



# ELECTRIC VEHICLE FUNDAMENTALS (EVF)

BODY OF KNOWLEDGE



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# ELECTRIC VEHICLE FUNDAMENTALS

## BODY OF KNOWLEDGE 2023

Topics	Importance	Competency
<b>1. Manufacturing Foundations/Awareness</b>	<b>15%</b>	
1.1. General OSHA Standards/Regulations	High	Remember and Understand
1.1.1. Bloodborne Pathogens		
1.1.2. Fire and Safety		
1.1.3. Personal Protective Equipment (PPE)		
1.1.4. Lockout/Tagout		
1.1.5. Hazardous Materials		
1.1.6. Hazardous Material Handling		
1.1.7. Electrical Safety		
1.1.8. High Voltage Safety		
1.1.9. High Voltage Cables		
1.1.10. Safety Switch		
1.2. Measurement	Medium	Apply & Analyze
1.3. Print Reading	Medium	Apply & Analyze
1.4. Fluid Mechanics	Low	Remember and Understand
1.5. Mechanical Technologies	Medium	Remember and Understand
1.6. Direct Current Electricity	Medium	Apply & Analyze
1.6.1. Direct Current Properties		
1.7. Ohm Law	Medium	Apply & Analyze
1.7.1. Voltage		
1.7.2. Current		
1.7.3. Resistance		
1.8. Analytical Simulation, Methods and Techniques - Digital Twin	Low	Remember and Understand
1.9. Situational Awareness	Medium	Evaluate Problems & Create Solutions
1.10. Introduction to Industry 4.0 & SMART Manufacturing	Low	Remember and Understand
<b>2. Electric Vehicle Overview</b>	<b>20%</b>	
2.1. What are Electric Vehicles?	High	Apply & Analyze
2.1.1. Electric Vehicle (EV) vs. Internal Combustion Engine (ICE)		

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Topics	Importance	Competency
2.2. Types of Electric Vehicles	High	Remember and Understand
2.2.1. Battery Electric Vehicle (BEV)		
2.2.2. Plug-in Hybrid Electric Vehicle (PHEV)		
2.2.3. Hybrid Electric Vehicle (HEV)		
2.2.4. Fuel Cell Electric Vehicle (FCEV)		
<b>3. Components of Electric Vehicles</b>	<b>25%</b>	
3.1. Electrical Storage Systems	Medium	Remember and Understand
3.2. Battery Selection	Medium	Remember and Understand
3.2.1. Lithium-ion		
3.2.2. Lithium Polymer		
3.3. Battery Cells	Medium	Remember and Understand
3.3.1. Cylindrical Cells		
3.3.2. Prismatic Cells		
3.3.3. Pouch Cells		
3.4. Battery Management System (BMS)	Medium	Remember and Understand
3.4.1. Battery State Determination	Medium	Remember and Understand
3.4.1.1. User Interface		
3.4.1.2. Electrical Control		
3.4.1.3. Safety Protection		
3.5. Battery Monitoring	Medium	Apply & Analyze
3.5.1. Current		
3.5.2. Voltage		
3.5.3. Temperature		
3.5.4. Data Acquisition	Low	Remember and Understand
3.5.5. Safety Protection	High	Apply & Analyze

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Topics	Importance	Competency
3.5.6. Thermal Management	High	Apply & Analyze
3.6. EV Traction/Propulsion System	High	Remember and Understand
3.6.1. EV Motor		
3.6.2. Direct Current Motor		
3.6.3. Alternating Current Motor		
3.7. EV Speed and Power Controller	High	Remember and Understand
3.7.1. Electronics Controller		
3.7.2. Silicon-Controlled Rectifiers (SCR)		
3.8. EV Braking Systems	High	Remember and Understand
3.8.1. Regenerative Braking System		
3.8.2. Traditional Braking System		
3.9. EV Charging Station Components	Medium	Remember and Understand
3.9.1. Miniature Circuit Breakers (MCB)		
3.9.2. Residual Current Circuit Breakers		
3.9.3. Disconnect Switches		
3.9.4. Surge Protection Devices		
3.9.5. Contactors		
3.9.6. Energy Meters		
3.9.7. Terminal Blocks		
3.9.8. Wire Duct		
3.9.9. DIN Rail		
3.10. EV Charging Systems and Technology	Medium	Remember and Understand
3.10.1. Charge Port		
3.10.2. DC/DC Convertor		
3.10.3. Electric Traction Motor		
3.10.4. Onboard Charger		
3.10.5. Thermal System (Cooling)		
3.10.6. Transmission (Electric)		

