

# Maneuverings behavior on the Ship-RUV during operational trials condition

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## Maneuverings behavior on the Ship-RUV during operational trials condition

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**Abstract.** Ship-RUV testing in trials conditions is a mandatory requirement or technical provision before carrying out real operational conditions to find out the existing performance results. In the maneuvering test, in the trial conditions of the Ship-RUV, it was carried out by the performance test method which included several experiments including: progressive speed, turning circle and Image Processing. The performance test is one method of the Ship-RUV tests before making actual operational performance efforts. This is to determine the performance of Ship-RUV in an effort to determine the characteristics it has actually. Several provisions in the Ship-RUV test refer to the specified technical specifications. This is of course regulated in the owner's request, where it is customized. In the Ship-RUV maneuvering test, the Ship-RUV test results were obtained with a maximum speed of 5 knots with a tactical maneuvering diameter of 1500 mm. The result of image processing resolution is 720P, which is sufficient for investigating the ship's hull. These conditions are in accordance with the technical provisions required in accordance with those calculated in the classification.

### 1. Introduction

There are many accidents of collision or rubbing between ships at sea when maneuvering which requires fast and accurate handling to avoid the ship before sinking. This makes the main concentration in handling the risk of shipwreck, so it must be responsive in its operations. Conventional technology requires a method of diving directly into the hull that is experiencing friction or a ship collision. This is less effective and very dangerous for divers if the current conditions at sea are very strong and high waves occur [2]. The requirement to maintain class notation on ships also needs to be done by direct diving for hull investigations. However, the direct dive method is expensive and requires a long time to investigate the hull. So that Ship-RUV is a breakthrough in hull investigation by replacing the role of direct human diving.

So that Ship-RUV provides an effective and efficient method of hull navigation investment. Ship-RUV testing in trials conditions is a mandatory requirement or technical provision before carrying out real operational conditions to find out the existing performance results. In the maneuvering test, in the



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trial conditions of the Ship-RUV, it was carried out by the performance test method which included several experiments including: progressive speed, turning circle and Image Processing.

## 2. Object Research

### 2.1. Ship-RUV

Ship-RUV is a Remote Under Water Vehicle for hull investigation. Ship-RUV is operated equipped by main components, including Remote Joystick, Display Monitor, Enclosure or main Body and thruster propeller. Ship-RUV conditions are planned with conditions into the ship's operation of 30 meters [7]. As Information for the operational provisions of the stomach investigation with calm water conditions. The following shows a picture of the Ship-RUV product with a display as shown below.



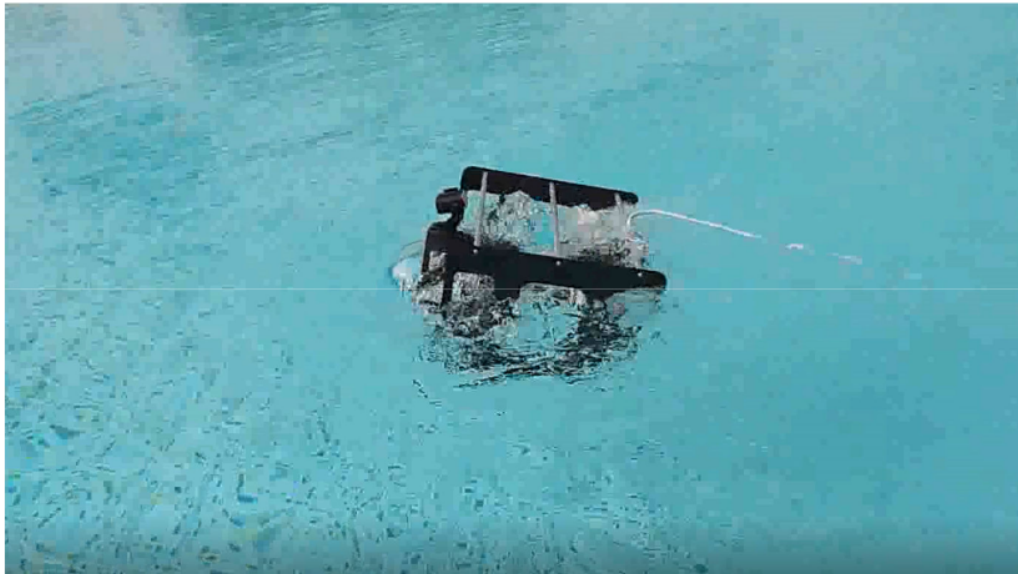
Figure 1. Set up Ship-RUV before performance test

