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| **Document No:** | 55000-E-59.15-1 |
| **Document****Name** | **Integrated Test Plan** |
| **SDRL No.:** | **E-59.15** |
| **Revision:** | **-** |
| **Date:** | **7/18/2019** |

Integrated Test Plan

VC-25B - Cargo Baggage Loader (CBL)

|  |  |
| --- | --- |
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REVISION HISTORY

|  |  |  |
| --- | --- | --- |
| **Rev Ltr.** | **Date** | **Description** |
| - | 09/20/2018 | Initial Release |
|  |  |  |
|  |  |  |

**ACRONYMS AND ABBREVIATIONS**

| **Acronym/Abbreviation** | **Definition** |
| --- | --- |
| ACP | Auxiliary Control Panel  |
| ATP | Acceptance Test Procedure  |
| CAN | Controller Area Network |
| CBL | Cargo Baggage Loader |
| EMD | Engineering Manufacturing Development |
| ESD | Electrostatic Discharge  |
| EUT | Equipment Under Test |
| FAA  | Federal Aviation Administration  |
| FRACAS | Failure Reporting and Corrective Action System  |
| HMI | Human-Machine Interface |
| LRUs | Line Replaceable Units  |
| MCP | Main Control Panel |
| ms | millisecond |
| NTS | National Technical Systems |
| PD | Preliminary Design |
| QTP | Qualification Test Procedure  |
| QTR | Qualification Test Report  |
| RTCA  | Radio Technical Commission for Aeronautics |
| SCD | Source Control Drawing  |
| SOW | Statement Of Work |
| TDS | Technical Data Sheet |
| TRR | Test Readiness Review |

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# Introduction

Under contract 1685535, Renmark Pacific Corp (Renmark) (RPC) is conducting Engineering Manufacturing Development (EMD)design for the Cargo Baggage Loader (CBL) for the
VC-25B.

Boeing has supplied Renmark with the CBLTechnical Data Sheet (TDS), TDS-115 REV A, Document PWS #1.1.3.13 / FA8625-16-C-6599 dated 6/05/17, and a released version of the Source Control Drawing (SCD), Drawing Number 9152582002 REV A Draft 3.

# Purpose

With reference to Radio Technical Commission for Aeronautics, (RTCA) DO-160G, this document provides an Integrated Test Plan for the Cargo Baggage Loader. This procedure will describe the sequence and methods of test and shall note the equipment and facilities required, length of tests, environments and tolerances, and the parameters to be monitored.

The purpose of this document is to present the system test program to be employed byRenmark Pacific Corp., during qualification testing of the Cargo Baggage LoaderSystem (CBL) P/N 55000 for the VC-25B.

# Scope

This document provides a test execution plan for all of the tests required by the VC-25B Cargo Baggage Loader – SCD 9152582002 REV A Draft 3.This document does not include any of the software verification tests. The software verification will be covered in the Software Verification Plan E-78.84 and Software Verification Cases & ProceduresE-78.87.

# REFERENCE DOCUMENTS

| **Document Number** | **Document Title** |
| --- | --- |
| 9152582002 REV A Draft 3 | VC-25B Cargo Baggage Loader Subsystem - Source Control Drawing |
| Radio TechnicalCommission for Aeronautics (RTCA) DO-160 Rev G | Environmental Conditions and Test Procedures for Airborne Equipment |
| D9152810002-2 | PAR Electrical Requirements for Utilization Equipment |
| 55000-E-59.15-Matrix RevA | CBL Integrated Test Matrix |
| 55000-xxx | VC-25B - Cargo Baggage Loader (CBL)Structural Substantiation Plan |
| 55000-RPC.10013 | CBL Standard Baggage Test |
| 55000-E-59.09-01  | CBL Qualification Test Procedure (QTP) |
| 55000-E-59.05-01 | CBL Acceptance Test Procedure (ATP) |
|  |  |

# Test Articles

The testing requirements for the VC-25B and the scheduling needs of the program require two test articles,identified as serial numbers T-001 and T-002. The program scheduling needs dictate that Electrical and the Environmental tests be conducted concurrently. Test Article T-001 will be used to conduct the electrical tests. Upon completion of the electrical tests the test article will be used to conduct functional testing at Renmark’s facility. Renmark anticipates the electrical and functional test duration to be 4 months. Test Article T-002 will be a dedicated unit used to conduct environmental tests. The expected duration of the environmental tests is 4.5 months. The test articles are not deliverable items.

|  |  |
| --- | --- |
| **Test Articles** | **Tests** |
| **Environmental** | **Electrical** | **Functional** | **Structural** |
| T-001 |  | X1 | X |  |
| T-002 | X |  |  |  |
| 1 includes ESD |  |  |  |

First Article Inspection (FAI) will be accomplished by Renmark and Boeing quality inspection personal. Test articles will go through Acceptance Testing Procedure to verify performance and compliance prior to the start of testing.

# Test Readiness review

A Test Readiness Review (TRR) will be conducted prior to start of testing to confirm completeness of test procedures and assure CBL readiness for testing. Renmark and Boeing may choose to have separate TRRs for environmental, functional, electrical and structuralsubstantiation testing, as appropriate.

