measurements are intended to qualify a specific attribute for future reference rather than a pass/fail item.

Proof Testing

SAAMI qualified proof round to be shot in each rifle prior to all other firing. No visible deformation of bolt head, barrel locking lugs, and/or barrel. Inspect the fired case for indication of chamber flaws, i.e. rings, scratches, or concentricity issues.

Pass/Fail: Round fires, extracts and ejects properly, No mechanical deformation of the action, No scratches/rings in case of .005" or greater offset. No greater than .002" headspace growth, final measurement must be within SAAMI min. +.005.

Michael D. Koenig
Staff Engineer

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Static Measurements

Physical Characteristics

Weights

Overall Weight - Documentation Only

Test samples with solid aluminum stock

Stock Assembly - Documentation Only

Test samples with solid aluminum stock

Barrel Assembly - Documentation Only

Test samples with incorrect bolt plug

Bolt Assembly - Documentation Only

Test samples with incorrect bolt plug

Lengths

Overall length - Documentation Only

Test samples with incorrect recoil pad

Barrel Length - 22" +/- .125" from bolt face to muzzle
(30-06, 270)

24" +/- .125" from bolt face to muzzle
(magnum)

Length of Pull - XXXXXXXXXXXXXXXX

Test sample documentation only

Gun Characteristics

Balance Point - Documentation Only

Not required for test samples - alum. stock

Drop & Cast - Drop at Comb - XXXXXXXXXXXX

Drop at Heel - XXXXXXXXXXXXXXXX

Cast off - None

Not required for test samples - alum. stock

Stock Pitch - XXXXXXXXXXXXXXXX

Not required for test samples - alum stock

Chamber Cast - 30-06 Chamber drawing LB-153

.4708/.4728 .4425/.4440 34deg. 30 min.

.3404/.3424 .3095/.3105

Firearm Measurements

Bore Diameter (30-06) - .300/.301

Groove Diameter (30-06) - .308/.309

Twist Rate (30-06) - 1 turn in 10" +/- .25", RH

Measure Headspace - SAAMI headspace gauges

Minimum to min. +.005

Re-Measure headspace after proof - .002" max. growth

Max. = min. +.005

Michael D. Keeney
Staff Engineer

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Dynamic Measurements

- Firing Pin Indents - SAAMI Copper Crushers
 - Average of three indents equal to or greater than .015"
 - SAAMI suggested min. depth is .017"
- Trigger Pull - Force measured parallel to bore with stock attached
 - Trigger contact to be at midpoint of finger radius
 - 3.0 lbs to 5.0 lbs.
- Safe On/Off Forces - Minimum 1 lb. either direction
 - Documentation only, assum. above 1 lb.
- Bolt Opening Force - Documentation only
- Recoil Force - Documentation only, aluminum stock influence
- Lock Time - Documentation Only, expected 3 msec. range
- Magazine Spring Force - Documentation Only
- Engagement (Sear/Trigger) - .020" to .025" measured with bolt closed.

Function

The function category involves verification of the basic mechanical interactions of the firearm components. The objective is to develop a preliminary understanding of the performance level of the test specimens provided, in an attempt to justify progression of testing to the endurance level.

- Magazine Capacity - (4) 30-06/270 rounds, loaded magazine must be able to be inserted into firearm with bolt closed, i.e. (5) shot maximum firearm capacity.
- Basic Function Test - (20) rounds of each of (5) Remington 30-06 offerings
 - Record all malfunctions and performance related comments
 - Pass/Fail -- All guns must be equal to or below 1% malfunctions. No mechanical failure of firearms.
 - Inspect for excessive wear of receiver insert upon completion.
- Shoulder Shooting in Long Range - (10) rounds per rifle shot from shoulder
 - Record all malfunctions and performance related comments.
 - Pass/Fail -- equal to or below 1% malf.
 - no mechanical failure of firearm
- Field Function Test - XXXXXXXXXXXXXXXXXXXXXXXXXXXX
 - Pass/Fail - equal to or below 1% malfunctions
 - no mechanical failure of firearm

Michael D. Kerner
Staff Engineer

Endurance

The endurance category involves verification of extended use performance characteristics. The performance criteria have been specified based on expected consumer usage rates and expected wear characteristics of certain components. As components wear, a reduction in performance level is expected. If components are consumer replaceable, they may be replaced during the endurance testing. The endurance testing results will provide a history of performance trends (if present) and component replacement levels to be used for consumer component replacement requirements.

Function/Reliability

Stage 1 - 400 rounds of various ammo, based on availability

XX guns

Pass/Fail - equal to or less than 1% malfunctions

- no mechanical failure of components

Stage 2 - 500 rounds of (2) types of Rem ammo

XX guns

Pass/Fail - equal to or less than 1 % malfunctions

- no mechanical failures of components

- headspace min. +.005 or less.

