

SENTINEL

MK 2000*

**Automatic Emergency Parachute
Release System**

*US Patents No. 3112091, 3300606 and 3667705



SSE INCORPORATED
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SPECIAL NOTICE

WARNING—NO WARRANTIES—DISCLAIMER

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It must also be understood that this device is an emergency device only, intended only as an **AID to safety**, and must **NOT** be solely relied upon by the user.

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**THERE ARE NO WARRANTIES
FOR THIS DEVICE**

DESCRIPTION AND THEORY OF OPERATION

DESCRIPTION

The SENTINEL MK 2000 automatic emergency parachute release system is precision engineered and manufactured to provide automatic **emergency** opening of the auxiliary parachute pack assembly.

Basically, the Sentinel MK 2000 consists of four main operating elements:

1. Altitude sensing mechanism including calibration means
2. Automatic rate of descent sensing "On-Off" capability for controlling the altitude actuation output signal*
3. Self-Test indicating system for battery and actuator cartridge condition checks
4. Power ripcord actuating mechanism

Properly calibrated the Sentinel MK 2000 has the ability to accurately sense the preset actuation altitude of 1000 feet above the drop zone by inherently compensating for the particular drop zone elevation and variations in local atmospheric pressure. Altitude and rate of descent sensing capability combine with reliable solid state electronic circuitry to provide completely automatic operation while in the air. The electronic circuitry supplies the power to the explosive detonating cartridge. When the explosive cartridge fires, powerful expanding gases drive the actuating piston within the power actuating cylinder with ample force and movement, to extract the pins from the locking cones on the auxiliary parachute pack.

The batteries are self-contained and are alkaline type, which exhibit good low temperature characteristics. Ni-Cad type cells are available for use at extreme low temperatures. These AA size cells are automatically checked by a built-in test circuit that operates every time the unit is calibrated. This test circuit checks both the battery capacity to operate the unit, plus the electrical integrity of the actuating cartridge. Solid state electronic indicating lights are used to provide calibration information and "go/no-go" system functional checks.

The Sentinel MK 200 consists of the following components:

1. The Sensing Unit—It contains altitude sensing means, rate of descent sensing means, self-testing means, calibrating means and the batteries.
2. Power Ripcord—It converts explosive energy into mechanical motion to activate the reserve ripcord.
3. Cartridge—Electrically detonated, gas pressure provides energy to operate the power ripcord.

*THE SENTINEL MK 2000 SHOULD NOT BE EXPECTED TO OPERATE UNDER ALL MALFUNCTIONS. THE SENTINEL MK 2000 WILL ONLY OPERATE UNDER MALFUNCTIONS WHICH HAVE RATES OF DESCENT IN EXCESS OF APPROXIMATELY 40% OF TERMINAL VELOCITY. In case of partial malfunctions, the MK 2000 may or may not operate, depending on the rate of descent produced by the particular malfunction.

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DESCRIPTION AND THEORY OF OPERATION

THEORY OF OPERATION

After exit from the aircraft, the rate of descent sensing element automatically turns on when the vertical falling speed reaches approximately 40% of terminal velocity.* Automatic disarming occurs when the rate of descent falls below this level. Reserve actuation only occurs when the 1000 foot firing altitude is reached with a velocity greater than 40% of terminal falling speed. Therefore, descent through the 1000 foot altitude under a normally inflated canopy would not cause activation of the reserve assembly.

Should the jumper's rate of descent for any reason increase after a normal opening due to canopy damage or destruction, the Sentinel MK 2000 will again automatically "Re-Arm" itself as it senses the increased vertical velocity. The Sentinel MK 2000 also has the unique operating characteristic which provides for automatic reserve actuation within 1-4 seconds after a cutaway release is made from a partially malfunctioned canopy below 1000 feet, if manual operation does not occur sooner.

Manual override of the system is inherently provided at all times due to the integrated design of the power ripcord assembly.

