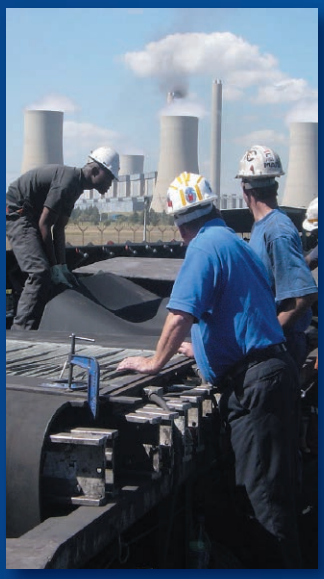
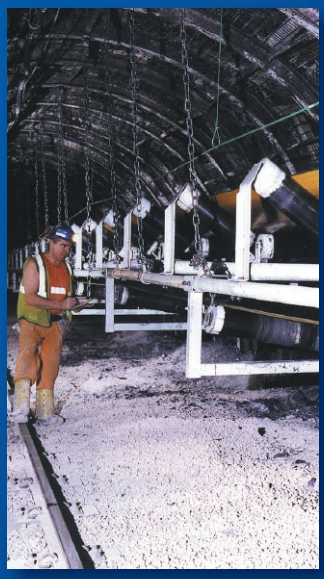
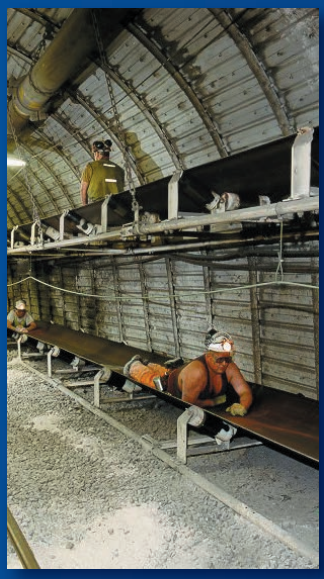
FENNER DUNLOP

ENGINEERED CONVEYOR SOLUTIONS

Solid Woven Conveyor Belting



The World's Leading Conveyor Belt Company

fennerdunlopeurope.com

CONVEYORS - THE BACKBONE OF A MODERN MINING OPERATION

Without efficient conveying, mine production can be severly 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 60 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 is 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.

Fenner Dunlop solid woven belting is manufactured to the same exacting standards in the UK, China, India, South Africa and Australia.

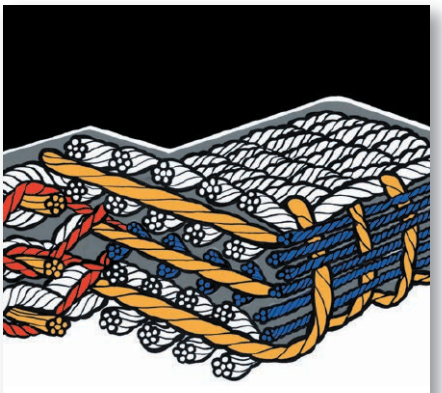
THE ADVANTAGES OF SOLID WOVEN CONVEYOR BELT

Our extensive knowledge of conveyor belt applications, fabric weaving and polymer technology are combined in our market-leading range that has been at the forefront of development for over half a century.

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

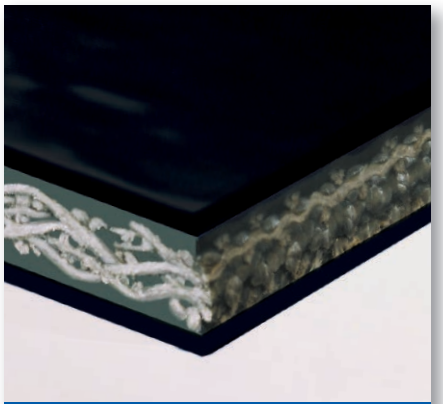
- Fire resistant and anti-static properties which meet the most stringent safety standards in the world
- Greater flexibility, making it easier to trough and track when installed
- A solid woven one piece carcass with no risk of ply separation
- Covers which form an integral bond preventing any form 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



Fenner Dunlop's unique binder warp system

Solid woven carcass prior to PVC impregnation



Finished PVC belting

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 Fenner Dunlop 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, pile warp yarns may be included to further improve impact resistance. Additional edge reinforcement is included where required.

