



## **TSO-C179b Testing Summary Statement**

Models:

IBBS-12v-3ah-CRT

IBBS-12v-6ah-CRT

IBBS-24v-3ah-CRT

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The IBBS-12v-3ah-CRT, IBBS-12v-6ah-CRT and IBBS-24v-3ah-CRT systems have been designed in accordance with Section 1 and tested to the requirements of Section 2 of DO-311a, each test has been completed and compliance has been demonstrated. The following tables indicate the test and results for each model.

All functional performance requirements under the test conditions of 2.2.1 of RTCA/DO-311a have been met. All safety requirements under test conditions of 2.2.2 of RTCA/DO-311a have been met. Table 1 provides a list of tests and a summary of each test for the IBBS-12v-3ah-CRT and IBBS-12v-6ah-CRT. Table 2 provides a list of tests and a summary of each test for the IBBS-24v-3ah-CRT.

**TABLE 1. Test Summary IBBS-12v-(3)(6)ah-CRT**

Test	Test reference	Status	Summary of Test Results: Each article was found to be in compliance with the testing listed below.
Physical Examination	2.4.4.1	PASS	Each sample was inspected and found to conform with the manufacture’s specifications for the article. Para 2.2.1.1
Handle Strength	2.4.4.4	n/a	Article has no handles, does not apply. Para 2.2.1.4
ATP	2.4.4.2	PASS	Each article is constructed and tested per an ATP manual, p/n 720.0001 for IBBS-12v-3ah-CRT Para 2.2.1.2
Insulation Resistance and dielectric strength	2.4.4.3	PASS	Each sample was tested to confirm its insulation resistance exceeded 10 megaohms, post environmental testing and found to be in compliance. Para 2.2.1.3
Rated Capacity C1	2.4.4.5	PASS	Each sample was tested to confirm it delivered the rated capacity per the manufacturer’s specifications. Para 2.2.1.5
Capacity at different temperatures	2.4.4.6	PASS	Each sample was tested to confirm it delivered the rated capacity at high and lower operating temperatures per the manufacturer’s specifications. Para 2.2.1.6
Constant voltage discharge	2.4.4.7	n/a	Article is not a high rate battery, test n/a. Para 2.2.1.7
Charge acceptance	2.4.4.8	PASS	Each sample was tested to confirm it would accept charge at ambient and low operating temperatures per the manufacturer’s specifications. Para 2.2.1.8
Charge retention	2.4.4.9	PASS	Each sample was tested to confirm it retained charge when stored at ambient and 50C° temperatures for 28

			days per the manufacturer's specifications. Para 2.2.1.9
Altitude	2.3	PASS	Each sample was subjected to the altitude test of DO-160(f) sect 4 for cat. B2 and found to be in compliance.
Rapid Decompression	2.3	PASS	Each sample was subjected to the rapid decompression test of DO-160(f) sect 4.6.2 for cat B2 and found to be in compliance.
Temperature Variation	2.3	PASS	Each sample was subjected to the Temperature Variation test of DO-160(f) sect 5 for cat B and found to be in compliance.
Power Input	2.3	PASS	Each sample was subjected to the Power Input of DO-160(f) sect 16 cat B(ix) and found to be in compliance.
Magnetic Effects	2.3	PASS	Each sample was subjected to the Magnetic Effect test of DO-160(f) sect 15. Cat Z and found to be in compliance.
Electrostatic Discharge	2.3	PASS	Each sample was subjected to the Electrostatic Discharge test of DO-160(f) sect 25 Cat A and found to be in compliance.
Voltage Spike	2.3	PASS	Each sample was subjected to the Voltage Spike test of DO-160(f) sect 17 Cat A and found to be in compliance.
Audio Frequency Conducted Susceptibility	2.3	PASS	Each sample was subjected to the AF conducted susceptibility test of DO-160(f) sect 18 cat B and found to be in compliance.
Induced Signal Susceptibility	2.3	PASS	Each sample was subjected to the Induced Signal Susceptibility test of DO-160(f) sect 19 cat ZC and found to be in compliance.
RF Susceptibility Test	2.3	PASS	Each sample was subjected to the RF Susceptibility test of DO-160(g) sect 20 cat TT and found to be in compliance.
Emission of RF Energy Test	2.3	PASS	Each sample was subjected to the Emission of RF Energy test of DO-160(f) sect 21 cat M and found to be in compliance.
Lightning Induced Transient Susceptibility	2.3	PASS	Each sample was subjected to the Lightning Induced Transient Susceptibility test of DO-160(g) sect 22 cat A3H3L3 level 3 and found to be in compliance.
Lightning Direct Effects	2.3	n/a	N/A not for exterior mounting
Humidity	2.3	PASS	Each sample was subjected to the Humidity test of DO-160(f) sect 6 cat B and found to be in compliance.
Waterproofness	2.3	PASS	Each sample was subjected to the Waterproofness test of DO-160(f) sect 10 cat Y and found to be in compliance.
Salt Fog/Salt Spray	2.3	PASS	Each sample was subjected to the Salt Fog/spray test of DO-160(f) sect 14 cat S and found to be in compliance.

