

## **US-2: The JMSDF Air-Sea Rescue Flying Boat**

*A Proud Technological Tradition and Prospects for the Future*

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Amphibious aircraft for air-sea rescue operations in the Japan Maritime Self-Defense Force (JMSDF) fleet have flown on over 960 search-and-rescue missions to date and have saved numerous lives, among the most prominent being newscaster Jiro Shinbo and blind sailor Mitsuhiro Iwamoto, whose yacht *Eorasu Issue* capsized in the Pacific on June 21, 2013. The latest model, the US-2, is considered the world's finest flying boat developed with leading-edge technology. The Ministry of Defense has approved the sharing of this technology with the civilian sector, and with the government considering the easing of its Three Principles on Arms Exports, other countries, including India, have shown interest in acquiring the aircraft.

Amphibious flying boats are highly versatile, and the range of potential uses—not only in Japan but also in many other countries—is expanding, from policing illegal fishing operations and surveying the marine environment to providing disaster relief. On August 2, 2013, the authors visited the Konan Plant of ShinMaywa Industries in Kobe where the US-2 is being manufactured and were given an explanation of the aircraft's technology, its features and performance, applications, market demand, and technological and usage prospects. The authors also visited the JMSDF Atsugi Air Base on October 10 to inspect a US-2 that was on standby for a rescue operation and interviewed its crew. The following is a report of these visits.

## Japan's Development of Seaplanes and Flying Boats

### *(1) The Imperial Japanese Navy*

Japan's first aircraft manufacturer was Nihon Hikoki (Nippon Aircraft Manufacturing Co.), founded in 1918. Two years later, one of the co-founders, Seibei Kawanishi, left to form the Kawanishi Machinery Co., which changed its name to Kawanishi Aircraft Co. in 1928. The company was a pioneer of Japan's aviation industry, building 2,862 aircraft through the end of the World War II in 1945. It later evolved into ShinMaywa Industries, which manufactures air-sea rescue flying boats for the JMSDF.

Kawanishi Aircraft Co. produced a number of outstanding military aircraft during the war years, including the Kawanishi E7K reconnaissance floatplane and the Kawanishi N1K-J *Shiden* and N1K2-J *Shiden Kai* land-based fighters, and it possessed unrivaled technology, particularly for seaplanes and flying boats. What is the difference between seaplanes and flying boats? The former have floats under the fuselage that are used for takeoffs from and landings on water, while the latter are without floats and use their fuselage for buoyancy. Compared to seaplanes, flying boats can be built bigger, allowing them to carry larger loads. Of the floating boats developed during the war, the Kawanishi H8K was widely regarded as being the best ever built. It was a large aircraft whose first flight was in 1941 and was equipped with four reciprocating engines. Of the three H8Ks that survived the war, one was taken by the US forces back for examination to the United States, where engineers reportedly marveled at its exceptional performance. It was later kept in storage by the US Navy and returned to Japan 34 years later in 1978, thanks to efforts by the Nippon Foundation. It subsequently remained on display at the

Museum of Maritime Science in Tokyo before being relocated to the Kanoya Air Base Museum.



*Kawanishi H8K flying boat. (JMSDF Kanoya Air Base website)*

Seaplanes were also built by a number of aircraft manufacturers for use by the Imperial Navy. One unique model called the *Seiran*, produced by Aichi Kokuki (Aichi Aircraft Co.), was an attack floatplane designed to be secretly loaded onto submarine aircraft carriers for surprise bombing raids of enemy bases. In the closing stages of World War II in June 1945, 10 *Seiran* planes were dispatched on a *kamikaze* special attack mission targeting a US fleet anchored at Ulithi Atoll. The unit left the port of Ominato in Aomori Prefecture and headed for the South Pacific, but the war ended before it could reach its destination, and the *Seiran* never saw combat. The planes were also seized by US forces, and one is now on display at the Smithsonian National Air and Space Museum.



