

December 1995

# ARMY AND MARINE CORPS M198 HOWITZER

## Maintenance Problems Are Not Severe Enough to Accelerate Replacement System





**National Security and  
International Affairs Division**

B-262208

December 27, 1995

The Honorable Floyd Spence  
Chairman, Committee on National Security  
House of Representatives

Dear Mr. Chairman:

As you requested, we obtained information on the Marine Corps' and Army's reported maintenance problems with the M198 155-millimeter (mm) towed howitzer to determine whether these reported problems justify accelerating the development of a replacement weapon. We also obtained information regarding the Marine Corps' and the Army's planned development of a new, light-weight 155-mm howitzer.

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**Background**

Active and reserve Marine Corps artillery units use the M198 howitzer for all direct support, general support, and reinforcing artillery missions. Army light cavalry units use the M198 for direct support, whereas airborne and airmobile infantry units use the M198 only for general support and reinforcing missions. The M198 howitzers, first delivered to the services in 1979, are approaching the end of their 20-year service life.

Marine Corps and Army users of the M198 want to replace the 15,600-pound howitzer with a lighter-weight weapon to ease the operational burden on crews and to improve air and ground mobility. The Marines have found it difficult to tow the M198 over soft terrain, and only their heavy-lift helicopter can move the weapon by air. With the Marine Corps leading the development of a new light-weight howitzer, in September 1995, the two services signed a joint operational requirements document calling for a 155-mm howitzer that (1) weighs 9,000 pounds or less and (2) fires munitions at least 30, but preferably 40, kilometers. Initially, the Marine Corps wanted to accelerate development of a light-weight howitzer to enable fielding by 2001 or earlier but found that acceleration would be too costly. The Marine Corps now plans to field the first light-weight howitzers in fiscal year 2002, and the Army in fiscal year 2005. The Marine Corps wants to buy 598 of the light-weight howitzers and the Army 347. Development and procurement of these weapons is estimated to cost about \$1.4 billion.

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## Results in Brief

By themselves, the maintenance problems with the M198 howitzer do not justify accelerating the development of a replacement. Although Army and Marine Corps users of the M198 have experienced recurring maintenance problems with the howitzer, some of these problems have been resolved, and solutions to most of the remaining problems have been identified but not funded. Even with these problems, availability of the M198 reported by Army and Marine Corps units over the last 6 years averaged about 93 percent and 89 percent respectively.

The Marine Corps believes that the poor mobility of the M198 is a more important reason than maintenance for replacing it with a lighter-weight weapon. However, the anticipated air mobility improvements are dependent on the ability of the MV-22 medium-lift aircraft, now in engineering and manufacturing development, to lift a 9,000-pound howitzer. So far, the developmental aircraft has not shown that it can lift that weight.

Current light-weight howitzer candidates will fire projectiles to 30 kilometers, the same range as the M198. To achieve the objective firing range of 40 kilometers, the weight of the new howitzer would have to be increased, but an increase in weight could negate mobility improvements. A new munition, the XM982, currently being developed by the Army independent of the light-weight howitzer development program and scheduled to become available in fiscal year 1998, is expected to achieve the desired 40-kilometer range. However, it has not yet been tested in the competing light-weight howitzer prototypes.

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## Despite Reported Maintenance Problems, Availability Rates Remain High

Marine Corps and Army users of the M198 howitzer have reported a variety of recurring maintenance problems. Some of the more serious problems have been resolved. According to the Marine Corps and Army weapon system managers, solutions have been identified for most of the other problems, but funds have not been provided to make the fixes. Data compiled from Marine Corps and Army equipment readiness reports indicate that despite these problems, the availability of the M198 has not been substantially affected. Although some units reported availability dropping below 70 percent in some instances, this condition was usually corrected within a few months.

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## Users of the M198 Report Recurring Maintenance Problems

In 1994, a joint Marine Corps and Army team of experts visited five major active duty Marine Corps and Army artillery units to identify and quantify the problems with the M198 howitzer, as reported by using units. This

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team found 15 recurring problems. The most serious recurring problems reported were the following:

