INTER-COMMAND/-INSTALLATION/-ACTIVITY

TRANSMITTAL ACTION

JR 25-9

SUSPENSE (If required)	DATE
	27 Aug 70

SUBJECT: Minutes of M16 Steering Group Meeting at Frankford Arsenal

TO:	FROM:	OFFICE SYMBOL
CO APG ATTN: STEAP-MT-D (Mr Gustafson) Pres USAIB	Commanding General USA Test & Evaluation Command APG, Maryland 21005	AMSTE-BC

	APPROPRIATE ACTION		FOR PREPARATION OF REPLY AND RETURN TO THIS OFFICE FOR SIGNATURE
	REVIEW, COMMENTS, RECOMMENDATIONS, AND/OR EVALUATION		CONCURRENCE
	DIRECT REPLY		FOR INPORMATION ON WHICH TO BASE A REPLY
	DIRECT REPLY COPY OF REPLY TO:	X	FOR INFORMATION

OTHER (Specify)

TYPED OR STAMPED NAME, GRADE (If mil), AND POSITION TITLE	FOR THE COMMANDER: (Signature)
GOODWIN MORROW, Tech Dir Inf Mat Test Dir, USATECOM	Goodwin Morrow

NO. OF INCLS	INCL IDENTIFICATION
1	Cy ltr, fm PM Rifles, 14 Aug 70, subj as above, w/1 incl

TO:	FROM:

USE FOR REPLY (If additional space is required, use reverse side)

TYPED OR STAMPED NAME, GRADE (if mil), AND POSITION TITLE	FOR THE COMMANDER: (Signature)

AMC FORM 9 JAN 64 1200-R

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U. S. ARMY MATERIAL COMMAND
PRODUCT MANAGER, M16 SERIES RIFLES
ROCK ISLAND ARSENAL
ROCK ISLAND, ILLINOIS 61201

14 AUG 1970

SUBJECT: Minutes of M16 Steering Group Meeting at Frankford Arsenal

Commanding General, US Army Test & Evaluation Command, ATTN: AMSTE-BC Mr. G. Morrow, Aberdeen Proving Ground, Maryland 21005
Commanding General, US Army Munitions Command, ATTN: AMSMU-RE-M Mr. S. Spaulding, Dover, New Jersey 07801
Commanding General, US Army Weapons Command, ATTN: AMSWE-RES-P Mr. R. Henry, Rock Island, Illinois 61201
Commanding Officer, US Aberdeen Research & Development Center, ATTN: AMXRD-AWD Mr. R. Simmons, Aberdeen Proving Ground, Maryland 21005
Commanding Officer, Frankford Arsenal, ATTN: SMUFA-J1000 Dr. Manning, Philadelphia, Pennsylvania 19137

Attached is the Minutes of the last M16 Steering Group Meeting held at Frankford Arsenal on 28 July 1970.

1 Incl
as

REX D. WING
LTC, OrdC
Product Manager
M16 Series Rifles

MINUTES
M16 STEERING GROUP MEETING
28 JULY 1970
FRANKFORD ARSENAL

1. The 11th meeting of the AMC M16 Steering Group was held at Frankford Arsenal 28 July 1970 for the purpose of reviewing and discussing facts related to the M16 Series Rifle. The tentative agenda, published in advance of the meeting, was modified considerably and (as modified) is attached as inclosure 1. A list of attendees is attached as inclosure 2. A summary of the discussions held on each of the various topics are included in the following paragraphs. Detailed publications in support of each of the topics are attached as inclosures 3 thru 16.

2. Opening Remarks by Chairman. Colonel Rex D. Wing, Product Manager M16 Series Rifles, provided introductory remarks on M16 program status. Topics were reported in some detail and are summarized as follows:

a. Procurement status of the FY-71 buy of M16A1/M16 Rifles.

b. The New Equipment Training Team departure to Europe for introduction of the M16 into that theater.

c. A possible Korean plant for M16 production.

d. Program funding information provided recently to Mr. Ivy and his team of congressional investigators.

e. The favorable status of production at H&R.

f. The scheduled closing of the Product Manager's Office on 30 June 1971.

g. M203 Grenade Launcher status including the plan for a multi-year buy out from a single source, the release of 5,000 launchers to SEA, the die-cast receiver status, and the Quadrant Sight status.

h. M16 rights clauses between the Government and Colt's Inc.

3. Mr. William Davis on behalf of Colonel Parker welcomed all attendees to the Frankford hosted meeting.

4. Development of Math Model Simulating Internal Weapon System Functioning. Mr. Frank Shinaly, Frankford Arsenal, presented a status report on this subject for the period ending 31 July 1970. (See inclosure 3.) A discussion was held following the presentation regarding the practical application of results to the M16 Rifle Program. It was concluded that the 3 or 4 year effort has produced extensive data and should be finalized. Little benefit exists for the M16 Rifle program but may be applicable to future rifle development.

5. Investigation of Design Approaches to Minimize Ammunition Variability. A copy of the presentation made by Mr. Charles Shindler is attached as inclosure 4. It was suggested and agreed upon, that of the 2 "open items" under this topic, quality control of ammunition mass production should be dropped from further review by the Steering Group. Standardization of the 5.56mm primer will continue as a reportable item.

6. Tracer Product Improvement Program. Mr. Peter Jamieson, Jacobson Frankford Arsenal, presented a status report on the guilding-metal, clad-steel, tracer bullet program. (See inclosure 5.) It was noted in the discussion that followed that M~~200~~ 196 Tracer round with the "older" lacquer sealant is still present in the system. The "new" rounds with the improved, non-fouling lacquer are just now going into production.

7. Interior Ballistics/Kinematic Studies. Mr. Stan Lentz, BRL, presented a brief status report on these studies that are very near completion. (See inclosure 6.) LTC Wing asked how many rounds (with a 4 ball and 1 tracer combination) could be fired before the M16 had to be cleaned. Mr. Davis responded that based on endurance testing, the number is higher than 1,000 rounds but depends to a large extent on field conditions. Mr. Crider added that TECOM test results indicate no statistical difference in reliability when firing all ball rounds vs the 4 ball and 1 tracer mix.

