

1:2273

SPLIT PAYLOAD HOUSING NOSE CONES, DOORS, AND RELEASE MECHANISMS

N. J. Guarino



Bedford, Massachusetts

PROPERTY FORM NO. 1270-20590
ACQUISITION NUMBER
30
DATE
105073
STATION
31
CODE
110001

FINAL REPORT
CONTRACT NO. NAS9-8232

PREPARED FOR
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACE FLIGHT CENTER
HOUSTON, TEXAS

NOVEMBER 1968

NAS 823

GCA-TR-68-17-N

**SPLIT PAYLOAD HOUSING NOSE CONES,
DOORS, AND RELEASE MECHANISMS**

N. J. Guarino

**GCA CORPORATION
GCA TECHNOLOGY DIVISION
Bedford, Massachusetts**

FINAL REPORT

Contract No. NAS9-8232

November 1968

Prepared for:

**NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
Manned Space Flight Center
Houston, Texas**

TABLE OF CONTENTS

<u>Section</u>	<u>Title</u>	<u>Page</u>
	SUMMARY	1
1	SPLIT NOSE CONE	1
2	DUAL DOOR RELEASE MECHANISM	18
	APPENDIX	23

SPLIT PAYLOAD HOUSING NOSE CONES, DOORS, AND RELEASE MECHANISMS

By Nicholas J. Guarino
GCA Corporation
GCA Technology Division
Bedford, Massachusetts

SUMMARY

The report describes a nosecone separation system and a door-ejection system developed under NAS9-8232 adaptable to a standard Nike Apache payload housing. The system will be used in conjunction with a sounding rocket experiment under the direction of Dr. A. Potter of NASA/MFC in which various photometric instrumentation will be exposed at prescribed altitudes.

The report includes the various engineering drawings and photographs applicable to the split nosecone and door-release systems. In addition, the installation, servicing and operating instructions are provided in some detail. An acceptance test plan and inspection procedure to insure system reliability is included in the Appendix.

The objective of the program is to provide four nosecone-release assemblies, two modified payload shells, two dual-door release mechanisms, and appropriate spare parts.

1. SPLIT NOSE CONE

The split nosecone assembly is illustrated in Figure 1. The assembly is installed in the forward end of the payload shell and sixteen screws are used to fasten the assembly and shell together by means of a mounting ring illustrated in Figure 2. Installation-torque value should be 20 to 30 inch-pounds.

Since the split nosecone assembly contains its own electrical release circuit, it is independent of the remainder of the payload. Consequently, the split nosecone assembly may be radially oriented with respect to the shell in any manner desired by the user.

There are three basic elements to the split nose cone. They are the pyrotechnic circuit, the release mechanism and the split cone. The split cone without the release mechanism and circuitry shown in Figure 3 does not require any special servicing. Consequently, only the pyrotechnic circuit shown in Figure 4 and release mechanism will be described.

Pyrotechnic Circuit Assembly

Servicing the pyrotechnic circuit will simply involve installation of two Yardney PM-1 batteries. A container of electrolyte and a filling kit is provided. Filling instructions by the manufacturer are also provided. Inject the electrolyte into the batteries before installing them. The batteries are fully charged within several minutes after the electrolyte is put in.

Place the batteries into the battery holder-bracket as shown in Figure 1 and the photograph of the pyrotechnic circuit assembly, Figure 5. The batteries are held in the bracket by torquing to 4 inch-pounds, the 1/4-28 binder head screws which are shown in Figure 6.

The battery wires have lugs on their ends. Place a lug on each of the two battery studs which are adjacent to the wire lugs. Tighten the nuts on the battery studs to about one inch-pound.

After installation of the batteries, the pyrotechnic circuit board assembly can be installed into its half-cone as shown in Figure 7.

I M P O R T A N T

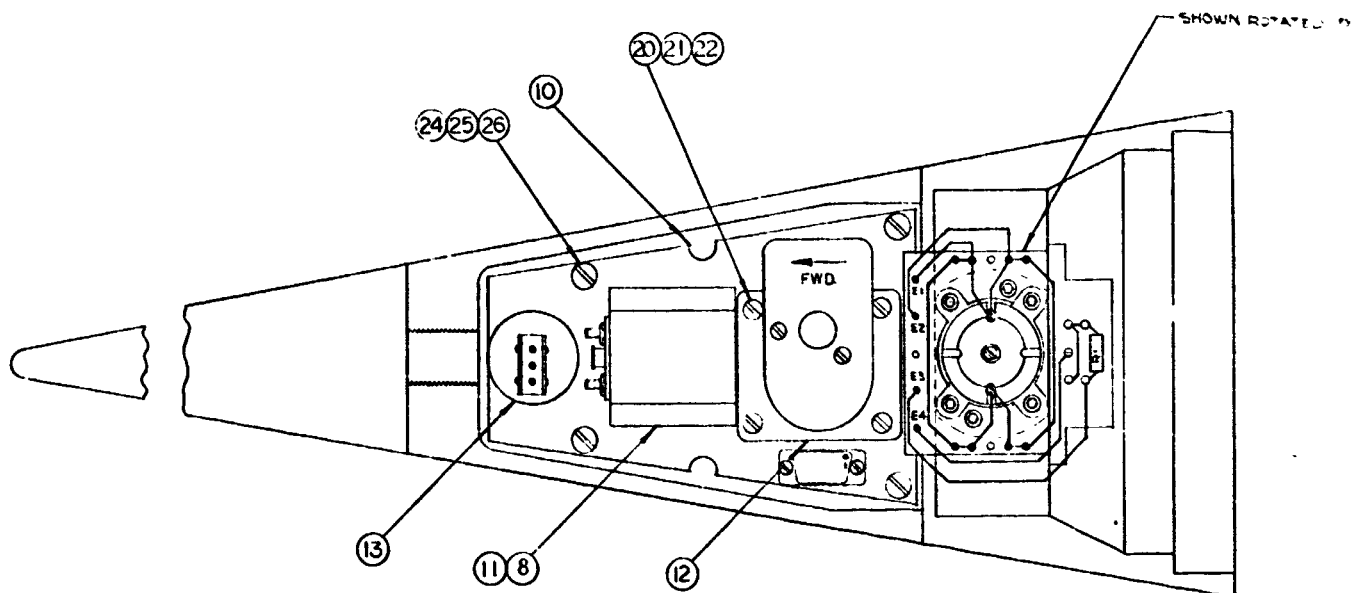
BEFORE FLIGHT MAKE SURE THE RAYMOND TIMER IS IN THE PROPER POSITION AS SHOWN ON ITS COVER PLATE.

The Raymond timer (Model 1090-5G-ISPDT) is a mechanical timer which starts when a 5G acceleration is applied to it for 1.8 seconds (maximum).

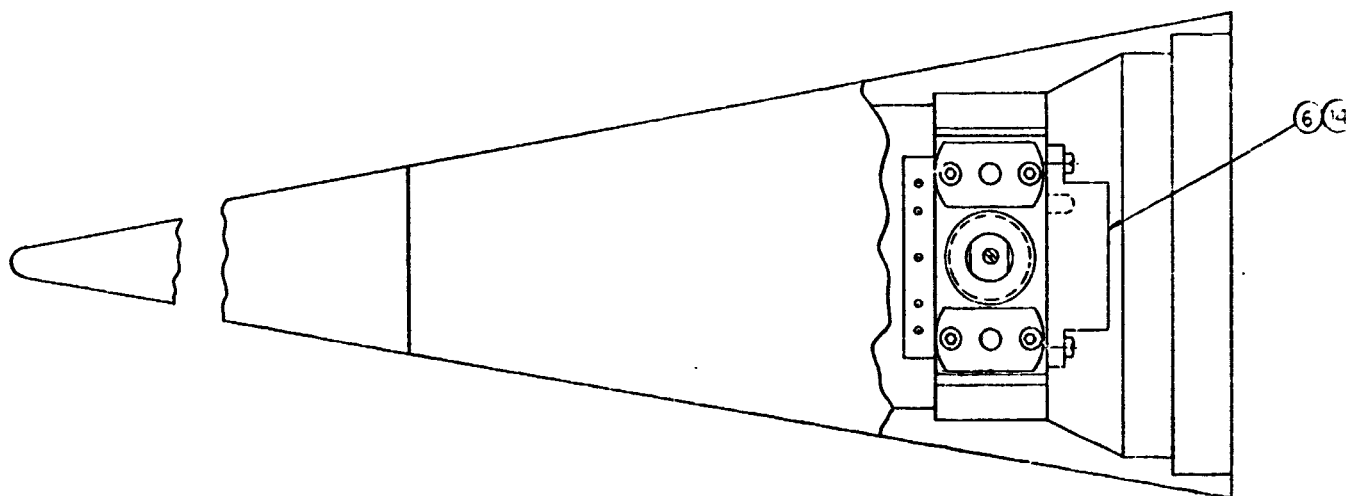
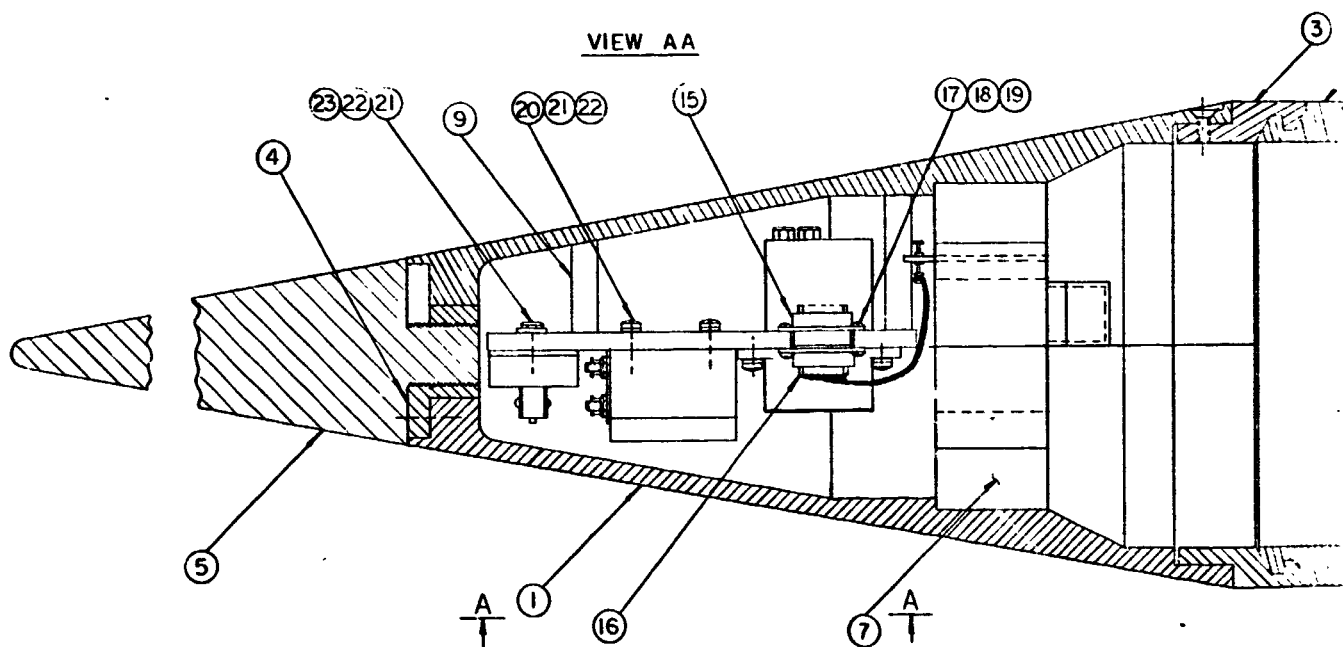
Figure 5 shows the Raymond timer with its cover-plate removed. The cam-finger is captivated under the brass-weight which is cantilevered on a spring. For testing purposes, the weight can be manually pushed down* (to simulate the acceleration effect) and the timer will start. At 50 seconds, the single pole-double throw switch, which is contained within the timer, actuates and applies the battery voltage to the piston actuators in the release mechanism. The timer is reset by holding down the brass-weight and manually rotating the cam-finger to its captivated position. The cover-plate should be installed on the timer after the tests.

