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U.S. Dept. of Defense. Deputy Assistant Secretary, Systems Analysis.
A comparison of AR-15 and M-14 rifles (Effectiveness and cost) 27 September 1962.

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WHEN WITH ATTACHMENTS

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AR-15 - M-14

Note: Some of data in Table I, page v, are wrong.

M-14 in production weighs about 1 pound more than shown here.

AK-47 comes in several models from many factories with differences as large as 1½ lb. between models.

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A COMPARISON OF AR-15 AND M-14 RIFLES

(Effectiveness and Cost)

27 September 1962

U.S. Dept. of Defense, Deputy Assistant Secretary, Systems Analysis

ABSTRACT

This report is a cost-effectiveness comparison of the M-14 rifle now being procured by the US Army, with the AR-15 rifle now being procured by the US Air Force. The comparison is relative to general combat use of the AR-15 by Army units in both normal and special combat situations. The report attempts to identify those factors which significantly affect the combat effectiveness of a rifle and for each factor to compare the two weapons. In each factor comparison the conclusion of the study is given, followed by a discussion which, in turn, is followed by direct quotations from available references on that particular issue.

The study indicates that the AR-15 is decidely superior in many of the factors considered. In none of them is the M-14 superior. The report, therefore, concludes that in combat the AR-15 is the superior weapon. Furthermore, the available cost data indicate that it is also a cheaper weapon. Although analyzed less thoroughly, the M-14 also appears somewhat inferior to the M-1 rifle of WW II and decidedly inferior to the Soviet combat rifle AK 47, which, in turn, was derived from the German "Sturmgewehr" of WW II.

INDEX

SUMMARY

Overall Squad Effectiveness

The inclosed study concludes that, taking into account the greater lethality of the AR-15 rifle and improvements in accuracy and rate of fire in this weapon since 1959, in overall squad kill potential the AR-15 rifle is up to 5 times as effective as the M-14 rifle. Army tests conducted in 1959 showed that with regard to squad hit potential a 5-man squad armed with the AR-15 rifle would be more effective than an 11-man squad armed with the M-14 rifle and that there would be tactical as well as manpower advantages with a smaller squad. (tab G)

Automatic Fire Capability and Tactical Flexibility

In automatic fire capability and tactical flexibility the AR-15 rifle is markedly superior to the M-14 rifle. The AR-15 rifle can replace, with gains in each case, all standard shoulder-fired weapons. It also is suitable for use by USAF and by small statured U.S.-supported forces. The M-14 rifle is marginal, at best, as a replacement for the BAR, is somewhat less satisfactory as a semi-automatic rifle than the M-1 rifle, and is not capable of replacing the submachine gun or the M-79 grenade launcher. The M-14 rifle also is not suitable for use by small statured U.S.-supported forces or by USAF. Soviet forces armed with the AK assault rifle have a definite firepower effectiveness advantage over U.S. forces equipped with either the M-1 rifle or the M-14 rifle. U. S. forces armed with the AR-15 rifle would have a marked firepower advantage over Soviet forces armed with the AK assault rifle. (tab E)

Cost and Logistics

With regard to facility of production and cost, the AR-15 rifle can be produced with less difficulty, to a higher quality, and at a lower cost than the M-14 rifle. It is estimated that in quantity production the item costs of the AR-15 rifle, ammunition, spare parts, and accessories would be about two thirds the FY63 item costs for corresponding items for the M-14 rifle system. In addition costs for the M-79 grenade launcher ($118 per weapon) would be eliminated. The logistical burden which would be imposed in CONUS and the field also would be less with the AR-15 rifle than with the M-14 rifle. The problem of adoption of a round other than the NATO standard 7.62 mm round does not appear prohibitive. There are serious disadvantages to extending the NATO round for use in rifles to other areas of the world, and in the long run, to retaining it in NATO. (tab K)

Reliability, Durability, and Ease of Maintenance

In reliability, durability, ruggedness, performance under adverse conditions, and ease of maintenance the AR-15 rifle is a significant improvement over any of the standard weapons including the M-14 rifle. The M-14 rifle is weak in the sum of these characteristics. Earlier reports that the AR-15 rifle is deficient in performance under Arctic conditions or with "rain in the barrel" are incorrect. (tab J)

Lethality

In lethality the AR-15 rifle bullet is markedly superior to that of the M-14 rifle or any other known bullet. (tab F)

Training

It is significantly easier to train the soldier with the AR-15 rifle than with the M-14 rifle. Based on tests conducted by the USAF and by CDTC in Vietnam, it is expected that the AR-15 rifle will produce significantly more experts and significantly fewer unqualified firers than the M-14 rifle. (tab I)

Weight

Three times as much ammunition can be carried on the individual soldier within the standard weapon-and-ammunition load, or alternately the soldier's combat load can be reduced by 40%, with the AR-15 rifle as compared with the M-14 rifle. (tab B)

Accuracy

In accuracy, at all ranges of U. S. Army interest for rifles, the AR-15 rifle is at least as effective as the M-14 rifle and the AR-15 rifle ammunition has further growth potential in this respect. (tab D)

Penetration

In meeting the U.S. Army penetration requirement (capability of inflecting a fatal wound through a steel helmet or armored vest at 500 yards) the M-14 and AR-15 rifles are essentially equal. (tab C)

Brush Penetration

In the ability of the bullet to penetrate brush the AR-15 and M-14 rifles are approximately equal and both are adequate. Earlier reports that the AR-15 rifle is deficient in this respect are incorrect. (tab H)

PHYSICAL CHARACTERISTICS

		AR-15	M-14	M-1	FN	CARBINE	SOVIET AK-47
1. WT of rifle and 220 rds in magazines*	Lb	13.68	25.33	24.34 (clips)	26.67	13.63	19.63(est)
2. WT of loaded rifle**	Lb	6.92	9.83	10.37	10.57	7.00	10.47
3. WT of one magazine, empty	Lb	0.18	0.50	0.07 (clip)	0.56	0.25	0.3(est)
4. Capacity of one magazine	Rd	20	20	8	20	30	30
5. WT of one rd of ammunition	Lb	0.0248	0.0525	0.0570	0.0525	0.0257	0.0361
6. Shipping Weight of 1000 rds of ammunition, cased	Lb	32	76.5 (960 rd)	84 (960 rd in clips)	--	--	--
7. Shipping Bulk of 1000 rds of ammo. cased	Cu.Ft.	0.5	0.91	0.93	--	--	--
8. Overall length of rifle	In.	38.8	44.19	43.6	44.4	35.58	34.3
9. Barrel length	In.	20	22	24	20.9	18	16.3
10. Caliber	In.	.223	7.62mm (.308)	.30	7.62mm (.308)	.30	7.62mm (.308)
11. Muzzle velocity	FPS	3300	2800	2800	2800	1970	2500 or 2350
12. Cyclic rate (auto fire)	Rd/Min	750	750	semi-auto	750?	750	600
13. Useable effective range	Yd.	500	500	500	500	300	440
14. Recoil Loaded Rifle	Ft.Lb.	4	13	13	--	4	6

* Number of rounds in standard combat load for M-14
** For AR-15 includes organic grenade launcher

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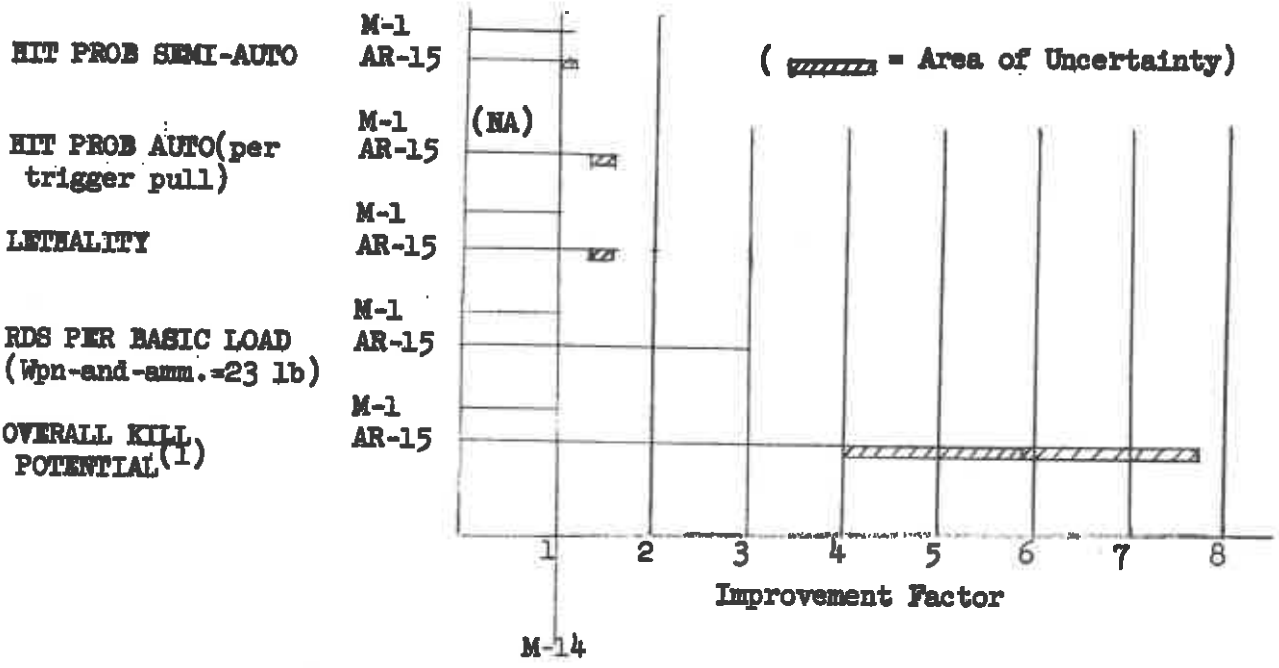
COMPARISON OF M-1, AR-15 AND M-14 RIFLES
(with M-14 as base)

WEAPONS EFFECTIVENESS, MAN/WEAPON SYSTEM



(1) Overall Kill Potential - Hit probability x lethality x rds available. (reliability factor not included.)

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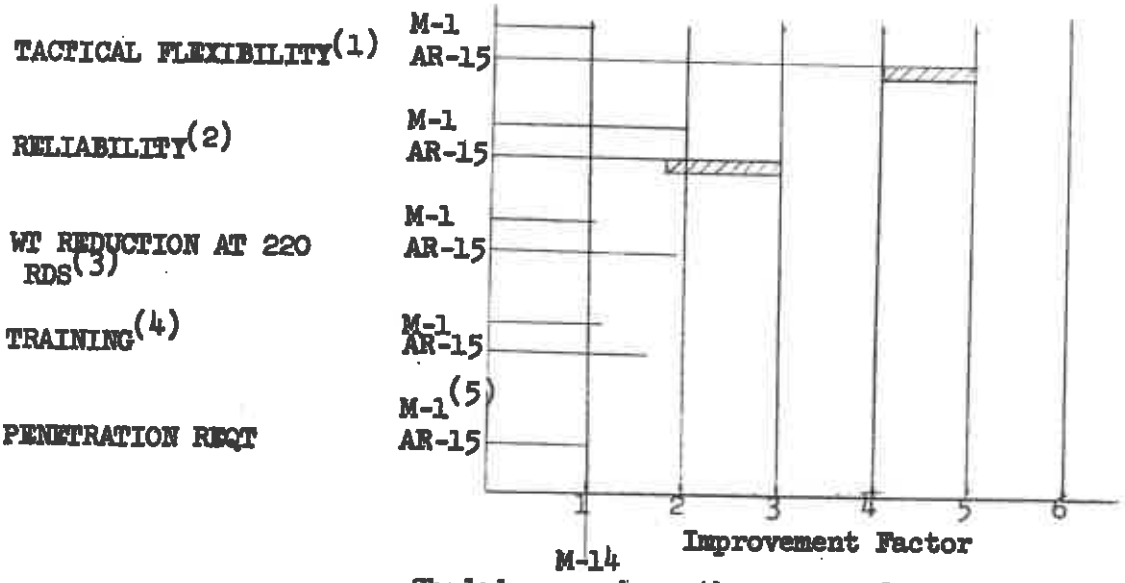
COMPARISON OF M-1, AR-15 AND M-14 RIFLES (Continued)
(with M-14 as base)
WEAPONS EFFECTIVENESS, MAN/WEAPON SYSTEM



Shaded area shows the range of uncertainty.

(1) Degree of ability to perform functions of rifle, carbine, submachine gun, BAR and grenade launcher.

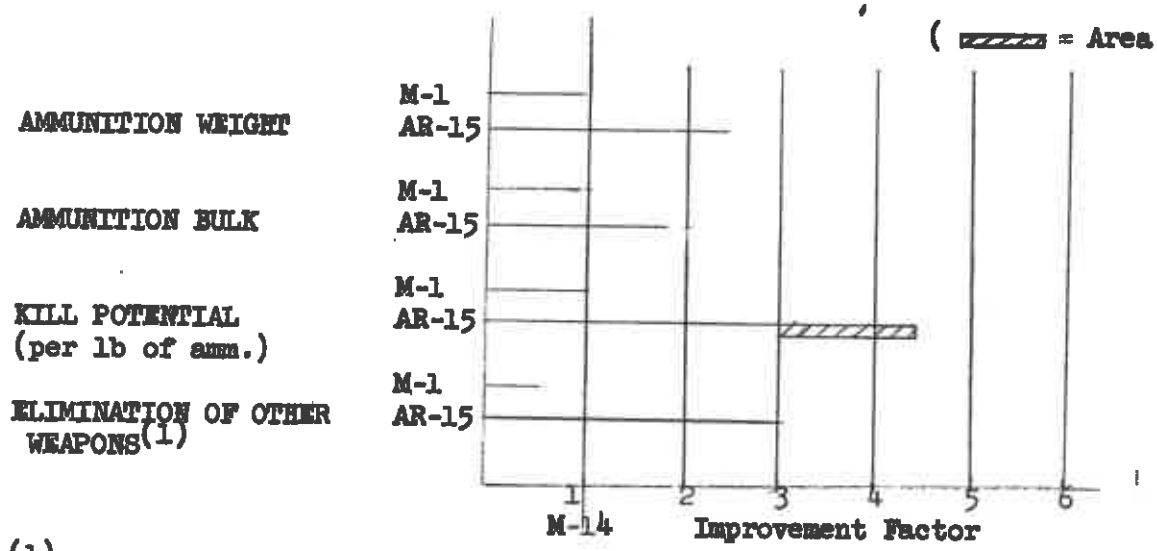
(2) Reliability, durability, ruggedness, performance under adverse conditions. The area of uncertainty in this case is variation in reliability performance of M-14 rifle depending upon the specific conditions of use; such as, Arctic, mud, parachute jumping, etc.

