Standby Battery Thermal Safety Monitor

User Guide

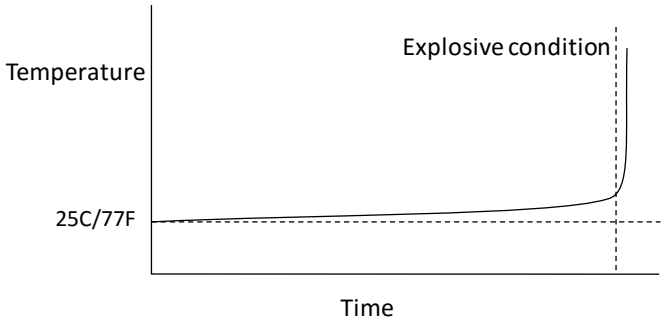
SAFETY

The BTM system is a low voltage system that requires no particular safety precautions, other than those for any 12 volt battery or system. The only precaution when installing the sensors and monitor is that the wires should be prevented from contact with the terminals, or any part of the high voltage/high current path of the standby battery system to which it will be attached.

Introduction

The BTM1000 battery safety system consists of a simple thermal unit sensor which attaches to each cell, jar or monobloc in a battery, and a system monitor which has five indicator LEDs and two change-over (SPDT) alarm relay outputs. It is powered by a 12 volt power supply and has no electrical connection to the battery it is monitoring, thus the voltage of the cells or jars are not relevant to the system. The system is designed to detect over-temperature in standby battery systems and thus assist in the prevention of a thermal runaway situation.

Thermal runaway is a 'positive feedback' process in which a faulty cell or jar rises in temperature, thus causing it to take more float current, which then causes a further rise in temperature and so on.



The process often ends in an explosive rise in temperature which can destroy the cell, and any cells adjacent to it. An example of a thermal runaway event is pictured below.

An example of a battery after thermal runaway

US IFC608.3 (2010) requires that if a sealed battery (or batteries) operated in a single premises contains a total of 50 gallons or over of acid the proprietor must install measures to prevent thermal runaway.

System description

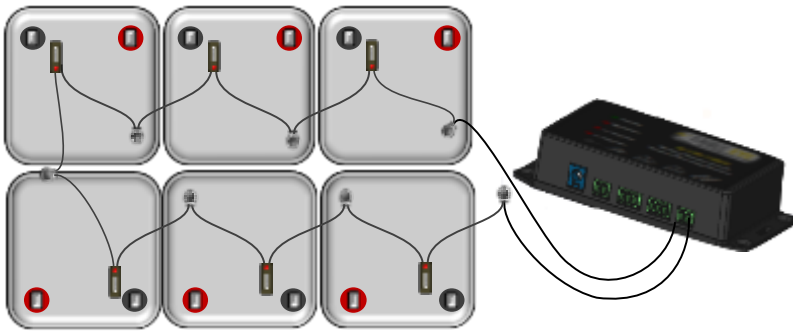
The thermal sensors are small, sealed units with two wires for connection to the adjacent sensor and an LED which activates to indicate when the cell is in over-temperature. Each thermal sensor is sealed to IP68 (water and dust proof) and the special gel-filled connectors provided are also sealed against acid ingress, dust and gasses.

Each individual cell, monobloc or jar must have a sensor attached, to detect the temperature of the unit. The sensors are connected in series, one wire of the sensor being connected to a wire of the adjacent sensor.

The connector (above) is an Insulation Displacement Connection (IDC), gel-filled for protection against corrosive atmosphere and Lloyds approved as the equivalent of a soldered joint for adverse environments.

Apart from securing the neat wall mounted monitor, the entire installation may be carried out with a small screwdriver and a pair of side-cutting pliers. Interconnections typically take less than 20 seconds each. Longer interconnections, such as shelf to shelf and rack to rack are simple to accommodate with standard 20SWG cable, and the IDC connectors provided; cable lengths, within reason, are not sensitive. Sensor installation for a 40-jar battery will typically take less than an hour. Several batteries in the vicinity of each other may be connected in series to the same monitor. As the system is completely electrically isolated from the battery, voltages and polarities are not an issue.

Once the sensors are connected, the two end wires are brought back to the system monitor and connected to the two connectors in the system monitor marked ‘Sensors’.



The system monitor must be supplied with a DC 12 volt, 1 Amp supply, connected as indicated below.