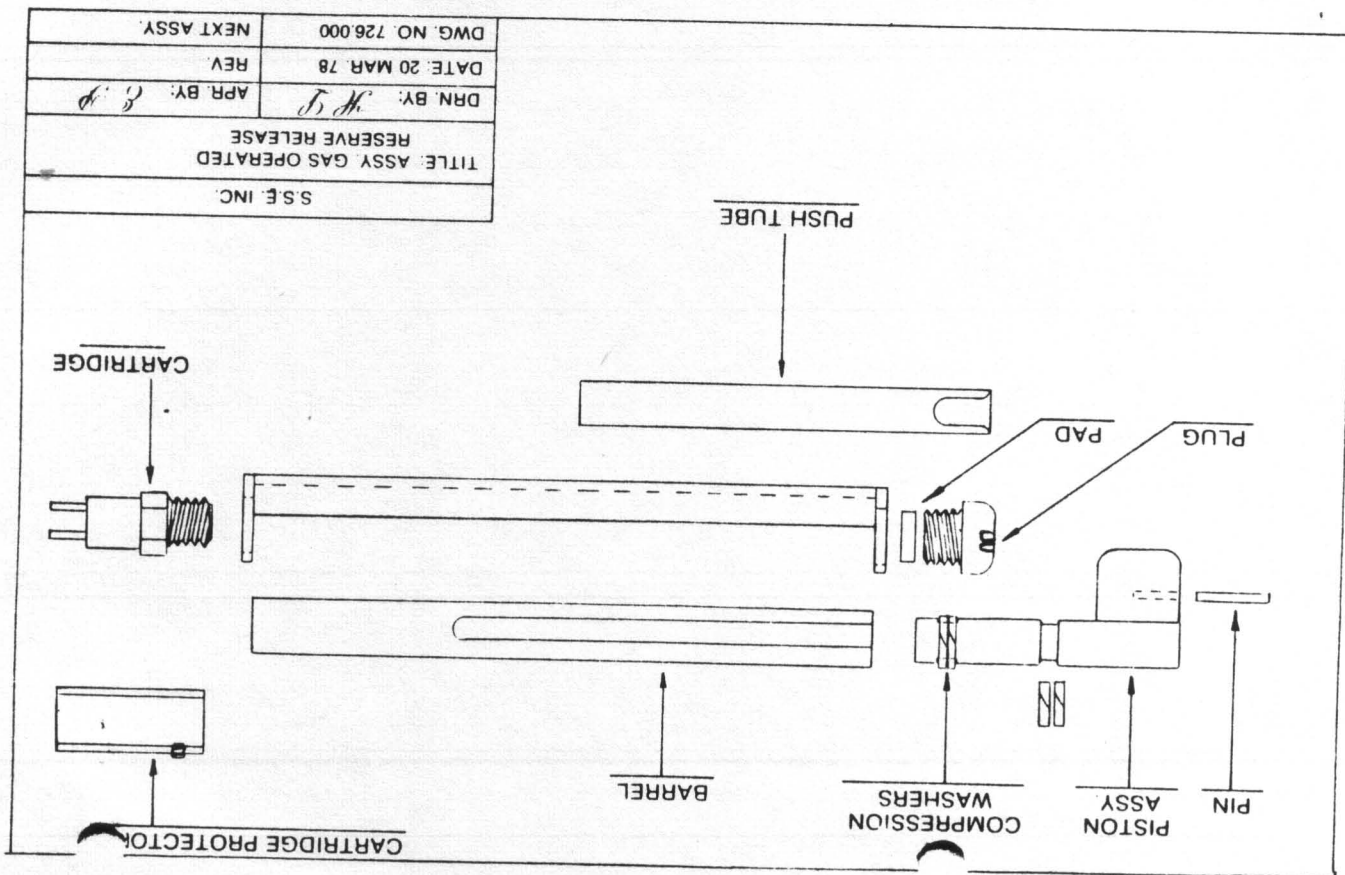
As a safety feature the Sentinel MK 2000 is only able to fire when the 1000 foot firing altitude is approached from a higher altitude and only for sixty seconds or so after passing 1000 feet on the way down. After 60 seconds a built in timer disables the circuit until the unit is taken above 2000 feet again and the cycle repeated.

See Figure Opposite Page

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*The rate of descent sensing element senses **only** rate of descent and **not** air velocity.