- Trunnion bearings were worn or had disintegrated. Worn or disabled bearings affect the alignment of the gun tube and the accuracy of projectiles fired from the howitzer. Improper alignment could cause projectiles to miss the target and could endanger friendly troops.
- When firing the howitzer with the maximum powder charge, cracks were discovered in the towers of the upper carriage. These towers hold the gun tube in place. If the cracks in the towers are too severe, the gun tube could back up too far during recoil and injure the crew.
- Travel locks crack and sometimes break when the M198 is being towed. If the locks were to break completely during movement of the M198, the gun tube could fall to the ground. Broken travel locks may damage the M198's elevation mechanism and equilibrators and make the weapon inoperable.
- Leaks found in recoil mechanism seals could limit howitzer operations. A properly operating recoil mechanism absorbs the shock of the weapon when it is fired and returns the tube to the proper position. Severe leaks might cause metal contact, which could result in seizure of parts and general failure of the recoil mechanism.
- Tires are prone to blowouts because they were not rated to carry the weight of the howitzer. According to the Army weapons manager, during 1994, users of the M198 reported about 25 to 30 blowouts a month. When a blowout occurs, the howitzer cannot be fired, and crews must either wait for a new tire to be mounted by direct support maintenance personnel or use one of the prime mover's tires.

In addition, delays in the delivery of certain parts have had an adverse effect on the availability of the M198 fleet.

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**Some Reported Problems Have Been Resolved, but Others Have Not**

According to the Army and Marine Corps weapons managers who are responsible for maintaining the M198 howitzer, problems with the trunnion bearings, upper carriage towers, and recoil mechanisms have been or are being resolved. They also said that they have identified potential fixes to the travel locks and the tires but have not been provided the funds to implement them.

**Problems Resolved or Being Resolved**

Trunnion bearings can now be replaced by maintenance units located near the users. Until recently, only depot-level repair shops could replace these bearings, but authority to replace the bearings was delegated to the Marine

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Corps' fourth echelon maintenance units and the Army's general support units, which are generally collocated with users.

In January 1994, the Marine Corps and the Army completed a modification intended to keep upper carriage towers from cracking. According to the M198 weapons managers, users have not reported any cracks in the towers since the repairs were completed.

### Unresolved Problems

According to the Department of Defense (DOD), the cause of recoil mechanism leaks is not entirely understood. For howitzers in long-term storage, leaks have been attributed primarily to seals that failed if the mechanism was not exercised regularly. Exercisers for the recoil mechanism are being developed and are expected to be fielded by June 1996. However, the cause of leaks found in howitzers used on a daily basis has not been determined.

According to the Army weapons manager, the Army's Armament and Chemical Acquisition and Logistics Activity (ACALA) has considered installing a shock-absorbing system on the M198 to resolve the problem of cracks in the travel lock area. However, ACALA has not been provided the estimated \$750,000 needed to fully study this potential solution. The manager said that although the Army and Marine Corps could simply strengthen the travel lock area, stress would be transferred to other points of the howitzer that could be more difficult to identify and repair.

Users have asked for better tires for the M198. According to the Army weapon system manager, several manufacturers have recently offered the Army tires that may be capable of supporting the weight of the M-198. The Army is testing these tires. However, the weapons manager has not been provided funds to buy them.

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### Reported Availability of the M198 Remains High

Although recurring maintenance problems are reported, availability data reported by using units to Marine Corps and Army weapons system managers indicate that the M198 fleet has a high availability rate. The availability rate reported by Army users from January 1989 through August 1995 averaged about 93 percent. During the same period the availability rate reported by Marine Corps M198 units averaged 89 percent.

Army artillery unit officials said that the M198 could have relatively high equipment availability rates and recurring maintenance problems at the same time. If a problem can be repaired within 24 hours, it is not reflected

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in equipment readiness reports. Our examination of one active Army battalion's maintenance records (June 1993 to March 1995) showed that seven of its 24 M198s had problems that rendered them inoperable for more than 10 days. Of the seven, two were inoperable for 30 and 39 days, respectively. However, according to the maintenance officer of this battalion, a majority of the problems were fixed within 24 hours.

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## Users and Weapon Managers Differ About the Projected Service Life of the M198

There is no consistent view regarding the state of the M198. Some users of the M198 believe that these weapons will not last until a new howitzer is fielded in fiscal year 2002. Officials of the Army's 18th Field Artillery Brigade expressed concern that the howitzer may not last its expected 20-year service life without a significant life-extension or product improvement program. They said that to reduce maintenance problems and extend the service life of the M198, about half of their oldest weapons are being sent to ACALA to be rebuilt and are being replaced with newer M198s from lower priority Army Reserve and National Guard units.

Similarly, the Marine Corps has begun to rotate newer M198s from maritime repositioning stocks to active artillery units. According to the 1st Marine Division, the M198's 20-year service life is overly optimistic because maintenance problems already identified may be symptomatic of other problems that have not yet been identified. In addition, a former artillery battalion commander of the division noted that the division's M198s receive the greatest use because in addition to providing direct support, general support, and reinforcing missions, they also lend their M198s to other Marine artillery units for training in the rough terrain of 29 Palms, California.

