MERCURIO
CONVEYOR BELT

MANUAL OF CONVEYOR BELTS AND SPLICES

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CEP: 13.321-441
Phone/Fax: +55 (11) 2840-0137
E-mail: contato.br@publischoba.com
www.editoraschoba.com.br

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History of Mercurio

In the middle of World War II when Brazil was passing through a great shortage of products and the industrialization process of the country was in the beginning, two engineers, one from the textile industry and another from the rubber industry, saw the opportunity to unite their experiences and began to manufacture power transmission belts. **This is how Mercurio Conveyor Belt was born in 1945**, starting in the garage of one of its founders manufacturing power transmission belts for engines of imported vehicles circulating in the country.

At that time the American automakers had not yet standardized the dimensions of the belts, making it necessary to produce a type of belt for each car model.

It was this way, producing belts tailored made for each customer, that the name Mercurio Conveyor Belt began to be synonymous with quality.

As time passed, the small garage company turned into a full-fledged industry with more than 500 employees and facilities that today occupy more than 27,000 m2 in the city of Jundiaí in the State of São Paulo.

With a policy of sustainable but bold investments to increase its productive capacity, Mercurio Conveyor Belt has consolidated its presence in the Brazilian market and has become Latin America's **largest conveyor belt manufacturer and one of the most important in the world.**

Today, the Mercurio Conveyor Belt brand can be seen on a large quantity of products ranging from the most basic belts to the most complex and modern conveyor belts and elevator belts. And even with all this growth, something still remains unchanged: **each belt is designed and manufactured always taking into account the customer's specific needs, as if they were the only ones.**

This commitment to its customers and to quality makes Mercurio Conveyor Belt much more than a simple belt manufacturer, but a real industry of solutions ready to solve material conveying and lifting problems. An industry that grows daily offering not only products, but also technical support in search of the best solution, always in a close partnership with its customers.

That is why Mercurio Conveyor Belt is today synonymous with tradition and quality.

Our Products

With a broad product portfolio, Mercurio Conveyor Belt has the ideal solution for your needs and applications. Talk with our highly specialized Application Engineering and Technical Assistance team!

These are some of Mercurio's products:

- **Mercurio PP Textile** Conveyor Belt
- **Mercurio EP Textile** Conveyor Belt
- **Mercurio ST Steel Cord** Conveyor Belt
- **Mercurio Steel Cord Pipe** Conveyor Belt
- **Mercurio Textile Pipe** Conveyor Belt
- **Mercurio MercoRip** Conveyor Belt
- **Mercurio Aramid** Conveyor Belt, etc.

There are also several Covers for the most varied applications:

- Flame Retardant;
- Transportation of Grains;
- Abrasion Resistant;
- High Temperatures, etc.

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SUMMARY

1. Conveyor Belt Components

In principle, a conveyor belt is made up of two basic components:

- **Carcass**
- **Cover**

Due to their importance, special attention will be given to these components below.

In addition to these, the belt may contain other components to meet certain applications, such as:

- **Cleats:** for conveying on inclined flights.
- **Shock absorbing fabric:** to assist in dampening impacts.
- **Skirtboards:** to ensure the belt's path in critical situations.
- **Self-sliding fabric:** to facilitate the belt's movement over polished surfaces.
- **Coated edges:** The coated edges used on conveyor belts serve as a buffer to protect the carcass, absorbing small impacts and preventing the entry of material from the sides of the belt since over time the small gaps that exist between the rubber and the plies may lead to them disconnecting.

1.1. Conveyor Belt Carcass

The carcasses of the Conveyor Belts can be made of textile fabric or steel cords and their correct specification is of fundamental importance in the belt's performance because it is responsible for:

- Resisting the **tension**[1] generated by the drive and the weight of the material conveyed.
- Resisting, together with the cover, the impact of the material on the belt.
- Ensuring the correct trough of the belt on the idlers.

The textile fabric can be manufactured with synthetic or natural fibers, but due to its best technical characteristics, most conveyor belts have plies made from synthetic fibers, which are as follows:

- **Polyester**
- **Nylon**
- **Aramid**

1. In reality, the correct term is "force" or "effort". The term "Tension", although used improperly, was kept in this handout because it is of common and current use among industry professionals.

The resistance of the belts is normally identified by its admissible tension, which is the maximum tension that the belt may be submitted to on the conveyor (Tables 1 and 2).

The Mercurio Conveyor Belt uses synthetic plies on its conveyor belts manufactured from the following three fibers:

• **EP:** Fabric manufactured with polyester fibers in the warp (longitudinal) and nylon in the weft (transversal)
• **PP**: Fabric manufactured with nylon fibers in the warp and nylon in the weft
• **ARAMID:** Fabric manufactured with aramid fibers in the warp and nylon in the weft

Each of these fibers has its own characteristics, which make them suitable for certain applications.

For example, nylon, when compared to polyester, has the characteristic of presenting higher elongation, which makes belts with NN type fabric to be more suitable in terms of impact, since the absorption will be more efficient. On the other hand, for large conveyor belts at high tensions, polyester becomes more appropriate.

Type of Textile (PP and EP)	Admissible Tension (kgf/cm)
PN1200	12.5
PN2200	22
PN3000	33
PN4000	44
PN5000	50
PN6500	65
PN1100	26
PN1800	36

Table 1

Type of Textile (Aramid)	Admissible Tension (kgf/cm)
DP630	63
DPP800	80
DPP1000	100
DPP1250	125
DPP1600	160
DPP1800	180
DPP2000	200
DPP2500	250
DPP3150	315

Table 2

- Orders by special request

1.2. Covers

They have the main function to protect the carcass against the attack of the material conveyed. For each type of application and material to be transported, there is a suitable coating made from specific rubber compounds.

A rubber compound is a mixture of several ingredients (chemicals) that give it various types of properties so that is able to perform the function for which it was designed. Among the various ingredients such as activators, protectors, accelerators, process agents, plasticizers, dyes, etc., **elastomers** have a prominent position.

The elastomer is the main element of the composition. Made up of an entire cluster of molecules of high molecular weight (called a Polymer), it is the element that gives the characteristics of chemical, physical, and processing resistance (Table 3). There are several types of elastomers, and the most used are as follows:

- **NR:** Natural Rubber
- **NBR:** Nitrile Rubber
- **SBR:** Butyl Rubber
- **CR:** Chloroprene Rubber or Neoprene
- **EPDM:** Ethylene-Propylene
- **BR:** Polybutadiene

Elastomer	Resistance to Abrasion	Resistance to Oil Derivatives	Resistence to Acids	Resistance to temperature
NR	EXCELLENT	LOW	LOW	GOOD
SBR	VERY GOOD	LOW	LOW	GOOD
NBR	GOOD	EXCELLENT	GOOD	GOOD
CR	GOOD	GOOD	EXCELLENT	GOOD
EPDM	GOOD	LOW	GOOD	EXCELLENT
BR	EXCELLENT	LOW	AVERAGE	GOOD

Table 3: Some characteristics of the elastomers

To meet the most diverse types of application, the Mercurio Conveyor Belt has developed through its highly equipped lab and state-of-the-art technology, covers to transport virtually any type of material.

The following types of covers are currently being used at Mercurio Conveyor Belt:

- High Abrasion (AB)
- Extra Abrasion (EA)
- Extra Abrasion Plus (EA PLUS)
- Extra Abrasion Super (EAS)
- Extra Abrasion Super Plus (EAS PLUS)
- X-Extra Abrasion (X-EAS)
- Impact and Rip (MERCORIP)
- High Temperature (AT)
- High Temperature Super (ATS)

- High Temperature Super Plus (ATS PLUS)
- Nitrile Oils and Acids (OAN)
- Mercochama (AC)
- Mercochama Plus (AC PLUS)
- Extra Abrasion Resins (EAR)
- Grain Transportation (TG)
- Grain Transportation Super (TGS)

The name of the covers suggests the type of application intended, but for more detailed information, use the Mercurio Conveyor Belt conveyor belt catalog or visit our website: (correiasmercurio.com.br/en/home).

2. Manufacturing of the Conveyor Belts

The manufacturing of a conveyor belt involves basically the following processes:

- Preparation of the fibers
- Manufacturing of the fabric
- Fabric treatment
- Manufacturing of the rubber
- Assembly of the belt (fabric or steel cords + cover)
- Pressing (vulcanization)

Through its own expertise and tradition acquired since 1945, the Mercurio Conveyor Belt performs all the phases of the process necessary for producing conveyor belts since preparing the fibers and manufacturing the rubber, all the way until the belt's final vulcanization.

Next we summarize the stages that comprise the manufacturing process.

2.1. Preparation of the fibers

Preparing the fibers consists of two phases, which are the **Joining** and the **Twisting**.

The raw material such as nylon and polyester are received in the form of filaments with characteristics that are far from what they need to be to be used in conveyor belts. For this reason, the fibers need to be joined (typically 3 to 5 fibers) and then twisted.

This procedure consists of twisting the fibers a certain number of turns around its axis per unit of length. The number of twists applied to the fiber depends on the nature and length of the fibers and can be either to the left or to the right.

2.2. Weaving

Weaving is one of the oldest manufacturing processes known to man. It is used to obtain a textile surface called fabric and consists of interlacing two sets of threads known as Warp and Weft. This interweaving is obtained through a machine called a **LOOM**.

Once the fabric is made, a series of analyses are carried out to test its structural, physical, and mechanical characteristics, which are:

- Length and width
- Thickness
- Weight per square meter or Grammage
- Number of threads per centimeter
- Resistance to rupture (kgf/cm)
- Elongation at rupture (%)

2.3. Dipping

To ensure optimal compatibility and/or adhesion between the substrate and the fabric used, such as the “fabric vs. rubber” adhesion, the fabric needs to undergo a pre-treatment called Dipping (Figure 1).

This dipping treatment consists in immersing the fabric in an adhesive solution that usually consists of a mixture of Resorcinol, Formaldehyde, and Latex.

Without this process, the substrate, in this case the rubber, would not adhere to the fabric after the vulcanization.

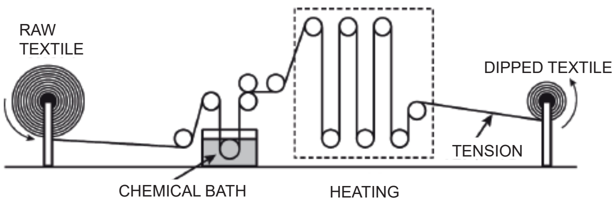


Figure 1: Schematic drawing of the dipping process

As can be seen in the figure above, after the impregnation, heating, and drying, the fabric is once again rolled under a certain tension. This tension has the objective of providing dimensional stability to the fabric and ensure that excessive stretching does not occur during the belt's normal operation in the field.

2.4. Preparation of the rubber

As already mentioned above, for each type of cover there will be a special rubber compound that contains many ingredients, each one with the function of providing the rubber a certain characteristic that will improve the performance of the belt cover.

These ingredients will pass through a precision weighing process in accordance with the compound's formulation and will then be introduced into the mixer in a certain order.

The mixture obtained is then taken to a mill. Rubber mats are then produced at the mill that will be placed on pallets where they will dry for a certain period (Figure 2).

During this period, which may vary from 12 to 24 hours, the rubber acquires certain characteristics and a greater interaction between its components.

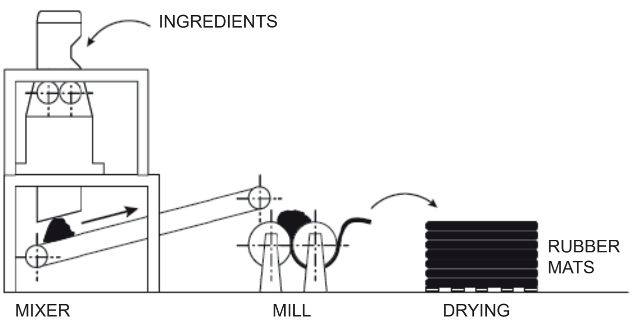


Figure 2: Ilustración esquemática del proceso de preparación del caucho

After this drying time, the rubber will pass through the mill and then through the rolling machine until it reaches the correct thickness for the belt's assembly (Figure 3).

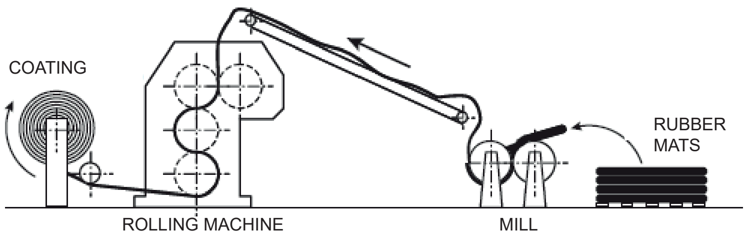


Figure 3: Schematic drawing of the manufacturing of the rubber cover

2.5. Impregnation of the plies

This is the first process in which rubber will be added to the treated fabric. This process is very similar to the previous one since it also is done using the rolling machine.

The objective of this phase is to make the fabric become impregnated with a thin layer of rubber so that one fabric is bonded to the other, a **BONDING LAYER**, when assembling the belt (Figure 4).

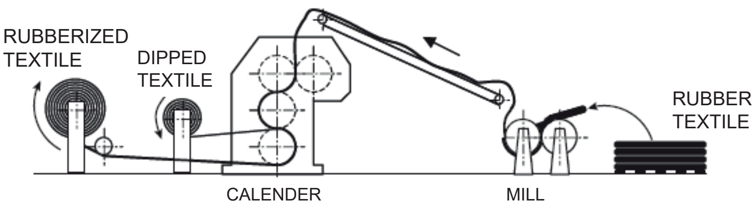


Figure 4: Schematic drawing of the textile impregnation or the rubberizing process

2.6. Assembly

After the manufacturing of the cover and impregnating the fabric with rubber, the belt assembly phase begins.

This process takes place on the **Assembly Machine**, which consists of a table on which the troughs are placed that support the rolls with upper and lower covers plus the ply in the quantity required for building the carcass.

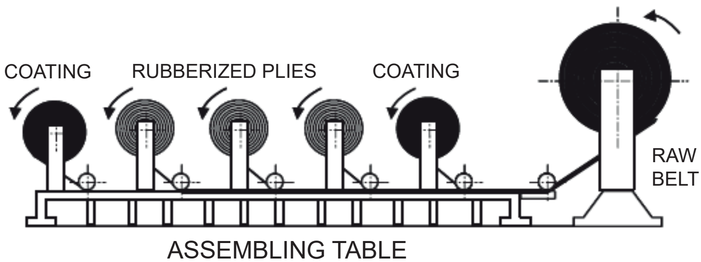


Figure 5: Schematic drawing of the conveyor belt assembling process

Once assembled, the belt will be rolled again into a new roll to then go through the vulcanization process.

2.7. Vulcanization

One of the definitions for Vulcanization is as follows: "It is the passage of the elastomer from its **Plastic State** to its **Elastic** state with defined, stable characteristics and of high resistance to the environmental elements".

To better understand the phenomenon of vulcanization, we should compare the properties before and after the procedure, which means between the plastic state and the elastic state. See Table 4 below:

Compound Not Vulcanized	Compound Vulcanized
PLASTIC STATE	**ELASTIC STATE**
THERMOPLASTIC	THERMOSET
STICKY	NOT STICKY
LOW VISCOSITY	HIGH VISCOSITY
HIGH ELONGATION	LOW ELONGATION
LOW HARDNESS	HIGH HARDNESS
LOW RESILIENCE	HIGH RESILIENCE
HIGH SWELLING	LOW SWELLING

Table 4: Some effects from vulcanization

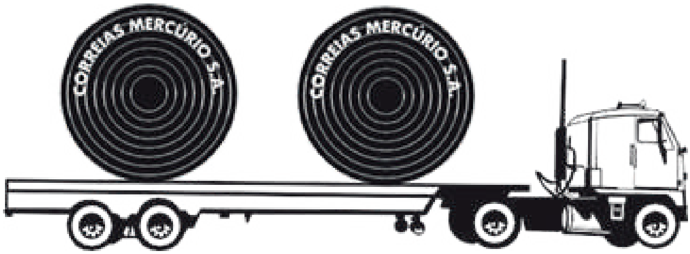
As shown below, the belt will be vulcanized by sections. Each pressing session will vulcanize a section that has the length of the press plate and will last about 25 minutes.

Figure 6: Schematic design of belt vulcanization

3. Shipping

As we can see, belt manufacturing is a continuous process in which the limits are the dimensions and weight of the roll. Often, the Mercurio Conveyor Belt ships rolls weighing more than 30 tons and are 4 meters in diameter each one.