# Test Configurations

The SCD CBL Cargo Baggage Loader Subsystem definition was used to determine the test configurations and test article requirements. The LRUs to be tested are theMCP, CBL, Forward Stowage Restraint System, Aft Stowage Restraint System and the Wire Harness. To enable operation of the CBL System during testing, a special test wire harness will be usedthat is identical to the production wire harness, but without the connection breaks for the aircraft fire breaks.

The Environmental tests will be conducted such that the least destructive (least risky) tests will be conducted first. The test conduct sequence may be modified to accommodate availability of NTS test chambers.

The CBL System will be performance tested pre- and post-exposure per 55000-RPC.10013, CBL Standard Baggage Test. The height of the test fixture for the performance tests will be set at the VC-25B height.

In addition, the CBL System Configuration State at the time of testing is described in Table 1. These state definitions are used throughout this document, and in the test matrix, to determine the state of the CBL during each noted test.

Table 1: CBL Configuration State Descriptions

|  |  |
| --- | --- |
| **Configuration State** | **Description** |
| Non-Operational | CBL not powered  |
| Stowed (not secured) | The Cargo Baggage Loader is in the STOWED state. No power. |
| Deployed | The Cargo Baggage Loader is attached to the aircraft, extended and in contact with the ground, ready for loading/unloading operations. |
| Deploying | CBL is attached the aircraft and going through the automatic deployment process |
| Secured | The Cargo Baggage Loader is in the STOWED state. Tilt arms are retracted and restraint mechanisms are engaged holding the equipment ready for flight. |
| Stowing | CBL is attached the aircraft and going through the automatic stowage process |
| Cargo Loading &Unloading During Exposure  | Cargo is being loaded and unloaded during the test |
| Cargo Loading & Unloading After Exposure | CBL function verified after the test completion by loading and unloading cargo. |
| Belt Operating During Test | CBL belt operating during the test.  |

# Test setup conformity

A test setup conformity inspection will be completed by Renmark quality inspection or

engineering personal. Alternatively, at the discretion of Renmark test setup conformity inspection may be delegated to the test laboratory quality inspection personal.

# Test Instrumentation

Accuracy of the instruments employed by the testing facility and Renmark will be commensurate with the readings required and have current calibration status as required. Instrumentation will be listed in the test report provided by the testing facility. Listed information will include the instrumentation manufacturer, manufacturer’s model number, serial number, and calibration due date.

# Test Logs

Testing facilities will use detailed Qualification Test Procedures provided by Renmark to conduct the tests. Detailed chronological logs of all tests will be maintained. The logs will describe each step of tests conducted and any anomaly occurring with the test articles or the test equipment. Each step performed will be verified and appropriate data entered on the CBL test data sheets.

Any deviation to the test procedure will be logged, along with the time and date. The lab must report all deviations to the test procedure and an authorization must be received from Renmark prior to the commencement of the test.

In addition, Renmark will also use detailed procedures to perform the tests and maintain detailed logs of all tests conducted.

# test Witnessing

Test witnessing will be accomplished by Renmark quality engineering personnel. Alternatively, at the discretion of Renmark, test witnessing may be delegated to the test laboratory quality engineering personnel. Renmark will notify Boeing in advance of all test dates, times and locations and allow Boeing personnel or FAA designated representatives to participate in the test witnessing.

# Tests

The CBL qualification test program includes:

* Environmental - Testing will be performed at NTS Santa Clarita 20970 Centre Pointe Pkwy, Santa Clarita, CA 91350, phone number (661) 259-8184 with the exception Electrostatic Discharge which will be performed at the NTS test lab in Fullerton, 1536 E Valencia Dr, Fullerton, CA 92831
* Electrical - Testing will be performed at Renmark’s facility by National Technical Systems (NTS) Fullerton personnel.
* Functional - Testing will be performed on the Renmark 747-200 cargo door test fixture at its 2675 Skypark Drive, Suite 103 in Torrance, CA 90505.
* Structural Substantiation

The CBL testing will be completed at the three primary locations noted above.

* Structural Substantiation required testing sites will be determined once the tests to be performed have been identified.

## Environmental Tests

The planned environmental tests of the CBL are listed in Table 2, which also indicates the associated SCD Requirement and Test IDs. Table 3 lists environmental tests by LRU and configuration.

Table 2: Environmental Tests

|  |  |  |
| --- | --- | --- |
| **SCD REQ ID** | **SCD Test ID** | **TEST TITLE** |
| BAGS\_SCD-82 | BAGS\_SCD-265 | Low Operating Temperature |
| BAGS\_SCD-83 | BAGS\_SCD-266 | High Operating Temperature |
| BAGS\_SCD-84 | BAGS\_SCD-267 | Humidity |
| BAGS\_SCD-85 | BAGS\_SCD-268 | Salt Fog |
| BAGS\_SCD-86 | BAGS\_SCD-269 | Sand and Dust |
| BAGS\_SCD-89 | BAGS\_SCD-272 | Waterproofness |
| BAGS\_SCD-94  | BAGS\_SCD-277  | Vibration |
| BAGS\_SCD-112 | BAGS\_SCD-295 | Electrostatic Discharge |

