

Safety Deflation System for Tethered Balloons

Summary

The HCS-03M is a safety device for tethered plastic-skinned helium balloons, blimps or Helikites. It is designed to deflate the balloon in the event of a tether break in order to help recover the payload and protect other airspace users. It uses the GPS satellite system to monitor the position of the balloon. If the balloon moves more than a certain distance away from its launch point, the HCS-03M will pass a current through a wire placed in contact with the balloon material. The wire heats up and melts a hole in the balloon, allowing the helium to escape and the balloon to descend.

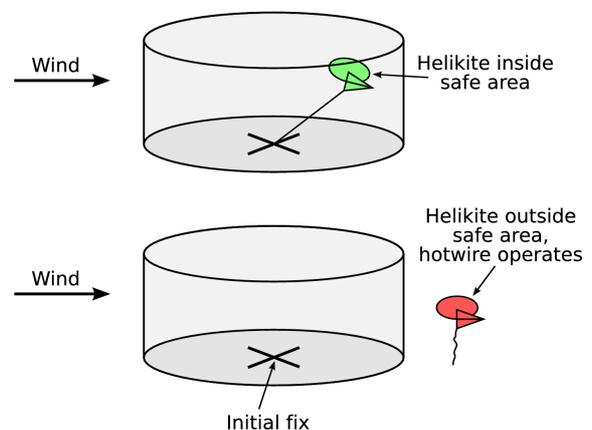


Features

- Simple operation
- Light weight
- Can protect blimps, Helikites and other lifting balloons where there is insufficient free lift to trigger a conventional barometric or pressure-operated deflation device
- Can be used instead of a second-line / rip-panel system

Theory of Operation

When first armed (turned-on), the HCS-03M obtains an initial position fix using the GPS satellite system. This initial position fix defines the bottom centre of a cylinder of space within which the hotwire will not operate. At periodic intervals, the HCS-03M obtains a new position fix and compares it to the initial fix to determine if the balloon is still within the safe area. If the balloon has strayed outside the safe area, the hotwire will heat up, cutting through the balloon material and allowing the helium to escape.



System Description

The system consists of 4 parts:

- HCS-03M Control Unit
- Hotwire Cable Assembly
- Battery Pack
- Battery Connecting Cable

The control unit houses the GPS receiver and processor. The hotwire cable assembly is a length of flexible connecting cable with a plug on one end and the hotwire on the other end. The hotwire is 400mm long and is mounted near the top of the balloon. The connecting cable allows the control unit to be placed at a distance from the hotwire to allow easier operation and to help balance the balloon. Different lengths of connecting cable are available, up to a maximum of 3.5m. Please contact the manufacturer if longer lengths are needed.

Installation

Control Unit

Because the HCS-03M uses the GPS satellite system, it will only work if it has a clear view of the sky. This is not normally a problem with balloons, though it is important that the unit is mounted with the clear lid uppermost and that there are no large metal, carbon-fibre or other conductive objects obscuring the unit's view of the sky.

The control unit should be positioned in such a way that the operator can access the connectors and see the LEDs when the balloon is on the ground (if this is not possible, contact the manufacture about options for remote operation.) The LEDs are situated on the front left hand side of the circuit board behind the battery connector and are visible through the clear lid.

Hotwire Cable Assembly

The connecting cable should be secured to the balloon at regular intervals to prevent chafing. There should be a small amount of slack at each end of the connecting cable to prevent any tension being applied to the connections.

Correct installation of the hotwire is critical to the successful operation of the system. Please contact Allsopp Helikites for advice and full details. The following information is included here to give an idea of the general principles. The hotwire should be mounted near the top of the balloon so that the helium will escape when it operates. It should be

placed in an area where there is a moderate to large amount of curvature in the balloon and secured at the ends by a light elastic cord such that it cuts into the balloon material when it operates. If the balloon operates at low pressures, it may also be necessary to provide additional measures to help open the cut and allow the helium to escape.

Be aware that the hotwire and its end connections are fragile and should be handled as little as possible. If you suspect that damage has occurred, please return the cable assembly to the manufacturer who offer a testing, repair and replacement service.

Operation

Important

Before using the HCS-03M, it is important to understand what happens after the unit is armed (switched on).

After the HCS-03M is armed, it must do two things before the balloon can be launched. Firstly, it performs a self-test routine in which it checks the battery and the hotwire. Secondly (if the self-test passes), it obtains an initial position fix using the GPS satellite network. The initial position fix defines the centre of the safe area of operation of the balloon, so it is important that the unit is powered-up in the correct location, ideally next to the balloon's tether position. If the initial position fix is successful then the HCS-03M enters its normal operating mode and the balloon can be launched.

