

System Test Description (STD)

Terma case

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Company F:

IVAN GRUJIC, 10454

LARS NIELSEN, 10765

LARS JUHL LUNDE, 10423

SERGIU-VLAD TALNACI, 201400122

LASSE BRØSTED PEDERSEN, 10769

FATEMEH SADAT KIAEERAD, 201210732

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1 Revision history

Date	Ver. No	Author	Contact	Description
24-Feb-2014	1.0	-	-	Initial version

2 Stakeholders

Name	Role	Contact
Stefan Hallerstede	Customer	sha@iha.dk
Company G	Subcontractor	201302499@iha.dk
Company F, Training department	Trainers	201210732@post.au.dk

3 Scope

The origin of this section is the section "Scope" in the F-SRS-2014-V1 document.

3.1 Identification

This document applies to the self protection suite to be developed by Terma A/S for the Royal Danish Airforce.

The solution will incorporate a pod and an intelligent cockpit control unit for the F-16 Combat Aircraft. The pod will be able to dispense payloads consisting of chaffs and flares and also host the Missile Warning System (MWS). The solutions will provide warning upon detection of missile threats and be able to automatically dispense payloads in response.

3.2 System-overview

The goal of the system is to protect the aircraft from enemy incoming missiles by deploying flares and chaffs. It also provides threat information to the information computer, which interacts with the pilot. It is possible for a technician to load the system with chaffs and flares. During the preparation phase before the missions, the system informs the technicians about the current amount of chaffs and flares present on the aircraft.

3.3 Document overview

In this document tests are identified as ReqNoXX-T. The XX is a number mapping to the requirement number in the document F-SRS-2014-V1.

4 Referenced documents

5 Test preparations

This section contains the preparations required for all tests.

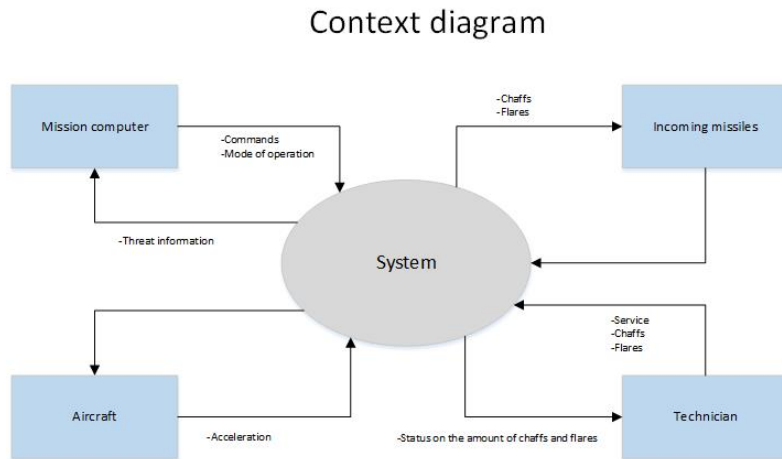


Figure 1: Context diagram

ReqNo1-T

Requirement: *The system shall comprise at least three modes, manual, semi-automatic and automatic.*

The ability for the pilot to select each mode is tested.

Preparations needed:

- None.

ReqNo2-T

Requirement: *Manual mode shall dispense the program selected by the pilot. The pilot may select payload, and dispense direction as defined by UR-2.*

The operator will dispense the desired payload in the desired direction. All combinations of payload and direction is tested.

Preparations needed:

- Manual mode is selected.

ReqNo3-T

ReqNo4-T

Requirement: *Automatic mode shall initiate an intelligent threat response without pilot interaction.*

This test verifies that the cockpit unit, in automatic mode, can send a signal to the dispenser.

Preparations needed:

- Automatic mode is selected.

ReqNo5-T

Requirement: *The pod shall include a minimum of eight standard magazines.*
This test verifies that the pod includes a minimum of eight standard magazines.

Preparations needed:

- None.