Table 3: Environmental Tests CBL LRUs & Configuration

|  |  | **TEST CONFIGURATION** |  |
| --- | --- | --- | --- |
| **SCD Test ID** | **TEST TITLE** | **Non-operational**  | **Deployed**  | **Deploying** | **Stowed** | **Secured** | **Stowing** | **Cargo Loading & Unloading During Exposure** | **Cargo Loading & Unloading After Exposure** | **Belt Operating During Test** | **System operational post exposure** |
| BAGS\_SCD-265 | Low Operating Temperature |   | X |   |   |   |   | X |   | X | X |
| BAGS\_SCD-266 | High Operating Temperature |   | X |   |   |   |   | X |   | X | X |
| BAGS\_SCD-266.1 | Temperature Rate of Change |   |   | X |   |   | X |   |   |   | X |
| BAGS\_SCD-267 | Humidity | X |   |   | X |   |   |   | X |   | X |
| BAGS\_SCD-268 | Salt Fog | X |   |   | X |   |   |   | X |   | X |
| BAGS\_SCD-269 | Sand and Dust | X |   |   | X |   |   |   | X |   | X |
| BAGS\_SCD-272 | Waterproofness | X | X |   |   |   |   |   | X | X | X |
| BAGS\_SCD-273 | Precipitation |   | X |   |   |   |   | X | X | X | X |
| BAGS\_SCD-277 (1) | Vibration | X |   |   |   | X |   |   | X |   | X |
| BAGS\_SCD-277 (2) | Vibration | X |   |   |   |   |   |   | X |   | X |
| BAGS\_SCD-295 | Electrostatic Discharge |   | X |   |   |   |   |   |   |   | X |

Environmental tests will be conducted in the same order as paragraphs in this section. However, the sequence of tests may be modified due to chamber availability at the test lab.

A test stand representing aircraft configuration will be erected on site at NTS. The CBL will be moved from the test chamber to the test stand for performance testing.

The size of the CBL prevents it being set up in environmental test chambers. Humidity, dust, and salt fog tests will be conducted in the STOWED state, not restrained.For these tests, the CBL LRU’s (MCP, Restraints, and wire harness) willnot be powered or operating, and not connected to each other.Space restrictions in the chamber dictate thatthe LRU’s be tested with the CBL. If this is not possible, they will be tested separately, in which case the CBL simulator may be used to verify performance after exposure.

### Low Operating Temperature

The low operating temperature test will be performed in accordance with RTCA DO-160 Section 4.5.2.

To simulate deployment from an aircraft, Renmark will assemble the test fixture inside the test chamber.The MCP, Forward (FWD)&Aft (AFT) Stowage Restraints and the Wire Harness will be tested simultaneously, with the CBL deployed. Renmark personnel will operate the transfer belt and load and unload bags for the duration of the test.

CBL System operation pre- and post-exposure will be verified by the performance of the Standard Bag Test, 55000-RPC.10013.

### High Operating Temperature

The high operating temperature test will be performed in accordance with RTCA DO-160 Section 4.5.4.

The MCP, FWD & AFT Stowage Restraints and the Wire Harness will be tested simultaneously, with the CBL deployed. Renmark personnel will operate the transfer belt and load and unload bags for the duration of the test.

CBL System operationpre- and post-exposure will be verified by the performance of the Standard Bag Test, 55000-RPC.10013.

### Temperature Variation

The Cargo Baggage Loader Subsystem shall operate with performance meeting requirements in section 3.2.3 during and after exposure to Temperature Variation in accordance with RTCA DO-160 Section 5 Category A, 10 degrees C per minute.

### Humidity

The humidity test will be performed in accordance with RTCA DO-160 Section 6 Category C.

The CBL will be tested in the stowed configuration. The CBL, MCP, FWD & AFT Stowage Restraints and the Wire Harness maybe testedsimultaneously, if possible. If the chamber size does not allow simultaneous testing, the MCP, and Stowage Restraints will be tested separately. Performance verification may be conducted using the CBL simulator.

CBL System operation post-exposure will be verified by the performance of the Standard Bag Test, 55000-RPC.10013.

### Waterproofness

The waterproofness test will be performed in accordance with RTCA DO-160, Paragraph 10.2, Category R.

The MCP, FWD & AFT Stowage Restraints and the Wire Harness will be tested simultaneously, with the CBL deployed. The CBL transfer belt will be operational during test.

CBL System operation pre- and post-exposure will be verified by the performance of the Standard Bag Test, 55000-RPC.10013.

### Salt Fog

The Salt Fog test will be performed in accordance with RTCA DO-160, Paragraph 14.2, Category S.

The CBL will be tested in the stowed configuration. The CBL, MCP, FWD & AFT Stowage Restraints and the Wire Harness may be tested simultaneously, if possible. If the chamber size does not allow simultaneous testing, the MCP, and Stowage Restraints will be tested separately. Performance verification of the may be conducted using the CBL simulator.

CBL System operation pre- and post-exposure will be verified by the performance of the Standard Bag Test, 55000-RPC.10013.