8. Development of Improved Instrumentation and Techniques. After lunch, a tour of the proof house was made by Steering Group members to witness the latest instrumentation and test techniques available at Frankford Arsenal. A copy of the formal report is attached as inclosure 7.

9. Profile and Alignment Acceptance Criteria. Mr. Robert Udell, Frankford Arsenal, led the discussion on the possible relaxation of acceptance criteria for ammunition using the profile and alignment gage. A copy of the Frankford Arsenal letter dated 9 June 1970 to the Product Manager, is attached as inclosure 8 for background information. Mr. Udell reported that Frankford has asked seven ammunition producers for an estimate of cost savings if acceptance criteria were relaxed as recommended by industry. Two producers have responded to date with estimates of 50 and 80 dollars

per million rounds produced; these are Remington Bridgeport and Federal Cartridge. These estimates indicate savings of considerably less than originally anticipated. Representatives of Frankford Arsenal agreed to assemble all industry cost data when received and submit this data to the Product Manager along with a Frankford estimate of the probability of successful evaluation of the proposed change. WECOM will also provide probability estimate and will develop time and cost estimates of the evaluation. TECOM will support and provide inputs to the WECOM time and cost estimates.

10. Plastic-Cased Ammunition. Considerable discussion of plastic-cased ammunition was held. It was agreed that development or "product improvement" of a blank 5.56mm round would be the first logical step to utilize the advantages of plastic. It was agreed that the Product Manager would request guidance from AMCRD; Colonel Boggs, regarding the possibility of using PEMA funds for a plastic blank round. The Product Manager will then request MUCOM to provide time and cost estimates with their best estimate of successfully completing a plastic blank program. As much guidance as possible will be provided MUCOM on technical and program restraints due to such items as Blank Firing Attachment development.

11. Muzzle Erosion of Barrel. A very preliminary report was provided Steering Group members by the Product Manager's Office on the subject of barrel erosion at the muzzle end of M16 rifle barrels in SEA. This problem had just been reported by the VLAPA representative in SEA. Rifles are reported to have serious muzzle erosion, thereby making it impossible to zero the weapon; bullet tumbling at less than 25 meters is also occurring. It was concluded that more information and hardware were necessary to examine this first known instance of serious muzzle erosion with the M16.

12. Investigation of Design Approaches to Reduce Sensitivity of the M16 Rifle to Ammunition Variability. Mr. Robert Henry, WECOM, presented the following reports.

a. Ejection Pattern Study (See inclosure 9.)

b. 30 Round Magazine (See inclosure 10.) It was reported to the Steering Group members that Colt's has experienced breaking of the plastic follower in the 30 round magazine. A subsequent check indicates there is no impact requirements stated in Government specifications. A stronger material must be found and added to the specifications prior to fielding 30 round magazines.

c. Extractor Spring (See inclosure 11.)

d. Chrome Bore (See inclosure 12.)

e. Bullet in Bore (See inclosure 13.)

13. Product Improvements Status. A report on the status of various product improvements to the M16 was provided by Jim Gallaugher, Office of the Product Manager.

a. Blank Firing Attachment (inclosure 14). Mr. Andrew Grandy presented several proposed BFA designs using a cleaning rod tip held in the muzzle by a clip inserted through the flash suppressor openings. These very simple designs were estimated to cost no more than 20 cents a piece. Mr. Grandy will remain in touch with Mr. Ray Wier, AMSWE-RES, for inclusion in the WECOM BFA development program.

b. Arms Rack (inclosure 15).

c. Modified Buttstock (inclosure 15).

14. Congressional Interest. The meeting was concluded with a brief presentation by LTC Wing on recent congressional interest in the M16 program. Comments are attached on inclosure 16.

J. R. Gallaugher

J. R. GALLAUGHER
Recorder

AGENDA
AMC M16 STEERING GROUP MEETING
28 JULY 1970
FRANKFORD ARSENAL

I. Opening Remarks by Chairman

II. Frankford Arsenal Task Assignments

A. Development of Math Model Simulating Internal Weapon System Functioning

B. Investigation of Design Approaches to Minimize Ammunition Variability

1. Primer Standardization

2. Quality Control of Mass Production

3. Tracer Product Improvement Program

III. Army Research & Development Center Task Assignment

Interior Ballistics/Kinematic Studies

IV. Development of Improved Instrumentation and Techniques

V. Profile & Alignment Acceptance Criteria

VI. Plastic - Cased Ammunition

VII. Muzzle Erosion of Barrel

VIII. Army Weapons Command Task Assignments

Investigation of Design Approaches to Reduce Sensitivity of the M16 Rifle to Ammunition Variability