(3) Weight on the soldier at 220 rds (the standard number of rds for the M-14). A measure of soldier energy conservation/mobility improvement.

(4) Ease of training in care and cleaning and quality of firers produced for same amount of marksmanship training.

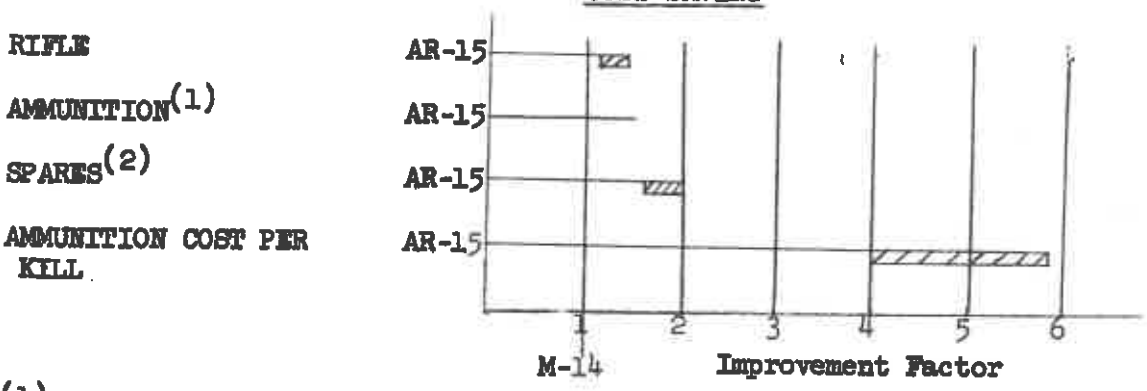
(5) No data for M-1

COMPARISON OF M-1, AR-15 AND M-14 RIFLES
(with M-14 as base)
LOGISTICS



(1) Ability to eliminate other weapons (M-1 rifle, carbine, BAR, submachine gun, M-79 grenade launcher) from the logistics system. Includes USAF and small-statured U.S. supported forces.

COST SAVING(3)



(1) Cost savings in ammunition are particularly significant since, as in the case of the M-14 rifle, ammunition programmed "per rifle" costs 1.5 times as much as the rifle.

(2) Currently $12 "per weapon" for M-14 rifle.

(3) M-1 rifle not compared. M-1 rifles and ammunition are available at no cost.

ITEM I - WEIGHT

WEIGHT

ITEM I: Because of the lighter weight of the weapon and ammunition the AR-15 provides a large increase, at constant weight, in sustained fire capability for the individual soldier. Alternatively, this could be used, at constant ammunition supply, to lighten the load the individual must carry in combat. The light weight also improves the combat effectiveness through its effect on shooting performance.

The ammunition available on the individual is a significant element in overall rifle system effectiveness in terms of hit potential. Current methods of measuring effectiveness generally multiply hit probability X lethality X field rate of fire X ammunition available on the individual. The amount of ammunition available on the individual is a measure of his ability to sustain the firefight.

The difference between the two systems in this last factor can be seen if comparison is made at total constant weight. The standard battle load of weapon and ammunition of 23 pounds could be the M-14 rifle and 220 rounds or the AR-15 and 650 rounds (not counting the weight of magazines). Of course it would be possible to hold the number of rounds fixed and reduce the weight of this element of the soldier's load. If the number of rounds is held to 220, the basic load for a soldier armed with an M-14 rifle, the weight reduction for the soldier armed with the AR-15 rifle is 50%. Combinations with decreased weapon and ammunition weight with simultaneous increases in ammunition supply are also possible because of the AR-15 weight advantages.

The reduced weight of the AR-15 rifle-ammunition combination makes it possible for the first time to arm US individual squad members with a rifle with the automatic fire capabilities of the BAR having the sustained fire capabilities, in terms of duration of fire without resupply, of the semi-automatic rifle.

Reduction of weight on the combat soldier is a vitally important goal. Studies and combat experience have shown that there is a close correlation between the physical condition of the infantryman at a given time and his aggressiveness, courage and combat effectiveness, and that ammunition normally is the heaviest single element of his combat-and-existence load. The combat unit commander has available a certain energy potential in the soldier which can be expended in high foot mobility and effective action against the enemy or by carrying excessive combat loads. Troops that arrive at the place of combat in an excessively fatigued condition are not in a condition to fight effectively. In practice, the combat experienced soldier habitually throws away essential and expensive gear in order to get his combat load down to manageable proportions. Frequently thrown away are items such as rations and clothing which are necessary to sustain his health and energy in the long run but are less essential to immediate needs than the items he retains.

There are several effects on shooting performance due to rifle weight. Hit probability, rate of effective fire, and hit distribution are all affected. The last of these may be defined as the number of different targets hit divided

by the total number of hits in situations where more than one target is present.

An infantry battle is not very similar to a rifle match. The targets appear and disappear, there is generally more than one, and these appear at various ranges, not predictable in advance. Furthermore, they appear widely scattered in direction. In the attack the infantryman generally fires from the standing or kneeling position, only in defensive operations or when acting as the base of fire for another attacking element would he fire from the prone or sitting position.

In match competition, expert shooters prefer a rifle weighing about 9 pounds, though even heavier weapons are frequently used. For offhand shooting, and especially for short duration targets appearing from unexpected directions, the primary conditions of combat, a lighter weapon is much to be preferred.

(Weight)

I. SUPPORTING STATEMENTS AND EXTRACTS

1. Rifle and ammunition loads.

a. From a 1959 test report of the Army Combat Development Experiment Center (CDEC):

. . ."With the presently planned battle load of 22.39 pounds, the fires would carry 650 rounds of the lightweight high-velocity ammunition or 220 rounds of M-14 ammunition. . ."

"Matching on a round-for-round basis, the currently envisioned M-14 weapon-ammunition load for the individual soldier (rifle plus 220 rounds), the soldier armed with the Armalite and 220 rounds would carry a battle load of 12.20 pounds. This represents a decrease of 10 lbs in the rifleman's overall combat load."

(The figure 650/220 given in this CDEC test report does not include the weight of the magazines. The weight of the AR-15 magazine (20 round capacity) is 0.18 lb compared with 0.5 lb (20 round capacity) for the M-14. For a 220 round basic load with the weight of the magazine considered, the soldier armed with the AR-15 carries 12 lbs less than the soldier armed with the M-14, a weight reduction of 50%.)

(pages 36 and 58, ref I)

b. Statements about the various possible choices of weapon and ammunition can be derived immediately from the table of Physical Characteristics (Tab B).

2. The Importance of Total Weight of the Infantryman's Load.

a. Army Field Forces Board Number 3 (the Infantry Board):

"Conclusions

"a. to meet the maximum combat load for the individual . . . the two basic elements of the load must consist of . . . .:

(1) Battle load: The individual's contribution to his small unit's fighting task such as the rifle, BAR, the crew-served weapon individual loads or other equivalent contributions. . . 25 lbs.

(3) Existence Load: Personal equipment including excess clothing, rations, water, side arms, etc. . . . 20 lbs.

"b. Increase in the weight of either of these loads can be made only at the expense of corresponding reduction of the other.

"c. Current combat loads still exceed the 45 lb maximum . . .

"e. The importance of reducing the load carried by the individual infantry soldier on the battlefield warrants a priority which will insure the availability of any developmental material required."

. . . ."one objective in development is the reduction of weight of items of equipment which must be man transported . . . . The difficulty of skillful compromise between the battlefield needs of the individual and the soldier's ability to carry the resultant load necessitates that the highest priority be given to reduction in weight of all equipment which must be man transported in the battlefield.

(page 5 and 6, and App V page 2, ref II)

b. From a 1951 Army ORO report on infantry operations and weapons usage in Korea by S.L.A. Marshall:

"The Korean research indicated that there is a natural limit imposed on what the average infantry soldier carries in fighting supply by what he has discovered about his own physical resources under varying conditions of stress. This is best judged by what happens within the average infantry company after it has been through repeated engagements, has shaken out all excess material, and has gotten down to fighting weight."

. . . . . .

"Operations in Korea prove that Department of the Army and Office of Chief of Army Field Forces concern over the problem of the infantry is wholly justified. . . . .

"This problem has only a marginal solution. It cannot be solved in total. Infantry by nature of its role in combat must remain heavily burdened. The best that may be hoped for is that through re-examining our staff processes and reappraising our material and human resources, we can insure a system whereby the fighting load is made tolerable in the main."

. . . . . .

"Most of this excess was thrown away - a waste to the Army and to the American people. This wastage cannot be called the consequence of a bad supply discipline within the troops . . . In the discard of items not really needed went also other items for which there was a genuine requirement a little later."

(pages 43, 44, and 45, ref SS)

3. Effects of weight on shooting performance

Throughout the remainder of this report, detailed discussions of accuracy, lethality and general effectiveness of the two systems is given. In this section only rather general statements from the references are included.

a. Accuracy

The following extract is from a report which involved test firing in 1958 comparing the AR-15 in early stage of development with the National Rifle Match model of the M-1.

"The total score in the 200 yard stage of the qualification - course test was 554-17V with the AR-15 as compared with a total score of 556-26V for the M-1 rifle. The score obtained with the AR-15 is much higher than would be expected considering the difference in accuracy between the two rifles. This is accounted for by the superior handling qualities of the AR-15 rifle, especially when firing from the standing position."

(page 55, Ref H)

b. Rate of Fire

From the 1958 Infantry Board Service Test:

The transition firing test of the Service Test showed the M-14 and the AR-15 equal in hit probability for the transition range used. However, "in nearly all instances the rifleman required the full 40 seconds to engage the 10 targets with the M-14 rifle; approximately 20-25 seconds to engage the 10 targets with the AR-15."

(incl. I, page 1, Ref F)

c. Hit Distribution

From a 1959 report of the Army Combat Development Experiment Center (CDEC):

"Another result presented through scientific analysis of the experiment was that the hit distribution of the lightweight high velocity rifles (one of which was the AR-15) was better than that of the M-14."

"A possible explanation of the superior hit distribution capability of the LWHVR system is that the lighter weapons could be shifted more rapidly from target to target and could be aligned more quickly than the M-14."

(page 74, Ref I)

ITEM II - PENETRATING POWER

(Penetrating Power)

II. SUPPORTING STATEMENTS AND EXTRACTS

1. Penetration Requirement

A. The requirement for rifle penetration as stated in the U. S. Army Military Characteristics against which the AR-15 rifle was service tested, using the M-14 rifle as a control, and the Infantry Board's conclusion as the result of this test:

"MC REQUIREMENT

. . . . .

"(B) Be capable of inflicting a fatal wound at ranges up to 500 yards on personnel protected by standard body armor and standard helmets."

"CHARACTERISTIC OF TEST WEAPON

. . . . . .

"Meets this requirement (see Test No. 9, App. I)"

The results of Test No. 9 of the Infantry Board report of test:

Range (yds)	Weapon	Perforation of Body Armor	Perforation of Steel Helmet w/Liner
400	M-14	yes	both sides
	AR-15	yes	" "
500	M-14	yes	" "
	AR-15	yes	one side
600	M-14	not tested	both sides
	AR-15	" "	one side

(pages 20 and 26, incl I, ref. F)

B. The results of a USAF helmet penetration test made in 1960 with the production version of the weapon:

"f. Range - 500 yards . . . . . the projectile passed completely through both sides of the helmet. . .

"g. Range - 600 yards . . . . . the projectile passed through one side of the helmet, severely bulged but did not penetrate the opposite side. . ." (Such one-sided perforations would be fatal.) (ref. M)

C. U. S. Army Ordnance Engineering tests, one conducted in 1958 and one in 1960, produced similar results on both body armor and helmets. One sided perforation of body armor was achieved at 600 yards. (refs. H, N)

2. Penetration in other media (no stated requirement).

A. Pine boards.

The 1958 Infantry Board service test gives 7 to 8 inches of perforation for the AR-15 versus 13 for the M-14 at 500 yards. The 1959 Arctic service test shows 19-22 inches of perforation for the AR-15 versus 17-20 for the M-14 at 300 yards. The 1960 Ordnance Engineering test shows an average of 11 inches (9 to 14 inches) of perforation for the AR-15 (M-14 not tested) at 500 yards. (refs. F, K, N)

B. Penetration in Sand.

The Infantry Board tested the weapon for penetration in the sand. (There was no stated military requirement). The test fixture was six inches of sand contained in a box made of 3/8" plywood. The M-14 achieved perforations to 300 yards, the maximum range tested. The AR-15 achieved marginal perforations at 300 yards only. (page 21, incl I, ref. F)

(Practical field tests conducted by another agency show the AR-15 to be superior to the M-14 round in sand penetration when successive bullets are fired into the same earth parapet. This was because of the explosive digging effect of the high velocity successive AR-15 rounds. Neither the AR-15 nor the M-14 round penetrated a single layer of wet sandbags with individual rounds.)(1)

In commenting on the penetration capability of the AR-15 round in its test report, the Infantry Board stated. . . ."the penetration capability of either test round (.222 or .224) would be greatly enhanced if steel cores are substituted for the currently used lead cores, or if the bullet jackets are increased in thickness.". . . A solid core bullet or heavier jacketed bullet could readily be provided if required, but it should not be provided in lieu of the present round which has been specifically designed for transverse instability in the target and which, in combination with high velocity, produces marked improvement in lethality. The present bullet appears to represent a good balance between all requirements. In addition, as mentioned above, there is no stated military requirement for penetration in sand and no clear-indication that the AR-15 bullet is deficient in this respect.