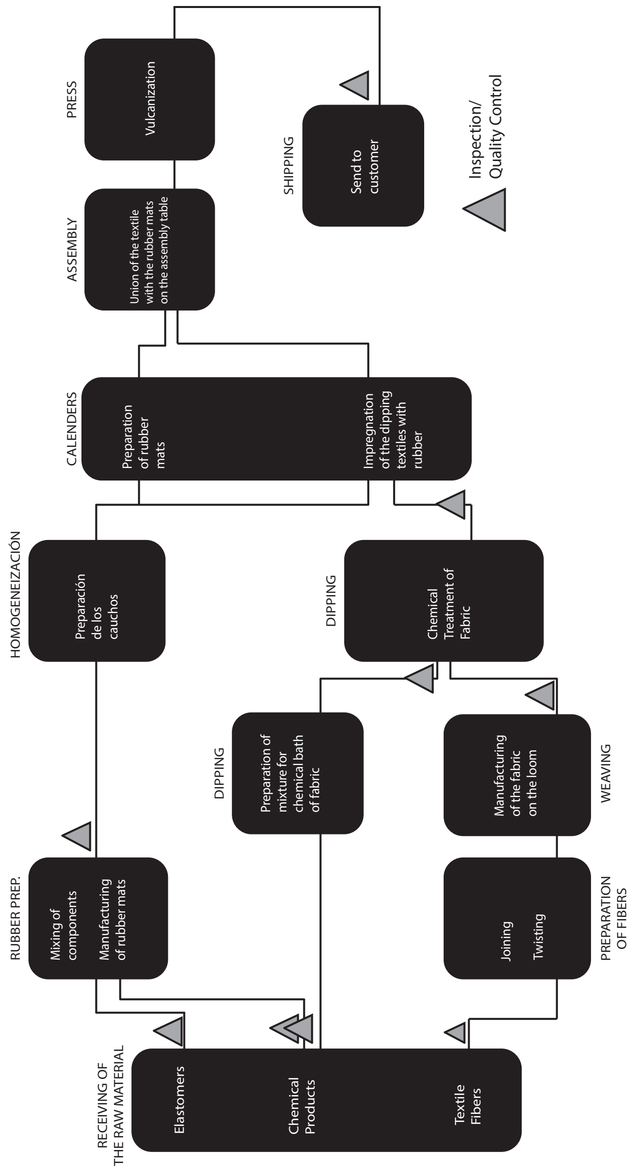
Belts of this size require to be transported on special boards since, due to their shape, the weight becomes very concentrated.



4. Inspección

As already said, the Mercurio Conveyor Belt performs all the manufacturing stages of a conveyor belt since preparing the fabric, preparing the rubber, and vulcanization. Because of this, the Quality Department has developed procedures for inspection and analysis of raw material received and for almost all stages of the process.

These procedures virtually eliminate the possibility of non--conformities in the product and ensure that the conveyor belt will have all the technical characteristics required.


RECEIVING OF THE RAW MATERIAL
Elastomers
Chemical Products
Textile Fibers
RUBBER PREP.
Mixing of components
Manufacturing of rubber mats
HOMOGENEIZACIÓN
Preparación de los cauchos
DIPPING
Preparation of mixture for chemical bath of fabric
PREPARATION OF FIBERS
Joining
Twisting
WEAVING
Manufacturing of the fabric on the loom
DIPPING
Chemical Treatment of Fabric
CALENDERS
Preparation of rubber mats
Impregnation of the dipping textiles with rubber
ASSEMBLY
Union of the textile with the rubber mats on the assembly table
PRESS
Vulcanization
SHIPPING
Send to customer
Inspection/ Quality Control

5. Selection of the conveyor belt

Several factors influence the proper selection of a conveyor belt, making it difficult to enumerate them. **Many times previous experiences in similar situations are the best source of information for the correct selection of the belt.** For didactic purposes, we describe the criteria used to arrive at the best option as if the background mentioned did not exist.

As previously mentioned, we can consider the belt as a set of the **carcass** and **cover** and because of that we specify one separate from the other.

5.1. Carcass

The carcass, which is made up of a group of two or more plies joined by bonding layers, will be responsible for resisting the tensions generated on the conveyor system, the impact of the material, and ensuring the belt's troughability.

Considering this, we identified four main selection criteria when considering conventional synthetic textile:

CRITERION Nº1: Choose between NYLON and POLYESTER.

According to item 1, the main difference between nylon and polyester is the stretching, which is reflected in the ability to absorb impacts or extreme flexibility.

In situations of impact of material on the belt and excessive stretching, the recommendation is to use a carcass with a warp made of nylon. On large conveyors, using polyester becomes more interesting because since it lengthens less, the belts with a polyester warp need less stretching length.

CRITERION Nº2: Determining the MAXIMUM TENSION of operation.

The maximum tension to which the belt will be submitted can be determined based on the type of material and operating conditions such as engine power, etc. This tension will be used for determining the type and quantity of plies.

The value obtained for the Maximum Tension should be divided by the belt's width and compared with its admissible tension.

TENSION EFECTIVA (TE)

The effective tension (or peripheral tension) is the tension required on the head pulley to drive the load on the conveyor and overcome all resistances to movement (Figure 8).

The total resistance to the movement of a conveyor belt is the sum of several resistances, which are as follows:

• Resistance to the rotation of the idlers and the belt slippage on them
• Resistance to the belt stretching and the material on the idlers
• Resistance to the lifting or lowering of the material on the belt
• Resistance to the acceleration of the material
• Resistance due to friction caused by accessories such as the action of the skirtboards, action of scrapers, stretching of the belt on pulleys, movement of the trippers, etc.

MINIMUM TENSION (T2)

For the belt to move, the head pulley's effective Tension (Te) should be transmitted to the belt through friction without slipping. However, the efficiency of this transmission depends on the turn angle (a) of the belt on the pulley and its type of surface (Figure 8).

MAXIMUM TENSION (T1)

Tension Tl refers to the maximum tension to which the belt will be subjected during its operation and it is the decisive value for the belt's specification (Figure 9).

The value for TI will then be: **Tl =Te+ T2:**

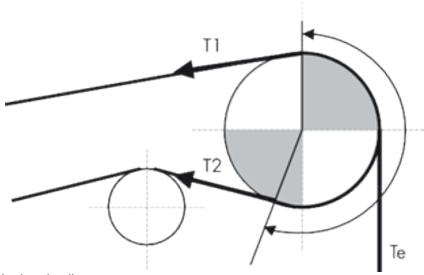


Figure 8: Tensions on the head pulley

In this situation, T2 will have the tension on the "loose" side of belt or the minimum tension so that the belt does not slip. It is located at the outlet of the head pulley.

As the objective is to try to make the tensions acting on the belt to be the minimum possible, we must ensure that the conditions of transmission are the best possible. This will be achieved with the increase in the turn angle (α) and with the pulley coating, thus increasing the friction.

COUNTERWEIGHT

As we know, the function of the counterweight is to provide the belt the tension needed to keep it from sliding on the head pulley. Consider the diagram below:

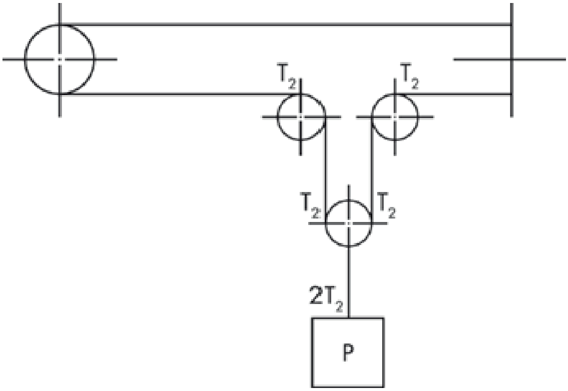


Figure 09: Action of the automatic take-up pulley

In this situation, we can see that for the belt to rotate properly, which means without sliding, the output of the head pulley must be under a tension of T2. In this example the weight of the counterweight (P) will be: P = 2 X T2.

In reality, tension T on the loose side takes on different values along the entire return as this variation may be higher or lower depending on the length, conveyor belt tilt, weight, etc.

CRITERION Nº3: Checking the troughability

We can define troughability as the belt being able to be supported on all idlers with a load or without a load, but without any content penetrating into the space between them.

The verification of the conditions of the belt's troughability is done based on information contained in the manufacturer's catalog and takes the following items into consideration:

- Specific weight of the material
- Inclination angle of the side idlers
- Amount and type of plies
- Belt width

In short we can say that for conveyors with angled rollers, very wide and thin belts should be avoided as well as belts that are very narrow and thick.

Figure 10 illustrates the conditions under which the conveyor belt may behave on the idlers.

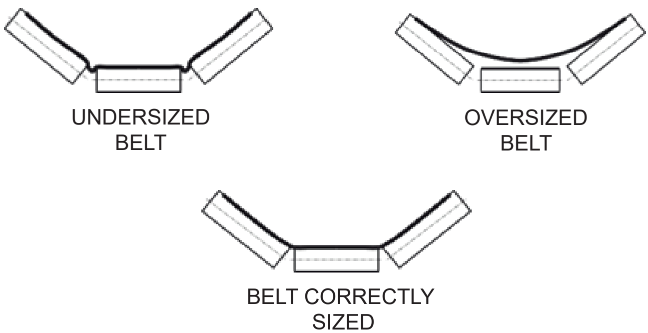


Figure 10

CRITERIO Nº4: Checking the diameter of the pulleys

As the belt conforms to the pulleys, its external fibers are extended and its internal fibers are compressed. To ensure that the belt does not suffer additional tensions above certain levels, the pulley should have a minimum diameter as set out in the catalog. Smaller diameters than recommended can also lead to the splices being forced open.

It is good to keep in mind that regardless of the pulley diameters, the belt should be specified with a carcass that will resist the work and accommodate properly on the idlers. So it is actually correct to say that the pulleys are suitable for the belt and not the other way around.

5.2. Choice of covers

In fact, when it comes to specifying the cover, what we are saying is to choose the type of rubber and its top and bottom thicknesses. This choice will be based on the following information:

- Type of material
- Height of material drop
- Granule size

- Abrasiveness
- Cutting action
- Temperature
- Presence of oil or other chemical products
- Belt cycle

The **belt cycle** or time of evolution depends on its speed and the length of the conveyor. That means that the shorter the equipment and/or the higher the speed, the smaller will be the belt cycle and consequently the greater will be its wear. If in addition to wear there are other combined critical factors such as temperature, oil, etc., then the belt cover needs to meet all of them.

In the case of transporting hot material, for example, regardless of how abrasive it is, the thickness of the cover should be proportional to the temperature generated on the belt.

5.3. Additional considerations when selecting

Belts bought in Brazil are specified by the admissible tension, while belts bought on the international market are specified by the rupture tension. It is necessary, therefore, to be very careful in international competition because this type of mistake can cause serious problems later on.

5.4. Changing belts with different types of carcasses

It is very common for a user to want to change the type of belt installed when it is at the end of its useful life, meaning to change it from one belt family to another family, such as changing it from a steel cord belt to a polyester/nylon one. This change is usually considered for economic reasons.

It is important to run the following checks when you want to make a change in belt type:

• **Curvature radius:**
When designing conveyors, there are variations of the curvature radius based on the type of belt to be used. This item should therefore be carefully analyzed.

• **Pulley diameter:**
Different belts need different pulley diameters. Because of this, if the type of belt is changed, then the diameter of the pulleys need to be checked.

Normally this is not critical because the belt conveyor manufacturers select pulley diameters with some slack.

• **The counterweight take-up length:**
The counterweight take-up length is calculated based on the type of belt carcass. It is necessary to check whether the take-up length of the new belt type is compatible with the take-up length already installed. Special attention should be given to those belts that work with hot material because in these cases the belt tends to normally stretch more.

• **Transition Distance:**
Transition is the change in belt zones, meaning going from the centerline of the terminal pulley to the first fully-troughed idler, which can cause an imbalance of tensions between the edges and the center, so it needs to be adequately sized because belts with different carcasses have a great variation in this distance.

5.5. Stantardized questionnaires: Data gathering

In many cases when the proper belt for each application is not known, it becomes crucial to gather data about the conveyor system. On the next page you will find a questionnaire that may be sent to be filled out and then analyzed by the Application Engineering Department of Mercurio Conveyor Belt depending on the needs of your company.

CONVEYOR BELTS I

This applies to heavier conveyors such as belts used for iron ore, booms, forklifts, reclaimers, etc. For these cases, the work tension tends to be a critical factor and can be decisive when specifying the carcass. These cases are usually seen in industries such as mining, steel, and cement.

The types of information requested on this questionnaire follow the standard set by the Conveyor Equipment Manufacturers Association (CEMA).

5.6. Specification for purchase

The following information must be given to specify a belt for purchase already defined by the previous parameters:

• Belt width, in millimeters or inches, depending on the user's standard
• Type of carcass (polyester-nylon, aramid, steel cord, etc.) and the resistance desired, observing the previous comments about purchases in the national and international market
• The number of plies
• Type of cover (High Abrasion, High Temperature, Grain Transportation, etc.)

- Thickness of the upper and lower covers in millimeters or inches
- Special characteristics such as with cleats, corrugated, self-sliding fabric, skirtboards, etc.
- Length in meters (the additional length required for handling and/or splices should be added)
- Information if the belt is endless (if the belt is used on a dosing scale, for example, this data must also be provided).

APPLICATION ENGINEERING

DATA GATHERING - CONVEYOR BELTS I

Company:
Fax:
C/O:
Sector:
Phone:

GENERAL INFORMATION

Belt Width (mm)
Belt length (m)
Speed (m/min)
Transport capacity (t/h)
Distance between pulley centers (m)
Height diff. H-including tripper (m)
Conveyor inclination (degrees)

DRIVE UNIT

Type (single / double)
Position (tail / head / intermediate)
Location (see fig. 2) Le(m): -le(m):
Engine power (HP)
Turn angle (if double: 1 + 2)
Coated? (yes / no)

TAKE-UP PULLEY

Type (manual/ automatic)
Position (tail / intermediate)
Location (see fig. 2) Le(m) -le(m)
Take-up length (m)
Weight of counterweight (kg)

DIAMETERS OF PULLEYS

Drive (mm)
Head / tail (mm) /
Bend / take-up / snub (mm)

ACCESORIES

Skirtboard length (m)
No. of scrapers and cleaners
No. of pulleys on tension side
No. of pulleys on loose side
No. of. Trippers

IDLERS

Type (flat/double/triple)
Inclination of side idlers (degrees)
Load idler spacing (m)
Diameter of idlers (mm)
Return idler spacing (m)

MATERIAL TRANSPORTED

Type:
Specific weight (kgf/m3)
Average Granulometry (mm) Max:
Rest angle (degrees)
Average temperature (°C) Max
Contains oil? Type
Contains chemical prod.? Type:

SPLICE (Open/endless)

BELT IN USE
Specification:

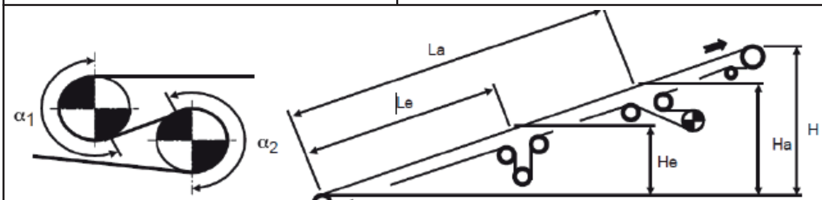


Figura 1 Figura 2

Any doubts as to filling out this questionnaire, please contact our Application Engineering Departament by the e-mail: tecnica@correiasmercurio.com.br

Date: _/__/__ Person filling out the form:_______________________________

5.7. Codificación

CT EAS: 4 PN4000: 10mm x 3mm: 109,0m x 1800mm: OPEN

CT: Conveyor belt
EAS: Type of cover
4: No. of plies
PN4000: Type of fabric
10mm: Upper cover
3mm: Lower cover
109,0: Lenght
1800: Width
OPEN: Supply mode

6. Receiving, storage and handling

6.1. Receiving

When receiving the conveyor belt, a visual and dimensional inspection should be carried out for checking the following points:

• Comparison between the Purchase Order and the product's Invoice;
• External conditions, making sure there was no transport damage;
• Belt width;
• Number of plies;
• Thickness of covers

Any irregularity should be immediately communicated to the supplier so that clarifications can be given.

