UNCLASSIFIED [redacted]

Rec'd 16 Copies from 3423

SANDIA SYSTEMATIC DECLASSIFICATION REVIEW DOWNGRADING OR DECLASSIFICATION STAMP	
CLASSIFICATION CHANGED TO: U	AUTHORITY: R. B. Craner
Emelda Selph 2/2/98 PERSON CHANGING MARKING & DATE	RECORD ID: 98SN1456
RB Craner 4/5/98 PERSON VERIFYING MARKING & DATE	DATED: 01/29/98

SCDR 312-61

ENGINEERING DEVELOPMENT AND DESIGN CHARACTERISTICS OF THE MC-1390 EXPLOSIVE SWITCH PACKAGE
(Title is Unclassified)

C. L. Sparks, 7124
F. F. McEwin, 7124

[redacted]

March 1962

Approved by: James W. Jones
J. W. Jones, 7120

SANDIA SYSTEMATIC DECLASSIFICATION REVIEW	
1st Review Date: 1/27/98	Determination (Circle Numbers):
Authority: ☐ ADC ☒ ADD	1 Classification Retained
Name: COC Layne	2 Classification Changed to: U
2nd Review Date: 1/29/98	3 Contains No DOE Classified Information
Authority: ADD	4 Coordinate With:
Name: RB Craner	5 Contains UCAI? no
	6 Comments: OK for Openmet

ABSTRACT

This report describes the development history of the MC-1390. A current, authoritative record of the design intent, product characteristics, and development history is presented.

[redacted]

UNCLASSIFIED

[redacted]

35p

DISTRIBUTION:
E. A. Kroencke, BKC
W. E. Boyes, 1440
I. M. Moore, 2310
D. S. Bliss, 2344
H. H. Brueggemann, 2533
J. W. Jones, 7120
W. J. Denison, 7124
W. L. Stevens, 7162
A. F. Cone, 7510
G. H. Roth, 7520
M. G. Randle, 3421-2
R. K. Smeltzer, 3421-3
W. F. Carstens, 3423
E. A. Paxton, Jr., 8233-2
Distribution, 3446-1 (2)
Jim Fife 3425 (1)

[redacted]

[redacted]

TABLE OF CONTENTS

	Page
1. Introduction	4
2. Design Intent	4
3. Description	5
4. Product Characteristics	6
5. Product Qualification	7
6. Product Acceptance Requirements	7
7. Development History	9
APPENDIX A -- PRODUCT SPECIFICATION FOR MC-1390	19
APPENDIX B -- TMS PLANNING FOR MC-1390	30

LIST OF ILLUSTRATIONS

Figure		
1.	In-Process Fixture Used to Determine Lead Length Cutoff Points in J1 Connector of the MC-1390	18
2.	In-Process Fixture Used to Determine P1 and P2 Cable and Lead Length Cutoff Points in the MC-1390	18
3.	In-Process Fixture Used to Locate P1 and P3 Cables in the Plastic Cable Guide Plate in the MC-1390	18
4.	MC-1390 Subassembly	18
5.	In-Process Hold-Down Fixture for Bonding the Cable Guide Plates to the Housing Prior to Potting	18
6.	Bottom View of the MC-1390 Explosive Switch Package Showing Potting	18

ENGINEERING DEVELOPMENT AND DESIGN CHARACTERISTICS OF THE MC-1390 EXPLOSIVE SWITCH PACKAGE

1. Introduction

This document provides a current, authoritative record of the design intent, product characteristics, and development history for the MC-1390 explosive switch package and the MC-1390 TR (Type 3A) trainer as used in the TX-57. The product definition, drawings, and specifications which are the basis for production contracts are listed on NX 311206 and NX 311386, respectively.

The assistance and contribution of W. K. Rogers in preparing the Development History Section is gratefully acknowledged.

2. Design Intent

2.1 Functional Requirements

2.1.1 Mechanical

The MC-1390 is required to fit with 100-percent interchangeability the mounting features of the aft pressure cover without interfering with other components after all mating connectors have been attached. The MC-1390 is required to be as small in size and weight as engineering design will permit, without sacrificing reliability.

2.1.2 Electrical

The MC-1390 is required to electrically interconnect the hydrostats with the TX-57 system and to provide switching functions dictated by the system depth bomb option.

2.2 Environmental Conditions

The MC-1390 switch package must be capable of performing its switching function through the temperature range of -65°F to +160°F. This function occurs both at the time of weapon release and at the time of water entry. The nonoperating environments which must not degrade the switch are:

Thermal Cycling
Handling Shock and Vibration
Laydown Shock, 1000 g
Delivery Aircraft Vibration
Parachute Retardation, 145 g
Water Entry Shock, 100 g

The MC-1390 is mounted inside the sealed and dessicated portion of the TX-57 and will not be subjected to humidity, salt atmosphere, fungus, ozone, fuel vapors, sand, dust, or ultraviolet radiation.

2.3 Reliability Requirements

The reliability of the MC-1390 must be compatible with the TX-57 system reliability as defined in the Military Characteristics. No specific requirement for the MC-1390 as a component has yet been established.

3. Description

The MC-1390 explosive switch package interconnects the MC-1366 and MC-1418 hydrostats with the TX-57 system. The package consists of four MC-1159 explosive switches, two printed-circuit boards, four pigtail cables with two SA-769-2 connectors and two SA-769-28 connectors, one SA-1066-5 chassis mounted connector (see Figure 1), two plastic (Diall 52-20-30) cable guide plates, one plastic assembly housing, eight laminated phenolic spacers, and associated wiring. Two MC-1159 explosive switches are plugged into one side of each printed-circuit board (PCB), and the switch pins are soldered into the PCB through gold-plated holes on the opposite side of the board. A phenolic spacer, 0.12-inch thick, is bonded to the switch at each end and to the PCB to provide structural rigidity and to prevent the metal switch case from shorting

electrically to the PCB. The SA-1066-5 connector, which electrically connects the MC-1390 to the MC-1351 interconnecting box J6 connector through the CF-1625 cable, is centered between the vertical planes of the two printed-circuit boards and protrudes through one wall of the plastic housing in final assembly. Cables P1 and P3 are wrapped with lacing twine and sealed into one cable guide plate (see Figures 2 and 3), and cables P2 and P4 are sealed into the second guide plate. The cable leads are soldered into the printed-circuit boards from opposite sides. The above components are fabricated as a subassembly as shown in Figure 4. During assembly into the housing, the SA-1066-5 connector is positioned into the housing wall by means of a "D"-hole, the printed circuit boards are positioned by bosses molded into the base of the housing, and the cable guide plates are bonded into opposite walls of the housing as shown in Figure 5. The MC-1390 is encapsulated with a two-part polyurethane resin foam potting material (see Figure 6).