The main characteristic in Ship-RUV is by using remote control tools in its operation. This is easier by controlling the movement of the Ship-RUV maneuvering in operation. To get optimal results in this design, each material that is composed in the ship-RUV component is required using marine used materials [3][4]. It aims to get maximum reliability results on ship-RUV. Before testing in the test pool, arrangements are made for the initial test inspection on the Ship-RUV components to ensure that the components can work properly.

### 2. Performance test

The performance test is one method of the Ship-RUV tests before making actual operational performance efforts [8]. This is to determine the performance of Ship-RUV in an effort to determine the characteristics it has actually. Several provisions in the Ship-RUV test refer to the specified technical specifications; this is of course regulated in the owner's request, where it is customized. In the performance test, it can be done in a number of ways in complete conditions, including: Progressive speed, turning Circle, Zigzag, Inertia Stop test, Crash Stop Ahead and Crash Stop Astern. Progressive speed is a test to determine the speed of the test object, because speed is very important in the characteristics of the test object and this is one of the bargaining capabilities in its operation. Zigzag is the condition of the motion of the test object with the maneuvering shape of this condition in real

operation to determine the characteristics of the test object in avoiding other objects. Inertia stop test is an attempt to find out how far the test object stops after the driving force is turned off. It can also be used to find out how far away the test object is to avoid colliding with other objects [9][10]. Crash Stop ahead and stern are test conditions for positioning the test object to move forward and backward simultaneously. Due to the limitations of the Test object size, the performance test is carried out at least into 2 (two) main capabilities of the tested object, namely: Progressive Speed and Turning Circle Maneuvering. The trial process in performance tests and image processing can be shown in the following figure, where the components fine work such as figure below:



**Figure 2.** Trial performance test

### 2.3. Power Propulsion Ship-RUV

The calculation of power requirements is carried out by designing with a formulation referring to the resulting maneuvering resistance to obtain efficient and effective trust power propulsion [6]. In this case, it gives the RUV power of 6 propellers with a trust force of 8 N. The power propulsion with the specifications technic by Ship-RUV can be shown in the following feature table below:

**Table 1.** Motor-Propulsion Specification

Product information:		Note
Voltage	12-24V	Marine Used
Current	20 A	Marine Used
Motor KV	1000KV	Marine Used
Diameter	75 mm	Marine Used
RPM	12000	

### 2.4. Progressive Speed

Progressive speed test is a test to determine the speed of the test object, because speed is very important in the characteristics of the test object and this is one of the bargaining capabilities in its operation. In

the contract for making the test object, the speed conditions are at stake with a fine if the speed conditions are not met. Usually a speed that is not met can be fined 5% to 10% of the construction contract value; this is stated in the technical specifications. Therefore, the speed condition is very much taken into account in the application of the design of the trainer power so that it can meet the criteria in the construction contract technical specifications. In the Progressive speed test with the procedure is carried out in 2 (two) opposite directions while still paying attention to the heading direction of the object of the test object. For example, the experimental conditions for the first progressive speed are carried out with a heading of 180 degrees and the direction of the second experiment is carried out with an experimental direction with a heading of 0 degrees. The progressive speed test conditions also take into account the capacity of the propulsion power. In this case it is carried out with the service conditions and the maximum speed. The conditions in the performance test should be done in calm water conditions.

