NASA Technical Memorandum 106810

# Applications Catalog of Pyrotechnically Actuated Devices/Systems

Thomas L. Seeholzer
*Lewis Research Center*
*Cleveland, Ohio*

Floyd Z. Smith, Charles W. Eastwood, and Paul R. Steffes
*Analex Corporation*
*Brook Park, Ohio*

January 1995



National Aeronautics and Space Administration

## ABSTRACT

A compilation of basic information on pyrotechnically actuated devices/systems used in NASA aerospace and aeronautic applications was formated into a catalog. The intent is to provide (1) a quick reference digest of the types of operational pyro mechanisms and (2) a source of contacts for further details. Data on these items was furnished by the NASA Centers that developed and/or utilized such devices to perform specific functions on spacecraft, launch vehicles, aircraft and ground support equipment. Information entries include an item title, user center name, commercial contractor/vendor, identifying part number(s), a basic figure, briefly described purpose and operation, previous usage, and operational limits/requirements.

# TABLE OF CONTENTS

# DISCLAIMER

Information in this catalogue on pyrotechnic devices and systems was gathered from NASA Centers that have used or are currently employing these assemblies on spacecraft, launch vehicles, aircraft, ground support equipment, or are in test phase.

The intended application of the data is as a ready reference of types of items available or recently used so that a designer can perform a basic review of those units that are of the nature desired. Actual usage of this information must be limited to a search of the field of devices/systems as a preliminary to a follow up contact with the associated center, contractor, vendor or all three to obtain design specifics, requirements, and for compliance with any legal restrictions.

Accordingly, as a reminder, each page of data has the following heading imprinted thereon:

> This document is an information source only and should not be used for design purposes.

## CONTRIBUTORS

Data on pyrotechnically actuated devices and systems, used by the contributing Center, were furnished by the respective center members of the Aerospace Pyrotechnic Steering Committee. The information includes figures and diagrams on the mechanisms and assemblies. All data relates to previously used, currently operational, or newly developed items.

The contributing centers are as follows:

NASA Goddard Space Flight Center
Greenbelt, Md 20771
301-286-2000

NASA Lyndon B. Johnson Space Center
Houston, Tx 77058
713-483-0123

NASA John F. Kennedy Space Center
Kennedy Space Center, Fl 32899
407-867-7110

NASA Langley Research Center
Hampton, Va 23665-5225
804-864-1000

NASA Lewis Research Center
Cleveland, Oh 44135
216-433-4000

NASA George C. Marshall Space Flight Center
Marshall Space Flight Center, Al 35812
205-544-2121

# LIST OF PYROTECHNIC DEVICES AND SYSTEMS

## DEVICES

## LIST OF PYROTECHNIC DEVICES AND SYSTEMS (CONT.)

### DEVICES (CONT.)



### SYSTEMS

# LIST OF PYROTECHNIC DEVICES AND SYSTEMS (CONT.)

## SYSTEMS (CONT.)

# LIST OF PYROTECHNIC DEVICES AND SYSTEMS (CONT.)

## SYSTEMS (CONT.)

# LIST OF ABBREVIATIONS AND ACRONYMS

| | |
|---|---|
| A&M | Actuation and Monitoring |
| AC-XX | Atlas Centaur vehicle No. |
| ACS | Attitude Control System |
| amp | ampere |
| ASC | American Satellite Co. |
| Assy | assembly |
| AZ | azimuth |
| B-B | Booster Barrier |
| Batt | battery |
| BBXRT | Broad Band X-Ray Telescope |
| $BKNO_3$ | Boron Potassium Nitrate |
| BSM | Booster Separation Motor |
| °C | degrees Centigrade |
| cc | cubic centimeters |
| CDF | Confined Detonating Fuse |
| cm | centimeter |
| CMDF | Confined Mild Detonating Fuse |
| $CO_2$ | Carbon Dioxide |
| COBE | Cosmic Background Explorer |
| cps | cycles per second (Hz) |
| CRES | Corrosion resistant steel |
| CSM | command service module |
| D | Diameter |
| DDU | Dual Detonator Unit |
| dia | diameter |
| DIPAM | Dipicramide |
| DTU | Detonation Transfer Unit |
| DWG | Drawing |
| EC | Explosive Cartridge |
| EED | ElectroExplosive Detonator |
| EEDC | ElectroExplosive Device Cartridge |
| EL | Elevator |
| ESD | Electrostatic Discharge |
| ET | External Tank |
| ETL | Explosive Transfer Line |
| ETSS | Expanding Tube Separation System |
| EUVE | Extreme Ultraviolet Explorer |
| °F | degrees Fahrenheit |
| FCDC | Flex Confined Detonator Cord |
| FETA | Flex Explosive Transfer Assy |
| FLSC | Flex Linear Shaped Charge |
| flt | flight |
| ft | foot |
| fwd | forward |
| g | gravity |
| G-force | Gravity-force |
| GFE | government furnished equipment |
| $GH_2$ | Gaseous Hydrogen |
| gms | grams |
| gpf | grains per foot |
| gr | grains |
| gr/ft | grains per foot |
| grms | gravities, root mean square |
| GSFC | Goddard Space Flight Center |
| $H_2$ | Hydrogen |
| $H_e$ | Helium |
| hex | hexagon |
| HGADS | Hi Gain Antenna Deployment System |
| HMX | Cyclotetramethylene Tetranitramine |
| HNS | Hexanitostilbene |
| hrs | hours |
| Hz | Hertz |
| in | inch |
| JSC | Johnson Space Center |
| KSC | Kennedy Space Center |
| KSI | Thousand pounds per sq in |
| LaRC | Langley Research Center |
| Lat | Lateral |
| $lbs/ft^3$ | pounds per cubic foot |
| LEM | lunar excursion module |
| LeRC | Lewis Research Center |
| LH Thrd | Left Hand Thread |
| $LH_2$ | Liquid Hydrogen |
| $LO_2$ | Liquid Oxygen (LOX) |
| LSC | Linear Shaped Charge |
| m | meter |
| Mat'l | material |
| max | maximum |
| MDC | Mild Detonating Cord |
| MDF | Mild Detonating Fuse |
| Mech | Mechanism |
| mg | milligram |
| mil | thousandths |
| min | minimum |

## LIST OF ABBREVIATIONS AND ACRONYMS (Cont.)

| | |
|---|---|
| mm . . . | milimeters |
| MO . . . | Mars Observer |
| MOP . . | Max Operating Pressure |
| ms . . . | millisecond |
| msec . . | millisecond |
| MSFC . | Marshall Space Flight Center |
| n/a . . . | not applicable |
| n/a . . . | not available |
| NASA . | NationalAeronautics and Space Administration |
| N/C . . | Norally Closed |
| NED . . | NonElectric Detonator |
| $N_2H_4$ . . | Hydrazine |
| N/O . . | Normally Open |
| NOAA . | National Oceanic and Atmospheric Administration |
| NSD . . | NASA Standard Detonator |
| NSI . . . | NASA Standard Initiator |
| PC . . . | Pressure Cartridge |
| PETN . | Petaerythrite Tetranitrate |
| PIC . . . | Pyro Initiator Controller |
| P/L . . . | PayLoad |
| PLF . . | Payload Fairing |
| plsc . . . | place(s) |
| P/N . . . | Part Number |
| press . . | pressure |
| psi . . . | pounds per square inch |
| psia . . . | pounds per sq inch absolute |
| PSIG . . | Pounds/Square Inch Gage |
| Pyro . . | Pyrotechnic(s) |
| R . . . . | Radius |
| RDX . . | Cyclotrimethylene Trinitramine |
| Ref . . . | Reference |
| RETA . | Rigid Explosive Transfer Assy |
| R/F . . . | Radio Frequency |
| RR . . . | Retro-Rocket |
| RSC . . | Reaction Control System |
| RSRA . | Rotor System Research Aircraft |
| RTU . . | Rotary Transfer Unit |
| s . . . . | second(s) |
| S&A . . | Safe and ArmSB Separation Bolt |
| SAD . . | Solar Array Drive |
| SAS . . | Solar Array System |
| SBASI . | Single Bridgewire Apollo Standard Initiator |
| S/C . . . | Spacecraft |
| sec . . . | second |
| SII . . . | SRM Ignition Ignitiator |
| SMDC . | Shielded Mild Detonating Cord |
| SPARTAN. . | Shuttle Pointed Autonomous Research Tool for Astronomy |
| spec . . | specification |
| Squib . . | Initiator or Detonator |
| SRB . . | Solid Rocket Booster |
| SRB/ET | SRB/External Tank |
| SRB/MLP . | SRB/Mobile Launch Platform |
| SRM . . | Solid Rocket Motor |
| TBD . . | To Be Determined |
| TBI . . . | Through BulkheId Initiator |
| TC-XX | Titan Centaur vehicle No. |
| TDRS . | Tracking and Data Relay Satellite |
| Temp . | Temperature |
| thrd . . . | thread |
| TOS . . | Trans Orbital Stage |
| TRMM | Tracking & Data Relay Satellite |
| TSM . . | Tail Service Mast |
| Typ . . . | Typical |
| UARS . | Upper Atmosphere Research Satellite |
| VDC . . | volts direct current |
| VSI . . . | Viking Standard Initiator |
| WFF . . | Wallops Flight Facility |
| XTE . . | X-Ray Timing Explorer |
| yrs . . . | years |
| $ZrKClO_4$ | Zirconium Potassium Nitrate |

THIS PAGE INTENTIONALLY LEFT BLANK

# INTRODUCTION

As requested by the Program Manager, NASA Aerospace Pyrotechnic Actuated Systems (PAS) Program, this applications catalog has been produced as part of Project 1.4 of the PAS Database and Applications Catalog.

The catalog is intended as a quick reference document to provide designers with options in a single up-to-date reference document. Devices and systems presently or previously used, plus newly developed units, in the field of aerospace and aeonautic pyrotechnics are hereby compiled for quick review of types of assemblies and as a source of contacts for further details. Only basic information on these items is included with a primary objective of alerting designers to the types of existing mechanisms and systems, the modes of operation, and the contacts available for inquiry into more exacting data for critical design.

The order of listing the devices and systems in this catalog is by alphabetical arrangement of the devices and systems by basic item or primary objective. A cross reference index listing devices and systems by contributing center is included.

Data on each device/system includes an item title, the user center name, contractor - subcontractor or vendor, and identification or part number. A figure of the pyro device, pyro actuated mechanism, or pyro system is presented for most items. The purpose and the operational description are briefly stated and previous usages are identified. Operational temperatures/pressures, dynamics, and electrical requirements are specified. A listing is made of pyrotechnic devices and mechanisms involved in the system assemblies. Qualification documentation, additional references, other comments, and any special features are included. Electrical schematics and operational block diagrams are infrequently included, based on catalog page spacing criteria and on the first-look requirements in a search for a type of pyrotechnic device or system.

A list of contributing centers and addresses is included both as acknowledgment of the contribution of data and as a principal contact for further information on specific items. Design and/or manufacturing contractor and vendor names are furnished with the respective device/system for identity and as a source of additional data.

THIS PAGE INTENTIONALLY LEFT BLANK

# PYROTECHNIC DEVICES

# LIST OF PYROTECHNIC DEVICES

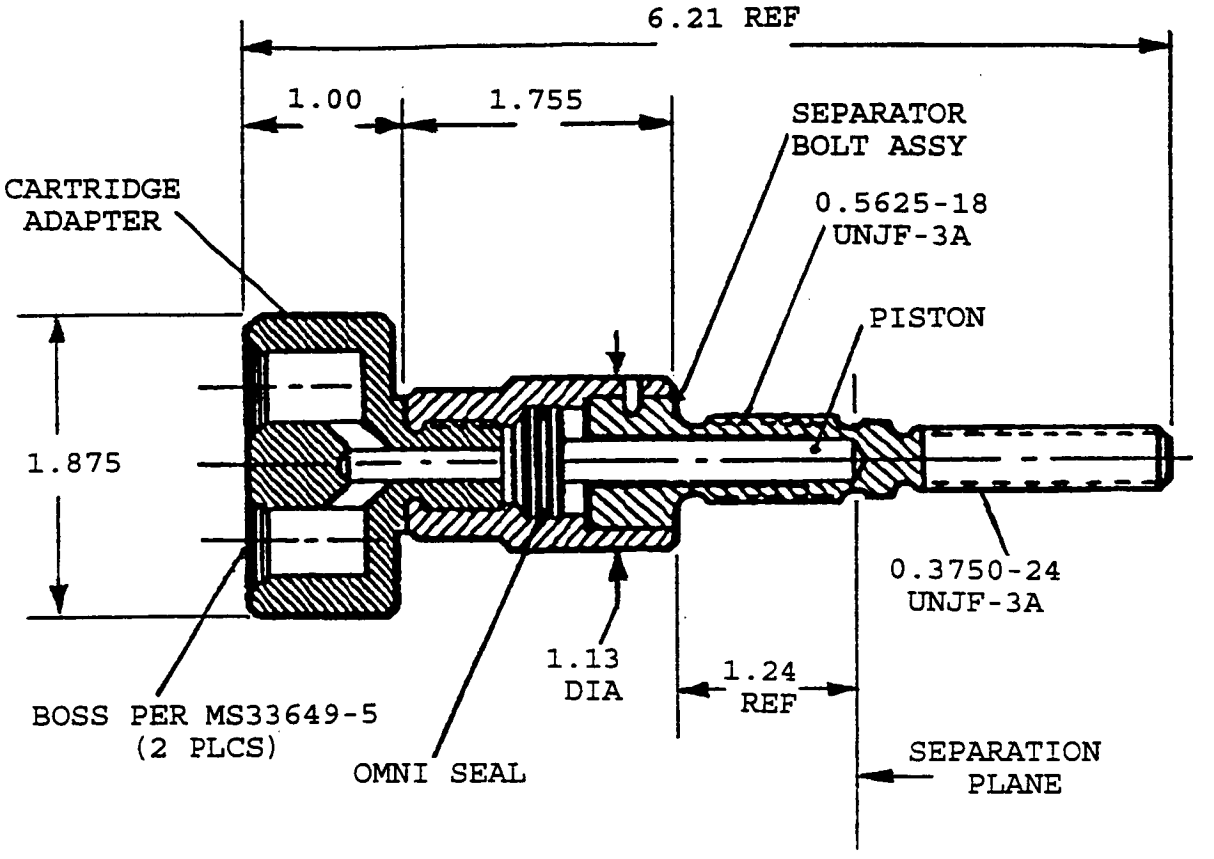
# LIST OF PYROTECHNIC DEVICES (CONT.)

# NASA/DOD/DOE Pyrotechnic Device

**TITLE:** Bolt - External Tank (ET) Intertank $GH_2$ Umbilical Separation

**AGENCY/CENTER:** NASA/Marshall Space Flight Center (MSFC)

**PHYSICAL DATA:**




SEPARATION BOLT (ET $GH_2$ UMBILICAL)

**CONTRACTOR:** Martin-Marietta Corporation

**SUBCONTRACTOR:** Hi-Shear Corporation

**DEVICE IDENTIFICATION NUMBER:**
Martin PD 5000020-060

**PURPOSE:**
To retain the GH2 umbilical to the intertank of the ET until the pressure cartridge causes the breakage of the separation bolt at liftoff.

# NASA/DOD/DOE Pyrotechnic Device

**PREVIOUS USAGE:**
n/a

**OPERATIONAL DESCRIPTION:**
Two redundant pressure cartridges discharge into the cartridge adapter and actuate the piston in the separator bolt assembly. The piston separates the bolt by axial tension at the separation plane.

**ENERGY SOURCE:**
**TYPE OF INITIATION:** Pressure Cartridge
**CHARGE MATERIAL:**
n/a
**ELECTRICAL CHARACTERISTICS:**
n/a

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** **Low** Ambient
**High** -200° F (after propellant loading)
**PRESSURE:** Tensile Proof Load: 5,450 (+50,-0) pounds
Ultimate Strength (bolt notch) axial tensile load: 8,000 (+/- 500) pounds

**DYNAMICS:**
**SHOCK:** n/a
**VIBRATION:** n/a

**QUALIFICATION:**
**DOCUMENTATION:** n/a
**SERVICE LIFE:**
**SHELF:** Temperature: -40° F to +160° F for 50 hours
Humidity: 0 to 100 percent
Storage Life: 10 years
**OPERATIONAL:** n/a

**ADDITIONAL REFERENCES:**
n/a

**ADDITIONAL COMMENTS:**
n/a

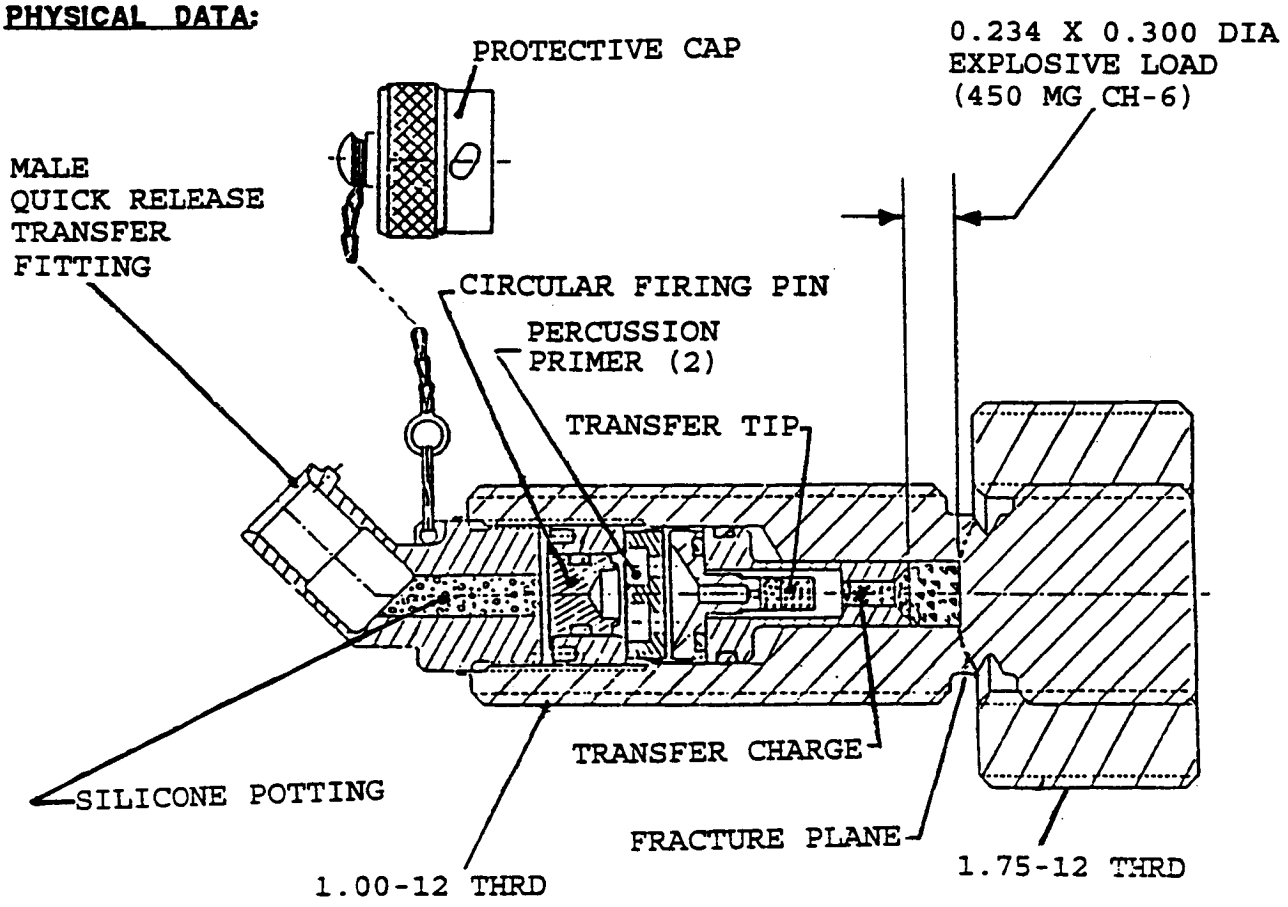
**SPECIAL FEATURES:**
n/a

# NASA/DOD/DOE Pyrotechnic Device

**TITLE:** Bolt - Ridge Cut Explosive

**AGENCY/CENTER:** NASA Langley Research Center (LaRC)

**PHYSICAL DATA:**




CROSS SECTION OF RIDGE CUT EXPLOSIVE BOLT

**CONTRACTOR:** Teledyne McCormick Selph

**SUBCONTRACTOR:** Same as Contractor above

**DEVICE IDENTIFICATION NUMBER:**
n/a

**PURPOSE:**
Instantaneous release of helicopter external stores.

**PREVIOUS USAGE:**
This bolt design has been applied to a number of aerospace applications.

**OPERATIONAL DESCRIPTION:**
The large diameter thread was installed and locked into the store. The store was then lifted and the bolts were inserted into the aircraft mounting plate.

The 450 milligram explosive main charge provides the energy to fracture the bolt. This bolt does not rely on explosively

## NASA/DOD/DOE Pyrotechnic Device

**OPERATIONAL DESCRIPTION: (CONT)**

generated gas pressure to burst the housing, but depends on explosively generated augmented shock waves, which exceed the tensile strength of the material to cause separation. The external configuration of the bolt stem is designed to reflect incident shock waves to induce tensile failure in a conical plane emanating from the bottom of the explosive cavity to a point to the left of the deep circumferential notch. Thus, the name "ridge cut" bolt. Unlike the conventional bursting explosive bolt, little or no fragmentation is produced.

Initiation of the bolt's main charge was accomplished by transferring the explosive pressure wave generated by the tip of the flexible explosive transfer line through the silicone potting to drive the circular firing pin into the dual percussion primers. The transfer tip is then initiated to initiate bolt's main charge.

**ENERGY SOURCE:**

**TYPE OF INITIATION:** Explosive transfer lines

**CHARGE MATERIAL:**

n/a

**ELECTRICAL CHARACTERISTICS:**

n/a

**OPERATING TEMPERATURE/PRESSURE:**

**TEMPERATURE RANGE:** **Low** n/a
**High** n/a

**PRESSURE:** n/a

**DYNAMICS:**

**SHOCK:** n/a
**VIBRATION:** n/a

**QUALIFICATION:**

**DOCUMENTATION:** Bement, Laurence J.; Jahsman, Dirk and Schimmel, Morry L. "Helicopter In-Flight Stores Jettison." Presented at the 1989 SAFE Symposium, Las Vegas, Nevada, December 4-8, 1989.

**SERVICE LIFE:**

**SHELF:** 7 years
**OPERATIONAL:** 5 years

**ADDITIONAL REFERENCES:**

n/a

**ADDITIONAL COMMENTS:**

n/a

**SPECIAL FEATURES:**

The silicone potting prevented concern for contaminating the explosive material; water in the connector would actually enhance transfer of the explosive shock wave to the firing pin. The input fitting to the bolt is a push/rotate electrical-type connector, which is unique in the aircraft arena.

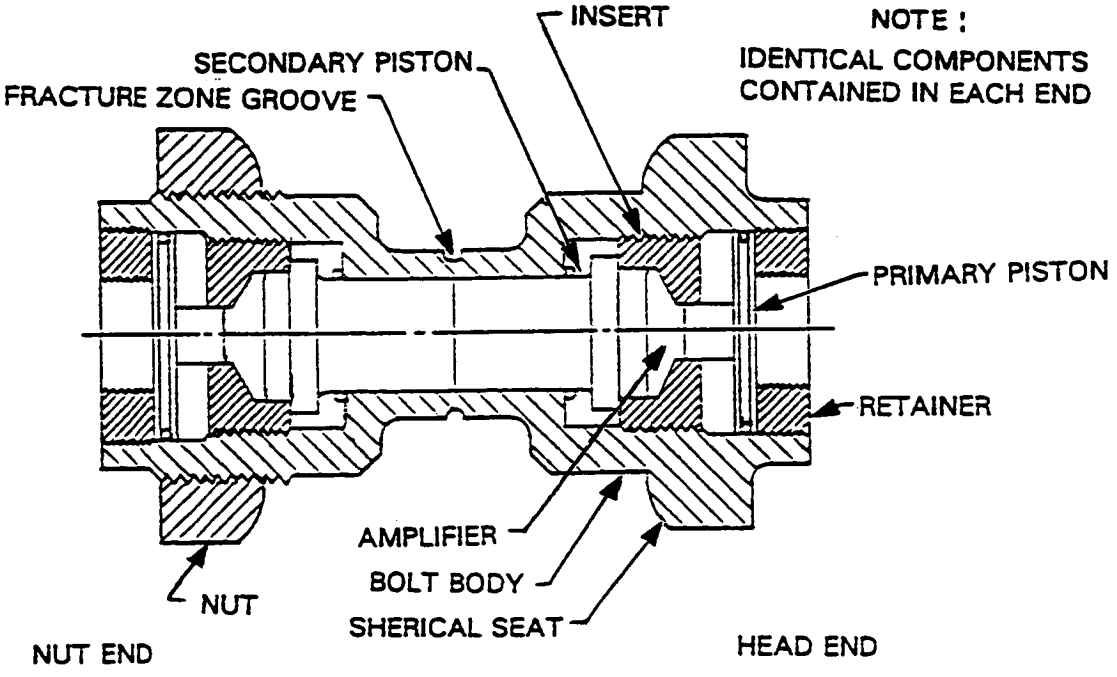
Design and development emphasis was placed on proving functional margins for all aspects of use and interfaces. Previously qualified design principles and hardware were employed to reduce the number of tests to demonstrate reliability and to eliminate the need for environmental qualification.

# NASA/DOD/DOE Pyrotechnic Device

**TITLE:** Bolt - Separation

**AGENCY/CENTER:** NASA Lewis Research Center (LeRC)

**PHYSICAL DATA:**




SEPARATION BOLT

**CONTRACTOR:** General Dynamics Space Systems Division (GDSSD)

**SUBCONTRACTOR:** Hi Shear Technology Corporation

**DEVICE IDENTIFICATION NUMBER:**
Contractor Spec. 55-07057

**PURPOSE:**
To attach separable structural items into an assembly. At event time the separation bolts can be fractured at a definite groove by pyro forces to allow separation of the structures.

# NASA/DOD/DOE Pyrotechnic Device

**PREVIOUS USAGE:**
Expendable Launch Vehicles: Atlas Centaur Vehicles AC-26 thru AC-68

**OPERATIONAL DESCRIPTION:**
Gas pressure from an activated pressure cartridge produces a force on the primary piston which applies the force on the small end of the force amplifier. The silicone rubber amplifier acts, for short duration loads, as an incompressible fluid and multiplies the force based on the area ratio of small to large ends. This amplified force is applied to the secondary piston which butts against the piston assembly of the opposite end. Reaction forces into the body fracture the bolt at the center groove and cause separation.

**ENERGY SOURCE:**
**TYPE OF INITIATION:** Pressure cartridge with electric bridgewire
**CHARGE MATERIAL:**
n/a
**ELECTRICAL CHARACTERISTICS:**
Normal 28 VDC, 5 amps (1 amp - 1 watt no fire)

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** **Low** -100 degrees F
**High** +200 degreesF
**PRESSURE:** n/a

**DYNAMICS:**
**SHOCK:** n/a
**VIBRATION:** n/a

**QUALIFICATION:**
**DOCUMENTATION:** Per above spec.
**SERVICE LIFE:**
**SHELF:** n/a
**OPERATIONAL:** n/a

**ADDITIONAL REFERENCES:**
n/a

**ADDITIONAL COMMENTS:**
Load capacity 41,000 pounds. One pressure cartridge firing of the two PCs used is sufficient to fracture the bolt.

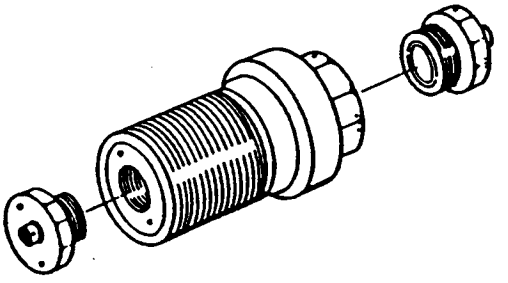
**SPECIAL FEATURES:**
n/a

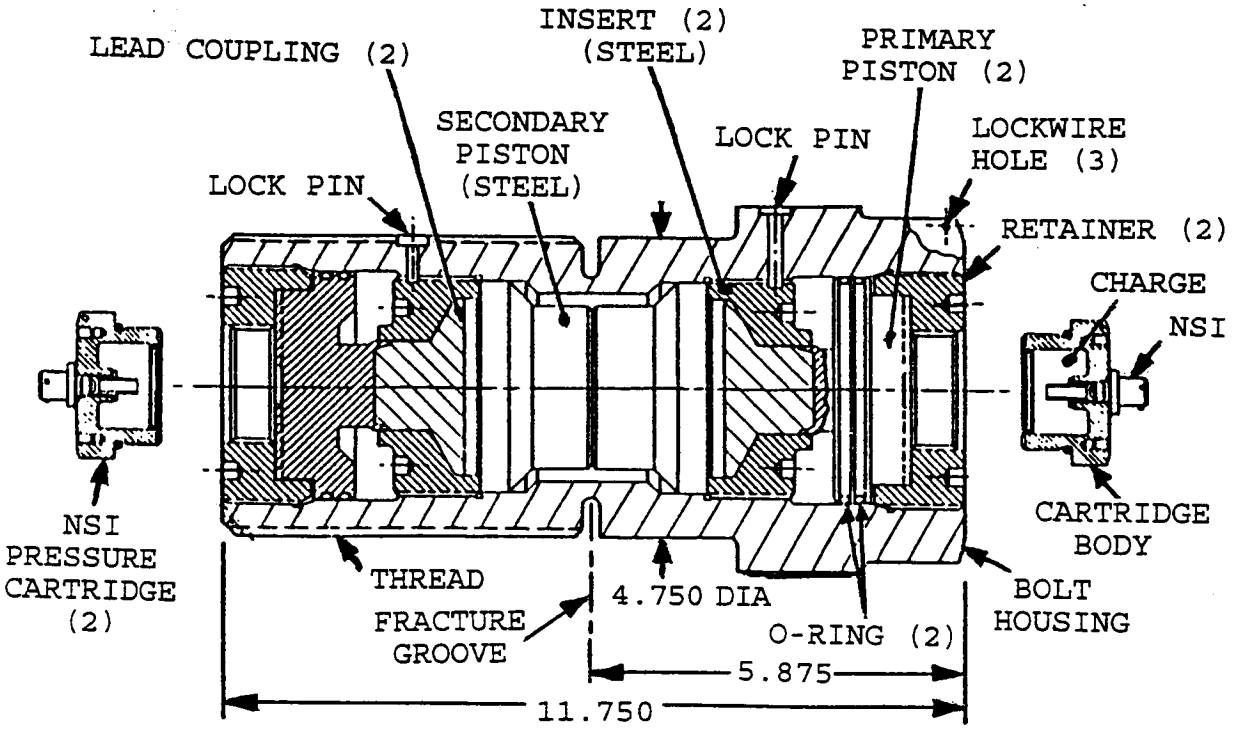
## NASA/DOD/DOE Pyrotechnic Device

**TITLE:** Bolt - SRB/ET Aft Strut Separation

**AGENCY/CENTER:** NASA/Marshall Space Flight Center (MSFC)

**PHYSICAL DATA:**






SRB/ET AFT STRUT SEPARATION BOLT

**CONTRACTOR:** USBI

**SUBCONTRACTOR:** Hi-Shear Corporation

**DEVICE IDENTIFICATION NUMBER:**
USBI PN 10302-0001-801

**PURPOSE:**
To provide separation at the solid rocket booster/external tank (SRB/ET) aft strut separation plane.

# NASA/DOD/DOE Pyrotechnic Device

**PREVIOUS USAGE:**
n/a

**OPERATIONAL DESCRIPTION:**
The bolts are fractured at the preselected fracture groove when the NASA standard initiator (NSI) pressure cartridges are initiated. The pressure produced by each NSI pressure cartridge acts against a primary piston. The force of the primary piston is amplified through the compression of soft lead couplings. The amplified force is then applied to a secondary piston. The redundant side of the bolt also applies a amplified force to its secondary piston. The two secondary pistons reacting against each other or against the shoulder of the opposite insert, depending on the simultaneity of the firing of the two cartridges, cause the bolt housing to fail in tension. The sudden release of tension and the extra margin of force/piston overstroke will accelerate both ends of the bolt to approximately 100 foot/second.

**ENERGY SOURCE:**
**TYPE OF INITIATION:** NSI Pressure Cartridge
**CHARGE MATERIAL:**
n/a
**ELECTRICAL CHARACTERISTICS:**
n/a

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** **Low** +20° F to
**High** +120° F for 4 hours
**PRESSURE:** Flight load (Limit): 393,000 pounds axial tension limit load.
Separation: The bolt will separate at the separation plane within 10.0 msec. when initiated by an NSI pressure cartridge.

**DYNAMICS:**
**SHOCK:** n/a
**VIBRATION:** n/a

**QUALIFICATION:**
**DOCUMENTATION:** n/a
**SERVICE LIFE:**
**SHELF:** Temperature: +25° F to +105° F Humidity: 0 to 100 percent Storage Life: 10 years
**OPERATIONAL:** n/a

**ADDITIONAL REFERENCES:**
n/a

**ADDITIONAL COMMENTS:**
n/a

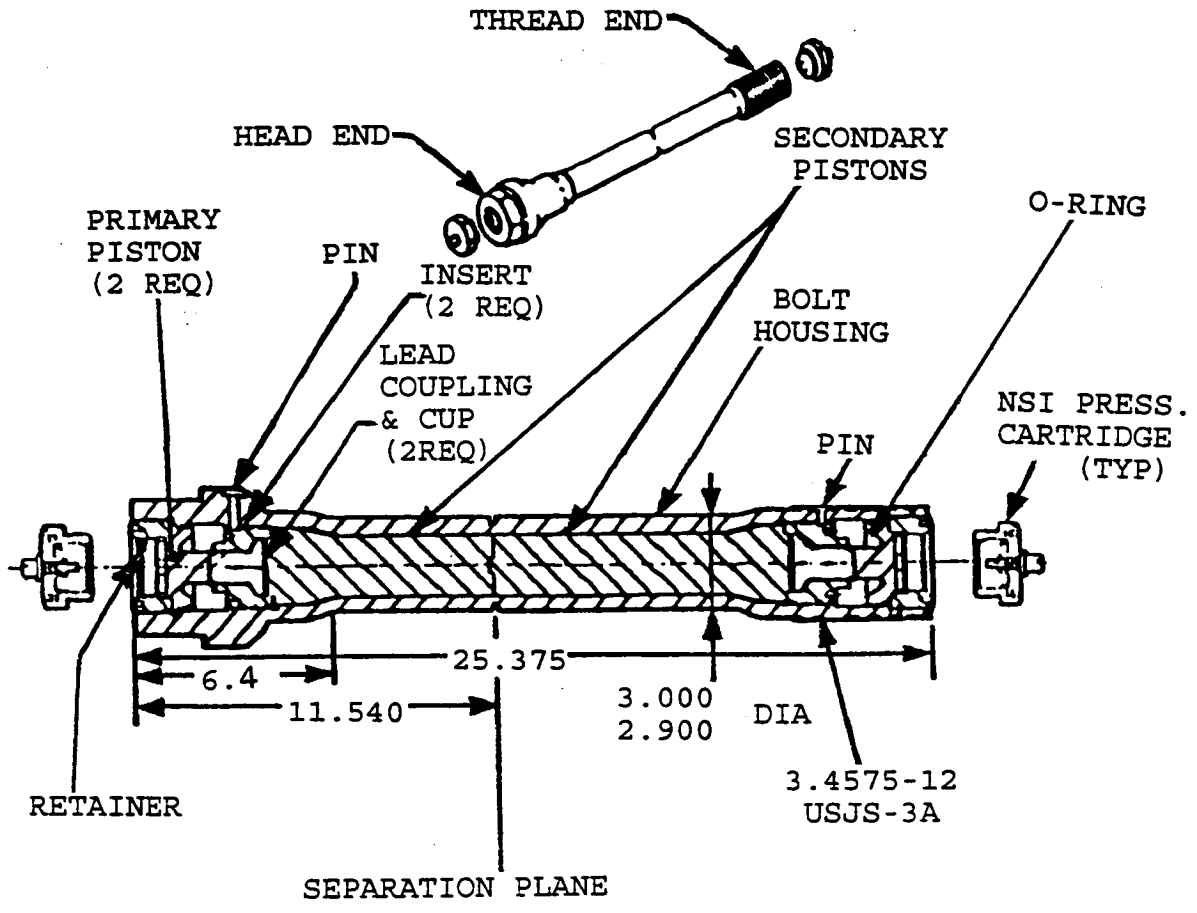
**SPECIAL FEATURES:**
n/a

## NASA/DOD/DOE Pyrotechnic Device

**TITLE:** Bolt - SRB/ET Forward Separation

**AGENCY/CENTER:** NASA/Marshall Space Flight Center (MSFC)

**PHYSICAL DATA:**




SRB/ET FORWARD SEPARATION BOLT

**CONTRACTOR:** USBI

**SUBCONTRACTOR:** Hi-Shear Corporation

**DEVICE IDENTIFICATION NUMBER:**
USBI PN 10301-0001-801

**PURPOSE:**
To provide separation at the Solid Rocket Booster/External Tank (SRB/ET) foward interface.

# NASA/DOD/DOE Pyrotechnic Device

**PREVIOUS USAGE:**
n/a

**OPERATIONAL DESCRIPTION:**
When the SRB and ET separate, the separation bolt is fractured at the predetermined separation plane allowing separation of the SRB/ET forward interface. The pressure produced by each NSI pressure cartridge acts against a primary piston. The force of the primary piston is amplified through the compression of soft lead couplings. The amplified force is then applied to a secondary piston. The redundant side of the bolt also applies an amplified force to its secondary piston. The two secondary pistons reacting against each other or against the shoulder of the opposite insert, depending on the simultaneity of the firing of the two cartridges, cause the bolt housing to fail in tension. The sudden release of tension and the extra margin of force/piston overstroke will accelerate both ends of the bolt to approximately 100 foot/second.

**ENERGY SOURCE:**
**TYPE OF INITIATION:** NSI Pressure Cartridge
**CHARGE MATERIAL:**
n/a
**ELECTRICAL CHARACTERISTICS:**
n/a

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** **Low** -10° F
**High** +120° F for 4 hours
**PRESSURE:** Flight load (Limit): 189,100 pounds axial tension limit load, 55,344 inch pounds end moment.
Separation: The bolt will separate at the separation plane within 10.0 msec. when initiated by an NSI pressure cartridge.

**DYNAMICS:**
**SHOCK:** n/a
**VIBRATION:** n/a

**QUALIFICATION:**
**DOCUMENTATION:** n/a
**SERVICE LIFE:**
**SHELF:** Temperature: +25° F to +105° F
Humidity: 0 to 100 percent
Storage Life: 10 years
**OPERATIONAL:** n/a

**ADDITIONAL REFERENCES:**
n/a

**ADDITIONAL COMMENTS:**
n/a

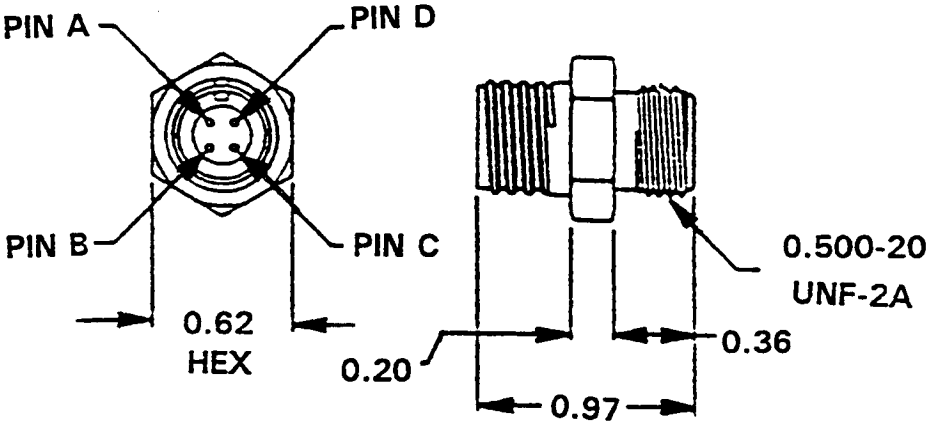
**SPECIAL FEATURES:**
n/a

# NASA/DOD/DOE Pyrotechnic Device

**TITLE:** Cartridge - BLACK BRANT Separation Pressure

**AGENCY/CENTER:** NASA Goddard Space Flight Center (GSFC)/Wallops Flight Facility (WFF)

**PHYSICAL DATA:**




BLACK BRANT SEPARATION PRESSURE CARTRIDGE DEVICE

**CONTRACTOR:** Bristol Aerospace Limited

**SUBCONTRACTOR:** Holex

**DEVICE IDENTIFICATION NUMBER:**
G104

**PURPOSE:**
n/a

# NASA/DOD/DOE Pyrotechnic Device

**PREVIOUS USAGE:**
n/a

**OPERATIONAL DESCRIPTION:**
The pressure cartridge serves to propel a piston-driven shear screw blade within the pressure cylinder to sever the pair of V-band shear screws.

**ENERGY SOURCE:**
**TYPE OF INITIATION:** Electrical
**CHARGE MATERIAL:**
n/a
**ELECTRICAL CHARACTERISTICS:**
2.5 Amperes (min recc all-fire) 0.5 Amp No-fire.

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** **Low** n/a
**High** n/a
**PRESSURE:** n/a

**DYNAMICS:**
**SHOCK:** n/a
**VIBRATION:** n/a

**QUALIFICATION:**
**DOCUMENTATION:** n/a
**SERVICE LIFE:**
**SHELF:** NASA regulation: 5 years
**OPERATIONAL:** n/a

**ADDITIONAL REFERENCES:**
n/a

**ADDITIONAL COMMENTS:**
n/a

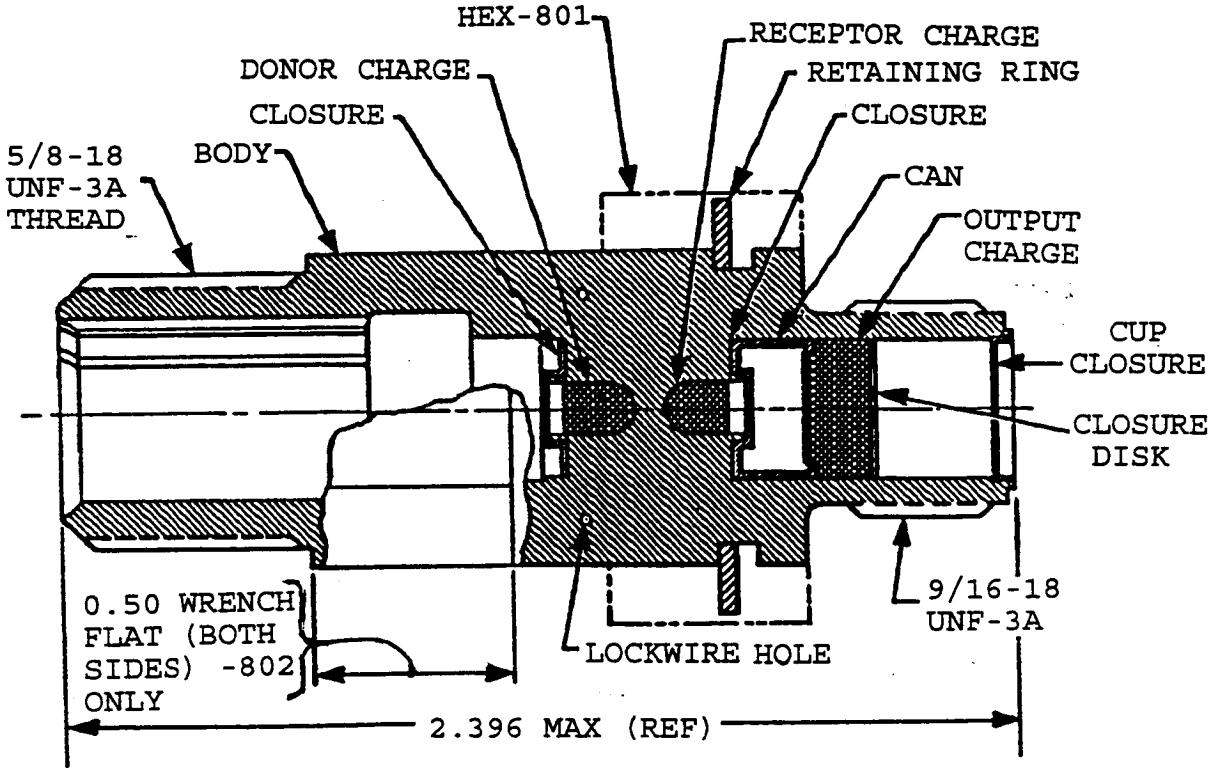
**SPECIAL FEATURES:**
n/a

## NASA/DOD/DOE Pyrotechnic Device

**TITLE:** Cartridge - Confined Detonating Fuse (CDF) Pressure

**AGENCY/CENTER:** NASA/Marshall Space Flight Center (MSFC)

**PHYSICAL DATA:**




CONFINED DETONATING FUSE PRESSURE CARTRIDGE

**CONTRACTOR:** USBI

**SUBCONTRACTOR:** UPCO

**DEVICE IDENTIFICATION NUMBER:**
USBI PN 10319-0002-801;
10319-0002-802 (ALT)

**PURPOSE:**
To actuate the parachute release nut.

# NASA/DOD/DOE Pyrotechnic Device

**PREVIOUS USAGE:**
n/a

**OPERATIONAL DESCRIPTION:**
The CDF pressure cartridge is used to actuate the parachute release nut and is initiated by a detonation shock from a CDF assembly. The detonation shock initiates the donor charge and propagates through the bulkhead to the receptor charge, which initiates the output charge. The donor and receptor charges are packed intimately against both sides of the bulkhead in a manner that ensures shock wave propagation through the bulkhead without rupturing or cracking the bulkhead. The output is reduced to a deflagration which is used to initiate a gas producing output mix or propellant.

**ENERGY SOURCE:**
**TYPE OF INITIATION:** CDF Assembly
**CHARGE MATERIAL:**
Donor Charge: 46 to 50 mg, Class 2, PETN per MIL-P-387
Receptor Charge: 32 to 36 mg, Class 2, PETN per MIL-P-387
Output Charge: 169 to 171 mg, Hercules Hi-Temp
**ELECTRICAL CHARACTERISTICS:**
n/a

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** **Low** +20° F for 12 hours
**High** +190° F for minimum of 4 hours.
**PRESSURE:** Output: the pressure cartridge produces a pressure of 1,200 to 1,800 psig in a 20.7 +/- 0.3 cc volume within five msec. after initiation.

**DYNAMICS:**
**SHOCK:** n/a
**VIBRATION:** n/a

**QUALIFICATION:**
**DOCUMENTATION:** n/a
**SERVICE LIFE:**
**SHELF:** Temperature: +25° F to +105° F Humidity: 0 to 100 percent Storage Life: 4 years, at temperature
**OPERATIONAL:** n/a

**ADDITIONAL REFERENCES:**
n/a

**ADDITIONAL COMMENTS:**
n/a

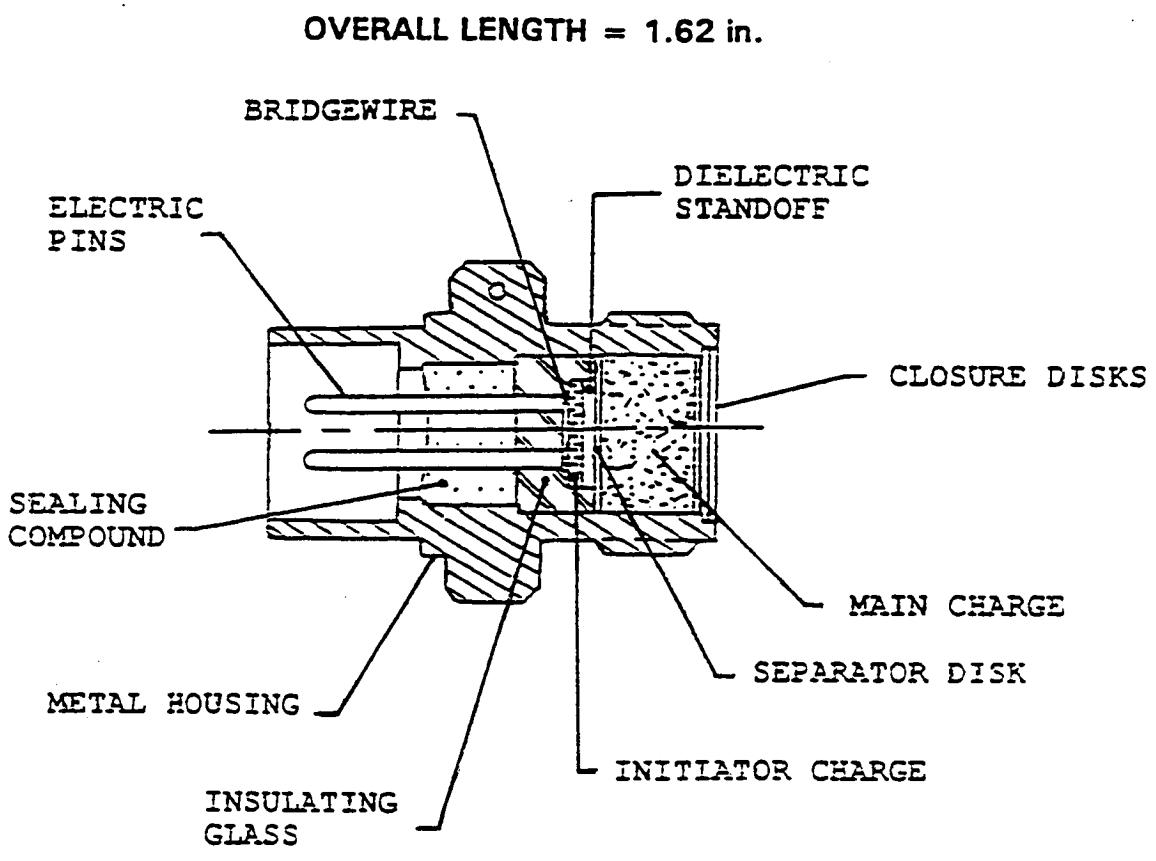
**SPECIAL FEATURES:**
n/a

# NASA/DOD/DOE Pyrotechnic Device

**TITLE:** Cartridge - Explosive

**AGENCY/CENTER:** NASA Lewis Research Center (LeRC)

**PHYSICAL DATA:**




EXPLOSIVE CARTRIDGE (EC)

**CONTRACTOR:** General Dynamics Space Systems Division (GDSSD)

**SUBCONTRACTOR:** Whittacker Company

**DEVICE IDENTIFICATION NUMBER:**
Contractor Spec. 55-07103

**PURPOSE:**
To produce pressurized gas for actuating a mechanism by converting electrical energy into thermal energy at the bridgewire and then, through chemical reaction of the heat sensitive initiator charge, into pyrotechnic energy which detonates the main charge in the

## NASA/DOD/DOE Pyrotechnic Device

explosive cartridge and generates the quantity of pressurized gas.

**PREVIOUS USAGE:**

Expendable Launch Vehicles:
Atlas Centaur Vehicles through AC-68
Titan Centaur Vehicles through AC-7

**OPERATIONAL DESCRIPTION:**

Electrical power issued at event time heats the bridgewire in the cartridge and the thermal energy activates the heat sensitive initiator charge. Subsequent heat, pressure, and shock effect detonate the core and main charges. The resulting blast energy erodes the thin end casing of the cartridge and the pyrotechnically produced gas pressure enters and actuates the device mechanism.

**ENERGY SOURCE:**

**TYPE OF INITIATION:** Electric Bridgewire

**CHARGE MATERIAL:**

Proprietary mix.

**ELECTRICAL CHARACTERISTICS:**

Nominal 28 VDC, 5 amps (1 amp - 1 watt no fire)

**OPERATING TEMPERATURE/PRESSURE:**

**TEMPERATURE RANGE:** **Low** -320 degrees F
**High** +200 degrees F

**PRESSURE:** n/a

**DYNAMICS:**

**SHOCK:** n/a
**VIBRATION:** n/a

**QUALIFICATION:**

**DOCUMENTATION:** Per above spec.
**SERVICE LIFE:**
**SHELF:** n/a
**OPERATIONAL:** n/a

**ADDITIONAL REFERENCES:**

n/a

**ADDITIONAL COMMENTS:**

n/a

**SPECIAL FEATURES:**

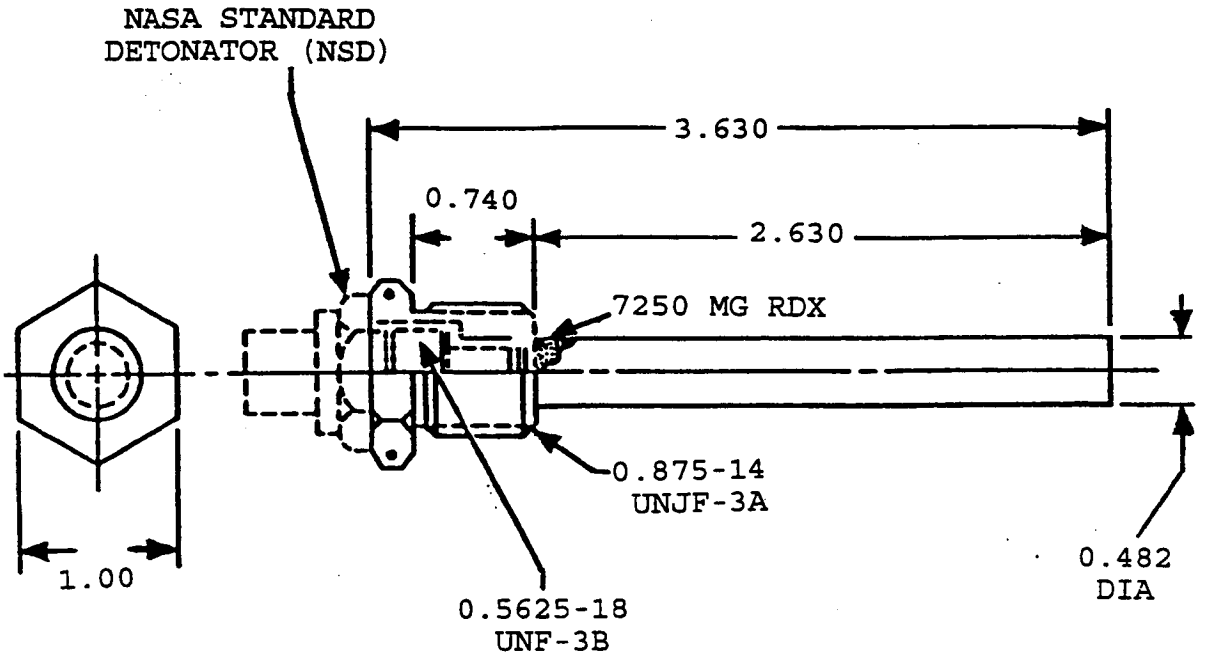
n/a

## NASA/DOD/DOE Pyrotechnic Device

**TITLE:** Cartridge - Frangible Nut Booster

**AGENCY/CENTER:** NASA/Marshall Space Flight Center (MSFC)

**PHYSICAL DATA:**




BOOSTER CARTRIDGE (FRANGIBLE NUT)

**CONTRACTOR:** USBI

**SUBCONTRACTOR:** UPCO and HTL Energy Systems Division

**DEVICE IDENTIFICATION NUMBER:**
USBI PN 10307-0001-801

**PURPOSE:**
To completely separate the frangible nut for the holddown bolt to be released.

# NASA/DOD/DOE Pyrotechnic Device

**PREVIOUS USAGE:**
n/a

**OPERATIONAL DESCRIPTION:**
The frangible nut booster cartridge assembly is an explosive device which will completely separate an Solid Rocket Booster/ Mobile Launch Platform (SRB/MLP) holddown frangible nut. The booster cartridge is initiated by a NSD. The booster consists of an explosive encased in a housing with a detonator port.

**ENERGY SOURCE:**
**TYPE OF INITIATION:** NSD
**CHARGE MATERIAL:**
Cyclotrimethylene-Trinitramine (RDX) per MIL-R-398, Type II, Class 7; 7,250 plus 87 mg minimum.
**ELECTRICAL CHARACTERISTICS:**
n/a

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** Low +20° F
High +150° F
**PRESSURE:** Output: The booster will completely separate a SRB/MLP frangible nut and will produce a 0.100 inch dent in a steel plate in accordance with MIL-STD-331.

**DYNAMICS:**
**SHOCK:** n/a
**VIBRATION:** n/a

**QUALIFICATION:**
**DOCUMENTATION:** n/a
**SERVICE LIFE:**
**SHELF:** Temperature: -65° F for 6 hours; -40° F to +150° F and 190° F for 1 hour.
Humidity: 0 to 100 percent
Storage Life: 4 years
**OPERATIONAL:** n/a

**ADDITIONAL REFERENCES:**
n/a

**ADDITIONAL COMMENTS:**
n/a

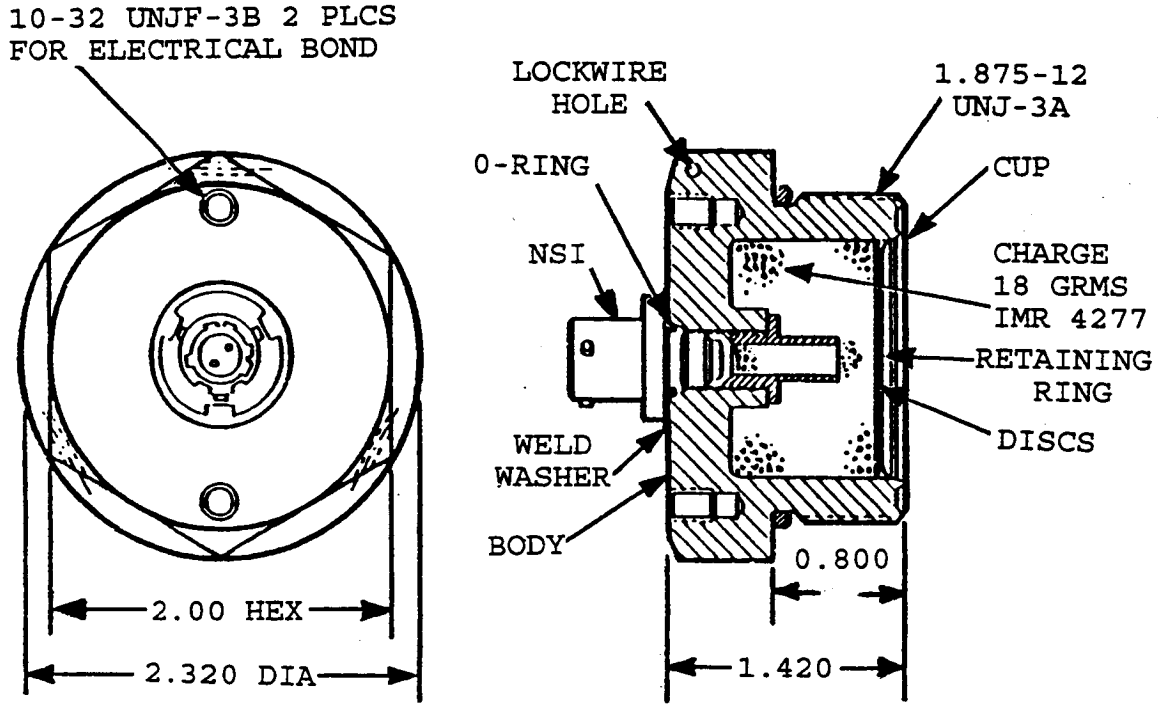
**SPECIAL FEATURES:**
n/a

## NASA/DOD/DOE Pyrotechnic Device

**TITLE:** Cartridge - NASA Standard Initiator (NSI) Pressure

**AGENCY/CENTER:** NASA/Marshall Space Flight Center (MSFC)

**PHYSICAL DATA:**




NASA STANDARD INITIATOR PRESSURE CARTRIDGE

**CONTRACTOR:** USBI

**SUBCONTRACTOR:** Hi-Shear Corporation

**DEVICE IDENTIFICATION NUMBER:**
USB PN 10303-0001-801

**PURPOSE:**
To produce the required pressure, in the required time, to activate either the foward or aft Solid Rocket Booster/External Tank (SRB/ET) separation bolt.

# NASA/DOD/DOE Pyrotechnic Device

**PREVIOUS USAGE:**
n/a

**OPERATIONAL DESCRIPTION:**
The NSI pressure cartridge uses the NSI as the electroexplosive initiation device. The NSI pressure cartridge developes pressure within 1.0 msec. after the current is applied to the NSI. Acceptable pressure is reached within 8.0m sec,thereafter in a closed bomb.

**ENERGY SOURCE:**
**TYPE OF INITIATION:** NSI
**CHARGE MATERIAL:**
Dupont IMR4227, 18+/-0.01 grams
**ELECTRICAL CHARACTERISTICS:**
n/a

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** Low -10° F
High +120° F for 4 hours
**PRESSURE:** Peak pressure output: 22,200 to 26,300 psi in a 104 cubic centimeter closed bomb.

**DYNAMICS:**
**SHOCK:** n/a
**VIBRATION:** n/a

**QUALIFICATION:**
**DOCUMENTATION:** n/a
**SERVICE LIFE:**
**SHELF:** Temperature: +25° F to 105° F
Humidity: 0 to 100 perce
Storage Life: 4 years
**OPERATIONAL:** n/a

**ADDITIONAL REFERENCES:**
n/a

**ADDITIONAL COMMENTS:**
n/a

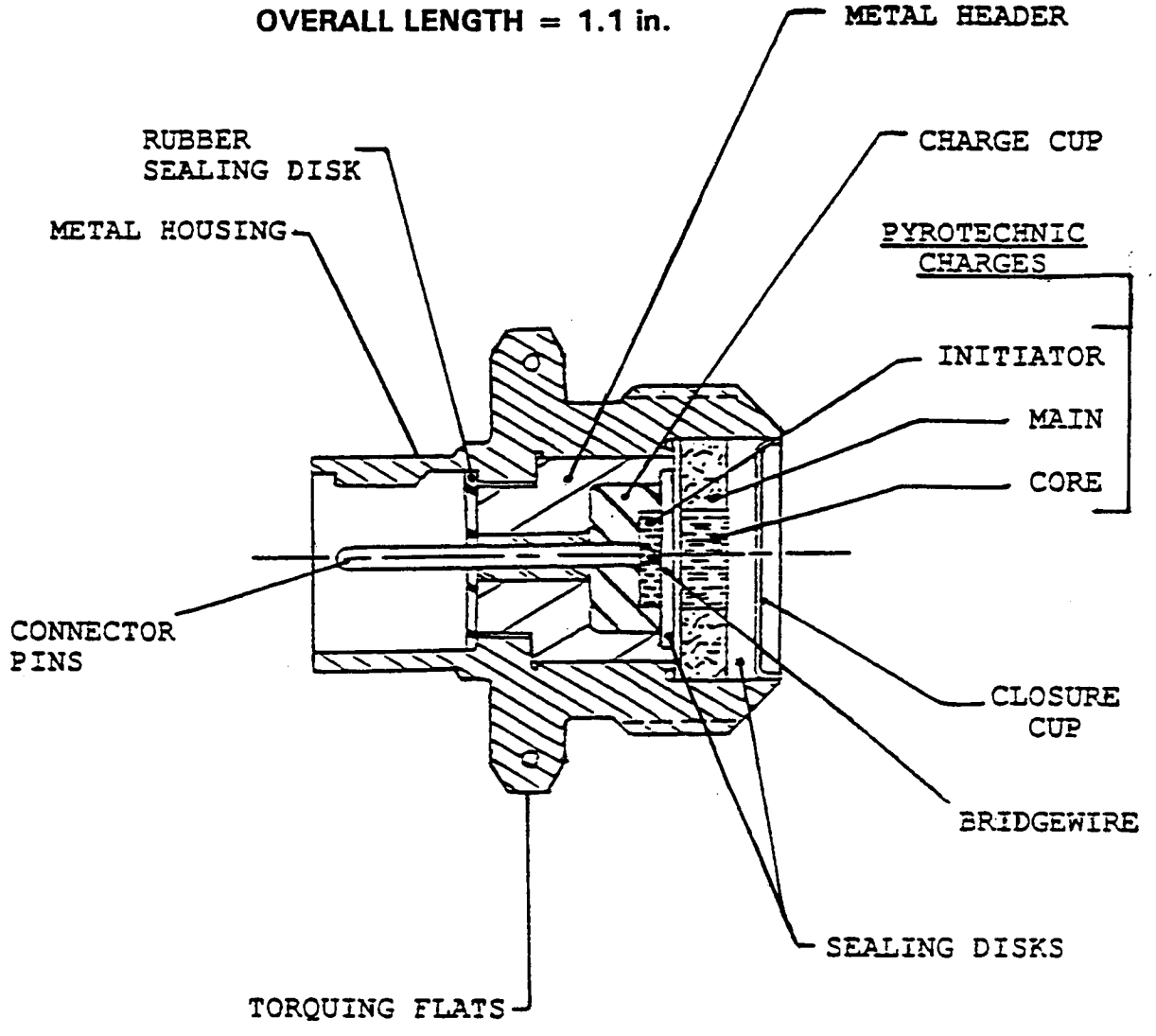
**SPECIAL FEATURES:**
n/a

## NASA/DOD/DOE Pyrotechnic Device

**TITLE:** Cartridge - Pressure

**AGENCY/CENTER:** NASA Lewis Research Center (LeRC)

**PHYSICAL DATA:**




PRESSURE CARTRIDGE

**CONTRACTOR:** General Dynamics Space Systems Division (GDSSD)

**SUBCONTRACTOR:** Hi Shear Technology Corporation

**DEVICE IDENTIFICATION NUMBER:**
Contractor Spec. 55-06018

**PURPOSE:**
To produce pressurized gas for actuating a mechanism by converting electrical energy into thermal energy at the bridgewire and sequentially, through chemical reaction of the heat sensitive initiation charge, into pyrotechnic energy which then detonates

## NASA/DOD/DOE Pyrotechnic Device

the main charge in the pressure cartridge and generates a quantity of pressurized gas.

**PREVIOUS USAGE:**

Expendable Launch Vehicles: Atlas Centaur Vehicles through AC-68

**OPERATIONAL DESCRIPTION:**

Electrical power issued at event time heats the bridgewire in the cartridge and the thermal energy activates the heat sensitive initiator charge. Subsequent heat, pressure, and shock effect detonate the core and main charges. The resulting blast energy erodes the thin end casing of the cartridge and the pyrotechnically produced has pressure enters and actuates the device mechanism.

**ENERGY SOURCE:**

**TYPE OF INITIATION:** Electrical bridgewire

**CHARGE MATERIAL:**

Proprietary mix

**ELECTRICAL CHARACTERISTICS:**

Nominal 28 VDC, 5 amps (1 amp - 1 watt no fire).

**OPERATING TEMPERATURE/PRESSURE:**

**TEMPERATURE RANGE:** Low -100 °F
High +200 °F

**PRESSURE:** n/a

**DYNAMICS:**

**SHOCK:** n/a
**VIBRATION:** n/a

**QUALIFICATION:**

**DOCUMENTATION:** per above spec.
**SERVICE LIFE:**
**SHELF:** n/a
**OPERATIONAL:** n/a

**ADDITIONAL REFERENCES:**

n/a

**ADDITIONAL COMMENTS:**

n/a

**SPECIAL FEATURES:**

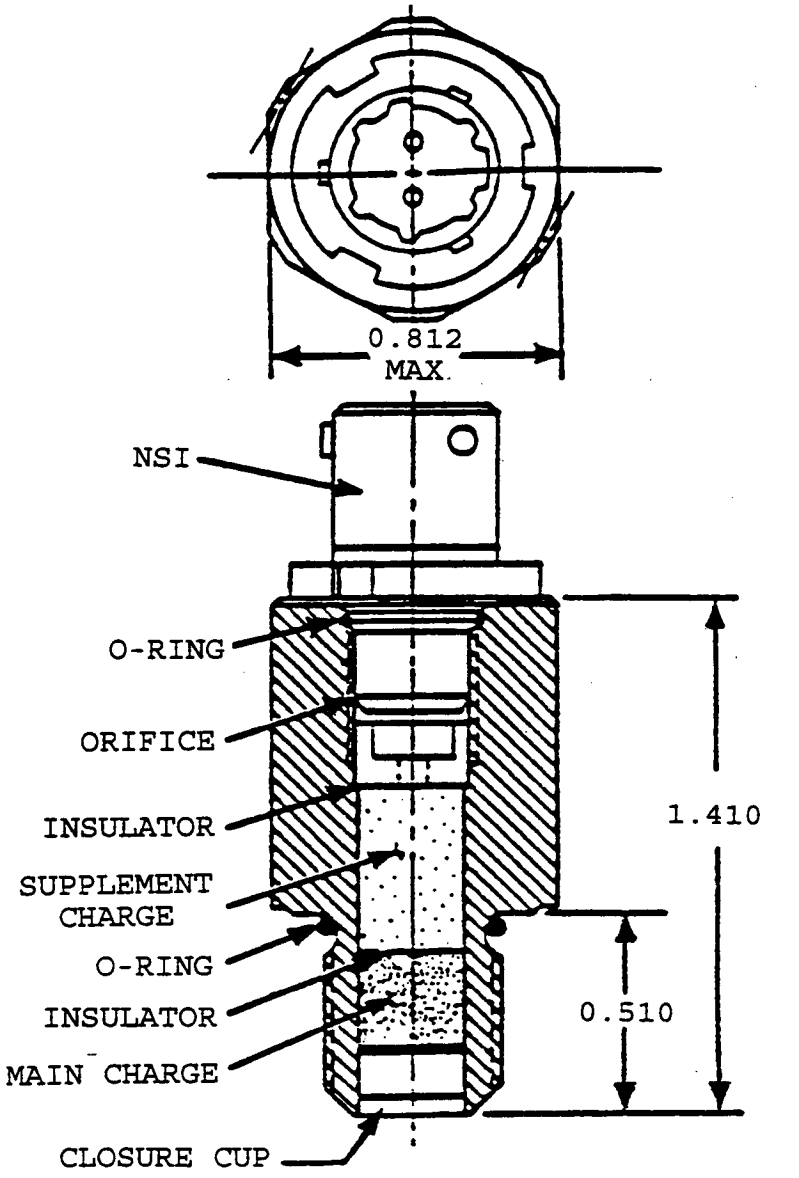
n/a

## NASA/DOD/DOE Pyrotechnic Device

**TITLE:** Cartridge - Separation Bolt Pressure

**AGENCY/CENTER:** NASA/Marshall Space Flight Center (MSFC)

**PHYSICAL DATA:**




PRESSURE CARTRIDGE (SEPARATION BOLT)

**CONTRACTOR:** Martin-Marietta Corporation

**SUBCONTRACTOR:** Hi-Shear Corporation

**DEVICE IDENTIFICATION NUMBER:**
Martin PD 5000020-030

**PURPOSE:**
To cause separation of the separation bolt in the notched area only when the cartridge is initiated.

# NASA/DOD/DOE Pyrotechnic Device

**PREVIOUS USAGE:**
n/a

**OPERATIONAL DESCRIPTION:**
The NSI initiates the supplement charge which initiates the main charge. The main charge activates the piston of the separation bolt.

**ENERGY SOURCE:**
**TYPE OF INITIATION:** NSI
**CHARGE MATERIAL:**
Formulation: 30% titanium hydride, 60% potassium perchlorate, and 5% viton B
Main Charge: 975 +/- 6 mg
Supplement charge: 350 +/- 2 mg
**ELECTRICAL CHARACTERISTICS:**
n/a

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** Low Ambient
High -200° F (after propellant loading)
**PRESSURE:** n/a

**DYNAMICS:**
**SHOCK:** n/a
**VIBRATION:** n/a

**QUALIFICATION:**
**DOCUMENTATION:** n/a
**SERVICE LIFE:**
**SHELF:** Temperature: -40° F to +160° F for 50 hours
Humidity: 0 to 100 percent
Storage Life: 4 years
**OPERATIONAL:** n/a

**ADDITIONAL REFERENCES:**
n/a

**ADDITIONAL COMMENTS:**
n/a

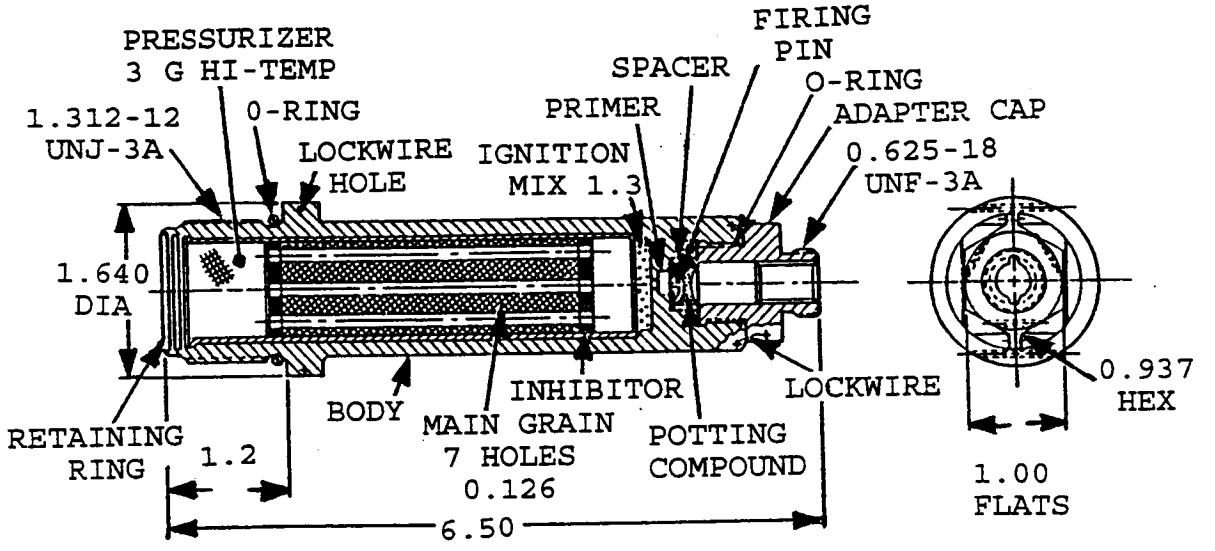
**SPECIAL FEATURES:**
n/a

## NASA/DOD/DOE Pyrotechnic Device

**TITLE:** Cartridge - Thruster Pressure

**AGENCY/CENTER:** NASA/Marshall Space Flight Center (MSFC)

**PHYSICAL DATA:**




THRUSTER PRESSURE CARTRIDGE

**CONTRACTOR:** USBI

**SUBCONTRACTOR:** Hi-Shear Corporation

**DEVICE IDENTIFICATION NUMBER:**
USBI PN 10305-0001-801

**PURPOSE:**
To provide the proper pressure during the time in which the thruster is operating.

# NASA/DOD/DOE Pyrotechnic Device

**PREVIOUS USAGE:**
n/a

**OPERATIONAL DESCRIPTION:**
The pressure cartridge is initiated when the output of a Confined Detonating Fuse (CDF) assembly causes the firing pin to strike the percussion primer. The percussion primer ignites the ignition mix which travels down the seven holes and ignites the main grain and pressure mix. The pressure mix is needed to rapidly pressurize the initial volume of the thruster. As the seven holes in the main grain burn, the surface area and gases produced increase, which is required to maintain almost constant force on the thruster. The combined force of the three thrusters accelerate the Solid Rocket Booster (SRB) nose cap to a required minimum velocity of 80 feet per second.

**ENERGY SOURCE:**
**TYPE OF INITIATION:** CDF Assembly
**CHARGE MATERIAL:**
Propellant Grain: Thiokol TP-H-3282C (55 gms). Pressurizer Mix: Hercules Hi-Temp (3 +/- 0.05 gms). Ignition Mix: Boron Potassium Nitrate (BKNO3) granules (1.2 +/- 0.05 gms) per MIL-P-46994, Type I-B. Primer: Olin Mathieson M42C1-PA101 per MIL-P-20444 (0.31 to 0.36 grain).
**ELECTRICAL CHARACTERISTICS:**
n/a

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** **Low** +20° F
**High** +195° F for 4 hours
**PRESSURE:** Output: The pressure cartridge will develop pressure within 3 ms after being initiated by a CDF assembly. The max. press. after initiation is 14,673 psi in a 24 cubic inch closed bomb at +195° F after approx. 25 ms.

**DYNAMICS:**
**SHOCK:** n/a
**VIBRATION:** n/a

**QUALIFICATION:**
**DOCUMENTATION:** n/a
**SERVICE LIFE:**
**SHELF:** Temperature: +25° F to +105° F
Humidity: 0 to 100 percent
Storage Life: 4 years
**OPERATIONAL:** n/a

**ADDITIONAL REFERENCES:**
n/a

**ADDITIONAL COMMENTS:**
n/a

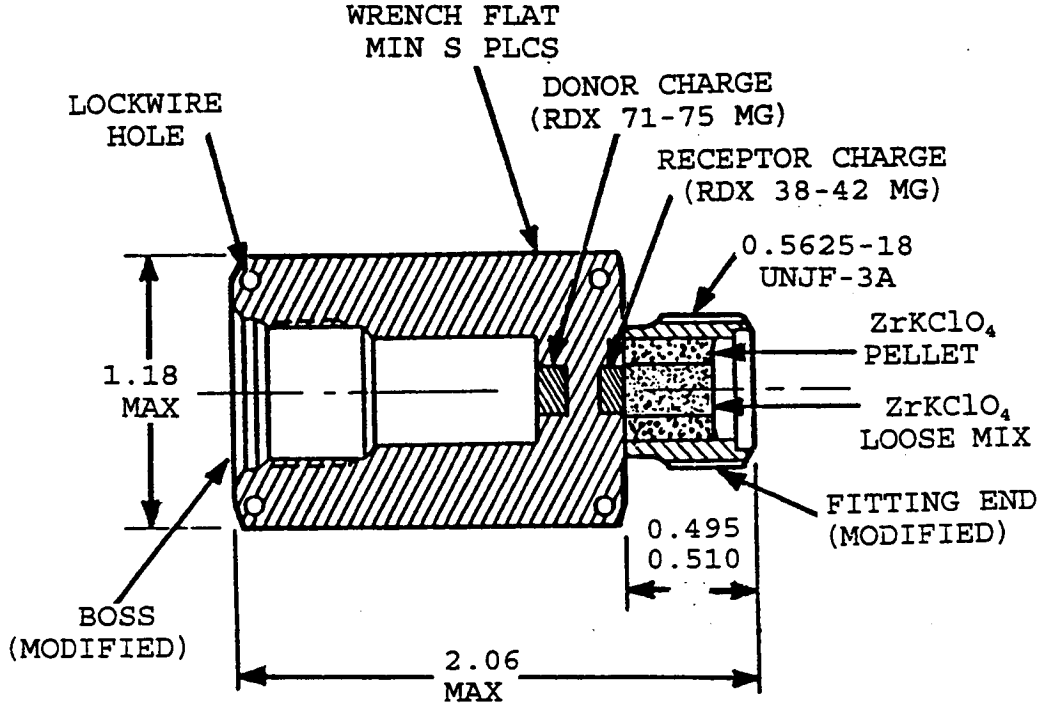
**SPECIAL FEATURES:**
n/a

## NASA/DOD/DOE Pyrotechnic Device

**TITLE:** Cartridge - Valve Actuation

**AGENCY/CENTER:** NASA/Marshall Space Flight Center (MSFC)

**PHYSICAL DATA:**




PYROTECHNIC VALVE ACTUATION CARTRIDGE

**CONTRACTOR:** Martin-Marietta Corporation

**SUBCONTRACTOR:** Hi-Shear Corporation

**DEVICE IDENTIFICATION NUMBER:**
Martin PD 5000011-009

**PURPOSE:**
To produce a gas output to actuate the pyrotechnic-operated tumble valve.

# NASA/DOD/DOE Pyrotechnic Device

**PREVIOUS USAGE:**
n/a

**OPERATIONAL DESCRIPTION:**
The pyrotechnic valve actuation cartridge will receive a detonation impulse from a NSD and will provide a detonation transfer through a bulkhead. Explosive material packed intimately against both sides of the bulkhead will ensure detonation propagation through the bulkhead. The detonation transfer across the bulkhead will not rupture the bulkhead. The output of the receptor charge ignites the output charge, which reduces to a deflagration in the output mix. The output mix produces the gas pressure to operate the tumble valve.

**ENERGY SOURCE:**
**TYPE OF INITIATION:** NSI
**CHARGE MATERIAL:**
Donor Charge: 73-77 mg of RDX, Type A, Class C, per MIL-R-398,
Receptor Charge: 38-42 mg of RDX, Type A, Class C, per MIL-R-398,
Output Charge: Pellet: 1015 to 1025 mg of ZrKClO4, Loose mix: 100 mg of ZrKCLO4
**ELECTRICAL CHARACTERISTICS:**
n/a

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** **Low** -150° F
**High** +200° F for 4 hours
**PRESSURE:** Output: 2,500 psig +/- 20 percent when fired into a 22 cc closed bomb.

**DYNAMICS:**
**SHOCK:** n/a
**VIBRATION:** n/a

**QUALIFICATION:**
**DOCUMENTATION:** n/a
**SERVICE LIFE:**
**SHELF:** Temperature: -40° F to +160° F for 50 hours
Humidity: 0 to 100 percent
Storage Life: 4 years
**OPERATIONAL:** n/a

**ADDITIONAL REFERENCES:**
n/a

**ADDITIONAL COMMENTS:**
n/a

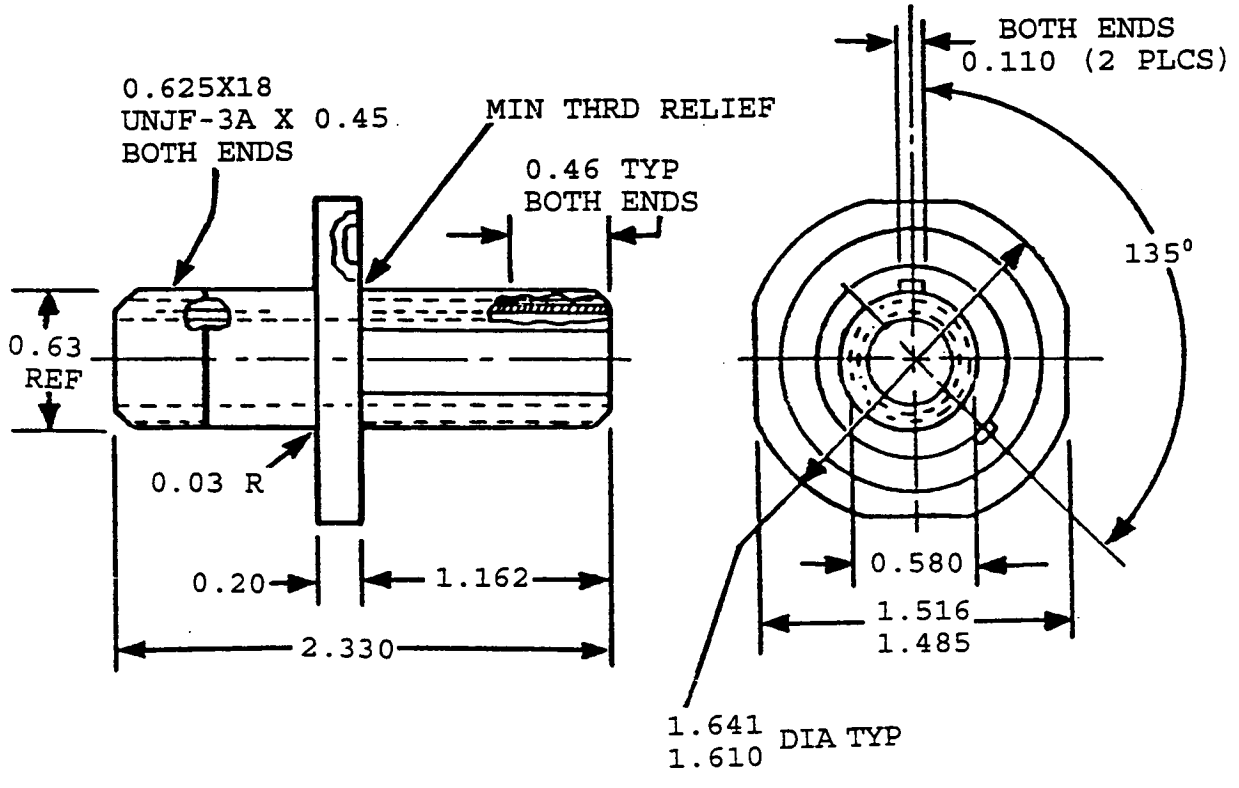
**SPECIAL FEATURES:**
n/a

# NASA/DOD/DOE Pyrotechnic Device

**TITLE:** Connector - Confined Detonating Fuse (CDF)/CDF

**AGENCY/CENTER:** NASA/Marshall Space Flight Center (MSFC)

**PHYSICAL DATA:**




CONFINED DETONATING FUSE (CDF)/CDF CONNNECTOR

**CONTRACTOR:** USBI

**SUBCONTRACTOR:** USBI

**DEVICE IDENTIFICATION NUMBER:**
USBI PN 10183-0010-0001

**PURPOSE:**
To provide the connection between the CDF assembly in the foward skirt and the CDF assembly in the system tunnel.

# NASA/DOD/DOE Pyrotechnic Device

**PREVIOUS USAGE:**
n/a

**OPERATIONAL DESCRIPTION:**
The CDF/CDF connector connects the CDF assembly in the foward skirt to the CDF assembly in the system tunnel. The CDF/CDF connector provides for bulkhead penetration between the foward skirt and the system tunnel while maintaining a water tight integrity for the foward skirt.

**ENERGY SOURCE:**
**TYPE OF INITIATION:** n/a
**CHARGE MATERIAL:**
n/a
**ELECTRICAL CHARACTERISTICS:**
n/a

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** Low n/a
High n/a
**PRESSURE:** n/a

**DYNAMICS:**
**SHOCK:** n/a
**VIBRATION:** n/a

**QUALIFICATION:**
**DOCUMENTATION:** n/a
**SERVICE LIFE:**
**SHELF:** indefinite
**OPERATIONAL:** n/a

**ADDITIONAL REFERENCES:**
n/a

**ADDITIONAL COMMENTS:**
n/a

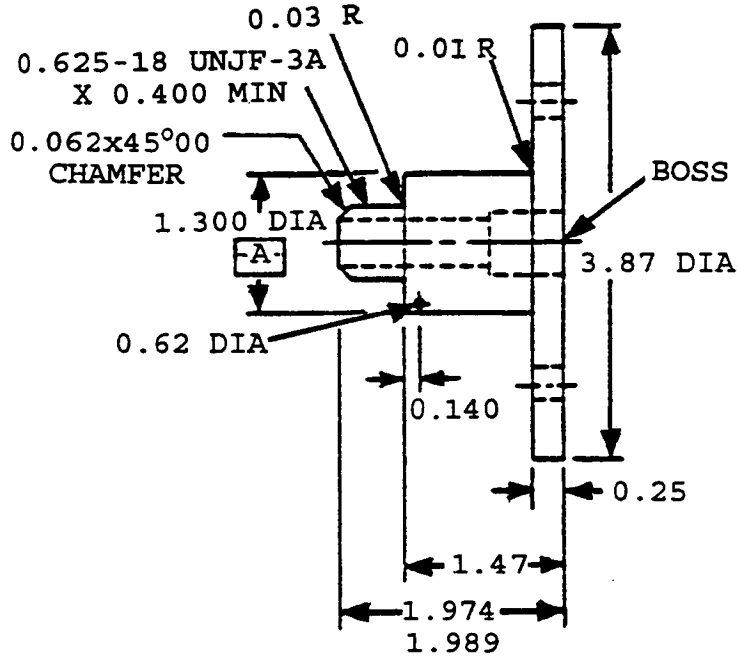
**SPECIAL FEATURES:**
n/a

## NASA/DOD/DOE Pyrotechnic Device

**TITLE:** Connector - NASA Standard Detonator (NSD)/CDF

**AGENCY/CENTER:** NASA/Marshall Space Flight Center (MSFC)

**PHYSICAL DATA:**




NASA STANDARD DETONATOR/CONFINED DETONATING FUSE CONNECTOR

**CONTRACTOR:** USBI

**SUBCONTRACTOR:** Explosive Technology

**DEVICE IDENTIFICATION NUMBER:**
USBI PN 10183-0008-001

**PURPOSE:**
The NSD/CDF assembly connector allows the NSD and CDF assembly to be physically connected and provides the passage for the NSD to detonate the CDF assembly.

# NASA/DOD/DOE Pyrotechnic Device

**PREVIOUS USAGE:**
n/a

**OPERATIONAL DESCRIPTION:**
The NSD / CDF assembly connector allows the NSD and CDF assembly to be physically connected and provides the passage for the NSD to initiate the CDF assembly.

**ENERGY SOURCE:**
**TYPE OF INITIATION:** NSD
**CHARGE MATERIAL:**
n/a
**ELECTRICAL CHARACTERISTICS:**
n/a

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** Low n/a
High n/a
**PRESSURE:** n/a

**DYNAMICS:**
**SHOCK:** n/a
**VIBRATION:** n/a

**QUALIFICATION:**
**DOCUMENTATION:** n/a
**SERVICE LIFE:**
**SHELF:** Indefinite
**OPERATIONAL:** n/a

**ADDITIONAL REFERENCES:**
n/a

**ADDITIONAL COMMENTS:**
n/a

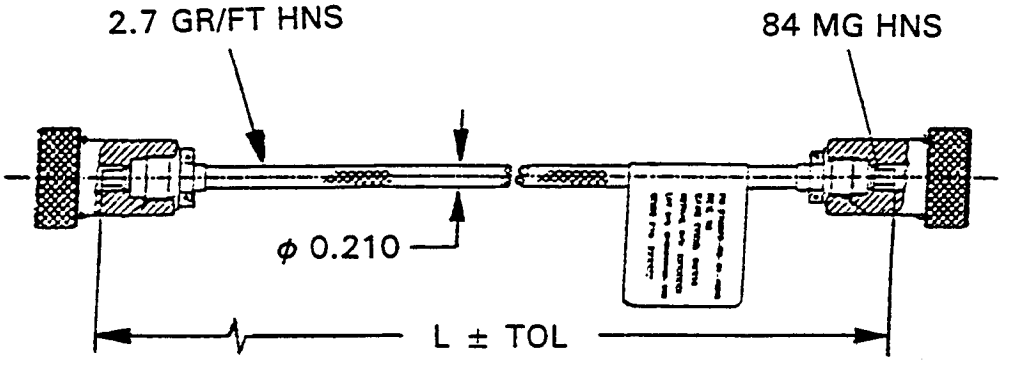
**SPECIAL FEATURES:**
n/a

## NASA/DOD/DOE Pyrotechnic Device

**TITLE:** Cord - Flexible Confined Detonating (FCDC)

**AGENCY/CENTER:** NASA/GSFC/Wallops Flight Facility (WFF)

**PHYSICAL DATA:**




FLEXIBLE CONFINED DETONATING CORD (FCDC)

**CONTRACTOR:** EER Systems Corporation

**SUBCONTRACTOR:** Ensign Bickford Aerospace

**DEVICE IDENTIFICATION NUMBER:**
FCDCA

**PURPOSE:**
Couple the explosive output of the system initiator (either Lanyard Delay Detonator or detonator in command portion of Flight Termination System) to the vehicle destruct charge.

# NASA/DOD/DOE Pyrotechnic Device

**PREVIOUS USAGE:**
ORBUS Flight Termination System, Red Tigress, Leap, Atlas/Centaur, Conestoga/COMET

**OPERATIONAL DESCRIPTION:**
The FCDC lines are attached to the appropriate system initiator block where a controlled gap between the detonator and FCDC end tip is maintained. The FCDC lines are routed through multiple manifolds and other devices to the system destruct charge. When a destruct detonator is fired, the FCDC lines are initiated which in turn initiates the appropriate destruct charge.

**ENERGY SOURCE:**
**TYPE OF INITIATION:** Detonation/energetic particle initiated
**CHARGE MATERIAL:**
n/a
**ELECTRICAL CHARACTERISTICS:**
n/a

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** **Low** -40°F
**High** +160°F
**PRESSURE:** n/a

**DYNAMICS:**
**SHOCK:** 12,000 g
**VIBRATION:** n/a

**QUALIFICATION:**
**DOCUMENTATION:** n/a
**SERVICE LIFE:**
**SHELF:** n/a
**OPERATIONAL:** n/a

**ADDITIONAL REFERENCES:**
n/a

**ADDITIONAL COMMENTS:**
n/a

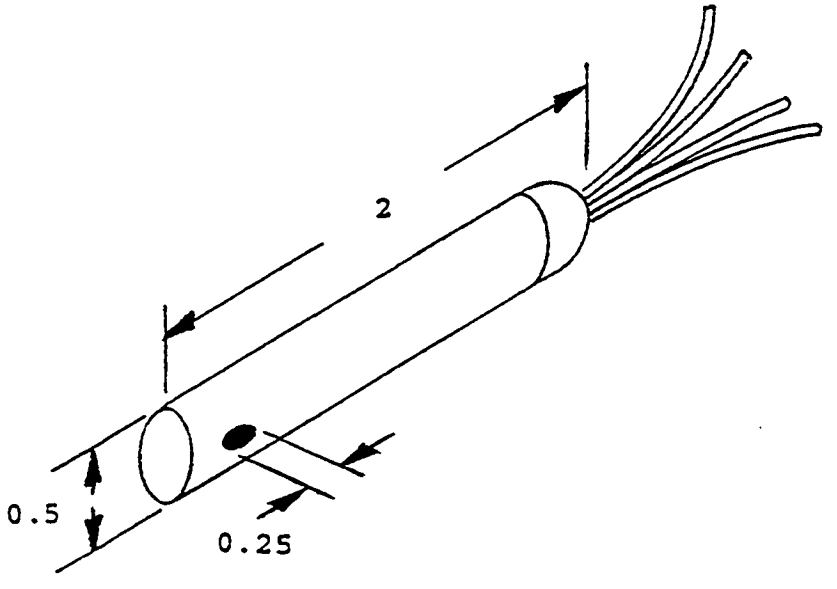
**SPECIAL FEATURES:**
One FCDC end tip is capable of initiating other FCDC lines by either an end-to-end, end-to-side, side-to-end, or side-to-side (least preferable) alignment of the respective FCDC end tips.