6.2. Qualitu Certificate

A certificate may contain a certain minimum standard of information established by norm. However, in the absence of this "standardized" certificate, it is recommended that an agreement be established gradually with the users. This avoids demands being made on purchasing specifications that make the product more expensive and that bring little or no benefit.

With the aim of explaining to its clients the actual characteristics of the product that was purchased and in order to meet real market needs, Mercurio Conveyor Belt has developed the certificate model below that compares the numbers obtained in standardized tests and the reference numbers from the respective standards.

MERCÚRIO

QUALITY CERTIFICATE

PROD. ORDER:
CUSTOMER ORDER N.:
CUSTOMER:
PRODUCT:

DATE:
INTERNAL ORDER N.:

DIMENSIONAL TEST						
ITEM	UNIT	STANDARD	ORDER	MIN. TOL.	MAX. TOL.	RESULTS
LENGTH	M	ISO 15236-1				
WIDTH	MM	ISO 15236-1				
TOTAL TICKNESS	MM	ISO 15236-1				
UPPER COVERING THICKNESS	MM	ISO 15236-1				
LOWER COVERING THICKNESS	MM	ISO 15236-1				

DESTRUCTIVE TEST					
ITEM		UNIT	STANDARD	SPECIFIED	RESULTS
CONVEYOR	TENSILE STRENGTH	KN/M	ISO 7622-2		
	SAFETY WORKING FACTOR	-	ISO 15236		
	TOTAL CABLE NUMBER	-	ISO 15236		
	CABLE DIAMETER (±3%)	MM	ISO 15236		
	CABLE DISTANCE TO EDGE	MM	ISO 15236		
	DISTANCE BETWEEN CABLES (PITCH)±1,5MM	MM	ISO 15236		
	UPPER COVERING ADHESION X CONNECTION	N/MM	ISO 8094		
	LOWER COVERING ADHESION X CONNECTION	N/MM	ISO 8094		
	CABLE PULLOUT DISPLACEMENT	N/MM	ISO 15236-1		
COVER	HARDNESS	SHORE A	ASTM D2240		
	TENSILE STRENGTH	MPA	ASTM D412		
	ELONGATION AT BREAK	%	ASTM D412		
	ABRASION	SHORE A	ISO 4649 MÉT A 10N		
STEEL CORD	DIAMETER (±3%)	MM	ISO 15236		
	BUILD	-	-		
	TENSILE STRENGTH	KN	ISO 7622-1		

ACESSORIES			
Shock Absorber ( )	RipStop ( )	Rip Scanner ( )	BRR ( )

DOCUMENT ISSUED ELECTRONICALLY, DOES NOT REQUIRE SIGNATURE

REGIANE OLIVEIRA DA SILVA
QUALITY ANALYST

RENATO LAREDO
ASSURED QUALITY AND TECHNOLOGY COORDINATOR

CORREIAS MERCURIO S/A IND. E COM.
PLANT: R. JOSÉ SPINA, 10 - VILA JUNDIAINÓPOLIS - JUNDIAÍ - SP ZIP CODE:13210-780
PABX - FAX - E-Mail:

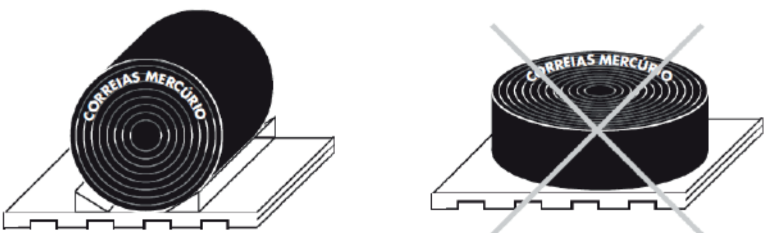
6.3. Storage

All conveyor or elevator belts made of elastomers must be stored in covered and ventilated areas without contact with direct light or radiated heat.

They should be fully protected against the deteriorating effects caused by oil, solvents, liquids, and corrosive vapors. The large belts that are not immediately installed need to be stored suspended on suitable stands and protected with black plastic.

When installing a belt that has been stored for a long period of time, it is advisable to avoid using the roll's first outside wrap because both the sunlight and the heat have attacked the rubber cover causing aging and oxidation.

If no stands are available, the belts should be placed on pallets due to the transportation ease by forklift. In all cases, the rolls must be stored standing up and never supported by the edges (Figure 13).



CORRECTO EQUIVOCADO

Figure 13: Belt storage

PERIOD OF BELT STORAGE - NBR13861			
	Covered Room	Others places	
		Direct Sunlight (undesirable)	Covered with fabric
RECOMMENDED	1,5 years	2 weeks	6 months
MAXIMIUM	3 years	1 month	1 year
Note: After this period, the belt may be damaged			

6.3. Movement

The belts should preferably be supported on stands as this provide a perfect way to unroll them and change them quickly. When you lift the roll, however, be careful not to damage the belt's edges:

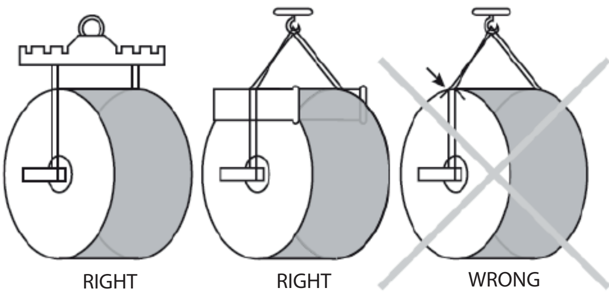


Figura 14: Belt movement

If the belt needs to be moved by rolling, the direction of movement indicated by the arrow stamped on the roll should be followed so as to keep it from narrowing.

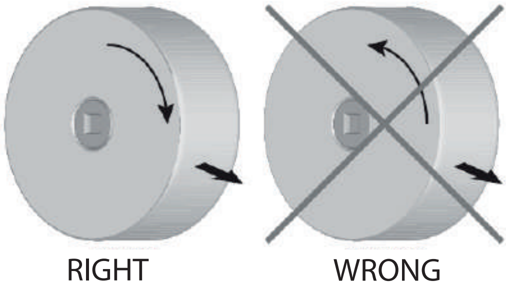


Figura 15: Moving the belt

6.5. Roll sizes

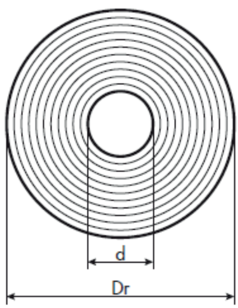
Conveyor belts are usually supplied in rolls with its initial tip attached to a wooden or iron pipe. They are rolled up so that the lower cover faces the outside. The core type and diameter are determined according to the belt's thickness and weight.

The final diameter of the roll and the belt length can be determined by means of the following formulas:

1	$Rd = \sqrt{127.T.Bl + d^2}$
2	$Bl = \pi/400.T \times (Rd^2 - d^2)$
3	$Bl = (\pi \times Nw)/200 \times (Rd + d)$

Where:

Rd = Roll diameter (cm)
T = Belt thickness (cm)
Bl = Belt lenght (m)
d = Core diameter (cm)
Nw = Number of wraps on the roll



7. Dimensional Tolerances

Standards NBR6110 and NBR8163 are the main references for dimensional tolerances and are a source of consultation for those who are responsible for the conveyor belt operation.

Below are the tolerances described in the standards:

7.1. Belt Width

Nominal width (mm)	Tolerances
Up to 500	± 5mm
Over 500	± 1%

Table 5

Example 1: A belt with a nominal width of 450 mm may present actual measurements between 445 mm and 455 mm.
Example 2: A belt with a nominal width of 1800 mm may present actual measurements between 1782 mm and 1818 mm.

7.2. Belt total thickness

Nominal thickness (mm)	Tolerances
Up to 10	± 1mm
Over 10	± 10%

Table 6

Example 1: A belt with a nominal thickness of 8 mm may present actual measurements between 7 mm and 9 mm.
Example 2: A belt with a nominal thickness of 16 mm may present actual measurements between 14.4 mm and 17.6 mm,

7.3. Thickness of covers

Nominal thickness (mm)	Tolerances
Up to 4mm	+ 1,0mm - 0,2mm
Above 4 mm	+ 1,0mm -5%

Table 7

Example: A belt with a nominal cover thicknesses of 6 mm x 2 mm may present actual cover measurements in the upper cover of 5.7 mm to 7.0 mm and in the lower cover between 1.8 mm and 3.0 mm.

7.4. Belt lenght

Nominal lenght nominal (mm)	Tolerances
Up to 15.000	± 50mm
From 15.000 to 20.000	± 75mm
Over 20.000	± 0,5%

Table 8: Endless belts | Note: The lenght should be measured with the belt not under tension

Example 1: An endless belt with a nominal length of 8,500 mm may present actual measurements ranging between 8,450 mm and 8,550 mm.
Example 2: An endless belt with a nominal length of 45,000 m may present actual measurements ranging between 44.775 m and 45.225 m.

Nominal lenght (mm)	Tolerances
All	+ 2,5% - 0

Table 9: Open belts (single flight)

7.5. Lenght of pulleys (Based on NBR 6172)

Considering that misalignments may occur on the belt and so that it can operate safely, it is recommended that there should be a surplus between the width and the length of the pulley.

This number varies from manufacturer to manufacturer, but below is a table for reference.

Belt width (mm)	Extra (mm)
Up to 650	100
From 650 to 1.000	150
From 1.000 to 2.000	200
Over 2.000	300

Table 11

Example: If a belt is 850 mm wide, it is recommended that it operate on conveyors whose pulley length is at least 1,000 mm.

8. Installation

8.1. Conveyor Belt Routing

The following elements are needed:

• Pull plates
• Steel cords
• Rollers
• 2 Tirfor winches
• Tractor (to pull large flights)
• Straps for securing belt ends
• Stands to support the rolls

The roll must be placed next to the tail pulley and be in the same alignment as the conveyor.

The placement of the roll on the support stand should make it easier to unroll the belt from the bottom because this condition provides better control as it is pulled to the conveyor and places the transportation side upwards.

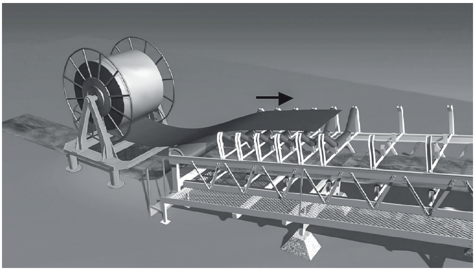


Figure 16

For the belt's passage, attach the pull plates at its end, secure them with the hook on the cable, and lay them along the conveyor so that it can be pulled. Pull plates need to have at least half the width of the belt and be sufficiently robust to withstand the tensile stress. The side tips of the belts next to the pull plates must be cut at an angle to prevent them from touching the structure and causing them to rip.

The take-up pulley should be suspended and attached to the frame to facilitate the passage of the belt and later tensioning.

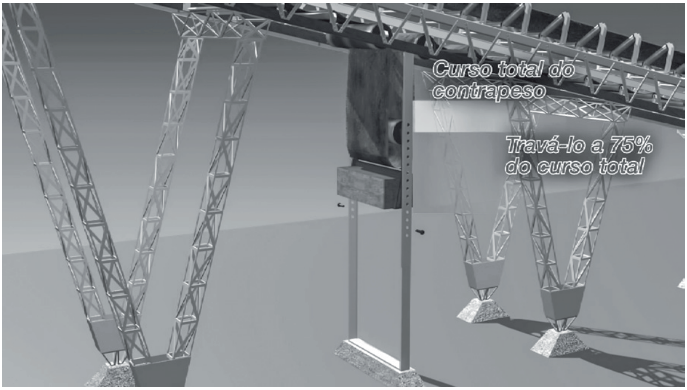


Figura 17

A tirfor winch, hoist, forklift, tractor, etc. can be used to pull the belt to the conveyor.

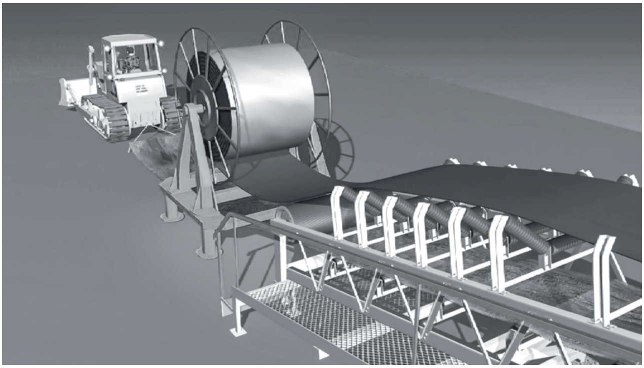


Figura 18

Changing the belt on long conveyors that requires preventive maintenance without loss of time, the splices of the flights can be done in advance in an area next to the tail pulley, leaving only the last splice to be done on the conveyor.

When passing them through the conveyor, the belt ends should be placed on the area designed for making the last splice.This area provides:

• Safety for the operators
• Better access to the area
• Construction of a cover (tent) for the protection of the area where the equipment will be assembled and the splice done.
• Easy electrical power

• Easy equipment handling
• In the area for roller placement, a space of about 8 meters needs to be removed to give conditions to obtain a perfect alignment of the splice when it is closed.

8.1. Initial Alingnment

With the belt positioned in the center of the head and tail pulleys, the alignment should be initiated with the belt empty, making sure that even in this condition it touches the central roller (flat) of the load stands.

With new installations, it is not recommended for the belt to run empty for a long time, so it should operate with a load during the adaptation period.

9. Techincal Assistance

9.1. To streamline your order

a) Check the belt's manufacturer
b) If Mercurio is the manufacturer, there is a PO (Production Order) number printed in relief, which refers to an internal document that contains the product's entire manufacturing history. Although there may be variations about the type of embossing, the PO No. will always be present on the stamp. See figure 19.
c) If you cannot find the embossed number, look for some data that identifies the product such as its invoice number or order number.
d) Write down the date of the belt's installation.
e) Keep a record of the equipment with information about the type, brand, and durability of the previous belts. Only in this way will it be possible to measure its performance.
f) If the splice is done in the field, try to find out who did it.
g) Whenever possible, get samples that will contribute to solving problems such as the sample of the new belt and a sample of the belt with the problem in order to compare the performance.

Note: The logo is placed in the bottom cover of the conveyor belts.

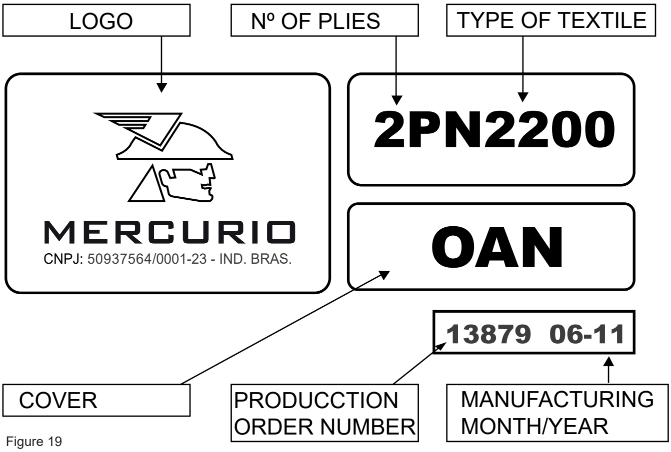


Figure 19

10. Maintenance aspects

The conveyor involves a series of elements that **have a direct influence on the belt's durability** and, therefore, must be observed to arrive at the best operating condition.

10.1. Structure

To ensure that the belt does not have a tendency toward misalignment, the structure must be aligned and leveled laterally and longitudinally according to the parameters of Table 12.

Part measurements										
Above	30	120	315	1.000	2.000	4.000	8.000	12.000	16.000	Over to 20.000
Up to	120	315	1.000	2.000	4.000	8.000	12.000	16.000	20.000	
Tolerance	±1	±1	±2	±3	±4	±5	±6	±7	±8	±9

Table 12: Structural tolerances

10.2. Pulley (See also item 7.5)

All pulleys must be parallel to each other and perpendicular in relation to the conveyor's centerline. The belt's line of travel is directly linked to the alignment of the pulleys and any deviation from one of them is enough to push the belt against the frame.

Remember: the conveyor belt will always have a tendency to misalign toward the side of less tension, which is the side where it is more loose. Special care should also be taken in relation to the impregnation of material on the pulleys since, in addition to the uneven wear of the belt's lower cover, this impregnated material will cause a difference in the pulley's diameter, destabilizing the belt.

10.3. Belt slipping on the pulley

This is a common phenomenon with conveyors and may be caused by high wear on the lower cover of the belt.