The solid woven fabric is 100% impregnated with PVC to make the finished carcass. Fenner Dunlop's unique, impregnation system renders the carcass impervious to attack from moisture, dirt, chemicals, bacteria and oils.

The countless options available in the construction of the Fenner Dunlop 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. Nitrile rubber covers are recommended for short-centre, high trip rate, steep incline (15-22 degrees), high tonnage installations above and below ground, coal preparation plants, coke works and for hard rock conveying applications.

SPECIAL APPLICATIONS

Tailor-made, low stretch Fenner Dunlop 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 FENNER DUNLOP BELT RANGE

PVC (FR)

Meeting or, in many cases, exceeding the fire-resistance and anti-static requirements of all worldwide safety standards, PVC 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. PVC 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.

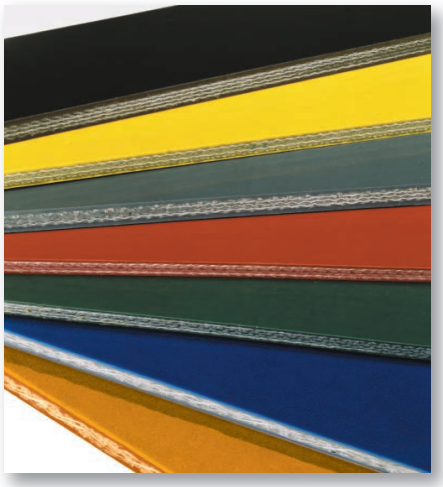
PVG (FRSR)

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

SR

Where there is no requirement for fire resistance SR, a rubber-covered belt for conveying abrasive or difficult minerals, is an ideal solution. 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 CONVEYOR BELTING



SPECIAL CARCASS PROPERTIES

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 in excess of 90°C (the normal limit for standard constructions)
- Improved edge wear protection for extensible and similar applications

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 covers, all of which are available with fire-resistant properties, including:

- Easy clean covers 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 and arid environments
- Leach resistant covers

HI-VIS

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.

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.

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

CENTRE OF EXCELLENCE

Our UK facility is the worldwide Centre of Excellence for Fenner Dunlop solid woven conveyor belting, operating at the forefront of research and development.

PRODUCT TESTING

Externally assessed to ISO 9001:2008, 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.

A key function of the Centre of Excellence is the continual testing of 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.

QUALITY TESTING

All Fenner Dunlop belting is produced within our Quality Management System which is compliant with ISO 9001:2008. 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

It is necessary to ensure that every belt will perform flawlessly throughout its operating life and that the jointing technology used, be it mechanical fasteners or vulcanised splices, performs as expected.

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

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, 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.

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, which utilises a sample length of conveyor belt supported by a steel trestle placed in a cabinet of specified dimensions. A continuous flow of air is drawn through the cabinet whilst the sample of belt is ignited at one end by a gas burner for a defined period of time.

Upon removal of the flame source the length of undamaged belt is quantified by physical measurement and/or mathematical means. Fenner Dunlop's in-house test facility is constructed in accordance with EN 1288-1 (Section 6) Mid Scale Fire Propagation Test and is the only one operating in the UK.

4. ELECTRICAL RESISTANCE TEST

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

Electrical resistance is determined by passing a 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). 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.

SAFETY & QUALITY ASSURANCE

SAFETY

Fenner Dunlop conveyor belting 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
Belarus	MI 600024712.001-2007
Canada	CSA M422-M12
China	MT914
Czech Republic	CS EN 14973 C1
Germany	DIN EN 14973 C2
India	IS3181
Italy	UNI EN 14973 C1
Norway	NS EN 14973 C1
Poland	PN EN 14973 C1 + PN-93-05013
Portugal	IPQ EN 14973 C1
South Africa	SABS 971
Spain	UNE EN 14973 C1
Russia	PD03-423-01
Turkey	TS EN 14973 C1
UK	BS EN 14973 C1
Ukraine	GSTU 12.0018579.001-99
USA	MSHA Title 30 Part 14 & MSHA 2G

Fenner Dunlop belt complies with the requirements of the ATEX Equipment Directive 94/9/EC Equipment and protective systems intended for use in potentially explosive atmospheres.

