

TM 9-1000-202-14
SUPERSEDES COPY DATED 18 JUNE 1993

TECHNICAL MANUAL

**EVALUATION
OF
CANNON TUBES**

DISTRIBUTION STATEMENT C - Distribution authorized to U.S. Government agencies and their contractors. This publication is required for administrative and operational purposes, as determined on 22 October 1990. Other requests for this document shall be referred to Commander, U.S. Army Tank-automotive and Armaments Command, ATTN: AMSTA-LC-LPIT, Rock Island, IL 61299-7630.

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HEADQUARTERS, DEPARTMENT OF THE ARMY

FEBRUARY 1999

WARNING

Always make sure that the cannon and any attached spotting gun are not loaded.

WARNING

Defective tubes may endanger the lives of using personnel through malfunction or inaccurate firing.

CHANGE
NO. 4

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DEPARTMENT OF THE ARMY
WASHINGTON, DC, 31 December 2006

TECHNICAL MANUAL

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OF
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S-1 through S-6
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By Order of the Secretary of the Army:

PETER J. SCHOOMAKER
General, United States Army
Chief of Staff

Official:

A handwritten signature in black ink that reads "Joyce E. Morrow". The signature is written in a cursive style with a large, stylized initial "J".

JOYCE E. MORROW
Administrative Assistant to the
Secretary of the Army
0633302

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TECHNICAL MANUAL

EVALUATION
OF
CANNON TUBES

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TECHNICAL MANUAL

EVALUATION
OF
CANNON TUBES

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JOHN M. KEANE
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TECHNICAL MANUAL

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Change	2	28 August 2003
Change	3	22 February 2005
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TECHNICAL MANUAL
NO. TM 9-1000-202-14*
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HEADQUARTERS
DEPARTMENTS OF ARMY
WASHINGTON D.C., 01 February 1999

EVALUATION OF CANNON TUBES

REPORTING ERRORS AND RECOMMENDING IMPROVEMENTS

You can help improve this publication. If you find any mistakes or if you know of a way to improve the procedures, please let us know. Submit your DA Form 2028 (Recommended Changes to Publications and Blank Forms), through the Internet, on the Army Electronic Product Support (AEPS) website. The Internet address is <http://aeps.ria.army.mil>. If you need a password, scroll down and click on "ACCESS REQUEST FORM". The DA Form 2028 is located in the ONLINE FORMS PROCESSING section of the AEPS. Fill out the form and click on SUBMIT. Using this form on the AEPS will enable us to respond quicker to your comments and better manage the DA Form 2028 program. You may also mail, fax or email your letter or DA Form 2028 direct to: AMSTA-LC-LPIT / TECH PUBS, TACOM-RI, 1 Rock Island Arsenal, Rock Island, IL 61299-7630. The email address is ROCK-TACOM-TECH-PUBS@conus.army.mil. The fax number is DSN 793-0726 or Commercial (309) 782-0726.

Units are required to input the same information into the computer that is now kept on the paper DA Form 2408-4. The electronic version is accessed through the Army Electronic Product Support (AEPS) website and is user friendly. You will need an AEPS password and then you will be able to request access to the Gun Card Firing Data site. Request an AEPS password by applying directly at the AEPS website, <http://aeps.ria.army.mil/aepspublic.cfm>. Once the AEPS password is received, you will need to request a Gun Card Firing Data password. Access the Gun Card site, which is located in the center of the AEPS Home Page, and follow the instructions given to obtain a password. Your Unit Commander or Supervisor will give the approval for your password. When TACOM receives the request, a password will be issued within 24 hours.

After you have received your password, entries will be made directly online to the Gun Card Firing Data site, eliminating the need to mail the paper DA Form 2408-4. Entries should be made immediately after firing or non-firing action is taken to allow the database to be a real-time system. This system will eliminate lost gun cards and make it easier for units to research the firing and non-firing data of any particular Tank, Artillery, or Mortar that has been entered into the database.

For units that are deployed and do not have access to the AEPS site, paper DA Form 2408-4 will need to be mailed so data can be entered into the database. The mailing address is: Tank-automotive and Armaments Command, AMSTA-LC-LETT (ATTN: AEPS Help Desk), 1 Rock Island Arsenal, Rock Island, IL 61299-7630. Mailing of the paper DA Form 2408-4 is scheduled for April and October for Active Duty deployed units and October for National Guard deployed units. Once your unit is redeployed to CONUS, you will resume entering the data to the Gun Card Firing Data site on the AEPS system.

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*This manual supersedes TM 9-1000-202-14 dated 18 June 1993.

The Air Force is no longer a joint user of this TM. TO 11W2-17-5-1 is deleted and all references to the Air Force were deleted from this TM.

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NOTE: The following low-use weapons are no longer supported in this manual: 75MM Pack Howitzer, M1A1/M1AC; 57MM Recoilless Rifle, M18/M18A1; 75MM Recoilless Rifle, M20; 152MM Gun Launcher. Any questions concerning these weapons should be referred to BENÉT LABORATORIES, ATTN: AMSTA-AR-CCB-O, WATERVLIET, NY 12189-4050.

CHAPTER 1

INTRODUCTION

1-1. PURPOSE AND SCOPE.

a. The purpose of this manual is to aid you in determining if a cannon tube can continue to be used or condemned, in estimating the remaining life, and in determining how often a new tube can be installed into the breech ring or breech coupling. You will find information in this manual on tube life, erosion (wear), damage, and inspection procedures which will be helpful in making the right decision.

b. Parts attached to the tube are not considered here except bore evacuators, muzzle brakes, basecaps on mortars and vents on recoilless rifles. Whether mentioned here or not, all attached parts (which include breech parts such as ring, coupling, block, crank, obturator spindle, extractor, cams, springs, keys, operating handle, receiver, buffer, evacuator, muzzle brake, flash suppressor, vents, basecaps, and plug brackets for a telescope for spotting rifle) should be inspected in accordance with operator, unit, or direct support maintenance manual for the specific weapon.

1-2. FORMS AND RECORDS.

a. **Authorized Forms.** Maintenance forms, records, and reports to be used by maintenance personnel at all maintenance levels are listed in and prescribed by DA PAM 750-8.

b. **Field Reports of Accidents.** Accidents involving injury to personnel or damage to materiel will be reported on DA Form 285 (Accident Report) in accordance with AR 385-40. Any accident or malfunctions involving use of ammunition must be reported in accordance with AR 75-1.

1-3. REPORTING EQUIPMENT IMPROVEMENT RECOMMENDATIONS (EIRs).

If your equipment needs improvement, let us know. Send us an EIR. You, the user, are the only one who can tell us what you don't like about your equipment. Let us know why you don't like the design. Tell us why a procedure is hard to perform. Put the improvement on an SF 368 (Product Quality Deficiency Report). The form should be submitted to:

ATTN: AMSRD-AAR-QEW-A
TACOM-ARDEC
1 Rock Island Arsenal
Rock Island, IL 61299-7300

E-mail: gawqdrs@ria.army.mil or FAX: DSN 793-6653, Commercial (309) 782-6653.

We'll send you a reply.

1-4. CORROSION PREVENTION AND CONTROL

a. Corrosion Prevention and Control (CPC) of materiel is a continuing concern. It is important that any corrosion problems with these items be reported so that the problem can be corrected and improvement can be made to prevent the problem in future items. While corrosion is typically associated with rusting of metals, it can also include deterioration of other materials, such as rubber and plastic. Unusual cracking, softening, swelling or breaking of these materials may be a corrosion problem. If a corrosion problem is identified, it can be reported using Standard Form 368, Product Quality Deficiency Report. Use of key words such as "corrosion," "rust," "deterioration," or "cracking" will assure that the information is identified as a CPC problem.

b. The form should be submitted to:

ATTN: AMSRD-AAR-QEW-A
TACOM-ARDEC
1 Rock Island Arsenal
Rock Island, IL 61299-7300

E-mail: gawqdrs@ria.army.mil or FAX: DSN 793-6653, Commercial (309) 782-6653.

1-5. ABBREVIATIONS.

APC	Armored Personnel Carrier
CLP	Cleaner, Lubricant, Preservative
EFC	Equivalent Full Charge
FT	Full-Tracked
HEP	High Explosive Plastic
LWC	Light Weight Company
RBC	Rifle Bore Cleaner
SP	Self-Propelled
W/E	With Equipment
LAR	Logistics Assistance Representative
CARC	Chemical Agent Resistant Coating

1-6. CROSS REFERENCE LIST, CANNON TUBE TO END ITEM.

a. **Guns.**

<u>Cannon</u>	<u>End Item</u>
M68A1 Cannon, 105mm Gun	Tank, Combat, FT: 105mm Gun, M1/IPM1
M68/M68A1 Cannon, 105mm Gun	Tank, Combat, FT: 105mm Gun, M48A5, M60A1, M60A1 Rise/Passive, M60A3
M68A1E8 Cannon, 105mm Gun	Stryker, Combat, Wheeled: 105mm Gun, M1128
M256 Cannon, 120mm Gun	Tank, Combat, FT: 120mm Gun, M1A1, M1A2
M81/M81E1, 152mm Gun Launcher	Armored Reconnaissance Airborne Assault Vehicle M551, M551A1 (Sheridan)
M135 Cannon, 165mm Gun	Combat Engineer Vehicle, FT: M728

b. Howitzers.

<u>Cannon</u>	<u>End Item</u>
M2A1/M2A2 Cannon, 105mm Howitzer	Howitzer, Light, Towed: 105mm, M101 & M101A1
M137/M137A1 Cannon, 105mm Howitzer	Howitzer, Light, Towed: 105mm, M102
M20/M20A1* Cannon, 105mm Howitzer	Howitzer, Light, Towed: 105mm, M119A1
*The cannon for the M119A1 Howitzer could be identified as M20, M119, or M20A1.	
M1A1 Cannon, 155mm Howitzer	Howitzer, Medium, Towed: 155mm, M114A2
M1A2 Cannon, 155mm Howitzer	Howitzer, Medium, Towed: 155mm, M114A2
M185 Cannon, 155mm Howitzer	Howitzer, Medium, SP: 155mm, M109A2, M109A3, M109A4
M199 Cannon, 155mm Howitzer	Howitzer, Medium, Towed: 155mm, M198
M284 Cannon, 155mm Howitzer	Howitzer, Medium, SP: 155mm, M109A5, M109A6
M201A1 Cannon, 8 Inch Howitzer	Howitzer, Heavy, SP: 8-Inch, M110A2

c. Mortars.

<u>Cannon</u>	<u>End item</u>
M2 Cannon, 60mm Mortar	Mortar, Infantry: 60mm, M2 W/E (Cannon, M2/Mount M5)
M225 Cannon, 60mm Mortar	Mortar, LWC: 60mm, M224, W/E (Cannon, M225/Mount M170)
M29A1 Cannon, 81mm Mortar	Mortar, 81mm: M29A1, W/E (Cannon, M29A1 Mount M23A1/Baseplate M3)
M29A1 Cannon, 81mm Mortar	Mortar, SP, FT: 81mm, M125, M125A1
M253 Cannon, 81mm Mortar	Mortar, 81mm: M252 W/E (Cannon, M253/Mount M177)
M298 Cannon, 120mm Mortar	Mortar, SP, FT: 120mm M121 W/E (Cannon, M298/Mount M191) Carrier Version
M298 Cannon, 120mm Mortar	Mortar, 120mm M120 W/E (Cannon M298/Mount M190) Towed Version
M30 Cannon, 4.2 Inch Mortar	Mortar, 4.2 Inch: M30, W/E (Cannon, M30/Mount M24A1)
M30 Cannon, 4.2 Inch Mortar	Mortar, SP, FT: 4.2 Inch M106A1 Mortar Carrier

d. Recoilless Rifles.

<u>Cannon</u>	<u>End item</u>
M67 Rifle, Recoilless, 90mm	Rifle, Recoilless, 90mm: M67, W/E
M40A2 Rifle, Recoilless, 106mm (U.S. Army Rqmt.)	Cannon, 106mm Rifle, Recoilless: M206 w/Gun, Spotting, Caliber .50 M8C; w/Mount, Rifle 106mm, M79
M40A4 Rifle, Recoilless, 106mm (U.S. Army Rqmt.)	Cannon, 106mm Recoilless Rifle: M206 w/Gun, Spotting, Caliber .50 M8C: w/Mount, Rifle, 106mm, M92 Rifle, 106mm, M27

1-7. LIST OF RELATED PUBLICATIONS.

<u>Publication Number</u>	<u>Publication Title</u>
DA Form 285	U.S. Army Accident Investigation Report
DA Form 2408-4	Weapon Record Data
SF 368	Product Quality Deficiency Report
TM 9-2350-230-35/2	DS, GS, and Depot Maintenance Manual, Turret, Elevating and Traversing Systems, Cupola, Gun Launcher and Mount for Armored Reconnaissance/Airborne Assault and Opposing Forces Vehicle: Full-Track, 152MM Gun, M551/M551A1
TM 9-4933-258-13&P	Operator's, Organizational (Unit), and DS Maintenance Manual (includes RPSTL) for Pullover Gage Kit (P/N 7242997)
TM 9-6650-235-13&P	Operator's, Organizational (Unit), and DS Maintenance Manual (includes RPSTL) (includes Depot Maintenance Repair Parts) for Borescope, M3 (6650-01-063-0035)
TM 43-0139	Painting Instructions for Army Materiel
AR 75-1	Malfunctions Involving Ammunition and Explosives
AR 385-40	Accident Reporting and Records
DA PAM 750-8	The Army Maintenance Management System (TAMMS) Users Manual

1-8. WARNING, CAUTION, AND NOTE STATEMENTS.

WARNING and CAUTION statements have been strategically placed throughout this text prior to operating or maintenance procedures, practices, or conditions considered essential to the protection of personnel (WARNING) or equipment and property (CAUTION). A WARNING or CAUTION will apply each time the related step is repeated. NOTES throughout this text provide important information on procedures. Prior to starting any task, the WARNINGS, CAUTIONS, and NOTES included in the text for that task will be reviewed and understood.

CHAPTER 2

INSPECTION BY OPERATOR AND UNIT PERSONNEL

2-1. REQUIREMENT FOR CLEANING AND INSPECTION.

WARNING

ENSURE THAT CANNON AND ANY ATTACHED SPOTTING GUN ARE NOT LOADED.

DEFECTIVE TUBES MAY ENDANGER THE LIVES OF USING PERSONNEL THROUGH MALFUNCTION OR INACCURATE FIRING.

TANK OR STRYKER GUN TUBES WHICH HAVE FIRED DEPLETED URANIUM (DU) AMMUNITION MAY HAVE DU RESIDUE ON THE INSIDE SURFACES AND IN THE BORE EVACUATOR. THIS CONTAMINATION MAY BE BOTH REMOVABLE, AND FIXED (REMAINING FOR THE LIFE OF THE GUN TUBE). DU EMITS VERY LOW LEVELS OF RADIATION. PERSONNEL CLEANING THE GUN TUBE OR BORE EVACUATOR MUST WEAR RUBBER/LATEX GLOVES. (EVEN IF GLOVES HAVE BEEN WORN, ALWAYS WASH HANDS AFTER CLEANING GUN TUBE). DO NOT TOUCH GLOVES TO FACE OR OTHER PARTS OF THE BODY. WASH HANDS AFTER REMOVING GLOVES. DEPRESS GUN TUBE AS MUCH AS POSSIBLE TO PREVENT CONTAMINATED CLEANING FLUID FROM FLOWING INTO BREECH OR CREW COMPARTMENT.

RAGS AND CLEANING FLUID GENERATED DURING MAINTENANCE ON THE BORE EVACUATOR OR DURING THE GUN TUBE CLEANING PROCESS MUST BE DISPOSED OF AS LOW-LEVEL RADIOACTIVE WASTE. MOP UP ALL EXCESS CLEANING FLUID WITH RAGS, AND (DOUBLE) BAG ALL TRASH, INCLUDING GLOVES, IN TWO PLASTIC BAGS. ENSURE BAG IS TAGGED AS CONTAINING RADIOACTIVELY CONTAMINATED MATERIEL. BE SURE THE TAG LISTS: CONTENTS (GLOVES, RAGS, TOWELS, ETC), ISOTOPE (DEPLETED URANIUM). CONTACT YOUR LOCAL RADIATION PROTECTION OFFICER (RPO) FOR DISPOSAL INSTRUCTIONS.

Operator and unit personnel should clean and inspect the cannon tube to find any damage or erosion (wear). With information in this manual, you can decide if the cannon tube can be used or if direct support should be notified.

2-2. CLEANING PROCEDURES.

CAUTION

USE OF UNAUTHORIZED CLEANING MATERIALS AND/OR PROCEDURES COULD RESULT IN BORE DAMAGE WHICH MAY LEAD TO PREMATURE CONDEMNATION OF CANNON TUBE.

Use cleaning procedures, tools, and equipment prescribed in operator's manual for specific weapon system. Clean bore, chamber, and exterior of cannon tube thoroughly and dry them prior to inspection. Ensure that all powder residue, dust, and rust have been removed. Do not attempt to obtain a bright finish. Colors throughout the length of the bore may range from a uniform gray/black color to streaks of gray, black or dark brown. Copper streaks found in the bore do not affect range or accuracy and shall be ignored; do not try

to remove the copper streaks. These are normal occurrences and, with additional firing, will continue to darken over the life of the cannon tube.

2-3. INSPECTION PROCEDURES.

a. **Records Inspection.** Refer to DA PAM 750-8 for how to compute estimated round life. Use the following information from the equipment record folder to help in figuring estimated remaining rounds.

(1) Number of rounds fired, and with what type projectiles or charges. If there is no complete record of number of rounds fired, notify direct support.

(2) Marking of breech when new tube is installed.

(3) Additional inspection criteria for each specific weapon.

NOTE

Make sure equipment record folder numbers correspond with those on weapon. (Locations of weapon numbers are found in illustrations for specific weapons in appendixes.)

b. **Frequency of Inspection.** Notify direct support to borescope and pullover gage all tubes within 180 days prior to firing, and at any other intervals when stated for specific weapons.

NOTE

It is not necessary to observe the time (180 days) and EFC intervals for inspection separately. However, neither interval is to be exceeded without inspection.

c. **Visual Inspection.** Inspect while cleaning the cannon tube. Examine rifled and smooth areas to find any damage or erosion in accordance with visual inspection criteria identified for each specific weapon system. When required, use flashlight or available electric lead light.

NOTE

M225, M253, and M29/M29A1 mortar cannons shall not be painted.

2-4. CONDEMNATION INFORMATION.

Notify direct support:

- a. When you find or think that there are cracks or other damages.
- b. When tube's round life limit will be reached soon.
- c. When tube cannot be fired accurately.
- d. When evidence of welding is found anywhere on the tube.
- e. When inspection criteria given for specific weapon system warrants it.

CHAPTER 3

INSPECTION BY DIRECT SUPPORT AND GENERAL SUPPORT PERSONNEL

3-1. REQUIREMENT FOR CLEANING AND INSPECTION.

WARNING

ENSURE THAT CANNON AND (IF SO EQUIPPED) ANY ATTACHED SPOTTING GUN ARE NOT LOADED.

DEFECTIVE CANNON TUBES MAY ENDANGER THE LIVES OF USING PERSONNEL THROUGH MALFUNCTION OR INACCURATE FIRING.

TANK OR STRYKER GUN TUBES WHICH HAVE FIRED DEPLETED URANIUM (DU) AMMUNITION MAY HAVE DU RESIDUE ON THE INSIDE SURFACES AND IN THE BORE EVACUATOR. THIS CONTAMINATION MAY BE BOTH REMOVABLE, AND FIXED (REMAINING FOR THE LIFE OF THE GUN TUBE). DU EMITS VERY LOW LEVELS OF RADIATION. PERSONNEL CLEANING THE GUN TUBE OR BORE EVACUATOR MUST WEAR RUBBER/LATEX GLOVES. (EVEN IF GLOVES HAVE BEEN WORN, ALWAYS WASH HANDS AFTER CLEANING GUN TUBE). DO NOT TOUCH GLOVES TO FACE OR OTHER PARTS OF THE BODY. WASH HANDS AFTER REMOVING GLOVES. DEPRESS GUN TUBE AS MUCH AS POSSIBLE TO PREVENT CONTAMINATED CLEANING FLUID FROM FLOWING INTO BREECH OR CREW COMPARTMENT.

RAGS AND CLEANING FLUID GENERATED DURING MAINTENANCE ON THE BORE EVACUATOR OR DURING THE GUN TUBE CLEANING PROCESS MUST BE DISPOSED OF AS LOW-LEVEL RADIOACTIVE WASTE. MOP UP ALL EXCESS CLEANING FLUID WITH RAGS, AND (DOUBLE) BAG ALL TRASH, INCLUDING GLOVES, IN TWO PLASTIC BAGS. ENSURE BAG IS TAGGED AS CONTAINING RADIOACTIVELY CONTAMINATED MATERIEL. BE SURE THE TAG LISTS: CONTENTS (GLOVES, RAGS, TOWELS, ETC), ISOTOPE (DEPLETED URANIUM). CONTACT YOUR LOCAL RADIATION PROTECTION OFFICER (RPO) FOR DISPOSAL INSTRUCTIONS.

Inspect cannon tube to find any damage or excessive wear. With the information in this manual, you can determine if the cannon tube can continue to be used or condemned, replaced, and disposed of.

3-2. CLEANING PROCEDURES.

Ensure that the bore, chamber, and exterior of the cannon tube have been cleaned and thoroughly dried prior to inspection using cleaning procedures, tools, and equipment prescribed in the Operator's Manual for the specific weapon system. Do not expect to see a bright shiny finish in the bore. The cannon tube may exhibit various colors throughout the length of the bore ranging from a uniform gray/black to streaks of gray, black, and/or dark brown. Copper streaks found in the bore do not affect range or accuracy and shall be ignored; do not try to remove the copper streaks. These are normal occurrences and, with additional firing, will continue to darken over the life of the cannon tube.

3-3. INSPECTION PROCEDURES AND CONDEMNATION CRITERIA.

a. **Records Inspection.** Use the following information from the equipment record to help in determining remaining round life:

(1) Locate cannon and tube serial numbers using diagrams in cannon tube appendices.

(2) Number of rounds fired, and with what projectile/charge type. Use criteria in following appendices for specific cannon tube and allowable safe service life, Cartridge or Zone EFC factor.

(a) Verify information provided by unit or operator by referring to instructions in DA PAM 750-8 for computing remaining life and where to record the information in equipment record.

(b) Where Cartridge or Zone EFC is missing from equipment record, assume 75 percent of fired rounds to have highest EFC factor and 25 percent to have lowest EFC factor for specific weapon.

(3) Marking of breech when a new cannon tube is installed or when round count mandates.

(a) Locate breech retubing or round count markings using diagrams in specific cannon tube appendices. If breech is not marked in accordance with diagram for specific cannon tube, stamp the note in the appropriate space using round bottom metal stamps.

(b) If breech markings and equipment records do not match, use the higher value. If you suspect numbers on breech ring and equipment record are inaccurate, record cannon and tube serial numbers, pullover gage readings, firing accuracy information, and any other pertinent weapon history, and send to:

DEPARTMENT OF THE ARMY
Attn: AMSRD-AAR-AEW-P (B)
Benét Laboratories
1 Buffington St.
Watervliet, NY 12189-4000
DSN: 374-5587 or 374-5586
Commercial: (518) 266-5587 or (518) 266-5586

(c) See specific cannon tube appendix for instructions on marking retubings or round count information and when to condemn breech mechanism. When breech mechanism is condemned, all component parts are to be condemned unless otherwise specified in specific cannon tube appendix.

NOTE

Do not mix components from different breech mechanisms of the same model Cannon. Components from the same breech mechanism must be kept together during maintenance and inspection.

(d) When cannon is retubed, annotate equipment record accordingly.

(4) Some cannon tubes are condemned on the basis of erosion (wear) only. Consult the specific appendix for information on your cannon tube.

(5) Additional inspection criteria for each specific cannon tube.

b. **Missing, or Incomplete Records.** If the records are missing or incomplete for the number of rounds fired, proceed as follows:

(1) Borescope Cannon Tube. If cannon tube is not condemnable based on damage, go to step (2).

(2) Take Pullover Gage Reading. Use erosion (wear) condemnation criteria as necessary for specific weapon. If cannon tube is not condemnable based upon wear or erosion, go to step (3).

(3) If you suspect incorrect record keeping, have missing records, or did not receive a card with your weapon, you will need to respond to the following list of questions and contact the following activity:

DEPARTMENT OF THE ARMY
 Attn: AMSRD-AAR-AEW-P (B)
 Benét Laboratories
 1 Buffington St.
 Watervliet, NY 12189-4000
 DSN: 374-5587 or 374-5586
 Commercial: (518) 266-5587 or (518) 266-5586

(a) Did the tube come directly or indirectly from a Depot?

(b) If the tube did not come from a Depot, is its last location known? Is a POC or means to contact the past owner known?

(c) Is the tube new, or does it appear to be new when compared to a known new tube after borescope inspection?

(d) If the gun tube is not new, what description does it most closely resemble (borescope inspection)? Clean the tube prior to inspection.

1 Light scratches.

2 Moderate scratches.

3 Light heat checking.

4 Moderate heat checking.

5 Light overall chrome loss (for chromed tubes only).

6 Moderate overall chrome loss (for chromed tubes only).

7 Rusted/corroded beyond recognition of bore condition.

e. After bore erosion gage inspection what is the largest reading in accordance with TM 9-1000-202-14 (applicable for M256 tube only)?

f. After pullover gage inspection, provide readings in accordance with TM 9-1000-202-14 (not applicable for M256 tube).

A disposition will be provided on estimated remaining life or condemnation for the cannon tube.

c. **Frequency of Inspection.** Inspect all cannon tubes in accordance with the following:

(1) When Unit Level Maintenance requests it.

(2) Within 180 days prior to firing.

(3) When troubleshooting indicates you should.

(4) Anytime a cannon tube is installed, even if new.

- (5) If you are uncertain whether or not a tube has been inspected.
- (6) At other intervals as required for specific cannon tubes in this manual.

NOTE

It is not necessary to observe the time (180 days) and EFC intervals for inspection separately. Neither interval should be exceeded without inspection.

d. **Visual Inspection.**

- (1) Includes the use of the following equipment:

WARNING

TANK OR STRYKER GUN TUBES WHICH HAVE FIRED DEPLETED URANIUM (DU) AMMUNITION MAY HAVE DU RESIDUE ON THE INSIDE SURFACES WHICH CAN CONTAMINATE BORESCOPE DEVICE AND PERSONNEL. THIS CONTAMINATION MAY BE BOTH REMOVABLE, AND FIXED (REMAINING FOR THE LIFE OF THE GUN TUBE). IF YOU SUSPECT, OR ARE UNSURE IF GUN TUBE HAS FIRED DU AMMUNITION, TREAT AS IF IT IS CONTAMINATED, AND INSURE GUN TUBE IS PROPERLY CLEANED TO ELIMINATE ANY POSSIBLE REMOVABLE CONTAMINATION.

(a) Borescope. Used to find damage in bore and chamber, this equipment is a telescope with a fixed lighted mirror used for closeup views of bore surface. See TM 9-6650-235-13&P for instructions on its selection and use.

NOTE

Viewing the bore surface from the end is not sufficient for making determinations on criticality of damage. The mirror is used to get a direct view down onto the bore surface. This must be done along the entire length of bore and chamber.

(b) Pullover Gage. Used to measure the inside diameter of smooth or rifled bore cannon tubes at specific positions for each weapon. See TM 9-4933-258-13&P for instructions on its selection and use.

(c) Special Equipment. Specific weapons may require the use of special inspection equipment. This equipment is identified in the individual appendix covering the specific cannon tube.

(2) View cannon tube interior and exterior and inspect for defects using the illustrations and descriptions as follows:

(a) Cracks.

1 Cracks may grow progressively worse through continued firing. Cracks may be found diagonally or transversely across or parallel to a land and groove (Figures 3-1 thru 3-3). Typical characteristics of a crack include feathered edges running in an irregular line, with varying width and depth (Figures 3-4 thru 3-7). Cracks may also be found in the chamber (Figures 3-8 and 3-9) and at the bore evacuator holes of some cannon (Figures 3-5 thru 3-7).

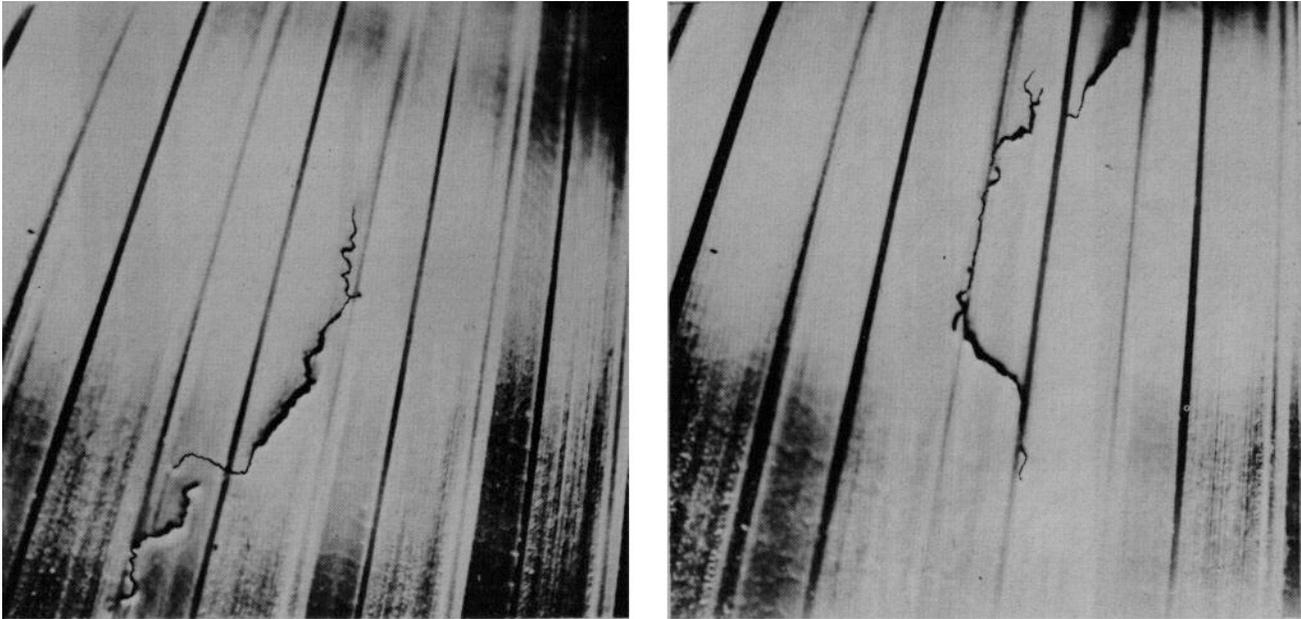
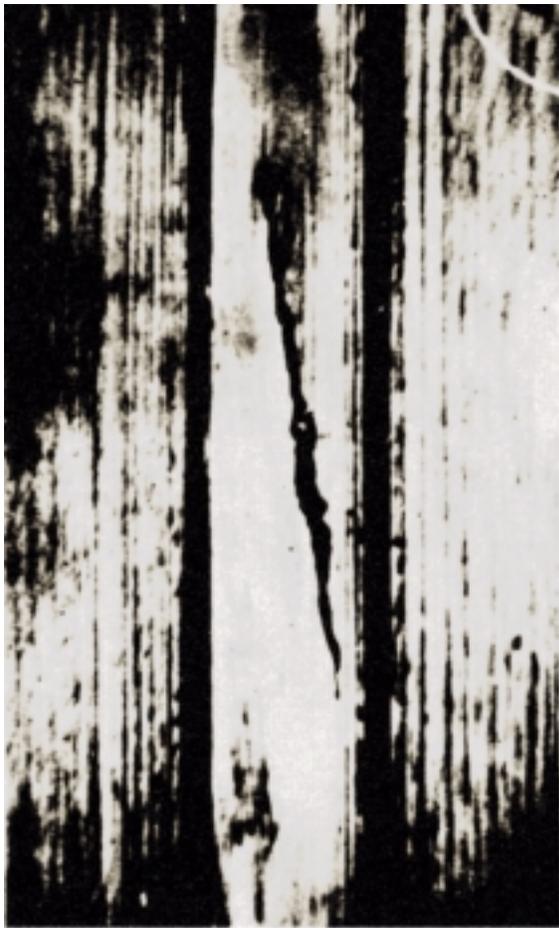
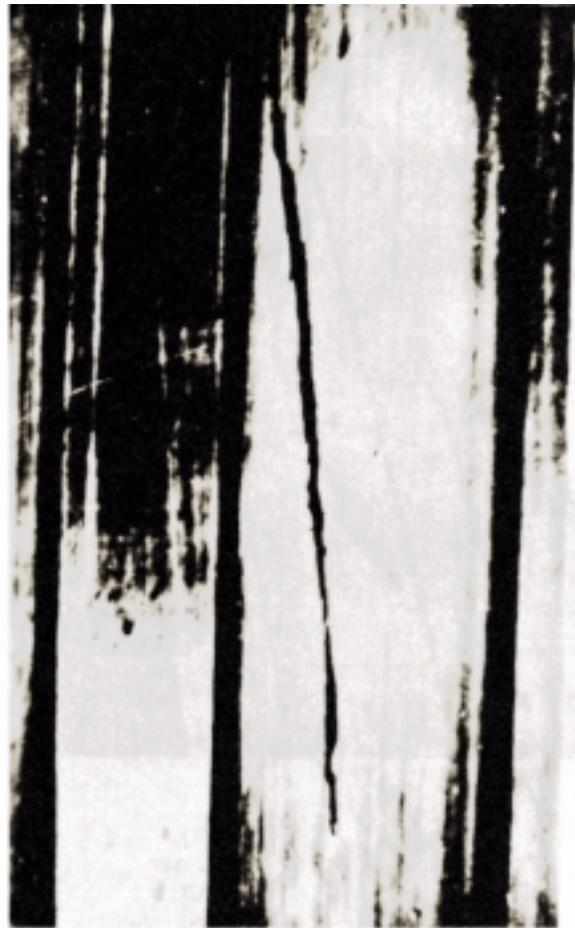


Figure 3-1. Cracks across lands and grooves.



LONGITUDINAL CRACK ON LAND



LONGITUDINAL CRACK ON GROOVE

Figure 3-2. Longitudinal crack on land or groove.

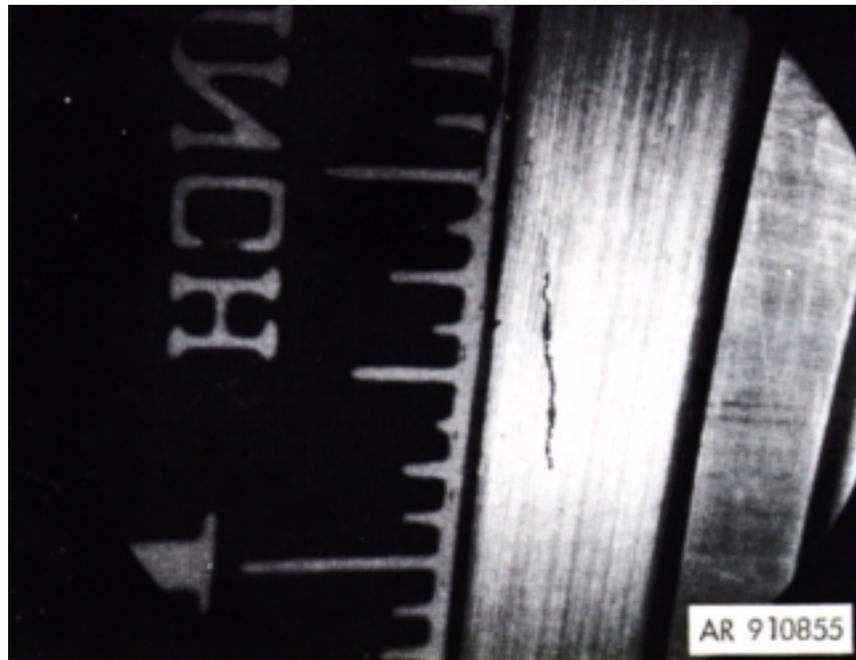
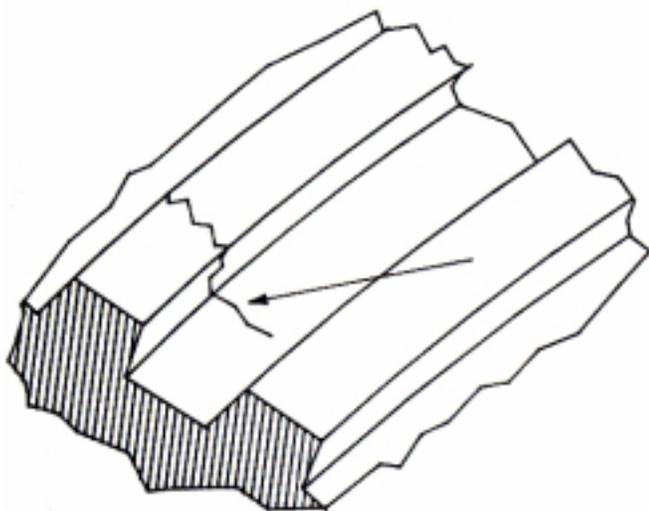


Figure 3-3. Crack in groove.



AR 910867

Figure 3-4. Crack across thread extending into tube surface.

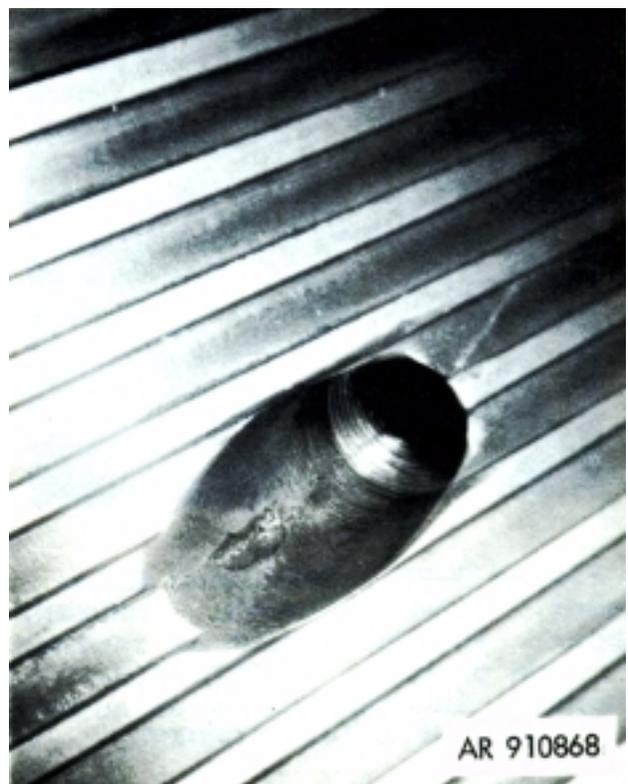


Figure 3-5. Evacuator hole: Internal crack on feather edge. Possible external crack.

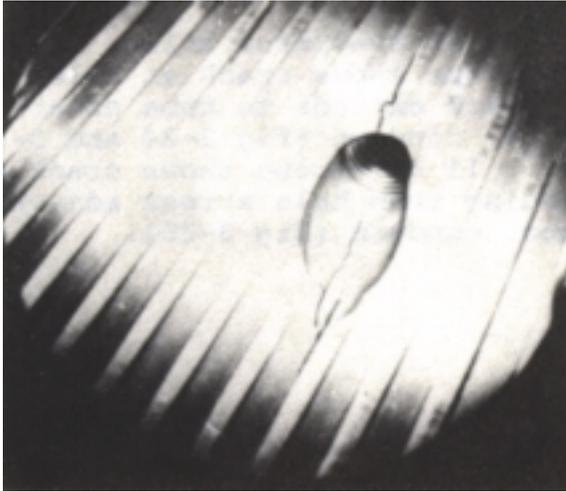


Figure 3-6. Evacuator hole: lower: external crack; upper: internal crack on feather edge of hole; upper: internal crack on outer side of hole.

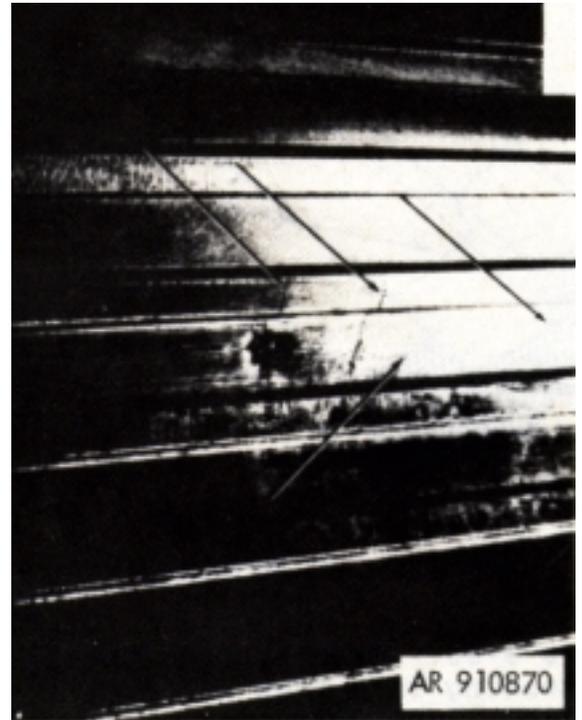


Figure 3-7. Four cracks at and near evacuator hole.

