

OALCF Tasks for the Apprenticeship Goal Path: Prepared for the Project, *Developing Best Practices for Increasing, Supporting and Retaining Apprentices in Northern Ontario (2014)*

OALCF Task Cover Sheet

Task Title: Understanding Gears and Calculating Gear Ratios

Learner Name:	
Date Started:	Date Completed:
Successful Completion: Yes ___ No ___	
Goal Path: Employment ___ Apprenticeship <input checked="" type="checkbox"/> Secondary School ___ Post Secondary ___ Independence ___	
Task Description: Understanding various gears used in industry and calculations for installing correct gears into machinery.	
Competency: A: Find and Use Information B: Communicate Ideas and Information C: Understand and Use Numbers	Task Group(s): A1: Read Continuous Text A2: Interpret Documents B2: Write Continuous Text C4: Manage Data
Level Indicators: A1.2: Read texts to locate and connect ideas and information A2.2: Interpret simple documents to locate and connect information B2.2: Write texts to explain and describe information and ideas C4.3: Find, integrate and analyze data; identify trends in data	
Performance Descriptors: see chart on last page	
Materials Required: <ul style="list-style-type: none"> • Attached document - Understanding Gears and Calculating Gear Ratios • Pen and paper 	

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Learner Information and Tasks

Millwrights must have a general knowledge of drive train systems and the components that make up those systems to effectively troubleshoot and repair. Repairing these systems may include gear replacement and therefore understanding gear ratios is vital to the proper operation of the system. Use the attached document **Understanding Gears and Calculating Gear Ratios** to complete the following tasks.

Task 1: Which is the most common gear?

Task 2: Name the typical angle of application for a Bevel Gear.

Task 3: Explain the difference between a Helical Gear and a Spur Gear.

Task 4: List two reasons that Intermediate or Idler gears are used.

Task 5: In your own words explain the difference between the *Driver* and *Driven*.

Task 6: Calculate the ratio for the following gears:

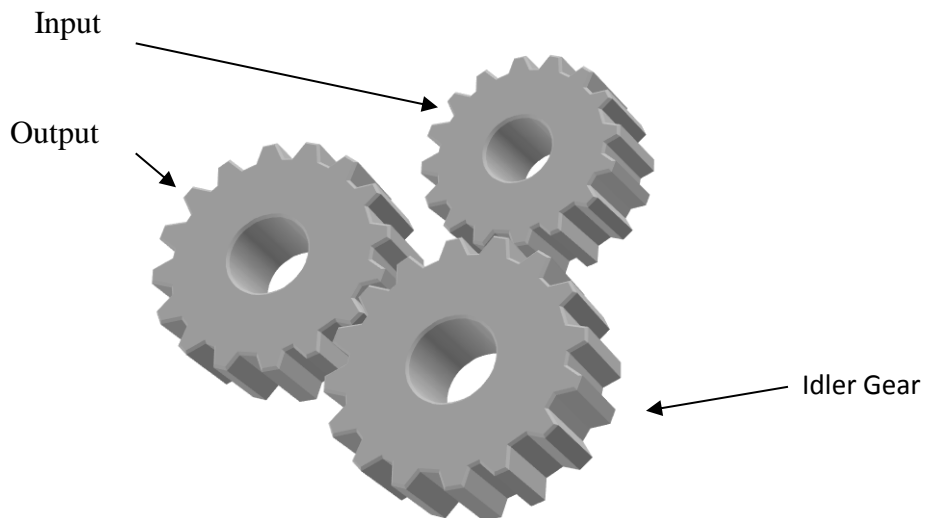
- Input movement (Driver) - 25 teeth
- Output movement (Driven) - 75 teeth

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Task 7: In the following diagram, the smaller gear is the Input movement and the larger gear is the Output movement. Count the number of teeth on each of the gears to calculate the gear ratio.



Task 8: Use the following diagram to count the number of teeth on each gear and calculate the gear ratio.










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Understanding Gears and Calculating Gear Ratios



The spur gear might be called the basic gear, as all other types have been developed from it. Its teeth are straight and parallel to the bore centre line. Spur gears may run together with other spur gears on parallel shafts; with internal gears on parallel shafts; and with a rack.

Many types and designs of gears have been developed from the spur gear. While they are commonly used in industry, many are complex in design and manufacture.

Types of gears include:

<p>Bevel gears</p> 	<p>Bevel gears are used mostly in situations that require power to be transmitted at right angles (or applications that are not parallel). Bevel gears can have different angles of application but tend to be 90°</p>
<p>Helical gears</p> 	<p>Helical gears are very similar to spur gears except the teeth are not perpendicular to the face. The teeth are at an angle to the face giving helical gears more tooth contact in the same area. Helical gears can also be used on non-parallel shafts to transmit motion.</p> <p>Helical gears tend to run quieter and smoother than spur gears due to the increased number of teeth in constant contact at any one period of time</p>
<p>Herringbone gears</p> 	<p>Herringbone gears resemble two helical gears that have been placed side by side. They are often referred to as "double helicals".</p> <p>One benefit of herringbone gears is that it helps to avoid issues related to side thrust created with the use of helical gears</p>
<p>Worm Gears</p> 	<p>Worm gears are used to transmit power at 90° and where high reductions are required. The worm resembles a thread that rides in concaved or helical teeth</p>
<p>Spur Gears</p> 	<p>Spur gears are by far the most common type of gear and with the exceptions of the "cog" the type of gear that has been around the longest.</p> <p>Spur gears have teeth that run perpendicular to the face of the gear</p>
<p>Internal Gears</p> 	<p>Internal gears typically resemble inverted spur gears but are occasionally cut as helical gears</p>
<p>Racks</p> 	<p>A rack is basically a straight gear used to transmit power and motion in a linear movement.</p>

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<p>Face Gears</p> 	<p>Face gears transmit power at (usually) right angles in a circular motion. Face gears are not very common in industrial application</p>
<p>Sprockets</p> 	<p>Sprockets are used to run chains or belts. They are typically used in conveyor systems</p>

Revolution - one complete turn of a gear.

For example, if the ratio is 2 or “2 to 1,” this usually means that the smaller gear or pinion makes two revolutions to one revolution of the larger mating gear.

Pinion - The smaller of a pair of gears

Bullgear - The larger of a pair of gears on large heavy-duty drives

Pressure Angle - The sides of each tooth incline toward the centre top at an angle

It is extremely important that the pressure angle be known when gears are mated, as all gears that run together must have the same pressure angle.

Gear Train - In a gear train, the *input gear*, or *drive gear*, transmits power to the *output gear*, also known as the *driven gear*. The input gear, which is usually connected to a power source, such as a motor or engine, transmits power through any other gears that may be in the gear train to the output gear.

Driver - Gear that is providing the effort of movement or input movement

Driven - Gear that is the load that the driver is moving or output movement

Gear Ratio - The **gear ratio** of a gear train, also known as its **speed ratio**, is the ratio of the angular velocity of the input gear to the angular velocity of the output gear.

Calculating Gear Ratio - Calculated directly from the numbers of teeth on the gears in the gear train. The ratio is found by dividing the number of teeth on the larger gear by the number of teeth on the smaller gear or pinion. Only the first and last gears are used to calculate the ratio.

Idler or Intermediate Gear - In a sequence of gears chained together, the ratio depends only on the number of teeth on the first and last gear. The intermediate gears, regardless of their size, do not alter the overall gear ratio of the chain. However, the addition of each intermediate gear reverses the direction of rotation of the final gear.

An intermediate gear which does not drive a shaft to perform any work is called an idler gear. Sometimes, a single idler gear is used to reverse the direction, in which case it may be referred to as a *reverse idler*. For instance, the typical automobile manual transmission engages reverse gear by means of inserting a reverse idler between two gears.

Idler gears can also transmit rotation among distant shafts in situations where it would be impractical to simply make the distant gears larger to bring them together. Not only do larger gears occupy more space, the mass and rotational inertia of a gear is proportional to the square of its radius. Instead of idler gears, a toothed belt or chain can be used to transmit

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torque over distance.

Idler or intermediate gears are used to assist with the transfer of power or for directional force.

Note: If the driver is smaller than the output this reduces speed
Note: If the driver is larger than the output this increases speed
The driver is not necessarily always the smaller gear.
The application dictates the configuration of the gears

Gear Ratio Equation

The following equation uses 60 teeth for the driver (Input) and 30 teeth for the driven (Output)

$$\frac{\text{Driven (Output Movement)}}{\text{Driver (Input Movement)}} = \frac{30 - \text{Number of teeth on Gear A}}{60 - \text{Number of teeth on Gear B}}$$

Find the common factor for 30 and 60
 The common factor is 30. 30 goes into 60 2 times
 Therefore
 30 goes into 30 1 time - the output is 1
 30 goes into 60 2 times - the input is 2

$$= \frac{1}{2} = \frac{\text{Output movement}}{\text{Input movement}}$$

$$= \text{Driven(Output) : Driver (Input)}$$

$$1:2$$

$$\frac{\text{Driven (Output Movement)}}{\text{Driver (Input Movement)}} = \frac{60 - \text{Number of teeth on Gear A}}{30 - \text{Number of teeth on Gear B}}$$

Find the common factor for 30 and 60
 The common factor is 30. 30 goes into 60 2 times
 Therefore
 30 goes into 30 1 time - the input is 1
 30 goes into 60 2 times - the output is 2

$$= \frac{2}{1} = \frac{\text{Input movement}}{\text{Output movement}}$$

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Task 8: Use the following diagram to calculate the gear ratio.

Count the number of teeth on each gear

All gears have 16 teeth

Calculate ratio using only the first and last gear, disregard the intermediate gear

Find the common factor for 16 and 16

The common factor is 16

$$\frac{16}{16} = \frac{1}{1}$$

Ratio is 1:1

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Performance Descriptors		Needs Work	Completes task with support from practitioner	Completes task independently
A1.2	<ul style="list-style-type: none"> scans text to locate information 			
	<ul style="list-style-type: none"> locates multiple pieces of information in simple texts 			
	<ul style="list-style-type: none"> makes low-level inferences 			
	<ul style="list-style-type: none"> makes connections between sentences and between paragraphs in a single text 			
	<ul style="list-style-type: none"> reads more complex texts to locate a single piece of information 			
	<ul style="list-style-type: none"> follows the main events of descriptive, narrative and informational texts 			
	<ul style="list-style-type: none"> obtains information from detailed reading 			
A2.2	<ul style="list-style-type: none"> performs limited searches using one or two search criteria 			
	<ul style="list-style-type: none"> extracts information from tables and forms 			
	<ul style="list-style-type: none"> uses layout to locate information 			
	<ul style="list-style-type: none"> makes connections between parts of documents 			
	<ul style="list-style-type: none"> makes low-level inferences 			
B2.2	<ul style="list-style-type: none"> writes texts to explain and describe 			
	<ul style="list-style-type: none"> conveys intended meaning on familiar topics for a limited range of purposes and audiences 			
	<ul style="list-style-type: none"> begins to sequence writing with some attention to organizing principles (e.g. time, importance) 			

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	<ul style="list-style-type: none"> connects ideas using paragraph structure 			
	<ul style="list-style-type: none"> uses limited range of vocabulary and punctuation appropriate to the task 			
	<ul style="list-style-type: none"> begins to select words and tone appropriate to the task 			
C4.3	<ul style="list-style-type: none"> calculates using numbers expressed as whole numbers, fractions, decimals, percentages and integers 			
	<ul style="list-style-type: none"> manages unfamiliar elements (e.g. context, content) to complete tasks 			
	<ul style="list-style-type: none"> makes estimates involving many factors where precision is required 			
	<ul style="list-style-type: none"> chooses and performs required operations; makes inferences to identify required operations 			
	<ul style="list-style-type: none"> selects appropriate steps to solutions from among options 			
	<ul style="list-style-type: none"> interprets, represents and converts values using whole numbers, decimals, percentages, ratios and fractions 			
	<ul style="list-style-type: none"> identifies a variety of ways to complete tasks 			
	<ul style="list-style-type: none"> uses strategies to check accuracy (e.g. estimating, using a calculator, repeating a calculation, using the reverse operation) 			

This task: was successfully completed____ needs to be tried again____

Learner Comments

Instructor (print)

Learner Signature