A Cannon 9-pin connector is mounted on the pyrotechnic circuit board assembly. The connector from the release-mechanism assembly must be plugged into this connector. Two 3/16-inch long 4-40 screws with lock and flat washers should be used to fasten the connector securely.

* To do this from a remote position a string may be tied to the brass weight.



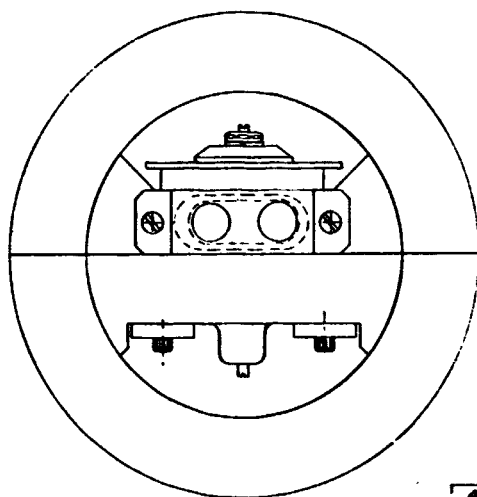
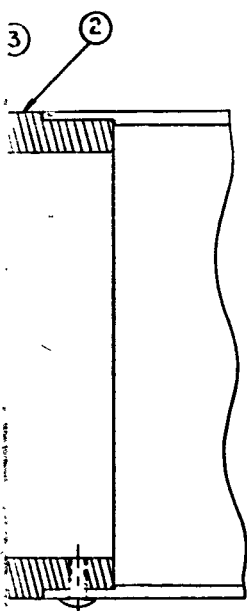
VIEW AA



FOLDOUT FRAME

REPRODUCIBILITY OF THE ORIGINAL PAGE IS POOR.

160° FOR CLARITY

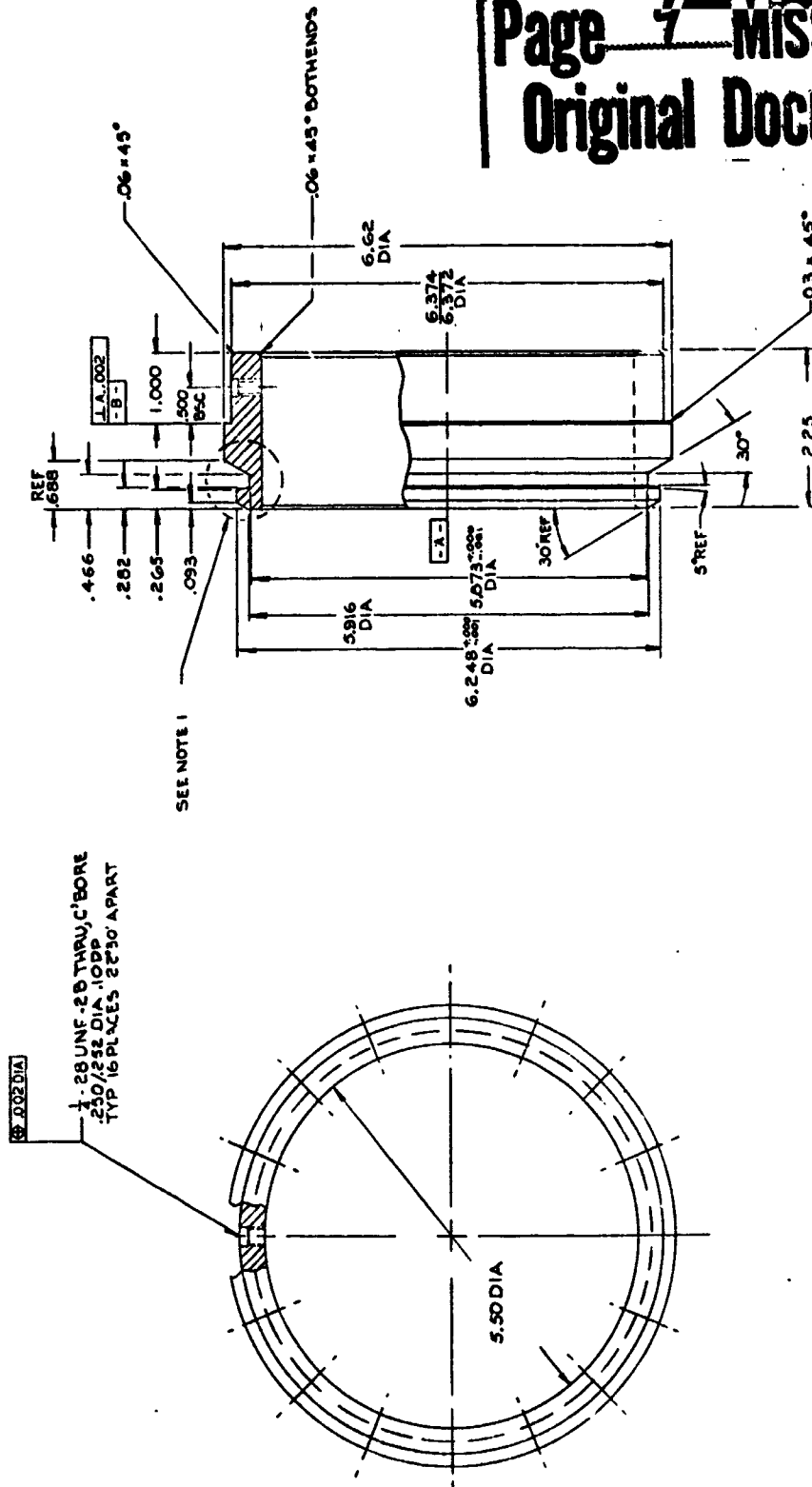


4		*10 SPLIT LOCK WASHER	CRES	26
4		*10 FLAT WASHER	CRES	25
4		*10-32UNC BND HD SCR 1/2 LG	CRES	24
7		*6-32UNC HEX MACH NUT	CRES	23
10		*6 SPLIT LOCK WASHER	CRES	22
10		*6 FLAT WASHER	CRES	2
8		*6-32UNC BND HD SCR 1/2 LG	CRES	20
4		*4 SPLIT LOCK WASHER	CRES	9
4		*4 FLAT WASHER	CRES	18
4		*4-40UNC BND HD SCR 1/4 LG	CRES	17
1		CONNECTOR CANNON	DE9PCT	19
1		CONNECTOR CANNON	DE9SC7	8
REF	B106085	SCHEMATIC-PYROTECHNIC		

106110

2		BULB	GE	*375	14
1		BAROSWITCH	PRECISION SEN	A77C	13
1		TIMER	RAYMOND ENG	360-55-507-VP	12
2		BATTERY	YARDNEY	PM1	11
1	C106081	PYRO DECK			10
4	C106093	STANDOFF S.S.			9
1	B106080	HOLDER BATTERY			8
1	C105933	SPLIT NOSE CONE RELEASE MECHANISM			7
1	C105876	HOLDER LAMP			6
1	B106079	NOSE TIP			5
1	B102853	NOSE TIP BUSHING			4
1	D105769	SPLIT MOUNTING RING			3
1	D105770	MOUNTING RING			2
1	D106082	10" NOSE CONE MACHINING			1
QTY REQD	PART NO.	DESCRIPTION	SPECIFICATION	ITEM NO	

Page 7 Missing in Original Document



NOTES
1. ALL DIM. ARE $\pm .001$ IN UNLESS OTHERWISE SPECIFIED
2. RING GROOVE TO MATE WITH DWG. D 105769

Figure 2. Mounting ring (Drawing No.D105770).

