

	NAME	DATE
ORIGINATOR	A.D. Hubert	07/01/2011

QUALIFICATION TEST REPORT for the **SERIES 200 SWITCH ASSEMBLY**

Testing performed in compliance with
MIL-PRF-22885G

DESC AUTHORIZATION
TEST REPORT NUMBER
22885-3290-11
LETTER NUMBER
VQH-11-022812

Prepared by: _____
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TR - 012 - S200

REVISION LOG

Rev.	E. R. No.	Revised By	Checked By	Approved By	Rel. Date
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1.0 Administrative Data

1.1 Proprietary Restrictions

This data package is submitted in accordance with and for the exclusive purpose of fulfilling the requirements of MIL-PRF-22885G referenced herein. The data, including any attached materials, is proprietary to StacoSystems, Inc. and remains the sole property of StacoSystems, Inc. This data is to be returned to Staco Systems, Inc. or destroyed, after it has fulfilled its intended purpose. Only by written permission of the Marketing Manager, Staco Systems, Inc. may any or all of this data be transmitted, either orally, by copies, or in writing to any agency other than the original receivers; e.g. preparing activity or qualifying activity.

1.2 Scope

This Evaluation Test Report, TR – 012 – S200, has been prepared by Staco Systems, Incorporated. It is intended for the exclusive purpose of providing quantitative evidence that the Series 200 Switch, Indicator and Pushbutton Assembly (hereinafter referred to as the S200, S200 Switch or S200 Assembly) complies with the requirements as directed by the specifications referenced herein as required. This report details characteristics of the test equipment used and the relevant test performance specifications as subjected to individual product samples.

1.3 Specifications

The following documents form a part of this document to the extent referenced herein. Unless a specific issue or revision is listed, the reference documents shall be of that issue or revision in effect on the date of the release of the original version of this document. Only the top level documents are called out.

MIL-PRF-22885, Revision G, 21 January 2005
Performance Specification – Switches, Push Buttons, Illuminated, General Specification For

MIL – STD – 108, Revision E, 4 August 1966
Definitions of and Basic Requirements for Enclosures for Electronic and Electronic Equipment.

MIL – STD – 202, Revision G, 8 February 2002
Department of Defense – Test Method Standard Electronic and Electrical Component Parts

MIL – S – 901, Revision D, 17 March 1989
Shock Test, H.I. (High Impact) Shipboard Machinery, Equipment, and Systems, Requirements For

MIL – STD – 810, Revision G, 31 October 2008
Department Of Defense Test Method Standard, Environmental Engineering Considerations And Laboratory Tests

MIL – PRF – 22885/115, Revision *DRAFT*, 1 April 2011
Performance Specification Sheet – Switches, Pushbutton, Ultra – Compact, LED Illuminated, NVIS, Sealed

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1.4 Test Facilities

All testing of the S200 Switch, Indicator and Pushbutton Assembly, for the purpose of fulfilling the obligations as described herein, took place at the following locations.

StacoSystems, Inc
Test Engineering Department,
7 Morgan
Irvine, CA 92618

National Technical Systems
1536 East Valencia Drive,
Fullerton, CA 92831

EMC TEMPEST Engineering
2190 East Winston Road
Anaheim, CA 92806

Intertek Analytical Testing Laboratories
4700 Broadmoor SE, Suite 200
Kentwood, MI 49512

1.5 Quantity of Units Tested

A total of eighty four (84) test sample units have been subjected to the various Group Inspections as detailed in the specifications referenced herein. These qualification units are production representative.

Table 1. STACO Tracking Number Cross Reference Table

STACO P/N	UUT Tracking Number	Quantity Each	Termination Type	Action Type	Indicator Voltage	Configuration Group
2HNC0-51S12311122	243020-#	2	Crimp (C)	Ind (N)	5V	1
2HNC0-51S12313344	243025-#	2	Crimp (C)	Ind (N)	5V	2
2HNC0-51S12316677	243030-#	2	Crimp (C)	Ind (N)	5V	3
2HNC0-51S12341122	243035-#	2	Crimp (C)	Ind (N)	5V	4
2HNC0-51S12343344	243040-#	2	Crimp (C)	Ind (N)	5V	5
2HNC0-51S12346677	243044-#	2	Crimp (C)	Ind (N)	5V	6
2HNC0-51S12351122	243049-#	2	Crimp (C)	Ind (N)	5V	7
2HNC0-51S12353344	243054-#	2	Crimp (C)	Ind (N)	5V	8
2HNC0-51S12356677	243059-#	2	Crimp (C)	Ind (N)	5V	9
2HNC0-71S12361122	243064-#	2	Crimp (C)	Ind (N)	28V	10
2HNC0-71S12361111	243069-#	2	Crimp (C)	Ind (N)	28V	11
2HNC0-71S12366677	243074-#	2	Crimp (C)	Ind (N)	28V	12
2HNC0-71S12370011	243078-#	2	Crimp (C)	Ind (N)	28V	13
2HNC0-71S12372233	243083-#	2	Crimp (C)	Ind (N)	28V	14
2HNC0-71S12374455	243088-#	2	Crimp (C)	Ind (N)	28V	15
2HNC0-71S12376600	243093-#	2	Crimp (C)	Ind (N)	28V	16
2HMS4-51S18311234	243098-#	4	Solder (S)	Mom (M)	5V	17
2HMS4-51S18316721	243103-#	4	Solder (S)	Mom (M)	5V	18
2HMS4-51S18341234	243108-#	2	Solder (S)	Mom (M)	5V	19

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2HMS4-51S18346721	243113-#	2	Solder (S)	Mom (M)	5V	20
2HMS4-51S18351234	243118-#	5	Solder (S)	Mom (M)	5V	21
2HMS4-51S18356721	243123-#	5	Solder (S)	Mom (M)	5V	22
2HAS4-71S31352222	243128-1	1	Solder (S)	Alt (A)	28V	23
2HAS4-71S18370123	243128-2	1	Solder (S)	Alt (A)	28V	23
2HAS4-71S18374561	243133-#	2	Solder (S)	Alt (A)	28V	24
2HAS4-71S11361111	243138-#	2	Solder (S)	Alt (A)	28V	25
2HAS4-71S11362222	243143-#	2	Solder (S)	Alt (A)	28V	26
2HAS4-71S11363333	243148-#	2	Solder (S)	Alt (A)	28V	27
2HAS4-71S11364444	243153-#	2	Solder (S)	Alt (A)	28V	28
2HAS4-71S11366666	243158-#	2	Solder (S)	Alt (A)	28V	29
2HAS4-71S11367777	243163-#	2	Solder (S)	Alt (A)	28V	30
2HMS4-62N21353333	250702-#	2	Solder (S)	Mom (M)	28V	31
2HAP4-61S12311111	250721-#	2	PCB (P)	Alt (A)	28V	32
2HMS4-62N21350000	250763-#	2	Solder (S)	Mom (M)	28V	33
2HNC0-71S12361122	250854-#	2	Crimp (C)	Ind (N)	28V	34
2HNC0-71S12363344	250855-#	2	Crimp (C)	Ind (N)	28V	35
2HNC0-71S12366677	250856-#	2	Crimp (C)	Ind (N)	28V	36
2HNC0-71S12360000	250857-#	2	Crimp (C)	Ind (N)	28V	37

1.6 Retention of Specimens

At completion of tests, samples shall be quarantined and kept on hand until the next inspection period for submittal to the qualifying activity if so requested (Ref. MIL-PRF-22885G, paragraph 4.6.3.1.3).

2.0 Test Summary

Staco System, in conjunction with commissioned vendors listed in section 1.4 Test Facilities, performed all necessary test on the Series 200 Switch to validate compliance with the applicable requirements as directed herein. Additional test summary information is provided in **Table 3**. Section 5.0 Test Results provides detailed findings and test methodology.

3.0 Conclusion

The Staco Systems Series 200 Switch, Indicator and Pushbutton Assembly has demonstrated the ability to conform to all applicable requirements of referenced specifications herein.

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4.0 VQ-SOF-36

QUALIFICATION TEST REPORT AT A NON-GOVERNMENT TEST LABORATORY THIS FORM SHALL BE COMPLETED FOR EACH TEST LOCATION	
MILITARY SPECIFICATION TITLE (Noun Name) DATE, AMENDMENT AND DATE PERFORMANCE SPECIFICATIONS FOR SWITCHES, PUSHBUTTON, ULTRA-COMPACT, LED ILLUMINATION, NVIS, SEALED SPECIFICATION FOR MIL-PRF-22885/115	TEST REPORT NUMBER DLA 22885-3290-11
	TEST REPORT DATE 09-30-2011
SPECIFICATION SHEET/DETAIL SPECIFICATION AND DATE MIL-PRF-22885/115 30 SEPTEMBER 2011	AMENDMENT AND DATE N/A
APPLICANTS NAME AND MAILING ADDRESS STACO SYSTEMS, INC 7 Morgan Irvine, CA 92618	MANUFACTURERS PLANT LOCATION(S) 7 Morgan Irvine, CA 92618
TEST LABORATORY NAME AND ADDRESS STACOSYSTEMS, INC. 1139 BAKER STREET COSTA MESA, CA 92626 NATIONAL TECHNICAL SYSTEMS 1536 EAST VALENCIA DRIVE FULLERTON, CA 92831 EMC TEMPEST Engineering 2190 East Winston Road Anaheim, CA 92806	
DESCRIPTION OF PRODUCTS TESTED (Government Designation and Manufacturer's Designation) SWITCHES, PUSHBUTTON, ULTRA-COMPACT, LED ILLUMINATION, NVIS, SEALED ASSEMBLIES OF MIL-PRF-22885/115	
LETTER NUMBER AND DATE OF DESC AUTHORIZATION TO TEST (DESC Form 19) VQH-11-022812 08 JULY 2011 (James R. Eschmeyer)	
GOVERNMENT REPRESENTATIVE <i>I certify that I did witness, at specified intervals, the tests indicated in this test report by my stamp or signature, and that such tests were conducted as specified. This certification does not constitute approval or disapproval of the product(s).</i> NAME <u>ART WOOLUM & KEVIN RUDD</u> (Government Representative) TITLE <u>DCAS QAR</u> SIGNATURE _____ DATE _____ TEST LABORATORY (Mfr. or commercial) <i>I certify that all tests described in this report were performed as specified, by competent personnel using test facilities which have been inspected and found acceptable by the Government.</i> NAME <u>SAM TRUONG</u> (Laboratory Representative) TITLE <u>DIRECTOR OF ENGINEERING.</u> SIGNATURE _____ DATE _____	MANUFACTURER (Check Applicable Block) <input type="checkbox"/> I certify that the tests were conducted upon sample items randomly selected from a normal production lot, and that the items were manufactured at the location and by the manufacturer indicated above. <input checked="" type="checkbox"/> I certify that the tests were conducted upon sample items which are representative of our production and that the items were manufactured at the location and by the manufactures indicated above. NAME <u>BRUCE GRAY</u> TITLE <u>PRESIDENT, STACO SYSTEMS, INC.</u> SIGNATURE _____ DATE _____
PURPOSE OF TESTING <input checked="" type="checkbox"/> INITIAL QUALIFICATION <input type="checkbox"/> EXTENSION OF RANGE OF PREVIOUSLY QUALIFIED ITEMS <input type="checkbox"/> REQUALIFICATION TO REVISED OR AMENDED SPECIFICATION <input type="checkbox"/> OTHER (Describe)	
EXTENT OF TESTING PERFORMED <input checked="" type="checkbox"/> COMPLETE <input type="checkbox"/> PARTIAL (Describe)	
DESC FORM 36F	

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TEST PERSONNEL *(List all Personnel Actually Performing Tests and Personnel Supervising Tests.)*

DEVICE FAILURES *(List all Failure Modes Encountered and The Causes of These Failures During Burn – In end Life Tests)*

REMARKS *(Include any Abnormalities in Testing, Explanation of Failures, etc. If for Design and Construction Change, Include Explanation of Change and Reason (Benefits) for Change.)*

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5.0 Test Results

Table 2. Abstract of Test Results

Manufacturer's Name: Staco Systems	Test Specification Number: MIL-PRF-22885G	DESC Test Report: 22885-3290-11			
Staco Test Report: TR – 012 – S200	Amendment Number: AMENDMENT 1	Test Report Date: 09-30-2011			
Laboratory Address: 7 Morgan, Irvine CA 92618	Detailed Specification Number: MIL-PRF-22885 / 115	Product: Series 200 Switch Assembly			
Inspection Type	Test Method Paragraph	UUT Tracking Numbers	Number Tested	Number Failed	Remarks
Visual & Mechanical Exam.	4.7.1	All UUT's	84	0	
Contact resistance	4.7.4	All Switches	44	0	
Contact bounce	4.7.5	All Switches	44	0	
Operating characteristics	4.7.6	All Switches	44	0	
Coincidence of operating & releasing points	4.7.7	All Switches	44	0	
Dielectric Withstanding	4.7.19.1	All Switches	44	0	
Solderability 1/	4.7.2	243103-3 & 243103-4	2	0	
Resistance to soldering heat 1/	4.7.3	243103-3 & 243103-4	2	0	
Permanency of marking 1/	4.7.8	243103-3, 243103-4 & 243044-1	3	0	
Terminal Strength	4.7.9	243118-3, 243118-4, 243059-1, 243059-2, 250721-1 & 250721-2	6	0	
Strength of Act. Means	4.7.10	243118-1 & 243118-2	2	0	
Thermal Shock	4.7.14	243118-1, 243118-2, 243118-3 & 243118-4	4	0	
Vibration	4.7.15	243118-1, 243118-2, 243118-3 & 243118-4	4	0	
Shock (Specified Pulse) 2/	4.7.16.1	243143-1, 243143-2, 243123-2 & 243123-4	4	0	
Shock (High Impact) 2/	4.7.16.2	243143-1, 243143-2, 243123-2 & 243123-4	4	0	
Acceleration	4.7.17	243143-1, 243143-2, 243123-2 & 243123-4	4	0	
Moisture Resistance	4.7.18	243118-1, 243118-2, 243118-3 & 243118-4	4	0	
Seal (Splashproof)	4.7.20.1	243103-1, 243103-2, 243103-3, 243103-4, 243123-2, 243123-4, 243143-1 & 243143-2	8	0	
Seal (Watertight)	4.7.20.2	250702-1, 250702-2, 250763-2 & 250763-2	4	0	
Marking visibility	4.7.21	243103-3, 243103-4, 243118-1, 243118-2, 243118-3 & 243118-4	6	0	
Salt Spray (Corrosion)	4.7.22	243120-1, 243120-2, 243125-1 & 243125-2	4	0	
Short Circuit	4.7.24	243103-3 & 243103-4	2	0	

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Explosion	4.7.25	243133-1 & 243133-2	2	0	
Sand & Dust	4.7.26	243133-1 & 243133-2	2	0	
Electric Endurance (Resistive Load, DC) (Sea Level) 3/	4.7.28.2	243163-1, 243163-2 & 243118-5	3	1	243163-1 replaced with 243118-5
Electric Endurance (Inductive Load, DC) (Sea Level) 3/	4.7.28.2	243138-1 & 243148-1	2	0	
Electric Endurance (Resistive, AC) (Sea Level) 3/4/	4.7.28.2	243153-1, 243153-2 & 243148-2	3	1	243153-1 replaced with 243148-2
Electric Endurance (Inductive, AC) (Sea Level) 3/4/	4.7.28.2	243103-1 & 243103-2	2	0	
Electric Endurance (Resistive Load, DC) (Altitude) 3/	4.7.28.2	243098-1, 243098-2 & 243123-1	3	1	243098-1 replaced with 243123-1
Electric Endurance (Inductive Load, DC) (Altitude) 3/	4.7.28.2	243098-3, 243098-4 & 243123-3	3	1	243098-3 replaced with 243123-3
Mechanical Endurance	4.7.29	243118-1 & 243118-2	2	0	
Low level life 6/	4.7.31	243158-1, 243158-2, 243113-1, 243113-2 & 243138-2	5	1	243158-2 replaced with 243138-2
EMI/RFI shielding	4.7.33	243054-1, 243054-2, 243074-1 & 243074-2	4	0	
Illuminated colors	4.7.34	250854-1, 250854-2, 250855-1, 250855-2, 250856-1, 250856-2, 250857-1 & 250857-2	8	0	
Luminance Non-NVIS	4.7.35	243020-1, 243020-2, 243025-1, 243025-2, 243030-1, 243030-2, 243035-1, 243035-2, 243040-1, 243040-2, 243045-1, 243045-2, 250857-1 & 250857-2	14	0	
Luminance NVIS	4.7.35	243093-1, 243093-2, 243083-1, 243083-2, 243128-1, 243128-2, 243133-1 & 243133-2	8	0	
Sunlight readability (when specified, 3.1)	4.7.36	250633-1, 250633-2, 250854-1, 250854-2, 250855-1, 250855-2, 250856-1, 250856-2, 250857-1, 250857-2, 243088-1, 243088-2, 243093-1, 243093-2, 243069-1 & 243069-2	10	0	
NVIS compatibility (when specified, 3.1)	4.7.37	243128-1, 243128-2, 250763-1, 250763-2, 243088-1, 243088-2, 243093-1 & 243093-2	8	0	

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A2/ At the option of the contractor, incoming or in-process inspection may be used to meet these requirements provided that they meet the acceptance criteria and all of the contractor's in-process control data on these tests are made available to the Government upon request.

A3/ Visually inspect switches with sunlight readable displays in each lot against the appropriately colored standard switch. The switches used as visual standards shall be certified annually by performing the sunlight readability test.

A5/ One hundred% test switches for light leak using NVIS viewing device in accordance With MIL-L-85762.

1/ Two sample units only. These two sample units shall be used for group IV inspections.

2/ Additional qualification of identical switches for method II (high-impact) shock will require four additional sample units for submission to group I and group II tests, using method II for the shock test.

3/ Two sample units for each electrical load (see 3.1).

4/ Unless otherwise specified, ac tests are to be 60 Hz. Where different current ratings for 60 Hz and 400 Hz are shown (see 3.1), both 60 Hz and 400 Hz tests are to be performed.

5/ Sea level dielectric withstanding voltage test (see 4.7.19) is to be conducted only on those units which are tested for sea level electrical endurance (see 4.7.28). Altitude dielectric withstanding voltage test (see 4.7.19) is to be conducted on those units which were tested for altitude electrical endurance tests (see 4.7.28).

6/ Two additional sample units.

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6.0 Test Equipment List

All test equipment used was within its current calibration cycle and traceable to NIST (National Institute of Standards and Technology) unless otherwise indicated. Equipment used at this facility is listed in Table 3. Test Equipment. All other equipment used is listed in the individual reports provided by the remote facilities for that specific set of test.

Table 3. Test Equipment

Manufacturer's Name: Staco Systems		Test Specification Number: MIL-PRF-22885G		Test Report: TR – 012 – S200	
Laboratory Address: 7 Morgan, Irvine CA 92618		Amendment Number: AMENDMENT 1		Test Report Date: 09-30-2011	
		Detailed Specification Number: MIL-PRF-22885 / 115		Product: Series 200 Switch Assembly	
Spec. Para. Or Test	Nomenclature	Mfg.	Model	Tracking Number	Calibration Due Date
Contact resistance, Contact bounce & Operating Characteristics	3½ Digit Multimeter	Fluke	8010A	418287	1-25-2012
	30V/2A DC Power Supply	Tektronix	PS280	419037	12-15-2011
	6½ Digit Multimeter	H.P.	34401A	419052	3-12-2012
	Contact Resistance Tester	Staco Systems	TN 418481	TN 418481	Not Applicable
	Contact Bounce Tester	Staco Systems	TN 418482	TN 418482	Not Applicable
Dielectric Withstanding Voltages	Series 200 Pushbutton Tester National Instruments PXI Express measurement instrumentation	AB Controls	--	419057	08-10-2012
	Dielectric Analyzer	Associated Research	7650 Ultra III	419008	1-25-2012
Solderability	S200 Break-Out Fixture	Staco Systems	--	--	Not Applicable
	Tubular Spirit (bubble) Level	--	--	--	--
	Stop Watch	Control Company	1043	111290712	1-26-1013
	Hot Plate	Waage Elect.	1212-2-2	00360	Not Applicable
	Handheld Digital Multimeter	Fluke	179	417365	1-25-2012
	Dial Drop Indicator, 0-1'	Teclock	AI-921	419023	8-16-2012
	Solder Pot, 320 Watt	American Beauty	300	--	Not Applicable
	Integrated DMM Temperature Probe	Fluke	80BK-A	--	Singular
	1000mL Heavy-Duty Beaker	Kimax	14005-1000	--	Not Applicable
	Pyrex Cylinder, Graduated, Scaled	Pyrex	3023-25	--	Not Applicable
Resistance to Solder Heat	Microscope w/ WF20x/10mm Eyepieces	Optika	SZM-T w/ 0.7x to 4.5x zoom	--	Not Applicable
	Dial Drop Indicator, 0-1'	Teclock	AI-921	419023	8-16-2012
	Stop Watch	Control Company	1043	111290712	1-26-1013
	Handheld Digital Multimeter	Fluke	179	417365	1-25-2012
	Integrated DMM Temperature Probe	Fluke	80BK-A	--	Singular
	Solder Pot, 320 Watt	American Beauty	300	--	Not Applicable
Thermal Shock	Microscope w/ WF20x/10mm Eyepieces	Optika	SZM-T w/ 0.7x to 4.5x zoom	--	Not Applicable
	Tubular Spirit (bubble) Level	--	--	--	--
	Environmental Chamber	Bemco	F-100/ 350-16	419029	8-16-2012
Seal, Splashproof	Environmental Chamber with Humidity	Bemco	FW-100/ 350-16	419030	8-16-2012
	Stop Watch	Control Company	1043	111290712	1-26-1013
	S200 EMI Test Panel (x4)	Staco	418475	TN 418475	Not Applicable
Marking Visibility	3 1/2 Digital Multimeter	Fluke	8010A	4178288	1-25-2012
	3/4" water hose w/specialized Nozzle	Staco Systems	--	--	Not Applicable
Moisture Resistance	Microscope w/ WF20x/10mm Eyepieces	Optika	SZM-T w/ 0.7x to 4.5x zoom	--	Not Applicable
	Environmental Chamber with Humidity	Bemco	FW-100/ 350-16	419030	8-12-2011
	S30 Mounting Panel, 15°	Staco Systems	--	--	Not Applicable
	3½ Digit Multimeter	Fluke	8010A	418287	1-25-2012
	Regulated Power Supply	Heath	SP-2717A	--	Reference Only

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Salt Spray (Corrosion)	Salt Spray Chamber	Bemco	P700XL	419032	8-16-2012
	Precision Hydrometer, Specific Gravity	San Jose Scientific	SJS-2549	--	Singular
	S30 Mounting Panel, 15°	Staco Systems	--	--	--
	Integrated DMM Temperature Probe	Fluke	80BK-A	--	Not Applicable
	Handheld Digital Multimeter	Fluke	179	417365	1-25-2012
	pH Tester, Microprocessor Based	Oakton Instruments	WD-35624-33	--	Before Use with ph Solutions
	Buffer Solution, ph 10.00 ±0.02 @ 25°C	Omega Engineering	PHA-10	101907268	1-10-2012
	Buffer Solution, ph 4.00 ±0.02 @ 25°C	Omega Engineering	PHA-4	101907268	1-10-2012
Overload Cycling, Sea Level	Buffer Solution, ph 7.00 ±0.02 @ 25°C	Omega Engineering	PHA-7	101907268	1-10-2012
	AC DC Cycle Counter 8x	Staco Systems	CUB 10000	4049	Not Applicable
	Regulated Pneumatic Cycle Actuator	Staco Systems	SAM1	P-11147	Not Applicable
	Variable High Wattage Resistor	Ohmite	Various	--	Not Applicable
	Actuation Holding Fixture	Staco Systems	--	--	Not Applicable
	Stop Watch	Control Company	1043	111290712	1-26-1013
	Pneumatic Controller	Staco Systems	4X	57	Not Applicable
	Environmental Chamber	Ranso Industries	SD-100-IM	3813	Reference Only
	Digital Thermometer, Multi-Probe	Fluke	2100A	10571	8-16-2013
	500MHz 4 Channel O'Scope	Tektronix	TDS 3054b	417358	1-25-2012
	Current Probe	Tektronix	TCP 202	00450	Not Applicable
	Overload Cycling, Altitude	3 1/2 Digital Multimeter	Fluke	8010A	4178288
AC DC Cycle Counter 8x		Staco Systems	CUB 10000	4049	Not Applicable
Variable High Wattage Resistor		Ohmite	Various	--	Not Applicable
Actuation Holding Fixture		Staco Systems	--	--	Not Applicable
Stop Watch		Control Company	1043	111290712	1-26-1013
Environmental Chamber with Altitude and Pneumatic Controller		Bemco	AF-80/ 350F- 1.75LN	419031	8-16-2012
500MHz 4 Channel O'Scope		Tektronix	TDS 3054b	417358	1-25-2012
Current Probe		Tektronix	TCP 202	00450	Not Applicable
Electrical Endurance, AC-DC, Sea Level	3 1/2 Digital Multimeter	Fluke	8010A	4178288	1-25-2012
	AC DC Cycle Counter 8x	Staco Systems	CUB 10000	4049	Not Applicable
	Environmental Chamber	Bemco	F-100/ 350-16	419029	8-16-2012
	Regulated Pneumatic Cycle Actuator	Staco Systems	SAM1	P-11147	Not Applicable
	Stop Watch	Control Company	1043	111290712	1-26-1013
	Variable High Wattage Resistor	Ohmite	Various	--	Not Applicable
	Pneumatic Controller	Staco Systems	4X	57	Not Applicable
	Environmental Chamber	Ranso Industries	SD-100-IM	3813	Reference Only
	500MHz 4 Channel O'Scope	Tektronix	TDS 3054b	417358	1-25-2012
	Current Probe	Tektronix	TCP 202	00450	Not Applicable
	36V 40A 1.44KW DC Power Supply	BK Precision	XLN3640	--	11-9-2011
	Electrical Endurance, AC-DC, Altitude	Data Acquisition/Switch Unit	Agilent	34970A	417363
3 1/2 Digital Multimeter		Fluke	8010A	4178288	1-25-2012
AC DC Cycle Counter 8x		Staco Systems	CUB 10000	4049	Not Applicable
Environmental Chamber with Altitude and Pneumatic Controller		Bemco	AF-80/ 350F- 1.75LN	419031	8-16-2012
Stop Watch		Control Company	1043	111290712	1-26-1013
Variable High Wattage Resistor		Ohmite	Various	--	Not Applicable
500MHz 4 Channel O'Scope		Tektronix	TDS 3054b	417358	1-25-2012
Current Probe		Tektronix	TCP 202	00450	Not Applicable
Permanency of Marking	36V 40A 1.44KW DC Power Supply	BK Precision	XLN3640	--	11-9-2011
	Data Acquisition/Switch Unit	Agilent	34970A	417363	1-25-2012
	3 1/2 Digital Multimeter	Fluke	8010A	4178288	1-25-2012
	isopropyl alcohol	Gallede Chemical I	UN1219	--	Not Applicable
	mineral spirits	Klean-Strip	QMS-44	--	Not Applicable
	terpene defluxer	Chemtronics	Max-Clean	--	Not Applicable
	water	Grainger	--	--	Not Applicable
	propylene glycol	Gallede Chemical	P12401	--	Not Applicable
	monoethanolamine	Gallede Chemical	M1456-06	--	Not Applicable
	Toothbrush (3)	Osco	Adult hard	--	Not Applicable
	Hot Plate	Waage Elect.	1212-2-2	00360	Not Applicable
	Handheld Digital Multimeter	Fluke	179	417365	1-25-2012
	Integrated DMM Temperature Probe	Fluke	80BK-A	--	Singular
	1000mL Heavy-Duty Beaker	Kimax	14005-1000	--	Not Applicable
	Pyrex Cylinder, Graduated, Scaled	Pyrex	3023-25	--	Not Applicable
Microscope w/ WF20x/10mm Eyepieces	Optika	SZM-T w/ 0.7x to 4.5x zoom	--	Not Applicable	
Stop Watch	Control Company	1043	111290712	1-26-1013	