1. Ejector Pattern

2. 30 Round Magazine

3. Extractor Spring Life

4. Chrome Bore

5. Bullet in Bore

IX. Product Improvement Status

A. Blank Firing Attachment

B. Arms Rack

C. Modified Buttstock

X. Congressional Interest

A. Investigation for House Appropriations Committee

B. Witloe Proposal

M16 STEERING COMMITTEE

LIST OF ATTENDEES

NAME	INSTALLATION/ORGANIZATION	AUTOVON/EXTENSION
LTC Rex Wing	Hq, WECOM - AMCPM-RS	433-1700 - 5546
Mr. J. R. Gallaugher	Hq, WECOM - AMCPM-RS	433-1700 - 6731
Mr. R. S. Henry	Hq, WECOM - AMSWE-RES-P	433-1700 - 4248
MAJ J. R. Curl	Hq, AMC - AMCGS-F	225-6563/227-5021
Mr. S. W. Spaulding	Hq, MUCOM - AMSMU-RE-M	880-2269
Mr. C. Crider	Hq, TECOM - AMSTE-BC	234-3350 - 3608/3307
Mr. S. S. Lentz	ARDC-BRL - AMXRD-BIL	234-3350 - 4771/2411
Mr. T. L. Brosseau	ARDC-BRL - AMXRD-BIL	234-3350 - 4443
Mr. W. F. Willoughby	ARDC-BRL - AMXRD-AR	234-3350 - 3277
Mr. A. L. Jamieson	FA - SMUFA-L1000	234-1800 - 6247
Mr. P. Gordon	FA - SMUFA-L7400	234-1800 - 24150/3127
Mr. W. C. Davis, Jr.	FA - SMUFA-J9000	234-1800 - 5204
Mr. R. L. Udell	FA - SMUFA-J9400	234-1800 - 24148
Mr. K. Pikus	FA - SMUFA-J9400	234-1800 - 5203
Mr. J. Mikulich	FA - SMUFA-J9600	234-1800 - 5261
Mr. F. Shinaly	FA - SMUFA-J7700	234-1800 - 4200
Mr. B. W. Brodman	FA - SMUFA-J8400	234-1800 - 22247
Mr. C. E. Shindler	FA - SMUFA-J8700	234-1800 - 6112

AMC M16 RIFLE STEERING GROUP

Development of Model Simulating Internal Weapon-System Functioning

Status Report for Period Ending 31 July 1970

A current materialization of the concept for the small arms diagnostic system combines the governing equations for component motion with measured force displacement data for the cycling mechanism. Data inputs consist of force values at evenly spaced displacements. An alternate input consists of a Fourier representation. The first procedure neglects important changes in force magnitude directions (peaks and valleys) while the second procedure is clumsy although valuable for comparing one rifle with another. An interpolation routine now being incorporated into the program accounts for all important sudden changes of force direction. Trial runs are in progress. These are to be followed by a series of sixty runs consisting of three sets of twenty with each set recorded at a different velocity. A typical record appeared as Figure 2 in the minutes of the meeting held 22 April 1970.

Both the steady state and dynamic test fixtures are undergoing modification to correct deficiencies and improve efficiency. Modifications to the steady state fixture, used to obtain the force displacement measurements mentioned in the preceding paragraph, will provide for accomodating greater variability among rifles and simultaneous location of displacement events. Strengthening of the active components of the dynamic test fixture, which conceptually replaces the steady state fixture/on-line computer arrangement, will reduce part breakage and wear as well as provide for greater variability among rifles and ammunition.

In addition to the basic mathematical model incorporated into the diagnostic system there exist a number of auxiliary models for which reports are in the draft or data compilation stage. These models cover ammunition rifle interfaces such as automatic fire models, case ejection, case extraction, cycling mechanism, cartridge feed/driving spring surge, and a variety of specialized but separate computer routines. Among the latter are random bolt pressure time generators, chamber pressure time record qualification, and a modified standard optimization process. In addition a great deal of experimental data exists which requires evaluation and compilation for publication.

The matching criteria between ammunition and rifle identified during the course of the mathematical model formulations relate to an ammunition energy/rifle response characteristic. Evaluation consisted of conducting tests with experimental equipment and computer programs. These evaluations indicate a high probability of success for reducing to practice a concept for a small arms diagnostic system. The present task does not include within its scope the required engineering effort.

INCL. 3

II-E

28-29 July 1970
C. E. Shindler (FA)

TITLE: Approaches to Minimize Ammunition Variability

There are currently two "open items" under this topic, namely:

1. Standardization of the 5.56mm Primer
2. Reassessment of Process & Quality Control of the Mass Production of 5.56mm Ammunition

1. Standardization of the 5.56mm Primer

Action has been taken to direct the effort at TCAAP to the production of the 5.56mm #41 type primer rather than production of the 7.62mm #34 primer as originally planned and previously reported to the M16 Steering Group. This action is taken in view of the cut-back in 7.62mm cartridge production and the continued production of 5.56mm ammunition. Although slippages and delay in funding have occurred with regard to the start-up of the primer mix line at TCAAP, the current schedule calls for the start of pilot production of the #41 primer by March 1971 and complete phase-out of production of the Federal 195 primer at TCAAP by December 1971.

The TDP for the #41 primer (after final coordination with all 5.56mm cartridge producers) will be incorporated into the FY 72 5.56mm ammunition procurement. This should mean that all 5.56mm ammunition will be produced with the #41 primer prior to 1 January 1972. All producers will be capable of making the #41 primer except Federal Cartridge Corporation, however, some arrangement will be made to provide #41 primers to this producer, if requested.

TCAAP intends to introduce the #41 primer into M200 blank cartridge production prior to that of the M193 ball and M196 tracer production. The reason for this is to gain experience and confidence in meeting the more stringent primer sensitivity requirements of the M193 and M196 cartridge (H+3s $\leqq$ 12" and H-3s $\geqq$ 3") since the sensitivity requirements for the M200 cartridge are (H+3s $\leqq$ 13" and H-3s $\geqq$ 2-1/2").

2. Reassessment of Process & Quality Control of the Mass Production of 5.56mm Ammunition

The most recent survey of the GOCO plants with regard to the number of propellant lots loaded into a 5.56mm cartridge lot revealed the following (1 March 1970 through 31 May 1970):

GOCO Plant	No. lots w/1 pwd lot	No. lots w/2 pwd lots
LCAAP	116	2
TCAAP	43	3

INCL. 4

Title: Approaches to Minimize Ammunition Variability (Contd)

Both of these sets of figures reflect the adoption of the policy whereby the quantity of cartridges is varied for the last ammunition lot to accomodate the total depletion of a propellant lot. This is the policy cited in the minutes of the 3 April 1970 meeting.

No further activity on this item is anticipated.

AMC M16 Rifle Steering Group

28-29 July 70

Tracer Product Improvement Program

It was reported at the last meeting of the AMC M16 Rifle Steering Group that test quantities of the Cartridge, 5.56mm tracer assembled with Gilding Metal Clad Steel (GMCS) jacketed bullets were furnished (in Oct 69) the USATECOM facilities at Ft. Greely, Alaska and the Aberdeen Proving Ground. The Arctic Test Center's portion of the Product Improvement Test was completed in February 1970, and while no formal report has been received to-date, informal telephone conversations indicate that no ammunition performance deficiencies were noted. The APG portion of the P.I. test, after repeated rescheduling, was initiated in May 70, and is currently in progress.