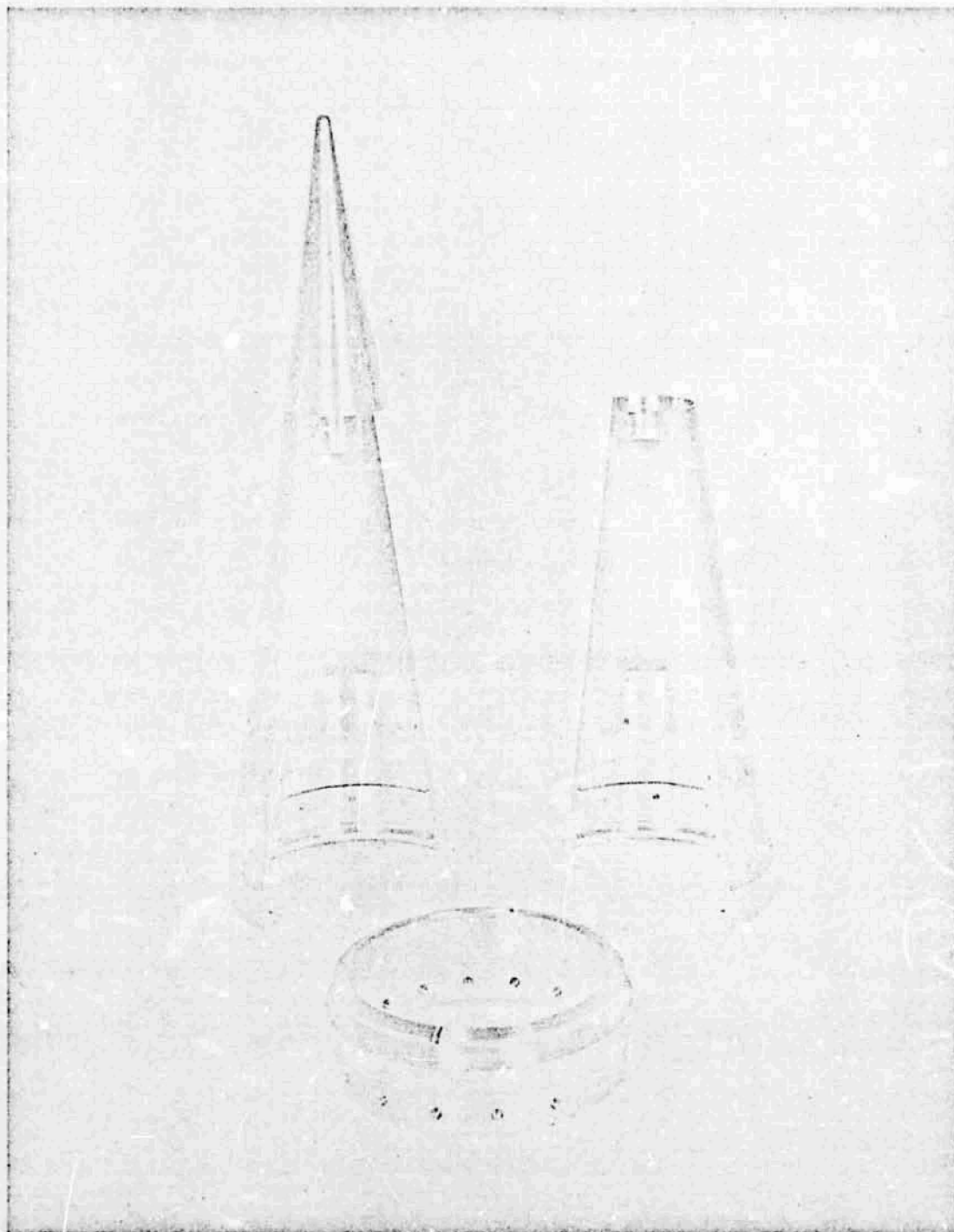
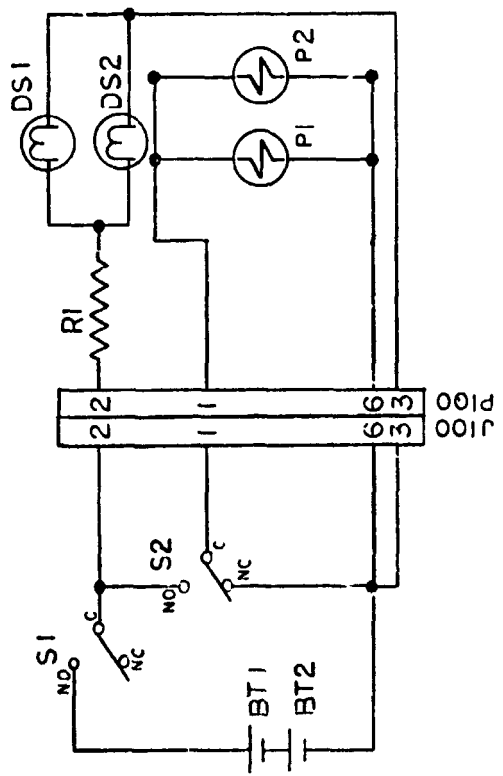


Figure 3. Split nose cone without release circuit.



P100
 P1 & 2
 BT1 & 2
 S2
 S1
 DS1 & 2
 J100
 R1

QTY REQD	DESCRIPTION						
1	CONNECTOR	CANNON	DE9PC7	8			
2	PISTON	ATLAS	IMT114	7			
2	BATTERY	YARDNEY	PM-1	6			
1	TIMER, G'SW. RAYMOND ENG.	1060-SG-1SPDT		5			
1	BARO. SW. 70K FT. P.S.I.	A37C		4			
2	TUNGSTEN FIL."375 3V@ 40MA	CHICAGO		3			
1	CONNECTOR	CANNON	DE9SC7	2			
1	RESISTOR 10Ω 2W 5%	CARBON		1			
	DESCRIPTION		SPEC.				ITEM NO.

Figure 4. Pyrotechnic circuit schematic (Drawing No. B 106089).

836

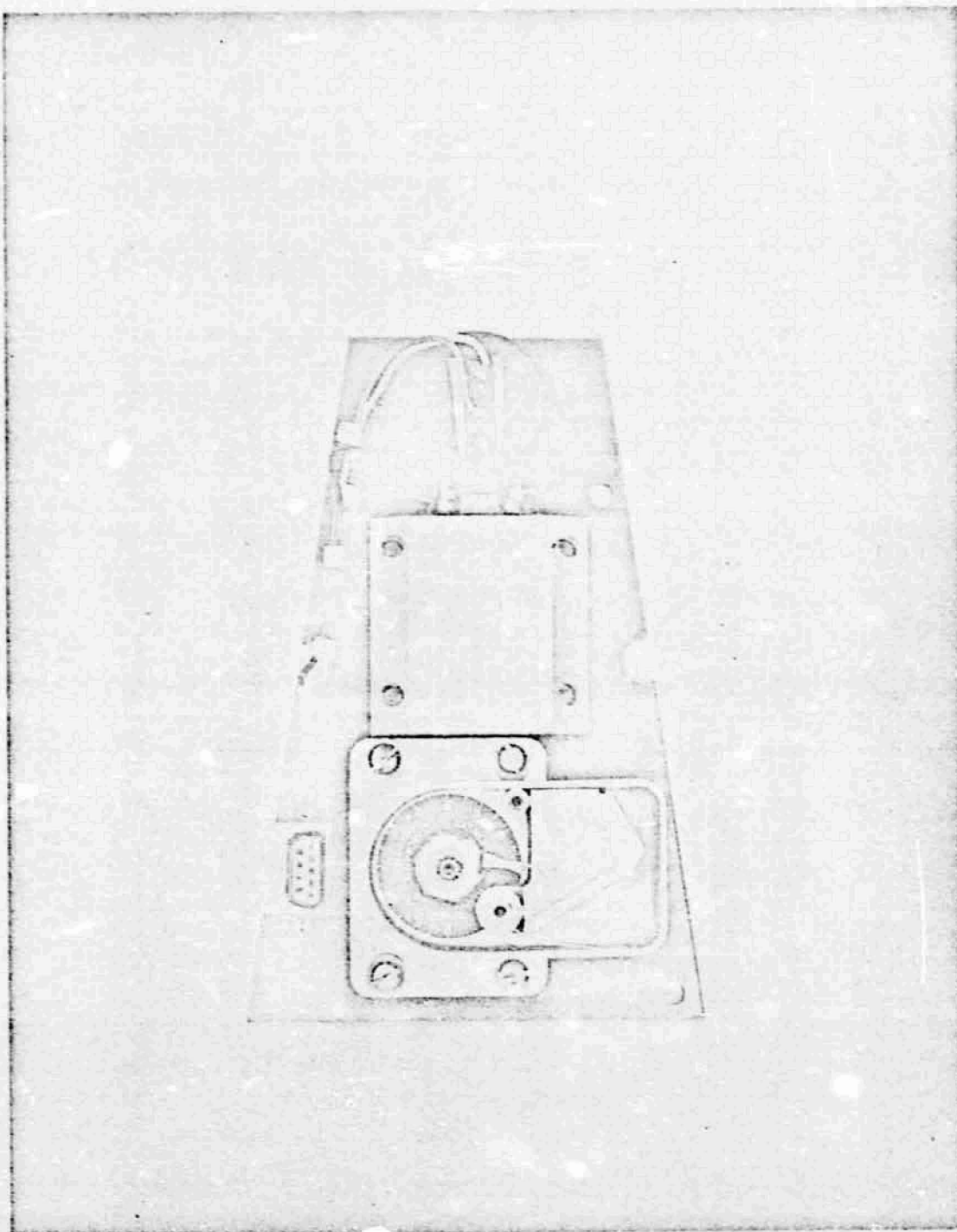


Figure 5. Pyrotechnic circuit showing cover plate removed from timer.