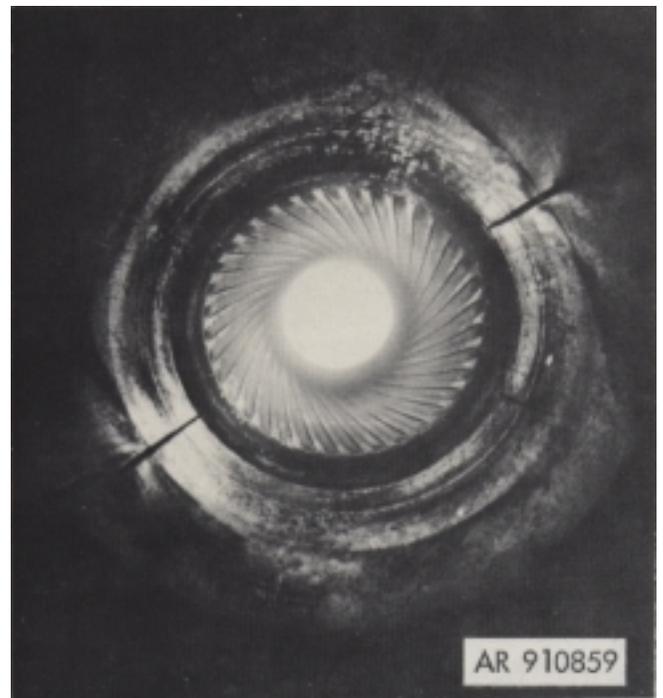
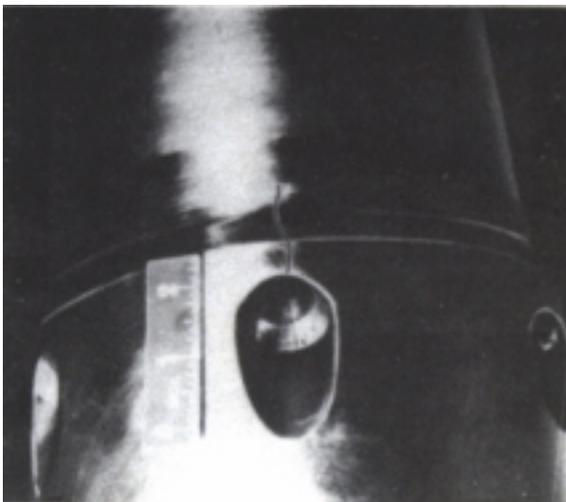


Figure 3-8. Split chamber caused by split case.

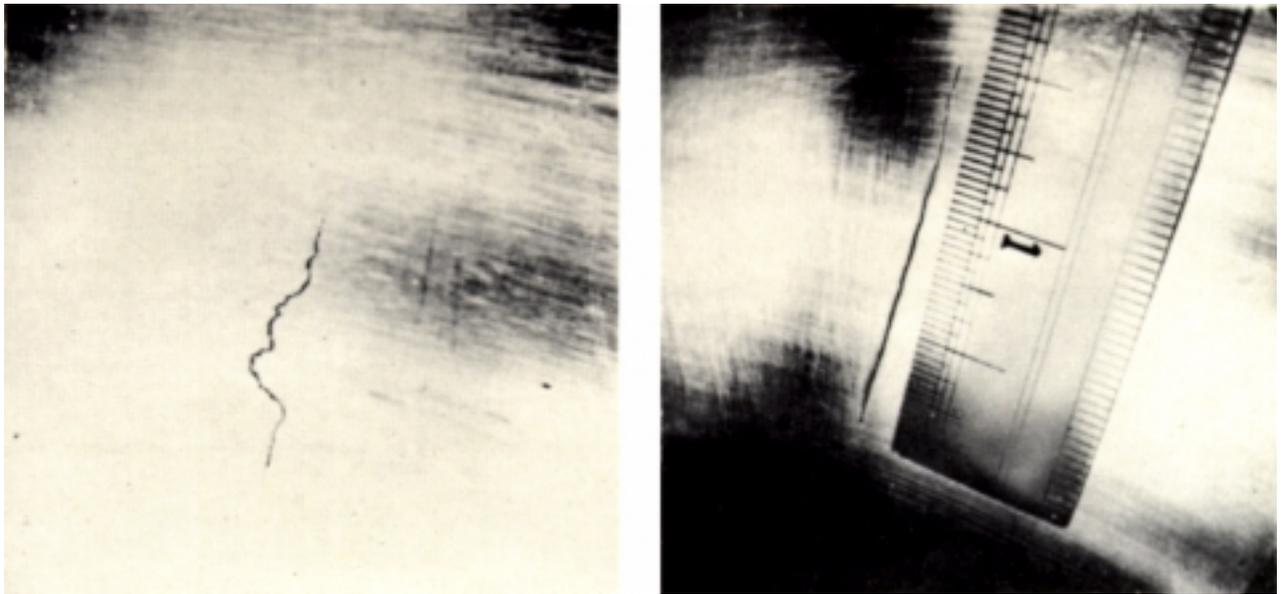


Figure 3-9. Cracks in chamber.

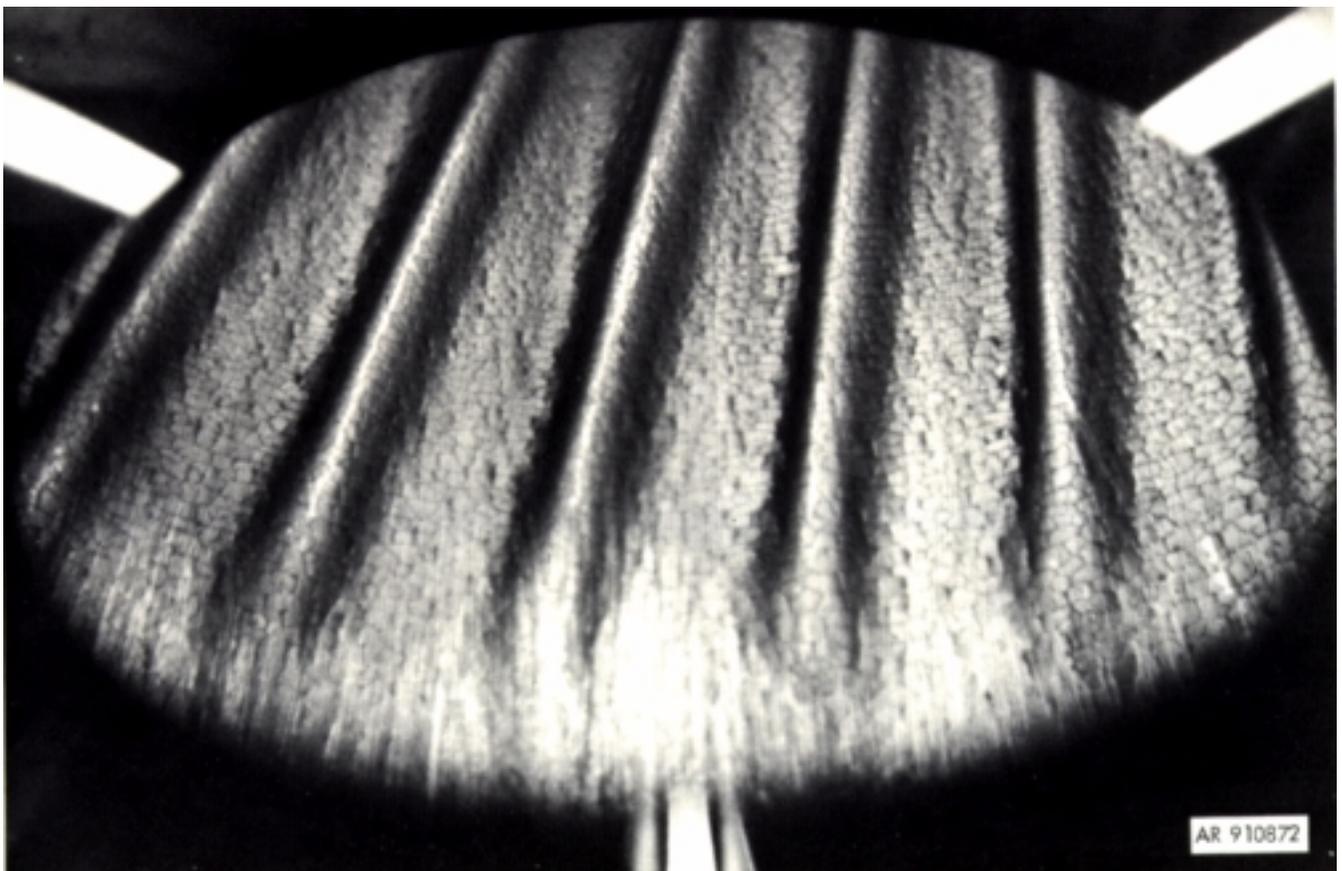


Figure 3-10. Rounded lands near origin of rifling.

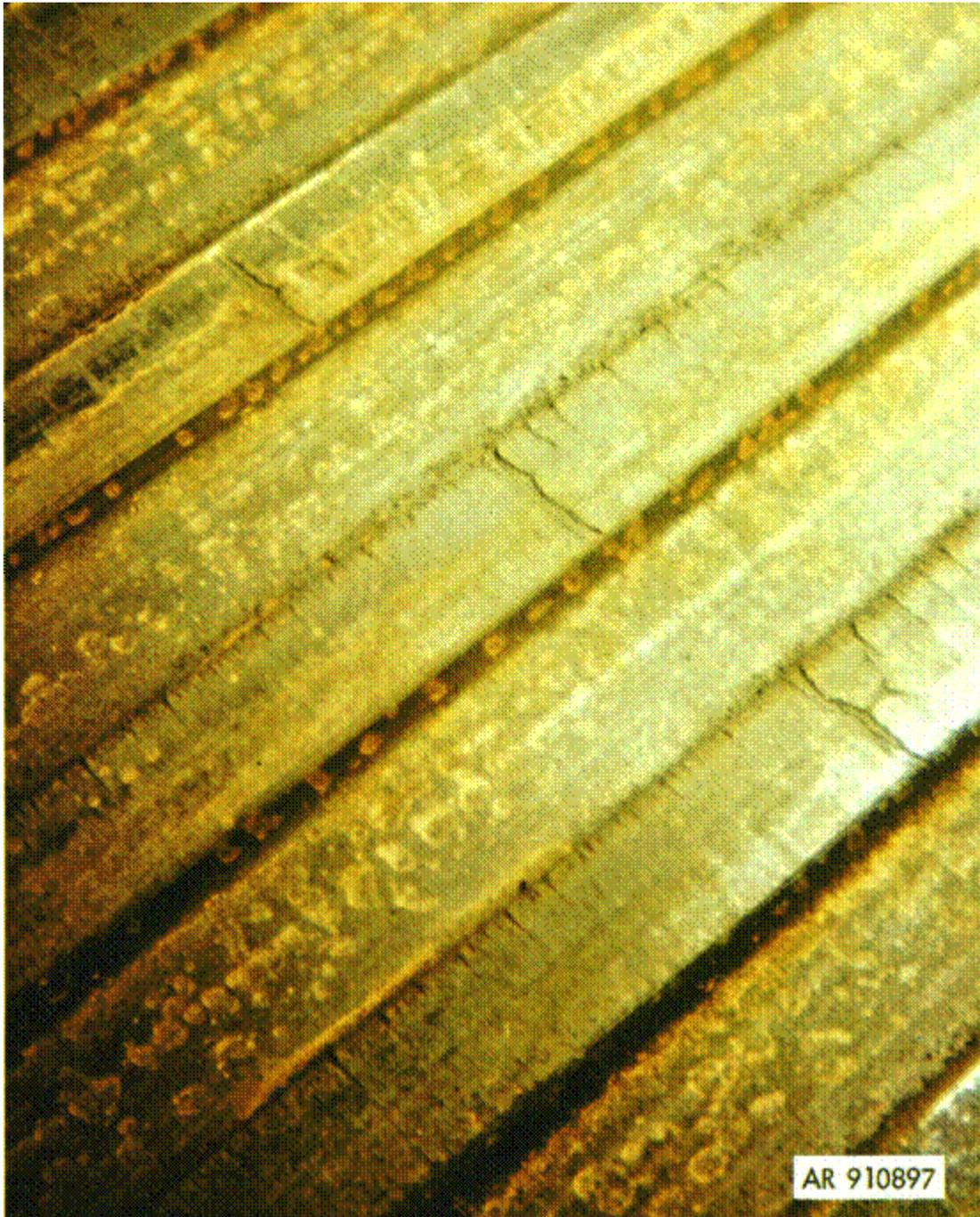


Figure 3-11. Heat checks which only seem to be cracks.

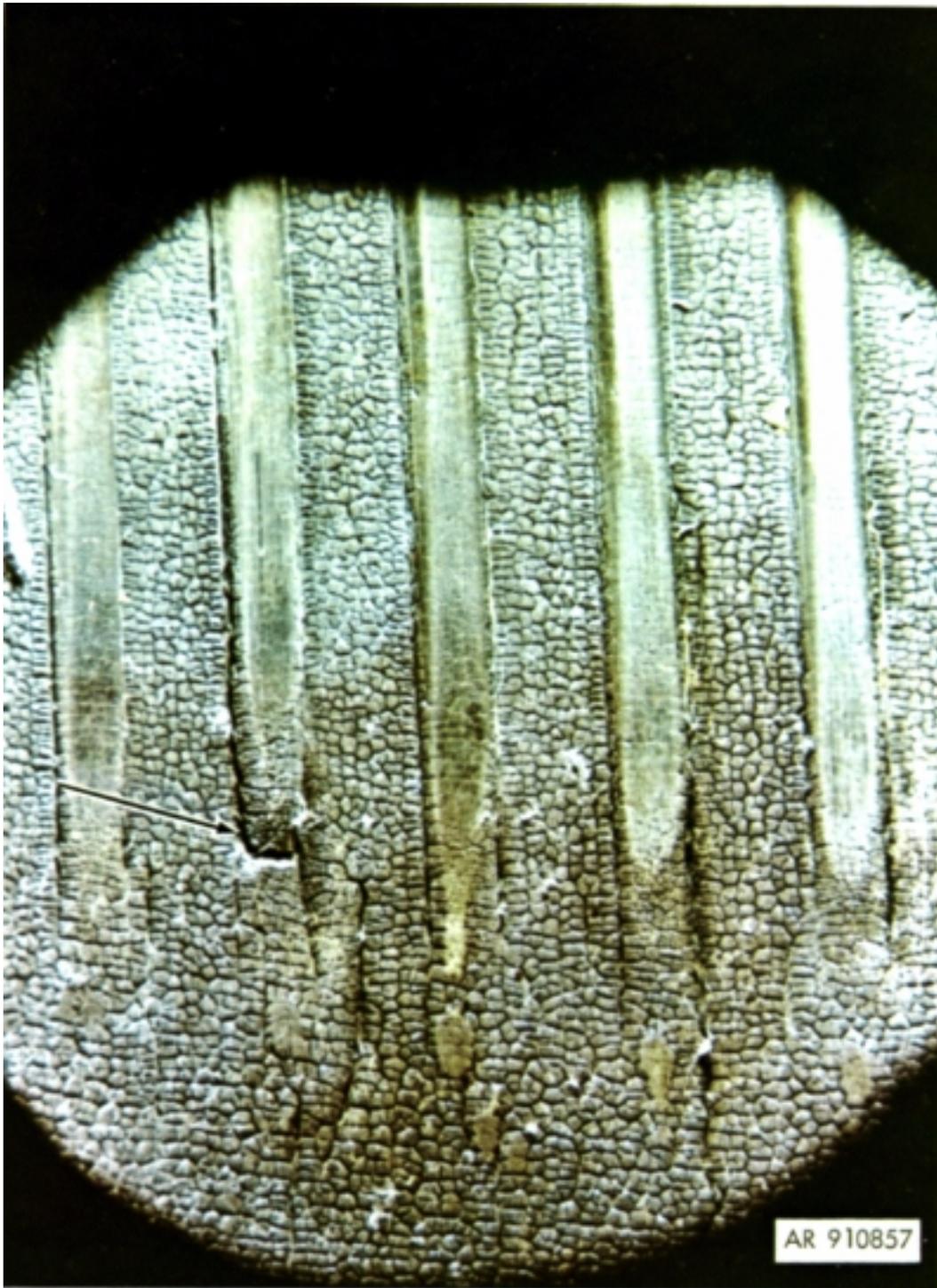


Figure 3-12. Single crack and two incipient cracks at origin of rifling.

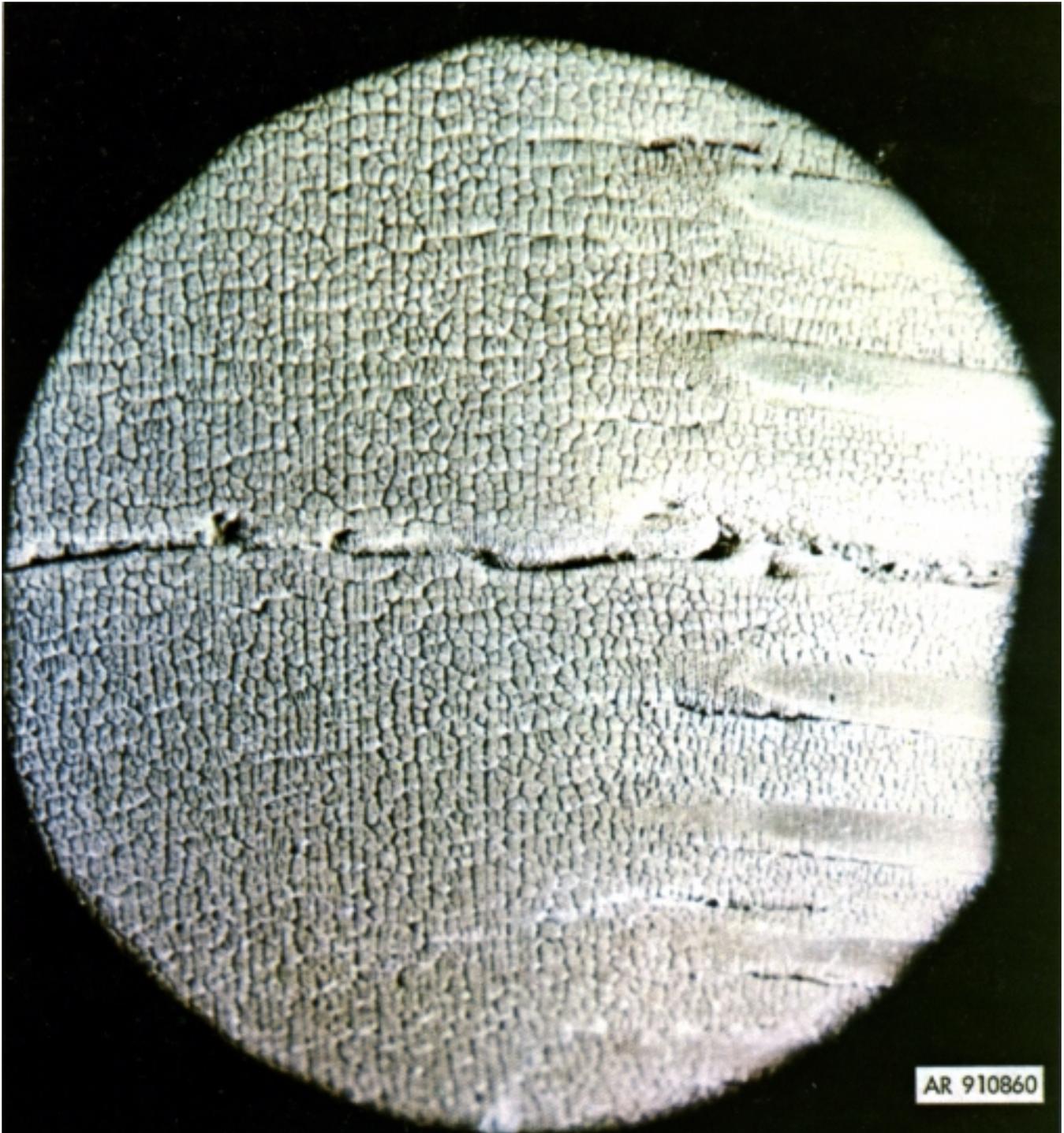


Figure 3-13. View of crack due to fatigue after 15,000 rounds extending from forward of origin of rifling rearward into chamber. (1 of 2)

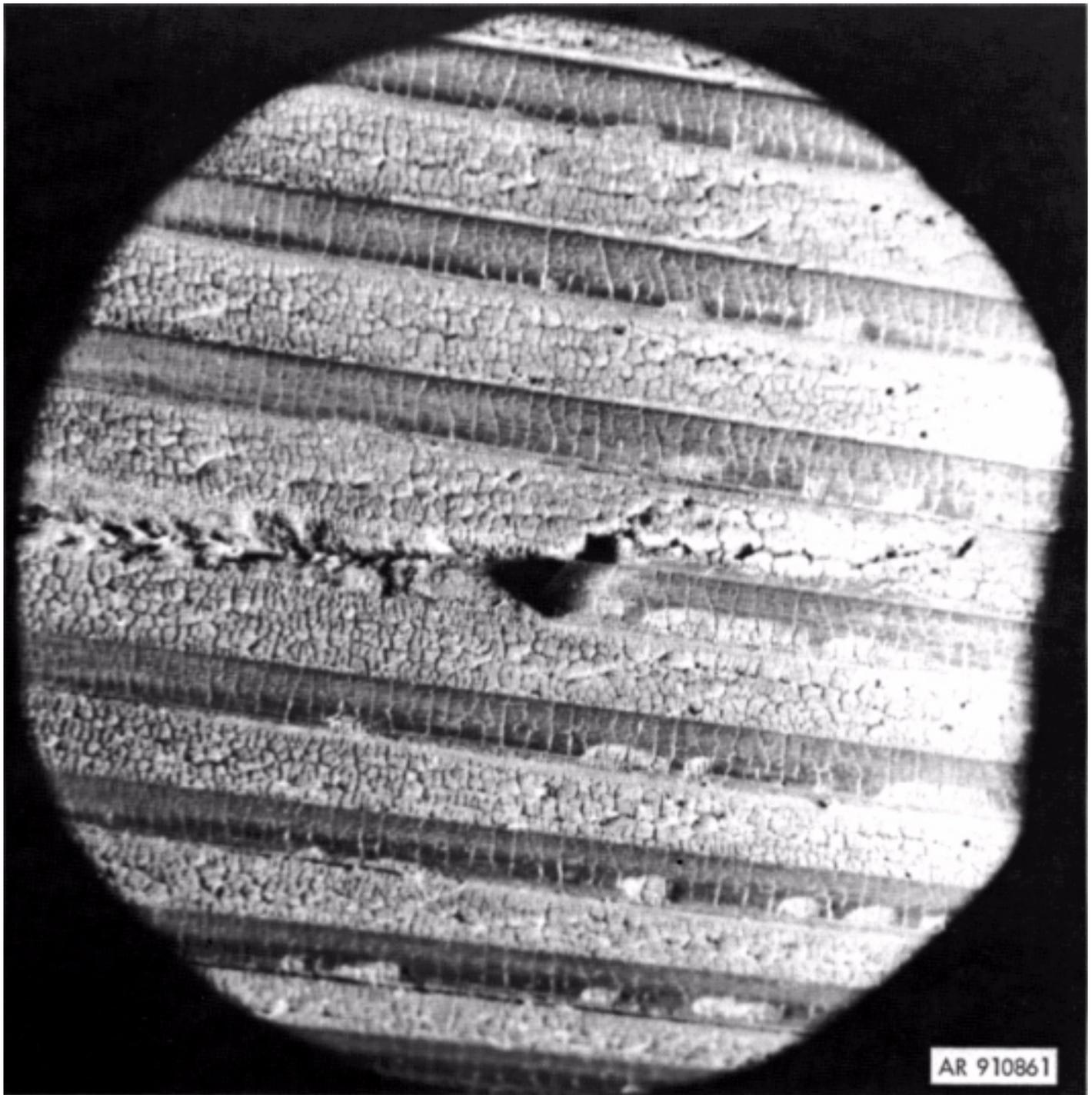


Figure 3-13. View of crack due to fatigue after 15,000 rounds extending from forward of origin of rifling rearward into chamber. (2 of 2)

2 Heat checks develop during repeated firing of cannon (Figures 3-10 and 3-11) and may evolve into cracks (Figures 3-12 and 3-13).

3 Cracks must be differentiated from other features such as scratches, heat checks, land damage, and machining marks. Tool marks and scratches usually run in straight lines or have smooth edges, uniform width, or shallow depth.

4 A cannon tube may be condemned because of excessive crack length even though the erosion (wear limit) or safe service life have not been reached. Unless otherwise specified in the specific cannon appendix for your weapon, the cannon tube shall be condemned for the following:

- a any external cracks, regardless of location, or
- b 0.5 inches for internal cracks within the chamber, or
- c 1 inch for internal cracks within the bore.

(b) Land Damage. The condition of rifling lands has a direct impact on projectile flight and accuracy (Figure 3-14).

**NOMENCLATURE FOR WORN OR DEFORMED RIFLING.
TRANSVERSE SECTIONS NORMAL TO AXIS OF GUN.**

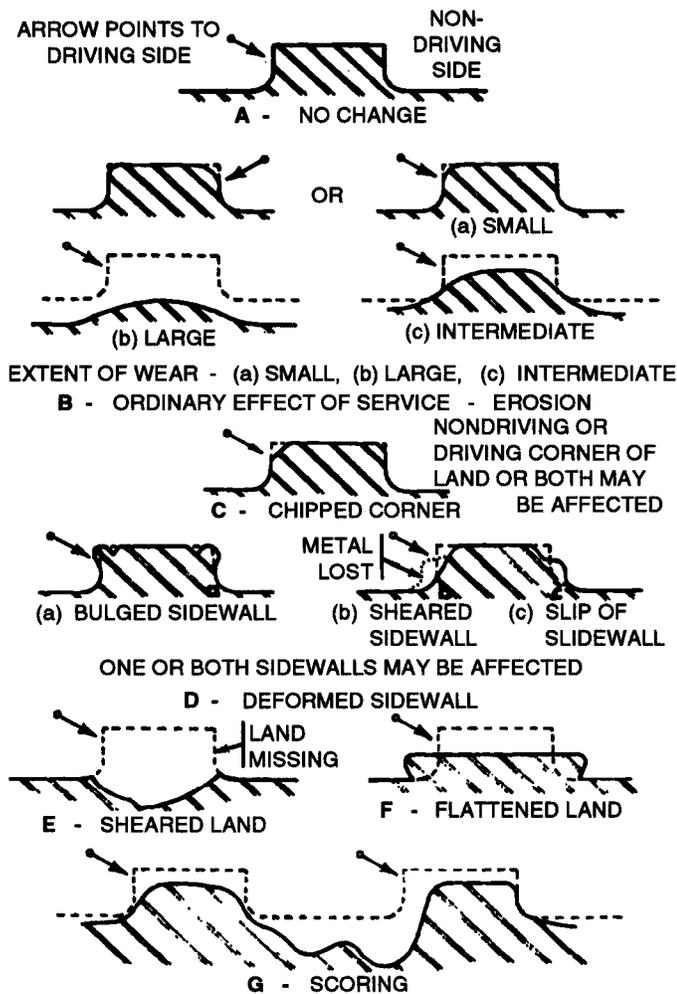


Figure 3-14. Nomenclature for conditions rifling lands.

The cannon tube shall be condemned for the following:

1 Three or more adjacent lands are stripped (missing) (Figure 3-15) or severely damaged (Figures 3-16 thru 3-18) regardless of length or location. Also if, damage on lands reaches all around the circumference and is also deep as a land at one or more locations on the circumference.

2 Any rifling damage which may result in shearing or stripping of a projectile obturator or rotating band (Figure 3-16), or any evidence that such has occurred (evidenced by sudden extremely short ranges during firing).

3 Other conditions as specified in the cannon tube appendix.

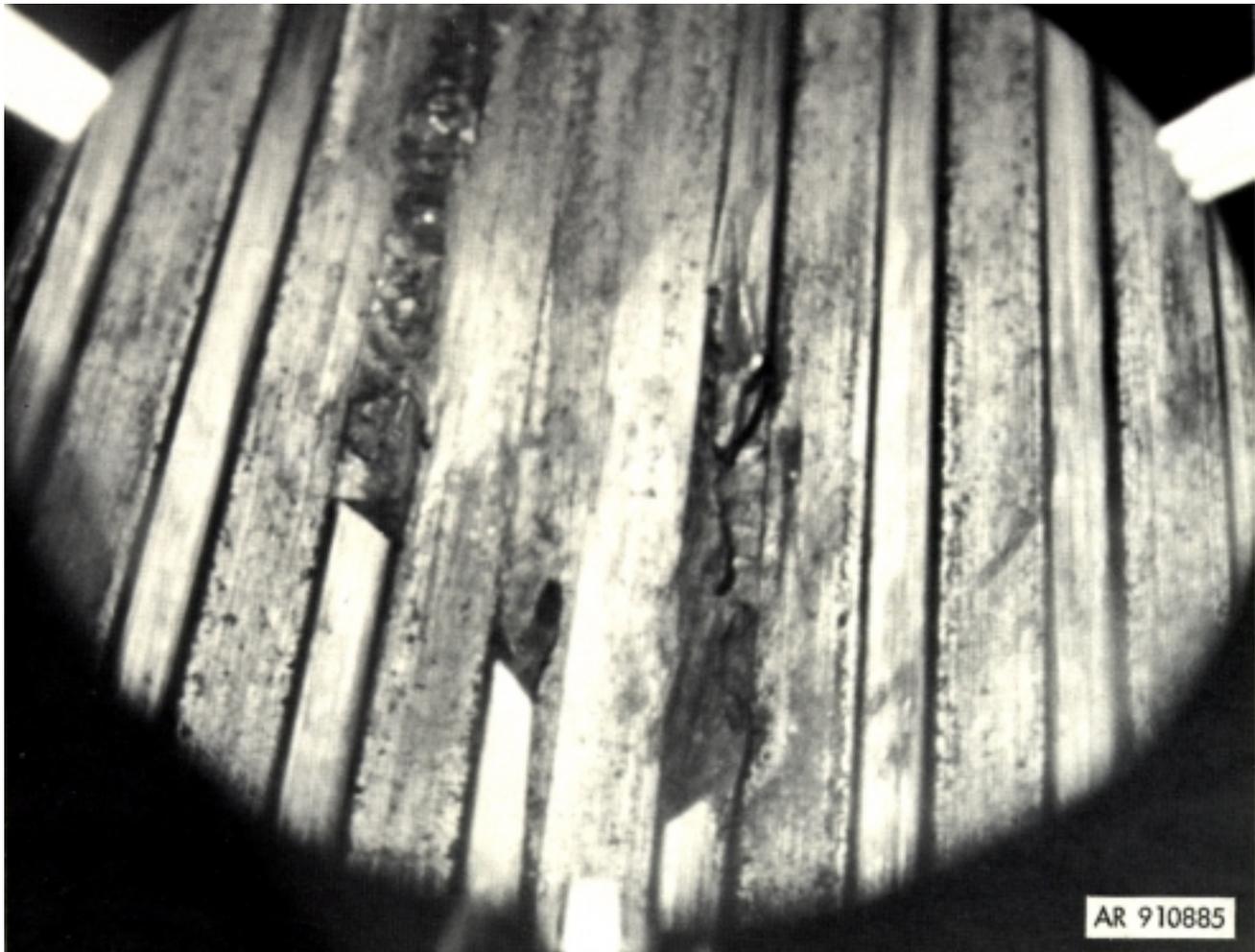


Figure 3-15. Three adjacent stripped lands: CONDEMN.

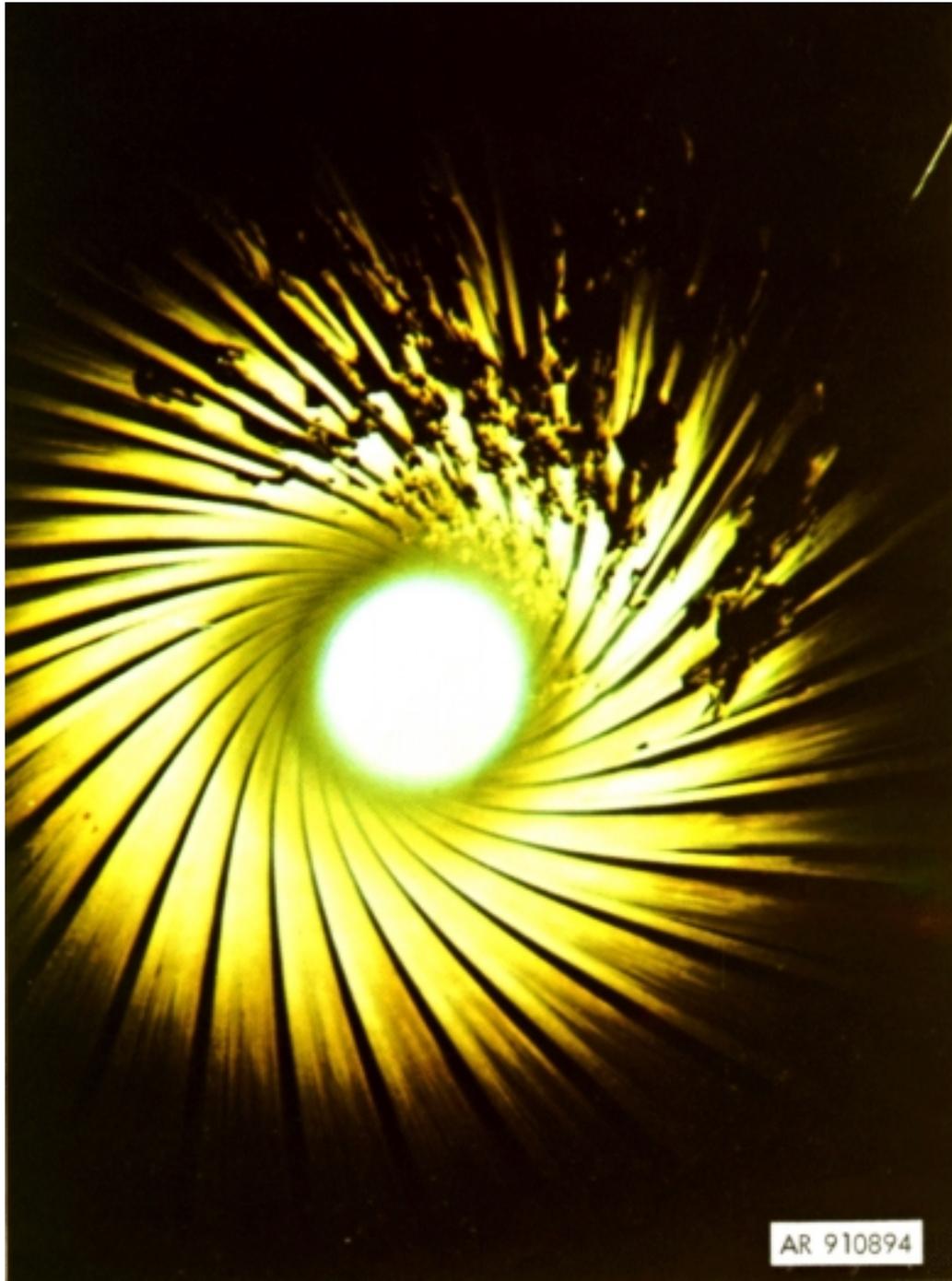


Figure 3-16. Damage to many lands: CONDEMN.



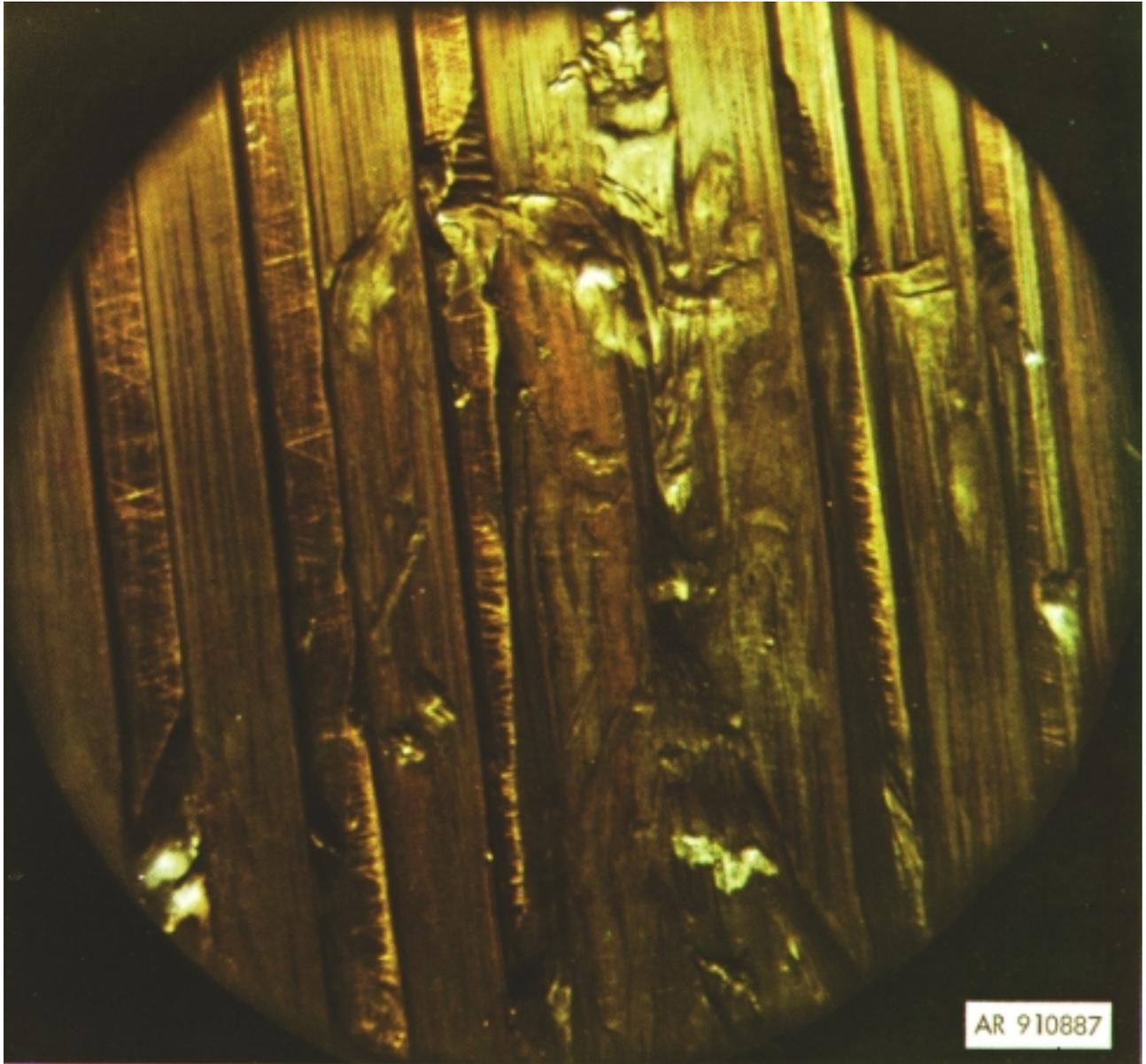


Figure 3-17. One severely and five lightly damaged lands: ACCEPTABLE.

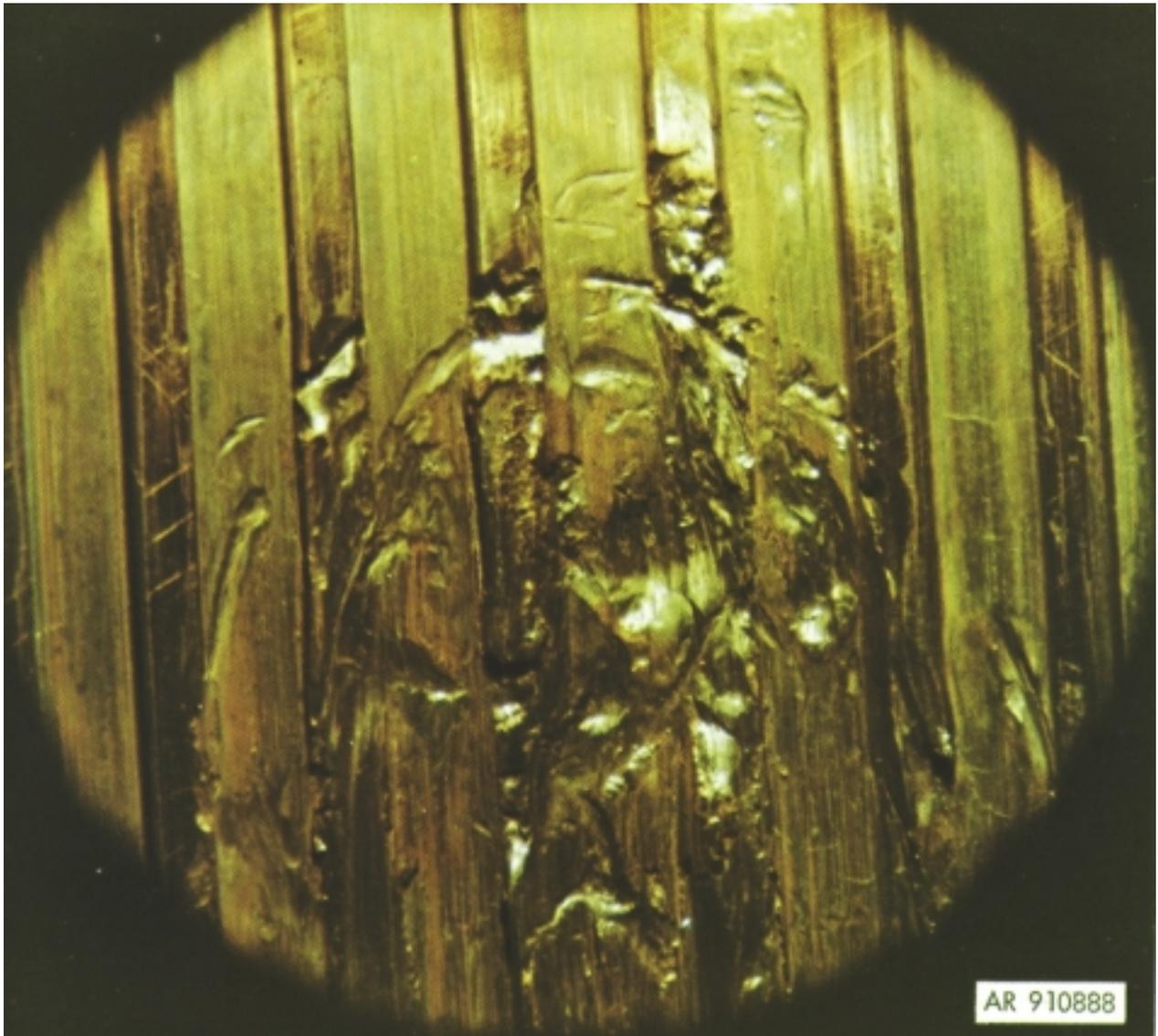


Figure 3-18. Two severely and two lightly damaged lands: ACCEPTABLE.

