Charging – what can be more simple?

SAE J1772™
Charging – What Can Be More Simple?

We charge our electronic devices everyday

- Laptops
- Cell phones
- PDAs
- Bluetooth devices
- Power tools
- MP3 players
- Toys
- Other...
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 – portable cord 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