On 16 July 1970, a meeting was held at FA, the purpose of which was to review and analyze the APG evaluation of the GMCS jacketed tracer bullet. While testing was only approximately 50% completed at this time, certain ammunition characteristics were becoming evident. Specifically, during sustained fire tests, which entails expending approximately 4000 rounds of straight tracer ammunition in each of several M16A1 rifles, metallic fouling in the rifle bores was exceedingly more prevelant in rifles firing cartridges loaded with ball propellant than in those firing IMR loaded cartridges. The degree of fouling with ball propellant loaded cartridges was sufficient to cause frequent bullet instability and subsequent increased round to round target dispersion. Standard M196 or M193 ammunition was not utilized in this test phase. Other ammunition trends indicated at present include:

1. Tracer ammunition assembled with GMCS jacketed bullets demonstrate superior penetration characteristics in laminated pine boards at 25M, and at 300M, were slightly better than either M196 or M193 bullets.

2. Accuracy obtained from Mann-barrel firings showed that GMCS jacketed bullets had a greater target dispersion than the standard M196 and M193 bullets, and approach the accuracy specification criteria of 5.0" mean radii at 200 yards.

3. During testing completed to-date, no instances of bullet jacket failure or separation have been observed.

NCL, 5

In order to provide additional information on the effects of ball propellant loaded tracer cartridges on metallic bore fouling, the sustained fire test will be repeated using the combat mix of four ball M193 cartridges to one tracer cartridge (GMCS bullets) loaded with ball propellant. To further clarify the possible advantages of using tracer ammunition with ball propellant, an attitudes firing test will be performed. This test will determine the functional reliability of the weapon when firing straight tracer ammunition (with GMCS jacketed bullets) loaded with both ball and IMR propellants.

As mentioned above, the GMCS jacketed tracer bullets produced a target dispersion greater than the M196 bullets. Although this bullet accuracy anomoly is not uncommon during the initial "make-shift" production of any new item and was indeed the case with other bullets entering manufacture for the first time, Frankford Arsenal will request that LCAAP establish a production line for 5.56mm GMCS jacketed bullets. This pilot production line will make the necessary modifications to raw materiel, tool and process design to effect the needed improvements in bullet accuracy.

M16 PROGRESS REPORT for FOURTH QUARTER FY70

INTERIOR BALLISTICS LABORATORY

1. Experimental studies of the effects of variation in temperature port diameter leakage area and vent area of the gas system have been completed and a report has been prepared for publication. The reference will be W. M. Warner "Comparison of a Theoretical and Experimental Study of the Gas System of the M16A1 Rifle", BRL Unnumbered Memorandum Report.

2. Experimental studies of the effects of throttling temperature and leakage in the measurement of pressure have been completed and the report prepared for publication. Reference will be T. L. Brosseau "Development of a Mini-Hat Pressure Transducer for use in the Extremes Environment of Small Caliber Gun Barrels". BRL Memorandum Report, Unnumbered.

3. Experimental studies on the Interior-Ballistic Characteristics of the M16 ammunition have been completed and a report is being written on the:

a. Comparison of 15 sample lots

b. Comparison of the data recorded on the automatic ballistic measuring system with data recorded on a magnetic tape system.

c. Correlation of rate of fire with the interior ballistic characteristic of the 15 sample lots.

4. Experimental studies in the Kinematic Characteristics of a weapon have been completed and the report is being written on the:

a. Forces required for extraction, buffing, feeding, and locking.

b. Pressure at the chamber, port, and cavity with respect to the displacement of the bolt and bolt carrier recorded at temperatures of -65° -40°, $+75^{\circ}$, and $+155^{\circ}$F.

5. Simulation of the M16 rifle is being conducted on an Electronics Associates Inc (EAI) TR48 Analog Computer. Thus far the system has been simulated to the motion of the hammer, firing pin, driving spring, and buffer; the pressure vs time of the forcing function and the impact between the carrier and the receiver.

AMC-M16 STEERING GROUP
INSTRUMENTATION AND TEST TECHNIQUES
STATUS REPORT FOR PERIOD ENDING 30 JUNE 1970

Transient Stress Measurements:

A contract has been awarded to the Kulite Corp. for the placement of semi-conductor strain gages on two 5.56mm weapon barrels. Each barrel is being strain gaged with a total of 20 gages. Ten gages will be mounted along the barrel at the same point on the circumference (active gages). Ten identical gages will be mounted in close proximity to the first (for temperature compensation) with their sensitive axis aligned longitudinal to the barrel (oriented 90° with respect to the accompanying active gages). Comparison tests of pressure-time measurements from the strain gages and piezo electric gages similarly mounted on a third 5.56mm weapon barrel will begin on delivery of the two barrels from Kulite (expected delivery date - August 1970).

The instrumentation developed on this program will improve present pressure measurement techniques in the engineering testing of small caliber ammunition.

Cyclic Time Measurements:

Preliminary tests conducted on the recently acquired Electro Optical Displacement Measuring Unit (Physitech, Model 441) are near completion. The results obtained to date have been very satisfactory, and all intended uses originally envisioned for this unit remain applicable. Within the coming month, the unit will be used in a test program to provide the measurement of the four components of cycle time of the M16 bolt carrier assembly (recoil, counter-recoil, and dwell times).

Heat Transfer:

A proposal for a study evaluation contract has been prepared and submitted to Contract and Purchasing to provide the ground-work for developing an adequate instrumentation system for use in heat transfer studies. The contracted effort will provide the specifications for the required equipment and equipment interfacing necessary for the procurement of a prototype instrumentation system. The system will operate from the following two types of heat sensing devices.

1. Those having direct contact with the equipment under test, such as thermo couples, etc. Applications for this type are:

a. Measurement of internal gas temperature within the barrel and gas tube during weapon function.

b. Measurement of barrel surface temperature under environmentally controlled conditions.

