Ammeraal Beltech

EN

Technical Manual

AMMdrive Positive Drive Belting

Innovation and Service in Belting

Table of Contents

1 Introduction 3

2 Material properties 4

3 Ordering belts, fabrication possibilities 5

4 Basic conveyor design 6

4.1 Drive lug configuration 7

4.2 Custom made lug configurations 8

4.3 Belt tensioning / take-up 9

4.4 Sprockets and support pulleys 10

4.5 Drum motors 12

4.6 Slider strips 13

4.7 Scrapers 16

4.8 Return part of the belt 17

4.9 Thermal expansion 18

4.10 Friction coefficients 19

5 Design guidelines for special conveyor types 20

5.1 Flexing and back flexing diameters 20

5.2 Inclined conveyors 20

5.3 Swan neck conveyors 21

5.4 Trough conveyors 22

5.5 Bi-directional conveyors – omega drives 22

6 Existing conveyor retrofit to AMMdrive PRO (mini) 23

6.1 From modular belts 23

6.2 From synthetic belting and flat slider bed conveyor 23

7 Belt calculation 24

7.1 Belt properties – allowable load 24

7.2 Belt loads on horizontal conveyors 25

7.3 Belt loads on inclined conveyors 26

7.4 Belt loads on swan neck conveyors 26

7.5 Dimensioning of the motor and shaft 27

7.6 Definitions 27

8 Tables 28

8.1 AMMdrive Specifications 28

8.2 Properties Sprocket 29

8.3 Others 32

1 Introduction

AMMdrive belts are synthetic thermoplastic belts. These belts have a top and bottom cover and sealed edges. The encapsulated belt are therefore hygienic and easy to clean. AMMdrive is used in a wide variety of applications in almost every industry.

AMMdrive is positively driven by the Soliflex PRO lug technology and offers ultimate tracking and a lower total cost of ownership. Conveyors equipped with AMMdrive are more cost efficient to build, provide ultimate tracking and require less installation time and maintenance

AMMdrive belts are available in various thicknesses and in various materials:
PVC (Polyvinyl Chloride) TPU (Polyurethane) and TPE (Polyester).

This manual covers the selection of AMMdrive belts. It helps to select the right AMMdrive belt for the job and assists in the design and layout of conveyor systems.

A calculation program is available to calculate the right configuration for your application. All technical data is available in chapter 8 Tables.

If your question is not mentioned here, or if you need more detailed information about splicing, overview of accessories, technical drawings etc. please contact your local Ammeraal Beltech representative.

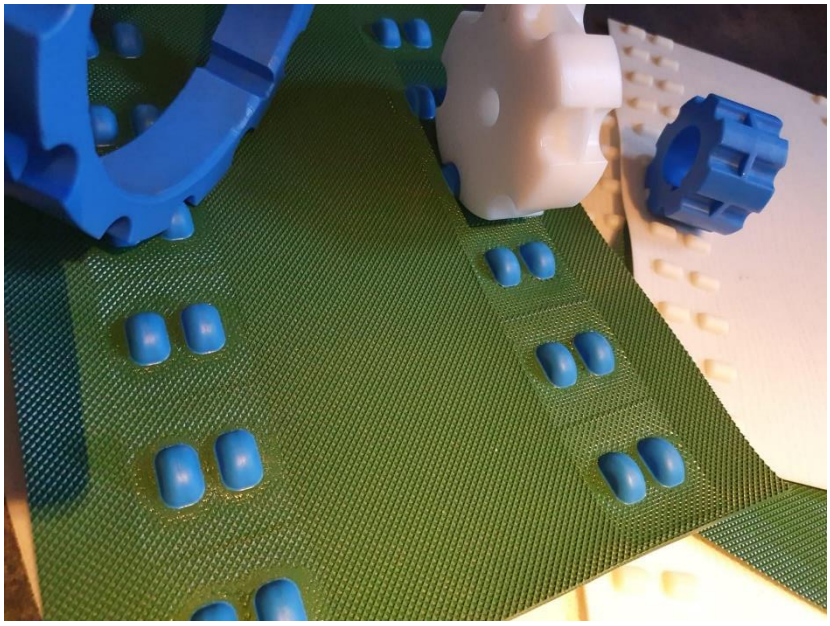
2 Material properties

AMMdrive belts are synthetic and thermoplastic. They can simply be cut, spliced and fabricated to customer needs. The accessories are "welded on" in specialized workshops. AMMdrive belts are available in PVC, TPU or TPE material, each with specific advantages. See the table for benefits and limitations of the materials to assist in choosing the right material for the application. More information is provided Table 1

AMMdrive PVC (V and VN)
The AMMdrive PVC are available in two grades. The PVC "V" grade has a monomeric plasticizer, is good chemical resistant, limited suitable for oil/fat and has a large range of hardnesses. The PVC "VN" grade has a polymeric plasticizer, is limited chemical resistant, good resistance to oil/fat and has a limited number of hard types due to viscosity.

AMMdrive TPU belts are very resistant to oils and fats. They are available in 85 shore A and 93 shore A and have a high abrasion resistance and will hardly show any wear. TPU 85 shore A is very flexible and used on smaller pulleys. Compared with V and TPE belts TPU belts have a limited chemical resistance are sensitive to chlorine based cleaning agents (when in doubt, consult the AMMdrive cleaning instructions).

AMMdrive TPE belts have a good chemical and low temperature resistance. In freezing applications up to -20°C TPE is the preferred solution. The material is strong and durable and suitable for plastic and steel slider strips. AMMdrive TPE is also suitable for high temperatures up to 110°C. It offers excellent non-stick properties ideal for the bakery and confectionary industry.

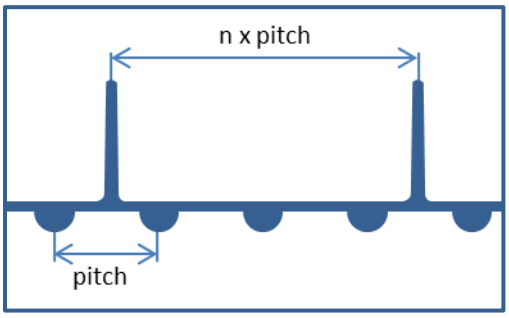


3 Ordering belts, fabrication possibilities

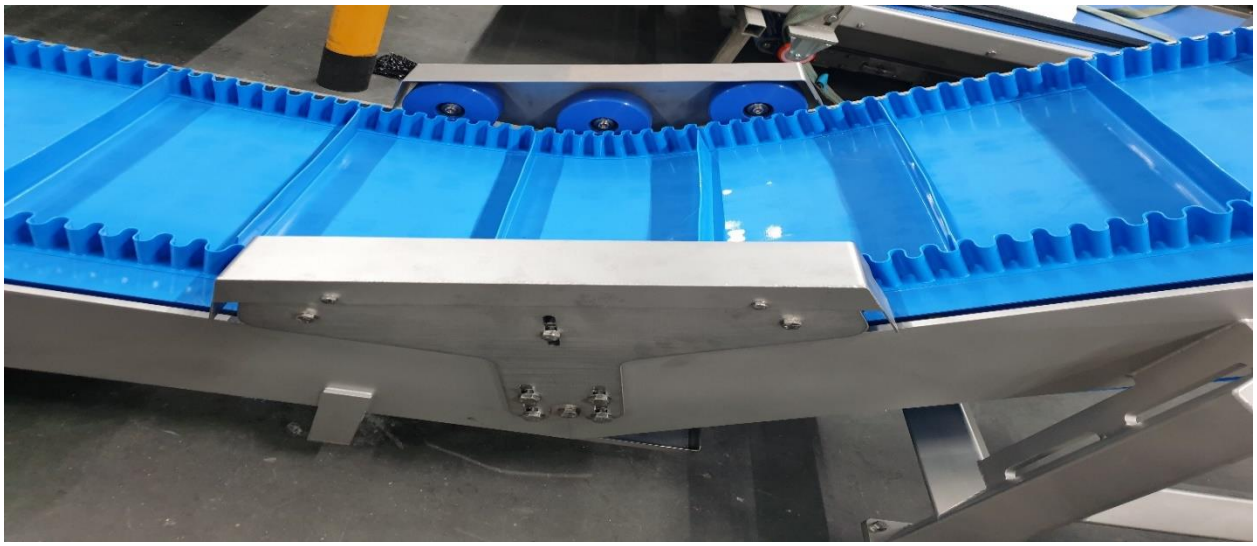
Endlessed AMMdrive belts can be supplied in widths up to 2000 mm. The practical minimum width for an AMMdrive mini belt is 50 mm.

For splicing on site up to widths of 1200 mm specially designed Soliflex Maestro splicing equipment is available. For AMMdrive PRO (mini) belts wider than 1200 mm contact your local Ammeraal Beltech representative for splicing instructions and information about the available splicing equipment.

The length of a belt must always be a whole number times the pitch of the drive lugs (= 51 mm or 25.5 mm for mini). Calculate the ordering length by measuring the belt length and round it to match a total length of *n* x 25.5 or 51 mm (where *n* = 1, 2, 3, etc.).



AMMdrive belts can be supplied spliced or open ended, with cleats, Bordoflex, punched holes, mechanical fasteners, guides and/or ropes. Notice that the distance between cleats should also match *n* times the pitch of 25.5 or 51 mm. The accessories program is continuously updated: contact your local Ammeraal Beltech representative for an overview of fabrication possibilities.

