Pulleys - types - solid - split and 'V' belt pulleys

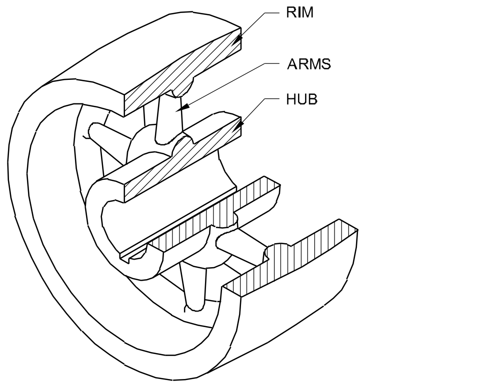
Objectives : At the end of this lesson you shall be able to
- **state the different types of pulleys and their uses**
- **state the purpose of crowning of a pulley**
- **state the importance of wrapping angles in a belt drive**
- **state the maintenance aspects of V belts**
- **state the advantages of a chain drive.**

Pulley for flat belt

Pulleys for flat belts are made from cast iron or mild steel and are available in solid or split form.

The flat pulleys have a wide rim with a crowned surface for retention of the belt. The hub is strongly designed and provides the means of securing the pulley to the shaft. The arms unite the hub and rim into a rigid assembly. The arms of a pulley may be of circular or elliptical cross-section, but larger at the hub than at the rim. (Fig 1)

Fig 1



FLAT PULLEY

Crowned face of pulley

The rim of a pulley for flat belt is generally made convex and this is called the crowned face of the pulley. The crown faced pulley will keep the belt centralised even if there is any slight tendency to run off. Shifting the belt from the fast pulley to the 'loose' pulley will be quick and easy. Excessive crowning will be injurious to belting.

'V' groove pulley

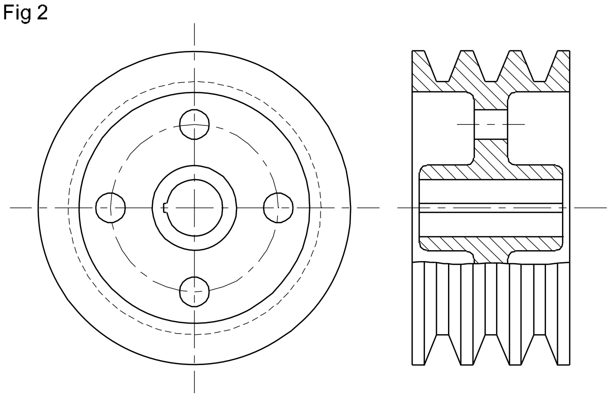
These pulleys have one or more 'V' grooves to carry the V belts. Fig 2 shows a V belt pulley having three V grooves. These pulleys are widely used in transmission of motion in machine tools and are made from cast iron, wrought iron, mild steel or wood.

Fast and loose pulley

Pulleys are usually secured to their shafts by means of a key or grub screw. The function of the pulley keyed to the shaft is to convey rotation from the driving to the driven pulley by means of a belt. This is called a fast pulley.

The loose pulley is not keyed to the shaft and is free to rotate on the shaft.