Many times the first measure taken by maintenance is to increase the weight of the gravity take-up to stretch the belt, but let's take a look at some considerations:

The efficiency of the transmission of movement from the pulley to the belt is the result of two basic factors:

Coefficient of friction between the pulley's surface and the belt cover

This means that the pulley's coating quality and its cleaning are fundamental to ensure the friction necessary for the transmission. Pulleys with a very hard coating, worn, dirty, or impregnated with material will not only misalign the belt, but will also make transmission difficult.

The pulley's turn angle (see also item 3.1 - criterion 2)

The greater the belt's arc of contact (α) on the pulley, meaning the more the belt wraps around the head pulley, the better the transmission will be. Therefore, an option to optimize the transmission is to insert a snub pulley close to the drive to increase the arc of contact. So, before stretching the belt even more, we recommend that you first check the two factors above.

10.4. Idlers

Similar to the pulleys, the idlers also have a vital role in maintaining the belt's line of travel and the following aspects should be checked:

a)The idlers should be aligned, as well as the pulleys, perpendicular to the structure's centerline.

b) The idlers must rotate freely with the touch of the hand as idlers that are locked cause belt wear and overload the driving system as they increase friction. If on the same stand one of the idlers is more stuck than the other, then logically this fact will also lead to an uneven wear of the cover and to the belt's misalignment.

10.5. Scrapers and cleaners

Sticky materials that do not come loose easily from the belt many times when unloading they are transferred to the rollers, causing them to lock up and for the pulleys to become impregnated.

The scrapers and cleaners have the function of avoiding this impregnation and are specified according to the application. The ideal is that the scrapers press on the belt, but with a wear resistance that is lower than it. Similar to the skirtboards, these accessories should never be made of old belts because they greatly wear down the belt in use.

In many cases it may become necessary for a specialized technician to analyze the scrapers and cleaners to determine the correct type to be used depending on the application.

10.6. Take-up idler (See also items 5.1 and 10.3)

The main function of the take-up pulley, whether automatic (counterweight) or manual (screw), is to provide the minimum tension required to keep the belt from sliding on the head pulley and limit the value of the arrow on the spacing between the idlers.

This slipping should be avoided at all cost because it causes an accentuated wear on the belt's lower cover and also on the pulley's coating. As the wear on the pulley's coating progresses, the smoother the pulley becomes and greater the tendency to slip, further aggravating the problem.

The force to be applied on the take-up pulley will be calculated on the basis of the tension generated in the system, the type of pulley surface, and the belt's arc of contact with the head pulley.

The better the belt's adhesion with the pulley, the lower will be the tension required to prevent the slipping and the smaller will be the demand on the belt, avoiding excessive stretching.

As for the parts of the equipment involved in the stretching, the same alignment considerations apply, which are:

a) On a screw take-up, the stretching distance should be equal on both sides of the conveyor, which will ensure the parallelism of the pulleys.

b) The take-up and bend pulleys need to be parallel to each other and perpendicular to the structure.

c) The guides of the vertical gravity take-up pulley should be assembled in a perfectly vertical position and have total freedom for the counterweight take-up length.

10.7. Feeding

The feeding unit should provide the belt with a uniform and centered loading. The decentralization of the loading will inevitably lead to misalignment since the material, once deposited on the belt, by the action of its weight will go to the center of the concavity.

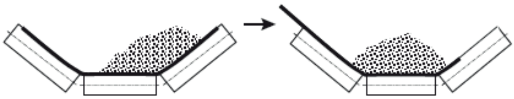


Figure 20

An ideal feeding chute would be one that would ensure not only a homogeneous and centralized loading, but also one where the material falls on the belt at the same speed in amount and direction, meaning that the speed of the material is the same as the belt's speed: Vm = Vc

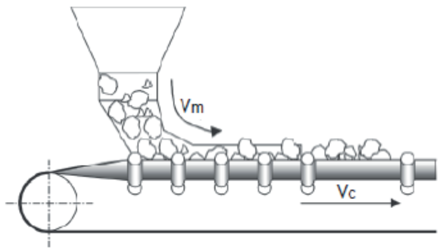


Figura 21

10.8. Skirtboards

The skirtboards have the function, along with the feeding chute, to make the material loaded stay centered during the belt's path and not escape to the sides and by that get the work environment and the system itself dirty.

The skirtboards should be made of soft rubber and must not have fabric in their constitution. They should be regularly adjusted to avoid the passage and the accumulation of material between the skirtboard and the belt, which would cause a wear along its entire extension, greatly reducing its useful life.

10.9. Transition distance

Transition is nothing more than a change in the belt's zones, which is a passage from the flat to the impact bed and vice versa. In the transition, the belt is subject to an imbalance of tensions between the edges and the center. To avoid an excessively high tension at the edges, the distance of the transition should be carefully analyzed. The transition can be done in two ways at these points:

1. When the work line coincides with the pulley's upper surface and with the trough average center of the first roller (figure 22-A)

2. When the work line coincides with the upper surface of the pulley and the first horizontal idler (figure 22-B)

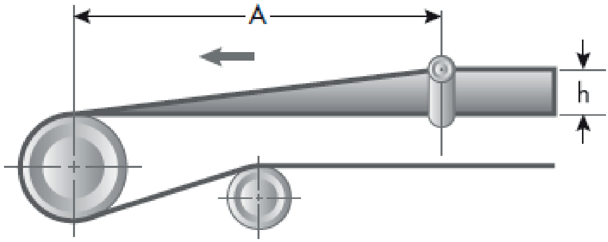


Figure 22-A

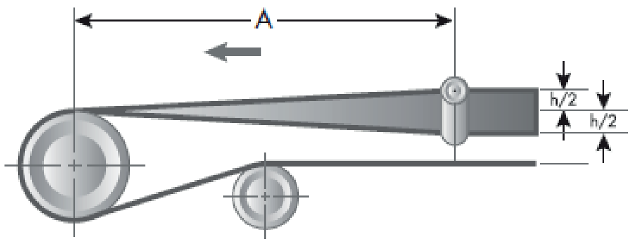


Figure 22-B

Inclination angle of side idlers	Percentage of the Admissible Tension	A (minimum)
20º	90	1,8 L
	60 to 90	1,6 L
	60	1,2 L
35º	90	2,4 L
	60 to 90	1,3 L
	60	1,8 L
45º	90	4,0 L
	60 to 90	3,2 L
	60	2,4 L

Table 13: table related to Figure 22-A

Inclination angle of side idlers	Percentage of the Admissible Tension	A (minimum)
20º	90	0,9 L
	60 to 90	0,8 L
	60	0,6 L
35º	90	1,6 L
	60 to 90	1,3 L
	60	1,0 L
45º	90	2,0 L
	60 to 90	1,6 L
	60	1,3 L

Table 14: table related to Figure 22-B

10.10. Alignment

The conveyor belt should keep its line of travel along the conveyor and to do so it is essential that all parts that influence its path are operating properly.

Misalignment can often require a very careful and lengthy analysis about its causes since it involves a large number of variables.

Basically, the alignment of the belt is ensured by observing the structure's alignment and the correct operation of the idlers and pulleys.

10.11. Alignment Correction

The normal sequence to align a belt is to start on the return side, working in the direction of the tail pulley, and then following to the load side in the direction of the belt's movement. For larger belts, it may be desirable to load them after the return side has been corrected for complete alignment.

If there is a misalignment at a specific point, the adjustment should be done while the belt is running and at some meters before this point. The result of the adjustment may not appear immediately.

So, it is good to allow the belt to operate for some time after the adjustment of the rollers to determine if a new adjustment is necessary.

If the adjustment was excessive, action must be taken on the same roller that was adjusted and not on other additional rollers.

If the belt is misaligned on a specific side of the conveyor's structure, the likely cause will probably be the alignment of the structure, the rollers, or the pulleys or a combination of these factors.

In a general way, to check if the misalignment is caused by the conveyor or by the belt, the following must be checked:

• If the same part of the belt stays misaligned along the entire conveyor, than it is damaged at that section or the splice is poorly done.

• If the belt always misaligns on the same point of the conveyor, the cause is a problem in the structure or of the idlers (see previous items).

Note: A belt that has worked satisfactorily on a conveyor may not necessarily work well in a new installation, despite all the precautions relating to alignment.

11. Most common damages, causes and solutions

11.1. Belt partially mistracking at a certain point of the structure

Causes	Corrections
The idlers before the deviation point are not perpendicular to the belt's centerline.	Move the ends of the idlers where the belt is mistracking in the direction of the work.
Bent frame	Stretch a wire across the structure to show t he deviation and fix it.
Idlers jammed	Replace them and improve maintenance by carrying out periodical lubrication and inspections.
Material buildup on the idlers	Put cleaners in place and keep material from falling on the return.
Pulleys or rollers misaligned	Align the pulleys or rollers.
Structure not level	Correct the structure by leveling it.

11.2. Lateral misalignment of a certain belt section along the entire extension of the conveyor

Causas	Correcciones
Splice is not on square	Redo it, correcting the aligment,
Belt cupping	a) Replace the belt or fix it by applying sef-aligning idlers, mainly on the return. b) If the belt is new, cupping can be corrected by means of tensioning and load centralization.

11.3. Belt partially deflecting at a certain point on the structure

Causes	Corrections
Load decentralization	Centralize the feeding chute or centralize the loading

11.4. Belt is jerking on conveyor

Causes	Corrections
Belt with little transversal flexibility or an oversized carcass.	a) Install self-aligning idlers. b) Decrease the lateral inclination of the idlers on the load rollers c) Change the belt, replacing it with another carcass correctly sized.

11.5. Excessive stretching of the belt

Causes	Corrections
Tensión excesiva	a)Increase the speed, keeping the same tonnage. b) Reduce the tonnage, keeping the speed. c) Reduce the friction of the moving parts and improve the maintenance. d) Reduce the tension, coat the head pulley, and use an automatic take-up pulley.
Initial position of the counterweight is improper	The initial position of the counterweight should be enough for the belt's natural stretching.
Counterweight is too heavy	Reassess the tension needed for stretching the belt.

11.6. Excessive wear of the belt on the side of the pulleys

Causes	Corrections
Belt slipping on head pulley	a) Increase the belt's tension, b) Increase the turn angle between the belt and the head pulley. c) Coat the head pulley d) Clean the pulley
Idlers jammed	Improve maintenance, change idlers, and lubricate
Material buildup between the idler and the belt.	Keep material from falling into the return side, put cleaners in place, replace mechanical splices with vulcanized ones, and adjust the feeding chute.
Absence of perpendicularity between idlers and structure	Correct the inclination of the load idlers, not exceeding 2% in the work direction in relation to perpendicular.

11.7. Transversal cuts on the belt edges

Causes	Corrections
Belt edges rubbing on the structure	Correct the causes of the mistracking, align idlers, level or straighten the structure.
Final idler before the terminal pulleys is too close and high, not providing a seamless transition.	Adjust idlers and distance them from the pulleys so that the transition is normal without straining the belt.

11.8. Transversal cuts on the belt next to the mechanical splices

Causes	Corrections
Poorly dimensioned staples for the diameter of the pulleys.	Replace the staples for others of appropriate size or increase the diameter of the pulleys.

11.9. Fatigue of the carcass at the gap between the idlers on the load rollers

Causes	Corrections
Irregularity in the transition between the impact idler and the pulleys.	Increase the distance between the last idler and the pulley and decrease the inclination angle of the side idlers.
Outer and inner transition curve with a small radius of concordance.	Increase the curvature radius, place rollers with less inclined side idlers and decrease their height along the curvature line.
The inclination angle of side idlers is too steep.	Reduce the inclination.
Carcass with the number of plies below recommended.	Replace the belt for another one properly sized.
Too much space in the gap between rollers on the load idlers.	Replace them with conventional ones.

11.10. Cover rubber swollen, loss of hardness and bubbles showing

Causes	Corrections
Presence of oil in material transported	Use a belt with an oil resistant cover
Environment close to the belt has air impregnated with oil	Use a belt with and oil resistant cover or eliminate contamination of the air

11.11. Groove or separation of the upper or lower cover, as well as small cuts on the carcass parallel to the edge

Causes	Corrections
Skirtboard is both hard and presses on the belt.	Use the appropriate skirtboards and reduce the pressure.
Metal parts of the feeding chute or skirtboard supports are closing the load against the skirtboard's movement.	Open the chute and the skirtboard supports in the direction of the movement, thus avoiding material from being trapped.
Impacts of the material from the feeding chute.	Add shock-absorption rollers to mitigate impacts. Lower the height of the material drop.
Material stuck under the feeding chute hardware.	Control the load flow or add skirtboards.
Material stuck between pulley and belt.	Put cleaners and control the load so that it doesn't fall on the return side.

11.12. Hardened or excessively dried out covers and bubbles showing

Causas	Correcciones
The presence of too much heat and/or chemical products in the environment or in material transported.	Use belt with a cover designed to resist these factors.
Inadequate storage.	Check the correct procedure for storing the belt.

11.13. Separation of the vulcanized splice

Causes	Corrections
The splice was done incorrectly	Redo the splice correctly
Diameters of pulleys are too small.	Use larger pulleys, as recommended by the catalog of the belt's manufacturer.
Excessive tension on the belt.	Decrease the tension on the belt by increasing the speed, reducing the tonnage or, if possible,improve the transmission to reduce the weight of the counterweight.
Material stuck between the pulley and belt.	Install scrapers close to the tail pulley.
Inadequate transition distance.	Check the correct distance of transition as recommended by the catalog of the belt's manufacturer.

11.14. Separation of the textile plies

Causes	Corrections
Carcass with a quantity of plies below recommendation.	Replace the belt for another one properly designed.
Diameters of pulleys are too small.	Use larger pulleys, as recommended by the catalog of the belt's manufacturer
The presence of too much heat, oil, or other chemical products in the environment or in the material transported.	Use belt with specific cover to resist these factors

12. Splices

12.1. Introduction

There are actually many variations in the way to prepare and execute a splice on a belt conveyor. In most cases these variations do not alter the final outcome, as explained below, but incorrect procedures can compromise the final result and render the conveyor belt useless.

Splices on conveyor belts can be done in three ways:

- MECHANICAL (using staples)
- HOT
- COLD (self-vulcanizing)

In this booklet we discuss hot and cold vulcanized splices

12.2. Cold splice

12.2.1 Tools needed

1. Pressure roller
2. Chalk, string
3. Metal ruler in milimeters at least as wide as the belt
4. Round whetstone (grit size 24, 0 4")
5. Specific adhesive, catalyst, and chemical remover
6. Various PPEs such as glasses, metal wire gloves, ear protectors, and helmet.
7. Metal square (approximately 15")
8. Tape measure (minimum 3m)
9. Paintbrush size 1.1/2’ or 2’ for applying the adhesive
10. Pliers
11. Knife for rubber
12. Knife for textile
13. Pencil or pen
14. Clamp
15. Brush
16. Rubber mallet
17. 7" Angular Sander (6000 rpm, sanding disc of grit 100, Ø 7")
18. Grinder with a flexible cable for steel brush (750W, 4800rpm)
19. Steel brush (Ø de 4")

Note: In addition to the items above, the activity in the field usually requires other equipment such as a base to support the conveyor, tools to take apart the conveyor frame, safety markings, protection for rain and dust, and infrared dryer, as the splice team must assess each situation, respecting the company's safety standards.

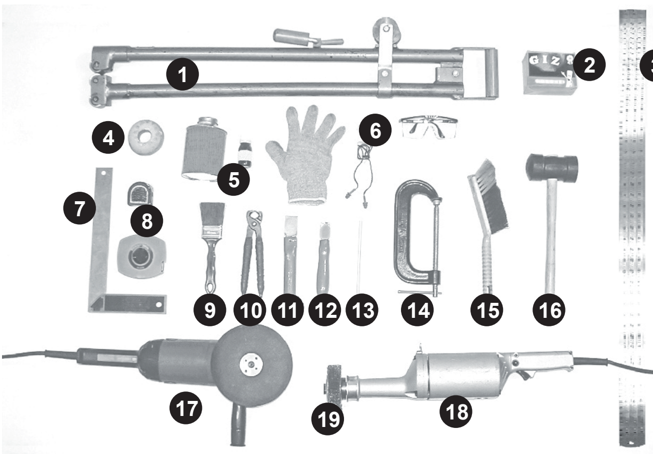
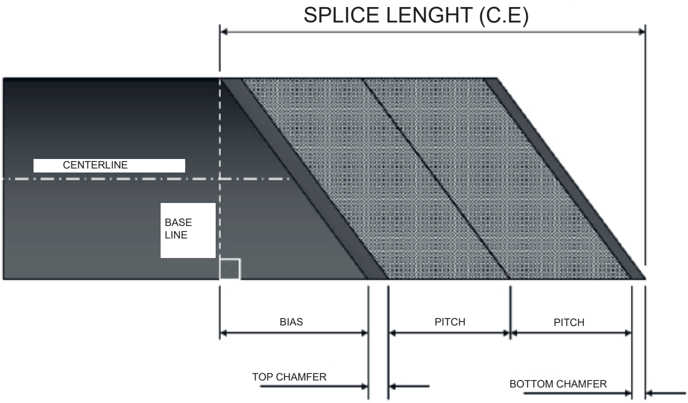


Figure 23

12.2.2 Basic Terminology



Below we describe the basic terminology used in preparing a splice.

- **BIAS:** Non-removable area of the splice and part of its length that determines the scaling angle.
- **PITCH:** Also called degree, is parallel along the bias line. It is responsible for the area of the splice's grip.
- **BASE LINE:** Is the line made at a 90° angle in relation to the belt's center that determines the splice length and that serves as the base for all scaling measurements.
- **CENTERLINE:** This is the line placed in the absolute center of the belt at a 90° angle in relation to the base line. It serves to ensure the alignment of the splice.

• **SCALING:** It is the process of cutting and marking the belt for making the splice.

12.2.3 Splice angle and lenght (C.E)

The first procedure for carrying out a splice is calculating its length, which will depend on the method to be used.

All splices should be done at an angle to reduce the effects of the belt's flexibility on the pulleys and passing through the scrapers.

Many splice technicians adopt angles that vary from 20° to 45°. This difference, although it has an influence on the total splice length, does **not determine its quality** as it does not change the splice's adhesive "grip" area.

In the field, as a matter of practicality, usually the splicing technicians calculate the bias as being half the width or even equal to the width. With this procedure, the angles that are being used are 26° or 45°, respectively.

Note: When we calculate the bias as being half the width (0.5 x width), we get the angle of **26.5°** (tg 26.5° = 0.5). When we calculate the bias as being equal to the width, we get the angle of **45°** (because tg 45° = 1) and when we get an angle of 20°, we use the constant "**0.364**" because **tg 20°** = 0.364.

12.2.4 Previous tensioning of the belt before making the splice

Prior to carrying out the splicing, especially when the belt to be spliced is new, we must check the correct tensioning and positioning of the counterweight in order to ensure that at the end of the service, when the counterweight is released, that the belt is properly tensioned and has a take-up length necessary for the application.

Therefore, we should proceed as follows:

• Analyze the position of the counterweight considering the take-up length. Usually it is above the recommended due to the stretching of the belt that was in use.

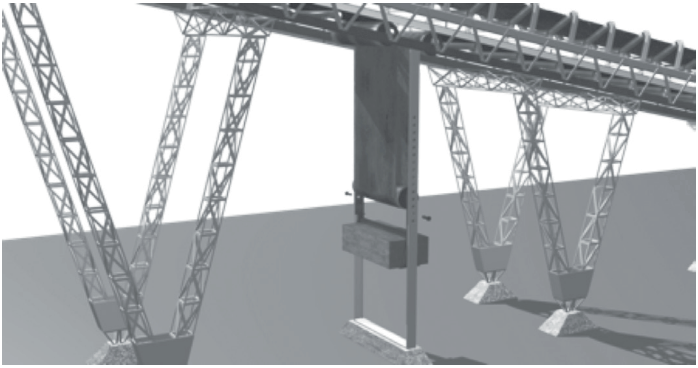


Figure 24 - Total counterweight take-up lenght

• Next, lift the counterweight, leaving an area for stretching of about 75% of the total take-up length.

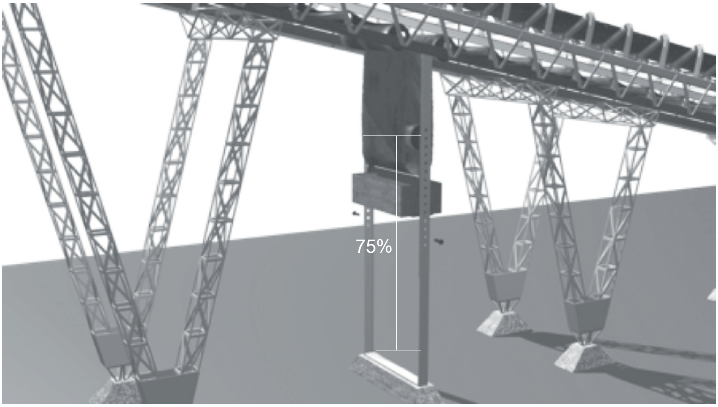


Figura 25

Note: Due to the conveyor belt's natural elongation during operation, many splice technicians err in not calculating the correct positioning of the counterweight, and in many situations it is necessary to shorten the belt.

12.2.5 Cold procedure for belts with 3 or more plies

12.2.5.1 Splice Lenght (C.E)

We need to be very careful when calculating the splice length, especially avoiding an area of insufficient grip.

For belts with more than two plies, the required amount of pitches will always be equal to the number of plies minus one:

Nº of Pitches = Nº of Plies - 1
Note: This rule applies only to belts with 3 or more plies

DETERMINING THE LENGTH OF THE PITCHES

The length of each pitch is measured along the edges of the belt, as well as the bias, and varies depending on the width. The goal is that the lighter belts (or lighter operations) have smaller pitches and that the heavier belts (heavier operations) have larger pitches.

To do this, Mercurio Conveyor Belt recommends adopting the dimensions of the table below, which contains the length of each pitch depending on the type of carcass.

Recommendation of pitches depending on the type of textile	
Type of Textile	**Pitch (mm)**
PN1200	250
PN2200/NN1100	Width ÷ Nº of pitches or 250mm (USE WHICHEVER IS GREATER)
PN3000/NN1800	Width ÷ Nº of pitches or 400mm (USE WHICHEVER IS GREATER)
PN400/PN500/PN6500	(1,5 X Width) ÷ Nº of pitches or 500mm (USE WHICHEVER IS GREATER)

Tabla 15

12.2.5.2 Calculating the splice lenght (C.E) for belts with 3 or more plies

The splice length will be calculated using the following formula:

CE= BIAS + (No° of PITCHES X PITCH)

Note: Add **100 mm** to the amount reached for making the top and bottom chamfers.

Where:

• Bias = 0,5 x Belt width (for angle of 26,5°)

EXAMPLE CALCULATION

We will be calculating the length of the splice for the following belt:

CT EA; 3PN2200; 8mm x 3mm; 800mm

From the product's description, we know that this is a **3-ply** conveyor belt, **800 mm** wide, type **PN2200**.

CALCULATION OF THE BIAS

Considering the angle of 26.5°, the bias length will be:

BIAS = Belt width ÷ 2 (or width x 0,5)
BIAS = 800 ÷ 2
BIAS = 400mm

NUMBER OF PITCHES (OR DEGREES)

As this belt has more than two plies, the no. of pitches will be calculated as follows:

No° of PITCHES = No° of Plies - 1
No° of PITCHES = 3 - 1
No° of PITCHES = 2

LENGTH OF EACH PITCH

Considering the width of 800 mm and the type of fabric (PN2200), according to Table 16, the length of each pitch will be:

PITCH = Belt width ÷ Number of pitches
PITCH = 800 ÷ 2
PITCH = 400mm

SPLICE LENGHT (C.E.)

C.E. = BIAS + (Noº of pitches x pitch)
C.E. = 400 + (2 X 400)
C.E. = 400 + 800
C.E. = 1200mm

Note: By adding **100 mm** to the S.L. found, we reach a total length of **1,300** mm, which is the measurement that becomes the base line.

12.2.5.3 Scaling of the first end (Belts with 3 or more plies)

Once properly fastened on the conveyor, we will begin with the end that will stay on top and with the lower cover.

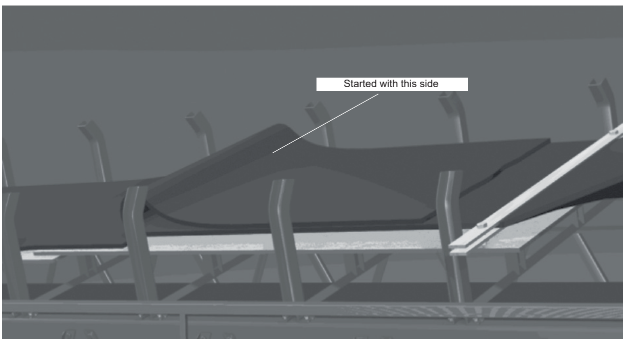


Figure 24

12.2.5.4 Marking and cutting procedures

• Cut the end of the belt on absolute square of 90° in relation to the edges.
• Mark the base line at the “S.L.” distance from the end of the belt.
• Measure and mark the bias along the edge of the belt starting from the base line.

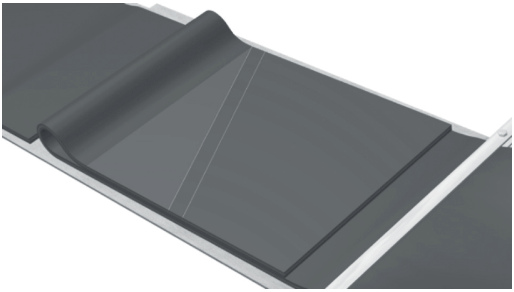


Figure 26

The scaling should be initiated with a cut on the bias line with the knife for rubber in as much of a slated position as possible (around 20°) so that only the rubber cover is cut without touching the fabric.

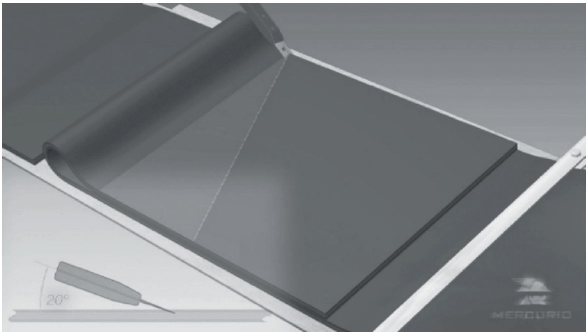


Figure 27

Another cut will be made parallel to the slanted cut with the knife for rubber in the vertical position, also in the cover's thickness and without touching the fabric.

The goal is to use the pliers to remove a diagonal strip from the cover, exposing the first ply in order to facilitate starting the scaling.

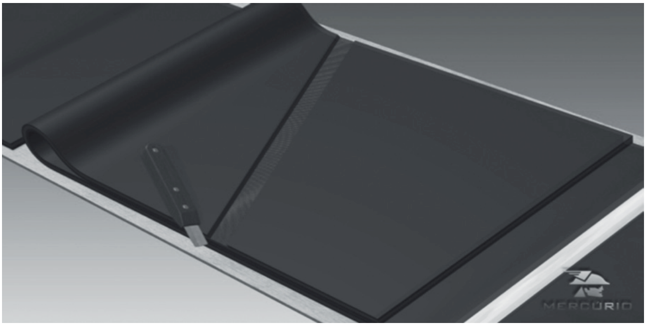


Figure 28

Cut the belt's end parallel to the bias, S.L. + 10%.

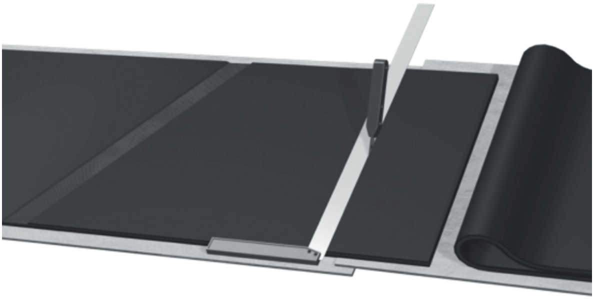


Figure 29

Make longitudinal cuts on the cover rubber +/- 40 mm between each of them from the bias toward the belt's end. These cuts should be made as the previous ones, trying not to affect the fabric.

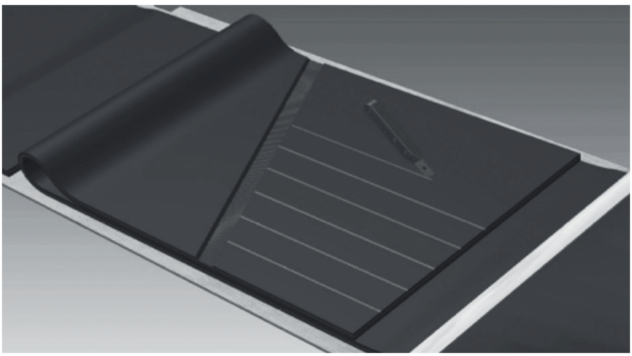


Figure 30

Con la tenaza, retirar las tiras de caucho, una por una, hasta exponer totalmente la primera tela.

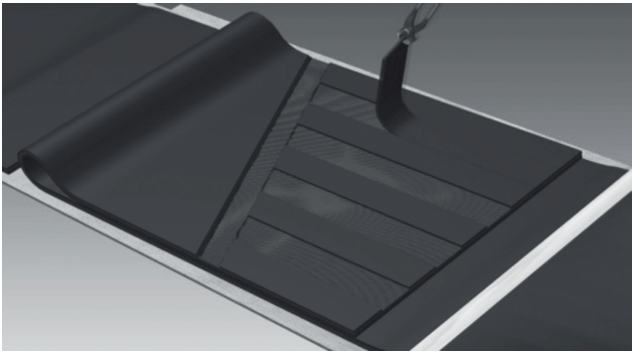


Figure 31

Use the pliers to remove the rubber strips one by one until the first ply is completely exposed.

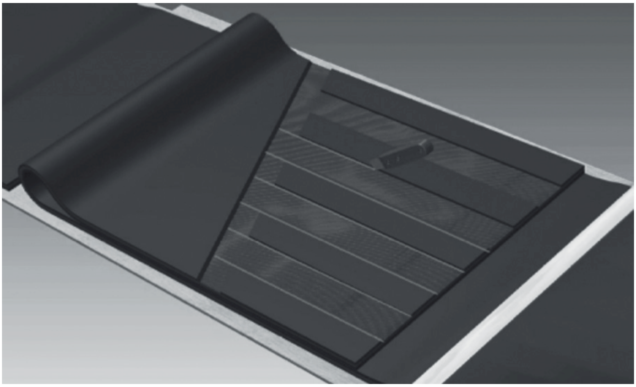


Figure 32

Use the knife to cut along the fabric forming strips. Great care must be taken not to affect the 2nd fabric.

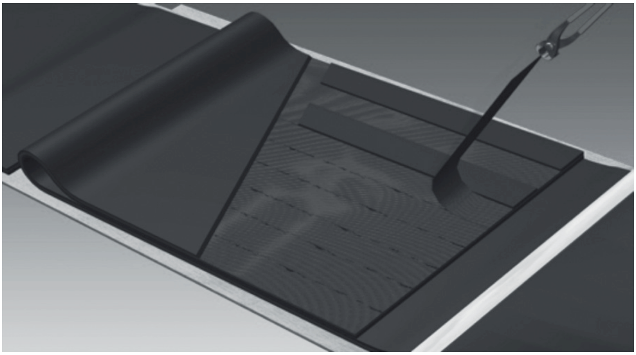


Figure 33

Use the knife for rubber as a spatula to remove the rubber burrs that remained on the belt, taking care not to damage it.

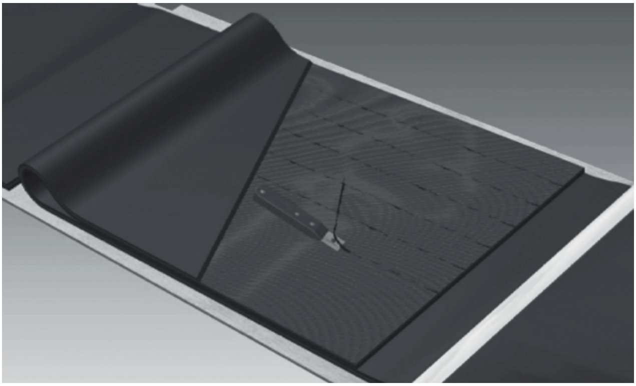


Figure 34

From the point where the chamfer ends (exactly where the first ply was cut), measure along the edge toward the end of the belt the length of the first pitch.