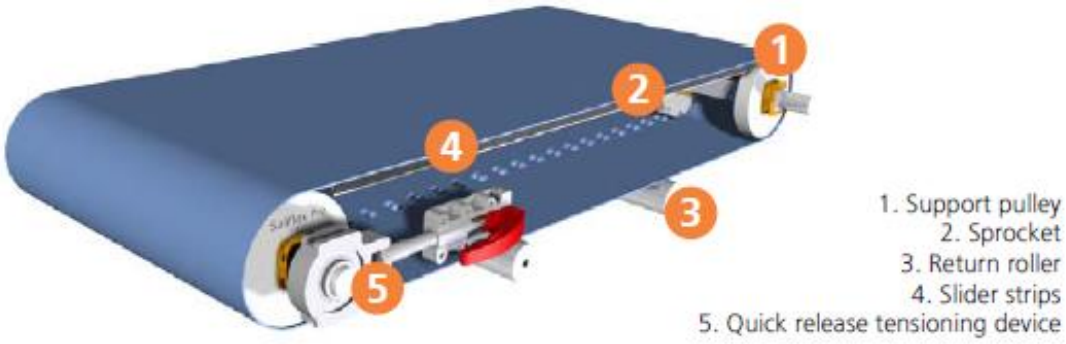


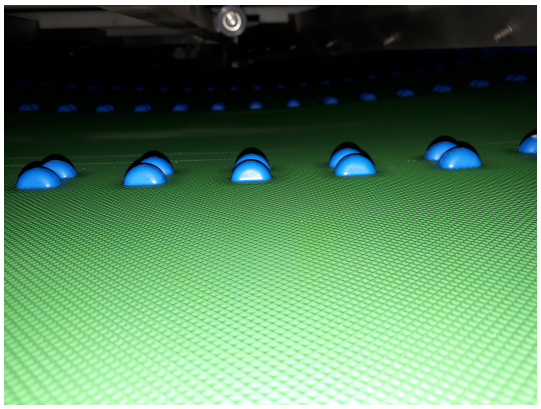
4 Basic conveyor design

To get the full benefits of AMMdrive positive driven belts, special attention should be given to the conveyor design. This chapter gives guidelines and design considerations for the lay-out of scrapers, slider beds, tensioning devices, etc. Belt calculation is covered in chapter 7.

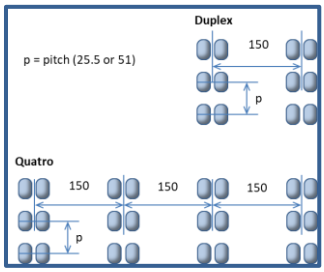
AMMdrive belts are tested at conveyor speeds up to 1 m/s. Higher speeds are possible after consultation with your local Ammeraal Beltech representative.

A typical conveyor layout for an AMMdrive belt would look like this:





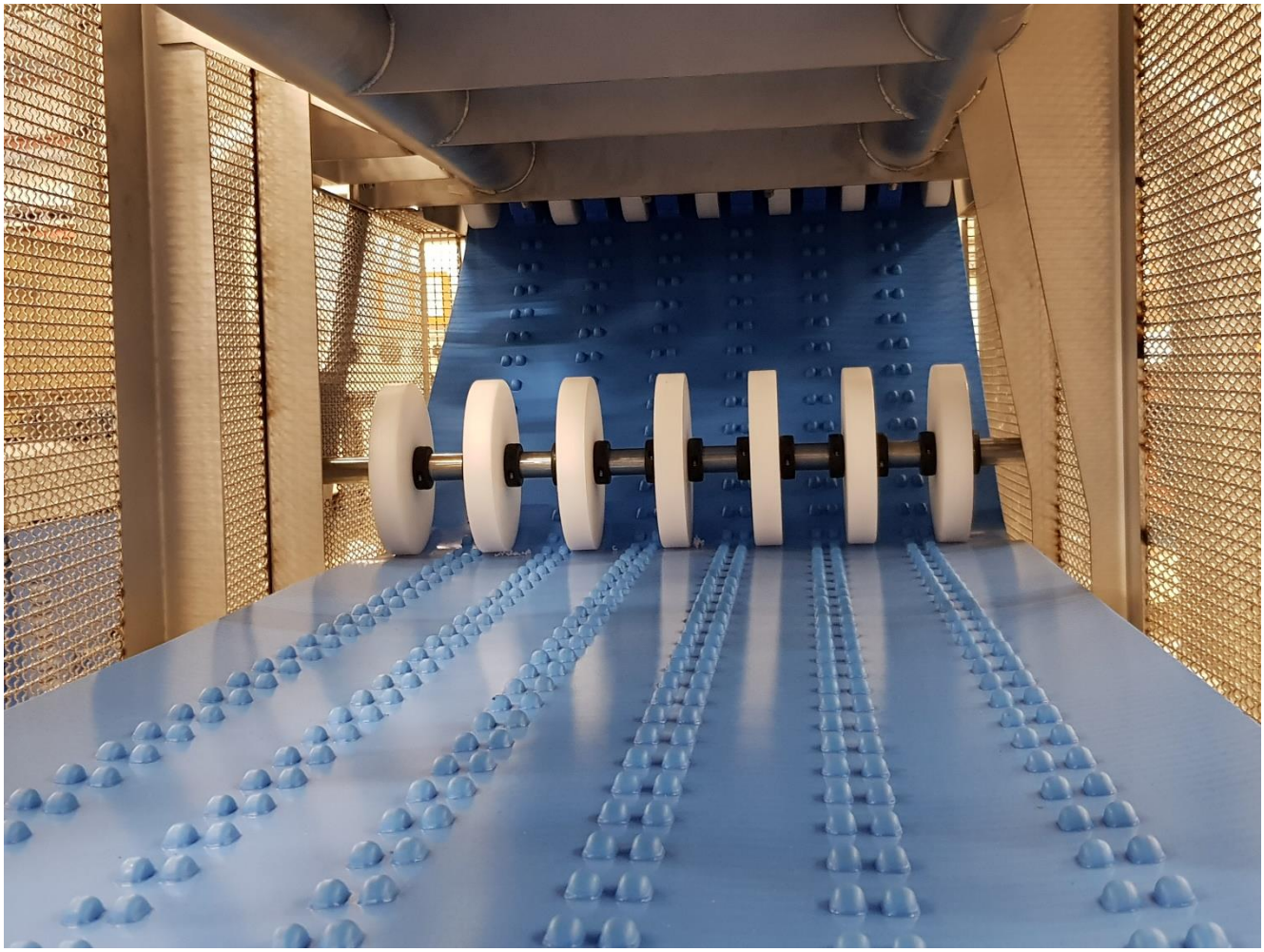
4.1 Drive lug configuration



AMMdrive PRO (mini) ***Duplex*** *- 2 rows of drive lugs*
The advice for most applications is AMMdrive PRO (mini) Duplex with 2 rows of drive lugs. Pitch of the AMMdrive lugs is 51 mm and for the AMMdrive mini 25.5 mm; center-to-center distance between the rows is 150 mm. Drive lugs are always positioned in the center of the belt. Other configurations are possible on request.

AMMdrive PRO (mini) ***Quattro*** *- 4 rows of drive lugs*
This AMMdrive PRO (mini) Quattro configuration is to be used for wider belts in combination with high loads. Using 4 rows spreads the transmitted force across the belt width, enabling a smooth operation.

AMMdrive PRO (mini) ***Sextet*** *- 6 rows of drive lugs*
This AMMdrive PRO (mini) Sextet configuration is to be used for wider belts in combination with high loads or for better tracking. Using 6 rows spreads the transmitted force across the belt width, enabling a smooth operation.



4.2 Custom made lug configurations

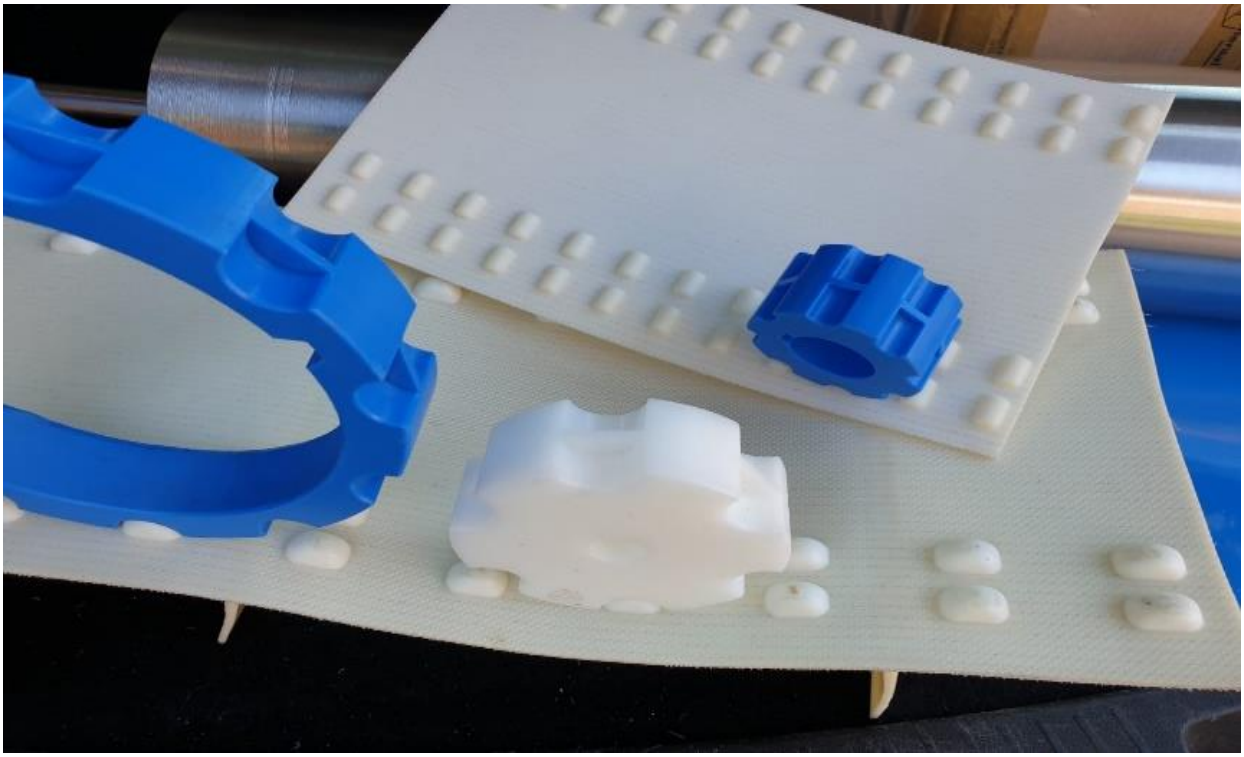
For example in case of a retro-fit, a standard configuration doesn't always fulfill the needs of the customer. In those cases it is needed to place the lugs at another center to center distance than 150 mm. This possibility to change the center to center distance is available for AMMdrive.

