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| IALA Guideline |

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Acceptance of VTS SYSTEM

Edition 1.0

Document date

Revisions to this IALA Document are to be noted in the table prior to the issue of a revised document.

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# INTRODUCTION

## Document Purpose

The purpose of this document is to advice authorities providing Vessel Traffic Services on the acceptance process of a VTS System or functional parts of a VTS System (as specified in IALA Recommendation V128 – Preparation of Operational and Technical Performance of VTS Systems).

IALA Guideline G.1111 – Preparation of Operational and Technical Performance Requirements for VTS Systems provides a framework to assist these authorities in the preparation of requirements for a VTS System(s) or any functional part of a VTS System.

This document provides a framework for the acceptance process such that the specified system:

* is working according to the agreed requirement (e.g. verification); and
* is suitable for the intended services (e.g. validation).

As a result, there will be a common understanding between the authority and the system supplier about the set requirements and the procedures that demonstrate compliance.

The suggested steps in this document can be tailored depending on the size and/or complexity of a system.

## Definitions

For the purposes of this document, the following definitions apply:

|  |  |  |
| --- | --- | --- |
| **Customer** | – | Authority providing Vessel Traffic Services |
| **Supplier** | – | The organization that provides a VTS System or functional parts of a VTS System. |
| **System** | – | A system is an arrangement of parts or elements that together exhibit behaviour or meaning that the individual constituents do not [8]. This can be a group of items or devices working together. |
| **Test Procedure** | – | A (detailed) sequence of steps to be executed to demonstrate compliance to a requirement. |
| **VTS System** | – | within this document, the VTS System is considered to be the VTS software, hardware, communications and sensors. This excludes personnel and procedures [3]. |

## References

1. IALA Recommendation V-119 The Implementation of Vessel Traffic Services
2. IALA Recommendation V-128 Preparation of Operational and Technical Performance Requirements for VTS Systems
3. IALA Guideline 1111 Preparation of Operational and Technical Performance Requirements for VTS Systems
4. IALA Guideline 1150 Establishing, Planning and Implementing VTS
5. IEEE 1012-2016 IEEE Standard for System, Software, and Hardware Verification and Validation
6. ISO 9000-2005 Quality Management Systems
7. ISO 15288-2008 Systems and Software Engineering – System life cycle processes
8. INCOSE-TP-2003-002-03.2.2 INCOSE Systems Engineering Handbook. A Guide for System Life Cycle Processes and Activities, Ver. 3.2.2 October 2011

# Acceptance Process

The acceptance process shall demonstrate the compliance of the VTS system, prior to operation, to the agreed requirements.

This section provide general framework to manage acceptance processes and suggest possible acceptance steps.

VTS system can be break down into functional parts of VTS system and acceptance step and acceptance criteria should be developed.

## Process Management

### Strategic Planning

The Acceptance Test Plan of a VTS System should describe how the acceptance is organised. This may include:

* A mutual understanding and agreement between Customer and Supplier of the requirements;
* System integration and interfacing;
* Dependencies between process and steps;
* Logistics arrangements;
* Key milestones;
* Test procedure and sequence;
* Acceptance criteria

The level of effort and detail should be in agreement with the system complexity and criticality.

In general, compliance to a given requirement should be demonstrated as early as possible to reduce risk of discrepancies in later stages of the acceptance process.

If a new system will be connected to an existing system, it may need to consider in which step to demonstrate interaction with the existing system.

### Acceptance criteria

The basis for any acceptance process is to demonstrate that the agreed requirements are fulfilled. The handling of any discrepancies should be considered.

The requirements should describe the operational scenarios, use cases, technical functions and performance of the system. These should:

* Be uniquely identifiable
* Have an acceptance criterion
* Be SMART (Specific, Measurable, Achievable, Relevant, Time bound).

However, it is noted that all requirements may not be SMART, or can easily be turned into SMART requirements. This might be the case with so called non-functional requirements. e.g. the system should be ergonomic, easy to use/intuitive, robust or etc. These requirements usually requires special attention in the Acceptance Process.

Also on forehand thought should/could/may be given to a classification of non-compliancies encounterd during testing. E.g. they may be classified as :

* Major/blocking ; the test procedure can not continue before this issue has been solved.  A decision (preferably on forehand ) has to be taken about the level of regression testing
* Corrective; the issue can be solved during the test process and thereafter testing can continue
* Cosmetic; testing can be continued and the issue may be solved in a later stage.

## Acceptance Steps

A VTS System is a complex system that includes many different technologies at multiple sites to support the operational process. These technologies are included in e.g. communications system, monitoring system, sensors and environmental monitoring systems.

