AD NUMBER

AD481006

NEW LIMITATION CHANGE

TO

Approved for public release, distribution unlimited

FROM

Distribution authorized to U.S. Gov't. agencies and their contractors; Administrative/Operational Use; 1 Apr 1965. Other requests shall be referred to U.S. Army, Frankford Arsenal, Philadelphia, PA 19137.

AUTHORITY

USAEA ltr, 22 Jun 1971

2004 1020 011

IEP-65-6370-8

PROPELLANT ACTUATED DEVICES ENGINEERING MANUAL

APRIL 1965

U.S. ARMY
FRANKFORD ARSENAL
PHILADELPHIA PA., 19137

(6) ENGINEERING MANUAL

FOR

PROPELLANT ACTUATED DEVICES.

(16) IPP-65-[illegible]70-8

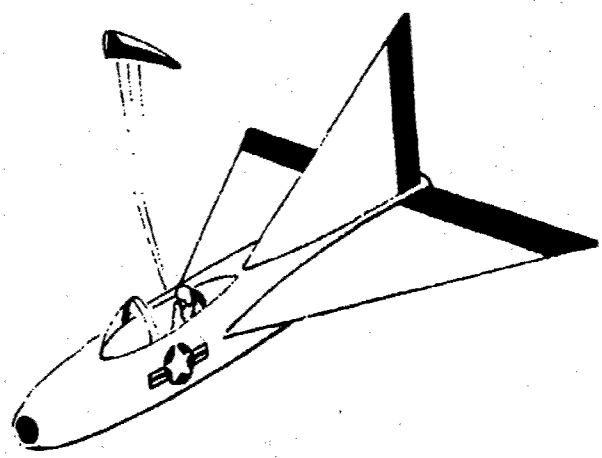
(11) 1 APR[illegible]65

(12) [illegible] p.

INTRODUCTION

The major purpose of this ~~Engineering~~ Manual is to provide technical personnel of industries involved in design and provisions for emergency escape from extra-terrestrial vehicles, a convenient reference of basic design and performance characteristics of Propellant Actuated Devices. Since the advent of high-speed jet aircraft generated the need for an automated means of escape from aircraft, Frankford Arsenal has pioneered the design and development of Propellant Actuated Devices; such as Catapults, Initiators, Thrusters, Removers and Rocket Catapults.

The major consideration in the design, development and production of the devices described in this Manual was to attain an optimum Reliability Design Goal. Fundamental to the theory of reliability is the relationship between total and component reliabilities. On this basis, total reliability can be no greater than the least reliable component. To attain this goal, the devices listed in this Manual undergo stringent quality control tests and analysis for the propellant, pyrotechnic and hardware components, [redacted] the complete loaded and assembled device.



SECTION I

REMOVERS

INTRODUCTION

Description:

The remover is a two or three tube telescoping device, containing an explosive component, designed to jettison the canopy from high-speed aircraft prior to the ejection of crewmen from disabled aircraft.

The Removers are of two basic types, i.e., mechanical and gas actuated. A third type is the electric-mechanical ballistic types which permits normal opening and closing of the canopy as well as emergency jettisoning of the canopy.

REMOVER, AIRCRAFT CANOPY, M1A3

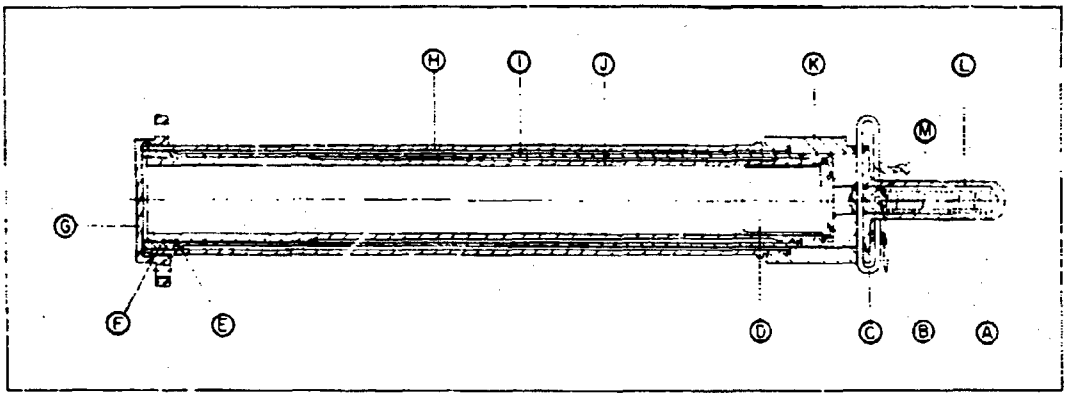
The M1A3 Remover is a three-tube, telescoping ejection device containing an explosive cartridge, designed to forcibly jettison the canopy from high-speed aircraft to provide a safe path for the ejection of the crewman from disabled aircraft.

The remover is approximately 16 inches long and 1.93 inches in diameter. The remover has the M1A1 Firing Pin Release attached. The firing pin release, which when functioned by the M3A1 Initiator, releases a spring loaded firing pin in the remover. The spring propels the firing pin which strikes and detonates the primer, thereby igniting the black powder and propellant in the M29A2 Cartridge. The remover thrust which is developed from the expanding gases of the burning propellant, forces the inside and telescoping tubes to move simultaneously until the shoulder of the telescoping tube comes in contact with the telescoping tube stop, thus restricting its movement. The continuous moving head assembly and inside tube are jettisoned with the aircraft canopy. The base, outside and telescoping tubes, and telescoping tube stop remain with the aircraft.

PRINCIPAL CHARACTERISTICS

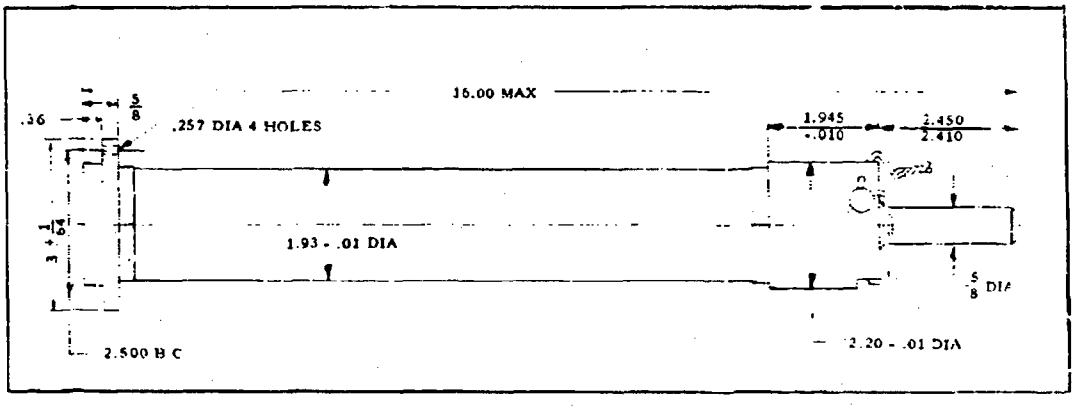
Stroke	23.3 inches
Weight (total assy)	2.1 pounds
Propelled Weight	300 pounds
Temperature Limits	−65°F to +160°F
Velocity, min (at 70°F)	20.0 fps
Thrust, min (at 70°F)	2800 pounds
Stroke Time (at 70°F)	0.135 seconds
Firing Method	Gas Actuation of the M1A1 Firing Pin Release, which releases M1A3 Remover Firing Pin

Remover, Aircraft Canopy, M1A3



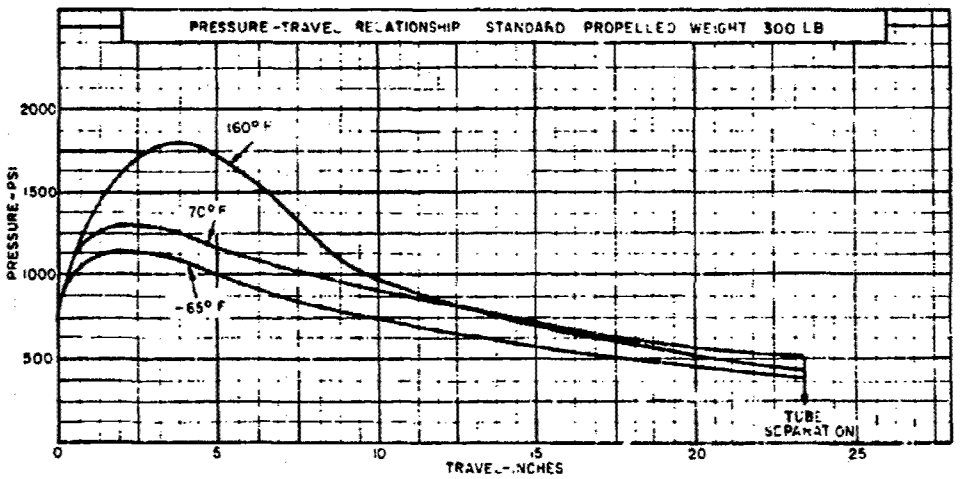
CROSS-SECTION DRAWING

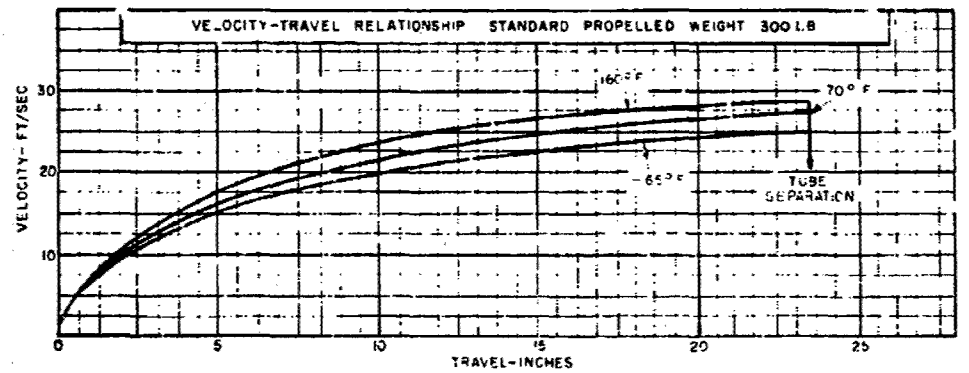
Component		Component	
A	Spring, Firing Pin	G	Base
B	Pin, Safety	H	Tube, Outside and Pellet Assembly
C	Wire, Locking, .062" x 8"	I	Tube, Telescoping
D	Cartridge, Aircraft Canopy Remover, M29A2	J	Tube, Inside and Pellet Assembly
E	Seal, Inside	K	Stop, Telescoping Tube
F	Seal, Telescoping	L	Head, Firing
		M	Pin, Firing

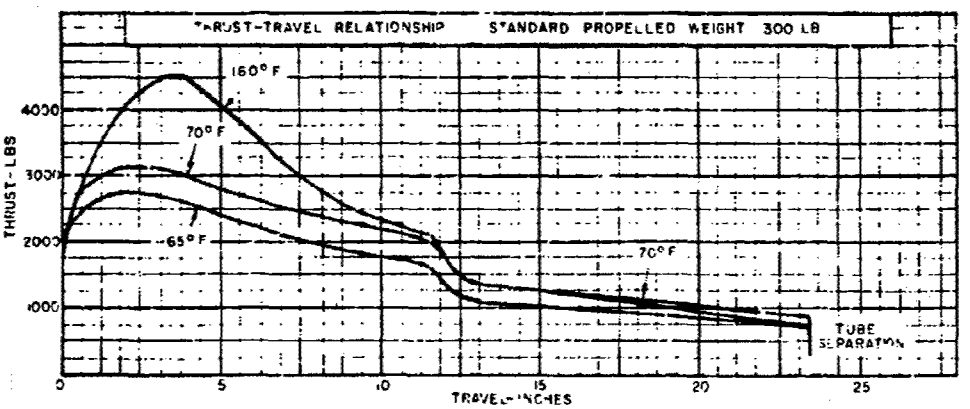


ENVELOPE DRAWING

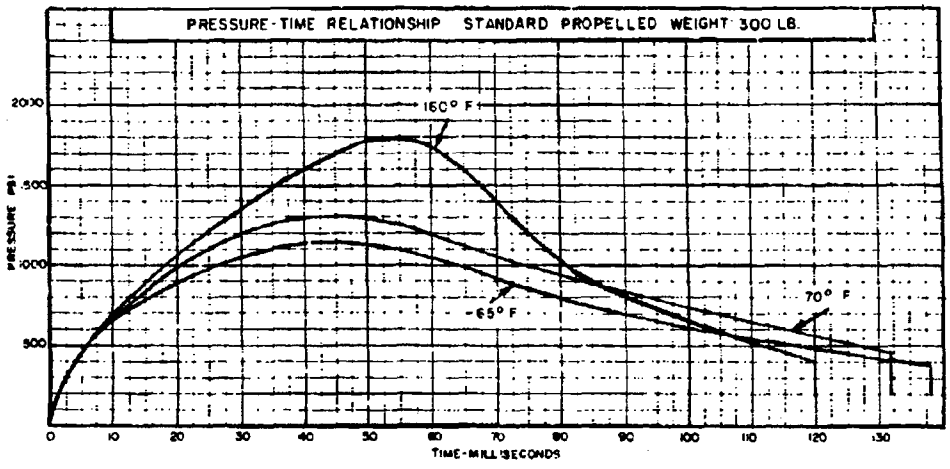
Remover, Aircraft Canopy, M1A3

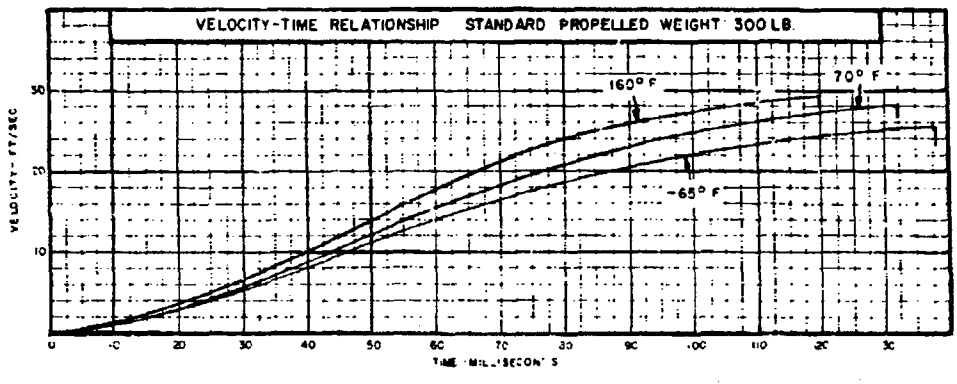


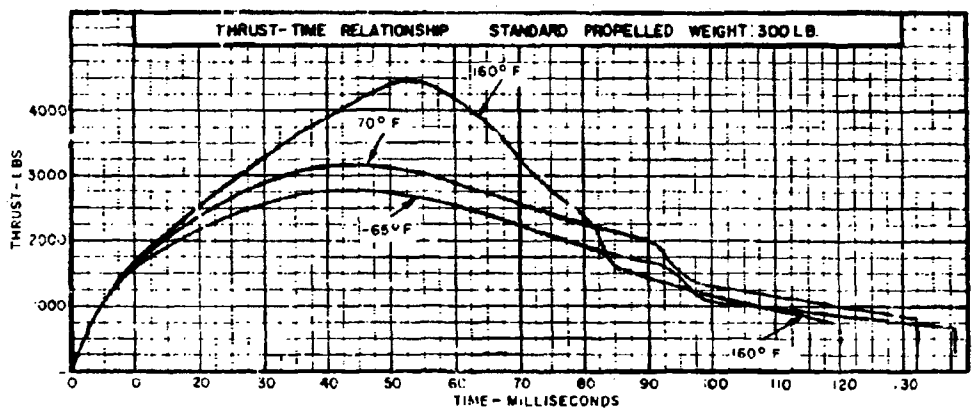




Remover, Aircraft Canopy, M1A3







REMOVER, AIRCRAFT CANOPY M2A1

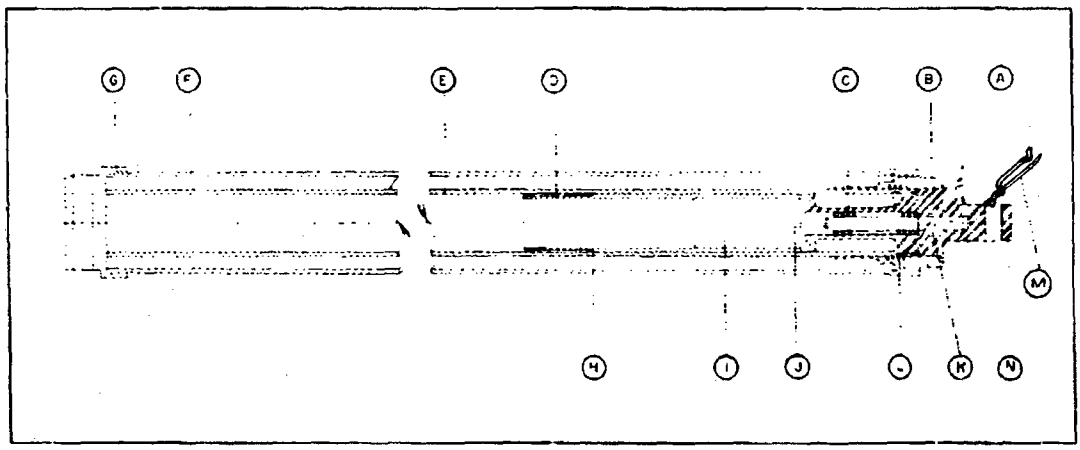
The M2A1 Remover is a two-tube, telescoping ejection device containing an explosive cartridge, designed to forcibly jettison the canopy from high-speed aircraft to provide a safe path for the ejection of the crewman from disabled aircraft.

The remover is approximately 31 inches long and 2.19 inches in diameter. The remover is actuated by removal of the safety locking pin first and the manual rotation of the sear through a pulley system connected to a lever on the pilot's seat. Rotation of the sear releases a spring loaded firing pin and unlocks the inside tube. The firing pin is propelled forward and detonates the primer, thereby igniting the black powder and propellant in the M31A1 Cartridge. The remover thrust which is developed from the expanding gases of the burning propellant, forces the inside tube outward. The block assembly and inside tube are jettisoned with aircraft canopy. The cap and outside tube remain with the aircraft.

PRINCIPAL CHARACTERISTICS

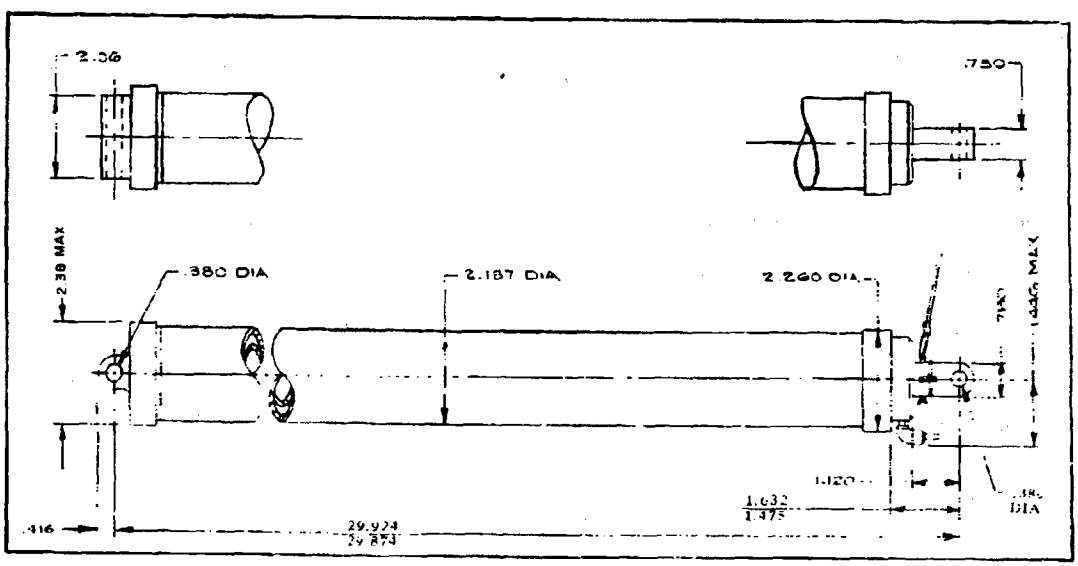
Stroke	26.0 inches
Weight	4.4 pounds
Propelled Weight	300 pounds
Temperature Limits	−65° to +160°F
Velocity, min (at 70°F)	20.5 fps
Thrust, min (at 70°F)	2600 pounds
Stroke Time (at 70°F)	0.150 seconds
Firing Method	Mechanical Actuation

Remover Aircraft Canopy, M2A1



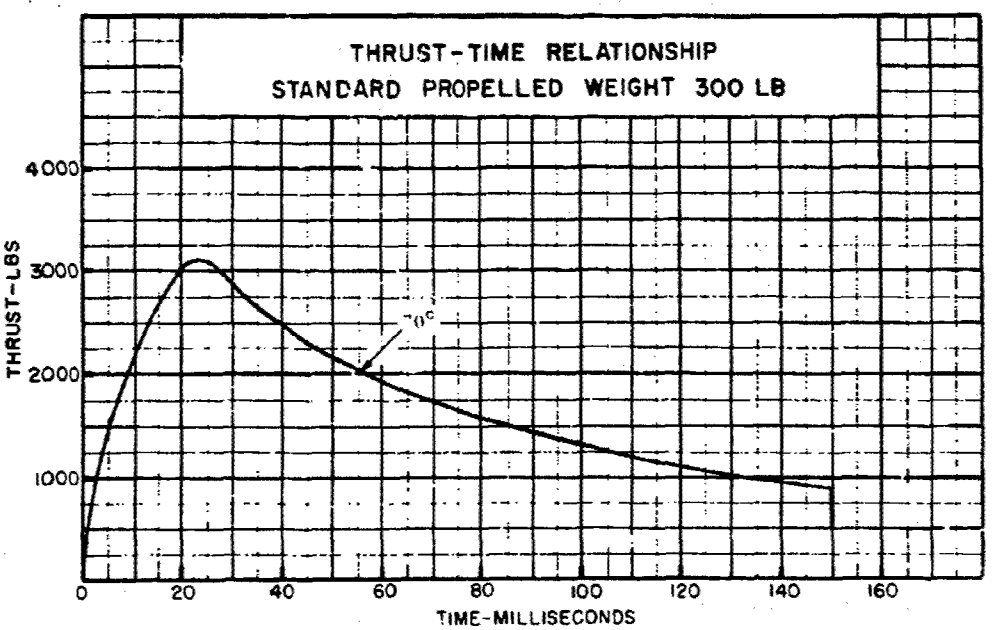
CROSS-SECTION DRAWING

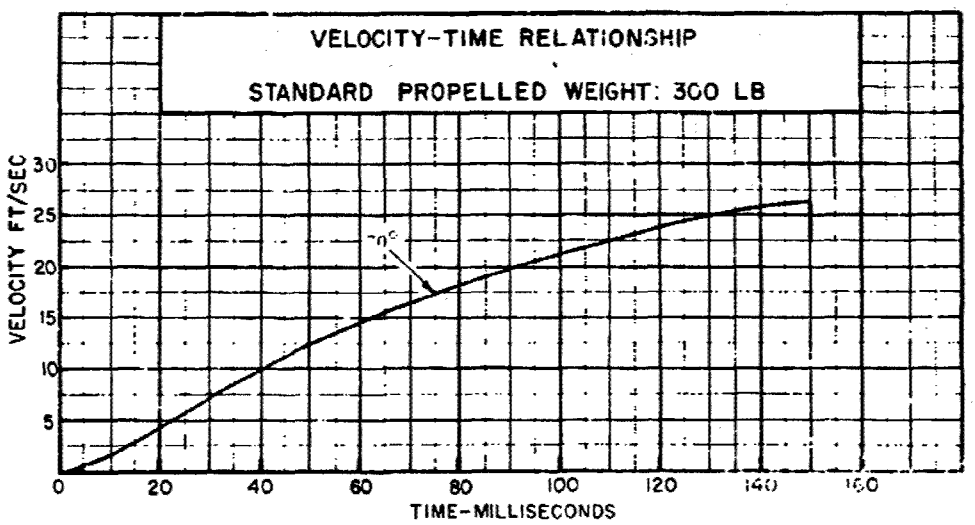
Component		Component	
A	Pin, Locking	I	Cartridge, Aircraft Canopy Remover, M31A1
B	Tube, Bearing	J	Pin, Firing
C	Spring, Firing Pin	K	Sear
D	Sleeve	L	Spring
E	Tube, inner	M	Safety Pin Assembly
F	Tube, Outside	N	Block Assembly
G	Cap		
H	Ring, Retaining		



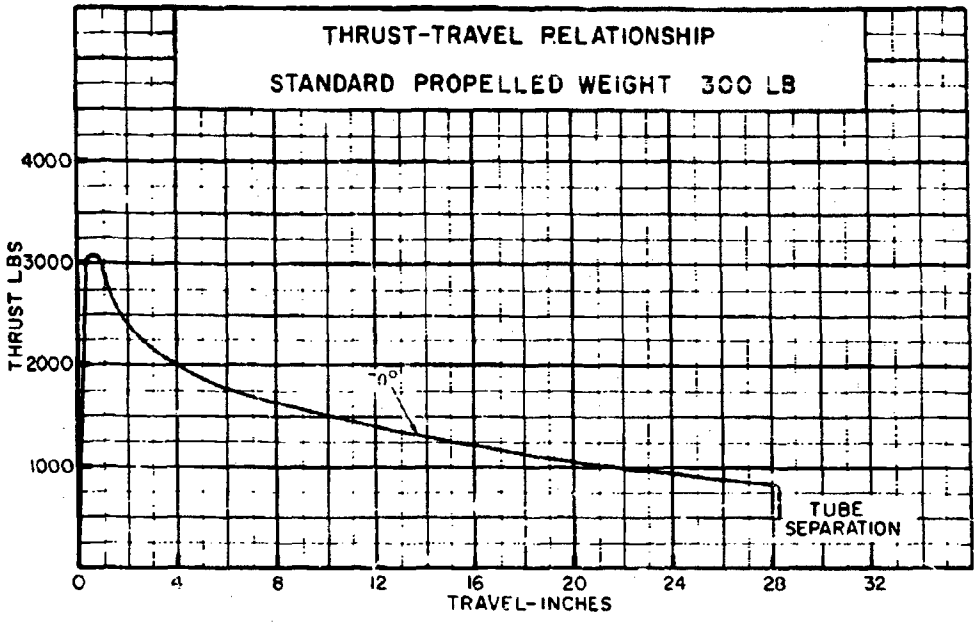
ENVELOPE DRAWING

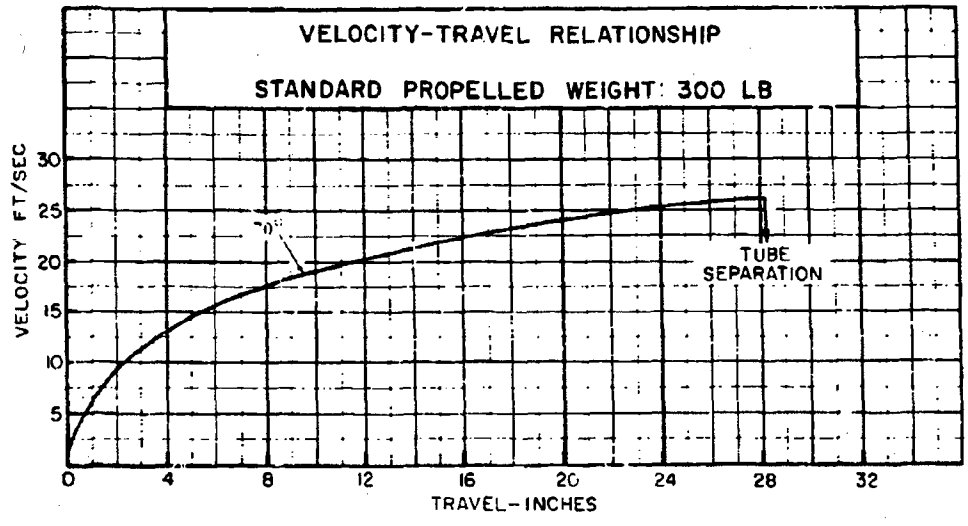
Remover, Aircraft Canopy, M2A1





Remover, Aircraft Canopy, M2A1





REMOVER, AIRCRAFT CANOPY, M3A1

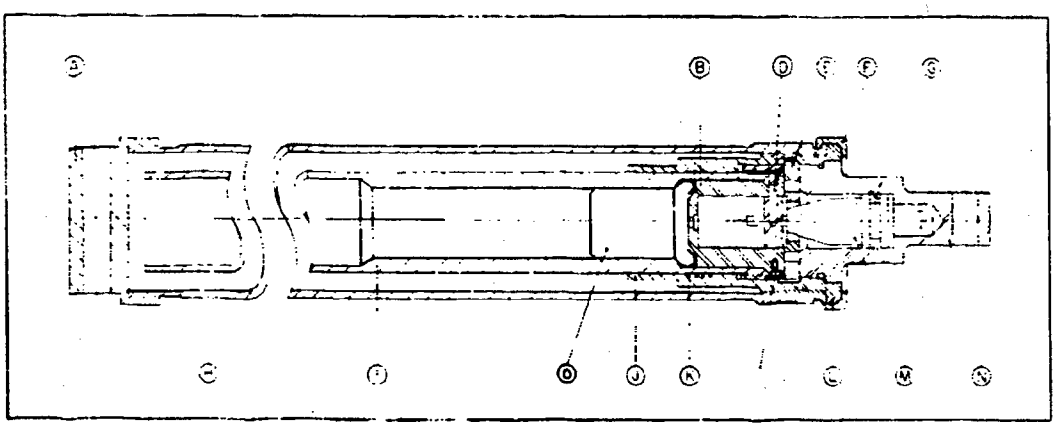
The M3A1 Remover is a two-tube ejection device containing an explosive cartridge, designed to forcibly jettison the canopy from high-speed aircraft to provide a safe path for the ejection of the crewman from disabled aircraft.

The remover is approximately 31 inches long and 2.19 inches in diameter. The remover has an initiator attached by a length of flexible hose. When the initiator is functioned, the gas developed flows through the flexible hose exerting force against the remover firing pin. The firing pin is propelled forward and strikes and detonates the primer, thereby igniting the black powder and propellant in the M31A1 Cartridge. The remover is unlocked by cam action as the firing pin moves toward the primer, unlocking the block assembly and inside tube. The remover thrust which is developed from the expanding gases of the burning propellant, forces the inside tube outward. The block assembly and inside tube are jettisoned with the aircraft canopy. The cap and outside tube remain with the aircraft.

PRINCIPAL CHARACTERISTICS

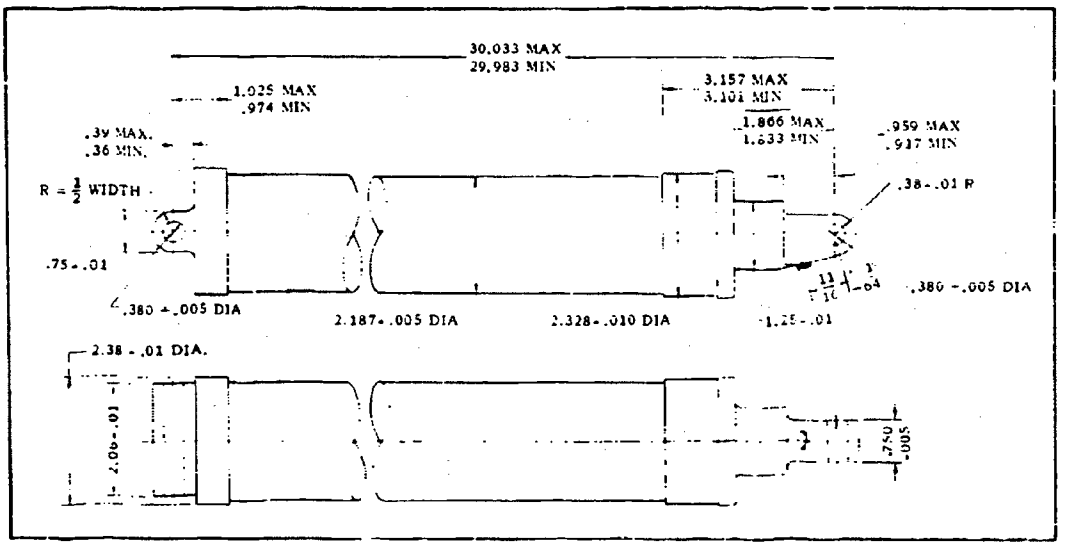
Stroke	26.0 inches
Weight (total assy)	4.4 pounds
Propelled Weight	300 pounds
Temperature Limits	−65° to +160°F
Velocity, min (at 70°F)	20.5 fps
Thrust, min (at 70°F)	2600 pounds
Stroke Time (at 70°F)	0.150 seconds
Firing Method	Gas Actuation

Remover Aircraft Canopy, M3A1



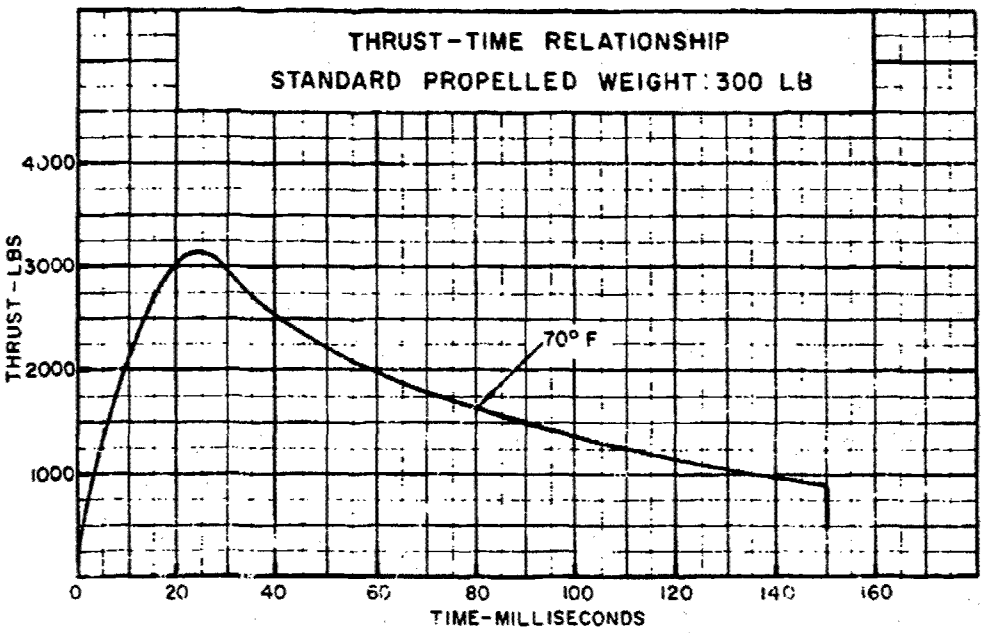
CROSS-SECTION DRAWING

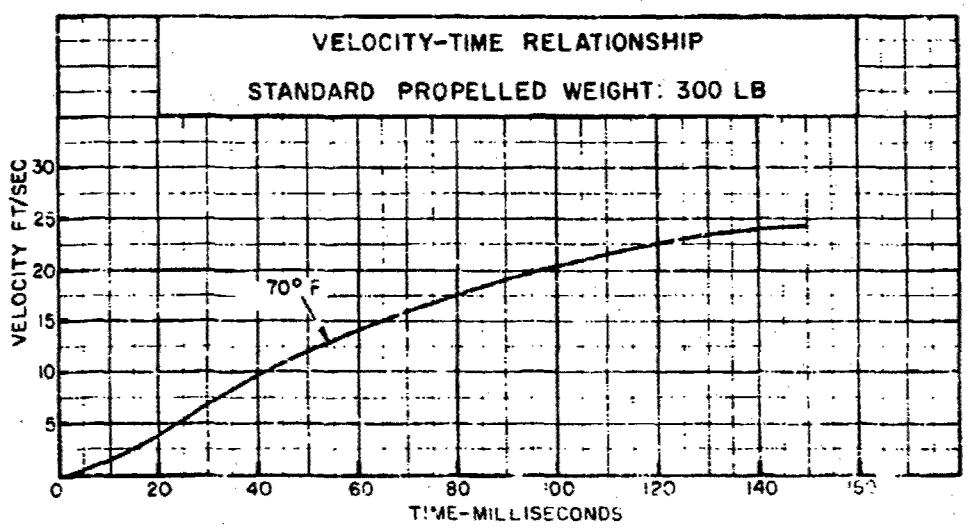
Component		Component	
A	Cap	H	Tube, Outside and Pellet Assembly
B	Plug	I	Tube, Inside and Pellet Assembly
C	Screw, Cap, Socket Head, Self Locking (Shown 90° Out of Position)	J	Tube, Bearing and Pellet Assembly
D	Pin, Shear	K	Seal, Fixed
E	Latch	L	Ring, Stop and Pellet Assembly
	Pipe Plug (for shipping only)	M	Pin, Firing
F	Seal, Tamper Proof	N	Block
G	'O' Ring	O	Cartridge, Aircraft Canopy Remover, M31A1



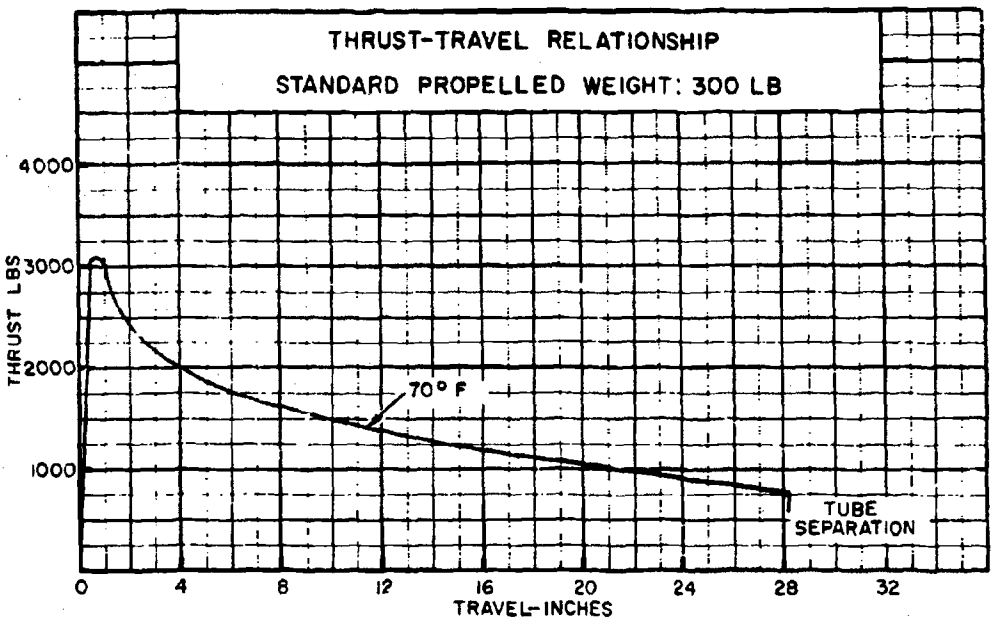
ENVELOPE DRAWING

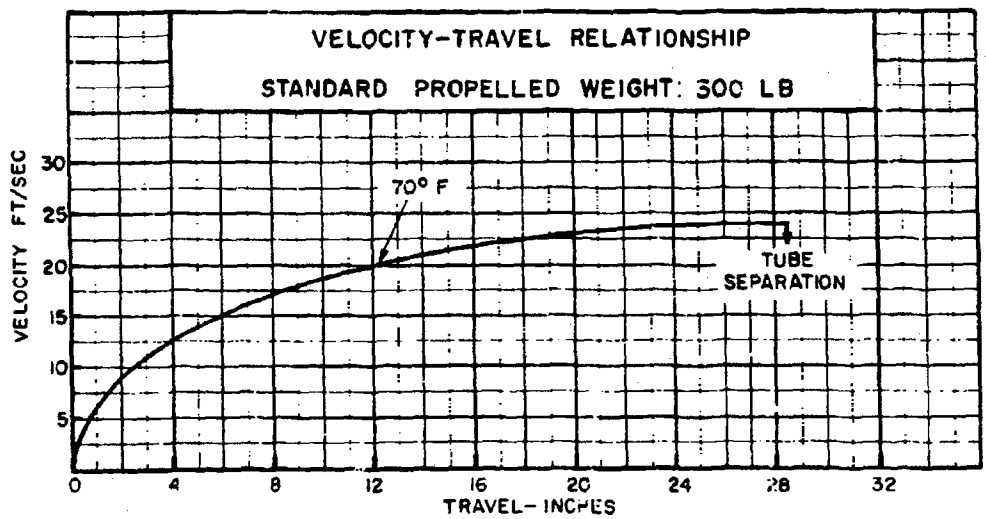
Remover, Aircraft Canopy, M3A1





Remover, Aircraft Canopy, M3A1





REMOVER, AIRCRAFT CANOPY, M4

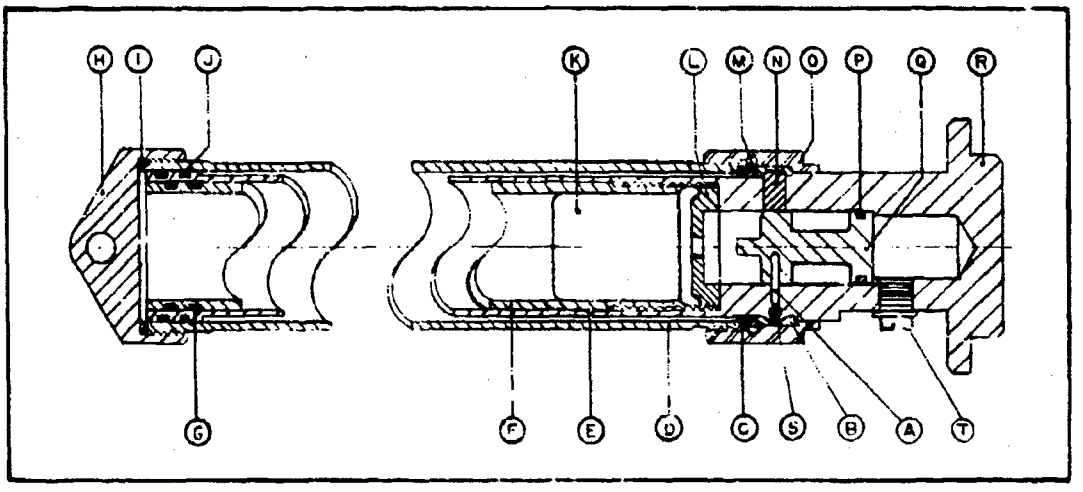
The M4 Remover is a three-tube, telescoping ejection device containing an explosive cartridge, designed to forcibly jettison the canopy from high-speed aircraft to provide a safe path for the ejection of the crewman from disabled aircraft.

The remover is approximately 14.67 inches long and 1.93 inches in diameter. The remover has an initiator attached by a length of flexible hose. When the initiator is functioned, the gas developed flows through the flexible hose exerting force against the remover firing pin. The firing pin is propelled forward and strikes and detonates the primer, thereby igniting the black powder and propellant in the M29A2 Cartridge. During the forward motion of the firing pin, the locking keys slide inward, thus unlocking the remover. The remover thrust which is developed from the expanding gases of the burning propellant, forces the outside tube to travel forward until the washer engages the shoulder on the telescoping tube. The telescoping tube is then pulled forward by the outer tube until it is free of the inside tube, and is jettisoned with the canopy. The inside tube and firing head assembly remain with the aircraft.

PRINCIPAL CHARACTERISTICS

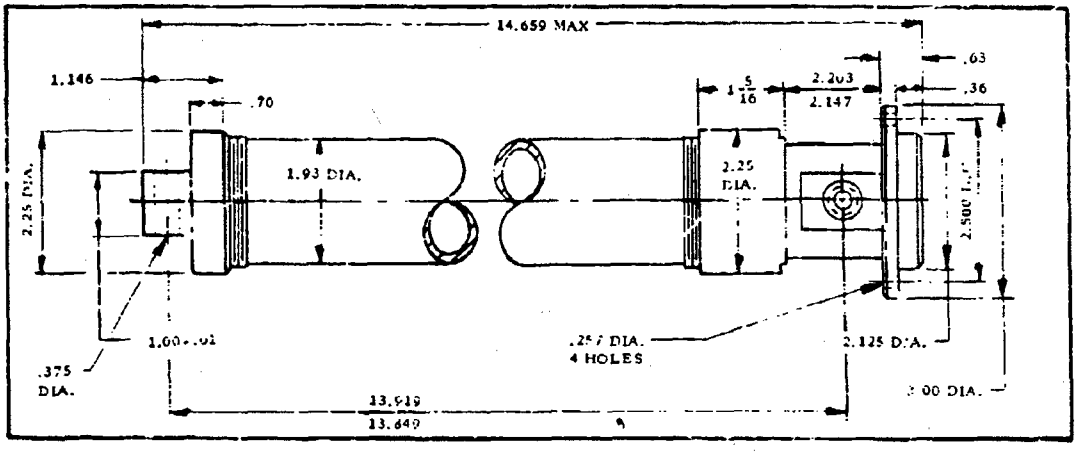
Stroke	19.0 inches
Weight (total assy.)	3.84 pounds
Propelled Weight	300 pounds
Temperature Limits	–65° to + 160°F
Velocity, min (at 70°F)	20 fps
Thrust, min (at 70°F)	2800 pounds
Stroke Time (at 70°F)	0.114 seconds
Firing Method	Gas Actuation

Remover, Aircraft Canopy, M4



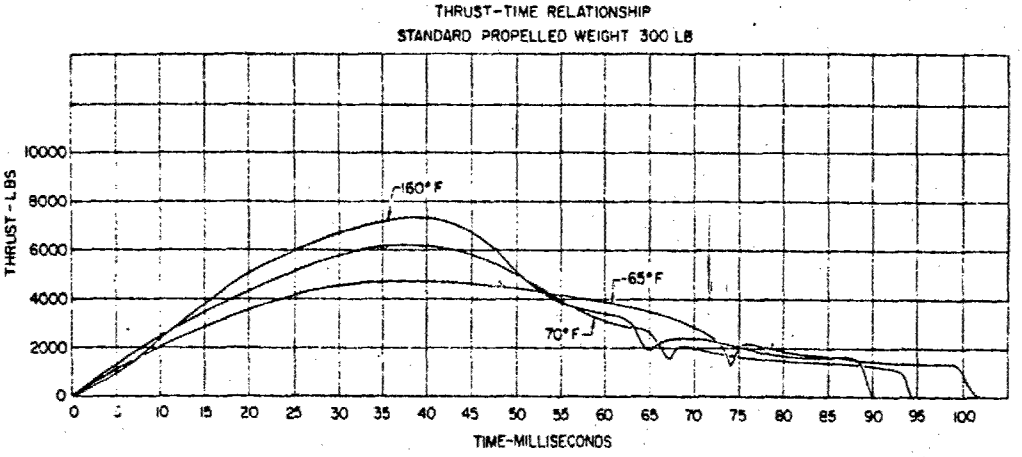
CROSS-SECTION DRAWING

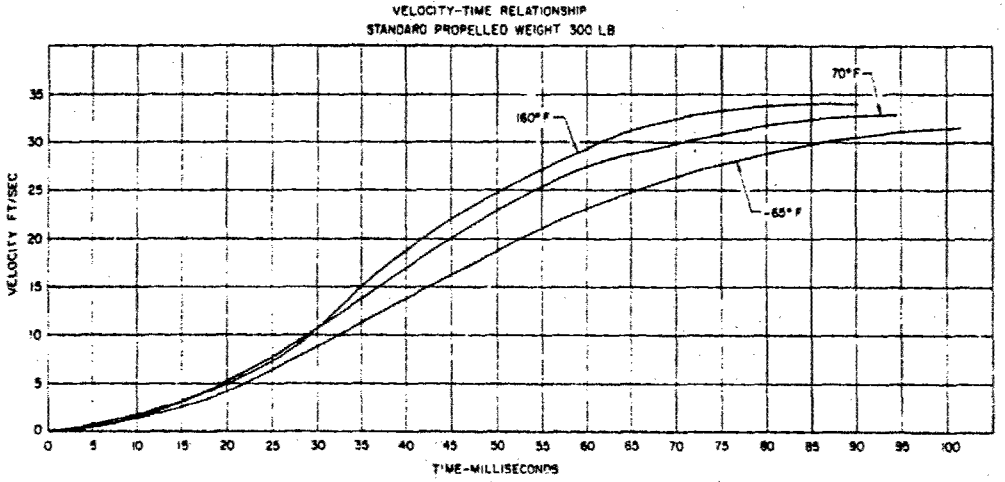
Component		Component	
A	Pin, Shear (Shown 90° out of position)	L	Stop, Firing Pin
B	Ring, Retaining	M	Washer
C	Ring, Sealing	N	Key, Locking (2)
D	Tube, Outside	O	Sleeve
E	Tube, Telescoping	P	"O" Ring
F	Tube, Inside	Q	Pin, Firing
G	Ring, Sealing	R	Head, Firing
H	Cap	S	Screw, Set (Shown 90° out of position)
I	Gasket	T	Shipping Plug
J	Ring, Sealing		
K	Cartridge, Aircraft Canopy Remover, M120		



ENVELOPE DRAWING

Remover, Aircraft Canopy, M4





REMOVER, AIRCRAFT CANOPY, M5

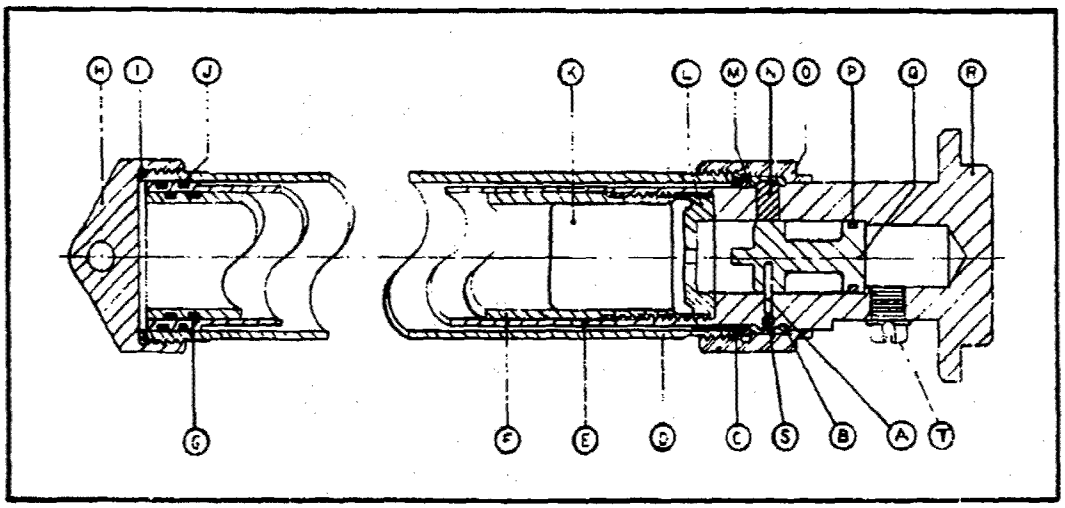
The M5 Remover is a three-tube, telescoping ejection device containing an explosive cartridge, designed to forcibly jettison the canopy from high speed aircraft to provide a safe path for the ejection of the crewman from disabled aircraft.

The remover is approximately 14.67 inches long and 1.93 inches in diameter. The remover has an initiator attached by a length of flexible hose. When the initiator is functioned, the gas developed flows through the flexible hose exerting force against the remover firing pin. The firing pin is propelled forward, strikes and detonates the primer, thereby igniting the black powder and propellant in the M120 Cartridge. During the forward motion of the firing pin, the locking keys slide inward, thus unlocking the remover. The remover thrust which is developed from the expanding gases of the burning propellant, forces the outside tube to travel forward until the washer engages the shoulder on the telescoping tube. The telescoping tube is then pulled forward by the outer tube until it is free of the inside tube and is jettisoned with the canopy. The inside tube and firing head assembly remain with the aircraft.

PRINCIPAL CHARACTERISTICS

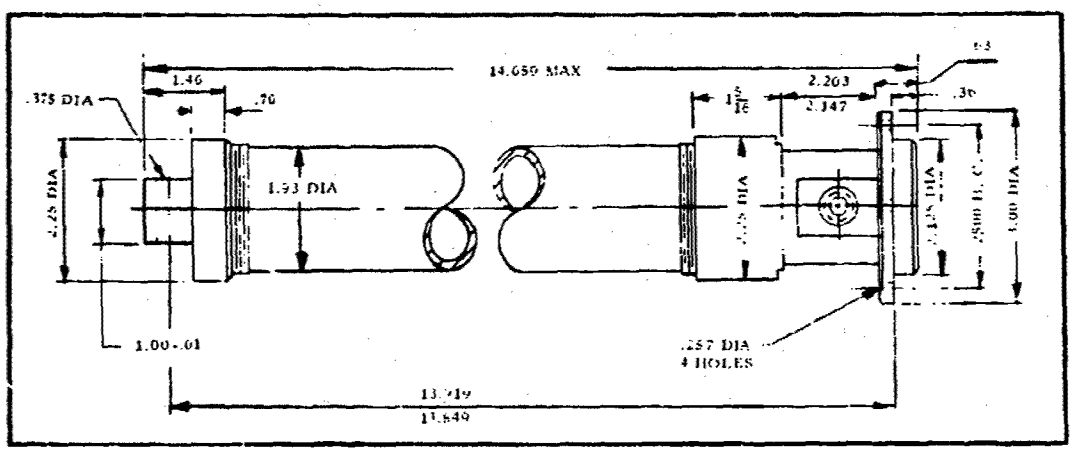
Stroke	19.0 inches
Weight (total assy)	3.84 pounds
Propelled Weight	1000 pounds
Temperature Limits	−65° to + 160°F
Velocity, min (at 70°F)	10 fps
Thrust, min (at 70°F)	4500 pounds
Firing Method	Gas Actuation

Remover, Aircraft Canopy, M5



CROSS-SECTION DRAWING

Component		Component	
A	Pin, Shear (Shown 90° out of position)	L	Stop, Firing Pin
B	Ring, Retaining	M	Washer
C	Ring, Sealing	N	Key, Locking (2)
D	Tube, Outside	O	Sleeve
E	Tube, Telescoping	P	"O" Ring
F	Tube, Inside	Q	Pin, Firing
G	Ring, Sealing	R	Head, Firing
H	Cap	S	Screw, Set (Shown 90° out of position)
I	Gasket	T	Shipping Plug
J	Ring, Sealing		
K	Cartridge, Aircraft Canopy Remover, M120		



ENVELOPE DRAWING

REMOVER, AIRCRAFT CANOPY, M8

The M8 Remover is an electro-machanical-ballistic, two tube telescoping device designed to raise and lower the F106A aircraft canopy under normal conditions during ground operation and to jettision the canopy prior to ejection of the pilot from the aircraft during emergency escape in flight or on the ground.

The electro-mechanical portion of the remover consists of a reversible, intermittent duty 26 volt direct current motor, a gear transmission with an indexing mechanism and torque limit switch, a solenoid-operated clutch with an integral ratchet mechanism, and a ball-bearing screw assembly which is coaxial with the remover ballistic chamber. Raising and lowering the aircraft canopy is accomplished by electrically energizing the remover motor which transmits rotary motion through the gear system to the clutch. As the clutch rotates the ball-bearing screw turns within a non-rotating ball nut, which is attached to the inside tube of the remover. Rotation of the ball-bearing screw drives the remover inside tube outward, raising the canopy; or inward, lowering the canopy, when the motor is electrically reversed. As the inside tube extends 9.38 inches, power to the motor is shut off automatically by an extension limit switch which is cam actuated. Upon retracting the remover inside tube and canopy, a torque limit switch de-energizes the motor when the canopy is restrained by the fuselage and a tension load of 1000 to 1450 pounds is imposed on the ball-bearing screw assembly. This cinch-down load insures that the canopy is properly seated on the fuselage for locking by the pilot. A safety feature is incorporated in the clutch mechanism which prevents the canopy dropping to the closed position should the clutch inadvertently disengage during any position of remover stroke. The remover in the retracted position is approximately 20.25 inches long between mounting points.

The ballistic portion of the remover is used to jettison the canopy prior to ejection of the pilot from the disabled aircraft. The remover has an initiator attached by a length of flexible hose. When the initiator is functioned, the gas developed flows through the hose, exerting force against the remover firing pin. The firing pin is propelled forward and strikes and detonates the cartridge primer, thereby igniting the black powder and propellant in the M150 Cartridge. Propellant gas from the cartridge expands through the opening in the adapter housing where it acts against the ballistic lock components and the inside tube. With the increase in pressure the ballistic lock unlocks the inside tube and the gas pressure forces the inside tube outward. The inside tube which is pin-mounted to the canopy, clears the outside tube and jettisons the canopy, clear of the aircraft. The outward movement also triggers an M3A1 Initiator for a related ballistic operation.