Number of sensors allowed on a system: Although a large number of sensors may be used in a single circuit (over 100), the number of alarm LEDs which can illuminate in alarm conditions is dictated by the amount of voltage available. The maximum number of sensors which can display an illuminated LED in alarm conditions is 15.

Note: If a system has more than 15 over-temperature warnings active then the brightness of the sensor LEDs will reduce. More over-temperatures will result in further reduction in brightness. However the LED's on the monitor box and the relay outputs **will continue to operate normally.**

Fail-safe operation: The system is configured for 'fail-safe' operation; this is required by many ultra-sensitive installations, particularly oil & gas installations, utilities, nuclear power generating stations etc. In fail-safe operation, the alarm relay outputs are held on at all times, except when in alarm condition. This means that if the power to the unit should fail, the unit will always alarm, due to the output relays 'dropping out' and changing over.

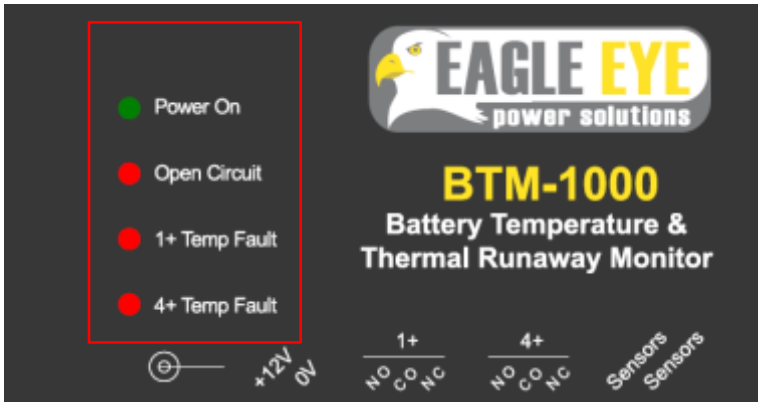
In fail-safe operation, the relays are held 'on' continuously, until an alarm event occurs, when they will go to the 'off' condition, i.e. open.

System operation

Quick Notes:

1. The sensors may be connected either way round, they are not polarity conscious.
2. The relays are 'fail-safe', i.e., they are continuously energised, and de-energise at a fault condition, including loss of unit power.
3. The microprocessor inside the unit updates change in conditions every four to five seconds.

LEDs (monitor)



Open circuit LED on control box illuminates fully on:

1. If power is switched on with an open circuit condition
2. If power is switched on with more than four over-temperatures
3. With the unit operating, if 3 or more over temperature occur within 1 second of the first over-temperature

With one over-temperature on one sensor the following will be indicated:

1. The 1+ LED on the control box with flash on/off in a period of 1/second
2. The LED on the sensor with the over-temperature will flash from low to high intensity at a rate of 1/second

When over temperature is detected on five or more sensors the following be indicated:

1. The 1+ LED and the 4+ LED will flash alternatively at a rate of 1/second
2. The LED's on the sensors with the over-temperatures will flash from low to high intensity at a rate of 1/second

The operation of the relays indicates the following:

1. Relay 1+ off (CO – NC, short), Relay 4+ off (CO – NC, short)
   a. More than four over temperatures exist **OR**
   b. No power to the control box – the green LED will be off.

2. Relay 1+ off (CO – NC, short), Relay 4+ on (CO – NC, open)
   a. Over temperature on one sensor

3. Relay 1+ on (CO – NC, open), Relay 4+ off (CO – NC, short)
   a. Open circuit connection

General information:

In the event of one or more Jars exceeding critical temperature, or a break in the sensor circuit, the monitor warning relay activates and the warning LED on the monitor is illuminated; at the same time a bright LED flashes on the sensor attached to the over-temperature battery jar, indicating the source of the fault. Should five or more Jars exceed critical temperature, the system-critical alarm relay activates, warning of a serious situation in the battery as a whole.

In the unlikely event of the sensors being connected after power up the following will occur after illumination of the open circuit LED

1. No over-temperature, the open circuit LED will go out
2. 4+ over-temperatures, the open circuit LED will stay on and the sensors that are over-temperature will show low intensity for 4 seconds then flash high intensity for 1 second. This will be repeated every 5 seconds
3. 1+ over-temperature, the open circuit LED will go out and the 1+ LED will flash from low to high intensity at a rate of 1/second

Connections - sensor

The sensor has only two wires. They may be attached to the adjacent sensor, or to the monitor in either orientation, the sensors are designed not to be sensitive to the polarity of the electricity of the circuit.