### Sand and Dust

The Dust test will be performed in accordance with RTCA DO-160, Paragraph 12.2, Category D.

The CBL will be tested in the stowed configuration. The CBL, MCP, FWD & AFT Stowage Restraints and the Wire Harness may be tested simultaneously, if possible. If the chamber size does not allow simultaneous testing, the MCP, and Stowage Restraints will be tested separately. Performance verification of the may be conducted using the CBL simulator.

CBL System operation pre- and post-exposure will be verified by the performance of the Standard Bag Test, 55000-RPC.10013.

### Vibration

The CBL will be subjected to Vibration levels of the SCD Figure 4 and be tested according to the Robust (category R) random vibration test procedure in RTCA/DO-160G Section 8.

The CBL will be tested in the Secured state.When Secured, the system is stowed and held by the FWD and AFT Stowage Restraints, representative of the configuration while in the aircraft.

The MCP can be tested on the same shaker table as the CBL or separately. If the MCP is tested separately the CBL simulator software will be used to verify MCP performance posttest.

CBL System operation pre- and post-exposure will be verified by the performance of the Standard Bag Test, 55000-RPC.10013.

### Operational Shock

The Cargo Baggage Loader Subsystem shall operate after exposure to Operational Shock in accordance with RTCA DO-160 Section 7 Category (A/D) when tested in the secured state according to the following:

* Three 6G shocks are applied in each axis in each direction (3 pulses x 3 axes x 2 directions) for a total of 18 pulses.
* Testing using terminal sawtooth shaped shock pulses. For equipment with first mode natural frequency greater than 100 Hz use a shock duration of 11ms and for equipment with first mode natural frequency less than 100 Hz use a duration of20ms. Other shock pulse shapes are permitted if it is shown that they produce an equivalent shock response spectrum.

### Electrostatic Discharge

The Electrostatic Discharge (ESD) testing will be conducted at NTS Fullertonon test article T-001 at the conclusion of the electrical tests. The CBL Subsystem will be exposed to ESD per RTCA/DO-160G section 25. The test will be conducted on the CBL, including the MCP and restraints.

The ESD tests will be conducted on the ESD test bench. The CBL System will be deployed and powered up, but not operating.

CBL System operation pre- and post-exposure will be verified by the performance of the Standard Baggage Test, 55000-RPC.10013 at the Renmark facility.

The LRU’s may be tested simultaneously. If simultaneous testing is not possible, the MCP performance may be verified using the CBL simulator software posttest.

## Electrical Tests

The planned CBL electrical tests are listed in , which also indicates the associated SCD Requirement and Test ID’s. The electrical tests will be conducted at the Renmark facilities with the assistance of the NTS Fullerton test lab crew and equipment. The only exception is the ESD test of the which will be conducted at NTS Fullerton at the conclusion of all electrical tests.

The SCD Appendix A tests per D9152810002-2 will be conducted on the MCP. The test article will be run at the Renmark facility while connected to the Renmark test stand and the current draw measured for each of the CBL states deploying, stowing, extend and belt and legs deploy will be used. These current draws then will be used during the planned electrical tests to simulate the CBL.

The electrical tests listed in Table 5 may be conducted in any order as appropriate, and may be decided during testing. ESD is the only test to be conducted at NTS and will be scheduled and tested per test chamber availability at the conclusion of all tests. Boeing will be notified of the test dates two weeks prior to test.

Table 4: Electrical Test Requirements

| **SCD REQ ID** | **SCD Test ID** | **TEST TITLE** |
| --- | --- | --- |
| BAGS\_SCD-106 | BAGS\_SCD-289 | Chassis Ground Pin Resistance |
| BAGS\_SCD-107  | BAGS\_SCD-290 | Chassis Ground Resistance |
| BAGS\_SCD-110 | BAGS\_SCD-293 | Connector Bonding |
| BAGS\_SCD-126 | BAGS\_SCD-309 | Power Return Isolation |
| BAGS\_SCD-118 | BAGS\_SCD-301 | Inrush Current |
| BAGS\_SCD-122 | BAGS\_SCD-305 | Load Capacitance |
| BAGS\_SCD-123 | BAGS\_SCD-306 | Power Interruptions |
| BAGS\_SCD-135  | BAGS\_SCD-318 | Small Load Capacitance |
| BAGS\_SCD-112 | BAGS\_SCD-295 | Electrostatic Discharge |
| SCD Appendix A: EE Power Tailoring | SCD Appendix A: EE Power Tailoring | D9152810002-2\_Rev\_New - |

Table 5: Electrical Tests CBL LRUs & Configuration



### Chassis Ground Pin Resistance

The test will be conducted on the CBL only and the CBL will be non-operational. Resistance from the chassis ground pin to the CBL internal chassis connection will be measured.

### Chassis Ground Resistance

The test will be conducted on the CBL only and the CBL will be non-operational.Resistance between the chassis connection and the groundwill be measured.

### Connector Bonding

The test will be conducted on the CBL only and the CBL will be non-operational.The test will measure the electrical resistance between each connector receptacle and the chassis.