Fig 2

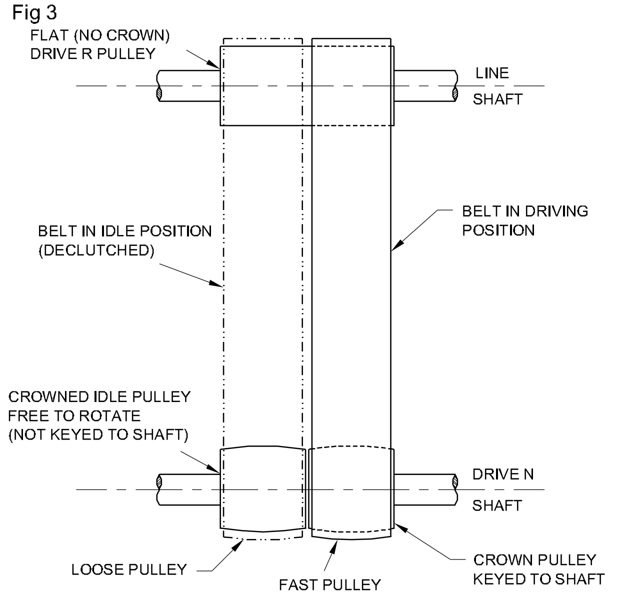


'V' PULLEY

Function

A machine can be easily stopped or started whenever required by the use of a pair of fast and loose pulleys. This pair is mounted on a counter- shaft near the machine to be operated. When the driving belt from the main shaft is on the fast pulley, the countershaft is in motion. If the belt is shifted from the fast pulley on to the loose pulley, the countershaft will stop rotation. Fig 3 shows the position of the fast and loose pulleys in a driving system.

Fig 3



Determining the size of crowning faces of pulley

Objectives: This shall help you to
- **define the importance of crowning**
- **state the specification of standard pulleys.**

Crowning one or several pulleys in belt system is the most common way of tracking a belt. For flat power transmission belts and narow conveyor belts(up to 8 in.), a radius crown is used. For wider conveyor belts, a trapezodal crown is typically applied. Note: Never utilize an apex crown!

Radius Crown Specifications for Flat Belt Pulleys

A radius crown represents a great way to track a belt. Dimensionally, it does not take a big crown height in order for the belt to track properly, and exceeding the seemingly small amounts below will actually do more harm than good!

In a system with multiple pulleys, crown the pulleys that turn the same way.

The min. pulley face width

W_p = (belt width W_b x 1.1) + 0.5 in.

The max. belt width

W_b = (pulley face width W_p - 0.5 in) / 1.10

Fig 1

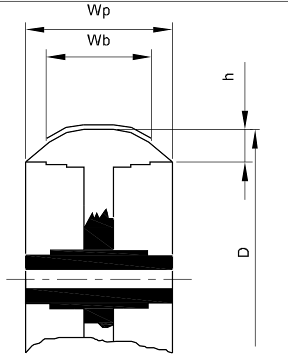


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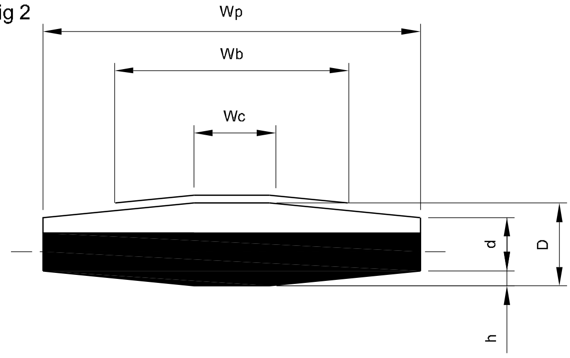
Fig 2



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Standard Radius crown heights h						
Pulley Face Width W_P	Pulley Diameter D					
	1-6	6-12	12-18	28-40	40-60	>60
in	in	in	in	in	in	in
1-5	0.031	0.047	0.051	0.067	0.078	0.098
5-10	0.039	0.051	0.059	0.078	0.090	0.110
10-16	0.043	0.055	0.063	0.087	0.098	0.118
>16	0.047	0.059	0.078	0.098	0.118	0.137

Convert to metric units

pulley Diameter D	Crown Height h
1 to 2.75	0.012
2.75 to 4	0.017
4 to 6	0.022
6 to 8	0.026
8 to 11	0.034
11 to 14	0.042
> 14	0.045

Note:

The cylindrical part of the pulley W_c is <u>half</u> of the belt width $W_{b.}$. Also, it is recommended for the pulley width w_b for the pulley crown to function properly. For pulley widths less than 8 in., use a radius crown and refer to the flat belt pulley specifications above.

Belt length

Objective: At the end of this lesson you shall be able to

- **Calculate the length of the belt for open belt drive.**

In belting technology, there are a few special expressions and technical data which need a brief explanation.

