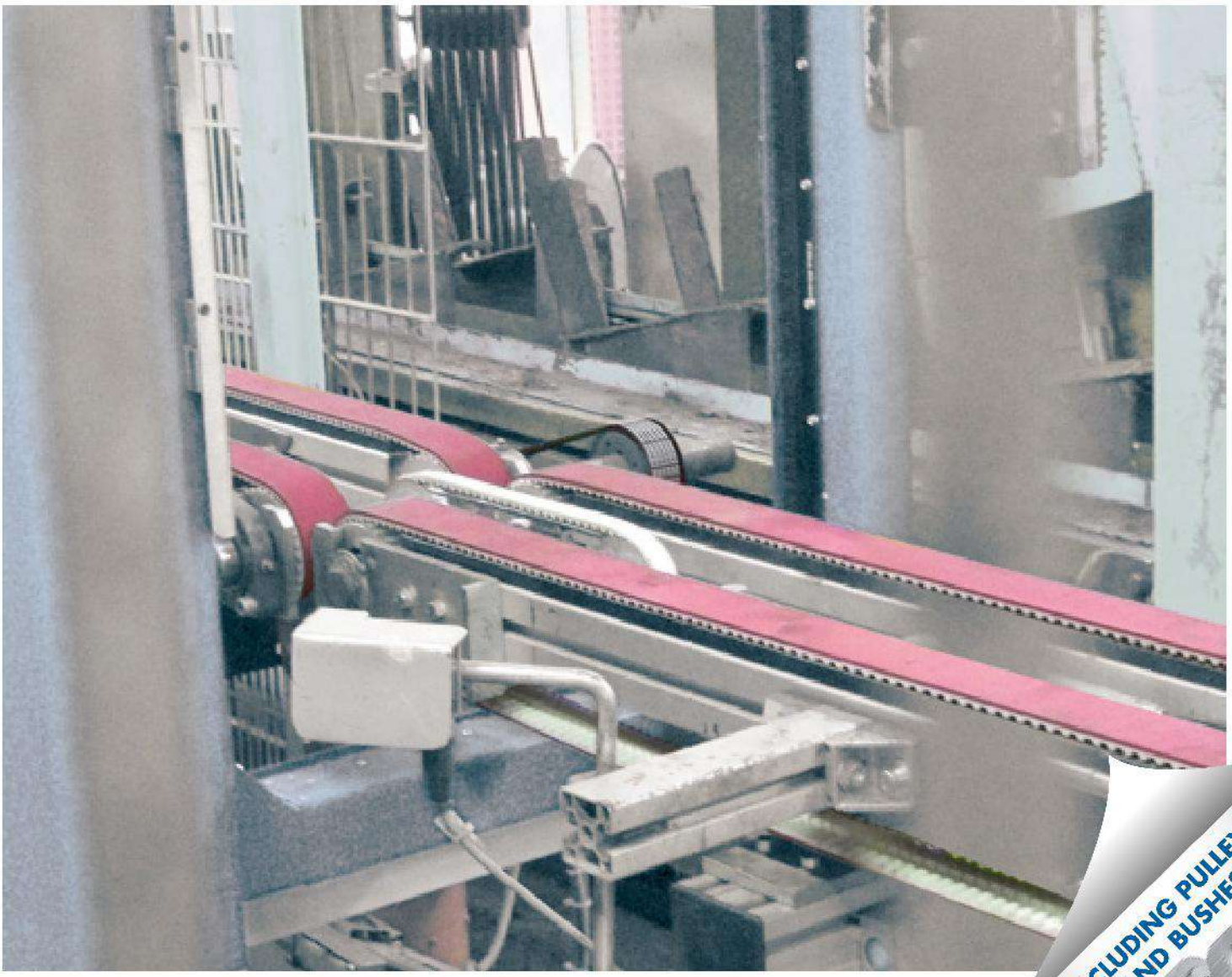
PICANOL
Let's grow together

TECHNICAL MANUAL
POLYURETHANE TIMING BELTS



PRODUCT DESCRIPTION

PRODUCTION PROCESSES AND FEATURES OF THE BASE BELTS

1.2 Production Processes and Features of the Base Belts

Optibelt timing belts
- ALPHA TORQUE, ALPHA POWER and ALPHA SRP of cast polyurethane or
- ALPHA FLEX, ALPHA LINEAR and ALPHA V of thermoplastic polyurethane

are basically also abrasion-resistant and shear-resistant. In addition, they feature an above-average resistance to chemicals and e.g. oils and greases and are highly ageing-resistant due to their resistance to ozone and UV light. Moreover thermoplastic polyurethane exhibits the benefit of welding capability as opposed to cast polyurethane.