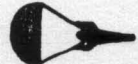


SITUATION ONE NORMAL JUMP



Sentinel 2000 arms in 6-9 seconds as rate of fall increases.

3500'
EXIT ALTITUDE



Sentinel 2000 disarms as rate of descent slows to approximately 50 feet per second.

2500'
OPENING ALTITUDE



Jumpers safe rate of descent—18 fps. Sentinel does not activate reserve.

1000'
ACTIVATING ALTITUDE



500'



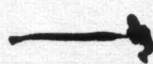
Sentinel 2000 calibrated on ground. It is disarmed during climb to jump altitude.

SITUATION TWO MALFUNCTION/NO PULL



Sentinel 2000 arms in 6-9 seconds as rate of fall increases.

3500'



Jumpers experience malfunction at opening altitude. Sentinel 2000 still armed but does not activate reserve, allowing jumper to override system with manual reserve activation.

2500'



Rate of descent still high due to malfunction. Sentinel 2000 takes over and activates reserve.

1000'
ACTIVATING ALTITUDE



500'

SITUATION THREE MID-AIR COLLISION JUMPER UNCONSCIOUS



Sentinel 2000 arms in 6-9 seconds as rate of fall increases.

3500'



Sentinel 2000 disarms as rate of descent slows to approx 50 fps. Collision by other jumper. Rate of descent increases. Sentinel rearms.

2500'



Jumpers unconscious and unable to manually activate reserve. Sentinel takes over and activates reserve.

1000'
ACTIVATING ALTITUDE



500'

1000'
ACTIVATING ALTITUDE

500'

SITUATION FOUR 1. CUT-AWAY ABOVE 1000' 2. CUT-AWAY BELOW 1000'



Sentinel 2000 arms in 6-9 seconds as rate of fall increases.

3500'



Rate of descent with partial malfunction still less than 50 fps. Sentinel disarms.

2500'

1. Jumper cuts away—Sentinel "rearms" 1-3 sec. after release as rate of descent increases. Allows for manual reserve activation before 1000'.



IF CUTAWAY EXECUTED BELOW 1000'—Sentinel rearms and activates reserve within 4 sec as rate of descent increases if manual pull delayed or not activated.

1000'
ACTIVATING ALTITUDE



500'

OPERATIONAL SITUATIONS CHART

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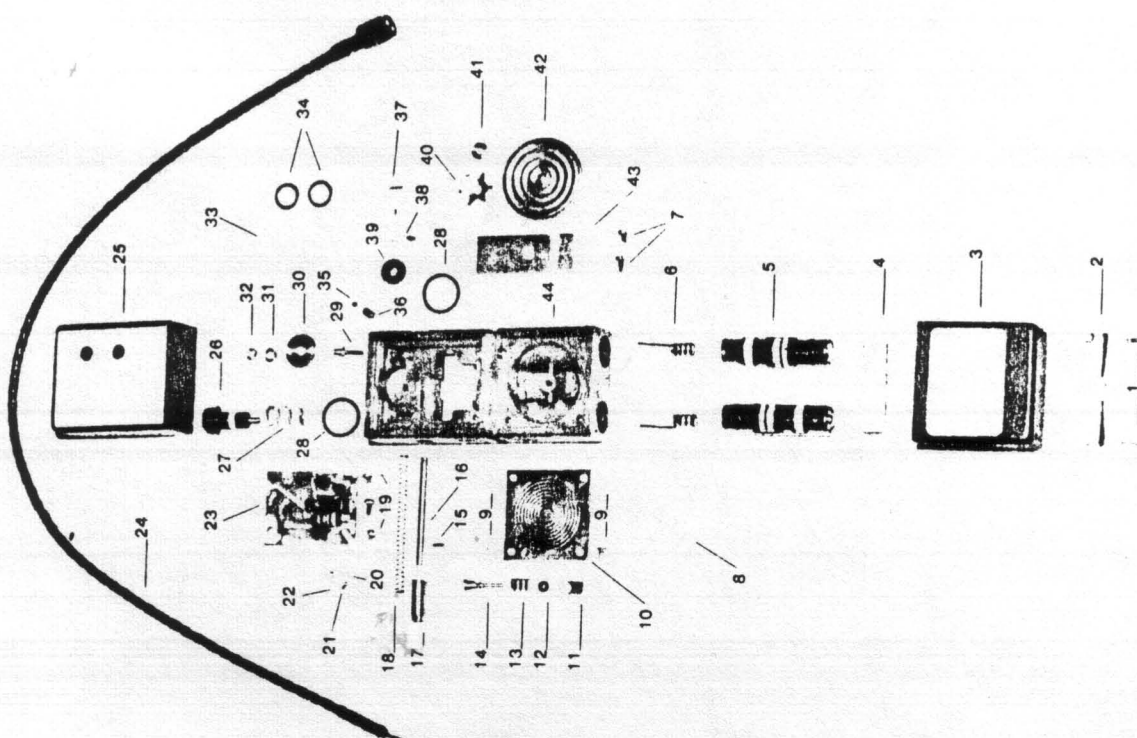
TECHNICAL DATA*