PRINCIPAL CHARACTERISTICS

Weight (Total Assy)	22.5 pounds
Temperature Limits	-65°F to 200°F

PRINCIPAL CHARACTERISTICS (M8 Cont'd)

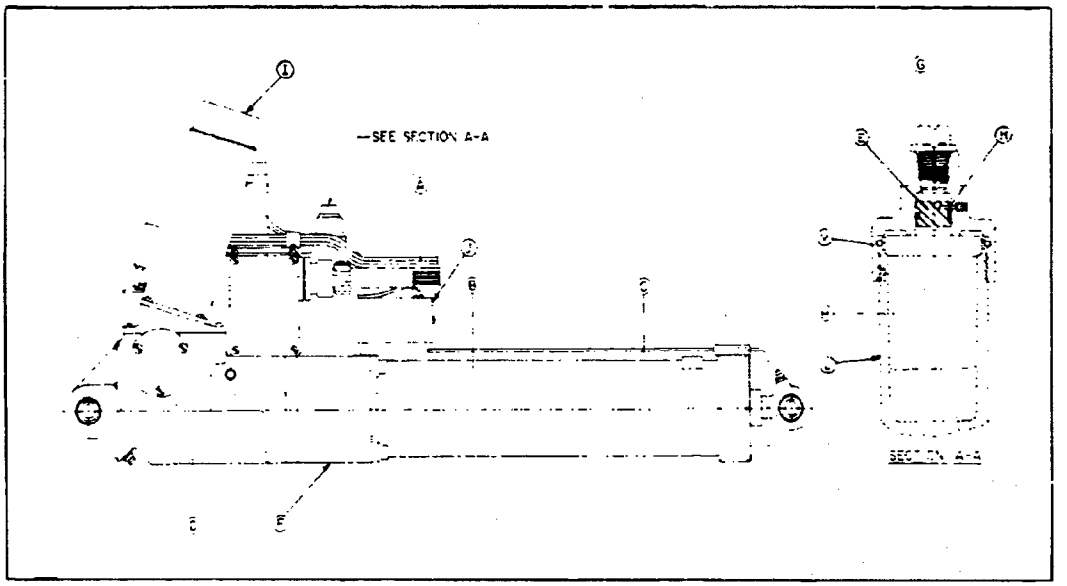
Electro-Mechanical

Electric Power	28 Volt D.C. System
Operating Voltage Limit	18 to 29 Volts
Operating Loads	
Overload	250 pounds (tension) to 680 pounds (compression)
Normal load	380 pounds (compression)
Overload	450 pounds (tension) to 940 pounds (tension)
Extension or Retraction Time	15 sec max; 5 sec. min.
Clutch Engage Time, max.	0.500 sec.
Clutch Disengage Time, max.	0.500 sec.
Cinch-Down Load	1000 to 1450 pounds
Stroke	8.38 to 9.38 inches

Ballistic

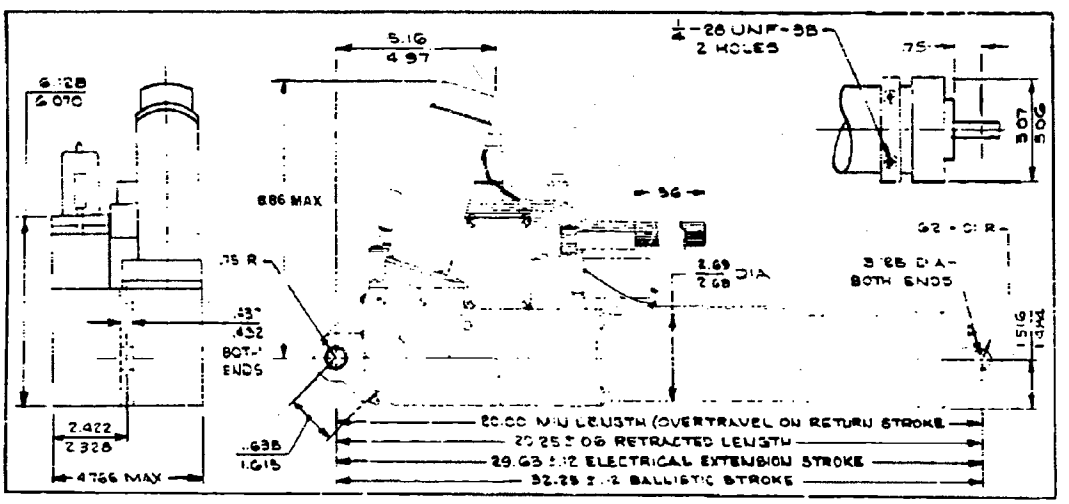
Stroke	12.0 inches
Propelled Weight	350 pounds
Velocity (at 70°F)	24.0 fps
Peak Thrust (at 70°F)	5400 pounds
Firing Method	Gas Actuation
Stroke Time (at 70°F)	0.150 sec.

Remover, Aircraft Canopy, M8



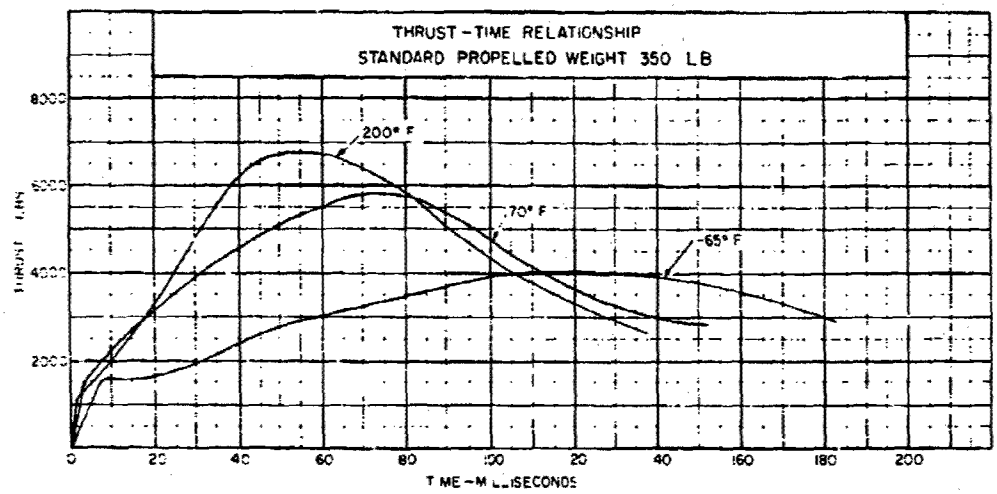
CROSS-SECTION DRAWING

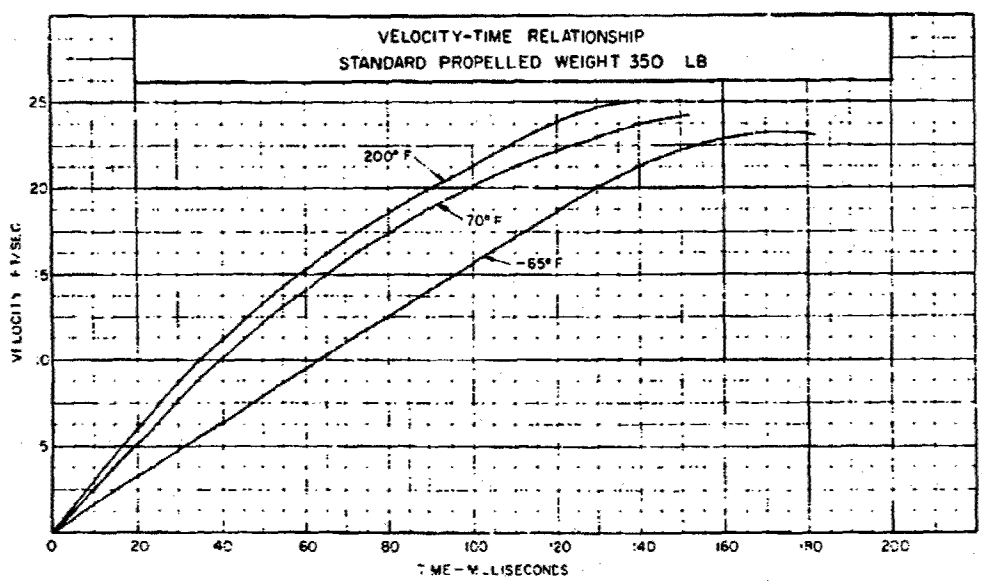
Component		Component	
A	Wiring Arrangement	H	Cartridge, Aircraft Canopy Remover, M150
B	Ballistic Assembly	I	Motor
C	Bracket, Shipping	J	Solenoid
D	Gear Box Assembly	K	Pin, Shear
E	Pin, Firing	L	Adapter
F	Housing	M	Head
G	Plug, Shipping		



ENVELOPE DRAWING

Remover, Aircraft Canopy, M8





REMOVER, AIRCRAFT CANOPY M9

The M9 Remover is an electro-mechanical ballistic, three tube telescoping device designed to raise and lower the F106B aircraft canopy under normal conditions during ground operation and to jettison the canopy prior to ejection of the pilot from the aircraft during emergency escape in flight or on the ground.

The electro-mechanical portion of the remover consists of a reversible, intermittent duty, 26 volt direct current motor, an electronic speed control box, a gear transmission, a clutch mechanism with an integral ratchet mechanism, mechanical clutch disengage mechanism, and a double ball-bearing screw assembly which is coaxial with the remover ballistic chamber. Raising and lowering the aircraft canopy is accomplished by electrically energizing the remover motor which transmit rotary motion through the gear system to the mechanically operated clutch. As the clutch rotates the ball-bearing screw turns within a non-rotating ball nut, which is attached to the inside tube of the remover through a bearing. Rotation of the ball-bearing screw drives the remover inside tubes outward, raising the canopy; or inward, lowering the canopy, when the motor is electrically reversed. As the inside tubes extend approximately 45.86 inches, power to the motor is shut off automatically by an extension limit switch which is cam actuated. Upon retracting the remover inside tubes and canopy, a torque limit switch de-energizes the motor when the canopy is restrained by the fuselage and a tension load of 400 to 500 pounds is imposed on the ball-bearing screw assembly. This cinch-down load insures that the canopy is properly seated on the fuselage for locking by the pilot. The electronic speed control box which is attached to the adapter housing is used to reduce the motor speed on the retraction stroke. A safety feature is incorporated in the clutch mechanism which prevents the canopy dropping to the closed position should the clutch inadvertently disengage during any position of remover stroke. The remover in the retracted position is approximately 23.51 inches long between mounting points.

The ballistic portion of the remover is used to jettison the canopy prior to ejection of the pilot from the disabled aircraft. The remover has an initiator attached by a length of flexible hose. When the initiator is functioned, the gas developed flows through the hose, exerting force against the remover firing pin. The firing pin is propelled forward and strikes and detonates the cartridge primer, thereby igniting the black powder and propellant in the M151 Cartridge. Propellant gas from the cartridge expands through the opening in the adapter housing where it acts against the ball-bearing screw assembly and the inside tube. With the increase in pressure the spring pin which secures the ball-bearing screw assembly to the bearing housing shears, and the continued production of gas pressure forces the inside tube and ball-bearing assembly outward simultaneously. The inside tube and ball-bearing assembly which is pin mounted to the canopy, clear the outside tube and jettisons the canopy clear of the aircraft.

PRINCIPAL CHARACTERISTICS

Weight (Total Assy)	35 pounds
Temperature Limits	-65°F to 200°F

PRINCIPAL CHARACTERISTICS (M9 Cont'd)

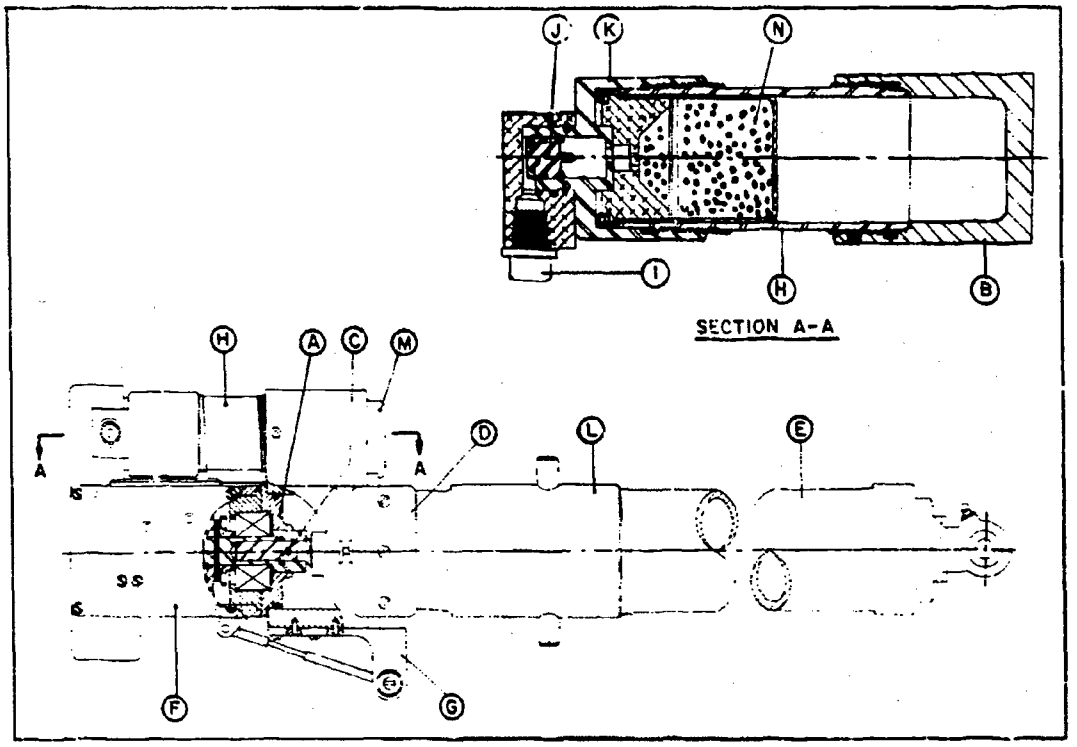
Electro-Mechanical

Electric Power	28 Volt D.C. System
Operating Voltage Limit	18 to 29 Volts
Operating Loads	
Overload	315 pounds (compression) to 398 pounds (compression)
Normal load	288 pounds (compression) to 228 pounds (compression)
Overload	196 pounds (tension) to 142 pounds (tension)
Extension or Retraction Time	20 sec. max; 10 sec. min.
Clutch Disengage Load	7 to 11 pounds
Cinch-Down Load	400 to 500 pounds
Stroke	45.86 inches

Ballistic

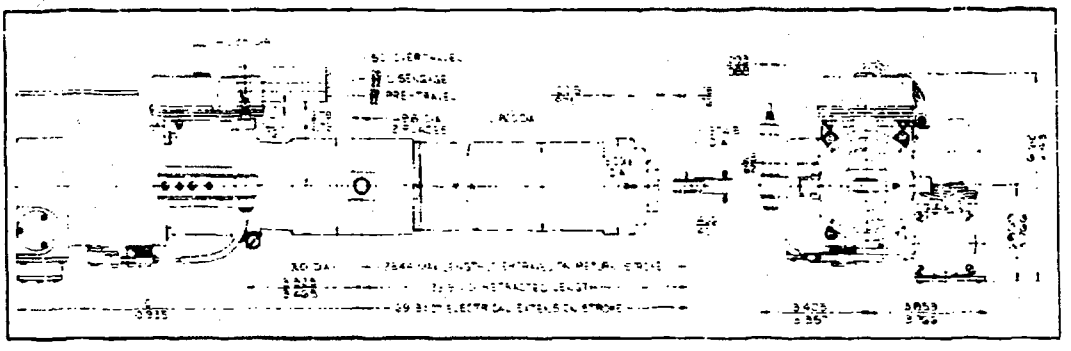
Stroke	27.0 inches
Propelled Weight	300 pounds
Velocity (at 70°F)	33.0 fps
Peak Thrust (at 70°F)	6000 pound
Firing Method	Gas Actuation
Stroke Time (at 70°F)	0.090 sec.

Remover, Aircraft Canopy, M9



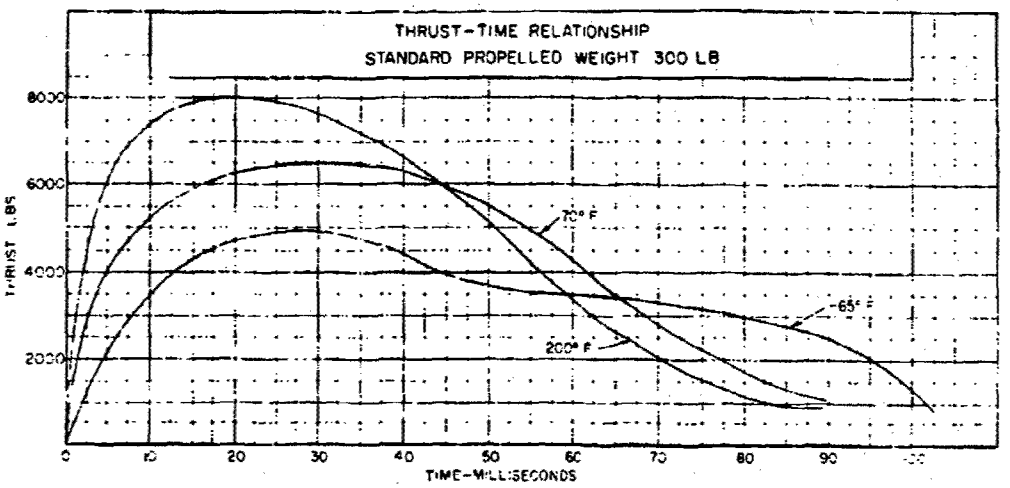
CROSS-SECTION DRAWING

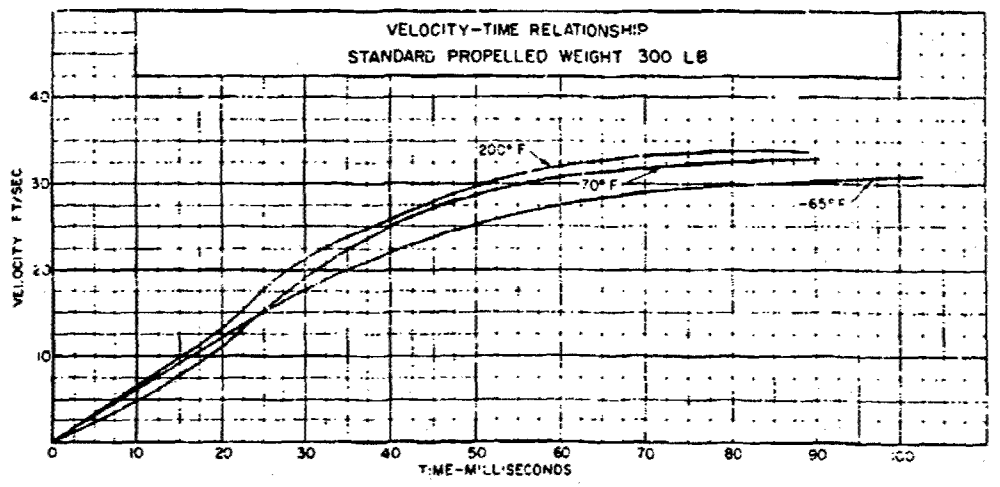
Component		Component	
A	Housing, Bearing	I	Plug, Shipping
B	Housing, Adapter	J	Pin, Firing
C	Pin, Spring	K	Cap, Ballistic Chamber
D	Speed Control Box Assembly	L	Tube, Trunnion
E	Actuator Assembly	M	Motor
F	Gear Box Assembly	N	Cartridge, Aircraft Canopy Remover, M151
G	Bracket, Clutch Release Cable		
H	Tube, Ballistic		

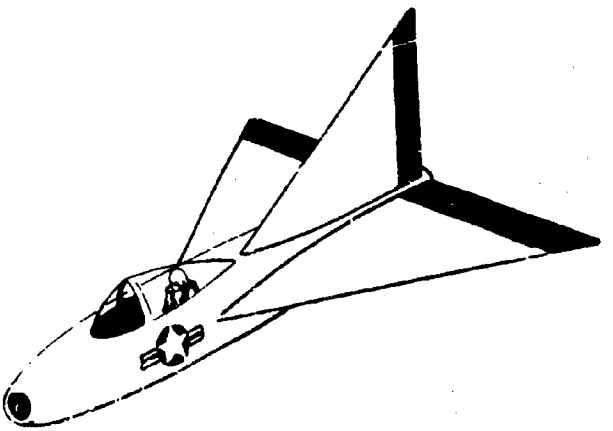


ENVELOPE DRAWING

Remover, Aircraft Canopy, M9







SECTION II

THRUSTERS

INTRODUCTION

Description:

A thruster is a component part of an aircraft escape system, which is used to accomplish a certain task prior to implementing the final phases of escape procedure, for crewman from a disabled aircraft. The basic parts of a thruster consist of a gas operated firing mechanism, cartridge, chamber and a piston. The main purpose of a thruster is to impart a thrust to a known load or oppose a force through a given travel (stroke).

Each thruster is provided with an initial lock mechanism for the piston. This mechanism is released only when the cartridge functions. Thrusters have been developed with piston strokes between 1-1 2 and 13 inches. Unlike corresponding parts of catapults and removers, the thruster piston does not separate from the thruster at the end of the piston stroke. Thus the thruster is a closed system.

Buffer or damper mechanisms are used in conjunction with thrusters to restrict the velocity and acceleration of the propelled load because of limitations on aircraft structure and human physiology. The rate of application of thrust and maximum thrust are specified when a thruster is used to position a crewman.

Operation:

All thrusters are triggered by gas pressure supplied from another cartridge actuated device. The firing pin of the thruster is held in position with a "shear pin". When gas pressure is supplied, the force applied on the firing pin will shear the "shear pin" and propel the firing pin against a cartridge containing a percussion-sensitive primer. The primer ignites the black powder and propellant contained in the cartridge. The cartridge ruptures at the unsupported area, and propellant gas fills the thruster chamber and exerts a force on the face of the piston. The initial piston motion unlocks the thruster and a force is applied through the piston to the load, setting it in motion. In some thrusters, there is a final lock to hold the piston in the extended position.

M1A2 THRUSTER

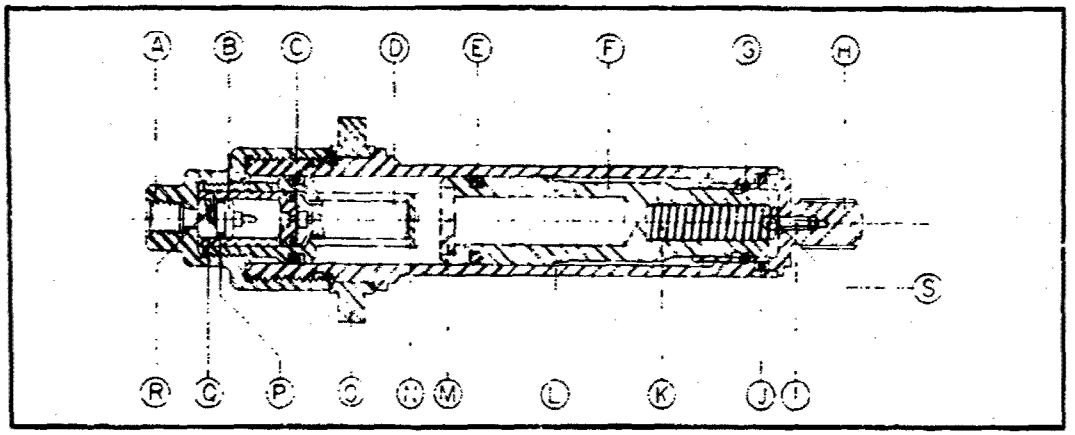
The M1A2 Thruster was developed to either jettison a hatch or unlock a tail turret. In both applications, the thruster is required to complete a 2 inch stroke against a varying force. The opposing force distance is represented by several shear pins located with respect to initial piston position. The diameter of each pin was selected so that the shear force at a given distance is equal to the corresponding maximum opposing force in the above applications. Thruster performance data using this test system is presented below.

The thruster is cylindrical in shape, approximately 9-1 2 inches long and 1-13 16 inches in diameter. The piston is initially locked in the chamber with 4 keys and is capable of withstanding a tensile load of 2000 pounds, without separation or mechanical failure.

PRINCIPAL CHARACTERISTICS

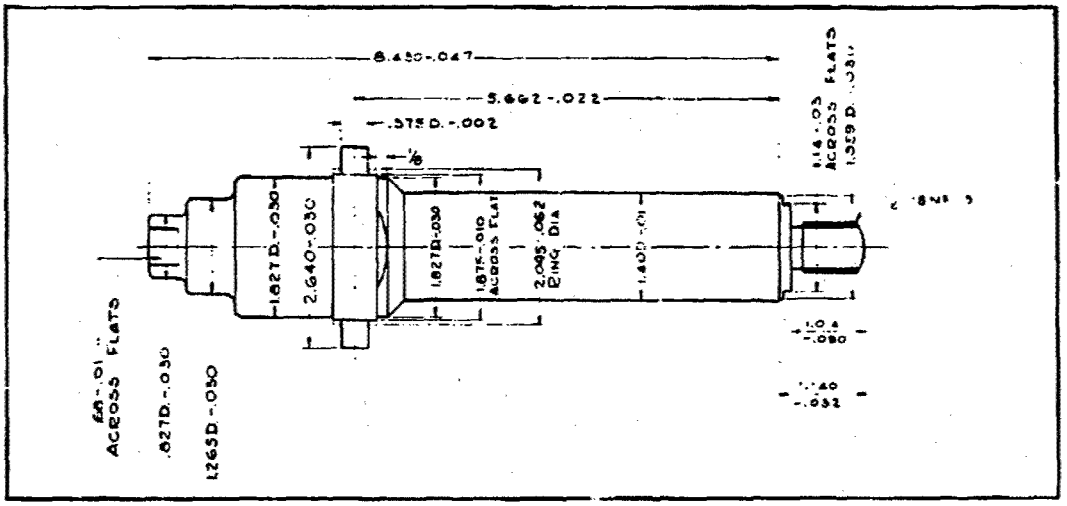
Average Peak Thrust	6900 lbs.
Completed Stroke	2 inches (min)
Average Stroke Time	0.009 seconds
Assembled Weight	3.2 lbs.
Propelled Mass, Horizontal	20 lbs.
Firing Method	Propellant Gas
Temperature Limits	−65°F to +160°F
Restraining Force	1000 lbs. ± .00 in. stroke; 6000 lbs. ± .25 in. stroke
Force Required to Unlock Initial Lock	60 lbs.

Thruster, Cartridge Actuated, M1A2



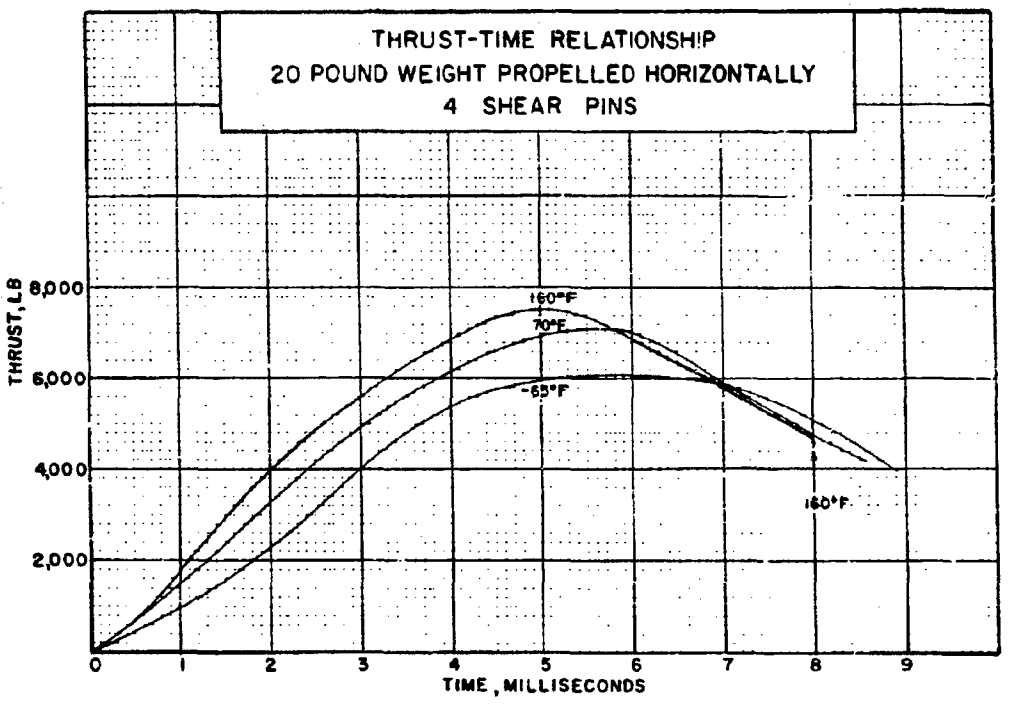
CROSS-SECTION DRAWING

Component	Component
A Head	K Spring, Piston Locking
B Pin, Firing	L Body
C "O" Ring	M Plug, Piston
D Cartridge, CAD, M42	N Retainer, Cartridge
E "O" Ring	O Trunnion
F Piston	P "O" Ring
G Key	Q Guide, Firing Pin
H Sleeve, End	R Pin, Shear
I Screw, Cap, Socket Head	S Washer, Lock
J "O" Ring	



ENVELOPE DRAWING

Thruster, Cartridge Actuated, M1A2



M2A2 THRUSTER

The M2A2 Thruster is a component part of an aircraft escape system whose purpose is to position the seat in an aircraft prior to ejection of the crewman. This device was designed to be used with a damper supplied by the airframe manufacturer. The thruster is required to complete a 5.7 inch stroke against an opposing force. The opposing force represents an approved ejection seat that must be moved either upward or downward with a velocity that does not exceed 12 feet per second.

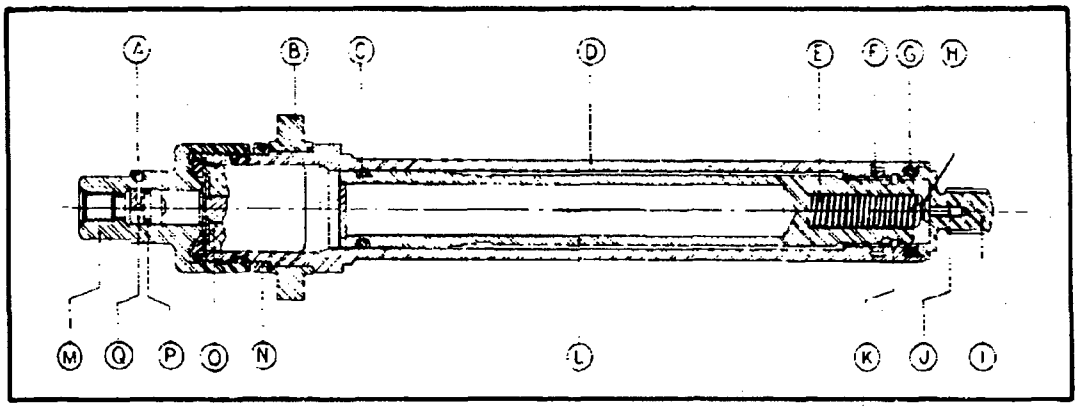
The thruster is cylindrical in shape, approximately 13.7 inches long and 1-7/8 inches in diameter. The piston is initially locked in the chamber with 4 keys and is capable of withstanding a tensile load of 2000 pounds without separation or mechanical failure. The thruster also has a final lock which holds the piston in the extended position and is capable of withstanding an 11,000 pound compressive load without unlocking.

The damper used with the M2A2 thruster is to control the acceleration of the propelled weight to limits consistent with human physiology limits and or restrict the final velocity so that the impact does not damage the aircraft structure.

PRINCIPAL CHARACTERISTICS

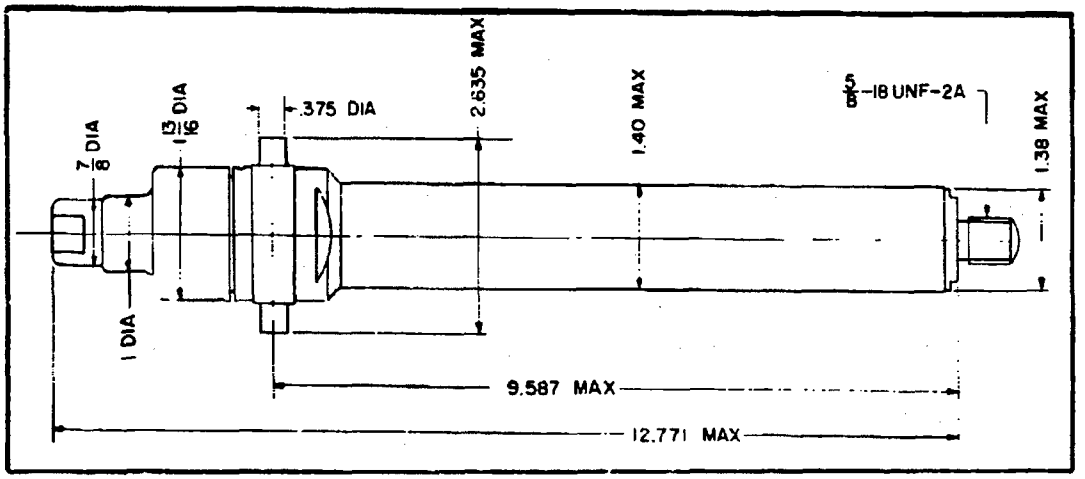
Average Peak Thrust w Seat in Horizontal Position @ 70°F	6170 lbs.
Completed Stroke	5.7 inches
Velocity, Maximum	12 ft sec
Assembled Weight	4.0 lbs.
Propelled Mass, Horizontal	300 lbs.
Firing Method	Propellant Gas
Temperature Limits	−65°F to +165°F
Average Stroke Time w Seat in Horizontal Position @ 70°F	.410 seconds
Force Required to Unlock Initial Lock	80 lbs

Thruster, Cartridge Actuated, M2A2



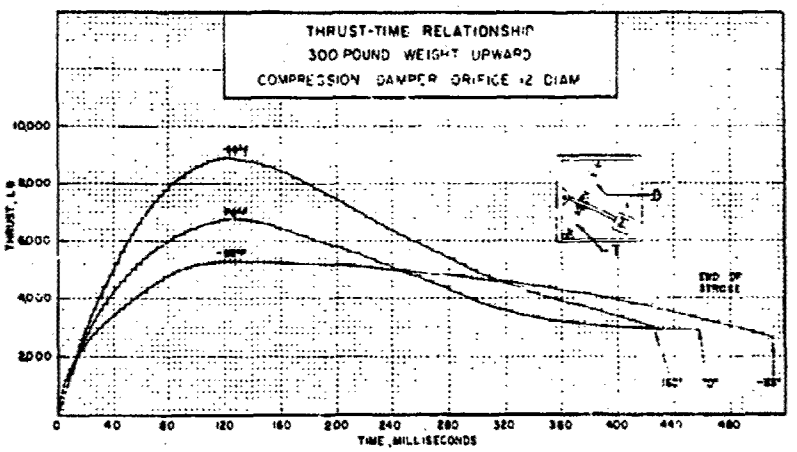
CROSS-SECTION DRAWING

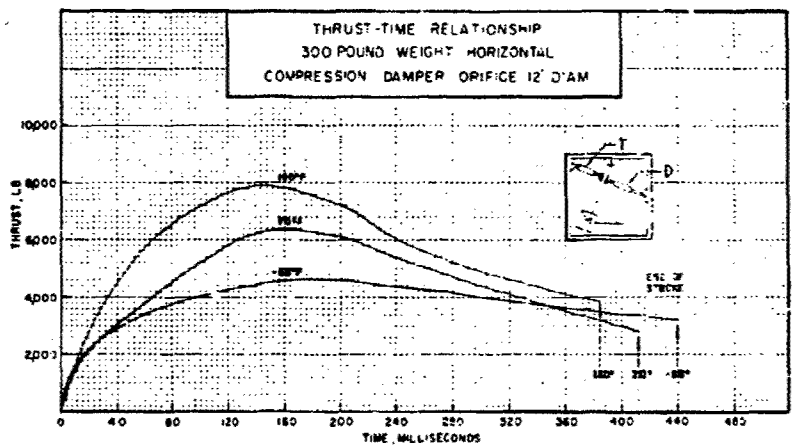
Component	Component
A Pin, Shear	J Screw, Cap, Socket Head
B Trunnion	K Key
C "O" Ring	L Piston And Plug Assembly
D Body	M Head
E Spring, Piston Locking	N Ring, Holding
F Ring, Snap	O Cartridge, CAD, M43
G "O" Ring	P "O" Ring
H Washer	Q Pin, Firing
I Sleeve, End	

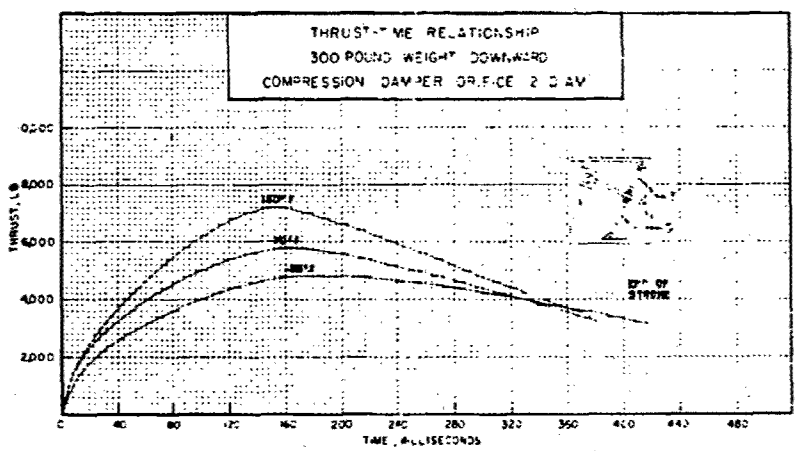


ENVELOPE DRAWING

Thruster, Cartridge Actuated, M2A2







M3A3 THRUSTER

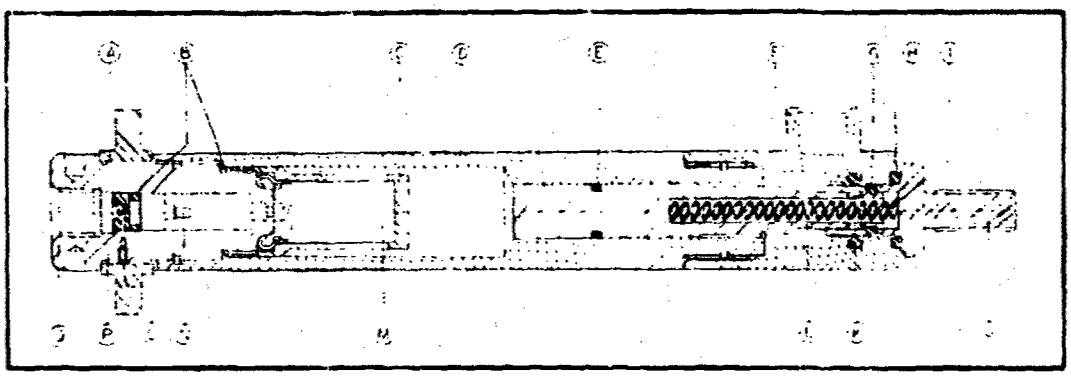
The M3A3 Thruster is a component part of an aircraft escape system whose purpose is to release the control column stowage spring and supply sufficient energy to operate the seat actuator disconnect. The thruster is required to complete a 1-1/2 inch stroke against an opposing force and supply 600 psi pressure, minimum, at the end of a 4 foot length of hose. The opposing force is represented by a 550 pound load that must be propelled vertically with sufficient force so that the load continues to move after the piston reaches the end of its stroke. Thruster performance data using this test system is presented below.

The thruster is cylindrical in shape, approximately 9 inches long and 1-5/64 inches in diameter. The piston is initially locked in the chamber with 3 keys and is capable of withstanding a tensile load of 800 pounds, without separation or mechanical failure.

PRINCIPAL CHARACTERISTICS

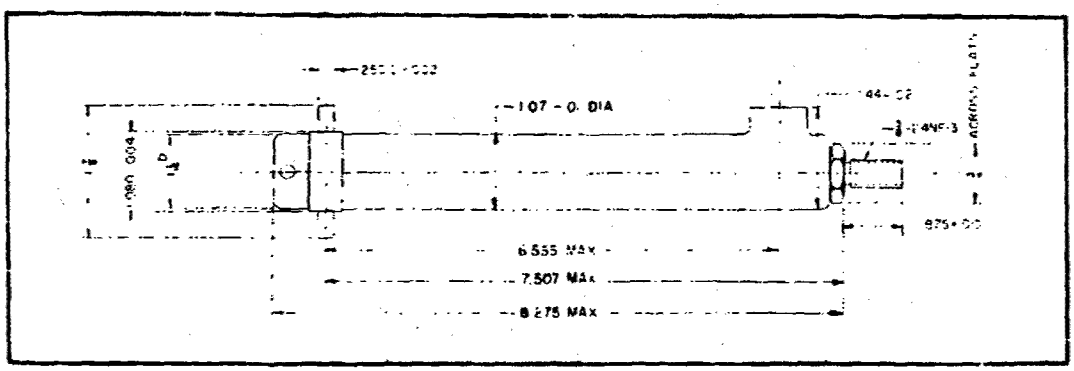
Average Peak Thrust Under Normal Load @ 70°F	1660 lbs.
Completed Stroke	1-1/2 inches, min.
Assembled Weight	1.0 lb.
Propelled Mass, Vertical	550 lbs.
Firing Method	Propellant Gas
Temperature Limits	-65°F to +165°F
By-Pass Pressure @ 70°F Under Normal Load at the End of 4 Ft Length of #4 Hose	600 psi, min.
Average Stroke Time	.090 seconds
Force Required to Unlock Initial Lock	20 lbs.

Thruster, Cartridge Actuated, M3A3



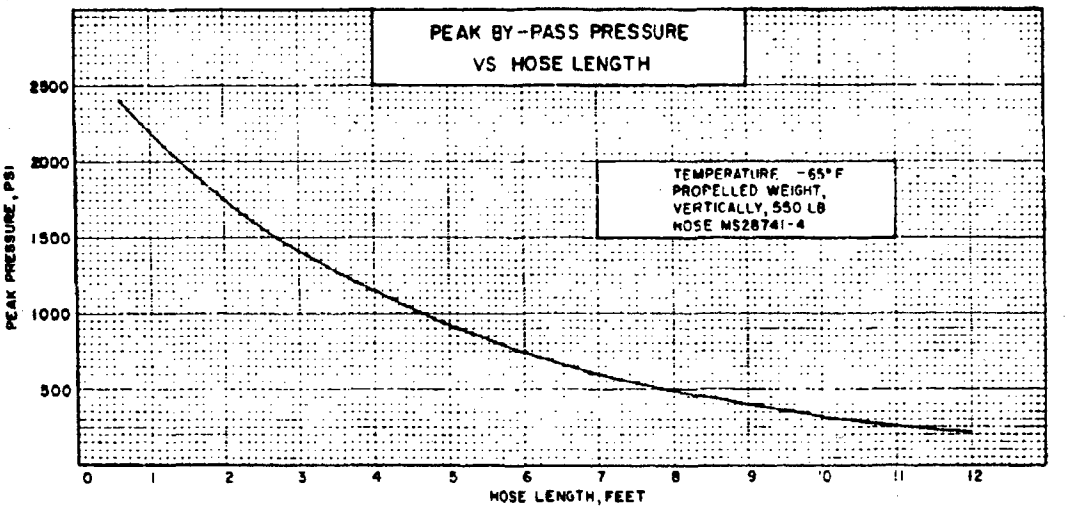
CROSS-SECTION DRAWING

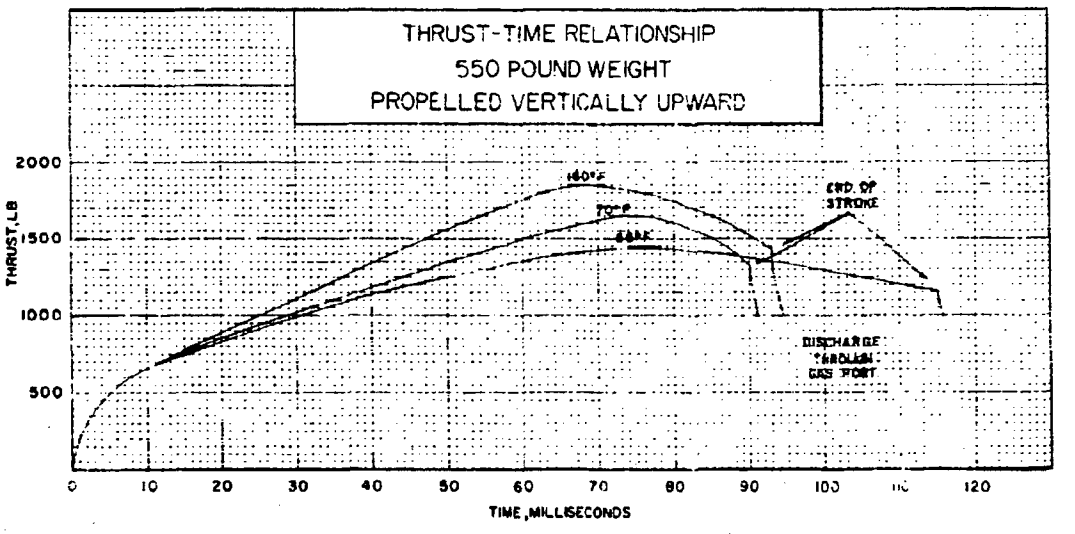
Component		Component	
A	Trunnion	J	Sleeve, End
B	"O" Ring	K	"O" Ring
C	Retainer, Cartridge	L	Rod, Piston
D	Body	M	Cartridge, M44A1
E	"O" Ring	N	Pin, Firing
F	Cap, End	O	Screw, Set, Socket
G	Key	P	Pin, Shear
H	"O" Ring	Q	Breech
I	Spring, Piston Locking		



ENVELOPE DRAWING

Thruster, Cartridge Actuated, M3A3





M5A3 THRUSTER

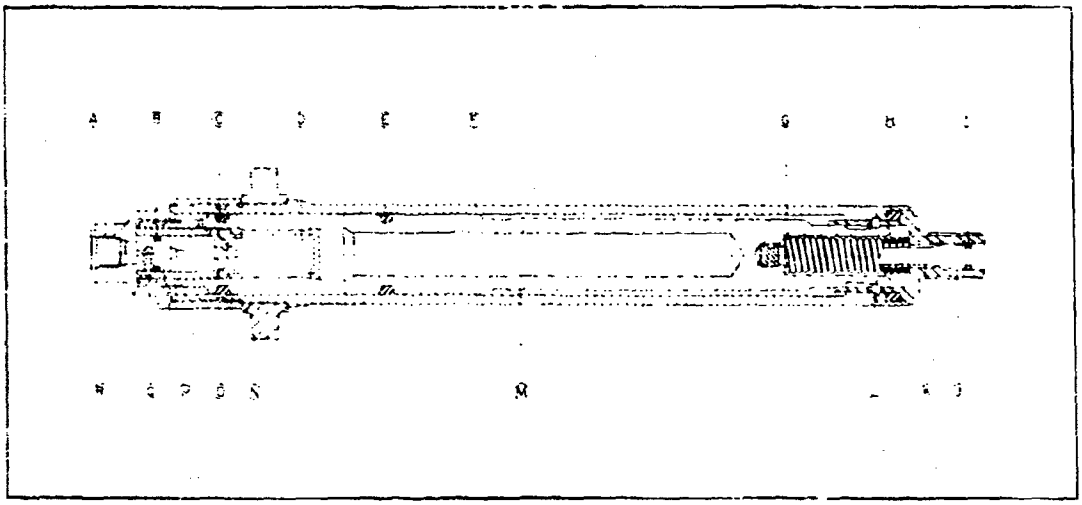
The M5A3 Thruster is a component part of an aircraft escape system whose purpose is to jettison the tail turret or to be used in various aircraft canopy release systems. The thruster is required to complete a 5 inch stroke against an opposing force. The opposing force is represented by a 500 pound carriage that must be propelled horizontally, after an initial restraining force of 4000 pounds is overcome. The initial restraining force is represented by a shear pin located at zero inches of stroke. Thruster performance data using this test system is presented below.

The thruster is cylindrical in shape, approximately 12.6 inches long and 1.4 inch in diameter. The piston is initially locked in the chamber with 4 keys and is capable of withstanding a tensile load of 2000 pounds without separation or mechanical failure.

PRINCIPAL CHARACTERISTICS

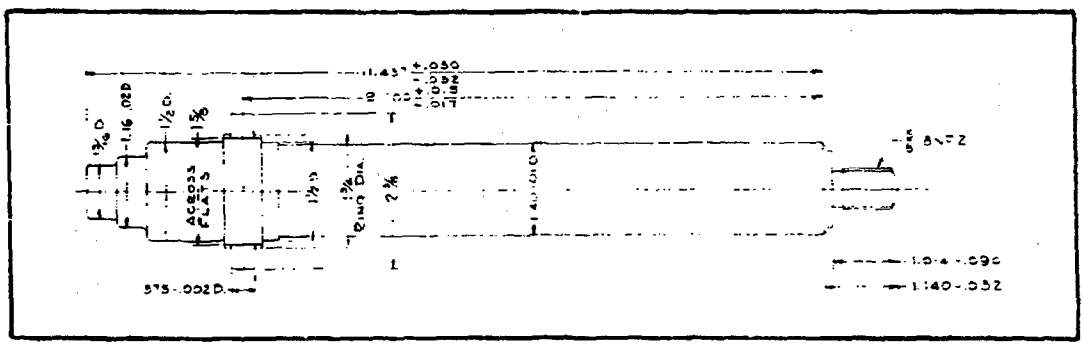
Average Peak Thrust Under Normal Load @ 70°F	6670 lbs.
Completed Stroke	5.0 inches
Average Stroke Time Under Normal Load @ 70°F	.075 seconds
Assembled Weight	3.6 lbs.
Propelled Mass, Horizontal	500 lbs.
Firing Method	Propellant Gas
Temperature Limits	−65°F to +165°F
Restraining Forces	4000 lbs. @ 0 inches of stroke 1000 lbs. @ .5 inches of stroke

Thruster, Cartridge Actuated, M5A3



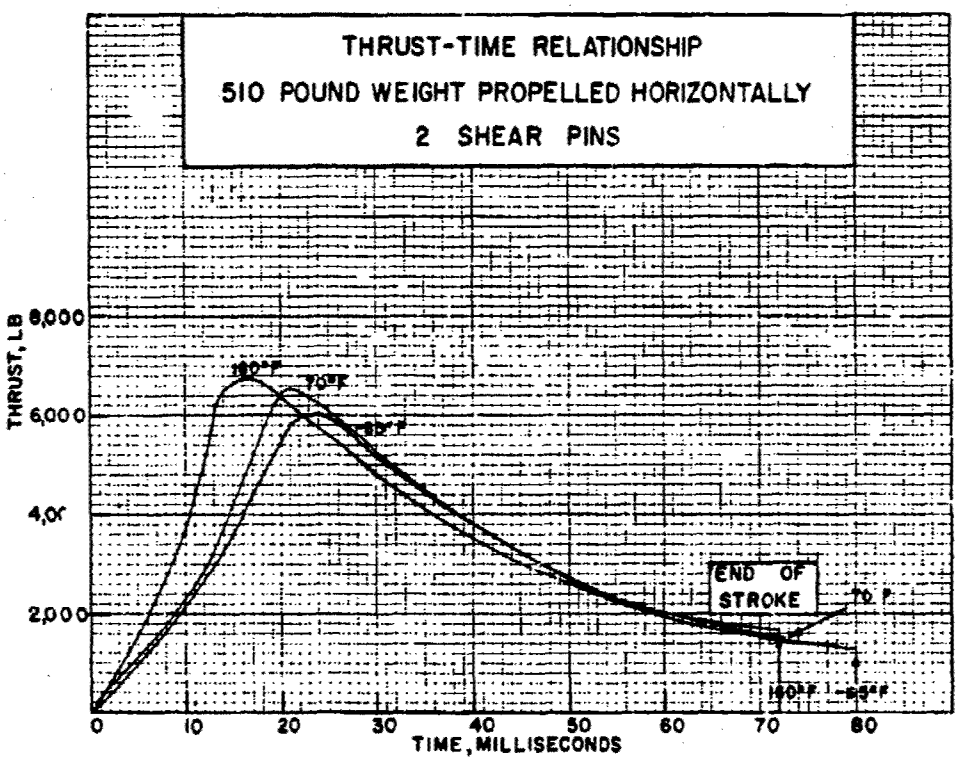
CROSS-SECTION DRAWING

Component		Component	
A	Head	K	Screw, Buffer
B	"O" Ring	L	Key
C	"O" Ring	M	Piston
D	Cartridge, M73	N	Trunnion
E	"O" Ring	O	Retainer, Cartridge
F	Body	P	Pin, Firing
G	Spring, Piston Locking	Q	Pin, Shear
H	"O" Ring	R	Guide, Firing Pin
I	"O" Ring		
J	Sleeve, End		



ENVELOPE DRAWING

Thruster, Cartridge Actuated, M5A3



M6 THRUSTER

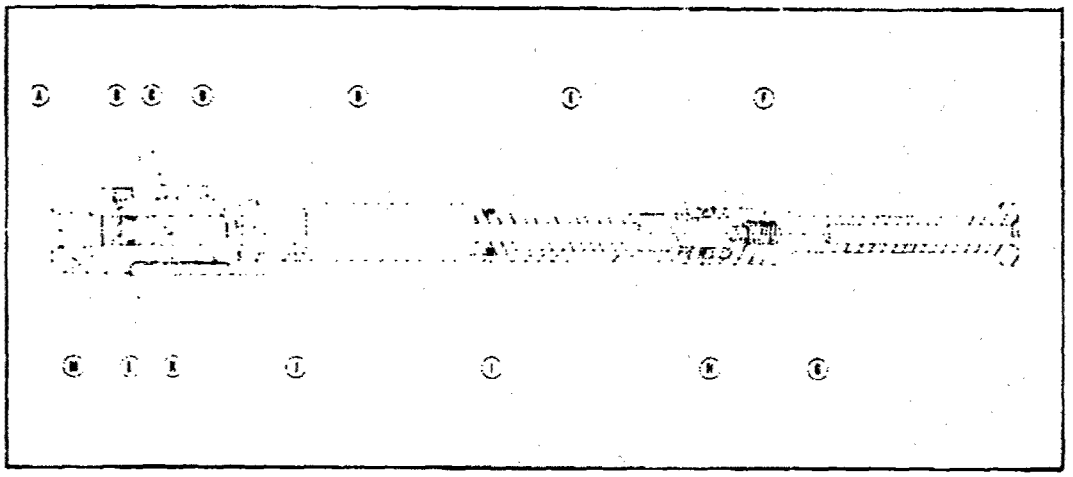
The M6 Thruster is a component part of an aircraft escape system whose purpose is to position the gun sighting equipment prior to implementing the escape procedure from the aircraft. The thruster is required to complete a 1-1 2 inch stroke against an opposing force. The opposing force is represented by a 60 pound weight that must be propelled horizontally, after an initial restraining force of 400 pounds is overcome. The initial restraining force is a shear pin located at zero inches of stroke.

The thruster is cylindrical in shape, approximately 11.73 inches long and 1.07 inches in diameter. The piston is initially locked in the chamber with 3 balls and is capable of withstanding a tensile load of 250 pounds, without separation or mechanical failure.

PRINCIPAL CHARACTERISTICS

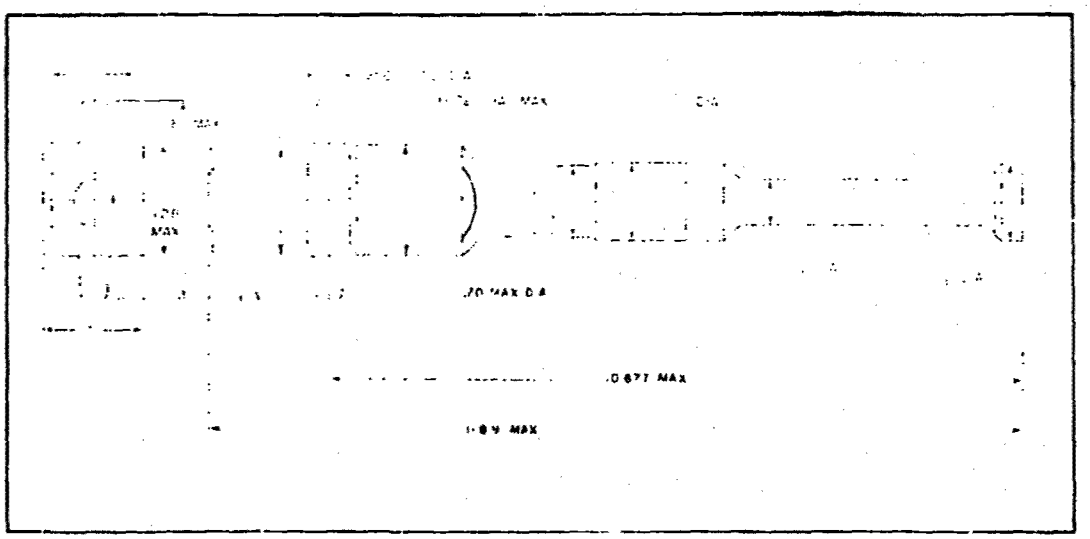
Average Peak Thrust Under Load @ 70°F	1100 lbs.
Completed Stroke	1.5 in.
Assembled Weight	1.0 lbs.
Propelled Mass, Horizontal	60 lbs.
Firing Method	Propellant Gas
Temperature Limits	-65°F to +165°F
Restraining Force	400 lbs.