The center to center distance of the lug rows can be changed in steps of 25 mm while the minimum distance between two lugs rows is 50 mm. The maximum distance of the two lug rows in a Duplex configuration is 750 mm and the maximum belt width is 800 mm. The maximum distance between the two outer lug rows in a Quattro or Sextet configuration is 1200 mm. The maximum belt width is 2000mm.

The minimum distance from the edges of the belt and the center of the outer lug rows is 25 mm.

Figure 1 Example of custom made configuration

In all cases the configuration needs to be symmetrical over the belt width.



4.3 Belt tensioning / take-up

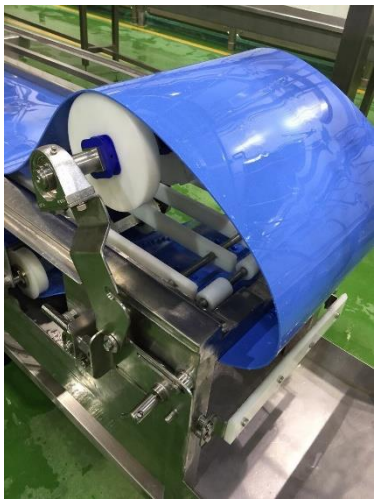
To operate an efficient AMMdrive conveyor, the tension should be ≤ 0.1%. A higher level of pretension will reduce the allowable loading of the belt.

The maximum allowable elongation at full load for an AMMdrive belt is 0.6% and in special cases up to 1.0%. At a higher elongation, the pitch of the drive lugs will no longer fit the sprockets. Your Ammeraal Beltech local representative can support you with the necessary design requirements.

A retractable pulley design is the preferred solution for quick removal and installation of the belt (e.g. for cleaning purposes). Another option is to use a quick release tensioning device. This enables easy belt removal for cleaning and/or maintenance.

4.3.1 How to tension the belt?

In general for most applications apply 0.1% tension by measuring a 1000 mm mark on both sides of the belt and tension until these become 1001 mm. Let the belt run for a short while and recheck the elongation.



4.3.2 Layout of drive and tail shaft

For optimal performance both the drive and tail shaft should have *both* sprockets *and* pulleys. For the return shaft this ensures a rotating shaft at all times, therefore eliminating the chance of slippage and thus reducing wear on sprockets and belt.

Depending on the actual situation (width, usage of scrapers, products to be transported etc.) it might be beneficial to fill out the complete shaft with sprockets and support pulleys. The maximum center to center distance between sprockets and/or pulleys is 150 mm.

4.4 Sprockets and support pulleys

AMMdrive makes use of the Soliflex PRO lug technology and also uses the Soliflex sprockets and support pulley system. These are available for both round and square shafts. All sprockets and support rollers are made from solid food grade HDPE, with FDA and EU approvals.

- Round bore 20, 25, 30, 40 and 50 mm; all with DIN keyway.
- Square bore 40 and mm; other types on request.
- Pilot bore PRO 15mm and PRO mini 6 mm; can be machined by customer

Soliflex sprockets and support rollers can be supplied in split versions (with a puzzle piece fit) for easy assembly on existing conveyors. Special sprockets versions are: self-cleaning or de-icing (where ice can be an issue). See also Table 5

Please note that the sprockets and support rollers are 30 mm wide and the PRO mini 35mm wide. The lugs rows are 1-2 mm wider than the sprockets and rollers. See also the drawings below.

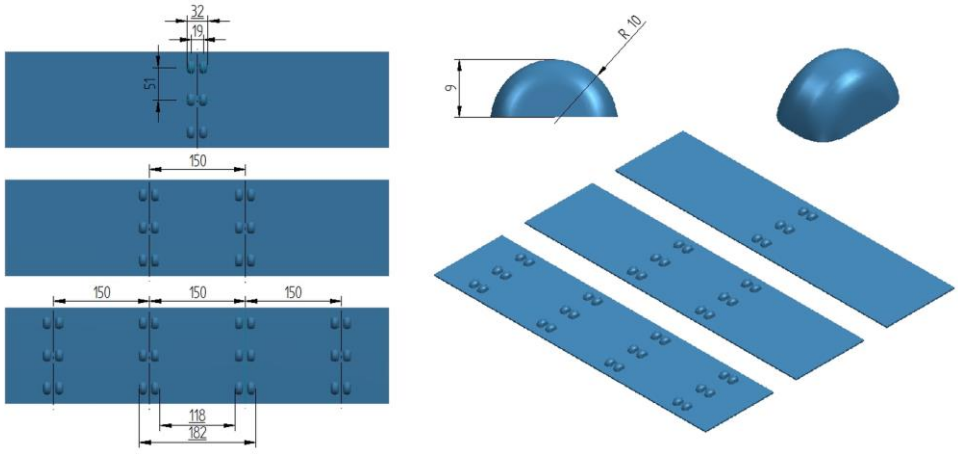


Figure 2 AMMdrive Lug Configurations and distances

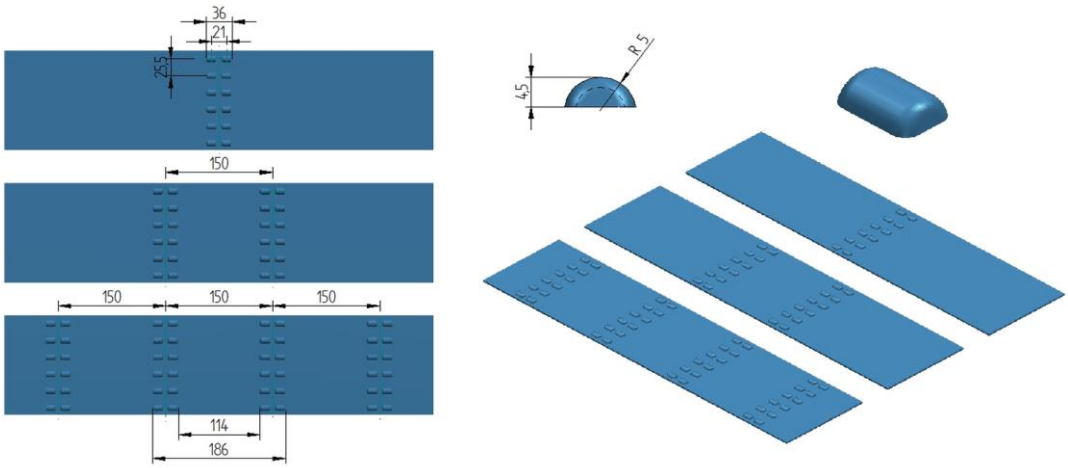


Figure 3 AMMdrive mini Configurations and distances

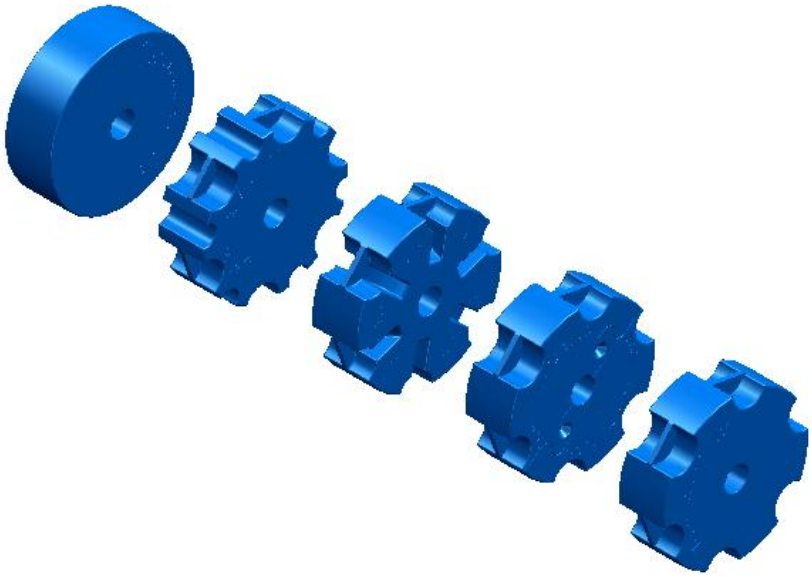


Figure 4 Soliflex Sprockets Variations

4.4.1 Mounting sprockets and support rollers to the shaft

- Both square and round bore sprockets and support rollers can be fixed in axial direction with retainer rings.
- Fixate one sprocket axial and give the other sprockets on the shaft some 2 mm play in axial direction to compensate for thermal expansion.
- Round bore sprockets and support rollers can be fitted with DIN keyways.
- To align the sprockets make sure that the engraved logos are all pointing in the same direction.

The minimum sprocket diameters for a belt type are valid for a flat belt. For a belt with ropes, guides or Bordoflex the minimum allowable sprocket diameter should be increased; see the chapter 5 with design tips for special conveyors possibilities.

4.5 Drum motors

For drum motors, Interroll developed a special Soliflex drum motor in 4 sizes:

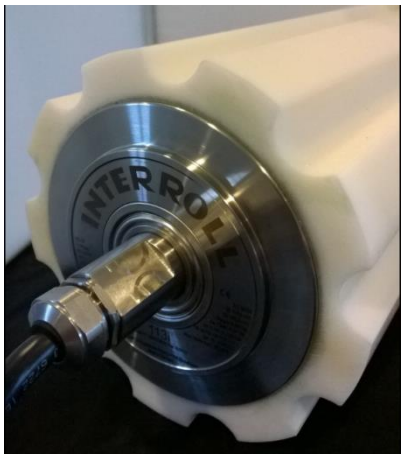


Figure 5 Interroll Drum Motor with Soliflex PRO technology Lagging

Interroll DM0080 with a Soliflex PRO Z7 lagging TPU 82 shore D

Interroll DM0113 with a Soliflex PRO Z9 lagging TPU 82 shore D

Interroll DM0138 with a Soliflex PRO Z10 lagging TPU 82 shore D

Interroll DM0165 with a Soliflex PRO Z12 lagging TPU 82 shore D

NOTE Drum motors do not offer the steering properties

We advise to contact your local Interroll representative for AMMdrive mini. There is not yet a special drum motor for the AMMdrive mini, but a sprocket sleeves is available. This sleeve can be placed over the Interroll drum motor DM0080 by means of a 6x6mm keyway.

