Plug-in Electric Vehicles
Home Charging Installation

Electrical Contractor & Inspector Outreach Presentation
Texas

May 3, 2011
Objectives

- Provide an overview of the Chevrolet Volt and home charging installation.

- Review home charging equipment, installation process and guidelines.

- Review utility coordination and involvement.

- Discuss National Electrical Code (NEC) requirements and implications.

- Gather electrical contractor and inspector feedback, issues and concerns.

- Q&A
Chevrolet Volt | Accelerated Rollout Plan

AVAILABLE NATIONWIDE BY END OF 2011

The Chevrolet Volt electric vehicle with extended range will be available across the U.S. by the end of this year – six months sooner than originally planned.
Chevrolet Volt | Technology Highlights

• How it Works
  – Volt is an electric vehicle with extended-range capability, powered by a propulsion system that primarily uses electricity
  – When the Volt runs out of battery charge, it uses gas in its onboard generator to create enough electricity to keep going for hundreds of miles

• All Electric Drive Mode (25-50 miles)
  – Volt will not use gasoline or produce tailpipe emissions
  – Volt is powered by electrical energy stored in its lithium-ion battery

• Extended-Range Mode (~300 miles)
  – Once the initial electric charge is depleted, the range-extending gas engine will turn on to seamlessly generate enough energy to continue to power the car for hundreds additional miles
  – The engine-generator eliminates “range anxiety,” giving peace of mind that the driver will not be stranded by a depleted battery
Chevrolet Volt | Technology Highlights (cont.)

• Battery (16 kWh)
  – The Volt is powered by a lithium-ion battery pack; the Li-ion battery holds its charge efficiently (it doesn’t have to be run down completely before recharging)

• Charging (Levels 1 and 2)
  – Volt can be plugged into a standard 120-volt household outlet or a 240-volt charging station can be installed
  – Most efficient when plugged in regularly, but will operate fine without being plugged in for days, weeks or even months

• Performance (No Compromises)
  – Functional, efficient and fun to drive with quick acceleration
  – 0-60 in under 9 seconds
  – Delivers 273 lb-ft of torque, the equivalent of 150 hp and a top speed of 100 mph
Chevrolet Volt | EPA Fuel Economy Label

EPA Fuel Economy and Environmental Comparisons

<table>
<thead>
<tr>
<th>Charge Time</th>
<th>All Electric</th>
<th>Gas Only</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 hours @ 240V</td>
<td>-93 MPG equivalent combined city/hwy</td>
<td>37 MPG combined city/hwy</td>
</tr>
<tr>
<td>$601 cost per year if always run in All Electric</td>
<td>$1,302 cost per year if always run in Gas Only mode</td>
<td></td>
</tr>
</tbody>
</table>

Range (Miles)

<table>
<thead>
<tr>
<th>All Electric Range (battery)</th>
<th>Extended Range (gas)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>35 miles</td>
</tr>
<tr>
<td>10</td>
<td>379 miles</td>
</tr>
<tr>
<td>20</td>
<td>TOTAL</td>
</tr>
<tr>
<td>30</td>
<td></td>
</tr>
<tr>
<td>40</td>
<td></td>
</tr>
<tr>
<td>50</td>
<td></td>
</tr>
<tr>
<td>60</td>
<td></td>
</tr>
<tr>
<td>350</td>
<td></td>
</tr>
<tr>
<td>360</td>
<td></td>
</tr>
<tr>
<td>370</td>
<td></td>
</tr>
</tbody>
</table>

How This Vehicle Compares (combined composite)

Among all vehicles and within compact cars

<table>
<thead>
<tr>
<th>Compact Cars</th>
</tr>
</thead>
<tbody>
<tr>
<td>60 miles</td>
</tr>
<tr>
<td>Best</td>
</tr>
</tbody>
</table>

Worst 14 MPG

Greenhouse Gases (CO₂ g/mile, tailpipe only)

| Worst | 987 |
|----------------|
| 0 |
| Best |

Other Air Pollutants

| Worst | 6 |
|----------------|
| 10 |
| Best |

Examples: Charging Routines

<table>
<thead>
<tr>
<th>Miles driven between full charge</th>
<th>Fuel Economy MPG</th>
<th>Electricity Consumed</th>
<th>Electricity + Fuel Energy Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td>N/A</td>
<td>10.9 kWh</td>
<td>4¢/mi</td>
</tr>
<tr>
<td>45</td>
<td>168</td>
<td>12.9 kWh</td>
<td>5¢/mi</td>
</tr>
<tr>
<td>60</td>
<td>89</td>
<td>12.9 kWh</td>
<td>6¢/mi</td>
</tr>
<tr>
<td>75</td>
<td>69</td>
<td>12.9 kWh</td>
<td>7¢/mi</td>
</tr>
<tr>
<td>Never Charge</td>
<td>37 35 city / 40 hwy</td>
<td>N/A</td>
<td>9¢/mi</td>
</tr>
</tbody>
</table>

Your actual mileage and costs will vary with fuel cost, temperature, driving conditions, and how you drive and maintain your vehicle. Cost estimates are based on 15,000 miles per year at $3.20 per gallon and 11 cents per kWh-hr. MPG equivalent: 33.7 kW-hrs = 1 gallon gasoline energy.

