



Team 1334:

RED DEVIL ROBOTICS

OAKVILLE TRAFALGAR HIGH SCHOOL

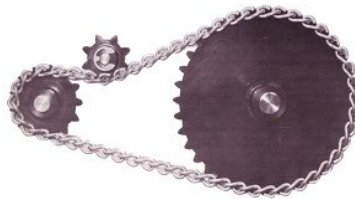


POWER TRANSMISSION

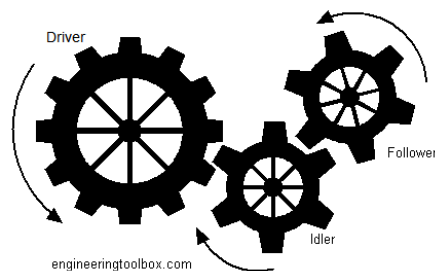
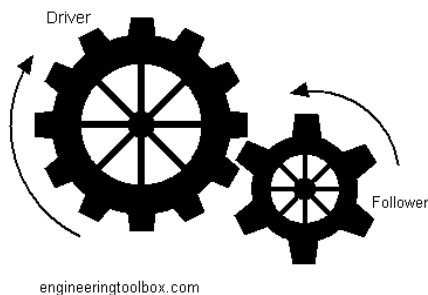
This handout is intended for the use of students involved with FIRST Robotics. Suggestions for revisions and corrections should be sent to George Chisholm, mentor of Team 1334, Oakville Trafalgar High School Robotics at georgechisholm@sympatico.ca

Power can be transmitted by **sprockets and chain**, **timing belt** or by **gearing**. The speed of rotation can be left the same, increased or decreased. Think of the sprockets on your bicycle. An increase in speed reduces torque. A decrease in speed increases torque.

With chain, the direction of rotation is kept the same and speed can be reduced or increased. The distance between **sprockets** is not critical but **chain tensioners** must usually be used.



With gears, the direction of rotation is reversed and speed can be reduced or increased. To get proper mesh, the distance between gears is very important



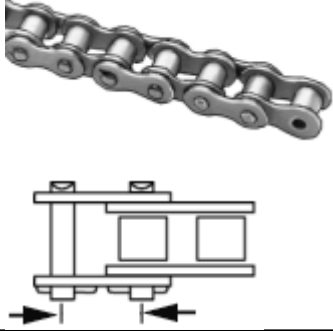




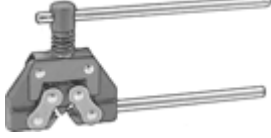


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	<p>Single Strand Chain is sized by the distance from one pin to the next called the pitch. The smallest commonly used is #25 (0.25" or 1/4"). FIRST usually uses #35 (0.375" or 3/8")</p>
	<p>Connecting or Master Link – used to fasten chain together.</p>
	<p>Add and Connect or Half Link – used to slightly lengthen a link. They require a master link as well. The second version is usually only used with #25 chain.</p>
	<p>Idler Sprocket – comes with or without a bearing included. These spin on a shaft and are used to change direction or route a chain around obstacle. A label includes the pitch and the number of teeth.</p>
	<p>Drive Sprocket – locks to a shaft or hub by bolting or using a grub or set screw. A key (see below) can also be used. A label includes the pitch and the number of teeth.</p>
	<p>Chain breaker – used to break a chain apart with limited success. Grinding the heads off the rivets frequently works better.</p>

Chain Tensioners are used to take the slack out of the chain so that it won't jump off the sprocket and also to cut down on **backlash**. There are several types.

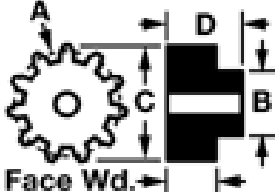

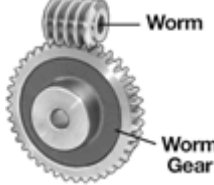




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	<p>Spur Gears – described by the pitch and the number of teeth. Pitch is defined as the number of teeth divided by the pitch diameter. The pitch diameter is about half way between the crest and root of the tooth. The larger the pitch, the smaller the teeth. They come plain bore (hole) for idling or with a keyway and grub screw for locking to a shaft. Small gears are sometimes called pinions. Gears are specified by the pitch (14, 16, 18, 20 etc) and by the number of teeth. Meshing gears must have the same pitch. The distance between the shafts on meshing gears must be the pitch radius of the driving gear plus the pitch radius of the driven gear.</p>
	<p>Gear rack is used to transfer rotary motion to linear motion.</p>
	<p>Worm gears change the direction of the shafts 90 degrees and change the speed of rotation They can only be driven one way</p>
	<p>Mitre gears or bevel gears change the direction of the shafts 90 degrees and keep the speed of rotation the same.</p>
	<p>Lead screws can be single start or multiple start. Used to transfer rotary motion to linear motion. Multiple start provides faster motion.</p>