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Mechanical Endurance	AC DC Cycle Counter 8x	Staco Systems	CUB 10000	4049	Not Applicable
	Regulated Pneumatic Cycle Actuator	Staco Systems	SAM1	P-11147	Not Applicable
	Stop Watch	Control Company	1043	111290712	1-26-1013
	Actuation Holding Fixture	Staco Systems	--	--	Not Applicable
Temperature Rise Measurement	Environmental Chamber	Bemco	F-100/ 350-16	419029	8-16-2012
	Data Acquisition/Switch Unit	Agilent	34970A	417363	1-25-2012
Vibration	Type-K Thermocouple Integrated Digital Multimeter Temperature Probe	Fluke 80BK-	Fluke 80BK-	--	Not Applicable
	Vibration & Shock Test Plate	Staco	40888	TN 40888	6-15-2011
	Face Plate, Vibration Fixture	Staco	40892	TN 40892	8-11-2011
	Base Plate, Vibration Fixture	Staco	40893	TN 40893	1-25-2012
	Mounting Block, Vibration Fixture	Staco	40894	TN 40894	12-15-2011
	Vibration Table	VTS	VG600-6	--	1-10-2012
	Vibration Controller	VTS	DVC-4	--	1-10-2012
Low level life	Environmental Chamber	Bemco	F-100/ 350-16	419029	8-16-2012
	Regulated Pneumatic Cycle Actuator	Staco Systems	SAM1	P-11147	Not Applicable
	Stop Watch	Control Company	1043	111290712	1-26-1013
	Variable Resistor (x16) Fixture	Ohmite	Various	--	Not Applicable
	6½ Digit Multimeter	H.P.	34401A	419052	3-12-12
	500MHz 4 Channel O"Scope	Tektronix	TDS 3054b	417358	1-25-2012
	Current Probe	Tektronix	TCP 202	00450	Not Applicable
	36V 40A 1.44KW DC Power Supply	BK Precision	XLN3640	--	11-9-2011
	Data Acquisition/Switch Unit	Agilent	34970A	417363	1-25-2012
Watertight Seal	3 1/2 Digital Multimeter	Fluke	8010A	4178288	1-25-2012
	Vertical Submersion Tube	Staco	--	--	Not Applicable
Terminal Strength	Acrylic Mounting Fixture	Staco	--	--	Not Applicable
	Force Gage, 140 lbs	Chatillon	HTC	417303	5-24-2012
Strength of Actuating Means	30V/2A DC Power Supply	Tektronix	PS280	419038	12-15-2011
	Force Gage, 140 lbs	Chatillon	HTC	417303	5-24-2012
Illuminated colors	30V/2A DC Power Supply	Tektronix	PS280	419038	12-15-2011
	30V/2A DC Power Supply	Tektronix	PS281	419039	12-15-2011
	Calibration Source Optics Head	Optronic Labs	455-6-1-NVG	TN 419044-A	1-26-2012
	NVIS CCD Image Telescope	Optronic Labs	OL 620-NVS	00455-a	08-11-20111
	Multi-Channel Spectroradiometer Interface	Optronic Labs	OL 770VIS/NIR	00455-b	Not Applicable
Luminance	Variable Integrating Sphere	Optronic Labs	OL 456-6-1-NVG	419044	1-25-2012
	Spectroradiometer	Spectra Pritchard	1980B	417304-A	12-15-2011
	Spectroradiometer Control Console	Spectra Pritchard	1980B-SC	417304-B	12-15-2011
	30V/2A DC Power Supply	Tektronix	PS281	419039	12-15-2011
	Spectroradiometer	Spectra Pritchard	1980B	417103-A	7-27-2012
	Spectroradiometer Control Console	Spectra Pritchard	1980B-SC	417103-B	7-27-2012
Sunlight readability	Multimeter & DC power supply	Agilent	U3606A	419040	8-10-2012
	ACE Light Source	Schott	20520	178177	Reference Only
	Spectroradiometer	Spectra Pritchard	1980B	417304-A	12-15-2011
	Spectroradiometer Control Console	Spectra Pritchard	1980B-SC	417304-B	12-15-2011
NVIS compatibility	30V/2A DC Power Supply	Tektronix	PS281	419039	12-15-2011
	Calibration Source Optics Head	Optronic Labs	455-6-1-NVG	TN 419044-A	1-26-2012
	NVIS CCD Image Telescope	Optronic Labs	OL 620-NVS	00455-a	08-11-20111
	Multi-Channel Spectroradiometer Interface	Optronic Labs	OL 770VIS/NIR	00455-b	Not Applicable
	Variable Integrating Sphere	Optronic Labs	OL 456-6-1-NVG	419044	1-25-2012
EMI/RFI shielding	30V/3A DC Power Supply	EXTECH	382213	419053	5-24-2012
Sand & Dust	As Listed in Report				
Explosion	As Listed in Report				
Shock (Specified Pulse)	As Listed in Report				
Shock (High Impact)	As Listed in Report				
Acceleration	As Listed in Report				
Short Circuit	As Listed in Report				
Fluid Susceptibility	As Listed in Report				

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7.0 Test Procedures

The Test Procedures section contains an itemized accounting of applicable tests scenarios, supporting data and results.

The following information is for clarification of results in this report. Referring to Figure 1. Switch Terminal Identification below, UUT terminals may be referred to in several manners. Terminals A3, B3, C3 & D3 may be referred to as the Common terminal for that pole. Terminals A1, B1, C1 & D1 may be referred to as the NC terminal for that pole and A2, B2, C2 & D2 may be referred to as the NO. For Switch Operating temperatures refer to Table 4. S200 Operating Temperatures

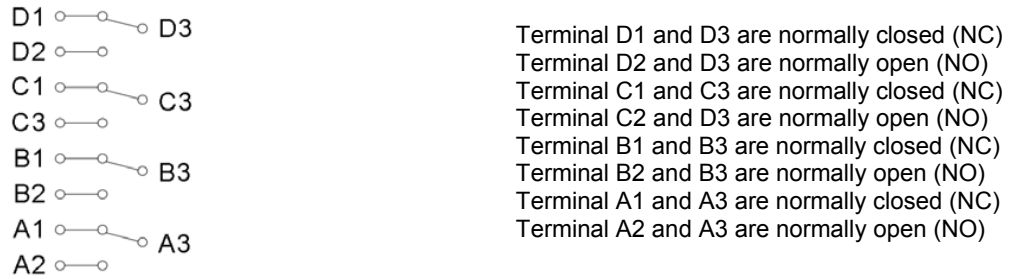


Figure 1. Switch Terminal Identification

Table 4. S200 Operating Temperatures

Condition	Temperature range
Operating with lamps un-energized	-65 °C to +85 °C
Operating with lamps energized	-55 °C to +71 °C

7.1 Dielectric Withstanding Voltage Testing

During QPL product testing, dielectric withstanding voltage testing may be required as a subsection of a performance test. The dielectric withstanding voltage test should be used with caution.

MIL-PRF-22885/115 DRAFT:

Dielectric strength: Tests are performed at both sea level and at a reduced barometric pressure simulating 70,000 feet altitude.

Dielectric withstanding voltage at atmospheric pressure: The switches are tested in accordance to the requirements of MIL-PRF-22885, Para. 4.7.19.1, MIL-STD-202F, Method 301.

Dielectric withstanding voltage at reduced pressure: The switches are tested in accordance to the requirements of MIL-PRF-22885, Para. 4.7.19.2, MIL-STD-202F, Method 105C, Cond. C.

Insulation resistance: The switches are tested in accordance to the requirements of MIL-STD-202F, Method 302, Cond. B.

Testing Requirements:

A potential of 1000 volts rms (400 Vrms at reduced pressure) is applied for a period of sixty (60) seconds at atmospheric pressure as follows:

- Between all terminals and exposed noncurrent carrying metal or grounded parts.
- Between all terminals of mutually isolated circuits, including between poles.
- Between all open terminal of the same pole. (This measurement is not applicable after electrical endurance.)

The voltage source shall be nominally 60 hertz in frequency and shall approximate, as closely as possible, a true sine wave in form.

The applied voltage source shall and the leakage current measurement shall have an accuracy of at least 5 percent.

The test voltage shall be raised from zero to the specified value as uniformly as possible, at a rate of approximately 500 volts per second.

Test units shall be inspected for and show no evidence of arching, flashover, breakdown of insulation, damage or current flow in excess of 500 microamperes.

Procedure:

Using normal mounting means and hardware, attach the test unit to the holding plate or fixture. The fixture must be sufficient to hold the test unit so it may be SAFELY placed in the actuated position during the test.

Attach leads of sufficient length to all contacts of the test units to connect to the test equipment as needed.

Using a Hipot Tester, apply a 1000 volts rms (400 Vrms at reduced pressure) potential for a period of sixty (60) seconds at atmospheric pressure across the following points:

- All Pins (including lamp pins 4 through 9) to housing
- A1, 2 & 3 to B1, 2 & 3
- B1, 2 & 3 to C1, 2 & 3
- C1, 2 & 3 to D1, 2 & 3
- D3 to D2
- C3 to C2
- B3 to B2
- A3 to A2
- D3 to D1(When actuated)
- C3 to C1(When actuated)
- B3 to B1(When actuated)
- A3 to A1(When actuated)

Test units shall be inspect the test units for evidence of arching, flashover, breakdown of insulation, damage or current flow in excess of 500 microamperes.

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7.2 GROUP ONE (All Units) Test

This section incorporates the following test from within the Group I section, Table IX of MIL-PRF-22885G.

Inspection	Requirement paragraph	Test Method paragraph
Visual and mechanical examination	3.1, 3.5, 3.6, 3.45 and 3.47	4.7.1
Contact resistance	3.9	4.7.4
Contact bounce	3.10	4.7.5
Operating characteristics	3.11	4.7.6
Coincidence of operating & releasing points	3.12	4.7.7

MIL-PRF-22885/115 DRAFT:

Contact resistance: The switches are tested in accordance to the requirements of MIL-PRF-22885 and MIL-STD-202G, Method 307.

Contact bounce: The switches are tested in accordance to the requirements of MIL-PRF-22885. Simultaneity is under 2 milliseconds.

Testing Requirements:

3.1 Specification sheets. The individual item requirements shall be as specified herein and in accordance with the applicable specification sheets. In the event of any conflict between the requirements of this specification and the specification sheet, the latter shall govern.

3.5 Material. Material shall be as specified herein. However, when a definite material is not specified, a material shall be used which will enable the switches to meet the performance requirements of this specification. Acceptance or approval of any constituent material shall not be construed as a guaranty of the acceptance of the finished product.

3.6 Interface and dimensions. Switches shall be so constructed as to insure proper operation when mounted in any position. The switches shall meet the interface and dimensions specified.

3.45 Marking.

3.47 Workmanship. Switches shall be processed in such a manner as to be uniform in quality and shall be free from cracked or displaced parts, sharp edges, burrs, and other defects which will affect life, serviceability, or appearance.

3.9 Contact resistance. The contact resistance shall not exceed 25 milliohms. After electrical endurance, the contact resistance shall not exceed 1 percent of the load impedance using the electrical parameters of the electrical endurance test load.

3.10 Contact bounce. When switches are tested as specified in 4.7.5, the contact bounce shall be as specified.

3.11 Operating characteristics. When switches are tested as specified in 4.7.6, the operating characteristics shall be as specified (see 3.1 and 6.2). Unless otherwise specified, switch action will be break before make.

3.12 Coincidence of operating and releasing points. When switches are tested as specified in 4.7.7, all poles shall have actuated (transfer of contacts) within the limits specified.

4.7.1 Visual and mechanical inspection. Switches and associated modular sub-assemblies shall be examined to verify that the materials, physical dimensions, marking, and workmanship are in accordance with the applicable requirements.

4.7.4 Contact resistance. Switch contacts shall be tested in accordance with method 307 of MIL-STD-202.

4.7.4.1 Switch contact resistance. The following details shall apply:

- a. Measurements shall be made between the terminals of the contacts of the same pole forming a switching circuit. Three measurements shall be made on each pair of switch contacts. The switch contacts shall be operated once between each measurement.
- b. Test current: 0.1 ampere \pm 5 percent. After electrical endurance, use the electrical parameters of the electrical endurance test load.
- c. Open-circuit test voltage: 6 volts direct current (V dc) \pm 1 V dc. After electrical endurance, use the electrical parameters of the electrical endurance test load.
- d. Number of test actuations: Three.
- e. Number of measurements per actuation: One measurement.

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4.7.5 Contact bounce. The switch shall be connected to a test circuit in accordance with figure 3. The switch shall be mechanically operated at a velocity 6 inches \pm 2 inches (15.24 mm \pm 5.08 mm) per second. The contacts under test shall be closed five times and the duration of the contact bounce shall be monitored. The duration of the contact bounce shall be defined in accordance with figure 4. Any contact bounce which exceeds the maximum value specified shall constitute failure. The test shall be repeated until all sets of contacts have been measured for contact bounce.

4.7.6 Operating characteristics. Switches shall be measured for operating characteristics in accordance with the applicable requirements.

Switch Characteristics Type:

- a. Momentary switches shall transfer as required when actuated. (Hold position)
- b. Momentary Switches shall return to the normal position after released.
- c. Alternate switches shall be transferred as required when actuated. (Push/Release)
- d. Alternate switches shall be returned to the original position after 2nd actuation.
- e. The lamps shall be energized with the rated power.

4.7.7 Coincidence of operating and releasing points. Coincidence of operating (releasing) points of all poles of a multipole switch shall be determined with suitable indicating circuits. The switch shall be rigidly held in a suitable fixture allowing the actuator to be moved in its intended manner. The actuator shall be advanced and retracted slowly and uniformly with no external vibratory influence while passing through the operating and releasing points, at a rate not exceeding .001 inch (0.025 mm) or 1 degree per second.

TEST: GROUP ONE (ALL UNITS) TEST	TEST SPECIFICATION: MIL – PRF – 22885G	TEST PERFORMED BY: W. Jensen, A. Letso, A. Barker & D. Hubert
UUT TRACKING NUMBERS: All Sample UUTs	Requirements Paragraph 3.1, 3.5, 3.6, 3.45, 3.47, 3.9, 3.10, 3.11 & 3.12 Test Method Paragraph 4.7.1, 4.7.4, 4.7.5, 4.7.6 & 4.7.7	
ACCEPT/REJECT CRITERIA		RESULTS SUMMARY
Visual and mechanical examination		✓
Contact resistance		✓
Contact bounce		✓
Operating characteristics		✓
Coincidence of operating & releasing points		✓
✓: Denotes compliance with the specified test requirements		
CONCLUSION: All Test Units met the above test requirements.		
NOTE: Individual test results are provided in the attachment “STACO Group One Test Results”.		

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7.3 Solderability

MIL-PRF-22885/115 DRAFT:

Solder terminals: Solderability is tested in accordance to the requirements of MIL-PRF-22885, Para. 4.7.2, MIL-STD-202, Method 208.

Testing Requirements:

Solder type terminations shall be tested to determine the solderability of all terminations which are normally joined by a soldering operation. Terminations shall exhibit the ability to be wetted by solder and the predictability of a suitable fillet resulting from solder application. Test results shall verify that the pre-assembly lead finish provides a solderable surface of sufficient quality to enable satisfactory soldering. Ninety-five percent of the total length of fillet between wrap wire and termination shall be tangent to the surface of the termination and be free of anomalies such as pinholes. A ragged or interrupted tangency line indicates a failure. A minimum of two terminals per switch shall be tested. Steam Conditioning Category 3. Test A - for through-hole mount and surface mount leaded components, solid wire less than .045 inch diameter and stranded wire 18 AWG or smaller. A minimum of two switch and two lamp terminals shall be tested.

Procedure:

As per Steam Conditioning Category 3, prior to soldering, UUTs are steamed for 8 hours (-0, +15 minutes) using distilled water at a temperature between 194.0 and 204.8 °F (90 and 96 °C) as specified for this test location altitude of 0-305 meters. The water level is maintained as needed to insure that no part of the UUT solder terminals are greater than 1.57 inches above the water line for the duration of the 8 hours.

Section 3 REQUIREMENTS and section 4 TEST PROCEDURES of EIA/IPC/J-STD-002B are followed as required (i.e. Solderability testing shall be performed within 72 hours of removal from the chamber. Solderability testing shall be done at a solder temperature of 245 (± 5)°C [473 (± 9)° F]. All specimens shall have a wrap of 1.5 turns of the standard wire around the portion of the specimen to be tested. The surface to be tested shall be immersed in flux for 5 to 10 seconds and allowed to drain for 10 to 60 seconds.

TEST: SOLDERABILITY	TEST SPECIFICATION: MIL – PRF – 22885G Requirements Paragraph 3.7 Test Method Paragraph 4.7.2	DATES STARTED & COMPLETED: 07-06-2011 & 07-08-2011
UUT TRACKING NUMBERS: 243103-3 & 243103-4		TEMPERATURE & HUMIDITY 24.0° C & 58 % R.H.
		TEST PERFORMED BY: D. Hubert
ACCEPT/REJECT CRITERIA		RESULTS
Two switch and two lamp terminals tested. 243103-3: switch pins A1 & D1, lamp pins 8 & 9 243103-4: switch pins A2 & D2, lamp pins 4 & 5		✓
Ninety-five percent of the total length of fillet between wrap wire and termination shall be tangent to the surface of the termination and be free of anomalies such as pinholes.		✓
A ragged or interrupted tangency line indicates a failure.		✓
In case of dispute, the percent of fillet-length with defects shall be determined by their actual measurement.		✓
✓: Denotes compliance with the specified test requirements		
CONCLUSION: All Test Units met the above test requirements.		
Samples show no evidence of pits or protrusions. Full wetting with smooth concave fillets throughout is present.		

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7.4 Resistance to Soldering Heat

MIL-PRF-22885/115 DRAFT:

Solder terminals: Resistance to solder heat is tested in accordance to the requirements of MIL-PRF-22885, Para. 4.7.3, MIL-STD-202, Method 210 condition B.

Testing Requirements:

There shall be no deformation or other damage at the conclusion of the test sequence. A minimum of two terminals of closed contacts per switch and two indicator light terminals (the indicator light terminals may be tested separately) shall be tested. Solder dip to simulate hot solder dipping (tinning) of leaded components shall be performed. The depth of immersion of the terminals in molten solder shall be to within .079 inch to .099 inch (2.0 mm to 2.5 mm) of the switch body. The UUTs shall be visually examined under a 10X magnification for deformation or other damage.

Procedure:

The UUTs were mounted to a holding fixture using normal mounting means. The fixture and UUT were checked for level using a Tubular Spirit (bubble) Level. Flux was applied to the terminals. The molten solder was agitated to assure that the temperature is uniform and the surface scraped to remove any oxidized materials to keep the solder clean and bright. The terminals were immersed simultaneously into the solder pot by mechanical means to the required depth. The UUTs were cleaned and examined.

TEST: RESISTANCE TO SOLDERING HEAT	TEST SPECIFICATION: MIL – PRF – 22885G Requirements Paragraph 3.8 Test Method Paragraph 4.7.3	DATES STARTED & COMPLETED: 07-09-2011 & 07-09-2011
UUT TRACKING NUMBERS: 243103-3 & 243103-4		TEMPERATURE & HUMIDITY 24.0° C & 57 % R.H.
		TEST PERFORMED BY: D. Hubert
ACCEPT/REJECT CRITERIA		RESULTS
All switch and lamp terminals tested.		✓
No deformation or other damage at the conclusion of the test.		✓
Samples shall be subjected to Group IV testing in the qualification table.		✓
✓: Denotes compliance with the specified test requirements		
CONCLUSION: All Test Units met the above test requirements.		
Good wetting with smooth fillets throughout is present.		

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7.5 Permanency of Marking

MIL-PRF-22885/115 DRAFT:

Marking: Permanency and legibility of markings shall conform to requirements of MIL-STD-202, Method 215 for resistance to solvents.

Testing Requirements:

Verification that markings or color coding do not become illegible or discolored when subjected to solvents and processes normally used to clean solder-flux, fingerprints, and other contaminants from printed-wiring and terminal-board assemblies, etc. Verification that component protective coatings and encapsulant materials are not degraded to the point where electrical or mechanical integrity is disturbed when subjected to solvents and processes normally used to clean solder flux, fingerprints, and other contaminants from printed-wiring and terminal-board assemblies, etc. Following the test, all required markings shall be legible.

Procedure:

The UUTs tested were divided into three groups of equal size. Temperature and time are monitored using Fluke Meter with thermocouple probe and stopwatch as listed. UUT's are immersed into the solvents once poured into a 1000mL Heavy-Duty Beaker. Brush strokes of each solvent solution were evenly divided between required identification, terminal, and circuit schematic markings. The immersion brushing process was repeated three times followed by air-blown drying. UUTs are inspected for markings which are missing in whole or in part, faded, smeared, blurred, or shifted. UUTs are inspected for cracks, separations, crazing, swelling, softening, and degradation of body material, end caps and seals if present, or any other damage or degradation.

TEST: PERMANENCY OF MARKING		TEST SPECIFICATION: MIL – PRF – 22885G	DATES STARTED & COMPLETED: 07-09-2011 & 07-09-2011
UUT TRACKING NUMBERS: 243103-3, 243103-4 & 243044-1		Requirements Paragraph 3.13 Test Method Paragraph 4.7.8	TEST PERFORMED BY: D. Hubert
UUT	SOLVENT MIXTURE EXPOSURE	UUT NOT SUSCEPTIBLE	
243044-1	Solution "a" (isopropyl alcohol and mineral spirits)	✓	
243103-3	Solution "c" (terpene defluxer)	✓	
243103-4	Solution "d" (water, propylene glycol and monoethanolamine)	✓	
✓: Denotes compliance with the specified test requirements.			
CONCLUSION: All Test Units met the above test requirements.			

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7.6 Terminal Strength

MIL-PRF-22885:

Terminal Strength: The pushbutton switches are tested in accordance to the requirements of method 211 of MIL-STD-202G, MIL-PRF-22885/115, and MIL-PRF-22885G.

Testing Requirements:

The switches were examined after the test for evidence of breakage, loosening of terminals, or damage to the body of the switch. A circuit, such as a pilot light, was used to monitor for short circuiting during the test.

Procedure:

Leads of sufficient length were attached to all necessary contacts of the test units to connect to the pilot light circuit, including power supply set to 8V. Using normal mounting means and hardware, the test units were mounted to the force gauge. Applied force was 5 pounds parallel to the long axis of the terminals. Test repeated with pull force perpendicular to the long axis of the terminals.

TEST: TERMINAL STRENGTH – SOLDER		TEST SPECIFICATION: MIL – PRF – 22885G Requirements Paragraph 3.14 Test Method Paragraph 4.7.9 MIL – STD – 202 Method 211, test condition A		DATES STARTED & COMPLETED: 08-12-2011 & 08-12-2011
UUT CONFIGURATION NUMBERS: 243118-3 & 243118-4				TEMPERATURE & HUMIDITY 27.0° C & 58 % R.H.
				TEST PERFORMED BY: A. Barker
UUT NUMBER	NO SHORT CIRCUIT DURING PULL FORCE, PARALLEL TO TERMINALS	NO SHORT CIRCUIT DURING PULL FORCE, PERPENDICULAR TO TERMINALS	NO EVIDENCE OF ANY DAMAGE (BROKEN, LOOSE, DEFORMED, OR DISPLACED PARTS) FOLLOWING THE TEST	
243118-3	✓	✓	✓	
243118-4	✓	✓	✓	
✓: Denotes compliance with the specified test requirements				
CONCLUSION: All Test Units met the above test requirements.				

TEST: TERMINAL STRENGTH – CRIMP PIN		TEST SPECIFICATION: MIL-PRF-22885/115 MIL – PRF – 22885G Requirements Paragraph 3.14 Test Method Paragraph 4.7.9 MIL – STD – 202 Method 211, test condition A		DATES STARTED & COMPLETED: 08-25-2011 & 08-26-2011
UUT CONFIGURATION NUMBERS: 243059-1 & 243059-2				TEMPERATURE & HUMIDITY 27.0° C & 58 % R.H.
				TEST PERFORMED BY: A. Barker
UUT NUMBER	NO SHORT CIRCUIT DURING PULL FORCE ON TERMINALS, PARALLEL TO TERMINALS	NO SHORT CIRCUIT DURING PULL FORCE ON WIRES, PARALLEL TO TERMINALS	NO EVIDENCE OF ANY DAMAGE (BROKEN, LOOSE, DEFORMED, OR DISPLACED PARTS) FOLLOWING THE TEST	
243059-1	✓	✓	✓	
243059-2	✓	✓	✓	
✓: Denotes compliance with the specified test requirements				
CONCLUSION: All Test Units met the above test requirements.				

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TEST: TERMINAL STRENGTH – PCB		TEST SPECIFICATION: MIL – PRF – 22885G		DATES STARTED & COMPLETED: 09-23-2011 & 09-24-2011	
UUT CONFIGURATION NUMBERS: 250721-1 & 250721-2		Requirements Paragraph 3.14 Test Method Paragraph 4.7.9		TEMPERATURE & HUMIDITY 27.0° C & 58 % R.H.	
		MIL – STD – 202 Method 211, test condition A		TEST PERFORMED BY: A. Barker	
UUT NUMBER	NO SHORT CIRCUIT DURING PULL FORCE, PARALLEL TO TERMINAL	NO SHORT CIRCUIT DURING PULL FORCE, PERPENDICULAR TO TERMINAL	NO EVIDENCE OF ANY DAMAGE (BROKEN, LOOSE, DEFORMED, OR DISPLACED PARTS) FOLLOWING THE TEST		
250721-1	✓	✓	✓		
250721-2	✓	✓	✓		
✓: Denotes compliance with the specified test requirements					
CONCLUSION: All Test Units met the above test requirements.					

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7.7 Strength of Actuating Means

MIL-PRF-22885:

Strength of Actuating Means: The pushbutton switches are tested in accordance to the requirements of MIL-PRF-22885G.

Testing Requirements:

The switches were wired to include an independent pilot light circuit for each normally open pole. All normally closed poles were wired in parallel to an additional pilot light circuit.

Procedure:

Leads of sufficient length were attached to all necessary contacts of the test units to connect to the pilot light circuits, including power supply set to 8V. Using normal mounting means and hardware, the test units were mounted to the force gauge. Applied force was 5 pounds parallel to the long axis of the terminals, repeated test perpendicular to the long axis of the terminals.

TEST: STRENGTH OF ACTUATING MEANS		TEST SPECIFICATION: MIL – PRF – 22885G Requirements Paragraph 3.15 Test Method Paragraph 4.7.10	DATES STARTED & COMPLETED: 08-12-2011 & 08-12-2011
UUT CONFIGURATION NUMBERS: 243118-1 & 243118-2			TEMPERATURE & HUMIDITY 27.0° C & 58 % R.H.
			TEST PERFORMED BY: A. Barker
UUT NUMBER	NO OPENING OF CLOSED CONTACTS (ALL PILOT LIGHTS LIT)	NO CLOSING OF OPEN CONTACTS (NO LIGHTING OF PILOT LIGHT)	NO EVIDENCE OF ANY DAMAGE (BROKEN, LOOSE, DEFORMED, OR DISPLACED PARTS) FOLLOWING THE TEST
243118-1	✓	✓	✓
243118-2	✓	✓	✓
✓: Denotes compliance with the specified test requirements			
CONCLUSION: All Test Units met the above test requirements.			

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7.8 Thermal Shock

MIL-PRF-22885/115 DRAFT:

Thermal Shock: The pushbutton switches are tested in accordance to the requirements of MIL-PRF-22885 and, MIL-STD-202, Method 107, Test Condition A.

Testing Requirements:

Switches shall be tested to determine the resistance to extreme temperatures, both high and low, and to the shock of alternate exposures. Failures shall be based on examinations upon completion of the final cycle after the specimen has stabilized at room temperature. Switches shall be examined and show no mechanical or electrical damage, or loosening of fastening devices. There shall be no discoloration or deformation of the lens.

Method 107 of MIL-STD-202:

Effects of thermal shock include cracking and de-lamination of finishes, cracking and crazing of embedding and encapsulating compounds, opening of thermal seals and case seams, leakage of filling materials, rupturing, or cracking of hermetic seals and vacuum glass to metal seals, and changes in electrical characteristics due to mechanical displacement or rupture of conductors or of insulating materials.

Procedure:

UUTs shall be placed to ensure unobstructed air flow around the specimens, while subjected to Test Condition A described in table 107-I of MIL-STD-202, Method 107 with the duration of one quarter hour for each temperature extreme cycle as detailed in Table 107-II. Transfer time between one extreme temperature and the other shall not exceed 5 minutes. Post test examination shall also include continuity tests for verification of proper switch action.

