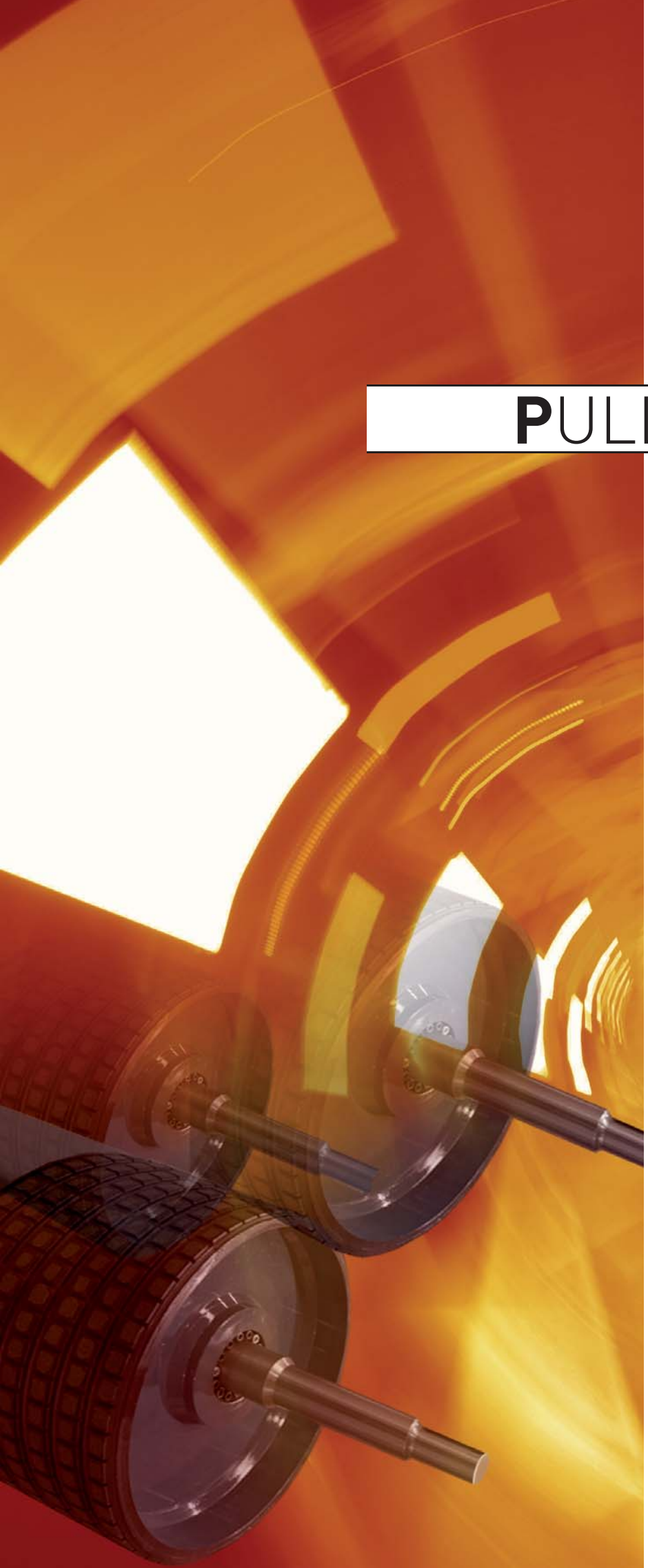


PULLEYS

55-64

ULMA

Introduction

Pulleys are similar to rollers but without bearings or rotating parts inside. They are placed in the front and rear of the conveyor and provide traction to the belt.

Applications

The ULMA heavy-duty series pulleys are generally used in steel plants, mines, thermal power stations, ports, quarries and in other similar working conditions.

Shape and dimensions

SHELL

Diameters exceeding 400 millimetres are built with curved metal and weldedlengthwise, being subsequently stabilised to remove material stresses.

