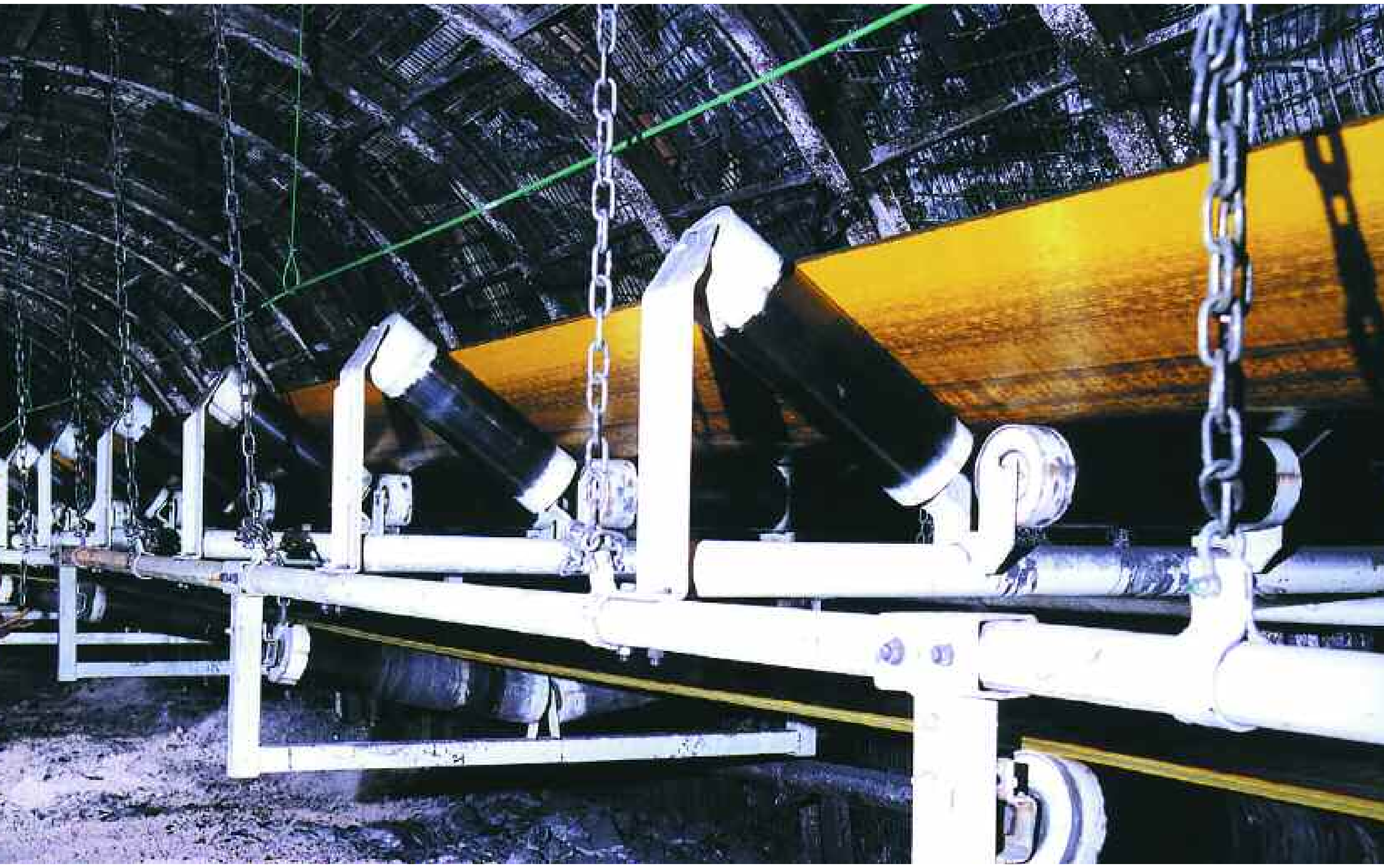
FENNER DUNLOP
CONVEYOR BELTING EUROPE



The World's Leading Conveyor Belt Company

Fenaplast

Material handling systems are the backbone of a modern mining operation – without efficient conveying, mine production can be severely affected. The efficiency of any conveyor depends largely on the trouble-free working life of the belt itself, yet the conditions under which it has to operate can be extremely arduous, having to resist ripping, impact, abrasion, bacteria, acid, water and general mechanical damage.

With over 50 years experience in the manufacture of conveyor belting, coupled with our innovative leadership in product design, manufacturing, application engineering and technical support plus a total dedication to customer service, Fenner Dunlop is the first choice for conveyor belting products and services.

Fenner Dunlop Europe is a member of Fenner Dunlop Conveyor Belting Worldwide, the world's largest manufacturer of conveyor belting for mining and industrial applications. With twelve manufacturing facilities on five continents, Fenner Dunlop is uniquely positioned to provide the most comprehensive conveyor belting service available today.

The Advantages of Fenaplast

First launched in the 1950s and developed continuously ever since, Fenaplast is Fenner Dunlop Europe's flagship product. Our extensive knowledge of conveyor belt applications, fabric weaving and polymer technology are combined in this market-leading range that has been at the forefront of development for over half a century.