2. Those having indirect contact with the equipment under test such as remotely controlled optical devices. Applications for this type are:

a. Locating and measuring trouble spots in a weapon/ammunition system which may be caused by excessive and unexpected heat generation.

Keele: Visit BRL, we may have to order instrumentation

b. Concentrating on known trouble areas in the weapons/ammunition system such as gas tube clogging, residue build-ups, etc.

c. Providing reliable and accurate history of heat transfer in the total weapon/ammunition system.

Internal Weapon Component Motion:

The test program to evaluate the Electro-Optical Displacement Measuring Unit (physitech, Model 441) is near completion. An M16 rifle bolt carrier assembly has been used as the test subject. The following two probelm areas were encountered, but adequate solutions were developed as described.

1. Since light intensity is the medium used to transmit bolt displacement data to the instrumentation, any metalic glare from parts of the rifle other than the bolt obliterates the desired information. A satisfactory solution was found by placing a polaroid filter in front of the optical head which reduced the glare to an acceptable level.

2. Because the surface of the bolt is not uniform, no linear correspondence exists between the bolt area and light intensity during the bolt travel cycle. This factor is important since the displacement measuring unit functions on the variation of total light energy received (i.e., one interface of the optical image moving with respect to the other). To minimize this non-linearity, two reflectors were positioned along side the rifle and parallel to the direction of bolt travel. The reflectors maximized the light over the previously less illuminated contours of the bolt, thus providing a more uniform illumination of the bolt area of interest.

A few additional tests remain to eliminate a minor problem developing from metalic glare reflected from the brass cartridge cases during extraction. An adequate solution should be to simply view the bolt from another angle. Once these tests are completed, the displacement measuring unit will be used to measure the four components of cycle rate of the M16 bolt carrier assembly for full automatic firings.

Pressure Measuring Equipment:

The Automated Ballistic Measuring System (ABMS) has been modified for use with the piezo electric type pressure transducers as well as the strain gage type. The unit is now capable of being used in a program to determine the suitability of several pressure transducers for production acceptance testing. At present, approximately five pressure transducers are being considered. They were selected because their construction reflects the latest design improvements considered necessary for extended ballistic testing. The transducer selection includes:

1. Kistler, Model 607A1
2. Kistler, Model 214B114-M
3. Kistler (Swiss), Model 6203
4. BRL - Minihat
5. Piezotronics, Model PCB109A

The proposed test plan consists of the following two phases:

1. Transducer Lifetime Tests

This phase includes the prolonged testing, of all transducers selected, under

actual firing conditions. This test is to be a severe endurance test for all transducers, and is intended to establish which gages are most suitable for production testing of small caliber ammunition (i.e., calibration stability, lifetime, etc.)

2. Development of Pressure Acceptance Levels

This phase is intended to develop the criteria for the pressure acceptance testing of 5.56 and 7.62mm ammunition with the use of the pressure transducers selected in Phase 1.

The program will be initiated within the first quarter FY71.

Standard Rifle Mount:

Progress in the development of the exoskeleton and anthropomorphic mount has been steady but slow because of numerous problems encountered in "debugging" the electrical and mechanical systems of both pieces of equipment.

In the present arrangement, the position of the gunner's body is monitored by potentiometers at thirteen locations throughout the exoskeleton, corresponding to the joints of the human torso. These monitoring stations are duplicated on the anthropomorphic mount. A time history of the position of each joint is recorded on a multichannel oscillograph. The elastic and frictional characteristics of the joints of the mount are adjustable, so that it will be possible to obtain identical response motions when the weapon is fired in the mount.

It was found that data from ten-round minimum bursts of automatic fire was easier to interpret and correlate than data from single rounds, because the gunner has a chance to compensate for the recoil and eliminate erratic body movements. At this stage in the experiments, greater reliability of interpretation and correlation is needed to qualify the validity of the data.

The contracted effort on this project has become increasingly oriented towards the human engineering study of the man/weapon interface effect. During the next quarter a concentrated effort will be made to extract all information pertinent to the development of a standard mount from the work accomplished to date, and to terminate the contract. All reports generated from this project will be forwarded to the Human Engineering Laboratory for possible continuation of effort in this area.

JUN 9 1970

A1000-J

SUBJECT: Revision of 5.56mm Cartridge Profile and Alignment Acceptance Criteria

Commanding General
US Army Materiel Command
ATTN: Office of the Product Manager, Rifles
Rock Island Arsenal
Rock Island, Illinois 61201

1. During the 32nd meeting of the Army-Industry Integration Committee on Small Caliber Ammunition, which was held on 29 April 1970, the committee formulated the following recommendation for consideration:

a. Increase the maximum permissible 5.56mm profile gaging force from the current limit of 10 pounds to a new limit of 20 pounds.

b. Allow a protrusion of .002" from the gage in lieu of the current requirement of flush or below.

2. This recommendation was based on the contention that the criteria for acceptance of 5.56mm ammunition in the Profile and Alignment (P&A) gage are unduly restrictive, necessitating the rejection or reworking of some serviceable ammunition, with attendant unwarranted costs of production. In support of the recommendation, the cartridge producers reported that testing at their facilities had demonstrated satisfactory functioning of M16/M16A1 rifles using ammunition which was rejected by the present P&A criteria, but acceptable under the relaxed criteria which were recommended. These tests were, of course, limited to the environment of proof-testing ranges, using weapons which were well maintained.

3. It is estimated that approval of the relaxed P&A requirements recommended by the Integration Committee could result in savings on the order of $200,000 per year, at present levels of procurement. Frankford Arsenal is proceeding to obtain more definitive information to verify this estimate.