The outline configuration, hole pattern, and hole locations are given on product drawing 311206. The box dimensions of the MC-1390 are approximately 3.51 x 3.26 x 2.44 inches, and the weight of the assembly is 1.13 pounds.
1.13

The MC-1390 TR (trainer for Type 3A weapon) has the same external configuration as the MC-1390. As defined in product drawing 311386, only five circuits are required to be continuous. Only wiring simulating one normally closed contact of each MC-1159 is provided in the trainer for the purpose of monitoring the continuity of the normally closed hydrostat contacts. The markings, "For Training Use Only," on the MC-1390 TR are the same color as the markings on the MC-1390 in order to make the trainer as close as possible in appearance to the WR MC-1390. The MC-1390 TR provides an inexpensive unit for military training purposes in the Type 3A trainer weapons.

4. Product Characteristics

4.1 Capabilities

The MC-1390 proved to be functional at the temperature extremes of +160°F and -65°F. The switch pack was not damaged when exposed to temperature extremes of +190°F and -89°F. Two mechanical shocks of 1000 g, 4 to 5 milliseconds, did not degrade the MC-1390.

Vibration cycling at the 10-g level to 500 cps and 5 g to 2000 cps, linear acceleration to 150 g, and vibration cycling at -65°F were performed, with no damage resulting to the MC-1390. Fifteen MC-1390's were used in the TX-57 drop program, with no failures.

4.2 Limitations

The MC-1390 has no known limitations in the TX-57 system.

5. Product Qualification

At the beginning of production and at the requalification of production, the manufacturing agency must produce units that comply with the Tool-Made Sample (TMS) plans (see Appendix B). The extent of the TMS testing is affected by the following:

(1) Judgment of design and production techniques

(2) Testing of parts, subassemblies, and assemblies prior to TMS submittal (development experience with units made on production or "hard" tooling)

(3) Compromise among (a) requirements of the Military Characteristics and Stockpile-to-Target document, (b) test facilities availability, and (c) time required to perform the qualification tests.

Tests, in addition to those shown in Section 6, Production Acceptance Requirements, may be chosen from the following:

(1) Vibration while at -65°F or +160°F

(2) High mechanical shock immediately after stabilization at -65°F or +160°F.

6. Product Acceptance Requirements

The Product Specification (PS-311206) included in Appendix A lists the requirements of the MC-1390 in production lot acceptance.

6.1 100-Percent Tests

All units must comply with the following tests:

(1) Bridge wire resistance,

(2) Insulation resistance (20 megohms minimum), and

(3) Circuit continuity and resistance requirements.

6.2 Lot Sample Tests

A lot of MC-1390's is described as follows:

First three lots	-	50 units maximum
Last three lots	-	50 units maximum
All others	-	150 units maximum

The sample size is six per lot, and the number of failures acceptable is zero. All lot sample tests are destructive (D) tests. These tests are described as:

(1) Temperature

Temperature	Duration
+160°F	4 hours
Ambient	1 hour
-65°F	4 hours

This cycle is to be performed three times, and the electrical tests (100 percent) are to be performed during the latter portion of the last temperature extreme.

(2) Mechanical Shock at Room Temperature

The MC-1390, while at room temperature, will receive two shocks of 1000 g, 4 to 5 milliseconds duration, one-half sine wave shape. The unit must maintain electrical and mechanical integrity during and after this test.

(3) Actuation

Each MC-1159 within the MC-1390 must actuate when fired with 580 milliamperes per bridge wire for 2 milliseconds.

6.3 Testers

The PT-988 provides for circuit continuity and insulation resistance tests and for bridgewire resistance checks. The PT-989 provides the switch actuation firing pulse and provides for post-fire bridge wire insulation resistance checks.

7. Development History

7.1 Design

Preliminary weapon layouts resulted in the planning of an initial package size not to exceed 3.5 x 3.25 x 2.25 inches with six cables extending from the sides of the package to the six hydrostats. The ease of manufacture and reliability in end-use environments were also prime factors.

A Diall plastic housing and microballoon encapsulation material met the requirements of weight and also appeared to provide the strength needed to withstand required thermal and mechanical environments. To facilitate encapsulation, the longitudinal axes of both the printed-circuit boards and the MC-1159 explosive switches were oriented in the vertical plane of the assembly. The cables were sealed into Diall plastic cable guide plates which in turn were bonded to the assembly housing. This latter feature enabled in-process electrical testing to be performed at the subassembly level immediately prior to installation into the housing. To improve reliability and to minimize circuit voltage drop, duplicate circuitry was electrically paralleled on each side of the printed-circuit boards. Also, in the interests of simplicity and reduced cost, the printed-circuit boards were made identical. One system channel is assigned to each board.

Upon completion of the initial design, much of the work on the MC-1390 was concerned with changes dictated by system requirements. Changes in the circuitry of the printed-circuit boards were necessitated by the deletion of two hydrostats within the system. This also required changes in cable lengths. The MC-1159 explosive switch was lengthened by 0.137 inch and required printed-circuit board changes as well as an increase of 0.060 inch in the MC-1390 package height. During first hardware assembly, an interference with the next assembly was discovered. It was necessary to invert the MC-1390 to avoid this interference. Structural changes in the next assembly necessitated a 90-degree rotation in the mounting orientation; this, in turn, required changes in the cable lengths of the P1, P2, and P3 cables. Except for the change in the height of the assembly, no changes in plastic parts tooling were required.

