



$$[Nm] \approx 9550 \frac{N [kW]}{n [obr/min]}$$

$$\approx 716 \frac{N [KM]}{n [obr/min]}$$

# DESIGNER HANDBOOK

General purpose belt gearings with v-belts produced by "STOMIL SANOK" S.A. used in the construction on machines and devices

fifth edition, february 2012



GENERAL PURPOSE BELT GEARINGS  
WITH V-BELTS PRODUCED BY "STOMIL SANOK" S.A.  
USED IN THE CONSTRUCTION  
ON MACHINES AND DEVICES

DESIGNER HANDBOOK  
FIFTH EDITION, FEBRUARY 2012

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# 1. General information.

## 1.1. Introduction.

Handbook discusses, used in engineering industry, V-belts gearings produced by "STOMIL SANOK" S.A. was developed in order to provide hints in correct gearing parameters selection. Following information create basic guidelines regarding product usage but do not exempt from the duty to fulfill rules of machines and devices designing as well as health and safety regulations.

Following handbook includes suggestions of correct gearing handling and maintenance, specification of narrow profile, normal profile and power bands produced by "STOMIL SANOK" S.A. used to drive gearings in engineering industry, as well as information necessary for correct stating:

- size and number of belts to transmit required power;
- dimensions of belt pulleys;
- length of belt and axle base;
- conditions of work and maintenance;
- conditions of storage.

V-belts produced by "STOMIL SANOK" S.A. fulfill requirements of producers of automotive vehicles, mining industry, engineering industry, railroad and many others. This product is manufactured over 40 years and production process is continuously modernized. Usage of quality management system (Certificate RW TUV from Essen for compliance of "STOMIL SANOK" S.A. quality system with standard EN ISO 9001), ensure obtaining excellent product which fulfill its designation without any reservations. "STOMIL SANOK" S.A. V-belts are designed to fulfill expectations of the most demanding users.

Production process includes many groups of V-belts, which are used in industry drives, agricultural drives, automotive industry drives and many others. Standard offer of "STOMIL SANOK" S.A. includes following V-belts:

- narrow profile (narrow);
- normal profile (normal);
- power bands;
- wide profile;
- variator;
- two-side action;
- flat drive belts;
- microbelts.

At the request of customers we also produce not typical V-belts of dimensions and properties agreed individually.

To deliver our products directly to our customers, distribution network of specialized distributors was created, who possess full range of V-belts. List of distributors is given on the last page.

## 1.2. Advantages of gearings with V-belts.

Belt gearing with V-belts guarantee quiet, calm and smooth operation. Its advantage is a possibility to smooth sudden load changes as well as damping of vibrations. Simple and cheap construction (without body and without lubrication) do not require special service and special maintenance what reduce costs of operation. Used up V-belts can be quickly and easily exchanged without prolongation of machine downtime. Belt gearings with V-belts give possibility to move power at long distances as well as big freedom in selection of axle base of pulleys.

The ration can be easily changed by usage of pulleys with number of grooves of different diameters and by moving a belt from one groove to other ones. The advantage of belt gearing is that drive is not transferred during overloads of short duration, what protects other mechanisms of drive from excessive overloads what could lead to their damage. Belt gearings are not very sensitive at imperfections of mutual setting of pulley axis. Belt drives give possibility for power distribution i.e. drives transferring from one shaft to other ones.

### 1.3. Factors influencing belt durability.

#### a) Number of belts in one set.

Belt gearing is designed for optimal number of used belts. If the number of belts in one set decrease, lifetime of remain belts lowers disproportionately. If for example: according to calculations drive requires usage of 10 belts, and if one belt will be removed, lifetime of remain belts decreases not by 10% but by 30%.

#### b) Belts tension.

For excellent drive transferring and for reaching required belts durability a very important factor is to ensure correct belts tension. Belts should be tensioned as appearing slippage at the pulley not exceed 1%.

Too small tension causes excessive belts slippage at belt pulley; too big tension – decrease belt lifetime as well as quicker bearings wear in propulsion machinery and driven machinery.

During machines transportation and during storage is required to lower belts tension.

As the tension was correct it is recommended its calculation, performing and controlling according to methods described in chapter 5.

#### c) Correct belt pulley selection.

Important factor of reliability and equal operation of V-belts is exact fulfilling of conditions specified for belt pulleys:

- belts should work at grooved pulleys of dimensions fitted to belt section, as only side (working) walls of belt were in contact with walls of pulley grooves;
- pulley grooves should be smooth, without deformations, snagging and contaminations, particularly grease and oils. Surface coincides of groove pulleys should not be painted.
- all grooves edges of belt pulleys should be rounded of radius  $r > 1$  mm;
- minimal recommended diameter of pulley for given belt section should be observed unless compactness of gear is going to be reached at all costs, even at the expense of reduced efficiency and lowering of belt lifetime;
- all wheel belts should be balanced statically (degree of quality Q in accordance to VDI 2060); additionally for wheel belts which peripheral speed exceed 30 m/s, or if a ratio of diameter to width of pulley rim  $d_p/s < 4$  while  $v > 20$  m/s, should be balanced dynamically (degree of quality Q 6.3);
- with respect to belt lifetime is recommended to use pulleys of big diameters, for which belt speed should be between 25-30 m/s;
- grooved pulleys should be made according to recommendations included in chapter 4.

#### d) Belts coupling in belt units.

In order to transfer a power which increase a power transferred by one belt, special units are used which consist of a few single belts of the same section and the same length, completed in one unit or power bands are used. In determining number of belts in a gearing it is necessary to remember, that in most favorable conditions works single belt. In multibelt gearing all dimension differences particular belts and grooves at pulleys create parasitic circulating power and increase belts slippages what negatively affect gearing efficiency and belts lifetime. In comparison with belt units better conditions of power transferring possess power bands.

In multibelt drives, to ensure comparable tension of each single belt is necessary to use selected belts with respect to length tolerance.

- Tolerance of length in belt unit is considerably lower in relation to tolerance of belts which do not work in the same set. "STOMIL SANOK" S.A. produce also belts of small length tolerance (with marking  $L=L$ ), which do not require complementing in belt units.

In case of damage of one belt is necessary to exchange whole belt unit. Belts of different producers should not be joined in one belt unit.

Power bands must not be used at pulleys of belt units.

### e) Usage of tension rollers.

In a gearing, where is not possible to strain a belt by changing a distance between driving machine and driven machine, a tension roller can be used for belt tension. Other phenomenon, which require usage of tension roller are vibration of long belt tie rod of small tension or short tie rod during rapid load changes.

Each usage of rollers increase frequency of belt inflection and introduce additional bending stresses, what shorten its lifetime.

Tension rollers can be placed outside and inside of belt. Tension rollers placed outside of a belt cause belt deflection in the opposite direction then during normal operation, what seriously shorten belt lifetime. So is decisively recommended to use tension rollers from inside of belt.

Dimensions of grooves of internal rollers should be the same as dimensions of grooves for work pulleys. For power bands and normal profile belts is allowed to use flat internal rollers. Diameter of internal roller should be bigger or equal minimal diameter recommended for given belt section. Internal roller decrease angle of wrap, so is necessary to place it as close as possible to a big pulley.

External rollers must be flat and must possess diameter bigger or equal 1,5 of minimal diameter, recommended for given belt section. External roller increases wrap angle, so it must be placed as close as possible to small pulley.

External and internal tension rollers should be placed from the passive tie rod side (loose); this exclude change of gearing rotation.

### f) Cleanliness.

Belt gearing is sensitive for chemical influence of environment, its temperature and humidity, as well as lubricants and pollutions. In case a gearing operate in an environment of increased pollution, then it should be protected by special covers. Power bands require special protection from environmental pollution.

Oils and lubricants cause decreasing of coupling between belt and pulley as well chemically affect at belt causing its quick destruction.

Minor pollutions like dust and sand cause quicker grinding of side walls of belt and pulley. Big pollutions like stones can cause destruction (snagging) of belt pulley or belt rapture.

Belt gearing should be screened and protected from direct influence of environmental conditions.

### g) Storage of belts.

Properly stored V-belts do not lose their properties rods for years. Rubber products stored in adverse conditions together with bad handling change physical properties. These changes are caused by influence of oxygen, ozone, extremely unfavorable temperatures, light, humidity or solvents.

Storehouse should be dry and free of dust. Belts should not be stored together with such materials like: solvents, fuel, lubricants, acids and other chemicals.

Low temperatures of storage are not usually harmful for V-belts, but because they are getting rigid in low temperatures, is necessary to heat them until +20°C. Belts should be protected from direct influence of heat sources.

V-belts should be protected from light, mainly from direct solar radiation as well as strong artificial light with large share of ultraviolet as for example not covered fluorescent lamps (ozone is created).

To protect from harmful ozone influence, storage compartments can't possess appliances which create ozone, for example: fluorescent light sources, mercury lamps, electrical high voltage devices, etc.

Compartments of big humidity are not good for storage of V-belts. Relative humidity of air is best for V-belts if is lower 65%.

Pay attention to store belts in not-tensioned state as well as not distorted state. If there are stored in a hanging position, then the mandrel the belts are hanged should have diameter at least 10 times bigger than belt thickness.



## 1.4. Rules of correct gearing utilization with V-belts.

After a gearing was mounted and belts were adjusted generally belt gearing do not require any maintenance work. To ensure satisfactory and error-free belt gearing operation as well as long lifetime of belts, following hints should be observed:

- while designing a gearing possibility of changing the distance between pulley belts must be taken into account in order to facilitate belt installation and then its tensioning in order to achieve required slippage (taking into account 1,5% possibility of total extension of belt length during its operation, as well as 1% tolerance of belt length);
- pulley belts should be made in accordance to dimensions and requirements included in following handbook in chapter 1.3.c);
- grooves of pulley belts must be clean, without any damages and rust protective substances. Belt should be exactly set in grooves as its whole side surface was in contact with groove walls; is not acceptable a belt was in contact with pulley by its bottom surface (exception: special drives as for example flat-V-belt drives);
- earlier exchange of broken (used-up) belt pulleys protect from unexpected failures of belts and gearing;
- is not acceptable to use whenever substances which increase adhesion a belt to a pulley; this is superfluous and what's more harmful;
- belts should be mounted manually and while least groove pulleys spacing; using any auxiliary tools in forbidden;
- after exact belts setting inside their grooves, tension should be preliminary adjusted; then gearing should be steered for a short period of time without load, then tension should be corrected again;
- maximal non-parallelism of gearing pulleys axes must not be bigger then 1 mm by 100 mm axis length, and tolerance their mutual pulleys grooves displacement must not exceed 0,25% of distance between axis;
- during first hours of operation, belt will be lengthened; during this time correction of its tension is required. According to our experience, after first hour of belt operation under full load, belt is lengthened by 70% of total allowable extension, which is 1,5% of belt length – a gearing must be protected by protective shield;
- tension of belts during normal operation should be periodically checked and adjusted;
- in multi-belts gearings only belt units should be used which consist of specially completed belts in accordance to required length tolerance;
- while one of belts in belt unit is broken, whole belt unit must be replaced by new one;
- in case of V-belts pollution they should be cleaned by glycerin-spirit mixture in a ratio 1:10, other chemical substances should be avoided.

Following sharp objects must not be used to clean belts: wire brush, abrasive paper, etc, because mechanical damages take place at the belt surface.

## 1.5. Typical failures of V-belts and their reasons.

Type of failure	Probable reasons
1. Belt rupture after short period of operation.	<ul style="list-style-type: none"> <li>• belt tearing during mounting on pulley;</li> <li>• drive blockage with respect to failure of driven machine or foreign body entrapped inside the drive;</li> <li>• poorly calculated drive with too small number of belts (poorly calculated coefficient of conditions of operation <math>k_7</math>);</li> </ul>
2. One-side usage of belt at its side wall.	<ul style="list-style-type: none"> <li>• too big not-parallelism of belt pulleys axis;</li> </ul>
3. Earlier usage of side surfaces at whole length of belts.	<ul style="list-style-type: none"> <li>• too big torque (mainly for drives with big start-up torque during driving machine start-up and big resistance torque during start-up of driven machine is necessary to use equipment ensuring soft start);</li> <li>• improper angle or excessive usage of groove of pulley;</li> <li>• too small belt tension;</li> <li>• too often short-term overloads of gearing with respect to failure of driving machine;</li> <li>• too small number of belts;</li> <li>• lack of parallelism of belt pulleys setting;</li> <li>• minimal pulley diameter is exceeded;</li> <li>• surface of grooves possess too big roughness;</li> </ul>
4. Local usage of side surfaces.	<ul style="list-style-type: none"> <li>• too small belt tension;</li> <li>• blockage of driven machine pulley with respect to bearing failure;</li> </ul>
5. Grooves at side surface at whole belt length.	<ul style="list-style-type: none"> <li>• belt friction because with contact with part of a machine;</li> <li>• belt works in used-up groove of pulley;</li> <li>• improper groove cross-section;</li> </ul>
6. Transversal belt breakage at the bottom side.	<ul style="list-style-type: none"> <li>• usage of external tension roller instead of internal;</li> <li>• too small diameter of tension roller;</li> <li>• excessive or too small temperature of operation;</li> <li>• too big slippage;</li> <li>• chemical influences;</li> <li>• excessive belt tension;</li> </ul>
7. Indurations and ruptures of a wrap.	<ul style="list-style-type: none"> <li>• strong influence of dust;</li> <li>• too big ambient temperature;</li> <li>• influence of chemicals;</li> </ul>
8. Detachment of cloth wrap and symptoms of rubber bulging.	<ul style="list-style-type: none"> <li>• reason of long-term influence of oil, grease or other chemicals at a belt;</li> </ul>

9. Strong vibration.	<ul style="list-style-type: none"> <li>• base of axle bigger than is recommended;</li> <li>• big shock load;</li> <li>• too small belt tension;</li> <li>• non balanced grooved pulleys;</li> <li>• overloaded drive;</li> <li>• angle of groove is not correct;</li> </ul>
10. Twisting of belts.	<ul style="list-style-type: none"> <li>• lack of coaxiality in pulleys setting;</li> <li>• not correct belt or groove profile;</li> <li>• excessive vibration;</li> <li>• too small belt tension;</li> <li>• penetration of foreign material into grooves;</li> <li>• overloaded drive;</li> </ul>
11. Falling of belts from pulleys after short period of operation.	<ul style="list-style-type: none"> <li>• too small belt tension;</li> <li>• too small frequency of control and adjustment of belt tension;</li> </ul>
12. Too loud operation of gearing.	<ul style="list-style-type: none"> <li>• belt pulleys are not set coaxial;</li> <li>• too small belt tension;</li> <li>• overloaded drive;</li> <li>• grooved pulleys not balanced;</li> </ul>
13. Uneven belts stretching.	<ul style="list-style-type: none"> <li>• faulty belts grooves;</li> <li>• used belts do not create a set of belts;</li> <li>• a few belts from a belt unit were replaced by new ones;</li> <li>• unit of belts composed of from belts of different producers;</li> </ul>
14. Excessive heating of bearings.	<ul style="list-style-type: none"> <li>• bearings not lubricated;</li> <li>• grooved pulleys not balanced;</li> <li>• too big tension;</li> </ul>
15. Lowering of speed of driven pulley.	<ul style="list-style-type: none"> <li>• check relationship between diameters of pulleys and their speeds;</li> <li>• too small tension;</li> </ul>
16. Different tension of single belts working in belt unit.	<ul style="list-style-type: none"> <li>• belts do not create a set of belts or do not possess marking <math>L=L</math>;</li> <li>• different pitch diameters of particular grooves in belt pulley;</li> <li>• usage of belts of different quality in one set as well as belts;</li> <li>• coming from different producers;</li> <li>• a few belts from a belt unit were replaced by new ones.</li> </ul>

## 2. 2. V-belts of general purpose used in belts drives of machines and devices.

### 2.1. V-belts produced by "STOMIL SANOK" S.A.

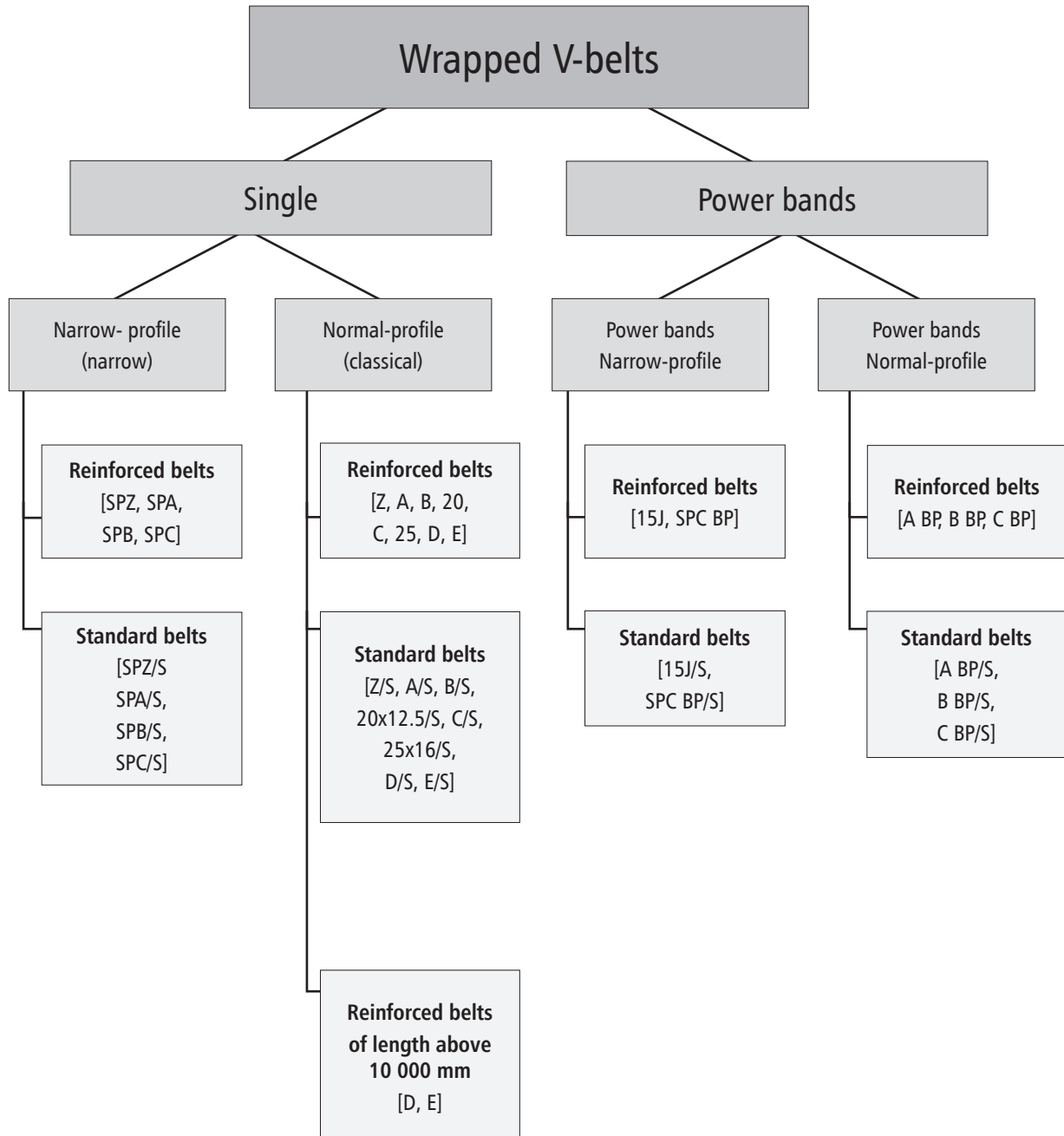
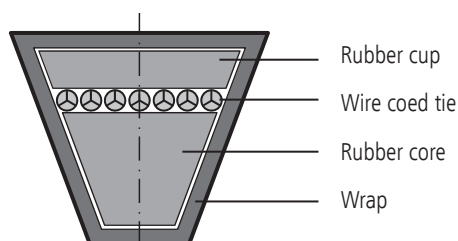


Fig. 2.1. Types of V-belts produced by "STOMIL SANOK" S.A., used in engineering industry.

## 2.2. Narrow profile V-belts (narrow) produced by "STOMIL SANOK" S.A.

### Structure and advantages

Narrow-profile V-belts produced by "STOMIL SANOK" S.A. with proven technology, specially developed construction (drawing 2.2) and composition suitably chosen raw materials create reliable element of industry drives as well automotive drives.



**Rys. 2.2.** Structure of narrow-profile belt (narrow).

Used for production of these belts high quality neoprene, polyester cord and cotton fabric ensure for them durability for temperature and oils.

On custom request antistatic version of belts is also possible.

Cord is impregnated and covered by special rubber mixture what ensure homogeneity of connection between cord and core as well as rubber overlay. Gummed wrapping made of special fabric increase its resistance for abrasion of the surface, big flexibility and fatigue strength. V-belts are continuously tested by static and dynamic control measuring devices. Functioning and continuous development and quality system in our plants ensure to get product of full traceability and repeatability.

Properties of narrow-profile V-belts:

- transmitted powers are highly bigger in relation to powers transmitted by classical V-belts of the same width of the pitch. Thanks to saved installation space costs of complete drive are approximately 30% lower in relation to drive with classical belts;
- a ratio of height to width of belt is approximately 1:1,2;
- lower mass of a belt (in relation to classical belts) lower centrifugal force, what let to increase bet speed until 40 m/s;
- big outside surface of a belt in relation to its cross section improves heat transferring;
- can work at temperatures in a range from -35°C to +100°C;
- minimal diameters of belt pulleys (for proper gearing operation) are bigger for classical belts.

### Structural variations and their markings

Narrow-profile V-belts produced by "STOMIL SANOK" S.A. were specially constructed to use in engineering industry. An area of application start from low-loaded drives like rotation pumps until highly-loaded milling drives and stones crushers.

They are produced according to standard PN-ISO 4184.

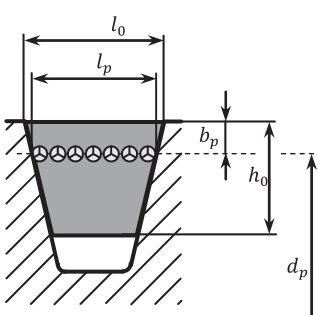
According to decisions of ISO TC41 committee, narrow-profile belt got marking SPZ, SPA, SPB, SPC (SP – marking of narrow profile, Z; A; B; C, - marking of belt section).

Two structural variations of narrow-profile belts are produced by "STOMIL SANOK" S.A.

- basic belt version of this profile are reinforced belts marked by symbols: SPZ, SPA, SPB, SPC, (overprint at a belt in yellow color);
- second version of narrow-profile belts are belts of standard type. This is a version, of which belts possess lifetime approximately 25% lower in relation to belts of reinforced version. These belts are marked by following symbols: SPZ/S, SPB/S, SPC/S (overprint at a belt in green color).

**Table 2.1.** Dimensions of narrow-profile belts.

Dimensions in millimetres

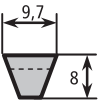
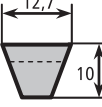
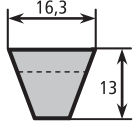
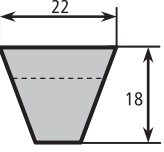
	Narrow belt ISO, DIN marking	SPZ	SPA	SPB	SPC
	ISO, DIN marking				
	approximate upper width $l_0$	9,7	12,7	16,3	22
	belt width $l_p$	8,5	11	14	19
	belt height $h_0$	8	10	13	18
	height under pitch line $b_p$	2	2,8	3,5	4,8
	minimal pulley pitch diameter $d_{p\ min}$	63	90	140	224
	1 m belt mass [kg] $\approx$	0,08	0,14	0,22	0,42
	Acceptable belt speed [m/s]	40			

### Determining of the length

Standards ISO and DIN take pitch width  $l_p$  (effective) as a basic value for V-belts and grooves standardization. This is width of V-belt, which is unchanged when V-belt is bent at an angle  $90^\circ$ . Pitch length  $L_p$  is then belt length measured at the height of its pitch width. So this dimension should be considered as reliable in determine the belt length. Then, determining the length of belt is necessary to pay attention on kind of pitch length and possibly calculate it, using for our belts calculation factors stated in table 2.2.

According to standards, gradation in length (pitch length) is realized in accordance to series of prime numbers R40. Actual production program of "STOMIL SANOK" S.A. covers a lot of lengths behind this series. Accurate information can be find in catalogs of V-belts issued by "STOMIL SANOK" S.A.

**Table 2.2.** Recommended length of narrow-profile belts\*.

				Dimensions in millimetres											
															
<b>SPZ</b>				<b>SPA</b>				<b>SPB</b>				<b>SPC</b>			
$L_p$				$L_p$				$L_p$				$L_p$			
537	875	1212		723	1232	3750		1250	4000			1800	6700		
562	887	1237		757	1250	4000		1320	4250			2240	7100		
587	<b>900</b>	1250		782	1320	4250		1400	4500			2360	7500		
612	912	1320		832	1400	4500		1500	4750			2500	8000		
637	925	1400		857	1500	4750		1600	5000			2650	8500		
662	937	1500		882	1600	5000		1700	5300			2800	9000		
687	947	1600		932	1700			1800	5600			3000	9500		
700	962	1700		957	1800			1900	6000			3150	10000		
712	987	1800		957	1900			2000				3350			
719	<b>1000</b>	1900		982	2000			2120				3550			
721	1012	2000		1007	2120			2240				3750			
737	1037	2120		1032	2240			2360				4000			
762	1062	2240		1057	2360			2500				4250			
787	1087	2360		1082	2500			2650				4500			
<b>800</b>	1112	<b>3000</b>		1107	2650			2800				4750			
812	1125			1132	2800			3000				5000			
825	1137			1157	3000			3150				5300			
837	1162			<b>1180</b>	3150			3350				5600			
<b>850</b>	1187			1182	3350			3550				6000			
862*	1200			1207	3550			3750				6300			
Deviations of pitch length $L_p$ – according to table 2.3 Acceptable difference of $L_p$ length working in belt unit – according to table 2.3. * Accurate information of currently produced belts length can be found from V-belt catalogs issued by "STOMIL SANOK" S.A. Lengths marked in bold are from series of normal digits R40 are recommended by "STOMIL SANOK" S.A.															
$L_z \approx L_p + 13 \text{ mm}$ $L_w \approx L_p - 37 \text{ mm}$ $L_z$ - external length of belt $L_p$ - pitch length of belt $L_w$ - internal length of belt Mass of 1 m: ~ 0,08 kg				$L_z \approx L_p + 18 \text{ mm}$ $L_w \approx L_p - 45 \text{ mm}$ $L_z$ - external length of belt $L_p$ - pitch length of belt $L_w$ - internal length of belt Mass of 1 m: ~ 0,14 kg				$L_z \approx L_p + 22 \text{ mm}$ $L_w \approx L_p - 60 \text{ mm}$ $L_z$ - external length of belt $L_p$ - pitch length of belt $L_w$ - internal length of belt Mass of 1 m: ~ 0,22 kg				$L_z \approx L_p + 30 \text{ mm}$ $L_w \approx L_p - 75 \text{ mm}$ $L_z$ - external length of belt $L_p$ - pitch length of belt $L_w$ - internal length of belt Mass of 1 m: ~ 0,42 kg			
Within the range:															
<b>1240-3000 mm</b>				<b>1240-5000 mm</b>				<b>1250-6000 mm</b>				<b>2050-10000 mm</b>			
It is possible to manufacture a belt of any length at customer request after an earlier agreement with "STOMIL SANOK" S.A.															

**Table 2.3.** Deviations of pitch length  $L_p$  for narrow – profile belts.

Dimensions in millimetres

Belt section	SPZ, SPZ/S	SPA, SPA/S	SPB, SPB/S	SPC, SPC/S	Acceptable length differences $L_p$ between belts operating in one unit
Tolerance	Length range				
$\pm 6$	537-630				2
$\pm 8$	631-800	732-800			2
$\pm 10$	801-1000	801-1000			2
$\pm 13$	1001-1250	1001-1250	1250		2
$\pm 16$	1251-1600	1251-1600	1251-1600		2
$\pm 20$	1601-1737	1601-2000	1601-2000	1800-2000	2
$\pm 25$		2001-2500	2001-2500	2001-2500	4
$\pm 32$		2501-2932			4
<b>L=L</b>	<b>1738-3000</b>	<b>2933-5000</b>	<b>2501-6096</b>	<b>2501-10000</b>	
<b>Belt length tolerance in version L=L</b>					
$\pm 2$	1738-3000	2933-3150	2501-3150	2501-3150	4
$\pm 3$		3151-5000	3151-5000	3151-5000	6
$\pm 5$			5001-6096	5001-8000	10
$\pm 8$				8001-10000	16

### Narrow-profile belts according to standard ISO I DIN

Narrow-profile V-belts produced by "STOMIL SANOK" S.A. conform requirements of Standard ISO 4184, which conforms requirements of DIN standard 7753 Part 1. These belts correspond in their construction and properties narrow-profile V-belts in accordance to USA standard RMA/MPTA. In USA three sections of narrow V-belts are standardized. These belts are: 3V/9N, 5V/15N, 8V/25N.

3V/9N belt correspond approximately to SPZ belt, 5V/15N belt correspond approximately to SPB belt. For 8V/25N there is not comparable narrow V-belt according to ISO.

Belt 3V/9N as well as belt 5V/15N can without any problem work in belt pulleys of belts SPZ-Z/10 and SPB-B17 (drawing 4.1, f). It is not recommended reverse use without correction of groove profile (drawing 4.1, g; h).

#### Example of belt marking according to RMA/MPTA:

##### 3V 800 belt

3 – 3/8" upper belt width  
 V – belt marking – single narrow-profile belt  
 800 – outside length in inches  
 divided by 10 (1 inch = 25.4 mm)  
 outside length of belt in mm:  
 $L_{out} = (800 \times 25,4) / 10 = 2031 \text{ mm}$

##### 9N 2032 belt

9 – upper belt width in mm  
 N – marking of single narrow-profile belt  
 (in case of power bands instead of N  
 (1 letter J is stated)  
 2032 - outside length of belt in mm

#### Example of order:

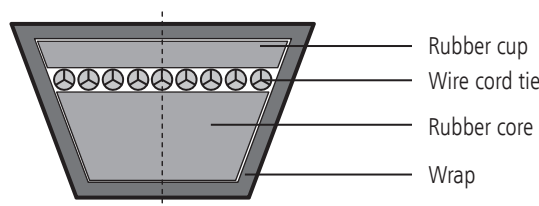
- single V-belts for example belt of SPZ section and pitch length  $L_p = 950 \text{ mm}$ :  
**V-belt SPZ – 950 pieces,**
- V-belts for operation in one unit; for example unit of 3 belts of SPZ section and pitch length  $L_p = 950 \text{ mm}$ :  
**V-belt 3 SPZ – 950 pieces of units.**



## 2.3. Normal profile V-belts (classical) produced by „Stomil Sanok” S.A.

### Structure and advantages.

Classical V-belts are manufactured by the same method as narrow-profile V-belts. Through to use of proven manufacturing technology, the best raw materials, special construction, we give a user perfect V-belt able to transfer big powers with optimal lifetime and security.



Rys. 2.3. Structure of normal-profile (classical) belt.

Properties of normal-profile V-belts:

- the ratio of height to width is 1:1,6;
- maximal speed of belt can't exceed 30m/s;
- minimal, recommended belt pulley diameter is lower for in comparison to narrow-profile belts;
- work temperature depends on belt structure.