(c) Gouging is the upset of surface metal which may or may not affect the function of the cannon. Examine the cannon tube for the following conditions:

1 External Gouges. Condemn the cannon tube if the gouges are greater than 0.1 inches in depth or 1/2 caliber in length. Any gouged cannon tube should be examined for possible bore constriction. Any cannon tube found to be out-of-round or with a constricted bore shall be condemned.

2 Internal Gouges. Condemn the cannon tube if the defect covers a circumferential area (360 degrees). See also Land Damage, para 3-3d(2)(b) and Gas Path Erosion, para 3-3d(2)(e).

(d) Internal or External Pitting. Condemn Cannon Tube in accordance with limits provided in the specific cannon tube appendix.

(e) Gas Path Erosion and Gas Check Seating Surface. Gas path erosion is a longitudinal streak or series of streaks which can form at a gas check seating surface. Erosion of this type can result in blow-by which will affect muzzle velocity and subsequently, accuracy or may lead to cracking. Ring or annular erosion in certain cannon tubes is acceptable up to an established limit. Consult the specific cannon tube appendix for information on allowable limits of ring or annular erosion. Unless otherwise specified in the specific cannon appendix, the cannon tube shall be condemned for ring or annular erosion anywhere in the bore or chamber. Consult the specific cannon tube appendix for instructions on inspection of gas check seating surfaces.

(f) Chrome Plate Loss or Damage. Unless otherwise specified in the specific cannon tube appendix, chrome plate loss or damages such as pitting, chipping, flaking, and stripping is normal (see Figure 3-19).

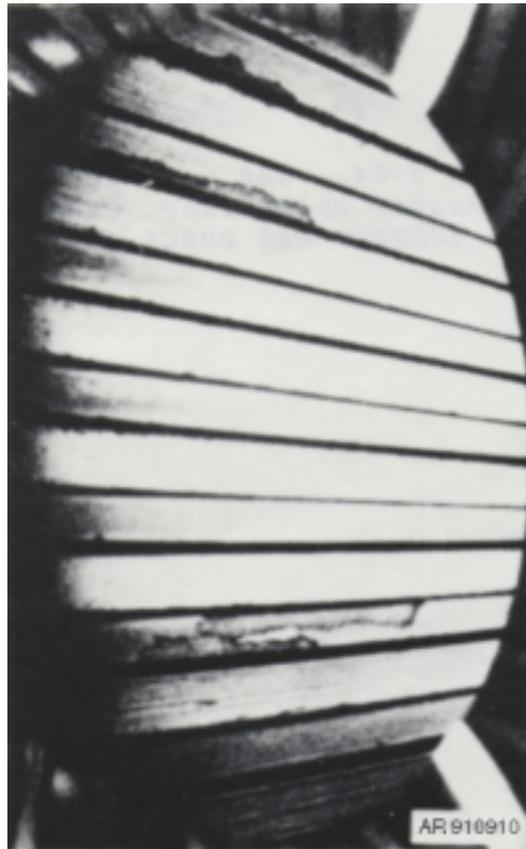


Figure 3-19. Chips missing from edges of lands.

1 Rust. Rust can be removed using fine emery cloth, or other abrasive, 320 grit or finer. Threads or bearing surfaces touched up in this fashion shall be coated with solid film lubricant, oil, or grease as specified in the specific cannon tube appendix. Non-bearing surfaces (under the bore evacuator, for instance) may be cleaned and touched up using CARC paint (see TM 43-0139).

NOTE

M225, M253, and M29/M29A1 mortar cannons shall not be painted.

2 Peened or Burred Threads. Metal upset by peening can be restored to original profile using emery cloth, or other abrasive, 320 grit or finer.

3-4. DIFFICULT INSPECTION.

a. Damage which is difficult to inspect can be measured by using impression casting inspections (outside diameters and powder chamber areas) as follows:

(1) Clean tube area to be measured.

(2) Prepare mold material.

(a) Build dam around area with putty.

(b) Add VEL-MIX-STONE (NSN 6520-00-557-7015) to water, four parts powder to one part water, and mix for one minute.

(3) Add release agent to area and pour mixture into dam.

(4) Casting will harden in 30 to 45 minutes; remove casting by prying from tube.

(5) Measure height of defect using comparator or height gage.

(6) Clean residue from cannon tube surface.

b. When damage is unique and difficult to analyze, forward borescope inspection notations and pullover gage measurements along with DA Form 2408-4, Weapon Record Data Card, to:

DEPARTMENT OF THE ARMY
Attn: AMSRD-AAR-AEW-P (B)
Benét Laboratories
1 Buffington St.
Watervliet, NY 12189-4000
DSN: 374-5587 or 374-5586
Commercial: (518) 266-5587 or (518) 266-5586

c. Another source of information and assistance available to you is your TACOM Logistics Assistance Representative (LAR).

APPENDIX A

Cannon, 105MM Gun: M68/M68A1/M68A1E8

SECTION I. OPERATOR AND UNIT INSPECTION

A-1. EQUIPMENT IDENTIFICATION.

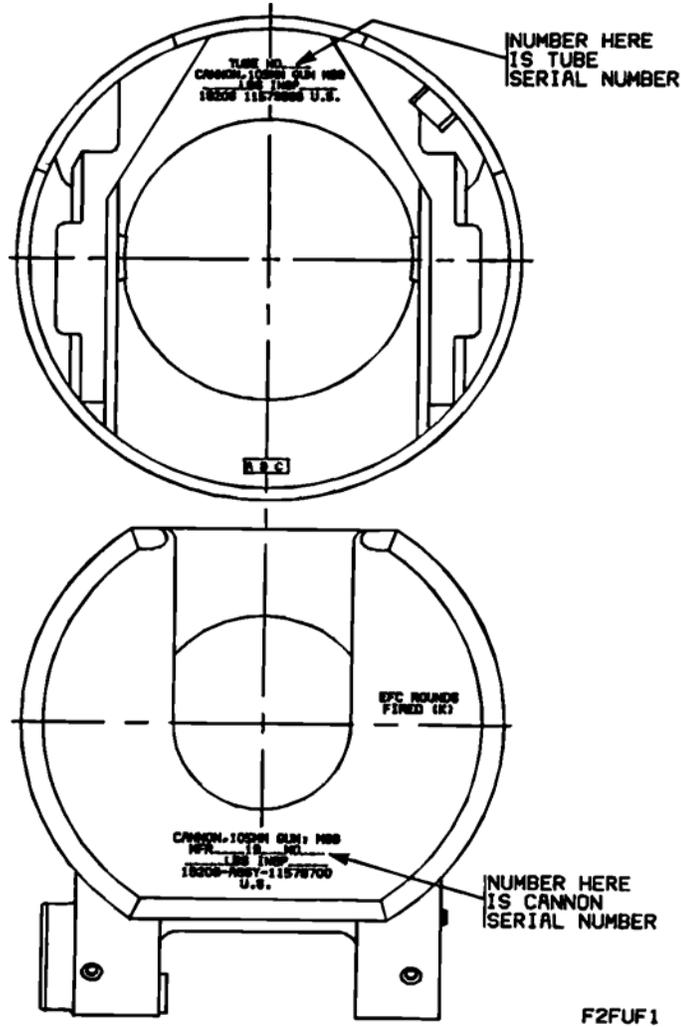


Figure A-1. Tube and cannon serial number:
105MM gun, M68/M68A1/M68A1E8.

CAUTION

ENSURE EQUIPMENT RECORD FOLDER NUMBERS CORRESPOND WITH SERIAL NUMBERS ON WEAPON. DO NOT CONFUSE NUMBERS WHEN MAKING ENTRIES.

A-2. CLEANING PROCEDURES.

WARNING

TANK OR STRYKER GUN TUBES WHICH HAVE FIRED DEPLETED URANIUM (DU) AMMUNITION MAY HAVE DU RESIDUE ON THE INSIDE SURFACES AND IN THE BORE EVACUATOR. THIS CONTAMINATION MAY BE BOTH REMOVABLE, AND FIXED (REMAINING FOR THE LIFE OF THE GUN TUBE). DU EMITS VERY LOW LEVELS OF RADIATION. PERSONNEL CLEANING THE GUN TUBE OR BORE EVACUATOR MUST WEAR RUBBER/LATEX GLOVES. (EVEN IF GLOVES HAVE BEEN WORN, ALWAYS WASH HANDS AFTER CLEANING GUN TUBE). DO NOT TOUCH GLOVES TO FACE OR OTHER PARTS OF THE BODY. WASH HANDS AFTER REMOVING GLOVES. DEPRESS GUN TUBE AS MUCH AS POSSIBLE TO PREVENT CONTAMINATED CLEANING FLUID FROM FLOWING INTO BREECH OR CREW COMPARTMENT.

RAGS AND CLEANING FLUID GENERATED DURING MAINTENANCE ON THE BORE EVACUATOR OR DURING THE GUN TUBE CLEANING PROCESS MUST BE DISPOSED OF AS LOW-LEVEL RADIOACTIVE WASTE. MOP UP ALL EXCESS CLEANING FLUID WITH RAGS, AND (DOUBLE) BAG ALL TRASH, INCLUDING GLOVES, IN TWO PLASTIC BAGS. ENSURE BAG IS TAGGED AS CONTAINING RADIOACTIVELY CONTAMINATED MATERIEL. BE SURE THE TAG LISTS: CONTENTS (GLOVES, RAGS, TOWELS, ETC), ISOTOPE (DEPLETED URANIUM). CONTACT YOUR LOCAL RADIATION PROTECTION OFFICER (RPO) FOR DISPOSAL INSTRUCTIONS.

- a. Remove bore evacuator in accordance with disassembly procedures found in the Operator's Manual.
- b. Clean surface of cannon tube under bore evacuator and bore surfaces using cleaning procedures detailed in para 2-2.

A-3. INSPECTION PROCEDURES AND CONDEMNATION CRITERIA.

- a. **Records Inspection.** Follow inspection procedures detailed in para 2-3a.
- b. **Frequency of Inspection.** In addition to Frequency of Inspection criteria found in para 2-3b, arrange for Direct Support to borescope and pullover gage the cannon tube at 200 EFC round intervals, or within 180 days prior to firing, whichever occurs first. It is not necessary to observe the time (180 days) and EFC round count intervals (200) separately. Neither interval should be exceeded without inspection.
- c. **Condemnation Information.** In addition to Condemnation Information found in para 2-4, the M68/M68A1/M68A1E8 cannon tube is condemned under a dual criteria of round count and erosion. Notify Direct Support when the following conditions are found:
 - (1) **Round Count.** The safe service life of the M68/M68A1/M68A1E8 cannon tube is 1000 EFC rounds. See Table A-1 for specific cartridge EFC information. Have Direct Support condemn the cannon tube when 1000 EFC rounds have been fired.
 - (2) **Wear.** Wear results from hot propellant gas wash and the passage of projectiles over the bore surface. This results in a uniform wear pattern which is measured by Direct Support using a pullover gage.
 - (3) **Breech Mechanism.** The breech mechanism and its component parts shall be condemned and replaced at 5000 EFC rounds. See Table A-1 for specific cartridge EFC information.

(4) Check weapon record data card, DA Form 2408-4, for rounds fired. Refer to DA PAM 750-8 for procedure used in computing estimated remaining life. If you suspect that the number of rounds listed is incorrect, notify Direct Support. Where the number of rounds fired is recorded but the ammunition model number is missing, assume 25 percent of fired rounds have an EFC of 0.5 and 75 percent of fired rounds have an EFC of 1.0.

TABLE A-1. CARTRIDGE 105MM EFC VALUES FOR USE WITH M68/M68A1/M68A1E8

<u>Type</u>	<u>Model</u>	<u>EFC</u>	<u>Remarks</u>
APDS-T	M392/M392A2	1.0	EFC=2.0 above 105°F.
APDS-T	M728	1.0	EFC=2.0 above 105°F.
APERS-T	M494	1.0	EFC=2.0 above 105°F.
APFSDS-T	M735	1.0	EFC=2.0 above 105°F.
APFSDS-T	M774	1.0	EFC=2.0 above 105°F.
APFSDS-T	M833	1.0	EFC=2.0 above 105°F. Upper Firing Limit of 125°F.
APFSDS-T	M900	3.0	Upper Firing Limit of 120°F. Not to be fired from Cannon with Breech S/N 5112, 4838, 4812, 4803, or less
CANISTER	M1040	1.0	EFC=2.0 above 105°F.
HEAT-T	M456/M456A1/M456A2	1.0	EFC=2.0 above 105°F.
HEP-T	M393A1/M393A2	0.5	EFC=1.0 above 105°F.
HEP-T	M393A3	0.5	EFC=1.0 above 105°F.
TP-T	M393A1	0.5	EFC=1.0 above 105°F.
TP-T	M490	1.0	EFC=2.0 above 105°F.
TP-T	M467	0.5	EFC=1.0 above 105°F.
TPCSDS-T	DM128	1.0	German Designed KE Trainer, EFC=2.0 above 105°F.
TPDS-T	M724/M724A1	1.0	EFC=2.0 above 105°F.
WP-T	M416	0.5	EFC=1.0 above 105°F.

A-4. VISUAL INSPECTION AND CRITERIA FOR VARIOUS TYPES OF DAMAGE.

a. **Pitting.** Notify Direct Support if:

(1) Pits resulting from corrosion on unpainted surfaces (tube outside diameter under recoil mechanism or bore evacuator bearing surfaces) exceed a depth of 0.020 inches or exceed 50 percent of total surface area (see Figure A-2).

NOTE

If you see any evidence of gas leakage during firing, powder streaks or gas erosion, service bore evacuator in accordance with procedures found in Operator's Manual.

(2) Pits on painted non-bearing surfaces (under bore evacuator for instance) exceed a depth of 0.125 inches or exceed 80 percent of total area.

b. **Cracks.** Notify Direct Support if:

(1) Cracks on internal surfaces.

(a) Cracks within 1 inch of muzzle end exceed 0.250 inches in length.

(b) Cracks on other interior surfaces exceed 0.625 inches in length.

(2) Cracks on exterior surfaces.

(a) Cracks on breech threads, keyways, and bore evacuator threads or intersecting bore evacuator holes exceed 0.125 inches in length.

(b) Cracks on other exterior surfaces exceed 0.375 inches in length.

(c) **Other Damage.** Notify Direct Support if cannon tube cannot be boresighted using muzzle boresight device.



**Figure A-2. Pitting Under Bore Evacuator:
105MM gun cannon, M68/M68A1/M68A1E8.**

SECTION II. DIRECT SUPPORT INSPECTION

A-5. **EQUIPMENT IDENTIFICATION.** See Figure A-1.

CAUTION

ENSURE EQUIPMENT RECORD FOLDER NUMBERS CORRESPOND WITH SERIAL NUMBERS ON WEAPON. DO NOT CONFUSE NUMBERS WHEN MAKING ENTRIES.

A-6. **INSPECTION PROCEDURES AND CONDEMNATION CRITERIA.**

WARNING

TANK OR STRYKER GUN TUBES WHICH HAVE FIRED DEPLETED URANIUM (DU) AMMUNITION MAY HAVE DU RESIDUE ON THE INSIDE SURFACES WHICH CAN CONTAMINATE BORESCOPE DEVICE AND PERSONNEL. THIS CONTAMINATION MAY BE BOTH REMOVABLE, AND FIXED (REMAINING FOR THE LIFE OF THE GUN TUBE). IF YOU SUSPECT, OR ARE UNSURE IF GUN TUBE HAS FIRED DU AMMUNITION, TREAT AS IF IT IS CONTAMINATED, AND ENSURE GUN TUBE IS PROPERLY CLEANED TO ELIMINATE ANY POSSIBLE REMOVABLE CONTAMINATION.

a. **Records Inspection.** Follow inspection procedures detailed in para 3-3a.

b. **Missing or Incomplete Records.** Follow procedures detailed in para 3-3b.

c. **Frequency of Inspection.** In addition to Frequency of Inspection criteria found in para 3-3c, pullover gage and borescope cannon tubes within 180 days prior to firing. Additionally, the interval between inspections (pullover gage and borescope) shall not exceed 200 EFC rounds. Information carried forward to each new DA Form 2408-4 is to include the EFC Rounds Remaining Life at the last pullover gage measurement and borescope inspection.

d. **Condemnation Information.** In addition to condemnation information found in this appendix and para 3-3d, visual evidence of a complete interruption of any rifling land is cause for condemnation of the M68/M68A1/M68A1E8 Cannon Tube. The M68/M68A1/M68A1E8 Cannon Tube is condemned under a dual criteria, based on wear or EFC round count, whichever occurs first, as follows:

(1) **Round Count.** The safe service life of the M68/M68A1/M68A1E8 cannon tube is 1000 EFC rounds. See Table A-1 for specific cartridge EFC information. Condemn the cannon tube when 1000 EFC rounds have been fired.

(2) **Wear.** Condemn the cannon tube when pullover gage inspection shows wear in excess of 0.056 inches in the region between 25.25 and 35 inches forward of the breech end of the cannon tube. The original bore diameter of the M68/M68A1/M68A1E8 cannon tube is 4.134 inches.

(3) **Bore Evacuator.** When a cannon tube is condemned for round count, the bore evacuator chamber assembly and preformed packing shall also be condemned. The front and rear thermal shrouds, however, should be retained for reuse with the replacement bore evacuator.

(4) **Breech Mechanism.** The breech mechanism and its component parts shall be condemned and replaced at 5000 EFC rounds. See Table A-1 for specific cartridge EFC information. It is important that the components of each breech mechanism assembly be kept together during maintenance and inspection and not be interchanged with other assemblies. Breech rings manufactured after 1977 will have the notation "EFC ROUNDS FIRED (K)" in the location shown in Figure A-1. Numbers are to be stamped below this line to indicate increments of 1000 EFC rounds fired (0, 1, 2, etc.). The "RETUBED" marking on breech rings

manufactured prior to 1978 shall be obliterated and "EFC ROUNDS FIRED (K)" shall be metal stamped immediately above the obliterated marking. Each retubing previously marked on the breech ring shall be considered equal to 1000 EFC rounds fired.

A-7. VISUAL INSPECTION AND CRITERIA FOR VARIOUS TYPES OF DAMAGE.

In addition to the criteria in Chapter 3, the following specific criteria apply to the 105mm M68/M68A1/M68A1E8 cannon:

a. **Pitting.** The cannon tube shall be condemned if:

(1) Internal pits cover 20 percent or more of entire chamber area or are over 0.010 inches deep. Ignore pitting in the bore.

(2) Pits resulting from corrosion on unpainted surfaces (tube outside diameter under recoil mechanism or bore evacuator bearing surfaces) exceed a depth of 0.020 inches or exceed 50 percent of total surface area.

NOTE

If you see any evidence of gas leakage during firing, powder streaks or gas erosion, service bore evacuator in accordance with procedures found in Operator's Manual.

(3) Pits on non-bearing surfaces (under bore evacuator for instance) exceed a depth of 0.125 inches or exceed 80 percent of total area (see Figure A-2).

(4) Evidence of gas erosion in sealing area of bore evacuator O-rings.

b. **Cracks.** Condemn the cannon tube if:

(1) Cracks on internal surfaces.

(a) Cracks within one (1) inch of muzzle end exceed 0.250 inches in length.

(b) Cracks on other interior surfaces exceed 0.625 inches in length.

(2) Cracks on exterior surfaces.

(a) Cracks on breech threads, keyways, and bore evacuator threads or intersecting bore evacuator holes exceed 0.125 inches in length.

(b) Cracks on other exterior surfaces exceed 0.375 inches in length.

c. **Other Damage.** Condemn the cannon tube if muzzle end shows evidence of an out of round condition preventing proper boresighting.

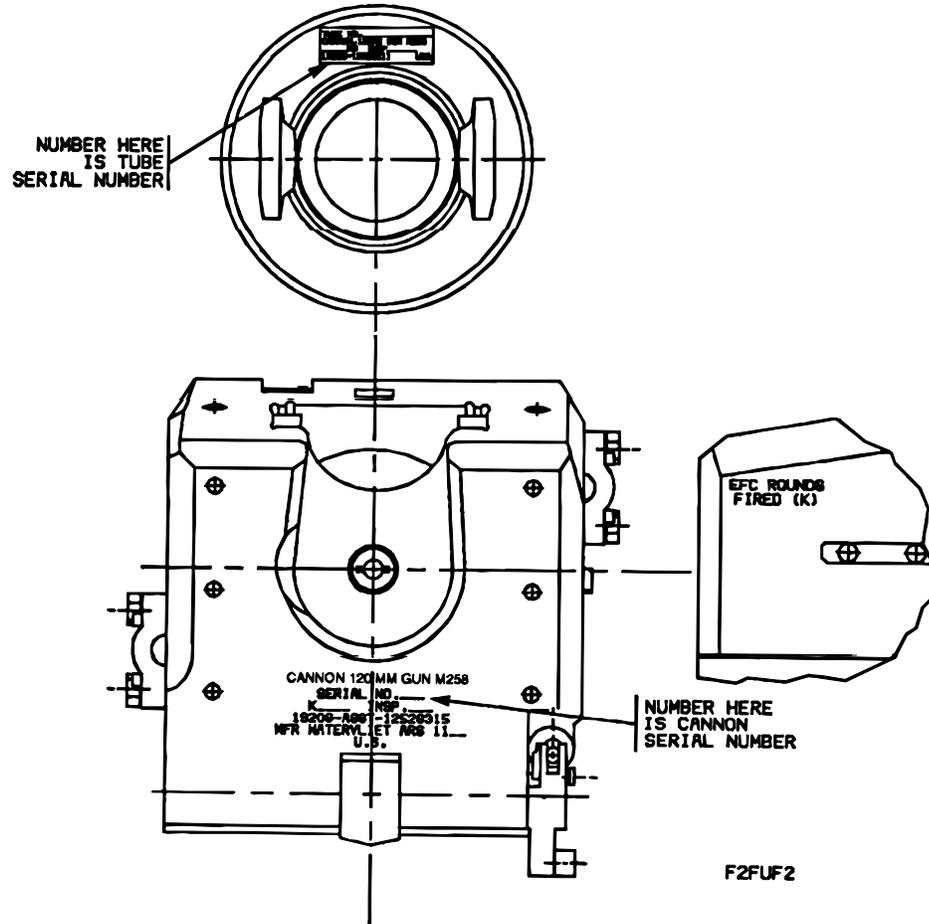
A-8. DIFFICULT INSPECTION. See para 3-4.

APPENDIX B

Cannon, 120MM Gun: M256

SECTION I. OPERATOR AND UNIT INSPECTION

B-1. EQUIPMENT IDENTIFICATION.



*Figure B-1. Location of tube and cannon serial number
120MM gun, M256.*

CAUTION

ENSURE EQUIPMENT RECORD FOLDER NUMBERS CORRESPOND WITH SERIAL NUMBERS ON WEAPON. DO NOT CONFUSE NUMBERS WHEN MAKING ENTRIES.

B-2. CLEANING PROCEDURES.

WARNING

TANK GUN TUBES WHICH HAVE FIRED DEPLETED URANIUM (DU) AMMUNITION MAY HAVE DU RESIDUE ON THE INSIDE SURFACES WHICH CAN CONTAMINATE BORESCOPE DEVICE AND PERSONNEL. THIS CONTAMINATION MAY BE BOTH REMOVABLE, AND FIXED (REMAINING FOR THE LIFE OF THE GUN TUBE). IF YOU SUSPECT, OR ARE UNSURE IF GUN TUBE HAS FIRED DU AMMUNITION, TREAT AS IF IT IS CONTAMINATED, AND INSURE GUN TUBE IS PROPERLY CLEANED TO ELIMINATE ANY POSSIBLE REMOVEABLE CONTAMINATION.

- a. Remove bore evacuator in accordance with disassembly procedures found in the Operator's Manual.
- b. Clean surface of cannon tube under bore evacuator and bore surfaces using cleaning procedures detailed in para 2-2.
- c. The M256 cannon tube will exhibit various colors throughout the length of the bore ranging from a uniform gray/black to streaks of gray, black, and/or dark brown. This is a normal occurrence and, with additional firing, will continue to darken over the life of the Cannon Tube (see Figure B-2). No attempt should be made to remove this coating. Any attempt would be very time consuming and you run a significant risk of damaging the tube.

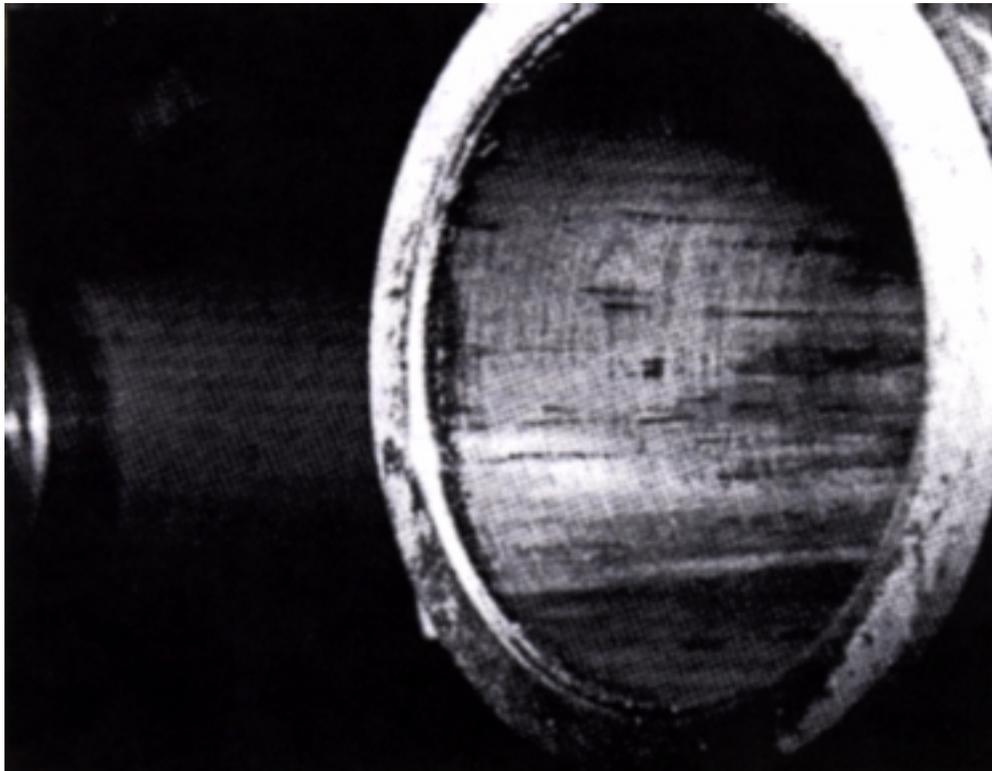


Figure B-2. M256 Cannon Tube: typical clean bore appearance.

B-3. INSPECTION PROCEDURES AND CONDEMNATION CRITERIA.

a. **Records Inspection.** Follow inspection procedures detailed in para 2-3a.

b. **Frequency of Inspection.** In addition to Frequency of Inspection criteria found in para 2-3b, arrange for Direct Support to borescope and inspect (bore erosion gage) the cannon tube after the first 300 rounds are fired and then every 150 rounds thereafter, or within 180 days prior to firing, whichever occurs first. It is not necessary to observe the time (180 days) and round count intervals (300/150) separately. Neither interval should be exceeded without inspection.

c. **Condemnation Information.** In addition to Condemnation Information found in para 2-4, the M256 cannon tube is condemned under a dual criteria of round count and erosion. Notify Direct Support when the following conditions are found:

(1) **Round Count.** The safe service life of the M256 cannon tube is 1500 EFC rounds. See Table B-1 for specific cartridge EFC information. Have Direct Support condemn the cannon tube when 1500 EFC rounds have been fired.

(2) **Erosion.** Erosion results when the chrome plating on the bore is lost and hot propellant gasses wash across the unprotected base metal of the tube bore. Erosion is detected and its location is determined by use of a borescope. The depth of erosion is measured using a bore erosion gage. Have Direct Support inspect the cannon tube with a borescope and bore erosion gage at the intervals specified or when erosion is suspected.

NOTE

The loss of small amounts of chrome plate over the life of the cannon tube is normal and will not affect accuracy safety of the cannon tube.

(3) The breech mechanism and its component parts shall be replaced at 4500 EFC rounds. See Table B-1 for specific cartridge EFC information.

(4) Check weapon record data card, DA Form 2408-4, for rounds fired. Refer to DA PAM 750-8 for procedure used in computing estimated remaining life. If you suspect that the number of rounds listed is incorrect, notify Direct Support.

TABLE B-1. 120MM CARTRIDGE EFC VALUES FOR USE WITH M256 CANNON

<u>Type</u>	<u>Model</u>	<u>EFC</u>	<u>Remarks</u>
APFSDS-T	M829A3	2.0	
All Other Cartridges		1.0	

B-4. VISUAL INSPECTION AND CRITERIA FOR VARIOUS TYPES OF DAMAGE.

a. **Pitting.**

(1) For evaluation of pitting, the interior of the cannon is divided into three zones.

(a) Zone 1 consists of the chamber region from the breech face of the tube to a point about 18-3/4 inches into the cannon. Notify Direct Support if internal pits in this zone are over 0.030 inches deep (see Figure B-3a).

(b) Zone 2 is the tapered zone. Zone 2 is the area starting at 18-3/4 inches and ending 22 inches into the cannon. Zone 2 is 3-1/4 inches long. The tapered zone is the transition between the chamber and the bore. Notify Direct Support if internal pits in this zone are over 0.050 inches deep (see Figure B-3a).

(c) Zone 3 is the bore. The bore is the rest of the interior of the cannon starting at 22 inches from the breech face (see Figure B-3a). Ignore pits in the bore. The bore is evaluated for erosion; see para B-3 c (2).

B-4. VISUAL INSPECTION AND CRITERIA FOR VARIOUS TYPES OF DAMAGE - Continued.

(d) Notify Direct Support if the internal pits of Zones 1 and 2 cover 20 percent or more of the total area (see Figure B-3a).

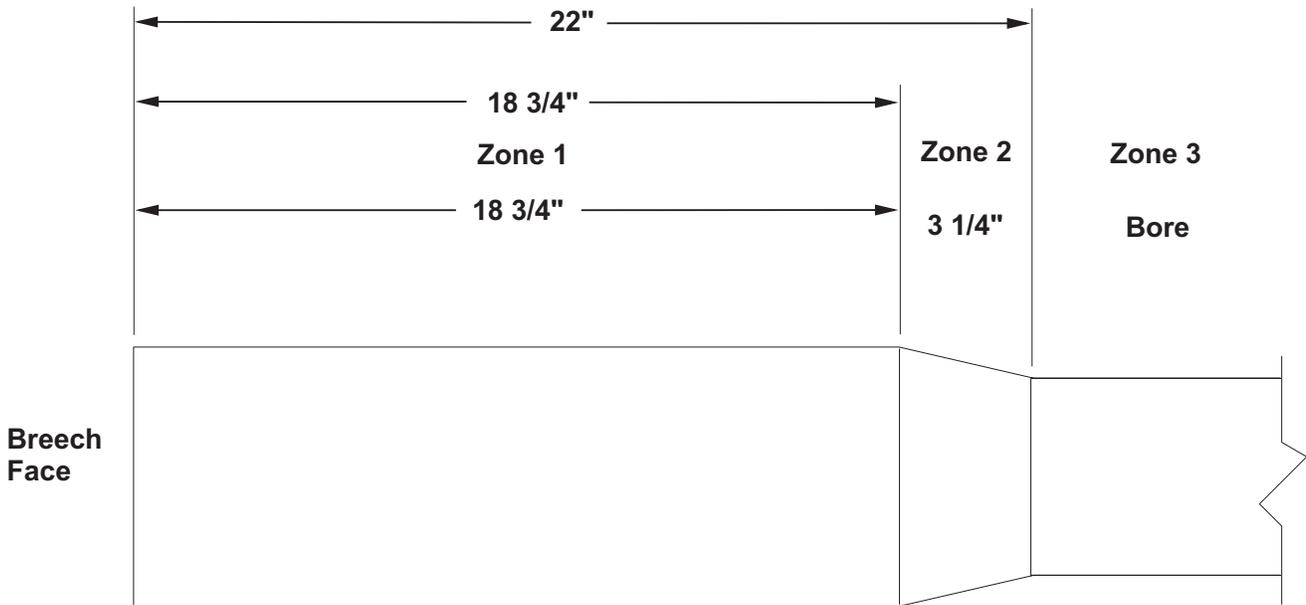


Figure B-3a. M256 Cannon Tube: Zones

(2) Notify Direct Support if pits resulting from corrosion on unpainted surfaces (tube outside diameter under recoil mechanism or bore evacuator bearing surfaces) exceed a depth of 0.020 inches or exceed 80 percent of total surface area (see Figure B-3).

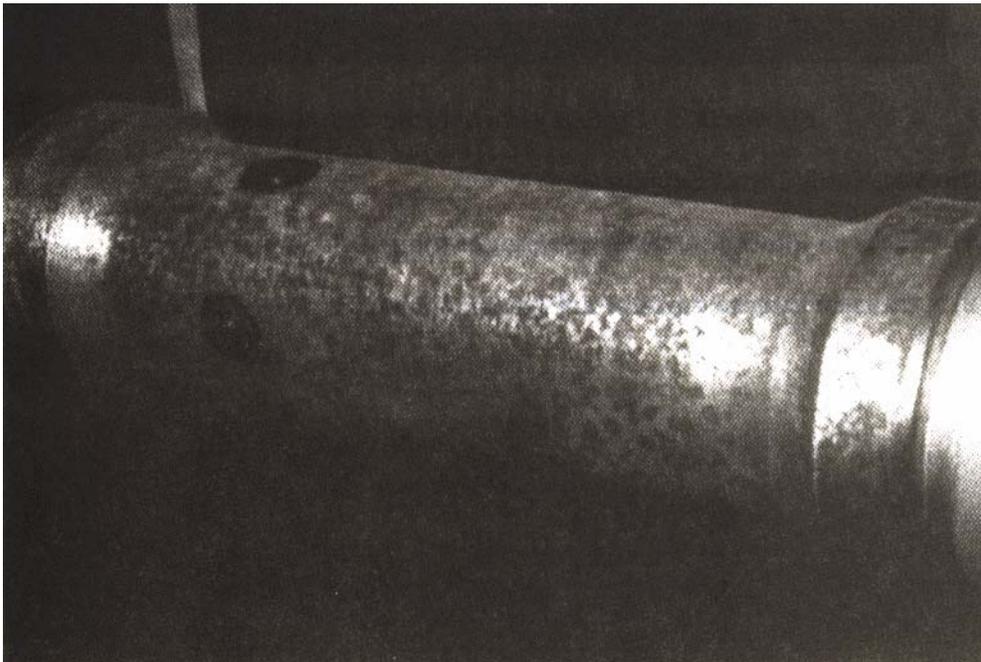


Figure B-3. Pits resulting from corrosion on unpainted surfaces.

NOTE

If you see any evidence of gas leakage during firing, powder streaks or gas erosion, service bore evacuator in accordance with procedures found in Operator's Manual.

(3) Pits on painted non-bearing surfaces (under bore evacuator for instance) exceed a depth of 0.040 inches or exceed 80 percent of total area (see Figure B-4).

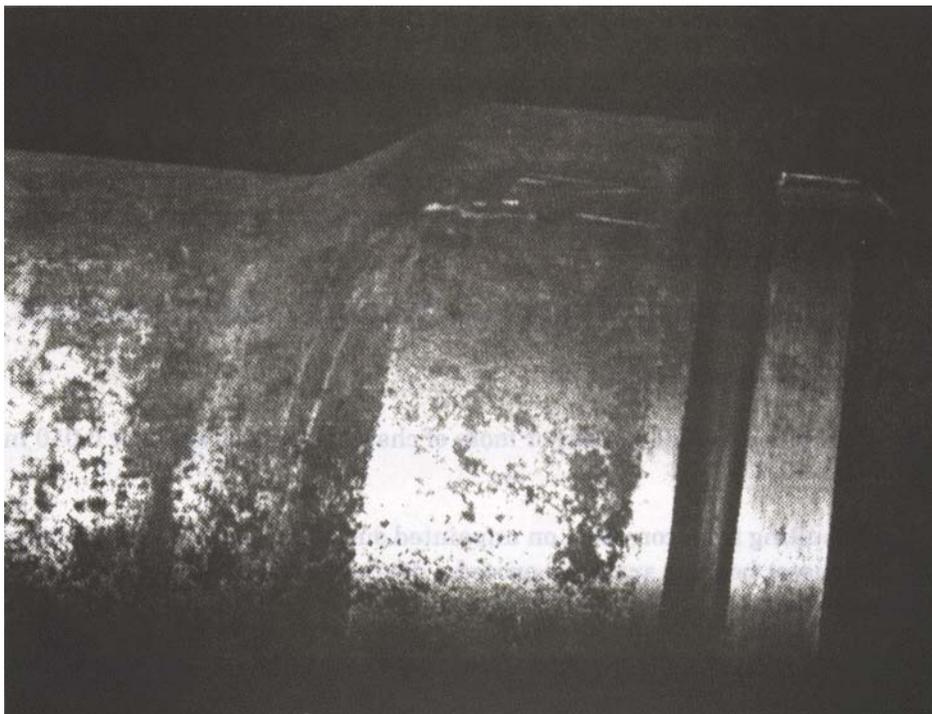


Figure B-4. Pits on painted non-bearing surfaces.

b. **Cracks.** Notify Direct Support If:

- (1) Cracks on internal surfaces are greater than 0.125 inches in length.
- (2) Cracks on exterior surfaces are greater than 0.25 inches in length.

SECTION II. DIRECT SUPPORT INSPECTION

B-5. EQUIPMENT IDENTIFICATION. See Figure B-1.

CAUTION

ENSURE EQUIPMENT RECORD FOLDER NUMBERS CORRESPOND WITH SERIAL NUMBERS ON WEAPON. DO NOT CONFUSE NUMBERS WHEN MAKING ENTRIES.

B-6. INSPECTION PROCEDURES AND CONDEMNATION CRITERIA.

WARNING

TANK GUN TUBES WHICH HAVE FIRED DEPLETED URANIUM (DU) AMMUNITION MAY HAVE DU RESIDUE ON THE INSIDE SURFACES WHICH CAN CONTAMINATE BORESCOPE DEVICE AND PERSONNEL. THIS CONTAMINATION MAY BE BOTH REMOVABLE, AND FIXED (REMAINING FOR THE LIFE OF THE GUN TUBE). IF YOU SUSPECT, OR ARE UNSURE IF GUN TUBE HAS FIRED DU AMMUNITION, TREAT AS IF IT IS CONTAMINATED, AND INSURE GUN TUBE IS PROPERLY CLEANED TO ELIMINATE ANY POSSIBLE REMOVABLE CONTAMINATION.

a. **Records Inspection.** Follow inspection procedures detailed in para 3-3a.

b. **Missing or Incomplete Records.** Follow procedures detailed in para 3-3b.

c. **Frequency of Inspection.** In addition to Frequency of Inspection criteria found in para 3-3c, arrange for Direct Support to borescope and inspect (bore erosion gage) the cannon tube after the first 300 rounds are fired and then every 150 rounds thereafter, or within 180 days prior to firing, whichever occurs first. It is not necessary to observe the time (180 days) and round count intervals (300/150) separately. Neither interval should be exceeded without inspection. Information carried forward to each new DA Form 2408-4 is to include the EFC Rounds Remaining Life at the last bore erosion gage measurement and borescope inspection.

d. **Condemnation Information.** In addition to Condemnation Information found in this appendix and para 3-3d, the M256 Cannon Tube is condemned under a dual criteria of round count and erosion, whichever occurs first as follows:

(1) **Round Count.** The Safe Service Life of the M256 Cannon Tube is 1500 EFC rounds. See Table B-1 for specific cartridge EFC information. Have Direct Support condemn the cannon tube when 1500 EFC rounds have been fired.

(2) **Erosion.** Erosion results when the chrome plating on the bore is lost (see Figure B-5) and hot propellant gasses wash across the unprotected base metal of the tube bore (see Figure B-6). Erosion is detected and its location is determined by use of a borescope. The depth of erosion is measured using a bore erosion gage. The cannon tube is condemned when erosion at any location exceeds 5mm in depth.

NOTE

The loss of small amounts of chrome plate over the life of the cannon tube is normal and will not affect accuracy or safety of the cannon tube.

(3) **Bore Evacuator.** Condemn the bore evacuator when visible damage (punctures, cracks, dents, severe abrasion) is present. Damage to the ends caused by removal (hammer marks, distortion, or material separation) will also render the bore evacuator unserviceable. Nicks, burrs, or cracks on the sealing surfaces (45 degree chamfer on the ends) will render the bore evacuator unserviceable.

