

MINUTE # 12 - June 30, 1982

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SUBJECT - GENERAL - FIREARMS LUBRICATION-STATUS REPORT

FIREARMS LUBRICATION - STATUS REPORT

Research reported the results of a study to determine which lubricants are most suited to use in firearms (Exhibit 10). Production noted that Du Pont's "Teflon Wet" will be adopted to lubricate Model 700 Fire Controls. They will also evaluate the possibility of replacing Steelgard with bulk "Teflon Wet" for in-process protection of steel parts.

Marketing reported that after reviewing the favorable test results of "Teflon Wet", they are interested in pursuing the possibilities of Marketing this product. They are assisting in the development of a Du Pont strategy that will optimize the marketing of "Teflon Wet", and "Teflon Dry", and consider the Remington branding of a similar product.

MODEL 700 FIRE CONTROL LUBRICATION EVALUATION

Good morning. My name is Evan Ritchie; I am the Sr. Supervisor of the Ilion Firearms Research Testing & Measurement Lab.

Today, I would like to review with you the results to date of the Model 700 fire control lubrication testing.

It is clear we have a problem in firearms due to improper cleaning and lubricating. This is evident by the visible signs of film and gum buildup on returned customer firearms, customer complaints in the field and product liability cases in this area. To improve this situation, the owners manual can be rewritten to include a more detailed description on "How to properly clean and lubricate the firearm." The best available lubricant would be one which offers outstanding cleaning, lubricating and rust preventative properties. Through extensive testing by both a Du Pont Lubrication Consultant and the Remington Research Test Lab, we feel we have found a few lubricants which are much better performers than those presently known in the firearms community.

Today's presentation will review the results of these tests.

Allen B. Hughes, Senior Consultant in the Engineering Service Division's Maintenance Engineering Group of Du Pont, was consulted to evaluate the many different lubricants on the market today for their capability to clean and lubricate a M/700 fire control. It is intended that the cleaning and lubrication procedure be done without disassembly from the receiver and the products used should not gum up the close tolerances of the mechanism. The products selected should be readily available on a nationwide basis, be non-flammable and non-toxic, as well as from -20°F. to 120°F.

Over 40 different products were considered for initial screening. The number was reduced to 25 samples for physical properties and performance evaluations. Some common names of lubricants tested which are related to the firearms industry are Hoppes & Outers Gun Oil, Steelguard, WD-40 and Molykote. The 16 lubricant properties looked at by Du Pont were:

The Test Lab looked at the more practical aspects such as cleaning, lubricating and rust prevention.

Of the 25 samples tested, 5 were rated superior to the others by Du Pont and further testing recommended. These are:

- o Du Pont - Synthetic Diester - "Wet Lubricant"
- o Krylon Ten-4
- o Sprayon 711
- o CRC 3-36
- o Houghton HLP

The Ilion Test Lab has taken these results and have developed additional tests which are more applicable to firearm evaluation. The tests include:

- o Cock and Fire Simulation
- o Environmental / Cold Test
- o Rust Prevention Test
- o Firearms Cleaning Ability
- o Relieved Fire Control Components
- o Ammunition Penetration by Lubricant
- o Fire Control - Gum Buildup Evaluation

Results are as follows:

1. M/700 Cock and Fire Simulation

This test was selected as a first test because the Test Lab felt it would be an excellent evaluation of the lubricating properties of the 5 lubricants recommended by Allen Hughes.

Five M/700 firecontrols per sample lubricant were dry cycle tested to 25,000 cycles or failure whichever came first. Tests were performed on pneumatic actuated equipment which simulate the cocking and firing of the M/700 fire control.

The results of this test are shown here on this slide (DRY CYCLE SLIDE OF RESULTS - DISCUSS)

The Du Pont Synthetic Diesther "Wet Lubricant" finished at the top with Sprayon 711 second and CRC 3-36 third. Houghton HLP and Krylon Ten-4 were eliminated from further testing due to their poor performance in this test.

2. Environmental/Cold Tests

The purpose of this test was to evaluate the lubricating properties over the temperature extremes -20°F to 120°F and to check for rust prevention.

M/700 centerfires and M/1100 shotguns were selected for this test. The test went as follows:

- At 8:00 A.M. each day bolt velocity measurements were taken by the Measurements Lab, utilizing the photo-diode transducer system.
- 100 rounds were fired through each gun.
- All guns were exposed to the environment by being placed on the roof for 3 hours each day.
- They were then placed in a freezer at -20°F for 3 hours. Trigger pull and firing pin indents were taken as guns were removed from the freezer.
- The guns were placed in a stress coat oven at 120°F overnight (16 hours).