Fenaplast solid-woven (monoply) belting, the first choice of countless mines throughout the world, has a number of significant advantages including

- fire resistant and anti-static properties which meet the most stringent safety standards in the world
- greater flexibility than press-manufactured belts, making it easier to trough and track when installed
- a solid woven one piece carcass with no risk of ply separation
- covers which form an integral bond preventing any form of belt delamination
- high resistance to longitudinal tears
- high dynamic and static vulcanised joint properties
- excellent retention of mechanical fasteners
- high resistance to impact damage
- impervious to attack from acid, water, oil, bacteria and chemicals
- high resistance to edge wear

Belt Construction

CARCASS

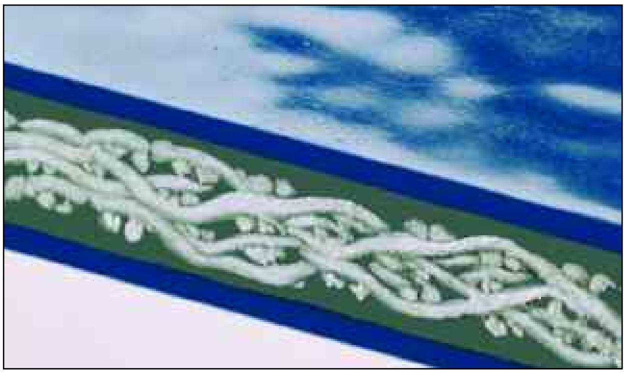
In many respects the carcass is the most important part of a conveyor belt since it provides the tensile strength necessary to move the loaded belt and absorb the impact of material falling on to it as well as providing the bulk and lateral stiffness required for load support and the strength required for bolt and/or fastener holding.

The Fenaplast solid-woven carcass is a highly complex design, utilising warp yarns interlocked and tied into one single mass by means of a uniquely designed binder warp system. Nylon or polyester load bearing warp yarns and nylon or nylon/cotton weft yarns are used. Various combinations of these synthetic and natural fibres ensure that the requirements for impact resistance, belt elongation, flexibility (for troughing and wrapping round small diameter pulleys), load support and fastener retention are met. Where there is a specific need, cotton pile warp yarns may be included to further improve impact resistance. Additional edge reinforcement is included where required.

Solid-woven carcass prior to PVC impregnation

The solid-woven fabric is impregnated with PVC to make the finished carcass. Fenner Dunlop's unique, patented impregnation system renders the carcass impervious to attack from moisture, dirt, chemicals, bacteria and oils.

The countless options available in the construction of the Fenaplast carcass enables the end user to define specific operational requirements and receive a custom-built belt exactly suited to a specific application.



COVERS

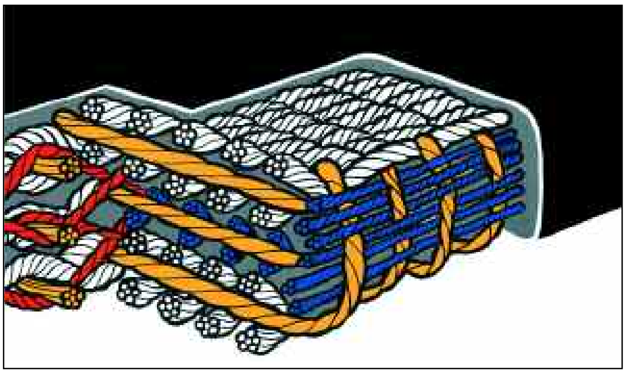
Following the impregnation process, PVC covers are applied to the top (carrying) and bottom (drive) surfaces of the belt to protect the carcass and extend service life. Cover type, quality and thickness are matched to specific customer requirements.

PVC covers can be formulated to meet any worldwide fire resistance specification and to offer resistance to other hazards, such as oils and chemicals. Special compounds can also be used to give improved abrasion resistance or a higher coefficient of friction.

For use above and below ground and where a higher coefficient of friction is required, rubber covers are vulcanised to the parent belt. These can be fire-resistant if required. Rubber covers are recommended for short-centre, high trip rate, high tonnage installations such as coal preparation plants, coke works and for hard rock conveying applications.

SPECIAL APPLICATIONS

Tailor-made, low stretch Fenaplast belting is also suitable for a variety of specialist applications, including bucket elevators and similar installations where take-up is limited. Other application-specific belts can be designed and custom built with the assistance of a Fenner Dunlop engineer, ensuring the correct selection of belt construction and covers every time.



The Fenaplast Range

FENAPLAST FR

Meeting or, in many cases, exceeding the fire-resistance and anti-static requirements of all worldwide safety standards, Fenaplast FR belting is designed primarily for use underground and in other potentially hazardous situations. PVC compounds, with cover thicknesses of up to 4mm, can be varied to suit any specific application. Fenaplast FR belting has a proven superior service life in coal mining and similar applications where high, continuous output depends on belt reliability.