Visit www.fueleconomy.gov to download the Fuel Economy Guide (also available at dealers).
Chevrolet Volt | Propulsion System Architecture

- Engine Generator
- Lithium-Ion Battery
- Regenerative Braking
- Electric Drive Unit
- Charge Port
- Fuel Tank
Chevrolet Volt | High Voltage Architecture

Note: GM’s Lithium Ion modules are non gaseous batteries
Chevrolet Volt | High Voltage Architecture

Traction Power Inverter Module (TPIM)
Converts DC into AC to drive electric motors

Accessory Power Module (APM)
Converts high voltage to 12V electricity
2.2kW, Max Current ~165A @ 12V

Manual Service Disconnect (MSD)
with integral 350A fuse

Home Charge Station

RESS Specifications
- Chemistry: Lithium-ion
- Number of cells: 288
- Rated Energy: 16 kW-h
- Nominal Voltage: ~360V

Traction Power Inverter Module (TPIM)
Converts DC into AC to drive electric motors

HV Battery - Rechargeable
Energy Storage System (RESS)

Cabin Heater Control Module (CHCM)
7.5kW max @ ~360V

Air Conditioning Control Module (ACCM)
6.5kW max @ ~360V

Electric Drive with integrated motors
- 115 kW max

On Board Charge Module (OBCM)
400W max @ 12V output, Max Current ~35A
3.3 kW max @ high voltage DC output with 240VAC input
1.2 kW max @ high voltage DC output with 120VAC input

GAS, 4 CYL, 1.4L, MFI, DOHC (LUU)
55kW max
Home Charging Installation | Our Perspective

Our Perspective

• Charging is a critical component of the Chevrolet Volt’s customer experience
  – Will directly impact consumer’s perception of the Volt regardless of the responsible party (e.g., automaker, EVSE hardware provider, installation company, electrical contractor, or utility company)
  – Not likely a delighter, potential to be a major source of dissatisfaction

• EVSE (Electric Vehicle Supply Equipment) is an extension of the vehicle
  – Consumers will expect the same high-level of safety, performance, durability, service, warranty and customer assistance for their EVSE as they do for their car

• HCI (Home Charging Installation) can be a complicated process with a high degree of variation
  – Requires proactive coordination among various entities (customer, automaker, hardware provider, electrical contractor, utility and inspector)
GM Objectives

• Ensure that all key aspects of the home charging installation process are managed from a customer point-of-view
  – Goal is to strive for a consistent and national process
    • Establish a single point-of-contact for consumer
    • Eliminate consumer confusion (permitting, electricity rates, metering options, special programs and incentives, etc.)
    • Provide a home charging experience that is safe, convenient, reliable and professional
    • Deliver at a low or reasonable cost – overall installation cost and electrical bill
    • Develop an integrated system that will help tie the processes together and ensure a great customer experience

• All aspects must be in place to support vehicle launch plans and markets

• Promote a favorable and long-term consumer relationship
Electrical contractors and inspectors play a critical role in supporting the adoption of electric vehicles

- Confirm safe and reliable home charging experience

- Ensure that certified EVSE and electrical wiring has been installed according to NEC (National Electrical Code), manufacturer, ANSI (American National Standards Institute), and local AHJ (Authority Having Jurisdiction) requirements

- Avoid customer uncertainty about quality of installation, charging safety or electrical code compliance

- Promote positive overall customer experience
  - Streamlined processes (e.g., permitting process)
  - Easy scheduling
  - Confirmed appointment times
  - Approved installations
Home Charging Installation | Chevrolet and SPX

- Chevrolet is partnering with SPX to create a national program that is integrated with local utility company activities, services and programs
  - SPX will ensure a consistent and coordinated customer experience that meets our common objectives (safe, simple, fast, low cost and satisfying experience) on a national basis
Home Charging Installation  |  SPX - Volt Website

www.homecharging.spx.com/volt

- One-Stop shopping for Volt Home Charging Installation
- Benefits of 240V Charging
- Recommended Charging Products
- Resource Center
- Installation Process
- Installation Pricing
- Electrical Contractor Network
- Home Charging FAQs
- Volt Vehicle Info
- Pre-Install Survey
- Coordinate Utility services
- Special Programs & Incentives
- How to Order
- Toll-free Number: 877-805-EVSE (3873)
<table>
<thead>
<tr>
<th>Online Pre-installation Survey</th>
<th>Home Electrical Site Survey</th>
<th>Permit &amp; Inspection</th>
<th>Standard Installation (240V)</th>
<th>2nd Utility Meter Installation (Optional)</th>
<th>Ready to Charge (240V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volt Customer</td>
<td>SPX</td>
<td>SPX</td>
<td>SPX</td>
<td>SPX</td>
<td>Volt Customer</td>
</tr>
</tbody>
</table>