## NASA/DOD/DOE Pyrotechnic Device

**TITLE:** Cutter - BLACK BRANT Despin Cable

**AGENCY/CENTER:** NASA Goddard Space Flight Center (GSFC)/Wallops Flight Facility (WFF)

**PHYSICAL DATA:**




BLACK BRANT DESPIN CABLE CUTTER DEVICE

**CONTRACTOR:** Bristol Aerospace Limited

**SUBCONTRACTOR:** Holex

**DEVICE IDENTIFICATION NUMBER:**
5801

**PURPOSE:**
To sever the 7x7 stranded cable which keeps the despin weights in place.

# NASA/DOD/DOE Pyrotechnic Device

**PREVIOUS USAGE:**
n/a

**OPERATIONAL DESCRIPTION:**
The device ~~is~~ electrically initiated and a propellant charge drives a piston with a wedge-shaped knife through the cable opening.

**ENERGY SOURCE:**
**TYPE OF INITIATION:** Electrical
**CHARGE MATERIAL:**
n/a
**ELECTRICAL CHARACTERISTICS:**
5.0 Amperes (recc. all-fire); 1 AMP/1 watt no fire

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** **Low** -65° F
**High** +160° F
**PRESSURE:** n/a

**DYNAMICS:**
**SHOCK:** n/a
**VIBRATION:** n/a
**QUALIFICATION:**
**DOCUMENTATION:** n/a
**SERVICE LIFE:**
**SHELF:** NASA regulations: 5 years
**OPERATIONAL:** n/a

**ADDITIONAL REFERENCES:**
n/a

**ADDITIONAL COMMENTS:**
n/a

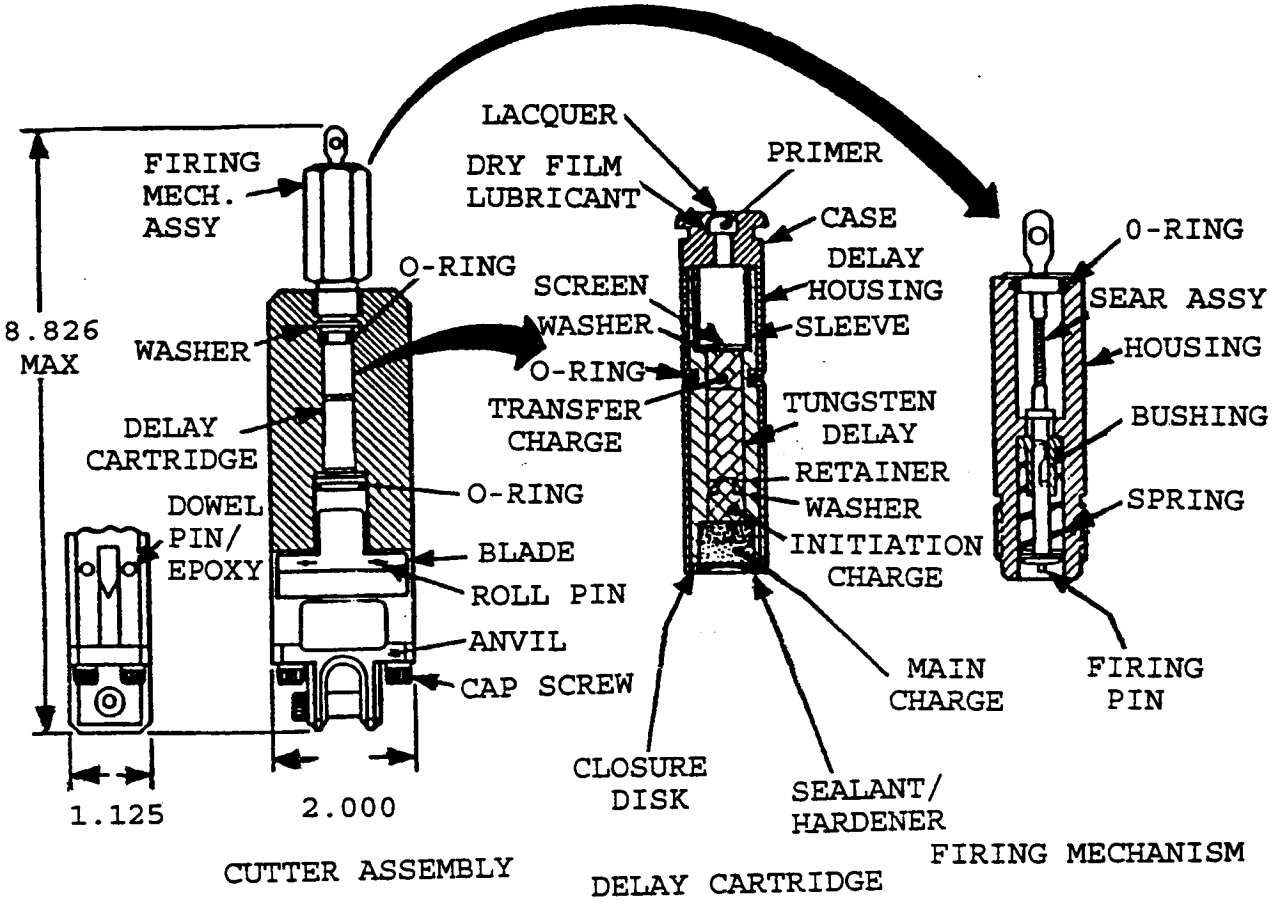
**SPECIAL FEATURES:**
n/a

## NASA/DOD/DOE Pyrotechnic Device

**TITLE:** Cutter - Parachute Reefing Line

**AGENCY/CENTER:** NASA/Marshall Space Flight Center (MSFC)

**PHYSICAL DATA:**




PARACHUTE REEFING LINE CUTTER(S)

**CONTRACTOR:** USBI

**SUBCONTRACTOR:** UPCO

**DEVICE IDENTIFICATION NUMBER:**

18 Parachute cutters:
2 Cut Loop Drogue, 0 sec. delay, 10320-0001-801
2 First Stage Drogue, 7 sec. delay, 10320-0001-802
2 Second Stage Drogue, 12 sec. delay, 10320-0001-804
6 First Stage Drogue, 10 sec. delay, 10320-0001-803
6 Second Stage Drogue, 17 sec. delay, 10320-0001-805

# NASA/DOD/DOE Pyrotechnic Device

**PURPOSE:**
To provide a time delay from a mechanical initiation and then to sever reefing lines for parachute deployment.

**PREVIOUS USAGE:**
n/a

**OPERATIONAL DESCRIPTION:**
The firing mechanism assembly is activated by the shear assembly being pulled and compressing the spring with the firing pin. The shear assembly releases and the firing pin strikes the primer. The primer initiates the transfer charge and starts the tungsten time delay. At the end of the delay time, the initiation charge is initiated which initiates the main charge. The main charge drives the blade into the anvil and cuts the reefing lines.

**ENERGY SOURCE:**
**TYPE OF INITIATION:** Mechanical, spring-loaded pin
**CHARGE MATERIAL:**
Initiation Charge: SOS-285 (150 mg), Transfer Charge: A-A1, Tungsten Delay: SOS-290 or SOS-289, Main Charge: Hercules Hi-Temp (100 mg), Primer: M42C1 per MIL-P-20444
**ELECTRICAL CHARACTERISTICS:**
n/a

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** **Low** +20° F
**High** +200° F for 4 hours
**PRESSURE:** Output: Severs three piles of 13,500 pounds kevlar webbing per MIL-T-87130, Type II, Class 6

**DYNAMICS:**
**SHOCK:** n/a
**VIBRATION:** n/a

**QUALIFICATION:**
**DOCUMENTATION:** n/a
**SERVICE LIFE:**
**SHELF:** Temperature: +20° F to +120° F
Humidity: 0 to 100 percent
Storage Life: 4 years
**OPERATIONAL:** n/a

**ADDITIONAL REFERENCES:**
n/a

**ADDITIONAL COMMENTS:**
n/a

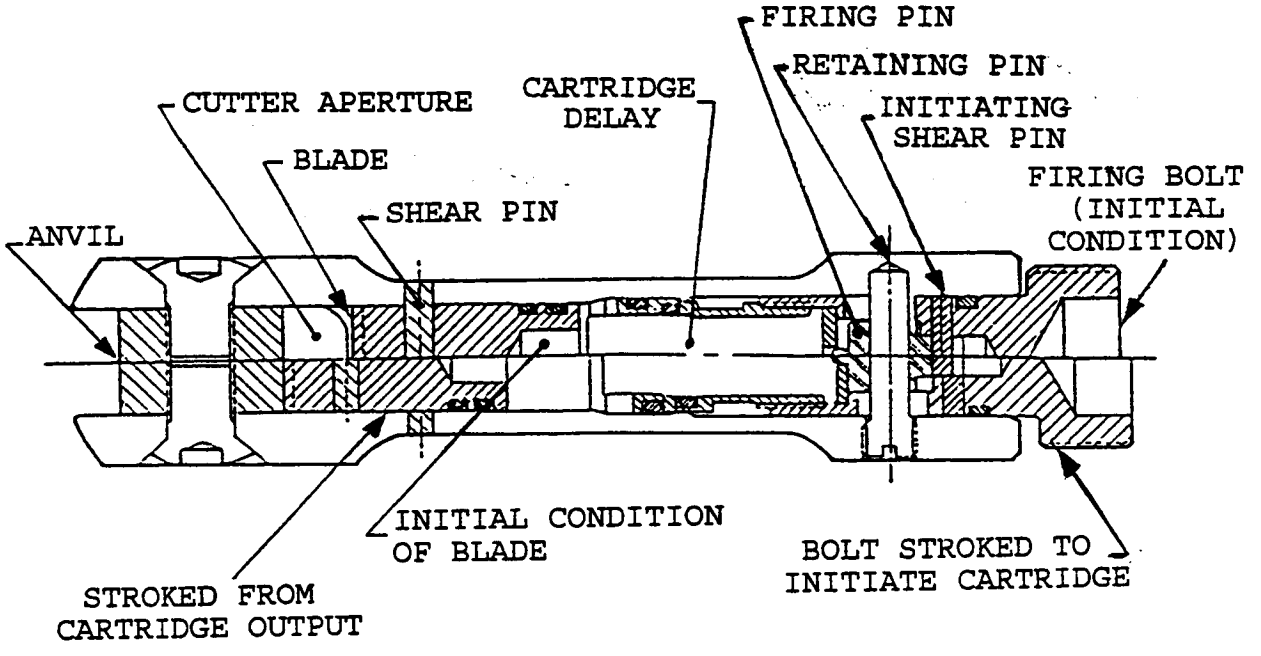
**SPECIAL FEATURES:**
n/a

# NASA/DOD/DOE Pyrotechnic Device

**TITLE:** Cutter - RSRA Pendant

**AGENCY/CENTER:** NASA Langley Research Center (LaRC)

**PHYSICAL DATA:**




PENDANT CUTTER

**CONTRACTOR:** Sikorsky Aircraft

**SUBCONTRACTOR:** Stanely Aviation

**DEVICE IDENTIFICATION NUMBER:**
n/a

**PURPOSE:**
Sever the pendant line connecting the crewmember and rocket, 0.8 second after pendant line stretch in the rocket launch.

# NASA/DOD/DOE Pyrotechnic Device

**PREVIOUS USAGE:**
n/a

**OPERATIONAL DESCRIPTION:**
The pendant line is attached to the firing bolt at the right; the pendant line to the seat assembly's upper corners routs the cutter's aperture. At pendant line stretch, the firing bolt (containing the primer-initiated cartridge) shears the initiating shear pin and forces the percussion primer to the right against the fixed firing pin. The cartridge's output drives the blade to the left, shearing its shear pin and cutting the pendant line.

**ENERGY SOURCE:**
**TYPE OF INITIATION:** Mechanical firing pin
**CHARGE MATERIAL:**
n/a
**ELECTRICAL CHARACTERISTICS:**
n/a

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** Low -65°F
High +200°F
**PRESSURE:** n/a

**DYNAMICS:**
**SHOCK:** } Helicopter environment
**VIBRATION:** }

**QUALIFICATION:**
**DOCUMENTATION:** Bement, Laurence J.: "Helicopter (RSRA) In-Flight Escape System Component Qualification" Presented at the Tenth Symposium on Explosives and Pyrotechnics, San Francisco, CA, February 14-16, 1979.
**SERVICE LIFE:**
**SHELF:** 7 years
**OPERATIONAL:** 5 years

**ADDITIONAL REFERENCES:**
n/a

**ADDITIONAL COMMENTS:**
The approach for qualification of this system was to minimize the quanity of device and system-level testing through an emphasis on functional margin demonstrations during development. The snatch loads on the pendant line were so severe that the blade's shear pin failed. Bench tests, simulating actual deployment, revealed that this shear pin strength had to be increased from 140 to 2200 pounds force.

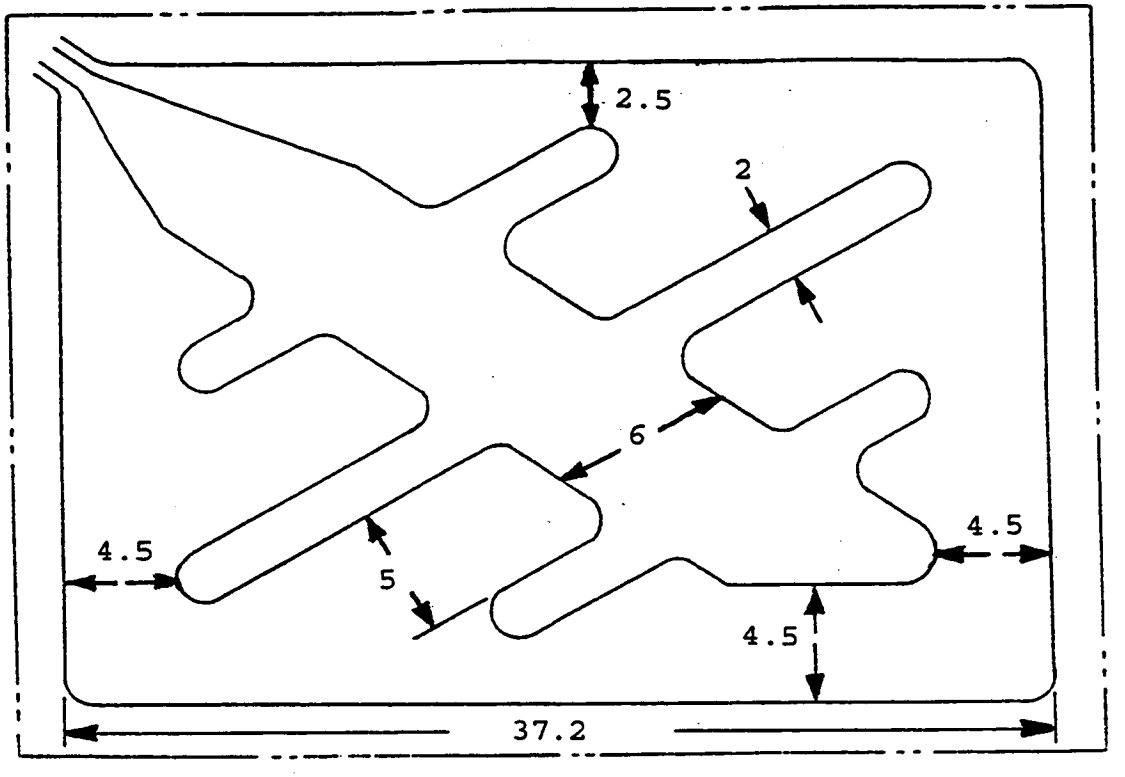
**SPECIAL FEATURES:**
n/a

# NASA/DOD/DOE Pyrotechnic Device

**TITLE:** Cutting Assembly - RSRA Window

**AGENCY/CENTER:** NASA Langley Research Center - (LaRC)

**PHYSICAL DATA:**




CANOPY REMOVAL PATTERN - POSITION

**CONTRACTOR:** Sikorsky Aircraft

**SUBCONTRACTOR:** Teledyne McCormick Selph

**DEVICE IDENTIFICATION NUMBER:**
n/a

**PURPOSE:**
Explosively severs and fractures the 0.25-inch thick, cast acrylic RSRA overhead canopies.

# NASA/DOD/DOE Pyrotechnic Device

**PREVIOUS USAGE:**
n/a

**OPERATIONAL DESCRIPTION:**
The RSRA's single and double-curvature canopies were explosively severed and fractured into pieces no larger than 0.5 square foot by two simultaneously initiated loops of lead-sheathed 3 grains/foot explosve (hexanitrostilbene (HNS)) cord. The four ends of the cord had booster tips installed and were cast into a common manifold, which was initiated by a dual input. The explosive cord was housed in a 0.25-inch diameter silicone rubber extrusion, which was bonded directly to the interior surface of the canopy. Severance occurs immediately above the explosive cord, followed by secondary fracturing in parallel planes on each side of the cord. Furthermore, secondary cracks occurred between loops of the inside pattern, from those loops to the peripheral cord and down the centerline of the internal pattern.

**ENERGY SOURCE:**
**TYPE OF INITIATION:** Explosive transfer lines
**CHARGE MATERIAL:**
n/a
**ELECTRICAL CHARACTERISTICS:**
n/a

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** **Low** −25°F
**High** +200°F
**PRESSURE:** n/a

**DYNAMICS:**
**SHOCK:** } Helicopter environment
**VIBRATION:** }

**QUALIFICATION:**
**DOCUMENTATION:** Bement, Laurence J.: "Rotor Systems Research Aircraft (RSRA) Canopy Explosive Severance/Fracture" Presented at the Ninth Symposium on Explosives and Pyrotechnics, September 15-16, 1976.
Bement, Laurence J.: "Helicopter (RSRA) In-Flight Escape System Component Qualification" Presented at the Tenth Symposium on Explosives and Pyrotechnics, San Francisco, CA, February 14-16, 1979.

**SERVICE LIFE:**
**SHELF:** Unlimited, based on programs conducted by U.S. Army on AH-1G helicopter.
**OPERATIONAL:** Unlimited, as above

**ADDITIONAL REFERENCES:**
n/a

**ADDITIONAL COMMENTS:**
n/a

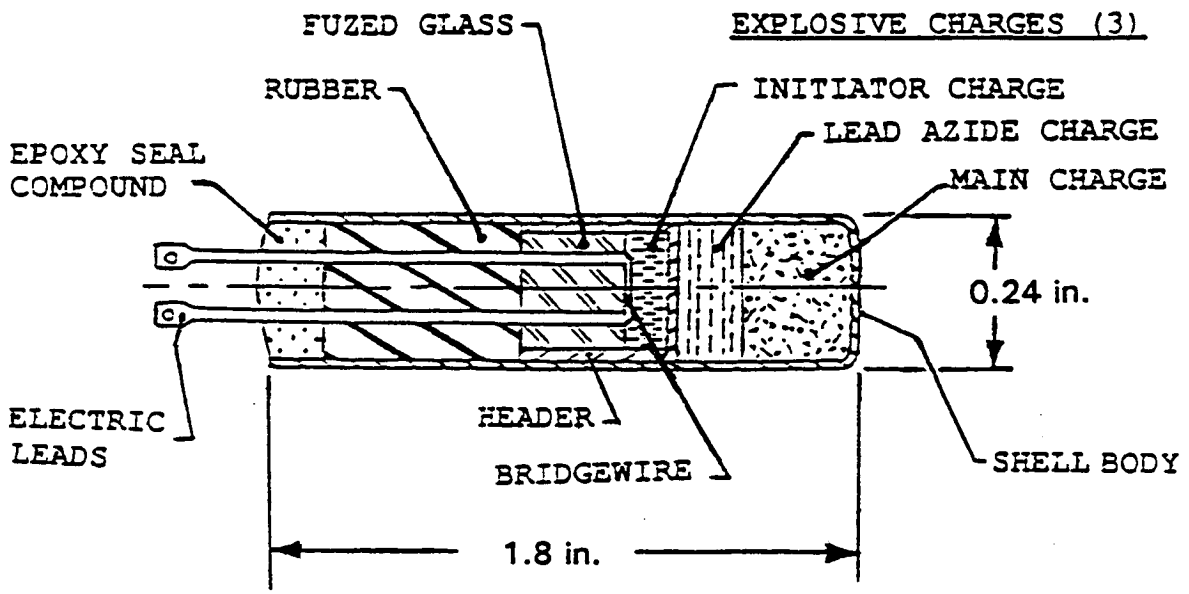
**SPECIAL FEATURES:**
n/a

# NASA/DOD/DOE Pyrotechnic Device

**TITLE:** Detonator - Electro-explosive

**AGENCY/CENTER:** NASA Lewis Research Center (LeRC)

**PHYSICAL DATA:**




ELECTRO-EXPLOSIVE DETONATOR (EED)

**CONTRACTOR:** General Dynamics Space Systems Division (GDSSD)

**SUBCONTRACTOR:** Hi Shear Technology Corporation

**DEVICE IDENTIFICATION NUMBER:**
Contractor Spec. 55-07041

**PURPOSE:**
To provide detonating energy by converting electrical energy into thermal energy at the detonator bridgewire and sequencially, via the heat sensitive pyrotechnic charge in contact with the bridgewire, into detonator pyrotechnic energy for initiating the

## NASA/DOD/DOE Pyrotechnic Device

firing of a main pyrotechnic charge.

**PREVIOUS USAGE:**

Expendable Launch Vehicles:
Atlas Centaur Vehicles through AC-68
Titan III Centaur Vehicles through TC-7

**OPERATIONAL DESCRIPTION:**

At event time, power is supplied to the EED. The electrical energy heats the bridgewire which activates the heat sensitive initiator charge in the detonator. Further heat and pressure from this ignition detonates the main charge. Released energy from the detonation blasts and erodes the thin end shell of the EED and starts detonation of the next item in the pyrotechnic charge train.

**ENERGY SOURCE:**

**TYPE OF INITIATION:** electrical bridgewire
**CHARGE MATERIAL:**
RDX
**ELECTRICAL CHARACTERISTICS:**
Nominal 28 VDC, 5 amps (1 amp - 1 watt no fire).

**OPERATING TEMPERATURE/PRESSURE:**

**TEMPERATURE RANGE:** Low -65 °F
High +200 °F
**PRESSURE:** n/a

**DYNAMICS:**

**SHOCK:** n/a
**VIBRATION:** n/a

**QUALIFICATION:**

**DOCUMENTATION:** per above spec
**SERVICE LIFE:**
**SHELF:** n/a
**OPERATIONAL:** n/a

**ADDITIONAL REFERENCES:**

n/a

**ADDITIONAL COMMENTS:**

n/a

**SPECIAL FEATURES:**

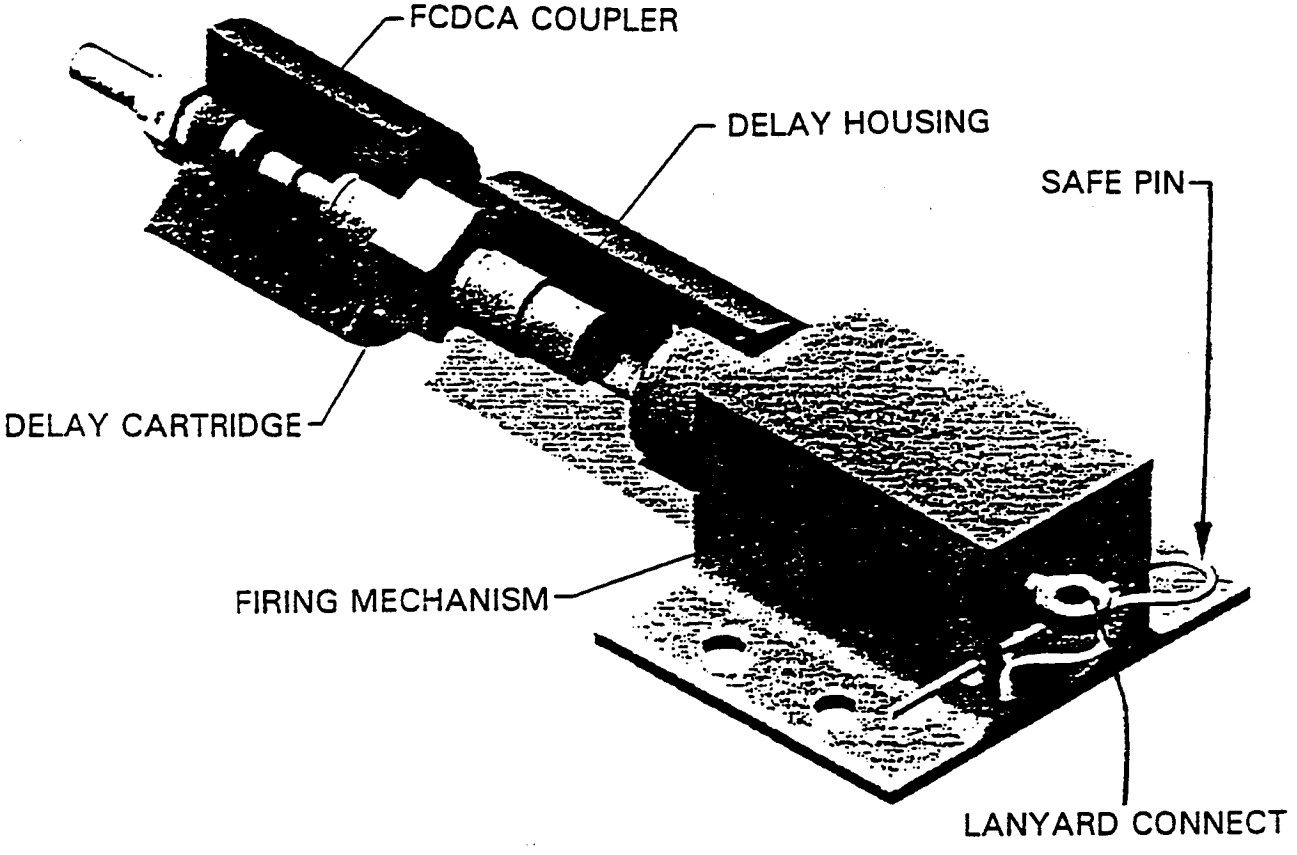
n/a

## NASA/DOD/DOE Pyrotechnic Device

**TITLE:** Detonator - Lanyard Delay (LDD)

**AGENCY/CENTER:** NASA/GSFC/Wallops Flight Facility (WFF)

**PHYSICAL DATA:**




LANYARD DELAY DETONATOR (LDD)

**CONTRACTOR:** EER Systems Corporation

**SUBCONTRACTOR:** Ensign Bickford Aerospace

**DEVICE IDENTIFICATION NUMBER:**
n/a

**PURPOSE:**
Provide a means of initiating the Inadvertent Separation Destruct System should a stage of the vehicle separate prematurely.

# NASA/DOD/DOE Pyrotechnic Device

**PREVIOUS USAGE:**
Pegasus, Conestoga/COMET

**OPERATIONAL DESCRIPTION:**
A lanyard is attached tot he firing pin mechanism. Should a stage separate prematurely, the lanyard, which is attached to the core vehicle, is pulled with sufficient force to cock and release the firing pin assembly. The firing pin initiates primer cap which in turn provides a detonation output from the device. An optional delay can be incorporated in the output of the device.

**ENERGY SOURCE:**
**TYPE OF INITIATION:** Mechanical/Pull Force
**CHARGE MATERIAL:**
n/a
**ELECTRICAL CHARACTERISTICS:**
n/a

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** **Low** -40°F
**High** +160°F
**PRESSURE:** n/a

**DYNAMICS:**
**SHOCK:** 1000 g's
**VIBRATION:** 12 grms 3 axes

**QUALIFICATION:**
**DOCUMENTATION:** Qualified for Pegasus program and Conestoga/ COMET program.
**SERVICE LIFE:**
**SHELF:** n/a
**OPERATIONAL:** n/a

**ADDITIONAL REFERENCES:**
n/a

**ADDITIONAL COMMENTS:**
n/a

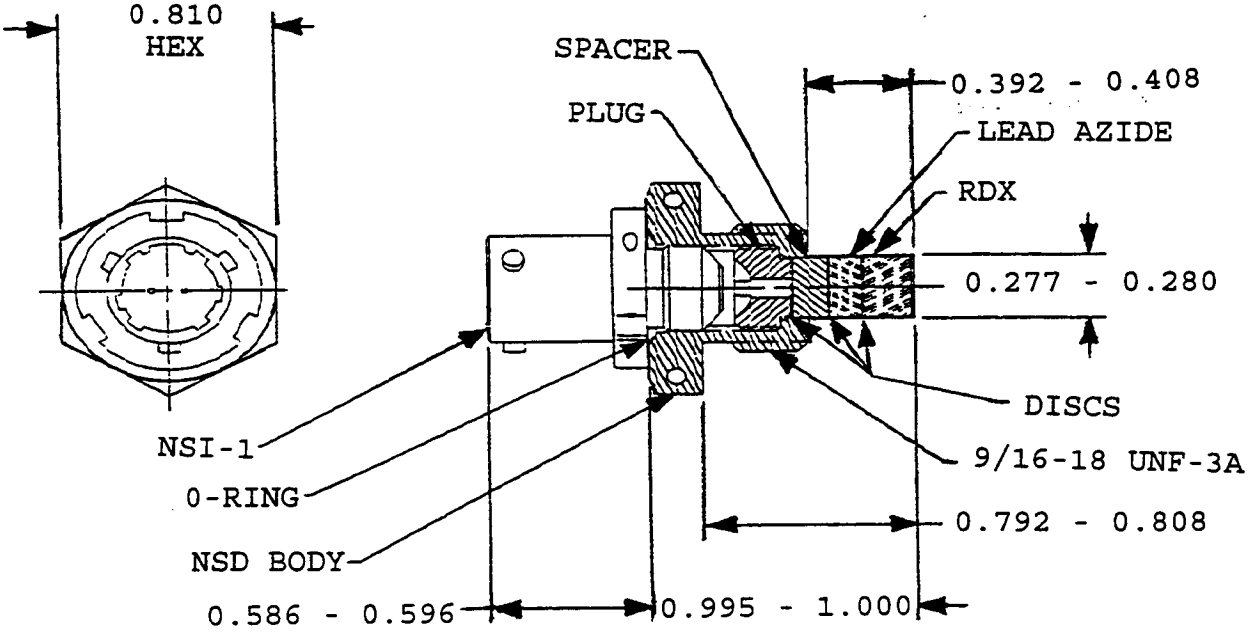
**SPECIAL FEATURES:**
Incorporates a safety pin which will prevent the firing pin mechanism from being armed (cocked). Delay may be selected up to several seconds depending on range requirements.

## NASA/DOD/DOE Pyrotechnic Device

**TITLE:** Detonator - NASA Standard

**AGENCY/CENTER:** NASA Johnson Space Center (JSC)

**PHYSICAL DATA:**




NASA STANDARD DETONATOR

**CONTRACTOR:** n/a

**SUBCONTRACTOR:** Hi Shear Tech. Corp., Explosive Technology Co., and Univeral Propulsion Co.

**DEVICE IDENTIFICATION NUMBER:**
NASA SEB26100094

**PURPOSE:**
To provide a high leveled detonating shockwave for initiating an explosive train or separating frangible devices.

# NASA/DOD/DOE Pyrotechnic Device

**PREVIOUS USAGE:**
Apollo, Skylab, Apollo-Soyuz and Space Shuttle.

**OPERATIONAL DESCRIPTION:**
The NSD is the stnadard detonator for the Space Shuttle and is provided as GFE to all shuttle users by the Johnson Space Center. The NSD consists of the NASA Standard Initiator (NSI) threaded into an A-286 stainless steel body containing a column of lead Azide progressing into a column of RDX. When the NSI is fired with the Pyrotechnic Initiator Controller (PIC) 38 vcs capacitor (680 microfarad) discharge, the NSD produces a 0.040 inch minimum dent into a mild steel block at ambient temperature.

**ENERGY SOURCE:**
**TYPE OF INITIATION:** NSI
**CHARGE MATERIAL:**
Dextrinated Lead Azide (376 mg) and RDX (400 mg).
**ELECTRICAL CHARACTERISTICS:**
n/a

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** **Low** -420°F
**High** +200°F
**PRESSURE:** n/a

**DYNAMICS:**
**SHOCK:** 30g, 11 msec sawtooth
**VIBRATION:** Random (-65°F to +200°F) at 2000 cps

**QUALIFICATION:**
**DOCUMENTATION:** SKD26100097 Design and Performance Spec, Qualification Documentation provided by each Contractor and on file at JSC.
**SERVICE LIFE:**
**SHELF:** 4 years minimum from Lot Acceptance test date, 10 years maximum based upon successful passing Age Life Testing per NSTS 08060
**OPERATIONAL:** see Shelf Life above

**ADDITIONAL REFERENCES:**
n/a

**ADDITIONAL COMMENTS:**
DOT Class C explosive

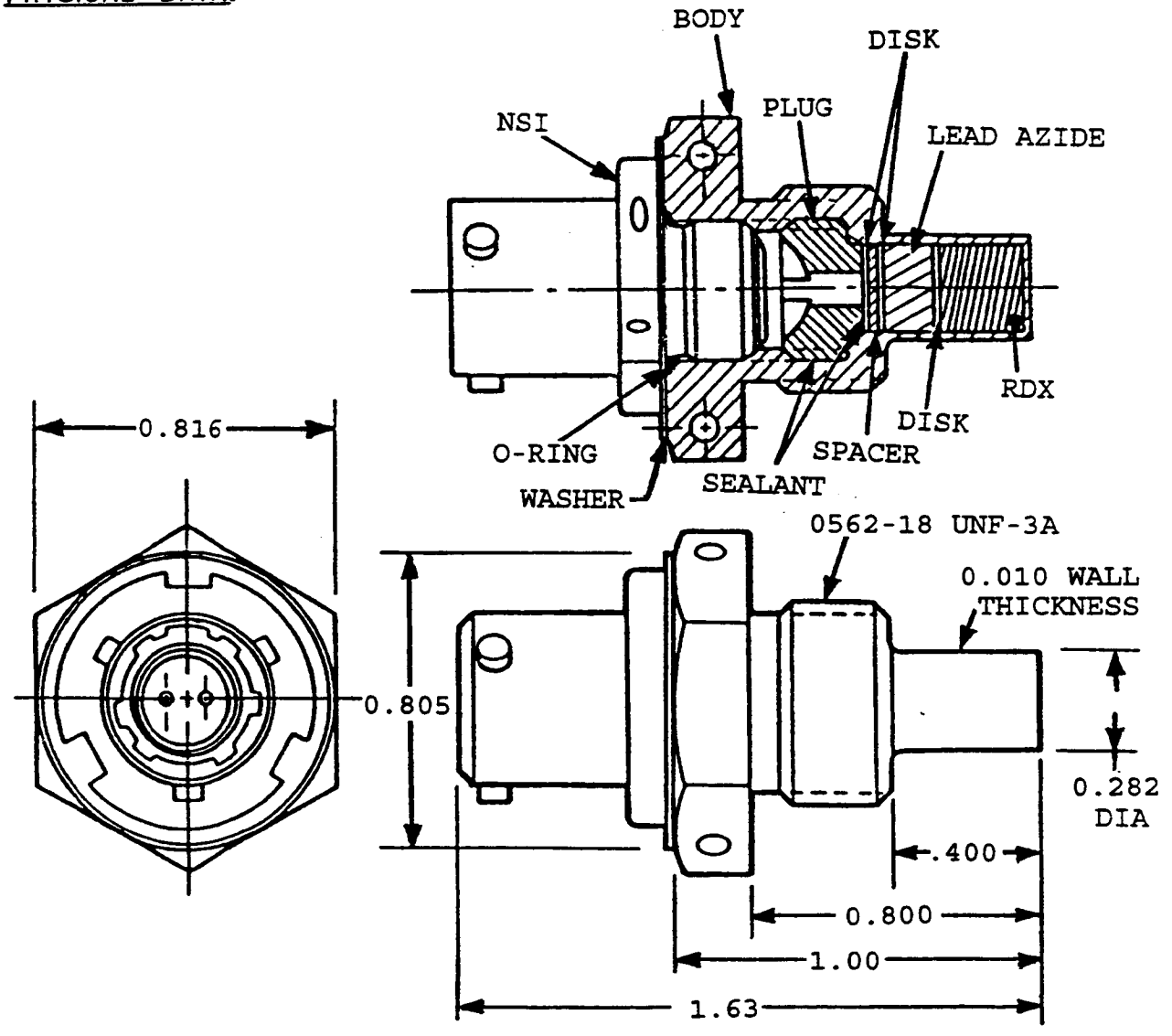
**SPECIAL FEATURES:**
n/a

# NASA/DOD/DOE Pyrotechnic Device

**TITLE:** Detonator - NASA Standard

**AGENCY/CENTER:** NASA/Marshall Space Flight Center (MSFC)

**PHYSICAL DATA:**




NASA STANDARD DETONATOR

**CONTRACTOR:** Thiokol Corporation

**SUBCONTRACTOR:** Thiokol Corporation

**DEVICE IDENTIFICATION NUMBER:**
JSC/SEB26100094

**PURPOSE:**
The NSD is the standard detonator for the space shuttle. The NSD is used to initiate LSC assemblies, frangible nut booster cartridges, CDF manifolds, and a pyro valve actuation cartridge.

# NASA/DOD/DOE Pyrotechnic Device

**PREVIOUS USAGE:**
Apollo, Skylab, Apollo-Soyuz.

**OPERATIONAL DESCRIPTION:**
The NSD is a housing with a NSI threaded into one end and a primary explosive train contained in the other end. The NSI initiates the lead azide, which initiates the RDX output charge. The NSD output charge is then used to continue an explosive train into a manifold, cartridge, or LSC assembly.

**ENERGY SOURCE:**
**TYPE OF INITIATION:** NSI
**CHARGE MATERIAL:**
Initiator: NSI, Zirconium Potassium Perchlorate (ZrKCLO4) 114 mg
Accelerator Charge: Lead Azide, Type I per MIL-I-3055, two increments, 188 mg each.
Output Charge: RDX, Type B, Class G per MIL-R-398, two increments, 200 mg each.
**ELECTRICAL CHARACTERISTICS:**
n/a

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** **Low** -450° F
**High** +200° F
**PRESSURE:** Output: 0.045 inch dent depth per MIL-STD- 331 test.

**DYNAMICS:**
**SHOCK:** n/a
**VIBRATION:** n/a

**QUALIFICATION:**
**DOCUMENTATION:** n/a
**SERVICE LIFE:**
**SHELF:** Temperature: +25° F to +105° F, Humidity: 0 to 95 %,
Storage Life: 4 years
**OPERATIONAL:** n/a

**ADDITIONAL REFERENCES:**
n/a

**ADDITIONAL COMMENTS:**
n/a

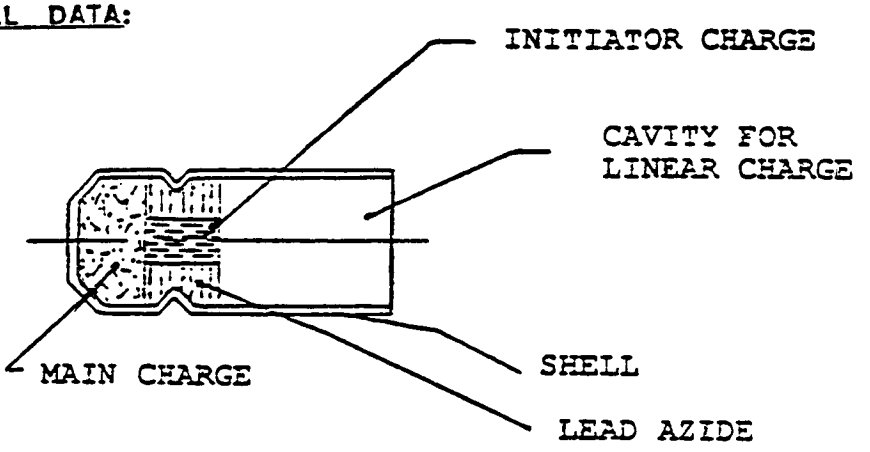
**SPECIAL FEATURES:**
n/a

# NASA/DOD/DOE Pyrotechnic Device

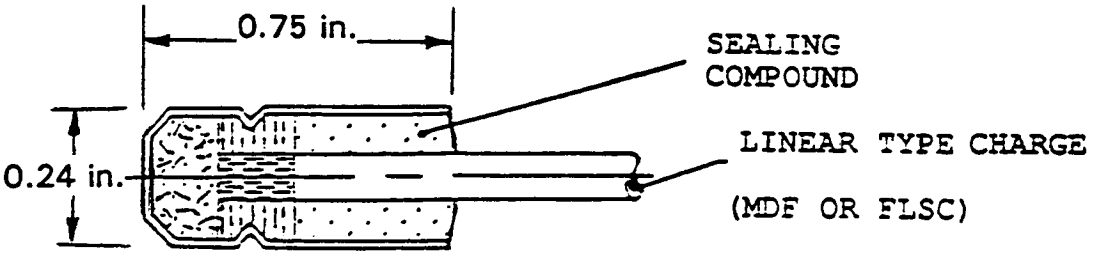
**TITLE:** Detonator - Non-Electric

**AGENCY/CENTER:** NASA Lewis Research Center (LeRC)

**PHYSICAL DATA:**




WITHOUT LINEAR CHARGE INSTALLED




WITH LINEAR CHARGE INSTALLED

NON-ELECTRIC DETONATOR (NED)

**CONTRACTOR:** General Dynamics Space Systems Division (GDSSD)

**SUBCONTRACTOR:** Hi Shear Technology Corporation

**DEVICE IDENTIFICATION NUMBER:**
Contractor Spec. 55-07040

**PURPOSE:**
To increase the pyrotechnic energy at the ends of linear charge cord (Mild Detonating Fuse, Confined MDF, Flexible Linear Shaped Charge) by functioning as a booster charge for propagating firing from a pyrotechnic item to the cord or from the cord to another

## NASA/DOD/DOE Pyrotechnic Device

pyrotechnic item in a multiple explosive charge system.

**PREVIOUS USAGE:**

Expendable Launch Vehicles:
Atlas Centaur Vehicles through AC-68
Titan III Centaur Vehicles through TC-7

**OPERATIONAL DESCRIPTION:**

As a receiver booster, the non electric detonator is activated by the blast energy received from an electric detonator or from the preceding pyro firing in the system charge train. In sequence, the NED blast activates the attached linear charge (mild detonating fuse or shaped charge). As a doner booster, the NED is activated by firing energy donated from the attached linear charge and in-turn activates the follow-on pyro item in the system.

**ENERGY SOURCE:**

**TYPE OF INITIATION:** Requires an initiator.

**CHARGE MATERIAL:**

PETN

**ELECTRICAL CHARACTERISTICS:**

n/a

**OPERATING TEMPERATURE/PRESSURE:**

**TEMPERATURE RANGE:** Low -305 °F
High +240 °F

**PRESSURE:** n/a

**DYNAMICS:**

**SHOCK:** n/a
**VIBRATION:** n/a

**QUALIFICATION:**

**DOCUMENTATION:** per above spec.
**SERVICE LIFE:**
**SHELF:** n/a
**OPERATIONAL:** n/a

**ADDITIONAL REFERENCES:**

n/a

**ADDITIONAL COMMENTS:**

n/a

**SPECIAL FEATURES:**

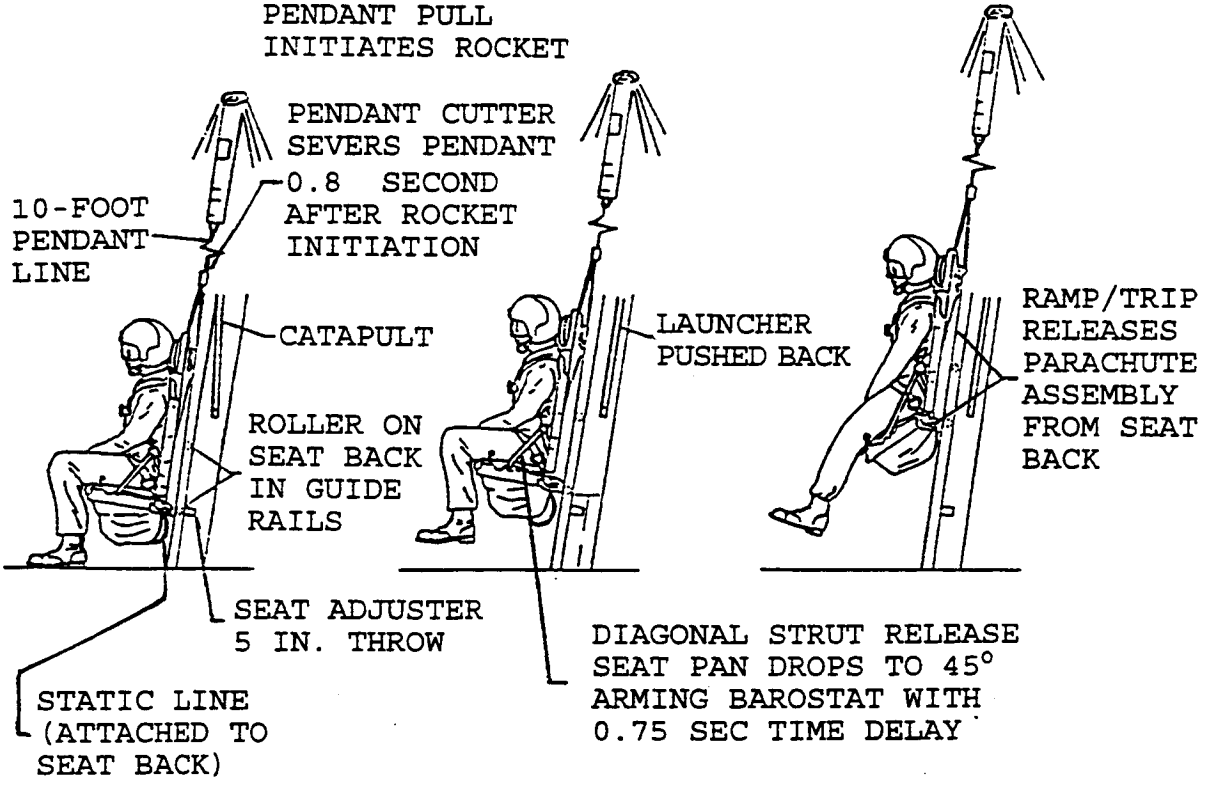
n/a

## NASA/DOD/DOE Pyrotechnic Device

**TITLE:** Escape Seat - Rotor System Research Aircraft

**AGENCY/CENTER:** NASA Langley Research Center (LaRC)

**PHYSICAL DATA:**




ROTOR SYSTEMS RESEARCH AIRCRAFT ESCAPE SEAT

**CONTRACTOR:** Stanley Aviation

**SUBCONTRACTOR:** n/a

**DEVICE IDENTIFICATION NUMBER:**
n/a

**PURPOSE:**
Sequentially extract three crewmembers from the (RSRA)

**PREVIOUS USAGE:**
Several propellor-driven, fixed wing aircraft, including the T-28.

**OPERATIONAL DESCRIPTION:**
On pulling the initiation ring at the front of the seat, a powered inertia reel withdraws the crewmember to the seat back. The extraction rocket was catapulted from the aircraft, using common-manifold, dual piston/cylinder mortars. On full extension of the pendant line, the 28-pound, hammerhead rocket ignites, producing 2000 pounds of thrust for a half-second. With pendant line stretch, the g level on the crewmember is approximately 16. As

# NASA/DOD/DOE Pyrotechnic Device

**OPERATIONAL DESCRIPTION (CONT.)**

the seat progresses up the quide rails a rail protrusion trip releases the diagonal struts to allow the seat pan to drop and position the crewmember into a near standup position. The seat pan drop also triggers a pyrotechnic time-delayed, barostat-activated parachute release. The seat back (parachute assembly) stays with the crewmember throughout extraction, and is released by pyrotechnic time delayed thrusters at the seat back corners to release the inertia reel straps and at the seat buckle. The rocket motor is released by a pyrotechnic time-delayed pendant cutter to avoid contacting the crewmember. The parachute, deployed by a static line attached to the aircraft is packaged under the seat pan. The parachute risers are routed over the seat back and to the crewmember's shoulders. A major advantage of this system over ejection seats is the low prifile of the standing crewmember.

**ENERGY SOURCE:**

**TYPE OF INITIATION:** Mechanical firing pin, rigid and flexible explosive transfer lines and hot gas.

**CHARGE MATERIAL:**

n/a

**ELECTRICAL CHARACTERISTICS:**

n/a

**OPERATING TEMPERATURE/PRESSURE:**

**TEMPERATURE RANGE:** Low -65°F
High +200°F

**PRESSURE:** n/a

**DYNAMICS:**

**SHOCK:** } Helicopter environment
**VIBRATION:** }

**QUALIFICATION:**

**DOCUMENTATION:** Bement, Laurence J.: "Helicopter (RSRA) In-Flight Escape System Component Qualification" Presented at the Tenth Symposium on Explosives and Pyrotechnics, San Francisco, CA, February 14-16, 1979.
Bement, Laurence J.: "Helicopter Emergency Escape" SAFE Journal - Vol. 9, No. 3, Fall Quarter, 1979.

**SERVICE LIFE:**

**SHELF:** 7 years **OPERATIONAL:** 5 years

**ADDITIONAL REFERENCES:**

The approach for qualification of this system was to minimize the quantity of device and system-level testing through an emphasis on functional margin demonstrations during development and escape trajectory copmuter analysis.

**ADDITIONAL COMMENTS:**

n/a

**SPECIAL FEATURES:**

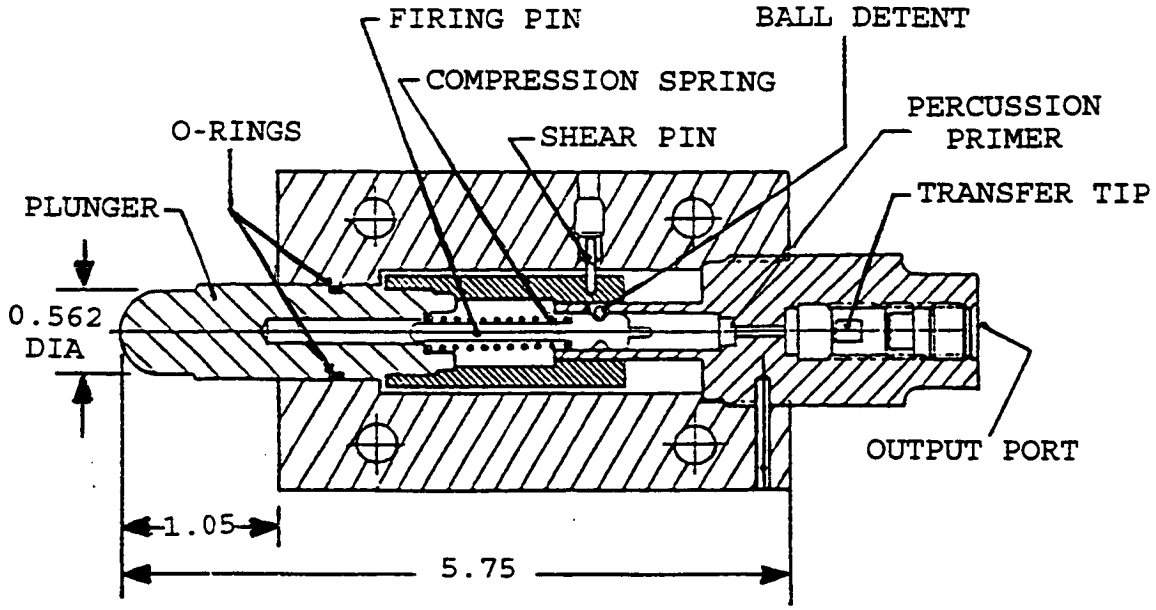
n/a

# NASA/DOD/DOE Pyrotechnic Device

**TITLE:** Firing Pin - RSRA Rotary Transfer Unit

**AGENCY/CENTER:** NASA Langley Research Center (LaRC)

**PHYSICAL DATA:**




FIRING PIN ASSEMBLY IN ROTARY TRANSFER UNIT

**CONTRACTOR:** Sikorsky Aircraft

**SUBCONTRACTOR:** Teledyne McCormick Selph

**DEVICE IDENTIFICATION NUMBER:**
n/a

**PURPOSE:**
Initiate a standard explosive transfer line.

# NASA/DOD/DOE Pyrotechnic Device

**PREVIOUS USAGE:**
n/a

**OPERATIONAL DESCRIPTION:**
The plunger was thrust inward by the ramp interface on the RSRA thruster. This motion compressed a firing spring, until the ball detent was released to allow the firing pin to be driven into a percussion primer, which in turn initiated a transfer tip. This tip then initiated an explosive transfer line.

**ENERGY SOURCE:**
**TYPE OF INITIATION:** Explosive transfer line
**CHARGE MATERIAL:**
n/a
**ELECTRICAL CHARACTERISTICS:**
n/a

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** Low -25°F
High +200°F
**PRESSURE:** n/a

**DYNAMICS:**
**SHOCK:** } Helicopter environment
**VIBRATION:** }

**QUALIFICATION:**
**DOCUMENTATION:** Bement, Laurence J.: "Helicopter (RSRA) In-Flight Escape System Component Qualification" Presented at the Tenth Symposium on Explosives and Pyrotechnics, San Francisco, CA, February 14-16, 1979.

**SERVICE LIFE:**
**SHELF:** 7 years
**OPERATIONAL:** 5 years

**ADDITIONAL REFERENCES:**
n/a

**ADDITIONAL COMMENTS:**
The approach for qualification of this system was to minimize the quantity of device and system-level testing through an emphasis on functional margin demonstrations during development.

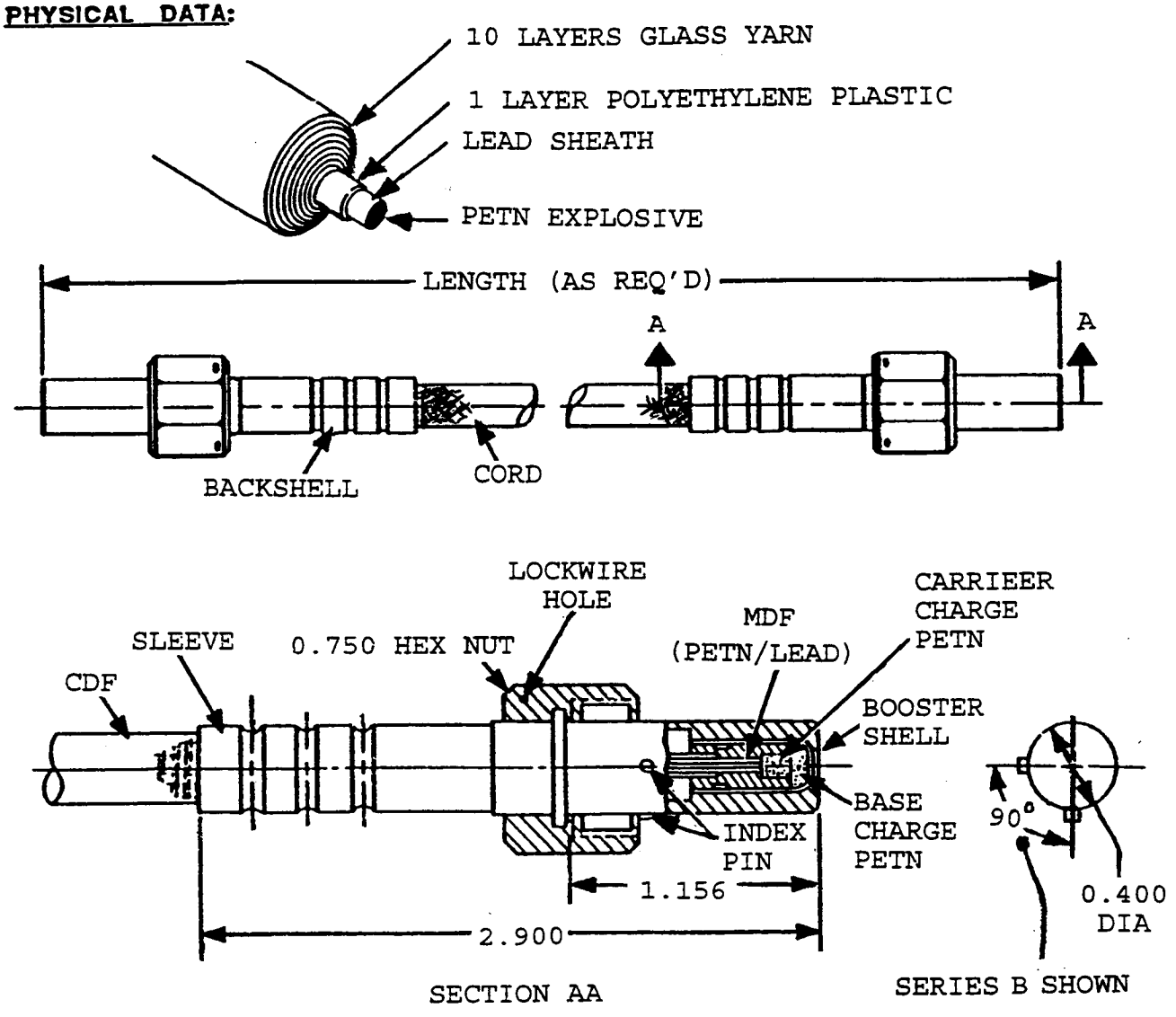
**SPECIAL FEATURES:**
n/a

# NASA/DOD/DOE Pyrotechnic Device

**TITLE:** Fuse - Confined Detonating

**AGENCY/CENTER:** NASA/Marshall Space Flight Center (MSFC)

**PHYSICAL DATA:**




CONFINED DETONATING FUSE (CDF) ASSEMBLY

**CONTRACTOR:** USBI

**SUBCONTRACTOR:** Ensign Bickford and Teledyne McCormick-Selph

**DEVICE IDENTIFICATION NUMBER:**
USBI PN
Ensign Bickford 10314-0001-8XX; Teledyne 10315-0001-8XX

**PURPOSE:**
To provide a means of detonation propagation between ordnance devices.

# NASA/DOD/DOE Pyrotechnic Device

**PREVIOUS USAGE:**
n/a

**OPERATIONAL DESCRIPTION:**
The CDF assembly consists of a mild detonating fuse, layers of material as the confining agent, identical end connectors and sleeves, and booster charges to ensure detonation transfer to the mating device. Each sleeve incorporates index keys to prevent connecton of unrelated pyrotechnic systems, and reference designators are required on all solid rocket booster/CDF (SRB/CDF) assemblies as an aid for proper installation.

**ENERGY SOURCE:**
**TYPE OF INITIATION:** CDF Manifold or NASA standard detonator (NSD)
**CHARGE MATERIAL:**
Base Charge: Superfine PETN (53 mg) per MIL-P-387
Carrier Charge: Superfine PETN (20 mg) per MIL-P-387
Mild Detonator Fuse (MDF): Silver Sheath with 2.5 gpf HNS, Type II, Grade A per WS5003
**ELECTRICAL CHARACTERISTICS:**
n/a

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** **Low** see additional comments
**High** see additional comments
**PRESSURE:** Output: equivalent to a X-349 end primer

**DYNAMICS:**
**SHOCK:** n/a
**VIBRATION:** n/a

**QUALIFICATION:**
**DOCUMENTATION:** n/a
**SERVICE LIFE:**
**SHELF:** Temperature: +25° F to +105° F Humidity: 0 to 100 Percent Storage Life: 4 yrs
**OPERATIONAL:** n/a

**ADDITIONAL REFERENCES:**
n/a

**ADDITIONAL COMMENTS:**
SRB: -319° F for 12 hours to +250° F for 30 minutes after stabilization at +195° F
ET: -319° F for 12 hours to +250°f for 30 minutes applied to the end tips and +350° F for 30 minutes applies to the cord

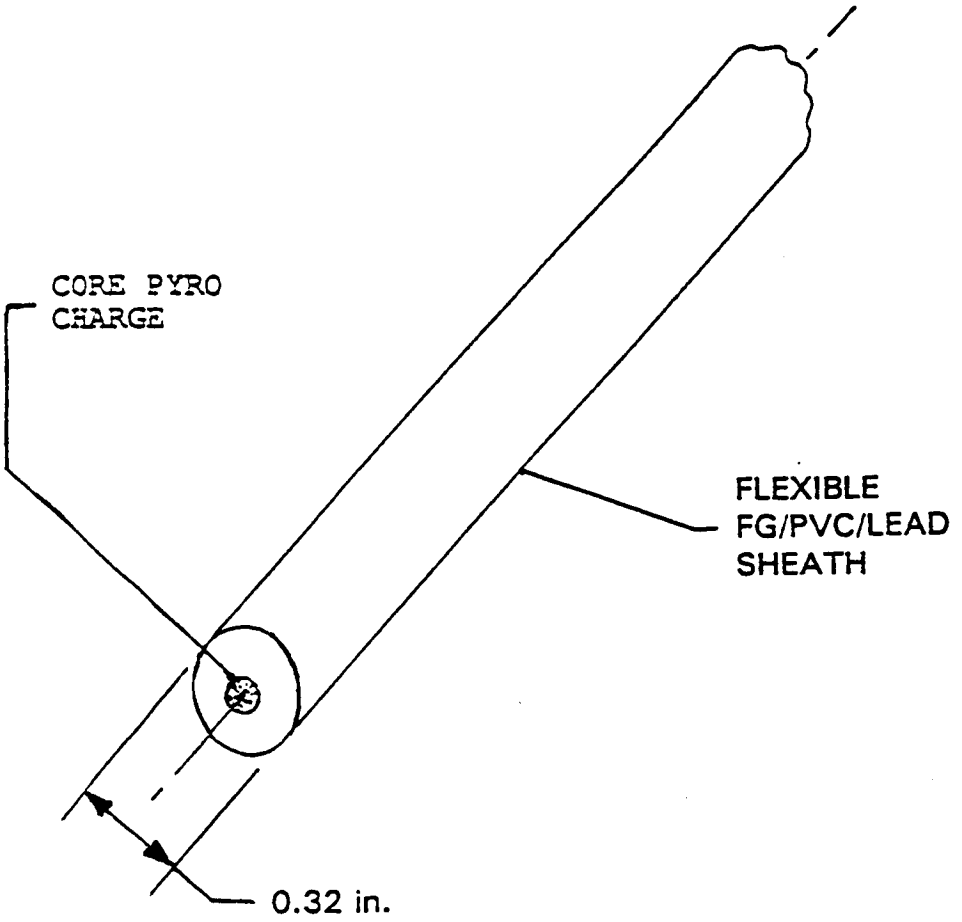
**SPECIAL FEATURES:**
n/a

# NASA/DOD/DOE Pyrotechnic Device

**TITLE:** Fuse - Mild Detonating

**AGENCY/CENTER:** NASA Lewis Research Center (LeRC)

**PHYSICAL DATA:**




MILD DETONATING FUZE (MDF)

**CONTRACTOR:** General Dynamics Space Systems Division (GDSSD)

**SUBCONTRACTOR:** Ensign Bickford Co.

**DEVICE IDENTIFICATION NUMBER:**
Contractor Spec. 55-00212

**PURPOSE:**
To transfer energy from an initiator or from an actively firing device by confined firing along the fuse length to detonate a follow-on pyrotechnic item.

# NASA/DOD/DOE Pyrotechnic Device

**PREVIOUS USAGE:**
Expendable Launch Vehicles:
Atlas Centaur Vehicles through AC-68
Titan III Centaur Vehicles through TC-7

**OPERATIONAL DESCRIPTION:**
The mild detonating fuse is used to transfer pyrotechnic firing from one pyrotechnic item to another and thereby continue a pyrotechnic propagation. Often, a non electric detonator (booster charge) is connected at each end of the fuse to enhance the energy and assure good transfer.

**ENERGY SOURCE:**
**TYPE OF INITIATION:** Requires an initiator and booster.
**CHARGE MATERIAL:**
PETN
**ELECTRICAL CHARACTERISTICS:**
n/a

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** Low -300 °F
High +200 °F
**PRESSURE:** n/a

**DYNAMICS:**
**SHOCK:** n/a
**VIBRATION:** n/a

**QUALIFICATION:**
**DOCUMENTATION:** per above spec
**SERVICE LIFE:**
**SHELF:** n/a
**OPERATIONAL:** n/a

**ADDITIONAL REFERENCES:**
n/a

**ADDITIONAL COMMENTS:**
n/a

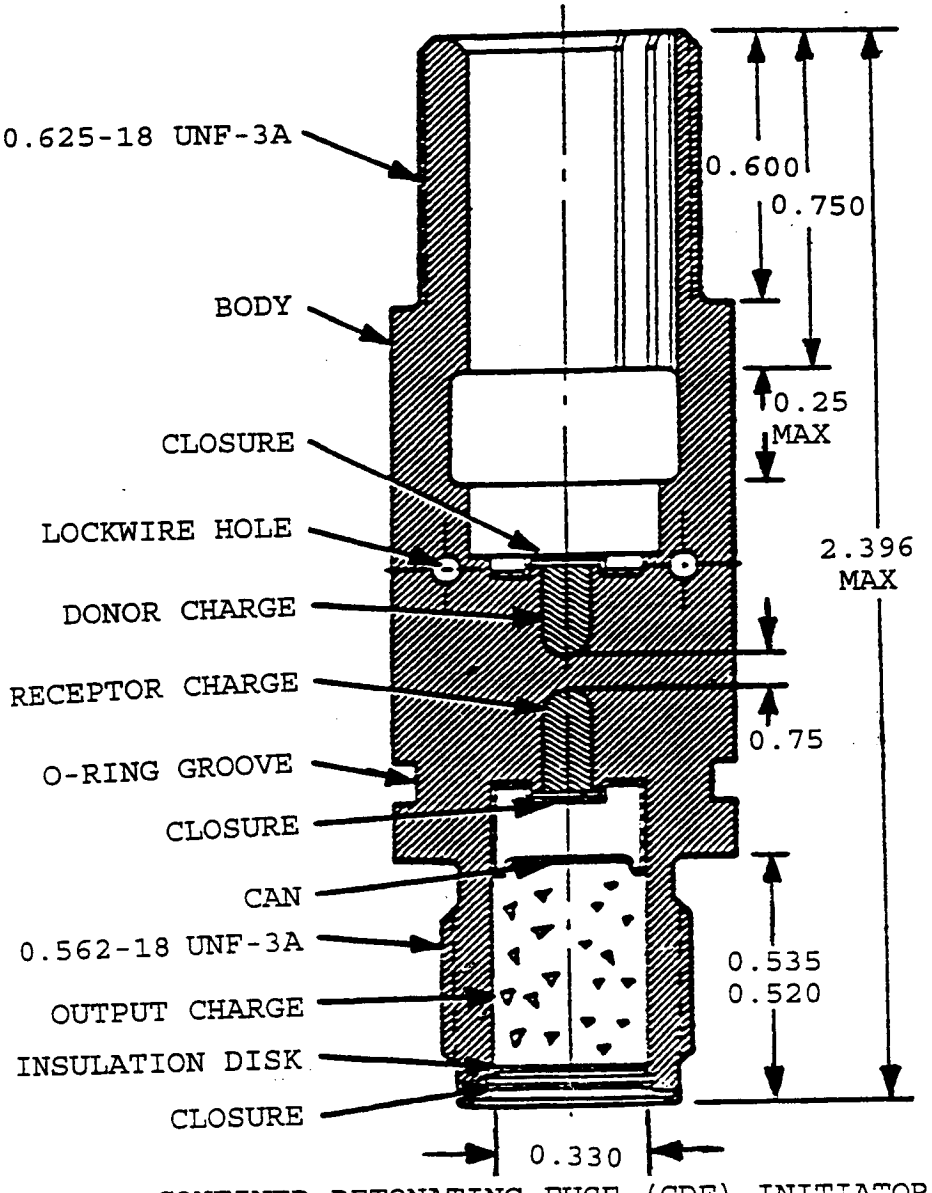
**SPECIAL FEATURES:**
Available in several charge load sizes. Also available with RDX charge material.

# NASA/DOD/DOE Pyrotechnic Device

**TITLE:** Initiator - Confined Detonating Fuse (CDF)

**AGENCY/CENTER:** NASA/Marshall Space Flight Center (MSFC)

**PHYSICAL DATA:**




CONFINED DETONATING FUSE (CDF) INITIATOR

**CONTRACTOR:** USBI

**SUBCONTRACTOR:** UPCO

**DEVICE IDENTIFICATION NUMBER:**
USBI PN 10308-0003-801

**PURPOSE:**
The CDF initiator is a device designed to initiate the igniter of a solid propellant motor and is used to initiate the booster separation motor (BSM) on the solid rocket booster (SRB).

# NASA/DOD/DOE Pyrotechnic Device

**PREVIOUS USAGE:**
n/a

**OPERATIONAL DESCRIPTION:**
The donor charge of the CDF initiator is initiated by a CDF assembly. The donor charge propagates a shock through the bulkhead to the receptor charge which initiates the output charge. The donor and receptor charges are packed intimately against both sides of the bulkhead. The arrangement ensures shockwave propagation through the bulkhead without rupturing it, which provides an effective seal from the output charge and gases from the solid rocket motor.

**ENERGY SOURCE:**
**TYPE OF INITIATION:** CDF Assembly
**CHARGE MATERIAL:**
n/a
**ELECTRICAL CHARACTERISTICS:**
n/a

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** **Low** +20° F for 12 hours
**High** +190° F for 4 hours
**PRESSURE:** Output: Upon receiving the detonation shock from a CDF assembly, the initiator will produce a maximum pressure of 420 to 800 psig in a 20.7 +/- 0.3 cc volume within 8 msec. after initiation.

**DYNAMICS:**
**SHOCK:** n/a
**VIBRATION:** n/a

**QUALIFICATION:**
**DOCUMENTATION:** n/a
**SERVICE LIFE:**
**SHELF:** Temperature: +25° F to +105° F Humidity: 0 to 100 percent Storage Life: 4 years
**OPERATIONAL:** n/a

**ADDITIONAL REFERENCES:**
n/a

**ADDITIONAL COMMENTS:**
n/a

**SPECIAL FEATURES:**
n/a

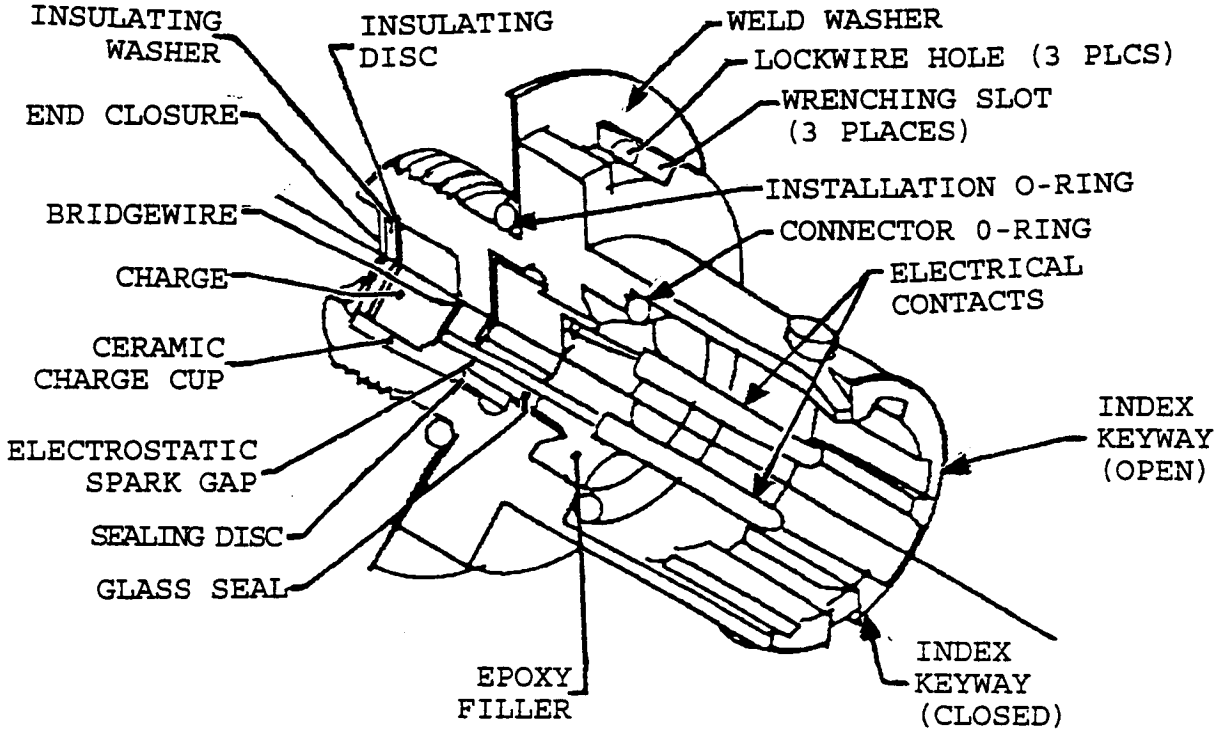
# NASA/DOD/DOE Pyrotechnic Device

**TITLE:** Initiator - NASA Standard, Type I

**AGENCY/CENTER:** NASA Johnson Space Center (JSC)

**PHYSICAL DATA:**

| | | | |
|---|---|---|---|
| WEIGHT: | 0.022 LB (9.9 GM) | LENGTH: | 0.873 IN |
| BODY MATL: | INCONEL 718 | WASHER DIA: | 0.8 IN |
| TORQUE: | 125±10 IN-LB | THREAD: | 3/8-24 UNJF-3A |




NASA STANDARD INITIATOR

**CONTRACTOR:** n/a

**SUBCONTRACTOR:** Hi Shear Tech Corp. and/or Universal Propulsion Co.

**DEVICE IDENTIFICATION NUMBER:**
NASA JSC SEB26100001-XXX

**PURPOSE:**
The device is an electroexplosive used to "initiate" or ignite higher level assemblies.

# NASA/DOD/DOE Pyrotechnic Device

**PREVIOUS USAGE:**
Standard EED in the Apollo, Skylab, Apollo-Soyuz and Space Shuttle programs. Standard for Aerospace community in payloads and launch vehicles.

**OPERATIONAL DESCRIPTION:**
The NSI is an electro-explosive initiator with a single, one ohm, stainless steel, propellant-slurried bridgewire and a propellant charge of 114 mg of a Zirconium, Potassium Perchlorate, Viton B and Graphite blend.

**ENERGY SOURCE:**
**TYPE OF INITIATION:** Propellant-slurried bridgewire
**CHARGE MATERIAL:**
See operational description above
**ELECTRICAL CHARACTERISTICS:**
1 ohm bridgewire, 3.5 amp all-fire, 1 amp - 1 watt no-fire

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** **Low** -420°F
**High** +300°F
**PRESSURE:** 650 ± 125 psi in 10cc bomb

**DYNAMICS:**
**SHOCK:** 100g, 11msec sawtooth
**VIBRATION:** 28 grms random (-260°F to +300°F)

**QUALIFICATION:**
**DOCUMENTATION:** Hishear TR2-323; Space Ordnance System TR 6068
**SERVICE LIFE:**
**SHELF:** 20 years demonstrated
**OPERATIONAL:** 10 years

**ADDITIONAL REFERENCES:**
n/a

**ADDITIONAL COMMENTS:**
n/a

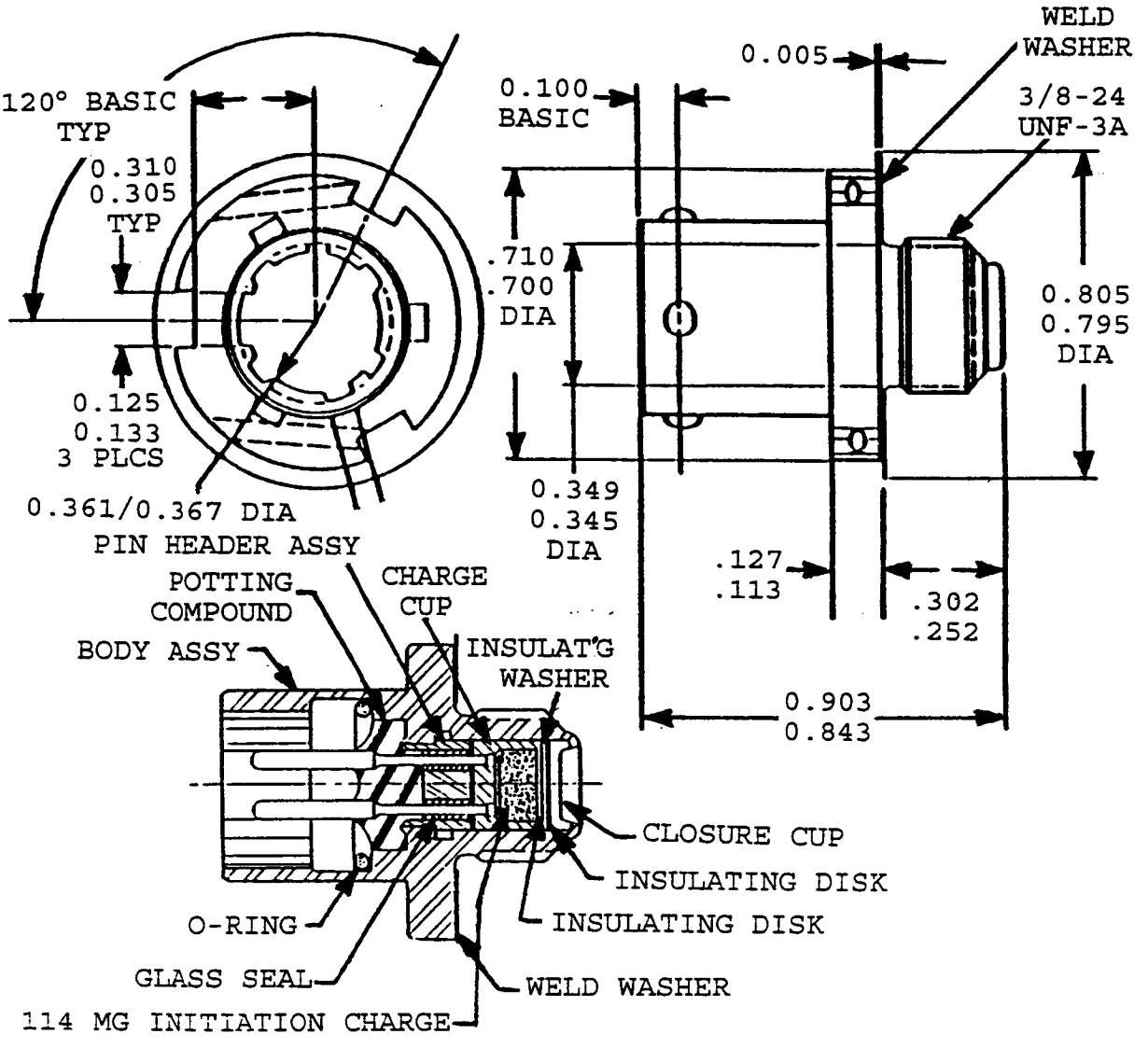
**SPECIAL FEATURES:**
n/a

## NASA/DOD/DOE Pyrotechnic Device

**TITLE:** Initiator - NSI/Solid Rocket Motor Igniter

**AGENCY/CENTER:** NASA/Marshall Space Flight Center (MSFC)

**PHYSICAL DATA:**




NSI/SOLID ROCKET MOTOR IGNITER INITIATOR

**CONTRACTOR:** Thiokoi

**SUBCONTRACTOR:** Hi-Shear Corporation and UPCO

**DEVICE IDENTIFICATION NUMBER:**
NSI: JSC/SEB26100001-XXX.
SII: JSC/SED26100107-301.

**PURPOSE:**
To be the standard electroexplosive device for the Space Shuttle. NSIs are used to initiate pyrotechnic trains in Safe and Arm S&A devices, Confined Detonating Fuse (CDF) manifolds, CDF assemblies, booster cartridges, pressure cartridges, and NSDs.

This document is an information source only and should not be used for design purposes.

# NASA/DOD/DOE Pyrotechnic Device

**PREVIOUS USAGE:**
Apollo, Skylab, Apollo-Soyuz

**OPERATIONAL DESCRIPTION:**
The NSI is initiated by the pyrotechnic initiator controller (PIC). The PIC capacitors are discharged into the NSI bridgewires, initiating the initiation charge. The initiation charge ignites the next stage of the pyrotechnic train.

**ENERGY SOURCE:**
**TYPE OF INITIATION:** Electrical
**CHARGE MATERIAL:**
Zirconium Potassium Perchlorate (ZrKCL04), 114 mg
**ELECTRICAL CHARACTERISTICS:**
n/a

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** Low -260° F
High +300° F
**PRESSURE:** 650 +/- 125 psi in a 10 cc closed bomb and 150 calories minimum

**DYNAMICS:**
**SHOCK:** n/a
**VIBRATION:** n/a

**QUALIFICATION:**
**DOCUMENTATION:** n/a
**SERVICE LIFE:**
**SHELF:** Temperature: 0° F to +105° F
Humidity: 0 to 95%
Storage Life: 10 years
**OPERATIONAL:** n/a

**ADDITIONAL REFERENCES:**
n/a

**ADDITIONAL COMMENTS:**
n/a

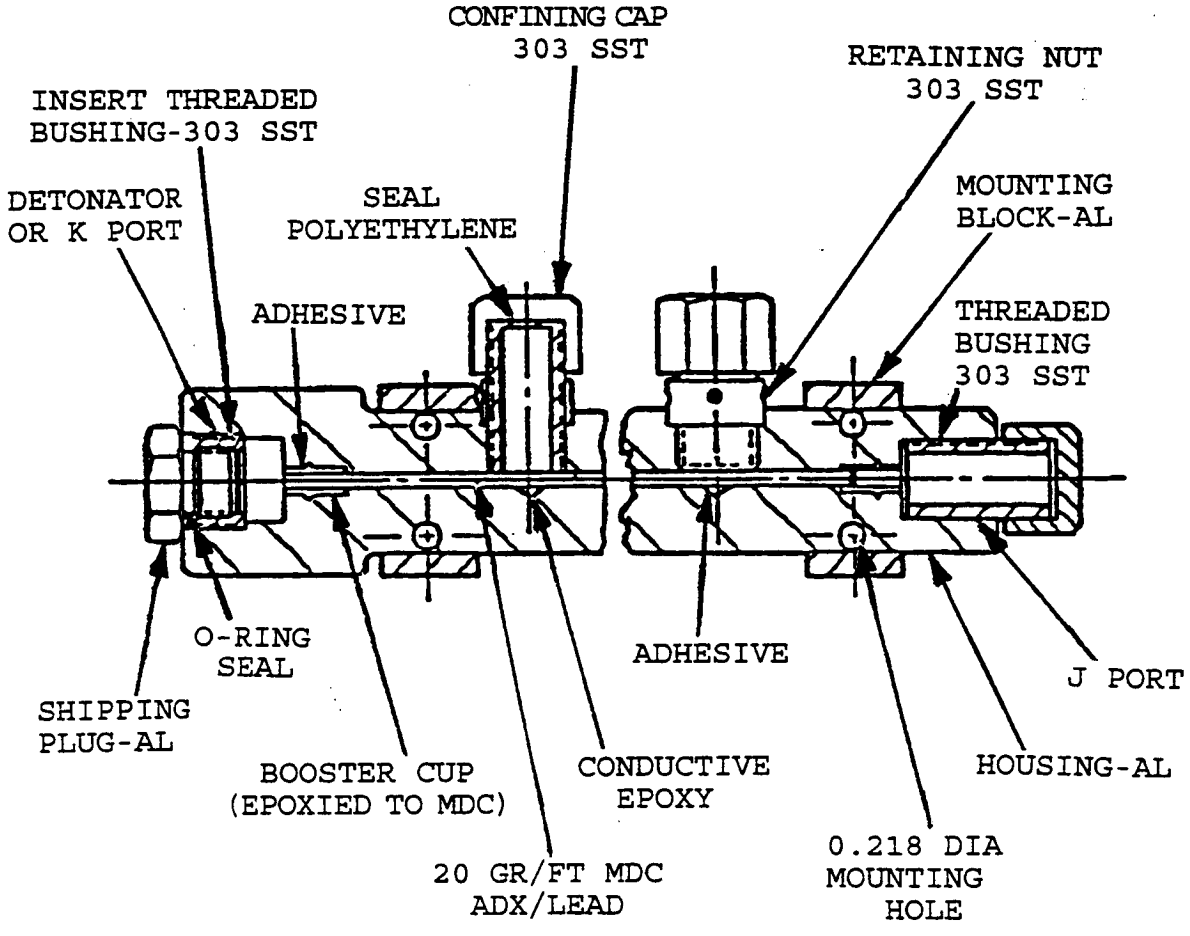
**SPECIAL FEATURES:**
n/a

# NASA/DOD/DOE Pyrotechnic Device

**TITLE:** Manifold - Confined Detonating Fuse (CDF)

**AGENCY/CENTER:** NASA/Marshall Space Flight Center (MSFC)

**PHYSICAL DATA:**




CONFINED DETONATING FUSE MANIFOLD

**CONTRACTOR:** USBI

**SUBCONTRACTOR:** Explosive Technology

**DEVICE IDENTIFICATION NUMBER:**
USBI PN ET: 10312-0002-803
SRB: 10312-0001-101 thru 10312-0001-108

**PURPOSE:**
To allow a NSD to initiate two to eight CDF assemblies.

# NASA/DOD/DOE Pyrotechnic Device

**PREVIOUS USAGE:**
Saturn and Delta vehicles

**OPERATIONAL DESCRIPTION:**
The CDF manifold assembly is comprised of the explosive train or booster subassembly and the housing subassembly. The explosive train is comprised of a mild detonating cord (MDC), RDX (20 gpf), with thin-wall (5 mil) guiding metal cups on the ends. The housing subassembly consists of rectangular aluminum mounting blocks secured to a drilled and ported cylinderical aluminum housing. A NASA standard initiator (NSI) initiates the explosive train in the CDF manifold. The CDF manifold initiates the booster charges in the CDF assembly which initiates the CDF assemblies.

**ENERGY SOURCE:**
**TYPE OF INITIATION:** NSD
**CHARGE MATERIAL:**
RDX, 20 gpf per MIL-R-398
Lead Sheath per WS15027
**ELECTRICAL CHARACTERISTICS:**
n/a

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** **Low** -150° F for 4 hours
**High** +250° F for 15 minutes after exposure to +
+195° F for 4 hours

**PRESSURE:** n/a

**DYNAMICS:**
**SHOCK:** n/a
**VIBRATION:** n/a

**QUALIFICATION:**
**DOCUMENTATION:** n/a
**SERVICE LIFE:**
**SHELF:** Temperature: +20° F to +105° F Humidity: 0 to 100 percent Storage Life: 4 years
**OPERATIONAL:** n/a

**ADDITIONAL REFERENCES:**
n/a

**ADDITIONAL COMMENTS:**
n/a

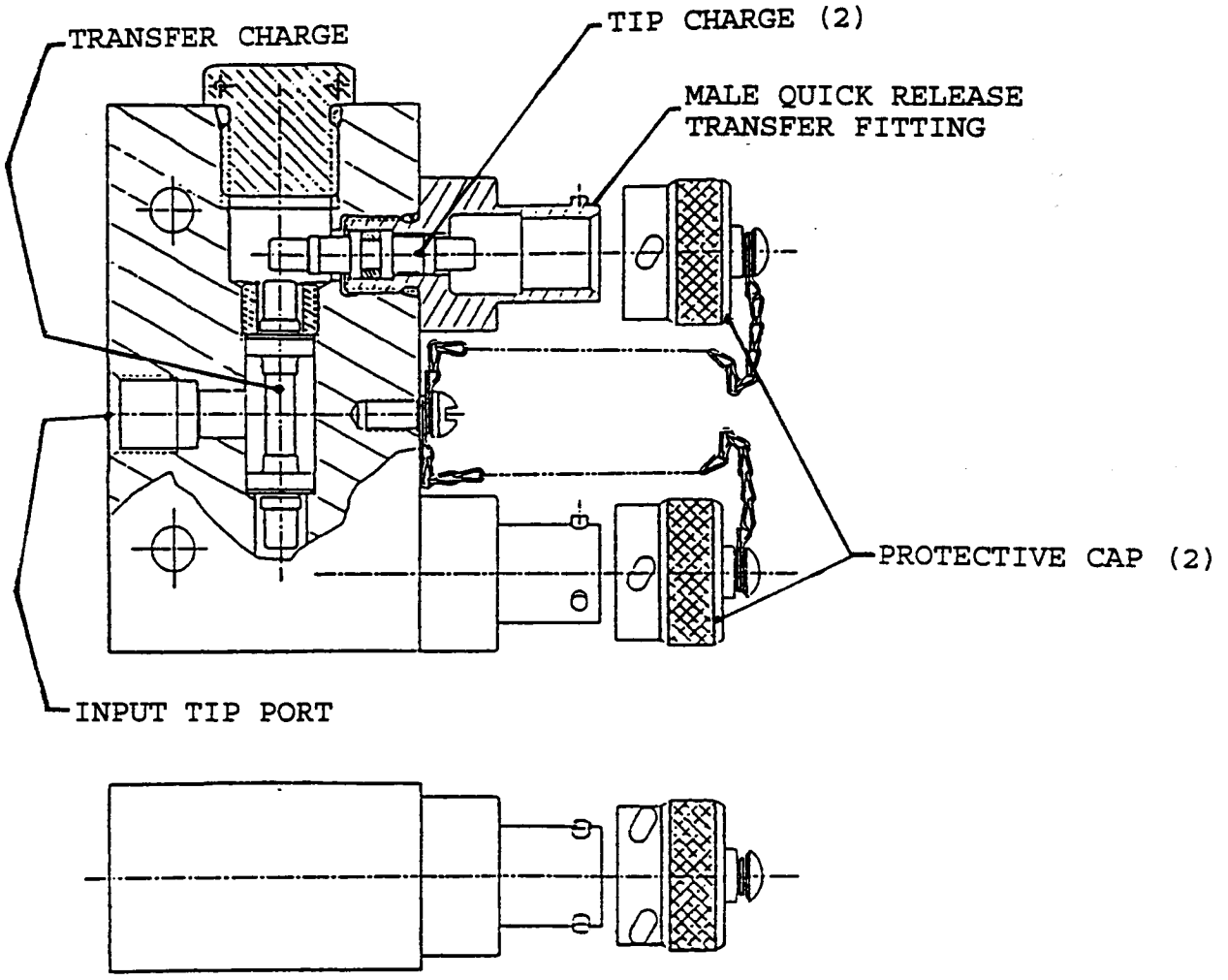
**SPECIAL FEATURES:**
n/a

## NASA/DOD/DOE Pyrotechnic Device

**TITLE:** Manifold - Transfer Line, Multiport

**AGENCY/CENTER:** NASA Langley Research Center (LaRC)

**PHYSICAL DATA:**




CROSS SECTION OF MANIFOLD

**CONTRACTOR:** Teledyne McCormick Selph

**SUBCONTRACTOR:** See Contractor above.

**DEVICE IDENTIFICATION NUMBER:**
n/a

**PURPOSE:**
Transfer an explosive initiation signal from a standard explosive input to two quick-release flexible transfer lines attached to one side of the manifold.

# NASA/DOD/DOE Pyrotechnic Device

**PREVIOUS USAGE:**
This is generally accepted technology with a number of aerospace applications.

**OPERATIONAL DESCRIPTION:**
The input initiates the transfer charge, which is a thin-walled, steel tube filled with explosive. This explosive, on detonating, initiates its own tip charges, which in turn initiate the two tip charges in the male quick disconnect fitting. The two output ports wre placed on the same side of the manifold for ease of access by the crew. In addition, these two fittings are oriented downward at a 45° angle, when mounted in the aircraft, to prevent contaminants, such as water, from entering the connector.

**ENERGY SOURCE:**
**TYPE OF INITIATION:** Explosive transfer
**CHARGE MATERIAL:**
n/a
**ELECTRICAL CHARACTERISTICS:**
n/a

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** **Low** n/a
**High** n/a
**PRESSURE:** n/a

**DYNAMICS:**
**SHOCK:** n/a
**VIBRATION:** n/a

**QUALIFICATION:**
**DOCUMENTATION:** Bement, Laurence J.; Jahsman, Dirk and Schimmel, Morry L. "Helicopter In-Flight Stores Jettison." Presented at the 1989 SAFE Symposium, Las Vegas, Nevada, December 4-8, 1989.

**SERVICE LIFE:**
**SHELF:** Unlimited
**OPERATIONAL:** 15 years

**ADDITIONAL REFERENCES:**
n/a

**ADDITIONAL COMMENTS:**
Design and development emphasis was placed on proving functional margins for all aspects of use and interfaces. Previously qualified design principles and hardware were employed to reduce the number of tests to demonstrate reliability and to eliminate the need for environmental qualification.