The PVC covers give excellent cleaning properties and, together with the advantages of a solid woven carcass, provide a belt ideal for conveying coal, potash, phosphate, fertiliser, salt, gypsum and clay, as well as for use in the timber industry and other applications where moist, sticky materials are handled.

FENAPLAST FRSR/PVG/CRG

Where a high level of fire resistance is required together with special cover properties more readily achievable with synthetic rubber compounds, Fenaplast FRSR is the ideal solution. This belting is Fenaplast FR with the addition of single or double rubber covers of up to 6mm thick. Increased belt life, steep gradient and high trip rate conveying are the main advantages of this type of belting. It is generally used on high tonnage drift and trunk conveyors as well as in power stations and coal preparation plants.

FENAPLAST SR

Where there is no requirement for fire resistance, Fenaplast SR is offered as a rubber-covered belt for conveying abrasive or difficult minerals. A durable rubber cover, compounded for maximum abrasion resistance up to 6mm thick, combined with our PVC impregnated solid-woven carcass has proven ideally suited to high impact installations such as the conveying of aggregates and similar hard, sharp materials.

Customised Fenaplast

SPECIAL CARCASS PROPERTIES

Fenaplast carcass designs can be customised to include one or more of the following features

- increased fastener holding efficiency for high speed/tonnage applications
- improved lateral stability to further enhance resistance to longitudinal splitting on high capacity/deep trough conveyors
- high tear and rip resistance for arduous applications where belts are difficult to align and maintain
- additional carcass mass to allow belts to negotiate small radius catenary curves which would normally require steel cord belt (to prevent the belt lifting off the structure under no load conditions)
- the ability to operate at temperatures well in excess of 90°C (the normal limit for standard constructions)
- improved edge wear protection for extensible and similar applications

FENAPLAST HI-VIS

Fenaplast High Visibility (Hi-Vis) yellow covered belting provides improved safety and inspection capabilities, particularly on underground conveyors. The enhanced visibility of the yellow covers significantly improves the sighting of the conveyor's moving parts and structure against the belt, allowing easier inspection and making the conveyor itself more conspicuous. In use in the UK, Scandinavia and Canada, the advantages of Hi-Vis belting have been recognised by engineers as a useful feature in improving safety around conveyors - always an area of concern.

Fenaplast Hi-Vis belting is a product innovation driven by the need for improved safety and is especially advantageous on man-riding conveyors, making the belt edges and conveyor moving parts more obvious to the rider.

Fenaplast belting is also available in a range of other colours to assist in belt identification.

FENAPLAST SPECIAL COVERS

Certain applications require conveyor belts with special properties and our highly experienced in-house research and development team has developed a range of PVC compounds for Fenaplast covers, all of which are available with fire-resistant properties, including

- hard, highly abrasion resistant covers for conveying underground in high ambient temperatures
- thick covers with an easily cleaned surface for handling wet, sticky materials such as chalk, clay and lignite
- high coefficient of friction covers for additional grip on pulleys and load retention on inclines
- covers suitable for low temperature environments
- special elevator belt covers

The Fenaplast Centre of Excellence

Our UK facility is the worldwide Centre of Excellence for Fenner Dunlop solid-woven conveyor belting and as such is at the forefront of research and development. Externally certified to ISO 9001:2000, the Centre of Excellence is constantly seeking ways to make product and process improvements as well as researching new manufacturing techniques and materials. It is staffed by experts in engineering, chemistry, polymers and textile technology.

Product Testing

A key function of the Centre of Excellence is the continual testing of Fenaplast products to ensure that the very highest standards are met. Conveyor belting, particularly for use in underground applications, is subject to rigorous safety testing in our state-of-the-art facilities to ensure that all belts meet the most stringent requirements. Our in-house dynamic performance testing ensures that every belt is fit for purpose.

SAFETY TESTING

The Fenner Dunlop approach to fire safety testing is based on the premise that a belt should never be the cause of a fire, should be difficult to ignite, and if ignited by an external fire source, should not propagate the fire.

Whilst fire resistance specifications vary from country to country, Fenaplast belts can be formulated to meet any fire performance specifications in the world.

The tests carried out on conveyor belts to assess their compliance with fire safety standards are associated with four particular hazards.

1. **Drum Friction Test**

The danger associated with a stalled belt and a driven rotating drum or pulley resulting in frictional heat build up.

A test piece of conveyor belt, suitably mounted and tensioned, is wrapped half way around a rotating steel drum, simulating a stalled belt. The test is continued at specified tensions for a given time period, or until the belt breaks. The presence, or absence, of flame or glow is noted and the temperature of the drive drum is measured. The test is conducted in still air and/or in moving air. This test has probably been the major single contributor to mine safety in respect to conveyor fire prevention.

2. **Laboratory Flame Test**

The possibility of igniting the considerable mass of a conveyor belt with a relatively small ignition source.

This hazard is usually assessed by the application of a small "Bunsen" type flame to a belt sample and observation of the effect. The time taken for all flame and/or glow to self-extinguish is noted.

Fenner Dunlop solid woven conveyor belting for use underground conforms to all major international standards including BS 3289

3. **Gallery Fire Test**

The possibility of a belt, ignited from a larger ignition source, spreading the fire to other areas (often referred to as fire propagation).

