



SAE International

Electric Vehicle Supply Equipment

Field Technician

Body of Knowledge and Certification

The Electric Vehicle Supply Equipment (EVSE) Field Technician Certification Body of Knowledge (BOK) defines the pre-requisite training, knowledge, and skills needed to effectively perform the role of a field technician responsible for the commissioning, maintenance, and repair of EVSE. This BOK was developed by an SAE International-led panel of subject matter experts from a wide range of EVSE-associated industries.

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It is with the deepest respect and gratitude that SAE International thanks the many people who volunteered their time to develop this document.

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Introduction

The SAE EVSE Field Technician Body of Knowledge (BOK) was created to facilitate the workforce development of Electric Vehicle Supply Equipment (EVSE) Field Technicians in response to the rapid expansion of EV charging infrastructure.

The Electric Vehicle Supply Equipment (EVSE) Field Technician role includes a range of responsibilities maintaining and repairing electric vehicle (EV) charging stations' software, firmware, and hardware. These responsibilities include calibrating, commissioning, communications and cell signal testing, corrective and preventative maintenance, diagnostics, parts replacement, reprogramming, troubleshooting, and upgrades.

The knowledge, skills, and training defined herein are within the scope of job tasks performed by the field technician. Outside the scope of this role are knowledge and skills needed in the design, construction, and decommissioning phases of EVSE deployment. And, while there is substantial overlap between the knowledge and skills required by field technicians and those required by remote network operations center technicians (NOCs), this document is focused on field technicians, specifically. NOCs may benefit from acquiring this certification in addition to other knowledge and skills.

This document covers field technician knowledge and skills common to all basic EVSE equipment; however, technicians hired by EVSE manufacturers or network providers are expected to undergo further training specific to the equipment produced or used by their employer.

The information in this BOK will provide guidance for the following:

- Training providers and employers who wish to develop training courses intended to support the EVSE Field Technician
- EVSE certification examination candidate preparation

Certification

The SAE EVSE Field Technician Certification certifies that credential holders have demonstrated a thorough understanding of the knowledge and skills (described herein) needed to perform the role safely and effectively. SAE developed the program in

conjunction with leading manufacturers who hire and employ this critical workforce. The program creates clarity for job seekers and employers alike to align on a consistent set of requirements needed for the role.

The Certification will be granted to field technicians who have passed a rigorous exam administered by SAE ITC Probitas.

Job Tiers

Field technicians may earn certifications at two levels:

- EVSE Technician Tier 1: Servicing Level 1 and Level 2 charging stations
- EVSE Technician Tier 2: Servicing Level 3 DC Fast Chargers

Tier 2 technicians will require more advanced safety training, knowledge, and skills, in order to ensure their safety while working with higher voltages.

How this document was created

In response to the growing need for reliability in the charging infrastructure, several prominent EVSE industry experts approached SAE with a common request: help us formalize the knowledge and skills of this growing workforce and help credential them. As a response, SAE International assembled a panel of industry experts to develop a BOK to be used as the basis for a certification program. These experts represented various sectors of the EVSE ecosystem, including EV manufacturers, charging station manufacturers, network suppliers, and existing EVSE technician service providers. The panel developed and reviewed a list of knowledge, skills, and abilities with respect to their scope and substance. The result is a comprehensive BOK that reflects the complete set of knowledge and skills needed to effectively and safely service EVSE equipment in the field.