Classical V-belts are manufactured for industry mainly as spare parts. For new drives is recommended – with respect of costs and gearing size – almost always drive unit with narrow V-belts. Only with special drives, as for example flat-belt drives, drives with small diameters of belt pulleys, classical belts are used.

### Structural variations and their markings

Classical V-belts produced by "STOMIL SANOK" S.A. are produced according to requirements stated in Standard PN-ISO 4184 (with the exception for profiles 20 and 25), which are manufactured in accordance to Stomil Sanok ZN-71 standard).

Three construction variations of normal-profile belts are produced in "STOMIL SANOK" S.A., of section Z, A, B, 20, C, 25, D, E.

Basic version are belts marked by symbols Z, A, B, 20, C, 25, D, E) (overprint in yellow color at the belt). This is reinforced version, produced in a range of lengths 500-10000 mm, which can operate in temperature range from -35°C to +100°C.

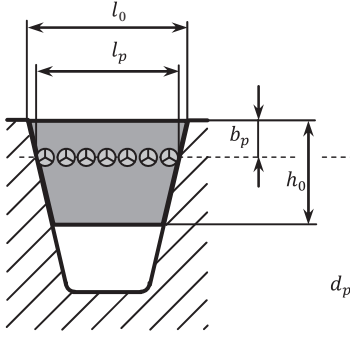
Second versions are belts of standard type; these belts possess 25% lower lifetime in relation to reinforced version. They are marked by following symbols: Z/S, A/S, B/S, 20x12.5/S, C/S, 25x16/S, D/S, E/S (overprint in green color at the belt).

Third versions are reinforced belts marked by symbols: D, E (overprint in yellow color at the belt). These belts are manufacture solely in a range of length 10000 – 18000 mm). Tie rod in these kinds of belts create viscose cord fabric. They can operate in a temperature range from -30°C to +60°C.

According to ISO length of narrow-profile and classical profile belts produced by "STOMIL SANOK" S.A. is determined by the length of the pitch.

**Table 2.4.** Dimensions of normal-profile belts.

dimensions in millimetres



Classical belt	ISO marking	Z	A	B	-	C	-	D	E
	DIN marking	10	13	17	20	22	25	32	40
approximate upper width $l_0$		10	13	17	20	22	25	32	40
pitch width $l_p$		8,5	11	14	17	19	21	27	32
belt height $h_0$		6	8	11	12,5	14	16	20	23
height under pitch line $b_p$		2,5	3,3	4,2	4,8	5,7	6,3	8,1	9,6
minimal pulley pitch diameter $d_{p \text{ min.}}$		50	71	112	160	180	250	355	500
1 m belt mass [kg] $\approx$		0,07	0,12	0,20	0,27	0,37	0,44	0,69	1,03
acceptable belt speed [m/s]		30							

### Belts marking according to Standards ISO and DIN

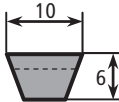
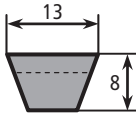
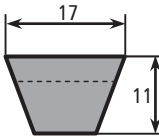
Classical V-belts produced by "STOMIL SANOK" S.A. are manufactured in accordance to Standard ISO 4184. Additionally sections 20 and 25 are manufactured in accordance to Standard DIN 2215, which is not stated in ISO, and which with the reasons of convertibility and efficiency should be avoided.

DIN standard as a base of belt marking assumes upper width of belt; internationally belt is marked by letter, for example belt no 17 is marked by letter B. Standard ISO 4184 assumes pitch length (effective length) for measurement of length of narrow-profile and normal-profile belts. According to DIN, internal length of belt is in force to state its length. So, stating the length of a belt is necessary to pay attention on type of gauge length and possibly calculate it using converting factors stated in table 2.5.

According to standards, gradation in length (pitch length) is realized in accordance to series of prime numbers R40. Actual production program of "STOMIL SANOK" S.A. covers a lot of lengths behind this series. Accurate information can be find in catalogs of V-belts issued by "STOMIL SANOK" S.A.

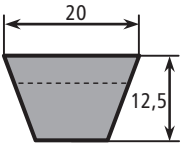
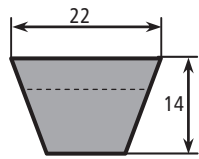
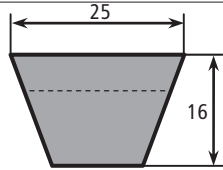
**Table 2.5.** Recommended length of normal-profile length\*.

Dimensions in millimetres

 <b>Z</b>		 <b>A</b>			 <b>B</b>		
$L_p$		$L_p$			$L_p$		
500	1500	500	1400	4500	630	1190	3350
530	1600	530	1500	4750	670	1250	3550
560	1700	560	1600	5000	710	1259	3750
582	1800	600	1700		750	1260	4000
600	1900	630	1800		800	1320	4250
630	2000	670	1900		820	1400	4500
670	2120	710	2000		865	1500	4750
710	2240	750	2120		870	1600	5000
750	2360	800	2240		890	1700	5300
800	2500	850	2360		945	1800	5600
850	2650	900	2500		970	1900	6000
900	2800	950	2650		990	2000	6300
950	3000	1000	2800		1000	2120	6700
1000		1040	3000		1020	2240	7100
1060		1060	3150		1060	2360	7500
1120		1120	3350		1100	2500	8000
1180		1180	3550		1120	2650	8500
1250		1210	3750		1145	2800	9000
1320		1250	4000		1165	3000	9500
1400		1320	4250		1180	3150	10000
Deviations of pitch length $L_p$ – according to table 2.6 Acceptable difference of $L_p$ length working in belt unit – according to table 2.6. * Accurate information of currently produced belts length can be found from V-belt catalogs issued by "STOMIL SANOK" S.A. Lengths marked in bold are from series of normal digits R40 are recommended by "STOMIL SANOK" S.A.							
$L_z \approx L_p + 16 \text{ mm}$ $L_w \approx L_p - 24 \text{ mm}$ $L_z$ - external length of belt $L_p$ - pitch length of belt $L_w$ - internal length of belt Mass of 1 m: ~ 0,07 kg		$L_z \approx L_p + 20 \text{ mm}$ $L_w \approx L_p - 30 \text{ mm}$ $L_z$ - external length of belt $L_p$ - pitch length of belt $L_w$ - internal length of belt Mass of 1 m: ~ 0,12 kg			$L_z \approx L_p + 26 \text{ mm}$ $L_w \approx L_p - 44 \text{ mm}$ $L_z$ - external length of belt $L_p$ - pitch length of belt $L_w$ - internal length of belt Mass of 1 m: ~ 0,20 kg		
<b>1210-3000 mm</b>		With the range: <b>1220-5000 mm</b>			<b>1260-10000 mm</b>		
It is possible to manufacture a belt of any length at customer request after earlier agreement with "STOMIL SANOK" S.A.							

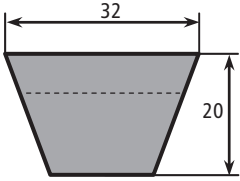
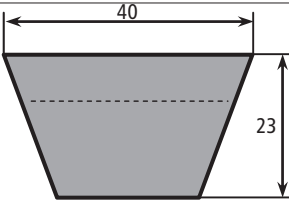
**Table 2.5.** Recommended length of normal-profile length\* - continued

Dimensions in millimetres

 <b>20</b>	 <b>C</b>	 <b>25</b>			
$L_p$	$L_p$	$L_p$			
1190	<b>4000</b>	1320	<b>4250</b>	1320	<b>4250</b>
1320	<b>4250</b>	1400	<b>4500</b>	1400	<b>4500</b>
1400	<b>4500</b>	1500	<b>4750</b>	1500	<b>4750</b>
1500	<b>4750</b>	1600	<b>5000</b>	1600	<b>5000</b>
1600	<b>5000</b>	1700	<b>5300</b>	1700	<b>5300</b>
1700	<b>5300</b>	1800	<b>5600</b>	1800	<b>5600</b>
1800	<b>5600</b>	1900	<b>6000</b>	1900	<b>6000</b>
1900	<b>6000</b>	2000	<b>6300</b>	2000	<b>6300</b>
2000	<b>6300</b>	2120	<b>6700</b>	2120	<b>6700</b>
2120	<b>6700</b>	2240	<b>7100</b>	2240	<b>7100</b>
2240	<b>7100</b>	2360	<b>7500</b>	2360	<b>7500</b>
2360	<b>7500</b>	2500	<b>8000</b>	2500	<b>8000</b>
2500	<b>8000</b>	2650	<b>8500</b>	2650	<b>8500</b>
2650	<b>8500</b>	2800	<b>9000</b>	2800	<b>9000</b>
2800	<b>9000</b>	3000	<b>9500</b>	3000	<b>9500</b>
3000	<b>9500</b>	3150	<b>10000</b>	3150	<b>10000</b>
3150	<b>10000</b>	3350		3350	
3350		3550		3550	
3550		3750		3750	
3750		4000		4000	
Deviations of pitch length $L_p$ – according to table 2.6 Acceptable difference of $L_p$ length working in belt unit – according to table 2.6. * Accurate information of currently produced belts length can be found from V-belt catalogs issued by "STOMIL SANOK" S.A. Lengths marked in bold are from series of normal digits R40 are recommended by "STOMIL SANOK" S.A.					
$L_z \approx L_p + 30 \text{ mm}$ $L_w \approx L_p - 48 \text{ mm}$ $L_z$ - external length of belt $L_p$ - pitch length of belt $L_w$ - internal length of belt Mass of 1 m: ~ 0,27 kg	$L_z \approx L_p + 36 \text{ mm}$ $L_w \approx L_p - 54 \text{ mm}$ $L_z$ - external length of belt $L_p$ - pitch length of belt $L_w$ - internal length of belt Mass of 1 m: ~ 0,37 kg	$L_z \approx L_p + 39 \text{ mm}$ $L_w \approx L_p - 61 \text{ mm}$ $L_z$ - external length of belt $L_p$ - pitch length of belt $L_w$ - internal length of belt Mass of 1 m: ~ 0,44 kg			
<b>1260-10000 mm</b>	within the range of: <b>1260-10000 mm</b>	<b>1320-10000 mm</b>			
It is possible to manufacture a belt of any length at customer request after earlier agreement with "STOMIL SANOK" S.A.					

**Table 2.5.** Recommended length of normal-profile length\* - continued

Dimensions in millimetres

 <b>D</b>		 <b>E</b>	
$L_p$		$L_p$	
2000	5000	4500	
2120	5300	4750	
2240	5600	5000	
2360	6000	5300	
2500	6300	5600	
2650	6700	6000	
2800	7100	6300	
3000	7500	6700	
3150	8000	7100	
3350	8500	7500	
3550	9000	8000	
3750	9500	8500	
4000	10000	9000	
4250		9500	
4500		10000	
4750			
Deviations of pitch length $L_p$ – according to table 2.6 Acceptable difference of $L_p$ length working in belt unit – according to table 2.6. * Accurate information of currently produced belts length can be found from V-belt catalogs issued by "STOMIL SANOK" S.A. Lengths marked in bold are from series of normal digits R40 are recommended by "STOMIL SANOK" S.A.			
$L_z \approx L_p + 50 \text{ mm}$ $L_w \approx L_p - 70 \text{ mm}$ $L_z$ - external length of belt $L_p$ - pitch length of belt $L_w$ - internal length of belt Mass of 1 m: ~ 0,69 kg		$L_z \approx L_p + 57 \text{ mm}$ $L_w \approx L_p - 88 \text{ mm}$ $L_z$ - external length of belt $L_p$ - pitch length of belt $L_w$ - internal length of belt Mass of 1 m: ~ 1,03 kg	
With the range:			
<b>2000-10000 mm</b>		<b>4400-10000 mm</b>	
It is possible to manufacture a belt of any length at customer request after earlier agreement with "STOMIL SANOK" S.A.			

**Table 2.6.** Deviations of pitch length  $L_p$  for normal-profile belts

dimensions in millimeters

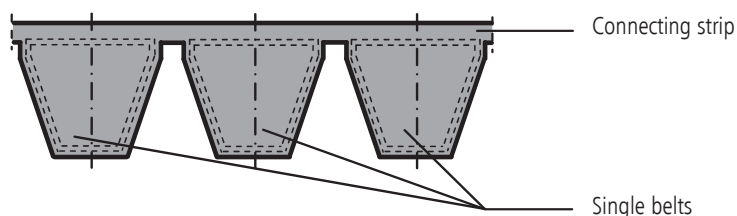
Belt section	Z	A	B	C	D	E		20	25
Tolerance	Length range						Tolerance	Length range	
+11 - 6	500	500					+5 - 10	1190-1250	1250
+13 - 6	501-630	501-630	630				+6 - 12	1251-1400	1251-1400
+15 - 7	631-800	631-800	631-800				+7 - 14	1401-1600	1401-1600
+17 - 8	801-1000	801-1000	801-1000				+8 - 16	1601-2000	1601-2000
+19 - 10	1001-1250	1001-1250	1001-1250				+9 - 18	2001-2279	2001-2279
+23 - 11	1251-1600	1251-1600	1251-1600	1251-1600			+10 - 20	2280-2650	2280-2650
+27 - 13	1601-2000	1601-2000	1601-2000	1601-2000	2000		+11 - 22	2651-2811	2651-2811
+31 - 16		2001-2360	2001-2500	2001-2500	2011-2500		+12 - 24	2812-3150	2812-3150
+37 - 18			2501-2800						
<b>L = L</b>			<b>2801-10000</b>	<b>2501-10000</b>	<b>2501-10000</b>	<b>4400-10000</b>		<b>3151-10000</b>	<b>2862-10000</b>
+112 - 56					10001-15500	10001-15500			
+140 - 70					12501-16000	12501-16000			
+170 - 85					16001-20000	16001-20000			
<b>Belt tolerances for belts in version L = L</b>									
$\pm 4$	2001-3000	2361-3150	2801-3150	2501-3150	2501-3150		$\pm 4$		2862-3150
$\pm 6$		3151-5000	3151-5000	3151-5000	3151-5000	4400-5000	$\pm 6$	3151-5000	3151-5000
$\pm 10$			5001-8000	5001-8000	5001-8000	5001-8000	$\pm 10$	5001-8000	5001-8000
$\pm 16$			8001-10000	8001-10000	8001-10000	8001-10000	$\pm 16$	8001-10000	8001-10000
<b>Acceptable differences of <math>L_p</math> length between belts operating in one unit</b>									
2	do 1250						2	do 1180	
4	1251-2000						4	1181-1900	
8	2001-3150						8	1901-3150	
12	3151-5000						12	3151-5000	
20	5001-8000						20	5001-8000	
32	8001-12500						32	8001-10000	
48	12501-20000								

**Example of ordering**a) single V-belts for example B profile V-belt of pitch length  $L_p = 2360$  mm:**B profile V-belt – 2360 pieces**b) V-belts for operation in one unit for example 3-belt unit of B profile and pitch length  $L_p = 2360$  mm:**3B profile V-belt – 2360 pieces of units**

## 2.4. Power bands produced by "STOMIL SANOK" S.A.

### Structure and advantages

Power bands create permanent connection, connecting band, 2,3,4 or 5 single belts of given section, drawing 2.4. They can be built from narrow belts or classical belts. In case of necessity of usage bigger number of rib then 5, sets of power bands should be used according to table 4.6.



**Rys. 2.4.** Power bands.

Power bands, by using connection band, create permanent, longitudinally flexible, and transversely rigid drive element of one-belt characteristics.

Some demands related with drive task can't be solved by single working belts or even by a unit of V-belts. During side shock load and/or during pulsing operation (for example compressor, internal combustion engine, etc.) single V-belts have a tendency to vibration. This may lead to belt twisting inside a groove and its damage or jumping from pulley belt. Such failures can be avoided by using power bands, because their connecting band possess higher transversal rigidity and simultaneously protect from belt vibration.

Power bands are mainly used for improvement of operating conditions in drives during:

- pulsating run;
- side shock load;
- big axle base in connection with small pulley belts;
- vertical shafts;
- flat-V-belt drives;
- clutch drives;
- transport technology.

They are successfully used in engineering industry with vibrators, splitters, road machines, compressors, fans, lathes, grinders and milling machines.

Power bands should operate on groove wheels made according to hints included in chapter 4.

While using power bands general rule is obligatory – avoid direct contact of belt with foreign materials like stones, collected dust, sawdust, etc. In conditions like mentioned above, drive must be protected by shield.

### Belts marking

Standardization committee ISO TC41/SCI used for power bands with narrow belts American standard RMA/MPTA as a base. So far profiles markings 3V, 5V, 8V was changed to markings 9J, 15J and 25J.

In case of power bands with normal profile marking of single belts A, B, C, D and E was changed to markings: AJ, BJ, CJ, DJ and EJ.

## The structural variations and their markings

Power bands are produced by "STOMIL SANOK" S.A. according to ZN-Stomil Sanok-65 standard and are marked 15J, A BP; B BP; C BP which correspond ISO markings 15J; AJ; BJ; CJ.

These belts can work in temperature range from  $-30^{\circ}\text{C}$  to  $+60^{\circ}\text{C}$  awhile belt speed do not exceed 30 m/s.

## Determining a length

In international Standard ISO 5290 nominal effective width of belt pulley groove  $w_e$  was established as a base value for normalization of belt pulley groove and belonging to them power bands. Effective width of groove this is the biggest groove width measured at rectilinear groove walls. For all measuring pulleys and mostly for working pulleys mass-produced this concept coincides with real upper width of groove. In connection of this, location of pitch diameter  $d_p$  (effective diameter) is stated as approximate value. To calculate dimensions and power of gearing effective pulley diameter is used. Minimal calculated differences in ratio and rotating frequency do not have any practical influence. Effective length  $L_e$  is a belt length measured at the height of its effective width  $w_e$ . So, effective length  $L_e$  should be considered as plausible for determining the length of power bands. With respect to lack of compatibility regarding measuring length stating length of power bands, while stating the length is necessary to pay attention at kind of measuring length and possibly calculate it, using for our belts calculating factors given in table 2.7. Calculation of gearings with power bands should be done according to example stated in chapter 3.8.

According to standards, gradation in length (effective length) is performed according to series of normal numbers R40. Actual production program of "STOMIL SANOK" S.A. covers a lot of lengths from outside of this series. Exact information can be found in catalogs of V-belts issued by "STOMIL SANOK" S.A.



**Table 2.7.** Recommended length of power bands\*.

Dimensions in millimetres

15J	A BP	B BP	C BP	SPC BP					
					$L_e$	$L_e$	$L_e$	$L_e$	$L_p$
2360	1320	1500	2000	2240					
2500	1400	1600	2120	2500					
2650	1500	1700	2240	4250					
2800	1600	1800	2360	4500					
3000	1700	1900	2500	5000					
3150	1800	2000	2650	5600					
3350	1900	2120	2800	6000					
3550	2000	2240	3000	6700					
3750	2120	2360	3150						
4000	2240	2500	3350						
4250	2360	2650	3550						
4500	2500	2800	3750						
4750	2650	3000	4000						
5000	2800	3150	4250						
5300	3000	3350	4500						
5600		3550	4750						
6000		3750	5000						
		4000							
		4250							
		4500							

Deviations of length  $L_e : \pm 0,5\%$ ;  $L_p : \pm 0,5\%$ .  
 Acceptable difference of  $L_e$  or  $L_p$  length working in belt unit – according to table 2.8.  
 \* Accurate information of currently produced belts length can be found from V-belt catalogs issued by "STOMIL SANOK" S.A.  
 Lengths marked in bold are from series of normal digits R40 are are recommended by "STOMIL SANOK" S.A.

$L_w \approx L_e - 71 \text{ mm}$	$L_w \approx L_e - 36 \text{ mm}$	$L_w \approx L_e - 52 \text{ mm}$	$L_w \approx L_e - 68 \text{ mm}$	$L_w \approx L_p - 74 \text{ mm}$
$L_w$ - internal length of belt,		$L_e$ - effective length of belt,		$L_p$ - pitch length of belt

Mass of 1mb of one belt: ~ 0,28 kg	Mass of 1mb of one belt: ~ 0,17 kg	Mass of 1mb of one belt: ~ 0,27 kg	Mass of 1mb of one belt: ~ 0,45 kg	Mass of 1mb of one belt: ~ 0,53 kg
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In the range of:

1500-6000 mm	1250-3000 mm	1250-10000 mm	2000-5000 mm	2000-6700 mm
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It is possible to manufacture a belt of any length at customer request after earlier agreement with "STOMIL SANOK" S.A.

**Table 2.8.** Deviations of effective lengths of power bands

Dimensions in millimetres			
Belt section	Range of lengths $L_e$ or $L_p$	Deviations of lengths $L_e$ or $L_p$	Accessible differences of lengths $L_e$ or $L_p$ between belts working in one unit
15J, A BP, B BP, C BP, SPC BP	od 1345	$\pm 0,5\%$	4
	1346 – 2690		6
	2691 – 6000		10
	6001 – 10000		16

**Example of ordering**

Because there is not international consistency in the scope of determining the length of power bands, and assortment is reached, power bands produced by "STOMIL SANOK" S.A. should be ordered in accordance to following example.

a) single power bands, for example power bands consisting of 3 tie rods of 15J section and effective length  $L_e = 3000$  mm:

**V-belt 3 – 15J – 3000 no of pieces,**

b) power bands working in a unit for drive; power bands is required of section B BP consisting of 18 tie rods and of effective length  $L_e = 4250$  mm. Generally 4 power bands are required: 2 pcs with 4 ribs and 2 pcs with 5 ribs (look table 4.6)

Order is:

**1 unit consisting of:    2 pieces of power bands 4 B BP – 4250  $L_e$   
                                  2 pieces of power bands 5 B BP – 4250  $L_e$**



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## 3. Calculating of gearing with V-belts produced by „STOMIL SANOK“ S.A.

### 3.1. Number of belts in the gearing.

To obtain optimal conditions of power transferring, high gearing reliability and required belt lifetime is necessary to design a gearing at a base of calculations, which idea is to get optimal belt section and number of belts which should be used in considered gearing.

Required number of belts to transfer the power is calculated from a formula:

$$z \geq \frac{N \cdot k_T}{N_1 \cdot k_\phi \cdot k_L}$$

where:

- $z$  - number of required belts in a gearing (calculated value should be rounded up to integer),
- $N$  - power transferred by gearings,
- $N_1$  - power transferred by one belt,
- $k_T$  - coefficient of work conditions,
- $k$  - coefficient of angle of wrap,
- $k_L$  - coefficient of belt length,

To determine values of correction coefficients is necessary to know basic technical data of gearing:

- kind of driving and driven gearing;
- required transferred power [kW];
- revolutions of driving machine [r.p.m.];
- revolutions of driven machine [r.p.m.];
- conditions of work of gearing.

For intermediate value of power transferred by single belt and coefficients, they should be calculated by means of linear interpolation.

### 3.2. Guidelines to choose V-belt profile

By means of below diagrams there is a possibility to choose suitable section of V-belt, taking into account economy and the size of structure.

For new drives is recommended – with respect of economy aspects and size of the gearing – almost always drive unit with narrow-profile (narrow) belts. Only with special drives, like for example flat V-belt drives, drives with maximally small belt pulleys diameters, normal-profile, classical belts are used (classical).

Size of used section depends on rotating speed of smaller pulley ( $n_d$  [r.p.m.]) and computational power ( $N_o = N \cdot k_T$  [kW]).

Taking into account optimal conditions of power transferring as well as economy, is possible to obtain, by using big belt pulleys for which belt speed there is in a range (25-30) m/s. Experience has shown that minimal diameter of belt pulleys should be avoided.

While selecting diameter of small pulley ( $d_p$ ) is necessary to remember, that decreasing of diameter, while stated other parameters, leads to increasing of circumferential force, what increase loading of bearings and shafts.

Narrow-profile belts are characterized by the fact that they possess bigger possibility of power transferring in relation to normal-profile belts, but they require bigger minimal diameters. Limit allowable value of belt speed must be observed, which for narrow profiles possess value 40 m/s and for classical belts possess value 30 m/s.

If in the used graph of belt section selection the point of intersection is near the line dividing two sections, good drive can be get using both sections. The gearing must be calculated using both sections and then chosen more economical gearing, which better suits stated requirements.

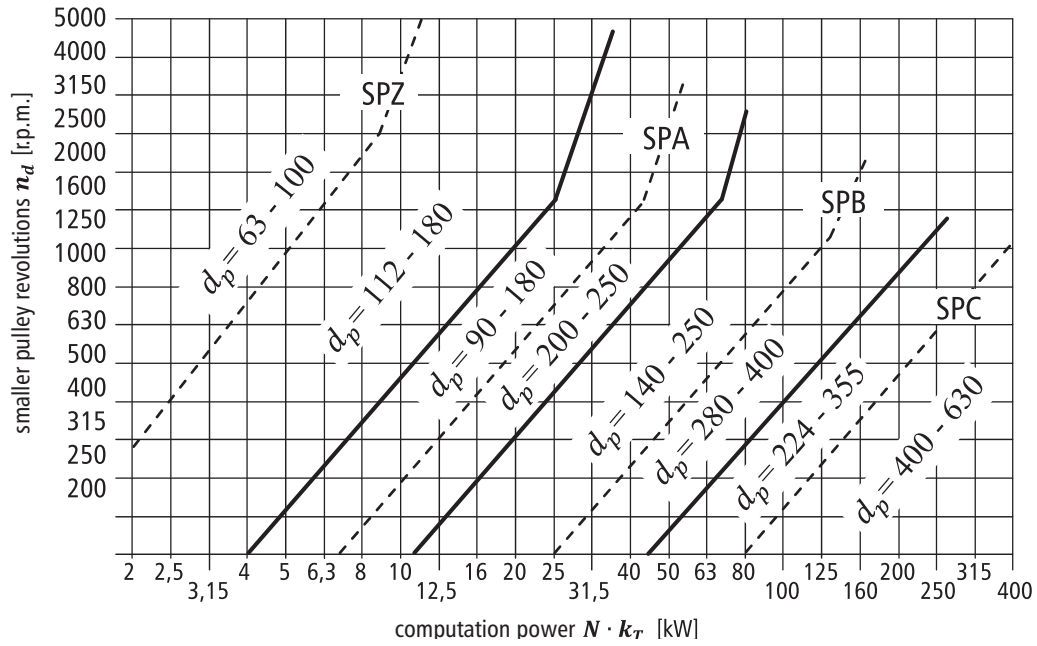


Fig. 3.1. Diagram of section value preselection of narrow – profile belt.

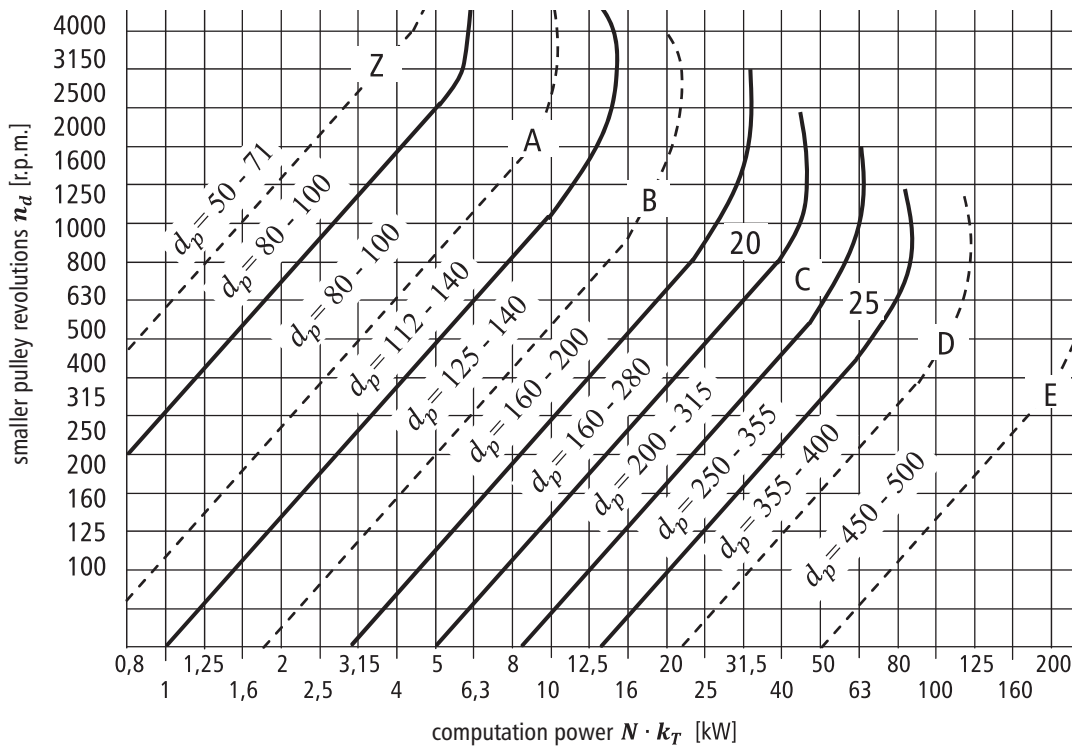


Fig. 3.2. Diagram of section value preselection of normal – profile belt.

### 3.3. Coefficient of work conditions $k_T$ .

Coefficient of work conditions  $k_T$  takes into account time of operation and type of driving and driven machine.

Is obligatory exclusively for belts with two pulley belts and does not take into account other conditions of gearing operation, like: drives with tension rollers, extremely adverse work conditions (for example caustic dust, high temperatures or adverse influent of other factors).

Because brief description of each probable combination: driving machine – work conditions – driven machine, is not possible, so suggested values of  $k_T$  coefficient must be treated only as guidelines. In special case, for example increased initial torque, increase frequency of starts, operation with extraordinary shock loads, during considerable inertness of rotated masses, value of  $k_T$  coefficient must be increased.

Problem of size of gearing load is in many cases very complex. Inattention to the fact is very often a reason of wrong load valuation what consequently leads to faulty determination of design parameters of a gearing. In light of the analysis of the load, correct statement is that the same gearing in different load conditions can be used to transfer different loads.

Values of  $k_T$  coefficient, for example machines, are stated at the next page.

**Table 3.1.** Values of coefficient  $k_T$  for example machines,

Examples of driven machines	Examples of driving machines					
	AC motors and 3-phases induction motors of normal torque (of value maximum 2x of nominal torque) for example synchronous motors and 1-phase with auxiliary booting phase, 3-phase induction motors operated by star/delta switch or slip ring starter, shunt dc motor, internal combustion engines and turbines of above 600 revolutions/minute			AC motors and induction motors of high torque (of value maximum 2x of nominal torque) for example 1-phase motors of high torque, serial and serial-shunt DC motors, combustion engines and turbines of above 600 revolutions/minute		
	Values of work coefficient $k_T$					
	For day time of work [h]			For day time of work [h]		
	to 10	from 10 to 16	powyżej 16	to 10	from 10 to 16	above16
<b>Low-power drives:</b> blowers and extractors, fluid mixers, pumps and centrifugal turbines, belt conveyors for light materials, fans of power not bigger then 7,5 kW;	1,0	1,1	1,2	1,1	1,2	1,3
<b>Middle-power drives:</b> printing machines, agitators for cakes, metal processing machines (lathes, grinders), transmissions, three-cylinder (or more) pumps and compressors, washing machines, presses, stamping plants, shears, generators, chain and belt conveyors for heavy materials, revolving and vibration screens, fans and pumps of power above 7,5 kW;	1,1	1,2	1,3	1,2	1,3	1,4
<b>High-power drives:</b> displacement blowers, machines: brick, paper and fabric, hammer mills, log saws, 1-cylinder and 2-cylinder pumps and compressors, briquette presses, conveyors: bucket, scrapper and worm, atomizers, exciters;	1,2	1,3	1,4	1,4	1,5	1,6
<b>Very high-power drives:</b> cranes and lifters, calenders for rubber, stone splitters, mills: ball, rod and pipe.	1,3	1,4	1,5	1,5	1,6	1,8

### 3.4. Coefficient of angle $k_\phi$ .

Because value  $N_1$  was determined for small pulley with wrap angle  $180^\circ$ , then coefficient of angle  $k_\phi$  revises value of power  $N_1$  in case wrap angle  $k_\phi$  is less than  $180^\circ$ .

