

Choosing the Correct APP® Connectors Based on Battery Charging Technologies



Material Handling Battery Charging

- **SB®50, 175 & 350**
- **SBE®80, 160 & 320**
- **SBX®175 & 350**
- **A Series & E Series
(DIN) 80, 160 & 320**

Material Handling Equipment charging trends are changing. This application document offers a brief explanation of the charging technologies, the pros and cons of each, and then will describe the appropriate APP® products to recommend and the attributes to discuss that make APP® the correct partner for their needs.

Traditional

Conventional Charging – Charging requires 8-10 hours to fully recharge the battery allowing one shift per battery and requires multiple batteries, as well as changing equipment, to run multiple shifts.

New Trends

Opportunity Charging – Charging at every possible opportunity (lunch and breaks, between shifts, etc.) to extend battery shift life and minimize changeover/downtime.

Fast Charging – Charging at every possible opportunity and at 3-4 times the rate of conventional systems with power requirements often exceeding 600 amps.

Conventional Charging

Conventional Charging - Best Suited for Single Shift Warehouses

Batteries are charged at rates of 16-18 amp/100 amp hours and takes about 8-10 hours to fully recharge the battery. A battery is charged using the 8-8-8 rule: the battery charges over an 8-10 hour period, rests and cools down for another 8 hours and is used (discharged) over an 8 hour shift.

Positives

- 1. Uses existing or standard chargers that are less expensive.
- 2. No need to move from lead acid batteries (purchased cost is least expensive on the market).
- 3. Uses existing warehouse infrastructure for conventional charging.

Negatives

- 1. Multi-shift facilities require additional batteries to keep forklifts operational.
- 2. Traditional charging generates gas requiring special rooms/areas for charging operation – Forklifts must be moved to one area only for charging.
- 3. Company requires one charger per forklift.
- 4. Charging must take place where washing facilities are present in case of personnel exposure to acids or when spills take place (typically indoors).
- 5. Battery swapping causes lost production and additional risk of equipment damage or personal injury.

Typical Battery Charging Rooms

Areas surrounding forklift battery chargers require specific safety equipment to mitigate damage in the event of a spill, splash or other accident. The following items are recommended safety equipment for battery charging rooms:

1. Battery Wash Stations
2. Adequate Ventilation
3. Battery Spill Kits
4. Eye Wash Stations
5. Hydrogen Gas Sensors



Opportunity Charging

Opportunity Charging – Best Suited for Multi-shift Operation

Batteries are charged at rates of 25 amp/100 amp hours at every possible opportunity (i.e. lunch breaks, between shifts) for anywhere from 10-30 minutes and charges battery to 80-85% state of charge (SOC) and 100% charge overnight. Once a week the battery must be fully charged to 100% typically on weekends.

Positives

- 1. Excellent choice for extended shift operations or 2 shift operations where battery changing can be eliminated.
- 2. Opportunity charging extends the run time of aging batteries and recoups the lost capacity that comes with age.
- 3. Allows two shift operation with one battery per forklift required saving battery costs.
- 4. Eliminates need for battery changing equipment and the warehouse space required.

Negatives

- 1. Users will need to purchase opportunity chargers (more expensive) that are designed to shut off at 80% charge.
- 2. It often requires additional chargers situated near break rooms and exits to assure opportunity charging takes place.
- 3. Reduced battery life – Most batteries list a 1,500 cycle life (based on 8 hour charging) and that any time you charge you use one cycle. There is debate on whether a 10-30 minute charge has the same negative impact as an 8 hour charge. The damaging component is the heat generated during charge. Short charge cycles generate less heat (5°F to 15°F for 30 min.) as opposed to 25°F generated in an 8 hour period. How much heat is generated is dependent on type of charger used. The assumption is it takes multiple opportunity charges to impact a battery equal to the impact of one 8 hour charge.

Fast Charging

Fast Charging - Best Suited for Three Shift/Heavy Use Operations

Batteries are charged at rates of 40+ amp/100 amp hours at every possible opportunity. Fast chargers have charging rates that are 3-4 times that of a conventional charger with some chargers reaching over 600 amps. Fast chargers incorporate controls that maximize battery acceptance of higher charge rate. Batteries do require a 100% equalization charge once a week and typically on weekends.