- **Customer Completes Online Pre-installation Survey**
- **SPX contacts customer and schedules home electrical survey**
- **SPX electrical contractor completes home survey and provides options / quotes to customer**
- **SPX certified, trained and licensed electrical contractor secures permit for installation (on behalf of customer)**
- **SPX schedules and completes installation**
- **SPX schedules electrical inspection**
- **Electrical inspector approves install**
- **Local electric utility company installs and activates 2nd utility meter (if required)**
- **Customer ready to charge Volt at home**

EVSE = Electric Vehicle Supply Equipment
Volt Charging Power Levels | Customer Options

120V (1.2 kW) Charging
- Plugs into standard household outlet (NEMA 5-15, 5-20)
- Full charge in about 10 hours
- No additional equipment or installation may be required (however, dedicated circuits are preferred to ensure a satisfying charging experience)
- 120V portable charge cord included as standard equipment with the vehicle

240V (3.3 kW) Charging
- Full charge in about 4 hours
- Efficient and enables more opportunity to drive electrically
- Requires a one-time investment to upgrade garage with dedicated 240V circuit
SAE J1772 Charge Coupler | Pin Functions

- **Power**: 2 pins (AC Line 1 & AC Line 2/neutral)
- **Ground**: First to engage, last to disengage and break (for safety)
- **Proximity Detection**: Prevents the car from moving while charging (for safety)
- **Control Pilot**: Last to engage, first to disengage and break. Communicates charge rate available to determine amount of current (amperes) allowed for the vehicle being charged.
J1772 Charge Coupler | Testing Requirements

- 10,000 cycle life
- Exposure to dust, salt, water
- Drive over with no functional damage
- Sealing
- Corrosion resistance
- Touch temperature limits
• Plug not powered until plugged into and commanded by vehicle

• Electric Vehicle Supply Equipment (EVSE) signals presence of AC input power

• Vehicle detects plug via proximity circuit (prevents drive away while connected)
**Vehicle Plug | Design Overview**

**Latch**
- Provides retention to vehicle charge port
- Prevents “hot disconnects”

**SAE J1772 Interface**
- Standard pin protocol for EVs

**Flashlight**
- Ultra-bright LED for nighttime convenience

**Latch Release/Trigger**
- Releases vehicle plug latch
- Activates flashlight
- Terminates charge

**Main Housing**
- Resistant to vehicle drive over

**Soft touch overmold**
- Human factors consideration

**Strain relief**
- Per electrical code requirements
120V Portable Charge Cord | Design Overview

**Soft-touch carry handle**
- Human factors consideration

**Integrated Storage Design**
- Allows for stowing cord when not in use.

**Soft-Touch Charge Rate Select**
- Enables two charge rates in US (high / low) and four charge rates in Europe

**Unit Status LED Indicators**
- Reports go/no-go unit operation

**Charge Rate LED Indicators**
- Reports charge rate selection

**Vehicle Plug**
- Interface to the vehicle charging system
  - Detailed on prior slide

**Standard US Wall Plug**
- Electrical Code standard rated power plug
**Integrated Storage Design**
- Allows for stowing cord when not in use.

**Stealth Gray Paint**
- Premium styling accent

**Retractile Cord**
- 25 feet of flexible coiled cord that can stretch to 30+ ft of working length.

**Vehicle Plug**
- Interface to the vehicle charging system

**Unit Status LED Indicators**
- Reports go/no-go unit operation

**Chrome Bezel Ring**
- Premium styling touch

**Vehicle Plug Park Port**
- Port design to park vehicle plug when not in use

**Break-away feature**
- Prevent permanent damage to vehicle and overall unit
**ETL Listing Label**
- Located on front of unit, underneath the vehicle charge plug
- Shows listing number, Catalog number, Date of Manufacture, Voltage, Frequency, Current and Power rating
- Lists standards (UL 2594, CSA C22 No. 107.1)

**Installation Instructions**
- Packaged with charge station
- Details method of installation and recommendations
- Contains explanation of indicators, safety warnings, etc.
120V / 240V EVSE | ETL Certified

- UL Standards tested to by ETL
  - 120V Portable Charge Cord: UL2251, UL2231, CSA C22 No. 107.1
  - 240V Charge Station: UL2594, CSA C22 No. 107.1
240V Charge Station | Installation Guide

WARNING

Installation shall be performed by a licensed electrician in accordance with local electrical codes. Improper installation could result in personal injury or property damage. Do not attempt to install without a professional, licensed electrician.
240V Charge Station | Hang Tag Label

**AVERTISSEMENT**
- POUR ÉVITER LES RISQUES D’INCENDIE OU DE CHOC ÉLECTRIQUE, NE PAS UTILISER CE DISPOSITIF AVEC UNE RALLONGE.
- CE PRODUIT POURRAIT CONTENIR DES PIÈCES FORMANT DES ARCS OU DES ÉTINCELLES ET NE DOIT PAS ÊTRE EXPOSÉ À DES VAPEURS INFLAMMABLES. AFIN DE RÉDUIRE LES RISQUES D’EXPLOSION LORS DE LA CHARGE, S’ASSURER QUE L’UNITÉ SOIT SITUÉE À AU MOINS 46 CM (18 PO) AU-DESSUS DU PLANCHER.
- DISPOSITIF EST CONÇU UNIQUEMENT POUR CHARGER LES VÉHICULES QUI NE NÉCESSITENT PAS DE VENTILATION AU COURS DE LA CHARGE.

