Memorandum Report

Noise Suppressor of AR-15 Sub-Machine Gun

JA 465

Colt Industries Inc
Colt's Firearms Division

William C. Davis
Engineering Project Manager

July 19-1965

Commanding General
U.S. Army Test and Evaluation Command
Aberdeen Proving Ground
Maryland

July 19, 1965

Attention: Lt. Colonel LaChaussee

Dear Colonel LaChaussee:

Enclosed is a copy of a Colt's memorandum report, dealing with the noise suppressor on the AR-15 Submachine Gun. The report is self-explanatory.

We had not anticipated, in the original design of the submachine gun noise suppressor, the severity of the firing schedule to which it might be subjected. However, we are glad to have called to our attention, by your tests, the need for improvement. We believe that the problem is satisfactorily solved by the improved design of suppressor.

Mr. William Webb carried to your station, on 16 July 1965, two of the improved suppressors, for delivery to the testing agency in D & PS. We hope that these will enable you to resume the program.

All of the AR-15 submachine guns to be shipped henceforth will be equipped with suppressors of improved design, and new suppressors will be furnished for retro-fitting to the weapons which have already been shipped.

We will appreciate the opportunity to be of service in the event any other problems arise during the course of your testing of Colt's items.

Very truly yours,

COLT INDUSTRIES INC
COLT'S FIREARMS DIVISION

Walter J. Hutchins

Walter J. Hutchins
Vice President - Engineering

One Enclosure
cc (with enc.)
Lt. Col. Yount
Mr. A.R. Hankins, D & PS ✓

Memorandum Report

SUBJECT: Noise Suppressor of AR-15 Sub-Machine Gun

I INTRODUCTION:

1. The AR-15 sub-machine gun is designed with a barrel length of 10 inches, to achieve the most compact feasible configuration. Because of the short barrel, and the relatively high barrel pressure of the 5.56 mm cartridge at this 10-inch point, the noise of the SMG is considered objectionable without a noise-suppressor attachment. Accordingly, a noise suppressor was designed and attached to the SMG. Comparative tests conducted with a decibel meter show that the noise suppressor is effective in serving its intended purpose. The short-barrel SMG, with suppressor attached, produces only about 125 db under the same test conditions in which the regular AR-15 with its 20-inch barrel produces 124 db. In the subjective judgement of some firers, the quality of sound produced by the SMG, with suppressor, is less unpleasant than that of the regular AR-15 rifle or other comparable weapons, being less "sharp."

2. The original design of suppressor has an outer wall of .062-inch thickness. This is quite sufficient to withstand the internal pressure when the material is at temperatures below red heat. Calculations indicate this, and it was confirmed by testing two suppressors in the standard endurance cycle (which provides cooling after each 100 rounds), for 5,000 rounds and 10,000 rounds respectively, without damage. However, tests were not made with a firing schedule severe enough to heat the suppressor to the red-heat range, at which the physical properties of the steel are seriously reduced.

II BACKGROUND:

One specimen of the SMG was submitted to Aberdeen Proving Ground for testing. A report was received from APG on 13 July 1965 that the suppressor had failed during cook-off tests. The circumstances were that 180 rounds, fired in 57 seconds (in accordance with usual cook-off procedures) produced a split in the outer wall of the suppressor assembly. Investigation of the problem was begun immediately at Colt's.

III PROCEDURES AND RESULTS:

1. It was hypothesized that the very severe firing schedule of the cook-off test at APG had raised the temperature of the suppressor assembly into the red-heat range, in which the tensile strength of the material was drastically reduced, and thus induced the failure.

2. To test this hypothesis, the conditions of the APG test were reproduced, insofar as possible, in a test carried out on 14 July 1965 at Colt's. Temperature at the surface of the suppressor, in the middle region, was recorded at appropriate intervals, to enable construction of a heating curve. That curve is one of those (Curve A) shown in Figure 1. At the 199th round fired, in an elapsed time of 80 seconds, the suppressor wall failed by splitting (an axial-plane rupture) in the same manner as was described in the APG test. The temperature at the time of failure was approximately 1150°F. This experiment thus reproduced the APG result, and substantiated the hypothesis regarding its cause. The expected tensile strength of the material at the temperature where failure occurred is only about 25% to 40% of its value in the normal ambient temperature range. The design of the original suppressor is evidently inadequate for high red-heat temperatures, at which the physical properties of the material are so drastically impaired.

