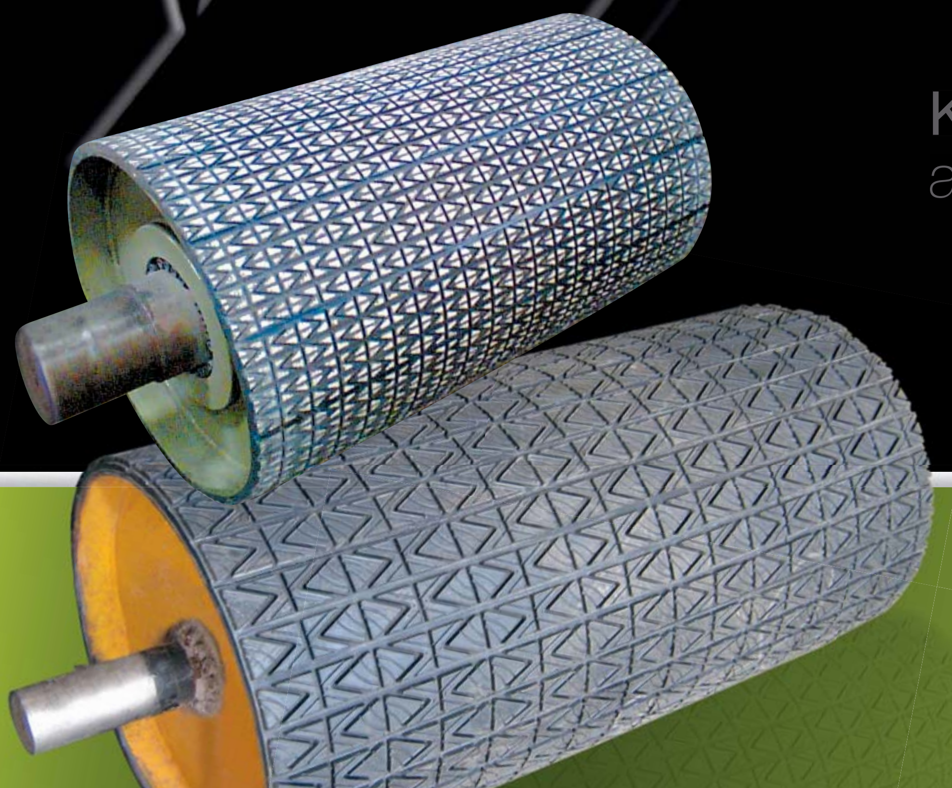
AllRubber WesBelt

Innovators of Rubber Technology



KOLAG Rubber and Ceramic Lagging

Know How & Why How

To know how to manufacture lagging is one thing, but to understand how it works and therefore optimize the design for superior performance is something else. This is what we call the "Why How", and it is the secret to the success of KOLAG rubber and ceramic lagging.

Belt Slip

The drive pulley applies a torque force onto the bottom cover of the belt, to pull the belt along the system. This causes a high tension on the material carry side of the conveyor belt (T1), and the belt may stretch. As the belt passes around the drive pulley, it has less load, and no longer receives the same pulling force, and is therefore able to compress by the time it leaves the pulley, due to lower tension (T2). Given that the pulley is a rigid steel surface, and the belt is an elastomeric material which is contracting, this will inevitably lead to slip between the belt and the steel pulley, as the belt length shrinks while passing over the drive pulley.

This slip will cause wear in both the steel drive pulley and the conveyor belt. KOLAG rubber lagging is used to reduce this effect by acting as an intermediate layer which is able to be fixed to the steel at one end, and contract with the belt at the other end. The diagram below illustrates how the unique embossed design of KOLAG Arrow-Boss and Butterfly Lagging designs, enable the lagging to distort when compressed and spring back when not. This highly dynamic design has higher amount of grooves than most conventional lagging, to optimize this feature and reduce wear.