Thruster, Cartridge Actuated, M6

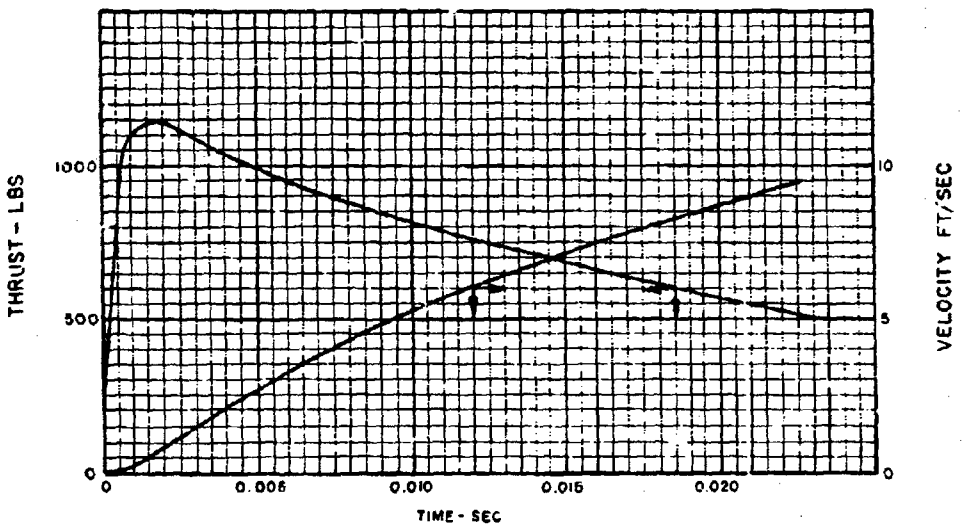


CROSS-SECTION DRAWING

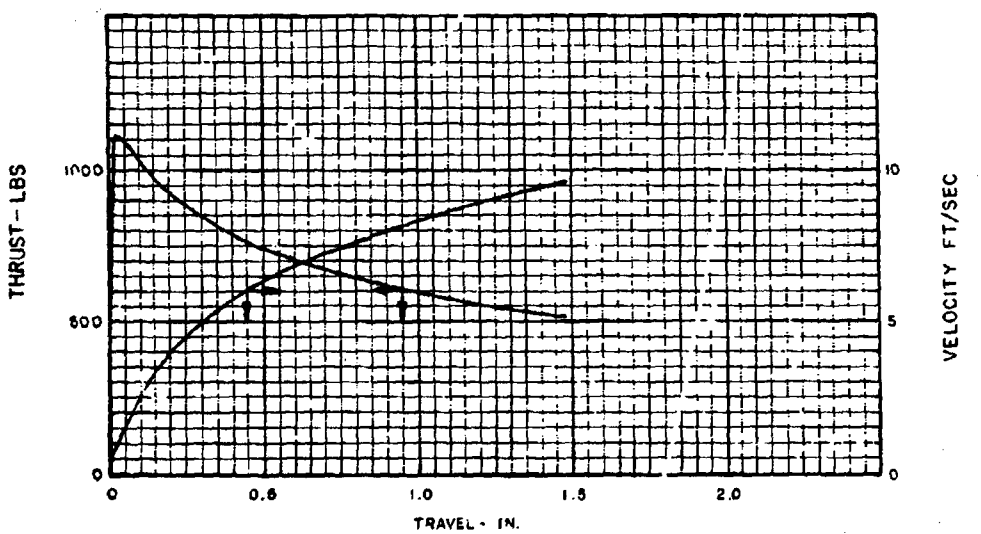
Component		Component	
A	Pin, Shear	H	Ball
B	Screw, Socket, Set	I	"O" Ring
C	Trunnion	J	Cartridge, Thruster, M6"
D	Body	K	Pin, Firing
E	Piston	L	"O" Ring
F	Spring, Piston Locking	M	Breech
G	Sleeve, End		



ENVELOPE DRAWING



A



B

A - TYPICAL PERFORMANCE - TIME CURVES
B - TYPICAL PERFORMANCE - TRAVEL CURVES

M7 THRUSTER

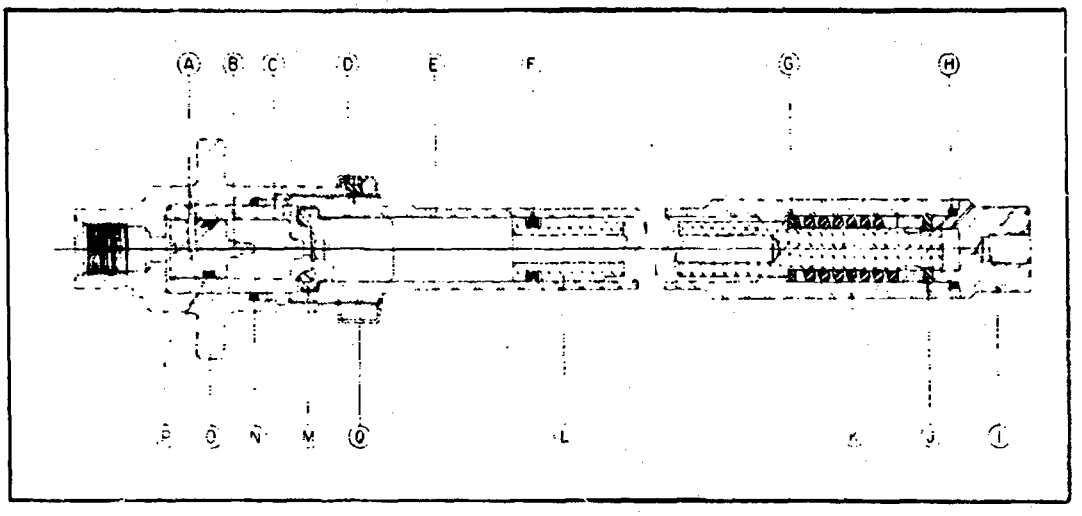
The M7 Thruster is a component part of an aircraft escape system whose purpose is to unlock and or open a hatch. The thruster is required to complete a 2-1/2 inch stroke against an opposing force. The opposing force is represented by an 11.6 pound weight that must be propelled horizontally against constant 500 pound restraining force, which is simulated with an air cylinder.

The thruster is cylindrical in shape, approximately 10.2 inches long and 1.1 inches in diameter. The piston is initially locked in the chamber with 2 keys and is capable of withstanding a tensile load of 500 lbs., without separation or mechanical failure.

PRINCIPAL CHARACTERISTICS

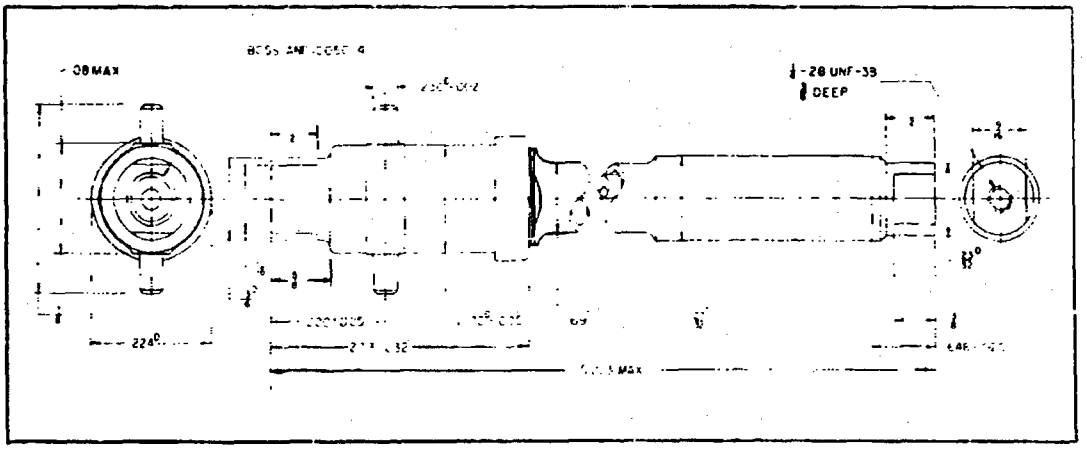
Average Peak Thrust Under Normal Load @ 70°F	1600 lbs.
Completed Stroke	2.5 inches
Average Stroke Time	.070 seconds
Assembled Weight	1.08 lbs.
Propelled Mass, Horizontal	11.6 lbs.
Firing Method	Propellant Gas
Temperature Limits	-65 F to +165 F
Restraining Force	500 lbs.

Thruster, Cartridge Actuated, M7



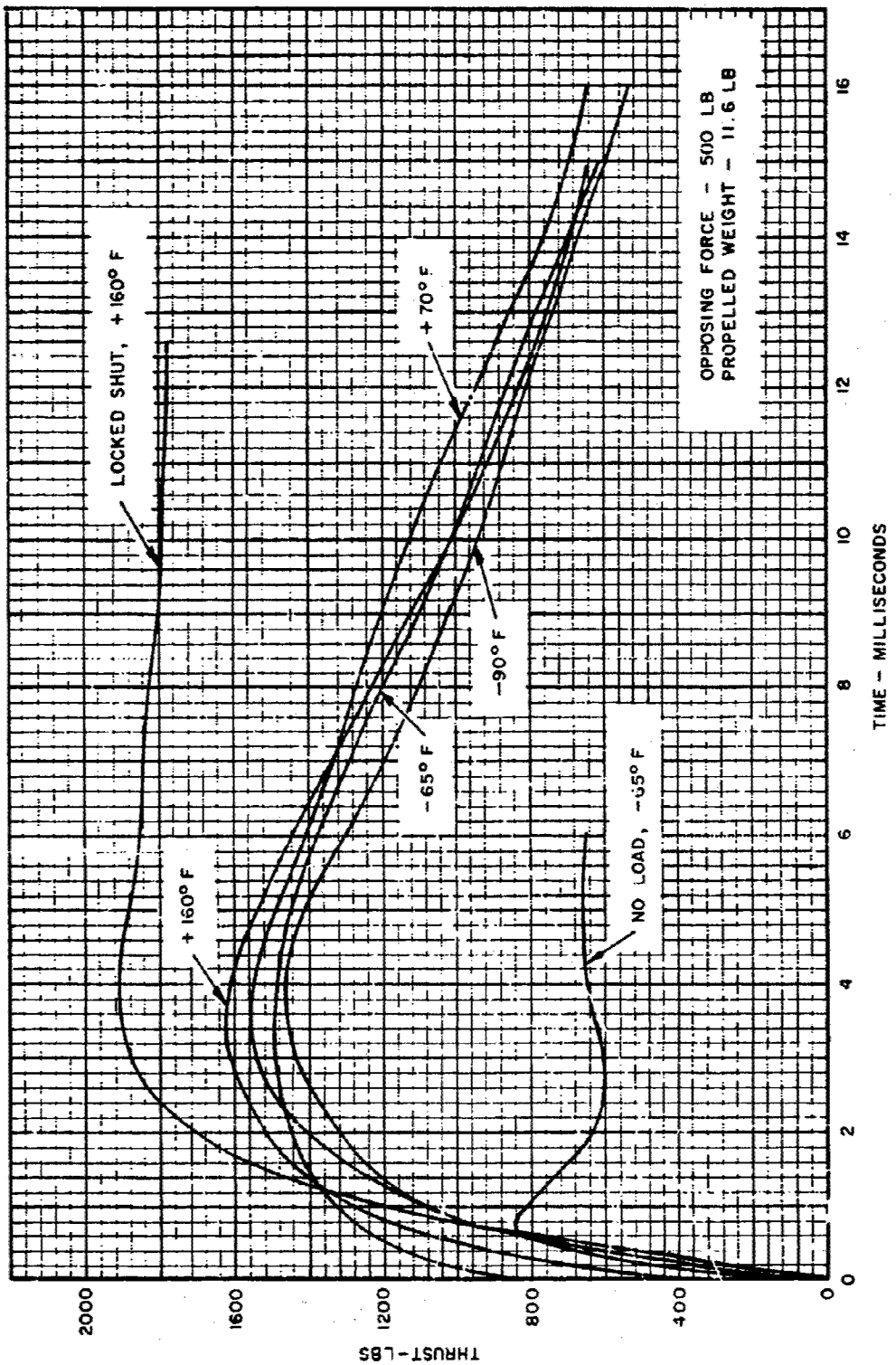
CROSS-SECTION DRAWING

Component	Component
A Pin, Shear	J Key
B Pin, Firing	K Spring, Piston Locking
C Guide	L Piston
D Screw, Set	M Cartridge, Thruster, M57
E Body	N "O" Ring
F Gasket, "O" Ring	O Head
G Collar	P Gasket, "O" Ring
H "O" Ring	Q Seal
I Sleeve, End	



ENVELOPE DRAWING

Thruster, Cartridge Actuated, M7



M9 THRUSTER

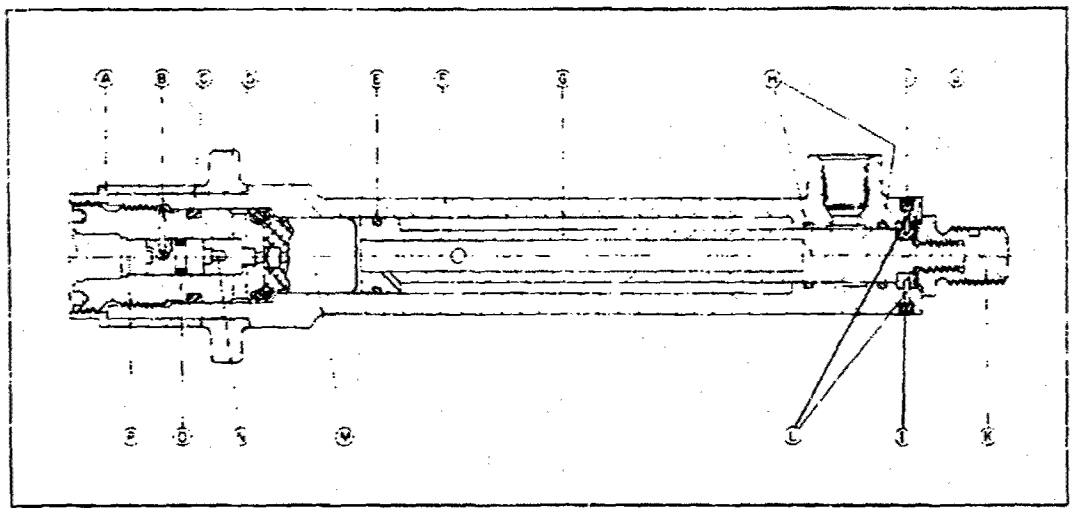
The M9 Thruster is a component part of an aircraft escape system whose purpose is to unlatch the canopy of an aircraft prior to implementing the escape procedures of aircraft personnel from the aircraft. The thruster is required to complete a stroke of 3.6 inches against a constant resistive force and supply a 1000 psi minimum pressure at the end of a 42 inch length of hose upon completion of its stroke. The force is represented by 50 pounds mass which is propelled against a 500 pound resistive force. Thruster performance data using this test system is presented below.

The thruster is cylindrical in shape, approximately 9.1 inches long and 1.5 inches in diameter. The piston is initially locked in the chamber with two "shear pins" and will unlock upon the application of a tensile load of 96 ±10 pounds.

PRINCIPAL CHARACTERISTICS

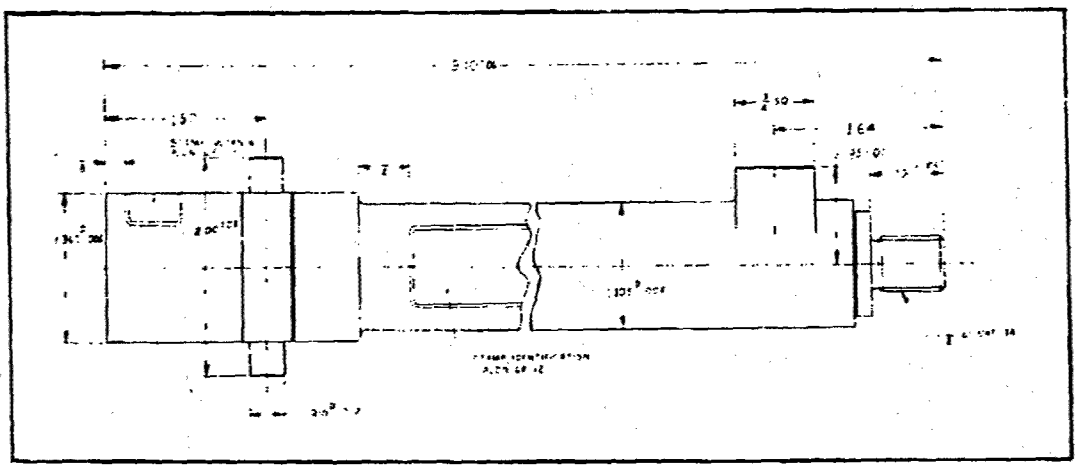
Average Peak Thrust Under Load @ 70°F	2600 lbs.
Completed Stroke	3.6 inches minimum
Operating Time	.080 seconds
Assembled Weight	1.0 lbs.
Propelled Mass, Horizontal	50 lbs.
Firing Method	Propellant Gas
Temperature Limits	−65°F to +200°F
Resisting Force	500 lbs.
By-Pass Pressure Under Normal Load at the End of 42 Inch Length of #4 Hose	1900 psi

Thruster, Cartridge Actuated, M9



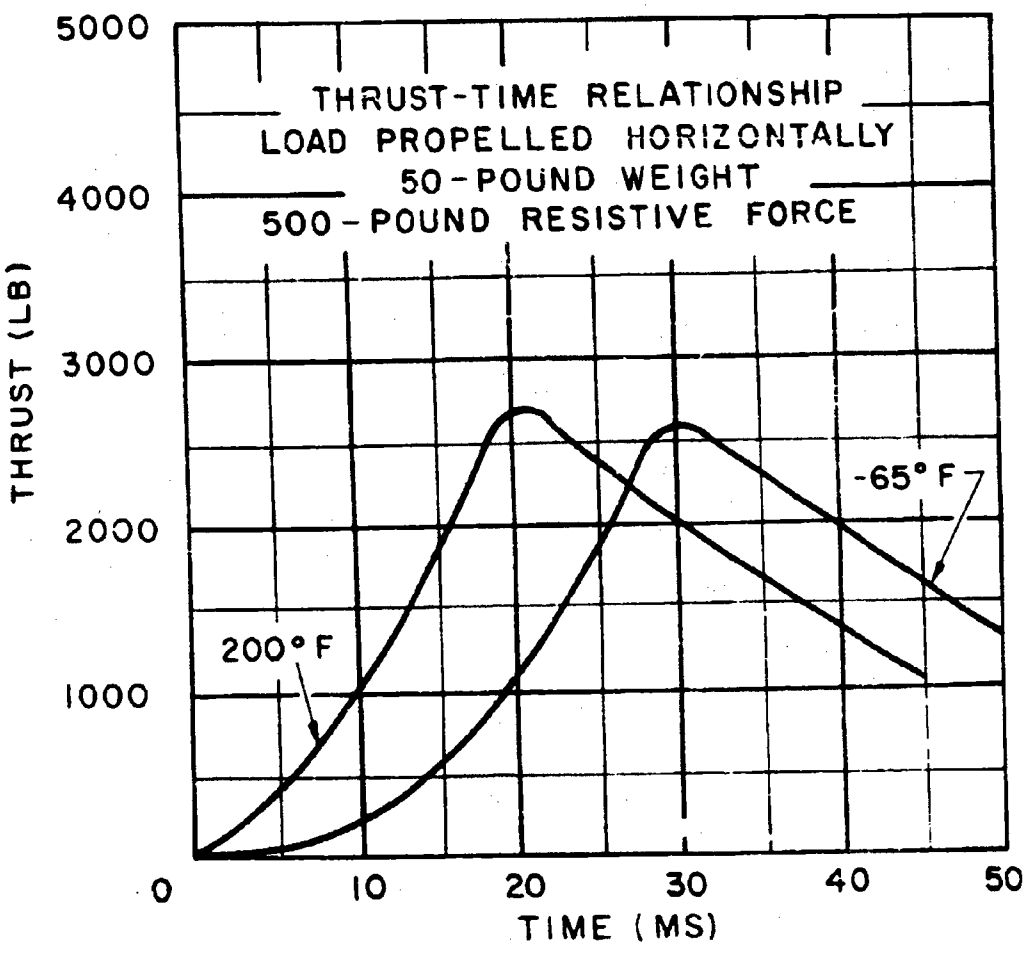
CROSS-SECTION, DRAWING

Component		Component	
A	Collar	I	Screw, Set (2)
B	Pin, Shear, Firing Pin	J	Ring
C	"O" Ring	K	Adapter and Pellet Assembly
D	Trunnion	L	Pin, Shear, Piston (2)
E	"O" Ring	M	Cartridge, Thruster, M119
F	Body	N	Pin, Firing
G	Piston	O	"O" Ring
H	"O" Ring (2)	P	Breech



ENVELOPE DRAWING

Thruster, Cartridge Actuated, M9



M11 THRUSTER

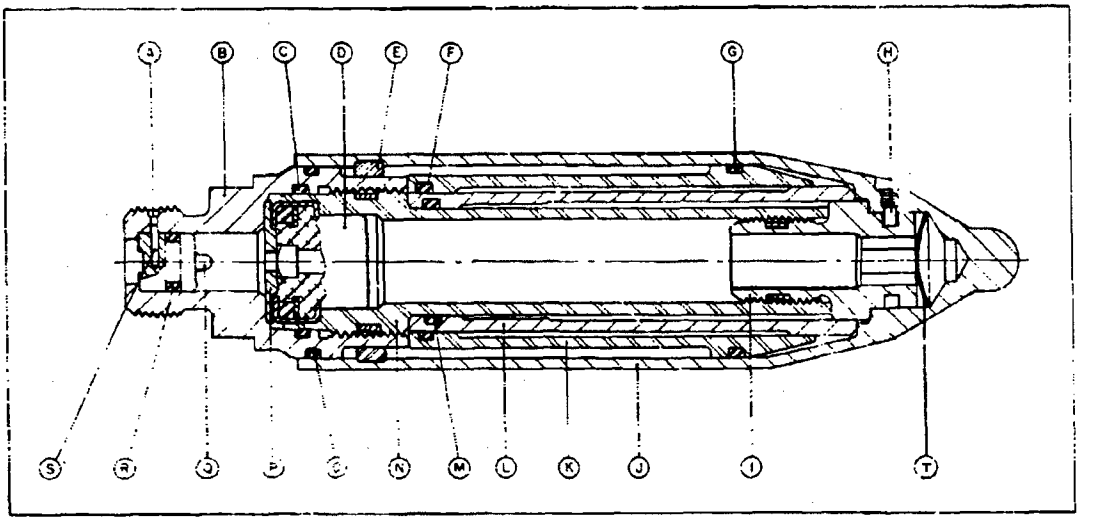
The M11 Thruster is a component part of an aircraft escape system whose purpose is to jettison the canopy of an aircraft prior to implementing the escape procedures of aircraft personnel from the aircraft. The thruster is required to complete a stroke of 5-3/4 inches and propel a simulated canopy through an arc of 90 degrees at a rate of 5 radians per second. The simulated canopy is represented by a 35 inch beam weighing 45 pounds. Thruster performance data using this test system is presented below.

The thruster is cylindrical in shape, approximately 5.3 inches long and 1.25 inches in diameter. This thruster differs from the ordinary thrusters because it has three telescoping tubes in lieu of a moving piston. The tubes are initially locked with a shear screw, which will unlock upon the application of a tensile load of 160 ± 20 pounds.

PRINCIPAL CHARACTERISTICS

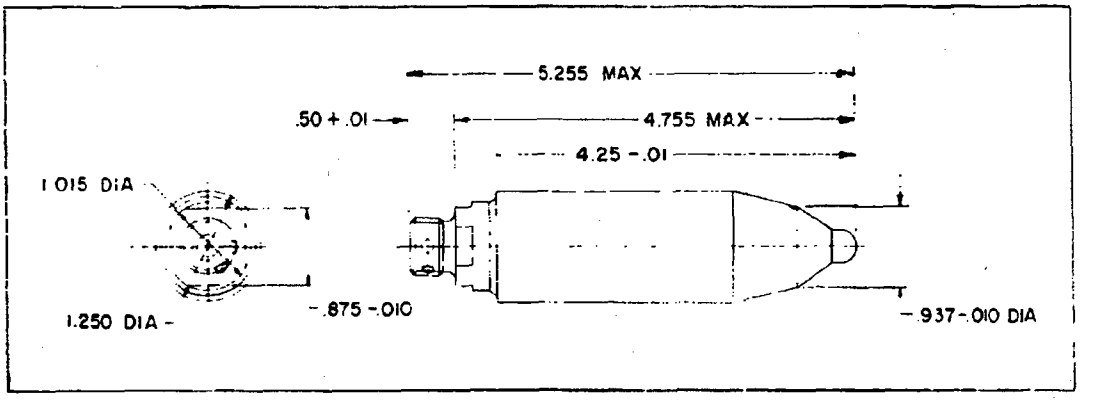
Average Peak Thrust Under Normal Load @ 70°F	2272 lbs.
Completed Stroke	5.75 inches
Assembled Weight	.95 lbs.
Propelled Mass, Radially	45 lbs.
Firing Method	Propellant Gas
Temperature Limits	-65°F to +200°F
Velocity of Propelled Mass, Min.	5 rad sec

Thruster, Cartridge Actuated, M11



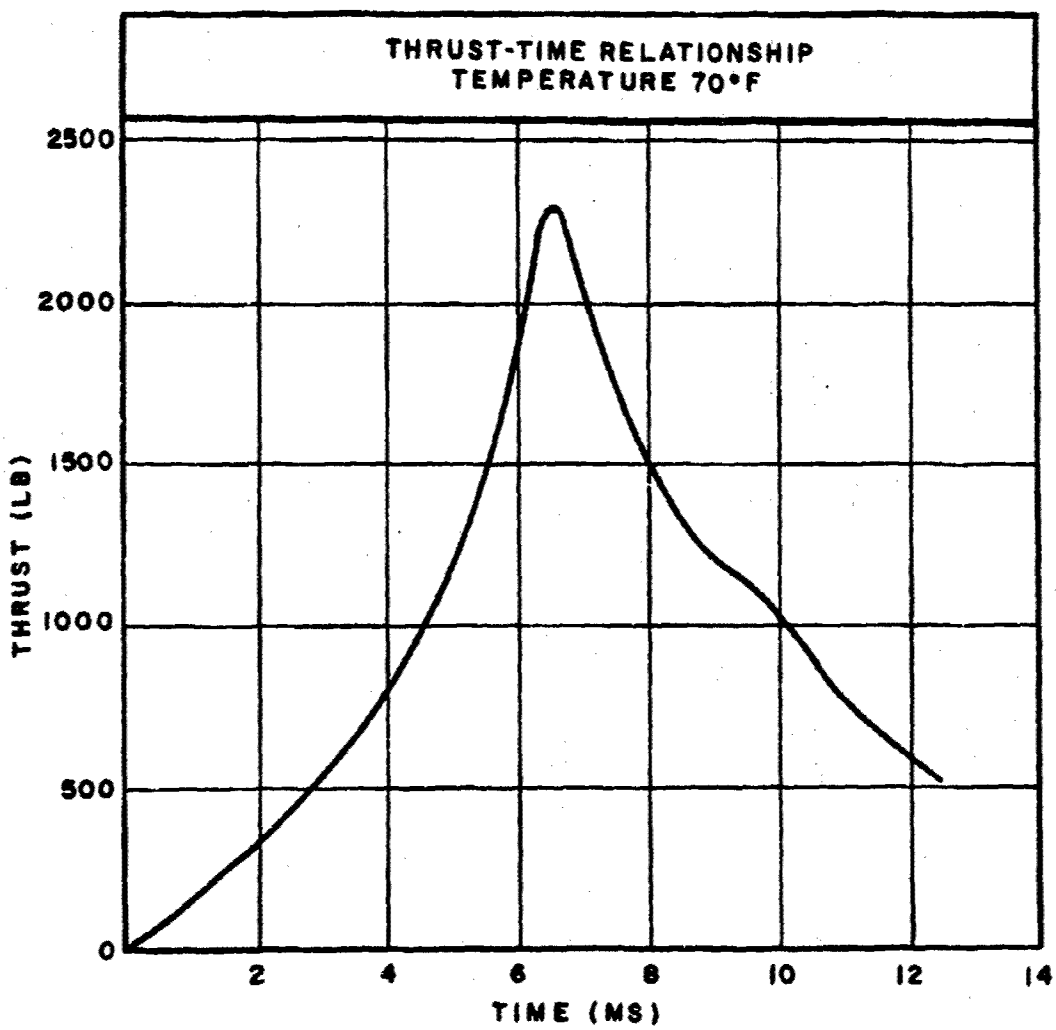
CROSS-SECTION DRAWING

Component	Component
A Pellet	K Tube, Outside
B Head and Pellet Assembly	L Tube, Inside
C "O" Ring	M "O" Ring
D Cartridge, Thruster, M141	N Retainer and Pellet Assembly
E Ring, Segment	O "O" Ring
F "O" Ring	P Guide
G "O" Ring	Q Pin, Firing
H Screw, Shear	R "O" Ring
I Stop and Pellet Assembly	S Pin, Shear
J Body	T Washer, Curved



ENVELOPE DRAWING

Thruster, Cartridge Actuated, M11



M13 THRUSTER

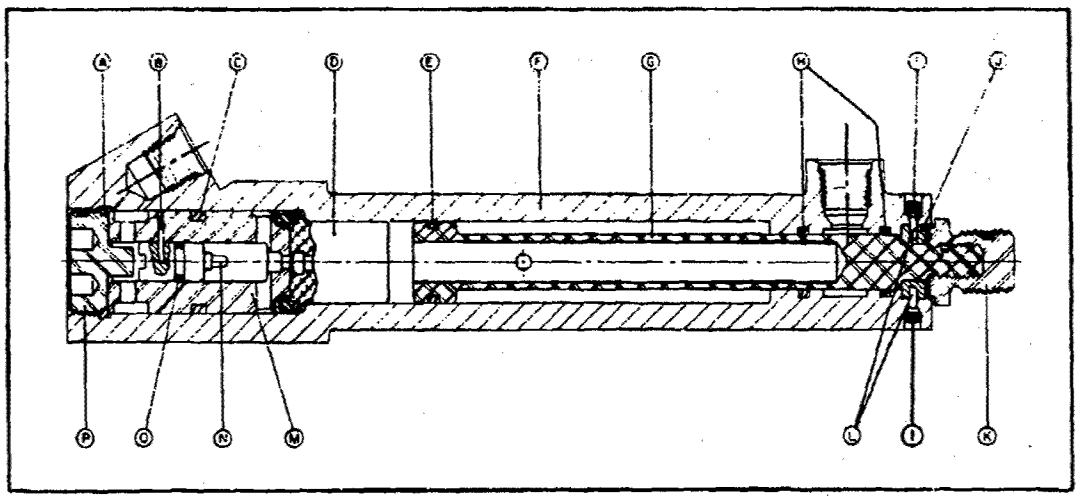
The M13 Thruster is a component part of an aircraft escape system whose purpose is to unlock the canopy of an aircraft prior to ejection of the crewman. The thruster is required to complete a stroke of 2.76 inches against an opposing force and supply 1000 psi pressure, minimum, at the end of a 6 foot length of hose. The opposing forces are represented by a 70 pound weight which is propelled vertically after an initial restraining force of 2000 pounds is overcome. The initial restraining force is represented by a shear pin located at zero inches of stroke. Thruster performance data using this test system is presented below.

The thruster is cylindrical in shape, approximately 8.3 inches long and 1.2 inches in diameter. The piston is initially locked in the chamber with 2 shear pins and will unlock upon the application of a tensile load of 96 pounds.

PRINCIPAL CHARACTERISTICS

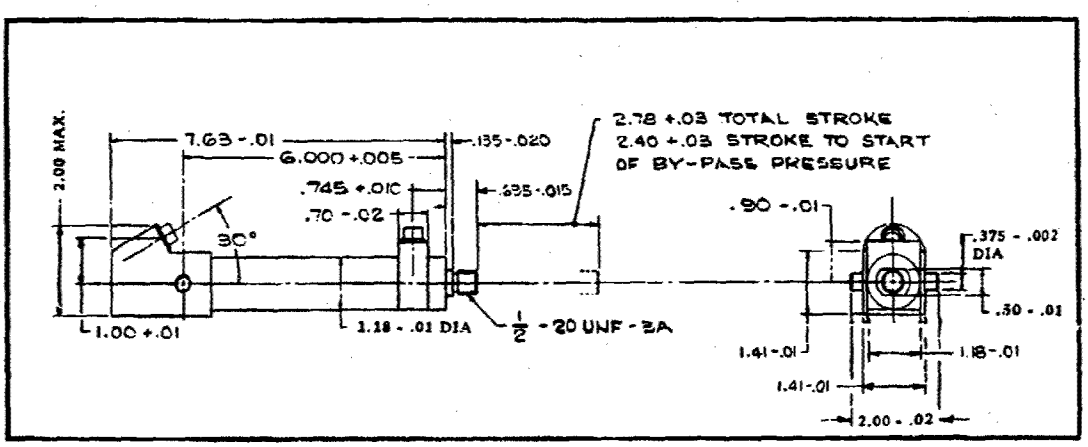
Thrust Under Load @ 70°F	2700 lbs.
Completed Stroke	2.86 inches, max.
Assembled Weight	1.07 lbs.
Propelled Mass, Vertical	70 lbs.
Firing Method	Propellant Gas
Temperature Limits	−65°F to +200°F
By-Pass Pressure Under Load @ 6 Foot of #4 Hose	1000 lbs., min.
Restraining Force	2000 lbs. @ "0" inches of stroke
Operating Time	.080 seconds, max.

Thruster, Cartridge Actuated, M13



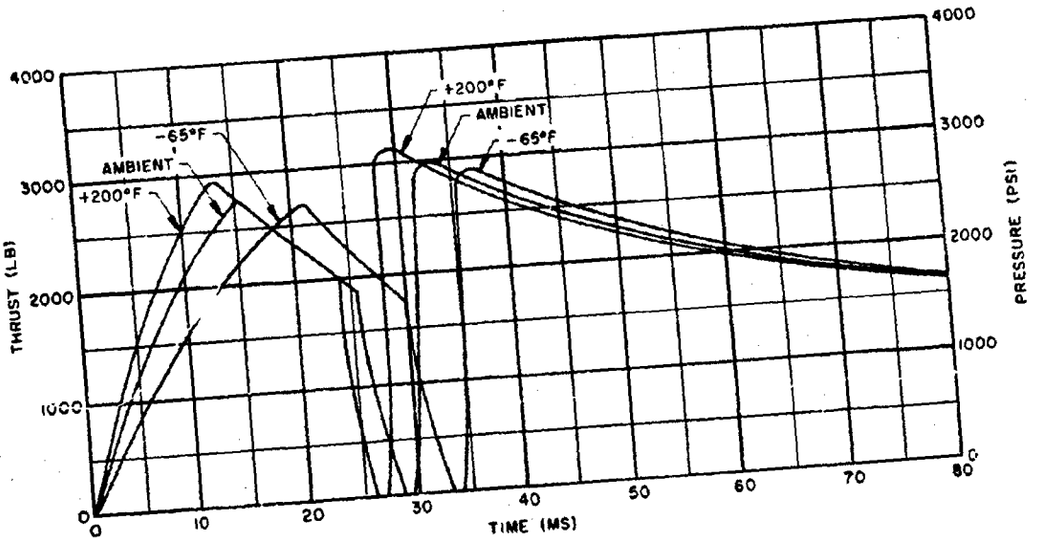
CROSS-SECTION DRAWING

Component	Component
A "O" Ring	I Screw, Set (2)
B Pin, Shear, Firing Pin	J Ring, Shear
C "O" Ring	K Fastener, Piston and Pellet Assembly
D Cartridge, Thruster, M119	L Pin, Shear, Piston (2)
E "O" Ring	M Breech
F Body	N Pin, Firing
G Piston	O "O" Ring
H "O" Ring (2)	P Cap, Base and Pellet Assembly



ENVELOPE DRAWING

Thruster, Cartridge Actuated, M13



M15 THRUSTER

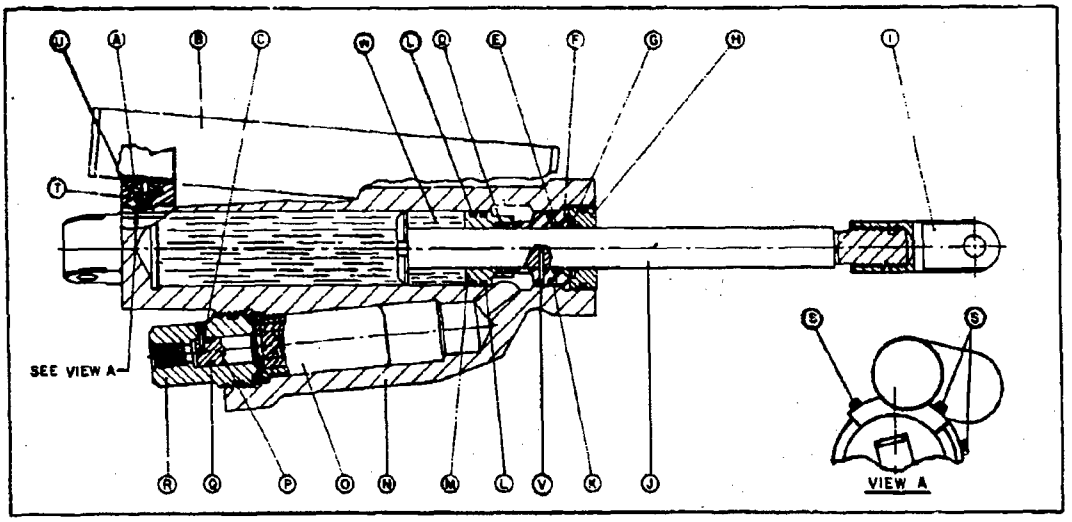
The M15 Thruster is a component part of an aircraft escape system whose purpose is to position the crewman's feet and raise the leg guards of the ejection seat prior to ejection of the crewman. The thruster is required to complete a 4.42 inch stroke, with the piston being retracted into the cylinder, against an opposing force. The opposing force is represented by an 11 pound weight which must be propelled horizontally against a restraining force of 2250 pounds after an initial restraining force of 3750 pounds is overcome. Silicone oil is employed for internal damping to keep the acceleration of the propelled weight within limits consistent with human physiology. Thruster performance data using this test system is presented below.

The thruster is irregular in shape, approximately 16-7/8 inches from the end of the extended piston to opposite mounting end of the body. An external reservoir is attached to the body for the accumulation of oil as it is metered from the body. The piston is initially locked in the body with a "shear pin" which will unlock upon the application of a compressive load of 1150 pounds. The thruster also has a final lock which holds the piston in the retracted position and is capable of withstanding a tensile load of 15,000 pounds without unlocking.

PRINCIPAL CHARACTERISTICS

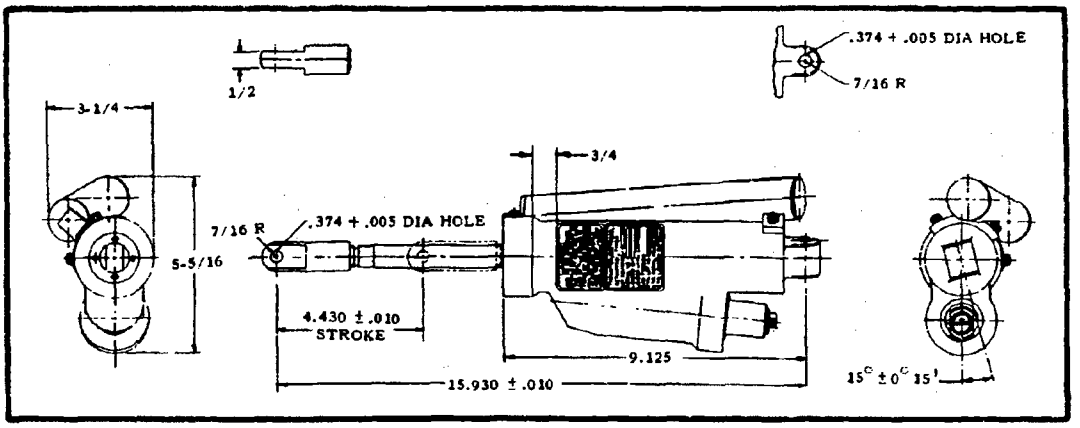
Approximate Thrust	6700 psi
Completed Stroke	4.42 inches
Assembled Weight	5.0 lbs.
Resistive Force (shear pin)	3750 lbs.
Resistive Force (air load)	2250 pounds
Firing Method	Propellant Gas
Temperature Limits	−65°F to +165°F
Propelled Mass	11 lbs.
Operating Time @ −65°F	500 milliseconds, approximately

Thruster, Cartridge Actuated, M15



CROSS-SECTION DRAWING

Component		Component	
A	Spacer	M	Piston
B	Body, Reservoir	N	Body
C	Pin, Shear, Firing Pin	O	Cartridge, Thruster, M94
D	Ring, Back-Up (4)	P	Pin, Firing
E	"O" Ring (2)	Q	"O" Ring
F	Spacer	R	Housing, Firing Pin
G	Ring, Retaining	S	Screw, Cap, Socket Head (4)
H	Nut, Ring And Pellet Assembly	T	Screw, Hollow Lock Plug, Reservoir Gasket
I	Rod, End	U	"O" Ring
J	Rod, Piston	V	Pin, Unlock Shear
K	"O" Ring	W	Fluid, Silicone
L	"O" Ring (2)		



ENVELOPE DRAWING

M20A1 THRUSTER

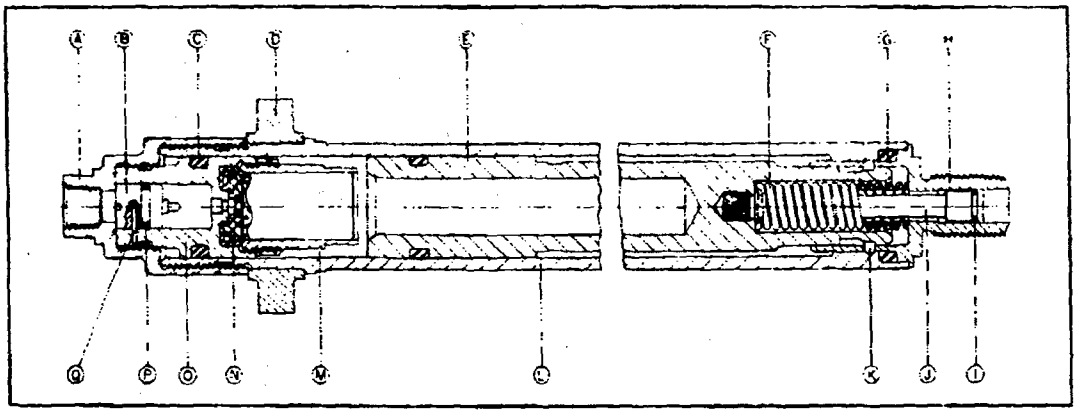
The M20A1 Thruster is a component part of an aircraft system whose purpose is to jettison the canopy of an aircraft prior to implementing the escape procedure of aircraft personnel from the aircraft. The thruster is required to complete a 5 inch stroke against a constant force. With the thruster connected to a 50 pound weight, the piston shall move a constant load of 3000 pounds, horizontally, throughout its entire 5 inch stroke.

The thruster is cylindrical in shape, approximately 12.6 inches long and 1.4 inches in diameter. The piston is initially locked by 4 keys in a locking groove and will withstand a tensile load of 2000 pounds without separation or mechanical failure.

PRINCIPAL CHARACTERISTICS

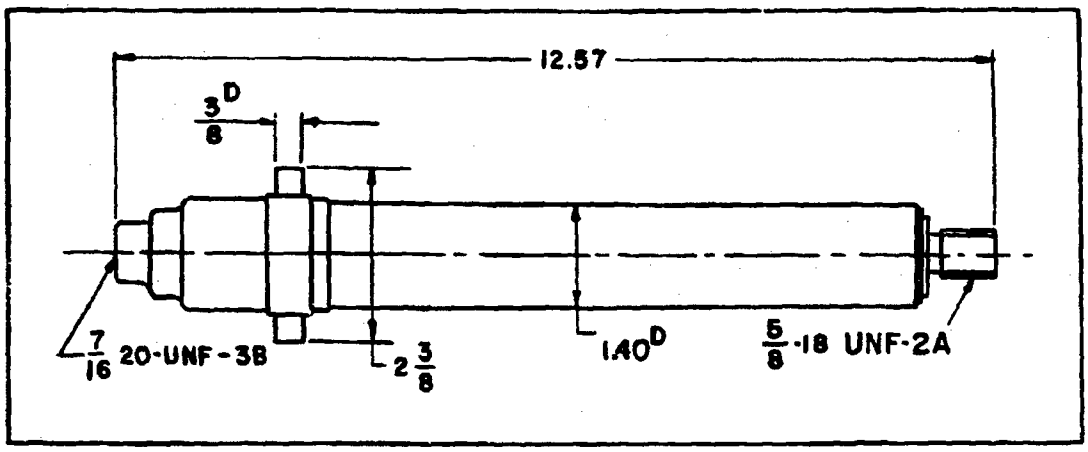
Average Peak Thrust Under Normal Load @ 70°F	5877 lbs.
Completed Stroke	5.0 inches
Average Stroke Time	.046 sec.
Assembled Weight	3.6 lbs.
Propelled Mass, Horizontal	50 lbs.
Firing Method	Propellant Gas
Temperature Limits	-65°F to +200°F
Restraining Force	3000 lbs.
Force Required to Unlock Initial Lock	60 lbs.

Thruster, Cartridge Actuated, M20A1



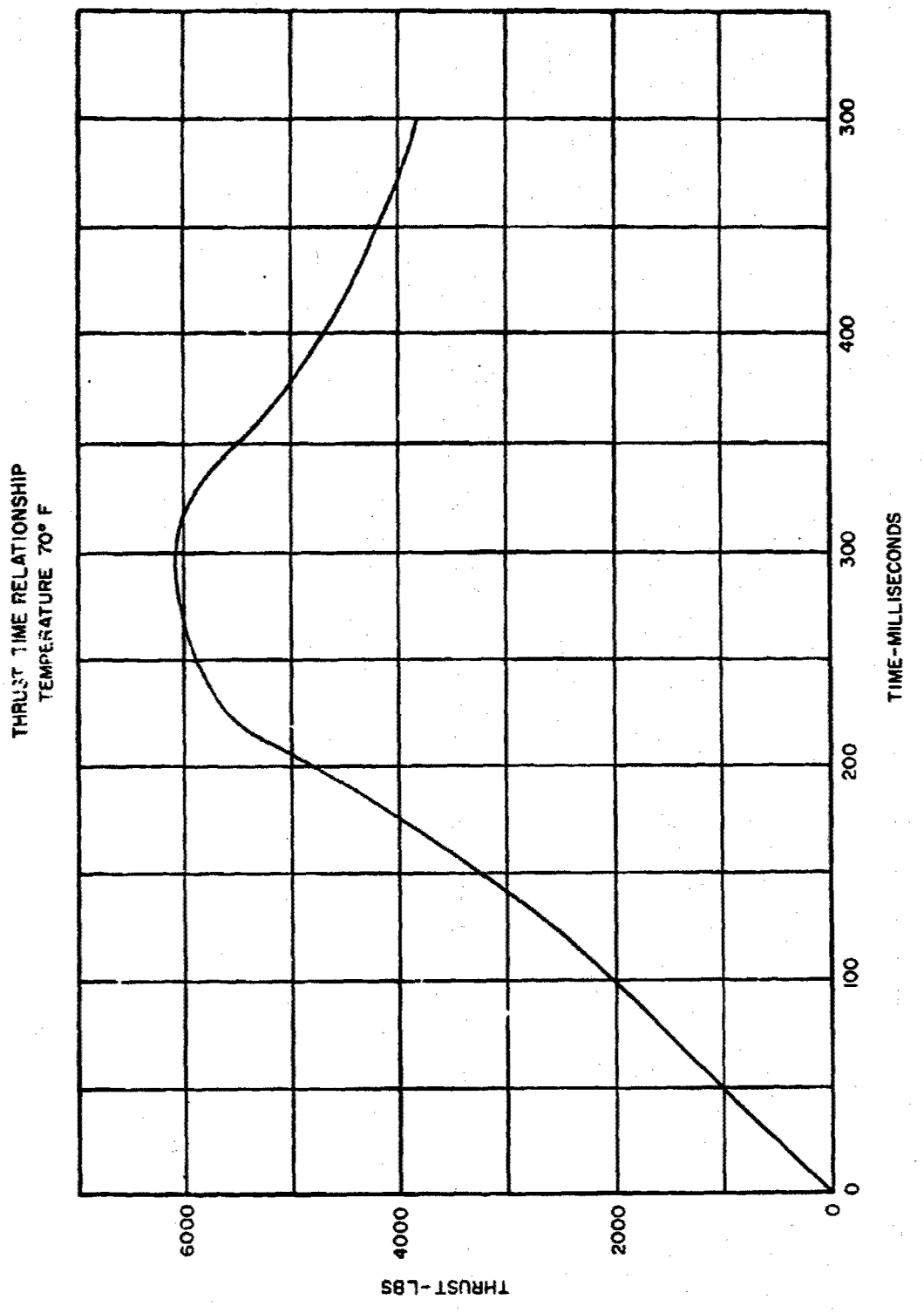
CROSS-SECTION DRAWING

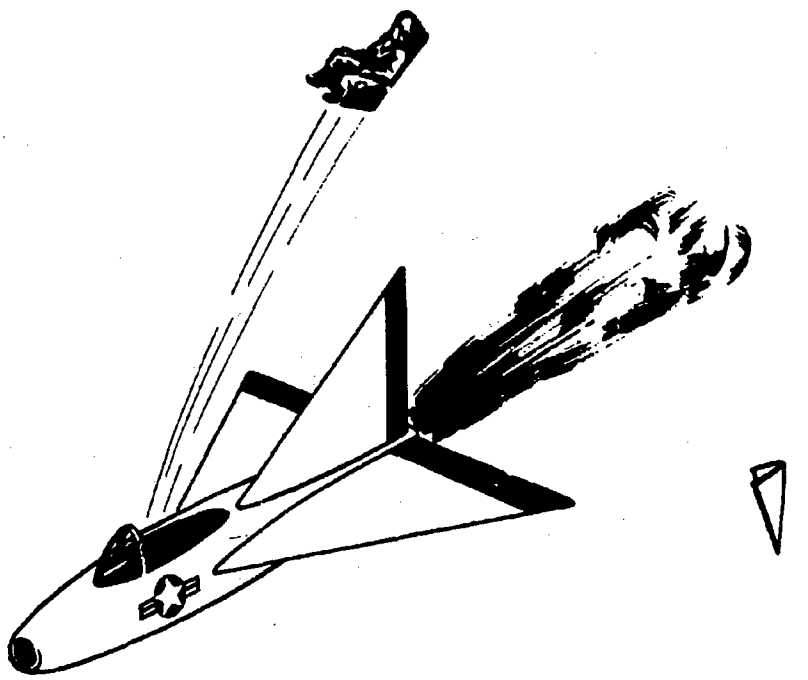
Component	Component
A Head	J Screw, Buffer and Pellet Assembly
B Pin, Firing	K Key (4)
C "O" Ring (2)	L Body and Pellet Assembly
D Trunnion	M Sleeve
E Piston	N Cartridge, Thruster, M127
F Spring	O Guide Retainer Assembly
G "O" Ring	P "O" Ring
H Sleeve, End	Q Pin, Shear
I "O" Ring	



ENVELOPE DRAWING

Thruster, Cartridge Actuated, M20A1





SECTION III

CATAPULTS

INTRODUCTION

Description

The catapult is a two or three tube telescoping device, containing an explosive component, designed for upward or downward ejection of crewmen and their seat from high-speed aircraft to provide safe escape from disabled aircraft.

Operation

The catapult must impart to its load (ejection seat with occupant) a velocity which will insure its clearing the aircraft and reach sufficient height to permit full deployment of a parachute, at the same time keeping the acceleration within safe physiological limits.

Two additional types of catapults have been designed to indoctrinate USAF trainees in the catapult ejection procedures; namely, one type which is used on a fixed vertical training tower and a mobile type which propells the seat and occupant along a guided vertical track.

CATAPULT, AIRCRAFT EJECTION SEAT, M1A1

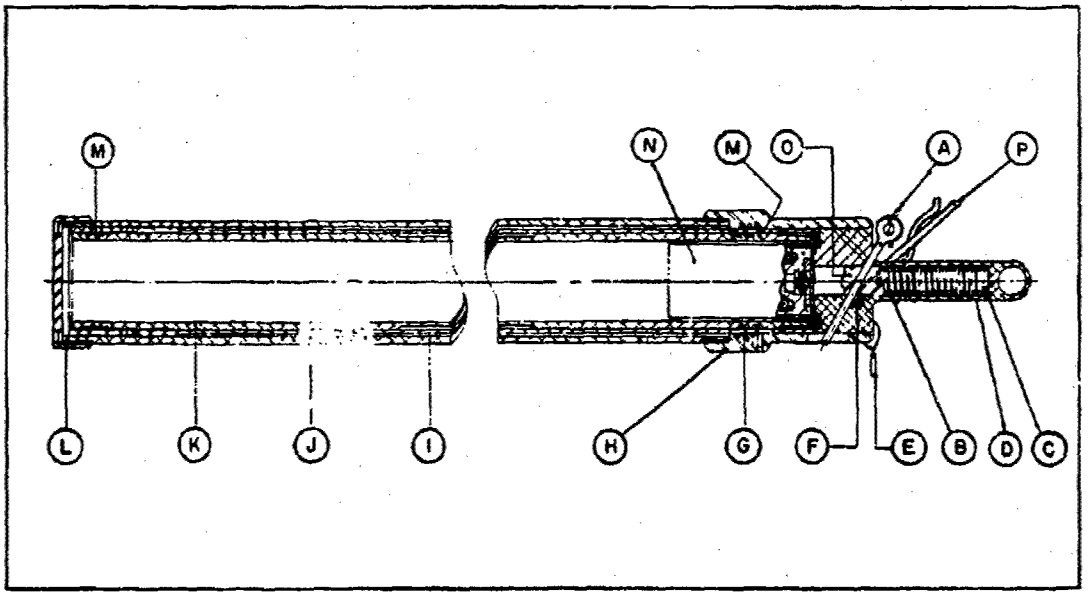
The first catapult developed for USAF was the mechanically actuated M1A1 Catapult. The catapult is a three tube telescoping ejection device, containing an explosive cartridge, designed for upward ejection of crewmen and their seat from high speed aircraft to provide safe escape from disabled aircraft.

The catapult is approximately 39 inches long and 2.3 inches in diameter. The catapult is actuated by removal of the safety locking pin first and manual operation of the sear through a pulley system connected to a lever on the pilot's seat. Rotation of the sear unlocks the catapult tubes and releases the spring loaded firing pin which strikes and detonates the primer, therby igniting the black powder and propellant in the M28A1 Cartridge. The catapult thrust which is developed from the expanding gases of the burning propellant, forces the inside and telescoping tubes to move simultaneously until the shoulder on the telescoping tube comes in contact with the trunnion, thus restricting its movement. The continuous moving block assembly and inside tube are ejected with the seat. The outside and telescoping tubes remain with the aircraft.

PRINCIPAL CHARACTERISTICS

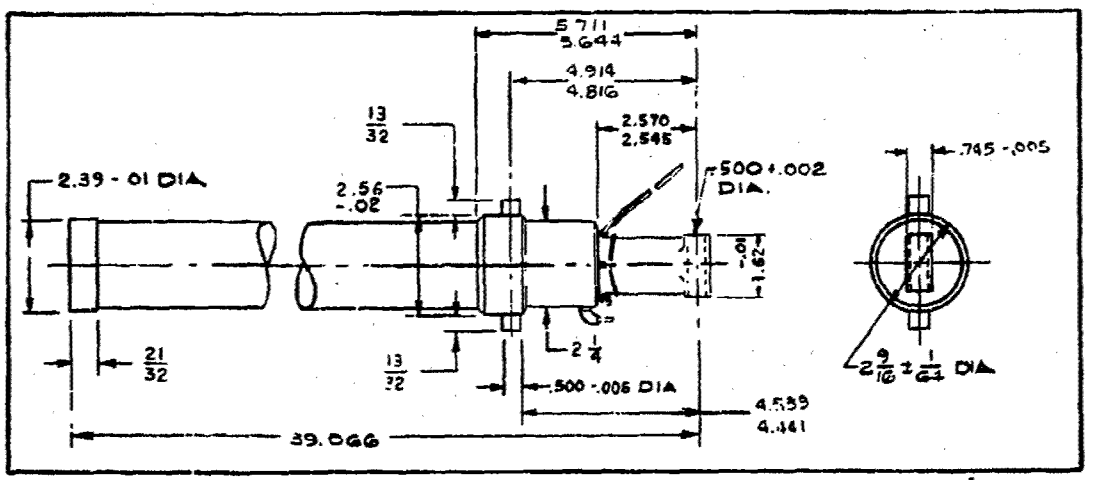
Stroke	66.0 inches
Weight (total assembly)	8.2 pounds
Propelled Weight	300.0 pounds
Temperature Limits	−65°F to +160°F
Max Acceleration (at 70°F)	20.0 g
Velocity, min (at 70°F)	60.0 fps
Max. Rate of Change of Acceleration (at 70°F)	170.0 g/sec
Firing method	Mechanical Actuation
Stroke Time (at 70°F)	0.220 sec

Catapult, Aircraft Ejection Seat, M1A1



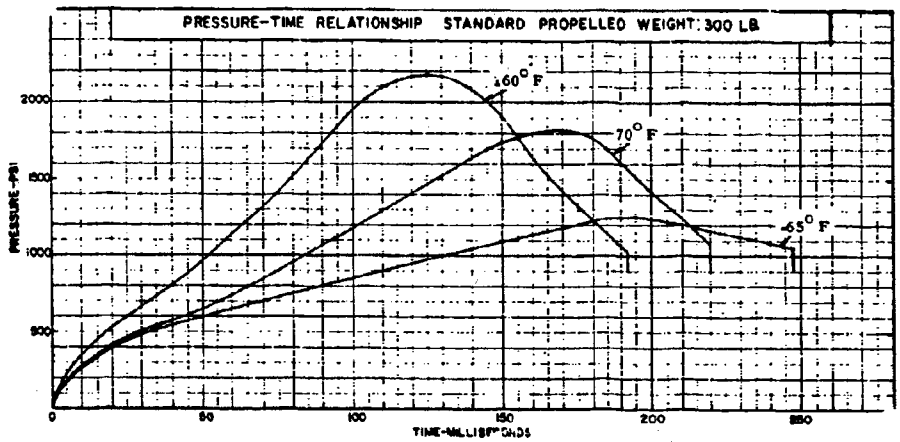
CROSS-SECTION DRAWING

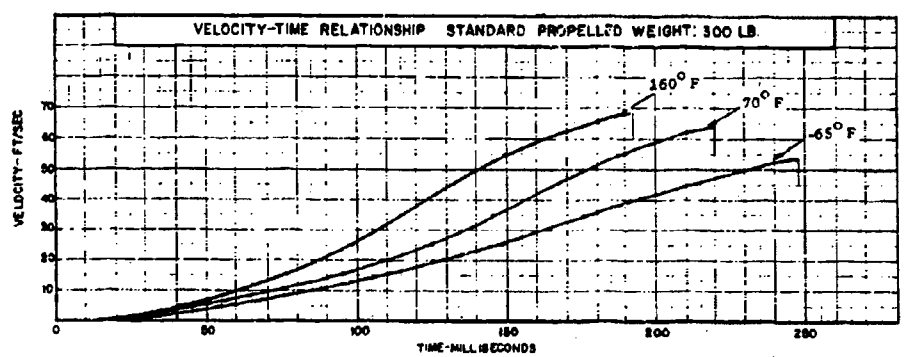
Component		Component	
A	Pin, Locking	I	Tube, Outside
B	Wire, Locking	J	Tube, Telescoping
C	Spring, Firing Pin	K	Tube, Inside
D	Block Assembly	L	Cap
E	Seal, Lead	M	Seal, Plain
F	Sear	N	Cartridge, Aircraft Ejection Seat, Catapult, M28A1
G	Seal, Fixed	O	Pin, Firing
H	Trunnion	P	Pin, Safety, Assembly

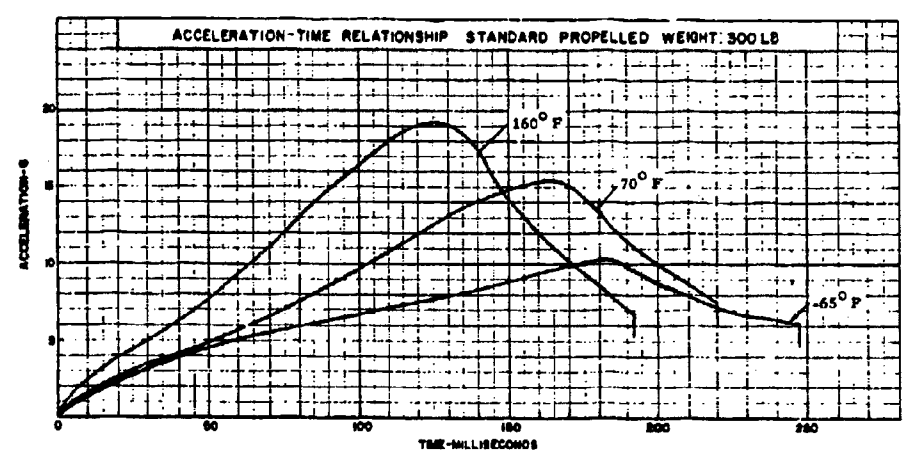


ENVELOPE DRAWING

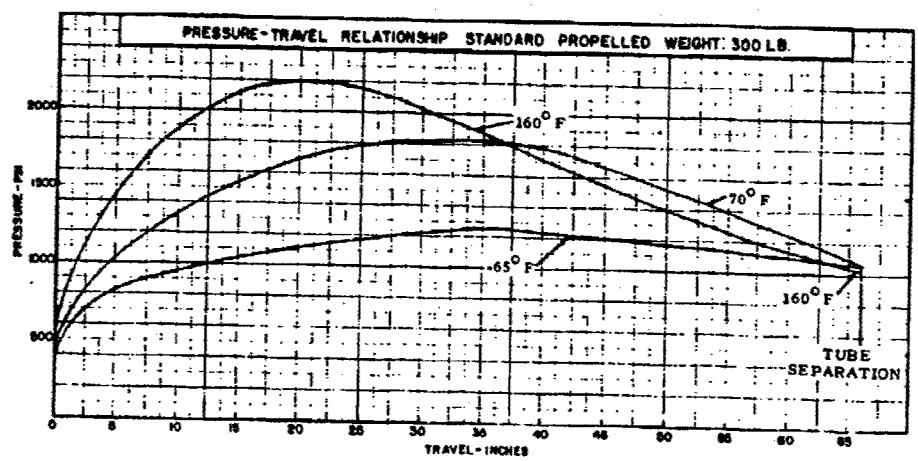
Catapult, Aircraft Ejection Seat, M1A1

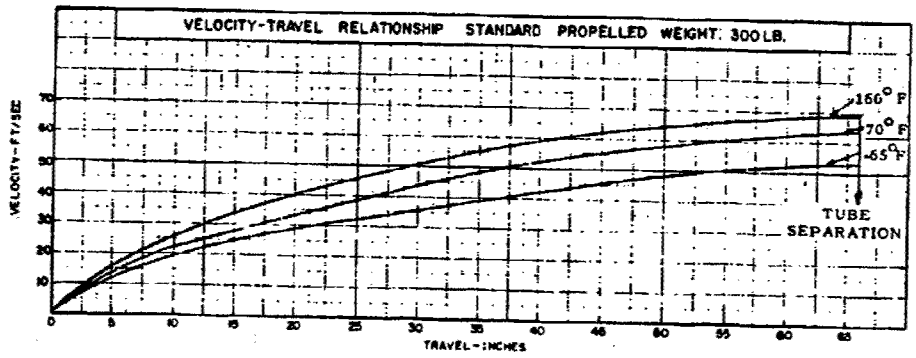


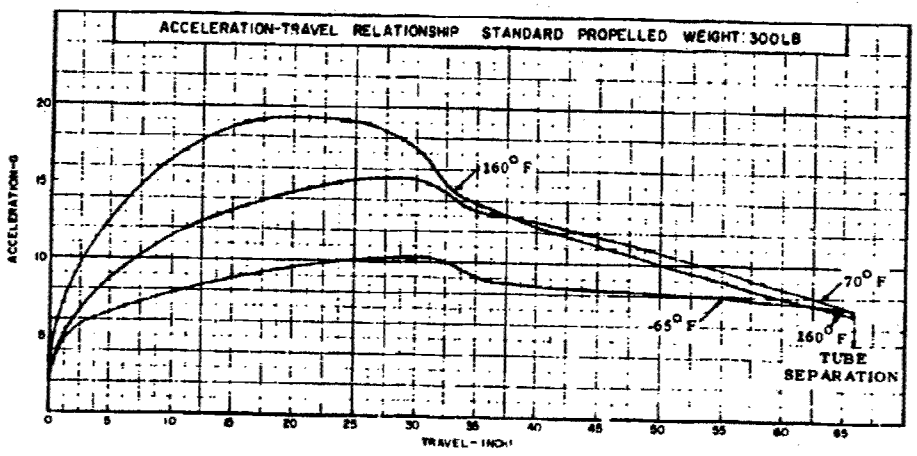




Catapult, Aircraft Ejection Seat, M1A1







CATAPULT, AIRCRAFT EJECTION SEAT, TRAINING, M2

The Catapult, Aircraft Ejection Seat, Training, M2 with the Cartridge M30A1 was designed to be used on a fixed vertical training tower for indoctrinating United States Air Force trainees in the catapult ejection procedure. In this application, the catapult ejects the seat and occupant along a guided track to about a height of 40 feet with moderate acceleration.

