

**EVALUATING
ACADEMIC READINESS
FOR APPRENTICESHIP TRAINING**
Revised for
ACCESS TO APPRENTICESHIP

**COMMUNICATIONS SKILLS
EVALUATION OF INFORMATION**

AN ACADEMIC SKILLS MANUAL
for
The Construction Trades: Mechanical Systems

This trade group includes the following trades:
Electrician, Network Cabling, Painter & Decorator,
Plumber, Steamfitter, Sprinkler & Fire Protection, and
Refrigeration/Air Conditioning

*Workplace Support Services Branch
Ontario Ministry of Training, Colleges and Universities*

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In preparing these Academic Skills Manuals, we have used passages, diagrams and questions similar to those an apprentice might find in a text, guide or trade manual.

This trade related material is not intended to instruct you in your trade. It is used only to demonstrate how understanding an academic skill will help you find and use the information you need.

COMMUNICATIONS SKILLS

EVALUATION OF INFORMATION

*An academic skill required for the study of the
Construction Trades: Mechanical Systems*

INTRODUCTION

Evaluation of information means careful consideration of information in order to make a judgment about its purpose, meaning, or accuracy. We evaluate information to understand and solve a problem, to plan a job, or to choose a material, a tool or a method to do a job. As you learn your trade, and as you work, you will use this skill to make the best possible decisions about how to use information.

In order to make the best choices you need the best information. During training, and on the job, you will have many sources of information including textbooks, manuals, tables, diagrams as well as your teachers, supervisors and co-workers. You will decide if the information you have been given is accurate, or if it is just someone's opinion. And, you will decide how to use that information.

You also evaluate information to help you make decisions as you proceed. For example, you might evaluate where you went wrong in the case of a problem or you might identify the most efficient use of materials to minimize waste.

In this unit, we will examine evaluation of information under the following headings:

- ◆ Getting the right information
- ◆ Selecting relevant information
- ◆ Cause and effect
- ◆ Fact and opinion

PART I

GETTING THE RIGHT INFORMATION

In order to work through a project in an organized and effective way, you need to assess or *evaluate* the steps required to successfully reach your goal. Start by thinking about and planning the whole project before you begin any work.

Example: You have a job to complete. You need to plan how you will proceed from the beginning of the job through to the end. Identifying safety or problem areas is probably a good first step. Next, you have to organize information, tools, materials, and equipment. Once you have all of the information, make a list in your head or on paper of how to proceed with the job. Now you are ready to actually start working.

Approach your work systematically. The first step in a systematic approach is to *evaluate* your situation. Size up the job to identify safety or problem areas. Next, organize the information, tools, materials, and equipment. The goal is to think about and plan the project *before you begin*.

The Right Information

Once your purpose is clear, you can gather the right information from the right texts and manuals, manufacturers' guides and suppliers. Just choose the table or text that applies to the job.

Examples:

If you work in Ontario, you need Ontario's codes.

If you work with metric tools, follow the guides for the metric system - not the Imperial or U.S. system.

Making evaluated choices

When you have found information that seems relevant, you have to evaluate whether it is exactly what you need.

Example: Workplaces are supplied with safety equipment such as fire extinguishers. The choice of safety equipment is based on evaluating your working conditions and matching the equipment to the situation. To determine the class or type of fire extinguisher needed on the work site, you need to know information such as:

- the square footage of the work area,
- the presence of heat, combustibles, flammable products, chemicals, liquids, gases, etc. and
- legal requirements such as up to date regulations and fire and safety codes for your jurisdiction (your city, county or province).

Next you need information on types or classes of fire extinguishers such as the following:

- size,
- discharge times,
- approximate range of extinguisher, and
- the types of extinguisher used for different types of fire.

Now you can evaluate the situation and make a decision as to which types of fire extinguishers are required.

The right choice is based on an evaluation of all the information gathered.

General steps used in making sound decisions include:

1. evaluate the situation,
2. get up-to-date information,
3. make sure you understand the information, and,
4. use it to make your decision

Passage 1 below might be used for troubleshooting a problem with an air conditioning system. It describes a device (solid-state module) and how it works. Figure 1 is a schematic diagram which shows, in a simplified way, the electrical wiring.

Read the passage as if you were troubleshooting a problem with the system. Several areas of this passage will require you to make evaluations. We will examine them at the end of the passage.

Passage 1 Solid-State Devices

A solid-state defrost control module is used to start and stop the defrost cycle of a heat pump. Defrost control keeps the outdoor coil of the pump clear of frost resulting in greater unit efficiency. Figure 1 shows a schematic of a defrost module with DC relay and two thermistors. The DC relay stops the outdoor fan motor and energizes the reversing valve. When the reversing valve is energized, the refrigerant cycle runs in the cooling mode of operation and defrosts the outdoor coil.