**ATTENTION**
- AFIN DE RÉDUIRE LES RISQUES DE CHOC ÉLECTRIQUE, NE BRANCHER QUE SUR DES PRISES DE COURANT MISES À LA MASSE DE FAÇON APPROPRIÉE.
- NE PAS UTILISER EN PRÉSENCE DE Dommages À L’UNITÉ, AU CORDON D’ALIMENTATION FLEXIBLE OU AU CÂBLE EV.
- RISQUE DE CHOC ÉLECTRIQUE. NE PAS RETIRER LE COUVERCLE OU TENTER D’OUVRIR LE COFFRET. NE COMPORTF AUCUNE PIÈCE REPARABLE PAR L’UTILISATEUR. FAIRE APPEL AU PERSONNEL TECHNIQUE QUALIFIÉ POUR EFFECTUER LES RÉPARATIONS.

**WARNING**
- TO AVOID A RISK OF FIRE OR ELECTRIC SHOCK, DO NOT USE THIS DEVICE WITH AN EXTENSION CORD.
- THIS PRODUCT MAY CONTAIN ARGING AND SPARKING PARTS THAT SHOULD NOT BE EXPOSED TO FLAMMABLE VAPORS. TO REDUCE THE RISK OF EXPLOSION DURING CHARGING, MAKE SURE UNIT IS LOCATED AT LEAST 46 CM (18 IN.) ABOVE FLOOR. THIS DEVICE IS INTENDED ONLY FOR CHARGING VEHICLES NOT REQUIRING VENTILATION DURING CHARGING.

**CAUTION**
- TO REDUCE THE RISK OF ELECTRIC SHOCK, CONNECT ONLY TO PROPERLY GROUNDED OUTLETS.
- DO NOT USE THIS PRODUCT IF THERE IS DAMAGE TO THE UNIT, FLEXIBLE POWER CORD OR EV CABLE.
- RISK OF ELECTRIC SHOCK. DO NOT REMOVE COVER OR ATTEMPT TO OPEN THE ENCLOSURE. NO USER SERVICEABLE PARTS INSIDE. REFER SERVICING TO QUALIFIED SERVICE PERSONNEL.

**CONSULTATION RAPIDE POUR LE FONCTIONNEMENT**

<table>
<thead>
<tr>
<th>ÉTAT</th>
<th>POURCHARGE</th>
<th>CLIQUEUR ACTION</th>
<th>CODE D’ANOMALIE</th>
<th>MISE À LA MASSE MANUETE, NE PAS UTILISER L’EVSE</th>
<th>AUCUNE ALIMENTATION DE LA PRISE DE COURANT</th>
</tr>
</thead>
<tbody>
<tr>
<td>VERT</td>
<td>VERT</td>
<td>CLIQUEUR BLANC</td>
<td>CODE D’ANOMALIE DÉCÉLÉ</td>
<td>MISE À LA MASSE MANUETE, NE PAS UTILISER L’EVSE</td>
<td>AUCUNE ALIMENTATION DE LA PRISE DE COURANT</td>
</tr>
<tr>
<td>CLIQUEUR ROUGE</td>
<td>VERT</td>
<td>CLIQUEUR ROUGE</td>
<td>MISE À LA MASSE MANUETE, NE PAS UTILISER L’EVSE</td>
<td>AUCUNE ALIMENTATION DE LA PRISE DE COURANT</td>
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<td>MISE À LA MASSE MANUETE, NE PAS UTILISER L’EVSE</td>
<td>AUCUNE ALIMENTATION DE LA PRISE DE COURANT</td>
<td></td>
</tr>
<tr>
<td>(aucun témoin)</td>
<td>(aucun témoin)</td>
<td>(aucun témoin)</td>
<td>(aucun témoin)</td>
<td>(aucun témoin)</td>
<td></td>
</tr>
</tbody>
</table>

**UNIT IS DESIGNED TO ATTEMPT TO RESET ITSELF UNDER FAULT CONDITIONS.**
- FOR USE WITH ELECTRIC VEHICLES.
- VENTILATION NOT REQUIRED.
- THIS DEVICE COMPLIES WITH PART 15 OF THE FCC RULES AND WITH ICES-003E OF INDUSTRY CANADA.