The production processes
- Casting,
- Extrusion and
- Optional welding,

assigned to product groups, are explained below.

The potential adjustment of base belts to transport tasks with the required production processes is described in Chapter 6 "Coatings, Cleats and Adjustments".

Production process: Casting

optibelt ALPHA TORQUE, ALPHA POWER and ALPHA SRP timing belts

Endless optibelt ALPHA TORQUE, ALPHA POWER and ALPHA SRP timing belts are manufactured from cast polyurethane and, in most cases, a tensile reinforcement in cylindrical cast moulds. Prior to the casting of the timing belt sleeve, usually a high-strength, flexible steel tensile reinforcement is helically wound around the interior mould core, see Fig. 1.2.1. The tensile reinforcement lies on the narrow production noses so that this takes on a defined position in the timing belt. The cast polyurethane is cast between the mould core and the cylindrical exterior mould. In the case of a double profile tooth system or the optibelt ALPHA SRP timing belt with cleats or a coating, the exterior shape is adjusted in terms of dimensions and geometry, see also Chapters 6.3 and 6.5. The timing belts are cut to width from the produced demoulded sleeve. The uncut steel tensile reinforcements protruding at the sides are separated manually so that the two ends lie in the frame without protruding at the sides. In the web region between the teeth, a small sleeve nose remains visible.
The polyamide fabric widely used for extruded timing belts cannot be integrated if casting is used as production process. This is only subsequently possible on the belt back. Subsequent welding of a cleat directly on the belt top surface is not possible with the cast polyurethane. Cast polyurethane does not have an EU food compliance / FDA approval for food contact.
Endless, cast polyurethane timing belts have the following features:

- High pitch precision
- optibelt ALPHA POWER with a 30 % higher performance
- Useful sleeve widths of up to 380 mm
- Belt lengths up to 2250 mm
- Fine contouring of e.g. cast cleats
- Free colour selection from two sleeves
- Cast double profile design
- Position of the tolerance field slightly variable, e.g. for firm axis distances
- No direct welding of cleats
- No optional polyamide fabric on tooth and top surfaces
- Polyamide fabric only subsequently on the top surface
- No EU food compliance / FDA

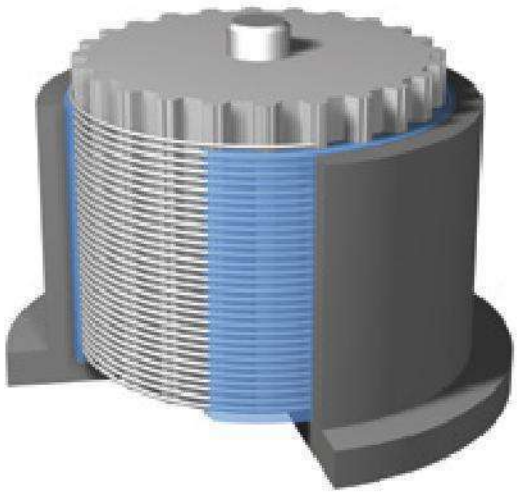


Figure 1.2.1: Moulding in a casting process with helically wound tensile reinforcement

PRODUCT DESCRIPTION

PRODUCTION PROCESSES AND FEATURES OF THE BASE BELTS

In an additional subsequent extrusion process, transparent polyurethane of the hardness 85 Shore A with the designation T2 or PU-Smart and further materials and designs such as PVC foil can be directly applied to the belt as an alternative to the design with a reinforced top surface.
As in the previous processes, the tensile reinforcements rest on narrow production noses so that the cord layer is defined in the belt. For applications e.g. in the food industry or in the wet area of washing lines, a continuous web without a sleeve nose can be manufactured to cover the cords on a special moulding wheel for the T10 profile.