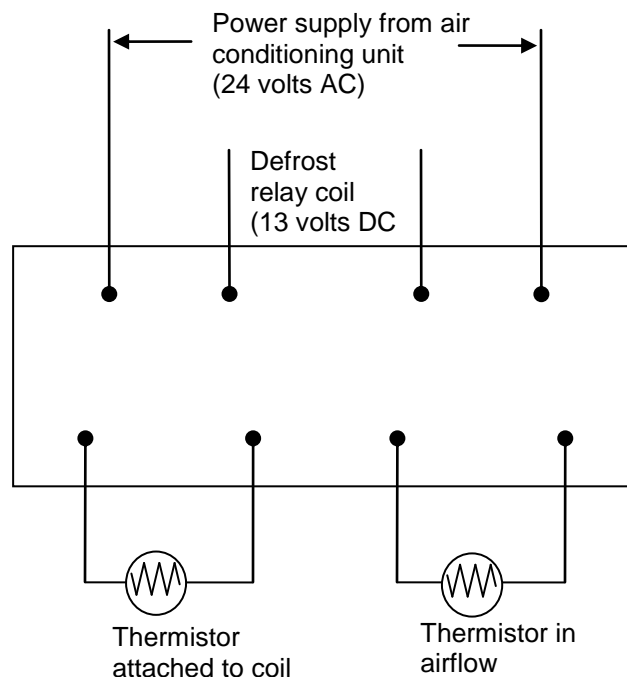


FIGURE 1: Schematic Diagram Of Wiring For A Solid State Defrost Module

Observe the eight connections shown. To troubleshoot the defrost system, examine how the module should operate and compare this to what is actually happening.

The thermistors sense the temperature of the outdoor coil and of the air temperature across the coil. If coil temperature falls below -1°C (30°F), the module feeds 18 volts DC to the defrost relay which energizes it, thus putting the unit in the cooling mode. Once the coil is defrosted, the air temperature crossing the coil and thus the coil temperature are high enough to bring the unit out of defrost cycle. It will put the unit back to the heating mode.

Paragraph one explains:

- what a solid-state defrost control module is for,
- why it is needed, and
- how it does this:

Figure 1 adds a simple diagram to show the wiring connections, power source and devices so you have a picture of how the module operates.

Paragraph two explains.

- *how* and *when* the system initiates and stops a cycle:
- *how* the device returns the system to operating mode.

Evaluation

Passage one describes a system and how it works. If there is a problem with any system, you will need a complete understanding of the situation: how something is supposed to work, what isn't working the way it's supposed to and a method for fixing it. An description such as this will guide you as you evaluate the problem and look for a solution. You will need all the relevant information so your evaluation is thorough whether you decide if a repair or a replacement is necessary.

When you understand what *should* be happening, you can recognize what *isn't* happening. You can evaluate the situation and the various devices. To evaluate each aspect of this system, you ask questions and cover all possibilities.

- What is happening now?
- What is supposed to be happening?
- What things control this operation?
- What things could be faulty?
- Which one is it?

You need to evaluate the importance of written material as you read it. The information refers to something that is part of the job you are doing; it is necessary and important to determine how to use it. The skill of evaluating includes figuring out what information is doing for you.

Example: Passage 1 explains aspects of the solid-state defrost control modules, and it does a bit more.

- It directs you to a diagram (Figure 1) and tells you what to look at;
- it tells you what various devices do; and
- It tells you the sequence of events in the system.

To evaluate *how*, *when* or *whether* to use any information, you really have to read **everything** available to you. For example, did you read the information following Figure 1 at the bottom of the diagram? If not, read it now. In addition to providing a picture, the diagram may also direct your task in some way.

Any note at the bottom of a diagram, chart or table provide more details. Read all notes and decide how or if they apply to your task so you have all the details. You may be directed to other sources to get the complete picture.

Examples: You need to follow up when you see notes like this:

Note: *Manufacturer's Guide which accompanies this appliance, Section II*

Important! *For complete information, consult the Machinist Guide.*

Generally, if you are aware of what to watch for, you can be prepared to react to correct any problems when they start to happen. You will evaluate your work as proceed.

When you are learning your trade, you will look for instructions from texts and advice from instructors or experienced workers. You practice a skill, evaluate the results, and practice again, until you are satisfied with the result.

Learning one step at a time

Using explanations such as those in Passage 1 reminds us that it is important to assess or evaluate our skill, experience and knowledge as we carry out any task. The quality of the end product, depends on the technician's skill, experience and knowledge about how a material behaves or how a tool is used.

Evaluation of your understanding as you learn and then practice new skills is important. You assess how well you know theory or the sequence of a skill and then assess your practice of the skill to ensure that you understand and can carry out a task using the skill.

This is a gradual learning process, of – study – evaluate – practice – evaluate. It takes time but the results will be worthwhile. It is the step by step learning that all skilled trades people go through.

In Brief

You evaluate any task as you make decisions about how to handle it. The evaluation includes, but is not limited to, the following:

- the purpose of the task,
- the understanding of each factor affecting the task,
- the manufacturers' recommendations,
- where to find complete information, and
- your own skill and knowledge.