Positives

- 1. Batteries can partially charge up in 10 minutes during breaks or between shifts.
- 2. Reduced battery requirements. The battery to truck ratio of 2 : 1 in conventional charging is now 1 : 1.
- 3. Increases productivity and reduces injury risk by eliminating battery change outs.
- 4. Eliminates costs for battery changing equipment and opens up warehouse space previously required for changing room.

Negatives

- 1. Initial costs are higher as fast charging batteries are approximentally 25% more expensive (batteries require alternate internal design and a thermistor for temperature communication) and chargers are approximentally 400% more expensive (includes battery management system (BMS) for temperature/charge control).
- 2. Battery life is shorter (approximentally 3 years versus 5 years in conventional charging).
- 3. Higher charging rates (up to 640 amps) require connectors between charger and battery using larger stiffer, cables (350MCM or larger). Alternately dual runs of stacked connectors with flexible cables to handle 600 amps are used. Additional signal contacts are required for communication with the battery management systems built into smart chargers.

Opportunity/Fast Charging

Opportunity and fast charge stations will appear similar as both are basically opportunity charging. The changes will be in the charger itself and sometimes the type of battery used.



Charging Connectors

SB® Product Family – SB®50, SB®175, SB®350

Conventional Charging and Opportunity Charging

- 1. Provides a wide range of cable sizes and up to 550 amps maximum.
- 2. Signal contacts are not required in conventional charging.
- 3. Color and mechanically keyed for voltage.
- 4. Low cost, robust, and easy to assemble.
- 5. 10,000 mating cycles ideal for multiple daily charge cycles.

Fast Charging

*Not recommended for fast charging due to lack of auxiliary contacts for communication between BMS and battery.

APP® Competitive Edge

- 1. APP® original designer of SB®/SBX®series connectors.
- 2. APP® provides a wide range of housings and contacts for both AWG and metric cable.
- 3. Complete line of accessories including handles, cable clamps, and dust covers.
- 4. Global technical support including literature for assembly, crimping, and electrical capability information
- 5. Crimp training available.

*Can be used in conjunction with an independent signal connector providing the communication between battery and charger BMS.



Charging Connectors

SBE® Product Family (80, 160, 320) , SBX® Family (175, 350)

Conventional, Opportunity, and Fast Charging

- 1. Provides a wide range of cable usage and up to 550 amps UL maximum (SBE® and SBX®).
- 2. Color and mechanically keyed for voltage.
- 3. SBE® meets EN1175-1 requirements.
- 4. Especially useful for Fast Charging – up to 8 auxiliary contacts available for charger/battery communication and auxiliary contacts can be used in conventional/opportunity charging for power on/off, digital signage, or vehicle lockout.
- 5. 10,000 mating cycles.

APP® Competitive Edge

- 1. APP® original designer of SBE®/SBX® series connectors.
- 2. APP® provides a wide range of housings and contacts for both AWG and metric cable.
- 3. Wide range of accessories including handles, cable clamps, and dust covers.
- 4. Global technical support including literature for assembly, crimping, and electrical capability information.
- 5. Crimp training available.



SBX® 350

SBE® 320

Charging Connectors Continued

A and E Series DIN Product Family (80, 160, 320)

Conventional, Opportunity, and Fast Charging

- 1. Provides a wide range of cable usage and UL rated up to 450 amps (A series only).
- 2. Universal housings with voltage keys that can be rotated based on voltage and color coded by battery type.
- 3. E series DIN meets 43589-1 standard and EN1175-1.
- 4. Especially useful for fast charging – up to 4 auxiliary contacts available for charger/battery communication and auxiliary contacts can be used in conventional/opportunity charging for power on/off, digital signage, or vehicle lockout.

APP® Competitive Edge

A Series

- 1. Has UL/CSA ratings up to 450/260 amps using 120mm cable.
- 2. Contacts designed for AWG wires for North American market.
- 3. No direct competition.
- 4. 5,000 mating cycles minimum.
- 5. High impact resistance.