The sleeves have a Z14 profile and are 112.2 mm in diameter. The maximum with is 250 mm. For wider drum motors multiple sleeves can be combined.

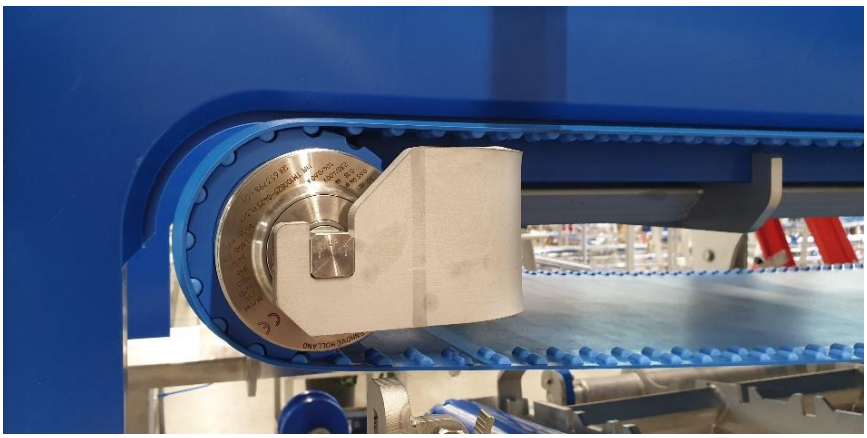
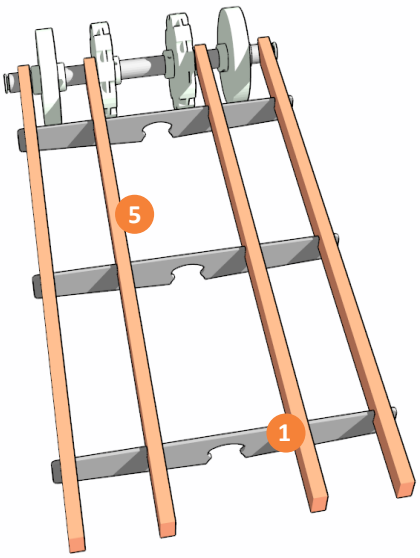


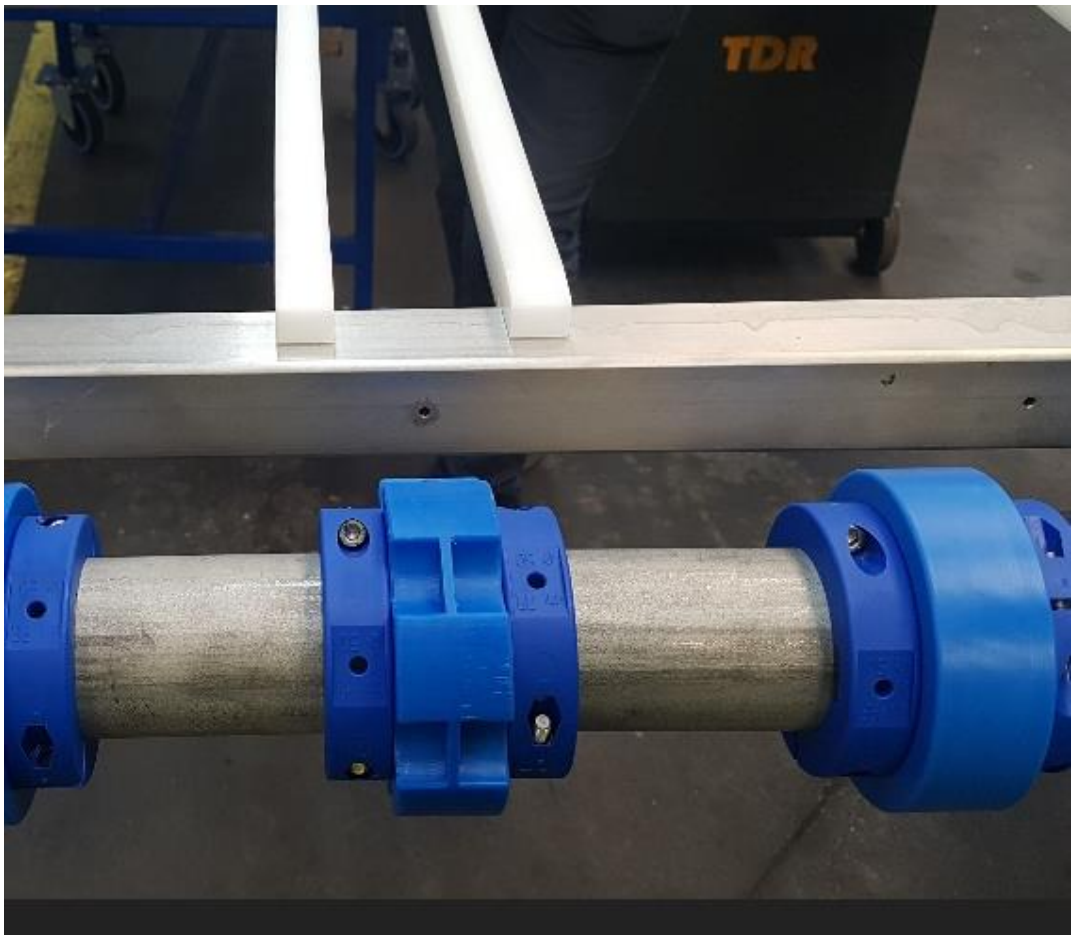
Figure 6 AMMdrive mini Z14 sleeve for Interroll DM0080



4.6 Slider strips

The unique lug design in combination with the guide strips ensure superior and 100% trouble free tracking.

A conveyor with slider strips is the preferred solution for AMMdrive PRO (mini). Use HDPE or UHMWPE slider strips to minimize the friction. The slider strips should be mounted close to the sprockets and pulleys. Allow some room to accommodate for possible thermal expansion (see page 18). Make sure that the height of the slider strips is not higher than the upper face of the pulleys. Stainless steel strips or round bars are possible; use the same configuration as for HDPE strips. Recommended stainless steel type is 316(L), stainless steel type 304 gives blackening on the belt. Make sure all edges are smooth. Be aware that in moist conditions TPU belts may 'stick' to steel sliders, apply TPU with diamond profile or TPE in those cases.

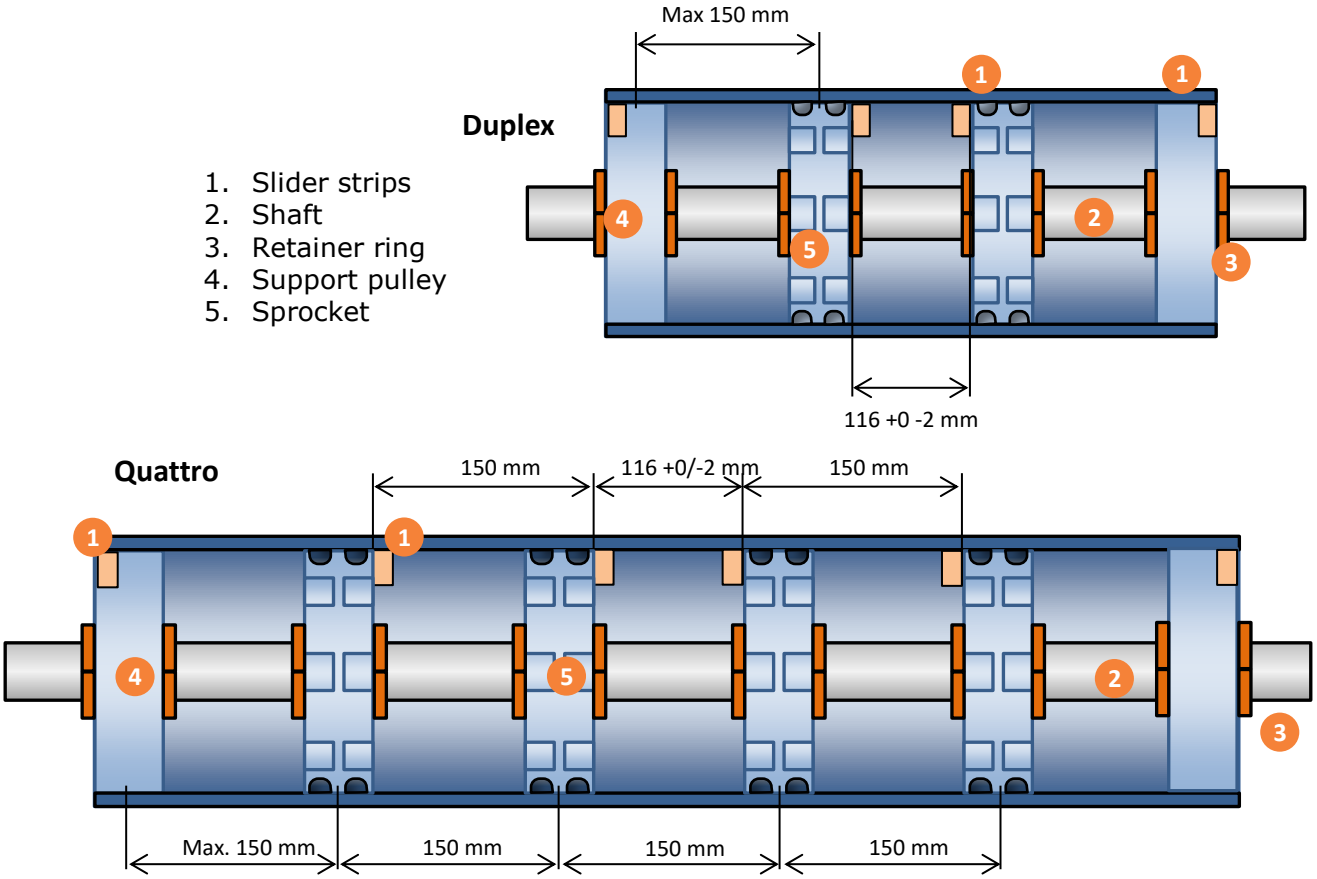


4.6.1 Positioning of slider strips AMMdrive PRO

How to calculate ……?

