EVALUATING
ACADEMIC READINESS
FOR APPRENTICESHIP TRAINING
Revised for
ACCESS TO APPRENTICESHIPS

COMMUNICATIONS SKILLS
COMPARISON OF INFORMATION

AN ACADEMIC SKILLS MANUAL
for
The Metal Work Trades

This trade group includes the following trades:
Heat & Frost Insulator, Iron Worker,
Precision Metal Fabricator, Sheet Metal Worker, and
Welder & Fitter

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

Revised 2011

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
COMPARISON OF INFORMATION

An academic skill required for the study of the Metal Work Trades

INTRODUCTION

Every day on the job, you make comparisons. You compare size when you pick one size of fastener instead of another. You compare techniques when you decide to use one type of welder instead of another. You compare long-term costs when you order a better grade of steel for a project because it is more durable than a less expensive grade.

*To make a **comparison**, you examine two or more things to find out how they are similar and how they are different.* While comparison examines both similarities and differences, contrast only looks at differences. Once you have made your comparison or contrast of the different options available, you are in a position to evaluate what is the best choice for a given situation.

In the metal work trades, you compare products and equipment for a variety of reasons: to decide which one is more durable, which is safer or which will work better in a specific situation. You learn to compare techniques and procedures through your reading, from listening to teachers, supervisors and skilled tradespeople, and through your experience on the job.

In this skills manual, we will look at the following aspects of comparison:

- How comparison works
- Words that compares and contrasts
- Using text and graphics to compare
- Making choices

PART I
HOW COMPARISON WORKS

From general to specific

Most comparisons start with general information about a topic. This general information is your base. The topic could be anything from sheet metals to welding techniques. From this foundation, you move to more specific topics such as methods of joining steel frames or welding surfaces.

As you read about a topic such as sheet metal machinery, you begin with explanations, definitions or descriptions that apply to the large body of information about this kind of machinery. This gives you an overview of the topic.

From this general information, you learn more specific information such as types of machines. As you learn the characteristics of each type, you see what the different machines have in common and how they differ.

Moving from the general to specific information leads you to make useful comparisons. The more detailed information about a topic provides a comparison of features, operation procedures, conditions or costs of each item in the group. You can then compare the advantages and disadvantages of each. You are now in a good position to choose the best method or product for a specific job.

Passage 1 shows this typical pattern. It starts with general information about rotary machines. It then describes two types of rotary machines with details about the similarities and differences between them.

Read Passage 1 and answer the questions that ask you to compare these sheet metal machines. Answers are at the end of this skills manual.

Passage 1
Rotary Machines

Rotary machines form the edges for circular and cylindrical objects. Available in many sizes and capacities, they are hand-operated or motor powered. The operating principles are basically the same for all machines.

Turning and Burring Machines
The operation and results of these two common machines are similar. The main difference between the two is in the shape (profile) of the forming rolls.

Turning machines: The edges of the rolls on this machine are rounded. This rounded edge produces a curved bend or *radius* on the metal that means it is better adapted for bending heavier gauge materials. A sharp or angular bend in these metals would cause stress at the bend which would weaken the product. This machine is commonly used in preparing wired edges because of the radius bend; it is also used for the edges of the sides of cans or buckets as the sides are usually a heavier gauge than the bottom or top.

Burring machines: The upper roll of the burring machine has a sharp edge which produces an angular bend. It is better suited for lighter metal fittings because these require a narrow (usually ¼ inch or less), sharply angled edge.

Questions:

1. According to Passage 1, which machine would you use to produce a curved bend on a heavier gauge of metal?

   a) turning
   b) burring
   c) either turning or burring

2. Which machine would you use to fabricate a can or bucket?

   a) turning
   b) burring
   c) both turning and burring

3. What is the main difference between turning and burring machines?

    a) the principles for operation
    b) the shape of the forming rolls
    c) the ease of working with materials

When you read Passage 1, it doesn't say anywhere that types of rotary machines will be compared, but this is what is happening. We will look at Passage 1 in more detail to see how the comparison is organized.

