

Charging – what can be more simple?



SAE J1772™

Why the Confusion?

- Many factors determine a device's battery size, capacity and recharge time
 - Power requirement
 - Duty cycle
 - Physical size
 - Target cost
- Each manufacturer is allowed to optimize a device's battery strategy
- Results in abundance of solutions!

PEV Charging –A Different Road

- Minimize charging equipment based on use cases
 - Residential slow charge rate –portablecord sets
 - Residential and public intermediate charge rate –fixed charge equipment
 - Public fast charge rate –fixed charge equipment
- Commonize the user charging experience
 - Gasoline pump analogy –Each pump may have multiple grades of gasoline available but fueling is the same
 - Reduces customer apprehension and speeds acceptance of the technology
- **120V Portable Vehicle Charge Cord**

Terminology

- AC Level 1 Charging*
 - 120V AC charging from standard 15 or 20 amp NEMA outlet, on-board vehicle charger (~1.9kw)
- AC Level 2 Charging*
 - 208 –240 AC charging up to 80 amps, on-board vehicle charger (~19kw)
- DC Charging (Fast Charging)**
 - Off-board charger connects directly to vehicle high voltage battery bus
 - Charger controlled by vehicle which allows for extremely high power transfer (>100kw) and thus faster recharge times (minutes instead of hours)
 - Actual charge rate limited by battery chemistry, infrastructure and other factors

** Same charge coupler used for AC Level 1 and 2 charging** Requires unique charge coupler other than the AC Level 1 and 2 coupler. Currently under development.*

Terminology

- Electric Vehicle Supply Equipment (EVSE)
 - General term used for any off-board equipment used to supply charge energy to the vehicle. EVSE includes:
 - Vehicle Charge Cord
 - Charge Stands (public or residential)
 - Attachment Plugs
 - Power Outlets
 - Vehicle Connector
 - Miscellaneous Infrastructure

Components of PEV Charging System

–Vehicle Inlet/Plug

- 2 power contacts –up to 80 amps, 240V AC, 19.2kw
- 1 ground contact
- Control Pilot signal
 - Verification of vehicle connection
 - Supply equipment ready to supply energy
 - PEV ready to accept energy
 - Ventilation requirements
 - Supply equipment current capacity
 - Equipment ground present
- Proximity detection
 - Indicates to vehicle that plug is present to prevent drive away
- Latch feature

Components of PEV Charging System – Electric Vehicle Supply Equipment (EVSE)

- Can be a cord set or fixed mounted
- Includes enclosure and method of attachment to AC mains (plug or direct connect)
- Generates Control Pilot signal
- Protects from ground faults
- Switches power to vehicle based on vehicle command
- Displays presence of AC input power

Components of PEV Charging System

–On-Board Charging System

- Control system
 - Interprets Control Pilot and proximity signal information
 - Charge algorithm
- On-board charger
 - Converts AC mains power to DC high voltage to charge PEV battery
 - Converts AC mains power to DC low voltage to power vehicle system during charge
- Thermal system
 - Condition PEV battery
 - Cool charger
- Charge status indicator

PEV Charging –How It Works

- Charge plug not powered until plugged into and commanded by vehicle
- Supply equipment signals presence of AC input power
- Vehicle detects plug via proximity circuit (prevents drive away while connected)

PEV Charging –How It Works

- Control Pilot functions begin
 - Supply equipment detects PEV
 - Supply equipment indicates to PEV readiness to supply energy
 - PEV ventilation requirements are determined
 - Supply equipment current capacity provided to PEV
 - PEV commands energy flow
 - PEV and supply equipment continuously monitor continuity of safety ground
- Charge continues as determined by PEV
- Charge may be interrupted by disconnecting the plug from the vehicle

PEV Charging –Safety & Durability

- Receptacle and cord plug
 - Specified to comply with international standards including:
 - J1772™
 - IEC 62196
 - UL 2251
 - Electrical safety
 - 10,000 cycle life with exposure to dust, salt and water
 - Vehicle drive over does not expose a hazard
 - Sealing
 - Corrosion resistance
 - Touch temperature limits

PEV Charging –Safety & Durability

- Supply equipment
 - Specified to comply with international standards including:
 - J1772™
 - IEC 61851
 - National Electric Code, Article 625
 - UL 2202, 2231
 - Electrical safety (shock protection)
 - Enclosure durability
 - Charge cable durability

Summary

- Common interface standard
 - No Beta vs. VHS confusion or apprehension
 - Reduces overall cost to consumer
- Major components of charging system
 - Supply equipment
 - Portable vehicle charge cord
 - Fixed charge stations
 - Public charge stations
 - Common interface plug and receptacle
 - On-board charging system
 - Charger
 - Battery
 - Charging controls

Summary

- Durability and safety
 - Designed for 10,000 charge cycles
 - Able to withstand vehicle drive-over
 - Durable cabling
 - Multiple layers of safety
 - Ground Fault Circuit Interrupter
 - Safety ground verification
 - Finger-proof
 - Sealed
 - Vehicle control of charge power
 - UL listed