(4) **Breech Mechanism.** The breech mechanism and its component parts shall be condemned and replaced at 4500 EFC rounds. See Table B-1 for specific cartridge EFC information. It is important that the components of each breech mechanism assembly be kept together during maintenance and inspection and not be interchanged with other assemblies. Breech rings are stamped "EFC ROUNDS FIRED (K)" in the location shown in Figure B-1. Numbers are to be metal stamped below this notation to indicate increments of 1000 EFC rounds fired (1, 2, etc.).

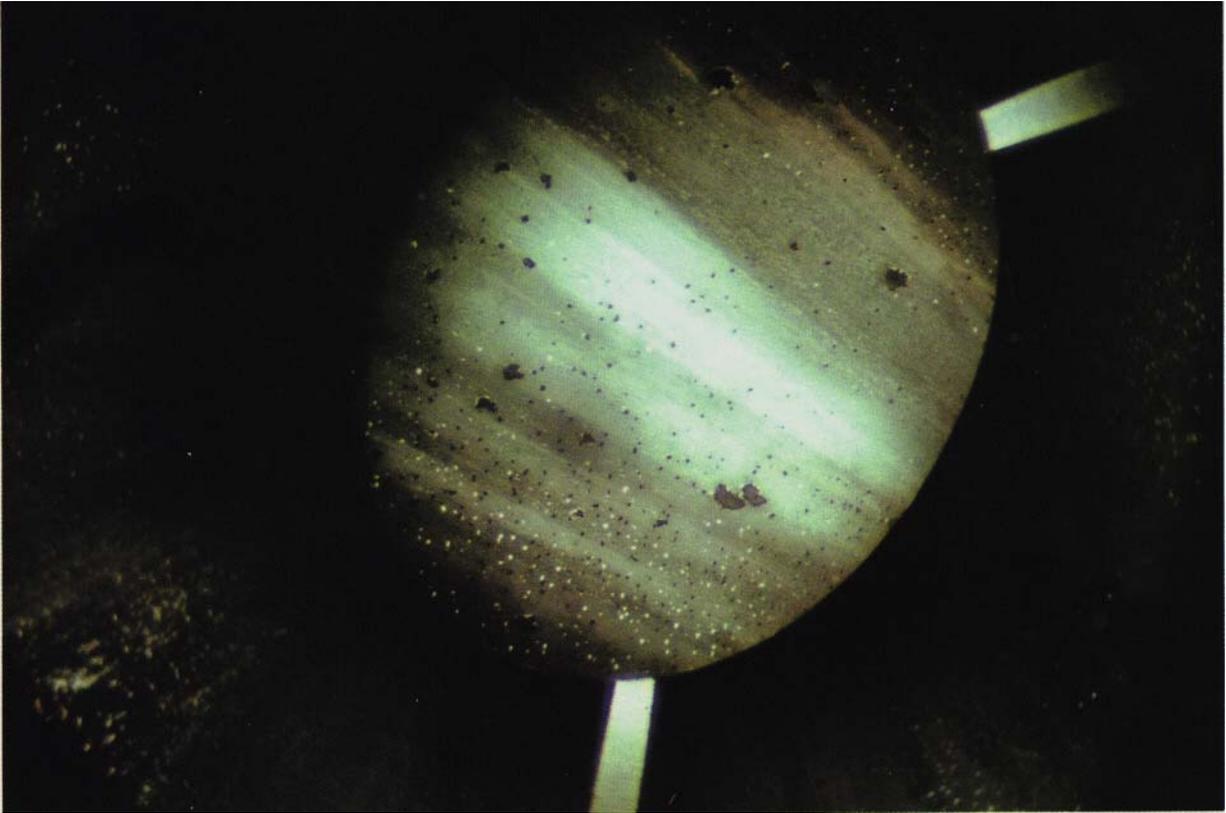


Figure B-5. 120MM M256 Tube: Light chrome pitting and chipping of bore.

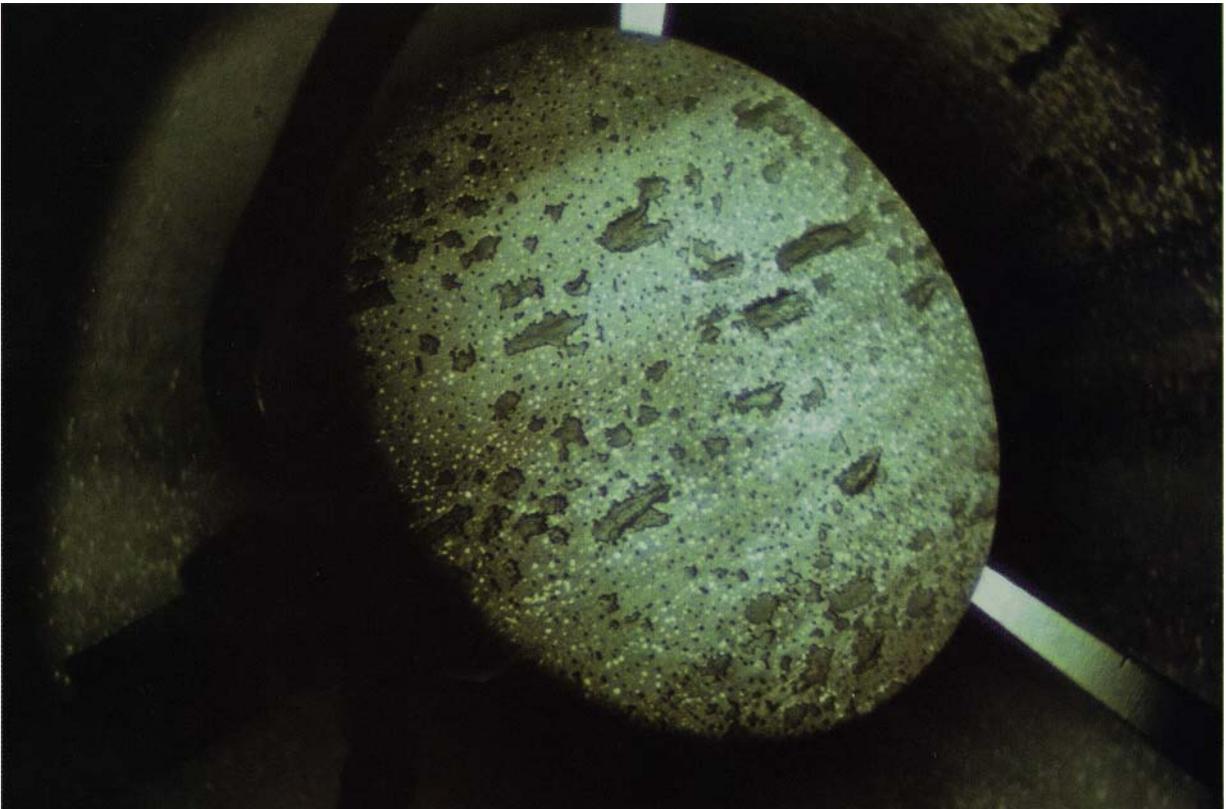


Figure B-6. 120MM M256 Tube: Heavy chrome chipping of bore with some light bore erosion.

B-7. VISUAL INSPECTION AND CRITERIA FOR VARIOUS TYPES OF DAMAGE.

a. **Pitting.**

(1) For evaluation of pitting, the interior of the cannon is divided into three zones (see Figure B-3a). The cannon tube shall be condemned if internal pits:

(a) In Zone 1 are over 0.030 inches deep.

(b) In Zone 2 are over 0.050 inches deep.

(c) Zone 3 is the bore. Ignore pits in the bore. The bore is evaluated for erosion; see para B-3 c (2).

(d) In Zones 1 and 2 cover 20 percent or more of the total area (see Figure B-3a).

(2) External pits resulting from corrosion on unpainted surfaces (tube outside diameter under recoil mechanism or bore evacuator sealing surfaces) exceed a depth of 0.020 inches or exceed 80 percent of total surface area (see Figure B-3) and evidence of blowby exists.

NOTE

If you see any evidence of gas leakage during firing, powder streaks or gas erosion, service bore evacuator in accordance with procedures found in Operator's Manual.

(3) Pits on painted non-sealing surfaces (under bore evacuator for instance) exceed a depth of 0.040 inches or exceed 80 percent of total area (see Figure B-4).

(4) Evidence of gas erosion in sealing area of bore evacuator O-rings.

b. **Cracks.** Condemn the cannon tube if:

(1) Cracks on internal surfaces are greater than 0.125 inches in length.

(2) Cracks on exterior surfaces are greater than 0.25 inches in length.

c. **Other Damage.** Condemn the cannon tube if muzzle end shows evidence of an out of round condition preventing proper boresighting and/or removal of the thermal shroud assembly for servicing and inspection.

B-8. DIFFICULT INSPECTION. See para 3-4.

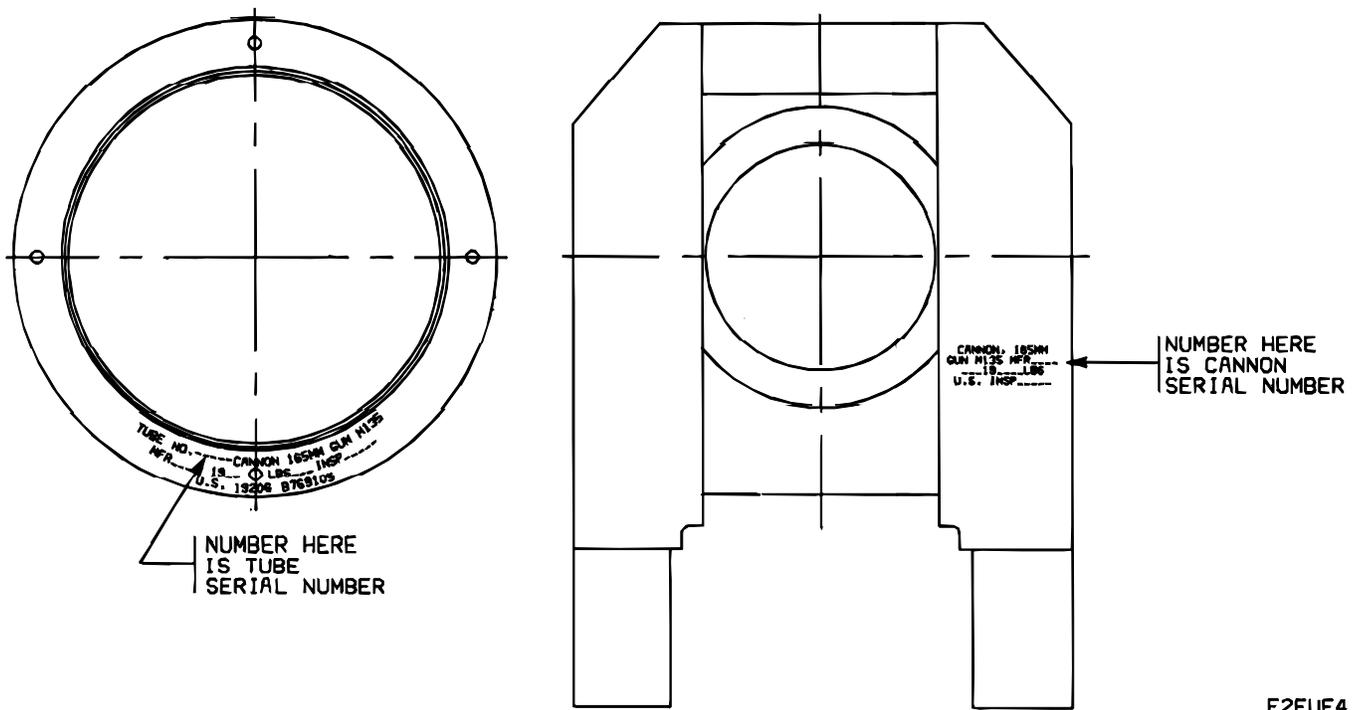
APPENDIX C DELETED

APPENDIX D

Cannon, 165MM Gun: M135

SECTION I. OPERATOR AND UNIT INSPECTION

D-1. EQUIPMENT IDENTIFICATION.



F2FUF4

Figure D-1. Location of tube and cannon serial number: 165MM gun, M135.

CAUTION

ENSURE EQUIPMENT RECORD FOLDER NUMBERS CORRESPOND WITH SERIAL NUMBERS ON WEAPON. DO NOT CONFUSE NUMBERS WHEN MAKING ENTRIES.

D-2. CLEANING PROCEDURES

Clean the chamber area and bore of the cannon tube using cleaning procedures detailed in para 2-2.

D-3. INSPECTION PROCEDURES AND CONDEMNATION CRITERIA.

a. **Records Inspection.** Follow inspection procedures detailed in para 2-3a.

b. **Frequency of Inspection.** In addition to Frequency of Inspection criteria found in para 2-3b, arrange for Direct Support to borescope the cannon tube at 250 EFC round intervals, or within 180 days prior to firing, whichever occurs first. The cannon tube shall be pullover gage inspected at 1000 EFC round intervals. All rounds fired in the M135 have an EFC of 1.0. It is not necessary to observe the time (180 days) and EFC round count intervals (250/1000) separately. Neither interval should be exceeded without inspection.

c. **Condemnation Information.** In addition to Condemnation Information found in paragraph 2-4, the M135 cannon tube is condemned on the basis of wear. Notify Direct Support when the following conditions are found:

(1) **Wear.** Wear results from hot propellant gas wash and the passage of projectiles over the bore surface. This results in a uniform wear pattern which is measured by Direct Support using a pullover gage.

(2) There is no limit to the number of retubings for the M135 breech mechanism.

(3) Check weapon record data card, DA Form 2408-4, for rounds fired. Refer to DA PAM 738-750 for procedure used in computing estimated remaining life. If you suspect that the number of rounds listed is incorrect, notify Direct Support.

SECTION II. DIRECT SUPPORT INSPECTION

D-4. **EQUIPMENT IDENTIFICATION.** See Figure D-1.

CAUTION

ENSURE EQUIPMENT RECORD FOLDER NUMBERS CORRESPOND WITH SERIAL NUMBERS ON WEAPON. DO NOT CONFUSE NUMBERS WHEN MAKING ENTRIES.

D-5. INSPECTION PROCEDURES AND CONDEMNATION CRITERIA.

a. **Records Inspection.** Follow inspection procedures detailed in para 3-3a.

b. **Missing or Incomplete Records.** Follow procedures detailed in para 3-3b, (1) and (2) only, and begin EFC round count to next inspection interval.

c. **Frequency of Inspection.** In addition to Frequency of Inspection criteria found in para 3-3c, pullover gage and borescope cannon tubes within 180 days prior to firing. Additionally, the interval between inspections shall not exceed 250 EFC rounds for borescope or 1000 EFC rounds for pullover gage. Information carried forward to each new DA Form 2408-4 is to include the last pullover gage measurement and borescope inspection.

d. **Condemnation Information.** In addition to Condemnation Information found in this appendix and para 3-3d, the M135 Cannon Tube is condemned on the basis of wear as follows:

(1) **Wear.** Condemn the cannon tube when pullover gage inspection shows wear in excess of 0.100 inches 89.75 inches from the muzzle end of the cannon tube. The original bore diameter of the M135 cannon tube is 6.500 inches.

(2) **Breech Mechanism.** There is no limit to the number of retubings for the M135 breech mechanism.

D-6. VISUAL INSPECTION AND CRITERIA FOR VARIOUS TYPES OF DAMAGE.

In addition to the criteria in para 3-3d, the following specific criteria apply to the 165mm, M135 cannon:

a. **Pitting.** There is no limit to the amount of acceptable pitting in the bore and chamber.

b. **Gas Path Erosion and Gas Check Seating Surface.** Inspect the gas check seating surface of the M135 cannon tube as follows:

(1) Remove all burrs with 320 grit or finer emery cloth or equivalent.

(2) Clean gas check seating surface of oil, grease, abrasive, or foreign material.

(3) To test for proper seating, lightly coat the surface of the obturator pad with red lead or prussian blue. Close and lock breech. Open breech and examine the imprint of the red lead or prussian blue on cannon tube gas check seating surface for the following conditions:

(a) Condemn the cannon tube if an erosion gas path crosses the gas check seating surface and is 0.003 inches in depth, or deeper.

(b) Condemn the cannon tube if the gas check seating surface is so damaged (chipped, spalled, indented, nicked, or pitted) such that it does not make full 360 degrees contact with the mating surface on the obturator pad, or its forward and aft mating surfaces contact less than 80 percent of the obturator pad outer and inner surfaces.

(4) Following inspection, remove red lead or prussian blue from obturator pad and gas check seating surface by wiping with a clean non-abrasive cloth.

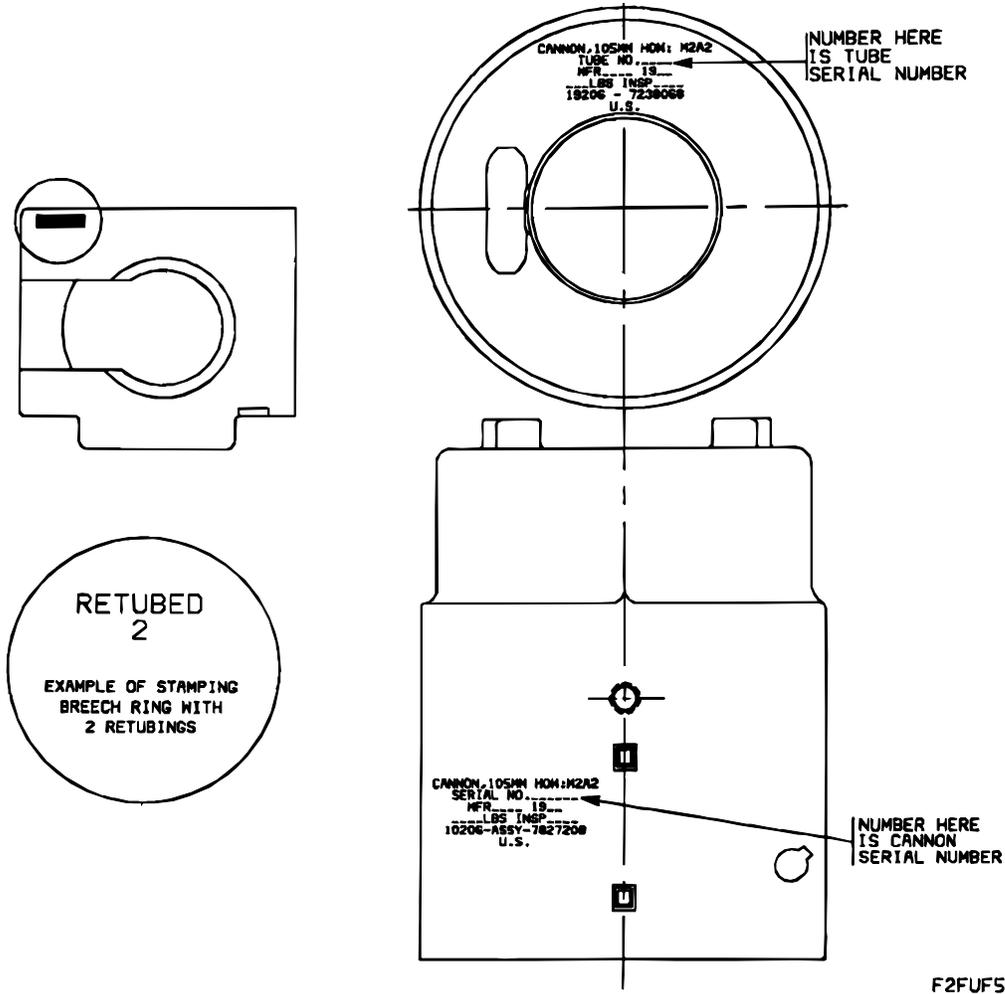
D-7. DIFFICULT INSPECTION. See para 3-4.

APPENDIX E

Cannon, 105MM Howitzer: M2A2

SECTION I. OPERATOR AND UNIT INSPECTION

E-1. EQUIPMENT IDENTIFICATION.



*Figure E-1. Tube and cannon serial number:
105MM howitzer, M2A2.*

CAUTION

**ENSURE EQUIPMENT RECORD FOLDER NUMBERS CORRESPOND WITH SERIAL
NUMBERS ON WEAPON. DO NOT CONFUSE NUMBERS WHEN MAKING ENTRIES.**

E-2. CLEANING PROCEDURES.

Clean the chamber area and bore of the cannon tube using cleaning procedures detailed in para 2-2.

E-3. INSPECTION PROCEDURES AND CONDEMNATION CRITERIA.

a. **Records Inspection.** Follow inspection procedures detailed in para 2-3a.

b. **Frequency of Inspection.** In addition to Frequency of Inspection criteria found in para 2-3b, arrange for Direct Support to borescope the cannon tube at 500 EFC round intervals, or within 180 days prior to firing, whichever occurs first. It is not necessary to observe the time (180 days) and EFC round count intervals (500) separately. Neither interval should be exceeded without inspection.

c. **Condemnation Information.** In addition to Condemnation Information found in para 2-4, the M2A2 cannon tube is condemned on the basis of EFC round count. Notify Direct Support when the following conditions are found:

(1) **Round Count.** The safe service life of the M2A2 cannon tube is 7500 EFC rounds. Have Direct Support condemn the cannon tube when 7500 EFC rounds have been fired. See Table E-1 for specific ammunition EFC factors.

(2) **Breech Mechanism.** The breech ring may be retubed a maximum of two times (two plus original tube). After the third retubing the breech mechanism and its component parts shall be condemned. It is important that the components of each breech mechanism assembly be kept together during maintenance and inspection and not be interchanged with other assemblies.

d. Check weapon record data card, DA Form 2408-4, for rounds fired. Refer to DA PAM 738-750 for procedure used in computing estimated remaining life. If you suspect that the number of rounds listed is incorrect, notify Direct Support. Where the number of rounds fired is recorded but the ammunition model number is missing, assume 25 percent of fired rounds have an EFC of 0.25 and 75 percent of fired rounds have an EFC of 1.0.

TABLE E-1. AMMUNITION EFC VALUES FOR USE WITH M2A2 CANNON

<u>CHARGE</u>	<u>EFC</u>
Zone 7	1.00
Zones 1 - 6	0.25

E-4. VISUAL INSPECTION AND CRITERIA FOR VARIOUS TYPES OF DAMAGE.

In addition to the criteria in Chapter 2, the following specific criteria apply to the 105mm M2A2 cannon:

Pitting. Notify Direct Support if:

(1) Pits on external surfaces exceed a depth of 0.015 inches or exceed 20 percent of total surface area.

(2) Pits on painted non-bearing surfaces exceed 20 percent of total surface area.

(3) Pits on chamber surfaces exceed 20 percent of entire chamber surface or are over 0.010 inches in depth. Ignore pitting in bore.

SECTION II. DIRECT SUPPORT INSPECTION

E-5. EQUIPMENT IDENTIFICATION. See Figure E-1.



ENSURE EQUIPMENT RECORD FOLDER NUMBERS CORRESPOND WITH SERIAL NUMBERS ON WEAPON. DO NOT CONFUSE NUMBERS WHEN MAKING ENTRIES.

E-6. INSPECTION PROCEDURES AND CONDEMNATION CRITERIA.

a. **Records Inspection.** Follow inspection procedures detailed in para 3-3a.

b. **Missing or Incomplete Records.** Follow procedures detailed in para 3-3b and E-8.

c. **Frequency of Inspection.** In addition to Frequency of Inspection criteria found in para 3-3c, borescope cannon tubes within 180 days prior to firing. Additionally, the interval between inspections shall not exceed 500 EFC rounds. Information carried forward to each new DA Form 2408-4 is to include the EFC Rounds Remaining Life at the last borescope inspection.

d. **Condemnation Information.** In addition to Condemnation Information found in this appendix and para 3-3d, the M2A2 cannon tube is condemned on the basis of EFC round count as follows:

(1) **Round Count.** The safe service life of the M2A2 cannon tube is 7500 EFC rounds. Condemn the cannon tube when 7500 EFC rounds have been fired. See Table E-1 for specific ammunition EFC factors.

(2) **Breech Mechanism.** The breech ring may be retubed a maximum of two times (two plus original tube). After the second retubing the breech mechanism and its component parts shall be condemned and replaced. See Table E-1 for specific ammunition EFC information. It is important that the components of each breech mechanism assembly be kept together during maintenance and inspection and not be interchanged with other assemblies.

E-7. VISUAL INSPECTION AND CRITERIA FOR VARIOUS TYPES OF DAMAGE.

In addition to the criteria in para 3-3d, the following specific criteria apply to the 105mm M2A2 cannon:

Pitting. Condemn the cannon tube if:

(1) Pits on external surfaces exceed a depth of 0.015 inches or exceed 20 percent of total surface area.

(2) Pits on painted non-bearing surfaces exceed 20 percent of total surface area.

(3) Pits on chamber surfaces exceed 20 percent of entire chamber surface or are over 0.010 inches in depth. Ignore pitting in bore.

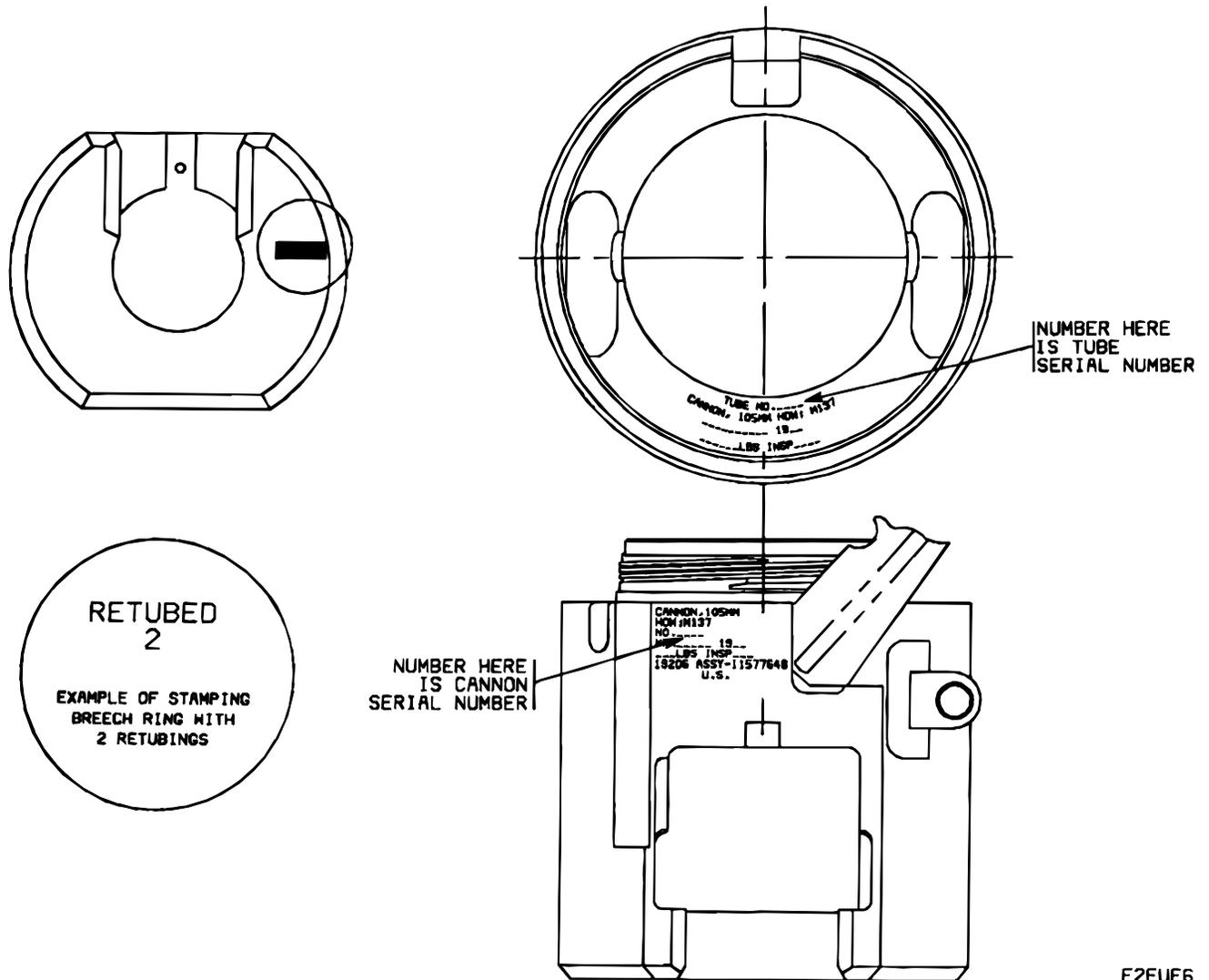
■ E-8. DIFFICULT INSPECTION. See para 3-4.

APPENDIX F

Cannon, 105MM Howitzer: M137/M137A1

SECTION I. OPERATOR AND UNIT INSPECTION

F-1. EQUIPMENT IDENTIFICATION.



F2FUF6

Figure F-1. Location of tube and cannon serial number:
105MM howitzer, M137/M137A1.

CAUTION

ENSURE EQUIPMENT RECORD FOLDER NUMBERS CORRESPOND WITH SERIAL NUMBERS ON WEAPON. DO NOT CONFUSE NUMBERS WHEN MAKING ENTRIES.

F-2. CLEANING PROCEDURES.

Clean the chamber and bore of the cannon tube using cleaning procedures detailed in para 2-2.

F-3. INSPECTION PROCEDURES AND CONDEMNATION CRITERIA.

a. **Records Inspection.** Follow inspection procedures detailed in para 2-3a.

b. **Frequency of Inspection.** In addition to Frequency of Inspection criteria found in para 2-3b, arrange for Direct Support to borescope and the cannon tube at 500 EFC round intervals, or within 180 days prior to firing, whichever occurs first. It is not necessary to observe the time (180 days) and EFC round count intervals (500) separately. Neither interval should be exceeded without inspection.

c. **Condemnation Information.** In addition to Condemnation Information found in para 2-4, the M137/M137A1 cannon tube is condemned on the basis of EFC round count. Notify Direct Support when the following conditions are found:

(1) **Round Count.** The safe service life of the M137/M137A1 cannon tube is 5000 EFC rounds. Have Direct Support condemn the cannon tube when 5000 EFC rounds have been fired. If total cumulative round count (not EFC) is equal to, or exceeds, 10,000 rounds, turn in cannon tube for inspection at Depot level. Service life extensions of 2000 cumulative rounds (not EFC) may be given by Depot level. See Table F-1 for specific ammunition EFC factors.

(2) **Breech Mechanism.** The breech ring may be retubed a maximum of three times (three plus original tube). After the third retubing the breech mechanism and its component parts shall be condemned. It is important that the components of each breech mechanism assembly be kept together during maintenance and inspection and not be interchanged with other assemblies.

(3) Check weapon record data card, DA Form 2408-4, for rounds fired. Refer to DA PAM 738-750 for procedure used in computing estimated remaining life. If you suspect that the number of rounds listed is incorrect, notify Direct Support. Where the number of rounds fired is recorded but the ammunition model number is missing, assume 25 percent of fired rounds have an EFC of 0.10 and 75 percent of fired rounds have an EFC of 1.0.

TABLE F-1. AMMUNITION EFC VALUES FOR USE WITH M137/M137A1 CANNON

<u>CHARGE</u>	<u>EFC</u>
M546/Zone 7	1.00
Zones 1-6	0.10

F-4. VISUAL INSPECTION AND CRITERIA FOR VARIOUS TYPES OF DAMAGE.

In addition to the criteria in Chapter 2, the following specific criteria apply to the 105mm M137/M137A1 cannon:

Pitting. Notify Direct Support if:

(1) Pits on external surfaces exceed a depth of 0.015 inches or exceed 20 percent of total surface area.

(2) Pits on painted non-bearing surfaces exceed 20 percent of total surface area.

(3) Pits on chamber surfaces exceed 20 percent of entire chamber surface or are over 0.010 inches in depth. Ignore pitting in bore.

SECTION II. DIRECT SUPPORT INSPECTION

F-5. EQUIPMENT IDENTIFICATION. See Figure F-1.



ENSURE EQUIPMENT RECORD FOLDER NUMBERS CORRESPOND WITH SERIAL NUMBERS ON WEAPON. DO NOT CONFUSE NUMBERS WHEN MAKING ENTRIES.

F-6. INSPECTION PROCEDURES AND CONDEMNATION CRITERIA.

a. **Records Inspection.** Follow inspection procedures detailed in para 3-3a.

b. **Missing or Incomplete Records.** Follow procedures detailed in para 3-3b and F-8.

c. **Frequency of Inspection.** In addition to Frequency of Inspection criteria found in para 3-3c, borescope cannon tubes within 180 days prior to firing. Additionally, the interval between inspections shall not exceed 500 EFC rounds. Information carried forward to each new DA Form 2408-4 is to include the EFC Rounds Remaining Life at the last borescope inspection.

d. **Condemnation Information.** In addition to Condemnation Information found in this appendix and para 3-3d, the M137/M137A1 cannon tube is condemned on the basis of EFC round count as follows:

(1) **Round Count.** The safe service life of the M137/M137A1 cannon tube is 5000 EFC rounds. Condemn the cannon tube when 5000 EFC rounds have been fired. See Table F-1 for specific ammunition EFC factors. If total cumulative round count (not EFC) is equal to, or exceeds, 10,000 rounds, turn in cannon tube for inspection at Depot level. Service life extensions of 2000 cumulative rounds (not EFC) may be given by Depot level.

(2) **Breech Mechanism.** The breech ring may be retubed a maximum of three times (three plus original tube). After the third retubing the breech mechanism and its component parts shall be condemned and replaced. See Table F-1 for specific ammunition EFC information. It is important that the components of each breech mechanism assembly be kept together during maintenance and inspection and not be interchanged with other assemblies.

F-7. VISUAL INSPECTION AND CRITERIA FOR VARIOUS TYPES OF DAMAGE.

In addition to the criteria in Chapter 3, the following specific criteria apply to the 105mm M137/M137A1 cannon:

Pitting. Condemn the cannon tube if:

(1) Pits on external surfaces exceed a depth of 0.015 inches or exceed 20 percent of total surface area.

(2) Pits on painted non-bearing surfaces exceed 20 percent of total surface area.

(3) Pits on chamber surfaces exceed 20 percent of entire chamber surface or are over 0.010 inches in depth. Ignore pitting in bore.

F-8. DIFFICULT INSPECTION. See para 3-4.

■ All data deleted from page F-4.

APPENDIX G

Cannon, 105MM Howitzer: M20

SECTION I. OPERATOR AND UNIT INSPECTION

G-1. EQUIPMENT IDENTIFICATION.

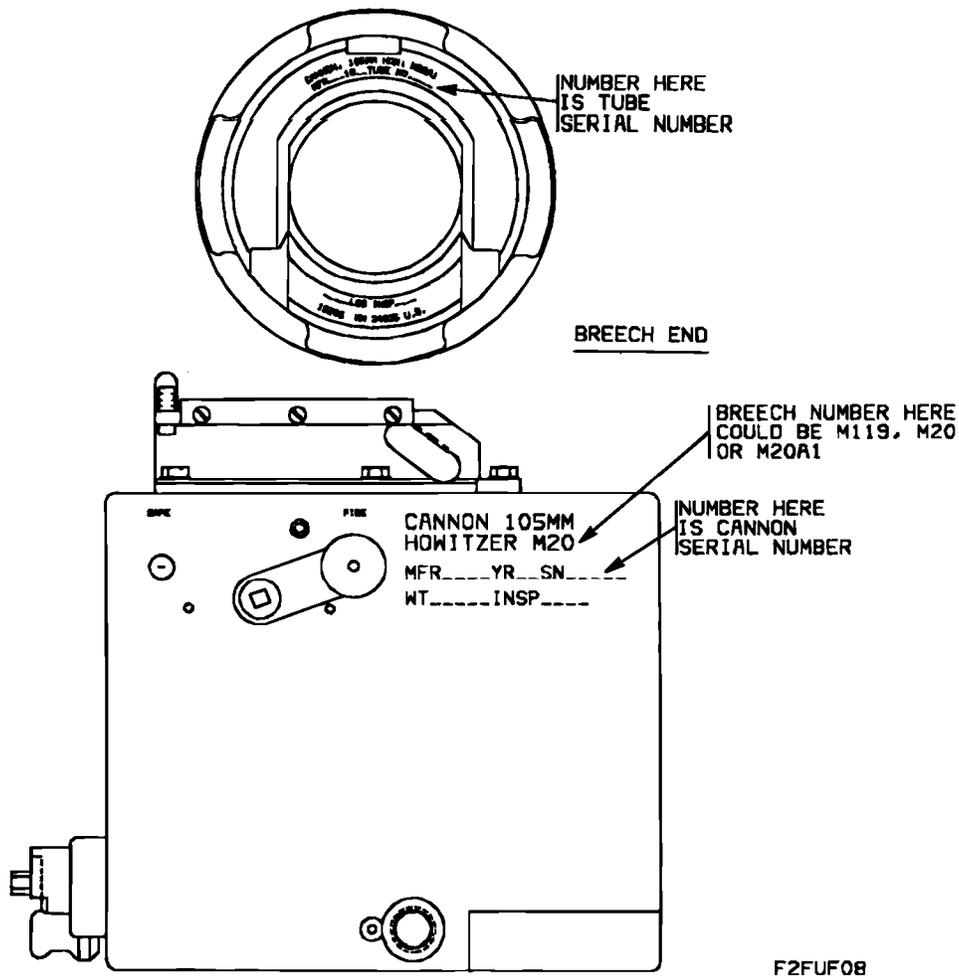


Figure G-1. Location of tube and cannon serial number: cannon, 105MM howitzer, M20.

CAUTION

ENSURE EQUIPMENT RECORD FOLDER NUMBERS CORRESPOND WITH SERIAL NUMBERS ON WEAPON. DO NOT CONFUSE NUMBERS WHEN MAKING ENTRIES.

G-2. CLEANING PROCEDURES.

Clean the chamber area and bore of the cannon tube using cleaning procedures detailed in para 2-2.

G-3. INSPECTION PROCEDURES AND CONDEMNATION CRITERIA.

a. **Records Inspection.** Follow inspection procedures detailed in para 2-3a.

b. **Frequency of Inspection.** In addition to Frequency of Inspection criteria found in para 2-3b, arrange for Direct Support to borescope the cannon tube at 500 EFC round intervals, or within 180 days prior to firing, whichever occurs first. It is not necessary to observe the time (180 days) and EFC round count intervals (500) separately. Neither interval should be exceeded without inspection.

c. **Condemnation Information.** In addition to Condemnation Information found in para 2-4, the M20 cannon tube is condemned on the basis of EFC round count. Notify Direct Support when the following conditions are found:

(1) **Round Count.** The safe service life of the M20 cannon tube, muzzle brake, and breech mechanism is 6500 EFC rounds. Have Direct Support condemn the cannon tube when 6500 EFC rounds have been fired. See Table G-1 for specific ammunition EFC factors.

(2) Check weapon record data card, DA Form 2408-4, for rounds fired. Refer to DA PAM 738-750 for procedure used in computing estimated remaining life. If you suspect that the number of rounds listed is incorrect, notify Direct Support. Where the number of rounds fired is recorded but the ammunition model number is missing, assume 25 percent of fired rounds have an EFC of 0.40 and 75 percent of fired rounds have an EFC of 1.0.

TABLE G-1. AMMUNITION EFC VALUES FOR USE WITH M20 CANNON

<u>CHARGE</u>	<u>EFC</u>
Zone 8	1.00
Zone 7	0.40
Zones 1 - 6	0.10

G-4. VISUAL INSPECTION AND CRITERIA FOR VARIOUS TYPES OF DAMAGE.

In addition to criteria specified in Chapter 2, the following specific criteria apply to the 105mm M20 cannon:

a. **Cracks.** Notify Direct Support if cracks of 0.5 inches or longer are found on the muzzle brake.

b. **Pitting.** Notify Direct Support if:

(1) External pitting exceeds 0.015 inches in depth or exceeds 20 percent of total surface area.

(2) Pitting in the chamber exceeds 0.010 inches in depth. (Ignore the amount of pitting in the chamber.) Ignore pitting in bore.

SECTION II. DIRECT SUPPORT INSPECTION

G-5. EQUIPMENT IDENTIFICATION. See Figure G-1.



ENSURE EQUIPMENT RECORD FOLDER NUMBERS CORRESPOND WITH SERIAL NUMBERS ON WEAPON. DO NOT CONFUSE NUMBERS WHEN MAKING ENTRIES.

G-6. INSPECTION PROCEDURES AND CONDEMNATION CRITERIA.

- a. **Records Inspection.** Follow inspection procedures detailed in para 3-3a.
- b. **Missing or Incomplete Records.** Follow procedures detailed in para 3-3b.
- c. **Frequency of Inspection.** In addition to Frequency of Inspection criteria found in para 3-3c, borescope cannon tubes within 180 days prior to firing. Additionally, the interval between inspections (borescope) shall not exceed 500 EFC rounds. Information carried forward to each new DA Form 2408-4 is to include the EFC Rounds Remaining Life at the last borescope inspection.
- d. **Condemnation Information.** In addition to information found in para 3-3d, the M20 Cannon Tube is condemned on the round count as follows:
 - (1) Condemn the cannon tube, muzzle brake, and breech mechanism when 6500 EFC rounds have been fired.
 - (2) **Round Count.** The safe service life of the M20 cannon tube, muzzle brake, and breech mechanism is 6500 EFC rounds. Condemn the cannon tube and breech mechanism when 6500 EFC rounds have been fired. See Table G-1 for specific ammunition EFC factors.

G-7. VISUAL INSPECTION AND CRITERIA FOR VARIOUS TYPES OF DAMAGE.

