



2.3 - Selection method

The choice of roller type, most suitable for a certain application, will be dealt with in the following section but should also take into account other factors such as:

- the abrasive and corrosive characteristics of the conveyed material
- the environmental working conditions of the plant in which the rollers will be installed.

Abrasive materials (clay, granite, ferrous minerals) may influence the roller choice towards the heaviest series (PSV, MPS) and the choice of a large tube diameter as this results in only a minor contact of the roller surface with the conveyor belt itself.

The conveyor transport of corrosive materials (salt, chemicals etc....) requires the chosen rollers to be protected or manufactured from the appropriate materials that are time resistant to the corrosive substance.

The rollers may be in steel, covered with several layers of a particular specification of paint, or covered in rubber or in other anti corrosive materials.

Otherwise the rollers may be entirely manufactured from plastic materials that are resistant to corrosion (see PL rollers).

Environmental conditions where, in particular, dusty conditions prevail (cement, limestone, ash) rollers with the very best sealing systems that offer the highest possible protection are required (PSV).



2.3.1 - Choice of diameter in relation to speed

It has already been stated that one of the important factors to consider in the project design of a conveyor is the speed of the belt, in relation to the required conditions of transport.

From the speed of the belt and the roller diameter one is able to establish the number of revolutions of the roller from the formula:

$$n = \frac{v \times 1000 \times 60}{D \times \pi} \text{ [revs/min]}$$

where:

D = roller diameter [mm]

v = belt speed [m/s]

Tab.15 shows the relationship between the maximum belt speed, the roller diameter and its relative numbers of revolutions.

It is interesting, in the choice of the roller, to note that a roller of large diameter will also imply a major start up inertia but may still be the choice, because there are many other advantages to satisfy other conditions.

Tab. 15 - Maximum speed and roller revolutions

Roller diameter mm	Belt speed m/s	rpm n
50	1.5	573
63	2.0	606
76	2.5	628
89	3.0	644
102	3.5	655
108	4.0	707
133	5.0	718
159	6.0	720
194	7.0	689

The correct choice of diameter must take into account the belt width. **Tab.16** indicates our advice for roller diameters.

Tab.16 - Recommended roller diameter

Belt width mm	For speed								
	≤ 2 m/s			2 ÷ 4 m/s			≥ 4 m/s		
	Ø roller mm			Ø roller mm			Ø roller mm		
500	89			89					
650	89			89	108				
800	89	108		89	108	133	133		
1000	108	133		108	133		133	159	
1200	108	133		108	133	159	133	159	
1400	133	159		133	159		133	159	
1600	133	159		133	159	194	133	159	194
1800	159	159	194	159	194				
2000	159	194		159	194		159	194	
2200 and more	194			194			194		

Where more diameters of roller are indicated the choice will be made in relation to the lump size of material and to the severity of plant conditions.



2 Rollers

2.3.2 - Choice of the type in relation to load

The type and size of rollers to use in a belt conveyor depends essentially on the belt width, the pitch of troughing sets, and above all the maximum load on the roller under the greatest forces, notwithstanding other corrective factors.

The calculation of this load is normally made by the plant project designer. Nevertheless, as a check or as in the case of straightforward conveyors, we would like to give you the following helpful fundamental concepts.

The first value to define is the load on the troughing set transom. Following this, according to the type of troughing set

their angle, the lump size of material and various other operating factors which are listed below, one is able to determine the load that exists on the most stressed roller for each type of troughing set.

Besides this, we may provide various corrective coefficients that take into account the number of daily working hours of the equipment (service factors), the environment conditions and the speed for different roller diameters.

The load values obtained in this way may then be compared to the indicated roller load from the catalogue, valid for a project life of 30,000 hours.

For a theoretically different life, the load capacity may be multiplied by the determined coefficient from **Tab.22** that corresponds to the required life.