In paragraphs one and two, you learn the following:

- uses for rotary machines – forming edges for circular and cylindrical objects,
- range of machines – available in many sizes, capacities, hand-operated and motor-driven,
- similarities between machines – basically the same operating principles for all machines,
- differences between two machines – the profile (shape) of the forming rolls.

This information is a starting point, or base, from which to work. It will be true in most situations. For specific comparisons, you have to read on.

The next paragraphs give you these kinds of details about each rotary machine:

- the shape of the rolls: rounded on turning machines, sharp on burring machines
- uses for each machine

By comparing and contrasting such things as features and use, you can find out which item is suitable or recommended for a specific application.

Using the information

When you learn information about machines such as rotary machines, you get knowledge that enables you to make useful comparisons. You could explain to someone else what to expect if you substituted one machine for another. Comparing results can also show why an inappropriate process, such as using a burring machine with heavy metal fittings, could produce an unsuitable outcome, such as a too narrow edge.

As you learn about one thing, in this case, rotary machines, be prepared for information about the features and use of other machines. Use this information to think about their similarities and differences. Consider making your own list of advantages and disadvantages of different machinery so you have a handy reference.

Classification

An important method of comparison is *classification*. ***Classification*** *is a method of grouping things according to their similarities*. Classifying materials, tools and techniques is a good way of keeping things organized. It also helps you see how things are related and how they differ.

Read Passage 2 below to see how this works.

Passage 2
Simple Machines

A *machine* is a device that makes work easier by changing the speed, direction or amount of force. A *simple machine* magnifies the effects of an applied force.

Levers
Levers are the simplest of basic machines. The point where the lever pivots is the *fulcrum* of the lever. There are three classes of levers:

Class 1: These levers have a fulcrum between the resistance force and the effort. Crowbars, bolt-cutters, jacks, pliers and scissors are all examples of Class 1 levers.

Class 2: The resistance in these levers is between the fulcrum and the effort. If you lift an object by one end, it is a Class 2 lever. Wheelbarrows are an example.

Class 3: The effort in these levers is applied between the fulcrum and the resistance. The effort arm is shorter than the resistance arm, and the effort is always greater than the resistant force. If you use your hand and arm to carry something, this is an example of a Class 3 lever. Cranes, backhoes and hammers are also examples.

Passage 2 sets up comparison in a series of steps. Paragraph one starts with general information.

- It introduces the large classification, *machines*, and defines what a machine is.
- It then describes a more specific classification: *simple machines*.

Then the passage focuses specifically on one type of simple machine – levers.

- You already know what a *simple* machine is or does. You can apply these facts to levers.
- You learn the definition of a lever.
- You also learn there are three classes of levers.

Next, you get a definition for each of the three classes of levers.

- You can compare each of the three types of levers as to:
    - fulcrum points,
    - the relationship between resistance and effort
- You are also given examples of each class of lever.

By the end of Passage 2 you know how the different classes of levers are similar and how they different. You also know how each type is used.

This description moves you gradually to a more detailed understanding. It is organized so that you build your knowledge gradually. *Comparison through classification* leads you to recognize the ways that something is similar to and different from others in its category. You can then use this information to generalize about how each will function in the workplace.

Tables, charts and lists

Tables, charts and lists *are used to organize and compare information.* The information is easy to use for comparisons because it is already organized into categories. You will find tables in manuals, texts and on-line.

Tables cover a wide variety of material from metric and imperial measurement to categories of fasteners and gauges of material. You can use tables or lists to organize and compare information such as sheet gauges and weights, uses and strengths of different alloys, or possible solutions to problems with welded seams.

Read Passage 3 and examine the table to see how it compares different types of ducts two types.

Passage 3
Spiral Duct

Spiral duct is round duct. Made from one continuous strip of sheet metal, it is formed and joined using a special production machine. A narrow strip of sheet metal is fed into the machine. The machine joins the edges with a lock that is similar to an elbow lock thus creating an airtight, rigid circular duct.

Spiral duct is available in diameters from 3" to 60". It is fabricated to specific lengths needed for each application. Wall thicknesses range from 16 to 26 gauge. Elbows are made in the factory. Sections of spiral duct are attached using connectors that bolt together.