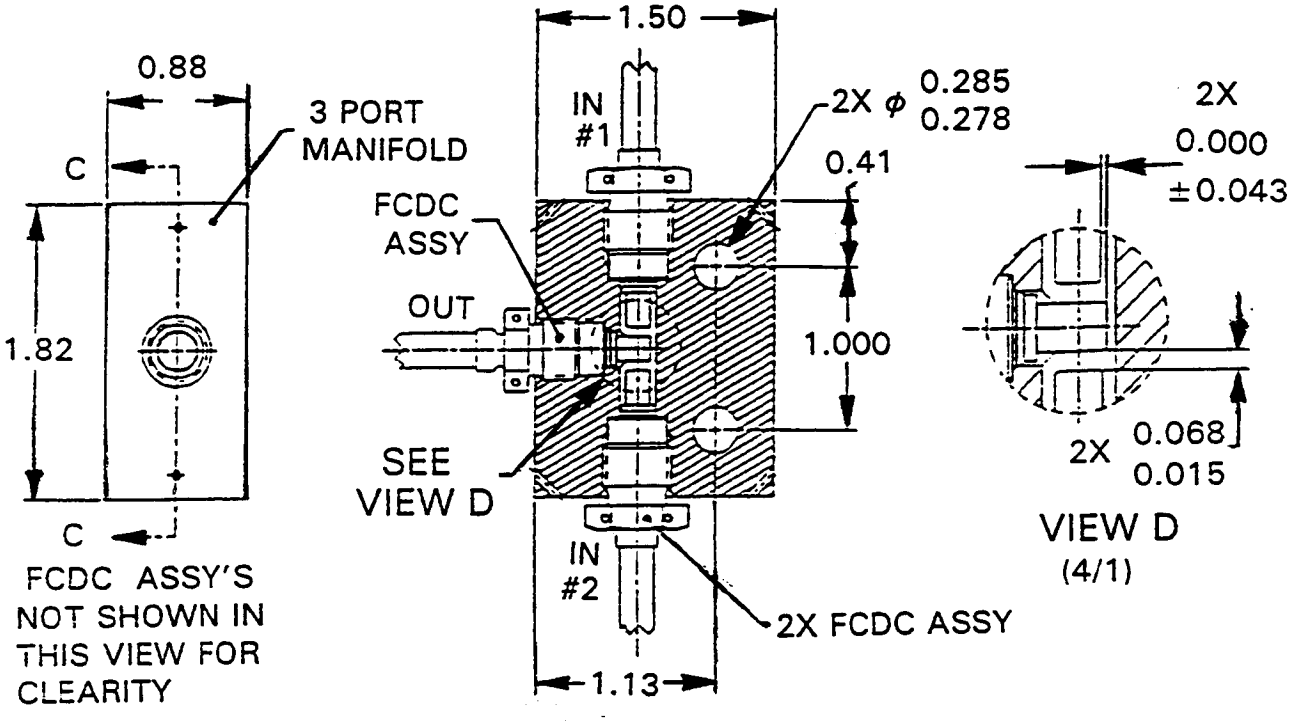
**SPECIAL FEATURES:**
These manifolds incorporate quick-release, fully contained connectors, comparable to electrical fittings.

# NASA/DOD/DOE Pyrotechnic Device

**TITLE:** Manifold - Two-In One-Out

**AGENCY/CENTER:** NASA/GSFC/Wallops Flight Facility (WFF)

**PHYSICAL DATA:**




VIEW C C

TWO-IN ONE-OUT MANIFOLD DEVICE

**CONTRACTOR:** EER Systems Corporation

**SUBCONTRACTOR:** Ensign Bickford Aerospace

**DEVICE IDENTIFICATION NUMBER:**
n/a

**PURPOSE:**
Provide a single FCDC output from either of two FCDC inputs.

# NASA/DOD/DOE Pyrotechnic Device

**PREVIOUS USAGE:**
Conestoga/COMET

**OPERATIONAL DESCRIPTION:**
Three FCDC lines are installed into the manifold. There is one output line leading to the destruct charge and two input lines with one coming from the ISDS and the other from the command destruct system. Upon initiation of either of the input lines, the output line will be initiated and in turn will initiate the vehicle destruct charge.

**ENERGY SOURCE:**
**TYPE OF INITIATION:** n/a
**CHARGE MATERIAL:**
n/a
**ELECTRICAL CHARACTERISTICS:**
n/a

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** **Low** n/a
**High** n/a
**PRESSURE:** n/a

**DYNAMICS:**
**SHOCK:** n/a
**VIBRATION:** n/a

**QUALIFICATION:**
**DOCUMENTATION:** Qualified for the Conestoga/COMET program. Similar manifolds (one-in-two-out) have been qualified on Atlas/Centaur, and Titan IV.
**SERVICE LIFE:**
**SHELF:** n/a
**OPERATIONAL:** n/a

**ADDITIONAL REFERENCES:**
n/a

**ADDITIONAL COMMENTS:**
Inert Device

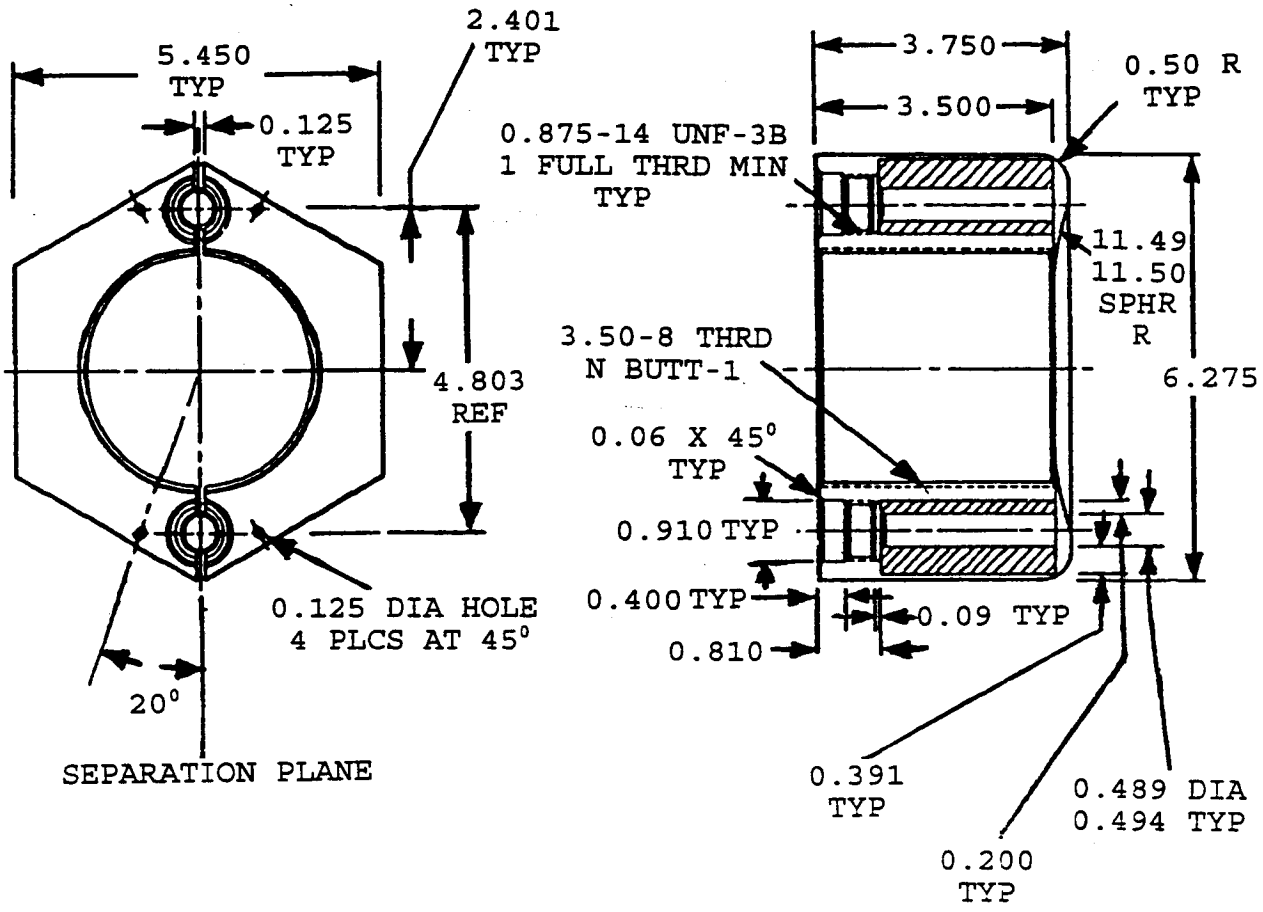
**SPECIAL FEATURES:**
n/a

# NASA/DOD/DOE Pyrotechnic Device

**TITLE:** Nut - Frangible

**AGENCY/CENTER:** NASA/Marshall Space Flight Center (MSFC)

**PHYSICAL DATA:**




FRANGIBLE NUT

**CONTRACTOR:** USBI

**SUBCONTRACTOR:** UPCO

**DEVICE IDENTIFICATION NUMBER:**
USBI PN 10306-0001-801 OR
10306-0001-802

**PURPOSE:**
To separate at a predetermined separation plane and release the Solid Rocket Booster/Mobile Launch Platform (SRB/MLP) holddown stud for launch.

# NASA/DOD/DOE Pyrotechnic Device

**PREVIOUS USAGE:**
n/a

**OPERATIONAL DESCRIPTION:**
The frangible nut is an inert, high strength nut installed on the SRB side of the SRB/MLP holddown release. Two frangible nut booster cartridge assemblies are used in each nut. The frangible nut will separate along a predetermined separation plane when either one or both assemblies are initiated. Separation of the nut provides for the release of the SRB/MLP holddown stud.

**ENERGY SOURCE:**
**TYPE OF INITIATION:** NSD/Frangible Nut Booster Cartridge Assembly
**CHARGE MATERIAL:**
n/a
**ELECTRICAL CHARACTERISTICS:**
n/a

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** Low +20° F
High +150° F
**PRESSURE:** n/a

**DYNAMICS:**
**SHOCK:** n/a
**VIBRATION:** n/a

**QUALIFICATION:**
**DOCUMENTATION:** n/a
**SERVICE LIFE:**
**SHELF:** Temperature: -65° for 6 hours; -40° F to +150° F and +170° F for 1 hour
Humidity: 0 to 100 percent
Storage Life: Indefinite
**OPERATIONAL:** n/a

**ADDITIONAL REFERENCES:**
n/a

**ADDITIONAL COMMENTS:**
n/a

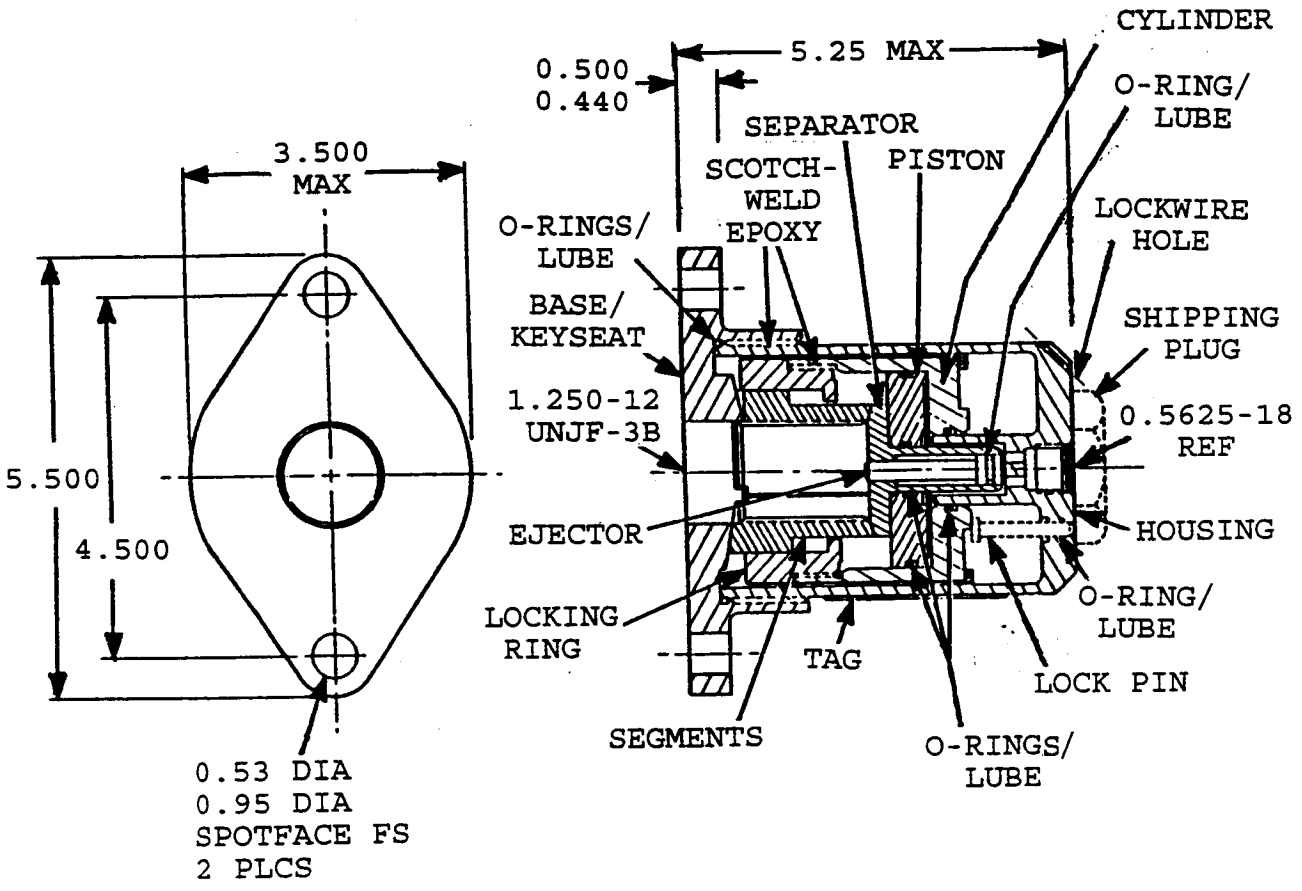
**SPECIAL FEATURES:**
n/a

# NASA/DOD/DOE Pyrotechnic Device

**TITLE:** Nut - Parachute Release

**AGENCY/CENTER:** NASA/Marshall Space Flight Center (MSFC)

**PHYSICAL DATA:**




PARACHUTE RELEASE NUT

**CONTRACTOR:** USBI

**SUBCONTRACTOR:** Hi-Shear Corporation

**DEVICE IDENTIFICATION NUMBER:**
USBI PN 10309-0011-801

**PURPOSE:**
To release the main parachute attach bolt and eject the bolt from the parachute release nut.

# NASA/DOD/DOE Pyrotechnic Device

**PREVIOUS USAGE:**
n/a

**OPERATIONAL DESCRIPTION:**
The parachute release nut is operated by the pressure output of the CDF pressure cartridge. The pressure output moves the cylinder assembly and locking ring backwards and allows the separator to radially open the segments. The main chute attach bolt is then released and then ejected from the parachute release nut by the ejector.

**ENERGY SOURCE:**
**TYPE OF INITIATION:** CDF Pressure Cartridge
**CHARGE MATERIAL:**
n/a
**ELECTRICAL CHARACTERISTICS:**
n/a

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** **Low** +20° F
**High** +200° F for 4 hours
**PRESSURE:** Strength: Will hold a 1.25 - 12 UNJ -3A bolt under a limit static tension load of 170,000 pounds applied along the longitudinal axis of the bolt.

**DYNAMICS:**
**SHOCK:** n/a
**VIBRATION:** n/a

**QUALIFICATION:**
**DOCUMENTATION:** n/a
**SERVICE LIFE:**
**SHELF:** Temperature: +25° F to +105° F
Humidity: 0 to 100 percent
Storage Life: 10 years
**OPERATIONAL:** n/a

**ADDITIONAL REFERENCES:**
n/a

**ADDITIONAL COMMENTS:**
n/a

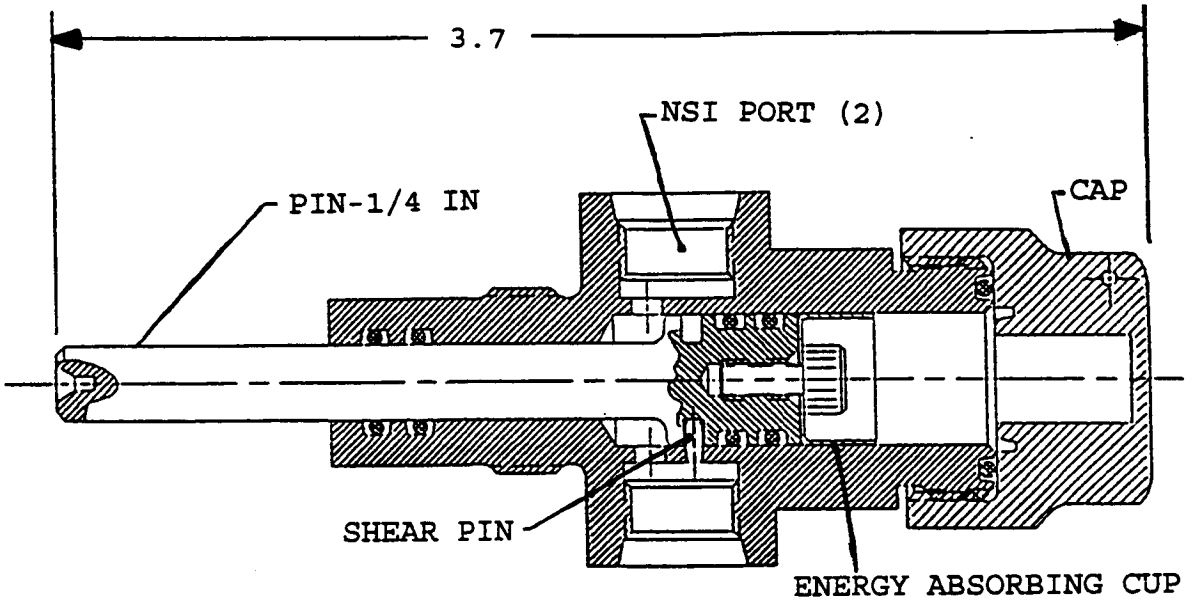
**SPECIAL FEATURES:**
n/a

# NASA/DOD/DOE Pyrotechnic Device

**TITLE:** Pin Puller - Halogen Occultation Experiment (HALOE)

**AGENCY/CENTER:** NASA Langley Research Center (LaRC)

**PHYSICAL DATA:**




CROSS SECTIONAL VIEW OF STEEL-BODIED HALOE PIN PULLER

**CONTRACTOR:** Manufactured in-house, based on drawings from Space Ordnance Systems (SOS, now UPCO)

**SUBCONTRACTOR:** n/a

**DEVICE IDENTIFICATION NUMBER:**
n/a

**PURPOSE:**
Release telescope mounting gimbals following release from the Shuttle in orbit. The HALOE is an experiment on the Upper Atmospheric Research Satellite (UARS).

**PREVIOUS USAGE:**
This pin puller, made from 6061-T651 aluminum, was qualified for the Viking Program. This pin puller released a high-gain antenna on the surface of Mars. A failed attempt was made by the Magellan Program (radar mapping of Venus) to use this pin puller to release solar panels.

**OPERATIONAL DESCRIPTION:**
The pin/piston was driven from left to right, failing the 80-pound static strength shear pin, with the output of a NASA Standard Initiator (NSI). The singly fired NSI outputs were directed into blind ports, which had a 0.1-inch diameter vent to the back side of the piston. The A 0.25-inch tall energy-absorbing steel cup removed the excess energy from the pin/piston at the end of the stroke.

This document is an information source only and should not be used for design purposes.

# NASA/DOD/DOE Pyrotechnic Device

**ENERGY SOURCE:**
**TYPE OF INITIATION:** NASA Standard Initiator (NSI)
**CHARGE MATERIAL:**
n/a
**ELECTRICAL CHARACTERISTICS:**
n/a

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** Low -65°F
High +160°F
**PRESSURE:** n/a

**DYNAMICS:**
**SHOCK:** 300 g's in half-sine wave for 3 msec, 3 axes
**VIBRATION:** 18 grms, 3 axes, 3 min each

**QUALIFICATION:**
**DOCUMENTATION:** Bement, Laurence J. and Schimmel, Morry L.: "Determination of Pyrotechnic Functional Margin" Presented at the 21st Annual SAFE Symposium, November 11-13, 1991 in Las Vegas, Nevada.
**SERVICE LIFE:**
**SHELF:** 20 years
**OPERATIONAL:** 15 years

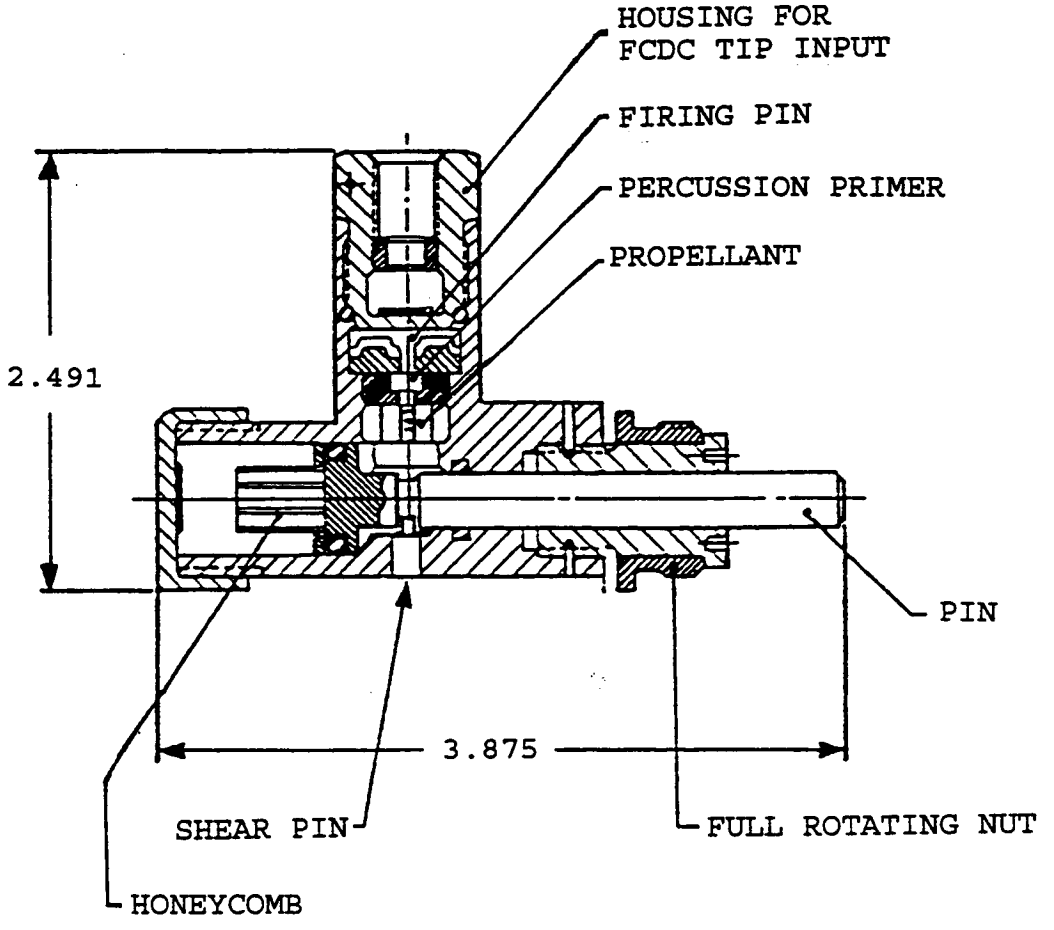
**ADDITIONAL REFERENCES:**
n/a
**ADDITIONAL COMMENTS:**
Following the failure of this pin puller design, manufactured by SOS for the Magellan Program, a failure investigation was initiated at NASA LaRC. It was found: 1) residual Viking units exhibited a marginal performance; the pin/piston had not stroked to the limit of its stroke; 2) the Viking Standard Initiator (VSI, virtually identical to the NSI) and two lots of NSI cartridges produced markedly different performances; 3) considerable blowby was occurring past all o-ring seals; o-ring seals were prevented from sealing by the chemical chromate coating wiping off from the piston bore onto the o-rings, and the molybdenum disulfide coating on the pin wiping off and piling up in front of the o-ring; and 4) friction, particularly with poor lubrication, consumed a great deal of energy in stroking. The pin puller was redesigned, using a steel body and a nickel/Teflon dry-lubricant coating on the pin. Functional margins were demonstrated on this pin puller by comparing the energy required to stroke and lock to the energy deliverable by the NSI. "Energy required" was determined by dropping a small mass on the vertically oriented pin; the drop height was increase until the pin reached its full stroke. The drop tests were continued at increasing drop heights to calibrate the crush characteristics of the energy absorbing cup. "Energy deliverable" was determined by disassembling the pin pullers after each firing, measuring the cup crush, and relating to the previous calibration. The "energy deliverable" by the NSI lot selected for flight was more than 6 times the "energy required" to accomplish the function with the pin puller assembled into the gimbal interface.
**SPECIAL FEATURES:**
n/a

## NASA/DOD/DOE Pyrotechnic Device

**TITLE:** Pin Puller - RSRA Cyclic Stick Release

**AGENCY/CENTER:** NASA Langley Research Center (LaRC)

**PHYSICAL DATA:**




PIN PULLER FOR CYCLIC STICK AND CONTROL ROD RELEASE

**CONTRACTOR:** Sikorsky Aircraft

**SUBCONTRACTOR:** Teledyne McCormick Selph

**DEVICE IDENTIFICATION NUMBER:**
n/a

**PURPOSE:**
Withdrawal of the pin released the cyclic sticks to prevent harm to crewmembers during extraction.

This document is an information source only and should not be used for design purposes.

# NASA/DOD/DOE Pyrotechnic Device

**PREVIOUS USAGE:**
n/a

**OPERATIONAL DESCRIPTION:**
An explosive transfer line input deflects a metal sealing diaphragm to drive the diring pin into the percussion primer to initiate the propellant. The piston is driven to the left, impacting (in stopping) against the housing, absorbing the excess energy in the crushing of the aluminum honeycomb. The full-rotating nut facilitated installation of the pin puller at any angle on the axis of the pin.

**ENERGY SOURCE:**
**TYPE OF INITIATION:** Explosive transfer line
**CHARGE MATERIAL:**
n/a
**ELECTRICAL CHARACTERISTICS:**
n/a

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** Low −25°F
High +200°F
**PRESSURE:** n/a

**DYNAMICS:**
**SHOCK:** n/a
**VIBRATION:** n/a

**QUALIFICATION:**
**DOCUMENTATION:** Bement, Laurence J.: "Helicopter (RSRA) In-Flight Escape System Component Qualification" Presented at the Tenth Symposium on Explosives and Pyrotechnics, San Francisco, CA, February 14-16, 1979.
**SERVICE LIFE:**
**SHELF:** 7 years
**OPERATIONAL:** 5 years

**ADDITIONAL REFERENCES:**
n/a

**ADDITIONAL COMMENTS:**
The approach for qualification of this system was to minimize the quantity of device and system-level testing through an emphasis on functional margin demonstrations during development.

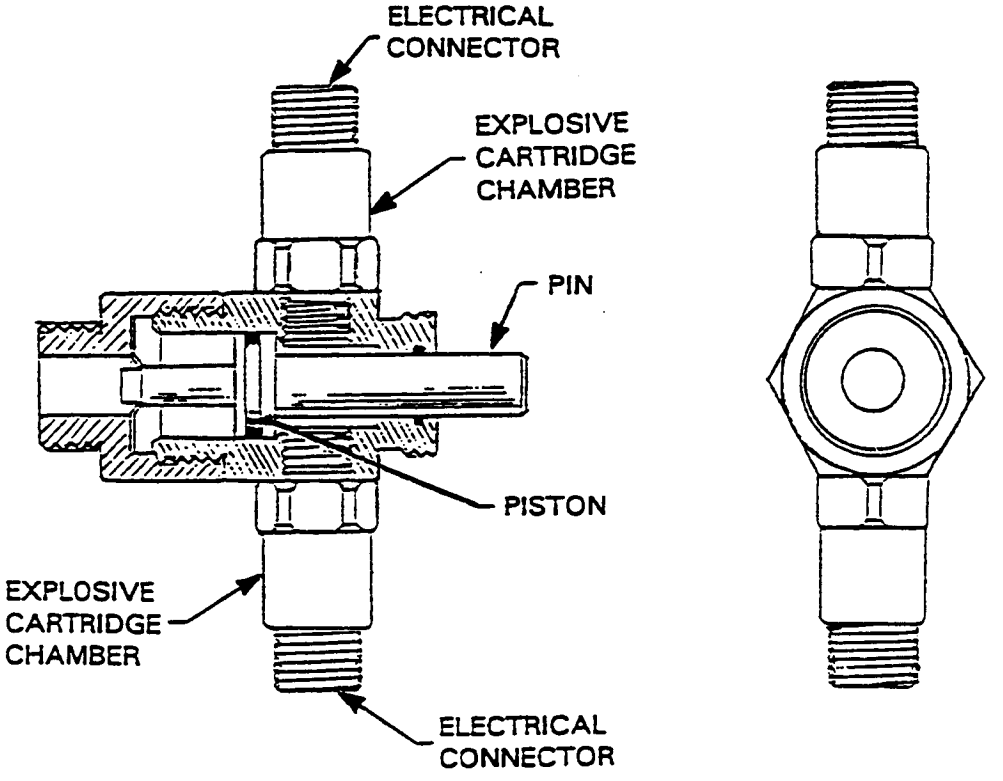
**SPECIAL FEATURES:**
n/a

# NASA/DOD/DOE Pyrotechnic Device

**TITLE:** Pin Puller - Vent Door Latch

**AGENCY/CENTER:** NASA Lewis Research Center (LeRC)

**PHYSICAL DATA:**




LATCH PIN PULLER

**CONTRACTOR:** General Dynamics Space Systems Division (GDSSD)

**SUBCONTRACTOR:** Conax Corporation

**DEVICE IDENTIFICATION NUMBER:**
Contractor Spec. 55-71320

**PURPOSE:**
To extract a pin that holds a spring loaded vent door shut and thus allow door to open and venting to occur.

# NASA/DOD/DOE Pyrotechnic Device

**PREVIOUS USAGE:**
Expendable Launch Vehicles:
Atlas Centaur Vehicles through AC-68
Titan Centaur Vehicles through AC-7

**OPERATIONAL DESCRIPTION:**
The pin puller is actuated just before vehicle liftoff by electrical power to the explosive cartridges (2 used redundantly - 1 is sufficient). Bridgewire heating activates charge in cartridge with resulting gas pressure moving piston and extracting latch pin.

**ENERGY SOURCE:**
**TYPE OF INITIATION:** Explosive cartridge with electric bridgeware.
**CHARGE MATERIAL:**
Properiety mix
**ELECTRICAL CHARACTERISTICS:**
Normal 28 VDC, 5 amps (1 amp - 1 watt no fire)

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** Low -320 °F
High +200 °F
**PRESSURE:** n/a

**DYNAMICS:**
**SHOCK:** n/a
**VIBRATION:** n/a

**QUALIFICATION:**
**DOCUMENTATION:** Per above spec.
**SERVICE LIFE:**
**SHELF:** n/a
**OPERATIONAL:** n/a

**ADDITIONAL REFERENCES:**
n/a

**ADDITIONAL COMMENTS:**
n/a

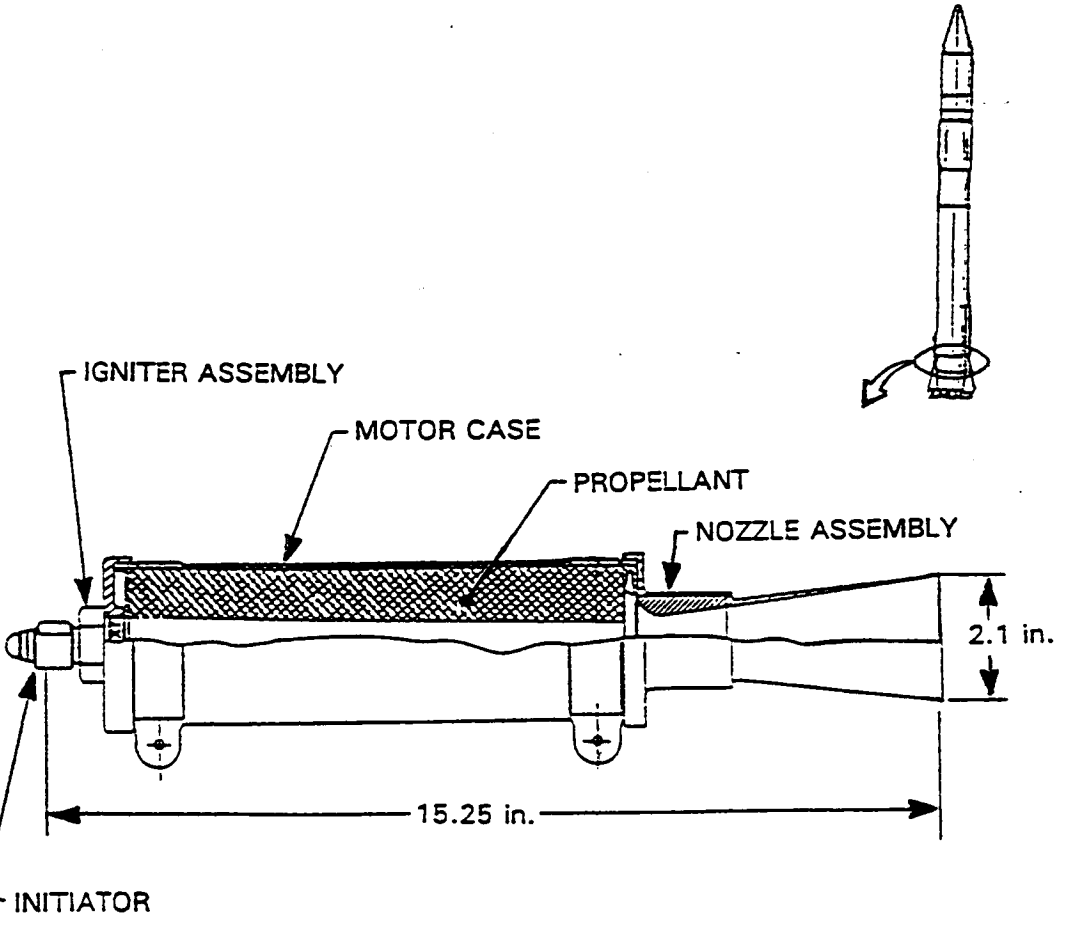
**SPECIAL FEATURES:**
n/a

## NASA/DOD/DOE Pyrotechnic Device

**TITLE:** Retro-Rocket - Retarding

**AGENCY/CENTER:** NASA Lewis Research Center (LeRC)

**PHYSICAL DATA:**




RETRO-ROCKET (RETARDING)

**CONTRACTOR:** General Dynamics Space Systems Division (GDSSD)

**SUBCONTRACTOR:** Rocket Power, Inc.

**DEVICE IDENTIFICATION NUMBER:**
Contractor Spec. 27-04300, 27-04219

**PURPOSE:**
To provide energy for decelerating the Atlas stage following separation of the expended Atlas from the Centaur stage and thus attain adequate clearance between the two stages of the vehicle prior to Centaur engine ignition.

# NASA/DOD/DOE Pyrotechnic Device

**PREVIOUS USAGE:**
Expendable Launch Vehicles: Atlas Centaur Vehicles through AC-68

**OPERATIONAL DESCRIPTION:**
Following severence of the Atlas sustainer section from the upper stage Centaur, electrical power is issued to the bridgewire of the initiator mounted in the retro-rocket. The resulting thermal energy activates the iniator charge which in turn activates the igniter assembly in the rocket. Igniter burning then fires the main propellant of the rocket to provide a decelerating force for positive separation and full clearance of Atlas from Centuar.

**ENERGY SOURCE:**
**TYPE OF INITIATION:** Electric bridgewire initiator
**CHARGE MATERIAL:**
PAP-8
**ELECTRICAL CHARACTERISTICS:**
Normal 28 VDC, 5 amps. (1 amp - 1 wat no fire)

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** **Low** -65 degrees F
**High** +160 degrees F
**PRESSURE:** n/a

**DYNAMICS:**
**SHOCK:** n/a
**VIBRATION:** n/a

**QUALIFICATION:**
**DOCUMENTATION:** Per above spec.
**SERVICE LIFE:**
**SHELF:** n/a
**OPERATIONAL:** n/a

**ADDITIONAL REFERENCES:**
n/a

**ADDITIONAL COMMENTS:**
n/a

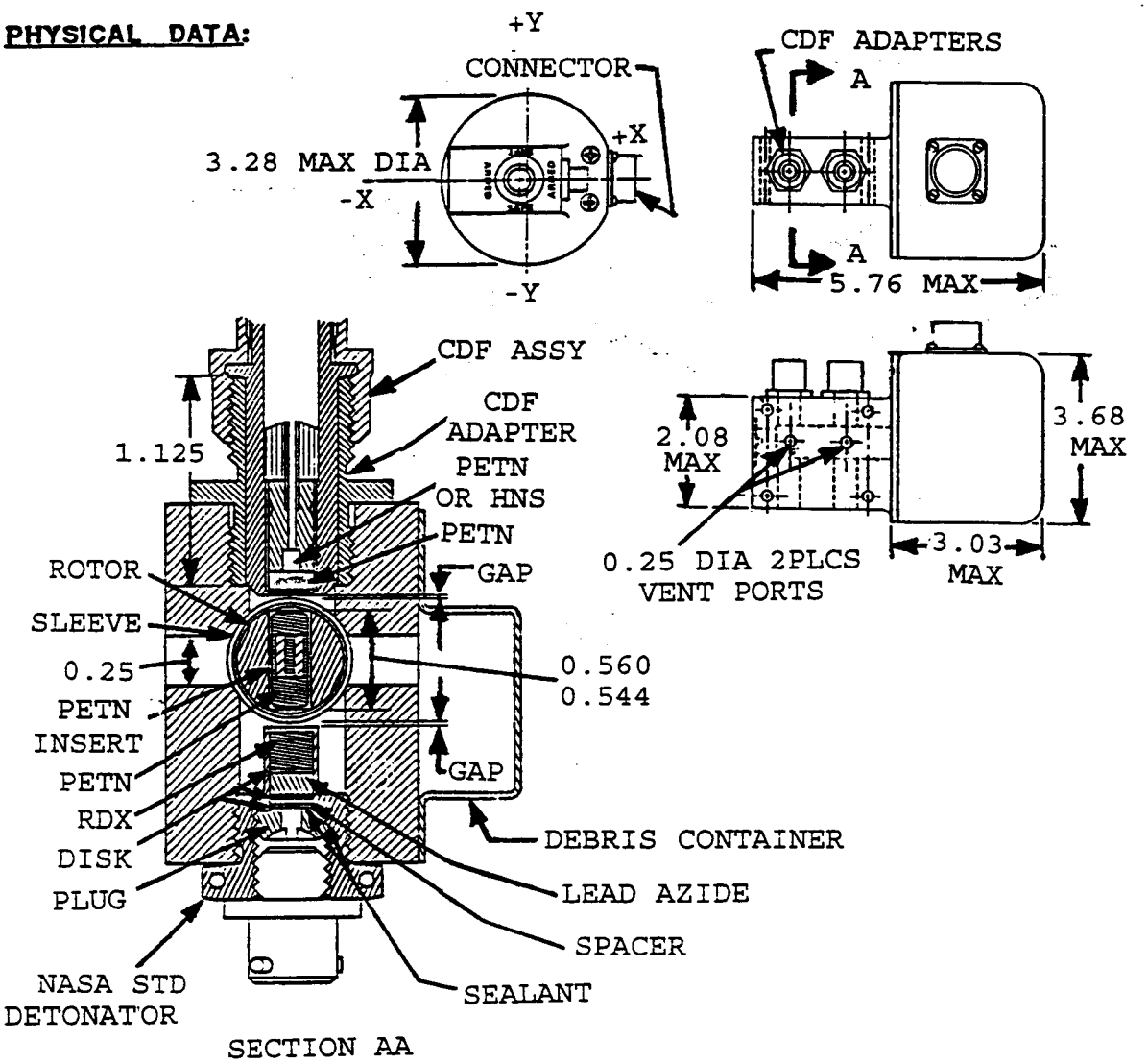
**SPECIAL FEATURES:**
n/a

# NASA/DOD/DOE Pyrotechnic Device

**TITLE:** Safe & Arm - Range Safety Ordnance

**AGENCY/CENTER:** NASA/Marshall Space Flight Center (MSFC)

**PHYSICAL DATA:**




SECTION AA

RANGE SAFETY ORDNANCE SAFE AND ARM DEVICE

**CONTRACTOR:** USBI

**SUBCONTRACTOR:** Teledyne McCormick-Selph

**DEVICE IDENTIFICATION NUMBER:**
USBI PN 10311-0001-801

**PURPOSE:**
The range safety S&A device is a remotely controlled electro-mechanical ordnance device that is used to "safe" and to "arm" the Solid Rocket Booster (SRB) and External Tank (ET) destruct systems. The device can complete or interrupt the explosive train

by remote control, provide position indications to remote monitoring equipment, provide a visual position indication, and provide a manual operation capability.

**PREVIOUS USAGE:**
n/a

**OPERATIONAL DESCRIPTION:**
The S&A device consists of a Ledex 95 degrees rotary solenoid assembly, a metal rotor shaft with two PETN explosive inserts, and position sensing and command switches that operate from the rotor shaft cam. On electrical command from the ground system just prior to automated countdown, the solenoid assembly rotates the shaft, containing the two explosive inserts, 90°. This aligns the inserts between the NSDs and the CDF assemblies to complete the explosive train.

**ENERGY SOURCE:**
**TYPE OF INITIATION:** NSD
**CHARGE MATERIAL:**
Mild Detonating Cord: Explosive Core: PETN Class 2 per MIL-P-387
Sheath: 0.999 pure aluminum
Explosive: 124 mg PETN Class 2 per MIL-P-387
**ELECTRICAL CHARACTERISTICS:**
n/a

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** Low +20° F
High +165° F for 4 hours
**PRESSURE:** n/a

**DYNAMICS:**
**SHOCK:** n/a
**VIBRATION:** n/a

**QUALIFICATION:**
**DOCUMENTATION:** n/a
**SERVICE LIFE:**
**SHELF:** Temperature: -65° F to 140° F for 8 hours, +25° F to +105° F for 10 years
Humidity: 0 to 100 percent
Storage Life: 4 years
**OPERATIONAL:** n/a

**ADDITIONAL REFERENCES:**
n/a

**ADDITIONAL COMMENTS:**
n/a

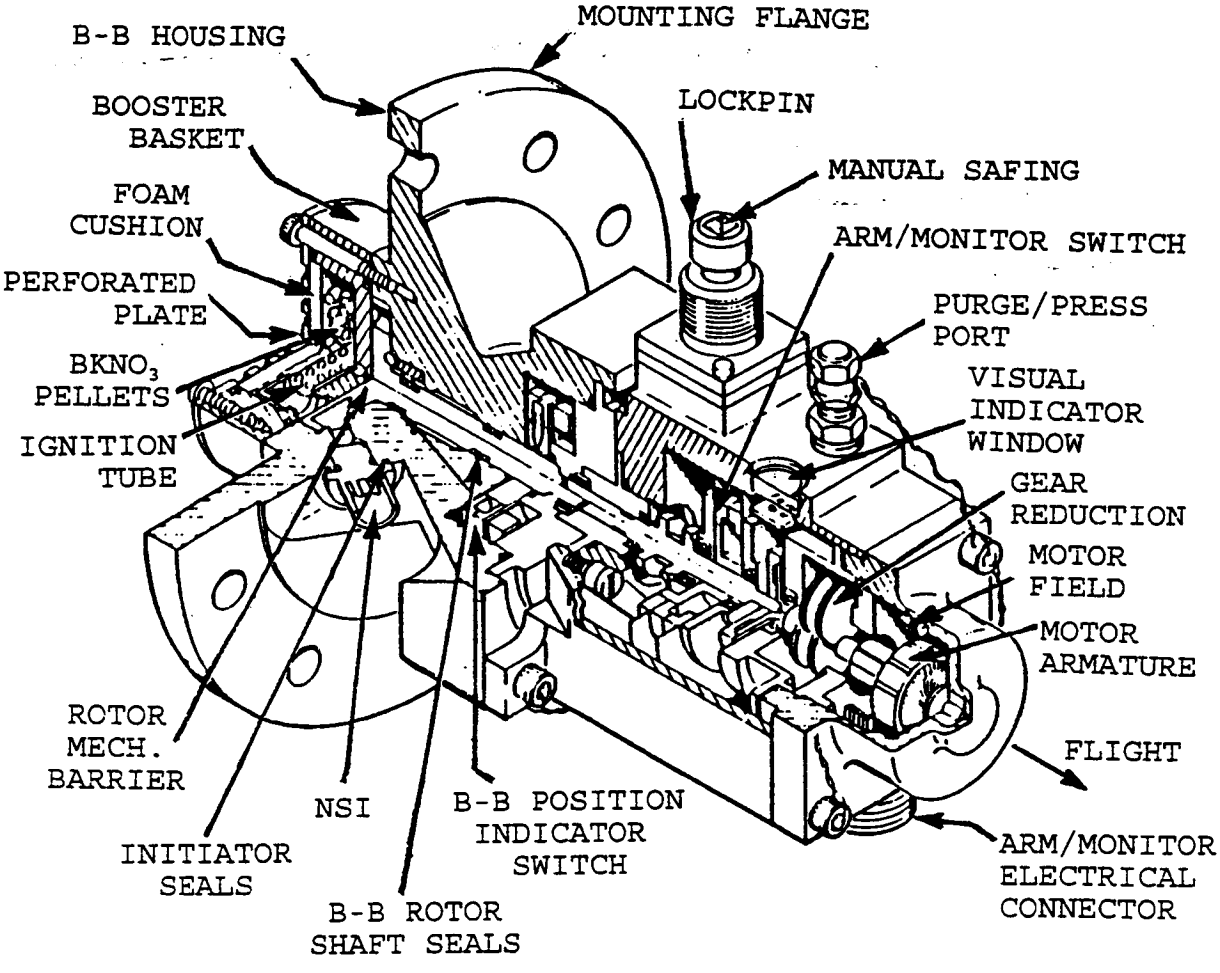
**SPECIAL FEATURES:**
n/a

## NASA/DOD/DOE Pyrotechnic Device

**TITLE:** Safe & Arm - Solid Rocket Motor Ignition

**AGENCY/CENTER:** NASA/Marshall Space Flight Center (MSFC)

**PHYSICAL DATA:**




SOLID ROCKET MOTOR IGNITION SAFE AND ARM

**CONTRACTOR:** Thiokol Corporation

**SUBCONTRACTOR:** Eaton Consolidated Controls Corporation

**DEVICE IDENTIFICATION NUMBER:**
Contractor: 1U52295-01

**PURPOSE:**
To ignite the SRM igniter

# NASA/DOD/DOE Pyrotechnic Device

**PREVIOUS USAGE:**
Minuteman

**OPERATIONAL DESCRIPTION:**
The SRM ignition S&A device is a two part electromechanical assembly. The actuation and monitoring (A&M) assembly is a reusable component and contains the elctric drive motor, switches, manual safing mechanism, lock pin, and visual indicator, all in a sealed enclosure. The booster-barrier (B-B) assembly contains the safety barrier, the electrical initiator ports, the booster charge, the S&A-to-igniter adapter attachment flange, the remote safe and arm indicator switches, and the pressure seal surface to maintain pyrogen and motor chamber pressure.

**ENERGY SOURCE:**
**TYPE OF INITIATION:** NSI
**CHARGE MATERIAL:**
Boron Potassium Nitrate (BKNO3) granules (1.4 grams) retained in a taped, perforated tube assembly. BKNO3 pellets (18 grams) installed in the output end of the booster housing assembly.
**ELECTRICAL CHARACTERISTICS:**
n/a

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** **Low** +20° F
**High** +120° F
**PRESSURE:** The B-B assembly redundant seals will withstand a minimum pressure of 3,640 psig.

**DYNAMICS:**
**SHOCK:** n/a
**VIBRATION:** n/a

**QUALIFICATION:**
**DOCUMENTATION:** n/a
**SERVICE LIFE:**
**SHELF:** Temperature: +15° F to +105° F
Humidity: 40% or below (BKNO3 only)
Stoage Life: 5 years
**OPERATIONAL:** n/a

**ADDITIONAL REFERENCES:**
n/a

**ADDITIONAL COMMENTS:**
n/a

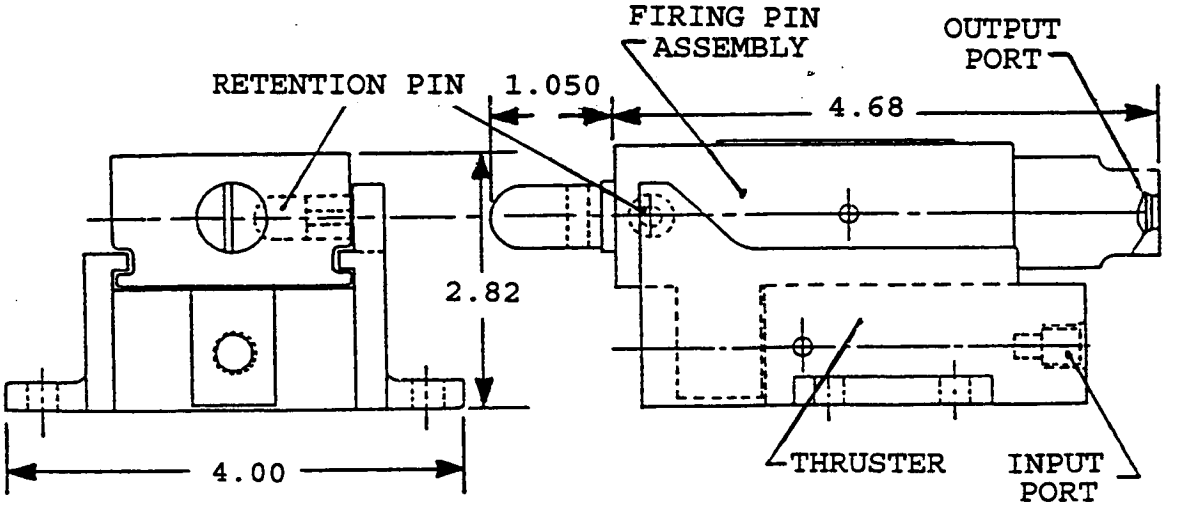
**SPECIAL FEATURES:**
n/a

# NASA/DOD/DOE Pyrotechnic Device

**TITLE:** Sequencer - RSRA Rotary Transfer Unit

**AGENCY/CENTER:** NASA Langley Research Center (LaRC)

**PHYSICAL DATA:**




SEQUENCER IN ROTARY TRANSFER UNIT

**CONTRACTOR:** Sikorsky Aircraft

**SUBCONTRACTOR:** Teledyne McCormick Selph

**DEVICE IDENTIFICATION NUMBER:**
n/a

**PURPOSE:**
Thrust a firing pin assembly into an interference path with fixed cams on the RSRA rotary transfer unit, and provide an explosive output to initiate an explosive transfer line.

# NASA/DOD/DOE Pyrotechnic Device

**PREVIOUS USAGE:**
n/a

**OPERATIONAL DESCRIPTION:**
This assembly combines the previously described RSRA thruster and firing pin assembly.

**ENERGY SOURCE:**
**TYPE OF INITIATION:** Explosive transfer line
**CHARGE MATERIAL:**
n/a
**ELECTRICAL CHARACTERISTICS:**
n/a

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** **Low** −25°F
**High** +200°F
**PRESSURE:** n/a

**DYNAMICS:**
**SHOCK:** } Helicopter environment
**VIBRATION:** }

**QUALIFICATION:**
**DOCUMENTATION:** Bement, Laurence J.: "Helicopter (RSRA) In-Flight Escape System Component Qualification" Presented at the Tenth Symposium on Explosives and Pyrotechnics, San Francisco, CA, February 14-16, 1979.

**SERVICE LIFE:**
**SHELF:** 7 years
**OPERATIONAL:** 5 years

**ADDITIONAL REFERENCES:**
n/a

**ADDITIONAL COMMENTS:**
The approach for qualification of this system was to minimize the quantity of device and system-level testing through an emphasis on functional margin demonstrations during development.

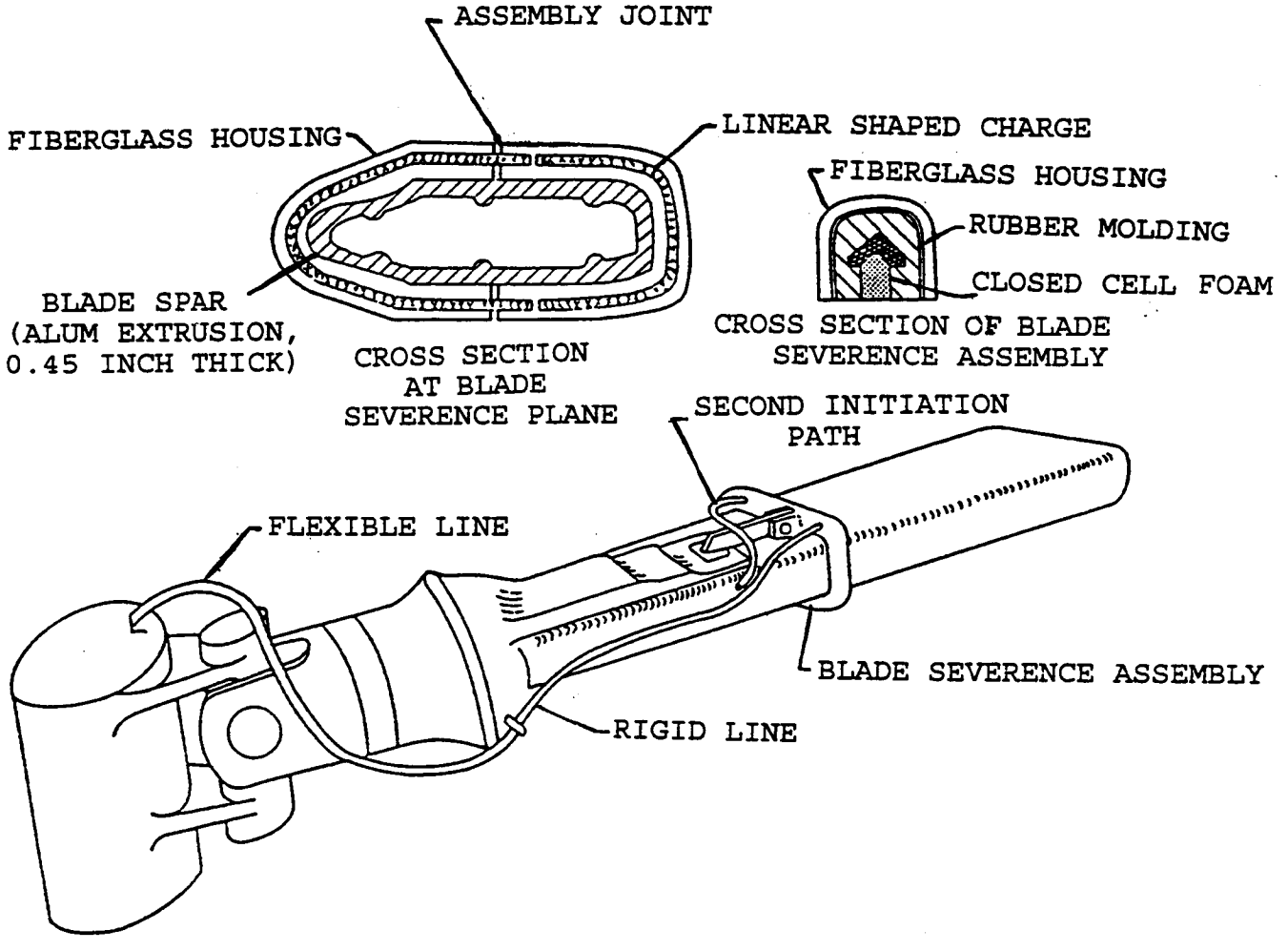
**SPECIAL FEATURES:**
n/a

# NASA/DOD/DOE Pyrotechnic Device

**TITLE:** Severence Assembly - RSRA Blade

**AGENCY/CENTER:** NASA Langley Research Center (LaRC)

**PHYSICAL DATA:**




BLADE SEVERENCE ASSEMBLY (BSA)

**CONTRACTOR:** Sikorsky Aircraft

**SUBCONTRACTOR:** Teledyne McCormick Selph

**DEVICE IDENTIFICATION NUMBER:**
n/a

**PURPOSE:**
Explosively sever the RSRA rotor blades

# NASA/DOD/DOE Pyrotechnic Device

**PREVIOUS USAGE:**
None

**OPERATIONAL DESCRIPTION:**
The tough (6061-T3 aluminum) rotor spar was severed by a carefully shaped flexible linear shaped charge (FLSC). The FLSC, 125 grains/foot, lead-sheathed CH-6 (94% cyclotrimethylene trinitramine (RDX), 6% wax) was manufactured in two lengths to allow assembly and mounted in rubber molding within a fiberglass housing. This assembly was bonded to the rotor spar. The assembly was sealed and closed-cell foam was employed in the shaped charge cavity to prevent contamination and assure that the FLSC's severability was maintained. The FLSC was initiated directly by a standard explosive transfer line tip. To assure initiation reliability, the lead sheath was machined to a minimum thickness at the input point.

**ENERGY SOURCE:**
**TYPE OF INITIATION:** Explosive transfer lines
**CHARGE MATERIAL:**
n/a
**ELECTRICAL CHARACTERISTICS:**
n/a

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** Low -25°F
High +200°F
**PRESSURE:** n/a

**DYNAMICS:**
**SHOCK:** } Helicopter environment
**VIBRATION:** }

**QUALIFICATION:**
**DOCUMENTATION:** Bement, Laurence J.: "Helicopter (RSRA) In-Flight Escape System Component Qualification" Presented at the Tenth Symposium on Explosives and Pyrotechnics, San Francisco, CA, February 14-16, 1979.
**SERVICE LIFE:**
**SHELF:** 7 years
**OPERATIONAL:** 5 years

**ADDITIONAL REFERENCES:**
na/

**ADDITIONAL COMMENTS:**
The approach for qualification of this system was to minimize the quantity of device and system-level testing through an emphasis on functional margin demonstrations during development.

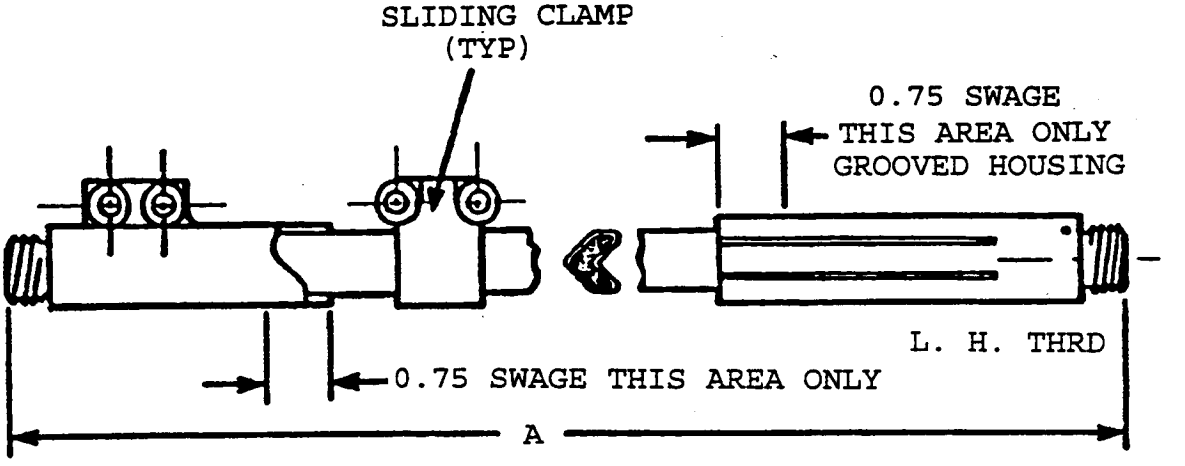
**SPECIAL FEATURES:**
n/a

## NASA/DOD/DOE Pyrotechnic Device

**TITLE:** Shaped Charge - External Tank Destruct

**AGENCY/CENTER:** NASA/Marshall Space Flight Center (MSFC)

**PHYSICAL DATA:**




SHAPED CHARGE ASSEMBLY (ET DESTRUCT)

**CONTRACTOR:** Martin-Marietta Corporation

**SUBCONTRACTOR:** Teledyne McCormick-Selph

**DEVICE IDENTIFICATION NUMBER:**
Martin: LO2 LSC, PD 5000016-050; LH2 LSC, PD 5000016-059

**PURPOSE:**
To sever the ET barrel panel sections of the LO2 and LH2 tanks.

# NASA/DOD/DOE Pyrotechnic Device

**PREVIOUS USAGE:**
n/a

**OPERATIONAL DESCRIPTION:**
The LSC assembly will receive a detonation impulse from a CDF assembly and booster and function to sever the ET barrel panel sections of the LO2 and LH2 tanks. The LSC assembly consists of two LSC subassemblies (one LO2 LSC and one LH2 LSC).

**ENERGY SOURCE:**
**TYPE OF INITIATION:** CDF Assembly
**CHARGE MATERIAL:**
Explosive Core: 750 gpf HMX; Sheath Material: Copper per WW-T-775A
**ELECTRICAL CHARACTERISTICS:**
n/a

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** Low -319° F for 7.5 hours
High +350° F for 30 minutes
**PRESSURE:** see Additional Comments.

**DYNAMICS:**
**SHOCK:** n/a
**VIBRATION:** n/a

**QUALIFICATION:**
**DOCUMENTATION:** n/a
**SERVICE LIFE:**
**SHELF:** Temperature: -40° F to +160° F for 50 hours at each extreme
Humidity: 0 to 100 percent
Storage Life: 4 yrs
**OPERATIONAL:** n/a

**ADDITIONAL REFERENCES:**
n/a

**ADDITIONAL COMMENTS:**
Output: The detonation output of the LSC assembly shall be capable of severing a 0.125 inch, 2024-T8511 aluminum barrier plate (per QQ-A-250/30) and a 0.255 inch, 2219-T87 aluminum target plate per QQ-A-250/30. The barrier plate has insulation (15-19 lbs/ft3, 0.69 inch thick) directly under it, and the target plate has insulation (15-17 lbs/ft3, 0.23 inch thick) directly on top of it, with foam insulation (2.1-2.6 lbs/ft3, 1.00 inch thick) on top of the insulation. The standoff of the base of the LSC assembly from the barrier plate shall be 0.260 inch and from the target plate shall be 4.50 inch. The LSC assembly detonation shall cause complete severance of the target plate along a line corresponding to the entire length of each LSC segment of the assembly except for the areas covered by end fitings.

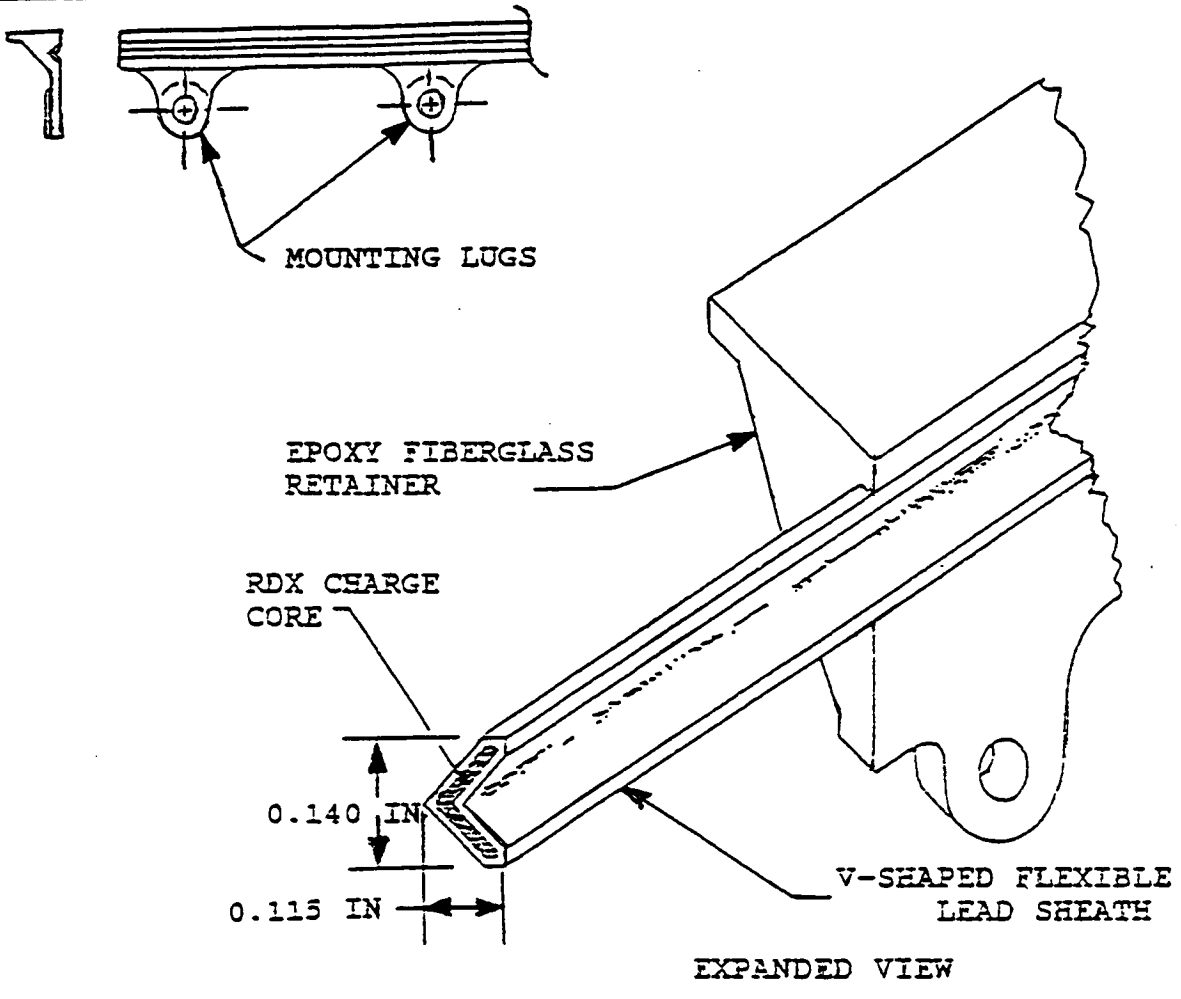
**SPECIAL FEATURES:**
n/a

# NASA/DOD/DOE Pyrotechnic Device

**TITLE:** Shaped Charge - Flexible Linear

**AGENCY/CENTER:** NASA Lewis Research Center (LeRC)

**PHYSICAL DATA:**




FLEXIBLE LINEAR SHAPED CHARGE (FLSC)
15 GR/FT SIZE SHOWN

**CONTRACTOR:** General Dynamics Space Systems Division (GDSSD)

**SUBCONTRACTOR:** Ensign Bickford Company (EBC)

**DEVICE IDENTIFICATION NUMBER:**
Contractor Spec. 55-00211

**PURPOSE:**
To separate one structure from another by use of pyrotechnic energy linearly severing the part by the blast cutting action of the high temperature explosive jet focused by the chevron shape of the charge.

# NASA/DOD/DOE Pyrotechnic Device

**PREVIOUS USAGE:**
Atlas Centaur Launch Vehicles through AC-68

**OPERATIONAL DESCRIPTION:**
The flexible linear shaped charge (FLSC) is chevron or inverted "V" shaped in section. Although activation causes outward force over 360 degrees, the cheveron shape concentrates a portion of the blast energy below the open end of the inverted "V". Over a length of FLSC, the focused energy becomes a linear high temperature jet for cutting action by melting/blasting through a structural attachment.

Activation of the FLSC is accomplished by use of an initiator(s) in conjunction with booster detonators and confined mild detonating fuse firing transfer lines as appropriate.

**ENERGY SOURCE:**
**TYPE OF INITIATION:** Requires an initiator and booster charges
**CHARGE MATERIAL:**
RDX
**ELECTRICAL CHARACTERISTICS:**
n/a

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** **Low** -300 °F
**High** +200 °F
**PRESSURE:** Cutting Depth (typical):
FLSC Size = 15 gr/ft
Temp. = -300 °F
Standoff = 0.025 in.
Cut Depth = 0.090 in. max.

**DYNAMICS:**
**SHOCK:** n/a
**VIBRATION:** n/a

**QUALIFICATION:**
**DOCUMENTATION:** n/a
**SERVICE LIFE:**
**SHELF:** No limitations.
**OPERATIONAL:** n/a

**ADDITIONAL REFERENCES:**
n/a

**ADDITIONAL COMMENTS:**
n/a

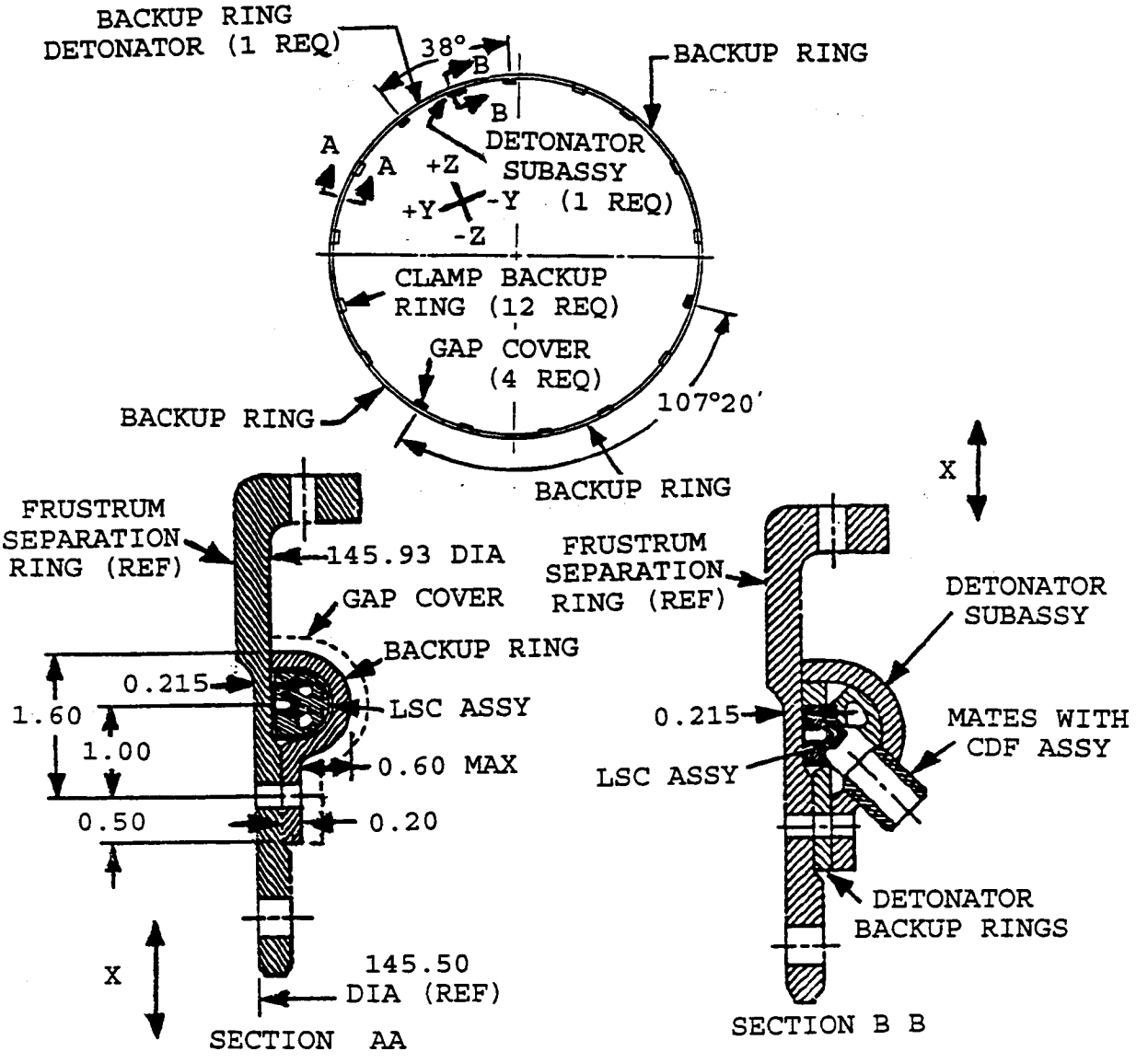
**SPECIAL FEATURES:**
n/a

## NASA/DOD/DOE Pyrotechnic Device

**TITLE:** Shaped Charge - Frustrum Separation Assembly

**AGENCY/CENTER:** NASA/Marshall Space Flight Center (MSFC)

**PHYSICAL DATA:**




FRUSTRUM SEPARATION ASSEMBLY

**CONTRACTOR:** USBI

**SUBCONTRACTOR:** Explosive Technology

**DEVICE IDENTIFICATION NUMBER:**
See Additional Comments item.

**PURPOSE:**
To sever the tension ring that holds the frustum to the forward skirt.

# NASA/DOD/DOE Pyrotechnic Device

**PREVIOUS USAGE:**
n/a

**OPERATIONAL DESCRIPTION:**
The output of the Confined Detonating Fuse (CDF) assembly detonates the Linear Shaped Charge (LSC) in the detonator block assembly, which detonates the LSC in the frustum separation assembly. The LSC severs the tension ring that holds the frustum to the forward skirt.

**ENERGY SOURCE:**
**TYPE OF INITIATION:** n/a
**CHARGE MATERIAL:**
n/a
**ELECTRICAL CHARACTERISTICS:**
n/a

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** **Low** +20° F for 12 hours
**High** +250° F for 30 minutes
**PRESSURE:** Severs a 0.25 inch thick separation ring.

**DYNAMICS:**
**SHOCK:** n/a
**VIBRATION:** n/a

**QUALIFICATION:**
**DOCUMENTATION:** n/a
**SERVICE LIFE:**
**SHELF:** 4 years
**OPERATIONAL:** n/a

**ADDITIONAL REFERENCES:**
n/a

**ADDITIONAL COMMENTS:**
USBI PN
1 Frustum Separation Assembly:
3 Backup Rings, 10310-0005-801
1 Detonator Backup Ring, 10310-0006-801
1 LSC Assembly, 10310-0002-801
1 Detonator Subassembly, 10310-0003-801 and 10310-0003-802
4 Gap Covers, 10310-0004-801
12 Clamps, Backup Ring, 10310-0001-801

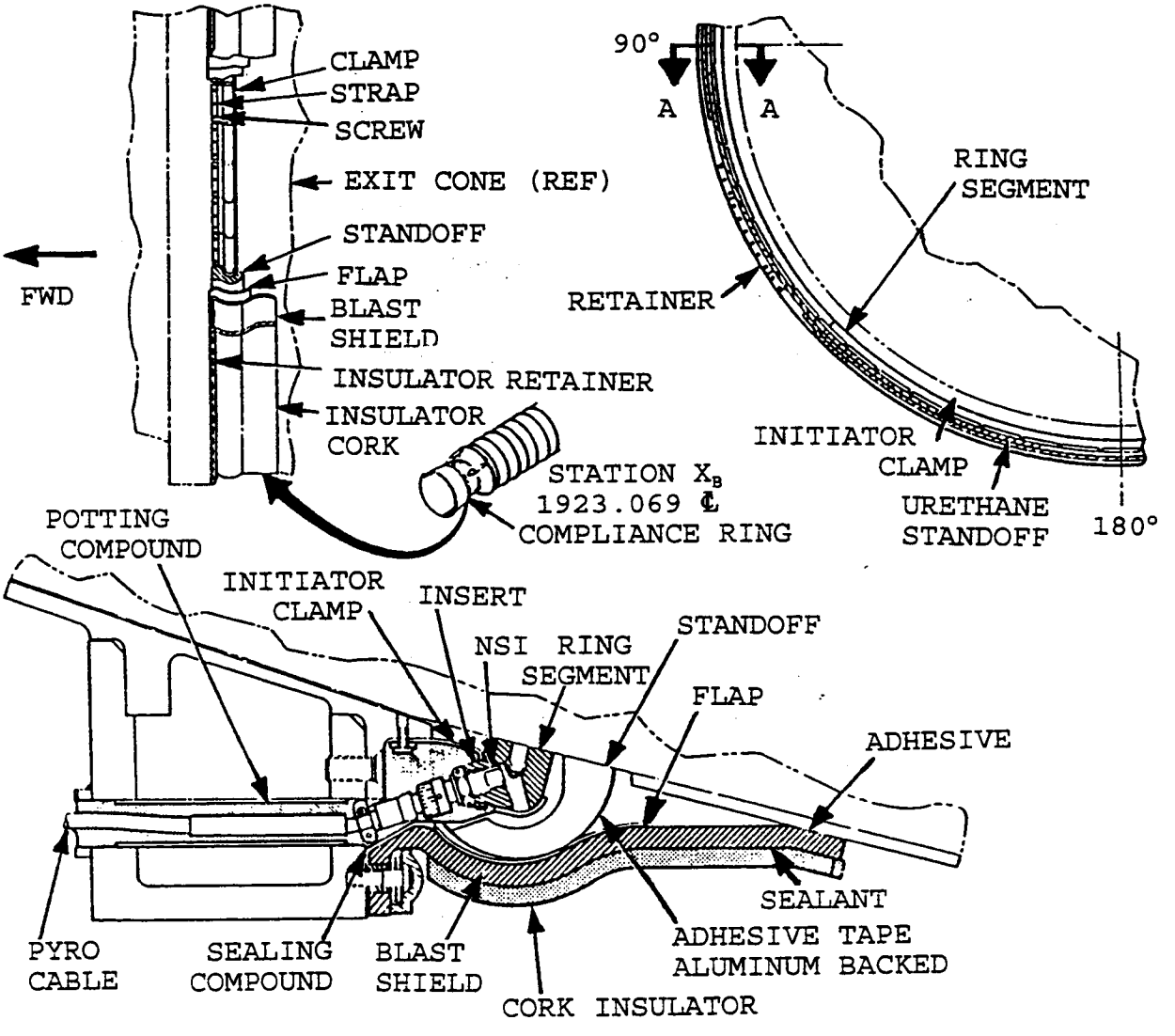
**SPECIAL FEATURES:**
n/a

# NASA/DOD/DOE Pyrotechnic Device

**TITLE:** Shaped Charge - SRM Nozzle Extension Separation Linear

**AGENCY/CENTER:** NASA/Marshall Space Flight Center (MSFC)

**PHYSICAL DATA:**




SRM NOZZLE EXTENSION SEPARATION LINEAR SHAPED CHARGE

**CONTRACTOR:** Thoikol Corporation

**SUBCONTRACTOR:** Jet Research Center

**DEVICE IDENTIFICATION NUMBER:**
Contractor: 1 LSC ring segment, 1U52306-07; 3 LSC ring segments, 1U52306-06

**PURPOSE:**
To separate a structure by the cutting action of a high temperature explosive jet focused by chevron shape of the charge.

This document is an information source only and should not be used for design purposes.

# NASA/DOD/DOE Pyrotechnic Device

**PREVIOUS USAGE:**
n/a

**OPERATIONAL DESCRIPTION:**
The LSC assembly consists of four ring segments that form a complete loop around the Solid Rocket Motor (SRM) nozzle extension after installation. The LSC assembly is positioned so that the explosive cutting force is directed perpendicularly to the outer surface and toward the center of the nozzle. The LSC assembly is initiated by a NSD which is initiated by a Pyrotechnic Initiator Controller (PIC).

**ENERGY SOURCE:**
**TYPE OF INITIATION:** NSD
**CHARGE MATERIAL:**
Cyclotrimethylene-Trinitramine (RDX), (CH2N3NO2)3, 250 gpf per MIL-R-398
Sheath: Copper
**ELECTRICAL CHARACTERISTICS:**
n/a

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** **Low** 0° F
**High** +250° F
**PRESSURE:** Cutting Depth: The 250 gpf LSC shall produce a minimum penetration of 0.410 inch into a cold-rolled steel witness plate at a standoff of 0.35 +/- 0.020 inch.

**DYNAMICS:**
**SHOCK:** n/a
**VIBRATION:** n/a

**QUALIFICATION:**
**DOCUMENTATION:** n/a
**SERVICE LIFE:**
**SHELF:** Temperature: +32° F to +95° F
Humidity: Uncontrolled
Storage Life: 4 years
**OPERATIONAL:** n/a

**ADDITIONAL REFERENCES:**
n/a

**ADDITIONAL COMMENTS:**
n/a

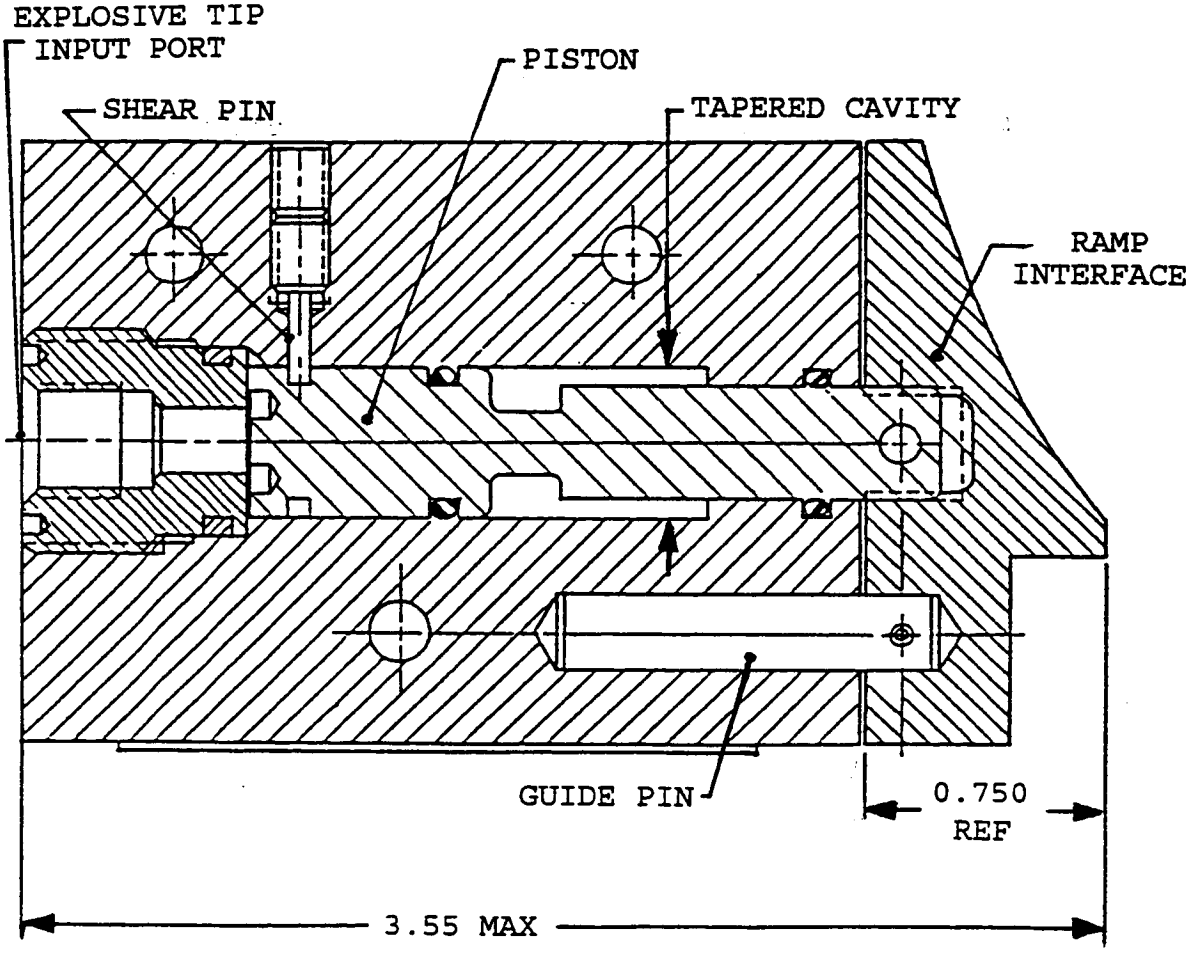
**SPECIAL FEATURES:**
n/a

# NASA/DOD/DOE Pyrotechnic Device

**TITLE:** Thruster - RSRA Rotary Transfer Unit

**AGENCY/CENTER:** NASA Langley Research Center (LaRC)

**PHYSICAL DATA:**




THRUSTER IN ROTARY TRANSFER UNIT

**CONTRACTOR:** Sikorsky Aircraft

**SUBCONTRACTOR:** Teledyne McCormick Selph

**DEVICE IDENTIFICATION NUMBER:**
n/a

**PURPOSE:**
Thrust a ramp interface.

This document is an information source only and should not be used for design purposes.

# NASA/DOD/DOE Pyrotechnic Device

**PREVIOUS USAGE:**
n/a

**OPERATIONAL DESCRIPTION:**
The piston was stroked, using the output energy from a standard explisvie transfer line tip. The piston was decelerated by a tapered cavity and a shoulder. The ramp interface was prevented from rotation by the guide pin.

**ENERGY SOURCE:**
**TYPE OF INITIATION:** Explosive transfer line.
**CHARGE MATERIAL:**
n/a
**ELECTRICAL CHARACTERISTICS:**
n/a

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** Low -25°F
High +200°F
**PRESSURE:** n/a

**DYNAMICS:**
**SHOCK:** } Helicopter environment
**VIBRATION:** }

**QUALIFICATION:**
**DOCUMENTATION:** Bement, Laurence J.: "Helicopter (RSRA) In-Flight Escape System Component Qualification" Presented at the Tenth Symposium on Explosives and Pyrotechnics, San Francisco, CA, February 14-16, 1979.
Bement, Laurence J.: "Helicopter Emergency Escape" SAFE Journal - Vol. 9, No. 3, Fall Quarter, 1979.

**SERVICE LIFE:**
**SHELF:** Umlimited, inert part
**OPERATIONAL:** n/a

**ADDITIONAL REFERENCES:**
n/a

**ADDITIONAL COMMENTS:**
The approach for qualification of this system was to minimize the quantity of device and system-level testing through an emphasis on functional margin demonstrations during development.

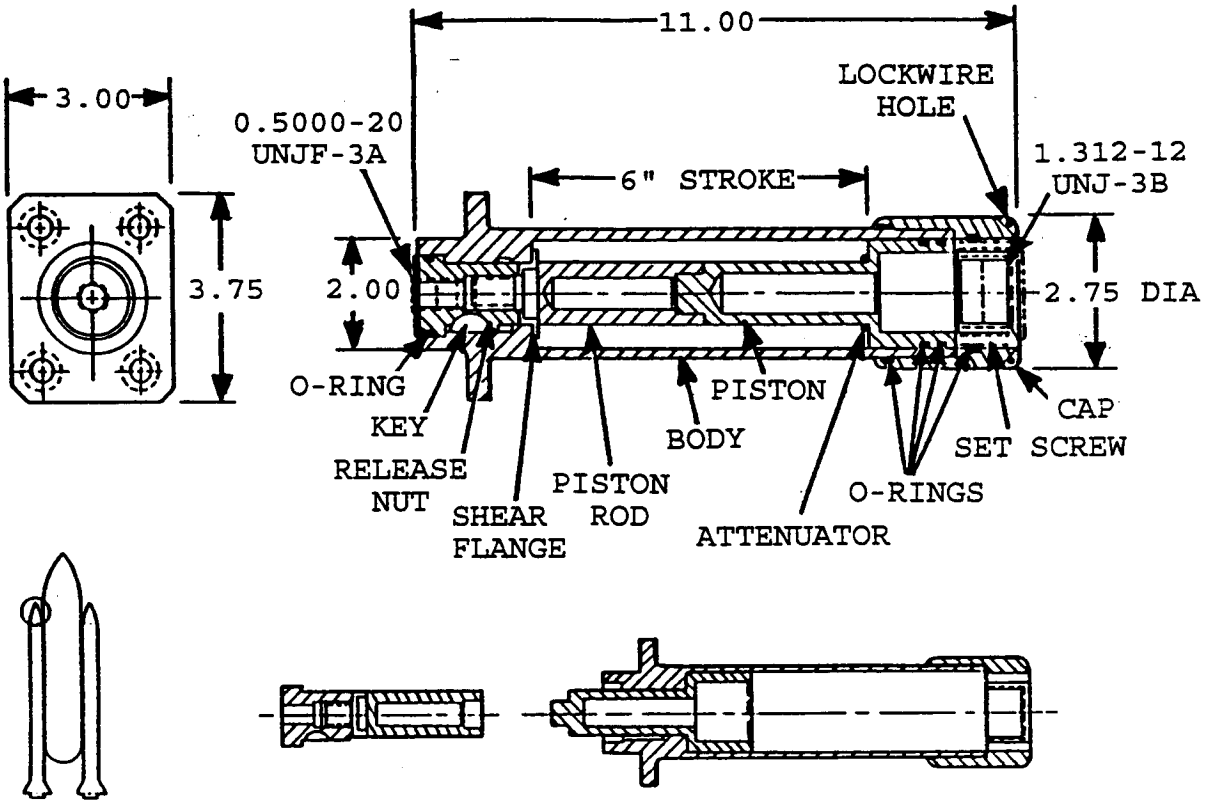
**SPECIAL FEATURES:**
n/a

# NASA/DOD/DOE Pyrotechnic Device

**TITLE:** Thruster - SRB Nose Cap

**AGENCY/CENTER:** NASA/Marshall Space Flight Center (MSFC)

**PHYSICAL DATA:**




SOLID ROCKET BOOSTER NOSE CAP THRUSTER

**CONTRACTOR:** USBI

**SUBCONTRACTOR:** Hi-Shear Corporation

**DEVICE IDENTIFICATION NUMBER:**
USBI PN 10304-0001-801

**PURPOSE:**
To hold down the nose cap on the Solid Rocket Booster (SRB) until the nose cap separation command is initiated, and then to release and accelerate the nose cap to 80 feet per second.

# NASA/DOD/DOE Pyrotechnic Device

**PREVIOUS USAGE:**
n/a

**OPERATIONAL DESCRIPTION:**
Three thrusters, located 120 degrees apart on the top ring of the frustum, hold the nose cap on the SRB until the separation command is given at approximately 16,000 feet descent. At separation, the thruster pressure cartridge provides the pressure to shear the thruster shear flange and release the nose cap. The nose cap is accelerated to a minimum velocity of 80 feet per second due to the pressure acting on the piston over its six-inch stroke. At the end of the stroke, the piston and rod separate, allowing the piston to remain in the thruster body and seal in all the products of combustion. The rod stays with the nose cap to prevent drogue line interference.

**ENERGY SOURCE:**
**TYPE OF INITIATION:** Thruster Pressure Cartridge
**CHARGE MATERIAL:**
n/a
**ELECTRICAL CHARACTERISTICS:**
n/a

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** **Low** +20° F
**High** +195° F for 4 hours
**PRESSURE:** Thrust: When powered by a thruster pressure cartridge, the thruster releases and produces a 30,000 +/- 6,000 pound thrust over a six- inch stroke length while under a 0 to 2,000 pound side load on the piston rod. Strength: The thruster will withstand a static tension load of 10,000 pounds applied through the one-half inch nose cap holddown bolt's longitudinal axis.

**DYNAMICS:**
**SHOCK:** n/a
**VIBRATION:** n/a

**QUALIFICATION:**
**DOCUMENTATION:** n/a
**SERVICE LIFE:**
**SHELF:** Temperature: +25° F to +105° F
Humidity: 0 to 100 percent
Storage Life: 10 years
**OPERATIONAL:** n/a

**ADDITIONAL REFERENCES:**
n/a

**ADDITIONAL COMMENTS:**
n/a

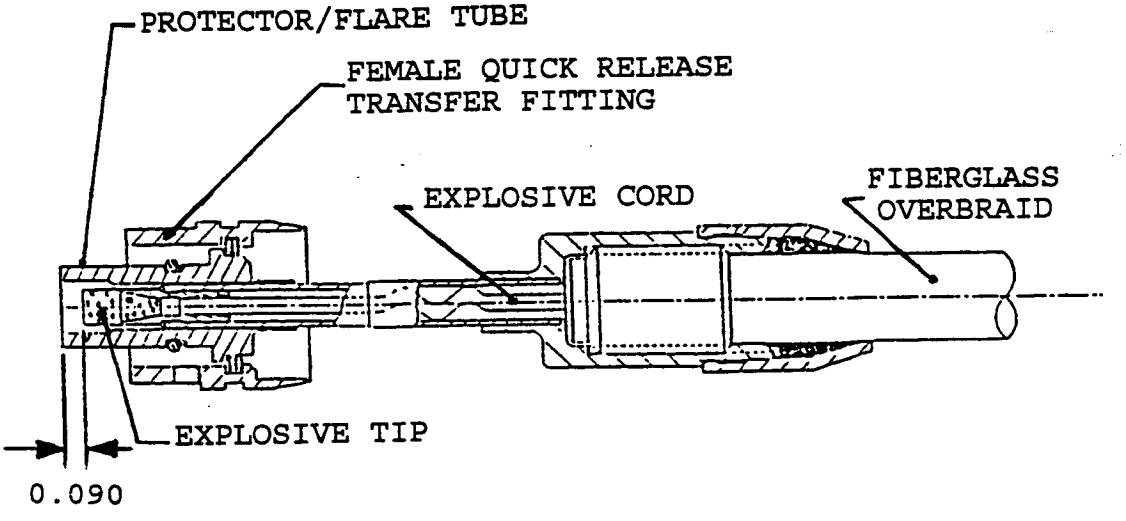
**SPECIAL FEATURES:**
n/a

## NASA/DOD/DOE Pyrotechnic Device

**TITLE:** Transfer Line - Quick Release, Flexible Explosive

**AGENCY/CENTER:** NASA Langley Research Center (LaRC)

**PHYSICAL DATA:**




CROSS SECTION OF QUICK-RELEASE FLEXIBLE EXPLOSIVE TRANSFER LINE

**CONTRACTOR:** Teledyne McCormich Selph

**SUBCONTRACTOR:** Same as Contractor above.

**DEVICE IDENTIFICATION NUMBER:**
n/a

**PURPOSE:**
Transfer an explosive stimulus from the aircraft to an explosive bolt.

**PREVIOUS USAGE:**
The flexible explosive transfer line has had considerable application to military aircraft escape systems.

