Discover®
Innovative Battery Solutions

OPPORTUNITY CHARGING GUIDELINES & DEFINITION

OVERVIEW

Opportunity charging is a battery charging technique that can extend the run times and service of battery powered equipment. The term *opportunity charging* refers to the charging of the batteries wherever and whenever power is available. Simply put, rather than waiting for the battery to be completely discharged, or for the duty cycle or work shift to be over, opportunity charging is the "power as you go" opportunity to extend the capabilities of your equipment during shift breaks, meal breaks and other equipment downtime opportunities.

Opportunity charging is used with batteries in cycle service - typically in applications where energy may be available only intermittently, or where battery sizing may not practically meet duty cycle or work shift needs such as:

- Industrial floor scrubbers/sweepers
- Commercial applications such as aerial platforms and pallet jacks used in material handling
- Automated guided vehicles (AGV) using inductive opportunity charging*
- Electric vehicles such as, mine vehicles, low speed electric city vehicles (LSV) used for meter reading or by-law enforcement, on-route electric transit buses, or entertainment park vehicles
- Renewable stored energy applications

Appropriate relationships between equipment capabilities, battery design and service requirements, along with environmental considerations will determine successful opportunity charging. Opportunity charging with Discover® provides charging, environmental and operational advantage over flooded batteries.

**Inductive Opportunity Charging refers to Induction chargers typically that use an induction coil to create an alternating electromagnetic field from within a charging base station, and a second induction coil in the portable device takes power from the electromagnetic field and converts it back into electrical current to charge the battery.*

IMPLEMENTING OPPORTUNITY CHARGING WITH DISCOVER

Successful implementation of Discover® Opportunity Charging required three main considerations:

1. Charger Considerations – Discover® Batteries

    - Use of a battery charger that is programmed with the correct charge algorithms (or "charging curve").
    - Use of a battery charger that is temperature compensated.
    - Charger design must allow for quick and intelligent diagnosis of the batteries current charge status to avoid over-charging or improperly charging and damaging the battery.
    - You should not opportunity charge a battery that is already discharged beyond 50% depth of discharge. Do not "opportunity charge" a battery that has been fully discharged. When the equipment is not in use, it should be kept plugged in.
    - A minimum of ½ hour of charge time should be facilitated, followed by a ½ hour cool down time prior to the equipment being put back into service.
    - It is extremely important to use the battery manufacturer's recommended charging voltage and procedures whenever possible for optimum battery capacity, maintenance and service life.

2. Environment Considerations – Discover® Batteries
    - There are no environmental considerations for opportunity charging with Discover®, as it is maintenance-free, and non-gassing under normal operating conditions.

3. Performance Considerations – Discover® Batteries
    - Ideal opportunity charging occurs when the batteries have been sized for an average depth of discharge of 50%.
    - Where off-board chargers are used, the equipment must be returned to the charging station to plug in.
    - Allowances must be made to fully recharge the battery at least once during a 24 hour period or prior to the next shift. (A full recharge means allowing a design optimized charger with the suggested charge regime, algorithm or charge curve to run a complete cycle without interruption to fully recharge and condition the battery.)
    - Rapid charging (charging with higher currents) is feasible and more efficient with Discover's maintenance-free EV Traction technology.

IMPLEMENTING OPPORTUNITY CHARGING WITH FLOODED BATTERIES

Opportunity charging of a high quality flooded or wet battery is possible, however is neither recommended nor appropriate given the battery technology and procedures necessary to successfully implement. The operational procedure allowances that must be made to meet the related health and safety regulations to achieve acceptable flooded battery cycle life are not reasonably achievable.

In addition to some of the considerations used in Discover® opportunity charging, the following factors apply to opportunity charging of flooded batteries.

1. Charger Considerations – Flooded Batteries
    - When flooded batteries are charged, pre-charge and after-charge acid leveling and cleaning services must be performed.
    - Specially trained battery maintenance personnel, tools and equipment are required.

2. Environment Considerations – Flooded Batteries
    - Health and safety regulations for charge stations and handling of flooded batteries.
    - Spill protection, venting for corrosive and hydrogen gas emissions.
    - When flooded batteries are used, the equipment must be returned to OHSA and WCB approved and ventilated charging areas for charging every time.
    - Use of a battery charger that is temperature compensated.

3. Performance Considerations – Flooded Batteries
    - Rapid charging of flooded batteries will result in excess heat and off-gassing.
    - Increased heat produced during charging will reduce flooded battery cycle life and increase maintenance levels.
    - With rapid charging, additional allowances must be made for heat dissipation, and service for the resulting increased corrosion.

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CONCLUSION

With Discover's Clean & Green EV Traction Dry Cell power solutions, battery charging is simple and efficient. Opportunity charging of Discover® offers operators freedom from the charging limitations of conventional flooded wet cell batteries. Operators can take full advantage of extended breaks or downtime between shifts to opportunity charge their power blocks. This results in increased productivity.

Discover® EV Traction Dry Cell Power Blocks are environmentally safer and cleaner than ordinary flooded batteries. The extremely acid starved and sealed design eliminates corrosive and hydrogen gas emissions, and makes these batteries spill proof and leak proof, saving you money and considerable aggravation from spilled acid and gas emissions which will cause damage to floors, electronics and battery compartments.

With Discover® you have no need for specially trained battery maintenance personnel, tools or equipment. You won't need specially vented charging areas or space to store battery maintenance equipment, and Discover® EV Traction Dry Cell batteries are completely recyclable.

DISCOVER® OPPORTUNITY QUICK FACTS

SEALED & MAINTENANCE-FREE DESIGN	Eliminates downtime for watering, special employee training, and battery maintenance equipment or charging rooms.
DRY CELL TECHNOLOGY	Spill proof, leak proof, vibration resistant and safe for shipment by air, land or water.
NON-HAZARDOUS & ENGINEERED FOR SAFETY	Non-gassing, non-spillable, will not cause corrosion of sensitive electronics or equipment.
SIZES TO REPLACE ALL FLOODED TYPES	The answer for all types of battery powered equipment and vehicles.
OPPORTUNITY CHARGING FRIENDLY	Works all day everyday without shortening battery life.

Contact your local Discover® representative for more information on appropriate procedure when incorporating opportunity charging into your battery program.