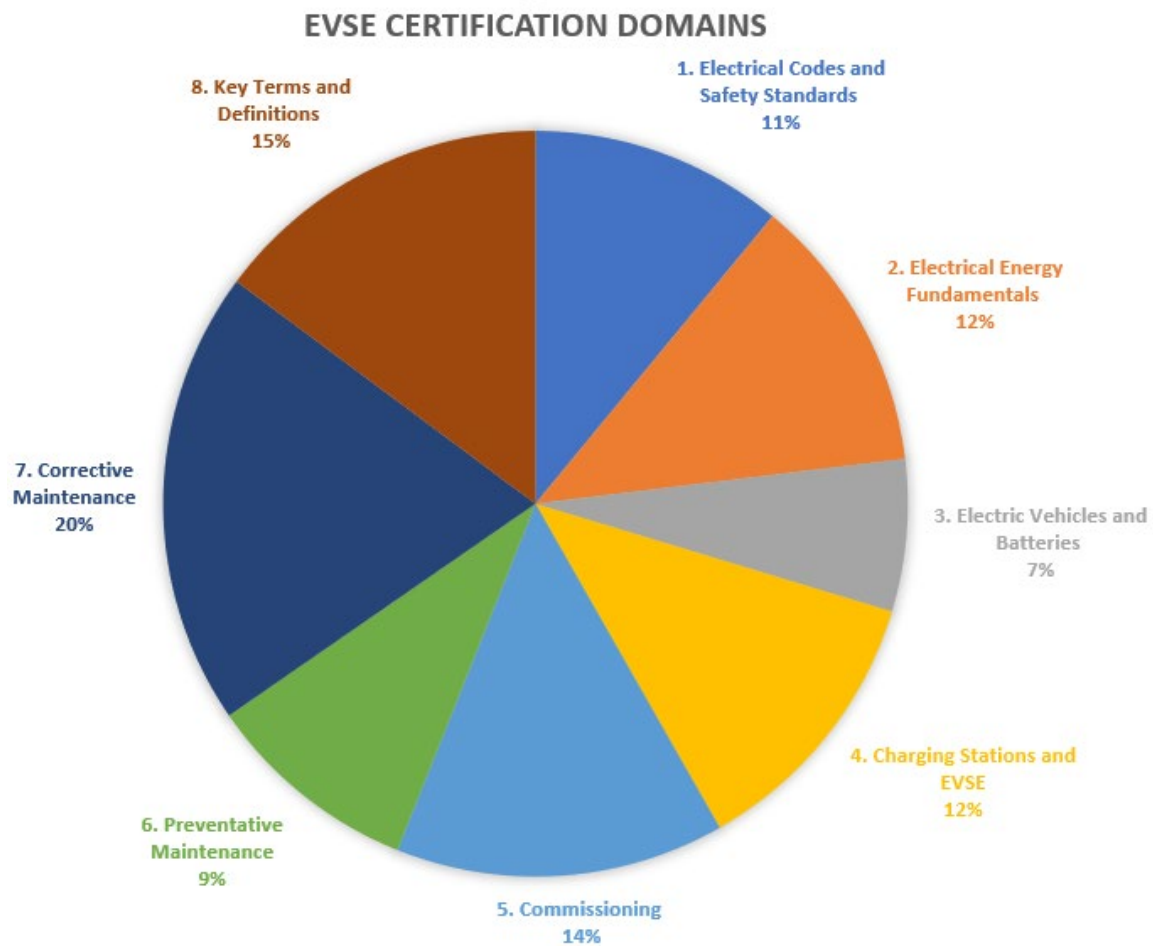
BOK Structure and Scope

Domains

The BOK is comprised of 7 domains that encompass the range of knowledge and skills needed by the EVSE technician to commission, maintain, and service EVSE equipment:

1. Codes, Standards, and Regulations
2. Electrical Energy Fundamentals
3. Electric Vehicles and Batteries
4. Charging Stations and EVSE
5. Commissioning
6. Preventative Maintenance
7. Corrective Maintenance

The following chart shows the relative distribution of knowledge and skills across the various domains.



Domain one focuses entirely on safety training and regulations associated with servicing EVSE.

Domains two, three, and four cover background knowledge on the fundamentals of electrical energy, electric vehicles (EVs), EV batteries, and charging station equipment.

Domains five, six, and seven describe the tasks associated with the commissioning, preventive maintenance, and corrective maintenance of EVSE and are primarily skills focused.

Subdomains

Each domain is divided into three or more subdomains. The subdomains group related knowledge and skills together and make the domain easier to navigate. For example:

Domain 7: Corrective Maintenance

7.1 Background/Preparation

7.2 Site Inspection

7.3 Troubleshooting

7.4 Repair

7.5 Report Writing

Subdomain Categories and Tiers

Each subdomain falls into one of 3 categories:

1. **KNOWLEDGE:** information that a technician will need to know in order to service EVSE
2. **SKILL:** the ability to perform a specific task associated with EVSE maintenance or repair, often involving the use of specific tools or technology
3. **TRAINING:** specific safety certification training, such as OSHA or NEC

Except where noted, every competency applies to both Tier 1 and Tier 2 technicians.

Assessment Type

The certification exam will utilize several modalities to verify mastery of the knowledge and skills included in the BOK that is required for awarding the SAE International credential. Each subdomain is marked with the assessment type that may appear on the certification exam.

Written: These subdomains can be tested using a traditional assessment item, such as multiple choice, matching, sorting, fill-in-the-blank, or short answer.

Practical: These subdomains require a more advanced verification of mastery, such as remotely proctored simulation-based questions or in-person observation of skills.

Domain 1: Codes, Standards, and Regulations

Overview

An understanding of electrical codes, safety standards, and environmental regulations is required to ensure that technicians are able to perform their jobs safely and legally. Safety training allows Tier 1 EVSE technicians to safely and effectively perform the job duties required to service Level 1 and Level 2 electric vehicle charging stations. While Tier 1 technicians are not performing electrical tasks, this training will prevent unintentional exposure to electrical and chemical hazards. Tier 2 EVSE technicians require additional safety training.

