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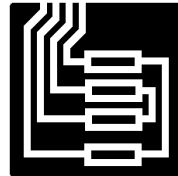
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Boeing CH-46/Model 107

Outlook

- \$188.2 million GASSP effort likely to be final major program
- H-46 saw heavier use than anticipated in Iraq and Afghanistan

Note: Icons indicate area(s) of current and potential retrofit/modernization activity



Orientation

Description. Tandem-rotor, twin-engine, utility transport helicopter.

Licensee. Kawasaki Heavy Industries Ltd, Aircraft Group, Gifu, Japan (KV-107).

Current Status. Boeing production completed in 1971. Kawasaki KV-107 production ended in 1990.

Total Produced. U.S. production totaled more than 650 units. Kawasaki delivered a total of 160 units.

Application. Transport, search and rescue.

Price Range. SR&M kits for U.S. Navy and Marine Corps CH-46 aircraft cost approximately \$760,000 per kit (1986 figure).

Contractors

Prime

Boeing	http://www.boeing.com , 100 N Riverside, Chicago, IL 60606 United States, Tel: + 1 (312) 544-2000, Fax: + 1 (312) 544-2082, Prime
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Boeing CH-46/Model 107

Technical Data

(KV-107-II A-2)

	<u>Metric</u>	<u>U.S.</u>
Dimensions		
Length overall, both rotors turning	25.40 m	83.31 ft
Height to top of rear rotor head	5.13 m	16.83 ft
Rotor diameter (each)	15.24 m	50.0 ft
Weight		
Empty, equipped	5,250 kg	11,574 lb
Fuel weight		
Standard sponson tanks	1,032 kg	2,275 lb
Auxiliary tank	493 kg	1,087 lb
Extended-range tank	3,061 kg	6,748 lb
Performance (a)		
Never-exceed speed	270 kmph	146 kt
Max speed (b)	254 kmph	137 kt
Service ceiling	5,183 m	17,000 ft
Range		
Standard fuel	357 km	192 nm
Max fuel	1,097 km	592 nm
Propulsion		
Two General Electric CT58-140-1 turboshafts		
Thrust (each)	1,044 kW	1,400 shp
or		
Two Ishikawajima-Harima CT58-IHI-140-1		
Thrust (each)	1,044 kW	1,400 shp

(a) At 8,618 kg (19,000 lb) AUW.

(b) At sea level, normal rated power.

CH-46 Sea Knight

Source: Boeing

Boeing CH-46/Model 107

Program Review

A prototype of the Vertol Aircraft Corp Model 107 first flew in April 1958. Boeing's initial aim was to market the aircraft, a turboshaft-powered transport helicopter, to the civilian sector. However, during the design process, special attention was paid to ensuring that the helicopter would also be suitable for military use. This proved to be prescient.

Refinements to the basic design resulted in the YHC-1A configuration. The U.S. Army, the U.S. Navy, and seven military agencies from other countries carried out flight evaluations of both the YHC-1A and the Model 107 prototype. The U.S. Army originally ordered 10 YHC-1As, but subsequently reduced its order to three.

In 1961, a special version of the 107-II variant won a U.S. Navy design competition for an assault transport helicopter for the U.S. Marine Corps. U.S. Navy orders for this model, designated the CH-46A Sea Knight, began that year. Through the end of production, in

1971, Vertol (then part of Boeing Co) delivered a total of 624 CH/UH-46 helicopters to the USN and USMC.

In 1984, a total of 357 USN/USMC H-46s began undergoing a Safety, Reliability, and Maintainability (SR&M) retrofit program aimed at enabling the aircraft to accomplish its mission requirements at reduced operating costs. Boeing Vertol manufactured the modifications, which did not change the flying characteristics or capabilities of the aircraft. The program incorporated technical advances that included 26 modifications grouped into six major categories: electrical systems, hydraulic systems, avionics, rotor drive systems, airframe, and landing gear.

A few aircraft were exported to Canada and Sweden, and some 107-IIIs have been sold commercially, bringing the total Boeing output to more than 650 aircraft. Kawasaki of Japan produced the Model 107-II under license, and has manufactured the aircraft for use in Japan, Thailand, Sweden, and Saudi Arabia.

Variants

CH-46A. Initial USMC/USN version, powered by General Electric T58-GE-8B turboshafts rated at 932 kW (1,250 shp). First flew in October 1962.

CH-46D. USMC version generally similar to CH-46A; powered by T58-GE-10 engines rated at 1,044 kW (1,400 shp).

CH-46E. Designation for modified USMC CH-46s. Total of 275 completed. Improvements included T58-GE-16 engines, pilot and copilot crash-attenuating seats, crash- and combat-resistant fuel systems, and an improved rescue system for older H-46s.

CH-46F. USMC version; generally similar to CH-46D but featuring additional avionics.

CH-113 Labrador. Royal Canadian Air Force version; similar to CH-46A but with increased fuel capacity.

CH-113A Voyageur. Canadian Army version; similar to CH-46A.

Hkp4. Designation for two versions Boeing produced for Sweden: one for the Swedish Navy and one for the Swedish Air Force.

UH-46A. U.S. Navy version used for vertical replenishment of ships at sea; similar to CH-46A.