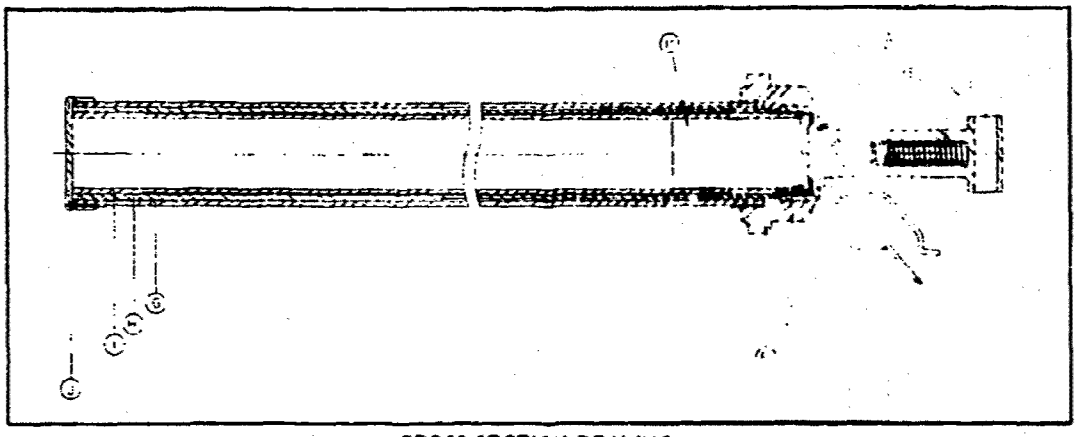
The training catapult is a three-tube, mechanically actuated unit which is constructed of steel. This catapult is approximately 39 inches long and 2.2 inches in diameter. After removal of the safety locking pin, the catapult is actuated by manual rotation of the sear through a pulley system connected to the actuating lever on the indoctrinee's seat. Rotation of the sear releases the spring-loaded firing pin which strikes and detonates the primer, thereby igniting the black powder and propellant in the M30A1 Cartridge. The Catapult thrust which is developed from the expanding gases of the burning propellant, forces the inside and telescoping tubes to move simultaneously until the shoulder on the telescoping tube comes in contact with the trunnion, thus restricting its movement. The continuous moving block assembly and inside tube are ejected with the seat. The outside and telescoping tubes remain with the simulated cockpit.

The catapult is designed for repeated use on a fixed tower installation, with a new cartridge inserted for each firing.

PRINCIPAL CHARACTERISTICS

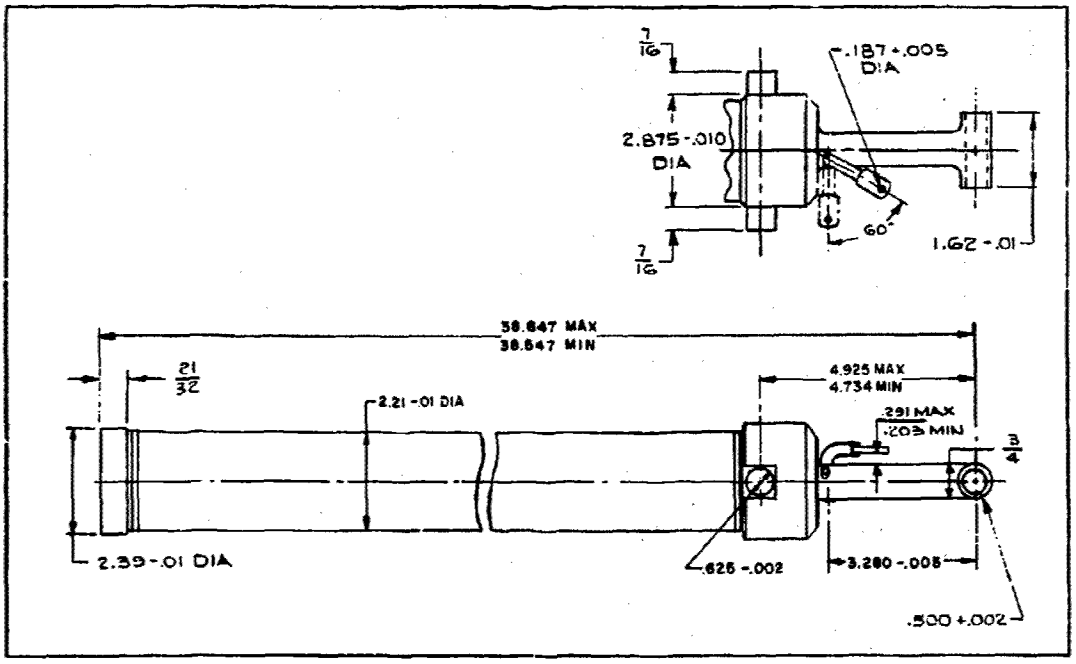
Stroke	60.0 inches
Weight (total assembly)	13.0 pounds
Propelled Weight	300.0 pounds
Temperature Limits	−65°F to + 160°F
Max Acceleration (at 70°F)	12.0 g
Velocity, min (at 70°F)	38 fps
Max Rate of Change of Accel (at 70°F)	150 g/sec
Firing Method	Mechanical Actuation
Stroke Time (at 70°F)	0.210 seconds

Catapult, Aircraft Ejection Seat, Training, M2



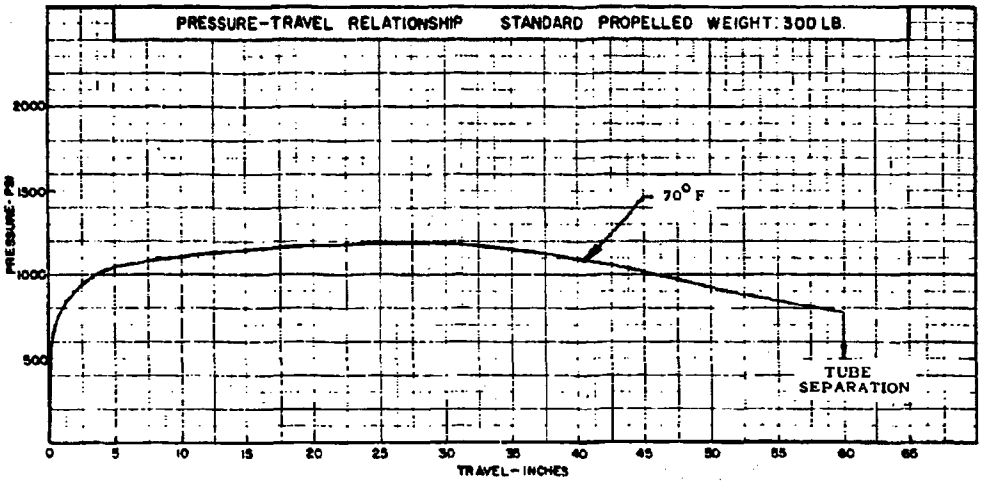
CROSS-SECTION DRAWING

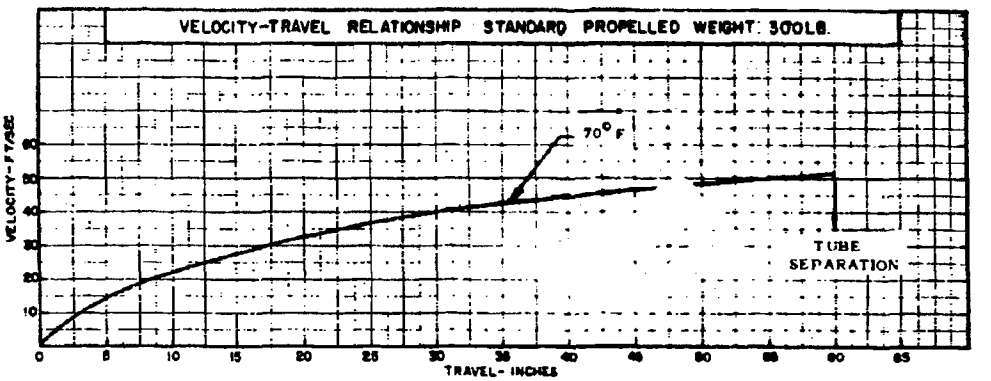
Component		Component	
A	Pin, Firing	G	Tube, Outside
B	Sear	H	Tube, Telescoping
C	Spring, Firing Pin	I	Tube, Inside
D	Pin, Safety, Assembly	J	Cap
E	Block	K	Cartridge, Aircraft Ejection Seat Catapult, M30A1 – (Installed at Training Base)
F	Trunnion		

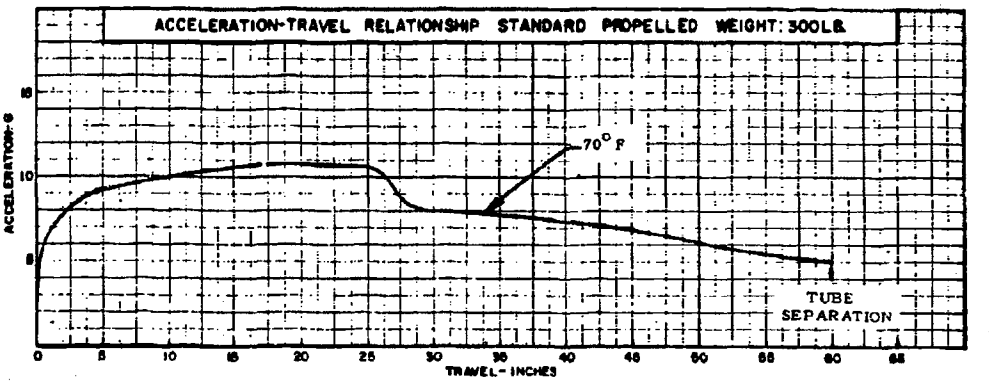


ENVELOPE DRAWING

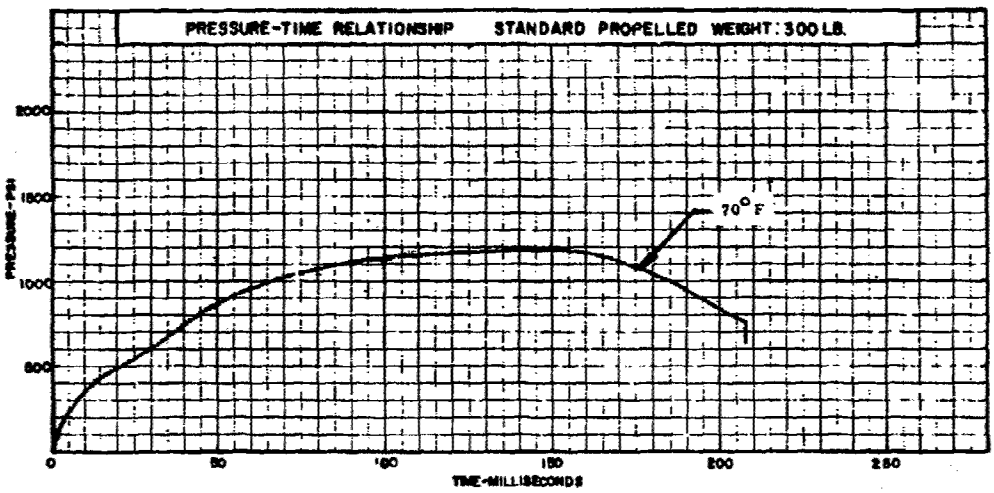
Catapult, Aircraft Ejection Seat, Training, M2

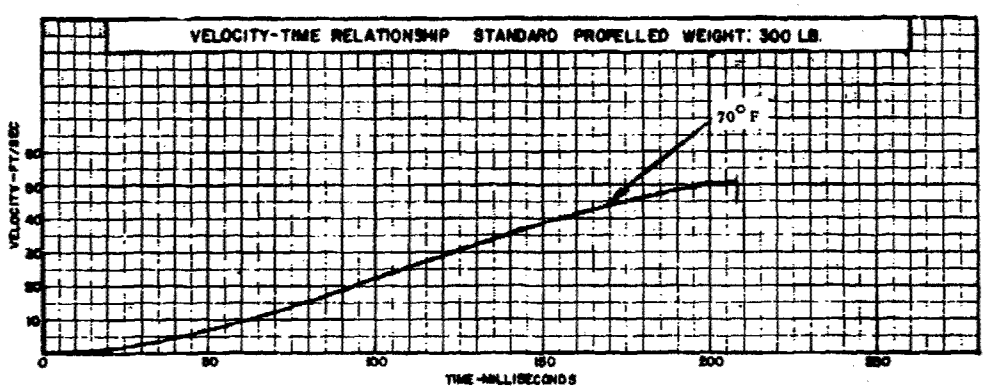


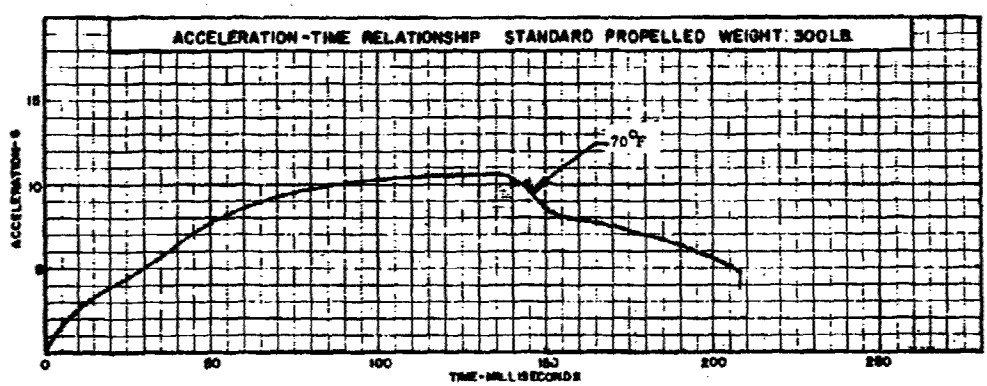




Catapult, Aircraft Ejection Seat, Training, M2







CATAPULT, AIRCRAFT EJECTION SEAT, M3A1

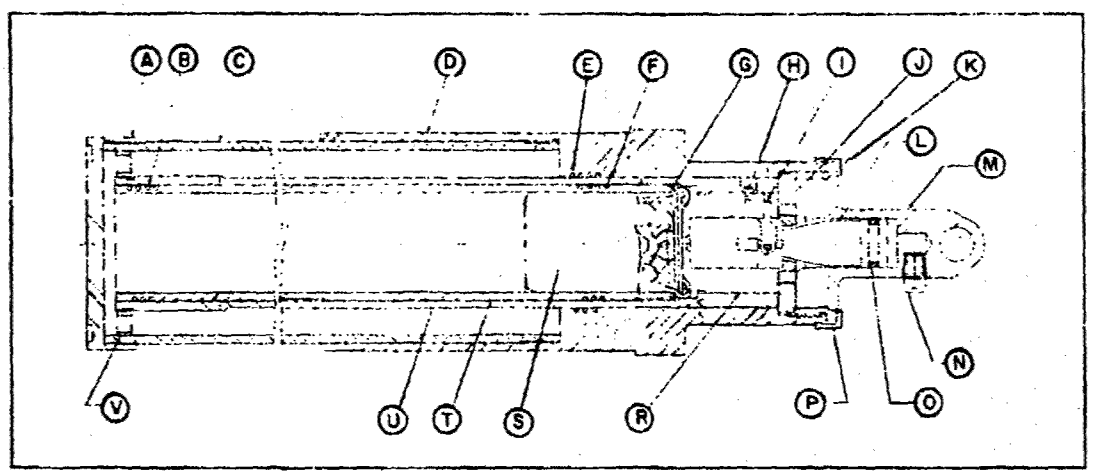
The M3A1 Catapult is a gas actuated three-tube telescoping device containing an explosive cartridge, designed to propel upward, an ejection seat together with a crewman from high-speed aircraft to provide safe escape from disabled aircraft.

The catapult is approximately 51 inches long and 3.0 inches in diameter. The catapult has an initiator attached by a length of flexible hose. When the initiator is functioned, the gas developed flows through the flexible hose, exerting force against the catapult firing pin. The firing pin is propelled forward and strikes and detonates the primer, thereby igniting the black powder and propellant in the M36 Cartridge. The catapult is unlocked by cam action as the firing pin moves toward the primer, unlocking the block assembly and inside tube. The catapult thrust which is developed from the expanding gases of the burning propellant forces the inside and telescoping tubes to move simultaneously until the shoulder on the telescoping tube comes in contact with the trunnion, thus restricting its movement. The continuous moving block assembly and inside tube are ejected with the seat. The outside and telescoping tubes remain with the aircraft.

PRINCIPAL CHARACTERISTICS

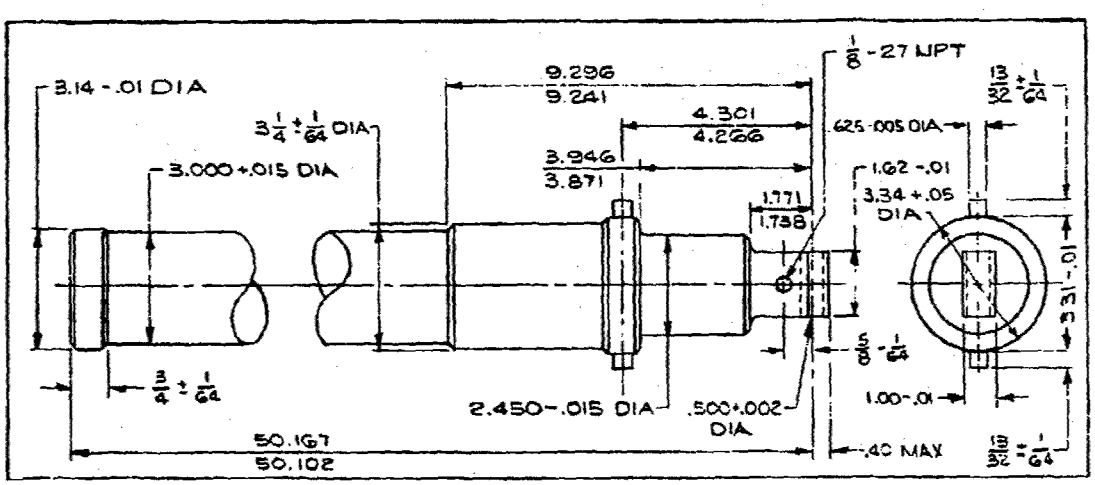
Stroke	88.0 inches
Weight (total assembly)	24.9 pounds
Propelled Weight	350.0 pounds
Temperature Limits	−65°F to +160°F
Max Accel. (at 70°F)	20.0 g
Velocity, min. (at 70°F)	77.0 fps
Max Rate of Change of Accel (at 70°F)	180.0 g/sec
Firing Method	Gas Actuation
Stroke Time (at 70°F)	0.240 sec

Catapult, Aircraft Ejection Seat, M3A1



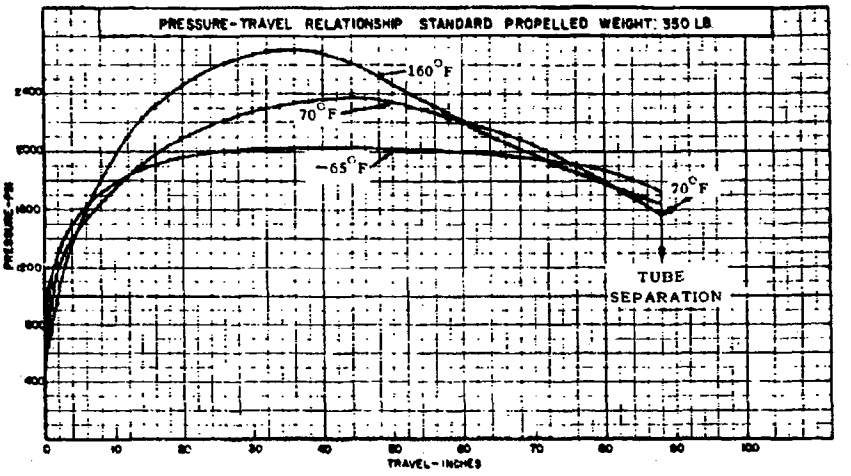
CROSS-SECTION DRAWING

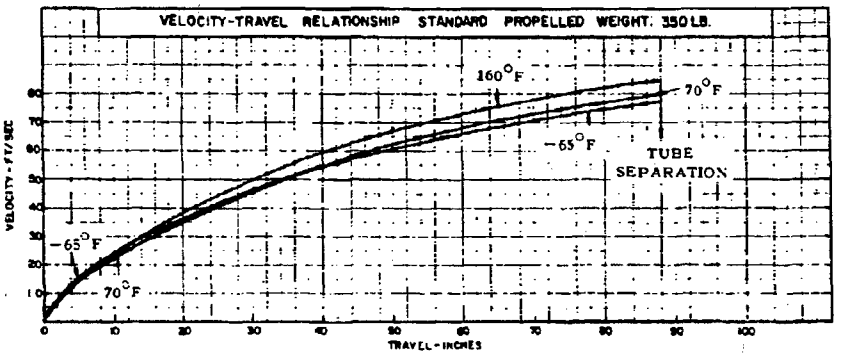
	Component		Component
A	Cap	L	Pin, Firing
B	Seal, Plain	M	Block
C	Tube, Outside and Pellet Assembly	N	Plug, Shipping
		O	"O" Ring
D	Trunnion	P	Ring, Stop and Pellet Assembly
E	Seal, Fixed	R	Plug
F	Seal, Plain	S	Cartridge, Aircraft Ejection Seat, Catapult, M36
G	Washer, Shock		
H	Screw, Cap, Socket Head, Self-Locking (shown out of position)	T	Tube, Inside and Pellet Assembly
		U	Tube, Telescoping
J	Pin, Shear	V	Spacer
J	Latch (2)		
K	Seal, Tamper Proof		

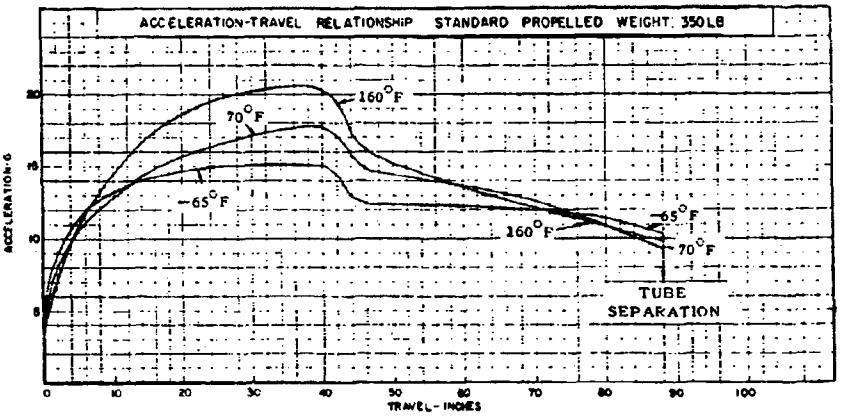


ENVELOPE DRAWING

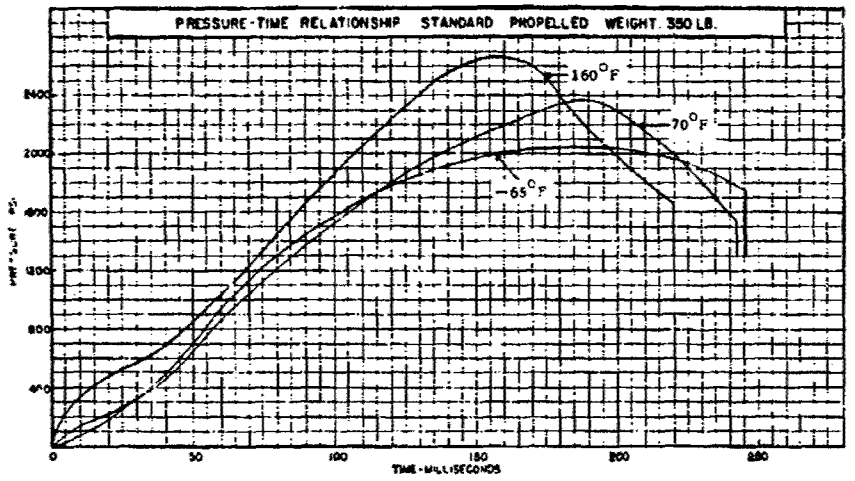
Catapult, Aircraft Ejection Seat, M3A1

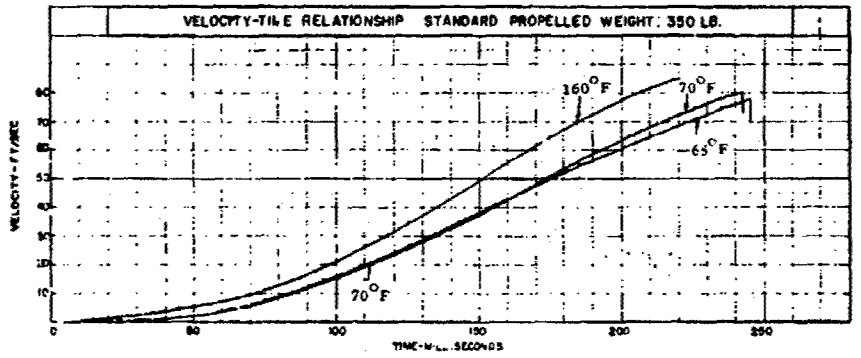


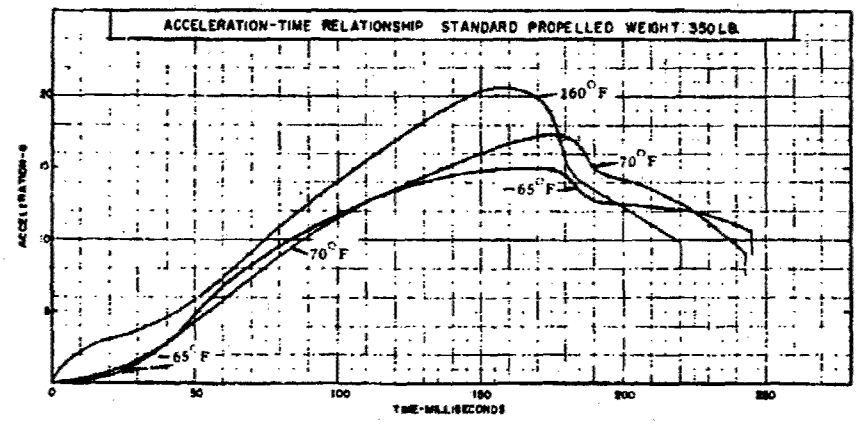




Catapult, Aircraft Ejection Seat, M3A1







CATAPULT, AIRCRAFT EJECTION SEAT, M4A1

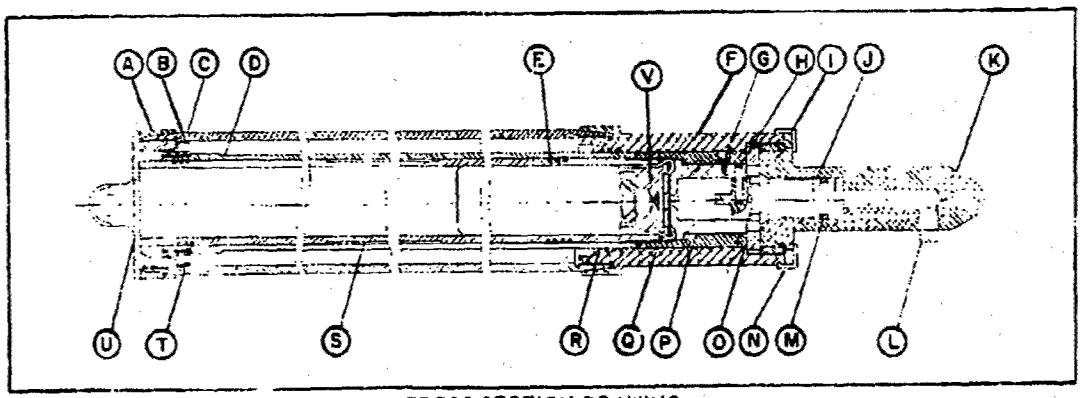
The M4A1 Catapult is a gas actuated three-tube telescoping device, containing an explosive cartridge, designed to propel downward, an ejection seat together with a crewman from high-speed aircraft to provide safe escape from disabled aircraft.

The catapult is approximately 31 inches long and 2.6 inches in diameter. The catapult has an initiator attached by a length of flexible hose. When the initiator is functioned, the gas developed flows through the flexible hose, exerting force against the catapult firing pin. The firing pin is propelled forward and strikes and detonates the primer, thereby igniting the black powder and propellant in the M37 Cartridge. The catapult is unlocked by cam action as the firing pin moves toward the primer, unlocking the block assembly and inside tube. The catapult thrust which is developed from the expanding gases of the burning propellant, forces the inside and telescoping tubes to move simultaniously until the shoulder on the telescoping tube comes in contact with the ring tube stop, thus restricting its movement. The continuous moving block assembly and inside tube are ejected with the seat. The outside and telescoping tubes remain with the aircraft.

PRINCIPAL CHARACTERISTICS

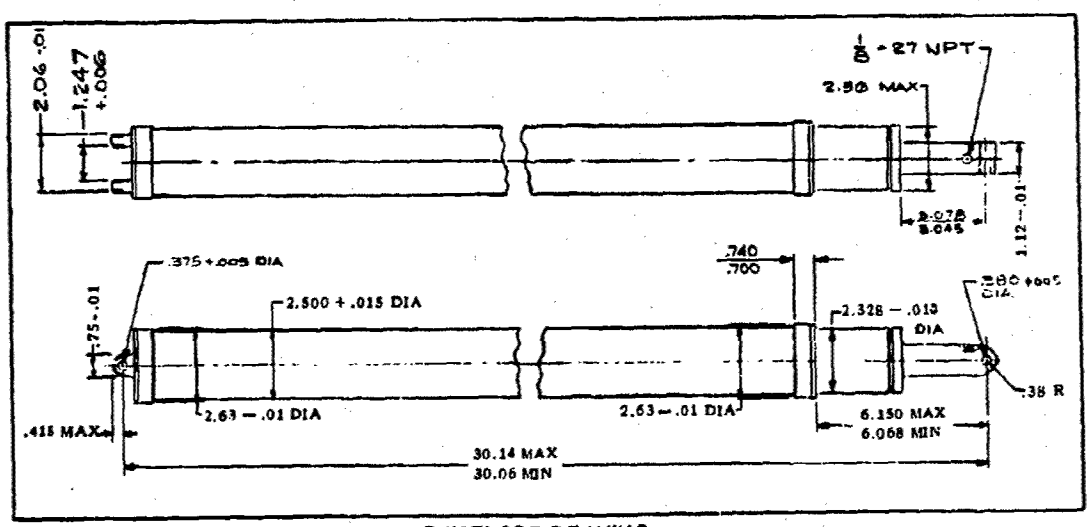
Stroke	45.0 inches
Weight (total assembly)	6.7 pounds
Propelled Weight	325.0 pounds
Temperature Limits	-65°F to +160°F
Max Accel (at 70°F)	12.5 g
Velocity, min. (at 70°F)	38.0 fps
Max rate of change of Accel (at 70°F)	100.0 g/sec
Firing Method	Gas Actuation
Stroke Time (at 70°F)	0.240 sec

Catapult, Aircraft Ejection Seat, M4A1



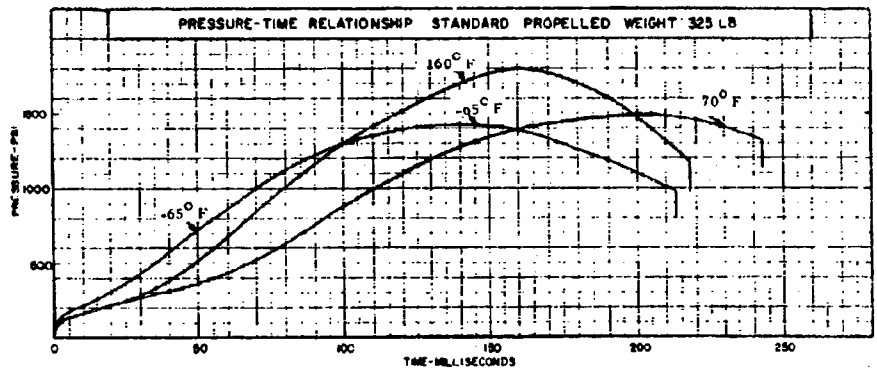
CROSS-SECTION DRAWING

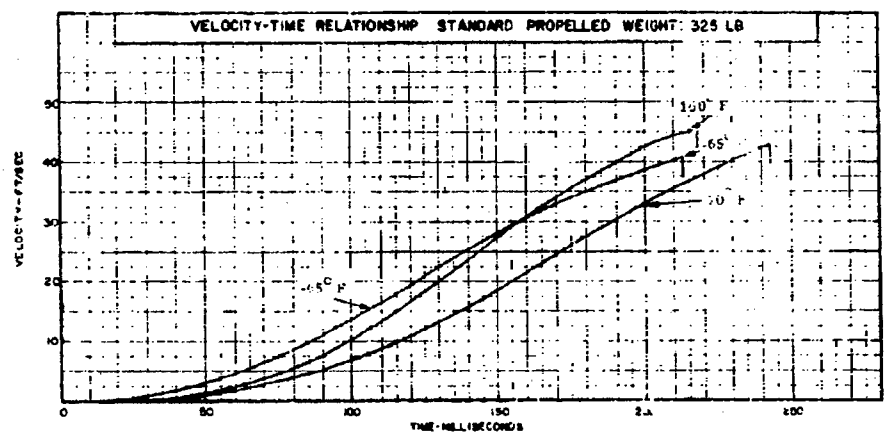
Component		Component	
A	Ring, Compression	M	"O" Ring
B	Spacer	N	Seal, Tamper Proof
C	Tube, Outside	O	Latch (2)
D	Tube, Telescoping & Pellet Assembly	P	Plug
E	Seal, Plain	Q	Washer, Shock
F	Ring, Tube Stop & Pellet Assembly	R	Seal, Fixed
G	Screw, Cap, Socket Head, Self-Locking	S	Tube, Inside & Pellet Assembly
H	Pin, Shear	T	Seal, Plain
I	Ring, Stop & Pellet Assembly	U	Cap & Pellet Assembly
J	Pin, Firing	V	Cartridge, Aircraft Ejection Seat Catapult, M3
K	Block		
L	Plug, Shipping		

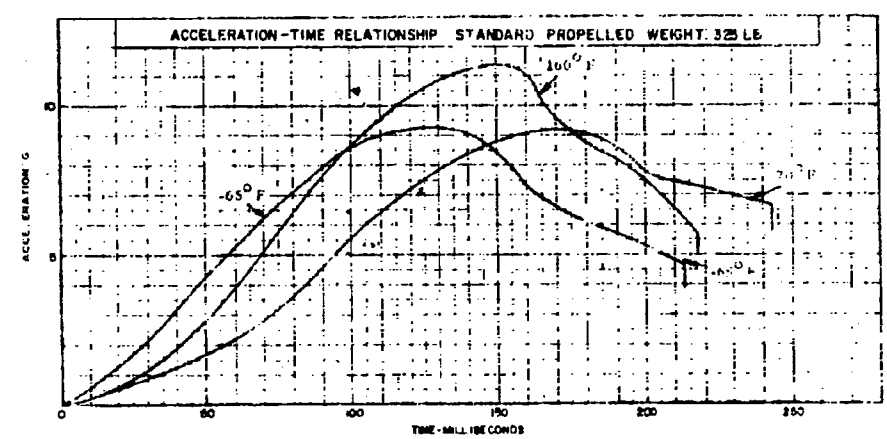


ENVELOPE DRAWING

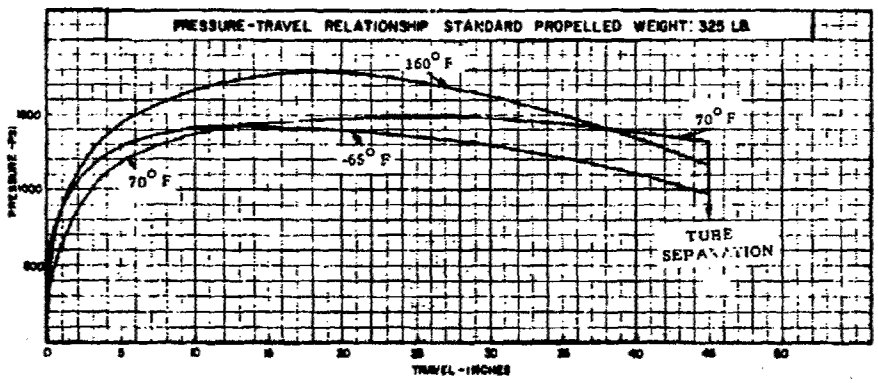
Catapult, Aircraft Ejection Seat, M4A1

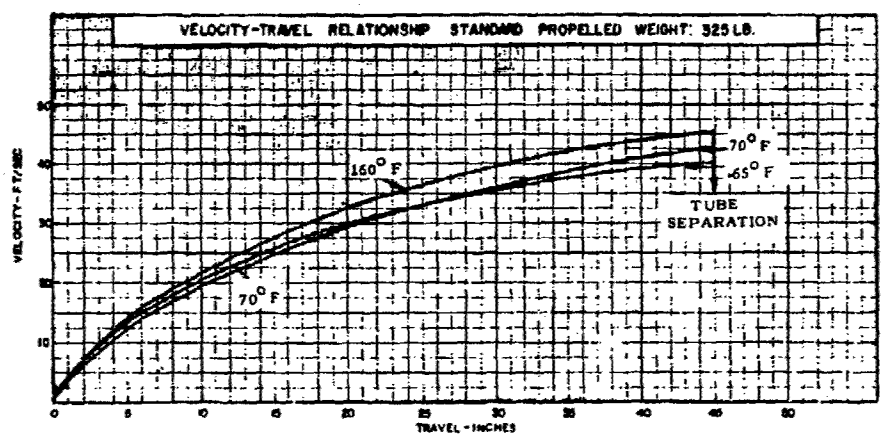


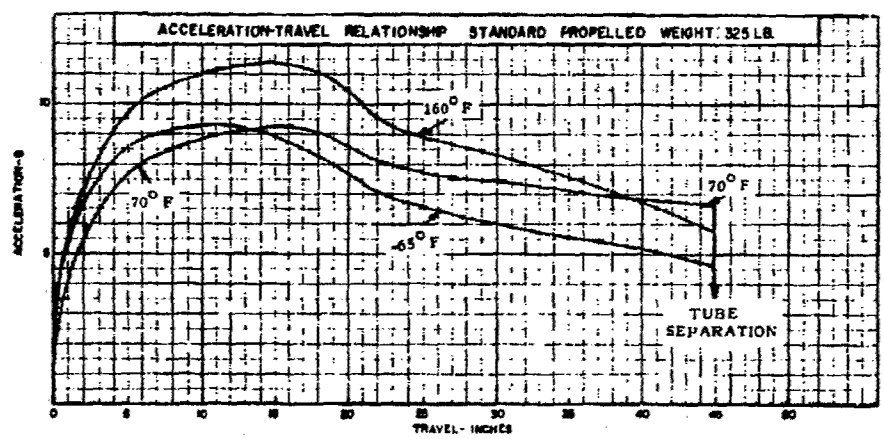




Catapult, Aircraft Ejection Seat, M4A1







CATAPULT, AIRCRAFT EJECTION SEAT, M5A1

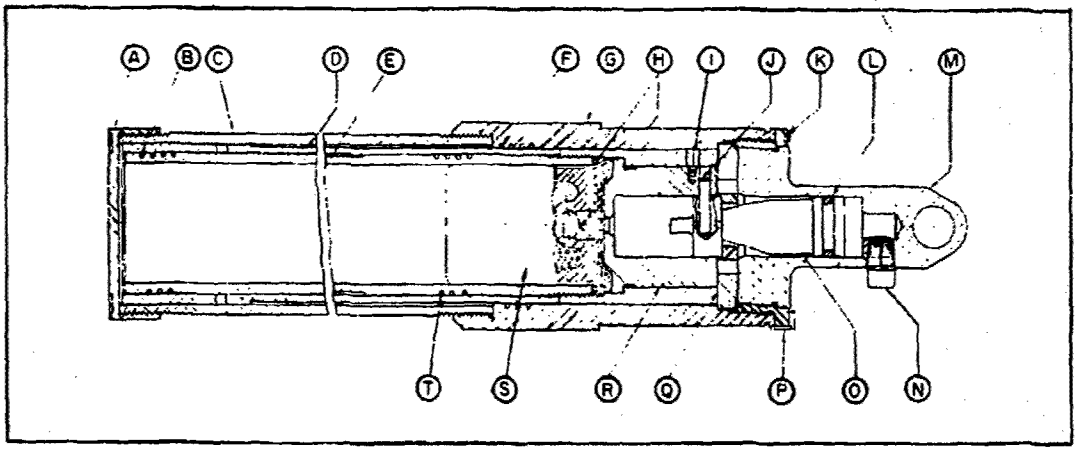
The M5A1 Catapult is a gas actuated three-tube telescoping device containing an explosive cartridge, designed to propel upward an ejection seat together with a crewman from high-speed aircraft to provide safe escape from disabled aircraft.

The catapult is approximately 39 inches long and 2.3 inches in diameter. The catapult has an initiator attached by a length of flexible hose. When the initiator is functioned, the gas developed flows through the flexible hose, exerting force against the catapult firing pin. The firing pin is propelled forward and strikes and detonates the primer, thereby igniting the black powder and propellant in the M28A1 Cartridge. The catapult is unlocked by cam action as the firing pin moves toward the primer, unlocking the block assembly and inside tube. The catapult thrust which is developed from the expanding gases of the burning propellant forces the inside and telescoping tubes to move simultaniously until the shoulder on the telescoping tube comes in contact with the trunnion, thus restricting its movement. The continuous moving block assembly and inside tube are ejected with the seat. The outside and telescoping tubes remain with the aircraft.

PRINCIPAL CHARACTERISTICS

Stroke	66.0 inches
Weight (total assy)	8.2 pounds
Propelled Weight	300.0 pounds
Temperature limits	-65°F to +160°F
Max Accel (at 70°F)	20.0 g
Velocity, min (at 70°F)	60.0 fps
Max rate of change of accel (at 70°F)	170.0 g/sec
Firing Method	Gas Actuation
Stroke Time (at 70°F)	0.220 sec

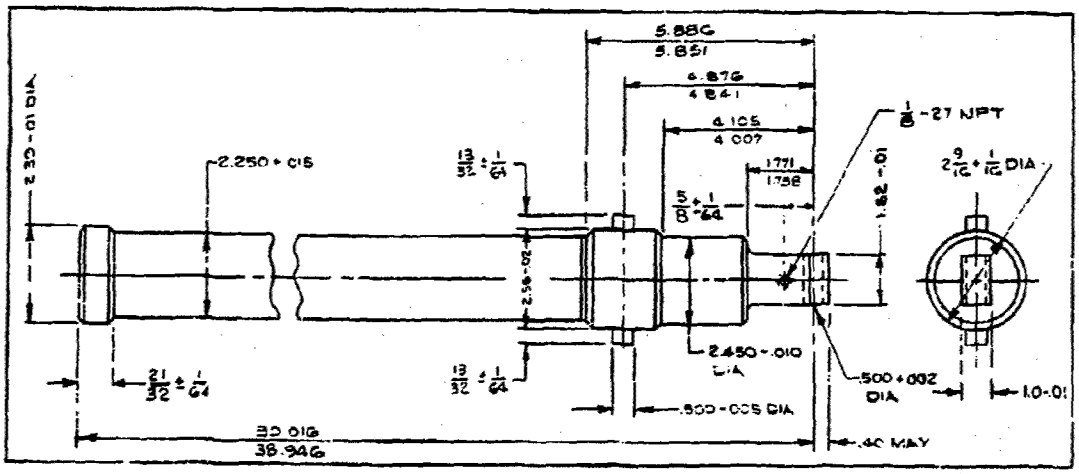
Catapult, Aircraft Ejection Seat, M5A1



CROSS-SECTION DRAWING

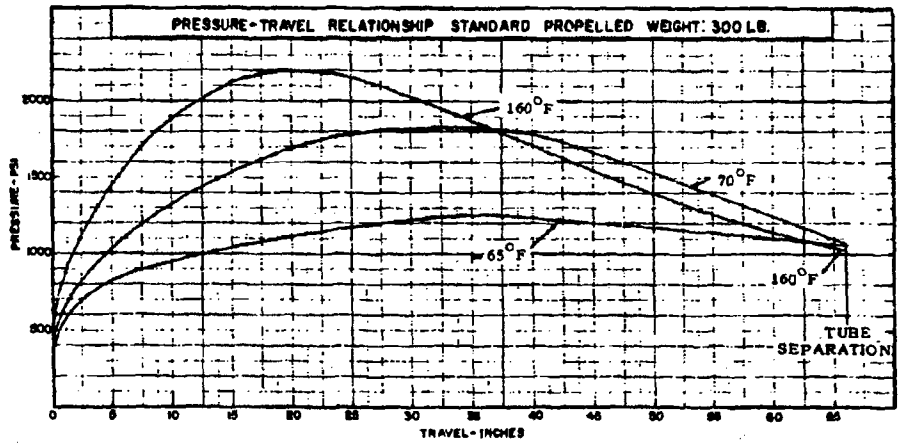
	Component
A	Cap
B	Seal, Plain
C	Tube, Outside & Pellet Assembly
D	Tube, Telescoping
E	Tube, Inside & Pellet Assembly
F	Seal, Fixed
G	Trunnion
H	Washer, Shock
I	Screw, Cap, Socket Head, Self-Locking

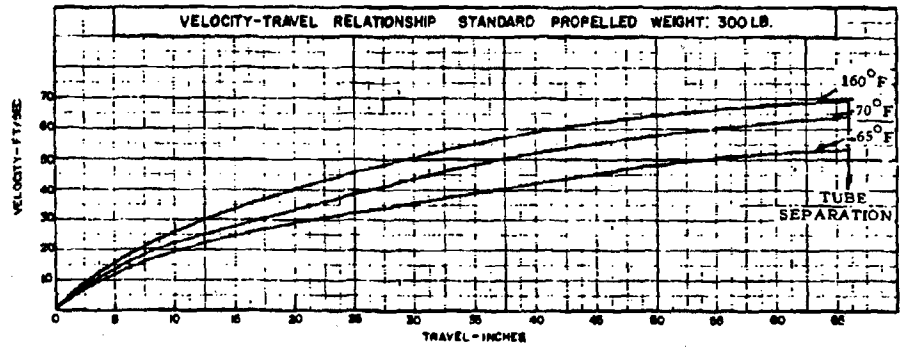
	Component
J	Pin, Shear
K	Ring, Step & Pallet Assembly
L	"O" Ring
M	Block
N	Pipe Plug, Shipping
O	Pin, Firing
P	Seal, Tamper Proof
Q	Latch (2)
R	Plug
S	Cartridge, Aircraft Ejection Seat Catapult, M28A1
T	Seal, Plain

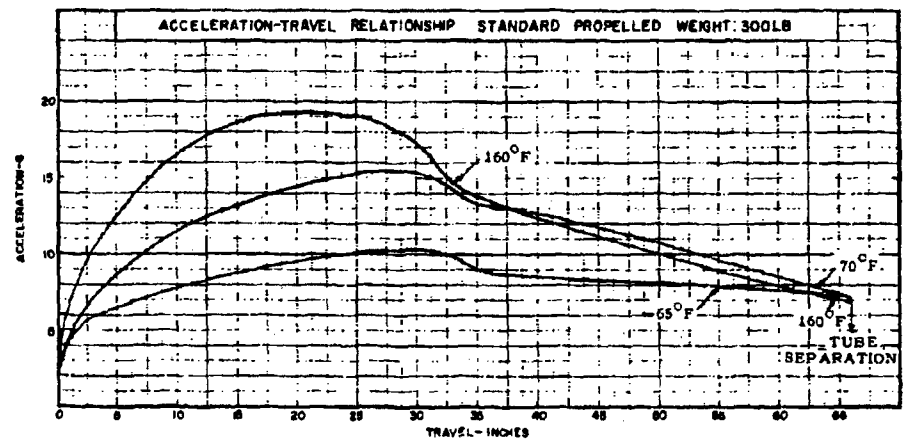


ENVELOPE DRAWING

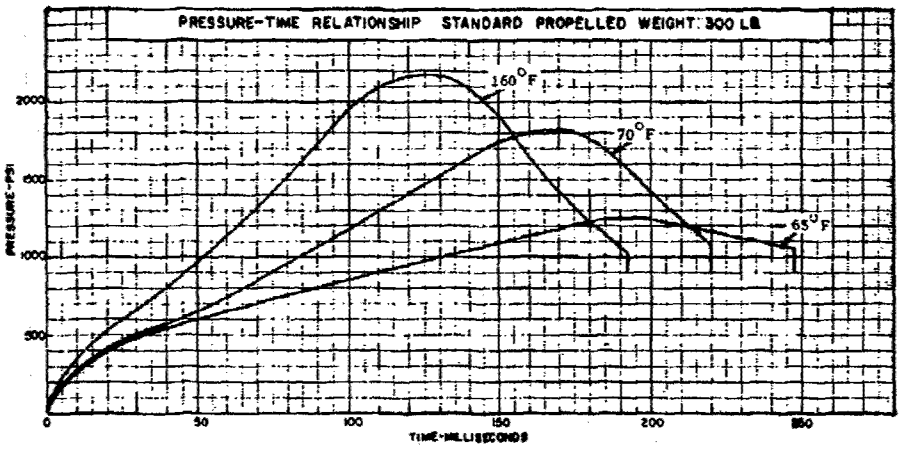
Catapult, Aircraft Ejection Seat, M5A1

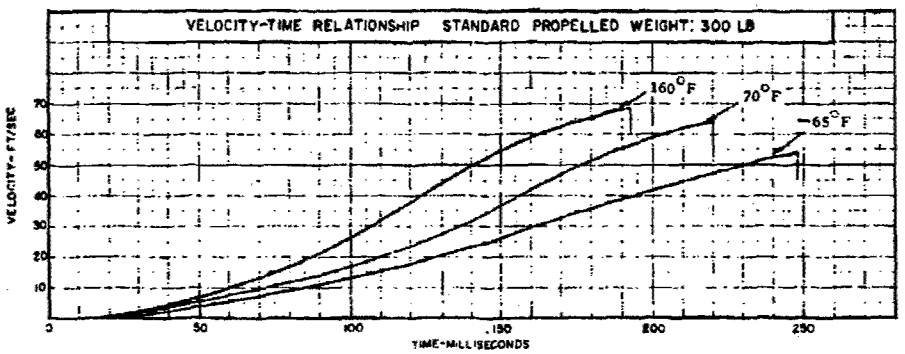


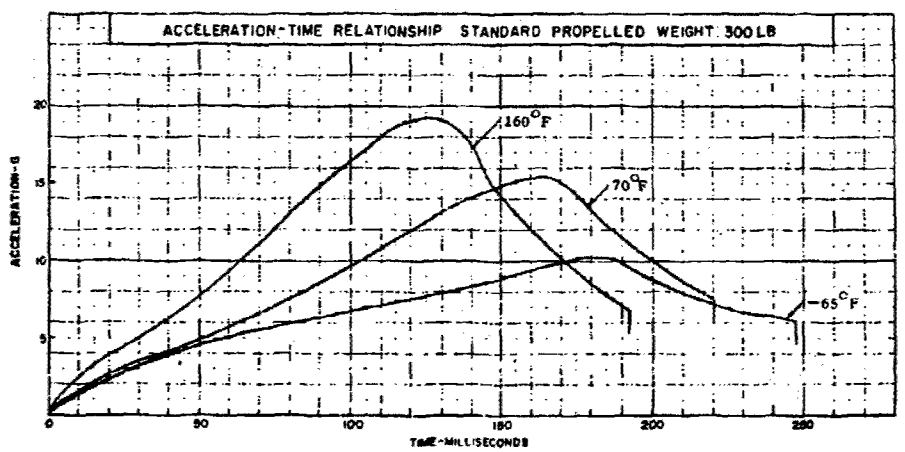




Catapult, Aircraft Ejection Seat, M5A1







CATAPULT, AIRCRAFT EJECTION SEAT, TRAINING, M6A1

The M6A1 Catapult with the Cartridge, Aircraft Ejection Seat Catapult, Training, M57 was designed to be used in the MH-15 Ejection Seat, Indoctrination Trainer (Mobile Type) for indoctrinating U. S. Air Force trainees in the catapult ejection procedures. In this application, the catapult ejects the seat and occupant along a guided track to about a height of 12 feet with moderate acceleration.

The training catapult is a two-tube, mechanically actuated, short stroke unit which is constructed of steel. The catapult is approximately 50.0 inches long. After actuation of the safety plate, the catapult is actuated by mechanical operation by the indoctrinee by means of a grip on the arm rest which is connected to the firing arm by a cable. Squeezing the grip rotates the firing arm and releases the spring loaded firing pin which strikes and detonates the primer, thereby igniting the black powder and propellant in the M57 Cartridge. The catapult thrust which is developed from the expanding gases of the burning propellant propels the seat and occupant up the tower. The inside tube and firing head assembly, which are attached to the seat, separate from the outside tube and are carried with the seat on ascent. The outside tube and its permanently attached parts remain in the cockpit of the trainer.

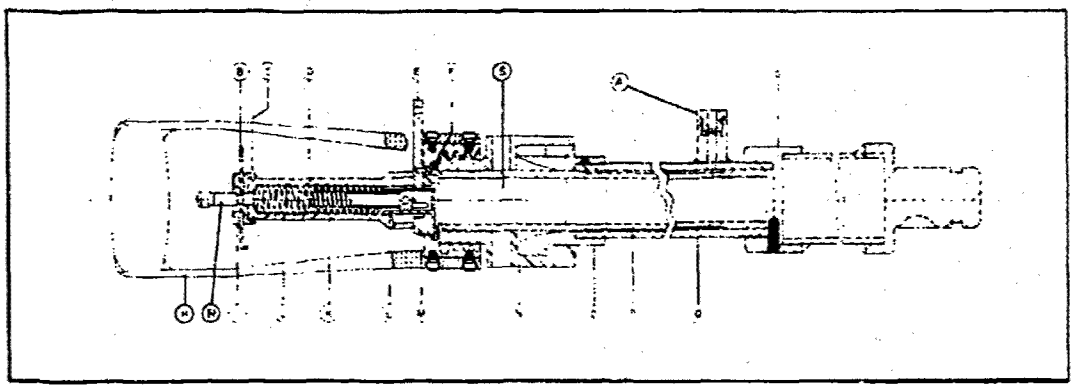
There are two safety systems connected to the catapult. The first system consisting of a plate prevents firing of the catapult inadvertently by the trainee, while the second prevents seat movement in the event of cartridge failure or other malfunctions. The latter safety system is accomplished by rotating the catapult outside tube through a cable locking system located on the trainer. This rotation causes the lugs of the bell cap located on top of the outside tube to engage corresponding protrusions inside the trunnion and securely locks both inner and outer tubes together.