837

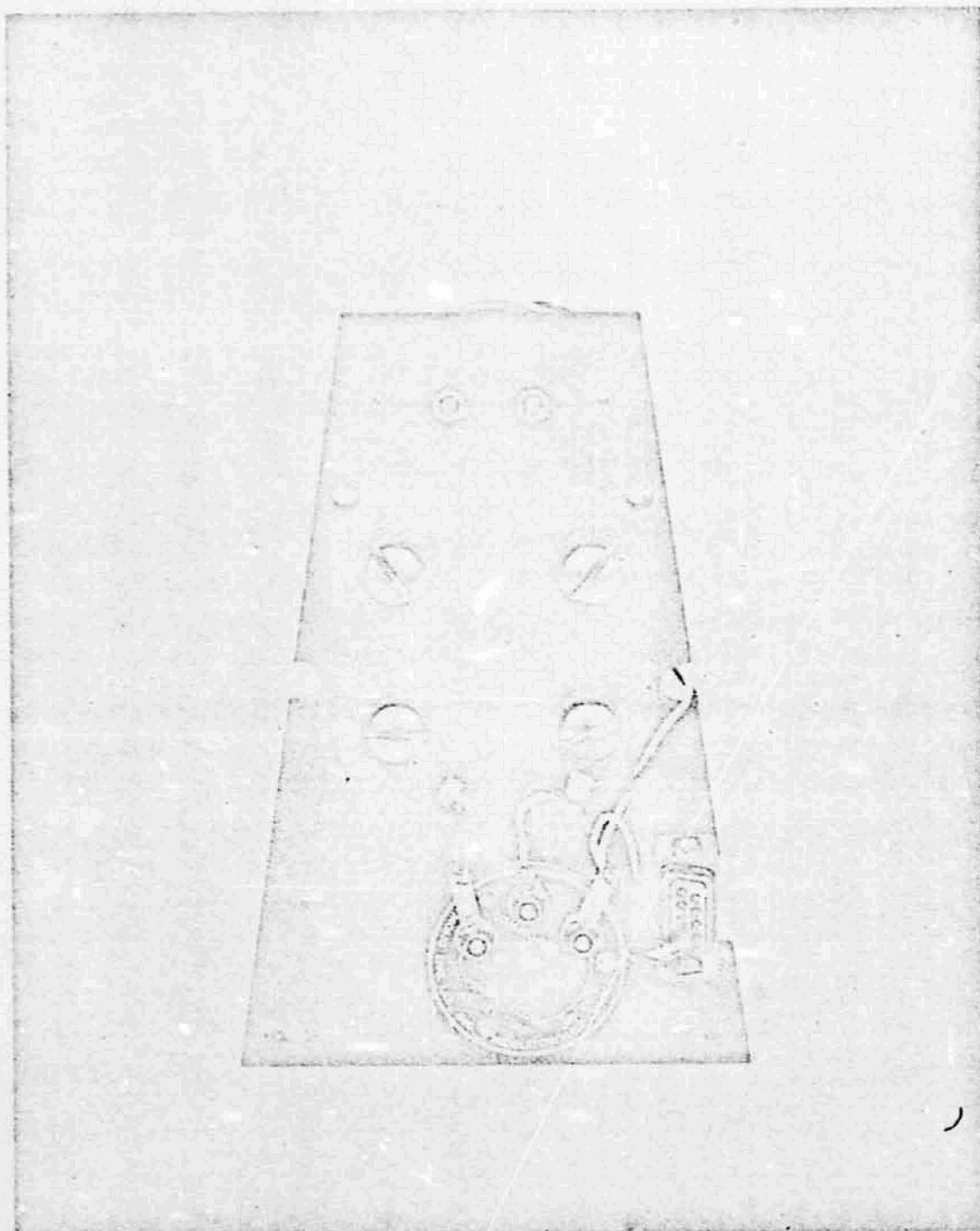


Figure 6. Rear view of pyrotechnic circuit assembly .

838

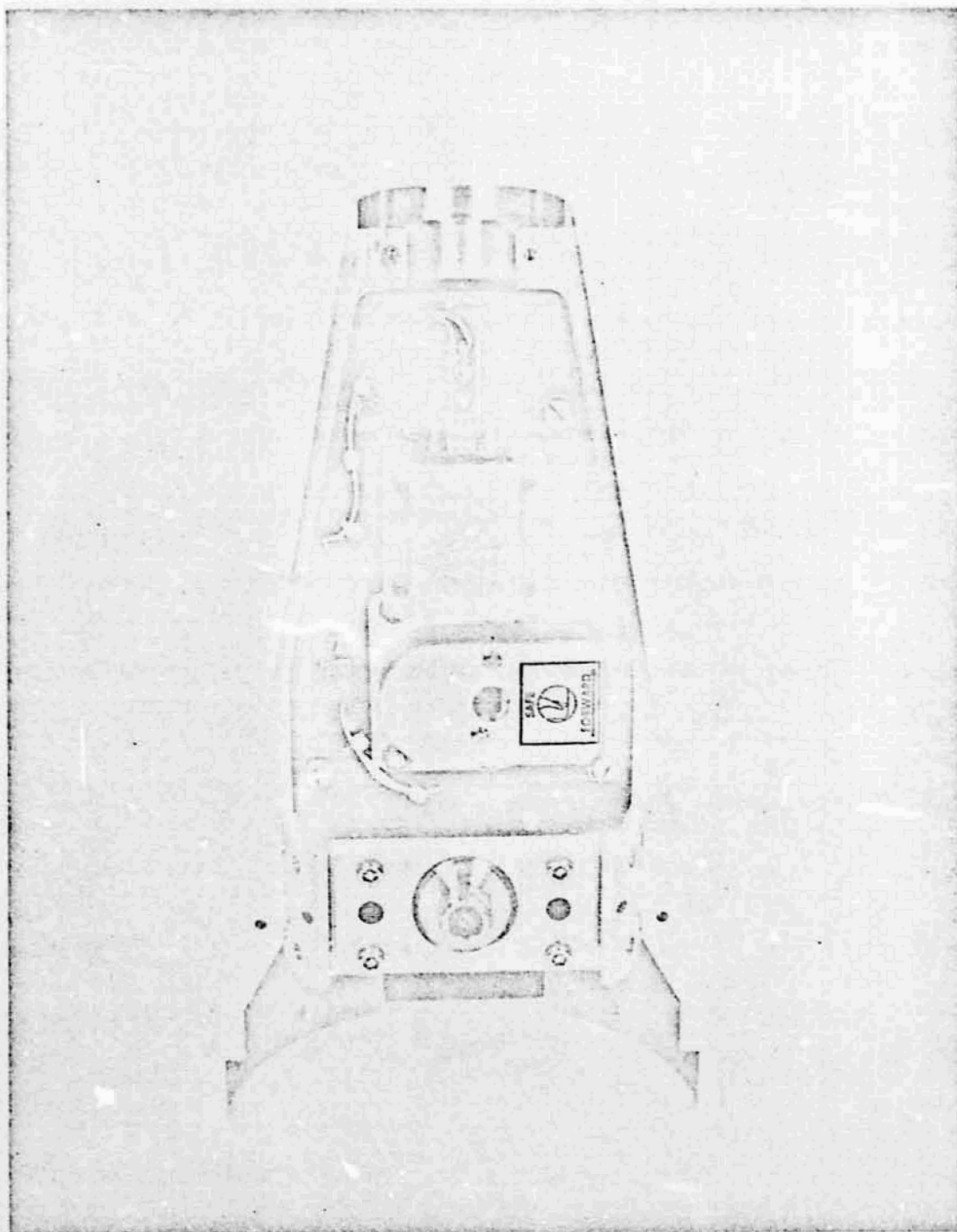


Figure 7. Pyrotechnic circuit installed in its cone-half.

Release Mechanism Assembly

The release mechanism (Figure 8) consists primarily of two halves which are held together by a ball detent device. Manual operation is performed by pushing the piston-plunger rod. This causes the balls to disengage from their detent and the two halves may be separated or fastened together. About a 20 to 30 pound force is required to push the rod for separating the halves. This can be done easily by one man by placing a flat-bladed screwdriver into the slot of the piston-plunger rod and holding the mechanism with both hands. The handle-end of the screwdriver can then be pushed by the operator with his chest. This method may be used for manually separating and assembling the mechanism halves. A Teflon loading tool is provided to facilitate assembly which is described later. Figure 9 is a view of the side of the mechanism which shows the slotted end of the piston-plunger rod.

The release mechanism is shipped to the user in the assembled and loaded condition ready for flight or test (the batteries must be serviced according to the previous instructions). If the mechanism is tested before flight, the following procedure shall be followed for re-assembling.

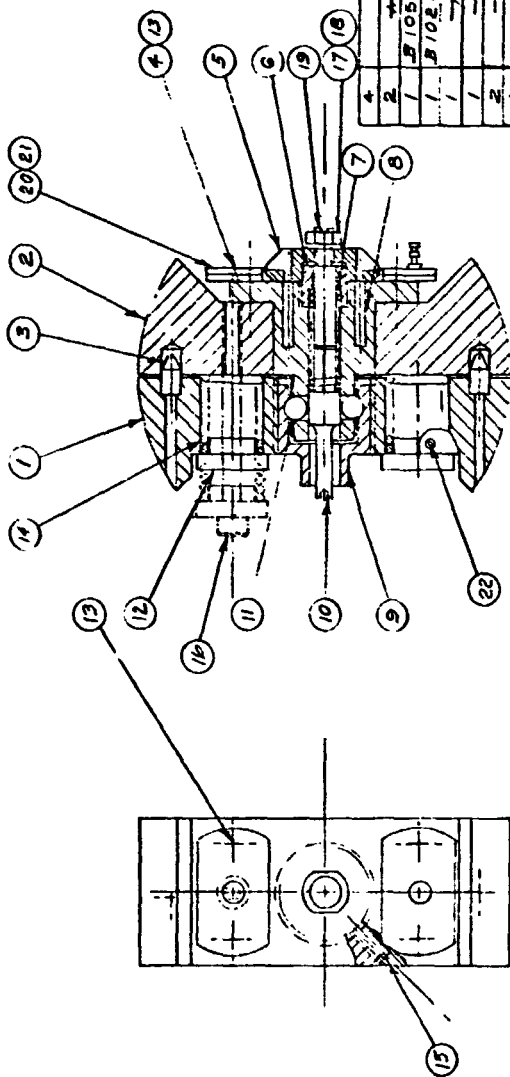
- (1) Unsolder the piston actuator leads from their terminal connections.

- (2) Remove the 1/4-28 nut and lock washer from the piston-plunger rod. Use a screwdriver on the slotted end of the rod to prevent the rod from turning. Figure 10 shows that side of the mechanism which is opposite the side shown in Figure 9.

- (3) Lift off the piston actuator retainer cap and remove the expended piston actuators.

- (4) Remove the two 3/4-inch diameter ejection springs from their housings. The springs are captivated by 4-40 socket head screws which must be backed out slightly. (NOTE: The purpose of captivating the springs is to prevent them from falling free upon ejection; they could possibly fall into the experiment instrumentation of the payload).

- (5) Assemble the two mechanism halves pushing the piston-plunger rod and inserting the Teflon loading tool under the flat washer and retainer ring which is on the piston-plunger rod. This holds the rod in the release position. Note that the halves are match-marked and can only go together in one way. Align them properly and extract the Teflon loading tool. The operator should hear a "click" sound when the balls engage the detent as the piston-plunger rod is released.



NOTE:
 1 ITEM 16 IS A LOADING SCREW AND MUST
 BE REMOVED BEFORE FINAL ASSEMBLY.

QTY REQD	PART NO	DESCRIPTION	SPECIFICATION	ITEM NO
LIST OF MATERIAL				
4	SET SCREWS	4-40UNC-2A		22
2	10-32 X 2.50 SDC HD SCREW			21
1	B105891	TERMINAL BOARD REL MECH		20
1	B102875	BALL PLUNGER EXTENSION		19
1	1/4 LOCK WASHER			18
1	1/4-20 NUT, CRCS			17
2	1/4-20 X 1.50 SDC HD SCREW			16
1	1/4-20 X 1.50 SDC HD SCREW			15
2	10-32 X 1.50 SDC HD SCREW			14
2	10-32 X 1.50 SDC HD SCREW			13
2	B102867	SPRING RETAINING PLATE		12
3	B102867	.281 DIA. HARDENED STEEL BALL		11
1	B102869	BALL PLUNGER		10
1	B102868	PISTON RETENTION RING		9
1	1/4-20 X 1.50 SDC HD SCREW			8
1	A102877	SPRING RETAINING RING		7
1	B102870	PISTON PLUNGER CAP		6
1	C102871	PISTON CHAMBER		5
2	A102866	DOWEL PIN		4
1	C105888-P2	HOUSING NOSE CONE REL MECH		3
1	C105888-P1			2

Figure 8. Split nosecone release mechanism (Drawing No.C105893).

