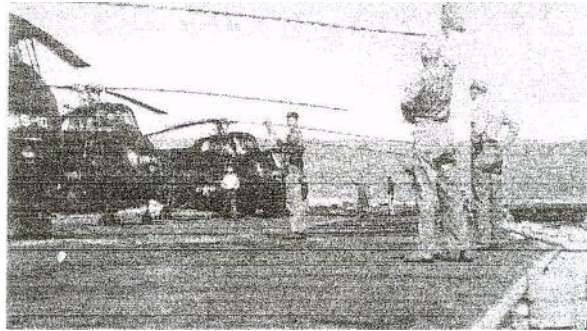


HISTORIC HELICOPTERS

"The Story of the



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NHHS Historian

In November 1949 the S-55 made its first flight. "S-55" was the Sikorsky designation for this model. Once in production it had several designations: HO4S in the U. S. Navy and Coast. Guard; MRS in the L.J. S. Marine Corps; and H-19 in the U. S. Air Force and Army. The design and fabrication of the first article was accomplished in record time. It had to be.

This model was actually born at a precarious time. The defense budget had been reduced following World War II, the country's military budget was being reduced, its military structure was being re-organized and procurement was at its lowest ebb. At the time, Sikorsky was contemplating lay-offs as production of S-51 models was winding down and competition for available proposals had not been successful. In June 1950 the first H-19 was delivered to Wright-Patterson AFB, Dayton, Ohio for accelerated service tests. One week after delivery, the Korean War broke out.

The first test and production models were powered with Pratt & Whitney R-1 340-57 engines, delivering 550 HP at normal rated power, 600 HP at maximum power. As users found more and more missions for this aircraft the need for more power resulted in a change that installed Wright R-1300-3 engines rated at 700 HP normal rated power, 800 HP at maximum power. These models carried the designations HO4S-3, HRS-3, and H-19B&D.

The S-55 was 42 feet long, 13 feet high and had a 3-bladed main rotor with a 53-foot diameter. Its cabin had provisions for 10 passengers and its raised cockpit was configured for a pilot and co-pilot. It could carry internal cargo in lieu of passengers, or it could carry external loads on a cargo sling attached beneath the cabin. The aircraft could also be equipped with a hydraulically powered rescue hoist that lifted rescues up alongside the large cabin door.

A look at its pedigree explains, in part, why this aircraft turned out to be successful and popular. Helicopter production started at Sikorsky Aircraft in 1943 following successful development of the VS-300 and XR-4 helicopters. By the end of 1944 one hundred R-4S's, the first production model, had been delivered to the U. S. Army Air Corps, the U. S. Navy and Coast Guard and the British Royal Navy as HNS's. As R-4 production ended, manufacture of the R-5 series began.

The first R-5's were two-place aircraft, with the passenger in the front seat and the pilot in the rear seat. After a number were built in this configuration a change was introduced to increase the capacity

of the cabin. The pilot's location was moved to the front seat and the rear-half of the cabin was widened to accept a 3-wide seat, creating a 4-place aircraft. A nose wheel was added under the pilot's seat. The designation was changed to R-5D. In a second "in-line" change the cabin exterior lines were smoothed out and the landing gear was modified to an inverted tricycle configuration. This changed the designation to R-5E through H for USAF and Army models, HO3S-1 for Navy and Coast Guard and S-51 for FAA certificated civilian helicopters.

While this was going on in the "production" side of the company, the "experimental" side built and flew three other models. The first, designated the R-6 (HOS in the Navy and Coast Guard), was a 4-place helicopter slightly larger than the R-4. It had an all metal fuselage, as an improvement over the fabric covered R-4. It was powered with a 6 cylinder horizontally opposed Franklin engine. Sikorsky built six (6) of this model and Nash-Kelvinator was selected by the War Production Board to build an additional 223.

In 1946, Sikorsky was selected by the U. S. Navy to build three (3) XHJS-1 helicopters. This model was a 4-place aircraft powered with a 525 HP Continental engine and was the same shape as the HO3S-1 helicopter, but a little larger. It was evaluated against the XHJP at Patuxent River. Both aircraft were close performance-wise, but the XHJS had the same undesirable center-of-gravity problems as the HO3S-1, so the Navy selected the XHJP, later changing its designation to HUP. The XHJS-1 was fitted with metal main rotor blades with an 8-degree negative twist toward the tip. This type of blade construction became standard on future models.

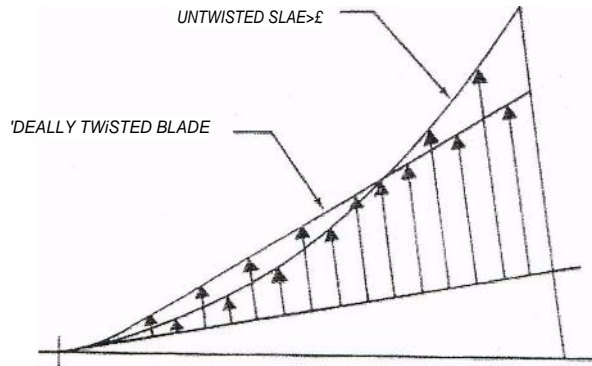
The third model helicopter developed during this time frame was the S-52 series. Four 2-place versions were built. The first three were fitted with 165 HP Franklin engines. The fourth was modified with a 245 HP Franklin engine. This aircraft set international speed and altitude records. This helicopter was very agile and was capable of "un-helicopter" type maneuvers, including loops. The rotor head design, which featured offset flapping hinges, made this possible.

