

Development and Mass Production of SH-60L: the State-of-the-Art Patrol Helicopter



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In order to maintain an advantage in anti submarine warfare against foreign submarines in the waters surrounding Japan, enhancing onboard system capabilities and flight performance of helicopters operated by the Japan Maritime Self-Defense Force (JMSDF) is needed. Mitsubishi Heavy Industries, Ltd. began development of the new SH-60L patrol helicopter in 2015, based on the existing SH-60K patrol helicopter. Approval of SH-60L for use by JMSDF was granted in December 2023. In March 2024, the first contract for SH-60L production aircraft was concluded.

1. Introduction

In the development of SH-60L, improvement in the capability to detect submarines in shallow waters, enhancement of autopilot capability and crew operability, improved hovering capability to relax shipboard takeoff/landing restrictions, and reduction of airframe vibration by enhancement of airframe rigidity were addressed as key objectives.

Among these, improvement in the capability to detect submarines in shallow waters, which is a new feature added to the existing SH-60K, as well as enhancement of autopilot capability and crew operability, are presented in this report. In addition, verification tests and future prospects are also described.

2. Improved capability to detect submarines in shallow waters

In the shallow waters commonly seen in the southwestern sea area of Japan, overlapping of reflected sound echo from seabed and reflected sound echo from the target submarine makes detection difficult. To reduce the impact of seabed reflections and improve submarine detection opportunities, a multistatic tactical function, where multiple patrol helicopters are assigned roles, such as to transmit detection sound waves from dipping sonar or to receive the echo of distant position, has been added. (Figure 1). Additionally, the optimal tactics planning function is expanded, and helicopter communication capabilities between consort helicopters and between vessel have been enhanced. The following sections outline improvements in the sonar system, combat direction system, and enhanced communication capabilities.

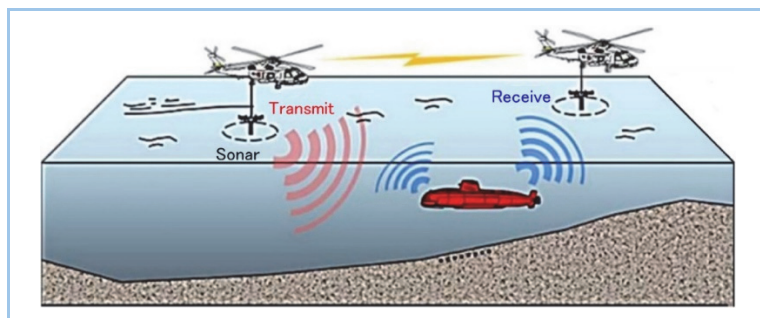


Figure 1 Sonar multistatic operation
(Ministry of Defense, FY2016 Budget Overview, "Defense Programs and Budget of Japan")

2.1 Sonar system

The sonar system on SH-60K detects a submarine by processing the signals obtained by transmitting sound waves and receiving the waves reflected off the submarine. On the other hand, the sonar system on SH-60L includes an additional multistatic function, where a helicopter in the formation transmits sound waves and the other helicopter receives the waves reflecting off a submarine to obtain signals and process them. For the multistatic function, different helicopters in the fleet plays roles of transmitting and receiving sound waves, respectively. To integrate the information obtained from these helicopters, the transmission location and timing must be precisely identified to accurately determine the detection positions. Therefore, a system which can accurately incorporate these information into the signal processing was developed. Furthermore, to grasp the detectable area of the multistatic function, the system can display sonar performance prediction—the detectable range considering water temperature and topography at any transmitting and receiving positions.

In addition, improvement to the sonar's basic performance has been carried out. The improvement includes such as adding transmission pulse waveforms, enhancing signal processing—including the addition of reverberation reduction processing—and installing an automatic detection function using pattern recognition.

2.2 Combat direction system

To achieve detection by multiple helicopters, the combat direction system calculates the optimal role, sonar transmission/receiving position, and transmission timing for each helicopter, which varies from time to time, thereby providing optimal tactical planning and sonar performance prediction. To enable high-speed complex processing while transmitting large amounts of data, open commercial standards and open-source software were adopted for the onboard equipment. Furthermore, modifications can be flexibly carried out by the software, allowing for rapid capability enhancements.

2.3 Enhanced communication capabilities

The currently deployed SH-60K is equipped with a data link for communication with vessels and a data link for communication between helicopters. The following functions of these data links have been enhanced for SH-60L, allowing vessels to easily grasp the situation during various conditions that would arise during missions (**Figure 2**).

