How to implement flat belt drives

Flat belt drives are simple mechanisms that enable power from a rotational power source, such as an electric motor or combustion engine, to be transferred to rotating machinery.

You can achieve operating efficiencies of up to 98% by installing them correctly. In comparison to V-belt drives, you can typically make savings of up to 3% with a payback period of only a few years. Flat belt drives should be considered for both new applications and replacing existing belt drives.

The business case

When flat belt drives are installed correctly, with optimum alignment and tensioning, they can achieve efficiencies of up to 98%. This is 2.5% to 3% more efficient than V-belt drives. While low-power flat belt drives, with pulley diameters greater than about 75cm, may cost less than the equivalent V-belt drive, smaller flat belt drives may be more expensive. Despite this, the energy saved from flat belt drives' higher efficiency will repay the additional cost for typical low-power applications within a few years.

The technology

Previously, flat belt drives had problems with high tension and alignment. Improved designs and advances in materials now mean that both low and high-power transmission is efficient using flat belt drives.

The advantages of using flat belt drives and V-belt drives can be summarised as follows:

Table 1

Flat belt drive	V-belt drive
Higher efficiency – maximum possible efficiency attained by flat belts is 98%.	2.5% to 3% lower efficiency due to larger bending losses and creep; and pulley wedge losses.
Better service life – belt is frictionally engaged on the outer pulley diameter, less wear on belts and pulleys.	Worse service life – engaged on lateral wedge surfaces, more wear on belts and pulleys.
Simple to install securely and tension accurately using simple measuring marks on the belt.	V-belt drives pulleys are physically narrower than the equivalent flat belt pulley, saving space.

Application

Direct flat belt drives are typically used as conveyors, including inclined conveyors, as well as for general power transmission applications such as compressors, machine tools, and other heavy industrial equipment.

Flat belts are available in almost any width and length. This means that drives can be sized closer to optimum, rather than the next size larger, improving efficiency.

The material used for the belt can greatly affect the performance of the system and determines the types of applications for which it is suitable. The properties of various rubber materials may also be sensitive to temperature, or other extreme operating environments, which may change the characteristics of the material.

V-belt drives are useful when there is a restriction on the width of the pulley to save space.

The following table summarises the types of flat belt drives suitable for different applications:

Table 2

Type of flat belt drive	Comments
Small woven semi-elastic endless flat belts	Damping maximised by choice of materials.
	Do not require pulley adjustment.
	Can work well in sets.
	Relatively inexpensive.
Non-stretch endless	Belts can be thin, reducing losses. They may be made of a range of materials including Kevlar, rubber and steel.
	Can be used in place of gearing.
Higher power flat belts	Availability of new rubber materials eliminates the need for high tension to grip pulley.
	Reduces shaft and bearing loads and maximises power transmission.
	Adding a pattern to the surface of the belt can enhance efficiency.

Specification checklist

The following table sets out the key parameters you will need to discuss with your supplier when you are carrying out a project to implement direct flat belt drives.

Table 3

Item No	Parameter	Comments
1	Belt material	e.g. Kevlar, leather, rubber, steel. Other attributes such as operating temperature range, dusty/oily/wet operating environment or anti-static required may be specified depending upon the application.
2	Belt length	In mm
3	Belt thickness	In mm
4	Belt width	In mm
5	Working load per unit width	Many belts can be produced in any width so this allows for proper width selection.
6	Maximum operating speed	Maximum speed at which the belt will retain its strength specification.
7	Minimum pulley size	Usually determined by the stiffness of the belt and its ability to go around a pulley without kinking or exceeding its deformation limit.
8	Modular, open-ended or endless belt	• Modular belt – customizable and/or adjustable via interlocking sections. • Open ended – Comes in a roll and may be cut and spliced to desired length. • Endless – made as one piece with no obvious join. • Belts are also available with a half-twist included before the ends are joined so the belt wears evenly on both sides.
9	Tracking features	Tracking features (which engage with the pulleys to prevent slippage) should be specified wherever possible.
10	Drive unit and power	• Electric motor/combustion engine • Power in kW.

Commissioning checklist

When you are commissioning flat belt drives make sure you ask a supplier or manufacturer to check the following:

- The alignment of the belt on the pulleys: although flat belt drives can operate while misaligned, this reduces belt life.
- The tensioning of the belt should be as specified. Also ensure tracking features on the belt are working.

Common problems

Make sure that the belt is operated at the recommended tension. This is essential for optimum energy efficiency and should be checked routinely.

The power transmitted by the belt from the drive rises with increasing belt tension. If the tension is too low the belt will slip at high loads. However, putting too much tension on the belt will increase the load on the belt and bearings and increase losses. Use tracking features to help minimise problems.

Finding a supplier

The best way the find a manufacturer of direct flat belt drives is to do a web search. Ask for references to ascertain whether the product has performed successfully in other, similar situations.