

# ARCHIVED REPORT

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## PAQ-3 (MULE) - Archived 2/97

### Outlook

- Deliveries complete 1988
- Program transitioned to spares support

### Orientation

**Description.** The PAQ-3, also known as the Modular Universal Laser Equipment (MULE), is a man-portable laser designator/rangefinder.

**Sponsor**

US Army  
Missile Command  
Redstone Arsenal, Alabama (AL)  
USA  
(Executive agency for USMC)

**Contractors**

GM Hughes Electronics Corp  
Hughes Aircraft Co  
Electro-Optical and Data Systems Group  
El Segundo, California (CA)  
USA

**Status.** Spares support.

**Total Produced.** A total of 380 systems were produced.

**Application.** The PAQ-3 is used as a rangefinder/designator for laser-guided weapons and conventional artillery by the US Marine Corps.

**Price Range.** Approximately US\$102,000.

### Technical Data

Characteristics

	<u>Metric</u>	<u>US</u>
Weight:		
Laser	7.264 kg	16.0 lb
Battery	2.043 kg	4.5 lb
System	9.307 kg	20.5 lb
Tripod	7.945 kg	17.5 lb

System with tripod	17.252 kg	38.0 lb
Output Energy:	80 MJ Minimum	
Beam Divergence:	250 urad Maximum	
Coding:	Tri-Service band I, II	
Duty Cycle:	50 percent at all rates	
Remote Operation:	Requires special adapters	
Day Sight:		
Magnification	10 X	
Field of View	4°	
Night Sight Interface:	TAS-4	
Environmental:		
Operating Temperature	-25° F to + 25° F	
Storage Temperature	-50° F to +160° F	

**Design Features.** Approximately 80 percent of the PAQ-3's components come from other systems. From the PAQ-1 (laser target designator) it takes the laser transmitter and electronics, with a change in output optics to meet different beam characteristic needs. From the GVS-5 (hand-held laser rangefinder) it takes rangefinder components such as the detector, video amplifier, range counter/display, and low- voltage power supply. From the TVQ-2 (ground laser locator designator) it takes tripod design concepts. (See separate TVQ-2 report.)

The MULE has three basic modules. These are the laser designator/rangefinder module, the north-finding module, and the stabilized tracking tripod module (multifunctional). The designator/rangefinder can be hand-aimed for target designation or rangefinding by detaching it from the tripod. The tripod shows range, azimuth, and target elevation angle on a viscous liquid damped platform for the precise tracking of moving targets. The north-finding module is a small gyrocompass that locates true north to give azimuth accuracy.

**Operational Characteristics.** For instant target ranging, an operator manually trains the PAQ-3 on the target, using the telescopic sight for precise aim. As the operator fires a laser beam, the PAQ-3 measures the time the beam takes to reach the target and return. The system's computer multiplies half the elapsed time by the speed of light and immediately displays the range on a digital readout.

Azimuth and elevation coordinates are automatically determined and displayed by the tripod. Along with range, this information can be sent quickly, in digital form, to a fire control center via a digital communication terminal (PSC-2), or relayed to an artillery battery by voice channel. Target illumination for laser-guided weapons is achieved simply by training the sights on the target and triggering the laser beam. The reflected beam is then followed to the target by the various compatible munitions, such as the Laser Maverick and HELLFIRE missiles, Copperhead 155 mm artillery projectiles, the Navy's shipboard five-inch guided projectile, and also laser-guided bombs. It also pinpoints targets for aircraft equipped with laser spot trackers.

MULE met or exceeded all environmental and operational requirements during its far-ranging first-article testing. It is also one of three similar ground laser designator rangefinders (all made by Hughes) that meet full US military specifications. Hughes greatly expedited the required test program by fabricating two proof-of-manufacturing models that verified the design and the production process and also showed in advance the areas that needed fine tuning.

According to Hughes, developmental tests of the PAQ-3 lasted for the equivalent of more than 25,000 laser-guided weapon missions without a failure. With a TAS-4 thermal imager, the PAQ-3 can operate at night or in smoke.

## Variants/Upgrades

Product Improved Program. A lighter version of the MULE is now available. The weight of the laser and battery components has been reduced from 20.5 pounds to

15 pounds. Output energy has been improved from 80 to 85 MJ minimum. Remote operation now is via a built-in remote interface, rather than requiring special adapters.