Following up

When information leaves you with one or two unanswered questions, you need to search for answers.

Example: You read this:

The experience of the welder often has a bearing on the size of the electrode. In particular, for out-of-position welding, the welder's skill determines the size of the molten pool that he/she can control.

Now you need to know, how is the size of the molten pool controlled? Finding the answer should lead you to the right sources to find out what controls molten pool size.

When you look for answers to questions, you accomplish two things:

- 1) You do the job you've been hired to do with the right tools, equipment and metals.
- 2) You develop your research skills which increases your knowledge of the trade.

You may get information that tells you that you need to evaluate your experience and /or be prepared to try, or to try again.

Example:

It is easy to operate the slip-roll forming machine but difficult to produce well formed rolls – that is, unless the operator is experienced. Experiment to determine how to set the rolls to form so you achieve the required curvature.

You may need to evaluate how information applies to you, you have to evaluate what you know.

Example:

In many cases, the weld timing can be left to the discretion of the operator.

Consider: When can I use my judgment instead of a guideline?

Observing What's Important

Evaluating information means being observant. Trade materials use a variety of methods to emphasize important information. You may see words such as **NOTE:** or **Caution.** You may see boxed information, different sizes or types of print, or symbols such as ►, !, or ▪. *These are signals* used to catch your attention so you read the information that comes next carefully.

Use the signals to make sure you observe all essential points or steps. Look over the material first to note the **highlighted information**. Signals give advance warning about an important safety issue or an essential procedure. Reread these points and make sure you follow any instructions.

Examples:

- ◆ **Learn the technique for this *before* attempting the procedure. Serious burns can result.**

WARNING: An ungrounded power tool can kill you.

Never use an air tool to blow off dust or dirt from clothes. Compressed air can enter the skin and bloodstream with disastrous results.

The ♦, **bold print**, CAPITAL LETTERS, **coloured type**, and box make information stand out. Pay attention! The information is designed to keep you safe and your materials in good shape.

PART II

SELECT RELEVANT INFORMATION

As you read and become familiar with technical information, your ability to identify and select the right information improves:

- ♦ You distinguish between general rules that apply to most situations and unique situations where you have to figure out the best way to proceed.
- ♦ You notice that patterns and principles you use today on the job also can apply to future situations.
- ♦ You see the *relevance* of information you come across.

Charts and tables

Charts and tables give you quick information. They are designed to be orderly, simplified, and usually in a list format. You can see all the information and select what fits your situation.

Tables can guide you in any of the following:

- troubleshooting guides for causes and solutions to problems,
- system standards,
- appropriate test tools,
- material and equipment capacity
- disadvantages or advantages of a product.

***NOTE:** Information in a table should be reliable, but it may not cover all the information you need. If it doesn't, make sure to use a number of sources to get a complete picture. Be sure you use current tables and up-to-date information suitable for the task.*

Table 1 below illustrates the clear and simple organization of tables. The row headings clearly tell you what the numbers mean. The table allows you to find what you want quickly.

Get familiar with the table – understand what it is telling you and how it is organized.

Study Table 1. Answer the questions that follow. Answers are at the end of this skill manual.

**Table 1: Cable Capacity (number of cables)
for Horizontal Conduit (ANSI/TIA/EIA-569-A)***

Trade size	Cable Outside Diameter (OD) centimetres (inches)			
	0.33 (0.13)	0.46 (0.18)	0.56 (0.22)	0.61 (0.24)
1/2	1	1	0	0
3/4	6	5	4	3
1	8	8	7	6

* See CSA T530 in Canada

Note: Guidelines apply for conduits with no more than two 90° bends (total of 180°) and no longer than 30m (98ft). Find additional information on conduit fill in the appropriate guide.

Questions:

1. Which guide would you use for standards and information about cable capacity for the trade sizes listed?
 - a) ANSI/NPA 70
 - b) Cabling design guidelines for raceways
 - c) CSA T530
2. Trade size 1 cable capacity is the same for cable with an OD of 0.33cm and 0.46cm.

T F

3. Trade size 1/2 cable capacity is the same for cable with an OD of 0.33cm and 0.18 inches.

T F

In Table 1, you see the following information:

- cable capacity for horizontal conduits according to outside diameter,
- an abbreviation for outside diameter (OD) which you will see in other trade material,
- OD listed in centimetres and, inside the brackets (), listed in inches,
- trade sizes for conduit,
- the standards used (ANSI...and CSA...).

Did you also read the notes at the bottom of the chart? If not, read it now. To evaluate *how*, *when* or *whether* to use any information, it is important to *read everything available to you*. The note at the bottom provides more details.

Be sure to read all notes and decide how or if they apply to your job. The notes with Table one tell you this:

- this table is not the guideline for Canadian product,
- there are angle and length limits on cables, and
- where to find information on conduit fill.