839

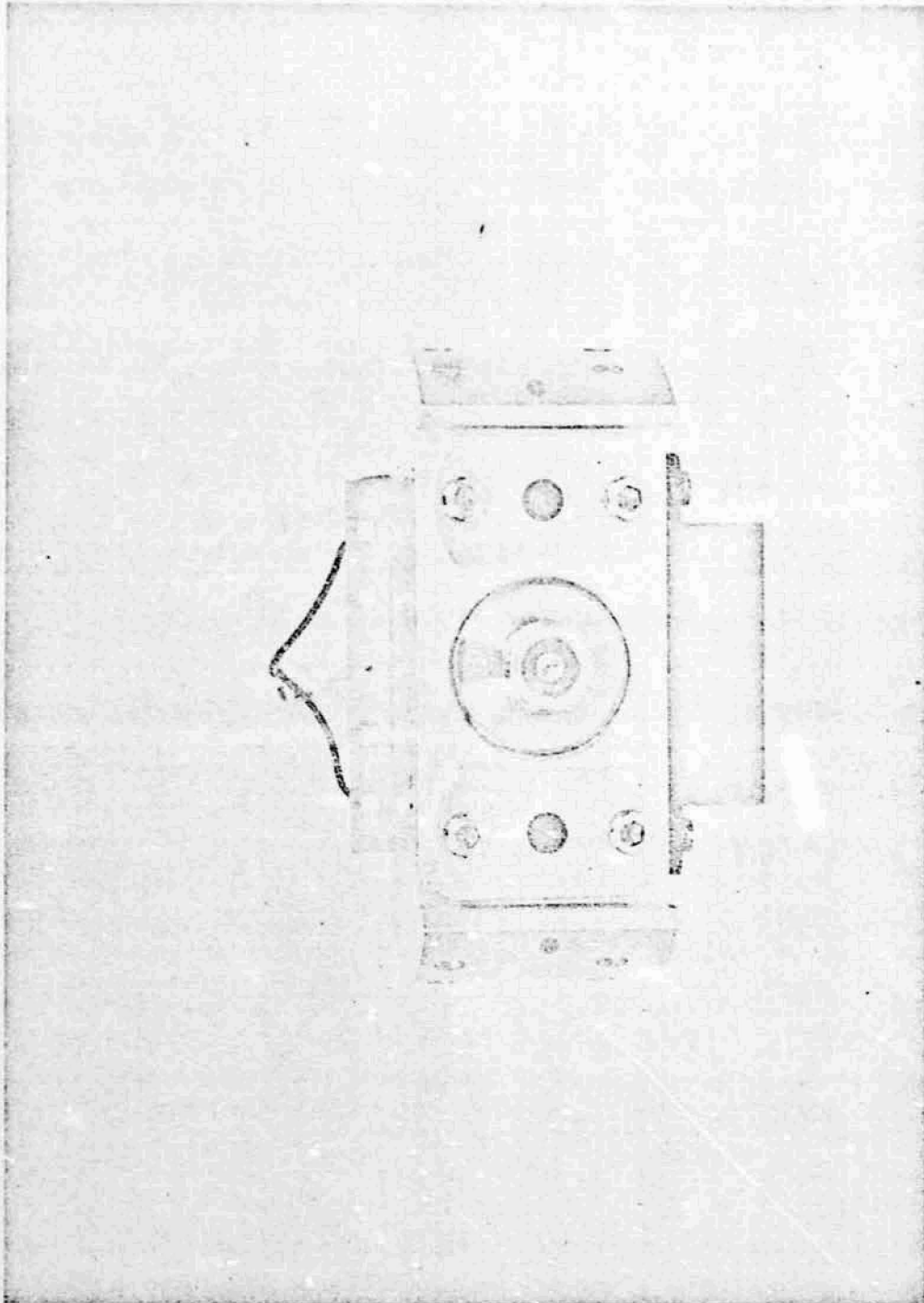


Figure 9. Split nose-cone release mechanism showing slotted end of piston plunger rod.

840

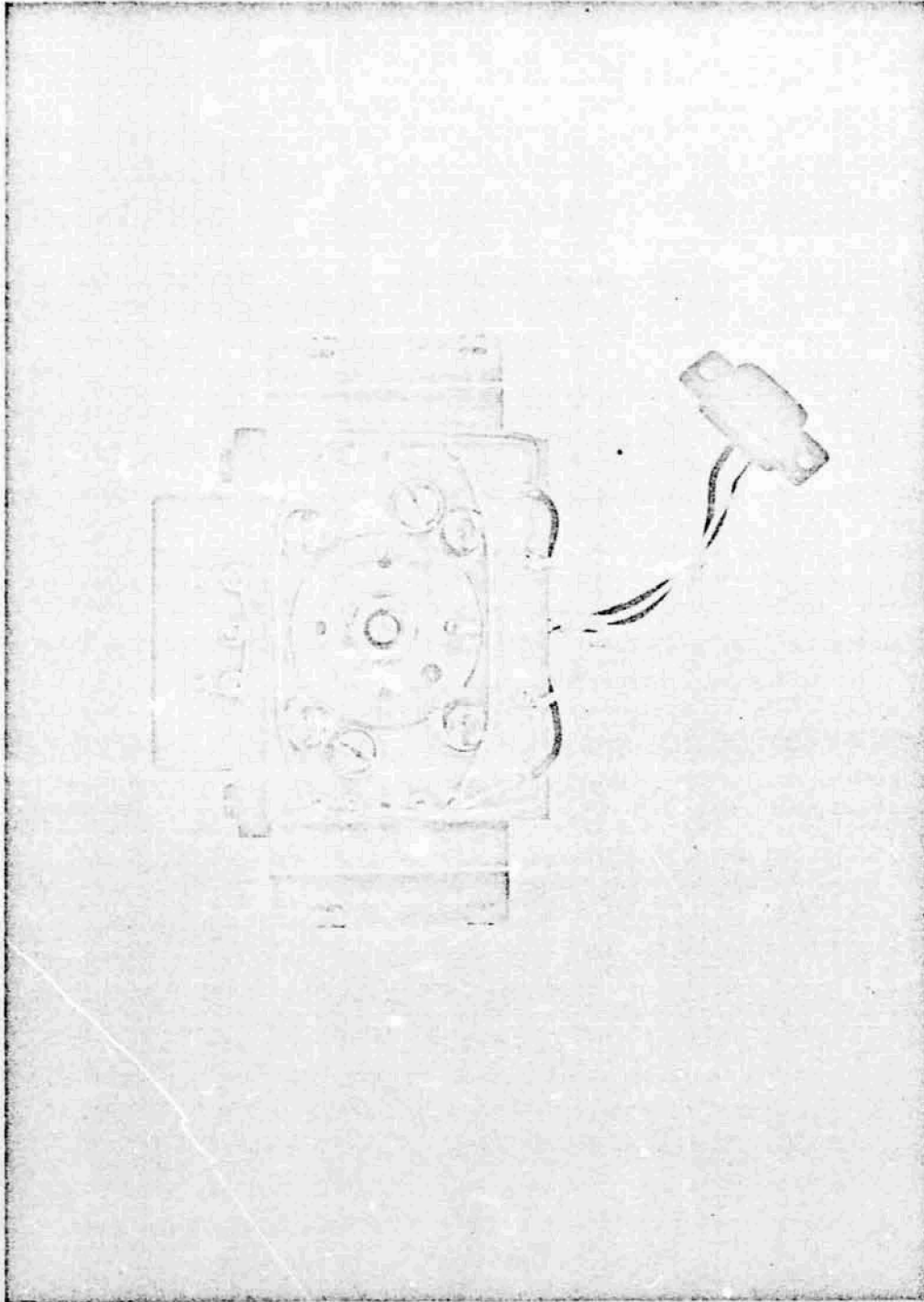


Figure 10. Split nose-cone release mechanism showing threaded end of piston plunger rod.

(6) Remove the spring retainer caps from the portion of the mechanism which is shown in Figure 9. The caps are fastened with two 10-32 screws. Insert the two 3/4-inch diameter ejection springs into the mechanism. The springs will fall out unless they are captivated in the holes. Therefore, turn the two 4-40 set screws, 1 for each spring, until they lock the springs in place.

(7) Place the spring retainer caps on the free end of the spring and pass a 1/4-20 socket head loading bolt through the center of each cap. This bolt has a painted red head. Screw the bolts down thus compressing the ejection springs. Then fasten each cap to the mechanism with the two 10-32 screws. After doing this, remove the loading bolts; if the loading bolts are not removed the mechanism will not come apart.

(8) Insert two piston actuators (ATLAS 1MT114) into the mechanism. Place the piston actuator retainer cap over the actuators, making sure the leads pass through the proper holes. Note the location of the alignment hole and pin. Then carefully bend the actuator leads towards the solder terminal and solder each lead to its terminal. The terminals are marked L.

(9) Place the lock washer and 1/4-28 nut onto the threaded portion of the piston-plunger rod. Torque the nut to 8 inch-pounds by holding the nut with a wrench and using a screw driver on the other end of the piston-plunger shaft. The mechanism assembly is now complete.

(10) Install the mechanism into the cone-half as shown in Figure 11. Note that the harness attached to the mechanism remains with the cone half which contains the pyrotechnic circuit assembly.

(11) Place the other cone half on to the release mechanism and fasten with the 10-32 flat head screws.

The split nosecone assembly is complete.

The following recommendations are to be noted with regard to use of the split nosecone assemblies.

- (1) Do not forget to remove the two 1/4-20 loading bolts.
- (2) Insure that batteries are properly filled and installed before flight.
- (3) Insure that the timer is in proper position before flight.

Figure 12 shows the side of the mechanism which faces the payload instrumentation. The plastic holder contains two light bulbs which will turn on when the barometric switch actuates (70,000 feet). This is used as a monitor through the payload instrument. The light source vanishes upon ejection of the nose cone. No servicing of this component is necessary.