3. A solution to the problem was sought by increasing the thickness of the outer wall of the suppressor. A two-fold benefit is thus gained: (1) the strength of the wall is increased at all temperatures, and (2) the rate of temperature increase is somewhat reduced by the increase in heat capacity.

4. To confirm the solution to the problem of noise-suppressor failure, the 450-round phase of EXERCISE II of the APG Sustained-Fire Test was conducted. This consists of firing at 30 rds./min. for 15 minutes. Temperature of the suppressor was taken in the middle region of the external surface after each 30 rounds. (The 450-round phase of EXERCISE III was not employed, because previous experience has indicated that rifles would generally become much too hot for normal handling in sustained fire at 60 rds./min., and furthermore, the test was considered likely to be destructive to the weapon for causes other than suppressor failure.) The heating curve of the improved suppressor at a sustained firing rate of 30 rds./min. is shown in Figure 1 (Curve C), for comparison with the curves obtained in the "fastest deliverable" rate of the simulated cook-off schedule. For purposes of further information, the test was extended to 480 rounds, and immediately upon cessation of firing, temperature measurements were made at the center of the handguard (left lateral surface), at the front edge of receiver (left side), and at the center of carrying handle (left side). These measurements are recorded on the Lab Firing Reports attached, and range from 340°F to 530°F. This indicates that the weapon could not be held for firing in the normal manner, with bare hands, after firing this schedule. The schedule therefore seems somewhat more severe than is practicable in

normal field use, and the successful performance of the improved suppressor in this severe schedule would suggest that this suppressor of improved design does not in itself impose any significant limitation upon sustained field firing of the weapon.

5. To enable comparison of the original and the improved suppressor designs at the "fastest deliverable" firing rate, the latter was fired 300 rounds, measuring temperature at 100-round intervals. The resulting data are plotted in Figure 1 (Curve B). The greater heat capacity of the improved design accounts for the difference in the slopes of the respective heating curves (A and B). The suppressor was undamaged at the conclusion of the 300-round firing, in which a temperature of 1310°F was reached.

IV ANALYSIS AND CONCLUSIONS:

1. The original design of noise suppressor does not provide adequate bursting strength when heated to temperatures above about 1100°F, which temperatures are reached in firing of about 180 to 200 rounds at the maximum possible rate of fire (about 150 - 180 rds./min.).

2. The improved design of noise suppressor, having a thicker outer wall, shows a moderate reduction in rate of heating, but nevertheless reaches a temperature of about 1300°F after the firing of 300 rounds at the maximum possible rate of fire. However, the design of the improved suppressor provides about twice the bursting strength of the original design, at any given temperature. This undoubtedly accounts for the fact that, whereas the original design failed at about 1150°F (after firing less than 200 rounds), the improved design successfully withstood more than 1300°F (after firing 300 rounds) without damage.

3. The improved design of suppressor reaches a temperature of about 920°F in the firing of about 250 rounds at a rate of 30 rds./min., and at that temperature the rate of heat dissipation equals the rate of heat input, so that the temperature is essentially stabilized. Since the improved suppressor has successfully withstood temperatures up to 1310°F in other firing, it is clear that the design could withstand extended firing--indefinitely, from the standpoint of heat-induced failure--at a rate of 30 rds./min.

V RECOMMENDATIONS:

1. The original design of noise suppressor should not be used in any application which may raise the temperature of the outer wall to the red-heat range (about 1100°F), which is reached in the firing of about 180 to 200 rounds at the maximum possible rate of fire. The

strength is sufficient, however, for firing in which the temperature of the suppressor does not reach red heat. At least 100 rounds can safely be fired before cooling.

2. The improved design of noise suppressor can safely withstand at least 200-300 rounds of firing at the maximum possible rate of fire, or firing indefinitely at a sustained rate of 30 rds./min., and the improved design should be used in lieu of the original design in all applications where the severity of these schedules may be approached.