Difficulty was encountered with the design of an in-process test fixture to be used in making electrical checks of the circuits which cannot be checked after encapsulation. Because of the short length of the MC-1159 pins which protrude through the printed-circuit boards, it may be difficult to assure proper electrical contact while performing circuit resistance checks. The in-process test fixtures are presently being fabricated. Quality Control engineering personnel have performed a study using data obtained on early development units by open setup and have determined that, if continuity checks instead of circuit resistance checks were made, there would be a 0.999 confidence that the resistance of these circuits would be below 0.010 ohm in 100 percent of the circuits. This alternate method will be utilized if proper electrical contact with the switch cannot be made.

Between the conclusion of Phase III and the start of Phase IV in the MC-1390 development program, a high percentage of MC-1159 switches received from the supplier for use in the MC-1390 exhibited cracking in both contact pin and actuator pin glass headers. It was evident that the cracks were caused during buildup of the switch by the supplier, and corrective action

was initiated. However, during this investigation it was determined that microballoon resin could possibly be drawn into the switch housing through the header cracks as a consequence of a high vaccuum being pulled on the unit during the encapsulation process. Any switch malfunction which might result would not be detected until after firing the switch. The encapsulating material for the MC-1390 was changed to 10-pound-per-cubic-foot density polyurethane foam to avoid this problem, since cracked headers might occur for other reasons and might go undetected before inclusion into the MC-1390. This change decreased the component weight by 0.37 pound.

Two MC-1390 switch packs had been foam-potted prior to this change and had satisfactorily passed necessary environmental testing. Four additional foam-potted MC-1390's are now being subjected to environmental tests.

7.2 Schedules

Complete AOI for the MC-1390 was accomplished on June 23, 1961, while CER occurred on September 8, 1961. TMS submittal is scheduled for February 5, 1962. The first production unit is scheduled for March 1962.

Sixty-two MC-1390 development units were ordered on development order 91-1346 to BAC/KCD to be delivered in four phases between October 1960 and January 1962.

7.3 Development Test History

Ten units have completed development environmental tests, and four are in the process of development environmental testing. The ten tested units showed no problems. The tests are described below.

7.3.1 MC-1390-X006

(1) 100-percent tests - bridge wire, continuity, and insulation resistance.

(2) Load test - 20 amperes for 0.1 second, and 5 amperes for 5 minutes, on normally closed contacts.

(3) High temperature - 48 hours at +160°F and two hours at +190°F.

(4) Temperature shock:

Temperature	Duration
+160°F	4 hours
Ambient	5 minutes
-65°F	4 hours
-80°F	2 hours
-65°F	2 hours
Ambient	5 minutes

This cycle was repeated three times, and an electrical check (100-percent test) was made.

(5) X-ray

(6) Linear acceleration - The unit, while at ambient temperature, was accelerated to 150 g.

(7) Mechanical shock - The unit, while at ambient temperature, was shocked twice at 1000 g, 4 to 5 ms duration, without damage. An electrical check showed no problem.

7.3.2 MC-1390-X008

(1) 100-percent tests - Bridge wire, continuity, and insulation resistance.

(2) Load test of normally closed contacts, 100-percent tests.

(3) Temperature shock:

Temperature	Duration
+160°F	4 hours
Ambient	5 minutes
-65°F	4 hours
-80°F	2 hours
-65°F	2 hours
Ambient	5 minutes

One switch was actuated at -65°F during the third cycle.

(4) High temperature - The unit was stabilized at +160°F for 48 hours and then placed in a +190°F chamber for two hours. After stabilization at ambient room temperature the unit successfully passed the 100-percent electrical tests.

(5) -65°F vibration - The unit was stabilized at -65°F and given the vibration cycling test per SC-4451(M) E-1-a. This high-level vibration had no detrimental effect.

(6) Linear acceleration - The unit was subjected to linear acceleration, in both directions of each axis, of 150 g for one minute. There was no detrimental effect.

(7) X-ray - An X-ray picture along the three axes showed no detrimental effect from the environments.

7.3.3 MC-1390-X016 and MC-1390-X024

(1) 100-percent electrical tests - The units were given 100-percent electrical tests.

(2) High temperature - The units were subjected to 48 hours exposure to +160°F without detriment.

(3) [illegible]erature cycle - The units were cycled as follows:

Temperature	Duration
+160°F	4 hours
Ambient	1 hour
-65°F	4 hours
Ambient	1 hour

Three cycles were performed, with no detrimental effect.

(4) Vibration cycling - The units were cycled for one hour in each axis in accordance with SC-4451(M) E-1-a (high-level). The units were then vibrated an additional hour at resonance in each axis. This vibration had no detrimental effect.

(5) Linear acceleration - The units were subjected to 150 g linear acceleration in the +Y axis. There was no detrimental effect.

(6) High-g shock - The units were shocked twice to 1000 g, 4 to 5 milliseconds duration. There was no detrimental effect.

(7) X-ray - Pictures along each axis showed no degradation.

7.3.4 MC-1390-X029 and MC-1390-X030

(1) 100 percent electrical tests - The units were subjected to the electrical acceptance tests per PS-311206.

(2) High temperature - The units were subjected to 48 hours exposure to +160°F without detriment.

(3) Temperature cycling - The units were cycled as follows:

Temperature	Duration
+160°F	4 hours
Ambient	1 hour
-65°F	4 hours
Ambient	1 hour

The units were subjected to three of these cycles with no detrimental effect.

(4) Linear acceleration - The units were soaked at -65°F and then accelerated to 200 g on a centrifuge. There were no detrimental effects.

(5) Mechanical shock - The units were soaked at +160 F and subjected to 1000 g, 4 to 5 milliseconds duration, once in each of two directions. There were no detrimental effects.

7.3.5 MC-1390-X020 and MC-1390-X025

(1) 100 percent electrical tests - These units were given 100 percent electrical tests.

(2) Temperature cycle - The units were cycled as follows:

Temperature	Duration
+160°F	4 hours
Ambient	1 hour
-65°F	4 hours
Ambient	1 hour

The units were subjected to three of these cycles with no detrimental effects.

(3) High Temperature - The units were subjected to 48 hours exposure to +160°F without detriment.

(4) Vibration cycling at -65°F - The units were cycled for 20 minutes in each axis per SC-4451(M) E-1-a. There was no degradation of the MC-1390.

(5) High-g shock - The units were shocked twice to 1000 g, 4 to 5 milliseconds duration. There were no detrimental effects.