TEST: THERMAL SHOCK	TEST SPECIFICATION: MIL – PRF – 22885G Requirements Paragraph 3.19 Test Method Paragraph 4.7.14	DATES STARTED & COMPLETED: 08-30-2011 & 08-30-2011
UUT CONFIGURATION NUMBERS: 243118-1 & 243118-2 & 243118-3 & 243118-4	MIL – STD – 202G Test Method 107 – Condition A	TEMPERATURES -56° C, 25.0° C, 86° C
		TEST PERFORMED BY: A. Barker
UUT NUMBER		RESULTS
243118-1		✓
243118-2		✓
243118-3		✓
243118-4		✓
✓: Denotes compliance with the specified test requirements		
CONCLUSION: All Units Under Test (UUT) met the above test requirements.		
Samples show no effects of thermal shock as specified in MIL-STD-202.		

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TIMER (HOURS:MIN:SEC)	EXPOSURE TIME (HOURS:MIN:SEC)	TEMPERATURE (°C)	STEP (#)	CYCLE (#)
0:00:00				1
0:15:00	0:15:00	-55	1	
0:15:40	0:00:40	25	2	
0:30:40	0:15:00	85	3	
0:31:40	0:01:00	25	4	
0:46:40	0:15:00	-55	1	2
0:47:38	0:00:58	25	2	
1:02:38	0:15:00	85	3	
1:03:15	0:00:37	25	4	
1:18:15	0:15:00	-55	1	3
1:19:02	0:00:47	25	2	
1:34:02	0:15:00	85	3	
1:34:55	0:00:53	25	4	
1:49:55	0:15:00	-55	1	4
1:50:35	0:00:40	25	2	
2:05:35	0:15:00	85	3	
2:06:15	0:00:40	25	4	
2:21:15	0:15:00	-55	1	5
2:22:01	0:00:46	25	2	
2:37:01	0:15:00	85	3	
2:40:00	0:02:59	25	4	

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7.9 Vibration

MIL-PRF-22885/115 DRAFT:

Vibration: The pushbutton switches are tested in accordance to the requirements of MIL-STD-202, and MIL-PRF-22885G vibration grade 3.

Testing Requirements:

There shall be no opening of closed contacts or closing of open contacts in excess of 10 microseconds (μs) when tested in accordance with MIL-STD-202 Method 204 for vibration grade 3, test condition B (10 Hz-2,000 Hz & 15g peak) and monitored per MIL-STD-202 Method 202, Test Condition A. The entire frequency range of 10 to 2,000 Hz and return to 10 Hz shall be traversed in 20 minutes. This cycle shall be performed 12 times in each of three mutually perpendicular directions (total of 36 times), so that the motion shall be applied for a total period of approximately 12 hours. At the conclusion of the test, there shall be no broken, loose, deformed, or displaced parts.

Procedure:

Leads of sufficient length were attached to all necessary contacts of the test units to connect to the test equipment. All normally-closed contacts were wired in series to monitor for opening of contacts. Using normal mounting means and hardware, the test units were attached to the 40892 Face Plate, Vibration Fixture with half of the units mounting hardware in front of the Face Plate and the other half behind. The momentary action switches remained in the relaxed position. The Vibration equipment profile "Method 204D TC B (15 G)" for each of the three axis: X, Y & Z.

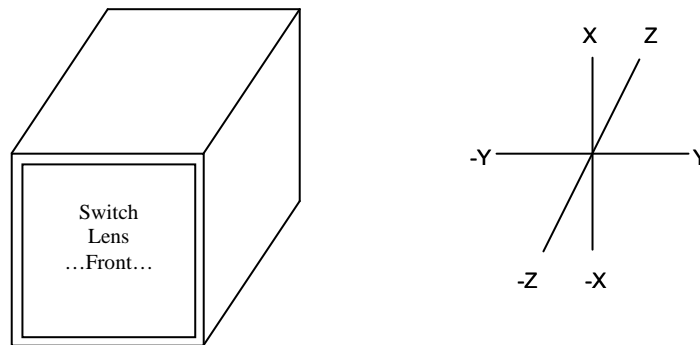


Figure 2. Definition Of UUT Axis

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TEST: VIBRATION	TEST SPECIFICATION: MIL – PRF – 22885G Requirements Paragraph 3.20 Test Method Paragraph 4.7.15	DATES STARTED & COMPLETED: 07-14-2011 & 07-15-2011
UUT TRACKING NUMBERS: 243118-1, 243118-2, 243118-3 & 243118-4,		TEMPERATURE & HUMIDITY 27.0° C & 58 % R.H.
		TEST PERFORMED BY: D. Hubert

UUT NUMBER	FIXTURE MOUNTED AXES	NO OPENING OF CLOSED CONTACTS > 10 MICROSECONDS DURATION	NO CLOSING OF OPEN CONTACTS >10 MICROSECONDS DURATION	NO EVIDENCE OF ANY DAMAGE (BROKEN, LOOSE, DEFORMED, OR DISPLACED PARTS) FOLLOWING THE TEST
243118-1	X	✓	✓	✓
243118-2	X	✓	✓	✓
243118-3	X	✓	✓	✓
243118-4	X	✓	✓	✓
243118-1	Y	✓	✓	✓
243118-2	Y	✓	✓	✓
243118-3	Y	✓	✓	✓
243118-4	Y	✓	✓	✓
243118-1	Z	✓	✓	✓
243118-2	Z	✓	✓	✓
243118-3	Z	✓	✓	✓
243118-4	Z	✓	✓	✓

✓: Denotes compliance with the specified test requirements

CONCLUSION: All Test Units met the above test requirements.

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7.10 Acceleration and Shock (Specified Pulse & High Impact)

7.10.1 Shock (Specified Pulse)

MIL-PRF-22885/115 DRAFT:

Shock: The pushbutton switches are tested in accordance to the requirements of MIL-PRF-22885 and MIL-STD-202, method 213.

Testing Requirements:

There shall be no opening of closed contacts or closing of open contacts in excess of 10 μ s. At the conclusion of the test, there shall be no broken, loose, deformed, or displaced parts. No part of the switch shall become displaced from its normal (ready to operate) position during shock testing.

Switches shall be tested in accordance with method 213 of MIL-STD-202. The following details shall apply:

- a. Test condition: B (75 g's, half-sine).
- b. Measurements during test: Switch contact stability shall be continuously monitored in accordance with method 310 of MIL-STD-202, test condition A.
- c. Measurement after test: Switches shall be examined for broken, deformed, or displaced parts.
- d. Mounting: Switches shall be mounted on a rigid metal panel.

7.10.2 Shock (High Impact)

MIL-PRF-22885/115 DRAFT:

High Impact Shock: The pushbutton switch shall meet the requirements of MIL-S-901, Grade A, Class II.

Testing Requirements:

There shall be no opening of closed contacts or closing of open contacts in excess of 20 ms and the switch shall be retained in the panel by its mounting means. No part of the switch shall become displaced from its normal (ready to operate) position during shock testing. At the conclusion of test, the switch shall be electrically and mechanically operable. Switches shall be tested in accordance with method 207 of MIL-STD-202. The following details shall apply:

- a. Measurements during test: Unless otherwise specified (see 3.1), switch contact stability shall be continuously monitored in accordance with method 310 of MIL-STD-202, test condition E.
- b. Measurement after test: Switches shall be electrically and mechanically operable.
- c. Mounting: The standard mounting fixture shown on figure 207-4A of method 207 of MIL-STD-202 shall be used.

7.10.3 Acceleration

MIL-PRF-22885/115 DRAFT:

Acceleration: The pushbutton switches are tested in accordance to the requirements of MIL-PRF-22885

Testing Requirements:

There shall be no opening of closed contacts or closing of open contacts, and there shall be no mechanical or electrical damage.

Switches shall be tested in accordance with method 212 of MIL-STD-202. The following details and exceptions shall apply:

- a. Test condition: A.
- b. Acceleration force: 20 G.
- c. The switches shall be monitored for opening of closed contacts and closing of open contacts. Half of the units shall be tested with the actuating means in one position and the other half of the units shall be tested with the actuating means in an alternate position. When testing momentary action switches, all shall remain in the relaxed position.

Provisions shall be made to permit mounting by the normal means so that the specimen can be tested in both directions, 180 degrees apart, of each of three mutually perpendicular axes.

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TEST: ACCELERATION, SHOCK (SPECIFIED PULSE) & SHOCK (HIGH IMPACT)	TEST SPECIFICATION: MIL – PRF – 22885G Requirements Paragraph 3.21 & 3.22	DATES STARTED & COMPLETED: 08-08-2011 & 08-09-2011
UUT TRACKING NUMBERS: 243143-1, 243143-2, 243123-2 & 243123-4	Test Method Paragraph 4.7.16 & 4.7.17	TEST PERFORMED BY: NTS Labs

ACTION	RESULTS	COMPLIES WITH REQUIRMENTS
Switches were testing in accordance to MIL-PRF-22885G as described. Each switch was tested for opening of closed contacts and closing of open contacts.	There was no opening of closed contacts nor closing of open contacts.	✓
Examination of each switch for mechanical or electrical damage or broken, deformed, or displaced parts.	Switches show no indication of damage. Switches properly operate electrically and mechanically.	✓
✓: Denotes compliance with the specified test requirements.		
CONCLUSION: All Test Units met the above test requirements.		
NOTE: Complete test results are provided in the attachment “NTS LABS Shock-Accel-Explosion Test”.		

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7.10.4 Dielectric Withstanding Voltage

Post test for UUT's subjected to Shock (Specified Pulse), Shock (High Impact) and Acceleration

TEST: DIELECTRIC WITHSTANDING VOLTAGE	TEST SPECIFICATION: MIL – PRF – 22885G Requirements Paragraph 3.24 Test Method Paragraph 4.7.19	DATES STARTED & COMPLETED: 08-10-2011 & 08-10-2011
UUT TRACKING NUMBERS: 243143-1, 243143-2, 243123-2 & 243123-4		TEMPERATURE & HUMIDITY 25.0° C & 49 % R.H. TEST PERFORMED BY: D. Hubert

PASS Condition : No measurements > 500 Microamps of current flow :					
UUT 243143-1	Miliamps Measured	Relaxed Condition	Miliamps Measured	Depressed Condition	Miliamps Measured
A1, 2 & 3 to B1, 2 & 3	0.075	D3 to D2	0.040	D3 to D1	0.040
B1, 2 & 3 to C1, 2 & 3	0.075	C3 to C2	0.042	C3 to C1	0.042
C1, 2 & 3 to D1, 2 & 3	0.066	B3 to B2	0.042	B3 to B1	0.041
All Pins (including lamp pins 4 through 9) to housing	0.019	A3 to A2	0.037	A3 to A1	0.037
PASS / FAIL : PASS					
UUT 243143-2	Miliamps Measured	Relaxed Condition	Miliamps Measured	Depressed Condition	Miliamps Measured
A1, 2 & 3 to B1, 2 & 3	0.076	D3 to D2	0.042	D3 to D1	0.040
B1, 2 & 3 to C1, 2 & 3	0.076	C3 to C2	0.042	C3 to C1	0.042
C1, 2 & 3 to D1, 2 & 3	0.067	B3 to B2	0.042	B3 to B1	0.041
All Pins (including lamp pins 4 through 9) to housing	0.019	A3 to A2	0.038	A3 to A1	0.039
PASS / FAIL : PASS					
UUT 243143-3	Miliamps Measured	Relaxed Condition	Miliamps Measured	Depressed Condition	Miliamps Measured
A1, 2 & 3 to B1, 2 & 3	0.074	D3 to D2	0.041	D3 to D1	0.037
B1, 2 & 3 to C1, 2 & 3	0.073	C3 to C2	0.039	C3 to C1	0.040
C1, 2 & 3 to D1, 2 & 3	0.064	B3 to B2	0.040	B3 to B1	0.040
All Pins (including lamp pins 4 through 9) to housing	0.019	A3 to A2	0.038	A3 to A1	0.038
PASS / FAIL : PASS					
UUT 243143-4	Miliamps Measured	Relaxed Condition	Miliamps Measured	Depressed Condition	Miliamps Measured
A1, 2 & 3 to B1, 2 & 3	0.071	D3 to D2	0.041	D3 to D1	0.038
B1, 2 & 3 to C1, 2 & 3	0.070	C3 to C2	0.040	C3 to C1	0.038
C1, 2 & 3 to D1, 2 & 3	0.062	B3 to B2	0.041	B3 to B1	0.040
All Pins (including lamp pins 4 through 9) to housing	0.021	A3 to A2	0.037	A3 to A1	0.038
PASS / FAIL : PASS					

CONCLUSION: All Test Units met the above test requirements.

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7.11 Moisture Resistance

MIL-PRF-22885/115 DRAFT:

Moisture Resistance: The pushbutton switches are tested in accordance to the requirements of MIL-PRF-22885G and MIL-STD-202G, Method 106G.

Testing Requirements:

When switches are tested in the wet condition as specified, the insulation resistance shall be not less than 10 megohms. At the end of the drying period, the insulation resistance shall not be less than 1,000 megohms. At the conclusion of the test, there shall be no excessive corrosion, breaking, cracking, spalling, or loosening of terminals, and mounting hardware shall be readily removable. Excessive corrosion is defined as that which interferes with the electrical or mechanical performance and has penetrated the plating and has attacked the base material. When testing momentary action switches, all shall remain in the relaxed position. Switches shall be tested in accordance with method 106 of MIL-STD-202. For Insulation resistance measurements, Switches shall be tested in accordance with method 302 of MIL-STD-202, Test condition: B (500 volts $\pm 10\%$).

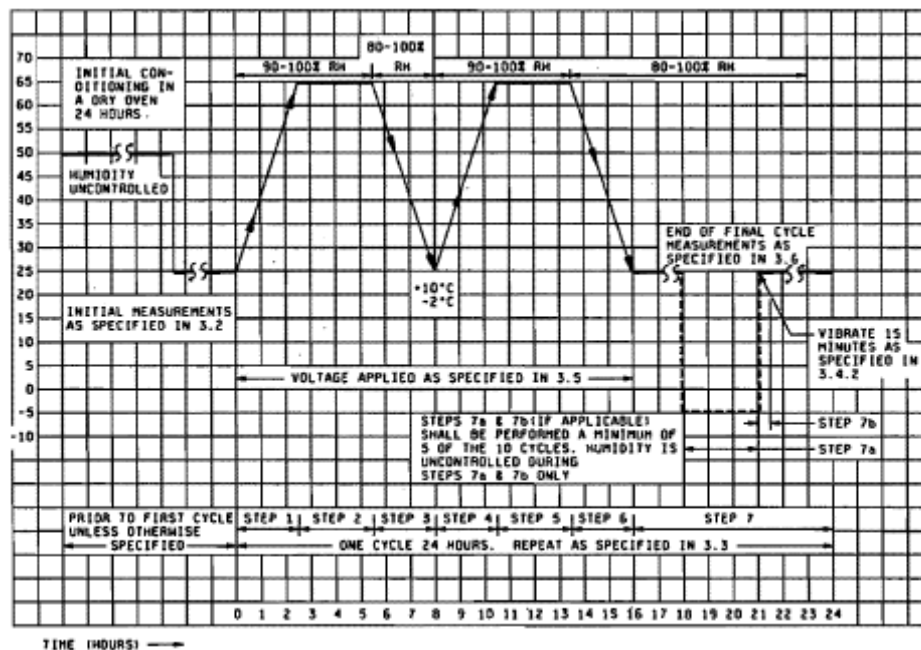


Figure 3. Graphical representation of moisture-resistance test

Initial measurements: Prior to step 1 of the first cycle (Post Bake), the specified initial measurements shall be made at room ambient conditions, or as specified.

Final measurements: Within 5 minutes after conclusion of the test and while the switches are still wet, insulation resistance shall be measured as specified

After drying period: Following step 6 of the final cycle or following measurements at high humidity, if applicable, specimens shall be conditioned for 24 hours at the ambient conditions specified for the initial measurements (see 3.2) after which the specified measurements shall be made. Measurements may be made during the 24 hour conditioning period

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Procedure:

Samples were placed into a thermal chamber set to 50°C for 24 hours. Temperature within the chamber was at 50°C at the start, end and when checked at all intervening times. "Initial measurements" were taken. Using normal mounting means and hardware, the test units were attached to the 15 degree stainless steel bracket with half of the units mounting hardware in front of the bracket and the other half behind. The brackets were attached to a common conductive base plate. A polarizing 100 Volts DC was applied between all current carrying parts of the switches and the metal base plate. The negative polarity was applied to the metal base plate. The momentary action switches remained in the relaxed position. UUTs are positioned so that they do not contact each other and each received essentially the same degree of humidity. Following 10 continuous cycles, the samples were removed from the humidity chamber and Wet Insulation Resistance was immediately performed. Dry condition insulation resistance was later performed. All insulation resistance testing per MIL-STD-202G, METHOD 302, Test Condition B, 500 volts ±10%.

TEST: MOISTURE RESISTANCE	TEST SPECIFICATION: MIL – PRF – 22885G Requirements Paragraph 3.23 Test Method Paragraph 4.7.18	DATES STARTED & COMPLETED: 07-19-2011 & 07-31-2011	
UUT TRACKING NUMBERS: 243118-1, 243118-2, 243118-3 & 243118-4		TEMPERATURE & HUMIDITY 25.0° C & 48 % R.H.	
		TEST PERFORMED BY: D. Hubert	
ACTION		UUT NUMBER	COMPLIES WITH REQUIREMENTS
Post 24 hour drying Insulation Resistance measurements 07-20-11.	243118-1	✓	
	243118-2	✓	
	243118-3	✓	
	243118-4	✓	
Complete 10 cycles outlined in Figure 3. Graphical representation of moisture-resistance test without incident 07-30-11.	243118-1	✓	
	243118-2	✓	
	243118-3	✓	
	243118-4	✓	
Post 10 cycle Wet Insulation Resistance measurements 07-30-11.	243118-1	✓	
	243118-2	✓	
	243118-3	✓	
	243118-4	✓	
Drying period Insulation Resistance measurements 07-31-11.	243118-1	✓	
	243118-2	✓	
	243118-3	✓	
	243118-4	✓	
Mounting hardware was easily removed. Samples show no evidence of excessive corrosion, breaking, cracking, spalling or loosening of terminals.	243118-1	✓	
	243118-2	✓	
	243118-3	✓	
	243118-4	✓	
✓: Denotes compliance with the specified test requirements			
CONCLUSION: All Test Units met the above test requirements.			

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POST 24 HOUR DRYING					
PASS Condition : No insulation measurements < 1000 Megohms :					
UUT 243118-1	Megohms Measured	Relaxed Condition	Megohms Measured	Depressed Condition	Megohms Measured
A1, 2 & 3 to B1, 2 & 3	✓	D3 to D2	✓	D3 to D1	✓
B1, 2 & 3 to C1, 2 & 3	3980	C3 to C2	✓	C3 to C1	✓
C1, 2 & 3 to D1, 2 & 3	✓	B3 to B2	✓	B3 to B1	✓
All Pins (including lamp pins 4 through 9) to housing	✓	A3 to A2	✓	A3 to A1	✓
PASS / FAIL :					PASS
UUT 243118-2	Megohms Measured	Relaxed Condition	Megohms Measured	Depressed Condition	Megohms Measured
A1, 2 & 3 to B1, 2 & 3	✓	D3 to D2	✓	D3 to D1	✓
B1, 2 & 3 to C1, 2 & 3	4360	C3 to C2	✓	C3 to C1	✓
C1, 2 & 3 to D1, 2 & 3	✓	B3 to B2	✓	B3 to B1	✓
All Pins (including lamp pins 4 through 9) to housing	✓	A3 to A2	✓	A3 to A1	✓
PASS / FAIL :					PASS
UUT 243118-3	Megohms Measured	Relaxed Condition	Megohms Measured	Depressed Condition	Megohms Measured
A1, 2 & 3 to B1, 2 & 3	✓	D3 to D2	✓	D3 to D1	✓
B1, 2 & 3 to C1, 2 & 3	4220	C3 to C2	✓	C3 to C1	✓
C1, 2 & 3 to D1, 2 & 3	✓	B3 to B2	✓	B3 to B1	✓
All Pins (including lamp pins 4 through 9) to housing	✓	A3 to A2	✓	A3 to A1	✓
PASS / FAIL :					PASS
UUT 243118-4	Megohms Measured	Relaxed Condition	Megohms Measured	Depressed Condition	Megohms Measured
A1, 2 & 3 to B1, 2 & 3	✓	D3 to D2	✓	D3 to D1	✓
B1, 2 & 3 to C1, 2 & 3	4830	C3 to C2	✓	C3 to C1	✓
C1, 2 & 3 to D1, 2 & 3	✓	B3 to B2	✓	B3 to B1	✓
All Pins (including lamp pins 4 through 9) to housing	✓	A3 to A2	✓	A3 to A1	✓
PASS / FAIL :					PASS

✓: Denotes measurement ≥ 10.0 Gigaohms

Wet Insulation Resistance					
PASS Condition : No insulation measurements < 10 Megohms :					
UUT 243118-1	Megohms Measured	Relaxed Condition	Megohms Measured	Depressed Condition	Megohms Measured
A1, 2 & 3 to B1, 2 & 3	✓	D3 to D2	✓	D3 to D1	✓
B1, 2 & 3 to C1, 2 & 3	2398	C3 to C2	✓	C3 to C1	✓
C1, 2 & 3 to D1, 2 & 3	✓	B3 to B2	✓	B3 to B1	✓
All Pins (including lamp pins 4 through 9) to housing	2657	A3 to A2	✓	A3 to A1	✓
PASS / FAIL :					PASS
UUT 243118-2	Megohms Measured	Relaxed Condition	Megohms Measured	Depressed Condition	Megohms Measured
A1, 2 & 3 to B1, 2 & 3	✓	D3 to D2	✓	D3 to D1	✓
B1, 2 & 3 to C1, 2 & 3	2931	C3 to C2	✓	C3 to C1	✓
C1, 2 & 3 to D1, 2 & 3	✓	B3 to B2	✓	B3 to B1	✓
All Pins (including lamp pins 4 through 9) to housing	1947	A3 to A2	✓	A3 to A1	✓
PASS / FAIL :					PASS
UUT 243118-3	Megohms Measured	Relaxed Condition	Megohms Measured	Depressed Condition	Megohms Measured
A1, 2 & 3 to B1, 2 & 3	✓	D3 to D2	✓	D3 to D1	✓
B1, 2 & 3 to C1, 2 & 3	25290	C3 to C2	✓	C3 to C1	✓
C1, 2 & 3 to D1, 2 & 3	✓	B3 to B2	✓	B3 to B1	✓
All Pins (including lamp pins 4 through 9) to housing	2681	A3 to A2	✓	A3 to A1	✓
PASS / FAIL :					PASS

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UUT 243118-4	Megohms Measured	Relaxed Condition	Megohms Measured	Depressed Condition	Megohms Measured
A1, 2 & 3 to B1, 2 & 3	✓	D3 to D2	✓	D3 to D1	✓
B1, 2 & 3 to C1, 2 & 3	2760	C3 to C2	✓	C3 to C1	✓
C1, 2 & 3 to D1, 2 & 3	✓	B3 to B2	✓	B3 to B1	✓
All Pins (including lamp pins 4 through 9) to housing	1769	A3 to A2	✓	A3 to A1	✓
PASS / FAIL :					PASS
✓: Denotes measurement ≥ 10.0 Gigaohms					

Dry Insulation Resistance					
PASS Condition : No insulation measurements < 1000 Megohms :					
UUT 243118-1	Megohms Measured	Relaxed Condition	Megohms Measured	Depressed Condition	Megohms Measured
A1, 2 & 3 to B1, 2 & 3	✓	D3 to D2	✓	D3 to D1	✓
B1, 2 & 3 to C1, 2 & 3	2736	C3 to C2	✓	C3 to C1	✓
C1, 2 & 3 to D1, 2 & 3	✓	B3 to B2	✓	B3 to B1	✓
All Pins (including lamp pins 4 through 9) to housing	✓	A3 to A2	✓	A3 to A1	✓
PASS / FAIL :					PASS
UUT 243118-2	Megohms Measured	Relaxed Condition	Megohms Measured	Depressed Condition	Megohms Measured
A1, 2 & 3 to B1, 2 & 3	✓	D3 to D2	✓	D3 to D1	✓
B1, 2 & 3 to C1, 2 & 3	2228	C3 to C2	✓	C3 to C1	✓
C1, 2 & 3 to D1, 2 & 3	✓	B3 to B2	✓	B3 to B1	✓
All Pins (including lamp pins 4 through 9) to housing	✓	A3 to A2	✓	A3 to A1	✓
PASS / FAIL :					PASS
UUT 243118-3	Megohms Measured	Relaxed Condition	Megohms Measured	Depressed Condition	Megohms Measured
A1, 2 & 3 to B1, 2 & 3	✓	D3 to D2	✓	D3 to D1	✓
B1, 2 & 3 to C1, 2 & 3	2272	C3 to C2	✓	C3 to C1	✓
C1, 2 & 3 to D1, 2 & 3	✓	B3 to B2	✓	B3 to B1	✓
All Pins (including lamp pins 4 through 9) to housing	✓	A3 to A2	✓	A3 to A1	✓
PASS / FAIL :					PASS
UUT 243118-4	Megohms Measured	Relaxed Condition	Megohms Measured	Depressed Condition	Megohms Measured
A1, 2 & 3 to B1, 2 & 3	✓	D3 to D2	✓	D3 to D1	✓
B1, 2 & 3 to C1, 2 & 3	2593	C3 to C2	✓	C3 to C1	✓
C1, 2 & 3 to D1, 2 & 3	✓	B3 to B2	✓	B3 to B1	✓
All Pins (including lamp pins 4 through 9) to housing	✓	A3 to A2	✓	A3 to A1	✓
PASS / FAIL :					PASS
✓: Denotes measurement ≥ 10.0 Gigaohms					

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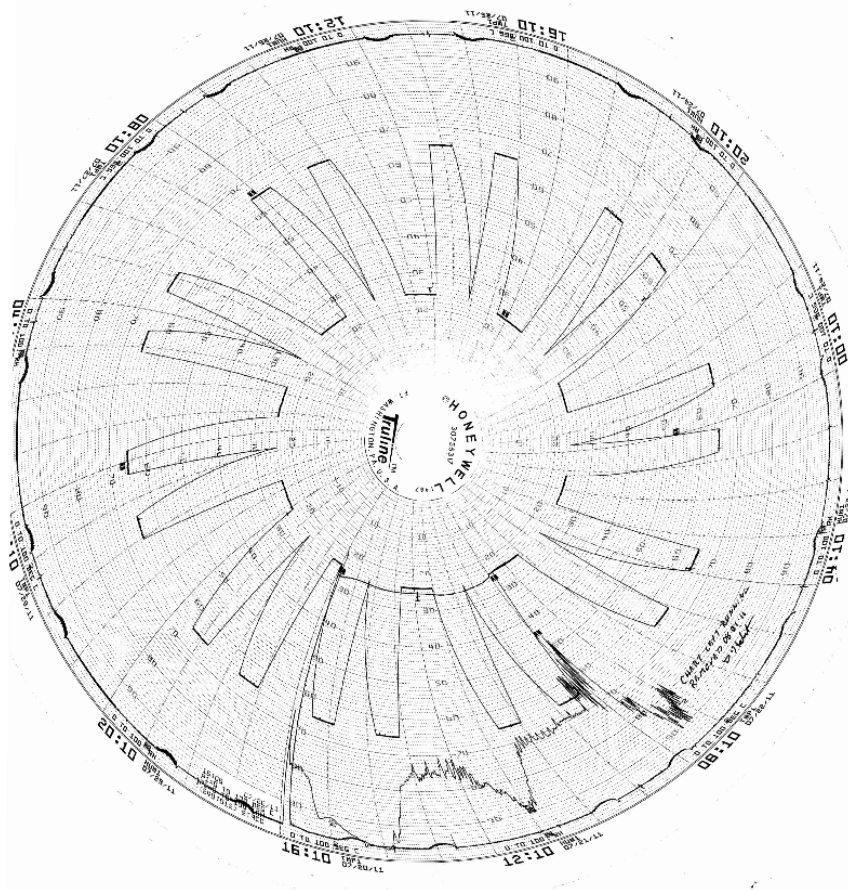


Figure 4. Chamber Chart for Moisture-Resistance Test

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7.12 Marking visibility

MIL-PRF-22885/115 DRAFT:

Marking: Permanency and legibility of markings shall conform to requirements of MIL-STD-202, Method 215 for resistance to solvents.