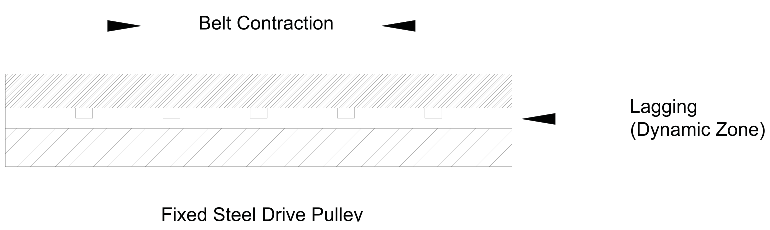


Diagram 2 Above: Action of Lagging to Prevent Slip

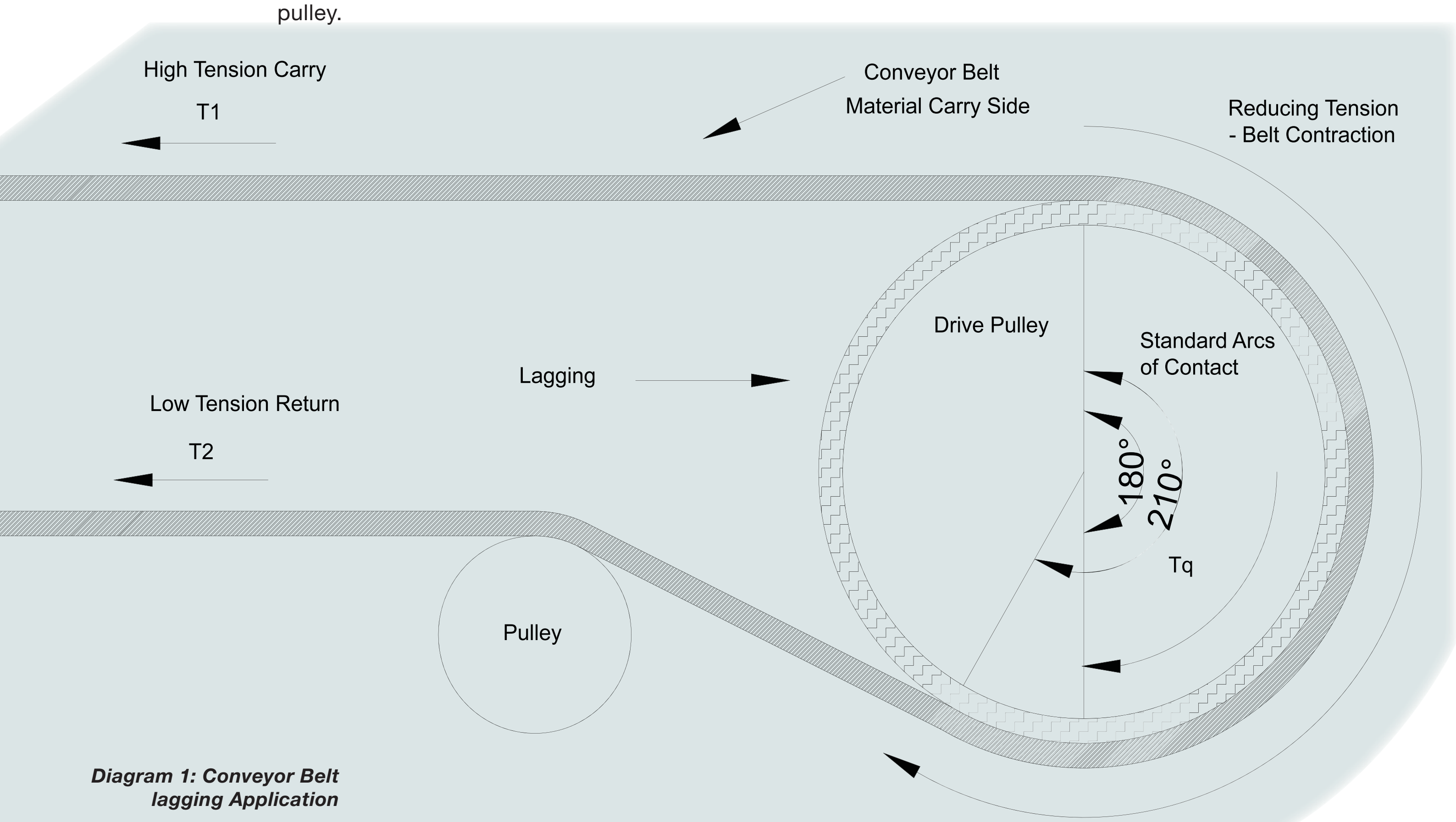


Diagram 1: Conveyor Belt lagging Application

KOLAG Rubber and Ceramic Lagging

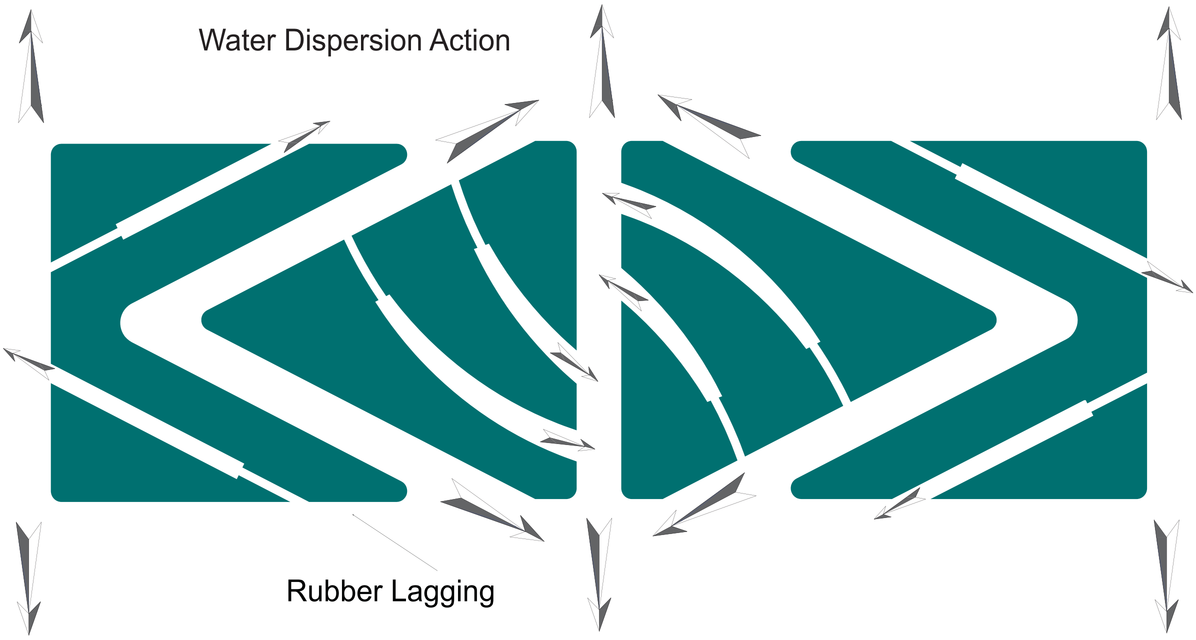


Diagram 3: KOLAG Arrow-Boss Design

Coefficient of Friction

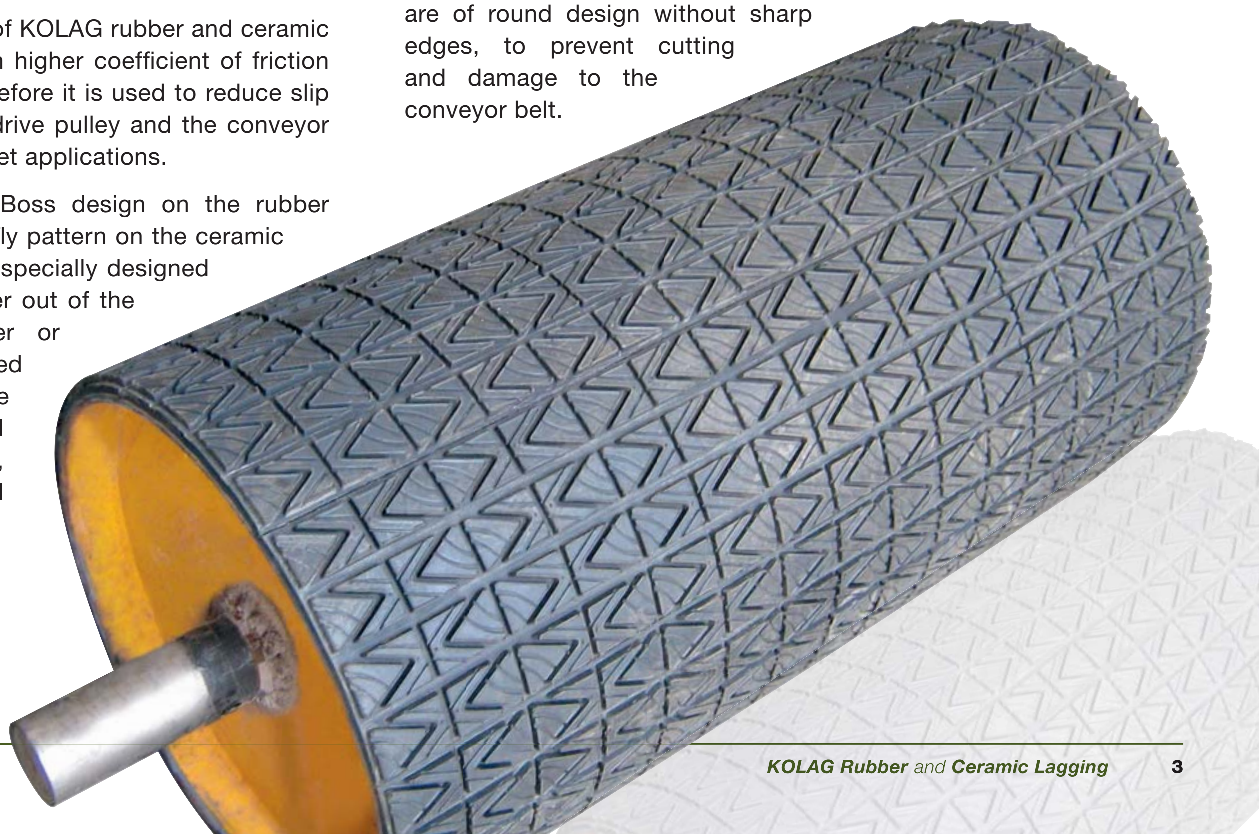
The degree of friction between the conveyor belt and the drive pulley is a key element in reducing wear. The greater the amount of friction the less slip between the belt and the steel pulley, and therefore the less wear and greater operational efficiency of the conveyor system. The amount of friction between two surfaces can be measured and given a value call the Coefficient of Friction (CoF). The higher the CoF, then the less will be the slip.

The unique design of KOLAG rubber and ceramic lagging has a much higher coefficient of friction than steel, and therefore it is used to reduce slip between the steel drive pulley and the conveyor belt, especially in wet applications.

The unique Arrow-Boss design on the rubber lagging, and Butterfly pattern on the ceramic lagging, have been specially designed to "pump" the water out of the lagging. The water or mud is then pushed through the unique radial grooves, and horizontal grooves, for maximum speed of displacement.

Wear Resistance

Due to slip and factors mentioned above, rubber lagging will eventually wear out. KOLAG lagging uses rubber of very high abrasion resistance to give longer life to the lagging. In addition ceramic tiles are used in areas of high wear or high slip. The ceramics have dimples on the surface to greatly improve the Coefficient of Friction, between the lagging and the conveyor belt. The ceramics also have a very high resistance to abrasion, which prolongs the life of the lagging. The dimples are of round design without sharp edges, to prevent cutting and damage to the conveyor belt.