UH-46D. U.S. Navy variant; similar to CH-46D.

KV-107-II. Variant of Model 107-II produced by Kawasaki under license; several versions have been built, including KV-107-IIA-2, a basic airline helicopter.

Funding

U.S. FUNDING

	FY12 QTY	FY12 AMT	FY13 QTY	FY13 AMT	FY14 QTY	FY14 AMT	FY15 (Req) QTY	FY15 (Req) AMT
USN								
Mods	-	21.6	-	2.3	-	2.1	-	0.5

All \$ are in millions.

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Milestones

<u>Month</u>	<u>Year</u>	<u>Major Development</u>
Apr	1958	First flight of Model 107 prototype
	1961	USN/USMC initial orders placed
	1971	Boeing Vertol production ends
	1975	Two units converted to CH-46E configuration
Dec	1980	Initial SR&M contract awarded to Boeing
	1984	Final CH-46E conversion completed
Feb	1990	Kawasaki production ends

Worldwide Distribution/Inventories

Operator	Designation	Quantity	Average Age
United States Government	CH-46E	10	46.80
United States Marines	CH-46E	211	46.63
United States Navy	HH-46D	10	41.50

Identified Retrofit & Modernization Contractors

Propulsion

General Electric Co	http://www.ge.com , 3135 Easton Tpk, Fairfield, CT 06828-0001 United States, Tel: + 1 (203) 373-2211 (T58 Reliability Improvement Upgrade)
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Electronics

Northrop Grumman Electronic Systems	http://www.es.northropgrumman.com , 1580-A W Nursery Rd, Linthicum, MD 21090 United States, Tel: + 1 (800) 443-9219, Email: ES_Communications@ngc.com (LAIRCM)
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Opportunities

The H-46 is not a young aircraft, and the Pentagon is firmly committed to a number of competing platforms. Future upgrades will focus on maintaining safety and operability until the aircraft can be safely retired, rather than adding significant new capabilities.

That said, the H-46 is seeing much more action than anticipated in support of the Global War on Terror – by some accounts, four times as much as planned. Given the age of the aircraft and the harshness of the hot/high environment in Iraq and Afghanistan, the GASSP was critical to maintaining safe operating conditions. The H-46's place in the United States inventory is secure in the short term, but retirement is imminent and may be hastened by a reduction of U.S. presence in Iraq and Afghanistan.

The Navy has decided to retire its entire CH-46 fleet, citing high maintenance and upkeep costs, but announced intentions to convert four CH-46E helicopters to the HH-46E configuration for USMC use. It has yet to officially request funding for the conversion program, and may have abandoned the effort due to budgetary restrictions.

The USMC has recently upgraded its aircraft with SA transceivers as part of a Blue Force Tracker program, though the system is primarily ship-based and required little aircraft modification.

Though the CH-46 has served the United States well in many capacities, its days are numbered. The USMC intends to fly the aircraft until a suitable replacement

Boeing CH-46/Model 107

can be found, though there are many other comparable aircraft already on the market that can perform the same missions as well as the CH-46, if not better, and at a lower cost per flight hour. FY15 budget documentation lists the USMC's standing fleet at 54 aircraft, including 38 CH-46Es and 4 HH-46Es, with another 12 CH-46Es in reserve.

AIRFRAME

Geriatric Aircraft Safety and Sustainment Program (GASSP) Upgrade. This \$188.2 million program received first funding in FY07 and covers an array of structural and electrical modifications to ensure the safety and reliability of the USN's CH-46 fleet. Block B modifications ran through FY12 and affected 147 aircraft. Through 2014, additional aircraft will receive further, minor modifications based on existing configuration.

Modifications include redesign and modernization of wiring harnesses, hydraulic subsystems, and fatigued airframe components, as well as improvements to avionics and survival equipment. The program initially included an Infrared Suppression System, though the requirement was terminated in 2009 as the result of performance and weight issues.

ELECTRONICS

Avionics Upgrade. With the unexpected demand for the H-46 in Iraq and Afghanistan, the aircraft's deficiencies have become more apparent, most notably its aging avionics systems. The USMC has funded upgrades to cockpit displays, navigation systems, communications systems, situational awareness capability, and defensive countermeasures.

The upgrade included an improved Control Display Navigation Unit (CDNU) system with additional memory and processing power (needed for proper integration of some other improvements), an ARC-210 secure communications system, ARC-220 digital HF radios, and a Large Aircraft Infrared Counter Measure (LAIRCM) system.

Funding ran through the end of FY13 at a total cost of \$67.3 million. This program is now complete.

We do not anticipate any significant future avionics modification programs for the aircraft as the fleet is drawn down in favor of more modern, sustainable aircraft.

FI's Opportunity Outlook

AIRFRAME													
Status		Thru 2013	High Confidence				Good Confidence			Less Confidence			Total
			2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	
Estimated Potential Candidates	80	Geriatric Aircraft Safety and Sustainment Program (GASSP) Upgrade <- H-46/ Model 107 <- United States <- Marine Corps											
Planned/In Progress		147	0	0	0	0	0	0	0	0	0	0	0
Speculative			20	20	20	0	0	0	0	0	0	0	60