In addition to the criteria in Chapter 3, the following specific criteria apply to the 105mm M20 cannon:

- a. **Cracks.** Condemn the muzzle brake if cracks of 0.5 inches or longer are found.
- b. **Pitting.** Condemn the cannon tube if:
 - (1) External pitting exceeds 0.015 inches in depth or exceeds 20 percent of total surface area.
 - (2) Pitting in the chamber exceeds 0.010 inches in depth. (Ignore the amount of pitting in the chamber.) Ignore pitting in bore.

G-8. DIFFICULT INSPECTION.

Damage which is difficult to inspect can be measured by using impression castings of outside diameters and powder chamber areas as follows:

a. Clean tube area to be measured.

b. Prepare mold material.

(1) Build dam around area with putty.

(2) Add VEL-MIX-STONE (NSN 6520-00-557-7015) to water, using four parts powder to one part water. Mix for one minute.

c. Add release agent to area prior to pouring mixture into dam.

d. Casting will harden in 30 to 45 minutes; remove casting by prying from tube.

e. Measure height of defect, using comparator or height gage.

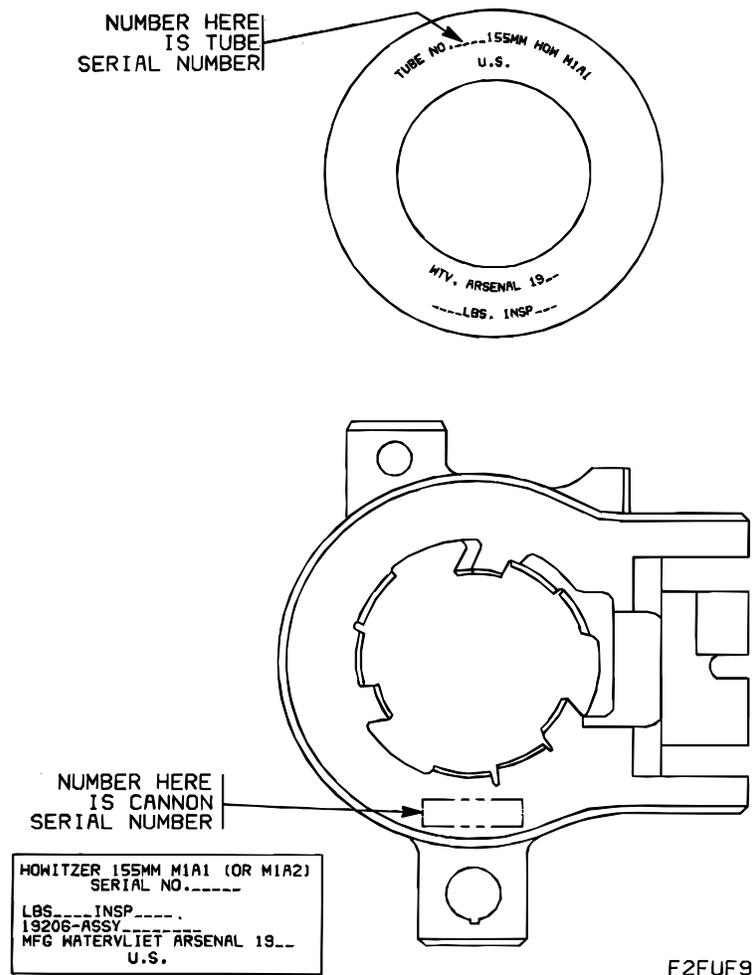
f. Clean residue from cannon tube surface.

APPENDIX H

Cannon, 155MM Howitzer, M1A1/M1A2

SECTION I. OPERATOR AND UNIT INSPECTION

H-1. EQUIPMENT IDENTIFICATION.



**Figure H-1. Tube and cannon serial number:
155-MM howitzer, M1A1/M1A2.**

CAUTION

**ENSURE EQUIPMENT RECORD FOLDER NUMBERS CORRESPOND WITH SERIAL
NUMBERS ON WEAPON. DO NOT CONFUSE NUMBERS WHEN MAKING ENTRIES.**

H-2. CLEANING PROCEDURES.

Clean the chamber area and bore of the cannon tube using cleaning procedures detailed in para 2-2.

H-3. INSPECTION PROCEDURES AND CONDEMNATION CRITERIA.

a. **Records Inspection.** Follow inspection procedures detailed in para 2-3a.

b. **Frequency of Inspection.** In addition to Frequency of Inspection criteria found in para 2-3b, arrange for Direct Support to borescope and pullover gage the cannon tube at 2500 EFC round intervals, or within 180 days prior to firing, whichever occurs first. It is not necessary to observe the time (180 days) and EFC round count intervals (2500) separately. Neither interval should be exceeded without inspection.

c. **Condemnation Information.** In addition to Condemnation Information found in para 2-4, the M1A1/M1A2 cannon tube is condemned on the basis of EFC round count. Notify Direct Support when the following conditions are found:

(1) **Round Count.** The safe service life of the M1A1/M1A2 cannon tube is 7500 EFC rounds. Have Direct Support condemn the cannon tube when 7500 EFC rounds have been fired. See Table H-1 for specific ammunition EFC factors.

(2) **Breech Mechanism.** The breech ring is condemned at the same time as the cannon tube; no retubings are permitted. It is important that the component parts of each breech mechanism assembly be kept together during maintenance and inspection and not be interchanged with other assemblies.

(3) Check weapon record data card, DA Form 2408-4, for rounds fired. Refer to DA PAM 738-750 for procedure used in computing estimated remaining life. If you suspect that the number of rounds listed is incorrect, notify Direct Support. Where the number of rounds fired is recorded but the ammunition model number is missing, assume 25 percent of fired rounds have an EFC of 0.25 and 75 percent of fired rounds have an EFC of 1.0.

TABLE H-1. AMMUNITION EFC VALUES FOR USE WITH M1A1/M1A2 CANNON

<u>CHARGE</u>	<u>ZONE</u>	<u>COLOR</u>	<u>EFC</u>
M4A2	7	White	1.00
M4A2	3-6	White	0.25
M3A1	1-5	White	0.25

H-4. VISUAL INSPECTION AND CRITERIA FOR VARIOUS TYPES OF DAMAGE.

In addition to the criteria in Chapter 2, the following specific criteria apply to the 155mm M1A1/M1A2 Cannon:

Land Damage. A unique pattern of damage to rifling lands, shown in Figure H-2, is often found in the area up to 10 inches forward of the origin of rifling. This type of damage is acceptable.



Figure H-2. Damage to lands up to 10 inches forward of origin of rifling.

SECTION II. DIRECT SUPPORT INSPECTION

H-5. **EQUIPMENT IDENTIFICATION.** See Figure H-1.



ENSURE EQUIPMENT RECORD FOLDER NUMBERS CORRESPOND WITH SERIAL NUMBERS ON WEAPON. DO NOT CONFUSE NUMBERS WHEN MAKING ENTRIES.

H-6. **INSPECTION PROCEDURES AND CONDEMNATION CRITERIA.**

a. **Records Inspection.** Follow inspection procedures detailed in para 3-3a.

b. **Missing or Incomplete Records.** Follow procedures detailed in para 3-3b.

c. **Frequency of Inspection.** In addition to Frequency of Inspection criteria found in para 3-3c, pullover gage and borescope cannon tubes within 180 days prior to firing. It is not necessary to observe the time (180 days) and EFC round counts (2500) separately. Neither interval should be exceeded without inspection. Additionally, the interval between inspections shall not exceed 2500 EFC rounds.

d. **Condemnation Information.** In addition to condemnation information found in this appendix and para 3-3d, the M1A1/M1A2 cannon tube is condemned on the basis of EFC round count as follows:

(1) **Round Count.** The safe service life of the M1A1/M1A2 cannon tube bore evacuator and muzzle brake is 7500 EFC rounds. Condemn the cannon tube when 7500 EFC rounds have been fired. See Table H-1 for specific ammunition EFC information.

(2) **Breech Mechanism.** The breech ring is condemned at the same time as the cannon tube; no retubings are permitted. It is important that the component parts of each breech mechanism assembly be kept together during maintenance and inspection and not be interchanged with other assemblies.

H-7. **VISUAL INSPECTION AND CRITERIA FOR VARIOUS TYPES OF DAMAGE.**

In addition to the criteria in Chapter 3, the following specific criteria apply to the 155mm M1A1/M1A2 cannon:

(1) **Land Damage.** A unique pattern of damage to rifling lands, shown in Figure H-2, is often found in the area up to 10 inches forward of the origin of rifling. This type of damage is acceptable.

(2) **Gas Path Erosion and Gas Check Seating Surface.** Inspect the gas check seating surface of the M1A1/M1A2 cannon tube as follows:

(a) Remove all burrs with a medium India stone or equivalent (240 grit or finer).

(b) Clean gas check seating surface of oil, grease, abrasive, or foreign material.

(c) To test for proper seating, lightly coat the surface of the split rings with red lead or prussian blue. Close and lock breech. Open breech and examine the imprint of the red lead or prussian blue on tube gas check seating surface for the following conditions:

1 Condemn the cannon tube if an erosion gas path crosses the obturator interace and is 0.003 inches in depth, or deeper (see Figures H-3, H-4, and H-5).

2 Condemn the cannon tube if the gas check seating surface is so damaged (chipped, spalled, indented, nicked, or pitted) such that it does not make full 360 degrees contact with the mating surface

on the split rings, or its forward and aft mating surfaces contact less than 80 percent of the split rings forward and aft surfaces.

(d) Following inspection, remove red lead or prussian blue from split ring and gas check seating surface by wiping with a clean non-abrasive cloth.

H-8. DIFFICULT INSPECTION. See para 3-4.



Figure H-3. Groove cut by gas wash across gas check seat: CONDEMN.

NOTE

M185 Cannon spindle and split ring are used for illustration purposes only.



***Figure H-4. Gas wash across one obturator split ring.
CAREFULLY INSPECT GAS CHECK SEAT.***



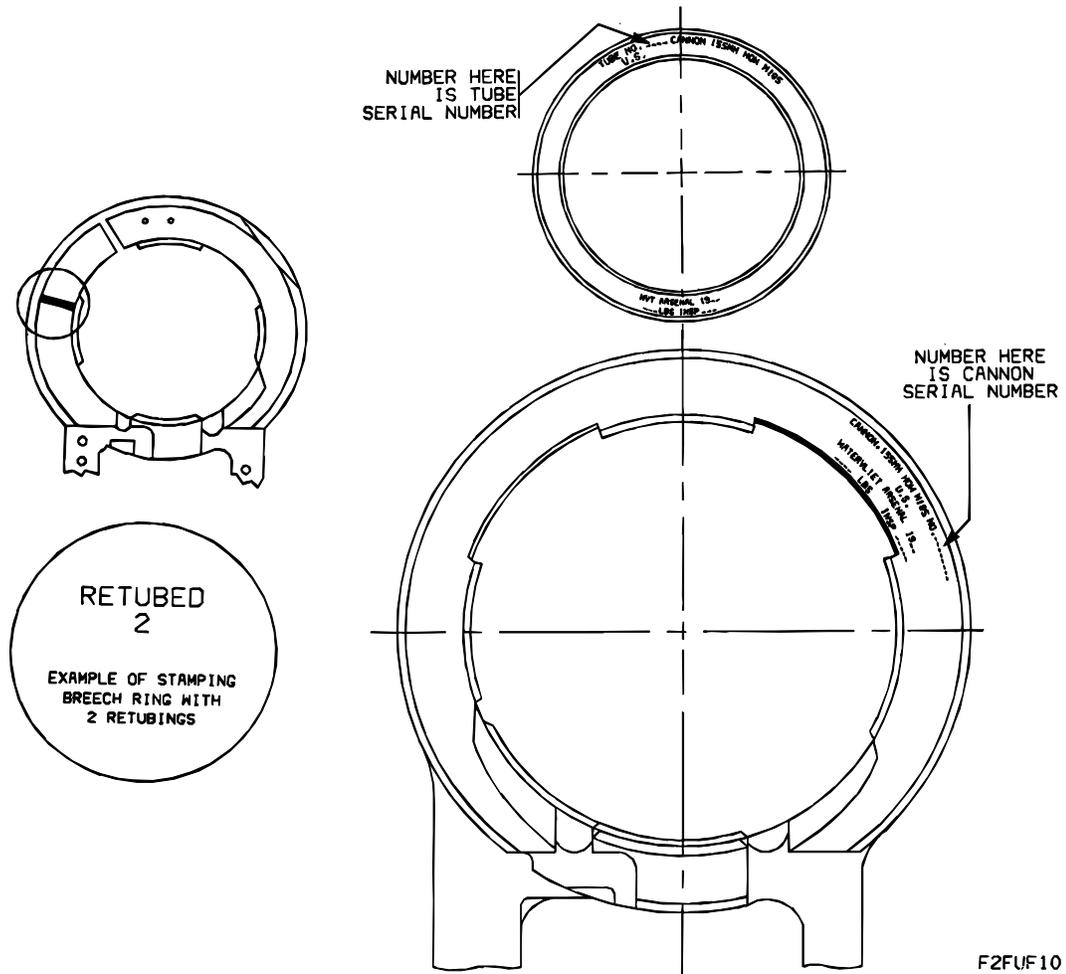
***Figure H-5. Gas wash across obturator split rings.
CAREFULLY INSPECT GAS SEAT.***

APPENDIX I

Cannon, 155MM Howitzer: M185

SECTION I. OPERATOR AND UNIT INSPECTION

I-1. EQUIPMENT IDENTIFICATION.



*Figure I-1. Location of tube and cannon serial number:
155MM howitzer, M185.*

CAUTION

ENSURE EQUIPMENT RECORD FOLDER NUMBERS CORRESPOND WITH SERIAL NUMBERS ON WEAPON. DO NOT CONFUSE NUMBERS WHEN MAKING ENTRIES.

I-2. CLEANING PROCEDURES.

Clean the chamber area and bore of the cannon tube using cleaning procedures detailed in para 2-2.

I-3. INSPECTION PROCEDURES AND CONDEMNATION CRITERIA.

a. **Records Inspection.** Follow inspection procedures detailed in para 2-3a.

b. **Frequency of Inspection.** In addition to Frequency of Inspection criteria found in para 2-3b, arrange for Direct Support to borescope and pullover gage the cannon tube at 1000 EFC round intervals, or within 180 days prior to firing, whichever occurs first. It is not necessary to observe the time (180 days) and EFC round count intervals (1000) separately. Neither interval should be exceeded without inspection. After 4000 EFC rounds, the interval of borescope and pullover gage inspection increases to 500 EFC rounds.

c. **Condemnation Information.** In addition to Condemnation Information found in para 2-4, the M185 cannon tube is condemned under a dual criteria of EFC round count and wear. Notify Direct Support when the following conditions are found:

(1) **Round Count.** The safe service life of the M185 cannon tube is 6375 EFC rounds. Have Direct Support condemn the cannon tube when 6375 EFC rounds have been fired. See Table I-1 for specific ammunition EFC factors.

(2) **Wear.** Wear results from hot propellant gas wash and the passage of projectiles over the bore surface. This results in a uniform wear pattern which is measured by Direct Support using a pullover gage.

(3) **Breech Mechanism.** The breech ring may be retubed a maximum of two times (two plus original tube). After the second retubing the breech mechanism and its component parts shall be condemned. It is important that the component parts of each breech mechanism assembly be kept together during maintenance and inspection and not be interchanged with other assemblies.

(4) Check weapon record data card, DA Form 2408-4 for rounds fired. Refer to DA PAM 738-750 for procedure used in computing estimated remaining life. If you suspect that the number of rounds listed is incorrect, notify Direct Support. Where the number of rounds fired is recorded but the ammunition model number is missing, assume 25 percent of fired rounds have an EFC of 0.75 and 75 percent of fired rounds have an EFC of 1.0.

TABLE I-1. AMMUNITION EFC VALUES FOR USE WITH M185 CANNON

<u>CHARGE</u>	<u>ZONE</u>	<u>COLOR</u>	<u>EFC</u>
M119A1	8	White	1.00
M119A2	7	Red	0.75
M4A2	7	White	0.75
M4A2	3-6	White	0.25
M4A2	3-6	White	0.25
M3A1	1-5	Green	0.25

I-4. VISUAL INSPECTION AND CRITERIA FOR VARIOUS TYPES OF DAMAGE.

In addition to criteria specified in Chapter 2, the following specific criteria apply to the 155mm M185 Cannon:

- a. **Cracks.** Notify Direct Support if cracks of 1 inch or longer are found on the muzzle brake.
- b. **Land Damage.** A unique pattern of damage to rifling lands, shown in Figure I-2, is often found in the area up to 10 inches forward of the origin of rifling. This type of damage is acceptable.



Figure I-2. Damage to lands up to 10 inches forward of origin of rifling.

SECTION II. DIRECT SUPPORT INSPECTION

I-5. **EQUIPMENT IDENTIFICATION.** See Figure I-1.



ENSURE EQUIPMENT RECORD FOLDER NUMBERS CORRESPOND WITH SERIAL NUMBERS ON WEAPON. DO NOT CONFUSE NUMBERS WHEN MAKING ENTRIES.

I-6. **INSPECTION PROCEDURES AND CONDEMNATION CRITERIA.**

a. **Records Inspection.** Follow inspection procedures detailed in para 3-3a.

b. **Missing or Incomplete Records.** Follow procedures detailed in para 3-3b.

c. **Frequency of Inspection.** In addition to Frequency of Inspection criteria found in para 3-3c, pullover gage and borescope cannon tubes within 180 days prior to firing. It is not necessary to observe the time (180 days) and EFC round count intervals (1000) separately. Neither interval should be exceeded without inspection. Additionally, the interval between inspections (pullover gage and borescope) shall not exceed 1000 EFC rounds. After 4000 EFC rounds the borescope and pullover gage inspection interval increases to every 500 EFC rounds. Information carried forward to each new DA Form 2408-4 is to include the EFC Rounds Remaining Life at the last pullover gage measurement and borescope inspection.

d. **Condemnation Information.** In addition to Condemnation Information found in this appendix and para 3-3d, the M185 cannon tube is condemned under a dual criteria of EFC round count and wear, whichever occurs first, as follows:

(1) **Round Count.** The safe service life of the M185 cannon tube and muzzle brake is 6375 EFC rounds. Condemn the cannon tube and muzzle brake when 6375 EFC rounds have been fired. See Table I-1 for specific ammunition EFC factors.

(2) **Wear.** Condemn the cannon tube when pullover gage inspection shows wear in excess of 0.150 inches 40 inches forward of the breech face. The original bore diameter of the M185 cannon tube is 6.100 inches.

(3) **Breech Mechanism.** The breech ring may be retubed a maximum of two times (two plus original tube). After the second retubing the breech mechanism and its component parts shall be condemned. It is important that the component parts of each breech mechanism assembly be kept together during maintenance and inspection and not be interchanged with other assemblies.

(4) **Bore Evacuator Region.**

<u>Tube Area</u>	<u>Criteria</u>	<u>Method</u>
Evacuator Holes	No pitting allowed	Visual
Evacuator Hole Chamfer	0.010 in. maximum pit depth	Mold material
Tube Surfaces	0.100 in. maximum pit depth (bearing and non-bearing surface)	Mold material

I-7. **VISUAL INSPECTION AND CRITERIA FOR VARIOUS TYPES OF DAMAGE.**

In addition to the criteria in Chapter 2, the following specific criteria apply to the 155mm M185 cannon:

a. **Cracks.** Condemn the muzzle brake if cracks of 1 inch or longer are found.

b. **Land Damage.** A unique pattern of damage to rifling lands, shown in Figure I-2, is often found in the area up to 10 inches forward of the origin of rifling. This type of damage is acceptable.

c. **Gas Path Erosion and Gas Check Seating Surface.** Inspect the gas check seating surface of the M185 cannon tube as follows:

(1) Remove all burrs with a medium India stone or equivalent (240 grit or finer).

(2) Clean gas check seating surface of oil, grease, abrasive, or foreign material.

(3) To test for proper seating, lightly coat the surface of the split rings with red lead or prussian blue. Close and lock breech. Open breech and examine the imprint of the red lead or prussian blue on tube gas check seating surface for the following conditions:

(a) Condemn the cannon tube if an erosion gas path crosses the obturator interface and is 0.003 inches in depth, or deeper (see Figures I-3, I-4, and I-5).

(b) Condemn the cannon tube if the gas check seating surface is so damaged (chipped, spalled, indented, nicked, or pitted) such that it does not make full 360 degrees contact with the mating surface on the split rings, or its forward and aft mating surfaces contact less than 80 percent of the split rings forward and aft surfaces.

(4) Following inspection, remove red lead or prussian blue from split ring and gas check seating surface by wiping with a clean non-abrasive cloth.

d. **Recoil Keyway Wear.** Condemn the cannon tube if recoil keyway wear exceeds 0.010 inches (1.010 maximum width). See Figure I-6.



Figure I-3. Groove cut by gas wash across gas check seat: CONDEMN.

NOTE

M185 Cannon spindle and split ring are used for illustration purposes only.



***Figure I-4. Gas wash across one obturator split ring.
CAREFULLY INSPECT GAS CHECK SEAT.***



***Figure I-5. Gas wash across obturator split rings.
CAREFULLY INSPECT GAS SEAT.***

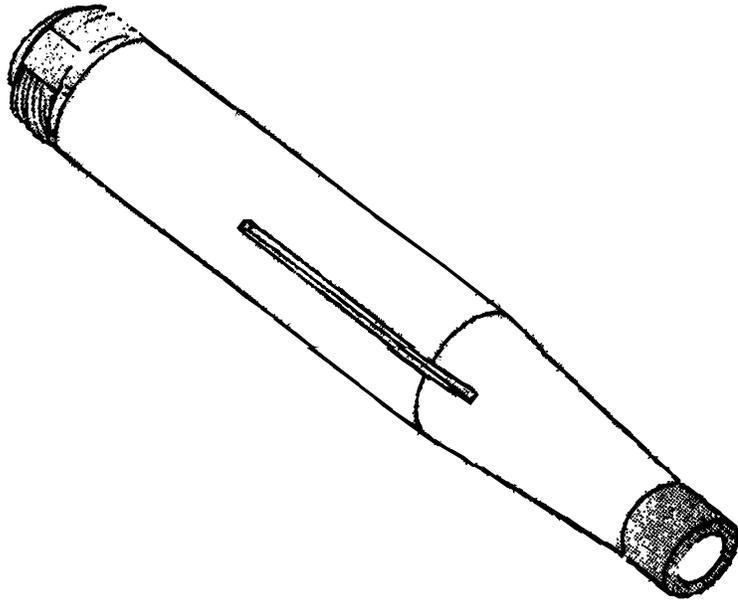


Figure I-6. Recoil keyway on tube.

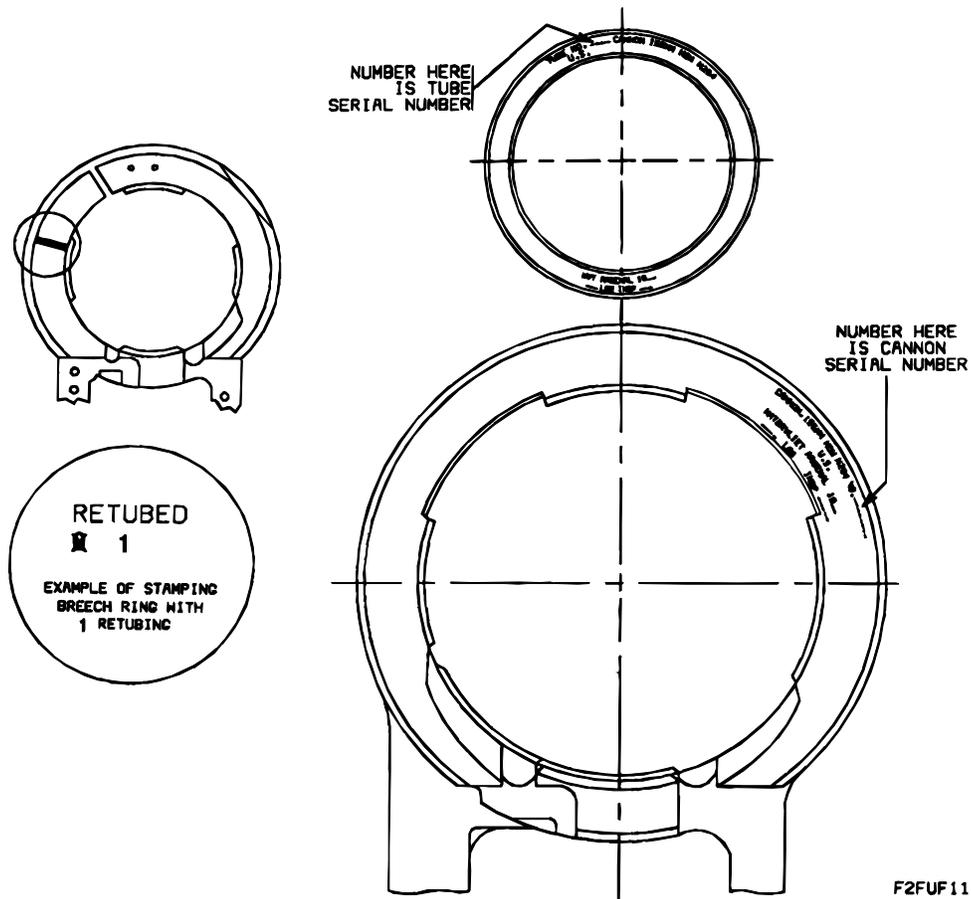
I-8. DIFFICULT INSPECTION. See para 3-4.

APPENDIX J

Cannon, 155MM Howitzer: M284

SECTION I. OPERATOR AND UNIT INSPECTION

J-1. EQUIPMENT IDENTIFICATION.



*Figure J-1. Location of tube and cannon serial number:
155MM howitzer, M284.*

CAUTION

ENSURE EQUIPMENT RECORD FOLDER NUMBERS CORRESPOND WITH SERIAL NUMBERS ON WEAPON. DO NOT CONFUSE NUMBERS WHEN MAKING ENTRIES.

J-2. CLEANING PROCEDURES.

Clean the chamber area and bore of the cannon tube using cleaning procedures detailed in para 2-2.

J-3. INSPECTION PROCEDURES AND CONDEMNATION CRITERIA.

a. **Records Inspection.** Follow inspection procedures detailed in para 2-3a.

b. **Frequency of Inspection.** In addition to Frequency of Inspection criteria found in para 2-3b, arrange for Direct Support to borescope the cannon tube at 1000 EFC round intervals. Arrange for Direct Support to pullover gage the cannon tube, first at 1000 EFC rounds, at 1500 EFC rounds, then at 2000 EFC rounds, and at each 100 EFC round interval thereafter, or within 180 days prior to firing, whichever occurs first. It is not necessary to observe the time (180 days) and EFC round count intervals (1000) separately. Neither interval should be exceeded without inspection. With less than 10 percent estimated remaining life, arrange for Direct Support to pullover gage the cannon tube after every firing operation.

c. **Condemnation Information.** In addition to Condemnation Information found in para 2-4, the M284 cannon tube is condemned under a dual criteria of EFC round count and wear. Notify Direct Support when the following conditions are found:

(1) **Round Count.** The safe service life of the M284 cannon tube and muzzle brake is 2650 EFC rounds. Have Direct Support condemn the cannon tube and muzzle brake when 2650 EFC rounds have been fired. See Table J-1 for specific ammunition EFC factors.

(2) **Wear.** Wear results from hot propellant gas wash and the passage of projectiles over the bore surface. This results in a uniform wear pattern which is measured by Direct Support using a pullover gage.

(3) **Breech Mechanism.** The breech ring may be retubed a maximum of one time (one plus original tube). After the first retubing the breech mechanism and its component parts shall be condemned. It is important that the component parts of each breech mechanism assembly be kept together during maintenance and inspection and not be interchanged with other assemblies.

(4) Check weapon record data card, DA Form 2408-4, for rounds fired. Refer to DA PAM 738-750 for procedure used in computing estimated remaining life. If you suspect that the number of rounds listed is incorrect, notify Direct Support. Where the number of rounds fired is recorded but the ammunition model number is missing, assume 25 percent of fired rounds have an EFC of 0.25 and 75 percent of fired rounds have an EFC of 1.0.

■ **TABLE J-1 has been moved to J-3**

TABLE J-1. AMMUNITION EFC VALUES FOR USE WITH M284 CANNON

<u>CHARGE</u>	<u>ZONE</u>	<u>COLOR</u>	<u>EFC</u>
M203/M203A1	8	Red/Neutral*	1.00 *Combustible Cartridge
M119A1	8	White	0.25
M119A2	7	Red	0.25
M4A2	7	White	0.15
M4A2	3-6	White	0.05
M3A1	3-5	Green	0.05
M231	1	Green	0.05 *Combustible Cartridge
M231	2	Green	0.15 *Combustible Cartridge
M232/M232A1	3	Tan	0.10 *Combustible Cartridge
M232/M232A1	4	Tan	0.25 *Combustible Cartridge
M232/M232A1	5	Tan	1.00 *Combustible Cartridge

J-4. VISUAL INSPECTION AND CRITERIA FOR VARIOUS TYPES OF DAMAGE.

In addition to the criteria in Chapter 2, the following specific criterion applies to the 155mm M284 cannon:

Cracks. Notify Direct Support if cracks of 1 inch or longer are found on the muzzle brake.

SECTION II. DIRECT SUPPORT INSPECTION

J-5. **EQUIPMENT IDENTIFICATION.** See Figure J-1.



ENSURE EQUIPMENT RECORD FOLDER NUMBERS CORRESPOND WITH SERIAL NUMBERS ON WEAPON. DO NOT CONFUSE NUMBERS WHEN MAKING ENTRIES.

J-6. **INSPECTION PROCEDURES AND CONDEMNATION CRITERIA.**

a. **Records Inspection.** Follow inspection procedures detailed in para 3-3a.

b. **Missing or Incomplete Records.** Follow procedures detailed in para 3-3b.

c. **Frequency of Inspection.** In addition to Frequency of Inspection criteria found in para 3-3c, borescope the cannon tube at 1000 EFC round intervals. Pullover gage the cannon tube, first at 1000 EFC rounds, at 1500 EFC rounds, then at 2000 EFC rounds, and at each 100 EFC round interval thereafter, or within 180 days prior to firing, whichever occurs first. It is not necessary to observe the time (180 days) and EFC round count intervals (1000) separately. Neither interval should be exceeded without inspection. With less than 10 percent estimated remaining life, pullover gage the cannon tube after every firing operation.

d. **Condemnation Information.** In addition to Condemnation Information found in this appendix and para 3-3d, the M284 cannon tube is condemned under a dual criteria of EFC round count and wear, whichever occurs first, as follows:

(1) **Round Count.** The safe service life of the M284 cannon tube is 2650 EFC rounds. Condemn the cannon tube when 2650 EFC rounds have been fired. See Table J-1 for specific ammunition EFC factors.

(2) **Wear.** Condemn the cannon tube when pullover gage inspection shows wear in excess of 0.095 inches at 41.75 inches forward of the rear face of the cannon tube. The original bore diameter of the M284 cannon tube is 6.100 inches.

(3) **Breech Mechanism.** The breech ring may be retubed a maximum of one time (one plus original tube). After the first retubing the breech mechanism and its component parts shall be condemned. It is important that the component parts of each breech mechanism assembly be kept together during maintenance and inspection and not be interchanged with other assemblies.

(4) **Bore Evacuator Region.**

<u>Tube Area</u>	<u>Criteria</u>	<u>Method</u>
Evacuator Holes	No pitting allowed	Visual
Evacuator Hole Chamfer	0.010 in. maximum pit depth	Mold material
Tube Surfaces	0.100 in. maximum pit depth (bearing and non-bearing surface)	Mold material

J-7. VISUAL INSPECTION AND CRITERIA FOR VARIOUS TYPES OF DAMAGE.

In addition to the criteria in para 3-3d, the following specific criteria apply to the 155mm M284 cannon:

- a. **Cracks.** Condemn the muzzle brake if cracks of 1 inch or longer are found.
- b. **Gas Path Erosion and Gas Check Seating Surface.** Inspect the gas check seating surface of the M284 cannon tube as follows:
 - (1) Remove all burrs with a medium India stone or equivalent (240 grit or finer). Clean gas check seating surface of oil, grease, abrasive, or foreign material.
 - (2) To test for proper seating, lightly coat the surface of the split rings with red lead or prussian blue. Close and lock breech. Open breech and examine the imprint of the red lead or prussian blue on tube gas check seating surface for the following conditions:
 - (a) Condemn the cannon tube if an erosion gas path crosses the gas check seating surface and is 0.003 inches in depth, or deeper (see Figures J-2, J-3, and J-4).
 - (b) Condemn the cannon tube if the gas check seating surface is so damaged (chipped, spalled, indented, nicked, or pitted) such that it does not make full 360 degrees contact with the mating surface on the split rings, or its forward and aft mating surfaces contact less than 80 percent of the split rings forward and aft surfaces.
 - (3) Following inspection, remove red lead or prussian blue from split ring and gas check seating surface by wiping with a clean non-abrasive cloth.

J-8. DIFFICULT INSPECTION. See para 3-4.

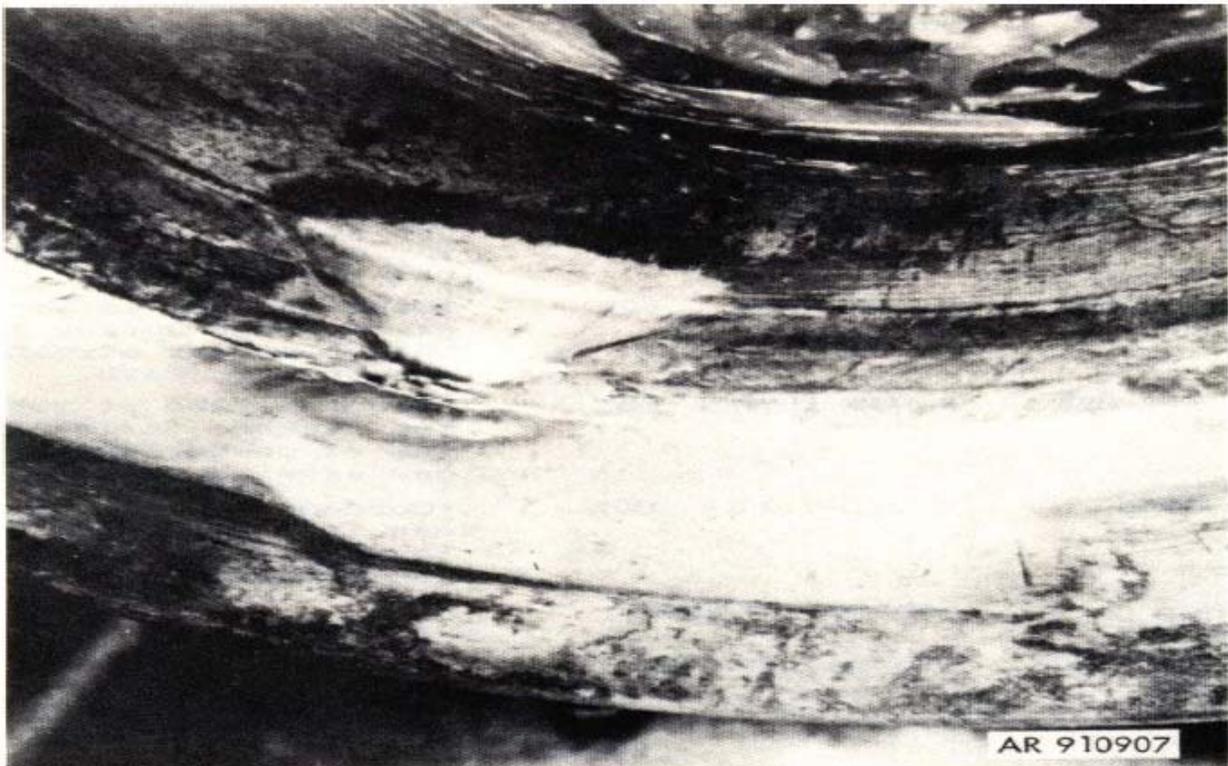
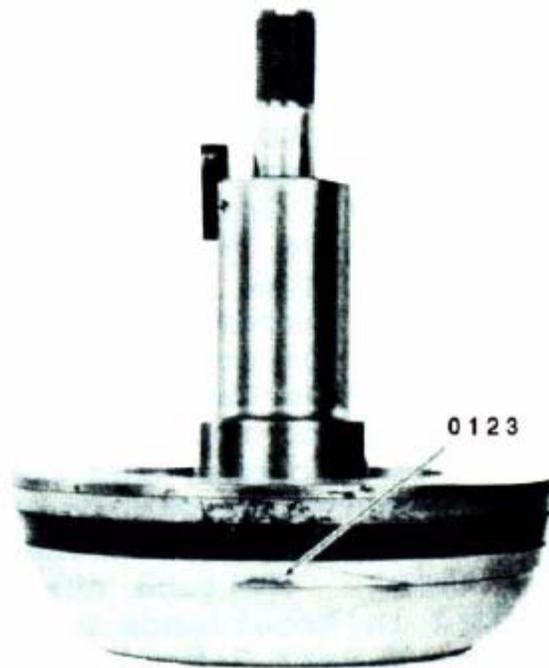


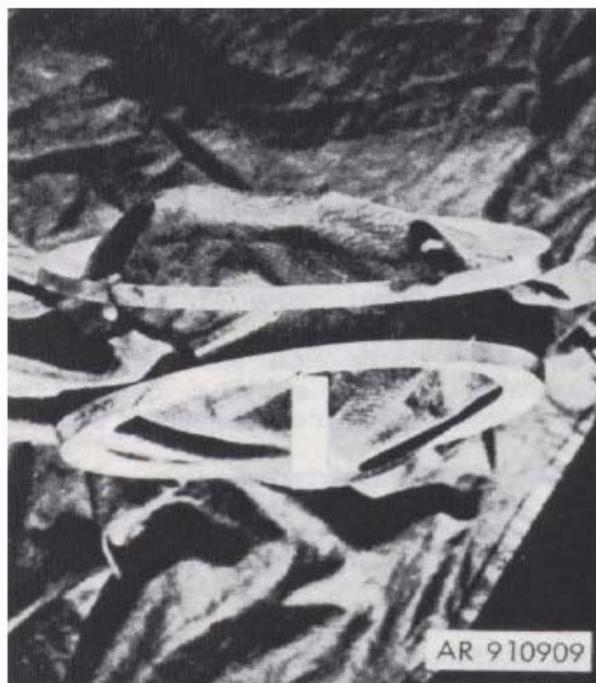
Figure J-2. Groove cut by gas wash across gas check seat: CONDEMN.

NOTE

M185 Cannon spindle and split ring are used for illustration purposes only.



***Figure J-3. Gas wash across one obturator split ring.
CAREFULLY INSPECT GAS SEAT.***



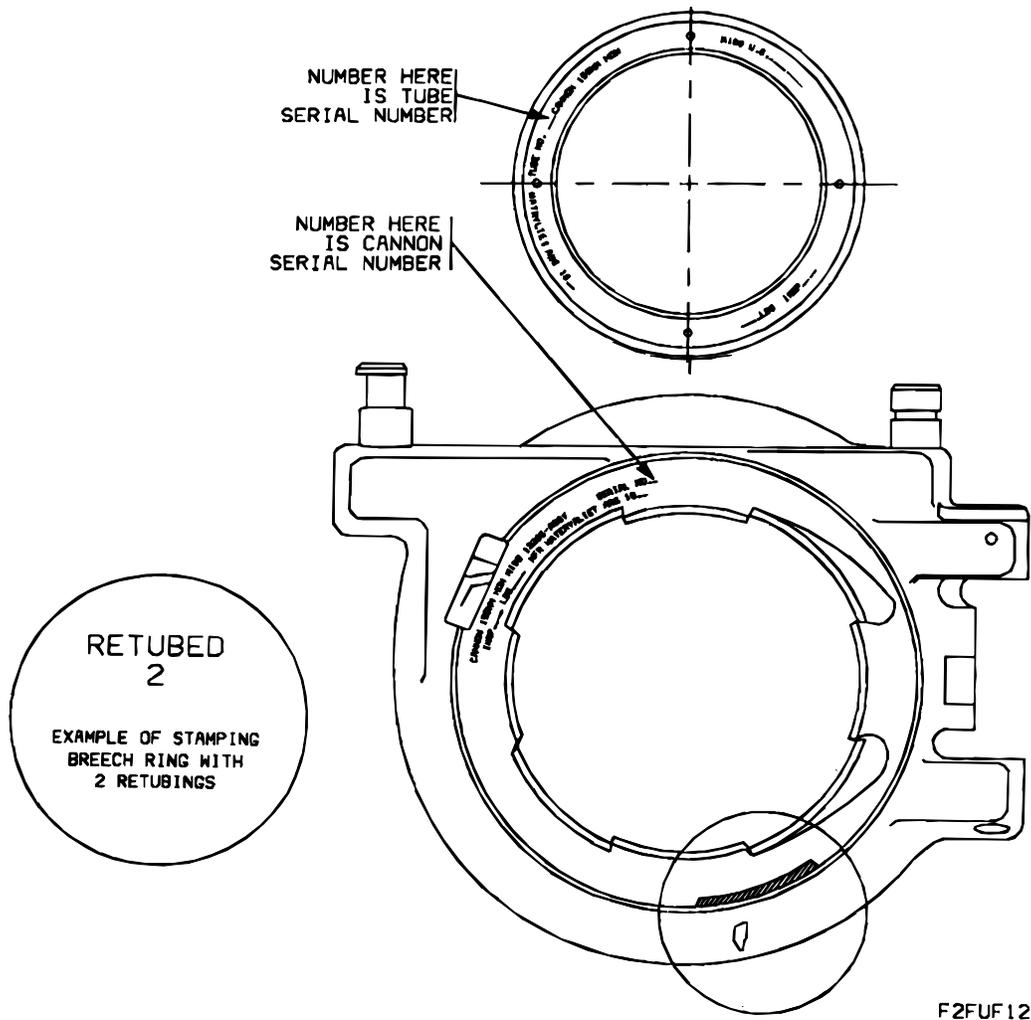
***Figure J-4. Gas wash across one obturator split ring.
CAREFULLY INSPECT GAS CHECK SEAT.***

APPENDIX K

Cannon, 155MM Howitzer: M199

SECTION I. OPERATOR AND UNIT INSPECTION

K-1. EQUIPMENT IDENTIFICATION.