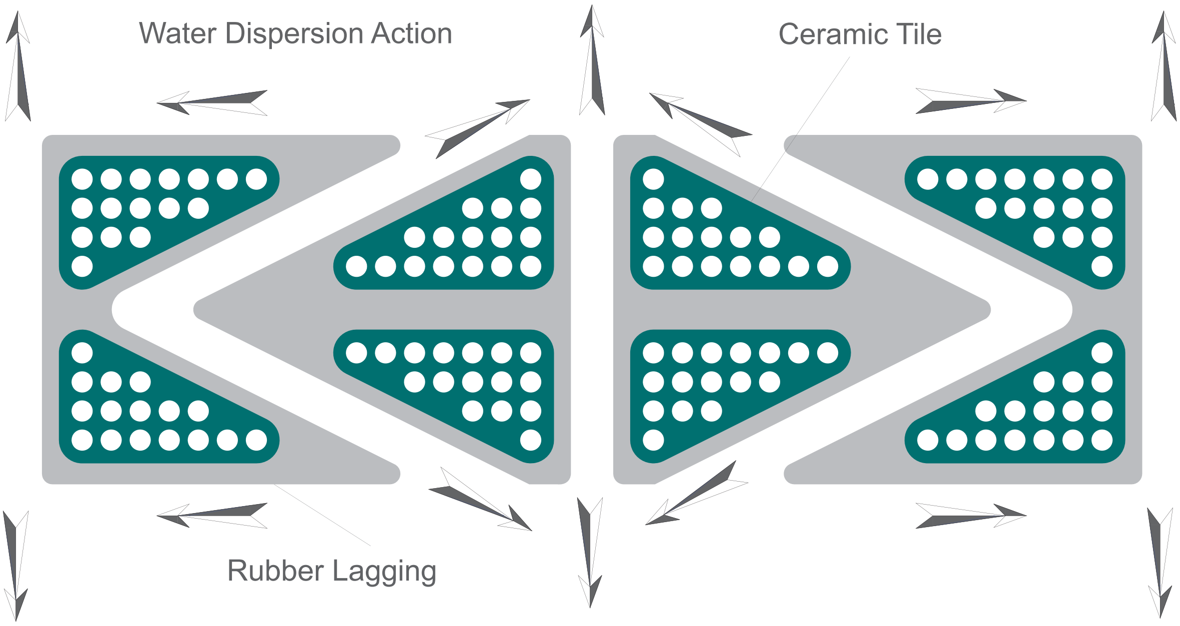


Diagram 4: KOLAG Butterfly Design

Ceramic Lagging

All Rubber Pty. Ltd., was the first company in Australia to manufacture ceramic lagging with individual tiles fully encapsulated in a conventional rubber rhomboid pattern. This fixed a major problem of tiles delaminating from the rubber base lagging, due to being too rigidly packed one against the other, and not having sufficient bonding area. The ceramic tiles are rigid in nature, and the dynamic mechanical action required as the belt passed over the drive pulley, would cause the tiles to come loose.

This original design was later evolved into the current unique "Butterfly" ceramic lagging, which has proven to give high performance in some of the world's largest mining operations for over six years. The success of this lagging is due to the design of the encapsulating rubber providing a highly dynamic base, together with the unique water shed properties of the "Arrow-Boss" pattern.

The size and shape of the triangular tile, also helps to overcome the problem of tile breakage and delamination as experienced on other ceramic lagging. Being small in nature and encapsulated with rubber on all sides, gives the highest bonding ratio to surface area of any comparable lagging.

Sizing Options

KOLAG ceramic lagging can be supplied as individual strip lengths to suit specific pulley face dimensions. These strips consist of a length of ceramic tiles, with rubber flaps on each end for ease of trimming to suit the pulley. They are specified as comprising of a Ceramic Length (CL) dimension, and a Rubber Length (RL) dimension.

Hot Bonding of precured Rubber & Ceramic Lagging

Kolag is also available is specially manufactured strips that allow it to be hot bonded onto pulleys. This unique innovation allows for press cured strip lagging to now have the additional advantage of hot bond to the steel pulley. The high physical properties that are achieved from a press-cured sheet, manufactured under heavy tonnage, can now be incorporated in a hot bond application, thereby achieving the greatest possible bond strength.

This unique bonding technique was developed in Chile and is now available worldwide with Kolag rubber and ceramic lagging....

KOLAG Rubber and Ceramic Lagging

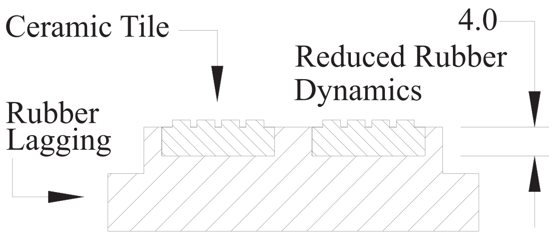


Diagram 6 Above:
Side View of Tiles Embedded in Rubber

Standard Roll:
205mm Wide x 6.5mtr Long.