A ballistic safety value assembly, incorporating a pre-bulged rupture disc, is attached to the lower end of the catapult outside tube and its purpose is to bleed off excessive gas pressure which might result in an excessive height of travel on the trainer.

PRINCIPAL CHARACTERISTICS

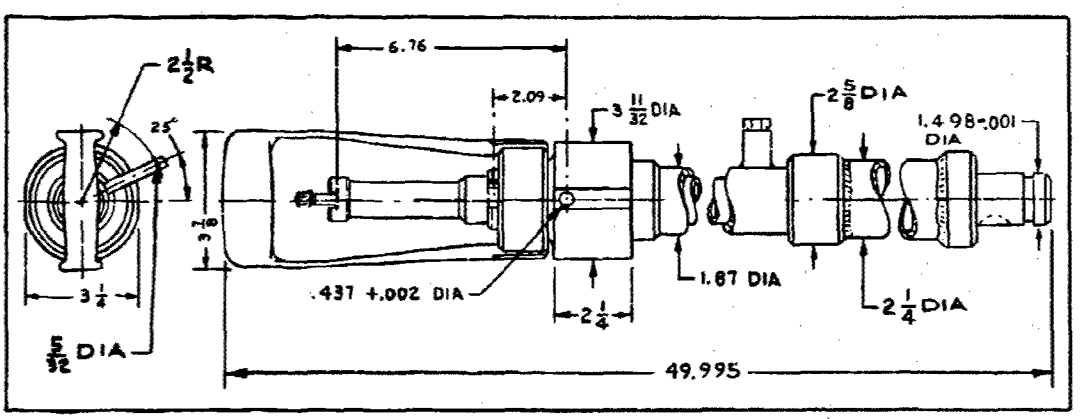
Stroke	21.0 inches
Weight (total Assembly)	31.5 pounds
Propelled weight	300.0 pounds
Temperature Limits	-40°F to 125°F
Max accel (at 70°F)	8.5 g
Firing Method	Mechanical Actuation
Stroke Time (at 70°F)	0.163 sec

Catapult, Aircraft Ejection Seat, Training, M6A1



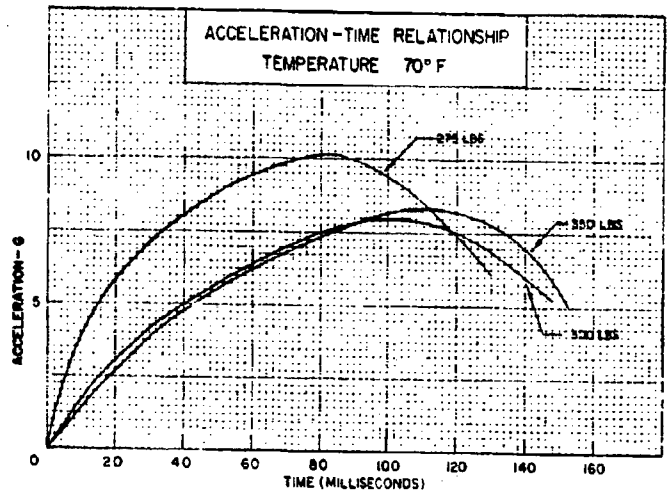
CROSS-SECTION DRAWING

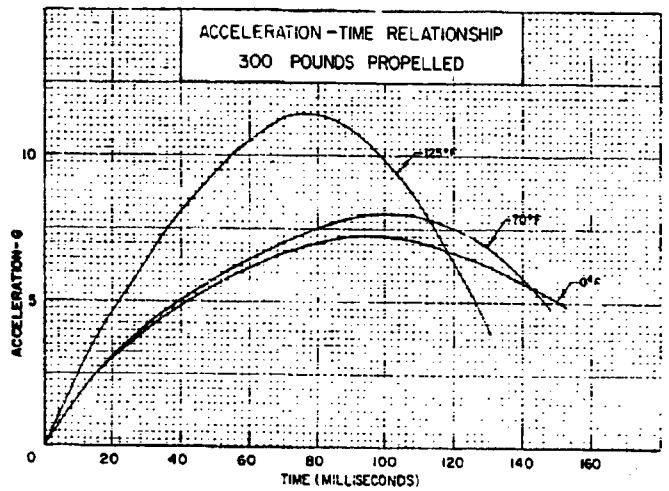
	Component		Component
A	Valve, Safety Assembly (shown out of position)	K	Spring, Firing Pin
B	Plate	L	Ring, Sear
C	Ring, Snap	M	Body, Breech
D	Cap, Breech	N	Trunnion and Breech Ring Assembly
E	Firing Arm Assembly	O	Cap, Bell
F	Ring, Snap, Retaining, Internal, Inverted Lug	P	Tube, Inside
G	Mount Assembly	Q	Tube, Outside
H	Handle	R	Pin, Firing and Stop Assembly
I	Slide	S	Cartridge, Aircraft Ejection Seat, Catapult, M57 (Installed at Training Base)
J	Spring, Sear, Ring		

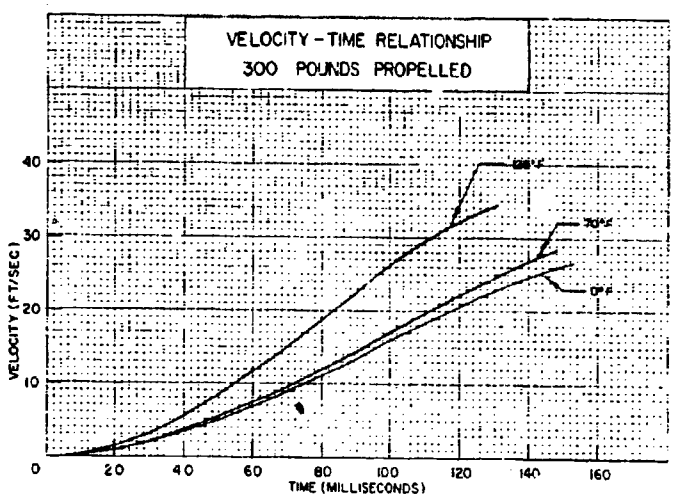


ENVELOPE DRAWING

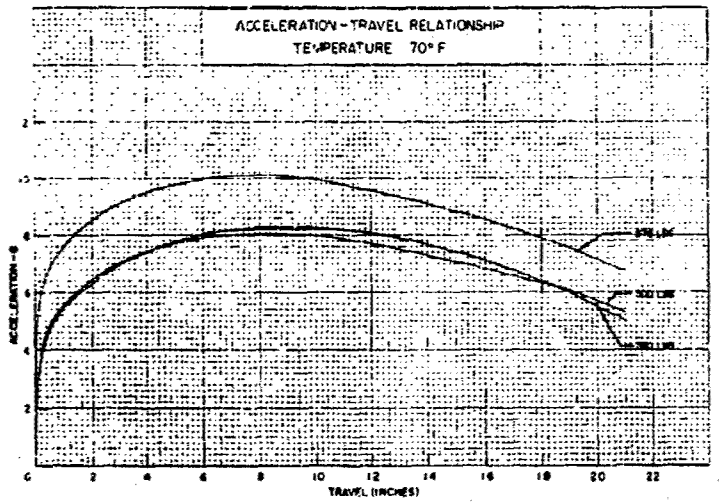
Catapult, Aircraft Ejection Seat, Training, M6A1

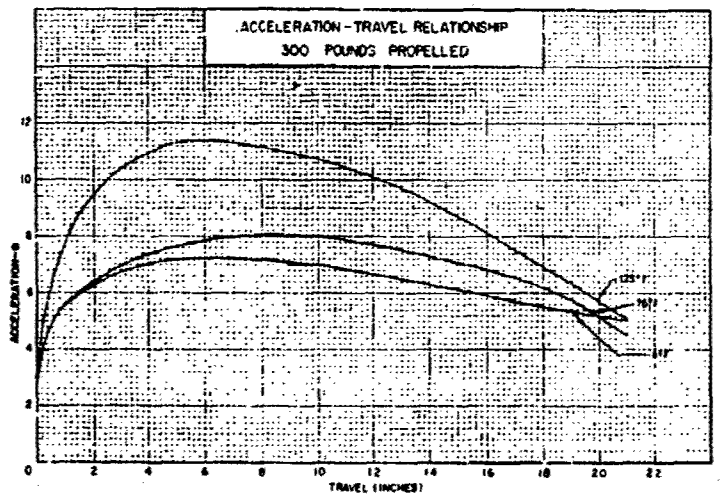


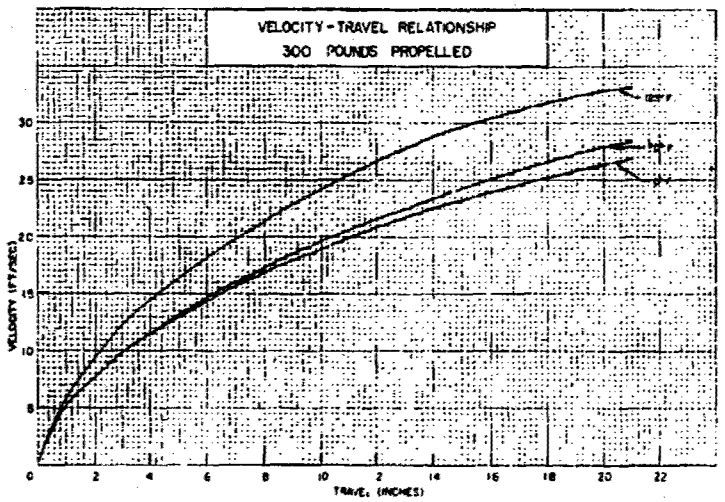




Catapult, Aircraft Ejection Seat, Training, M6A1







CATAPULT, AIRCRAFT EJECTION SEAT, M8

The M8 Catapult is a rocket-assisted two tube telescoping device developed for use in the F105 Aircraft to provide "off-the-deck" as well as high speed ejection capability from disabiled aircraft. The catapult is a two-stage device; the initial booster phase and final rocket motor phase.

The catapult is approximately 46.3 inches long and 2.89 inches in diameter. The catapult has an initiator attached by a length of flexible hose. When the initiator is functioned, the gas developed flows through the hose, exerting force against the catapult firing pin. The firing pin is propelled forward and strikes and detonates the primer contained in the primary igniter. This action initiates the firing of the booster phase. The primer ignites the pyrotechnic composition contained in the igniter which flashes down the booster tube igniting the strip propellant bonded to the strip holder. The booster gas pressure moves the can, thereby permitting the tangs of the nozzle retainer to be cammed inward, unlocking the unit. Continued booster gas production propels the rocket motor and the seat vertically. At a point prior to motor tube separation, the cable, which is attached to the can, engages the cable guide on the strip holder assembly and forces the piston slider valve downward uncovering the gas by-pass ports on the cylinder booster tube assembly. This allows the hot booster gases to dump into the motor chamber which ignites the auxiliary igniter and the rocket propellant grain. The burning propellant grain produces gas at a high rate, pressurizing the motor chamber. This pressure forces out the nozzle cups allowing the gas to exhaust through the nozzle ports, thus providing thrust which propels the seat and occupant upward and forward. The nozzle is canted 37°30′ so as to direct the rocket thrust through the center of gravity of the seat-man combination.

PRINCIPAL CHARACTERISTICS

Weight (total assembly)	27.0 lbs.
Propelled Weight	350.0 lbs.
Temperature Limits	−65° to +160°F

Catapult (Booster Section)

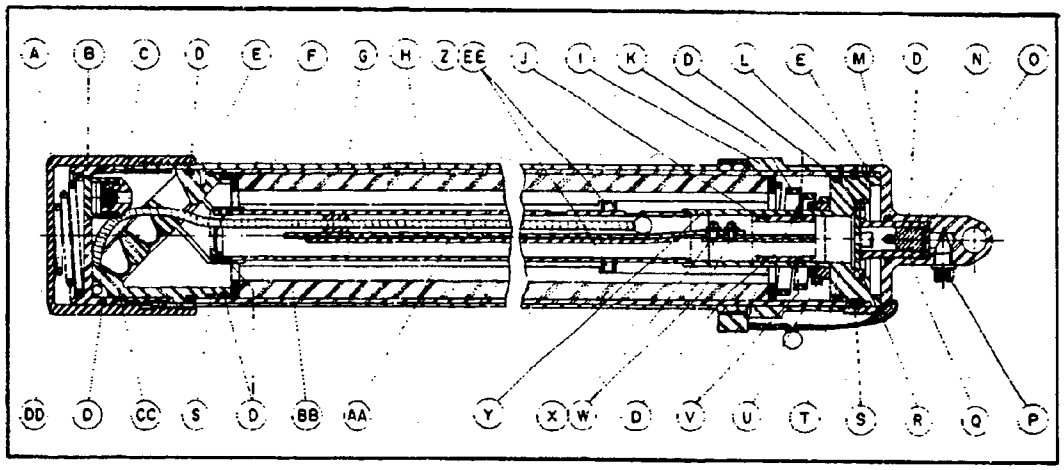
Stroke	40 inches
Max Acceleration (at 70°F)	20.0 g
Velocity (at 70°F)	40.0 fps
Max Rate of Change of Acceleration (at 70°F)	300.0 g/sec
Stroke Time (at 70°F)	0.175 sec
Firing Method	Gas Actuation

PRINCIPAL CHARACTERISTICS (M8 Cont'd)

Rocket (Sustainer Section)

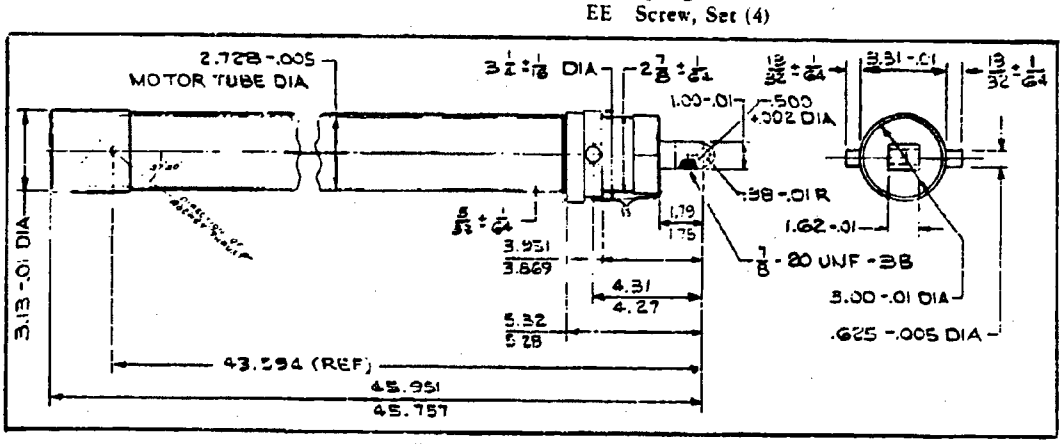
Action Time, max (at 70°F)	0.400 sec.
Impulse (resultant at 70°F)	1200 lb-sec.
Pressure, max	4600 psi.
Ignition Delay, max (at 70°F)	0.012 sec.
Nozzle Angle	37°30′

Catapult, Aircraft Ejection Seat, M8



CROSS-SECTION DRAWING

Component		Component	
A	Breech, Launcher	P	Plug, Shipping
B	Can, Bottom	Q	Sleeve, Firing Pin
C	Holder, Cable Lower	R	Ring, Retaining
D	"O" Ring	S	Wire, Lock
E	Screw, Set	T	Igniter, Primary Assembly
F	Plate, Orifice	U	Igniter, Auxiliary Assembly
G	Tube, Launcher And Pellet Assembly	V	Pin, Valve Shear (4)
H	Tube, Motor	W	Screw (2)
I	Trunnion	X	Washer (2)
J	Piston, Slider Valve	Y	Cylinder, Slider Valve And Tube Booster Assembly
K	Spring, Grain	Z	Collar, Grain
L	Cap, Igniter	AA	Holder, Strip, Loaded Assembly
M	Head, Motor Tube	BB	Propellant, Grain Inhibited
N	Pin, Firing	CC	Nozzle Assembly
O	Pin, Shear	DD	Spring, Can
		EE	Screw, Set (4)



ENVELOPE DRAWING

CATAPULT, AIRCRAFT EJECTION SEAT, M9

The M9 Catapult is a rocket-assisted two tube telescoping device developed for use in the T-38 Aircraft to provide "off-the-deck" as well as high speed ejection capability from disabled aircraft. The catapult is a two-stage device; the initial booster phase and final rocket motor phase.

The catapult is approximately 41.9 inches long and 2.89 inches in diameter. The catapult has an initiator attached by a length of flexible hose. When the initiator is functioned, the gas developed flows through the hose, exerting force against the catapult firing pin. The firing pin is propelled forward and strikes and detonates the primer contained in the primary igniter. This action initiates the firing of the booster phase. The primer ignites the pyrotechnic composition contained in the igniter which flashes down the booster tube igniting the strip propellant bonded to the strip holder. The booster gas pressure moves the can, thereby permitting the tangs of the nozzle retainer to be cammed inward, unlocking the unit. Continued booster gas production propels the rocket motor and the seat vertically. At a point prior to motor tube separation, the cable, which is attached to the can, engages the cable guide on the strip holder assembly and forces the piston slider valve downward uncovering the gas by-pass ports on the cylinder booster tube assembly. This allows the hot booster gases to dump into the motor chamber which ignites the auxiliary igniter and the rocket propellant grain. The burning propellant grain produces gas at a high rate, pressurizing the motor chamber. This pressure forces out the nozzle cups allowing the gas to exhaust through the nozzle ports, thus providing thrust which propels the seat and occupant upward and forward. The nozzle is canted 47° 30', so as to direct the rocket thrust through the center of gravity of the seat-man combination.

PRINCIPAL CHARACTERISTICS

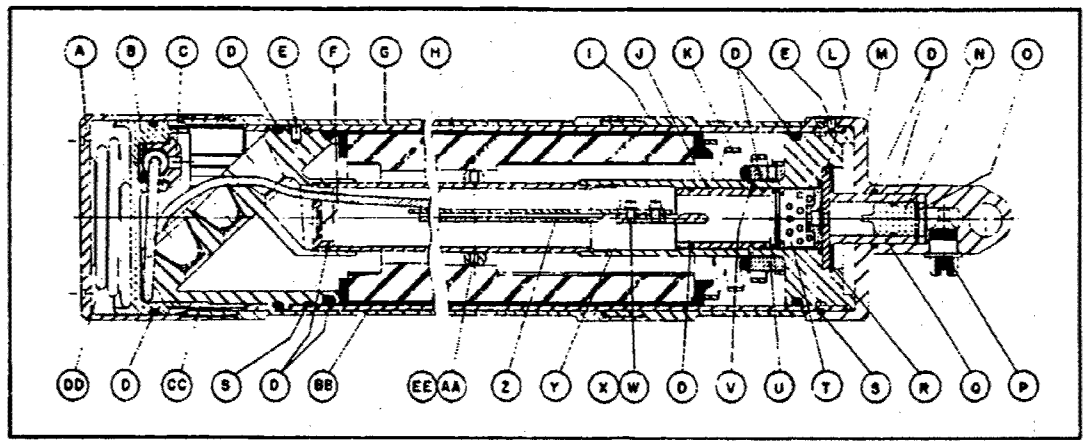
Weight (total Assembly)	24.0 lbs.
Propelled Weight	350 lbs.
Temperature Limits	−65°F to +160°F
Catapult (Booster Section)	
Stroke	35-3/4 inches
Max Accel. (at 70°F)	20.0 g
Velocity (at 70°F)	40.0 fps
Max. Rate of Change of Accel. (at 70°F)	300 g sec
Stroke Time (at 70°F)	0.160 sec
Firing Method	Gas Actuation

PRINCIPAL CHARACTERISTICS (M9 Cont'd)

Rocket (Sustainer Section)

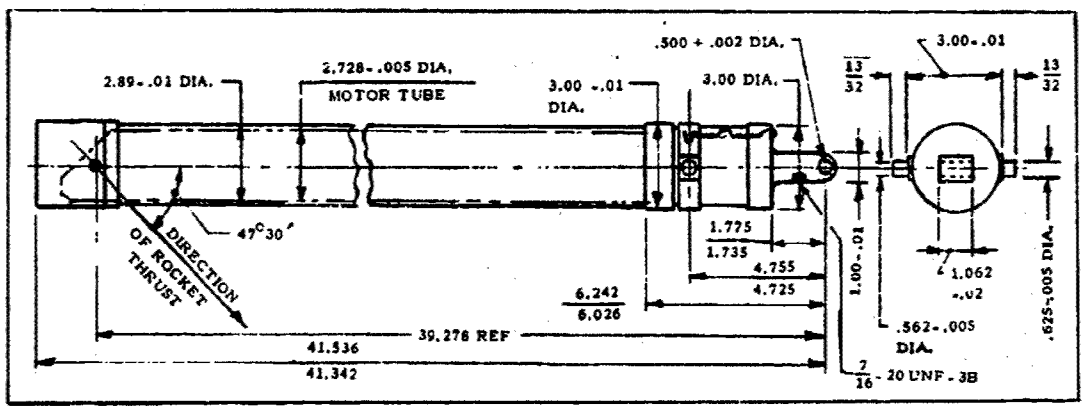
Action Time, max (at 70°F)	0.350 sec
Impulse (resultant at 70°F)	1100 lb-sec
Pressure, max	4600 psi
Ignition Delay, max (at 70°F)	0.012 sec
Nozzle Angle	47°30′

Catapult, Aircraft Ejection Seat, M9



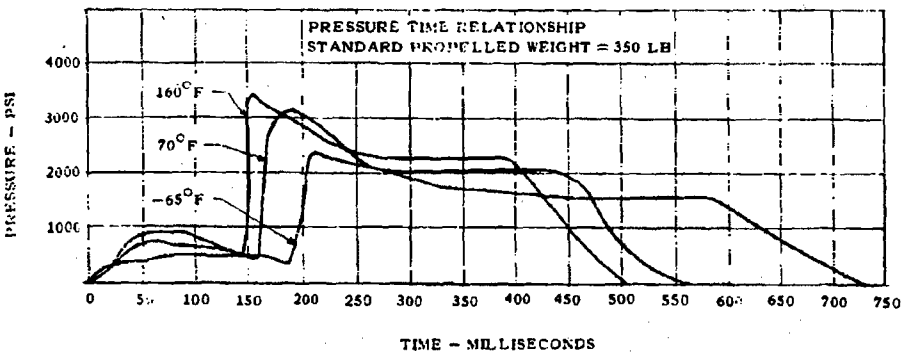
CROSS-SECTION DRAWING

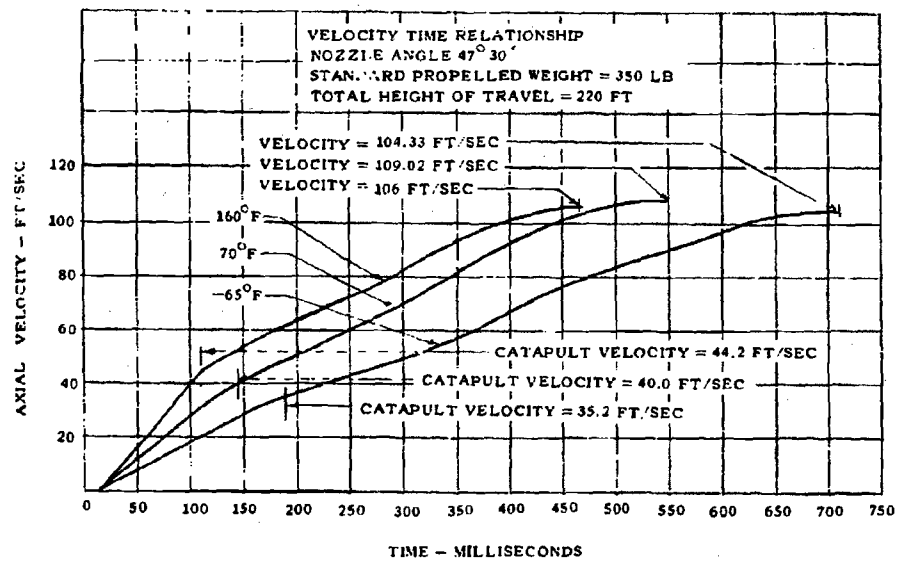
	Component		Component
A	Breech, Launcher	P	Plug, Shipping
B	Can, Bottom	Q	Sleeve, Firing Pin
C	Holder, Cable Lower	R	Ring, Retaining
D	"O" Ring	S	Wire, Lock
E	Screw, Set	T	Igniter, Primary Assembly
F	Plate, Orfice	U	Igniter, Auxiliary Assembly
G	Tube, Launcher And Pellet Assembly	V	Pin, Valve Shear (4)
H	Tube, Motor	W	Screw (2)
I	Trunnion And Pellet Assembly	X	Washer (2)
J	Piston, Slider Valve	Y	Cylinder, Slider Valve And Tube Booster Assembly
K	Spring, Grain	Z	Holder, Strip, Loaded Assembly
L	Cap, Igniter	AA	Collar, Grain
M	Head, Motor Tube	BB	Propellant, Grain Inhibited
N	Pin, Firing	CC	Nozzle Assembly
O	Pin, Shear	DD	Spring, Can
		EE	Screw, Set (4)

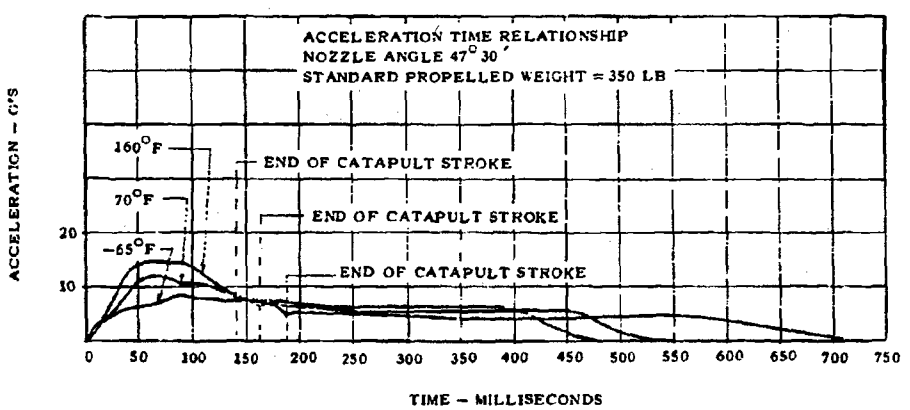


ENVELOPE DRAWING

Catapult, Aircraft Ejection Seat, M9







CATAPULT, AIRCRAFT EJECTION SEAT, M10

The M10 Catapult is a rocket-assisted two tube telescoping device developed for use in the F104 Aircraft to provide "off-the-deck" as well as high speed ejection capability from disabled aircraft. The catapult is a two stage device; the initial booster phase and final rocket motor phase.

The catapult is approximately 44.1 inches long and 2.89 inches in diameter. The catapult has an initiator attached by a length of flexible hose. When the initiator is functioned, the gas developed flows through the hose, exerting force against the catapult firing pin. The firing pin is propelled forward and strikes and detonates the primer contained in the primary igniter. This action initiates the firing of the booster phase. The primer ignites the pyrotechnic composition contained in the igniter which flashes down the booster tube igniting the strip propellant bonded to the strip holder. The booster gas pressure moves the can, thereby permitting the tangs of the nozzle retainer to be cammed inward, unlocking the unit. Continued booster gas production propels the rocket motor and the seat vertically. At a point prior to motor tube separation the cable, which is attached to the can, engages the cable guide on the strip holder assembly and forces the piston slider valve downward uncovering the gas by-pass ports on the cylinder booster tube assembly. This allows the hot booster gases to dump into the motor chamber which ignite the auxiliary igniter and the rocket propellant grain. The burning propellant grain produces gas at a high rate, pressurizing the motor chamber. This pressure forces out the nozzle cups allowing the gas to exhaust through the nozzle ports, thus providing thrust which propels the seat and occupant upward and forward. The nozzle is canted 36°20', so as to direct the rocket thrust through the center of gravity of the seat-man combination.

PRINCIPAL CHARACTERISTICS

Weight (Total Assy)	26.0 pounds
Propelled Weight	400.0 pounds
Temperature Limits	-65°F to +160°F

Catapult (Booster Section)

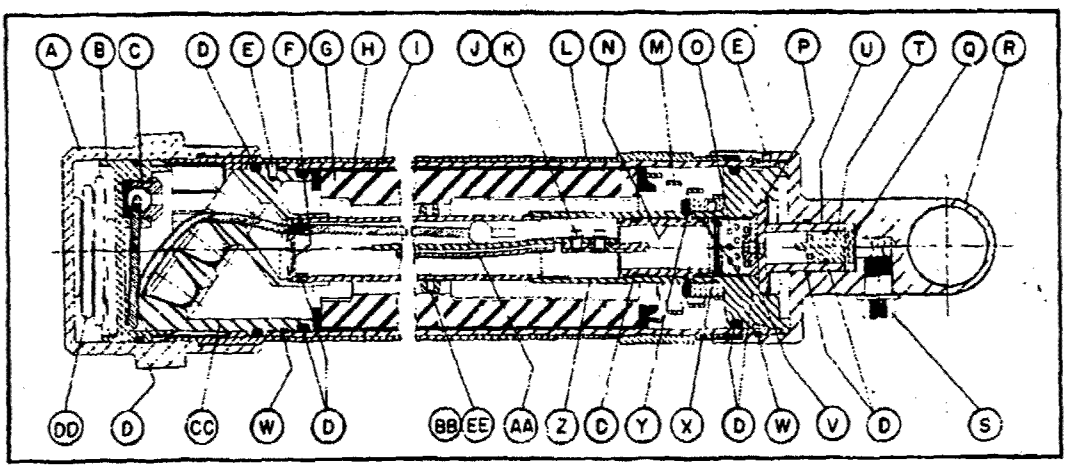
Stroke	34.0 inches
Max. Acceleration (at 70°F)	20.0 g
Velocity (at 70°F)	40.0 fps
Max. Rate of Change of Acceleration (at 70°F)	350.0 g/sec
Stroke time (at 70°F)	0.155 sec
Firing Method	Gas Actuation

PRINCIPAL CHARACTERISTICS (M10 Cont'd)

Rocket (Sustainer Section)

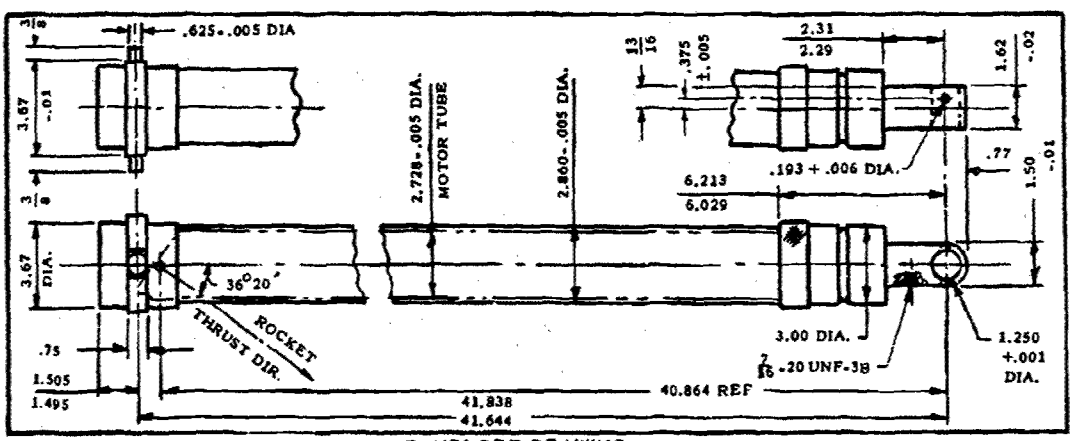
Action Time, max. (at 70°F)	0.400 sec
Impulse (resultant, at 70°F)	1100 lb-sec
Pressure, max.	4600 psi
Ignition Delay, max. (at 70°F)	0.012 sec
Nozzle Angle	36° 20′

Catapult, Aircraft Ejection Seat, M10



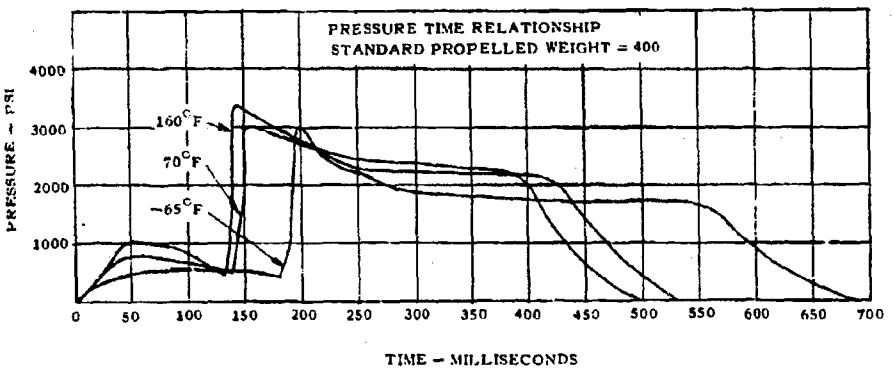
CROSS-SECTION DRAWING

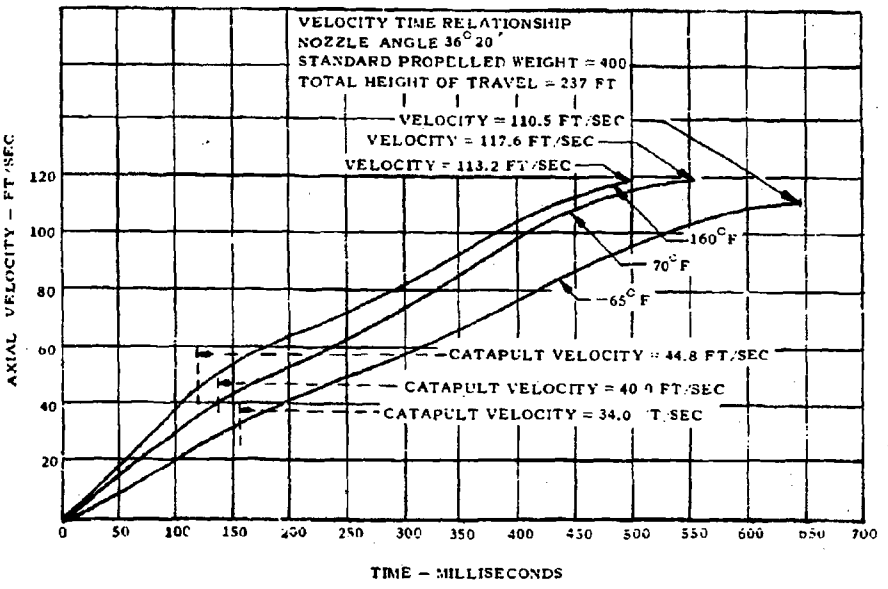
Component		Component	
A	Breech, Launcher Trunnion	Q	Pin, Shear
B	Can, Bottom	R	Head, Motor Tube
C	Holder, Cable Lower	S	Plug, Shipping
D	"O" Ring	T	Pin, Firing
E	Screw, Set	U	Sleeve, Firing Pin
F	Plate, Orifice	V	Cap, Igniter Retaining
G	Propellant Grain, Inhibited	W	Wire, Lock
H	Tube, Launcher	X	Igniter, Auxiliary Assembly
I	Tube, Motor	Y	Pin, Valve, Shear (4)
J	Screw (2)	Z	Cylinder, Slider Valve And Tube Booster Assembly
K	Washer (2)	AA	Holder, Strip Loaded Assembly
L	Sleeve, Head	BB	Collar, Grain
M	Spring, Grain	CC	Nozzle Assembly
N	Piston, Slider Valve	DD	Spring, Can
O	Igniter, Primary Assembly	EE	Screw Set (4)
P	Ring, Retaining		

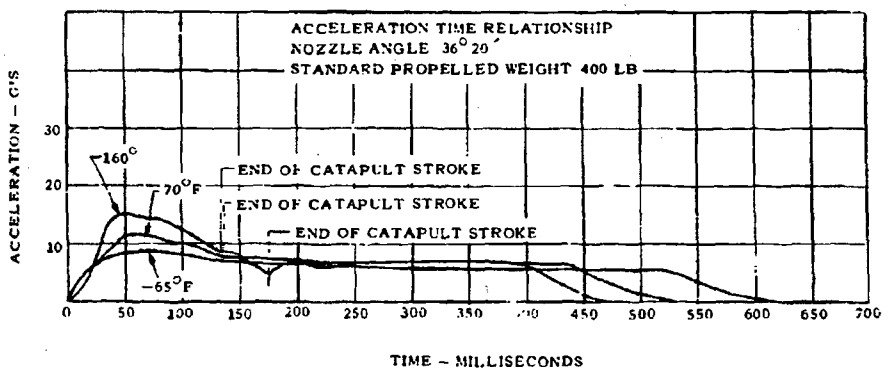


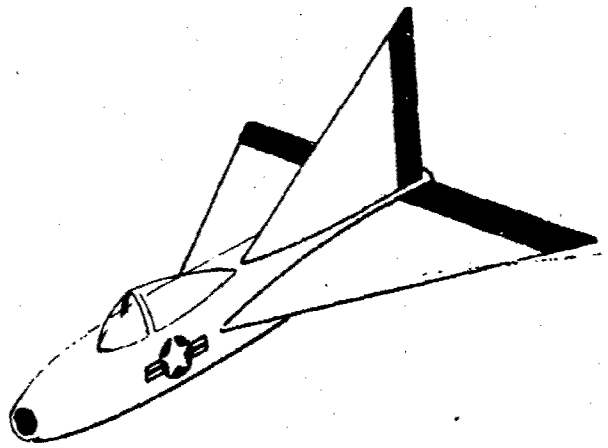
ENVELOPE DRAWING

Catapult, Aircraft Ejection Seat, M10









SECTION IV

INITIATORS

INTRODUCTION

Description:

An initiator is an actuating energy source for the operation of the firing mechanisms of other propellant actuated device components of aircrew escape systems. It is a cylindrical device consisting of a chamber with a pressure outlet port, a firing mechanism and a cartridge.

Initiator devices are classified in accordance with the following characteristics: (1) Method of Actuation – mechanical or gas pressure; (2) Function Time – nondelay or delay; and (3) Performance – low or high pressure energy.

Operation:

Actuation of the mechanical initiator is accomplished by an axial load application to the initiator pin. The firing pin, which is locked to the initiator pin with steel balls, compresses the spring enclosed in the firing pin housing and initiator cap, upon initiator pin withdrawal. When the firing pin enters the relieved section of the spring enclosure, the balls move outward, disengaging the initiator pin which is withdrawn from the device. The released firing pin is then propelled against the cartridge percussion primer by the exerted force of the compressed spring.

Actuation of the gas-fired initiator is accomplished when gas pressure, supplied by another propellant actuated device is introduced into the initiator inlet port, exerting a force against the firing pin which is retained in position by a shear pin. The resultant force application, causing shearing of the pin, propels the firing pin against the cartridge percussion primer.

INITIATOR, CARTRIDGE ACTUATED, M3A1

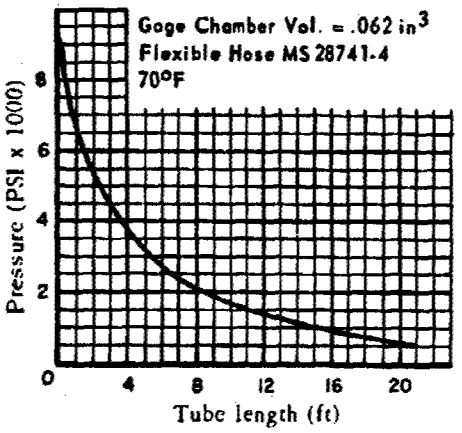
The M3A1 Initiator consists of a constant volume chamber with a pressure outlet port incorporating a standard pressure fitting, a mechanically operated firing mechanism and an M73 Cartridge. A length of tube or hose connects the initiator to another remotely installed propellant actuated device.

Upon cartridge function, the gas produced by the burning of the propellant and black powder charge flows through the tube to the gas pressure actuated firing mechanism of the other propellant actuated device, exerting a force which propels the firing pin against the cartridge contained in that device. The length of the connecting tube and/or hose, or the distance that the initiator can be mounted from the other device, is limited by the firing pin energy required for reliable operation of the device.

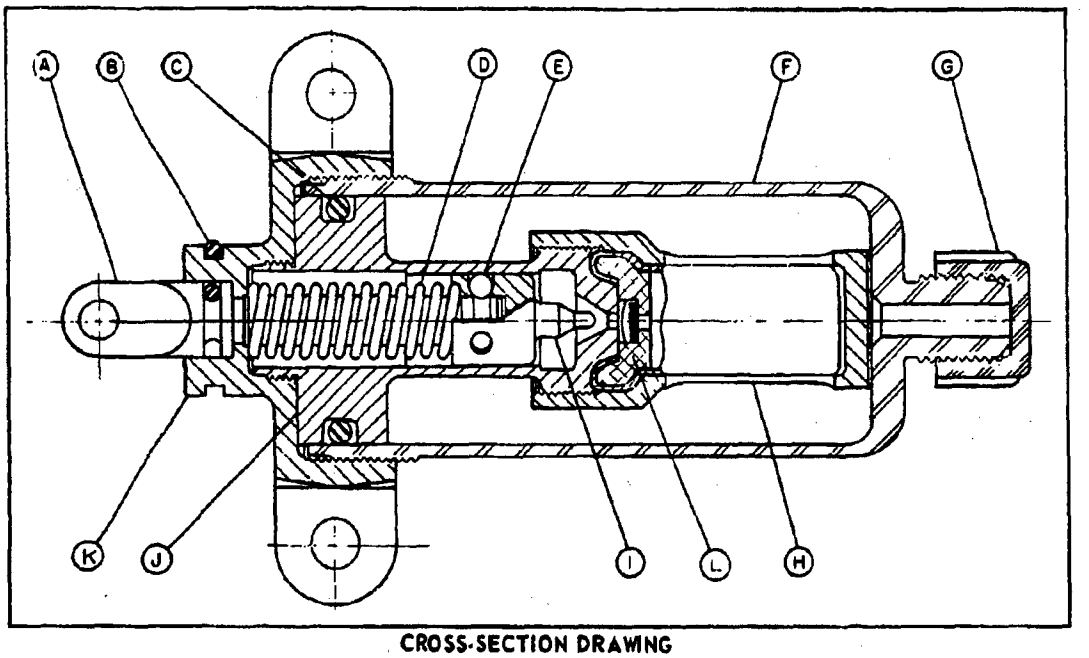
PRINCIPAL CHARACTERISTICS

Actuation Method	Mechanical
Actuation Force	40 lbs. min.
Temperature Limits	−65°F to +160°F
Assembled Weight	0.9 lb.

TYPICAL PERFORMANCE

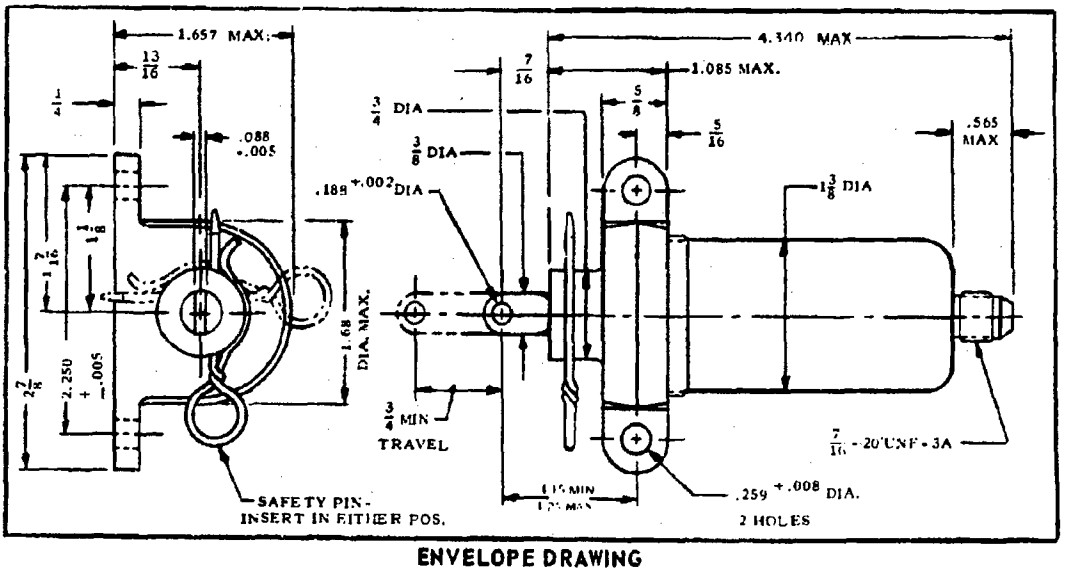


Initiator, Cartridge Actuated, M3A1



CROSS-SECTION DRAWING

Component		Component	
A	Pin, Initiator	G	Cap, Shipping
B	Pin, Safety	H	Cartridge, Initiator
C	"O" Ring	I	Pin, Firing
D	Spring, Initiator	J	Housing, Firing Pin
E	Ball	K	Cap, Initiator
F	Chamber, Initiator	L	Cartridge, Initiator, M73 Assembly



ENVELOPE DRAWING

INITIATOR CARTRIDGE ACTUATED, DELAY, M4

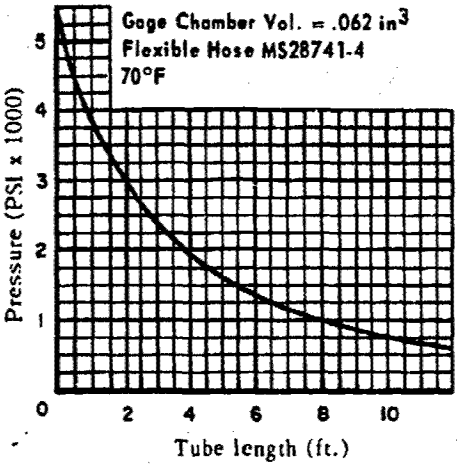
The M4 Initiator consists of a constant volume chamber with a pressure outlet port incorporating a standard pressure fitting, a mechanically operated firing mechanism and an M46 Delay Cartridge. A length of tube or hose connects the initiator to another remotely installed propellant actuated device.

Upon cartridge function, an M5 Delay Element contained in the cartridge burns for 2 seconds, after which the propellant and black powder are ignited. The gas produced by the burning of the propellant and black powder charge flows through the tube to the gas pressure actuated firing mechanism of the other propellant actuated device, exerting a force which propels the firing pin against the cartridge contained in that device. The length of the connecting tube and/or hose, or the distance that the initiator can be mounted from the other device, is limited by the firing pin energy required for reliable operation of the device.

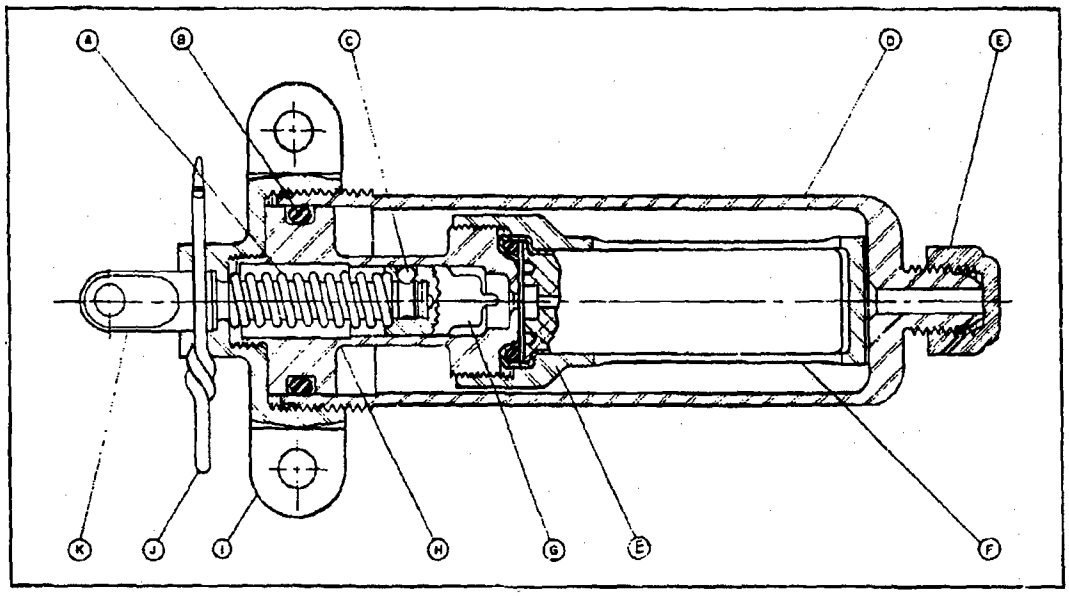
PRINCIPAL CHARACTERISTICS

Actuation Method	Mechanical
Actuation Force	40 lbs. min.
Temperature Limits	−65°F to +160°F
Assembled Weight	1.0 lb.
Delay Time	2.0 seconds

TYPICAL PERFORMANCE

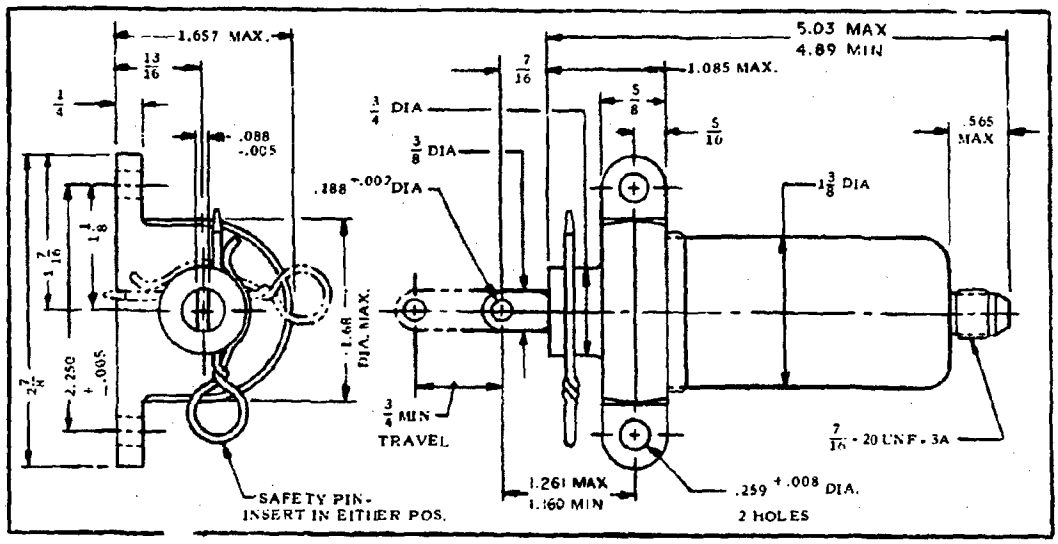


Initiator, Cartridge Actuated, Delay, M4



CROSS-SECTION DRAWING

Component		Component	
A	Spring, Initiator	H	Housing, Firing Pin
B	"O" Ring	I	Cap
C	Ball	J	Pin, Safety
D	Chamber, Initiator	K	Pin, Initiator
E	Cap, Shipping	L	Cartridge, Initiator, Delay M46 Assembly
F	Retainer, Cartridge		
G	Pin, Firing		



ENVELOPE DRAWING

INITIATOR, CARTRIDGE ACTUATED, M5A2

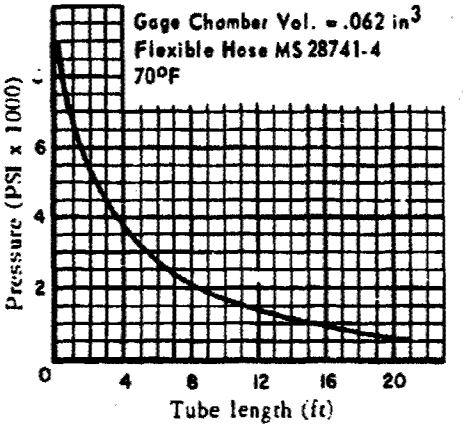
The M5A2 Initiator consists of a constant volume chamber with a pressure outlet port incorporating a standard pressure fitting, a gas pressure actuated firing mechansim and an M73 Cartridge. A length of tube or hose connects the initiator to another remotely installed propellant actuated device.

Upon cartridge function, the gas produced by the burning of the propellant and black powder charge flows through the tube to the gas pressure actuated firing mechanism of the other propellant actuated device, exerting a force which propels the firing pin against the cartridge contained in that device. The length of connecting tube and/or hose, or the distance that the initiator can be mounted from the other device, is limited by the firing pin energy required for reliable operation of the device.

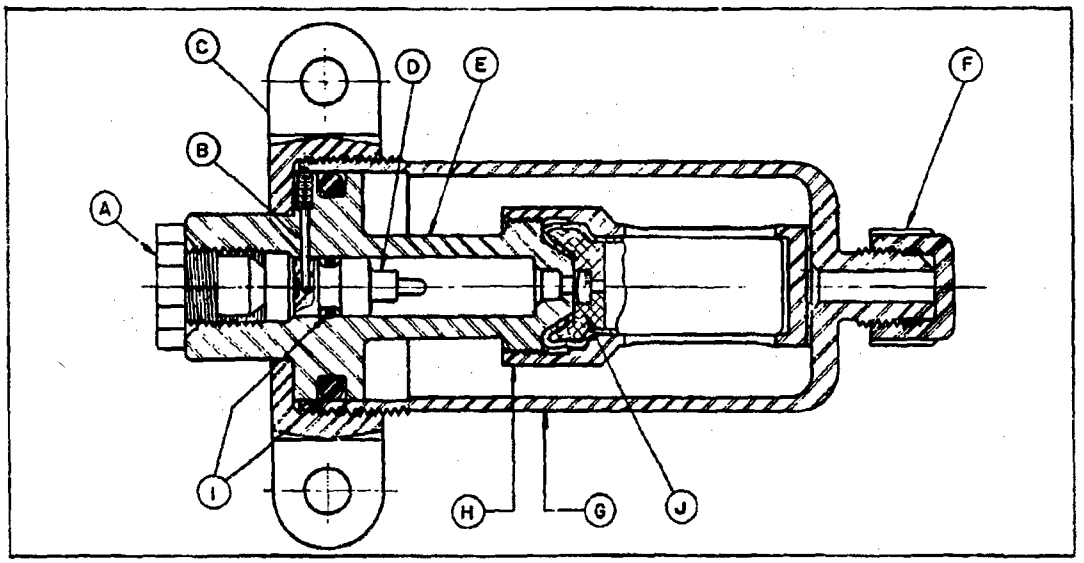
PRINCIPAL CHARACTERISTICS

Actuation Method	Gas Pressure
Actuation Force	750 psi min.
Temperature Limits	−65°F to +160°F
Assembled Weight	0.9 lb.

TYPICAL PERFORMANCE

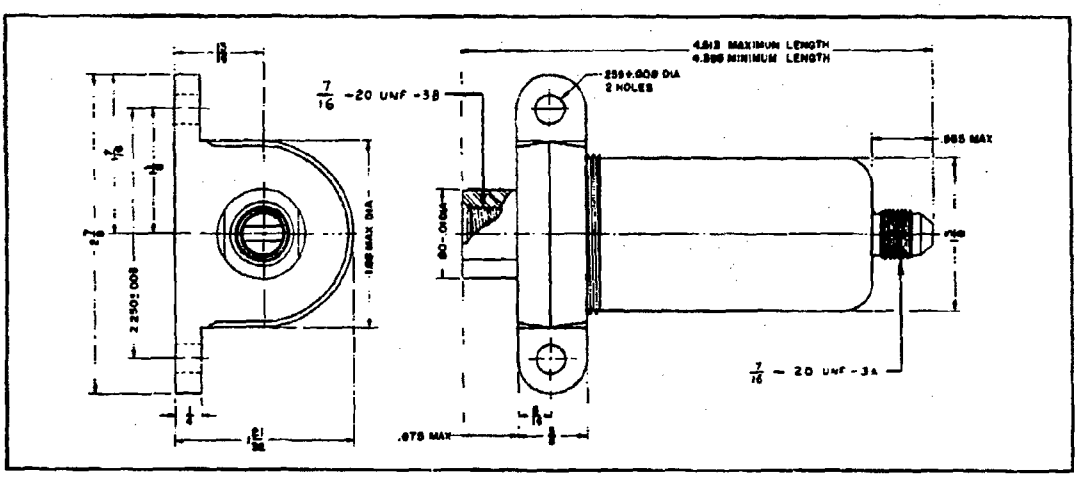


Initiator, Cartridge Actuated, M5A2



CROSS-SECTION DRAWING

Component		Component	
A	Plug, Shipping	F	Cap, Shipping
B	Pin, Shear	G	Chamber, Initiator
C	Cap	H	Retainer, Cartridge
D	Pin, Firing	I	"O" Ring
E	Housing, Firing Pin	J	Cartridge, Initiator, M73 Assembly



ENVELOPE DRAWING

INITIATOR, CARTRIDGE ACTUATED, DELAY, M6A1

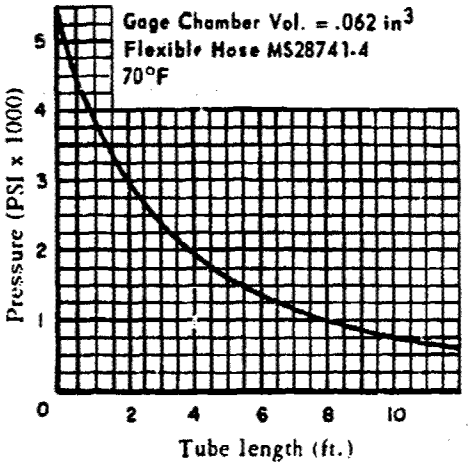
The M6A1 Delay Initiator consists of a constant volume chamber with a pressure outlet port incorporating a standard pressure fitting, a gas pressure actuated firing mechanism and an M46 Delay Cartridge. A length of tube or hose connects the initiator to another remotely installed propellant actuated device.

Upon cartridge function, an M5 Delay Element contained in the cartridge burns for two seconds, after which the propellant and black powder are ignited. The gas produced by the burning of the propellant and black powder charge flows through the tube to the gas pressure actuated firing mechanism of the other propellant actuated device, exerting a force which propels the firing pin against the cartridge contained in that device. The length of the connecting tube and/or hose, or the distance that the initiator can be mounted from the other device, is limited by the firing pin energy required for reliable operation of the device.