Incl 8

SMUFA-A1000-J
SUBJECT: Revision of 5.56mm Cartridge Profile and Alignment Acceptance Criteria

4. It is recognized that the relaxation of the P&A gaging criteria might affect the weapon-system reliability under some conditions. Therefore, it is apparent that adequate testing and analysis should be performed, probably by USATECOM, to determine whether system reliability would be significantly impaired by adoption of the relaxed requirements. In view of the potential savings in the cost of ammunition procurement, it appears that such testing may be justified. Therefore, it is requested that estimates of time and cost be obtained from USATECOM and USAWECOM for the analysis, testing and evaluation which would provide the necessary assurance regarding the effect of the proposed changes in P&A gaging criteria for ammunition acceptance. Upon receipt of this information, and further verification of data on the potential savings in ammunition procurement, Frankford Arsenal will be prepared to respond to the recommendation of the Integration Committee, and to proceed with the action which is most advantageous to the Government in this matter.

EUGENE C. BARBERO
Colonel, Ord Corps
Commanding

EJECTION PATTERN STUDY

PURPOSE:

To eliminate hazard of fired brass to left handed rifleman.

CURRENT STATUS:

The firing tests have been conducted utilizing the extreme spread of presently permitted tolerances and total permitted range of firing rates. Data was taken relating ejection angle to rate of fire. Tests indicate that design change will be required. Redesigned item will be ejector spring. Presently conducting tests with two designs of ejector springs.

PLANNED ACTION:

Evaluate results of present testing and develop redesigned ejector spring.

EXTRACTOR SPRING

PURPOSE:

To increase the life of the extractor spring.

CURRENT STATUS:

Presently the extractor spring is the item that fails first on the M16. Studies are being conducted to determine if the clearance between the extractor and the bolt contribute to early extractor spring breakage. The use of elastomeric materials inside the spring and as a substitute for the spring are being investigated. Laboratory report on the elastomeric materials is expected in November. A redesigned spring has been fabricated. This spring will be tested during chrome plated bore test to be conducted at GE. Results of that test expected in August.

PLANNED ACTION:

To fabricate prototypes utilizing elastomeric materials. Conduct firing tests utilizing the elastomeric materials to determine best material. Evaluate performance of elastomeric materials as compared with standard spring and with redesigned spring test at GE. Also determine if clearance between extractor and bolt contribute to short extractor spring life.

COLT 30 ROUND MAGAZINE

PURPOSE:

To investigate Colt's TDP to determine possible problem areas.

CURRENT STATUS:

Production 30 Round Magazines are not yet available. Dimensional data taken by TECOM has been compared to TDP. Extreme limit study is underway.

PLANNED ACTION:

Evaluate extreme limit study and propose changes to TDP to correct any problem areas uncovered in extreme limit study.

ACCEPTANCE CRITERIA FOR M16/M16A1 RIFLE USING 30 ROUND MAGAZINES

PURPOSE:

To determine the affects, if any, of the 30 round magazine on the purchase description specification for procuring M16/M16A1 Rifles.

CURRENT STATUS:

Detailed Test Program is presently being finalized to statistically address the following anticipated problem areas:

a. What cyclic rate limits should be specified using the 30 round magazine and how many rounds must be fired to meet this specification.

b. What cyclic rate must be met during endurance qualification.

c. In what sequence of firing shall the endurance test be conducted.

The test program will be completed this month in anticipation of a 30 round magazine availability date of September 1970.

EXPECTED RESULTS:

Based on preliminary indications from TECOM and Colt tests, no variation in characteristics is expected between the 20 and 30 round magazine. This study is being made, however, since no previous data is available on cycle times between the 20th and 30th rounds during a continuous burst.

PLANNED ACTION:

Incorporation of findings into SAPD 253F and MIL-R-45587.

TITLE:

Colt's Chrome Bore Test.

HISTORY:

Colt's has supplied the Government with (3) M16A1 Rifle barrels with chrome plated bores for test and evaluation.

A test program was written and conducted at the H&K range in building #68. This test was very similar to that conducted on Hydramatic barrels at GE.

The same high rate of fire was used as at GE. The barrels were number 2G, 3G, and 5G.

Barrel #2G was fired 12,000 rounds, measured and found that air spindle would not pass through bore. Barrel was decoppered but air spindle still would not pass.

Barrel #3G was fired 4,000 rounds, measured and found that air spindle would not pass. Resumed test, measured at 8,000 rounds. Air spindle would not penetrate as far as at 4,000. At 12,000 rounds, measured, clearance was considerably smaller.

Barrel 5G fired 4,000 rounds. Could not measure with air gage-bore was decoppered but still was unable to insert spindle.

During test, one primer was blown out and test was terminated.

CURRENT STATUS:

The barrels were removed from the weapons and sectioned for closer scrutiny of the bullet seat and forcing cone. Measurements taken during the test indicated a reduction in bore diameter which caused blown primers.

The sectioned barrels have been sent to the metalurgical laboratory for inspection and comment. As yet, no reply has been received.

J.O. 3004 X.O. 443009

TITLE:

Test on chrome plated bores of M16A1 Rifle barrels furnished by Hydramatic, Division of General Motors.

HISTORY:

During March of this year a test was conducted, at General Electric Co. facilities at Springfield Armory, on the 6 chrome plated rifle barrels supplied by Hydramatics. Two rifles with standard barrels were used as Control rifles. The first chrome plated barrel was subjected to a high rate of fire as follows: one 20 round automatic burst every 20 seconds forced air cooled to ambient temperature after each 200 rounds. On the 9th magazine and after 961 rounds a blown primer occurred. During the 10th magazine and after the 981 round another blown primer occurred.

The second chrome bore was used on the same rate of fire but after 561 rounds a primer was blown. Blown primers occurred thereafter as follows: 6th magazine, 701 rounds; 9th magazine, 761 rounds; 10th magazine, 781 rounds. In the three cases mentioned, the blown primer occurred on the 1st round of the new magazine. The 2nd round of the 10th magazine also resulted in a blown primer.

Headspace was checked. Land and groove gage was unable to pass bullet seat area. Severe coppering was encountered at the forcing cone. It was estimated that pressures in excess of 80,000 psi had occurred to blow primers. Test was terminated.

CURRENT STATUS:

Hydramatic Corporation recalled remaining barrels for test and inspection. They will supply six more chrome plated barrels for testing for continuation of test at GE. These barrels are to be furnished during first week of Aug. at which time the test will be resumed. Results of said test should be available by end of August.