William C. Davis

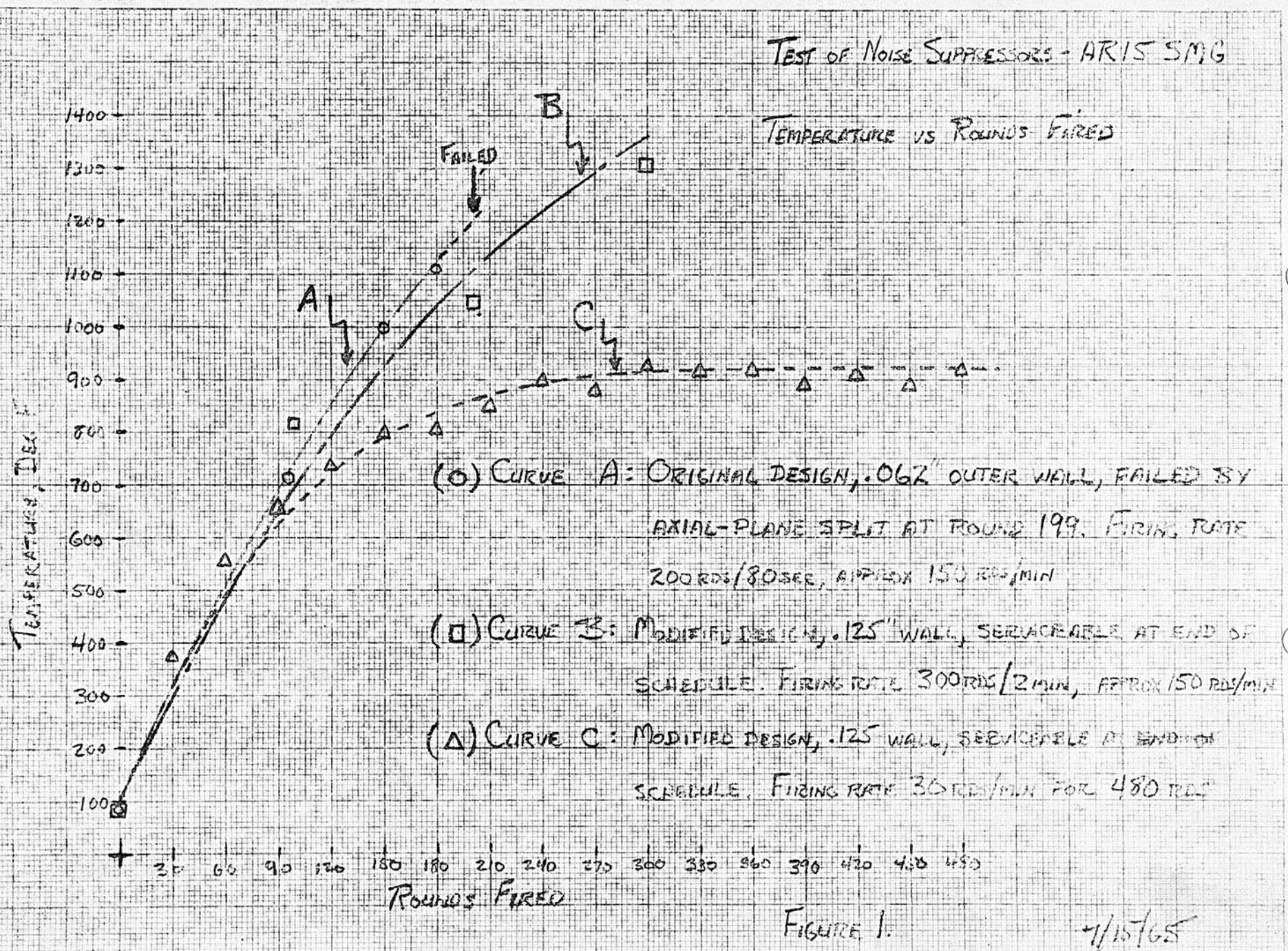
Attachments:

1. Figure 1
2. Lab Firing Reports (3 sheets)

WCD:sam

TEST OF NOISE SUPPRESSORS - AR15 SMG

TEMPERATURE VS ROUNDS FIRED



(○) CURVE A: ORIGINAL DESIGN, .062" OUTER WALL, FAILED BY AXIAL-PLANE SPLIT AT ROUND 199. FIRING RATE 200 RDS/80 SEC, APPROX 150 RDS/MIN

(□) CURVE B: MODIFIED DESIGN, .125" WALL, SERVICEABLE AT END OF SCHEDULE. FIRING RATE 300 RDS/2 MIN, APPROX 150 RDS/MIN

(△) CURVE C: MODIFIED DESIGN, .125 WALL, SERVICEABLE AT END OF SCHEDULE. FIRING RATE 30 RDS/MIN FOR 480 RDS

FIGURE 1.

