



Study Guide
for
INSTRUMENT CONTROL
& ELECTRICIAN
TECHNICIAN TEST

Test No. 2178

Human Resources
Talent & Assessment Programs
Southern California Edison
An Edison International Company

Introduction

The 2178 Instrument Control and Electrician (ICE) Technician Test is a job knowledge test designed to cover the major knowledge areas necessary to perform the job. This Guide contains strategies to use for taking tests and a study outline, which includes knowledge categories, major job activities, and study references.

Test Session

It is important that you follow the directions of the Test Administrator exactly. If you have any questions about the testing session, be sure to ask the Test Administrator before the testing begins. During testing, you may **NOT** leave the room, talk, smoke, eat, or drink. Since some tests take several hours, you should consider these factors before the test begins.

All cellular/mobile phones, pagers or other electronic equipment will NOT be allowed in the testing area.

All questions on this test are multiple-choice or hot spot questions. Multiple choice questions have four possible answers. Hot spot questions have a picture, and you must click the correct spot on the picture to answer the question. All knowledge tests will be taken on the computer. For more information on this, please see the next section of this study guide on *Computer Based Testing*.

The test has a three hour time limit. A non-programmable scientific calculator will be provided for you to use during the test. The calculator provided during the test session will be:

- Texas Instruments TI-36X

You will NOT be able to bring or use your own calculator during testing.

You will receive a Test Comment form so that you can make comments about test questions. Write any comments you have and turn it in with your test when you are done.

Study Guide Feedback

At the end of this Guide you have been provided with a Study Guide Feedback page. If a procedure or policy has changed, making any part of this Guide incorrect, your feedback would be appreciated so that corrections can be made.

Computer Based Testing

Taking an SCE knowledge test on the computer is simple. You do not need any computer experience or typing skills. You will only use the keyboard to enter your candidate ID and password. You'll answer all questions by pressing a single button on the mouse.

Log in Screen

You will be seated at a testing station. When you are seated, the computer will prompt you to enter the candidate ID and password you received in your invitation e-mail. You **MUST** have your candidate ID and password or you will be unable to take the test. Once you have confirmed your identity by entering this information, you will see a list of tests available to you.

Sample/Tutorial

Before you start your actual test, a Sample/Tutorial Test is provided to help you become familiar with the computer and the mouse. From the list of exams that appear when you complete the log in, you will select Sample/Tutorial. You will have up to 10 minutes to take the Sample/Tutorial Test. The time you spend on this Sample Test does **NOT** count toward your examination time. Sample questions are included so that you may practice answering questions. In the Sample/Tutorial Test, you will get feedback on your answers. You will not receive feedback on your actual test.

Example

During the test, you may see several different types of items. Many of the questions will be multiple choice items. A few items will be pictures, where you'll have to click the spot on the picture that answers the question. Those picture questions are known as "Hot Spot" questions. More information on each type is below.

Overall Test Information

- When you begin the test, you can see the total time allowed for completion displayed at the top of the screen. You can scroll up to see that information at any time during the test.
- You can change your answers at any time during the test until the time runs out, or you click the "Submit" button. Once you click Submit, you can not change your answers.

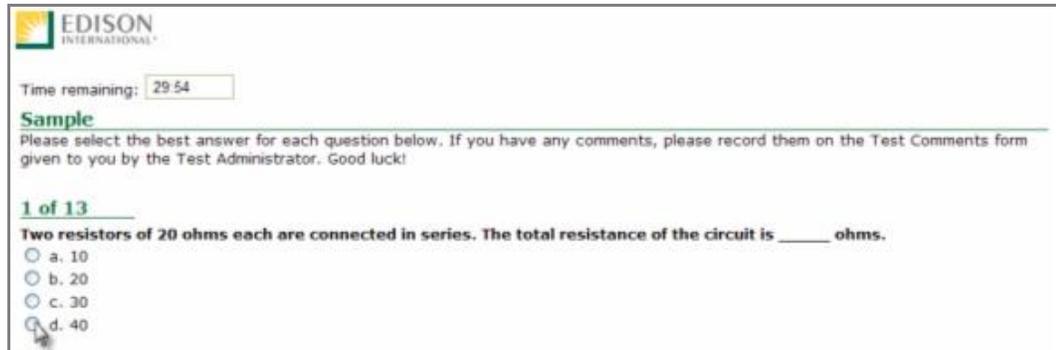


Multiple Choice Questions

To answer each multiple choice question, you should move the mouse pointer over the circle (radio button) next to the answer of your choice, and click the left mouse button.