The procedure was repeated each day for 5 consecutive days. The guns were then placed on the roof over the

week-end. At 8:00 A.M. Monday, they were removed and bolt velocity measurements were taken.

The guns were then placed in a dry cabinet for 24 hours.

The guns were removed from the dry cabinet and bolt velocity measurements were taken.

At the completion of the test, all the guns were disassembled and examined for rust.

The results of the test are as follows:

For Function:

Du Pont	-	0 Malfunctions
CRC 3-36	-	1 Fail to Connect
711	-	2 Fail to Connect

For Rust Prevention:

Du Pont & CRC	-	Very little rust.
711	-	Greater amounts of rust.

3. Rust Prevention Test

The third test was the Rust Prevention Test. The purpose was to evaluate the lubricants' ability to prevent rust from developing on a firearm continuously exposed to the elements. M/1100 shotguns had their stock and fore-ends removed, and totally degreased. All metal parts were saturated with an assigned lubricant and placed horizontally in a rack on the roof of Bldg. 52 for one month.

Results of the test are:

• CRC 3-36	-	Best
• Du Pont & 711	-	Not as good as CRC 3-36

4. Firearms Cleaning Ability

The purpose of this test was to compare: the cleaning capabilities of each lubricant, and the ability to continue to lubricate after an extended period of shooting.

Sixteen M/1100 shotguns were removed from the Ilion Fish & Game Club. Each lubricant was used as a cleaning agent to clean the dirty components.

The following conclusions were made during the cleaning of the Fish & Game Club shotguns:

- Sprayon 711 emits a heavy fog while spraying. It wiped off better than CRC 5-56 but not as well as Du Pont Synthetic Diesther.

NOTE: CRC 3-36 and CRC 5-56 are slightly different

DISCUSS

- CRC 5-56 became gummy after setting for 1/2 hour. It also was harder to remove grime (i.e., elbow grease).
- Du Pont Synthetic Diesther - cleaned relatively easy and did not gum up after setting.

After cleaning; the guns were degreased, relubricated by sample lubricants and returned to the Fish & Game Club.

Three months later, those 16 guns were inspected.

The following conclusions were made while inspecting the 16 M/1100 shotguns at the Ilion Fish & Game Club.

- Sprayon 711 - performed the worst. Samples showed signs of rust and film buildup.

- CRC 5-56 - performed better than 711. Samples showed signs of good lubrication but some signs of drying and light rust.
- Du Pont Synthetic Diesther - performed the best of all. Samples all showed good signs of lubrication and rust prevention.

5. M/700 Relieved Fire Control Components

Fifteen (15) fire controls were dry cycled to 10,000 or 25,000 cycles. Five (5) fire controls had the sear safety cam, trigger and connector relieved 0.005" - ten (10) fire controls were by 0.010". Each fire control was degreased and lubricated before beginning of the test.

There were no noticeable difference between the lubricants used (Du Pont, CRC and WD-40). (Discuss WD-40 Use)

6. Lubricant Contamination of Ammunition

The purpose of this test was to see if any of the three lubricants being tested would contaminate the primer and cause a misfire or delay fire.

Centerfire and shotgun ammunition were sprayed or soaked in each of the three lubricants for periods ranging from 1 to 7 days and then test fired.

In 80 centerfire rounds shot: Du Pont and CRC 3-36 have experienced only one (1) misfire each. The 711 has had 50 misfires or delay fires.

In ten (10) shotshells shot: There were no misfires or delay fires of these 3 lubricants. We also tested WD-40, Hoppes Gun Oil and Hoppes Solvent just to see if they would cause misfires too.

In 10 shotshells shot: 1 misfire (Hoppes Solvent)

In 20 centerfire rounds:

Spray:	Hoppes Solvent	3 misfire - 1 delay
	Hoppes Oil	3 misfire - 5 delay
	WD-40	0 misfire - 0 delay
Soak:	Hoppes Solvent	16 misfire - 0 delay
	Hoppes Oil	8 misfire - 5 delay
	WD-40	13 misfire - 1 delay

We felt this information was worthwhile to note.

Overall - Du Pont came out equal to CRC and both well ahead of 711.

7. M/700 Fire Control - Gum Buildup

The purpose of this test is to induce gumming of M/700 fire controls using only assigned lubricants.