Fungus Resistance	2.3	PASS	Each sample was subjected to the Fungus Resistance test of DO-160(f) sect 13 cat F and found to be in compliance.
Fluid Susceptibility	2.3	n/a	n/a cat X
Vibration	2.3	PASS	Each sample was subjected to the Vibration test of DO-160(g) sect 8 cat S-C, and found to be in compliance.
Operational Shocks and Crash Safety	2.3	PASS	Each sample was subjected to the Operational Shocks and Crash Safety Test of DO-160(g) sect 7 cat B and found to be in compliance.
Duty Cycle performance	2.4.4.10	n/a	n/a for high rate batteries only. Para 2.2.1.10
Short-circuit current with protection enabled	2.4.4.12	PASS	A sample was subjected to direct short circuit of its output with all protection features enabled and found to be in compliance. Para 2.2.1.12
Short-circuit current with protection disabled	2.4.5.2	PASS	A sample was subjected to direct short circuit of its output with all protection features disabled and found to be in compliance. Para 2.2.2.1
Overcharge Protection enabled	2.4.4.14	PASS	A sample was subjected to a 1.5x overvoltage application in an attempt to overcharge the battery pack with all of protection features enabled and found to be in compliance. Para 2.2.1.14
Explosion containment	2.4.5.6	n/a	n/a only for battery systems of 100 Watt-hrs, the IBBS article is <40 watt-hrs. Para 2.2.2.5
short circuit of a cell	2.4.5.1	PASS	A sample was subjected to direct short circuit of one of its cells and found to be in compliance. Para 2.2.2.1
overdischarge without protection	2.4.5.3	PASS	A sample was subjected to an overdischarge event beyond the EPV to zero volts of the battery pack. The unit was modified to disable its protection features and then the unit was connected to a power source in an attempt to force a recharge cycle and found to be in compliance. Para 2.2.2.2
single cell thermal runaway test	2.4.5.4	n/a	Not required when Battery thermal runaway containment test 2.4.5.5 is completed. Para 2.2.2.3
rapid discharge at high temp	2.4.4.11	PASS	Each sample was subjected to a maximum rate discharge while in a high temperature environment without tripping any thermal protection devices and found to be in compliance. The units delivered their rated capacity per the manufacturer's specification. Para 2.2.1.11
Over discharge test	2.4.4.13	PASS	A sample was subject to an overdischarge of the battery pack beyond the EPV to zero volts, followed by a recharge cycle with all protection mechanism enabled and found to be in compliance. Para 2.2.1.13
Battery thermal runaway containment	2.4.5.5	PASS	A sample was subject to the Battery Thermal Runaway Containment test by the method of Overheating. An external source of power was applied to a heating element wrapped around the battery pack to force a thermal runaway event. The structure of the IBBS system contained the event and was found to be in compliance. Para 2.2.2.4

drop impact	2.4.5.7	n/a	Para 2.2.2.6
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**TABLE 2. Test Summary IBBS-24v-3ah-CRT**