This hazard can only be assessed by a gallery fire test. Historically, this was a large scale test that involved the use of 7.5kg of propane over 50 minutes to ignite a belt. Whilst the testing method was robust, the test itself required large scale facilities and created environmental and health and safety issues. In 2002, Fenner Dunlop provided assistance for the UK Health and Safety Executive's development of the mid-scale high energy test. Accurate correlation with the large gallery test was achieved and this test was incorporated into the European Standards.

Fenner Dunlop's in-house test facility is the only such one in operation in the UK.

4. **Electrical Resistance Test**

The possible build-up and subsequent discharge of static electrical charge on moving conveyors.

Fenner Dunlop's PVC and rubber compounds are specially formulated to ensure that belts are sufficiently conductive to avoid the build up of static electricity. The electrical resistance is determined by passing an electric current of specified voltage between electrodes placed on the surface of the belt. The internationally recognised acceptance criteria for electrical conductivity is a maximum resistance of 3.0×10^8 Ohms (300M Ohms).

QUALITY TESTING

All Fenner Dunlop belting is produced within our Quality Management System which is compliant with ISO 9001:2000. As part of this system, the quality of all belt is verified prior to despatch by a programme of comprehensive testing.

Typically this testing will include

- dimensional measurements
- warp and weft tensile strengths
- tear strength
- elongation
- cover adhesion
- small scale safety tests (laboratory flame and electrical resistance)
- abrasion resistance
- transverse stability

DYNAMIC PERFORMANCE TESTING

In addition to the tests outlined above it is also necessary to ensure that every belt will meet our customers' requirements and be fit for purpose. The belt's ability to be joined, either by the use of mechanical fasteners or vulcanised splices, are all tested.

Our testing facility is equipped with a range of dynamic test rigs enabling us to perform

- accelerated life testing on both the belt and related jointing methods
- field problem simulation
- troughing/transition distance evaluations
- product and material development testing
- specific belt testing to individual customer requirements

FENNER DUNLOP
CONVEYOR BELTING EUROPE

Our mission is to achieve total customer satisfaction. Whilst the above paragraphs provide an indication of Fenner Dunlop's commitment to product quality, we believe that the key to achieving this goal is the establishment of excellent working partnerships with our customers. Our commitment does not stop with the sale of a belt. Our technical personnel are always available to help customers get the most from our products and achieve safe, economical conveying.

Technical Information

BELT DESIGNATION

Belts can be produced to various tensile specifications, using either polyamide (Nylon) or polyester base warp yarn. Some markets still prefer to specify belt types based on tensile strength expressed in lbs/in width (the Fenaplast belt designation uses this term), whilst others opt for the preferred ISO nomenclature expressed in N/mm. The table below shows typical figures for minimum warp and weft strengths, belt thickness and weight for a selection of belt types, based on 1mm PVC covers. For thicker covers, add 1.3 kg/m2/mm for PVC covers and 1.4 kg/m2/mm for rubber covers.

Alternative constructions are available which give values higher than those in the table. This is particularly relevant to weft strength, where special yarns /designs may be recommended for improved properties such as fastener holding, load support and weft stability.

The use of such special yarns may increase the belt weight and thickness which could be critical for shipping purposes or underground transportation. A Fenner Dunlop engineer should always be consulted where this is likely to be an issue.

BELT THICKNESS

When considering cover thickness, please be aware of the high textile content of Fenaplast and the properties afforded by the increased carcass bulk compared to rubber plied belting. Consequently, thinner covers may generally be chosen than would normally be associated with an equivalent plied product, the enhanced textile density of Fenaplast providing the necessary load support and resistance to impact.

BELT WEIGHT

Customers should be aware that lower belt weights may be advantageous on long conveyors as a means of reducing power consumption. High lift conveyors can incur a correction for slope tension which may be avoided by careful belt selection to minimise weight, resulting in considerable cost savings on certain applications, for example drift conveyors.

DRUM DIAMETERS

The drum diameters quoted are the minimum generally recommended. Given specific information regarding wrap configurations, tensions, belt speeds and jointing methods, it may be possible to recommend smaller drums.

BELT STRETCH

The unique design and manufacturing process of Fenaplast allows both permanent and elastic stretch to be kept to a minimum, consistent with good operation. With numerous carcass designs available in both nylon and polyester yarns, it is impracticable to indicate all stretch figures. Further details can be provided on request.

OPERATING FACTOR OF SAFETY

With good quality mechanical fasteners or vulcanised joints a factor of safety of 10:1 is generally acceptable. However we would be pleased to confirm the recommended belt construction and acceptable safety factor for any specific application on receipt of the necessary conveyor details.