For non MIL SPEC parts, the following shall be provided as a baseline and as shown in figure 18

- a. Manufacturer name
- b. Cage code
- c. Date code (YYWW; YEAR YEAR WEEK WEEK)
- d. Applicable voltage
- e. Assembly Part Number (or customer P/N)
- f. Switch schematic

For MIL SPEC parts, the following shall be provided as a baseline and as shown in figure 19

- a. Manufacturer name
- b. Cage code
- c. Date code (YYWW; YEAR YEAR WEEK WEEK)
- d. Applicable voltage
- e. Assembly Part Number (or customer P/N)
- f. Switch schematic
- g. MIL SPEC Part Number

Testing Requirements:

Switches shall be examined for legibility of all required marking.

Procedure:

Visually inspect the test samples for legibility of required markings. Magnification of $\geq 5X$ shall be used.

TEST: MARKING VISIBILITY	TEST SPECIFICATION: MIL – PRF – 22885G Requirements Paragraph 3.26 Test Method Paragraph 4.7.21					DATES STARTED & COMPLETED: 09-01-2011 & 09-28-2011
UUT TRACKING NUMBERS: 243103-3, 243103-4, 243118-1, 243118-2, 243118-3 & 243118-4						TEMPERATURE & HUMIDITY 27.0° C & 44 % R.H.
					TEST PERFORMED BY: D. Hubert	
VISUAL EXAMINATION FOR MARKING LEGIBILITY OF REQUIRED MARKINGS	243103-3	243103-4	243118-1	243118-2	243118-3	243118-4
Manufacturer's name:	✓	✓	✓	✓	✓	✓
Cage code:	✓	✓	✓	✓	✓	✓
Date code:	✓	✓	✓	✓	✓	✓
Applicable voltage:	✓	✓	✓	✓	✓	✓
Assembly Part Number:	✓	✓	✓	✓	✓	✓
Switch schematic:	✓	✓	✓	✓	✓	✓
✓: Denotes compliance with the specified test requirements						
CONCLUSION: All Test Units met the above test requirements.						

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7.13 Salt Spray (corrosion)

MIL-PRF-22885/115 DRAFT:

Salt Spray: The pushbutton switches are tested in accordance to the requirements of MIL-PRF-22885G and MIL-STD-202G, Method 101E, Cond. A.

Testing Requirements:

There shall be no evidence of excessive corrosion. Excessive corrosion is defined as that which interferes with the electrical or mechanical performance and has penetrated the plating and has attacked the base material when tested in accordance with MIL-STD-202 Method 101, test condition A (test length of 96 hours). Post test: Switches shall be examined for evidence of warping, cracking, excessive corrosion, or other damage.

Procedure:

An adequate supply of salt solution was prepared by dissolving 5 (\pm 1) parts, by weight, of salt in 95 parts, by weight, of deionized or distilled water. The salt was sodium chloride (NaCl) containing on the dry basis not more than 0.1% of sodium iodide, and not more than 0.5% of total impurities. The solution was adjusted to and maintained at a specific gravity of 1.031 at 25° C and between 6.5 and 7.2 pH.

The compressed air entering the atomizers was free from all impurities such as oil and dirt and the air pressure is suitable to produce a finely divided dense fog with the atomizer. The air has a relative humidity of 95 to 98% at the point of release from the nozzle by using the described method of passing the air in very fine bubbles through a tower containing heated water. The temperature of the water was 95°F (35°C) or higher.

Two clean 10 cm fog collecting receptacles are placed in the chamber; one nearest the nozzle and the other farthest from the nozzle so that no drops from test units or any other source will be collected. The chamber was run for between 16 and 24 hours to allow the chamber and salt solution reservoir to stabilize at 95 (\pm 5) ° F [35 (\pm 3)°C]. At the conclusion of stabilization, the fog collecting receptacles are removed and measured for the quantity of solution that collected in the receptacles to verify each receptacle collected 0.5 to 3.0 milliliters of solution per hour.

Using normal mounting means and hardware, the test units were attached to the 15 degree stainless steel bracket with half of the units mounting hardware in front of the bracket and the other half behind. The brackets were suspended from the top by wax string and plastic support rods made of non-reactive plastic. UUTs are positioned so that they do not contact each other and so that they do not shield each other from the freely settling fog.

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TEST: SALT SPRAY (Corrosion)	TEST SPECIFICATION: MIL – PRF – 22885G Requirements Paragraph 3.27 Test Method Paragraph 4.7.22	DATES STARTED & COMPLETED: 07-06-2011 & 07-12-2011
UUT TRACKING NUMBERS: 243020-1, 243020-2, 243025-1 & 243025-2		TEMPERATURE & HUMIDITY 27.0° C & 44 % R.H.
		TEST PERFORMED BY: D. Hubert

ACTION	RESULTS	COMPLIES WITH REQUIREMENTS
Test preparation of salt solution for specific gravity (Method 101 of MIL-STD-202G Figure 101-1 5% NaCl).	1.031 @ 24.1°C	✓
Test preparation of salt solution for pH level (Method 101 of MIL-STD-202G paragraph 3).	6.73 @ 33.0°C	✓
Measure and average the hourly quantity of solution that collected in the receptacles following 20 hour stabilization.	Stabilization at 99°F Receptacle 1: 1.2 ml./Hr. Receptacle 2: 0.95 ml./Hr.	✓
At the duration of the 96 hour salt spray exposure, examine UUT's and verify there is no of warping, cracking, excessive corrosion, or other damage.	No evidence of damage or corrosion. Salt deposits were minimal. Using a brush dipped in water, most visible deposits were easily removed.	✓
Verify the mounting hardware is easily removable and does not cause mechanical malfunction of the hardware or the test units.	All hardware functioned properly as the UUT's were easily removed from the mounting brackets.	✓
Verify there is no evidence of any type of corrosion, which in any way, interferes with the electrical or mechanical performance of the test units.	No evidence of damage or corrosion. Salt deposits were minimal. UUT's were connected to the appropriate power level and functioned correctly.	✓
✓: Denotes compliance with the specified test requirements		
CONCLUSION: All Test Units met the above test requirements.		

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7.14 Short Circuit

MIL-PRF-22885/115 DRAFT:

Short circuit: The switches are tested in accordance to the requirements of MIL-PRF-22885, Method I, for 2 cycles.

Testing Requirements:

When switches are tested as specified in Method I, there shall be no welding or sticking of contacts, or damage. Switches shall be mechanically and electrically operative at the end of the test.

Procedure:

The UUT is inserted in a circuit calibrated to supply current equal to 60 times the rated resistive load (10A) at the lowest rated dc voltage specified (10uVolts). The UUT is in series to the thermal-type circuit breaker in accordance with MS25244-10 and the wire size of AN-18.

With both the UUT and circuit breaker in the closed condition, the circuit shall be closed manually by a No-Bounce switch of sufficient means for the rated current. The UUT is tested two times with a minimum of 2 minutes is elapsed between each successive closings of the No-Bounce switch.

Half the UUTs are tested in the normally closed (Released) position and half in the normally open (Depressed) position.

TEST: SHORT CIRCUIT	TEST SPECIFICATION:	DATES STARTED & COMPLETED:
UUT TRACKING NUMBERS: 243103-3 & 243103-4	MIL – PRF – 22885G Requirements Paragraph 3.29 Test Method Paragraph 4.7.24	09-16-2011 & 09-29-2011
		TEST PERFORMED BY: Intertek
UUT NUMBER	ACTION	COMPLIES WITH REQUIREMENTS
243103-3	Apply 600 Amps direct current through the UUT in the prescribed test circuit.	✓
243103-4	Apply 600 Amps direct current through the UUT in the prescribed test circuit.	✓
✓: Denotes compliance with the specified test requirements		
CONCLUSION: All Test Units met the above test requirements.		
NOTE: Complete test results are provided in the attachment "INTERTEK Short-Circuit Test".		

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7.15 Explosion

MIL-PRF-22885/115 DRAFT:

Explosion: The pushbutton switches are tested in accordance to the requirements MIL-PRF-22885 and MIL-STD-202G, Method 109G.

Testing Requirements:

The explosive mixture in the test chamber surrounding and external to the switch shall not explode, whether or not explosion occurs within the switch. The switch shall be electrically and mechanically operable at the conclusion of the test. Switches shall be operated at their rated inductive current and at their maximum rated dc voltage (+28VDC at 5.0 Amps, Table 5. S200 Electrical Endurance Test Ratings. The switches, including the lamp circuits, shall be checked for electrical and mechanical operation at the conclusion of the test.

Procedure:

Spark devices are tested for proper functionality. The fuel atomizing system is determined to be free from deposits that could inhibit its functioning. Test chamber is adjusted to the highest test altitude. The vacuum system is shut off and any air leakage is measured. The UUT's are mounted in the chamber so normal electrical operation is possible from the exterior of the chamber. No external covers of the UUT's are present. The UUT's are operated to determine that it is functioning properly and to observe the location of any sparking or high temperature spots that may constitute potential explosion hazards. A 5.0 Amp inductive load is applied to the UUT.

TEST: EXPLOSION	TEST SPECIFICATION:	DATES STARTED & COMPLETED:
UUT TRACKING NUMBERS: 243133-1 & 243133-2	MIL – PRF – 22885G Requirements Paragraph 3.30 Test Method Paragraph 4.7.25	08-11-2011 & 08-11-2011
		TEST PERFORMED BY: NTS Labs
ACTION	RESULTS	COMPLIES WITH REQUIREMENTS
Introduce the test fuel and wait three minutes for full vaporization, yet still be at least 3300 feet (≈1000m) above the test altitude.	Verify that any leakage will not prevent the test from being performed as required.	✓
Switches were testing in accordance to MIL-PRF-22885G as described. Each switch was operated under load during exposure to fuel mixture.	There was no evidence of main chamber detonation when the test items were operated.	✓
Examination of each switch for mechanical or electrical damage or broken, deformed, or displaced parts.	Switches show no indication of damage. Switches properly operate electrically and mechanically.	✓
✓: Denotes compliance with the specified test requirements.		
CONCLUSION: All Test Units met the above test requirements.		
NOTE: Complete test results are provided in the attachment “NTS Labs Shock-Accel-Explosion Test”.		

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7.16 Sand & Dust

MIL-PRF-22885/115 DRAFT:

Sand & Dust: The pushbutton switches are tested in accordance to the requirements of MIL-PRF-22885G, Para. 4.7.26, MIL-STD-202G, Method 110, Cond. B.

Testing Requirements:

There shall be no operating characteristics degradation and the switches shall be mechanically and electrically operative at the conclusion of the tests. Switches shall be examined for operating characteristics and circuit continuity.

The test facility shall consist of a chamber and accessories to control dust concentration, velocity, temperature, and humidity of dust-laden air. In order to provide adequate circulation of the dust laden air, no more than 50 percent of the cross-sectional area (normal to air flow) and 30 percent of the volume of the chamber shall be occupied by the test item(s). The chamber shall be provided with a suitable means of maintaining and verifying the dust concentration in circulation.

The dust used in this test shall be a fine sand (97-99% by weight SiO₂) of angular structure, and shall have the following size distribution as determined by weight, using the U.S. Standard Sieve Series. 98 ±2 percent of the dust shall pass through a 140-mesh screen.

Procedure:

Place the test item in the chamber, positioned as near the center of the chamber as practicable. If more than one item is being tested, there shall be a minimum clearance of 4 inches between surfaces of test items or any other material or object capable of furnishing protection. Also, no surface of the test item shall be closer than 4 inches from any wall of the test chamber. Orient the item so as to expose the most critical or vulnerable parts to the dust stream. The test item orientation may be changed during the test if so required by the component specification.

Step 1 - Set the chamber controls to maintain an internal chamber temperature of 23°C (73°F) and a relative humidity of less than 22 percent. Adjust the air velocity to 1,750 ±250 feet per minute. Adjust the dust feeder to control the dust concentration at 0.3 ±0.2 grams per cubic foot. With test item nonoperating, maintain these conditions for 6 hours.

Step 2 - Stop the dust feed and reduce the air velocity to 300 ±200 feet per minute. Raise the internal chamber air temperature to 63°C (145°F) and adjust humidity control to maintain a relative humidity of less than 10 percent. Hold these conditions for 16 hours.

Step 3 - While holding chamber temperature at 63°C (145°F) adjust the air velocity to 1,750 ±250 fpm, maintain a relative humidity of less than 10 percent. Adjust the dust feeder to control the dust concentration at 0.3 ±0.2 grams per cubic foot. With the test item nonoperating, maintain these conditions for 6 hours.

Step 4 - Turn off all chamber controls and allow the test item to return to standard ambient conditions. Remove accumulated dust from the test item by brushing, wiping, or shaking, care being taken to avoid introduction of additional dust into the test item. Under no circumstances, shall dust be removed by either air blast or vacuum cleaning.

The test specimen may be operating during either or both of the 6-hour test periods (step 1 or 3) if so required by the component specification. When the component specifications reference test conditions A, B, or C of the previous version of this test method, steps 1 through 4 of this test will be used unless otherwise specified.

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TEST: SAND & DUST	TEST SPECIFICATION: MIL – PRF – 22885G Requirements Paragraph 3.31 Test Method Paragraph 4.7.26	DATES STARTED & COMPLETED: 09-08-2011 & 09-09-2011
UUT TRACKING NUMBERS: 243133-1 & 243133-2		TEST PERFORMED BY: NTS Labs

UUT	RESULTS	COMPLIES WITH REQUIREMENTS
Operating characteristics for 243113-1	Actuation force (2 to 5 pounds):	✓
	Actuation Travel 0.070" ±0.005"):	✓
	Break Before Make:	✓
	Alternate switches shall transfer as required when actuated. (Push/Release):	✓
	Alternate Switches shall return to the original position after second actuation	✓
Operating characteristics for 243113-2	Actuation force (2 to 5 pounds):	✓
	Actuation Travel 0.070" ±0.005"):	✓
	Break Before Make:	✓
	Alternate switches shall transfer as required when actuated. (Push/Release):	✓
	Alternate Switches shall return to the original position after second actuation	✓

✓: Denotes compliance with the specified test requirements.

CONCLUSION: All Test Units met the above test requirements.

NOTE: Complete test results are provided in the attachment "NTS Labs Sand-n-Dust Test".

243133-1		243133-2	
Actuation force in pounds:	3.75	Actuation force:	4.2
Actuation Travel in inches:	0.066	Actuation Travel:	0.068
Break Before Make:	✓	Break Before Make:	✓
Transfer as required when actuated:	✓	Transfer as required when actuated:	✓
Return after second actuation:	✓	Return after second actuation:	✓

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7.17 Electric Endurance DC Power Supply Inrush and Inductive Load

The dc power source was first tested to ensure that it would provide the rated inrush current on resistive loads based on the following specifications:

The highest rated switch current: 10 Amps

Overload test requirement of 150%: 15 Amps

A load circuit was configured set to draw 17 Amps from the P/S when a bounceless switch was closed.

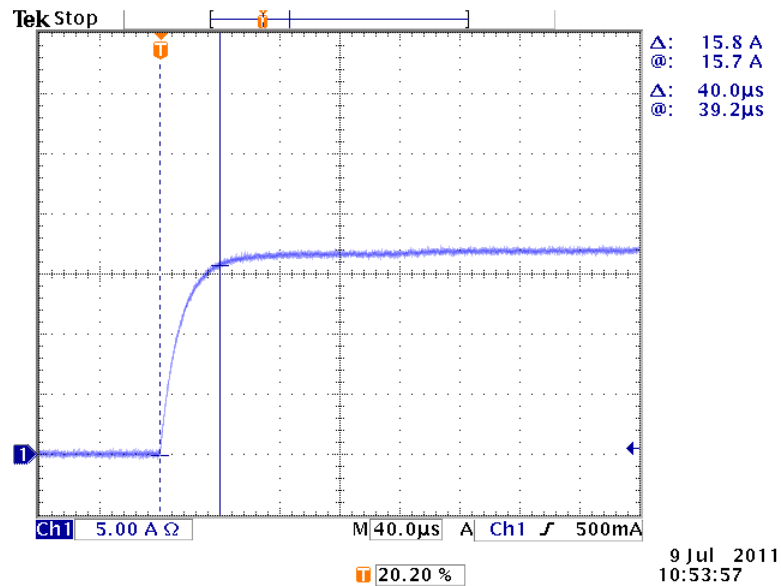


Figure 5. DC P/S Inrush Oscillogram

The Inductive dc loads were first tested to ensure that it would provide the rated response and stored energy values as indicated on figure 6 and figure 7, section b, paragraph 4.7.28.2 of MIL-PRF-22885G.

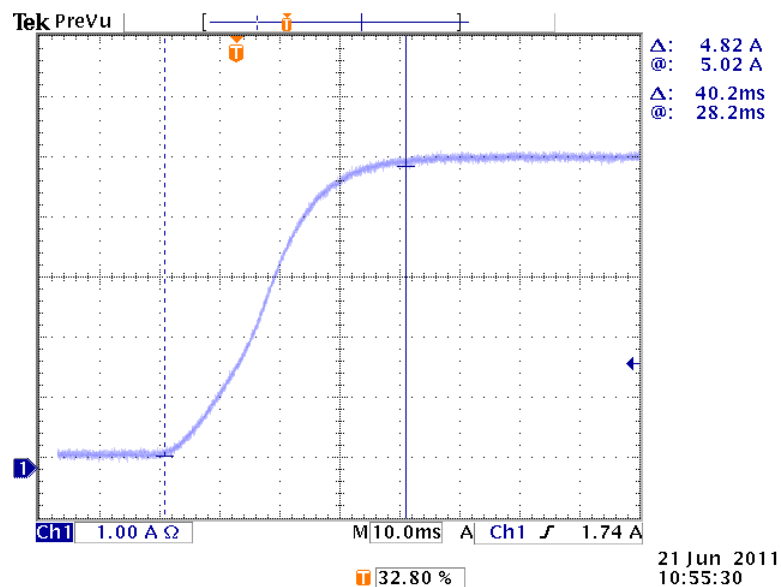


Figure 6. Inductive DC Load

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TEST: ELECTRIC ENDURANCE DC POWER SUPPLY INRUSH AND INDUCTIVE LOAD	TEST SPECIFICATION: MIL – PRF – 22885G Requirements Paragraph 3.33 Test Method Paragraph 4.7.28.2	DATES STARTED & COMPLETED: 06-21-2011 & 07-09-2011
		TEMPERATURE & HUMIDITY 25.5° C & 45 % R.H.
		TEST PERFORMED BY: D. Hubert
ACTION	RESULTS	COMPLIES WITH REQUIRMENTS
DC P/S inrush current test of rated (15 Amps) inrush current on resistive loads within 300 μ s	\geq 15 Amps Inrush Current provided within 40 μ s.	✓
5 Amp Steady State response (current versus time)	Response is within shaded area	✓
✓: Denotes compliance with the specified test requirements		
CONCLUSION: Test met the above requirements.		

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7.18 Electric Endurance UUT Specifications

For all Electrical Endurance testing of the S200 Switch Assembly, the specifications are outlined in Table 5. S200 Electrical Endurance Test Ratings apply.

MIL-PRF-22885/115 DRAFT:

Operating temperature: The switches are tested in accordance to the requirements of MIL-PRF-22885: (Table 4. S200 Operating Temperatures)

Electrical endurance: The switches are tested in accordance to the requirements of MIL-PRF-22885, at the following electrical ratings: (Table 4.)

Table 5. S200 Electrical Endurance Test Ratings

		Sea level	50,000 feet
28 VDC	Resistive	10.0 Amperes	5.0 Amperes
	Inductive	5.0 Amperes	2.5 Amperes
115 VAC, 60Hz	Resistive	7.0 Amperes	
	Inductive	3.5 Amperes	
LOW LEVEL	Resistive	10.0 uAmperes	
	Inductive		

7.19 Electric Endurance (Resistive Load, DC) Sea Level

Testing Requirements:

The dc power source shall provide the rated or inrush current on resistive loads within 300 μ s after closing the circuit with a bounceless contact device. Oscillograms shall be provided with the test report documenting this characteristic.

Each switch to be tested for electrical endurance shall first be tested for overload cycling at room ambient conditions, using the same voltage, electrical frequency, and the same pairs of contacts that will subsequently be used for the electrical endurance test. The switches shall close and open the overload current of a resistive circuit equal to 150% of the resistive load rating at the particular voltage and electrical frequency. The cycling rate shall be five cycles to six cycles of operation per minute. 50 cycles of operation shall be performed. The duty cycle shall be approximately 50 % on, 50% off. Switches shall make and break the specified electrical load for 25,000 cycles of operation. The cycling shall be continuous, except at the option of the contractor, cycling may be interrupted after each 5,000 cycles of operation. When switches are tested as specified, no contact shall fail to open or close its individual circuit in proper sequence.

The switches tested for electrical endurance at the rated resistive current shall be tested immediately thereafter for temperature rise. The temperature rise shall not exceed 50°C when measured as specified. The temperature shall be considered stable when three successive readings taken at 5 minute intervals indicate no change in temperature. The contact resistance shall not exceed 1% of the load resistance using the electrical parameters of the electrical endurance test load. After the test, switches shall be electrically and mechanically operative; there shall be no deformation, melting, delamination, or blistering of the pushbutton/lens assembly and the legend shall be legible.

Electrical tolerances are as follows: Voltage: \pm 5% for dc, \pm 7% for ac. Frequency: \pm 5%. Current: \pm 5%.

When switches are tested, post endurance, for Dielectric withstanding voltage, there shall be no flashover, arcing, breakdown, or current flow in excess of 500 microamperes.

NOTE: As per MIL-PRF-22885G, paragraph 4.7.19.1, section c.(3):
Dielectric withstanding measurement between all unconnected contact terminals of the same pole is not applicable after electrical endurance.

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Procedure:

Leads of sufficient length and size were attached to all necessary contacts of the test units to connect to the test equipment. Using normal mounting means and hardware, attach the test units to the Actuation Holding Fixture affixed to the Pneumatic Actuator.

As double throw switches, one-half of the two switches were tested with the load circuit connected to one throw (NC) on all poles, and the remaining half of the switches were tested with the load circuit connected to the other throw (NO) on all poles.

Test loads are arranged so that an independent load is provided for each pole tested and continuously monitored and recorded to determine whether any contact has failed to open or close its individual circuit in the proper sequence. The Load Resistors were adjusted as necessary to obtain a current of 15 (± 0.75)(5%) amperes for Overload and 10 (± 0.5)(5%) amperes for Endurance with the DC Power Supply set to 28 (± 1.4)(5%) Vdc. The monitoring circuit did not shunt switch contacts. See Figure 7. Resistive Load Test Set-Up below. The duty cycle was set to approximately 50% on and 50% off with a cycling rate of 10 to 12 cycles per minute. ≥ 50 cycles of operation were executed for Overload and ≥ 25000 cycles for Endurance. Temperature was set to +85 °C ± 2 °C and the LED's were not energized as per UUT specification (Table 4. S200 Operating Temperatures).

The switch terminal temperature was measured using a suitable thermocouple, while the switch was continuously carrying its maximum specified resistive load. The test was performed with the switch in still air which had a temperature of 25°C ±5°C. The temperature measuring thermocouple was attached directly to the terminals which were carrying current during the overload and endurance tests with only Kapton Polyimide Film tape providing electrical insulation between the switch terminal and the thermocouple. Measurements were taken no less often than every 5.0 minutes. The temperature rise shall be calculated by subtracting the lowest recorded ambient air temperature from the highest recorded switch terminal temperature.

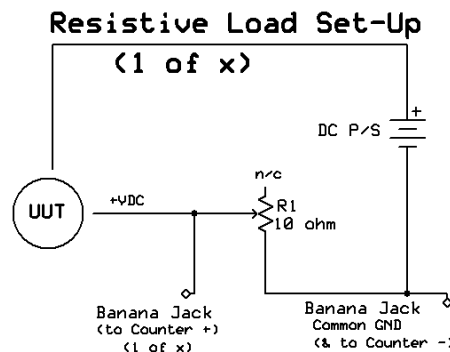


Figure 7. Resistive Load Test Set-Up

Poles tested on 243163-1:

- D-NO
- C-NO
- B-NO
- A-NO

Poles tested on 243163-2:

- D-NC
- C-NC
- B-NC
- A-NC

Poles tested on 243118-5:

- D-NO
- C-NO
- B-NO
- A-NO

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TEST: ELECTRIC ENDURANCE (RESISTIVE LOAD, DC) SEA LEVEL	TEST SPECIFICATION: MIL – PRF – 22885G Requirements Paragraph 3.33 Test Method Paragraph 4.7.28	DATES STARTED & COMPLETED: 07-12-2011 & 08-10-2011
		TEMPERATURE & HUMIDITY 26.5° C & 53 % R.H.
UUT TRACKING NUMBERS: 243163-1, 243163-2 & 243118-5		TEST PERFORMED BY: D. Hubert

ACTION		RESULTS	COMPLIES WITH REQUIREMENTS
243163-1	50 cycles @ 15 Amps Resistive DC Load	≥ 50 cycles without instance	✓
	25000 cycles @ 10 Amps Resistive DC Load	≥ 25000 cycles without instance	Test Halted See Note Below
	Post Endurance Temperature Rise, Max current in still air.	Temperature rise ≤ 50°C	See Note Below
	Post Endurance Contact Resistance. 1% VDC drop allowed over contacts: 280 mVolts	Highest measurement Pass Value ≤ 1%	See Note Below
	Dielectric Withstanding Voltage, 1000 volts RMS, 60 seconds	≤ 500 microamperes current flow	See Note Below
243163-2	50 cycles @ 15 Amps Resistive DC Load	≥ 50 cycles without instance	✓
	25000 cycles @ 10 Amps Resistive DC Load	≥ 25000 cycles without instance	✓
	Post Endurance Temperature Rise, Max current in still air.	Temperature rise ≤ 50°C	✓
	Post Endurance Contact Resistance. 1% VDC drop allowed over contacts: 280 mVolts	Highest measurement Pass Value ≤ 1%	✓
	Dielectric Withstanding Voltage, 1000 volts RMS, 60 seconds	≤ 500 microamperes current flow	✓
243118-5	50 cycles @ 15 Amps Resistive DC Load	≥ 50 cycles without instance	✓
	25000 cycles @ 10 Amps Resistive DC Load	≥ 25000 cycles without instance	✓
	Post Endurance Temperature Rise, Max current in still air.	Temperature rise ≤ 50°C	✓
	Post Endurance Contact Resistance. 1% VDC drop allowed over contacts: 280 mVolts	Highest measurement Pass Value ≤ 1%	✓
	Dielectric Withstanding Voltage, 1000 volts RMS, 60 seconds	≤ 500 microamperes current flow	✓

UUT 243118-5					UUT 243163-2				
Common to:	Test #, Readings in mVolts DC			% of Highest Reading	Common to:	Test #, Readings in mVolts DC			% of Highest Reading
	1	2	3			1	2	3	
A-NO	78.0	89.0	81.0	0.32	A-NC	143.0	120.2	115.7	0.51
B-NO	86.0	70.0	75.0	0.31	B-NC	68.2	76.7	61.2	0.27
C-NO	73.0	52.0	49.0	0.26	C-NC	171.5	164.9	140.1	0.61
D-NO	114.0	110.0	92.0	0.41	D-NC	91.5	94.9	101.0	0.36

PASS Condition : No measurements > 500 Microamps current flow : (see NOTE in Requirements section)			
UUT 243118-5	Miliamps Measured	UUT 243163-2	Miliamps Measured
A1, 2 & 3 to B1, 2 & 3	0.074	A1, 2 & 3 to B1, 2 & 3	0.068
B1, 2 & 3 to C1, 2 & 3	0.073	B1, 2 & 3 to C1, 2 & 3	0.068
C1, 2 & 3 to D1, 2 & 3	0.064	C1, 2 & 3 to D1, 2 & 3	0.059
All Pins (including lamp pins 4 through 9) to housing	0.017	All Pins (including lamp pins 4 through 9) to housing	0.014

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243163-2 Post Endurance Temperature Rise

All readings in °C.

Passing ≤ 50°C Delta.

NOTE: Temperature stabilized on all poles over a ≥15 minute period.