**Table 3.2.** Value of coefficient  $k_\phi$

$\frac{D_p - d_p}{A}$	Wrap angle $\phi \approx$	$k_\phi$ angle coefficient
0,00	180°	1,00
0,05	177°	0,99
0,10	174°	0,99
0,15	171°	0,98
0,20	169°	0,97
0,25	166°	0,97
0,30	163°	0,96
0,35	160°	0,95
0,40	157°	0,94
0,45	154°	0,93
0,50	151°	0,93
0,55	148°	0,92
0,60	145°	0,91
0,65	142°	0,90
0,70	139°	0,89
0,75	136°	0,88
0,80	133°	0,87
0,85	130°	0,86
0,90	127°	0,85
0,95	123°	0,83
1,00	120°	0,82
1,05	117°	0,81
1,10	113°	0,80
1,15	110°	0,78
1,20	106°	0,77
1,25	103°	0,75
1,30	99°	0,73
1,35	95°	0,72
1,40	91°	0,70
1,45	87°	0,68
1,50	83°	0,65



### 3.5. Coefficient of length $k_L$ .

Coefficient of length  $k_L$  takes into account frequency of bent frequency of used belt. This value depends on section as well as pitch length of a belt.

**Table 3.3.** Value of  $k_L$  coefficient for narrow-profile belts.

Belt SPZ		Belt SPA		Belt SPB		Belt SPC	
$L_p$	$k_L$	$L_p$	$k_L$	$L_p$	$k_L$	$L_p$	$k_L$
630	0,82	800	0,81	1250	0,82	2240	0,83
710	0,84	900	0,83	1400	0,84	2500	0,86
800	0,86	1000	0,85	1600	0,86	2800	0,88
900	0,88	1120	0,87	1800	0,88	3150	0,90
1000	0,90	1250	0,89	2000	0,90	3550	0,92
1120	0,93	1400	0,91	2240	0,92	4000	0,94
1250	0,94	1600	0,93	2500	0,94	4500	0,96
1400	0,96	1800	0,95	2800	0,96	5000	0,98
<b>1600</b>	<b>1,00</b>	2000	0,96	3150	0,98	<b>5600</b>	<b>1,00</b>
1800	1,01	2240	0,98	<b>3550</b>	<b>1,00</b>	6300	1,02
2000	1,02	<b>2500</b>	<b>1,00</b>	4000	1,02	7100	1,04
2240	1,05	2800	1,02	4500	1,04	8000	1,06
2500	1,07	3150	1,04	5000	1,06	9000	1,08
2800	1,09	3550	1,06	5600	1,08	10000	1,10
3150	1,11	4000	1,08	6300	1,10	11200	1,12
3550	1,13	4500	1,09	7100	1,12	12500	1,14
				8000	1,14		

**Table 3.4.** Value of  $k_L$  coefficient for classical-profile belts.

Belt Z		Belt A		Belt B		Belt 20	
$L_p$	$k_L$	$L_p$	$k_L$	$L_p$	$k_L$	$L_p$	$k_L$
424	0,87	662	0,81	942	0,81	950	0,77
449	0,88	742	0,82	1042	0,84	1050	0,79
474	0,89	832	0,85	1142	0,86	1170	0,80
494	0,90	932	0,87	1292	0,88	1300	0,82
524	0,91	1032	0,89	1442	0,90	1450	0,84
554	0,93	1152	0,91	1642	0,93	1650	0,87
584	0,94	1282	0,93	1842	0,95	2050	0,91
624	0,95	1432	0,96	2042	0,98	2300	0,93
654	0,96	1632	0,99	<b>2282</b>	<b>1,00</b>	2550	0,96
704	0,97	<b>1732</b>	<b>1,00</b>	2592	1,03	2850	0,98
734	0,99	1832	1,01	2842	1,05	<b>3200</b>	<b>1,00</b>
<b>824</b>	<b>1,00</b>	2032	1,03	3192	1,07	3600	1,03
924	1,03	2272	1,06	3592	1,10	4050	1,06
1024	1,06	2532	1,09	4042	1,13	4550	1,08
1144	1,08	2832	1,11	4542	1,15	5050	1,12
1274	1,11	3182	1,13	5042	1,18	5650	1,14
1424	1,14	4032	1,20	5642	1,20	6350	1,18
1624	1,17	5032	1,25	6342	1,23	8050	1,24

Belt C		Belt 25		Belt D		Belt E	
$L_p$	$k_L$	$L_p$	$k_L$	$L_p$	$k_L$	$L_p$	$k_L$
1461	0,81	1314	0,76	3230	0,86	4834	0,91
1661	0,84	1516	0,79	3630	0,89	5084	0,92
1861	0,85	1864	0,82	4080	0,91	5384	0,94
2061	0,88	2064	0,84	4580	0,93	5684	0,95
2301	0,91	2304	0,86	5080	0,96	6084	0,96
2561	0,93	2564	0,88	5680	0,98	6384	0,97
2861	0,95	2864	0,91	<b>6380</b>	<b>1,00</b>	6784	0,99
3211	0,97	3214	0,93	7180	1,03	<b>7184</b>	<b>1,00</b>
3611	0,98	3614	0,95	7580	1,05	7584	1,01
<b>3811</b>	<b>1,00</b>	4064	0,98	8080	1,06	8084	1,02
4061	1,02	<b>4564</b>	<b>1,00</b>	8580	1,07	8584	1,03
4561	1,04	5064	1,03	9080	1,08	9084	1,05
5061	1,07	5664	1,05	9580	1,10	9584	1,06
5661	1,09	6364	1,08	10080	1,11	10084	1,07
6361	1,12	7164	1,11	11280	1,14	11284	1,10
7161	1,15	8064	1,13	12580	1,17	12584	1,12
8061	1,18	10064	1,19	14080	1,20	14084	1,15
10061	1,23	12564	1,25	16080	1,22	16084	1,18

3.6. Rated powers  $N_T$  transferred by one V-belt.

Table 3.5. Rated power  $N_T$  transferred by one belt of SPZ (9,7x8) section

d <sub>p</sub> [mm]	i or 1/i	Smaller pulley speed $n_d$ [r.p.m.]																						
		200	400	700	800	950	1200	1450	1600	2000	2400	2800	3200	3600	4000	4500	5000	5500	6000					
		Nominal power value $N_T$ [kW]																						
63	1	0,20	0,35	0,54	0,60	0,68	0,81	0,93	1,00	1,17	1,32	1,45	1,56	1,66	1,74	1,81	1,85	1,87	1,85					
	1,05	0,21	0,37	0,58	0,64	0,73	0,88	1,01	1,09	1,27	1,44	1,59	1,73	1,84	1,94	2,04	2,11	2,15	2,16					
	1,2	0,22	0,39	0,61	0,68	0,78	0,94	1,08	1,17	1,38	1,57	1,74	1,89	2,03	2,15	2,27	2,37	2,43	2,47					
	1,5	0,23	0,41	0,65	0,72	0,83	1,00	1,16	1,25	1,48	1,69	1,88	2,06	2,21	2,35	2,50	2,63	2,72	2,77					
	>3	0,24	0,43	0,68	0,76	0,88	1,06	1,23	1,33	1,58	1,81	2,03	2,22	2,40	2,56	2,74	2,88	3,00	3,08					
71	1	0,25	0,44	0,70	0,78	0,90	1,08	1,25	1,35	1,59	1,81	2,00	2,18	2,33	2,46	2,59	2,68	2,73	2,74					
	1,05	0,26	0,46	0,74	0,82	0,95	1,04	1,32	1,43	1,69	1,93	2,15	2,34	2,51	2,67	2,82	2,94	3,02	3,05					
	1,2	0,27	0,49	0,77	0,87	1,00	1,20	1,40	1,51	1,79	2,05	2,29	2,51	2,70	2,87	3,05	3,20	3,30	3,36					
	1,5	0,28	0,51	0,81	0,91	1,04	1,26	1,47	1,59	1,90	2,18	2,43	2,67	2,88	3,08	3,28	3,45	3,58	3,67					
	>3	0,29	0,53	0,85	0,95	1,09	1,33	1,55	1,68	2,00	2,30	2,58	2,83	3,07	3,28	3,51	3,71	3,86	3,98					
80	1	0,31	0,55	0,88	0,99	1,14	1,38	1,60	1,73	2,05	2,34	2,61	2,85	3,06	3,24	3,42	3,56	3,64	3,66					
	1,05	0,32	0,57	0,92	1,03	1,19	1,44	1,67	1,81	2,15	2,47	2,75	3,01	3,24	3,45	3,65	3,81	3,92	3,97					
	1,2	0,33	0,59	0,96	1,07	1,24	1,50	1,75	1,89	2,25	2,59	2,90	3,18	3,43	3,65	3,89	4,07	4,20	4,27					
	1,5	0,34	0,61	0,99	1,11	1,28	1,56	1,82	1,97	2,36	2,71	3,04	3,34	3,61	3,86	4,12	4,33	4,48	4,58					
	>3	0,35	0,64	1,03	1,15	1,33	1,62	1,90	2,06	2,46	2,84	3,18	3,51	3,80	4,05	4,35	4,58	4,77	4,89					
90	1	0,37	0,67	1,09	1,21	1,40	1,70	1,98	2,14	2,55	2,93	3,26	3,57	3,84	4,07	4,30	4,46	4,55	4,56					
	1,05	0,38	0,69	1,12	1,26	1,45	1,76	2,06	2,23	2,65	3,05	3,41	3,73	4,02	4,27	4,53	4,71	4,83	4,87					
	1,2	0,39	0,71	1,16	1,30	1,50	1,82	2,13	2,31	2,76	3,17	3,55	3,90	4,21	4,48	4,76	4,97	5,11	5,17					
	1,5	0,40	0,74	1,19	1,34	1,55	1,88	2,20	2,39	2,86	3,30	3,70	4,06	4,39	4,68	4,99	5,23	5,39	5,48					
	>3	0,41	0,76	1,23	1,38	1,60	1,95	2,28	2,47	2,96	3,42	3,84	4,23	4,58	4,89	5,22	5,48	5,68	5,79					
100	1	0,43	0,79	1,28	1,44	1,66	2,02	2,36	2,55	3,05	3,49	3,90	4,26	4,58	4,85	5,10	5,27	5,35	5,32					
	1,05	0,44	0,81	1,32	1,48	1,71	2,08	2,43	2,64	3,15	3,62	4,05	4,43	4,76	5,05	5,34	5,53	5,63	5,63					
	1,2	0,45	0,83	1,35	1,52	1,76	2,14	2,51	2,72	3,25	3,74	4,19	4,59	4,95	5,26	5,57	5,79	5,92	5,94					
	1,5	0,46	0,85	1,39	1,56	1,81	2,20	2,58	2,80	3,35	3,86	4,33	4,76	5,13	5,46	5,80	6,05	6,20	6,25					
	>3	0,47	0,87	1,43	1,60	1,86	2,27	2,66	2,88	3,46	3,99	4,48	4,92	5,32	5,67	6,03	6,30	6,48	6,56					
112	1	0,51	0,93	1,52	1,70	1,97	2,40	2,80	3,04	3,62	4,16	4,64	5,06	5,42	5,72	5,99	6,14	6,16	6,05					
	1,05	0,52	0,95	1,55	1,74	2,02	2,46	2,88	3,12	3,73	4,28	4,78	5,23	5,61	5,92	6,22	6,40	6,45	6,36					
	1,2	0,53	0,98	1,59	1,78	2,07	2,52	2,95	3,20	3,83	4,41	4,93	5,39	5,79	6,13	6,45	6,65	6,73	6,66					
	1,5	0,54	1,00	1,63	1,83	2,12	2,58	3,03	3,28	3,93	4,53	5,07	5,55	5,98	6,33	6,68	6,91	7,01	6,97					
	>3	0,55	1,02	1,66	1,87	2,17	2,65	3,10	3,37	4,04	4,65	5,21	5,72	6,16	6,54	6,91	7,17	7,29	7,28					
125	1	0,59	1,09	1,77	1,99	2,30	2,80	3,28	3,55	4,24	4,85	5,40	5,88	6,27	6,58	6,83	6,92	6,84	6,57					
	1,05	0,60	1,11	1,81	2,03	2,35	2,86	3,35	3,63	4,34	4,98	5,55	6,04	6,46	6,78	7,06	7,18	7,12	6,88					
	1,2	0,61	1,13	1,84	2,07	2,40	2,93	3,43	3,72	4,44	5,10	5,69	6,21	6,64	6,99	7,29	7,44	7,41	7,19					
	1,5	0,62	1,15	1,88	2,11	2,45	2,99	3,50	3,80	4,54	5,22	5,93	6,37	6,83	7,19	7,52	7,69	7,69	7,50					
	>3	0,63	1,17	1,91	2,15	2,50	3,05	3,58	3,88	4,65	5,35	5,98	6,53	7,01	7,40	7,75	7,95	7,97	7,81					
140	1	0,68	1,26	2,06	2,31	2,68	3,26	3,82	4,13	4,92	5,63	6,24	6,75	7,16	7,45	7,64	7,60	7,34	6,81					
	1,05	0,69	1,28	2,09	2,35	2,73	3,32	3,89	4,21	5,02	5,75	6,38	6,92	7,35	7,66	7,87	7,86	7,62	7,12					
	1,2	0,70	1,30	2,13	2,39	2,77	3,39	3,96	4,30	5,13	5,87	6,53	7,08	7,53	7,86	8,10	8,12	7,90	7,43					
	1,5	0,71	1,32	2,17	2,43	2,82	3,45	4,04	4,38	5,23	6,00	6,67	7,25	7,72	8,07	8,33	8,37	8,18	7,74					
	>3	0,72	1,34	2,20	2,47	2,87	3,51	4,11	4,46	5,33	6,12	6,81	7,41	7,90	8,27	8,56	8,63	8,47	8,04					
160	1	0,80	1,49	2,44	2,73	3,17	3,86	4,51	4,88	5,80	6,60	7,24	7,81	8,19	8,40	8,41	8,11	7,47	6,45					
	1,05	0,81	1,51	2,47	2,78	3,22	3,92	4,59	4,97	5,90	6,72	7,42	7,97	8,37	8,61	8,64	8,37	7,75	6,76					
	1,2	0,82	1,53	2,51	2,82	3,27	3,98	4,66	5,05	6,00	6,84	7,56	8,13	8,56	8,81	8,88	8,62	8,03	7,07					
	1,5	0,83	1,55	2,54	2,86	3,32	4,05	4,74	5,13	6,11	6,97	7,70	8,30	8,74	9,02	9,11	8,88	8,31	7,37					
	>3	0,84	1,57	2,58	2,90	3,37	4,11	4,81	5,21	6,21	7,09	7,85	8,46	8,93	9,22	9,34	9,14	8,60	7,68					
180	1	0,92	1,71	2,81	3,15	3,65	4,45	5,19	5,61	6,63	7,50	8,20	8,71	9,01	9,08	8,81	8,11	6,93	5,22					
	1,05	0,93	1,74	2,84	3,19	3,70	4,51	5,26	5,69	6,74	7,63	8,35	8,88	9,20	9,29	9,04	8,36	7,21	5,53					
	1,2	0,94	1,76	2,88	3,23	3,75	4,57	5,34	5,77	6,84	7,75	8,49	9,04	9,38	9,49	9,28	8,62	7,49	5,84					
	1,5	0,95	1,78	2,92	3,28	3,80	4,63	5,41	5,86	6,94	7,87	8,63	9,21	9,57	9,70	9,51	8,88	7,77	6,15					
	>3	0,96	1,80	2,95	3,32	3,85	4,69	5,49	5,94	7,04	8,00	8,78	9,37	9,75	9,90	9,74	9,14	8,06	6,45					
v [m/s]	5			10			15			20			25			30			35			40		
Belt pulley – balancing				static						dynamic														

$$\text{Required number of belts in a gearing: } z \geq \frac{N \cdot k_T}{N_T \cdot k_\phi \cdot k_L}$$

where:

$N$  – power transferred by a gearing;

$N_T$  – rated power transferred by one belt;

$k_\phi$  – coefficient of wrap angle, see the table 3.2.;

$k_T$  – coefficient of working conditions, see the table 3.1.;

$k_L$  – coefficient of belt length, see the table 3.3.

Table 3.6. Rated power  $N_T$  transferred by one belt of SPA (12,7x10) section

$d_p$ [mm]	i or 1/i	Smaller pulley speed $n_d$ [r.p.m.]																	
		200	400	700	800	950	1 200	1 450	1 600	2 000	2 400	2 800	3 200	3 600	4 000	4 500	5 000	5 500	6 000
		Nominal power value $N_T$ [kW]																	
90	1	0,43	0,75	1,17	1,30	1,48	1,76	2,02	2,16	2,49	2,77	3,00	3,16	3,26	3,29	3,24	3,07	2,77	2,34
	1,05	0,45	0,80	1,25	1,39	1,59	1,90	2,18	2,34	2,72	3,05	3,32	3,53	3,67	3,76	3,76	3,64	3,40	3,03
	1,2	0,47	0,85	1,34	1,49	1,70	2,04	2,35	2,53	2,96	3,33	3,64	3,90	4,09	4,22	4,28	4,22	4,04	3,72
	1,5	0,50	0,89	1,42	1,58	1,81	2,18	2,52	2,71	3,19	3,60	3,96	4,27	4,50	4,68	4,80	4,80	4,67	4,41
	>3	0,52	0,94	1,50	1,67	1,92	2,32	2,69	2,90	3,42	3,88	4,29	4,63	4,92	5,14	5,32	5,37	5,31	5,10
100	1	0,53	0,94	1,49	1,65	1,89	2,27	2,61	2,80	3,27	3,67	3,99	4,25	4,42	4,50	4,48	4,31	3,97	3,46
	1,05	0,55	0,99	1,57	1,75	2,00	2,41	2,78	2,99	3,50	3,94	4,32	4,61	4,83	4,96	5,00	4,89	4,61	4,15
	1,2	0,57	1,03	1,65	1,84	2,11	2,54	2,95	3,17	3,73	4,22	4,64	4,98	5,25	5,43	5,52	5,46	5,24	4,84
	1,5	0,60	1,08	1,73	1,93	2,22	2,68	3,11	3,36	3,96	4,50	4,96	5,35	5,66	5,89	6,04	6,04	5,88	5,53
	>3	0,62	1,13	1,81	2,02	2,33	2,82	3,28	3,54	4,19	4,78	5,29	5,72	6,08	6,35	6,56	6,62	6,51	6,22
112	1	0,64	1,16	1,86	2,07	2,38	2,86	3,31	3,57	4,18	4,71	5,15	5,49	5,72	5,85	5,83	5,61	5,16	4,47
	1,05	0,67	1,21	1,94	2,16	2,49	3,00	3,48	3,75	4,41	4,99	5,47	5,86	6,14	6,31	6,35	6,18	5,80	5,17
	1,2	0,69	1,26	2,02	2,26	2,60	3,14	3,65	3,94	4,64	5,27	5,79	6,23	6,55	6,77	6,87	6,76	6,43	5,86
	1,5	0,71	1,30	2,10	2,35	2,71	3,28	3,82	4,12	4,87	5,54	6,12	6,60	6,97	7,23	7,39	7,34	7,06	6,55
	>3	0,74	1,35	2,18	2,44	2,82	3,42	3,98	4,30	5,11	5,82	6,44	6,96	7,38	7,69	7,91	7,91	7,70	7,24
125	1	0,77	1,40	2,25	2,52	2,90	3,50	4,06	4,38	5,15	5,80	6,34	6,76	7,03	7,16	7,09	6,75	6,11	5,14
	1,05	0,79	1,45	2,33	2,61	3,01	3,64	4,23	4,56	5,38	6,08	6,67	7,13	7,45	7,62	7,61	7,33	6,74	5,83
	1,2	0,82	1,50	2,42	2,70	3,12	3,78	4,40	4,75	5,61	6,36	6,99	7,49	7,86	8,08	8,13	7,90	7,37	6,52
	1,5	0,84	1,54	2,50	2,80	3,23	3,92	4,56	4,93	5,84	6,63	7,31	7,86	8,28	8,54	8,65	8,48	8,01	7,21
	>3	0,86	1,59	2,58	2,89	3,34	4,06	4,73	5,12	6,07	6,91	7,63	8,23	8,69	9,01	9,17	9,06	8,64	7,91
140	1	0,92	1,68	2,71	3,03	3,49	4,23	4,91	5,29	6,22	7,01	7,64	8,11	8,39	8,48	8,27	7,69	6,71	5,28
	1,05	0,94	1,72	2,79	3,12	3,60	4,37	5,07	5,48	6,45	7,29	7,97	8,48	8,81	8,94	8,79	8,27	7,34	5,79
	1,2	0,96	1,77	2,87	3,21	3,71	4,50	5,24	5,66	6,68	7,56	8,29	8,85	9,22	9,40	9,31	8,85	7,98	6,66
	1,5	0,99	1,82	2,95	3,31	3,82	4,64	5,41	5,84	6,91	7,84	8,61	9,22	9,64	9,86	9,83	9,42	8,61	7,35
	>3	1,01	1,86	3,03	3,40	3,93	4,78	5,58	6,03	7,14	8,12	8,94	9,56	10,05	10,32	10,35	10,00	9,25	8,05
160	1	1,11	2,04	3,30	3,70	4,27	5,17	6,01	6,47	7,60	8,53	9,24	9,72	9,94	9,87	9,34	8,28	6,62	4,31
	1,05	1,13	2,08	3,38	3,79	4,38	5,31	6,17	6,66	7,83	8,80	9,57	10,09	10,35	10,33	9,89	8,85	7,25	5,00
	1,2	1,15	2,13	3,46	3,88	4,49	5,45	6,34	6,84	8,06	9,08	9,89	10,46	10,77	10,79	10,38	9,43	7,88	5,70
	1,5	1,18	2,18	3,55	3,98	4,60	5,59	6,51	7,03	8,29	9,36	10,21	10,83	11,18	11,25	10,90	10,01	8,52	6,39
	>3	1,20	2,22	3,63	4,07	4,71	5,73	6,68	7,21	8,52	9,63	10,53	11,20	11,60	11,72	11,42	10,58	9,15	7,08
180	1	1,30	2,39	3,89	4,36	5,04	6,10	7,07	7,62	8,90	9,93	10,67	11,09	11,15	10,81	9,78	7,99	5,38	1,88
	1,05	1,32	2,44	3,97	4,45	5,15	6,23	7,24	7,80	9,13	10,21	11,00	11,46	11,56	11,27	10,29	8,57	6,02	2,57
	1,2	1,34	2,49	4,05	4,54	5,25	6,37	7,41	7,99	9,37	10,49	11,32	11,83	11,98	11,73	10,81	9,15	6,65	3,26
	1,5	1,37	2,53	4,13	4,64	5,36	6,51	7,57	8,17	9,60	10,76	11,64	12,20	12,39	12,19	11,33	9,72	7,29	3,95
	>3	1,39	2,58	4,21	4,73	5,47	6,65	7,74	8,35	9,83	11,04	11,96	12,56	12,81	12,65	11,85	10,30	7,92	4,64
200	1	1,49	2,75	4,47	5,01	5,79	7,00	8,10	8,72	10,13	11,22	11,92	12,19	11,98	11,25	9,50	6,75	2,89	-
	1,05	1,51	2,79	4,55	5,10	5,89	7,14	8,27	8,90	10,37	11,49	12,24	12,56	12,40	11,71	10,02	7,33	3,52	-
	1,2	1,53	2,84	4,63	5,19	6,00	7,27	8,44	9,08	10,60	11,77	12,56	12,93	12,81	12,17	10,54	7,91	4,16	-
	1,5	1,55	2,89	4,71	5,29	6,11	7,41	8,61	9,27	10,83	12,05	12,89	13,30	13,23	12,63	11,06	8,48	4,79	-
	>3	1,58	2,93	4,79	5,38	6,22	7,55	8,77	9,45	11,06	12,32	13,21	13,67	13,64	13,09	11,58	9,06	5,43	-
224	1	1,71	3,17	5,16	5,77	6,67	8,05	9,30	9,97	11,51	12,59	13,15	13,13	12,45	11,04	8,15	3,87	-	-
	1,05	1,73	3,21	5,24	5,87	6,78	8,19	9,46	10,16	11,74	12,86	13,47	13,49	12,86	11,50	8,67	4,44	-	-
	1,2	1,75	3,26	5,32	5,96	6,89	8,33	9,63	10,34	11,97	13,14	13,79	13,86	13,28	11,96	9,19	5,02	-	-
	1,5	1,78	3,30	5,40	6,05	6,99	8,46	9,80	10,53	12,20	13,42	14,12	14,23	13,69	12,42	9,71	5,60	-	-
	>3	1,80	3,35	5,48	6,14	7,10	8,60	9,96	10,71	12,43	13,69	14,44	14,60	14,11	12,89	10,23	6,17	-	-
250	1	1,95	3,62	5,88	6,59	7,60	9,15	10,53	11,26	12,85	13,84	14,13	13,62	12,22	9,83	5,29	-	-	-
	1,05	1,97	3,66	5,97	6,68	7,71	9,29	10,69	11,44	13,08	14,12	14,45	13,99	12,64	10,29	5,81	-	-	-
	1,2	1,99	3,71	6,05	6,77	7,82	9,43	10,86	11,63	13,31	14,39	14,77	14,36	13,05	10,75	6,33	-	-	-
	1,5	2,02	3,75	6,13	6,87	7,93	9,56	11,03	11,81	13,54	14,67	15,10	14,73	13,47	11,21	6,85	-	-	-
	>3	2,04	3,80	6,21	6,96	8,04	9,70	11,19	12,00	13,77	14,95	15,42	15,10	13,88	11,67	7,36	-	-	-
v [m/s]		5	10	15	20	25	30	35	40										
Belt pulley – balancing				static				dynamic											

$$\text{Required number of belts in a gearing: } z \geq \frac{N \cdot k_T}{N_T \cdot k_\phi \cdot k_L}$$

where:

$N$  – power transferred by a gearing;

$N_T$  – rated power transferred by one belt;

$k_\phi$  – coefficient of wrap angle, see the table 3.2.;

$k_T$  – coefficient of working conditions, see the table 3.1.;

$k_L$  – coefficient of belt length, see the table 3.3.

Table 3.7. Rated power  $N_1$  transferred by one belt **SPB (16,3x13) – 15J** section.