**Figure K-1. Location of tube and cannon serial number:
155MM howitzer, M199.**

CAUTION

ENSURE EQUIPMENT RECORD FOLDER NUMBERS CORRESPOND WITH SERIAL NUMBERS ON WEAPON. DO NOT CONFUSE NUMBERS WHEN MAKING ENTRIES.

K-2. CLEANING PROCEDURES.

Clean the chamber area and bore of the cannon tube using cleaning procedures detailed in para 2-2.

K-3. INSPECTION PROCEDURES AND CONDEMNATION CRITERIA.

a. **Records Inspection.** Follow inspection procedures detailed in para 2-3a.

b. **Frequency of Inspection.** In addition to Frequency of Inspection criteria found in para 2-3b, arrange for Direct Support to borescope the cannon tube at 1000 EFC round intervals. Pullover gage the cannon tube, first at 1000 EFC rounds, then at 1500 EFC and at each 100 EFC round interval thereafter, or within 180 days, prior to firing whichever occurs first. It is not necessary to observe the time (180 days) and EFC round count intervals (1000) separately. Neither interval should be exceeded without inspection. With less than 10 percent estimated remaining life, arrange for Direct Support to pullover gage the cannon tube after every firing operation.

c. **Condemnation Information.** In addition to Condemnation Information found in para 2-4, the M199 cannon tube is condemned on the basis of wear. Notify Direct Support when the following conditions are found:

(1) **Wear.** Wear results from hot propellant gas wash and the passage of projectiles over the bore surface. This results in a uniform wear pattern which is measured by Direct Support using a pullover gage.

(2) **Breech Mechanism.** The breech ring may be retubed a maximum of five times (five plus original tube). After the fifth retubing the breech mechanism and its component parts shall be condemned. It is important that the component parts of each breech mechanism assembly be kept together during maintenance and inspection and not be interchanged with other assemblies.

(3) Check weapon record data card, DA Form 2408-4, for rounds fired. Refer to DA PAM 738-750 for procedure used in computing estimated remaining life. If you suspect that the number of rounds listed is incorrect, notify Direct Support. Where the number of rounds fired is recorded but the ammunition model number is missing, assume 25 percent of fired rounds have an EFC of 0.5 and 75 percent of fired rounds have an EFC of 1.0.

TABLE K-1 has been moved to K-3

TABLE K-1. AMMUNITION EFC VALUES FOR USE WITH M199 CANNON

<u>CHARGE</u>	<u>ZONE</u>	<u>COLOR</u>	<u>EFC</u>
M203/M203A1	8	Red/Neutral*	1.00 *Combustible Cartridge
M119A1	8	White	0.5
M119A2	7	Red	0.5
M4A2	7	White	0.15
M4A2	3-6	White	0.075
M3A1	1-5	Green	0.075
M231	1	Green	0.050 *Combustible Cartridge
M231	2	Green	0.150 *Combustible Cartridge
M232/M232A1	3	Tan	0.10 *Combustible Cartridge
M232/M232A1	4	Tan	0.25 *Combustible Cartridge
M232/M232A1	5	Tan	1.00 *Combustible Cartridge

K-4. VISUAL INSPECTION AND CRITERIA FOR VARIOUS TYPES OF DAMAGE.

In addition to the criteria in Chapter 2, the following specific criterion applies to the 155mm, M199 cannon:

Cracks. Notify Direct Support if cracks of 1 inch or longer are found on the muzzle brake.

SECTION II. DIRECT SUPPORT INSPECTION

K-5. EQUIPMENT IDENTIFICATION. See Figure K-1.



ENSURE EQUIPMENT RECORD FOLDER NUMBERS CORRESPOND WITH SERIAL NUMBERS ON WEAPON. DO NOT CONFUSE NUMBERS WHEN MAKING ENTRIES.

K-6. INSPECTION PROCEDURES AND CONDEMNATION CRITERIA.

- a. **Records Inspection.** Follow inspection procedures detailed in para 3-3a.
- b. **Missing or Incomplete Records.** Follow procedures detailed in para 3-3b and K-8.

c. **Frequency of Inspection.** In addition to Frequency of Inspection criteria found in para 3-3c, borescope the cannon tube at 1000 EFC round intervals. Pullover gage the cannon tube, first at 1000 EFC rounds, then at 1500 EFC rounds and at each 100 EFC round interval thereafter, or within 180 days prior to firing whichever occurs first. It is not necessary to observe the time (180 days) and EFC round count intervals (1000) separately. Neither interval should be exceeded without inspection. With less than 10 percent estimated remaining life, pullover gage the cannon tube after every firing operation.

d. **Condemnation Information.** In addition to Condemnation Information found in this appendix and para 3-3d, the M199 cannon tube is condemned on the basis of wear as follows:

(1) Deleted.

(2) **Wear.** Condemn the cannon tube when pullover gage inspection shows wear in excess of 0.095 inches at 41.75 inches forward of the rear face of the cannon tube. The original bore diameter of the M199 cannon tube is 6.100 inches.

(3) **Breech Mechanism.**

(a) **Parts Control.** It is important that the component parts of each breech mechanism assembly be kept together during maintenance and inspection and not be interchanged with other assemblies.

(b) **Limited Life Breech Parts.** Upon the second retubing and every retubing thereafter it is mandatory to replace the following parts:

Firing Mechanism Assembly	1025-01-292-0960
Firing Mechanism Block Assembly	1025-01-515-9264
Housing Assembly.....	1025-01-516-2476

(c) **Maximum Life.** The breech ring may be retubed a maximum of five times (a total of six tubes). At the end of the sixth tube's life the breech and all its component parts shall be condemned.

K-7. VISUAL INSPECTION AND CRITERIA FOR VARIOUS TYPES OF DAMAGE.

In addition to the criteria in para 3-3d, the following specific criteria apply to the 155mm, M199 cannon:

(1) **Cracks.** Condemn the muzzle brake if cracks of 1 inch or longer are found.

(2) **Gas Path Erosion and Gas Check Seating Surface.** Inspect the gas check seating surface of the M199 cannon tube as follows:

(a) Remove all burrs with a medium India stone or equivalent (320 grit or finer).

(b) Clean gas check seating surface of oil, grease, abrasive, or foreign material.

(c) To test for proper seating, lightly coat the surface of the split rings with red lead or prussian blue. Close and lock breech. Open breech and examine the imprint of the red lead or prussian blue on tube gas check seating surface for the following conditions:

1 Condemn the cannon tube if an erosion gas path crosses the gas check seating surface and is 0.003 inches in depth, or deeper (see Figures K-2, K-3 and K-4).

2 Condemn the cannon tube if the gas check seating surface is so damaged (chipped, spalled, indented, nicked, or pitted) such that it does not make full 360 degrees contact with the mating surface on the split rings, or its forward and aft mating surfaces contact less than 80 percent of the split rings forward and aft surfaces.

(d) Following inspection, remove red lead or prussian blue from split ring and gas check seating surface by wiping with a clean non-abrasive cloth.

TABLE K-2 has been moved to K-5

K-8. DIFFICULT INSPECTION. See para 3-4 and the following:

**TABLE K-2. ESTIMATED REMAINING LIFE OF CANNON TUBE OF 155MM HOWITZER
CANNON, M199,
FOR: HOWITZER, TOWED, M198**

BORE MEASUREMENT		EST. REMAINING LIFE**	
41.75 INCHES			
WEAR	ACTUAL DIA.	PERCENTAGE	EFC ROUNDS
(Gage Reading)			
0.000	6.100	100	1750
0.005	6.105	95	1658
0.010	6.110	89	1566
0.015	6.115	84	1474
0.020	6.120	79	1382
0.025	6.125	74	1290
0.030	6.130	68	1197
0.035	6.135	63	1105
0.040	6.140	58	1013
0.045	6.145	53	921
0.050	6.150	47	829
0.055	6.155	42	737
0.060	6.160	37	645
0.065	6.165	32	553
0.070	6.170	26	461
0.075	6.175	21	368
0.080	6.180	16	276
0.085	6.185	11	184
0.090	6.190	5	92
0.095***	6.195	0	0
0.100	6.200		

*Forward of rear face of tube.

**Use lowest estimated remaining life obtained with wear at the 41.75 in. location. Enter the "EFC Rounds" value on the cannon tube's DA Form 2408-4 card in the "Remaining Life (EFC RDS)" column.

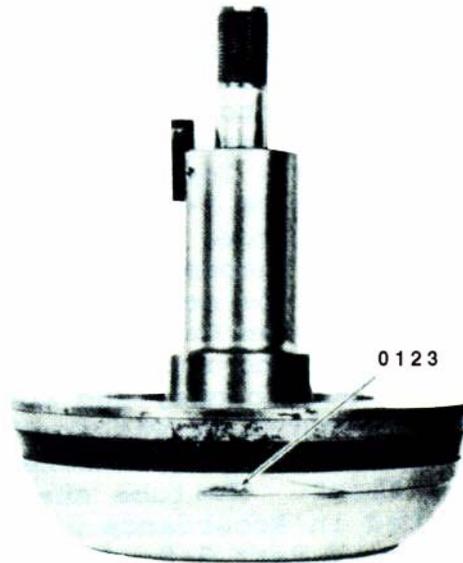
***Condemnation Limit: Condemnation will be based on tube wear regardless of rounds fired.



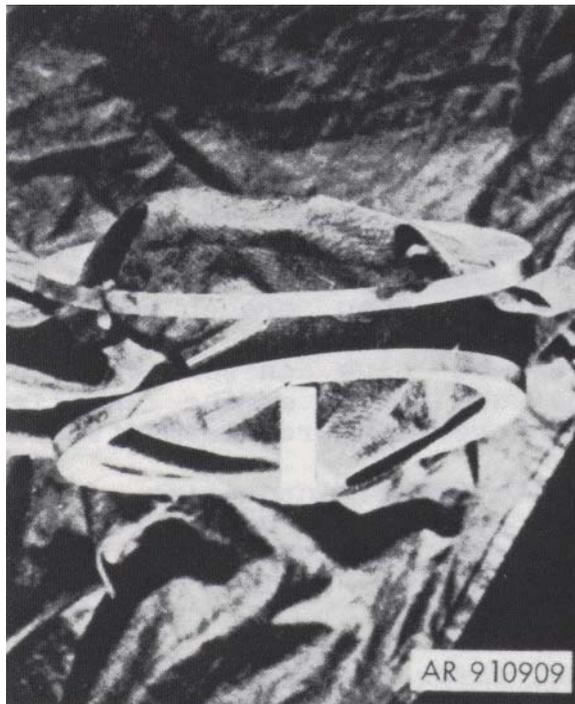
Figure K-2. Damage to lands up to 10 inches forward of origin of rifling.

NOTE

M185 Cannon spindle and split ring are used for illustration purposes only.



***Figure K-3. Gas wash across one obturator split ring.
CAREFULLY INSPECT GAS CHECK SEAT.***



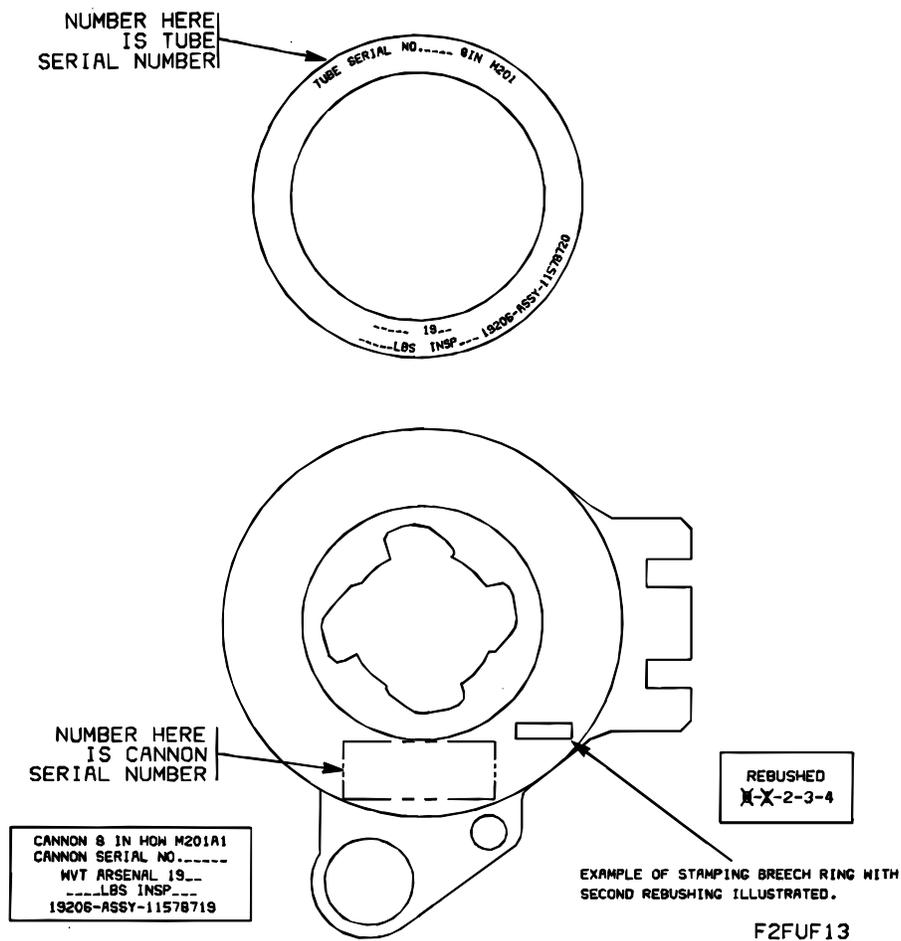
***Figure K-4. Gas wash across obturator split rings.
CAREFULLY INSPECT GAS SEAT.***

APPENDIX L

Cannon, 8 Inch Howitzer: M201A1

SECTION I. OPERATOR AND UNIT INSPECTION

L-1. EQUIPMENT IDENTIFICATION.



**Figure L-1. Location of tube and cannon serial number:
8 inch howitzer, M201A1.**

CAUTION

ENSURE EQUIPMENT RECORD FOLDER NUMBERS CORRESPOND WITH SERIAL NUMBERS ON WEAPON. DO NOT CONFUSE NUMBERS WHEN MAKING ENTRIES.

L-2. CLEANING PROCEDURES.

Clean the chamber area and bore of the cannon tube using cleaning procedures detailed in para 2-2.

L-3. INSPECTION PROCEDURES AND CONDEMNATION CRITERIA.

a. **Records Inspection.** Follow inspection procedures detailed in para 2-3a.

b. **Frequency of Inspection.** In addition to Frequency of Inspection criteria found in para 2-3b, arrange for Direct Support to borescope and pullover gage the cannon tube at 1000 EFC round intervals, or within 180 days prior to firing, whichever occurs first. It is not necessary to observe the time (180 days) and EFC round count intervals (1000) separately. Neither interval should be exceeded without inspection.

c. **Condemnation Information.** In addition to Condemnation Information found in para 2-4, the M201A1 cannon tube is condemned under a dual criteria of EFC round count and wear. Notify Direct Support when the following conditions are found:

(1) **Round Count.** The safe service life of the M201A1 cannon tube and muzzle brake is 10,000 EFC rounds. Have Direct Support condemn the cannon tube and muzzle brake when 10,000 EFC rounds have been fired. See Table L-1 for specific ammunition EFC factors.

(2) **Wear.** Wear results from hot propellant gas wash and the passage of projectiles over the bore surface. This results in a uniform wear pattern which is measured by Direct Support using a pullover gage.

Notify Direct Support when either of the above criteria are met. See Table L-1 for specific ammunition EFC factors. Check weapon record data card, DA Form 2408-4, for rounds fired. Refer to DA PAM 738-750 for procedure used in computing estimated remaining life. If you suspect that the number of rounds listed is incorrect, notify Direct Support. Where the number of rounds fired is recorded but the ammunition model number is missing, assume 25 percent of fired rounds have an EFC of 0.75 and 75 percent of fired rounds have an EFC of 1.0.

TABLE L-1. AMMUNITION EFC VALUES FOR USE WITH M201A1 CANNON

<u>CHARGE</u>	<u>EFC</u>
Zone 9	1.00
Zones 7-8	0.75
Zones 1-6	0.25

L-4. VISUAL INSPECTION AND CRITERIA FOR VARIOUS TYPES OF DAMAGE.

In addition to the criteria in Chapter 2, the following specific criteria apply to the 8-inch M201A1 cannon:

(1) **Cracks.** Notify Direct Support if cracks of 1 inch or longer are found on the muzzle brake.

(2) **Land Damage.** A unique pattern of damage to rifling lands, shown in Figure L-2, is often found in the area up to 10 inches forward of the origin of rifling. This type of damage is acceptable.



Figure L-2. Damage to lands up to 10 inches forward of origin of rifling.

SECTION II. DIRECT SUPPORT INSPECTION

L-5. **EQUIPMENT IDENTIFICATION.** See Figure L-1.



ENSURE EQUIPMENT RECORD FOLDER NUMBERS CORRESPOND WITH SERIAL NUMBERS ON WEAPON. DO NOT CONFUSE NUMBERS WHEN MAKING ENTRIES.

L-6. **INSPECTION PROCEDURES AND CONDEMNATION CRITERIA.**

a. **Records Inspection.** Follow inspection procedures detailed in para 3-3a.

b. **Missing or Incomplete Records.** Follow procedures detailed in para 3-3b.

c. **Frequency of Inspection.** In addition to Frequency of Inspection criteria found in para 3-3c, pullover gage and borescope cannon tubes within 180 days prior to firing. Additionally, the interval between inspections (pullover gage and borescope) shall not exceed 1000 EFC rounds. Information carried forward to each new DA Form 2408-4 is to include the EFC Rounds Remaining Life at the last pullover gage measurement and borescope inspection.

d. **Condemnation Information.** In addition to Condemnation Information found in this appendix and para 3-3d, the M201A1 cannon tube is condemned under a dual criteria of EFC round count and wear, whichever occurs first, as follows:

(1) **Round Count.** The safe service life of the M201A1 cannon tube is 10,000 EFC rounds. Condemn the cannon tube when 10,000 EFC rounds have been fired. See Table L-1 for specific ammunition EFC factors. When a cannon tube is condemned, the muzzle brake and its attaching hardware shall also be condemned.

(2) **Wear.** Condemn the cannon tube when pullover gage inspection shows wear in excess of 0.135 inches 46 inches forward of the rear face of the cannon tube. The original bore diameter of the M201A1 cannon tube is 8.000 inches.

When either of the above criteria are met, the cannon shall be removed from service and returned to Watervliet Arsenal, where the breech ring will be rebushed and a new tube assembly installed. The breech ring may be rebushed a maximum of four times. After the fourth rebushing the breech mechanism and its component parts shall be condemned and replaced at 50,000 EFC rounds. See Table L-1 for specific ammunition EFC information. It is important that the components of each breech mechanism assembly be kept together during maintenance and inspection and not be interchanged with other assemblies.

L-7. **VISUAL INSPECTION AND CRITERIA FOR VARIOUS TYPES OF DAMAGE.**

In addition to the criteria in para 3-3d, the following specific criteria apply to the 8-inch M201A1 cannon:

(1) **Cracks.** Condemn the muzzle brake if cracks of 1 inch or longer are found.

(2) **Land Damage.** A unique pattern of damage to rifling lands, shown in Figure L-2, is often found in the area up to 10 inches forward of the origin of rifling. This type of damage is acceptable.

(3) **Gas Path Erosion and Gas Check Seating Surface.** Inspect the gas check seating surface of the M201A1 cannon tube as follows:

(a) Remove all burrs with a medium India stone or equivalent (240 grit or finer).

(b) Clean gas check seating surface of oil, grease, abrasive, or foreign material.

(c) To test for proper seating, lightly coat the surface of the split rings with red lead or prussian blue. Close and lock breech. Open breech and examine the imprint of the red lead or prussian blue on tube gas check seating surface for the following conditions:

1 Condemn the cannon tube if an erosion gas path crosses the obturator interface and is 0.003 inches in depth, or deeper (see Figures L-3, L-4 and L-5).

2 Condemn the cannon tube if the gas check seating surface is so damaged (chipped, spalled, indented, nicked, or pitted) such that it does not make full 360 degrees contact with the mating surface on the split rings, or its forward and aft mating surfaces contact less than 80 percent of the split rings forward and aft surfaces.

L-8. DIFFICULT INSPECTION. See para 3-4.

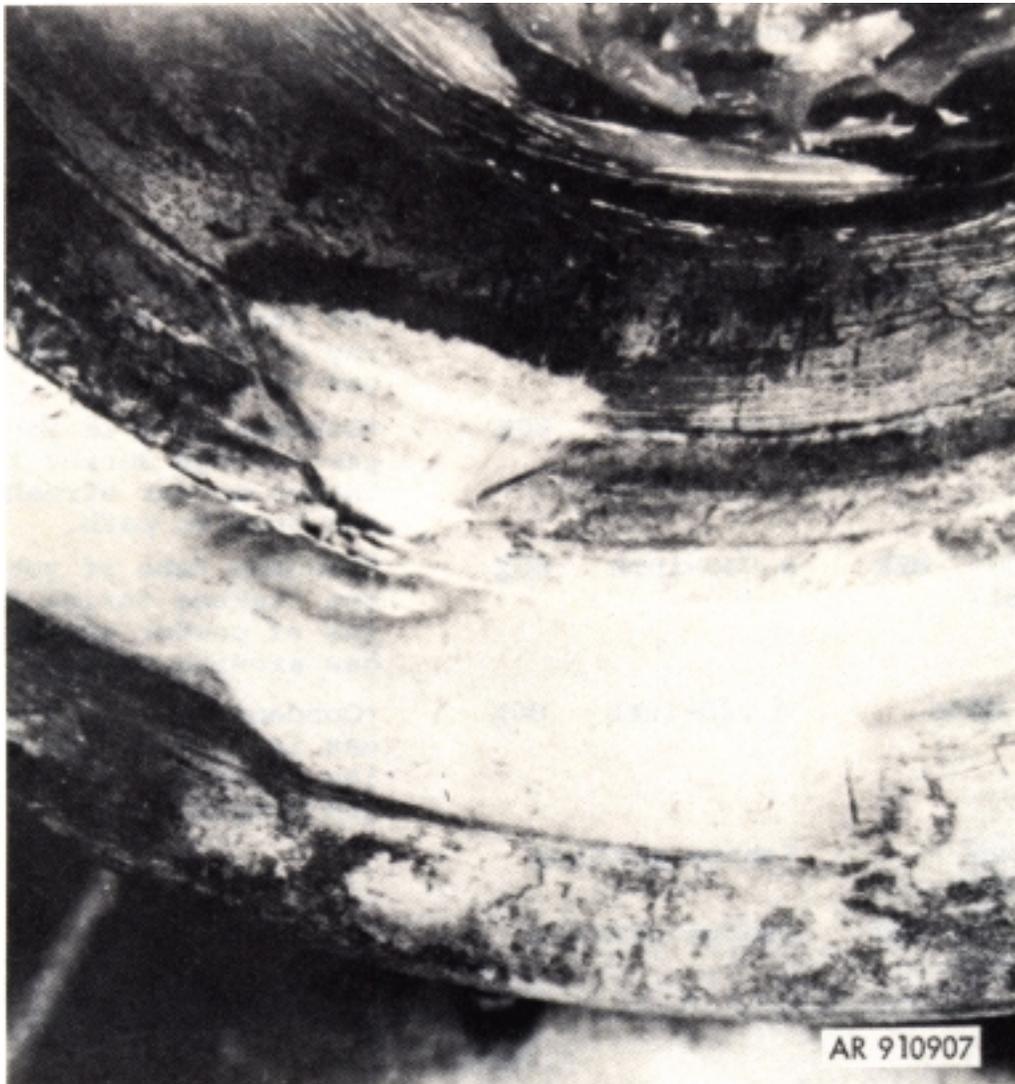
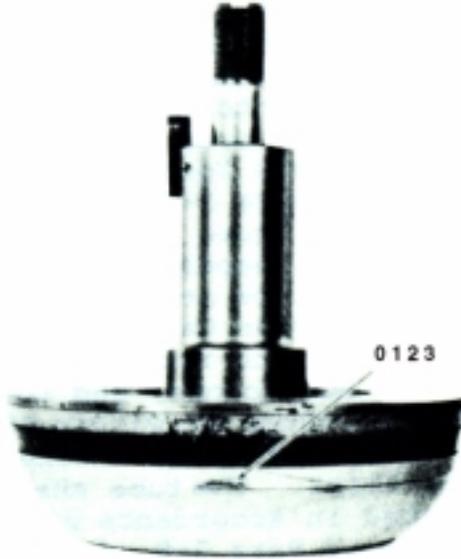


Figure L-3. Groove cut by gas wash across gas check seat.

NOTE

M185 Cannon spindle and split ring are used for illustration purposes only.



***Figure L-4. Gas wash across one obturator split ring.
CAREFULLY INSPECT GAS CHECK SEAT.***



***Figure L-5. Gas wash across obturator split rings.
CAREFULLY INSPECT GAS SEAT.***

APPENDIX M

Cannon, 60MM Mortar: M2 Cannon, 60MM Mortar: M225

SECTION I. OPERATOR AND UNIT INSPECTION

M-1. EQUIPMENT IDENTIFICATION.

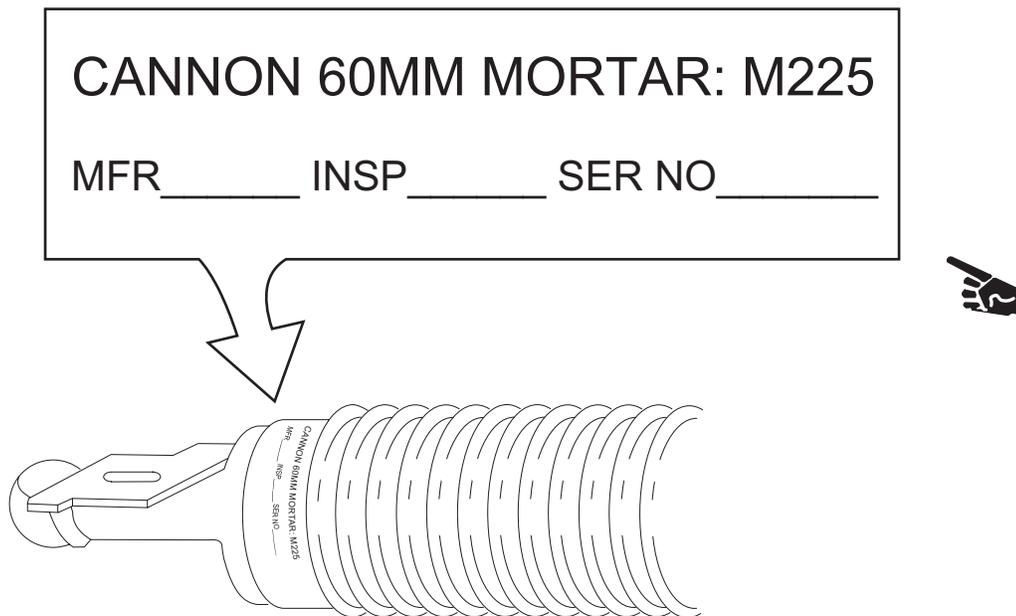


Figure M-1. Location of 60MM cannon serial number.

CAUTION

**ENSURE EQUIPMENT RECORD FOLDER NUMBERS
CORRESPOND WITH SERIAL NUMBERS ON WEAPON.**

M-2. CLEANING PROCEDURES.

Clean the chamber area and bore of the cannon tube using cleaning procedures detailed in para 2-2.

M-3. INSPECTION PROCEDURES AND CONDEMNATION CRITERIA.

a. **Records Inspection.** Follow inspection procedures detailed in para 2-3a.

b. **Frequency of Inspection.**

(1) M225 Cannon. In addition to Frequency of Inspection criteria found in para 2-3b, arrange for Direct Support to borescope and pullover gage the cannon tube after every additional 1000 rounds once 10,000 rounds have been fired or when the bore diameter equals or exceeds 2.402 inches. Arrange for Direct Support to borescope and pullover gage the cannon tube after every additional 500 rounds once the bore diameter equals or exceeds 2.411 inches.

(2) M2 Cannon. In addition to Frequency of Inspection criteria found in para 2-3b, arrange for Direct Support to borescope and pullover gage the cannon tube after every additional 1000 rounds once 10,000 rounds have been fired or when the bore diameter equals or exceeds 2.402 inches.

Borescope both the M225 and M2 cannon tubes every 100 rounds when firing subcaliber training rounds. Additionally, the cannon tube should be inspected following three successive short rounds. Ensure that correct number of charges and correct firing tables were used.

M-4. VISUAL INSPECTION AND CRITERIA FOR VARIOUS TYPES OF DAMAGE.

In addition to the criteria in Chapter 2, the following specific criteria apply to the 60mm Mortar:

(1) Notify Direct Support if the following are found:

(a) Evidence of gas leakage indicated by black streaks (visible discoloration) around base cap.

(b) Loose basecap joint or bent basecap or immovable firing pin.

(c) Cracks or suspected cracks in tube, basecap, or cooling fins.

(d) Visible bulges or dents.

(e) Internal pits or scores in excess of 0.375 inches in length or in excess of 0.010 inches in depth.

(f) (For M225 cannon tube) Erosion in excess of 0.125 inches. Erosion around the firing pin in the basecap can result from firing subcaliber training rounds.

(g) (For M225 cannon tube) Cooling fin is cracked or broken.

NOTE

M225 mortar cannon shall not be painted.

(2) Check weapon record data card, DA Form 2408-4, for rounds fired. If you suspect that the number of rounds listed is incorrect, notify Direct Support.

SECTION II. DIRECT SUPPORT INSPECTION

M-5. EQUIPMENT IDENTIFICATION. See Figure M-1.

CAUTION

ENSURE EQUIPMENT RECORD FOLDER NUMBERS CORRESPOND WITH SERIAL NUMBERS ON WEAPON. DO NOT CONFUSE NUMBERS WHEN MAKING ENTRIES.

M-6. INSPECTION PROCEDURES AND CONDEMNATION CRITERIA.

a. **Records Inspection.** Follow inspection procedures detailed in para 3-3a.

b. **Missing or Incomplete Records.** If firing record information is missing or suspected of being incorrect or if borescope inspection finds evidence of erosion rings, begin round count at 10,000 rounds.

c. **Frequency of Inspection.**

(1) M225 Cannon. In addition to Frequency of Inspection criteria found in para 2-3b, borescope and pullover gage the cannon tube after every additional 1000 rounds once 10,000 rounds have been fired or when the bore diameter equals or exceeds 2.402 inches. Bore scope and pullover gage the cannon tube after every additional 500 rounds once the bore diameter equals or exceeds 2.411 inches.

(2) M2 Cannon. In addition to Frequency of Inspection criteria found in para 2-3b, borescope and pullover gage the cannon tube after every additional 1000 rounds once 10,000 rounds have been fired or when the bore diameter equals or exceeds 2.402 inches.

Pullover readings are to be taken in accordance with para M-6d.

d. **Condemnation Information.** In addition to condemnation information found in this appendix and para 3-3d, the M2 and M225 cannon tubes are condemned on the basis of wear. The basic diameter of the 60mm M2 and M225 cannon tubes is 2.392 inches. If cannon tube is suspected of meeting condemnation criteria, contact item manager.

(1) M225 Cannon Tube Pullover Gage Inspection. Take multiple readings at various locations throughout the length of the tube in accordance with para M-6e. Condemn the cannon tube if wear in the lower 9 inches of the bore, as measured from the basecap (26 inches down from the muzzle), exceeds 2.421 inches. Condemn the cannon tube if wear at or above 26 inches from the muzzle exceeds 2.411 inches.

(2) M2 Cannon Tube Pullover Gage Inspection. Take multiple readings at various locations throughout the length of the tube in accordance with para M-6e. Condemn the cannon tube if wear at any location in the bore exceeds 2.411 inches.

(3) Bore scope Inspection of 60mm M225 and M2 Cannon Tubes. Perform borescope of M225 and M2 cannon tubes looking specifically for evidence of erosion rings in the cannon tube, and for erosion around the firing pin area. If erosion rings are present, refer to para M-8 and perform steps a through e. Step e provides condemnation criteria for erosion rings in the wall of the cannon tube. If erosion in the firing pin area is present, refer to para M-7.b.(4) for condemnation criteria.

e. **Readings.** Take multiple readings at unspecified locations throughout the length of the tube. A reading in excess of the condemnation limit diameter at any location will be cause for condemnation.

(1) M225 Minimum Reading Locations. A minimum of six readings should be taken, with three in the lower 9 inches (26 inches down from the muzzle) and three in the remainder of the tube. One pullover gage reading should be taken at 26 inches down from the muzzle. Bore diameter in excess of 2.411 inches at this location is cause for condemnation. Another pullover gage reading should be taken as close to basecap as possible; this area receives heavy wear.

(2) M2 Minimum Reading Locations. A minimum of six readings should be taken, with two in each 1/3 length of the tube (i.e., muzzle to 10 inches, 10 inches to 20 inches, and 20 inches to breechcap).

Any area suspect, for any reason, must be measured. Wear measurements are taken on the bore diameter and are not meant to measure the depth of erosion (rings) or other pitting/scoring. Impression casting will be used in addition to pullover gaging.

f. **Effective Full Charge.** Regardless of propellant/charge count, all mortar cartridges fired are to be considered as one EFC for Weapon Record Data Card (DA Form 2408-4) purposes. Mortar cannons are not condemned by round count.

M-7. VISUAL INSPECTION AND CRITERIA FOR VARIOUS TYPES OF DAMAGE.

In addition to the criteria in para 3-3d, the following specific criteria apply to the M2 and M225 cannon tubes:

CAUTION

DO NOT REMOVE BASECAP OR ALLOW BASECAP TO BECOME LOOSE.

a. **For M2 Cannon Tube:**

(1) Condemn cannon tube and basecap if inspection reveals gas leakage (visible discoloration) or base metal erosion, or if loose or bent, or if firing pin is immovable.

(2) Condemn the cannon tube and basecap if cracks are found in either component.

(3) Condemn the cannon tube and basecap if there is a visible bulge or pullover gage inspection reveals a bore diameter variation in excess of 0.010 inches. Cannon tube may also be condemned if internal damage prevents a dummy round from dropping freely.

(4) Condemn cannon tube and basecap if internal scoring or pitting exceeds 0.375 inches in length or is in excess of 0.010 inches in depth (see Figures M-2 and M-3). Check any aluminum colored streaks (dark gray) for depth.

(5) Condemn cannon when erosion exceeds 0.125 inches in depth at any point around firing pin.



Figure M-2. Internal pits and scores.



Figure M-3. Brass impingement.

b. For M225 Cannon Tube:

- (1) Send mortar and pertinent records to depot for basecap replacement if inspection reveals gas leakage (visible discoloration) or base metal erosion, or if loose or bent, or if firing pin is immovable.
- (2) Condemn the cannon tube and basecap if cracks are found in tube or basecap or cooling fins.
- (3) Condemn the cannon tube and basecap if there is a visible bulge or if pullover gage inspection reveals a bore diameter out-of-round variation in excess of 0.010 inches. Bore diameter out-of-round variation is to be calculated from pullover gage readings taken 90 degrees apart, at same distance from the muzzle. Bore diameter variation is not meant to include diameters taken at different axial positions in the bore. Cannon tube may also be condemned if internal damage prevents a dummy round from dropping freely.
- (4) Condemn the cannon tube if inspection reveals erosion in excess of 0.125 inches around the firing pin in the basecap.
- (5) Condemn the cannon tube if internal scoring or pitting exceeds 0.375 inches in length or is in excess of 0.010 inches in depth (see Figures M-2 and M-3). Check any aluminum colored streaks (dark gray) for depth.
- (6) For the M225 cannon only, two of the minimum of six pullover gage readings shall be at 26 inches from muzzle and as close to the basecap as possible. Additional measurements at other locations may be made at the discretion of the inspector. Always pullover gage any suspect tube area regardless of its location.

NOTE

M225 mortar cannon shall not be painted.

M-8. DIFFICULT INSPECTION.

Damage which is difficult to inspect can be measured by using impression casting inspection as follows:

a. Clean cannon tube with firing pin installed.

b. Mold materials:

(1) For bore damage. Cut a wooden casting stop 2.38 inches in diameter.

(2) (For M225 cannon tube) Erosion around firing pin. Cut piece of 2 inch ID aluminum tubing approximately 6 inches longer than cannon tube. Ensure ends are cut square.

(3) Add VEL-MIX-STONE (NSN 6520-00-557-7015) to water, four parts powder to one part water, and mix for 1 minute.

c. Casting:

(1) For bore damage. With cannon tube in horizontal position, place casting stop against firing pin. Pour mixture into cannon tube.

(2) (For M225 cannon tube) Erosion around firing pin. With cannon tube in vertical position, place aluminum tubing into cannon tube, centered on firing pin, and pour mixture into tubing.

d. Casting will harden in 30 to 45 minutes. Remove casting by inverting tube and measure defect. Clean residue from cannon tube surfaces.

e. Measure height of defect using thickness gage and straightedge (see Figure M-4). Double impression height and add to pullover gage reading taken ahead of first erosion ring.

(1) M225 Cannon: If measurement is taken in the lower 9 inches of the tube as measured from the basecap (26 inches from the muzzle) and sum equals or exceeds 2.421 inches, condemn cannon tube and basecap. If measurement is taken in the remainder of the tube and sum equals or exceeds 2.411 inches, condemn cannon tube and basecap.

(2) M2 Cannon: If sum equals or exceeds 2.411 inches, condemn cannon tube and basecap.

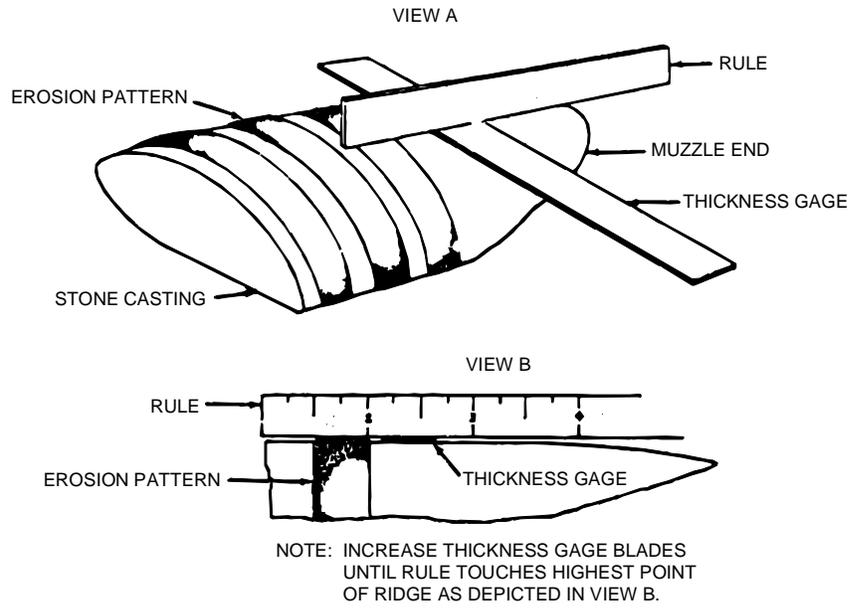


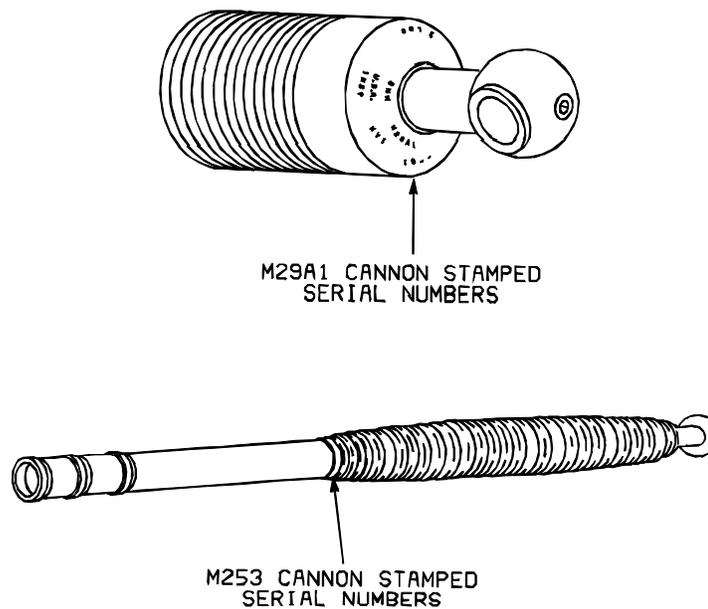
Figure M-4. Measurement of erosion rings.

APPENDIX N

Cannon, 81MM Mortar: M29/M29A1 Cannon, 81MM Mortar: M253

SECTION I. OPERATOR AND UNIT INSPECTION

N-1. EQUIPMENT IDENTIFICATION.



F2FUF15

Figure N-1. Location of cannon tube serial numbers.

CAUTION

**ENSURE EQUIPMENT RECORD FOLDER NUMBERS
CORRESPOND WITH SERIAL NUMBERS ON WEAPON.**

N-2. CLEANING PROCEDURES.