834

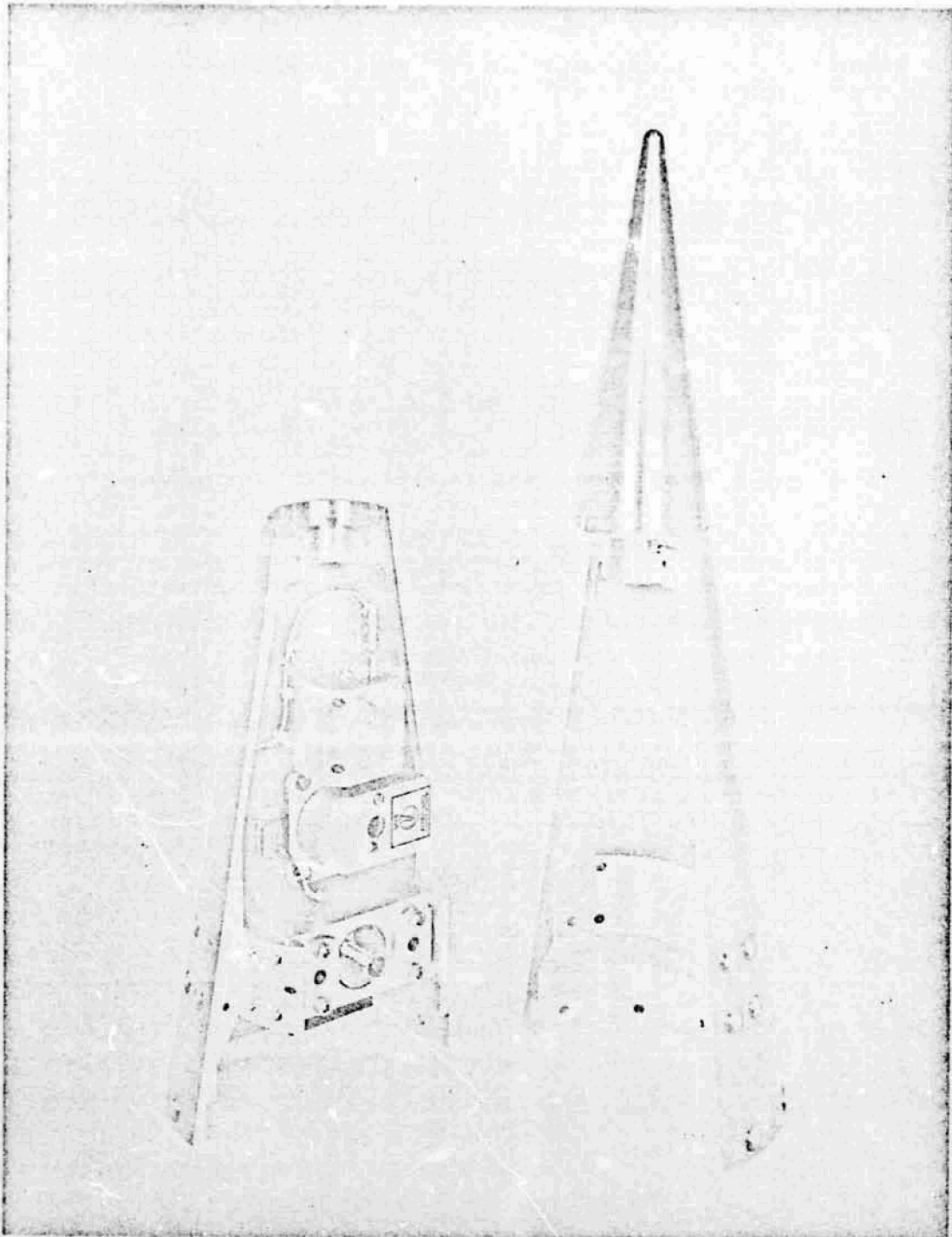


Figure 11. Split nose cone with release circuit.

841

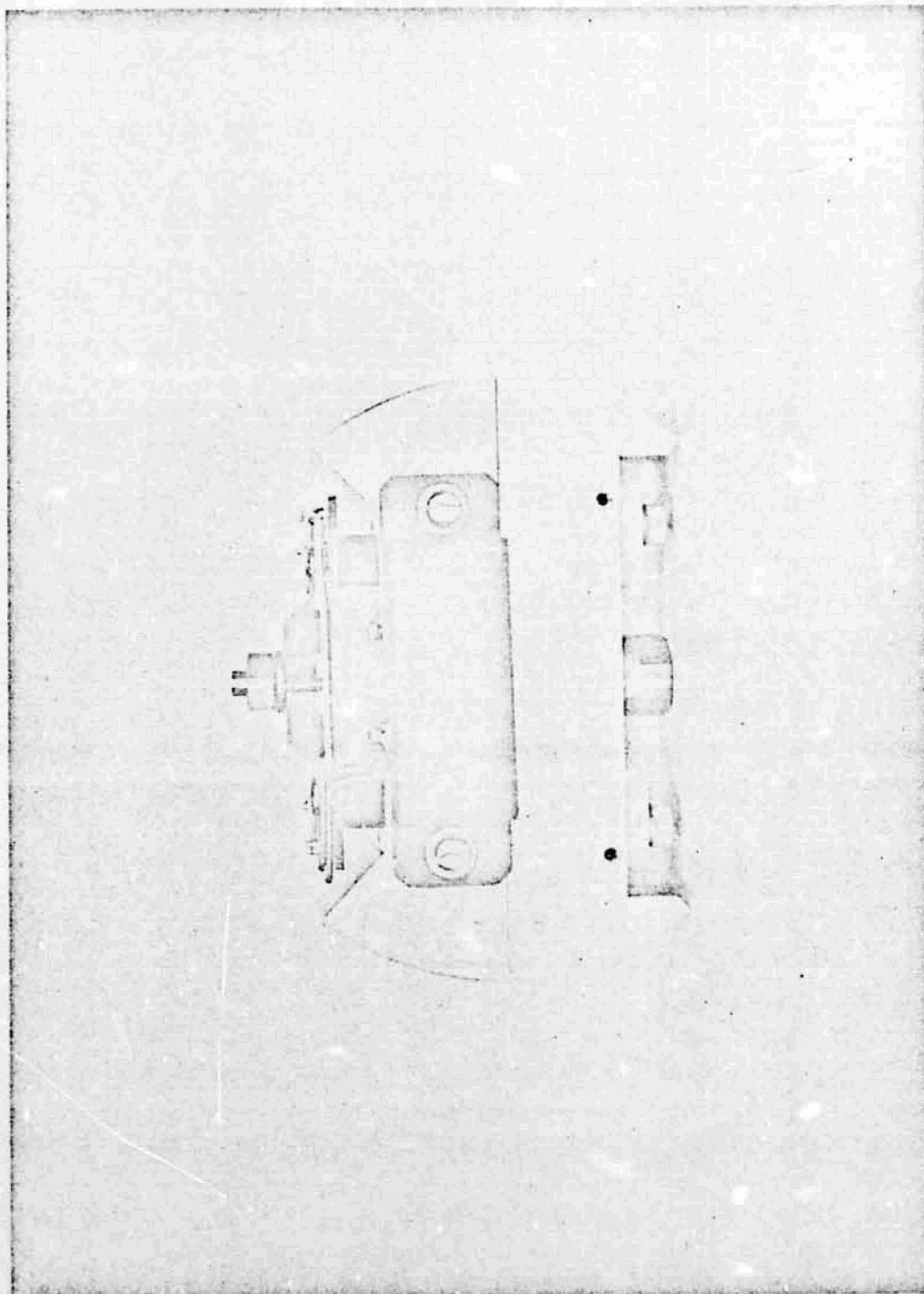


Figure 12. Bottom view of split nose-cone release mechanism showing lamp monitors.

2. DUAL DOOR RELEASE MECHANISM

The door release mechanism shall be installed so that the center of the device is on the centerline of the payload cylinder. Thus, the attachment point for each door is equally distant from each door. Note the attachment point for the door may be located and put in by the user. This simply means drilling a 0.281 diameter clearance hole for a 1/4-28 screw. It is recommended the hole be placed in the forward portion of the door at least beyond the midpoint.

The door is installed by engaging the steel half-hinge in the indentation slot provided in the payload shell. Center the door in the opening provided in the shell and fasten it to the release mechanism with the 1/4-28 door screw. If desired by the user, the door fastening hole may be counterbored for the depth of the screw head. This is a "cleaner" aerodynamic installation. Do not use flat head screws to fasten the doors to the door release mechanism. Experience has shown that the dimensional tolerances of the internal payload rack structure will generally not permit the use of flat head screws for fastening the door.

Tapped holes as well as clearance holes are provided for mounting the Dual Door release mechanism to suit the user's installation requirements.

VERY IMPORTANT

DO NOT EXCEED 20 INCH-POUNDS TORQUE WHEN INSTALLING DOOR SCREW. EXCESSIVE TORQUE WILL TOTALLY OR PARTIALLY SHEAR THE SHEAR PINS IN THE DOOR RELEASE MECHANISM.

The batteries which are furnished are "dry-charged". This means that when the electrolyte is added, the batteries are immediately fully charged and no "forming" period is necessary.

Dual Door Release Mechanism

A Model 6200 Halex gas cartridge, which uses a Bendix PC06P-8-4S connector is located in the center of the housing. When the gas cartridge fires, the plugs are ejected from the housing. The doors, which are attached to the plugs (with a 1/4-28 screw), are then released from the payload shell. The action of door release is extremely rapid and ejection velocity is high. Personnel should not stand in-line with the door during release tests. Figure 13 shows the mechanism and doors.