7.3.6 MC-1390-001 and MC-1390-002 - These units were encapsulated with foam plastic. They were tested as follows:

(1) 100 percent electrical tests - The units were subjected to the electrical tests without failure.

(2) High-temperature tests - The units were subjected to 48 hours exposure to +160°F without degradation.

(3) Temperature cycle - The units were cycled as follows:

Temperature	Duration
+160°F	4 hours
Ambient	1 hour
-65°F	4 hours
Ambient	1 hour

The units were subjected to three of these cycles with no detrimental effects.

(4) X-ray - The X-ray was made in each axis. No trouble was evident.

(5) Vibration - The units were vibrated at ambient temperature for one hour in each axis to the test SC-4451(M) E-1-a, high-level cycling. There were no detrimental effects.

(6) Linear acceleration - The units were accelerated to 150 g without detriment. This test was performed at ambient temperature.

(7) Mechanical shock - The units were shocked once in each of two directions to 1000 g, 4 to 5 milliseconds duration. There were no detrimental effects.

TABLE I

MC-1390 Component Test History

Key:
1. Number tested
2. Test performed
3. Acceptance criteria
4. Number of failures
5. Test report

Test parameter	Development tests including TMS	Acceptance
Temperature	1. Ten 2. Temperature cycle 3. To demonstrate function during and after test 4. No failures 5. T-17258 T-17925 T-17709 T-18018 T-17811	SC-4451(M)A-5 Modified to one hour at ambient room temperature
Vibration	1. Seven 2. SC-4451(M) E-1-a plus SC-4451(M)I 3. To demonstrate function after test 4. No failures 5. T-17258 T-17811 T-17709 T-18018	
Shock	1. Nine 2. 1000 g, 4-5 ms, two shocks 3. Maintain function during and after test 4. No failures 5. T-17258 T-17811 T-17709 T-18018	1000 g, 4-5 ms, two shocks
Linear Acceleration	1. Eight 2. 150 g, 1 to 10 seconds 3. Function during and after test 4. No failures 5. T-17258 T-17925 T-17709 T-18018	

[redacted]