(page 4, ref. F)

(1) These field tests also showed that the explosive digging effect of the AR-15 rifle bullet permits rapid "mouse holing" through concrete under block walls.

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ITEM III - ACCURACY AND RANGE

ACCURACY AND RANGE

ITEM III. The AR-15 rifle is equal, and probably superior, to the M-14 rifle in basic accuracy at ranges of interest.

1958 Army Service Tests show the AR-15 rifle (prototype model) to have been at that time slightly less accurate (bench rest) at 300 yards, and slightly more accurate (bench rest) at 500 yards, than the M-14 rifle. Identical Ordnance Engineering tests conducted in 1958 and 1960 show that the bench rest accuracy of the 1960 AR-15 rifle (production model) has increased approximately 50% over the 1958 prototype. This may be attributed to the modifications which have been made in the rifle, as a result of tests and development, since 1958. These modifications include slightly heavier barrel, sight improvement, redesign of the trigger group, and refinement of the ammunition.

The U. S. Army Military Characteristics against which the AR-15 was tested with the M-14 as a control, specify an maximum range requirement (expressed in terms of accuracy, helmet penetration, and lethality) of 500 yards. This is somewhat more than ranges of practical interest for a rifle. The AR-15 meets, and somewhat exceeds, this requirement. Automatic fire capability is covered under Item IV.

It is estimated that there is further accuracy growth potential in the AR-15 ammunition. (C)

(Accuracy and Range)

III. SUPPORTING STATEMENTS AND EXTRACTS

1. Accuracy

A. From the 1958 Infantry Board Service test:

(1) "Analysis - The test and control rifles are comparable in accuracy in semi-automatic fire."
(Test number 4, ref. F)

(2) Bench Rest Semi-automatic Accuracy
(Av. MR for 3 10-round groups at:)

	300 yds	500 yds
M-14	5.53	10.44
AR-15	6.00	9.12

(Test number 4, ref. 5)

(3) The transition firing test of the Service Test showed the M-14 and the AR-15 equal in hit probability for the transition range used. However, "in nearly all instances, the riflemen required the full 40 seconds to engage the 10 targets with the M-14 rifle; approximately 20-25 seconds were required to engage the 10 targets with the AR-15."

(page 1, incl I, ref. F)

B. Comparison of the accuracy of the AR-15 (prototype) in 1958 with its (production model) accuracy in 1960 as shown in identical standard Army Ordnance Engineering Tests:

AR-15 BENCH REST ACCURACY SEMI-AUTOMATIC FIRE
(Av. for four 10-shot targets-100 yds)

Test	MR(inches)	With telescopic sight and .223 ammunition
1958	2.2	
1960	1.5	1.1

(page 33, ref. H; 21 ref. N)

C. The following modifications and developments, as recommended in previous Army tests, have been made in the AR 15 since 1958:

III-1-C (continued)

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Slightly heavier barrel
Redesign of magazine
Redesign of sights
Redesign of handguard
Addition of rubber butt plate
Improved roll pins
Charging handle redesigned and relocated
Trigger group redesigned
Bayonet lug and bayonet added
Snap on tripod added
Provision for telescopic sight
Addition of grenade launcher-flash hider

2. Range

The following extracts from Army studies discuss range requirements for rifles:

A. From a 1952 Army ORO SALVO Study:

"Rifle Bullet Hits as a Function of Range in Combat-- Oughterson analyzed experience in Bougainville in World War II and found that, of those case studies, almost all rifle hits were received at ranges less than 75 yards. (This figure is perhaps atypically low one because it refers to jungle fighting in which visibility was abnormally restricted.) The Surgeon General recently examined wounded in Korea, and from a sample of 109 rifle bullet hits suffered among members of the Turkish Brigade, the mean range for those hits was found to be just over 100 yards. . . .

"Man-Rifle Operation Studies. . . . The agreement of the two (British and American) independent studies is striking. For attack and defense in European actions (World War II), it was found that about 80% of effective rifle and LMG fire takes place at less than 200 yards, and 90% at less than 300 yards, according to the estimates made by men interviewed. . . Of 602 men questioned about the use of the M-1 in Korea, 87% said that at least 95%. . , of all of their firing was done at targets within 300 yard range (day-time offensive fighting). For day-time defensive fighting, 80% of the men said that rifles were used at 300 yards or less.

"Map Analysis (Varied Combat Terrain Target Study) - Employing this method (measuring range of visibility) map studies of Canada, France, Germany, Korea, North Africa and the U. S. to a total of 18,000 readings showed that 70% of the ranges at which an erect human target can be seen by a defending prone rifleman are less than 300 yards. (and that 90% are less than 700 yards).

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"The Rifleman and His Weapon - Markmanship: Test and Analysis. . . . .16 expert riflemen (highest grade) and 16 marksmen (lowest qualified grade) were used in a series of experiments designed to simulate some of the conditions of combat . . . . Firing the M-1 rifle from the prone position, using battle sights, they shot at a man-silhouette target operated on a transition type range, at distance 100-300 yards. Significant results from these analyses are (a) hit probability is high for both grades of riflemen at ranges up to 100 yards; (b) at ranges beyond 100 yards, a sharp decline in hit probability occurs and this decline in effectiveness is most marked at the common battle ranges, between 100 and 300 yards; (c) at 500 yards both experts and marksmen perform unsatisfactorily, a performance quite inconsistent with the design capability of the weapon and with military specifications. These findings provide part of the explanation for most frequent use of rifles at ranges less than 300 yards and for the incurrence of the majority of rifle bullet wounds in combat within this range."

(Abstract, ref. A)

B. From a 1959 Army ORO SALVO Study:

"7. Most day targets range from 75 to 350 yards; night targets from 50 to 225 yards.

"8. Mean ranges of firing are 177 yards for day targets and 121 yards for night targets.

"The target system, based on the questionnaire of App. C, gives day targets with ranges of 75 to 340 yards with a mean range of 190 yards. Table P1 of App. P gives hits by target and permits the calculation of a mean range of hits. This value is 133 yards. App. F gives single bullet rounds fired by target, and permits calculation of a mean range by rounds fired. This weighted mean range is 177 yards. . . The computed mean range. . . (for night targets). . . . is 85 yards. . ."

(page 39, ref. J)

C. From an ORO Study of Infantry Combat in Korea.

The average effective infantry fire with weapons lighter than the machine gun was consistently less than 200 yards. In no instance was it established, in the operations brought under survey, that any significant move by the enemy forces had been stopped and turned by rifle and carbine fire alone at ranges in excess of that figure.

(page 7&8, ref. SS)

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ITEM IV - AUTOMATIC FIRE CAPABILITY AND TACTICAL FLEXIBILITY

AUTOMATIC FIRE CAPABILITY AND TACTICAL FLEXIBILITY

ITEM IV. The AR-15 rifle provides for the first time a practical, usable rifle automatic fire capability for the individual soldier and is capable of replacing the majority of shoulder fired weapons; the M-14 does not possess an effective automatic fire capability.

Although it is easy to show, particularly under the usual test conditions (single known target, moderate range, etc), that hit probabilities are higher under most conditions with semi-automatic than automatic fire, automatic fire has applications that cannot adequately be met with semi-automatic fire. The established kill records of the BAR/BREN gun and submachine guns in wars attest to this.

The AR-15 rifle possesses good automatic fire capability. The tests show that the weapon is exceptionally easy to handle and reliable in automatic fire and that short-burst automatic fire is an especially deadly fire technique with this system.

Although developed to provide an automatic fire capability, the M-14 rifle does not provide such a capability practical for use by the individual soldier. This is because of recoil, extreme accumulative climb, and over heating. Also the ammunition is too heavy, in combination with the weapon (see Item I), to permit the individual soldier to carry enough to sustain the weapon in a firefight in automatic fire. Because of these characteristics the weapon has been issued to the rifle squad in semi-automatic version except for the two weapons in the squad that are intended to replace the Browning Automatic Rifles (BAR).

Good selective, automatic/semi-automatic fire capability, combined with light weight of gun and ammunition, small size, low recoil, simplicity, and reliability, make the AR-15 rifle capable of replacing, with gains in each case, the BAR, M-1 rifle, carbine, submachine gun, and M-79 grenade launcher. The AR-15 rifle also is suitable for USAF purposes and for use by small statured U.S.-supported forces. The M-14 rifle is marginal, at best, as a replacement for the BAR, is somewhat less satisfactory as a semi-automatic rifle than the M-1 rifle, and is not capable of replacing the submachine gun or the M-79 grenade launcher. Because of size, weight, and recoil the M-14 rifle also is not suitable for use by small statured U.S.-supported forces or by USAF. While the M-14 rifle also cannot replace the Carbine, the latter is an unsatisfactory weapon, primarily because of submarginal reliability and a poor round of ammunition.

The provision of selective automatic/semi-automatic fire capability to each rifleman is an important objective in view of the massed assault shock tactics of Soviet/Chinese trained forces and their heavy emphasis on automatic weapons. The Soviets already have equipped their troops with an effective assault rifle with an automatic fire capability. (This Soviet development, borrowed from the Germans[1], was successful because it is based on a lighter round of ammunition with less recoil, designed for practical combat ranges.) U. S. and U. S. equipped ground troops fighting against Soviet bloc troops during the next decade can expect to have a substantial firepower disadvantage if equipped with the M-1 or M-14 rifles. The AR-15 rifle is superior to the Soviet weapon.

Light weight automatic "assault fire" capability is specially important for airborne troops and counter-insurgency forces. (C)

(1) A German World War II development.

IV. SUPPORTING STATEMENTS AND EXTRACTS

1. Discussion

a. The need for automatic fire.

(1) The fact that hit probability for any rifle yet developed is significantly higher against separate known targets, particularly at 100 yards and greater, for semi-automatic fire than automatic fire can be misleading. Both forms of fire, selectively available to the rifleman, are needed. However, full automatic fire has particularly significant roles to play, which are not always obvious to the non-user. These include fire at very close range and assault fire, supporting and neutralizing fire, hits on unknown targets, and, last but not least, psychological effect (on both the firer and the enemy). Short range automatic fire applications include assault, village fighting, defense against massed attack, night and jungle fighting, and patrol action. Lethal fire capability at close range is particularly important because the majority of the killing that is decisive to the outcome of actions takes place at very close range - possibly from 0 to 40 yards. In recent wars it has been possible to achieve the proper automatic fire effects in the rifle squad only by a mix of automatic and semi-automatic weapons (M-1 rifle, BAR, submachine gun) with resultant problems of reduced sustained fire capability, training, weight, and logistics.

(2) Although it would be desirable to be able to fire bursts of automatic fire which grouped nicely at all ranges instead of the successive rounds having a tendency to climb, automatic fire can be highly effective well short of ideal objectives. For example, with a basically adequate weapon the less accurate fire of the standing position can be accepted because this type of fire is delivered at close range, while for the longer ranges the more accurate prone position is practicable. In addition, the troops learn to shoot in front of, and walk their fire through, the target, thus making the climb work for them and getting additional hits through deliberate ricochets.

b. Discussion of the ability of the M-14 and AR-15 rifles to replace other weapons.

The M-14 and M-1 rifle and ammunition combinations are approximately equal in weight and performance. However, the M-14 rifle is not as rugged or durable as the M-1 rifle and not as reliable insofar as reliability is affected by these factors and the greater complexity of the weapon. It also is not as accurate as the M-1 rifle. The M-14 is not a satisfactory replacement for the BAR because of inaccuracy in automatic fire, and lack of sustained automatic fire capability due to overheating.

Because of size, recoil, ammunition weight and, to a lesser extent, accuracy in automatic fire, the M-14 rifle cannot replace the submachine gun. Since it does not have a grenade launching capability, the M-14 rifle cannot replace the M-79 grenade launcher. (In its present state of development the M-79 grenade launcher does

not do any more than compensate for the M-14 rifle's lack of grenade launching capability. The M-79 grenade launcher costs $118 and each launcher eliminates a man armed with a rifle.) The M-14 rifle is not suitable for small statured U. S. supported forces because of combinations of recoil, weight, and size. It also is not satisfactory for USAF purposes because of weight, size, and recoil excessive to their needs. The M-14 rifle also cannot be considered as replacing the Carbine; however, the carbine is an unsatisfactory weapon.

Because of low recoil, small size, light weight and organic grenade launching capability the AR-15 rifle can replace all of the above weapons with gains in each case. With regard to the M-79 grenade launcher, the AR-15 rifle has the advantage that it gives every rifleman the additional advantage of being able to launch grenades(1) and the grenade warhead can be heavier for both anti-personnel and anti-tank applications. The AR-15 rifle does not require an accessory attachment for launching grenades as does the M-1 rifle and its grenade cartridges can be fired semi-automatically. This allows rapid adjustment of successive rounds and permits the weapon to be useable in short range mortar type fire.

The Soviet AK assault rifle is more effective than the M-1 or M-14 rifles because of its effective automatic fire capability and the lighter weight of its ammunition. It is not as effective as the AR-15 rifle because it is not as lethal, both the weapon and the ammunition are heavier, and its trajectory is not as flat.

The carbine is not a satisfactory combat weapon because of submarginal reliability and the relative inefficiency of its round. In several respects it is even less satisfactory in its automatic version. It has tended to be used, and misused, in combat units because of the need of the troops for a lighter weight weapon and ammunition than the M-1 rifle system and the need for selective semi-automatic/automatic fire capability for the individual soldier. It was developed as a defensive weapon, as a substitute for the Cal .45 pistol.