Thickness options for rubber lagging are 10mm, 12mm, 15mm and 20mm. For ceramic lagging it is traditionally 12mm total thickness. However when rigid ceramic tiles are embedded 4mm into the rubber, this typically reduces the dynamic nature of the rubber, since the tile is not elastomeric. To overcome this effect, KOLAG ceramic lagging is now also available in thicker strips.

Advantages of Ceramic Tile Butterfly Pattern

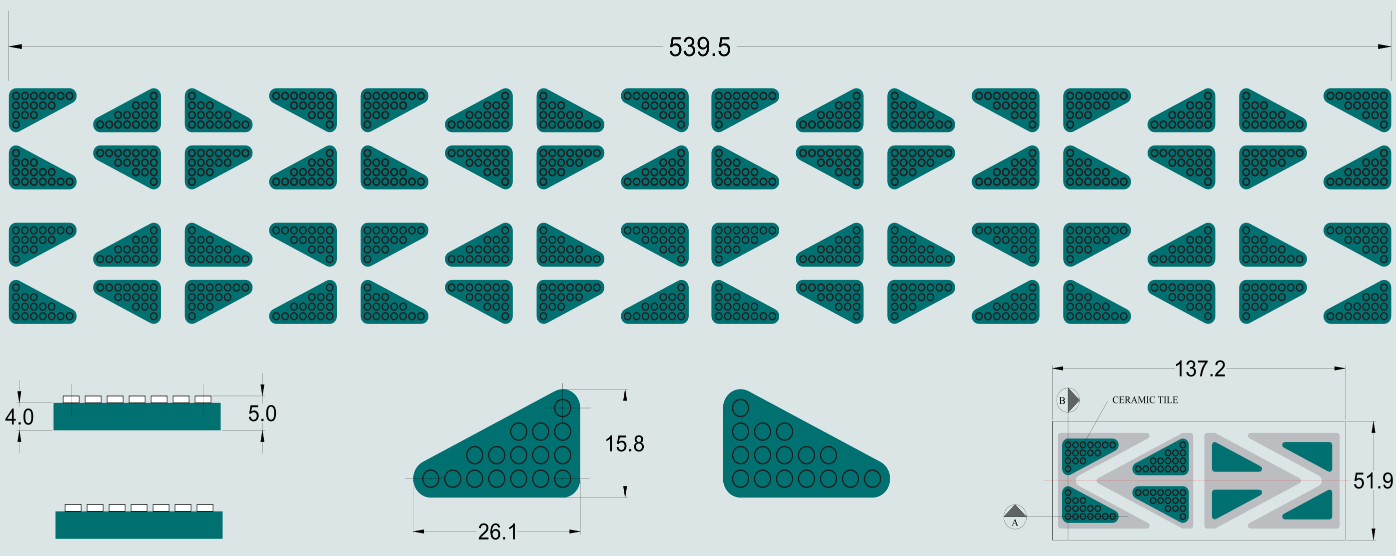
1 High percentage bond area (BA)/surface area (SA) = Exceptional tile bond strength.

- Butterfly Lagging: [(BA) 647mm2/(SA) 286mm2] x 100 = 226% Bond Strength
- Conventional 20mm x 20mm square lagging (without encapsulation): [(BA) 400mm2/(SA) 400mm2] x 100 = 100% Bond Strength

2 High percentage ceramic content. KOLAG ceramic lagging has achieved the perfect balance of sufficient amount of high abrasion resistant ceramic tiles to resist wear, any yet sufficient embossed rubber to retain mechanical dynamics. The ceramic content per area of rubber lagging is 32%, as shown below:

- Area of Repeating Segment = 137.2mm x 51.9mm = 7120.7mm2
- Area of Tile = 286mm2
- No. of Tiles in repeating segment = 8 off.
- Percentage Ceramic Content = [(286 x 8) /7129.7] x 100 = 32.1%

Diagram 5 Below:
Ceramic Tile Sizing



3 High percentage Al2O3 oxide in ceramic tile to give maximum wear resistance.
• 92% min. Al2O3 content.

4 Excellent mechanical dynamics to resist slip and prevent tile delamination.

5 High abrasion resistant and tensile strength rubber backing, to suit various physical property requirements such as fire resistance (FRAS), oil resistance, heat resistance.

6 Can be provided in specific lengths to suit specific pulley face dimensions or in continuous length of 6.5mtr roll which can be trimmed to suit any pulley. This unique continuous roll form ensures that there is always stock to lag pullies of any size, giving faster turnaround time, and lower inventory costs.

7 Can be hot bonded onto pulleys, which is especially desirable for high tension/high speed belts, where heat resistant high strength bonds are required. For cold bonding an adhesion promoting bonding layer is supplied, or a buffed finish can be optional.