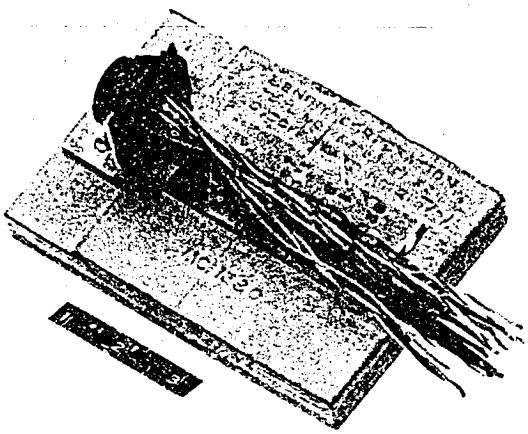

FIGURE 1. IN-PROCESS FIXTURE USED TO DETERMINE LEAD LENGTH CUTOFF POINTS IN J1 CONNECTOR OF THE MC-1390

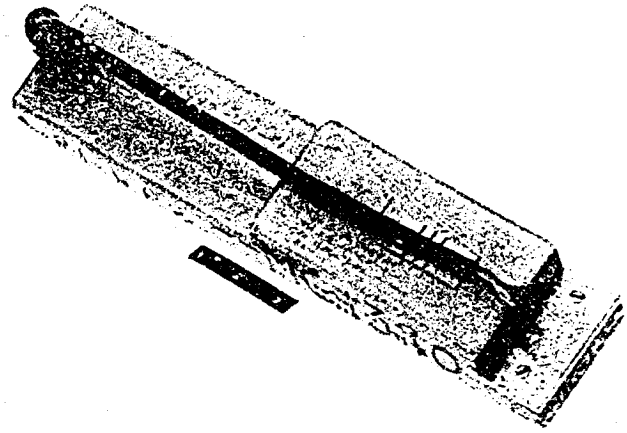

FIGURE 2. IN-PROCESS FIXTURE USED TO DETERMINE P1 AND P3 CABLE AND LEAD LENGTH CUTOFF POINTS IN THE MC-1390

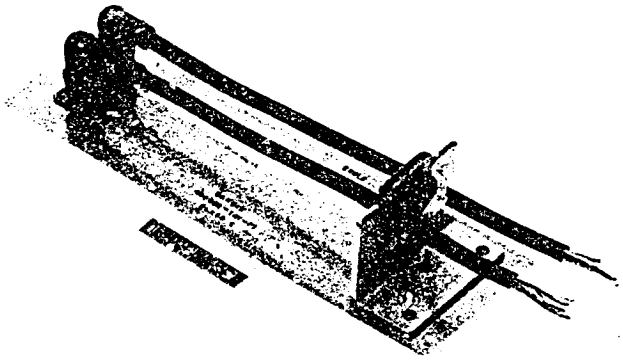

FIGURE 3. IN-PROCESS FIXTURE USED TO LOCATE P1 AND P3 CABLES IN THE PLASTIC CABLE GUIDE PLATE IN THE MC-1390

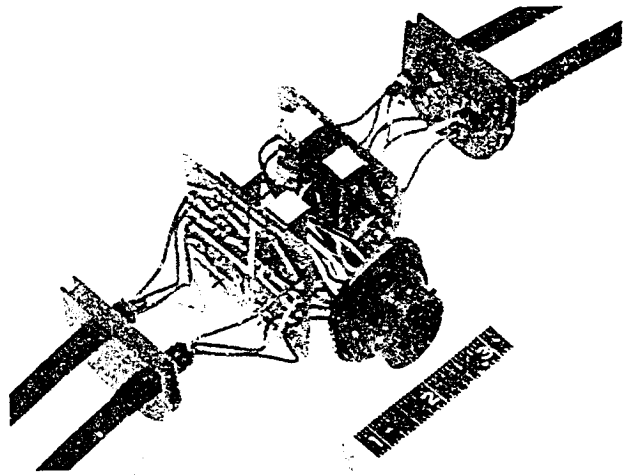

FIGURE 4. MC-1390 SUBASSEMBLY

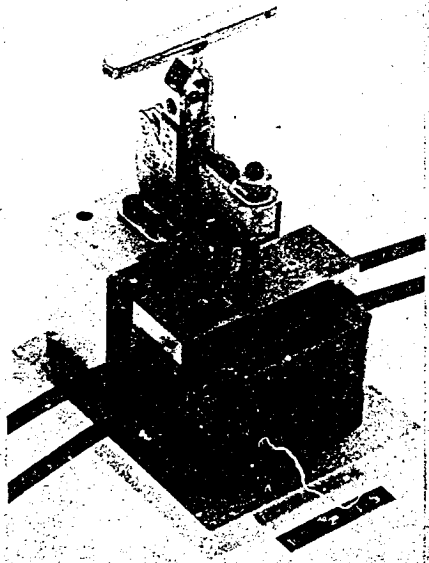

FIGURE 5. IN-PROCESS HOLD-DOWN FIXTURE FOR BONDING THE CABLE GUIDE PLATES TO THE HOUSING PRIOR TO POTTING.

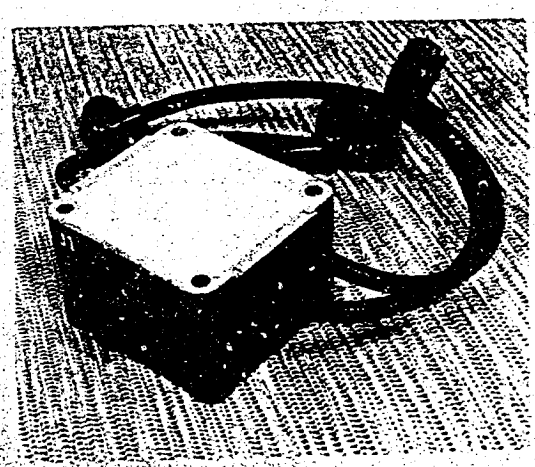

FIGURE 6. BOTTOM VIEW OF THE MC-1390 EXPLOSIVE SWITCH PACKAGE SHOWING POTTING

[redacted]

APPENDIX A

PRODUCT SPECIFICATION FOR MC-1390

UNCLASSIFIED

THIS DOCUMENT CONSISTS OF 12 SHEETS

SHEET INDEX

SHEET	1	3	2	4	5	6	7	8	9	10
ISSUE	H	H	G	G	E	E	G	G	G	G

SHEET
ISSUE

SHEET
ISSUE

SHEET
ISSUE

SHEET
ISSUE

REVISIONS

ISS.	DESCRIPTION	DATE	CHK.	ENG.
H	See ECN 7070612/MC-1390 1. Added para. 4.1.2. FIELD	12-27-61		
	File act 1-3-62 MR			

DIST.	UDS
2	RX

APPD.	ORG.	INITIALS
DGS.		
MATL.		
MFG.		
DFTG.		

CONTRACTOR PREPARED

DRWN.	CHKD.	ENG.

TITLE

PRODUCT SPECIFICATION FOR MC-1390

5Y | A | PS-311206

SHEET

CLASSIFICATION

UNCLASSIFIED

SCS-408-AD (8-59) PRINTED IN U.S.A.

PS 311206 H
10 sheets

ALL REQUIREMENTS OF SECTIONS 3 AND 4 OF THIS DRAWING ARE C*. THIS NOTATION IS FOR DESIGN AGENCY INFORMATION ONLY.

1 SCOPE

This specification covers one type of explosive switch pack, MC-1390.

2 APPLICABLE DOCUMENTS

Drawing 311206
NX-311206 (For Design Agency Information Only)

3 REQUIREMENTS

3.1 General. The product shall be manufactured in accordance with Drawing 311206 or NX-311206 as specified by the Buyer.

3.2 Precedence of Documents. If requirements of the following documents are in conflict, precedence shall apply in the order shown.

1. Contract or Purchase Order
2. Product drawings and specifications
3. Referenced specifications and instructions

3.3 Serial Numbers. MC-1390's shall be serial numbered in sequence of manufacture and shall be marked with respective serial numbers before starting 100-per-cent tests. Once assigned, a serial number shall not be reassigned to another MC-1390.

4 QUALITY PROVISIONS

4.1 General. The provisions of 162768, Inspection and Testing, shall apply.

4.1.1 Records. The Supplier shall be responsible for completion and distribution of the forms listed on DF-311206-01.

4.1.2 Test Instructions. The provisions of 173119, Test Instructions for 311206, shall apply (this requirement is not C*).

4.2 In-Process Inspection and Testing. The Supplier shall perform such in-process inspection and testing as he deems necessary to obtain product conforming to the requirements of this specification.

4.3 Final Assembly Testing

4.3.1 General

ISS	F	H																											

DWG. CLASSIFICATION	TITLE	5Y	A	DWG. NO.
	PRODUCT SPECIFICATION FOR MC-1390			PS-311206
DOC. REF. SYM.		SHEET 2		

PRINTED IN U.S.A.
SC 5402-AE(5-68)

4.3.1.1 Test Conditions. Unless otherwise specified, tests shall be performed at room atmospheric conditions (70±15°F, not less than 23.08 inches Hg) and the MC-1390 shall be at room temperature when each test is started. All test chambers shall have a volume of at least three times that of the items being tested therein.

4.3.1.2 Tolerances. Limiting values specified herein are absolute. See 400207. Unless otherwise specified, tolerances shall be:

Temperature:	±5°F
Time:	±5 per cent
Shock:	±15 per cent

4.3.1.3 Lot. A lot is defined as a quantity of items manufactured or assembled without significant changes in materials, tools, processing, design essentials, or other factors which substantially affect the homogeneity of the items. The lot size shall not exceed 50 MC-1390's for the first three and the last three lots; for all other lots the lot size shall not exceed 150 MC-1390's. Unless otherwise approved by the Design Agency, all lot acceptance tests shall be completed before the lot is shipped.

4.3.1.4 Rejected Units. MC-1390's that fail any 100-per-cent test shall be rejected. Test records for a rejected unit shall be submitted with the lot of which it was a part. Rejected units shall not be reworked and shall be marked so as to prevent accidental use.

4.3.1.5 "D-Tested" Units. Units subjected to tests designated as destructive or degrading shall be marked "D", or "D-Tested" if space permits, in a contrasting color, preferably red.