### Grounding in Wet Areas

The test will be conducted on the CBL, including the MCP and restraints. The CBL Subsystem will be tested to show that it has two case ground paths with operating voltages 115 V or greater, either AC or DC, with each resistance path low enough to limit the case voltage to less than 1.25 V AC or 5 V DC during a fault.

### Inrush Current

The test will be conducted on the MCP only.Test will simulate the inrush current while the normal voltage is applied. The inrush current will be measured.

### Large Load Capacitance

The test will be conducted on the CBL, including the MCP and restraints. The test will consist of stimulating aload of greater than 200VA to the CBL Subsystem, thenmeasuring and recording the capacitance. Each operation of the CBL will be tested; turn on, engage tilt arms, retract restraints, tilt to level, rotate out, extend boom, deploy legs, tilt to ground, stow tilt arms, operate belt, and each Stow stage, the same as above, repeated in the reverse direction. This and the power test will be done first, and surrogate loads will be used on other tests.

### Power Interruptions

The test will be conducted on the CBL, including the MCP and restraints. The test will simulate a power interrupt up to 50 ms and power reapplication per MIL-STD-704 as tailored in the PAR Power Quality Requirements for Utilization Equipment (D9152810002-1), sections 3.3.2 and 3.3.3 including the power transient.

### Power Return Isolation

The test will be conducted on the CBL, including the MCP and restraints. The test will measure the electrical isolation between each power return connector pin and the chassis.

### Small Load Capacitance

The test will be conducted on the MCP utilizing the two connectors that connect to aircraft power.

### SCD Appendix A: EE Power Tailoring

The Cargo Baggage Loader Subsystem will be testedIAWSCD Appendix A, D9152810002-2, Electrical Requirements for Utilization Equipment. The detailed tests and associated D9152810002-2 are noted in Table 5.

The D9152810002-2 tests sequencing will be determined at the start of tests. Tests will be conducted on the MCP with resistive loads simulating the current loads measured during all CBL configurations as such as deploying, stowing, deployed and transferring loads.

#### Steady State Load Measurement (Three-Phase & Single-Phase)

The test will verify that the MCP meets the requirements of section 2.1.1 of D9152810002-2, PAR Electrical Requirements for Utilization Equipment.

#### Steady State Limits for Voltage, Including Unbalance, and Frequency (3-Phase & Single-Phase)

The test will verify that the MCP meets the requirements of section 2.1.2 of D9152810002-2, PAR Electrical Requirements for Utilization Equipment. Test conducted per MIL-HDBK-704-3 Method TAC 102.

#### Phase Displacement (Three-Phase Equipment only)

The test will verify that the MCP meets the requirements of section 2.1.2 of D9152810002-2, PAR Electrical Requirements for Utilization Equipment. Test conducted per MIL-HDBK-704-3 Method TAC 103.

#### Voltage Modulation (3-Phase & Single-Phase)

The test will verify that the MCP meets the requirements of section 2.1.4 of D9152810002-2, PAR Electrical Requirements for Utilization Equipment. Test conducted per MIL-HDBK-704-3 Method TAC 104.

#### Frequency modulation (Three-Phase & Single-Phase)

The test will verify that the MCP meets the requirements of section 2.1.5 of D9152810002-2, PAR Electrical Requirements for Utilization Equipment. Test conducted per MIL-HDBK-704-3 Method TAC 105.

#### Total Voltage Distortion (Total Harmonic Content, Three-Phase & Single Phase)

The test will verify that the MCP meets the requirements of section 2.1.6 of D9152810002-2, PAR Electrical Requirements for Utilization Equipment. Test conducted per MIL-HDBK-704-3 Method TAC 106.

#### Current Harmonic Distortion (Three-Phase, Single-Phase, & Standby AC Loads) - Design Requirements

The test will verify that when the MCP is supplied with a voltage waveform of low THD (Test Condition 1 and Test Condition 2 defined in Paragraph 2.1.7) the equipment shall not demand harmonic current components in excess of the values given in Table 2.1.7 – 1 (for single-phase equipment) and 2.1.7-2 (for three-phase equipment) of D9152810002-2.

#### Steady State Limits for DC Voltage Component (Three-Phase & Single-Phase)

Test will verify that the MCP meets the requirements 2.1.8 of D9152810002-2. Test conducted per MIL-HDBK-704-3 Method TAC 108.

#### Normal Voltage Transients (Three-Phase & Single-Phase)

Operation, including entered data, displayed function, and engaged function shall be checked after each major set or transients to verity that there has been no change to system operation in all test configurations while tested per MIL-HDBK-704-3Method TAC 108 (three-phase).

#### Power Transfer Interrupts (Three-Phase & Single-Phase)

The test will verify that the load equipment operates and maintains performance as specified for conditions when utilization equipment is tested and subject to power transfer interrupts as defined in 2.1.11 of D9152810002-2. Test per MIL-HDBK-704-3 Method TAC201 (three-phase) as defined in 2.1.11 of D91581000-2-2.

#### Abnormal Voltage Transients (Three-Phase & Single-Phase)

The test will verify that theMCP operates and maintains performance as specified for conditions when it is tested and subject to power transfer interrupts as defined in 2.1.11 of D9152810002-2. Test per MIL-HDBK-704-3 Method TAC302.