A typical acceptance process will demonstrate compliance, starting from the lowest-level building blocks to functional sub-systems and, finally, the complete VTS System. This process may include multiple sub-systems at multiple sites (e.g. the VTS centre and multiple sites for sensors and communications).

Basically, however, the acceptance process is the same at all levels:

* There is a set of applicable requirements;
* There is a physical implementation of the requirements;
* There is a set of test procedures with acceptance criteria.

Once the lower levels are satisfactory tested, testing at the next higher level can commence. This is illustrated in Figure 2.

The acceptance cost generally increases when going down through lower level system, but also provides increased confidence that the requirement is actually met. The selection of steps and methods involve balancing the most cost-effective mix of adequate testing against minimizing the risk of not meeting a requirement.



1. VTS System breakdown structure and order of acceptance

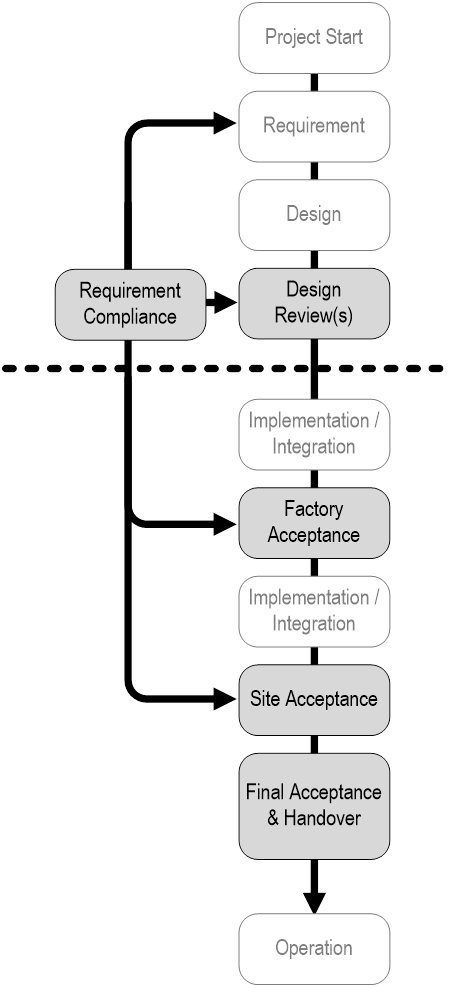
Typically, the acceptance of a VTS system will already start during the design of the system and continue while the system is being implemented.

The typical steps are shown in Figure 1, and acceptance steps are illustrated in grey boxes:

* Acceptance at Design Review(s);
* Factory Acceptance;
* Site Acceptance;
* Final Acceptance.

The steps illustrated by the white boxes are important steps in the establishment, planning and implementation of a VTS system, but as these steps are not directly a part of the system acceptance, they are not discussed in this document.

Note that this acceptance process applies equally well to the different functional sub-systems of a VTS System.



1. Acceptance steps within the establishment of a VTS System

## Acceptance Documentation

Acceptance Documentation within this section covers mainly Factory and Site Acceptance. This documentation could comprise the following:

1. Factory/Site Acceptance Test Plan;
2. Factory/Site Acceptance Test Procedures; and
3. Factory/Site Acceptance Test Report.

### Test Plan

The test plan describes overview of overall acceptance steps how the Supplier intends to demonstrate compliance to the requirements at a given stage. The test plan should be approved by the customer prior to excecuting tests.

Both Customer and Supplier may check the availability of a historical recorded data to be performed in order to demonstrate system criticality to comply with the agreed requirement.

Apart from the test methodology, the acceptance criteria should be specified and there should be an indication of how discrepancies are handled. The criteria would differ depending on the criticality of the requirement to the entire system.

It should include:

* Scope;
* List of items to be tested: which can be overall VTS System or breaking down into functional part of VTS System;
* Test approach;
* The Requirements Traceability Matrix (if not maintained separately);
* Test readiness criteria;
* Resources and Schedule;
* Documentation (e.g. Design Document, System configuration drawing, Manual);
* Risk assessment (including action plan how to deal with discrepancies)
* Logistics; and Responsibilities.

The Responsibility of personnel who accept VTS System and / or a functional part of systems should be:

* familiar with setup and operation of the system;
* appropriately qualified to review test report and accept the system and/or VTS System; and
* appropriately qualified to decide direction in case of discrepancies.

The Responsibility of personnel who conducts VTS System and / or a functional part of systems should be:

* familiar with setup of the system to be tested;
* appropriately qualified to conduct test; and
* appropriately qualified to decide direction in case of discrepancies.