4.3.1.6 Rejected Lots. Whenever a lot is rejected, the Supplier shall hold the lot and immediately notify the Buyer and the Design Agency. Disposition of the lot will be determined jointly by the Buyer and the Design Agency.

4.3.1.7 Selection of Samples. Each lot shall be sampled at random, after all defectives found in 100-per-cent testing have been removed, so that each unit in a lot shall have an equal chance of being drawn as part of a sample.

4.3.2 Test Requirements

Test Title	Test par.	QUALITY REQUIREMENTS Test 100%	Lot Sampling a	Lot Sampling c	Notes
Group I	--	yes	--	--	4
Bridge Wire Resistance	4.3.3.1	--	--	--	--
Insulation Resistance	4.3.3.2	--	--	--	--
Circuit Continuity and Resistance	4.3.3.3	--	--	--	--
Group II	--	--	6	0	5
Temperature	4.3.3.6	--	--	--	1
Mechanical Shock at RT	4.3.3.7	--	--	--	1
Actuation	4.3.3.5	--	--	--	1
Non-Actuation	4.3.3.4	--	--	--	2

NOTES:
1. This test is destructive or degrading ("D-Tested").
2. This test is used only in conjunction with other tests.
3. **Deleted.**
4. Group I tests shall be performed in the order shown.
5. These are lot acceptance tests. Each of the sample units shall meet the requirements of each of the Group II tests, in the order shown.

4.3.3 Tests

4.3.3.1 Bridge Wire Resistance. Using a current of not more than 20 milliamperes and a potential of not more than 30 volts DC, the resistance of the following circuits shall be as specified.

Circuit	From	To	Resistance (ohms)
1	J1-Z	J1-L	2.00 to 2.52
2	J1-V	J1-F	2.00 to 2.52
3	J1-S	J1-Y	2.00 to 2.52
4	J1-T	J1-W	2.00 to 2.52

4.3.3.2 Insulation Resistance. With current limited to not more than 1 milliampere, a potential of 500±50 volts DC shall be applied for at least 0.5 second between each of the following circuits and all other electrically isolated circuits shorted to tester ground. During these tests, all unused connector pins shall be shorted to tester ground. The leakage current shall not exceed 25 microamperes.

Number	Circuit
1	J1-F,L,V,Z
2	J1-S,T,W,Y
3	J1-K, P3-B
4	J1-c, P3-D
5	J1-R
6	J1-P,N
7	J1-a, P1-C
8	P1-A, P3-A
9	J1-G, P4-B
10	J1-b, P4-D
11	J1-B
12	J1-C,D
13	J1-U, P2-C
14	P2-A, P4-A
15	J1-M, P1-B
16	J1-E, P2-B
17	P3-C, P4-C
18	J1-J, P1-D
19	J1-H, P2-D

4.3.3.3 Circuit Continuity and Resistance. Measurements shall be made by the voltmeter-ammeter or equivalent method. Using a current of not more than 100 milliamperes and a potential of not more than 30 volts DC, the resistance of the following circuits shall be as specified. Circuits shall be tested in the order shown.

Circuit	From	To	Resistance (milliohms max.)
1	J1-c	P3-D	20
2	J1-L	J1-F	20
3	J1-J	P1-D	25
4	J1-K	P3-B	25
5	J1-H	P2-D	25
6	J1-W	J1-Y	20
7	J1-M	P1-B	25
8	J1-E	P2-B	25
9	J1-a	P1-C	35
10	J1-G	P4-B	30
11	J1-b	P4-D	30
12	J1-U	P2-C	35
13	P3-C	P4-C	40
14	J1-P	J1-N	30
15	J1-C	J1-D	30
16	P1-A	P3-A	40
17	P2-A	P4-A	45

4.3.3.4 Non-Actuation. Circuits 1, 2, 3, and 4 (4.3.3.1) shall simultaneously be subjected (in-series) to a current flow of 175±5 milliamperes DC for 5 minutes after which circuits 9, 12, 14, 15, 16, and 17 (4.3.3.3) shall meet the requirements of 4.3.3.3.

4.3.3.5 Actuation. Each of the following bridge-wire circuits shall be subjected to the specified current flow for 2 milliseconds and all MC-1159's shall fire.

Bridge-Wire Circuits

Circuit	From	To	Current (amperes DC)
1	J1-S	J1-Y	1.30±.05
2	J1-T	J1-W	1.30±.05
3	J1-Z	J1-L (even serial No. units only)	1.30±.05
4	J1-V	J1-F (odd serial No. units only)	1.30±.05

Upon firing, each of the following normally-open switch circuits shall make and carry a current of 27±2 amperes DC for 50±5 milliseconds followed by 5.0±.5 amperes for one minute. The MC-1390 shall then meet the requirements of 4.3.3.5.1, 4.3.3.5.2 and 4.3.3.5.3.

Normally-Open Switch Circuits

Circuit	From	To
1	J1-E	P1-B
2	J1-R	J1-P
3	J1-B	P2-B
4	J1-B	J1-C
5	J1-K	J1-c
6	J1-b	J1-G

4.3.3.5.1 Contact Circuit Resistance. Measurements shall be made by the voltmeter-ammeter or equivalent method. Using a current of not more than 100 milliamperes and a potential of not more than 30 volts DC, the resistance of each of the normally-open switch circuits (4.3.3.5) shall be less than 0.035 ohm.

4.3.3.5.2 Fired Bridge Wire. For at least one second, each of the bridge-wire circuits in 4.3.3.1 shall be connected to a power supply having a capability of 12 volts DC maximum open-circuit voltage and 10 volts DC minimum voltage with a 2ohm load. Then a potential of 50±5 volts DC current limited to 110 milliamperes shall be applied to each bridge-wire circuit. The insulation resistance shall be at least 500 ohms for each circuit.

4.3.3.5.3 Open Circuit. A potential of 500±50 volts DC shall be applied for at least 0.5 second between each electrically isolated circuit and all other circuits shorted to tester ground. The leakage current shall not exceed 25 microamperes.

4.3.3.6 Temperature. During this test, the MC-1390 connectors shall be mated. The MC-1390 shall be subjected to the following exposures in immediate sequence, with testing as indicated.

