VTS50-10.2.9

THE ON-SITE ACCEPTANCE CONTENT AND METHOD OF VESSEL TRAFFIC SERVICE SYSTEM

*CHINA MSA*

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**Chapter Ⅰ TESTING CONTENT**

The on-site acceptance of the Vessel Traffic Services system refers to the tests carried out after the completion of equipment installation, connection, commissioning and calibration, including system function testing and System performance metrics testing.

The system function testing is mainly carried out according to the contract requirements.

The system performance metrics testing mainly includes radar detection range, positioning error, range resolution, bearing resolution, target tracking reliability, system MTBF and so on, the specific values are according to the contract requirements.

**Chapter Ⅱ TESTING METHOD**

**2.1 System function**

**Testing method:** Complete the functions required by the contract on the terminal screen in accordance with the established implementation steps.

**Testing requirements:** According to the contract requirements.

**2.2 Radar detection range**

The target with the required ability to reflect (or radiate) electromagnetic waves (such as a target with a radar cross section of 1 m2 or 10 m2) should be selected on the terminal screen. the nearest radar station is selected to measure the maximum and minimum detection range.

**2.2.1 Maximum detection range**

**Testing method:** Before testing the maximum detection range, firstly, adjust the receiver gain to meet the specified false alarm probability requirements. Under the agreed sea and meteorological conditions, the radar cross section of the selected target shall meet the specified requirements and moved it to the position that meet the maximum range detection requirements meets to check whether the testing results meet the requirements of discovery probability (that is, in the antenna continuous scanning, the ratio of the sum of the number of targets found on the display to the sum of the number of antenna revolutions, the number of antenna revolutions should not be less than 20). The target can also be moved to a position that meets the requirements of the probability of discovery to determine its distance. that is the maximum detection range.

**Testing requirements:** According to the contract requirements.

**2.2.2 Minimum detection range**

**Testing method:** The anti-jamming "button" should be set to 0. The little boat with a 10m2 radar cross section should be selected and proceeding to the radar station. When the echo of this boat is almost disappeared on the radar screen, the horizontal distance from the boat to the radar station should be measured by the radar. Repeat 10 times to find the average value, that is the minimum detection range.

**Testing requirements:** According to the contract requirements.

**2.3 Positioning error**

Stationary point targets and moving targets should be selected. The bearing and distance of the target measured by high-precision locator are taken as the true value. The bearing and distance of the target measured simultaneously on the terminal screen as the system observation value. Compare the observation value with true value to determine the maximum positioning error.

**2.3.1 Range error**

**Testing method:** Stationary point targets and moving targets should be selected. The distance of the target measured by high-precision locator (Its accuracy is at least one order of magnitude higher than radar’s accuracy) is taken as the true value. Compared that with the distance measured by radar. The range error of stationary and moving targets can be determined separately according to the following formula.

（1）Range fixed error (system error)

－radar range observation value.

－range observation value of high precision locator (true value).

－number of observations,.

（2）The range accidental error (random error) is

The root mean square error of range is

（3）The Maximum range error (limit error) is

The acceptance data shall be subject to the maximum range error.

**Testing requirements:** According to the contract requirements.

**2.2.2 Bearing error**

**Testing method:** Stationary point targets and moving targets should be selected. The bearing of the target measured by high-precision locator (Its accuracy is at least one order of magnitude higher than radar’s accuracy) is taken as the true value. Compared that with the bearing measured by radar. The bearing error of stationary and moving targets can be determined separately according to the following formula.

（1）Bearing fixed error.

－Radar Bearing observations value.

－Bearing observation value of high precision locator (true value).

－number of observations,.

（2）The accidental bearing error is

（3）The root mean square error is

The maximum bearing error is

The acceptance data shall be subject to the maximum bearing error.

**Testing requirements:** According to the contract requirements.

**2.4 Range resolution**

**Testing method:** The pulse width should be set to the specified value, and the anti-rain interference should be set to "0" at the selected testing point and agreed range. Two-point targets should be selected to support an omni-directional reflector with a height of 3 meters and a radar cross section of 1m2. The two targets should maintain a same orientation, the distance between them should meet the specified requirements of range resolution. The gain and wave suppression buttons should be adjusted to make the detection probability of the two targets is about 90% (the joint detection probability of the two targets is 80%). The echoes of the two targets can be separated display as qualified. Or under the condition that the joint discovery probability of the two targets is about 80%, change the radial distance between the two targets slowly, when the echoes of the two targets are exactly tangent, measuring the radial distance between the two targets, that is radar range resolution. The average value of 10 tests was taken as the test result.