### 2.5. Turning Circle Test

The process of testing the test object by experimenting with the rotation conditions of the object maneuvering, among others: right turning and left turning. In this case the propulsion propeller is moved with a maximum angle of 30 degrees to be able to perform maneuvering to rotate in a circle to the right of 360 degrees with the next step carried out which is the same as turning a circle to the left. So that the tactical diameter will be obtained and it is formed and measured in accordance with the real conditions of the Ship-RUV maneuvering.

### 2.6. Image processing

In this case, it is done by carrying out the image-taking process that can be carried out in the test pool. In this case, the image-taking process is carried out in water to take the existing photo images. In this case it is done with the moving Ship-RUV and at rest conditions. The results of the imaging process are calculated with the resolution of the results with the results of the camera components installed in the Ship-RUV.

## 3. Methodology of experimental

Methodology of experiment to get test results that are effective and efficient in the Ship-RUV experiment, it can be done with the following test stage conditions, among others:

### 1. Preparation for testing the test object

In the preparation for testing the Ship-RUV specimens, the testing tools are prepared by performing the calibration of the tools. Result test to produce good values in accurate results at the time of testing. Some of the object test equipment includes: GPS, Stopwatch, Anemometer and Test Pool. GPS is used to monitor the location of the Ship-RUV Test object. Stop watch is to calculate the speed of the Ship-RUV test object. To find out the wind speed anemometer Inspection of the initial Ship-RUV specimens can be done by checking the enclosure with the hope that this will provide the condition of the components to work properly before testing. So that we get Ship-RUV conditions that are worthy of the testing is needed and conditioned in the Calm Water condition test column.

### 2. Components check and Process Starting from the test object

Inspection of the initial Ship-RUV prototype can be done by good component the enclosure with the function. That Ship-RUV have the condition of the components to work properly before operation test. So it to get Ship-RUV conditions with worthy of the test.

### 3. Wind check speed conditions

In this case the wind speed should not exceed 2 m / s as this will result in an increase in the wave water conditions. Therefore, checking the wind speed within the specified limits will provide a maximum value in the Ship-RUV speed due to the influence of stable water wave conditions.

#### 4. Test Pool Conditions

The condition of the test pool when the experiment was used was in calm water conditions. The water wave conditions are not significantly high. Besides the main requirement, there is an addition that the test pool is in a clear condition, so it can monitor the movement of the Ship-RUV. Therefore, the selection of the test pool plans in clear conditions, free from objects or garbage when maneuvering and has the intensity of light that enters the water a lot [11][12].

#### 5. Progressive Speed Test

The testing process is calculated based on the speed of the test object where it is carried out in two directions with the experimental conditions with the opposite heading.

#### 6. Turning Circle Test

The process of testing the test object by performing rotating conditions includes: right turning and left turning.

#### 7. Image Processing

In this case, it is done by carrying out the image-taking process that can be carried out in the test pool.

#### 8. Result

Provide track record results on ship-RUV to show maneuvering characteristics and image processing results.

### 1 Analysis and Discussion

In the Ship-RUV maneuvering test, the Ship-RUV test results were obtained with a maximum speed of 5 knots with a tactical maneuvering diameter of 1500 mm. The result of image processing resolution is 720P, which is sufficient for investigating the ship's hull. These conditions are in accordance with the technical provisions required in accordance with those calculated in the classification [1]. The following shows the laboratory test results at Ship-RUV as follows:

**Table 2.** Result Laboratorium Test

Result Description Object:

No	Description Object	Value	Result	Note
1	Manouverig Turning Left 360 degree (Diameter Result)	1500 mm	Pass	Specification Technic
2	Maneuvering Turning Right 360 degree (Diameter Result)	1500 mm	Pass	Specification Technic
3	Maneuvering Speed Progression	2-5 knot	Pass	Specification Technic
4	Resolusi Image Processing	720P	Pass	Specification Technic

### 5. Conclusion

From result of behavioral analysis in the Ship-RUV maneuvering test, the Ship-RUV test results were obtained with a maximum speed of 5 knots with a tactical maneuvering diameter of 1500 mm. The result of image processing resolution is 720P, which is sufficient for investigating the ship's hull.

### 2

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