**OPERATIONAL DESCRIPTION:**
An explosive input from the aircraft detonates the tip of this transfer line, which focuses the explosive input to the explosive cord. The explosive signal propagates down the length of the line to initiate an identical tip on the opposite end. The exploding of this tip provides the input to the explosive bolt. All explosive products within the line are contained by the fiberglass overbraid.

# NASA/DOD/DOE Pyrotechnic Device

**OPERATIONAL DESCRIPTION (CONT.)**
The design challenge was to retain the quick release transfer fittings and end tip explosive products on functioning to prevent harm to the crew or the aircraft. Since the three small posts of the electrical connector could not withstand the explosive forces generated, the approach used was to carry the loads into the fitting through another path. The aluminum protector/flare tube projects beyond the tip on the flexible line and is inserted into a fitting either on the bolt or on the manifold as part of the assembly. As each tip explodes, this tube flares and locks into the internal shoulder of the male fitting cavity. The protector/ flare tube also protects the end tip from potential damage during repeated assembly and disassembly.

**ENERGY SOURCE:**
**TYPE OF INITIATION:** Explosive transfer
**CHARGE MATERIAL:**
n/a
**ELECTRICAL CHARACTERISTICS:**
n/a

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** Low n/a
High n/a
**PRESSURE:** n/a

**DYNAMICS:**
**SHOCK:** n/a
**VIBRATION:**

**QUALIFICATION:**
**DOCUMENTATION:** Bement, Laurence J.; Jahsman, Dirk and Schimmel, Morry L. "Helicopter In-Flight Stores Jettison." Presented at the 1989 SAFE Symposium, Las Vegas, Nevada, December 4-8, 1989.
**SERVICE LIFE:**
**SHELF:** 7 years
**OPERATIONAL:** 5 years

**ADDITIONAL REFERENCES:**
n/a

**ADDITIONAL COMMENTS:**
Service life on this component must be limited to allow a demonstration within a previously unknown environment, including ground crew handling and flight conditions.

Design and evelopment emphasis was placed on proving functional margins for all aspects of use and interfaces. Previously qualified design principles and hardware were employed to reduce the number of tests to demonstrate reliability and to eliminate the need for environmental qualification.

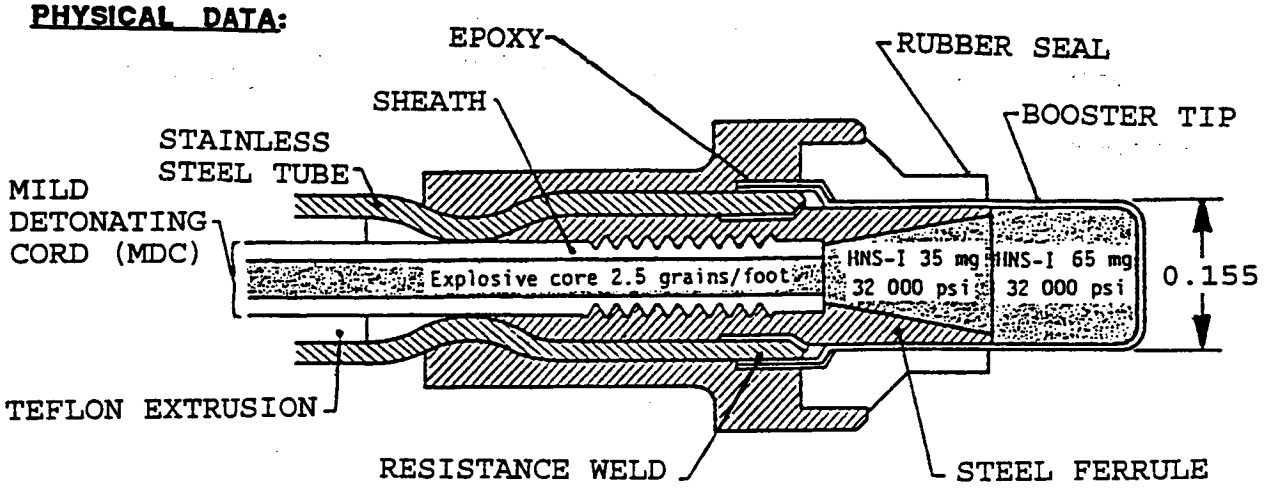
**SPECIAL FEATURES:**
These transfer lines incorporate quick-release, fully contained connectors, comaprable to electrical fittings.

# NASA/DOD/DOE Pyrotechnic Device

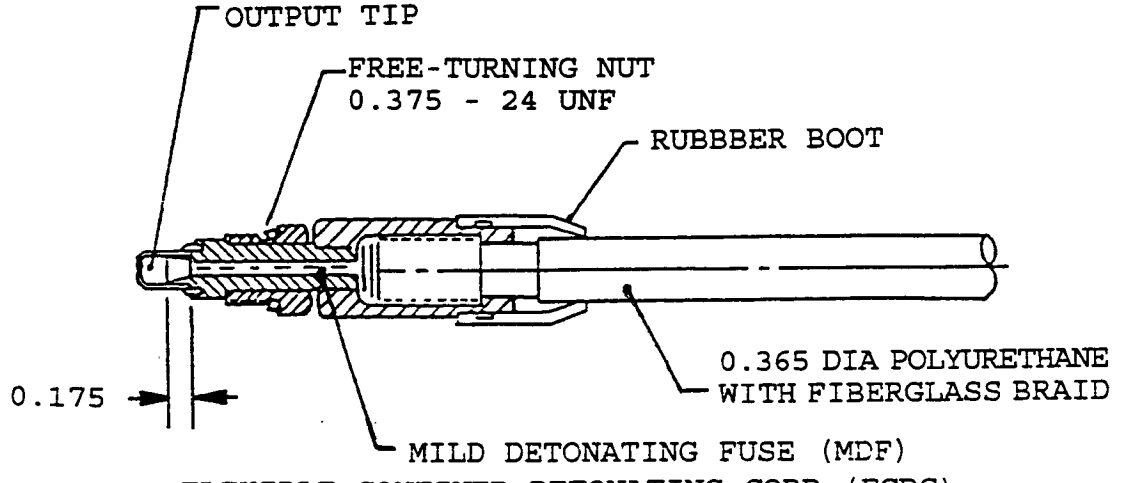
**TITLE:** Transfer Line - RSRA Shielded MD Cord (Rigid & Flexible)

**AGENCY/CENTER:** NASA Langley Research Center (LaRC)

**PHYSICAL DATA:**




SECTION OF RIDGID EXPLOSIVE TRANSFER LINE (1 GRAIN = 65 MG)




FLEXIBLE CONFINED DETONATING CORD (FCDC)

**CONTRACTOR:** Teledyne McCormick Selph

**SUBCONTRACTOR:** n/a

**DEVICE IDENTIFICATION NUMBER:**
n/a

**PURPOSE:**
These lines are assembled with free-turning nuts at each end into manifolds, like high-pressure plumbing to communicate an explosive signal throughout aircraft systems. This is the redundant system employed by the RSRA to initiate the labeled components.

**PREVIOUS USAGE:**
Cobra, F-11, B-1, F-14, F-15, T-28

This document is an information source only and should not be used for design purposes.

# NASA/DOD/DOE Pyrotechnic Device

**OPERATIONAL DESCRIPTION:**

A low-load, silver-sheathed explosive cord (mild detonating cord (MDC) is containe din a 3/16 diameter, 0.030-inch wall thickness steel tube, which contains all explosive products on functioning. The mechanically swaged and welded end fittings (identical on each end) provide for reliable explosive transfer from unit to unit. The figure shows a similar view of a flexible explosive transfer line, which has multiple layers of fiberglass overbraid and polyurethane tubing on the lead-sheathed cord to contain the explosive products. The overbraid is potted into the end fitting. An explosive stimulus input initiates the explosive in the booster tip, which is housed in a 0.005-inch wall thickness, 302 stainless steel cup. The explosive propagation passes through the tip, is focused by the ferrule charge to the small-diameter explosive core. The velocity of propagation through the MDC, which is hexanitrostilbene (HNS), is typically 22,000 feet/second (7,000 meters/second). On arrival at the opposite end of the line, the output tip is initiated, producing high-velocity steel fragments (7 to 11,000 ft/sec) and a high-pressure gas wave.

**ENERGY SOURCE:**

**TYPE OF INITIATION:** Explosive transfer

**CHARGE MATERIAL:**

See Operational Description above.

**ELECTRICAL CHARACTERISTICS:**

n/a

**OPERATING TEMPERATURE/PRESSURE:**

**TEMPERATURE RANGE:** Low -25°F
High +200°F

**PRESSURE:** n/a

**DYNAMICS:**

**SHOCK:** } Previously qualified on a variety of U.S.
**VIBRATION:** } military fighter aircraft.

**QUALIFICATION:**

**DOCUMENTATION:** Bement, Laurence J.: "Helicopter (RSRA) In-Flight Escape System Componenet Qualification" Presented at the Tenth Symposium on Explosives and Pyrotechnics, San Francisco, CA, February 14-16, 1979.

**SERVICE LIFE:**

**SHELF:** unlimited for rigid lines, based on supporting programs by U. S. Military.

**OPERATIONAL:** Unlimited for rigid lines, as above. Flexible lines limited to 5 years

**ADDITIONAL REFERENCES:**

n/a

**ADDITIONAL COMMENTS:**

An extensive evaluation was conducted with flexible lines for application to the RSRA rotorhead, sending a signal from the rotor hub, across the flexing rotor hinge, to the blade severance assembly. A total of 7 million cycles with +/-20° flap and 40° twist were conducted, followed by removing specimens after scheduled flight hours. These lines and associated manifolds were previously qualified on other aircraft systems, as described in table 2.

**SPECIAL FEATURES:**

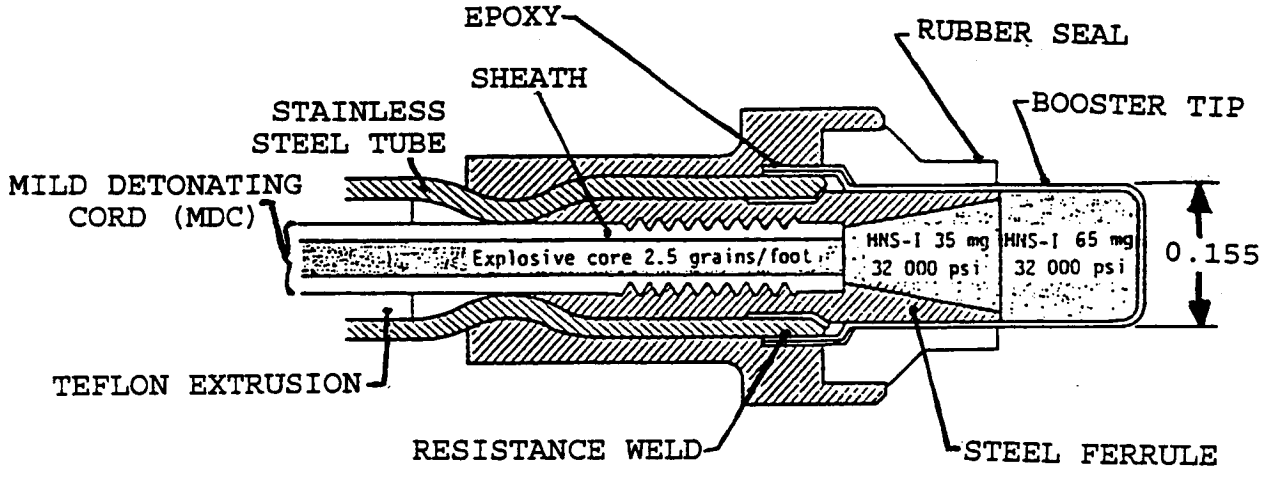
n/a

# NASA/DOD/DOE Pyrotechnic Device

**TITLE:** Transfer Line - Shielded MD Cord (Rigid)

**AGENCY/CENTER:** NASA Langley Research Center (LaRC)

**PHYSICAL DATA:**




CROSS SECTION OF RIGID EXPLOSIVE TRANSFER LINE (1 GRAIN = 65MG)

**CONTRACTOR:** Teledyne McCormick Selph

**SUBCONTRACTOR:** n/a

**DEVICE IDENTIFICATION NUMBER:**
n/a

**PURPOSE:**
These lines are assembled with free-turning nuts at each end into manifolds, like high-pressure plumbing, to communicate an explosive signal throughout aircraft systems.

# NASA/DOD/DOE Pyrotechnic Device

**PREVIOUS USAGE:**
Used on virtually every military fighter.

**OPERATIONAL DESCRIPTION:**
As shown, a low-load, silver-sheathed explosive cord (mild detonating cord (MDC)) is contained in a 3/16 diameter, 0.030-inch wall thickness steel tube, which contains all explosive products on functioning. The mechanically swaged and welded end fittings (identical on each end) provide for reliable explosive transfer from unit to unit. An explosive stimulus input initiates the explosive in the booster tip, which is housed in a 0.005-inch wall thickness, 302 stainless steel cup. The explosive propagation passes through the tip, is focused by the ferrule charge to the small-diameter explosive core. The velocity of propagation through the MDC, which is hexanitrostilbene (HNS), is typically 22,000 feet/second (7,000 meters/second). On arrival at the opposite end of the line, the output tip is initiated, producing high-velocity steel fragments (7 to 11,000 ft/sec) and a high-pressure gas wave to initiate other tips or accomplish work.

**ENERGY SOURCE:**
**TYPE OF INITIATION:** Explosive transfer
**CHARGE MATERIAL:**
n/a
**ELECTRICAL CHARACTERISTICS:**
n/a

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** **Low** n/a
**High** n/a
**PRESSURE:** n/a

**DYNAMICS:**
**SHOCK:** n/a
**VIBRATION:** n/a

**QUALIFICATION:**
**DOCUMENTATION:** Documented in a variety of aircraft systems.
**SERVICE LIFE:**
**SHELF:** Unlimited for rigid lines, based on supporting programs by U. S. Military.
**OPERATIONAL:** Unlimited for rigid lines, as above

**ADDITIONAL REFERENCES:**
n/a

**ADDITIONAL COMMENTS:**
These lines and associated manifolds were previously qualified on other aircraft systems.

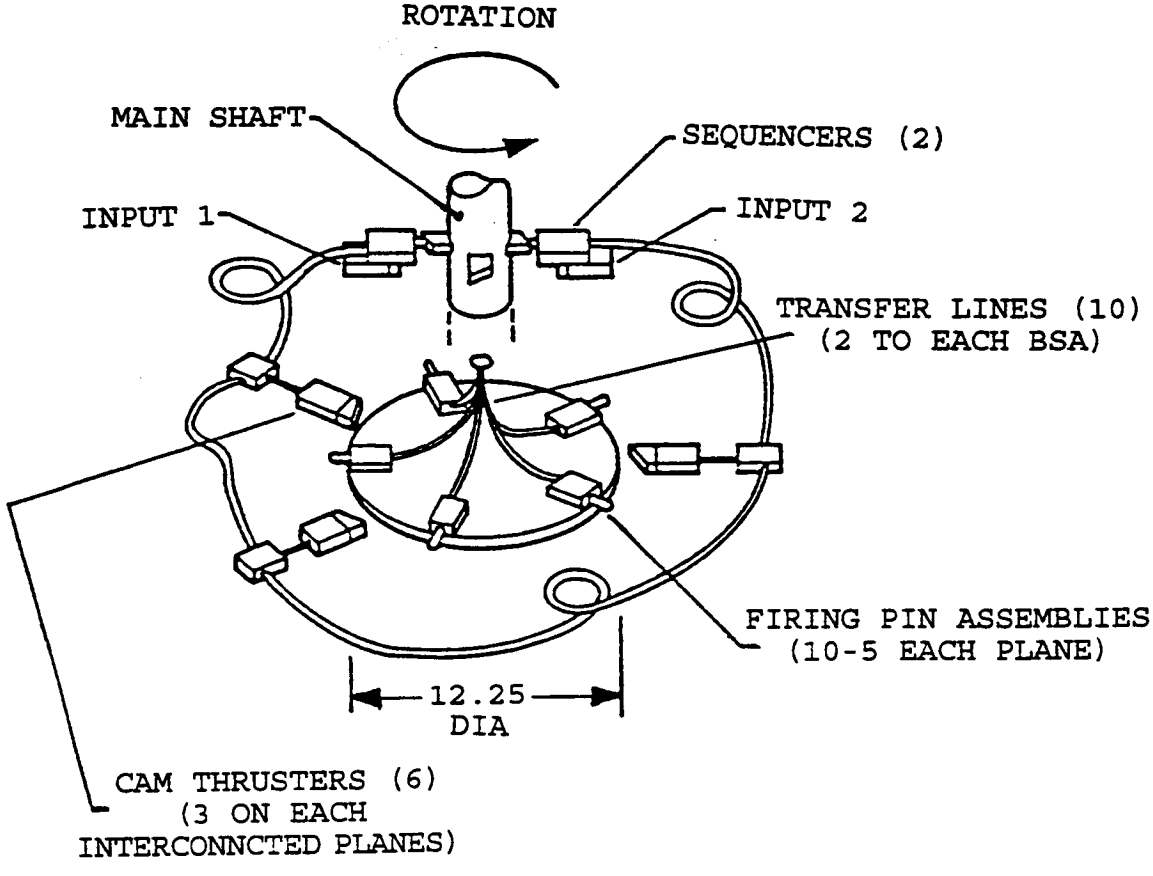
**SPECIAL FEATURES:**
n/a

# NASA/DOD/DOE Pyrotechnic Device

**TITLE:** Transfer Unit - RSRA Rotary

**AGENCY/CENTER:** NASA Langley Research Center (LaRC)

**PHYSICAL DATA:**




ROTARY TRANSFER UNIT

**CONTRACTOR:** Sikorsky Aircraft

**SUBCONTRACTOR:** Teledyne McCormick Selph

**DEVICE IDENTIFICATION NUMBER:**
n/a

**PURPOSE:**
This system provided the sequenced severance of the five RSRA rotor blades, assuring that the rotor blades were released so that their trajectories were away from the aircraft.

# NASA/DOD/DOE Pyrotechnic Device

**PREVIOUS USAGE:**
none

**OPERATIONAL DESCRIPTION:**
Inputs from explosive transfer lines into the sequencers (mounted on the non-rotating portion of the aircraft) thrust firing pin assemblies into an interference path with fixed cams, mounted on the bottom of the main rotor shaft. When these firing pin assemblies were struck, an explosive transfer intitiation signal was transmitted to redundant sets of three cam thrusters. The cam thrusters then projected an interference with two sets of five firing pin assemblies (one for each rotor blade), mounted on a rotating assembly to the main rotor shaft. This arrangement assured that the cam thrusters would be positioned prior to arrival of the rotating firing pin assemblies and to initiate blade severance in a three/two sequence at positions relative to the aircraft.

**ENERGY SOURCE:**
**TYPE OF INITIATION:** Explosive transfer
**CHARGE MATERIAL:**
n/a
**ELECTRICAL CHARACTERISTICS:**
n/a

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** Low -25°F
High +200°F
**PRESSURE:** n/a

**DYNAMICS:**
**SHOCK:** } Helicopter environment
**VIBRATION:** }

**QUALIFICATION:**
**DOCUMENTATION:** Bement, Laurence J.: "Helicopter (RSRA) In-Flight Escape System Component Qualification" Presented at the Tenth Symposium on Explosives and Pyrotechnics, San Francisco, CA, February 14-16, 1979.
**SERVICE LIFE:**
**SHELF:** 7 years
**OPERATIONAL:** 5 years

**ADDITIONAL REFERENCES:**
n/a

**ADDITIONAL COMMENTS:**
The approach for qualification of this system was to minimize the quanity of device and system-level testing through an emphasis cn functional margin demonstrations during development.

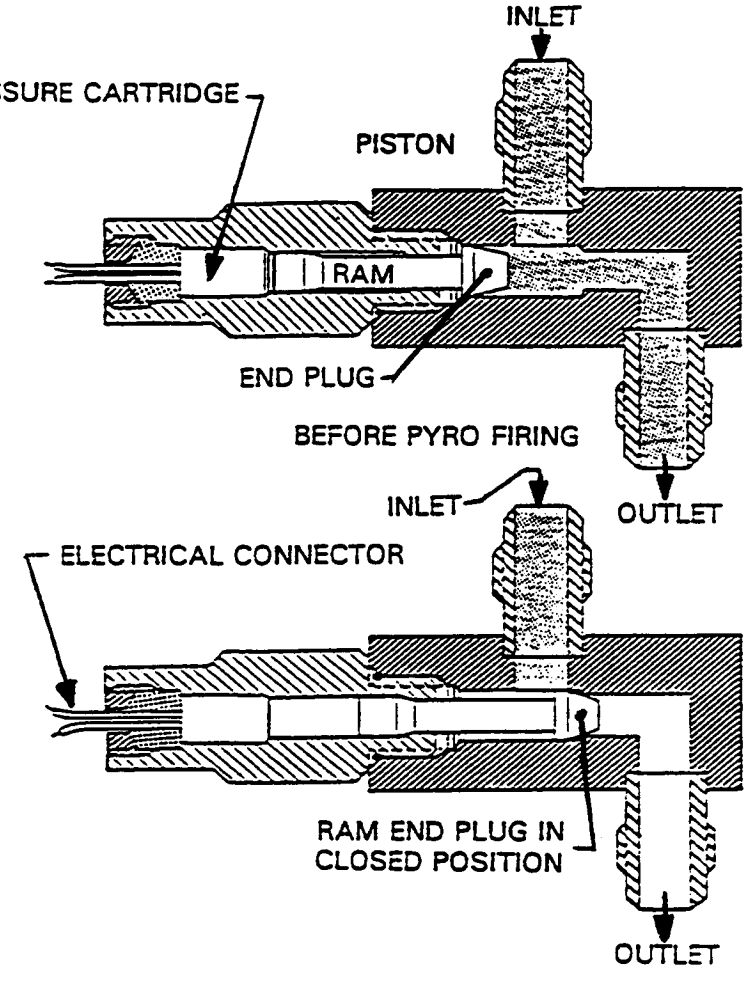
**SPECIAL FEATURES:**
n/a

# NASA/DOD/DOE Pyrotechnic Device

**TITLE:** Valve - Atlas LO2 Sensing Line Shutoff

**AGENCY/CENTER:** NASA Lewis Research Center (LeRC)

**PHYSICAL DATA:**




ATLAS $LO_2$ SENSING LINE SHUTOFF VALVE

**CONTRACTOR:** General Dynamics Space Systems Division (GDSSD)

**SUBCONTRACTOR:** Conax Corporation

**DEVICE IDENTIFICATION NUMBER:**
Contractor Spec. 69-06011

**PURPOSE:**
To close a sensing line by pyrotechnically actuating a normally open valve to the closed position and thereby shutting off the line.

# NASA/DOD/DOE Pyrotechnic Device

**PREVIOUS USAGE:**
Expendable Launch Vehicles: Atlas Centaur Vehicles through AC-68

**OPERATIONAL DESCRIPTION:**
The valve is actuated at event time by electrical power to the pyro cartridge bridgewire. The heat sensitive charge in contact with the electrical bridge initiates the pyrotechnic firing. Gas pressure from the charge actuates the piston ram rod. The plug end on the rod jams the outlet channel closed in the valve and shuts off the sensing line.

**ENERGY SOURCE:**
**TYPE OF INITIATION:** Pressure cartridge with electrical bridgewire.
**CHARGE MATERIAL:**
Proprietary mix.
**ELECTRICAL CHARACTERISTICS:**
Normal, 28 VDC, 2 amps.

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** Low -65 °F
High +160 °F
**PRESSURE:** 5000 psi

**DYNAMICS:**
**SHOCK:** n/a
**VIBRATION:** n/a

**QUALIFICATION:**
**DOCUMENTATION:** Per above spec.
**SERVICE LIFE:**
**SHELF:** n/a
**OPERATIONAL:** n/a

**ADDITIONAL REFERENCES:**
n/a

**ADDITIONAL COMMENTS:**
n/a

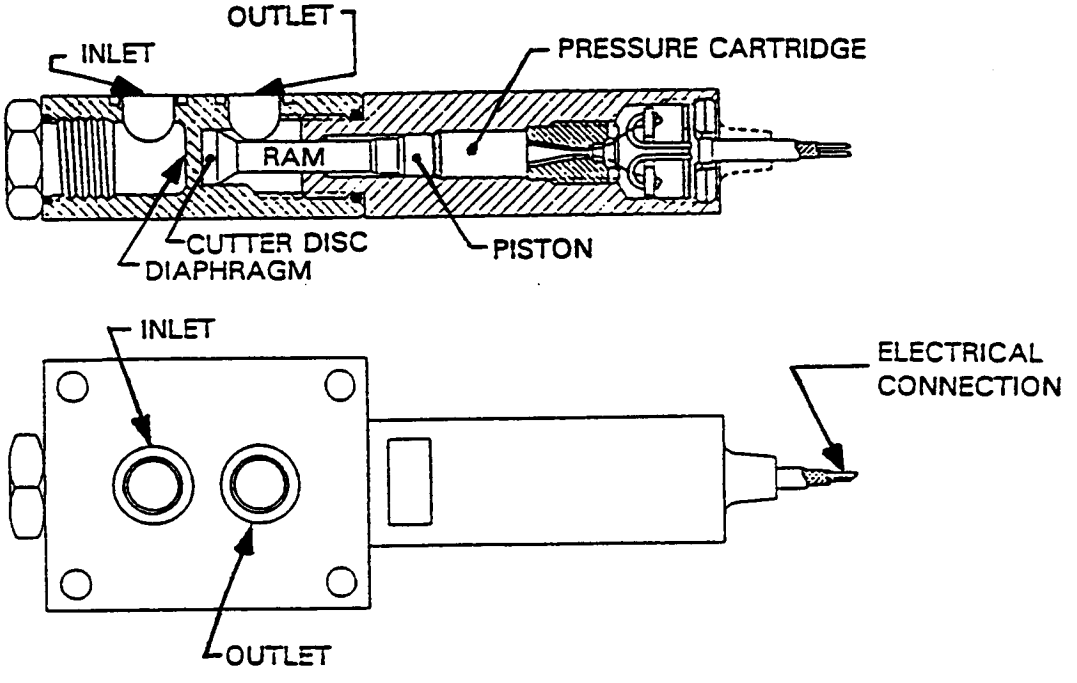
**SPECIAL FEATURES:**
n/a

# NASA/DOD/DOE Pyrotechnic Device

**TITLE:** Valve - Booster Separation Staging

**AGENCY/CENTER:** NASA Lewis Research Center (LeRC)

**PHYSICAL DATA:**




BOOSTER SEPARARTION STAGING VALVE

**CONTRACTOR:** General Dynamics Space Systems Division (GDSSD)

**SUBCONTRACTOR:** Conax Corp.

**DEVICE IDENTIFICATION NUMBER:**
Contractor Spec. 27-04304

**PURPOSE:**
To open a flow line by pyrotechnically actuating a normal closed valve located between a pneumatic source and pressure operated unlatching mechanisms.

# NASA/DOD/DOE Pyrotechnic Device

**PREVIOUS USAGE:**
Expendable Launch Vehicles: Atlas Centaur Vehicles through AC-68

**OPERATIONAL DESCRIPTION:**
The valve is actuated at event time by electrical power to the pyro cartridge bridgewire. The heat sensitive charge in contact with the electrical bridge initiates the pyrotechnic firing. Gas pressure from the charge actuates the piston ram rod. The cutter disk on the rod shears the valve diaphragm allowing pneumatic flow of the working gas. The pneuamtic gas flows to the unlatching mechanisms.

**ENERGY SOURCE:**
**TYPE OF INITIATION:** Pressure cartridge with electrical bridgewire
**CHARGE MATERIAL:**
Proprietary mix.
**ELECTRICAL CHARACTERISTICS:**
Normal 28 VDC, 2 amps.

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** Low -65 °F
High +160 °F
**PRESSURE:** 5000 psi

**DYNAMICS:**
**SHOCK:** n/a
**VIBRATION:** n/a

**QUALIFICATION:**
**DOCUMENTATION:** Per above spec.
**SERVICE LIFE:**
**SHELF:** n/a
**OPERATIONAL:** n/a

**ADDITIONAL REFERENCES:**
n/a

**ADDITIONAL COMMENTS:**
n/a

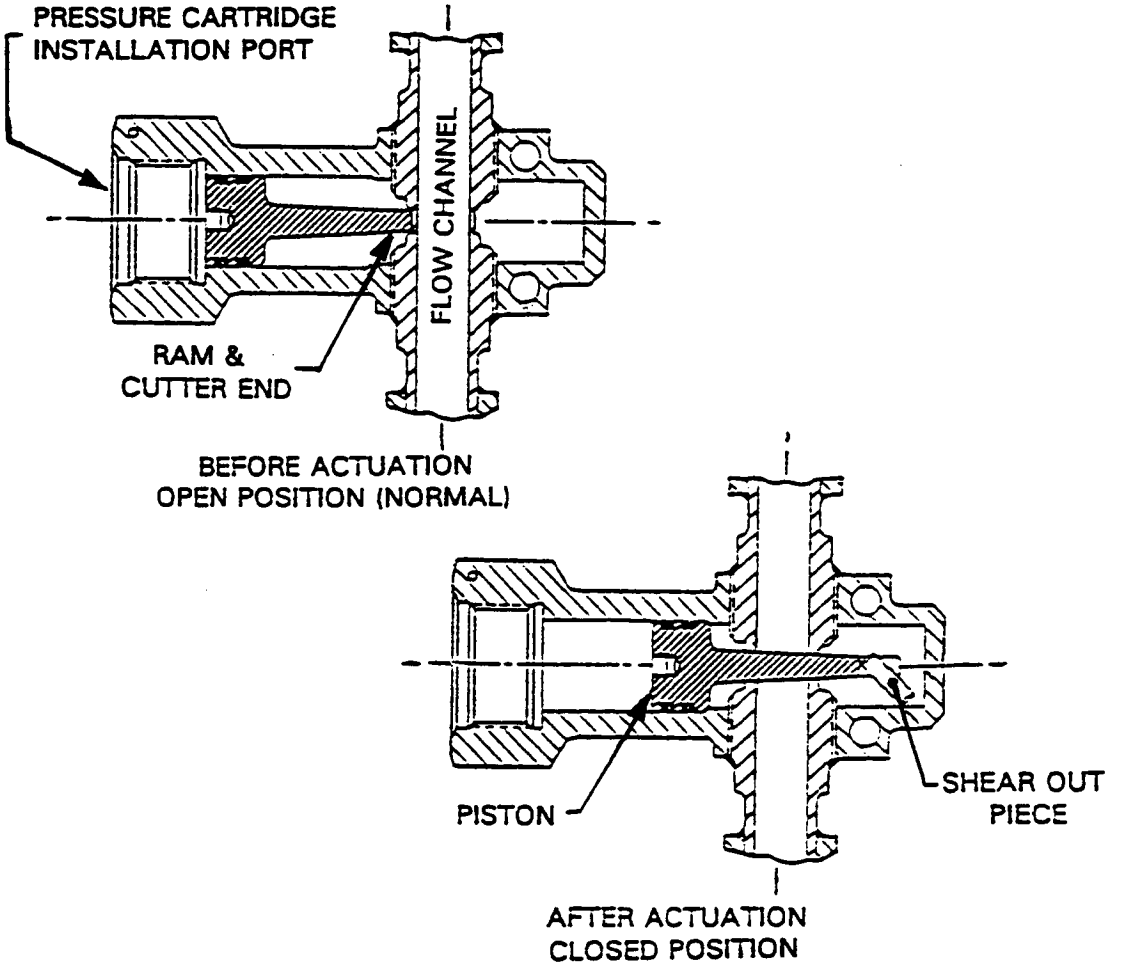
**SPECIAL FEATURES:**
n/a

## NASA/DOD/DOE Pyrotechnic Device

**TITLE:** Valve - Centaur Tank Pressurization Umbilical Shutoff

**AGENCY/CENTER:** NASA Lewis Research Center (LeRC)

**PHYSICAL DATA:**




CENTAUR TANK PRESSURIZATION UMBILICAL SHUTOFF VALVE

**CONTRACTOR:** General Dynamics Space Systems Division (GDSSD)

**SUBCONTRACTOR:** Pyronetics Incorporated

**DEVICE IDENTIFICATION NUMBER:**
Contractor Spec. 55-08401

**PURPOSE:**
To close an onboard Centaur tank pressurization line as a backup to the airborne shutoff half of the umbilical disconnect.

# NASA/DOD/DOE Pyrotechnic Device

**PREVIOUS USAGE:**
Expendable Launch Vehicles:
Atlas Centaur Vehicles through AC-68
Titan III Centaur Vehicles through TC-7

**OPERATIONAL DESCRIPTION:**
The valve is actuated just before vehicle liftoff by electrical power to the pyro cartridge bridgewire which activates the heat sensitive charge. Gas pressure from the pyro firing actuates the piston ram and the cutter end shears out a frangible section as the tapered ram jams the line closed.

**ENERGY SOURCE:**
**TYPE OF INITIATION:** Cartridge with electrical bridgewire.
**CHARGE MATERIAL:**
n/a
**ELECTRICAL CHARACTERISTICS:**
Normal 28 VDC, (1 amp - 1 watt no fire)

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** Low n/a
High n/a
**PRESSURE:** n/a

**DYNAMICS:**
**SHOCK:** n/a
**VIBRATION:** n/a

**QUALIFICATION:**
**DOCUMENTATION:** Per above spec.
**SERVICE LIFE:**
**SHELF:** n/a
**OPERATIONAL:** n/a

**ADDITIONAL REFERENCES:**
n/a

**ADDITIONAL COMMENTS:**
n/a

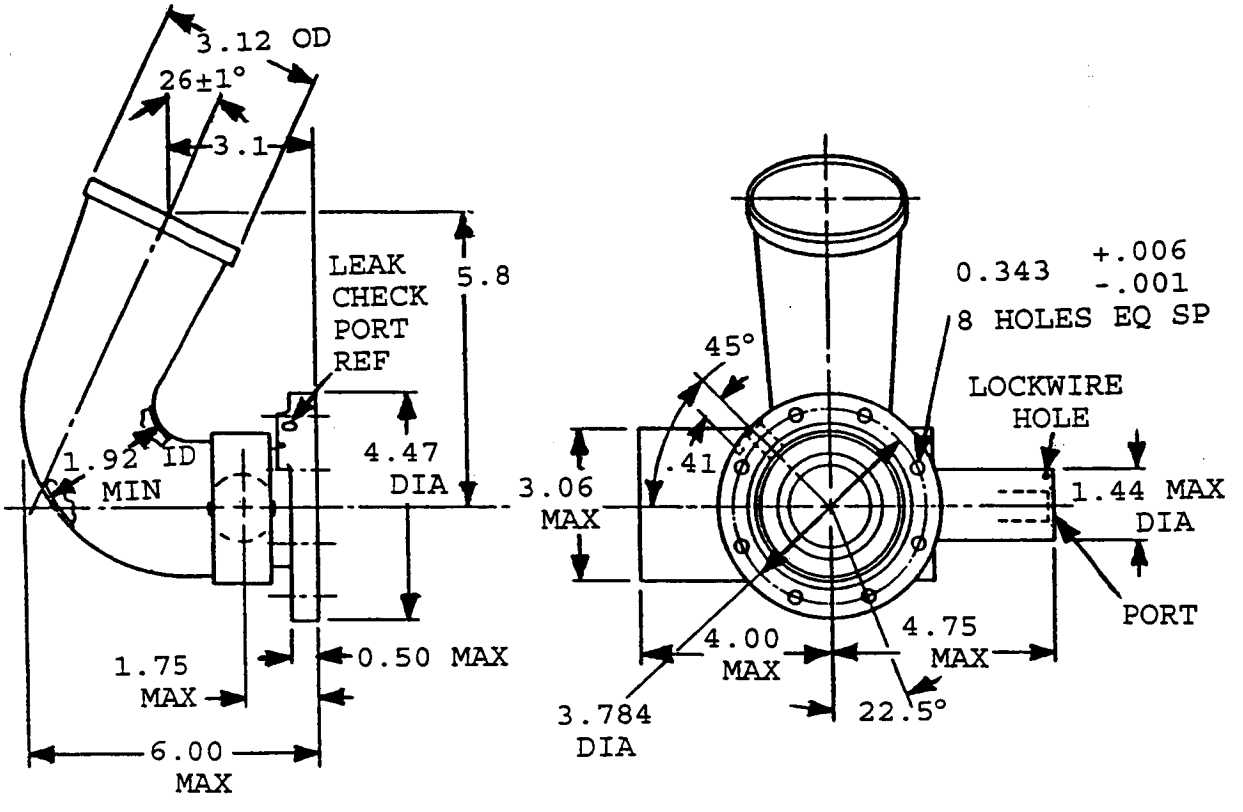
**SPECIAL FEATURES:**
n/a

# NASA/DOD/DOE Pyrotechnic Device

**TITLE:** Valve - External Tank Tumble

**AGENCY/CENTER:** NASA/Marshall Space Flight Center (MSFC)

**PHYSICAL DATA:**




PYROTECHNIC-OPERATED TUMBLE VALVE

**CONTRACTOR:** Martin-Marietta Corporation

**SUBCONTRACTOR:** Pyronetics

**DEVICE IDENTIFICATION NUMBER:**
Martin PD 4700193-020

**PURPOSE:**
To vent the gases from the LO2 tank and, after separation, to direct the gases so that it causes the ET to tumble.

# NASA/DOD/DOE Pyrotechnic Device

**PREVIOUS USAGE:**
n/a

**OPERATIONAL DESCRIPTION:**
The "normally closed" pyrotechnic-operated tumble valve is activated by a pressure cartridge. When the pressure cartridge is activated, the pressure generated drives the valve actuator piston against the ram assembly which shears the closure member from the inlet body at the valve. The ram assembly and sheared member are propelled into the containment chamber where they are retained by wedging the externally tapered projection of the ram assembly into the internally tapered opening in the end cap. This action unblocks the passage in the valve to permit venting of the LO2 tank. The steel bellows in the actuator assembly seals cartridge pressure gas and contaminants from the valve flow passage.

**ENERGY SOURCE:**
**TYPE OF INITIATION:** Pyrotechnic Valve Actuation Cartridge
**CHARGE MATERIAL:**
n/a
**ELECTRICAL CHARACTERISTICS:**
n/a

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** Low -150° F
High +200° F
**PRESSURE:** The valve shall operate at a working pressure of 25 pounds per square inch in the tank venting system and shall be capable of handling a varying flow for a nonuniform duration, during which time the venting source pressure will decrease to zero psig.

**DYNAMICS:**
**SHOCK:** n/a
**VIBRATION:** n/a

**QUALIFICATION:**
**DOCUMENTATION:** n/a
**SERVICE LIFE:**
**SHELF:** Temperature: -40° F to +160° F for 50 hours
Humidity: 0 to 100 percent
Storage Life: 10 years
**OPERATIONAL:** n/a

**ADDITIONAL REFERENCES:**
n/a

**ADDITIONAL COMMENTS:**
n/a

**SPECIAL FEATURES:**
n/a

THIS PAGE INTENTIONALLY LEFT BLANK

# PYROTECHNIC SYSTEMS

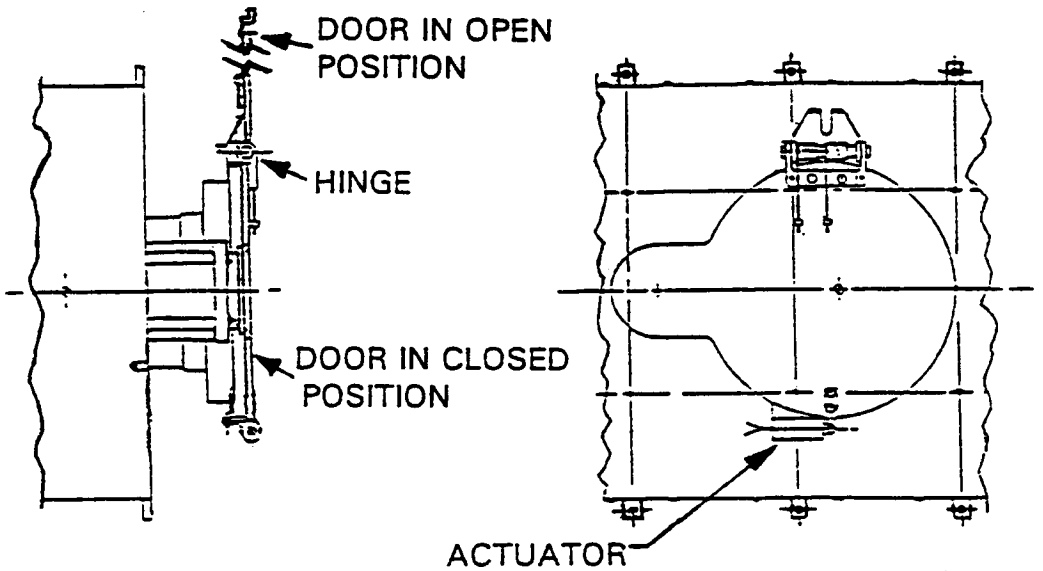
# LIST OF PYROTECHNIC SYSTEMS

# LIST OF PYROTECHNIC SYSTEMS (CONT.)

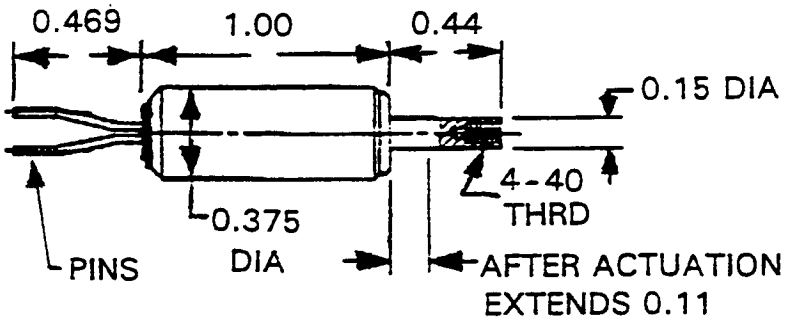
# NASA/DOD/DOE Pyrotechnic System

**TITLE:** Actuator System - SAMPEX Acoustic Cover Retractable

**AGENCY/CENTER:** NASA Goddard Space Flight Center (GSFC)




ACOUSTIC COVER




RETRACTABLE PISTON ACTUATOR

SAMPEX PAYLOAD ACOUSTIC COVER RETRACTABLE ACTUATOR

**CONTRACTOR:** n/a

**SUBCONTRACTOR:** ICI Aerospace

**SYSTEM IDENTIFICATION NUMBER:**
Refer to List of Devices (below)

**PURPOSE:**
To open the Acoustic Cover on the MAST/PET Instrument.

# NASA/DOD/DOE Pyrotechnic System

**PREVIOUS USAGE:**
n/a

**OPERATIONAL DESCRIPTION:**
The Retractable Piston Actuator contains an ignition compound, which when actuated produces a pulling or withdrawing type of linear motion partially retracting the piston into the casing, releasing the cover. The actuator contains redundant bridgewire actuated by a circuit with a redundant bus.

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** **Low** −65°F
**High** +160°F

**PRESSURE:** n/a

**LIST OF DEVICES:**
Retractable Actuator; ICI Aerospace # IMT18CC (228-5000)

**QUALIFICATION DOCUMENTATION:**
n/a

**ADDITIONAL REFERENCES:**
n/a

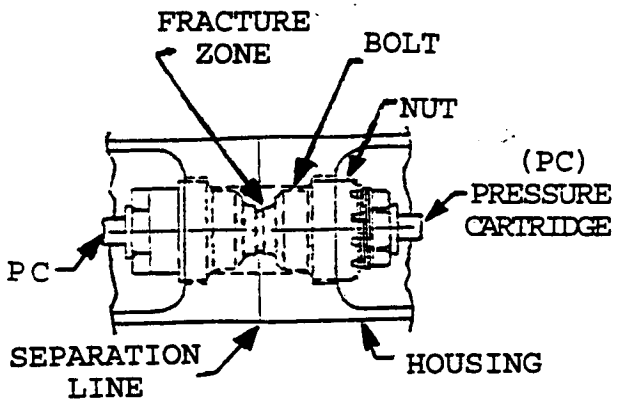
**ADDITIONAL COMMENTS:**
All fire current: 1 amp for 10 ms; No-fire current: 0.1 amp for 5 minutes minimum; Bridgewire resistance: 1.8 ± 0.2 Ohms; Insulation resistance 50 megohms min at 500 volts DC.

# NASA/DOD/DOE Pyrotechnic System

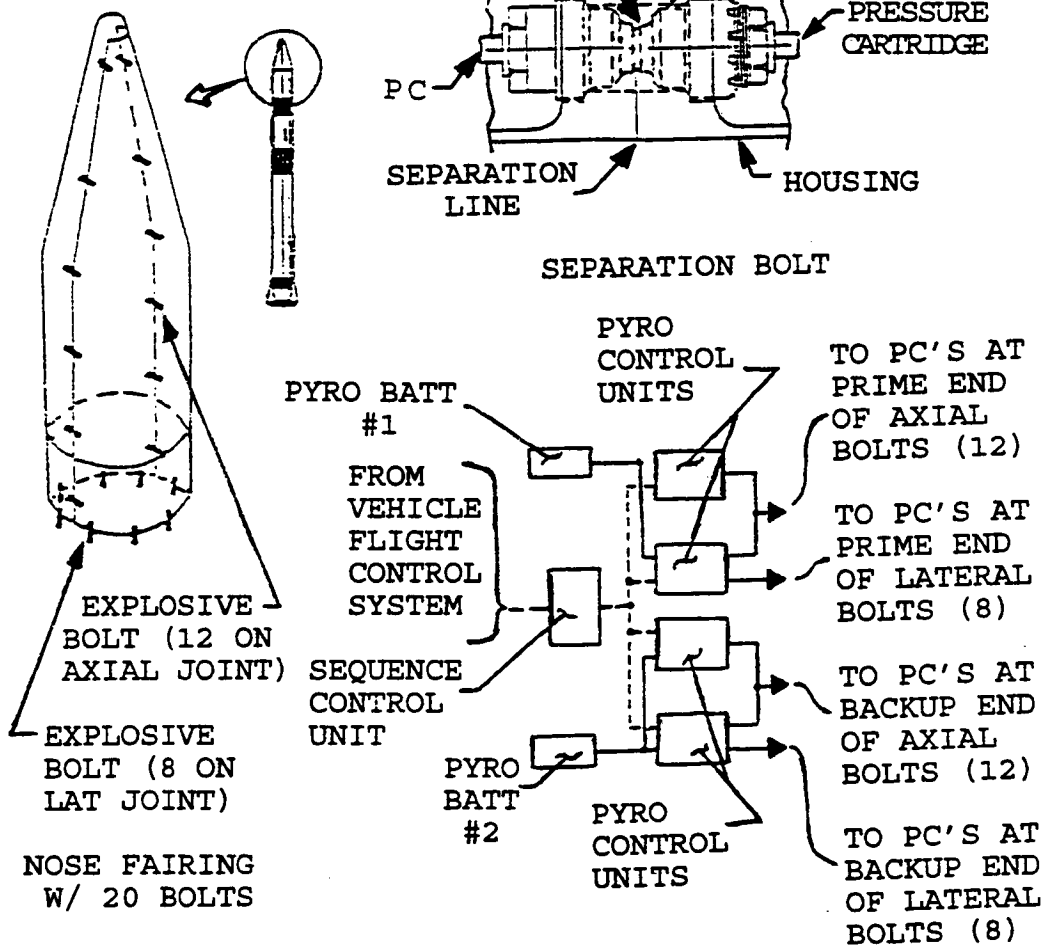
**TITLE:** Bolt System - Centaur Nose Fairing Separation

**AGENCY/CENTER:** NASA Lewis Research Center (LeRC)

**PHYSICAL DATA:**




SEPARATION BOLT




NOSE FAIRING SEPARATION SYSTEM

**CONTRACTOR:** General Dynamics Space Systems Division (GDSSD)

**SUBCONTRACTOR:** No system vendor; only device vendors (see each device).

**SYSTEM IDENTIFICATION NUMBER:**
no system number; refer to specific components (devices).

**PURPOSE:**
To unlatch the halves of the bisegmented nose fairing from each other and from the Centaur vehicle by pyrotechnically generated pressure on internal pistons forcing latch bolts to fail in tension for separation and jettison of the fairing.

# NASA/DOD/DOE Pyrotechnic System

**PREVIOUS USAGE:**
Expendable Launch Vehicles:
Atlas Centaur Vehicles through AC-68

**OPERATIONAL DESCRIPTION:**
Battery power is issued at event time by the control units to the pressure cartridge (PC) detonators installed in each separation bolt end. Activation of the PC's develops pressure on the pistons and force amplifiers in the bolts causing bolt tension failure. This failure of the fasteners holding the fairing halves together and to the vehicle allows separation and jettison of the nose fairing, on separable aft hinges, by spring actuators.

**OPERATING TEMPERATURE/PRESSURE:**

**TEMPERATURE RANGE:** **Low** -100° F
**High** +200° F

**PRESSURE:** n/a

**LIST OF DEVICES:**
Separation Bolt; GDSSD 55-07057
Pressure Cartridge; GDSSD 55-06018

**QUALIFICATION DOCUMENTATION:**
n/a

**ADDITIONAL REFERENCES:**
n/a

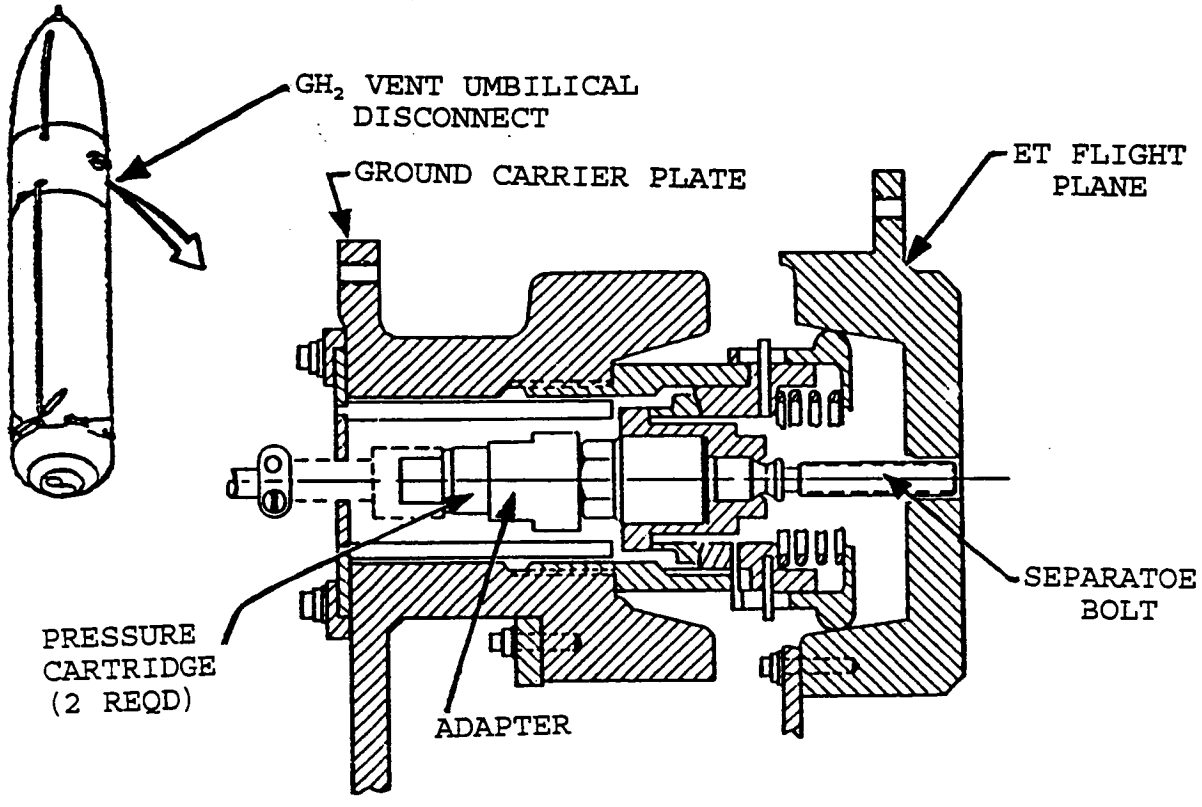
**ADDITIONAL COMMENTS:**
One pressure cartridge per separation bolt is sifficient to fail the bolt. See separation bolt listed under devices for more operational description.

# NASA/DOD/DOE Pyrotechnic System

**TITLE:** Bolt System - ET Gaseous $H_2$ Vent Umbilical Disconnect

**AGENCY/CENTER:** NASA/Marshall Space Flight Center (MSFC)

**PHYSICAL DATA:**




EXTERNAL TANK (ET) GASEOUS HYDROGEN ($GH_2$) VENT UMBILICAL DISCONNECT BOLT SYSTEM

**CONTRACTOR:** Martin-Marietta Corporation

**SUBCONTRACTOR:** Martin-Marietta Corporation

**SYSTEM IDENTIFICATION NUMBER:**
No system number; refer to specific components (devices).

**PURPOSE:**
To disconnect a facility GH2 vent umbilical assemly from the ET intertank.

# NASA/DOD/DOE Pyrotechnic System

**PREVIOUS USAGE:**
n/a

**OPERATIONAL DESCRIPTION:**
A separation bolt is used to secure a facility GH2 vent umbilical assembly to the ET intertank. The facility portion of the umbilical assembly is referred to as the ground carrier assembly. The separation bolt attaches the ground carrier to the intertank. At liftoff, the pressure cartridges are initiated, which causes the separation bolt to separate. Upon separation the ground carrier assembly drops away from the vehicle.

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** **Low** Ambient
**High** -200° F (after propellant loading)
**PRESSURE:** Refer to specific components (devices).

**LIST OF DEVICES:**
2 Pressure Cartridges, PD 5000020-030
1 Separation Bolt, PD 5000020-060

**QUALIFICATION DOCUMENTATION:**
n/a

**ADDITIONAL REFERENCES:**
n/a

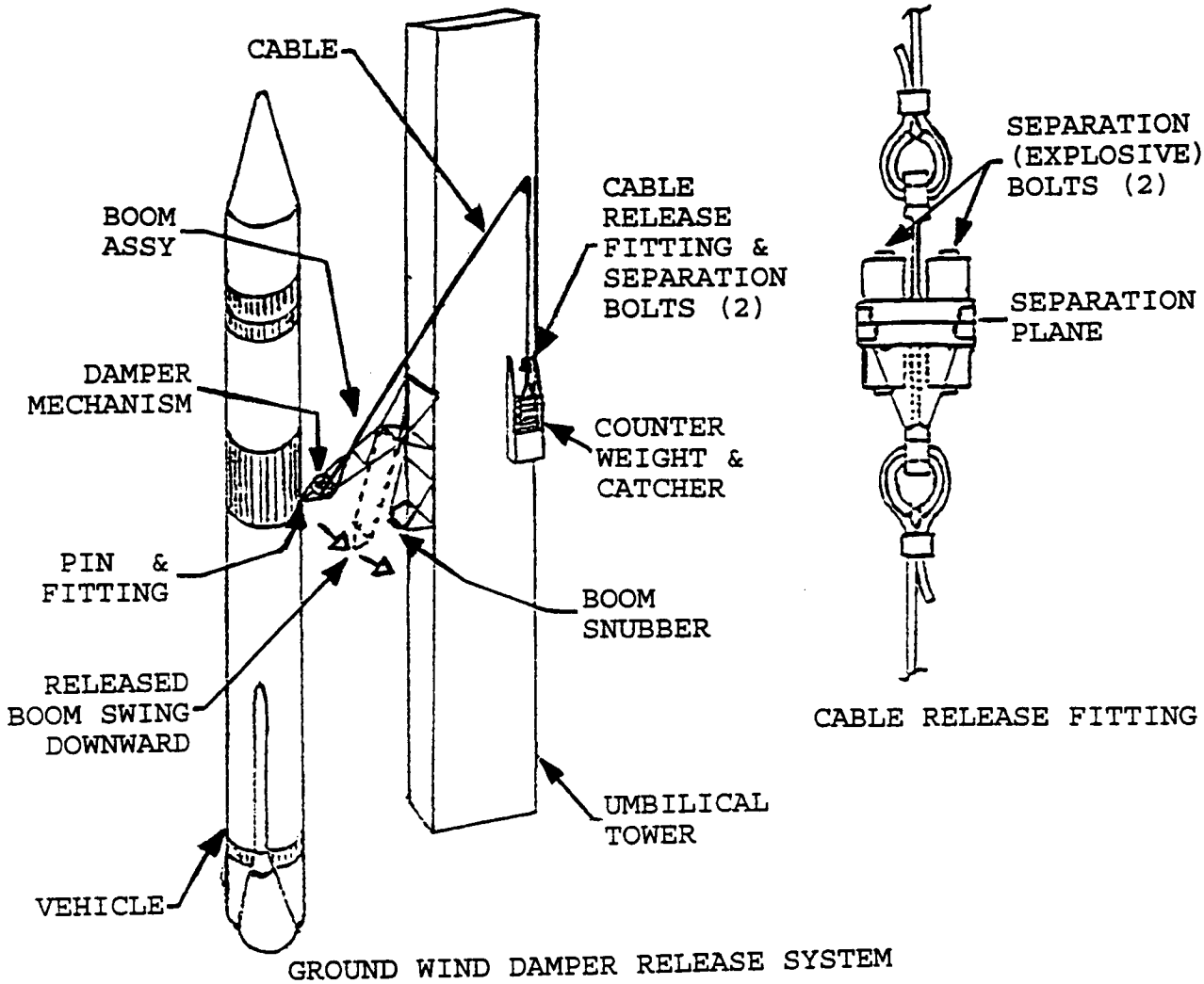
**ADDITIONAL COMMENTS:**
n/a

# NASA/DOD/DOE Pyrotechnic System

**TITLE:** Bolt System - Ground Wind Damper Release Separation

**AGENCY/CENTER:** NASA Lewis Research Center (LeRC)

**PHYSICAL DATA:**




GROUND WIND DAMPER RELEASE SYSTEM

**CONTRACTOR:** General Dynamics Space Systems Division (GDSSD)

**SUBCONTRACTOR:** No system vendor; only device vendors (see each device).

**SYSTEM IDENTIFICATION NUMBER:**
No system number; refer to specific components (devices).

**PURPOSE:**
To disconnect the ground wind damper boom from the vehicle at launch by failing the separation bolts that join the boom to the counter weight support cable and thereby, releasing the boom to swing downward, disengaging the pin connection, and pivoting

clear.

**PREVIOUS USAGE:**

Expendable Launch Vehicles:
Latter Atlas Centaur Vehicles through AC-68

**OPERATIONAL DESCRIPTION:**

The damper stabilizes the vehicle by absorbing oscillatory motion induced by ground wind during periods when the mobile service tower is rolled back from the vehicle for testing or launch. At launch the ground control unit switches electric power to the pressure cartridges at the two separation bolts in a release fitting. The fitting ties the boom support cable to a counterweight. Activation of the cartridges fail the bolts freeing the support cable. The boom pivots downward disengaging from the vehicle and locks onto the snubber/catcher clear of the vehicle.

**OPERATING TEMPERATURE/PRESSURE:**

**TEMPERATURE RANGE:** **Low** -100° F
**High** +200° F

**PRESSURE:** n/a

**LIST OF DEVICES:**

Separation Bolt; GDSSD 55-07057
Pressure Cartridge; GDSSD 55-06018

**QUALIFICATION DOCUMENTATION:**

n/a

**ADDITIONAL REFERENCES:**

n/a

**ADDITIONAL COMMENTS:**

n/a

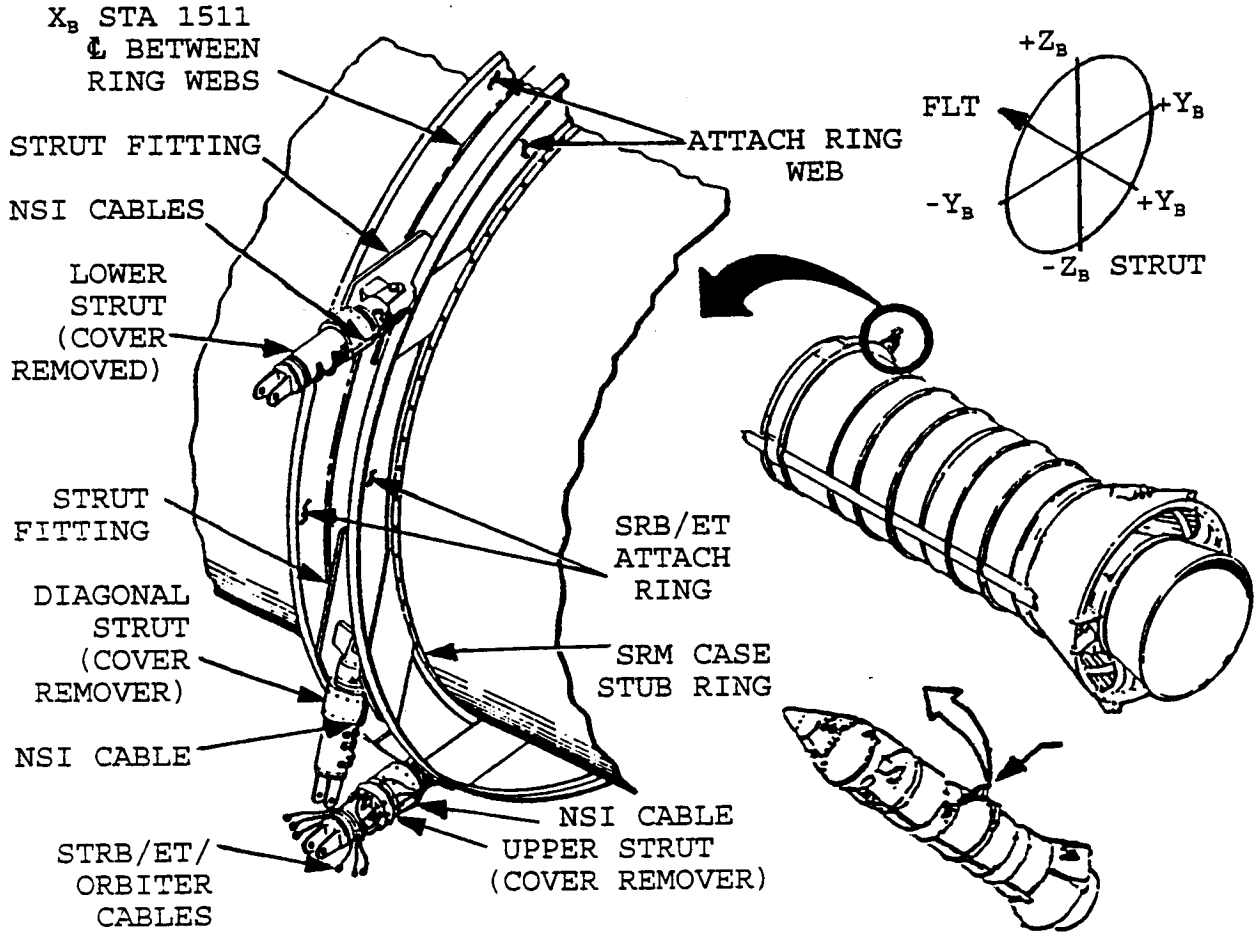
This document is an information source only and should not be used for design purposes.

## NASA/DOD/DOE Pyrotechnic System

**TITLE:** Bolt System - SRB/ET Aft Separation

**AGENCY/CENTER:** NASA/Marshall Space Flight Center (MSFC)

**PHYSICAL DATA:**




VIEW ROTATED 180°

SRB/ET AFT SEPARATION BOLT SYSTEM

**CONTRACTOR:** USBI

**SUBCONTRACTOR:** USBI

**SYSTEM IDENTIFICATION NUMBER:**
No system number; refer to specific components (devices).

**PURPOSE:**
To provide aft SRB/ET separation by the use of three aft struts held together at the separation plane by three separation bolts.

# NASA/DOD/DOE Pyrotechnic System

**PREVIOUS USAGE:**
n/a

**OPERATIONAL DESCRIPTION:**
The aft SRB/ET separation system consists of three aft separation bolts located in three aft struts with two NSI pressure cartridges per separation bolt, six per SRB/ET separation system. The struts are held together at the separation plane by the separation bolts. The bolts are fractured at the preselected fracture groove when the NSI pressure cartridges are initiated. The separation sequence begins when the internal pressure of both SRMs is below 50 psi. At that point redundant separation signals are sent to the aft struts which initiate the redundant NSI pressure cartridges. The pressure produced by each NSI pressure cartridge acts against a primary piston. The force of the primary piston is amplified through the compression of soft lead couplings. The amplified force is then applied to a secondary piston. The redundant side of the bolt also applies a amplified force to its secondary piston. The two secondary pistons reacting against each other or against the shoulder of the opposite insert, depending on the simultaneity of the firing of the two cartridges, cause the bolt housing to fail in tension. The sudden release of tension and the extra margin of force/piston overstroke will accelerate both ends of the bolt to approximately 100 foot/second. Crushable honeycomb is installed in both ends of the strut to decellerate and stop both ends of the separation bolt.

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** **Low** +20° F
**High** +120° F for 4 hours
**PRESSURE:** Refer to specific components (devices).

**LIST OF DEVICES:**
6 NSI Pressure Cartridges, 2 per bolt, 10303-0001-801
3 Aft Separation Bolts, 10302-0001-801

**QUALIFICATION DOCUMENTATION:**
n/a

**ADDITIONAL REFERENCES:**
n/a

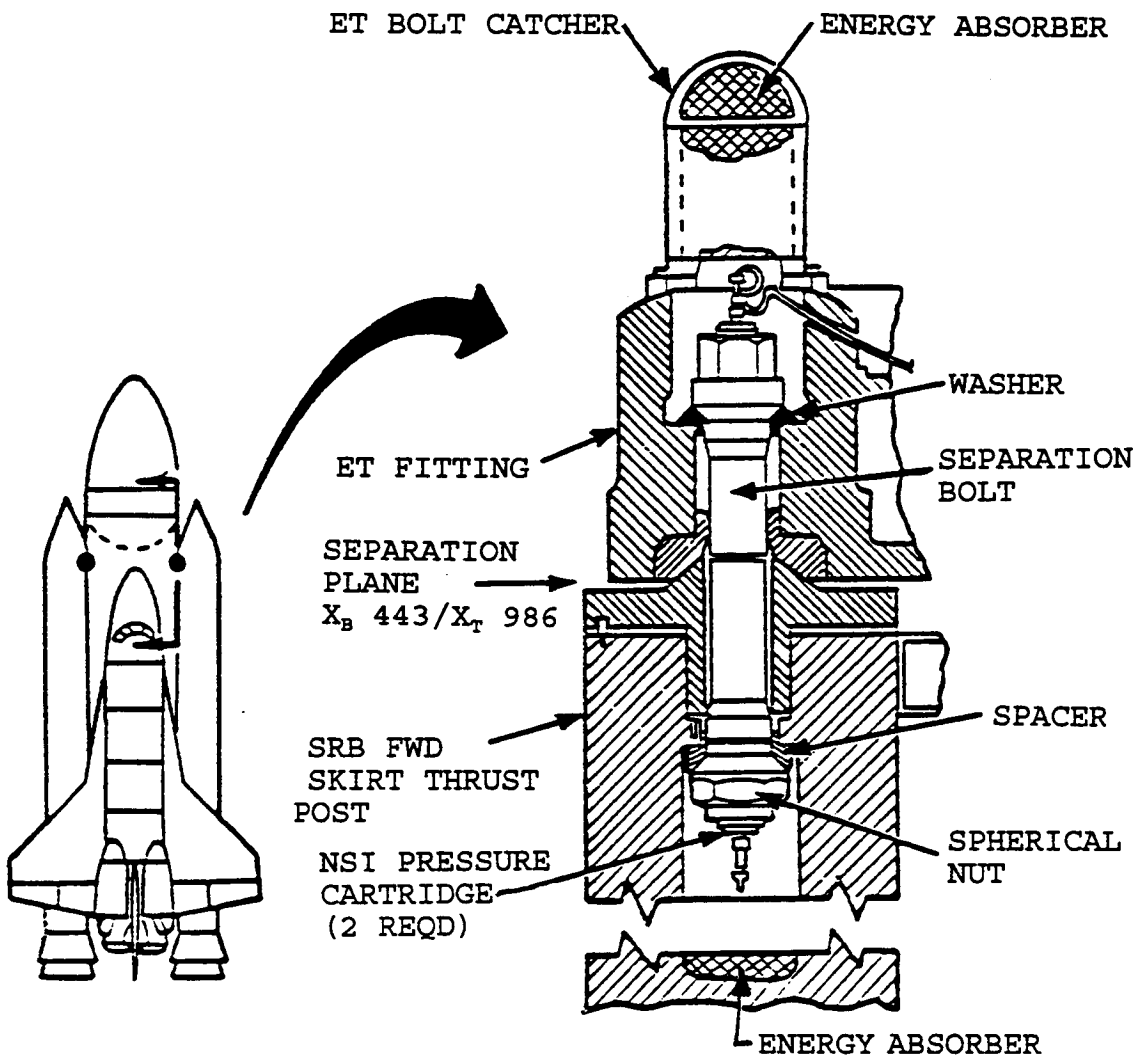
**ADDITIONAL COMMENTS:**
n/a

# NASA/DOD/DOE Pyrotechnic System

**TITLE:** Bolt System - SRB/ET Forward Separation

**AGENCY/CENTER:** NASA/Marshall Space Flight Center (MSFC)

**PHYSICAL DATA:**




FORWARD SOLID ROCKET BOOSTER/EXTERNAL TANK (SRB/ET)
SEPARATION BOLT SYSTEM

**CONTRACTOR:** USBI

**SUBCONTRACTOR:** USBI

**SYSTEM IDENTIFICATION NUMBER:**
No system number; refer to specific components (devices).

**PURPOSE:**
To provide separation at the SRB/ET foward interface by way of a separation bolt.

# NASA/DOD/DOE Pyrotechnic System

**PREVIOUS USAGE:**
n/a

**OPERATIONAL DESCRIPTION:**
When the SRB and ET separate, the separation bolt is fractured at the predetermined separation plane allowing separation of the SRB/ET foward interface. The separation sequence begins when the internal pressure of both SRMs are below 50 psi. At that point redundant separation signals are sent to the foward attach points which initiate the redundant NSI pressure cartridges. The pressure produced by each NSI pressure cartridge acts against a primary piston. The force of the primary piston is amplified through the compression of soft lead couplings. The amplified force is then applied to a secondary piston. The redundant side of the bolt also applies a amplified force to its secondary piston. The two secondary pistons reacting against each other or against the shoulder of the opposite insert, depending on the simultaneity of the firing of the two cartridges, cause the bolt housing to fail in tension. The sudden release of tension and the extra margin of force/piston overstroke will accelerate both ends of the bolt to approximately 100 foot/second. Crushable honeycomb is installed in the SRB thrust fitting and ET bolt catcher to decelerate and stop both ends of the separation bolt.

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** **Low** −10° F
**High** +120° F for 4 hours
**PRESSURE:** Refer to specific components (devices).

**LIST OF DEVICES:**
2 NSI Pressure Cartridges, 10303-0001-801
3 Foward Separation Bolts, 10302-0001-801

**QUALIFICATION DOCUMENTATION:**
n/a

**ADDITIONAL REFERENCES:**
n/a

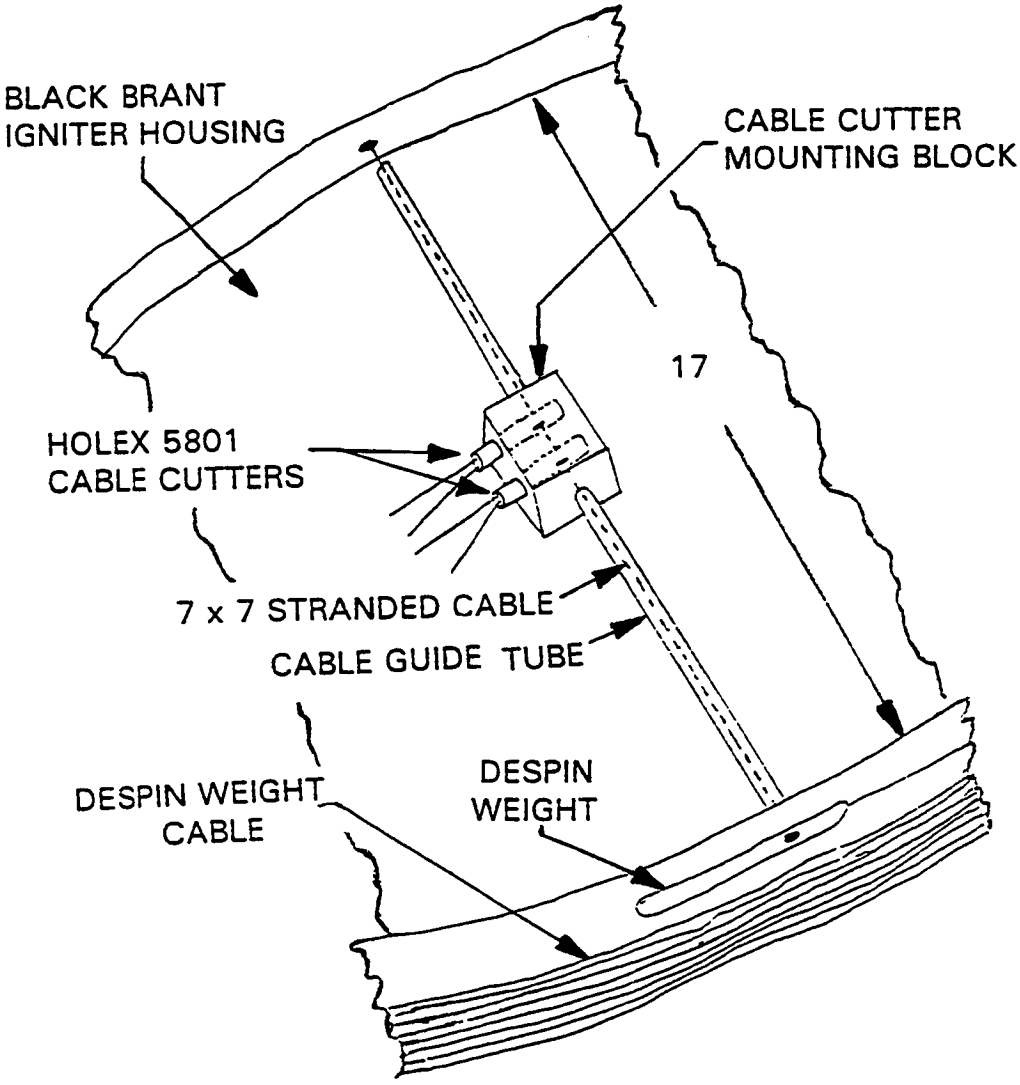
**ADDITIONAL COMMENTS:**
n/a

## NASA/DOD/DOE Pyrotechnic System

**TITLE:** Cutter System - BLACK BRANT Despin Cable

**AGENCY/CENTER:** NASA Goddard Space Flight System (GSFC)/Wallops Flight Facility (WFF)

**PHYSICAL DATA:**




1-12 BLACK BRANT DESPIN CABLE CUTTER SYSTEM

**CONTRACTOR:** Bristol Aerospace Limited

**SUBCONTRACTOR:** See Device Vendor

**SYSTEM IDENTIFICATION NUMBER:**
n/a

**PURPOSE:**
To release a pair of despin weights which serve to decrease the roll rate of a spinning vehicle.

# NASA/DOD/DOE Pyrotechnic System

**PREVIOUS USAGE:**
Used on Multiple NASA GSFC/WFF Sounding Rocket Missions.

**OPERATIONAL DESCRIPTION:**
The system employs redundant holex 5801 cable cutters to sever a 7x7 stranded cable which keeps the despin weights in place. After the cable is severed, the inertial force due to the spinning vehicle causes the despin weights to unwrap from it's stowed state around the circumference of the vehicle.

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** **Low** n/a
**High** n/a
**PRESSURE:** n/a

**LIST OF DEVICES:**
Holex 5801 cable cutter

**QUALIFICATION DOCUMENTATION:**
n/a

**ADDITIONAL REFERENCES:**
n/a

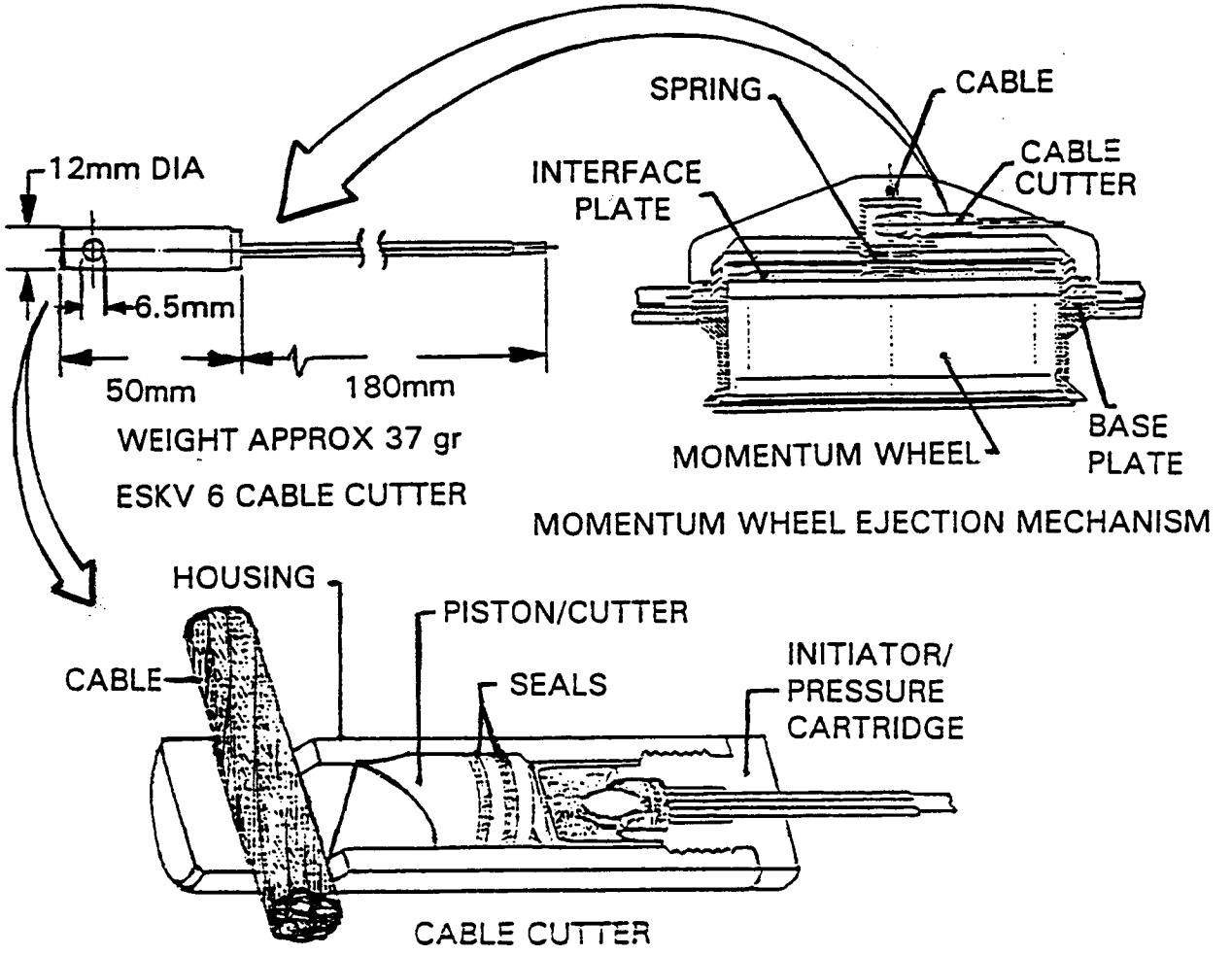
**ADDITIONAL COMMENTS:**
n/a

## NASA/DOD/DOE Pyrotechnic System

**TITLE:** Cutter System - BREM-SAT Flap Release Cable

**AGENCY/CENTER:** NASA Goddard Space Flight Center (GSFC)

**PHYSICAL DATA:**




BREM-SAT PAYLOAD CABLE CUTTER FOR FLAP RELEASE

**CONTRACTOR:** n/a

**SUBCONTRACTOR:** Dynamit Nobel

**SYSTEM IDENTIFICATION NUMBER:**
Refer to List of Devices (below)

**PURPOSE:**
Cable cutter will be used for flap release to stabilize the satellite after the momentum wheel has been released.

# NASA/DOD/DOE Pyrotechnic System

**PREVIOUS USAGE:**
n/a

**OPERATIONAL DESCRIPTION:**
The cable cutters are single bridge wire types. Each stabilizing flap is fixed to the baseplate via two hinges and a hook. The hook is fixed by a tension hook and a steel rope. The steel rope is held in a matched hole. Upon connection of a specified electric current, the steel rope will be cut by the pyrotechnically driven cutting blade. All four flaps will then be released by springs which are located at the hinges.

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** **Low** -40°C
**High** +63°C
**PRESSURE:** n/a

**LIST OF DEVICES:**
Cable Cutter; Dynamit Nobel #ESKV 2

**QUALIFICATION DOCUMENTATION:**
n/a

**ADDITIONAL REFERENCES:**
n/a

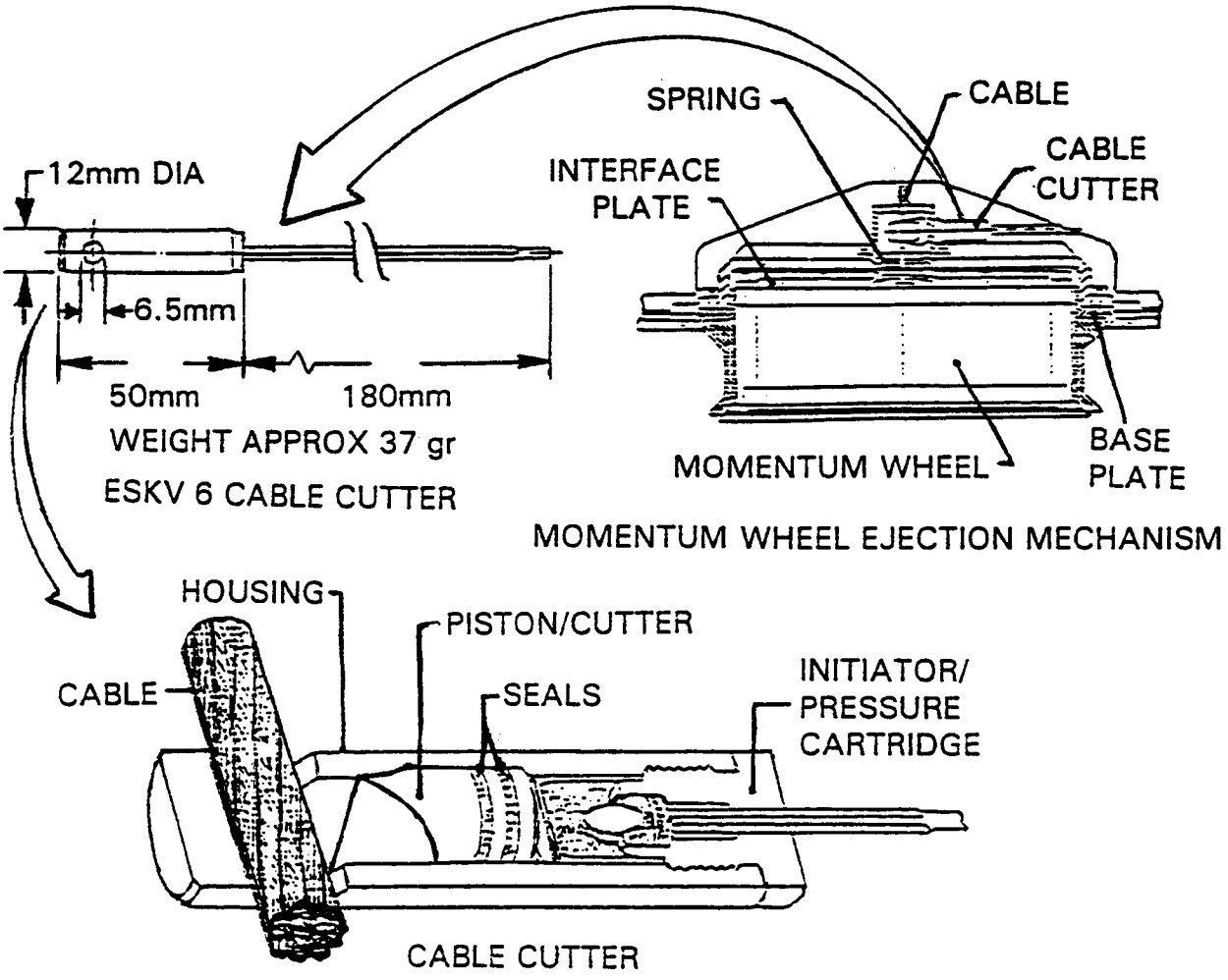
**ADDITIONAL COMMENTS:**
n/a

## NASA/DOD/DOE Pyrotechnic System

**TITLE:** Cutter System - BREM-SAT Momentum Wheel Cable/Harness

**AGENCY/CENTER:** NASA Goddard Space Flight Center (GSFC)

**PHYSICAL DATA:**




BREM-SAT PAYLOAD CABLE CUTTER FOR MOMENTUM WHEEL CABLE/HARNESS

**CONTRACTOR:** n/a

**SUBCONTRACTOR:** Dynamit Nobel

**SYSTEM IDENTIFICATION NUMBER:**
Refer to List of Devices (below)

**PURPOSE:**
Cable cutter will be to cut the momentum wheel cable/harness.

# NASA/DOD/DOE Pyrotechnic System

**PREVIOUS USAGE:**
n/a

**OPERATIONAL DESCRIPTION:**
The cable cutters are single bridge wire types. The cable/harness is held in a matched hole. After ignition of the cable cutter the cable/harness will be cut to allow the momentum wheel to be ejected.

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** **Low** -40°C
**High** +63°C
**PRESSURE:** n/a

**LIST OF DEVICES:**
Cable Cutter; Dynamit Nobel #ESKV 6

**QUALIFICATION DOCUMENTATION:**
n/a

**ADDITIONAL REFERENCES:**
n/a

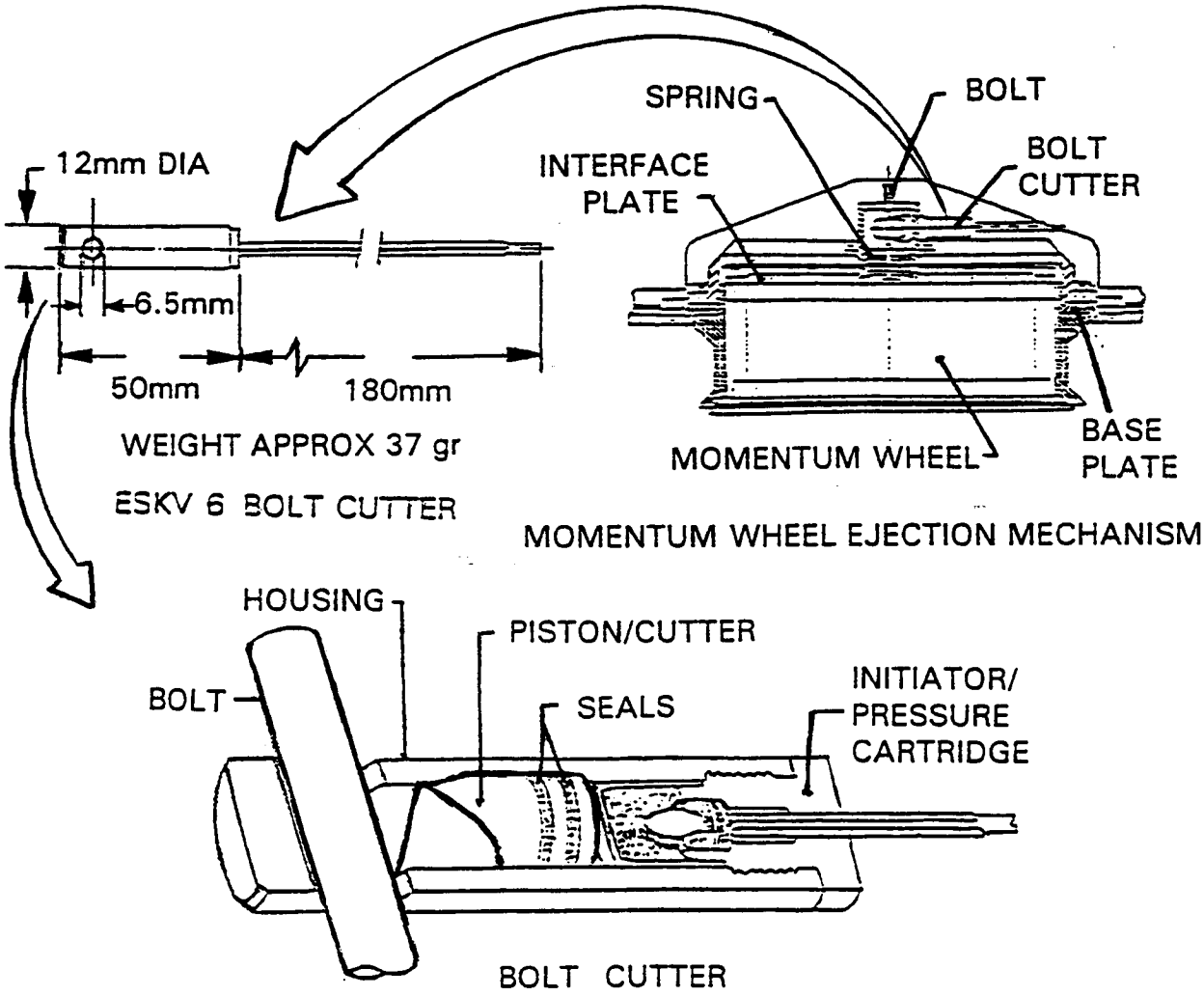
**ADDITIONAL COMMENTS:**
Cable Cutters comply with MIL-STD 331.

## NASA/DOD/DOE Pyrotechnic System

**TITLE:** Cutter System - BREM-SAT Momentum Wheel Ejection Bolt

**AGENCY/CENTER:** NASA Goddard Space Flight Center (GSFC)

**PHYSICAL DATA:**




BREM-SAT PAYLOAD BOLT CUTTER FOR MOMENTUM WHEEL EJECTION

**CONTRACTOR:** n/a

**SUBCONTRACTOR:** Dynamit Nobel

**SYSTEM IDENTIFICATION NUMBER:**
Refer to List of Devices (below)

**PURPOSE:**
Bolt cutter will eject the momentum wheel.

# NASA/DOD/DOE Pyrotechnic System

**PREVIOUS USAGE:**
n/a

**OPERATIONAL DESCRIPTION:**
The bolt cutter is single bridge wire type. The bolt is held in a matched hole. After ignition of the bolt cutter the central bolt will be cut and the momentum wheel will be ejected by a spring that is located between the housing and the interface plate.

