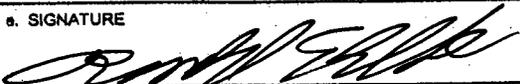
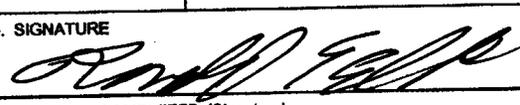


<b>NOTICE OF REVISION (NOR)</b>		1. DATE (YYYYMMDD) <b>20020806</b>	Form Approved OMB No. 0704-0188
THIS REVISION DESCRIBED BELOW HAS BEEN AUTHORIZED FOR THE DOCUMENT LISTED			
The public reporting burden for this collection of information is estimated to average 2 hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing the burden, to Department of Defense, Washington Headquarters Services, Directorate for Information Operations and Reports (0704-0188), 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to any penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.		2. PROCURING ACTIVITY NO. <b>R252024</b>	
PLEASE DO NOT RETURN YOUR COMPLETED FORM TO THIS ADDRESS. RETURN COMPLETED FORM TO THE GOVERNMENT ISSUING CONTRACTING OFFICER FOR THE CONTRACT/PROCURING ACTIVITY NUMBER LISTED IN ITEM 2 OF THIS FORM.		3. DODAAC	
4. ORIGINATOR	b. ADDRESS (Street, City, State, Zip Code)	5. CAGE CODE	6. NOR NO.
a. TYPED NAME (First, Middle Initial, Last) <b>SUNG H. CHO</b>	<b>U.S. ARMY, TACOM-ARDEC, AMSTA-AR-CCF-D, PICATINNY ARSENAL, NJ 07806-5000</b>	<b>19200</b>	<b>R252024-1</b>
		7. CAGE CODE	8. DOCUMENT NO.
		<b>19200</b>	<b>12944723</b>
9. TITLE OF DOCUMENT <b>CENTERPLATE</b>	10. REVISION LETTER		11. ECP NO.
	a. CURRENT	b. NEW	<b>R2S2024</b>
		<b>A</b>	
12. CONFIGURATION ITEM (OR SYSTEM) TO WHICH ECP APPLIES <b>40MM M549A1 PIBD FUZE</b>			
13. DESCRIPTION OF REVISION			
<p>Zone 3/B: Change: From: .165+.010</p> <p>To: .185+.005  <input checked="" type="checkbox"/> .003 (M) <input checked="" type="checkbox"/> A (M)</p> <p>Zone 4/B: Change: From: .020+.005</p> <p>To: .030+.005</p> <p>Zone 2-3/B: Change: From: R .015 Max or .015 Max Cham X <input checked="" type="checkbox"/> 45</p> <p>To: R .010 Max or .010 Max cham X <input checked="" type="checkbox"/> 45</p> <p>Change DISTRIBUTION STATEMENT X: From: "OTHER REQUESTS.....TO ARDEC, AMSTA-AR-AEF-D, PICATINNY ARSENAL, NJ 07806-5000". To: "OTHER REQUESTS.....TO DOD-5230-25".</p> <p>NOTE 7: CHANGE FROM: "MIL-F-50869" TO: "DTL 12944738"</p> <p>ZONE B-718 DELETE "(UNLESS OTHERWISE SPECIFIED)"</p>			
14. THIS SECTION FOR GOVERNMENT USE ONLY			
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	<input type="checkbox"/>	(2) Revised document must be received before manufacturer may incorporate this change.	
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b. ACTIVITY AUTHORIZED TO APPROVE CHANGE FOR GOVERNMENT <b>TACOM-ARDEC, AMSTA-AR-CCF</b>		c. TYPED NAME (First, Middle Initial, Last)	
d. TITLE <b>Ronald E. Etbe Chief, CCAC Prod &amp; Field Spt Team</b>	e. SIGNATURE 		f. DATE SIGNED (YYYYMMDD) <b>20020911</b>
15.a. ACTIVITY ACCOMPLISHING REVISION	b. REVISION COMPLETED (Signature)		c. DATE SIGNED (YYYYMMDD)

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<small>The public reporting burden for this collection of information is estimated to average 2 hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing the burden, to Department of Defense, Washington Headquarters Services, Directorate for Information Operations and Reports (0704-0188), 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to any penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.</small> <b>PLEASE DO NOT RETURN YOUR COMPLETED FORM TO THIS ADDRESS. RETURN COMPLETED FORM TO THE GOVERNMENT ISSUING CONTRACTING OFFICER FOR THE CONTRACT/PROCURING ACTIVITY NUMBER LISTED IN ITEM 2 OF THIS FORM.</b>		<b>2. PROCURING ACTIVITY NO.</b> R2S2024	<b>3. DODAAC</b>
<b>4. ORIGINATOR</b> a. TYPED NAME (First, Middle Initial, Last) SUNG H. CHO	b. ADDRESS (Street, City, State, Zip Code) U.S. ARMY, TACOM-ARDEC, AMSTA-AR-CCF-D, PICATINNY ARSENAL, NJ 07806-5000	<b>5. CAGE CODE</b> 19200	<b>6. NOR NO.</b> R2S2024-2
<b>9. TITLE OF DOCUMENT</b> BRACKET	<b>10. REVISION LETTER</b> a. CURRENT b. NEW A	<b>7. CAGE CODE</b> 19200	<b>8. DOCUMENT NO.</b> 12944724
<b>12. CONFIGURATION ITEM (OR SYSTEM) TO WHICH ECP APPLIES</b> 40MM M549A1 PIBD FUZE		<b>11. ECP NO.</b> R2S2024	
<b>13. DESCRIPTION OF REVISION</b>  Delete Note 6 entirety.  Zone 6/D: Change: From: 2 x .099-.006 To: 2 x .099-.005  Zone 3-4/B: Change View			
<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>From:</p> </div> <div style="text-align: center;"> <p>To:</p> </div> </div>			
<b>14. THIS SECTION FOR GOVERNMENT USE ONLY</b>			
a. (X one) <input checked="" type="checkbox"/> (1) Existing document supplemented by this NOR may be used in manufacture. <input type="checkbox"/> (2) Revised document must be received before manufacturer may incorporate this change. <input type="checkbox"/> (3) Custodian of master document shall make above revision and furnish revised document.			
b. ACTIVITY AUTHORIZED TO APPROVE CHANGE FOR GOVERNMENT <b>TACOM-ARDEC, AMSTA-AR-CCF-F</b>		c. TYPED NAME (First, Middle Initial, Last)	
d. TITLE <b>Ronald E. Eibe          Chief, CCAC Prod &amp; Field Spt Team</b>		e. SIGNATURE 	f. DATE SIGNED (YYYYMMDD) 20020911
15.a. ACTIVITY ACCOMPLISHING REVISION		b. REVISION COMPLETED (Signature)	c. DATE SIGNED (YYYYMMDD)

Sheet 1 of 2

<b>NOTICE OF REVISION (NOR)</b> THIS REVISION DESCRIBED BELOW HAS BEEN AUTHORIZED FOR THE DOCUMENT LISTED		1. DATE (YYYYMMDD) 20020806	Form Approved OMB No. 0704-0188
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4. ORIGINATOR	b. ADDRESS (Street, City, State, Zip Code)	5. CAGE CODE 19200	6. NOR NO. R2S2024-2
a. TYPED NAME (First, Middle Initial, Last) SUNG H. CHO	U.S. ARMY, TACOM-ARDEC, AMSTA-AR-CCF-D, PICATINNY ARSENAL, NJ 07806-5000	7. CAGE CODE 19200	8. DOCUMENT NO. 12944724
9. TITLE OF DOCUMENT BRACKET	10. REVISION LETTER		11. ECP NO. R2S2024
		a. CURRENT -	b. NEW A
12. CONFIGURATION ITEM (OR SYSTEM) TO WHICH ECP APPLIES 40MM M549A1 PIBD FUZE			
Sheet 2 of 2			
13. DESCRIPTION OF REVISION  Change DISTRIBUTION STATEMENT X: From: "OTHER REQUESTS.....TO ARDEC, AMSTA-AR-AEF-D, PICATINNY, NJ 07806-5000". To: "OTHER REQUESTS.....TO DOD-5230-25".  ZONE A7-A8, B7-B8 DELETE "(UNLESS OTHERWISE SPECIFIED)"			
14. THIS SECTION FOR GOVERNMENT USE ONLY			
a. (X one)	<input checked="" type="checkbox"/>	(1) Existing document supplemented by this NOR may be used in manufacture.	
	<input type="checkbox"/>	(2) Revised document must be received before manufacturer may incorporate this change.	
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b. ACTIVITY AUTHORIZED TO APPROVE CHANGE FOR GOVERNMENT TACOM-ARDEC, AMSTA-AR-CCL-F		c. TYPED NAME (First, Middle Initial, Last)	
d. TITLE Ronald E. Eibe Chief, OCAC Prod & Field Spt Team		e. SIGNATURE 	f. DATE SIGNED (YYYYMMDD) 20020911
15.a. ACTIVITY ACCOMPLISHING REVISION		b. REVISION COMPLETED (Signature)	c. DATE SIGNED (YYYYMMDD)