ReqNo6-T

Requirement: *The pod shall be able to dispense forwards, downwards and sideways.*

This test verifies the mechanical capability and reliability. The test applies to the pod components, meaning magazines and dispensers.

Preparations needed:

- Accurate, high precision motor control needed for all ways movements.
- High precision time calculator needs for measuring the delay and accuracy of the synchronization between the components.

ReqNo7-T

Requirement: *The cockpit unit shall be able to power ON and OFF the dispensing system and the MWS.*

The MWS and dispenser assembly is turned on and off. In each state the the result is verified.

Preparations needed:

- The system main power source must be turned on.

ReqNo8-T

Requirement: *The system shall be able to dispense a minimum of two payloads within 0.1 sec.*

Using manual mode, the operator tries to dispense two payloads simultaneously. It is measured whether the payloads are dispensed within 0.1 sec.

Preparations needed:

- A stop-watch must be provided.

ReqNo9-T**ReqNo11-T**

Requirement: *The System shall be able to erase prior defense patterns and usage statistics upon receiving the string 'zeroize' from the mission computer.*

This test verifies that the system is able to erase prior defence patterns and usage statistics.

Preparations needed:

- None

ReqNo12-T

Requirement: *The cockpit unit shall communicate with the MWS via a MIL-STD-1553-B data bus.*

This test verifies that the cockpit unit and the MWS communicate with the MIL-STD-1553-B data bus.

Preparations needed:

- None.

ReqNo13-T

Requirement: *Threats shall be transmitted to the aircraft mission computer in body frame format (relative to aircraft) for displaying purposes.*

The test includes simulating different types of threats from different directions and testing the reliability of the aircraft mission computer for displaying the threat.

Preparations needed:

- Threat simulation should be comparable to the real case threat
- Different directions relative to north and different velocities should be provided for the simulated threat.
- Different displaying tools, such as audio and visual needed
- Time calculator needs for calculating the time takes for transmitting the threat from MSW to display.
- Pilot reaction time for testing different display methods

ReqNo14-T

Requirement: *Threat information will be provided by the Electronics Control Unit (ECU).*

It is tested that threat information is supplied by the ECU when a threat is simulated.

Preparations needed:

- A method for simulating threats must be supplied.
- A method for reading the interface I-IF-MWSCTRL defined in section 6 of F-DDD-2014-V1.

ReqNo15-T

Requirement: *The system shall provide the aircraft mission computer with status information and built-in test results.*

Test-software installed on the mission computer requests status information and built-in test results from the system. The test-software verifies that the received data is correct.

Preparations needed:

- Test-software for the mission computer must be developed.

ReqNo16-T

ReqNo17-T

Requirement: *The system status on individual LRU level shall be provided by cockpit unit.*

This test verifies that the Cockpit Unit can provide status updates from the Pod.

Preparations needed:

- The Pod must be attached to the plane.

ReqNo18-T

Requirement: *The MWS must receive navigation data from the aircraft mission computer with a latency of no more than 10 ms. Navigation data includes aircraft attitude, heading, altitude and GPS data.*

This test verifies that the MWS receives navigation data from the aircraft mission computer within the allowed time range.

Preparations needed:

- Test navigation data including attitude, heading, altitude and GPS data must be loaded on the aircraft mission computer.
- A high precision stop-watch must be provided.

ReqNo20-T

Requirement: *The cockpit unit shall communicate with the mission computer via a MIX-STD-1553-B data bus.*

Test includes sending commands to the mission computer and making it understandable for the pilot.

Preparations needed:

- The communication of cockpit unit with Pod should have been done and tested before hand.
- The mission computer need compatibility for data bus.

ReqNo21-T

Requirement: *Introduction of the system may not compromise the operation of the current weapon systems.*

Current weapon systems are tested with the self-protection suite installed.

Preparations needed:

- All current weapon systems must be available for testing.