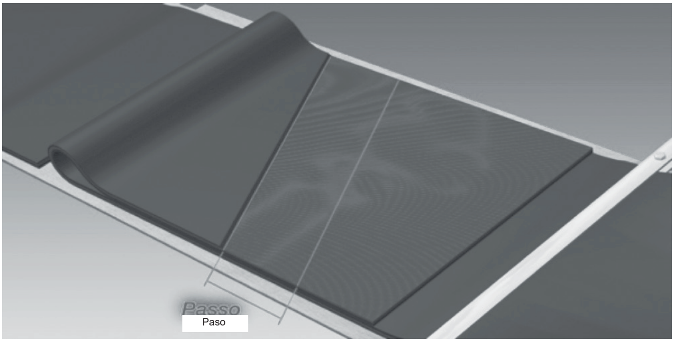


Figure 35

Cut the 2nd ply flush with the diagonal line that determines the 1st pitch, being very careful not to affect the third ply.

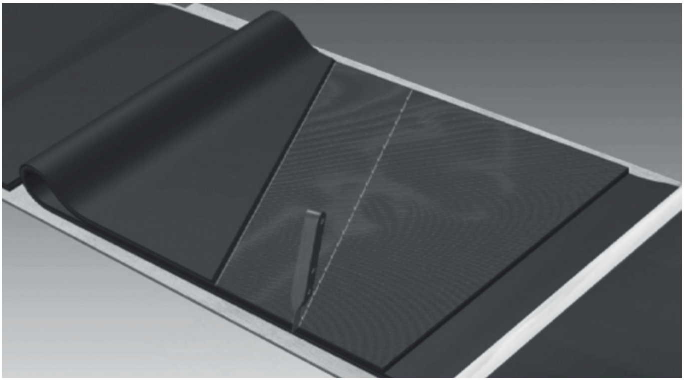


Figure 36

Cut along the second ply forming strips, then remove them one by one until the third ply is completely exposed.

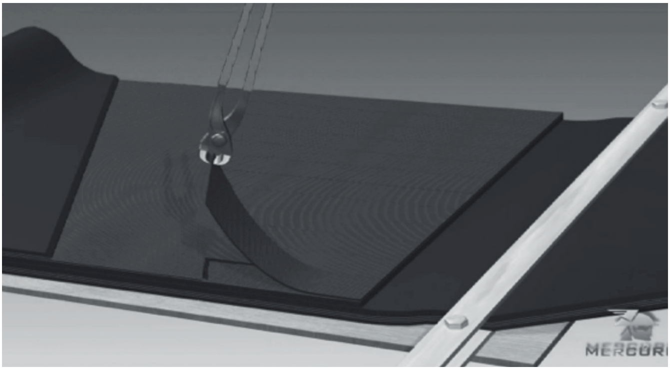


Figure 37

Use the knife for rubber as a spatula to remove the burrs that remained on the belt, taking care not to damage it.

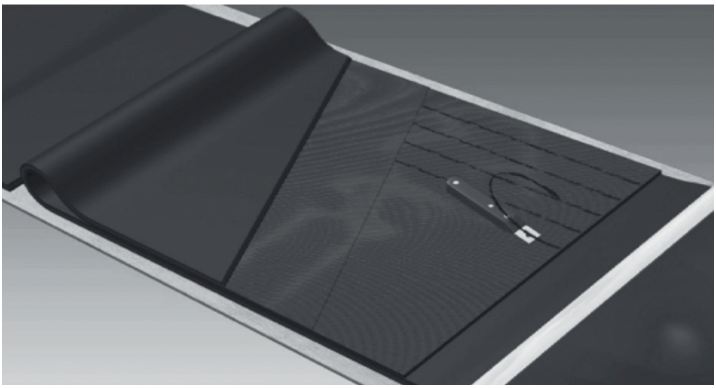


Figure 38

From the point where the second ply was cut (where the second pitch begins), toward the end of the belt, measure along the edge the length of the last pitch.

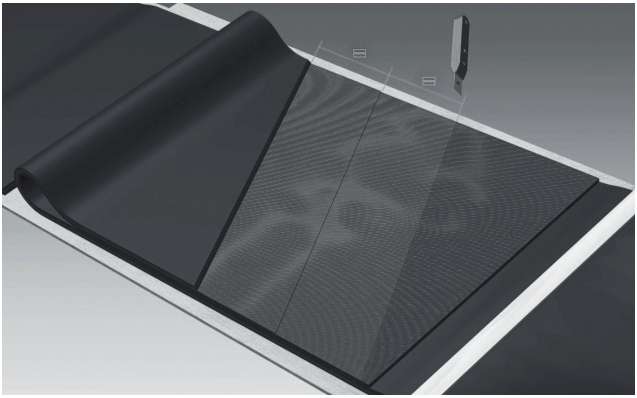


Figure 39

Cut the fabric flush with the diagonal line on the 3rd ply and the rubber in as much of a slanted position as possible (around 20°), thus forming the top chamfer.

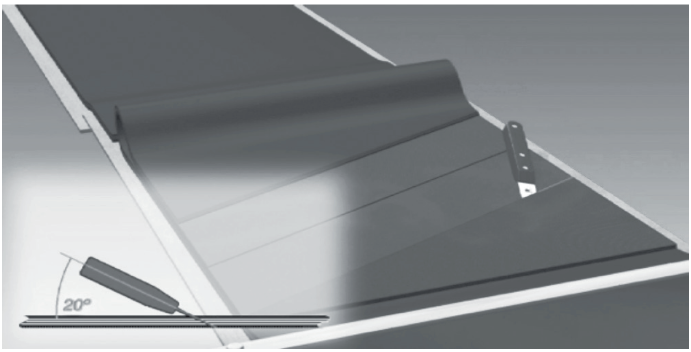


Figure 40

For belts with more than three plies, the procedure is virtually identical, requiring only to add more pitches and repeat the scaling procedures.

12.2.5.5 Scaling of the second end

This scaling will be done using the process called "photography", which consists in transferring all the lines and measurements from one end to the other by overlapping. As suggested by this booklet, the scaling that was done on the bottom cover will be copied to the top cover from the belt's other end.

Return to the end that has already been scaled for the situation of overlapping, checking the perfect alignment through the two center lines.

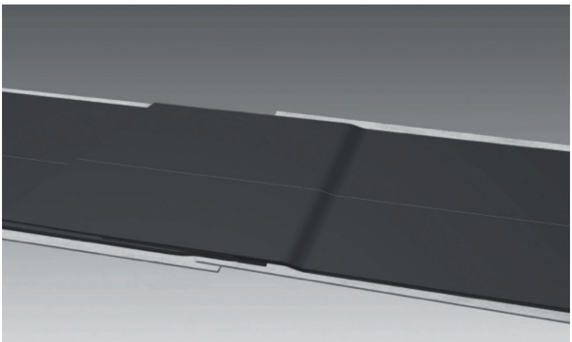


Figure 41

Using the edge that is on top as if it were a ruler, marking the bias line at the end that is underneath, thereby obtaining exactly the same angle.

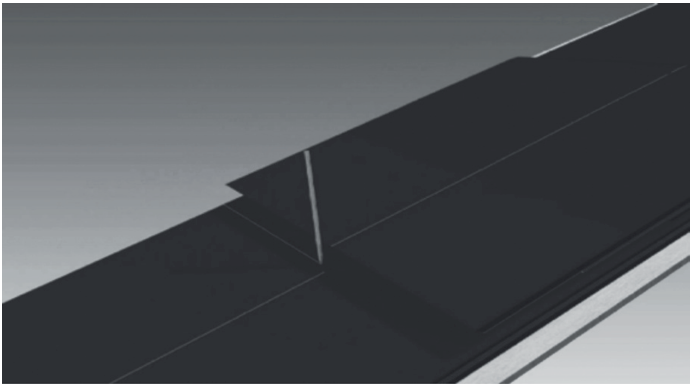


Figure 42

Note: The cutting procedure is similar to that shown previously, and care must be taken not to affect the fabric, which is responsible for the splice's grip area.

Use the knife for rubber to start the scaling with a cut on the bias line with the knife in as much of a slanted position as possible (around 20°) so that only the cover rubber is cut without touching the fabric.

Another cut will be made parallel to this one with the knife in the vertical position also in the cover's thickness and without touching the fabric as instructed previously. The goal is to use the pliers to withdraw a diagonal strip from the top cover, exposing the first ply in order to facilitate starting the scaling.

Cut the end of the belt parallel to the bias at an angle of 26.5°, being careful to have sufficient length to make the splice.

Use the pliers to remove the rubber from the top cover in strips.

Use the knife for fabric with care and precision to cut the first ply diagonally, accompanying the bias exactly at the point where the chamfer ends.

Using the knife for fabric for lifting the edges of the first ply next to the chamfer so that you can then grab it with the pliers.

Use the pliers to remove the first ply in strips.

Remove the rubber burrs that were left on the belt.

Make a temporary mark with chalk on the diagonal line of the 2nd ply. Go back to the end that is on top to the situation of overlapping in order to mark the line where the second pitch begins.

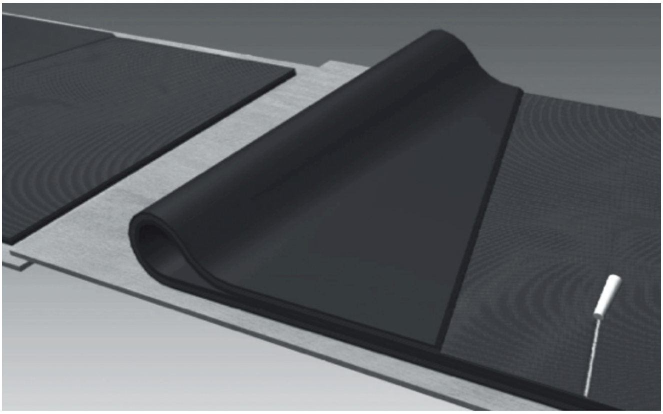


Figure 43

Using the knife for fabric, cut the second ply, taking care not to affect the third ply. Use the pliers to remove the first ply in strips.

Remove the rubber burrs that were left on the belt.

In an overlapping situation, "photograph" **at the same time** the line where the second pitch ends and where the bottom chamfer ends.

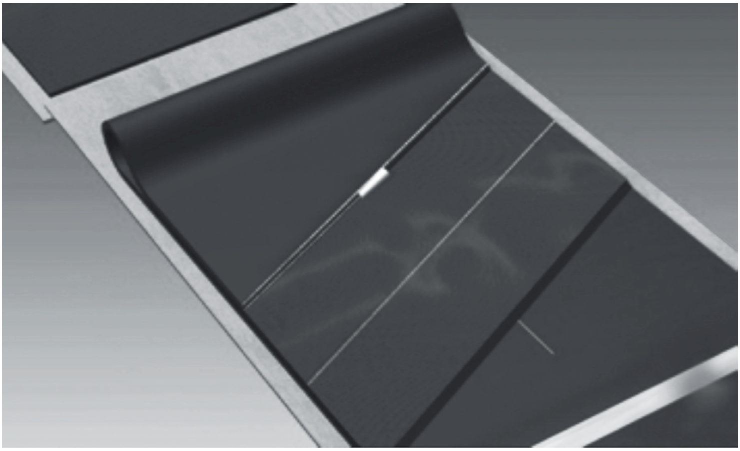


Figure 44

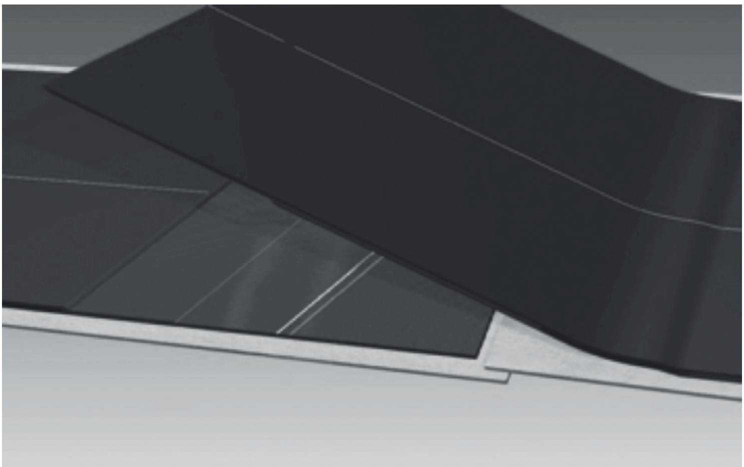


Figure 45

With the knife for fabric, cut the third ply parallel to the bias.
Using the knife for rubber, cut the entire cover to form the bottom chamfer.

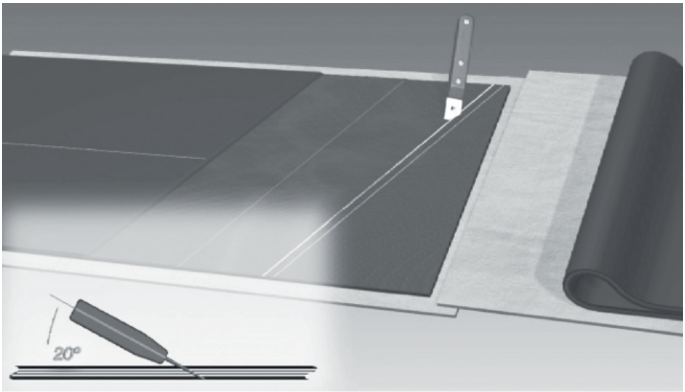


Figure 46

12.2.6 Calculating the splice lenght (C.E): Procedure for belts with 2 plies

NUMBER OF PITCHES (OR DEGREES)

For belts with 2 plies, the quantity of pitches necessary will always be equal to 2.

No° of PITCHES = 2

LENGHT OF EACH PITCH

The length of each pitch is measured along the edges of the belt, as well as the bias, and varies depending on the width.

The goal is that the lighter belts (or lighter operations) have smaller pitches and that the heavier belts (heavier operations) have larger pitches.

To do this, Mercurio Conveyor Belt recommends adopting the dimensions of table 16 below, which contains the length of each pitch depending on the type of fabric and belt width.

Recommendation of pitches depending on the type of textile	
Type of Fabric	**Pitch (mm)**
PN1200	250
PN2200/NN1100	Width ÷ Noº of PITCHES 250mm (USE WHICHEVER IS GREATER)
PN3000/NN1800	Width ÷ Noº of PITCHES 400mm (USE WHICHEVER IS GREATER)
PN400/PN500/PN6500	(1,5 X Width) ÷ Noº of PITCHES 500mm (USE WHICHEVER IS GREATER)

Table 16

Note: According to the table above, we can conclude that whatever the width, the pitch should never be less than 250 mm for plies PN1200 / PN2200 / NN1100, 400 mm for plies PN3000 / NN1800, and 500 mm for plies PN4000 / PN5000 / PN6500.

12.2.6.1 Calculating the splice lenght (C.E)

The splice length will be calculated using the following formula:

CE= BIAS + (2 X PITCH)

Note: Add 100 mm to the amount reached for making the top and bottom chamfers.

Where:

• Bias = 0,5 x Belt width (For angle of 26,5°)

EXAMPLE CALCULATION

Let's calculate the splice length for the following belt:

CT EA; 2PN2200; 8mm x 3mm; 650mm

From the product's description, we know that this is a **2-ply** conveyor belt, **650 mm** wide, type **PN2200**.

CALCULATION OF THE BIAS

Considering the angle of 26.5°, the bias length will be:

BIAS = Belt width ÷ 2 (or Width X 0,5)
BIAS = 650 ÷ 2
BIAS = 325mm

QUANTITY OF PITCHES

As this belt has **two plies**, the number of pitches will be equal to **2**.

PITCH LENGHT

Considering the width of 650 mm and the type of fabric (PN2200), according to Table 16, the length of each pitch will be:

PITCH LENGTH = Belt width ÷ 2
PITCH = 650 ÷ 2
PITCH = 325mm

SPLICE LENGHT (C.E.)

Thus, the total splice length will be:

C.E. = BIAS + (No° of PITCHES X PITCH)
C.E. = 325 + (2 X 325)
C.E. = 325 + 650
C.E. = 975mm

By adding 100 mm to the S.L. found, we reach a total length of 1075 mm, which is the measurement that becomes the base line.

12.2.6.2 Escaling of the first end

Once properly fastened on the conveyor, we will begin with the end that will stay on top and with the lower cover, according to the procedure of three plies mentioned above.

Cut the end of the belt squarely in an absolute of 90° in relation to the edges.

Mark the base line at the distance “S.L. + 100 mm” from the end of the belt.

Measure and mark the bias along the edge of the belt starting from the base line.

The scaling should be initiated with a cut on the bias line with the knife in as much of a slanted position as possible (around 20°) so that only the cover rubber is cut without touching the fabric.