Notes with tables

Notes, or footnotes, that are with tables include essential information. You will have to read and follow the directions found in a table, at the bottom of the table and in the guides. Much more information is available to you when you combine footnotes with the table details. When you have more information to work from, you can decide how or if they apply to your assignment. You can *evaluate*. There is always a good reason for footnotes, so make sure you get all the details.

Notes explain terms or abbreviations.

Example:

Note: PSIG stands for pounds per square inch gauge

Notes point out exceptions to a use.

Example:

Note: Some metals are excluded from this use because of corrosion.

Notes guide you to the information you need.

Examples:

NOTE: See Chart 5 for Imperial. – Metric conversions

See Manufacture's Guide that accompanies this tester.

Notes guide you to make correct adjustments.

Example:

Δ You can check that you have determined pressure accurately, that equipment is operating to mechanical specifications (80 psi air line pressure), and that you apply the specified force to get the results you expect.

Notes may tell you where to find more details.

Examples:

See Figure 3-1 for a cross section of this diagram.

Consult the torque guideline when using lubricants X, Y or Z.

Consult local codes available at Planning and Building Departments, Your City.

Notes may explain why you should perform an operation:

Example:

Cut off the first few feet of cable before terminating because it may be damaged by the pulling operation

How And When To Use Information

To decide *how and when* to use information, it is important to evaluate whether it is relevant to a specific situation. The information must:

- ◆ be reliable,
- ◆ be complete, and
- ◆ answer all the questions about the situation.

You may need to read from more than one source to get the information you need. When you have enough information to work from, you can decide how it applies to your task.

Diagrams and Text

Passage 2 below describes the difficulties of getting a perfectly round hole when drilling through thin metal and what can be done about it. As you carefully read, think about tool selection and drilling techniques. In short, *evaluate what you read*.

Read Passage 2 and answer the questions that follow. Answers are at the end of this unit

Passage 2

Drilling Thin Material

Drilling holes in sheet metal is difficult, and the results may be damaged work. This is especially true with standard twist drills over 12.7 mm (½ in) in diameter. The standard twist drill has a tendency to "hook" into the thin metal. This "hooking" action is caused by the rake angle created by the helix of the flutes and the drill point. A clean, round hole is not produced by the standard twist drill (See Figure 1).

Ragged holes produced by standard twist drill

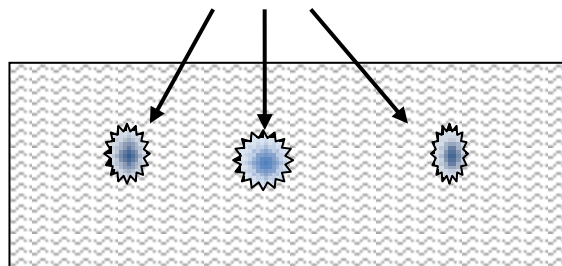


Figure 1: Standard twist drill should not be used to drill holes in sheet metal.

Special drills and specially ground twist drills should be used when drilling thin material.

A low helix drill or a straight-fluted drill which has no rake angle improves the quality of drilled holes in thin materials. A standard twist drill can be modified by grinding a short flat on the lip of the drill to remove the rake angle if a straight-fluted or low helix drill is not available.

Another factor affecting the quality of the hole is the manner in which the drill point is ground. Grind so there is a small point in the centre to position the drill in the punch mark. Then grind the rest of the drill point to an angle of 5° from the flat with a lip clearance of about 12°. As the drill point penetrates the work, the outer edges act as a repanning tool and result in a round, almost burr-free hole.

Questions:

1. A specially ground twist drill will produce approximately the same results as a standard twist drill.
T F

2. By referring to Figure 1, you can understand how “the rake angle created by the helix of the flutes and the drill point” creates the “hooking” action.
T F

3. Which topic below does Passage 2 give you the *least* information about?
 - a) how to modify a standard twist drill
 - b) how to produce a burr-free hole in thin material
 - c) the causes of “damaged work”

4. Passage 2 gives enough information for you to understand helix of the flutes and trepanning tool.
T F

Evaluation

You need to get the expected results from a project – drilled holes of the right size and quality. You need to avoid damage to tools, to the material and other classes of problem. To do all of this, you depend on a clear understanding of clamping, drilling, equipment and materials. *Your purpose is to select the right information to come to this understanding.*

Passage 2 is an evaluation of a drilling operation and a problem. The passage describes the problem, looks at the cause, directs you to Figure 1 to show it to you and offers a solution.

In a passage like this, someone has evaluated a task and a problem you might face. This kind of evaluation will direct you to correct procedures, directions, tools and materials. It may help you to do a job efficiently or to avoid a problem you might otherwise encounter.

There’s a bit missing

It is just as important in any evaluation to recognize when a piece of information is missing.

In some instances, you read information that causes you some difficulty or uncertainty.

Example: You might read this about tension:
Materials can withstand a certain amount of stress before they break or weaken.

What does *a certain amount* mean? The information doesn’t explain, so how do you know?