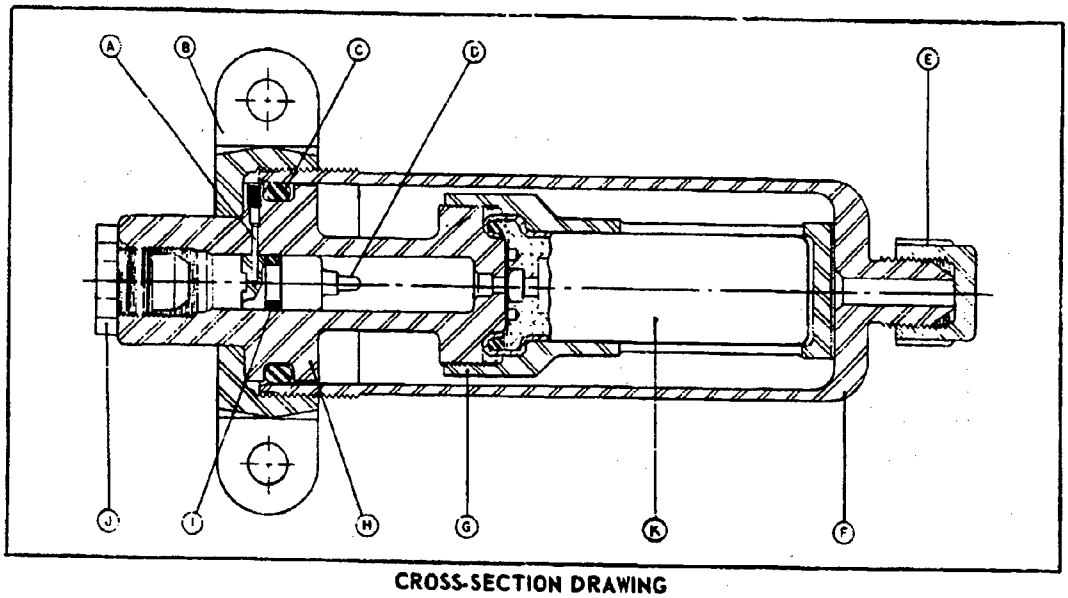
PRINCIPAL CHARACTERISTICS

Actuation Method	Gas Pressure
Actuation Force	750 psi min.
Temperature Limits	−65°F to +160°F
Assembled Weight	0.9 lb.

TYPICAL PERFORMANCE

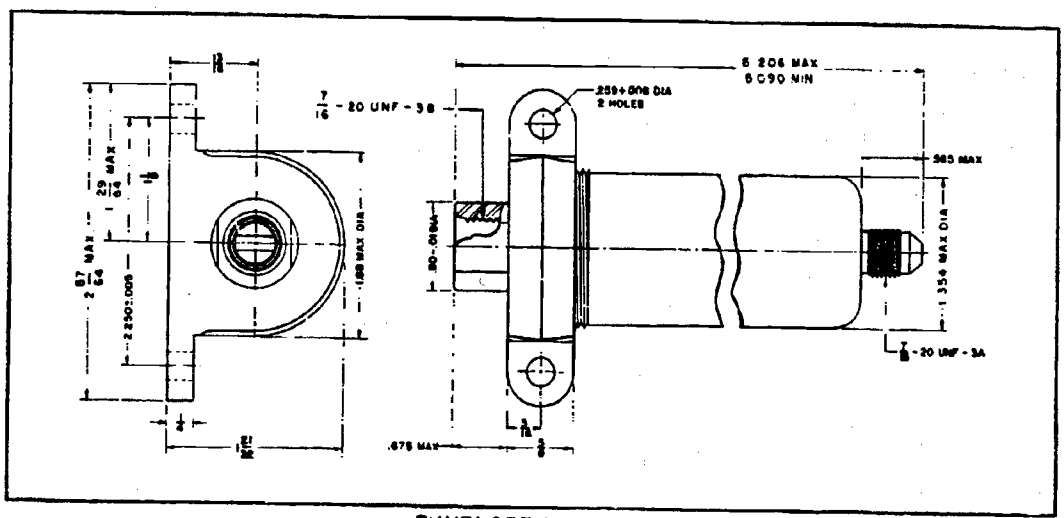


Initiator, Cartridge Actuated, Delay, M6A1



CROSS-SECTION DRAWING

Component		Component	
A	Pin, Shear	G	Retainer, Cartridge
B	Cap	H	Housing, Firing Pin
C	"O" Ring	I	"O" Ring
D	Pin, Firing	J	Plug Shipping
E	Cap, Shipping	K	Cartridge, Initiator, Delay, M46 Assembly
F	Chamber, Initiator		



ENVELOPE DRAWING

INITIATOR, CARTRIDGE ACTUATED, M8

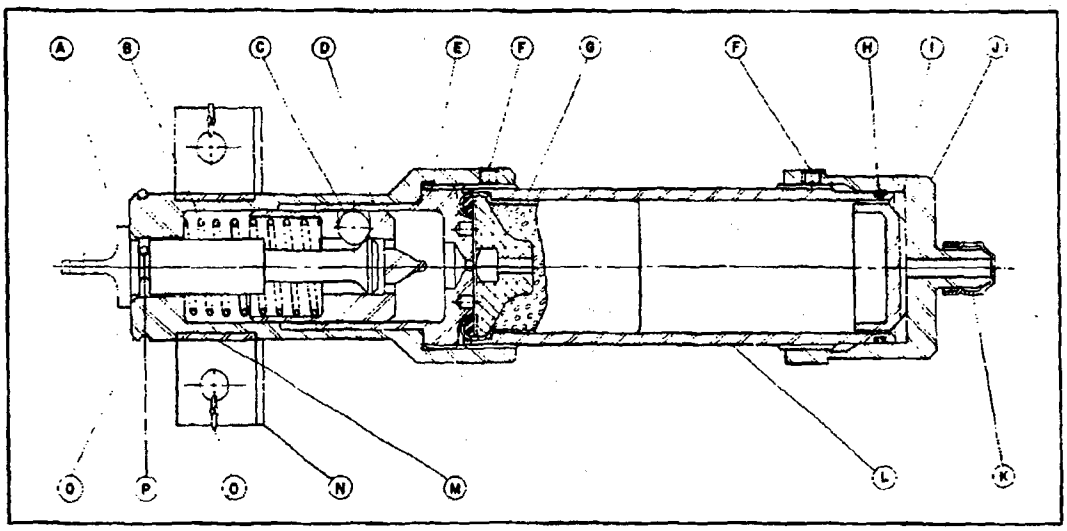
The M8 Initiator is a cylindrical constant volume device consisting of a mechanically operated firing mechanism, a chamber and end cap with a pressure outlet port incorporating a standard pressure fitting and an M68 Cartridge. A length of tube or hose connects the initiator to another remotely installed propellant actuated device.

Upon cartridge function the gas produced by burning of the propellant and black powder charge flows through the tube to the gas pressure actuated firing mechanism of the other propellant actuated device, exerting a force which propels the firing pin against the cartridge contained in that device. The length of connecting tube and/or hose, or the distance that the initiator can be mounted from the other device, is limited by the firing pin energy required for reliable operation of the device. The M8 Initiator is capable of delivering to an .062 in^3 terminal chamber volume at the end of a 30 foot length of MS28741-4 hose, pressure within the limits of 1000 psi minimum and 3000 psi maximum.

PRINCIPAL CHARACTERISTICS

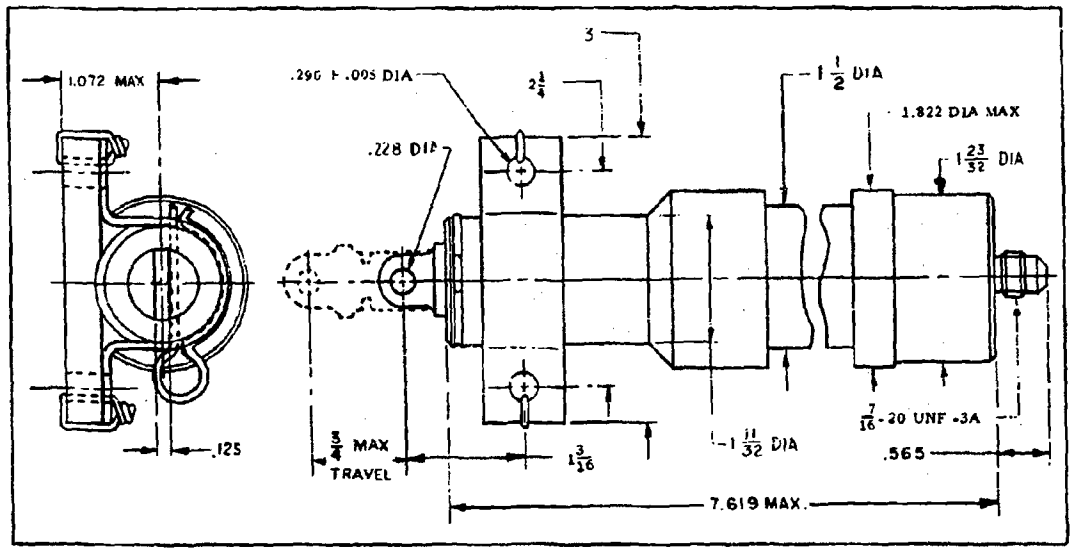
Actuation Method	Mechanical
Actuation Force	40 lbs min
Temperature Limits	−65°F to +160°F
Assembled Weight	3.2 lbs.

Initiator, Cartridge Actuated, M8



CROSS-SECTION DRAWING

Component		Component	
A	Guide, Firing Pin	J	Cap, End
B	Spring, Firing	K	Cap, Shipping
C	Ball	L	Body
D	Guide, Firing Pin	M	Strap
E	Pin, Firing	N	Stand
F	Screw, Set	O	Wire Lock
G	Cartridge, M68	P	Pin, Safety
H	"O" Ring	Q	Cap, Initiator
I	Filter		



ENVELOPE DRAWING

INITIATOR, CARTRIDGE ACTUATED, M9

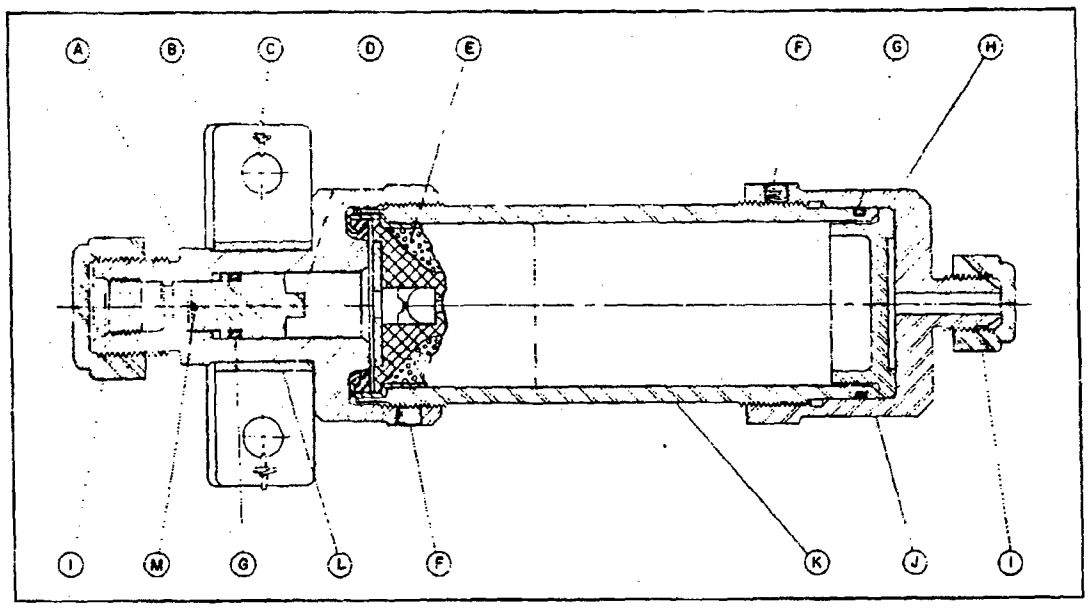
The M9 Initiator is a cylindrical constant volume device consisting of a gas pressure actuated firing mechanism, a chamber and end cap with a pressure outlet port incorporating a standard pressure fitting and an M69 Cartridge. A length of tube or hose connects the initiator to another remotely installed propellant actuated device.

Upon cartridge function, the gas produced by burning of the propellant and black powder charge flows through the tube to the gas pressure actuated firing mechanism of the other propellant actuated device, exerting a force which propels the firing pin against the cartridge contained in that device. The length of connecting tube and/or hose, or the distance that the initiator can be mounted from the other device, is limited by the firing pin energy required for reliable operation of the device. The M9 Initiator is capable of delivering to an .062 in^3 terminal chamber volume at the end of a 30 foot length of MS28741-4 hose, pressure within the limits of 1000 psi minimum and 3000 psi maximum.

PRINCIPAL CHARACTERISTICS

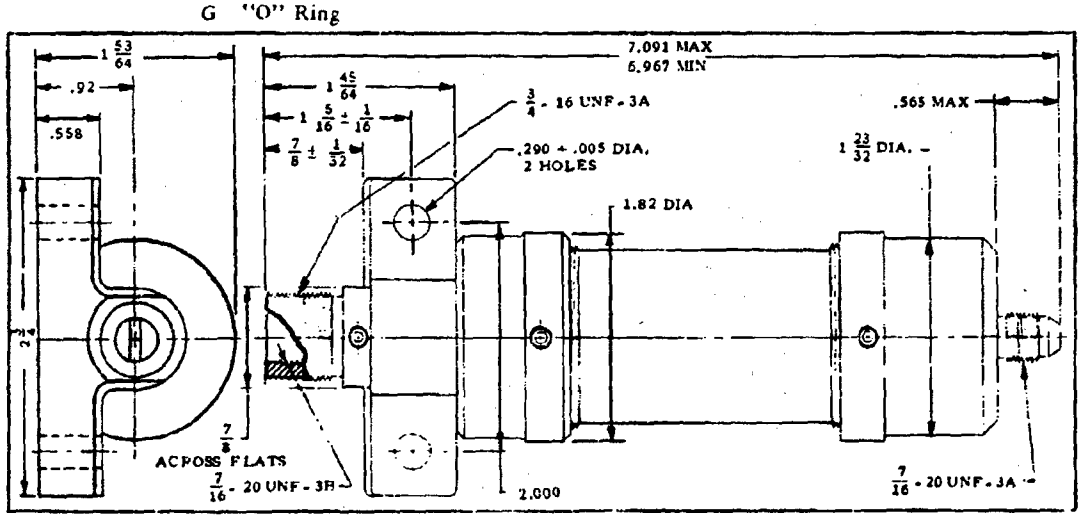
Actuation Method	Gas Pressure
Actuation Force	750 psi min
Temperature Limits	-65°F to +160°F
Assembled Weight	3.2 lbs.

Initiator, Cartridge Actuated, M9



CROSS-SECTION DRAWING

Component		Component	
A	Cap, Initiator	H	Filter
B	Stand	I	Cap, Shipping
C	Wire, Lock	J	Cap, End
D	Pin, Firing	K	Body
E	Cartridge, Initiator, M69 Assembly	L	Strap
F	Screw, Set	M	Pin, Shear And Screw, Set
G	"O" Ring		



ENVELOPE DRAWING

INITIATOR, CARTRIDGE ACTUATED, DELAY, M10

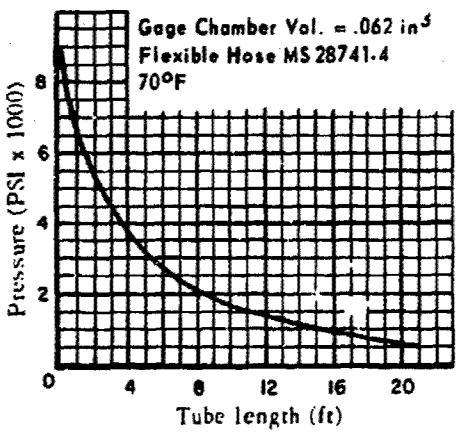
The M10 Delay Initiator consists of a constant volume chamber with a pressure outlet port incorporating a standard pressure fitting, a gas pressure actuated firing mechanism and an M70 Delay Cartridge. A length of tube or hose connects the initiator to another remotely installed propellant actuated device.

Upon cartridge function, an M5 Delay Element contained in the cartridge burns for two seconds, after which the propellant and black powder are ignited. The gas produced by the burning of the propellant and black powder charge flows through the tube to the gas pressure actuated firing mechanism of the other propellant actuated device, exerting a force which propels the firing pin against the cartridge contained in that device. The length of the connecting tube and or hose, or the distance that the initiator can be mounted from the other device, is limited by the firing pin energy for reliable operation of the device.

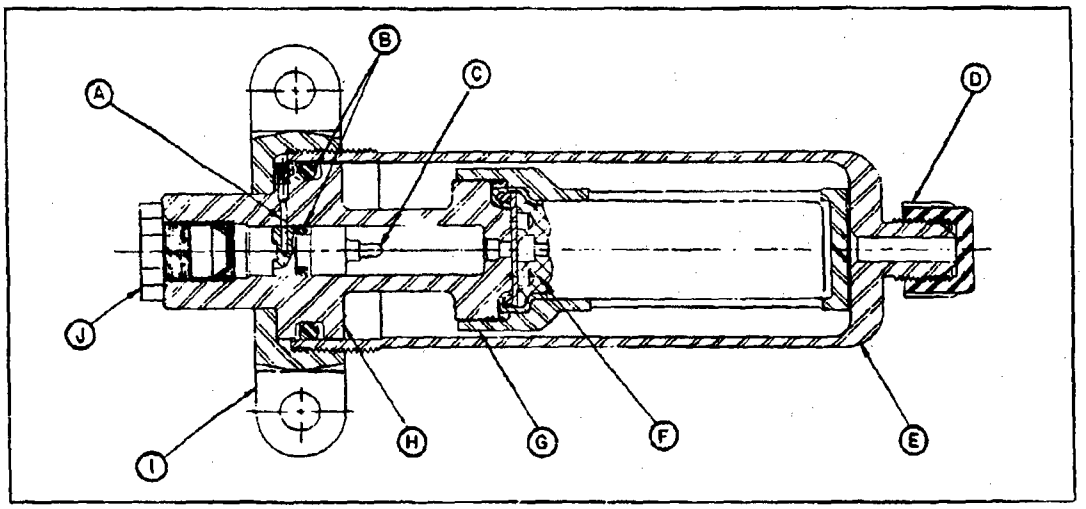
PRINCIPAL CHARACTERISTICS

Actuation Method	Gas Pressure
Actuation Force	750 psi min
Temperature Limits	−65°F to +160°F
Assembled Weight	0.9 lb.
Delay Time	2.0 seconds

TYPICAL PERFORMANCE

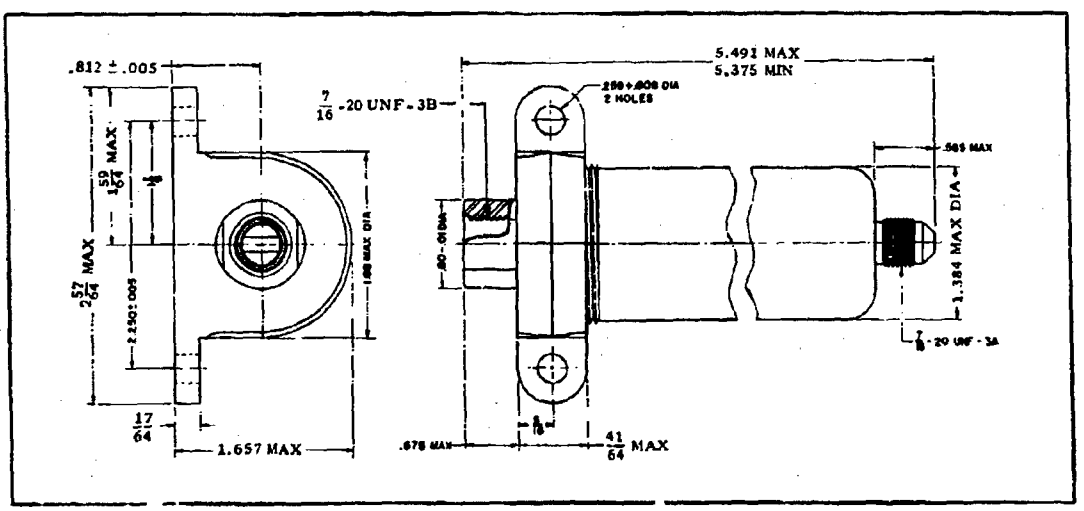


Initiator, Cartridge Actuated, Delay, M10



CROSS-SECTION DRAWING

Component		Component	
A	Pin, Shear	F	Cartridge, Initiator, Delay, M70 Assembly
B	"O" Ring	G	Retainer, Cartridge
C	Pin, Firing	H	Housing, Firing Pin
D	Cap, Shipping	I	Cap
E	Chamber, Initiator	J	Plug, Shipping



ENVELOPE DRAWING

INITIATOR CARTRIDGE ACTUATED, DELAY, M12

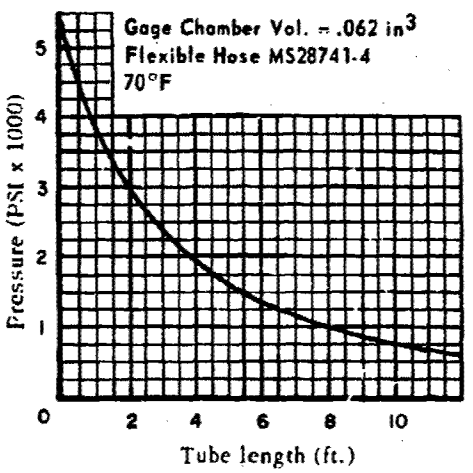
The M12 Initiator consists of a constant volume chamber with a pressure outlet port incorporating a standard pressure fitting, a mechanically operated firing mechanism and an M71 Delay Cartridge. A length of tube or hose connects the initiator to another remotely installed propellant actuated device.

Upon cartridge function, an M8 Delay Element contained in the cartridge burns for 1 second, after which the propellant and black powder are ignited. The gas produced by the burning of the propellant and black powder charge flows through the tube to the gas pressure actuated firing mechanism of the other propellant actuated device, exerting a force which propels the firing pin against the cartridge contained in that device. The length of the connecting tube and/or hose, or the distance that the initiator can be mounted from the other device, is limited by the firing pin energy required for reliable operation of the device.

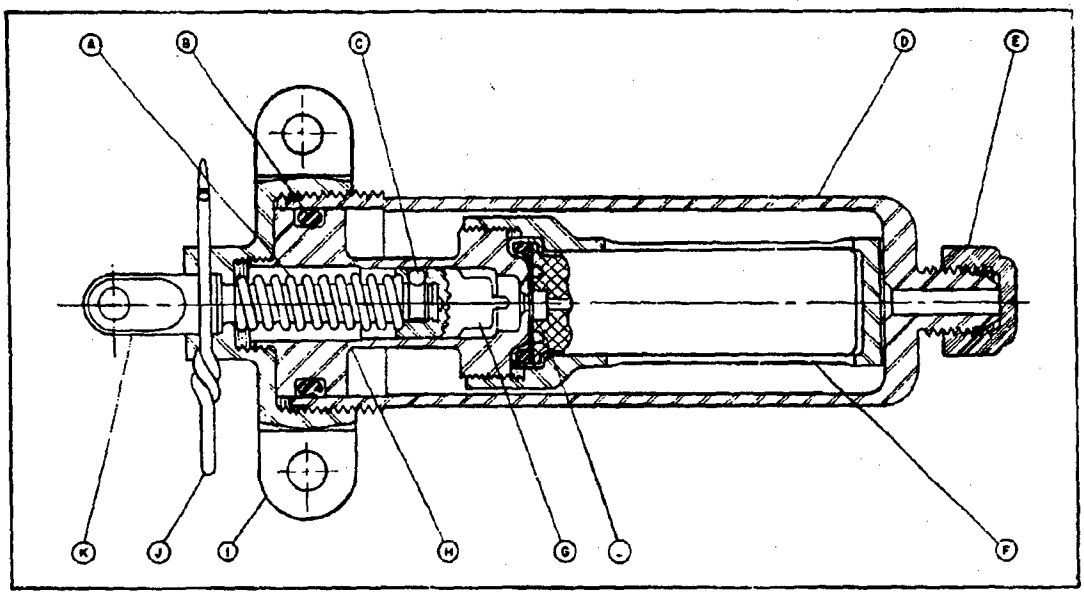
PRINCIPAL CHARACTERISTICS

Actuation Method	Mechanical
Actuation Force	40 lbs. min.
Temperature Limits	−65°F to +160°F
Assembled Weight	1.0 lb.
Delay Time	1.0 second

TYPICAL PERFORMANCE

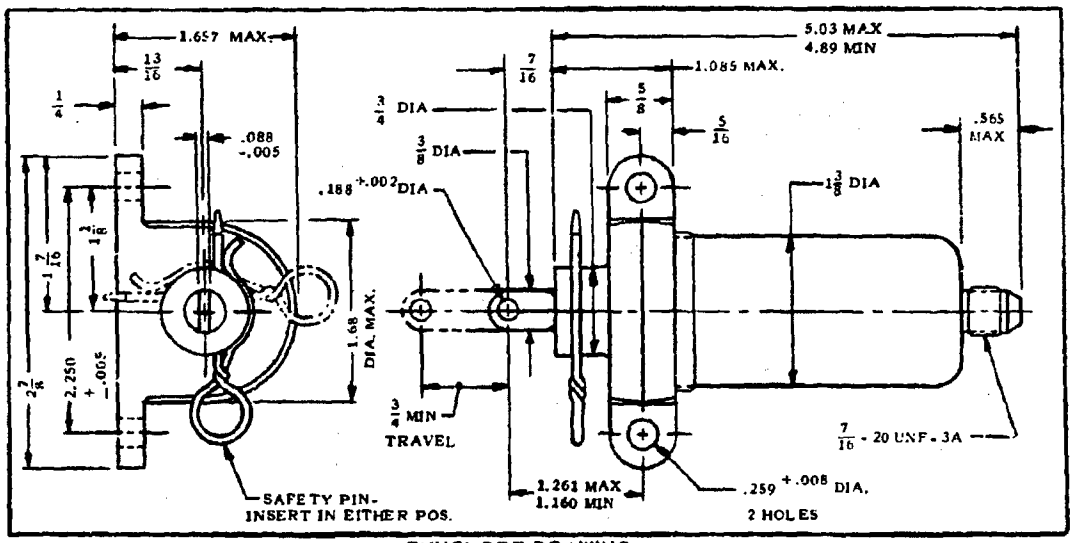


Initiator, Cartridge Actuated, Delay, M12



CROSS-SECTION DRAWING

Component		Component	
A	Spring, Initiator	H	Housing, Firing Pin
B	"O" Ring	I	Cap
C	Ball	J	Pin, Safety
D	Chamber, Initiator	K	Pin, Initiator
E	Cap, Shipping	L	Cartridge, Initiator, Delay, M71 Assembly
F	Retainer, Cartridge		
G	Pin, Firing		



ENVELOPE DRAWING

INITIATORS, CARTRIDGE ACTUATED, DELAY, M14

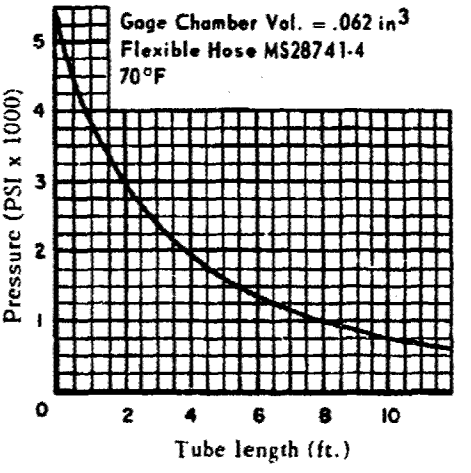
The M14 Delay Initiator, a miniature version of the M45 Delay Initiator, consists of a constant volume chamber with a pressure outlet port incorporating a standard pressure fitting, a mechanically operated firing mechanism and an M84 Delay Cartridge. A length of tube or hose connects the initiator to another remotely installed propellant actuated device.

Upon cartridge function, an XM25 Delay Element contained in the cartridge, burns for 3 seconds, after which the propellant and black powder are ignited. The gas produced by the burning of the propellant and black powder charge flows through the tube to the gas pressure actuated firing mechanism of the other propellant actuated device, exerting a force which propels the firing pin against the cartridge contained in that device. The length of the connecting tube and/or hose, or distance that the initiator can be mounted from the other device, is limited by the firing pin energy required for reliable operation of the device.

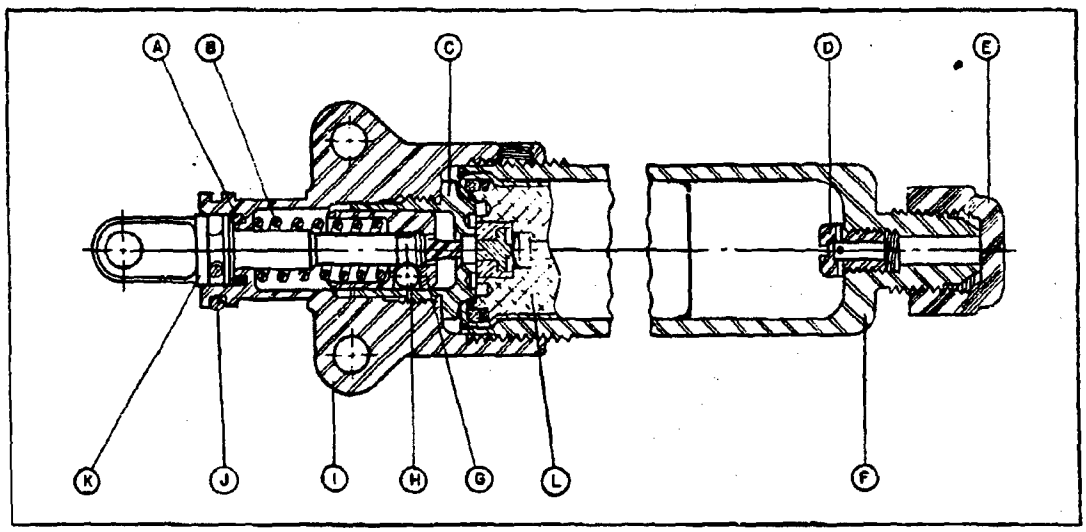
PRINCIPAL CHARACTERISTICS

Actuation Method	Mechanical
Actuation Force	40 lbs min
Temperature Limits	−65°F to +160°F
Assembled Weight	0.39 lb.
Delay Time	3.0 seconds
Mounting	Integral Lugs

TYPICAL PERFORMANCE

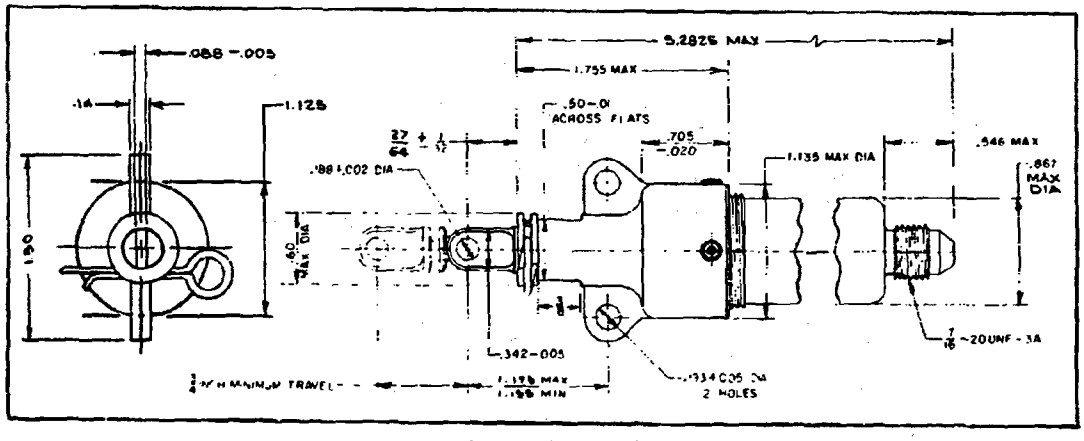


Initiator, Cartridge Actuated, Delay, M14



CROSS-SECTION DRAWING

Component		Component	
A	Seal	G	Pin, Firing
B	Spring, Initiator	H	Balls (3)
C	Housing, Firing Pin	I	Cap, Initiator
D	Filter	J	Pin, Safety
E	Cap, Shipping	K	Pin, Initiator
F	Chamber, Initiator	L	Cartridge, Initiator, Delay, XM84 Assembly



ENVELOPE DRAWING

INITIATOR, CARTRIDGE ACTUATED, DELAY, M15

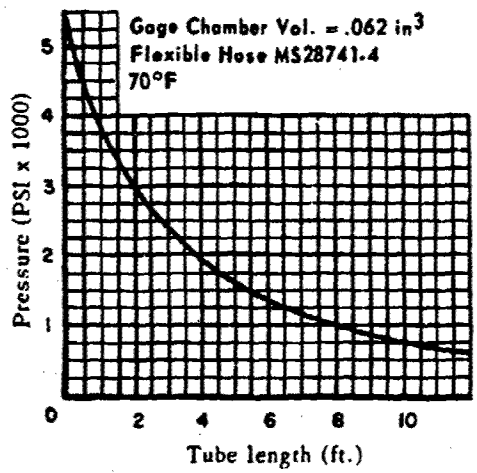
The M15 Delay Initiator, a miniature version of the M44 Delay Initiator, consists of a constant volume chamber with a pressure outlet incorporating a standard pressure fitting, a gas pressure actuated firing mechanism and an M84 Delay Cartridge. A length of tube or hose connects the initiator to another remotely installed propellant actuated device.

Upon cartridge function, an XM25 Delay Element contained in the cartridge burns for 3 seconds, after which the propellant and black powder are ignited. The gas produced by the burning of the propellant and black powder charge flows through the tube to the gas pressure actuated firing mechanism of the other propellant actuated device, exerting a force which propels the firing pin against the cartridge contained in that device. The length of the connecting tube and/or hose, or the distance that the initiator can be mounted from the other device is limited by the firing pin energy for reliable operation of the device.

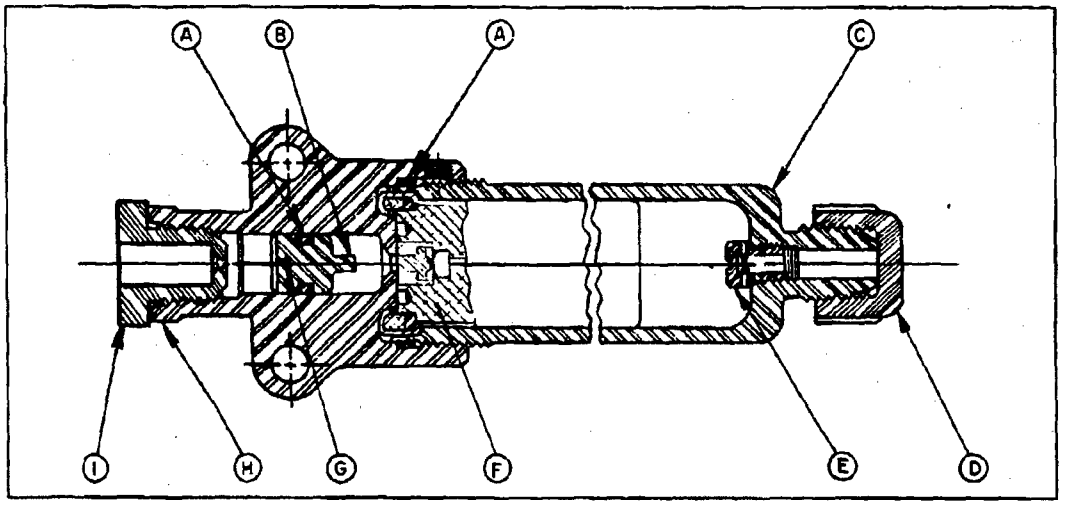
PRINCIPAL CHARACTERISTICS

Actuation Method	Gas Pressure
Actuation Force	750 psi min
Temperature Limits	−65°F to +160°F
Assembled Weight	0.39 lb.
Delay Time	3.0 seconds
Mounting	Integral Lugs

TYPICAL PERFORMANCE

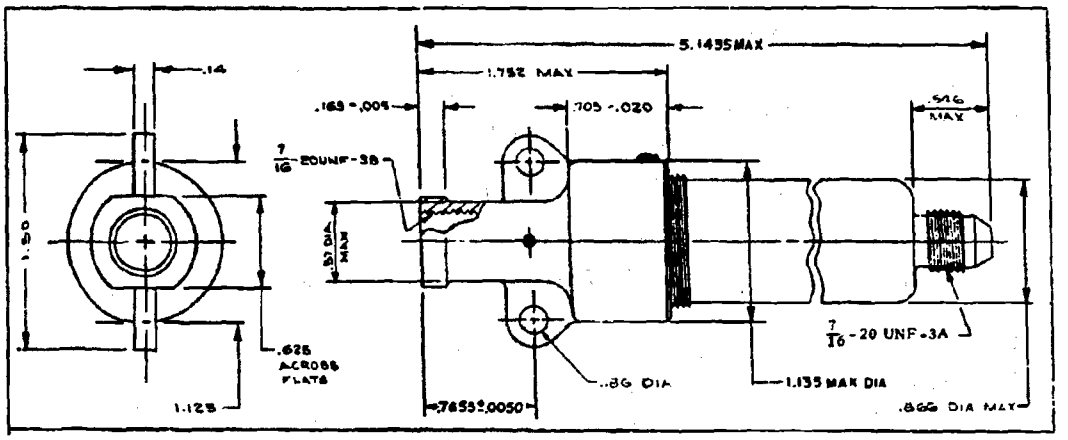


Initiator, Cartridge Actuated, Delay, M15



CROSS-SECTION DRAWING

Component		Component	
A	"O" Ring	F	Cartridge, Initiator, Delay, XM84 Assembly
B	Pin, Firing	G	Pin, Shear
C	Chamber, Initiator	H	Cap, Initiator
D	Cap, Shipping	I	Plug, Shipping
E	Filter		



ENVELOPE DRAWING

INITIATOR, CARTRIDGE ACTUATED, DELAY, M16

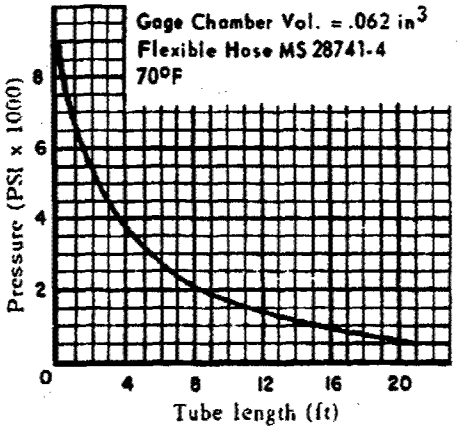
The M16 Delay Initiator, a miniature version of the M43 Delay Initiator, consists of a constant volume chamber with a pressure outlet port incorporating a standard pressure fitting, a mechanically operated firing mechanism and an XM85 Delay Cartridge. A length of tube or hose connects the initiator to another remotely installed propellant actuated device.

Upon cartridge function, an XM25 Delay Element contained in the cartridge, burns for 3 seconds, after which the propellant and black powder are ignited. The gas produced by the burning of the propellant and black powder charge flows through the tube to the gas pressure actuated firing mechanism of the other propellant actuated device, exerting a force which propels the firing pin against the cartridge contained in that device. The length of the connecting tube and/or hose, or distance that the initiator can be mounted from the other device, is limited by the firing pin energy required for reliable operation of the device.

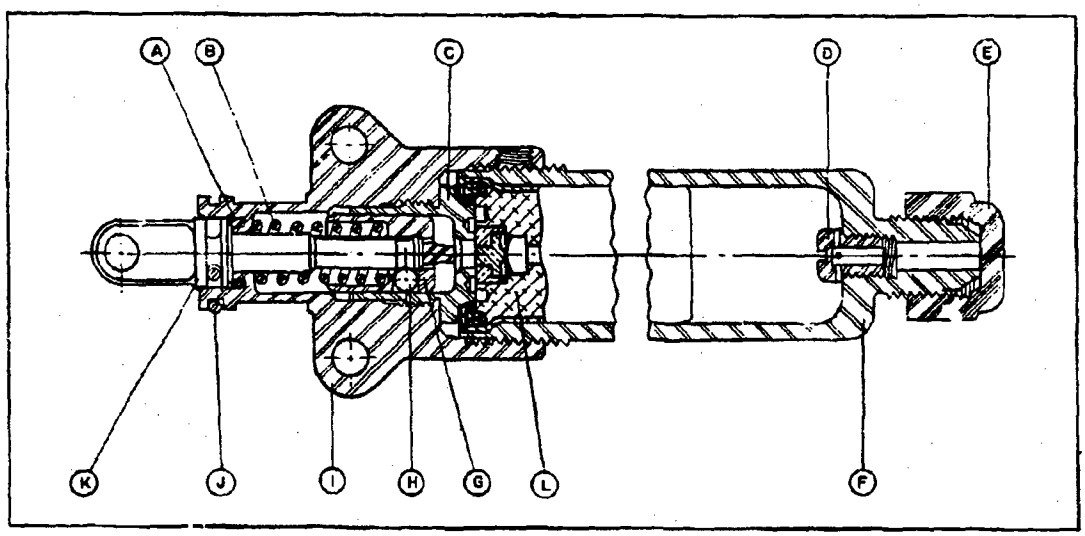
PRINCIPAL CHARACTERISTICS

Actuation Method	Mechanical
Actuation Force	40 lbs min
Temperature Limits	−65°F to +160°F
Assembled Weight	0.39 lb.
Delay Time	3.0 seconds
Mounting	Integral Lugs

TYPICAL PERFORMANCE

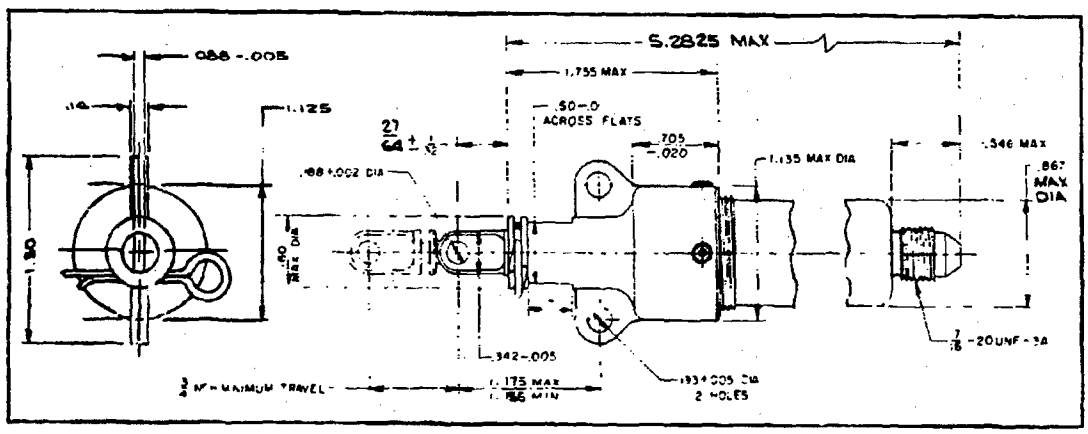


Initiator, Cartridge Actuated, Delay, M16



CROSS-SECTION DRAWING

Component		Component	
A	Seal	G	Pin, Firing
B	Spring, Initiator	H	Balls (3)
C	Housing, Firing Pin	I	Cap, Initiator
D	Filter	J	Pin, Safety
E	Cap, Shipping	K	Pin, Initiator
F	Chamber, Initiator	L	Cartridge, Initiator, Delay, XM85 Assembly



ENVELOPE DRAWING

INITIATOR, CARTRIDGE ACTUATED, DELAY, M26

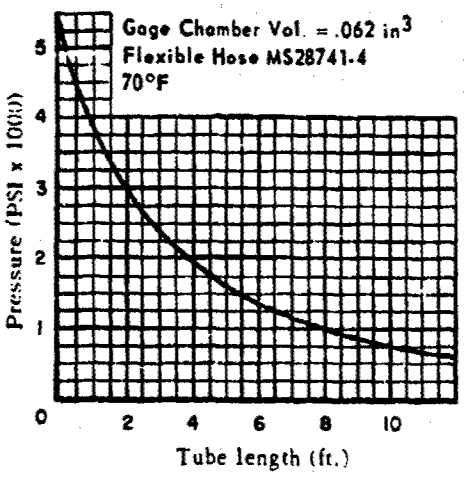
The M26 Delay Initiator consists of a constant volume chamber with a pressure outlet port incorporating a standard pressure fitting, a gas pressure actuated firing mechanism and an M90 Delay Cartridge. A length of tube or hose connects the initiator to another remotely installed propellant actuated device.

Upon cartridge function, an M14 Delay Element contained in the cartridge burns for 0.3 second, after which the propellant and black powder are ignited. The gas produced by the burning of the propellant and black powder charge flows through the tube to the gas pressure actuated firing mechanism of the other propellant actuated device, exerting a force which propels the firing pin against the cartridge contained in that device. The length of the connecting tube and or hose, or the distance that the initiator can be mounted from the other device, is limited by the firing pin energy required for reliable operation of the device.

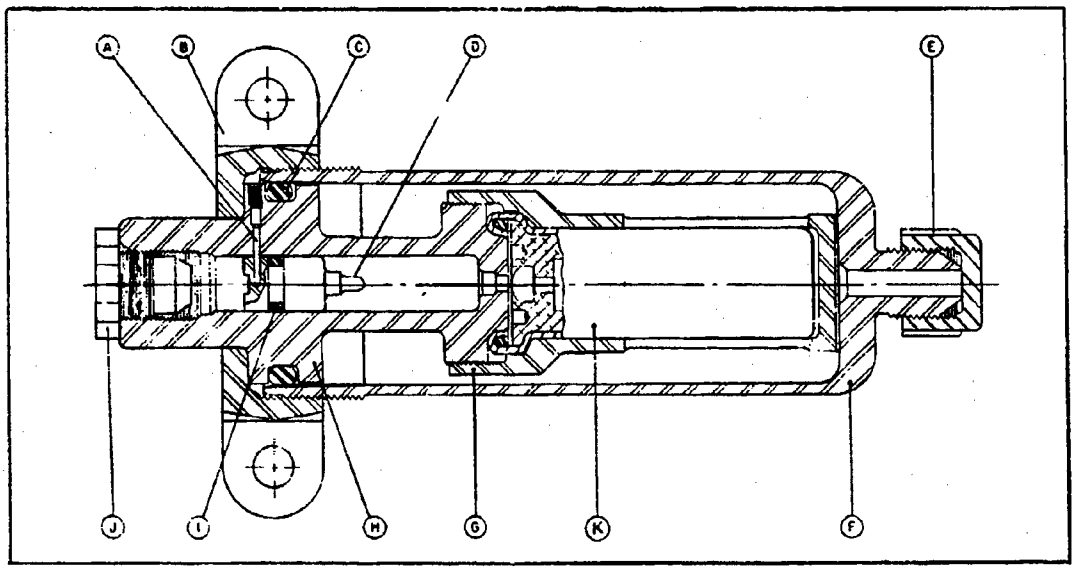
PRINCIPAL CHARACTERISTICS

Actuation Method	Ga Pressure
Actuation Force	750 psi min.
Temperature Limits	−65°F to +160°F
Assembled Weight	0.9 lb.
Delay Time	0.3 second

TYPICAL PERFORMANCE

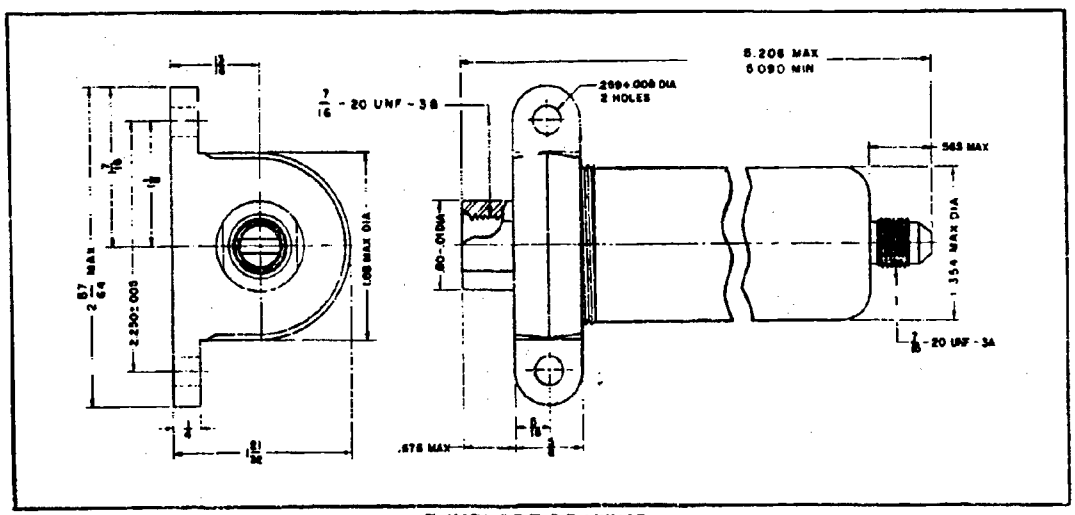


Initiator, Cartridge Actuated, Delay, M26



CROSS-SECTION DRAWING

Component		Component	
A	Pin, Shear	G	Retainer, Cartridge
B	Cap	H	Housing, Firing Pin
C	"O" Ring	I	"O" Ring
D	Pin, Firing	J	Plug, Shipping
E	Cap, Shipping	K	Cartridge, Initiator, Delay, M90 Assembly
F	Chamber, Initiator		



ENVELOPE DRAWING

INITIATOR, CARTRIDGE ACTUATED, M27

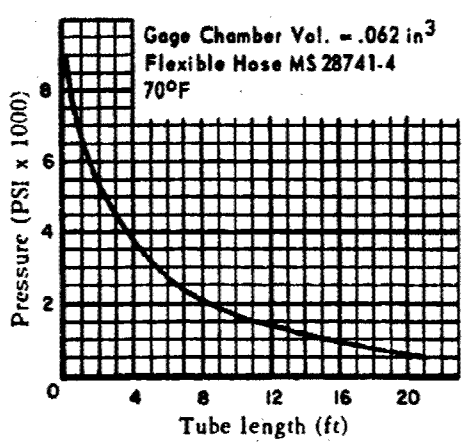
The M27 Initiator, a miniature version of the M3A1 Initiator, consists of a constant volume chamber with a pressure outlet port incorporating a standard pressure fitting, a mechanically operated firing mechanism and an M91 Cartridge. A length of tube or hose connects the initiator to another remotely installed propellant actuated device.

Upon cartridge function, the gas produced by the burning of the propellant and black powder charge flows through the tube to the gas pressure actuated firing mechanism of the other propellant actuated device, exerting a force which propels the firing pin against the cartridge contained in that device. The length of the connecting tube and/or hose, or distance that the initiator can be mounted from the other device, is limited by the firing pin energy required for reliable operation of the device.

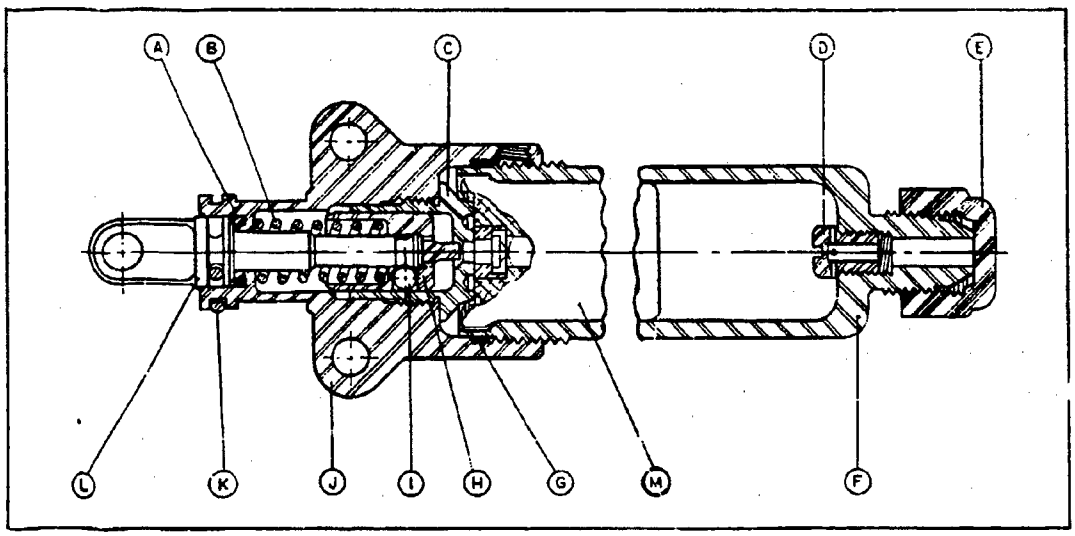
PRINCIPAL CHARACTERISTICS

Actuation Method	Mechanical
Actuation Force	40 lbs min
Temperature Limits	−65° to +160°F
Assembled Weight	0.33 lb.
Mounting	Integral Lugs

TYPICAL PERFORMANCE

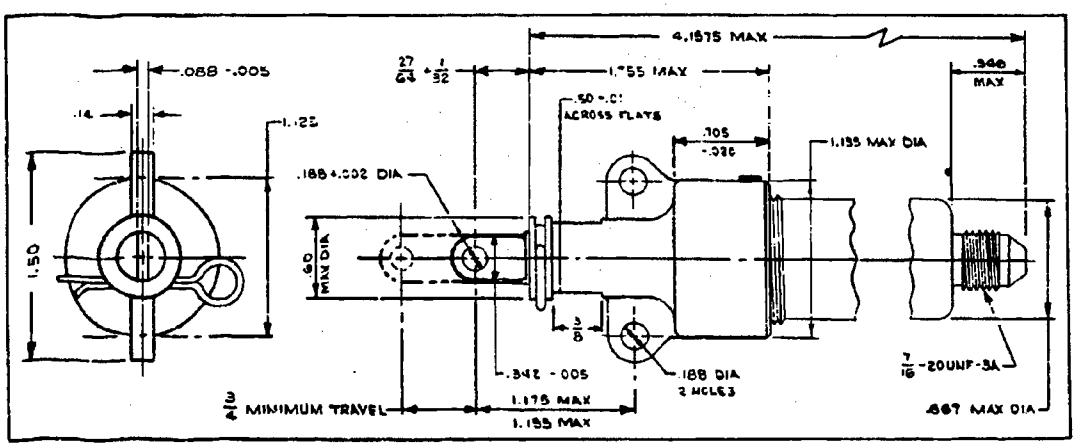


Initiator, Cartridge Actuated, M27



CROSS-SECTION DRAWING

Component		Component	
A	Seal	H	Pin, Firing
B	Spring, Initiator	I	Ball
C	Housing, Firing Pin	J	Cap, Initiator
D	Filter	K	Pin, Safety
E	Cap, Shipping	L	Pin, Initiator
F	Chamber, Initiator	M	Cartridge, Initiator, M91 Assembly
G	"O" Ring		



ENVELOPE DRAWING

INITIATOR, CARTRIDGE ACTUATED, M28

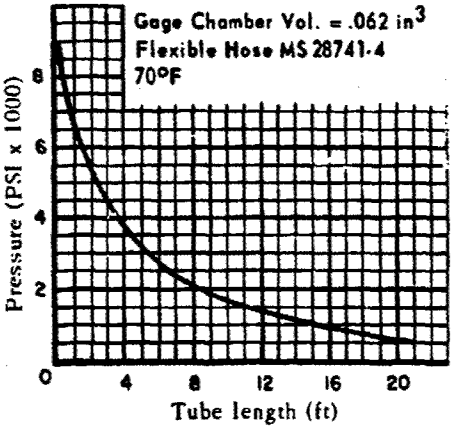
The M28 Initiator, a miniature version of the M5A2 Initiator, consists of a constant volume chamber with a pressure outlet port incorporating a standard pressure fitting, a gas pressure actuated firing mechanism and an M91 Cartridge. A length of tube or hose connects the initiator to another remotely installed propellant device.

Upon cartridge function, the gas produced by the burning of the propellant and black powder charge flows through the tube to the gas pressure actuated firing mechanism of the other propellant actuated device, exerting a force which propels the firing pin against the cartridge contained in that device. The length of connecting tube and/or hose, or the distance that the initiator can be mounted from the other device, is limited by the firing pin energy required for reliable operation of the device.

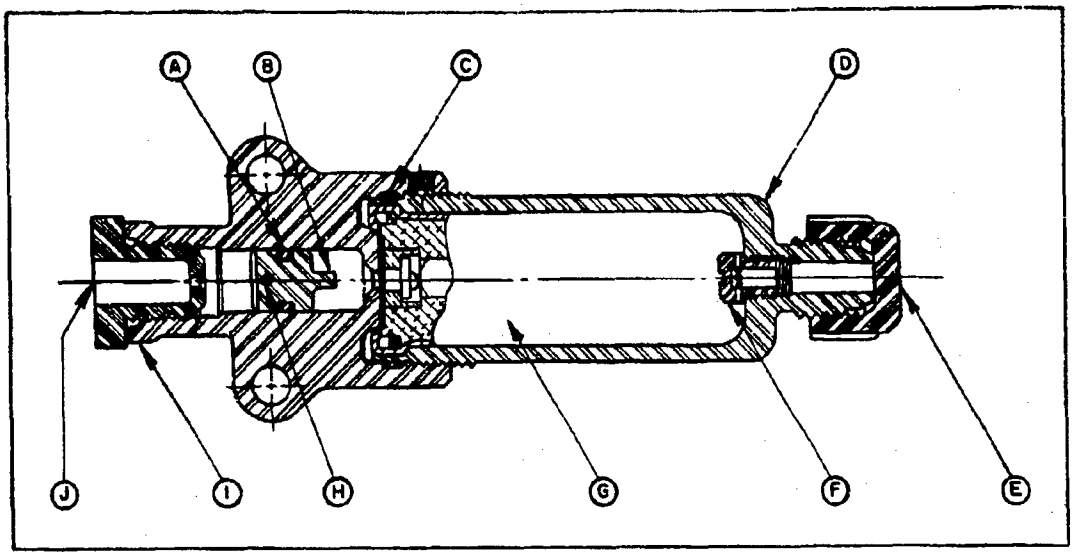
PRINCIPAL CHARACTERISTICS

Actuation Method	Gas Pressure
Actuation Force	750 psi min
Temperature Limits	−65°F to +160°F
Assembled Weight	0.3 lb.
Mounting	Integral Lugs

TYPICAL PERFORMANCE

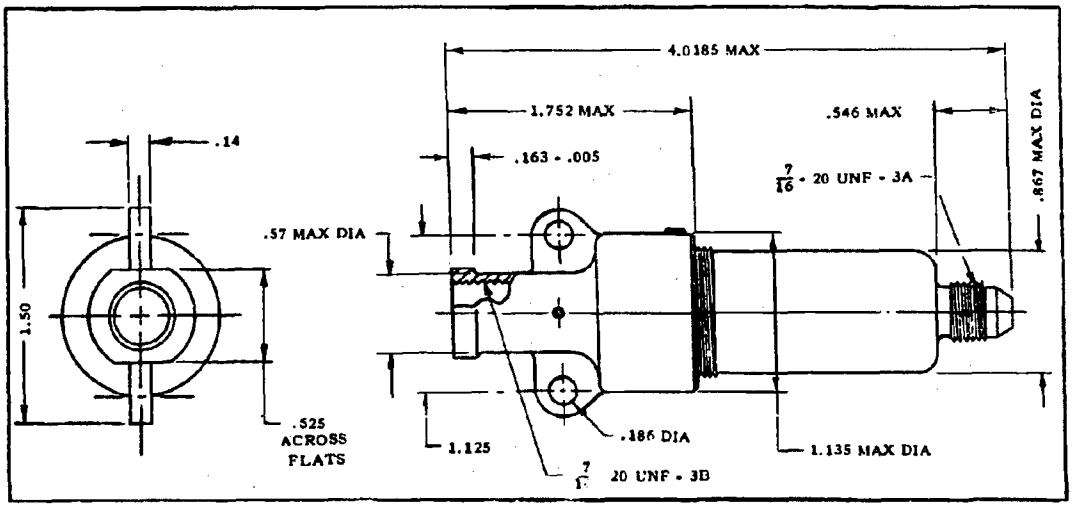


Initiator, Cartridge Actuated, M28



CROSS-SECTION DRAWING

Component		Component	
A	"O" Ring	F	Filter
B	Pin, Firing	G	Cartridge, Initiator, M91 Assembly
C	"O" Ring	H	Pin, Shear
D	Chamber, Initiator	I	Cap, Initiator
E	Cap, Shipping	J	Plug, Shipping



ENVELOPE DRAWING

INITIATOR, CARTRIDGE ACTUATED, M29

The M29 Initiator consists of a constant volume chamber with a pressure outlet port incorporating a standard pressure fitting, a mechanically operated firing mechanism, an M73 Cartridge, an integral arming mechanism with a gas intake port and a manual override, and integral mounting lugs. A length of tube or hose connects the initiator to another remotely installed propellant actuated device.