ReqNo22-T

Requirement: *The system shall include a hardware implemented safety interlock to prevent dispensing on ground.*

It is assured that the aircraft is touching the ground. Then it is tried to dispense payloads. It is observed whether the system dispenses the payload or not.

Preparations needed:

- None.

ReqNo23-T

ReqNo24-T

Requirement: *The system shall be able to erase sensitive data upon input from a discrete zeroize signal from aircraft.*

This test verifies that the zeroize signal is received by the cockpit unit.

Preparations needed:

- The cockpit unit main power must be turned on.

ReqNo25-T

ReqNo26-T

Requirement: *The magazines shall be stored at no lower than -10 degrees Celcius and no higher than 70 degrees Celcius.* The temperature at which the magazines are stored shall be verified to be between -10 degrees Celcius and 70 degrees Celcius.

Preparations needed:

- None.

ReqNo27-T

Requirement: *The pod structure must be functional when exposed to steady state acceleration levels of 4g forward, 2.5g backward, 22g upward or 10g downward.*

The pod structure is subjected to steady accelerations, and then inspected for damages that may reduce functionality.

Preparations needed:

- A test setup to create the required steady state accelerations must be provided.

ReqNo28-T

Requirement: *The total weight of pod cannot exceed 270 kg.*

The total weight of pod measured is measured using a weighing scale. It is noted whether the weight is above or below 270 kg.

Preparations needed:

- Weighing scale must be provided.

ReqNo29-T

ReqNo41-T

Requirement: *The pod shall be operational at temperatures of maximum 95 degrees Celcius on outer skin and 152 degrees Celcius on leading egde for a maximum of 25 minutes.*

This test verifies that the pod is operational at the given temperatures and places for 25 min.

Preparations needed:

- A thermometer must be provided.

ReqNo30-T

Requirement: *The system shall include a hardware implemented safety interlock to prevent dispensing on ground.*

This test verifies that the hardware implemented safety interlock prevents dispensing on ground.

Preparations needed:

- The aircraft must be grounded.
- The mode must be set to manual mode.

ReqNo31-T

Requirement: *The system shall provide a method of loading software to MWS.*

The system applied the method for loading software.

Preparations needed:

- This has to be done before the other tests involving MWS.
- Different methods should be provided

ReqNo35-T

Requirement: *The physical dimensions of the pod cannot exceed 0.5×0.5×5 meter.*

The dimensions of the pod is measured using a measuring tape.

Preparations needed:

- A measuring tape must be provided.

ReqNo36-T

Requirement: *The aircraft has to be loaded with the payloads before take-off.*

The aircraft is loaded with payloads before take-off. In air it is attempted to dispense the payloads. It is checked whether the loaded payloads are dispensed.

Preparations needed:

- None.

ReqNo37-T**ReqNo38-T**

Requirement: *Technicians must be educated in maintenance of the system.*

This test verifies that the technicians are licensed in maintaining the system.

Preparations needed:

- None.

ReqNo39-T

Requirement: *The chaffs and flares shall be transported in accordance to Military Standard Transportation and Movement Procedures (MILSTAMP).*

This test verifies that the chaffs and flares are transported in accordance to Military Standard Transportation and Movement Procedures (MILSTAMP).

Preparations needed:

- None.

ReqNo40-T

Requirement: *The chaffs and flares shall be labeled and packed in accordance to MIL-STD-2073-1E*

Packing and labelling of chaffs and flares must comply with MIL-STD-2073-1E.

Preparations needed:

- Packaging and labelling method should be provided.

6 Test descriptions

This section contains descriptions of the tests.

ReqNo1-T

Requirement: *The system shall comprise at least three modes, manual, semi-automatic and automatic.*

The ability for the pilot to select each mode is tested. The operator will select each mode(manual, semi-automatic, automatic), using available inputs to the mission computer to confirm that these modes exist.

Inputs:

1. Manual mode.
2. Semi-automatic mode.
3. Automatic mode.

Outputs:

1. Confirmation of manual mode from the system to the mission computer.
2. Confirmation of semi-automatic mode from the system to the mission computer.
3. Confirmation of automatic mode from the system to the mission computer.