NOTICE OF REVISION (NOR)		1. DATE (YYYYMMDD) 20020806	Form Approved OMB No. 0704-0188
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4. ORIGINATOR	b. ADDRESS (Street, City, State, Zip Code)	5. CAGE CODE	6. NOR NO.
a. TYPED NAME (First, Middle Initial, Last) SUNG H. CHO	U.S. ARMY, TACOM-ARDEC, AMSTA-AR-CCF-D, PICATINNY ARSENAL, NJ 07806-5000	19200	R2S2024-3
		7. CAGE CODE	8. DOCUMENT NO.
		19200	12944746
9. TITLE OF DOCUMENT FIRING PIN	10. REVISION LETTER		11. ECP NO.
	a. CURRENT	b. NEW	R2S2024
	-	A	
12. CONFIGURATION ITEM (OR SYSTEM) TO WHICH ECP APPLIES 40MM M549A1 PIBD FUZE			Sheet 1 of 2
13. DESCRIPTION OF REVISION Zone 2/C: Change View and circled dimensions:			
14. THIS SECTION FOR GOVERNMENT USE ONLY			
a. (X one)	<input checked="" type="checkbox"/>	(1) Existing document supplemented by this NOR may be used in manufacture.	
	<input type="checkbox"/>	(2) Revised document must be received before manufacturer may incorporate this change.	
	<input type="checkbox"/>	(3) Custodian of master document shall make above revision and furnish revised document.	
b. ACTIVITY AUTHORIZED TO APPROVE CHANGE FOR GOVERNMENT TACOM-ARDEC, AMSTA-AR-COL-F		c. TYPED NAME (First, Middle Initial, Last)	
d. TITLE Ronald E. Elbe Chief, OCAC Prod & Field Spt Team	e. SIGNATURE 		f. DATE SIGNED (YYYYMMDD) 20020911
15.a. ACTIVITY ACCOMPLISHING REVISION	b. REVISION COMPLETED (Signature)		c. DATE SIGNED (YYYYMMDD)

<b>NOTICE OF REVISION (NOR)</b> THIS REVISION DESCRIBED BELOW HAS BEEN AUTHORIZED FOR THE DOCUMENT LISTED		1. DATE (YYYYMMDD) 20020806	Form Approved OMB No. 0704-0188
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4. ORIGINATOR	b. ADDRESS (Street, City, State, Zip Code)	5. CAGE CODE 19200	6. NOR NO. R2S2024-3
a. TYPED NAME (First, Middle Initial, Last) SUNG H. CHO	U.S. ARMY, TACOM-ARDEC, AMSTA-AR-CCF-D, PICATINNY ARSENAL, NJ 07806-5000	7. CAGE CODE 19200	8. DOCUMENT NO. 12944746
9. TITLE OF DOCUMENT FIRING PIN	10. REVISION LETTER	11. ECP NO. R2S2024	
	a. CURRENT -	b. NEW A	
12. CONFIGURATION ITEM (OR SYSTEM) TO WHICH ECP APPLIES 40MM M549A1 PIBD FUZE			
13. DESCRIPTION OF REVISION			
<p>Zone 3-4/B: Change: From: .166-.004 To: .180-.004</p> <p>Change DISTRIBUTION STATEMENT X: From: "OTHER REQUESTS.....TO ARDEC, AMSTA-AR-AEF-D, PICATINNY ARSENAL, NJ 07806-5000". To: "OTHER REQUESTS.....TO DOD-5230-25".</p> <p>ZONE B-4 DELETE "(UNLESS OTHERWISE SPECIFIED)"</p>			
14. THIS SECTION FOR GOVERNMENT USE ONLY			
a. (X one)	<input checked="" type="checkbox"/>	(1) Existing document supplemented by this NOR may be used in manufacture.	
	<input type="checkbox"/>	(2) Revised document must be received before manufacturer may incorporate this change.	
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b. ACTIVITY AUTHORIZED TO APPROVE CHANGE FOR GOVERNMENT TACOM-ARDEC, AMSTA-AR-CCF-F		c. TYPED NAME (First, Middle Initial, Last)	
d. TITLE Ronald E. Eibe Chief, CCAC Prod & Field Spt Team	e. SIGNATURE 	f. DATE SIGNED (YYYYMMDD) 20020911	
15.a. ACTIVITY ACCOMPLISHING REVISION	b. REVISION COMPLETED (Signature)	c. DATE SIGNED (YYYYMMDD)	

Sheet 2 of 2

**STATEMENT X, CERTIFIED CONTRACTORS**

NOTICE OF REVISION (NOR)		1. DATE (YYMMDD)	FORM APPROVED
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Public reporting burden for this collection of information is estimated to average 2 hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing the collection of information. Send comments regarding this burden estimate or any other aspect of this information, including suggestions for reducing this burden to Department of Defense, Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503. PLEASE DO NOT RETURN YOUR COMPLETED FORM TO EITHER OF THESE ADDRESSES. RETURN COMPLETED FORM TO THE GOVERNMENT ISSUING CONTRACTING OFFICER FOR THE CONTRACT/PROCURING ACTIVITY NUMBER LISTED IN ITEM 2 OF THIS FORM		2. PROCURING ACTIVITY NO.	R2S2024
3. DODAAC		6. NOR NO.	R2S2024-4
4. ORIGINATOR		7. CAGE CODE	8. DOCUMENT NO.
a. TYPED NAME (First, Middle Initial, Last)	b. ADDRESS (Street, City, State, Zip Code)	19200	DTL 12944738
Héctor Morales	TACOM-ARDEC AMSTA-AR-QAC-C PICATINNY ARSENAL, NJ 07806-5000	19200	
9. TITLE OF DOCUMENT	10. REVISION LETTER		11. ECP NO.
Detail Specification for the Fuze, PIBD, M549A1; Less Spitback Metal Parts and Loading, Assembling and Packaging.	a. CURRENT	b. NEW	R2S2024
	-		
12. CONFIGURATION ITEM (OR SYSTEM) TO WHICH ECP APPLIES			Sheet 1 of 1
M549A1 Fuze			
13. DESCRIPTION OF REVISION			
PAGE 14			
Paragraph 4.4.2.1:			
DELETE: Major 102			
ADD: Major 102 "Length from point to underside head (.245) Level I 3.3 Gage"			
4. THIS SECTION FOR GOVERNMENT USE ONLY			
a. (X One)	X	(1.) Existing document supplemented by this NOR may be used in manufacture.	
		(2.) revised document must be received before manufacture may incorporate this change.	
		(3.) Custodian of master document shall make above revision and furnish revised document.	
b. AUTHORITY AUTHORIZED TO APPROVE CHANGE FOR GOVERNMENT		c. TYPED NAME (First, middle initial, Last)	
TACOM-ARDEC, AMSTA-AR-QAC-C			
d. TITLE	e. SIGNATURE	f. DATE SIGNED	
Ronald E. Elbe Chief, CCAC Prod & Field Spt Team		200209/1	
10a. ACTIVITY ACCOMPLISHING REVISION	b. REVISION COMPLETED (Signature)	f. DATE SIGNED	

STATEMENT X, CERTIFIED CONTRACTORS.

20. NEED FOR CHANGE:

The Red Team investigating the dud problem with the M549A1 fuze concluded that the problem was caused by "insufficient firing pin retraction " in the arming cycle. Based on this conclusion, Government project team and Dayron took the approach of improving the process and design in parallel effort.

In order to reduce a potential friction between the firing pin and firing pin hole in the centerplate during launch, the firing pin head configuration was changed from a conical head to a flat head with an increase head diameter and the centerplate hole was modified to increase bearing area.