$d_p$ [mm]	i or 1/i	Smaller pulley speed $n_d$ [r.p.m.]																									
		200	400	700	800	950	1 200	1 450	1 600	1 800	2 000	2 200	2 400	2 800	3 200	3 600	4 000	4 500									
		Nominal power value $N_1$ [kW]																									
140	1	1,08	1,92	3,02	3,35	3,83	4,55	5,19	5,54	5,95	6,31	6,62	6,86	7,15	7,17	6,89	6,28	5,00									
	1,05	1,12	2,02	3,19	3,55	4,06	4,84	5,55	5,93	6,39	6,80	7,15	7,44	7,84	7,95	7,77	7,25	6,10									
	1,2	1,17	2,12	3,36	3,74	4,29	5,14	5,90	6,32	6,83	7,29	7,69	8,03	8,52	8,73	8,65	8,23	7,20									
	1,5	1,22	2,21	3,53	3,94	4,52	5,43	6,25	6,71	7,27	7,78	8,23	8,61	9,20	9,51	9,52	9,20	8,30									
	>3	1,27	2,31	3,70	4,13	4,76	5,72	6,61	7,10	7,71	8,26	8,76	9,20	9,89	10,29	10,40	10,18	9,39									
160	1	1,37	2,47	3,92	4,37	5,01	5,98	6,86	7,33	7,89	8,38	8,80	9,13	9,52	9,53	9,10	8,21	6,36									
	1,05	1,41	2,57	4,10	4,57	5,24	6,28	7,21	7,72	8,33	8,87	9,33	9,71	10,20	10,31	9,98	9,18	7,46									
	1,2	1,46	2,66	4,27	4,76	5,47	6,57	7,56	8,11	8,77	9,36	9,87	10,30	10,89	11,09	10,86	10,16	8,55									
	1,5	1,51	2,76	4,44	4,96	5,70	6,86	7,92	8,50	9,21	9,85	10,41	10,88	11,57	11,87	11,74	11,13	9,65									
	>3	1,56	2,86	4,61	5,15	5,93	7,15	8,27	8,89	9,65	10,33	10,94	11,47	12,25	12,65	12,61	12,11	10,75									
180	1	1,65	3,01	4,82	5,37	6,16	7,38	8,46	9,05	9,74	10,34	10,83	11,21	11,62	11,49	10,77	9,40	6,68									
	1,05	1,70	3,11	4,99	5,57	6,40	7,67	8,82	9,44	10,18	10,83	11,38	11,80	12,30	12,27	11,65	10,37	7,77									
	1,2	1,75	3,20	5,16	5,76	6,63	7,97	9,17	9,83	10,62	11,32	11,91	12,39	12,98	13,05	12,52	11,35	8,87									
	1,5	1,80	3,30	5,33	5,96	6,86	8,26	9,53	10,22	11,06	11,80	12,44	12,97	13,66	13,83	13,40	12,32	9,97									
	>3	1,85	3,40	5,50	6,15	7,09	8,55	9,88	10,61	11,50	12,29	12,98	13,56	14,35	14,61	14,28	13,30	11,07									
200	1	1,94	3,54	5,69	6,35	7,30	8,74	10,02	10,70	11,50	12,18	12,72	13,11	13,41	13,01	11,83	9,77	5,85									
	1,05	1,99	3,64	5,86	6,55	7,53	9,04	10,37	11,09	11,94	12,67	13,25	13,69	14,10	13,79	12,71	10,75	6,95									
	1,2	2,03	3,74	6,03	6,75	7,76	9,33	10,73	11,48	12,38	13,15	13,79	14,28	14,78	14,57	13,59	11,72	8,04									
	1,5	2,08	3,84	6,21	6,94	7,99	9,62	11,08	11,87	12,82	13,64	14,33	14,86	15,46	15,36	14,46	12,70	9,14									
	>3	2,13	3,93	6,38	7,14	8,23	9,91	11,43	12,26	13,26	14,13	14,86	15,45	16,14	16,14	15,34	13,68	10,24									
224	1	2,28	4,18	6,73	7,52	8,63	10,33	11,81	12,59	13,49	14,21	14,76	15,10	15,14	14,22	12,23	9,04	3,18									
	1,05	2,32	4,28	6,90	7,71	8,86	10,62	12,17	12,98	13,93	14,70	15,29	15,69	15,83	15,00	13,11	10,01	4,28									
	1,2	2,37	4,37	7,07	7,91	9,10	10,92	12,52	13,37	14,37	15,19	15,83	16,27	16,51	15,78	13,98	10,99	5,38									
	1,5	2,42	4,47	7,24	8,10	9,33	11,21	12,87	13,76	14,80	15,68	16,37	16,86	17,19	16,57	14,86	11,96	6,47									
	>3	2,47	4,57	7,41	8,30	9,56	11,50	13,23	14,15	15,24	16,16	16,90	17,44	17,87	17,35	15,74	12,94	7,57									
250	1	2,64	4,86	7,84	8,75	10,04	11,99	13,66	14,51	15,47	16,19	16,68	16,89	16,44	14,69	11,48	6,63	-									
	1,05	2,69	4,96	8,01	8,94	10,27	12,28	14,01	14,90	15,91	16,68	17,21	17,47	17,13	15,47	12,36	7,61	-									
	1,2	2,74	5,05	8,18	9,14	10,50	12,57	14,37	15,29	16,35	17,17	17,75	18,06	17,81	16,25	13,23	8,58	-									
	1,5	2,79	5,15	8,35	9,33	10,74	12,87	14,72	15,68	16,78	17,66	18,28	18,65	18,49	17,03	14,11	9,56	-									
	>3	2,83	5,25	8,52	9,53	10,97	13,16	15,07	16,07	17,22	18,15	18,82	19,23	19,17	17,81	14,99	10,53	-									
280	1	3,05	5,63	9,09	10,14	11,62	13,82	15,65	16,56	17,52	18,17	18,48	18,43	17,13	14,04	8,92	1,55	-									
	1,05	3,10	5,73	9,26	10,33	11,85	14,11	16,01	16,95	17,96	18,65	19,01	19,01	17,81	14,82	9,80	2,53	-									
	1,2	3,15	5,83	9,43	10,53	12,08	14,41	16,36	17,34	18,39	19,14	19,55	19,60	18,49	15,60	10,68	3,50	-									
	1,5	3,20	5,93	9,60	10,72	12,32	14,70	16,72	17,73	18,83	19,63	20,09	20,18	19,18	16,38	11,56	4,48	-									
	>3	3,25	6,02	9,77	10,92	12,55	14,99	17,07	18,12	19,27	20,12	20,62	20,77	19,86	17,16	12,43	5,45	-									
315	1	3,53	6,53	10,51	11,71	13,40	15,84	17,79	18,70	19,56	20,00	19,97	19,44	16,71	11,47	3,40	-	-									
	1,05	3,58	6,62	10,68	11,91	13,63	16,13	18,15	19,09	20,00	20,49	20,51	20,03	17,39	12,25	4,28	-	-									
	1,2	3,63	6,72	10,85	12,11	13,86	16,43	18,50	19,48	20,44	20,97	21,05	20,61	18,07	13,03	5,16	-	-									
	1,5	3,68	6,82	11,02	12,30	14,09	16,72	18,85	19,87	20,88	21,46	21,58	21,20	18,76	13,81	6,04	-	-									
	>3	3,73	6,92	11,19	12,50	14,32	17,01	19,21	20,26	21,32	21,95	22,12	21,78	19,44	14,59	6,91	-	-									
355	1	4,08	7,53	12,10	13,46	15,33	17,99	19,96	20,78	21,39	21,42	20,79	19,46	14,45	5,91	-	-	-									
	1,05	4,12	7,63	12,27	13,65	15,57	18,28	20,31	21,17	21,83	21,91	21,33	20,05	15,13	6,69	-	-	-									
	1,2	4,17	7,73	12,44	13,85	15,80	18,57	20,67	21,56	22,27	22,39	21,87	20,63	15,81	7,47	-	-	-									
	1,5	4,22	7,82	12,61	14,04	16,03	18,86	21,02	21,95	22,71	22,88	22,40	21,22	16,50	8,25	-	-	-									
	>3	4,27	7,92	12,78	14,24	16,26	19,16	21,37	22,34	23,15	23,37	22,94	21,80	17,18	9,03	-	-	-									
400	1	4,68	8,64	13,82	15,34	17,39	20,17	22,02	22,62	22,76	22,07	20,46	17,87	9,37	-	-	-	-									
	1,05	4,73	8,74	13,99	15,53	17,62	20,46	22,37	23,01	23,19	22,55	21,00	18,46	10,05	-	-	-	-									
	1,2	4,78	8,84	14,16	15,73	17,85	20,75	22,72	23,40	23,63	23,04	21,54	19,04	10,74	-	-	-	-									
	1,5	4,83	8,94	14,33	15,92	18,09	21,05	23,08	23,79	24,07	23,53	22,07	19,63	11,42	-	-	-	-									
	>3	4,87	9,03	14,50	16,12	18,32	21,34	23,43	24,18	24,51	24,02	22,61	20,21	12,10	-	-	-	-									
$v$ [m/s]		5	10	15	20	25	30	35	40																		
Belt pulley – balancing				static				dynamic																			

$$\text{Required number of belts in a gearing: } z \geq \frac{N \cdot k_T}{N_1 \cdot k_\phi \cdot k_L}$$

where:

$N$  – power transferred by a gearing;

$N_1$  – rated power transferred by one belt;

$k_\phi$  – coefficient of wrap angle, see the table 3.2.;

$k_T$  – coefficient of working conditions, see the table 3.1.;

$k_L$  – coefficient of belt length, see the table 3.3.

Table 3.8. Rated power  $N_T$  transferred by one belt of SPC (22x18) – SPC BP section.

$d_p$ [mm]	i or 1/i	Smaller pulley speed $n_d$ [r.p.m.]																											
		200	300	400	500	600	700	800	950	1 200	1 450	1 600	1 800	2 000	2 200	2 400	2 800	3 200											
Nominal power value $N_T$ [kW]																													
224	1	2,90	4,08	5,19	6,23	7,21	8,13	8,99	10,19	11,89	13,22	13,81	14,35	14,58	14,47	14,01	11,89	8,01											
	1,05	3,02	4,26	5,43	6,53	7,57	8,55	9,47	10,76	12,61	14,09	14,77	15,43	15,78	15,79	15,44	13,57	9,93											
	1,2	3,14	4,44	5,67	6,83	7,92	8,97	9,95	11,33	13,33	14,95	15,73	16,51	16,98	17,11	16,88	15,25	11,85											
	1,5	3,26	4,26	5,91	7,13	8,28	9,39	10,43	11,90	14,05	15,82	16,69	17,59	18,17	18,43	18,32	16,92	13,77											
	>3	3,38	4,80	6,15	7,43	8,64	9,81	10,91	12,47	14,77	16,69	17,65	18,66	19,37	19,75	19,76	18,60	15,68											
250	1	3,50	4,95	6,31	7,60	8,81	9,95	11,02	12,51	14,61	16,21	16,92	17,52	17,70	17,44	16,69	13,60	8,12											
	1,05	3,62	5,13	6,55	7,89	9,17	10,37	11,50	13,07	15,33	17,08	17,88	18,59	18,90	18,76	18,13	15,28	10,04											
	1,2	3,74	5,31	6,79	8,19	9,53	10,79	11,98	13,64	16,05	17,95	18,83	19,67	20,10	20,08	19,57	16,96	11,96											
	1,5	3,86	5,49	7,03	8,49	9,89	11,21	12,46	14,21	16,77	18,82	19,79	20,75	21,30	21,40	21,01	18,64	13,88											
	>3	3,98	5,67	7,27	8,79	10,25	11,63	12,94	14,78	17,49	19,69	20,75	21,83	22,50	22,72	22,45	20,32	15,80											
280	1	4,18	5,94	7,59	9,15	10,62	12,01	13,31	15,10	17,60	19,44	20,20	20,75	20,75	20,13	18,86	14,11	6,10											
	1,05	4,30	6,12	7,83	9,45	10,98	12,43	13,79	15,67	18,32	20,31	21,16	21,83	21,95	21,45	20,30	15,79	8,02											
	1,2	4,42	6,30	8,07	9,75	11,34	12,85	14,27	16,24	19,04	21,18	22,12	22,91	23,15	22,77	21,73	17,47	9,93											
	1,5	4,54	6,48	8,31	10,05	11,70	13,27	14,75	16,81	19,76	22,05	23,07	23,99	24,35	24,09	23,17	19,15	11,85											
	>3	4,66	6,66	8,55	10,35	12,06	13,69	15,23	17,38	20,48	22,92	24,03	25,07	25,54	25,41	24,61	20,83	13,77											
315	1	4,97	7,08	9,07	10,94	12,70	14,36	15,90	18,01	20,88	22,87	23,58	23,91	23,47	22,18	19,98	12,53	-											
	1,05	5,09	7,26	9,31	11,24	13,06	14,78	16,38	18,58	21,60	23,74	24,54	24,99	24,67	23,50	21,42	14,20	-											
	1,2	5,21	7,44	9,55	11,54	13,42	15,20	16,86	19,15	22,32	24,60	25,50	26,07	25,87	24,82	22,86	15,88	-											
	1,5	5,33	7,62	9,79	11,84	13,78	15,62	17,34	19,72	23,04	25,47	26,46	27,15	27,07	26,14	24,30	17,56	-											
	>3	5,45	7,80	10,03	12,14	14,14	16,04	17,82	20,29	23,76	26,34	27,42	28,23	28,26	27,46	25,74	19,24	-											
355	1	5,87	8,37	10,72	12,94	15,02	16,96	18,76	21,17	24,34	26,29	26,80	26,62	25,37	22,94	19,22	-	-											
	1,05	5,99	8,55	10,96	13,24	15,38	17,38	19,24	21,74	25,06	27,16	27,76	27,70	26,57	24,26	20,66	-	-											
	1,2	6,11	8,73	11,20	13,54	15,74	17,80	19,72	22,31	25,78	28,03	28,72	28,78	27,77	25,58	22,10	-	-											
	1,5	6,23	8,91	11,44	13,84	16,10	18,22	20,20	22,88	26,50	28,90	29,68	29,86	28,97	26,90	23,54	-	-											
	>3	6,35	9,09	11,68	14,14	16,46	18,64	20,68	23,45	27,22	29,77	30,64	30,94	30,17	28,22	24,98	-	-											
400	1	6,86	9,80	12,56	15,15	17,56	19,79	21,84	24,52	27,83	29,46	29,53	28,42	25,81	21,54	15,48	-	-											
	1,05	6,98	9,98	12,80	15,45	17,92	20,21	22,32	25,09	28,55	30,33	30,49	29,50	27,01	22,86	16,91	-	-											
	1,2	7,10	10,16	13,04	15,75	18,28	20,63	22,80	25,66	29,27	31,20	31,45	30,58	28,21	24,18	18,35	-	-											
	1,5	7,22	10,34	13,28	16,04	18,64	21,05	23,28	26,23	29,99	32,07	32,41	31,66	29,41	25,50	19,79	-	-											
	>3	7,34	10,52	13,52	16,34	19,00	21,47	23,76	26,80	30,70	32,94	33,37	32,74	30,60	26,82	21,23	-	-											
450	1	7,96	11,37	14,56	17,54	20,29	22,81	25,07	27,94	31,15	32,06	31,33	28,69	23,95	16,89	-	-	-											
	1,05	8,08	11,55	14,80	17,83	20,65	23,23	25,55	28,51	31,87	32,93	32,29	29,77	25,15	18,21	-	-	-											
	1,2	8,20	11,73	15,04	18,13	21,01	23,65	26,03	29,08	32,59	33,80	33,25	30,85	26,34	19,53	-	-	-											
	1,5	8,32	11,91	15,28	18,43	21,37	24,07	26,51	29,65	33,31	34,67	34,21	31,92	27,54	20,85	-	-	-											
	>3	8,44	12,09	15,52	18,73	21,73	24,48	26,99	30,22	34,03	35,54	35,16	33,00	28,74	22,17	-	-	-											
500	1	9,04	12,91	16,52	19,86	22,92	25,67	28,09	31,04	33,85	33,58	31,70	26,94	19,35	-	-	-	-											
	1,05	9,16	13,09	16,76	20,16	23,28	26,09	28,57	31,61	34,57	34,45	32,66	28,02	20,54	-	-	-	-											
	1,2	9,28	13,27	17,00	20,46	23,64	26,51	29,05	32,18	35,29	35,31	33,62	29,10	21,74	-	-	-	-											
	1,5	9,40	13,45	17,24	20,76	24,00	26,93	29,53	32,75	36,01	36,18	34,57	30,18	22,94	-	-	-	-											
	>3	9,52	13,63	17,48	21,06	24,36	27,35	30,01	33,32	36,73	37,05	35,53	31,26	24,14	-	-	-	-											
560	1	10,32	14,74	18,82	22,56	25,93	28,90	31,43	34,29	36,18	33,83	30,05	21,90	-	-	-	-	-											
	1,05	10,44	14,92	19,06	22,86	26,29	29,32	31,91	34,86	36,90	34,70	31,01	22,98	-	-	-	-	-											
	1,2	10,56	15,09	19,30	23,16	26,65	29,74	32,39	35,43	37,62	35,57	31,97	24,06	-	-	-	-	-											
	1,5	10,68	15,27	19,54	23,46	27,01	30,16	32,87	36,00	38,34	36,44	32,93	25,14	-	-	-	-	-											
	>3	10,80	15,45	19,78	23,76	27,37	30,58	33,35	36,57	39,06	37,31	33,89	26,22	-	-	-	-	-											
630	1	11,80	16,82	21,42	25,58	29,25	32,37	34,88	37,37	37,52	31,74	24,96	-	-	-	-	-	-											
	1,05	11,92	17,00	21,66	25,88	29,61	32,79	35,36	37,94	38,24	32,61	25,92	-	-	-	-	-	-											
	1,2	12,04	17,18	21,90	26,18	29,96	33,21	35,84	38,51	38,96	33,48	26,88	-	-	-	-	-	-											
	1,5	12,16	17,36	22,14	26,48	30,32	33,63	36,32	39,07	39,68	34,35	27,84	-	-	-	-	-	-											
	>3	12,28	17,54	22,38	26,78	30,68	34,04	36,80	39,64	40,40	35,22	28,79	-	-	-	-	-	-											
v [m/s]		10				15				20				25				30				35				40			
Belt pulley – balancing						static						dynamic																	

$$\text{Required number of belts in a gearing: } z \geq \frac{N \cdot k_T}{N_T \cdot k_\phi \cdot k_L}$$

where:

$N$  – power transferred by a gearing;

$N_T$  – rated power transferred by one belt;

$k_\phi$  – coefficient of wrap angle, see the table 3.2.;

$k_T$  – coefficient of working conditions, see the table 3.1.;

$k_L$  – coefficient of belt length, see the table 3.3.

**Table 3.9.** Rated power  $N_T$  transferred by one belt of **Z (10x6)** section.

$d_p$ [mm]	$i$ or $1/i$	Smaller pulley speed $n_d$ [r.p.m.]																																		
		200	400	700	800	950	1 200	1 450	1 600	2 000	2 400	2 800	3 200	3 600	4 000	4 500	5 000	5 500	6 000																	
		Nominal power value $N_T$ [kW]																																		
50	1	0,062	0,11	0,16	0,18	0,21	0,25	0,28	0,30	0,35	0,40	0,44	0,47	0,50	0,53	0,55	0,57	0,57	0,57																	
	1,05	0,064	0,11	0,17	0,19	0,21	0,25	0,29	0,31	0,36	0,41	0,45	0,49	0,52	0,54	0,57	0,59	0,59	0,59																	
	1,2	0,066	0,11	0,18	0,19	0,22	0,26	0,30	0,32	1,38	0,42	0,47	0,50	0,54	0,56	0,59	0,61	0,61	0,61																	
	1,5	0,068	0,12	0,18	0,20	0,23	0,27	0,31	0,33	0,39	0,44	0,48	0,52	0,55	0,58	0,61	0,63	0,63	0,63																	
	>3	0,070	0,12	0,19	0,21	0,24	0,28	0,32	0,34	0,40	0,45	0,50	0,54	0,57	0,60	0,63	0,65	0,65	0,65																	
56	1	0,08	0,14	0,21	0,23	0,27	0,32	0,37	0,40	0,47	0,54	0,59	0,65	0,69	0,73	0,78	0,81	0,83	0,83																	
	1,05	0,08	0,14	0,22	0,24	0,28	0,33	0,38	0,41	0,49	0,55	0,62	0,67	0,72	0,76	0,80	0,83	0,85	0,86																	
	1,2	0,08	0,14	0,23	0,25	0,29	0,34	0,40	0,43	0,50	0,57	0,64	0,69	0,74	0,79	0,83	0,86	0,88	0,89																	
	1,5	0,08	0,15	0,23	0,26	0,30	0,36	0,41	0,44	0,52	0,59	0,66	0,72	0,77	0,81	0,86	0,89	0,91	0,92																	
	>3	0,09	0,15	0,24	0,27	0,31	0,37	0,42	0,46	0,54	0,61	0,68	0,74	0,79	0,84	0,88	0,92	0,94	0,95																	
63	1	0,09	0,17	0,27	0,30	0,34	0,41	0,48	0,51	0,61	0,70	0,78	0,85	0,91	0,97	1,03	1,07	1,10	1,11																	
	1,05	0,10	0,17	0,27	0,31	0,35	0,42	0,49	0,53	0,63	0,72	0,80	0,88	0,94	1,00	1,06	1,11	1,14	1,15																	
	1,2	0,10	0,18	0,28	0,32	0,36	0,44	0,51	0,55	0,65	0,75	0,83	0,91	0,98	1,04	1,10	1,14	1,17	1,19																	
	1,5	0,10	0,19	0,29	0,33	0,38	0,45	0,53	0,57	0,67	0,77	0,86	0,94	1,01	1,07	1,13	1,18	1,21	1,23																	
	>3	0,11	0,19	0,30	0,34	0,39	0,47	0,54	0,59	0,69	0,79	0,88	0,97	1,04	1,10	1,17	1,22	1,25	1,26																	
71	1	0,11	0,20	0,33	0,37	0,42	0,51	0,59	0,64	0,76	0,88	0,98	1,07	1,15	1,22	1,29	1,35	1,38	1,39																	
	1,05	0,12	0,21	0,34	0,38	0,44	0,53	0,61	0,66	0,79	0,91	1,01	1,11	1,19	1,27	1,34	1,39	1,43	1,44																	
	1,2	0,12	0,22	0,35	0,39	0,45	0,54	0,63	0,69	0,82	0,94	1,05	1,14	1,23	1,31	1,39	1,44	1,48	1,48																	
	1,5	0,13	0,23	0,36	0,40	0,46	0,56	0,66	0,71	0,84	0,97	1,08	1,18	1,27	1,35	1,43	1,49	1,52	1,53																	
	>3	0,13	0,23	0,37	0,42	0,48	0,58	0,68	0,73	0,87	1,00	1,11	1,22	1,31	1,39	1,48	1,54	1,57	1,58																	
80	1	0,14	0,25	0,40	0,44	0,51	0,62	0,72	0,78	0,93	1,07	1,20	1,31	1,41	1,49	1,57	1,63	1,65	1,65																	
	1,05	0,14	0,25	0,41	0,46	0,53	0,64	0,75	0,81	0,97	1,11	1,24	1,36	1,46	1,54	1,63	1,68	1,71	1,71																	
	1,2	0,15	0,26	0,42	0,47	0,55	0,66	0,77	0,84	1,00	1,15	1,28	1,40	1,51	1,60	1,68	1,74	1,77	1,76																	
	1,5	0,15	0,27	0,44	0,49	0,56	0,68	0,80	0,86	1,03	1,18	1,32	1,45	1,56	1,65	1,74	1,80	1,83	1,82																	
	>3	0,15	0,28	0,45	0,50	0,58	0,71	0,82	0,89	1,06	1,22	1,36	1,49	1,60	1,70	1,79	1,86	1,88	1,88																	
90	1	0,16	0,29	0,47	0,53	0,61	0,74	0,86	0,94	1,12	1,28	1,43	1,56	1,67	1,77	1,85	1,90	1,90	1,86																	
	1,05	0,17	0,30	0,49	0,54	0,63	0,77	0,89	0,97	1,16	1,33	1,48	1,62	1,73	1,83	1,91	1,96	1,97	1,93																	
	1,2	0,17	0,31	0,50	0,56	0,65	0,79	0,93	1,00	1,20	1,37	1,53	1,67	1,79	1,89	1,98	2,03	2,03	1,99																	
	1,5	0,18	0,32	0,52	0,58	0,67	0,82	0,96	1,03	1,23	1,42	1,58	1,73	1,85	1,95	2,04	2,09	2,10	2,06																	
	>3	0,18	0,33	0,54	0,60	0,69	0,84	0,99	1,07	1,27	1,46	1,63	1,78	1,91	2,01	2,11	2,16	2,17	2,12																	
100	1	0,18	0,34	0,54	0,61	0,71	0,86	1,00	1,09	1,30	1,49	1,65	1,80	1,92	2,01	2,09	2,11	2,08	2,00																	
	1,05	0,19	0,35	0,56	0,63	0,73	0,89	1,04	1,13	1,34	1,54	1,71	1,86	1,99	2,08	2,16	2,19	2,16	2,07																	
	1,2	0,20	0,36	0,58	0,65	0,75	0,92	1,07	1,16	1,39	1,59	1,77	1,93	2,05	2,15	2,23	2,26	2,23	2,14																	
	1,5	0,20	0,37	0,60	0,67	0,78	0,95	1,11	1,20	1,43	1,64	1,83	1,99	2,12	2,22	2,31	2,34	2,30	2,21																	
	>3	0,21	0,38	0,62	0,70	0,80	0,98	1,14	1,24	1,48	1,69	1,89	2,05	2,19	2,29	2,38	2,41	2,38	2,28																	
112	1	0,21	0,39	0,63	0,71	0,82	1,00	1,17	1,26	1,51	1,72	1,91	2,06	2,19	2,27	2,32	2,30	2,21	2,03																	
	1,05	0,22	0,40	0,65	0,73	0,85	1,03	1,21	1,31	1,56	1,78	1,97	2,14	2,26	2,35	2,40	2,38	2,29	2,10																	
	1,2	0,23	0,42	0,68	0,76	0,88	1,07	1,25	1,35	1,61	1,84	2,04	2,21	2,34	2,43	2,48	2,46	2,36	2,18																	
	1,5	0,23	0,43	0,70	0,78	0,91	1,10	1,29	1,40	1,66	1,90	2,11	2,28	2,42	2,51	2,57	2,54	2,44	2,25																	
	>3	0,24	0,44	0,72	0,81	0,94	1,14	1,33	1,44	1,72	1,96	2,17	2,35	2,49	2,59	2,65	2,63	2,52	2,32																	
$v$ [m/s]		5					10					15					20					25					30					35				
Belt pulley – balancing		static										dynamic																								

$$\text{Required number of belts in a gearing: } z \geq \frac{N \cdot k_T}{N_T \cdot k_\phi \cdot k_L}$$

where:

$N$  – power transferred by a gearing;

$N_T$  – rated power transferred by one belt;

$k_\phi$  – coefficient of wrap angle, see the table 3.2.;

$k_T$  – coefficient of working conditions, see the table 3.1.;

$k_L$  – coefficient of belt length, see the table 3.4.

Table 3.10. Rated power  $N_T$  transferred by one belt of A (13x8) – A BP section.

$d_p$ [mm]	$i$ or $1/i$	Smaller pulley speed $n_d$ [r.p.m.]																							
		200	400	700	800	950	1 200	1 450	1 600	2 000	2 400	2 800	3 200	3 600	4 000	4 500	5 000	5 500	6 000						
		Nominal power value $N_T$ [kW]																							
71	1	0,14	0,23	0,35	0,39	0,44	0,51	0,58	0,61	0,70	0,77	0,82	0,80	0,87	0,85	0,78	0,69	0,58							
	1,05	0,14	0,24	0,36	0,40	0,45	0,53	0,60	0,64	0,72	0,80	0,85	0,89	0,90	0,90	0,87	0,81	0,71	0,58						
	1,2	0,15	0,25	0,38	0,41	0,47	0,55	0,62	0,66	0,75	0,82	0,88	0,92	0,94	0,93	0,90	0,84	0,74	0,60						
	1,5	0,15	0,26	0,39	0,43	0,48	0,56	0,64	0,68	0,77	0,85	0,91	0,95	0,97	0,97	0,93	0,87	0,76	0,62						
	>3	0,16	0,27	0,40	0,44	0,50	0,58	0,68	0,70	0,80	0,88	0,94	0,98	1,00	1,00	0,96	0,89	0,79	0,63						
80	1	0,18	0,31	0,47	0,52	0,60	0,71	0,81	0,87	1,01	1,12	1,22	1,29	1,34	1,37	1,36	1,31	1,21	1,06						
	1,05	0,18	0,32	0,49	0,54	0,62	0,73	0,84	0,90	1,04	1,16	1,26	1,34	1,39	1,41	1,41	1,35	1,25	1,10						
	1,2	0,19	0,33	0,51	0,56	0,64	0,76	0,87	0,93	1,08	1,20	1,30	1,38	1,43	1,46	1,45	1,40	1,29	1,13						
	1,5	0,20	0,34	0,52	0,58	0,66	0,78	0,90	0,96	1,11	1,24	1,35	1,43	1,48	1,51	1,50	1,45	1,34	1,17						
	>3	0,20	0,35	0,54	0,60	0,68	0,81	0,92	0,99	1,15	1,28	1,39	1,47	1,53	1,56	1,55	1,49	1,38	1,21						
90	1	0,22	0,39	0,61	0,68	0,77	0,93	1,07	1,15	1,34	1,50	1,64	1,75	1,83	1,87	1,88	1,82	1,70	1,50						
	1,05	0,23	0,40	0,63	0,70	0,80	0,96	1,10	1,19	1,38	1,56	1,70	1,81	1,89	1,94	1,94	1,88	1,76	1,55						
	1,2	0,24	0,41	0,65	0,72	0,83	0,99	1,14	1,23	1,43	1,61	1,76	1,87	1,96	2,00	2,01	1,95	1,81	1,60						
	1,5	0,24	0,43	0,67	0,75	0,85	1,02	1,18	1,27	1,48	1,66	1,82	1,94	2,02	2,07	2,07	2,01	1,87	1,66						
	>3	0,25	0,44	0,69	0,77	0,88	1,05	1,21	1,31	1,53	1,71	1,87	2,00	2,09	2,14	2,14	2,07	1,93	1,71						
100	1	0,26	0,47	0,74	0,83	0,95	1,14	1,32	1,42	1,66	1,87	2,05	2,19	2,28	2,34	2,33	2,25	2,07	1,80						
	1,05	0,27	0,48	0,77	0,85	0,98	1,18	1,36	1,47	1,72	1,94	2,12	2,26	2,36	2,42	2,42	2,33	2,15	1,87						
	1,2	0,28	0,50	0,79	0,88	1,01	1,22	1,41	1,52	1,78	2,01	2,19	2,34	2,44	2,50	2,50	2,41	2,22	1,93						
	1,5	0,29	0,52	0,82	0,91	1,05	1,26	1,45	1,57	1,84	2,07	2,27	2,42	2,52	2,58	2,58	2,48	2,29	1,99						
	>3	0,30	0,53	0,84	0,94	1,08	1,30	1,50	1,62	1,89	2,14	2,34	2,49	2,60	2,66	2,66	2,56	2,36	2,05						
112	1	0,31	0,56	0,90	1,00	1,15	1,39	1,61	1,74	2,04	2,30	2,51	2,68	2,78	2,83	2,79	2,64	2,37	1,96						
	1,05	0,32	0,58	0,93	1,04	1,19	1,44	1,67	1,80	2,11	2,38	2,60	2,77	2,88	2,93	2,89	2,74	2,45	2,03						
	1,2	0,34	0,60	0,96	1,07	1,23	1,49	1,72	1,86	2,18	2,46	2,69	2,86	2,98	3,03	2,99	2,83	2,54	2,10						
	1,5	0,35	0,62	0,99	1,11	1,27	1,54	1,78	1,92	2,25	2,54	2,78	2,96	3,08	3,13	3,09	2,92	2,62	2,17						
	>3	0,36	0,64	1,02	1,14	1,31	1,59	1,84	1,98	2,33	2,62	2,87	3,05	3,17	3,22	3,18	3,01	2,70	2,24						
125	1	0,37	0,67	1,07	1,19	1,37	1,66	1,92	2,07	2,44	2,74	2,98	3,16	3,26	3,28	3,17	2,91	2,48	1,87						
	1,05	0,38	0,69	1,10	1,23	1,42	1,72	1,99	2,15	2,52	2,84	3,09	3,27	3,37	3,39	3,28	3,01	2,57	1,93						
	1,2	0,39	0,71	1,14	1,28	1,47	1,77	2,06	2,22	2,61	2,93	3,19	3,38	3,49	3,51	3,39	3,12	2,66	2,00						
	1,5	0,41	0,74	1,18	1,32	1,52	1,83	2,13	2,29	2,69	3,03	3,30	3,49	3,60	3,62	3,50	3,22	2,74	2,06						
	>3	0,42	0,76	1,22	1,36	1,57	1,89	2,19	2,36	2,78	3,12	3,40	3,60	3,72	3,74	3,62	3,32	2,83	2,13						
140	1	0,43	0,78	1,26	1,41	1,62	1,96	2,28	2,45	2,87	3,22	3,48	3,65	3,72	3,67	3,44	2,99	2,31	1,37						
	1,05	0,45	0,81	1,30	1,46	1,68	2,03	2,36	2,54	2,97	3,33	3,60	3,78	3,85	3,80	3,56	3,10	2,39	1,42						
	1,2	0,46	0,84	1,35	1,51	1,74	2,10	2,43	2,62	3,07	3,44	3,72	3,91	3,98	3,93	3,68	3,20	2,47	1,46						
	1,5	0,48	0,86	1,39	1,56	1,79	2,17	2,51	2,71	3,17	3,56	3,85	4,03	4,11	4,06	3,80	3,31	2,55	1,51						
	>3	0,49	0,89	1,43	1,60	1,85	2,24	2,59	2,79	3,27	3,67	3,97	4,16	4,24	4,19	3,92	3,41	2,63	1,56						
160	1	0,51	0,94	1,51	1,69	1,95	2,36	2,73	2,94	3,42	3,80	4,06	4,19	4,17	3,98	3,48	2,67	1,51	-						
	1,05	0,53	0,97	1,56	1,75	2,02	2,44	2,82	3,04	3,54	3,93	4,20	4,34	4,31	4,12	3,60	2,77	1,57	-						
	1,2	0,55	1,00	1,62	1,81	2,09	2,52	2,92	3,14	3,66	4,07	4,35	4,48	4,46	4,25	3,73	2,86	1,62	-						
	1,5	0,57	1,03	1,67	1,87	2,15	2,60	3,02	3,24	3,78	4,20	4,49	4,63	4,60	4,39	3,85	2,95	1,67	-						
	>3	0,58	1,07	1,72	1,93	2,22	2,69	3,11	3,35	3,90	4,33	4,63	4,78	4,75	4,53	3,97	3,05	1,73	-						
180	1	0,59	1,09	1,76	1,97	2,27	2,74	3,16	3,40	3,93	4,32	4,54	4,58	4,40	4,00	3,13	1,81	-	-						
	1,05	0,61	1,12	1,82	2,04	2,35	2,83	3,27	3,52	4,07	4,47	4,70	4,74	4,56	4,14	3,24	1,87	-	-						
	1,2	0,63	1,16	1,88	2,10	2,43	2,93	3,38	3,63	4,20	4,62	4,86	4,90	4,71	4,28	3,34	1,94	-	-						
	1,5	0,66	1,20	1,94	2,17	2,51	3,03	3,50	3,75	4,34	4,77	5,02	5,06	4,87	4,42	3,45	2,00	-	-						
	>3	0,68	1,24	2,00	2,24	2,59	3,12	3,61	3,87	4,48	4,92	5,18	5,22	5,02	4,56	3,56	2,06	-	-						
$v$ [m/s]		5			10			15			20			25			30			35			40		
Belt pulley – balancing				static								dynamic													

$$\text{Required number of belts in a gearing: } z \geq \frac{N \cdot k_T}{N_T \cdot k_\phi \cdot k_L}$$

where:

$N$  – power transferred by a gearing;

$N_T$  – rated power transferred by one belt;

$k_\phi$  – coefficient of wrap angle, see the table 3.2.;

$k_T$  – coefficient of working conditions, see the table 3.1.;

$k_L$  – coefficient of belt length, see the table 3.4.