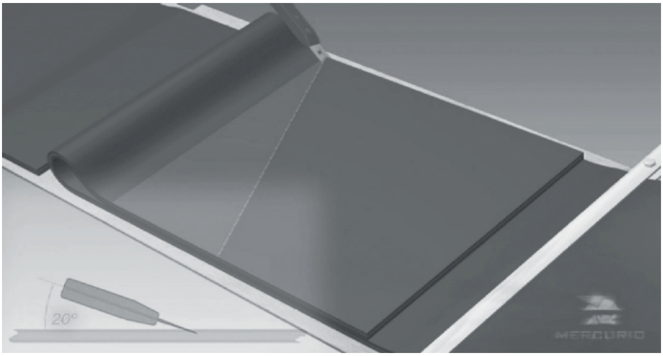


Figure 47

Starting from the bias line toward the edge of the belt, measure the distance of "PITCH + 100 mm" and cut the cover parallel to the bias line.

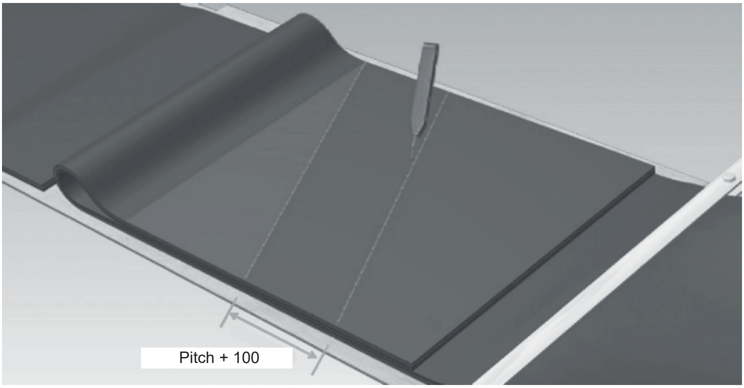


Figure 48

Make longitudinal cuts on the cover rubber, parallel and distant +/- 40 mm between them, from the bias toward the end of the belt until the length of "PITCH + l00 mm". These cuts should be done as the previous ones, trying not to affect the fabric.

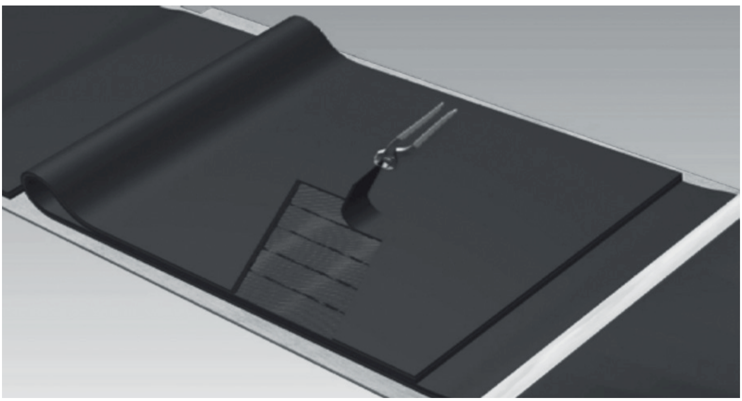


Figure 49

From the point where the chamfer ends toward the end of the belt, measure along the edge the length of one pitch and mark a line parallel to the bias line.

Using a knife specifically for cutting fabric, carefully and precisely cut the first ply diagonally.

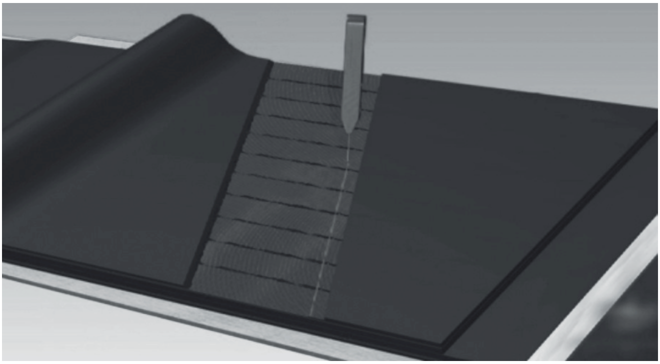


Figure 50

Lift the edges next to the pitch so that you can grab it with the pliers. Next pull strip by strip to expose the second ply.

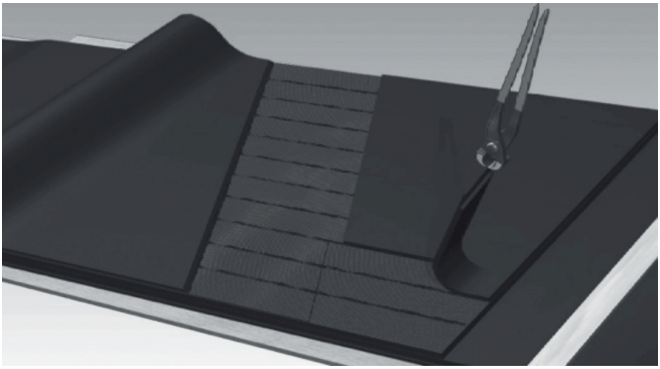


Figure 51

Use the knife for rubber as a spatula and **in longitudinal movements** remove the rubber burrs that remained on the belt, taking care not to damage it.

From the point where the second ply was cut (where the second pitch begins), toward the end of the belt, measure along the edge the length of one pitch.

From this distance, draw a parallel
line that will be the end of the second pitch and will begin the top chamfer. Use the knife for rubber in as much of a slanted position as possible (around 20°) to cut the second ply and the entire thickness of the upper cover, thus forming the top chamfer.

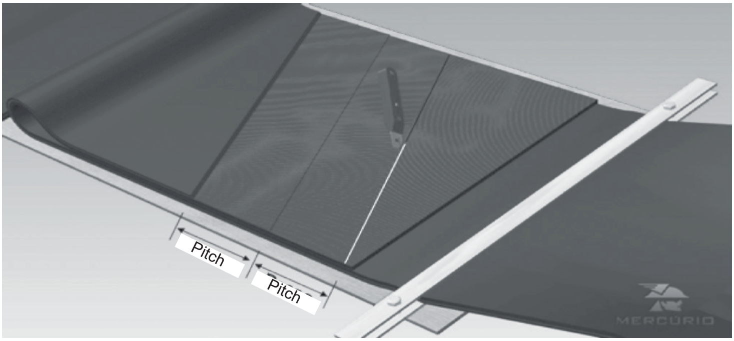


Figure 52

12.2.6.3 Scaling of the second end

This scaling will be done using the process called "photography", which consists in transferring all the lines and measurements from one end to the other by overlapping. As suggested by this booklet, the scaling that was done on the bottom cover will be copied to the top cover from the belt's other end.

Return to the end that has already been scaled for the situation of overlapping, checking the perfect alignment through the center lines.

Using the edge that is on top, mark the bias line at the end that is underneath, thereby obtaining exactly the same angle. With the knife for rubber, cut the first line, thus forming the bottom chamfer.

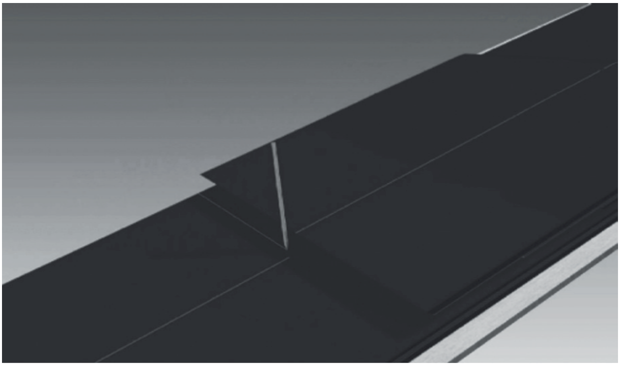


Figure 53

Use the knife specific for rubber to start the scaling with a cut on the bias line with the knife in as much of a slanted position as possible (around 20°) so that **only the cover rubber is cut without touching the fabric.**

Remember that this chamfer must fit perfectly in the chamfer on the other end, so their inclinations need to be equal (±20°).

Cut the end of the belt parallel to the bias at an angle of 26°, being careful to have sufficient length to make the splice (figure 52).

Con la tenaza y por tiras, retirar el caucho de la cubierta superior hasta la distancia de "PASO + 100mm". Procedimiento idéntico al ya realizado en la otra extremidad de la correa".

Remove the rubber burrs that were left on the belt.
Go back to the end that is on top to the
situation of overlapping in order to mark where the second pitch begins.

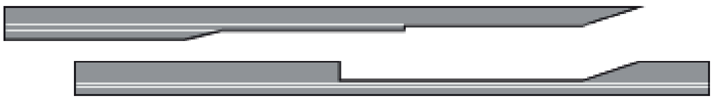


Figure 54

Using the knife for fabric, cut the first ply, taking care not to affect the second ply.

Use the pliers to remove the first ply in strips together with the top cover.

Remove the rubber burrs that were left on the second ply.

In an overlapping situation, "photograph" **at the same time** the line where the second pitch ends and where the bottom chamfer ends. Using the knife for rubber, cut the entire cover to form the bottom chamfer.

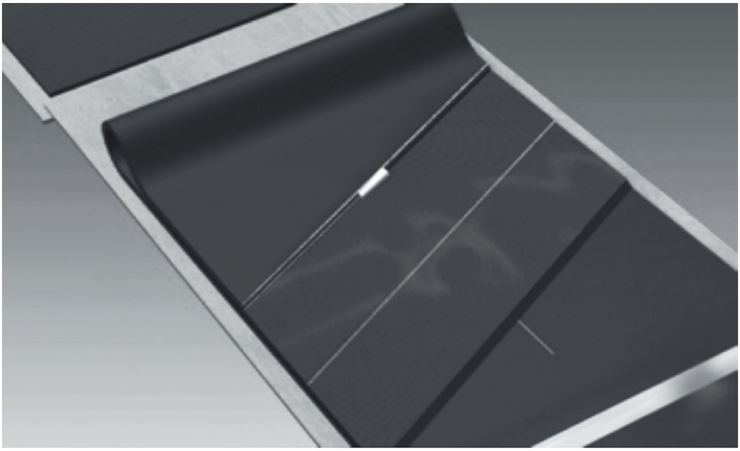


Figure 55

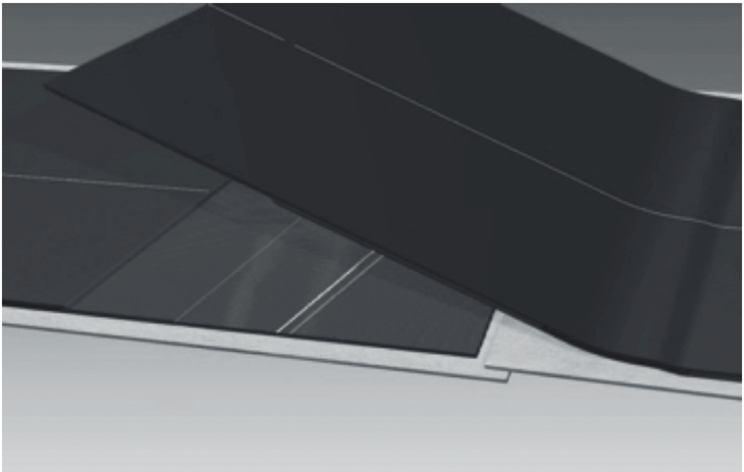


Figure 56

12.3. Cleaning

12.3.1. Chamfers

After the scaling, all the chamfers need to be made adjusted with the rotary steel brush so that they become sufficiently square for the fit and with the porosity required for the adhesive, **being careful to avoid contact of the tool with the fabric.**

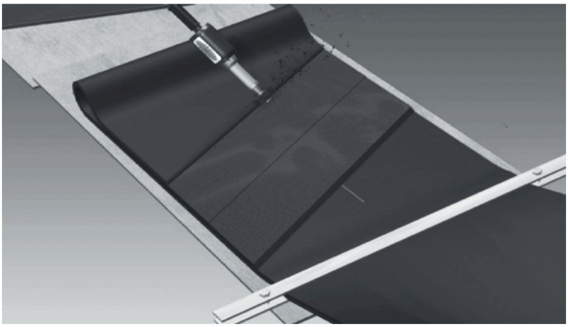


Figure 57

12.3.2. Plies

Any excesses rubber that might have stayed on the belt's surface should be removed with the knife being used as a spatula and then manually with the whetstone to ensure a rough surface.

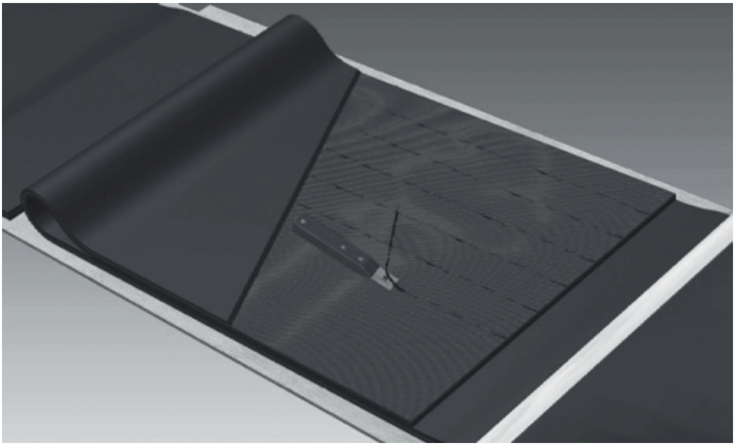


Figure 58

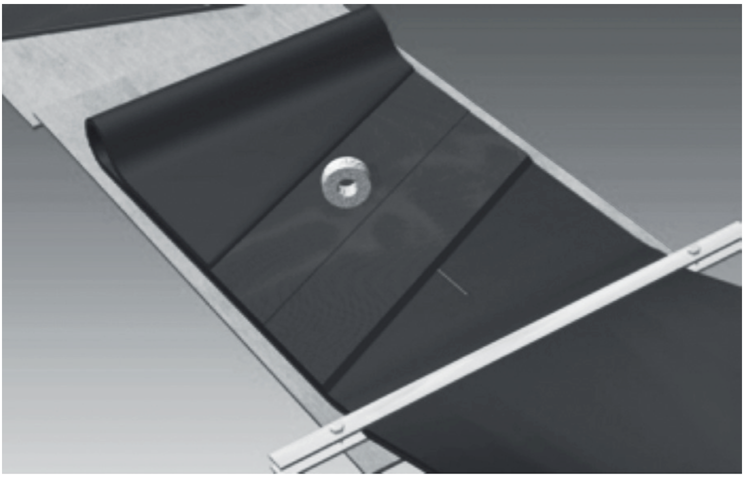


Figure 59

It is not necessary to remove all the rubber from the belt. What is important is to ensure a clean and uniform surface without sharp depressions and bumps of rubber that could cause blisters.

In some types of belts (or used belts) it is common that after the strips of fabric are removed that rubber remains on nearly the entire surface of the ply immediately below. This rubber is the bonding layer and does not need to be removed.

Important!
In no case is it recommended to use a "cup" or "tungsten" grinding device due to their extremely aggressive action.
Field experience shows that the vast majority of cases of splices opening is due to excessive sanding of the plies leading to the rupture of the fabric fibers.

Once all "sanding" operations required are done, carefully sweep with a brush the surfaces to be bonded and then with a paintbrush dipped in the chemical remover, brush away the rest of the impurities.

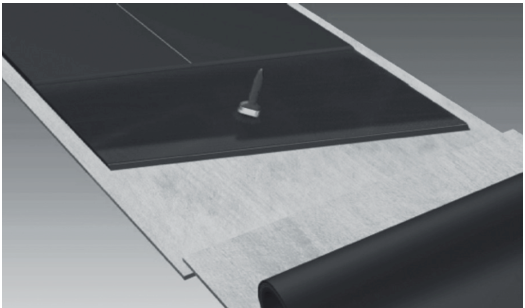


Figure 60

12.4. Bonding

12.4.1. Preparing

- The adhesive needs to be mixed until it reaches a uniform color.
- The adhesive and catalyst should be mixed only at the time of use.
- The quantity prepared of adhesive + catalyst depends on the area to be bonded and the time of consumption, keeping in mind that once prepared, the mixture needs to be consumed within a maximum of 2 hours.
- The proportion of adhesive and catalyst may vary so it is important to follow the recommendations of each manufacturer.
- Make sure that the adhesive is still within its validity date.