BELT DESIGNATION lbs/in	WARP STRENGTH N/mm	WEFT STRENGTH N/mm	BELT THICKNESS* mm	BELT WEIGHT* kg/m²	MINIMUM RECOMMENDED DRUM DIAMETERS High tension mm	Low tension mm
2240	400	250	5.5	7.3	250	225
2800	500	275	7.7	10.1	315	250
3300	580	275	8.0	10.3	355	315
3500	630	275	8.1	10.5	400	315
4000	710	300	8.3	11.0	400	355
4500	800	300	8.5	11.1	500	355
5000	875	300	8.8	11.2	500	355
6000	1000	350	9.4	11.9	630	400
6500	1140	350	9.5	12.0	630	400
7000	1250	350	10.4	12.2	750	450
8000	1400	350	10.5	13.2	750	450
9000	1600	425	11.9	14.8	800	600
10000	1800	425	12.9	16.1	800	600
12000	2100	425	13.9	17.6	1000	750
15000	2625	425	14.9	18.6	1250	800

Nominal values for specific belt constructions
Specification sheets detailing the actual data for any belt type supplied can be forwarded on request.

Safety and Quality Assurance

BELT WIDTH

Any width up to 2100mm can be manufactured. Whilst we recommend customers to follow the ISO range of preferred widths, non-standard widths can be supplied. Slit-edge belting is also available upon request.

ROLL LENGTHS

Customers are asked to specify their maximum acceptable roll diameters and weights so that Fenaplast belts can be supplied in the most suitable roll lengths to avoid unnecessary joints. Fenaplast can normally (subject to safe working limits in our factory) be produced in any required roll size to suit handling and transit to site.

Single or double coiled rolls can be supplied with fasteners fitted if required. Length tolerance is -0.5% +2%, unless otherwise agreed. Short belts can be spliced into endless loops as part of the manufacturing process.

OPERATING TEMPERATURE RANGE

Above 90°C PVC softens and the belt properties change. Fenaplast is therefore not recommended for conveying materials above this temperature. Standard Fenaplast can be used in cold climates at minus 15°C although special cover compounds are available for operation down to minus 30°C. Where applicable, cold weather details should be supplied to ensure that belting with suitable coefficient of friction and flexibility characteristics is specified.

SAFETY

Fenaplast meets the safety requirements of all the major mining nations and has been tested and/or approved by the appropriate national authorities, including

COUNTRY	APPLICABLE STANDARD
Australia	AS 4606
Canada	CSA M422-M87
China	MT914
Czech Republic	CSN 26 0372
Germany	DIN 22109 Part1
India	IS3181
Poland	PN-93-05013
South Africa	SABS 971
Spain	LOM
Russia	PD03-423-01
Turkey	TS 547
UK	BS 3289
Ukraine	GSTU 12.0018579.001-99
USA	Title 30 Part 18 Section 18.65

Fenaplast conveyor belting can also be formulated to comply with the proposed fire propagation test outlined in the MSHA publication, Belt Evaluation Laboratory Test, (B.E.L.T.).

QUALITY ASSURANCE

In accordance with the requirements of our major customers, the planning, design, manufacture and quality control procedures of Fenner Dunlop Europe have been assessed and are approved to Specification ISO 9001: 2000, the International Standard for official approval of a manufacturer's quality system.

The system approved under the above standard has been accepted by the USA Mines Safety and Health Commission. A similar assessment of Fenner Dunlop has been carried out by the Canadian Federal Energy Mines and Resources Department against the Canadian Standard CAN3Z299, 1-78 "Quality Assurance Programme Requirements" and by the Spanish LOM Authority.

Jointing of Fenaplast

Fenaplast conveyor belting can be joined in two ways, either by hot vulcanised finger splicing or by the use of mechanical fasteners.

SPLICED “FINGER” JOINTING

Conventional vulcanising presses are used for this process, in conjunction with a variety of polymeric jointing materials developed for maximum joint efficiency. This type of splice enables good quality joints to be made with strengths approaching that of the parent belt. Hot vulcanising offers certain advantages, including

- the highest joint strength possible
- a reduced risk of tearing at the splice area
- a smooth joint area for superior performance under scrapers, ploughs, deflectors and minimal impact over pulleys and idlers
- operation through automatic weighing devices and magnetic separators
- reduced maintenance
- resistance to harmful moisture and chemicals
- superior resistance to abrasion
- easier cleaning
- reduced spillage

MECHANICAL FASTENERS

The thick, high textile content of the Fenaplast solid-woven carcass, combined with the superior PVC impregnation produced by our unique process, gives excellent fastener holding properties. A wide range of fasteners including Mato, Goro, Flexco and Titan are suitable for use with Fenaplast. Mechanical fasteners are appropriate in conditions where

- belts are replaced frequently
- belts and conveyors are extended regularly
- emergency jointing or repairs are required
- take up travel is limited

The following mechanical fasteners can be fitted as standard.