**OPERATIONAL QUICK REFERENCE**

<table>
<thead>
<tr>
<th>ENTRÉE</th>
<th>ÉTAT</th>
<th>CONDITION</th>
</tr>
</thead>
<tbody>
<tr>
<td>VERT</td>
<td>VERT</td>
<td>Normal operation, proceed with charge</td>
</tr>
<tr>
<td>CLIQUEUR ROUGE</td>
<td>VERT</td>
<td>AG power out of range</td>
</tr>
<tr>
<td>CLIQUEUR ROUGE</td>
<td>CLIQUEUR ROUGE</td>
<td>Fault detected</td>
</tr>
<tr>
<td>CLIQUEUR ROUGE</td>
<td>CLIQUEUR ROUGE</td>
<td>Ground missing, do not use EVSE</td>
</tr>
<tr>
<td>(aucun témoin)</td>
<td>(aucun témoin)</td>
<td>No power from outlet</td>
</tr>
</tbody>
</table>
GM EVSE | Quick Reference Guides

VOLTEC Charge Cord - Quick Reference Guide

1. Plug Charge Cord into standard 120V outlet. (Do not plug in upside down)
2. Charge will flash GREEN to RED-GREEN to confirm Charge Cord is active and ready to charge.
3. Use Charge Level Button to set charge rate. (Full charge rate, half charge rate)
4. Insert charge plug into vehicle charge port (listen for click).
5. A horn chirp will confirm charge initiation.
6. Press plug lever to remove plug from charge port.

Voltec Vehicle Response

<table>
<thead>
<tr>
<th>VEHICLE CHARGING STATUS INDICATOR</th>
<th>SOUND</th>
<th>ACTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>NONE</td>
<td>NONE</td>
<td>Check charge cord connection.</td>
</tr>
<tr>
<td>SOLID YELLOW</td>
<td>NONE</td>
<td>Charge cord is OK, but vehicle is not charging.</td>
</tr>
<tr>
<td>SOLID GREEN</td>
<td>ONE HORN CHIRP</td>
<td>Charging has begun.</td>
</tr>
<tr>
<td>LONG GREEN PULSE</td>
<td>TWO HORN CHIRPS</td>
<td>Charging is delayed, scheduled to begin later.</td>
</tr>
<tr>
<td>SHORT GREEN PULSE</td>
<td>NONE</td>
<td>Charge is complete.</td>
</tr>
<tr>
<td>SOLID GREEN OR LONG GREEN PULSE</td>
<td>FOUR HORN CHIRPS</td>
<td>Insufficient time to charge prior to next departure time.</td>
</tr>
</tbody>
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For questions call (888) EV ASSIST (382-7747)

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120V Portable Charge Cord

240V Charge Station
Main Circuit Board
- CCID (Charge Circuit Interrupt Device) Protection
- Continuous Ground Monitor
- Self diagnostics
- Non-serviceable fuses
- Ribbon cable to LED board

Input Terminal Block
- L1, L2, GND inputs
- Utility interrupt inputs (not utilized)

Sealing
- Foam seals provide protection against the elements for outdoor applications (installations)
240V Charge Station | Specifications

Specification sheet available online at www.homecharging.spx.com/volt
Consumer Outreach | Installation Guidelines

Consumer Outreach

1. EVSE should always be installed and used in accordance with the EVSE installation and operating instructions.

2. Use of extension cords, adapters and/or other wiring accessories should be in accordance with the EVSE installation and operating instructions. Do not use extension cords, adapters and/or other wiring accessories if not permitted by the EVSE installation and operating instructions.

3. Failure to install an EVSE in accordance with its installation and operating instructions could result in electric shock or fire.

4. The GM’s Level 2 (Voltec) charge station is currently not listed to be used as a plug and cord connected device. Don't plug and cord connect the GM Level 2 EVSE. Follow the installation instructions provided with the unit.
Installation Don’ts (Recent Examples – Not endorsed by GM)
An extension cord should not be used to charge the vehicle. Use of an extension cord may increase the risk of electric shock or other hazards.

If an extension cord is used because of limited access to 120V AC power, use the following safeguards:

- The 120V AC outlet should be GFCI protected
- The extension cord should be GFCI protected, 12 or 14 gauge, 3 conductor, rated for outdoor

*Portable 220V device; Avcon adapter rig*
120V Charge Cord

- GM 120V Portable Cord Set (Level 1)

- Hardware (standard equipment)

- CHEVY DEALERS

- Installation, Service & Warranty

- Volt Customer

- Local, Certified Independent Electrical Contractor

- Installation Support (Site Surveys, Dedicated 120V Outlets, Mounting, Metering)

240V Charge Stations

- GM 240V Charging Station (Level 2)

- Coulomb or ECOTality Charging Station (Level 2)*

- Hardware

- SPX

- Local, Certified Independent Electrical Contractor

- Installation, Service & Warranty

- Volt Customer

* Select DoE Program Markets
240V EVSE | Other 3rd-Party Examples
Volt (Electric Vehicle) | First Responder Training