2. Summaries and Extracts

a. From the 1958 Ordnance Engineering Test report:

"While the M-14, which was developed as a light automatic rifle, has a provision for eliminating the change lever which permits automatic fire, the rifle design is handicapped since a number of parts, which have no other function than to provide automatic fire, remain in the rifle. For this reason the rifle is needlessly complicated and the soldier is penalized by carrying extra weight and by performing extra maintenance.

. . . . . .

". . . Automatic fire is accomplished in the AR-15 rifle with a small number of additional parts of comparatively simple design. . . "

(page 59, ref. H)

(1) With the M-79, each man armed as a grenadier displaces a rifleman, subtracting from rifle strength.

"Several characteristics of the AR-15 permit a higher rate of aimed fire than that obtainable with the present standard caliber .30 rifles. The caliber .22 rifle has a lighter recoil and the stock, which is in line with the bore, is a more favorable design. These characteristics cause a smaller rotation of the rifle around the shoulder of the shooter and the rifle can be aligned more rapidly. The straight stock requires a high line of sight. Less distortion of the shooter's view of the target by heat waves results when the high line of sight is used. Also the high line of sight permits the target to be visible a greater amount of time during firing. The grip of the AR-15 rifle permits better trigger control than does the grip of the conventional stock."

(page 52, ref. H)

b. From the 1959 Army CDEC test report:

"It (the AR-15) did not overheat or smoke as did the M-14, when fired on full automatic. The Armalite became the favorite weapon of the using troops, who appreciated most of all its reliability, its light weight, and its comfortable handling under all circumstances including full automatic fire." . . .

(page 73, ref. I)

"It appeared that the extreme cumulative recoil and rapid overheating of the M-14 seriously degraded performance when fired on full automatic.

. . . . . .

"(b) From constant observations on the line during the experiment, it became evident that even the LWHVR* system weapons with their negligible recoil and low rate of climb, long bursts of automatic fire (more than 7 rounds per burst) were ineffective at ranges of 100 yards and beyond. On the other hand, short burst automatic fire (3 to 6 rounds) using the LWHVR system weapons appeared effective, particularly at a range of 100 yards. Another factor which was noted through observation on the line was the automatic fire technique which the competing squads were employing with the LWHV rifles during automatic fire runs. They deliberately aimed the first shot of each burst so that it would strike the front of the target, and by firing a burst of 3 to 6 rounds they 'walked the bullets' through the target as the muzzle climbed. When the target appeared suddenly for a few seconds there was little time for slow, careful aiming. It is possible that massed troop assault would be particularly vulnerable to this type of automatic fire. All this would seem to reinforce the premise that every man armed with a LWHV rifle must have a rifle capable of being put on a cyclic rate of full automatic at the discretion of the individual rifleman. This is required in order to exploit the special characteristics of the LWHVR system.

*LWHVR - light weight high velocity rifle. Referred to AR-15 and Winchester light weight high velocity Cal .22 rifles used in this test in comparison with the M-14 rifle.

" (c) In summary, the advantages in hit distribution displayed by the LWHVR system appear to result from these characteristics. . . automatic fire, low recoil, low rate of climb, and a quick return. . . Further, the most potentially deadly fire technique with the LWHVR system appears to involve short-burst, full automatic fire."

(page 75, ref. I)

In a test of 8 runs at 100 yards using 5-man squads in automatic fire the AR-15 achieved a 28% greater rate of fire and 35% more hits than the M-14.

(page 77, table 16, ref. I)

PERCENTAGE "BEST" RATING
BY SHOOTERS AFTER EXPERIMENT

Subject	AR-15	M-14
least climb	65	13
accuracy on full automatic	68	25

(page 69, ref. I)

c. From the 1959 Army Arctic Service Test report:

. . ,"The AR-15 rifle, during all automatic firing, was stable and had very little vertical or horizontal movement."

(page 7, incl 1, ref. K)

Test Nr. 3, Functioning, of this report shows for the M-14 rifle that the "front handguards and stocks charred and burned" and had to be replaced. The frequency given is "continual".

(page 6, incl 1, ref. K)

d. The following data was extracted from the 1st (1958) and second (1960) Ordnance Engineering test reports and placed together for comparison:

AUTOMATIC AIMED FIRE
(Rate of fire test)
(Av of 3 trials, 1 min, 100 yards)

Test		Nr of shots	Nr of hits
1958	AR-15	81.7	25.0
	(M-14	94.3	17.4) (Ord. Proj. TS-2-2015)
1960	AR-15	128.7	41.3

Under engineering test conditions, the increase in rate of delivered automatic fire of the AR-15 between 1958 and 1960 is 27% at the same hit probability. Discounting the first shot in each burst, the hit probability of the M-14 in this test was zero. (page 34, ref. H, page 22, ref. N)

e. From the second (1960) Ordnance Engineering Test Report:

AUTOMATIC ACCURACY
(AR-15 Av for 10 3-rd bursts by each of 3 shooters 25 yd)

Position	Mean from aiming point (inches)
Prone	22.1
Standing (1)	45.6

(page 22, ref. N)

f. From the 1962 CDTC Vietnam, Combat Test report on the AR-15 rifle:

(Evaluation of Commanders and Advisors)

Item	AR-15	M-1 Rifle	BAR	SMG	M-1 Carbine	MAX POSS
Automatic accuracy	65	-	57	42	-	70
Preferred against massed troops	65	32	61	33	19	70
Tactically most versatile	69	43	38	29	31	70

(pages 2 & 3, annex A, ref. R)

"Conclusions:

. . . .

"d. The AR-15 is capable of replacing any or all of the shoulder weapons currently being used by the Armed Forces of the Republic of South Vietnam" (M-1 rifle, BAR, Carbine, SMG).

(page 9, ref. R)

g. The following information is from a 1959 Marine Corps report of a troop test of suitability of the M-14 rifle for Marine Corps use:

. . . .

(1) Shoulder shooting. Better accuracies can be obtained at this range by hip shooting. This is because in the latter position the recoil of an automatic weapon is at the center of gravity of the body, while from the shoulder there is a rotating moment. In general, there also are tactical advantages to hip shooting at this range.

"The shooters agreed that they would be hesitant to place their reliance on the Test Item M-14 Modified (BAR replacement version of M-14 with bipod and hinged butt plate) due to the inaccuracy of the weapon at ranges greater than 200 yards when fired full automatic."

. . . . . .

"Complaints during automatic fire stemmed from the lightness of the weapon, the great amount of recoil experienced, discomfort suffered from the present hinged butt plate and the extremely fast cyclic rate of fire, all factors making it impossible to control the weapon's accuracy."

. . . . . .

"Semi-automatic and automatic fire effectiveness.

"(1) The control items M-1 and BAR in the hands of three squads of testing personnel registered better scores than Test Items M-14 and M-14 Modified.

"(2) Test Item M-14 was extremely difficult to fire with accuracy thus lowering the total number of hits appreciably per squad so equipped, when compared with the same individual firing control item BAR upon firing the course with the control items."

. . . . . .

"Handling characteristics and accuracy obtain with the Test Item M-14 capable of automatic fire is not comparable to control item M3A1 (submachine gun)."

. . . . . .

"Test Items M-14 and M-14 Modified suffered more damage in rough handling in the field than did the Control Items M-1 and BAR although all damage incurred was limited to the stock and upper hand guards."

. . . . . .

"Control Item BAR was preferred to Test Item M-14 Modified since the using troops felt that effective accuracy was sacrificed. . . ."

. . . . . .

"Test Items M-14 Modified and M-14 capable of automatic fire are not suitable as replacements for Control Items BAR and M3A1 (submachine gun) respectively."

(pages 5, 7, 8, 9 ref. YY)

h. The following information is from a 1945 Ordnance Engineering Test report on the M-2 carbine:

"Conclusions

"Functioning and endurance were unsatisfactory".

. . . . . .

"Performance during dust, mud, and rain tests were unsatisfactory, but comparable to the performance of other carbines both M-1 and M-2, which have been tested in the past at the Ordnance Research and Development Center."

. . . . . .

"9. Standard Dust Test

All weapons (carbines) performed unsatisfactorily and gave excessive failures to feed, extract, and eject caused mainly by short recoil. In several instances the bolt "froze" and it was necessary to vigorously kick the operating handle open to continue firing. These results correspond to similar results obtained in the past during dust tests of both M-1 and M-2 carbines at the Ordnance Research and Development Center.

"10. Standard Mud Test

Carbines . . . were also subjected to the standard mud test with resulting unsatisfactory operation. The action of each weapon "froze" after firing from 3 to 9 rounds. Again, as in the dust test, results were comparable to other previous test results.

"11. Standard Rain Test

"Carbines . . . were subjected to the standard rain test and gave unsatisfactory performance. The bolts "froze" after limited firing. . . . which also corresponds closely to past results during rain tests of M-1 and M-2 carbines."

(page 22, ref. XX)

i. The following extracts from ORO R-13, "Commentary on Infantry Operations in Korea, Winter of 1950-51" relate to combat use of the Carbine.

"The one exception is the carbine. One company in the 38th Infantry Regiment expressed its satisfaction with this weapon; but it was alone in the Eighth Army. In all other units, bad experience in battle had made troops shy of this weapon, so that in the main those who continued to carry it of their own choice were either the lazy, the new arrivals, the few who had "pet" carbines that had worked

perfectly all along, or the individuals whose tasks did not permit them to physically carry the M-1. In all save one company after-action critique, malfunctioning of the carbine was prominent in the detail of weapons performance during engagement.

. . . . . .

"However, in each critique, as carbine failures were reported incidental to the fighting, the men were asked for a showing of hands on this question: "How, many of you who have used carbines at any time in Korea have experienced a misfire during some part of the fighting?" The lowest showing in any company was 30 percent. In some companies of the 27th and 35th Regiments - two extremely efficient and battlewise organizations - the figures rose to 80 and 85 percent.

"This reaction should be weighted against the background of troop's satisfaction with their other fighting tools. Even if the percentages are exaggerated - and this possibility is admitted - the fact that they feel that way about it implies that they have lost confidence in the weapon. Pending an obvious correction, that of itself makes the weapon a liability in terms of both morale and firepower."

(pages 3 - 5, ref. SS)

"ANVIL CHORUS

"In subfreezing weather, the carbine operates sluggishly and, depending upon the degree of cold, will require anywhere from 5 to 20 warm-up shots before it will fire full automatic.

"Since being made full automatic, it is hypersensitive. In hot weather, even small amounts of dust and moisture together will cause it to misfire. . . .

"The magazines are a continuing source of trouble. . . When the shell is ejected, the fouled metal leaves its accumulation in the chamber. As this builds up, it gradually develops a block, and the piece goes out of action. There is no way to prevent such stoppages except by frequent unclipping and cleaning of the ammunition; time is insufficient for that.

"The weapon lacks "power". It is "too delicate". Its day to day operation is "too variable", according to changes in the weather. . . when fired semi-automatic it isn't sufficiently accurate for "aimed fire at moderate distances."

". . . These are a few of the criticisms voiced by troops who used the carbine in Korean operations. The anvil chorus is much louder than during World War II operations, including the Pacific, when the carbine was hardly an outstanding success. The Marine criticism is even more harsh than that of the Army. . . Not alone does the infantry feel this way; the artillery batteries . . are also going over to the M-1 as rapidly as they can convert."

(pages 67 and 68, ref. SS)

"There are practically no data bearing on the accuracy of the carbine in excess of 50 yards. The record contains a few examples of carbine-aimed fire felling an enemy soldier at this distance or perhaps a little more. But they are so few in number that no general conclusion can be drawn from them. When carbine fire had proved killing effect, approximately 95 percent of the time the target was dropped at less than 50 yards.

. . . . . .

. . . " . . . ' But the main reason my men lost confidence in the carbine was because they would put a bullet right in a Chink's chest at 25 yards range, and he wouldn't stop.' . . . "

(page 69, ref. SS)

j. From the same source as the previous section, the following extracts discuss the importance of automatic fire in infantry combat.

. . " For example, all of the machine guns in a given company may go out one by one in the course of an action . . ; but so long as the BAR's continue to function reasonably well, the moral integrity of the unit will be preserved." . . .

(page 18, ref. SS)

. . " When the position comes under an increasing pressure and begins to contract, riflemen incline to fall back toward the ground covered by machine guns and BAR's rather than to deploy toward the adjacent spaces which the automatic fire cannot protect. Despite a general increase of firing by these who are armed with the M-1, it is rare indeed that a knot of riflemen, unaided by one of the heavier weapons, plays a pivotal part in stabilizing the defensive position. The examples of great individual initiative are generally provided by a bazooka man, a BAR carrier, or a machine gunner." . . .

(page 62, ref. SS)

". . . the one point which seems deserving of particular emphasis is that the BAR compounds the stopping effect of rifle fire at ranges considerably in excess of those at which unaided rifle fire is potent. It has long been prized as a mop-up agent, for depressing final resistance in a conquered area, or liquidating tenacious elements infesting the rear. There is perhaps need to emphasize that it adds body to the rifle volume at any range."

(page 18, ref. SS)

ITEM V - LETHALITY

LETHALITY

ITEM V. The AR-15 rifle bullet is significantly more lethal than that of the M-14.

The greater lethality of the .22 caliber high velocity bullet has been predicted in a series of Army laboratory studies and experiments since 1952 and resulted in the commercial development of the AR-15 rifle, based on a 55 gr 3300 FPS round, at the suggestion of CONARC.