Subdomain 1.1: Electrical Codes

Section #	Competency Category	Competency Description	Assessment Type
1.1.1	Knowledge	<p>Understand the sections of the National Electrical Code (NEC) that apply to EVSE maintenance and operation (Article 625*)</p> <ul style="list-style-type: none">• Voltage (625.4)• Cords and Cables (625.17)• Personnel Protections System (625.22)• Electric Vehicle Branch Circuit ((625.40)• Overcurrent Protection (625.41)• Rating (625.42)• Disconnecting Means (625.43)• Equipment Connection (625.44)• Loss of Primary Source (625.46)• Multiple Feeder or Branch Circuits (625.47)• Location (625.50)• Ventilation (625.52)• Ground-Fault Circuit-Interrupter Protection for Personnel (625.54)	Written

		<ul style="list-style-type: none"> • Receptacle Enclosures (625.56) • Grounding (625.101) • Installation (625.102) 	
1.1.2	Knowledge	Understand state-specific electrical codes that apply to EVSE maintenance and operation	Written
1.1.3	Knowledge	Understand the characteristics and operation of grounding systems, including the use of GFCI	Written
1.1.4	Skill	<p>Visually inspect the charging stations for adherence to proper bonding/grounding protocols, including</p> <ul style="list-style-type: none"> • Proper wire color/sizing • Proper terminal connections 	Written
1.1.5	Skill	Visually inspect the charging station for adherence to NEC codes (see list in 1.1.1) and state-level electrical codes	Written
1.1.6	Skill	<p>Analyze electric distribution system schemes (one-line drawings) for adherence to code, including</p> <ul style="list-style-type: none"> • Breakers • Fuses • Switchgear 	Written

*See Appendix for complete code text

Subdomain 1.2: Safety Standards

Section #	Competency Category	Competency Description	Assessment Type
1.2.1	Training	Complete OSHA 10 Hours for General Industry training, including Lock Out Tag Out (LOTO)	NA
1.2.2	Training	Complete safety training in defensive driving, ladder safety, arc flash awareness	NA
1.2.3	Training	Complete National Fire Protection Association (NFPA) 70E training	NA
1.2.4	Training	Complete high-voltage (over 600V) safety training (<i>TIER 2 only</i>)	NA
1.2.5	Knowledge	Identify safety protocols for site visits, including safety barriers and PPE to protect against arc flash <ul style="list-style-type: none"> • Boots • Safety glasses • Gloves • Visibility vest • AR/FR-Coveralls • Hard hat • Face shield 	Written
1.2.6	Knowledge	Identify safety protocols for working with charging equipment, including station shutdown procedures <ol style="list-style-type: none"> 1. Check in with the site host 2. Locate the breaker or breakers 3. Put on proper PPE 4. Shut off power at all breakers 	Written

5. Check station to ensure it is de-energized
6. Follow steps in work order/SOW

1.2.7	Knowledge	Identify safety protocols for working with lithium batteries	Written
1.2.8	Knowledge	Identify potential civil issues, including <ul style="list-style-type: none"> • No access to restricted/secured areas • Policy activity • Suspicious people • Irate customers • Unresponsive host and their best-practice mitigations	Written
1.2.9	Knowledge	Identify potential environmental issues, including <ul style="list-style-type: none"> • Extreme weather • Flooding • Fire and their best-practice mitigations	Written
1.2.10	Skill	Apply OSHA electrical hazard guidelines to EVSE site visits to prevent shock, electrocution, and arc flash	Written
1.2.11	Skill	Apply OSHA and NFPA fire hazard guidelines to EVSE site visits	Written
1.2.12	Skill	Demonstrate knowledge of the Lock Out Tag Out (LOTO) protocol to shut down a charging station, including	Written

- Use of one-line drawing to identify where to place device
- Testing to ensure lockout is working properly before starting work

1.2.13	Skill	Demonstrate the ability to safely handle high-voltage equipment (over 600V) to prevent electrical hazards (<i>TIER 2 only</i>)	Written
1.2.14	Skill	Demonstrate proper use of a voltage detector to determine that a station is de-energized before working on equipment	Practical

Subdomain 1.3: Regulations and Compliance

Section #	Competency Category	Competency Description	Assessment Type
1.3.1	Knowledge	Understand federal, state, and local environmental regulations related to the operation of EVSE sites, including best practices with regard to <ul style="list-style-type: none"> • Stormwater pollution • Endangered species • Hazardous material disposal 	Written
1.3.2	Knowledge	Understand the regulatory requirements of sites, including <ul style="list-style-type: none"> • Energy inflow and outflow, • Demand avoidance measures • Connectivity • Communication signals 	Written

1.3.3	Knowledge	Understand local and state-level compliance and signage requirements for the site, including <ul style="list-style-type: none">• ADA• EV Charging Only• Painting of stalls	Written
1.3.4	Knowledge	Understand state-level Energy Star eligibility criteria for certification of EVSE	Written

Domain 2: Electrical Energy Fundamentals

Overview

Basic knowledge of electrical terms and concepts serves as the foundation for safe EVSE operation and maintenance.