BRAND	TYPE	TENSILE RANGE		BELT THICKNESS mm
		max N/mm	max lbs/in	
Mato	U35A	1050	6000	5-9
	U35	1050	6000	7-11
	U37A	1400	8000	8-12
	U37	1400	8000	10-14
	U38A	3500	20000	12-15
	U38	3500	20000	15-18
	U65A	1400	8000	6-10
	U65	1400	8000	8-12
	U67A	1600	9000	9-13
	U67	1600	9000	12-16
	U68A	3500	20000	12-15
	U68	3500	20000	12-18
	MH22A	630	3500	5-7
	MH22B	630	3500	7-9
	MH25A	1050	6500	5-7
	MH25B	1050	6500	7-9
	MH27A	1400	8000	10-12
	MH27B	1400	8000	12-14
	MP27	800	4500	8-11
	MP28	800	4500	8.5-14.5
Goro	2001	650	3200	5-7
	2002	1400	8000	7-14
	2003	3500	20000	10-18
Titan	TIOH	1250	7000	5-14
	TIR	1250	7000	6-14
	TIO	1400	8000	6-14
	TI4	1600	9000	9.5-18
	T2	3500	20000	14-18
Flexco	R5	800	4500	6-11
	R51/2	114	6500	8-15
	R6	140	8000	10.5-17
	F8	800	4500	5-8
	F9	1140	6500	6-9
	F11	1140	6500	8-11
	F12	1400	8000	9-12
	F14	1400	8000	11-14

Note: All polymeric materials deteriorate with age and storage. Most materials have an effective life of six months and unsatisfactory splices may result from using old materials. Storage in warm conditions may reduce effective life further. This warning applies to all splicing materials, regardless of supply source or belt types. We would be pleased to advise further on the storage of such materials.

Field Service & Technical Support

Fenner Dunlop's commitment to our customers does not begin or end with the sale of a high quality belt. Our in-house trained and certified team of service engineers are available to offer a comprehensive range of services worldwide, both above and below ground, including

- SITE SURVEYS
  Reports on conveyor systems, belting and vulcanised/mechanical joints
- SITE VULCANISING
  Our mobile splicing teams are fully equipped to carry out splicing work both underground and on the surface anywhere in the world
- MECHANICAL FASTENERS
  Supplied and fitted on site
- BELT FITTING
  Complete belt changes or belt inserts
- DRUM LAGGING
  Both diamond and plain materials with a cold cure system of bonding to drive drums
- BELT COILING
  Belting up to 2m width coiled in lengths up to 150m

Belt Calculations

BELT CAPACITY CALCULATIONS

Belt capacity can be calculated using the ISO 5048 formula or more readily by the simple Fenner Dunlop method indicated below. The installed belting needs to be wide enough to carry the required peak tonnage at the design speed of the conveyor. The equations (below) in conjunction with the 'B' factors in Table 1 can be used to ascertain either the width of belting required for a new installation or the capacity of an existing conveyor.

When selecting belting to carry two or more types of material, it is imperative that capacity calculations are based on the smallest mass per unit volume.

$$B = \frac{P \times 1000}{D \times S}$$

$$P = \frac{B \times D \times S}{1000}$$

where:

P=Peak capacity (t/hr) B=Belt capacity factor (Table 1)

D=Material density (kg/m³) Table 2 S=Belt Speed (m/s)

BELT SELECTION

Full details of the installation should be given for Fenner Dunlop engineers to cross-check calculations and to give the most economic and reliable belt recommendation. It is essential to have some information on the belt tensile requirement, belt length and width and the material being conveyed.

Where the T1 figure (Tension at Drive Head) is known it should be used as the basis for initial belt selection. Otherwise at least the following information should be given to enable this figure to be calculated

1. Centre distance of conveyor (m).
2. Belt speed (m/s).
3. Peak loading (t/hr).
4. Belt width (mm).
5. Material carried.
6. Type of drive (number of drive pulleys, angle of wrap, and whether steel or rubber lagged) and take up arrangement (e.g. gravity, load sensed or fixed).
7. Net changes in elevation (rise or fall between loading point and delivery point in metres) and maximum gradient (degrees).
8. If known, details of idlers (angle of trough, type of bearings, style of idlers, idler diameters, and pitch).

Alternatively, installed motor power can be used as a rough guide together with belt speed which must be provided. Actual power consumed whilst running fully laden is more relevant than installed power.

Details of the material and general conditions are useful

1. Size of material (maximum lump size, proportion fines to lumps).
2. Loading details (height of drop, direction of feed, etc.).
3. Condition of material (dry/wet, temperature, etc.).
4. Exact nature of material (density, nature - sharp or rounded).

The correct belt selection must consider

- ◆ Belt Capacity
- ◆ Belt tensile strength
- ◆ Requirement due to load and conveyor structure

BELT TENSION CALCULATIONS A

The international Standard ISO 5048 is recommended for the calculation of belt tensions and horsepowers, the following showing the basic formula and data required.