The connectors are gel-filled IDC (see description above) and the connecting wires should be pushed into the connector without first stripping (removing the insulation from) the ends of the wire.

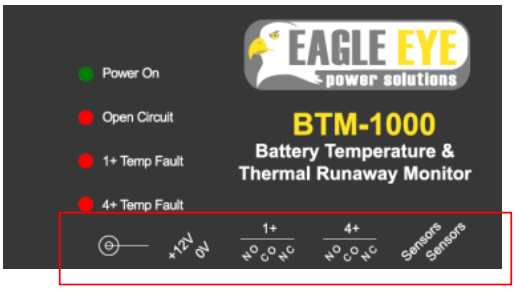
When both wires are firmly inserted into the connector, making sure that both reach the stop at the far end, the top and bottom of the connector should be compressed by a dedicated compression tool*, or, if this tool is not available, providing care is taken a suitable pair of pliers may be used.

This forms a secure, protected joint between the two sensors.

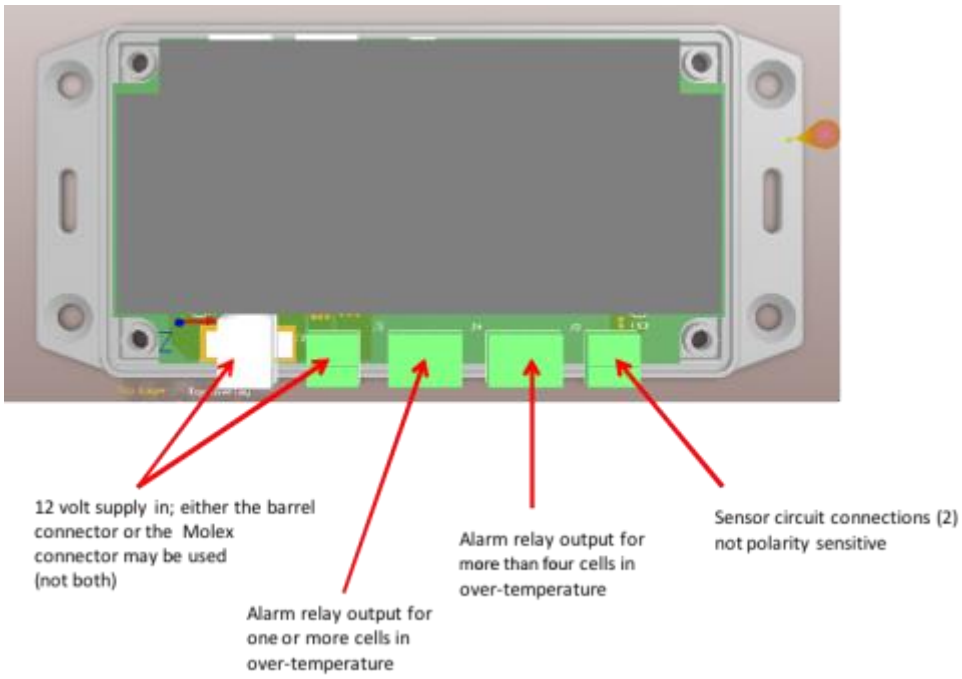
* A standard crimping tool is available from Eagle Eye Power Solutions.com

Connections - monitor

The input/output connections of the monitor are shown on the label on the top of the enclosure:



And on the long side of the enclosure, above the connections themselves:



Mounting the sensor

The sensor has a high reliability sticky pad on its base; this is covered by a clear plastic overlay.

The area on the cell on which the sensor is to be mounted should be cleaned of all dust and residue. Then the plastic protection should be peeled off the sensor and the sensor placed in position on the cell.

It is suggested that in flooded cells the sensor should be sited near the top of the enclosure, but below the level of the electrolyte. In starved electrolyte batteries (VRLA, SLA, Gel) the sensor can be placed in any available space, however the top of the unit is optimum.

Cleaning the Jars for maximum adhesion of the sensor

! MOST IMPORTANT !