Manufacturer SSE Incorporated
 Model Sentinel MK 2000
 Type Barometric electro-mechanical,
 electrically detonated, gas car-
 tridge actuated
 Actuating altitude 1000 ft. above ground calibration
 point, ± 200 ft.
 Operating range capability Can be set to actuate 1000 ft.
 above all fields from below sea
 level to 9000 ft.
 Altitude sensor Aneroid, barometric
 Rate of Descent sensor Diaphragm, arms unit at approx-
 imately 40% of terminal velocity.
 Disarms when rate of descent
 falls below this level.
 Power Ripcord Converts electrical energy to
 mechanical energy. Can be over-
 ridden manually, at any time.
 Cartridge Electrically detonated. Provides
 approximately 500 to 600 psi
 chamber pressure.
 Temperature range Alkaline cells $+20^{\circ}\text{F}$ to $+130^{\circ}\text{F}$
 Ni-Cad cells -20°F to $+130^{\circ}\text{F}$ *
 Power source 2.8 to 3 volts, 2 cells, either
 alkaline or rechargeable Ni-Cads.
 (Do not use flash light batteries)
 Physical dimensions 1" X 2" X 4" exclusive of cartridge
 and power ripcord.

*THE SENTINEL MK 2000 IS SUPPLIED WITH ALKA-
 LINE BATTERIES AS STANDARD EQUIPMENT.
 FOR LOW TEMPERATURE OPERATIONS, RECHARGE-
 ABLE NICKEL CADMIUM TYPE CELLS ARE AVAILABLE
 AT EXTRA COST.