EFFECTIVE TENSION

$T_e = CfLg\,(q_{ro}+q_{ru}+(2q_b+q_g))+(q_gHg)$ Newtons

TENSION AT DRIVE HEAD

$T_1 = T_e \times K$

SLACK SIDE TENSION

$T_2 = T_1 - T_e$

POWER REQUIREMENT @ DRUM

$P_a = T_e \times v$

where:

C = coefficient for length correction

f = coefficient for friction of moving parts

K = drive coefficient

L = Conveyor length (m)

g = gravity force = 9.81 (m/s²)

H = Vertical lift or fall (m)

v = belt speed (m/s)

TABLE 1
Belt capacity factor 'B'

Belt Width mm	Factor
400	50
450	68
500	88
600	125
650	150
750	202
800	230
900	300
1000	375
1050	420
1200	555
1350	725
1400	790
1500	910
1600	1050
1800	1365
2000	1710

TABLE 2
Material densities in kg/m³

Ash (dry/wet)	560/880
Ashphalt (solid/loose)	1900
Basalt	1280/1760
Bauxite	830/1360
Cement (loose)	1200/1360
Chalk (dry/wet)	1040/1360
Clay (wet)	1600
Coal (R.O.M.)	800
Coal (fines)	850
Coke	480
Copper Ore	2080/2560
Foundry Sand	1440/1760
Granite	1280/1400
Gravel (dry/wet)	1440/2000
Gypsum	960/1280
Iron Ore	1360/4800
Lead Ore	2400/4430
Lime (powder)	960
Limestone	1280/1750
Manganese Ore	2720
Peat	320
Phosphate (dry)	1200
Potash	1390
Quartz	1120/2240
Sand (dry/wet)	1140/2080
Sandstone	1360/1440
Slag	1200/1440
Slate	1200/2400
Stone	2400
Sulphur	960/1280
Superphosphate	1000
Wood Chips	300/900
Wood Pulp	480
Zinc Ore	2500

TABLE 3 'G' Factors

Belt Width mm	Idler Diameter 102 mm	127 mm	152/168 mm
400	25	29	37
450	28	32	41
500	29	35	44
600	34	40	50
650	35	43	53
750	40	49	59
800	43	52	62
900	47	65	77
1000	52	71	84
1050	53	74	87
1200	61	84	101
1350	67	93	111
1400		96	114
1500			122
1600			129
1800			144
2000			157

SLOPE TENSION

Theoretically the cosine of the incline angle should be considered, but since at practical conveyor angles this is unity (or near to unity) the incline factor can be ignored. However, on strong inclines (10° or steeper) it may be necessary to correct T_1 to T_{max} because of slope tension (T_{slope}) due to the belt mass being displaced over the gradient.

Simplified

$T_{slope} = q_b \times H \times g$ Newtons

when $T_{slope} > T_2$ then

$T_{max} = T_e + T_{slope}$

and Tmax should be used for belt tensile basis rather than T_1.

Complex undulating or downhill conveyors should consider the worst conditions of load carrying in order to ascertain T_{max} which may not be T_1 at drive.

BELT TENSION CALCULATIONS B

The Fenner Dunlop formulae on this page will give fairly accurate results though various other factors can affect the total power requirement. For example in winter, additional power may be required to overcome initial friction in the idlers and transmission units. Poor chute design and seized idlers will also bring about the need for additional power, as well as promoting unnecessary belt wear. Similarly, if extensive skirt plates are fitted there may be a small additional power requirement, as there will on installations where a tripper exists. Wherever the above factors are likely to be significant Fenner Dunlop should be contacted for advice.

Many similar formulae exist for calculating power requirements all of which are acceptable when correctly applied. It is important however, that attempts are not made to transpose factors and constants from sources other than this brochure into the Fenner Dunlop formulae, otherwise inaccuracies are likely.

The power required to drive a conveyor is comprised of the sum of three separate power elements:-

(a) Power to move load horizontally.

$$= \frac{2.72 \times L \times F \times (C+46)}{1000} \quad kW$$

(b) Power to move empty belt.

$$= \frac{9.81 \times F \times G \times (C + 46) \times S}{1000} \quad kW$$

(c) Power to elevate load.

$$= \frac{2.72 \times L \times H}{1000} \quad kW$$

where:-

C = Centre distance (m)
F = Friction factor (see above)
G = Inertia factor (Table 3)
H = Change in elevation (m)
L = Peak loading (t/hr)
S = Belt speed (m/s)

The total power required
= (a)+(b)+(c)
However, if the load is to be carried downhill, (c) must be subtracted.

Before the optimum belt type for a given installation can be determined, maximum tension (T_1) must be established, and for this, the following information is necessary:

(1) Total power requirement (kW)
(2) Belt width (mm)
(3) Belt speed (m/s)
(4) Take up details
(5) Drive configuration

The maximum tension for which the selected belt must cater can be calculated from the following formula

$$T_1 = \frac{K \times P}{S} \quad kN$$

where:-

K = Drive factor (Table 4)
P = Total power requirement (kW)
S = Belt speed (m/s)

Once this tension figure has been determined it must be divided by the belt width (metres) such that the tension can be expressed in kilonewtons per metre. The appropriate Fenaplast belt type can then be established. Belt selection is based upon the traditional 10:1 factor of safety which has proved satisfactory over many years of field experience. Nowadays, however, modern synthetic fibres, advanced belt designs and improved joint efficiencies enable lower factors of safety to be considered in certain circumstances. Fenner Dunlop will be pleased to advise on specific installations.

Once the appropriate belt has been selected, drum diameters should be checked against the minimum recommended values.