**Testing requirements:** According to the contract requirements.

**2.5 Bearing resolution**

**Testing method:** The pulse width should be set to the specified value and the anti-rain interference should be set to "0" at the selected testing point and agreed range. Two-point targets should be selected to support an omni-directional reflector with a height of 3 meters and a radar cross sectional of 1m2, and the two targets should maintain a same distance, the angle between them should meets the specified requirements of bearing resolution. The gain and wave suppression buttons should be adjusted to make the detection probability of the two targets is about 90% (the joint detection probability of the two targets is 80%). The echoes of the two targets are just in the critical state of separation display is qualified. Or under the condition that the joint detection probability of two targets is about 80%, keep the two targets equidistant from the radar station, reduce the angular interval between them slowly, and measure the angle between the two targets at the moment when the echoes of the two targets cannot separated in the display, measure the interval of the two targets, that is radar bearing resolution. The average value of 10 tests was taken as the test result.

**Testing requirements:** According to the contract requirements.

**2.6 Target tracking reliability of head-on situation, crossing situation, overtaking, changing speed, maximum speed and maximum rudder angle**

**Testing method:** The pulse width should be set to the specified value and the anti-rain interference should be set to "0" at the selected testing point and agreed range. Select two small ships to establish stable tracking respectively, the two ships shall adopt the specified CPA of head-on situation, crossing situation, overtaking, change speed, maximum speed, maximum rudder angle, etc. and the ratio of normal tracking number to the total number of tests is the target tracking reliability.

**Testing requirements:** According to the contract requirements.

**2.7 System MTBF**

**2.7.1 MTBF test method**

**Testing method:** The system MTBF adopt fixed time or fixed number truncation testing, the risk of the manufactureris 30%, the user is 30%, and the identification coefficient is 3, truncation time coefficient is 0.37, truncation coefficient is 1.

The truncation time is determined by the following formula:

*T＝×*

T - truncation time.

- specified acceptable MTBF.

- specify the acceptable multiple of MTBF.

The time recorded during the testing does not include the warm-up, maintenance and downtime of the system equipment.

The number of truncated coefficients is determined by the following formula is

*F＝＋0.333×*

F - total number of associated faults.

- number of serious failures.

- the number of mild failures.

**2.7.2 Definition of system fault**

**Critical failure.** There is a fault injury of personal or heavy loss of system equipment caused by the defects of the equipment when the operation and maintenance personnel operating according to the manual provided by production.

**Catastrophic failure.** Failures causing system interruption.

**Minor failure.** Failures of indicative components, self- checking components and failures that does not affect the specified functions of the system.

**ANNEX 1 Distance test sample sheet**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Content | System range detection | | | | Staff for SAT |
| NO. | 01 | Test subproject name | RCS target detection capability | | Testing staff |
| The test conditions | （1）The radar false alarm probability is 10-6 when the clear weather and calm water face are selected.  （2）4.5 nautical miles (give a typical example) from radar station was selected as testing waters.  （3）Place the 1m2 RCS reflector with a 3m high supporting pod on a small wooden or glass-steel boat. | | | |
| Procedure | （1）Get the test vessel to the designated point.  （2）Observe the echo of the target on screen, record the antenna revolution and the frequency of target finding echo in the table. The number of recorded observation data shall be no less than 10;  （3）Calculate the probability of discovery  (n is the number of recorded data, n≥10) | | | |
| Processing  results | Contract Requirements (Examples): Maximum detection range ≥4.5NM (probability of discovery ≥90%) | | | | Data processing staff: |
| Actual detection probability: | | | |
| Acceptance conclusion | qualified | | | unqualified |
|  | | |  |
| Acceptance Result Confirmation | Testing personnel Signature  Expert signature | | | |

**ANNEX 2 Target tracking stability test recording sheet**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Content | System tracking stability acceptance | | | | Staff for SAT |
| NO. | 02 | Test subproject name | Target steering manoeuvre tracking stability | | Testing staff |
| The test conditions | （1）Choose clear day and calm water conditions.  （2）4.5 nautical miles from radar station was selected as testing waters.  （3）One small high-speed boat, one laser rangefinder. | | | |
| Procedure | （1）The Small high-speed boat is standby 4 nautical miles from the radar station. When the test is ready, inform the boat to move in a straight line at a speed of 10kt for 2 minutes.  （2）Then the boat moves in a uniform circle with a radius of 98m at a speed of 10kt and (The safety of itself should be guaranteed). At the same time, DGPS is turned on to adjust the circle radius, so that the time of each circle is maintained between 90-120 seconds;  （3）The tracking stability of the boat was observed on the traffic display, and recorded by the tester and filled in the table.  （4）Repeat the above tests (2) and (3) more than 10 times.  10kt  10kt  3˚/s  98m  （5）Calculate the rate of discovery. | | | |
| Processing  results | Actual tracking success rate(Examples): 3°/s | | | | Data Processing staff: |
| Acceptance conclusion | qualified | | | unqualified |
|  | | |  |
| Acceptance Result Confirmation | Testing staff signature  Expert signature | | | |