The predicted increase in lethality of a high velocity 22 caliber round over the M-14 7.62 mm round and other conventional calibers has been explained on the basis of a combination of size of transient cavity (shock contributor which varies as the square of bullet velocity), hydrostatic effect of high velocity (bursting of organs, etc., by pressure transmitted through the blood-liquid system), and unique high speed tumbling capability of a high velocity .22 bullet on entering flesh (causing hemorrhaging and tearing of tissue and delivering more of the energy of the bullet to the body).

The practical results of firing in the field with the AR-15 rifle round against objects of the general consistency of the human body (water cans, coconuts, deer), and against human targets in combat in Vietnam, demonstrate a higher level of lethality than predicted from laboratory data. (C)

It is apparent that all factors present in wound ballistics are not yet understood.

V. SUPPORTING STATEMENTS AND EXTRACTS

1. The following extracts are from a 1952 Army ORO SALVO study:

. . . ."Moreover, evidence shows that at common ranges, .22 caliber bullets can produce wounds of measurably greater severity than .30 caliber bullets striking with the same velocity, providing that these veolocities at target are greater than a certain critical value. . . . Substantial logistics savings would also accrue from the introduction of substantially lighter and less expensive cartridges. . ."

. . . . . .

"In a recent study conducted by Dr. L. Hall at the Ballistics Laboratory, Aberdeen Proving Ground, a theoretical comparison of the effects and military usefulness of various calibers of rifles shows that, when the combined weight of weapon and ammunition is held constant to 15 lbs. the overall expected number of kills for the .21 caliber rifle is approximately 2.5 times that of the present standard .30 caliber rifle. When compared to M 1 ammunition (ammunition of .30 caliber rifle M-1), a .21 caliber missile of high velocity (about 3500 feet per second muzzle velocity) created equal or greater damage than the standard .30 caliber missiles at ranges up to 800 yards. This evidence, combined with the work of Project BALANCE (ORO), lends considerable support to the major conclusion that lighter hand-weapons of small caliber may well be provided without losing military effectiveness, while offering both impressive logistical gains and improved operations."

. . . . . .

"In addition to these gains, the advantages of low recoil effects offered by the smaller caliber weapons would be reflected in improved skill in use of the weapon by allowing a higher rate of single-round aimed fire. Such weapons would also be much less fatiguing to handle."

. . . . . .

"Since recoil of a small caliber weapon would be less that of present weapons, the dispersion of rounds in a short, fully automatic, burst would be considerably less than the current models."

. . . . . .

"At a cost of a small loss in armor penetrating ability at some ranges (a characteristic of doubtful military value in a rifle), a weapon of a caliber smaller than .30 providing a correspondingly higher velocity, offers generally superior wounding power at ranges of interest (and somewhat beyond); improved exterior ballistics; lighter ammunition; a slightly lighter rifle; and some reduction in recoil."

(Abstract, ref. A)

2. From an interim CDTC test report on the AR-15 rifle:

"The dramatic explosion of green coconuts and other substances when hit by caliber .223 bullets provides visible proof of the superiority of the AR-15 when compared to the "clean" holes drilled by the M-1, carbine, BAR, and submachine gun."

3. The following is an extract from the 1962 final report of a six months combat test of 1000 AR-15 rifles in Vietnam. These results confirm practical observations of the results of shooting of water cans, watermelons and deer and indicate an actual lethality considerably greater than assumed from laboratory studies:

"The lethality of the AR-15 and its reliability were particularly impressive. All confirmed casualties inflicted by the AR-15, including extremity hits, were fatal (see photographs 7 & 8 annex "D")." (Underline added.) Bodies were recovered and the nature of wounds examined. A hit in the arm caused the arm to fall off. A hit in the fleshy part of the buttocks was fatal in 5 minutes. A chest wound caused the thoracic cavity to explode. Ranges reported were 15 to 150 yards. Size of sample was 40 casualties.

(page 8, and Annex A, ref. R)

4. Practical field tests of the AR-15 rifle in shooting deer carried out by another agency also have demonstrated the type effects described in paragraph 3 above.

5. From a 1958 Army Ballistics Research Laboratory study:

PROBABILITY THAT A RANDOM BULLET KILLS (YDS)
(Sure kills only. Case: Assault soldier - 5 min after wounding)

	100	200	300	400	500
M-1 cal 30 AP	.50	.50	.49	.48	.48
LWHVR cal 22 (50 gr)	.56	.55	.53	.51	.48

M-14 lethality should be the same as that for the M-1 cal 30 AP. The data on the M-1 cal 30 AP was derived from actual test. The cal 22 (50 gr - 3500 FPS) round used is theoretical. It can be seen that the results actually being achieved with the AR-15 round are greater than those predicted here.

(page 21, ref. E)

6. The following is a summary of pertinent parts of a 1958 U. S. Army Ordnance Ballistics Research Laboratory experiment:

A. This study was designed, among other objectives, to explore the potential of a light weight, small caliber, high velocity rifle (LWHVR) system. The method is to use the M-1 rifle with 30 caliber ammunition to represent the conventional rifle system and a laboratory caliber .22 carbine, interpolated to a 6.5 lb weapon with a 50 grain 3500 FPS round, to represent the LWHVR system. (Although the AR-15 rifle and its ammunition

were available at this time and undergoing tests elsewhere in the Army, apparently this system was not available to the laboratory. Test data was borrowed heavily from the 1959 ORO SALVO 1-Rifle Field Experiment (ref. J).

Useful comparisons can be made, with caution, of the laboratory results with the M-14 rifle and the AR-15 rifle because the M-1 with 30 caliber AP round is similar to the M-14 system (and apparently was chosen for that reason) and the 6.5 lb rifle with 50 gr 3250 FPS bullet is similar to the AR-15 system(6.24 lb rifle with 55 gr 3250 FPS bullet).

B. Results

Based on previous test results for the .22 caliber carbine and M-1 cal. 30 AP and assuming rate of fire is a function of muzzle momentum:

	Relative Rate of Fire	Muzzle Momentum (grs - ft/sec x 10^5)
M-1 cal 30 AP	1.00	4.25
LWRVR cal .22 (50 gr)	1.20	1.73

(For an interesting comparison, the following data has been extracted from the 1958 and 1960 Ordnance Engineering test reports on the AR-15 rifle.

Rate of Aimed Fire
(av. of 3 trials, 1 min., 100 yds)

Semi-Automatic Fire

Test	Weapon	Shots in 1 Minute	(Relative rate)
1958	AR-15	59.6	1.50
	M-1 rifle	40.6	1.00
1960	AR-15	84.2	2.00

Automatic Fire

1958	AR-15	81.7	2.00
1960	AR-15	128.7	3.00

These data, of course, do not represent rate of delivered fire under field conditions.)

From previous test results for the M-1 rifle with cal. 30 AP and the .22 caliber carbine, and other tests which demonstrated that lighter weight weapons resulted in smaller aiming errors:

AIMING ACCURACY

M-1 cal 30 AP	3.8 mils
LWHVR cal .22 (50 gr)	3.0 mils

Assuming that the probability of hitting for the LWHVR is equal to that of the .22 caliber carbine (using hit probability data previously derived from tests of the M-1 rifle and .22 caliber carbine) and that the relative rate of fire is a function of muzzle momentum:

RELATIVE NUMBER OF HITS (YARDS)

	100	200	300	400
M-1 cal 30 AP	1	1	1	1
LWHVR cal .22 (50 gr)	1.54	1.48	1.44	1.38

Based on firings of single projectiles, including 30 cal. AP, against goats, and assuming that a 50-grain projectile which tumbles on impact will follow the same MV 3/2 - PHK laws as observed with other projectiles:

PROBABILITY THAT A RANDOM BULLET KILLS (YARDS)
(Sure kills only. Case: Assault soldier - 5 min after wounding.)

	100	200	300	400	500
M-1 cal 30 AP	.50	.50	.49	.48	.48
LWHVR cal .22 (50 gr)	.56	.55	.53	.51	.48

(This predicted lethality for a .22 caliber high velocity bullet designed to tumble appears to be significantly lower than the effects actually being demonstrated by the AR-15 .223 bullet against live and other targets. There is practical evidence that there is a higher speed tumbling or some other effect beyond that predicted.)

PROBABILITY OF HITTING (YARDS)

	100	200	300	400
M-1 cal 30 AP (3.8 mils)	.35	.10	.05	.03
LWHVR cal .22 (50 gr) (3 .mils)	.50	.16	.08	.04

(Averaging the above probabilities for 100, 200 and 300 yards, the probabilities for either weapon are lower than those achieved in the CDEC test (see Item VI) under the conditions tested.

The difference may be accounted for in the sights and the then state of development of the weapon (see Item III); and the AR-15 showed superiority in hit distribution (ratio of the number of targets hit to the number of hits) in the

CDEC test, a factor which tends to bear out the BRL conclusion but which was not specifically isolated in the BRL experiment.)

Multiplying the probability that a bullet kills if it hits by the hit probability, gives the probability of killing. For the LWMVR system, these values are shown for the assumed aiming error of 3 mils and for the tested error (3.8 mils) of the heavier (M-1) system:

PROBABILITY OF KILLING (YARDS)
(Rate of fire not considered)

	100	200	300	400
M-1 cal 30 AP (3.8 mils)	.16	.05	.02	.01
LWMVR cal .22 (50 gr)(3 mils)	.27	.09	.04	.02
(LWMVR cal .22 (50 gr)(3.8 mils)	.20	.06	.03	.01)

Multiplying the probability of killing by the rate of fire gives relative effectiveness:

RELATIVE EXPECTED NUMBER OF TARGETS KILLED (YARDS)
(Total weight of gun-and-ammunition = 15 lbs)

	100	200	300	400
M-1 cal 30 AP (3.8 mils)	1	1	1	1
LWMVR cal .22 (50 gr)(3 mils)	7.3	8.0	7.8	7.2
(LWMVR cal .22 (50 gr)(3.8 mils)	5.1	5.0	4.9	4.6)

(To convert the above table to the standard battle load of 22.39 lbs (from 15 lbs.), use a factor of 3 (instead of 3.8) as the multiplier of the Relative Effectiveness values. Assuming the worse of the two aiming conditions for the LWMVR (3.8 mils), the values for relative expected number of targets killed are:

	100	200	300	400
M-1 cal 30 AP (3.8 mils)	1	1	1	1
LWMVR (3.8 mils)	4.1	3.9	3.7	3.6

This may be compared with the results of the CDEC test (see Item VI) which, not counting lethality and with the accuracy of a weapon in early development, shows a superiority of the AR-15 LWMVR system over the M-14 to be about 2 1/2 to 1.) (ref.E)

C. The following are extracts from the above BRL study:

"An earlier BRL study indicated that a projectible which tended to tumble soon after target impact also tended to result in greater kill probabilities. As a conclusion to this study, it was shown that a caliber .22 projectile weighing 50 grains could be made to result in good wound ballistics performance if transverse moment of inertia were sufficiently low to encourage tumbling effect immediately after impact. This resulted in the recommendation of a caliber .22 50-grain lead core projectile."

"The initial velocity required for the proposed projectile has been assumed to be that which satisfies the CONARC requirement for a helmet penetration at 500 yards. For the 50-grain caliber .22 projectile, the velocity is approximately 3500 FPS." (The AR-15 caliber .223 round is 55 grains 3250 FPS and attains helmet penetration at 500 yds.)

"In order to establish the wounding power of this projectile in the absence of actual wound ballistic data for the specific design and velocities, it has been assumed that the 50-grain projectile which tumbles soon after impact will follow the same MV 3/2 - PHK laws as those observed with the caliber .22 carbine and the triplex ammunition."

. . . . . .

"The fact that light weight weapons result in smaller aiming errors, was also demonstrated in a series of tests of rifles, carbines, and pistols where aiming errors for each weapon were measured as a function of target exposure time." . . . .

. . . . . .

"It is felt that the increased rate of fire and decreasing aiming errors which appear to be a function of weight of the weapon resulted in higher percentage of hits. . . ."

. . . . . .

"Significant differences between weapons have been obtained when the weight of the weapon is considered or when a difference in aiming error is assumed. With respect to this conclusion, it must be reiterated that aiming errors for lighter weapons are apparently less than for heavier weapons. . . ."

(ref. E)

ITEM VI - OVERALL HIT POTENTIAL

OVERALL HIT POTENTIAL

ITEM VI. The AR-15 rifle is more effective (on the order of 250 percent) in overall hit potential than the M-14 rifle - a half squad armed with the AR-15 rifle is more effective in hit potential than a full squad armed with the M-14 rifle.

U. S. Army tactical tests of light weight rifle systems (AR-15 and Winchester) conducted by CDEC in 1958 concluded that a half squad armed with a light weight rifle system would be more effective in overall hit potential than a full squad armed with the M-14, and that there would be tactical advantages, in addition to the manpower economy advantage, of a smaller squad. The experiment employed live firing by various sized squads on tactical ranges.

The test data showed that a 5-man squad armed with the AR-15 rifle was equal to the 11-man squad armed with the M-14 rifle in terms of numbers of hits expected and was 1½ to 2 times as effective in the number of targets expected to be hit. Restated, the 5-man AR-15 rifle squad could be expected to get as many hits, and hit 1½ to 2 times as many targets, as the 11 man M-14 squad. The superiority of the AR-15 when the squads were of equal size was about 2½ to 1.

The results are conservative of current capabilities of a squad armed with the AR-15 rifle because the experiment did not take into account lethality (Item V) and the AR-15 has been improved significantly in accuracy (Item III) and field rate of fire since the 1958 CDEC test.

Taking these factors into account it is calculated that the AR-15 rifle in 1962 is up to 5 times as effective in overall squad kill potential as the M-14 rifle. (C)

VI SUPPORTING STATEMENTS AND EXTRACTS

1. The following results of the 1959 CDEC test were derived from over 500 firing runs made over instrumented tactical firing ranges at 100,200 and 300 yards using squads of varying sizes in attack and defense situations. The following is a summary, and extracts, of pertinent portions of the test report.