The electronics housing and tripod are constructed from composite materials. The lightweight version uses longer-life lithium batteries. It also has provisions to mount the

new PAS-13 Thermal Weapon Sight in lieu of the TAS-4 night sight.

## Program Review

**Background.** In 1975, the Marine Corps expressed a need for a laser designator compatible with the Navy's precision-guided munitions. Since the Department of Defense had expressed a desire that all services coordinate their laser programs to cut down on the developmental costs, the Marines initially looked at the Army's TVQ-2. However, at 52 pounds, it was found to be too heavy for the Marines' needs. The Marines then successfully combined the best features from the PAQ-1, the GVS-5, and the TVQ-2 in MULE, with the end result of significant cost-of-ownership savings.

The MULE has received as many darts as it did laurels following its use in Operation Desert Storm. It was used with fine results to provide the laser designation spot needed to guide precision munitions such as the Hellfire, Copperhead, and laser-guided bombs. Even with aircraft that have onboard trackers, the MULE was necessary to mark targets so the pilots could locate them quickly and precisely to use conventional weapons. It also proved an excellent tool for determining direction and vertical angle (as well as range) to targets. On the down side, the Marine Corps decided the device was too heavy and cumbersome to be used in sustained combat operations, a down side that has apparently cost it favor in the Corps.

In FY92, the Marines initiated development of a second-generation design, known as the Lightweight Laser Designator/Rangefinder (LLDR) that can be carried and operated by a single soldier. According to a notice in the June 26, 1992, Commerce Business Daily, the LLDR design will be 40 percent lighter than the 38.5-pound MULE. Tactical and technical performance of the MULE were to be retained or improved in the LLDR, and Hughes was expected to offer the product Improved MULE for the LLDR requirement.

Since then, an industry competition for the LLDR was launched in mid-FY94. In compiling its wish list for a "dream system," the Marines also indicated their displeasure with the short life of the PAQ-3's nickel cadmium batteries, its "limited designation stand-off range (2.5 km against moving tanks)," and training restrictions caused by the eye-hazardous laser rangefinder beam. Optimally, the new device will be two-man portable and one-man operable, and will allow quick mounting and operation aboard a stationary vehicle with a threshold designation of at least three kilometers for moving armored targets, and five kilometers against stationary ones.

## Recent Contracts

<u>Contractor</u>	<u>Award (\$ millions)</u>	<u>Date/Description</u>
Hughes	22.8	Dec 1984 — Modification to previously awarded contract for 115 MULEs and associated engineering services (DAAH0183-C-A118).
Hughes	1.4	Sept 1985 — Various spare and repair parts for MULE (DAAH01-84-G-A0120, 011).
Hughes	3.4	Jun 1986 — Modification to contract for 22 fault isolation sets, 22 external power supplies and various quantities of spare parts for MULE (DAAH01-83-C-A118).
Hughes	40	Aug 1987 — Order for 37 transmitters for MULE (DAAH01-84-G-A012).

## Timetable

1975	Marine Corps began development of a laser designator compatible with the Navy's precision-guided munitions
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	1976	Engineering Development phase began
Apr	1977	Hughes received a US\$2.2 million initial obligation for MULE Engineering Development models
	1981	Operational testing under simulated combat conditions at the USMC Ground Combat Training Center, Twenty-nine Palms, CA
	1981	Additional engineering development
	1983	Full-scale production began
	1984	132 North Finding Modules produced by Sperry
	1985	Product improvement effort commenced; investigated training device alternatives
	1986	Began fielding of MULE; contracted for a selected training device; continued MULE product improvements
	1987	Field training device; continued MULE product improvements
Jan	1988	Completion of deliveries of 380 MULEs contracted for by the USMC
	1988	Downsized version of MULE introduced
	1991	MULE used extensively in Operation Desert Storm
	1994	Competition begins for MULE replacement

## Worldwide Distribution

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In service with the US Marine Corps only.

## Forecast Rationale

With deliveries completed in January 1988, PAQ-3 production activity has transitioned to supporting the US Marine Corps inventory of the MULE. With a recent push toward a new LLDR rather than simply a lighter MULE,

the MULE system has been effectively killed. Unless it is resurrected over the next 12 months, this report will be deleted.

## Ten-Year Outlook.

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The MULE program has transitioned to spares support.