This is example of a standard configuration. Non-standard configurations can be calculated by the AMMdrive calculation program.

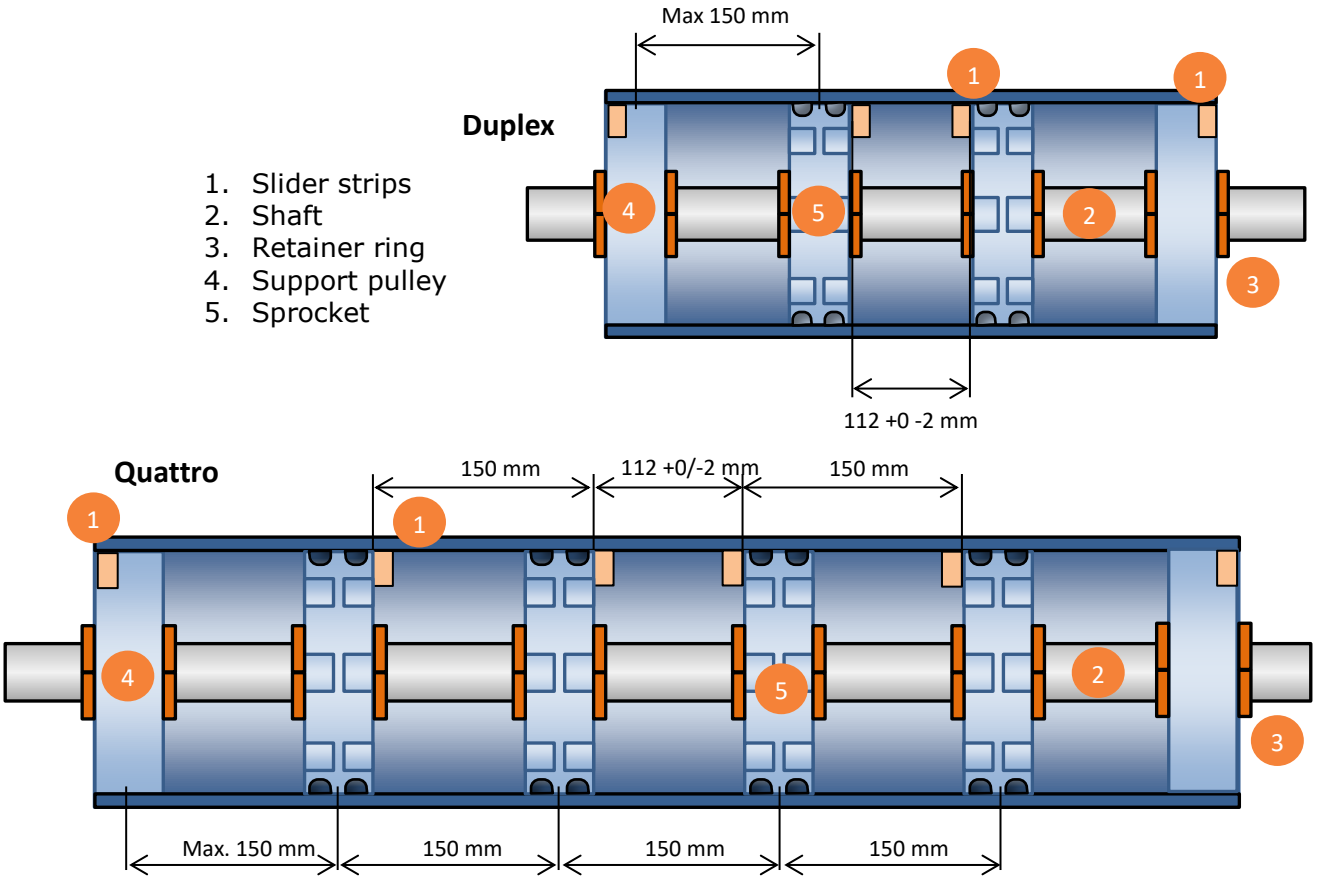
1. Slider strips
2. Shaft
3. Retainer ring
4. Support pulley
5. Sprocket



The slider strips should be used to guide/track the drive lugs in the running direction. Allow space between the slider strips and lugs.

Strip position	Distance between 2 strips
Outside lugs	185 mm +2 -0 mm
Inside lugs	116 mm +0 -2 mm

4.6.2 Positioning of slider strips AMMdrive PRO mini

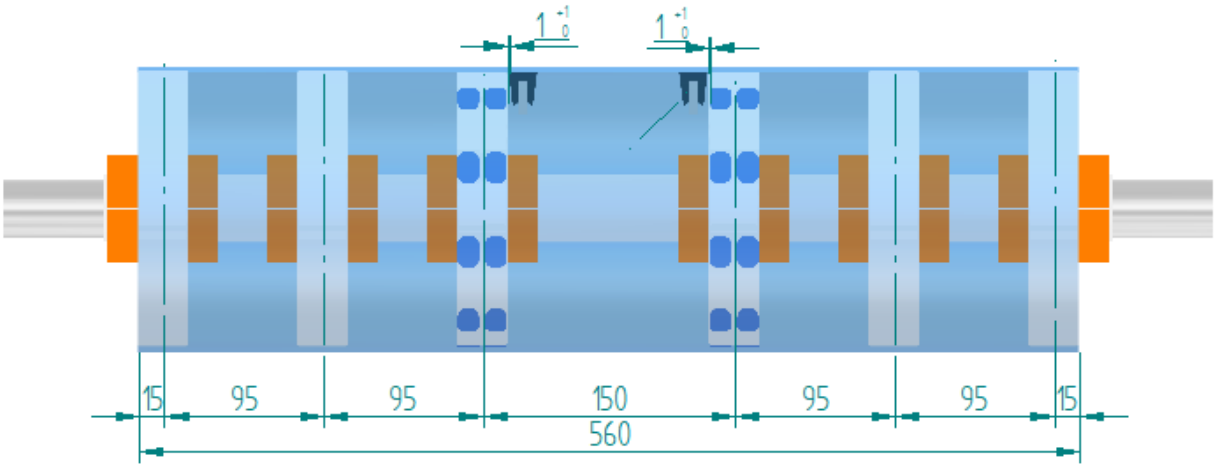


The slider strips should be used to guide/track the drive lugs in the running direction:

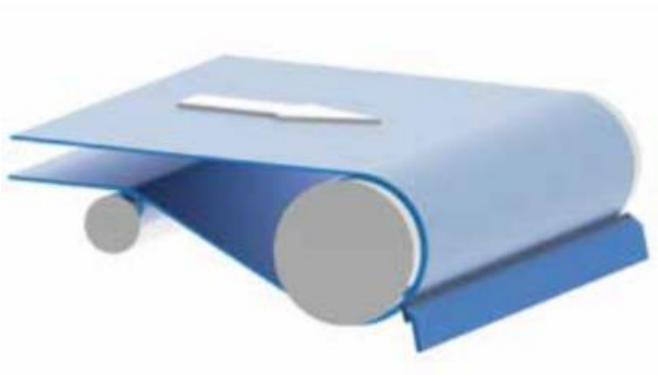
Strip position	Distance between 2 strips
Outside lugs	189 mm +2 -0 mm
Inside lugs	112 mm +0 -2 mm

4.6.3 Example positioning.

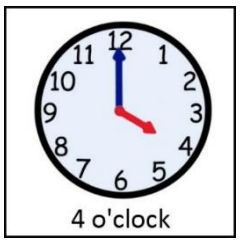
In the example below we see an AMMdrive belt of 560 mm wide. The sprockets are 150 mm center-to-center apart from each other. Two support rollers are at the edge of the belt. The center-to-center distance between the sprockets and the support rollers is now 190 mm. This is more than 150 mm and therefore extra support rollers are placed in the middle at a center-to-center distance of 95 mm (1/2 x 190 mm).



4.7 Scrapers

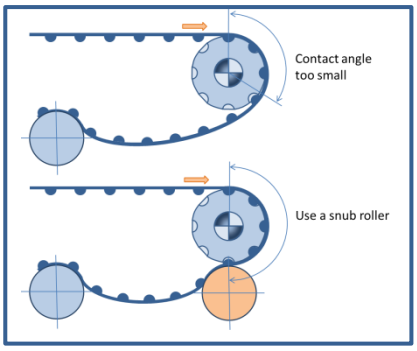


Ultra-Scrapers can be used to ensure proper cleaning of the belt. As the belt runs with very low tension the position of the scraper is critical.



To release the product from the belt; Position the scraper on the sprocket at 2/3 of the wrap of the belt on the sprocket. (Four o'clock position). For cleaning the belt the scraper has to be placed just after the wrap, so just after the 6 o'clock position. When a scraper is used 0.1% pretension has to be applied.

4.8 Return part of the belt

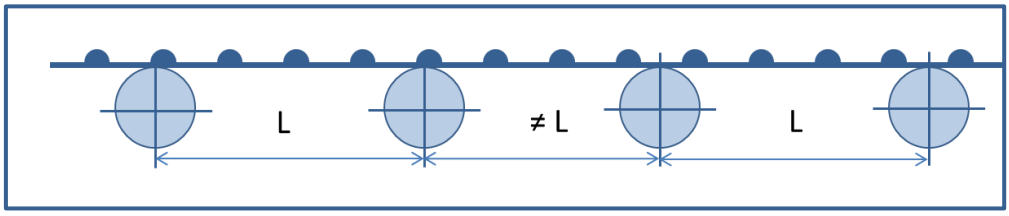


The belt in the return part will hardly have any stress. On a heavily loaded belt large catenary sag could form. In some cases this may become so big that the belt no longer has a sufficient wrapping angle on the drive sprocket. Use of pretension of 0.1% and a snub roller can be used just after the drive shaft. The snub roller must have the same width as the belt and a min. diameter of 50 mm. Position the snub roller just below or after the heart of the drive shaft and leave some room for the belt so that it is not pinched off.

Support pulleys or rollers in the return part should be positioned every 2 meters. To prevent resonance of the belt in the return part, this distance should be slightly varied as shown in the drawing. The diameter of these supports is minimum 50 mm.

Alternatively slider strips can be used to support the belt in the return part. This can be especially advantageous on inclined conveyors. Do not use these over the complete length of the conveyor; allow space for the catenary belt sag near the drive shaft. Slider strips can leave marks on the surface of the belt.