In diameters less than 400 millimetres, seamless tubes can be used. (Perforated bar).

The external diameter D can be flat or crown (according to requirements) and corresponding to the shell diameter. Coatings will increase that diameter.

Concentricity should not exceed 1% of its diameter D.

SHAFT

Shafts are manufactured and properly machined from F-1140 standard steel. They can also be custom manufactured from any other material.

Calculation and sizing of pulleys shafts

Calculation method

On pulleys, the only calculation that is performed is on the shaft diameter according to ANSI / CEMA standards. Allowable torsion, radius and shear limitation are all taken into account. The diameter of the shaft is calculated using five methods:

1 - Diameter according to allowable shear stress (τ)d= f(τ)(idler bearing).
2 - Diameter according to the allowable deflection or sag (Fixing units).
3 - Diameter according to the shaft inclination angle. d= f(tgα)
4 - Diameter according to the allowable twisting angle.
5 - Diameter according to bearing life.

The largest shaft diameter is chosen after these methods are calculated.

1-Diameter according to allowable shear stress (τ)d=f(τ) (idler bearing).

The following materials resistance formula is used in accordance with CEMA:

$$d=\sqrt[3]{\frac{16\cdot M_I}{\pi\ \tau}}$$

Where:

- $MI=\sqrt{(FS\cdot M_F)^2+M_T^2}$ Ideal or equivalent time.
- τ: Work stress shear (450 kg/cm^2 or according to customer).

A combined outcome between flex and torque is taken into account.

Where:

FS=1.5 safety factor
M_F Bending time
M_T Torque time

2-Diameter according to the allowable deflection or sag d = f(f) (fixing units).

The value of the deflection is usually a fraction of the distance between supports (d_{ea}).

Normally: $f_{max}=\frac{0.6\cdot d_{ea}}{1000}$

Using the following formula, the inertia of the circular section of the axle is obtained:

$$f=\frac{P\cdot a}{24\cdot E\cdot I}\cdot 3\cdot d_{ea}^2-4\cdot a^2$$

Where:

- a: Support distance -moyu
- E: Module el·stico of YOUNG (210 GPa)

Therefore, the minimum diameter:

$$d=\sqrt{\frac{64\cdot I}{\pi}}$$

3-Diameter according to the shaft **inclination angle d = f(tgα).**

This formula calculates the elastic tangent of the axle. The minimum diameter is obtained with the following formula:

$$d=\frac{1}{21.3}\cdot\sqrt[4]{\frac{M_F\cdot(d_{ea}-2a)}{tg\alpha}}$$

Usually 0.0015 radius is taken for this angle.

4-Diameter according to the allowable torque angle.

Torque angle is limited to 0.5 ∫. With this information, and the torque that is applied to the pulley, the diameter is obtained.

$$d=\cdot\sqrt[4]{\frac{I_P\cdot 32}{\pi}}$$

Where:

- $I=\frac{M_T\cdot d_{ea}}{\theta\cdot G}(mm^4)$
- θ Maximim torque angle (rad)
- G Young torque module (80GPa)
- M_T Torque time

5-Diameter according to bearing life.

Bearing life is calculated using the following formula:

$$L_{10} = \frac{1000000}{6 * n} \left(\frac{C}{P} \right)^{p}$$

Where:

- L_{10} Average life, in service hours
- n = Pulley revolutions, rpm.
- C Dynamic bearing load, in N.
- P Load carried by the pulley, the result of the stresses plus the weight of the pulley itself.
- p = Exponent,
  - -for ball bearings p = 3
  - -for roller bearings p = 10/3 = 3,3

It is recommended to use roller bearings due to their higher load capacity when compared to other types of bearings.

It is likewise recommended to use bearings that have a 40,000 working hours lifespan and to not use bearings with a lifespan below 30,000 working hours. These calculations must follow this recommendation.