Flex Duct
Flex duct is flexible, round duct. It is formed by tightly corrugated sheet metal, flex duct looks similar to spiral duct. It can be bent into several angles. It is commonly used for duct with small diameter that requires many turns.

Flex duct is available in diameters from 4" to 16". It is most commonly used for running small lengths from the main line of the duct to a terminal box. Precise lengths are not required as excess length is adjusted by repositioning the flex duct.*
The top of the terminal box has a sheet metal collar for connecting the flex duct. The other end of the flex duct is connected to the main duct line.
Because flex duct does not require small elbows and offsets, the cost of labour costs is reduced. Connections are made by fitting the flex duct over a sheet metal collar and fastening it with sheet metal screws. See table below for a comparison of the two types of ducts.

Table 1 Spiral And Flex Ducts

	Spiral Duct	**Flex Duct**
Features:	round, rigid, one continuous strip	round, flexible, corrugated sheet metal, easily bent or crushed
Lengths:	specific, according to application	not specific
Connectors:	elbows, offsets connectors fastened with bolts	collars, fastened with screws
Duct diameters	3" to 60"	4" to 16"
And so on…		

Table 2 below is a selection chart. Before you start, read the headings and the footnote to see what features, functions or problems are compared.

Look at how Table 2 is organized and what it compares. Answer the questions that follow. Answers are at the end of this skills manual.

Table 2 Electrode Selection Chart

Electrode	Coating Type	Penetration	Most Important Features	Applications
6010	Cellulose Sodium	Deep	Forceful arc; deep penetration; fast freezing makes out-of-position welding easier	Root passes; pipe welding; maintenance work – forceful arc penetrates rust, paint, etc. Out-of-position, light gauge welding (vertical down)
6011	Cellulose Potassium	Deep	Same as 6010 plus AC operation	Same as 6010 but on AC
6012	Rutile (Titania) Sodium	Shallow to medium	Soft arc, shallow penetration; fills gaps (bridging)	Light gauge sheet metal jobs with poor fit-ups (gaps)
7014	Rutile *Iron Powder 30%	Shallow to medium	AC operation; easy to use	All purpose electrode; not ideal for vertical welding
7018	Low-hydrogen *Iron Powder 25%	Medium	High quality welds; AC operation; good deposition rate	Most popular electrode fabrication, repair

Note: 1: * Indicates the percentage of iron powder in coating. Iron powder increases deposition rates.

Questions:

1. Penetration is the same for electrodes with cellulose sodium coating and low-hydrogen coating.

   T F

2. Electrodes 6010 and 6011 would be suitable for the same applications.

   T F

3. The following electrode wires would be suitable for out-of-position welding:

   a) 7018, 7014
   b) 6010, 6011
   c) neither a) nor b)

4. Iron powder in the coating increases deposition rates. The deposition rate will

   a) increase by the same amount as (be directly related to) the percentage of iron powder.
   b) increase by a different amount than the percentage of iron powder.
   c) chart does not give rate.

For learning and studying purposes, you can convert information from a text into table. After organizing material into a table, you can quickly recognize differences and similarities between products or techniques. You can also add row or columns to your table as you learn more about the topic.

Know your purpose
If your purpose is to select an electrode, you can look across the rows and headings in Table 2 to compare coating types or applications. Someone has tested and compared these electrodes under different conditions for a variety of jobs and then listed the information. *The table is a comparison in brief*, so you can quickly find information.

Comparisons presented in a table do some of the work for you when you are selecting the most suitable tools, materials and processes. Look carefully to compare characteristics, details and applications. This will enable you to make the best choice.

Build from the base up
Comparison comes in a variety of forms – some obvious and some not so obvious. However, the purpose remains the same: *to give you a base of knowledge and then to show you similarities and differences.*

PART II
WORDS THAT COMPARE AND CONTRAST

In Part II, we look at some of the words and phrases that you can use to recognize when something is being compared or contrasted. Remember, c***omparison*** means both similarities and differences while c***ontrast*** means differences only.

If someone says to you, "I drive the same car as you do," you immediately know a lot about their car. You take what you know about your own car and apply that information to their car.
To compare them thoroughly though, you have to ask some questions. You might compare this type of detail:

- make, model and year,
- engine size,
- colour and condition,
- number of kilometres,

Direct Comparison
Words and phrases that compare and contrast
Some words and phrases immediately signal that a comparison or a contrast is to be made. *When a comparison is signaled in this way it is called a* ***direct comparison.***

Words such as *same, like,* and *all* tell you about something and compare it to something else. Also note the different ways of saying *all - whatever the type* and *regardless of the type*.

Examples:
The first step in all parallel line developments is to draw an elevation or side view.

A roller-chain drive, *like* any other mechanical operating equipment, needs correct maintenance.
All hard blades are heat treated all over. This makes them very brittle and easily broken if misused.

These principles for pattern drafting apply in the *same* way, to a rectangular duct with an end at an angle.

Some comparisons show similarities and then point out differences using words such as *some, many, most, different* and *unlike*. For example, if *some* snips cut heavier gauge metals, it means that *some others* will not.

Examples:
Some setups on sheet metal machinery are relatively simple.

Most metals are conductors, but not all metals conduct electricity equally well.

The teakettle stake has four heads that are shaped *differently* making it suitable for many operations where other stakes are not useful.

Many patterns follow the same basic forms, but they may differ in size or the operations used.

Allow two times the thickness of the metal for everything thicker than 22 gauge *except* for these special situations.
.

Words and phrases such as *while, except, unless, on the other hand, whereas, instead of, however* set up comparison while pointing out contrasting features, uses, design or applications.

Examples:
Experienced fabricators can do many layouts directly on the metal; *however*, an apprentice should make more difficult layouts on paper.

While heavier metal is drilled, the lighter sheet metal is usually punched.

The turning machine is commonly used in preparing wired edges; *on the other hand*, the burring machine is well suited for lighter metal fittings...

The words *relative or relatively* mean compared to each other, or other items.

Examples:
Iron is *relatively* more active than copper.

Some setups on sheet metal machinery are *relatively* simple.

When comparing information, you might have to reread the material a few times to get all the details.

Example:
While differences in different manufacturers' standard roller chain exist, these differences do not affect interchangeability.

Some comparison/ contrast words and phrases restrict you, or tell you not to do something. Words like: *only as stated*: *exclusively, excluded,* and *only,* tell you when something is allowed or permitted.

Examples:
Use precision sheet measuring tools *only* for the uses and in the manner described.

Some metals are *excluded* for this use because of corrosion.

Also watch also for these comparison words and suffixes:

less . . . than	Steel pipe is less flexible than aluminum.
more . . . than	A welded joint on flat metal will provide more strength than a soldered joint.
as. . . as	Arc welding will produce a weld as strong as an oxyacetylene weld
___er . . than	Aviation snips can cut heavier gauge than the large bulldog snips.
	Duct tape is thicker than masking tape and provides more surface protection.
___est	The best way to cut rigid and flexible copper is with a tubing cutter.

Indirect Comparison
In some cases, a comparison is not obvious.

Example:
Experienced installers know the advantages of tools of high quality purchased from reputable manufacturers: Most do the following:

- offer lifetime guarantees against failure,
- are made from quality materials,
- hold up under use,
- enable them to do better work.

Although no comparison is stated here, turn the information around to discover indirect comparison. The information indirectly implies that the *opposite* is true about poor quality tools. While you might later find other opinions, you could conclude that many poor quality tools:

- **do not** offer lifetime guarantees against failure.
- are **not** made from quality materials,
- **do not** hold up under use,
- **do not** enable installers to do better work.

Watch for information that is not directly stated. You may have to pull out the details.

Example:
The disadvantage of open-end wrenches is that they only grip two faces of the nut. This rounds off the nuts and may cause injury to hands.

Use comparison and contrast to gather information. If open-end wrenches have disadvantages, another *more suitable* tool might be available. Select the proper product to avoid problems.

Math language
In math, the concepts of *proportion, ratio, decimals* and *percentages* are forms of comparison. Each of these terms is used to compare one amount or measurement to another. They are fundamental to mixing products, determining slope or finding safe bearing weights. They are also used to compare quality, strength of materials and cutting speeds.

Example:
The amount of hardener is usually 10 percent of the amount of filler (that is one part hardener for each ten parts filler).