Temperature	Duration	Tests
160°F	4 hours	--
Room	60±5 minutes	--
-65°F	4 hours	--
Room	60±5 minutes	--
160°F	4 hours	--
Room	60±5 minutes	--
-65°F	4 hours	--
Room	60±5 minutes	--
160°F	4 hours	Note 1
Room	60±5 minutes	--
-65°F	4 hours	Note 1

NOTE 1: During the last hour at this temperature, the MC-1390 shall meet the requirements of 4.3.3.1, 4.3.3.2, 4.3.3.3 and 4.3.3.4.

Upon completion of the last temperature exposure and after at least 4 hours at room temperature, the MC-1390 shall meet the requirements of 4.3.3.1, 4.3.3.2, 4.3.3.3, and 4.3.3.4; and visual inspection shall reveal no damage that might ultimately result in malfunction.

4.3.3.7 Mechanical Shock at Room Temperature. The MC-1390 shall be mounted per Figure 1. The MC-1390 shall then be subjected to the following shocks. Each shock shall approximate a half sine wave. Upon completion of these shocks, the MC-1390 shall meet the requirements of 4.3.3.1, 4.3.3.2, 4.3.3.3 and 4.3.3.4; and visual inspection shall reveal no damage that might ultimately result in malfunction.

Number of shocks	Impact acceleration (g)	Direction (see Figure 1)	Duration (milliseconds)
1	1000	Y+	4-5
1	1000	Z+	4-5

UNCLASSIFIED

NOTE:

1. Torque mounting bolts to 40 to 50 inch-pounds.
2. Tape cables securely to the mounting plate.
3. Connectors shall be mated.
4. Accelerometers used in monitoring accelerations shall be mounted on the test fixture, as close to an MC-1390 mounting point as possible without touching the MC-1390.

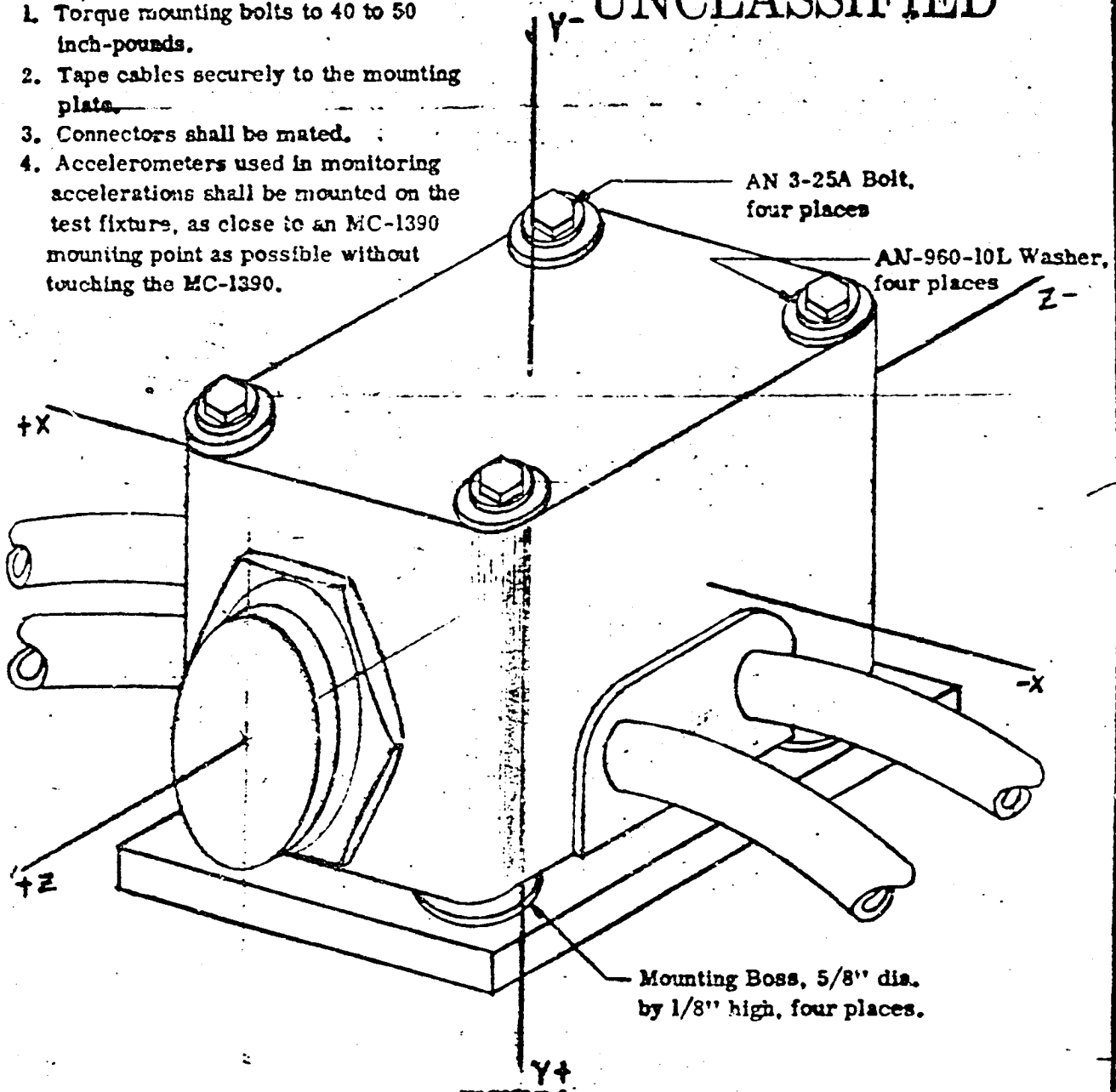

FIGURE 1

AXES ORIENTATION

REVS.	AUTHORIZATION	CHK ENG	DATE	ACTION	ORG.	INIT.	DATE
C				TYPE	4422	HS	
D				APPD.	4422		
E				APPD.	4422		
F				APPD.			
G				APPD.			
				APPD.			
				APPD.			
				APPD.			
				APPD.			
				APPD.			

