U.S. Department of Transportation
**Pipeline and Hazardous Materials Safety Administration**

1200 New Jersey Avenue, SE
Washington, DC 20590

JAN 22 2010

Mr. Richard J. Lloyd
Westgate Transportation Services, Inc.
31 Bastian Lane
Allentown, PA 18104

Ref. No.: 09-0261

Dear Mr. Lloyd:

This responds to your letter dated November 6, 2009, regarding the requirements in the Hazardous Materials Regulations (HMR; 49 CFR Parts 171-180) applicable to the transportation of lithium cells or batteries, including a lithium polymer cell or battery and a lithium-ion cell or battery. Specifically, you ask about regulatory requirements for cells that are connected in parallel and whether the requirements apply to any cells connected together in any configuration.

Section 173.185(a)(3) specifies that a lithium cell or battery, including a lithium polymer cell or battery and a lithium-ion cell or battery must be equipped with an effective means to prevent a dangerous reverse current flow (e.g., diodes, fuses, etc.) if a battery contains cells or series of cells that are connected in parallel (i.e., a closed circuit in which the current divides into two or more paths before recombining to complete the circuit). The requirement in §173.185(a)(3) means that if a battery contains cells or series of cells that are connected in parallel they must be equipped with an effective means to prevent a dangerous reverse current flow.

I hope this information is helpful. If we can be of further assistance, please contact us.

Sincerely yours,

Charles E. Betts
Chief, Standards Office
Office of Hazardous Materials Standards

**Drakeford, Carolyn (PHMSA)**

**From:** INFOCNTR (PHMSA)
**Sent:** Friday, November 06, 2009 11:13 AM
**To:** Drakeford, Carolyn (PHMSA)
**Subject:** FW: Lithium Batteries
**Attachments:** Diagram Sketch Series and Parallel.pdf

Engrum
§173.185
Lithium Batteries
09-0261

**From:** dickchar@enter.net [mailto:dickchar@enter.net]
**Sent:** Friday, November 06, 2009 10:56 AM
**To:** INFOCNTR (PHMSA)
**Subject:** Lithium Batteries

I will appreciate a letter of interpretation clarifying Section 173.185 (a) (3) addressing lithium cells or batteries, including a lithium polymer cell or battery and a lithium-ion cell or battery, that must conform in all of the following requirements:

Paragraph (a) (3) states: "Be equipped with an effective means to prevent dangerous reverse current flow (e.g., diodes, fuses, etc.) if a battery contains cells or series of cells that are connected in parallel."

I need to understand the meaning of "cells that are connected in parallel". I have attached a sketch showing both series and parallel configurations of battery connections. Both configurations are common and batteries may be shipped with units wired in either configuration.

Is the regulation (a) (3) interpreted literally to apply to a battery containing cells or series of cells wired in parallel as shown in my attachment or is the regulation interpreted more generically by applying it to any cells connected together?

Thank you for your response as your interpretation will provide guidance on the shipment of assembled units.

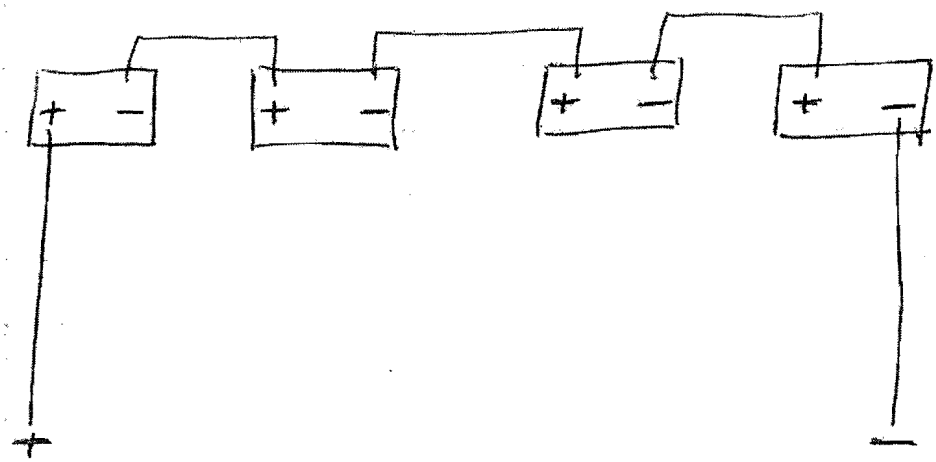
Please acknowledge receipt of this correspondence and, if possible, advise approximately when a response will be issued.