Stage 3 - 1000 rounds of (1) type of Rem ammo

XX guns

Pass/Fail - No mechanical failure of bolt and barrel assemblies, no safety related malfunctions or mechanical failures.

Stage 4 - 3000 rounds of (1) type of Rem ammo

(1) gun

Pass/Fail - No mechanical failure of bolt and barrel assemblies, no safety related malfunctions or mechanical failures

Dry Cycle Testing - X guns, 5000 cycles per firearm

Pass/Fail - No safety related failures

Safety forces remain above 1 lb.

Environmental

The environmental category involves verification of firearm performance when subjected to extreme atmospheric conditions and solvents. Although the majority of the test environments are intended to duplicate potential field conditions, several situations are presented that represent a worst possible situation. In these worst possible situations, the objective is to ensure the atmosphere/contaminants will not impede the safe operation of the firearm mechanisms.

Michael D. Keener
Staff Engineer

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Temperature

Hot - Subject firearm at XXX degrees for X hours, fire (5) rounds

Cold - Subject firearm at XX degrees for X hours, fire (5) rounds

Pass/Fail - firearm functions/cycles properly
- no safety related failures

Humidity - Subject firearm to XXX degrees, XX% humidity for X hours, fire (5) rounds

Pass/Fail - firearm functions/cycles properly
- no safety related failures

Drop & Impact - Documentation Only due to aluminum stock.

SAAMI Tests - X guns per SAAMI test procedures

Extended SAAMI Tests - X guns, SAAMI tests at X height intervals.

Dust, Dirt, Debris

Static Sand & Dust - Subject X guns, dry cycle each action (5) times

Sand & Dust - Subject X guns, dry cycle each action (5) times

Field Debris - Subject X guns, dry cycle each action (5) times

Pass/Fail - any malfunction that impedes safe operation of firearm.

Rain Test - Subject X guns to X minutes of simulated rain, dry cycle each action (5) times.

Pass/Fail - no malfunction that impedes operation of firearm, safety or function related

Solvent Test - Verify that all materials used for M/710 components have been evaluated when exposed to common solvents.

Pass/Fail - no safety related malfunction

Accuracy & Group Size

The accuracy and group size category involves verification of the firearms sighting system and potential shot to shot point of impact variation. The open sights must have sufficient adjustment in either direction when the rifle is sighted at 100 yds. Random variation and/or extreme differences in shot to shot point of impact typically, but not always, indicate improper barrel processing and is used as a final inspection flag. The objective of the DAT accuracy and group size testing is to establish a baseline for future reference.

Point of Impact (POI) - Adjust point of impact to bullseye at 100 yds.

Pass/Fail - Slide must be within second line from rear to third line from front.

Aperture must have width of screw retaining shoulder visible to either side.

Group Size - Mount target quality scope, fire (5) five shot groups per rifle with two ammo types (50 rds per rifle). Record maximum center to center spread of each group, record average of all groups per ammo type.

Pass/Fail - Average group size must be below 3.0"

Michael D. Koenig
Staff Engineer

Intentional Abuse

The intentional abuse category involves verification of firearm responses to extreme pressure conditions. Situations may occur during consumer use of the product that may far exceed standard operating pressures. The intentional abuse test is an attempt to simulate situations of extreme pressure. The objective is to ensure that under typical extreme pressure situations, there are no catastrophic mechanical failures that may cause severe damage to the shooter.

Pierced Primer - Intentionally pierce primer when firing cartridge.

Pass/Fail - no mechanical failure of bolt assembly or barrel assembly

High Pressure - Highest obtainable pressure generated by hand loading cartridge

Pass/Fail - no external mechanical failure of the bolt assembly or barrel assembly, the action may remain locked in the fired condition.

Obstructed Bore - Lodged bullet ahead of chamber, fire standard round

Pass/Fail - no external mechanical failure of the bolt assembly or barrel assembly, the action may remain locked in the fired condition

High Pressure/Obstructed Bore - high pressure hand load fired through an obstructed bore.

Pass/Fail - Reference only, no pass/fail criteria.

Summary

The test plan specifications and criteria as detailed above are an attempt to ensure proper function and safe operation of the M/710 product offering. Pass/fail criteria are based on model drawing tolerances, SAAMI specification and/or recommendations, industry standards, or predetermined consumer expectations. Non safety related failures may be accepted by a joint decision of R&D, Manufacturing and Marketing representatives. All failure adjustments must have a signed authorization stating failure and justification for acceptance submitted to the Test Lab Manager. Safety related failures may not be accepted.

Michael D. Koenig
Staff Engineer

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