Example: In a table on characteristics, uses and properties of copper, you find this:
It has relatively high strength but is difficult to cold work.

The note doesn’t explain what *relatively high strength* means, or what metals copper is compared to. Is it difficult for an apprentice *to cold work* or for everyone?

Something is missing: you may know what these directions or notes mean, but if you don't, how can you evaluate the strength of a metal, or the difficulty you would have working with it, or your own safety?

Up-to-date information should be reliable. But, if information is not clear to you or details are missing, you cannot evaluate thoroughly. New developments and materials in your trade mean that products and techniques, standards and codes change. Make sure you keep up to the standards. Make sure you know who to ask for explanations or clarification to get the whole picture.

PART III **CAUSE AND EFFECT**

When we refer to **cause and effect**, we are evaluating a relationship between two events. We want to see if one event is responsible for causing another event to happen. The connection between the two happenings can be established:

- by careful evaluation based on repeated observation,
- by referring to recognized standards and manuals, and
- by talking to respected supervisors and workers in the trade.

Safety on the job often means being aware of cause and effect. If a careless step can cause you harm, you should know the effects of that action. Safety warnings often highlight the cause and effect relationship in some way, especially if the effects are serious.

A warning might tell you to avoid doing something that can *cause* a danger. The warning may also state the consequences *effects* and general safety directions.

Example:

Avoid stringing wires for temporary circuits. Frequent relocation of circuits can loosen connections. This can break insulation, creating fire and other hazards.

Remember that electricity is **always** a potential source of danger. Consider all electrical wires and equipment to be live until they are tested.

Recognizing cause and effect relationships can help you understand:

- ◆ what action causes a problem,
- ◆ what action solves a problem without creating a new one, and,
- ◆ what action can prevent a problem from happening in the first place.

A problem happens because something causes it. When you search for the cause of a problem, look at the relationships between actions that are closely related to the problem. As you search for solutions, think about how to change the factors that have caused the problem. When planning a project, think ahead to the logical order of procedures so that you can avoid any action that has the potential to cause a problem.

Who (or what) caused it?

In the sentence below, it is clear what happened.
Fred threw a snowball and it went through the shed window.

Fred threw a snowball. The result, or effect was, it broke the shed window. You can reverse the order of the sentence and still make sense of the relationship: *The window was broken because Fred threw a snowball through it.*

Cause and effect relationships can be very clear. In the next example, you see a cause/ effect relationship between a drilling operation and a drill bit:

Example:

*Do not spin the drill bit too fast or press too hard.
This will result in overheating which can quickly soften and ruin the bit.*

In this example:

- The first sentence gives you a cause – a drill bit that spins *too fast* or has too much pressure applied.
- The second sentence tells you the effect of the action – overheating and softening of the bit.

We can reverse the order of the sentences and still make sense of what happened:

A drill bit can soften and be ruined if it overheats from spinning too fast or being pressed too hard.

But we **cannot** reverse the order of the relationship and still make sense. In other words, the result is not the cause. We cannot say:

*A drill bit which softens and is ruined from overheating **will cause** the bit to spin too fast and with too hard a pressure.*

And, we cannot say: *“A broken window caused a snowball to be thrown.”*

You cannot say: *“A broken window caused a snowball to be thrown.”*

It doesn't make sense if you mix up the cause and result. The events occur because of a cause and effect relationship. You have to keep this relationship in mind as you troubleshoot. As you search for problems and their solutions, remember to note the order of the actions even if the *sentence order* is changed.

Take two directions to study cause and effect

In practice, we often work in two directions - backwards and forwards - when we talk about cause and effect. Sometimes we know what happened (the *effect* or *result*), but we don't know

why (the *cause*). Sometimes we know what action we are taking (the *cause*), but we don't know the effects or results of it.

Example: As you are driving on a winter's night along an unfamiliar concession road, think ahead. Predict the likely results of your actions. You may do any of the following:

- a) skid into a ditch,
- b) miss a turn and get lost,
- c) hit an icy patch and spin, or,
- d) be lucky and arrive safely.

You have worked from your present actions forward to predict the probable or possible effects. The purpose in doing this is to evaluate the likelihood of an event taking place - of **a, b, c, or d**. When you evaluate the effects of what you are doing now, you can change your behaviour to avoid or prevent a problem.

Example: Knowing that improper care and/or use of a tool reduces its life and efficiency, you can do something to avoid this result. You can evaluate your own practices compared to recommended (proper) handling and use. This means you would choose these options for tool care:

- use only as directed,
- observe how experts handle and store their tools,
- properly lubricate, and
- repair it if it doesn't function.

Passage 3 outlines a relationship between cause and effect. The purpose is to understand and, therefore, avoid or solve potential problems. **Read Passage 3. Answer the questions that follow. Answers are at the end of this skills manual**

Passage 3 **Terminal Connections**

Terminal connections are a source of some of the more troublesome problems found in the control and power circuits of electric motors. A loose terminal connection can cause a load to burn out from under voltage. When this happens, the burned out load is located and replaced and the trouble thought to be remedied. However, the problem can recur until the loose terminal connector is found.