Subdomain 2.1: Energy Supply

Section #	Competency Category	Competency Description	Assessment Type
2.1.1	Knowledge	Describe the flow of energy from the grid to the charging station	Written
2.1.2	Knowledge	Understand the use of AC and DC power in EVs and EVSE circuits	Written
2.1.3	Knowledge	Identify units of measure related to electrical circuits (volts, amperages, kWh) in EVSE applications	Written
2.1.4	Knowledge	Differentiate between continuous (grid) and intermittent (backup) energy supply	Written
2.1.5	Knowledge	Identify the functions, characteristics, and operations of dry and auto transformers	Written
2.1.6	Knowledge	Describe the role of a diode bridge in rectification (conversion of AC power to DC power) <i>(Tier 2 only)</i>	Written
2.1.7	Skill	Demonstrate the ability to convert units of measure associated with electrical circuits (volts, amperages, kWh)	Written

2.1.8	Skill	Demonstrate the ability to use one-line drawing to differentiate between continuous (grid) and intermittent (backup) energy supply at a station	Written
2.1.9	Skill	Demonstrate the use of a multimeter to measure current, voltage, and resistance in direct current (DC) and alternating current (AC) circuits	Practical
2.1.10	Skill	Demonstrate the use of a phase rotation meter, megohmmeter (insulation resistance tester), and power meter (calibration)	Practical

Subdomain 2.2: Series and Parallel Circuits

Section #	Competency Category	Competency Description	Assessment Type
2.2.1	Knowledge	Identify the characteristics of the series, parallel, and combination circuits	Written
2.2.2	Knowledge	Describe how current, voltage, and resistance relate within the circuits	Written
2.2.3	Knowledge	Explain the role of Ohm's law in circuit design	Written
2.2.4	Skill	Calculate the current, voltage, and resistance in a series circuit	Written
2.2.5	Skill	Calculate the current, voltage, and resistance in a parallel circuit	Written
2.2.6	Skill	Apply Ohm's law to determine the level of current flowing in the circuits	Written

Subdomain 2.3: Schematics and Diagrams

Section #	Competency Category	Competency Description	Assessment Type
2.3.1	Knowledge	Identify types of electrical schematics and diagrams pertinent to the EVSE	Written
2.3.2	Skill	Demonstrate the ability to read electrical schematics and specifications pertinent to EVSE	Written
2.3.3	Skill	Demonstrate ability to read and understand electrical circuit diagrams, including single line diagrams	Written
2.3.4	Skill	Demonstrate the ability to read and understand a control diagram	Written
2.3.5	Skill	Use schematics to locate common components and wiring failures in EVSEs	Written

Domain 3: Electric Vehicles (EVs) and Batteries

Overview

Unlike their gas-powered counterparts, EVs run off of a battery and use an electric motor rather than an internal combustion engine. EVs are connected to EVSEs by charge cords that deliver charge to the battery.

Subdomain 3.1: Electric Vehicles (EVs)

Section #	Competency Category	Competency Description	Assessment Type
3.1.1	Knowledge	Understand differences in the type of energy used and method of propulsion in EVs, hybrids, plug-in hybrids, and ICE vehicles	Written
3.1.2	Knowledge	Describe the basic functionality of an EV	Written
3.1.3	Knowledge	Understand differences between BEVs and plug-in hybrids, including charger levels (AC or DC)	Written
3.1.4	Knowledge	Describe the main computer control modules and components in a BEV and PHEV	Written
3.1.5	Knowledge	Identify major EV manufacturers and their products	Written

Subdomain 3.2: EV Batteries

Section #	Competency Category	Competency Description	Assessment Type
3.2.1	Knowledge	Describe the basics of energy storage in EV batteries	Written

3.2.3	Knowledge	Describe how battery conditions such as temperature can affect charge rates	Written
3.2.4	Knowledge	Identify the different battery technologies used in the EV industry and the safety implications of each	Written

Subdomain 3.3: EV Charging

Section #	Competency Category	Competency Description	Assessment Type
3.3.1	Knowledge	Describe the basic charging specifications for different types of EVs	Written
3.3.2	Knowledge	Describe the key differences between different types of charge connectors (proprietary, North America, China, Europe) <ul style="list-style-type: none"> • CCS1 • CCS2 • GBT • NACS • J1772 	Written
3.3.3	Knowledge	Identify battery charge session states and describe their differences, including <ul style="list-style-type: none"> • State-of-charge • Range • Bulk charge • Trickle charge • Cable check • Pre-charge • Authorization 	Written

Domain 4: Charging Stations and EVSE

Overview

Charging stations, also known as chargers or wall boxes, contain one or more EVSEs that supply EVs with electrical power.

Subdomain 4.1: Charging Station Basics

Section #	Competency Category	Competency Description	Assessment Type
4.1.1	Knowledge	Identify the main differences between residential, public, commercial, and industrial EVSE applications	Written
4.1.2	Knowledge	Explain the differences between AC and DC charging <ul style="list-style-type: none">• AC charge is converted to DC charge inside the EV, then fed to the battery• DC charge is direct to the battery	Written
4.1.3	Knowledge	Explain the difference between Level 1, Level 2, and DC Fast chargers in terms of voltage (v), amperage (amp), charging load/power (kW), and power delivered/charge rate (miles of range/hr)	Written
4.1.4	Knowledge	Identify the primary charging systems used by the current top EVSE manufacturers	Written
4.1.5	Knowledge	Understand the basics of wireless charging	Written