**OPERATING TEMPERATURE/PRESSURE:**

**TEMPERATURE RANGE:** **Low** −40°C
**High** +63°C

**PRESSURE:** n/a

**LIST OF DEVICES:**
Bolt Cutter; Dynamit Nobel # ESKV 4

**QUALIFICATION DOCUMENTATION:**
n/a

**ADDITIONAL REFERENCES:**

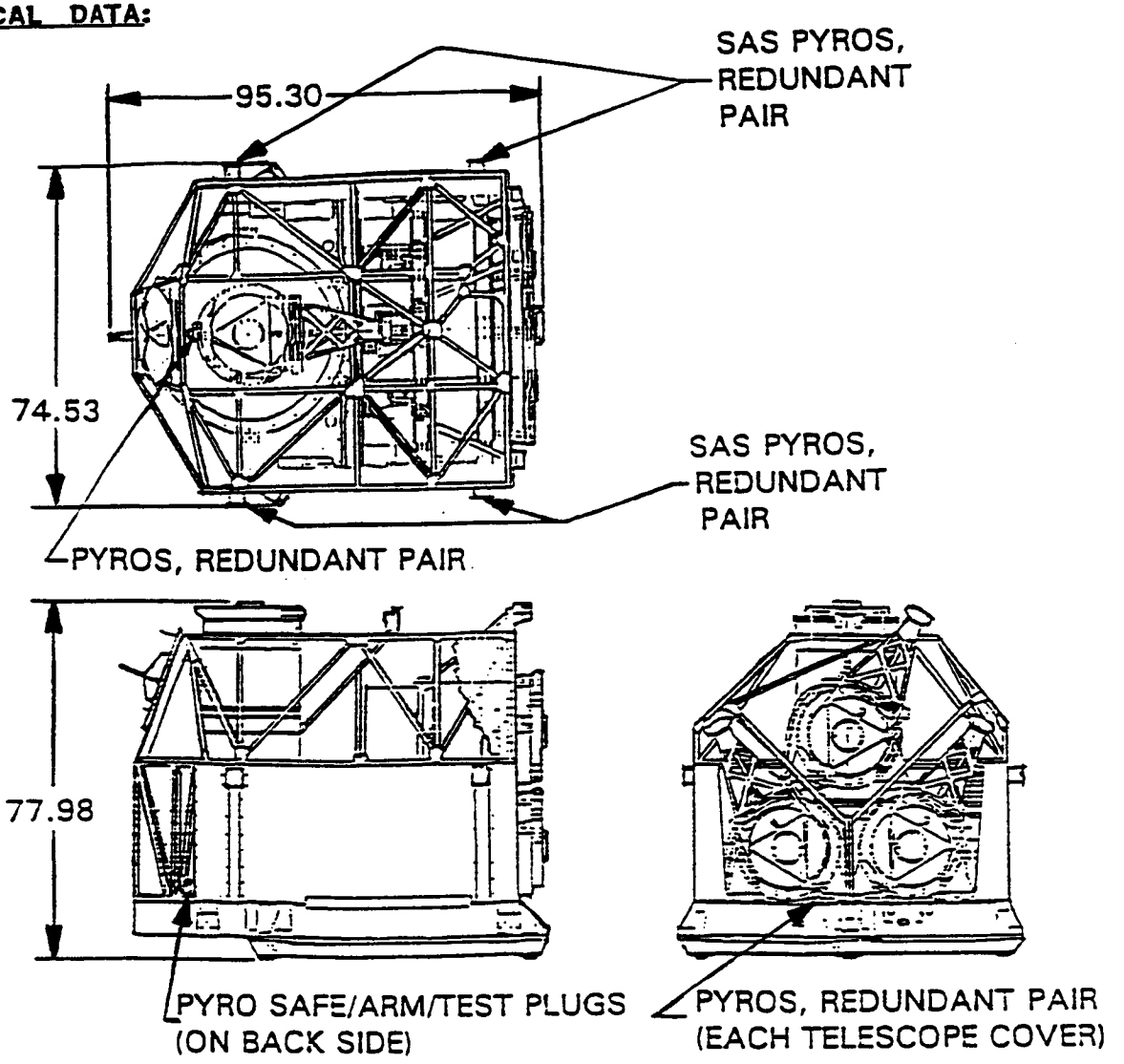
**ADDITIONAL COMMENTS:**
Cable cutters comply with MIL-STD-331.

# NASA/DOD/DOE Pyrotechnic System

**TITLE:** Cutter System - EUVE Detector Chamber Door Release Bolt

**AGENCY/CENTER:** NASA Goddard Space Flight Center (GSFC)

**PHYSICAL DATA:**




EUVE PAYLOAD DETECTOR CHAMBER DOOR RELEASE

**CONTRACTOR:** n/a

**SUBCONTRACTOR:** Whittaker

**SYSTEM IDENTIFICATION NUMBER:**
n/a

**PURPOSE:**
Back-up method of opening the motorized hinged door covering the end of the detector housing in each telescope.

# NASA/DOD/DOE Pyrotechnic System

**PREVIOUS USAGE:**
n/a

**OPERATIONAL DESCRIPTION:**
n/a

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** **Low** n/a
**High** n/a

**PRESSURE:** n/a

**LIST OF DEVICES:**
Bolt Butter; Whittaker #13200-2

**QUALIFICATION DOCUMENTATION:**
n/a

**ADDITIONAL REFERENCES:**
n/a

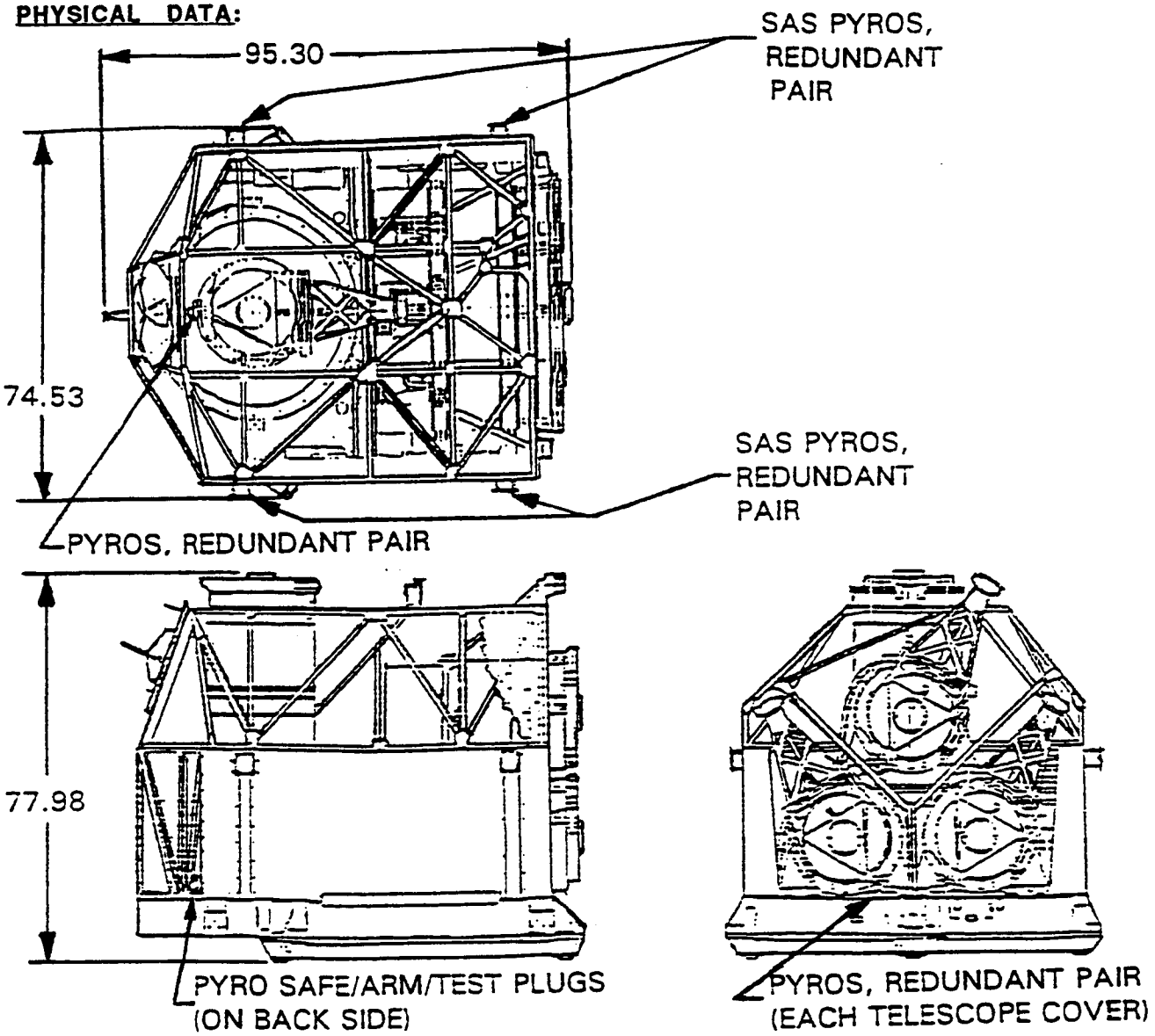
**ADDITIONAL COMMENTS:**
Bridgewire Resistance: 1.0 Ohms ± 5%; All fire current: 4.0 amps; No fire current: 1.0 amp, 1 watt for 5 minutes minimum.

# NASA/DOD/DOE Pyrotechnic System

**TITLE:** Cutter System - EUVE Solar Array Paddle Deployment Bolt

**AGENCY/CENTER:** NASA Goddard Space Flight Center (GSFC)

**PHYSICAL DATA:**




EUVE PAYLOAD SOLAR ARRAY PADDLE DEPLOYMENT

**CONTRACTOR:** n/a

**SUBCONTRACTOR:** Hi-Shear Technology, Inc.

**SYSTEM IDENTIFICATION NUMBER:**
Refer to List of Devices (below)

**PURPOSE:**
Activates Solar Array Deployment Mechanism.

# NASA/DOD/DOE Pyrotechnic System

**PREVIOUS USAGE:**
n/a

**OPERATIONAL DESCRIPTION:**
The Solar Array pyro fire lines (consisting of four redundant circuits) will be interconnected from the SC and CU to the PED/ Payload interface connector. The payload harness will interconnect these lines from the interface connector to the solar array bolt cutter ordnance devices attached to the structure.

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** **Low** n/a
**High** n/a

**PRESSURE:** n/a

**LIST OF DEVICES:**
Bolt Cutter; Hi-Shear #SL1056-3
NASA Standard Initiator (NSI); JSC SEB 26100001-217

**QUALIFICATION DOCUMENTATION:**
n/a

**ADDITIONAL REFERENCES:**
n/a

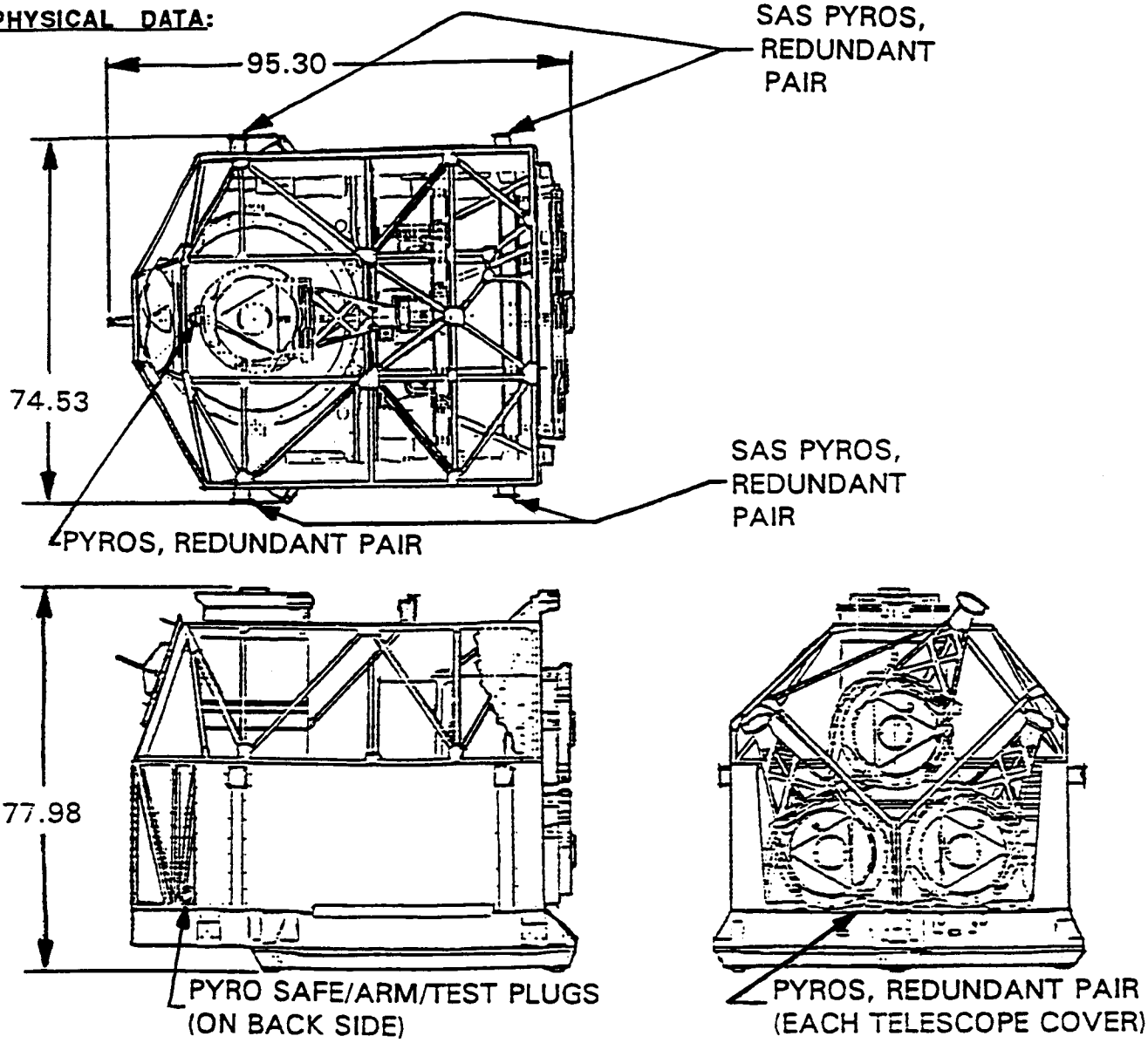
**ADDITIONAL COMMENTS:**
Bridgewire Resistance: 1.05 ± 0.1 Ohms; All fire current: 3.5 amps for 10 ms max.; No fire current: 1.0 amp, 1 watt for 5 minutes minimum.

# NASA/DOD/DOE Pyrotechnic System

**TITLE:** Cutter System - EUVE Solar Array Panel Deployment Bolt

**AGENCY/CENTER:** NASA Goddard Space Flight Center (GSFC)

**PHYSICAL DATA:**




EUVE PAYLOAD SOLAR ARRAY PANEL DEPLOYMENT

**CONTRACTOR:** n/a

**SUBCONTRACTOR:** Hi-Shear Technology, Inc.

**SYSTEM IDENTIFICATION NUMBER:**
Refer to List of Devices (below)

**PURPOSE:**
Releases the Solar Array Panels (three 1.37 x 2.13 m (54 x 84 in.) panels per paddle) so they can unfold.

# NASA/DOD/DOE Pyrotechnic System

**PREVIOUS USAGE:**
n/a

**OPERATIONAL DESCRIPTION:**
The Solar Array pyro fire lines (consisting of four redundant circuits) will be interconnected from the SC and CU to the PED/ Payload interface connector. The payload harness will interconnect these lines from the interface connector to the solar array bolt cutter ordnance devices attached to the structure.

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** **Low** n/a
**High** n/a

**PRESSURE:** n/a

**LIST OF DEVICES:**
Bolt Cutter; Hi-Shear #SL1056-3
NASA Standard Initiator (NSI); JSC SEB 26100001-216

**QUALIFICATION DOCUMENTATION:**
n/a

**ADDITIONAL REFERENCES:**
n/a

**ADDITIONAL COMMENTS:**
Bridgewire Resistance: 1.05 ± 0.1 Ohms; All fire current: 3.5 amps for 10 ms max.; No fire current: 1.0 amp, 1 watt for 5 minutes minimum.

Explosive composition and weight: 114 mg. Zirconium/Potassium Perchorate/ Graphite Formulation

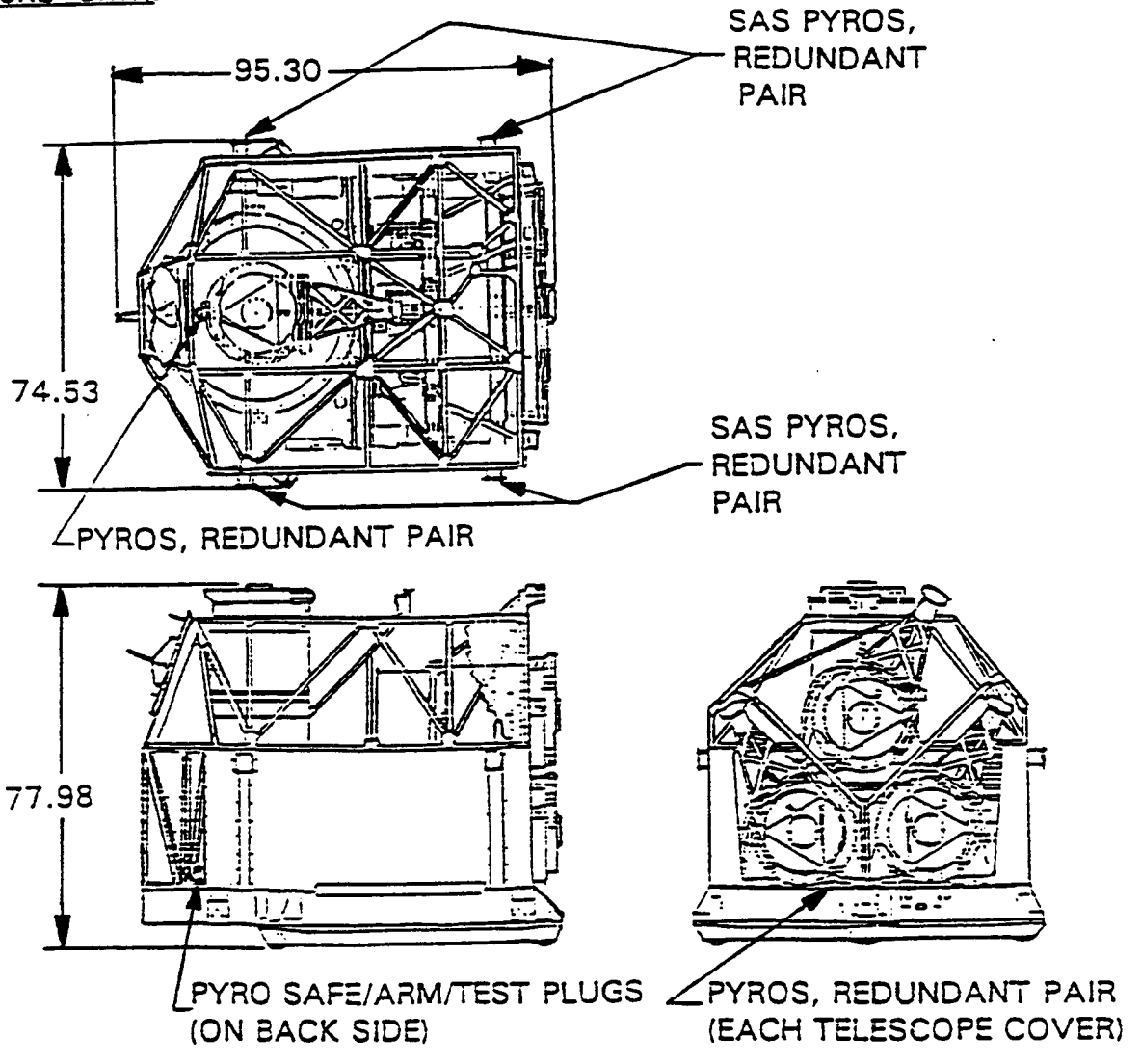
All pyro circuits are fully redundant and conform to the requirements of MIL-STD-1512.

# NASA/DOD/DOE Pyrotechnic System

**TITLE:** Cutter System - EUVE Telescope Door Release Bolt

**AGENCY/CENTER:** NASA Goddard Space Flight Center (GSFC)

**PHYSICAL DATA:**




EUVE PAYLOAD TELESCOPE DOOR RELEASE

**CONTRACTOR:** n/a

**SUBCONTRACTOR:** Whittaker

**SYSTEM IDENTIFICATION NUMBER:**
Refer to List of Devices (below)

**PURPOSE:**
Releases the spring-operated door covering the end of each telescope housing.

# NASA/DOD/DOE Pyrotechnic System

**PREVIOUS USAGE:**
n/a

**OPERATIONAL DESCRIPTION:**
n/a

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** **Low** n/a
**High** n/a
**PRESSURE:** n/a

**LIST OF DEVICES:**
Bolt Cutter; Whittaker #13200-2

**QUALIFICATION DOCUMENTATION:**
n/a

**ADDITIONAL REFERENCES:**
n/a

**ADDITIONAL COMMENTS:**
Bridgewire Resistance: 1.0 Ohms ± 5%; All fire current: 4.0 amps; No fire current: 1.0 amp, 1 watt for 5 minutes minimum.

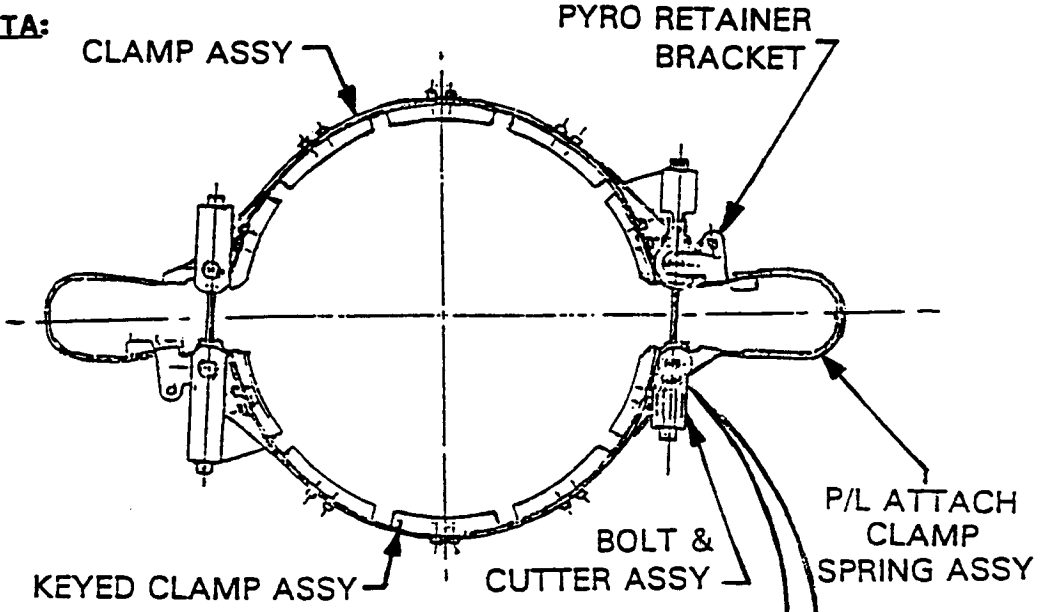
All pyro circuits are fully redundant and conform to the requirements of MIL-STD-1512.

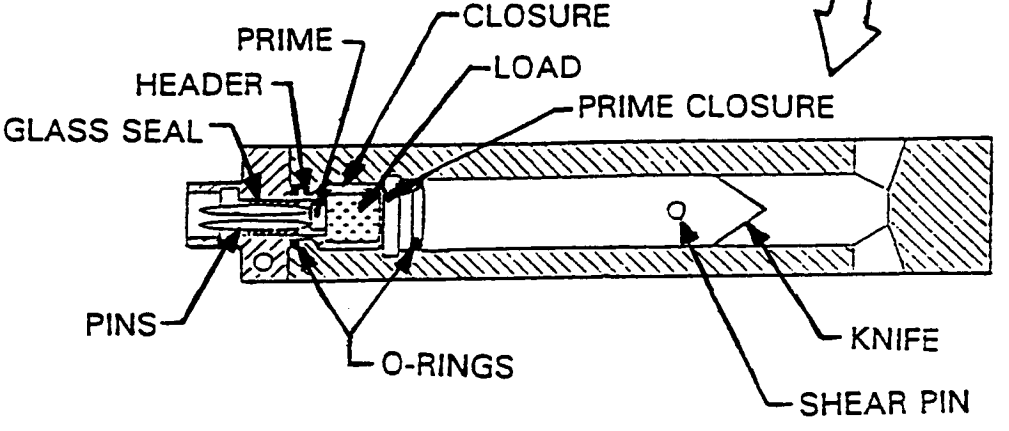
## NASA/DOD/DOE Pyrotechnic System

**TITLE:** Cutter System - Marman Band Bolt

**AGENCY/CENTER:** NASA Goddard Space Flight Center (GSFC)

**PHYSICAL DATA:**




BOLT CUTTER DEVICE

MARMAN BAND BOLT CUTTER

**CONTRACTOR:** McDonnell Douglas (MDAC)

**SUBCONTRACTOR:** n/a

**SYSTEM IDENTIFICATION NUMBER:**
MDAC 1B9975 Gas Carrier Ejection System

**PURPOSE:**
Redundant pyrotechnic bolt cutters are used to shear two bolts that are 180° apart. When either of the bolt cutters is fired, it shears the bolts which in turn releases the Marman band from the payload and initiates the deployment of the payload.

# NASA/DOD/DOE Pyrotechnic System

**PREVIOUS USAGE:**
Similar to flight qualified bolt cutter assembly currently used on all models of NASA Delta launch vehicle as well as the USAF Block 5-D program.

**OPERATIONAL DESCRIPTION:**
The bolt cutter assembly consists of a cutter and electrically initiated squibs. The squibs are installed in the cutter at the supplier facility and are not removed thereafter. Two 1B99775 bolt cutter assemblies are used for redundancy in severing the bolts which secure the clamp band assembly. The squibs conform to MIL-STD-1512; they have a maximum No-Fire current of 1 amp, 1 watt for 5 minutes. The squibs also have a single bridge wire and are in compliance with Shuttle requirements; however, they are not NSI's. Reduandancy is provided by the use of one cutter on each of the clamp bolts. Cutting of either bolt will permit the clamp band to release the payload.

The cartridge used in the 1B99775 bolt cutter meets the design requirements of MIL-STD-1512. It is a 1 amp 1 watt EEDC and contains a design feature of 25,000 volts protection for ESD. Initiation of the squibs creates gas pressure which drives the cutter blade through the clamp bolt.

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** **Low** n/a
**High** n/a

**PRESSURE:** n/a

**LIST OF DEVICES:**
n/a

**QUALIFICATION DOCUMENTATION:**
n/a

**ADDITIONAL REFERENCES:**
n/a

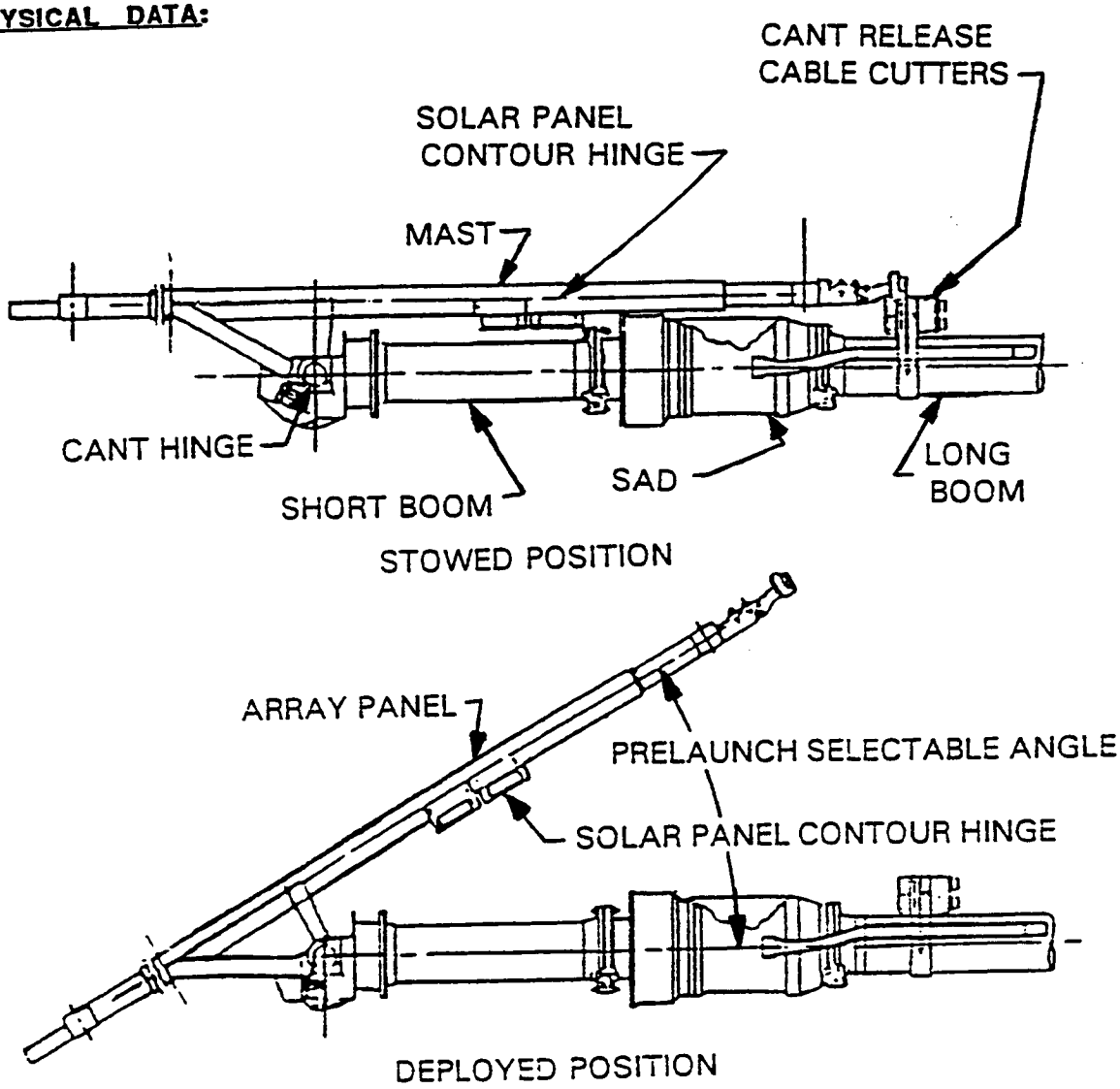
**ADDITIONAL COMMENTS:**
n/a

## NASA/DOD/DOE Pyrotechnic System

**TITLE:** Cutter System - NOAA Cant Release Cable

**AGENCY/CENTER:** NASA Goddard Space Flight Center (GSFC)

**PHYSICAL DATA:**




NOAA PAYLOAD CANT RELEASE CABLE CUTTER

**CONTRACTOR:** n/a

**SUBCONTRACTOR:** Hi-Shear

**SYSTEM IDENTIFICATION NUMBER:**
Refer to List of Devices (below)

**PURPOSE:**
Cable cutter will be used for Cant release

# NASA/DOD/DOE Pyrotechnic System

**PREVIOUS USAGE:**
n/a

**OPERATIONAL DESCRIPTION:**
The Cant cable cutter is EED initiated by a software-initiated computer-controlled fire command after orbit insertion. The deployable Cant is actuated by cable cutters which sever the cable.

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** Low n/a
High n/a

**PRESSURE:** n/a

**LIST OF DEVICES:**
Cord Cutter; Hi-Shear #SL1022J
Power Cartridge; Hi-Shear #3267153-1

**QUALIFICATION DOCUMENTATION:**
n/a

**ADDITIONAL REFERENCES:**
n/a

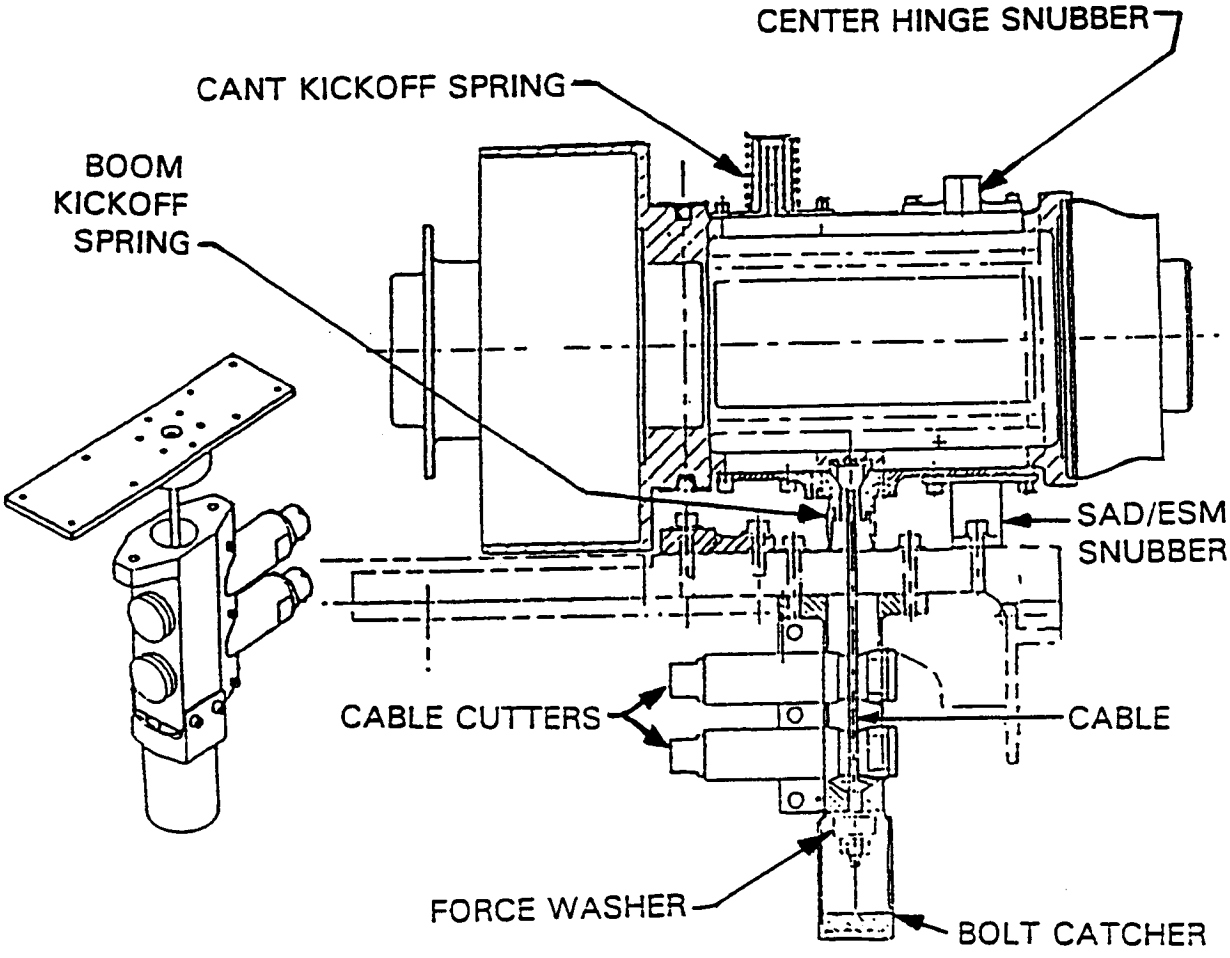
**ADDITIONAL COMMENTS:**
All-fire current: 3.5 Amps for 10 ms; No-fire current: 1.0 amp ,5 min. 1.0 watt for 5.0 minutes; Bridgewire Resistance: 1.05 ± 0. 10 Ohms

## NASA/DOD/DOE Pyrotechnic System

**TITLE:** Cutter System - NOAA Solar Array Boom Cable

**AGENCY/CENTER:** NASA Goddard Space Flight Center (GSFC)

**PHYSICAL DATA:**




NOAA PAYLOAD SOLAR ARRAY BOOM CABLE CUTTERS

**CONTRACTOR:**

**SUBCONTRACTOR:**

**SYSTEM IDENTIFICATION NUMBER:**
Refer to List of Devices (below)

**PURPOSE:**
Cable cutter will be used for Solar Array Boom release.

# NASA/DOD/DOE Pyrotechnic System

**PREVIOUS USAGE:**
n/a

**OPERATIONAL DESCRIPTION:**
The Solar Array Boom cable cutters are EED initiated by a software-initiated computer-controlled fire command after orbit insertion. The deployable Solar Array Boom is actuated by cable cutters which sever the cable.

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** **Low** n/a
**High** n/a

**PRESSURE:** n/a

**LIST OF DEVICES:**

**QUALIFICATION DOCUMENTATION:**
n/a

**ADDITIONAL REFERENCES:**
n/a

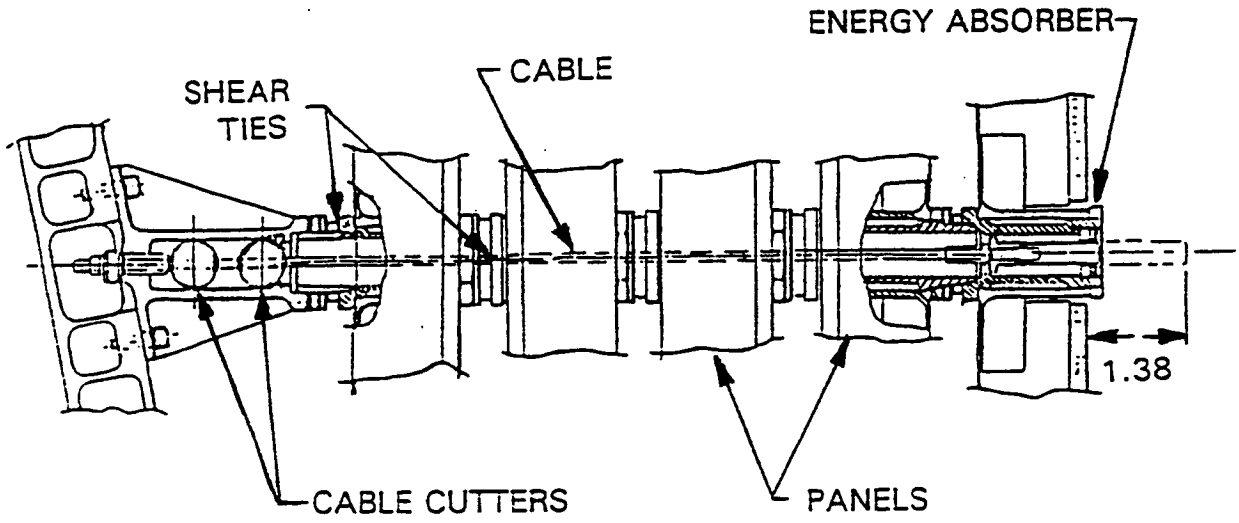
**ADDITIONAL COMMENTS:**
All-fire current: 3.5 Amps for 10 ms; No-fire current: 1.0 amp ,5 min. 1.0 watt for 5.0 minutes; Bridgewire Resistance: 1.05 ± 0. 10 Ohms

# NASA/DOD/DOE Pyrotechnic System

**TITLE:** Cutter System - NOAA Solar Array Cable

**AGENCY/CENTER:** NASA Goddard Space Flight Center (GSFC)

**PHYSICAL DATA:**




NOAA PAYLOAD SOLAR ARRAY CABLE CUTTERS

**CONTRACTOR:** n/a

**SUBCONTRACTOR:** Hi-Shear

**SYSTEM IDENTIFICATION NUMBER:**
Refer to List of Devices (below)

**PURPOSE:**
Cable cutter will be used for Solar Array release.

# NASA/DOD/DOE Pyrotechnic System

**PREVIOUS USAGE:**
n/a

**OPERATIONAL DESCRIPTION:**
The Solar Array cable cutters are EED initiated by a software-initiated computer-controlled fire command after orbit insertion. The deployable Solar Array is actuated by cable cutters which sever the cable. At least two cutters must fire to release panels. The energy absorber located at the face of the array will capture and restrain the severed cable.

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** **Low** n/a
**High** n/a

**PRESSURE:** n/a

**LIST OF DEVICES:**
Cord Cutter; Hi-Shear SL1022J
Power Cartridge; Hi-Shear 3267153-1 & -2

**QUALIFICATION DOCUMENTATION:**
n/a

**ADDITIONAL REFERENCES:**
n/a

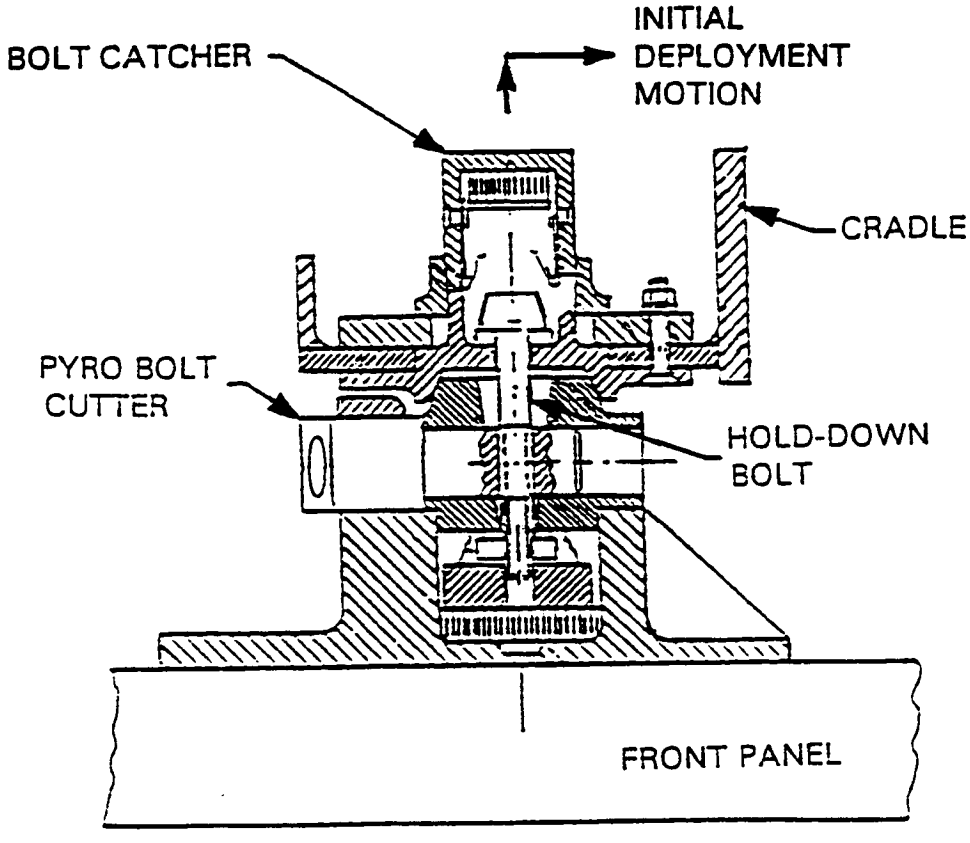
**ADDITIONAL COMMENTS:**
All-fire current: 3.5 Amps for 10 ms; No-fire current: 1.0 amp ,5 min. 1.0 watt for 5.0 minutes; Bridgewire Resistance: 1.05 ± 0. 10 Ohms

## NASA/DOD/DOE Pyrotechnic System

**TITLE:** Bolt Cutter System - NOAA SRA Deployment

**AGENCY/CENTER:** NASA Goddard Space Flight Center (GSFC)

**PHYSICAL DATA:**




NOAA PAYLOAD SRA DEPLOYMENT BOLT CUTTER

**CONTRACTOR:** n/a

**SUBCONTRACTOR:** Hi-Shear

**SYSTEM IDENTIFICATION NUMBER:**
Refer to List of Devices (below)

**PURPOSE:**
Bolt cutter will be used to deploy the SRA.

# NASA/DOD/DOE Pyrotechnic System

**PREVIOUS USAGE:**
n/a

**OPERATIONAL DESCRIPTION:**
The SRA deployment bolt cutter EED is initiated by a software-initiated fire command after orbit insertion.

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** **Low** n/a
**High** n/a
**PRESSURE:** n/a

**LIST OF DEVICES:**
Bolt Cutter; Hi-Shear #SL-1047D
Power Cartridge; Hi-Shear #2295262-12

**QUALIFICATION DOCUMENTATION:**
n/a

**ADDITIONAL REFERENCES:**
n/a

**ADDITIONAL COMMENTS:**
3.5 Amps; No-fire current: 1.0 amp , min 1.0 watt for 5.0 minutes; Bridgewire Resistance: 1.05 ± 0.10 Ohms

# NASA/DOD/DOE Pyrotechnic System

**TITLE:** Cutter System - NOAA Sunshade Cord

**AGENCY/CENTER:** NASA Goddard Space Flight Center (GSFC)

**PHYSICAL DATA:**

FIGURE

N/A

**CONTRACTOR:** n/a

**SUBCONTRACTOR:** Hi-Shear

**SYSTEM IDENTIFICATION NUMBER:**
Refer to List of Devices (below)

**PURPOSE:**
Cord cutter will be used for Deployable Sun Shade release.

# NASA/DOD/DOE Pyrotechnic System

**PREVIOUS USAGE:**
n/a

**OPERATIONAL DESCRIPTION:**
The sunshade cord cutter is EED initiated by a software-initiated fire command after orbit insertion. The deployable sunshades are actuated by cord cutters which sever the Kevlar cord. Two cord cutters are used for each deployable shade to provide release redundancy. The +Y sunshade deploys 116° and the -Y sunshade deploys 131°.

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** **Low** n/a
**High** n/a
**PRESSURE:** n/a

**LIST OF DEVICES:**
Cord Cutter; Hi-Shear SL1011T
Power Cartridge; Hi-Shear 2295262-3

**QUALIFICATION DOCUMENTATION:**
n/a

**ADDITIONAL REFERENCES:**

**ADDITIONAL COMMENTS:**
.5 Amps; No-fire current: 1.0 amp , min. 1.0 watt for 5.0 minutes; Bridgewire Resistance: 1.05 ± 0.10 Ohms

# NASA/DOD/DOE Pyrotechnic System

**TITLE:** Cutter System - NOAA VRA Cord

**AGENCY/CENTER:** NASA Goddard Space Flight Center (GSFC)

**PHYSICAL DATA:**

FIGURE

N/A

**CONTRACTOR:** n/a

**SUBCONTRACTOR:** Hi-Shear

**SYSTEM IDENTIFICATION NUMBER:**
Refer to List of Devices (below)

**PURPOSE:**
Cord cutter will be used for Deployable Sun Shade release.

# NASA/DOD/DOE Pyrotechnic System

**PREVIOUS USAGE:**
n/a

**OPERATIONAL DESCRIPTION:**
The VRA cord cutter is EED initiated by a software-initiated fire command after orbit insertion. The VRA are actuated by cord cutters which sever the cord.

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** **Low** n/a
**High** n/a
**PRESSURE:** n/a

**LIST OF DEVICES:**
Cord Cutter; Hi-Shear # SL1022J
Power Cartridge; Hi-Shear #3267153-1

**QUALIFICATION DOCUMENTATION:**
n/a

**ADDITIONAL REFERENCES:**
n/a

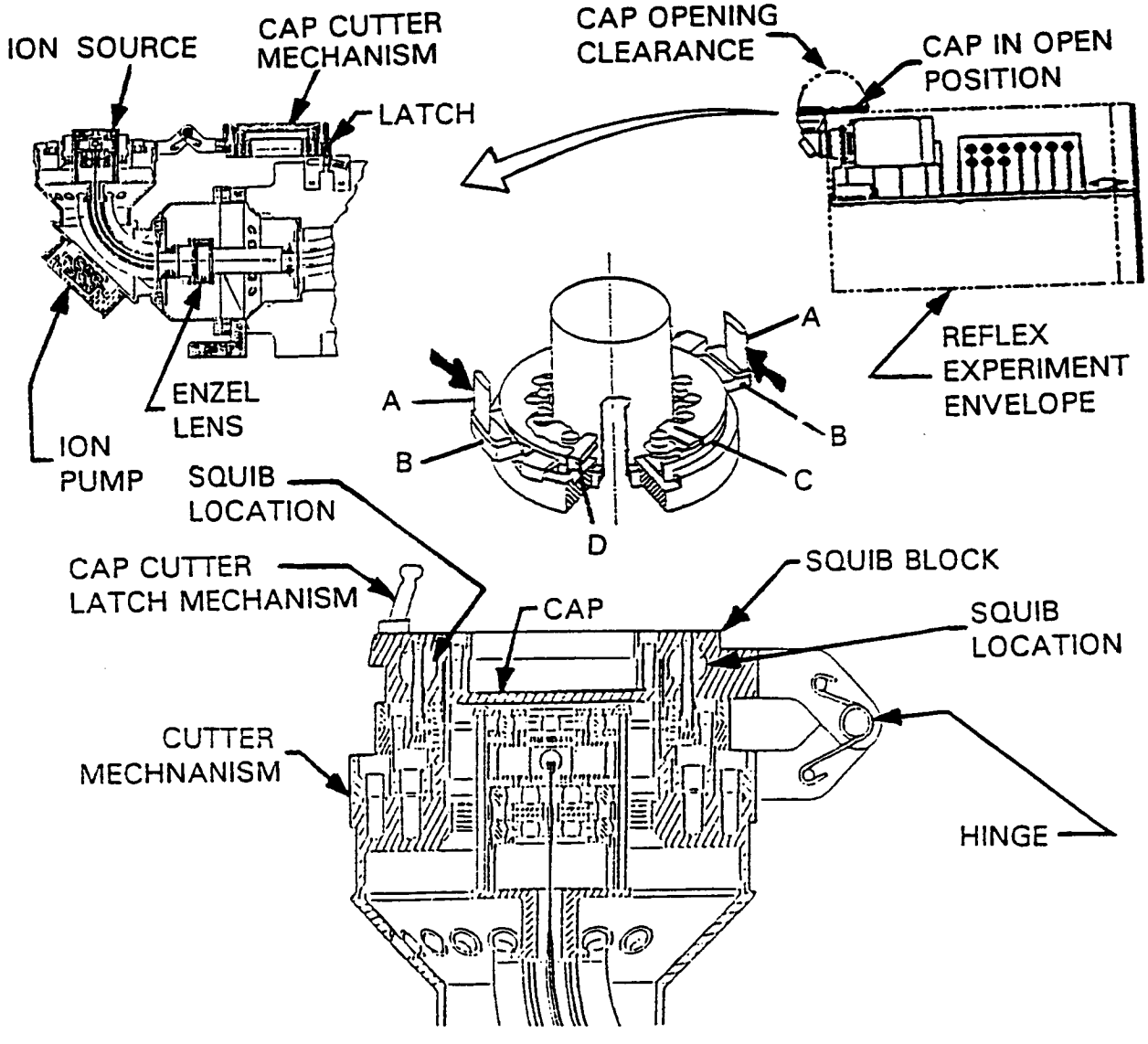
**ADDITIONAL COMMENTS:**
3.5 Amps; No-fire current: 1.0 amp 5 min. 1.0 watt for 5.0 minutes; Bridgewire Resistance: 1.05 ± 0.10 Ohms

# NASA/DOD/DOE Pyrotechnic System

**TITLE:** Cutter System - REFLEX Cap

**AGENCY/CENTER:** NASA Goddard Space Flight Center (GSFC)

**PHYSICAL DATA:**




REFLEX PAYLOAD CAP CUTTER MECHANISM

**CONTRACTOR:** n/a

**SUBCONTRACTOR:** IRECO Incorporated

**SYSTEM IDENTIFICATION NUMBER:**
Refer to List of Devices (below)

**PURPOSE:**
The cap cutter removes the cap that seals the vacuum on the mass spectrometer.

# NASA/DOD/DOE Pyrotechnic System

**PREVIOUS USAGE:**
n/a

**OPERATIONAL DESCRIPTION:**
The cap cutter operates by firing two squibs that rotate sixteen cutting wheels that release the cap and allows a spring-loaded arm to lift it from the opening. The squib hammer strikes the lugs A fastened to ears B on ring C. C turns counter-clockwise. As a result of the cam action, the cutter wheels are driven radially inward and break through the aluminum wall of the cap. One squib exerts enough force to operate the device, however, two are used as a precaution if one should fail. The cap is retained by the cutter block.

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** **Low** n/a
**High** n/a

**PRESSURE:** n/a

**LIST OF DEVICES:**
Cap Cutter; IRECO #BA31K23

**QUALIFICATION DOCUMENTATION:**
n/a

**ADDITIONAL REFERENCES:**
n/a

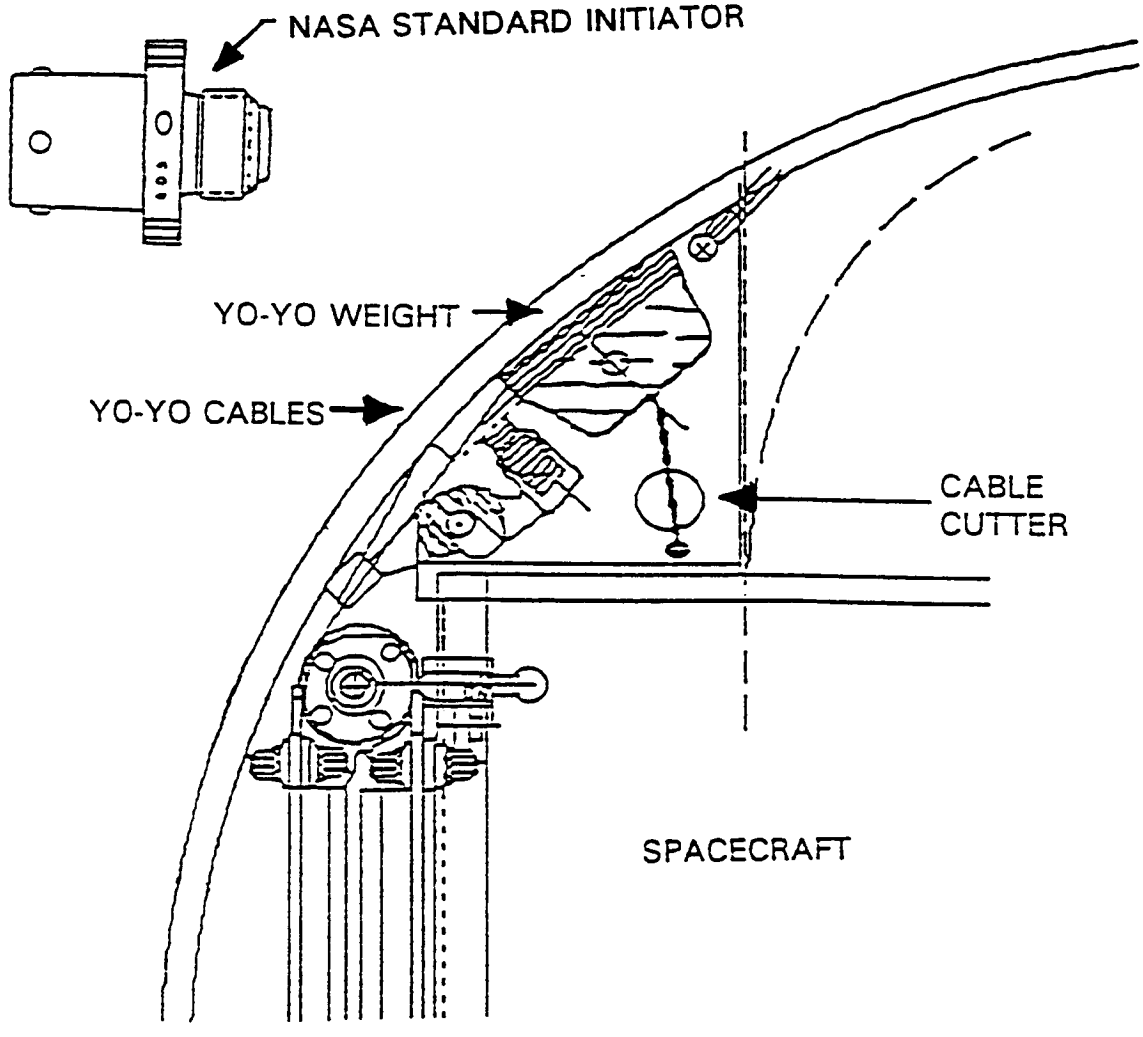
**ADDITIONAL COMMENTS:**
Bridgewire resistance :4-5 Ohms; No fire current: 50 ma., one 30 sec. pulse; All fire current 1.0 amp

## NASA/DOD/DOE Pyrotechnic System

**TITLE:** Cutter System - SAMPEX Yo-Yo Despin Cable

**AGENCY/CENTER:** NASA Goddard Space Flight Center (GSFC)

**PHYSICAL DATA:**




SAMPEX PAYLOAD YO-YO DESPIN CABLE CUTTER

**CONTRACTOR:** n/a

**SUBCONTRACTOR:** Space Ordnance Systems; High-Shear Corp.

**SYSTEM IDENTIFICATION NUMBER:**
Refer to List of Devices (below)

**PURPOSE:**
To despin the spacecraft

# NASA/DOD/DOE Pyrotechnic System

**PREVIOUS USAGE:**
n/a

**OPERATIONAL DESCRIPTION:**
The pin pullers contain redundant power cartridges actuated by a circuit with a redundant bus. The power cartridge utilizes a single bridgewire. When the power cartridges are fired, a pin is retracted releasing the Yo-Yo weights. The weights unwind the spinning Spacecraft cable and eventually despins the spacecraft at jettison.

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** **Low** n/a
**High** n/a

**PRESSURE:** n/a

**LIST OF DEVICES:**
Cable Cutter; n/a
NASA Standard Initiator (NSI); JSC SEB 26100001

**QUALIFICATION DOCUMENTATION:**
n/a

**ADDITIONAL REFERENCES:**
n/a

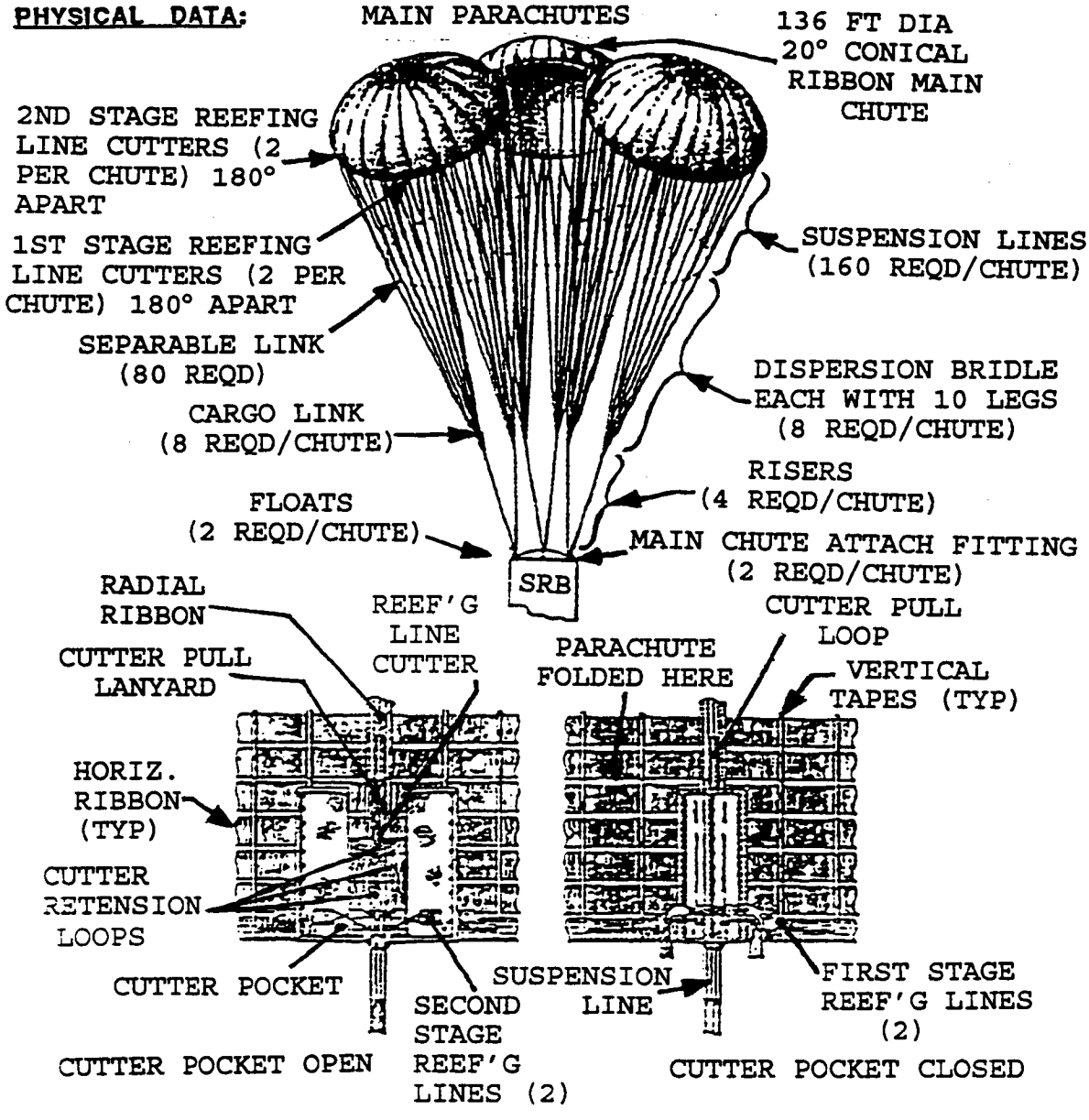
**ADDITIONAL COMMENTS:**
Bridgewire resistance: 1.05 ± 0.1 Ohms; All fire current: 3.5 amps for 10 ms max.; No fire current: 1.0 amp, 1 watt for 5 minutes min.

# NASA/DOD/DOE Pyrotechnic System

**TITLE:** Cutter System - SRB Main & Drogue Parachute Line

**AGENCY/CENTER:** NASA/Marshall Space Flight Center (MSFC)

**PHYSICAL DATA:**




SOLID ROCKET BOOSTER MAIN AND DROGUE PARACHUTE LINE CUTTER SYSTEM

**CONTRACTOR:** USBI

**SUBCONTRACTOR:** USBI

**SYSTEM IDENTIFICATION NUMBER:**
No system number; refer to specific components (devices).

**PURPOSE:**
To successfully deploy the SRB parachute by the use of a family of mechanically initiated pyrochemical time delay cutters.

# NASA/DOD/DOE Pyrotechnic System

**PREVIOUS USAGE:**
n/a

**OPERATIONAL DESCRIPTION:**
The cutters use the same mechanical components but different time delay cartridges. Two cutters for each function provide redundancy in the system.
Lanyards attached to the pilot parachute and to the firing mechanism of the cutters, which are attached to the drogue parachute pack, fire the cutters. The pilot parachute is now able to pull the drogue pack off the drogue parachute, which activates the first and second stage time delay cutters and allows the drogue parachute to be deployed to 60 percent of its drag area. The first stage cutters sever the reefing lines for 80 percent deployment at seven seconds after drogue cutter activation. At 12 seconds, the second stage cutters sever the second set of reefing lines, allowing the parachute to deploy to 100 percent.
At separation from the foward skirt, the frustum strips the three main parachute packs from the three main parachutes. This event allows the main parachutes to deploy to 19 percent of total drag area and activates the first and second stage reefing line cutters. The first stage cutter in each of the three main parachutes severs the reefing lines, which allows the main parachutes to deploy to 45 percent of total drag area at 10 seconds after main cutter activation. At seventeen seconds after main cutter activation, the second stage reefing line cutters allow the main parachutes to deploy to 100 percent of total drag area.

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** **Low** +20° F
**High** +200° F for 4 hours
**PRESSURE:** Refer to specific components (devices).

**LIST OF DEVICES:**
18 Parachute cutters:
2 Cut Loop Drogue, 0 sec. delay, 10320-0001-801
2 First Stage Drogue, 7 sec. delay, 10320-0001-802
2 Second Stage Drogue, 12 sec. delay, 10320-0001-804
5 First Stage Drogue, 10 sec. delay, 10320-0001-803
6 Second Stage Drogue, 17 sec. delay, 10320-0001-805

**QUALIFICATION DOCUMENTATION:**
n/a

**ADDITIONAL REFERENCES:**
n/a

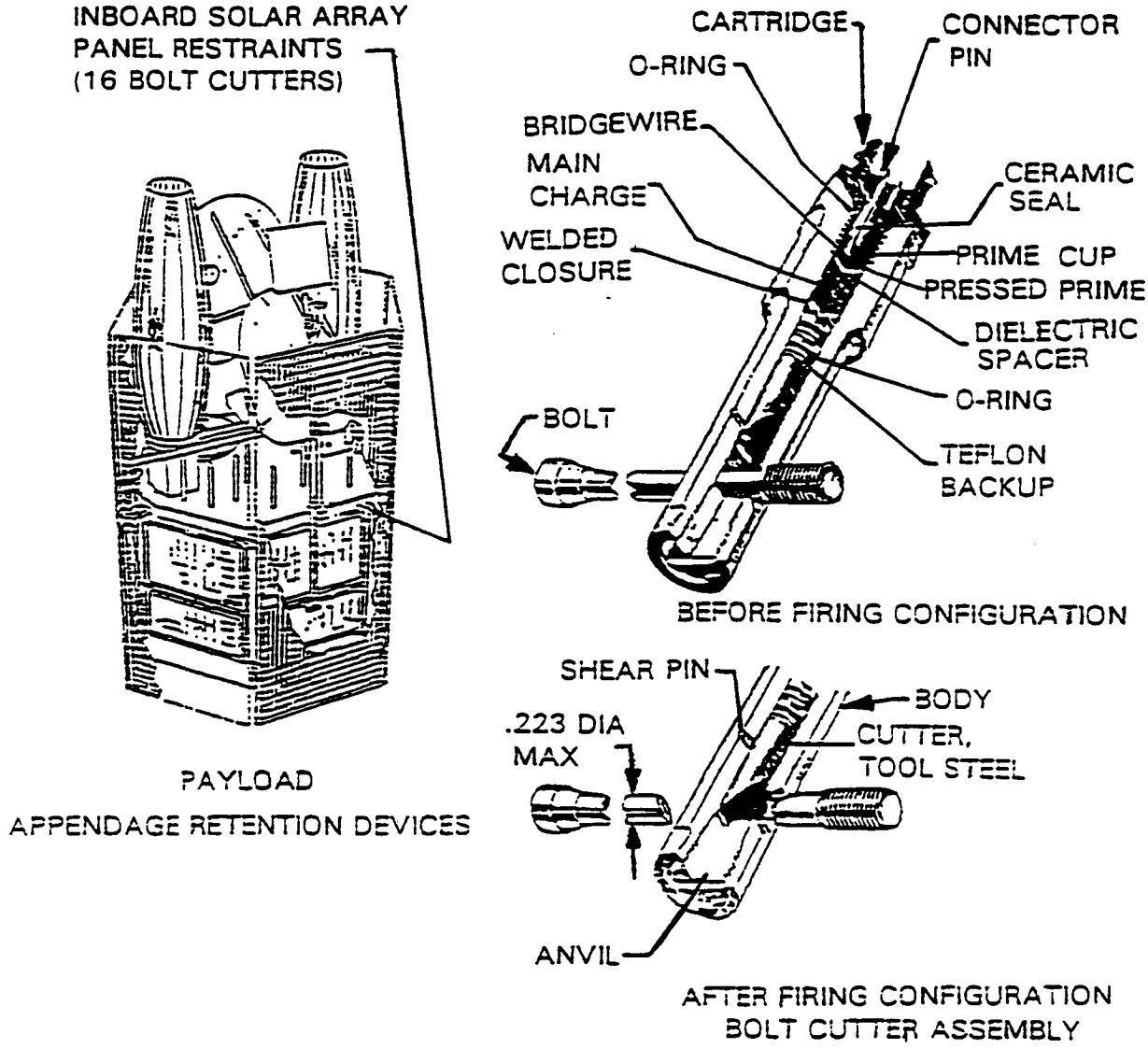
**ADDITIONAL COMMENTS:**
n/a

# NASA/DOD/DOE Pyrotechnic System

**TITLE:** Cutter System - TDRS Inboard Solar Array Panel Restraint Bolt

**AGENCY/CENTER:** NASA Goddard Space Flight Center (GSFC)

**PHYSICAL DATA:**




TDRS PAYLOAD INBOARD SOLAR ARRAY PANEL RESTRAINT BOLT CUTTER

**CONTRACTOR:** n/a

**SUBCONTRACTOR:** n/a

**SYSTEM IDENTIFICATION NUMBER:**
Refer to List of Devices (below)

**PURPOSE:**
Activates Inboard Solar Array Panel Restraint Mechanism.

# NASA/DOD/DOE Pyrotechnic System

**PREVIOUS USAGE:**
n/a

**OPERATIONAL DESCRIPTION:**
n/a

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** **Low** n/a
**High** n/a
**PRESSURE:** n/a

**LIST OF DEVICES:**
Bolt Cutter; n/a #106265

**QUALIFICATION DOCUMENTATION:**
n/a

**ADDITIONAL REFERENCES:**
n/a

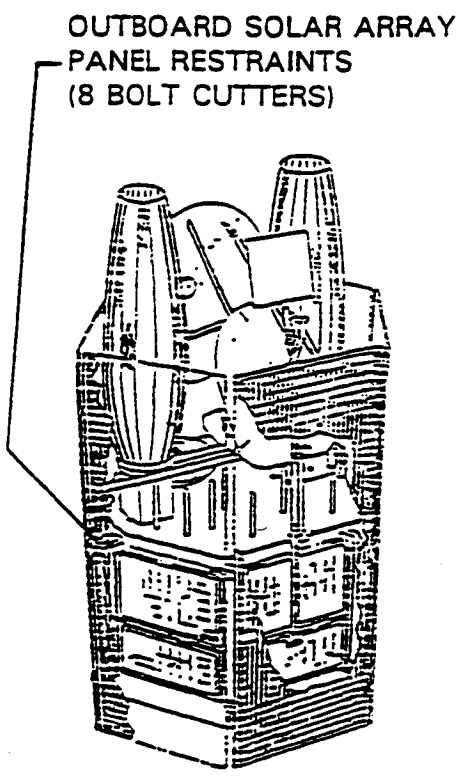
**ADDITIONAL COMMENTS:**
Bridgewire Resistance: 1.0 ± 0.5 Ohms; All fire current: 4.5 amps for 10 ms max.; No fire current: 1.0 amp F/5 minutes

# NASA/DOD/DOE Pyrotechnic System

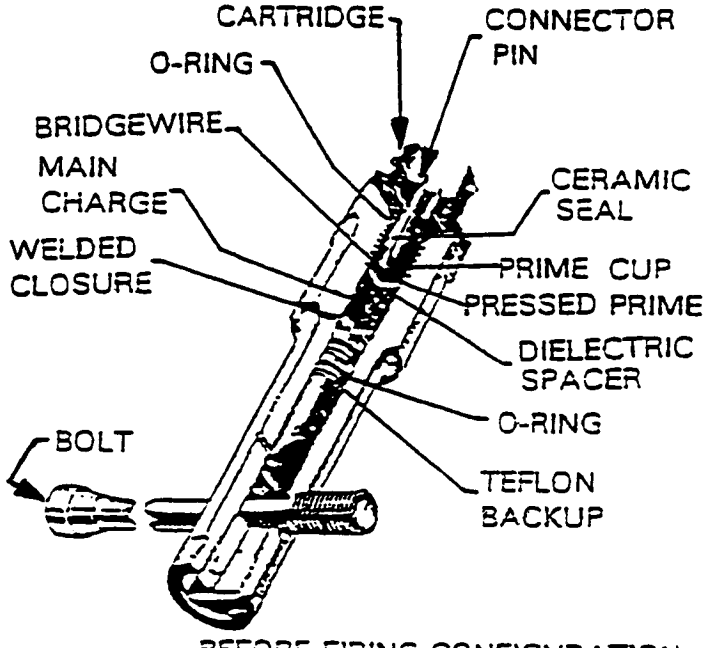
**TITLE:** Cutter System - TDRS Outboard Solar Array Panel Restraint Bolt

**AGENCY/CENTER:** NASA Goddard Space Flight Center (GSFC)

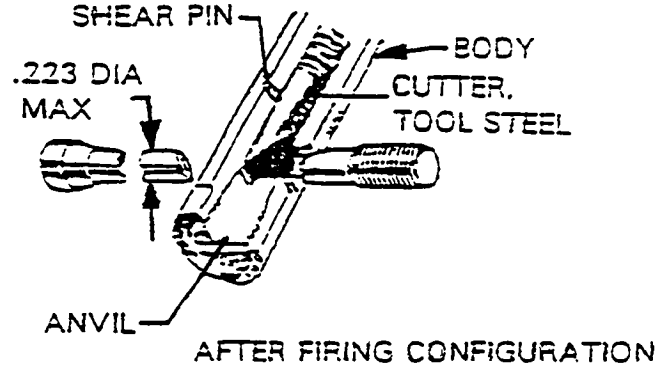
**PHYSICAL DATA:**




PAYLOAD
APPENDAGE RETENTION DEVICES




BEFORE FIRING CONFIGURATION




AFTER FIRING CONFIGURATION
BOLT CUTTER ASSEMBLY

TDRS PAYLOAD OUTBOARD SOLAR ARRAY PANEL RESTRAINT BOLT CUTTER

**CONTRACTOR:** n/a

**SUBCONTRACTOR:** n/a

**SYSTEM IDENTIFICATION NUMBER:**
Refer to List of Devices (below)

**PURPOSE:**
Activates Outboard Solar Array Panel Restraint Mechanism.

# NASA/DOD/DOE Pyrotechnic System

**PREVIOUS USAGE:**
n/a

**OPERATIONAL DESCRIPTION:**
n/a

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** **Low** n/a
**High** n/a
**PRESSURE:** n/a

**LIST OF DEVICES:**
Bolt Cutter; n/a #106265

**QUALIFICATION DOCUMENTATION:**
n/a

**ADDITIONAL REFERENCES:**
n/a

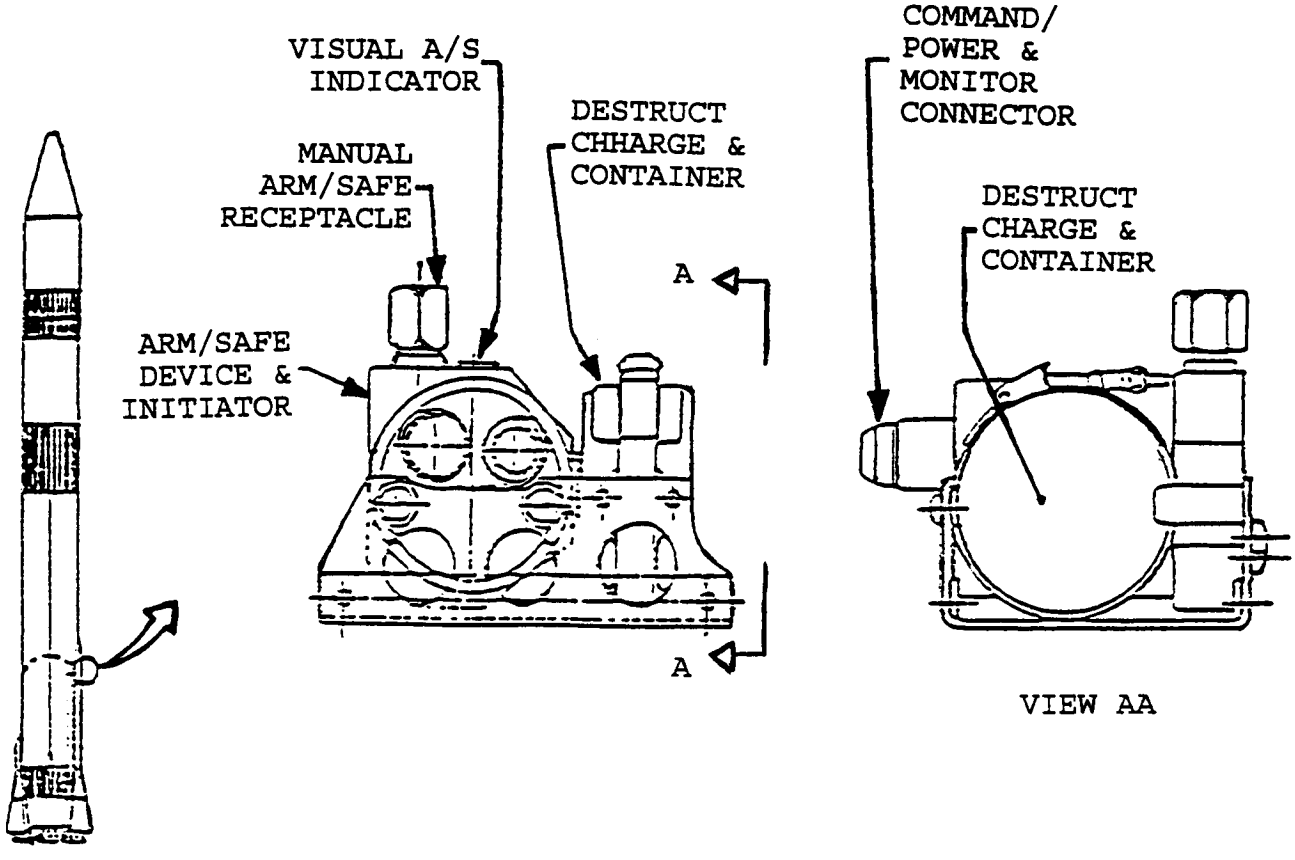
**ADDITIONAL COMMENTS:**
Bridgewire Resistance: 1.0 ± 0.5 Ohms; All fire current: 4.5 amps for 10 ms max.; No fire current: 1.0 amp F/5 minutes

# NASA/DOD/DOE Pyrotechnic System

**TITLE:** Destruct Ordnance System - Atlas

**AGENCY/CENTER:** NASA Lewis Research Center (LeRC)

**PHYSICAL DATA:**




RANGE-SAFETY-COMMAND ATLAS DESTRUCT ORDNANCE SYSTEM

**CONTRACTOR:** General Dynamics Space Systems Division (GDSSD)

**SUBCONTRACTOR:** No system vendor; only device vendor (see each device).

**SYSTEM IDENTIFICATION NUMBER:**
No system number; refer to specific components (devices).

**PURPOSE:**
To terminate and Atlas flight in an emergency condition, as when the vehicle flight varies from the allowable course or goes into tumble mode, by explosive rupture of the vehicle tanks and dispersion of propellants.

# NASA/DOD/DOE Pyrotechnic System

**PREVIOUS USAGE:**
Expendable Launch Vehicle:
Atlas Centaur Vehicles through AC-68

**OPERATIONAL DESCRIPTION:**
Upon radio command issued by the Range Safety Officer, the control unit switches battery power to the two detonators in the safe/arm destructor unit. Activation of the detonators (at least one) initiates firing of the booster and the destruct charge which is mounted against the vehicle tank. The resulting explosion ruptures the fuel and the oxygen tanks and disperses the propellants to prevent possible ground impact catastrophe.

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** **Low** -100° F
**High** +200° F

**PRESSURE:** n/a

**LIST OF DEVICES:**
Destructor; GDSSD 55-04348 (vendor-Bulova)
Electro-explosive Detonators (2)
Booster Charge
Destruct Charge (1 pound RDX).

**QUALIFICATION DOCUMENTATION:**
Bulova 800-012 (7-29-65) and revision A (10-22-65) for destructor unit.

**ADDITIONAL REFERENCES:**
n/a

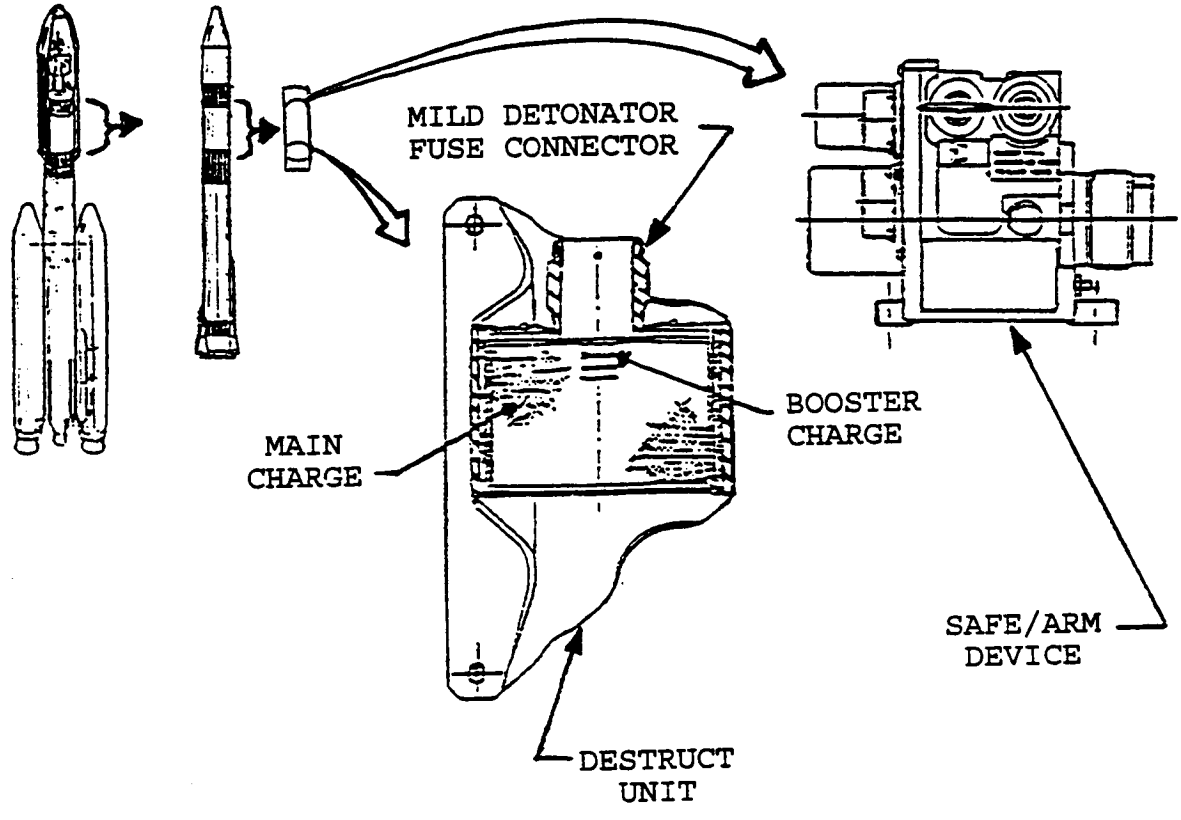
**ADDITIONAL COMMENTS:**
n/a

# NASA/DOD/DOE Pyrotechnic System

**TITLE:** Destruct Ordnance System - Centaur

**AGENCY/CENTER:** NASA Lewis Research Center (LeRC)

**PHYSICAL DATA:**




RANGE-SAFETY-COMMAND CENTAUR DESTRUCT ORDNANCE SYSTEM

**CONTRACTOR:** General Dynamics Space Systems Division (GDSSD)

**SUBCONTRACTOR:** No system vendor; only device vendors (see each device).

**SYSTEM IDENTIFICATION NUMBER:**
No system number; refer to specific components (devices).

**PURPOSE:**
To terminate a Centaur flight in an emergency condition, as when the vehicle flight varies from the allowable course or goes into a tumble mode, by explosive rupture of the vehicle tanks and dispersion of the propellants.

# NASA/DOD/DOE Pyrotechnic System

**PREVIOUS USAGE:**

Expendable Launch Vehicles:
Atlas Centaur Vehicles through AC-68
Titan Centaur Vehicles through TC-7

**OPERATIONAL DESCRIPTION:**

Upon radio command issued by the Range Safety Officer, the control unit switches battery power to the two detonators in the safe/arm device. Activition of the detonators (at least one) initiates mild detonating fuses, having non electric detonators (NED's) at the ends, that propagate the firing from the S/A device to the destruct charge. A booster charge receives the firing energy and initiates the destruct charge which is mounted against the Centaur tank. The destruct explosion ruptures the fuel and oxygen tanks dispersing the propellants to prevent possible ground impact catastrophe.

**OPERATING TEMPERATURE/PRESSURE:**

**TEMPERATURE RANGE:** Low -100° F
High +200° F

**PRESSURE:** n/a

**LIST OF DEVICES:**

Destruct Charge; GDSSD 55-04244 (vendor-Jet Research)
Safe and Arm Device; GDSSD 55-01276 (Vendor-Consolidated)
Mild Detonating Fuse; GDSSD 55-36074.

**QUALIFICATION DOCUMENTATION:**

Jet Research QA 1985 (5-25-76) & GDFW (GDSSD) FGT 55-135 for destruct charge. Consolidated 200 W55DTR1 for Safe/Arm device. Jet Research QA 1985 (5/25/76) for MD fuse tested with destruct charge, and GDFW (GDSSD) FGT 55-135.

**ADDITIONAL REFERENCES:**

n/a

**ADDITIONAL COMMENTS:**

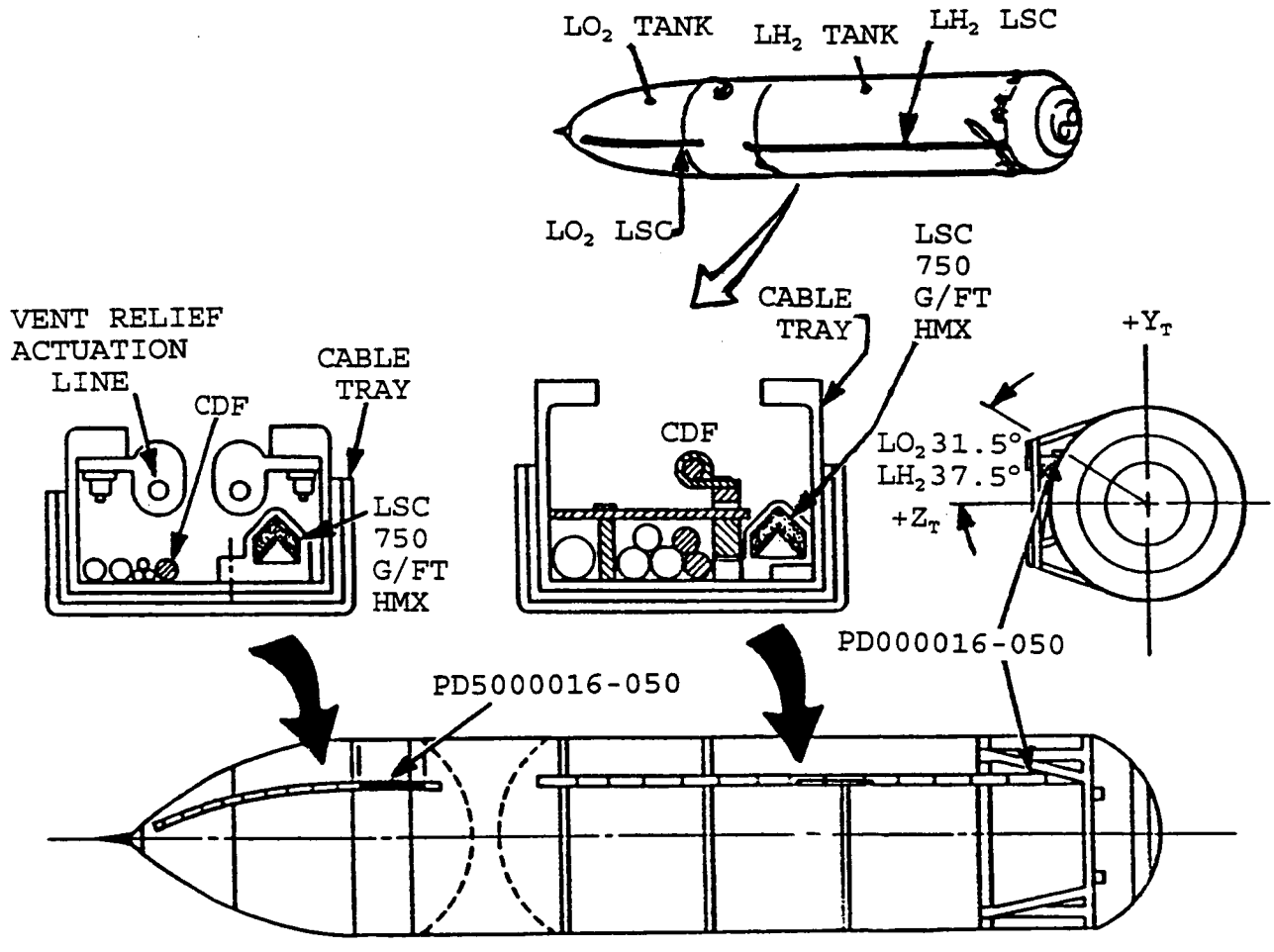
n/a

# NASA/DOD/DOE Pyrotechnic System

**TITLE:** Destruct System - External Tank (ET) Range Safety

**AGENCY/CENTER:** NASA/Marshall Space Flight Center (MSFC)

**PHYSICAL DATA:**




EXTERNAL TANK (ET) RANGE SAFETY DESTRUCT SYSTEM

**CONTRACTOR:** Martin-Marietta Corporation

**SUBCONTRACTOR:** Martin-Marietta Corporation

**SYSTEM IDENTIFICATION NUMBER:**
No system number; refer to specific components (devices)

**PURPOSE:**
To allow the range safety officer to intentionally destroy the ET in the event of flight path deviation, improper vehicle parameters, or inadvertent separation.

# NASA/DOD/DOE Pyrotechnic System

**PREVIOUS USAGE:**
n/a

**OPERATIONAL DESCRIPTION:**
The ET range safety system is an airborn command destruct system for the ET. Ground commands arm the Safety and Arming (S&A) device at 4 minutes, 58 seconds prior to ignition.

When flight termination (destruct) action is taken, the nominal Shuttle Range Safety Command System usage will consist of transmission of the "Arm" command several times, a pause of one second, and then the transmission of the "Fire" command several times or until the destruct action takes place. The "Fire" command triggers the Pyrotechnic Initiator Controller (PIC) which initiates the NSD. The NSD detonation propagates through the S&A device, transfer charge, Confined Detonating Fuse (CDF) manifold, and CDF assemblies to the Linear Shaped Charge (LSC) assembly. Redundancy is achieved in the LSC assembly by initiating the LSCs at both ends. The detonation output of the LSC assembly cuts both the LO2 and LH2 tanks, causing the destruction of the ET.

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** **Low** +20° F
**High** +165° F for 4 hours
**PRESSURE:** Refer to specific components (devices).

**LIST OF DEVICES:**
2 NSDs, SEB26100094-201
1 S & A Device, 10311-0001-801
2 CDF Manifolds, 10312-0002-803
7 CDF Assemblies, 10315-0001-825 thru 10315-0001-831
1 LSC Assembly:
1 LO2 LSC, PD 5000016-050
1 LH2 LSC, PD 5000016-059

**QUALIFICATION DOCUMENTATION:**
n/a

**ADDITIONAL REFERENCES:**
n/a

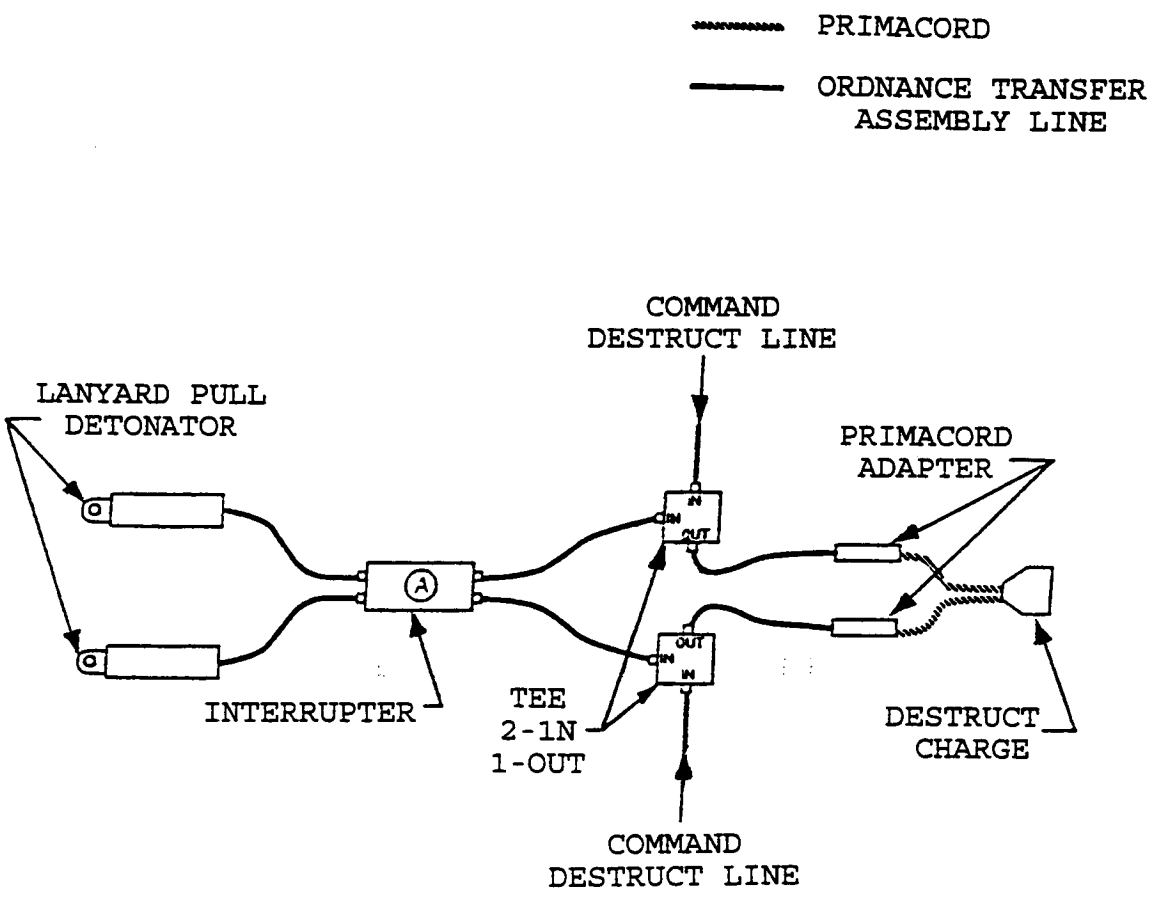
**ADDITIONAL COMMENTS:**
n/a

## NASA/DOD/DOE Pyrotechnic System

**TITLE:** Destruct System - Inadvertant Separation (ISDS)

**AGENCY/CENTER:** NASA/GSFC/Wallops Flight Facility (WFF)

**PHYSICAL DATA:**




INADVERTENT SEPARATION DESTRUCT SYSTEM

**CONTRACTOR:** EER Systems Corporation

**SUBCONTRACTOR:** EER Systems Corporation

**SYSTEM IDENTIFICATION NUMBER:**
n/a

**PURPOSE:**
This system is used on the Conestoga launch vehicle to terminate the flight of stages which separate from the vehicle stack-up prematurely. By utilizing this type of system, it is not required to utilize a complete command system for flight termination on

each individual powered stage.

**PREVIOUS USAGE:**

Conestoga/COMET program

**OPERATIONAL DESCRIPTION:**

During final vehicle processing mechanical SAFE pins are removed from the Lanyard Delay Detonators (LDD) and the Interrupter. Immediately prior to launch the Interrupter is remotely ARMED (can also be remotely SAFED). During flight should a stage separate prematurely, the LDD's would be initiated (lanyards on the LDD's are attached to the core vehicle which contains the command Flight Termination System). Following initiation of the LDD's, the Ordnance Transfer Assembly (OTA) lines will be initiated (Flexible Confined Detonating Cord (FCDC) is used as the OTA lines for this system). The OTA lines are routed through the Interrupter and through two-in-one manifolds to the destruct charge. For normal stage separations, an onboard command can be issued to SAFE the Interrupter thereby preventing the destruct charge from being initiated.

