**Belt Technology**  
The [belt and pulley drive system](https://www.sdp-si.com/products/Timing-Belt-Pulleys/index.php) is one of the most common, there are different types of belt drives, here at SDP/SI two of the main ones are [timing belts](https://www.sdp-si.com/products/details/timing-belt-detail.php) (synchronous belt) and [V-belts](https://shop.sdp-si.com/catalog?cid=p314).

Both are used to transmit motion from one shaft to another with the help of a thin, in-extensible band that runs over at least two pulleys. It is important to [select the right kind](https://www.sdp-si.com/PDFS/Technical-Section-Timing.pdf) of belt drive. V- belts are better suited for high-speed applications while timing belts are better for high torque.

**Advantages**

* Cost-effective
* Simple to use
* No need for parallel shaft
* Come with jam protection
* Load fluctuations are shock absorbed
* Reduce noise and vibrations

**Disadvantages**

* Not compact
* Greater wear and tear
* Inflict heavy load on shafts
* Angular velocity not constant
* Operating temperature at -35° to 85°C
* Velocity not constant due to V-belt slip

Gear drives are probably the first that come to mind when there is a need for power transmission. The [process of operation](https://www.sdp-si.com/resources/elements-of-metric-gear-technology/) is simple, the teeth mesh with each other to transmit power. There are different [types of gears](https://www.sdp-si.com/products/Gears/Index.php) for different purposes, spur gears that work primarily with parallel shafts, bevel gears that work angular, and worm gears that operate at 90° are just a few of the possibilities.

**Advantages**

* They are non-slip drives
* Mechanically strong
* Deliver high transmission efficiency
* Ideal for low, medium, and high-power transmission
* More compact compared to belts and chains
* They can transmit motion over small center distance of shafts

**Disadvantages**

* Cannot be used for shafts with large center distances
* Not ideal for large velocities
* Need regular lubrication
* Multiple gears raise machine overall weight
* They have no flexibility

<https://www.design-engineering.com/wp-content/uploads/2022/02/Table-1-660.jpg>

Advantages of belt drives

Compared to a gear drive, a belt drive can be used to bridge greater distances between two shafts in a simpler way. Chain drives also offer this advantage and are therefore used for bicycles where a relatively large distance has to be covered between pedal and rear wheel.

Frictionally operating belts such as flat belts or V-belts also offer a natural overload function. In contrast to gear drives, overload simply causes the belt to slip through (*sliding slip*). This protects the transmission from major damage. In the worst case, only the belt needs to be replaced and not the entire gears and shafts as in the case of a damaged gear drive.

Another advantage of belt drives is the elasticity of the belts compared to rigid gears. This offers good damping characteristics (shock absorption), especially in the case of sudden torque changes. This is why belt drives are used, for example, in grinding plants or [stone crushers](https://www.tec-science.com/material-science/steel-making/iron-ore-mining-and-dressing/). The starting and stopping behaviour is also damped accordingly and is not as jerky as with rigid gear drives. Note, however, that a high elasticity of the belt also results in increased [elastic slip](https://www.tec-science.com/mechanical-power-transmission/belt-drive/slippage/). Belts can therefore not be made too elastic, but neither can they be designed too inelastic, as otherwise the positive shock absorption properties would be missing.

An additional advantage of belt drives over gear drives is their insensitivity to angular misalignment as long as the axes continue to run in a parallel plane to each other. In many cases, such a misalignment is even deliberate. This makes it easy to redirect the direction of rotation. If the axis of the output shaft is turned by 180° and the belt is crossed, the original direction of rotation can easily be reversed. In contrast to an open belt drive, this is also referred to as a crossed belt drive.

Belt drives do not have to be lubricated in comparison to gear drives. This reduces maintenance costs accordingly. Belt drives also have lower noise emissions than gear drives, since no metallic teeth engage but only relatively soft, elastic belts drive the pulleys. This enables the transmission of high rotational speeds.

In addition, pulleys are usually not complete solid wheels, as is often the case with gears. Pulleys usually have recesses to reduce weight and manufacturing costs. As a result, belt drives are generally lighter than comparable gear drives.

## Disadvantages of belt drives

However, the above-mentioned advantages of belt drives are also countered by disadvantages. Depending on the ambient conditions, belts are subject to more or less severe ageing phenomena, i.e. they lose their elastic properties over time and must be replaced. For this reason, belts can only be used within a certain temperature range. In addition, over time the belts become plastically stretched, so that they have to be re-tensioned at regular intervals.

Another disadvantage of some belt types such as flat belts or V-belts is the associated [slip](https://www.tec-science.com/mechanical-power-transmission/belt-drive/slippage/), which reduces the efficiency of the transmission accordingly. Slippage can only be prevented with timing belts due to the positive force transmission.

In some cases, the increased space requirement of a belt drive compared to a gear drive can also have a disadvantage. This is due to the fact that the belt pulleys cannot be placed directly against each other, while the toothed wheels of gear drives can even mesh with each other and thus be set up in a more space-saving manner. In addition, the wrap angle decreases with decreasing centre distance, so that wrapping can become unacceptably small. Although this can be compensated by idler pulley, it not only increases the design effort but may also increase the required space again.

Regarding the belt Drive

Belt drive is an example of flexible machine element used to transmit power from one shaft to another. Belts are the cheapest mode of power transmission. The selection of a belt drive depends upon;

* The direction of belt motion.
* Power to be transmitted.
* The velocity of shaft and Velocity ratio.
* The distance between shafts, space available.
* Service conditions.

### **Advantages of belt drive**

* They are simple and economical.
* They can transmit Power over a considerable distance.
* They can protect the machine from overloading by slipping of the belt over a pulley.
* Belt drive can absorb shock and damp vibration.
* The operation is smooth and silent.
* They are durable and require very little maintenance.

### **Disadvantage of belt drive**

* Limited Speed range.
* They are not compact.
* Considerable power loss.
* Short service life compared to other mode power transmission.
* The velocity ratio may vary due to belt slip
* They inflict a heavy load on shafts and [bearings](https://www.mecholic.com/2018/10/essential-properties-of-bearing-metal.html).

We had looked up the average force that a typical person can apply with their legs and it was found that, with both legs, a human can push around 1.8-2.2 times their body weight. [13] It could then be assumed that each leg would be able to push half of that value. We assumed that each leg could push 1.1 times their body weight. This force is applied 7 inches away from the center producing a torque on the first gear of 2772lb-in. The force that the gear pulls the chain with can be determined from this torque and the radius of the gear being 3.25in. From this information it was determined that the force through the chain is 426.5lb. This force is transmitted to the secondary gear system where it will apply a torque on the drive shaft. The max torque would come from the chain being on the biggest gear in the system. With the force applied on that gear, it was shown that the maximum torque was 115.5lb-ft which was well within the limits of what the steel can handle with a factor of safety of 2.14.