An AMMdrive belt can have a monofilament fabric or multifilament fabric. When possible use monofilament for the wider conveyors with cleats and Bordoflex. A belt with cleats is normally not supported on the cleats. However the cleats add lateral stability together with the monofilament fabric. When a belt with cleats is wider than 800 mm extra support is needed. This can be achieved by dividing the cleat into two sections and leaving an indent of minimum of 50 mm in the middle. A support roller has to be placed in this free section to support the belt.



4.9 Thermal expansion

NOTICE *Be aware of the thermal expansion coefficient of the material.*

4.9.1 Thermal expansion / contraction

In applications where operating temperatures are different from ambient temperatures (20°C), linear expansion of the belt length and width will occur. In lateral direction the absolute expansion or contraction is relatively small and no special actions are necessary. In longitudinal direction the following will occur:

Operating temperatures higher than ambient temperatures: ***Expansion***

- Belt tension will reduce and at a certain point the pitch of the belt will no longer match the pitch of the sprockets. This will happen at about 50°C belt temperature. For belts operating at 50°C or more special precautions should be taken (e.g. using sprockets with larger pitch). Contact your local Ammeraal Beltech representative for special solutions.
- Example: belt is installed, spliced and pre-tensioned at 22°C and is then moved to an environment operating at 62°C. Temperature difference = 40°C, the belt will elongate 40 x 0.17 = 6.8 mm/m or 0.68%. In this example the belt needs to be stretched before starting!

Each material is characterized by its own coefficient of linear thermal expansion. Changes in the belt length can be calculated as follows:

$\Delta L = L \times \alpha \times \Delta T$	α	=	linear thermal expansion coefficient
	L	=	belt length nominal in m
	ΔL	=	thermal expansion / contraction
	ΔT	=	temperature difference

4.10 Friction coefficients

Friction is a very important belt feature. In most cases a low friction between belt and slider bed/strips is preferred, this reduces the drag forces and thus the elongation in the belt and necessary power to drive it. The coefficients of friction of AMMdrive PRO (mini) belts to slider materials in common conditions can be found in Table 8:

Values mentioned in this manual and used in our AMMdrive calculation program are based on clean environmental circumstances. Application circumstances can influence the friction both negative as positive. For example flower in bakeries create higher friction and fluids in meat factories cause lower friction.

The friction between TPU and stainless steel is quite high and this is not the preferred combination. When using AMMdrive PRO (mini) on existing installations with steel sliders the advice is to use a PVC or TPE belt with A18 profile. When TPU is required use preferably HDPE strips.

Electrostatic load can occur due to high friction. For example in **high speeds logistic applications**. The electrostatic charge depends on: specific material resistance, environment (dry or humid), speed, possible belt tension, belt width and pulley surfaces. Anti-static fabrics or metal rollers in-between the slider strips are possible methods to discharging an AMMdrive belt. Contact your local Ammeraal Beltech representative for detailed advice

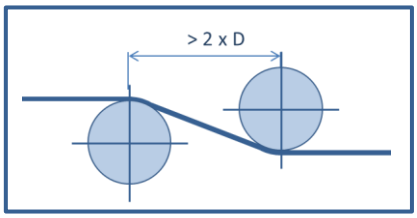
The smooth topside of the belt improves hygiene but limits the angle of inclination (±15°). In case a higher angle of inclination is needed cleats can be applied.

5 Design guidelines for special conveyor types

In most applications a straight standard conveyor does the job, sometimes special designs are needed. This chapter gives some design guidelines for a number of special conveyor types.

5.1 Flexing and back flexing diameters

The allowed minimum flexing diameters for AMMdrive PRO (mini) are depending on material and belt thickness. These values can be found in paragraph 8.1 and on the belt data sheet. If flex and back flex sprockets are close to each other, there should be at least a diameter distance in between. See also the chapter on omega drives.



Example: Scanner belt applications where flex and back flex rollers are close. The return part of the belt needs to be brought upward to accommodate for the relatively small opening through the scanner. Make sure that the centers of the rollers are at least two flex diameters apart.

Accessories can be used on AMMdrive belts. A limited number of accessories are possible on AMMdrive mini when used on small diameter sprockets, an overview is shown in Table 6 for cleats and Table 7 for bordoflex

5.2 Inclined conveyors

Inclined conveyors are used to overcome height differences. The angle of inclination is limited by the friction between the transported goods and the belt. For most bulk goods the angle of inclination should be less than 15°, use cleats otherwise. The friction for piece goods should be tested.

Make sure that the drive drum is always on the topside of the conveyor. This is also important for declining conveyors.

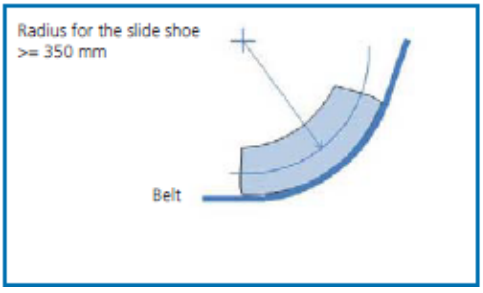
5.3 Swan neck conveyors

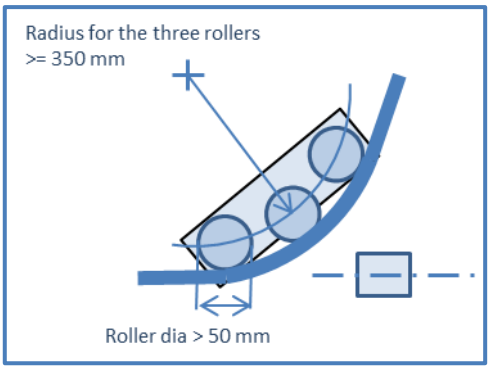
Swan neck conveyors are often used to transport bulk goods or small products coming from a hopper to a higher level. Swan neck conveyors only need a relatively small floor space. Inclination angles start at 30° and go up to 75°. In these conveyor types the belt width must be chosen carefully. Safe values normally recommended for homogeneous belts go up to a width op 500 mm. The special design of AMMdrive belts allows safe values up to 1000 mm. However even wider belts have been designed and are in use.

Design of the belt; the lug rows have to be placed as far as possible to the edge of the belt to lower the upward force in the middle of the bend area. Contact your local Ammeraal Beltech representative for detailed advice.

Give special attention to the design of the bends:

- The radius in these bends should be min. 350 mm. For slow moving conveyors (up to 0.2 m/s) slider shoes made from HDPE or UHMWPE can be used. A small outward pointing groove in the sole of the shoe can help to prevent dirt building up here.
- Use roller sets in the bends for conveyors running at higher speed. The effective width of shoes or rollers should be 50 mm. The space between shoe or roller and Bordoflex should be at least 10 mm.
- Looking from the width of the belt: The centerline of the shoe or rollers should be on the centerline of the outer lug rows.

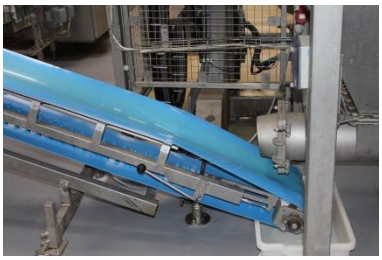




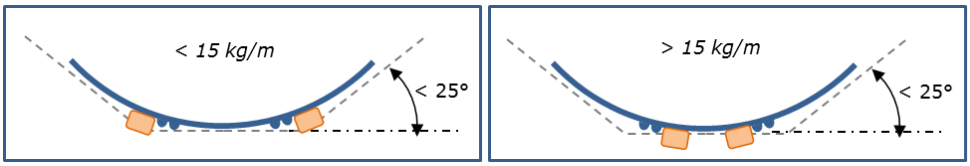
5.4 Trough conveyors

AMMdrive multifilament belts can be used for transport of bulk goods in troughed conveyors. Trough angles up to 25° are possible. Use stainless steel bars to support PVC and TPE belts and UHMWPE/HDPE slider strips for TPU belts.

For loads up to 15 kg/m the slider strips can be positioned on the outside of the drive lugs. Position the slider support in between the drive lugs for higher loads.

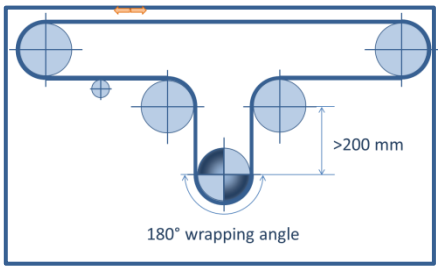


The transfer length from flat to trough as in-feed and out-feed should be equal to or larger than the belt width. A larger in-feed will increase the service life.



5.5 Bi-directional conveyors – omega drives

Some conveyors are designed to run bi-directionally. In those cases a special drive configuration, 'the omega drive' is recommended (see drawing). Note that the two upper (back flexing) pulleys are positioned in such a way that a wrapping angle of 180° on the driving sprockets is guaranteed.



Make sure that the upper pulleys are equal to or larger than the minimum allowed back flexing diameter for the belt.
Keep a distance of at least 200 mm between the center of the pulleys and the drive drum to prevent premature fatigue failure. The drive drum sprockets must have 2-4 teeth more than the standard minimal sprocket.

Cleaning of the drive shaft is more difficult due to limited accessibility of the drive drum. This can be improved by using a drum motor.

Minimum pulley diameters are mentioned in Table 1.

6 Existing conveyor retrofit to AMMdrive PRO (mini)

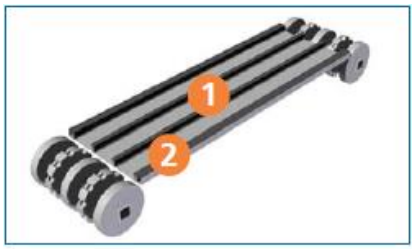
It is possible to exchange synthetic or modular belts for positive driven belting such as AMMdrive PRO (mini). Below are some tips for an AMMdrive PRO (mini) retrofit on existing conveyors.

6.1 From modular belts

Sprockets and Rollers

Exchange the drive and tail pulleys for the appropriate sprockets and support rollers.