Although most flooded battery jars look quite clean when they are delivered, they are actually covered with various chemicals. There are slip agents for release from the plastic moulds, ink and detritus from screen printing the manufacturer's information, or release agent and chemicals on any labels, used on some jars, which also contain manufacturer's information, and all this doesn't take into account any dirt from transport, etc.

Since the slip (release) agents used on the jars and labels are designed to prevent the jar or label adhering to anything, it is therefore **essential** that the area in which the BTM unit is to be mounted is **thoroughly cleaned.**

Eagle Eye Power Solutions recommend CRC PF Precision Cleaner, P/N: 03190 (US), Ambersil NF precision cleaning fluid (UK) for use on the jars and labels.

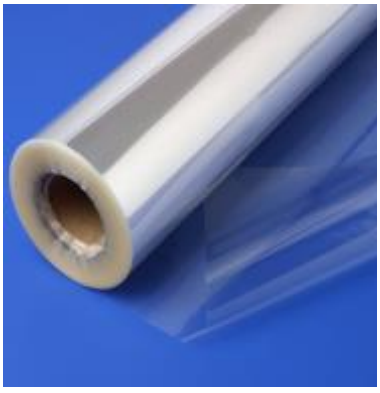
This fluid has been extensively tested and is warranted effective, and free from any possibility of damage to the plastic of the jars and labels. If other cleaning agents, such as Isopropyl alcohol are used special care must be taken to ensure the contaminants are thoroughly removed.

The second (buffing) cloth should be inspected to ensure it is free of any remaining residue

It has been proven on many different types of jars and labels that the tape adhesive used by the unit is extremely strong and provides an excellent high strength adhesive bond to the jar/label. The only time the adhesion of the module to the jars has been found to be less than perfect is when the jar or label has not been properly cleaned.

Note: Some cells or jars have printed labels attached with the manufacturers name and details of the cell, such as the rating of the cell and the maximum & minimum electrolyte levels. These labels can be difficult to identify, so care must be taken to ensure that there is in fact a label in place.

The during manufacture, the labels are serially printed in a continuous roll and an adhesive applied to one side; in order to prevent the roll sticking to itself there is a release or 'slip' agent applied to the other side.

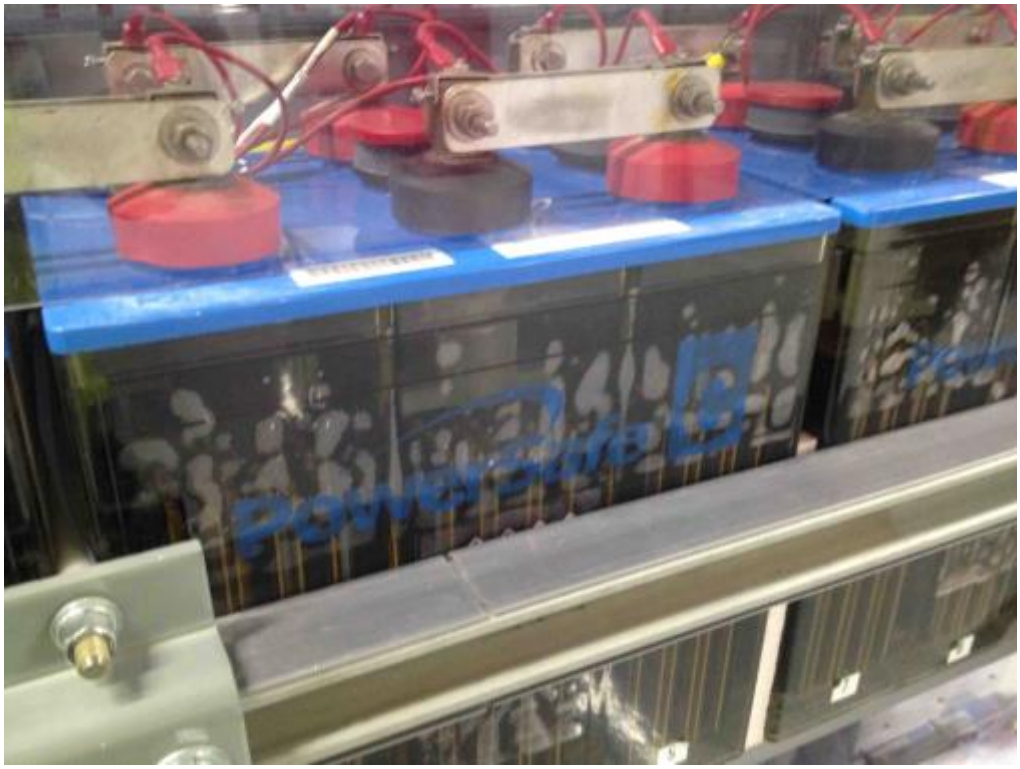


In order for the BTM to adhere successfully to the label, this release agent MUST be cleaned off.