#### Normal Frequency Transients (Three-Phase & Single-Phase)

The test will verify that the MCP operates and maintains performance as specified for conditions when utilization equipment is tested IAW and subject to normal frequency Transients defined in paragraph 2.1.10 of D9152810002-2.Test per MIL-HDBK-704-3 Method TAC110 (three-phase).

#### Abnormal Frequency Transients (Three-Phase & Single-Phase)

The test will verify the operations of the MCP when subjected to the Abnormal Frequency Transients IAW paragraph 2.1.14 of D9152810002-2. Test per MIL-HDBK-704-3 Method TAC303 (three-phase). The results are to be provided to Boeing stating the worst case(s) voltage transient level, time duration and decay/rise time slopes.

#### Abnormal Steady State Limits for Voltage and Frequency

The test will verify operations of the load equipment when subjected to the Abnormal Steady State limits for Voltage and Frequency per paragraph 2.1.15 of D9152810002-2. Conduct Test per MIL-HDBK-704-3 Method TAC301.

#### Power Failure (Three-Phase & Single-Phase)

Conduct Test per MIL-HDBK-704-3 Method TAC601. Power Failure limits are per D9152810002-1 Figure 7.

#### Power Failure One or Two Phase(s)

Conduct Test per MIL-HDBK-704-3 Method TAC602 except power failure limits are per D9152810002-1 Figure 7

#### Phase Reversal (Three-Phase & Single-Phase)

Conduct Test per MIL-HDBK-704-3 Method TAC603 (three-phase) except use MIL-HDBK-704-3 Table TAC603-I.

#### Open Input Power Line Test

Power lines to the load under test shall be disconnected, one at a time and in all plausible group combinations, while continuing to supply normal power to the remaining terminals. This shall include the initial and simultaneous application of 1-phase and 2-phase power to normal 3-phase loads. If the detailed specification has required external equipment protection, the test shall include such external equipment protection. Each condition shall be maintained until stable operation and temperature has been reached.

#### Power Demand Tests

The appropriate electrical power will be applied to the MCP in a manner simulating normal airplane operating conditions. The applied electrical power shall comply with the normal characteristics of D9152810002-1. The following parameters shall be recorded at the equipment terminals;

1. Apparent power (volt-ampere),

2. Real power (watt),

3. Reactive power (var),

4. Current AC-DC (ampere),

5. Voltage (volt),

6. Simultaneous current versus time and voltage versus time characteristics for all modes of operation including on-off transients and operating modulation characteristics.

#### Dielectric Tests - Insulation Resistance

SCD Note: The test should be conducted on subassembly electrical components (e.g. MCP, motors, actuators).

REF: D9152810002-2, Section 2.7.1

This test will verify the insulation resistance between all terminals and the component frame or case and between all mutually insulated terminals, i.e., between any terminal and its electrically common circuitry exclusively separated by a nonconductive material from any terminal and its electrically common circuitry, shall be measured at 500VDC and shall not be less than 40MΩ, unless otherwise specified in the detail specification. The test will be conducted on the following components in Table 6, with each component on a test bench, not installed in the CBL:

Table 6: Dielectric Tests - Insulation Resistance Bench Test

|  |  |  |  |
| --- | --- | --- | --- |
| **Part Name** | **Part Number** | **Part Name** | **Part Number** |
| Power Supply | 55418 | Rotate Motor | 55142 |
| Video Display | 55410 | Leg Motor |  |
| Controller | 55158 | Brake Roller | 55590 |
| Rotate Controller | 55162 | Button | 55335 |
| Tilt Controller | 55158 | Relay (two) | 55432 |
| Cartridge Controller |  | Encoder | 55171 |
| Section Lock |  | Tilt Brake | 55146 |
| Forward Auxiliary Control Panel | 55496 | Load Cell | 55010 |
| Aft Auxiliary Control Panel | 55685 | Tilt Motor | 55110 |
| Drive Roller Motor | 55672 |  |  |

#### Dielectric Tests - Dielectric Withstanding Voltage

SCD Note: The test should be conducted on subassembly electrical components (e.g. MCP, motors, actuators).

REF: D9152810002-2, Section 2.7.2

This test will verify the withstanding voltage between all terminals and the component frame or case. A dielectric withstanding voltage of 1500 VAC RMS, 60 Hz, shall be applied between all terminals and the component frame or case for one minute and between all mutually insulated parts, i.e., between any terminal and it’s electrically common circuitry exclusively separated by a nonconductive material from any terminal and its electrically common circuitry, for one minute. The test voltage shall be applied and removed at a uniform rate of 250 to 500 volts/second. Any arcing as evidenced by flashover, sparkover, or breakdown, or leakage current exceeding 2mA, shall constitute failure. After this test the insulation resistance test of (a) above shall be repeated.