- GM National Safety Training program kicked off in Chicago 2010
  - Launch market training roll out – incl. SF, LA, MI, TX, NYC, WDC
- GM First Responder Website
  - [https://www.gmstc.com/FirstResponder.aspx](https://www.gmstc.com/FirstResponder.aspx)
- OnStar Public Safety microsite
  - [http://www.onstar.com/web/portal/publicsafety](http://www.onstar.com/web/portal/publicsafety)

- NFPA has completed development of a national First Responder Training Program - $4.4M DOE Grant
- GM OnStar/NFPA partnership for training/education
  - NFPA launched first virtual safety training course for Chevrolet Volt Website  [www.evsafetytraining.org](http://www.evsafetytraining.org)

First Responder training started in partnership with NFPA – many self-explanatory training materials are available online.
Volt Launch | Nationwide Utility Coordination

**Volt Launch began late 2010**
- California, WDC, New York, Texas, Michigan, Connecticut, New Jersey

**Nationwide deployment by the end of 2011**
- 3 ways Volts expand into new markets - Dealer Sales / Migrations / Demonstrations
Charging Infrastructure | Prioritization

- **Public**
  - High Visibility
  - Commercial / Retail

- **Workplace**
  - Corporate, Municipal Parking Lots

- **Residential** *(majority)*
  - Satisfying consumer-driven home installation process
  - Permits, electrical contractors, inspections, meters, rates
Where Are the Cars? | Opportunities to Charge

Fleet Distribution during week

Source of Data - 2001 National Household Travel Survey ; GM Data Analysis (Tate/Savagian) - SAE paper 2009-01-1311
Volt charging options move customers away from peak charging, result in a “stagger” that prevents a new evening peak, and includes manual programmable features that anticipate the more automatic "smart grid" features to come.
Chevrolet, SPX and your local electric utility company want to ensure you have the most satisfying charging experience possible.

Please select your electric utility provider: [Select Utility]

We would like to share your contact information, vehicle preference, and home charging preference (for example, 120V or 240V) with your utility. This information will be used to help your utility perform local electric grid management and service planning.

Your utility may also want to reach out to you to identify electricity rate options, programs or incentives that may be available. To further understand how your utility will treat the information we provide on your behalf, please review your utility’s privacy statement.

Please share my contact, vehicle preference, and home charging preference information with the local utility identified above

- [ ] Agree
- [ ] Disagree

[Disagree] Pop-Down Window
Please note, regardless of your response above, there are cases when your information may be required by your utility in order to complete your home charging installation or to qualify for specific programs and incentives. As a result, we strongly recommend you contact your local utility to share your intent on purchasing an electric vehicle or to identify yourself as an electric vehicle owner.

GM Privacy Statement (www.gm.com/privacy/)
OnCor
Utility Role
Codes & Standards
The Intersection of Standards and Compliances

Society of Automotive Engineers (SAE)
  • Charging Configurations & Ratings

National Electrical Code (NEC)
  • NEC 625.13 | EVSE Cord & Plug Connection
  • NEC 625.14 | EVSE Power Rating
  • NEC 625.18 | EVSE Interlock
  • NEC 625.19 | EVSE Automatic De-Energization
  • NEC 625.21 | Overcurrent Protection
  • NEC 625.29 | Indoor Sites
**EVSE | Intersection of Standards & Compliance**

Cars are a “global product” made to global standards and chargers need to be a “global product”. Many “standards” pertain to the EVSE.

- **North America**
  - Article 625
  - Tested to: UL 2594, UL 2251, UL 1998, UL 62, UL 2231-1, -2
  - IEC 61851-1, -21, -22, IEC 62196, IEC 61000-4-2

- **European Union**
  - ISO
  - CE
  - IEC

- **SAE International**
  - J1772 Connector
  - CSA C22 No. 107.1

- **FCC Part 15**

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### SAE | Charging Configurations & Power Ratings

<table>
<thead>
<tr>
<th><strong>AC Charging Levels</strong></th>
<th><strong>DC Off Board Charging Levels</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>▶ <strong>AC L1:</strong> 120V AC Single Phase</td>
<td></td>
</tr>
<tr>
<td>◦ Configuration current 12, 16A</td>
<td></td>
</tr>
<tr>
<td>◦ Configuration power 1.44, 1.92kW</td>
<td></td>
</tr>
<tr>
<td>▶ <strong>AC L2:</strong> 240V AC Single Phase</td>
<td></td>
</tr>
<tr>
<td>◦ Rated Current ≤ 80A</td>
<td></td>
</tr>
<tr>
<td>◦ Rated Power ≤ 19.2kW</td>
<td></td>
</tr>
<tr>
<td>▶ <strong>AC L3:</strong> TBD</td>
<td></td>
</tr>
<tr>
<td>◦ AC Single and/or 3 Phase</td>
<td></td>
</tr>
<tr>
<td>◦ &gt; 19.2kW</td>
<td></td>
</tr>
<tr>
<td>▶ <strong>DC L1:</strong> 200 – 450V DC</td>
<td></td>
</tr>
<tr>
<td>◦ Rated Current ≤ 80A</td>
<td></td>
</tr>
<tr>
<td>◦ Rated Power ≤ 19.2kW</td>
<td></td>
</tr>
<tr>
<td>▶ <strong>DC L2:</strong> 200 – 450V DC</td>
<td></td>
</tr>
<tr>
<td>◦ Rated Current ≤ 200A</td>
<td></td>
</tr>
<tr>
<td>◦ Rated Power ≤ 90kW</td>
<td></td>
</tr>
<tr>
<td>▶ <strong>DC L3:</strong> TBD</td>
<td></td>
</tr>
<tr>
<td>◦ 200 – 600V DC ?</td>
<td></td>
</tr>
<tr>
<td>◦ Rated Current ≤ 400A?</td>
<td></td>
</tr>
<tr>
<td>◦ Rated Power ≤ 240kW?</td>
<td></td>
</tr>
</tbody>
</table>