The cleaning agent recommended is very effective for this purpose, however it is important to allow The cleaner to dry thoroughly before sticking the BTM in position.

LABELS

As mentioned above, some jar sides are covered with manufacturer's labels. It is normally perfectly fine to attach the sensor to these labels, provided they are properly cleaned. However some labels have been attached to the jars in a slipshod manner, such that they have air bubbles under the plastic label:

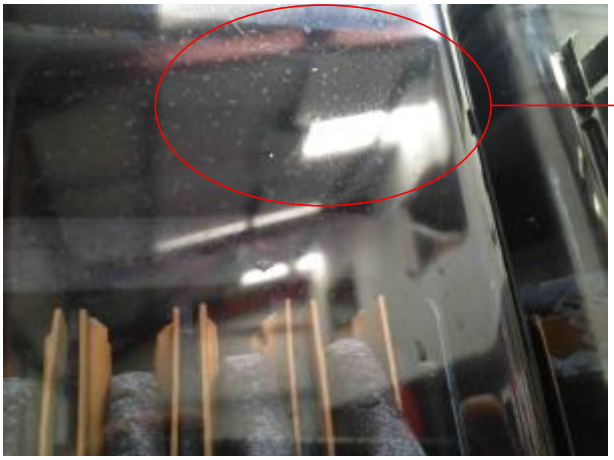


It would not be possible to fit the BTM sensor to a label with any air pockets. If the label has air pockets, the section of the label which would be under the sensor and sensor must be removed and the area cleaned particularly well.

Procedure for cleaning the jars

1. A **small** amount of cleaner should be sprayed on to either the cell or label and then rubbed vigorously with a clean soft dry cloth, to remove any release agents or chemical contaminants.

   At this stage the jar may look clean, however there is likely to be a deposit remaining, even after wiping. The jar in the photograph below was cleaned with isopropyl alcohol and thoroughly wiped dry.



Residue after cleaning with Isopropyl Alcohol

2. A second clean dry cloth should then be used to vigorously Buff (polish) the area.

Note: EEPS recommends Scott shop cloths, or similar

Below is an example of a clean cloth after buffing a previously cleaned jar. It is important that the jar is polished and that the polishing cloth used is changed every two or three jars.

Battery units on which the sensor is attached directly to the surface of the unit, may be wiped with isopropyl alcohol and then buffed with a dry cloth to ensure that the area is dry and clean. However, it has been found that the isopropyl alcohol can react with any silk screen printing in the area that is being cleaned, and that this can create a surface film which will prevent the sensor from being firmly attached. To ensure that any contamination caused by the potential ink/alcohol reaction is completely removed before attaching the sensor, the surface should be buffed a second time with a clean cloth and the surface of the cloth checked to ensure it is not soiled by any remaining residue.

After the sensor is placed in the chosen position a firm pressure should be applied, to initiate the bond. The bond will increase over the following 24 hours.

Specification

Thermal sensor: Totally enclosed, activation temperature 35°C (95F), +/- 3°C (5°F). Environmental: sealed IP67

Reinstatement temperature: 2°C (3.5°F) below activation temperature

Module and connections insulated to >2500V. Connection cable: UL1007

Sensor Interconnections: Gel-filled IDC 'cold-weld'; sealed against dust and gasses; solvent/acid resistant; UL listed cat. 5. Interconnection strength >90% of wire breaking strength

Connection wire: UL compliant

Monitor: Backplate mounted; Input power 12 volts DC, 0.1A; output: (on alarm) 2 x relays, SPDT volt-free contact (1+ units over-temperature, and 4+ units over-temperature). Monitor dimensions: H84 x W40 x D77mm

Output relay contact ratings: 7A at 240VAC, 10A at 120VAC, isolation 1K5V

General Compliance: CE.

Sensor dimensions: