EVALUATING
ACADEMIC READINESS
FOR APPRENTICESHIP TRAINING
Revised for
ACCESS TO APPRENTICESHIPS

COMMUNICATIONS SKILLS
COMPARISON OF INFORMATION

AN ACADEMIC SKILLS MANUAL
for
The Precision Machining And Tooling Apprentices Trades

This trade group includes the following trades:
General Machinist, Tool & Die Maker,
Mould Maker, Pattern Maker, and
Machine-Tool Builder Integrator

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

Revised 2011

In preparing these Skills Manuals we have used passages, diagrams and questions similar to those an apprentice might find in a text, guide or 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 Precision Machining & Tooling Trades

INTRODUCTION

You make comparisons on the job every day. You compare size when you pick one size of fastener instead of another. You compare techniques when you decide to use one type of drill 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.

*When you 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 your trade, 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
- Language 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 drilling 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 power tools, you begin with explanations, definitions or descriptions that apply to the large body of information about this kind of equipment. This gives you an overview of the topic.

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

Moving from the general to the specific is a way of making comparisons. The more detailed information about a topic usually compares 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 you this pattern. It gives general information about gears. Then it describes different types of gears with details about similarities and differences between them.

Read Passage 1 and answer the questions that ask you to compare gears. The answers are at the end of this skills manual.

Passage 1
Gears and Gearing

Gears transmit power positively from one shaft to another. When the matching teeth of two gears engage, they can maintain power and exact speed ratios. They can increase or decrease the speed of the driven shaft that results in an increase or decrease to the turning power (torque) of the shaft. Although shafts in a gear drive are usually parallel, they can be driven at any angle by gears designed to do this. Different types of gears are used in industry:

Spur gears generally transmit power between two parallel shafts. Teeth on these gears are straight and parallel to the shafts to which they are attached. They are used where slow to moderate speed drives are needed.
Internal gears are used where shafts are parallel but where the centres must be closer than possible with spur (or helical) gears. Because of a greater area of contact, a stronger drive than with conventional gear drive is possible. Speed reductions are also possible with minimum of space requirements. These gears are suited for heavy-duty tractors for high torque demands.
Helical gears can contact parallel or shafts at an angle. The action of the teeth is termed progressive rather than intermittent and for this reason, these gears run more smoothly and quietly than spur gears. Also, because more than one gear is engaged at any time, these gears are stronger than spur gears of the same size and pitch. Special bearings may be required on shafts to overcome the end thrust produced as these gears turn.

Questions:

1. According to Passage 1, which gear would you use to transmit power smoothly and quietly between parallel shafts?

   a) spur
   b) internal
   c) helical

2. Which gear would you choose where high torque is demanded?

   a) spur
   b) internal
   c) helical

3. What is the main advantage of the helical gear over the spur gear?

   a) The action of the teeth is intermittent.
   b) They are stronger than spur gears of the same size and pitch.
   c) They can increase or decrease the speed of the driven shaft.

4. Which is ***not*** common to spur and internal gears?

   a) They are used when shafts are parallel.
   b) They are used when centres must be close.
   c) They are used when shafts must be at angles.

When you read Passage 1, it doesn't say anywhere that types of gears 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 paragraph one, you learn the following general information:

- the function of gears
- how gears operate
- design differences

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

Paragraph two provides details about different gears. You can see how different designs are used.

Using the information

In this passage, you learn that different gears have different uses because of their different design and features. When you learn about gears, tools or instruments, you get information and details that enable you to make useful comparisons.

You could explain to someone else why special bearings are required on a shaft which has helical gears, what the advantage of herringbone gears might be in a certain situation or what to expect if you substituted one type of gear for another.

As you learn about one thing, in this case, gears used in industry, you get information about the features and uses different types of gears. Use this information to think about their similarities and differences. Consider making your own list of advantages and disadvantages of gears 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 to keep organized. Classification can help 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 (load) and the effort. Crowbars, bolt-cutters, jacks, pliers and scissors are all examples of Class 1 levers.

Class 2: The resistance (load) 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, and
- 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 organized into categories. Precision machining and tooling workers often use them to find specific information needed to make decisions. You will find tables in manuals, texts and on-line.

Tables cover a wide variety of material from metric and imperial measurements, cutting fluids for different materials, centre drill size for various diameters or shaper speeds. You can use tables 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.

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.

Table 1 below describe common metals. It provides information on how to identify metals by their appearance, how they are processed and their uses. Read the headings so you know what features are being compared and read the footnotes; cover all the details.

Read Table 1 and answer the questions that follow. The answers are at the end of this unit.

Table 1: Identification of Common Machine Metals

Metal	Carbon Content	Appearance	Processing Method	Uses
Cast iron	2.5 – 3.5	Grey, rough sandy surface	Molten metal poured into sand moulds	parts of machines (lathe beds, etc)
Machine steel	0.10 – 0.30	Black, scaly surface	Put through rollers while hot	bolts, rivets, nuts, machine parts
Cold rolled or cold drawn	0.10 – 0.30	Dull silver, smooth surface	Put through rollers or drawn though dies while cold	shafting, bolts, screws, nuts
High-speed steel	alloy steel	Black, glossy	Same as machine steel	dies, tools, taps, drills, toolbilts
Brass		Yellow (various shades): rough if cast, smooth if rolled	Same as cast iron or rolled to shape	bushings, pump parts, ornamental work
Etc.				

Note: The right metal must be used for each job to prevent failure of a part. Several methods can be used to identify metals: by their appearance, by a spark test, by the manufacturer's stamp or by a code colour painted on the bar. The last two methods are most common and are the most reliable.

Questions:

1. Machine steel and cold rolled steel have the same uses.

   T F

2. What is the main difference between machine steel and high-speed steel (HSS)?

   a) the processing method
   b) the colour
   c) the carbon content

3. Table 1 shows that higher carbon content (2.5 to 3.5) compared to lower content (0.10 to 0.30) results in a rougher surface to the metal.

   T F

4. Which is the most reliable method to use when identifying a metal?

   a) its appearance
   b) a spark test
   c) the manufacturer's stamp
   d) all are equally reliable

Know your purpose
If your purpose is to select a type of metal, you can look across the rows and headings in Table 1 to compare carbon content or appearance. Someone has tested and compared these metals 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 THART 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.

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

Drills, like other cutting tools, should not be allowed to become so dull that they cannot cut.

All hard blades are heat treated all over. This makes them very brittle and easily broken if misused.

If the cutting point of the toolbit is preset in the toolroom, it will be in exactly the same position as the tool it replaces.

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

Examples:
Most gear terms apply to either inch or metric gearing though the method of calculating dimensions may be different.

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

The module is an actual dimension unlike diametrical pitch that is a ratio of number of teeth to pitch diameter.

The words *relative or relatively* mean compared to each other or to 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 a few times to get all the details.

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

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

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

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

The threading tool is similar to a boring toolbit except the shape is ground to the form of the thread to be cut.

Some comparison/ contrast words restrict you, or tell you not to do something. Words like: *only as stated*: *different/differently*, *exclusively*, *excluded, should* and *only*, tell you if something is permitted or not.

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.

Fluid and air hoses are made differently and for this reason should not be interchanged. Study the different construction of fluid and air hoses.

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	If the hole in the workpiece is larger than the hole in the master, more air will flow through the gauging head and the float will rise higher in the tube. . 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. These tools:

- come with lifetime guarantees against failure,
- are made from quality materials,
- hold up under use,
- enable installers 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. Although 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 these disadvantages, another *more suitable* tool should be available.

Math language
In math, the terms *proportions ratios, 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. The machining trades use this system to indicate such things as quality, strength of materials and cutting speeds.

Examples:
A ten-tooth gear will make three revolutions for each revolution of a thirty-tooth gear. The large gear will turn at 1/3 the speed of the small gear.

The camshaft/crankshaft rotation for machine reaming is ½ that of HSS.

Discard this if wear on bearing surfaces is more than 10%.

Knots reduce rope strength by half (50%).

PART III
USING TEXT AND GRAPHICS TO COMPARE

Text and graphics often work together to compare parts of a relationship. The text explains and gives examples while graphics list or illustrate specific parts or procedures.

When the text asks you look at a figure, diagram, table, or chart, it is important that you do so. When you use both sources of information, they work together to provide you complete data from which to base your comparison.

Passage 3 briefly explains the relationship between distance and the pressure in hoses.

While Passage 3 explains the relationship, Table 2 gives you the correct data. The table shows you the amount of pressure drop compared to the length of hose and inside hose diameter. Note the language cues and patterns of comparing.

Read Passage 3 and Table 2 and answer the questions that follow. The answers are at the end of this skills manual.

Passage 3
Hose Size

The proper size and type of hose will deliver air from the compressor and material from its source to air tools and guns.

When air is compressed and travels a long distance, its pressure begins to drop. However, you can keep this pressure drop to a minimum (for a distance up to 100 feet) when you use proper fittings and a hose of the proper diameter.

Table 3 shows hoses of different lengths (5 feet and 50 feet) and different *internal diameters* (1/4 inch up to 3/8 inch). You can compare the pressure drop at different pressures for these hoses. Compare PSIG for 5-foot lengths (column 2) and PSIG for 50-foot lengths (column 3).