To prevent the brackets being crimped too close (or tight) to the centerplate, open end of the bracket legs was dimensioned instead of relying on the bracket leg angle.

The modified centerplate assembly was successfully qualified without a single failure in December 2001.

As a part of the process improvement, a modified centerplate assembly spin fixture was implemented in production to inspect the positive firing pin retraction in spin. Reliability of the M549A1 fuze will be significantly improved with the changes made to the design in conjunction with the modified centerplate assembly spin fixture.

Summary of testing:

Target	Sample
200 Meter sand	65 (verification)
200 Meter sand	150 (qualification)
190 Ft Homosote	150 (qualification)
60 Ft Homosote (Non-arm)	10 (information only)

**FINAL REPORT ATTACHED**

ARDEC

## M549A1 CENTERPLATE ASSEMBLY REDESIGN

### FINAL REPORT

The purpose of the M549A1 centerplate assembly redesign was to eliminate a seldom seen (less than one in a hundred) but repetitive failure mode in which the firing pin fails to retract during projectile flight thereby blocking the rotor from arming completely, resulting in a dud fuze. The format for the final report is consistent with the instructions put forth in the Statement of Work.

#### 1) Document design decisions, approaches and rationale.

Two major areas of redesign were investigated. First was the concern of whether there was sufficient space available for firing pin retraction under all tolerance combinations. This concern was addressed by changing from the M549A1 Bracket to the M533 Bracket. The theory was that the M533 Bracket, with a longer leg length (.120 vs. .099) would provide additional clearance for the firing pin. To accomplish this, the Ring had to be modified to clear the Ogive. The second area of investigation was to determine if the conical head of the firing pin could hang up in the center hole of the centerplate due to setback. The theory was that the conical head of the firing pin could wedge in the entrance radius of the center hole creating a locked condition. This approach involved using a "flat plate" firing pin with a larger diameter head such that, on setback, the flat surface of the firing pin head would bear against the enlarged counterbore diameter of the centerplate creating a "flat on flat" condition as opposed to a "cone on radius" condition found in the original design.

#### 2) Document the changes made to the M549A1 centerplate assembly

The final recommended changes are as follows:

Firing Pin, 12944746 --- revise head diameter from .166 - .004 to .180 - .004 to maximize the bearing area during setback yet not interfere with the center hole of the bracket spring. The head height was revised from .026 - .004 to .016 - .004 to provide additional clearance with the bracket points. In the original design, the firing pin was not under load against the centerplate due to the bracket spring. This was considered desirable to prevent galling during vibration. The "flat plate" firing pin sat higher in the centerplate counterbore so additional clearance was required to maintain a floating firing pin in the at rest condition. The 45 degree head was replaced with a flat surface.

Centerplate, 12944723 — increase the size of the center hole counterbore from .165 + .010 to .185 + .005 to accommodate the larger firing pin head. The counterbore depth was increased from .020 + .005 to .030 + .005 to provide additional clearance for the revised firing pin.

Bracket, 12944724 – tighten tolerance on leg length from .099 - .006 to .099 - .005 to eliminate a potential interference found in a Pro-E tolerance analysis. The center hole was changed from .126 + .002 to .093 + .003 to provide more material to strengthen the bracket. The method of defining the opening of the bracket legs was changed to insure a tapered opening exists at all times. This entailed eliminating the 2 x 5° MAX callout and dimensioning the tip of the opening of the legs to .232 + .007. This change will provide more clearance for staking the bracket at assembly minimizing the chance of jamming the bracket into the centerplate at assembly.

A government generated Pro-E tolerance analysis revealed a potential interference at the points of the M533 brackets after assembly. Sample hardware confirmed the interference and showed that it was detrimental to the proper opening of the brackets. Hence the M533 bracket was abandon. This action obviated the need to change the ring.

3) Identify the key characteristics associated with the M549A1 centerplate assembly.

Key characteristics for the proposed redesign and the current design are listed below. The rationale for the choices for the centerplate is that the leg width must assemble properly with the bracket and not create the possibility of a jam. The center hole diameter and counterbore diameter must provide clearance for the firing pin to retract. The rationale for the choices for the firing pin is that the length must be sufficient to penetrate the detonator. The body diameter and head diameter must clear the centerplate for proper retraction. The head height must ensure that the firing pin is not under an axial load in the at rest position. The rationale for the choices for the bracket is that the leg length must be sufficient to provide space for firing pin retraction. The width at the bottom of the opening must not jam at assembly to the centerplate. The opening width at the end of the .089 - .010 leg must provide sufficient clearance to prevent jamming of the bracket against the centerplate when the bracket pins are staked.

**PROPOSED REDESIGN**

<b>Dwg. No.</b>	<b>Name</b>	<b>Key Characteristic</b>
12944723	Centerplate	.220 - .007 leg width .128 + .003 center hole diameter .185 + .005 center hole counterbore dia.
12944746	Firing Pin	.245 + .004 length .127 - .002 body diameter .016 - .004 head height .180 - .004 head diameter

\* Currently this dimension is not specifically defined on the drawing. Dayron proposes this dimension as a key characteristic because it is the characteristic which gets staked over the hammerweight pin. Clearance of the staked joint with the centerplate leg is required for proper operation of the bracket.

### CURRENT DESIGN

Dwg. No.	Name	Key Characteristic
12944724	Bracket	.099 - .006 leg height .224 - .003 width at bottom of opening opening width at end of .089 - .010 leg *
12944723	Centerplate	.220 - .007 leg width .128 + .003 center hole diameter .165 + .010 center hole counterbore dia.
12944746	Firing Pin	.245 + .004 length .127 - .002 body diameter .026 - .004 head height .166 - .004 head diameter

#### 4) Inspect and record actual dimensions of each key characteristic

Raw data for the key characteristics is presented in the appendix. A brief discussion on this data is warranted. All hardware had been accepted as conforming to the requirements using approved inspection gages. In some cases attempts to obtain an actual numerical value for a key characteristic proved elusive. For example, a numerical value within .001 accuracy for the firing pin body diameter of .127 - .002 was readily obtainable using a micrometer. Likewise the corresponding center hole in the centerplate (.128 + .003) was easily measured using gage pins. Other key characteristics proved difficult to measure precisely. For the bracket, the .224 - .003 dimension was recorded using the best judgement of an experienced inspector. The first attempt at this inspection was made using a 50 power optical comparator. The difficulty was found in precisely aligning the legs of the bracket perpendicular to the light beam. Often readings .010 undersize were obtained for known acceptable parts. The second method was to use gage blocks. For instance, gage blocks could be set to exactly .221 and installed into the bracket opening. If the gage block would go all the way to the bottom of the opening, with no light showing between the gage block and the bottom of the bracket, the dimension was recorded as .221. However this method did not allow for the .005 radius permitted at the bottom of the bracket. For this measurement, it was left to the discretion of the inspector to record his best effort result. Likewise for the .220 - .007 width of the centerplate leg, it was difficult to

determine exactly where the true feature size of the leg existed in relation to the 2 X .02 R MAX.

The net result of these difficulties is that some recorded data appear outside the permitted tolerance range. This is due to difficulty in establishing numerical values for certain dimensions. All key characteristics were deemed acceptable by approved inspection methods.

5) Document key characteristics that are difficult to control or manufacture.

Dayron has not identified any key characteristic which is difficult to manufacture. However, we have no experience in controlling the opening at the end of the bracket leg within the previously permitted tolerance, so this is an uncertain area.

6) Identify key process controls

The key process control is staking of the bracket over the hammerweight pin. If Dayron does not maintain a perpendicular stake and drives material from the bracket against the centerplate, a dud could result. The change to control the open end of the bracket to provide additional clearance between the bracket and centerplate is a process improvement.

7) Document probable dimensions, within tolerance limit, that will maintain a high level of confidence.

Reducing the tolerance on the opening of the bracket legs and the tolerance on the bracket leg length are the only changes to existing tolerances recommended.

8) Provide test matrices for all bench level testing.

Dayron and government engineers worked closely through the evolution of the bench testing and ballistic testing. The detailed information was exchanged by E-mails, which are included in the appendix. With the recommended design changes implemented, a ballistic sample of 300 units was fired at the Dayron test range. 150 fuzes were fired against a homesote target at 190 feet and 150 fuzes were fired into sand at 200 meters. All fuzes functioned properly. No firing pin retraction problems were recorded.