Calculating the thickness of the shell and side discs

Calculation method

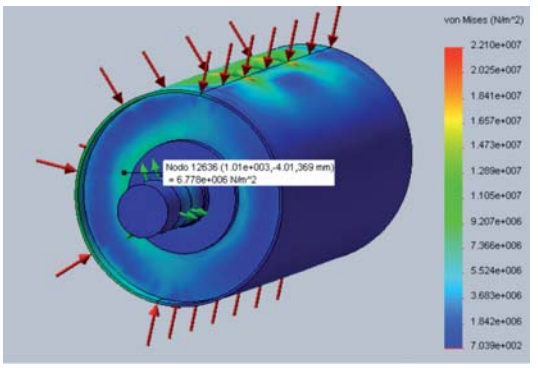
The following formula is used to calculate the thickness of the shell and side discs:

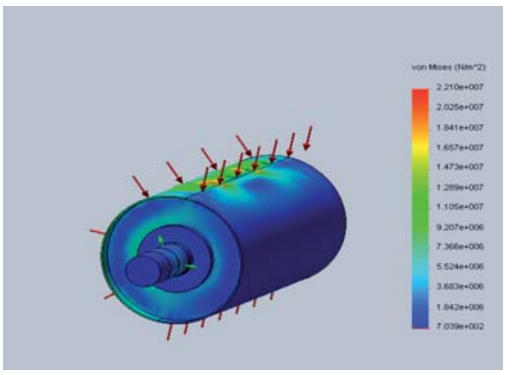
1)Stress condition of the pulley (VON MISSES)

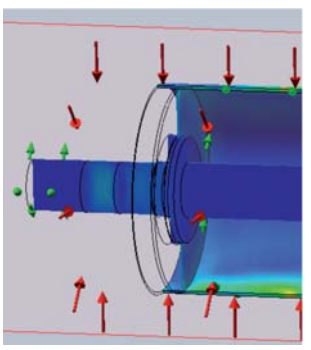
2)Pulley deformation

1) Stress condition of the pulley

The elastic limit of the steel is used as a reference. Based on this limit, the thickness of the shell and side discs is adjusted.

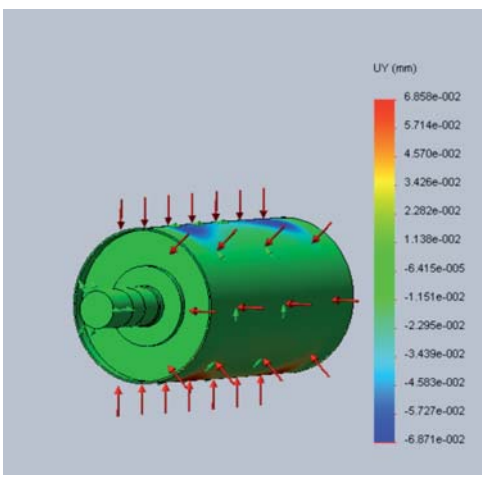






2) Elastic condition of the pulley.

Unless otherwise stated by the customer, elastic deformations on the pulley are calculated by taking into account a 0.5mm/m deflection.

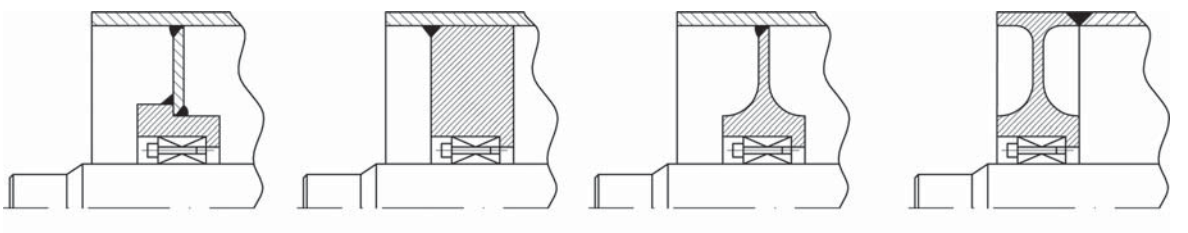


SIDE DISCS

Depending on the application, the pulleys have been designed with these types of side discs:

1 -Welded disc.
2 - Integrated disc.
3 - Contoured integrated disc.
4 - Disc in turbine, type T

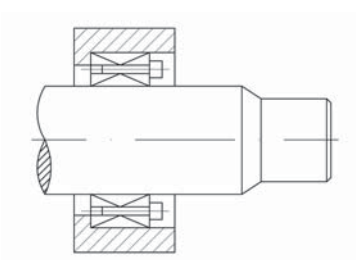
These designs have been designed to reduce the stress and tension areas produced during the welding process.



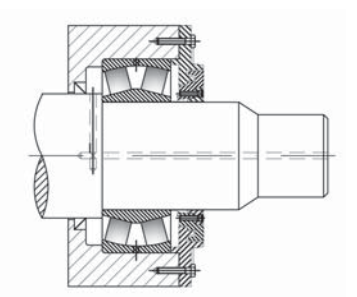
1-Hub with welded disc | 2-Solid hub | 3-Contured hub | 4-Type "T" or turbine

PULLEY AXLE ATTACHMENT

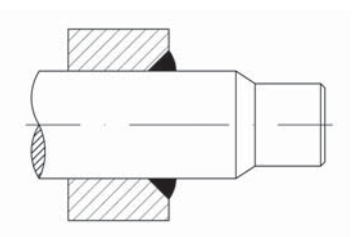
Attaching the axle onto the ferrule can be achieved using various systems:



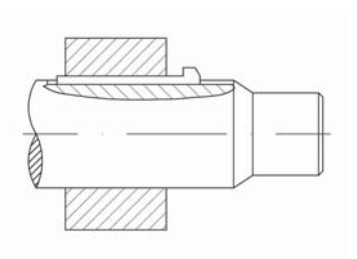
a- Pressure rings or conical units



b- Bearings



c- Welding



d -Smooth or tapered keyway

It is recommended that welding the shaft to the side discs or using tapered keyways should only be used under low workload requirements, because stress and vibration on the pulleys can cause a rupture of the weld seams and detachment of the keyway.

Pressure rings or conical units are recommended due to their great torque transmission, as well as their ease of assembly and disassembly.

The brands we work with are:

ECOLOC RINGFEDER TOLLOK

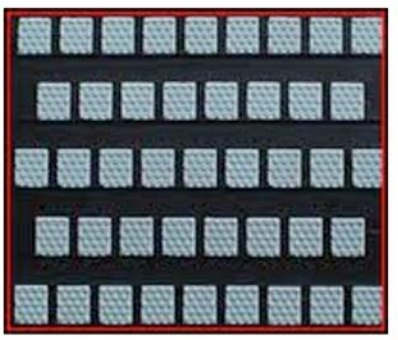
LAGGINGS

The laggings that we provide are: natural rubber, ceramic and polyurethane.

Natural rubber laggings can be supplied with the following shapes: Chevron (V), Diamond (Rhombic), Smooth and Custom order.

Rubber laggings can be supplied hot or cold vulcanized.

Thicknesses range from 6 to 40 millimetres and hardnesses from 40 to 90 Shore A.



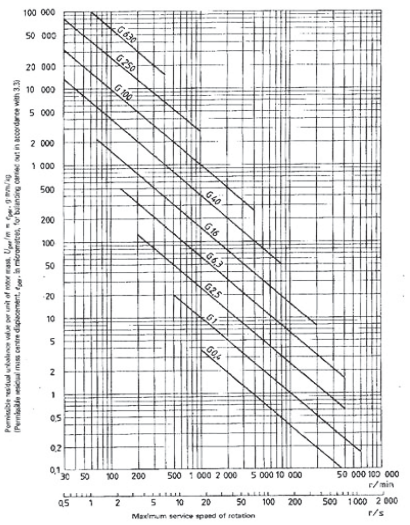
BALANCING

The pulleys are statically balanced. Pulleys may be balanced dynamically using custom specifications. All pulleys are internally balanced.