Table 3.11. Rated power  $N_T$  transferred by one belt of **B (17x11) – B BP** section.

$d_p$ [mm]	i or 1/i	Smaller pulley speed $n_d$ [r.p.m.]																	
		200	400	700	800	950	1 200	1 450	1 600	1 800	2 000	2 200	2 400	2 800	3 200	3 600	4 000	4 500	5 000
		Nominal power value $N_T$ [kW]																	
112	1	0,39	0,66	1,00	1,10	1,25	1,40	1,64	1,75	1,85	1,94	2,01	2,07	2,12	2,08	1,94	1,70	1,24	0,58
	1,05	0,40	0,68	1,04	1,14	1,29	1,51	1,70	1,79	1,91	2,01	2,08	2,14	2,19	2,15	2,01	1,76	1,28	0,60
	1,2	0,41	0,71	1,07	1,18	1,33	1,56	1,75	1,86	1,97	2,08	2,15	2,21	2,27	2,22	2,08	1,82	1,32	0,62
	1,5	0,43	0,73	1,11	1,22	1,38	1,61	1,81	1,92	2,04	2,14	2,23	2,29	2,34	2,30	2,14	1,88	1,37	0,64
	>3	0,44	0,75	1,14	1,26	1,42	1,66	1,87	1,98	2,10	2,21	2,30	2,36	2,41	2,37	2,21	1,94	1,41	0,66
125	1	0,48	0,84	1,30	1,44	1,64	1,93	2,19	2,33	2,50	2,64	2,76	2,85	2,96	2,94	2,80	2,51	1,93	1,09
	1,05	0,50	0,87	1,35	1,49	1,69	2,00	2,27	2,41	2,59	2,73	2,86	2,95	3,06	3,04	2,90	2,60	2,00	1,13
	1,2	0,52	0,90	1,39	1,54	1,75	2,07	2,35	2,50	2,67	2,83	2,95	3,05	3,16	3,15	2,99	2,69	2,07	1,17
	1,5	0,53	0,93	1,44	1,59	1,81	2,13	2,42	2,58	2,76	2,92	3,05	3,15	3,27	3,25	3,09	2,78	2,14	1,21
	>3	0,55	0,96	1,48	1,64	1,86	2,20	2,50	2,66	2,85	3,01	3,15	3,25	3,37	3,35	3,19	2,86	2,21	1,24
140	1	0,59	1,05	1,64	1,82	2,08	2,47	2,82	3,00	3,23	3,42	3,58	3,70	3,85	3,83	3,63	3,24	2,45	1,29
	1,05	0,61	1,09	1,70	1,89	2,15	2,56	2,91	3,11	3,34	3,54	3,70	3,83	3,98	3,96	3,76	3,35	2,53	1,33
	1,2	0,54	1,12	1,76	1,95	2,22	2,64	3,01	3,21	3,45	3,66	3,83	3,96	4,11	4,09	3,88	3,47	2,62	1,38
	1,5	0,66	1,16	1,81	2,01	2,30	2,73	3,11	3,32	3,56	3,78	3,95	4,09	4,25	4,23	4,01	3,58	2,70	1,42
	>3	0,68	1,20	1,87	2,08	2,37	2,81	3,21	3,42	3,68	3,90	4,08	4,22	4,38	4,36	4,14	3,69	2,79	1,47
160	1	0,74	1,32	2,09	2,32	2,66	3,17	3,62	3,86	4,15	4,40	4,60	4,75	4,89	4,80	4,46	3,82	2,59	0,81
	1,05	0,76	1,37	2,16	2,40	2,75	3,28	3,75	4,00	4,30	4,55	4,76	4,91	5,06	4,97	4,61	3,96	2,68	0,84
	1,2	0,79	1,41	2,23	2,48	2,84	3,39	3,87	4,13	4,44	4,70	4,92	5,08	5,23	5,14	4,77	4,09	2,77	0,87
	1,5	0,82	1,46	2,31	2,57	2,94	3,50	4,00	4,27	4,59	4,86	5,08	5,25	5,40	5,31	4,92	4,23	2,86	0,90
	>3	0,84	1,51	2,38	2,65	3,03	3,61	4,13	4,40	4,73	5,01	5,24	5,41	5,58	5,48	5,08	4,36	2,95	0,93
180	1	0,88	1,59	2,53	2,81	3,22	3,85	4,39	4,68	5,02	5,30	5,52	5,67	5,76	5,52	4,92	3,92	2,04	-
	1,05	0,91	1,64	2,61	2,91	3,33	3,98	4,55	4,85	5,20	5,49	5,71	5,87	5,96	5,71	5,09	4,06	2,12	-
	1,2	0,94	1,70	2,70	3,01	3,45	4,11	4,70	5,01	5,37	5,67	5,91	6,07	6,16	5,91	5,27	4,19	2,19	-
	1,5	0,98	1,76	2,79	3,11	3,56	4,25	4,85	5,17	5,55	5,86	6,10	6,27	6,36	6,10	5,44	4,33	2,26	-
	>3	1,01	1,81	2,88	3,21	3,67	4,38	5,01	5,34	5,73	6,05	6,29	6,47	6,56	6,29	5,61	4,47	2,33	-
200	1	1,02	1,85	2,96	3,30	3,77	4,50	5,13	5,46	5,83	6,13	6,35	6,47	6,43	5,95	4,98	3,47	0,73	-
	1,05	1,06	1,92	3,06	3,41	3,91	4,66	5,31	5,65	6,04	6,35	6,57	6,70	6,66	6,16	5,16	3,56	0,76	-
	1,2	1,10	1,98	3,16	3,53	4,04	4,82	5,49	5,84	6,24	6,56	6,79	6,93	6,88	6,37	5,33	3,71	0,78	-
	1,5	1,13	2,05	3,27	3,64	4,17	4,97	5,67	6,03	6,45	6,78	7,01	7,15	7,11	6,58	5,51	3,84	0,81	-
	>3	1,17	2,11	3,37	3,76	4,30	5,13	5,85	6,22	6,65	6,99	7,24	7,42	7,33	6,79	5,68	3,96	0,83	-
224	1	1,19	2,17	3,47	3,86	4,42	5,36	5,97	6,33	6,73	7,02	7,19	7,25	6,95	6,05	4,47	2,14	-	-
	1,05	1,24	2,24	3,59	4,00	4,58	5,44	6,18	6,55	6,96	7,26	7,49	7,55	7,20	6,27	4,63	2,21	-	-
	1,2	1,28	2,32	3,71	4,13	4,73	5,63	6,39	6,77	7,20	7,55	7,74	7,80	7,49	6,48	4,79	2,28	-	-
	1,5	1,32	2,40	3,83	4,27	4,89	5,81	6,60	7,00	7,48	7,80	8,00	8,06	7,73	6,69	4,94	2,36	-	-
	>3	1,36	2,47	3,95	4,40	5,04	6,00	6,81	7,22	7,71	8,05	8,25	8,31	7,97	6,90	5,10	2,43	-	-
250	1	1,37	2,50	4,00	4,46	5,10	6,04	6,82	7,20	7,63	7,87	7,97	7,89	7,14	5,60	3,12	-	-	-
	1,05	1,42	2,59	4,14	4,62	5,28	6,25	7,00	7,49	7,89	8,15	8,24	8,16	7,43	5,79	3,23	-	-	-
	1,2	1,47	2,68	4,28	4,77	5,46	6,47	7,30	7,74	8,16	8,42	8,52	8,44	7,68	5,99	3,34	-	-	-
	1,5	1,52	2,77	4,42	4,93	5,63	6,68	7,58	8,00	8,43	8,70	8,80	8,71	7,93	6,19	3,45	-	-	-
	>3	1,57	2,85	4,56	5,08	5,81	6,89	7,82	8,25	8,69	8,97	9,07	8,99	8,18	6,38	3,56	-	-	-
280	1	1,58	2,89	4,61	5,13	5,85	6,90	7,76	8,13	8,46	8,60	8,53	8,22	6,80	4,26	-	-	-	-
	1,05	1,64	2,99	4,77	5,31	6,06	7,14	8,03	8,41	8,76	8,90	8,83	8,51	7,04	4,41	-	-	-	-
	1,2	1,69	3,09	4,93	5,49	6,26	7,42	8,30	8,69	9,05	9,20	9,12	8,80	7,27	4,56	-	-	-	-
	1,5	1,75	3,19	5,10	5,67	6,47	7,66	8,57	8,97	9,35	9,50	9,42	9,08	7,56	4,71	-	-	-	-
	>3	1,80	3,29	5,26	5,85	6,67	7,91	8,84	9,26	9,64	9,80	9,72	9,37	7,80	4,86	-	-	-	-
v [m/s]		5	10		15	20		25		30	35	40							
Belt pulley – balancing				static					dynamic										

$$\text{Required number of belts in a gearing: } z \geq \frac{N \cdot k_T}{N_T \cdot k_\phi \cdot k_L}$$

where:

$N$  – power transferred by a gearing;

$N_T$  – rated power transferred by one belt;

$k_\phi$  – coefficient of wrap angle, see the table 3.2.;

$k_T$  – coefficient of working conditions, see the table 3.1.;

$k_L$  – coefficient of belt length, see the table 3.4.

**Table 3.12.** Rated power  $N_T$  transferred by one belt of **20 (20x12,5)** section.

$d_b$ [mm]	$i$ or $1/i$	Smaller pulley speed $n_a$ [r.p.m.]																	
		200	300	400	500	600	700	800	950	1 200	1 450	1 600	1 800	2 000	2 200	2 400	2 800	3 200	3 600
		Nominal power value $N_T$ [kW]																	
160	1	0,89	1,23	1,54	1,84	2,11	2,37	2,62	2,96	3,46	3,88	4,09	4,32	4,48	4,58	4,61	4,44	3,94	3,07
	1,05	0,92	1,27	1,60	1,90	2,19	2,45	2,71	3,06	3,58	4,02	4,23	4,47	4,64	4,74	4,77	4,60	4,08	3,18
	1,2	0,95	1,32	1,65	1,97	2,26	2,54	2,80	3,17	3,70	4,15	4,37	4,62	4,79	4,90	4,93	4,75	4,22	3,29
	1,5	0,98	1,36	1,71	2,03	2,33	2,62	2,89	3,27	3,82	4,29	4,52	4,77	4,95	5,06	5,09	4,91	4,36	3,40
	>3	1,01	1,40	1,76	2,09	2,41	2,70	2,98	3,37	3,95	4,42	4,66	4,92	5,11	5,22	5,26	5,07	4,50	3,50
180	1	1,10	1,54	1,94	2,32	2,68	3,02	3,35	3,80	4,47	5,03	5,31	5,62	5,84	5,97	6,01	5,77	5,06	3,84
	1,05	1,14	1,59	2,01	2,40	2,77	3,13	3,46	3,93	4,62	5,21	5,50	5,81	6,04	6,18	6,22	5,97	5,24	3,97
	1,2	1,18	1,64	2,08	2,48	2,87	3,23	3,58	4,06	4,78	5,38	5,68	6,01	6,25	6,39	6,43	6,17	5,42	4,11
	1,5	1,22	1,70	2,14	2,57	2,96	3,34	3,70	4,20	4,94	5,56	5,87	6,21	6,45	6,60	6,64	6,37	5,59	4,24
	>3	1,26	1,75	2,21	2,65	3,06	3,44	3,81	4,33	5,09	5,73	6,05	6,40	6,65	6,81	6,85	6,57	5,77	4,38
200	1	1,31	1,84	2,33	2,80	3,24	3,66	4,06	4,62	5,44	6,13	6,47	6,83	7,08	7,22	7,22	6,81	5,77	4,03
	1,05	1,36	1,90	2,42	2,90	3,36	3,79	4,20	4,78	5,63	6,34	6,70	7,07	7,33	7,51	7,52	7,05	5,97	4,17
	1,2	1,40	1,97	2,50	3,00	3,47	3,92	4,34	4,94	5,83	6,56	6,92	7,31	7,62	7,77	7,77	7,28	6,17	4,31
	1,5	1,45	2,03	2,58	3,09	3,58	4,05	4,49	5,10	6,02	6,77	7,15	7,59	7,87	8,02	8,20	7,57	6,38	4,45
	>3	1,50	2,10	2,66	3,19	3,70	4,17	4,63	5,27	6,21	6,99	7,42	7,83	8,12	8,27	8,28	7,81	6,58	4,60
224	1	1,56	2,20	2,80	3,37	3,90	4,42	4,90	5,58	6,57	7,43	7,82	8,22	8,47	8,55	8,46	7,70	6,02	3,42
	1,05	1,62	2,28	2,90	3,48	4,04	4,57	5,07	5,77	6,80	7,69	8,09	8,50	8,76	8,85	8,75	7,96	6,23	3,54
	1,2	1,67	2,35	3,00	3,60	4,18	4,72	5,24	5,97	7,03	7,95	8,36	8,79	9,05	9,15	9,05	8,23	6,45	3,66
	1,5	1,73	2,43	3,09	3,72	4,31	4,88	5,41	6,16	7,26	8,20	8,64	9,08	9,35	9,44	9,34	8,50	6,66	3,78
	>3	1,78	2,51	3,19	3,84	4,45	5,03	5,59	6,36	7,54	8,46	8,91	9,36	9,64	9,74	9,64	8,77	6,87	3,90
250	1	1,83	2,59	3,30	3,97	4,61	5,22	5,79	6,59	7,79	8,70	9,12	9,51	9,70	9,67	9,40	8,06	5,49	1,62
	1,05	1,89	2,68	3,41	4,11	4,77	5,40	5,99	6,82	8,06	9,00	9,43	9,84	10,04	10,01	9,73	8,34	5,68	1,68
	1,2	1,96	2,77	3,53	4,25	4,93	5,58	6,19	7,05	8,33	9,30	9,75	10,17	10,38	10,34	10,05	8,62	5,87	1,73
	1,5	2,02	2,86	3,64	4,39	5,09	5,76	6,40	7,28	8,60	9,61	10,07	10,51	10,72	10,68	10,38	8,90	6,07	1,79
	>3	2,09	2,95	3,76	4,53	5,25	5,95	6,60	7,55	8,87	9,91	10,39	10,84	11,05	11,02	10,71	9,18	6,26	1,85
280	1	2,14	3,03	3,86	4,66	5,41	6,12	6,79	7,75	9,06	10,04	10,45	10,78	10,83	10,57	9,98	7,70	3,71	-
	1,05	2,21	3,13	4,00	4,82	5,60	6,33	7,02	8,02	9,37	10,39	10,82	11,16	11,21	10,94	10,33	7,96	3,84	-
	1,2	2,28	3,24	4,13	4,98	5,79	6,54	7,26	8,29	9,69	10,74	11,18	11,53	11,58	11,31	10,68	8,23	3,97	-
	1,5	2,36	3,34	4,27	5,14	5,97	6,76	7,54	8,56	10,00	11,09	11,55	11,91	11,96	11,68	11,02	8,50	4,10	-
	>3	2,43	3,45	4,40	5,31	6,16	6,97	7,78	8,83	10,32	11,44	11,91	12,28	12,34	12,04	11,37	8,77	4,23	-
315	1	2,49	3,53	4,51	5,44	6,32	7,14	7,95	9,00	10,43	11,42	11,78	11,93	11,70	11,03	9,90	6,04	-	-
	1,05	2,57	3,66	4,67	5,63	6,54	7,43	8,23	9,31	10,80	11,82	12,19	12,35	12,11	11,42	10,25	6,25	-	-
	1,2	2,66	3,78	4,83	5,82	6,76	7,68	8,51	9,63	11,16	12,22	12,60	12,76	12,51	11,80	10,59	6,46	-	-
	1,5	2,75	3,90	4,99	6,01	6,98	7,93	8,78	9,94	11,53	12,62	13,01	13,18	12,92	12,19	10,94	6,68	-	-
	>3	2,84	4,03	5,15	6,20	7,20	8,18	9,06	10,26	11,89	13,02	13,42	13,60	13,33	12,57	11,28	6,89	-	-
355	1	2,89	4,10	5,24	6,32	7,33	8,31	9,18	10,34	11,85	12,74	12,94	12,77	12,04	10,71	8,71	2,46	-	-
	1,05	2,99	4,25	5,43	6,54	7,63	8,60	9,50	10,70	12,26	13,19	13,39	13,21	12,46	11,08	9,01	2,55	-	-
	1,2	3,09	4,39	5,61	6,76	7,88	8,89	9,82	11,06	12,68	13,63	13,84	13,66	12,88	11,45	9,32	2,63	-	-
	1,5	3,19	4,53	5,79	6,98	8,14	9,18	10,14	11,43	13,09	14,08	14,30	14,10	13,30	11,83	9,62	2,72	-	-
	>3	3,29	4,68	5,98	7,20	8,40	9,47	10,46	11,79	13,50	14,52	14,75	14,55	13,72	12,20	9,92	2,81	-	-
v [m/s]		5			10			15		20		25		30		35		40	
Belt pulley – balancing		static					dynamic												

$$\text{Required number of belts in a gearing: } z \geq \frac{N \cdot k_T}{N_T \cdot k_\phi \cdot k_L}$$

where:

$N$  – power transferred by a gearing;

$N_T$  – rated power transferred by one belt;

$k_\phi$  – coefficient of wrap angle, see the table 3.2.;

$k_T$  – coefficient of working conditions, see the table 3.1.;

$k_L$  – coefficient of belt length, see the table 3.4.

**Table 3.13.** Rated power  $N_T$  transferred by one belt of **C (22x14) – C BP** section,

$d_b$ [mm]	i or 1/i	Smaller pulley speed $n_d$ [r.p.m.]																	
		200	300	400	500	600	700	800	950	1 200	1 450	1 600	1 800	2 000	2 200	2 400	2 600	2 800	3 200
		Nominal power value $N_T$ [kW]																	
180	1	1,12	1,54	1,92	2,27	2,59	2,89	3,17	3,55	4,07	4,46	4,62	4,76	4,78	4,70	4,50	4,17	3,70	2,33
	1,05	1,16	1,60	1,99	2,35	2,68	3,00	3,26	3,67	4,22	4,62	4,79	4,92	4,95	4,86	4,65	4,31	3,83	2,41
	1,2	1,20	1,65	2,06	2,43	2,76	3,10	3,30	3,80	4,36	4,77	4,95	5,09	5,12	5,03	4,81	4,40	3,96	2,49
	1,5	1,24	1,70	2,12	2,51	2,87	3,20	3,51	3,92	4,50	4,93	5,11	5,25	5,28	5,19	4,97	4,60	4,09	2,57
	>3	1,28	1,76	2,19	2,59	2,96	3,30	3,62	4,65	4,64	5,08	5,27	5,42	5,45	5,36	5,13	4,75	4,22	2,65
200	1	1,39	1,92	2,41	2,87	3,30	3,69	4,07	4,58	5,29	5,84	6,07	6,28	6,34	6,26	6,02	5,61	5,01	3,23
	1,05	1,44	1,99	2,50	2,97	3,41	3,82	4,21	4,74	5,48	6,04	6,29	6,50	6,57	6,48	6,23	5,80	5,19	3,34
	1,2	1,48	2,06	2,58	3,07	3,53	3,95	4,35	4,90	5,66	6,25	6,50	6,72	6,79	6,70	6,44	6,00	5,36	3,46
	1,5	1,53	2,12	2,67	3,17	3,64	4,08	4,49	5,00	5,85	6,45	6,71	6,94	7,01	6,92	6,65	6,20	5,54	3,57
	>3	1,58	2,19	2,75	3,27	3,76	4,21	4,64	5,22	6,03	6,66	6,93	7,16	7,23	7,14	6,86	6,39	5,71	3,68
224	1	1,70	2,37	2,99	2,58	4,12	4,64	5,12	5,78	6,71	7,45	7,75	8,00	8,06	7,92	7,57	6,93	6,08	3,57
	1,05	1,76	2,45	3,10	3,70	4,27	4,80	5,30	5,98	6,94	7,71	8,02	8,28	8,35	8,20	7,83	7,17	6,30	3,69
	1,2	1,82	2,54	3,20	3,83	4,41	4,96	5,47	6,18	7,18	7,97	8,29	8,56	8,63	8,48	8,09	7,46	6,51	3,82
	1,5	1,88	2,62	3,31	3,95	4,56	5,12	5,65	6,38	7,45	8,23	8,56	8,84	8,91	8,75	8,36	7,70	6,72	3,94
	>3	1,94	2,70	3,41	4,08	4,70	5,29	5,83	6,58	7,69	8,49	8,83	9,12	9,19	9,03	8,62	7,94	6,93	4,07
250	1	2,03	2,85	3,62	4,33	5,00	5,64	6,23	7,04	8,21	9,04	9,38	9,63	9,62	9,34	8,75	7,85	6,56	2,93
	1,05	2,11	2,95	3,74	4,48	5,18	5,83	6,45	7,28	8,50	9,36	9,71	9,96	9,95	9,66	9,06	8,12	6,79	3,03
	1,2	2,18	3,05	3,87	4,64	5,35	6,03	6,66	7,58	8,78	9,67	10,03	10,30	10,29	9,99	9,36	8,40	7,02	3,14
	1,5	2,25	3,15	4,00	4,79	5,53	6,23	6,88	7,82	9,07	9,99	10,36	10,63	10,62	10,31	9,67	8,67	7,25	3,24
	>3	2,32	3,25	4,12	4,94	5,71	6,43	7,10	8,07	9,36	10,30	10,69	10,97	10,96	10,64	9,97	8,94	7,52	3,34
280	1	2,42	3,40	4,32	5,19	6,00	6,76	7,52	8,49	9,81	10,72	11,06	11,22	11,04	10,48	9,50	8,08	6,13	-
	1,05	2,50	3,52	4,48	5,37	6,21	7,00	7,78	8,78	10,15	11,10	11,44	11,61	11,42	10,84	9,83	8,36	6,35	-
	1,2	2,59	3,64	4,63	5,55	6,42	7,24	8,04	9,08	10,49	11,47	11,83	12,00	11,81	11,21	10,16	8,64	6,56	-
	1,5	2,67	3,76	4,78	5,73	6,63	7,52	8,30	9,37	10,83	11,84	12,21	12,39	12,19	11,57	10,49	8,92	6,77	-
	>3	2,76	3,88	4,93	5,92	6,84	7,76	8,57	9,67	11,17	12,22	12,60	12,79	12,58	11,94	10,82	9,20	6,99	-
315	1	2,86	4,04	5,14	6,17	7,14	8,09	8,92	10,05	11,53	12,46	12,72	12,67	12,14	11,08	9,43	7,11	4,16	-
	1,05	2,96	4,18	5,32	6,39	7,43	8,37	9,24	10,40	11,93	12,89	13,16	13,11	12,56	11,46	9,76	7,41	4,31	-
	1,2	3,06	4,32	5,50	6,60	7,68	8,65	9,55	10,75	12,33	13,33	13,60	13,56	12,99	11,85	10,09	7,66	4,45	-
	1,5	3,16	4,46	5,68	6,82	7,93	8,93	9,86	11,10	12,73	13,76	14,05	14,00	13,41	12,23	10,42	7,90	4,60	-
	>3	3,26	4,60	5,86	7,03	8,16	9,21	10,17	11,45	13,14	14,20	14,49	14,44	13,83	12,62	10,75	8,15	4,75	-
355	1	3,36	4,75	6,05	7,27	8,45	9,50	10,46	11,73	13,31	14,12	14,19	13,73	12,59	10,70	7,98	4,32	-	-
	1,05	3,47	4,91	6,26	7,57	8,74	9,83	10,83	12,14	13,77	14,61	14,68	14,21	13,03	11,07	8,26	4,47	-	-
	1,2	3,59	5,08	6,47	7,82	9,04	10,16	11,19	12,55	14,23	15,10	15,18	14,69	13,47	11,44	8,53	4,63	-	-
	1,5	3,71	5,25	6,69	8,08	9,33	10,49	11,56	12,95	14,70	15,59	15,67	15,17	13,91	11,81	8,81	4,78	-	-
	>3	3,82	5,41	6,90	8,33	9,62	10,82	11,92	13,36	15,16	16,09	16,17	15,65	14,35	12,19	9,09	4,93	-	-
400	1	3,91	5,54	7,06	8,52	9,82	11,02	12,10	13,48	15,04	15,53	15,24	14,08	11,95	8,75	4,34	-	-	-
	1,05	4,04	5,73	7,30	8,81	10,17	11,41	12,52	13,95	15,56	16,07	15,77	14,57	12,36	9,05	4,49	-	-	-
	1,2	4,18	5,93	7,60	9,11	10,51	11,79	12,94	14,42	16,08	16,61	16,30	15,06	12,78	9,36	4,64	-	-	-
	1,5	4,32	6,12	7,84	9,41	10,85	12,17	13,37	14,89	16,61	17,15	16,83	15,55	13,20	9,66	4,80	-	-	-
	>3	4,45	6,31	8,09	9,70	11,19	12,56	13,79	15,36	17,13	17,70	17,36	16,04	13,61	9,97	4,95	-	-	-
450	1	4,51	6,40	8,20	9,81	11,29	12,63	13,80	15,23	16,59	16,47	15,57	13,29	9,64	4,44	-	-	-	-
	1,05	4,67	6,62	8,48	10,16	11,69	13,07	14,28	15,76	17,17	17,04	16,12	13,75	9,98	4,59	-	-	-	-
	1,2	4,83	6,85	8,77	10,50	12,08	13,51	14,76	16,29	17,75	17,62	16,66	14,22	10,31	4,75	-	-	-	-
	1,5	4,99	7,07	9,05	10,84	12,48	13,95	15,24	16,82	18,33	18,19	17,20	14,68	10,65	4,90	-	-	-	-
	>3	5,15	7,30	9,34	11,18	12,87	14,39	15,72	17,35	18,91	18,77	17,75	15,14	10,98	5,06	-	-	-	-
$v$ [m/s]		5		10		15		20		25		30		35		40			
Belt pulley – balancing				static								dynamic							

$$\text{Required number of belts in a gearing: } z \geq \frac{N \cdot k_T}{N_T \cdot k_\phi \cdot k_L}$$

where:

$N$  – power transferred by a gearing;

$N_T$  – rated power transferred by one belt;

$k_\phi$  – coefficient of wrap angle, see the table 3.2.;

$k_T$  – coefficient of working conditions, see the table 3.1.;

$k_L$  – coefficient of belt length, see the table 3.4.

**Table 3.14.** Rated power  $N_T$  transferred by one belt of 25 (25x16) section.

$d_p$ [mm]	i or 1/i	Smaller pulley speed $n_d$ [r.p.m.]																							
		200	250	300	400	500	600	700	800	950	1 200	1 450	1 600	1 800	2 000	2 200	2 400	2 600	2 800						
		Nominal power value $N_T$ [kW]																							
250	1	2,35	2,81	3,26	4,10	4,89	5,61	6,29	6,91	7,79	8,91	9,64	9,88	9,94	9,68	9,07	8,08	6,65	4,82						
	1,05	2,43	2,91	3,38	4,25	5,06	5,81	6,51	7,15	8,06	9,22	9,98	10,22	10,28	10,01	9,38	8,37	6,88	4,99						
	1,2	2,51	3,01	3,49	4,39	5,23	6,01	6,73	7,44	8,33	9,53	10,31	10,57	10,63	10,35	9,70	8,65	7,12	5,16						
	1,5	2,59	3,11	3,60	4,54	5,40	6,20	6,95	7,68	8,61	9,84	10,65	10,91	10,98	10,69	10,02	8,93	7,35	5,33						
	>3	2,67	3,21	3,72	4,68	5,57	6,40	7,17	7,92	8,88	10,15	10,98	11,25	11,32	11,02	10,33	9,21	7,63	5,50						
280	1	2,84	3,42	3,98	5,03	6,00	6,91	7,80	8,58	9,62	10,99	11,85	12,09	12,06	11,59	10,65	9,18	7,10	4,47						
	1,05	2,94	3,54	4,12	5,20	6,21	7,15	8,07	8,88	9,96	11,38	12,27	12,52	12,48	12,00	11,02	9,50	7,35	4,62						
	1,2	3,04	3,66	4,26	5,38	6,42	7,44	8,35	9,18	10,29	11,76	12,68	12,94	12,90	12,40	11,39	9,82	7,64	4,78						
	1,5	3,14	3,78	4,39	5,55	6,63	7,68	8,62	9,48	10,63	12,14	13,09	13,36	13,33	12,81	11,76	10,14	7,89	4,93						
	>3	3,24	3,90	4,53	5,73	6,84	7,92	8,89	9,78	10,96	12,53	13,50	13,78	13,75	13,21	12,13	10,46	8,14	5,09						
315	1	3,42	4,12	4,80	6,08	7,28	8,44	9,47	10,42	11,67	13,26	14,15	14,31	14,03	13,13	11,57	9,27	6,14	2,20						
	1,05	3,54	4,27	4,97	6,30	7,58	8,73	9,80	10,78	12,07	13,72	14,64	14,81	14,52	13,59	11,97	9,59	6,35	2,27						
	1,2	3,66	4,41	5,14	6,51	7,83	9,03	10,13	11,14	12,48	14,18	15,14	15,30	15,00	14,05	12,37	9,92	6,57	2,35						
	1,5	3,77	4,55	5,30	6,72	8,09	9,32	10,46	11,50	12,89	14,64	15,63	15,80	15,49	14,51	12,78	10,24	6,78	2,43						
	>3	3,89	4,70	5,47	6,93	8,34	9,61	10,79	11,87	13,29	15,11	16,12	16,30	15,98	14,96	13,18	10,56	7,00	2,50						
355	1	4,06	4,91	5,73	7,27	8,75	10,09	11,31	12,42	13,87	15,60	16,36	16,29	15,51	13,87	11,28	7,65	2,85	-						
	1,05	4,21	5,08	5,93	7,57	9,06	10,44	11,71	12,86	14,35	16,14	16,94	16,86	16,06	14,35	11,67	7,91	2,95	-						
	1,2	4,35	5,25	6,13	7,82	9,36	10,79	12,10	13,29	14,83	16,69	17,51	17,43	16,60	14,84	12,06	8,18	3,05	-						
	1,5	4,49	5,43	6,33	8,08	9,67	11,14	12,49	13,72	15,32	17,23	18,08	18,00	17,14	15,32	12,46	8,44	3,15	-						
	>3	4,63	5,60	6,53	8,33	9,97	11,49	12,89	14,16	15,80	17,78	18,65	18,57	17,68	15,81	12,85	8,71	3,24	-						
400	1	4,78	5,79	6,75	8,63	10,32	11,88	13,30	14,57	16,16	17,89	18,28	17,77	16,12	13,25	9,04	3,31	-	-						
	1,05	4,95	5,99	6,99	8,93	10,68	12,29	13,76	15,08	16,73	18,52	18,92	18,39	16,69	13,71	9,35	3,42	-	-						
	1,2	5,12	6,19	7,23	9,23	11,04	12,71	14,23	15,58	17,29	19,14	19,56	19,01	17,25	14,18	9,67	3,54	-	-						
	1,5	5,28	6,39	7,51	9,53	11,40	13,12	14,69	16,09	17,85	19,77	20,20	19,63	17,81	14,64	9,98	3,65	-	-						
	>3	5,45	6,60	7,74	9,83	11,76	13,54	15,15	16,60	18,42	20,39	20,83	20,25	18,37	15,10	10,30	3,77	-	-						
450	1	5,57	6,75	7,92	10,05	12,01	13,80	15,40	16,80	18,47	19,98	19,62	18,37	15,32	10,56	3,85	-	-	-						
	1,05	5,76	6,98	8,20	10,40	12,43	14,28	15,94	17,38	19,12	20,68	20,31	19,01	15,86	10,93	3,99	-	-	-						
	1,2	5,96	7,22	8,47	10,75	12,85	14,76	16,47	17,97	19,76	21,38	20,99	19,65	16,39	11,30	4,12	-	-	-						
	1,5	6,15	7,50	8,75	11,10	13,27	15,24	17,01	18,55	20,41	22,08	21,68	20,29	16,93	11,67	4,26	-	-	-						
	>3	6,35	7,73	9,02	11,45	13,69	15,73	17,55	19,14	21,05	22,78	22,36	20,93	17,46	12,03	4,39	-	-	-						
500	1	6,35	7,74	9,02	11,44	13,65	15,63	17,38	18,85	20,50	21,54	20,05	17,74	12,80	5,48	-	-	-	-						
	1,05	6,57	8,00	9,34	11,84	14,13	16,18	17,98	19,51	21,22	22,29	20,75	18,36	13,25	5,67	-	-	-	-						
	1,2	6,79	8,27	9,65	12,24	14,60	16,73	18,59	20,17	21,93	23,05	21,45	18,98	13,70	5,86	-	-	-	-						
	1,5	7,01	8,54	9,97	12,64	15,08	17,27	19,20	20,82	22,65	23,80	22,15	19,60	14,14	6,05	-	-	-	-						
	>3	7,24	8,81	10,28	13,04	15,56	17,82	19,80	21,48	23,37	24,55	22,85	20,22	14,59	6,25	-	-	-	-						
560	1	7,27	8,85	10,32	13,07	15,54	17,72	19,57	21,06	22,54	22,63	19,21	15,20	7,21	-	-	-	-	-						
	1,05	7,57	9,16	10,68	13,52	16,08	18,34	20,26	21,80	23,33	23,42	19,88	15,73	7,51	-	-	-	-	-						
	1,2	7,82	9,47	11,04	13,98	16,63	18,96	20,94	22,54	24,11	24,22	20,55	16,26	7,76	-	-	-	-	-						
	1,5	8,08	9,78	11,40	14,43	17,17	19,58	21,62	23,27	24,90	25,01	21,23	16,79	8,01	-	-	-	-	-						
	>3	8,33	10,08	11,76	14,89	17,71	20,20	22,31	24,01	25,69	25,80	21,90	17,32	8,26	-	-	-	-	-						
v [m/s]		5			10			15			20			25			30			35			40		
Belt pulley – balancing		static						dynamic																	

$$\text{Required number of belts in a gearing: } z \geq \frac{N \cdot k_T}{N_T \cdot k_\phi \cdot k_L}$$

where:

$N$  – power transferred by a gearing;

$N_T$  – rated power transferred by one belt;

$k_\phi$  – coefficient of wrap angle, see the table 3.2.;

$k_T$  – coefficient of working conditions, see the table 3.1.;

$k_L$  – coefficient of belt length, see the table 3.4.

