

Product: ECAT, Mini, Mini-AT, Mini-Max, Pulse Accumulator, ER, ERX, EC 350 & ERX 350

FAQ: What Causes Alkaline Battery to Leak?

Question

What causes alkaline batteries to leak?

Answer

Overview:

Battery leakage in Honeywell/Mercury Instruments electronic products have occurred for many years. Installations with reported leaky batteries in Alkaline Receptacle Pack (such as p/n 40-3503, shown below) ranged from Alaska to Florida and all points in between. There is no trend in climate or customer that correlates to battery leaks.



Description:

Battery Leakage, which is defined as: A process that occurs when batteries are discharged below a safe cutoff voltage. Electrolysis results when the manganese dioxide is depleted and excess zinc and water remain. The internal gasses can possibly "vent" in this situation. Venting is the release of gas pressure through a vent that is designed into the battery for safety purposes.

Note: Leakage of electrolyte will almost always occur during venting."

Additional Information:

Per the United States Patent Application 20010046620: "In the sealed alkaline storage battery, when gas is generated internally as a result of conditions such as over-charge or over-discharge and the battery's internal pressure exceeds a given pressure, the safety vent unit is activated, and gas and electrolyte inside the battery are vented to the outside to prevent battery case deformation, etc."

The statement below correlates leakage to battery discharge:

Per Eveready: "Alkaline batteries are designed to operate in devices from 1.65 volts down to 0.8 volts per cell. At this point, approximately 90% or more of the usable capacity has been removed. As alkaline batteries are discharged, the potential for hydrogen gas generation due to electrolysis of electrolyte and zinc corrosion increases as the Closed Circuit Voltage (CCV) drops below 0.8 volts. Eveready recommends that devices be designed with an absolute minimum cell cutoff voltage of 0.8 volts per cell to avoid excess gassing that can occur during **deep discharge**."

(Note: Other sources suggests an absolute minimum cell cutoff voltage of 0.5 volts per cell.)

"Temperature cycling between extreme high and low temperatures can cause expansion and contraction of the battery components. Over time, extreme temperature cycling can cause a failure of the battery seal integrity thereby increasing the potential for leakage. Eveready rates the service temperature of their batteries from 0°F to 130°F."

(Note: There are some slight variations of these temperature limits between manufacturers of alkaline batteries.)

Alkaline batteries **in operation** will reach the deep discharge point sooner in cold temperatures. The need for monitoring voltage level and battery replacement will be more acute in winter and at more Northern latitudes.

In contrast, batteries **not operating** will approach the deep discharge point sooner when at higher temperatures. The need for monitoring voltage level and battery replacement will be more acute in summer and in warmer climates. Batteries that are not in a circuit will still self-discharge slowly, begin to generate gas, and cause a leak.

Summary:

- Alkaline battery technology was introduced more than fifty years ago.
- Alkaline batteries leak less than the zinc/carbon battery technology that preceded them. However, they are not leak-proof.
- Alkaline battery manufacturers have concluded that expectations of zero alkaline battery leakage are not realistic.
- Temperature, humidity, shock and vibration all can reduce battery performance and damage the battery. Not all of that damage will result in leakage.
- Condensation will increase the risk of leakage.
- Replace all batteries prior to reaching 0.8 volts per cell cutoff voltage.
- Temperature extremes (less than 0°F and greater than 130°F) can reduce battery life and increase the chance of battery leakage.
- Always replace all batteries at the same time. Batteries connected in series, in different states of discharge, may eventually drive the weakest battery into voltage reversal with progressive risk of leakage or rupture.
- Customers' prompt replacement of depleted batteries (battery packs) will diminish frequency of leakage.
- Only Lithium and Rechargeable battery manufacturers claim these types of batteries will not leak.
- If a customer's expectation is zero battery leakage, they should consider lithium batteries.

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