Defining the accurate balance point is essential in order for the pulleys to perform correctly without any vibrations. This depends in large part on the actual working revolutions and the size and shape of the pulley. The following table contains examples to assist in the selection of balancing grades that can be applied to the pulleys we need to balance. We must keep in mind that an unbalanced pulley will create vibrations.

Q 630	Two stroke engine crankshaft mounted on rigid bearings.
Q 250	Four stroke engine crankshaft mounted on rigid bearings or marine diesel engines crankshaft mounted on elastic bearings.
Q 100	Four piston diesel engine crankshaft mounted on rigid bearings.
Q 40	Automobile rims and tires. Fast 6 cylinder diesel engine crankshafts. Locomotive, truck and coach engines.
Q 16	Joined axles, transmissions. Four stroke engines on rigid bearings, having 6 or more cylinders. Locomotive, truck and coach engines.
Q 6.3	Specially joined axles, electric motor rotors, machining tools rotating parts, †centrifugal drums, fans, flywheels. Locomotive, truck and coach engine crankshaft parts. Special engine crankshafts of 6 or more cylinders.
Q 2.5	Turbine generators, small engine rotors, special electric motors, steam and gas turbines, fans, machining tool axles. Special crankshaft parts.
Q 1 precision	Grinder drives, special small motor rotors, turbo propellers, tape and video recorder drives.
Q 0.4 high precision	High precision grinder rotors, disk spindles and impellers.

Is recommended for large pulleys (⌀ shell > 350 mm) and Q16 for smaller pulleys.



Once the pulley's RPM and balancing grade are established, we use the following graph to obtain datum: U.

The maximum allowable imbalance (des.admis) is obtained from the following formula:

$$\text{des.admis.} = \frac{U \times m}{r}$$

Datum	Description	Units
Des.admis.	Maximum allowable imbalance	gr
U	Allowable residual imbalance	gr•mm
m	Mass of rotating parts	Kg
r	Radius in which we will place the supply of material	mm

HEAT TREATMENT

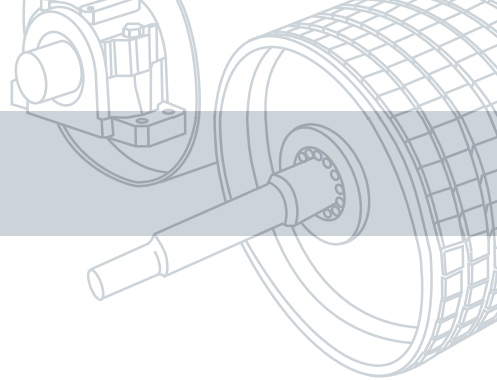
Heat treatment eliminates internal stresses produced by welding on those parts on which it is required. Should the provider already apply a stress relief process which is governed and approved by a competent body, it will be understood to be a general guideline.

NON-DESTRUCTIVE TESTING

These are performed to certify that the welds have been performed correctly, in order to avoid imperfections.