Slider strips/bed

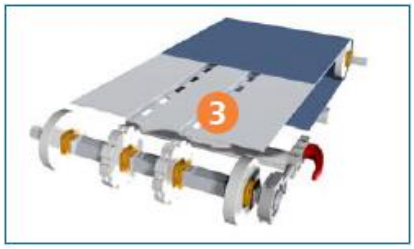


1. Flat slider bed
2. Slide strips

If the slider bed construction is made out of UHMWPE, HDPE or metal strips position them in such a way that they act as guides for the drive lugs (see also the chapter on slider strips).

Ensure that the slider bed height is slightly lower than or level with the upper face of the pulleys. A deviation of max. 5 mm will not negatively affect the operation of the positive drive.

6.2 From synthetic belting and flat slider bed conveyor



3. Bottom groove also acts as guide for lugs

For a full slider bed: provide strips on top of the flat slider bed to ensure a smooth and efficient operation. Position these strips in such a way that they act as guides for the drive lugs.

Make sure that the height of the slider bed is not higher than the upper face of the pulleys. A deviation of max. 5 mm will not negatively affect the operation of the positive drive.

It is also possible to use a profiled slider bed. It is recommended to have drainage holes in the bottom grooves to prevent dirt build up.

The coefficient of friction of TPU to steel is relatively high so it is recommended to use PVC or TPE with a diamond profile.

7 Belt calculation

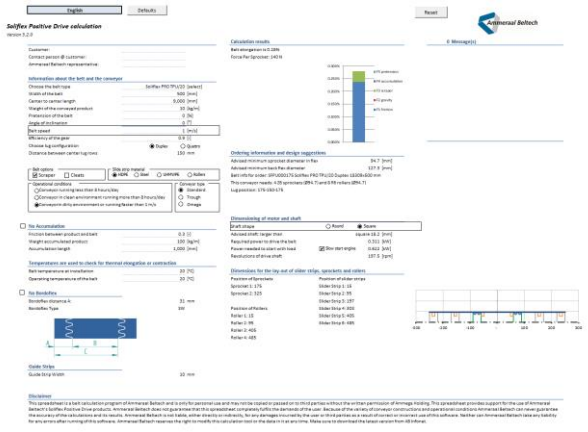


Figure 7 AMMdrive Positive Drive Calculation Program

For an AMMdrive PRO (mini) belt the load on the belt needs to be compared to the allowable load for the selected belt type. The belt is subject to different loads: friction on the slider strips, the mass of the transported goods, mass of the belt (for inclined conveyors) and possible influences from scrapers etc. When accumulating products the load will also be higher and this needs to be taken into account.

This chapter covers the calculation of the allowable load for AMMdrive PRO (mini) belts and calculation method for the determination of belt load for different types of conveyors. A dedicated tool is available; your local Ammeraal Beltech representative can support you with the necessary calculations.

The starting point for the calculations is that the belt is mounted without pretension.

7.1 Belt properties – allowable load

The allowable load for a belt depends on material and width and can be calculated as follows:

F_{all} allowable load $\quad F_{all} = LF * b * FE * SF * 1000$ [1]

See the belt data sheet for the force elongation behavior of a belt (FE). The Load Factor (LF) is 0.6 with the standard sprocket and 1.0 with the Plus sprockets. The service factor (SF) depends on the operational conditions and on the conveyor type. See the table below for the service factor values.

The belt design is acceptable if the load in the belt is less than the allowable load:

$F_B < F_{all}$ [2]

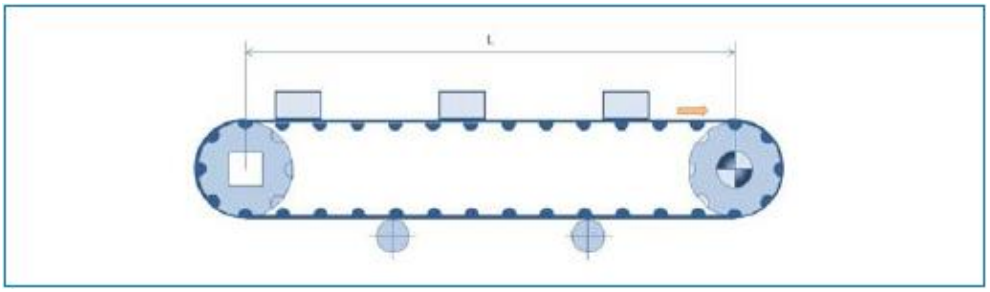
factor (SF)	Horizontal conveyors	Inclined conveyors	Trough or swan neck [1])
Conveyor in a *clean* environment running *less* than 8 hours/day with a speed *below* 1 m/s	1.0	0.9	0.8
Conveyor in a *clean* environment running *more* than 8 hours/day with a speed *below* 1 m/s	0.9	0.8	0.7

1) Or other conveyor types that have a combination of flat and inclined parts or back-flex rollers

7.2 Belt loads on horizontal conveyors

On a horizontal conveyor the main load comes from the friction on the slider strips. Also a scraper will create a load to the belt. Conveyors where products are accumulated encounter extra loads from the friction between products and belt. The friction coefficients between product and belt need to be determined. Notice that the weight per meter (m_A) will increase over the accumulation length.

F_1 friction load	$F_1 = \mu_1 * k * L * (m_b + m_p) * g$	[3]
F_3 scraper load	$F_3 = 85 * b$	[4]
F_4 accumulation load	$F_4 = \mu_2 * k * L_A * m_A * g$	[5]
F_B total belt load	$F_B = F_1 + F_3 + F_4$	[6]

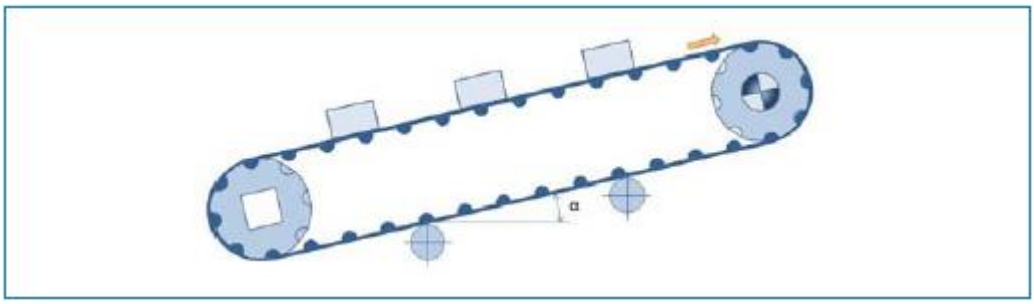


NOTICE Coefficient of friction correction factor (k). *In dirty environments the coefficient of friction will be higher than stated in the belt datasheets. The AMMdrive belt calculation program will add 25% on the coefficient of friction. Thus lowering the maximum load on the belt. In the formulas this is represented by the k. In clean environments k = 1 and dirty environments k = 1.25*

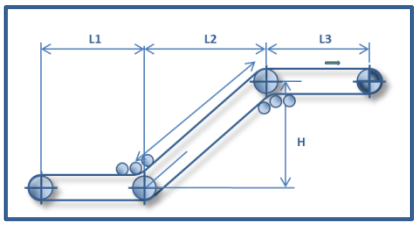
7.3 Belt loads on inclined conveyors

The product weight adds to the belt loads on an inclined conveyor, depending on the angle of inclination. Accumulation is not taken into account.

F_1 friction load	$F_1 = \mu_1 * k * L * (m_b + m_p) * g * \cos \alpha$	[7]
F_2 gravity load	$F_2 = L * (m_b + m_p) * g * \sin \alpha$	[8]
F_3 scraper load	$F_3 = 85 * b$	[9]
F_B total belt load	$F_B = F_1 + F_2 + F_3$	[10]



7.4 Belt loads on swan neck conveyors



The loads on swan neck conveyors and similar conveyors can be calculated by splitting the design up in separate horizontal and inclined conveyors. The total belt load is the sum of the belt loads for each part. Compare this total load to the allowable load for the given belt type, see formula [2]. The AMMdrive PRO (mini) Calculation tool allows for an easy evaluation of swan neck conveyors.

7.5 Dimensioning of the motor and shaft

Calculate the required power for the motor from the speed and the total load in the belt. Also take the efficiency of the gear into account.

$$P \text{ required motor power } P = F_B \times v / 1000 \times \eta \qquad [11]$$

For the calculations of the shaft we advise to use the CEMA guidelines.

7.6 Definitions

α	*inclination angle of the conveyor .....[rad]*
b	*belt width.....[m]*
F_1	*load in the belt caused by friction to the slider bed ..... [N]*
F_2	*load in the belt caused by weight of the conveyed product ..... [N]*
F_3	*load in the belt caused by a scraper ..... [N]*
F_4	*load in the belt caused by friction to the slider bed ..... [N]*
F_{all}	*allowable load for a belt type ..... [N]*
F_B	*total load in the belt ..... [N]*
FE	*force needed for 1% elongation (see belt data sheet) .....[N/mm]*
g	*gravitational acceleration; g = 9.81 ..... [m/s²]*
k	*correction factor friction coefficient ..... [-]*
L	*conveyor length c-c .....[m]*
L_A	*length where accumulation occurs .....[m]*
m_A	*weight of accumulated product per m length .....[kg/m]*
m_b	*weight of belt per m length .....[kg/m]*
m_p	*weight of conveyed product per m belt length .....[kg/m]*
η	*gear efficiency .....[-]*
P	*required motor power .....[kW]*
μ_1	*friction coefficient between belt and slider strips .....[-]*
μ_2	*friction coefficient between product and belt .....[-]*
1v	*belt speed .....[m/s]*