Testing for those parts listed in Table 7will be conducted on a test bench, not installed in the CBL:

Table 7: Dielectric Tests - Dielectric Withstanding Voltage Bench Test

|  |  |  |  |
| --- | --- | --- | --- |
| **Part Name** | **Part Number** | **Part Name** | **Part Number** |
| Power Supply  | 55418 | Button | 55335 |
| Video Display | 55410 | Relay (two) | 55432 |
| Controller | 55158 | Encoder  | 55171 |
| Rotate Controller | 55162 | Tilt Brake  | 55146 |
| Tilt Controller  | 55158 | Load Cell  | 55010 |
| Restraint Actuator  | 55516 | Tilt Motor  | 55110 |
| Forward Auxiliary Control Panel | 55496 | Rotate Motor  | 55142 |
| Aft Auxiliary Control Panel | 55685 | Drive Roller Motor  | 55672 |

## Functional Tests

The planned functional tests of the CBL are listed in , which also indicates the associated SCD Requirement and Test IDs. The tests will be conducted at the Renmark facility.

The preferred order of the tests is as the they appear in the paragraphs in this section. However, the order of the tests may be modified during test and as best suits the program needs.

Table 8: Functional Test Requirements

| **SCD REQ ID** | **SCD Test ID** | **TEST TITLE** |
| --- | --- | --- |
| BAGS\_SCD-6 | BAGS\_SCD-189 | Load Condition 5 - Tire Assembly |
| BAGS\_SCD-9 | BAGS\_SCD-192 | Noise Level |
| BAGS\_SCD-27 | BAGS\_SCD-210 | Emergency Jettison Time (Stowed) |
| BAGS\_SCD-30 | BAGS\_SCD-213 | Controlled Disconnect Time |
| BAGS\_SCD-39 | BAGS\_SCD-222 | Reduced Belt Speed |
| BAGS\_SCD-41 | BAGS\_SCD-224 | Power On Indication |
| BAGS\_SCD-44 | BAGS\_SCD-227 | Transfer Rate |
| BAGS\_SCD-45 | BAGS\_SCD-228 | Stop Position Hold |
| BAGS\_SCD-46 BAGS\_SCD-60 | BAGS\_SCD-229 BAGS\_SCD-243 | Load Condition 2 to 4 and 6 to 17 |
| BAGS\_SCD-65 | BAGS\_SCD-248 | Subsystem Weight |
| BAGS\_SCD-66 | BAGS\_SCD-249 | Cargo Baggage Loader - Maximum Weight |
| BAGS\_SCD-80 | BAGS\_SCD-263 | Power Consumption |
| BAGS\_SCD-90 | BAGS\_SCD-273 | Precipitation Test |
| BAGS\_SCD-95 | BAGS\_SCD-278 | Abuse Load Deployment |
| BAGS\_SCD-96 | BAGS\_SCD-279 | Abuse Load Stowage |
| BAGS\_SCD-97 | BAGS\_SCD-280 | Abuse Load Operations |
|  |  | MCP Abuse Loads |

Functional tests of the CBL LRUs are listed in Table 8.

Table 9: Functional Test CBL LRUs & Configuration



### CBL Maximum Weight and Subsystem Weight

The CBL will be weighed to ensure the maximum weight does not exceed 640 lbs. The CBL subsystem including the MCP will be weighed to ensure it does not exceed 762 lbs.

### Abuse Loads Deployment, Stowage and Operations

An abuse load of 300lbs. will be applied and removed within 10 seconds to the worst-case load location during the CBL deployment, stowage and operation.

### Abuse Loads MCP

An abuse load of 300lb will be applied and removed within 10 seconds to the worst-case load location for the MCP.

### Power On Indication

Power will be applied to the CBL Subsystem. MCP and ACP power on indication will be verified.

### Stop Position Hold

The CBL belt transfer system will be tested to ensure it has the capability to stop and hold its position +/-2 inches within three seconds when operating in either direction while transferring a load.

### Reduced Belt Speed

The CBL will be tested to verify the capability of transferring designated loads at a rate of 23 +/-4 feet per minute in both directions during automatic or manual override operations.

### Transfer Rate

The CBL will be tested to verify the capability of transferring designated loads at a rate of 46 +/-6 feet per minute.

### Noise Level

The CBL will be tested to ensure system noise levels do not exceed65 dBa, when measured at a minimum distance of three feet from the loader.

### Load Conditions (2 to 4 and 6 to 17)

The CBL will be tested with under all load conditions as defined by the SCD and the CBL Standard Baggage Test, 55000-RPC.10013.

### Load Condition 5 - Tire Assembly

The CBL must be capable of transferring a Tire Assembly with a weight ranging from 525 lbs. to 555 lbs., with an average load of 555 lbs., with maximum dimensions of 50 in. long x 52 in. wide x 21 in. high, the length of the loader in both directions.

### Controlled Disconnect Time

The CBL will be tested to ensure it can be removed from the aircraft in a controlled manner using the GFE hoist. Detailed instruction on how to use the hoist will be provided by Boeing.

### Emergency Jettison Time

The CBL will be tested to validate the capability to be jettisoned from the aircraft within less than forty-five (45) seconds of the operator initiating the emergency jettison procedure from the Cargo Baggage Loader Subsystem when the CBL is in the DEPLOYED state.