<b>Test</b>	<b>Test reference</b>	<b>Status</b>	<b>Summary of Test Results: each article was found to be in compliance with the testing listed below.</b>
Physical Examination	2.4.4.1	PASS	Each sample was inspected and found to conform with the manufacture's specifications for the article. Para 2.2.1.1
Handle Strength	2.4.4.4	n/a	Article has no handles, does not apply. Para 2.2.1.4
ATP	2.4.4.2	PASS	Each article is constructed and test per ATP manual p/n 720.0013. Para 2.2.1.2
Insulation Resistance and dielectric strength	2.4.4.3	PASS	Each sample was tested to confirm its insulation resistance exceeded 10 megaohms, post environmental testing and found to be in compliance. Para 2.2.1.3
Rated Capacity C1	2.4.4.5	PASS	Each sample was tested to confirm it delivered the rated capacity per the manufacturer's specifications. Para 2.2.1.5
Capacity at different temperatures	2.4.4.6	PASS	Each sample was tested to confirm it delivered the rated capacity at high and lower operating temperatures per the manufacturer's specifications. Para 2.2.1.6
Constant voltage discharge	2.4.4.7	n/a	Article is not a high-rate battery, test n/a. Para 2.2.1.7
Charge acceptance	2.4.4.8	PASS	Each sample was tested to confirm it would accept charge at ambient and low operating temperatures per the manufacturer's specifications. Para 2.2.1.8
Charge retention	2.4.4.9	PASS	Each sample was tested to confirm it retained charge when stored at ambient and 50C° temperatures for 28 days per the manufacturer's specifications. Para 2.2.1.9
Altitude	2.3	PASS	Each sample was subjected to the altitude test of DO-160(f) sect 4 for cat. B2 and found to be in compliance.
Rapid Decompression	2.3	PASS	Each sample was subjected to the rapid decompression test of DO-160(f) sect 4.6.2 for cat B2 and found to be in compliance.
Temperature Variation	2.3	PASS	Each sample was subjected to the Temperature Variation test of DO-160(f) sect 5 for cat B and found to be in compliance.
Power Input	2.3	PASS	Each sample was subjected to the Power Input of DO-160(f) sect 16 cat B(ix) and found to be in compliance.

Magnetic Effects	2.3	PASS	Each sample was subjected to the Magnetic Effect test of DO-160(f) sect 15. Cat Z and found to be in compliance.
Electrostatic Discharge	2.3	PASS	Each sample was subjected to the Electrostatic Discharge test of DO-160(f) sect 25 Cat A and found to be in compliance.
Voltage Spike	2.3	PASS	Each sample was subjected to the Voltage Spike test of DO-160(f) sect 17 Cat A and found to be in compliance.
Audio Frequency Conducted Susceptibility	2.3	PASS	Each sample was subjected to the AF conducted susceptibility test of DO-160(f) sect 18 cat B and found to be in compliance.
Induced Signal Susceptibility	2.3	PASS	Each sample was subjected to the Induced Signal Susceptibility test of DO-160(f) sect 19 cat ZC and found to be in compliance.
RF Susceptibility Test	2.3	PASS	Each sample was subjected to the RF Susceptibility test of DO-160(g) sect 20 cat TT and found to be in compliance.
Emission of RF Energy Test	2.3	PASS	Each sample was subjected to the Emission of RF Energy test of DO-160(f) sect 21 cat L and found to be in compliance.
Lightning Induced Transient Susceptibility	2.3	PASS	Each sample was subjected to the Lightning Induced Transient Susceptibility test of DO-160(g) sect 22 cat A3XXXX level 3 and found to be in compliance. PIN injection testing of all lead wires was determined to be acceptable data for this article. No cable bundle testing was required.
Lightning Direct Effects	2.3	n/a	N/a
Humidity	2.3	PASS	Each sample was subjected to the Humidity test of DO-160(f) sect 6 cat B and found to be in compliance. The approved data from IBBS-12v-6ah-CRT was found suitable to support compliance of this test condition.
Waterproofness	2.3	PASS	Each sample was subjected to the Waterproofness test of DO-160(f) sect 10 cat Y and found to be in compliance. The approved data from IBBS-12v-6ah-CRT was found suitable to support compliance of this test condition.
Salt Fog/Salt Spray	2.3	PASS	Each sample was subjected to the Salt Fog/spray test of DO-160(f) sect 14 cat S and found to be in compliance. The approved data from IBBS-12v-6ah-CRT was found suitable to support compliance of this test condition.
Fungus Resistance	2.3	PASS	Each sample was subjected to the Fungus Resistance test of DO-160(f) sect 13 cat F and found to be in compliance. The approved data from IBBS-12v-6ah-CRT was found suitable to support compliance of this test condition.
Fluid Susceptibility	2.3	n/a	n/a cat X
Vibration	2.3	PASS	Each sample was subjected to the Vibration test of DO-160(g) sect 8 cat S-C, U2,F&F1 and found to be in compliance.

