The Royal Navy's next generation helicopter, Wildcat, has completed 20 days of sea trials aboard HMS Iron Duke, laying the groundwork for future operations.

Wildcat landed nearly 400 times on the frigate's flight deck by day and night in various weather conditions as the ship sailed off the coasts of southern England and northern Scotland.

The Portsmouth-based frigate sought the most challenging weather conditions around the UK as she took the Wildcat - successor to the long-serving Lynx - to sea to help write the rulebook for the new helicopter.

From 2015, Wildcat will be the principal helicopter used by Royal Navy frigates, including Iron Duke and her Type 23 sisters, and destroyers on operations around the globe.

Although Wildcat looks like the final variant of the Lynx Mk8, currently in service with the Fleet Air Arm, it is classed as a new aircraft - it handles differently for a start, not least thanks to new engines and the distinctive tail boom which marks Wildcat out from its forebears.

As a result, a new rulebook has to be written to define what are known as 'ship-helicopter operating limits' - the guidelines for safe Wildcat operations by day and night in various weather conditions and with different payloads.

For that, Wildcat needed to go at sea. It enjoyed two ten-day periods of trials aboard Iron Duke, one in mid-January, the second at the beginning of this month, ranging from the waters off the South Coast to the Western Approaches, Irish Sea and northern shores of Scotland as the frigate searched for suitable weather conditions to lay down the limits for safe Wildcat operations. In all Wildcat touched down on Iron Duke's flight deck 390 times, including 148 night landings - 76 of them using night vision goggles.

Commander Nick Cooke-Priest, the frigate's Commanding Officer, said: "Wildcat is a very capable aircraft, a completely valued successor to the Lynx, and once fully mature will provide significantly enhanced capability to the maritime domain."

Prototype ZZ402 paid a brief visit to Iron Duke just before Christmas, when pilots and technicians tested some of the basics such as whether the flight deck recovery system could pull Wildcat into the hangar, did Wildcat fit in the hangar, can it be easily refuelled and rearmed and "talk" to the frigate's command systems, all of which were in the affirmative.

The prototype's two Fleet Air Arm test pilots assessed and scored the difficulty and workload required for each landing in each different weather condition or sea state, while a myriad of sensors recorded more than 4,000 different items of data from the helicopter's engines, rotor and transmission.

These included video feeds from all the crew positions, stresses and strains from all over the airframe and rotor blades, engine and gearbox parameters and undercarriage loadings.

The crew scores and reams of data are now being analysed by experts (it'll take them until towards the end of the year) to set the limits for day and night operations by Wildcat at sea in various conditions and with various payloads.

In addition to the test pilots, two flight test engineers, aircraft and stress engineers, instrumentation experts, ship's flight (to carry out maintenance on the prototype and move it in and out of the frigate's hangar) - a good 30 extra souls in all - squeezed aboard the Type 23, which was fitted with accurate ship motion and wind sensors for the tests.

The trials team used the opportunity of operating Wildcat at sea for the first time to test its mission systems, night-vision cockpit and navigation systems, paving the way for the helicopter's front-line duties in three years' time.

Cdr Cooke-Priest said that the helicopter is "ideally suited to the nature and breadth of naval operations".

While Wildcats work their way along the production line at AgustaWestland's Yeovil factory, ZZ402 will continue her trials, carrying out tests of radar, electro-optics, navigational kit and conduct missile firings.

The first of 28 naval variants of Wildcat is due to be delivered to its future home at RNAS Yeovilton ten days before Christmas for trials with 700W Naval Air Squadron.