9) If any failure occur during testing, document causes of the failures.

No failures occurred during testing.

10) Provide a full summary of lab and ballistic testing.

This was provided in the response to item 8.

### 11) Define cost impact of redesign

From a material standpoint, the largest cost associated with the redesign is a change to the production tooling of the centerplate die. Changes to the production tooling for the firing pin is an order of magnitude less. Changes to the bracket die can be accomplished as part of routine maintenance with no additional associated cost. From an assembly standpoint, a new feeder bowl for the firing pin must be purchased and installed on the assembly machine. This effort will include the design and building of new feeder tracks from the bowl to the assembly machine. There will be additional cost to document the redesign.

The only issue which may affect producibility is the change to the opening of the legs of the bracket. Dayron does not believe this will become an issue but, having no experience with this matter, can not rule out the possibility of a producibility problem.

### 12) Document "lessons learned"

A methodology which emphasizes testing is more productive than theory and conjecture.

### 13) Attach an assembly process flow chart

An assembly flow diagram for the M549A1 fuze has been generated and is submitted along with this final report. Critical inspection stations have been identified.

## **M549A1 CENTERPLATE REDESIGN**

### **APPENDICES SUMMARY**

- 1 – Test showing potential hang up of conical firing pin
- 2 - Test measuring degree of hang up of conical firing pin
- 3 – Test attempting to correlate actual dimensions to hang up
- 4 – First flat plate firing pin ballistic test, and escapement timing tests
- 5 – Hammerweight pin force tests
- 6 – Variable staking pressure test of hammerweight pin
- 7 – Ballistic test of flat plate firing pin
- 8 – Special test of centerplate assemblies rejected by vision system
- 9 – “Journey” inspection data

To: hendricksd@ioc.army.mil  
 Cc: sungcho@pica.army.mil  
 Subject: M549A1 centerplate assembly tests

Sung, Doug,

Per Sung's request, I repeated the firing pin/centerplate tests, this time using a firing pin spring. I serialized the assemblies and tried to measure the load which the firing pin spring exerts on the firing pin when the spring is compressed. As I explained in my previous FAX, these loads are not perfectly accurate because I had to use my judgement with the readings. I feel very confident that all the readings are above 130 grams, but the absolute load in the compressed position is less clear, but I'm confident the load is below 170 grams.

Chart legend:

- H/F - after application of the load, the firing pin was hung in the centerplate but was freed by compressing the firing pin spring
- F - after application of the load, the firing pin was totally free
- H - after application of the load, the firing pin was hung up even after compression of the firing pin spring

10 LB	S/N	Spring Load (gm)	Result	20 Lb	S/N	Spring Load (gm)	Result
	1	132	H/F		11	138	H/F
	2	152	H/F		12	140	H/F
	3	134	F		13	145	F
	4	137	H/F		14	154	H
	5	151	H/F		15	149	F
	6	145	H/F		16	144	F
	7	143	H/F		17	152	H/F
	8	153	H/F		18	149	H
	9	151	H/F		19	138	H
	10	143	F		20	147	H

50 LB	S/N	Spring Load (gm)	Result
	21	134	F
	22	142	F
	23	143	H
	24	143	H
	25	148	H
	26	151	No test- spring misassembled
	27	143	F
	28	141	F
	29	145	H
	30	145	F

My plan is to test "flat head" firing pins in the same manner. My feeling is that I should not use the firing pin spring initially. This way, if the concept indicates merit, I'll have hardware for an initial ballistic test, without having the firing pins damaged by removal of the firing pin spring. Please pass along any suggestions for testing.

Jim

From: Jim Nasternak [jnasternak@dsedayron.com]  
 Sent: Thursday, May 31, 2001 9:24 AM  
 To: 'Cho, Sung H [AMSTA-AR-CCF]'; 'jnasternak@dsedayron.com'; 'hendricksd@ioc.army.mil'  
 Subject: RE: M549A1 centerplate

Doug, Sung,

We did a push out test on some of the bound up firing pins. Data is presented below.

AXIAL LOAD	50lb	20lb	10lb
PUSH OUT FORCE	250gm	90gm	50gm
	255gm	40gm	60gm *
	175gm		40gm
	345gm		
	330gm		

I tried to apply the push out load as slow as possible. The "\*" indicates a reading where I might have applied to load too fast, judgement call. The push out loads corresponding to the 10 pound axial force are higher than I expected and about 1/3 of the minimum firing pin spring force. We are looking at this area more closely.

Neither Ken nor myself could see any witness marks on either the free firing pins and centerplates or the bound hardware. Keep in mind that we are pushing the firing pin in the same direction that the punch pushes material to form the centerhole so it may be impossible to separate witness marks from fabrication marks.

We refined our method for inspecting the size of the centerplate counterbore. I believe that you can add .001 to the dimensions previously reported. We repeated the inspection using the camera on new hardware. Then we took the same hardware and made molds of the centerhole and used an optical comparator to measure the mold. In all cases, the mold gave a .001 higher reading than the camera.

Jim

-----Original Message-----

From: Cho, Sung H [AMSTA-AR-CCF] [SMTP:sungcho@pica.army.mil]  
 Sent: Wednesday, May 30, 2001 1:27 PM  
 To: 'jnasternak@dsedayron.com'; 'hendricksd@ioc.army.mil'  
 Cc: Cho, Sung H [AMSTA-AR-CCF]  
 Subject: RE: M549A1 centerplate

Jim,

Would you also check for any binding marks on the firing pins and center holes including the units that exhibited the loose firing pins after load was removed? Please do not discard the test hardware.

Sung Cho

-----Original Message-----

From: Jim Nasternak [mailto:jnasternak@dsedayron.com]  
 Sent: Wednesday, May 30, 2001 6:50 PM  
 To: 'hendricksd@ioc.army.mil'  
 Cc: 'sungcho@pica.army.mil'  
 Subject: M549A1 centerplate

Doug, Sung,

I tried a crude test of the firing pin/centerplate interface. First, five samples of each were measured. The OD of the firing pin head measured .1652, .1653, .1646, .1645, and .1644. The diameter of the centerplate counterbore was also measured for five pieces with the following results, .1665, .1647, .1658, .1655, and .1653. The .1647 is undersize, but this reading was obtained using the coordinate measuring machine camera and there is some operator interpretation on exactly where the feature is located with respect to the cross hairs. These were the reported readings.

The calculated load on the centerplate by the firing pin is 9.3 pounds. Ten centerplate and firing pin combinations were subjected to a 10 pound load along the axis of the firing pin when it was installed in the centerplate. No attempt was made to record individual dimensions for the sets of hardware. This was to represent a normal production build. After the load was removed, the firing pin was checked for freedom of movement. Slight finger pressure was used to check for movement. The first combination was free, but the second combination hung up slightly. For the remaining 8 sets of hardware, after removal of the 10 pound load, the combination was set down gently on the firing pin point. In four of those 8 sets, the firing pin was loose and pushed back out of the centerhole under the weight of the centerplate. In the remaining 4 sets, the firing pin was bound up enough to support the weight of the centerplate (3.05 gms).

This test was repeated with new hardware subjected to a 20 pound load. This time 2 of 10 firing pins were bound enough to support the centerplate. Again the test was repeated with new hardware and a 50 pound load. This time 8 of 10 firing pins supported the centerplate.

Photographs of both a free and a bound firing pin are attached. Next we will try to quantify how much load it takes to break the firing pin free. An additional 10 sets of hardware are being inspected and individual dimensions will be recorded. We will cherry pick combinations to see if there is a trend. This is just preliminary work. I can't lay out a detailed plan yet as I don't know where these preliminary tests will lead. Feel free to suggest any preliminary tests.

Jim

**To:** Hendricks, Doug C; 'jnasternak@dsedayron.com'; 'Cho, Sung H [AMSTA-AR-CCF]'  
**Subject:** RE: M549A1 centerplate

Sung, Doug,

In response to your latest E-mails: Sung - It will take me a bit of time to perform your suggested test. We do not stock firing pin springs. We blank them and form them at the assembly machine. I have to activate the machine station and then get the springs inspected. It is a good test. I believe that the springs will retract all firing pins with the possible exception of those pins subjected to a 50 pound load.

Doug- I'll try bluing this afternoon. We don't have a calculated push out force for the firing pin spring. Intuition tells me it's about 150 grams minimum. It is 300 grams maximum per the drawing. We need to quantify this area.