A sample is shown below:

1. In order to answer each question, first read the question and determine the response that best answers the question. Put the mouse pointer directly over the circle corresponding to that response.



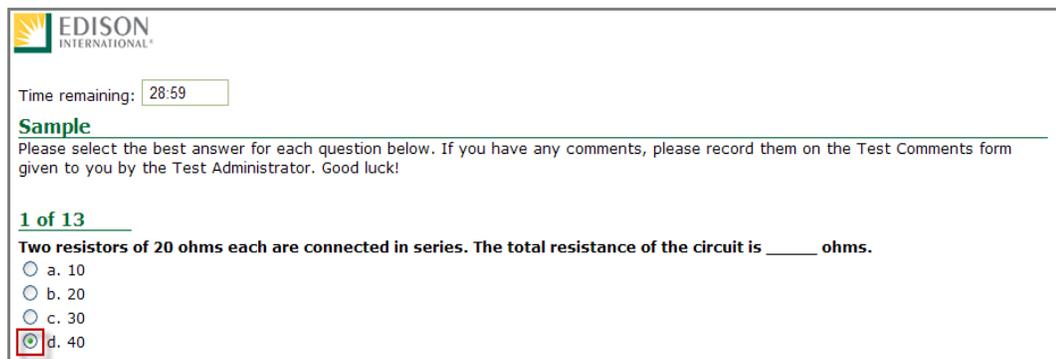
The screenshot shows the Edison International logo at the top left. Below it is a timer showing "Time remaining: 29:54". A section titled "Sample" contains the instruction: "Please select the best answer for each question below. If you have any comments, please record them on the Test Comments form given to you by the Test Administrator. Good luck!". Below this is the question number "1 of 13" and the question text: "Two resistors of 20 ohms each are connected in series. The total resistance of the circuit is ____ ohms." There are four radio button options: a. 10, b. 20, c. 30, and d. 40. A mouse cursor is hovering over the radio button for option d.

2. While the pointer is over the circle corresponding to the best answer, click the left mouse button.



Click the left button when the pointer icon is over your answer choice.

3. The answer you selected should now have a green dot in the circle. If you need to select an alternate answer, simply move the pointer over that circle, and click again.



This screenshot is identical to the previous one, but now the radio button for option d. 40 has a green dot inside it, indicating it has been selected. The timer now shows "Time remaining: 28:59".

Hot Spot Questions

To answer each Hot Spot question, you should move the mouse pointer over the part of the image that best answers the question, and click the left mouse button. You will see a pointer appear in that spot. If you want to change your answer, simply move the mouse pointer to a new area on the picture and click again. The pointer will move to the new spot.

A sample is shown below:

1. In order to answer each question, first read the question and determine the place on the image that best answers the question. The pointer that will indicate your answer can always be seen in the bottom left of the image. It looks like this:



Put the mouse pointer directly over the spot on the image you want to select, and click the left mouse button.

1 of 8

On the screen below, where would you click to find out how much vacation time you have left?

About Me

Welcome to the "About Me" section

"About Me" has information about your benefits, programs that help you in your work and/or home life and more. Click on the links below to access the various areas.

Pointer starts out at the bottom left of the image.

About Me Map

	Overview An Overview of what's contained in this section of the Portal		Career & Jobs Find out about career information and opportunities at Edison International.
	Pay Find information about base pay, job descriptions, Results Sharing, and recognition awards here.		Time & Attendance Use this section to complete and submit your timesheet for approval, or to view your time-off balances and time

Place the mouse pointer on the spot you want to select, then click on the left button.

2. The pointer will move from the bottom left of the image and appear over the spot you selected.

1 of 8

On the screen below, where would you click to find out how much vacation time you have left?

About Me



Welcome to the "About Me" section

"About Me" has information about your benefits, programs that help you in your work and/or home life and more. Click on the links below to access the various areas.

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	Pay Find information about base pay, job descriptions, Results Sharing, and recognition awards here.		Time & Attendance Use this section to complete and submit your timesheet for approval, or to view your time-off balances and time

The pointer now appears over the correct answer.