Lowest Ambient Temp: 26.9				Lowest Ambient Temp: 27.0			
Highest Temp Pole A: 43.3		Highest Temp Pole B: 43.8		Highest Temp Pole C: 44.4		Highest Temp Pole D: 45.0	
Delta to Ambient: 16.4		Delta to Ambient: 17.0		Delta to Ambient: 17.4		Delta to Ambient: 18.8	
Highest variance: 1.4		Highest variance: 1.0		Highest variance: 1.5		Highest variance: 1.5	
Time	Ambient Air	Terminal A	Terminal B	Time	Ambient Air	Terminal C	Terminal D
14:00:39	27.1	41.9	42.9	16:00:27	27.3	44.0	45.6
14:01:54	27.2	42.3	43.2	16:01:42	27.2	43.6	45.0
14:03:09	27.3	42.4	43.5	16:02:57	27.0	43.8	45.3
14:04:24	27.3	42.8	43.4	16:04:12	27.0	42.9	44.3
14:05:39	27.5	42.8	43.8	16:05:27	27.1	43.5	45.1
14:06:54	27.5	42.5	43.1	16:06:42	27.3	43.9	45.5
14:08:09	27.8	42.3	43.0	16:07:57	27.3	44.1	45.8
14:09:24	27.8	42.5	43.0	16:09:12	27.3	44.0	45.6
14:10:39	27.7	42.4	43.0	16:10:27	27.4	44.0	45.5
14:11:54	27.7	42.2	42.8	16:11:42	27.3	44.1	45.6
14:13:09	27.6	42.3	43.1	16:12:57	27.4	43.7	45.2
14:14:24	27.1	42.4	43.4	16:14:12	27.5	44.2	45.8
14:15:39	26.9	42.5	43.0	16:15:27	27.5	44.1	45.6
14:16:54	26.9	42.0	42.9	16:16:42	27.6	44.4	45.6
14:18:09	27.4	42.9	43.8	16:17:57	27.6	43.0	44.5
14:19:24	27.6	43.1	43.8	16:19:12	27.6	44.2	45.8
14:20:39	27.7	43.0	43.6	16:20:27	27.7	44.0	45.4
14:21:54	27.7	42.9	43.5	16:21:42	27.6	43.0	44.4
14:23:09	27.7	42.8	43.3	16:22:57	27.7	42.4	43.9
14:24:24	27.9	42.9	43.2	16:24:12	27.8	42.9	44.3
14:25:39	27.9	42.8	43.3	16:25:27	27.7	44.0	45.5
14:26:54	27.9	43.0	43.5	16:26:42	27.9	44.0	45.4
14:28:09	28.0	43.2	43.5	16:27:57	27.9	44.0	45.6
14:29:24	28.0	43.0	43.5	16:29:12	27.7	44.4	45.8
14:30:39	27.9	43.3	43.6	16:30:27	27.9	43.6	45.0

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243118-5 Post Endurance Temperature Rise
 Passing $\leq 50^{\circ}\text{C}$ Delta.

All readings in $^{\circ}\text{C}$.

Lowest Ambient Temp: 26.6				Lowest Ambient Temp: 26.6			
Highest Temp Pole A: 47.5		Highest Temp Pole C: 47.8		Highest Temp Pole B: 61.2		Highest Temp Pole D: 58.8	
Delta to Ambient: 20.9		Delta to Ambient: 21.1		Delta to Ambient: 17.4		Delta to Ambient: 18.8	
Highest variance: 14.8		Highest variance: 14.1		Highest variance: 1.5		Highest variance: 1.5	
Time	Ambient Air	Terminal A	Terminal C	Time	Ambient Air	Terminal C	Terminal D
13:25	27.2	31.0	31.4	16:15	27.0	55.1	55.2
13:30	27.1	37.1	36.8	16:20	27.0	55.5	56.0
13:35	27.1	37.9	37.9	16:25	26.9	52.7	55.1
13:40	27.1	45.5	45.4	16:30	27.0	53.9	55.0
13:45	27.1	45.4	44.8	16:35	27.1	57.3	56.1
13:50	27.1	46.5	46.4	16:40	27.0	53.3	55.2
13:55	26.9	45.9	44.8	16:45	27.0	53.0	54.6
14:00	26.9	45.0	44.7	16:50	27.0	53.3	55.1
14:05	26.9	44.6	44.4	16:55	27.1	56.0	55.8
14:10	26.9	45.3	45.2	17:00	26.9	52.9	55.0
14:15	26.8	44.0	43.5	17:05	27.2	57.6	55.7
14:20	26.7	43.9	42.7	17:10	27.2	58.7	56.0
14:25	26.7	43.9	43.6	17:15	27.1	58.8	57.8
14:30	26.8	44.5	43.1	17:20	27.0	60.0	57.6
14:35	26.7	43.9	42.5	17:25	27.1	60.2	57.4
14:40	26.9	43.6	46.6	17:30	27.2	59.1	57.1
14:45	27.1	44.1	46.6	17:35	27.3	59.8	57.5
14:50	27.2	43.9	46.3	17:40	27.7	60.1	58.2
14:55	27.2	43.2	45.8	17:45	27.8	61.1	58.0
15:00	27.2	43.1	46.0	17:50	27.9	59.2	57.8
15:05	27.2	42.9	45.7	17:55	28.0	59.9	57.7
15:10	27.2	43.2	46.0	18:00	28.1	59.9	58.4
15:15	27.2	43.0	45.3	18:05	28.4	60.7	58.2
15:20	27.2	43.3	45.6	18:10	28.3	59.9	57.7
15:25	27.1	42.9	45.6	18:15	28.5	60.7	58.3

NOTE for UUT 243163-1:

ABSTRACT:

During a periodic check of the ongoing Resistive DC Endurance test (post Overload Testing) the scanner (Agilent, Data Acquisition/Switch Unit) display showed serious irregularities on pole A of the 243163-1 UUT. The test was momentarily halted with the actuator count at 8998. Investigation revealed that the UUT remained properly mounted to the panel but the mounting panel connection to the actuator holding bracket hardware had loosened and the bracket slid to one side.

CONCLUSION:

Test Equipment failure in turn caused one pole of the UUT to fail. The loosened hardware and worn slot in the mounting panel allowed it to move to an approximate 20(+) degree angle from the proper facing of the mechanical actuator. This also in turn caused tension on the test lead wires. The UUT was there for being improperly actuated (or teased) for an unknown amount of cycles. A simple continuity check was performed revealing the switch abnormality. With the switch in the depressed position, A-NC was short to A-Common and A-NO was open to A-Common.

CORRECTIVE ACTION:

The UUT was disconnected from the test set up and the in process test continued for the other UUT (243163-2). The worn mounting panel and old hardware were discarded. Lock washers were added to the mounting hardware. The UUT was replaced with an existing QPL sample 243118-5. The procedure was restarted and completed successfully with sample 243118-5.

Dave Hubert, Test Engineer

✓: Denotes compliance with the specified test requirements

CONCLUSION: Required number of Test Units met the above test requirements.

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7.20 Electric Endurance (Inductive Load, DC) Sea Level

Testing Requirements:

Each switch to be tested for electrical endurance shall first be tested for overload cycling at room ambient conditions, using the same voltage, electrical frequency, and the same pairs of contacts that will subsequently be used for the electrical endurance test. The switches shall close and open the overload current of a resistive circuit equal to 150% of the resistive load rating at the particular voltage and electrical frequency. The cycling rate shall be five cycles to six cycles of operation per minute. 50 cycles of operation shall be performed. The duty cycle shall be approximately 50 % on, 50% off. Switches shall make and break the specified electrical load for 25,000 cycles of operation. The cycling shall be continuous, except at the option of the contractor, cycling may be interrupted after each 5,000 cycles of operation. When switches are tested as specified, no contact shall fail to open or close its individual circuit in proper sequence.

The contact resistance shall not exceed 1% of the load resistance using the electrical parameters of the electrical endurance test load. After the test, switches shall be electrically and mechanically operative; there shall be no deformation, melting, delamination, or blistering of the pushbutton/lens assembly and the legend shall be legible.

Electrical tolerances are as follows: Voltage: $\pm 5\%$ for dc, $\pm 7\%$ for ac. Frequency: $\pm 5\%$. Current: $\pm 5\%$.

The dc power source shall provide the rated or inrush current on resistive loads within 300 μ s after closing the circuit with a bounceless contact device. Oscillograms shall be provided with the test report documenting this characteristic.

NOTE: As per MIL-PRF-22885G, paragraph 4.7.19.1, section c.(3):
Dielectric withstanding measurement between all unconnected contact terminals of the same pole is not applicable after electrical endurance.

Procedure:

Leads of sufficient length and size were attached to all necessary contacts of the test units to connect to the test equipment. Using normal mounting means and hardware, test units were attached to the Actuation Holding Fixture affixed to the Pneumatic Actuator.

As double throw switches, one-half of the poles within each of the two switches were tested with the load circuit connected to one throw (NC), and the remaining poles were tested with the load circuit connected to the other throw (NO).

Test loads are arranged so that an independent load is provided for each pole tested and continuously monitored and recorded to determine whether any contact has failed to open or close its individual circuit in the proper sequence. The Load Resistors were adjusted as necessary to obtain a current of 7.5 (± 0.375)(5%) amperes for Overload and 5 (± 0.25)(5%) amperes for Endurance with the DC Power Supply set to 28 (± 1.4)(5%) Vdc. The monitoring circuit did not shunt inductive components or switch contacts. See Figure 8. Inductive Load Set-Up. The duty cycle was set to approximately 50% on and 50% off with a cycling rate of 10 to 12 cycles per minute. ≥ 50 cycles of operation were executed for Overload and ≥ 25000 cycles for Endurance.

Poles tested on 243138-1:

D-NO
C-NC
B-NO
A-NC

Poles tested on 243148-1:

D-NC
C-NO
B-NC
A-NO

CAGE CODE

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DRAWING NO.

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Inductive Load Set-Up

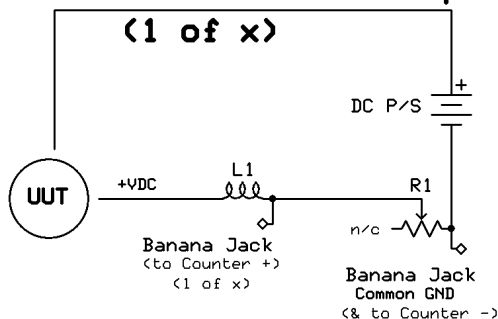


Figure 8. Inductive Load Set-Up

TEST: ELECTRIC ENDURANCE (INDUCTIVE LOAD, DC) SEA LEVEL	TEST SPECIFICATION: MIL – PRF – 22885G Requirements Paragraph 3.33 Test Method Paragraph 4.7.28	DATES STARTED & COMPLETED: 07-17-2011 & 07-20-2011 TEMPERATURE & HUMIDITY 26.5° C & 53 % R.H. TEST PERFORMED BY: D. Hubert
UUT TRACKING NUMBERS: 243138-1 & 243148-1		

ACTION		RESULTS				COMPLIES WITH REQUIREMENTS			
50 cycles @ 7.5 Amps Inductive DC Load		≥ 50 cycles without instance				✓			
25000 cycles @ 5 Amps Inductive DC Load		≥ 25000 cycles without instance				✓			
Post Endurance Contact Resistance. 1% VDC drop allowed over contacts: 280 mVolts		Highest measurement Pass Value ≤ 1%				✓			
UUT 243138-2				UUT 243148-1					
Common to:	Test #, Readings in mVolts DC			% of Highest Reading	Common to:	Test #, Readings in mVolts DC			% of Highest Reading
	1	2	3			1	2	3	
A-NC	41.2	38.4	36.5	0.15	B-NC	94.5	105.4	97.3	0.38
C-NC	68.6	49.7	58.1	0.24	D-NC	41.1	56.6	40.8	0.20
B-NO	28.3	28.7	44.2	0.16	A-NO	49.1	79.6	36.7	0.28
D-NO	89.0	125.0	101.6	0.45	C-NO	43.3	78.9	57.7	0.28

PASS Condition : No measurements > 500 Microamps current flow : (see NOTE in Requirements section)			
UUT 243118-5	Miliamps Measured	UUT 243163-2	Miliamps Measured
A1, 2 & 3 to B1, 2 & 3	0.074	A1, 2 & 3 to B1, 2 & 3	0.068
B1, 2 & 3 to C1, 2 & 3	0.073	B1, 2 & 3 to C1, 2 & 3	0.068
C1, 2 & 3 to D1, 2 & 3	0.064	C1, 2 & 3 to D1, 2 & 3	0.059
All Pins (including lamp pins 4 through 9) to housing	0.017	All Pins (including lamp pins 4 through 9) to housing	0.014

✓: Denotes compliance with the specified test requirements

CONCLUSION: All Test Units met the above test requirements.

CAGE CODE	DRAWING NO.	REV.	SHT.
12522	TR – 012 – S200	1.0	53

7.21 Electric Endurance (Resistive Load, AC) Sea Level

Testing Requirements:

The dc power source shall provide the rated or inrush current on resistive loads within 300 μ s after closing the circuit with a bounceless contact device. Oscillograms shall be provided with the test report documenting this characteristic.

Each switch to be tested for electrical endurance shall first be tested for overload cycling at room ambient conditions, using the same voltage, electrical frequency, and the same pairs of contacts that will subsequently be used for the electrical endurance test. The switches shall close and open the overload current of a resistive circuit equal to 150% of the resistive load rating at the particular voltage and electrical frequency. The cycling rate shall be five cycles to six cycles of operation per minute. 50 cycles of operation shall be performed. The duty cycle shall be approximately 50 % on, 50% off. Switches shall make and break the specified electrical load for 25,000 cycles of operation. The cycling shall be continuous, except at the option of the contractor, cycling may be interrupted after each 5,000 cycles of operation. When switches are tested as specified, no contact shall fail to open or close its individual circuit in proper sequence.

The switches tested for electrical endurance at the rated resistive current shall be tested immediately thereafter for temperature rise. The temperature rise shall not exceed 50°C when measured as specified. The temperature shall be considered stable when three successive readings taken at 5 minute intervals indicate no change in temperature. The contact resistance shall not exceed 1% of the load resistance using the electrical parameters of the electrical endurance test load. After the test, switches shall be electrically and mechanically operative; there shall be no deformation, melting, delamination, or blistering of the pushbutton/lens assembly and the legend shall be legible.

Electrical tolerances are as follows: Voltage: $\pm 5\%$ for dc, $\pm 7\%$ for ac. Frequency: $\pm 5\%$. Current: $\pm 5\%$.

When switches are tested, post endurance, for Dielectric withstanding voltage, there shall be no flashover, arcing, breakdown, or current flow in excess of 500 microamperes.

NOTE: As per MIL-PRF-22885G, paragraph 4.7.19.1, section c.(3):
Dielectric withstanding measurement between all unconnected contact terminals of the same pole is not applicable after electrical endurance.

Procedure:

Leads of sufficient length and size were attached to all necessary contacts of the test units to connect to the test equipment. Using normal mounting means and hardware, attach the test units to the Actuation Holding Fixture affixed to the Pneumatic Actuator.

As double throw switches, one-half of the poles on each switch was tested with the load circuit connected to one throw (NC) half the poles and the remaining half of the poles were tested with the load circuit connected to the other throw (NO).

Test loads are arranged so that an independent load is provided for each pole tested and continuously monitored and recorded to determine whether any contact has failed to open or close its individual circuit in the proper sequence. The Load Resistors were adjusted as necessary to obtain a current of 10.5 (± 0.525)(5%) amperes RMS for Overload and 7.0 (± 0.35)(5%) amperes RMS for Endurance with the AC Power Supply set to 120 (± 6.0)(5%) Vac (84.85 Volts RMS). The monitoring circuit did not shunt switch contacts. The duty cycle was set to approximately 50% on and 50% off with a cycling rate of 10 to 12 cycles per minute. ≥ 50 cycles of operation were executed for Overload and ≥ 25000 cycles for Endurance. Temperature was set to $+71\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ as the LED's energized with +28.0 Vdc as per UUT specification (Table 4. S200 Operating Temperatures).

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The switch terminal temperature was measured using a suitable thermocouple, while the switch was continuously carrying its maximum specified resistive load. The test was performed with the switch in still air which had a temperature of $25^{\circ}\text{C} \pm 5^{\circ}\text{C}$. The temperature measuring thermocouple was attached directly to the terminals which were carrying current during the overload and endurance tests with only Kapton Polyimide Film tape providing electrical insulation between the switch terminal and the thermocouple. Measurements were taken no less often than every 5.0 minutes. The temperature rise shall be calculated by subtracting the lowest recorded ambient air temperature from the highest recorded switch terminal temperature.

Poles tested on 243153-1:

D-NO
C-NC
B-NO
A-NC

Poles tested on 243153-2:

D-NC
C-NO
B-NC
A-NO

Poles tested on 243148-2:

D-NO
C-NC
B-NO
A-NC

CAGE CODE	DRAWING NO.	REV.	SHT.
12522	TR - 012 - S200	1.0	55

TEST: ELECTRIC ENDURANCE (RESISTIVE LOAD, AC) SEA LEVEL	TEST SPECIFICATION: MIL – PRF – 22885G Requirements Paragraph 3.33 Test Method Paragraph 4.7.28	DATES STARTED & COMPLETED: 08-08-2011 & 08-16-2011
UUT TRACKING NUMBERS: 243153-1, 243153-2 & 243148-2		TEMPERATURE & HUMIDITY 24.5° C & 55% R.H.
		TEST PERFORMED BY: D. Hubert

ACTION		RESULTS	COMPLIES WITH REQUIREMENTS
243153-1	50 cycles @ 10.5 Amps Resistive AC Load	≥ 50 cycles without instance	✓
	25000 cycles @ 7.0 Amps Resistive AC Load	≥ 25000 cycles without instance	See Note Below
	Post Endurance Temperature Rise, Max current in still air.	Temperature rise ≤ 50°C	See Note Below
	Post Endurance Contact Resistance. 1% VAC drop allowed over contacts: 1.2 Volts	Highest measurement Pass Value ≤ 1%	See Note Below
	Dielectric Withstanding Voltage, 1000 volts RMS, 60 seconds	≤ 500 microamperes current flow	See Note Below
243153-2	50 cycles @ 10.5 Amps Resistive AC Load	≥ 50 cycles without instance	✓
	25000 cycles @ 7.0 Amps Resistive AC Load	≥ 25000 cycles without instance	✓
	Post Endurance Temperature Rise, Max current in still air.	Temperature rise ≤ 50°C	✓
	Post Endurance Contact Resistance. 1% VAC drop allowed over contacts: 1.2 Volts	Highest measurement Pass Value ≤ 1%	✓
	Dielectric Withstanding Voltage, 1000 volts RMS, 60 seconds	≤ 500 microamperes current flow	✓
243148-2	50 cycles @ 10.5 Amps Resistive AC Load	≥ 50 cycles without instance	✓
	25000 cycles @ 7.0 Amps Resistive AC Load	≥ 25000 cycles without instance	✓
	Post Endurance Temperature Rise, Max current in still air.	Temperature rise ≤ 50°C	✓
	Post Endurance Contact Resistance. 1% VAC drop allowed over contacts: 1.2 Volts	Highest measurement Pass Value ≤ 1%	✓
	Dielectric Withstanding Voltage, 1000 volts RMS, 60 seconds	≤ 500 microamperes current flow	✓

UUT 243153-2					UUT 243148-2				
Common to:	Test #, Readings in mVolts AC			% of Highest Reading	Common to:	Test #, Readings in mVolts AC			% of Highest Reading
	1	2	3			1	2	3	
A-NO	39.9	46.9	39.6	0.04	A-NC	40.2	45.1	51.9	0.04
B-NC	41.0	41.8	53.1	0.04	B-NO	69.7	56.7	59.9	0.06
C-NO	83.5	74.6	77.2	0.07	C-NC	69.0	52.2	46.8	0.06
D-NC	398.2	302.7	277.0	0.33	D-NO	79.6	68.2	52.5	0.07

PASS Condition : No insulation measurements > 500 Microamps current flow : (see NOTE in Requirements section)			
UUT 243153-2	Miliamps Measured	UUT 243148-2	Miliamps Measured
A1, 2 & 3 to B1, 2 & 3	0.106	A1, 2 & 3 to B1, 2 & 3	0.060
B1, 2 & 3 to C1, 2 & 3	0.103	B1, 2 & 3 to C1, 2 & 3	0.070
C1, 2 & 3 to D1, 2 & 3	0.110	C1, 2 & 3 to D1, 2 & 3	0.070
All Pins (including lamp pins 4 through 9) to housing	0.039	All Pins (including lamp pins 4 through 9) to housing	0.020

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243153-2 Post Endurance Temperature Rise

All readings in °C.

Passing ≤ 50°C Delta.

NOTE: Temperature stabilized on all poles over a ≥15 minute period.

Lowest Ambient Temp: 26.8				Lowest Ambient Temp: 28.8			
Highest Temp Pole A: 35.2		Highest Temp Pole B: 41.4		Highest Temp Pole C: 35.9		Highest Temp Pole D: 41.5	
Delta to Ambient: 8.3		Delta to Ambient: 14.6		Delta to Ambient: 7.1		Delta to Ambient: 12.7	
Highest variance: 3.5		Highest variance: 2.5		Highest variance: 0.9		Highest variance: 0.7	
Time	Ambient Air	Terminal A	Terminal B	Time	Ambient Air	Terminal C	Terminal D
10:25	27.3	32.8	39.1	12:45	29.5	35.1	40.8
10:30	25.8	31.6	39.0	12:50	29.5	35.2	40.9
10:35	27.3	32.7	39.7	12:55	29.2	35.1	40.9
10:40	27.6	33.4	40.1	13:00	29.1	35.7	41.3
10:45	28.2	33.5	40.3	13:05	28.8	35.4	41.2
10:50	28.3	34.6	40.7	13:10	29.2	35.2	40.9
10:55	27.8	32.8	40.0	13:15	29.8	35.6	41.2
11:00	28.6	33.4	40.4	13:20	29.9	35.3	41.1
11:05	29.0	34.7	40.9	13:25	29.4	35.4	41.0
11:10	28.5	33.9	40.6	13:30	29.2	35.7	41.3
11:15	28.5	34.0	40.5	13:35	29.7	35.5	41.2
11:20	28.8	34.9	40.8	13:40	29.3	35.0	41.0
11:25	28.8	35.2	41.4	13:45	29.5	35.9	41.4
11:30	28.4	35.1	41.0	13:50	29.8	35.8	41.5

243148-2 Post Endurance Temperature Rise

All readings in °C.

Passing ≤ 50°C Delta.

Lowest Ambient Temp: 28.3				Lowest Ambient Temp: 28.4			
Highest Temp Pole A: 41.7		Highest Temp Pole C: 46.7		Highest Temp Pole B: 48.5		Highest Temp Pole D: 43.7	
Delta to Ambient: 13.4		Delta to Ambient: 18.4		Delta to Ambient: 20.1		Delta to Ambient: 15.3	
Highest variance: 3.4		Highest variance: 3.31		Highest variance: 3.4		Highest variance: 2.6	
Time	Ambient Air	Terminal A	Terminal C	Time	Ambient Air	Terminal C	Terminal D
13:49	27.7	37.8	43.6	16:09	28.6	45.3	42.5
13:54	28.7	38.3	44.1	16:14	28.6	45.3	42.2
13:59	28.9	39.5	45.7	16:19	28.8	45.1	43.2
14:04	28.7	41.0	46.4	16:24	28.7	45.7	41.9
14:09	29.2	41.7	46.7	16:29	28.9	45.1	42.7
14:14	28.7	40.8	45.4	16:34	28.8	45.4	42.2
14:19	28.8	40.7	45.6	16:39	28.8	46.7	41.2
14:24	29.1	41.4	46.1	16:44	28.9	45.3	42.7
14:29	28.8	40.5	45.4	16:49	28.8	46.2	41.6
14:34	29.0	41.2	45.6	16:54	29.0	45.2	42.8
14:39	28.4	40.1	44.4	16:59	28.9	45.1	42.6
14:44	28.9	41.1	45.7	17:04	28.9	45.4	41.8
14:49	28.6	40.6	44.8	17:09	29.2	45.9	42.7
14:54	28.7	40.5	44.8	17:14	29.4	46.2	42.8
14:59	28.7	40.7	44.5	17:19	29.6	46.9	43.1
15:04	28.6	39.9	43.5	17:24	29.8	46.8	43.1
15:09	28.8	40.7	45.2	17:29	29.9	47.0	42.9
15:14	28.5	40.5	44.6	17:34	30.1	47.2	43.3
15:19	28.3	39.9	43.6	17:39	30.4	47.7	43.0
15:24	28.9	40.9	45.3	17:44	30.4	47.2	43.6
15:29	28.7	40.7	44.1	17:49	30.6	47.9	43.2
15:34	28.5	40.1	43.7	17:54	30.7	48.0	43.3
15:39	29.0	41.0	44.9	17:59	30.9	48.0	43.4
15:44	28.5	40.2	43.4	18:04	31.0	48.5	43.7
15:49	28.7	40.4	43.9	18:09	31.2	48.3	43.7

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TR - 012 - S200

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1.0 57

NOTE for UUT 243153-1:

FAILURE EVALUATION:

Examination of test switch S/N 243153-1 revealed significant heat damage to external areas in the vicinity of the contact system. The input terminals and associated enclosure material was either melted or otherwise damaged as evidenced by charring and bubbling. The switch was partially mechanically inoperable as a result of the contact mechanism being disabled.

ANALYSIS:

Tear-down and inspection revealed significant heat damage of the switch contacts under test. Said contact elements were severely melted and the surrounding plastic materials were either melted or charred. The observed damage is consistent with contacts under heavy electrical load having insufficient mating contact pressure to maintain electrical continuity, which results in high contact resistance and subsequent arc heating. Low contact pressure in this design can occur from contact elements having insufficient dimension to maintain correct operating forces, or from contacts that are held in an intermediate position due to incomplete transfer from one stable state to the other. In this instance, parts were damaged to the extent that it cannot be determined which of the above conditions existed. However, inspection of parts in inventory revealed no discrepancies that would produce low contact pressure. It is therefore concluded that insufficient contact movement due to partial contact operation caused the failure. Note: the contact actuating mechanism was observed to work correctly.

Further to the above evaluation, additional testing was conducted on a spare QPL test sample re-confirmed to meet all pre-electrical endurance test requirements.

- The spare test sample was retested per Group A requirements with special attention to contact position response to pushbutton movement. This was to confirm that upon successful completion of these tests, the sample was deemed acceptable for electrical endurance testing. The unit was tested in the same test fixture as the failed unit.
- The unit successfully completed the maximum electrical load endurance test and all other required post-endurance tests.
- It is inconclusive as to why the contacts failed to operate correctly, whether through assembly error or test equipment operation.
- It is also concluded that a correctly functioning switch meets the rated electrical load endurance requirements.

CORRECTIVE ACTION:

- Monitor production Acceptance Test output data for any anomalies. Electronic data is collected for contact resistance, contact simultaneity and contact bounce.
- Review assembly procedures/test fixtures for potential causes of performance variance. Refine processes as necessary.
- Note critical parts operation at subassembly level. Implement inspection points as appropriate.

Roy Hart, Principle Design Engineer

✓: Denotes compliance with the specified test requirements

CONCLUSION: Required number of Test Units met the above test requirements.

CAGE CODE
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DRAWING NO.
TR – 012 – S200

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1.0 58

7.22 Electric Endurance (Inductive Load, AC) Sea Level

Testing Requirements:

Each switch to be tested for electrical endurance shall first be tested for overload cycling at room ambient conditions, using the same voltage, electrical frequency, and the same pairs of contacts that will subsequently be used for the electrical endurance test. The switches shall close and open the overload current of a resistive circuit equal to 150% of the resistive load rating at the particular voltage and electrical frequency. The cycling rate shall be five cycles to six cycles of operation per minute. 50 cycles of operation shall be performed. The duty cycle shall be approximately 50 % on, 50% off. Switches shall make and break the specified electrical load for 25,000 cycles of operation. The cycling shall be continuous, except at the option of the contractor, cycling may be interrupted after each 5,000 cycles of operation. When switches are tested as specified, no contact shall fail to open or close its individual circuit in proper sequence.

The contact resistance shall not exceed 1% of the load resistance using the electrical parameters of the electrical endurance test load. After the test, switches shall be electrically and mechanically operative; there shall be no deformation, melting, delamination, or blistering of the pushbutton/lens assembly and the legend shall be legible.