Open-ended, extruded polyurethane timing belts have the following features:

- High tensile forces with low elongation
- High positioning accuracy
- S+Z tensile reinforcements parallel to the edges
- Base belt without sleeve nose in profile T10
- Also as flat belt in the F profile
- PAZ/PAR, polyamide fabric possible on tooth side and top surface
- Optional PU with EU Declaration of Compliance / FDA, see www.optibelt.com
- Designs such as reinforced top surface, T2, PU-Smart and others available
- Roll length 50 m or 100 m

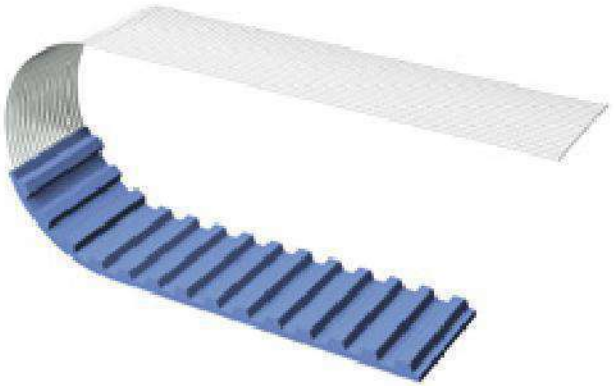


Figure 1.2.3: Extruded and moulded polyurethane with tensile reinforcements parallel to the edges

Production process: Welding

optibelt ALPHA V timing belts

Thermoplastic polyurethane timing belts optibelt ALPHA V are produced by endlessly welding open-ended, extruded optibelt ALPHA LINEAR timing belts.
As shown in Fig. 1.2.4, the two belt ends of the optibelt ALPHA LINEAR are, prior to welding, punched out in the shape of a finger or cut by a water jet in the shape of a finger. The belt ends are laid in a smooth and a toothed mould, depending on profile and width. Under pressure and temperature, the belt ends are welded together in the mould. Once the thermoplastic polyurethane has spread, the mould is cooled and the endlessly connected optibelt ALPHA V is withdrawn.
Due to the high strength of the thermoplastic polyurethane, welded timing belts exhibit, despite the interrupted tensile reinforcement, a permissible connection tensile force in the finger-shaped connection point, which reaches at least 50 % of the permissible tensile reinforcement of a belt with uninterrupted cords.
The PU coatings of the base belt designs reinforced top surface, T2, PU-Smart and APL plus are welded in conjunction with the base belt joint-free.

Open-ended, cast polyurethane timing belts have the following features:

- Minimum lengths depending on profiles and widths as of 400 mm
- Also very large lengths producible in partition stages
- Can be delivered on a short-term basis
- Ideal for transport drives
- PAZ/PAR, polyamide fabric possible on tooth side and top surface
- Optional PU EU food compliant / FDA
- Designs reinforced top surface, T2, PU-Smart and APL plus weldable when used together
- Direct welding of cleats and V-guides
- Without sleeve nose, profile-dependent in profile T10
- Also available as welded flat belt in the F profile

Figure 1.2.4: Punched out belt ends in finger shape and welded ALPHA V timing belt

PRODUCT DESCRIPTION

PRODUCTION PROCESSES AND FEATURES OF THE BASE BELTS

Overview of production processes and features

Table 1.2.1: Production processes, material, hardness, colour, product groups, lengths, polyamide fabric