Arming (turning-on)

1. Check the battery pack is fully charged. The packs normally supplied with the HCS-03M have an LED level gauge which can be activated by pressing a button on the pack.
2. Check the control unit and battery pack are securely installed on the balloon and that the hotwire cable assembly is undamaged.
3. Connect the battery pack to the HCS-03M using the supplied connecting cable.
4. Ensure the balloon is placed near the tether point (ideally within 50m).
5. Turn-on the control unit by plugging the hotwire cable into the connector on the control unit. Note: the battery and hotwire connectors are different so it is not possible to connect them incorrectly.

6. The LEDs will show the status of the unit as follows:

6.1. After power-up, both LEDs will light for 2 seconds then go out. If the self-test fails, the red LED will show a repeating sequence of a long flash followed by a number of short flashes. The number of short flashes indicates the fault that has occurred. These are detailed below.

6.1. If the self-test is successful, the green LED will make a short flash once every second or so. This indicates that the unit is trying to obtain its initial position fix. If the unit has not been used for a while or has been moved to a new location, then this process could take a few minutes.

6.1. When the initial fix has been obtained, the green LED will stop making short flashes and make a slightly longer flash once every 15-20 seconds. This shows the unit is operational and the balloon can be launched.

Disarming (turning-off)

Once the balloon has been lowered back to the ground, the system can be disarmed (turned-off) by unplugging either connector from the control unit. It is important that the system is disarmed before moving the balloon to a new site or deflating it for storage.

A shortened version of these operating instructions are printed on the underside of the control unit.

Precautions

- Ensure the clear lid of the control unit is uppermost. The top surface (lid) of control unit should be within +/- 30° of horizontal
- Ensure the antenna area has a clear view of the sky unobstructed by large metal structures or radio-frequency absorbing materials.
- Do not place any metal components immediately under the control unit.
- Ensure the battery is re-charged every 4 days of continuous operation (for 4Ah battery packs – larger packs are available on request for longer operation).
- Only use battery packs supplied by or recommended by the manufacturer.
- Always arm the unit close to the balloon's tether point.
- Do not operate the balloon with more than the specified maximum tether length (see specifications section).
- If RF Transmitters are to be used on the balloon, it is strongly recommended that trials be carried out to see how they affect the GPS reception, especially if the transmitters are operating in L-band.

Specifications

Control Unit	
Approximate mass (excluding battery pack)	350g
Battery specification	12V 4Ah Lithium Polymer with discharge capability of at least 6A. (others capacities available on request)
Battery operating life	At least 4 days total operating time (4Ah pack)
Maximum recommended tether length	1000m (3280ft)
Safe area radius	1500m from initial fix, +/- 100m
Safe area ceiling	1500m above initial fix, +/- 100m
Safe area floor	Unlimited distance below initial fix
Minimum time balloon must be outside safe area before hotwire operates	30 seconds
Hotwire operating time	90 seconds
Environmental Protection	Equivalent to IP65
GPS frequency	L1 (1575.42 MHz)
Hotwire Cable Assembly	
Approximate mass	150g
Hotwire length	400mm
Hotwire type	0.315 mm diameter Cu/Ni
Approximate operating power	90 Watts/metre
Connecting cable length	Up to 3.5m
Connecting cable type	1.0mm ² flexible silicon covered, twisted pair
Connector type	MIL-C-26428 (62GB) Size 10-6

Fault Codes

Number of green flashes	Faults present			
	Battery volts too low	Hotwire current too low	Hotwire current too high	GPS Error
1	x			
2		x		
3	x	x		
4			x	
5	x		x	
8				x
9	x			x

Number of green flashes	Faults present			
	Battery volts too low	Hotwire current too low	Hotwire current too high	GPS Error
10		x		x
11	x	x		x
12			x	x
13	x		x	x

Explanation of fault states:

Battery voltage too low

The battery pack should be recharged or replaced with a freshly charged one.

Hotwire current too low

This most likely means the hotwire or its associated cabling has become damaged. Visually check for any damage.

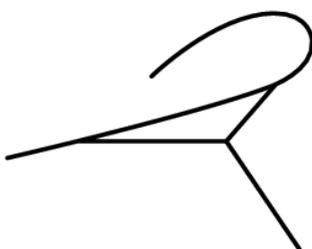
If no fault is found with the hotwire cable assembly, the hotwire batteries should be checked and recharged if necessary. If this does not solve the problem, the system should be returned to the manufacturer for repair.

Hotwire current too high

This fault code indicates a short-circuit in the hotwire assembly. Visually check the hotwire to make sure that it hasn't folded back on itself and created a short-circuit.

GPS Error

This fault code means that the GPS receiver has experienced an error on start-up. This is unlikely to happen. If it does, turn off the power switch, wait at least 20 seconds and turn it on again. If the fault persists, the unit should be returned to the manufacturer for repair.



Disclaimer

The makers will not be held responsible for improper use of this device, incorrect installation, failure to follow the instructions and precautions in this manual, unauthorized modifications to the device, failures due to mis-handling or damage to the hardware, changes or failures in the GPS satellite system, problems due to GPS jamming or RF interference.