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	<p>Lead screw nuts – usually plastic.</p>
	<p>Timing Belt – similar to chain but quiet and strong. Belts must be purchased at the correct length. Specified by Trade Size, series, pitch, width and number of teeth.</p>
	<p>Timing Belt Pulley – must match pitch and width of belt. Distance between pulleys isn't critical but a tensioner or idler must frequently be used.</p>
	<p>Vee Belt – quiet and strong. Belts must be purchased at the correct length. Specified by Trade Size, series, width and length. Not used much in FIRST as they can slip.</p>
	<p>Vee Belt Pulley – must match the width of the belt. Distance between pulleys isn't critical but a tensioner or idler must frequently be used.</p>
	<p>Rounthane – a flexible and easily-joined round plastic extrusion. Available in several diameters</p>



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BEARINGS

All bearings are size by the shaft diameter and the outside diameter. Length is sometimes included.

	<p>Sleeve bearing or bushing – usually made of bronze but also of plastic. Usually for low-speed</p>
	<p>Flanged sleeve bearing or bushing – the flange keeps it in place.</p>
	<p>Ball Bearing – more expensive but less friction. Can handle higher speed. Can have a flange which can be very useful. Can be open, sealed or double sealed (to prevent dust etc from getting in to the bearing)</p>
	<p>Roller Bearings – not commonly used by FIRST</p>
	<p>Pillow Blocks and Mounted bearings – not commonly used by FIRST</p>
	<p>Thrust bearings – used with axial loads (parallel to the shaft)</p>
	<p>Turntables or Lazy Susan Bearings – used to support a platform. Range from 3" diameter up.</p>
	<p>Rod ends – used with linkages.</p>



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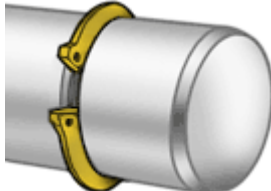
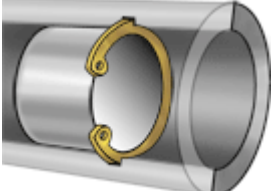


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Other

Retaining Rings are used to hold things in place on shafts. External rings make a good, lighter replacement for shaft collars but aren't adjustable. They are installed and removed using special pliers. A groove must be cut using the lathe for the ring to fit in to.

 <p>External</p>	 <p>Internal</p>
	<p>Snap Ring</p>
	<p>E Style</p>

Shaft Collars are used to stop lateral movement of shafts and gears, sprockets etc on a shaft. They are sized by the diameter of the shaft they fit. They allow adjustment along the shaft

	<p>Set Screw</p>
	<p>Two-piece</p>

Keys are used to prevent sprockets and gears from turning on a shaft. The shaft is usually purchased with the **keyway** already cut in it although a keyway can be machined using a milling machine. A **keyway** can be cut into a gear or sprocket using a **broach**.



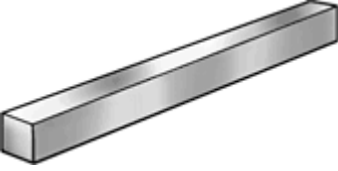
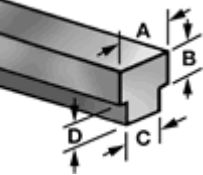
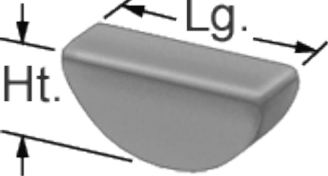
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FIRST

	<p>Square key – come in 12” lengths and get cut to desired length.</p>
	<p>Step Key Used when the keyway in the shaft isn't the same size as the keyway in the gear or sprocket.</p>
	<p>Woodruff key – fits in a half-moon slot in a shaft. The gear or sprocket must be installed after the key. Not commonly used in FIRST.</p>