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Topics	Importance	Competency
3.10.7. Full-Size Charger		
3.10.8. Portable Charger		
3.10.9. Level 1 Charging Station		
3.10.10. Level 2 Charging Station		
3.10.11. Level 3 Charging Station		
3.10.12. Wireless Charging Station		
<b>4. EV Manufacturing Processes</b>	<b>10%</b>	
4.1. Joining	Medium	Remember and Understand
4.2. Welding	Medium	Remember and Understand
4.3. Laser Welding Technology	Medium	Remember and Understand
4.4. Assembly	Medium	Remember and Understand
4.5. Automation	Medium	Remember and Understand
4.6. Paint/Spray Paint	Low	Remember and Understand
4.7. Finishing	Low	Remember and Understand
4.8. Adhesives	Medium	Remember and Understand
<b>5. Robotics</b>	<b>15%</b>	
5.1. Robot Types	Medium	Remember and Understand
5.1.1. Collaborative Robots (Cobots)		
5.1.2. Mobile/Autonomous Robots (Wheeled, Legged, Drones, etc.)		
5.1.3. Stationary Robots		
5.1.4. Selective Compliance Assembly Robot Arm (SCARA)		
5.1.5. Cartesian		
5.1.6. Cylindrical		
5.1.7. Spherical		
5.1.8. 6-Axis		
5.1.9. Articulated (or Serial) Robots		
5.1.10. Parallel Robot (Delta Robot)		
5.1.11. Pick & Place Robots		

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Topics	Importance	Competency
5.2. Types of Safety Devices & Barriers	High	Remember and Understand
5.2.1. Safety Barriers/Guards		
5.2.2. Interlocked Barrier Guard		
5.2.3. Presence-Sensing Devices		
5.2.4. Sensor Arms		
5.2.5. Pressure Mat		
5.2.6. Alarms		
5.2.7. e-stops		
5.2.8. Light Curtain		
5.3. Ergonomics	Medium	Remember and Understand
5.4. Pinch Points	Medium	Remember and Understand
5.5. Robot Safety Guidelines & Standards Awareness (OSHA, ANSI/RIA, ISO, UL, IEC, NIOSH)	High	Remember and Understand
5.5.1. Process Safety (Avoidance)	High	Remember and Understand
5.5.2. Types of Accidents Caused by Robots	High	Remember and Understand
5.5.2.1. Impact/Collision		
5.5.2.2. Trapping		
5.5.2.3. Crushing		
5.5.2.4. Equipment		
5.5.3. Cobot vs. Industrial Robot Safety Considerations	High	Remember and Understand
<b>6. Additive Manufacturing</b>	<b>5%</b>	
6.1. Overview of Additive Manufacturing	Low	Remember and Understand
6.2. Basic Additive Manufacturing Processes	Low	Remember and Understand
6.3. Materials used in Additive Manufacturing	Low	Remember and Understand
6.4. Advantages and Disadvantages in Additive Manufacturing	Low	Remember and Understand
6.5. Uses of Additive Manufacturing	Low	Remember and Understand

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Topics	Importance	Competency
6.6. Additive Manufacturing Safety	Low	Remember and Understand
<b>7. Lean Manufacturing</b>	<b>2.5%</b>	
7.1. Lean Manufacturing Overview	Medium	Remember and Understand
7.1.1. 5S Principles (Sort, Set in Order, Sweep, Standardize, Sustain)		
7.1.2. Basic Lean Principles and Lean Terminology		
7.1.3. Seven Forms of Waste		
7.1.4. Value-Added		
7.1.5. Push and Pull Systems		
7.1.6. Continuous Improvement		
<b>8. Quality</b>	<b>2.5%</b>	
8.1. Total Quality Management (TQM)	Medium	Remember and Understand
8.2. Quality Management Systems (QMS)	Medium	Remember and Understand
8.3. Quality Standards (e.g. QS, ISO, etc.)	Medium	Remember and Understand
8.4. Metrology	Medium	Remember and Understand
8.5. Inspection, Test and Validation	Medium	Remember and Understand
8.5.1. Defect Inspections		
8.5.2. Non-Destructive Testing		
8.5.3. Vision Inspection System		
8.5.4. Validation & Compliance		
8.5.5. Secondary Processes		
<b>9. Essential Skills</b>	<b>5%</b>	
9.1. Effective Communication	Medium	Remember and Understand
9.2. Working in Teams	Medium	Remember and Understand
9.3. Collaboration	Medium	Remember and Understand
9.4. Managing Conflict	Medium	Remember and Understand
9.5. Workforce Diversity	Medium	Remember and Understand
9.6. Ethics	Medium	Remember and Understand