Advanced Electricity and Electronics Performance Assessment

The **Cert*TEC* Advanced Electricity and Electronics Performance Assessment** (AEE) challenges the candidate to demonstrate their skills and knowledge in measuring, analyzing, and troubleshooting DC, AC, analog and digital electronic circuits. The candidates are presented live electronic circuits that emulate circuits found in industrial applications. Each circuit is capable of providing numerous scenarios, signal levels, and faulted conditions. Successful candidates correctly measure electronic parameters at various test points, follow normal circuit signal flow, and identify faults as they are presented in the circuit. Each discipline; DC, AC, analog, and digital electronics, utilize 3 assessment circuit cards that offer progressively more complex circuits as the candidate progresses from the beginning of the assessment to the to the end. A trainer base unit, common to all the assessment circuit cards, provides power, circuit protection, and non-destructive faulting to the circuit cards.

The full basic electrical and electronics performance assessment is segmented into four distinct sections; DC, AC, Analog and Digital. The four sections can be challenged individually or all at one time. A candidate successfully completing any section of the full AEE assessment program has earned the certification for that section. The following assessment points are common to all performance assessment sections.

- Follow specific instructions
- Demonstrate knowledge of electronics fundamental laws
- Properly use electronic test equipment
- Measure circuit values and compare them to calculated circuit values
- Recognize when an electronic circuit is faulty
- Identify faulty components or elements of a circuit

Details of the four sections of the Advanced Electricity and Electronics (AEE) Performance Assessment are as follows.

Direct Current Performance Assessment – The DC performance assessment is divided into three elements; DC-1, DC-2 and DC-3. Paramount to successfully completing each part, the candidate must demonstrate skills and knowledge in using a common multimeter, measuring voltage, current and resistance values, and recognizing the proper operation of common DC circuits.

> DC-1 Performance Assessment – The DC-1 performance assessment requires the candidate to successfully measure voltage, resistance, and current values in a simple series circuit. To demonstrate this skill, the candidate performs calculations for the DC circuit and then performs measurements to confirm the calculations. The candidate will require a working knowledge of Ohm's Law to successfully evaluate whether the calculations support the measured values.

DC-2 Performance Assessment – The DC-2 performance assessment challenges the candidate's ability to troubleshoot series, parallel, and series-parallel circuits. The assessment card contains two series resistance circuits, one parallel resistance circuit and two series-parallel resistance circuits. Candidates use a multimeter to measure a circuit's resistance, current, and voltage. To determine correct circuit performance, candidates use Ohm's Law and their knowledge of circuit values in series, parallel, and series-parallel circuits to compare measured values to calculated values. Faults are randomly inserted into the circuit based on specific scenarios provided to the candidate. Although the complexity level of the fault will be standard throughout this performance assessment; the candidate could potentially receive one of dozens of faults for each series, parallel, and series-parallel circuit.

DC-3 Performance Assessment – The DC-3 performance assessment requires the candidate to diagnose and troubleshoot complex DC circuits including loaded voltage dividers, bridge circuits and complex series-parallel circuits. The candidates are presented with a scenario related to one of 13 different circuit configurations. There are 20 scenarios available to challenge the candidate. The candidate must use their skills and knowledge to identify if a circuit is faulted, correctly measure circuit parameters, and troubleshoot the circuit. This performance assessment allows the candidate to fully power down the circuit for resistance measurements; a critical step when troubleshooting some of the scenarios.

Alternating Current Performance Assessment – The AC performance assessment is divided into three elements; AC-1, AC-2 and AC-3. To successfully complete each element, the candidate must demonstrate skills and knowledge in using a multimeter, oscilloscope, and function generator. The candidate must be able to measure voltage, current and resistance in AC circuits and identify faults in common AC circuits.

AC-1 Performance Assessment – The AC-1 performance assessment requires the candidate to measure voltages and identify faults in step-up, step-down, and isolation transformers. Candidates will be presented with four transformers in various configurations. The candidate will identify each type of transformer and determine whether the transformer is operating correctly. When faulted, the candidates must determine if a transformer's windings are open or shorted.

AC-2 Performance Assessment – The AC-2 performance assessment challenges the candidate's ability to identify and troubleshoot RC, RL, and RLC circuits. Candidates will evaluate circuit phase relationships; measure circuit frequency, amplitude, and phase; troubleshoot frequency-sensitive AC circuits; and identify defective components in an AC circuit. The AC-2 assessment card contains two RC series circuits, two RL series circuits, and three RLC series circuits. Properly setting up test equipment to measure AC circuit parameters is essential for successfully completing this element of the AC performance assessment.