Contrary to the views of Army and Marine Corps users, the Army's M198 weapons manager told us that the M198 can be maintained in service indefinitely, since direct or general support repair facilities can replace almost all parts, and enough M198-unique parts are available to meet the services' peacetime needs for 2-1/2 years. However, according to DOD, nonavailability of common user parts procured and distributed by the Defense Logistics Agency has created some significant delays in the repair of some M198s.

The Marine Corps' weapons manager does not believe that the M198s can be sustained indefinitely but said that recent initiatives to repair major problems have improved the availability of the howitzer. Availability rates

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for the Marines' M198s have remained above 91 percent from May through August 1995.

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## The Army and Marine Corps Are Developing a Lighter-Weight Howitzer

According to users, Marine Corps doctrine, and systems development officials, poor mobility of the M198 is the main reason requiring its replacement. A new, light-weight howitzer, currently in development, is expected to be easier to operate and move on the ground and in the air. However, a howitzer weighing 9,000 pounds may not be capable of firing munitions any farther than the M198. To achieve ranges beyond those of the M198, the new howitzer would have to be made heavier, or a new family of extended-range munitions would need to be developed. The XM982, an extended-range rocket-assisted projectile currently being developed under a separate program and expected to be usable in the new howitzer, may achieve the desired 40-kilometer range.

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## Moving the Heavy M198 Around the Battlefield Is Difficult

The 5-ton truck assigned as the Marine Corps' prime mover of the M198 has difficulty towing the 15,600-pound howitzer over soft terrain such as sand. According to an artillery systems development official, although the Gulf War was the perfect situation for artillery because there was no mud, the Marine Corps found it difficult to move the M198 by land and air during Operation Desert Storm. To resolve the problem, the Marine Corps is remanufacturing its 5-ton truck fleet with a stonger power train and a 22,000-pound towing capacity, which will allow it to move the M198 over most types of terrain. This program is funded, and the first remanufactured vehicles are expected to be delivered in fiscal year 2001.

The Marines can now airlift the M198 only with its CH-53E heavy-lift helicopter and only under optimal weather conditions. The Marine Corps has assumed that its new medium-lift aircraft now in engineering and manufacturing development, the MV-22 Osprey, will be able to lift the new light-weight howitzer. However, Osprey prototypes have not demonstrated that they can lift the required 8,300 pounds or demonstrated their ability to lift actual cargo.<sup>1</sup> Program officials are optimistic that the Osprey will be able to lift a 9,000-pound load safely but told us that they do not know whether a howitzer can be made sufficiently aerodynamic and stable to allow for its safe movement by the Osprey.

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<sup>1</sup>Navy Aviation: V-22 Development—Schedule Extended, Performance Reduced, and Costs Increased (GAO/NSIAD-94-44, Jan. 13, 1994).



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Although it uses the same truck, the Army has had fewer problems towing the M198 than the Marine Corps. The Army's 18th Airborne Corps successfully transported the M198 in the sand throughout Operation Desert Storm. Army and Marine Corps officials told us that the reason for the difference may lie in how the two services use the M198. The Marine Corps uses the M198 for direct support and general support missions. The direct support mission requires the M198 units to closely follow supported units, often over difficult terrain. The Army uses the M198 only for general support missions, which may allow firing units to avoid difficult terrain.

The Army has no problem lifting the M198 with its medium-lift CH-47D helicopter, a system the Marine Corps does not own. The CH-47D can lift up to 22,000 pounds of cargo and easily carries the M198, its crew, and a limited load of ammunition, in all but the hottest weather.

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### Light-Weight Howitzer May Not Fire Any Farther Than the M198

The Army and Marine Corps have been testing two light-weight howitzer prototypes, and a third is expected to be available for a shoot-off in fiscal year 1996. While these prototypes are expected to meet the weight requirement, they probably will not fire beyond 30 kilometers. DOD said that targets beyond 30 kilometers can be attacked with the extended range Multiple Launch Rocket System, by aircraft, or by a new rocket-assisted projectile currently in development.

According to the Joint Operational Requirements Document (JORD) for a new light-weight howitzer, it must be able to fire projectiles 30 kilometers, which is the same range as the M198's. The Army agreed to this range, although it had initially desired a light-weight howitzer with a range of up to 40 kilometers to enable counterfire against other countries' artillery that can currently fire to that distance. The JORD now states that 40 kilometers is the desired range.