A number of problems can result from a loose connection in a lug. Any loose connection means an increase in resistance. As current passes through any kind of resistance, there is a voltage drop at the resistance point, and heat develops. Both the voltage drop and the heat produced by the loose connection can cause problems.

If the loose terminal happens to be on the circuit breaker, the heat at the terminal can be carried by the wire to the thermal overload inside the breaker. The resulting heat, in addition to the current overload, can cause the breaker to trip on a current much below the rating. In this situation, an electrician may incorrectly suspect that the problem is an overloaded circuit or a faulty breaker.

Sometimes, the loose terminal develops a high enough voltage drop across it so that the loads connected to the circuit develop numerous problems. Burn out of the loads are the simplest, but the drop out of coils and the resetting of timers and counters create more difficult problems.

Heat that develops at loose connections can cause other problems. If left undetected long enough, the insulation around the terminal may be destroyed, resulting in a possible short circuit. In addition, the heat may also destroy any device near or connected to the loose connection.

In order to avoid a loose connection, the wires must be carefully placed in the lugs. If solid, be sure the lug will clamp the wire tightly, especially with aluminum wire which is softer than copper. Also, aluminum will expand and contract more, resulting in a possible loose connection. If two wires are used in the same lug, they must fit tightly. Also, constantly watch for loose terminals and check possible problem areas.

Questions:

1. According to this passage, an electrician might have difficulty in determining the cause of and permanently fixing a terminal connection problem.

T F

2. What might an electrician incorrectly assume if the breaker tripped on a current much below the rating?

- a) loose terminal on the circuit breaker
- b) overloaded circuit or a faulty breaker
- c) a loose connection in a lug

3. When placing copper wire in the lugs, greater care must be taken than when using aluminum wire.

T F

4. According to Passage 3, which of the following would **not** occur if a loose connection is left undetected for too long?

- a) damage to devices in near proximity
- b) short circuit
- c) damaged insulation around terminal
- d) excessive heat

Passage 3 gives you information about causes and solutions to terminal connection problems. Once you know about common problems and their causes, and evaluate the system you are looking at, you can decide upon a method of action to ensure a task is performed correctly with attention to quality, products and procedures. In this way you can solve existing problems and avoid creating future problems..

Trouble Shooting Guides

Troubleshooting guides list common causes of problems and solutions so you can find and solve them without a major investigation. Table 2 is an example of a cause and effect guide found in your trade.

Note: Table 2 is only a partial table: some steps have been omitted.

Table 2 Motor Control Trouble-Remedy Table For Magnetic Contactors and Starters		
Trouble	Cause	Remedy
CONTACTS Contact Chatter	<ol style="list-style-type: none"> 1. Broken shading coil. 2. Poor contact in control circuit. 3. Low Voltage. 	<ol style="list-style-type: none"> 1. Replace magnet and armature. 2. Replace the contact device or use holding circuit interlock (3 wire control). 3. Correct voltage condition.
Welding or Freezing	<ol style="list-style-type: none"> 1. Abnormal inrush of current. 2. Rapid jogging. 3. Foreign matter preventing contacts from closing. 4. Short circuit 	<ol style="list-style-type: none"> 1. Check for grounds, shorts or excessive motor load current or use larger contactor. 2. Install larger device rated for jogging service (see manufacturer's specifications). 3. Clean contacts with Freon. Contactors, starters, and control accessories used with very small current or low voltage, should be cleaned with Freon. 4. Remove short or fault and check to be sure fuse or breaker size is correct.
COILS Open Circuit	<ol style="list-style-type: none"> 1. Mechanical damage. 	<ol style="list-style-type: none"> 1. Handle and store coils carefully.
Roasted Coil	<ol style="list-style-type: none"> 1. Over voltage or high ambient temperature. 2. Incorrect coil. 	<ol style="list-style-type: none"> 1. Check application, circuit and correct. 2. Install correct coil.
OVERLOAD RELAYS Tripping	<ol style="list-style-type: none"> 1. Sustained overload. 2. Loose connection on load wires. 3. Incorrect heater. 	<ol style="list-style-type: none"> 1. Check for grounds, shorts or excessive motor currents and correct cause. 2. Clean and tighten. 3. Heater should be replaced with correct size.

If you have experienced a problem, your first step is to eliminate the obvious causes. The table above serves this purpose. Start looking for the places where the problem could have occurred. A systematic check will isolate the cause. Finding the cause will lead you to the solution whether it's a change in your installation method, careful reading of manufacturer's guidelines or upgrading the motor.

You can apply a check system to review the steps you have followed correctly:

- 1) checked for grounds, shorts and excessive load current;
- 2) installed larger device for jogging service (and checked against manufacturer's guide);
- 3) cleaned contacts properly with Freon.
- 4) etc.

