# V-Belt Drive: Number of Belts and Centrifugal Tension

Belt speed, design power with a service factor, number of V-belts from the rated power per belt, centrifugal tension and the tight- and slack-side tensions.

**Method:** Budynas and Nisbett; Shigley's Mechanical Engineering Design; ...

## Input parameters

Unit system: SI

| Parameter | Value | Unit |
|---|---|---|
| Transmitted power | 22.000 | kW |
| Service factor | 1.3000 | |
| Rated power per belt (maker's data at this speed and diameter) | 6.0000 | kW |
| Driver pulley pitch diameter | 200.00 | mm |
| Driver speed | 1,450.0 | rpm |
| Belt mass per metre | 0.19000 | kg/m |
| Belt–groove friction coefficient | 0.30000 | |
| Groove angle | 39.998 | ° |
| Wrap angle on the small pulley | 160.43 | ° |

## Calculated results

| Parameter | Value | Unit |
|---|---|---|
| Belt speed | 15.184 | m/s |
| Number of belts | 5.0000 | |
| Centrifugal tension per belt | 43.807 | N |
| Tight-side tension per belt | 455.85 | N |
| Slack-side tension per belt | 79.148 | N |

### Notes for this case

• Rated power per belt comes from the belt maker's tables for the section, small pulley diameter and speed (with arc and length corrections). Tensions are at the design power, just at slip. Arc-of-contact and belt-length corrections to the rated power per belt are left to you.

## Formula and method

$$n = \left\lceil \frac{K_s P}{P_b} \right\rceil, \quad T_c = m_b v^2, \quad \frac{T_1 - T_c}{T_2 - T_c} = e^{\mu\theta/\sin\beta}$$

### Variables

| | | |
|---|---|---|
| $P$ | Transmitted power | W |
| $K_s$ | Service factor | - |
| $P_b$ | Rated power per belt (maker's data at this speed and diameter) | W |
| $d$ | Driver pulley pitch diameter | m |
| $N$ | Driver speed | 1/s |
| $m_b$ | Belt mass per metre | kg/m |
| $\mu$ | Belt–groove friction coefficient | - |
| $2\beta$ | Groove angle | rad |
| $\theta$ | Wrap angle on the small pulley | rad |
| $v$ | Belt speed | m/s |

| | | |
|---|---|---|
| $n$ | Number of belts | - |
| $T_c$ | Centrifugal tension per belt | N |
| $T_1$ | Tight-side tension per belt | N |
| $T_2$ | Slack-side tension per belt | N |

### Method and standards

Belt mechanics.

### Assumptions and limits

- The rated power per belt is entered as the maker gives it; arc-of-contact and belt-length correction factors must be applied to it before entry. The page warns above about 30 m/s belt speed.
- Belt at the point of slip at design load.

### References

- Budynas and Nisbett
- Shigley's Mechanical Engineering Design
- 10th ed. (McGraw-Hill, 2015)
- ch. 17 (V-belts: tension ratio e^(μθ/sin β), centrifugal tension)

## Report details

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|---|---|
| Report reference | FCC-18BP-B33K (the same inputs always give the same reference) |
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| Calculator | V-Belt Drive: Number of Belts and Centrifugal Tension |
| Method last reviewed | 13 November 2026 |
| Software release | FireCAD Calc, release of 17 November 2026 |
| Release checks | 2 reference cases of this calculator, computed independently, are checked on every release |

Results are for engineering estimation. Verify critical designs against the referenced standards and your own data.

### This calculator online

https://calc.firecad.com/mechanical/machine-design/v-belt-drive-number-of-belts

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.