This morning, the latest test was to take new firing pins and centerplates and measure pin head diameter and centerplate counterbore. I'm more confident of these numbers today than the ones reported yesterday because of our improved inspection technique. The firing pins were subjected to a 10 pound load. The units were paired to provide a sample of the largest and smallest clearances. The smaller numerical dimension is the firing pin head diameter. The largest dimension of the pair is the centerplate counterbore diameter.

DIMENSION	CLEARANCE	PUSH OUT FORCE
.1649 .1691	.0042	Free
.1650 .1691	.0041	40gm
.1656 .1680	.0024	Free
.1654 .1682	.0028	90, 115gm *
.1650 .1690	.0040	65gm
.1650 .1688	.0038	50gm
.1650 .1685	.0035	50gm
.1657 .1679	.0022	45gm
.1655 .1681	.0026	Free
.1652 .1682	.0030	Free

The "\*" test was halted at 90gm to verify that the unit was properly lined up with the fixture. It was. The load was reapplied and the pin fell out at 115gm.

Keep your suggestions coming. You're welcome to witness/participate in any part of the centerplate redesign effort. There are some circumstances which will lead to some inefficiency here. Besides have to fabricate firing pin springs, we are in the midst of an inventory, the M549A1 program being completed. It causes problems for our material control people when I ask to withdraw hardware for testing, since this causes them to change all their previous counts. Just keep the communication open and we will make progress.

Jim

-----Original Message-----

**From:** Hendricks, Doug C [SMTP:HendricksD@osc.army.mil]  
**Sent:** Thursday, May 31, 2001 7:27 AM  
**To:** 'jnasternak@dsedayron.com'; 'Cho, Sung H [AMSTA-AR-CCF]'; Hendricks, Doug C  
**Subject:** RE: M549A1 centerplate

To: sungcho@pica.army.mil  
 Cc: hendricksd@ioc.army.mil  
 Subject: M549A1 centerplate redesign

Sung, Doug,

The purpose of this is to update you on some of the testing that has taken place recently.

### TEST 1

The flat plate firing pin configuration was a .180 diameter head, head thickness in two steps of .026 and .015 (see current drawing). The counterbore in the centerplate was opened to .185 OD and deepened to .030. When the centerplates were assembled, the brackets held the firing pin tightly against the centerplate. There was no axial clearance as in the tapered head configuration. The centerplates were assembled in live rounds and shot at the 190 foot Homesote target. 9 functioned with one dud functioning on subsequent sand impact. No failure analysis was possible due to the damage to the hardware.

### TEST 2

Similar to test 1 except inert detonators were used. The flat plate firing pin head steps were altered to .016 and .010. This configuration provided axial clearance when assembled to the centerplate. I was building the escapement assemblies while a production person was hand loading the centerplate parts into the assembly machine. I asked for normal production inspection, but did not stand watch over the effort. The production person got two centerplates rotated with respect to their nest and one bracket pin was not staked at all on one side in both units. I did not know this prior to the test. The fuzes were shot at 190 foot Homesote target and soft recovered. The two fuzes with unstaked bracket pins dudded with a hung firing pin. Seven fuzes functioned with good detonator penetration (firing pin length of .245). One fuze missed the barrel and functioned on sand. For your information, the Mk 19 gun is not nearly as accurate as the M129 gun, so soft recover testing becomes a challenge.

In building the escapements, I tried a little experiment to determine the numerical contribution of lubrication of the top plate to the fuze arming time. Two arming time tests were run on each escapement. First test was using an unlubricated top plate, unstaked. The second test used a lubricated top plate, staked. The reason for using the unstaked top plate was in case I has bad verges, I could replace them without losing an escapement. This proved wise.

S/N	Run 1	Run 2
1	116.1	114.7
2	130.3	118.7
3	140.7	122.2
4	121.7	120.4
5	105.9	102.9
6	126.8	124.3
7	139.1	127.1
8	226.5*	129.5
9	120.2	105.1
10	185.6*	124.7

\* -- verge assembly replaced after run 1

### TEST 3

Component dimensions identical to test 2. This time a lubricated top plate was used for both arming time tests. Run 1 used an unstaked top plate. This time the centerplate assemblies were more carefully watched. Bracket openings were running near the lower limit. I measured .221 to .222 using dial calipers. After the brackets were staked, the stakes were visually inspected. One bracket had one leg toed in a bit, but the bracket was free. The firing pin retraction test requires discussion. When I cut down the steps on the head of the firing pin to .016 and .010, this provides additional clearance between the firing pin and the brackets in the free state. When the retraction test is run, this additional clearance is immediately taken up when I turn the centerplate upside down, before the measurement of retraction is made. Consequently the readings are lower. The readings ran .028 to .032, as opposed to .038 to .042 with the conical head firing pin. One centerplate had a reading of .027 (it worked just fine). Same target as before, soft recovery. 8 functioned, 1 dud (firing pin hang up), 1 hit the edge of the barrel. In both test 2 and 3, the flat plate firing pins were free after round recovery.

Escapement assembly arm times for run 1 were using an unstaked, but lubricated top plate.

S/N	RUN 1	RUN 2
1	120	118
2	126	117
3	125	119
4	131	123
5	133	121
6	130	127
7	134	124
8	121	117
9	131	123
10	125	118

At this point in time, the ballistic tests show that the flat plate firing pin doesn't gain us anything, but the laboratory tests say otherwise. I have not ordered flat plate firing pins or modifications to the centerplate yet. Any thoughts?

My next test will be another soft recovery like before. This time I'm going overboard in spreading the bracket legs, targeting a .240 to .245 dimension. My plan is to test a dozen with the present firing pin and another dozen with the flat plate firing pin. I'll give you the particulars once I get the hardware modified.

Jim

**M549A1 CENTERPLATE ASSEMBLY**

**HAMMERWEIGHT PIN FORCE TESTS**

The centerplate assembly, 12944734, requires that the stake of the hammerweight pins must withstand a crimp stake of 30 pounds perpendicular to the stake and an axial dislodging force of 5 pounds. Five centerplate assemblies were tested to destruction perpendicular to the stake. Five centerplate assemblies were tested axial dislodging force using a 10 pound force gage. Data is presented below.

**30 pound test**

**5 pound test**

75	10+
75	10+
70	10+
75	10+
73	10+
76	10+
75	10+
80	10+
72	10+
79	10+
75	10+
74	10+
78	10+
79	10+
77	10+

Each hammerweight pin exceed the 10 pound force gage limit.

**Jim Nasternak**

**From:** Cho, Sung H [AMSTA-AR-CCF] [sungcho@pica.army.mil]  
**Sent:** Monday, October 29, 2001 8:02 AM  
**To:** 'Nasternak'  
**Cc:** Vize, Joseph [ROCK ISLAND]; Hendricks, Doug C [ROCK ISLAND]; Cho, Sung H [AMSTA-AR-CCF]  
**Subject:** Variable staking pressure test

Jim,

SOW requires "Variable staking pressure and spin test". However, we did "pull / push" test on the hammerweight pins.

Staking pressure	Pull					
Push						
80 lbs (2 units)	10+	10+	10+	60	70	
*						
75 lbs (2 units)	10+	10+	10+	*	*	
*						
70 lbs (2 units)	10+	10+	10+	74	74	*
65 lbs (2 units)	10+	10+	10+	70	73	69
60 lbs (2 units)	10+	10+	10+	*	*	
*						
50 lbs (2 units)	10+	10+	10+	60	72	65

\* Pin could not be pushed out.

Note: All staking looked the same regardless of the applied pressures (Observed no difference in appearance).

### **M549A1 CENTERPLATE REDESIGN**

On 12/5/01, a special test was run on centerplate assemblies which were accepted by the original spin fixture but subsequently rejected by the vision system.

All centerplate assemblies used in the flat plate firing pin ballistic test were run through a centerplate assembly spin fixture twice. The first run utilized the original spin fixture. The second run utilized the new vision system fixture. The new fixture rejected three centerplate assemblies which were accepted by the original spin fixture. One centerplate assembly had two firing pin springs. One centerplate assembly had a misaligned firing pin spring. The third centerplate assembly had a bent bracket.

These rejected assemblies were built into rounds and ballistic tested. Only the assembly with the misaligned firing pin spring failed to fire on homesote at 190 feet from the gun.