*Seiran attack floatplane. (Wikipedia)**(2) The Flying Boats of the JMSDF*

Kawanishi Aircraft Co., which spawned the H8K, was reestablished in 1949 as Shin Meiwa Industry Co. (later renamed ShinMaywa Industries) and began once again manufacturing aircraft. In 1967 it built the PX-S prototype antisubmarine flying boat for the JMSDF, which after flight tests became the first PS-1. At the time, detecting submarines using sonar-equipped aircraft was considered much more effective than using surface vessels as the aircraft were able to reach their destination much faster and the PS-1 went into volume production. Owing to advances in aerial detection technology, however, demand for antisubmarine flying boats went into decline. All of the JMSDF's PS-1 aircraft have now been decommissioned, and none are being manufactured today.

The JMSDF recognized the potential of flying boats for search-and-rescue missions, however, and placed an order with ShinMaywa to manufacture US-1 air-sea-rescue flying boats alongside the antisubmarine PS-1. The first model was completed in 1975, which was later replaced by the US-1A with a more powerful engine. The latest variant, the US-2, features the latest technology, including computer-controlled navigation and a glass cockpit with full-color displays.

Maritime search-and-rescue operations involve the search for shipwrecked vessels or water-landed aircraft and the rescue of their crew. Fortunately, no JMSDF vessel or aircraft has ever been involved in an accident that has caused them to be in distress on the high seas. The 960 operations by JMSDF aircraft mentioned above have been to search for and rescue the crew of fishing boats or cargo ships involved in accidents or to undertake emergency transport operations following

natural disasters for remote islands without airfields or ships at sea. In transporting emergency patients, the JMSDF uses different terminology to distinguish between those being carried from the Ogasawara Islands and those from seagoing vessels. For the latter operation, the JMSDF has a fleet of seven flying boats, of which two are US-1As and the remaining five are US-2s.



*PS-1 antisubmarine flying boat. (ShinMaywa Industries)*



*US-2 flying boat. (ShinMaywa Industries)*

## **The JMSDF's Air-Sea Rescue Flying Boats**

### *(1) Features and Performance of the US-2*

The US-2 flying boats operated by the JMSDF measure 33.25 meters in length and 10.06 meters in height and have a wingspan of 33.15 meters. They have four turboprop engines, one auxiliary engine, and a boundary layer control (BLC) engine. BLC is the mechanism for controlling the layer of air around the wing of the aircraft to sustain lift at low speeds without stalling. Climb-out and approach

speeds for smooth takeoff and landing on the sea need to be lower than on land because of possible damage to the hull when waves or currents are struck at high speeds. The development of BLC technology enables the US-2 to remain airborne at speeds as low as 50 knots. Its maximum speed is 315 knots, and it has a range of 4,500 kilometers, enabling it to perform search-and-rescue operations as far north as the southern tip of Kamchatka Peninsula, as far south as Mindanao in the Philippines, and as far east as the island of Minamitorishima.

In addition, the US-2 can land on stormy waters with waves as high as 3 meters, making it one of the highest-performing flying boats in the world.

*(2) The 71st Flight Squadron: Prepared for Duty*

The air-sea rescue flying boats of the JMSDF are operated by the 71st Flight Squadron, headquartered at Iwakuni Air Base. The squadron operates seven flying boats, of which five are US-2s and two are US-1As. Each flying boat normally carries an 11-member crew, including 2 pilots, 1 search-and-rescue coordinator, 2 on-board maintenance personnel, 3 divers, 2 paramedics, and 1 sensor operator. Two of the flying boats in the 71st Flight Squadron are usually stationed at Atsugi Air Base to enable a prompt response in all sea areas surrounding Japan.

The authors were given an opportunity to visit Atsugi Air Base on October 10, 2013, to interview the crew of the US-2 stationed there—including Commander Shinji Nakahara, leader of the 71st Flight Squadron—about the aircraft and its mission. Commander Nakahara is a veteran member of the JMSDF with 6,500 hours of flight time, including on the US-2 and P-3C. He is a search-and-rescue coordinator on the US-2, on which the aircraft captain is either the pilot or the SAR coordinator.