Four 4-place S-52's, designated YH-18, were built under a U. S. Army contract. This aircraft, with modifications requested by the Marines, became the HO5S-1. Ninety were built and some of them were used to replace the HO3S-1 at VMO-6 in Korea in the summer of 1952. The U. S. Coast Guard also procured a small quantity.

In designing the S-55, the designers used some of the aforementioned features. The fuselage size and configuration were new. They were selected to provide the largest passenger or cargo capacity available in a helicopter at the time. Most of the load was centered under the inner portion of the main rotor disc. This minimized shifts in the center-of-gravity and corrected a condition that was a chronic source of dissatisfaction on earlier Sikorsky models.

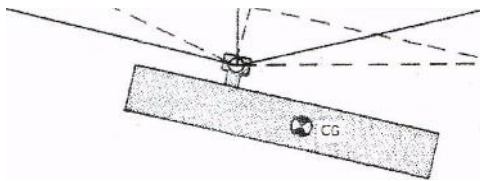
A major improvement in the S-55 was the metal rotor blades. They reduced so-called "helicopter" vibrations considerably for several reasons. All-metal construction made it possible to build the blades to closer manufacturing tolerances. Provisions were incorporated to locate balance weights used to adjust static and dynamic balance where they could readily be accessed during the balancing procedures. An improved main rotor blade dynamic test-stand and techniques refined from experience with earlier models, made it possible to produce interchangeable blades. Previously, if one blade in a set was damaged all three blades had to be removed and returned for balancing as a set after repair. On the S-55, only the damage blade had to be replaced, thus reducing maintenance time and spare blade requirements.

The metal blades were manufactured with a span-wise negative 8-degree twist. This twist compensated for the difference in airspeed across the blade between the root and the tip of the blade. It equalized the lift across the span of the blade by reducing the angle-of-attack of the airfoil. This reduced the bending loads on the blade and extended its fatigue life.

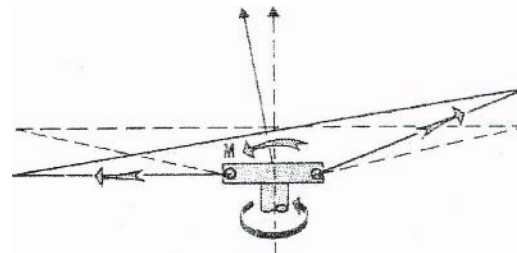


Blade loading - twisted versus untwisted

The S-55 main rotor head was designed with "offset" flapping hinges, as first introduced on the S-52. This design used the centrifugal forces generated by the rotating blades in-flight to align the fuselage with the tilt of the main rotor disc in steady state flight regimes. This feature enhanced the controllability of the helicopter by maintaining ample range in the flight controls regardless of airspeed and center-of-gravity location, as long as they remained within prescribed limits.



Rotor **without** offset hinges - CG off center



Tilting rotor **with** offset hinges

Another improvement that enhanced the S-55 helicopter was hydraulic powered flight control servos. These devices are comparable to power steering in an automobile. Flight control servos were first installed in a company owned S-51 on an experimental basis. It was expected that they would be removed when the test program was completed. They worked so well that they were never removed. They were FAA certificated and left on the aircraft. When metal main rotor blades were installed on the last batch of USAF H-5H helicopters, hydraulic servos were installed in the main rotor flight control system to unburden the pilot from the slightly higher loads that came with the metal blades. The feedback forces in the S-55 flight controls were stronger than in the H-5H aircraft, but the servos provided fingertip control.

The net results of these improvements were most favorable. Many pilots after their first flight in this model came away praising it as the "Cadillac" of helicopters. Maintenance personnel also liked what they saw. Previous models had their engine installed in the bowels of the aircraft, making engine

maintenance, repair and replacement difficult and time consuming. On this helicopter the engine was readily accessible by swinging open two hinged "clamshell" doors. The rear section of the engine and the installed accessories could be worked on from floor level. With planning and the use of spare engine change units, engine replacement could be reduced to hours from days. The maintenance crews at Marine and Navy squadrons affectionately referred to their HRS and HO4S aircraft as "the horse", because they said it was as strong and dependable as a good horse.

This praise of the S-55 series is validated by the fact that 1,828 were built by Sikorsky for military and civilian users. The aircraft was also built under license in England, France and Japan. A derivative of the S-55, the S-62 (U. S. Coast Guard HH-52) provided years of service to air stations throughout the U. S. Coast Guard. Changes from the S-55 to the S-62 included a boat hull, a General Electric T-58 turbine engine and modification of the lower portion of the main gearbox to accept the output speed of the turbine engine.

The S-55 was flown by military and civilian operators around the world and was truly the "rotary winged" workhorse of its era.

Harold Naughtin