VENDOR DAYRON "Journey" P.O. NO. 12944723 QTY. 60 ID. NO. 60

PART NO. 12944723 Accept 60 Reject

Date 8-30-01 Inspected By Day

**DAYRON "Journey"**  
**INSPECTION REPORT**

*Center Gate*

REQUIRED DIMENSIONS	ACTUAL DIMENSIONS														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
<i>leg work</i>															
<i>220-007</i>	.214	.214	.214	.214	.214	.214	.214	.214	.214	.214	.214	.214	.214	.214	.214
	.214	.214	.214	.214	.214	.214	.214	.214	.214	.214	.214	.214	.214	.214	.214
	.214	.214	.214	.214	.214	.214	.214	.214	.214	.214	.214	.214	.214	.214	.214
	.214	.214	.214	.214	.214	.214	.214	.214	.214	.214	.214	.214	.214	.214	.214
<i>Center hole</i>															
<i>Dia. 1287-003</i>	.129	.129	.129	.129	.129	.129	.129	.129	.129	.129	.129	.129	.129	.129	.129
	.129	.129	.129	.129	.129	.129	.129	.129	.129	.129	.129	.129	.129	.129	.129
	.129	.129	.129	.129	.129	.129	.129	.129	.129	.129	.129	.129	.129	.129	.129
	.129	.129	.129	.129	.129	.129	.129	.129	.129	.129	.129	.129	.129	.129	.129
<i>Center hole</i>															
<i>C1/6 Dia. 1057-010</i>	.169	.169	.169	.169	.169	.169	.169	.169	.169	.169	.169	.169	.169	.169	.169
	.169	.169	.169	.169	.169	.169	.169	.169	.169	.169	.169	.169	.169	.169	.169
	.169	.169	.169	.169	.169	.169	.169	.169	.169	.169	.169	.169	.169	.169	.169
	.169	.169	.169	.169	.169	.169	.169	.169	.169	.169	.169	.169	.169	.169	.169

STATEMENT X, CERTIFIED CONTRACTORS

20-26

COMMENTS:

1 of 2

# DAYRON

## INSPECTION REPORT

BAAAC/16T

VENDOR \_\_\_\_\_ P.O. NO. \_\_\_\_\_ QTY. 50 ID. NO. \_\_\_\_\_  
 PART NO. 12944724 Accept \_\_\_\_\_ Reject \_\_\_\_\_  
 Date 11-20-01 Inspected By clay

REQUIRED DIMENSIONS	ACTUAL DIMENSIONS														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1-000	.098	.098	.096	.095	.097	.098	.097	.097	.097	.095	.098	.097	.095	.099	.099
2X.099--005	.098	.098	.097	.096	.097	.097	.095	.097	.098	.094	.097	.099	.099	.097	.095
	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
	.097	.099	.097	.097	.097	.096	.097	.097	.099	.099	.096	.098	.098	.097	.087
	.097	.095	.098	.097	.097	.097	.097	.097	.096	.097	.097	.097	.097	.097	.087
	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
	.097	.099	.096	.099	.096	.097	.097	.097	.098	.098	.097	.096	.097	.095	.089
	.099	.098	.097	.098	.097	.096	.096	.097	.097	.096	.096	.098	.096	.098	.099
	46	47	48	49	50										
	.097	.097	.098	.098	.099										
	.097	.095	.098	.097	.099										
224-000	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	.221	.221	.221	.220	.221	.220	.221	.221	.221	.221	.221	.221	.220	.220	.221
	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
	.221	.221	.221	.221	.221	.221	.221	.221	.221	.221	.220	.221	.221	.221	.221
	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
	.220	.220	.221	.221	.221	.221	.221	.221	.221	.221	.220	.221	.221	.221	.220
	46	47	48	49	50										
	.220	.221	.220	.221	.221	.221	.221	.221	.221	.221	.221	.221	.221	.221	.220



DAYRON

INSPECTION REPORT

Center Plate (REDESIGN)

VENDOR P.O. NO. QTY. 50 ID. NO.

PART NO. 12944723 Accept Reject

Date 11-19-01 Inspected By [Signature]

REQUIRED DIMENSIONS	ACTUAL DIMENSIONS														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
7-000	.213 .214 .212	.211 .214 .212	.212 .214 .212	.214 .214 .213	.212 .213 .213	.212 .212 .215	.212 .211 .215	.214 .212 .212	.212 .215 .212	.212 .212 .214	.212 .212 .213	.212 .214 .213	.212 .212 .214	.212 .213 .212	.212 .212 .215
3 X .220 - .007	.214 .215 .215	.213 .214 .213	.212 .213 .212	.211 .213 .212	.212 .213 .214	.212 .214 .212	.213 .213 .213	.212 .214 .214	.212 .215 .215	.213 .213 .213	.213 .214 .213	.213 .213 .213	.214 .214 .214	.214 .214 .214	.212 .212 .215
⊙	.212 .213 .213	.214 .214 .213	.212 .213 .212	.213 .213 .213	.212 .214 .212	.212 .214 .212	.213 .213 .213	.212 .214 .214	.212 .215 .215	.212 .213 .213	.213 .214 .213	.213 .214 .213	.214 .214 .214	.214 .214 .214	.212 .213 .214
⊙	.212 .213 .213	.213 .214 .214	.212 .213 .213	.213 .213 .214	.212 .214 .212	.212 .215 .212	.214 .212 .215	.212 .214 .213	.213 .213 .213	.213 .214 .213	.214 .213 .213	.214 .214 .213	.213 .213 .214	.212 .214 .212	.211 .215 .212
⊙	.213 .212 .214	.212 .214 .213	.212 .213 .213	.212 .213 .213	.213 .214 .212	.212 .215 .212	.214 .212 .215	.212 .214 .213	.213 .213 .213	.213 .214 .213	.214 .213 .213	.214 .214 .213	.213 .213 .214	.212 .214 .212	.211 .215 .212
.185 T-.005	.187	.189	.188	.185	.186	.188	.188	.187	.186	.188	.187	.186	.188	.186	.187
⊙	.188	.188	.187	.187	.186	.188	.187	.188	.187	.186	.187	.188	.186	.186	.187
	.187	.186	.187	.186	.189	.187	.188	.187	.186	.188	.186	.189	.190	.186	.187
	.188	.188	.186	.189	.188										
.128 T-.000	.130	.130	.130	.130	.130	.130	.130	.130	.129	.130	.130	.130	.130	.130	.129
	.130	.130	.130	.130	.130	.130	.130	.130	.130	.130	.130	.130	.130	.130	.130
	.130	.130	.129	.130	.130	.130	.129	.129	.129	.129	.130	.130	.129	.130	.129
	.130	.129	.130	.130	.130										

VENDOR DAYRON P.O. NO. 12944746 QTY. 50 ID. NO. 50  
 PART NO. 12944746 Accept 50 Reject  
 Date 10-4-01 Inspected By Clay

**DAYRON**

**INSPECTION REPORT**

*Filing Pin (REDESIGN)*

REQUIRED DIMENSIONS	ACTUAL DIMENSIONS														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Length .245 +.004	.247	.247	.247	.247	.247	.247	.247	.247	.247	.247	.247	.247	.247	.247	.247
body dia. .127 -.002	.127	.127	.126	.127	.126	.126	.125	.127	.127	.127	.127	.126	.127	.126	.127
head height .016 -.004	.015	.015	.015	.014	.015	.016	.014	.014	.014	.015	.015	.015	.014	.015	.015
head dia. .180 -.004	.178	.178	.178	.178	.178	.178	.178	.178	.178	.177	.178	.178	.178	.178	.178
	.178	.178	.178	.178	.178	.178	.178	.178	.178	.178	.178	.178	.178	.178	.178
	.178	.178	.178	.178	.178	.178	.178	.178	.177	.178	.178	.178	.178	.178	.178
	.178	.177	.178	.178	.178										

STATEMENT X, CERTIFIED CONTRACTORS

24-26

DAY - 864, REV. - 03-25-98 COMMENTS:

**RANGE FIRING RECORD**

Test Type M549A# SPECIAL TEST

Powder Capsule# B#0197 (Long)

Fuze M549/M549A1 FUZE

O Ring # N/A

Contract No. \_\_\_\_\_

\*GFM\* M169 CARTRIDGE CASE

Fuze Lot No \_\_\_\_\_

MA00K010-001

Date 12/5/01

Lot Qty. \_\_\_\_\_

Target 190' 3" HOMOSOTE F.