As you eliminate possible causes, you narrow in on the ones that are most likely. This process will help you find the cause of contact chatter, roasted coils, or relay tripping. Careful research will lead you to answers in a logical manner.

Test Your Abilities

Evaluate the situation and yourself. If the troubleshooting process leads you to the limits of your own expertise, you may have to find another source of information. Tables and manuals can help you make this assessment.

Example: Under the heading, “*Remedy*”, one recommendation is to refer to the manufacturer’s guide to determine if a device is rated for jogging. That should send you looking for the manufacturer’s guide. Always get help from the right source.

Directions in manuals may say something like:

- *if the tool is not functioning properly...*
- *Maintain tools...*
- *use proper lubrication*

These directions assume that you know what *functioning properly*, *maintaining tools*, and *proper lubrication* mean, and that if you don’t know, you will find out. An important part of evaluating a situation is to figure out when you have to look something up, or when you have to find further information. It also means knowing where to go for help.

Looking for more causes

Be aware that there may be more than one cause of a problem. A problem such as a badly maintained air drill may be the cause of another problem such as an overworked air compressor. If you have not lubricated the air drill properly, or you used the wrong type or quantity of oil, this problem may lead to another in the compressor.

PART IV

FACT AND OPINION

A **fact** is based on something that can be measured or proven. When you can explain a statement based on solid information, you are presenting a fact.

Examples:

Aluminum, galvanized or cadmium plated steel nails are used for outside finish work to avoid rust.

The Maple Leafs did not win the Stanley Cup last year.

An **opinion** is based on an unproven belief. When we base a choice on an opinion, we need to look closely to find our reasons for thinking the way we do.

Examples:

Fords are better than Hondas.

The Maple Leafs will win the Stanley Cup.

Know the difference

When you evaluate information, you need to look closely at your reasons for thinking the way you do.

Example: Are tools produced for professional use better than tools produced for ordinary use? In what ways? For which situations? Explain your answers.

If you can explain the answers to these questions by drawing on facts that support what you say, your answer will be true.

If you explain your answer by saying “I think “ or “I heard that ...”, you are stating an opinion. It may or may not be true.

When someone tells you something is wrong with a finished project, they are probably giving you valuable information. It’s your job to evaluate this information. Can you get reliable details about where and when the product failed, with an accurate description? Or, is it an opinion? Something like, “This fixture doesn’t seem like the other ones”. *In evaluating any situation, keep an open mind and ask questions; include fact and opinion from a variety of sources.*

Know your sources

Table 2 is an example that includes directions to “*handle and store coils carefully.*” It is important when you evaluate information is to find out who wrote it. A maintenance manual provided by the manufacturer is a very reliable source. An article in a respected trade magazine is another. A chat room on the internet may not contain dependable information. *An important rule is to use only reliable sources to provide your information.*

You will seek advice from experts and experienced professionals. But even the time-honoured practices of seasoned trades people come under occasional review that can lead to a new and better way of doing things. You need to learn and respect traditional methods but be open to new ideas. New and better ideas can only develop by someone carefully observing the actual relationship between cause and effect in the work site.

Language

Just as some words make a cause and effect relationship very clear, some words and phrases make rules and codes very clear. Sometimes, the language tells you there is no room for opinion.

Words such as *never, always, must (not), shall (not), are prohibited*, make it very clear that the *information presented is not open to opinion, debate or evaluation*. Your experience may not give you enough information to understand or evaluate the reasons for every direction. The language tells you what to do; it tells you there is no decision-making necessary.

Examples:

Never use a chisel for prying!

Gasoline must never be used as a cleaning agent. It presents an extreme fire hazard.

Employees must wear approved safety equipment.

Never attempt to make repairs to extinguishers.

Always maintain and use tools properly. A defective tool is a dangerous tool.

Words like *should be*, *ought to*, *is recommended* and *make a reasonable effort*, offer suggestions or offer opinions. They offer advice that you will consider and evaluate. There may be some room for decision-making based on opinion:

Examples:

Tools should be good quality.

In some cases, two people ought to work together.

A metatarsal type safety shoe is recommended.

Make a reasonable effort to contain the fire.

In Brief

As you learn about your trade, make observations with a clear, open mind. Constantly evaluate your ideas or materials. Assess your skill level in carrying out a project. What do you still need to learn? Based on your experiments and observations, you will learn to make evaluations based on useful facts, not unsupported opinions.

CONCLUSION

The steps in a procedure may be straightforward, but you still have to evaluate information as you make decisions about materials, equipment, costs and time or when you look for trouble spots. To solve most problems, you first need a clear understanding of how something is supposed to work. Through experience, you will discover causes of and solutions to problems. You will also learn to use experience to evaluate the effectiveness of each solution as you try it.

Materials, installation techniques, equipment and codes are constantly changing in the trades. You have to keep up with these changes. You have to differentiate between someone's opinion and reliable facts. Check with inspectors, suppliers and manufacturers to learn about the latest products and information. Learn to recognize the relevance of the information you read by evaluating how it to your trade and to the job you are doing.