Voltages are nominal configuration operating voltages, not coupler rating. Rated power is at nominal configuration operating voltage and coupler rated current.

Values not finalized
**Electric Vehicle Supply Equipment.** The conductors, including the ungrounded, grounded, and equipment grounding conductors and the electric vehicle connectors, attachment plugs, and all other fittings, devices, power outlets, or apparatus installed specifically for the purpose of transferring energy between the premises wiring and the electric vehicle.
**NEC 625.13 | EVSE Cord & Plug Connection**

625.13 Electric Vehicle Supply Equipment. Electric vehicle supply equipment rated at 125 volts, single phase, 15 or 20 amperes *or part of a system identified and listed as suitable for the purpose and meeting the requirements of 625.18, 625.19, and 625.29 shall be permitted to be cord and-plug-connected*. All other electric vehicle supply equipment shall be permanently connected and fastened in place. This equipment shall have no exposed live parts.

**2011 NEC REPORT ON COMMENTS (ROC)**

*The Code Panel in their statement rejecting any changes to 625.13 stated:*

An electric vehicle supply equipment (EVSE) meeting the requirements of 625.18, 625.19 and 625.29 *can be cord and plug connected* even when the voltage is greater than 125 VAC.
**NEC 625.14 | EVSE Power Rating**

**625.14 Rating.** Electric vehicle supply equipment shall have sufficient rating to supply the load served. For the purposes of this article, electric vehicle charging loads shall be considered to be continuous loads (over 3 hours duration).

*Continuous loads should not exceed 80% of a branch breaker rating. PEVs should be considered continuous loads due to charge times exceeding 3 hours.*

*Consideration should be given to 120V circuits sharing non-continuous loads while being used to charge the continuous load of a PEV. The combination of non-continuous and continuous loads on the same circuit may overload the circuit and trip the breaker.*

*The Voltec charge station is rated at 240V/16A. We are recommending that customers install a 240A/40A rated circuit to allow for future expandability of vehicle charge rates. A minimum 20A circuit is required or likely preferred if there are cost considerations due to panel upgrade requirement for 40A.*
625.18 Interlock. Electric vehicle supply equipment shall be provided with an interlock that de-energizes the electric vehicle connector and its cable whenever the electrical connector is uncoupled from the electric vehicle. An interlock shall not be required for portable cord-and-plug-connected electric vehicle supply equipment intended for connection to receptacle outlets rated at 125 volts, single phase, 15 and 20 amperes.

The cable connecting to the PEV will be de-energized when not connected to the PEV.

This does not apply to 125V, single phase, 15A and 20A plug and cord connected EVSEs. While not required by code, a J1772 compliant 125V cord and plug EVSE will de-energize the cable connecting to the PEV.
625.19 Automatic De-Energization of Cable. The electric vehicle supply equipment or the cable-connector combination of the equipment shall be provided with an automatic means to de-energize the cable conductors and electric vehicle connector upon exposure to strain that could result in either cable rupture or separation of the cable from the electric connector and exposure of live parts. Automatic means to de-energize the cable conductors and electric vehicle connector shall not be required for portable cord-and-plug-connected electric vehicle supply equipment intended for connection to receptacle outlets rated at 125 volts, single phase, 15 and 20 amperes.

The cable connecting to the PEV will be de-energized when sufficient strain is applied to the cable that can rupture the cable or expose live parts. This does not apply to 125V, single phase, 15A and 20A plug and cord connected EVSEs.
625.29 Indoor Sites. Indoor sites shall include, but not be limited to, integral, attached, and detached residential garages; enclosed and underground parking structures; repair and nonrepair commercial garages; and agricultural buildings.

(A) Location. The electric vehicle supply equipment shall be located to permit direct connection to the electric vehicle.

(B) Height. Unless specifically listed for the purpose and location, the coupling means of the electric vehicle supply equipment shall be stored or located at a height of not less than 450 mm (18 in.) and not more than 1.2 m (4 ft) above the floor level.

(C) Ventilation Not Required. Where electric vehicle nonvented storage batteries are used or where the electric vehicle supply equipment is listed or labeled as suitable for charging electric vehicles indoors without ventilation and marked in accordance with 625.15(B), mechanical ventilation shall not be required.