Table 3.15. Rated power  $N_T$  transferred by one belt of **D (32x20)** section.

$d_p$ [mm]	i or 1/i	Smaller pulley speed $n_d$ [r.p.m.]																							
		100	150	200	250	300	400	500	600	700	800	950	1 100	1 200	1 300	1 450	1 600	1 800	2 000						
		Nominal power value $N_T$ [kW]																							
355	1	3,01	4,20	5,31	6,36	7,35	9,24	10,90	12,39	13,70	14,83	16,15	16,98	17,25	17,26	16,77	15,63	12,97	8,92						
	1,05	3,11	4,35	5,50	6,58	7,65	9,56	11,28	12,82	14,18	15,35	16,71	17,58	17,85	17,86	17,36	16,17	13,43	9,23						
	1,2	3,22	4,50	5,69	6,81	7,91	9,88	11,66	13,25	14,66	15,86	17,28	18,17	18,45	18,47	17,94	16,72	13,88	9,54						
	1,5	3,32	4,64	5,87	7,03	8,17	10,20	12,04	13,68	15,13	16,38	17,84	18,76	19,06	19,07	18,53	17,26	14,33	9,85						
	>3	3,43	4,79	6,06	7,25	8,43	10,52	12,42	14,12	15,61	16,90	18,40	19,36	19,66	19,67	19,11	17,81	14,78	10,16						
400	1	3,66	5,14	6,25	7,88	9,13	11,45	13,55	15,42	17,07	18,46	20,06	20,99	21,20	21,06	20,15	18,31	14,28	8,26						
	1,05	3,79	5,32	6,75	8,16	9,45	11,85	14,02	15,96	17,66	19,11	20,76	21,72	21,94	21,80	20,85	18,95	14,78	8,55						
	1,2	3,91	5,50	6,98	8,43	9,76	12,25	14,49	16,50	18,26	19,75	21,46	22,45	22,68	22,54	21,56	19,59	15,28	8,84						
	1,5	4,04	5,68	7,21	8,70	10,08	12,64	14,96	17,04	18,85	20,40	22,16	23,19	23,42	23,27	22,26	20,23	15,78	9,13						
	>3	4,17	5,86	7,48	8,98	10,40	13,04	15,44	17,57	19,45	21,04	22,86	23,92	24,16	24,01	22,97	20,87	16,28	9,41						
450	1	4,37	6,17	7,90	9,50	11,02	13,85	16,40	18,67	20,63	22,25	24,01	24,84	24,84	24,35	22,62	19,59	13,34	4,23						
	1,05	4,52	6,38	8,17	9,83	11,40	14,33	16,98	19,32	21,35	23,03	24,84	25,71	25,71	25,20	23,41	20,28	13,80	4,38						
	1,2	4,68	6,60	8,45	10,16	11,79	14,82	17,55	19,97	22,07	23,81	25,68	26,58	26,58	26,05	24,20	20,96	14,27	4,53						
	1,5	4,83	6,81	8,72	10,49	12,17	15,30	18,12	20,62	22,79	24,58	26,52	27,45	27,44	26,90	24,99	21,64	14,73	4,68						
	>3	4,98	7,03	9,00	10,82	12,56	15,78	18,69	21,28	23,51	25,36	27,36	28,32	28,31	27,75	25,78	22,33	15,20	4,83						
500	1	5,08	7,18	9,21	11,09	12,88	16,20	19,17	21,78	23,99	25,76	27,50	28,02	27,61	26,54	23,59	18,88	9,59	-						
	1,05	5,25	7,48	9,53	11,48	13,33	16,77	19,84	22,54	24,82	26,66	28,46	29,00	28,57	27,47	24,42	19,54	9,92	-						
	1,2	5,43	7,73	9,85	11,86	13,78	17,33	20,51	23,30	25,66	27,56	29,42	29,98	29,54	28,39	25,24	20,20	10,26	-						
	1,5	5,61	7,98	10,17	12,25	14,23	17,90	21,18	24,06	26,50	28,45	30,38	30,96	30,50	29,32	26,06	20,86	10,59	-						
	>3	5,79	8,23	10,49	12,64	14,68	18,46	21,85	24,82	27,34	29,35	31,34	31,94	31,47	30,25	26,89	21,52	10,92	-						
560	1	5,91	8,43	10,76	12,97	15,07	18,95	22,38	25,32	27,73	29,55	31,04	30,85	29,67	27,58	22,58	15,13	-	-						
	1,05	6,12	8,72	11,14	13,42	15,60	19,61	23,16	26,21	28,70	30,59	32,13	31,92	30,71	28,54	23,37	15,66	-	-						
	1,2	6,33	9,02	11,51	13,88	16,12	20,27	23,94	27,09	29,67	31,62	33,21	33,00	31,74	29,51	24,15	16,18	-	-						
	1,5	6,53	9,31	11,89	14,33	16,65	20,93	24,72	27,98	30,64	32,65	34,30	34,08	32,78	30,47	24,94	16,71	-	-						
	>3	6,74	9,60	12,26	14,78	17,17	21,59	25,50	28,86	31,61	33,68	35,38	35,16	33,82	31,43	25,73	17,24	-	-						
630	1	6,88	9,82	12,54	15,13	17,57	22,05	25,94	29,18	31,68	33,38	34,19	32,65	30,15	26,37	18,06	6,25	-	-						
	1,05	7,12	10,16	12,98	15,65	18,18	22,82	26,84	30,19	32,79	34,54	35,38	33,79	31,21	27,29	18,69	6,47	-	-						
	1,2	7,36	10,50	13,42	16,18	18,80	23,59	27,75	31,21	33,90	35,71	36,58	34,93	32,26	28,21	19,32	6,69	-	-						
	1,5	7,65	10,84	13,86	16,71	19,41	24,36	28,66	32,23	35,01	36,88	37,78	36,07	33,31	29,13	19,95	6,91	-	-						
	>3	7,89	11,19	14,29	17,24	20,02	25,13	29,56	33,25	36,11	38,04	38,97	37,21	34,37	30,05	20,58	7,12	-	-						
710	1	8,01	11,38	14,55	17,54	20,35	25,45	29,76	33,18	35,59	36,87	36,35	32,52	27,88	21,42	7,99	-	-	-						
	1,05	8,29	11,78	15,05	18,15	21,06	26,34	30,80	34,34	36,84	38,16	37,62	33,66	28,86	22,17	8,27	-	-	-						
	1,2	8,57	12,17	15,56	18,76	21,78	27,23	31,84	35,50	38,08	39,44	38,90	34,79	29,83	22,92	8,54	-	-	-						
	1,5	8,85	12,57	16,07	19,37	22,49	28,12	32,88	36,66	39,32	40,73	40,17	35,93	30,81	23,67	8,82	-	-	-						
	>3	9,13	12,97	16,58	19,99	23,20	29,01	33,92	37,82	40,57	42,02	41,44	37,07	31,78	24,41	9,10	-	-	-						
800	1	9,22	13,11	16,76	20,18	23,39	29,08	33,72	37,13	39,14	39,55	36,76	29,26	21,32	10,78	-	-	-	-						
	1,05	9,55	13,57	17,34	20,89	24,20	30,10	34,90	38,43	40,51	40,94	38,04	30,29	22,07	11,16	-	-	-	-						
	1,2	9,87	14,03	17,93	21,59	25,02	31,12	36,08	39,73	41,88	42,32	39,33	31,31	22,81	11,53	-	-	-	-						
	1,5	10,19	14,48	18,51	22,30	25,84	32,13	37,26	41,03	43,25	43,70	40,61	32,33	23,55	11,91	-	-	-	-						
	>3	10,51	14,94	19,10	23,00	26,66	33,15	38,44	42,33	44,61	45,08	41,90	33,36	24,30	12,28	-	-	-	-						
v [m/s]		5			10			15			20			25			30			35			40		
	Belt pulley – balancing				static				dynamic																

$$\text{Required number of belts in a gearing: } z \geq \frac{N \cdot k_T}{N_T \cdot k_\phi \cdot k_L}$$

where:

$N$  – power transferred by a gearing;

$N_T$  – rated power transferred by one belt;

$k_\phi$  – coefficient of wrap angle, see the table 3.2.;

$k_T$  – coefficient of working conditions, see the table 3.1.;

$k_L$  – coefficient of belt length, see the table 3.4.

**Table 3.16.** Rated power  $N_T$  transferred by one belt of E (40x23) section.

$d_p$ [mm]	i or 1/i	Smaller pulley speed $n_d$ [r.p.m.]																								
		100	150	200	250	300	350	400	500	600	700	800	950	1 100	1 200	1 300	1 450	1 600	1 700							
		Nominal power value $N_T$ [kW]																								
500	1	6,12	8,60	10,86	12,97	14,96	16,81	18,55	21,65	24,21	26,21	27,57	28,32	27,30	25,53	22,82	16,82	8,29	1,04							
	1,05	6,33	8,90	11,24	13,42	15,48	17,40	19,20	22,40	25,06	27,12	28,54	29,31	28,25	26,43	23,62	17,41	8,58	1,08							
	1,2	6,54	9,20	11,61	13,88	16,00	17,99	19,85	23,16	25,91	28,04	29,50	30,30	29,21	27,32	24,41	17,99	8,87	1,12							
	1,5	6,76	9,50	11,99	14,33	16,52	18,58	20,49	23,92	26,75	28,96	30,46	31,28	30,16	28,21	25,21	18,58	9,16	1,15							
	>3	6,97	9,79	12,37	14,78	17,04	19,16	21,14	24,67	27,60	29,87	31,43	32,27	31,11	29,10	26,01	19,17	9,45	1,19							
560	1	7,23	10,33	13,09	15,67	18,10	20,38	22,49	26,25	29,30	31,59	33,03	33,40	31,35	28,49	24,31	15,35	2,84	-							
	1,05	7,62	10,69	13,54	16,22	18,73	21,09	23,28	27,16	30,33	32,69	34,18	34,57	32,45	29,48	25,16	15,89	2,94	-							
	1,2	7,87	11,05	14,00	16,77	19,37	21,80	24,07	28,08	31,35	33,80	35,34	35,74	33,55	30,48	26,01	16,43	3,04	-							
	1,5	8,13	11,41	14,46	17,31	20,00	22,51	24,85	29,00	32,37	34,90	36,49	36,90	34,64	31,48	26,85	16,96	3,14	-							
	>3	8,39	11,77	14,91	17,86	20,63	23,22	25,64	29,91	33,40	36,01	37,65	38,07	35,74	32,47	27,70	17,50	3,24	-							
630	1	8,75	12,32	15,65	18,77	21,69	24,42	26,95	31,36	34,83	37,26	38,52	37,92	33,94	29,17	22,56	8,85	-	-							
	1,05	9,05	12,75	16,19	19,42	22,45	25,27	27,89	32,45	36,05	38,56	39,86	39,24	35,12	30,19	23,35	9,16	-	-							
	1,2	9,36	13,18	16,74	20,08	23,21	26,13	28,83	33,55	37,27	39,87	41,21	40,57	36,31	31,21	24,13	9,47	-	-							
	1,5	9,66	13,61	17,28	20,73	23,96	26,98	29,77	34,65	38,49	41,17	42,56	41,89	37,50	32,23	24,92	9,78	-	-							
	>3	9,97	14,04	17,83	21,39	24,72	27,83	30,71	35,74	39,70	42,47	43,90	43,22	38,68	33,25	25,71	10,09	-	-							
710	1	10,31	14,56	18,52	22,23	25,69	28,89	31,83	36,85	40,58	42,87	43,52	41,02	33,74	25,91	15,44	-	-	-							
	1,05	10,67	15,07	19,17	23,01	26,59	29,90	32,94	38,13	42,00	44,37	45,05	42,45	34,92	26,81	15,98	-	-	-							
	1,2	11,03	15,58	19,82	23,78	27,48	30,91	34,06	39,42	43,42	45,87	46,57	43,89	36,10	27,72	16,52	-	-	-							
	1,5	11,39	16,09	20,46	24,56	28,38	31,92	35,17	40,71	44,84	47,37	48,09	45,32	37,28	28,62	17,06	-	-	-							
	>3	11,75	16,59	21,11	25,34	29,28	32,93	36,28	42,00	46,26	48,87	49,61	46,76	38,46	29,53	17,60	-	-	-							
800	1	12,05	17,05	21,70	26,03	30,05	33,73	37,05	42,53	46,26	47,96	47,38	41,59	29,06	16,46	-	-	-	-							
	1,05	12,47	17,64	22,46	26,94	31,10	34,90	38,35	44,02	47,87	49,64	49,03	43,05	30,07	17,04	-	-	-	-							
	1,2	12,89	18,24	23,21	27,85	32,15	36,08	39,64	45,51	49,49	51,32	50,69	44,50	31,09	17,61	-	-	-	-							
	1,5	13,31	18,83	23,97	28,76	33,20	37,26	40,94	47,00	51,11	52,99	52,35	45,96	32,10	18,19	-	-	-	-							
	>3	13,74	19,43	24,73	29,67	34,25	38,44	42,23	48,48	52,73	54,67	54,00	47,41	33,12	18,76	-	-	-	-							
900	1	13,96	19,76	25,15	30,14	34,71	38,84	42,49	48,20	51,48	51,95	49,21	38,19	17,65	-	-	-	-	-							
	1,05	14,45	20,45	26,03	31,19	35,92	40,20	43,98	49,89	53,28	53,77	50,93	39,53	18,27	-	-	-	-	-							
	1,2	14,94	21,14	26,91	32,24	37,13	41,55	45,46	51,57	55,08	55,58	52,65	40,87	18,88	-	-	-	-	-							
	1,5	15,42	21,84	27,79	33,30	38,35	42,91	46,95	53,26	56,88	57,40	54,37	42,20	19,50	-	-	-	-	-							
	>3	15,91	22,53	28,67	34,35	39,56	44,27	48,43	54,94	58,68	59,20	56,09	43,54	20,12	-	-	-	-	-							
1000	1	15,84	22,44	28,52	34,11	39,17	43,66	47,52	53,12	55,45	54,00	48,19	30,08	-	-	-	-	-	-							
	1,05	16,40	23,22	29,52	35,31	40,54	45,19	49,18	54,97	57,39	55,88	49,87	31,13	-	-	-	-	-	-							
	1,2	16,95	24,00	30,52	36,70	41,91	46,71	50,84	56,83	59,33	57,77	51,56	32,18	-	-	-	-	-	-							
	1,5	17,50	24,79	31,51	37,69	43,28	48,24	52,51	58,69	61,27	59,66	53,24	33,23	-	-	-	-	-	-							
	>3	18,06	25,57	32,51	38,88	44,65	49,77	54,17	60,55	63,21	61,55	54,93	34,28	-	-	-	-	-	-							
1120	1	18,07	25,58	32,47	38,71	44,26	49,04	52,98	57,94	58,42	53,62	42,77	-	-	-	-	-	-	-							
	1,05	18,71	26,48	33,60	40,06	45,81	50,76	54,83	59,97	60,46	55,49	44,27	-	-	-	-	-	-	-							
	1,2	19,34	27,37	34,74	41,42	47,38	52,47	56,69	61,99	62,51	57,37	45,77	-	-	-	-	-	-	-							
	1,5	19,97	28,27	35,88	42,72	48,90	54,19	58,54	64,03	64,59	59,25	47,26	-	-	-	-	-	-	-							
	>3	20,61	29,16	37,01	44,12	50,45	55,91	60,39	66,06	66,59	61,13	48,76	-	-	-	-	-	-	-							
v [m/s]		5	10	15	20	25	30	35	40																	
		Belt pulley – balancing			static				dynamic																	

Required number of belts in a gearing: 
$$z \geq \frac{N \cdot k_T}{N_T \cdot k_\phi \cdot k_L}$$

where:

$N$  – power transferred by a gearing;

$N_T$  – rated power transferred by one belt;

$k_\phi$  – coefficient of wrap angle, see the table 3.2.;

$k_T$  – coefficient of working conditions, see the table 3.1.;

$k_L$  – coefficient of belt length, see the table 3.4.

### 3.7. Formulas and markings.

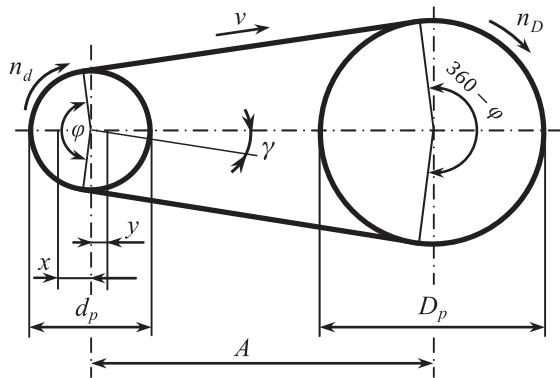


Fig. 3.3. Geometric model of belt gearing

Wrap angle:

- approximate:  $\phi$  from table 3.2.; for  $\frac{D_p - d_p}{A}$

- or:  $\phi \approx 180^\circ - 60^\circ \frac{D_p - d_p}{A}$

- exact:  $\cos \frac{\phi}{2} = \frac{D_p - d_p}{2A}$

Rotation of belt:  $v = \frac{n_d \cdot d_p}{19100} = \frac{n_D \cdot D_p}{19100}$

Number of belts:  $z \geq \frac{N \cdot k_T}{N_l \cdot k_\phi \cdot k_L}$

#### Formulas:

Ratio:

$$i = \frac{n_c}{n_b}$$

Big pulley diameter:

- when small pulley works as a driving pulley:  $D_p = i \cdot d_p$

- when big pulley works as a driving pulley:  $D_p = \frac{d_p}{i}$

Axle base:

- recomm.:  $0,7(D_p + d_p) < A_0 < 2(D_p + d_p)$

- calculated for known:  $L_p$ :  $A \approx p + \sqrt{p^2 - q}$

where:  $p = 0,25L_p - 0,393(D_p + d_p)$

$$q = 0,125(D_p - d_p)^2$$

Changing of base axle:

- for belt tension:  $x \geq 0,03L_p$

- for belt mounting:  $y \geq 0,015L_p$

Belt pitch length:

- approximate

$$L_p \approx 2A + 1,57(D_p + d_p) + \frac{(D_p - d_p)^2}{4A}$$

- exact:

$$L_p = 2A \cdot \sin \frac{\phi}{2} + \frac{\pi}{2}(D_p + d_p) + \frac{\gamma \cdot \pi}{180^\circ} \cdot (D_p - d_p)$$

#### Markings:

**A** - gearing base axle [mm]

**A<sub>0</sub>** - preliminary base axle [mm]

**k<sub>T</sub>** - coefficient of work conditions

**k<sub>φ</sub>** - coefficient of small pulley wrap angle

**k<sub>L</sub>** - coefficient of length

**d<sub>p</sub>** - pitch diameter of small pulley [mm]

**D<sub>p</sub>** - pitch diameter of big pulley [mm]

**i** - gearing ratio

**L<sub>p</sub>** - pitch diameter [mm]

**n<sub>b</sub>** - rotation of passive pulley (driven) [obr/min]

**n<sub>c</sub>** - rotation of active pulley (driving) [obr/min]

**n<sub>d</sub>** - rotation of small pulley [obr/min]

**n<sub>D</sub>** - rotation of big pulley [obr/min]

**N** - power transferred by a gearing [kW]

**N<sub>l</sub>** - nominal power for single belt [kW]

**v** - belt speed [m/s]

**z** - number of belts in a gearing [szt.]

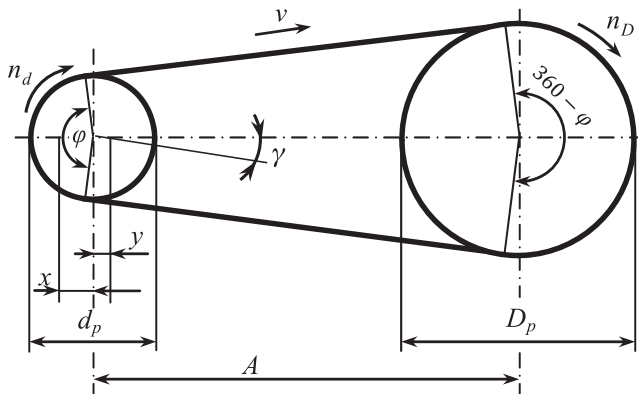
**φ** - wrap angle of smaller pulley [°]

**γ** - displacement angle of belt from centrelines of pulley grooves  $\gamma = 90^\circ - \frac{\phi}{2}$  [°]

**x** - minimal distance required for belt tension [mm]

**y** - minimal distance required for belt mounting [mm]

### 3.8. Example of belt bearing calculations with two pulleys.



Rys. 3.4. Diagram of belt gearing.

Driving machine: 3-phase induction motor started by star/delta switch,  
power:  $N=10$  kW, rotations:  $n_c=2920$  r.p.m.

Driven machine: fan, rotations:  $n_b=1950$  r.p.m.

Gearing parameters: daily time of operation:  $T = 10 - 16$  hours,  
pulleys diameter and base axle - optimal.

$$n_c > n_b \Rightarrow n_c = n_d, d_c = d_p; \quad n_b = n_D, d_b = D_p$$

#### Coefficient of work conditions $k_T$

$k_T$  from the table 3.1

For motor with star/delta start up,  $T = 10 - 16$ h  
And fan of power above 7,5 kW

$$k_T = 1,2$$

#### Calculation power $N_o$

$$N_o = N \cdot k_T$$

$$N_o = 10 \cdot 1,2 = 12 \text{ kW}$$

#### Belt section

Fig. 3.1.; 3.2.

For:  $N_o=12$  kW,  $n_d=2920$  r.p.m., optimal pulley diam.  
SPZ was chosen, and diameter of small pulley  $d_p=160$  mm

#### Belt speed $v$

$$v = \frac{n_d \cdot d_p}{19100}$$

$$v = \frac{2920 \cdot 160}{19100} = 24,5 \text{ m/s}$$

for SPZ,  $v_{max} = 40$  m/s

#### Ratio $i$

$$i = \frac{n_c}{n_b}$$

$$i = \frac{2920}{1950} = 1,5$$



**Diameter of big pulley  $D_p$** 

For gearing with small active pulley:

$$D_p = i \cdot d_p$$

$$D_p = 1,5 \cdot 160 = 240 \text{ mm}$$

**Preliminary axle base  $A_0$** 

$$A_{max} = 2(D_p + d_p)$$

$$A_{max} = 2 \cdot (240 + 160) = 800 \text{ mm}$$

$$A_{min} = 0,7(D_p + d_p)$$

$$A_{min} = 0,7 \cdot (240 + 160) = 280 \text{ mm}$$

assumed:  $A_0 = 540 \text{ mm}$ **Belt length  $L_p$** 

- approximate

$$L_p \approx 2A + 1,57(D_p + d_p) + \frac{(D_p - d_p)^2}{4A}$$

$$L_p \approx 2 \cdot 540 + 1,57(240 + 160) + \frac{(240 - 160)^2}{4 \cdot 540} = 1711 \text{ mm}$$

- exact

$$L_p = 2A \cdot \sin \frac{\varphi}{2} + \frac{\pi}{2}(D_p + d_p) + \frac{\gamma \cdot \pi}{180^\circ} \cdot (D_p - d_p)$$

final belt length was taken from the table 2.2.

assumed:  $L_p = 1700 \text{ mm}$ **Base axle  $A$** 

$$A \approx p + \sqrt{p^2 - q}$$

$$A \approx 267,80 + \sqrt{267,80^2 - 800} = 534 \text{ mm}$$

where:

$$p = 0,25L_p - 0,393(D_p + d_p)$$

$$p = 0,25 \cdot 1700 - 0,393 \cdot (240 + 160) = 267,80 \text{ mm}$$

$$q = 0,125 \cdot (D_p - d_p)^2$$

$$q = 0,125 \cdot (240 - 160)^2 = 800 \text{ mm}^2$$

**Axis shift**

$$x \geq 0,03L_p$$

$$x \geq 0,03 \cdot 1700 = 51 \text{ mm}$$

$$y \geq 0,015L_p$$

$$y \geq 0,015 \cdot 1700 = 25,5 \text{ mm}$$

**Coefficient of work conditions  $k_T$**  $k_T$  was determined in point 1 from the table 3.1.

$$k_T = 1,2$$

**Coefficient of angle wraps  $k_\phi$** 

For:  $\frac{D_p - d_p}{A} = \frac{240 - 160}{534} = 0,15$

$k_\phi$  and approximate value of angle  $\phi$   $k_\phi = 0.98$

from the table 3.2  $\cos \frac{\phi}{2} = \frac{D_p - d_p}{2A}$   $\phi = 171^\circ$

**Coefficient of belt length  $k_L$** 

$k_L$  from the table 3.3.

For SPZ belt  $L_p = 1700$  mm  
 $k_L = 1.005$

**Nominal power  $N_1$** 

$N_1$  from the table 3.5

For SPZ belt;  $d_p = 160$  mm,  $i = 1,5$ ;  $n_d = 2920$  r.p.m.  
using linear interpolation  
 $N_1 = 7,88$  kW

**Required number of belts in a gearing  $z$** 

$$z \geq \frac{N \cdot k_T}{N_1 \cdot k_\phi \cdot k_L} \quad z \geq \frac{10 \cdot 1,2}{7,88 \cdot 0,98 \cdot 1,005} \geq 1,55$$

Calculated  $z$  value should be rounded up to integer number

Two SPZ belts were assumed of length  $L_p = 1700$  mm each

**Static force in belt tie  $T_s$** 

$$T_s = \frac{500 \cdot (2,02 - k_\phi) \cdot N \cdot k_T}{k_\phi \cdot z \cdot v} + c \cdot v^2 \quad T_s = \frac{500 \cdot (2,02 - 0,98) \cdot 10 \cdot 1,2}{0,98 \cdot 2 \cdot 24,5} + 0,08 \cdot 24,5^2 = 178 \text{ N}$$

$c$  – from fig.5.2; for the belt SPZ:  $c = 0,08$

**Minimal axis force in static state  $N_s$** 

$$N_s = 2T_s \cdot \sin \frac{\phi}{2} \cdot z \quad N_s = 2 \cdot 178 \cdot \sin \frac{171}{2} \cdot 2 = 710 \text{ N}$$

**Tie deflection value  $U_p$** 

$$U_p = \frac{U \cdot L}{100} \quad U_p = \frac{2,5 \cdot 532,4}{100} = 13,3 \text{ mm}$$

where  $U$  – from fig. 5.2

$$L = A \cdot \sin \frac{\phi}{2} \quad L = 534 \cdot \sin \frac{171}{2} = 532,4 \text{ mm}$$

Control force  $q$  exerted at belt from the table 5.2  $q = 25 \text{ N}$

**NOTE:** Belt tension should be periodically checked and adjusted mainly during first hours of gearing operation, when its length is extended mostly. Incorrect belt tension or lack its correction is the most frequent reason of belt usage.

(More information in chapter "5. Tension of belts").