PART III
USING TEXT AND GRAPHICS TO COMPARE

Text and graphics often work together to compare different aspects of a relationship. The text explains and gives examples while graphics illustrate specific parts or procedures. When you use both sources, they work together to provide complete data on which to base your comparison. Read Passage 4 and Table 3 below to compare the relative activities of metals. **Use the text and the table to answer the questions that follow**. **Answers are at the end of this skills manual.**

Passage 4
Galvanic Corrosion

When two dissimilar metals are in contact with each other, *galvanic corrosion* occurs. The metal that is more chemically active will corrode. See Table 3. For example, zinc will corrode, cover, and thus protect, steel.

TABLE 3: Relative Activity of Metal

Magnesium	**Most Active**
Aluminum	▲
Zinc	
Chromium	
Iron	
Cadmium	
Cobalt	
Nickel	
Tin	
Lead	▼
Copper	**Least Active**

With other metals, galvanic corrosion can cause problems. For example, the coatings on galvanized steel and tin plate are corrosion resistant. If the seams of these metals were welded, the welding process would burn off the protective coating. This would result in a product that fails. For wood-shingled roofs, only rust resistant nails are recommended. Hot-dipped, zinc-coated nails with the strength of steel and corrosion resistance of zinc are recommended.

Questions:

1. According to Passage 5 and Table 3, aluminum is more chemically active than nickel.

   T F

2. If iron and nickel are in contact with each other, the nickel will corrode.

   T F

3. Galvanic corrosion may cause problems even when dissimilar metals are in the *least chemically active* range.

   T F

4. The following will prevent accelerated (faster) galvanic corrosion:

   a) using the least active metals
   b) using specialized (dielectric) fittings
   c) using two dissimilar metals

Text and graphics work together

When information is complex, using both text and graphics to compare and contrast helps you *get the whole picture.* Text and graphics - diagrams, tables, charts, illustrations, photos- work together to describe and illustrate what you need to know in order to make good choices in the workplace.

PART IV
MAKING CHOICES

To follow steps correctly, to double-check work or to understand a problem, you are constantly making comparisons. Think about how this works. To follow instructions, you have to compare what you are reading in a manual to what you are actually doing. Comparing what is shown in the text to the results in front of you will help you decide if you are on the right track

The list below suggests questions you might ask when you are making a decision:

- What features do these products or methods have in common?
- How do they differ?
- Is one better in certain situations than the others? Why?
- How do costs compare?
- Which is the better choice for my situation? Why?

Passage 5 compares and contrasts features of two types of wrench. **Read the passage and answer the questions that follow. Answers are at the end of this skills manual.**

Passage 5
Wrenches

Box-end wrenches have a closed end for better holding power. The jaws fit completely around a bolt or nut and grip each point on the fastener. The box-end wrench is thus the safest. More force can be applied without slipping and causing damage to the bolt or nut head.

The 6-point wrench is the strongest because it surrounds completely the hex nut and brings force to bear on all six sides and points. The 12-point wrench also grips the six points but does not bear on the face surfaces of a hex nut; this means there is a greater potential for slippage. The advantage of a 12-point wrench is that the wrench can grab the nut in twelve different positions. In confined spaces, the additional engagement points increase the possible turning radius. The handle of a box-end wrench is often offset 10 to 60 degrees to reach down into an area without the handle hitting the part.

Questions:

1. In confined spaces, the 6-point wrench will give an increase in turning radius.

   T F

2. Which of the following describes advantages of box-end wrenches?

   a) closed end, offset handle, jaws fit completely around a nut
   b) more force can be applied without slipping, the box-end grips in twelve different positions
   c) both a) and b)

3. Both the 12-point and 6-point wrench have equal grip on a bolt or nut.

   T F

4. Which wrench would you choose for greatest strength?

   a) either 6 or 12-point
   b) 6-point
   c) 12-point

A final point about how comparisons work.

When you start with good basic knowledge about something, you can understand and evaluate the details that follow. You will be ready for each new idea as it is presented. When you know how a tool or fitting works, you can understand why it is designed the way it is. This foundation will also help you decide which tool or fitting to choose.