28 July 70

REPORT TO M16 STEERING GROUP

BULLET IN BORE PROBLEM

1. In June 1970 the USAWECOM received a TT from Spain stating that an M16 Rifle had blown up. The TT also stated that cause appeared to be a bullet in the barrel when a subsequent round was fired.

2. Based on the findings by a team from USAWECOM which had visited several military posts in the US during the past few years investigating similar blowups, the analysis of a bullet in the bore when a subsequent round was fired appears to be correct. Cause for such a condition is that the primer of a cartridge, with no propellant or one on which the propellant fails to ignite, pushes the bullet into an eroded bore. The subsequent round can then be chambered if the bore is eroded sufficiently forward so the bullet in the bore does not prevent this next round from chambering. It should be noted that the majority of such instances have occurred in the Continental US where a rifle is not subjected to rebarreling until a barrel erosion gage extends beyond 6.625 inches into the bore, measured from the rear surface of the barrel extension, whereas in weapons being shipped overseas the erosion gage cannot extend beyond 3.625 into the bore from the rear surface of the barrel extension. The overseas weapons are rebarreled after overseas use when the erosion gage extends beyond 6.625 into the bore. The reason for lack of overseas difficulties may be that only a limited number of rounds have been fired in the weapons and that a rash of difficulties may be reported as weapons approach the rebarreling stage sometime in the future.

3. In June 70 a meeting was held at AMCPM-RS to discuss the situation and attempt to find a solution which would minimize these incidents in the field. A literature survey was made to determine the number of rounds which had been fired on average barrels which accepted the erosion gage to a 3.625 reading. This figure appears to be in the neighborhood of 16 to 18 thousand rounds. Further analysis is required.

4. A study was made of various bore conditions considering the distance a bullet could drop into the barrel assuming the bullet ramp moved forward to the various bore gage distances i.e. 3.625 and 6.625 from the rear of the barrel extension. A sketch depicting bullets located in the 3.625 position is attached. The sketch also includes showing of a live cartridge in position and indicates the logitudinal relationship between a chambered round and bullets located at the 3.625 erosion gage position. It should be understood that the bullets located in the bore are theoretical as the bore gage has a smaller diameter than the bullet. The increase in bore diameter due to erosion is greater at the breech end, and the erosion gage, with its reduced diameter, may go considerably beyond the point at which a bullet would meet resistance.

Proposed Corrective Action

It is recommended that the erosion gage requirements be changed to reject all weapons when the gage reading from the rear surface of the barrel extension, to a .2206 diameter in the bore is in excess of 3.625 inches, and rejecting barrels for overseas shipment when a dia. gage can be inserted in a like manner more than ____. Gaging weapons for overseas use in this manner should insure only barrels with a 10,000 round potential would be shipped.

Incl 13

BFA DEVELOPMENT
M16/M16A1 Rifle

1. Funding and direction to redesign the XM15 blank firing attachment with a less than $3.00 cost has been received. The program will address the following objectives:

a. Provide a modified Navy (screw on type) BFA for ARVN Forces in SEA.

b. Provide a newly designed BFA for the M16/M16A1 Rifle that will meet Army requirements as written.

c. Redesign the M16/M16A1 flash suppressor to provide a simple means of easily attaching a low cost BFA.

(1) The standard Navy BFA and two modified concepts that will provide blast deflection have been tested. All test items provided better performance than the XM15 BFA that was used as a control. All concepts met or exceeded the test requirements. The estimated cost in production is less than $1.50. We are presently awaiting further direction from MACV with regards to their requirements. It should be noted that this simple one piece design will not meet existing Army requirements for BFA.

(2) The redesign of a BFA for the M16/M16A1 Rifle has generated approximately 35 concepts. The more promising concepts have or are being fabricated for test and evaluation. The concepts now under consideration encompass a wide range of attachment methods, restriction methods, and blast deflection.

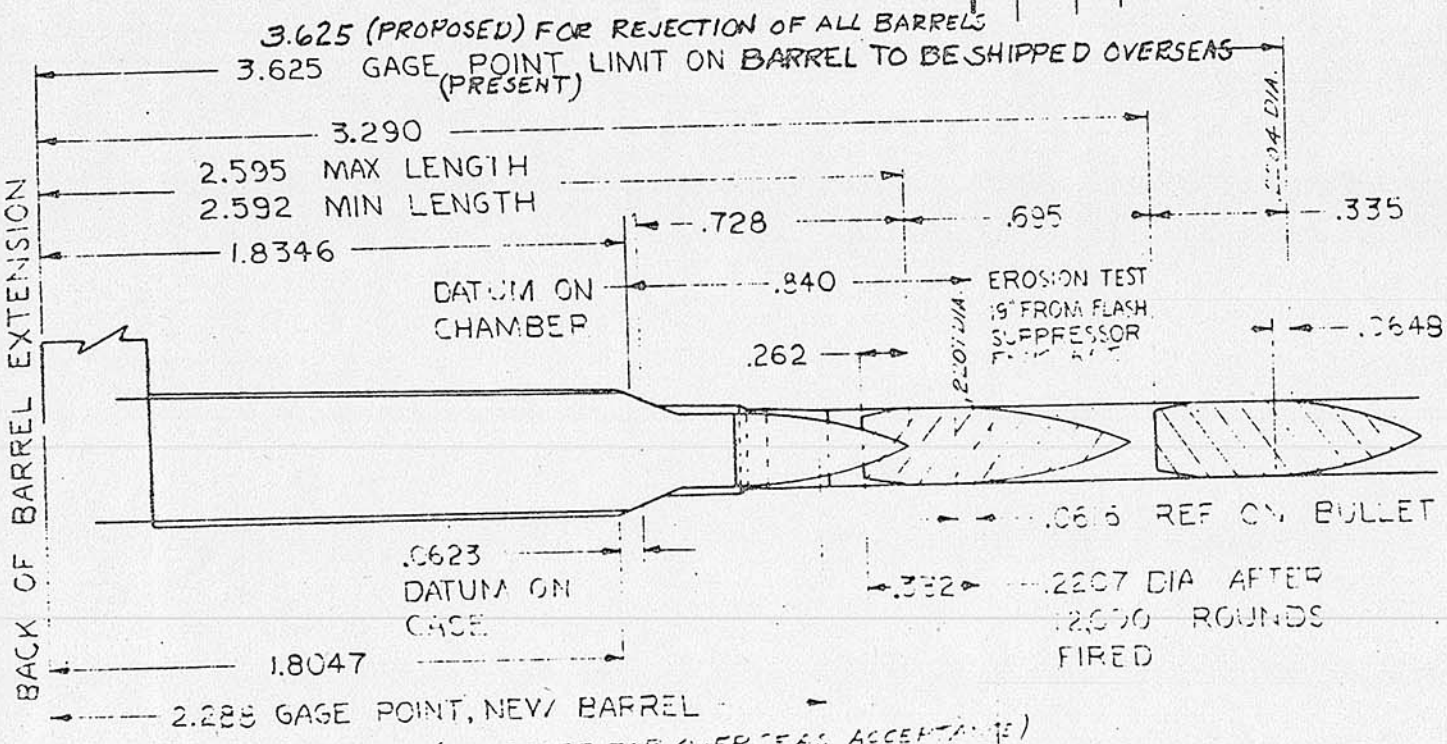
(3) Redesign of the M16/M16A1 flash suppressor is under review to provide a means of attachment of a simple low cost BFA that will not preclude the use of either the bayonet or the rifle grenades. Some concepts have been generated, however, the allowable latitude of redesign is limited by the use of bayonets and rifle grenades. The outside diameter and the length forward of the muzzle cannot be infringed upon. It may however allow the tightening of tolerances to effect a seal on the outside diameter of the flash suppressor or allow control of the grooves around the flash suppressor to facilitate locking of the BFA. These approaches are under consideration.