Electrical tolerances are as follows: Voltage: $\pm 5\%$ for dc, $\pm 7\%$ for ac. Frequency: $\pm 5\%$. Current: $\pm 5\%$.

The dc power source shall provide the rated or inrush current on resistive loads within 300 μ s after closing the circuit with a bounceless contact device. Oscillograms shall be provided with the test report documenting this characteristic.

NOTE: As per MIL-PRF-22885G, paragraph 4.7.19.1, section c.(3):
Dielectric withstanding measurement between all unconnected contact terminals of the same pole is not applicable after electrical endurance.

Procedure:

Leads of sufficient length and size were attached to all necessary contacts of the test units to connect to the test equipment. Using normal mounting means and hardware, test units were attached to the Actuation Holding Fixture affixed to the Pneumatic Actuator.

As double throw switches, one-half of the poles within each of the two switches were tested with the load circuit connected to one throw (NC), and the remaining poles were tested with the load circuit connected to the other throw (NO).

Test loads are arranged so that an independent load is provided for each pole tested and continuously monitored and recorded to determine whether any contact has failed to open or close its individual circuit in the proper sequence. The Load Resistors were adjusted as necessary to obtain a current of 5.25 (± 0.2625)(5%) amperes RMS for Overload and 3.5 (± 0.175)(5%) amperes RMS for Endurance with the AC Power Supply set to 120 (± 6.0)(5%) Vac (84.85 Volts RMS). The monitoring circuit did not shunt switch contacts. The duty cycle was set to approximately 50% on and 50% off with a cycling rate of 10 to 12 cycles per minute. ≥ 50 cycles of operation were executed for Overload and ≥ 25000 cycles for Endurance. Temperature was set to $+71\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ as the LED's energized with +28.0 Vdc as per UUT specification (Table 4. S200 Operating Temperatures).

Poles tested on 243103-1:

D-NO
C-NC
B-NC
A-NO

Poles tested on 243103-2:

D-NO
C-NC
B-NC
A-NO

CAGE CODE

12522

DRAWING NO.

TR - 012 - S200

REV.

1.0

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TEST: ELECTRIC ENDURANCE (INDUCTIVE LOAD, AC) SEA LEVEL	TEST SPECIFICATION: MIL – PRF – 22885G Requirements Paragraph 3.33 Test Method Paragraph 4.7.28	DATES STARTED & COMPLETED: 08-17-2011 & 08-22-2011
		TEMPERATURE & HUMIDITY 24.0° C & 53 % R.H.
UUT TRACKING NUMBERS: 243103-1 & 243103-2		TEST PERFORMED BY: D. Hubert

ACTION		RESULTS	COMPLIES WITH REQUIREMENTS
243103-1	50 cycles @ 5.25 Amps Inductive AC Load	≥ 50 cycles without instance	✓
	25000 cycles @ 3.5 Amps Inductive AC Load	≥ 25000 cycles without instance	✓
	Post Endurance Contact Resistance. 1% VDC drop allowed over contacts: 1200 mVolts	Highest measurement Pass Value ≤ 1%	✓
	Dielectric Withstanding Voltage, 400 volts RMS, 60 seconds	≤ 500 microamperes current flow	✓
243103-2	50 cycles @ 5.25 Amps Inductive AC Load	≥ 50 cycles without instance	✓
	25000 cycles @ 3.5 Amps Inductive AC Load	≥ 25000 cycles without instance	✓
	Post Endurance Contact Resistance. 1% VDC drop allowed over contacts:1200 mVolts	Highest measurement Pass Value ≤ 1%	✓
	Dielectric Withstanding Voltage, 400 volts RMS, 60 seconds	≤ 500 microamperes current flow	✓

UUT 243103-1					UUT 243103-2				
Common to:	Test #, Readings in mVolts DC			% of Highest Reading	Common to:	Test #, Readings in mVolts DC			% of Highest Reading
	1	2	3			1	2	3	
A-NO	76.6	91.5	77.6	0.08	A-NO	119.8	126.9	97.1	0.11
B-NC	128.3	109.3	114.9	0.11	B-NC	82.2	124.5	115.0	0.10
C-NC	95.7	89.9	90.4	0.08	C-NC	97.9	87.8	76.3	0.08
D-NO	77.7	111.9	87.7	0.09	D-NO	97.3	71.0	81.4	0.08

PASS Condition : No measurements > 500 Microamps current flow : (see NOTE in Requirements section)			
UUT 243103-1	Miliamps Measured	UUT 243103-2	Miliamps Measured
A1, 2 & 3 to B1, 2 & 3	0.073	A1, 2 & 3 to B1, 2 & 3	0.073
B1, 2 & 3 to C1, 2 & 3	0.072	B1, 2 & 3 to C1, 2 & 3	0.073
C1, 2 & 3 to D1, 2 & 3	0.062	C1, 2 & 3 to D1, 2 & 3	0.064
All Pins (including lamp pins 4 through 9) to housing	0.019	All Pins (including lamp pins 4 through 9) to housing	0.020

✓: Denotes compliance with the specified test requirements
CONCLUSION: All Test Units met the above test requirements.

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7.23 Electric Endurance (Resistive Load, DC) At Altitude

Testing Requirements:

The dc power source shall provide the rated or inrush current on resistive loads within 300 μ s after closing the circuit with a bounceless contact device. Oscillograms shall be provided with the test report documenting this characteristic.

Each switch to be tested for electrical endurance shall first be tested for overload cycling at room ambient conditions, using the same voltage, electrical frequency, and the same pairs of contacts that will subsequently be used for the electrical endurance test. The switches shall close and open the overload current of a resistive circuit equal to 150% of the resistive load rating at the particular voltage and electrical frequency. The cycling rate shall be five cycles to six cycles of operation per minute. 50 cycles of operation shall be performed. The duty cycle shall be approximately 50 % on, 50% off. Switches shall make and break the specified electrical load for 25,000 cycles of operation. The cycling shall be continuous, except at the option of the contractor, cycling may be interrupted after each 5,000 cycles of operation. When switches are tested as specified, no contact shall fail to open or close its individual circuit in proper sequence.

The UUT's shall be mounted in the test chamber and the pressure reduced to the value indicated. While the specimens are maintained at the specified pressure, and after sufficient time has been allowed for all entrapped air in the chamber to escape, the UUT's shall be subjected to the specified tests.

The switches tested for electrical endurance at the rated resistive current shall be tested immediately thereafter for temperature rise. The temperature rise shall not exceed 50°C when measured as specified. The temperature shall be considered stable when three successive readings taken at 5 minute intervals indicate no change in temperature. The contact resistance shall not exceed 1% of the load resistance using the electrical parameters of the electrical endurance test load. After the test, switches shall be electrically and mechanically operative; there shall be no deformation, melting, delamination, or blistering of the pushbutton/lens assembly and the legend shall be legible.

Electrical tolerances are as follows: Voltage: $\pm 5\%$ for dc, $\pm 7\%$ for ac. Frequency: $\pm 5\%$. Current: $\pm 5\%$.

When switches are tested, post endurance, for Dielectric withstanding voltage, there shall be no flashover, arcing, breakdown, or current flow in excess of 500 microamperes.

NOTE: As per MIL-PRF-22885G, paragraph 4.7.19.1, section c.(3):
Dielectric withstanding measurement between all unconnected contact terminals of the same pole is not applicable after electrical endurance.

NOTE: As per MIL-PRF-22885G, paragraph 4.7.19.2:
Dielectric withstanding voltage potential is 400 volts RMS.

NOTE: As per MIL-PRF-22885G, paragraph 4.7.28.1, condition j:
Altitude electrical tests shall be conducted at room temperature conditions only.

Procedure:

Leads of sufficient length and size were attached to all necessary contacts of the test units to connect to the test equipment. Using normal mounting means and hardware, attach the test units to the Actuation Holding Fixture affixed to the Pneumatic Actuator.

As double throw switches, one-half of the poles within each of the two switches were tested with the load circuit connected to one throw (NC), and the remaining poles were tested with the load circuit connected to the other throw (NO).

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Test loads are arranged so that an independent load is provided for each pole tested and continuously monitored and recorded to determine whether any contact has failed to open or close its individual circuit in the proper sequence. The Load Resistors were adjusted as necessary to obtain a current of 7.5 (\pm 0.375)(5%) amperes for Overload and 5.0 (\pm 0.25)(5%) amperes for Endurance with the DC Power Supply set to 28 (\pm 1.4)(5%) Vdc. The monitoring circuit did not shunt switch contacts. See Figure 7. Resistive Load Test Set-Up. The duty cycle was set to approximately 50% on and 50% off with a cycling rate of 10 to 12 cycles per minute. \geq 50 cycles of operation were executed for Overload and \geq 25000 cycles for Endurance. LED's were energized.

Poles tested on 243098-1:

D-NC
C-NO
B-NO
A-NC

Poles tested on 243098-2:

D-NO
C-NC
B-NC
A-NO

Poles tested on 243123-1:

D-NC
C-NO
B-NO
A-NC

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TEST: ELECTRIC ENDURANCE (RESISTIVE LOAD, DC) ALTITUDE	TEST SPECIFICATION: MIL – PRF – 22885G Requirements Paragraph 3.33 Test Method Paragraph 4.7.28	DATES STARTED & COMPLETED: 08-26-2011 & 09-01-2011
		TEMPERATURE & HUMIDITY 24.0° C & 55 % R.H.
UUT TRACKING NUMBERS: 243098-1, 243098-2 & 243123-1		TEST PERFORMED BY: D. Hubert

ACTION		RESULTS	COMPLIES WITH REQUIREMENTS
243098-1	50 cycles @ 7.5 Amps Resistive DC Load	≥ 50 cycles without instance	See Below
	25000 cycles @ 5 Amps Resistive DC Load	≥ 25000 cycles without instance	See Below
	Post Endurance Temperature Rise, Max current in still air.	Temperature rise ≤ 50°C	See Below
	Post Endurance Contact Resistance. 1% VDC drop allowed over contacts: 280 mVolts	Highest measurement Pass Value ≤ 1%	See Below
	Dielectric Withstanding Voltage, 400 volts RMS, 60 seconds	≤ 500 microamperes current flow	See Below
243098-2	50 cycles @ 7.5 Amps Resistive DC Load	≥ 50 cycles without instance	✓
	25000 cycles @ 5 Amps Resistive DC Load	≥ 25000 cycles without instance	✓
	Post Endurance Temperature Rise, Max current in still air.	Temperature rise ≤ 50°C	✓
	Post Endurance Contact Resistance. 1% VDC drop allowed over contacts: 280 mVolts	Highest measurement Pass Value ≤ 1%	✓
	Dielectric Withstanding Voltage, 400 volts RMS, 60 seconds	≤ 500 microamperes current flow	✓
243123-1	50 cycles @ 7.5 Amps Resistive DC Load	≥ 50 cycles without instance	✓
	25000 cycles @ 5 Amps Resistive DC Load	≥ 25000 cycles without instance	✓
	Post Endurance Temperature Rise, Max current in still air.	Temperature rise ≤ 50°C	✓
	Post Endurance Contact Resistance. 1% VDC drop allowed over contacts: 280 mVolts	Highest measurement Pass Value ≤ 1%	✓
	Dielectric Withstanding Voltage, 400 volts RMS, 60 seconds	≤ 500 microamperes current flow	✓

UUT 243123-1					UUT 243098-2				
Common to:	Test #, Readings in mVolts DC			% of Highest Reading	Common to:	Test #, Readings in mVolts DC			% of Highest Reading
	1	2	3			1	2	3	
A-NO	104.0	57.0	87.0	0.37	A-NO	67.0	97.0	116.0	0.41
B-NC	76.0	66.0	67.0	0.27	B-NC	126.0	98.0	74.0	0.45
C-NC	38.0	19.0	24.0	0.14	C-NC	54.0	29.0	44.0	0.19
D-NO	47.0	91.0	33.0	0.33	D-NO	41.0	39.0	46.0	0.16

PASS Condition : No measurements > 500 Microamps current flow : (see NOTE in Requirements section)			
UUT 243123-1	Miliamps Measured	UUT 243098-2	Miliamps Measured
A1, 2 & 3 to B1, 2 & 3	0.009	A1, 2 & 3 to B1, 2 & 3	0.009
B1, 2 & 3 to C1, 2 & 3	0.009	B1, 2 & 3 to C1, 2 & 3	0.010
C1, 2 & 3 to D1, 2 & 3	0.010	C1, 2 & 3 to D1, 2 & 3	0.009
All Pins (including lamp pins 4 through 9) to housing	0.016	All Pins (including lamp pins 4 through 9) to housing	0.019

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243098-2 Post Endurance Temperature Rise All readings in °C.
 Passing $\leq 50^{\circ}\text{C}$ Delta.

NOTE: Temperature stabilized on all poles over a ≥ 15 minute period

Lowest Ambient Temp: 26.3				Lowest Ambient Temp: 27.0			
Highest Temp Pole A: 37.4		Highest Temp Pole D: 40.4		Highest Temp Pole B: 49.8		Highest Temp Pole C: 44.7	
Delta to Ambient: 11.1		Delta to Ambient: 14.1		Delta to Ambient: 22.8		Delta to Ambient: 17.7	
Highest variance: 2.9		Highest variance: 3.9		Highest variance: 1.1		Highest variance: 1.3	
9:30	26.3	34.5	36.5	10:46	27.0	48.8	43.4
9:35	26.7	35.7	37.7	10:51	27.5	49.8	44.6
9:40	26.9	36.7	39.2	10:56	27.5	49.8	44.7
9:45	27.0	36.7	39.9	11:01	27.4	49.8	44.5
9:50	26.9	37.0	40.1	11:06	27.3	49.7	44.5
9:55	26.8	37.1	40.0	11:11	27.3	49.4	44.3
10:00	26.8	37.0	40.2	11:16	27.4	49.6	44.4
10:05	26.9	37.2	40.3	11:21	27.1	49.3	44.1
10:10	27.1	37.3	40.4	11:26	27.3	49.4	44.1
10:15	27.0	37.4	40.4	11:31	27.5	49.5	44.4
10:20	26.9	37.2	40.3	11:36	27.5	49.5	44.3
10:25	26.9	37.2	40.3	11:41	27.2	49.4	43.9
10:30	26.9	37.1	40.2	11:46	27.2	49.3	43.9

243113-1 Post Endurance Temperature Rise All readings in °C.
 Passing $\leq 50^{\circ}\text{C}$ Delta.

NOTE: Temperature stabilized on all poles over a ≥ 15 minute period

Lowest Ambient Temp: 25.7				Lowest Ambient Temp: 26.8			
Highest Temp Pole A: 41.4		Highest Temp Pole B: 44.2		Highest Temp Pole B: 40.1		Highest Temp Pole C: 38.8	
Delta to Ambient: 15.7		Delta to Ambient: 18.5		Delta to Ambient: 13.3		Delta to Ambient: 12.0	
Highest variance: 0.8		Highest variance: 0.5		Highest variance: 0.7		Highest variance: 0.8	
13:32	25.8	41.2	43.8	12:05	27.0	39.7	38.5
13:37	25.8	41.1	43.8	12:10	27.1	40.0	38.7
13:42	25.7	41.4	44.1	12:15	27.1	40.1	38.8
13:47	25.8	41.4	44.2	12:20	27.0	39.5	38.0
13:52	25.9	41.1	43.9	12:25	26.9	39.7	38.3
13:57	25.8	41.4	44.2	12:30	27.0	39.8	38.6
14:02	25.8	41.1	44.1	12:35	27.2	40.1	38.8
14:07	25.8	40.7	43.8	12:40	27.0	39.4	38.0
14:12	25.7	41.1	44.0	12:45	26.8	39.6	38.3
14:17	25.8	41.3	44.2	12:50	27.0	39.8	38.6
14:22	25.8	40.7	43.8	12:55	27.0	39.8	38.5
14:27	25.9	41.1	44.0	13:00	26.8	39.4	38.1
14:32	25.9	41.1	44.1	13:05	26.9	39.8	38.5

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NOTE for UUT 243098-1:

ABSTRACT:

The UUT (Sample 243098-1) failed during test setup for Electric Endurance, Resistive Load, DC, Ambient Temperature at Altitude. Once the mounting and installation was concluded, it was determined during the electro-mechanical pretest that only Pole A was functioning properly and poles B, C & D were not. The only previous use/testing by engineering conducted on the UUT was for luminance at 5VDC, mounting to a small face plate, and soldering wires to all poles to be used in the endurance testing. Contained below are statements to support and illustrate this finding.

CONCLUSION:

Due to improper installation of the switch base (portion that contains poles A thru D), the fastening snap base tabs had been damaged (creating cracks thru the tabs), thus disallowing proper fitment/holding strength into the interfacing switch housing.

CORRECTIVE ACTION:

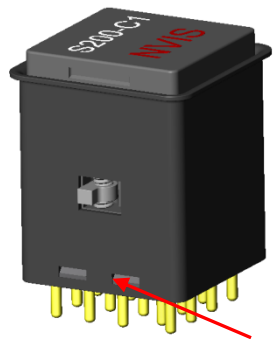
Ensuring proper installation of the switch base into the switch housing during final assembly must be maintained by abiding by the proper work instruction as set forth by manufacturing and process engineering. Units will not only require mechanical testing but visual inspection as well.

DISASSEMBLY PROCEDURE:

Prior to disassembly, the failed UUT was visually examined for abnormalities. The switch base was noticeably protruding below the housing on one side with the tabs. (Note: the header base bottom surface should be sitting flush to the switch housing bottom surface in all locations of this interface). On one side location, it was exhibited that one snap base tab had been completely sheared off and the other was loosely connected to the switch base (there are 2 snap base tabs per side on each switch base on opposite sides [180 degrees apart] of each other, 4 snap tabs total). During disassembly when opening the housing, the loose snap base tab had fallen off completely, leaving this one said side of the header base completely free of its snap base tabs.

OBSERVATIONS/ROOT CAUSE ANALYSIS:

Root cause analysis immediately leads to the fact that the base snap tabs were damaged prior to testing and most likely during installation. The UUT did not have all base snap tabs properly installed into the housing which lead to the switch base protruding out the housing. With the switch base not securely locked in, the actuator link will not allow all four poles to actuate properly. Subsequent verification was completed with a new header base being installed and confirming that proper actuation occurs when all 4 base snap tabs are engaged properly in the switch housing.



base snap tabs (2 per side)

Roger Kwan, Design/Process Engineer

✓: Denotes compliance with the specified test requirements

CONCLUSION: Required number of Test Units met the above test requirements.

CAGE CODE
12522

DRAWING NO.
TR – 012 – S200

REV. SHT.
1.0 65

7.24 Electric Endurance (Inductive Load, DC) At Altitude

Testing Requirements:

The dc power source shall provide the rated or inrush current on resistive loads within 300 μ s after closing the circuit with a bounceless contact device. Oscillograms shall be provided with the test report documenting this characteristic.

Each switch to be tested for electrical endurance shall first be tested for overload cycling at room ambient conditions, using the same voltage, electrical frequency, and the same pairs of contacts that will subsequently be used for the electrical endurance test. The switches shall close and open the overload current of a resistive circuit equal to 150% of the resistive load rating at the particular voltage and electrical frequency. The cycling rate shall be five cycles to six cycles of operation per minute. 50 cycles of operation shall be performed. The duty cycle shall be approximately 50 % on, 50% off. Switches shall make and break the specified electrical load for 25,000 cycles of operation. The cycling shall be continuous, except at the option of the contractor, cycling may be interrupted after each 5,000 cycles of operation. When switches are tested as specified, no contact shall fail to open or close its individual circuit in proper sequence.

The UUT's shall be mounted in the test chamber and the pressure reduced to the value indicated. While the specimens are maintained at the specified pressure, and after sufficient time has been allowed for all entrapped air in the chamber to escape, the UUT's shall be subjected to the specified tests.

The switches tested for electrical endurance at the rated resistive current shall be tested immediately thereafter for temperature rise. The temperature rise shall not exceed 50°C when measured as specified. The temperature shall be considered stable when three successive readings taken at 5 minute intervals indicate no change in temperature. The contact resistance shall not exceed 1% of the load resistance using the electrical parameters of the electrical endurance test load. After the test, switches shall be electrically and mechanically operative; there shall be no deformation, melting, delamination, or blistering of the pushbutton/lens assembly and the legend shall be legible.

Electrical tolerances are as follows: Voltage: $\pm 5\%$ for dc, $\pm 7\%$ for ac. Frequency: $\pm 5\%$. Current: $\pm 5\%$.

When switches are tested, post endurance, for Dielectric withstanding voltage, there shall be no flashover, arcing, breakdown, or current flow in excess of 500 microamperes.

NOTE: As per MIL-PRF-22885G, paragraph 4.7.19.1, section c.(3):
Dielectric withstanding measurement between all unconnected contact terminals of the same pole is not applicable after electrical endurance.

NOTE: As per MIL-PRF-22885G, paragraph 4.7.19.2:
Dielectric withstanding voltage potential is 400 volts RMS.

NOTE: As per MIL-PRF-22885G, paragraph 4.7.28.1, condition j:
Altitude electrical tests shall be conducted at room temperature conditions only.

Procedure:

Leads of sufficient length and size were attached to all necessary contacts of the test units to connect to the test equipment. Using normal mounting means and hardware, attach the test units to the Actuation Holding Fixture affixed to the Pneumatic Actuator.

As double throw switches, one-half of the poles within each of the two switches were tested with the load circuit connected to one throw (NC), and the remaining poles were tested with the load circuit connected to the other throw (NO).

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Test loads are arranged so that an independent load is provided for each pole tested and continuously monitored and recorded to determine whether any contact has failed to open or close its individual circuit in the proper sequence. The Load Resistors were adjusted as necessary to obtain a current of $3.75 (\pm 0.1875)(5\%)$ amperes for Overload and $2.5 (\pm 0.125)(5\%)$ amperes for Endurance with the DC Power Supply set to $28 (\pm 1.4)(5\%)$ Vdc. The monitoring circuit did not shunt switch contacts. See Figure 6. Inductive DC Load. The duty cycle was set to approximately 50% on and 50% off with a cycling rate of 10 to 12 cycles per minute. ≥ 50 cycles of operation were executed for Overload and ≥ 25000 cycles for Endurance. LED's were energized.

Poles tested on 243098-3:

D-NO
C-NC
B-NC
A-NO

Poles tested on 243098-4:

D-NC
C-NO
B-NO
A-NC

Poles tested on 243123-3:

D-NO
C-NC
B-NC
A-NO

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TEST: ELECTRIC ENDURANCE (INDUCTIVE LOAD, DC) ALTITUDE	TEST SPECIFICATION: MIL – PRF – 22885G Requirements Paragraph 3.33 Test Method Paragraph 4.7.28	DATES STARTED & COMPLETED: 08-22-2011 & 09-15-2011
UUT TRACKING NUMBERS: 243098-3, 243098-4 & 243128-3		TEMPERATURE & HUMIDITY 24.0° C & 56 % R.H.
		TEST PERFORMED BY: D. Hubert

ACTION		RESULTS	COMPLIES WITH REQUIREMENTS
243098-3	50 cycles @ 3.75 Amps Inductive DC Load	≥ 50 cycles without instance	✓
	25000 cycles @ 2.5 Amps Inductive DC Load	≥ 25000 cycles without instance	✓
	Post Endurance Contact Inductive. 1% VDC drop allowed over contacts: 280 mVolts	Highest measurement Pass Value ≤ 1%	✓
	Dielectric Withstanding Voltage, 400 volts RMS, 60 seconds	≤ 500 microamperes current flow	FAILED See Note Below
243098-4	50 cycles @ 3.75 Amps Inductive DC Load	≥ 50 cycles without instance	✓
	25000 cycles @ 2.5 Amps Inductive DC Load	≥ 25000 cycles without instance	✓
	Post Endurance Contact Inductive. 1% VDC drop allowed over contacts: 280 mVolts	Highest measurement Pass Value ≤ 1%	✓
	Dielectric Withstanding Voltage, 400 volts RMS, 60 seconds	≤ 500 microamperes current flow	✓
243123-3	50 cycles @ 3.75 Amps Inductive DC Load	≥ 50 cycles without instance	✓
	25000 cycles @ 2.5 Amps Inductive DC Load	≥ 25000 cycles without instance	✓
	Post Endurance Contact Inductive. 1% VDC drop allowed over contacts: 280 mVolts	Highest measurement Pass Value ≤ 1%	✓
	Dielectric Withstanding Voltage, 400 volts RMS, 60 seconds	≤ 500 microamperes current flow	✓

✓: Denotes compliance with the specified test requirements

CONCLUSION: Required number of Test Units met the above test requirements.

UUT 243098-3					UUT 243098-4				
Common to:	Test #, Readings in mVolts DC			% of Highest Reading	Common to:	Test #, Readings in mVolts DC			% of Highest Reading
	1	2	3			136.0	123.0	208.0	
A-NO	124.0	164.0	189.0	0.68	A-NO	64.0	51.0	81.0	0.74
B-NC	132.0	115.0	137.0	0.49	B-NC	93.0	141.0	91.0	0.29
C-NC	190.0	104.0	186.0	0.68	C-NC	35.0	64.0	41.0	0.50
D-NO	160.0	141.0	210.0	0.75	D-NO	136.0	123.0	208.0	0.23
UUT 243123-3									
Common to:	Test #, Readings in mVolts DC			% of Highest Reading					
	1	2	3						
A-NO	132.0	113.0	142.0	0.51					
B-NC	96.0	110.0	102.0	0.39					
C-NC	130.0	125.0	152.0	0.54					
D-NO	189.0	165.0	152.0	0.68					
	132.0	113.0	142.0	0.51					

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PASS Condition : No insulation measurements > 500 Microamps current flow :
(see NOTE in Requirements section)

UUT 243098-3	Miliamps Measured	UUT 243098-4	Miliamps Measured	UUT 243123-3	Miliamps Measured
A1, 2 & 3 to B1, 2 & 3	≥ 30.0	A1, 2 & 3 to B1, 2 & 3	0.015	A1, 2 & 3 to B1, 2 & 3	0.008
B1, 2 & 3 to C1, 2 & 3	0.017	B1, 2 & 3 to C1, 2 & 3	0.014	B1, 2 & 3 to C1, 2 & 3	0.012
C1, 2 & 3 to D1, 2 & 3	0.013	C1, 2 & 3 to D1, 2 & 3	0.013	C1, 2 & 3 to D1, 2 & 3	0.009
All Pins (including lamp pins 4 through 9) to housing	0.028	All Pins (including lamp pins 4 through 9) to housing	0.026	All Pins (including lamp pins 4 through 9) to housing	0.016

NOTE for UUT 243098-3:

ANALYSIS

- Confirmed dielectric test failure through bench testing.
- Removed switch mechanism from metal enclosure--continued to fail test.
- Removed insulator housing from contact mechanism--noted normal large amounts of debris due to contact erosion from the inductive load test. Also noted a small nick in the plastic near the associated dielectric shut-off area between switch poles.
- Tested the unprotected (insulator housing removed) contact mechanism--passed test.
- Re-installed insulator housing--failed test.
- Removed insulator housing second time from contact mechanism--passed test.
- Removed some of the contact debris from the insulator housing (lightly dry brushed) around the nicked area, which is the closest point between the contact poles where failure occurred.
- Re-installed insulator housing--repeatedly passed test.

CONCLUSION

- The metallic debris from normal contact erosion under inductive electrical load provided a leak path between adjacent switch Pole A and Pole B.
- The leak path was augmented by the nick/void in the edge of the insulator housing.
- This is the first occurrence of this condition in over 30 poles of Pre-qualification testing and 20 poles of Qualification.
- This is likely a random failure.

CORRECTIVE ACTION

- Inspect insulator housings in stock for any voids or nicks that could promote a leak path.
- Note in the inspection folder to watch for nicks or voids in dielectric shut-off areas of this and the mating parts.

Roy Hart, Principle Design Engineer

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7.25 Mechanical Endurance

MIL-PRF-22885/115 DRAFT:

Mechanical endurance: 1,000,000 cycles consists of 5,000 cycles of operation at $-55^{\circ}\text{C} \pm 2^{\circ}\text{C}$, 10,000 cycles of operation at $+85^{\circ}\text{C} \pm 2^{\circ}\text{C}$, and 985,000 cycles of operation at room temperature.