Production process **Material**	**Casting** Cast polyurethane	**Extrusion** Thermoplastic polyurethane		
Standard hardness	84 Shore A 86 Shore A	92 Shore A		
Standard colour	transparent [1] grey [1]	white		
PU (FDA): **hardness, colour**	–	85 Shore A, blue, optional transparent, ALPHA LINEAR: with EU Declaration of Compliance / FDA, see www.optibelt.com		
Special hardness	60-95 Shore A	85, 98 Shore A		
Special colour	on request according to RAL No.	e. g. black, blue or on request according to RAL No.		
Minimum quantity for special hardness, colour	two sleeves	from 200 m with maximum production width		
Product group	**ALPHA TORQUE** **ALPHA POWER** **ALPHA SRP** endless	**ALPHA FLEX** endless	**ALPHA LINEAR** open-ended	**ALPHA V** welded endless
	Length ranges, partly depending on profile, width			
Minimum length	53 mm [2], 60.96 mm [3]	1100 mm, with PAZ from 1500 mm	in indexing steps	400 -1000 mm for self-tracking timing belts [4]
Non standard lengths	see product range	in indexing steps	in indexing steps	in indexing steps
Largest length	900 mm [5], 2250 mm	22 000 mm	50 m, 100 m rolls, longer [6]	weldable in any arrangement
	Drive design			
Load bearing capacity	100 %, 130 % [7]	100 %	100 %	50 %
Number of teeth in gear [8]	12	12	12	6
	Base belt optionally with polyamide fabric: PAZ / PAR			
on tooth system, **PAZ** [9]	–	+	+	+
on top surface, **PAR**	–	–	+	+

[1] optibelt ALPHA TORQUE, 84 Shore A, transparent; optibelt ALPHA POWER, 86 Shore A, grey; ± 4 Shore A each
[2] For example splined optibelt ALPHA POWER timing belt, pitch 1.5 mm, e. g. for car mirror adjustment
[3] Profile MXL, pitch 2.032 mm; profile T5 from 120 mm
[4] Minimum length: depending on profile and width, see Technical Data Sheets
[5] optibelt SRP in SpinCast; optibelt ALPHA TORQUE, ALPHA POWER, ALPHA SRP up to 2250 mm
[6] Roll length bigger than 100 m on request; limited by roll handling
[7] optibelt ALPHA TORQUE 100 %; optibelt ALPHA POWER 130 %; optibelt ALPHA SRP 100 % or 130 %
[8] Maximum calculated number of teeth
[9] Double profile optibelt ALPHA LINEAR / V with PA fabric on one side only

1.4 Profiles, Features, Dimensions and Standards

The first timing belts had a trapezoidal shape with imperial pitch and were designed for synchronous power drives. The trapezoidal shape is likewise suitable for conveyor drives with a support rail which the flat tooth head can rest on. This does not only apply to round profiles with a too small contact area on the support rail. The improved round HTD profile is especially suitable for power drives and linear drives thanks to its higher skip protection and reduced operating noise. Nevertheless, the further developed trapezoidal AT profile is to be preferred for linear drives of high requirements for the positioning accuracy – especially due to the reduced backlash between belt and pulley.
For reversing the sense of rotation, double profile timing belts are possible in addition to single profile timing belts. Like the single profile timing belts, they exhibit a sleeve nose generally on one side only. The top tooth widths given in the following table may differ slightly depending on the product group, and profile.

Imperial profile

Today, the imperial, trapezoidal profile is hardly used any more in new designs, particularly in the European area. An exemption is e.g. the H pitch as a standby solution for transport chains.
Optibelt polyurethane timing belts with an imperial pitch replace chloroprene timing belts with the same pitch where the requirements for chemical resistance are high.

Table 1.4.1: Dimensions of imperial profile

Profile	Pitch	Overall height	Tooth height	Tooth width	Flank angle
	t [mm]	h [mm]	h_t [mm]	s [mm]	β [°]
MXL	2.032	1.14	0.51	0.77	40
XL	5.080	2.30	1.27	1.39	50
L	9.525	3.60	1.91	3.26	40
H	12.700	4.30	2.29	4.45	40
XH	22.225	11.20	6.35	7.95	40

Bottom tooth width [mm]: MXL: 1.14; XL: 2.57; L: 4.65; H: 6.12; XH: 12.57

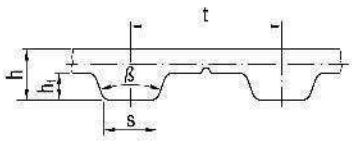


Figure 1.4.1: Imperial profile

T profile

The most common metric T profile has a trapezoidal shape as the imperial profile. In new designs, this profile is selected for drives that are specifically exposed to low loads. Due to the thinner tension cord diameters and the smaller teeth compared to the AT and HTD profiles, the belt is more flexible and can be used on smaller timing belt pulley diameters.
The backlash and the belt elongation under load are bigger than at the AT timing belt of the same pitch. The belt web between the teeth rests on the tooth heads of the pulley tooth system. In e.g. strongly dust-loaded environments, the larger backlash or the larger clearance between belt and pulley can minimize the tendency to build up accumulations as opposed to the AT profile.