Subdomain 4.2: Charging Station Configuration

Section #	Competency Category	Competency Description	Assessment Type
4.2.1	Knowledge	Identify the component parts of an EV charging station: <ul style="list-style-type: none">• Dispenser/kiosk• Rectification cabinet• Capacitors• Contactors• Relays• Transformers• Control products• Charging software	Written
4.2.2	Knowledge	Identify an EVSE as an individual circuit in a charging station that can have one or more charging sockets (port/connector) available to drivers	Written
4.2.3	Knowledge	Understand that the number of EVSEs determines the charger's ability to charge multiple vehicles at the same time	Written

4.2.4	Knowledge	Understand that a charging station with one EVSE and two sockets will allow only one EV to charge, with the second socket status becoming “unavailable”	Written
4.2.5	Knowledge	Understand that a charging station with two EVSEs and two sockets will allow two EVs to charge simultaneously, with the available energy being split between the two sockets	Written

Subdomain 4.3: Charging Station Specifications

Section #	Competency Category	Competency Description	Assessment Type
4.3.1	Knowledge	Explain the difference between the 4 lead acid stages (bulk, absorption, float, equalization), including the role of battery temperature	Written
4.3.2	Knowledge	Explain the difference between the constant current (CC) and constant voltage (CV) stages of charging	Written
4.3.3	Knowledge	Identify the relationship between the charge rate and the battery life	Written
4.3.4	Knowledge	Describe the difference between conventional charging (constant p-charge) and smart charging (variable p-charge to avoid peak loads)	Written
4.3.5	Knowledge	Explain the role of proper torquing in electrical connections	Written

Subdomain 4.4: Communication and Networking

Section #	Competency Category	Competency Description	Assessment Type
4.4.1	Knowledge	Explain communication between mobile apps, network administrators, EV chargers, EVs, electric utility, service centers, and transaction processors for both LAN and remote networks	Written
4.4.2	Knowledge	Identify whether communications involve cellular service, wifi, or wired internet connections	Written
4.4.3	Knowledge	Identify the EVSE communication protocols: <ul style="list-style-type: none">• Proprietary and non-proprietary• Secure and unsecure• With or without authorization	Written
4.4.4	Knowledge	Describe the function of OCPP in the EVSE ecosystem and what distinguishes the latest version from the previous versions	Written
4.4.5	Knowledge	Describe the general process for remote software updates or reprogramming of electronic modules	Written
4.4.6	Knowledge	Demonstrate a general understanding of information security and how to avoid breeches at stations	Written
4.4.7	Knowledge	Describe the function of cell signal boosters and amplifiers	Written

Domain 5: Commissioning

Overview

Commissioning newly installed chargers is a core responsibility of EVSE technicians.

Subdomain 5.1: Background/Preparation

Section #	Competency Category	Competency Description	Assessment Type
5.1.1	Knowledge	Describe the basic responsibilities listed in a typical commissioning work order and how they differ from those in a preventative or corrective work order	Written
5.1.2	Skill	Ability to review and understand site construction plans (physical and electrical/one-line drawings) to verify that installation was done correctly for that jurisdiction, including <ul style="list-style-type: none">• Wire size• Breaker settings• Equipment location• Signage/stripping	Written
5.1.3	Skill	Ability to review and understand manufacturer-specific installation manuals and plan sets to identify the requirements for switchgear/electrical distribution equipment installation	Written

Subdomain 5.2: Site Inspection

Section #	Competency Category	Competency Description	Assessment Type
5.2.1	Skill	Ability to determine and gather required PPE and tools/equipment needed for a commissioning site visit	Written
5.2.2	Skill	Verify correct labeling requirements for the equipment on site (by owner), including <ul style="list-style-type: none">• Carbon offset• Max load amperage for input/output and document the findings	Written
5.2.3	Skill	Verify correct installation of signage/stripping and document findings	Written
5.2.4	Skill	Verify correct installation of switchgear/electrical distribution equipment, including <ul style="list-style-type: none">• Wire size• Breaker settings• Equipment location• Signage/stripping and document the findings	Written
5.2.5	Skill	Demonstrate proper use of commissioning tools and technologies, including <ul style="list-style-type: none">• Laptop• Multimeter• Torque wrench	Practical

5.2.6	Skill	Inspect cords, plugs, and cabling systems for proper installation and document findings	Practical
5.2.7	Skill	Verify manufacturer-specified torque levels at all terminals and document findings	Practical
5.2.8	Skill	Work with NOC to verify metering data for appropriate settings and document findings	Written
5.2.9	Skill	Work with NOC to verify that load control algorithm is functional and document findings	Written
5.2.10	Skill	Work with NOC to perform software/firmware updates as needed and document findings	Written
5.2.11	Skill	Work with NOC to verify through testing functionality of charging equipment on site and document findings	Written
5.2.12	Skill	Use an EV or simulator to test functionality of station and document findings	Practical

Subdomain 5.3: Communication Systems

Section #	Competency Category	Competency Description	Assessment Type
5.3.1	Knowledge	Understand the function of Supervisory Control and Data Acquisition (SCADA)/Communication Systems	Written
5.3.2	Skill	Work with NOC to test and verify the operability of SCADA systems on site and document findings	Written