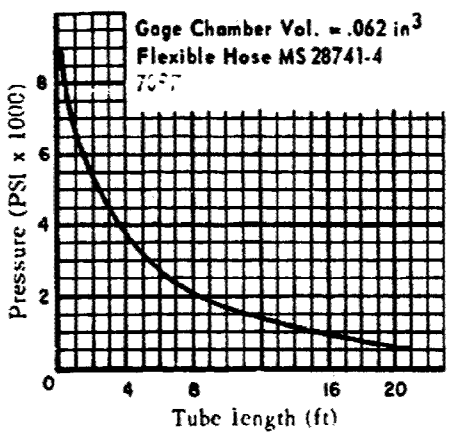
Actuation of this initiator is accomplished when gas pressure supplied by another propellant actuated device is introduced into the intake port of the arming mechanism, causing the arming mechanism to disengage with the preloaded initiator pin. The sequence of actuation events following are the same as those for the conventional mechanical initiator.

Upon cartridge function, the gas produced by the burning of the propellant and black powder charge flows through the tube to the gas pressure actuated firing mechanism of the other propellant actuated device, exerting a force which propels the firing pin against the cartridge contained in that device. The length of the connecting tube and/or hose, or the distance that the initiator can be mounted from the other device, is limited by the firing pin energy required for reliable operation of the device.

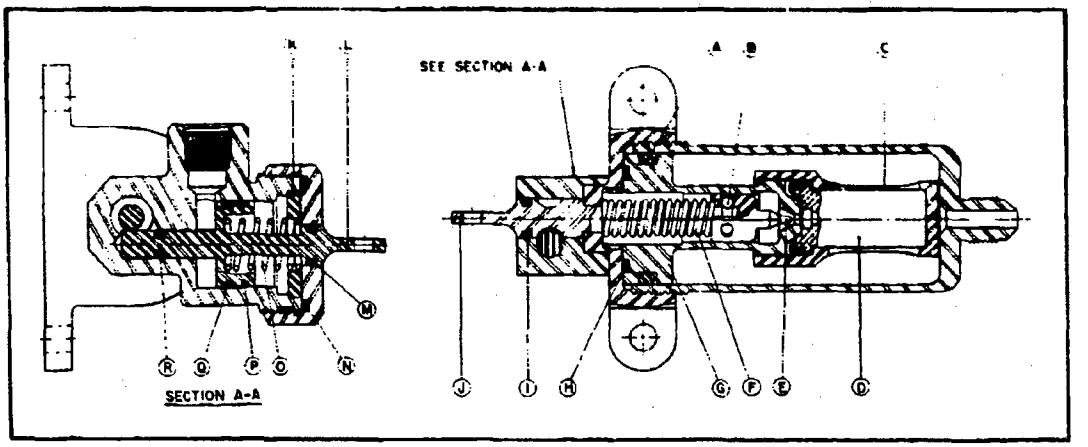
PRINCIPAL CHARACTERISTICS

Actuation Method	Gas Pressure w/manual override
Actuation Force	750 psi min
Initiator Pin Preload	40 lbs min
Manual Override Force	25 lbs min
Temperature Limits	−65°F to +160°F
Assembled Weight	1.75 lbs.

TYPICAL PERFORMANCE

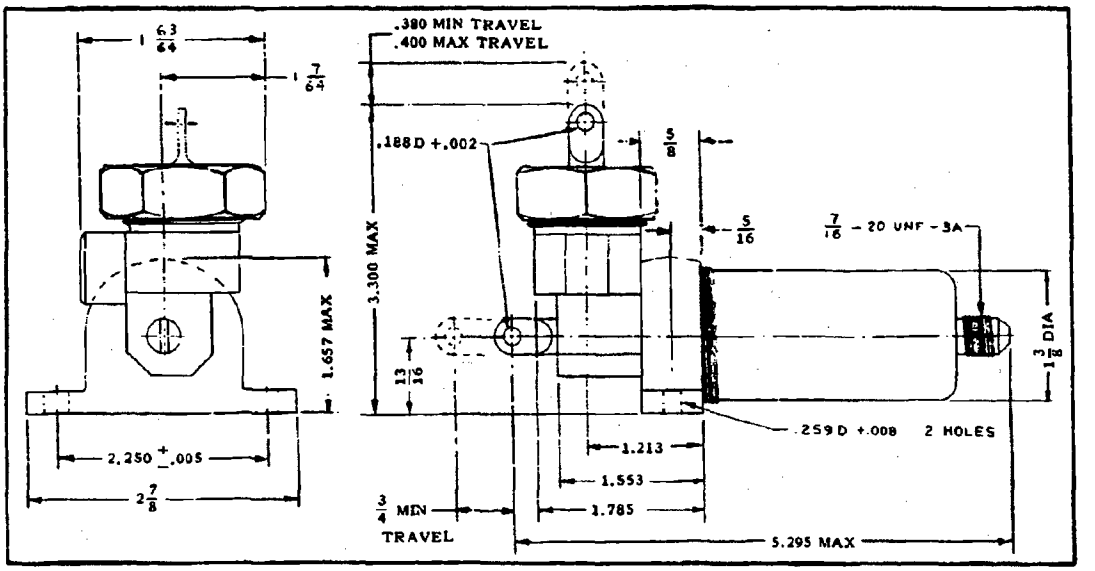


Initiator, Cartridge Actuated, M29



CROSS-SECTION DRAWING

Component		Component	
A	Gasket	J	Pin, Initiator
B	Balls (3)	K	Stop, Piston
C	Retainer, Cartridge	L	Piston
D	Cartridge, Initiator, M73	M	Gasket
E	Pin, Firing	N	Gasket
F	Spring, Initiator	O	Spring, Exactor
G	Housing, Firing Pin	P	Ring, Locking
H	Gasket	Q	Gasket
I	Gasket	R	Gasket



ENVELOPE DRAWING

INITIATOR,CARTRIDGE ACTUATED, DELAY, M30

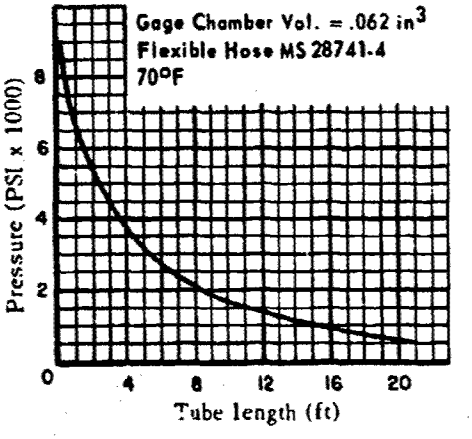
The M30 Initiator consists of a constant volume chamber with a pressure outlet port incorporating a standard pressure fitting, a mechanically operated firing mechanism and an M70 Delay Cartridge. A length of tube or hose connects the initiator to another remotely installed propellant actuated device.

Upon cartridge function, an M5 Delay Element contained in the cartridge burns for 2 seconds, after which the propellant and black powder are ignited. The gas produced by the burning of the propellant and black powder charge flows through the tube to the gas pressure actuated firing mechanism of the other propellant actuated device, exerting a force which propels the firing pin against the cartridge contained in that device. The length of the connecting tube and/or hose, or the distance that the initiator can be mounted from the other device, is limited by the firing pin energy required for reliable operation of the device.

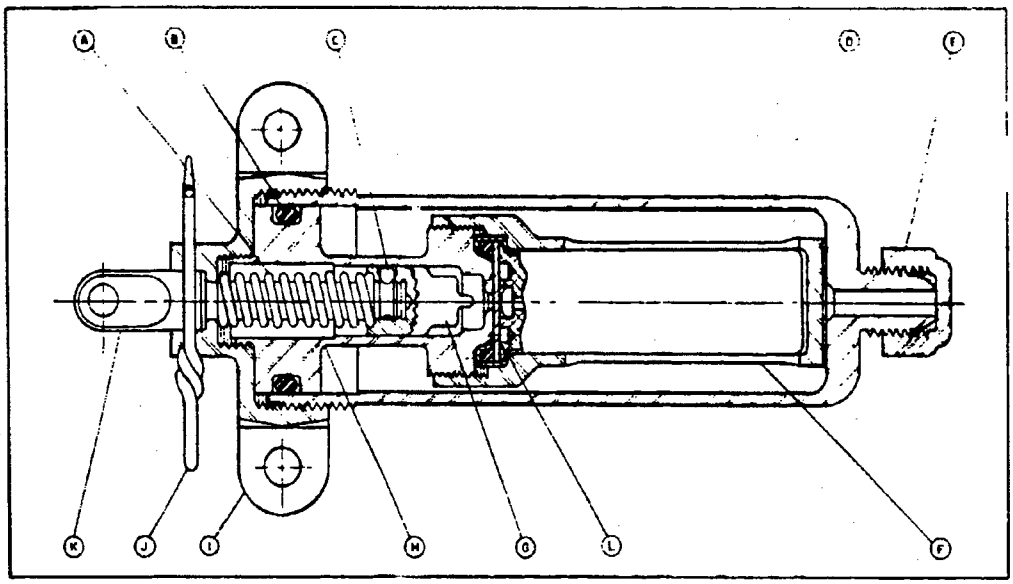
PRINCIPAL CHARACTERISTICS

Actuation Method	Mechanical
Actuation Force	40 lbs min
Temperature Limits	−65°F to +160°F
Assembled Weight	1.0 lb.
Delay Time	2.0 seconds

TYPICAL PERFORMANCE

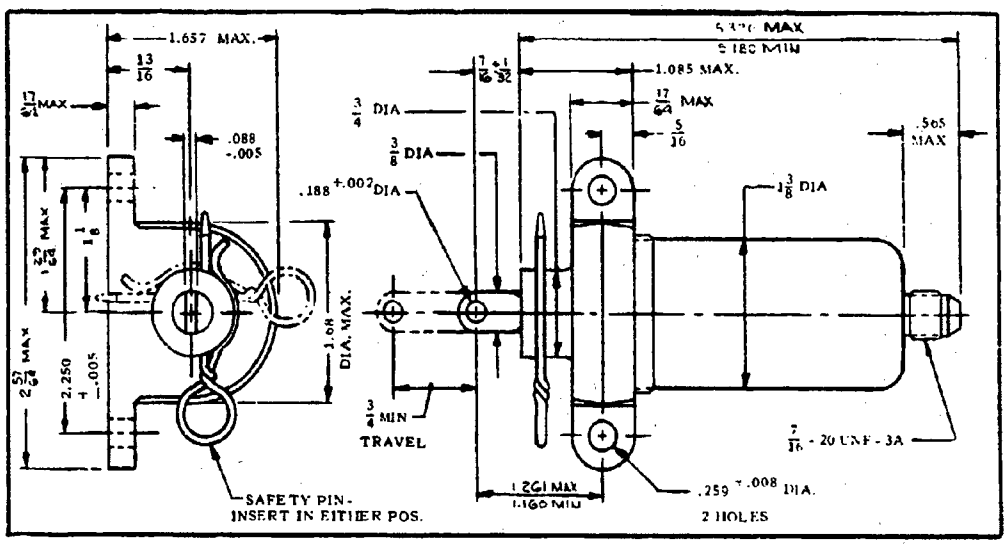


Initiator, Cartridge Actuated, Delay, M30



CROSS-SECTION DRAWING

Component		Component	
A	Spring, Initiator	H	Housing, Firing Pin
B	"O" Ring	I	Cap
C	Balls (3)	J	Pin, Safety
D	Chamber, Initiator	K	Pin, Initiator
E	Cap, Shipping	L	Cartridge, Initiator, Delay, M70 Assembly
F	Retainer, Cartridge		
G	Pin, Firing		



ENVELOPE DRAWING

INITIATOR, CARTRIDGE ACTUATED, DELAY, M31

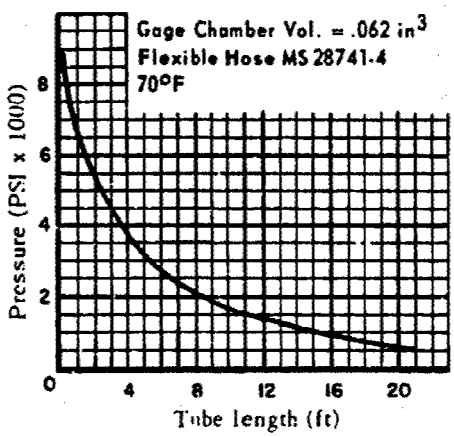
The M31 Delay Initiator consists of a constant volume chamber with a pressure outlet port incorporating a standard pressure fitting, a gas pressure actuated firing mechanism and an M93 Delay Cartridge. A length of tube or hose connects the initiator to another remotely installed propellant actuated device.

Upon cartridge function, an M8 Delay Element contained in the cartridge burns for 1 second, after which the propellant and black powder are ignited. The gas produced by the burning of the propellant and black powder charge flows through the tube to the gas pressure actuated firing mechanism of the other propellant actuated device, exerting a force which propels the firing pin against the cartridge contained in that device. The length of the connecting tube and/or hose, or the distance that the initiator can be mounted from the other device, is limited by the firing pin energy for reliable operation of the device.

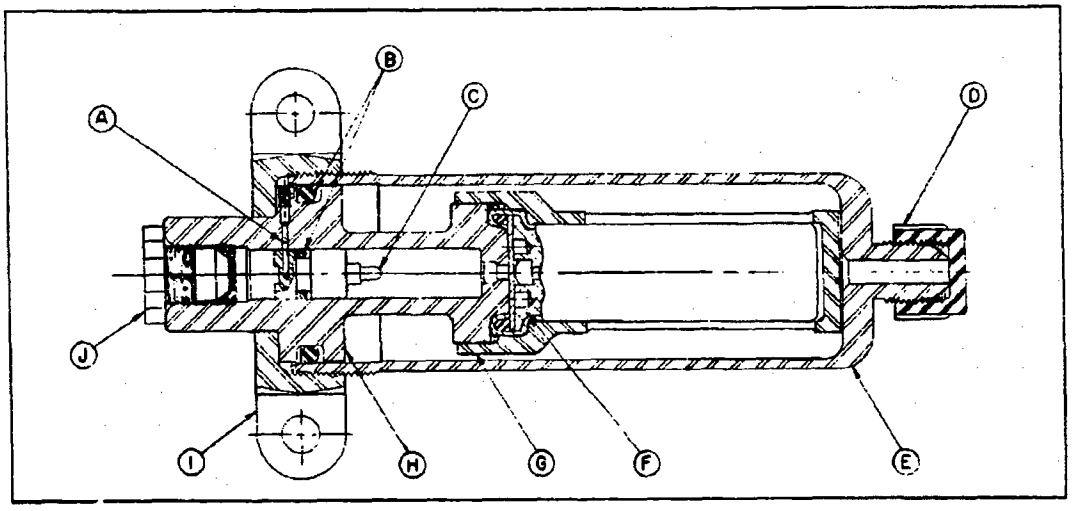
PRINCIPAL CHARACTERISTICS

Actuation Method	Gas Pressure
Actuation Force	750 psi min
Temperature Limits	−65°F to +160°F
Assembled Weight	0.9 lb.
Delay Time	1.0 second

TYPICAL PERFORMANCE

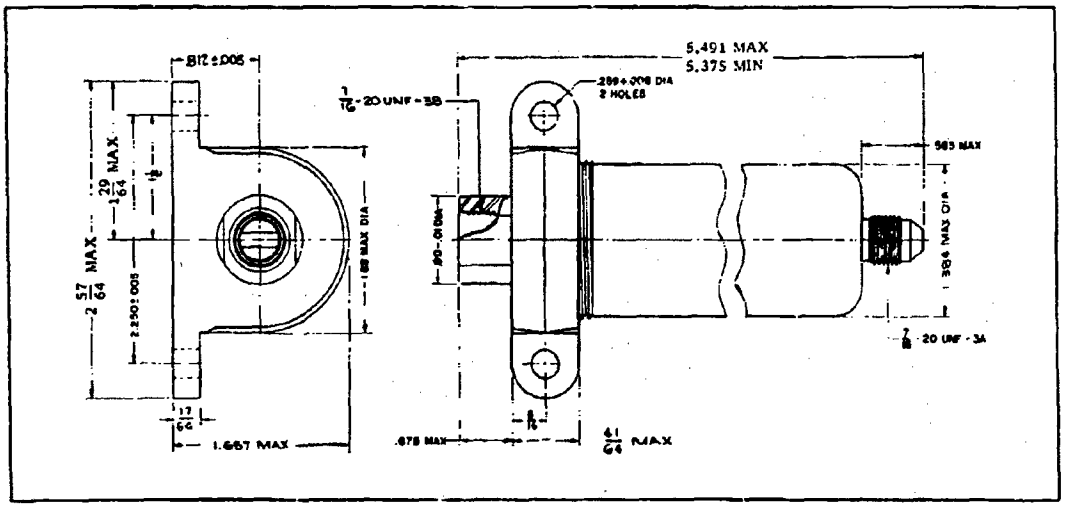


Initiator, Cartridge Actuated, Delay, M31



CROSS-SECTION DRAWING

Component		Component	
A	Pin, Shear	F	Cartridge, Initiator, Delay, M93 Assembly
B	"O" Ring	G	Retainer, Cartridge
C	Pin, Firing	H	Housing, Firing Pin
D	Cap, Shipping	I	Cap
E	Chamber, Initiator	J	Plug, Shipping



ENVELOPE DRAWING

INITIATOR, CARTRIDGE ACTUATED, DELAY, M32

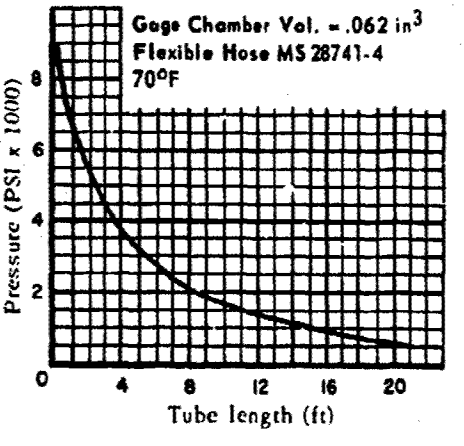
The M32 Initiator consists of a constant volume chamber with a pressure outlet port incorporating a standard pressure fitting, a mechanically operated firing mechanism and an M93 Delay Cartridge. A length of tube or hose connects the initiator to another remotely installed propellant actuated device.

Upon cartridge function, an M8 Delay Element contained in the cartridge burns for 1 second, after which the propellant and black powder are ignited. The gas produced by the burning of the propellant and black powder charge flows through the tube to the gas pressure actuated firing mechanism of the other propellant actuated device, exerting a force which propels the firing pin against the cartridge contained in that device. The length of the connecting tube and/or hose, or the distance that the initiator can be mounted from the other device, is limited by the firing pin energy required for reliable operation of the device.

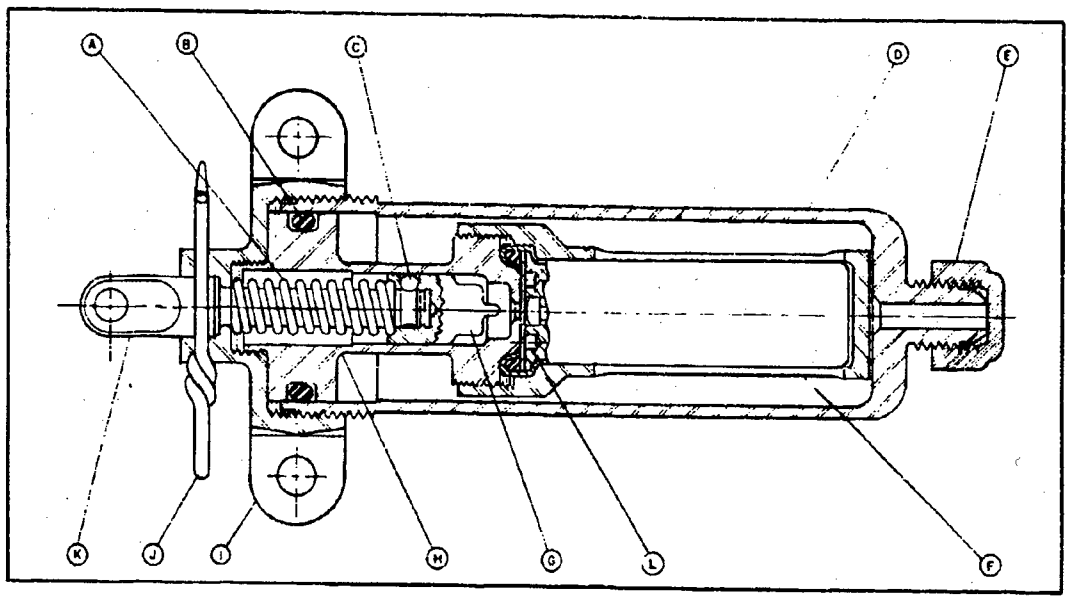
PRINCIPAL CHARACTERISTICS

Actuation Method	Mechanical
Actuation Force	40 lbs. min.
Temperature Limits	-65°F to +160°F
Assembled Weight	1.0 lb.
Delay Time	1.0 second

TYPICAL PERFORMANCE

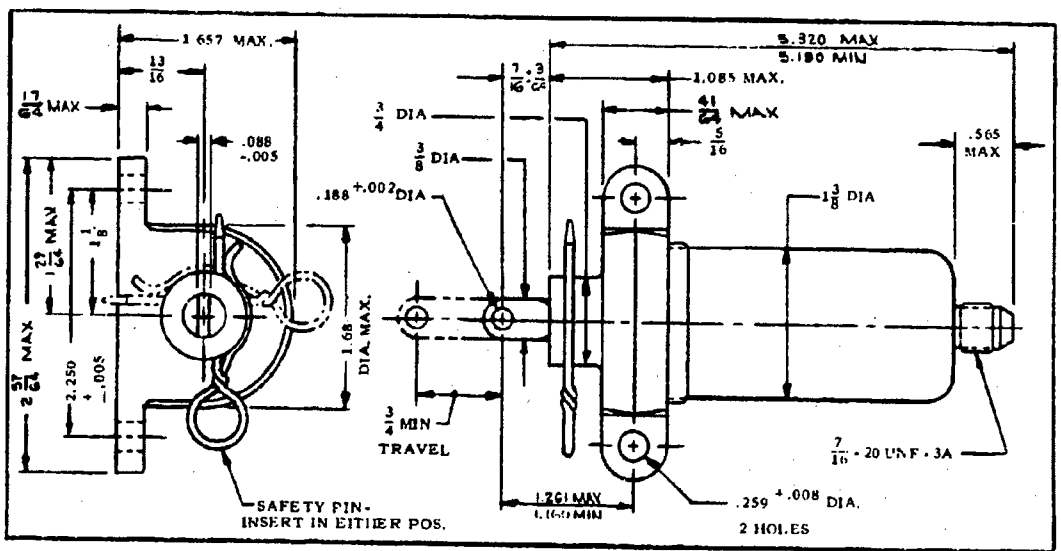


Initiator, Cartridge Actuated, Delay, M32



CROSS-SECTION DRAWING

Component		Component	
A	Spring, Initiator	H	Housing, Firing Pin
B	"O" Ring	I	Cap
C	Balls (3)	J	Pin, Safety
D	Chamber, Initiator	K	Pin, Initiator
E	Cap, Shipping	L	Cartridge, Initiator, Delay, M93 Assembly
F	Retainer, Cartridge		
G	Pin, Firing		



ENVELOPE DRAWING

INITIATOR, CARTRIDGE ACTUATED, DELAY, M33

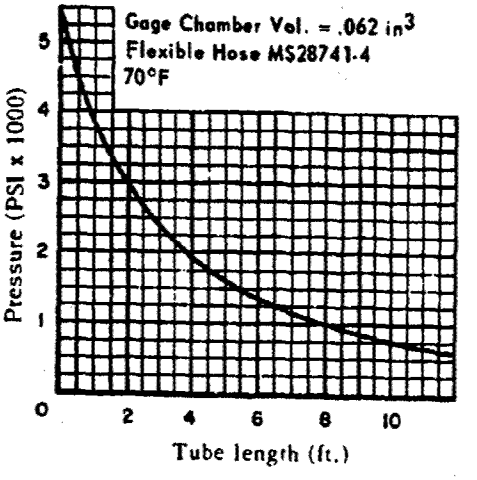
The M33 Delay Initiator consists of a constant volume chamber with a pressure outlet port incorporating a standard pressure fitting, a gas pressure actuated firing mechanism and an M71 Delay Cartridge. A length of tube or hose connects the initiator to another remotely installed propellant actuated device.

Upon cartridge function, an M8 Delay Element contained in the cartridge burns for 1 second, after which the propellant and black powder are ignited. The gas produced by the burning of the propellant and black powder charge flows through the tube to the gas pressure actuated firing mechanism of the other propellant actuated device, exerting a force which propels the firing pin against the cartridge contained in that device. The length of the connecting tube and/or hose, or the distance that the initiator can be mounted from the other device, is limited by the firing pin energy required for reliable operation of the device.

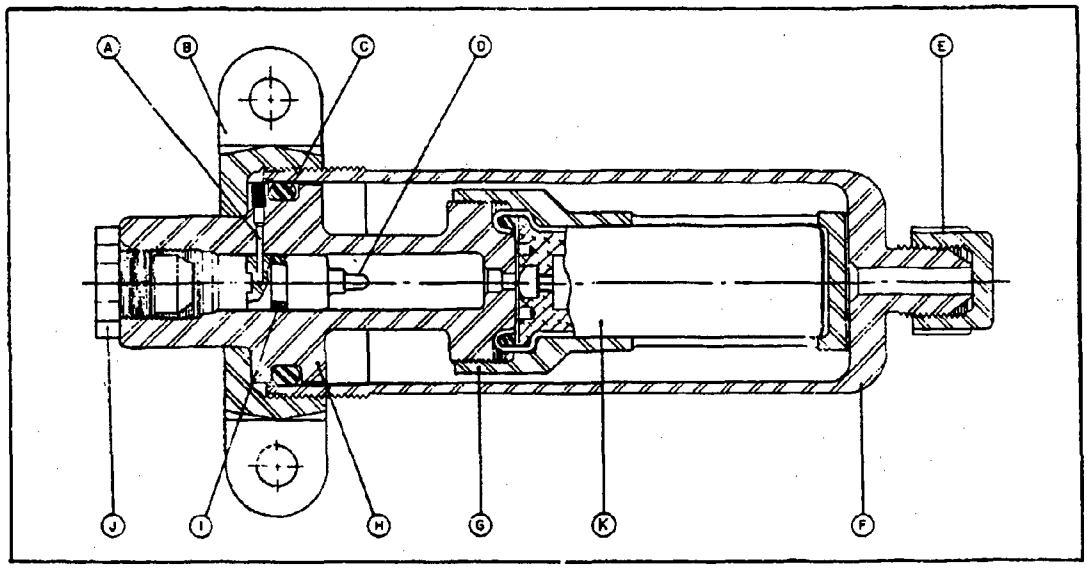
PRINCIPAL CHARACTERISTICS

Actuation Method	Ga Pressure
Actuation Force	750 psi min.
Temperature Limits	−65°F to +160°F
Assembled Weight	0.9 lb.
Delay Time	1.0 second

TYPICAL PERFORMANCE

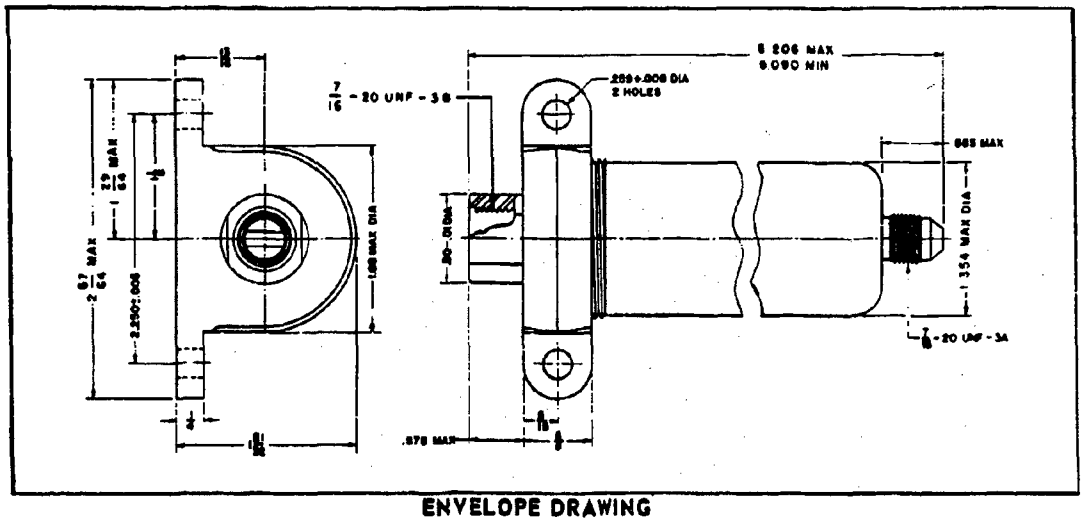


Initiator, Cartridge Actuated, Delay, M33



CROSS-SECTION DRAWING

Component		Component	
A	Pin, Shear	G	Retainer, Cartridge
B	Cap	H	Housing, Firing Pin
C	"O" Ring	I	"O" Ring
D	Pin, Firing	J	Plug, Shipping
E	Cap, Shipping	K	Cartridge, Initiator, Delay, M71 Assembly
F	Chamber, Initiator		



ENVELOPE DRAWING

INITIATOR, CARTRIDGE ACTUATED, DELAY, M42

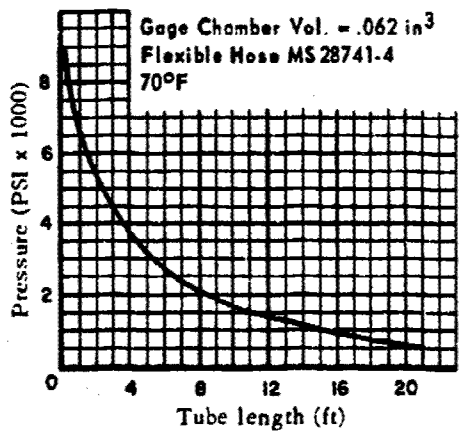
The M42 Delay Initiator consists of a constant volume chamber with a pressure outlet port incorporating a standard pressure fitting, a gas pressure actuated firing mechanism and an M113 Delay Cartridge. A length of tube or hose connects the initiator to another remotely installed propellant actuated device.

Upon cartridge function, an M13 Delay Element contained in the cartridge burns for 3 seconds, after which the propellant and black powder are ignited. The gas produced by the burning of the propellant and black powder charge flows through the tube to the gas pressure actuated firing mechanism of the other propellant actuated device, exerting a force which propels the firing pin against the cartridge contained in that device. The length of the connecting tube and/or hose, or the distance that the initiator can be mounted from the other device, is limited by the firing pin energy for reliable operation of the device.

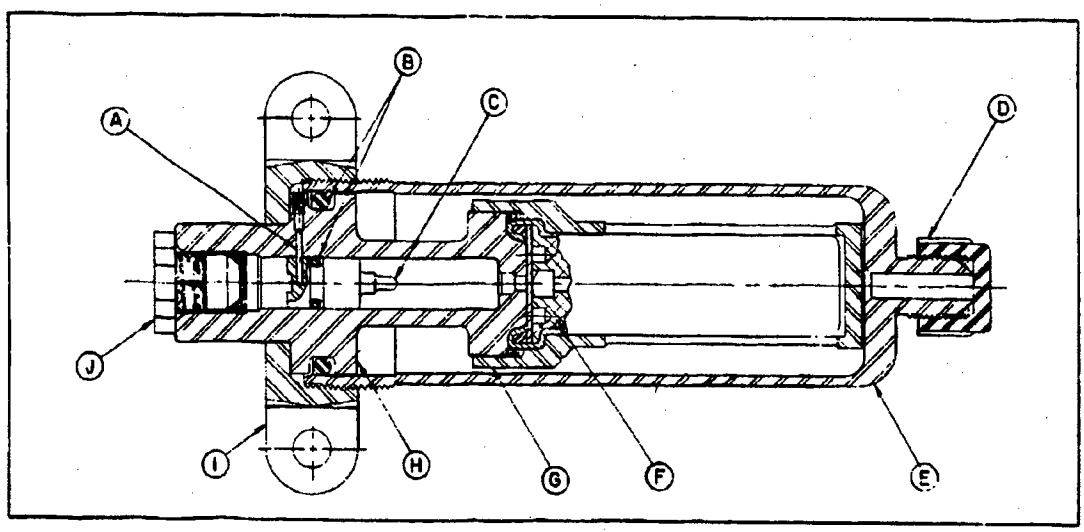
PRINCIPAL CHARACTERISTICS

Actuation Method	Gas Pressure
Actuation Force	750 psi min.
Temperature Limits	−65°F to +160°F
Assembled Weight	0.9 lb.
Delay Time	3.0 seconds

TYPICAL PERFORMANCE

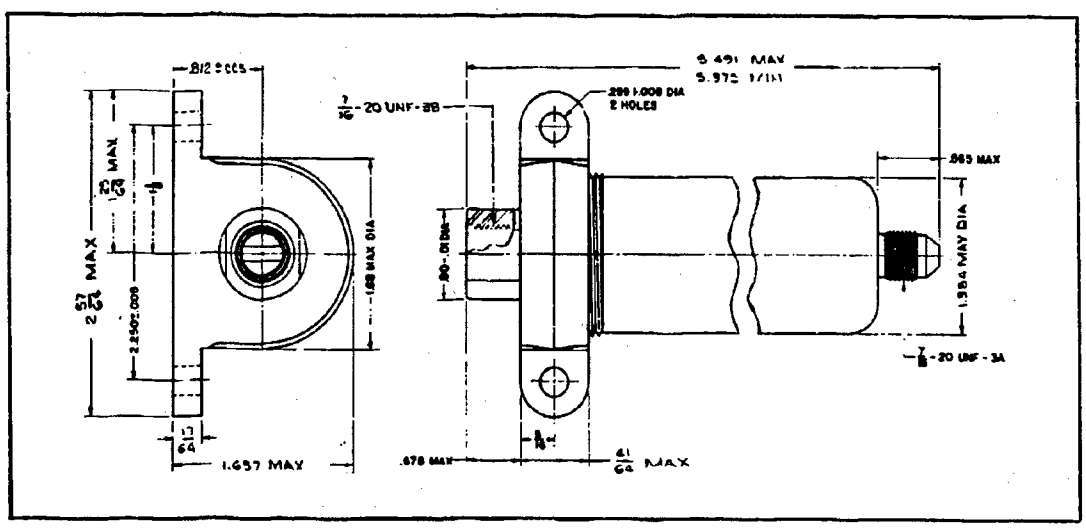


Initiator, Cartridge Actuated, Delay, M42



CROSS-SECTION DRAWING

Component		Component	
A	Pin, Shear	F	Cartridge, Initiator, Delay, M113 Assembly
B	"O" Ring	G	Retainer, Cartridge
C	Pin, Firing	H	Housing, Firing Pin
D	Cap, Shipping	I	Cap
E	Chamber, Initiator	J	Plug, Shipping



ENVELOPE DRAWING

INITIATOR, CARTRIDGE ACTUATED, DELAY, M43

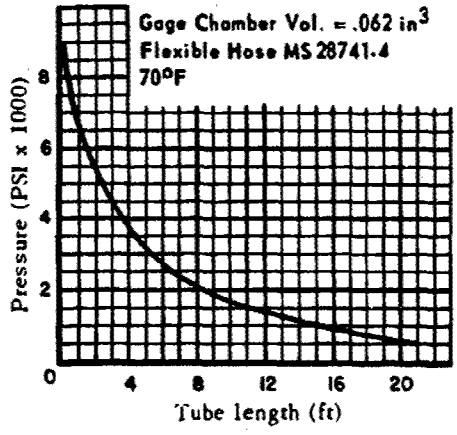
The M43 Initiator consists of a constant volume chamber with a pressure outlet port incorporating a standard pressure fitting, a mechanically operated firing mechanism and an M113 Delay Cartridge. A length of tube or hose connects the initiator to another remotely installed propellant actuated device.

Upon cartridge function, an M13 Delay Element contained in the cartridge burns for 3 seconds, after which the propellant and black powder are ignited. The gas produced by the burning of the propellant and black powder charge flows through the tube to the gas pressure actuated firing mechanism of the other propellant actuated device, exerting a force which propels the firing pin against the cartridge contained in that device. The length of the connecting tube and/or hose, or the distance that the initiator can be mounted from the other device, is limited by the firing pin energy required for reliable operation of the device.

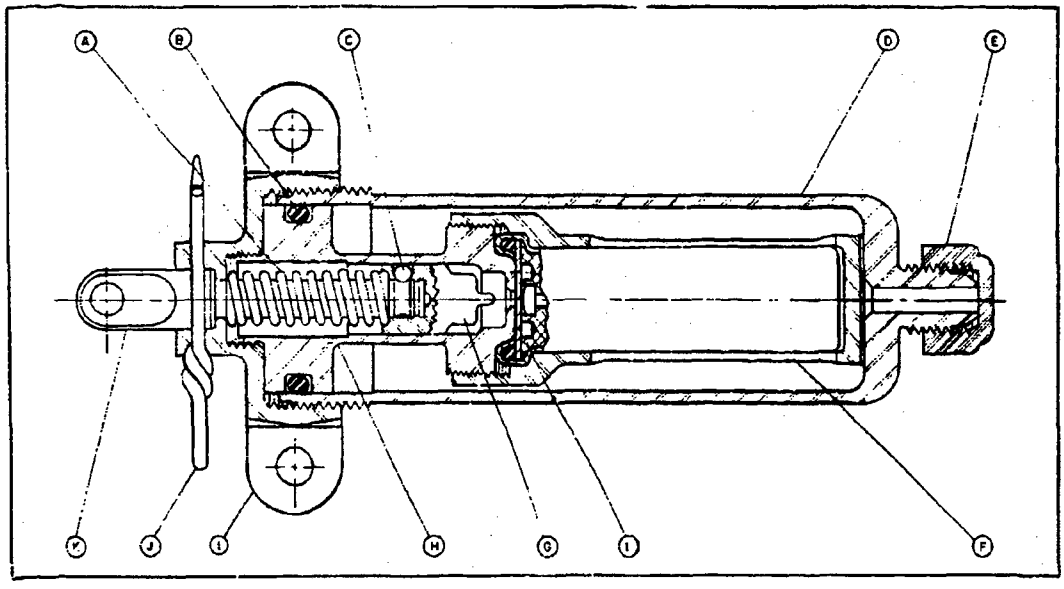
PRINCIPAL CHARACTERISTICS

Actuation Method	Mechanical
Actuation Force	40 lbs. min.
Temperature Limits	−65°F to +160°F
Assembled Weight	1.0 lb.
Delay Time	3.0 seconds

TYPICAL PERFORMANCE

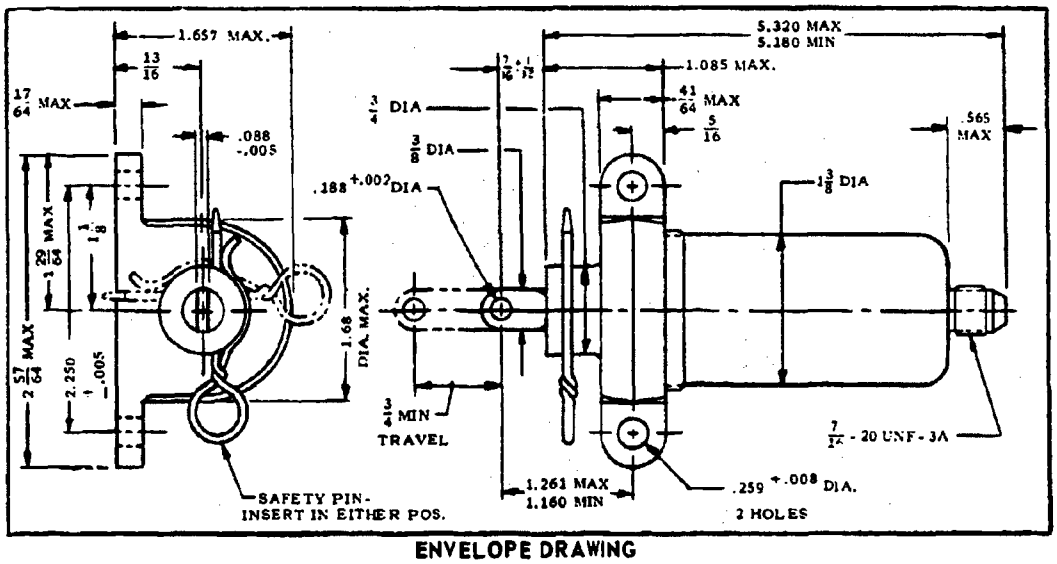


Initiator, Cartridge Actuated, Delay, M43



CROSS-SECTION DRAWING

Component		Component	
A	Spring, Initiator	H	Housing, Firing Pin
B	"O" Ring	I	Cap
C	Balls (3)	J	Pin, Safety
D	Chamber, Initiator	K	Pin, Initiator
E	Cap, Shipping	L	Cartridge, Initiator, Delay, 113 Assembly
F	Retainer, Cartridge		
G	Pin, Firing		



ENVELOPE DRAWING

INITIATOR, CARTRIDGE ACTUATED, DELAY, M44

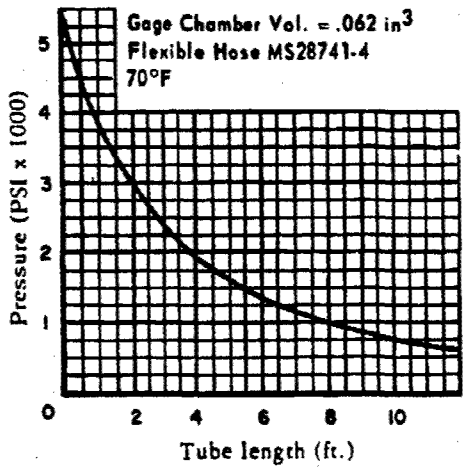
The M44 Delay Initiator consists of a constant volume chamber with a pressure outlet port incorporating a standard pressure fitting, a gas pressure actuated firing mechanism and an M114 Delay Cartridge. A length of tube or hose connects the initiator to another remotely installed propellant actuated device.

Upon cartridge function, an M13 Delay Element contained in the cartridge burns for 3 seconds, after which the propellant and black powder are ignited. The gas produced by the burning of the propellant and black powder charge flows through the tube to the gas pressure actuated firing mechanism of the other propellant actuated device, exerting a force which propels the firing pin against the cartridge contained in that device. The length of the connecting tube and/or hose, or the distance that the initiator can be mounted from the other device, is limited by the firing pin energy required for reliable operation of the device.

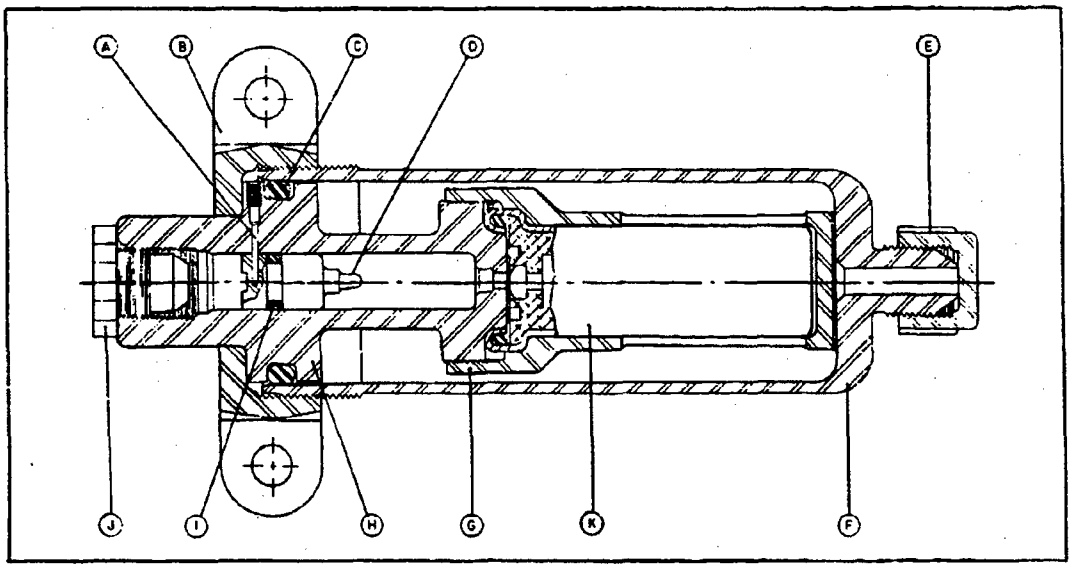
PRINCIPAL CHARACTERISTICS

Actuation Method	Gas Pressure
Actuation Force	750 psi min.
Temperature Limits	−65°F to +160°F
Assembled Weight	0.9 lb.
Delay Time	3.0 seconds

TYPICAL PERFORMANCE

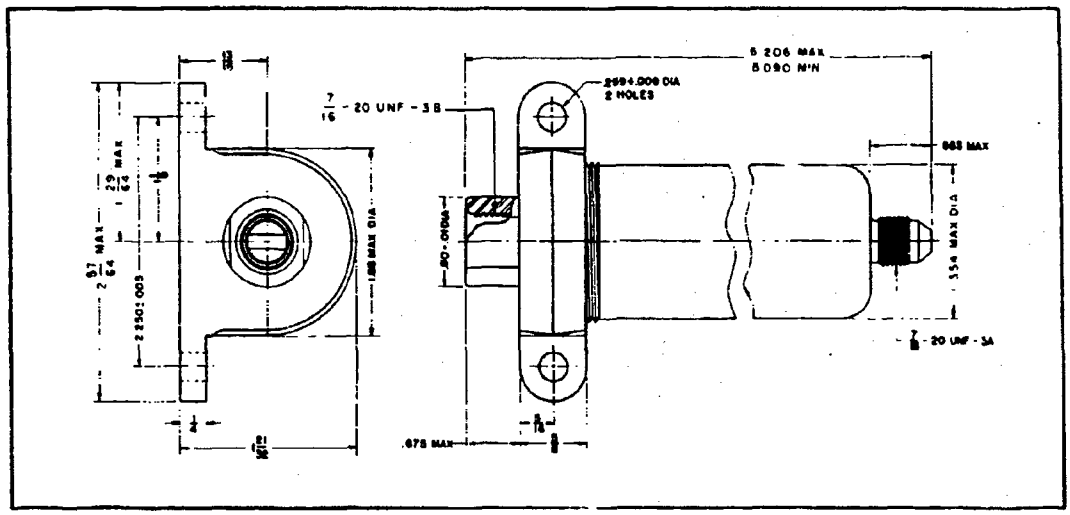


Initiator, Cartridge Actuated, Delay, M44



CROSS-SECTION DRAWING

Component		Component	
A	Pin, Shear	G	Retainer, Cartridge
B	Cap	H	Housing, Firing Pin
C	"O" Ring	I	"O" Ring
D	Pin, Firing	J	Plug, Shipping
E	Cap, Shipping	K	Cartridge, Initiator, Delay, M114 Assembly
F	Chamber, Initiator		



ENVELOPE DRAWING

INITIATOR CARTRIDGE ACTUATED, DELAY, M45

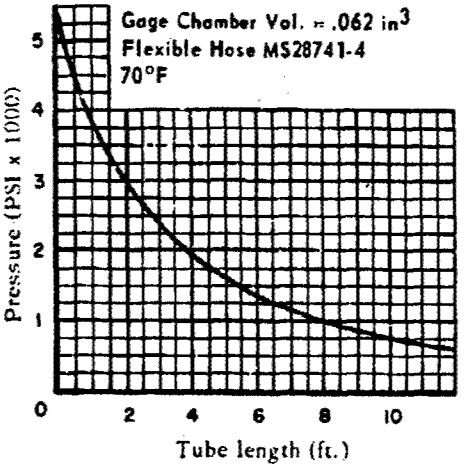
The M45 Initiator consists of a constant volume chamber with a pressure outlet port incorporating a standard pressure fitting, a mechanically operated firing mechanism and an M114 Delay Cartridge. A length of tube or hose connects the initiator to another remotely installed propellant actuated device.

Upon cartridge function, an M13 Delay Element contained in the cartridge burns for 3 seconds, after which the propellant and black powder are ignited. The gas produced by the burning of the propellant and black powder charge flows through the tube to the gas pressure actuated firing mechanism of the other propellant actuated device, exerting a force which propels the firing pin against the cartridge contained in that device. The length of the connecting tube and/or hose, or the distance that the initiator can be mounted from the other device, is limited by the firing pin energy required for reliable operation of the device.

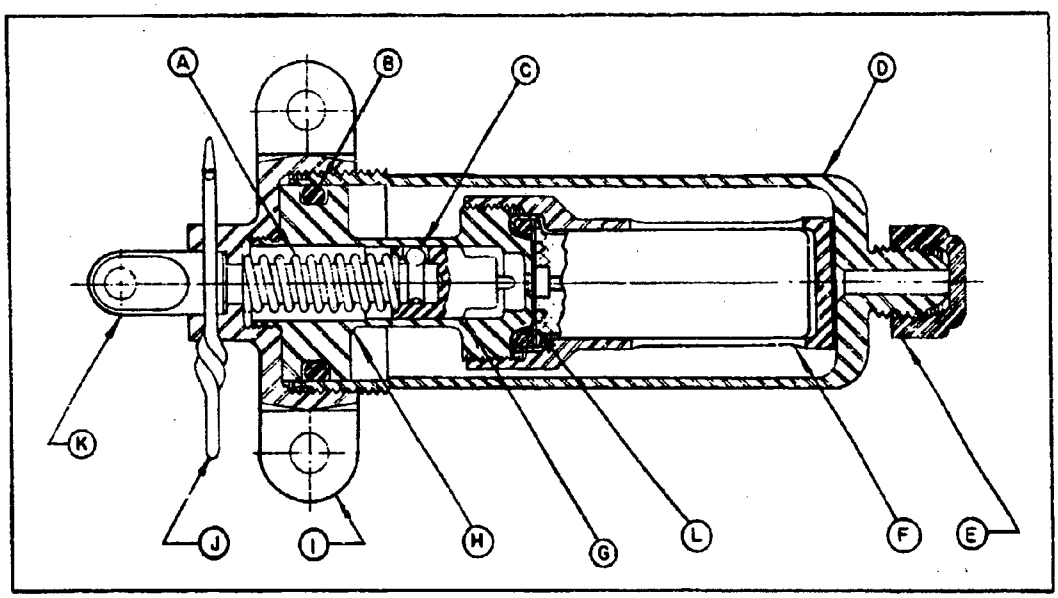
PRINCIPAL CHARACTERISTICS

Actuation Method	Mechanical
Actuation Force	40 lbs. min.
Temperature Limits	−65°F to +160°F
Assembled Weight	1.0 lb.
Delay Time	3.0 seconds

TYPICAL PERFORMANCE

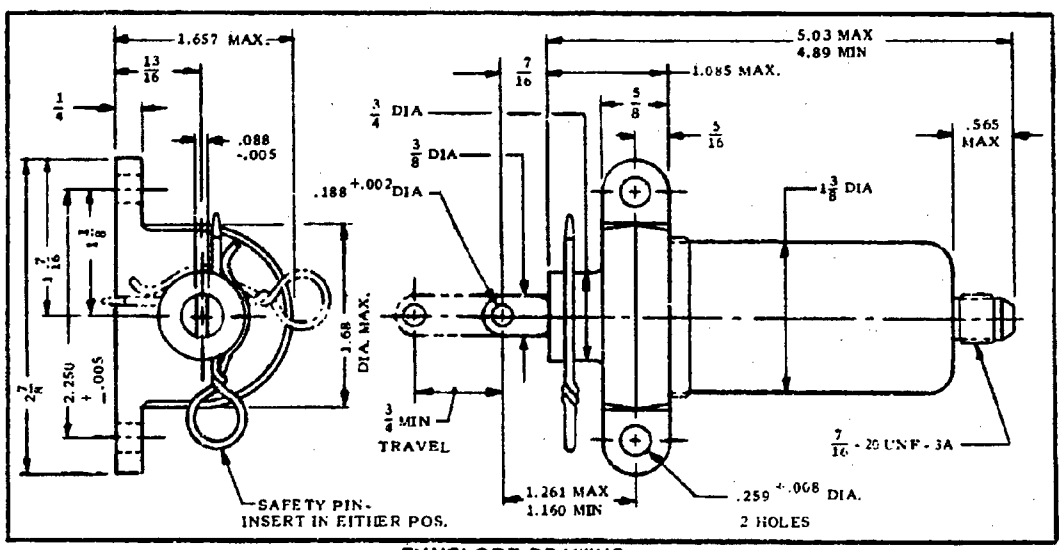


Initiator, Cartridge Actuated, Delay, M45



CROSS-SECTION DRAWING

Component		Component	
A	Spring, Initiator	H	Housing, Firing Pin
B	"O" Ring	I	Cap
C	Ball	J	Pin, Safety
D	Chamber, Initiator	K	Pin, Initiator
E	Cap, Shipping	L	Cartridge, Initiator, Delay, M114 Assembly
F	Retainer, Cartridge		
G	Pin, Firing		



ENVELOPE DRAWING

INITIATOR CARTRIDGE ACTUATED, DELAY, M49

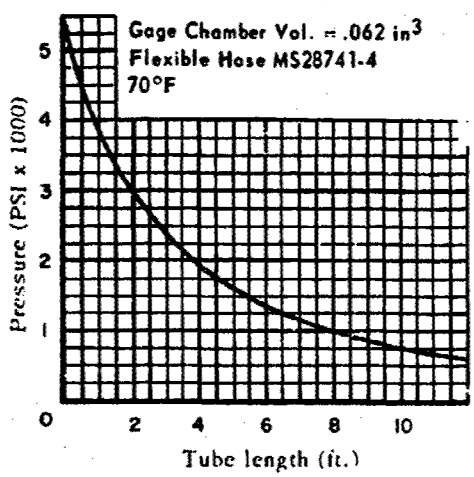
The M49 Initiator consists of a constant volume chamber with a pressure outlet port incorporating a standard pressure fitting, a mechanically operated firing mechanism and an M90 Delay Cartridge. A length of tube or hose connects the initiator to another remotely installed propellant actuated device.

Upon cartridge function, an M14 Delay Element contained in the cartridge burns for 0.3 second, after which the propellant and black powder are ignited. The gas produced by the burning of the propellant and black powder charge flows through the tube to the gas pressure actuated firing mechanism of the other propellant actuated device, exerting a force which propels the firing pin against the cartridge contained in that device. The length of the connecting tube and/or hose, or the distance that the initiator can be mounted from the other device, is limited by the firing pin energy required for reliable operation of the device.