8 Can be supplied in thickness of up to 15mm to give improved mechanical dynamics.

9 High coefficient of friction.

10 Round dimple design. No sharp edges to cause damage to conveyor belts.

11 Prevents buildup. Continuous movement of the rubber lagging prevents buildup of material and glazing of the lagging.

Coefficient of Friction

The maximum tension T1, generated in any conveyor belt is he tension which is required to be imparted on the belt in order to transmit, through traction, at the belt-pulley interface, the tension, Te, necessary to overcome all the system resistances and convey the desired throughput at stipulated operating parameters (refer diagram 1). The residual tension T2, is responsible for maintaining the integrity of the belt run and limits the inter-idler sag of the belt to permissible limits. The three tension values are related through mathematical equations, namely

T1 – T2 = Te, and
T1/T2 = $e^{\mu\theta}$
μ = Coefficient of friction between belt and pulley
θ = Arc of contact between belt and pulley

The value of μ is determined using the dynamic test rig as shown below. A section of belt is wrapped around a pulley (180 degree Arc of Contact) with a constant load on one end. A motor applies a torque force to the pulley. At a threshold torque the pulley begins to rotate.

KOLAG Rubber and Ceramic Lagging

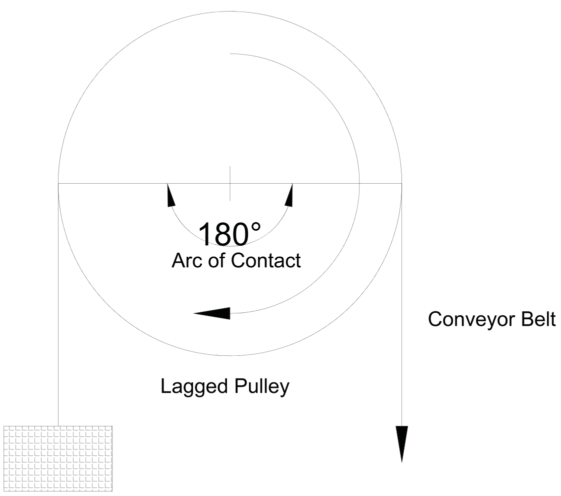
Aerospace design technology

The unique Butterfly ceramic lagging design, and the Water-groove rubber lagging design, have been inspired by the radial tread patterns used on aircraft and formula one high performance racing cars. The vertically grooved lines in these tyres are the most efficient means of shedding water and mud, since it represents the shortest distance from the centre of the tyre to the edge where the trapped water can be expelled. This is even more critical in pulleys, which can be over 3 meters in face width.

The cross-sectional circumference of the pulley in a conventional conveyor belt will generally always be significantly less in distance from the centre to the edge (covered by the belt), than it will be to the edge of the pulley. Therefore this much lower displacement distance that the water will have to travel, directly correlates to the time required to displace the water, and therefore effective drainage. Obviously if the water-shedding is more effective, the belt will be dryer, and therefore the coefficient of friction will be higher. This all translates into less slippage, and more effective drive of the conveyor system. Kolag is the only lagging which utilises this classical aerospace design of radial grooved drainage lines. In addition it also still retains the horizontal drainage lines, as well as the traditional herringbone pattern. This three way drainage system gives it superior performance in the field.

Aircraft tyre with radial grooves.

Test Rig for Determining Coefficient of Friction

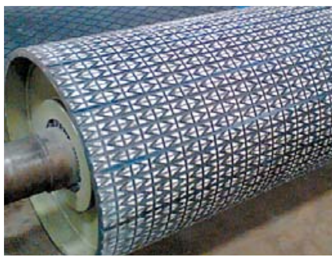


From the second relationship above (T1/T2 = $e^{\mu\theta}$) we see that the tension on the belt (T1) increases significantly as coefficient of friction (μ) increase. Increasing the coefficient of friction therefore has the following benefits:

- Reduced belt tension required
- Reduced slip and therefore less wear on belt and lagging
- Reduced load on shaft and bearings

The frictional force is significantly increased in the ceramic lagging due to the mechanical of the dimples. However care has been taken that this does not damage the conveyor belt. The following table shows the observed coefficient of friction results for Kolag lagging, and also shows the commonly accepted values for calculation purposes.

Coefficient of Friction	Observed value
KOLAG CERAMIC	
Wet :-	0.56
Dry :-	0.84
KOLAG RUBBER STRIP	
Wet :-	0.35
Dry :-	0.50



Bare Steel Pulley COF Typically 0.25 – 0.3

Kolag - Pulley Lagging Sheets

Specially formulated abrasion resistant sheets, with a CN bonding layer for better adhesion. Diamond and square embossed grooves improve belt grip and tracking on conveyors, while reducing belt wear. Available in various grades of rubber including N and FRAS.

Prepare metal surface as described using Konprim primer and Kontact cold vulcanizing cement. Special polymer bonding layer produces a superior bond and eliminates the need for buffing the rubber prior to bonding.

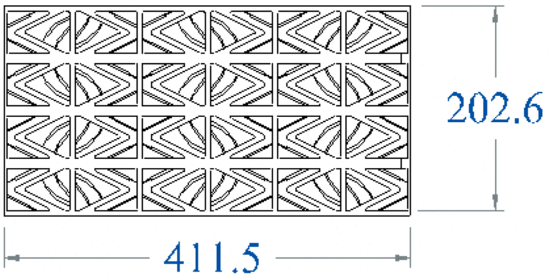
Physical Data	
Thickness	8mm, 10mm, 12mm & above to order
Length	10 mtr roll
Shore A hardness	65 +/-5
Description	High abrasion resistant “N” grade rubber (FRAS and specialty compounds also available). Pulley lagging material.
Tensile strength	>18 MPa
Density	1.13 kg/dm3
Elongation	350% min
Specific Gravity	1.2 gr.cm3
Colour	Black
Width	2000mm and 1700mm