PRODUCT DESCRIPTION

PROFILES, FEATURES, DIMENSIONS AND STANDARDS

Table 1.4.2: Dimensions of T profile

Profile	Pitch	Overall height	Tooth height	Tooth width	Flank angle
	t [mm]	h [mm]	h_t [mm]	s [mm]	β [°]
T2.5	2.5	1.3	0.7	0.99	40
T5	5.0	2.2	1.2	1.78	40
T10	10.0	4.5	2.5	3.48	40
T20	20.0	8.0	5.0	6.51	40

Bottom tooth width [mm]: T2.5: 1.50; T5: 2.65; T10: 5.30; T20: 10.15

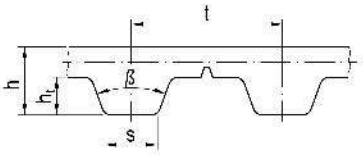


Figure 1.4.2: T profile

Table 1.4.3: Dimensions of DT profile, double profile

Profile	Pitch	Overall height	Tooth height	Tooth width	Flank angle
	t [mm]	h [mm]	h_t [mm]	s [mm]	β [°]
DT5	5.0	3.4	1.2	1.78	40
DT10	10.0	7.0	2.5	3.48	40
DT20	20.0	13.0	5.0	6.51	40

Bottom tooth width [mm]: see table 1.4.2

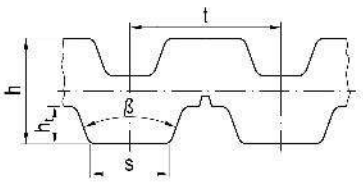


Figure 1.4.3: DT profile

TK profile with notched V-guide

The described T profile is produced with the pitches of 5 mm and 10 mm for transport drives, alternatively also with a V-guide in the TK profile. The central V-guide provides a lateral guidance of the conveyor timing belt in the groove of the timing belt pulley and the support rail. To achieve a reduced minimum pulley diameter as opposed to track timing belts with full-profile wedge, the V-guide is notched.
In applications with e.g. eccentric guide groove, a full-profile V-guide can be welded subsequently into an accordingly longitudinally grooved tooth system.

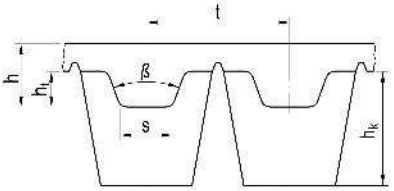


Figure 1.4.4: TK profile with notched V-guide viewed from the side

Table 1.4.4: Dimensions of TK profile

Profile	Profile dimensions	Wedge width	Wedge height	Wedge angle
	see	b_K [mm]	h_K [mm]	β_K [°]
T5K6	T5	6	4	38
T10K6	T10	6	4	38
T10K13	T10	13	6.5	38

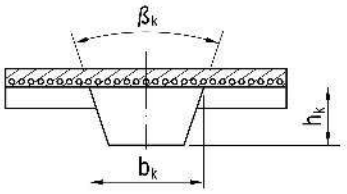


Figure 1.4.5: TK profile with notched V-guide in cross profile

PRODUCT DESCRIPTION

PROFILES, FEATURES, DIMENSIONS AND STANDARDS

AT profile

The AT profile was developed on the basis of the proven trapezoidal T profile and is generally preferred in new designs not only for power drives. The designation AT stands for advanced T profile.
The AT timing belt has the biggest tooth widths and hence the highest tooth shear resistance or the highest permissible specific tooth force of all trapezoidal profiles. Due to the low tooth deformation of the AT profile, the comparably strong cords and the comparably low backlash, high positioning accuracies under load are achieved in linear drives.
In contrast to the other trapezoidal profiles, the AT tooth rests on the tooth head area in the tooth gaps of the tooth system of the pulleys. A further benefit of the large tooth head of the AT tooth system is the low tooth wear or the higher load bearing capacity of the tooth in conveyor drives due to the reduced surface pressure between belt and supporting rail.