**OPERATING TEMPERATURE/PRESSURE:**

**TEMPERATURE RANGE:** **Low** n/a
**High** n/a

**PRESSURE:** n/a

**LIST OF DEVICES:**

Lanyard Delay Detonators (LDD), Interrupter, Flexible Confined Detonating Cord, two-in-one-out manifold, appropriate destruct charge (mission unique item).

**QUALIFICATION DOCUMENTATION:**

Components Qualified at vendor level.

**ADDITIONAL REFERENCES:**

n/a

**ADDITIONAL COMMENTS:**

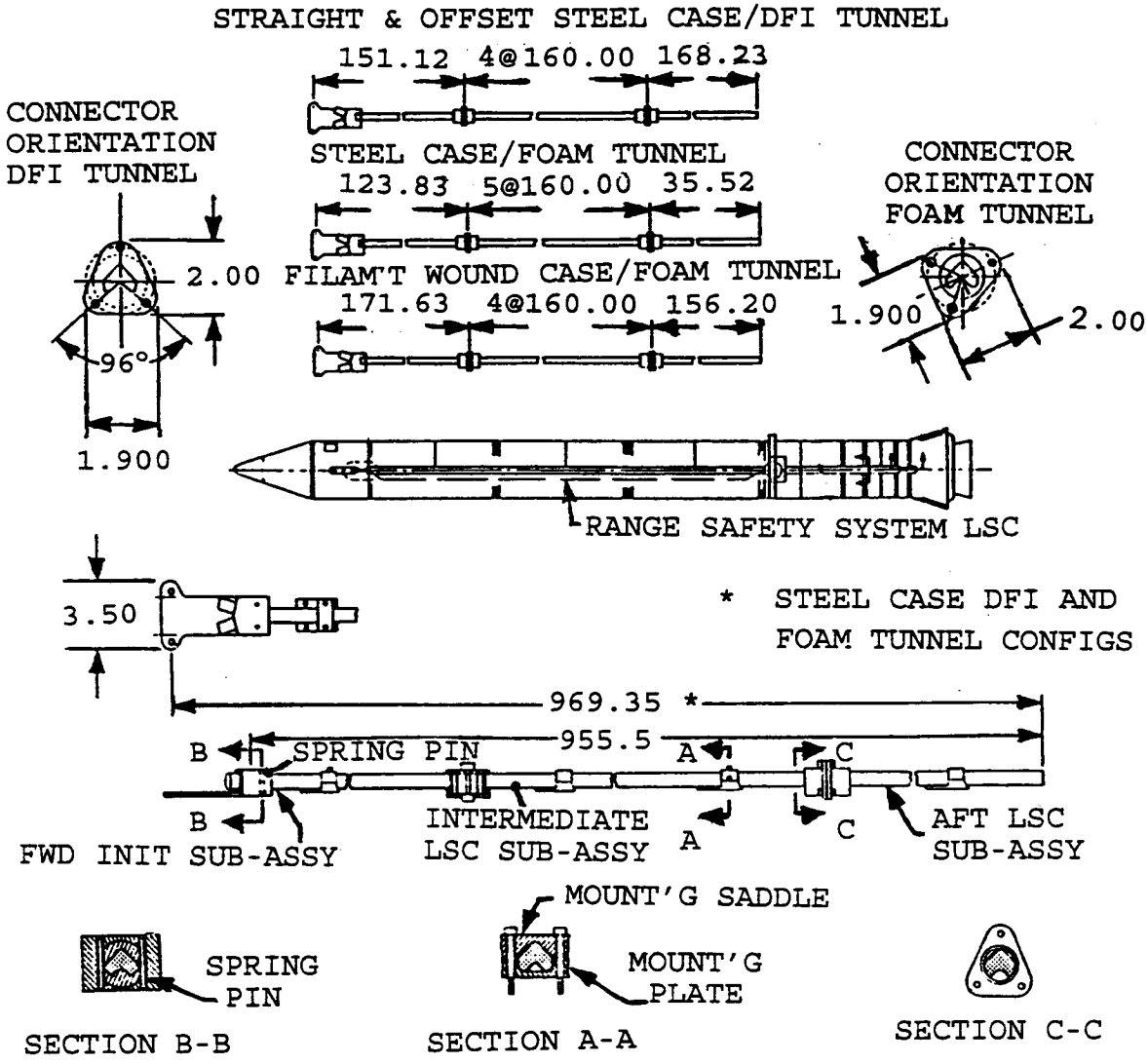
System permits flight termination of a stage from either a ground command or from the ISDS. By utilizing the Interrupter, it is possible to prevent destruct action during normal stage separations thereby minimizing debris. System is redundant to meet Range Safety requirements.

# NASA/DOD/DOE Pyrotechnic System

**TITLE:** Destruct System - Solid Rocket Booster

**AGENCY/CENTER:** NASA/Marshall Space Flight Center (MSFC)

**PHYSICAL DATA:**




SOLID ROCKET BOOSTER (SRB) DESTRUCT ASSEMBLY

**CONTRACTOR:** USBI

**SUBCONTRACTOR:** Explosive Technology

**SYSTEM IDENTIFICATION NUMBER:**

USBI PN

1 FWD LSC Assembly, 151.12 (+0.25-0.0) inches, 10313-0002-801
8 Intermediate LSC Assemblies, 160.00 (+.25-0.0) inches, 10313-0003-801
2 AFT LSC Assembly, 168.23 (+0.25-0.0) inches, 10313-0004-801
1 FWD LSC Assembly, 123.83 (+0.25-0.0) inches, 10313-0007-801
9 Intermediate LSC Assemblies, 160.00 (+0.25-0.0) inches, 10313-

# NASA/DOD/DOE Pyrotechnic System

0008-801
1 AFT LSC Assembly, 35.52 (+0.25-0.0) inches, 10313-0009-801
1 FWD LSC Assembly, 171.63 (+0.25-0.0) inches, 10313-0010-801
1 AFT LSC Assembly, 156.20 (+0.25-0.0) inches, 10313-0011-801
1 FWD LSC Assembly, 151.12 (+0.25-0.0) inches, 10313-0012-801

**PURPOSE:**
To cut the Solid Rocket Booster (SRB) 70% of its length and destroy the SRB in flight in the event of flight deviation.

**PREVIOUS USAGE:**
n/a

**OPERATIONAL DESCRIPTION:**
The destruct assembly has one Linear Shaped Charge (LSC) train initiated by redundant Confined Detonating Fuse (CDF) assemblies and RDX transfer boosters. The destruct assembly consist of one CDF/Linear Shaped Charge (LSC) connector, either five FWC or six SC assemblies, four or five LSC/LSC connectors, 72 mounting plates, and 72 mounting saddles. The CDF assemblies and RDX transfer boosters ignite the LSC through the CDF/LSC connector. The LSC is held in place by the mounting plates and saddles and connected together by the LSC/LSC connectors. The LSC will cut the SRB 70% of its length.

**OPERATING TEMPERATURE/PRESSURE:**

**TEMPERATURE RANGE:** **Low** +20° F for 12 hours
**High** +200° F for 2 hours

**PRESSURE:** Output: the LSC assembly shall sever a 0.125 inch 2219-T87 AL plate and a 0.5 inch D6AC 180 KSI steel plate with a 0.375 inch separation between the plates and at a LSC assembly standoff of 0.84 inch above the Al plate.

**LIST OF DEVICES:**
USBI PN
1 FWD LSC Assembly, 151.12 (+0.25-0.0) inches, 10313-0002-801
8 Intermediate LSC Assemblies, 160.00 (+.25-0.0) inches, 10313-0003-801
2 AFT LSC Assembly, 168.23 (+0.25-0.0) inches, 10313-0004-801
1 FWD LSC Assembly, 123.83 (+0.25-0.0) inches, 10313-0007-801
9 Intermediate LSC Assemblies, 160.00 (+0.25-0.0 inches, 10313-0008--801
1 AFT LSC Assembly, 35.52 (+0.25-0.0) inches, 10313-0009-801
1 FWD LSC Assembly, 171.63 (+0.25-0.0) inches, 10313-0010-801
1 AFT LSC Assembly, 156.20 (+0.25-0.0) inches, 10313-0011-801
A FWD LSC Assembly, 151.12 (+0.25-0.0) inches, 10313-0012-801

**QUALIFICATION DOCUMENTATION:**
n/a

**ADDITIONAL REFERENCES:**
n/a

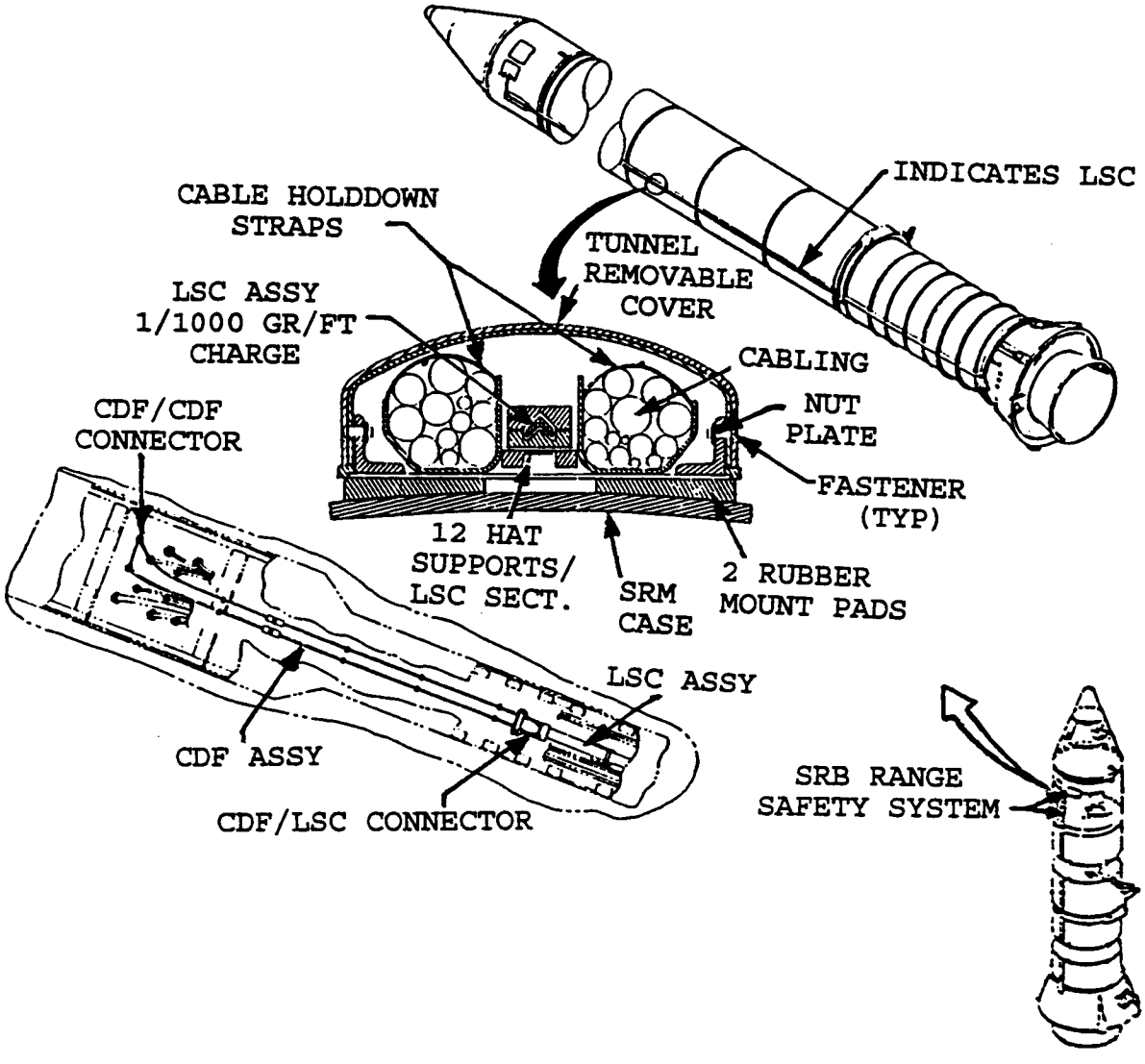
**ADDITIONAL COMMENTS:**
n/a

## NASA/DOD/DOE Pyrotechnic System

**TITLE:** Destruct System - Solid Rocket Booster (SRB) Range Safety

**AGENCY/CENTER:** NASA/Marshall Space Flight Center (MSFC)

**PHYSICAL DATA:**




SOLID ROCKET BOOSTER (SRB) RANGE SAFETY DESTRUCT SYSTEM

**CONTRACTOR:** USBI

**SUBCONTRACTOR:** USBI

**SYSTEM IDENTIFICATION NUMBER:**
No system number; refer to specific components (devices).

**PURPOSE:**
To allow the range safety officer to intentionally destroy the SRB in the event of flight path deviation, improper vehicle parameters, or inadvertent separation.

# NASA/DOD/DOE Pyrotechnic System

**PREVIOUS USAGE:**
n/a

**OPERATIONAL DESCRIPTION:**
The SRB range safety system is an airborn command destruct system for the SRB. Ground commands arm the Safety and Arming (S&A) device at 4 minutes, 58 seconds prior to ignition. The (S&A) device is safed at SEPCUE.

When flight termination (destruct) action is taken, the nominal Shuttle Range Safety Command System usage will consist of transmission of the "Arm" command several times, a pause of one second, and then the transmission of the "Fire" command several times or until the destruct action takes place. The "Fire" command triggers the Pyrotechnic Initiator Controller (PIC) which initiates the NSD. The NSD detonation propagates through the S&A device, transfer charge, Confined Detonating Fuse (CDF) manifold, and CDF assemblies to the destruct assembly. The detonation output of the destruct assembly cuts 70 percent of the length of the SRM, causing the destruction of the SRB.

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** **Low** +20° F for 12 hours
**High** +165° F for 4 hours
**PRESSURE:** Refer to specific components (devices).

**LIST OF DEVICES:**
2 NSDs, SEB26100094-201
1 Safety and Arming (S&A) Device, 10311-0001-801
7 CDF Assemblies, 10314-0001-123 thru 10314-0001-129
2 CDF Manifolds, 10312-0001-106 and 10312-0001-107
2 CDF/CDF Connectors, 10183-0010-0001
1 Destruct Assembly

**QUALIFICATION DOCUMENTATION:**
n/a

**ADDITIONAL REFERENCES:**
n/a

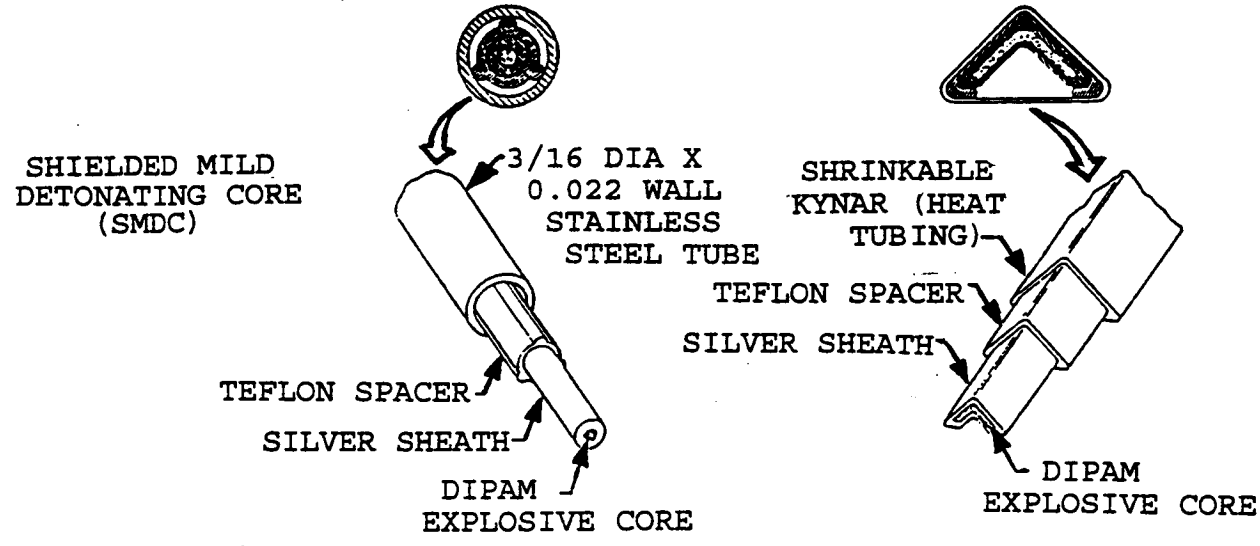
**ADDITIONAL COMMENTS:**
n/a

# NASA/DOD/DOE Pyrotechnic System

**TITLE:** Escape System - F-111 Crew Module

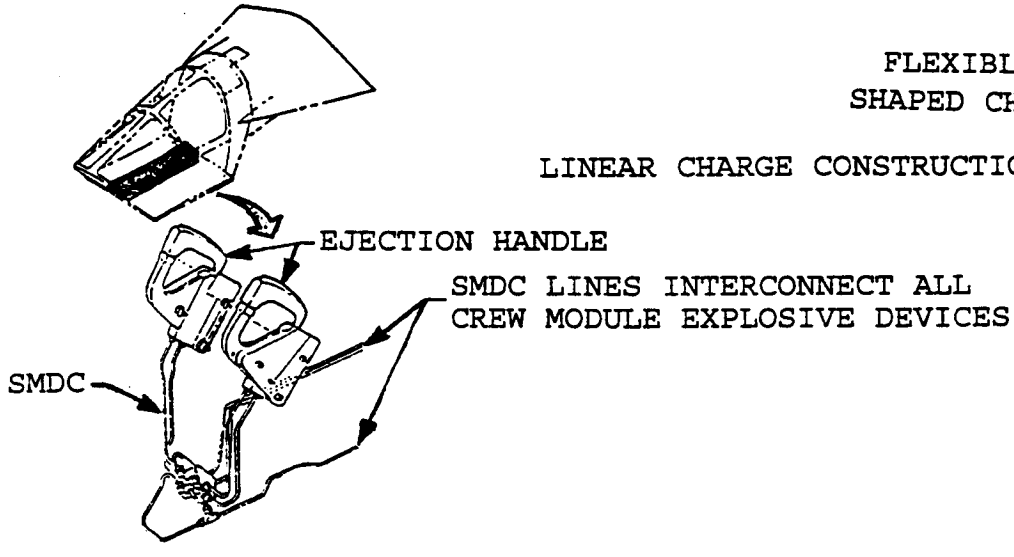
**AGENCY/CENTER:** Submitted by - NASA Langley Research Center (LaRC)
Developed by - USAF Wright Patterson AFB

**PHYSICAL DATA:**




FLEXIBLE LINEAR SHAPED CHARGE (FLSC)

LINEAR CHARGE CONSTRUCTION




TYPICAL SMDC INSTALLATION

**CONTRACTOR:** General Dynamics

**SUBCONTRACTOR:** McDonnell Aircraft Company

**SYSTEM IDENTIFICATION NUMBER:**
n/a

**PURPOSE:**
Provide emergency in-flight escape for two crewmen from the F-111 aircraft.

# NASA/DOD/DOE Pyrotechnic System

**PREVIOUS USAGE:**
n/a

**OPERATIONAL DESCRIPTION:**
Either crewman can initiate escape at each seat by pulling an ejection handle, which initiates explosive transfer lines afor the remainder of the system. Inertia-lock reels position the crew for ejection. Actuators provide emergency oxygen and cabin pressurization. Flexible linear shaped charge cuts splice plates between the crew module and the aircraft. Guillotines sever secondary controls and antenna leads. A solid rocket motor propels the crew module from the aircraft. A stabilization-brake chute catapult deploys a parachute for increasing crew module drag. A q-actuated selector and g-sensor initiator select the proper time delay prior to actuating a barostat lock initiator. The barostat lock initiator assures parachute deployment at an altitude of approximately 15,000 feet. A recovery parachute catapult deploys a parachute at a velocity adequate for proper bag strip-off. Reefing line cutters disreef the parachute after line stretch. Recovery parachute release retractors permit repositioning of the bridle cable for proper crew module touchdown attitude. Explosive valves release pressurized gas for inflating an impact attenuation bag.

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** **Low** -65°F
**High** +425°F
**PRESSURE:** F-111 altitude envelope

**LIST OF DEVICES:**
see Operational Description for devices used.

**QUALIFICATION DOCUMENTATION:**
Schimmel, Morry L.: "The F-111 Crew Module: Major Challenge for Thermally Stable Explosives." Presented at the Symposium on Thermally Stable Explosives, U.S. Naval Ordnance Laboratory-White Oak, Silver Spring, Maryland, June 23-25, 1970.
Lake, E. R.; Thompson, S. J.; and Drexelius, V. W.: "A Study of the Role of Pyrotechnic Systems on the Space Shuttle Program." NASA Contractor Report NASA CR-2292, September, 1973.

**ADDITIONAL REFERENCES:**
n/a

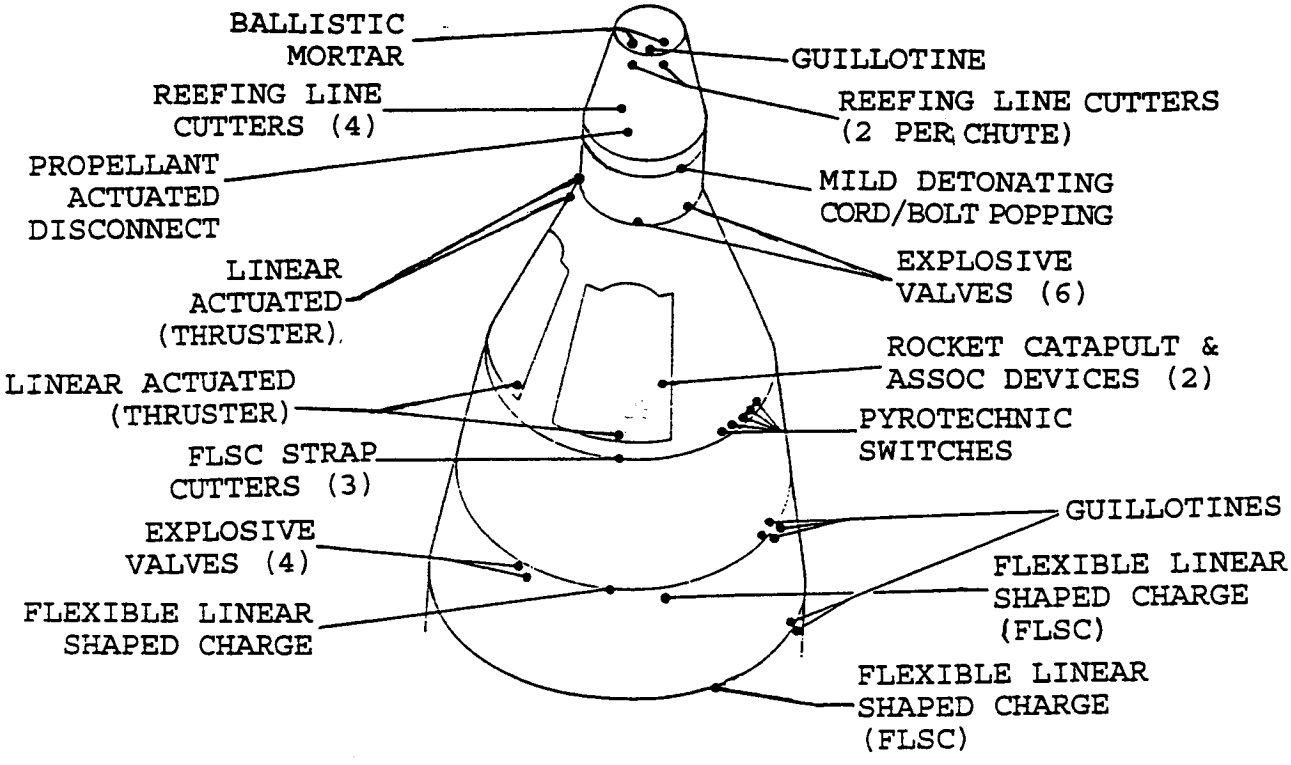
**ADDITIONAL COMMENTS:**
The crew module was designed to be aerodynamically stable throughout ejection.

# NASA/DOD/DOE Pyrotechnic System

**TITLE:** Escape System - Gemini Capsule

**AGENCY/CENTER:** NASA Johnson Space Center (JSC)
[Submitted by NASA Langley R.C.]

**PHYSICAL DATA:**




PROJECT GEMINI

**CONTRACTOR:** McDonnell Aircraft Company

**SUBCONTRACTOR:** n/a

**SYSTEM IDENTIFICATION NUMBER:**
n/a

**PURPOSE:**
Provide for manned space flight, orbital rendezvous, deorbit and water recover.

# NASA/DOD/DOE Pyrotechnic System

**PREVIOUS USAGE:**
None

**OPERATIONAL DESCRIPTION:**
In-Flight escape was provided at low altitudes and velocities by open ejection seats and associated panel severance for the two crewmembers. Capsule separation from the Titan II launch vehicle was accomplished by flexible linear shaped charge (FLSC). Following deorbit, pyrotechnically actuated parachutes deployed to provide a soft landing in water.

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** **Low** n/a
**High** n/a
**PRESSURE:** n/a

**LIST OF DEVICES:**
See Operational Description for devices used.

**QUALIFICATION DOCUMENTATION:**
Anonymous: "McDonnell Aircraft Co., Project Gemini Familiarization Manual." SEDR 104, December 15, 1959.
Anonymous: "Gemini Final Summary Report." McDonnell Aircraft Co. Report F 169, February 20, 1967.
Lake, E.R.; Thompson, S.J.; and Drexeluis, V.W.: "A Study of the Role of Pyrotechnic Systems on the Space Shuttle Program." NASA Contractor Report NASA CR-2292, September, 1973.

**ADDITIONAL REFERENCES:**
n/a

**ADDITIONAL COMMENTS:**
Gemini pioneered in the use of rigid explosive transfer lines, known as shielded mild detonating cord (SMDC) and the use of high-temperature resistant explosive material (Dipicramide or DIPAM).

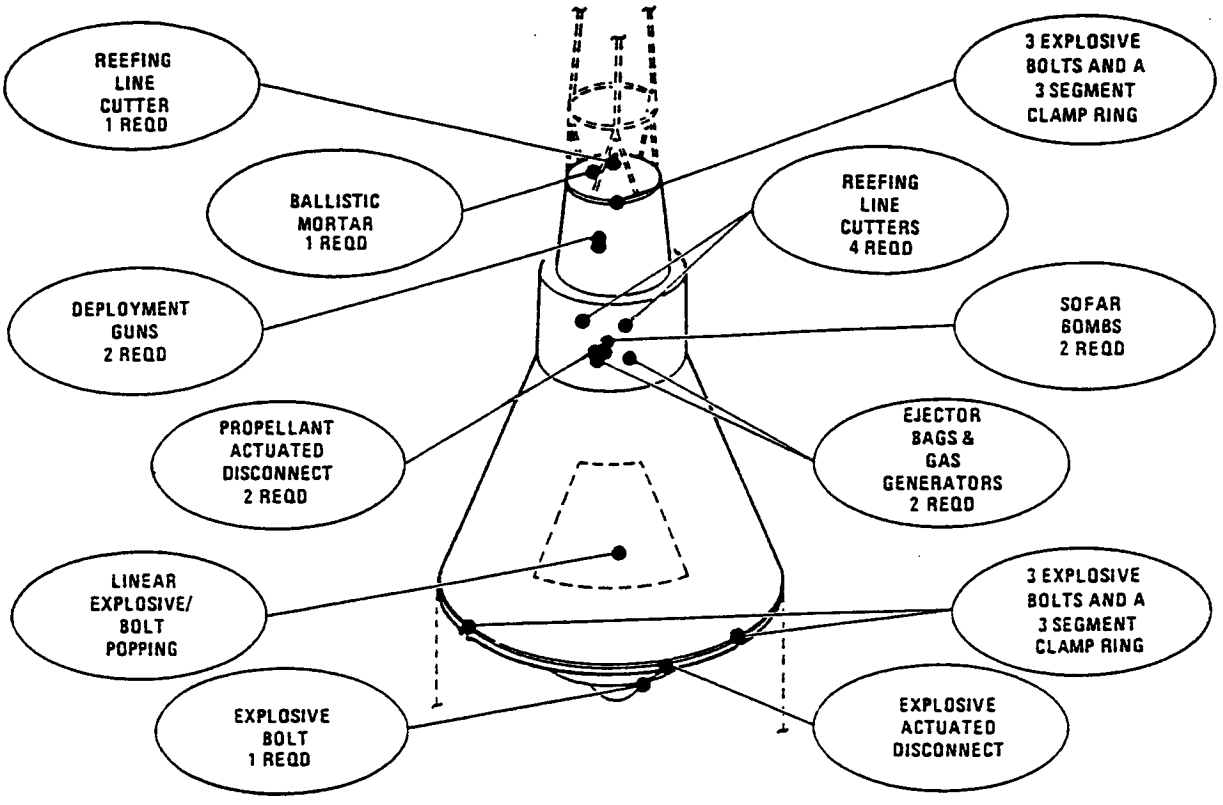
# NASA/DOD/DOE Pyrotechnic System

**TITLE:** Escape System - Mercury Capsule

**AGENCY/CENTER:** NASA Langley Research Center (LaRC)

**PHYSICAL DATA:**

PROJECT MERCURY
PYROTECHNIC DEVICES




MERCURY CAPSULE

**CONTRACTOR:** McDonnell Aircraft Company

**SUBCONTRACTOR:** n/a

**SYSTEM IDENTIFICATION NUMBER:**
n/a

**PURPOSE:**
Provide for manned space flight (ballistic and orbital), deorbit and water recovery.

This document is an information source only and should not be used for design purposes.

# NASA/DOD/DOE Pyrotechnic System

**PREVIOUS USAGE:**
n/a

**OPERATIONAL DESCRIPTION:**
A solid-propellant rocket tower on top of the capsule provided for escape on the pad, following release of a Marman band separation joint. Normal flights utilized this separation joint to free the capsule from the Atlas D launch vehicle. The escape tower had to be released early in the normal flight sequence. Mercury used electrical-hotwire initiation systems, along with ballistic hot gas (500 psi tubing) that communicated an initiation signal to subsystems. Mercury also perhaps accomplished the earliest use of linear explosive cord. Two strands of 5 grains/ft cord were used to break 70 prenotched titanium bolts around the periphery of the entrance hatch, which provided emergency and routine egress. Following reentry, the capsule descended on a pyrotechnically deployed parachute.

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** **Low** n/a
**High** n/a
**PRESSURE:** Orbital

**LIST OF DEVICES:**
See Operational Description for devices used.

**QUALIFICATION DOCUMENTATION:**
Anonymous: "McDonnell Aircraft Co., Project Mercury Familiarization Manual." SEDR 104, December 15, 1959.
Lake, E. R.; Thompson, S. J.; and Drexelius, V.W.: "A study of the Role of Pyrotechnic Systems on the Space Shuttle Program." NASA Contractor Report NASA CR-2292, September, 1973.

**ADDITIONAL REFERENCES:**
n/a

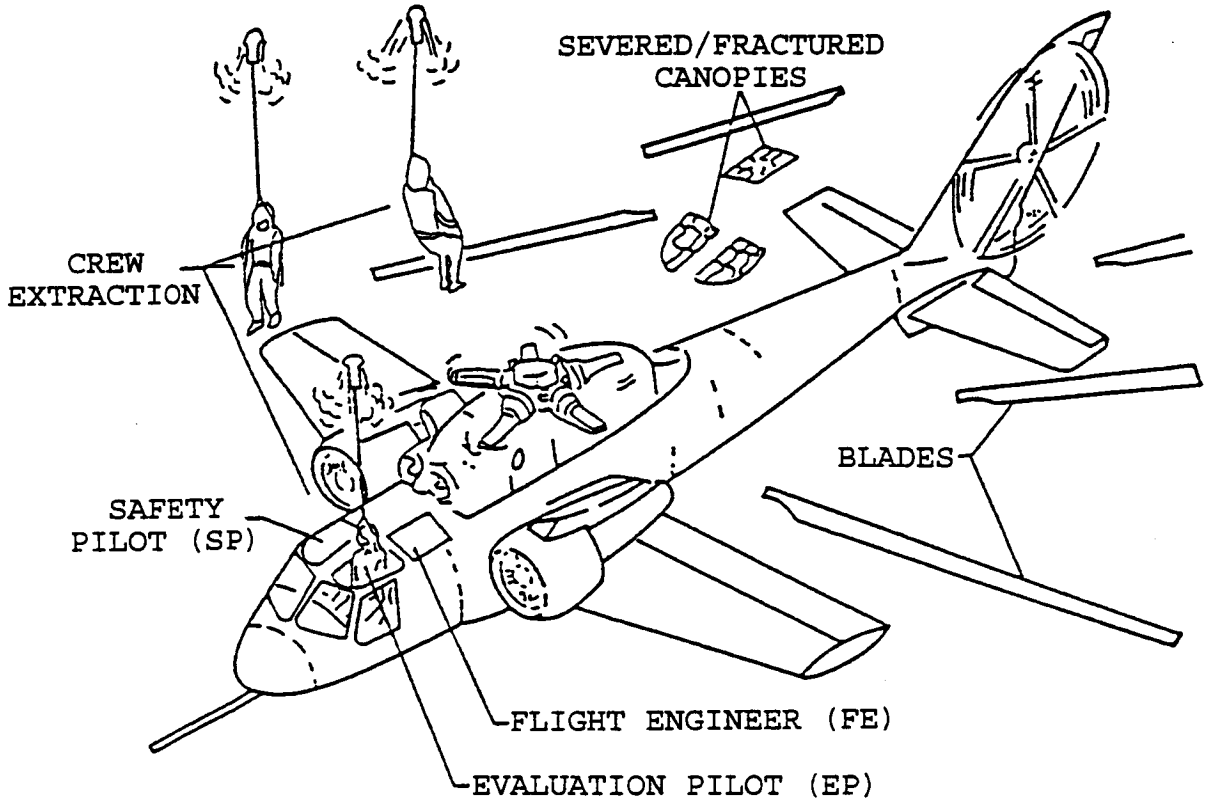
**ADDITIONAL COMMENTS:**
n/a

# NASA/DOD/DOE Pyrotechnic System

**TITLE:** Escape System - Rotor Systems Research Aircraft (RSRA) In-Flight

**AGENCY/CENTER:** NASA Langley Research Center (LaRC)

**PHYSICAL DATA:**




RSRA EMERGENCY ESCAPE SYSTEM

**CONTRACTOR:** Sikorsky Aircraft

**SUBCONTRACTOR:** Teledyne McCormick Selph
Stanley Aviation

**SYSTEM IDENTIFICATION NUMBER:**
n/a

**PURPOSE:**
This system provided two emergency operational capabilities: Rotor blade severance and return to base on the wing; and in-flight escape for three crew members.

# NASA/DOD/DOE Pyrotechnic System

**PREVIOUS USAGE:**

None. This is the first operational in-flight escape system for a helicopter.

**OPERATIONAL DESCRIPTION:**

A single overhead handle provided for the initiation of programmed severance of the rotor blades to allow the blads to be jettisoned away from the path of the aircraft. Either pilot could initiate escape by pulling a handle on the front edge of each seat. The blade severance system described above was employed, overhead canopies were explosively fractured, the cyclic sticks released to hinge out of the path of the crewmembers, and the crewmembers were sequentially extracted. The Flight Engineer faced aft. All three members were clear of the aircraft in 2.3 seconds. The figure describes the system's major functions.

**OPERATING TEMPERATURE/PRESSURE:**

**TEMPERATURE RANGE:** Low -65°F
High +200°F

**PRESSURE:** n/a

**LIST OF DEVICES:**

F-111 initiation handle, rigid and flexible explosive transfer lines (SMDC and FCDC, respectively), pin pullers, canopy fracture systems, cam thrusters, firing pin assemblies, blade severance assemblies, and extraction seat, which is made up of a variety of components: mechanical initiators, hot has generators, buckle release, barostat actuator, extraction rocket, pendant line cutter, seat belt release thruster and FCDC.

**QUALIFICATION DOCUMENTATION:**

Bement, Laurence J.: "Rotor Systems Research Aircraft (RSRA) Canopy Explosive Severance/Fracture" Presented a the Ninth Symposium on Explosives and Pyrotechnics, September 15-16, 1976.
Bement, Laurence J.: "Helicopter (RSRA) In-Flight Escape System Component Qualification" Presented at the Tenth Symposium on Explisives and Pyrotechnics, San Francisco, CA, February 14-16, 1979.
Bement, Laurence J.: "Helicopter Emergency Escape" SAFE Journal - Vol. 9, No. 3, Fall Quarter, 1979.

**ADDITIONAL REFERENCES:**

n/a

**ADDITIONAL COMMENTS:**

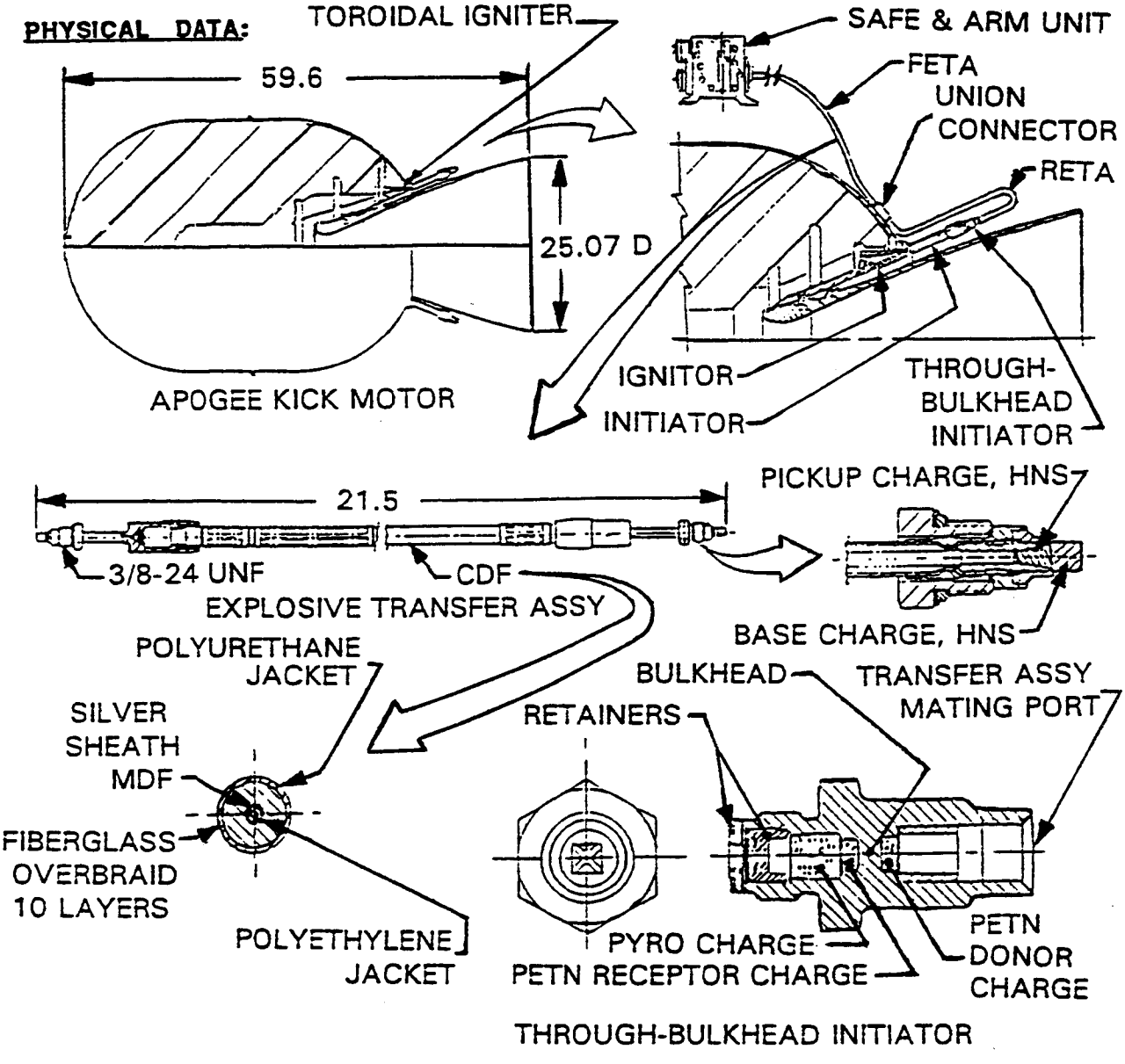
The approach for qualification of this system was to minimize the quantity of device and system-level testing through an emphasis on functional margin demonstrations during development and escape trajectory computer analysis. The result was that the numberof component tests for environmental testing were as few as 10 with only 5 system-level demonstrations. That is, a total of 13 extractions were made, rather than 72 (24 consecutive, successful tests from each position) as required by military specifications.

## NASA/DOD/DOE Pyrotechnic System

**TITLE:** Igniter System - NOAA Apogee Kick Motor Safe/Arm

**AGENCY/CENTER:** NASA Goddard Space Flight Center (GSFC)

**PHYSICAL DATA:**




NOAA PAYLOAD KICK MOTOR SAFE/ARM SQUIBS

**CONTRACTOR:** n/a

**SUBCONTRACTOR:** Thiokol

**SYSTEM IDENTIFICATION NUMBER:**
Refer to List of Devices (below)

**PURPOSE:**
Ignites the rocket motor by spraying the motor propellant grain with hot pyrotechnic material through igniter nozzles.

# NASA/DOD/DOE Pyrotechnic System

**PREVIOUS USAGE:**
n/a

**OPERATIONAL DESCRIPTION:**
The Safe/Arm output initiates the explosive transfer assembly which produces a high pressure pulse at each of the two bulkhead initiator interfaces. A pressure pulse initiates the TBI shock sensitive PETN charge which transfers a shock pulse through the TBI bulkhead metal without rupturing the bulkhead. This prevents rocket motor case combustion gases from leaking though the initiator. The charge initiates a PETN receptor charge and pyrotechnic charge in the TBI. The TBI output initiates the igniter assembly which produces a pyrotechnic output that ignites the toroidal igniter. The toroidal igniter ignites the rocket motor by spraying motor propellant grain with hot pyrotechnic material through igniter nozzles.

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** **Low** n/a
**High** n/a
**PRESSURE:** n/a

**LIST OF DEVICES:**
S&A Squibs; Thiokol #2134B
Detonator; Thiokol # 41734

**QUALIFICATION DOCUMENTATION:**
n/a

**ADDITIONAL REFERENCES:**
n/a

**ADDITIONAL COMMENTS:**
All fire current: 3.5 Amps for 20 ms; No-fire current: 1.0 amp ,5 min. 1.0 watt for 5.0 minutes; Bridgewire Resistance: 1.0 ± 0.10 Ohms

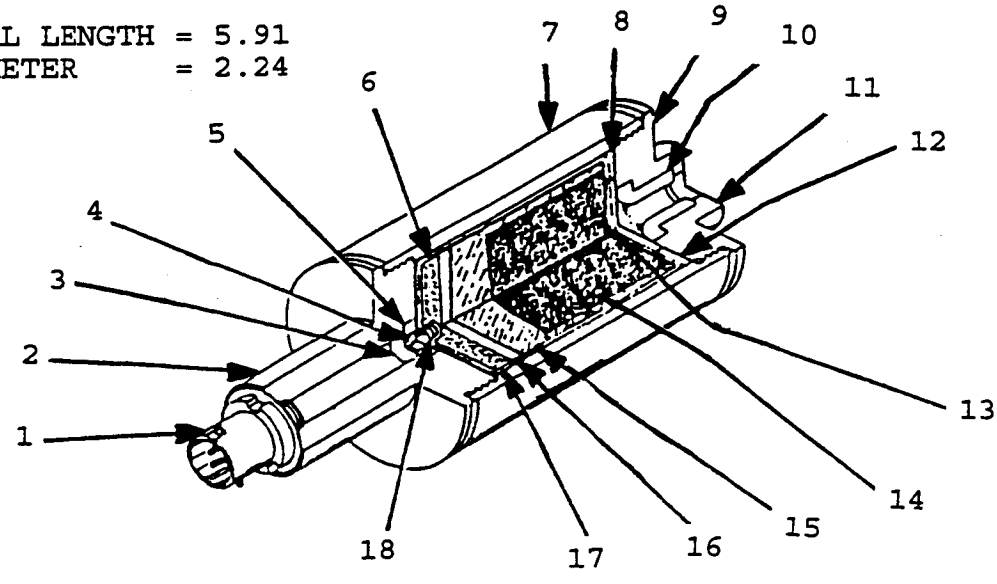
# NASA/DOD/DOE Pyrotechnic System

**TITLE:** Igniter System - Shuttle Main Engine Hydrogen Burn-off

**AGENCY/CENTER:** NASA Kennedy Space Center (KSC)

**PHYSICAL DATA:**

TOTAL LENGTH = 5.91
DIAMETER = 2.24




1. NSI
2. ADAPTER
3. ALUMINUM FOIL
4. 107-PPR-02 (LOOSE LOAD)
5. TRANSFER PELLET
6. FITCO
7. CASE
8. PAD
9. NOZZLE HOUSING
10. NOZZLE
11. WELDED CLOSURE DISK
12. PAPER DISK
13. IGNITION PELLET
14. GRAIN
15. INHIBITOR
16. DISK
17. PROTECTIVE CAP
18. ALUMINUM FOIL

HYDROGEN BURNOFF IGNITER

**CONTRACTOR:** Lockheed Space Division-Shuttle Processing Contractor/ KSC
**SUBCONTRACTOR:** Unidynamics/Phoenix Inc.

**SYSTEM IDENTIFICATION NUMBER:**
P/N 51-1151-2 NASA/KSC

**PURPOSE:**
The H2 burn igniter ignites at T-10 seconds to burn off free hydrogen at the main engine level prior to main engine ignition. This prevents the accumulation of hydrogen and an explosive overpressure.

# NASA/DOD/DOE Pyrotechnic System

**PREVIOUS USAGE:**
n/a

**OPERATIONAL DESCRIPTION:**
The system uses six hydrogen igniters. Two igniters aimed at each of the three main engines throw hot Zirconium particles under the engine bell for 8 to 12 seconds, igniting the free hydrogen as it is released. Each igniter is initiated by an NSI by ground command.

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** **Low** -65°F
**High** +150°F
**PRESSURE:** n/a

**LIST OF DEVICES:**
NSI, H2 burn-off igniter

**QUALIFICATION DOCUMENTATION:**
80K50593 hydrogen burn-off igniter specification

**ADDITIONAL REFERENCES:**

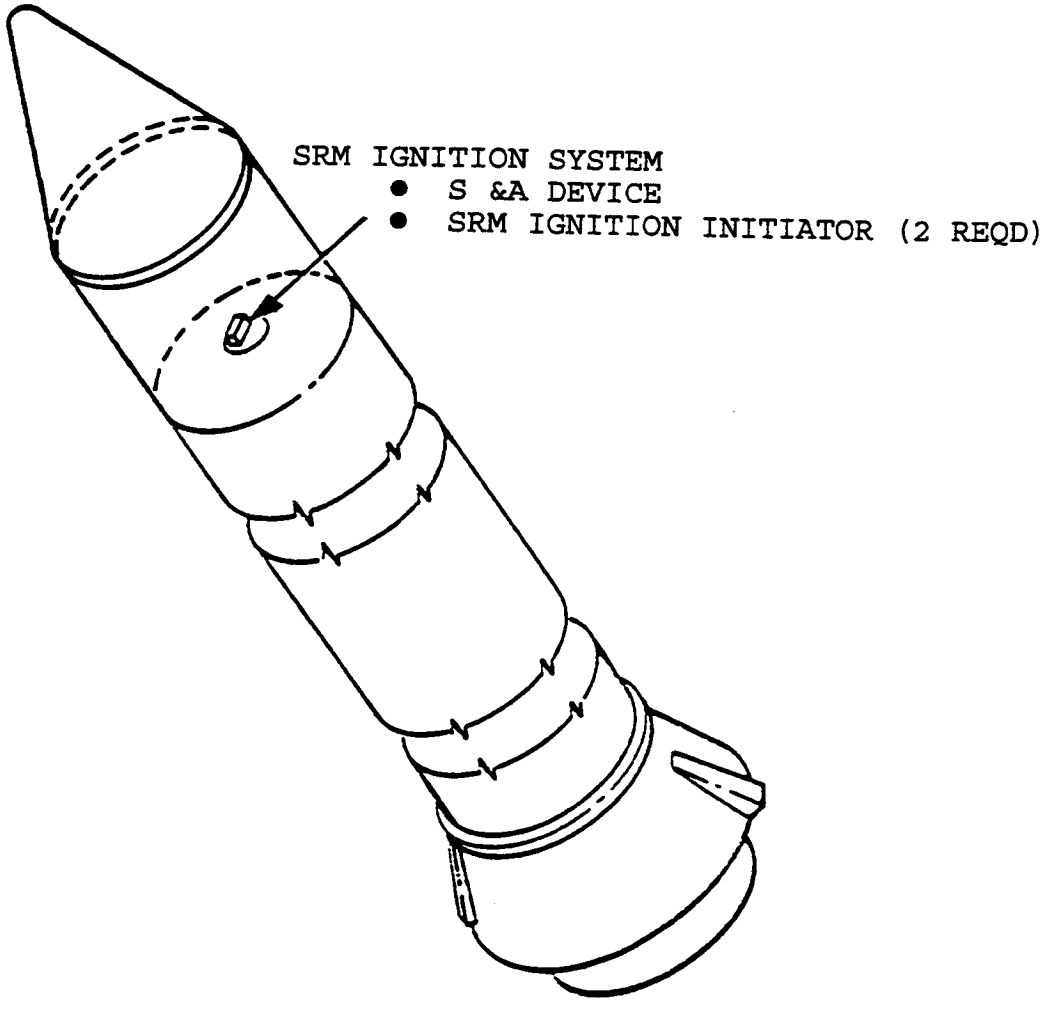
**ADDITIONAL COMMENTS:**
Redundancy is achieved by providing two H2 burn-off igniters with an independent firing system for each main engine.

## NASA/DOD/DOE Pyrotechnic System

**TITLE:** Ignition System - Solid Rocket Motor (SRM)

**AGENCY/CENTER:** NASA/Marshall Space Flight Center (MSFC)

**PHYSICAL DATA:**




SOLID ROCKET MOTOR (SRM) IGNITION SYSTEM

**CONTRACTOR:** Thiokol Corporation

**SUBCONTRACTOR:** Thiokol Corporation

**SYSTEM IDENTIFICATION NUMBER:**
No system number; refer to specific components (devices).

**PURPOSE:**
To ignite and prevent the premature ignition of the SRM.

# NASA/DOD/DOE Pyrotechnic System

**PREVIOUS USAGE:**
Minuteman, second stage

**OPERATIONAL DESCRIPTION:**
At 4 minutes, 58 seconds before launch, a signal is sent to the Safety and Arming (S&A) device to rotate the booster-barrier rotor from the SAFE to the ARM position. The S&A device, when in the SAFE position, will prevent the premature ignition of the SRM. When the S&A device is in the ARM position, the 2 holes in the barrier rotor plate are aligned with the output end of the initiators and the booster charge in the S&A device. Charge commands are sent to the ignition pyrotechnic initiator controllers (PICs) at t-15 seconds in the launch count down. Redundant fire commands are sent to the triggers of two PICs at time zero. The PIC capacitors are discharged into the SRM Ignition Initiator (SII) bridgewires, initiating the output charges. The output of the redundant NSIs passes through the booster-barrier holes and ignites the S&A booster charge, which ignites the SRM igniter.

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** Low +20° F
High +120° F
**PRESSURE:** Refer to specific components (devices).

**LIST OF DEVICES:**
2 NSI/SRM Ignition Initiator (SII), Type I, JSC/SEB26100001-256 as modified by drawing number SED26100107-301
Safety and Arming (S&A) device, 1U52295-01

**QUALIFICATION DOCUMENTATION:**
n/a

**ADDITIONAL REFERENCES:**
n/a

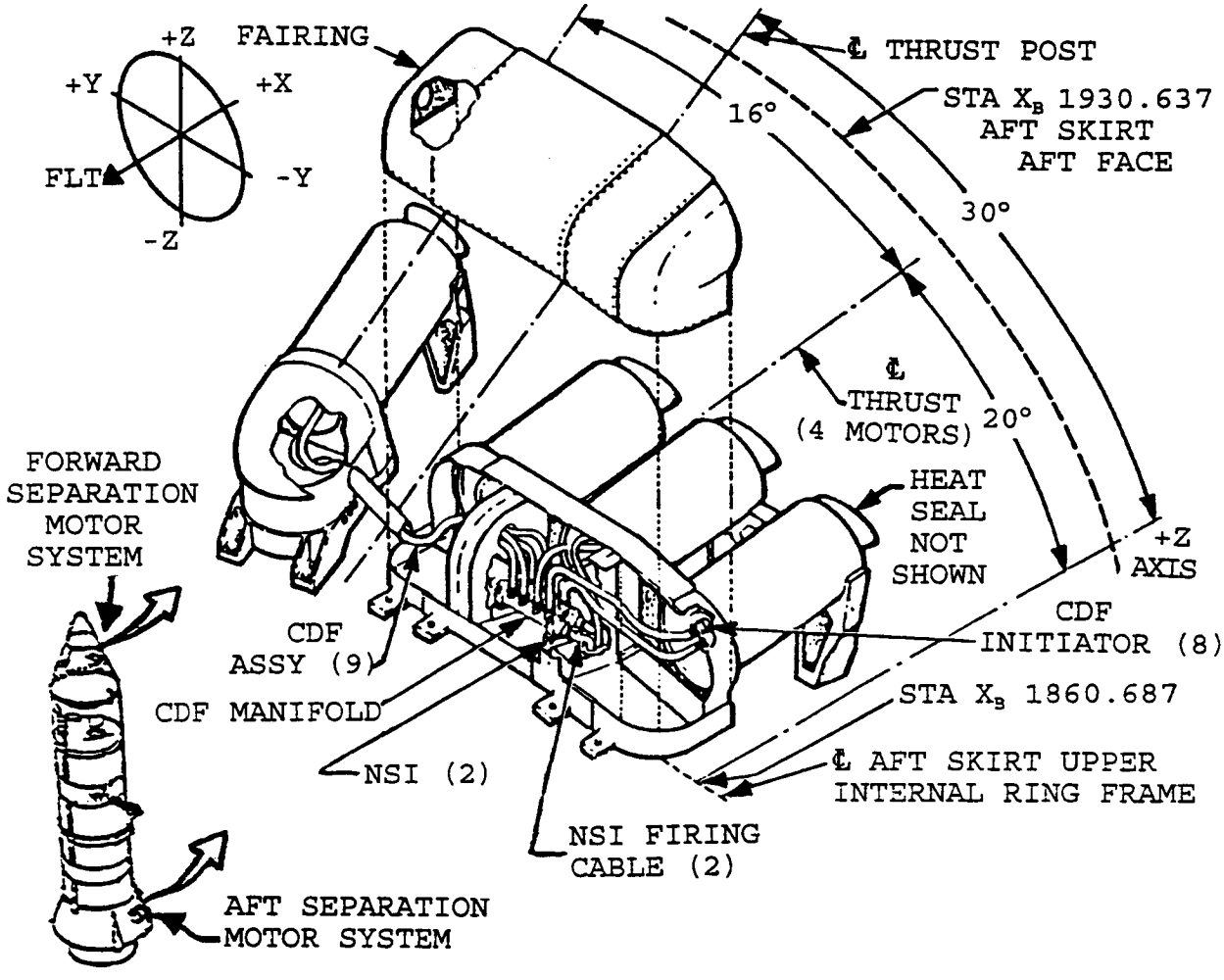
**ADDITIONAL COMMENTS:**
n/a

# NASA/DOD/DOE Pyrotechnic System

**TITLE:** Ignition System - SRB/ET Booster Separation Motor

**AGENCY/CENTER:** NASA/Marshall Space Flight Center (MSFC)

**PHYSICAL DATA:**




SRB/ET BOOSTER SEPARATION MOTOR IGNITION SYSTEM

**CONTRACTOR:** USBI

**SUBCONTRACTOR:** USBI

**SYSTEM IDENTIFICATION NUMBER:**
No system number; refer to specific components (devices).

**PURPOSE:**
To ignite the foward and aft SRB/ET separation motors which provide positive separation between the SRM and ET/Orbiter during structural separation.

# NASA/DOD/DOE Pyrotechnic System

**PREVIOUS USAGE:**
n/a

**OPERATIONAL DESCRIPTION:**
Eight BSMs, four foward and four aft, are ignited by two SRB/ET separation motor ignition systems. Redundant separation signals initiate two NSDs which propagates a shock wave through two CDF manifolds and eight CDF assemblies to eight CDF initiators mounted in the separation motors. The CDF initiators ignite the separation motor igniters which ignites the solid propellant and produces the required separation force.

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** **Low** +20° F for 12 hours
**High** +190° F for 4 hours
**PRESSURE:** Refer to specific components (devices).

**LIST OF DEVICES:**
2 NSDs, SEB26100094-201
2 Confined Detonating Fuse (CDF) Manifolds, 10312-0001-102 thru 10312-0001-105
9 CDF assemblies, 10314-0001-105 thru 10314-0001-122
8 CDF Initiators, 10308-0003-801

**QUALIFICATION DOCUMENTATION:**
n/a

**ADDITIONAL REFERENCES:**
n/a

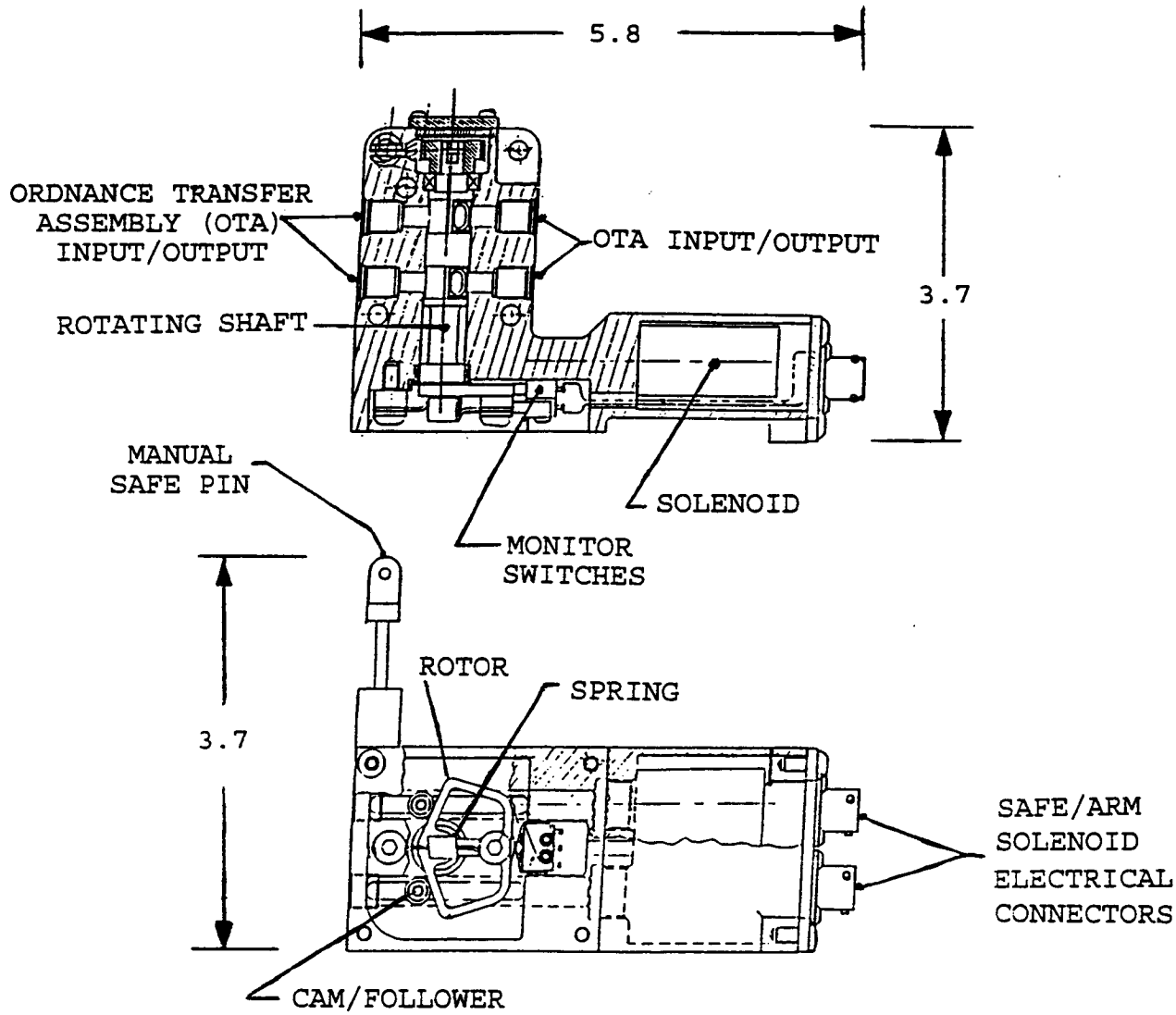
**ADDITIONAL COMMENTS:**
n/a

# NASA/DOD/DOE Pyrotechnic System

**TITLE:** Interupter System - Ordnance Transfer Assembly (OTA)

**AGENCY/CENTER:** NASA/GSFC/Wallops Flight Facility (WFF)

**PHYSICAL DATA:**




INTERRUPTER

**CONTRACTOR:** EER Systems Corporation

**SUBCONTRACTOR:** Pacific Scientific

**SYSTEM IDENTIFICATION NUMBER:**
n/a

**PURPOSE:**
Provide a means to interrupt an Ordnance Transfer Assembly (OTA) explosive train (Flexible Confined Detonating Cord (FCDC) is used as the OTA in this system). In the ARM position, this device will permit transfer of the explosive train. In the SAFE position,

this device will stop the transfer of the explosive train.

**PREVIOUS USAGE:**
Conestoga/COMET

**OPERATIONAL DESCRIPTION:**
FCDC lines (redundant) are inserted into input and output ports respectively. When properly torqued, the distance between explosive end tips of the FCDC's is approzximately 0.5 inch. With the device in the ARM position, propagation of the FCDC lines is permitted. With the device in the SAFE position, propagation of the FCDC lines is not permitted as a barrier is placed between the FCDC explosive end tips. The device may be switched from ARM-to-SAFE or SAFE-to-ARM remotely by applying the proper external command.

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** **Low** −65°F
**High** +200°F
**PRESSURE:** n/a

**LIST OF DEVICES:**

**QUALIFICATION DOCUMENTATION:**
Qualified for the Conestoga/COMET program

**ADDITIONAL REFERENCES:**
n/a

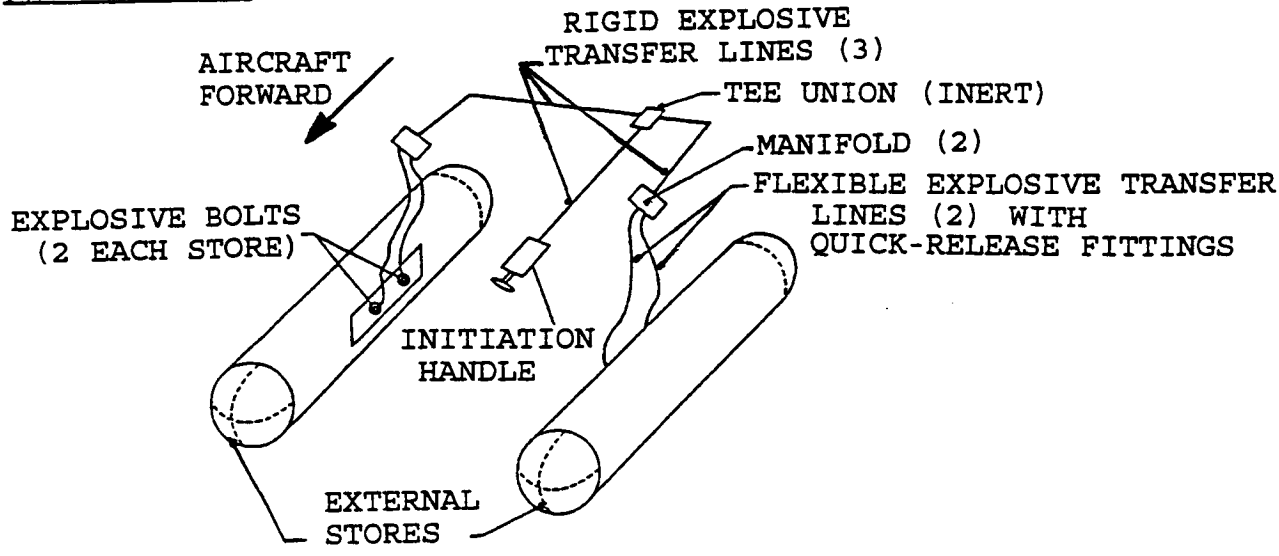
**ADDITIONAL COMMENTS:**
Incorporates redundant Input/Output ports. Device is inert.

# NASA/DOD/DOE Pyrotechnic System

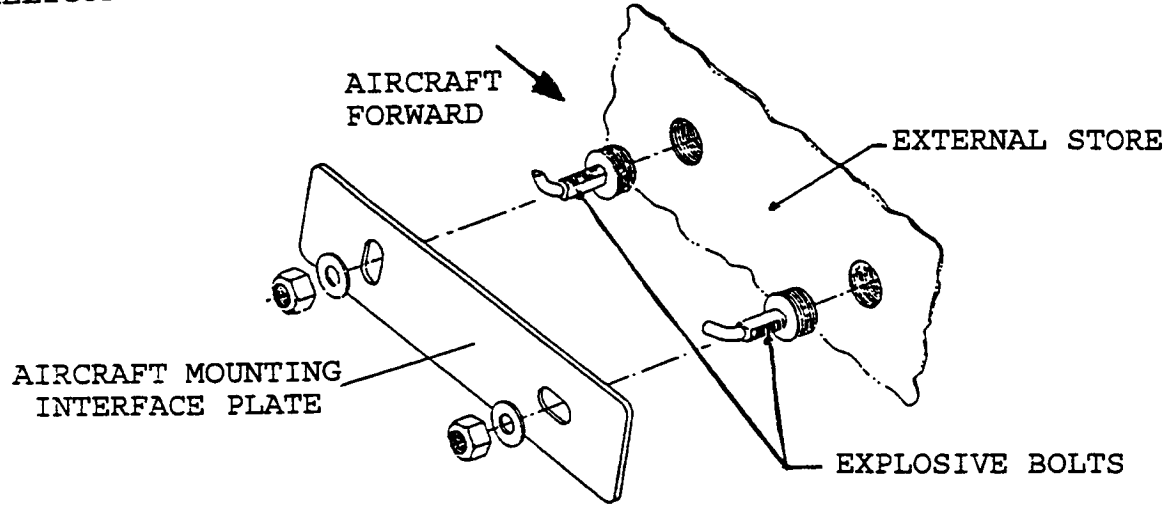
**TITLE:** Jettison System - Helicopter In-Flight Stores

**AGENCY/CENTER:** NASA Langley Research Center (LaRC) and U.S. Army Aviation Laboratory, FT. Eustis, Virginia

**PHYSICAL DATA:**




HELICOPTER STORES JETTISON SYSTEM




DETAILS OF AIRCRAFT TO EXTERNAL STORE INTERFACE

**CONTRACTOR:** Teledyne McCormick Selph

**SUBCONTRACTOR:** Teledyne McCormick Selph

**SYSTEM IDENTIFICATION NUMBER:**
n/a

**PURPOSE:**
Provide for rapid, emergecy release of helicopter side-mounted stores to enhance flight maneuverability.

This document is an information source only and should not be used for design purposes.

# NASA/DOD/DOE Pyrotechnic System

**PREVIOUS USAGE:**
None

**OPERATIONAL DESCRIPTION:**
The system approach was to use two nonfragmenting explosive bolts mounted in each 600-pound store to interface with a simple plate on the aircraft. The bolts were initiated by flexible explosive transfer lines with electrical-type push rotate quick-release connectors.

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** Low n/a
High n/a
**PRESSURE:** n/a

**LIST OF DEVICES:**
AH-1G (Cobra) helicopter initiation handle, standard rigid explosive transfer lines (SMDC), flexible explosive transfer lines, explosive manifold, and explosive bolts.

**QUALIFICATION DOCUMENTATION:**
Bement, Laurence J.; Jahsman, Dirk and Schimmel, Morry L. "Helicopter In-Flight Stores Jettison". Presented at the 1989 SAFE Symposium, Las Vegas, Nevada, December 4-8, 1989.

**ADDITIONAL REFERENCES:**
n/a

**ADDITIONAL COMMENTS:**
This sytem design emphasized operational simplicity, speed of assembly, ruggedness under military conditions, safety and reliability.

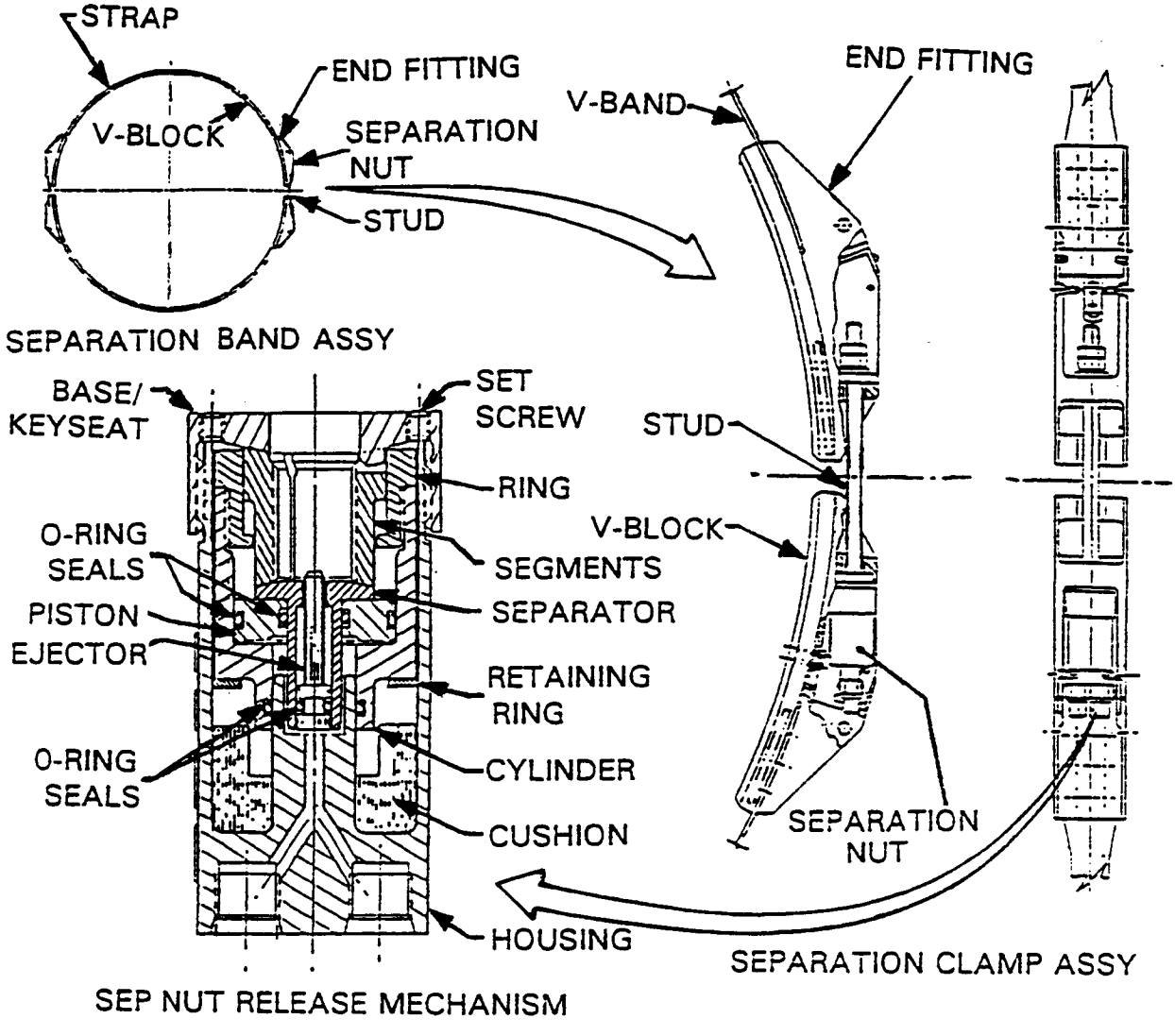
Design and development emphasis was placed on proving functional margins for all aspects of use and interfaces. Previously qualified design principles and hardware wre employed to reduce the number of tests to demonstrate reliability and to eliminate the need for environmental qualification.

# NASA/DOD/DOE Pyrotechnic System

**TITLE:** Nut System - NOAA V-Band Separation

**AGENCY/CENTER:** NASA Goddard Space Flight Center (GSFC)

**PHYSICAL DATA:**




NOAA PAYLOAD V-BAND SEPARATION NUT

**CONTRACTOR:** n/a

**SUBCONTRACTOR:** Hi-Shear, General Electric

**SYSTEM IDENTIFICATION NUMBER:**
Refer to List of Devices (below)

**PURPOSE:**
The ordnance actuated V-band is used to separate the spacecraft from the booster adapter at the proper point in the launch sequence.

# NASA/DOD/DOE Pyrotechnic System

**PREVIOUS USAGE:**
n/a

**OPERATIONAL DESCRIPTION:**
There are 2 mechanisms per separation band. The actuation of the single bridgewire pressure cartridge operates the separation or nut which releases the bolt holding the band halves together. Upon actuation, the release of tension in the bands moves the V-blocks off the flanges and the stages are free to separate.

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** **Low** n/a
**High** n/a

**PRESSURE:** n/a

**LIST OF DEVICES:**
Separation Nut; GE #2631523-1
Power Cartridge; Hi-Shear #32684549-1

**QUALIFICATION DOCUMENTATION:**
n/a

**ADDITIONAL REFERENCES:**
n/a

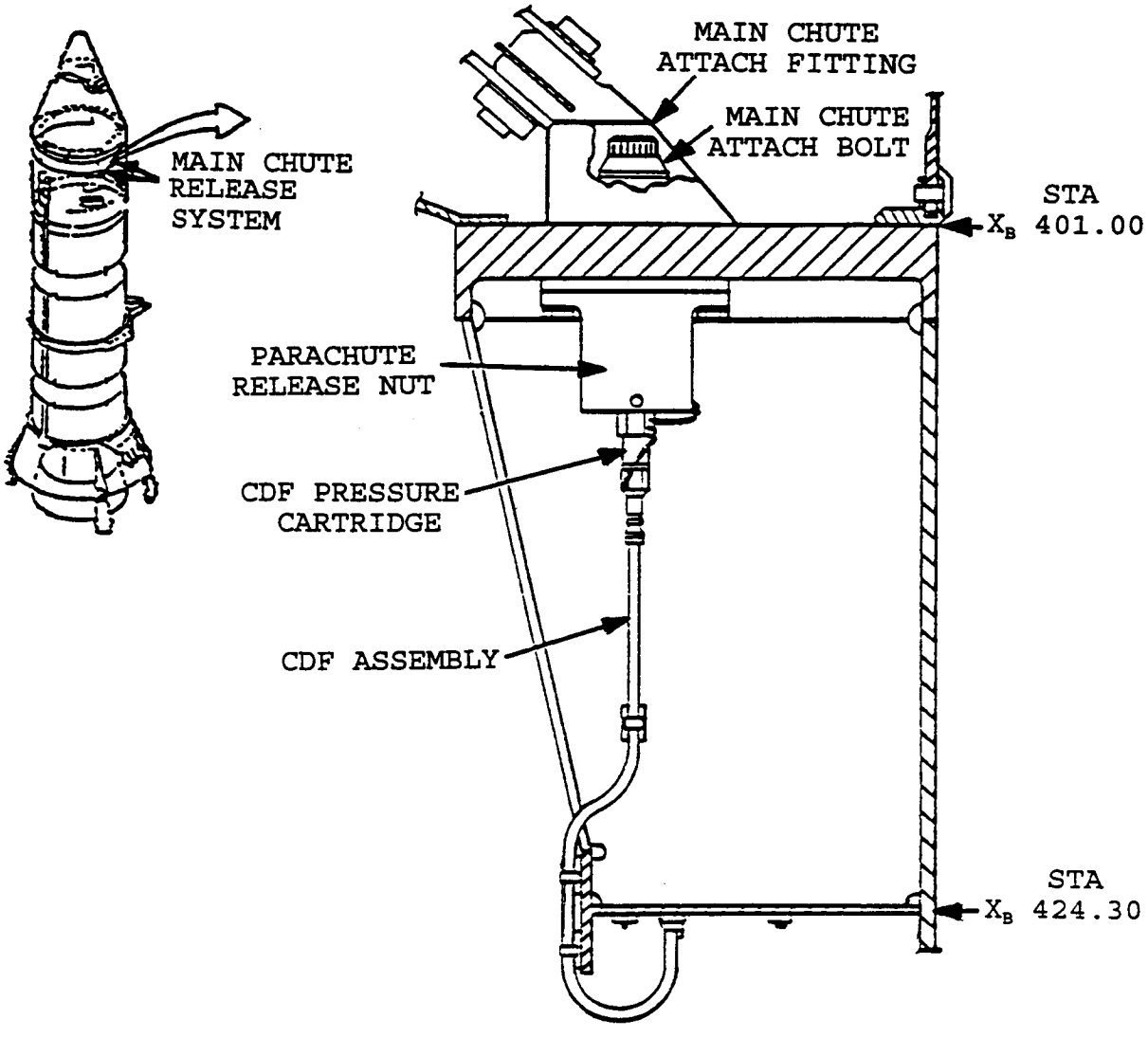
**ADDITIONAL COMMENTS:**
All fire current: 3.5 Amps; No-fire current: 1.0 amp , min. 1.0 watt for 5.0 minutes; Bridgewire Resistance: 1.05 ± 0.10 Ohms

# NASA/DOD/DOE Pyrotechnic System

**TITLE:** Nut System - SRB Main Parachute Release

**AGENCY/CENTER:** NASA/Marshall Space Flight Center (MSFC)

**PHYSICAL DATA:**




SOLID ROCKET BOOSTER (SRB) MAIN PARACHUTE RELEASE NUT SYSTEM

**CONTRACTOR:** USBI

**SUBCONTRACTOR:** USBI

**SYSTEM IDENTIFICATION NUMBER:**
No system number; refer to specific components (devices).

**PURPOSE:**
To release the main parachute attach bolt on splashdown by way of a parachute release nut.

# NASA/DOD/DOE Pyrotechnic System

**PREVIOUS USAGE:**
n/a

**OPERATIONAL DESCRIPTION:**
At splashdown, a G-force type impact switch in the foward IEA of the SRB causes a fire command to be sent to the main parachute disconnect Pyrotechnic Initiator Controller (PIC). The PIC ignites a NSD which propagates through a Confined Detonating Fuse (CDF) manifold and six CDF assemblies to six CDF pressure cartridges installed in each of the six parachute release nuts. The parachute release nuts attach the three main parachutes to the SRB. When the pressure cartridges are fired, the pressure causes the parachute release nut to release the main parachute attach bolt. The attach bolt is ejected from the nut by the ejector and the tension in the main parachute lines.

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** **Low** +20° F for 12 hours
**High** +190° F for a minimum of 4 hours.
**PRESSURE:** Refer to specific components (devices)

**LIST OF DEVICES:**
1 NSD, SEB26100094-201
1 CDF Manifold, 10312-0001-801
6 CDF Assemblies, 10314-0001-130 thru 10314-0001-135
6 CDF Pressure Cartridges, 10319-0002-801; 10319-0002-802 (ALT)
6 SRB Main Parachute Release Nuts, 10309-0011-801

**QUALIFICATION DOCUMENTATION:**
n/a

**ADDITIONAL REFERENCES:**
n/a

**ADDITIONAL COMMENTS:**
n/a

# NASA/DOD/DOE Pyrotechnic System

**TITLE:** Nut System - UARS Solar Array Deployment Separation

**AGENCY/CENTER:** NASA Goddard Space Flight Center (GSFC)

**PHYSICAL DATA:**

FIGURE

N/A

**CONTRACTOR:** n/a

**SUBCONTRACTOR:** n/a

**SYSTEM IDENTIFICATION NUMBER:**
Refer to List of Devices (below)

**PURPOSE:**
Purpose: Activates Solar Array Separation Nuts Assembly to release solar array retention bolts to deploy Solar Array.

# NASA/DOD/DOE Pyrotechnic System

**PREVIOUS USAGE:**
n/a

**OPERATIONAL DESCRIPTION:**
n/a

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** Low n/a
High n/a
**PRESSURE:** MOP 3000 PSIG

**LIST OF DEVICES:**
Separation Nut; n/a
NASA Standard Initiator (NSI); JSC SEB 26100001

**QUALIFICATION DOCUMENTATION:**
n/a

**ADDITIONAL REFERENCES:**
n/a

**ADDITIONAL COMMENTS:**
Bridgewire Resistance: 1.05 ± 0.1 Ohms; All fire current: 3.5 amps for 10 ms max.; No fire current: 1.0 amp, 1 watt for 5 minutes minimum.

# NASA/DOD/DOE Pyrotechnic System

**TITLE:** Nut System - UARS Solar Array Jettison Separation

**AGENCY/CENTER:** NASA Goddard Space Flight Center (GSFC)

**PHYSICAL DATA:**

FIGURE

N/A

**CONTRACTOR:** n/a

**SUBCONTRACTOR:** n/a

**SYSTEM IDENTIFICATION NUMBER:**
Refer to List of Devices (below)

**PURPOSE:**
Activates Solar Array Jettison Separation Nuts Assembly to release solar array retention bolts to deploy Solar Array.

# NASA/DOD/DOE Pyrotechnic System

**PREVIOUS USAGE:**
n/a

**OPERATIONAL DESCRIPTION:**
n/a

**OPERATING TEMPERATURE/PRESSURE:**
TEMPERATURE RANGE: Low n/a
High n/a
PRESSURE: MOP 3000 PSIG

**LIST OF DEVICES:**
Separation Nut; n/a
NASA Standard Initiator (NSI); JSC SEB 26100001

**QUALIFICATION DOCUMENTATION:**
n/a

**ADDITIONAL REFERENCES:**
n/a

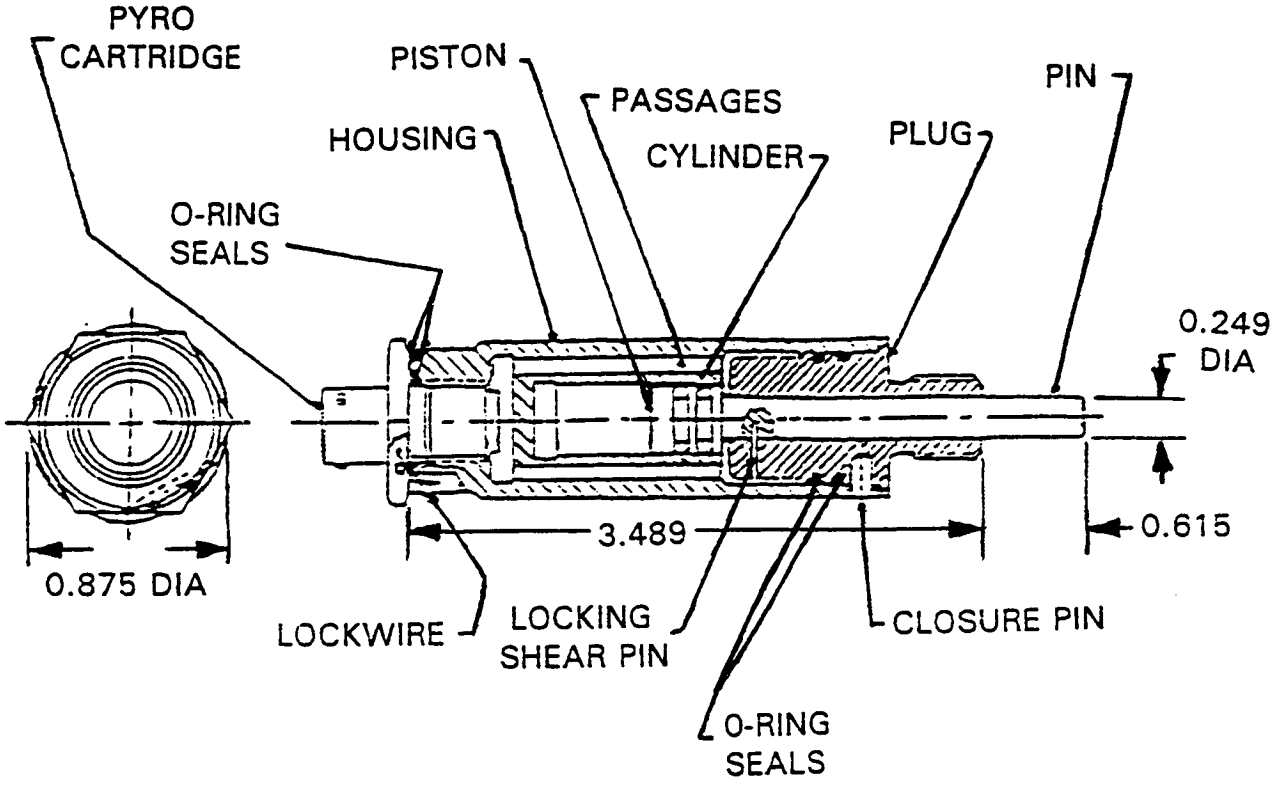
**ADDITIONAL COMMENTS:**
Bridgewire Resistance: 1.05 ± 0.1 Ohms; All fire current: 3.5 amps for 10 ms max.; No fire current: 1.0 amp, 1 watt for 5 minutes minimum.

## NASA/DOD/DOE Pyrotechnic System

**TITLE:** Pin Puller System - BBXRT Launch Locking Mechanism

**AGENCY/CENTER:** NASA Goddard Space Flight Center (GSFC)

**PHYSICAL DATA:**




BBXRT PAYLOAD PIN PULLER FOR LAUNCH LOCKING MECHANISM

**CONTRACTOR:** n/a

**SUBCONTRACTOR:** Hi-Shear Technology, Inc.

**SYSTEM IDENTIFICATION NUMBER:**
Refer to List of Devices (Below)

**PURPOSE:**
Pyro Pin pullers unlock the Launch Locking Mechanism

# NASA/DOD/DOE Pyrotechnic System

**PREVIOUS USAGE:**
n/a

**OPERATIONAL DESCRIPTION:**
BBXRT spacecraft utilizes a pair of Pyro pin pullers for each release mechanism assembly for mechanical redundancy. Each pressure cartridge has redundant bridgewires. Either bridgewire activated, Pressure cartridge will actuate the Pin Puller. This redundant bridgewire pressure cartridge design meets the electrical requirements of NSI cartridge. When commanded, the pyro pin-puller shall fire uncontrolled sequence at the restraint mechanism. Redundant firing signals shall be applied through redundant bridgewires after a short delay. The cartridges shall have 2 independent bridgewires, either capable of initiating the charge including failure of the first bridgewire.

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** **Low** -20°C
**High** +150°C
**PRESSURE:** n/a

**LIST OF DEVICES:**
Pin Puller; Hi-Shear #9364246-1, GSFC #1456479
Pressure Cartridge; Hi-Shear #9392129-1, GSFC #1456480

**QUALIFICATION DOCUMENTATION:**
n/a

**ADDITIONAL REFERENCES:**
n/a

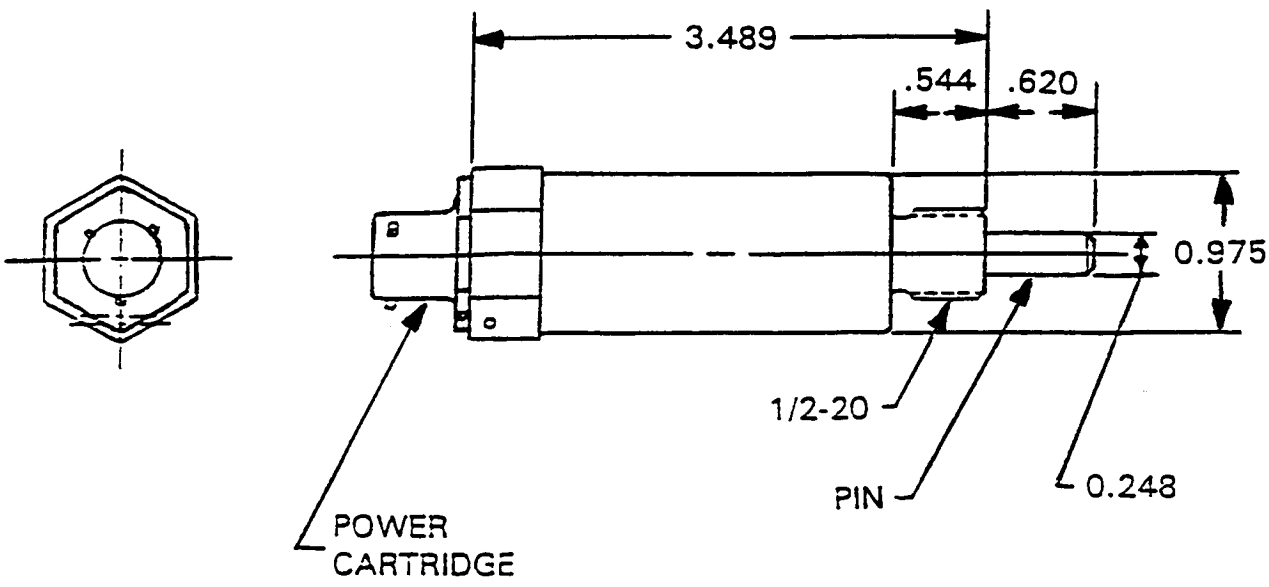
**ADDITIONAL COMMENTS:**
All fire current: 4.0 Amps; No-fire current: 1.0 amp ,5 min. 1.0 watt for 5.0 minutes; Bridgewire Resistance: 1.10 ± 0.10 Ohms

# NASA/DOD/DOE Pyrotechnic System

**TITLE:** Pin Puller System - COBE Omni Antenna

**AGENCY/CENTER:** NASA Goddard Space Flight Center (GSFC)

**PHYSICAL DATA:**




COBE PAYLOAD PIN PULLER FOR OMNI ANTENNA

**CONTRACTOR:** n/a

**SUBCONTRACTOR:** Hi-Shear Technology, Inc.

**SYSTEM IDENTIFICATION NUMBER:**
Refer to List of Devices (below)

**PURPOSE:**
Pyro Pin pullers are used to stow the COBE Omni Antenna Deployment System during launch, and then release to deploy the Omni Antenna into their deployed configuration in orbit. Pyros can be activated by either ground command or PSDU.

# NASA/DOD/DOE Pyrotechnic System

**PREVIOUS USAGE:**
n/a

**OPERATIONAL DESCRIPTION:**
COBE spacecraft utilizes a pair of Pyro pin pullers for each release mechanism assembly for mechanical redundancy. Each pressure cartridge has redundant bridgewires. Either bridgeware activated, Pressure cartridge will actuate the Pin Puller. This redundant bridgewire pressure cartridge design meets the electrical requirements of NSI cartridge. When commanded, the pyro pin-puller shall fire uncontrolled sequence at the restraint mechanism. Redundant firing signals shall be applied through redundant bridgewires after a short delay. The cartridges shall have 2 independent bridgewires, either capable of initiating the charge including failure of the first bridgewire. When commanded by the PSDU, the pyro-pin pullers shall fire uncontrolled sequence at the panel and boom restraint mechanisms. Redundant firing signals shall be applied through redundant bridgewires after a short delay.