Once you know how to select an electrode, you are on your way to learning to weld. Textbooks, manuals and supervisors assume you understand basic information as you move through the course. If you are missing basic information, then you may find you can't make effective comparisons as new ideas are presented. *Make sure your basics are sound before going on.*

And remember, a change in a routine or a product might affect the outcome. For example, you might always get 80% or more on tests. If you change the number of hours you study, or skip breakfast, your results may be different.

If you compare such cause and effects over a period of time, you learn something about the relationship between behavior and outcome. This can lead you to think about how you make choices in your learning and your job.

CONCLUSION

Information in your texts is set up so you can create a base of knowledge. From your base, you can compare and contrast the different materials, tools and procedures that you have learned.

When reading technical material, look for words that compare and contrast. They can alert you to comparisons. This enables you to make sound choices as to what is most suitable for each situation

Charts and table provide easy ways to compare and contrast because the information is organized into categories

Principles and measurements may not change but tools, applications, materials, equipment, conditions and seasons do. To adapt to change, compare the old with newer information. This will enable you to keep up to date in the metal trade and have happy employers and clients.

Summary

1. **Understand how comparisons work**:
   - from the large topic to an item by item comparison
   - through classification
   - through tables and charts

2. **Build from a solid base**. If a comparison doesn't make sense, stop and get help before going on.

3. **Look for patterns and language that compare and contrast**. Watch for tables and passages that compare without telling you (indirect comparison).

4. **Use text (written) and diagrams together** to compare information. Use all details available to you.

5. **Change in one area results in change to another area.** Compare details to make the right adjustments to adapt to the change.

6. **Compare what you read with what you do**. It is an important technical tool.

Answer page

PART I **Passage 1, Rotary Machines**

1. According to Passage 1, which machine would you use to produce a curved bend on a heavier gauge of metal?
   a) turning. The passage tells you that turning machines have a curved roll to produce a curved bend (*radius)*. It also states that it is better adapted for heavier gauges.

2. Which machine would you use to fabricate a can or bucket?
   c) both turning and burring. The turning machine would form the edges for the heavier sides and the burring machine would form the edges of the lighter bottom and end.

3. What is the main difference between turning and burring machines?
   b) the shape of the forming rolls

PART I **Table 1, Electrode Selection Chart**

1. Penetration is the same for electrodes with cellulose sodium coating and low-hydrogen coating.
   F This question asks you to compare one detail – penetration. Find the appropriate electrode on the chart and compare under the heading **Penetration**.

2. Electrodes 6010 and 6011 would be suitable for the same applications.

   T If you checked 6010 and 6011 for penetration and application you would find them the same.

3. The following electrode wires would be suitable for out-of-position welding:

   a) Only electrodes 6010 and 6011 are listed for "*out-of-position welding*

4. Iron powder in the coating increases deposition rates.

   c) chart does not give rate. We are told in the note at the bottom that "*Iron powder increases deposition rates"* but we do not know the rate.

PART III **Passage 4, Galvanic Corrosion and Table 3**

1. According to Passage 4 and Table 3, aluminum is more chemically active than nickel.

   T Find each metal on Table 3 and compare its position to the other to determine which is least and most active.

2. If iron and nickel are in contact with each other, the nickel will corrode.

F "Whichever of the two metals is more chemically active will corrode." The more active metal in the table is iron. The nickel, therefore, would not corrode.

3. Galvanic corrosion may cause problems even when dissimilar metals are in the *least chemically active* area.

T If dissimilar metals are in contact, problems can occur. This is why you are directed to use the same materials for fittings.

PART IV **Passage 5, Wrenches**

1. In confined spaces, the 6-point wrench will give an increase in turning radius.

F It is stated that a 12-point wrench increases the turning radius. The passage doesn't tell us about a 6-point. This is a question where you will need more information.

2. Which of the following describes advantages of box-end wrenches?

a) closed end, offset handle, jaws fit completely around a nut.

3. Both the 12-point and 6-point wrench have equal grip on a bolt or nut.

F Paragraph 2 states that the 6-point surrounds the hex nut. The next sentence states that the 12-point does not bear on face surfaces and has a "greater potential for slippage."

4. Which wrench would you choose for greatest strength?

b) 6-point. This is stated in paragraph two.