7/15/65

COLT'S FIREARMS DIVISION

LABORATORY FIRING REPORT

DATE: 14 JULY 1965

WEAPON TYPE: AR15 SMG TECHNICIAN: FITZGERALD

CALIBER: 5.56 mm SERIAL NO. 015586 RANGE: (FUNCTIONING)

PREVIOUS ROUNDS: — TEMPERATURE: 8

AMMUNITION DESCRIPTION: BALL, M193

AMMUNITION LOT NO.: 223-142 MOUNT/POSITION: TEST STAND

ORIGINAL SUPPRESSOR WITH .062" OUTER WALL (DWG GX-6170-6/2/65)

ELAPSED TIME	RD. NOS.	SUPP'R TEMP	REMARKS
0	0	85°F	
—	100	715	
—	150	1000	SUPP'R RED HOT IN CENTER REGION.
—	180	1110	SUPP'R BRIGHT RED IN CENTER REGION
80 SEC	200	(LOST)	SUPP'R SPLIT AT ROUND 199. TOTAL ELAPSED TIME FOR 200 RDS: 80 SECONDS.

COLT'S FIREARMS DIVISION

LABORATORY FIRING REPORT

DATE: 15 JULY 65

WEAPON TYPE: AR-15 - SMG TECHNICIAN: FITZGERALD

CALIBER: 5.56 mm SERIAL NO. 015586 RANGE: (FUNCTIONING)

PREVIOUS ROUNDS: — TEMPERATURE:

AMMUNITION DESCRIPTION: BALL, M193

AMMUNITION LOT NO.: 223-142 MOUNT/POSITION: TEST STAND

ELAPSED TIME	RD. NOS.	SUPP'R TEMP	REMARKS
0	0	82°F	
40 sec	100	820	
80 sec	200	1050	SUPPRESSOR RED.
120 sec	300	1310	SUPPRESSOR BRIGHT RED.
			NO DAMAGE TO SUPPRESSOR AT COMPLETION.

COLT'S FIREARMS DIVISION

LABORATORY FIRING REPORT

DATE: 15 JULY 65

WEAPON TYPE: AR-15 SMG TECHNICIAN: FITZGERALD

CALIBER: 5.56 mm SERIAL NO. 015586 RANGE: (FUNCTIONING)

PREVIOUS ROUNDS: — TEMPERATURE: 82°F

AMMUNITION DESCRIPTION: BALL, M193

AMMUNITION LOT NO.: 223-142 MOUNT/POSITION: TEST STAND

MODIFIED SUPPRESSOR WITH .125" OUTER WALL

(OTHERWISE AS IN GX-6170-6/2/65)

ELAPSED TIME	RD. NOS.	SUPP'R TEMP	REMARKS
0 MIN	0	82°F	
1	30	380	
2	60	560	
3	90	660	
4	120	740	
5	150	800	
6	180	810	
7	210	850	
8	240	900	
9	270	880	
10	300	930	
11	330	920	TEMPERATURES AFTER 480 ROUNDS:
12	360	920	CENTER, SIDE OF HANDGUARD: 450°F
13	390	890	RECEIVER, FRONT, SIDE: 530°F
14	420	910	CARRYING HANDLE: 340°F
15	450	890	NO DAMAGE TO SUPPRESSOR AT COMPLETION
16	480	920	

Distribution of Report on Noise Suppressor of AR-15 Sub-Machine Gun

William C. Davis
July 16, 1965

Col. Yount (w/ letter)
APG (w/ letter) (2 copies)
W. Hutchins
W. Webb
H. McCoan
F. Sturtevant
R. Fremont
S. Percy
R. Roy
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Lab File