Belt length

The length of power transmission flat belts can be expressed in three ways:

- Geometric belt lenght (l_g)
- Effective belt length (l_{eff})
- Shortened belt lenght (l_s)

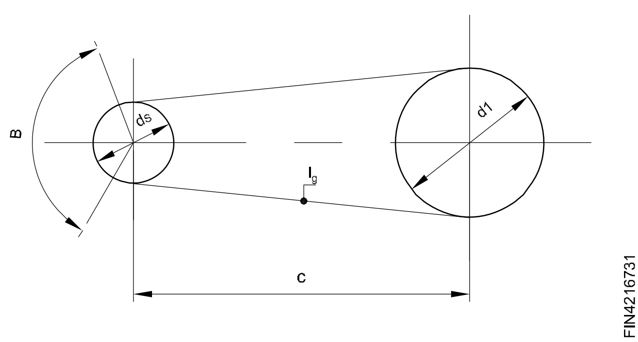
For common two pulley drives, the difference between geometric and effective belt length is negliglble. However, in specific applications, e.g. short centre distance and / or relatively thick belts, limited take -up etc., greater calculation accuracy is necessary.

Please note that the theoretical considerations below are automatically taken into consideration when using the POWER - SeleCalc calculation program.

Geometric belt length (l_g)

The geometric belt length means the inner circumference of an un-tensioned belt drive on the assumption that the belt is infinitely thin. The belt thickness and the position of the neutral layer are not considered.

Fig 1



Exact formula for the calculation of the geometric belt length of a two pulley drive:

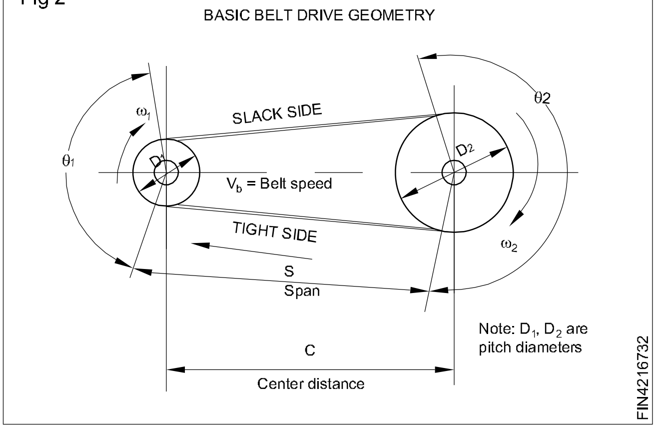
$$lg = 2_c \sin(\frac{\beta}{2}) + \frac{\pi}{2}\left[d_S\ d_l + \frac{(d_l\_d_S)(180-\beta)}{180}\right](mm)$$

c = center distance (mm)

d_s = diameter of small pulley (mm)

According to SANS 1669 Bag centre	Belt Face 1350	900 1050 1700	1050 1200 1850	1200 1350 2050	1350 1500 2300	1500 1700 2450	1650 1850 2600	1800 2000 2900	2100 2300 3200	2400 2600
Pulley Diameter	Shat Dia Pulley Dia				Resultant tensions (KN)					
200	100/315	21	18	16	13	10	10	9	8	7
250	110/400	30	26	23	19	16	14	13	12	10
315	120/400	45	37	33	27	22	20	19	16	14
400	130/400	60	51	45	37	30	28	26	22	19
500	140/500	80	70	60	50	41	37	35	30	75
630	150/500	100	90	80	66	54	49	45	40	35
800	160/500	119	119	105	86	70	64	60	50	45
1000	170/630	144	144	133	110	88	81	75	65	55
1250	180/630	170	170	165	138	112	100	95	82	70
	190/630	200	200	200	170	138	130	120	100	90

Fig 2



- The belt is placing around the two sheaves while the center distance between them is reduced, then sheaves are moved apart
- Friction causes the belt to grip the driving sheave, increasing the tension in one side, called the “tight side”, of the drive
- The opposite side of the belt is still under tension (at a smaller value) that is called the ‘slack side’.

d_l = diameter of large pulley (mm)

β = arc of contact on small pulley [°]

$$\beta = 2 \arccos \frac{(d_l - d_S)}{2c} = [°]$$