832

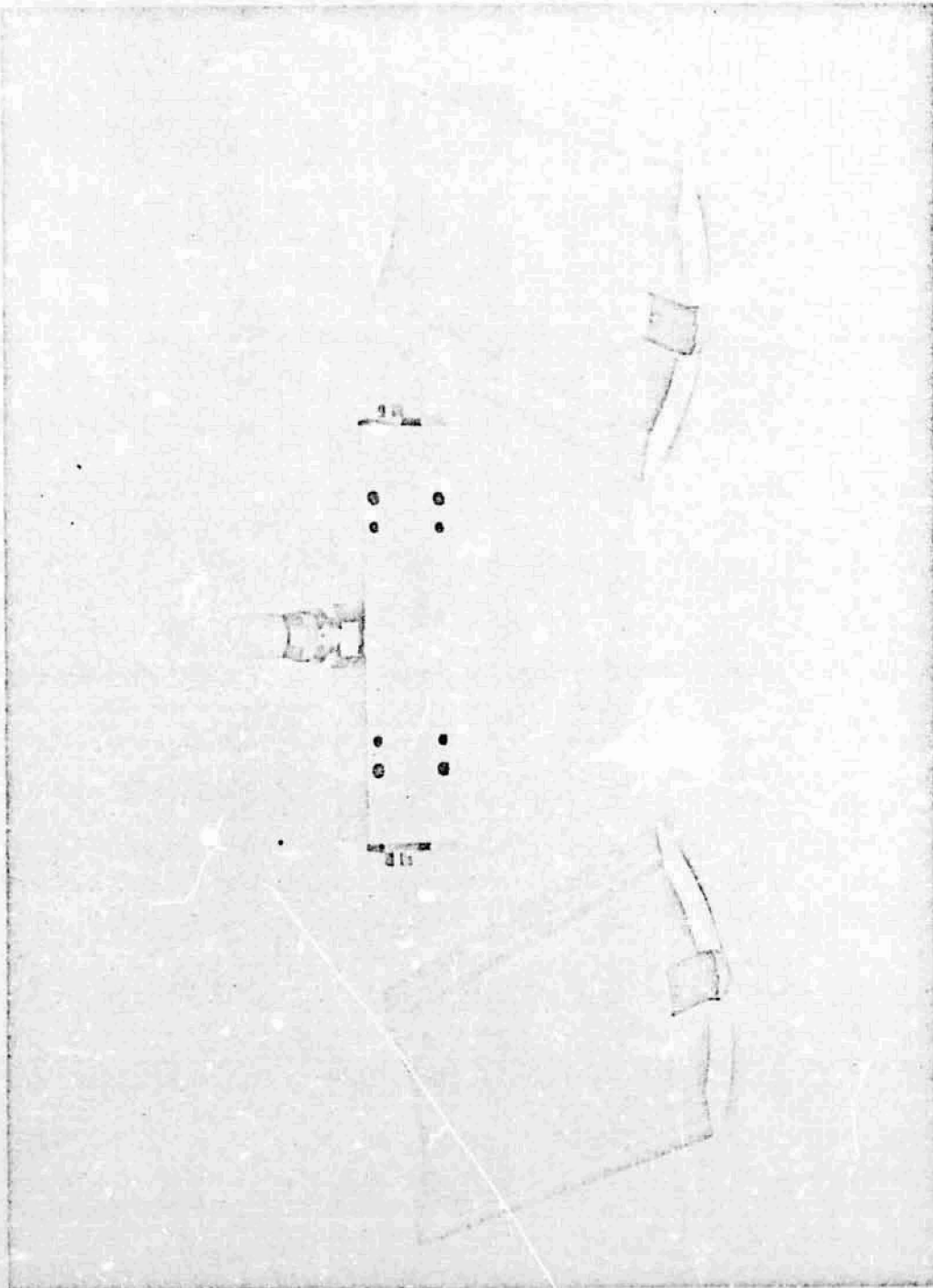


Figure 13. Dual door release mechanism assembly.

The ejectable plugs consist of three parts, a threaded sleeve, a tapped cylinder plug, and a shear pin. The pin shears when the gas cartridge is fired and the tapped cylinder plug is violently ejected.

After test firings the following servicing operations are required.

(1) Remove the expended cartridge from the housing, and clean out the area into which it fired. Blow air through the housing to assure that the passages to each end are clear of any debris.

(2) Install a new gas cartridge. Torque it to 30 inch-pounds maximum.

(3) The threaded sleeve and tapped cylinder plug are re-usable. Therefore, knock out the broken shear pins with a 1/16-inch diameter drift pin. Re-assemble them with a new shear pin.

(4) Replace all O-Rings with new ones even if the used O-Rings appear good. Note: When the threaded sleeve is unthreaded from each end of the housing, the piston which ejects the tapped plug, can be removed. This piston has two O-Rings which must be replaced. Note that air can be blown through the housing when the pistons are removed.

(5) Re-install the pistons into the housing and thread in the ejectable plugs to about 20 inch-pounds torque. The mechanism is then ready for flight.

VERY IMPORTANT

DO NOT EXCEED 20 INCH-POUNDS TORQUE ON THE DOOR SCREW.

Figure 14 shows the complete assembly of the nose cone and payload shell.

842

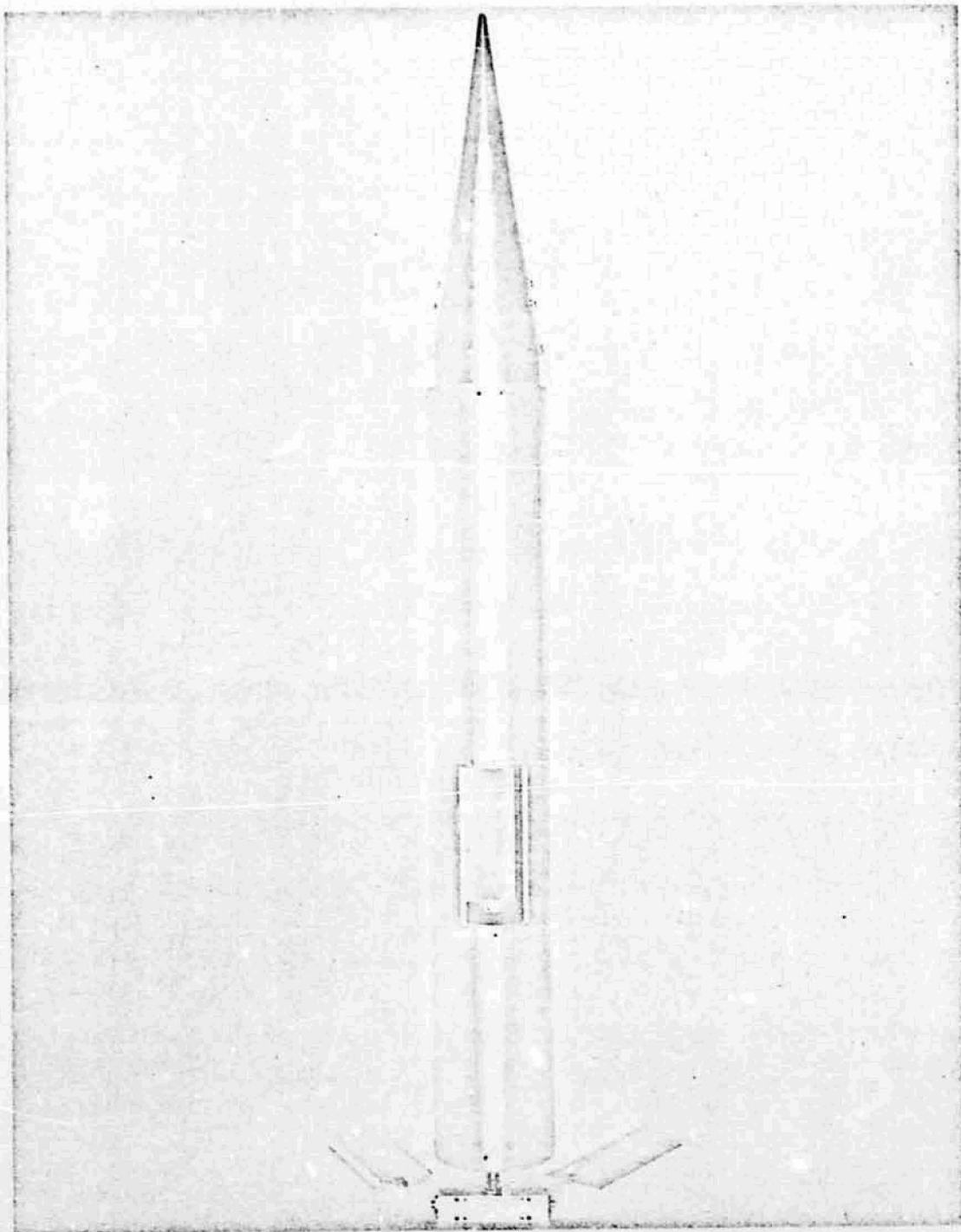


Figure 14. Overall assembly showing modified shell.

APPENDIX

ACCEPTANCE TESTS AND INSPECTION PROCEDURE

Split Nosecone Release System, Payload Shell and Door Release Mechanism.

OBJECTIVE: The objective of this procedure is to specify the method of inspection for acceptance of the split nosecone release mechanisms, modified payload shells, and door release mechanism which are to be delivered under Contract NAS9-8232.

Parts Inspection

A. Split Nose Cone Assembly

1. Nose Cone Casting P/N D102851

This casting shall conform to MIL C-6021 class 2A, grade B. A certificate of compliance must be submitted by the vendor. Quality Control (QC) inspection shall verify the quality of the casting.

2. Raymond Timer, Model 5G-90T-SPDT

This purchased part shall be QC inspected and tested. The part shall be visually inspected for obvious defects in workmanship. Six time cycles shall be performed in sequence and the actuation time value recorded. Total variation in actuation time of one second shall not be exceeded.

3. Barometric Switch, Model A37C (70,000 feet)

This purchased part shall be QC inspected and tested. The part shall be visually inspected for obvious defects in workmanship. Uncertainties with regard to determining a visual defect shall be recorded and brought to the attention of the project engineer. The project engineer shall be responsible for verifying the defect. Six test actuations of the switch shall be performed. The switch must be placed in a pressure-altitude calibrated vacuum chamber in order to perform this test. Actuation altitude shall be recorded. Total variation in actuation altitude shall not exceed 10,000 feet.

4. Release Mechanism Assembly (P/N C105893)

The assembly shall be QC tested for smoothness of release. Manual actuation of release can be performed by pushing the piston plunger rod. Any malfunctions or defects shall be recorded and brought to the attention of the project engineer.

**Page 22 Missing in
Original Document**

5. Control Circuit Assembly

The control circuit assembly which consists of the barometric switch, batteries, timer, harness and support bracket, shall be inspected after wiring. Any discrepancies with regard to wiring, soldering, assembly, etc., shall be recorded. One test cycle shall be performed to check for proper wiring. This shall be performed by short circuiting the barometric switch with a wire jumper and manually actuating the timer. A small lamp shall be electrically connected to the harness squib wires to simulate the pyrotechnic squib. Actuation of the lamp, when the timer actuates, must occur.

6. Final Assembly

The final assembly shall be visually QC inspected for mechanical defects with regard to mating with the payload shell and fastening of the nose tip.

Testing of the complete assembly is a contract-required item and shall be performed under the supervision of the project engineer. A representative of QC must be present to witness the tests and record any malfunctions if they occur.