E Series

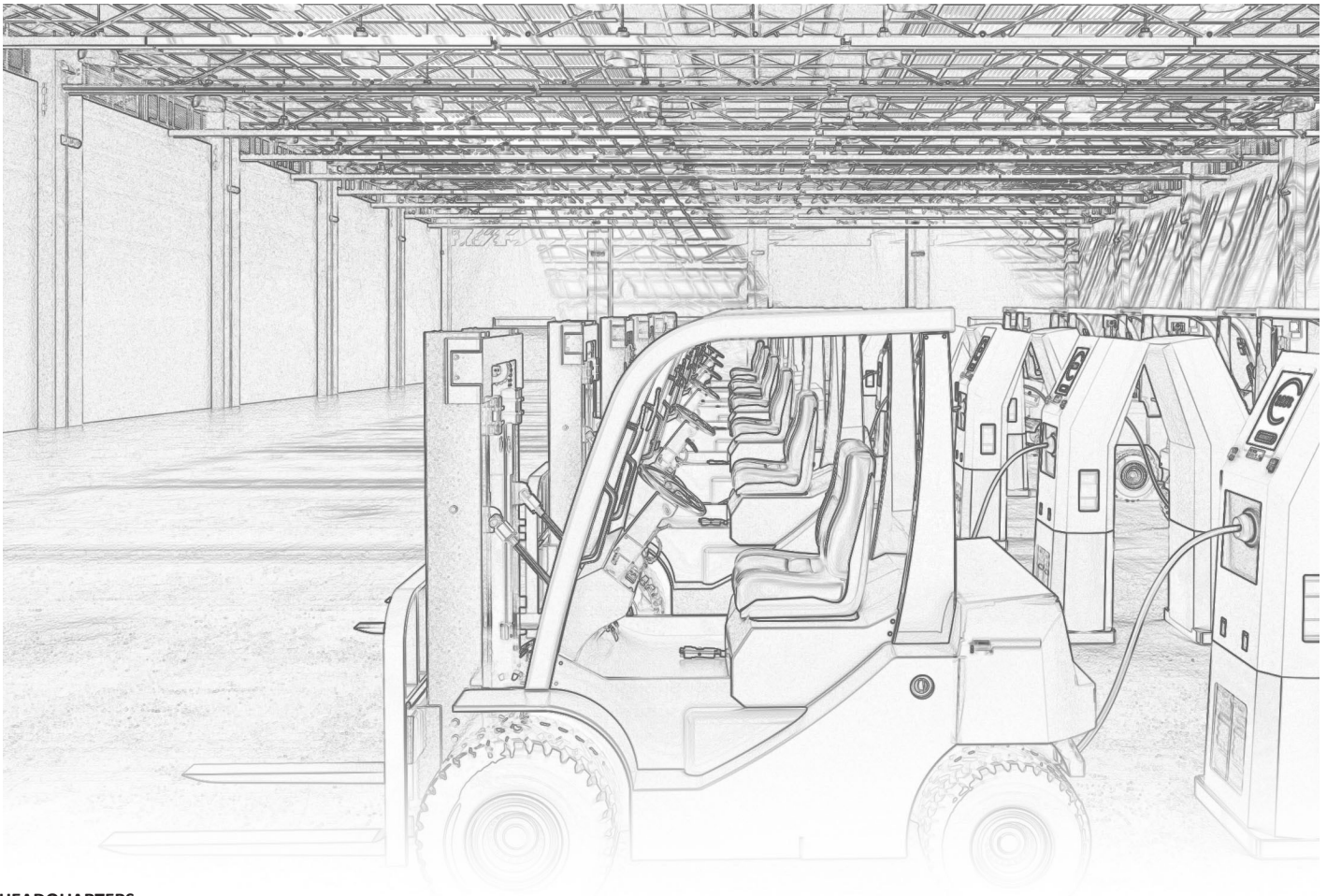
- 1. Has UL and CSA approvals.
- 2. Meets Din 43589-1 mating cycle requirement of 5,000 min (competitors don't).
- 3. Offer 80, 160, and 320 sizes.
- 4. E Series offers optional air tubes for circulating battery electrolytes during conventional charging.



A 80

A 160

A 320



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