Tester (s) WESS. SHAWN P.

JIM N.

Spitback Assembly MA-01A 001-001

DCAS QAR LIZ MCFADDEN

Launcher MK19# 30688

Director DICK SCHNEIDER

NO.	RESULTS								
1	F	31	F	61	F	91	F	121	F
2	F	32	301 F	62	F	92	F	122	F
3	F	33	F	63	F	93	F	123	F
4	F	34	F	64	F	94	F	124	F
5	F	35	F	65	F	95	F	125	F
6	F	36	F	66	F	96	F	126	F
7	F	37	F	67	F	97	F	127	F
8	F	38	F	68	F	98	F	128	F
9	F	39	F	69	F	99	F	129	F
10	F	40	F	70	F	100	F	130	F
11	F	41	F	71	F	101	F	131	F
12	F	42	F	72	F	102	F	132	F
13	F	43	F	73	F	103	F	133	F
14	F	44	F	74	F	104	F	134	F
15	F	45	F	75	F	105	F	135	F
16	F	46	F	76	F	106	F	136	F
17	F	47	F	77	F	107	F	137	F
18	F	48	F	78	NT302 F	108	F	138	F
19	F	49	F	79	F	109	F	139	F
20	F	50	F	80	F	110	F	140	F
21	F	51	F	81	F	111	F	141	F
22	F	52	F	82	F	112	F	142	F
23	F	53	F	83	F	113	F	143	F
24	F	54	F	84	F	114	F	144	F
25	F	55	F	85	F	115	F	145	F
26	F	56	F	86	F	116	F	146	F
27	F	57	F	87	F	117	F	147	F
28	F	58	F	88	F	118	F	148	F
29	F	59	F	89	F	119	F	149	F
30	F	60	F	90	F	120	F	150	F

SUMMARY	
ACCEPT	150
REJECT	0
NO TEST	1

TESTER: <u>W.P. Sproule</u>	DATE: <u>12/5/01</u>
TESTER:	DATE:
DIRECTOR:	DATE:
DCAS:	DATE:

151 TOTAL QUANTITY BUILT  
MA00K010-001

STATEMENT X, CERTIFIED CONTRACTORS

15-26

SPECIAL PORTIM RANGE FIRING RECORD

Test Type M549A #1  
 Fuze M549/M549A1 FUZE  
 Contract No. \_\_\_\_\_  
 Fuze Lot No ALD # SPECIAL  
 Date 1/14/02  
 Target 200' 190' & FUNCTION  
 Spitback Assembly MA-DIA001-001  
 Launcher MK #19 #30688

Powder Capsule# STD 01 M DAY 003-001  
 O Ring # N/A  
 \*GFM\* M169 CARTRIDGE CASE  
MA00K010-001  
 Lot Qty. 50 Rds.  
 Tester (s) Wes S. Richard U.  
U/V  
 DCAS QAR LIE McFadden  
 Director DICK SCHNEIDER

NO.	RESULTS								
1	F	31	F	61		91		121	
2	F	32	F	62		92		122	
3	F	33	F	63		93		123	
4	F	34	F	64		94		124	
5	F	35	F	65		95		125	
6	F	36	F	66		96		126	
7	F	37	F	67		97		127	
8	F	38	F	68		98		128	
9	F	39	F	69		99		129	
10	F	40	F	70		100		130	
11	F	41	F	71		101		131	
12	F	42	F	72		102		132	
13	F	43	F	73		103		133	
14	F	44	F	74		104		134	
15	F	45	F	75		105		135	
16	F	46	F	76		106		136	
17	F	47	F	77		107		137	
18	F	48	F	78		108		138	
19	F	49	F	79		109		139	
20	F	50	F	80		110		140	
21	F	51		81		111		141	
22	F	52		82		112		142	
23	F	53		83		113		143	
24	NT	54		84		114		144	
25	F	55		85		115		145	
26	F	56		86		116		146	
27	F	57		87		117		147	
28	F	58		88		118		148	
29	F	59		89		119		149	
30	F	60		90		120		150	

SUMMARY	
ACCEPT	49
REJECT	0
NO TEST	1

TESTER: <u>W.P. Spradlin</u>	DATE: <u>1/14/02</u>
TESTER: <u>Wyer</u>	DATE: <u>1/14/02</u>
DIRECTOR: _____	DATE: _____
DCAS: _____	DATE: _____

50 TOTAL QUANTITY BUILT  
 C/C MA00K010-001

50 5/B MA DIA001-001

STATEMENT X, CERTIFIED CONTRACTORS

25-26

**RANGE FIRING RECORD**

Test Type M549A1 Special Test  
 Fuze M549/M549A1 FUZE  
 Contract No. \_\_\_\_\_  
 Fuze Lot No \_\_\_\_\_  
 Date 12/5/01  
 Target 190' 1/2" Homosote  
 Spitback Assembly MA-01A 001-001  
 Launcher M129 F 498

Powder Capsule# BHO197  
 O Ring # N/A  
 \*GFM\* M169 CARTRIDGE CASE  
MA 00K 010-001  
 Lot Qty. \_\_\_\_\_  
 Tester (s) Wes S. Shawn P. Jim N.  
 DCAS QAR \_\_\_\_\_  
 Director Dick Schneider

NO.	RESULTS	NO.	RESULTS	NO.	RESULTS	NO.	RESULTS	NO.	RESULTS
1	F	2	firing pin spring	61		91		121	
2	NF	3	firing 32 pin spr. align	62		92		122	
3	F	4	bent bracket	63		93		123	
4		34		64		94		124	
5		35		65		95		125	
6		36		66		96		126	
7		37		67		97		127	
8		38		68		98		128	
9		39		69		99		129	
10		40		70		100		130	
11		41		71		101		131	
12		42		72		102		132	
13		43		73		103		133	
14		44		74		104		134	
15		45		75		105		135	
16		46		76		106		136	
17		47		77		107		137	
18		48		78		108		138	
19		49		79		109		139	
20		50		80		110		140	
21		51		81		111		141	
22		52		82		112		142	
23		53		83		113		143	
24		54		84		114		144	
25		55		85		115		145	
26		56		86		116		146	
27		57		87		117		147	
28		58		88		118		148	
29		59		89		119		149	
30		60		90		120		150	

SUMMARY	
ACCEPT	2
REJECT	1
NO TEST	0

TESTER: <u>W.P. Spruill</u>	DATE: <u>12/5/01</u>
TESTER:	DATE:
DIRECTOR:	DATE:
DCAS:	DATE:

TOTAL QUANTITY BUILT  
3 MA 00K 010-001

STATEMENT X, CERTIFIED CONTRACTORS

failures for new vision system spin fixture

18-26

**RANGE FIRING RECORD**

Test Type M549 A#1 SPECIAL TEST  
 Fuze M549/M549A1 FUZE  
 Contract No. \_\_\_\_\_  
 Fuze Lot No \_\_\_\_\_  
 Date 12/5/01  
 Target F. SAND

Powder Capsule# B#0197 (Long)  
 O Ring # N/A  
 \*GFM\* M169 CARTRIDGE CASE  
MA00K010-001  
 Lot Qty. \_\_\_\_\_  
 Tester (s) WESS. SHAWN P.  
JIMM.  
 DCAS QAR Liz McFadden  
 Director Dick Schneider