Testing Requirements:

Switches shall be electrically and mechanically operative. No contact shall fail to open or close its individual circuit in proper sequence. The switches shall be subjected to 5,000 cycles of operation at $-55^{\circ}\text{C} \pm 2^{\circ}\text{C}$, 10,000 cycles of operation at $85^{\circ}\text{C} \pm 2^{\circ}\text{C}$, and 35,000 (Exception: Additional cycles performed as per **MIL-PRF-22885/115 DRAFT**) cycles of operation at room temperature. The cycling rate shall not exceed 100 cycles of operation per minute and shall not be less than 10 cycles of operation per minute. Each cycle of operation shall be the movement of the actuating means through the entire range of its travel (from free position to full overtravel position and return to the fully released position) causing the switch contacts to change from one position to another and then return to their original position. All switches except those with push-pull operation shall be returned from their depressed position solely by the internal mechanism of the switch. Switches shall be continuously monitored to determine whether any contact has failed to open or close its individual circuit in proper sequence. Lamps shall not be energized.

Procedure:

Leads of sufficient length were attached to all contacts of the test units to connect to the test equipment. Using normal mounting means and hardware, test units were attached to the Actuation Holding Fixture affixed to the Pneumatic Actuator. To accommodate the number of counters available, like terminal connections of each switch pole were connected in series. Test loads are arranged so that an independent load is provided for each pole group tested. Actuation cycle was set to approximately 60/minute and continuously monitored and recorded to determine whether any contact has failed to open or close its individual circuit in the proper sequence.

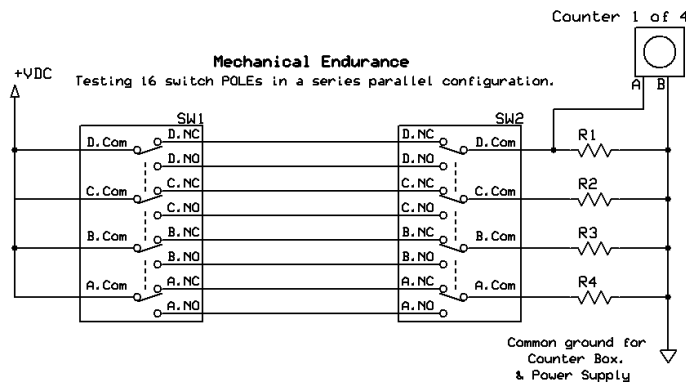


Figure 9. Mechanical Endurance Set-up

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TEST: MECHANICAL ENDURANCE	TEST SPECIFICATION: MIL – PRF – 22885G Requirements Paragraph 3.34 Test Method Paragraph 4.7.29	DATES STARTED & COMPLETED: 07-07-2011 & 07-24-2011
UUT TRACKING NUMBERS: 243108-1 & 243108-2		TEMPERATURE & HUMIDITY 24.5° C & 50 % R.H.
		TEST PERFORMED BY: D. Hubert

ACTION	RESULTS	COMPLIES WITH REQUIREMENTS
07-07-11, 5000 cycles @ -55°C ±2°C	≥ 5,000 cycles without instance	✓
07-08-11, 10000 cycles @ 85°C ±2°C	≥ 10,000 cycles without instance	✓
07-08-11, 985,000 cycles of operation at room temperature	≥ 985,000 cycles without instance	✓
Operating characteristics for 243108-1	Actuation force (2 to 5 pounds):	✓
	Actuation Travel 0.070" ±0.005"):	✓
	Break Before Make:	✓
	Momentary switches shall transfer as required when actuated. (Hold position):	✓
	Momentary Switches shall return to the normal position after released	✓
Operating characteristics for 243108-2	Actuation force (2 to 5 pounds):	✓
	Actuation Travel 0.070" ±0.005"):	✓
	Break Before Make:	✓
	Momentary switches shall transfer as required when actuated. (Hold position):	✓
	Momentary Switches shall return to the normal position after released	✓

✓: Denotes compliance with the specified test requirements

CONCLUSION: All Test Units met the above test requirements.

243108-1		243108-2	
Actuation force in pounds:	3.01	Actuation force:	2.75
Actuation Travel in inches:	0.072	Actuation Travel:	0.069
Break Before Make:	✓	Break Before Make:	✓
Transfer as required when actuated:	✓	Transfer as required when actuated:	✓
Return to the normal position after released:	✓	Return to the normal position after released:	✓

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7.26 Low level life

MIL-PRF-22885/115 DRAFT:

Operating temperature: The switches are tested in accordance to the requirements of MIL-PRF-22885: (Table 4. S200 Operating Temperatures)

Low level circuit: The switches are tested in accordance to the requirements of MIL-PRF-22885, and ML-STD-202, Method 311.

Testing Requirements:

The contact resistance of any individual switch circuit shall be less than 3.0 ohms during each contact closure. No contact shall fail to open or close its individual circuit in proper sequence. Fifty thousand at a rate not to exceed 60 cycles per minute with "ON" and "OFF" times approximately equal as follows:

- (1) Twenty-five percent of the test cycles at the minimum temperature specified (12500 cycles @ -55°C.)
- (2) Twenty-five percent of the test cycles at room ambient temperature (25000 cycles @ +25°C.).
- (3) Fifty percent of the cycles at the maximum temperature specified (12500 cycles @ +85°C.).

The power source for the open circuit voltage shall not exceed 30 millivolts DC maximum at 10 milliamps (mA) maximum

Procedure:

Leads of sufficient length were attached to all contacts of the test units to connect to the test equipment. The UUT Indicators were not illuminated for this test as per Table 4. S200 Operating Temperatures. Using normal mounting means and hardware, test units were attached to the Actuation Holding Fixture affixed to the Pneumatic Actuator. Test loads are arranged so that an independent load is provided for each switch pole. The Load Resistors were adjusted as necessary to obtain a current of 10uAmps at 30mVDC. The monitoring circuit did not shunt switch contacts. Actuation cycle was set to approximately 20/minute and continuously monitored and recorded to determine whether any contact has failed to open or close its individual circuit in the proper sequence.

TEST: LOW LEVEL LIFE		TEST SPECIFICATION: MIL – PRF – 22885G Requirements Paragraph 3.36 Test Method Paragraph 4.7.31	DATES STARTED & COMPLETED: 07-27-2011 & 09-19-2011
UUT TRACKING NUMBERS: 243158-1, 243158-2, 243113-1, 243113-2 & 243138-2			TEMPERATURE & HUMIDITY 27° C & 45 % R.H.
			TEST PERFORMED BY: D. Hubert
UUT	ACTION	RESULTS	COMPLIES WITH REQUIREMENTS
243158-1 & 243158-2	07-27-11, 12500 cycles @ 85°C ±2°C (Indicators not energized)	≥ 25000 cycles without instance	✓
	07-28-11, 12500 cycles @ -55°C ±2°C (Indicators energized)	≥ 12000 cycles without instance	✓
	07-29-11, 25000 cycles of operation at room temperature	≥ 12000 cycles without instance	✓
Operating characteristics for 243158-1		Actuation force (2 to 5 pounds):	✓
		Actuation Travel 0.070" ±0.005"):	✓
		Break Before Make:	✓
		Alternate switches shall transfer as required when actuated. (Push/Release):	✓
		Alternate Switches shall return to the original position after second actuation	✓

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Operating characteristics for 243158-2		Actuation force (2 to 5 pounds):	✓
		Actuation Travel 0.070" ±0.005"):	✓
		Break Before Make:	✓
		Alternate switches shall transfer as required when actuated. (Push/Release):	FAILED See Note Below
		Alternate Switches shall return to the original position after second actuation	FAILED See Note Below
UUT	ACTION	RESULTS	COMPLIES WITH REQUIREMENTS
243113-1 & 243113-2	09-07-11, 12500 cycles @ 85°C ±2°C (Indicators not energized)	≥ 25000 cycles without instance	✓
	09-05-11, 12500 cycles @ -55°C ±2°C (Indicators energized)	≥ 12000 cycles without instance	✓
	09-01-11, 25000 cycles of operation at room temperature	≥ 12000 cycles without instance	✓
Operating characteristics for 243113-1		Actuation force (2 to 5 pounds):	✓
		Actuation Travel 0.070" ±0.005"):	✓
		Break Before Make:	✓
		Alternate switches shall transfer as required when actuated. (Push/Release):	✓
		Alternate Switches shall return to the original position after second actuation	✓
Operating characteristics for 243113-2		Actuation force (2 to 5 pounds):	✓
		Actuation Travel 0.070" ±0.005"):	✓
		Break Before Make:	✓
		Alternate switches shall transfer as required when actuated. (Push/Release):	✓
		Alternate Switches shall return to the original position after second actuation	✓
UUT	ACTION	RESULTS	COMPLIES WITH REQUIREMENTS
243138-2	09-12-11, 12500 cycles @ 85°C ±2°C (Indicators not energized)	≥ 25000 cycles without instance	✓
	09-14-11, 12500 cycles @ -55°C ±2°C (Indicators energized)	≥ 12000 cycles without instance	✓
	09-15-11, 25000 cycles of operation at room temperature	≥ 12000 cycles without instance	✓
Operating characteristics for 243138-2		Actuation force (2 to 5 pounds):	✓
		Actuation Travel 0.070" ±0.005"):	✓
		Break Before Make:	✓
		Alternate switches shall transfer as required when actuated. (Push/Release):	✓
		Alternate Switches shall return to the original position after second actuation	✓
✓: Denotes compliance with the specified test requirements			
CONCLUSION: Required Test Units met the above test requirements.			

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243158-1		243158-2	
Actuation force in pounds:	3.1	Actuation force:	3.1
Actuation Travel in inches:	0.069	Actuation Travel:	0.070
Break Before Make:	✓	Break Before Make:	✓
Transfer as required when actuated:	✓	Transfer as required when actuated:	FAILED See Note Below
Return after second actuation:	✓	Return after second actuation:	FAILED See Note Below
243113-1		243113-2	
Actuation force in pounds:	3.0	Actuation force:	3.2
Actuation Travel in inches:	0.067	Actuation Travel:	0.072
Break Before Make:	✓	Break Before Make:	✓
Transfer as required when actuated:	✓	Transfer as required when actuated:	✓
Return after second actuation:	✓	Return after second actuation:	✓
243138-2			
Actuation force in pounds:	3.3		
Actuation Travel in inches:	0.069		
Break Before Make:	✓		
Transfer as required when actuated:	✓		
Return after second actuation:	✓		

NOTE for UUT 243158-2:

FAILURE EVALUATION:

- Switch reported to operate as Momentary Action when it should be Alternate Action only after successfully completing the endurance test.
- Confirmed that the switch operates as a Momentary Action, but it is specified to be Alternate Action.
- Disassembly and inspection revealed that the switch is constructed as an Alternate Action device.
- Detailed inspection of internal parts revealed a small piece of plastic, black in color similar to that of the ULTEM 1000 used for the immediate enclosure, was laying in the path of one of four poles' contact operating levers. The plastic was adjacent to one of the ejector pin recesses in the plastic enclosure and appeared to be ejector pin flash. Removal of this tiny piece of material with a brush and re-assembly of the mechanism restored Alternate Action function.

ANALYSIS:

- FOD Interference with the contact arm interfered with mechanism travel, which in turn, prevented the cam follower pin from properly following the cam track.
- Limited travel of the cam follower pin within the cam track prevented the Alternate Action mechanism from "committing to latch", thus it became Momentary Action.
- The failure occurred during post-test functional evaluation.
- The FOD was estimated to be ejector pin flash.
- This is the first instance of this anomaly in approximately 300 units produced.

CORRECTIVE ACTION:

- Re-inspect all material in stock for ejector pin flash and other possible FOD (Housing B P/N 114303).
- Review cleaning and stocking procedures for this part and other similar parts for this product and take appropriate measures to assure clean, flash-free parts reach the assembly station.

Roy Hart, Principle Design Engineer

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7.27 EMI/RFI shielding

MIL-PRF-22885/115 DRAFT:

EMI/RFI Shielding: The pushbutton switches are tested in accordance to the requirements of MIL-PRF-22885.

Testing Requirements:

When switches are tested as specified in 4.7.33.2, the shielding attenuation shall be not less than 60 dB over the frequency range from 100 MHz to 1,000 MHz.

Procedure:

Leads of sufficient length were attached to all contacts of the test units to connect to the test equipment. The UUT Indicators were illuminated throughout the test. Using normal mounting means and hardware, test units were attached to the S200 EMI Test Panel.

Switches are tested utilizing a test setup (or equivalent) as shown on figure 8 of MIL-PRF-22885G. Measurements are taken as follows:

- a. With the door open and the antennas in the "initial setup" position, establish a test level over the 200 MHz to 1 GHz range such that the received signal level is at least as many dB above the RF ambient level as that of the shielded enclosure attenuation.
- b. Record the received signal level and the signal generator output level. Repeat measurements at 100 MHz, 200 MHz, 400 MHz, 600 MHz, 800 MHz and 1,000 MHz.
- c. Move the antennas to the final test positions, close the door and with an RF-tight blank panel between the antennas, measure the integrity of the enclosure by setting the signal generator to the same output and record the received signal level for each frequency used in 4.7.33.2b. The shielded enclosure attenuation is then calculated using the following equation:

$$\text{Attenuation (dB)} = 20 \log E1$$

Where E1 is the receiver reading in 4.7.33.2b and E2 is the receiver reading in 4.7.33.2c.

- d. Mount the test switch in the blank panel with the rear of the switch outside of the shielded enclosure (toward the signal generator antenna). The switch shall be mounted as it would be for normal installation using the mounting hardware supplied or recommended. Repeat the measurements of 4.7.33.2c above and calculate the shielding attenuation of the switch using the new receiver readings.

TEST: EMI/RFI SHIELDING	TEST SPECIFICATION: MIL – PRF – 22885G Requirements Paragraph 3.38 Test Method Paragraph 4.7.33	DATES STARTED & COMPLETED: 08-03-2011 & 08-05-2011
UUT TRACKING NUMBERS: 243054-1, 243054-2, 243074-1 & 243074-2		TEST PERFORMED BY: EMC TEMPEST Engineering
ACTION	RESULTS	COMPLIES WITH REQUIREMENTS
Switches were testing in accordance to MIL-PRF-22885G as described. Each switch was independently tested for shielding effectiveness in each of two polarities.	A shielding effectiveness of ≥ 60 dB over a frequency range of 100 to 1000 MHz.	✓
✓: Denotes compliance with the specified test requirements.		
CONCLUSION: All Test Units met the above test requirements.		
NOTE: Complete test results are provided in the attachment "EMC TEMPEST Engineering EMI Test".		

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7.28 Seal, Splash Proof

MIL-PRF-22885/115 DRAFT:

Splash Proof Seal: The pushbutton switches are tested in accordance to the requirements of MIL-PRF-22885G and MIL-STD-108E.

Testing Requirements:

While operating, test units shall be subjected to a course spray from a distance of 6 feet for a duration of 5 minutes minimum at all exposed enclosure surfaces and at surface at which enclosed equipment is mounted. The spray shall have a flow rate of 15 gallons per minute minimum and with a pressure head of not less than 10 feet.

Following the Seal test there shall be no leakage of water through the panel seal or into the test unit as determined by visual inspection.

Within 24 hours of being subjected to the required water spray, the test units shall also meet the dielectric withstanding voltage requirements of 1000 volts rms when applied for a duration of one (1) minute as follows:

- Between all terminals and exposed noncurrent carrying metal or grounded parts.
- Between all terminals of mutually isolated circuits, including between poles.
- Between all open terminal of the same pole.

Test units shall be inspected for evidence of arching, flashover, breakdown of insulation, and damage. There shall be no flashover, arcing, or current flow in excess of 500 microamperes.

Procedure:

Verify the spray: Collect and measure the water flow rate. Verify a water flow rate of 15 gallons per minute minimum. For determination of adequate water pressure head, direct the test stream vertically (straight upward). Verify the stream rises to a height of not less than 10 feet.

Using the normal mounting means, with applicable hardware, flush mount the UUT's onto the adapter plate and onto the spray tight fixture. From a 6 foot distance direct the water spray onto the test units at all exposed surfaces for a period of one (1) minute. Temporally halt the water spray and operate the UUT. Repeat the one minute spray followed by the switch button and contact operation for a total test time of five (5) minutes of water spray. Carefully remove the test units from spray tight fixture and visually examine the test units. Verify there was no visible leakage of water through the panel seal or into the test unit.

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TEST: SEAL, SPLASH PROOF	TEST SPECIFICATION: MIL – PRF – 22885G Requirements Paragraph 3.25 Test Method Paragraph 4.7.20		DATES STARTED & COMPLETED: 08-31-2011 & 08-31-2011		
UUT TRACKING NUMBERS: 243123-2, 243123-4, 243143-1 & 243143-2			TEMPERATURE & HUMIDITY 29° C & 35 % R.H		
			TEST PERFORMED BY: D. Hubert		
ACTION				COMPLIES WITH REQUIREMENTS	
Verify a water flow rate of 15 gallons per minute minimum				✓	
Verify the stream rises to a height of not less than 10 feet				✓	
Verify there was no visible leakage of water through the panel seal or into the test unit.				✓	
PASS Condition Dielectric Withstanding: 1000 Vrms @ Sea Level with current flow ≤ 500 microamperes.					
UUT 243123-2	Miliamps Measured	Relaxed Condition	Miliamps Measured	Depressed Condition	Miliamps Measured
A1, 2 & 3 to B1, 2 & 3	0.075	D3 to D2	0.044	D3 to D1	0.040
B1, 2 & 3 to C1, 2 & 3	0.074	C3 to C2	0.043	C3 to C1	0.043
C1, 2 & 3 to D1, 2 & 3	0.065	B3 to B2	0.043	B3 to B1	0.043
All Pins (including lamp pins 4 through 9) to housing	0.018	A3 to A2	0.040	A3 to A1	0.042
PASS / FAIL : Pass					
UUT 243123-4	Miliamps Measured	Relaxed Condition	Miliamps Measured	Depressed Condition	Miliamps Measured
A1, 2 & 3 to B1, 2 & 3	0.074	D3 to D2	0.043	D3 to D1	0.041
B1, 2 & 3 to C1, 2 & 3	0.074	C3 to C2	0.042	C3 to C1	0.043
C1, 2 & 3 to D1, 2 & 3	0.065	B3 to B2	0.043	B3 to B1	0.042
All Pins (including lamp pins 4 through 9) to housing	0.018	A3 to A2	0.046	A3 to A1	0.040
PASS / FAIL : Pass					
UUT 243143-1	Miliamps Measured	Relaxed Condition	Miliamps Measured	Depressed Condition	Miliamps Measured
A1, 2 & 3 to B1, 2 & 3	0.221	D3 to D2	0.046	D3 to D1	0.042
B1, 2 & 3 to C1, 2 & 3	0.093	C3 to C2	0.044	C3 to C1	0.043
C1, 2 & 3 to D1, 2 & 3	0.064	B3 to B2	0.069	B3 to B1	0.077
All Pins (including lamp pins 4 through 9) to housing	0.247	A3 to A2	0.067	A3 to A1	0.059
PASS / FAIL : Pass					
UUT 243143-2	Miliamps Measured	Relaxed Condition	Miliamps Measured	Depressed Condition	Miliamps Measured
A1, 2 & 3 to B1, 2 & 3	0.074	D3 to D2	0.042	D3 to D1	0.041
B1, 2 & 3 to C1, 2 & 3	0.074	C3 to C2	0.043	C3 to C1	0.044
C1, 2 & 3 to D1, 2 & 3	0.064	B3 to B2	0.043	B3 to B1	0.043
All Pins (including lamp pins 4 through 9) to housing	0.043	A3 to A2	0.040	A3 to A1	0.040
PASS / FAIL : Pass					
✓: Denotes compliance with the specified test requirements.					
CONCLUSION: All Test Units met the above test requirements.					

CAGE CODE
12522

DRAWING NO.
TR – 012 – S200

REV. SHT.
1.0 77

TEST: SEAL, SPLASH PROOF	TEST SPECIFICATION: MIL – PRF – 22885G Requirements Paragraph 3.25 Test Method Paragraph 4.7.20				DATES STARTED & COMPLETED: 09-28-2011 & 09-28-2011	
UUT TRACKING NUMBERS: 243133-1 & 243133-2					TEMPERATURE & HUMIDITY 27° C & 55 % R.H	
				TEST PERFORMED BY: D. Hubert		
ACTION					COMPLIES WITH REQUIREMENTS	
Verify a water flow rate of 15 gallons per minute minimum					✓	
Verify the stream rises to a height of not less than 10 feet					✓	
Verify there was no visible leakage of water through the panel seal or into the test unit.					✓	
PASS Condition Dielectric Withstanding: 1000 Vrms @ Sea Level with current flow ≤ 500 microamperes.						
UUT 243133-1	Miliamps Measured	Relaxed Condition	Miliamps Measured	Depressed Condition	Miliamps Measured	
A1, 2 & 3 to B1, 2 & 3	0.076	D3 to D2	0.043	D3 to D1	0.039	
B1, 2 & 3 to C1, 2 & 3	0.075	C3 to C2	0.042	C3 to C1	0.042	
C1, 2 & 3 to D1, 2 & 3	0.064	B3 to B2	0.043	B3 to B1	0.042	
All Pins (including lamp pins 4 through 9) to housing	0.018	A3 to A2	0.040	A3 to A1	0.040	
PASS / FAIL :						Pass
UUT 243133-2	Miliamps Measured	Relaxed Condition	Miliamps Measured	Depressed Condition	Miliamps Measured	
A1, 2 & 3 to B1, 2 & 3	0.078	D3 to D2	0.044	D3 to D1	0.041	
B1, 2 & 3 to C1, 2 & 3	0.076	C3 to C2	0.042	C3 to C1	0.042	
C1, 2 & 3 to D1, 2 & 3	0.065	B3 to B2	0.044	B3 to B1	0.043	
All Pins (including lamp pins 4 through 9) to housing	0.021	A3 to A2	0.040	A3 to A1	0.040	
PASS / FAIL :						Pass
✓: Denotes compliance with the specified test requirements.						
CONCLUSION: All Test Units met the above test requirements.						

CAGE CODE	DRAWING NO.	REV.	SHT.
12522	TR – 012 – S200	1.0	78

TEST: SEAL, SPLASH PROOF	TEST SPECIFICATION: MIL – PRF – 22885G Requirements Paragraph 3.25 Test Method Paragraph 4.7.20				DATES STARTED & COMPLETED: 09-14-2011 & 09-14-2011	
UUT TRACKING NUMBERS: 243103-3 & 243103-4					TEMPERATURE & HUMIDITY 26° C & 55 % R.H	
				TEST PERFORMED BY: D. Hubert		
ACTION					COMPLIES WITH REQUIREMENTS	
Verify a water flow rate of 15 gallons per minute minimum					✓	
Verify the stream rises to a height of not less than 10 feet					✓	
Verify there was no visible leakage of water through the panel seal or into the test unit.					✓	
PASS Condition Dielectric Withstanding: 1000 Vrms @ Sea Level with current flow ≤ 500 microamperes.						
UUT 243103-3	Miliamps Measured	Relaxed Condition	Miliamps Measured	Depressed Condition	Miliamps Measured	
A1, 2 & 3 to B1, 2 & 3	0.070	D3 to D2	0.040	D3 to D1	0.039	
B1, 2 & 3 to C1, 2 & 3	0.070	C3 to C2	0.039	C3 to C1	0.037	
C1, 2 & 3 to D1, 2 & 3	0.060	B3 to B2	0.038	B3 to B1	0.036	
All Pins (including lamp pins 4 through 9) to housing	0.013	A3 to A2	0.034	A3 to A1	0.035	
						PASS / FAIL : Pass
UUT 243103-4	Miliamps Measured	Relaxed Condition	Miliamps Measured	Depressed Condition	Miliamps Measured	
A1, 2 & 3 to B1, 2 & 3		D3 to D2	0.038	D3 to D1	0.038	
B1, 2 & 3 to C1, 2 & 3		C3 to C2	0.037	C3 to C1	0.037	
C1, 2 & 3 to D1, 2 & 3		B3 to B2	0.039	B3 to B1	0.036	
All Pins (including lamp pins 4 through 9) to housing		A3 to A2	0.034	A3 to A1	0.036	
						PASS / FAIL : Pass
✓: Denotes compliance with the specified test requirements.						
CONCLUSION: All Test Units met the above test requirements.						

CAGE CODE	DRAWING NO.	REV.	SHT.
12522	TR – 012 – S200	1.0	79

7.29 Seal, Watertight

MIL-PRF-22885/115 DRAFT:

Splash Proof Seal: The pushbutton switches are tested in accordance to the requirements of MIL-PRF-22885G and MIL-STD-108E.

Testing Requirements:

The switches were submerged under 3 feet (1.3 psi) of water for 1 hour, while being manually operated for three complete cycles of operation. When tested as specified in MIL-STD-108E, there shall be no leakage of water through the panel seal into the lamp module or into the switch, determined by visual examination and the dielectric test of 4.7.19.1. Under group A visual inspection, there shall be no pinholes or other surface defects.

Procedure:

The switches were singularly mounted to the bottom of a 3-inch diameter, 4-foot long optically clear acrylic column held up vertically by a fixture. A clear measuring cup was placed directly below the switch in order to observe any leakage through the bottom of the switch. The column was filled with 3 feet of water, manually actuating the switch with a ½-inch diameter, 5-foot long PVC tube every 20 minutes for 1 hour. After completion of test, seals were extracted and switches were examined for any entry of water. Measuring cup was also examined for any leakage of water through the bottom of the switch. Switches were then subjected to dielectric testing per 4.7.19.1 of MIL-PRF-22885G.

CAGE CODE	DRAWING NO.	REV.	SHT.
12522	TR – 012 – S200	1.0	80

TEST: SEAL, WATERTIGHT	TEST SPECIFICATION: MIL – PRF – 22885G Requirements Paragraph 3.25 Test Method Paragraph 4.7.20.2 MIL – STD – 108E Watertight 4.13	DATES STARTED & COMPLETED: 09-20-2011 & 09-20-2011
UUT TRACKING NUMBERS: 250763-1, 250763-2, 250702-1, 250702-2		TEMPERATURE & HUMIDITY 27° C & 58 % R.H
		TEST PERFORMED BY: R. Kwan

UUT NUMBER	VISUAL INSPECTION – NO WATER LEAKAGE FROM BELOW THE SWITCH & THROUGH THE SEAL	VISUAL INSPECTION - NO PINHOLES OR OTHER SURFACE DEFECTS	DIELECTRIC TESTING PASSED
250763-1	✓	✓	✓
250763-2	✓	✓	✓
250702-1	✓	✓	✓
250702-2	✓	✓	✓

PASS Condition Dielectric Withstanding: 1000 Vrms @ Sea Level with current flow ≤ 500 microamperes.

UUT 205702-1	Miliamps Measured	Relaxed Condition	Miliamps Measured	Depressed Condition	Miliamps Measured
A1, 2 & 3 to B1, 2 & 3	0.070	D3 to D2	0.039	D3 to D1	0.034
B1, 2 & 3 to C1, 2 & 3	0.069	C3 to C2	0.038	C3 to C1	0.037
C1, 2 & 3 to D1, 2 & 3	0.059	B3 to B2	0.038	B3 to B1	0.036
All Pins (including lamp pins 4 through 9) to housing	0.013	A3 to A2	0.035	A3 to A1	0.034
PASS / FAIL : Pass					
UUT 205702-2	Miliamps Measured	Relaxed Condition	Miliamps Measured	Depressed Condition	Miliamps Measured
A1, 2 & 3 to B1, 2 & 3	0.070	D3 to D2	0.039	D3 to D1	0.035
B1, 2 & 3 to C1, 2 & 3	0.070	C3 to C2	0.038	C3 to C1	0.037
C1, 2 & 3 to D1, 2 & 3	0.060	B3 to B2	0.038	B3 to B1	0.036
All Pins (including lamp pins 4 through 9) to housing	0.013	A3 to A2	0.035	A3 to A1	0.035
PASS / FAIL : Pass					
UUT 205763-1	Miliamps Measured	Relaxed Condition	Miliamps Measured	Depressed Condition	Miliamps Measured
A1, 2 & 3 to B1, 2 & 3	0.070	D3 to D2	0.039	D3 to D1	0.034
B1, 2 & 3 to C1, 2 & 3	0.070	C3 to C2	0.038	C3 to C1	0.037
C1, 2 & 3 to D1, 2 & 3	0.060	B3 to B2	0.038	B3 to B1	0.037
All Pins (including lamp pins 4 through 9) to housing	0.013	A3 to A2	0.035	A3 to A1	0.034
PASS / FAIL : Pass					
UUT 205763-2	Miliamps Measured	Relaxed Condition	Miliamps Measured	Depressed Condition	Miliamps Measured
A1, 2 & 3 to B1, 2 & 3	0.071	D3 to D2	0.038	D3 to D1	0.035
B1, 2 & 3 to C1, 2 & 3	0.070	C3 to C2	0.038	C3 to C1	0.037
C1, 2 & 3 to D1, 2 & 3	0.060	B3 to B2	0.038	B3 to B1	0.037
All Pins (including lamp pins 4 through 9) to housing	0.014	A3 to A2	0.034	A3 to A1	0.034
PASS / FAIL : Pass					

✓: Denotes compliance with the specified test requirements.