Table 1.4.5: Dimensions of AT profile

Profile	Pitch	Overall height	Tooth height	Tooth width	Flank angle
	t [mm]	h [mm]	h_t [mm]	s [mm]	β [°]
AT5	5.0	2.7	1.2	2.5	50
AT10	10.0	4,5*	2.5	5.0	50
AT20	20.0	8.0	5.0	10.0	50

Bottom tooth width [mm]: AT5: 3.62; AT10: 7.33; AT20: 14.66
* For ALPHA TORQUE and ALPHA POWER timing belts: 5.0 mm

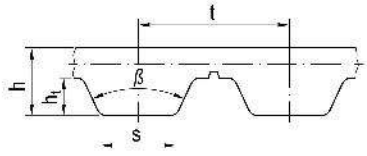


Figure 1.4.6: AT profile

ATK profile with notched V-guide

The described AT profile is produced in the pitches 5 mm and 10 mm for transport drives alternatively also with a V-guide in the ATK profile. The central V-guide provides a lateral guidance of the conveyor timing belt in the groove of the timing belt pulley and the support rail. To achieve a reduced minimum pulley diameter as opposed to track timing belts with full-profile wedge, the V-guide is notched.
In applications with belt widths of 75 mm and a smaller and/or e.g. eccentric guide groove, and with a belt width of 100 mm, a full-profile V-guide can be welded subsequently into a corresponding longitudinally grooved tooth system.

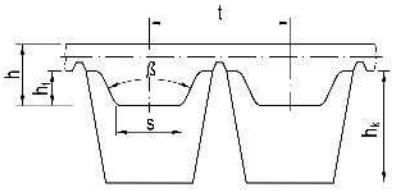


Figure 1.4.7: ATK profile with notched V-guide viewed from the side

Table 1.4.6: Dimensions of ATK profile

Profile	Profile dimensions	Wedge width	Wedge height	Wedge angle
	see	b_K [mm]	h_K [mm]	β_K [°]
AT5K6	AT5	6	4	38
AT10K6	AT10	6	4	38
AT10K13	AT10	13	6.5	38

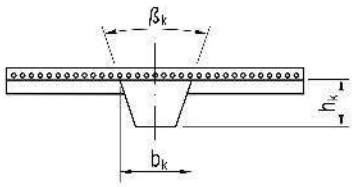


Figure 1.4.8: ATK profile with notched V-guide in cross profile

PRODUCT DESCRIPTION

PROFILES, FEATURES, DIMENSIONS AND STANDARDS

ATL profile

For a more accurate positioning in the linear technology, reinforced tension cords which are more flexible due to an increased cord diameter are included in belts with ATL profile. The specific shapes of the ATL profile with a reduced height of the production nose enable an identical position of the tension cord centre of the reinforced cords as opposed to the AT profiles and, as a result, their use in AT pulleys. Consequently, no deviating, in the effective diameter adjusted special timing belt pulleys are required.
In addition, the belts are produced to balance the higher pre-tension in a slight negative tolerance.
The data indicated to the AT profile apply accordingly, see Table 1.4.5.

HTD profile

The HTD profile is a round curved profile that features a smoother run in comparison to the trapezoidal tooth and a higher skip protection due to the larger tooth height. The profile designation stands for "high torque drive". It was developed for the highly loaded drives in today's new designs primarily used in power drives which cannot be equipped with chloroprene timing belts in the HTD or OMEGA profile e.g. due to chemical loads. The HTD profile has a large tooth width at the tooth basis and features therefore a high tooth shear resistance and a high permissible specific tooth force. In addition, timing belts with HTD profile are applied, despite the slightly increased tooth clearance for power drives, in linear drives of increased requirements regarding the running noise. The belt webs between the teeth rest on the tooth heads of the tooth system of the pulleys. Double profile timing belts in the D5M and D8M profiles are available depending on the product group.
Due to the round tooth shape and the very small contact area, a high surface pressure is produced at the contact with a support rail in transport applications. As a result, for conveyor drives with a high transport load, the HTD profile cannot be recommended, due to the unfavourable wear behaviour at the tooth head.