QUALITY ASSURANCE

In accordance with the requirements of our major customers, the planning, design, manufacture and quality control procedures of Fenner Dunlop have been assessed to ISO 9001:2008, the International Standard for assessment 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.

Fenner Dunlop solid woven conveyor belting for use underground can be manufactured to all relevant international standards.

BELT DESIGNATION	WARP STRENGTH	WEFT STRENGTH	BELT THICKNESS*	BELT WEIGHT*	MINIMUM RECOMMENDED DRUM DIAMETERS	
lbs/in	N/mm	N/mm	mm	kg/m²	High tension mm	Low tension mm
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
-	2000	425	13.9	17.6	1000	750
12000	2100	425	13.9	17.6	1000	750
-	2500	425	14.9	18.6	1250	800
15000	2625	425	14.9	18.6	1250	800
18000	3150	400	20	22.6	1500	1000

**** Nominal values for specific belt constructions with 1+1 PVC covers***

Specification sheets detailing the actual data for any belt type supplied can be forwarded on request. For thicker covers add 1.3kg/m²/mm for PVC and 1.4kg/m²/mm for nitrile covers.

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, whilst others opt for the preferred ISO nomenclature expressed in N/mm. The table on page 8 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/m^2/mm for PVC covers and 1.4 kg/m^2/mm for nitrile 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 WIDTH

Any width up to 2000mm 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.

BELT THICKNESS

When considering cover thickness, please be aware of the high textile content of solid woven 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 a solid woven carcass 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.

ROLL LENGTHS

Customers are asked to specify their maximum acceptable roll diameters and weights so that belts can be supplied in the most suitable roll lengths to avoid unnecessary joints. Belts 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, double or special double coiled rolls can be supplied with fasteners fitted if required. Short belts can be spliced into endless loops as part of the manufacturing process.

The relationship between roll length and diameter is given by the formula:

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

Where,

L = length of belt (m)
D = rolled belt diameter (mm)
K = 1275 (constant)
d = core diameter (mm)
t = thickness of belt (mm)

BELT STRETCH

The unique design and manufacturing process of solid woven belt allows both permanent and elastic stretch to be kept to a minimum. 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.

OPERATING TEMPERATURE RANGE

Above 90°C PVC softens and the belt properties change. PVC belt is therefore not recommended for conveying materials above this temperature. Standard belts can be used in cold climates down to -10°C. Where applicable, cold weather details should be supplied to ensure that belting with suitable coefficient of friction and flexibility characteristics is specified.

FITTED FASTENERS

Mechanical fasteners to customer requirements can be pre-fitted in the factory. Please advise when ordering the belt.

JOINTING OF SOLID WOVEN BELTING

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

HOT VULCANISED FINGER SPLICING

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 moisture and harmful chemicals
- Superior resistance to abrasion
- Easier cleaning
- Reduced spillage

MECHANICAL FASTENERS

The thick, high textile content of the 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, Titan and Flexco are suitable for use with solid woven conveyor belting. 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 mm		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	8-12
	U38A	3500	20000	10-14
	U38	3500	20000	12-15
	U65A	1250	7000	15-18
	U65	1250	7000	6-10
	U67A	1400	8000	8-12
	U67	1400	8000	10-14
	U68A	3500	20000	12-15
	U68	3500	20000	15-18
	H35A	1050	6000	6-9
	H35	1050	6000	7-11
	H37A	1400	8000	8-11
	H37	1400	8000	10-14
	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

All fasteners should be fitted according to manufacturers instructions

NOTE: All polymeric vulcanising materials deteriorate with age. 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.