5.3.3	Skill	Demonstrate proper use of commissioning tools and technologies, including ethernet tester and cell network tester	Practical
5.3.4	Skill	Inspect the physical layer of communications (fiber optic lines and ethernet) to verify done to code /mf specifications and document findings	Written
5.3.5	Skill	Verify through testing functionality of communications on site and document findings	Practical
5.3.6	Skill	Test and verify the operability of credit card readers and document findings	Practical

Subdomain 5.4: Report Writing

Section #	Competency Category	Competency Description	Assessment Type
5.4.1	Skill	Ability to create field service report that includes <ul style="list-style-type: none"> • Clear and well-labeled photos • Detailed notes • Accurate data • Comprehensive summary of actions taken 	Written

Domain 6: Preventative Maintenance

Overview

Performing preventative maintenance tasks on chargers is a fundamental job of the EVSE technician.

Subdomain 6.1: Background/Preparation

Section #	Competency Category	Competency Description	Assessment Type
6.1.1	Knowledge	Describe the basic responsibilities listed in a typical preventative maintenance work order and how they differ from those in a commissioning or corrective work order	Written
6.1.2	Knowledge	Identify the volume of use data upon which maintenance schedules are built, including <ul style="list-style-type: none">• Elapsed time• Use hours• Number of cycles• Amount of time down/offline	Written
6.1.3	Knowledge	Identify environmental factors that might affect a site's preventative maintenance plan, including <ul style="list-style-type: none">• Indoor/outdoor location• Presence of vegetation• Sun exposure• Proximity to corrosive salt water or dusty conditions• Presence of pests• History of vandalism	Written

6.1.4	Skill	Ability to follow a preventative maintenance schedule provided by the network provider according to their specifications	Written
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Subdomain 6.2: Site Inspection

Section #	Competency Category	Competency Description	Assessment Type
6.2.1	Skill	Ability to determine and gather required PPE, replacement parts, and tools/equipment needed for a preventative maintenance site visit	Written
6.2.2	Skill	<p>Ability to inspect the structural condition of the site, including</p> <ul style="list-style-type: none"> • Integrity of the structure • Chipped asphalt • Potholes • Faded striping • Fences falling down • Signage deterioration <p>document findings, and work with the NP/site host to remediate as needed</p>	Written
6.2.3	Skill	<p>Ability to inspect equipment components, including</p> <ul style="list-style-type: none"> • Pedestal • Cabinets • Screens • Cords • Plugs • Cabling systems <p>for</p> <ul style="list-style-type: none"> • Wear and tear 	Written

- Vandalism
- Environmental deterioration
- Malfunction

and document the findings

6.2.4	Skill	Ability to place a station out of service (in coordination with site host) by creating a barrier and shutting off power/LOTO if conditions are found to be hazardous/not safe	Written
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Subdomain 6.3: Site Maintenance

Section #	Competency Category	Competency Description	Assessment Type
6.3.1	Skill	Demonstrate proficiency with technologies and tools common to EVSE communication systems, including <ul style="list-style-type: none"> • Ethernet tester • Fiber optics tester • Cellular network strength tool • Internet speed test 	Practical
6.3.2	Skill	Ability to perform tests of communications and cell signal systems at the site and document results	Practical

6.3.3	Skill	Ability to perform cleaning of charging station components according to the manufacturer's specifications	Written
6.3.4	Skill	Demonstrate proficiency with tools related to site maintenance, including <ul style="list-style-type: none"> • Multimeter • Torque wrench • Phase rotation meter • Megohmmeter (insulation resistance tester) • Power meter (calibration) • Refractometer (checking for coolant leaks) 	Practical
6.3.5	Skill	Ability to evaluate issues in thermal/cooling systems (air filters, fans, coolant levels/leaks), remediate as needed, and document results	Written
6.3.6	Skill	Ability to check torque settings of all electrical connections, re-torque as needed to appropriate levels, and document results	Practical
6.3.7	Skill	Ability to collect metering data, work with NOC to calibrate as needed, and document results	Written
6.3.8	Skill	Ability to use a simulator or EV to verify the functionality of a station and document results	Practical

Subdomain 6.4: Report Writing

Section #	Competency Category	Competency Description	Assessment Type
6.4.1	Skill	Ability to create field service report that includes <ul style="list-style-type: none">• Clear and well-labeled photos• Detailed notes• Accurate data• Comprehensive summary of actions taken	Written

Domain 7: Corrective Maintenance

Overview

Repairing EVSEs when they are down is a fundamental task of the EVSE technician. This task involves the use of diagnostic tools and data analysis and often involves coordination with a NOC at the back end.