Expected result:

- Entering each mode is confirmed by the mission computer.

ReqNo2-T

Requirement: *Manual mode shall dispense the program selected by the pilot. The pilot may select payload, and dispense direction as defined by UR-2.*

The operator will dispense the desired payload in the desired direction. All combinations of payload and direction is tested.

Inputs:

- Desired dispensing combination.

Outputs:

- Chaffs or flares.

Expected result:

- The dispensed payload is either chaff or flare corresponding to the one selected. The payloads are dispensed in every selected direction.

ReqNo3-T**ReqNo4-T**

Requirement: *Automatic mode shall initiate an intelligent threat response without pilot interaction.*

A threat is simulated and the cockpit unit sends a signal to the dispenser. The dispenser then dispenses the payload.

Inputs:

- Simulated threat

Outputs:

- Chaffs or flares.

Expected result:

- The cockpit unit sends a signal to the dispenser. The dispenser then dispenses the payload.

ReqNo5-T

Requirement: *The pod shall include a minimum of eight standard magazines.*

The test official verifies that the pod includes a minimum of eight standard magazines.

Expected result:

- The pod includes a minimum of eight standard magazines.

ReqNo6-T

Requirement: *The pod shall be able to dispense forwards, downwards and sideways.*

This test verifies the mechanical capability and reliability. The test applies to the pod components, meaning magazines and dispensers.

Inputs:

- Dispensing commands for forward, downward and sideways directions
- The complete pod unit
- timer

Outputs:

- Status output of the dispenser
- Direction of movement after the command applied
- Time taken from the dispense command to actual dispense

Expected result:

- The movement directions of pod be in accordance with the dispenser commands and be applied in a fraction of second.

ReqNo7-T

Requirement: *The cockpit unit shall be able to power ON and OFF the dispensing system and the MWS.*

The test official turns on the dispenser assembly and the MWS using the mission computer. It is verified that the dispensing assembly and the MWS is on. Similarly turning off the MWS and dispenser assembly is also verified.

Inputs:

1. Switch on
2. Switch off

Outputs:

1. The MWS and dispenser assembly turns on.
2. The MWS and dispenser assembly turns off.

Expected result:

- The MWS and dispenser assembly can be turned on and off.

ReqNo8-T

Requirement: *The system shall be able to dispense a minimum of two payloads within 0.1 sec.*

Using manual mode, the operator tries to dispense two payloads simultaneously. It is measured whether the payloads are dispensed within 0.1 sec.

Inputs:

- Manual mode
- Dispensing command

Outputs:

- Confirmation of manual mode from the system to the mission computer.
- Two payloads.

Expected result:

- The two payloads are dispensed within 0.1 sec.

ReqNo9-T

ReqNo11-T

Requirement: *The System shall be able to erase prior defense patterns and usage statistics upon receiving the string 'zeroize' from the mission computer.*

Inputs:

- 'zeroize' string

Outputs:

- Confirmation of erasure.

Expected result:

- The system has erased prior defense patterns and usage statistics.

ReqNo12-T

Requirement: *The cockpit unit shall communicate with the MWS via a MIL-STD-1553-B data bus.*

The test official verifies that the communication bus between the cockpit unit and the MWS is a MIL-STD-1553-B data bus.

Expected result:

- The communication bus between the cockpit unit and the MWS is a MIL-STD-1553-B data bus.

ReqNo13-T

Requirement: *Threats shall be transmitted to the aircraft mission computer in body frame format (relative to aircraft) for displaying purposes.*

The test includes simulating different types of threats from different directions and testing the reliability of the aircraft mission computer for displaying the threat.

Inputs:

- Threats
- Timer

Outputs:

- Mission computer

Expected result:

- The display shows illustratively the coming threats for different directions.