INSPECTION, PACKAGING & STORAGE

FINAL INSPECTION

Before shipping, belts are 100% inspected. Double coils and Special Double Coils can be supplied if there are height constraints. At this point, the customer's preferred mechanical fasteners can be fitted.

STORAGE OF CONVEYOR BELTING

Belting should be stored coiled with the central axis horizontal. Rolls may be stacked several rolls high providing the resultant pressure does not collapse or distort the centres.

Conveyor belting should be stored and handled in accordance with the guidelines outlined in the following standards:- ISO 2230 - Vulcanised rubber – Guide to storage, ISO 5285 – Conveyor belts – Guide to storage and handling.

Particular attention should be paid to the following.

TEMPERATURE

Ideally the storage temperature should be below 25° C though temperatures up to 40° C can be tolerated. The effects of low temperatures are not permanently detrimental though below 0° C belts become stiffer and care should be taken when handling at and below this temperature. When rolls are removed from storage at low temperatures for immediate use, their temperature should be raised to approximately 20° C throughout before being put into service.

LIGHT

Conveyor belting should be protected from sunlight, in particular direct sunlight and strong artificial light with a high ultra-violet content.

OZONE

As ozone can be particularly damaging to vulcanised rubber, storage rooms should not contain any equipment capable of generating ozone such as high voltage electrical equipment, electric motors or other equipment which may give rise to electric sparks or electrical discharges. Combustion gases and organic vapours should be excluded as they may give rise to ozone via photochemical reactions.

PACKAGING

Belting requiring long term storage should be bound with steel or high tenacity plastic or textile straps and protected with waterproof plastic material. A supporting centre core of suitable dimensions manufactured from wood or steel should be specified at the time of order.

BELT CALCULATIONS

BELT SELECTION

Full details of the installation should be given to Fenner Dunlop engineers for them to cross-check calculations and 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. Angle of trough
7. 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)
8. Net changes in elevation (rise or fall between loading point and delivery point in metres) and maximum gradient (degrees)
9. If known, details of idlers (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

The Fenner Dunlop formulae on these pages 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.

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

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.

$$= \frac{2.72 \times L \times H}{100} \quad kW$$

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

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.

where:-
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 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 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
Cement (loose)	1200/1360
Chalk (dry/wet)	1040/1360
Clay (wet)	1600
Coal (R.O.M.)	800
Coal (fines)	850
Coke	480
Foundry Sand	1440/1760
Gypsum	960/1280
Lime (powder)	960
Limestone	1280/1750
Peat	320
Phosphate (dry)	1200
Potash	1390
Quartz	1120/2240
Sand (dry/wet)	1140/2080
Slag	1200/1440
Slate	1200/2400
Sulphur	960/1280
Superphosphate	1000
Wood Chips	300/900
Wood Pulp	480

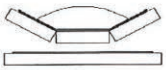
BELT WIZARD

Belt wizard is a powerful mathematical modelling tool used by Fenner Dunlop engineers to ensure compatability of the specified conveyor system with Fenner Dunlop Solid Woven belting. The system calculates all relevant parameters, including tensions, power requirements, transition distances and load capacity as in the example below. These are presented in a report form which can be supplied to the end user in either pdf or hard copy format. Please consult your Fenner Dunlop representative for further details.

Belt Wizard - 1069 m x 1200 mm FR 10000 4 + 2 mm covers

Material Input Data

Tons per Hour	2000 mtph
Description	Coal, ROM Bitum
Material Density	1600 kg/m^3
Surcharge Angle	21 Deg
Lump Size	400 mm
Material Temperature	Ambient
Chute Drop Height	1.0 m
Material Impact	1149.6 N-m



Conveyor Input Data

Horz Center Distance	476 m
Lift / Drop	22 m
Belt Speed	3.2 m/sec
Low Temperature	-15 Deg C

Idler Input Data

	Carry	Return
Angle	30 Deg	0 Deg
CEMA Type	D5	D5
Maximum Spacing	1.5 m	3.0 m
Rotating Weight	17.8 kg	17.6 kg
Seal Drag	8.0 N	2.7 N
Load Rating	5338 N	1890 N