Principal operating factors:

lv	= belt load	t/h
v	= belt speed	m/s
a_o	= pitch of carrying trough set	m
a_u	= pitch of return set	m
q_b	= weight of belt per linear metre	Kg/m
F_p	= participating factor of the highest stressed roller see Tab.17 (depends on the side angle of the roller in transom)	
F_d	= shock factor see Tab.20 (depends on lump size of material)	
F_s	= service factor see Tab.18	
F_m	= ambient factor see Tab.19	
F_v	= speed factor see Tab.21	

Tab. 17 - Participation factor F_p - loaded rate on the most loaded roller

0°	20°	20°	30°	35°	45°	$30^\circ-45^\circ$	60°
1.00	0.50	0.60	0.65	0.67	0.72	- 0.52 - 0.60	0.47
						Shorter central roller	5 rollers garland

Tab. 18 - Service factors

Working life	Fs
Less than 6 hours per day	0.8
From 6 to 9 hours per day	1.0
From 10 to 16 hours per day	1.1
Over 16 hours per day	1.2

Tab. 19 - Environmental factors

Conditions	Fm
Clean and with regular maintenance	0.9
Presence of abrasive or corrosive materials	1.0
Presence of very abrasive or very corrosive materials	1.1

Tab. 20 - Shock factor Fd

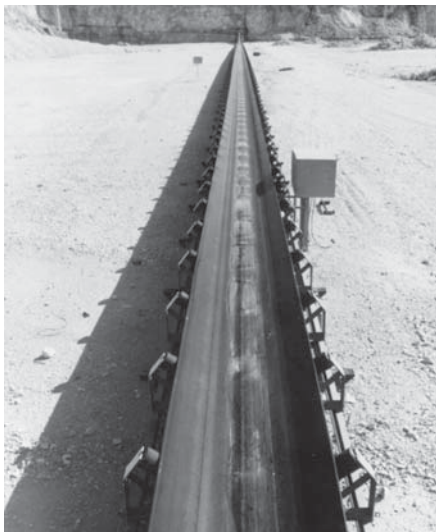
Lump size	Belt speed m/s						
	2	2.5	3	3.5	4	5	6
0 ÷ 100 mm	1	1	1	1	1	1	1
100 ÷ 150 mm 1.18	1.02	1.03	1.05	1.07	1.09	1.13	
150 ÷ 300 mm with layers of fine material	1.04	1.06	1.09	1.12	1.16	1.24	1.33
150 ÷ 300 mm without layers of fine material	1.06	1.09	1.12	1.16	1.21	1.35	1.50
300 ÷ 450 mm	1.20	1.32	1.50	1.70	1.90	2.30	2.80

Tab. 21 - Speed factors Fv

Belt speed m/s	Roller diameter mm						
	60	76	89-90	102	108-110	133-140	159
0.5	0.81	0.80	0.80	0.80	0.80	0.80	0.80
1.0	0.92	0.87	0.85	0.83	0.82	0.80	0.80
1.5	0.99	0.99	0.92	0.89	0.88	0.85	0.82
2.0	1.05	1.00	0.96	0.95	0.94	0.90	0.86
2.5			1.01	0.98	0.97	0.93	0.91
3.0			1.05	1.03	1.01	0.96	0.92
3.5					1.04	1.00	0.96
4.0					1.07	1.03	0.99
4.5					1.14	1.05	1.02
5.0					1.17	1.08	1.00

Tab. 22 - Coefficient of theoretical bearing life

Project theoretical working life of bearings	10'000	20'000	30'000	40'000	50'000	100'000
Coefficient based on 30'000 hours	1.440	1.145	1.000	0.909	0.843	0.670
Coefficient based on 10'000 hours	1	0.79	0.69	0.63	---	---



2 Rollers



Load determination

Having defined the diameter of the roller in relation to the speed and therefore the number of revolutions, one may now proceed to determine the static load Ca on the carrying troughing set, using the following formula:

$$Ca = a_0 \times \left(q_b + \frac{lv}{3.6 \times v} \right) 0,981 \quad [\text{daN}]$$