Richard J.
Lloyd
nbsp; &nb sp; 31 Bastian
Lane
bsp; &nbs p; Allentown, PA 18104

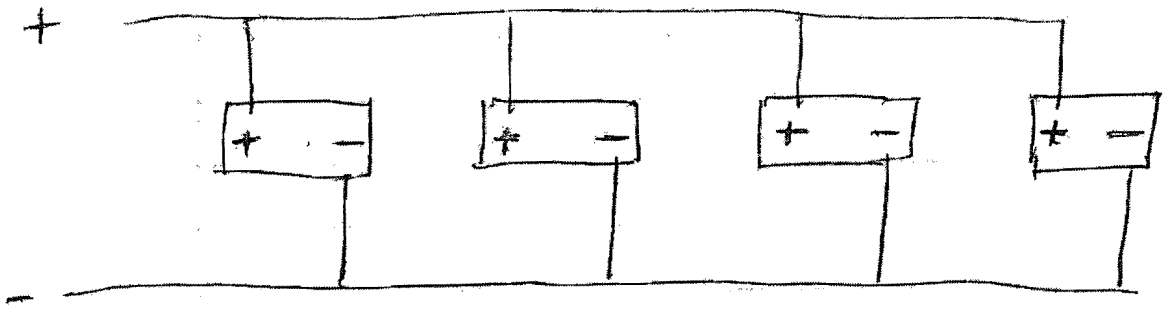
Telephone: 610-398-
3954
&n bsp; E-mail: dickchar@enter.net

Dick

Richard J. Lloyd
Westgate Transporation Services, Inc.
2299 Brodhead Road
Bethlehem, PA 18020
Office: 610-866-8001
Home: 610-398-3954
dick.lloyd@westgate-global-logistics.com



SERIES CONNECTION



PARALLEL CONNECTION

EJ
11/3/09

Keywords: Reverse-Current Circuitry Protection

Jan 31, 2001

APPLICATION NOTE 636

# Reverse-Current Circuitry Protection

*Battery reversal can be fatal to portable equipment. However, numerous circuits can protect against the backward installation of batteries and other overcurrent-causing conditions.*

Battery-operated equipment is prone to the consequences of batteries installed backward, accidental short circuits, and other types of careless use. The effects of a reversed battery are critical. Unfortunately, it is difficult to guard against this situation.

To make equipment resistant to batteries installed backward, you must design either a mechanical block to the reverse installation or an electrical safeguard that prevents ill effects when the reverse installation occurs. Mechanical protection can be a one-way connector that accepts the battery only when oriented with the correct polarity.

For example, 9V radio batteries have mechanically dissimilar terminals, although a user fumbling with the mechanical connection can still momentarily make the reverse electrical connection. On the other hand, you can configure connectors for rechargeable battery packs so that momentary reverse connections are impossible unless the user modifies the connector.

The greatest challenge, however, is in applications powered by one or more single-cell batteries such as AA-alkaline, NiCd, and nickel-metal-hydride types. In general, these batteries offer no mechanical means for preventing the reversal of one or more cells. For these systems, a designer must ensure that any flow of reverse current is low enough to avoid damaging the circuit or the battery. A variety of circuits can provide this assurance.

## Diodes Provide the Simplest Protection

The simplest form of battery-reversal protection is a diode in series with the positive supply line (**Figure 1a**). The diode allows current from a correctly installed battery to flow to the load and blocks current flow to a backward-installed battery. This solution has two major drawbacks: The diode must handle the full load current, and its forward voltage drop shortens the equipment's operating time. (The regulator output is one diode drop below the battery voltage, so the regulator drops out prematurely.)

If the application calls for an alkaline or other type of battery with relatively high output impedance, you can guard against reverse installations using a parallel (shunt) diode. The circuit in **Figure 1b** is simple but far from ideal. This approach protects the load yet draws high current from the shorted battery. As before, the diode must be able to handle the high current.