Hit probability and hit distribution were treated as dependent variables. The independent variables were squad size, rifle type, and firer proficiency, in situations of daylight attack, daylight defense, and night defense.

The rifles used were the Winchester (high velocity 22 cal), AR-15, and the M-14. The Winchester light weight rifle is not referred to further in this summary because it was discarded due to basic unreliability of its design. However, it was more accurate at the time than the AR-15 and it fully supported the finding of the superiority of the high velocity, light weight rifle system. (The Winchester equaled and, in some instances, exceeded the hit probability of the M-14 in this test. The superiority of the Winchester in accuracy over the AR-15 in this test was attributed to poor sights on the AR-15. The sights have since been modified, as a result of this test.)

A. Method

Hit probability is defined as the ratio of the number of hits to the number of rounds fired. Hit distribution is defined as the ratio of the number of different targets hit to the number of hits.

Hits expected per various sized squads is defined as hit probability multiplied by the battle load of 650 rounds per man for the AR-15 or 220 rounds per man for the M-14, by the number of firers.

Targets expected per various size squad is defined as the number of targets hit divided by the number of rounds expended times the number of rounds available (650 or 220) times the number of firers. The objective was to compare the rifles under tactica conditions at various squad sizes with regard to Hits Expected and Targets Expected - described as Hit Potential.

B. Results

(1) Hit probability and hit distribution.

Situation	Rifle	Hit Probability	Hit Distribution
Daylight Attack	AR-15	.357	.451
	M-14	.447	.432
Daylight Defense	AR-15	.223	.432
	M-14	.259	.414

The M-14 was better in hit probability. The AR-15 was better in hit distribution. The difference in hit probability in this test between the two weapons is attributed by the test report to the sights which have since been redesigned. (The AR-15 test weapons were the early prototype, which has since been refined by test and development and used ammunition which had not been designed for the weapon. For an indication of the difference in accuracy of the 1958 and 1960 versions of the AR-15, see Item III. Based on the known improvements in the AR-15 and the hit probability of the Winchester cal 22 in this test, it can be assumed that the hit probability of the AR-15 today equals and probably exceeds that of the M-14.)

(2) Effect of squad size on hit probability and hit distribution.

DAYLIGHT ATTACK

Squad Size	Rifle Type	Hit Probability	Hit Distribution
5	AR-15	.380	.546
	M-14	.484	.534
7	AR-15	.373	.490
	M-14	.403	.479
9	AR-15	.360	.427
	M-14	.437	.428
11	AR-15	.334	.398
	M-14	.447	.361

DAYLIGHT DEFENSE

5	AR-15	.241	.547
	M-14	.303	.528
7	AR-15	.233	.465
	M-14	.283	.447
9	AR-15	.226	.415
	M-14	.243	.404
11	AR-15	.208	.371
	M-14	.240	.342

The evidence is that hit probability and hit distribution tend to decrease (vary inversely) somewhat with squad size. The report does not note this fact, but it probably is related to span of control.

(3) Hits expected and targets hit. (Rifle and ammunition =22.39 lbs.)

(3) "The advantages of a smaller-sized squad are obvious - easier to control and more mobile, easier to transport, and easier to supply. The greater advantage lies in economy of manpower that can be realized through reduction in squad size. All this can be achieved while increasing squad hit potential."

(Para. 4B, page 73, ref. I

2. The overall squad kill potential of the AR-15 rifle in 1962 can be estimated by assuming in the above 1959 CDEC experiment (AR-15 rifle in 1958 state of development) that in 1962 the AR-15 rifle is equal to the M-14 rifle in hits per round fired and that the lethality of the AR-15 rifle bullet, based on combat tests and other evaluation (solid extremity hits are fatal), is 1.6 times that of the M-14 rifle bullet. Therefore for equal weights of rifle-and-ammunition (22.39 lb combat load) overall squad kill potential of the AR-15 rifle is about 5 times as effective as that of the M-14 rifle. If the lethality factor assumed for the AR-15 should be high, the hit probability factor probably is low in terms of demonstrated improvement in the accuracy and rate of fire of the weapon since 1958 and in the growth potential of the accuracy of the ammunition. In addition, this calculation does not consider the significance of the better performance of the AR-15 rifle over the M-14 rifle in hit distribution - number of targets expected to be hit. It is likely that the increase in accuracy and rate of fire of the AR-15 rifle since 1958 has gone at least as much into hit distribution as into hit probability.

In addition, the CDEC test apparantly included automatic fire only in defensive situations (Army Engineering tests and a test conducted within the CDEC test, cited elsewhere in this study, show that the hit probability of the AR-15 rifle in automatic fire per trigger pull is up to 1.6 times that of the M-14 rifle. This advantage should be greater with 3 round bursts (five round bursts were used)).

ITEM VII - BRUSH PENETRATION

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BRUSH PENETRATION

ITEM VII. The individual AR-15 round and the individual M-14 round are comparable in ability to penetrate brush without undue fragmentation or deflection. (The M-14 round is possibly slightly superior.) However, the AR-15 weapon system is superior to the M-14 system in overall expected hit and kill effectiveness through brush by a factor of at least two to one.

From the brush penetration and other tests which have been conducted under different conditions by the several agencies, it can be concluded:

That the individual AR-15 round is not deficient in brush penetration capability and that its brush penetration capability is adequate.

That the amount of deflection of the individual round possibly is less for the M-14 round than for the AR-15 round but not significantly so.

That the AR-15 bullet and the M-14 bullet normally tumble during penetration of brush (the AR-15 with faster revolutions); but, in general, this tumbling is more of an advantage than a disadvantage (a bullet tipped close to or at the target is more lethal than a stable one and may cut away more vegetation).

That the AR-15 bullet may splinter more than the M-14 bullet under certain limited conditions (very close range and exceptionally hard brush materials), but the difference is not significant; such splintering, in general, probably is more of an advantage than a disadvantage (by increasing hit probability).

That, considering the superiority of the AR-15 rifle system in hit potential (Item VI) and in kill potential (Item V) and that the brush penetration capabilities of the individual rounds are about equal, the AR-15 rifle system can be expected to be superior to the M-14 system in brush penetration effectiveness by a factor of at least four to one.

Although the brush penetration tests of the several agencies contain some uncontrolled variables, considerable confidence is lent to the above conclusions by the results of the recent six months combat trial of 1000 AR-15 rifles in Vietnam against actual enemy targets under jungle conditions. (C)

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VII. SUPPORTING STATEMENTS AND EXTRACTS

1. Discussion

Brush penetration probabilities have not been established for the AR-15 rifle or the M-14 rifle (or for any other weapon, so far as is known). Reliable data for this purpose would be difficult to develop because of the number of variables present in any brush penetration test, the number of tests which would be necessary to produce statistically valid results, and the number of cases which would be needed to satisfy combat requirements for various geographical areas. These variables, some of which cannot be controlled, include the nature and mixture of the vegetation material, the season of the year, the density of the brush and the thickness of the individual branches and stems; the range from the rifle to the front of the brush, the distance through the brush, and the distance from the rear of the brush to the target. In any small sample, it also would be necessary to distinguish between fair hits/ricochets and random ricochets (both vertical and horizontal and mixed). Therefore, none of the tests which have been conducted can be considered to be more than good, practical indicators. Further, any useful assessment of the relative effectiveness of two weapons in killing through brush should take into consideration not only single-round brush penetration capability but also hit and kill probabilities, rates of fire, and amount of ammunition available within the standard weight allowance for weapons systems compared. Since, in these respects (see Items V and VI), the AR-15 is superior to the M-14, and the single round brush penetration of the two rounds are comparable, the AR-15 can be assumed to be superior in expected brush penetration effectiveness by a factor of at least four to one.

2. Extracts

A. The following are extracts from the 1958 Infantry Board service test report:

1. "One hundred rounds of each type ammunition were fired in 10-round groups, into a fixture containing approximately 12 inches of green, freshly cut, tightly packed, brush (limbs varied from small to approximately 3/4 inches) at ranges of 100, 300 and 500 yards. Mean radius was determined for each 10-round shot group before the projectile entered the brush. The change in mean radius and the performance characteristics of the projectiles, such as tumbling, yawing, etc., as evidenced from a witness plate 10 feet in rear of the brush, were recorded. . . . .

"Range (yds). . . .		Percentage of change
100	M-14 . . .	- 2
	AR-15 . . .	- 5
300	M-14 . . .	- 6
	AR-15 . . .	- 7
500	M-14 . . .	- 9
	AR-15 . . .	- 12

A footnote to the above table indicates that the AR-15 bullets tumbled more than those of the M-14 and that there was evidence of the AR-15 ammunition breaking up at 100 yards range, the amount and effect unspecified. The fixture of "12 inches of green, freshly cut, tightly packed brush" does not appear to be a realistic simulation of actual brush penetrating conditions and may have been a more severe test than likely to be found in the field; and the thickness of the front witness target is not described (relatively thin material could cause tipping of the AR-15 bullet prior to contact with brush.). However, these factors are not important to the conclusions since the degree of deflection of the AR-15 bullet was well within tolerable limits and the difference between the two bullets was not statistically significant (1 to 3 percent)

The test report classifies the brush deflection characteristic under the heading "minor deficiencies" . . . and under "Suggested Modifications" indicates "None."

(pages 19, 21, and 31, ref. F)

B. The CDTC combat test of 1000 AR-15 rifles in Vietnam placed special emphasis on brush penetration performance. A questionnaire containing four questions on this subject was filled out by each combat unit commander. In addition, a functional test was conducted by the CDTC. The report concludes that "the trajectory of the bullet was not significantly effected when fired through dense underbrush" . . at ranges of jungle interest for brush penetration. Extract from the functional test:

"Brush Penetration

. . . . .

(Beyond 50 meters it was impossible to distinguish a target, so this was considered an acceptable maximum distance for the test.)

"Results:

	Range (m)	No. Shots	No. hits AR-15	No. hits M2 (carbine)
Light underbrush	15	6	6	6
Moderate underbrush and bamboo thicket	15	6	6	6
Heavy underbrush and bamboo thicket interwoven with vines	15	6	6	6
Light underbrush	50	6	6	6
Moderate underbrush and bamboo thicket	50	6	6	5
Heavy underbrush and bamboo thicket interwoven with vines	50	6	6	5

No reference was made to any problem of splintering.

(page 9, Annex)

C. In field tests of the AR-15 in comparison with the M-14 as a control conducted by another agency, firing at 100 yards through 12 meters of thick cut brush from 1/2 inch to wrist thickness using a witness plate target, the number of hits and amount of deflection on the target were comparable and both rounds tumbled but both retained acceptable dispersion patterns and velocities. Neither round showed any tendency to break up. The tests in both paragraph B and C are at the more significant ranges of interest in firing into brush. These close ranges also are the most severe test of bullet breakup because of the higher target velocities of close ranges. However, some bullet splintering is not necessarily a disadvantage.

D. From the U. S. Navy Service Test of the AR-15 rifle for use by SEAL Teams:

"(4) Phase Four: Undergrowth Brush Test . . . .

Ten rounds were fired at a distance of 100 yards through 12 meters of heavy undergrowth and brush (see figure 1, inclosure 2). Seven out of 10 rounds were on target in scoring zone." No reference is made to any problem of splintering.

(ref. U)

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ITEM VIII - TRAINING

TRAINING

ITEM VIII. The AR-15 rifle is significantly better than the M-14 rifle in effectiveness in recruit rifle marksmanship training - on the order of 25% better in the number of qualified firers, and of 50% in the number of Experts, produced.

The comparative evaluation of effectiveness in recruit training of the AR-15, M-14, and M-2 carbine conducted by the marksmanship school at the USAF Lackland Training Center in 1960 showed the AR-15 to be 26% better than the M-14, and 5% better than the carbine, in the number of qualified firers produced; and 51% better than the M-14, and 37% better than the carbine, in the number of Experts produced. The unqualified rate for the AR-15 was .03 against .28 for the M-14. The Expert rate for the AR-15 was .43 compared with .22 for the M-14.

The superiority of the AR-15 over the M-14 in effectiveness in marksmanship training was predictable based upon the considerably lesser recoil and weight of the AR-15 rifle.

Such improvement in effectiveness of recruit marksmanship training is significant. It would improve the quality of qualified firers in the rifle squad and/or reduce training time; and it would save manpower by qualifying more firers and by reducing the number of marginal firers that require additional training. It is of particular importance in time of emergency expansion of U. S. forces and in U. S. training of less developed, allied soldiers, as in counter insurgency conflict. (U)

(Training)

VIII. SUPPORTING STATEMENTS AND EXTRACTS

A. The following are the results of a comparative facility of training evaluation conducted by the USAF Lackland Training Center in 1960 using the AR-15, M-2 carbine, and M-14. The evaluation used 150 new trainees and the standard USAF marksmanship train ing course consisting of 21 hours of instruction with three record firings, one at the end of each week's instruction:

RECORD FIRINGS

"LEVEL OF QUALIFICATION	FIRST WEEK AR-15	M-2	M-14	SECOND WEEK AR-15	M-2	M-14	THIRD WEEK AR-15	M-2	M-14
Expert	28	14	8	38	25	14	43	27	22
Sharpshooter	50	47	22	48	43	38	41	45	32
Marksman	11	22	26	9	20	20	13	20	18
Unqualified	11	17	44	9	12	28	3	8	28 "

(1st endorsement, ref. O)

B. An evaluation conducted by CDTC, Vietnam, with Vietnamese soldiers and standard Vietnamese qualification course, using the AR-15, M-2 carbine, and M-1 rifle also pro- duced results indicating a higher qualification rate for the AR-15.