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** **Low** -20°C
**High** +125°C
**PRESSURE:** n/a

**LIST OF DEVICES:**
Pin Puller; Hi-Shear #9364246-2, GSFC #1456479
Pressure Cartridge; Hi-Shear #9392129-1, GSFC #1456480

**QUALIFICATION DOCUMENTATION:**
Pyrotechnically Actuated Pin Puller Specification COBE-ST-731-1100-01

Electrically Initiated Pressure Cartridge Specification COBE-ST-731-1100-02

**ADDITIONAL REFERENCES:**
n/a

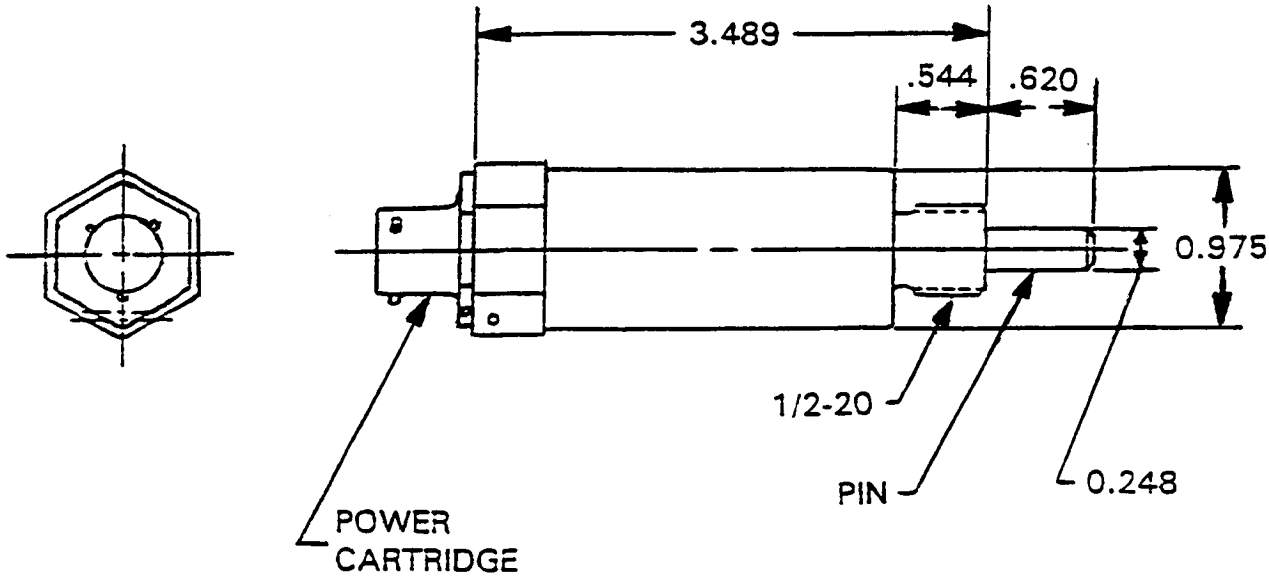
**ADDITIONAL COMMENTS:**
All fire current: 4.0 Amps; No-fire current: 1.0 amp , min. 1.0 watt for 5.0 minutes; Bridgewire Resistance: 1.10 ± 0.10 Ohms

# NASA/DOD/DOE Pyrotechnic System

**TITLE:** Pin Puller System - COBE RF Thermal Shield

**AGENCY/CENTER:** NASA Goddard Space Flight Center (GSFC)

**PHYSICAL DATA:**




COBE PAYLOAD PIN PULLER FOR R/F THERMAL SHIELD

**CONTRACTOR:** n/a

**SUBCONTRACTOR:** Hi-Shear Technology, Inc.

**SYSTEM IDENTIFICATION NUMBER:**
Refer to List of Devices (below)

**PURPOSE:**
Pyro Pin pullers are used to stow the COBE R/F Thermal Shield during launch, and then release the R/F Thermal Shield into their deployed configuration in orbit. Pyros can be activated by either ground command or PSDU.

# NASA/DOD/DOE Pyrotechnic System

**PREVIOUS USAGE:**
n/a

**OPERATIONAL DESCRIPTION:**
COBE spacecraft utilizes a pair of Pyro pin pullers for each release mechanism assembly for mechanical redundancy. Each pressure cartridge has redundant bridgewires. Either bridgewire activated, Pressure cartridge will actuate the Pin Puller. This redundant bridgewire pressure cartridge design meets the electrical requirements of NSI cartridge. When commanded, the pyro pin-puller shall fire uncontrolled sequence at the restraint mechanism. Redundant firing signals shall be applied through redundant bridgewires after a short delay. The cartridges shall have 2 independent bridgewires, either capable of initiating the charge including failure of the first bridgewire. When commanded by the PSDU, the pyro-pin pullers shall fire uncontrolled sequence at the panel and boom restraint mechanisms. Redundant firing signals shall be applied through redundant bridgewires after a short delay.

**OPERATING TEMPERATURE/PRESSURE:**

**TEMPERATURE RANGE:** **Low** -20°C
**High** +125°C

**PRESSURE:** n/a

**LIST OF DEVICES:**
Pin Puller; ;Hi-Shear #9364246-2, GSFC #1456479
Pressure Cartridge; Hi-Shear #9392129-1, GSFC #1456480

**QUALIFICATION DOCUMENTATION:**
Pyrotechnically Actuated Pin Puller Specification COBE-ST-731-1100-01

Electrically Initiated Pressure Cartridge Specification COBE-ST-731-1100-02

**ADDITIONAL REFERENCES:**
n/a

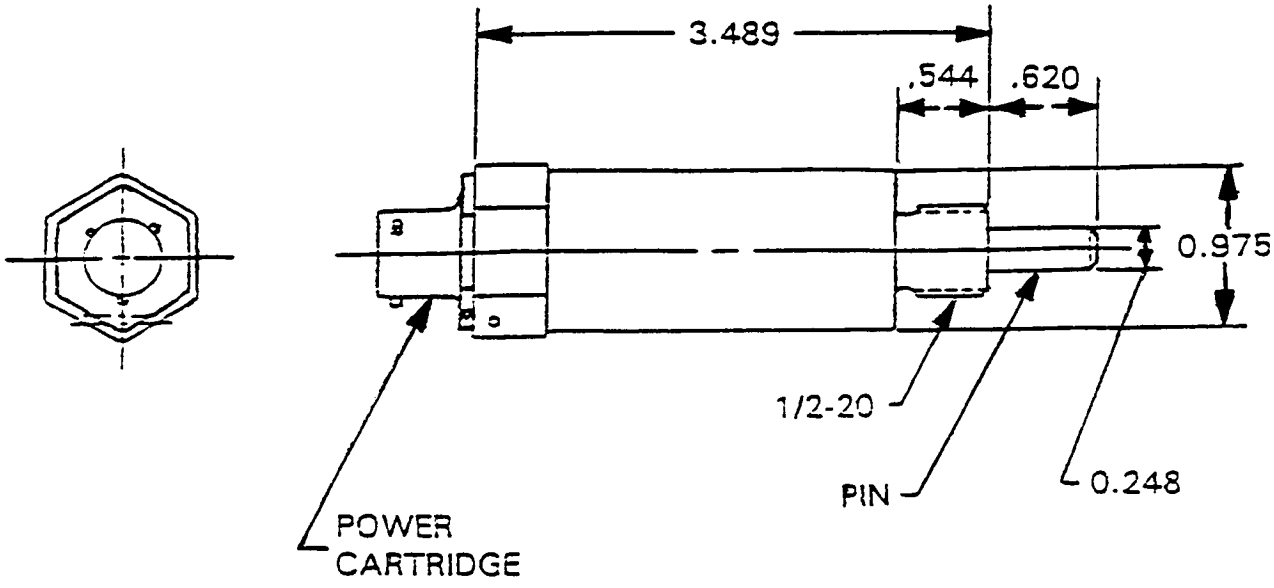
**ADDITIONAL COMMENTS:**
All fire current: 4.0 Amps; No-fire current: 1.0 amp , min 1.0 watt for 5.0 minutes; Bridgewire Resistance: 1.10 ± 0.10 Ohms

# NASA/DOD/DOE Pyrotechnic System

**TITLE:** Pin Puller System - COBE Solar Array

**AGENCY/CENTER:** NASA Goddard Space Flight Center (GSFC)

**PHYSICAL DATA:**




COBE PAYLOAD PIN PULLER FOR SOLAR ARRAY

**CONTRACTOR:** n/a

**SUBCONTRACTOR:** Hi-Shear Technology, Inc.

**SYSTEM IDENTIFICATION NUMBER:**
Refer to List of Devices (below)

**PURPOSE:**
Pyro Pin pullers are used to stow the COBE Solar Array Deployment System during launch, and then release to deploy the Solar Array into their deployed configuration in orbit. Pyros can be activated by either ground command or PSDU.

# NASA/DOD/DOE Pyrotechnic System

**PREVIOUS USAGE:**
n/a

**OPERATIONAL DESCRIPTION:**
COBE spacecraft utilizes a pair of Pyro pin pullers for each release mechanism assembly for mechanical redundancy. Each pressure cartridge has redundant bridgewires. Either bridgewire activated, Pressure cartridge will actuate the Pin Puller. This redundant bridgewire pressure cartridge design meets the electrical requirements of NSI cartridge. When commanded, the pyro pin-puller shall fire uncontrolled sequence at the restraint mechanism. Redundant firing signals shall be applied through redundant bridgewires after a short delay. The cartridges shall have 2 independent bridgewires, either capable of initiating the charge including failure of the first bridgewire. When commanded by the PSDU, the pyro-pin pullers shall fire uncontrolled sequence at the panel and boom restraint mechanisms. Redundant firing signals shall be applied through redundant bridgewires after a short delay.

**OPERATING TEMPERATURE/PRESSURE:**

**TEMPERATURE RANGE:** **Low** -20°C
**High** +125°C

**PRESSURE:** n/a

**LIST OF DEVICES:**
Pin Puller; Hi-Shear #9364246-2, GSFC #1456479
Pressure Cartridge; Hi-Shear #9392129-1, GSFC #1456480

**QUALIFICATION DOCUMENTATION:**
Pyrotechnically Actuated Pin Puller Specification COBE-ST-731-1100-01

Electrically Initiated Pressure Cartridge Specification COBE-ST-731-1100-02

**ADDITIONAL REFERENCES:**
n/a

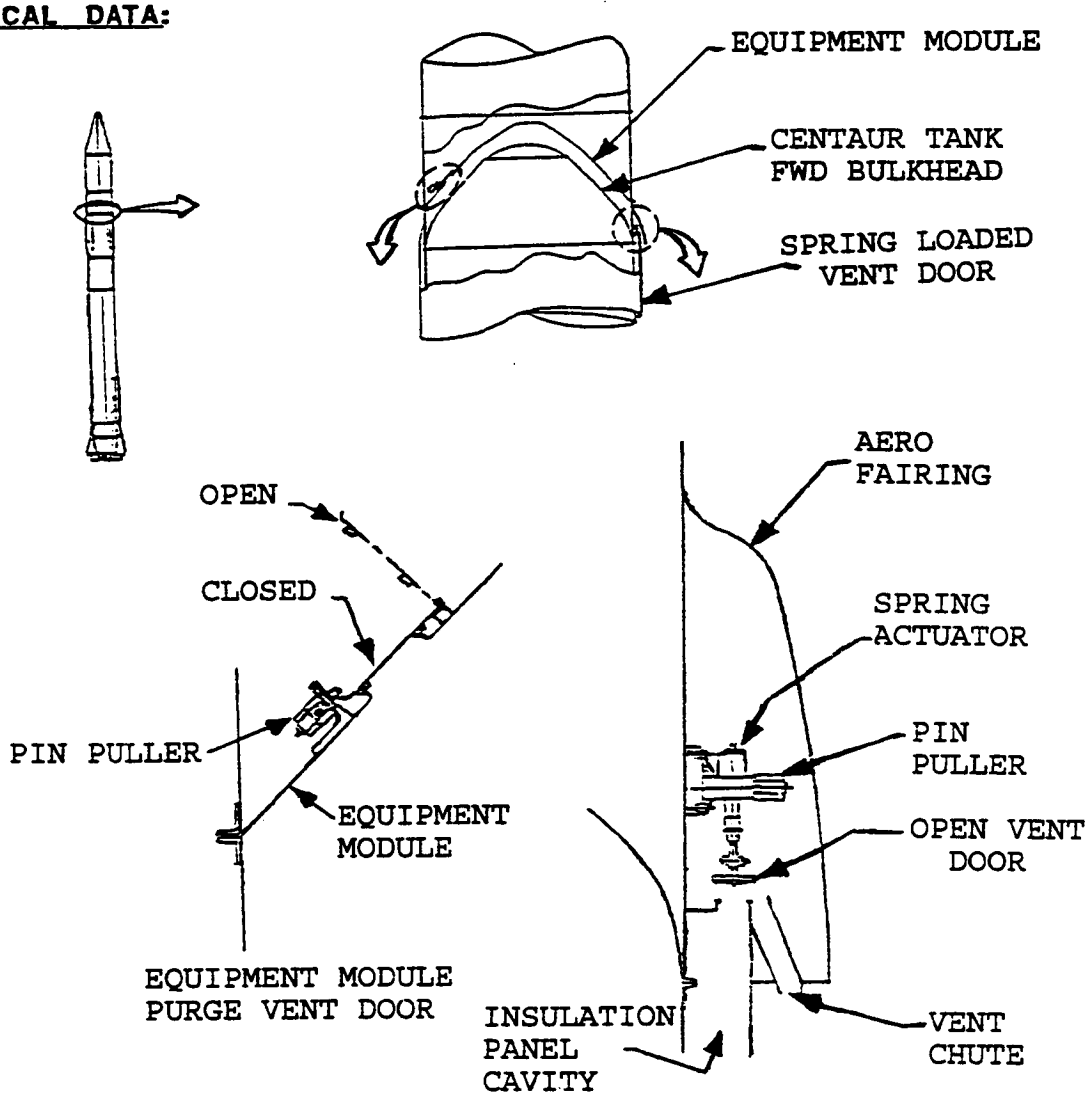
**ADDITIONAL COMMENTS:**
All fire current: 4.0 Amps; No-fire current: 1.0 amp , min. 1.0 watt for 5.0 minutes; Bridgewire Resistance: 1.10 ± 0.10 Ohms

## NASA/DOD/DOE Pyrotechnic System

**TITLE:** Pin Puller System - Insulation Panel/Equipment Module Vent Door

**AGENCY/CENTER:** NASA Lewis Research Center (LeRC)

**PHYSICAL DATA:**




INSULATION PANEL AND EQUIPMENT MODULE VENT DOOR SYSTEM

**CONTRACTOR:** General Dynamics Space Systems Division (GDSSD)

**SUBCONTRACTOR:** Conax - for pin pullers

**SYSTEM IDENTIFICATION NUMBER:**
Refer to specific components in List of Devices (below)

**PURPOSE:**
To open a door in the equipment module and one at the insulation panel cavity forward end by pyro actuated pin pullers for venting purge gas from the compartments.

# NASA/DOD/DOE Pyrotechnic System

**PREVIOUS USAGE:**
Expendable Launch Vehicles: Atlas Centaur Vehicles through AC-68

**OPERATIONAL DESCRIPTION:**
Just prior to vehicle liftoff electrical power is supplied to the two on board pyro pin pullers. Each of the pin pullers has two detonator explosive cartridges. Activation of at least one cartridge per puller actuates the mechanism to pull the pin. The pins are retainers that hold spring loaded doors in the closed position. Upon retraction of the pins, the doors spring open to vent the purge gas from the equipment module compartment and the insulation panel cavity.

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** **Low** -320 °F
**High** +200 °F
**PRESSURE:** 1300 psi in 10 cc

**LIST OF DEVICES:**
Latch Pin Puller; GDSSD 55-71320
Explosive Cartridge; GDSSD 55-07103

**QUALIFICATION DOCUMENTATION:**
n/a

**ADDITIONAL REFERENCES:**
n/a

**ADDITIONAL COMMENTS:**
n/a

# NASA/DOD/DOE Pyrotechnic System

**TITLE:** Pin Puller System - NOAA UDA Antenna

**AGENCY/CENTER:** NASA Goddard Space Flight Center (GSFC)

**PHYSICAL DATA:**

FIGURE

N/A

**CONTRACTOR:** n/a

**SUBCONTRACTOR:** Hi-Shear

**SYSTEM IDENTIFICATION NUMBER:**
Refer to List of Devices (below)

**PURPOSE:**
Pin pullers actuate UDA Antenna release.

# NASA/DOD/DOE Pyrotechnic System

**PREVIOUS USAGE:**
n/a

**OPERATIONAL DESCRIPTION:**
The antenna is caged to a satellite bracket located appoximately at the antenna center of gravity. The release mechanism for the antenna, a pyro-actuated pin puller, is located between the hinge and preload cradle. A dual-bridgewire in the pyrotechnic pin puller provides release redundancy.

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** **Low** n/a
**High** n/a

**PRESSURE:** n/a

**LIST OF DEVICES:**
Pin Puller; Hi-Shear #SP1105
Power Cartridge; Hi-Shear #2295262

**QUALIFICATION DOCUMENTATION:**
n/a

**ADDITIONAL REFERENCES:**
n/a

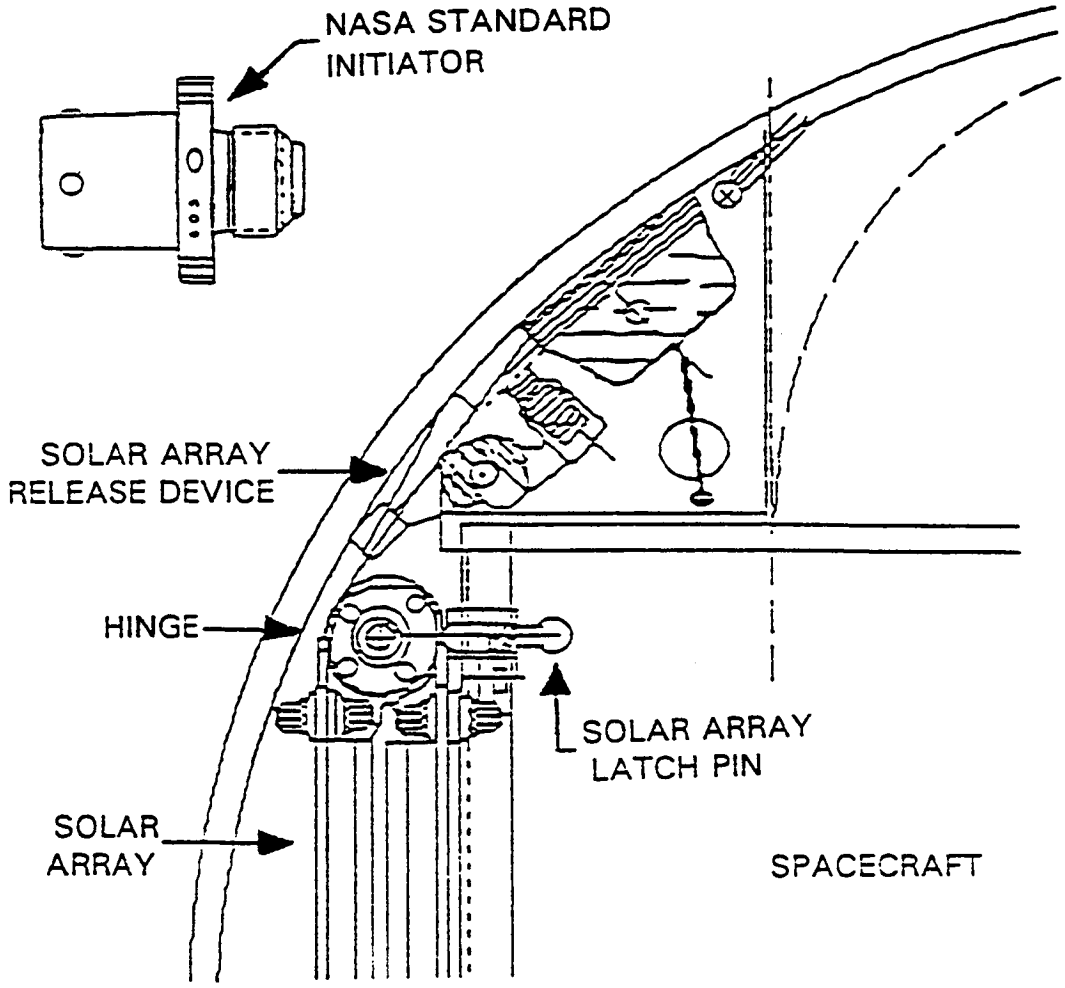
**ADDITIONAL COMMENTS:**
All fire current: 3.5 Amps for 10 ms; No-fire current: 1.0 amp ,5 min 1.0 watt for 5.0 minutes; Bridgewire Resistance: 1.10 ± 0.10 Ohms

## NASA/DOD/DOE Pyrotechnic System

**TITLE:** Pin Puller System - SAMPEX Solar Array Deployment

**AGENCY/CENTER:** NASA Goddard Space Flight Center (GSFC)

**PHYSICAL DATA:**




SAMPEX PAYLOAD SOLAR ARRAY DEPLOYMENT PIN PULLER

**CONTRACTOR:** n/a

**SUBCONTRACTOR:** Space Ordnance Systems; High-Shear Corp.

**SYSTEM IDENTIFICATION NUMBER:**
Refer to List of Devices (below)

**PURPOSE:**
Deploy the Solar Arrays

# NASA/DOD/DOE Pyrotechnic System

**PREVIOUS USAGE:**
n/a

**OPERATIONAL DESCRIPTION:**
The pin pullers contain redundant power cartridges actuated by a circuit with a redundant bus. The power cartridge utilizes a single bridgewire. When the power cartridges are fired, a pin is retracted releasing the Yo-Yo weights. The weights unwind deploying the Solar Arrays.

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** **Low** −260°F
**High** +300°F
**PRESSURE:** n/a

**LIST OF DEVICES:**
Pin Puller; n/a
NASA Standard Initiator (NSI); JSC SEB 26100001

**QUALIFICATION DOCUMENTATION:**
n/a

**ADDITIONAL REFERENCES:**
n/a

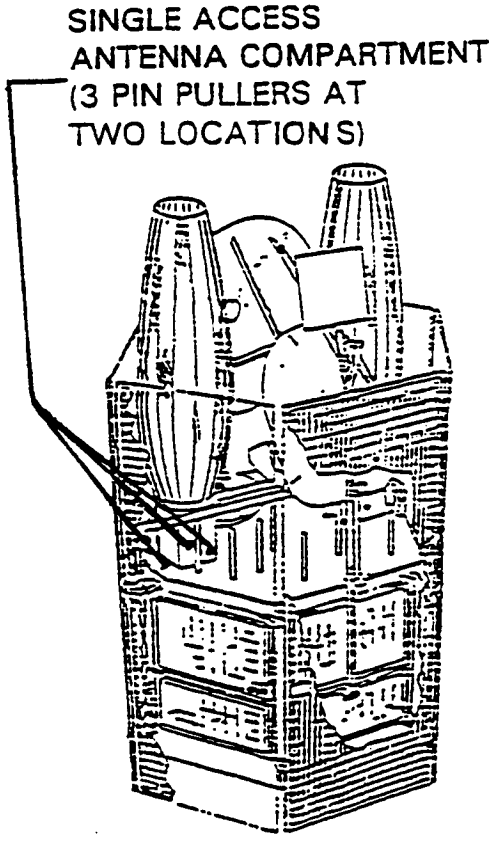
**ADDITIONAL COMMENTS:**
Bridgewire resistance: 1.05 ± 0.1 Ohms; All fire current: 3.5 amps for 10 ms max.; No fire current: 1.0 amp, 1 watt for 5 minutes min.

## NASA/DOD/DOE Pyrotechnic System

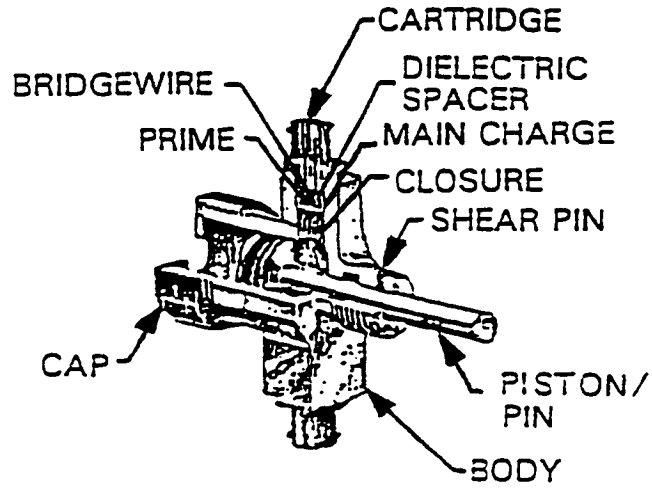
**TITLE:** Pin Puller System - TDRS Single Access Antenna Compartment

**AGENCY/CENTER:** NASA Goddard Space Flight Center (GSFC)

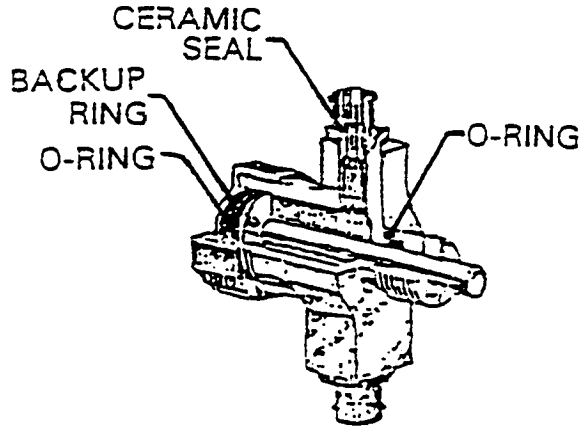
**PHYSICAL DATA:**




PAYLOAD
APPENDAGE RETENTION DEVICES




CONFIGURATION BEFORE FIRING




CONFIGURATION AFTER FIRING
PIN PULLER ASSEMBLY

TDRS PAYLOAD SINGLE ACCESS ANTENNA COMPARTMENT PIN PULLER

**CONTRACTOR:** n/a

**SUBCONTRACTOR:** n/a

**SYSTEM IDENTIFICATION NUMBER:**
Refer to List of Devices (below)

**PURPOSE:**
Activates Single Access Antenna Compartment.

# NASA/DOD/DOE Pyrotechnic System

**PREVIOUS USAGE:**
n/a

**OPERATIONAL DESCRIPTION:**
n/a

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** **Low** n/a
**High** n/a
**PRESSURE:** n/a

**LIST OF DEVICES:**
Pin Puller; n/a #127950
Pressure Cartridge; n/a

**QUALIFICATION DOCUMENTATION:**
n/a

**ADDITIONAL REFERENCES:**
n/a

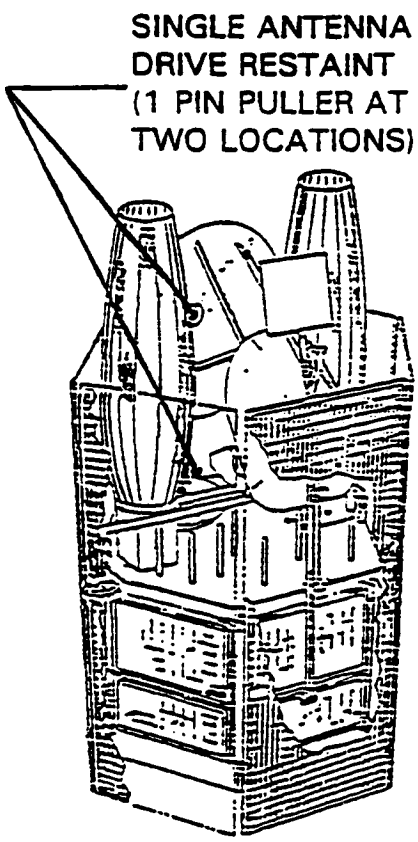
**ADDITIONAL COMMENTS:**
Bridgewire Resistance: 1.0 ± 0.5 Ohms; All fire current: 4.5 amps for 10 ms max.; No fire current: 1.0 amp F/5 minutes.

## NASA/DOD/DOE Pyrotechnic System

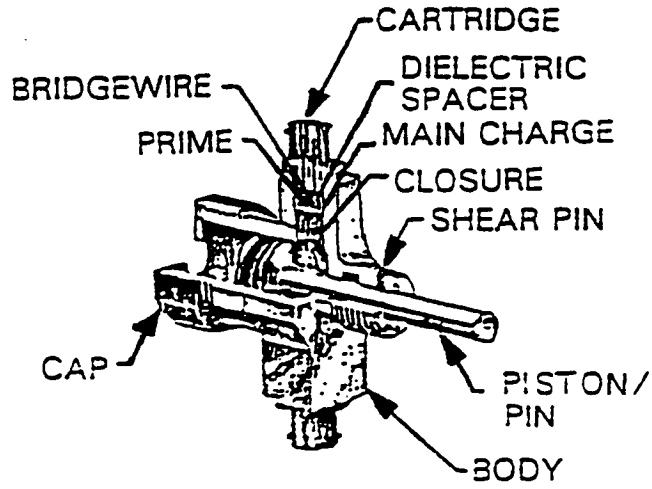
**TITLE:** Pin Puller System - TDRS Single Antenna Drive Restraint

**AGENCY/CENTER:** NASA Goddard Space Flight Center (GSFC)

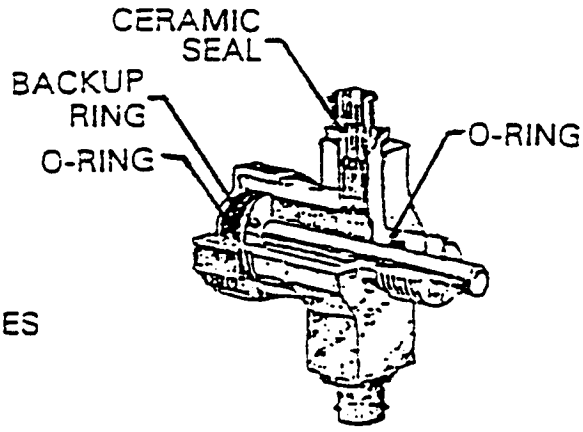
**PHYSICAL DATA:**




PAYLOAD
APPENDAGE RETENTION DEVICES




CONFIGURATION BEFORE FIRING




CONFIGURATION AFTER FIRING

PIN PULLER ASSEMBLY

TDRS PAYLOAD SINGLE ANTENNA DRIVE RESTRAINT PIN PULLER

**CONTRACTOR:** n/a

**SUBCONTRACTOR:** n/a

**SYSTEM IDENTIFICATION NUMBER:**
Refer to List of Devices (below)

**PURPOSE:**
Activates Antenna deployment mechanism.

# NASA/DOD/DOE Pyrotechnic System

**PREVIOUS USAGE:**
n/a

**OPERATIONAL DESCRIPTION:**
n/a

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** **Low** n/a
**High** n/a
**PRESSURE:** n/a

**LIST OF DEVICES:**
Pin Puller; n/a #127950
Pressure Cartridge; n/a

**QUALIFICATION DOCUMENTATION:**
n/a

**ADDITIONAL REFERENCES:**
n/a

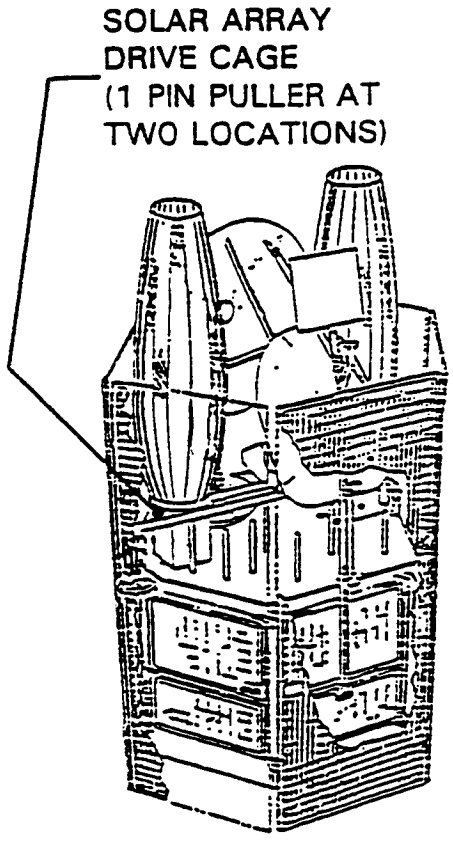
**ADDITIONAL COMMENTS:**
Bridgewire Resistance: 1.0 ± 0.5 Ohms; All fire current: 4.5 amps for 10 ms max.; No fire current: 1.0 amp F/5 minutes.

# NASA/DOD/DOE Pyrotechnic System

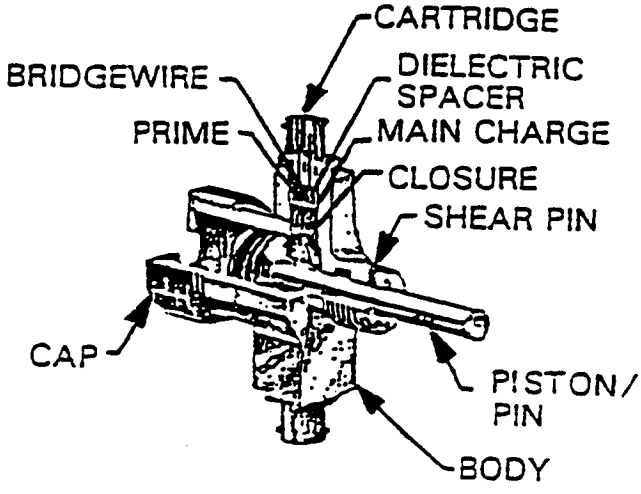
**TITLE:** Pin Puller System - TDRS Solar Array Drive Cage

**AGENCY/CENTER:** NASA Goddard Space Flight Center (GSFC)

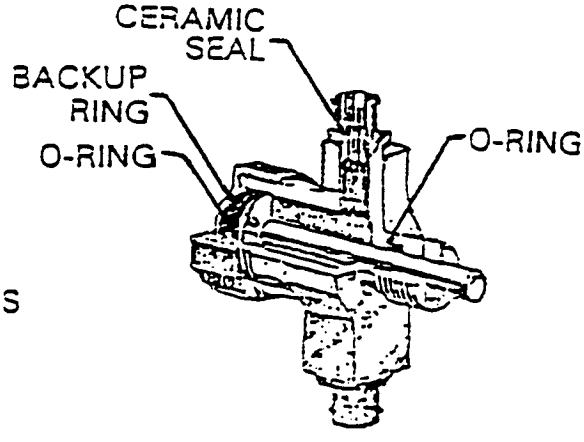
**PHYSICAL DATA:**




PAYLOAD
APPENDAGE RETENTION DEVICES




CONFIGURATION BEFORE FIRING




CONFIGURATION AFTER FIRING
PIN PULLER ASSEMBLY

TDRS PAYLOAD SOLAR ARRAY DRIVE CAGE PIN PULLER

**CONTRACTOR:** n/a

**SUBCONTRACTOR:** n/a

**SYSTEM IDENTIFICATION NUMBER:**
Refer to List of Device (below)

**PURPOSE:**
Activates Solar Array Drive Cage release mechanism.

# NASA/DOD/DOE Pyrotechnic System

**PREVIOUS USAGE:**
n/a

**OPERATIONAL DESCRIPTION:**
n/a

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** **Low** n/a
**High** n/a
**PRESSURE:** n/a

**LIST OF DEVICES:**
Pin Puller; n/a #127950
Pressure Cartridge; n/a #n/a

**QUALIFICATION DOCUMENTATION:**
n/a

**ADDITIONAL REFERENCES:**
n/a

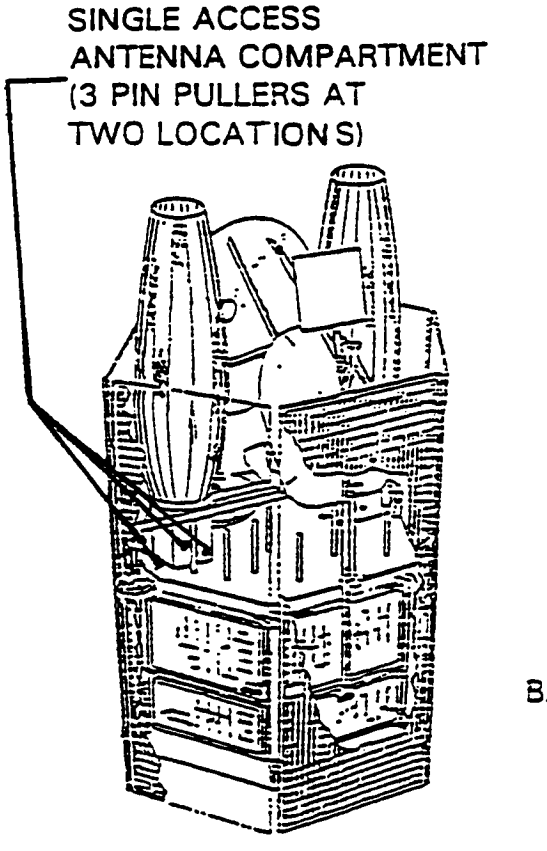
**ADDITIONAL COMMENTS:**
Bridgewire Resistance: 1.0 ± 0.5 Ohms; All fire current: 4.5 amps for 10 ms max.; No fire current: 1.0 amp F/5 minutes

# NASA/DOD/DOE Pyrotechnic System

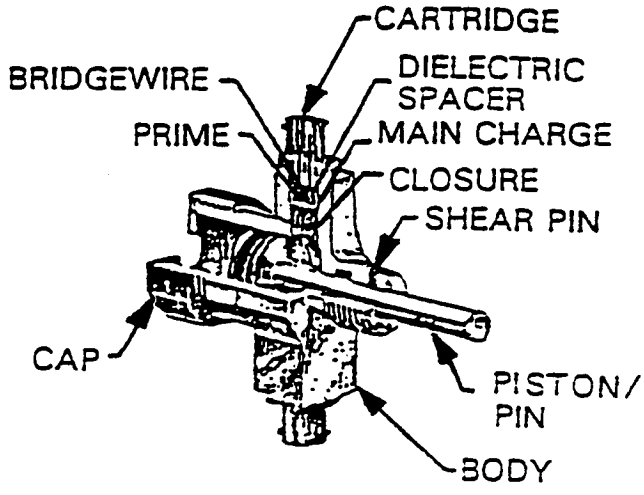
**TITLE:** Pin Puller System - TDRS Solar C-Band Boom Restraint

**AGENCY/CENTER:** NASA Goddard Space Flight Cente (GSFC)

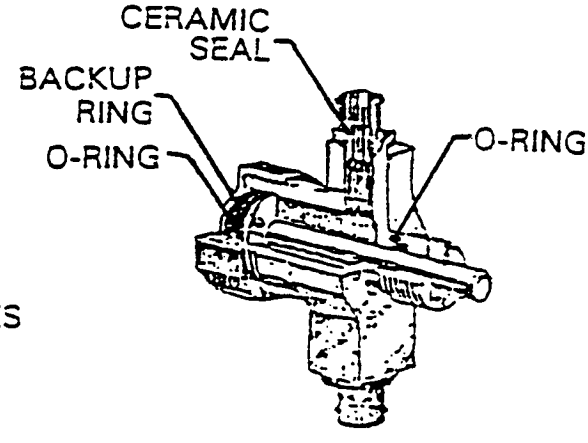
**PHYSICAL DATA:**




PAYLOAD
APPENDAGE RETENTION DEVICES




CONFIGURATION BEFORE FIRING




CONFIGURATION AFTER FIRING
PIN PULLER ASSEMBLY

TDRS PAYLOAD SOLAR C-BAND BOOM RESTRAINT PIN PULLER

**CONTRACTOR:** n/a

**SUBCONTRACTOR:** n/a

**SYSTEM IDENTIFICATION NUMBER:**
Refer to List of Devices (below)

**PURPOSE:**
Activates C-Band Antenna Boom deployment mechanism.

# NASA/DOD/DOE Pyrotechnic System

**PREVIOUS USAGE:**
n/a

**OPERATIONAL DESCRIPTION:**
n/a

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** **Low** n/a
**High** n/a
**PRESSURE:** n/a

**LIST OF DEVICES:**
Pin Puller; n/a #127950
Pressure Cartridge; n/a

**QUALIFICATION DOCUMENTATION:**
n/a

**ADDITIONAL REFERENCES:**
n/a

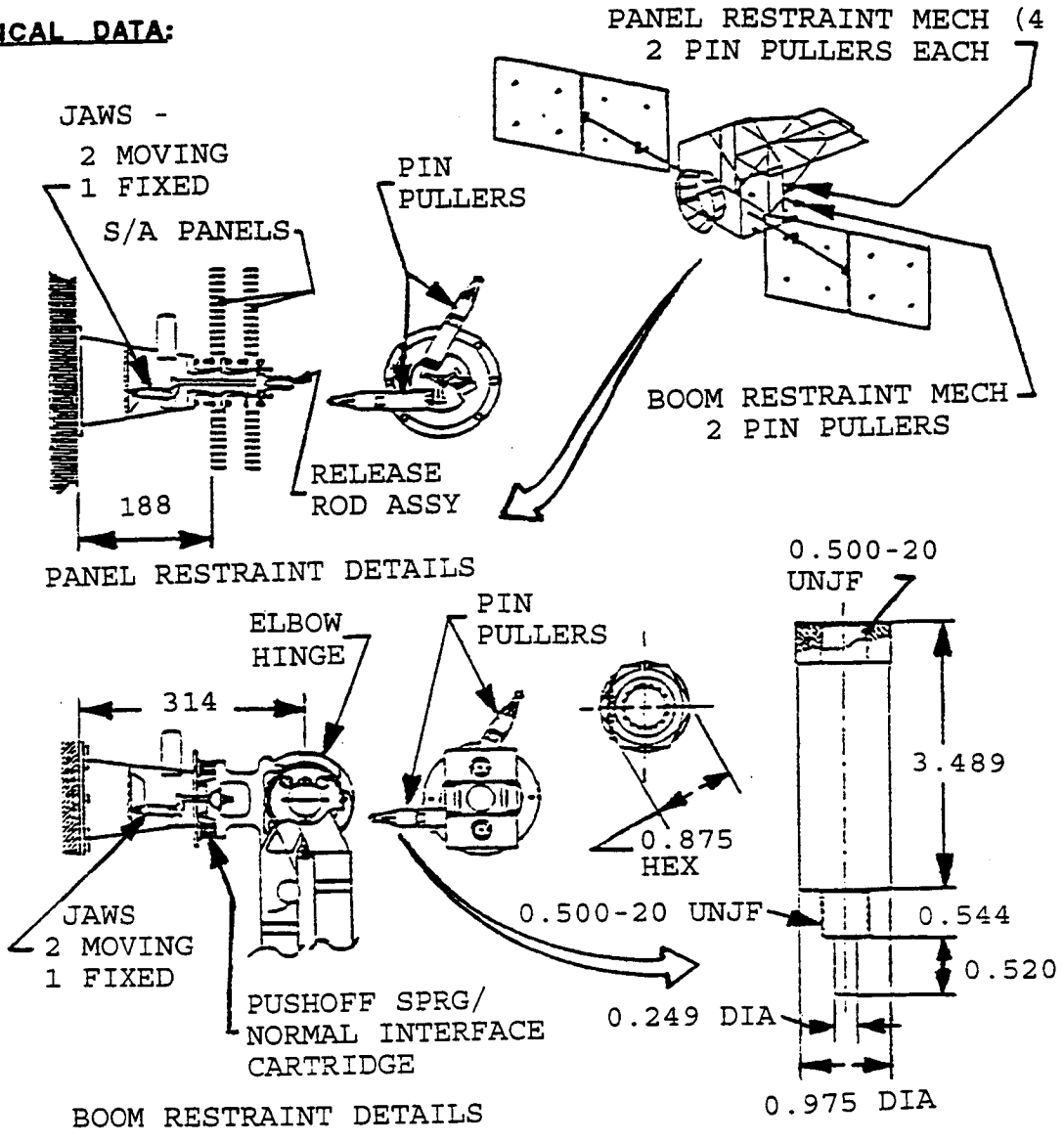
**ADDITIONAL COMMENTS:**
Bridgewire Resistance: 1.0 ± 0.5 Ohms; All fire current: 4.5 amps for 10 ms max.; No fire current: 1.0 amp F/5 minutes

# NASA/DOD/DOE Pyrotechnic System

**TITLE:** Pin Puller System - TRMM

**AGENCY/CENTER:** NASA Goddard Space Flight Center (GSFC)

**PHYSICAL DATA:**




TRMM PAYLOAD DEPLOYABLES RELEASE PINS PULLERS

**CONTRACTOR:** n/a

**SUBCONTRACTOR:** TBD

**SYSTEM IDENTIFICATION NUMBER:**
Refer to List of Devices (below)

**PURPOSE:**
Pin pullers/Pressure Cartridge actuate deployables release (solar arrays)

# NASA/DOD/DOE Pyrotechnic System

**PREVIOUS USAGE:**
n/a

**OPERATIONAL DESCRIPTION:**
When commanded by the PSDU, the pyro-pin pullers shall fire uncontrolled sequence at the panel and boom restraint mechanisms. Redundant firing signals shall be applied through redundant bridgewires after a short delay.

Dual pin pullers at each release mechanism (20 total) shall be fired in timed sequence spaced approximately 0.05 S apart. The sequence shall be repeated through redundant bridgewires after an approximate, 1 S pause.

The cartridge shall have two independent bridgewires, either capable of initiating the charge, including following failure of the first bridgewire.

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** **Low** −20°C
**High** +125°C
**PRESSURE:** n/a

**LIST OF DEVICES:**
TBD

**QUALIFICATION DOCUMENTATION:**
Pyrotechnically Actuated Pin Puller Specification for TRMM-TRMM-731-101
Pin Puller Pressure Cartridge Specification for TRMM-TRMM-731-102

**ADDITIONAL REFERENCES:**
n/a

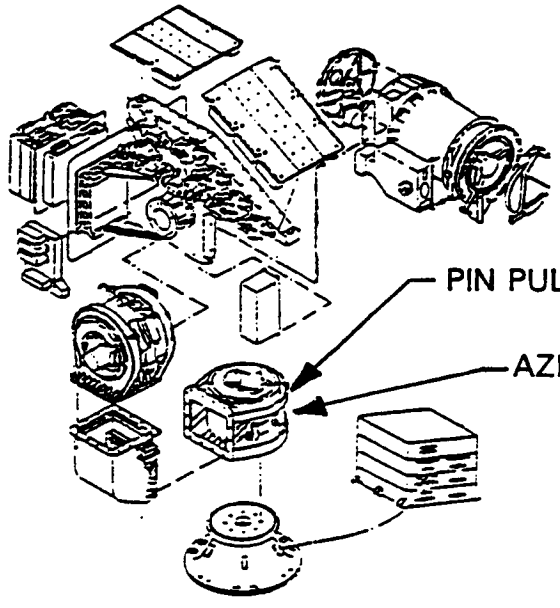
**ADDITIONAL COMMENTS:**
All fire current: 4.0 Amps; No-fire current: 1.0 amp , min 1.0 watt for 5.0 minutes; Bridgewire Resistance: 1.10 ± 0.10 Ohms

# NASA/DOD/DOE Pyrotechnic System

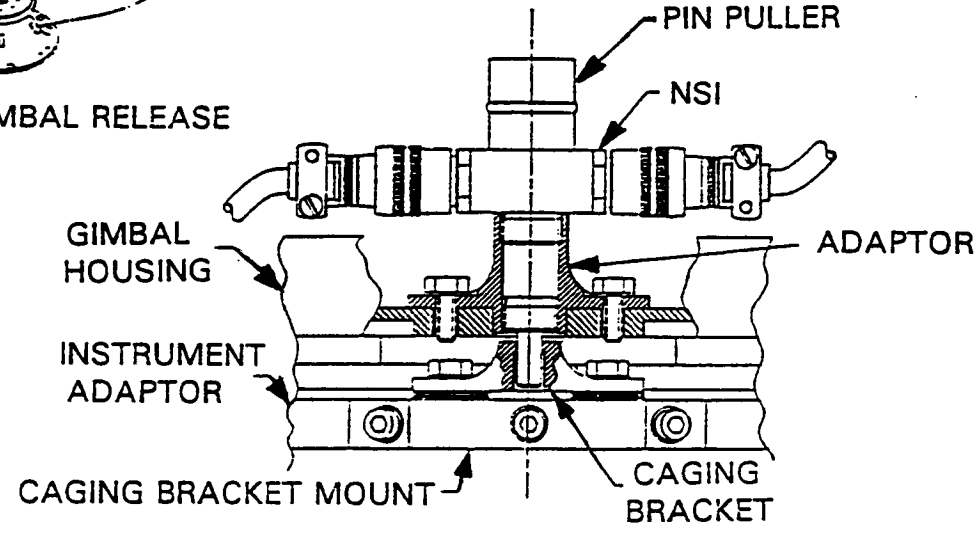
**TITLE:** Pin Puller System - UARS HALOE Azimuth Gimbal Release

**AGENCY/CENTER:** NASA Goddard Space Flight Center (GSFC)
Developed & Managed by NASA LaRC

**PHYSICAL DATA:**




AZIMUTH GIMBAL RELEASE




AZIMUTH PIN PULLER INSTALLATION

UARS HALOE PAYLOAD AZIMUTH GIMBAL RELEASE

**CONTRACTOR:** n/a

**SUBCONTRACTOR:** n/a

**SYSTEM IDENTIFICATION NUMBER:**
Refer to List of Devices (below)

**PURPOSE:**
Activates AZ Gimbal Release Mechanism on HALOE Instrument.

# NASA/DOD/DOE Pyrotechnic System

**PREVIOUS USAGE:**
n/a

**OPERATIONAL DESCRIPTION:**
The azimuth gimbal drive is uncaged by giving the AZ GIMBAL UNCAGE discrete command. Its uncaging status is verified by gimbal angle telemetry monitor when gimbals are first slewed. Pyrotechnic Pin Pullers uncage the device.

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** **Low** n/a
**High** n/a
**PRESSURE:** n/a

**LIST OF DEVICES:**
Pin Puller; n/a #825963
NASA Standard Initiator (NSI); JSC SEB 26100001

**QUALIFICATION DOCUMENTATION:**
1.05 ± 0.1 Ohms; All fire current: 3.5 amps for 10 ms max.; No fire current: 1.0 amp, 1 watt for 5 minutes minimum.

**ADDITIONAL REFERENCES:**
n/a

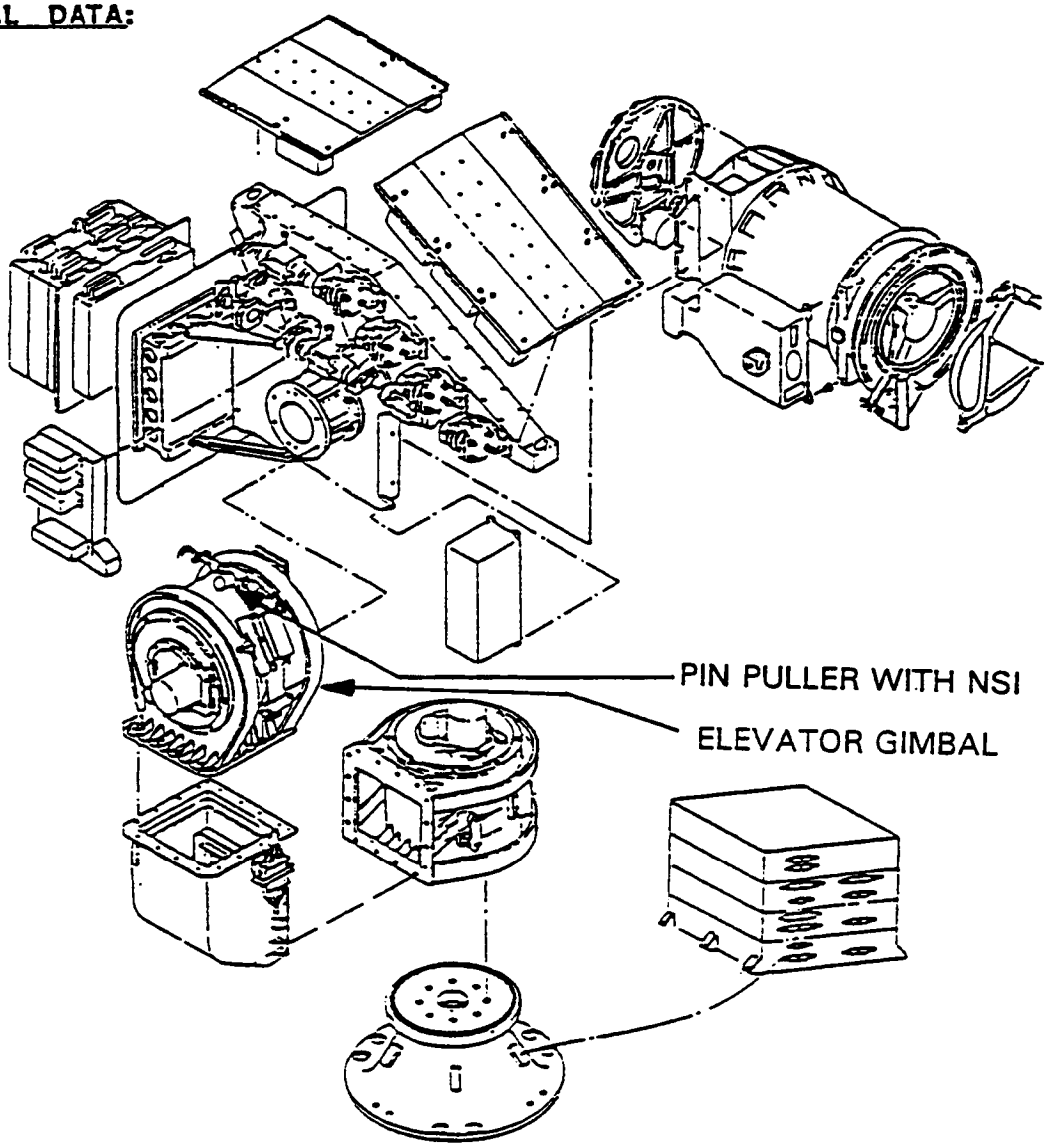
**ADDITIONAL COMMENTS:**
n/a

# NASA/DOD/DOE Pyrotechnic System

**TITLE:** Pin Puller System - UARS HALOE Elevator Gimbal Release

**AGENCY/CENTER:** NASA Goddard Space Flight Center (GSFC)

**PHYSICAL DATA:**




UARS HALOE PAYLOAD ELEVATOR GIMBAL RELEASE

**CONTRACTOR:** n/a

**SUBCONTRACTOR:** n/a

**SYSTEM IDENTIFICATION NUMBER:**
Refer to List of Devices (below)

**PURPOSE:**
Activates EL Gimbal Release Mechanism on HALOE Instrument.

# NASA/DOD/DOE Pyrotechnic System

**PREVIOUS USAGE:**
n/a

**OPERATIONAL DESCRIPTION:**
The azimuth gimbal drive is uncaged by giving the EL Gimbal Uncage discrete command. Its uncaging status is verified by gimbal angle telemetry monitor when gimbals are first slewed. Haloe instrument utilizes pyro activated uncaging devices (pin pullers).

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** **Low** n/a
**High** n/a
**PRESSURE:** n/a

**LIST OF DEVICES:**
Pin Puller; ICI America #1MT18
NASA Standard Initiator (NSI); JSC SEB 26100001

**QUALIFICATION DOCUMENTATION:**
n/a

**ADDITIONAL REFERENCES:**
n/a

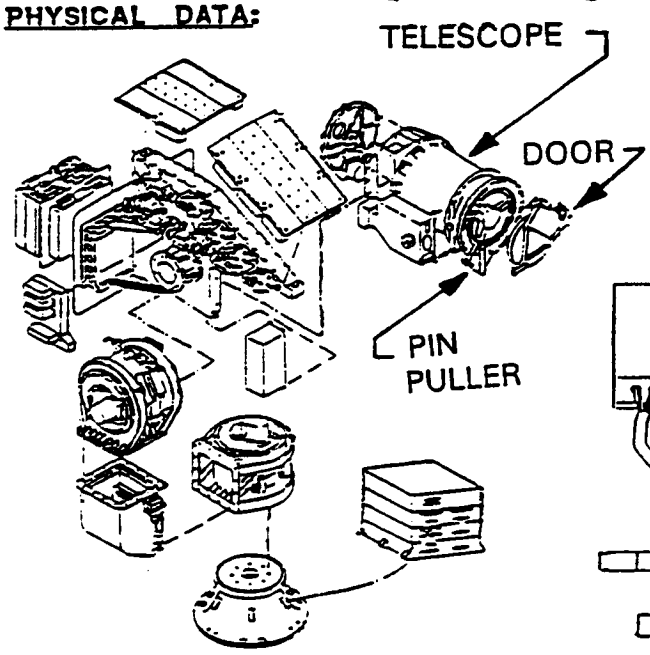
**ADDITIONAL COMMENTS:**
Bridgewire Resistance: 1.05 ± 0.1 Ohms; All fire current: 3.5 amps for 10 ms max.; No fire current: 1.0 amp, 1 watt for 5 minutes minimum.

# NASA/DOD/DOE Pyrotechnic System

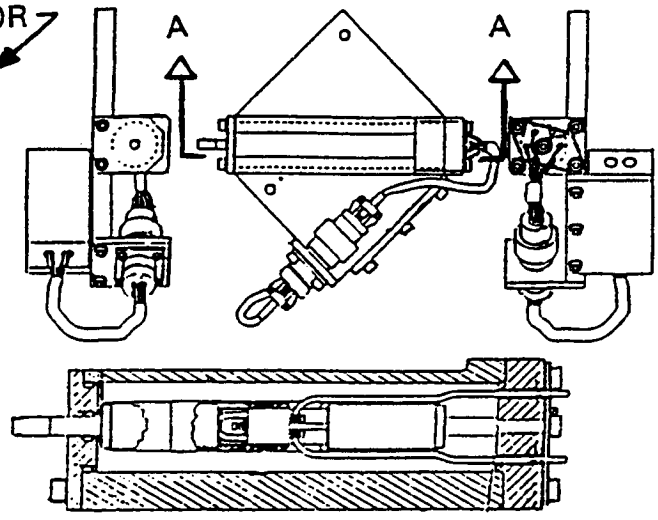
**TITLE:** Pin Puller System - UARS HALOE Telescope Door Latch Release

**AGENCY/CENTER:** NASA Goddard Space Flight Center (GSFC)
Developed & Managed by NASA LaRC

**PHYSICAL DATA:**

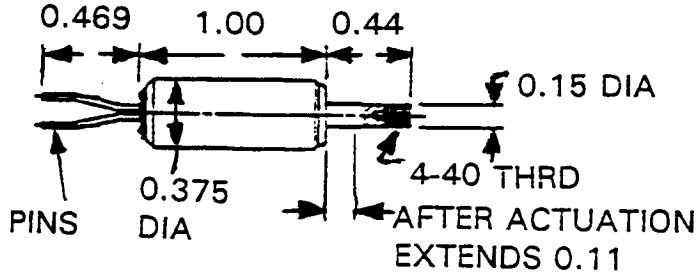



TELESCOPE DOOR LATCH RELEASE




SECTION A A

TELESCOPE DOOR PIN PULLER
MOUNTING ASSY




RETRACTABLE PISTON ACTUATOR

UARS HALOE PAYLOAD TELESCOPE DOOR LATCH RELEASE

**CONTRACTOR:** n/a

**SUBCONTRACTOR:** ICI America, Inc.

**SYSTEM IDENTIFICATION NUMBER:**
Refer to List of Devices (below)

**PURPOSE:**
Activates Telescope Door Latch Release Mechanism on HALOE Instrument.

# NASA/DOD/DOE Pyrotechnic System

**PREVIOUS USAGE:**
n/a

**OPERATIONAL DESCRIPTION:**
The telescope aperture cover is opened by sending a discrete command, APERTURE OPEN, which activates the retractable actuator mechansim.

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** **Low** -65°F
**High** +160°F
**PRESSURE:** MOP 3000 PSIG

**LIST OF DEVICES:**
Pin Puller; ICI America #1MT18

**QUALIFICATION DOCUMENTATION:**
n/a

**ADDITIONAL REFERENCES:**
n/a

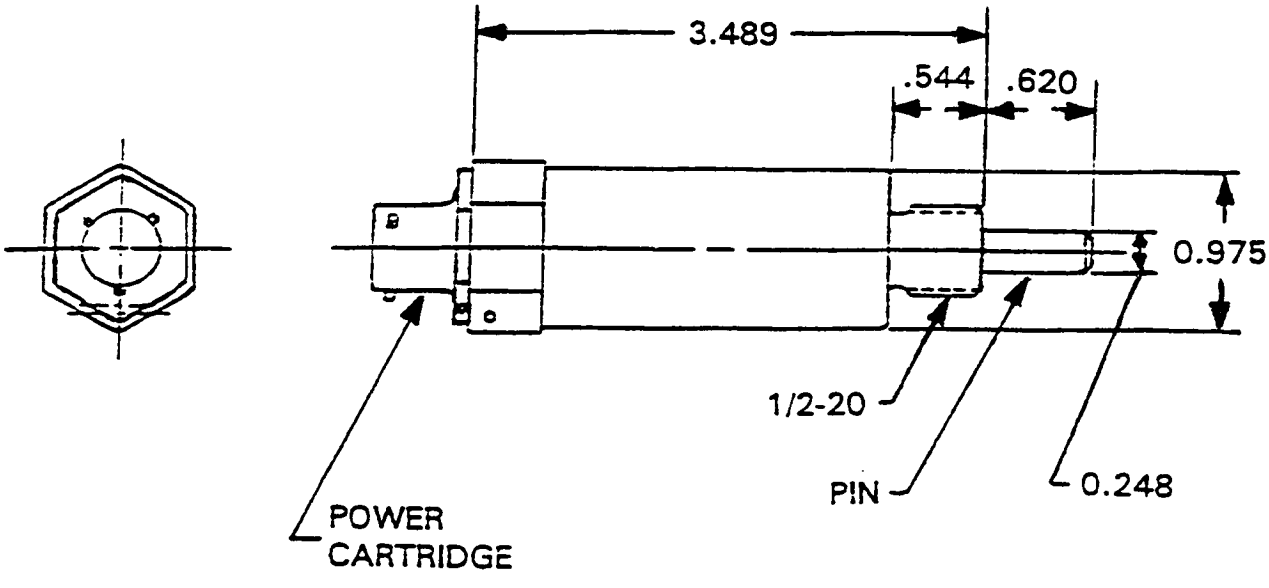
**ADDITIONAL COMMENTS:**
n/a

# NASA/DOD/DOE Pyrotechnic System

**TITLE:** Pin Puller System - XTE HEXTE

**AGENCY/CENTER:** NASA Goddard Space Flight Center (GSFC)

**PHYSICAL DATA:**




XTE PAYLOAD PIN PULLER FOR HEXTE

**CONTRACTOR:** n/a

**SUBCONTRACTOR:** Hi-Shear Technology, Inc.

**SYSTEM IDENTIFICATION NUMBER:**
Refer to List of Devices (below)

**PURPOSE:**
Pin pullers are used to stow the XTE HEXTE Instrument clusters during launch, and then release the launch locks on the HEXTE Instrument Cluster. Pyros can be activated by either ground command or PSDU.

This document is an information source only and should not be used for design purposes.

# NASA/DOD/DOE Pyrotechnic System

**PREVIOUS USAGE:**
COBE and BBXRT

**OPERATIONAL DESCRIPTION:**
XTE spacecraft utilizes a pair of Pyro pin pullers for each release mechanism assembly for mechanical redundancy. Each pressure cartridge has redundant bridgewires. Either bridgewire activated, the Pressure cartridge will actuate the Pin Puller. This redundant bridgewire pressure cartridge design meets the electrical requirements of NSI cartridge. When commanded, the pyro pin-puller shall fire uncontrolled sequence at the restraint mechanism. Redundant firing signals shall be applied through redundant bridgewires after a short delay. The cartridges shall have 2 independent bridgewires, either capable of initiating the charge including failure of the first bridgewire.

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** Low -20°C
High +125°C
**PRESSURE:** n/a

**LIST OF DEVICES:**
Pin Puller; Hi-Shear #9364246-2, GSFC #1496901
Pressure Cartridge; Hi-Shear #9392129-1, GSFC #1496902

**QUALIFICATION DOCUMENTATION:**
Pyrotechnic Actuated Pin Puller Specification for XTE-GSFC-722-92-010
Electrically Initiated Pressure Cartridge Specification for XTE GSFC-722-92-011

**ADDITIONAL REFERENCES:**
n/a

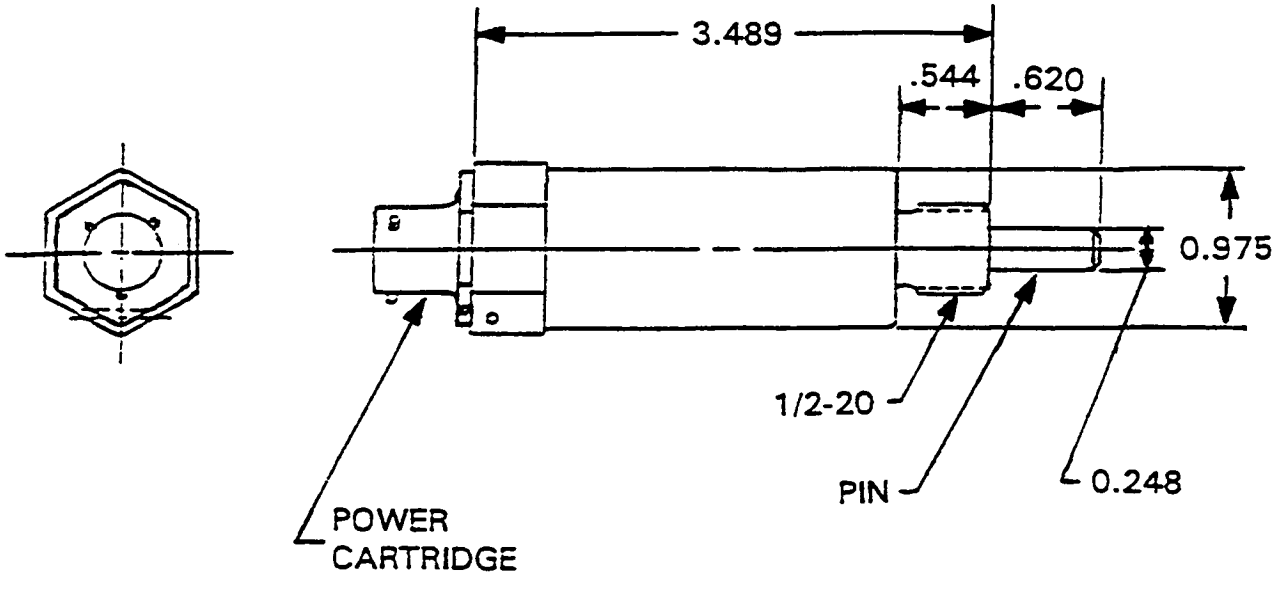
**ADDITIONAL COMMENTS:**
All fire current: 4.0 Amps; No-fire current: 1.0 amp , min. 1.0 watt for 5.0 minutes; Bridgewire Resistance: 1.10 ± 0.10 Ohms

# NASA/DOD/DOE Pyrotechnic System

**TITLE:** Pin Puller System - XTE High Gain Antenna Deployment

**AGENCY/CENTER:** NASA Goddard Space Flight Center (GSFC)

**PHYSICAL DATA:**




XTE PAYLOAD PIN PULLER FOR HGADS

**CONTRACTOR:** n/a

**SUBCONTRACTOR:** Hi-Shear Technology, Inc.

**SYSTEM IDENTIFICATION NUMBER:**
Refer to List of Devices (below)

**PURPOSE:**
Pin pullers are used to stow the XTE High Gain Antenna Deployment System during launch, and then release to deploy the -X and +Y HGADS of the HGASs. Pyros can be activated by either ground command or PSDU.

# NASA/DOD/DOE Pyrotechnic System

**PREVIOUS USAGE:**
n/a

**OPERATIONAL DESCRIPTION:**
XTE spacecraft utilizes a pair of Pyro pin pullers for each release mechanism assembly for mechanical redundancy. Each pressure cartridge has redundant bridgewires. Either bridgewire activated, Pressure cartridge will actuate the Pin Puller. This redundant bridgewire pressure cartridge design meets the electrical requirements of NSI cartridge. When commanded, the pyro pin-puller shall fire uncontrolled sequence at the restraint mechanism. Redundant firing signals shall be applied through redundant bridgewires after a short delay. The cartridges shall have 2 independent bridgewires, either capable of initiating the charge including failure of the first bridgewire.

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** **Low** -20°C
**High** +125°C

**PRESSURE:** n/a

**LIST OF DEVICES:**
Pin Puller; Hi-Shear #9364246-2, GSFC #1496901
Pressure Cartridge; Hi-Shear #9392129-1, GSFC #1496902

**QUALIFICATION DOCUMENTATION:**
Pyrotechnic Actuated Pin Puller Specification for XTE-GSFC-722-92-010
Electrically Initiated Pressure Cartridge Specification for XTE GSFC-722-92-011

**ADDITIONAL REFERENCES:**
n/a

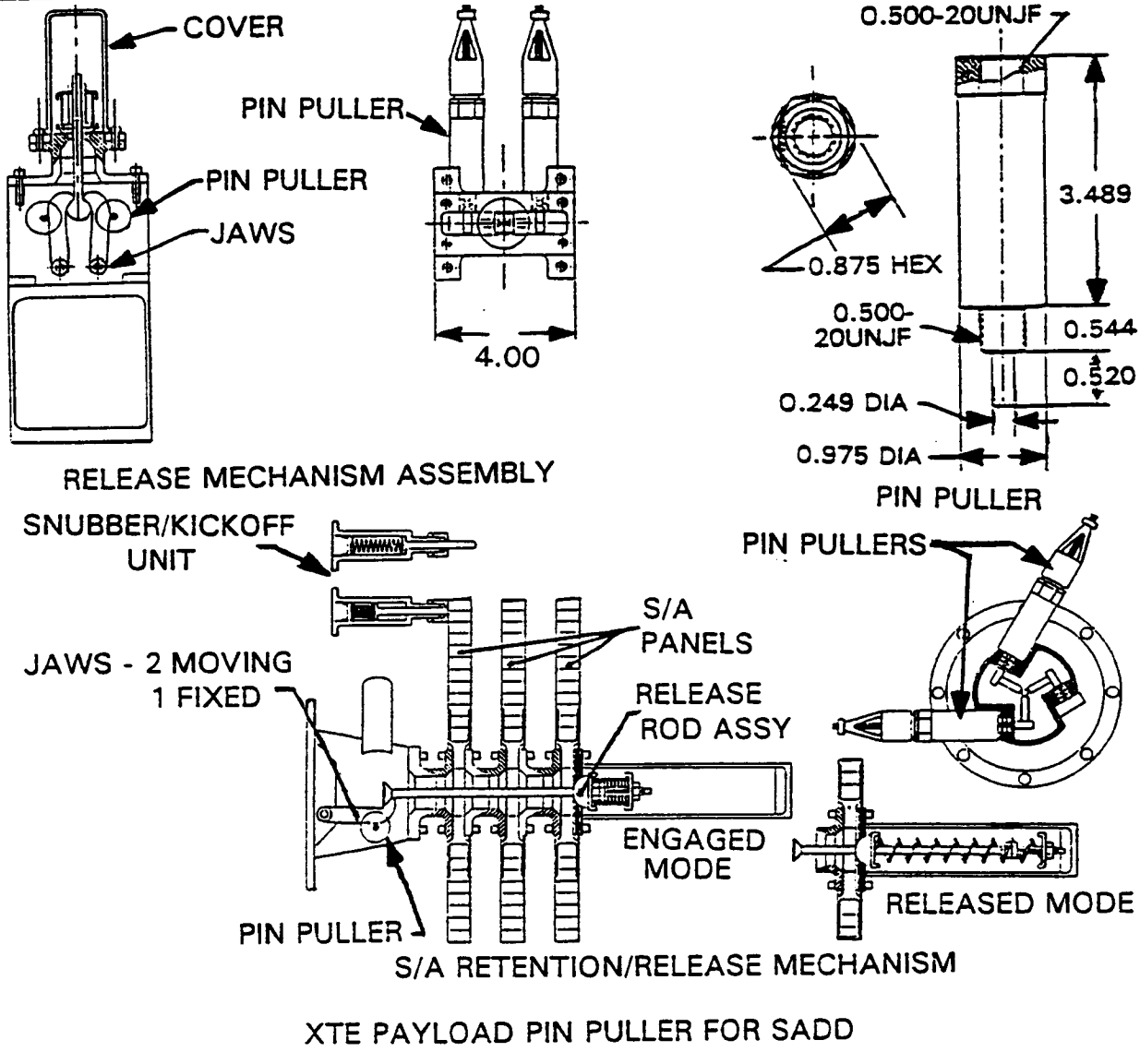
**ADDITIONAL COMMENTS:**
All fire current: 4.0 Amps; No-fire current: 1.0 amp , min. 1.0 watt for 5.0 minutes; Bridgewire Resistance: 1.10 ± 0.10 Ohms

# NASA/DOD/DOE Pyrotechnic System

**TITLE:** Pin Puller System - XTE Solar Array Deployment

**AGENCY/CENTER:** NASA Goddard Space Flight Center (GSFC)

**PHYSICAL DATA:**




XTE PAYLOAD PIN PULLER FOR SADD

**CONTRACTOR:** n/a

**SUBCONTRACTOR:** Hi-Shear Technology, Inc.

**SYSTEM IDENTIFICATION NUMBER:**
Refer to List of Devices (below)

**PURPOSE:**
Pin pullers are used to stow the XTE Solar Array Deployment System during launch, and then release to deploy the Solar Array into their deployed configuration in orbit. Pyros can be activated by either ground command or PSDU.

# NASA/DOD/DOE Pyrotechnic System

**PREVIOUS USAGE:**
n/a

**OPERATIONAL DESCRIPTION:**
XTE spacecraft utilizes a pair of Pyro pin pullers for each release mechanism assembly for mechanical redundancy. Each pressure cartridge has redundant bridgewires. Either bridgewire activated, Pressure cartridge will actuate the Pin Puller. This redundant bridgewire pressure cartridge design meets the electrical requirements of NSI cartridge. When commanded, the pyro pin-puller shall fire uncontrolled sequence at the restraint mechanism. Redundant firing signals shall be applied through redundant bridgewires after a short delay. The cartridges shall have 2 independent bridgewires, either capable of initiating the charge including failure of the first bridgewire.

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** Low -20°C
High +125°C
**PRESSURE:** n/a

**LIST OF DEVICES:**
Pin Puller; Hi-Shear #9364246-2, GSFC #1496901
Pressure Cartridge; Hi-Shear #9392129-1, GSFC #1496902

**QUALIFICATION DOCUMENTATION:**

Pyrotechnic Actuated Pin Puller Specification for XTE-GSFC-722-92-010
Electrically Initiated Pressure Cartridge Specification for XTE GSFC-722-92-011

**ADDITIONAL REFERENCES:**
n/a

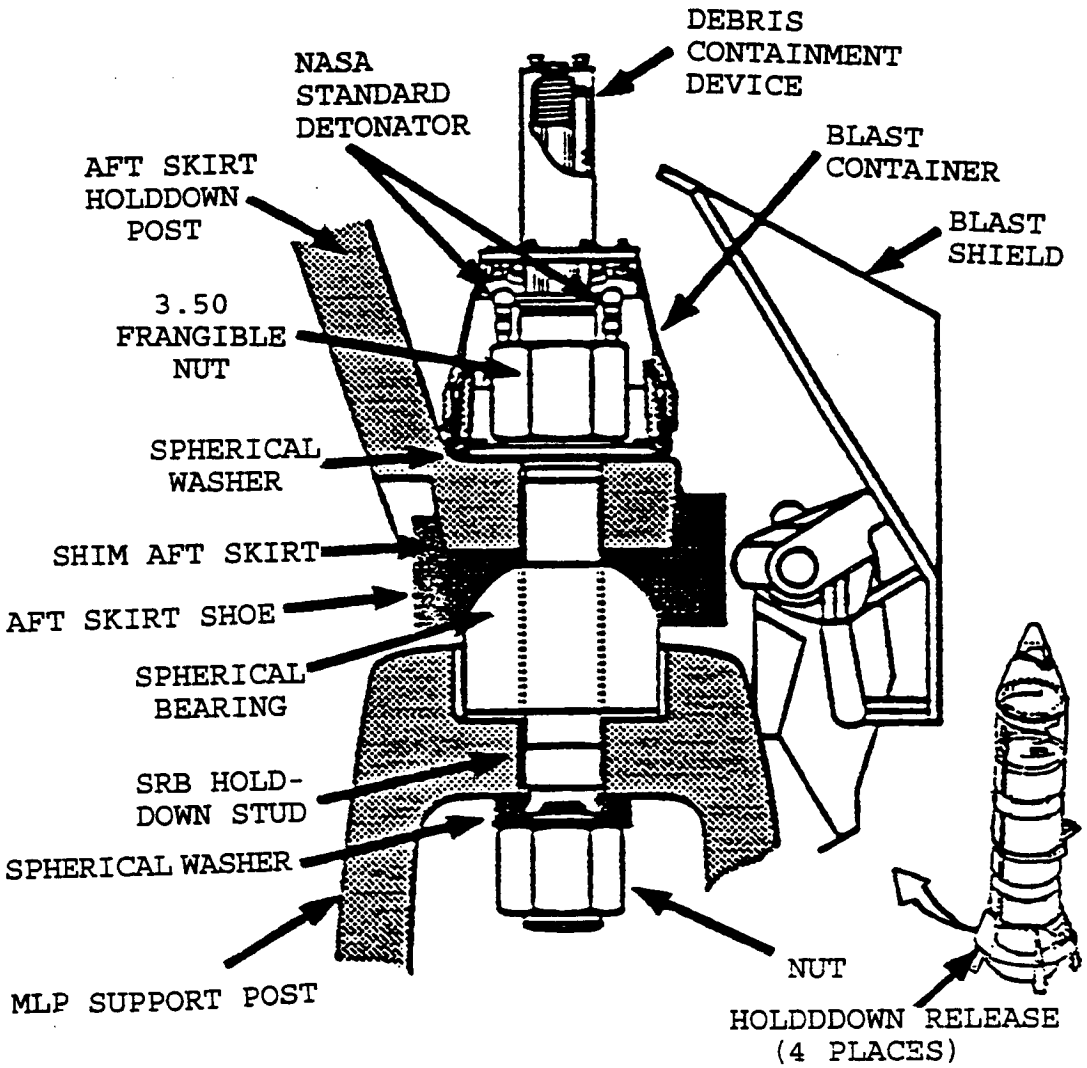
**ADDITIONAL COMMENTS:**
All fire current: 4.0 Amps; No-fire current: 1.0 amp , min. 1.0 watt for 5.0 minutes; Bridgewire Resistance: 1.10 ± 0.10 Ohms

# NASA/DOD/DOE Pyrotechnic System

**TITLE:** Release System - SRB/Mobile Launch Platform (MLP) Holddown

**AGENCY/CENTER:** NASA/Marshall Space Flight Center (MSFC)

**PHYSICAL DATA:**




SOLID ROCKET BOOSTER/MOBILE LAUNCH PLATFORM (SRB/MLP)
HOLDDOWN RELEASE NUT SYSTEM

**CONTRACTOR:** USBI

**SUBCONTRACTOR:** USBI

**SYSTEM IDENTIFICATION NUMBER:**
No system number; refer to specific components (devices).

**PURPOSE:**
To holddown the SRBs prior to launch and allow for a quick release at launch.

# NASA/DOD/DOE Pyrotechnic System

**PREVIOUS USAGE:**
None

**OPERATIONAL DESCRIPTION:**
At t-15 seconds before launch, the (Pyrotechnic Initiator Controllers (PICs) are armed, and at t-0.30 seconds before launch, the PICs are discharged, initiating the NSD. The NSD detonates the frangible nut booster cartridge assembly, which separates the nut due to the detonation shock and the booster cartridge pressure. There are two NSD/frangible nut booster cartridge assemblies per frangible nut for redundancy, but it only takes one booster cartridge assembly to completely separate the frangible nut.

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** **Low** +20° F
**High** +150° F
**PRESSURE:** Refer to specific components (devices).

**LIST OF DEVICES:**
8 NSD, SEB26100094-201
8 Frangible Nut Booster Cartridge Assemblies, 10307-0001-801

**QUALIFICATION DOCUMENTATION:**
n/a

**ADDITIONAL REFERENCES:**
n/a

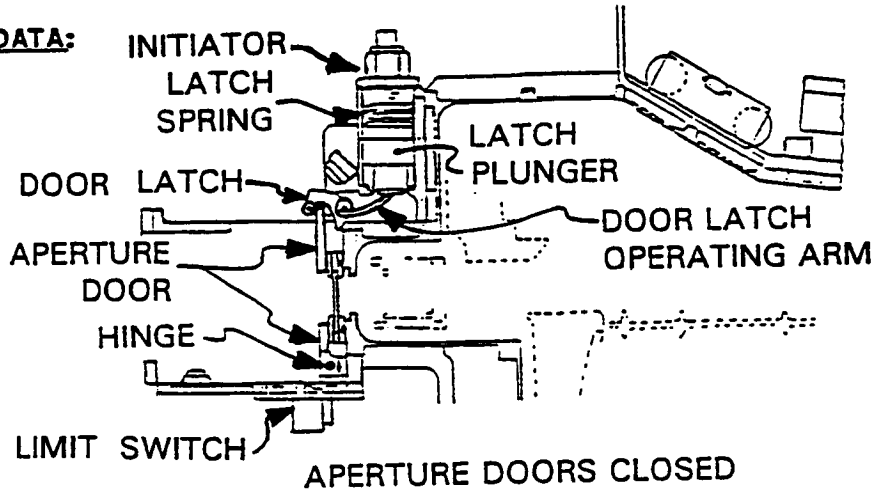
**ADDITIONAL COMMENTS:**
n/a

# NASA/DOD/DOE Pyrotechnic System

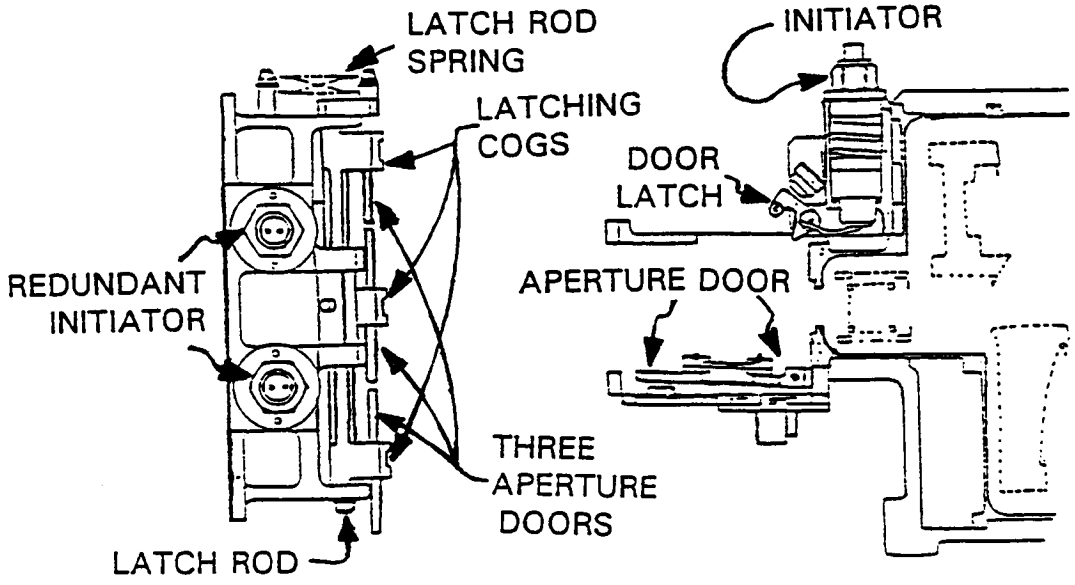
**TITLE:** Release System - UARS SOLSTICE Monochomater Door Latch

**AGENCY/CENTER:** NASA Goddard Space Flight Center (GSFC)

**PHYSICAL DATA:**




APERTURE DOORS CLOSED




END VIEW OF LATCHING MECHANISM

APERTURE DOORS OPEN

UARS PAYLOAD SOLSTICE MONOCHROMATER DOOR RELEASE

**CONTRACTOR:** n/a

**SUBCONTRACTOR:** n/a

**SYSTEM IDENTIFICATION NUMBER:**
Refer to List of Devices (below)

**PURPOSE:**
Activates Monochromater Door Latch Release Mechanism on SOLSTICE Instrument.

# NASA/DOD/DOE Pyrotechnic System

**PREVIOUS USAGE:**
n/a

**OPERATIONAL DESCRIPTION:**
Aperature doors are opened by firing 1 of 2 pyrotechnic initiators. The pyro fires and cuts the shear pin that normlly holds that latch operating spring compressed.

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** **Low** n/a
**High** n/a
**PRESSURE:** MOP 3000 PSIG

**LIST OF DEVICES:**
Release Mechanism; n/a
NASA Standard Initiator (NSI); JSC SEB 26100001

**QUALIFICATION DOCUMENTATION:**
n/a

**ADDITIONAL REFERENCES:**
n/a

**ADDITIONAL COMMENTS:**
Bridgewire Resistance: 1.05 ± 0.1 Ohms; All fire current: 3.5 amps for 10 ms max.; No fire current: 1.0 amp, 1 watt for 5 minutes minimum.

# NASA/DOD/DOE Pyrotechnic System

**TITLE:** Latch Release System - UARS Telescope Door

**AGENCY/CENTER:** NASA Goddard Space Flight Center (GSFC)

**PHYSICAL DATA:**

FIGURE

N/A

**CONTRACTOR:** n/a

**SUBCONTRACTOR:** n/a

**SYSTEM IDENTIFICATION NUMBER:**
Refer to List of Devices (below)

**PURPOSE:**
Activates Telescope Door Latch Release Mechanism on CLAES Instrument.

# NASA/DOD/DOE Pyrotechnic System

**PREVIOUS USAGE:**
n/a

**OPERATIONAL DESCRIPTION:**
Door is held in place against spring force by 2 pyrotechnic pin pullers. Each pin puller contains an NSI which is actuated in orbit, subsequent to release from the Orbiter Bay. Upon actuation, the pin pullers retract and the door latch is retracted by spring force.

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** **Low** n/a
**High** n/a
**PRESSURE:** MOP 3000 PSIG

**LIST OF DEVICES:**
Pin Puller; n/a
NASA Standard Initiator (NSI); JSC SEB 26100001

**QUALIFICATION DOCUMENTATION:**
n/a

**ADDITIONAL REFERENCES:**
n/a

**ADDITIONAL COMMENTS:**
Bridgewire Resistance: 1.05 ± 0.1 Ohms; All fire current: 3.5 amps for 10 ms max.; No fire current: 1.0 amp, 1 watt for 5 minutes minimum.

# NASA/DOD/DOE Pyrotechnic System

**TITLE:** Release System - UARS WINDII Outer Baffle Door

**AGENCY/CENTER:** NASA Goddard Space Flight Center (GSFC)

**PHYSICAL DATA:**

FIGURE

N/A

**CONTRACTOR:** n/a

**SUBCONTRACTOR:** n/a

**SYSTEM IDENTIFICATION NUMBER:**
Refer to List of Devices (below)

**PURPOSE:**
Activates Outer Baffle Door Latch Release Mechanism on WINDII Instrument.

# NASA/DOD/DOE Pyrotechnic System

**PREVIOUS USAGE:**
n/a

**OPERATIONAL DESCRIPTION:**
Aperature doors are opened by firing 1 of 2 pyrotechnic initiators. The pyro fires and cuts the shear pin that normlly holds that latch operating spring compressed. The door is activated in orbit by observing command and interface circuitry using NSIs.

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** **Low** n/a
**High** n/a
**PRESSURE:** MOP 3000 PSIG

**LIST OF DEVICES:**
Release Mechanism; n/a
NASA Standard Initiator (NSI); JSC SEB 26100001

**QUALIFICATION DOCUMENTATION:**
n/a

**ADDITIONAL REFERENCES:**
n/a

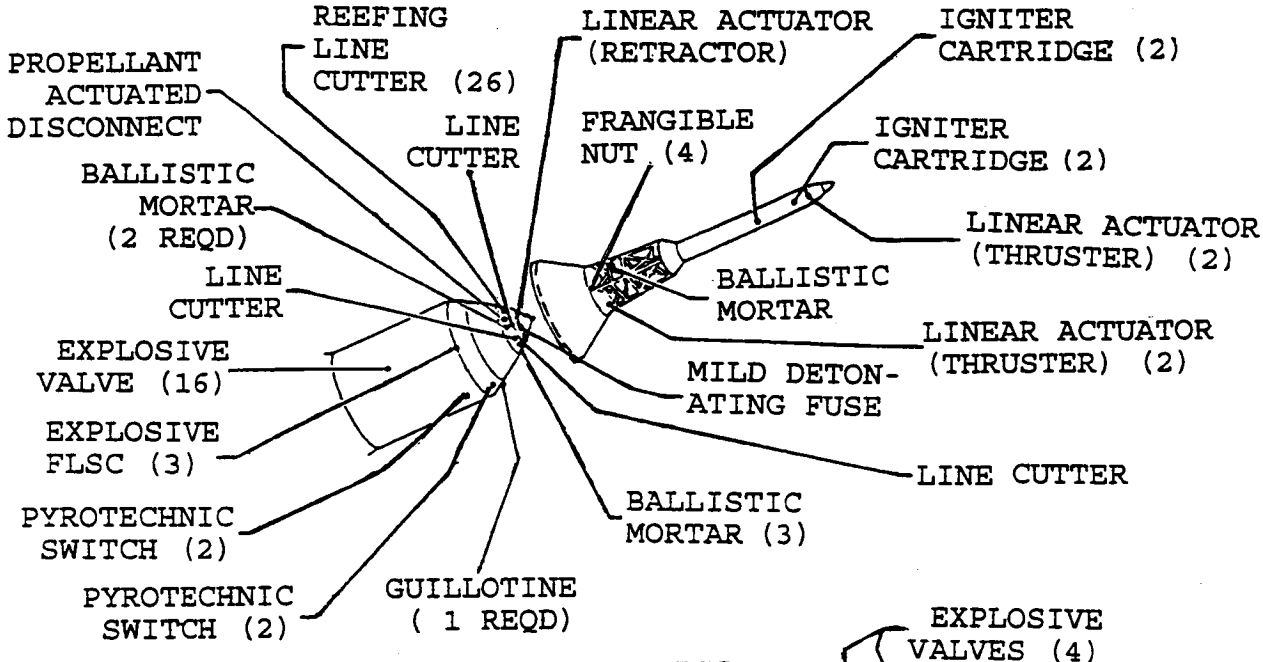
**ADDITIONAL COMMENTS:**
Bridgewire Resistance: 1.05 ± 0.1 Ohms; All fire current: 3.5 amps for 10 ms max.; No fire current: 1.0 amp, 1 watt for 5 minutes minimum.

# NASA/DOD/DOE Pyrotechnic System

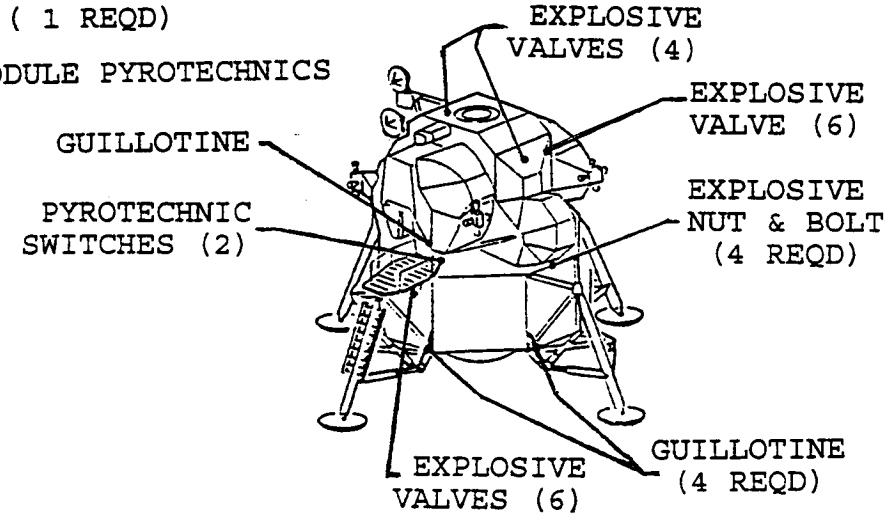
**TITLE:** Separation/Release Systems - Appollo LSM and CSM

**AGENCY/CENTER:** NASA Johnson Space Center (JSC)
[Submitted by NASA Langley R.C.]

**PHYSICAL DATA:**




LUNAR EXCURSION MODULE PYROTECHNICS




PROJECT APOLLO PYROTECHNIC ITEMS

**CONTRACTOR:** Lunar Excursion Module - Grumman Aircraft Command and Service Module - Rockwell
**SUBCONTRACTOR:** n/a

**SYSTEM IDENTIFICATION NUMBER:**
n/a

**PURPOSE:**
Provide for manned landing on the moon.

# NASA/DOD/DOE Pyrotechnic System

**PREVIOUS USAGE:**
n/a

**OPERATIONAL DESCRIPTION:**
A solid-propellant rocket tower on top of the command service module provided for escape on the pad, following release of a flexible linear shaped charge (FLSC) separation joint. Normal flights utilized this separation joint to free the capsule from the Saturn V launch vehicle. The escape tower had to be relased early in the normal flight sequence. Following transluanr injection, the command service module (CSM) is separated and docks with the lunar excursion module (LEM). Following lunar orbit insertion, the LEM landing geaer is deployed. The LEM's liqud propulsion and reaction control systems are activated and the LEM is unlocked for descent to the lunar surface. The ascent stage of the LEM is released and is propelled to a lunar orbital rendezvous with the SCM. Once the crew transfers to the CSM, the LEM is jettisoned. The CCM is propelled to return to Earth, followed by reentry and a parachute landing in water.

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** **Low** n/a
**High** n/a
**PRESSURE:** n/a

**LIST OF DEVICES:**
See Operational Description for devices used.

**QUALIFICATION DOCUMENTATION:**
Simmons, William H.: "Apollo Spacecraft Pyrotechnics." NASA TM X-58032, October, 1969.
Falbo, Mario J. and Robinson, Robert L.: "Apollo Experience Report-Spacecraft Pyrotechnic Systems." NASA Technical Note, NASA TN D-7141, March, 1973.
Lake, E. R.; Thompson, S. J.; and Drexelius, V. W.: "A Study of the Role of Pyrotechnic Systems on the Space Shuttle Program." NASA Contractor Report NASA CR-2292, September, 1973.