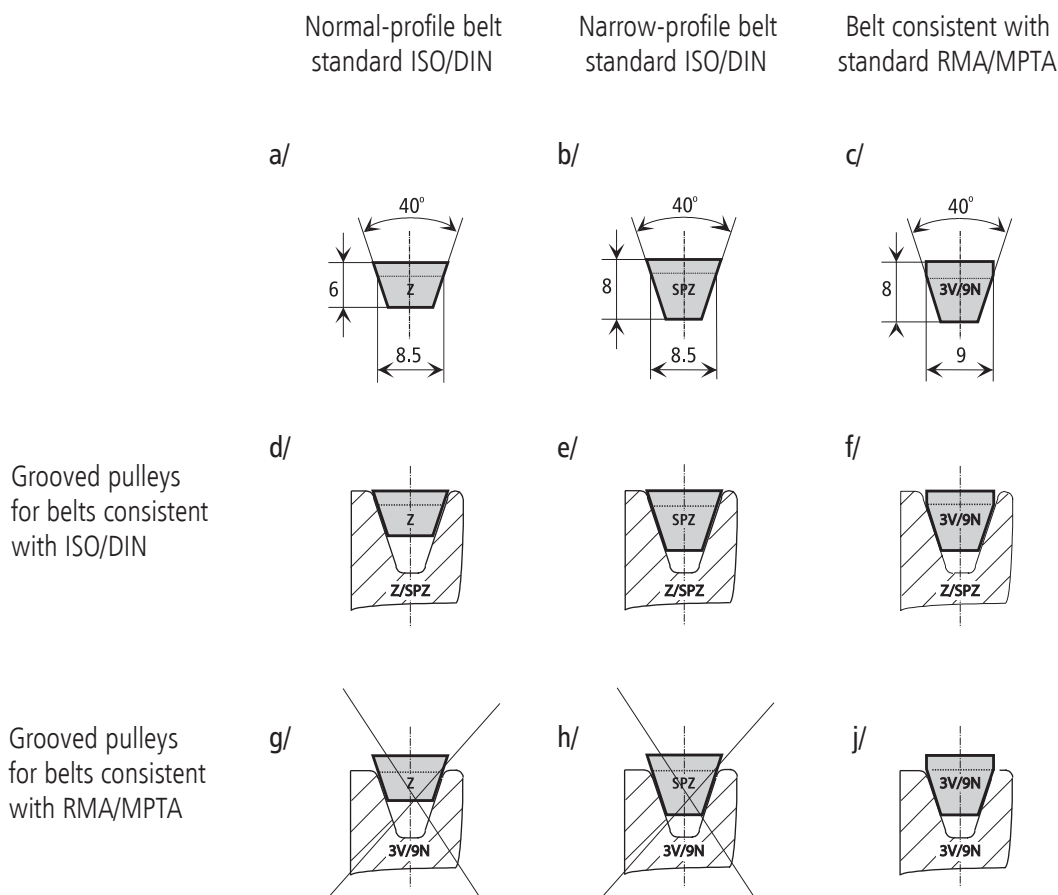
## 4. Grooved pulleys.

### 4.1. Grooved pulleys for single belts.

Belt pulleys are the main part of belt drive. They are simply name grooved pulleys. Basic standard which standardize pulleys for single belts is international standard ISO 4183.

Grooved pulleys for narrow V-belts can also be used for classical belts of the same pitch width  $I_p$  ( $w_p$ ) with respect of rationalizing of V-belt drives, for belts of size Z, A, B and C, the same pulleys as for SPZ, SPA, SPB and SPC should be used. These belts, for a given section size, possess the same pitch width, angle, but they vary in height (drawing 4.1a;b).

Rules regarding correct pulley selection are included in point 1.3.c

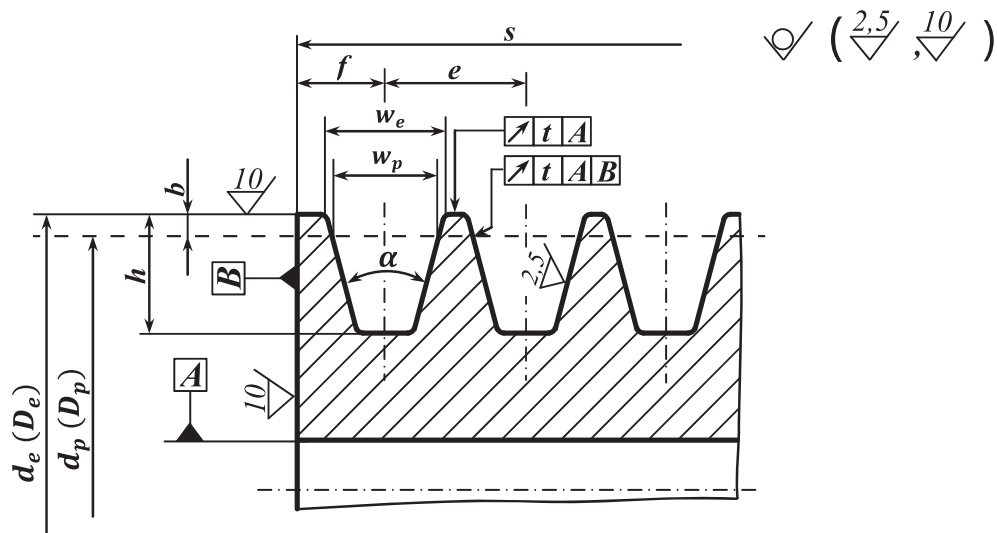


**Rys. 4.1.** Differences in dimensions of belts and pulley wheels according to DIN and RMA/MPTA

Belts according to RMA/MPTA of section size 3V/9N and 5V/15N can easily work in pulleys designed for belts SPZ-Z/10 and SPB-B/17. Nevertheless, reversal usage is not recommended without profile correction as upper width of grooves of American pulleys is lower in relation to ISO/DIN equivalents. So narrow V-belts SPZ or SPB are destroyed at a 2/3 height of belt walls what leads to lowering their lifetime (drawing 4.1 g and h).

Narrow SPB belt the production of "STOMIL SANOK" S.A. is so designed, that can freely work in belt wheels suited for 5V/15N belts.

Dimension



Rys. 4.2. Pulley for single belts.

Table 4.1. Grooved pulleys dimensions for narrow and classical belts.

		Dimensions in millimetres							
Narrow belt: ISO and DIN marking		SPZ	SPA	SPB	-	SPC	-	-	-
Classical belt	ISO marking	Z	A	B	-	C	-	D	E
	DIN marking	10	13	17	20	22	25	32	40
Pitch width $w_p$		8,5	11	14	17	19	21	27	32
Approximate upper width $w_e$		9,7	12,7	16,3	20	22	25	32	40
Groove height under dividing line $b$		2	2,8	3,5	5,1	4,8	6,3	8,1	9,6
Minimal groove depth $h_{min}$		11	13,8	17,5	18	23,8	22	28	33
Pulley pitch $e$		$12 \pm 0,3$	$15 \pm 0,3$	$19 \pm 0,4$	$23 \pm 0,4$	$25,5 \pm 0,5$	$29 \pm 0,5$	$37 \pm 0,6$	$44,5 \pm 0,7$
Edge pitch $f$		$8 \pm 0,6$	$10 \pm 0,8$	$12,5 \pm 0,8$	$15 \pm 0,8$	$17 \pm 1$	$19 \pm 1$	$24 \pm 2$	$29 \pm 2$
max. $\Sigma$ of deviations $e$ in pulley		$\pm 0,6$	$\pm 0,6$	$\pm 0,8$	$\pm 0,8$	$\pm 1,0$	$\pm 1,0$	$\pm 1,2$	$\pm 1,4$
$d_{p min}$	Classical profile	63	90	140	-	224	-	-	-
	Narrow profile	50	71	112	160	180	250	355	500
Pitch diameter $d_p$	$\alpha = 34^\circ$	<80	<118	<190	<250	<315	<355	-	-
	$\alpha = 36^\circ$	-	-	-	-	-	-	<500	<630
	$\alpha = 38^\circ$	>80	>180	>190	>250	>315	>355	>500	>630
Acceptable deviations of $\alpha$		$\pm 0,5^\circ$	$\pm 0,5^\circ$	$\pm 0,5^\circ$	$\pm 0,5^\circ$	$\pm 0,5^\circ$	$\pm 0,5^\circ$	$\pm 0,5^\circ$	$\pm 0,5^\circ$
Belt pulley rim width $s$ for belts $s = (z - 1) \cdot e + 2f$	1	16	20	25	30	34	38	48	58
	2	28	35	44	53	59,5	67	85	105,5
	3	40	50	63	76	85	96	122	147
	4	52	65	82	99	110,5	125	159	191,5
	5	64	80	101	122	136	154	196	236
	6	76	95	120	145	161,5	183	233	280,5
	7	88	110	139	168	187	212	270	325
	8	100	125	158	191	212,5	241	307	369,5
	9	112	140	177	214	238	270	344	414
	10	124	155	169	237	263,5	299	381	458,5

**Table 4.2.** Recommended diameters of grooved pulleys and their tolerances.

Dimensions in millimetres

Narrow belt ISO and DIN		SPZ	SPA	SPB	-	SPC	-	-	-	Range of pitch diameter $d_p$		Toleran. of runout $t$
Classical belt	ISO marking	Z	A	B	-	C	-	D	E	min	max	
	DIN marking	10	13	17	20	22	25	32	40			
Pitch diameter $d_p$	50*									50	50,8	0,2
	56*									56	56,9	
	63									63	64,0	
	71	71*								71	72,1	
	80	80								80	81,3	
	90	90								90	91,4	
	100	100								100	101,6	0,3
	112	112	112*							112	113,8	
			118	(118)*						118	119,9	
	125	125	125							125	127,0	
			132	(132)*						132	134,1	
	140	140	140							140	142,2	
	150	150	150							150	152,4	0,4
	160	160	160	160						160	162,6	
			(170)	(170)						170	172,7	
	180	180	180	180	180	<b>180*</b>				180	182,9	
	190	190	190	190		<b>190*</b>				190	193,0	
	200	200	200	200	200	<b>200*</b>				200	203,2	
			(212)	(212)		<b>212*</b>				212	215,4	0,5
	224	224	224	224	224	<b>224</b>				224	227,6	
			236	236		<b>236</b>				236	239,8	
	250	250	250	250	250	<b>250</b>	250			250	254,0	
	280	280	280	280	280	<b>280</b>	280			280	284,5	
	300	300	300	300		<b>300</b>				300	304,8	
	315	315	315	315	315	<b>315</b>	315			315	320,0	0,6
	355	355	355	355	355	<b>355</b>	355	355		355	360,7	
	400	400	400	400	400	<b>400</b>	400	<b>400</b>		400	406,4	
	450	450	450	450	450	<b>450</b>	450	450		450	457,2	
	500	500	500	500	500	<b>500</b>	500	500	<b>500</b>	500	508,0	0,8
	560	560	560	560	560	<b>560</b>	560	560	<b>560</b>	560	569,0	
	630	630	630	630	630	<b>630</b>	630	630	<b>630</b>	630	640,1	
	710	710	710	710	710	<b>710</b>	710	710	<b>710</b>	710	721,4	
			800	<b>800</b>	800	<b>800</b>	800	<b>800</b>	<b>800</b>	800	812,8	1,0
			900	900	900	<b>900</b>	900	900	900	900	914,4	
			1000	1000	1000	<b>1000</b>	1000	<b>1000</b>	<b>1000</b>	1000	1016,0	
					1120	<b>1120</b>	1120	1120	1120	1120	1137,9	
				1250	<b>1250</b>	1250	<b>1250</b>	<b>1250</b>	1250	1270,0	1,2	
				1400	<b>1400</b>	1400	1400	1400	1400	1422,4		
				1600	<b>1600</b>	1600	<b>1600</b>	<b>1600</b>	1600	1625,6		
				1800	<b>1800</b>	1800	1800	1800	1800	1828,8	1,2	
				2000	<b>2000</b>	2000	<b>2000</b>	<b>2000</b>	2000	2032,0		
Acceptable deviations of grooves pitch diameters in one pulley		0,4				0,6				-		
Diameters marked in bold take precedence in new constructions												
Diameters marked with * regard only classical V-belts												
Diameters above 2000 mm should be chosen in accordance with series of normal digits R20.												

## Measurement of geometrical quantities.

### A) Pitch diameter measurement.

- measurement is performed with the aid of measuring cylinders of diameter  $d$  in a way shown at Fig.4.3.

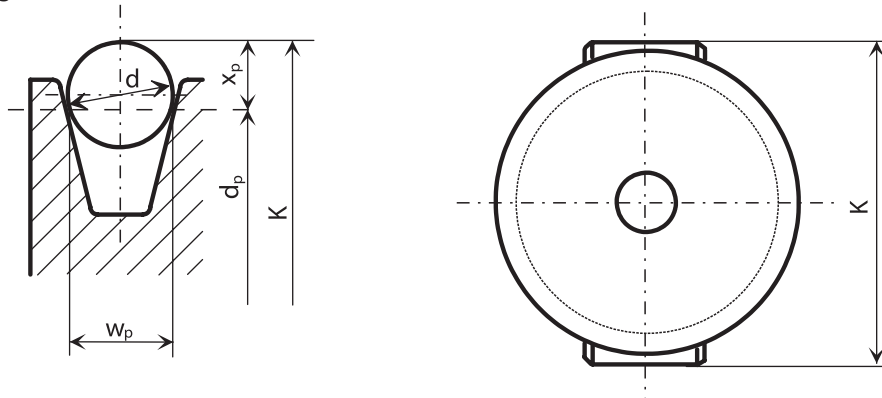


Fig. 4.3. Pitch diameter measurement with the aid of measuring cylinders.

Diameter  $K$  is measured. Pitch diameter  $d_p$  is then calculated at the base of following formula:

$$d_p = K - 2x_p$$

Table 4.3. Measured values of grooved pulleys for single belts.

Dimensions in millimetres

Narrow profile ISO and DIN marking	SPZ	SPA	SPB	-	SPC	-	-	-
Classical profile	ISO marking	Z	A	B	-	C	-	D
	DIN marking	10	13	17	20	22	25	32
Diameter of measuring cylinder $d$	$9^{+0}_{-0,036}$	$11,6^{+0}_{-0,043}$	$14,7^{+0}_{-0,110}$	$18^{+0}_{-0,110}$	$20^{+0}_{-0,130}$	$22,2^{+0}_{-0,130}$	$28,5^{+0}_{-0,130}$	$38,8^{+0}_{-0,160}$
Approximate correction dimension $2x_p$	12	15	19	24	26	29	37	44

In case of pulleys of machined outside cylindrical surface and big diameter, instead of measurement with the aid of measuring cylinders, external diameter  $d_e$  can be measured, then dimension  $b$  can be measured with the aid of depth gauge according to drawing 4.4. then effective diameter  $d_p$  can be calculated at a base of following formula:

$$d_p = d_e - 2b$$

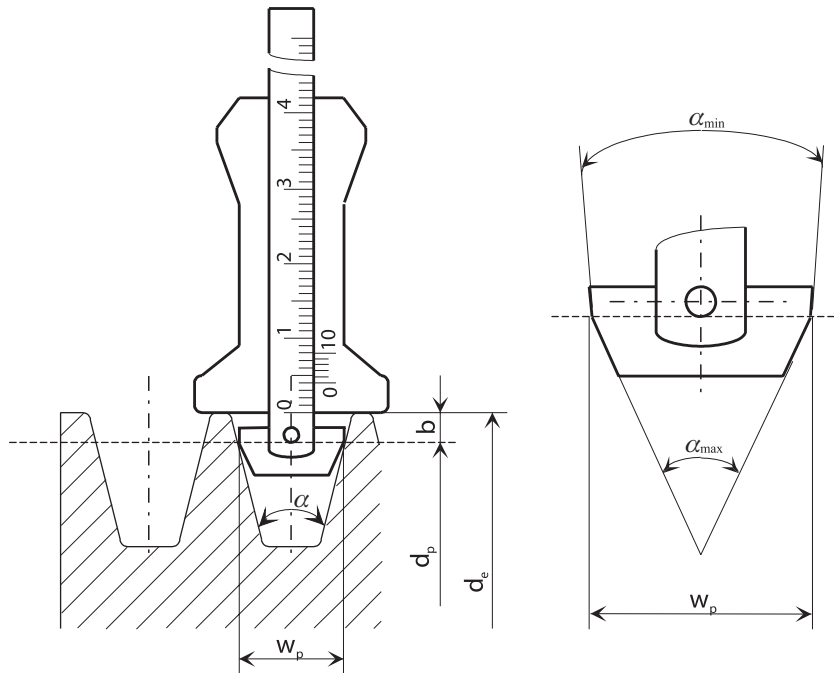


Fig. 4.4. Depth gauge for measurement of  $b$  dimension.

### B) Pitch diameters concentration checking.

Checking is performed by usage of depth gauge according to Figure 4.4. Dimension  $b$  is measured at whole circumference of each groove.

### C) Angle of groove profile checking.

Angle of groove profile checking is performed by different gauge in accordance to the Figure 4.5.

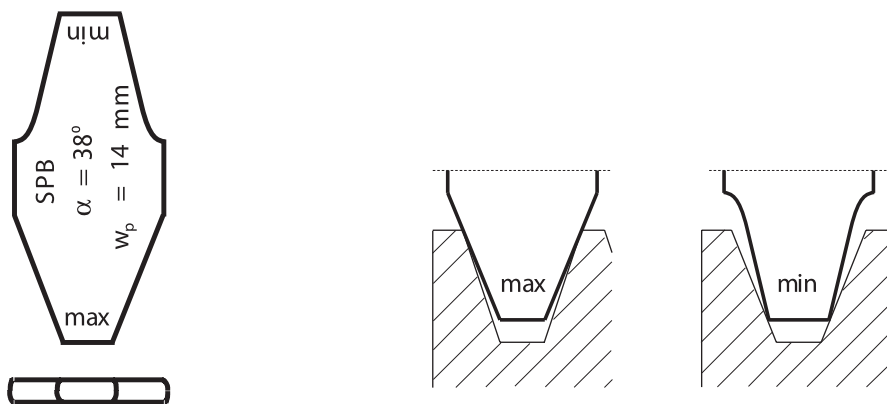


Fig. 4.5. Angle of groove profile checking.



## 4.2. Grooved pulley for power bands.

Belt pulleys for power bands of narrow profile are normalized in accordance to standard ISO 5290, and for power bands of classical profile in accordance to standard ISO 5291.

In international ISO standard effective (upper) nominal groove width  $w_e$  of belt pulley was determined as a base value for groove normalization of belt pulley and adherent power bands. Effective groove width is a biggest groove width measured at rectilinear groove walls. For all measuring wheels and mostly for working pulleys mass-produced this concept coincides with real upper groove width. Pitch diameter  $d_p$  location (effective) is given only as a approximate value. For determination of gearing dimensions and power, effective (outside) dimension of wheel is used. Minimal calculation differences in a ratio and rotational frequency do not have any practical influence.

General rules regarding belt pulleys are included in point 1.3.c.

Power bands can work only on belt pulleys made in accordance to dimensions shown in table 4.4.

Power bands can't be used at pulleys for belts units, because dimensions of these wheels are different (compare table 4.1 and 4.4).

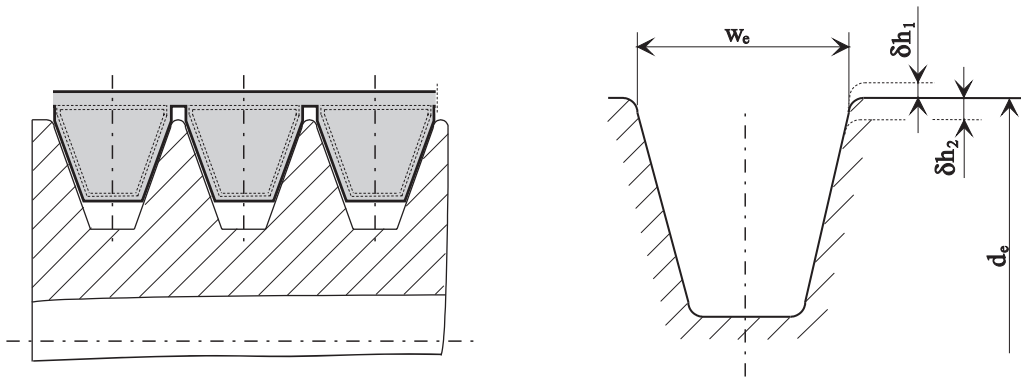


Fig. 4.6. Deviations of groove depth in relations to effective diameter.

Values  $\delta h_1$  and  $\delta h_2$  were chosen in this way, outside wheel diameter does not come into contact with connecting tape (what can cause separation of connection tape from belts), and simultaneously guarantee such groove depth which ensure good power transferring.

## Dimensions

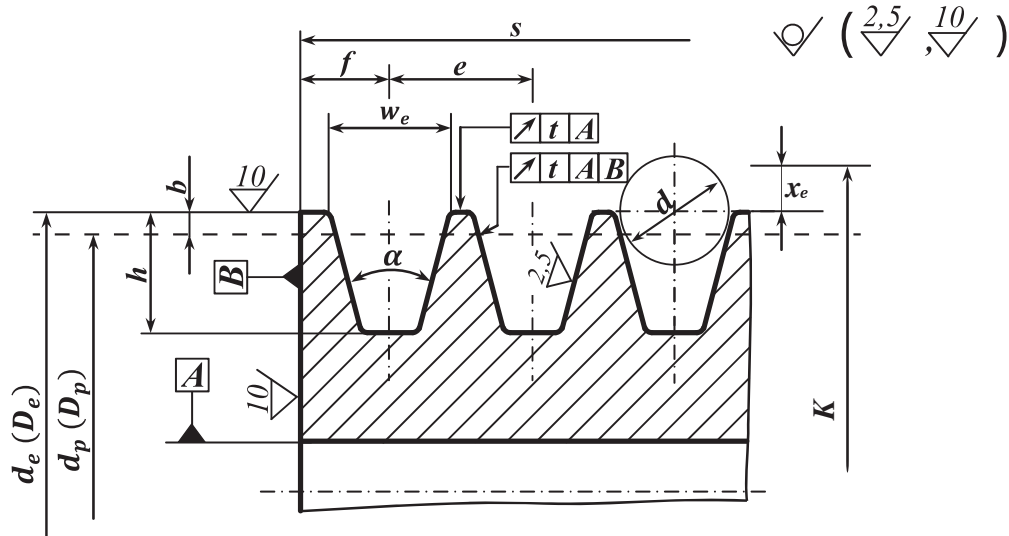


Fig. 4.7. Pulley for power bands.

Table 4.4. Grooved pulleys dimensions for power bands.

Dimensions in millimetres

ISO marking		15J	AJ	BJ	CJ	-
Power bands	RMA marking	5V/15J	-	-	-	-
	"Stomil Sanok" S.A. marking	15J	A BP	B BP	C BP	SPC BP
Pitch width $w_e$		15,2	13	16,5	22,4	22,4
Max. Value of deviation $h_1$		0,25	0,2	0,25	0,3	0,3
Max. Value of deviation $h_2$		0,4	0,35	0,4	0,45	0,45
Groove height $b$		1,3	1,5	2	3	3
Minimal groove depth $h_{min}$		15,2	12	14	19	23
Pulley pitch $e$		$17,5 \pm 0,25$	$15,88 \pm 0,3$	$19,05 \pm 0,4$	$25,4 \pm 0,5$	$25,4 \pm 0,5$
Edge pitch $f_{min}$		13	9	11,5	16	16
Max. $\Sigma$ deviations $e$ in a pulley		$\pm 0,5$	$\pm 0,6$	$\pm 0,8$	$\pm 1$	$\pm 1$
Minimal effective diameter $d_{emin}$		180	80	130	210	250
Effective diameter $d_e$	$\alpha = 34^\circ$	-	<125	<195	<325	<325
	$\alpha = 38^\circ$	<250	>125	>195	>325	>325
	$\alpha = 40^\circ$	250 - 400	-	-	-	-
	$\alpha = 42^\circ$	>400	-	-	-	-
Acceptable deviations $\alpha$		$\pm 0,25^\circ$	$\pm 0,5^\circ$	$\pm 0,5^\circ$	$\pm 0,5^\circ$	$\pm 0,5^\circ$
Diameter of measuring cylinder $d$		$14,7^{+0}_{-0,043}$	$11,6^{+0}_{-0,043}$	$14,7^{+0}_{-0,043}$	$20,7^{+0}_{-0,052}$	$14,7^{+0}_{-0,052}$
Approximate correction dimension $2x_e$	$\alpha = 34^\circ$	16	9	11	15	15
	$\alpha = 38^\circ$		9	12	16	16
	$\alpha = 40^\circ$		-	-	-	-
	$\alpha = 42^\circ$		-	-	-	-

**Table 4.5.** Tolerance of radial and axial runout for power bands.

Dimensions in millimetres

Effective diameter $d_e$	Runout tolerance	
	radial $t_1$	axial $t_2$
$d_e < 125$	0,2	0,3
$125 < d_e < 315$	0,3	0,4
$315 < d_e < 710$	0,4	0,6
$710 < d_e < 1000$	0,6	0,8
$1000 < d_e < 1250$	0,8	1,0
$1250 < d_e < 1600$	1,0	1,2
$1600 < d_e < 2500$	1,2	1,2

**Table 4.6.** Summary of power bands in belt unit and widths of pulley rim.

Dimensions in millimetres

Number of grooves	Belts setting	15J	A BP	B BP	C BP and SPC BP
		Width of pulley $s$ for grooves number $s = (z-1) \cdot e + 2f$			
2	2	43,5	33,88	45,05	61,40
3	3	61,0	49,76	64,1	86,8
4	4	78,50	65,64	83,15	112,20
5	5	96,00	81,52	102,2	137,60
6	3/3	113,50	97,40	121,25	163,00
7	3/4	131,00	113,28	140,30	188,40
8	4/4	148,50	129,16	159,35	213,80
9	5/4	166,00	145,04	178,40	239,20
10	5/5	183,50	160,92	197,45	264,60
11	4/3/4	201,00	176,80	216,50	290,00
12	4/4/4	218,50	192,68	235,55	315,40
13	4/5/4	236,00	208,56	254,60	340,80
14	5/4/5	253,50	224,44	273,65	366,20
15	5/5/5	271,00	240,32	292,70	391,60
16	4/4/4/4	288,50	256,20	311,75	417,00
17	4/4/5/4	306,00	272,08	330,80	442,40
18	5/4/4/5	323,50	287,96	349,85	467,80
19	5/4/5/5	341,00	303,84	368,90	493,20
20	5/5/5/5	358,50	319,72	387,95	518,60
21	4/4/5/4/4	376,00	335,60	407,00	544,00
22	5/4/4/4/5	393,50	351,48	426,05	569,40
23	5/4/5/4/5	411,00	367,36	445,10	594,80
24	5/5/4/5/5	428,50	383,24	464,15	620,20
25	5/5/5/5/5	446,00	399,12	483,20	645,60
26	5/4/4/4/4/5	463,50	415,00	502,25	671,00
27	5/5/4/4/4/5	481,00	430,88	521,30	696,40
28	5/5/4/4/5/5	498,50	446,76	540,35	721,80
29	5/5/5/4/5/5	516,00	462,64	559,40	747,20
30	5/5/5/5/5/5	533,50	478,52	578,45	772,60
31	5/4/4/5/4/4/5	551,00	494,40	597,50	798,00
32	5/5/4/4/4/5/5	568,50	510,28	616,55	823,40
33	5/5/5/4/4/5/5	586,00	526,16	635,60	848,80
34	5/5/5/4/5/5/5	603,50	542,04	654,65	874,20
35	5/5/5/5/5/5/5	621,00	557,92	673,70	899,60
36	5/5/4/4/4/4/5/5	638,50	573,80	692,75	925,00
37	5/5/5/4/4/4/5/5	656,00	589,68	711,80	950,40
38	5/5/5/4/4/5/5/5	673,50	605,56	730,85	975,80
39	5/5/5/5/4/5/5/5	691,00	621,44	749,90	1001,20
40	5/5/5/5/5/5/5/5	708,50	637,32	768,95	1026,60

## 5. Tension of belts.

For ideal power transferring and to achieving required belts lifetime, correct belts tensioning is a very important factor. Too small or too big tension often leads to earlier belt destruction. Excessive belt tension also cause quicker bearings damage in driving machine as well as in driven machine.

Was found that, commonly known way of belt tensioning checking, a method often called "pressure with the thumb", is not accurate enough to determine optimal belt tension. Excessive or too small belt tension can be avoided if a tension is calculated, performed and controlled in accordance to below described methods, or in accordance to design intentions stated in Operation and Maintenance Manual of a gearing.

After a gearing is mounted and belt tensioning is adjusted, belt gearing practically do not require maintenance. During first hours of operation tensioning of belts must be observed and according to experience, after approximately 0,5 – 4 hours of operation under full load – all belts must be tightened.

In this way initial tensile was taken into account. After 24 hours of operation tension of belts must be checked again and then corrected in case of necessity. Next control intervals can be significantly extended; after hundreds and even after thousands hours of operation, belts should be tensioned.

### 5.1. Tension belt control by measurement of tie rod belt deflection.

This method allows for indirect determining static force in tie belt  $T_s$  by measurement of deflection of belt measuring distance under control force action. Static force  $T_s$  is a minimal force existing in tie belt which allows for transferring of nominal force in a drive while slippage not exceeding allowable value.

This method can be used for belts of sections: SPZ, SPA, SPB, SPC, Z, A, B, 20, C, 25, D.

$T_s$ - minimal force existing in tie belt in static state	[N]
$N_s$ - minimal axis force in static state	[N]
$U$ - belt deflection at a distance 100 mm measuring length of a belt	[mm]
$U_p$ - deflection value of measuring distance of a belt	[mm]
$L$ - measuring distance length	[mm]
$q$ - control force exerted at a belt	[N]
$c$ - constant for centrifugal force calculation	[kg/m]
$A$ - axle base	[mm]
$N$ - power transferred by gearings	[kW]
$v$ - belt speed	[m/s]
$k_T$ - coefficient of work condition	
$k_\phi$ - coefficient of wrap angle,	
$\phi$ - wrap angle of smaller wheel	[°]

To correctly determine parameters of tension control, perform the following steps:

1. Calculate static force  $T_s$  existing in tie belt:

$$T_s = \frac{500 \cdot (2,02 - k_\phi) \cdot N \cdot k_T}{k_\phi \cdot z \cdot v} + c \cdot v^2$$

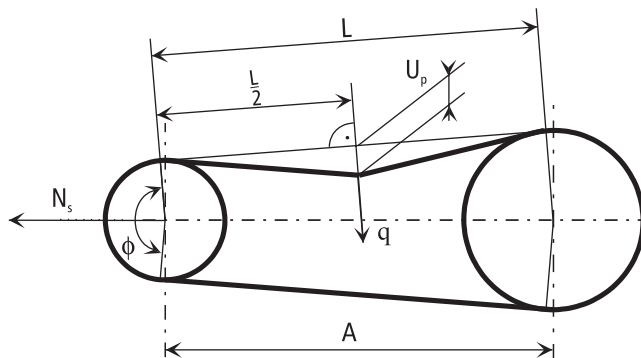


Fig. 5.1. Belt tension control by measurement of tie belt deflection.

2. Determine deflection value at length  $U$  of 100 mm of belt measuring distance at the base of belt tension curve from Figures 5.2. or 5.3.

3. Calculate deflection value  $U_p$  for existing length of measuring distance  $L$ .

$$U_p \approx \frac{U \cdot L}{100}$$

$$L = A \cdot \sin \frac{\varphi}{2}$$

Control force  $q$  determined from Fig. 5.2. or 5.3. in the middle of measuring distance  $L$ , must be applied perpendicular to belt tie in accordance to above drawing, then tie deflection value  $U_p$  must be measured; in case of necessity tension should be corrected.