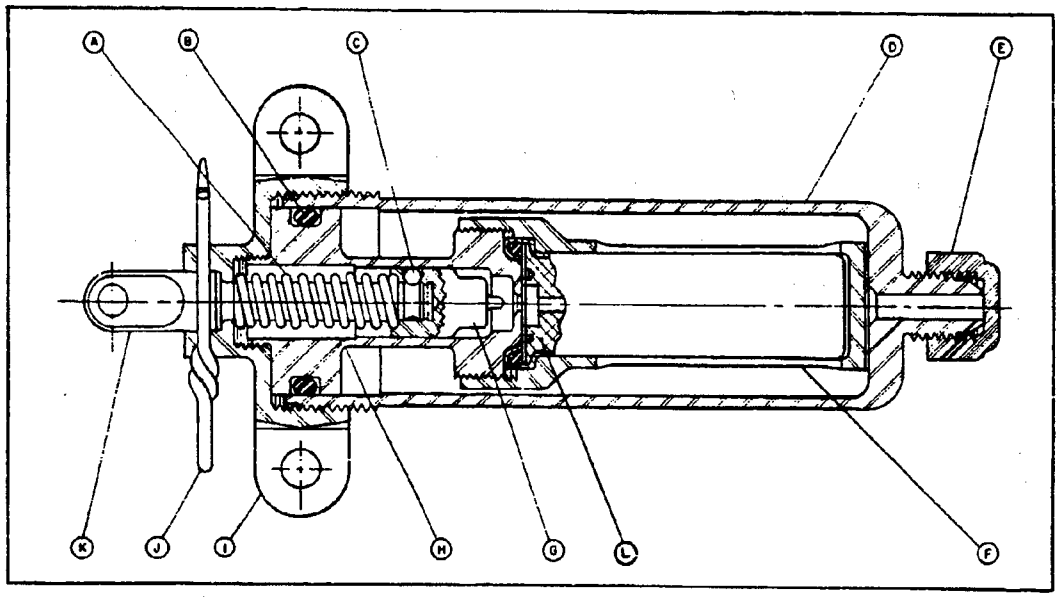
PRINCIPAL CHARACTERISTICS

Actuation Method	Mechanical
Actuation Force	40 lbs. min.
Temperature Limits	-65°F to +160°F
Assembled Weight	1.0 lb.
Delay Time	0.3 second

TYPICAL PERFORMANCE

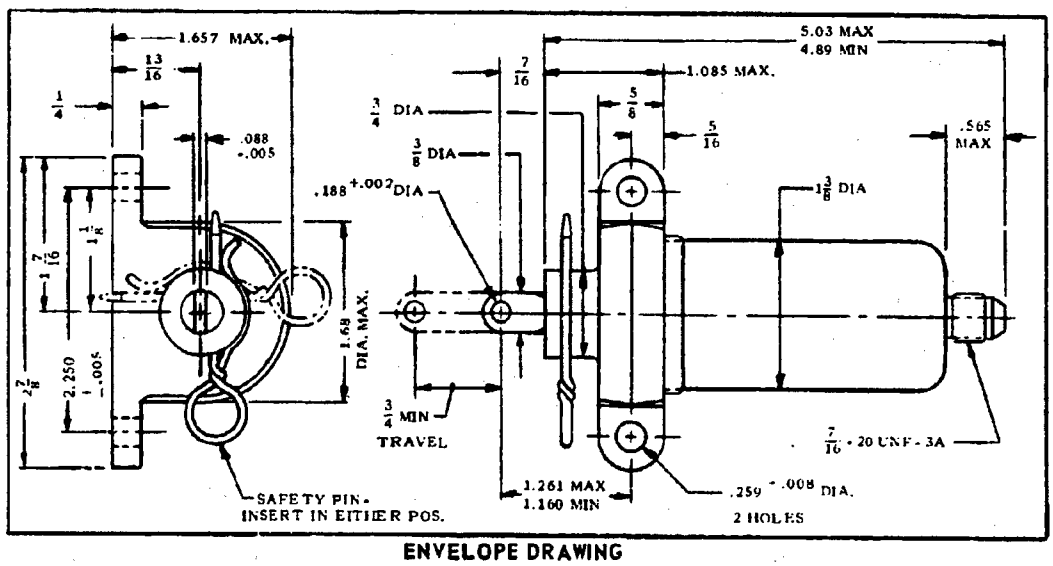


Initiator, Cartridge Actuated, Delay, M49



CROSS-SECTION DRAWING

Component		Component	
A	Spring, Initiator	H	Housing, Firing Pin
B	"O" Ring	I	Cap
C	Ball	J	Pin, Safety
D	Chamber, Initiator	K	Pin, Initiator
E	Cap, Shipping	L	Cartridge, Initiator, Delay, M90 Assembly
F	Retainer, Cartridge		
G	Pin, Firing		



ENVELOPE DRAWING

INITIATOR, CARTRIDGE ACTUATED, DELAY, M51

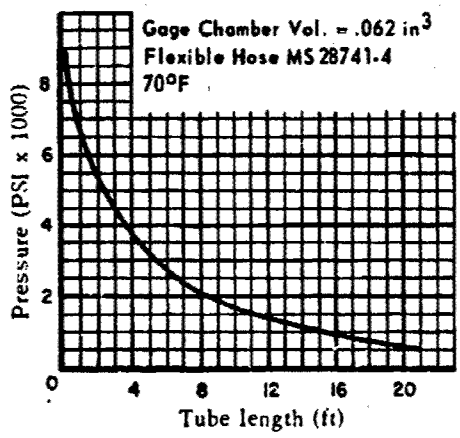
The M51 Delay Initiator consists of a constant volume chamber with a pressure outlet incorporating a standard pressure fitting, a gas pressure actuated firing mechanism and an M89 Delay Cartridge. A length of tube or hose connects the initiator to another remotely installed propellant actuated device.

Upon cartridge function, an XM24 Delay Element contained in the cartridge burns for 2 seconds, after which the propellant and black powder are ignited. The gas produced by the burning of the propellant and black powder charge flows through the tube to the gas pressure actuated firing mechanism of the other propellant actuated device, exerting a force which propels the firing pin against the cartridge contained in that device. The length of the connecting tube and/or hose, or the distance that the initiator can be mounted from the other device is limited by the firing pin energy for reliable operation of the device.

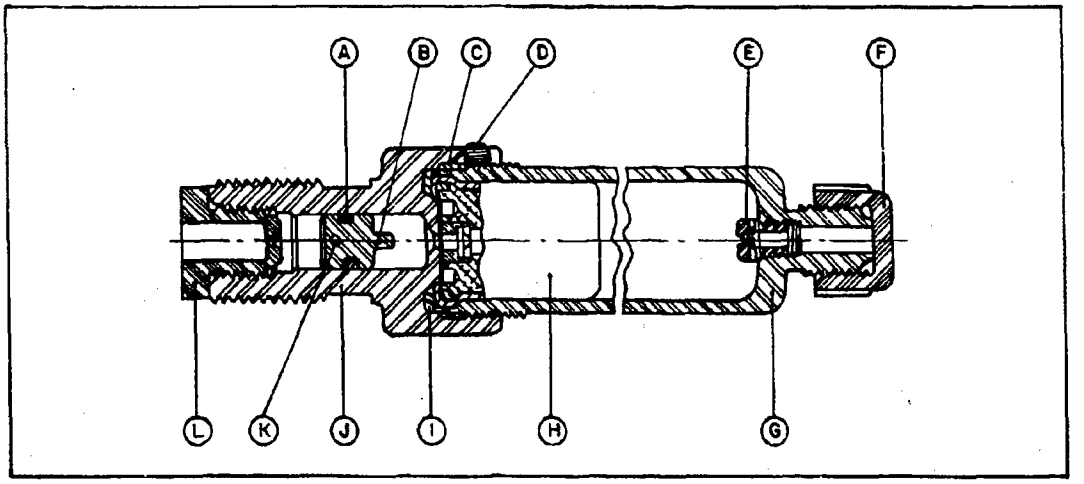
PRINCIPAL CHARACTERISTICS

Actuation Method	Gas Pressure
Actuation Force	750 psi min.
Temperature Limits	−65°F to +160°F
Assembled Weight	0.39 lb.
Delay Time	2.0 seconds
Mounting	Integral Threads

TYPICAL PERFORMANCE

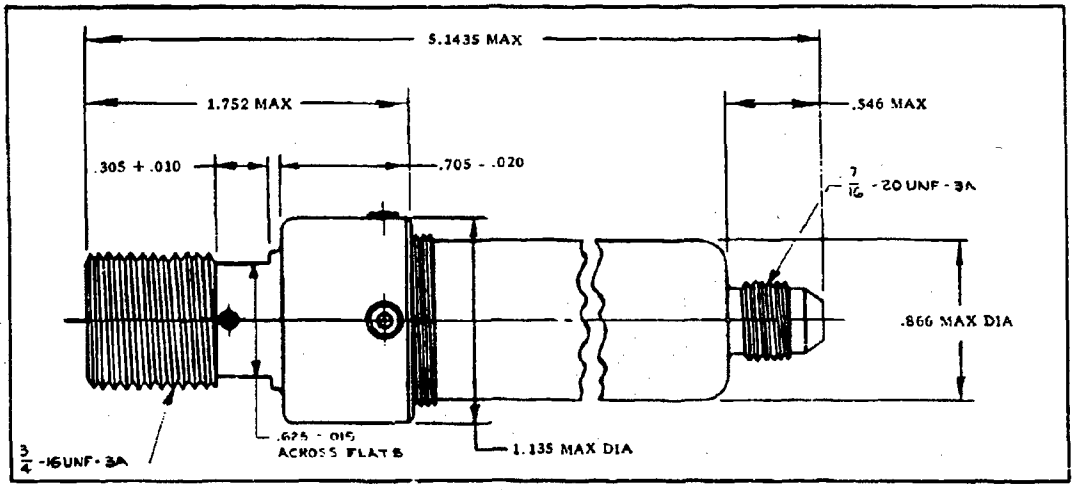


Initiator, Cartridge Actuated, Delay, M51



CROSS-SECTION DRAWING

Component		Component	
A	"O" Ring	H	Cartridge, Initiator, Delay, M89 Assembly
B	Pin, Firing	I	"O" Ring
C	"O" Ring	J	Cap, Initiator
D	Screw, Set	K	Pin, Shear
E	Filter	L	Plug, Shipping
F	Cap, Shipping		
G	Chamber, Initiator		



ENVELOPE DRAWING

INITIATOR, CARTRIDGE ACTUATED, DELAY, M52

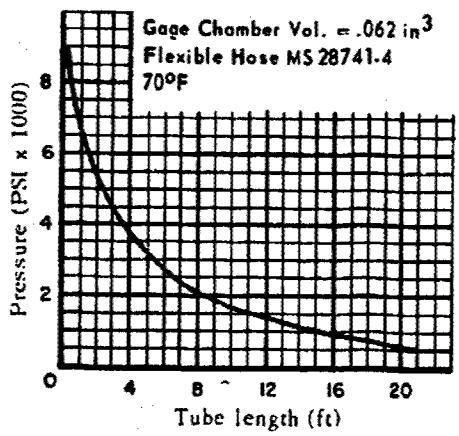
The M52 Delay Initiator consists of a constant volume chamber with a pressure outlet port incorporating a standard pressure fitting, a mechanically operated firing mechanism and an MX128 Delay Cartridge. A length of tube or hose connects the initiator to another remotely installed propellant actuated device.

Upon cartridge function, an XM27 Delay Element contained in the cartridge, burns for 5 seconds, after which the propellant and black powder are ignited. The gas produced by the burning of the propellant and black powder charge flows through the tube to the gas pressure actuated firing mechanism of the other propellant actuated device, exerting a force which propels the firing pin against the cartridge contained in that device. The length of the connecting tube and/or hose, or distance that the initiator can be mounted from the other device, is limited by the firing pin energy required for reliable operation of the device.

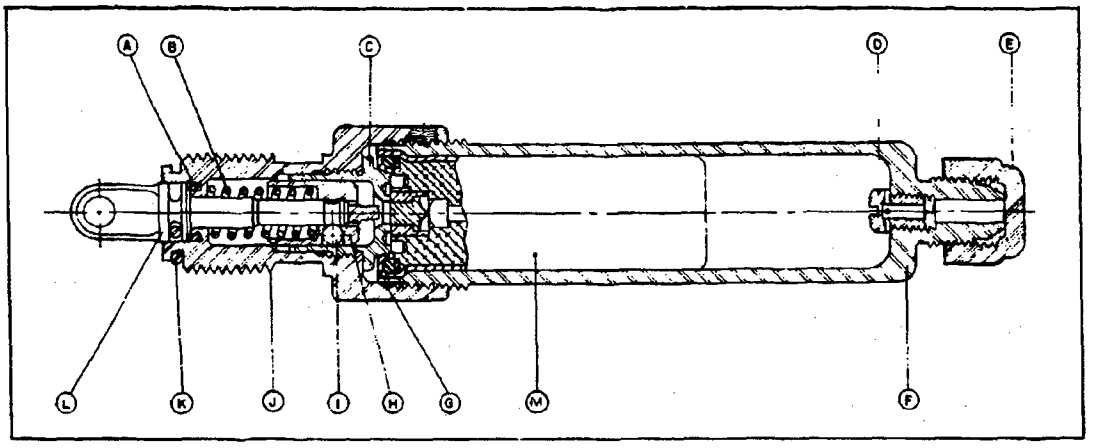
PRINCIPAL CHARACTERISTICS

Actuation Method	Mechanical
Actuation Force	40 lb. min.
Temperature Limits	−65°F to +160°F
Assembled Weight	0.39 lb.
Delay Time	5.0 seconds
Mounting	Integral Threads

TYPICAL PERFORMANCE

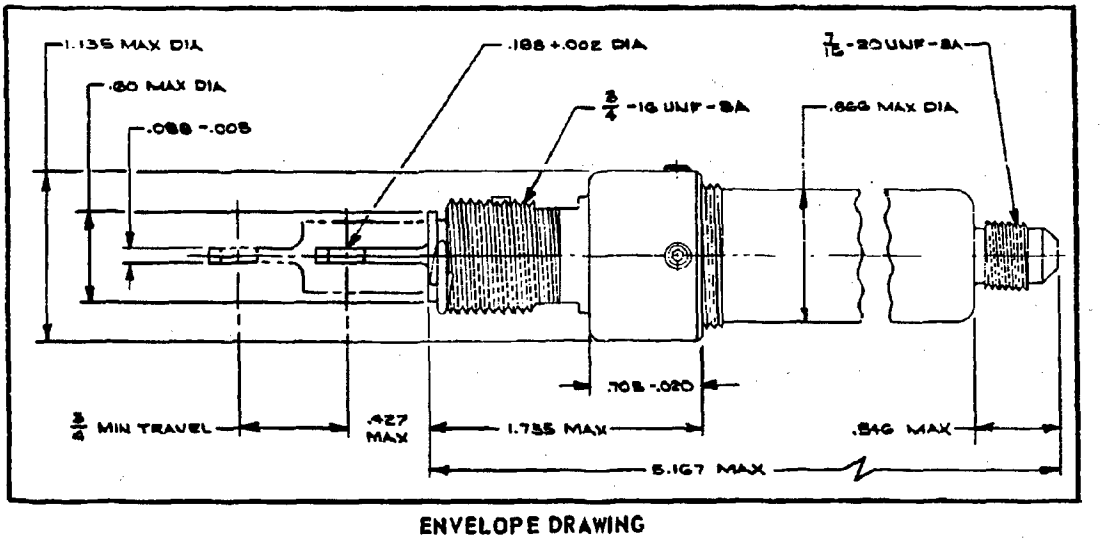


Initiator, Cartridge Actuated, Delay, M52



CROSS-SECTION DRAWING

Component		Component	
A	Seal	H	Pin, Firing
B	Spring, Initiator	I	Ball
C	Housing, Firing Pin	J	Cap, Initiator
D	Filter	K	Pin, Safety
E	Cap, Shipping	L	Pin, Initiator
F	Chamber, Initiator	M	Cartridge, Initiator, Delay, XM128
G	"O" Ring		



ENVELOPE DRAWING

INITIATOR, CARTRIDGE ACTUATED, DELAY, M54

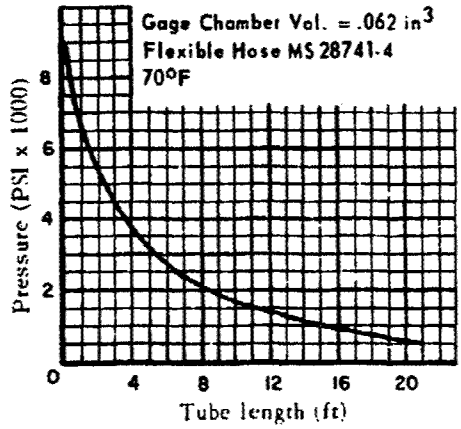
The M54 Delay Initiator consists of a constant volume chamber with a pressure outlet port incorporating a standard pressure fitting, a mechanically operated firing mechanism and an XM128 Delay Cartridge. A length of tube or hose connects the initiator to another remotely installed propellant actuated device.

Upon cartridge function, an XM27 Delay Element contained in the cartridge, burns for 5 seconds, after which the propellant and black powder are ignited. The gas produced by the burning of the propellant and black powder charge flows through the tube to the gas pressure actuated firing mechanism of the other propellant actuated device, exerting a force which propels the firing pin against the cartridge contained in that device. The length of the connecting tube and/or hose, or distance that the initiator can be mounted from the other device, is limited by the firing pin energy required for reliable operation of the device.

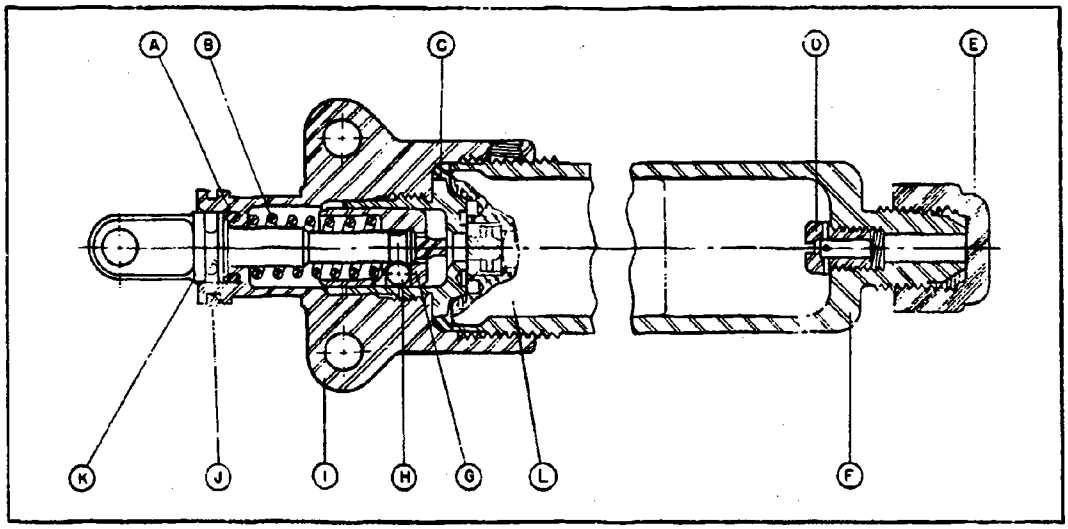
PRINCIPAL CHARACTERISTICS

Actuation Method	Mechanical
Actuation Force	40 lbs min
Temperature Limits	−65°F to +160°F
Assembled Weight	0.39 lb.
Delay Time	5.0 seconds
Mounting	Integral Lugs

TYPICAL PERFORMANCE

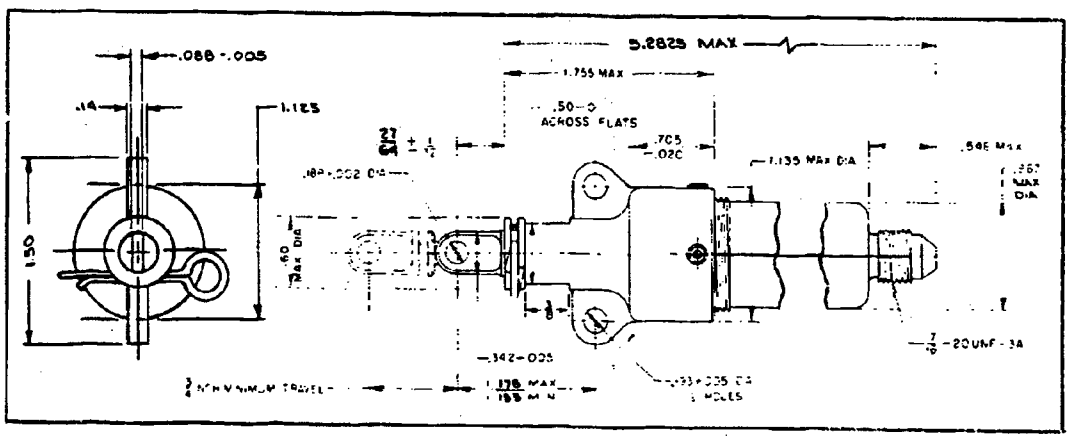


Initiator, Cartridge Actuated, Delay, M54



CROSS-SECTION DRAWING

	Component		Component
A	Seal	G	Pin, Firing
B	Spring, Initiator	H	Balls (3)
C	Housing, Firing Pin	I	Cap, Initiator
D	Filter	J	Pin, Safety
E	Cap, Shipping	K	Pin, Initiator
F	Chamber, Initiator	L	Cartridge, Initiator, XM128



ENVELOPE DRAWING

INITIATOR, CARTRIDGE ACTUATED, M80

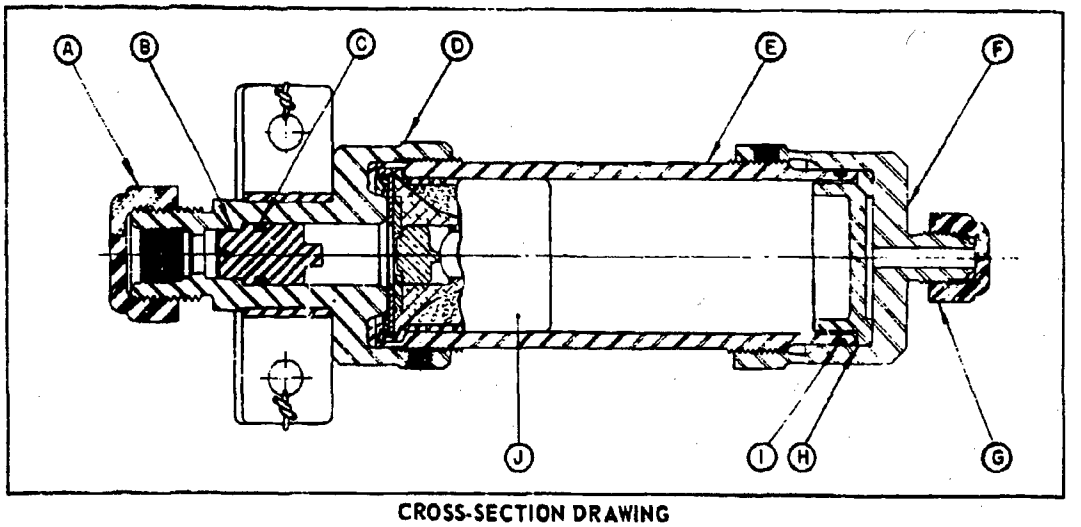
The M80 Initiator is a sealed M9 type Initiator which restricts toxic gas leakage to prevent atmospheric contamination exceeding concentration limits safe for human occupancy in encapsulated environments. It consists of a gas pressure actuated firing mechanism, a chamber and end cap with a pressure outlet port incorporating a standard pressure fitting and an M69 Cartridge. A length of tube or hose connects the initiator to another remotely installed propellant actuated device.

Upon cartridge function, the gas produced by burning of the propellant and black powder charge flows through the tube to the gas pressure actuated firing mechanism of the other propellant actuated device, exerting a force which propels the firing pin against the cartridge contained in that device. The length of the connecting tube and/or hose, or the distance that the initiator can be mounted from the other device, is limited by the firing pin energy required for reliable operation of the device. The M80 Initiator is capable of delivering to an .062 in^3 terminal chamber volume at the end of a 30 foot length of MS28741-4 hose, pressure within the limits of 1000 psi minimum and 3000 psi maximum.

PRINCIPAL CHARACTERISTICS

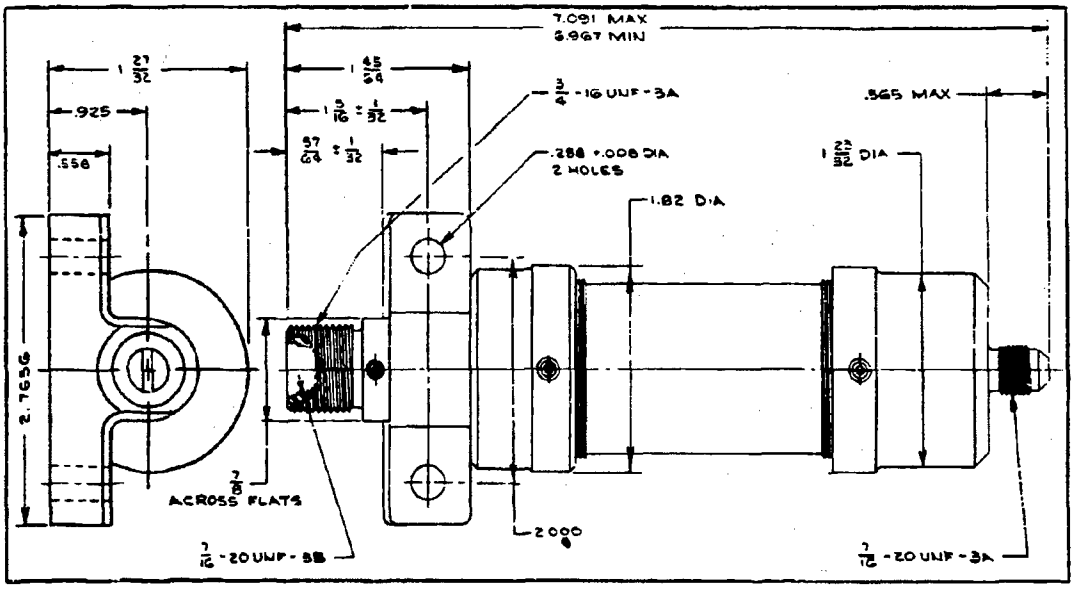
Actuation Method	Gas Pressure
Actuation Force	750 psi min.
Temperature Limits	−65°F to +160°F
Assembled Weight	3.2 lbs.

Initiator, Cartridge Actuated, M80



CROSS-SECTION DRAWING

Component		Component	
A	Cap, Shipping	F	Cap
B	Pin, Firing	G	Cap, Shipping
C	"O" Ring	H	Filter
D	Cap, Initiator	I	"O" Ring
E	Body	J	Cartridge, Initiator, M69 Assembly



ENVELOPE DRAWING

INITIATOR, CARTRIDGE ACTUATED, XM86

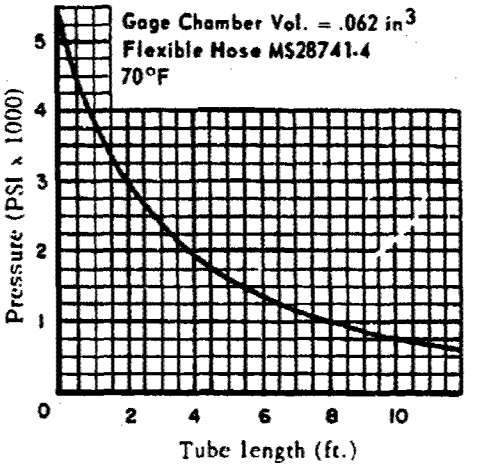
The XM86 Initiator consists of a constant volume chamber with a pressure outlet port incorporating a standard pressure fitting, a mechanically operated firing mechanism and an XM169 Cartridge. A length of tube or hose connects the initiator to another remotely installed propellant actuated device.

Upon cartridge function, the gas produced by the burning of the propellant and black powder charge, flows through the tube to the gas pressure actuated firing mechanism of the other propellant actuated device, exerting a force which propels the firing pin against the cartridge contained in that device. The length of the connecting tube and/or hose, or distance that the initiator can be mounted from the other device, is limited by the firing pin energy required for reliable operation of the device.

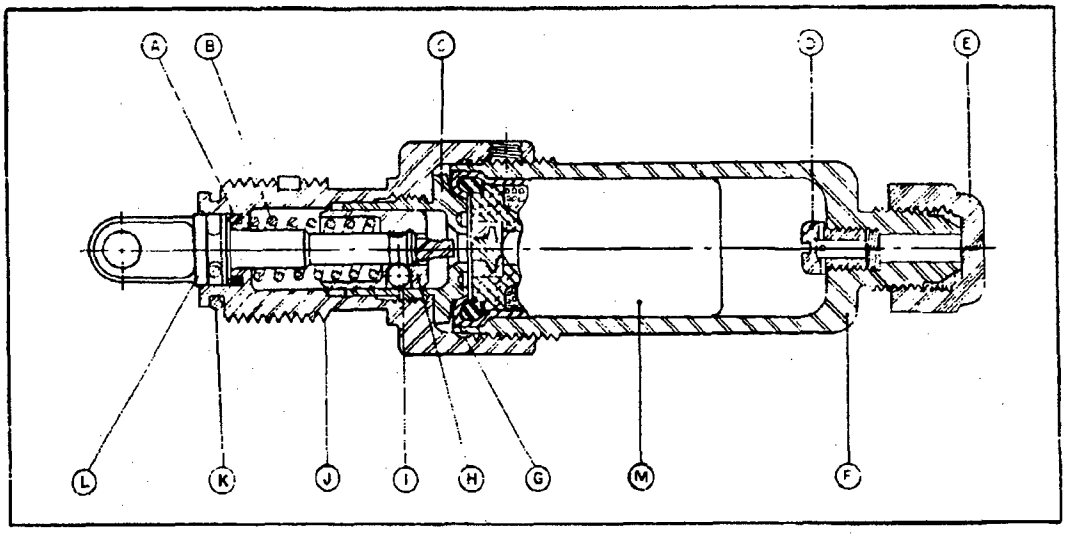
PRINCIPAL CHARACTERISTICS

Actuation Method	Mechanical
Actuation Force	40 lbs. min.
Temperature Limits	−65°F to +160°F
Assembled Weight	0.3 lb.
Mounting	Integral Thread

TYPICAL PERFORMANCE

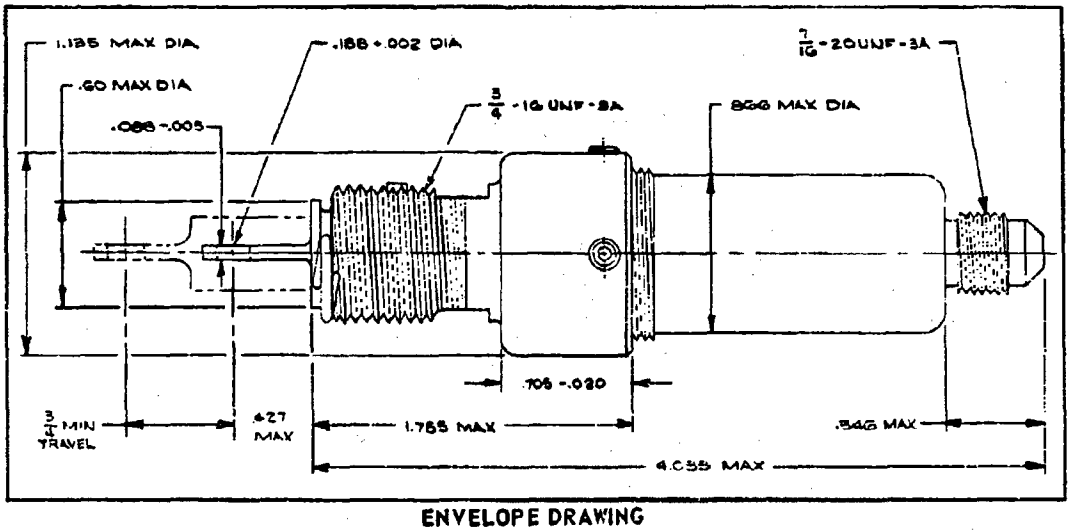


Initiator, Cartridge Actuated, XM86



CROSS-SECTION DRAWING

Component		Component	
A	St	H	Pin, Firing
B	Spring, I.. .iator	I	Ball
C	Housing, Firing Pin	J	Cap, Initiator
D	Filter	K	Pin, Safety
E	Cap, Shipping	L	Pin, Initiator
F	Chamber, Initiator	M	Cartridge, Initiator, XM169 Assembly
G	"O" Ring		



ENVELOPE DRAWING

INITIATOR, CARTRIDGE ACTUATED, M87

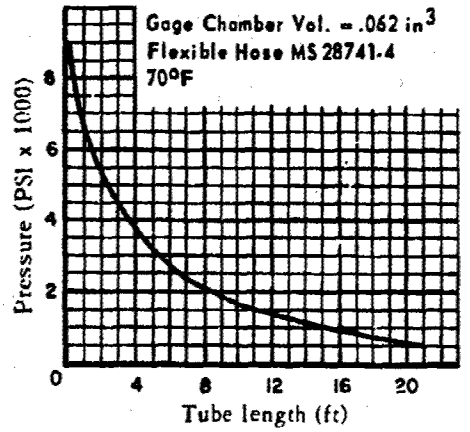
The M87 Initiator is a sealed M27 type Initiator which restricts toxic propellant gas leakage to prevent atmospheric contamination exceeding concentration limits safe for human occupancy in encapsulated environments. It consists of a constant volume chamber with a pressure outlet port incorporating a standard pressure fitting, a mechanically operated firing mechanism and an M173 Cartridge. A length of tube or hose connects the initiator to another remotely installed propellant actuated device.

Upon cartridge function, the gas produced by the burning of the propellant and black powder charge flows through the tube to the gas pressure actuated firing mechanism of the other propellant actuated device, exerting a force which propels the firing pin against the cartridge contained in that device. The length of the connecting tube and/or hose, or distance that the initiator can be mounted from the other device is limited by the firing pin energy required for reliable operation of the device.

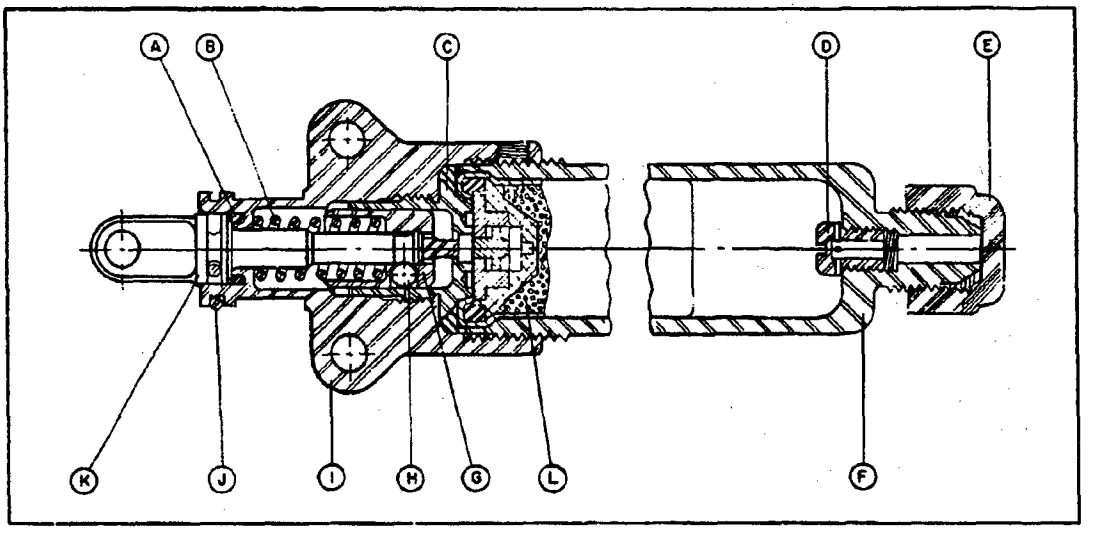
PRINCIPAL CHARACTERISTICS

Actuation Method	Mechanical
Actuation Force	40 lbs. min.
Temperature limits	−65°F to +160°F
Assembled Weight	0.33 lb.
Mounting	Integral Lugs

TYPICAL PERFORMANCE

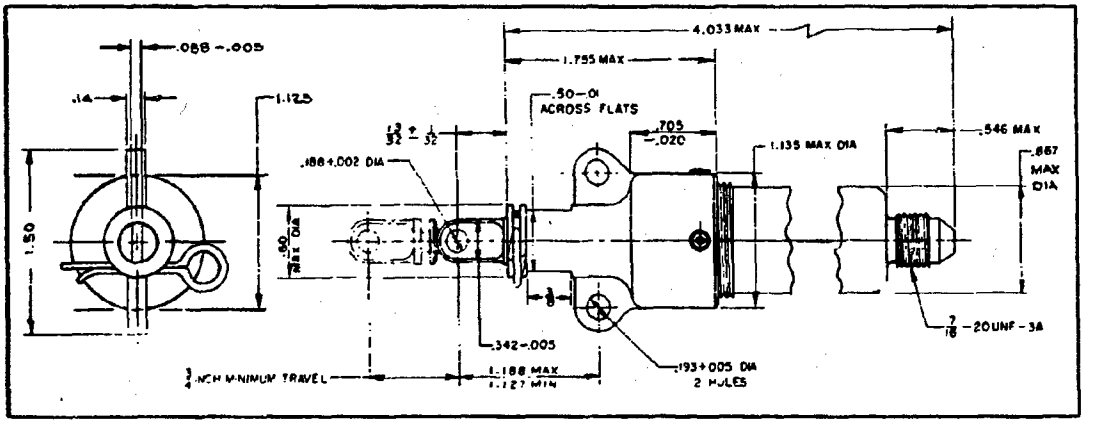


Initiator, Cartridge Actuated, M87



CROSS-SECTION DRAWING

Component		Component	
A	Seal	G	Pin, Firing
B	Spring, Initiator	H	Ball
C	Housing, Firing Pin	I	Cap, Initiator
D	Filter	J	Pin, Safety
E	Cap, Shipping	K	Pin, Initiator
F	Chamber, Initiator	L	Cartridge, Initiator, M173



ENVELOPE DRAWING

INITIATOR, CARTRIDGE ACTUATED, DELAY, M88

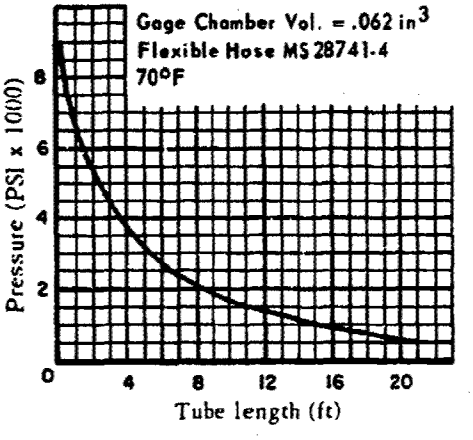
The M88 Initiator is a sealed M51 type Initiator which restricts toxic propellant gas leakage to prevent atmospheric contamination exceeding concentration limits safe for human occupancy in encapsulated environments. It consists of a constant volume chamber with a pressure outlet port incorporating a standard pressure fitting, a gas pressure actuated firing mechanism and an M174 Delay Cartridge. A length of tube or hose connects the initiator to another remotely installed propellant actuated device.

Upon cartridge function, an XM24 Delay Element contained in the cartridge burns for 2 seconds, after which the propellant and black powder are ignited. The gas produced by the burning of the propellant and black powder charge flows through the tube to the gas pressure actuated firing mechanism of the other propellant actuated device, exerting a force which propels the firing pin against the cartridge contained in that device. The length of the connecting tube and or hose, or the distance that the initiator can be mounted from the other device is limited by the firing pin energy required for reliable operation of the device.

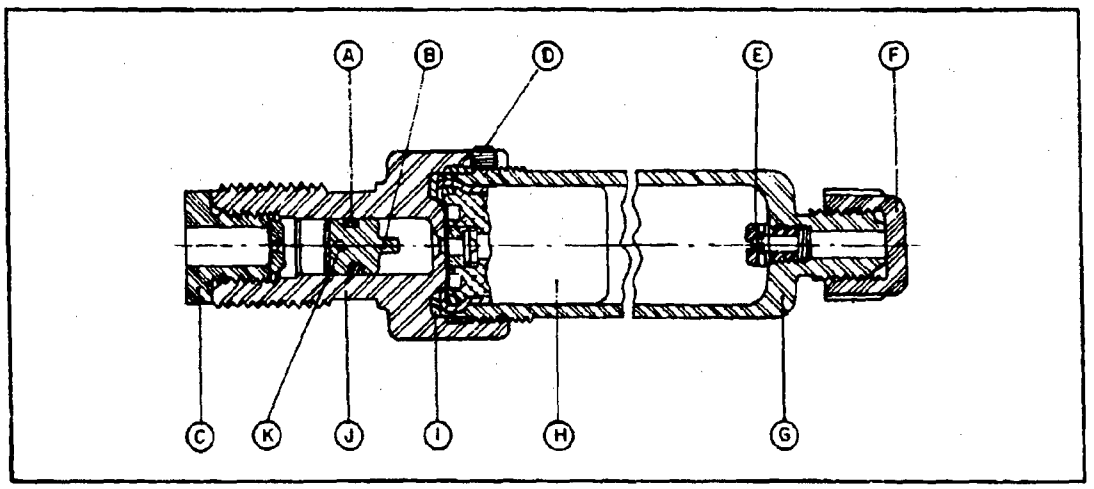
PRINCIPAL CHARACTERISTICS

Actuation Method	Gas Pressure
Actuation Force	750 psi, min.
Temperature Limits	−65°F to +160°F
Assembled Weight	0.39 lbs.
Delay Time	2.0 seconds
Mounting	Integral Threads

TYPICAL PERFORMANCE

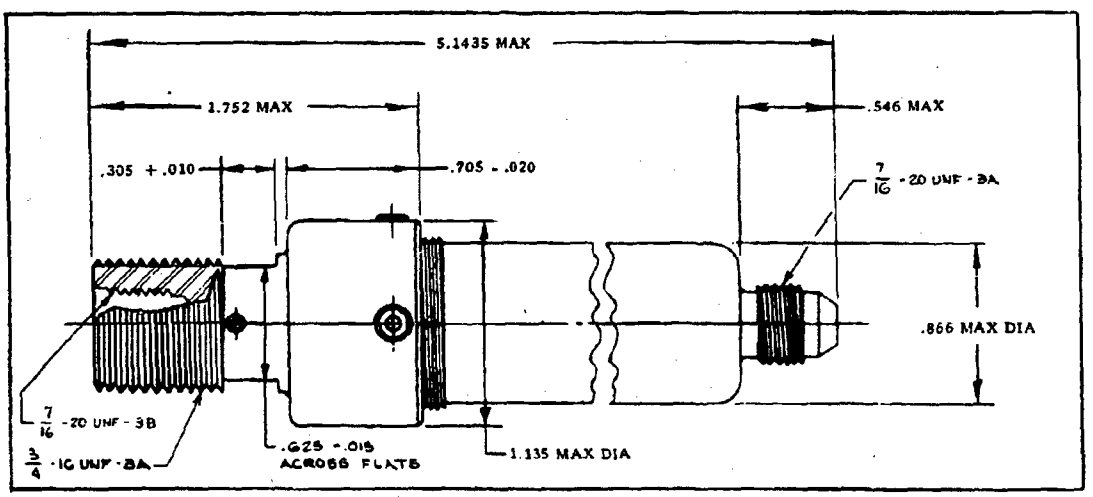


Initiator, Cartridge Actuated, Delay, M88



CROSS-SECTION DRAWING

Component		Component	
A	"O" Ring	G	Chamber, Initiator
B	Pin, Firing	H	Cartridge, Initiator, Delay, M174 Assembly
C	Plug, Shipping	I	"O" Ring
D	Screw, Set	J	Cap, Initiator
E	Filter	K	Pin, Shear
F	Cap, Shipping		



ENVELOPE DRAWING

INITIATOR, CARTRIDGE ACTUATED, DELAY, M89

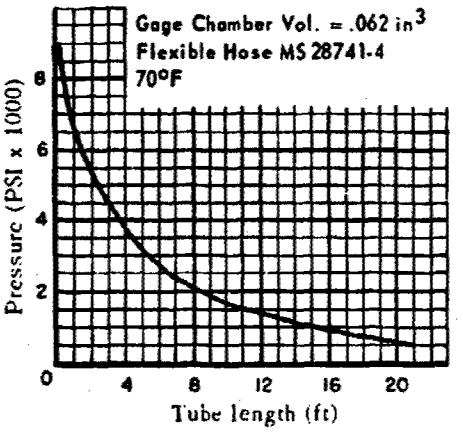
The M89 Initiator is a sealed M54 type Initiator which restricts toxic gas to prevent atmospheric contamination exceeding concentration limits safe for human occupancy in encapsulated environments. It consists of a constant volume chamber with a pressure outlet port incorporating a standard pressure fitting, a mechanically operated firing mechanism and an M175 Delay Cartridge. A length of tube or hose connects the initiator to another remotely installed propellant actuated device.

Upon cartridge function, an XM27 Delay Element contained in the cartridge burns for 5 seconds, after which the propellant and black powder are ignited. The gas produced by the burning of the propellant and black powder charge flows through the tube to the gas pressure actuated firing mechanism of the other propellant actuated device, exerting a force which propels the firing pin against the cartridge contained in that device. The length of the connecting tube and/or hose, or the distance that the initiator can be mounted from the other device is limited by the firing pin energy required for reliable operation of the device.

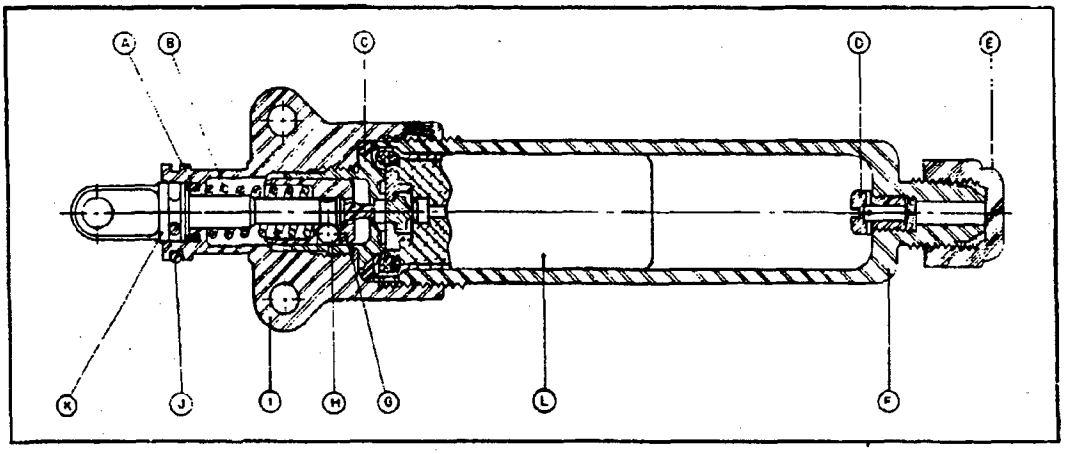
PRINCIPAL CHARACTERISTICS

Actuation Method	Mechanical
Actuation Force	40 lbs. min.
Temperature Limits	−65°F to +160°F
Assembled Weight	0.39 lb.
Delay Time	5.0 seconds
Mounting	Integral Lugs

TYPICAL PERFORMANCE

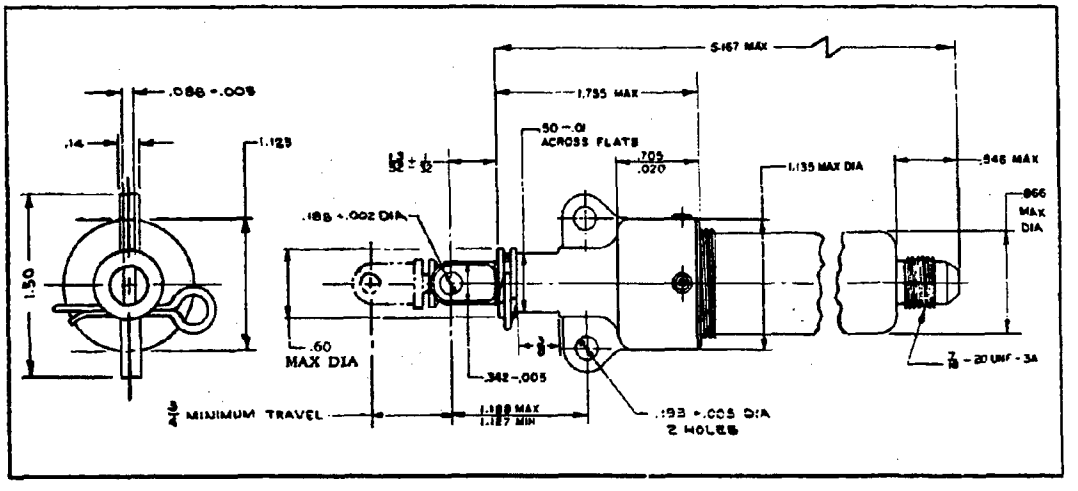


Initiator, Cartridge Actuated, Delay, M89

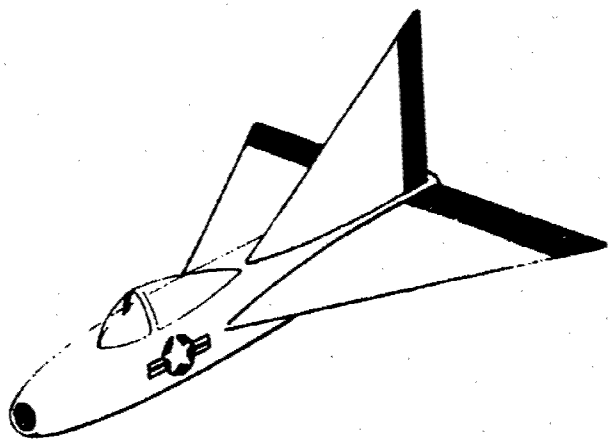


CROSS-SECTION DRAWING

Component		Component	
A	Seal	H	Ball
B	Spring, Initiator	I	Cap, Initiator
C	Housing, Firing Pin	J	Pin, Safety
D	Filter	K	Pin, Initiator
E	Cap, Shipping	L	Cartridge, Initiator, Delay, M175 Assembly
F	Chamber, Initiator		
G	Pin, Firing		



ENVELOPE DRAWING



SECTION V

MISCELLANEOUS

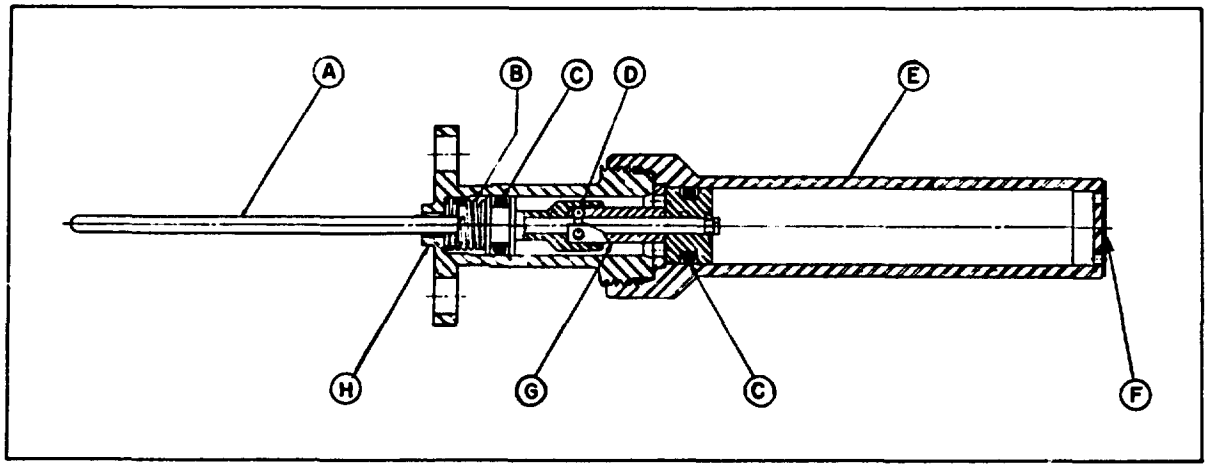
RELEASE, FIRING PIN, M1A1

The M1A1 Firing Pin Release is a gas pressure actuated device which performs firing pin release function for such devices as the M1A3 Remover. It is a piston and cylinder unit, actuated by propellant gas pressure supplied from another propellant actuated device. As gas pressure is introduced through the intake port, a force is exerted on the unlocking piston resulting in its displacement and the release of the rod and piston assembly. Upon release, the rod and piston assembly is propelled by gas pressure through the cylinder causing withdrawal of the extended rod into the unit.

PRINCIPAL CHARACTERISTICS

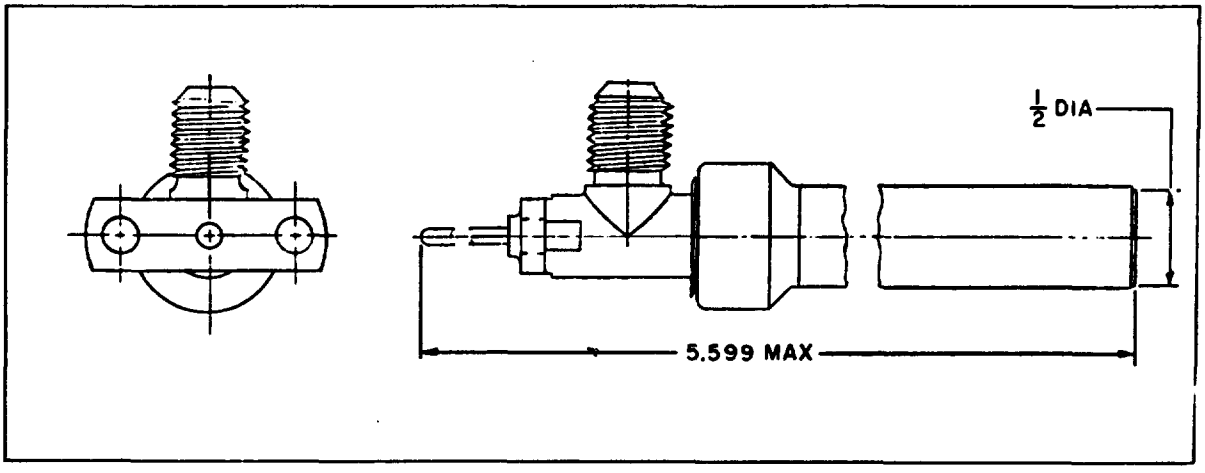
Actuation Method	Gas Pressure
Actuation Force	250 psi min.

Release, Firing Pin, Gas Actuated, M1A1



CROSS-SECTION DRAWING

Component		Component	
A	Rod, Piston Assembly	E	Cylinder
B	Spring, Piston Assembly	F	Disc
C	"O" Ring (2)	G	Piston Assembly
D	Ball	H	Housing, Piston Assembly



ENVELOPE DRAWING

CUTTER M8

The M8 Cable Cutter is a component part of an aircraft escape system whose purpose is to sever wires or cables prior to implementing the escape procedure of aircraft personnel from the aircraft. The cutter is capable of severing either a bundle of coaxial cables or a bundle of wires. The blade of the cutter is coated to prevent shorting as the blade passes through the cables or wires.

The cutter is cylindrical in shape, approximately 5.8 inches long and 2.3 inches in diameter. The blade of the cutter is held in position by a "shear pin" which will shear in double shear when a load of 2160 ± 200 pounds is applied.

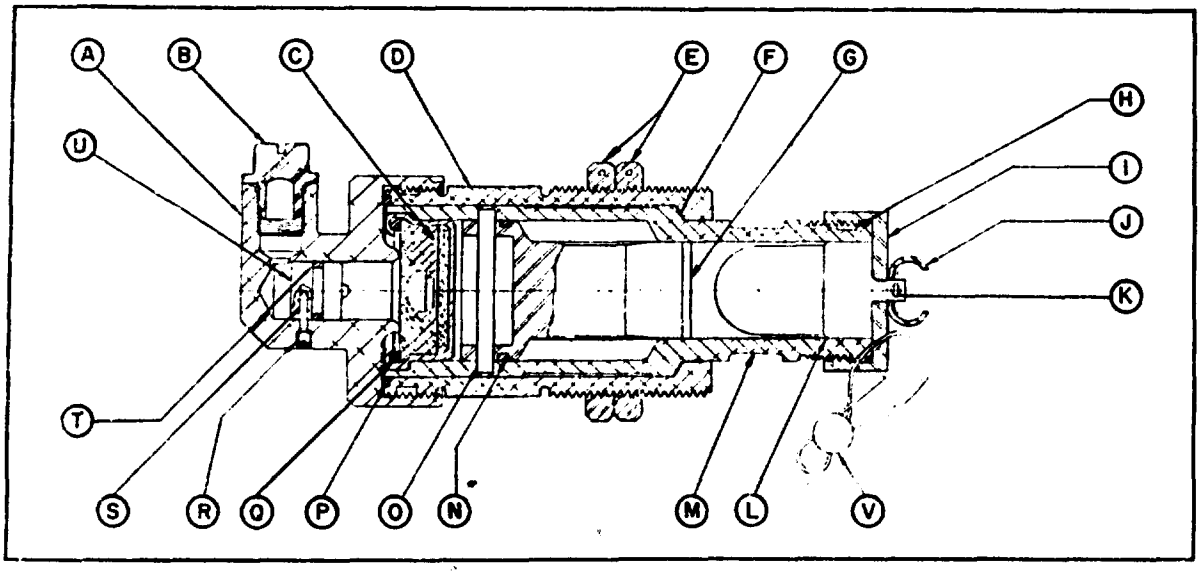
The cutter incorporates a propellant gas operated firing mechanism. It is actuated by gas pressure supplied from another propellant actuated device.

PRINCIPAL CHARACTERISTICS

Stroke	1.25 inches
Assembled Weight	.75 ibs.
*Blades average depth of penetration into anvil when fired at 70°F	.004 inches
Firing Method	Propellant Gas
Temperature Limits	–65°F to +200°F
Material Severed	
Cable Assembly	.060 inch thick vinyl sheath around 9 RG-62 A/U Coax Cables (MIL-C-17/30)
Wire Bundle	.060 inch thick vinyl sheath around 27 strands #22 wire (MIL-W-8777) 6 strands #18 wire (MIL-W-8777) 8 strands #20 wire (MIL-W-12349)

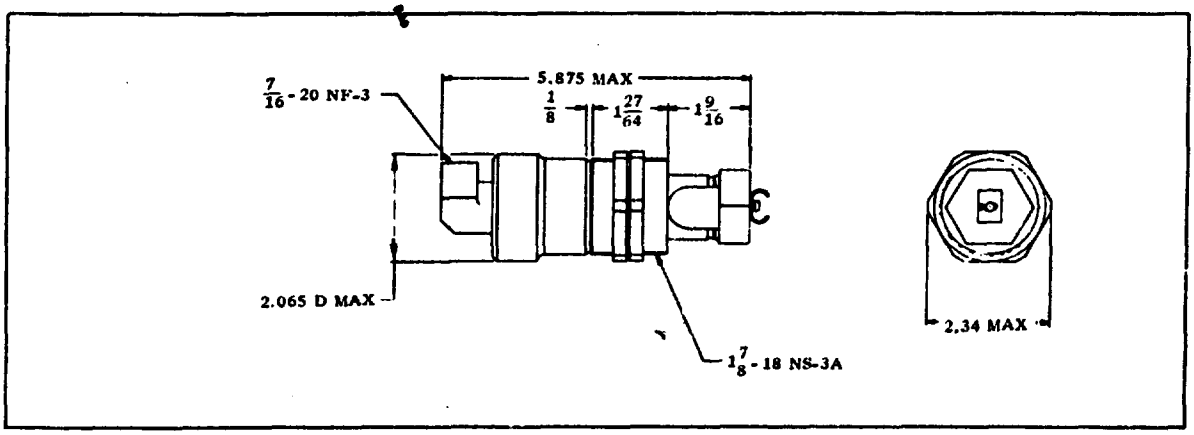
* Depth of penetration of the blade into the anvil is a rough measure of the kinetic energy remaining in the blade after it has cut the cable. It is also an indication of the margin of safety insuring that the cable will be severed.

Cutter, Cartridge Actuated, M8



CROSS-SECTION DRAWING

Component		Component	
A	Head	L	Anvil
B	Plug, Shipping	M	Swivel Assembly
C	Cartridge, Cutter M122	N	"O" Ring
D	Body Assembly	O	Pin, Shear Unlock
E	Nut, Mounting	P	"O" Ring
F	Gasket	Q	"O" Ring
G	Blade	R	Screw, Set
H	Pellet (Shown 22° 30' out of Position)	S	Pin, Shear
I	Cap	T	"O" Ring
J	Clip, Cable Holder	U	Pin, Firing
K	Pin, Cotter	V	Seal, Car



ENVELOPE DRAWING