Spitback Assembly MA-01A 001-001  
 Launcher MK 19 # 30688

NO.	RESULTS	NO.	RESULTS	NO.	RESULTS	NO.	RESULTS	NO.	RESULTS
1	F	31	F	61	F	91	F	121	F
2	F	32	F	62	F	92	F	122	F
3	F	33	R	63	F	93	F	123	F
4	F	34	F	64	F	94	F	124	F
5	F	35	F	65	F	95	F	125	F
6	F	36	F	66	F	96	F	126	F
7	R	37	F	67	F	97	F	127	F
8	F	38	P	68	F	98	F	128	F
9	F	39	F	69	R	99	F	129	F
<del>10</del>	<del>F</del>	<del>40</del>	<del>R</del>	<del>70</del>	<del>F</del>	<del>100</del>	<del>F</del>	<del>130</del>	<del>F</del>
11	F	41	F	71	F	101	F	131	F
12	F	42	F	72	F	102	F	132	F
13	F	43	F	73	F	103	F	133	F
14	F	44	F	74	R	104	F	134	F
15	F	45	R	75	F	105	F	135	F
16	F	46	F	76	F	106	F	136	F
17	F	47	F	77	F	107	F	137	F
18	F	48	F	78	R	108	F	138	F
19	F	49	R	79	R	109	R	139	F
<del>20</del>	<del>F</del>	<del>50</del>	<del>F</del>	<del>80</del>	<del>F</del>	<del>110</del>	<del>R</del>	<del>140</del>	<del>F</del>
21	F	51	R	81	F	111	F	141	F
22	F	52	F	82	F	112	F	142	F
23	F	53	R	83	F	113	F	143	F
24	F	54	F	84	F	114	F	144	F
25	F	55	F	85	F	115	F	145	F
26	F	56	F	86	F	116	F	146	F
27	F	57	F	87	F	117	F	147	F
28	F	58	F	88	F	118	F	148	R
29	F	59	F	89	F	119	F	149	F
<del>30</del>	<del>F</del>	<del>60</del>	<del>R</del>	<del>90</del>	<del>F</del>	<del>120</del>	<del>F</del>	<del>150</del>	<del>F</del>

SUMMARY	
ACCEPT	150
REJECT	0
NO TEST	0

TESTER: <u>W.P. Sprule</u>	DATE: <u>12/5/01</u>
TESTER:	DATE:
DIRECTOR:	DATE:
DCAS:	DATE:

TOTAL QUANTITY BUILT  
 C/C 150 MA00K010-001  
 S/B 150 MA01A001-001  
 "JOURNEY" FUZES

STATEMENT X, CERTIFIED CONTRACTORS

**CONFIGURATION CONTROL BOARD DIRECTIVE**  
DESIGN ACTIVITY EVALUATION

1. PAN  
R2S2024

2a. TYPE ITEM (Check only one)  
 TRANSFERRED  
 PROJECT MANAGED  
 OTHER \_\_\_\_\_

2b. TYPE ACTION  
 ECP     RFP  
 VEP     RFW     OTHER \_\_\_\_\_  
 VECP

3a. CONTRACT(s) AFFECTED

3b. SOLICITATION(s) AFFECTED

4. APPLICATION  
 Apply to current contracts / solicitations  
 Apply to future applications  
 Formalizes change previously authorized via:  
 Alteration \_\_\_\_\_  
 Associated or Interface Changes as listed in Remarks.

RETROFIT BY:  
 Attrition     Minor  
 MWO

5. COST IMPACT  
 NONE  
 INCREASE \$ \_\_\_\_\_  
 DECREASE \$ \_\_\_\_\_

6a. RECOMMENDATION TO CONFIGURATION MANAGER:  
 APPROVE     APPROVE WITH MODIFICATION  
 DISAPPROVE     OTHER: \_\_\_\_\_

6b. MODIFICATION(s) TO SUBMITTED ACTION  
 NONE     AS FOLLOWS:

7. POSITION ON RECOMMENDATION TO CONFIGURATION MANAGER

DOCUMENTS/ DISCIPLINE	IMPACTED		OFFICE SYMBOL	TELEPHONE	TYPED/PRINTED NAME AND SIGNATURE	CONCUR	
	YES	NO				YES	NO
PRODUCT DRAWINGS	✓		AMSTA-AR-RECD	DSN 880-3265	SUNG H. CHO <i>[Signature]</i>	✓	
SPECIFICATIONS/ QAPs	✓		AMSTA-AR-ORCL	DSN 880-3610	Hector Alvar Hector Morales James Douglas for Greg Farbanish	✓	
PACKAGING DATA		✓				✓	
SOFTWARE							
MAINTENANCE		✓	AMSTA-AR WEL-A	PBB 5571	L. INGRASSIA <i>[Signature]</i>	✓	
OTHER (Specify) ENGINEERING INSTRUMENTATION	X		AMSTA-AR- CCL-C	DSN 880-3867	REMI CATIAW Remi Clouan.		X
VALUE ENGINEERING							

\* NOTE: A Notice of Revision (NOR) is required for each document needing revision when a change is recommended for approval.

8. REMARKS  
 APPROVAL OF THE ECP IS RECOMMENDED. PROPOSED DIMENSIONAL CHANGES WILL ENHANCE PRODUCTIBILITY AND RELIABILITY OF THE M549A1 FUZE.

9a. OFFICE SYMBOL  
AMSTA-AR  
CCL-C

9b. TYPED/PRINTED NAME AND TITLE  
ELIAS GHAZI  
ICCH EXEC

9c. SIGNATURE  
*[Signature]*

9d. DATE  
8/9/92

9e. TELEPHONE  
880-3896

(AMCCOM 390-R-E, 1 Feb 92)

DISTRIBUTION STATEMENT X, Certified contractor, ARDEC, AMSTA-AR-CCL-CA

SUPPLEMENTAL INFO SHEET FOR ECP ACTION

1. Description of change:

Revise dimensions of Centerplate (12944723):

From: .165+.010 To: .185+.005  
From: .020+.005 To: .030+.005  
From: R .015 Max or .015 Max Cham x 45°  
To: R .010 Max or .010 Max Cham x 45°

Revise dimensions of Bracket (12944724):

From: 2 x .099-.006 To: 2 x .099-.005  
Delete Note 6 entirety  
Delete 2 x 5° Max Note 6  
Add dimension to inside surface of open end of  
bracket legs: .232+.007

Revise dimensions of Firing pin (12944746):

From: .166-.004 To: .180-.004  
From: .026-.004 To: .016-.004  
From: .015 -.005 To: .010-.005  
Delete: 45° and 9°

2. Need for Action:

As a result of the M549A1 dud investigation, the red team determined the root cause to be "insufficient firing pin retraction" in the arming cycle.

In an effort to address the above, a 2-phase effort was concurrently undertaken to improve both the inspection process, as well as, the robustness of the design.

As a result of the investigation, it was concluded that excessive friction between the firing pin and firing pin hole in the centerplate, may have contributed to the potential inability of the pin to retract during arming. A redesign of the pin from a conical head to a flat head incorporating an increased head diameter in order to increase the bearing area was implemented.

In addition to the above, it was also suspected that the current bracket design may have also contributed to the condition by allowing them to be crimped too close to the centerplate. To address the above, the open end of the bracket was re-dimensioned instead of relying on the

bracket leg angle, to allow the crimp to be more robust to the process.

The modified centerplate assembly was successfully qualified without a single failure in December 2001.

To supplement this effort, a process improvement that consisted of designing a modified centerplate assembly spin fixture, was successfully implemented in the production to inspect the positive firing pin retraction in spin. Reliability of the M549A1 fuze will be significantly improved by the implementation of the proposed redesign and the modified centerplate assembly spin fixture.

3. Key Performance Characteristic Affected:

Impact Function: It is defined as function of the cartridge upon impact at the target.

4. Impact on key characteristic:

Centerplate:

Change from  $.165+.010$  to  $.185+.005$  of the center hole counterbore diameter will facilitate the firing pin retraction by providing sufficient bearing surface with the firing pin head dimension increase of  $.180-.004$ .

Bracket:

Change from  $.099-.006$  to  $.099-.005$  of the bracket leg will provide greater bracket motion in spin such that the firing pin retracts faster and further out of the rotor.

Firing pin:

Change from  $.166-.004$  to  $.180-.004$  of the firing pin head diameter will provide sufficient bearing surface and minimize potential friction on setback with the dimensional increase of the  $.180+.005$  in the center hole of the centerplate.

Change from  $.026-.004$  from  $.016-.004$  of the firing pin head height will facilitate the firing pin retraction since a short firing pin head moves further out of the rotor.

5. Alternative to this Action:

Continue to use the existing centerplate assembly in conjunction with new centerplate assembly spin fixture: The continued use of the existing centerplate assembly with the improved spin fixture may segregate the units with potential dud concern. However, insufficient firing pin retraction problem induced by gun launch (setback force) will not be corrected and will be persisted.

6. Additional Information:

Additional technical information is available in the form of the following document:

Final Report: M549A1 Centerplate assembly Redesign.

POC: Sung Cho, AMSTA-AR-CCF-D, DSN880-3265

Joe Vize, AMSTA-AR-CCL-F, DSN793-6520

Doug Hendricks, AMSOS-PRD, DSN793-8386