CONCLUSION: All Test Units met the above test requirements.

CAGE CODE	DRAWING NO.	REV.	SHT.
12522	TR – 012 – S200	1.0	81

7.30 Illuminated colors

MIL-PRF-22885/115 DRAFT:

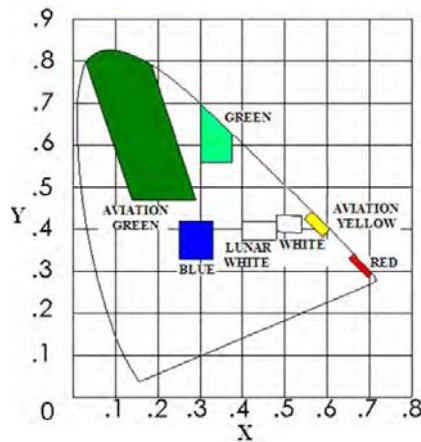
Optical characteristics: The pushbuttons illuminated color is tested in accordance to the requirements of MIL-PRF-22885G.

Testing Requirements:

When switches are tested as specified, the illuminated colors of the lens shall be in accordance with the table and diagram below.

Color limit Table													
Red		Green		Aviation Yellow		Lunar White		Blue		Aviation Green		White	
x	y	x	y	x	y	x	y	x	y	x	y	x	y
0.695	0.285	0.3	0.56	0.545	0.425	0.4	0.375	0.25	0.33	0.14	0.47	0.48	0.395
0.705	SL 1/	0.3	SL 1/	0.56	SL 1/	0.4	0.42	0.25	0.42	0.29	0.47	0.48	0.435
0.65	0.33	0.375	0.56	0.59	0.382	0.48	0.375	0.33	0.33	0.03	SL 1/	0.54	0.431
0.66	SL 1/	0.375	SL 1/	0.604	SL 1/	0.48	0.42	0.33	0.42	0.185	SL 1/	0.54	0.391

- 1/ The color expressed as “x” and “y” coordinates on the standard 1931 CIE chromaticity diagram. Illuminated colors, measured as specified herein, shall be within the limits bounded by the coordinates listed for each color. See diagram below.
- 2/ The term “SL” indicates where intersections occur within the spectrum locus on the CIE chromaticity diagram.



CIE chromaticity diagram

Procedure:

The chromaticity shall be determined by spectrographic or visual means, as specified below. Unless otherwise specified, lamps used for chromaticity testing shall have a calibrated mean spherical candle power of .34 ±.02 for T-1-3/4 lamps and .15 ±.02 for T-1 lamps.

- a. Method I: Spectrophotometer - flat slab: Chromaticity shall be determined using a spectrophotometer, flat slab material of the same density and thickness of the shaped filter, and necessary calibration filters.
- b. Method II: Spectroradiometric - Chromaticity shall be determined using a spectroradiometer, a complete illuminated push button assembly, calibrated lamps of specified color temperature, and necessary calibration filters.
- c. Method III: Visual comparator - Chromaticity shall be determined by a color comparator, necessary high and low limit plastic or glass filters of known chromaticity, and calibrated light sources of specific color temperature.

CAGE CODE	DRAWING NO.	REV.	SHT.
12522	TR – 012 – S200	1.0	82

TEST: ILLUMINATED COLORS	TEST SPECIFICATION: MIL – PRF – 22885G Requirements Paragraph 3.39 Test Method Paragraph 4.7.34	DATES STARTED & COMPLETED: 09-19-2011 & 09-30-2011
UUT TRACKING NUMBERS: See Below		TEMPERATURE & HUMIDITY 25° C & 50 % R.H
		TEST PERFORMED BY: B. Helstern

CHROMATICITY DETERMINED BY SPECTROGRAPHIC (2 UUT's FOR EACH COLOR)

UUT NUMBER	STACO P/N	COLOR TESTED	TRISTIMULUS DATA			CALCULATED RESULTS			MEETS REQUIREMENT
			Y	X	Z	SUM	CIEx	CIey	
205854-1	2HNC0- 71S12361122	RED	103	195	-0.036	297.964	0.6544	0.3457	✓
		GREEN	580	363	33.3	976.3	0.3718	0.5941	✓
205854-2	2HNC0- 71S12361122	RED	214	451	0.059	665.059	0.6781	0.3218	✓
		GREEN	740	461	46	1247	0.3697	0.5934	✓
205855-1	2HNC0- 71S12363344	AVIATION YELLOW	565	682	0.122	1247.122	0.5469	0.4530	✓
		LUNAR WHITE	940	1060	239	2239	0.4734	0.4198	✓
205855-2	2HNC0- 71S12363344	AVIATION YELLOW	530	643	0.125	1173.125	0.5481	0.4518	✓
		LUNAR WHITE	1530	1720	398	3648	0.4715	0.4194	✓
205856-1	2HNC0- 71S12366677	BLUE	254	175	181.4	610.4	0.2867	0.4161	✓
		AVIATION GREEN	534	246	175	955	0.2576	0.5592	✓
205856-2	2HNC0- 71S12366677	BLUE	641	506	398	1545	0.3275	0.4149	✓
		AVIATION GREEN	882	419	296	1597	0.2624	0.5523	✓
205857-1	2HNC0- 71S12360000	WHITE	795	973	115	1883	0.5167	0.4222	✓
205857-2	2HNC0- 71S12360000	WHITE	743	909	95	1747	0.5203	0.4253	✓

✓: Denotes compliance with the specified test requirements.

CONCLUSION: All Test Units met the above test requirements.

CAGE CODE
12522

DRAWING NO.
TR – 012 – S200

REV. SHT.
1.0 83

7.31 Luminance

Testing Requirements:

Photometric brightness shall be measured in foot lamberts. All luminance measurements shall be taken in completely dark surroundings. All readings shall be point readings and averaged. Luminance readings shall be taken by a calibrated photoelectric photometer. Luminance may be taken without the legend installed if the legend material is not a significant part of the illumination system.

Procedure:

Test equipment is set-up per released Staco procedure 85171 sections 6.0 and 7.0. Luminance measurements are taken and recorded per section 8.0. Included is a replica of FIGURE 9 Luminance measurement points from page 36 of MIL-PRF-22885G. See attachment "Staco Luminance Test 85171".

7.31.1 Non-NVIS Luminance

MIL-PRF-22885/115 DRAFT:

Luminance characteristics: The pushbutton luminance is tested in accordance to the requirements of MIL-PRF-22885 for Non-NVIS colors and NVIS colors.

22885 Symbol	Minimum Average Luminance (footlamberts)					
	C	B	H	N	W	S
S200 Code	1	2	3	4	5	6
Red	100	100	150	20	125	200
Green	100	100	150	25	100	250
Aviation Yellow	250	250	300	30	250	450
Lunar White	150	150	200	30	150	450
Blue	100	100	100	20	100	200
Aviation Green	100	100	100	20	100	250
White	150	150	175	25	150	450

7.31.1 NVIS Luminance

MIL-PRF-22885/115 DRAFT:

NVIS compatibility: NVIS compatibility is tested in accordance to the requirements of MIL-PRF-22885, MIL-STD-3009, and MIL-L-85762 (when applicable).

COLOR	AVERAGE LEGEND ON CONTRAST MIN	AVERAGE LEGEND OFF CONTRAST MAX	MIN LUMINANCE in FOOTLAMBERTS
GREEN A	0.6	0.1	150
GREEN B	0.6	0.1	150
YEL A	0.6	0.1	150
YEL B	0.6	0.1	150
RED	0.3	0.1	80
WHITE	0.3	0.1	80
BLUE	N/A	0.1	0.50

CAGE CODE

12522

DRAWING NO.

TR - 012 - S200

REV.

1.0

SHT.

84

TEST: LUMINANCE, NON-NVIS		TEST SPECIFICATION: MIL – PRF – 22885G Requirements Paragraph 3.40 Test Method Paragraph 4.7.35			DATES STARTED & COMPLETED: 09-26-2011 & 08-30-2011	
UUT TRACKING NUMBERS: See Below					TEMPERATURE & HUMIDITY 25° C & 50% R.H	
					TEST PERFORMED BY: D. Hubert, A. Barker	
UUT NUMBER	STACO P/N	S200 CODE	COLOR(S) TESTED	REQUIREMENT	READING	MEETS REQUIREMENT
243020-1	2HNC0-51S12311122	1	Red	100	207	✓
			Green	100	963	✓
243020-2	2HNC0-51S12311122	1	Red	100	208	✓
			Green	100	969	✓
243025-1	2HNC0-51S12313344	1	Aviation Yellow	250	1152	✓
			Lunar White	150	1526	✓
243025-2	2HNC0-51S12313344	1	Aviation Yellow	250	1135	✓
			Lunar White	150	1465	✓
243030-1	2HNC0-51S12316677	1	Blue	100	643	✓
			Aviation Green	100	710	✓
243030-2	2HNC0-51S12316677	1	Blue	100	675	✓
			Aviation Green	100	712	✓
243035-1	2HNC0-51S12341122	4	Red	20	260	✓
			Green	25	966	✓
243035-2	2HNC0-51S12341122	4	Red	20	260	✓
			Green	25	1000	✓
243040-1	2HNC0-51S12343344	4	Aviation Yellow	30	909	✓
			Lunar White	30	1040	✓
243040-2	2HNC0-51S12343344	4	Aviation Yellow	30	923	✓
			Lunar White	30	1146	✓
243044-1	2HNC0-51S12346677	4	Blue	20	596	✓
			Aviation Green	20	780	✓
243044-2	2HNC0-51S12346677	4	Blue	20	570	✓
			Aviation Green	20	830	✓
250857-1	2HNC0-71S12360000	6	White	450	738	✓
250857-2	2HNC0-71S12360000	6	White	450	598	✓
✓: Denotes compliance with the specified test requirements.						
CONCLUSION: All Test Units met the above test requirements.						

CAGE CODE
12522

DRAWING NO.
TR – 012 – S200

REV. SHT.
1.0 85

TEST: LUMINANCE, NVIS		TEST SPECIFICATION: MIL – PRF – 22885G Requirements Paragraph 3.40 Test Method Paragraph 4.7.35			DATES STARTED & COMPLETED: 09-26-2011 & 09-30-2011	
UUT TRACKING NUMBERS: See Below					TEMPERATURE & HUMIDITY 25° C & 50% R.H	
UUT NUMBER	STACO P/N	S200 CODE	COLOR(S) TESTED	REQUIREMENT	READING	MEETS REQUIREMENT
243128-1	2HAS4-71S18370123	7	Blue	0.50	3.57	✓
			Red	80	114	✓
			Yellow B	150	377	✓
243128-2	2HAS4-71S18370123	7	Blue	0.50	2.38	✓
			Red	80	85.12	✓
			Yellow B	150	256	✓
243133-1	2HAS4-71S18374561	7	White	80	82.6	✓
			Yellow A	150	158	✓
			Red	80	80.1	✓
243133-2	2HAS4-71S18374561	7	White	80	87.9	✓
			Yellow A	150	194	✓
			Red	80	92.9	✓
243083-1	2HNC0-71S12372233	7	Green B	150	155	✓
243083-2	2HNC0-71S12372233	7	Green B	150	161	✓
243093-1	2HNC0-71S12376600	7	Green A	150	227	✓
243093-2	2HNC0-71S12376600	7	Green A	150	221	✓
✓: Denotes compliance with the specified test requirements.						
CONCLUSION: All Test Units met the above test requirements.						

CAGE CODE	DRAWING NO.	REV.	SHT.
12522	TR – 012 – S200	1.0	86

7.32 Sunlight readability

MIL-PRF-22885/115 DRAFT:

Sunlight readability: The Sunlight Readability is tested in accordance to the requirements of MIL-PRF-22885g with the following exceptions: The contrast ratio of each lighted legend to the background exceeded the 0.6 minimum requirements, and for unlighted legend to the background, the average contrast ratio is ≤ 0.1 . Test performed once with the light source at an angle of 45 degree and all character measurements are averaged.

Testing Requirements:

When tested as specified, the average contrast ratio of each lighted legend character to the background shall be 0.6 minimum; and the average contrast ratio of each unlighted legend character to the background shall have an absolute value less than or equal to 0.1.

Procedure:

A light source of 3,000 degrees to 5,000 degrees Kelvin color temperature is directed at an angle of 45 degrees ± 2 degrees to the normal of a diffuse reflectance standard (pressed barium sulphate or PTFE powder (polytetrafluorethylene resin). The size of the light source is limited so that $\theta < 20$ degrees. A photometer is positioned at an angle of zero degrees ± 2 degrees to the normal of the reflectance standard. The light source is adjusted to produce 10,000 foot candles illumination on the reflectance standard as measured by the photometer. The reflectance standard is then removed and replaced by the viewing surfaces of the display to be tested. Using this test configuration, the luminance of the legend, both illuminated and nonilluminated, plus that of the adjacent background areas, are measured. Three luminance readings per legend character are taken. From these readings, the following contrast ratios can be calculated for each character:

The ON / BACKGROUND contrast CL =

The OFF / BACKGROUND contrast CUL =

B1 = Average background luminance

B2 = Average character luminance, lighted

B3 = Average character luminance, unlighted

The test is repeated with $\phi 1$ and $\phi 2 = 30$ degrees ± 2 degrees. The sample units have two lines of characters which utilize at least three-fourths of the maximum horizontal length of the legend. The contrast readings for the characters with the highest and lowest average contrast on each unit is be reported.

CAGE CODE

12522

DRAWING NO.

TR - 012 - S200

REV.

1.0

SHT.

87

TEST: SUNLIGHT READABLE	TEST SPECIFICATION: MIL – PRF – 22885G Requirements Paragraph 3.41 Test Method Paragraph 4.7.36	DATES STARTED & COMPLETED: 09-19-2011 & 09-30-2011
UUT TRACKING NUMBERS: See Below		TEMPERATURE & HUMIDITY 25° C & 55 % R.H
		TEST PERFORMED BY: B. Helstern, A. Barker

**CONTRAST READINGS FOR THE CHARACTERS WITH THE HIGHEST AND LOWEST AVERAGE
CONTRAST ON EACH UNIT**

CHROMATICITY DETERMINED BY SPECTROGRAPHIC (2 UUT's FOR EACH COLOR)

lighted character to background contrast ratio ≥ 0.6

unlighted character to background average contrast ratio ≤ 0.1

UUT NUMBER	SECTION COLOR	AVERAGE ON/BACKGROUND CONTRAST (C _L)	AVERAGE OFF/BACKGROUND CONTRAST (C _{UL})	MEETS REQUIREMENT
250854-1	GREEN	2.823	0.036	✓
250854-2	GREEN	1.901	0.023	✓
250855-1	AVIATION YELLOW	2.063	0.010	✓
	LUNAR WHITE	2.757	0.013	✓
250855-2	AVIATION YELLOW	1.859	-0.004	✓
	LUNAR WHITE	2.644	0.042	✓
250856-1	BLUE	1.456	0.018	✓
	AVIATION GREEN	1.666	0.042	✓
250856-2	BLUE	1.963	0.028	✓
	AVIATION GREEN	2.082	0.012	✓
250857-1	WHITE	2.776	-0.004	✓
	WHITE	2.233	0.008	✓
250857-2	WHITE	2.685	0.019	✓
	WHITE	2.225	-0.006	✓
243069-1	RED	1.308	0.019	✓
	RED	0.747	-0.005	✓
243069-2	RED	1.611	0.007	✓
	RED	1.135	0.042	✓

✓: Denotes compliance with the specified test requirements.

CONCLUSION: All Test Units met the above test requirements.

CAGE CODE
12522

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1.0	88

7.33 NVIS compatibility

MIL-PRF-22885/115 DRAFT:

NVIS compatibility: NVIS compatibility is tested in accordance to the requirements of MIL-PRF-22885, MIL-STD-3009, and MIL-L-85762 (when applicable). The colors are expressed as u' and v' coordinates on the U.C.S. 1976 chromaticity diagram shown in figure 17. Illuminated colors, measured as specified herein, shall be within the limits bounded by the coordinates listed for each color shown in table X.

Table X: Illuminated color

Color	Minimum Luminance (fL)	Chromaticity Coordinates			Contrast - 0°/45° Degrees @10,000 FC		Radiance		
		u'	v'	r	"ON"	"OFF"	Nra	Nrb	Scaled Luminance (fL)
Green A	150	0.088	0.543	0.037	> 0.6	< 0.1	$\leq 1.7 \text{ E-}10$	$\leq 1.7 \text{ E-}10$	0.1
Green B	200	0.131	0.623	0.057	> 0.6	< 0.1	$\leq 1.7 \text{ E-}10$	$\leq 1.7 \text{ E-}10$	0.1
Yellow A	200	0.274	0.622	0.083	> 0.6	< 0.1	$\leq 1.7 \text{ E-}10$	-	0.1
Yellow B	200	0.274	0.622	0.083	> 0.6	< 0.1	-	$\leq 1.5 \text{ E-}07$	15
Red	80	0.450	0.550	0.060	> 0.3	< 0.1	-	$\leq 1.5 \text{ E-}07$	15
White	100	0.190	0.490	0.040	> 0.6	< 0.1	-	$\leq 2.2 \text{ E-}09$	0.1
Blue	75	0.175	0.167	0.040	> 0.2	< 0.1	-	$\leq 1.0 \text{ E-}08$	0.5

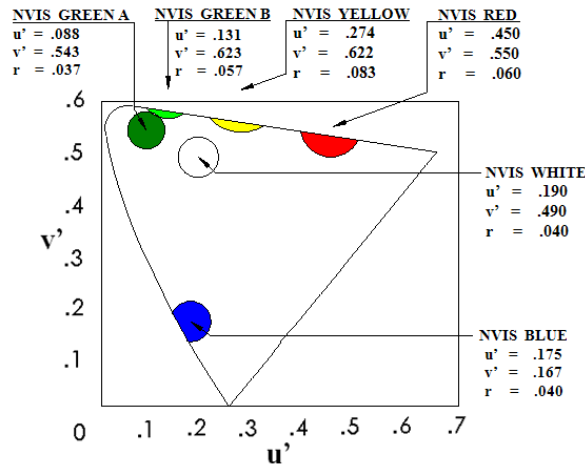


Figure 17. U.C.S 1976 Chromaticity diagram

Testing Requirements:

Night vision imaging system (NVIS) compatibility switches are tested as specified. The chromaticity, luminance, and spectral radiance output of the illuminated display shall be NVIS compatible as specified in MIL-L-85762: NVIS green A and NVIS green B colors shall meet all class A and class B equipment requirements for illuminated controls. NVIS yellow color shall meet all class A and class B equipment requirements for caution signals. NVIS red color shall meet all class B equipment requirements for warning signals.

Procedure:

The test procedure for measuring luminance, chromaticity and spectral radiance is in accordance with MIL-STD-3009, Formula 1, Appendix B.
 Example: $(u' - ui')^2 + (v' - vi')^2 \leq (r)^2$

TEST: NVIS COMPATIBILITY	TEST SPECIFICATION: MIL – PRF – 22885G Requirements Paragraph 3.42 Test Method Paragraph 4.7.37	DATES STARTED & COMPLETED: 09-19-2011 & 09-30-2011
UUT TRACKING NUMBERS: See Below		TEMPERATURE & HUMIDITY 24° C & 45 % R.H
		TEST PERFORMED BY: B. Helstern

CHROMATICITY
DETERMINED BY SPECTROGRAPHIC (2 UUT's FOR EACH COLOR)
COMPLIANCE IS WHEN DERIVED $r^2 < OR = r^2$

UUT NUMBER	STACO P/N	COLOR TESTED	LAB RESULTS		DERIVED	SPECIFICATION				MEETS REQUIREMENT
			u'	v'	r ²	u'	v'	r	r ²	
243128-1	2HAS4-71S18370123	BLUE	0.1688	0.1388	0.0008	0.1750	0.1670	0.040	0.0016	✓
		GREEN B	0.1395	0.5718	0.0027	0.1310	0.6230	0.057	0.0032	✓
		YELLOW B	0.2755	0.5581	0.0041	0.2740	0.6220	0.083	0.0069	✓
243128-2	2HAS4-71S18370123	BLUE	0.1666	0.1395	0.0008	0.1750	0.1670	0.040	0.0016	✓
		GREEN B	0.1399	0.5715	0.0027	0.1310	0.6230	0.057	0.0032	✓
		YELLOW B	0.2739	0.5587	0.0040	0.2740	0.6220	0.083	0.0069	✓
250763-1	2HMS4-62N21350000	RED	0.4072	0.5385	0.0020	0.4500	0.5500	0.060	0.0036	✓
250763-2	2HMS4-62N21350000	RED	0.4045	0.5379	0.0022	0.4500	0.5500	0.060	0.0036	✓
243088-1	2HNC0-71S12374455	WHITE	0.2056	0.5018	0.0004	0.1900	0.4900	0.040	0.0016	✓
		YELLOW A	0.2559	0.5607	0.0041	0.2740	0.6220	0.083	0.0069	✓
243088-2	2HNC0-71S12374455	WHITE	0.2058	0.5033	0.0004	0.1900	0.4900	0.040	0.0016	✓
		YELLOW A	0.2566	0.5606	0.0041	0.2740	0.6220	0.083	0.0069	✓
243093-1	2HNC0-71S12376600	GREEN A	0.1123	0.5558	0.0008	0.0880	0.5430	0.037	0.0014	✓
243093-2	2HNC0-71S12376600	GREEN A	0.1115	0.5521	0.0006	0.0880	0.5430	0.037	0.0014	✓

NVIS RADIANCE
DETERMINED BY SPECTROGRAPHIC (2 UUT's FOR EACH COLOR)

UUT NUMBER	STACO P/N	COLOR TESTED	LAB RESULTS UNSCALED	DERIVED RESULTS SCALED	SPECIFICATION	MEETS REQUIREMENT
243128-1	2HAS4-71S18370123	BLUE	6.1E-07 W/sr cm ²	6.7E-09 uW/sr cm ²	< 1.1 E-08 uW/sr cm ² @ 0.5 FL	✓
		GREEN B	1.9E-09 W/sr cm ²	2.9E-11 uW/sr cm ²	< 1.7E-10 uW/sr cm ² @ 0.1 FL	✓
		YELLOW B	2.1E-06 W/sr cm ²	1.2E-07 uW/sr cm ²	< 1.4E-07 uW/sr cm ² @ 15.0 FL	✓
243088-2	2HNC0-71S12374455	YELLOW A	3.3E-06 W/sr cm ²	6.6E-11 W/sr cm ²	< 1.7E-10 uW/sr cm ² @ 0.1 FL	✓
		YELLOW B	2.1E-07 W/sr cm ²	7.7E-08 uW/sr cm ²	< 1.4E-07 uW/sr cm ² @ 15.0 FL	✓
		WHITE	1.7E-07 W/sr cm ²	7.5E-10 uW/sr cm ²	< 2.2E-09 uW/sr cm ² @ 0.1 FL	✓
243093-1	2HNC0-71S12376600	GREEN A	1.8E-06 W/sr cm ²	3.6E-11 uW/sr cm ²	< 1.7E-10 uW/sr cm ² @ 0.1 FL	✓
243093-2	2HNC0-71S12376600	GREEN A	1.6E-07 W/sr cm ²	3.3E-12 uW/sr cm ²	< 1.7E-10 uW/sr cm ² @ 0.1 FL	✓
243088-1	2HNC0-71S12374455	WHITE	1.7E-07 W/sr cm ²	7.5E-10 uW/sr cm ²	< 2.2E-09 uW/sr cm ² @ 0.1 FL	✓
		YELLOW A	3.2E-06 W/sr cm ²	6.4 E-11 uW/sr cm ²	< 1.7E-10 uW/sr cm ² @ 0.1 FL	✓

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250763-1	2HMS4-62N21350000	RED	2.1 E-06 W/sr cm ²	1.1 E-07 uW sr cm ²	< 1.4E-07 uW/sr cm ² @ 15.0 FL	✓
250763-2	2HMS4-62N21350000	RED	2.04 E-07 W/sr cm ²	1.2E-07 uW/sr cm ²	< 1.4E-07 uW/sr cm ² @ 15.0 FL	✓
✓: Denotes compliance with the specified test requirements.						
CONCLUSION: All Test Units met the above test requirements.						

CAGE CODE	DRAWING NO.	REV.	SHT.
12522	TR – 012 – S200	1.0	91

7.34 Fluid Susceptibility

MIL-PRF-22885/115 DRAFT:

Solvent Resistance Seal: The pushbutton switches are tested in accordance to the requirements of MIL-STD-108G, Method 504, Procedure II.

Testing Requirements:

Visual examination may show no evidence of physical damage or degradation resulting from the test.

Procedure:

Select the appropriate chemicals/solutions for the test. Prepare the test items. If etching will not affect the test item, number the parts to help with identification. Use all test items and chemicals that are at standard ambient conditions during testing. Record the standard ambient conditions. Record the item nomenclature, serial or lot numbers, manufacturer, chemicals/solutions, and any other pertinent test data. Immerse, spray, splash, or brush each item with a required chemical(s). If immersing the items, let them soak for one hour. If spraying, wiping, or brushing on the chemical, make additional applications to ensure the item is kept wet for one hour. After one hour, stop applying the fluids or remove the test items from the chemicals and visually observe any deterioration including softening, color changes, cracking, or dissolving of the material into the solution. If any hardness or other tests are to be performed, blot the items of any excess chemical and proceed with the testing. When the physical properties or the visual only check has been performed, either place the items back into the solutions or re-apply the solutions, and continue the test for another seven hours (total of eight hours in contact with chemicals). If moderate or greater deterioration is noted on any test item after one hour, discontinue testing in that chemical and record all pertinent data. After a total exposure time of eight hours, remove the test item(s) from the solutions or stop applying, blot excess chemicals from the item, and inspect again for any type of chemical reaction resulting from the additional exposure to that particular compound. Record any weight, hardness, or other physical data for each piece where appropriate. Let all items dry for a maximum of 24-hours. After the drying period, record final measurements and weights, if any, and record final visual observations.

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12522	TR – 012 – S200	1.0	92

TEST: FLUID SUSCEPTIBILITY	TEST SPECIFICATION: MIL – STD – 108G Method 504 Procedure II	DATES STARTED & COMPLETED: 08-29-2011 & 09-16-2011
UUT TRACKING NUMBERS: 243128-1, 243128-2, 243044-1 & 243044-2		TEST PERFORMED BY: NTS Labs

UUT	SEAL TYPE	FLUID EXPOSURE	UUT NOT SUSCEPTIBLE
243128-1	Watertight	Kerosene	✓
243128-1	Watertight	Diesel Fuel	✓
243128-1	Watertight	JP-4	✓
243128-1	Watertight	JP-5	✓
243128-1	Watertight	Transmission Fluid	✓
243128-1	Watertight	Unleaded Gasoline	✓
243128-2	Splashproof	Linseed Oil	✓
243128-2	Splashproof	Mineral Oil (Mil-H-5606)	✓
243128-2	Splashproof	Silicone Greases	✓
243128-2	Splashproof	Animal Fats (Lard)	✓
243128-2	Splashproof	Motor Oil (multipurpose)	✓
243044-1	Splashproof	Denatured Alcohol	✓
243044-1	Splashproof	Isopropyl Alcohol	✓
243044-1	Splashproof	Methanol	✓
243044-1	Splashproof	Prestone Antifreeze	✓
243044-2	Splashproof	Sea Water	✓
243044-2	Splashproof	Water	✓
243044-2	Splashproof	Soap Solutions	✓
243044-2	Splashproof	Detergent Solutions	✓
243044-2	Splashproof	Hydrochloric Acid 10%	✓

✓: Denotes compliance with the specified test requirements.

CONCLUSION: All Test Units met the above test requirements.

NOTE: Complete test results are provided in the attachment "NTS LABS Fluid Susceptibility Test".

CAGE CODE
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1.0	93