Clean the chamber area and bore of the cannon tube using cleaning procedures detailed in para 2-2.

N-3. INSPECTION PROCEDURES AND CONDEMNATION CRITERIA.

a. **Records Inspection.** Follow inspection procedures detailed in para 2-3a.

b. **Frequency of Inspection.** In addition to Frequency of Inspection criteria found in para 2-3b, arrange for Direct Support to borescope and pullover gage the cannon tube after every additional 500 rounds once 5000 rounds have been fired. Borescope every 100 rounds when firing subcaliber training rounds. Additionally, the cannon tube should be inspected following three successive short rounds. Ensure that correct number of charges and correct firing tables were used.

N-4. VISUAL INSPECTION AND CRITERIA FOR VARIOUS TYPES OF DAMAGE.

In addition to the criteria in Chapter 2, the following specific criteria apply:

a. Notify Direct Support if the following are found:

(1) **For M253 Cannon:**

- (a) Loose or bent breech plug or immovable firing pin.
- (b) Cracks or suspected cracks in tube, breech plug, or cooling fins.
- (c) Visible bulges or dents.
- (d) Internal pits or scores in excess of 0.375 inches in length and in excess of 0.010 inches in depth.
- (e) Erosion around firing pin in breech plug.

(2) **For M29/M29A1 Cannon:**

- (a) Loose basecap joint or bent basecap or immovable firing pin.
- (b) Cracks or suspected cracks in tube or basecap.
- (c) Visible bulges or dents.
- (d) Internal pits or scores in excess of 0.375 inches in length and in excess of 0.010 inches in depth.
- (e) Erosion around firing pin in basecap.

b. Check weapon record data card, DA Form 2408-4, for rounds fired. If you suspect that the number of rounds listed is incorrect, notify Direct Support.

NOTE

M253 and M29/M29A1 mortar cannons shall not be painted.

SECTION II. DIRECT SUPPORT INSPECTION

N-5. EQUIPMENT IDENTIFICATION. See Figure N-1.



**ENSURE EQUIPMENT RECORD FOLDER NUMBERS
CORRESPOND WITH SERIAL NUMBERS ON WEAPON.**

N-6. INSPECTION PROCEDURES AND CONDEMNATION CRITERIA.

- a. **Records Inspection.** Follow inspection procedures detailed in para 3-3a.
- b. **Missing or Incomplete Records.** If firing record information is missing, or suspected of being incorrect, and borescope inspection finds no evidence of erosion rings, begin round count at 4000 rounds. If erosion rings are present, begin round count at 5000 rounds.
- c. **Frequency of Inspection.** In addition to Frequency of Inspection criteria found in para 2-3c, borescope and pullover gage the cannon tube after every additional 500 rounds once 5000 rounds have been fired.
- d. **Condemnation Information.** In addition to Condemnation Information found in this appendix and para 3-3c, the cannon tubes are condemned on the basis of wear. Condemn the cannon tube if wear at any location in the bore exceeds 3.227 inches. The basic diameter of the 81-mm cannon tube is 3.205 inches. If cannon tube is suspected of meeting condemnation criteria, contact item manager.
- e. **Readings.** Take multiple readings at different locations throughout the length of the tube. A reading at any location in excess of the condemnation limit diameter will be cause for condemnation. A minimum of six readings should be taken, with two in each 1/3 length of the tube (for the M253, muzzle to 15 inches, 15 inches to 30 inches, and 30 inches to breechcap). Each reading should include pullover gage data from two clock positions, 90 degrees apart, at the same location measured from the muzzle end. One pullover gage reading (M253 Cannon only) should be taken below the 38 inch location (down from muzzle). This is not intended to prevent additional readings at the inspector's discretion. Any area suspect, for any reason, must be measured. Wear measurements are taken on the bore diameter and are not meant to measure the depth of erosion (rings) or other pitting/scoring. Impression casting will be used in addition to pullover gaging.
- f. **Effective Full Charge.** Regardless of propellant/charge count, all mortar cartridges fired are to be considered as one EFC for Weapon Record Data Card (DA Form 2408-4) purposes. Mortar cannons are not condemned by round count.

N-7. VISUAL INSPECTION AND CRITERIA FOR VARIOUS TYPES OF DAMAGE.

NOTE

M253 and M29/M29A1 mortar cannons shall not be painted.

In addition to the criteria in para 3-3d, the following specific criteria apply to the 81mm cannon:

a. For M253 Cannon Tube:

NOTE

The M253 Cannon has a replaceable breech plug. Do not condemn a cannon if the condemning condition can be corrected by installing a new breech plug.

(1) Condemn mortar if inspection reveals metal erosion at cannon tube breech plug joint, or if breech plug is loose and cannot be retightened, or if firing pin is immovable. Inspect cannon's breech plug's thrust washer for serviceability.

(2) Condemn the cannon tube if inspection reveals cracks in cannon, breech plug, or cooling fins.

(3) Condemn the cannon tube and basecap if there is a visible bulge or if pullover gage inspection reveals a bore diameter out-of-round variation in excess of 0.010 inches. Bore diameter out-of-round variation is to be calculated from pullover gage readings taken 90 degrees apart, at same distance from the muzzle. Bore diameter variation is not meant to include diameters taken at different axial positions in the bore. Cannon tube can also be condemned if internal damage prevents a dummy round from dropping freely.

(4) Condemn the cannon tube and basecap if internal scoring or pitting exceeds 0.375 inches in length and is in excess of 0.010 inches in depth (see Figures N-2 and N-3). Check any aluminum colored streaks (dark gray) for depth.

(5) Replace breech plug if erosion exceeds 0.125 inches in depth at any point around firing pin, or breech plug.



Figure N-2. Internal pits and scores.



Figure N-3. Brass impingement.

b. For M29/M29A1 Cannon Tube:

- (1) Condemn cannon tube and basecap if inspection reveals gas leakage (visible discoloration) or base metal erosion, or if loose or bent, or if firing pin is immovable.
- (2) Condemn the cannon tube and basecap if cracks are found in either component.
- (3) Condemn the cannon tube and basecap if there is a visible bulge or if pullover gage inspection reveals a bore diameter out-of-round variation in excess of 0.010 inches. Bore diameter out-of-round variation is to be calculated from pullover gage readings taken 90 degrees apart, at same distance from the muzzle. Bore diameter variation is not meant to include diameters taken at different axial positions in the bore. Cannon tube can also be condemned if internal damage prevents a dummy round from dropping freely.
- (4) Condemn cannon tube and basecap if internal scoring or pitting exceeds 0.375 inches in length and is in excess of 0.010 inches in depth (see Figures N-2 and N-3). Check any aluminum colored streaks (dark gray) for depth.
- (5) Condemn mortar tube when erosion exceeds 0.125 inches in depth at any point around the firing pin.

CAUTION

DO NOT REMOVE BASECAP OR ALLOW BASECAP TO BECOME LOOSEMED.

N-8. DIFFICULT INSPECTION.

Annular erosion rings or damage which is difficult to inspect can be measured by using impression casting inspection as follows:

a. Clean cannon tube with firing pin installed.

b. Prepare mold materials:

(1) For erosion around firing pin. Cut piece of 2-inch inside diameter aluminum tubing approximately 6 inches longer than cannon tube. Ensure ends are cut square.

(2) For bore damage. Cut a wooden casting stop 3.20 inches in diameter.

(3) Add VEL-MIX-STONE (NSN 6520-00-557-7015) to water, four parts powder to one part water, and mix for one minute.

c. **Casting:**

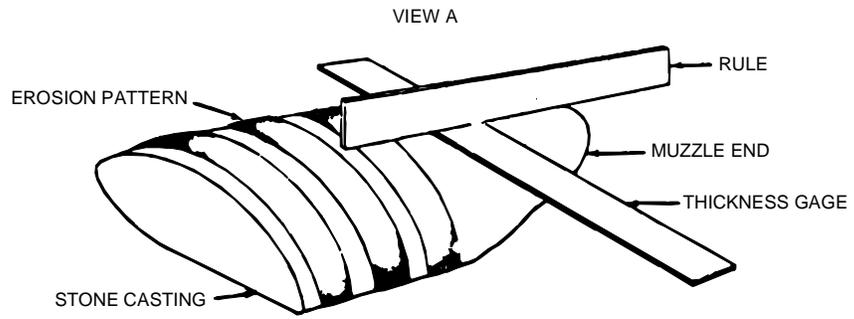
(1) For erosion around firing pin. With cannon tube in vertical position, place aluminum tubing into cannon tube, centered on firing pin, and pour mixture into tubing.

(2) For bore damage. With cannon tube in horizontal position, place casting stop against firing pin. Pour mixture into cannon tube.

d. Casting will harden in 35 to 45 minutes. Remove casting by inverting tube and measure defect.

e. Measure height of defect using thickness gage and straightedge (see Figure N-4). Double impression height and add to pullover gage reading taken ahead of first erosion ring. If sum equals or exceeds 3.227 inches, condemn cannon tube and basecap.

f. Clean residue from cannon tube surfaces.



NOTE: INCREASE THICKNESS GAGE BLADES UNTIL RULE TOUCHES HIGHEST POINT OF RIDGE AS DEPICTED IN VIEW B.

APPENDIX O

Cannon, 4.2 Inch Mortar: M30

SECTION I. OPERATOR AND UNIT INSPECTION

O-1. EQUIPMENT IDENTIFICATION.

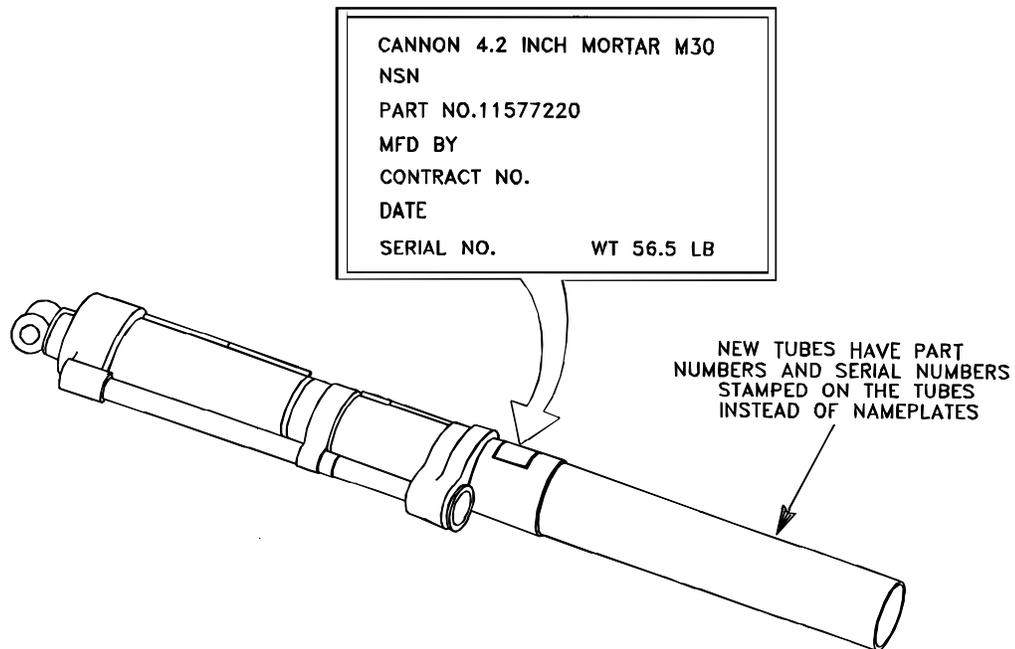


Figure O-1. Location of 4.2 inch mortar cannon tube serial number.

CAUTION

**ENSURE EQUIPMENT RECORD FOLDER NUMBERS
CORRESPOND WITH SERIAL NUMBERS ON WEAPON.**

O-2. CLEANING PROCEDURES.

Clean the chamber area and bore of the cannon tube using cleaning procedures detailed in para 2-2.

O-3. INSPECTION PROCEDURES AND CONDEMNATION CRITERIA.

a. **Records Inspection.** Follow inspection procedures detailed in para 2-3a.

b. **Frequency of Inspection.** In addition to Frequency of Inspection criteria found in para 2-3b, arrange for Direct Support to borescope and pullover gage the cannon tube after every additional 500 rounds once 4000 rounds have been fired. Additionally, the cannon should be inspected following three successive short rounds. Ensure that correct number of charges and correct firing tables were used.

O-4. VISUAL INSPECTION AND CRITERIA FOR VARIOUS TYPES OF DAMAGE.

In addition to the criteria in Chapter 2, the following specific criteria apply to the 4.2 inch M30 mortar:

a. Notify Direct Support if the following are found:

- (1) Gas leakage (visible discoloration) or base metal erosion, or if basecap is loose or bent.
- (2) Cracks or suspected cracks in tube or basecap.
- (3) Visible bulges or dents.
- (4) Internal pits or scores in excess of 0.375 inches in length and in excess of 0.010 inches in depth.
- (5) One or more missing lands.
- (6) Firing pin damage which prevents operation.

b. Check weapon record data card, DA Form 2408-4, for rounds fired. If you suspect that the number of rounds listed is incorrect, notify Direct Support.

SECTION II. DIRECT SUPPORT INSPECTION

O-5. EQUIPMENT IDENTIFICATION. See Figure O-1.



**ENSURE EQUIPMENT RECORD FOLDER NUMBERS
CORRESPOND WITH SERIAL NUMBERS ON WEAPON.**

O-6. INSPECTION PROCEDURES AND CONDEMNATION CRITERIA.

- a. **Records Inspection.** Follow inspection procedures detailed in para 3-3a.
- b. **Missing or Incomplete Records.** Follow procedures detailed in para 3-3b. If firing record information is missing or suspected of being incorrect or your borescope finds evidence of erosion rings, begin round count at 4000 rounds.
- c. **Frequency of Inspection.** In addition to Frequency of Inspection criteria found in para 2-3c, borescope and pullover gage the cannon tube after every additional 500 rounds once 4000 rounds have been fired.
- d. **Condemnation Information.** In addition to Condemnation Information found in this appendix and para 3-3d, the M30 cannon tube is condemned on the basis of wear. Condemn the cannon tube if wear at any location in the bore exceeds *4.221 inches. The basic diameter of the 4.2 inch M30 cannon tube is *4.200 inches (*land diameter).
- e. **Readings.** Take multiple readings at unspecified locations throughout length of tube. A reading at any location in excess of the condemning limit diameter will be cause for condemnation.
- f. **Effective Full Charge.** Regardless of propellant/charge count, all mortar cartridges fired are to be considered as one EFC for Weapon Record Data Card (DA Form 2408-4) purposes. Mortar cannons are not condemned by round count.

O-7. VISUAL INSPECTION AND CRITERIA FOR VARIOUS TYPES OF DAMAGE.

In addition to the criteria in para 3-3d, the following specific criteria apply to the 4.2 inch M30 mortar:



**DO NOT REMOVE BASECAP OR ALLOW BASECAP
TO BECOME LOOSEMED.**

- a. Send mortar and pertinent records to depot if inspection reveals gas leakage (visible discoloration), base metal erosion, if basecap is loose or bent, or if firing pin is broken.
- b. Condemn the cannon tube and basecap, if cracks are found in either component.
- c. Condemn the cannon tube and basecap if there is a visible bulge or pullover gage inspection reveals a bore diameter variation in excess of 0.010 inches. Cannon tube may also be condemned if internal damage prevents a dummy round from dropping freely.
- d. Condemn cannon tube and basecap if internal scoring or pitting exceeds 0.375 inches in length or is in excess of 0.010 inches in depth (see Figures O-2 and O-3). Check any aluminum colored streaks (dark gray) for depth.



Figure O-2. Internal pits and scores.



Figure O-3. Brass impingement.

e. Condemn the cannon tube if inspection reveals one or more missing lands or if lands are mushroomed, split, or severely flattened (see Figures O-4 and O-5).

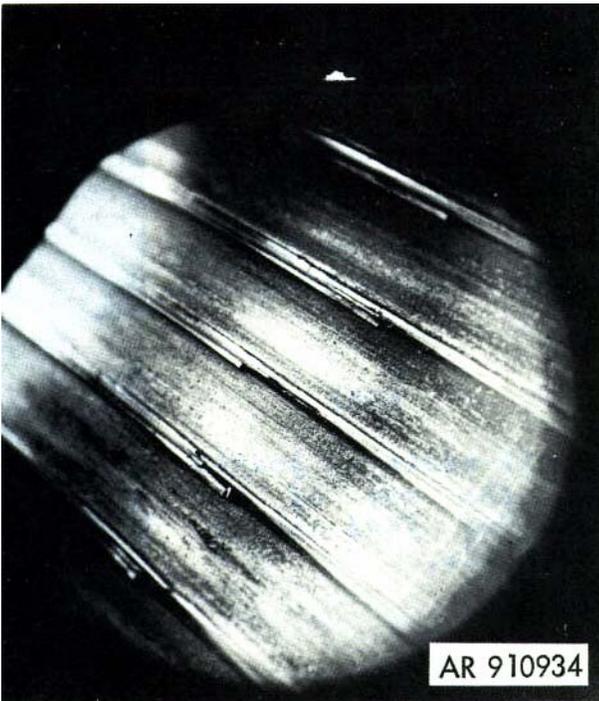


Figure O-4. Lands mushroomed and split, 4.2-inch mortar.

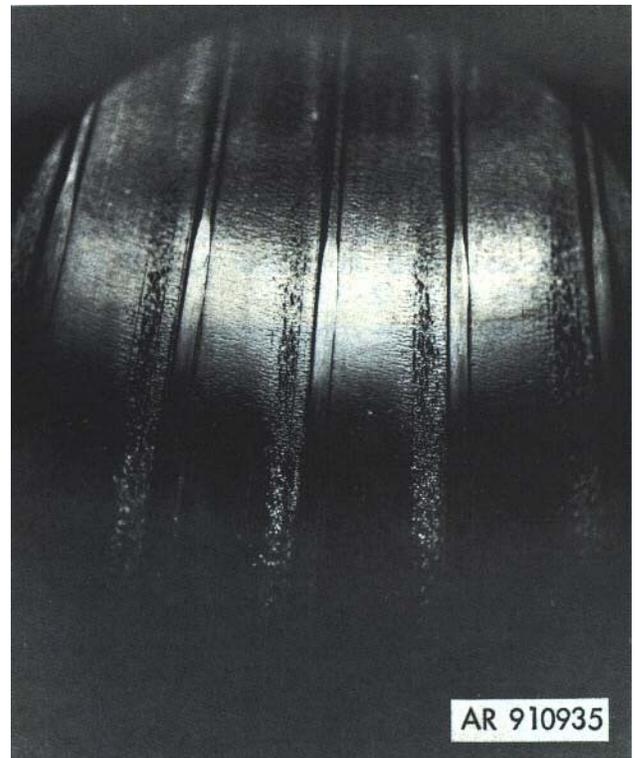


Figure O-5. Severely flattened lands, 4.2-inch mortar.

O-8. DIFFICULT INSPECTION.

Annular erosion rings or damage which is difficult to inspect can be measured by using impression casting inspection as follows:

- a. Clean cannon tube.
- b. Prepare mold materials:
 - (1) Cut a wooden casting stop 4.20-inches in diameter.
 - (2) Add VEL-MIX-STONE (NSN 6520-00-557-7015) to water, four parts powder to one part water, and mix for 1 minute.
- c. Casting: With cannon tube in horizontal position, place casting stop against firing pin. Pour mixture into cannon tube.
- d. Casting will harden in 30 to 45 minutes. Remove casting by inverting tube and measure defect.
- e. Measure height of defect using thickness gage and straightedge (see Figure O-6). Double impression height and add to pullover gage reading taken ahead of first erosion ring. If sum equals or exceeds 4.221 inches, condemn cannon tube.
- f. Clean residue from cannon tube surfaces.

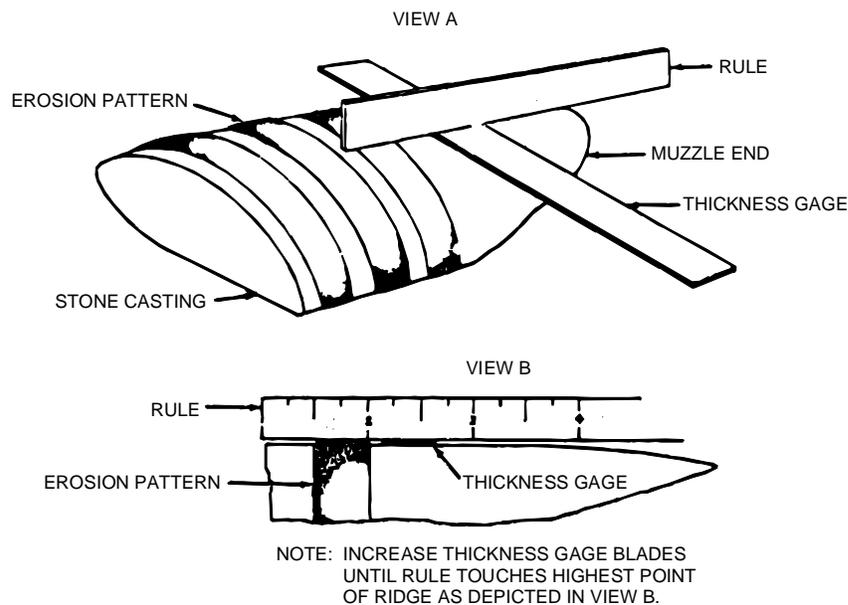


Figure O-6. Measurement of erosion rings.

APPENDIX P

Cannon, 120MM Mortar: M298

SECTION I. OPERATOR AND UNIT INSPECTION

P-1. EQUIPMENT IDENTIFICATION.

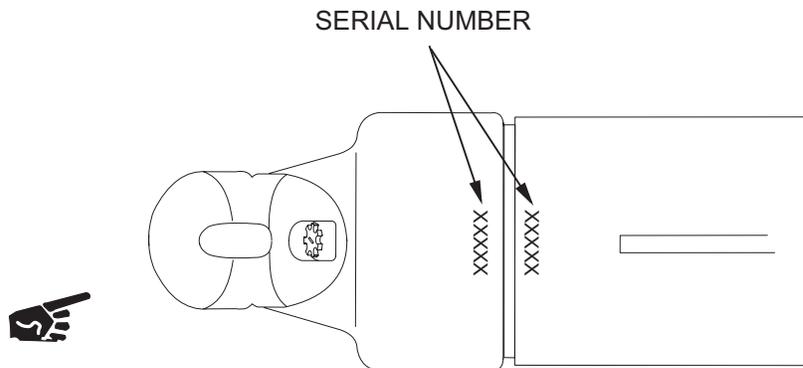


Figure P-1. Location of 120MM mortar cannon tube serial number.

CAUTION

**ENSURE EQUIPMENT RECORD FOLDER NUMBERS
CORRESPOND WITH SERIAL NUMBERS ON WEAPON.**

P-2. CLEANING PROCEDURES.

Clean the chamber area and bore of the cannon tube using cleaning procedures detailed in para 2-2.

P-3. INSPECTION PROCEDURES AND CONDEMNATION CRITERIA.

a. **Records Inspection.** Follow inspection procedures detailed in para 2-3a.

b. **Frequency of Inspection.** In addition to Frequency of Inspection criteria found in para 2-3b, arrange for Direct Support to borescope and pullover gage the cannon tube after every additional 500 rounds once 3000 rounds have been fired. Additionally, the cannon should be inspected following three successive short rounds. Ensure that correct number of charges and correct firing tables were used.

P-4. VISUAL INSPECTION AND CRITERIA FOR VARIOUS TYPES OF DAMAGE.

In addition to the criteria in Chapter 2, the following specific criteria apply to the 120mm M298 mortar:

a. Notify Direct Support if the following are found:

- (1) Gas leakage (visible discoloration), base metal erosion, or if basecap is loose or bent.
- (2) Cracks or suspected cracks in cannon tube or basecap.
- (3) Visible bulges or dents.
- (4) Internal pits or scores in excess of 0.375 inches in length and in excess of 0.010 inches in depth.
- (5) White line on cannon does not align with breechcap's safety mechanism when assembled.

b. Check Weapon Record Data Card, DA Form 2408-4, for rounds fired. If you suspect that the number of rounds listed is incorrect, notify Direct Support.

SECTION II. DIRECT SUPPORT INSPECTION

P-5. EQUIPMENT IDENTIFICATION. See Figure P-1.



**ENSURE EQUIPMENT RECORD FOLDER NUMBERS
CORRESPOND WITH SERIAL NUMBERS ON WEAPON.**

P-6. INSPECTION PROCEDURES AND CONDEMNATION CRITERIA.

a. **Records Inspection.** Follow inspection procedures detailed in para 3-3a.

b. **Missing or Incomplete Records.** If firing record information is missing or suspected of being incorrect or your borescope finds evidence of erosion rings, begin round count at 3000 rounds.

c. **Frequency of Inspection.** In addition to Frequency of Inspection criteria found in para 3-3c, borescope and pullover gage the cannon tube after every additional 500 rounds once 3000 rounds have been fired.

NOTE

If cannon tube or basecap meets condemnation criteria, both must be condemned.

d. **Condemnation Information.** In addition to Condemnation Information found in this appendix and para 3-3d, the M298 cannon tube is condemned on the basis of wear. Condemn the cannon tube if wear at any location in the bore exceeds 4.761 inches. The basic diameter of the 120mm M298 cannon tube is 4.747 inches. If cannon tube is suspected of meeting condemnation criteria, contact item manager.

e. **Readings.** Take multiple readings at different locations throughout the length of the tube. A reading at any location in excess of the condemnation limit diameter will be cause for condemnation. A minimum of six readings should be taken, with two in each 1/3 length of the tube (i.e., muzzle to 20 inches, 20 inches to 40 inches, and 40 inches to breechcap). Each reading should include pullover gage data from two clock positions, 90 degrees apart, at the same location measured from the muzzle end. One pullover gage reading should be taken below the 56.5 inch location (down from muzzle). This is not intended to prevent additional readings at the inspector's discretion. Any area which is suspicious, for any reason, must be measured. Wear measurements are taken on the bore diameter and are not meant to measure the depth of erosion (rings) or other pitting/scoring. Impression casting will be used in addition to pullover gaging.

f. **Effective Full Charge.** Regardless of propellant/charge count, all mortar cartridges fired are to be considered as one EFC for Weapon Record Data Card (DA Form 2408-4) purposes. Mortar cannons are not condemned by round count.

P-7. VISUAL INSPECTION AND CRITERIA FOR VARIOUS TYPES OF DAMAGE.

In addition to the criteria in para 3-3d, the following specific criteria apply to the 120mm M298 mortar:

a. Send mortar and pertinent records to depot if inspection reveals gas leakage (visible discoloration) or base metal erosion between mating surfaces of tube and basecap or if firing pin indicator lever and white stripe on tube do not align when tightened.

b. Condemn the cannon tube and basecap if cracks are found in either component.

P-7. VISUAL INSPECTION AND CRITERIA FOR VARIOUS TYPES OF DAMAGE - Continued.

c. Condemn the cannon tube and basecap if there is a visible bulge or if pullover gage inspection reveals a bore diameter out-of-round variation in excess of 0.010 inches. Bore diameter out-of-round variation is to be calculated from pullover gage readings taken 90 degrees apart, at same distance from the muzzle. Bore diameter variation is not meant to include diameters taken at different axial positions in the bore. Cannon tube can also be condemned if internal damage prevents a dummy round from dropping freely.

d. Condemn cannon tube and basecap if internal scoring or pitting exceeds 0.375 inches in length and is in excess of 0.010 inches in depth (see Figures P-2 and P-3). Check any aluminum colored streaks (dark gray) for depth.

e. Contact Item Manager if white line on cannon does not align with breechcap's safety mechanism when assembled.



Figure P-2. Internal pits and scores.



Figure P-3. Brass impingement.

P-8. DIFFICULT INSPECTION.

Damage which is difficult to inspect can be measured by using impression casting inspection as follows:

a. Clean cannon tube with firing pin installed.

- b. Prepare mold materials:
 - (1) Cut a wooden casting stop 4.730-inches in diameter.
 - (2) Add VEL-MIX-STONE (NSN 6520-00-557-7015) to water, four parts powder to one part water, and mix for 1 minute.
- c. Casting: With cannon tube in horizontal position, place casting stop against firing pin. Pour mixture into cannon tube.
- d. Casting will harden in 30 to 45 minutes. Remove casting by inverting tube and measure for defect.
- e. Measure height of defect using thickness gage and straightedge (see Figure P-4). Double impression height and add to pullover gage reading taken ahead of first erosion ring. If sum equals or exceeds 4.761 inches, condemn cannon tube.
- f. Clean residue from cannon tube surfaces.

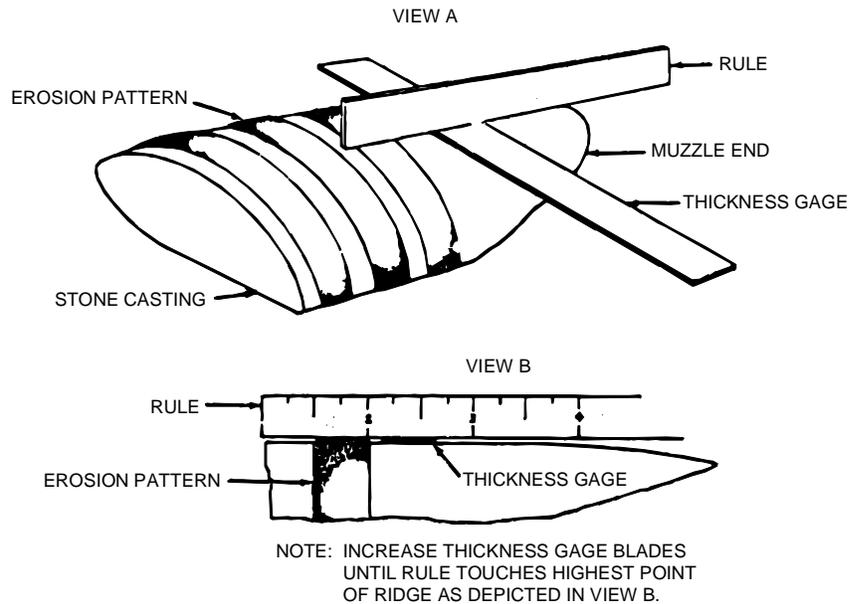


Figure P-4. Measurement of erosion rings.

APPENDIX Q

Cannon, 90MM Recoilless Rifle: M67

SECTION I. OPERATOR AND UNIT INSPECTION

Q-1. EQUIPMENT IDENTIFICATION.

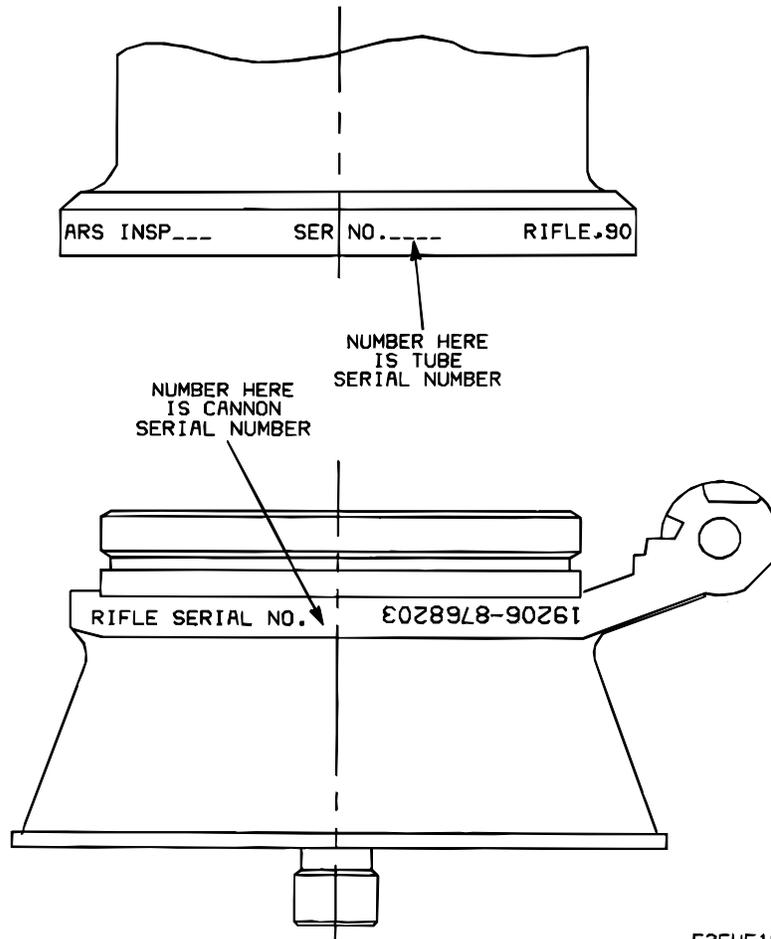


Figure Q-1. Location of 90MM cannon tube serial number.

CAUTION

ENSURE EQUIPMENT RECORD FOLDER NUMBERS CORRESPOND WITH SERIAL NUMBERS ON WEAPON. DO NOT CONFUSE NUMBERS WHEN MAKING ENTRIES.

Q-2. CLEANING PROCEDURES.

Clean the chamber area and bore of the cannon tube using cleaning procedures detailed in para 2-2.

Q-3. INSPECTION PROCEDURES AND CONDEMNATION CRITERIA.

a. **Records Inspection.** Follow inspection procedures detailed in para 2-3a.

b. **Frequency of Inspection.** In addition to Frequency of Inspection criteria found in para 2-3b, arrange for Direct Support to borescope and pullover gage the cannon tube at least once per year.

c. **Condemnation Information.** The M67 cannon tube has a condemnation limit of 2000 EFC rounds. All rounds fired in the M67 have an EFC of 1.0.

Q-4. VISUAL INSPECTION AND CRITERIA FOR VARIOUS TYPES OF DAMAGE.

In addition to the criteria in Chapter 2, the following specific criteria apply to the 90mm M67 recoilless rifle:

a. Notify Direct Support if the following are found:

(1) Cracks anywhere on the cannon tube or breechblock or badly worn sector threads on the breech end of the M67 cannon tube (see Figures Q-2 and Q-3).

(2) Visible dents or out-of-roundness.

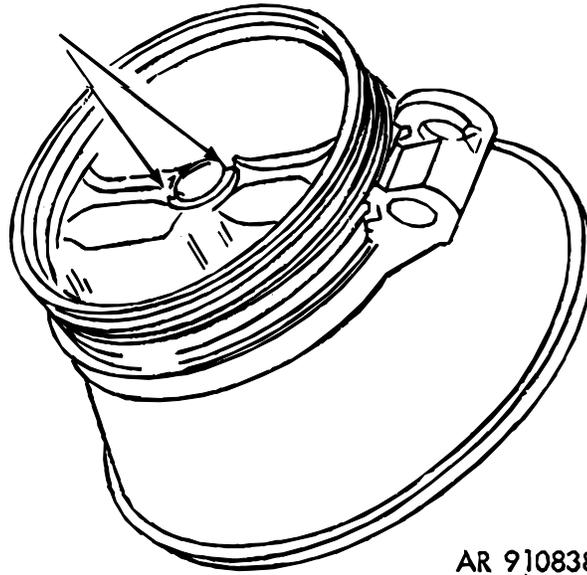
(3) A missing land or stripped/spalled grooves between lands.

(4) Rifle is unbalanced, resulting in forward motion strong enough to cause inaccurate firing.

(5) Internal pits or scores in excess of 0.375 inches and in excess of 0.010 inches in depth.

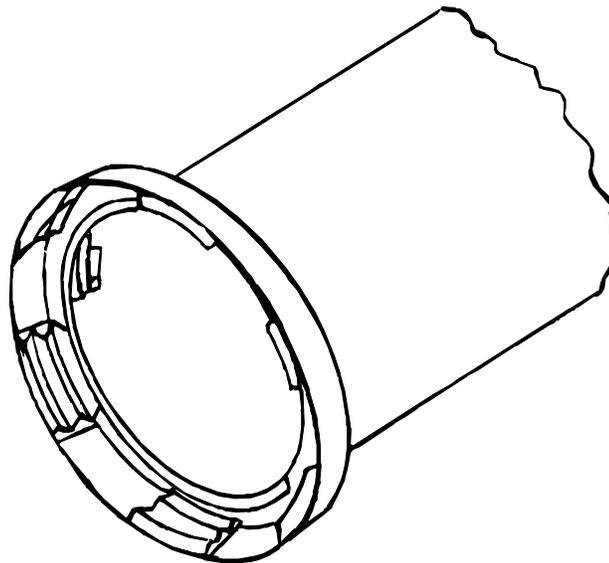
(6) External gouging in excess of 1.5 inches in length or in excess of one-fourth wall thickness of cannon tube.

b. Check weapon record data card, DA Form 2408-4, for rounds fired. If you suspect that the number of rounds listed is incorrect, notify Direct Support.



AR 910838

**Figure Q-2. Cracks in breechblock hole for hammer bushing:
90MM recoilless rifle, M67.**



AR 910839

**Figure Q-3. Breech threads on tube:
90MM recoilless rifle, M67.**

SECTION II. DIRECT SUPPORT INSPECTION

Q-5. EQUIPMENT IDENTIFICATION. See Figure Q-1.



**ENSURE EQUIPMENT RECORD FOLDER NUMBERS
CORRESPOND WITH SERIAL NUMBERS ON WEAPON.
DO NOT CONFUSE NUMBERS WHEN MAKING
ENTRIES.**

Q-6. INSPECTION PROCEDURES AND CONDEMNATION CRITERIA.

a. **Records Inspection.** Follow inspection procedures detailed in para 3-3a.

b. **Missing or Incomplete Records.** Follow procedures detailed in para 3-3b. Identify markings on breechblock (see Figure Q-4) and measure breechblock erosion using radius gage in vent (see Figures Q-5, Q-6, Q-7, Table Q-8) and find estimated remaining cannon tube life.

c. **Frequency of Inspection.** In addition to Frequency of Inspection criteria found in para 3-3c, pullover gage the cannon tube at least once per year.

d. **Condemnation Information.** In addition to Condemnation Information found in this appendix and para 3-3d, the M67 cannon tube has a condemnation limit of 2000 EFC rounds. All rounds fired in the M67 have an EFC of 1.0.

Q-7. VISUAL INSPECTION AND CRITERIA FOR VARIOUS TYPES OF DAMAGE.

In addition to the criteria in para 3-3d, the following specific criteria apply to the 90mm M67 recoilless rifle:

a. Condemn the breechblock if both the hammer bushing and its replacement fall out of the breechblock hole or if cracks around hole are in excess of 0.25 inches in length (see Figure Q-2).

b. Condemn the cannon tube if there is a visible bulge or pullover gage inspection reveals an out-of-round condition or if bore diameter variation at any location exceeds 0.010 inches. Inspect by taking readings 1-inch from muzzle end, 90 degrees apart and at two other random locations in tube bore. Basic bore diameter for the M67 cannon tube is 3.543 inches.

c. Condemn the cannon tube if breech end sectored threads are cracked or worn (see Figure Q-3).

d. Condemn the cannon tube if external gouging is in excess of 1.5 inches in length or exceeds one-fourth wall thickness in depth.

e. **Land Damage.** Condemn the cannon tube if a land is missing or stripped or if land damage may result in shearing or stripping of projectile obturator band.

f. Condemn the cannon tube if internal scoring or pitting exceeds 0.375 inches in length or is in excess of 0.010 inches in depth.