**ADDITIONAL REFERENCES:**
n/a

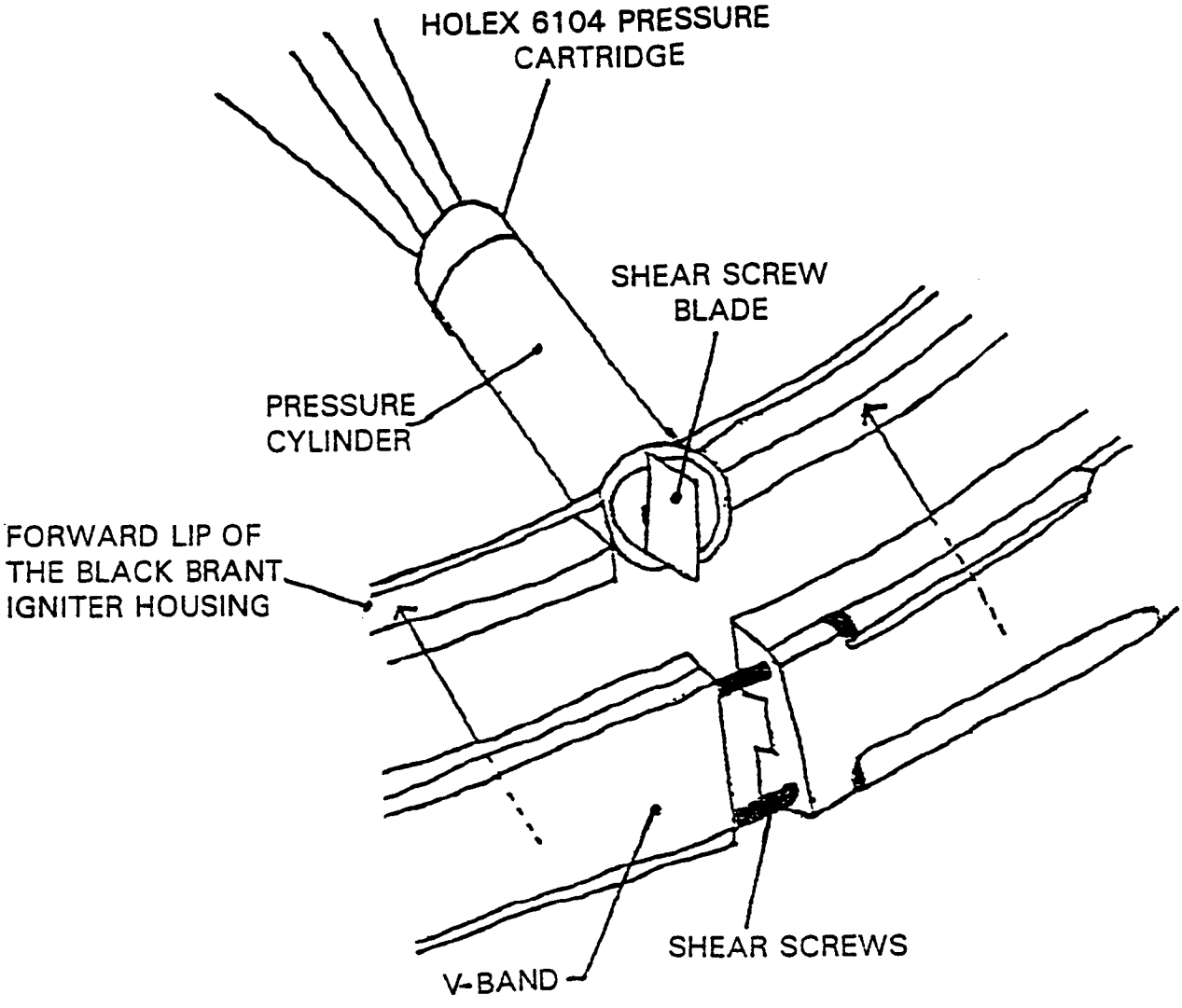
**ADDITIONAL COMMENTS:**
n/a

# NASA/DOD/DOE Pyrotechnic System

**TITLE:** Separation System - BLACK BRANT

**AGENCY/CENTER:** NASA Goddard Space Flight Facility (GSFC)/Wallops Flight Facility (WFF)

**PHYSICAL DATA:**




BLACK BRANT SEPARATION SYSTEM

**CONTRACTOR:** Bristol Aerospace Limited

**SUBCONTRACTOR:** See Device Vendor

**SYSTEM IDENTIFICATION NUMBER:**
n/a

**PURPOSE:**
Separation mechanism between Black Brant Stage and forward stage (or payload).

# NASA/DOD/DOE Pyrotechnic System

**PREVIOUS USAGE:**
Used on multiple NASA GSFC/WFF Sounding rocket missions.

**OPERATIONAL DESCRIPTION:**
The system employs two (spaced 180° apart on the igniter housing) Gun/Blade Assemblies each containing a Holex G104 pressure cartridge. Each assembly severs a pair of shear screws which function to keep both halves of the v-band together. When the pressure cartridge is initiated, the piston-driven shear screw blade is propelled within the pressure cylinder assembly until it has made contact with the pair of screws and severed them. The V-Band is thus free to fall away and four compressed springs actuate separation between the two stages

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** **Low** n/a
**High** n/a
**PRESSURE:** n/a

**LIST OF DEVICES:**
Holex G104 Pressure Cartridge.

**QUALIFICATION DOCUMENTATION:**
n/a

**ADDITIONAL REFERENCES:**
n/a

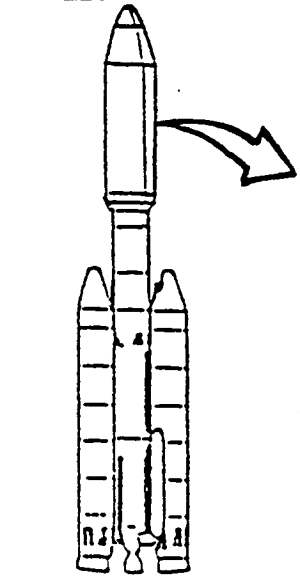
**ADDITIONAL COMMENTS:**
n/a

## NASA/DOD/DOE Pyrotechnic System

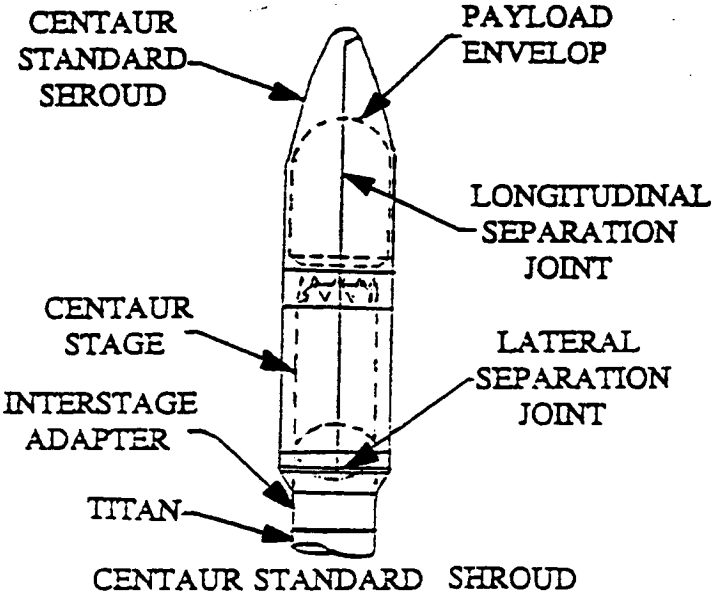
**TITLE:** Separation System - Centaur Standard Shroud (Fairing)

**AGENCY/CENTER:** NASA Lewis Research Center (LeRC)

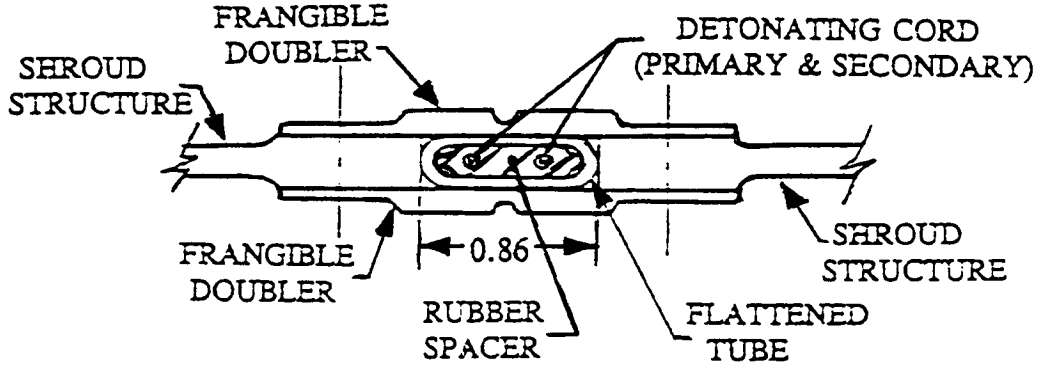
**PHYSICAL DATA:**



TITAN CENTAUR LAUNCH VEHICLE




CENTAUR STANDARD SHROUD (2ND STAGE CENTAUR & PAYLOAD FAIRING)




TYPICAL SEPARATION JOINT

CENTAUR STANDARD SHROUD (FAIRING) SEPARATION SYSTEM

**CONTRACTOR:** Lockheed Space and Missile Co.

**SUBCONTRACTOR:** n/a

**SYSTEM IDENTIFICATION NUMBER:**
n/a

**PURPOSE:**
To fail the frangible doubler joints on the second stage Centaur and payload shroud type fairing and thereby separate the longitudinal and lateral connections to allow jettison of the fairing from the vehicle.

# NASA/DOD/DOE Pyrotechnic System

**PREVIOUS USAGE:**
Titan Centaur vehicles TC-1 through TC-7

**OPERATIONAL DESCRIPTION:**
Pyrotechnically generated gases develope pressure that expand the flattened retaining tube into a circularized shape in setion. The expanding tube applies force to the frangible structureal separation joints causing failure along the grooved sections. This rupture of the joints separates the fairing halves from each other and from the launch vehicle. Spring forces then rotate the fairing halves apart and jettison them from the vehicle.

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** **Low** -65°F
**High** +275°F
**PRESSURE:** n/a

**LIST OF DEVICES:**
Electric detonator, SBASI
Non electric detonator (NED)
Shielded mild detonating cord (SMDC) transfer cord
Detonating cord and CRES tubing.

**QUALIFICATION DOCUMENTATION:**
n/a

**ADDITIONAL REFERENCES:**
n/a

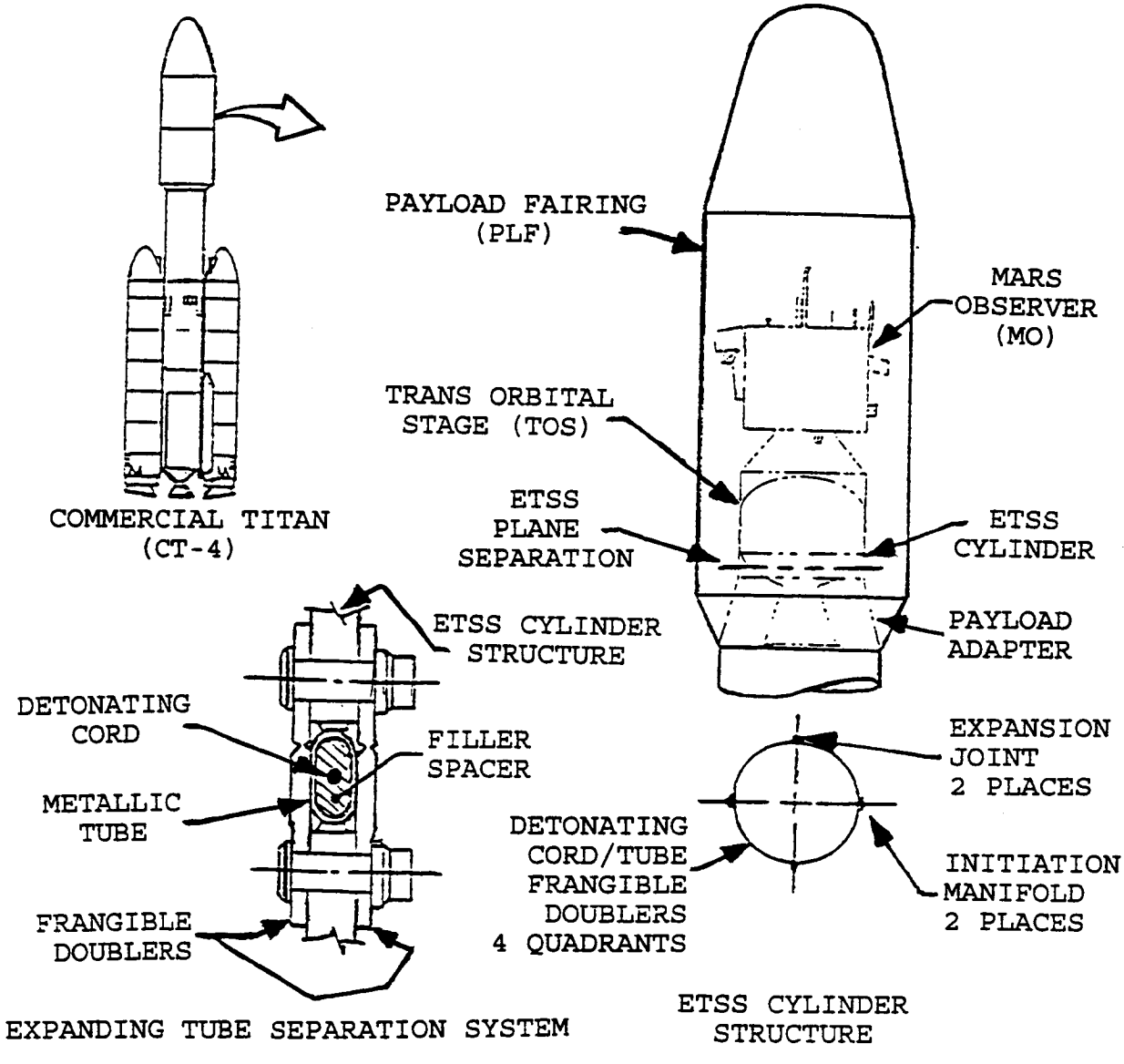
**ADDITIONAL COMMENTS:**
Uses two detonating cords in the retaining tube. One is primary and is fired first. The second cord is a redundant part and is fired only if the first cord does not separate the fairing within a programmed time delay.

## NASA/DOD/DOE Pyrotechnic System

**TITLE:** Separation System - Mars Observer Expanding Tube

**AGENCY/CENTER:** NASA Lewis Research Center (LeRC)

**PHYSICAL DATA:**




MARS OBSERVER EXPANDING TUBE SEPARATION SYSTEM (ETSS)

**CONTRACTOR:** Martin Marietta

**SUBCONTRACTOR:** Explosive Techlology, Inc.

**SYSTEM IDENTIFICATION NUMBER:**
n/a

**PURPOSE:**
To separate the payload spacecraft from the launch vehicle by pyrotechnical fracture of the attaching frangible structural joint.

# NASA/DOD/DOE Pyrotechnic System

**PREVIOUS USAGE:**
n/a

**OPERATIONAL DESCRIPTION:**
Pyrotechnically formed gas pressure expands the flattened metallic tube into a circularized sectional shape. The force exerted by the rounding of the tube fractures the notched frangible doublers in shear. This joint failure separates the payload spacecraft from the launch vehicle. Initiation of the shielded mild detonating cords is by electrical bridgewire detonators, one detonator at each end of each cord length. After first detonator firing, a detonator per cord is fired after a time delay (for redundancy) following first detonator firing.

**OPERATING TEMPERATURE/PRESSURE:**

**TEMPERATURE RANGE:** Low +20°F
High 120°F

**PRESSURE:** n/a

**LIST OF DEVICES:**
Electrical detonator
Non electric transfer detonator
Shielded mild detonating (transfer) cord
Detonating cord and metal tubing

**QUALIFICATION DOCUMENTATION:**
n/a

**ADDITIONAL REFERENCES:**
n/a

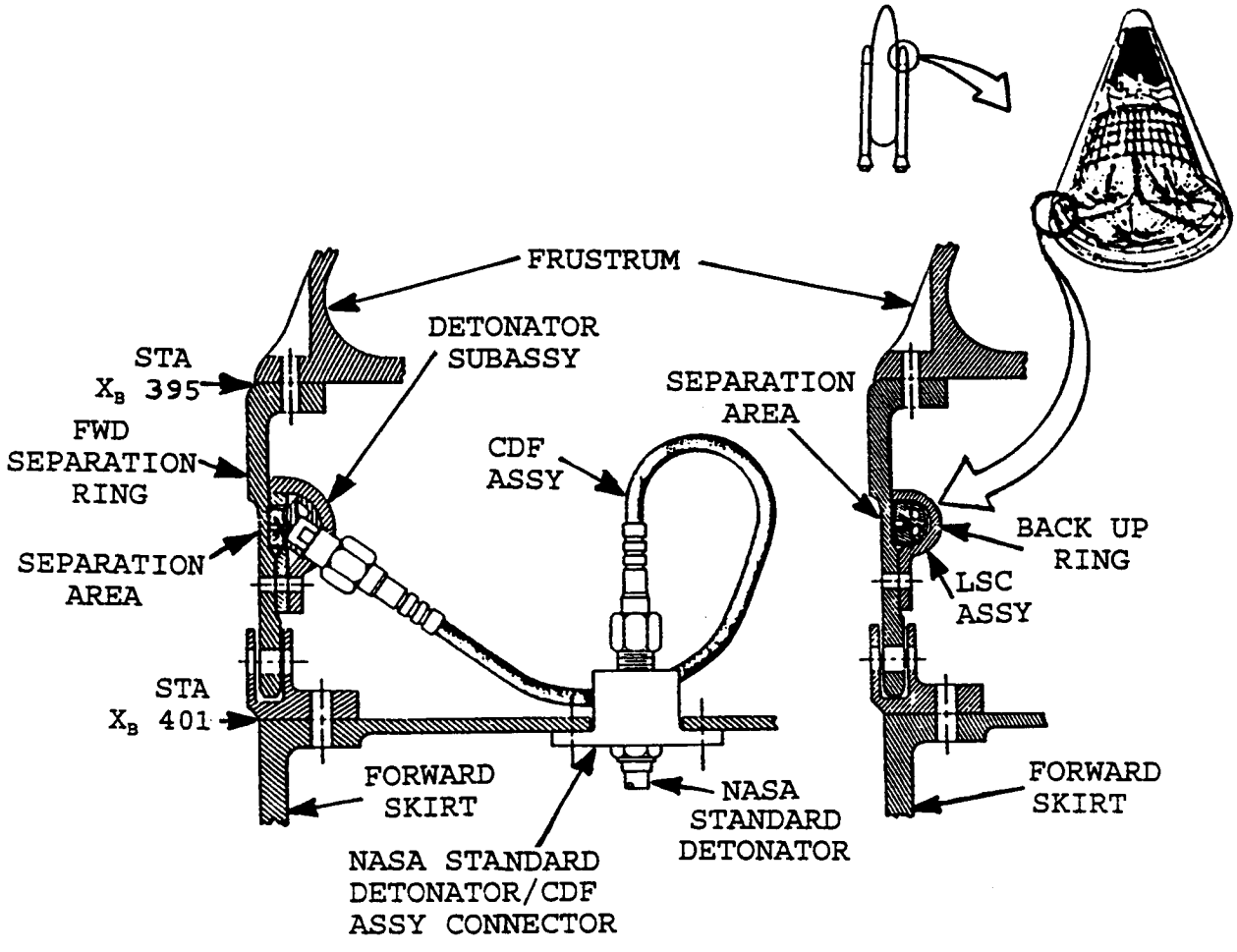
**ADDITIONAL COMMENTS:**
n/a

# NASA/DOD/DOE Pyrotechnic System

**TITLE:** Separation System - Solid Rocket Booster Frustrum

**AGENCY/CENTER:** NASA/Marshall Space Flight Center (MSFC)

**PHYSICAL DATA:**




SOLID ROCKET BOOSTER FRUSTRUM SEPARATION SHAPED CHARGE SYSTEM

**CONTRACTOR:** USBI

**SUBCONTRACTOR:** USBI

**SYSTEM IDENTIFICATION NUMBER:**
No system number; refer to specific components (devices).

**PURPOSE:**
To sever the tension ring that holds the frustum to the foward skirt and allow the drogue chute to pull the frustum away from the SRB.

# NASA/DOD/DOE Pyrotechnic System

**PREVIOUS USAGE:**
n/a

**OPERATIONAL DESCRIPTION:**
During recovery at an altitude of approximately 6,000 feet, the redundant low altitude barometric switches send fire commands to the frustum separation Pyrotechnic Initiator Controller (PIC) (main chute deployment) which initiates a NSD. The NSD is located in the top ring of the foward skirt. The output of the NSD is propagated through the pyrotechnic train of the Confined Detonating Fuse (CDF) assembly, detonator block assembly Linear Shaped Charge (LSC), and frustum separation assembly LSC. The LSC severs the tension ring that holds the frustum to the foward skirt and allows the drogue chute to pull the frustum away from the SRB for main chute deployment.

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** **Low** +20° F for 12 hours
**High** +250° F
**PRESSURE:** Refer to specific components (devices).

**LIST OF DEVICES:**
1 NSD, SEB26100094-201
1 NSD / CDF Assembly Connector, 10183-0008-001
1 CDF Assembly, 10314-0001-104
1 Frustum Separation Assembly:
3 Backup Rings, 10310-0005-801
1 Detonator Backup Ring, 10310-0006-801
1 LSC Assembly, 10310-0002-801
1 Detonator Subassembly, 10310-0003-801 and 10310-0003-802
4 Gap Covers, 10310-0004-801
12 Clamps, Backup Ring, 10310-0001-801

**QUALIFICATION DOCUMENTATION:**
n/a

**ADDITIONAL REFERENCES:**
n/a

**ADDITIONAL COMMENTS:**
n/a

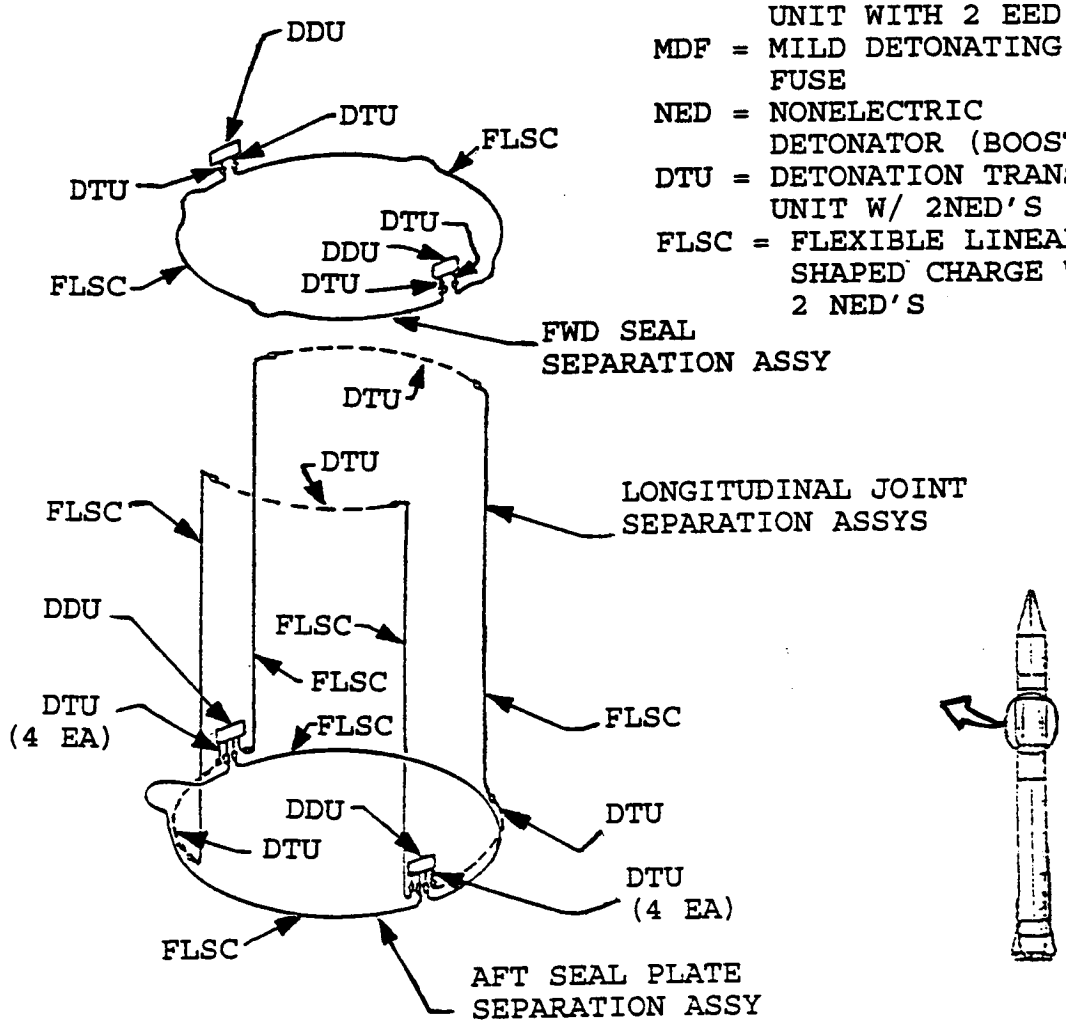
# NASA/DOD/DOE Pyrotechnic System

**TITLE:** Shaped Charge System - Centaur Insulation Panel Separation

**AGENCY/CENTER:** NASA Lewis Research Center (LeRC)

**PHYSICAL DATA:**

EED = ELECTRO EXPLOSIVE DETONATOR
DDU = DUAL DETONATOR UNIT WITH 2 EED'S
MDF = MILD DETONATING FUSE
NED = NONELECTRIC DETONATOR (BOOSTER)
DTU = DETONATION TRANSFER UNIT W/ 2NED'S & MDF
FLSC = FLEXIBLE LINEAR SHAPED CHARGE W/ 2 NED'S




CENTAUR INSULATION PANEL SEPARATION SYSTEM

**CONTRACTOR:** General Dynamics Space Systems Division (GDSSD)

**SUBCONTRACTOR:** No system vendor; only device vendors (see each device).

**SYSTEM IDENTIFICATION NUMBER:**
No system number; refer to specific components (devices).

**PURPOSE:**
To separate the four-segmented insulation panels longitudinally from each other and from the aft circular seal plate and the forward circular seal by severing the connections with flexible linear shaped charge for panel jettison from the vehicle.

# NASA/DOD/DOE Pyrotechnic System

**PREVIOUS USAGE:**
Expendable Launch Vehicles:
Atlas Centaur Vehciels through AC-68

**OPERATIONAL DESCRIPTION:**
The system has 3 main subsystems (1) longitudinal joint, (2) aft seal plate, and (3) fwd seal separtion subsystems. There are four joint cutting subassemblies in the longitudinal joint subsystem and two semicircular joint cutters each in the aft and the fwd seal subsystems. Detonation transfer units and flexible linear shaped charge units, that include a nonelectric detonator (booster) at each end, are used in the subsystems.

At event time power activates the electro-explosive detonators in the dual detonator units. The resulting energy propagates firing in the detonation transfer units that transfer firing to the flexible linear shaped charges which do the joint severing by the heat and blast effect.

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** **Low** −300° F
**High** +200° F (except EED's)
**PRESSURE:** n/a

**LIST OF DEVICES:**
Electro-Explosive Detonator (EED); GDSSD 55-07041 (DDA Assy 55-74365)
Nonelectric Detonator (NED); GDSSD 55-07040
Mild Detonating Fuse (MDF) GDSSD 55-00212; (Transfer Assy 55-74355)
Flexible Linear Shaped Charge (FLSC); GDSSD 55-00211

**QUALIFICATION DOCUMENTATION:**
n/a

**ADDITIONAL REFERENCES:**
n/a

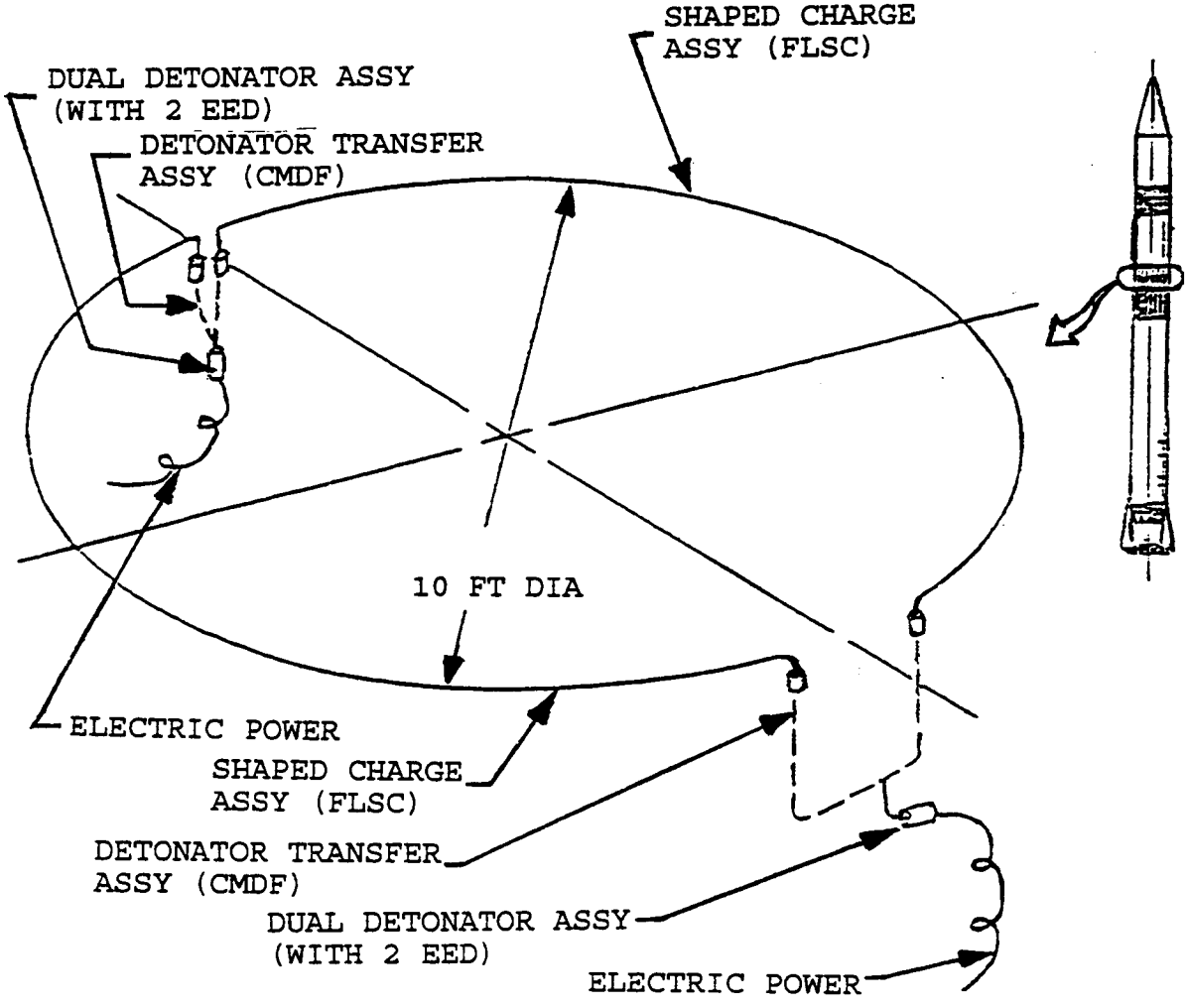
**ADDITIONAL COMMENTS:**
Interconnection and EED redundancy are such that detonation of one of the two EED's in only one of the two aft DDU's can activate both the longitudinal joint and the aft seal plate separation subsystems. Similarly, one EED can activate the fwd seal separation subsystem.

# NASA/DOD/DOE Pyrotechnic System

**TITLE:** Shaped Charge System - Centaur Separation

**AGENCY/CENTER:** NASA Lewis Research Center (LeRC)

**PHYSICAL DATA:**




CENTAUR SEPARATION SYSTEM

**CONTRACTOR:** General Dynamics Space Systems Division (GDSSD)

**SUBCONTRACTOR:** No system vendor; only device vendors (see each device).

**SYSTEM IDENTIFICATION NUMBER:**
No system number; refer to specific components (devices).

**PURPOSE:**
To pyrotechnically sever the structural connection between the Centaur stage and the expended Atlas stage of Atlas/Centaur vehicle by cutting the forward ring of the interstage adapter with flexible linear shaped charge for separation, followed by jettison

of the Atlas.

**PREVIOUS USAGE:**

Atlas/Centaur launch vehicles through AC-68.

**OPERATIONAL DESCRIPTION:**

The system uses two semicircular lengths of flexible linear shaped charge (FLSC) and four lengths of confined mild detonating fuse (CMDF) plus two dual detonator assemblies (DDA's) that contain two electro-explosive detonators (EED's) each. Non electric detonator (NED's), 12 total, are attached one to each end of the lengths of FLSC and CMDF. These NED's act as booster detonators to ensure propagation of the pyrotechnic activation from the EED's to the CMDF to the FLSC.

A programmed command, operating through control units, switches electrical power to thermally detonate the four heat sensitive EED type initiators. The activation is transferred to the lengths of CMDF which convey the activation to the FLSC's. Sufficient blast energy of the firing along the FLSC's cuts through the forward aluminum ring of the Centaur stage and severs the structural attachment to the Atlas stage.

**OPERATING TEMPERATURE/PRESSURE:**

**TEMPERATURE RANGE:** **Low** -300 °F (except EED's = -65 °F)
**High** +200 °F

**PRESSURE:** n/a

**LIST OF DEVICES:**

Electro-Explosive Detonator (EED); GDSSD 55-07041 (DDA Assy 55-74365)
Nonelectric Detonator (NED); GDSSD 55-07040
Confined Mild Detonating Fuse (CMDF); GDSSD 55-00212 (Transfer Assy 55-74355)
Flexible Linear Shaped Charge (FLSC); GDSSD 55-00211 (Centaur Separation Assy 55-75882)

**QUALIFICATION DOCUMENTATION:**

n/a

**ADDITIONAL REFERENCES:**

n/a

**ADDITIONAL COMMENTS:**

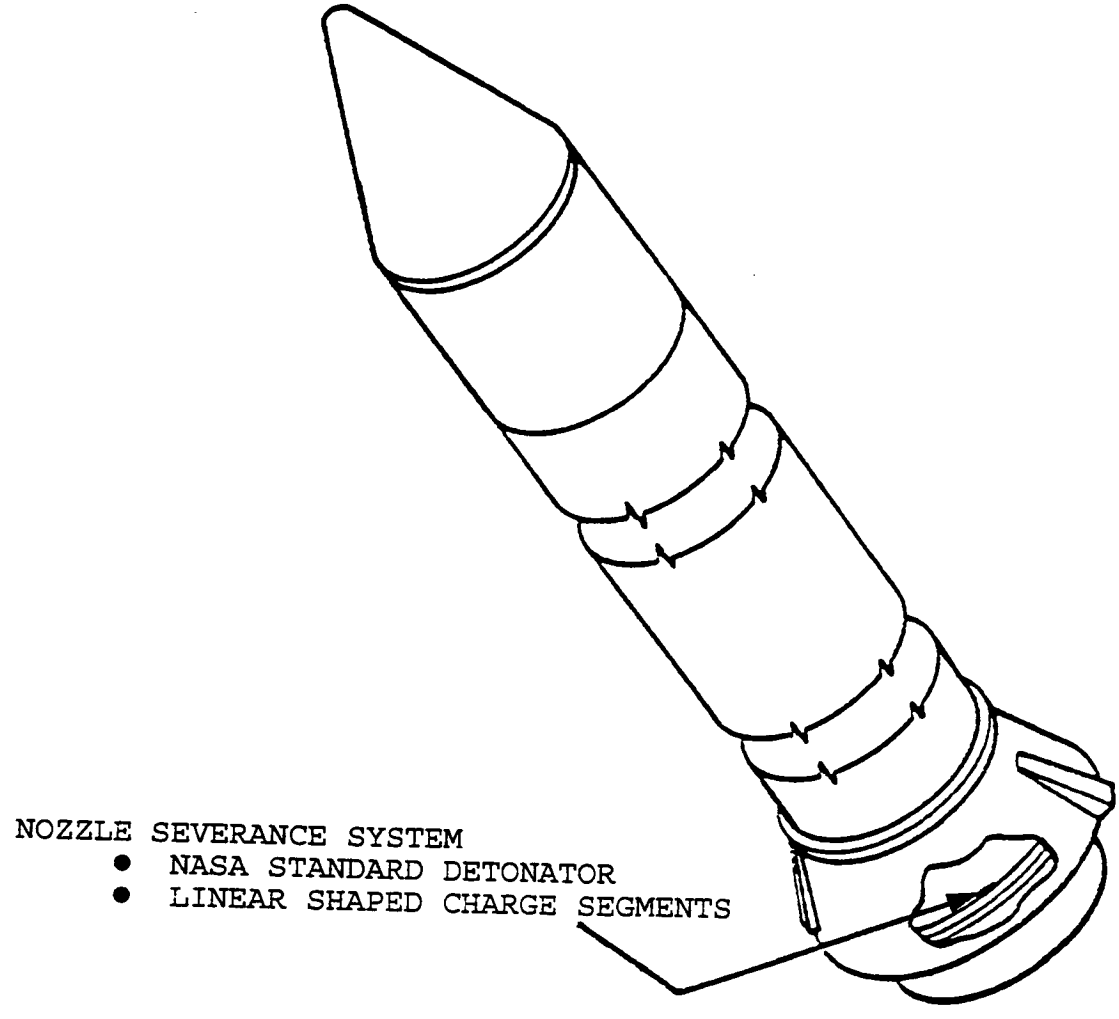
Initiation redundancy is achieved in that detonation of only one of the four EED's is sufficient to activate both semicircular sections of FLSC's.

## NASA/DOD/DOE Pyrotechnic System

**TITLE:** Shaped Charge System - Solid Rocket Motor (SRM) Nozzle Severance

**AGENCY/CENTER:** NASA/Marshall Space Flight Center (MSFC)

**PHYSICAL DATA:**




SOLID ROCKET MOTOR (SRM) NOZZLE SEVERANCE SHAPED CHARGE SYSTEM

**CONTRACTOR:** Thiokol Corporation

**SUBCONTRACTOR:** Thiokol Corporation

**SYSTEM IDENTIFICATION NUMBER:**
No system number; refer to specific components (devices).

**PURPOSE:**
To pyrotechnically sever the SRM nozzle during reentry, allowing it to fall away from the Solid Rocket Booster (SRB) while preventing damage to the heat shield, aft skirt, and components mounted on the aft skirt at water impact.

# NASA/DOD/DOE Pyrotechnic System

**PREVIOUS USAGE:**
n/a

**OPERATIONAL DESCRIPTION:**
The SRM nozzle severance system consists of one NASA standard detonator (NSD) and four linear-shaped charge ring segments. When the SRM chamber pressure drops below 50 psia, two timers are triggered. After 30 seconds, the nozzle severance pyrotechnic initiator controller (PIC) is armed. After 70 seconds, a fire command is sent to both triggers of the nozzle severance PIC. The PIC initiates the NSD, Linear Shaped Charge (LSC) assembly pyrotechnic train, which severs the SRM nozzle. The SRM nozzle is now free to fall away from the SRB. A blast shield covering the LSC assembly prevents damage to the heat shield, aft skirt, and components mounted on the aft skirt during the pyrotechnic firing.

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** **Low** 0° F
**High** +200° F
**PRESSURE:** Refer to specific components (devices).

**LIST OF DEVICES:**
1 NASA Standard Detonator (NSD), SEB26100094-201
1 LSC Assembly:
- 1 LSC ring segment, 1U52306-07
- 3 LSC ring segments, 1U52306-06

**QUALIFICATION DOCUMENTATION:**
n/a

**ADDITIONAL REFERENCES:**
n/a

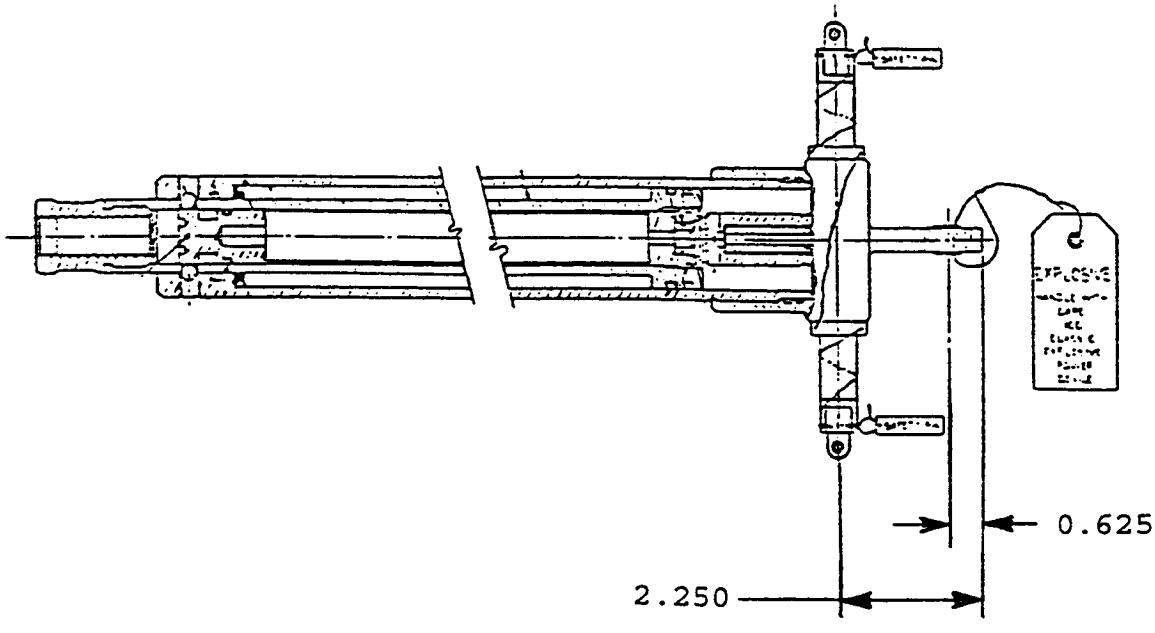
**ADDITIONAL COMMENTS:**
n/a

# NASA/DOD/DOE Pyrotechnic System

**TITLE:** Thruster System - Shuttle-Tail Service Mast Bonnet

**AGENCY/CENTER:** NASA Kennedy Space Center (KSC)

**PHYSICAL DATA:**




THRUSTER ASSEMBLY

**CONTRACTOR:** Lockheed Space Division-Shuttle Processing Contractor/ KSC
**SUBCONTRACTOR:** Unidynamics/Phoenix Inc.

**SYSTEM IDENTIFICATION NUMBER:**
79K22641 NASA/KSC

**PURPOSE:**
The Bonnet Thruster is fired at T-0 and closes a steel door (Bonnet) after the Shuttle T-0 ground umbilical is pulled back into its protective housing (Tail Service Mast). The Bonnet closure protects the T-0 umbilical from blast damage.

# NASA/DOD/DOE Pyrotechnic System

**PREVIOUS USAGE:**
n/a

**OPERATIONAL DESCRIPTION:**
The system uses two Bonnet Thrusters, one for the hydrogen tail service mast and one for the LOX tail sevice mast. The thruster is initiated by two firing pins which are pulled by a Lanyard attached to a 23,000 pound drop weight. The thruster provides a thrust of 2,250 pounds throughout a 16 inch stroke.

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** **Low** n/a
**High** n/a
**PRESSURE:** n/a

**LIST OF DEVICES:**
The thruster is the only pyro device used in the system.

**QUALIFICATION DOCUMENTATION:**
79K22034 - fabrication and refurbishment of TSM Bonnet Thruster.

**ADDITIONAL REFERENCES:**
n/a

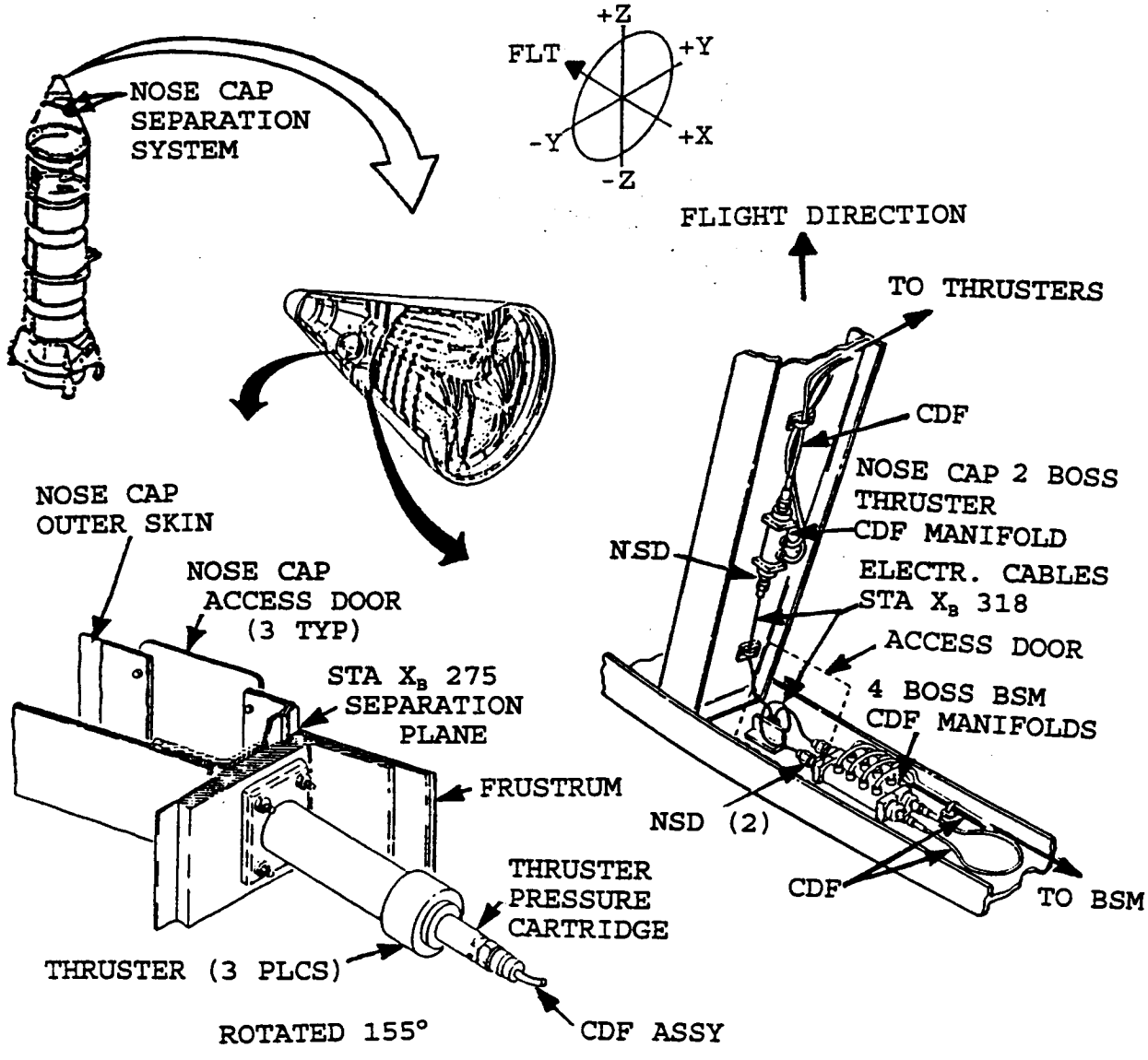
**ADDITIONAL COMMENTS:**
Redundancy is achieved by providing two firing pins for each thruster assembly.

# NASA/DOD/DOE Pyrotechnic System

**TITLE:** Thruster System - SRB Nose Cap Separation

**AGENCY/CENTER:** NASA/Marshall Space Flight Center (MSFC)

**PHYSICAL DATA:**




SOLID ROCKET BOOSTER (SRB) NOSE CAP SEPARATION THRUSTER SYSTEM

**CONTRACTOR:** USBI

**SUBCONTRACTOR:** USBI

**SYSTEM IDENTIFICATION NUMBER:**
No system number; refer to specific components (devices).

**PURPOSE:**
To holddown and, on command, release and accelerate the nose cap for SRB recovery.

# NASA/DOD/DOE Pyrotechnic System

**PREVIOUS USAGE:**
n/a

**OPERATIONAL DESCRIPTION:**
As the SRB freefalls to an altitude of approximately 16,000 feet, barometric switches send fire commands to the separation Pyrotechnic Initiator Controller (PIC) which initiates a NSD. The output of the detonator is propagated through a Confined Detonating Fuse (CDF) manifold and three CDF assemblies to three pressure cartridges located in the three thrusters spaced 120 degrees apart on the top ring of the frustum. The pressure cartridges produce pressure against the thruster piston shearing the thruster shear flange and producing a 30,000 pound thrust over a six-inch stroke. At the end of the stroke, the piston and rod separate, allowing the piston to remain in the thruster body and seal in all the products of combustion. The rod stays with the nose cap to prevent drogue line interference.

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** **Low** +20° F
**High** +195° F for 4 hours
**PRESSURE:** Refer to specific components (devices).

**LIST OF DEVICES:**
1 NASA Standard Detonator (NSD), SEB26100094-202
3 Confined Detonating Fuse (CDF) Manifolds, 10312-0001-101
3 CDF Assemblies, 10314-0001-101 thru 10314-0001-103
3 Thrusters, 10304-0001-801

**QUALIFICATION DOCUMENTATION:**
n/a

**ADDITIONAL REFERENCES:**
n/a

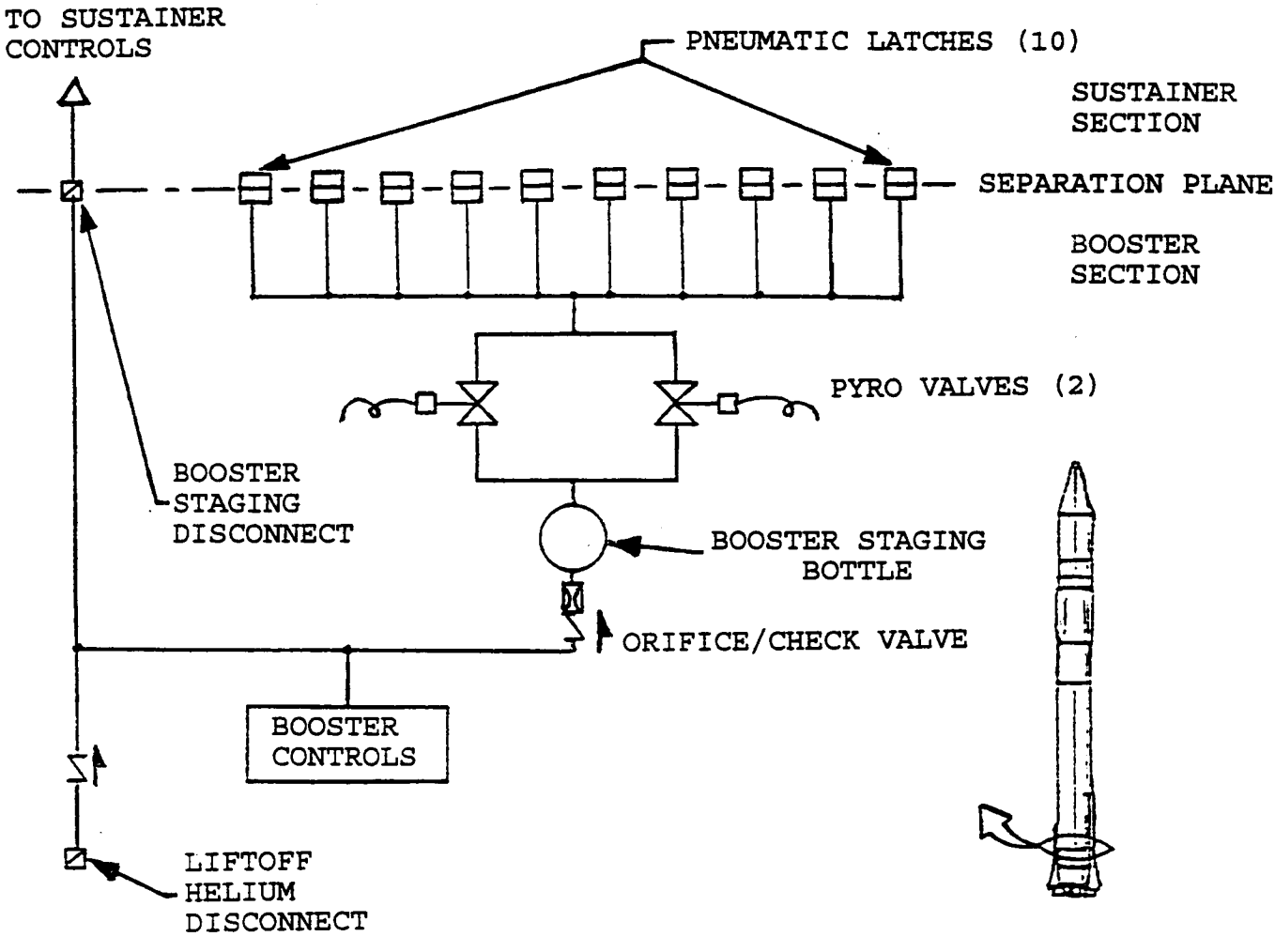
**ADDITIONAL COMMENTS:**
n/a

# NASA/DOD/DOE Pyrotechnic System

**TITLE:** Valve System - Atlas Booster Separation

**AGENCY/CENTER:** NASA Lewis Research Center (LeRC)

**PHYSICAL DATA:**




ATLAS BOOSTER SEPARATION SYSTEM

**CONTRACTOR:** General Dynamics Space Systems Division (GDSSD)

**SUBCONTRACTOR:** Conax Corporation - for pyro valves

**SYSTEM IDENTIFICATION NUMBER:**
Refer to specific components in List of Devices (below)

**PURPOSE:**
To open a pneumatic line by pyrotechnically actuating two in-parallel, normally closed valves to the open position and allow pneumatic pressure to operate unlatching mechanisms.

# NASA/DOD/DOE Pyrotechnic System

**PREVIOUS USAGE:**
Expendable Launch Vehicles: Atlas Centaur Vehicles through AC-68

**OPERATIONAL DESCRIPTION:**
Electric power issued at event time activates a pyro cartridge in each of the two normally closed valves that are connected in parallel for redundancy. Resulting pyro gas pressures force the piston rod cutter disks to shear out the diaphragms in the valves. The opened valves allow helium gas to flow to 10 pneumatically operated latches at the interface and separate the booster section from the Atlas sustainer section of the vehicle.

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** **Low** −65 °F
**High** + 160 °F
**PRESSURE:** n/a

**LIST OF DEVICES:**
Booster Separation Staging Valve; GDSSD 27-04304
Explosive Cartridge; GDSSD 55-07103

**QUALIFICATION DOCUMENTATION:**
n/a

**ADDITIONAL REFERENCES:**
n/a

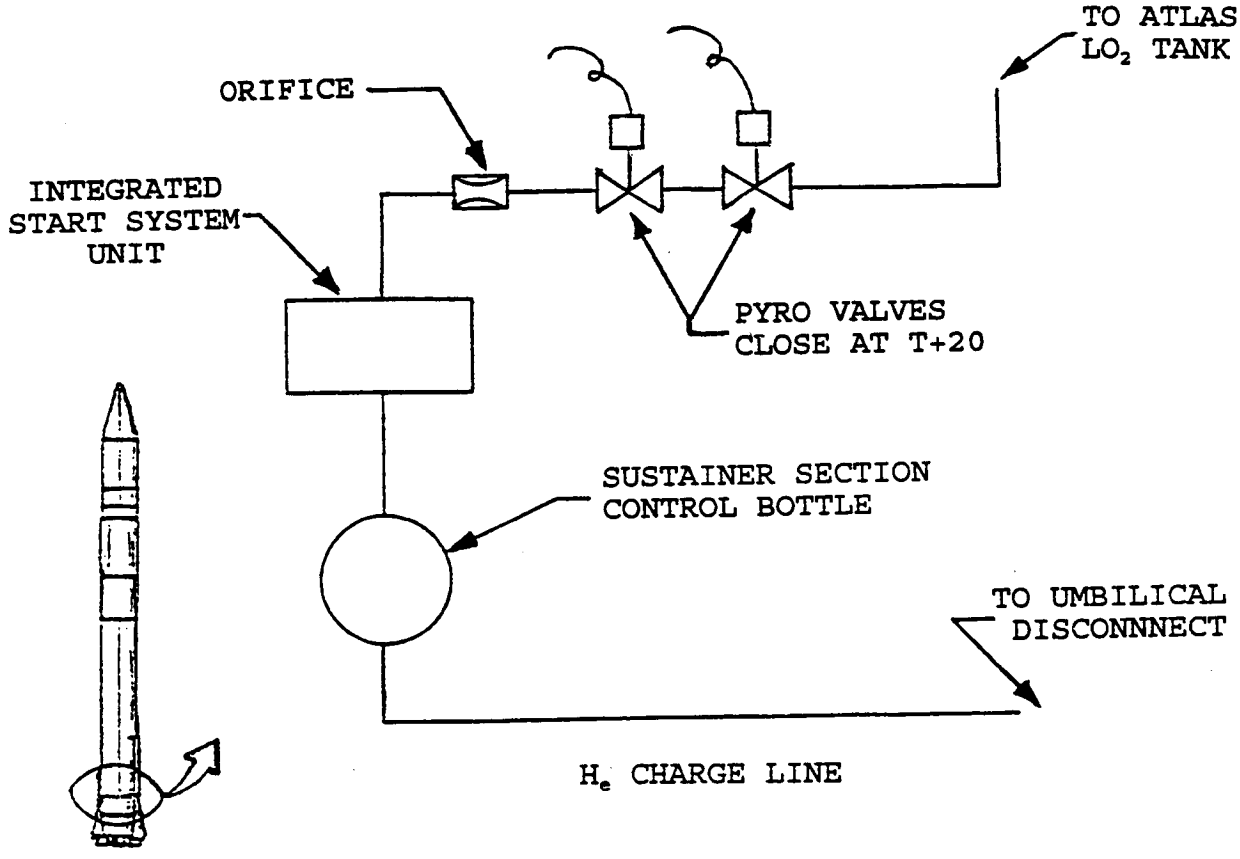
**ADDITIONAL COMMENTS:**
n/a

# NASA/DOD/DOE Pyrotechnic System

**TITLE:** Valve System - Atlas $LO_2$ Sensing Line Shutoff

**AGENCY/CENTER:** NASA Lewis Research Center (LeRC)

**PHYSICAL DATA:**




ATLAS $LO_2$ SENSING LINE SHUTOFF SYSTEM

**CONTRACTOR:** General Dynamics Space Systems Division (GDSSD)

**SUBCONTRACTOR:** Conax Corporation

**SYSTEM IDENTIFICATION NUMBER:**
Refer to specific components in List of Devices (below).

**PURPOSE:**
To close the Atlas oxygen (LO2) sensing line by pyrotechnically actuating the two in-series, normally open valves to the closed position and thus shutting off the line.

# NASA/DOD/DOE Pyrotechnic System

**PREVIOUS USAGE:**
Expendable Launch Vehicle: Atlas Centaur Vehicles through AC-68

**OPERATIONAL DESCRIPTION:**
At T +20 seconds electrical power is routed to activate a pyro cartridge in each valve. Resulting gas pressures in the two valves move the piston rod plug ends to the closed position and shutoff the sensing line.

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** **Low** −65 °F
**High** +160 °F
**PRESSURE:** n/a

**LIST OF DEVICES:**
Oxygen (LO2) Sensing Line Shutoff Valve; GDSSD 69-06011
Pressure Cartridge; GDSSD 55-06018

**QUALIFICATION DOCUMENTATION:**
n/a

**ADDITIONAL REFERENCES:**
n/a

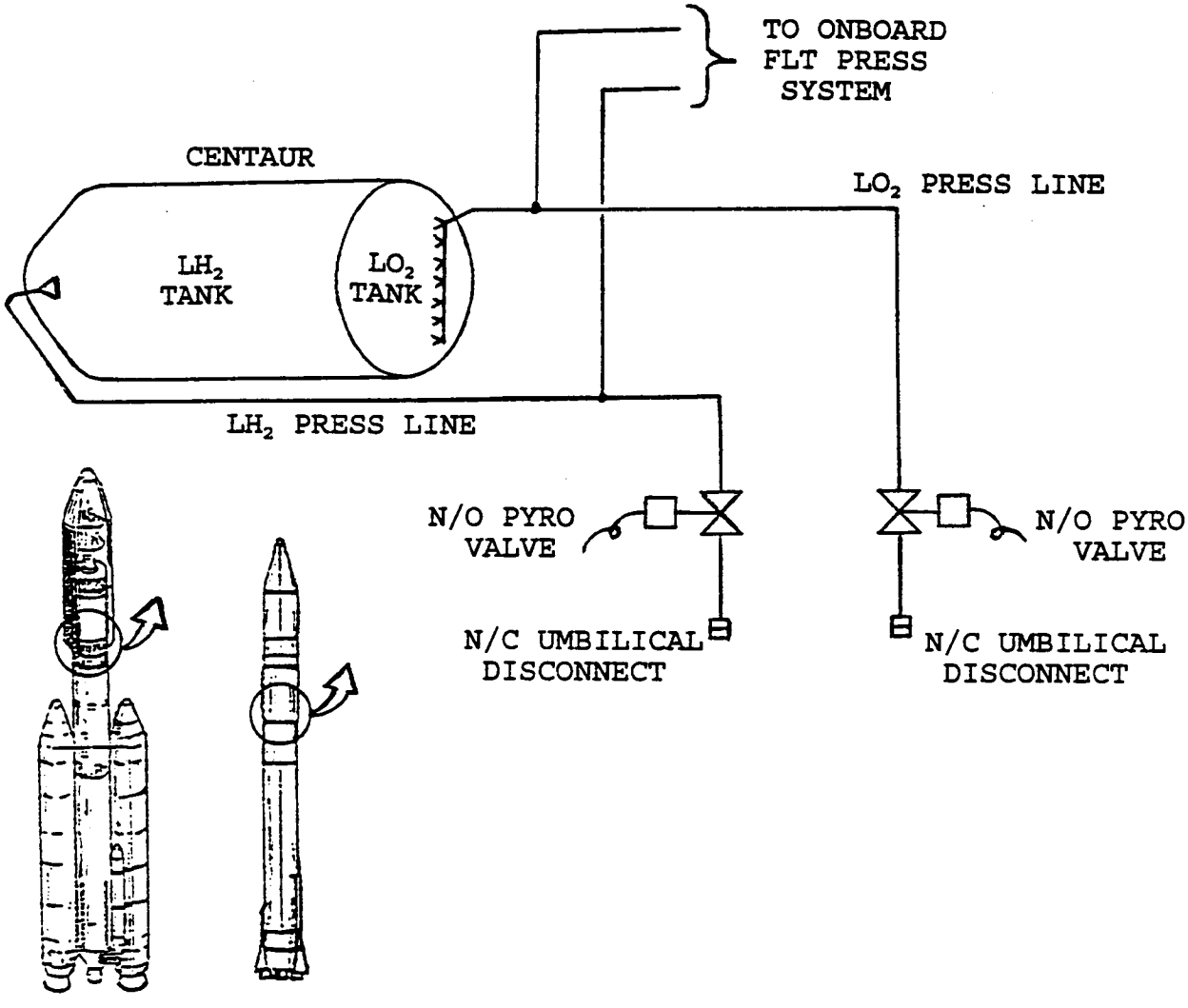
**ADDITIONAL COMMENTS:**
n/a

## NASA/DOD/DOE Pyrotechnic System

**TITLE:** Valve System - Centaur Pressurization Disconnect Shutoff Backup

**AGENCY/CENTER:** NASA Lewis Research Center (LeRC)

**PHYSICAL DATA:**




CENTAUR PRESSURIZATION DISCONNECT SHUTOFF BACKUP SYSTEM

**CONTRACTOR:** General Dynamics Space Systems Division (GDSSD)

**SUBCONTRACTOR:** Pyronetics Incorporated - for valves and cartridges

**SYSTEM IDENTIFICATION NUMBER:**
Refer to specific components in List of Devices (below)

**PURPOSE:**
To provide backup shutoffs for Centaur vehicle tank pressurization umbilical disconnect closure poppet valves.

# NASA/DOD/DOE Pyrotechnic System

**PREVIOUS USAGE:**

Expendable Launch Vehicle:
Atlas Centaur Vehicles through AC-68
Titan Centaur Vehicles through TC-7

**OPERATIONAL DESCRIPTION:**

Immediately prior to liftoff the ground supply umbilical lines disconnect from the vehicle. Each of the two propellant tank ground supply pressure lines for Centaur stage utilize an onboard normally open valve that is pyrotechnically actuated to close at umbilical separation. The pyro valves reinforce line closure by backup to the disconnect poppet valves in the airborne portion of the disconnect.

**OPERATING TEMPERATURE/PRESSURE:**

**TEMPERATURE RANGE:** **Low** −65 °F
**High** +200 °F

**PRESSURE:** n/a

**LIST OF DEVICES:**

Tank Pressurization Umbilical Shutoff Valve; GDSSD 55-08401
Detonator Cartridge; JPL 10049711

**QUALIFICATION DOCUMENTATION:**

n/a

**ADDITIONAL REFERENCES:**

n/a

**ADDITIONAL COMMENTS:**

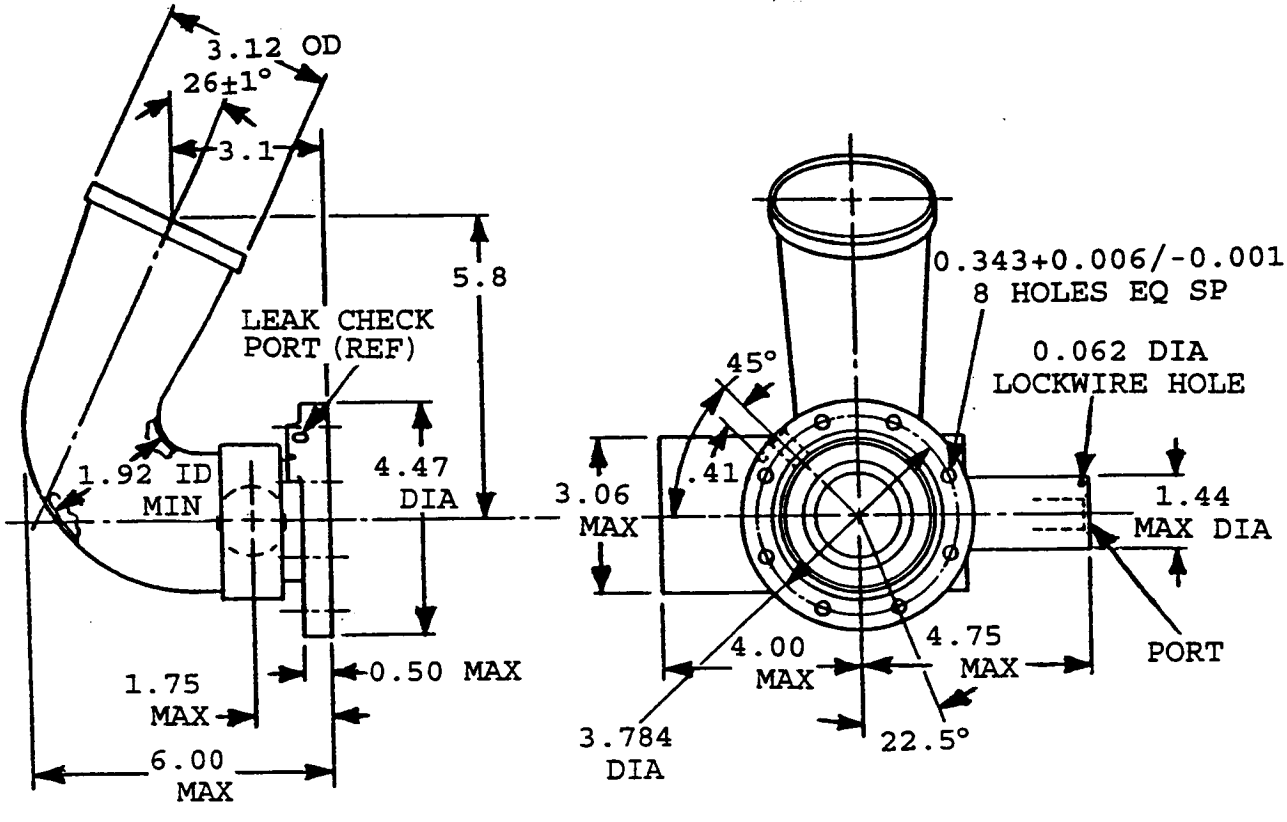
n/a

# NASA/DOD/DOE Pyrotechnic System

**TITLE:** Valve System - External Tank (ET) Tumble

**AGENCY/CENTER:** NASA/Marshall Space Flight Center (MSFC)

**PHYSICAL DATA:**




EXTERNAL TANK (ET) TUMBLE VALVE

**CONTRACTOR:** Martin-Marietta Corporation

**SUBCONTRACTOR:** Martin-Marietta Corporation

**SYSTEM IDENTIFICATION NUMBER:**
No system number; refer to specific components (devices).

**PURPOSE:**
To vent the gases from the LO2 tank and, after separation, to direct the gases so that it causes the ET to tumble.

# NASA/DOD/DOE Pyrotechnic System

**PREVIOUS USAGE:**
n/a

**OPERATIONAL DESCRIPTION:**
The ET tumble valve is located in the ET nose cap. The tumble valve actuates and starts venting the gases from the LO2 tank just prior to ET / Orbitor separation. After separation, the vented gases are directed so that it causes the ET to tumble. The tumbling action helps keep the ET from becoming aerodynamically stable during reentry and, therefore, aids in the ET breakup during reentry. The tumble valve is actuated by a pyrotechnic valve actuation cartridge in conjunction with a NASA Standard Detonator (NSD).

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** **Low** -150° F
**High** +200° F for 4 hours
**PRESSURE:** Refer to specific components (devices).

**LIST OF DEVICES:**
1 Pyrotechnic Valve Actuation Cartridge, PD 5000011-009
1 Pyrotechnic-Operated tumble valve, PD 4700193-020

**QUALIFICATION DOCUMENTATION:**
n/a

**ADDITIONAL REFERENCES:**
n/a

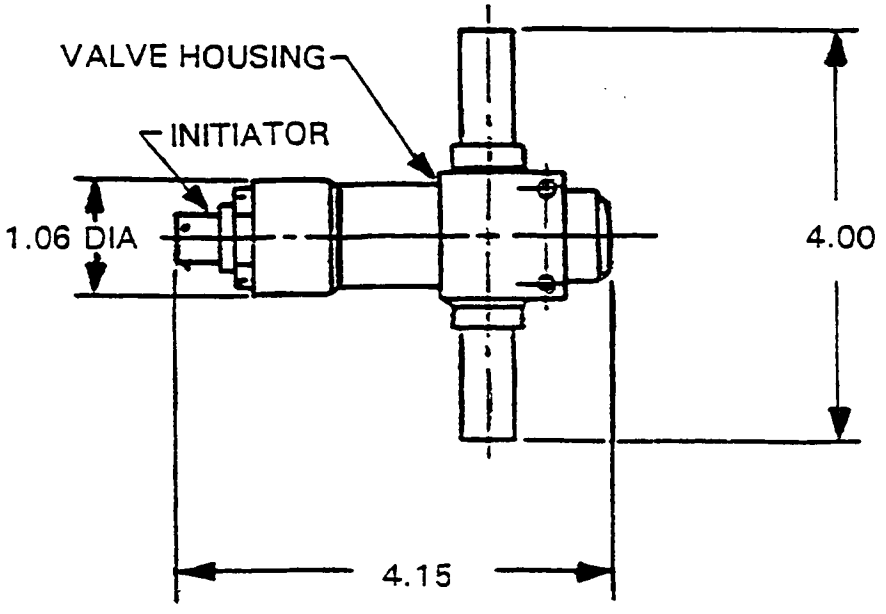
**ADDITIONAL COMMENTS:**
n/a

## NASA/DOD/DOE Pyrotechnic System

**TITLE:** Valve System - NOAA RCE Isolation

**AGENCY/CENTER:** NASA Goddard Space Flight Center (GSFC)

**PHYSICAL DATA:**




NOAA PAYLOAD RCE ISOLATION VALVE

**CONTRACTOR:** n/a

**SUBCONTRACTOR:** Pyronetics

**SYSTEM IDENTIFICATION NUMBER:**
Refer to List of Devices (below)

**PURPOSE:**
NOAA RCE Isolation Valve

# NASA/DOD/DOE Pyrotechnic System

**PREVIOUS USAGE:**
n/a

**OPERATIONAL DESCRIPTION:**
The RCE N2H4 isolation valves are normally open during ascent following completion of the spacecraft propulsive functions, the two RCE isolation valves are closed to prevent the flow of hydrazine to the thrusters for the remaining mission. Each valve is closed by firing the initiator which drives a guillotine-like blade which permaneltly closes the valve. Each closed valve will isolate its respective propellant tank from the Fill/drain and pressure sensor.

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** Low n/a
High n/a

**PRESSURE:** n/a

**LIST OF DEVICES:**
n/a

**QUALIFICATION DOCUMENTATION:**
n/a

**ADDITIONAL REFERENCES:**
n/a

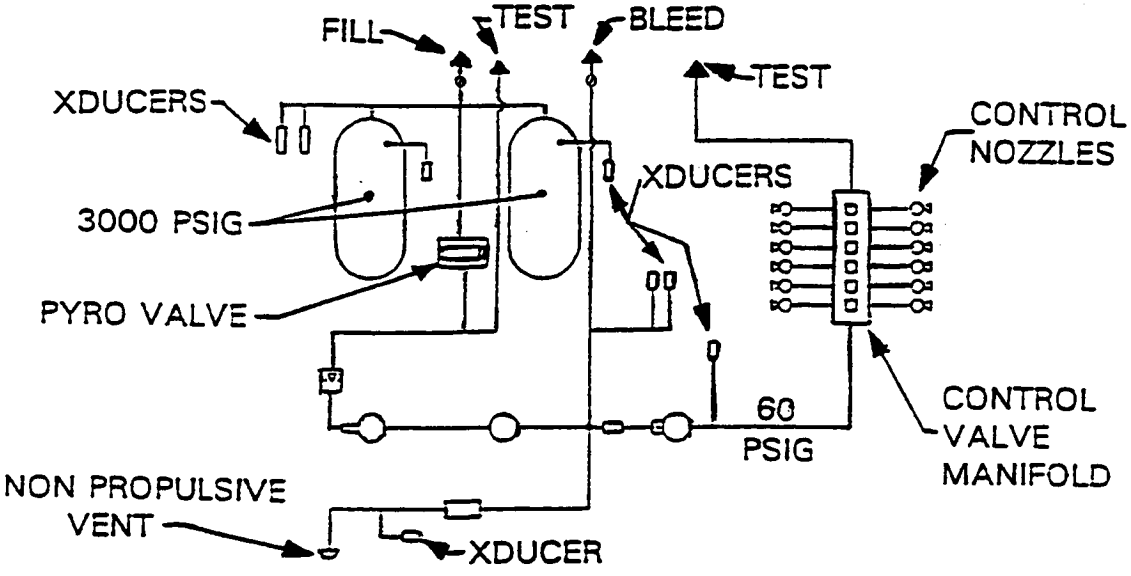
**ADDITIONAL COMMENTS:**
All fire current: 4 Amps for 10ms; No-fire current: 1.0 amp, 5 min. 1.0 watt for 5.0 minutes; Bridgewire Resistance: 1.0 ± 0.10 Ohms

## NASA/DOD/DOE Pyrotechnic System

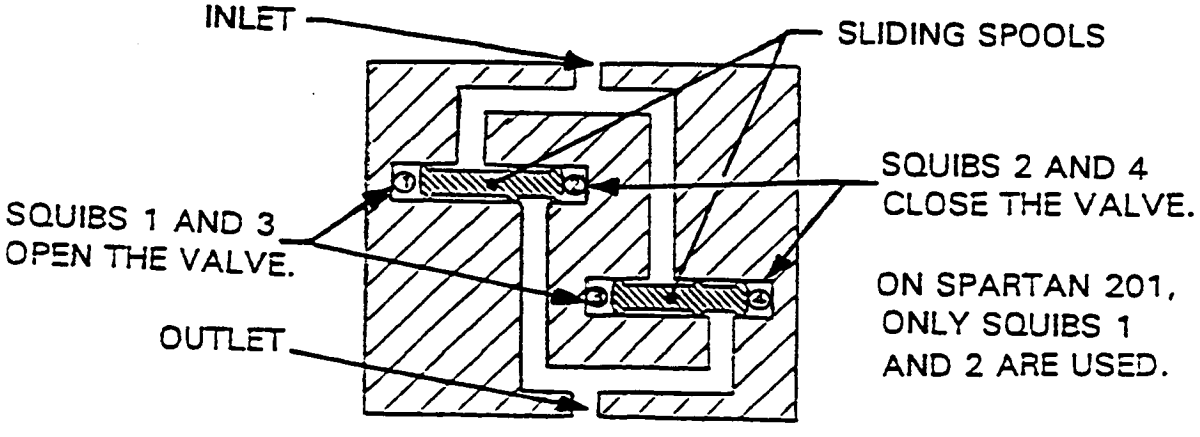
**TITLE:** Valve System - SPARTAN 201 ACS Gas Enable/Disable

**AGENCY/CENTER:** NASA Goddard Space Flight Center (GSFC)

**PHYSICAL DATA:**




SYSTEM DIAGRAM




PNEUMATIC ENABLE-DISABLE VALVE SCHEMATIC

SPARTAN 201 PAYLOAD ACS GAS ENABLE-DISABLE VALVE

**CONTRACTOR:** n/a

**SUBCONTRACTOR:** n/a

**SYSTEM IDENTIFICATION NUMBER:**
Refer to List of Devices (below)

**PURPOSE:**
Spartan enable/disable pyrotechnic valve open/closes valve sealing propellant gases from pneumatic circuits

# NASA/DOD/DOE Pyrotechnic System

**PREVIOUS USAGE:**
n/a

**OPERATIONAL DESCRIPTION:**
The pyrotechnic enable/disable valve (pyro valve) is a dual phase, dual stage unit where each cycle is driven by two EEDs that are simultneously fired by separate ordnance circuits. The ordnance used is the NSI-1 standard initiator. Only one open/close cycle of the valve will be used on SP201, therefore, the valve will be equipped with four EEDs. When the EEDs are fired (both prime and backup) the products of combustion are completely contained within the body of the valve and all moving parts are contained.

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** **Low** −260°F
**High** +300°F
**PRESSURE:** MOP 3000 PSIG

**LIST OF DEVICES:**
Valve; n/a
NASA Standard Initiator (NSI); JSC SEB 26100001

**QUALIFICATION DOCUMENTATION:**
n/a

**ADDITIONAL REFERENCES:**
n/a

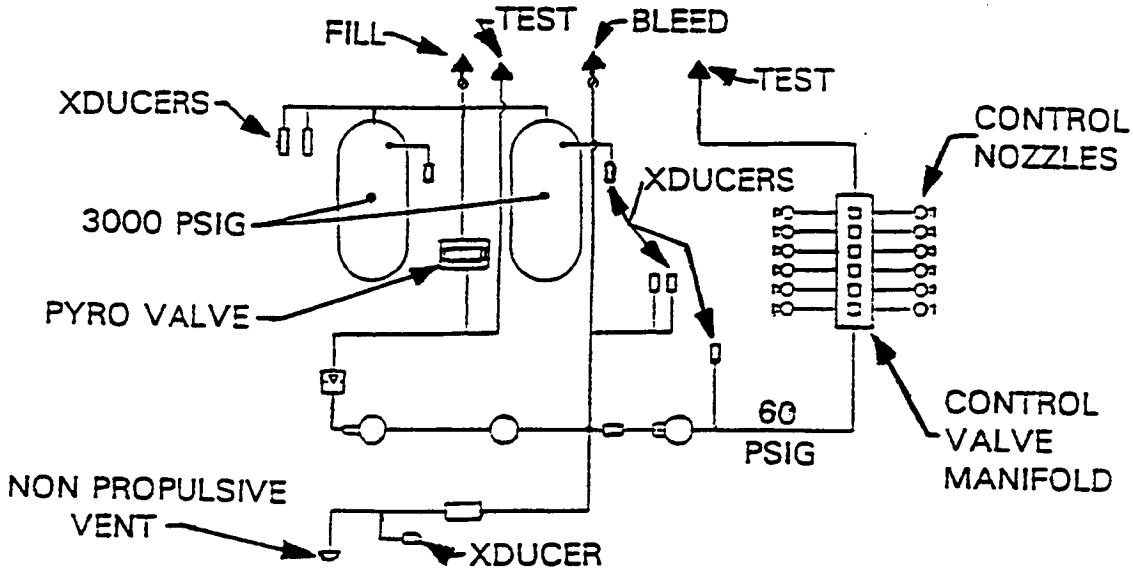
**ADDITIONAL COMMENTS:**
Bridgewire Resistance: 1.05 ± 0.1 Ohms; All fire current: 3.5 amps for 10 ms max.; No fire current: 1.0 amp, 1 watt for 5 minutes minimum.

# NASA/DOD/DOE Pyrotechnic System

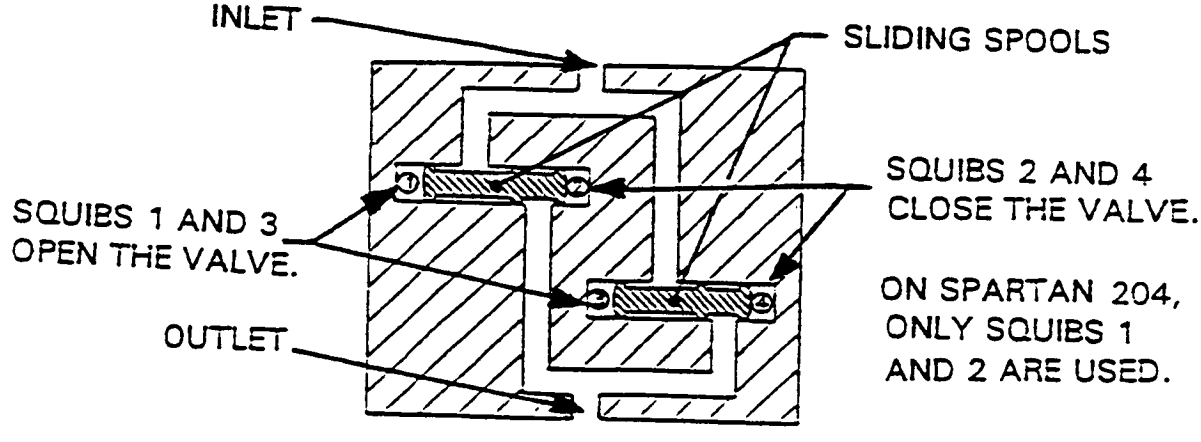
**TITLE:** Valve System - SPARTAN 204 ACS Gas Enable/Disable

**AGENCY/CENTER:** NASA Goddard Space Flight Center (GSFC)

**PHYSICAL DATA:**




SYSTEM DIAGRAM




PNEUMATIC ENABLE-DISABLE VALVE SCHEMATIC

SPARTAN 204 PAYLOAD ACS GAS ENABLE-DISABLE VALVE

**CONTRACTOR:** n/a

**SUBCONTRACTOR:** n/a

**SYSTEM IDENTIFICATION NUMBER:**
Refer to List of Devices (below)

**PURPOSE:**
Spartan enable/disable pyrotechnic valve open/closes valve sealing propellant gases from pneumatic circuits

# NASA/DOD/DOE Pyrotechnic System

**PREVIOUS USAGE:**
n/a

**OPERATIONAL DESCRIPTION:**
The pyrotechnic enable/disable valve (pyro valve) is a dual phase, dual stage unit where each cycle is driven by two EEDs that are simultaneously fired by separate ordnance circuits. The ordnance used is the NSI-1 standard initiator. Only one open/close cycle of the valve will be used on SP204, therefore, the valve will be equipped with four EEDs. When the EEDs are fired (both prime and backup) the products of combustion are completely contained within the body of the valve and all moving parts are contained.

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** **Low** -260°F
**High** +300°F
**PRESSURE:** MOP 3000 PSIG

**LIST OF DEVICES:**
Valve; n/a
NASA Standard Initiator (NSI); JSC SEB 26100001

**QUALIFICATION DOCUMENTATION:**
n/a

**ADDITIONAL REFERENCES:**
n/a

**ADDITIONAL COMMENTS:**
Bridgewire Resistance: 1.05 ± 0.1 Ohms; All fire current: 3.5 amps for 10 ms max.; No fire current: 1.0 amp, 1 watt for 5 minutes minimum.

# NASA/DOD/DOE Pyrotechnic System

**TITLE:** Valve System - TRMM Reaction Control

**AGENCY/CENTER:** NASA Goddard Space Flight Center (GSFC)

**PHYSICAL DATA:**

FIGURE

N/A

VALVE SIZE 3IN X 3IN X 1 IN MAX

INLET AND OUTLET PORTS 1/4 IN ID

**CONTRACTOR:** n/a

**SUBCONTRACTOR:** TBD

**SYSTEM IDENTIFICATION NUMBER:**
Refer to List of Devices (below)

**PURPOSE:**
Open the Reaction Control Subsystems valve

# NASA/DOD/DOE Pyrotechnic System

**PREVIOUS USAGE:**
n/a

**OPERATIONAL DESCRIPTION:**
The RCS valve shall incorporate two NASA Standard initiators, with each initiator being capable of opening the valve.

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** **Low** −40°C
**High** +125°C

**PRESSURE:** n/a

**LIST OF DEVICES:**
Valve; TBD
NASA Standard Initiator (NSI-1); JSC DWG #SKB26100066

**QUALIFICATION DOCUMENTATION:**
n/a

**ADDITIONAL REFERENCES:**
n/a

**ADDITIONAL COMMENTS:**
n/a

# NASA/DOD/DOE Pyrotechnic System

**TITLE:** Valve System - UARS CO2 Orbiter Vent

**AGENCY/CENTER:** NASA Goddard Space Flight Center (GSFC)

**PHYSICAL DATA:**

FIGURE

N/A

**CONTRACTOR:** n/a

**SUBCONTRACTOR:** n/a

**SYSTEM IDENTIFICATION NUMBER:**
Refer to List of Devices (below)

**PURPOSE:**
Activates CO2 Orbiter Vent on CLAES Instrument.

# NASA/DOD/DOE Pyrotechnic System

**PREVIOUS USAGE:**
n/a

**OPERATIONAL DESCRIPTION:**
The pyro actuates valves consisting of a single parent-metal barrier that is sheared in a guillotine-type action from a piston actuated by the pressure of 1 or 2 NSIs.

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** **Low** n/a
**High** n/a
**PRESSURE:** MOP 3000 PSIG

**LIST OF DEVICES:**
Valve; TBD
NSI; JSC SEB 26100001

**QUALIFICATION DOCUMENTATION:**
Design and Performance Specification for NSI-1 SKB 26100066

**ADDITIONAL REFERENCES:**
n/a

**ADDITIONAL COMMENTS:**
Bridgewire Resistance: 1.05 ± 0.1 Ohms; All fire current: 3.5 amps for 10 ms max.; No fire current: 1.0 amp, 1 watt for 5 minutes minimum.

# NASA/DOD/DOE Pyrotechnic System

**TITLE:** Valve System - UARS Neon Orbiter Vent

**AGENCY/CENTER:** NASA Goddard Space Flight Center (GSFC)

**PHYSICAL DATA:**

FIGURE

N/A

**CONTRACTOR:** n/a

**SUBCONTRACTOR:** n/a

**SYSTEM IDENTIFICATION NUMBER:**
Refer to List of Devices (below)

**PURPOSE:**
Activates Neon Orbiter Vent on CLAES Instrument.

# NASA/DOD/DOE Pyrotechnic System

**PREVIOUS USAGE:**
n/a

**OPERATIONAL DESCRIPTION:**
The pyro actuates valves consisting of a single parent-metal barrier that is sheared in a guillotine-type action from a piston actuated by the presure of 1 or 2 NSIs.

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** **Low** n/a
**High** n/a
**PRESSURE:** MOP 3000 PSIG

**LIST OF DEVICES:**
Valve; n/a
NASA Standard Initiator (NSI); JSC SEB 26100001

**QUALIFICATION DOCUMENTATION:**
n/a

**ADDITIONAL REFERENCES:**
n/a

**ADDITIONAL COMMENTS:**
Bridgewire Resistance: 1.05 ± 0.1 Ohms; All fire current: 3.5 amps for 10 ms max.; No fire current: 1.0 amp, 1 watt for 5 minutes minimum.

# NASA/DOD/DOE Pyrotechnic System

**TITLE:** Valve System - UARS Vacuum Orbiter Vent Cluster

**AGENCY/CENTER:** NASA Goddard Space Flight Center (GSFC)

**PHYSICAL DATA:**

FIGURE

N/A

**CONTRACTOR:** n/a

**SUBCONTRACTOR:** n/a

**SYSTEM IDENTIFICATION NUMBER:**
Refer to List of Devices (below)

**PURPOSE:**
Activates vacuum valve cluster on CLAES Instrument.

# NASA/DOD/DOE Pyrotechnic System

**PREVIOUS USAGE:**
n/a

**OPERATIONAL DESCRIPTION:**
The pyro actuates valves consisting of a single parent-metal barrier that is sheared in a guillotine-type action from a piston actuated by the presure of 1 or 2 NSIs.

**OPERATING TEMPERATURE/PRESSURE:**
**TEMPERATURE RANGE:** Low n/a
High n/a
**PRESSURE:** MOP 3000 PSIG

**LIST OF DEVICES:**
Valve; n/a
NASA Standard Initiator (NSI); JSC SEB 26100001

**QUALIFICATION DOCUMENTATION:**
n/a

**ADDITIONAL REFERENCES:**
n/a

**ADDITIONAL COMMENTS:**
Bridgewire Resistance: 1.05 ± 0.1 Ohms; All fire current: 3.5 amps for 10 ms max.; No fire current: 1.0 amp, 1 watt for 5 minutes minimum.

THIS PAGE INTENTIONALLY LEFT BLANK

# CROSS REFERENCE INDEX

This index is an alphabetical listing of Devices and Systems grouped by the contributing NASA Centers

# CROSS REFERENCE INDEX

NASA GODDARD SPACE FLIGHT CENTER

# CROSS REFERENCE INDEX (CONT.)

NASA GODDARD SPACE FLIGHT CENTER (CONT.)

# CROSS REFERENCE INDEX (CONT.)

NASA JOHNSON SPACE CENTER

# CROSS REFERENCE INDEX (CONT.)

NASA KENNEDY SPACE CENTER

# CROSS REFERENCE INDEX (CONT.)

NASA LANGLEY RESEARCH CENTER

# CROSS REFERENCE INDEX (CONT.)

NASA LEWIS RESEARCH CENTER

# CROSS REFERENCE INDEX (CONT.)

NASA MARSHALL SPACE FLIGHT CENTER

# CROSS REFERENCE INDEX (CONT.)

NASA MARSHALL SPACE FLIGHT CENTER (CONT.)

THIS PAGE INTENTIONALLY LEFT BLANK

# REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188



| 1. AGENCY USE ONLY (*Leave blank*) | 2. REPORT DATE | 3. REPORT TYPE AND DATES COVERED |
|---|---|---|
| | January 1995 | Technical Memorandum |

**4. TITLE AND SUBTITLE**

Applications Catalog of Pyrotechnically Actuated Devices/Systems

**5. FUNDING NUMBERS**

WU-323-17-07

**6. AUTHOR(S)**

Thomas L. Seeholzer, Floyd Z. Smith, Charles W. Eastwood, and Paul R. Steffes

**7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)**

National Aeronautics and Space Administration
Lewis Research Center
Cleveland, Ohio 44135-3191

**8. PERFORMING ORGANIZATION REPORT NUMBER**

E-9297

**9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)**

National Aeronautics and Space Administration
Washington, D.C. 20546-0001

**10. SPONSORING/MONITORING AGENCY REPORT NUMBER**

NASA TM-106810

**11. SUPPLEMENTARY NOTES**

Thomas L. Seeholzer, NASA Lewis Research Center; Floyd Z. Smith, Charles W. Eastwood, and Paul R. Steffes, Analex Corporation, 3001 Aerospace Parkway, Brook Park, Ohio 44142 (work funded by NASA Contract NAS3-25776). Prepared in support of Project 1.4 Pyrotechnically Actuated Systems Data Base and Applications Catalog for NASA Pyrotechnially Actuated Systems (PAC) Program. Responsible person, Thomas P. Cahill, organization code 4300, (216) 433-5538.

**12a. DISTRIBUTION/AVAILABILITY STATEMENT**

Unclassified - Unlimited
Subject Categories 03, 15, and 31

This publication is available from the NASA Center for Aerospace Information, (301) 621-0390.

**12b. DISTRIBUTION CODE**

**13. ABSTRACT** (*Maximum 200 words*)

A compilation of basic information on pyrotechnially actuated devices/systems used in NASA aerospace and aeronautic applications was formated into a catalog. The intent is to provide (1) a quick reference digest of the types of operational pyro mechanisms and (2) a source of contacts for further details. Data on these items was furnished by the NASA Centers that developed and/or utilized such devices to perform specific functions on spacecraft, launch vehicles, aircraft and ground support equipment. Information entries include an item title, user center name, commercial contractor/vendor, identifying part number(s), a basic figure, briefly described purpose and operation, previous usage, and operational limits/ requirements.

| 14. SUBJECT TERMS | 15. NUMBER OF PAGES |
|---|---|
| Pyrotechnic devices; Launch vehicle pyrotechnics; Spacecraft pyrotechnics | 331 |
| | 16. PRICE CODE: A15 |

| 17. SECURITY CLASSIFICATION OF REPORT | 18. SECURITY CLASSIFICATION OF THIS PAGE | 19. SECURITY CLASSIFICATION OF ABSTRACT | 20. LIMITATION OF ABSTRACT |
|---|---|---|---|
| Unclassified | Unclassified | Unclassified | |