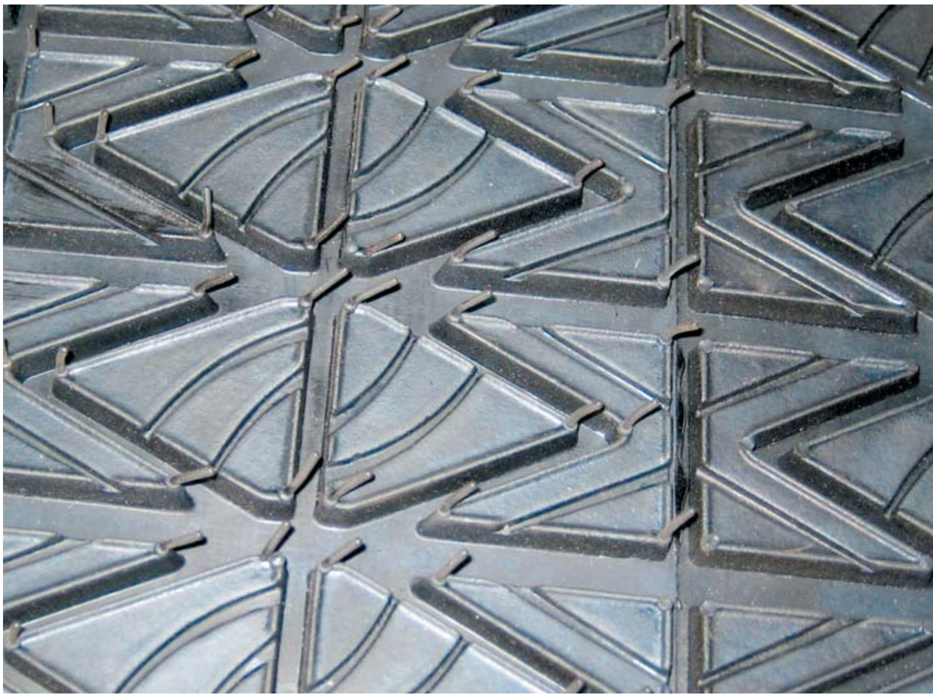
Ordering Information

Code	Description	Mass (kg/unit)	Measure (units)	Order (unit lots)
KOLGSHNSP0817	Kolag square lagging 8mm x 1.7mt x 10mt N	8.0	m2	17
KOLGSHNSP1017	Kolag square lagging 10mm x 1.7mt x 10mt N	10.0	m2	17
KOLGSHNDP1020	Kolag Diamond lagging 10mm x 2mt x 10mt N	13.4	m2	20
KOLGSHNDP1220	Kolag Diamond lagging 12mm x 2mt x 10mt N	16.4	m2	20
KOLGSHNDP1520	Kolag Diamond lagging 15mm x 2mt x 10mt N	16.4	m2	20
KOLGSHFDP1020	Kolag Diamond FRAS lagging 10mm x 2mt x 10mt	10.1	m2	20
KOLGSHFDP1220	Kolag Diamond FRAS lagging 12mm x 2mt x 10mt	10.1	m2	20
KOLGSHFDP1520	Kolag Diamond FRAS lagging 15mm x 2mt x 10mt	12.38	m2	20

Kolag - Pulley Lagging Strips

Kolag strips of pulley lagging rubber is especially suited to in-situ work. Easily applied by cutting lengths off a roll, reduces wastage. Available also in fire resistant and antistatic (FRAS) compounds for use in underground mines. Kolag strips are produced in a unique "arrowboss" pattern for superior grip, with radial lines and groved pattern for superior water shedding. Buffed finish for fine tolerances of up to +/- 0.25mm, or optional bonding layer.





Physical Data		
Physical Properties	**Natural**	**FRAS**
Colour	Black	Black
Description	High abrasion resistant rubber.	Fire res. antistatic wear res.
Hardness	(DIN 53505) 65 +/- 5 duro shore A	70 +/- 5 duro shore A
Specific Gravity	1.2 gr.cm3	1.25 gr. cm3
Tensile strength	>18 MPa	>17 MPa
Elongation at break	350% min	450%.
Max Operating temperature	70.C.	80C.
Width	205mm.	205mm.
Abrasion Resistance(DIN 53505)	110mm3.	190mm3.

Ordering Information

Code	Description	Mass (kg/unit)	Measure (units)	Order (unit lots)
KOLGSTNWP1020	Kolag strip lagging 10mm x 205mm x 6.5mt B/L	13.0	roll	1
KOLGSTNWP1220	Kolag strip lagging 12mm x 205mm x 6.5mt B/L	15.8	roll	1
KOLGSTNWP1520	Kolag strip lagging 15mm x 205mm x 6.5mt B/L	21.6	roll	1
KOLGSTFWP1020	Kolag FRAS strip lagging 10mm x 205mm x 6.5mt B/L	13.5	roll	1
KOLGSTFWP1220	Kolag FRAS strip lagging 12mm x 205mm x 6.5mt B/L	16.5	roll	1
KOLGSTFWP1520	Kolag FRAS strip lagging 15mm x 205mm x 6.5mt B/L	22.5	roll	1