3. To change your answer, simply move the mouse pointer to the new spot, and click again. The pointer graphic will move to the new spot you've selected. In order for your answer to be considered correct, the center of the pointer (•) must be over the correct spot on the graphic.

Test Taking Strategies

Introduction

The 2178 Instrument Control and Electrician (ICE) Test contains multiple-choice questions and may also contain hot spot questions. The purpose of this section is to help you to identify some special features of a multiple-choice test and to suggest techniques for you to use when taking one.

Your emotional and physical state during the test may determine whether you are prepared to do your best. The following list provides common sense techniques you can use before the test begins.

Technique	Remarks
<i>Be confident</i>	<ul style="list-style-type: none">- If you feel confident about passing the test, you may lose some of your anxiety.- Think of the test as a way of demonstrating how much you know, the skills you can apply, the problems you can solve, and your good judgment capabilities.
<i>Be punctual</i>	<ul style="list-style-type: none">- Arrive early enough to feel relaxed and comfortable before the test begins.
<i>Concentrate</i>	<ul style="list-style-type: none">- Try to block out all distractions and concentrate only on the test. You will not only finish faster but you will reduce your chances of making careless mistakes.- If possible, select a seat away from others who might be distracting.- If lighting in the room is poor, sit under a light fixture.- If the test room becomes noisy or there are other distractions or irregularities, mention them to the Test Administrator immediately.
<i>Budget your times</i>	<ul style="list-style-type: none">- Pace yourself carefully to ensure that you will have enough time to complete all items and review your answers.
<i>Read critically</i>	<ul style="list-style-type: none">- Read all directions and questions carefully.

- Even though the first or second answer choice looks good, be sure to read all the choices before selecting your answer.
- Make educated guesses*
 - Make an educated guess if you do not know the answer or if you are unsure of it.
- Changing answers*
 - If you need to change an answer when testing on a computer, be sure that the new answer is selected instead of the old one.
- Return to difficult questions*
 - If particular questions seem difficult to understand, make a note of them, continue with the test and return to them later.
- Double-check math calculations*
 - Use scratch paper to double check your mathematical calculations.
- Review*
 - If time permits, review your answers.
 - Do the questions you skipped previously.
 - When testing on a computer, make sure each multiple choice question has a dot next to the correct answer.

Remember the techniques described in this section are only suggestions. You should follow the test taking methods that work best for you.

Job Knowledge Categories

Below are the major job knowledge areas (topics) covered on the 2178 Instrument Control and Electrician (ICE) Technician Test and the associated study references. Listed next to each knowledge category is the number of items on the exam that will measure that topic. You can use this information to guide your studying. Some exams also contain additional pretest items. Pretest items will appear just like all of the other items on your exam, but they will not affect your score. They are an essential part of ensuring the 2178 Instrument Control and Electrician test remains relevant to successful performance of the job.

There are a total of 88 items on the 2178 Instrument Control and Electrician Technician Test and the passing score is 70%.

A. Electrical Theory and Practice (18 items)

Includes knowledge of AC and DC theory, Ohm's Law, series and parallel circuits, inductance, capacitance, three-phase power, AC and DC motors, and electrical terminology. Knowledge of power generation including generator excitation, standard electrical symbols, and abbreviations used in electrical drawings such as single lines, schematics, elementaries, and wiring diagrams. Knowledge of transformer theory, relay protection, switchgear, and motor control center. Ability to read and apply diagram information.

B. Instrument Theory and Practice (9 items)

Includes knowledge of the types and methods of measurement and control of flow, pressure, level, and temperature. Knowledge of strategies of control dynamics, such as PID (Proportional, Integral and Derivative) loops. Knowledge of how to test, troubleshoot, repair, and maintain instrumentation equipment.

C. Safety (10 items)

Includes knowledge of electrical safety procedures and precautions as specified by Cal OSHA and the National Electric Code (NEC). Knowledge of how to install electrical, instrumentation, and control equipment following regulatory processes and safety standards and procedures. Knowledge of how to test, troubleshoot, repair, and maintain control equipment following safety processes and procedures. Knowledge of work authorization, including lock out tag out (LOTO). Knowledge of the use of high voltage safety equipment, hazardous material safety equipment, and personal protection equipment (PPE).

D. Electronics (7 of items)

Includes knowledge of basic electronic theory, circuitry, electronic symbols, solid state theory, diodes, transistors, and AC/DC voltage regulators.