ReqNo14-T

Requirement: *Threat information will be provided by the Electronics Control Unit (ECU).*

A threat is simulated. By monitoring the interface I-IF-MWSCCTRL (defined in section 6 of F-DDD-2014-V), it is then verified, that threat information is provided.

Inputs:

- A simulated threat.

Outputs:

- Threat information

Expected result:

- The threat information is provided by the ECU.

ReqNo15-T

Requirement: *The system shall provide the aircraft mission computer with status information and built-in test results.*

Test-software installed on the mission computer requests status information and built-in test results from the system. The test-software verifies that the received data is correct.

Inputs:

- Command that requests status information and built-in test results.

Outputs:

- Status information
- Built-in test results

Expected result:

- The status information and built-in test results is provided by the system.

ReqNo16-T

ReqNo17-T

Requirement: *The system status on individual LRU level shall be provided by cockpit unit.*

Inputs:

1. Status request for all Pod components.

Outputs:

1. Status information from all Pod components to the cockpit unit.

Expected result:

- All status information is sent from the cockpit unit.

ReqNo18-T

Requirement: *The MWS must receive navigation data from the aircraft mission computer with a latency of no more than 10 ms. Navigation data includes aircraft attitude, heading, altitude and GPS data.*

Navigation data is sent from the aircraft mission computer to the MWS. The time elapsed from the start of transmission to the end of reception is measured.

Inputs:

1. Navigation data from aircraft mission computer
2. Start transmission time stamp

Outputs:

1. Navigation data in the MWS
2. End reception time stamp

Expected result:

- The navigation data is received by the MWS.
- The time difference between the start and end timestamps is less than 10 ms.

ReqNo20-T

Requirement: *The cockpit unit shall communicate with the mission computer via a MIL-STD-1553-B data bus.*

Test includes sending commands to the mission computer and making it understandable for the pilot.

Inputs:

- Cockpit unit
- MIL-STD-1553-B data bus

Outputs:

- Mission computer
- pilot

Expected result:

- The communication from the cockpit unit and the computer mission be flawless and understandable by a pilot.

ReqNo21-T

Requirement: *Introduction of the system may not compromise the operation of the current weapon systems.*

Every current weapon system is tested. The test of each weapon system is carried out as described by the test description of that system.

Inputs:

- Appropriate test input for each weapon system.

Outputs:

- Appropriate output of a successful test for each weapon system.

Expected result:

- All weapons systems operate as before the self-protection suite was installed.

ReqNo22-T

Requirement: *The system shall include a hardware implemented safety interlock to prevent dispensing on ground.*

It is assured that the aircraft is touching the ground. Then it is tried to dispense payloads. It is observed whether the system dispenses the payload or not.

Inputs:

- Command that makes the system dispense payloads

Outputs:

- A warning signal from the cockpit unit interface.

Expected result:

- The system will not dispense on ground. Instead a warning signal will be provided from the cockpit unit.

ReqNo23-T

ReqNo24-T

Requirement: *The system shall be able to erase sensitive data upon input from a discrete zeroize signal from aircraft.*

Inputs:

- 'zeroize' string

Outputs:

- Confirmation of erasure.

Expected result:

- The cockpit unit receives 'zeroize' string and initiates the erasing of prior defense patterns and usage statistics.

ReqNo25-T

Requirement: *The zeroize signal shall be received by the cockpit unit.*

The zeroize signal is transmitted to the cockpit unit.

Inputs:

1. Zeroize signal transmission

Outputs:

1. Zeroize signal reception by the cockpit unit

Expected result:

- The cockpit unit receives the zeroize signal

ReqNo26-T

Requirement: *The magazines shall be stored at no lower than -10 degrees Celcius and no higher than 70 degrees Celcius. The temperature at which the magazines are stored shall be verified to be between -10 degrees Celcius and 70 degrees Celcius.*

Inputs:

- Storage rooms for magazines with accurate temperature control
- magazines

Outputs:

- Measured temperature

Expected result:

- The temperature of the storage room for the magazines does not go out of -10 to 70 degree Celcius.