Subdomain 7.1: Background/Preparation

Section #	Competency Category	Competency Description	Assessment Type
7.1.1	Knowledge	Describe the basic responsibilities listed in a typical corrective maintenance work order and how they differ from those in a commissioning or preventative work order	Written
7.1.2	Knowledge	Demonstrate a holistic understanding of how the overall charging system is structured in order to effectively troubleshoot a problem	Written
7.1.3	Knowledge	Identify the most common errors that customers experience and their causes/interventions, including those not directly related to EVSE	Written
7.1.4	Knowledge	Summarize common EVSE hardware-based and software-based failure scenarios and fixes	Written
7.1.5	Skill	Ability to use a manufacturer-specific service manual to look up and troubleshoot an issue	Written

7.1.6	Skill	Ability to look up standard OCPP error codes (GFCI fault, etc.) to derive their meanings	Written
7.1.7	Skill	Ability to look up standard OCPP port status terms and derive their meanings	Written
7.1.8	Skill	Ability to use schematics (one-line drawings) to locate potential points of failure in a station that is down	Written
7.1.9	Knowledge	Explain the difference between utility and backup power and be able to identify which power sources are being used on site	Written
7.1.10	Knowledge	Understand the relationship between electrical capacity/supply and station load and how a service panel might become overloaded	Written
7.1.11	Knowledge	Understand how firmware updates on one part of the system may require firmware updates on other parts of the system to restore the functionality of the station	Written
7.1.12	Knowledge	Understand the function of demand control response (DCR) in EVs and how it might affect the amount of charge received by the EV (regardless of the station output)	Written
7.1.13	Knowledge	Understand what the local safety training/licensure requirements are for EVSE swap-outs (<i>Tier 1 only</i>)	Written

7.1.14	Skill	Ability to follow a corrective maintenance work order, including <ul style="list-style-type: none"> • Running tests • Logging data • Communicating with the NOC and documenting the findings	Written
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Subdomain 7.2: Site Inspection

Section #	Competency Category	Competency Description	Assessment Type
7.2.1	Skill	Ability to determine and gather required PPE, replacement parts, and tools/equipment needed for a corrective maintenance site visit	Written
7.2.2	Skill	Ability to inspect parts for failures, including <ul style="list-style-type: none"> • Cords • Plugs • Cabling systems • Adapters • Circuit boards and document the findings	Practical
7.2.3	Skill	Ability to use appropriate tools, including <ul style="list-style-type: none"> • Multimeter • Phase rotation meter • Megohmmeter to run tests on <ul style="list-style-type: none"> • Hardware • Firmware • Software and collect data	Practical

7.2.4	Skill	Ability to perform diagnostic tests on charger equipment per manufacturer's specifications and document findings	Practical
7.2.5	Skill	Ability to retrieve and translate error codes from chargers made by different manufacturers by <ul style="list-style-type: none"> • Scanning QR code • Logging in and entering error codes and document the findings	Practical
7.2.6	Skill	Ability to use tools, including <ul style="list-style-type: none"> • Ethernet tester • Fiber optics tester • Cell signal meter • Internet speed test to test the EVSE communication systems	Practical
7.2.7	Skill	Ability to perform tests of communications and cell signal systems at the site and document results	Practical
7.2.8	Skill	Ability to use a laptop to perform diagnostics and do updates, connecting with NOC as needed to perform these tasks	Practical
7.2.9	Skill	Ability to use tools (power meter) to collect metering data	Practical
7.2.10	Skill	Ability to share metering data with NOC and calibrate as needed	Written

Subdomain 7.3: Troubleshooting

Section #	Competency Category	Competency Description	Assessment Type
7.3.1	Skill	Ability to use troubleshooting trees to assess root of problem	Written
7.3.2	Skill	Ability to describe key steps in determining if an issue is with the EV or with the EVSE	Written
7.3.3	Skill	Ability to identify which part of the charging system (software or hardware) is failing when given feedback from a user or host	Written
7.3.4	Skill	Ability to process information and offer assessment of the next steps needed to resolve problem to NOCs	Written

Subdomain 7.4: Repair

Section #	Competency Category	Competency Description	Assessment Type
7.4.1	Skill	Ability to replace parts (cords, plugs, cabling systems) due to <ul style="list-style-type: none">• Wear and tear• Vandalism• Environmental deterioration• Malfunction	Practical

7.4.2	Skill	Ability to perform hardware updates as needed for <ul style="list-style-type: none"> • Circuit boards • Upgrading to 5G 	Practical
7.4.3	Skill	Ability to perform SIM card swap as needed for <ul style="list-style-type: none"> • Upgrading to 5G • Swapping out bad cards 	Practical
7.4.4	Skill	Ability to safely perform simple (no running of new wires) EVSE swap-outs for plug-in chargers if allowed by state (<i>Tier 1 only</i>)	Practical
7.4.5	Knowledge	Describe the process for clearing an alarm code from chargers of different manufacturers	Written
7.4.6	Skill	Ability to follow safety protocols to safely power cycle after a power outage or firmware updates in order to restore system functionality	Written
7.4.7	Skill	Ability to perform verifications of equipment functionality by running a test charge on a simulator or EV	Practical
7.4.8	Knowledge	Describe circumstances in which it may be necessary to escalate an issue, including those that require the work of a licensed electrician	Written
7.4.9	Skill	Ability to place a station out of service (in coordination with site host) by creating a barrier and	Written

shutting off power/LOTO if conditions are found to be hazardous/not safe

Subdomain 7.5: Report Writing

Section #	Competency Category	Competency Description	Assessment Type
7.5.1	Skill	Ability to create field service report that includes <ul style="list-style-type: none">• Clear and well-labeled photos• Detailed notes• Accurate data• Comprehensive summary of actions taken	Written
7.5.2	Skill	Ability to identify, note, and photograph specific points of failure (damaged cords or improperly opened cabinets) for use in determining warranty coverage by NOC or another party	Written