AC-3 Performance Assessment – The AC-3 performance assessment requires the candidate to demonstrate the skills and knowledge to identify and troubleshoot complex AC circuits. The AC-3 card contains six RC series circuits and four RL series circuits that can be configured as timing

circuits and filter circuits. Filter circuit configurations include low pass and high pass filters. Candidates are presented with scenarios and determine the proper circuit outputs. Faults are introduced into the scenario circuit to challenge the candidate's troubleshooting skills using AC test equipment.

Analog Performance Assessment – The Analog Performance Assessment is divided into three elements; A-1, A-2 and A-3. To successfully complete each element, the candidate must demonstrate skills and knowledge in using a multimeter and oscilloscope. The candidate must be able to identify analog circuit types, measure analog circuit values, and identify faults in common analog circuits.

A-1 Performance Assessment – The A-1 performance assessment challenges the candidate to troubleshoot a simple discrete power supply. The A-1 assessment card contains a full-wave bridge rectifier circuit and a NPN series transistor regulator. Candidates must identify signals, follow signal flow through the circuit, and identify faulty components and outputs. Candidates will use their knowledge of power supplies and analog circuit performance to successfully troubleshoot the fault scenarios.

A-2 Performance Assessment – The A-2 performance assessment requires the candidate to demonstrate their knowledge and skills in troubleshooting MOSFET, IGBT, and SCR switching circuits. The A-2 assessment card has two primary output circuits, using the IGBT or the SCR, to drive a DC electric motor. The MOSFET is used to trigger the SCR or provide input to a Pulse Width Modulator (PWM) circuit. The candidate must be able to safely implement circuit operating procedures with a multimeter and an oscilloscope to verify proper operation and successfully troubleshoot various solid state switching circuits.

A-3 Performance Assessment – The A-3 assessment requires the candidate to measure DC voltages and trace AC signals to identify faults in amplifier circuits containing BJT, JFET, and Op-Amp solid state devices. The A-3 circuit card also uses a 555 integrated circuit and a waveshaping RC network to create a fixed-frequency sine-wave oscillator. Skills and knowledge of signal tracing techniques on cascaded amplifier circuits is necessary to successfully complete this assessment element.

Digital Performance Assessment – The Digital Performance Assessment is divided into three elements; D-1, D-2 and D-3. To successfully complete each element, the candidate must demonstrate skills and knowledge in using a multimeter, oscilloscope, and logic probe. The candidate must be able to identify digital logic circuit types, measure digital inputs and outputs, and identify faults in common digital logic circuits.

D-1 Performance Assessment – The D-1 performance assessment tests the candidate's ability to measure the outputs and troubleshoot simple digital logic gates. Candidates are presented with

nine digital gates making up a logic array. The array has LED indicators at the inputs and LED indicators at the three digital outputs. To successfully complete this element the candidates must have a working knowledge of truth tables and logic gate troubleshooting. Candidates can use a multimeter, oscilloscope, or logic probe to test the logic gates.

D-2 Performance Assessment – The D-2 performance assessment requires the candidate to demonstrate skill and knowledge in assessing and troubleshooting digital timers and flip-flop circuits. As a building block of digital counters, arithmetic, and memory circuits; the flip-flops presented on the D-2 assessment card represent the more common flip-flops found in digital electronics. The candidate must be familiar with 555 timers, identify clock frequencies, adjust timing circuitry, and troubleshoot D-type and JK flip-flops to successfully complete this element. Circuit faults are inserted into the circuits to challenge the candidate's ability to troubleshoot simple digital circuits.

D-3 Performance Assessment – The D-3 performance assessment challenges the candidate to troubleshoot decade counters and a BCD-to-7 segment display. The D-3 circuit card contains a digital decade counter with preset inputs, a BCD-to-7 segment display driver, a digital pulse generator, and a 7-segment display. This common digital circuit requires the candidate to follow a logic signal through the circuit to determine the proper operation of the display output. An understanding of binary number systems, binary coded decimal, and pulse generator operation is required to successfully complete this element. Once the candidate has established that the circuit is working properly, faults are introduced to challenge the candidate's troubleshooting skills.