DWG CLASSIFICATION

UNCLASSIFIED

TITLE
PRODUCT SPECIFICATION FOR MC-1390

5Y | DWG SIZE A

DRAWING NO. PS-311296

SHEET 10 OF 11

APPENDIX B

TMS PLANNING FOR MC-1390

SC 8722-P (7-61)

UNCLASSIFIED

TMS: 2344- 951

MC-1390 ; 2-7

Revised 12/28/61

MR. W. J. Denison, 7124

Attn: C. L. Sparks

Re: Results of the Tool-Made Sample Evaluation of the MC-1390, Explosive Switch Pack, Manufactured by BC/KCD, Purchase Order Number 91-1346, Evaluated in Accordance with the Tool-Made Sample Planning below.

Current P/N- 311206-00
Current N/X- 311206, Issue R
TMS Serial Numbers-

TMS PLANNING FOR THE MC-1390
(Minimum Requirements)

NX at TMS Planning 311206 Issue R
Number of TMS 6, one unpotted
Number to be Destructively Tested 5
Est. TMS Availability Date
Actual TMS Availability Date
Design Engineer C. L. Sparks Div 7124 Ext 29273
MD Engineer R. S. Fox Div 2533 Ext 20170
TMS Engineer J. P. Rynders Ext 33169
Date TMS Planning Completed 10-20-61
Location of Evaluation Sandia, Albuquerque

MANUFACTURING DEVELOPMENT SUBMITTAL INFORMATION (Fill in after recipt of TMS)

1. Items manufactured by _____ for _____
2. Items manufactured to ____ Issue of NX _____ and ____ Issue of Dwg. _____
3. Item is (not) manufactured from production tools.
4. Supplier is (not) authorized to continue fabrication prior to TMS release.
5. Supplier has (not) been authorized to ship product before TMS approved.
6. Gages and testers required and ones used for the evaluation: _____
7. Design changes in process at time of TMS submittal: _____
8. General comments of Manufacturing Development: _____

UNCLASSIFIED

MD ENGINEER ORG. DATE

1. SUMMARY OF RESULTS

UNCLASSIFIED

2. DRAWING CONFORMANCE Action Org. BC/KCD

2.1 Three of the six TMS MC-1390's shall be checked dimensionally and the results recorded as follows:

2.1.1 Drawing 311206, Issue H

Gage mounting holes using Gage No. 311206-G1

2.1.2 Certification of material and process specifications shall be supplied with the TMS units, as follows:

Dwg. 205035, Issue B, encapsulation

Dwg. 400198, bonding

2.2 Notes and dimensions shall be checked on drawings as follows:

2.2.1 Drawing 164507, Issue G, Note 1, Soldering

UNCLASSIFIED

3. MARKING AND IDENTIFICATION Action Org. 2344

3.1 The marking of the MC-1390's shall be checked per Note 3 of Dwg 163488, Issue F, 163489, Issue F, 163490, Issue F, 163491, Issue F, and Note 5 and 7 of Dwg 311206, Issue H.

4. ENVIRONMENTAL TESTS Action Org. 7321

4.1 Five TMS units shall be subjected to the following environmental tests. Visual inspection as well as possible post-mortem shall be performed following the tests. All tests shall be performed in the sequence shown.

PS-311206, Issue G

Description	Paragraph Number
X-ray	*Note 1
Bridge-wire Resis.	4.3.3.1
Insulation Resis	4.3.3.2
Ckt. Con'ty. and Resis.	4.3.3.3
Non-Actuation	4.3.3.4
Temperature	4.3.3.6
Vibration at 160°F	*Note 2
Vibration at -65°F	*Note 3
Actuation (S-9 and S-10 only)	4.3.3.5
Mech. Shock at -65°F	*Note 4
Actuation (S-15 and S-16 only)	4.3.3.5

*See Appendix

5. FUNCTIONAL FIT TO MOCK-UP

5.1 One unit shall be checked for compatibility with the next assembly.

The signatures below denote agreement to the above planning only.

Original signed by:

J. P. Rynders	C. LeRoy Sparks	R. S. Fox
(TMS Engineer and Date)	(Design Engineer and Date)	(MD Engineer and Date)
(Planning Prepared)	(Planning Approved)	(Planning Concurred With)

Note 1 One shot through top and one through side opposite connector.

Note 2 Vibration at 160°F - The MC-1390 shall be exposed to a temperature of 160°F during the test and for four hours before the test is started. The MC-1390 shall then be subjected to the Vibration Requirements listed below. Upon completion of this vibration, the MC-1390 shall meet the requirements of 4.3.3.1, 4.3.3.2, 4.3.3.3 and 4.3.3.4 of PS-311206-G .

Note 3 Vibration at -65°F - The MC-1390 shall be exposed to a temperature of -65°F during the test and for four hours before the test is started. The MC-1390 shall then be subjected to the Vibration Requirements listed below. Upon completion of this vibration, the MC-1390 shall meet the requirements of 4.3.3.1, 4.3.3.2, 4.3.3.3 and 4.3.3.4 of PS-311206-G .

Vibration Requirements: The MC-1390 shall be mounted per Figure 1 and shall be vibrated for 20 minutes in each of the three axes shown in Figure 1. This shall be accomplished by vibrating in one 20-minute cycle through a frequency range of 10 to 2000 to 10 cps at the vibratory accelerations specified below. During this vibration, all contacts shall be constantly monitored with a thyratron contact chatter monitor capable of detecting chatter of 10 microseconds duration and there shall be no indication of chatter.

Frequency Cycle Range (cps)	Constant Acceleration or Double Amplitude
10-73.7-10	0.036 inch
73.7-500-73.7	10.0g
500-2000-500	5.0g

Note 4 Mechanical Shock at -65°F - The MC-1390 shall be exposed to a temperature of -65°F during the test and for four hours before the test started. The MC-1390 shall be mounted per Figure 1. The MC-1390 shall then be subjected to the following shocks. Each shock shall approximate a half sine wave. Upon completion of these shocks, the MC-1390 shall meet the requirements of 4.3.3.1, 4.3.3.2, 4.3.3.3 and 4.3.3.4 of PS-311206-G.

Number of Shocks	Impact Acceleration (g)	Direction (See Figure 1)	Duration (Milliseconds)
1	150	Y+	11±1
1	150	Z+	11±1

Figure 1 is per PS-311206-G.