Multiplying them using the operating factors we have the dynamic load Ca_1 on the transom:

$$Ca_1 = Ca \times F_d \times F_s \times F_m \quad [\text{daN}]$$

Multiplying them by the participation factors one obtains the load ca on the highest stressed roller (central roller in the case of troughing set with rollers of equal length).

$$ca = Ca_1 \times F_p \quad [\text{daN}]$$

The static load on the return set, Cr (not needing to take account of the material weight) is determined from the following formula:

$$Cr = a_u \times q_b \times 0,981 \quad [\text{daN}]$$

The dynamic load on the return set will be:

$$Cr_1 = Cr \times F_s \times F_m \times F_v \quad [\text{daN}]$$

and the load on the single return roller or on a pair will be:

$$cr = Cr_1 \times F_p \quad [\text{daN}]$$

Having established the values of “ ca ” and “ cr ” one may find in the roller catalogue (the diameter being found first) the roller that provides a sufficient load capacity.



Example:

One wishes to select a troughing set and rollers for a belt conveyor to convey crushed limestone, with a load requirement $Q = 2000$ t/h at a speed $v = 2$ m/s and with the following additional data:

lump size	100-150 mm
working function	8 h for day
belt width	1200 mm
belt weight	16 Kg/m
carrying transom pitch	1 m
return set pitch	3 m
roller diameter	133 mm

Choosing a transom at 30° satisfies the load requirements on the 1200 mm belt. The static load on the carrying trough set is given by:

$$Ca = a_o \times \left(q_b + \frac{l_v}{3.6 \times v} \right) 0,981 \text{ [daN]}$$

$$Ca = 1 \times \left(16 + \frac{2000}{3.6 \times 2} \right) 0,981 = 288 \text{ daN}$$

The dynamic load will be:

$$Ca_1 = Ca \times Fs \times Fd \times Fm \text{ [daN]}$$

$$Ca_1 = 288 \times 1 \times 1.02 \times 1 = 294$$

On the central roller of the troughing set we have a load:

$$ca = Ca_1 \times Fp \text{ [daN]}$$

$$ca = 294 \times 0.65 = 191 \text{ daN}$$

On the return set the static load is given by:

$$Cr = a_u \times q_b \times 0,981 \text{ [daN]}$$

$$Cr = 3 \times 16 \times 0,981 = 47 \text{ daN}$$

The dynamic load will be:

$$Cr_1 = Cr \times Fs \times Fm \times Fv \text{ [daN]}$$

$$Cr_1 = 47 \times 1 \times 1 \times 0.9 = 42,3 \text{ daN}$$

therefore the roller load will be:

$$cr = Cr_1 \times Fp \text{ [daN]}$$

$$cr = 42.3 \times 1 = 42.3$$

where:

$$Fp = 1 \text{ see Tab. 16}$$

For each type of application, in an environment with the presence of dust and water, one should choose from the series PSV for which the load is equal to or immediately higher than the calculated value (for a carrying trough set).

Analysing the load tables of rollers $\varnothing 133$, one may choose the type PSV2, with a sufficient load capacity: PSV/2-FHD, 25F18, 133N, 473 (Chapter 2).

To select the transom for these rollers, reference is made to the chapter in the catalogue on troughing sets, and tipe A3P is selected (Chapter 3.3.3)

For the return roller, we select it with rubber rings, so that the formation of scale on the belt or the roller itself is discouraged.

We therefore select the series PSV with rings that have sufficient load capacity. The basic roller will be $\varnothing 89$ with rings $\varnothing_e 133$ and the ordering code is PSV/1-FHD, 20F14, 133NL, 1408 (see section 2.6.2).

As frames for these rollers we should utilise the type: R1P (see chapter 3.3.3).

In the case where the conveyor is very long (let us say over 300 m) we advise the choice of a double roller "V" return set that helps the belt to self-centralise. In this case we may select rollers type PSV/1-FHD, 20F14, 133NC, 708.

The frames for these return rollers as a "V" will be type R2S (see chapter 3.3.4).