Key Terms and Definitions

TERM	DEFINITION
AC (Alternating Current)	An electric current that reverses its direction many times a second; typically used in Level 1 and Level 2 stations
Ampere (amp)	The unit for how fast electric current flows; flow rate
CAN (Controller Area Network)	A communication system made for vehicle intercommunication; a vehicle bus standard designed to allow microcontrollers and devices to communicate with each other's applications without a host computer
CCS (Combined Charging System)	A direct current (DC) fast charging protocol that is SAE-certified, and is featured on vehicles produced by European and American car companies
Charging connector	The device that connects the charging cable to the EV; comes in many different configurations
DC (Direct Current)	An electric current that flows in one direction only; typically used in Level 3 stations
Electric Vehicle Supply Equipment (EVSE)	Cabinet and dispenser that uses cabling and connector to recharge an electric vehicle's battery with electric power from the grid
EV manufacturer	Original equipment manufacturer (OEM) that manufactures electric vehicles (EVs) including battery electric and plug-in hybrid vehicles
EV (Electric Vehicle)	Vehicles that contain a battery, including battery electric and plug-in hybrid vehicles

EVSE manufacturer	Company that makes the charging station equipment
EVSE service technician	Person who performs commissioning, as well as preventative and corrective maintenance, of EVSEs
Hard faults	Interruptions to the flow of charge caused by problems in the EVSE; cleared by power cycling
ICE (Internal Combustion Engine) vehicle	Vehicles with engines in which power is derived from the combustion of liquid fuel
Installing an electrical contractor	Licensed electrician that installs the charging station
Kilowatt (kW)	A unit of electric power; for EVs, kW tells you how fast you can charge your car
Kilowatt hour (kWh)	Capacity of charging, therefore mileage range
Lockout Tagout (LOTO)	Safety procedure to prevent unexpected startup or release of stored energy
Network operator (NOC)	Company/person that supports the charging station on the backend with software updates
Network provider	Company that connects charging stations to EV drivers (using software), and typically is responsible for those stations
OCPP (Open Charge Point Protocol)	A standardized language for communicating between a networked charging station and a network management system; designed by the Open Charge Alliance
Owner/owner-operator	Company that monitors the charging station
PLC (Powerline Communication)	A data transmission technology that facilitates interoperability between the EV and the charger

SOC (State of Charge)	The level of charge of an electric battery relative to its capacity
Soft faults	Interruptions to the flow of charge usually caused by problems in the EV; cleared by disconnecting/reconnecting EV
Station locator	Web-based or mobile apps that help EV drivers locate charging stations
The Cloud	Non-localized software services
Volt (V)	The unit of electromotive force; measures how much “pressure” there is in an electric circuit
ZEV	Zero-Emission Vehicle

Appendix

NEC Article 625

625.4	Voltage	Identify AC system voltages (120, 120/240, 208Y/120, 240, 480Y/277, 480, 600Y/347, 600, and 1000 volts) and DC system voltages (up to 1000V)
625.17	Cords and Cables	Identify the required specifications for the power supply cord and output cable, including composition, ampacity, and length
625.22	Personnel Protection System	Identify system for protection against electric shock of personnel, including use of an interrupting device
625.40	Electric Vehicle Branch Circuit	Describe the importance of using an individual branch circuit for each outlet used to charge an electric vehicle
625.41	Overcurrent Protection	Describe the importance of overcurrent protection for feeders and branch circuits supplying EVSE
625.42	Rating	Describe the importance of power transfer equipment having sufficient rating to supply the load served
625.43	Disconnecting Means	Describe the importance of supplying a means of disconnection for equipment rated more than 60 amperes or more than 150 volts to ground
625.44	Equipment Connection	Describe the differences between portable, fastened-in-place, and fixed equipment
625.46	Loss of Primary Source	Describe the means for preventing the feedback of energy from the EV/EVSE to the premises wiring system

625.47	Multiple Feeder or Branch Circuits	Describe situations where more than one feeder or branch circuit could be permitted to supply equipment
625.50	Location	Describe specifications for EVSE location, including height above grade level
625.52	Ventilation	Know how to use branch-circuit voltage and current tables to determine the ventilation requirements of EVSE equipment installed in an indoor enclosed space
625.54	Ground-Fault Circuit-Interrupter Protection for Personnel	Understand the importance of installing GFCIs for all EV charging receptacles in order to protect personnel
625.56	Receptacle Enclosures	Understand the importance of supplying a weatherproof enclosure for all receptacles installed in wet locations
625.101	Grounding	Describe the use of a primary pad base plate of nonferrous material for use in grounding EVSE equipment
625.102	Installation	Describe the specifications for installation of the charger power converter and the primary pad, and the protection of the output cable

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