However, views within the Marine Corps artillery community have differed on what the range should be. On one hand, several Marine Corps officials told us that mobility is the primary reason for wanting a lighter-weight howitzer. Those artillerymen with a direct support mission favored mobility over range. On the other hand, artillerymen with general support and reinforcing missions said they need additional range to accomplish their counterfire mission. One artillery battalion commander told us that the Marine Corps should not invest in a new howitzer that will not fire projectiles to distances significantly greater than the M198.

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Not having the mobility problems of the Marine Corps, the Army had wanted to take a more measured approach to the development of a light-weight howitzer to gain additional range. However, according to an official of the Program Executive Office for the light-weight howitzer development program, the Army concluded that insistence on a 40-kilometer range could delay the howitzer's development up to 3 years. To avoid such a delay, the Army and Marine Corps agreed that the JORD would specify a minimum range of 30 kilometers and a desired range of 40 kilometers.

According to DOD, technical and simulation work led to the determination that the optimal range for a towed weapons system is 30 kilometers. The JORD working group, composed of user representatives and technical experts, determined that a towed howitzer weighing 9,000 pounds and firing 40 kilometers was not technically feasible. In addition to requiring a longer development time, achieving a 40-kilometer range would require a propellant development program, which would greatly increase the cost and risk of the light-weight howitzer development program.

Under another program, the Army is developing the XM982, a 155-mm rocket-assisted projectile that is expected to fire to a range of 40 kilometers. Since the XM982 is not to be a precision-guided projectile, it will not be used for close support missions. If it successfully reaches the desired 40-kilometer range, the XM982 will primarily be used for counterfire missions.

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## Agency Comments and Our Evaluation

In written comments (see app.I) DOD agreed that maintenance problems of the M198 alone do not warrant accelerating a replacement and stated that accelerating the acquisition strategy would be cost prohibitive.

DOD disagreed on two counts with our conclusion that even with the remaining problems the M198 availability rate remains high. First, DOD stated that operational reliability of the M198 over the last 2 years provides a much more realistic picture than the average availability we calculated for a 6 year period. Army officials said that operational reliability refers to the reliability of individual parts of the M198. However, according to the Army weapons manager, operational availability data on the M198 fleet is incomplete because it has not been systematically collected. He said that the availability data reported in the Unit Readiness Reporting system remains the most reliable indicator of the condition of the M198 fleet.

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Second, DOD said that the variability, rather than the average, of the operational reliability and availability should be considered. DOD said that between April 1991 and June 1994, the average availability rate for Army units was 91 percent and for generally the same period the rate for the Marine Corps was 88 percent. However, DOD said that during these periods, the rate dropped to 72 percent in some Army and 69 percent in some Marine Corps units. Our review of Army data indicates that the lowest availability rate reported for the overall M198 fleet was 80.7 percent in the fourth quarter of fiscal year 1991, but that the rate recovered to 91.7 percent the following month. Individual Army battalions and separate batteries reported availability rates as low as 37 percent for any one month, but in all cases, including for school support and reserve component units, availability was restored to levels above 90 percent within 3 months.

We did not review availability reports from individual Marine Corps battalions and batteries but analyzed average monthly availability rates of M198s reported to the weapons manager by each of the four Marine Expeditionary Forces (MEF) from May 1993 through September 1995. According to this data, the lowest availability rate was 68.1 percent, as reported by the 2d MEF in June 1993. However, this unit reported a 90.3 percent availability 3 months later.

DOD stated that we appear to argue against the need for the light-weight howitzer. We were not asked for and are not offering an opinion about whether a lighter-weight howitzer is needed. Our objectives were to determine whether maintenance problems with the M-198 justify accelerating the development of a replacement and to describe the current light-weight howitzer development program.

Technical comments provided by the DOD have been incorporated in this report as appropriate.

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## Scope and Methodology

To obtain information on the current status of the M198 howitzer, we interviewed officials and reviewed documents from the Office of the Assistant Deputy Chief of Staff of the Army for Operations and Plans in Washington, D.C.; the Marine Corps Combat Development and Marine Corps Systems Commands in Quantico, Virginia; the U.S. Army Armament and Chemical Acquisition and Logistics Activity, Rock Island, Illinois; and the Marine Corps Logistics Base, Albany, Georgia. We obtained an operational perspective and discussed maintenance issues with officials

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from the Army's 18th Airborne Corps and its subordinate units at Fort Bragg, North Carolina, and Fort Campbell, Kentucky, and with officials from artillery and support units of the 1st and 2nd Marine Divisions at 29 Palms, California, and Camp Lejeune, North Carolina. Finally, officials of the Joint Program Management Office, at Picatinny Arsenal, New Jersey; the Army staff; and the Army Field Artillery School, Fort Sill, Oklahoma, provided us with information on the Lightweight 155-mm Howitzer and XM982 development programs.