(page 4, test Nr. 3, ref. R)

C. The following are the results of a questionnaire evaluation by Vietnamese combat unit commanders and their U. S. MAAG unit advisors as part of the combat field test of 1000 AR-15 rifles in Vietnam:

"TRAINING	AR-15	M-1 Rifle	BAR	SMG	M-1 CARBINE	MAX.POSS
"1 a. Simplest to train troops to use	59	44	15	37	55	70
b. Simplest to train in functioning	61	50	15	37	47	70
c. Simplest to train in assembly and disassembly	63	48	14	37	48	70
TOTAL	183	142	44	111	150	210 "

(ref. W)

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ITEM IX - RELIABILITY, DURABILITY, EASE OF MAINTENANCE

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RELIABILITY, DURABILITY, EASE OF MAINTENANCE

ITEM IX. The AR-15 rifle is reliable, durable, rugged and easy to maintain both in garrison and in combat and in these respects is definitely superior to the M-14.

The AR-15 rifle is exceptionally durable, reliable, rugged, trouble-free, and easy to maintain under all conditions of use, and is superior to standard weapons in these characteristics. The M-14 rifle is weak in a number of these characteristics.

As tested, barrel life of the AR-15 is double that of the M-14. The gas system of the AR-15 requires no cleaning or adjustment for the field life of the weapon, eliminating one of the major problems of all automatic and semi-automatic rifles. The AR-15 performs satisfactorily under severe standard engineering tests of endurance, cold, dust, water, and unlubricated firing. In the Army Arctic Service Test, with the M-14 rifle, M-1 rifle, and BAR as control weapons, the AR-15 was the only weapon which would function at low arctic temperatures. The handguard and/or stock do not char or burn at high sustained rates of fire as they do with the M-14 and conventional weapons. Spare parts usage is exceptionally low - in a recent test no parts were replaced due to breakage in 80,000 rounds fired. Because of light weight, small size, and ruggedness, the AR-15 is easy to jump unprotected on the parachutist without damage - the barrel and the flash hider bend in jumping with the M-14. The flash hider does not bend in normal field use as with the M-14.

The reliability-durability-ease of maintenance characteristics of the AR-15 rifle result from simple construction and some unique features of design. The gas system design eliminates the gas cylinder, piston, and adjustable gas port and has no moving parts. The handguard and stock are made of fibreglass for heat dissipation, lightness of weight, and freedom from maintenance. The in-line recoil system allows the recoil spring to be contained in the hollow fibreglass stock, shielding it from heat. The bolt locks in the chamber relieving stresses on the receiver and allowing the receiver, normally the source of malfunctions and difficult production problems, to be made by high production die-casting process. Other parts are made largely by automatic screw machines. The flash hider is short and rugged and at the same time functions as grenade launcher and bayonet support. The firing mechanism is enclosed with a rain-mud-dust-snow cover reducing malfunctions from foreign matter. Due to light overall weight of the weapon resulting from lower recoil, the parts are enabled to be correspondingly more rugged than the M-14. The rifle is designed so that it can be broken open like a shotgun for ease of field stripping, which involves the disassembly of only 8 parts and can be accomplished in 6 seconds.

Statements widely circulated that the AR-15 rifle is dangerous to fire with water in the barrel are inaccurate. The 1959 U.S. Army Ordnance Engineering test shows with the present barrel, as modified at that time, the AR-15 is no more dangerous to fire with water in the barrel than the M-14 or M-1 rifles. The standard rifles accumulate water either in rain or when submerged at a more rapid rate than the AR-15, and there is no practical user problem in these respects with any of the weapons.

Another widely circulated statement - that the AR-15 rifle bullet performs unsatisfactorily under arctic conditions - also is without foundation. The only test data behind such statements is the finding in the U. S. Army 1958-59 Arctic service test report that "Winds of 8 mph with gusts up to 20 mph cause caliber .224 bullets to drift completely off the target at a range of 500 yards. Firing under these conditions was suspended when approximately 15 rounds were fired, resulting in complete misses. . . Ambient temperatures ranged from 27°F to 0°F." Inferences from this data that the AR-15 rifle has an inherent Arctic deficiency are invalid for the following reasons:

The test was conducted with the Winchester Cal .224 round not the Remington Cal .223 round designed for the weapon. The Winchester bullet is two grains lighter, about one eighth inch shorter, has a different nose shape, and is flat-based rather than boat-tailed. Its shape, weight, and ballistic characteristics are different from the AR-15 bullet.

Indications of this difficulty do not show up in the Arctic accuracy tests conducted at any of the lesser ranges. The dispersion patterns at the lesser ranges are normal.

The temperatures at which the firing was conducted (27°F to 0°F) are not particularly arctic temperatures. Firing at these temperatures and winds in the temperate zone have produced normal results. Wind drift has not been mentioned as a problem in any of the numerous and thorough other tests of the weapon that have been conducted.

There is evidence that the front sight brackets of the AR-15 rifles had been disassembled and their pins lost and replaced with pieces of welding rod and fired in this condition.

A later Army arctic test conducted in 1962, using .223 ammunition, showed that, under similar wind and temperature conditions to those cited in the original Arctic test, there was little, if any, bullet drift at ranges to 500 yards and beyond.

(Reliability, Durability, Ease of Maintenance)

IX. SUPPORTING STATEMENTS AND EXTRACTS

To evaluate a rifle with regard to reliability, durability, functioning and ease of maintenance it is necessary to be able to compare it with other weapons in similar stage of development. Account has been taken of this factor. The following extracts and summaries also do not list AR-15 deficiencies which were corrected as a result of various tests and which have been proven to have been eliminated by later Army tests. The weapon as tested since 1960 has been in its developed, production form:

1. The following are extracts and/or summaries from the first (1958) U. S. Army Ordnance engineering test report on the AR-15 rifle:

A. Time required to "field strip" the AR-15 in comparison with the M-1 rifle;

	(Seconds) AR-15	M-1 RIFLE
Disassemble operating parts	6	21
Assemble operating parts	6	48

(page 32, ref. H)

B. "The AR-15 rifle is convenient to clean. During the endurance test (6000 rounds per rifle) the bolt group was not disassembled for cleaning in order to observe the effect of fouling on functioning. No malfunctions occurred which could be attributed to lack of cleaning."

(page 61, ref. H)

C. "The design of the AR-15 is favorable for obtaining a high level of function and endurance performance. The design of the rifle is simple and effective. Parts which serve as piston, operating rod or slide on arms such as the present standard U. S. military rifles have been replaced by a tube which is a stationary part, and the maintenance, malfunctions and breakages associated with these parts have been eliminated. The spring which returns the operating parts is located in the stock, a space which is not utilized in many rifles. This location is advantageous since it permits a large spring to be used, the spring is not affected by the heat of the barrel, and the spring is in direct line with the recoiling parts. Parts which act as levers have been eliminated as well as the friction points associated with these parts."

The initial ordnance engineer rain test damaged the AR-15. The barrel then was replaced, during the test, with the present barrel which is 2 oz. heavier with the following results:

WATER REMAINING IN BORE AFTER BEING FILLED IN VERTICAL POSITION AND ROTATED (Av. 5 trials)

Caliber	Angle rotated (degrees)	Water remaining in bore (grains)
.22	0	163.5
.30	0	81.8
.22	45	8.3
.30	45	6.9
.22	90	6.7
.30	90	8.3

WATER FLOWING INTO BORE WHEN WEAPON SUBMERGED

Caliber	Total water in bore (gr)	Total remaining in bore (gr)
.22	2	2
.30	13	5

RIFLE SUBMERGED 2 MIN, THEN FIRED W/O ATTEMPTING TO RELEASE WATER

AR-15	Normal operation. No damage
M-14	Barrel ruptured at 2 points

(page 69, ref. M)

. . . "The AR-15 rifle was fired without damage to the rifle with 70 grains of water in the breech end of the bore. The modified barrel was bulged when the rifle was fired with fifty drops of water in the bore at the muzzle end. Fifty drops of water in the caliber .22 bore is equivalent to a five inch column. This represents the amount of water which would be expected to accumulate in the bore in a five-hour exposure to moderate rain with the bore positioned vertically (assuming that no water leaked past the chambered cartridge). The volume of water which would accumulate in a caliber .30 bore under the same conditions would be 1.9 times as great as that accumulating in the caliber .22 since the amount collected would be in proportion with the bore area." . . .

"A loss of accuracy and velocity would probably result from a bulged bore. Only a limited amount of data are available on accuracy in barrels with bulged bores. Two T35 rifles gave (7.62 cal M-1 rifles) an average mean radius of 1.9 inches at 100 yd when fired from a bench rest before being subjected to the rain test. After the rain test, in which both bores were bulged, the average mean radius was 2.85 inches."

. . . . . UNCLASSIFIED

" Conclusions. . . . The original barrel installed on this rifle (AR-15) was too light to be fired safely with water in the bore. However, a modified barrel demonstrated a level of safety comparable with that of standard rifles."

(pages 61, 70, 71, ref. E)

2. The following extract is from the report of the 1958 Service Test of the AR-15 rifle conducted by the U. S. Army Infantry Board:

" ANALYSIS - The test rifle (AR-15) is significantly more reliable under simulated combat conditions than the control rifle (M-14)." . . .

3. The following extracts or summaries are from the report of the 1958/59 Army Arctic Service Test:

" Although the gas systems of the two test rifles (AR-15) were never cleaned, each rifle functioned properly for over 10,000 rounds (Test Nr. 2, incl. 1)". . . . .

(page 3, ref. K)

" Attempts were made to fire two each AR-15, M-14, BAR, and M-1 rifles at ambient temperatures ranging from - 53°F to - 56°F. The two AR-15 rifles were the only rifles that functioned". . . .

(page 4, ref. K)

" Bullets fired from M-14 rifles, . . . keyholed at 4449 and 4826 rounds respectively (Incl. 9) (Military characteristics for this weapon specify barrel life of 10,000 rounds. . . . . Bullets fired from AR-15 rifles, . . . keyholed at 9137 and 10,094 rounds respectively (Incl. 7). (Military characteristics for this weapon specify barrel life of 5000 rounds.)"

(pages 17, 18, incl. 1, ref. K)

" The barrel of the M-14 rifle became hot, causing stock and handguard to char and burn after approximately 200 rounds were fired automatic at an ambient temperature of - 36°F. Handguard was rendered unuseable."

(page 18, incl. 1, ref. K)

4. From the 1958/59 U. S. Army CDEC test:

"5. Conclusions

. . . . . .

"b. By opinion poll, the experimentation troops favor the LWHVR system, as represented by the Armalite, because of its demonstrated characteristics of lightness of weight, reliability, ... "

(page 3, ref. I)

5. From the second U. S. Army Engineering test of the AR-15 conducted in 1960:

. . . " The average malfunction rate with the rifle held normally was 0.25 per hundred rounds. Only 10 parts were broken in firing 18,000 rounds in the endurance test. . . The AR-15 gave near normal performance in the unlubricated, dust, extreme cold, and rain tests, and it completed the mud test.". . .

(Abstract, ref. N)

" Only the bolt and bolt carrier assemblies were removed from the rifle and cleaned after each 600 round firing cycle in the endurance test. The chamber was cleaned with a brush after each firing cycle, but the bore was not cleaned during the endurance test. No stoppages occurred which could be attributed to lack of maintenance in this test."

(page 23, ref. N)

6. From a technical evaluation of the AR-15 rifle made by the Technical Director, Eglin AF Base in 1960:

The evaluation begins with a summary of the qualifications of the author: . . . "16 years (1940-1956) of testing developmental shoulder weapons for the Army at Aberdeen Proving Ground. In addition to the above experience as Project Engineer, Section, Branch and Division Chief, the writer holds a "master" classification in two fields of rifle competition in registered matches of the National Rifle Association. Prior experience is necessary to provide comparative data of present standard weapons when they were in similar stages of development. . . "

. . . . . .

" A study of the above referenced attachments shows that the AR-15 performed exceptionally well during the recent tests at Aberdeen. Functioning and durability were excellent in comparison with the M-14 rifle, especially at a similar stage of development. The AR-15 was outstandingly better than the M-14 in performance under adverse combat conditions, such as, unlubricated weapon, extreme cold, severe dust, excessive mud, heavy rain, and sustained rapid firing. . . . "

. . . . . .

" A complete discussion of the mechanical design and construction characteristics will not be given here. . . . However, certain basic features are

worth stressing. Perhaps the most important is the simple system which feeds trapped gas to the bolt carrier without use of moving parts. A second major design feature is the direct locking of the bolt to the barrel. This permits low strength, precision casting of the complex receiver housing. The in-line stock design, plus the other two features just mentioned result in a large number of simple components which can be fabricated by screw machine techniques. The completely inclosed mechanism is a major factor in the fine performance under adverse conditions.

" The M-1 rifle, the M-1 and M-2 carbines and the M-14 are notoriously difficult and expensive to manufacture. It is estimated that the AR-15 could be produced at about half the cost of an M-14 and that less difficulty in producing a properly functioning weapon would result."

(Appendix E, ref. O)

7. From the 1962 CDTC functional and combat test of 1000 AR-15 rifles in Vietnam:

" Results, Combat Evaluation

"(c) It is easier to maintain the AR-15 both in the field and in garrison than the M-1 rifle, BAR, sub-machine gun, or the M-1 carbine.

"(d) The ruggedness and durability of the AR-15 are comparable to that of the M-1 rifle and superior to that of the BAR, sub-machine gun and M-1 carbine.

"(e) . . . The high degree of reliability and trouble free performance of the weapon reflected in previous test reports . . . was also noteworthy during testing and evaluation here. No parts breakage was encountered while firing 80,000 rounds during the comparison test. Only two parts have been issued to date to replace breakage for the entire 1000 weapons. Stoppages on the AR-15 are easily cleared by the individual soldier through the application of "immediate action."

(pages 4 and 8, ref. R)

"72 AR-15 rifles were carried into action (airborne assault). The drop zone was barely acceptable and many troops landed in high trees. Several LMG's and BAR's were not operational after the drop. Only one AR-15 was reported slightly damaged (damaged pistol grip) and all were operational. . . "

. . . . . .