Text continues....
625.15 (B) & (C) provide labeling requirements for EVSEs. EVSEs designed for use with vehicles that do not require ventilation while charging are to be labeled, “Ventilation Not Required”.

Voltec EVSEs are designed to be used with vehicles that do not require ventilation. (Volt Lithium Ion Batteries do not require ventilation)

EVSEs designed to be used with vehicles that require ventilation while charging are to be labeled, “Ventilation Required”. These EVSE must be interlocked with an appropriate ventilation system Per NEC Art 625.29 (D).

A vehicle that requires ventilation while charging cannot be charged by an EVSE labeled, “Ventilation Not Required”.
625.21 Overcurrent Protection. Overcurrent protection for feeders and branch circuits supplying electric vehicle supply equipment shall be sized for continuous duty and shall have a rating of not less than 125 percent of the maximum load of the electric vehicle supply equipment. Where non-continuous loads are supplied from the same feeder or branch circuit, the overcurrent device shall have a rating of not less than the sum of the non-continuous loads plus 125 percent of the continuous loads.

A 120V/15A circuit meets the requirement for the Voltec portable charge cord. As stated above non-continuous loads need to be considered in the circuit load calculation. The 120V Voltec charge cord charge current can be selected at 12A or 8A to accommodate use on circuits with non-continuous loads.

240V/20A meets the requirement for the Voltec wall EVSE. EVSEs with higher ratings (e.g., 240V/40A) require higher rated circuits with appropriate breaker ratings.
1. This is an ongoing process (there are 40,000 jurisdictions having authority in the U.S.)

2. Many of our utility partners have begun outreach awareness to their local inspectors

3. USCAR GITT (Grid Interaction Tech Team) and the U.S. DoE (Clean Cities Initiative) are developing a national outreach program with input from relevant stakeholders (including the ICC)

4. EVITP (Electric Vehicle Infrastructure Training Program) - GM collaborating with NECA, IBEW and IAEI (both nationally and at the local chapter level) to roll-out training to electrical contractors and inspectors
What is EVITP?

A not-for-profit, collaborative training program that addresses the technical requirements, safety imperatives, and performance integrity of industry partners and stakeholders including:

- Automobile Manufacturers
- Investor-Owned and Municipal Utilities
- Electric Vehicle Supply Equipment Manufacturers
- Electrical Energy Storage Device Manufacturers
- State and Local Electrical Inspectors
- Electrical Contractors
- Electrical Workers
- First Responders

The EVITP curriculum was developed in partnership with EV Industry Stakeholders and subject matter experts from around the country.
EVITP Partner Advisors

- General Motors (Vehicle Manufacturer)
- AeroVironment, Inc. (EVSE Manufacturer; Nissan Partner)
- General Electric (EVSE Manufacturer)
- The National Fire Protection Association (NFPA)
- The International Association of Electrical Inspectors (IAEI)
- Schneider Electric (EVSE Manufacturer)
- DTE Energy (Michigan Utility)
- PEP Stations (EVSE Manufacturer)
- ClipperCreek (EVSE Manufacturer)
- Exergonix (Battery Storage)
- Ameren (Missouri Utility)
- Milbank Manufacturing Co. (EVSE Manufacturer)
- California Community Colleges-Advanced Transportation Technology & Energy Program
- The University of California-Davis, PHEV Research Center
- Orlando Utilities Commission (Municipal Utility)
- Southern California Edison (SCE)
- Smith Electric Vehicles (Vehicle Manufacturer)
- National Electrical Contractors Association (NECA)
- Hubbell (EVSE Manufacturer)
- Commonwealth Edison (Illinois Utility)
- Leviton (EVSE Manufacturer)
- Legrand/Pass & Seymour (EVSE Manufacturer)
- Kansas City Power & Light (Utility)
- Duke Energy (Southeastern & Midwestern U.S. Utility)
- National Joint Apprenticeship Training Committee (NJATC)
EVITP Master Train the Trainer

April 14-16, 2011 - Over 56 Candidates from 21 states completed the first ever EVITP Master Train the Trainer in Chicago

21 Hours of Classroom instruction was given to the EVITP Trainer Candidates

Comprehensive Hands-On Lab Instruction included Customer Relations material.
EVITP Next Steps

- By the end of June 2011, EVITP Master Instructors will have completed course training in over 21 states for both EVITP Instructors and Contractors & Electricians.

- Training will be offered through a network of Electrical Industry Training Centers and select Community Colleges throughout the United States.

- EVITP considering inspector specific training curriculum, subset modules of Electrical Contractor Training.
Contractor & Inspector Outreach

• What do you need to know?

• What information is critical?

• How do we ensure safe and compliant installations?

• How do we improve the installation and inspection process for customers, contractors and inspectors?

On-Going Dialogue Required
THANK-YOU!

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Information Websites
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http://www.homecharging.spx.com/volt