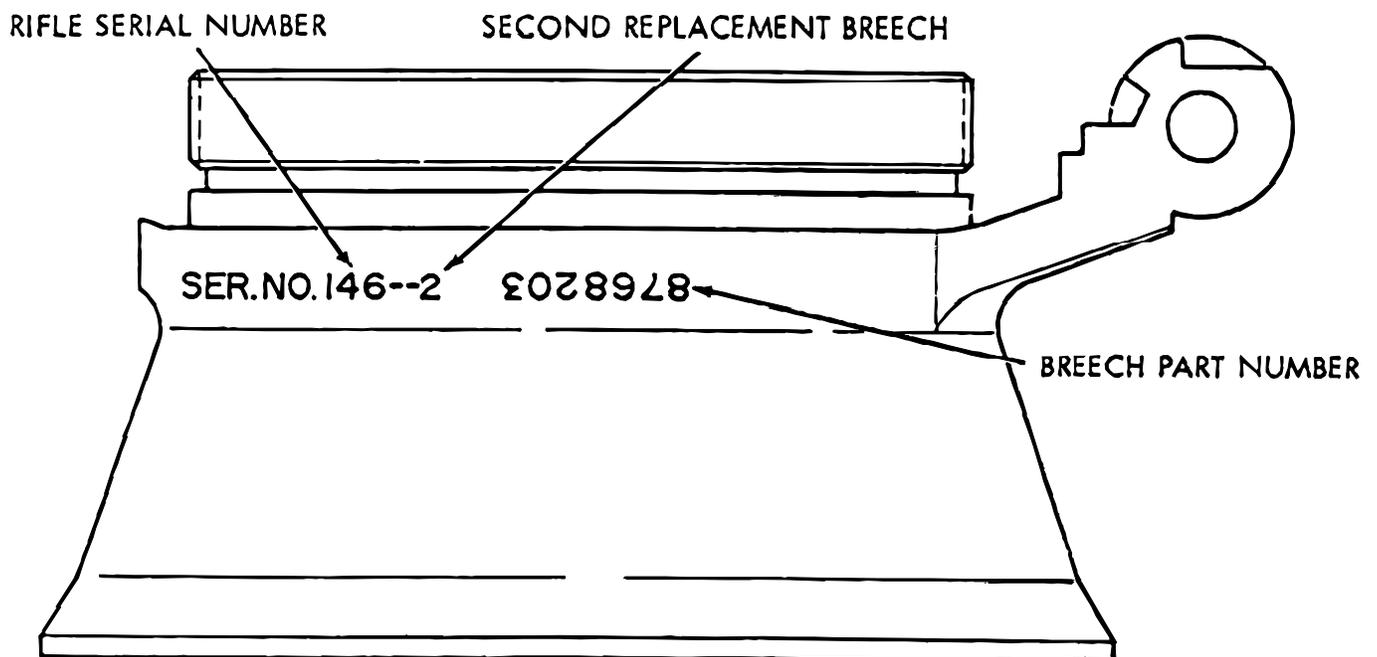
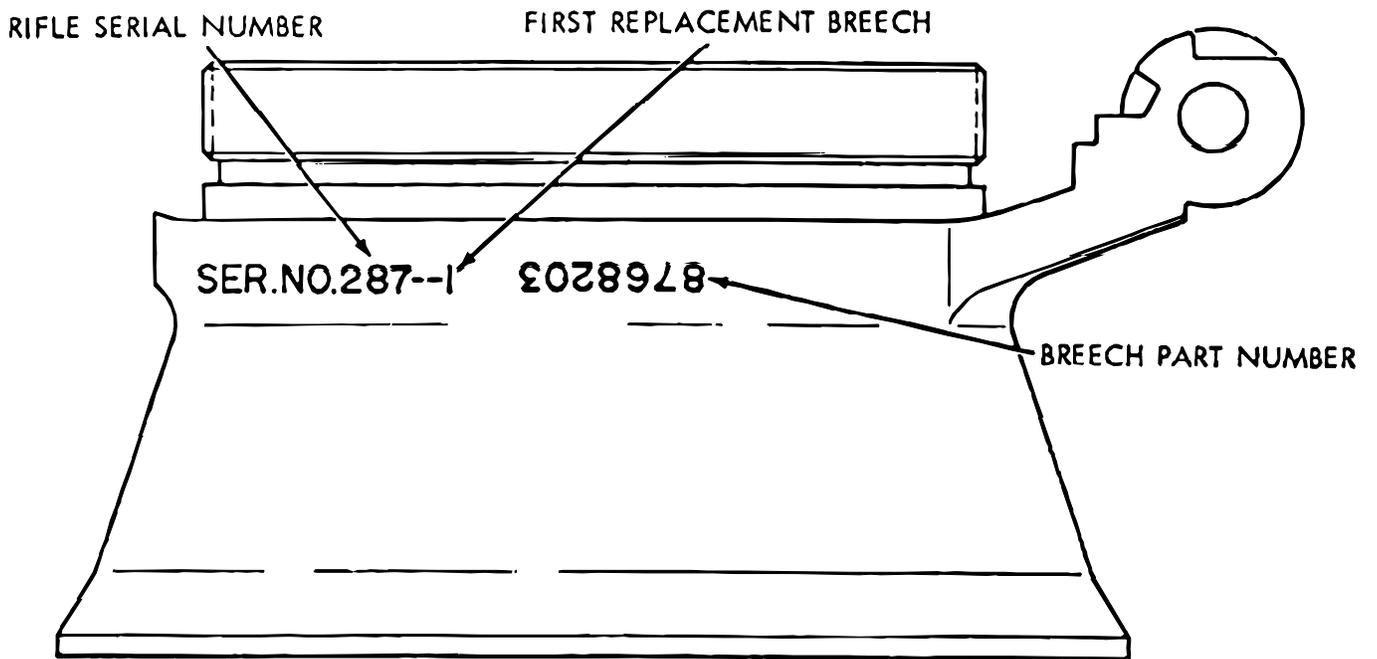
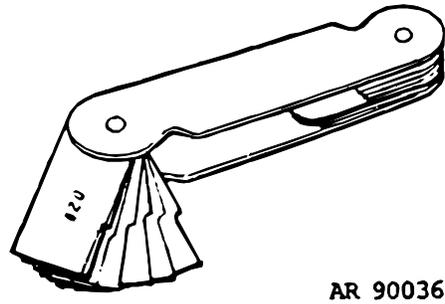
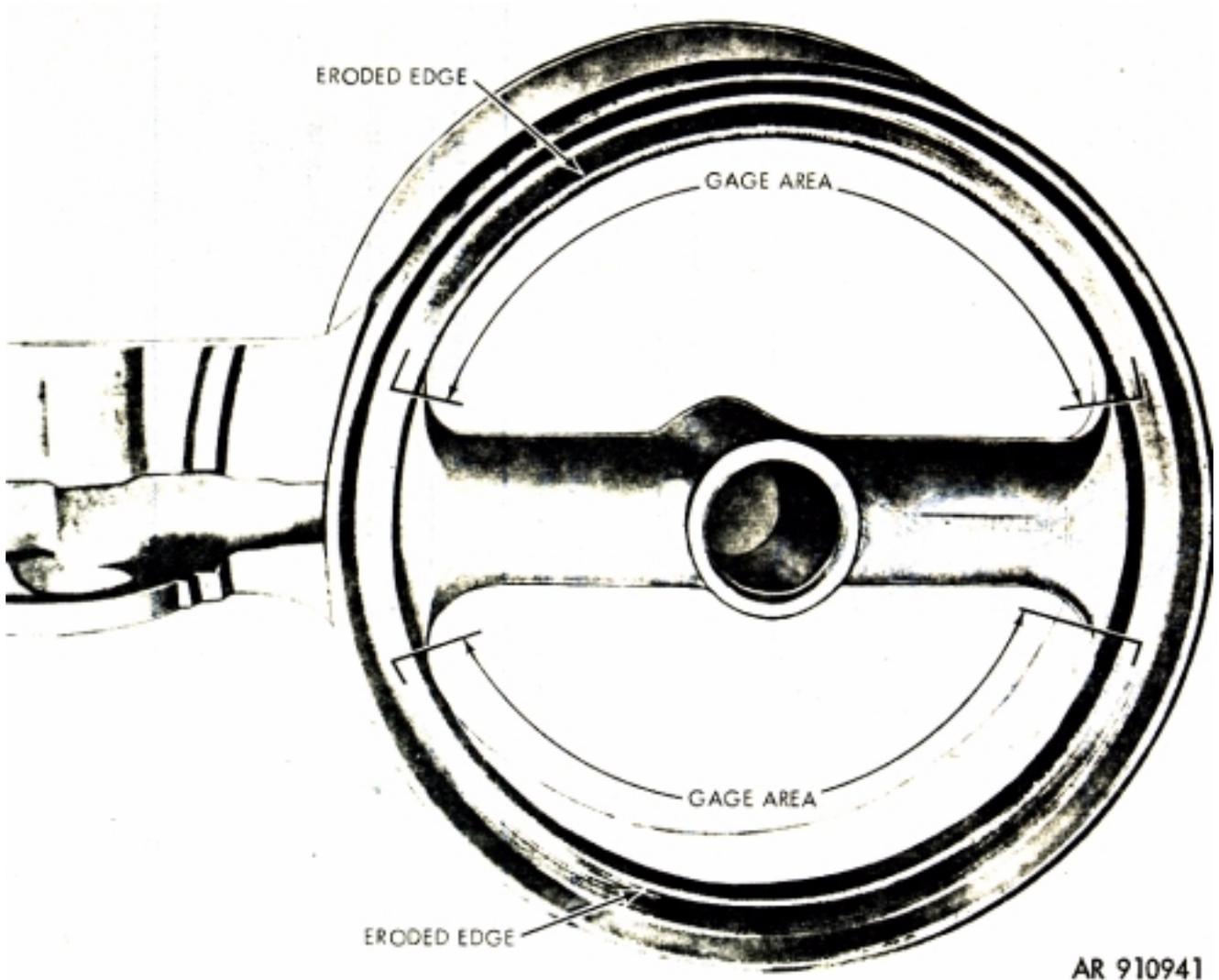


Figure Q-4. Identification of replacement breechblock:
90MM recoilless rifle, M67.



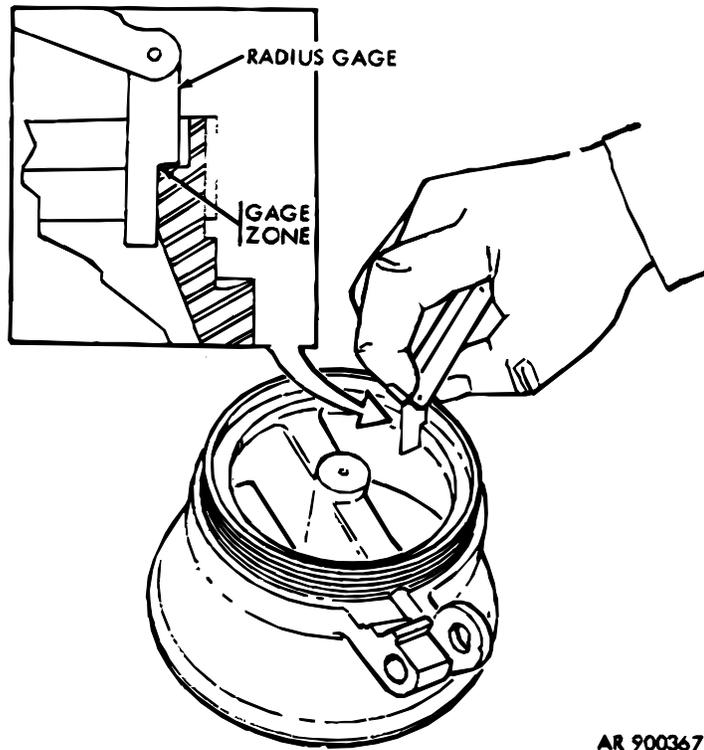
AR 900366

**Figure Q-5. Fillet and radius gage: 90MM recoilless rifle, M67.
(NSN 5210-00-476-8801)**



AR 910941

**Figure Q-6. Breechblock gage area:
90MM recoilless rifle, M67.**



AR 900367

**Figure Q-7. Gaging breechblock erosion:
90MM recoilless rifle, M67.**

TABLE Q-8. ESTIMATES REMAINING LIFE OF 90MM RECOILLESS RIFLE, M67

Edge of radius of breechblock	Estimated remaining roundlife
0.001 to 0.020-Inch	1500 Rounds
0.021 to 0.030-Inch	1000 Rounds
0.031 to 0.040-inch	500 Rounds
0.041-inch and over	0

NOTE

Following condemnation of cannon tube and breechblock, serviceable parts may be removed for use on another rifle according to appropriate DS/GS technical manuals.

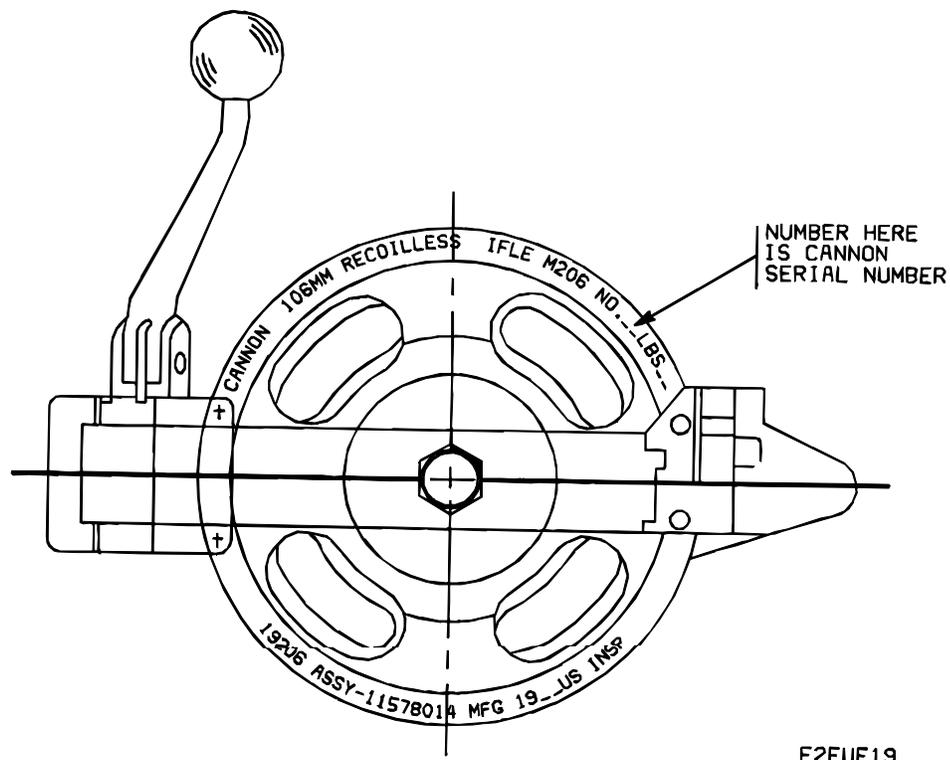
Q-8. DIFFICULT INSPECTION. See para 3-4.

APPENDIX R

Cannon, 106MM Recoilless Rifle: M40 Series

SECTION I. OPERATOR AND UNIT INSPECTION

R-1. EQUIPMENT IDENTIFICATION.



*Figure R-1. Location of cannon tube serial number:
106MM recoilless rifle, M40 series.*

CAUTION

**ENSURE EQUIPMENT RECORD FOLDER NUMBERS
CORRESPOND WITH SERIAL NUMBERS ON WEAPON.**

R-2. CLEANING PROCEDURES.

Clean the chamber area and bore of the cannon tube using cleaning procedures detailed in para 2-2.

R-3. INSPECTION PROCEDURES AND CONDEMNATION CRITERIA.

a. **Records Inspection.** Follow inspection procedures detailed in para 2-3a.

b. **Frequency of Inspection.** In addition to Frequency of Inspection criteria found in para 2-3b, arrange for Direct Support to borescope and pullover gage the cannon tube at least once per year.

c. **Condemnation Information.** The M40 series cannon tube has a condemnation limit of 3000 EFC rounds. All rounds fired in the M40 series have an EFC of 1.0.

R-4. VISUAL INSPECTION AND CRITERIA FOR VARIOUS TYPES OF DAMAGE.

In addition to the criteria in Chapter 2, the following specific criteria apply to the 106mm M40 series recoilless rifle:

a. Notify Direct Support if the following are found:

(1) Cracks anywhere on the cannon tube or breechblock.

(2) Visible dents or out-of-roundness.

(3) A missing land or stripped/spalled grooves between lands.

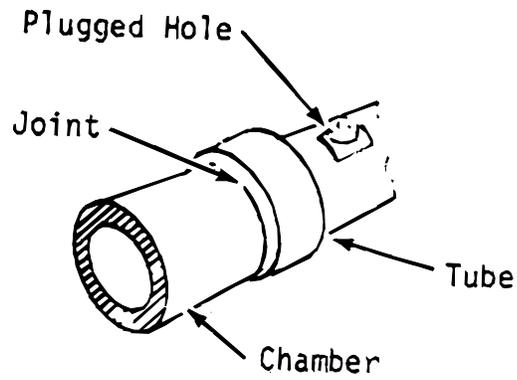
(4) Internal pits or scores in excess of 0.375 inches and in excess of 0.010 inches in depth.

(5) External gouging in excess of 1.5 inches in length or in excess of one-fourth wall thickness of cannon tube.

(6) Evidence of gas leakage at chamber/tube joint or at plugged hole for round indicator (see Figure R-2).

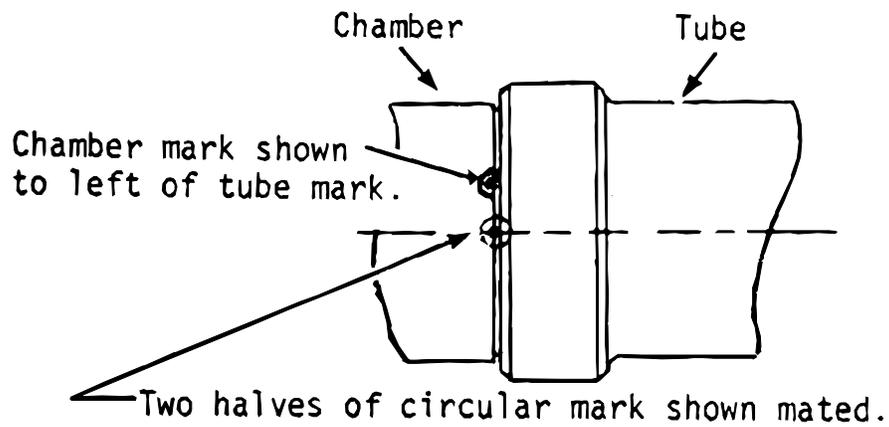
(7) Alignment marks at connection of tube and chamber are not matched (see Figure R-3).

b. Check weapon record data card, DA Form 2408-4, for rounds fired. If you suspect that the number of rounds listed is incorrect, notify Direct Support.



AR 910840

Figure R-2. Plugged hole for round indicator: tube chamber joint: 106MM recoilless rifle, M40 series.



AR 910841

Figure R-3. Alignment mark at tube chamber joint: 106MM recoilless rifle, M40 series.

SECTION II. DIRECT SUPPORT INSPECTION

R-5. **EQUIPMENT IDENTIFICATION.** See Figure R-1.



**ENSURE EQUIPMENT RECORD FOLDER NUMBERS
CORRESPOND WITH SERIAL NUMBERS ON WEAPON.
DO NOT CONFUSE NUMBERS WHEN MAKING
ENTRIES.**

R-6. **INSPECTION PROCEDURES AND CONDEMNATION CRITERIA.**

a. **Records Inspection.** Follow inspection procedures detailed in para 3-3a.

b. **Missing or Incomplete Records.** Follow procedures detailed in para 3-3b. Identify markings on breechblock (see Figure R-1).

c. **Frequency of Inspection.** In addition to Frequency of Inspection criteria found in para 3-3c, pullover gage the cannon tube at least once per year.

d. **Condemnation Information.** In addition to Condemnation Information found in this appendix and para 3-3d, the following special criteria apply:

(1) The M40 series cannon tube has a condemnation limit of 3000 EFC rounds. All rounds fired in the M40 Series have an EFC of 1.0.

(2) The vent assembly has a maximum Life of 1250 EFC rounds allowing for a maximum of three nozzles over the life of the M40 recoilless rifle. If a cannon tube is condemned, and the last nozzle has fired 500 EFC rounds or less, the nozzle may be removed and used on another rifle. Note previous rounds fired in weapon records to ensure proper adjustment of compensating ring.

R-7. **VISUAL INSPECTION AND CRITERIA FOR VARIOUS TYPES OF DAMAGE.**

In addition to the criteria in Chapter 3, the following specific criteria apply to the 106mm M40 series recoilless rifle:

a. Condemn the cannon tube if there is a visible bulge or pullover gage inspection reveals an out-of-round condition or if bore diameter variation at any location exceeds 0.010 inches. Inspect by taking readings 1-inch from muzzle end, 90 degrees apart and at two other random locations in tube bore. Basic bore diameter for the M40 series cannon tube is 4.134 inches. Cannon tube may also be condemned if dummy round cannot be pushed through bore.

b. Condemn the cannon tube if external gouging is in excess of 1.5 inches in length or exceeds one-fourth wall thickness in depth.

c. Land Damage. Condemn the cannon tube if a land is missing or stripped or if land damage may result in shearing or stripping of projectile obturator band.

d. Condemn the cannon tube if internal scoring or pitting exceeds 0.375 inches in length or is in excess of 0.010 inches in depth.

- e. Send rifle and pertinent records to Depot if spotting gun support brackets are misaligned or damaged.
- f. Send rifle and pertinent records to Depot if tube/chamber alignment markings are misaligned to the loosening side (chamber mark left of tube mark when viewed from breech) or in excess of 10 degrees (0.3875 inches) to the tightening side.
- g. Send rifle and pertinent records to Depot if gas leakage is found at chamber/tube joint or past the plugged hole for round indicator (see Figure R-2).

NOTE

Following condemnation of cannon tube and breechblock, serviceable parts may be removed for use on another rifle according to appropriate DS/GS technical manuals.

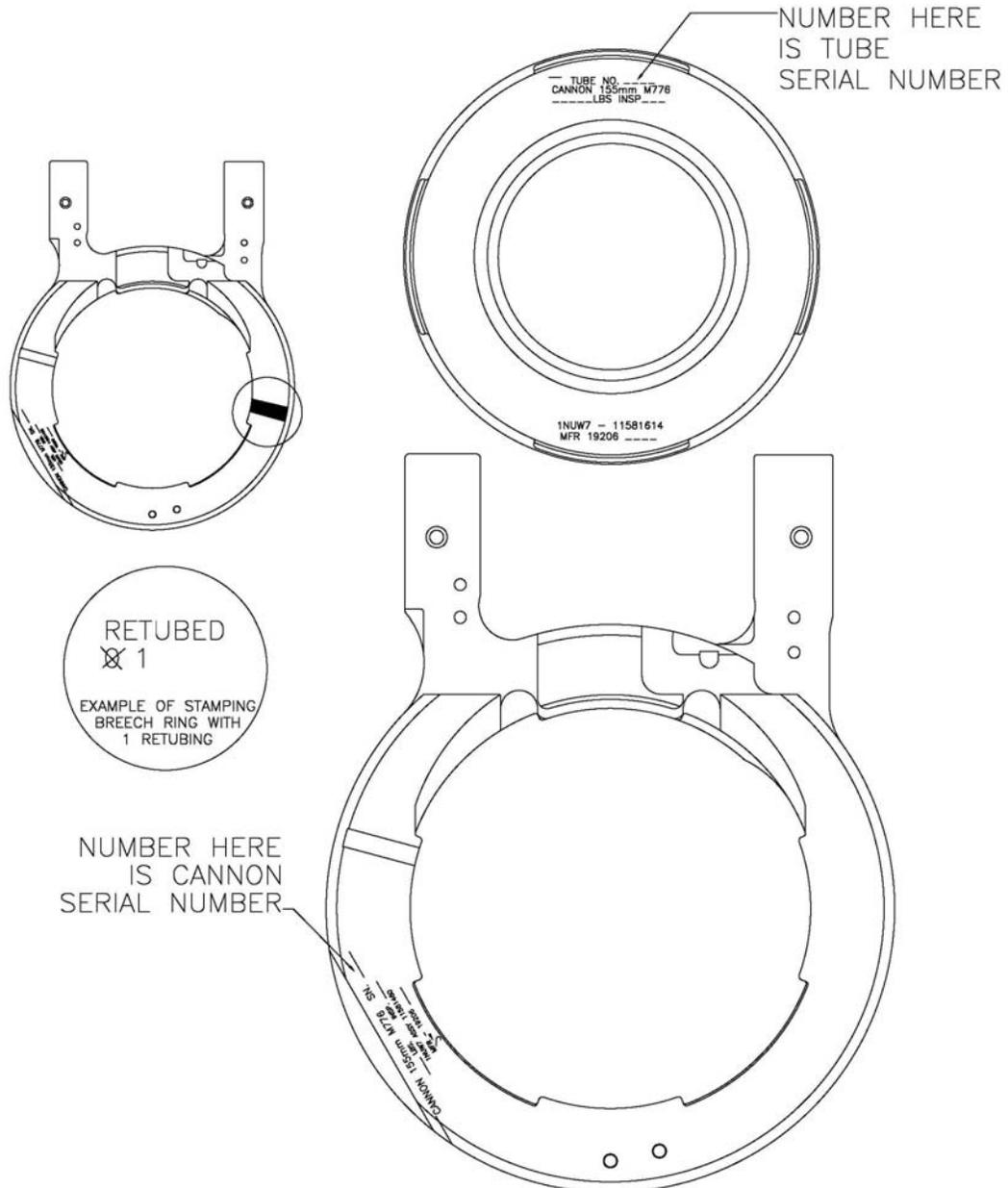
R-8. DIFFICULT INSPECTION. See para 3-4.

APPENDIX S

Cannon, 155MM Howitzer: M776

SECTION I. OPERATOR AND UNIT INSPECTION

S-1. EQUIPMENT IDENTIFICATION.



**Figure S-1. Location of tube and cannon serial number:
155MM howitzer, M776.**

CAUTION

ENSURE EQUIPMENT RECORD FOLDER NUMBERS CORRESPOND WITH SERIAL NUMBERS ON WEAPON. DO NOT CONFUSE NUMBERS WHEN MAKING ENTRIES.

S-2. CLEANING PROCEDURES.

Clean the chamber area and bore of the cannon using the cleaning procedures detailed in para 2-2.

S-3. INSPECTION PROCEDURES AND CONDEMNATION CRITERIA.

a. **Records Inspection.** Follow inspection procedures detailed in para 2-3a.

b. **Frequency of Inspection.** In addition to Frequency of Inspection criteria found in para 2-3b, arrange for Direct Support to borescope the cannon tube at 1000 EFC round intervals. Arrange for Direct Support to pullover gage the cannon tube, first at 1000 EFC rounds, at 1500 EFC rounds, and at each 100 EFC round interval thereafter, or within 180 days prior to firing, whichever occurs first. Neither interval should be exceeded without inspection. With less than 10 percent estimated remaining life, arrange for Direct Support to pullover gage the cannon tube after every firing operation.

c. **Condemnation Information.** In addition to Condemnation Information found in para 2-4, the M776 cannon tube is condemned under a dual criterion of EFC round count and wear. Notify Direct Support when the following conditions are found:

(1) **Round Count.** The safe service life of the M776 cannon tube and muzzle brake is 2650 EFC rounds. Have Direct Support condemn the cannon tube when 2650 EFC rounds have been fired. See Table S-1 for specific ammunition EFC factors.

(2) **Wear.** Wear results from hot propellant gas wash and the passage of projectiles over the bore surface. This results in a uniform wear pattern which is measured by Direct Support using a pullover gage.

(3) **Breech Mechanism.** The breech ring may be retubed a maximum of one time (one plus original tube). After the first retubing the breech mechanism and its component parts shall be condemned. It is important that the component parts of each breech mechanism assembly be kept together during maintenance and inspection and not be interchanged with other assemblies.

(4) Check weapon record data card, DA Form 2408-4, for rounds fired. Refer to DA PAM 750-8 for procedure used in computing estimated remaining life. If you suspect that the number of rounds listed is incorrect, notify Direct Support. When the number of rounds fired is recorded but the ammunition model number is missing, assume 25 percent of fired rounds have an EFC of 0.25 and 75 percent of fired rounds have an EFC of 1.0.

TABLE S-1. AMMUNITION EFC VALUES FOR USE WITH M776 CANNON

<u>CHARGE</u>	<u>ZONE</u>	<u>COLOR</u>	<u>EFC</u>
M203/M203A1	8	Red/Neutral*	1.00 *Combustible Cartridge
M119A1	8	White	0.25
M119A2	7	Red	0.25
M4A2	7	White	0.15
M4A2	3-6	White	0.05
M3A1	3-5	Green	0.05
M231	1	Green	0.05 *Combustible Cartridge
M231	2	Green	0.15 *Combustible Cartridge
M232/M232A1	3	Tan	0.10 *Combustible Cartridge
M232/M232A1	4	Tan	0.25 *Combustible Cartridge
M232/M232A1	5	Tan	1.00 *Combustible Cartridge

S-4. VISUAL INSPECTION AND CRITERIA FOR VARIOUS TYPES OF DAMAGE.

In addition to the criteria in Chapter 2, the following specific criterion applies to the 155mm M776 cannon:

Cracks. Notify Direct Support if cracks of 1 inch or longer are found on the muzzle brake.

SECTION II. DIRECT SUPPORT INSPECTION

S-5. EQUIPMENT IDENTIFICATION. See Figure S-1.

CAUTION

ENSURE EQUIPMENT RECORD FOLDER NUMBERS CORRESPOND WITH SERIAL NUMBERS ON WEAPON. DO NOT CONFUSE NUMBERS WHEN MAKING ENTRIES.

S-6. INSPECTION PROCEDURES AND CONDEMNATION CRITERIA.

a. **Records Inspection.** Follow inspection procedures detailed in para 3-3a.

b. **Missing or Incomplete Records.** Follow procedures detailed in para 3-3b.

c. **Frequency of Inspection.** In addition to Frequency of Inspection criteria found in para 3-3c, borescope the cannon tube at 1000 EFC round intervals. Pullover gage the cannon tube, at 1000 EFC rounds, at 1500 EFC rounds, and at each 100 EFC round interval thereafter, or within 180 days prior to firing, whichever occurs first. Neither interval should be exceeded without inspection. With less than 10 percent estimated remaining life, pullover gage the cannon tube after every firing operation.

d. **Condemnation Information.** In addition to Condemnation Information found in this appendix and para 3-3d, the M776 cannon tube is condemned under a dual criteria of EFC round count and wear, whichever occurs first, as follows:

(1) **Round Count.** The safe service life of the M776 cannon tube is 2650 EFC rounds. Condemn the cannon tube when 2650 EFC rounds have been fired. See Table S-1 for specific ammunition EFC factors.

(2) **Wear.** Condemn the cannon tube when pullover gage inspection shows wear in excess of 0.095 inches at 41.75 inches forward of the rear face of the cannon tube. The original bore diameter of the M776 cannon tube is 6.100 inches.

(3) **Breech Mechanism.** The breech ring may be retubed a maximum of one time (one plus original tube). After the first retubing the breech mechanism and its component parts shall be condemned. It is important that the component parts of each breech mechanism assembly be kept together during maintenance and inspection and not be interchanged with other assemblies.

S-7. VISUAL INSPECTION AND CRITERIA FOR VARIOUS TYPES OF DAMAGE.

In addition to the criteria in para 3-3d, the following specific criteria apply to the 155mm M776 cannon:

a. **Cracks.** Condemn the muzzle brake if cracks of 1 inch or longer are found.

b. **Gas Path Erosion and Gas Check Seating Surface.** Inspect the gas check seating surface of the M776 cannon tube as follows:

(1) Remove all burrs with a medium India stone or equivalent (240 grit or finer).

(2) Clean gas check seat surface of oil, grease, abrasive, or foreign material.

(3) To test for proper seating, using an obturator group in good condition, lightly coat the surface of the split rings with red lead or prussian blue. Close and lock breech. Open breech and examine the imprint of the red lead or prussian blue on tube gas check seating surface for the following conditions:

(a) Condemn the cannon tube if an erosion gas path crosses the gas check seating surface and is 0.003 inches in depth, or deeper (see Figures S-2, S-3, and S-4).

(b) Condemn the cannon tube if the gas check seating surface is damaged (chipped, spalled, indented, nicked, or pitted) so that it does not make full 360 degrees contact with the mating surface on the split rings, or its forward and aft mating surfaces contact less than 80 percent of the forward and aft surfaces of the split rings.

(4) Following inspection, remove red lead or Prussian blue from split ring and gas check seat seating surface by wiping with a clean non-abrasive cloth.

S-8. DIFFICULT INSPECTION. See para 3-4.

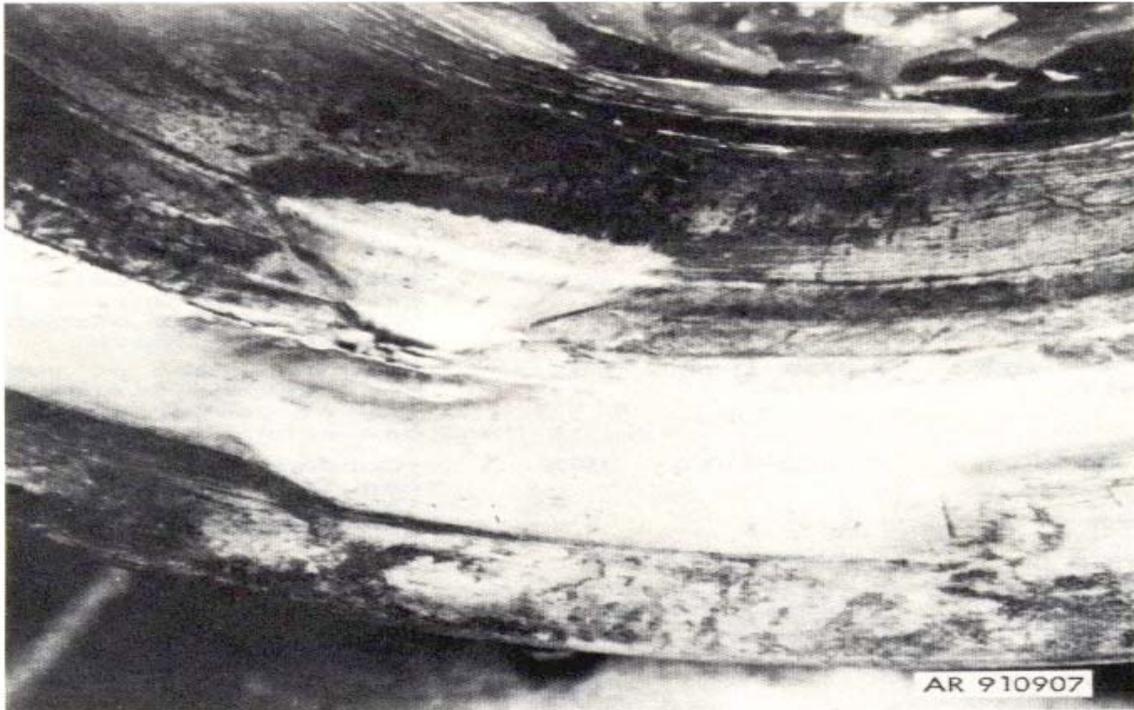


Figure S-2. Groove cut by gas wash across gas check seat: CONDEMN.

NOTE

M185 Cannon spindle and split ring are used for illustration purposes only.



*Figure S-3. Gas wash across one obturator split ring.
CAREFULLY INSPECT GAS SEAT.*

S-8. DIFFICULT INSPECTION - Continued.



*Figure S-4. Gas wash across one obturator split ring.
CAREFULLY INSPECT GAS SEAT.*

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TO: (<i>Forward to proponent of publication or form</i>) (<i>Include ZIP Code</i>) AMSTA-LC-LMIT/ TECH PUBS, TACOM-RI 1 Rock Island Arsenal Rock Island, IL 61299-7630						FROM: (<i>Activity and location</i>) (<i>Include ZIP Code</i>) Your mailing address	
PART I – ALL PUBLICATIONS (EXCEPT RPSTL AND SC/SM) AND BLANK FORMS							
PUBLICATION/FORM NUMBER TM 9-1000-202-14						DATE 1 February 1999	TITLE EVALUATION OF CANNON TUBES
ITEM NO.	PAGE NO.	PARA-GRAPH	LINE NO. *	FIGURE NO.	TABLE NO.	RECOMMENDED CHANGES AND REASON (<i>Provide exact wording of recommended changes, if possible.</i>)	
	3-15			3-16		Damage to many lands: Condemn. Adding "Condemn" to figure title would add clarity to the procedure.	
							
<i>*Reference to line numbers within the paragraph or subparagraph.</i>							
TYPED NAME, GRADE OR TITLE Your Name					TELEPHONE EXCHANGE/AUTOVON, PLUS EXTENSION		SIGNATURE Your Signature

TO: <i>(Forward direct to addressee listed in publication)</i> AMSTA-LC-LMIT / TECH PUBS, TACOM-RI 1 Rock Island Arsenal Rock Island, IL 61299-7630	FROM: <i>(Activity and location) (Include ZIP Code)</i> Your address	DATE Date you filled out this form
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PART II - REPAIR PARTS AND SPECIAL TOOL LISTS AND SUPPLY CATALOGS/SUPPLY MANUALS

PUBLICATION NUMBER TM 9-1000-202-14					DATE 1 February 1999			TITLE EVALUATION OF CANNON TUBES
PAGE NO.	COLM NO.	LINE NO.	NATIONAL STOCK NUMBER	REFERENCE NO.	FIGURE NO.	ITEM NO.	TOTAL NO. OF MAJOR ITEMS SUPPORTED	RECOMMENDED ACTION

PART III - REMARKS *(Any general remarks or recommendations, or suggestions for improvement of publications and blank forms. Additional blank sheets may be used if more space is needed.)*

TYPED NAME, GRADE OR TITLE Your Name	TELEPHONE EXCHANGE/AUTOVON, PLUS EXTENSION	SIGNATURE Your Signature
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THE METRIC SYSTEM AND EQUIVALENTS

LINEAR MEASURE

1 Centimeter = 10 Millimeters = 0.01 Meter = 0.3937 Inch
 1 Decimeter = 10 Centimeters = 3.94 Inches
 1 Meter = 10 Decimeters = 100 Centimeters
 = 1000 Millimeters = 39.37 Inches
 1 Dekameter = 10 Meters = 32.8 Feet
 1 Hectometer = 10 Dekameters = 328.08 Feet
 1 Kilometer = 10 Hectometers = 1000 Meters
 = 0.621 Mile = 3,280.8 Feet
 Millimeters = Inches times 25.4
 Inches = Millimeters divided by 25.4

WEIGHTS

1 Centigram = 10 Milligrams = 0.154 Grain
 1 Decigram = 10 Centigrams = 1.543 Grains
 1 Gram = 0.001 Kilogram = 10 Decigrams
 = 1000 Milligrams = 0.035 Ounce
 1 Dekagram = 10 Grams = 0.353 Ounce
 1 Hectogram = 10 Dekagrams = 3.527 Ounces
 1 Kilogram = 10 Hectograms = 1000 Grams = 2.205 Pounds
 1 Quintal = 100 Kilograms = 220.46 Pounds
 1 Metric Ton = 10 Quintals = 1000 Kilograms = 1.1 Short Tons

LIQUID MEASURE

1 Milliliter = 0.001 Liter = 0.034 Fluid Ounce
 1 Centiliter = 10 Milliliters = 0.34 Fluid Ounce
 1 Deciliter = 10 Centiliters = 3.38 Fluid Ounces
 1 Liter = 10 Deciliters = 1000 Milliliters = 33.82 Fluid Ounces
 1 Dekaliter = 10 Liters = 2.64 Gallons
 1 Hectoliter = 10 Dekaliters = 26.42 Gallons
 1 Kiloliter = 10 Hectoliters = 264.18 Gallons

SQUARE MEASURE

1 Sq Centimeter = 100 Sq Millimeters = 0.155 Sq Inch
 1 Sq Decimeter = 100 Sq Centimeters = 15.5 Sq Inches
 1 Sq Meter (Centare) = 10 Sq Decimeters
 = 10,000 Sq Centimeters = 10.764 Sq Feet
 1 Sq Dekameter (Are) = 100 Sq Meters = 1,076.4 Sq Feet
 1 Sq Hectometer (Hectare) = 100 Sq Dekameters = 2.471 Acres
 1 Sq Kilometer = 100 Sq Hectometers = 1,000,000 Sq Meters
 = 0.386 Sq Mile

CUBIC MEASURE

1 Cu Centimeter = 1000 Cu Millimeters = 0.061 Cu Inches
 1 Cu Decimeter = 1000 Cu Centimeters = 61.02 Cu Inches
 1 Cu Meter = 1000 Cu Decimeters = 1,000,000 Cu Centimeters
 = 35.31 Cu Feet

TEMPERATURE

$5/9 (^{\circ}\text{F} - 32^{\circ}) = ^{\circ}\text{C}$
 $9/5 (^{\circ}\text{C} + 32^{\circ}) = ^{\circ}\text{F}$
 -35° Fahrenheit is equivalent to -37° Celsius
 0° Fahrenheit is equivalent to -18° Celsius
 32° Fahrenheit is equivalent to 0° Celsius
 90° Fahrenheit is equivalent to 32.2° Celsius
 100° Fahrenheit is equivalent to 38° Celsius
 212° Fahrenheit is equivalent to 100° Celsius

APPROXIMATE CONVERSION FACTORS

<u>TO CHANGE</u>	<u>TO</u>	<u>MULTIPLY BY</u>	<u>TO CHANGE</u>	<u>TO</u>	<u>MULTIPLY BY</u>
Inches	Centimeters	2.540	Meters	Feet	3.280
Feet	Meters	0.305	Meters	Yards	1.094
Yards	Meters	0.914	Kilometers	Miles	0.621
Miles	Kilometers	1.609	Square Centimeters	Square Inches	0.155
Square Inches	Square Centimeters	6.451	Square Meters	Square Feet	10.764
Square Feet	Square Meters	0.093	Square Meters	Square Yards	1.196
Square Yards	Square Meters	0.836	Square Kilometers	Square Miles	0.386
Square Miles	Square Kilometers	2.590	Square Hectometers	Acres	2.471
Acres	Square Hectometers	0.405	Cubic Meters	Cubic Feet	35.315
Cubic Feet	Cubic Meters	0.028	Cubic Meters	Cubic Yards	1.308
Cubic Yards	Cubic Meters	0.765	Milliliters	Fluid Ounces	0.034
Fluid Ounces	Milliliters	29.573	Liters	Pints	2.113
Pints	Liters	0.473	Liters	Quarts	1.057
Quarts	Liters	0.946	Liters	Gallons	0.264
Gallons	Liters	3.785	Grams	Ounces	0.035
Ounces	Grams	28.349	Kilograms	Pounds	2.205
Pounds	Kilograms	0.473	Metric Tons	Short Tons	1.102
Short Tons	Metric Tons	0.907	Newton-Meters	Pound-Feet	0.738
Pound-Feet	Newton-Meters	1.356	Kilopascals	Pounds per Square Inch	0.145
Pounds-Inches	Newton-Meters	0.11375	Kilometers per Liter	Miles per Gallon	2.354
Pounds per Square Inch	Kilopascals	6.895	Kilometers per Hour	Miles per Hour	0.621
Ounce-Inches	Newton-Meters	0.007062	°Fahrenheit	°Celsius	$^{\circ}\text{C} = (^{\circ}\text{F} - 32^{\circ}) \times 5/9$
Miles per Gallon	Kilometers per Liter	0.425	°Celsius	°Fahrenheit	$^{\circ}\text{F} = (9/5 \times ^{\circ}\text{C}) + 32$
Miles per Hour	Kilometers per Hour	1.609			
Centimeters	Inches	0.394			