Kolag - Ceramic Pulley Lagging

Ordering Information				
Code	Description	Mass (kg/unit)	Measure (units)	Order (unit lots)
CLFBP1220048	Kolag cerstr FRAS 480CL/730RL suit 450mm belt	2.3	1	strip
CLFBP1220062	Kolag cerstr FRAS 620CL/867RL suit 600mm belt	2.9	1	strip
CLFBP1220075	Kolag cerstr FRAS 750CL/1000RL suit 750mm belt	3.2	1	strip
CLFBP1220089	Kolag cerstr FRAS 890/CL1140RL suit 900mm belt	3.5	1	strip
CLFBP1220103	Kolag cerstr FRAS 1030CL/1280RL suit 1050mm belt	4.1	1	strip
CLFBP1220117	Kolag cerstr FRAS 1170CL/1415RL suit 1200mm belt	4.3	1	strip
CLFBP1220137	Kolag cerstr FRAS 1370CL/1620RL suit 1350mm belt	5.2	1	strip
CLFBP1220144	Kolag cerstr FRAS 1440CL/1690RL suit 1500mm belt	6.4	1	strip
CLFBP1220178	Kolag cerstr FRAS 1780CL/2030RL suit 1800mm belt	7.2	1	strip
CLFBP1220199	Kolag cerstr FRAS 1990CL/2030RL suit 2000mm belt	7.2	1	strip
CLFBP1220206	Kolag cerstr FRAS 2060CL/2310RL suit 2100mm belt	7.6	1	strip
CLFBP1220219	Kolag cerstr FRAS 2195CL/2445RL suit 2200mm belt	8.0	1	strip
CLFBP1220649	Kolag cerstr FRAS 6490CL	26	1	strip
CLNBP1220048	Kolag cerstr N 480CL/730RL suit 450mm belt	2.3	1	strip
CLNBP1220062	Kolag cerstr N 620CL/867RL suit 600mm belt	2.9	1	strip
CLNBP1220075	Kolag cerstr N 750CL/1000RL suit 750mm belt	3.2	1	strip
CLNBP1220089	Kolag cerstr N 890/CL1140RL suit 900mm belt	3.5	1	strip
CLNBP1220103	Kolag cerstr N 1030CL/1280RL suit 1050mm belt	4.1	1	strip
CLNBP1220117	Kolag cerstr N 1170CL/1415RL suit 1200mm belt	4.3	1	strip
CLNBP1220137	Kolag cerstr N 1370CL/1620RL suit 1350mm belt	5.2	1	strip
CLNBP1220144	Kolag cerstr N 1440CL/1690RL suit 1500mm belt	6.4	1	strip
CLNBP1220178	Kolag cerstr N 1780CL/2030RL suit 1800mm belt	7.2	1	strip
CLNBP1220199	Kolag cerstr N 1990CL/2030RL suit 2000mm belt	7.2	1	strip
CLNBP1220206	Kolag cerstr N 2060CL/2310RL suit 2100mm belt	7.6	1	strip
CLNBP1220219	Kolag cerstr N 2195CL/2445RL suit 2200mm belt	8.0	1	strip
CLNBP1220649	Kolag cerstr N 6490CL	26.0	1	strip

Kolag - Ceramic Pulley Lagging

Kolag ceramic lagging is a ceramic embedded rubber strip lagging. The ceramic tiles are designed with a dimple profile to ensure there is minimal slippage between the belt and drive pulley.

It is especially suitable for wet or muddy applications where slippage can be a problem. The rough ceramic face produces an excellent coefficient of friction between the conveyor belt and the pulley. In some cases this can be up to two times the friction ratio that can be generated with conventional rubber lagging.

The ceramics also are much more wear resistant than conventional rubber lining, and consequently it will be longer before replacement becomes necessary.

The unique "arrow-boss" design, produces a ceramic lagging which is on an embossed rubber pattern. This achieves the maximum water shedding benefits of a conventional rubber lagging, together with the intrinsic benefits of the added ceramics.

The vertical radial troughs in the design incorporate the latest technology derived from formula one racing car tyres, which dictates that the most efficient water shedding pattern is effected by using vortical radial grooves. Kolag comes with a buffed finish or optional bonding layer, to enable it to be cold bonded on site. The benefits of reduced belt slippage will also result in improved conveyor belt life.

Ceramic Tile Specifications	
Aluminium Oxide (min) Al_2O_3	92%
Density (g/cc)	3.65
Hardness (R 45 N)	79 min.
Cold Crushing Strength (Mpa)	2050 min.
Flexural Strength at Room Temp. (MPa)	240 min.
Water absorption	0%
Test	**Specification**
Abrasion by Impingement	0.05 grams max.
Abrasion by Rubbing	0.1 grams max.

Base Rubber Specification	
Compound Code	**R-1608**
Polymer	SBR
Specific Gravity	1.13 +/- 0.03
Shore Hardness °A	60 +/- 5
Elongation at break % Min.	450%
Tensile Strength	17.5 N/mm2
Abrasion Loss	150 mm^3 at 10N

AllRubber WesBelt

Innovators of Rubber Technology

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Distributed by:

Issue date: MARCH 2012