Idler Calculated Data

	Carry	Return
Max Adjusted Load	4557 N	1094 N
Percent Utilised	85 %	58 %

Drive Data

		1	2
Location		5	6
Nameplate Horsepower	kW	250	250
Demand Horsepower	kW	88	88
Efficiency		0.92	0.92
Wrap Angle	Deg	210	210
No of Pulleys		1	1
Lagging Type		Ceramic	Ceramic
Running Friction		0.45	0.45
Wrap Factor		0.24	0.24
Accel/Decel Friction		0.50	0.50
Wrap Factor		0.19	0.19
Drive Ratio		0.50	0.50
Pulley Ratio		0.00	0.00
Sync Speed	RPM	1800	1800
Drive Inertia	N-m^2	67	67
Brake Ratio		0.50	0.50
Brake Torque	N-m	4243	4243

Capacity Summary

Full Volumteric Area	0.220 m^2
100% CEMA Area	0.155 m^2
Edge Distance	158.7 mm
Bed Depth	184.2 mm
Percent Loaded	71.1 %

Belt Input Data

Belt Width	1200 mm
Rated Tension	175 N/mm
Belt Weight	24.1 kg/m

DIN

Friction Factor	0.0221
Length Factor	1.16

Take-Up Data

Type	Auto
No of Pulleys	1

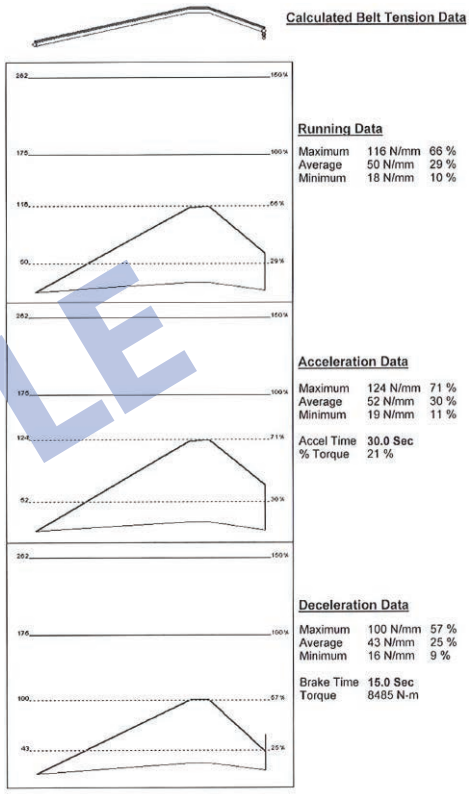
Forces

Belt Tension	24114 N
Counterweight	4918 kg
Percent Sag Allowed	2.0 %
Min Sag Tension	20829 N
Min Slip Tension	6363 N

Travel

Elastic Running	0.8 m
Accelerating	0.8 m
Decelerating	0.6 m
Permanent	1.6 m
Total Travel	2.5 m

	Run N	Accel N	Decel N
Maximum	139,395	148,939	120,307
Average	60,311	62,785	51,614
Minimum	21,885	23,404	18,848
Take-Up	24,114	24,114	24,114
Effective Dr 1	25,666	6,869	-13,919
Effective Dr 2	25,666	7,059	-13,919



Pts	Desc	Run N	Accel N	Decel N
1	Carry	22,006	23,539	18,942
2	Carry	137,388	146,042	120,080
3	Carry	139,395	148,939	120,307
4	Head	74,361	86,486	50,110
5	Drive	74,666	86,817	50,364
6	Drive	49,306	79,948	61,758
7	Snub	23,857	72,889	72,976
8	Takeup Bend	23,986	73,032	73,075
9	Takeup	24,114	24,114	24,114
10	Takeup Bend	24,243	24,258	24,214
11	Return	24,373	24,402	24,315
12	Return	35,052	35,444	34,268
13	Return	35,069	35,586	34,034
14	Tail	21,885	23,404	18,848

TABLE 3 'G' Factors

BELT WIDTH mm	IDLER DIAMETER 102 mm	127 mm	152/168 mm
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

TABLE 4 K

ANGLE OF WRAP DEGREES	SCREW BARE	SCREW LAGGED	GRAVITY BARE	GRAVITY 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

METRICATION - The following metric/imperial conversion chart provides useful reference.