SYSTEM		TESTING		NOTES	
PROCEDURE	LITE INDICATIONS	INDICATION MEANING			
TEST	Press "TEST" button (to check batteries, cartridge, and external wiring integrity.)	INDICATOR LITES REFER TO "BATTERY" AND "CARTRIDGE"		1. Internal electronic circuitry measures the battery capacity to operate the explosive car- tridge and displays the battery condition visually through the means of the "Bat" lite. 2. If "Bat" lite is dimmer than the cartridge lite, the unit will operate and the cartridge will fire, but the battery output is low. 3. In bright sunlight, use one hand to shield the lites in order to see them more easily. Send repairs to: SSE Incorporated 5801 Magnolia Ave. Pennsauken, N.J. 08109	
		a. "Battery" indicator light "on". "Cartridge" indicator light "on".			System operational, batteries and cartridge operational, proceed with CALIBRATION phase.
		b. "Battery" light "off". "Cartridge" light "on".			System Inoperative—DO NOT USE. Battery power inadequate—replace batteries. Cartridge is operative.
		c. "Battery" light "on". "Cartridge" light "off".			System Inoperative—DO NOT USE. Cartridge and/or external wiring defective— replace cartridge. Battery power adequate.
		d. "Battery" light "off". "Cartridge" light "off".		System Inoperative—DO NOT USE. Replace batteries—then retest. If after battery replacement battery light comes on but car- tridge light remains off, proceed with step c. (Check battery installation.) If after steps 1, 2, 3, 4, and one or both of the lights remain off, unit is not operational— DO NOT USE.	
ALTITUDE		CALIBRATION		IMPORTANT NOTES	
PROCEDURE	LITE INDICATIONS	INDICATION MEANING			
CALIBRATION	INDICATOR LITES REFER TO #1 & #2 LITE POSITIONS	The electronic circuit is indicating SYSTEM TEST MODE.			
1. Press test button and hold it depressed and at the same time	a. Both lights should be on.	The electronic circuit is now in the CALIBRATION mode.			
2. Pull cable lanyard on calibration knob until calibration knob locks in the extended position for cali- bration.	b. Only one light will be on.				
3a. IF #1 LIGHT IS ON Turn calibration knob towards #1 light until it goes off and #2 light comes on, release test button, make sure calib. knob re- tracts completely, the unit is now calibrated and ready for use, the actuation al- titude is now set for approx- imately 1000 ft. above the drop-zone elevation, where calibration took place.	c. #1 light is on: unit is ready for final calibration. Follow 3a instructions As #1 goes out and #2 lite comes on—unit is calibrated for activation 1000' AGL. Release test button as #2 lite comes on—jump.	VERY IMPORTANT (The aneroid is now accurately positioned to provide an activation altitude of 1000 feet above field elevation where the unit is cali- brated.)			
3b. IF #2 LIGHT IS ON Turn calib. knob towards #2 light until it goes off and #1 comes on, then turn calib. knob towards #1 light until it goes off and #2 comes on, release test button, make sure calib. knob retracts com- pletely. The unit is now calibrated and ready for use, the actuation altitude is set for approximately 1000 ft. above the drop- zone elevation, where cali- bration took place.	d. #2 light is on: unit is not yet calibrated. Follow 3b instructions Release test button as #2 lite comes on. Unit is calibrated for 1000' AGL and is now ready to jump. e. When making the final pin check prior to boarding the aircraft, be sure the output cable is connected to the car- tridge	VERY IMPORTANT			

MK 2000 PARTS LIST



ITEM #	DESCRIPTION	QUANTITY /UNIT	PART NUMBER
	MK 2000 Complete	1	702
	Power Ripcord	1	702.1
	Piston Assy	1	702.4
	Buffer Pad	1	702.6
2	Mounting Bracket	1	702.7
	Owner's Manual	1	702.8
5	Batteries, Alkaline E91	2	702.9
	Batteries, Ni-Cad CH500		702.9A
	CARTRIDGE		
42	Aneroid Capsule	1	702.13
2	Cover, batt., rear	1	702.15
25	Cover, Front	1	702.16A
44	Housing	1	702.16B
38	Lanyard	1	702.17
1	Screw, 4-40 X 1/2 Phillips	2	702.21
4	Battery PCB	1	702.23
6	Contact Spring	1	702.24
7	Screw, 4-40 X 1/4	2	702.25
8	Cover, rate adjust	2	702.26
9	Screw, 4-40 X 1/4 flat	1	702.27
10	Rate Sensor	4	702.28
11	Contact, rate screw	1	702.29
12	O Ring	1	702.30
13	Spring, rate screw	1	702.31
14	Rate adjust screw	1	702.32
16	Shaft	1	702.34
17	Worm Gear	1	702.35
18	Spring, Calib.	1	702.36
19	Screw, 4-40 X 1/4	3	702.37
20	Contact, PCB	6	702.38
21	Rivet, contact	6	702.39
22	Spring, contact	6	702.40
23	Printed Circuit	1	702.41
	Board, Complete		
24	Cable, output	1	702.42
26	Button, test	1	702.43
27	Spring, test	1	702.44
28	O ring	2	702.45
29	Screw, altitude	1	702.46
30	Gear	1	702.47
31	Spring washer	1	702.48
32	E clip	1	702.49
33	Window	1	702.61
34	O ring	2	702.62
35	Ball, cable	1	702.63
36	Set screw	1	702.64
37	Set screw	1	702.65
39	Knob, calib.	1	702.66
40	Star washer	1	702.67
41	Nut Capsule	1	702.68
43	Support, capsule	1	702.69