B. Modified Payload Shell (P/N E106084)(Figure 15)

The payload shell shall be inspected to determine conformance with Drawing E106084. The following dimensions are to be inspected:

(a) 19.75

(b) 8.12

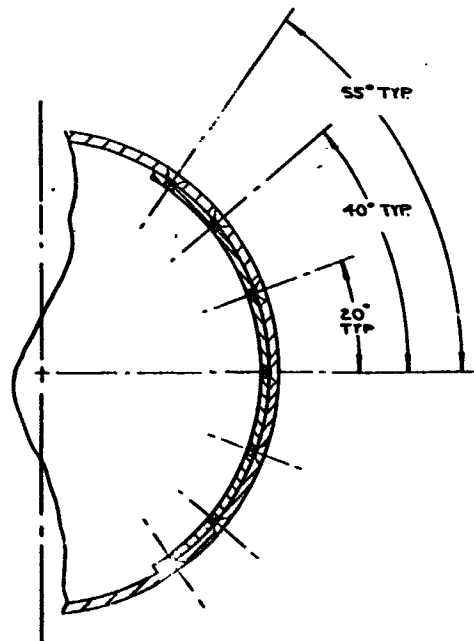
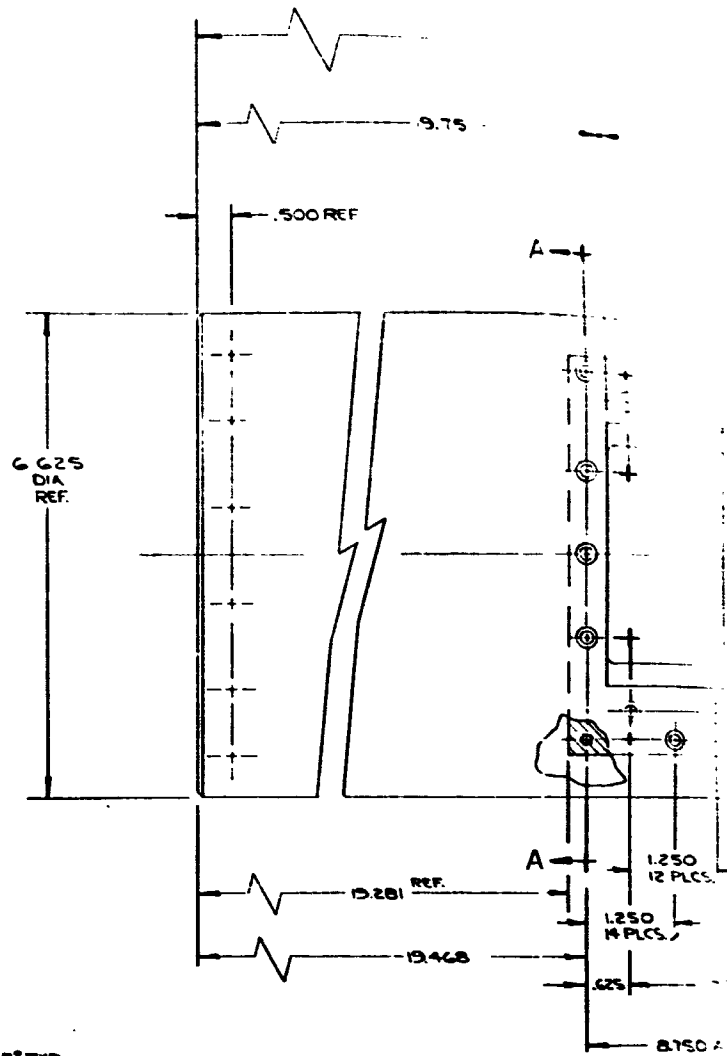
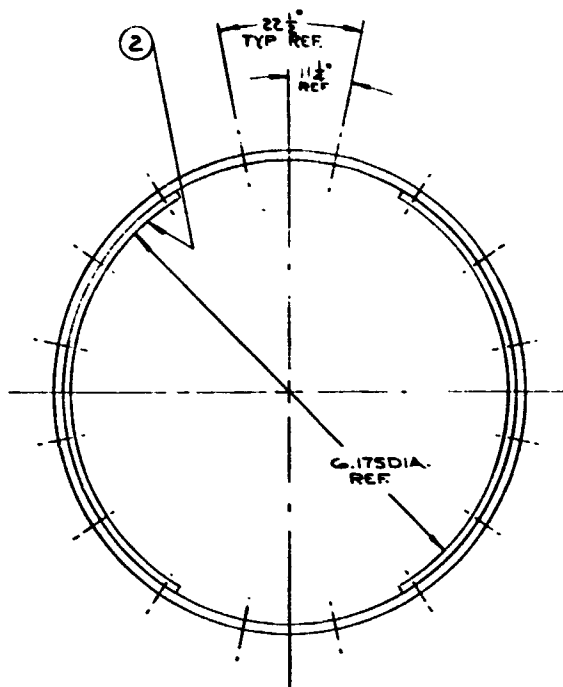
(c) 3.00

C. Door Release Mechanism (P/N C107433)

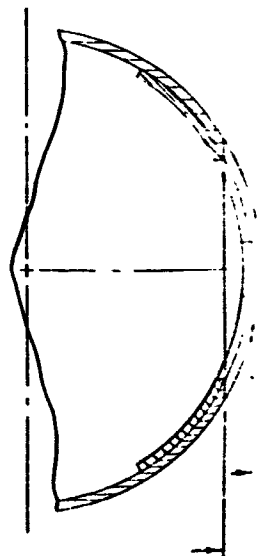
The final assembly shall be visually inspected for mechanical defects in workmanship.

Testing of the completed assembly is a contract-required item and shall be performed under the supervision of the project engineer. A representative of QC must be present to witness the tests and record any malfunctions if they occur.

If a hole is not provided in the door for fastening to the release mechanism, the door may be fastened by means of tape to the release piston.

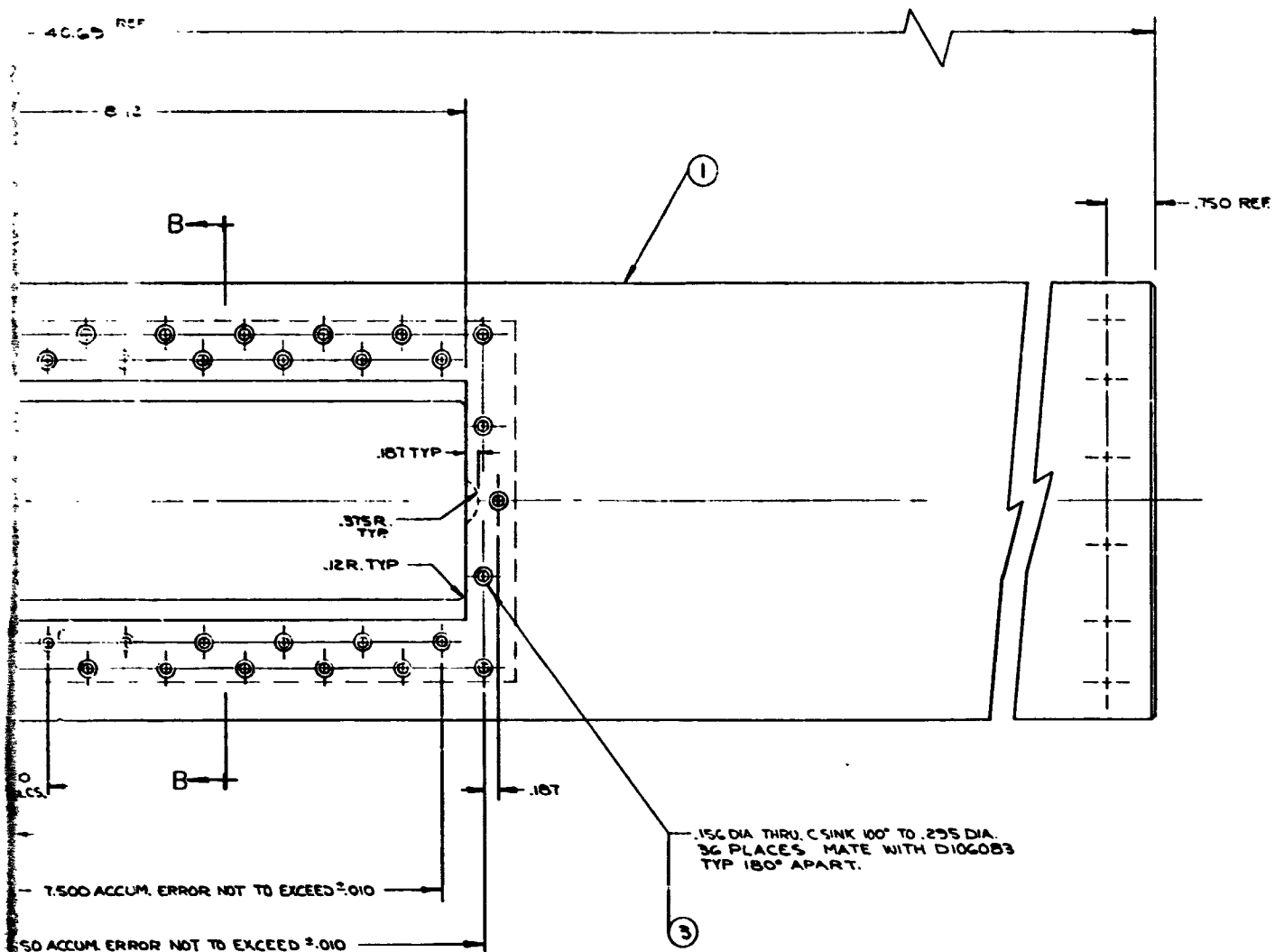


SECTION AA
2 PLACES 180° APART



SECTION BB
2 PLACES 180° APART

BOLDOUT FRAME 1



72		SCREW #6-32 100° FLT. HD 2SLG. CRES. 18-8	3
2	D106083	DOUBLER PLATE	2
1	R	SHELL - PAYLOAD	1
QTY REQD	PART NO.	DESCRIPTION	SPECIFICATION
LIST OF MATERIAL			

EXPLOSION FRAME 2

Figure 15. Shell payload (Drawing No. E106084)

INSPECTION FORM

A. Split Nose Cone Release System

Serial No.: _____

1. Nose Cone Casting (P/N D102851)

(a) Visual: _____

(b) X-Ray, (conforms to MIL C-6021): _____

2. Raymond Timer, Model 5G-90-SPDT

(a) Visual: _____

(b) Test actuation times:

1	4
2	5
3	6

3. Barometric Switch, Model A37C

(a) Visual: _____

(b) Actuation altitudes:

1	4
2	5
3	6

4. Release Mechanism Assembly

(a) Assembly of Mechanism: _____

(b) Release Operation (Manual): _____

5. Control Circuit Assembly

(a) Visual: _____

(b) Test Cycle: _____

**Page 26 Missing in
Original Document**

6. Final Assembly

(a) Visual: _____

(b) Release Tests:

1

2

3

B. Modified Payload Shell (P/N E106084)

Dimensional check:

(a) 19.75 dimension: _____

(b) 8.12 dimension: _____

(c) 3.00 dimension: _____

C. Door Release Mechanism (P/N C107433)

(a) Visual: _____

(b) Release Tests:

1

2

3