Yards	to	metres	x	by 0.9144
Feet	to	metres	÷	by 3.28
Inches	to	millimetres	x	by 25.4
lb/ft³	to	kgm³	x	by 16.02
ft/min	to	m/s	÷	by 197
lb	to	kg	÷	by 2.2046
ton/h	to	t/hr	x	by 1.016
hp	to	kW	x	by 0.746
lbf/in	to	N/mm	÷	by 5.71
lbf	to	Newtons	x	by 4.4482
kgf	to	Newtons	x	by 9.81
lb/ft	to	kgm	x	by 1.49
ft²	to	m²	÷	by 10.76
kg/cm	to	N/mm	x	by 0.981

TECHNICAL SUPPORT

Fenner Dunlop's commitment to our customers does not begin or end with the sale of a high quality belt. In addition we offer a comprehensive range of services.

TRAINING

A number of different procedures can be used to splice a solid woven belt and accredited supervision and training, on-site or in-house, ensures that a belt is jointed so as to ensure maximum performance.

SITE SURVEYS & CALCULATIONS

Reports on conveyor systems, belting and vulcanised or mechanical joints can be produced and we also offer expert assistance to calculate the parameters of any non standard conveyor.

DESTRUCTIVE TESTING & ANALYSIS

Our testing of new belt is extensive. However we can also test used belt to gauge performance in service. A section of belt removed and sent to us can be tested and analysed to check ultimate tensile strength and to check that original design parameters and agreed factors of safety are still being met. We also offer testing for both mechanical and vulcanised joints.

SITE VULCANISING

Highly qualified splicing teams are fully equipped to carry out splicing work both underground and on the surface anywhere in the world using our extensive range of sectional vulcanising presses.

BELT FITTING

We offer the complete installation of belts or inserts and assistance with developing method statements and risk assessments to ensure that belt changes are completed safely.

DRUM LAGGING

Either in-situ or in our workshops, we can lag drums with rubber, PU or ceramic in different designs and thicknesses, both standard or fire resistant and using hot or cold bonding procedures.

SPLICE MATERIALS

There is a specific splice kit available for every solid woven belt, using the same raw materials used in the production of the belt. Using approved splicing materials and following the approved splice procedure will ensure the highest joint strength and best in-field performance from the conveyor belt.

BELT COILING

Within our factories we have the equipment and capability to coil rolls of belt up to a maximum of 2m wide. Belts can be coiled in a number of ways including Double Coiled and Special Double Coiled when there is limited access, there are height or dimension restrictions or just for ease of installation.

MECHANICAL FASTENERS

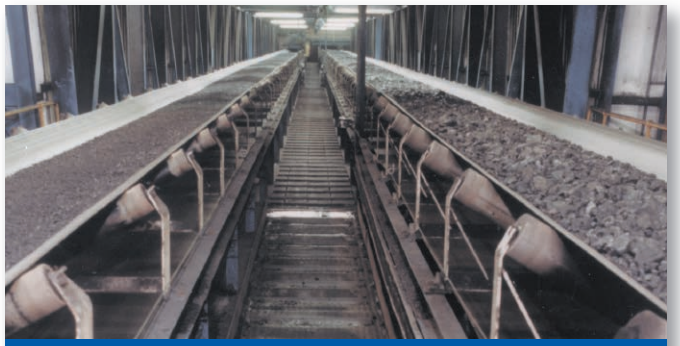
Fasteners chosen by or recommended to customers can be supplied and fitted to belts before delivery. Training for on-site fitting can also be arranged.

APPLICATIONS

Coal

Potash

Gypsum



Power Generation

Steep Gradients

Man-Riding

Salt

Timber

FENNER DUNLOP

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