(4) Other possibilities include a change to the inside configuration of the flash suppressor to provide an easy attachment method.

2. Future Work:

Concepts generated under b and c above have been reviewed for technical soundness, feasibility and probability of success. Selected concepts will receive a detailed engineering study to further evaluate individual feasibility. Those showing the greatest probability of success will be

REVISIONS					
MF	ZONE	LTR	DESCRIPTION	DATE	APPROVED



NOTES

BORE DIA .219 +.001

BULLET DIA .2239 MIN.

GAGE DIA .2204 +.0002

DO NOT SCALE

R Joyce 26 JUL 70

MECHANICAL PROPERTIES					UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ANGLES ± 3 PLACE DECIMALS ± 2 PLACE DECIMALS ±	CONTRACT NO DATE	DEPT OF THE ARMY US ARMY WEAPONS COMMAND ROCK ISLAND, ILLINOIS, 61201	
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reduced to hardware for engineering design testing.

3. The current schedule calls for final designs to be subjected to competitive testing by October 1970. Availability of a TDP for production is scheduled May 1971.

MAJOR DEVELOPMENTS/PRODUCT IMPROVEMENTS

1. Arms Rack XM12

Purpose: To replace modified M11 Racks currently in use and to be type classified Standard A for M16 Series of Rifles. Include capability of storing M203 Grenade Launcher to M16.

Status: Statement of suitability for release contingent upon results of initial production test. A correspondence IPR was initiated on 26 June 1970. Participating Agencies have concurred in recommendation to type classify Standard A. A request for approval to initiate procurement of not more than 6000 racks, pending completion of TC action, has been forwarded to ACSFOR.

2. In-Weapon Stowage of Cleaning Equipment

Purpose: Stated requirement to provide in-weapon stowage capability of individual cleaning equipment.

Status: Statement of suitability for issue has been received. US Marine Corps and Coast Guard have stated intention to retrofit. Future contracts will include the modified buttstock. Replacement will be by attrition, excepting Marine Corps and Coast Guard.

CONGRESSIONAL INTEREST

1. House Appropriations Committee

Visit by Survey and Investigation Staff: Product Manager for Rifles was requested to provide M16/M16A1 rifle contract related costs to this S&I staff. The data supplied reflected all contract quantities with a breakout of all factors contributing to unit cost. Additional information reflecting background information on expenditures of PEMA Product Improvement funds for FY 68 has been prepared for forwarding to the S&I staff.

2. Witloe Tool and Ordnance Company Proposal: Expressions of interest and inquiries from various sources, including public news media and Congressional, are expected to be received for the remainder of this year. The PM-RS presented a briefing to Congressman Williams (R-Pa) on 8 July 1970 to provide details on the Army rejection of the Witloe proposal. The Congressman is in support of the Army position. The latest action by Witloe (13 July 1970) is a request to PM/RS that the Army review a film dealing with the proposal. Date and time have not been established. Senator Scott (R-Pa) has previcusly requested Army review of this film.

Witloe proposal refers to a design change in bolt assembly to prevent possibility of improper assembly in the field. To my knowledge, response was not viewed favorably since the frequency of occurrence of misassembly was low, the suggested change was not a foolproof solution, and the cost of retrofit was prohibitive.

JRM.

MEMO ROUTING SLIP	*NEVER USE FOR APPROVALS, DISAPPROVALS, CONCURRENCES, OR SIMILAR ACTIONS*		ACTION
1 TO Small Arms Branch Bldg 350		INITIALS [illegible]	CIRCULATE
		DATE 31 Aug 70	COORDINATION
2 Please circulate. Michelson Note GE work.			FILE
			INFORMATION
3			NOTE AND RETURN
			PER CONVERSATION
4			SEE ME
			SIGNATURE

REMARKS

~~KEELE~~ EAR
~~MILLER~~
~~FARIS~~
~~STALEY~~
~~HENDRICKS~~ GEA
~~CONNALLY~~ RLC
~~ELLER~~
MICHELSON

FROM [signature]	DATE
	PHONE

DD FORM 1 OCT 60 95 REPLACES PREVIOUS EDITION ☆ GPO : 1967 O - 248-677