Table 1.4.7: Dimensions of HTD profile

Profile	Pitch	Overall height	Tooth height	Tooth width	Flank angle
	t [mm]	h [mm]	h_t [mm]	s [mm]	β [°]
5M	5.0	3.6	2.06	–	–
8M	8.0	5.6	3.38	–	–
S8M	8.0	5.3	3.05	–	–
14M/ML	14.0	10.0	6.00	–	–

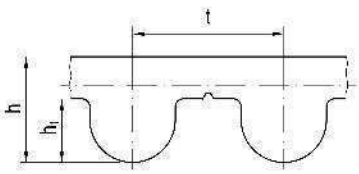


Figure 1.4.9: HTD profile

F profile

The F profile is a flat belt profile that is used on cylindrical shapes with production noses with a pitch of 10 mm similar to the timing belts.

Table 1.4.8: Dimensions of F profile

Profile	Pitch	Overall height	Tooth height	Tooth width	Flank angle
	t [mm]	h [mm]	h_t [mm]	s [mm]	β [°]
F2	–	2	–	–	–
F2.5	–	2.5	–	–	–
F3, FL3	–	3	–	–	–

Figure 1.4.10: F profile

PRODUCT DESCRIPTION

PROFILES, FEATURES, DIMENSIONS AND STANDARDS

Standards

Table 1.4.9: Standards

Standard	AT profile	T profile	Imperial profile	HTD profile
Timing belt standard	ISO 17396	ISO 17396	DIN ISO 5296 Part 1	ISO 13050
Timing belt pulley standard	ISO 17396	ISO 17396	DIN ISO 5294	ISO 13050

Product groups, base profiles, profiles and cords

Table 1.4.10 provides an overview of the product groups with the pertaining profiles together with the superordinated base profiles and cords.
In the product group optibelt ALPHA TORQUE, ALPHA POWER and ALPHA SRP, further pitches of the T and AT profiles such as e.g. T2, T20, AT3, AT20 or the notched timing profiles TR10, TR15 with the pitches 1.0 mm and 1.5 mm can be delivered on request.

PRODUCT DESCRIPTION

PROFILES, FEATURES, DIMENSIONS AND STANDARDS

Table 1.4.10: Product groups, base profiles, profiles and cords

	Product groups			
	ALPHA TORQUE **ALPHA POWER** **ALPHA SRP** cast, endless	**ALPHA FLEX** extruded, endless	**ALPHA LINEAR** extruded, open-ended	**ALPHA V** welded, endless
Base profiles	Profiles			
Imperial profile	MXL, XL, L (ALPHA TORQUE)	H	XL, L, H, XH	L, H, XH
T profile	T2.5, T5, T10, DT5, DT10	T5, T10, T20, DT5, DT10	T5, T10, T20 T10 groove-free	T5, T10, T20, TT5, DT5[1], DT10[1]
TK profile, V-guide				T5K6, T10K6, T10K13
AT profile	AT5, AT10	AT5, AT10, AT20, DAT5, DAT10	AT5, AT10, AT20	AT5, AT10, AT20, DAT5[1], DAT10[1]
ATK profile, V-guide				AT5K6, AT10K6, AT10K13
ATL profile			ATL5, ATL10, ATL20	
HTD profile S8M		5M, 8M, 14M, D5M, D8M	5M, 8M, S8M, 14M, 14ML, 14 MLP	5M, 8M, 14M, D5M[1], D8M[1]
F profile, flat belts			F2, F2.5, F3, FL3	F2, F2.5, F3, FL3
Standard tension cord[2]	Steel	Steel	Steel Aramid	
Special tension cord[2] see Chapter 1.5	Aramid Highly flexible steel Stainless steel Vectran Polyester	Aramid Highly flexible steel Stainless steel	Highly flexible steel Stainless steel	
Optional without sleeve nose	–	–	+[3]	

[1] Double toothed profiles on request
[2] Aramid and special cords per profile on request
[3] T10 profile available without sleeve nose, other profiles on request