8 Tables

8.1 AMMdrive Specifications

Table 1 AMMdrive Specifications

	Thickness (mm)	Hardness (Sh)	Belt Colour	Lug Colour	Temperature Min (°C)	Temperature Max (°C)	Min Pulley Dia (mm)	Min Pulley Dia Backflexing (mm)	Minimum Pulley Dia Omega (mm)
AMMdrive/FE PRO mini E1/A21+02 Ivory FG M2 AS	1.4	40D	Ivory	Natural	-20	110	63.3 (Z08)	95.9 (Z12)	112.2 (Z14)
AMMdrive PRO mini E2/A18+03 Ivory FG M2	2.7	40D	Ivory	Natural	-20	110	79.6 (Z10)	95.9 (Z12)	112.2 (Z14)
AMMdrive PRO mini U2/03+F1 Light blue FG AM	1.8	85A	Light blue	Light blue	-20	90	63.3 (Z08)	95.9 (Z12)	112.2 (Z14)
AMMdrive PRO mini U2/04M2+04 Light blue FG	2.2	93A	Light blue	Light blue	-20	90	63.3 (Z08)	95.9 (Z12)	112.2 (Z14)
AMMdrive PRO mini U2/04M2+04 White FG	2.2	93A	White	White	-20	90	63.3 (Z08)	95.9 (Z12)	112.2 (Z14)
AMMdrive PRO mini U2/A2+04 Light blue FG	2.2	93A	Light blue	Light blue	-20	90	63.3 (Z08)	95.9 (Z12)	112.2 (Z14)
AMMdrive PRO mini V1/A18+05 green FG	1.8	80A	Green	Natural	-15	80	79.6 (Z10)	95.9 (Z12)	112.2 (Z14)
AMMdrive/FE PRO mini V1F/02M1+03 light blue FG	1.0	80A	Light blue	Natural	-15	80	47.0 (Z06)	63.3 (Z08)	112.2 (Z14)
AMMdrive PRO mini V1F/A18+06 light blue FG	1.8	80A	Light blue	Light blue	-15	80	79.6 (Z10)	95.9 (Z12)	112.2 (Z14)
AMMdrive PRO V2/A18+05 green FG	2.8	80A	Green	Light blue	-15	80	127.3 (Z08)	143.5 (Z09)	192.4 (Z12)
AMMdrive PRO mini V2/A18+05 green FG	2.8	80A	Green	Light blue	-15	80°	79.6 (Z10)	112.2 (Z14)	128.5 (Z16)
AMMdrive PRO V2/A18+05 light blue FG M1	2.8	80A	Light blue	Light blue	-15	80°	127.3 (Z08)	143.5 (Z09)	192.4 (Z12)
AMMdrive PRO mini V2/A18+05 light blue FG M1	2.8	80A	Light blue	Light blue	-15	80	79.6 (Z10)	112.2 (Z14)	128.5 (Z16)
AMMdrive PRO V2F/A18+07 green FG	3.0	80A	Green	Light blue	-15	80	127.3 (Z08)	143.5 (Z09)	192.4 (Z12)
AMMdrive PRO mini V2F/A18+07 green FG	3.0	80A	Green	Light blue	-15	80°	79.6 (Z10)	112.2 (Z14)	128.5 (Z16)
AMMdrive PRO V2F/A18+07 Light blue FG	3.2	80A	Light blue	Light blue	-15	80	127.3 (Z08)	143.5 (Z09)	192.4 (Z12)
AMMdrive PRO mini V2F/A18+07 Light blue FG	3.2	80A	Light blue	Light blue	-15	80	79.6 (Z10)	112.2 (Z14)	128.5 (Z16)
AMMdrive PRO V2R/A18+07 light blue FG	3.4	80A	Light blue	Light blue	-15	80	143.5 (Z09)	225.0 (Z14)	257.5 (Z16)
AMMdrive PRO V3R/A18+07 light blue FG	4.5	80A	Light blue	Light blue	-15	80	159.8 (Z10)	225.0 (Z14)	257.5 (Z16)
AMMdrive PRO V2NF/A18+07 white FG	3.2	65A	White	White	-15	80	127.3 (Z08)	143.5 (Z09)	192.4 (Z12)
AMMdrive PRO mini VN2F/A18+07 white FG	3.2	65A	White	White	-15	80	79.6 (Z10)	112.2 (Z14)	128.5 (Z16)
AMMdrive PRO VN2F/A18+07 light blue FG	3.2	65A	Light blue	Light blue	-15	80	79.6 (Z10)	112.2 (Z14)	128.5 (Z16)
AMMdrive PRO mini VN2F/A18+07 light blue FG	3.2	65A	Light blue	Light blue	-15	80	79.6 (Z10)	112.2 (Z14)	128.5 (Z16)

Table 2 Pretension

Belt type	**Advised pretension**	**Max. allowable elongation**
AMMdrive PRO (mini)	0 - 0.1%	0.6% standard
		1.0 % special

Table 2 Recommended minimum configurations AMMdrive (based on default lug row pitch of 150 mm)

Duplex	***Belt width***	**200 - 300 mm**	**300 - 500 mm**	**> 500 mm**
	Sprockets	2	2	2
	Support Rollers	0	2	4

Quattro	***Belt width***	**> 550 mm wide or with high load**
	Sprockets	4
	Support Rollers	every 150 mm belt width

Sextet	***Belt width***	**> 1200 mm wide or with high load**
	Sprockets	6
	Support Rollers	every 150 mm belt width

8.2 Properties Sprocket

Table 3 Sprocket Dimensions for 1-ply and 2-ply AMMdrive belt

No. of teeth (Z)	diameter (mm)	
	AMMdrive PRO	**AMMdrive PRO mini**
6	94.7	47.0
7	111.0	
8	127.3	63.3
9	143.5	
10	159.8	79.6
11	176.1	
12	192.4	95.9
13	208.7	
14	225.0	112.2
16	257.5	128.5
	Other dimensions available on request	

Please consult your local Ammeraal representative for 3-ply AMMdrive belt sprockets

Table 4 Sprocket Bore dimensions

Pilot Bore (PB)	**Square (SQ)**	**Round (RR)**
6	40	20
15	50	25
		30
		40
		50
Not all options are applicable on all sprocket type/sizes		

Table 5 Sprocket Executions

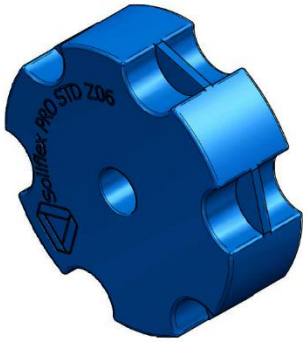
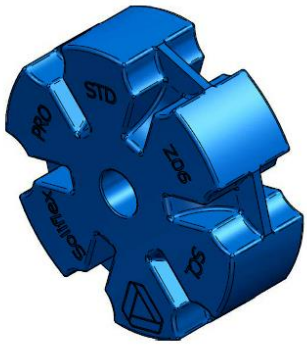
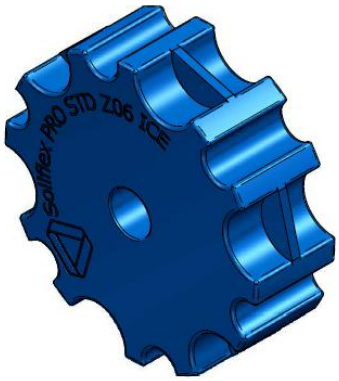
 Standard Sprocket	 Self-Cleaning Sprocket
 De-Icing Sprocket	 Support Roller

Table 6 Maximum Cleat type per sprocket type

AMMdrive PRO	AMMdrive PRO mini	Maximum Synthetic footless PVC cleats *	Maximum Synthetic footless Ropanyl cleats **	Maximum Synthetic footless Amtel cleats ***	TPU Soliflex (scoop) cleats
	Z06 47.0	*Na*	*Na*	*Na*	*Na*
	Z08 63.3	*TN20*	*PN22*	*Na*	*Na*
	Z10 79.6	*TN40*	*PN37*	*Na*	*Na*
	Z12 95.9	*TN50*	*PN53*	*TN35*	*Na*
Z06 94.7		*TN50*	*PN53*	*Na*	3.0
Z07 111.0		*TN50*	*PN53*	*Na*	3.0
Z08 127.3		*TN60*	*PN53*	*TN35*	4.0
Z09 143.5		*TN75*	*PN79*	*TN35*	4.0
Z10 159.8		*TN75*	*PN79 / 100 x 6*	*TN50*	6.0
Z11 176.1		*TN75*	*PN79 / 100 x 6*	*TN50*	6.0
Z12 192.4		*TN75*	*PN79 / 100 x 6*	*TN75 / 100 x 6*	8.0
Z13 208.7		*TN100*	*PN79 / 100 x 6*	*TN75 / 100 x 6*	8.0
Z14 225.0	Z14 112.2	*TN100*	*PN79 / 100 x 6*	*TN75 / 100 x 6*	8.0
Z16 257.5	Z16 128.5	*TN100*	*PN79 / 100 x 6*	*TN75 / 100 x 6*	8.0

Reducing PN-cleat height does not influence minimum sprocket diameter.

* For AMMdrive V (PVC) belts
** For AMMdrive U (TPU) belts
*** For AMMdrive V (PVC) and E (TPE) belts

Table 7 Maximum Bordoflex Height per sprocket type

	AMMdrive PRO	AMMdrive PRO mini	Maximum height (mm)
		Z06 47.0	na
		Z08 63.3	na
		Z10 79.6	na
	Z06 94.7	Z12 95.9	30 mm
	Z07 111.0		30 mm
	Z08 127.3		40 mm
	Z09 143.5		45 mm
	Z10 159.8		50 mm
	Z11 176.1		60 mm
	Z12 192.4		65 mm
	Z13 208.7		70 mm
	Z14 225.0		75 mm
	Z16 257.5		80 mm
	Z18 290.1		100 mm
	For belts with Bordoflex the sprocket size must be chosen larger than the standard sizes. The minimum sprocket diameter must be higher than 3 times the Bordoflex height and also be bigger than the minimum sprocket diameter than the belt.		

All AMMdrive Bordoflex belts have a pitch of 50mm (Normal wave) or 25mm (small wave). Exception is the AMMdrive **U** where the Bordoflex Normal wave is supplied with a 51mm pitch. This offers the possibility of Bordoflex and cleats to be aligned.

8.3 Others

Table 8 Thermal expansion

$\Delta L = L \times \alpha \times \Delta T$	α	=	linear thermal expansion coefficient
	L	=	belt length nominal in m
	ΔL	=	thermal expansion / contraction
	ΔT	=	temperature difference

	Material	α [mm/m/°C]
AMMdrive PRO (mini)	TPE	0.17
	TPU	0.17
	PVC	0.17