To date only Steelguard has showed signs of starting to congeal. All others are still liquid.

This is an overview of the test results.

It is easily seen that the Du Pont Synthetic Diesther "Wet Lubricant" offers:

Outstanding lubricating and cleaning properties as well as good rust preventitive.

The writing of the owners manuals on cleaning and lubricating is presently in progress. Both legal and marketing will be contacted for their input and final approval during this process.

MODEL 700

FIRE CONTROL

LUBRICATION

EVALUATION

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FIREARMS RESEARCH
JUNE 30, 1982

PROBLEM

- VISUAL FILM BUILDUP
- CUSTOMER COMPLAINTS
- PRODUCT LIABILITY

CLEANING / LUBRICATING PROCEDURE

- WITHOUT DISASSEMBLY
- NO GUMMING
- NATIONALLY AVAILABLE
- NON-FLAMMABLE
- NON-TOXIC
- -20°F TO 120°F

EVALUATION

DU PONT

- ODOR
- FEEL
- DRYING RATE
- PENETRATION
- SURFACE WETTING
- GREASE DISPLACEMENT
- TYPE CONTAINER
- LIQUID APPEARANCE
- WOOD OPEN PORE
- METAL SURFACE
- RUST REMOVAL
- DISPLACE MOISTURE
- DISPLACE SOLIDS
- GUN BARREL
- WOOD STOCK
- RUST PREVENTION

REMINGTON

- CLEANING
- LUBRICATION
- RUST PREVENTION

RECOMMENDED LUBRICANTS BY DU PONT

- DU PONT SYNTHETIC DIESTHER "WET LUBRICANT"
- KRYLON TEN-4
- SPRAYON 711
- CRC 3-36
- HOUGHTON HLP

FIREARMS TESTS

- M/700 COCK & FIRE SIMULATION
- ENVIRONMENTAL / COLD TEST
- RUST PREVENTION TEST
- FIREARMS CLEANING ABILITY
- M/700 RELIEVED FIRE CONTROL COMPONENTS
- AMMUNITION PENETRATION BY LUBRICANT
- M/700 FIRE CONTROL - GUM BUILDUP

1. M/700 COCK & FIRE SIMULATION

- DU PONT
- SPRAYON 711
- CRC 3-36
- HOUGHTON HLP
- KRYLON TEN-4

2. ENVIRONMENTAL / COLD TESTS

FUNCTION:

- DU PONT - 0 MALFUNCTIONS
- CRC 3-36 - 1 FAIL TO CONNECT
- SPRAYON 711 - 2 FAIL TO CONNECT

RUST PREVENTION:

- DU PONT & CRC - VERY LITTLE RUST
- 711 - GREATER AMOUNTS OF RUST

3. RUST PREVENTION TEST

- CRC 3-36 - BEST
- DU PONT & SPRAYON 711 - NOT AS GOOD AS CRC 3-36

4. FIREARMS CLEANING ABILITY

CLEANING RESULTS:

- DU PONT
- CRC 5-56 (3-36)
- SPRAYON 711

LUBRICATION RESULTS:

- DU PONT
- CRC 5-56 (3-36)
- SPRAYON 711

5. M/700 RELIEVED-FIRE CONTROL COMPONENTS

NO NOTICEABLE DIFFERENCES BETWEEN

DU PONT
CRC 3-36
WD-40

5. M/700 RELIEVED FIRE CONTROL COMPONENTS

6. LUBRICANT CONTAMINATION OF AMMUNITION

- DU PONT
- CRC 3-36
- SPRAYON 711

7. M/700 FIRE CONTROL - GUM BUILDUP

STEEL GUARD - STARTING TO CONGEAL

ALL OTHERS - NO CONGEALING

TEST RESULTS SUMMARY

	<u>DU PONT SYNTHETIC DIESTHER</u>	<u>CRC 3-36 (5-56)</u>	<u>SPRAYON 711</u>
COCK & FIRE SIMULATION	1	3	2
ENVIRONMENTAL/COLD	1	2	3
RUST PREVENTION	2	1	2
CLEANING	1	2	3
RELIEVED FIRE CONTROL	-	-	-
AMMO PENETRATION	1	1	2
GUM BUILDUP	-	-	-

RECOMMENDATIONS

DU PONT SYNTHETIC DIESTHER (WET LUBRICANT)

- BEST LUBRICATING PROPERTIES
- BEST CLEANING CAPABILITIES
- GOOD RUST PREVENTITIVE