ReqNo27-T

Requirement: *The pod structure must be functional when exposed to steady state acceleration levels of 4g forward, 2.5g backward, 22g upward or 10g downward.*

Each acceleration level and direction specified in requirement no. 27 of F-SRS-2014-V1 is applied the pod structure. The pod structure is then inspected for damages that may reduce functionality.

Inputs:

- Acceleration levels and directions specified in requirement no. 27 of F-SRS-2014-V1.

Outputs:

- None.

Expected result:

- The pod has no damages that may reduce functionality.

ReqNo28-T

Requirement: *The total weight of pod cannot exceed 270 kg.*

The total weight of pod measured is measured using a weighing scale. It is noted whether the weight is above or below 270 kg.

Inputs:

- None.

Outputs:

- Weight.

Expected result:

- The weight of the pod is below 270 kg.

ReqNo29-T

ReqNo41-T

Requirement: *The pod shall be operational at temperatures of maximum 95 degrees Celcius on outer skin and 152 degrees Celcius on leading egde for a maximum of 25 minutes.*

The pod is heated to 95 degrees Celcius on outer skin and 152 degrees Celcius on leading egde for 25 min.

Expected result:

- The pod is still operational.

ReqNo30-T

Requirement: *The system shall include a hardware implemented safety interlock to prevent dispensing on ground.*

The test official verifies that the system includes a hardware implemented safety interlock.

The test official attempts to dispense the payload.

Inputs:

1. Hardware implemented safety interlock
2. Dispense payload signal

Outputs:

1. No outputs

Expected result:

- The system includes a hardware implemented safety interlock.
- When the payload dispensing is attempted, nothing happens since the hardware implemented safety interlock prevents dispensing on ground.

ReqNo31-T

Requirement: *The system shall provide a method of loading software to MWS.*

The system applied the method for loading software.

Inputs:

- Software for MSW

Outputs:

- Method for applying the software

Expected result:

- Working method for applying the SW software.

ReqNo35-T

Requirement: *The physical dimensions of the pod cannot exceed 0.5×0.5×5 meter.*

The dimensions of the pod is measured using a measuring tape.

Inputs:

- None.

Outputs:

- Dimensions.

Expected result:

- The dimensions of the pod does not exceed 0.5×0.5×5 meter.

ReqNo36-T

Requirement: *The aircraft has to be loaded with the payloads before take-off.*

The aircraft is loaded with payloads before take-off. In air it is attempted to dispense the payloads. It is checked whether the loaded payloads are dispensed.

Inputs:

- Payloads

Outputs:

- Payloads

Expected result:

- The aircraft is able to dispense the payloads that are loaded on the aircraft.

ReqNo37-T

ReqNo38-T

Requirement: *Technicians must be educated in maintenance of the system.*

Expected result:

- The technicians have attended and passed the maintenance course provided by Terma A/S.

ReqNo39-T

Requirement: *The chaffs and flares shall be transported in accordance to Military Standard Transportation and Movement Procedures (MILSTAMP).*

The test official verifies that the chaffs and flares are transported in accordance to Military Standard Transportation and Movement Procedures (MILSTAMP).

Expected result:

- The chaffs and flares are transported in accordance to Military Standard Transportation and Movement Procedures (MILSTAMP).

ReqNo40-T

Requirement: *The chaffs and flares shall be labeled and packed in accordance to MIL-STD-2073-1E*

Packing and labelling of chaffs and flares must comply with MIL-STD-2073-1E.

Inputs:

- Packing and labelling mechanism
- Chaffs and flares
- MIL-STD-2073-1E standard

Outputs:

- Status of standard follow-up

Expected result:

- The packing and labelling of chaffs and flares complies with MIL-STD-2073-1E.

7 Requirements traceability

Every requirement has a test associated to it, e.g. "Req. No 1" is tested in the test "ReqNo1-T".

8 Other