### Test Procedure

Test procedures should describe how to execute a functional part of system and / or overall VTS System. It includes the test:

* Scope
* Test conditions, equipment, and environments;
* Test methods;
* Acceptance Criteria (if not maintained separately); and
* Expected outcomes (e.g. test measurement result and log file).
* Test scripts, describing the tests (if applicable) to be executed and the order in which they are executed step by step

The basic test methodologies applicable to system acceptance may include the following:

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| Inspection | – | Inspection determines acceptance by whether the system is in proper condition and right quantity involving examination and observation (e.g. paint colour, weight, physical dimensions, etc.); |
| Similarity | – | Similarity determines acceptance by whether the system is modified or similar to an existing accepted system. It need to be similar system and / or system architecture. |
| Analysis: | – | Analysis determines acceptance by showing theoretical compliance under defined conditions between proposed system and the agreed requirement. Analysis (including simulation) is used where testing to realistic conditions cannot be achieved or is not cost-effective. |
| Demonstration | – | Demonstration determines acceptance by a practical or qualitative exhibition and explanation of how system works or performs functionally. Demonstration may be conducted by using a set of system stimuli or test jig. Demonstration can be used to show that the system responses to the stimuli is suitable. Demonstration may be appropriate when requirements or specifications are given in statistical or practical terms (e.g. mean time to repair, average power consumption, etc.) or test item is partial system of larger system (e.g. replace or repair of system module). |
| Test: | – | An action by which the operability, supportability, or performance capability of an item is verified when subjected to controlled conditions that are real or simulated. These verifications often use special test equipment or instrumentation to obtain very accurate quantitative data for analysis. |
| Operational Trial | – | A period of time by which the system performance and reliability has to be proven according to Operational Procedure and reliability requirement. |
| Certification | – | Written assurance that the product has been developed and can perform its assigned functions in accordance with legal or industrial standards. The development reviews and verification results form the basis for certification; however, outside authorities, without direction as to how the requirements are to be verified, typically perform certification (e.g. CE certification, UL certification, etc.) |

### Test Report

At each stage of acceptance, the test report should, at least, include:

* Tested requirement(s);
* List of items to be tested;
* Configuration details (e.g. customer, software revisions, hardware revisions, parts and serial numbers);
* Test date;
* Test environment (e.g. temperature, humidity, and air pressure);
* Person(s) who performed/witnessed the test and Signatories;
* Test outcome (e.g. Pass/fail);
* Functional and Performance Test results (e.g. measurement result, log file) and comments (e.g. measurements, findings, etc.);
* Updated Compliance matrix to the requirement and design;
* Documentation (e.g. Manuals, Quality assurance document, copy of certifications);
* References to project name;
* List of instruments and their calibration status; and
* Report of discrepancies (if applicable).

In case of discrepancies, corrective actions should be agreed upon at later stage of the executed test.

# Test execution / Acceptance steps

## Design Review

### Introduction

Depending on the VTS system complexity, design review(s) can be included in the acceptance process. Early involvement of relevant stakeholders in the process of the system architecture/design? development:

* Reduces risk of misunderstandings of the requirement;
* Aware possible risks (e.g. first-time development risk, delay of delivery or etc.)
* Developing mutual understandings of design architecture;
* Assure compliance of the future VTS System to requirement; and
* Ensures awareness of design, performance and legal issues.

### Test readiness

Prior to Design Review, the following should be considered:

* Completion of design documentations by Supplier;
* Completion of additional risk assessment by Supplier (e.g. interference or unwanted reflection of radio transmitting system); and
* Site Survey (if applicable): (e.g. a new radar implementation may require a site-survey in order to test that the planned location doesn’t lead to any unexpected/unwanted side effects, like reflections from large objects in neighbourhood etc.)

### test execution

Design Review can be executed by inspection of design documentations which include;

* System architecture diagram;
* Technical data sheet;
* Manuals (if applicable or available) and;
* Analysis or Demonstrated documentation of proposed system under defined conditions (e.g. coverage simulation, strength calculation and wind load calculation).

## Factory Acceptance

### Introduction

Depending on the VTS system complexity, Factory Acceptance can be conducted to accept functionality and technical performance and their interaction before installation for a functional part of system or overall VTS System. The main reasons for factory acceptance are:

* Ensuring that the system is performing according to agreed requirements or design before being installed on-site
* Availability of specific and specialised test equipment and environments;
* Tests can be conducted in a controlled environment which is :
* Methodical;
* Efficient;
* Precise; and
* Repeatable.

### Test readiness

Prior to Factory Acceptance, the following should be considered that:

* Condition of the production and integration of a functional part of system or overall VTS System
* Condition of the test set ups;
* Agreement on the Factory Acceptance Test Plan; and
* Agreement on the Factory Acceptance Test Procedure.