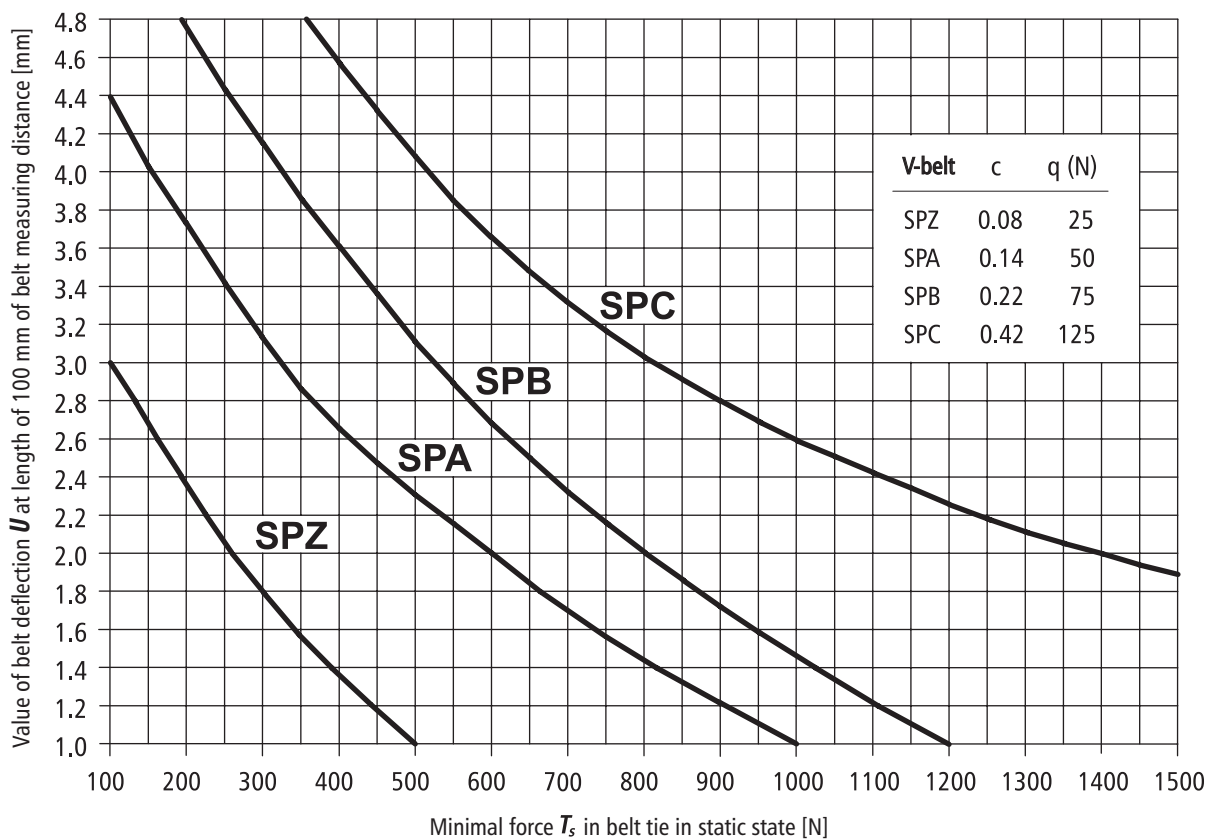
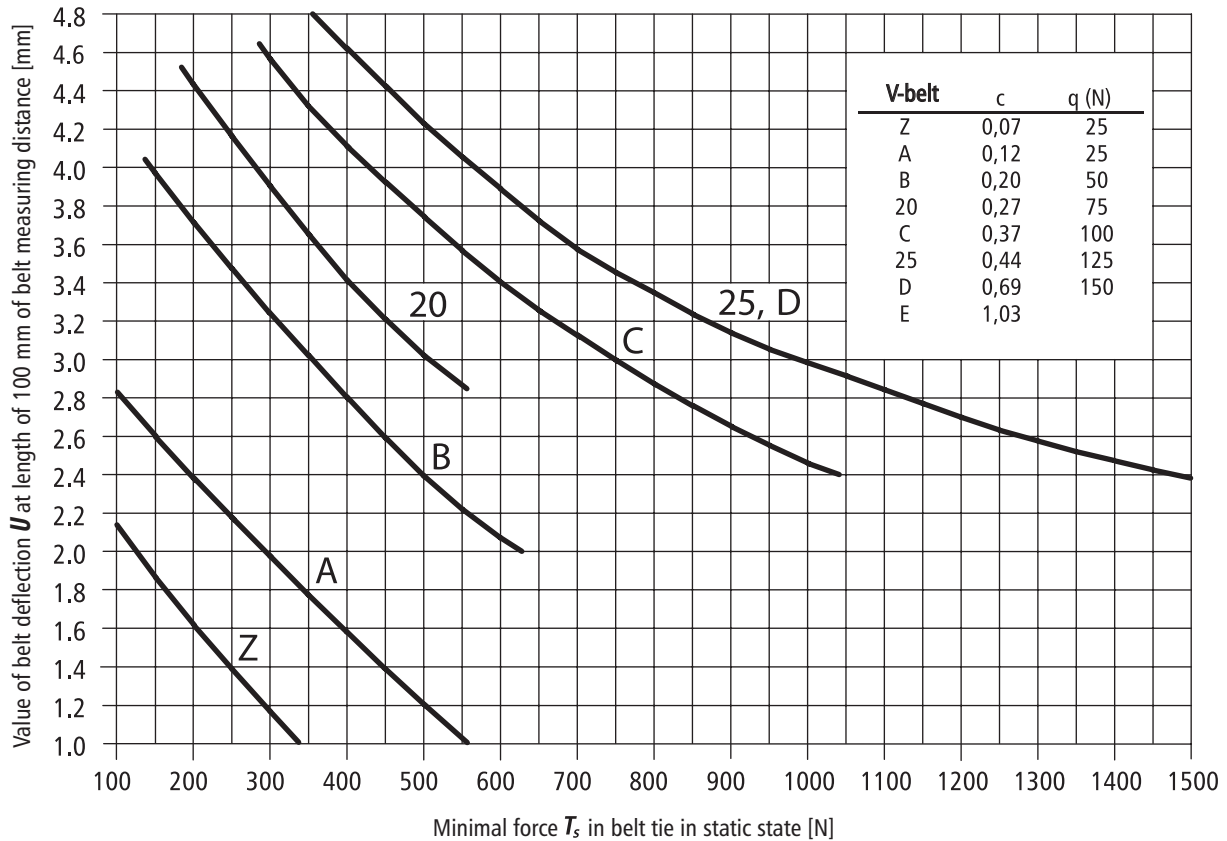


Fig. 5.2. Relation between deflection  $U$  and force  $T_s$  for narrow belts



Rys. 5.3. Relation between deflection  $U$  and force  $T_s$  for classical belts

## 5.2. Tension belt control by measurement of revolutions

By usage of this method belts tension is controlled by calculating belts slippage on pulley. Active pulley revolutions are measured (driving wheel) as well as passive pulley revolutions (driven wheel) during idle run and under load and then slippage is calculated at the base of following formula:

$$s = \left(1 - \frac{n_{cj}/n_{bj}}{n_{co}/n_{bo}}\right) \cdot 100\%$$

where:

$s$ - slippage	[%]
$n_{cj}$ - active pulley revolutions during idle run	[r.p.m.]
$n_{bj}$ - passive pulley revolutions during idle run	[r.p.m.]
$n_{co}$ - active pulley revolutions during load run	[r.p.m.]
$n_{bo}$ - passive pulley revolutions during load run	[r.p.m.]

During normal load slippage should not exceed 1%. Small tension or longer load is unacceptable with a slippage above 2% because it adversely affects belts lifetime.

### 5.3. Tension belt control by measurement of static axial force.

Direct measurement of static axial force is very exact method in order to set correct belt tension. Static axial force is calculated at the base of following formula:

$$N_s = 2T_s \cdot \sin \frac{\varphi}{2} \cdot z$$

This belt tension control method is not suitable for usage if we don't have measuring instruments for direct static axial force measurement  $N_s$ .

### 5.4. Designation of axial load in dynamic state.

In case of drives with internal combustion engines, turbines or highly-loaded drives like calander drives, splitters or mill machinery determination of dynamic load of bearings is required - i.e. existing loads of shafts and bearings in a drive.

Exact calculation of dynamic axial force will save unnecessary costs which may appear with respect of:

- earlier bearings usage;
- shaft cracking;
- oversized bearings and shafts.

Shafts and bearings in a drive with two pulleys are loaded by the same net dynamic force, but - which is obvious – directed in the opposite direction. Using tension rollers, value and direction of net dynamic force is almost always different at each pulley.

If value as well as direction of dynamic force must be determined, graphic solution is recommended by parallelogram of force: dynamic force  $T_c$  loading the axle and forces in active belt ties as well as dynamic force  $T_b$  loading the axle and forces in passive belt ties.

If dynamic axial force is only to be calculated, then calculation can be done by the following formula for  $N_{s \text{ dyn}}$ .

Axe load coming from forces in active ties

$$T_c \approx \frac{1020 \cdot N \cdot k_T}{k_\varphi \cdot v}$$

Axe load coming from forces in passive ties

$$T_b \approx \frac{1000 \cdot (1,02 - k_\varphi) \cdot N \cdot k_T}{k_\varphi \cdot v}$$

$T_c$  - dynamic axe load coming from forces in active ties [N]

$T_b$  - dynamic axe load coming from forces in passive ties [N]

$N_{s \text{ dyn}}$  - resultant dynamic force [N]

$N$  - power transferred by a gearing [kW]

$v$  - belt speed [m/s]

$k_T$  - coefficient of work conditions

$k_\varphi$  - coefficient of wrap angle of small pulley

$\varphi$  - wrap angle of smaller pulley [°]

Graphic Solution:

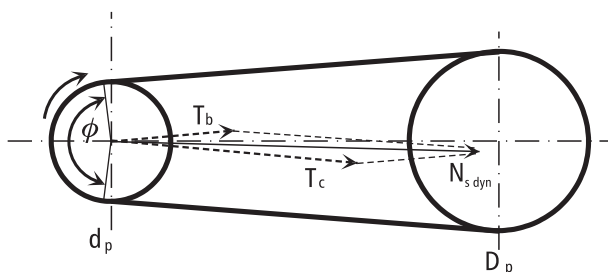


Fig. 5.4. Parallelogram of dynamic forces in belt gearing.

Formula Solution:

$$N_{s \text{ dyn}} \approx \sqrt{T_c^2 + T_b^2 - 2T_c \cdot T_b \cdot \cos \varphi}$$

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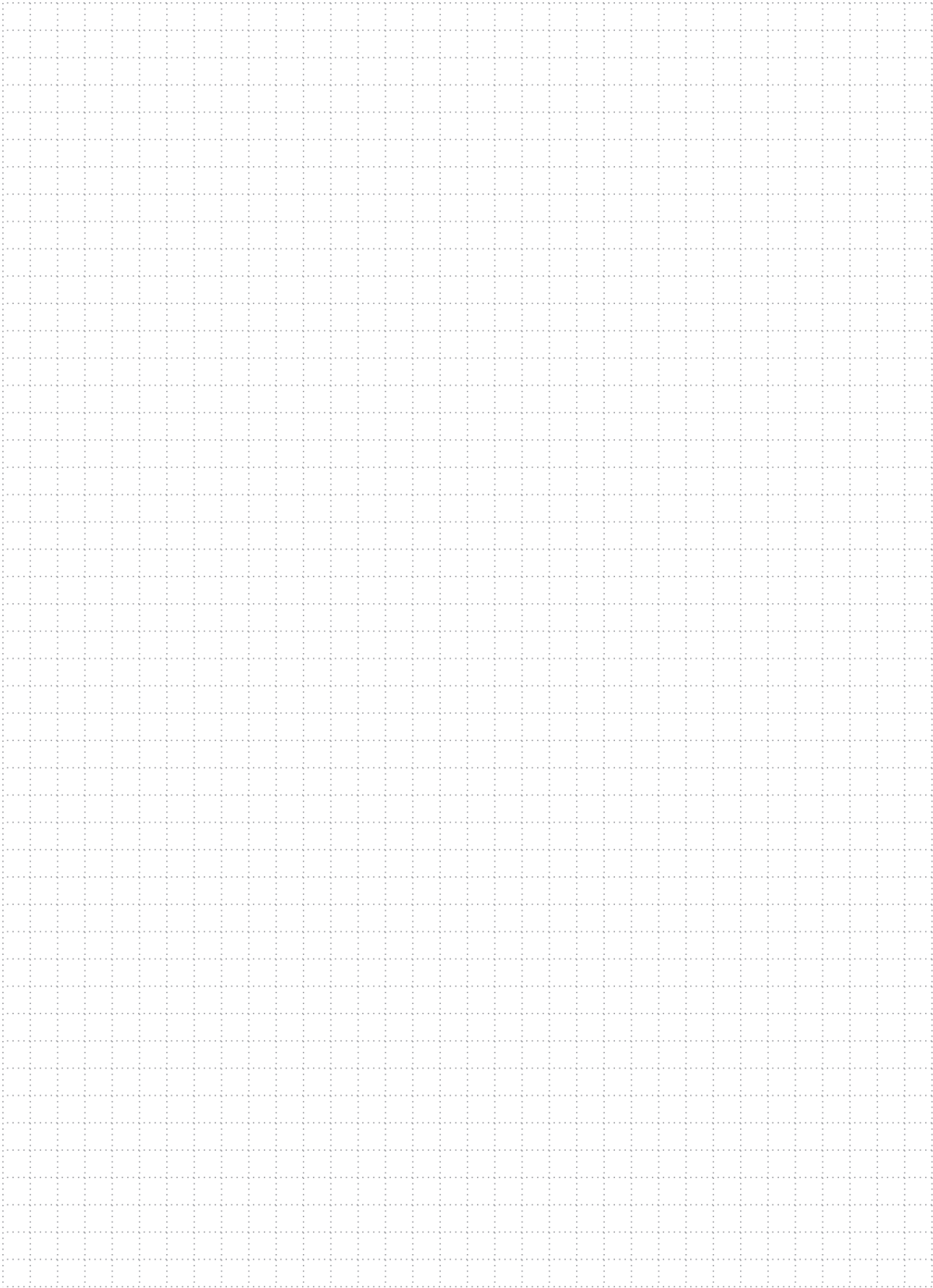


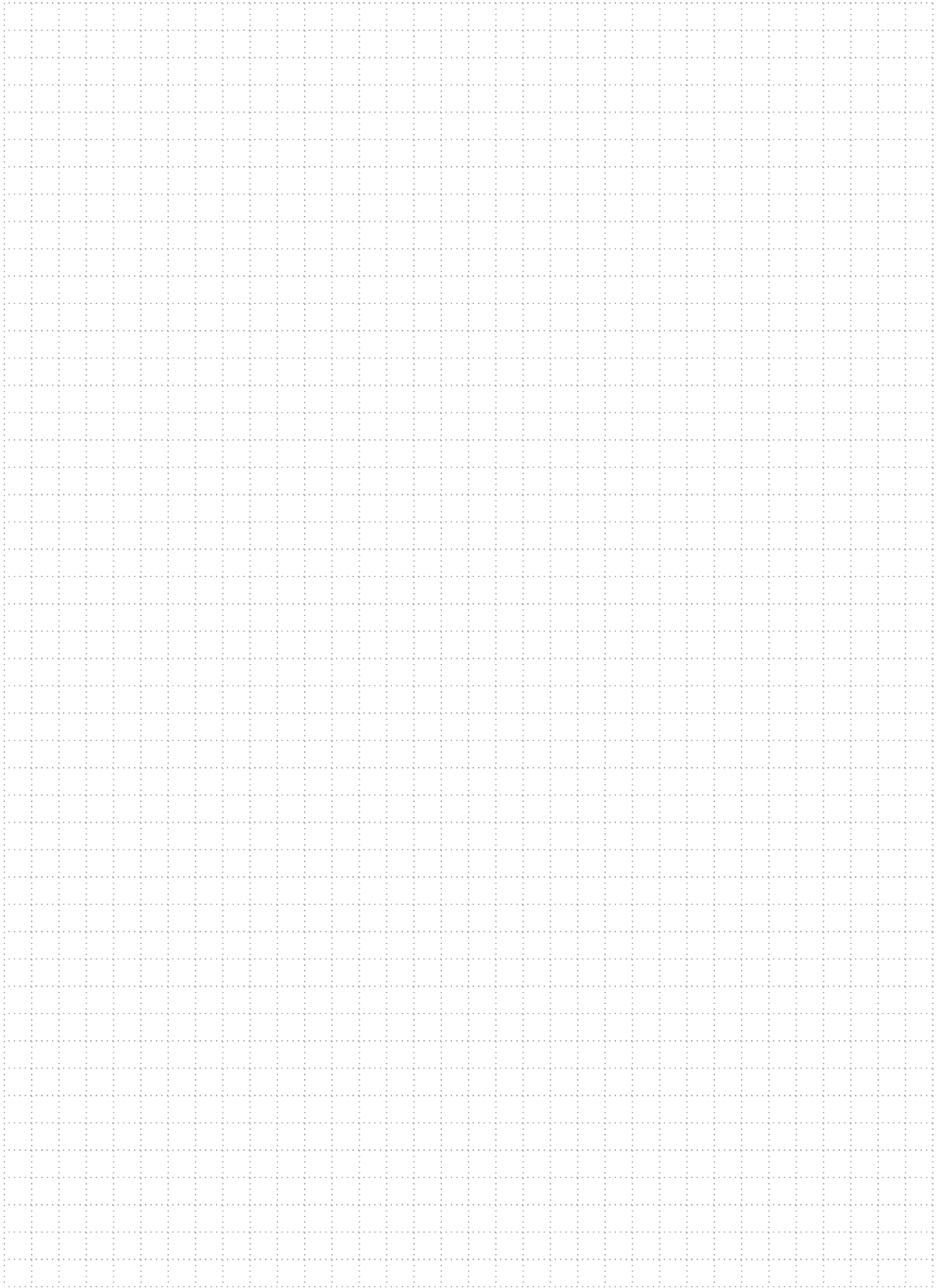
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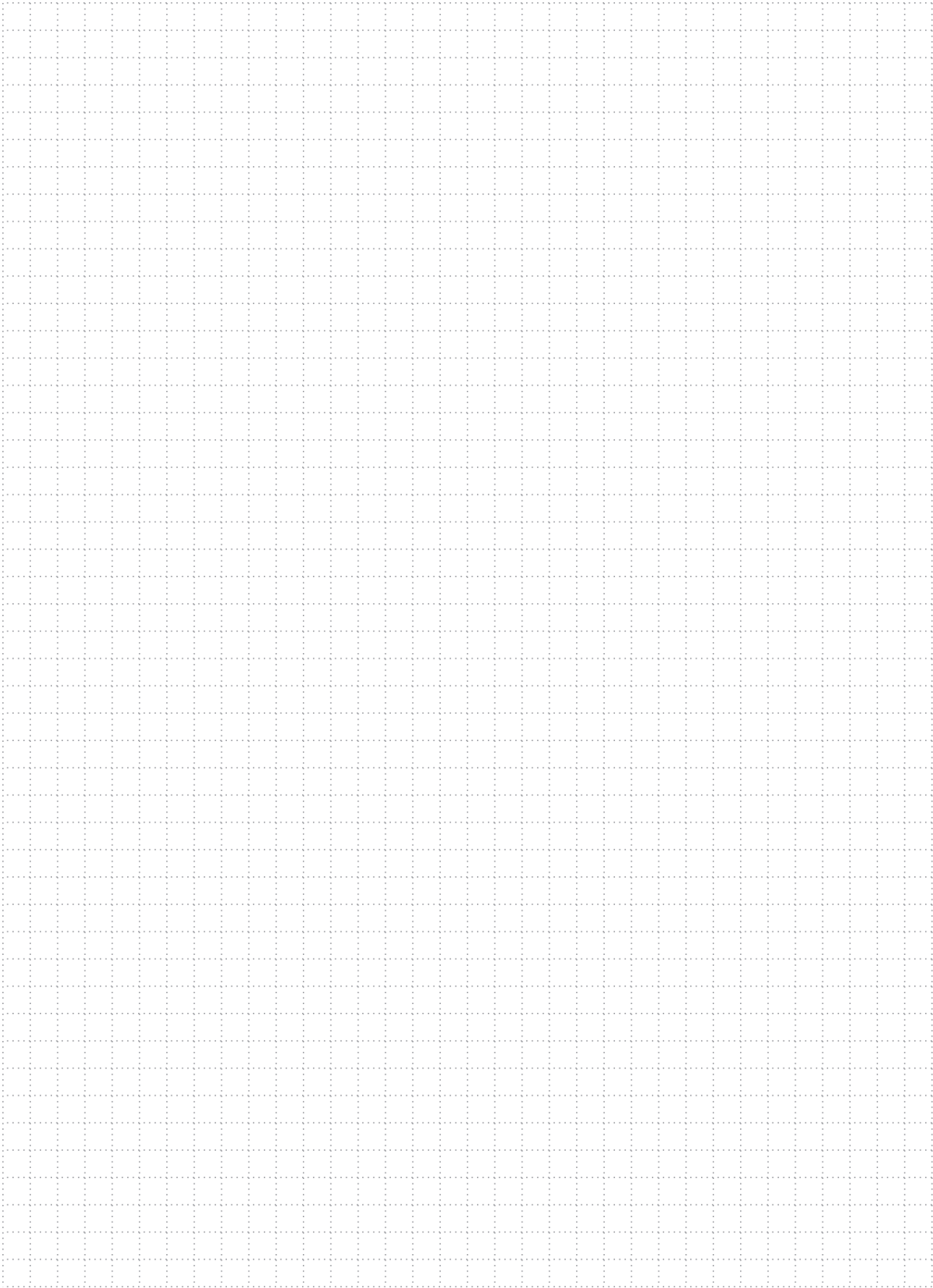


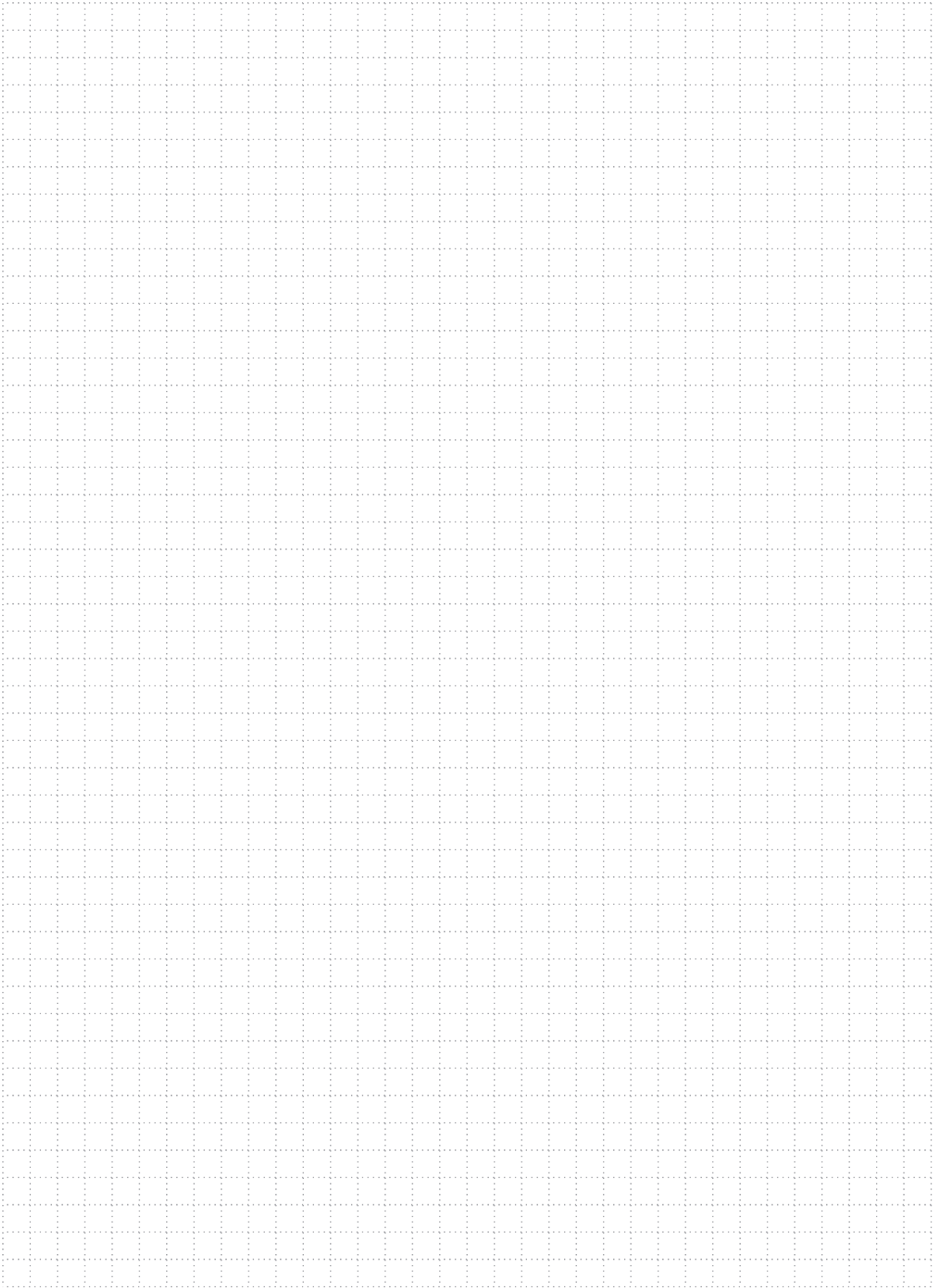
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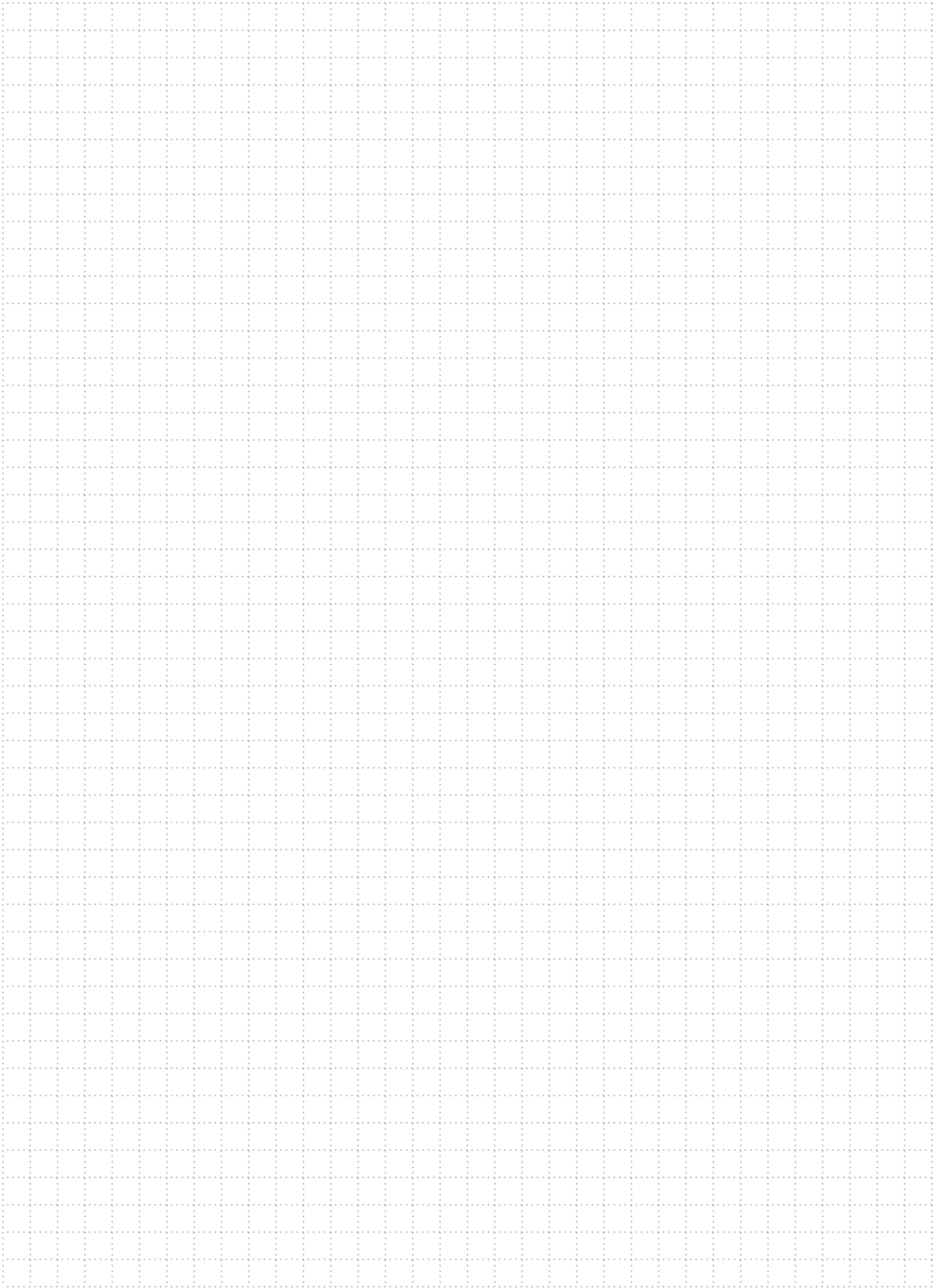












Prędkość liniowa  
i obrotowa

$$v [m/s] \approx \frac{d [mm] \cdot n [obr/min]}{19100}$$

$$n [obr/min] \approx 19100 \frac{v [m/s]}{d [mm]}$$

$$N [kW] \approx \frac{F [N] \cdot v [m/s]}{1000}$$

$$N [kW] \approx \frac{M [Nm] \cdot n [obr/min]}{9550}$$

$$N [KM] \approx \frac{F [kG] \cdot v [m/s]}{75}$$

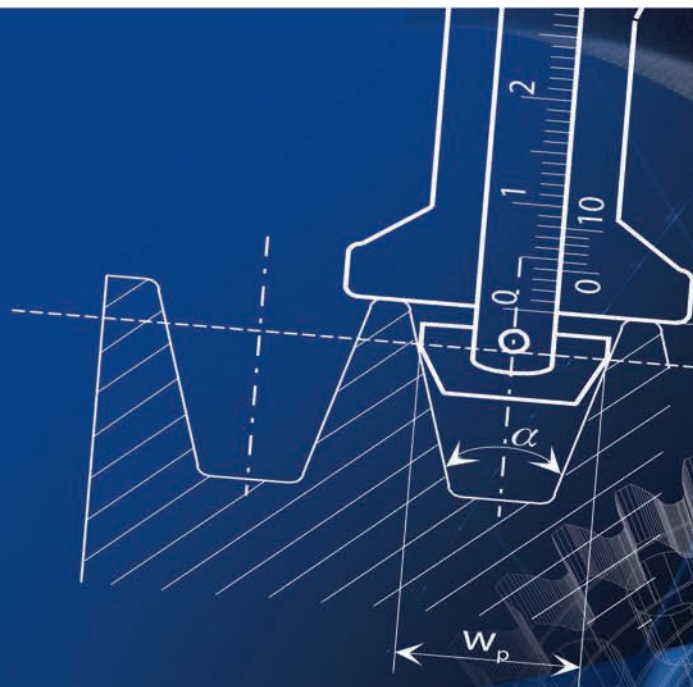
MOC

$$N [KM] \approx \frac{M [kGm] \cdot n [obr/min]}{716}$$

$$1 [kW] \approx 1,360 [KM] \approx 1,341 [HP]$$

$$1 [KM] \approx 0,735 [kW] \approx 0,986 [HP]$$

$$1 [HP] \approx 0,746 [kW] \approx 1,014 [KM]$$



Moment  
obrotowy M [

M [kGm]



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