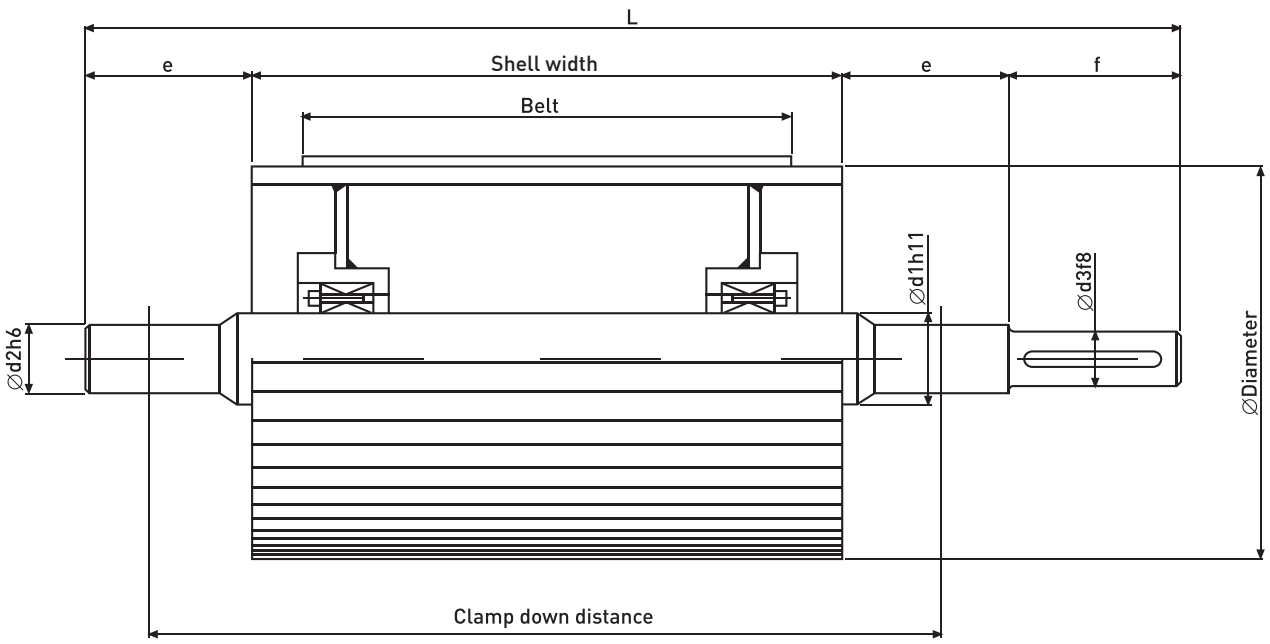
SHIPPING PACKAGING

The pulley shall be provided with suitable materials packed for international transport.