### Precipitation

The CBL will be tested to show that it can withstand the wet environmental condition simulated by water spraying for 20 minutes for heavy rain scenarios at a rate of 0.76 +/- 10% gallons per minute while loading and unloading cargo/baggage as defined in the Standard Baggage Test 55000-RPC.10013.

## Structural Substantiation Tests

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# Test Data & REports

Environmental testing performed at the designated test laboratory will include a detailed test report and graphical test data where applicable. Data provided by the designated test laboratory must comply with all the qualification test report requirements mandated by RTCA DO-160Rev. G and theE-59.09 Qualification Test Procedure (QTP), asapplicable.

Renmark will perform compilation and preparation of a final Qualification TestReport (QTR), which integrates the laboratory test report, EUT Performance Data Sheets,and copies of any required test deviation notices or QTP modifications in addition to the functional test conducted at Renmark facility.

# Failure and Re-Test Criteria

Renmark will use the Failure Reporting and Corrective Action System (FRACAS) to document any failures anomalies or suspect items and monitor trends during Acceptance and Qualification testing of the CBL.

If the performance of the CBL falls outside of the limits established in the 55000-RPC.10013CBL Standard Baggage Test, Renmark will notify Boeing representative and assess the failure and determine cause and a course of action.

If the CBL is determined to be unusable due to physical damage, Boeing will be notified and a Failure Report E-14.08 will be prepared immediately after the failure. Renmark will then assess the failure and the CBL will be repaired and the failed test will be re-executed. If a re-design of the unit is required in order to pass a specific test, then the unit will be reconformed prior to re-test. Renmark quality engineering personal will evaluate the failure to determine if any other testing that had been accomplished prior to the failure needs to berepeated.

For each failure that occurs, Renmark will perform a failure analysis on the Test Article. If thecause of failure is determined to be an erroneous test setup or test execution, then a notewill be made in the test log and the test will be repeated.

If the cause of the testing failurelies with the Test Article, then Renmark will draft a Failure Analysis Report E-14.09document no later than 30 days after failure, which at a minimum, will contain the followinginformation:

1. Where in the test procedure the failure occurred.

2. Identification of component(s) or part(s) that failed.

3. An analysis of the root cause of the failure.

4. An analysis of the safety impact.

5. Proposed corrective action.

6. Analysis of the corrective action.

7. Plan for the continuation of the qualification test.

FRACAS – SOW 3.3.2.10 paragraph above is based on the FRACAS SSOW paragraph.

# appendix a

# Cargo Baggage Loader Subsystem Description

The CBL is designed and built specifically for use on the 747-8 aircraft. Its purpose is to load and offload passenger luggage, light cargo and wheel assemblies to and from the aircrafts aft cargo compartment. The CBL is a conveyor which stows inboard of the aft cargo door and travels in an unpowered, restrained state during flight, as shown in . Only when the aircraft is on the ground, and the aft cargo door is fully open, does the aircraft supply power to the CBL.



**Figure A-1: CBL Stowed Inside Aircraft**

The CBL is an extending slider-bed belt conveyor, which rotates and tilts from the rear cargo door of the aircraft. The conveyor belt is supported by a three-section extendable boom. When deployed, the boom is supported by an end support assembly. . When stowed, the CBL is fully retracted and stowed inside the cargo door. Prior to closing the cargo door, the CBL is restrained at the forward and aft ends by restraint mechanisms mounted to the frame of the cargo door.



**Figure A-2: CBL Fully Deployed**

The CBL system consists of the telescoping boom, end support assembly, conveyor belt, forward and aft restraint mechanisms, wire harnesses, Main Control Panel (MCP), and two auxiliary control panels at the distal end of the CBL.

## System Operation Description

Once the cargo door is opened, and power is applied at the MCP, the CBL can be deployed. To deploy, the CBL tilts and pivots outboard, extends to its full length, and then rotates downward to the ground. A single conveyor belt, driven by two electrically-powered rollers, transfers cargo and baggage up and down the surface of the conveyor. The CBL transitions from the STOWED and RESTRAINED condition to fully DEPLOYED, as shown in . While the CBL is in the DEPLOYED state, an emergency disconnect lever can be pulled to manually jettison the CBL from the aircraft.



**Figure A-3: CBL Deployment Operations**

When deployed, the CBL transfers cargo and baggage up and down the conveyor belt. The CBL is primarily operated and controlled from the MCP, which is mounted on an aircraft bulkhead located just forward of the cargo door. The MCP includes a controller, a Human-Machine Interface (HMI), a power supply and associated circuitry. The CBL is powered by 115V/3Ph/400Hz aircraft power, which is converted to 28VDC by the CBL power supply.

The CBL control system uses a Controller Area Network (CAN) bus, and controls distributed DC drives located adjacent to brushless DC motors. The controller acts as the CAN master and also controls the HMI. The belt direction and motion may also be controlled by personnel on the ground, at either of the two auxiliary control panels located at the lower end of the boom. See .

|  |  |
| --- | --- |
|  |  |
| CBL MAIN CONTROL PANEL (MCP) | AUXILIARY CONTROL PANEL (ACP) |
| **Figure A-4: CBL Preliminary Main Control and Auxiliary Control Panel Designs** |