E. Test Equipment (15 of items)

Includes knowledge of the proper use of various test instruments, such as multimeters, meggers, ductors, oscilloscopes, handheld communicators, high voltage meters, ammeters, and manometers. Knowledge of the purpose of the tests applied, why it is appropriate, and the accuracy requirements. Knowledge of test tolerances. Knowledge of test and calibration requirements and how to interpret test and calibration results.

F. Physics and Chemistry (4 items)

Knowledge of applied physics, including fluids, gasses, dynamic forces of levers, pneumatics, and hydraulics. Knowledge of basic chemistry as it applies to chemical measurement and control used in water treatment. Knowledge of chemical and physical properties of instrumentation applications.

G. Instrument/Electrical Maintenance and Installation (17 of items)

Includes knowledge of installation, maintenance, and repair of batteries. Knowledge of how to perform (install, repair, maintain) low voltage wiring. Knowledge of how to perform conduit installation based upon the National Electric Code (NEC). Knowledge of how to perform connection practices and how to install and repair communication wiring. Knowledge of the types and applications of hand tools used in the instrumentation field and of power tools (e.g., drill motors, conduit benders, etc.). Knowledge of standard installation practices of flow instrumentation, pressure instrumentation, level instrumentation, temperature sensors and transducers, final control elements (e.g., valves, dampers), and tubing installations. Knowledge of logical applications of troubleshooting instrument problems using electrical drawings and Piping & Instrument Diagrams (P&ID). Knowledge of logical applications of troubleshooting instrument problems using electrical drawings. Knowledge of variable frequency drive (VFDs). Knowledge of soft start motor controls.

H. Math (4 items)

Includes knowledge of algebra, geometry, and trigonometry. Ability to apply mathematical formulas to job related problems.

I. Controls/Programming (4 items)

Includes knowledge of programmable logic controllers (PLC) and associated equipment, such as HMI screen, router, power supply, UPS, etc.

Study References

A. Electrical Theory and Practice

Electricity One-Seven, 3rd Edition, by Harry Mileaf.

Delmar Standard Textbook of Electricity, 4th Edition.

B. Instrument Theory and Practice

Programmable Logic Controllers, by W. Bolton.

Instrumentation 4th ed, by F, Kirk, T Weedon, P Kirk (2005).

Measurement and Control Basics, 3rd Edition, by T.A. Hughes.

C. Safety

2011 National Electric Code.

Federal OSHA Standards, 29CFR, Sections 1910.137, 1910.331 to 1910.335, &1926.957. www.OSHA.gov.us.

D. Electronics

Electronics Principles, 8th Edition, by Albert P Malvino.

Electricity One-Seven, 3rd Edition, by Harry Mileaf.

E. Test Equipment

Electricity One-Seven, 3rd Edition, by Harry Mileaf.

Measurement and Control Basics, 3rd Edition, by T.A. Hughes.

Instrumentation 4th ed, by F, Kirk, T Weedon, P Kirk (2005).

2011 National Electric Code.

F. Physics and Chemistry

Electricity One-Seven, 3rd Edition, by Harry Mileaf.

Instrumentation 4th ed, by F, Kirk, T Weedon, P Kirk (2005).

G. Instrument/Electrical Maintenance and Installation

Electricity One-Seven, 3rd Edition, by Harry Mileaf.

Electronics Principles, 8th Edition, by Albert P Malvino.

2011 National Electric Code.

Instrumentation 4th ed, by F, Kirk, T Weedon, P Kirk (2005).

Soft Starter Bypass Technology in Smart Motor Controllers, by Bernhardt, William & Anderson, Richard, Rockwell Automation.

<http://www.csanyigroup.com/download/knowledge/ansi-ieee-device-numbers>

H. Math

Math The Easy Way, 3rd Edition, by Prindle & Prindle.

Trigonometry The Easy Way, 3rd Edition, by Douglas Downing.

I. Controls/Programming

Programmable Logic Controllers, by W. Bolton.

Instrumentation 4th ed, by F, Kirk, T Weedon, P Kirk (2005).

Study Guide Feedback

Please use this page to notify us of any changes in policies, procedures, or materials affecting this guide. Once completed, return to:

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Rosemead, CA 91770

Test Name: 2178 Instrument Control and Electrician (ICE) Technician Test

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