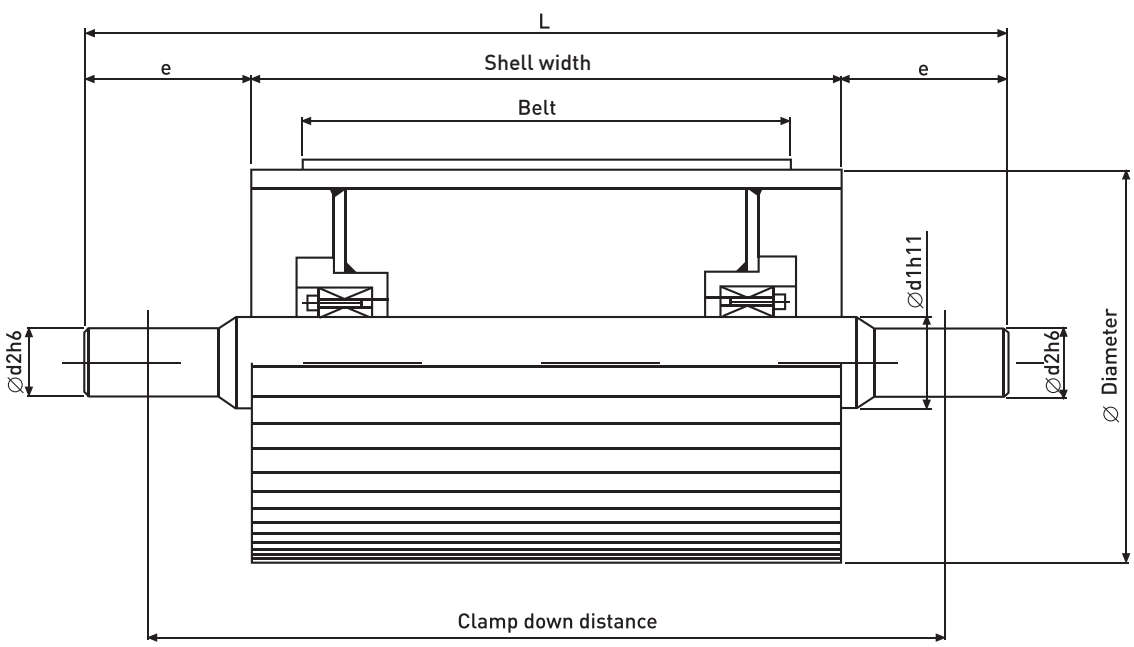


DIMENSIONS

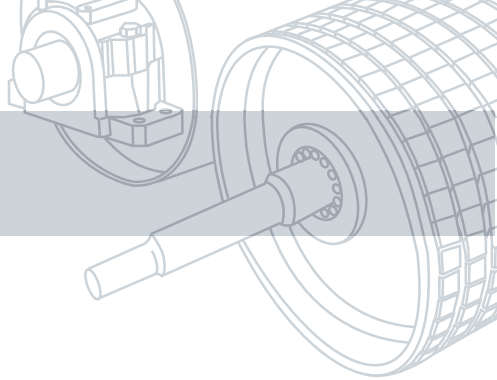
DRIVE PULLEY



RETURN PULLEY



PULLEYS



Belt	Shell width	Clamp down distance	f	e	L	Diameter	d1	d2	d3
400	500	675	60	100	795	315	50	40	35
			65	120	805	400	70	50	45
			80	150	835	500	90	65	60
500	600	775	65	120	905	315	70	50	45
			80	150	935	400	90	60	55
			90	160	955	500	110	80	75
650	750	950	65	120	1080	315	70	50	45
			80	150	1110	400	90	60	55
			90	160	1130	500	110	80	75
			110	190	1170	630	130	100	95
800	950	1150	65	120	1280	315	70	50	45
			80	150	1310	400	90	60	55
			90	160	1330	500	110	80	75
			110	190	1370	630	130	100	95
			120	230	1390	800	150	125	120
1000	1150	1350	65	120	1280	315	70	50	45
			80	150	1310	400	90	60	55
			90	160	1330	500	110	80	75
			110	190	1370	630	130	100	95
			120	230	1390	800	150	125	120
			140	270	1430	1000	190	160	155
1200	1400	1650	65	120	1280	315	70	50	45
			80	150	1310	400	90	60	55
			90	160	1330	500	110	80	75
			110	190	1370	630	130	100	95
			120	230	1390	800	150	125	120
			140	270	1430	1000	190	160	155
1400	1600	1900	80	150	1310	315	70	50	45
			90	160	1330	400	90	60	55
			110	190	1370	500	110	80	75
			120	230	1390	630	130	100	95
			140	270	1430	800	150	125	120
			180	300	1510	1000	190	160	155
			200	350	1550	1250	240	200	195
1600	1800	2200	80	150	1310	315	70	50	45
			90	160	1330	400	90	60	55
			110	190	1370	500	110	80	75
			120	230	1390	630	130	100	95
			140	270	1430	800	150	125	120
			180	300	1510	1000	190	160	155
			200	350	1550	1250	240	200	195
1800	2000	2450	80	150	1310	315	70	50	45
			90	160	1330	400	90	60	55
			110	190	1370	500	110	80	75
			120	230	1390	630	130	100	95
			140	270	1430	800	150	125	120
			180	300	1510	1000	190	160	155
			200	350	1550	1250	240	200	195
			260	460	1670	1400	350	300	295
2000	2200	2700	80	150	1310	315	70	50	45
			90	160	1330	400	90	60	55
			110	190	1370	500	110	80	75
			120	230	1390	630	130	100	95
			140	270	1430	800	150	125	120
			180	300	1510	1000	190	160	155
			200	350	1550	1250	240	200	195
			260	460	1670	1400	350	300	295

Measurements in millimetres