Operational Shocks and Crash Safety	2.3	PASS	Each sample was subjected to the Operational Shocks and Crash Safety test of DO-160(g) sect 7 cat B and found to be in compliance. The approved data from IBBS-12v-6ah-CRT was found suitable to support compliance of this test condition.
Duty Cycle performance	2.4.4.10	n/a	n/a for high rate batteries only. Para 2.2.1.10
Short-circuit current with protection enabled	2.4.4.12	PASS	A sample was subjected to direct short circuit of its output with all protection features enabled and found to be in compliance. Para 2.2.1.12
Short-circuit current with protection disabled	2.4.5.2	PASS	A sample was subjected to direct short circuit of its output with all protection features disabled and found to be in compliance. Para 2.2.2.1
Overcharge Protection enabled	2.4.4.14	PASS	A sample was subjected to a 1.5x overvoltage application to attempt to overcharge the battery pack with all of its protection features enabled and found to be in compliance. Para 2.2.1.14
Explosion containment	2.4.5.6	n/a	n/a only for battery systems of 100 Watt-hrs, the IBBS article is <80 watt-hrs. Para 2.2.2.5
short circuit of a cell	2.4.5.1	PASS	A sample was subjected to direct short circuit of one of its cells and found to be in compliance. Para 2.2.2.1
overdischarge without protection	2.4.5.3	PASS	A sample was subjected to an overdischarge event beyond the EPV to zero volts of the battery pack. The unit was modified to disable its protection features and then the unit was connected to a power source to attempt a forced recharge cycle and found to be in compliance. Para 2.2.2.2
single cell thermal runaway test	2.4.5.4	n/a	Not required when Battery thermal runaway containment test 2.4.5.5 is competed. Para 2.2.2.3
rapid discharge at high temp	2.4.4.11	PASS	Each sample was subjected to a maximum rate discharge while in a high temperature environment without tripping any thermal protection devices and found to be in compliance. The units delivered their rated capacity per the manufacturer's specification. Para 2.2.1.11
Over discharge test	2.4.4.13	PASS	A sample was subject to an overdischarge of the battery pack beyond the EPV to zero volts, followed by a recharge cycle with all protection mechanism enabled and found to be in compliance. Para 2.2.1.13
Battery thermal runaway containment	2.4.5.5	PASS	A sample was subject to the Battery Thermal Runaway Containment test by the method of Overheating. An external source of power was applied to a heating element wrapped around the battery pack to force a thermal runaway event. The structure of the IBBS system contained the event and was found to be in compliance. Para 2.2.2.4
drop impact	2.4.5.7	n/a	Para 2.2.2.6
Explosive Atmosphere	2.3	PASS	Each sample was subjected to the Explosive Atmosphere test of DO-160(f) sect 9 cat E and found to be in compliance.