". . . Landings of the troopers were much rougher than normal. Many troops landed in high trees. This subjected the individual weapons to a much more severe test than usual. Some of the LMG's and BAR's were not operational after the jump. All AR-15's were functional. . . ."

(pages 5 and 6, ref. R)

ITEM X - COST AND LOGISTICS

COST AND LOGISTICS

ITEM X. The AR-15 rifle (as well as its ammunition) costs less than the M-14 and can be readily produced in good quality, with significant logistical gains both in CONUS and in the field.

The AR-15 rifle is considerably easier to manufacture than the M-14 rifle because of design features previously described. The receiver, which is the most difficult part to manufacture on most rifles and which has been especially difficult with the M-14, is made from low strength precision casting. The majority of other parts are made by automatic screw machine, and the stock and the handguard are molded. Sufficient quantities of AR-15 rifles have been manufactured (about 7000) to indicate that there should be no special problems in quantity production. As an additional assurance factor, the product of this pilot production has been troop tested in the field.

The total program cost of the M-14 rifle for FY 61 and FY was $164 per rifle. This high cost reflects development, production base, and special problems encountered in producing this weapon. The average program cost for all years through FY 62 was $147 per rifle. The programmed cost for FY 63 is $114 per rifle, reflecting the solution of the production problems and the amortization of the production base.

The cost of 50,000 AR-15 rifles at 5000 per month (no facilitization) is estimated to be $101 per rifle. (Note: the USAF is buying 8,500 rifles at $107 per rifle). The cost of the AR-15 in quantity production (case: 500,000 rifles at 25,000 per month, $6,000,000 facilitization required, one shift), prior to amortization of production base, is estimated to be $100. After amortization, the cost is estimated to be $88 per rifle. This cost should drop further with learning curve improvement. Another case, if quantity production were desired, would be that of having the companies which have been facilitized to manufacture the M-14 rifle make such parts and components for the AR-15 for which their machinery may be suitable, with the present manufacturer of the AR-15 rifle acting as project manager, responsible for assembly and quality control on a fixed fee basis. This case has not been studied but might well reduce production base cost.

The current production capability of the present manufacturer of the AR-15 rifle appears to be 2500 rifles per month. On the basis of available information, it appears that this could be increased in four months to 5000 per month maximum, but that further increase would require facilitization. The manufacturer states in a formal production proposal that, for a quantity order calling for a rate of 25,000 rifles per month, he could begin producing rifles 7 months after delivery of tools and equipment and would reach 25,000 per month in an additional 3 months.

Programmed cost of M-14 ammunition for FY 63 is $90 per 1000. Estimated cost based on firm price quotation from a manufacturer, for AR-15 ammunition is $67 per 1000 rounds which is also the price at which the Air Force is buying 8,500,000 rounds. This cost should decrease to $60 in high quantity production. Reduced ammunition

costs would be a major savings, since ammunition, as a consumable, is a major cost. On the basis of quantities of ammunition programmed per M-14 rifle, ammunition costs about 1.5 times as much as the rifle. Ammunition requirements for the M-14 rifle through FY 67 appear to be about 245 million dollars. A similar amount of AR-15 ammunition would cost 80 million dollars less.

Current ammunition production capability of the present manufacturer of the AR-15 cal .223 round is 1,500,000 rounds per month, with an apparant capability on presen machinery of 4,000,000 rounds per month. There should be no difficulty in the industry of producing the necessary ammunition.

Other logistical advantages of the AR-15 rifle and its ammunition are obvious from the physical and reliability characteristics described elsewhere in this report. Savings which would result from the reduced weight and cube of ammunition which must be stored, handled, and transported would be appreciable. The quantities and costs of spare parts and required maintenance are less than for the M-14 (the cost is less than half). The lesser weight of the AR-15 rifle and its ammunition are particularly attractive in economy and effectiveness gains offered in the area of battlefield, and strategic, air mobility, as air mobility is increasingly stressed for ground forces.

Procurement of the AR-15 rifle would introduce a round of ammunition which is not standard in NATO. While the matter is not examined in this study, certain observations can be made. Major parts of the world where rifles are likely to be used by U. S. or U. S.-supported forces during the next 10 years are not in the NATO area. Introduction of the NATO round into these areas for hand held weapons would increase rather than decrease standardization problems in those areas (in most instances the M-14 rifle and/or NATO round could not be effectively used by the indigenous forces concerned because of the excessive weight and recoil of the weapon, with respect to indigenous physique, resulting from the 7.62 mm NATO round). On the other hand, in any such area where the AR-15 might replace M-1's, BAR's, carbines, and submachine guns in the hands of local forces, there would be standardization gains both in ammunition and spare parts. For the present, currently produced M-14 rifles and ammunition meet the NATO committment to that area. For the future, the wisdom of retaining the present 7.62 mm round in NATO on an indefinite basis may be questioned in terms of the long range effects on weapons development in the member NATO countries. Since the NATO round is not up to the state of the art, in either effectiveness or cost it can be expected that the member countries will, in time, become increasingly uneasy with its retention. In fact, several NATO countries already are seeking lighter rounds.

Adoption of the AR-15 caliber .223 round would result in the rifle and machine gun having different rounds of ammunition. This is not considered a significant problem either tactically or logistically; and, in fact, machine gun loadings are not readily useable in rifles as packaged. Retention of the M-14 rifle will require caliber 45, and possibly carbine, ammunition to be retained and, in addition, has introduced the 40mm grenade round. In the long run machine gun ammunition may be standardized on the lighter round to take advantage of the increased lethality, lighter weight system and lower cost. The fact that in the interim the machine gun uses the NATO round assists the adoption of the AR-15 rifle since it insures that 7.62mm ammunition made excess by this action, if

any, can be consumed in machine guns.

In quantity production the item costs of the AR-15 rifle, ammunition, spare parts, and accessories would be about two thirds the FY63 item costs for corresponding items for the M-14 rifle system. In addition, the costs for the M-79 grenade launcher ($118 per weapon) would be eliminated. (C)

(Cost and Logistics)

X. SUPPORTING STATEMENTS AND EXTRACTS

1.

RIFLE, M-14

PROGRAM AND COST DATA

(Quantities in thousands; amounts in millions)

APPROPRIATION	FY61 & PY QTY	FY61 & PY AMT	FY62 QTY	FY62 AMT	FY63 QTY	FY63 AMT
ARMY						
RDT&E	-	$11.7	-	0	-	0
PEMA	445.6	54.5	39000	$38.0	300.0	$33.6
PROD. BASE	-	14.2	-	1.5	-	0
MARINE CORPS						
PROC., MARINE CORPS	127.0	13.6	63.5	8.0	63.5	8.0
TOTAL	572.6	$94.0	363.5	$47.5	363.5	$41.6
AV. UNIT COST PER RIFLE (TOTAL PROGRAM BASIS)		$164.16		$130.67		$114.44

In addition to the above, the following amounts have been programmed for spare parts for the M-14 rifle, financed by the Army and Marine Corps stock funds:

	FY61 & PY	FY62	FY63
ARMY	7.9M	.8M	2.5M
MARINE CORPS	2.3M	1.4M	.2M

From the above data the averaged programmed cost for spares per rifle is $12.

Source: OSD(Budget)

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2.

RIFLE, M-14

AVERAGE PROGRAM COST, BY MANUFACTURER

	1958	1959	1960	1961	1962
Springfield Arsenal	400.64	-	181.50	154.69	135.50
Olin-Mathieson Corp.	-	123.16	143.02	-	123.35
Harrington & Richardson	-	122.43	148.60	150.29	123.35
Thompson-Ramo-Wooldridge	-	-	-	104.73	-

(Rifle, ORD7, tests and test equipment, and ECO's)

Source: OSD (Budget)

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3. A. M-14 RIFLE STATUS AS OF 30 JUNE 1962

	Army	MarineCorps	Total
Deliveries in FY 1962 and prior years	408,844	106,500	515,344
Programmed Deliveries in FY 1963	375,285	63,500	436,785
TOTAL	782,129	170,000	952,129
Requirement to Equip(1 U.S. Forces in Europe (plus training)	351,654	-	351,654
M-1's in Inventory by end of FY 1963	1,434,988	166,960	1,601,948
World-wide Asset Objectives (including substitutes)	2,023,631	314,530	2,338,161

(1 SHRAC has a requirement of 212,281. Roundout for active Army involves an additional 235,927 (a percentage of which goes to Europe.)

B.

Contractor	Total Scheduled	Acceptances	Current Orders	Undelivered	Contract Schedule Rates	Estimated Completion Dates
Springfield Armory, Mass.	167,107	111,802	70,500(FY61) 49,000(FY62)	55,305	4,000/Mo.	Sept 63
Harrington & Richardson, Worcester, Mass.	462,582	338,082	224,500(FY62)	124,500	25,200/Mo.	Nov 62
Olin-Mathieson Corp., New Haven, Conn.	206,500	87,500	81,500(FY60) 90,000(FY62)	119,000	12,000/Mo.	May 63
Thompson-Ramo-Wooldridge, Cleveland, Ohio	100,000	-	100,000(FY61)	100,000 to start Nov 62	12,000/Mo. to attain in approx 7 mos. from start	Sept 63
TOTALS	936,189	537,384		398,805		

Distribution of M-14 Rifles

Air Force - Only test quantities	20
Coast Guard-Only test quantities	3
Marine Corps	105,337
Army	432,024

Contractor, Personnel and Subcontractors (Approximate)

Springfield Armory	710	About 8
H&R	1,023	99 Subcontractors
Olin-Mathieson	1,000	56 Subcontractors
T-R-W	300 (current)	32 Subcontractors

Fiscal Year 1963 Funds

A. Army has been provided funds to procure 300,000 rifles
B. Marine Corps will provide funds to procure 63,500

Status of Fiscal Year 1963 Funds

Army currently reviewing proposals submitted by the three current producers and should award contract by end of week - 17 August 1962.

Source: OSD (I&L)

4. The following information was extracted or computed from a 1961 Army plan for modernization of material:

A. PROGRAMMED COSTS AND QUANTITIES M-14 RIFLE AND ITS AMMUNITION, FY 63 THROUGH FY 67

ITEM	QTY	COST
M-14 rifle	1.5M	168.0M
Ball ammo	1.565M	159.8M
Blank ammo	1.036M	88.0M
Bipod	47.1K	1.4M
Bayonet knife	1.6M	8.1M
		425.315

B. The above program calls for 1043 rounds of ball ammunition, and 690 rounds of blank ammunition, per rifle.

C. The cost of an M-14 rifle bipod(for M-14 rifle in BAR replacement version) is $30.

D. The cost of M-14 rifle ammunition under this program per 1000 rounds:

Ball	Blank
$102	$70

E. The ratio of cost of ammunition to cost of rifle is 1.5 to 1. (248M versus 168M dollars) (ref. ZZ)

5. The following information was extracted or computed from the 1962 Army procurement list:

A. The FY 63 programmed cost of ammunition per 1000 rounds:

Ball	Blank
$90	$72

(ref. Y)

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6. A letter of the Colt Patent Fire Arms Manufacturing Company, Incorporated, of 5 June 1962 provides the following information:

For a fixed-price, incentive type committment providing for a maximum upward adjustment of 10% and with the government supplying the tooling, the unit price would be $88 for 150,000 rifles ($96 for 100,000, $101 for 50,000).

The present production rate of AR-15 rifles at Colt is about 2,500 per month (including production for USAF). The Company states that a production rate of 10,000 or 20,000 (depending on the size of the order) per month could be achieved in 12 months from the time of contract.

(ref. T)

7. Study of a formal Colt proposal for production of AR-15 rifles, prepared in August 1962, provides the following information:

Based on a contract similar to that described in paragraph 6 above, with an upward maximum revision of 15% and the government providing the tools for approximately $4-6 million (not firm) and on the basis of 500,000 rifles to be provided at 25,000 per month, the unit price is quoted by the company as $87.77.

The Company states that it would begin delivery of finished rifles seven months after delivery of equipment and tooling and would reach a volume of 25,000 per month in three additional months. Production could be approximately doubled by adding a second shift or providing additional plant and tooling.

(ref. X)

8. A Remington Arms Company, Incorporated, letter of June 1962 contains the following information:

The price of .223 ammunition quoted by the Company is:

Amount (rds)	(Depending upon the packaging) Price/1000	Price/1000
50,000,000	$67.75	$68.70
100,000,000	66.75	67.70
150,000,000	65.75	66.70

On the basis of 50,000,000 rounds, ammunition would be delivered at approximately 1,500,000 rounds per month from the time the contract is received until six months. Thereafter, it would be delivered at the rate of 4,000,000 per month. For quantities over 50,000,000 rounds the Company would consider installing additional capacity.

9. Letter from Colt Patent Fire Arms Manufacturing Company to USAF of May 1962:

The price of AR-15 8,500 rifles to the USAF is $107 per rifle.

The price of 8,500,000 rounds of AR-15 ammunition to the USAF is $67.75/1000 rounds.

". . . If expedited shipment is required, we can produce 5000 rifles per month on a three shift basis. We would need at least four months production lead time to reach this quantity output."

(ref. Z)

10. The cost of ORD 7 items supplied with the M-14 rifle, as computed in the unit cost in paragraph 1 above, is comparable to the cost of similar items included by the manufacturer in the unit cost of the AR-15 rifle. (The difference is three magazines versus a grenade launcher.)

The cost of a bipod for the M-14 rifle (BAR version) is $30. A bipod is not needed with the AR-15 but can be purchased optionally for $5.

The cost of spares, for the AR-15 rifle in accordance with amounts proposed by the Company, is $8 per rifle. (Note: Based on field tests to date the amount proposed by the Company is more than would be required. Initial purchases (FY 61 and FY) for the M-14 rifle were $20 per weapon. The average for all years, Army and Marine Corps, through FY 63 is $12 per weapon.)

(ref. V)

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