TABLE 4 K

Angle of Wrap degrees	Screw		Gravity	
	Bare	Lagged	Bare	Lagged
180	2.00	1.84	1.64	1.52
200	1.87	1.72	1.54	1.44
210	1.81	1.67	1.50	1.40
220	1.76	1.60	1.46	1.37
240	1.66	1.55	1.40	1.32
250	1.63	1.50	1.37	1.30
270	1.55	1.45	1.32	1.25
300	1.46	1.37	1.26	1.20
360	1.34	1.26	1.18	1.13
420	1.25	1.19	1.13	1.09
430	1.24	1.18	1.12	1.08
450	1.22	1.16	1.11	1.07

COEFFICIENTS C

L	C
<50	2.50
80	1.92
100	1.78
200	1.45
500	1.20
1000	1.09
2000	1.05
4000+	1.03

q_{ro} = top idler mass per metre
q_{ru} = bottom idler mass per metre
q_b = belt mass per metre
q_g = load mass per metre

$$= \frac{tph\ 0.278}{v}$$

F

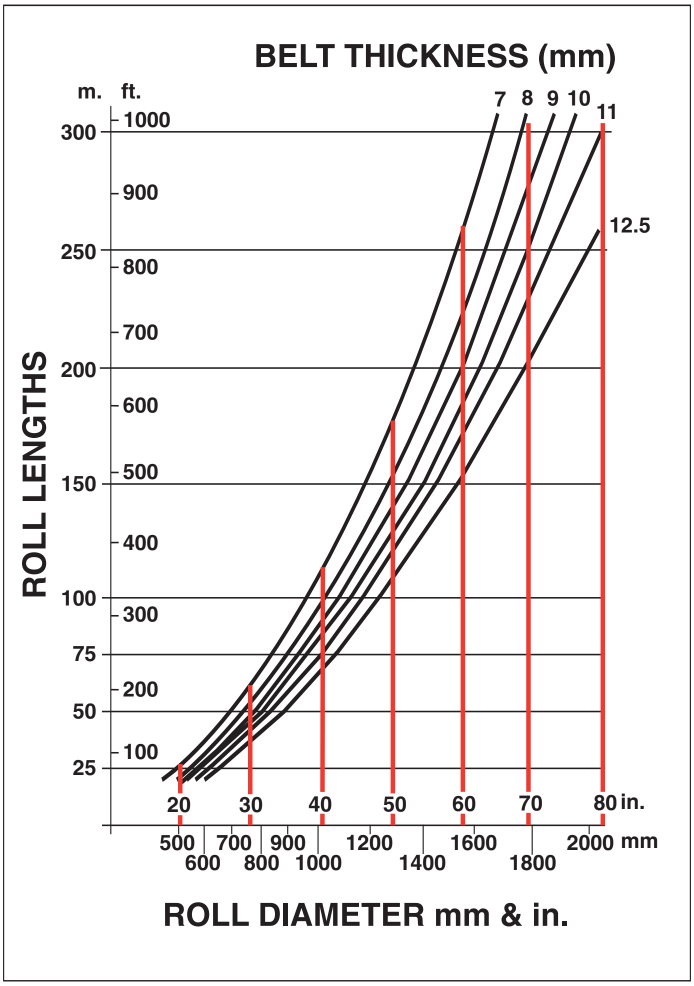
Normally 0.022 can be used but this may be reduced to 0.018 for well engineered and maintained applications or increased up to 0.030 for poor conveyor installations

METRICATION

The following metric/imperial conversion chart provides useful reference.

Yards	to metres	x by 0.9144	hp	to kW	x by 0.746
Feet	to metres	÷ by 3.28	lbf/in	to N/mm	÷ by 5.71
Inches	to millimetres	x by 25.4	lbf	to Newtons	x by 4.4482
lb/ft^3	to kgm^3	x by 16.02	kgf	to Newtons	x by 9.81
ft/min	to m/s	÷ by 197	lb/ft	to kgm	x by 1.49
lb	to kg	÷ by 2.2046	ft^2	to m^2	÷ by 10.76
ton/h	to t/hr	x by 1.016	kg/cm	to N/mm	x by 0.981

Inspection and Shipping



FINAL INSPECTION

Before shipping, belts are 100% inspected and recoiled into a maximum of 3m diameter rolls (the maximum size that can be handled safely through the factory). Double coils can be supplied if there are height constraints. At this point, the customer's preferred mechanical fasteners can be fitted.

PACKING

Central cores are supplied in either wood or steel. Various packaging materials of different durability are used, dependent on transport, site environment and customer preference.

The graph above shows the relationship for belts of various thickness on a 200mm core. The relationship between roll diameter and roll length is given by the formula

$$L = \frac{D^2 - d^2}{K \times t}$$

$$D = \sqrt{(K \times L \times t + d^2)}$$

Where,

D = rolled belt diameter (mm)
d = core diameter (mm)

L = length of belt (m)
t = thickness of belt (mm)
K = 1275 (constant)

Further information on Fenaplast belt handling and storage is available upon request.

Applications


Coal


Salt


Power generation


Man-riding


Potash


Steep gradients


Timber


Gypsum

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