



FT Opto Laboratories

Client

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Influence of Temperature on Eflare Operating Performance

The Eflare beacon consists of plastic mouldings, a printed circuit board (PCB) loaded with electronic components including light-emitting diodes (LEDs), rubber components, electrical connectors and two D Cell Alkaline batteries. Each group of materials reacts to extremes in temperature according to its specific properties. In general, the beacon construction will withstand temperature ranges encountered in normal operating conditions as detailed in this paper. The battery power source, however, has more limited functionality at low temperatures.

Eflare beacon housing materials comprise polycarbonate for the lens and modified ABS for the housing. These plastics and the circuit board materials, components and construction techniques are known to function effectively over a temperature range from -40°C (-40°F) to above 70°C (158°F). Some flexibility of the plastic materials may be temporarily lost at very low temperatures and self-adhesive labels may detach if rubbed.

The LEDs are specified to operate from -40°C to $+85^{\circ}\text{C}$.

The main limitation on performance at low temperatures is the D cell Alkaline battery power source.

Alkaline batteries use chemicals to generate power and to pass the current through an alkali gel inside the battery. Low temperature decreases the activity of the chemical reaction and increases the resistance of the gel. This has several detrimental effects on the Eflare operation:

- reduced capacity giving fewer operational hours
- reduced ability to supply high power, especially with partly discharged batteries
- slower recovery after a period of use

These effects can be minimised by reducing the time of exposure of the Eflare to extreme low temperatures. It is suggested to rotate beacon sets from cold to ambient temperatures. Batteries recover their capacity once their internal temperature returns to normal.

The following chart summarises the status:

Temperature		Status	
°C	°F	Eflare Beacon	Duracell Alkaline D Cell
Above 70	Above 158	Not operational	Not recommended
70	158	Operational	Not rated above 54°C
54	130	Operational	Operational
-20	-4	Operational	Operational
-40	-40	Operational, plastic may be brittle	Limited capacity and power
Below -40	Below -40	Not yet tested	Not recommended

70°C is the upper limit of standard electronic components without special manufacture for extended range

54°C is the upper specified operational limit of alkaline batteries

-20°C is the lower specified operational limit of alkaline batteries for normal use

-40°C is the lower functional limit of plastics and batteries (found by experience)