At low pressure and short lengths of hose, the drop is not significant. At higher pressure and longer lengths, the pressure drop becomes much greater. It must be compensated for.

TABLE 2: AIR PRESSURE DROP

ID stands for Inner Diameter
PSIG stands for Pounds per Square Inch Gauge

Size of Air Hose (ID)*	5-foot length	50-foot length
1/4 inch @ 40 PSIG 60 PSIG 80 PSIG	PSIG ^ 0.4 4.5 5.5	PSIG 16.0 20.0 25.0
5/16 inch @ 40 PSIG 60 PSIG 80 PSIG	PSIG 0.5 1.0 1.5	PSIG 4.0 6.0 8.0

Questions:

1. Low pressure and short lengths of hose may cause a significant drop in air pressure.

   T F

2. Higher pressure and longer lengths would result in approximately the same drop in air pressure as lower pressures and shorter lengths.

   T F

3. Which of the following would you compensate for?

   a) low pressure and short lengths of hose
   b) higher pressure and longer lengths of hose
   c) higher pressure and hose of proper diameter

4. An inner diameter of 1/4" with a 60 PSIG will experience pressure drop of 4.5 at 5-foot lengths.
   T F

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?

Passage 4 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 4
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 completely surrounds 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. The box-end wrench is described as the safest type. According to Passage 4, why is this true?

   a) The wrench does not bear on the face surfaces of a hex nut.
   b) The handle is least likely to hit a part and cause damage.
   c) It is least likely to slip and cause damage to the bolt or nut head.

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

   T **F**

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 note 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 behaviour 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 organized so you can create a knowledge base. From this base, you can compare and contrast the different materials, tools and procedures that you have learned.

Look for words that compare and contrast in your technical reading. 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 precision metal trades, make the right choices, and have satisfied employers and customers.

Summary

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 knowledge 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. **Combine written information with graphics** to compare information. Use all the details.

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

6. **Compare what you read with what you do** as you progress to ensure successful results.

Answer page

PART I **Passage 1, Gears and Gearing,**

1. According to Passage 1, which gear would you use to transmit power smoothly and quietly between parallel shafts?
   c) helical

2. Which gear would you choose where high torque is demanded?
   b) internal

3. What is the main advantage of the helical gear over the spur gear?
   b) They are stronger than spur gears of the same size and pitch.

4. Which is ***not*** common to spur and internal gears?
   b) They are used when centres must be close.

PART I **Table 1, Identification of Common Machine Metals,**

1. Machine steel and cold rolled steel have the same uses.

   F This is false because two items are different (rivets and screws).

2. What is the main difference between machine steel and high-speed steel (HSS)?
   c) the carbon content

3. Table 1 shows that higher carbon content (2.5 to 3.5) compared to lower content (0.10 to 0.30) results in a rougher surface to the metal.

   F Although cold rolled steel (0.10 to 0.30--carbon content) has a smooth surface, machine steel with the same content has a *scaly* surface. The difference between scaly and rough is not clear from this table, so state False until it is clear.

4. Which is the most reliable method to use when identifying a metal?
   c) the manufacturer's stamp

PART III **Passage 3, Hose Size and Air Pressure Drop,**

1. Low pressure and short lengths of hose may cause a significant drop in air pressure.

   F Paragraph four states that this combination would ***not*** cause a significant drop.

2. Higher pressure and longer lengths would result in approximately the same drop in air pressure as lower pressures and shorter lengths.

   F You need to compare low pressure and short lengths to high pressure and long lengths..

3. Which of the following would you compensate for?
   b) higher pressure and longer lengths of hose

4. An inner diameter of 1/4" with a 60 PSIG will experience pressure drop of 4.5 at 5-foot lengths.

   T This question asks you to compare information in a question to data in a table. Find the ¼-inch ID, go to 60 PSIG. Run your finger to the 5-foot column and read the answer.

PART IV **Passage 4, Wrenches**

1. The box-end wrench is described as the safest type. According to Passage 4, why is this true?
   c) It is least likely to slip and cause damage to the bolt or nut head.

   Paragraph one states that the box-end wrench is the safest because more force can be applied without slipping and causing damage to the bolt or nut head.

2. 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 possible turning radius. The passage doesn't tell us about a 6-point. This is a question you will need more information about to answer.

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

   F Paragraph two describes different types of grip and advantages of a 12- and 6-point wrench. However, they do not have equal grip. Because the 12-point does not bear on the face surfaces of a hex nut, it is more likely to slip.

4. Which wrench would you choose for greatest strength?
   b) 6-point

   Paragraph two states that the 6-point is the strongest and explains why.