*Commander Shinji Nakahara of the 71st Flight Squadron in front of a US-2 at Atsugi Air Base (photo by the authors).*



*The cockpit, left, and cabin of the US-2 (photo by the authors).*

The air-sea rescue flying boats of the JMSDF are kept in a state of readiness at all times, enabling them to take off within an hour of an accident or other incident at sea. In fact, Nakahara said, they can take off in about 30 minutes if the main engines are in start-ready condition. The 71st Flight Squadron conducts around 30 to 40 search-and-rescue and disaster-relief operations a year, and Nakahara himself has been involved in a wide range of situations, including the transport of a woman who had gone prematurely into labor from the Ogasawara Islands. He commented that he was overjoyed and proud of his flying boat squadron when the woman later sent him a thank-you note saying that the baby had been delivered safely.

The JMSDF air-sea rescue team can operate in foreign countries as well. The US-2's outstanding features were on display during the 2011 international fleet review in Brunei, and Nakahara believes the aircraft may someday be able to participate in the Rim of the Pacific Exercise (RIMPAC) should there be an opportunity for joint training in search-and-rescue operations.

### **Maintaining Domestic Aircraft Production and the Future of Flying Boats**

One major issue is maintaining the technology and production capacity to manufacture SDF aircraft in Japan in the face of declining domestic defense demand. Should demand continue to falter, the aircraft-production technology and capacity assiduously nurtured in Japan since the prewar years will also decline. This will come at a time when civilian aircraft demand is booming; over the two decades between 2008 and 2028, new aircraft demand is estimated to reach 26,000 units, valued at 300 trillion yen. Thus promoting the conversion of aircraft developed by the Defense Ministry for civilian use could stem the decline in

technology and production capacity. The conclusions of a 2010 Defense Ministry study group on this issue led to the issuance of a notification from the administrative vice-minister of defense in 2011 regarding the procedures to be followed for such conversions. Applications for disclosures of defense technologies for civilian use were subsequently filed by Kawasaki Heavy Industries and ShinMaywa Industries in 2011. The relaxation of the Three Principles on Arms Exports currently under consideration is adding further momentum to the possible conversion for civilian use and exports of highly versatile flying boats.

There are great advantages to being able to take off from and land on water, which broadly expands the flying boat's potential uses. In the future, new demand from various quarters may arise, which could consequently spur the development of new technologies and upgraded models. Because of its large transport capacity, the US-2 can deliver medical and relief supplies to remote islands without airfields or when airports become unserviceable in the wake of a disaster—as long as there are bodies of water nearby. These flying boats can also carry goods to ships at sea in emergency situations, and they may even be modified for use as passenger planes in such island countries as Indonesia and the Philippines. There would certainly be many uses for such aircraft on UN peacekeeping operations.

One particularly promising use of the flying boat is to fight fires following a major earthquake or tsunami or in mountain areas that cannot be reached by fire trucks. The US-2 can be adapted to carry and spray 15,000 liters of water, which is over five times the 2,700-liter capacity of the AS332 helicopters now used by the Tokyo Fire Department. Many countries have a fleet of fixed-wing aircraft to fight both forest and urban fires: 54 are owned by Canada, 24 by Italy, 21 by Spain, and 2 by Malaysia in Southeast Asia. The United Nations is seeking to build a system for international cooperation in aerial firefighting, and Japan will need to adopt measures in response to such initiatives. Unlike fixed-wing landplanes, which need to return each time to have their water tank refilled, flying boats can refill their tanks automatically by gliding along the sea or a lake and then quickly fly back to the scene of the fire. Every minute counts when fighting fires, so the shorter refilling time can make flying boats much more effective.

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*The Wind Rises*, an animated film by Hayao Miyazaki released in summer 2013, is a fictionalized biography of Jiro Horikoshi, designer of the Mitsubishi A6M “Zero” fighter of the Imperial Japanese Navy during World War II. The film's protagonist survives the 1923 Great Kanto Earthquake, the deadliest quake in Japanese history, and eventually begins turning the airplanes of his dreams into reality. While the film is fiction, there is truth to the fact that Japan—a small and poor nation with an



underdeveloped aviation industry — was able to pool all its resources to produce some of the world's finest aircraft at the time, including a number of flying boats. The US-2 is the latest incarnation of this long and proud tradition, which began with the Kawanishi H8K, as described above. Japan's aircraft production today is buttressed by technologies such as these, which have enabled the country to develop new industries and products and to prosper through trade. This is a reminder that we must never allow our technological capacity to fall into decline.