We conducted our review between May and October 1995 in accordance with generally accepted government auditing standards.

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We are sending copies of this report to the Secretary of Defense, the Secretaries of the Army and the Navy, and the Commandant of the Marine Corps.

Please contact me at (202) 512-3504 if you have questions about this report. The major contributors to this report are listed in appendix II.

Sincerely yours,



Richard Davis  
Director, National Security  
Analysis

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# Comments From the Department of Defense



ACQUISITION AND  
TECHNOLOGY

## OFFICE OF THE UNDER SECRETARY OF DEFENSE

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21 SEP 1995

Mr. Richard Davis  
Director, National Security Analysis  
National Security and International Affairs Division  
U.S. General Accounting Office  
Washington, DC 20548

Dear Mr. Davis:

This is the Department of Defense (DoD) response to the General Accounting Office (GAO) draft report, "ARMY AND MARINE CORPS M-198 HOWITZER: Maintenance Problems Do Not Warrant Acceleration of a Replacement," dated July 31, 1995 (GAO Code 701070) OSD Case 9989. The DoD partially concurs with the report.

The DoD agrees that maintenance problems alone do not warrant accelerating the replacement system, and the DoD found that accelerating the acquisition strategy would be cost prohibitive. The light-weight 155mm howitzer program manager structured the acquisition strategy to deliver a replacement system for the M198 at the projected end of its useful life, in FY 2002. The Milestone Decision Authority approved this acquisition strategy at the Milestone 0 Review and directed the project manager to explore, if practical, a more streamlined approach that would allow fielding the replacement howitzer as early as feasible. After careful analysis, the project manager determined that FY 2002 is the earliest date the Initial Operating Capability can be achieved. As costs would not be reduced, but rather, would increase by accelerating the light-weight 155mm howitzer program, the accelerated acquisition strategy was not pursued.

The DoD disagrees with the GAO conclusion that even with the remaining problems the M198 availability rate remains high. The GAO reported the M198 availability rate of 90 percent for the Marine Corps and 93 percent for the Army, calculated over a 6-year time period. Operational reliability of the M198 over the last 2 years provides a much more realistic picture, as the systemic maintenance problems have increased as the system aged. Further, the variability of, more so than the average of, the operational reliability and availability should be considered. The Army Research Laboratory determined the Army readiness rate for every month between April 1991 and June 1994. While the calculated average of 91 percent compared favorably with the GAO reported rate of 93 percent, the rate actually dropped as low as 72



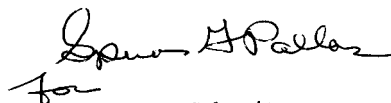
**Appendix I**  
**Comments From the Department of Defense**

percent during this period. For the Marine Corps, the readiness rate was determined for each month between May 1991 and August 1994. The average Marine Corps readiness rate was 88 percent. The rate, again, compared favorably with the GAO reported rate of 90 percent, but readiness rates dropped as low as 69 percent during this period.

The DoD does not agree with the GAO characterization of the range and weight requirements. It appears that the GAO is making an argument against the need for the designated replacement, the light-weight 155mm howitzer. The Joint Operational Requirements Document (JORD) for the howitzer was approved by the USMC on June 27, 1995 and is currently being staffed in the Office of the Deputy Chief of Staff for Operations and Plans; final approval is expected imminently. Throughout the draft report, the GAO emphasizes the Army and Marine Corps need or desire for a light howitzer weighing 9,000 to 10,000 pounds that fires to a range of 40 kilometers. The JORD requires that the new howitzer weigh no more than 9,000 pounds and fire assisted projectiles to at least 30 kilometers. While an objective range of 40 kilometers is listed in the ORD, the light weight 155mm howitzer must achieve a range of 30 kilometers and weigh no more than 9,000 pounds.

In conclusion, the DoD agrees that while maintenance problems alone do not necessitate the acceleration of a replacement for the M198, nonetheless, the increasing burden and cost of maintenance considered in conjunction with the current operational deficiencies -- inadequate lift capability and declining availability and reliability -- of the M198 provide ample justification for a replacement system at the end of the M198 useful life, in FY 2002.

Technical comments were provided separately to the GAO staff. The Department appreciates the opportunity to review the draft report.



for  
George R. Schneider  
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