### Test Execution

Factory Acceptance should be conducted based on agreed Factory Acceptance Test Plan and Factory Acceptance Test Procedure, and Supplier should issue the FAT report which includes the items listed in Section 2.3.3. Factory Acceptance could include the following activities:

* Inspection of Documentation (including Production Test Reports);
* Review of Quality, Health, Safety and Environmental processes;
* System(s) inspection; and
* Demonstration and Test by Factory Acceptance Test (FAT).

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The FAT for a functional part of VTS Systems is generally the Supplier’s responsibility and such FAT has to be setup and performed by the Supplier in agreement with the Customer. The Customer may elect to attend or to be represented at such FAT.

Installation

The process of installation will not be described in in detail and often has to do with a lot of technical detail which are described in G.1111?. However, this fase needs not to be underestimated and requires good preparation. E.g. in most cases it is adviseable to check in an early stage if the environment where equipment will be installed is fit for this purpose. E.g. in case of transmitting equipment a check on possible interference should be done on fore hand, and e.g. in case of a radarsystem a site-survey should take place in order to check if the suggested location doesn’t lead to any unexpected/unwanted side effects, like reflections on foreign objects etc. Skipping these checks may lead to a situation that the required/expected results from the equipement to be installed will not be met.  
A Supplier may wish to perform a crosscheck on forehand.

## Site Acceptance

* + 1. **Introduction**

Site Acceptance should demonstrate against the agreed design and / or requirements of the system after installation.

Site Acceptance should address those requirements that can only be tested in the operational environment. It can reference the Factory Acceptance outcome to

Site acceptance may include inspections, functional checks and performance measurements.

The main reasons for testing on site are to accept:

* Dynamic performance measurement/tests in the field with live data
* Interaction of system(s) to system(s);
* Interaction with present system(s) and infrastructure; and
* representative environment (e.g. geography)
* to demonstrate compliance and suitability for the purpose of the system.
  + 1. **Test readiness**

Prior to Site Acceptance, the following should be considered:

* Condition of installation, system set up and integration, if not, status should be reported;
* Status of possible corrective actions from Factory Acceptance;
* Site access and physical security;
* Construction works;
* Facilities such as power supplies (grid / non-grid / backup) and environmental conditioning;
* Safety measures, such as proper grounding, fire and lightning protection;
* Ergonomics; and
* Communication connections, on-site and, if required, off-site.
* Agreement on the Site Acceptance Test Plan; and
* Agreement on the Site Acceptance Test Procedure.
  + 1. **Test Execution**

Site Acceptance should be conducted based on agreed Site Acceptance Test Plan and Test Procedure, and Supplier should issue the report which includes the items listed in Section 2.3.3. Site Acceptance Test could comprise:

* Physical Configuration Audits;
* Inspection of installation and workmanship including regulatory compliance;
* Test of system integration, including communications;
* Inspection of setup, parameter adaptations, and tuning; and
* Site Acceptance Tests (SAT), including Functions and Performance.

## FINAL Acceptance

### Introduction

### Test Readiness

### Test Execution

# Overall Acceptance

* + 1. **Introduction**

The VTS System or functional parts of a VTS System should go through an Final Acceptance.

The Final Acceptance for the overall VTS System should demonstrate that the system is fit for operational use and compliant with the requirements.

Reasons for a Final Acceptance for the overall VTS System are:

* Opportunity to test the complete VTS system
* Ensures the interfaces are performing correctly
* Ensure the VTS system is performing as intended
* Ensure the VTS system is reliable
* Observe the VTS system across different Meteorological and Hydrographical conditions

The Final Acceptance for the overall VTS System is a separate process and may follow acceptance documentation(s) to those listed in Section 2.3 of the functional parts of the VTS System. The process and acceptance criteria should be pre-agreed and the time period defined with the customer in advance.

* + 1. **Test Readiness**

The VTS System may have been through its own:

* Design Review acceptance
* Factory Acceptance
* Site Acceptance.

The VTS System is in the intended operational mode.

* + 1. **Execution**

Overall Acceptance could be performed over a period of time and could monitor the performance of the Overall VTS System including:

* + Communications (e.g. Networking);
  + Interfaces and Integration;
  + Reliability and Availability;
  + Coverage.

# ANNEX

Example of different test procedures / reports for single system and complex system.

**Design Review Acceptance Report**

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| I**ntroduction**  **blah** | |  |
| **Item** | **Description** | **Pass / Fail** |
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**FAT Report**

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| I**ntroduction**  **blah** | |  |
| **Item** | **Description** | **Pass / Fail** |
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**SAT Report**

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| --- | --- | --- |
| I**ntroduction**  **blah** | |  |
| **Item** | **Description** | **Pass / Fail** |
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