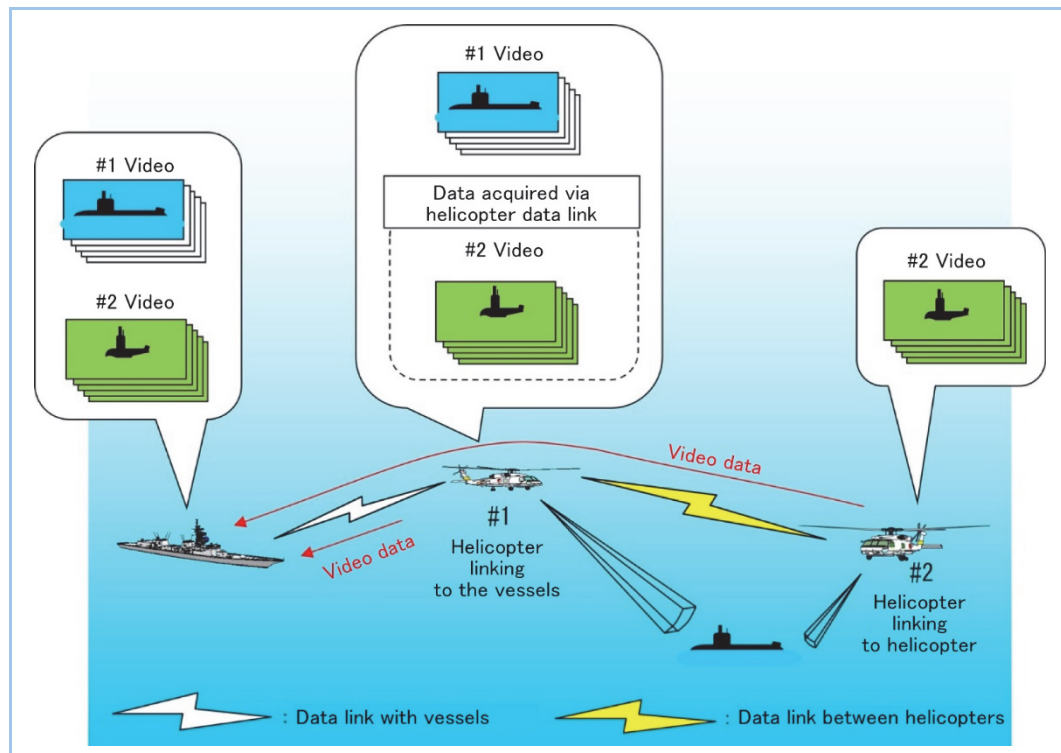


Figure 2 Improvement in communication capability

- Video data transmission to vessels from any of the helicopters in the formation enabled by expanding the communication lines to increase the data transmission capacity between consort helicopters and by using a helicopter linked to the consort vessel as a relay.
- Configuration that enables easy accommodation to additions or changes in transmission data using software-based radios.

3. Enhancement of autopilot capability and crew operability

To realize mission flights that utilize autopilot functions more than before, reducing pilot workload during flight and enhancing safety, improving autopilot capability and crew operability were sought to the greatest extent by incorporating knowhow gained from the SH-60K operation and its operator feedback.

3.1 Enhancement of autopilot capability

Regarding the autopilot system, the analog amplifier used in SH-60K was replaced by digital computer, which allows any control command to be output via software. In addition, by revising command allocation for the flight control software to make full use of the capabilities of each autopilot actuator, autopilot capability with improved maneuverability were achieved while ensuring stability.

From these modifications, the following additional functions and improvements over SH-60K were achieved.

- Reducing time for the helicopter to reach target locations by increasing turn bank angles and acceleration/deceleration rates during autopilot flight.
- Additional functions to assist pilot recovery action from unusual attitudes caused by spatial disorientation (**Figure 3**) and to automatically assist maneuvering in response to a missile warning.

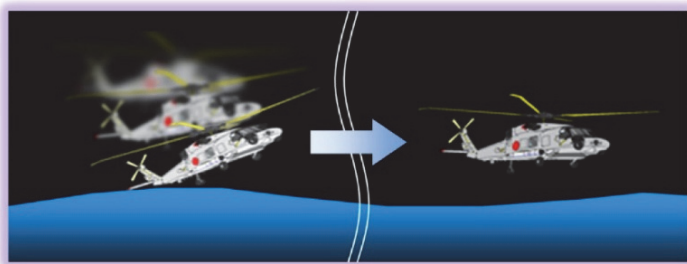


Figure 3 Function to assist recovery from unusual attitudes (illustration)

3.2 Enhancement of crew operability

The equipment for the pilot and co-pilot on SH-60K cockpit are different, but the SH-60L features common cockpit displays and control display units, thereby the same operations can be performed at either seat. Hence the same roles can be performed at either the co-pilot seat or the pilot seat, significantly improving crew operability. The cockpit display is larger than that of SH-60K and touch screen is adopted. As the crew can directly manipulate symbols on the display, intuitive operation is possible (**Figure 4**).