Sound decisions depend on knowing your sources and on your ability to take advantage of all the available resources. Information can come from written material, from lessons with experts and from your own experience. Learn to evaluate what you learn so you can choose the information that best fits the situation.

Summary

1. **Evaluate the situation from every angle** and choose information, products and rules that fit the job.
2. **Understand the relationship of the information in a table, diagram and the text.** Use it all and relate it all to what you are doing or learning.
3. **Assess your skills, experience, information, and how you are applying the information.** Evaluation is one of the best learning tools we have.
4. **Understand what cause is, and what effect is.** Work backwards to find cause and work forward to predict the effect, or the result. Your object is to prevent problems.
5. **Weigh the facts you have available and make appropriate choices at every step.**
5. **Learn the difference between fact and opinion.**

ANSWER PAGE

PART II Table 1: Cable Capacity for Horizontal Conduit

1. Which guide would you use for standards and information on cable capacity for these trade sizes?

c) CSA T530

In Canada, you would refer to this guide. ANSI/TIA/EIA-569-A also covers this topic. The asterisk * after it directs you to the bottom of the chart where you see the guide used in Canada. Check with an expert in your field to find out if both guides are suitable.

2. Trade size 1 cable capacity is the same for cable with an OD of 0.33cm and 0.46cm.

T This question asks you to refer to a table to find information. It then asks you to compare one set of data with another. Conduit with the trade size 1 has the same capacity (8) for cable with an outside diameter of 0.33cm and 0.46cm.

3. Trade size ½ cable capacity is the same for cable with an OD of 0.33cm and 0.18 inches.

T This question again asks you to compare details you find in a table to select the correct data. In this case, you are comparing outside diameters measured in centimetres and inches. The measurement in centimetres is listed in the second row; the measurement in inches is below it and in brackets. The question asks you to pay attention to all the details when you read numbers (or anything else) so you compare the right data.

PART II Passage 2, Drilling Thin Material

1. A specially- ground twist drill will produce approximately the same results as a standard twist drill.

F Paragraph one states that “a clean round hole is not produced by a standard twist drill” and that “special drills and specially ground drills should be used”.

2. By referring to Figure 1, you can understand how “the rake angle created by the helix of the flutes and the drill point” creates the “hooking” action.

F By referring to Figure 1, you can see the effects of the hooking action (a ragged hole) but it does not show *how* this occurs.

3. Which topic below does Passage 2 give you the *least* information about?

c) the causes of “damaged work.” We get one type of damage and one cause of this type. We do not know about any other types.

4. Passage 2 gives enough information for you to understand rake angle and low helix drill.

F There's really nothing in Passage 2 to explain, describe or illustrate either term above. This goes back to the answer to question 2.

PART III **Passage 3, Terminal Connections**

1. According to this passage, an electrician might have difficulty in determining the cause of and permanently fixing a terminal connection problem.

T The opening sentence of this passage states that terminal connections are “*a source of some of the more troublesome problems found in the control and power circuits of electric motors.*” This is the first indication that the answer is true. Evaluate the rest of the passage. You are given examples of how easy it is for a problem to be incorrectly diagnosed, while the real source of the problem is left unsolved (paragraphs 1, 3 and 5). This passage clearly suggests that terminal connection problems are difficult to assess and solve. The correct answer is **True**.

2. What might an electrician incorrectly assume if the breaker tripped on a current much below the rating?

b) overloaded circuit or a faulty breaker

You need to begin by finding the part of the passage that deals with the tripping of a breaker (paragraph 3). We can easily rule out Answer **c)** because a loose connection in a lug (dealt with in paragraph two) results in several problems, but none of them is a tripped breaker. Now it gets tricky. We may be tempted to say Answer **a)** because the loose terminal on the circuit breaker will cause the breaker to trip much below the rating. However, the question asks what an electrician might *incorrectly* assume and this answer is given in the last sentence: *an overloaded circuit or a faulty breaker*. Answer **b)** is the correct choice.

3. When placing copper wire in the lugs, greater care must be taken than when using aluminum wire.

F Although the passage does not specifically say that greater care should be taken with aluminum, Paragraph 6 does say that “you need to be sure the lug will clamp to the wire tightly *especially with aluminum wire...*” It continues to compare copper and aluminum wire. We are told that aluminum wire is softer and will expand and contract more which could result in a loose connection. From this information, an electrician can assume that aluminum wire requires more care and attention than copper and therefore, the answer must be **False**.

4. According to Passage 3, which of the following would **not** occur if a loose connection is left undetected for too long?
d) excessive heat

The answer to this question can be found in paragraph 5. By reading closely, we can see that heat is *caused* by a loosened connection and, if left undetected, will cause the problems described by the other answers. Therefore, heat is not a result of the undetected loose connection, but a direct result of the loose connection that can cause these other problems if undetected. The correct answer is **d**).