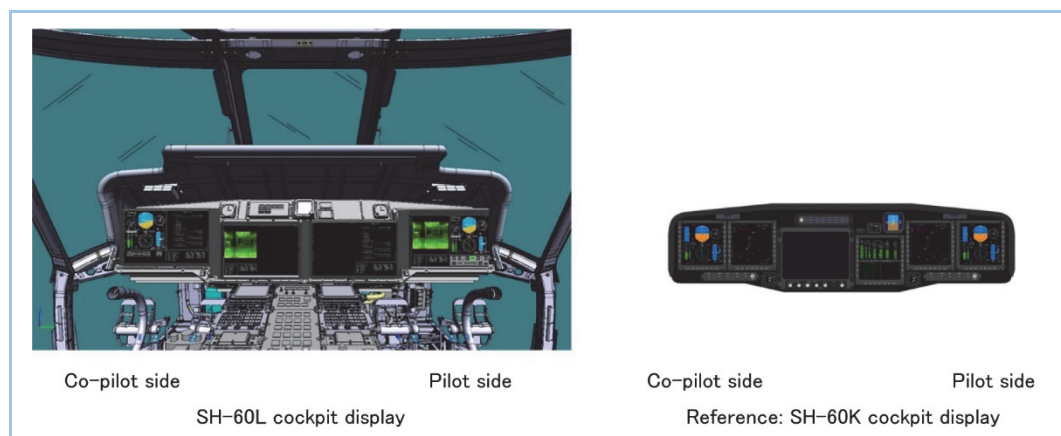


Figure 4 Enhanced cockpit display

4. Validation test tests and development completion

Development items were verified in a step-by-step manner. System integration tests were conducted using only the onboard equipment. Subsequently, verification with the onboard equipment actually installed on the helicopter was conducted by aircraft ground test and by company flight test, using two test helicopters, after which the aircraft was delivered to the government. After delivery, technical and operational validation tests were conducted by the government to confirm weapon operation and verify areas which could not be confirmed in company flight. Following these tests, approval of SH-60L for use by JMSDF was granted in December 2023, which lead to the completion of SH-60L development. Subsequently, the first contract for SH-60L production was concluded in March 2024.

5. Future Prospects

In May 2025, a riveting ceremony was held marking the milestone commencement of fuselage structural assembly of the first SH-60L production aircraft, signifying the united effort of Mitsubishi Heavy Industries, Ltd. to take the first step toward mass production. Currently, SH-60L production is underway with the goal to deliver the first SH-60L production aircraft in Japan fiscal year 2027 (Figure 5).

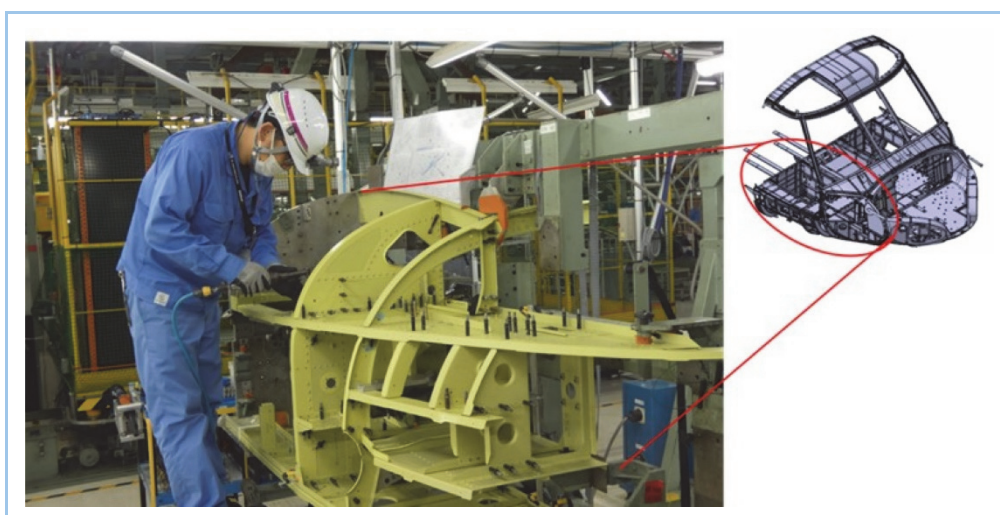


Figure 5 Structural assembly for the first SH-60L production aircraft