Important!
Before and after applying the first coat of cement adhesive, be sure to check the procedure on the Dew Point (table on the page 115):

Example: To determine the dew point.
Tools needed:

- Temperature measurement tool to determine the temperature of the air and the surface of the parts to be bonded together.

- Measurement tool to determine the relative humidity.
- Dew Point Table.

Measure the relative humidity, the air temperature, and the temperature of the parts to be bonded together. Refer to the Dew Point Table and proceed as follows:

- Relative Humidity (RH) = 70%
- Air Temperature (LT) = + 28°C
- Temp. of parts to be bonded = + 18°C

	Umidade Relativa do Ar													
	30	35	40	45	50	55	60	65	70	75	80	85	90	95
LT* °C	Ponto de Orvalho (TP)													
-4	17,5	15,8	14,4	13,1	11,9	10,8	-9,9	-9,0	-8,1	-7,3	-6,6	-5,9	-5,3	-4,6
-2	15,7	13,9	12,6	11,2	10,2	-8,9	-8,0	-7,1	-6,2	-5,4	-4,6	-3,9	-3,3	-2,6
0	13,9	12,1	10,7	-9,3	-8,4	-7,0	-6,0	-5,1	-4,2	-3,4	-2,7	-1,9	-1,3	-0,6
2	12,3	10,6	-9,0	-7,7	-6,6	-5,4	-4,4	-3,4	-2,6	-1,7	-1,0	-0,2	0,5	1,3
4	10,7	-8,9	-7,4	-6,0	-4,9	-3,7	-2,7	-1,7	-0,9	0,0	0,9	1,8	2,5	3,3
6	-9,1	-7,3	-5,8	-4,4	-3,2	-2,1	-1,0	0,0	0,9	2,0	2,8	3,7	4,5	5,3
8	-7,6	-5,7	-4,2	-2,8	-1,6	-0,4	0,7	1,9	2,9	3,9	4,8	5,7	6,5	7,3
10	-6,0	-4,2	-2,6	-1,0	0,0	1,4	2,6	3,7	4,8	5,8	6,7	7,6	8,4	9,2
12	-4,5	-2,6	-1,0	0,4	1,9	3,2	4,5	5,7	6,7	7,7	8,7	9,6	10,4	11,2
14	-2,9	-1,0	0,6	2,2	3,7	6,1	6,4	7,5	8,6	9,7	10,6	11,5	12,4	13,2
16	-1,4	0,5	2,4	4,0	5,6	7,0	8,2	9,4	10,	11,6	12,5	13,5	14,3	15,2
18	0,2	2,3	4,2	5,9	7,4	8,8	10,1	11,3	12,4	13,6	14,5	15,5	16,3	17,2
20	1,9	4,1	6,0	7,7	9,2	10,7	12,0	13,2	14,4	15,4	16,4	17,4	18,3	19,2
22	3,6	5,9	7,8	9,5	11,1	12,5	13,9	15,1	16,3	17,4	18,4	19,4	20,3	21,2
24	5,4	7,6	9,6	11,3	12,9	14,3	15,8	17,0	18,2	19,3	20,3	21,3	22,2	23,1
26	7,1	9,3	11,3	13,1	14,8	16,2	17,6	18,9	20,1	21,2	22,3	23,3	24,2	25,1
28	8,8	11,1	13,1	14,9	16,6	18,1	19,5	20,8	22,0	23,1	24,2	25,3	26,2	27,1
30	10,5	12,8	14,9	16,7	18,4	19,9	21,4	22,7	23,9	25,1	26,2	27,2	28,2	29,1
32	12,2	14,6	16,7	18,5	20,2	21,7	23,2	24,6	25,9	27,0	28,2	29,2	30,2	31,1
34	14,0	16,4	18,5	20,3	22,1	23,6	25,1	26,5	27,8	28,9	30,1	31,2	32,1	33,1
36	15,7	18,1	20,3	22,1	24,0	25,5	26,9	28,4	29,7	30,9	32,0	33,2	34,1	35,1
38	17,4	19,8	22,1	23,9	25,8	27,3	28,8	30,3	31,6	32,8	34,0	35,1	36,1	37,0
40	19,1	21,5	23,9	25,7	27,6	29,1	30,7	32,2	33,5	34,7	35,9	37,0	38,1	39,0
42	20,8	23,2	25,7	27,6	29,4	31,0	32,5	34,1	35,4	36,7	37,8	39,0	40,1	41,0
44	22,5	24,9	27,5	29,4	31,3	32,9	34,4	35,9	37,3	38,6	39,7	41,0	42,1	43,0
46	24,3	26,7	29,2	31,3	33,1	34,7	36,6	37,8	39,2	40,5	41,6	42,9	44,0	45,0
48	26,0	28,5	31,0	33,0	34,9	36,5	38,2	39,7	41,1	42,4	43,4	44,9	46,0	47,0

*LT= Temperatura do ar

Umidade Relativa do Ar: **Relative Humidity**
Ponto de Orvalho: **Dew Point (TP)**

Table 16

Look for the level of 70% on the "Relative Humidity" line. Find the intersection between the column "70%" and the line "Air Temperature +28°C".

The amount shown in this intersection is "22", which means that:

• With an air humidity of 70% and an air temperature of 28°C, condensation is formed if the temperature of the parts to be bonded is less than (<) 22°C. If the temperature of the parts to be bonded is 18°C, the bond is not possible.

12.4.2. Applying the adhesive

The adhesive properly mixed with the corresponding catalyst should be applied using a paintbrush, but the bristles need to be cut in order to increase the penetration of the adhesive into the pores of the fabric. The number of coats should be according to the table below:

Number of coats x Waiting time		
Belt type	**Number of coats**	**Dry time between coats**
PN1200	2	30 (estimate)
PN2200/NN1100		
PN3000/NN1800		
PN4000/PN5000/ PN6000	3	40 (estimate)
Note: When checking the time to put the last coat, it may vary depending on the weather and should be analyzed based on the tack by using the back of your finger. More details about the waiting period between coats should be checked with the adhesive manufacturers.		

Table 17

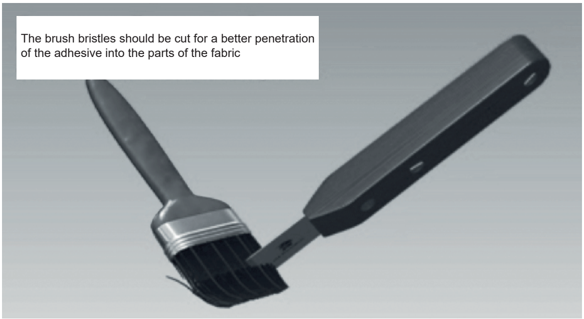


Figure 61

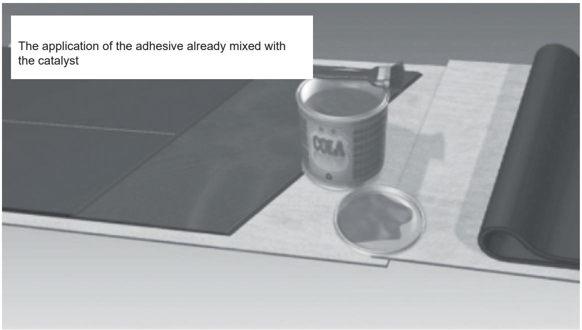


Figure 62

Both ends need to receive a coat of the adhesive using circular and vigorous movements to make sure that the adhesive penetrates into every pore and across the entire surface **of the textile and chamfers.**

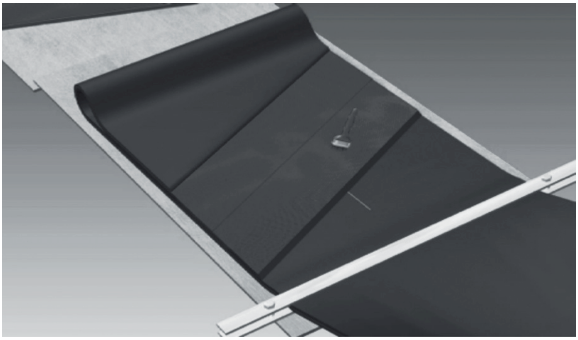


Figure 63

Note: : Too much adhesive in one place should be avoided as this can cause blisters.

• After the first coat it will be necessary to wait for a period of approximately 40 minutes, which may vary to more or less time depending on the humidity and temperature conditions.

• After this period of waiting, apply a second coat exactly like the first, but considering that after this application, the waiting time should be enough to allow the adhesive to reach the cure it needs. In practice, many professionals in the vulcanization industry use the back of their fingers to do this assessment. Usually this time corresponds to 5 minutes.

12.5. Joining the ends

Though the ends are already fastened, which will prevent the misalignment at this time of the work, it is important that splice technicians use extreme caution for fitting each point of the splice because once the parts touch it will be quite difficult to separate them.
Because of this, we recommend the following procedures:

a) **For belts up to 20" wide:** The tip that is on top can be lowered all at once (observing the notches), tapping with the rubber mallet first the central region and then the sides of the splice.

b) **For belts more than 20" wide:** Clean PVC tubes cut in half should be used as supports or made from the belt itself, arranged longitudinally along the splice with a spacing that ensures the support of the end that needs to be lifted.

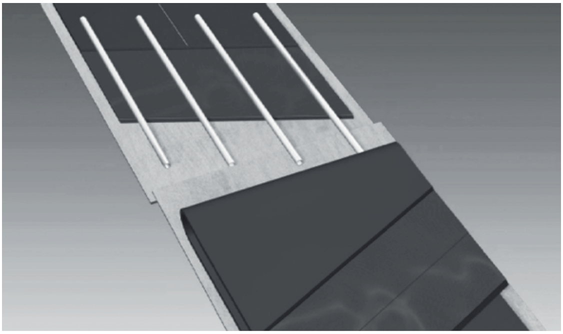


Figure 63

Once fully supported on these bars, for the bonding, **first remove the center supports** so that the center of the splice be bonded and pressed first.

Then remove the supports first from one side, then the other, and from inside to outside, always tapping with a rubber mallet.

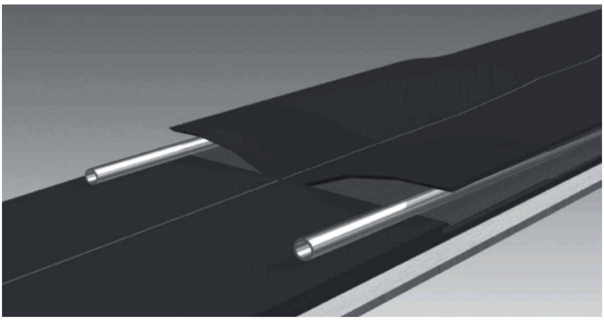


Figure 64

Once the ends are joined, the entire surface of the splice, including the chamfer, should receive **strong blows with the rubber mallet beginning from the center and then moving toward the edge of the belt** in order to expel any air that may be trapped in the splice.

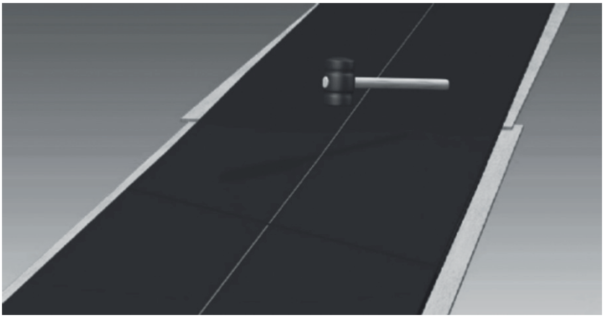


Figure 65

After the hammering process, use the pressure roller to make sure that the surface is compressed, including the chamfers.

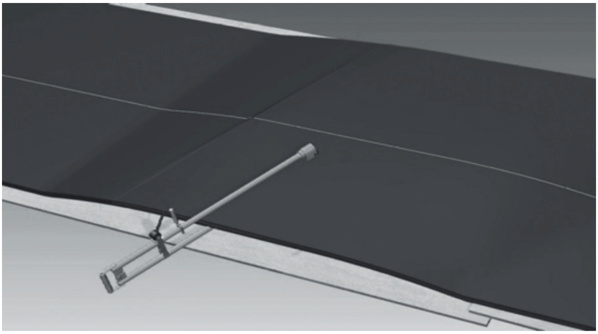


Figure 66

12.6. Finishing

The finish is of fundamental importance in the performance of the splice, so it must be done with extreme care. Excessive protrusions and cracks should be avoided along the finishing lines. To ensure that the splice has a perfect finish, we recommend as a last procedure to sand the finish area in order to correct any protrusions derived from the bonding process.

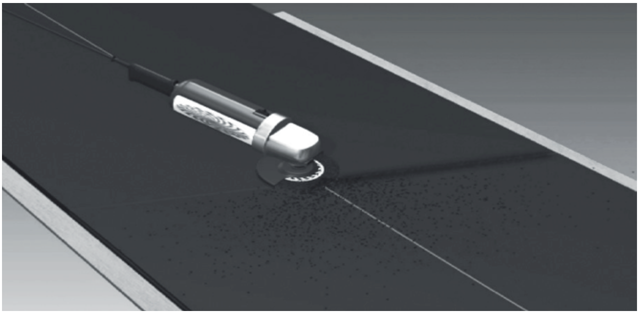


Figura 67

The right time to do this job is at least 2 hours after bonding because the drier the adhesive, the less likely that the finish will peel off due to the temperature generated.

Note: The sanding should be done with an angular sander in quick movements, being careful to avoid the action of the tool on the same point for more than 1 second. This will keep the rubber from overheating and consequently the sandpaper from getting full of melted rubber. The movement of the tool when the sandpaper is in contact with the rubber can never occur against the grain of the finish.

To finish, paint a coat of adhesive along the entire finished line for waterproofing the splice.

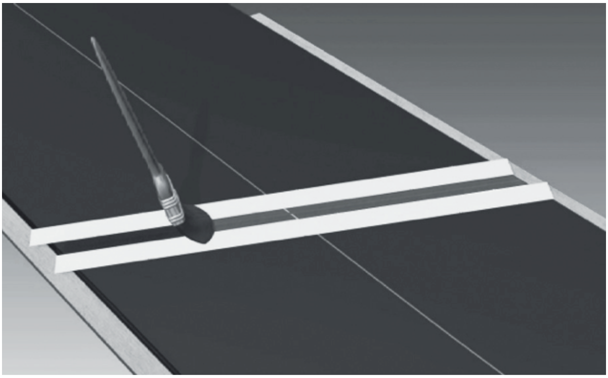


Figura 68

12.7 Wait time before use

Before using the belt to operate the equipment, follow the wait time recommendations of the adhesive's manufacturer, which is usually a minimum of 2 hours.

Note: We suggest sanding the protrusions of the chamfers immediately before sending the belt to the operation and after the adhesive's curing time for maximum quality.

12.8 Hot splice procedure (Except for ATS and ATS Plus covers)

12.8.1 Introduction

Many of the procedures described in the previous item (cold splicing) are also used for hot splicing such as alignment, fastening, preparation, etc. and therefore will not be repeated here. Because of this, the following procedures shall describe only the peculiar points to the methods for hot splicing.

12.8.2 Tools and Materials needed

- Chalk and string
- Metal ruler in millimeters at least as wide as the belt
- Round whetstone (grit size 24, Ø 4”)
- PPEs (safety glasses, metal wire gloves, ear protectors, helmet, etc.)
- Metal square (approximately 15")
- Tape measure (minimum 3 m)
- Paintbrush size 1.1/2" or 2" for applying the adhesive
- Pliers
- Knife for rubber
- Knife for fabric
- Pencil or pen
- Clamp
- Brush
- 7" Angular Sander (6000 rpm, sanding disc of grit 100, Ø7")
- Grinder with a flexible cable for steel brush (750W, 4800rpm)
- Steel brush (Ø 4")
- Awl
- Screwdriver with rounded corners
- Cement adhesive
- Bonding rubber
- Cover rubbers
- Rollers to roll the splice (1/2" and 2" wide)
- Press
- Solvent

- Siliconized paper
- Side shims (1 mm lower than the belt's thickness)

12.8.3 Splice angle and total lenght (C.E)

In the field, we should respect the angle of the presses to determine the splice's bias and usually this angle varies between 20° and 22°. Where the constant is 20°, it is 0.364 and where it is 22° it is 0.404.

So the length of the splice considered below will be based on the angle of 20°.

PITCH LENGHT

The length of each pitch is measured along the edges of the belt and, unlike the cold splices, it should vary according to the type of fabric and **not according to the belt width.**

The Mercurio Conveyor Belt has set the lengths for carrying out hot splices according to the table below:

Type of textile	Pitch (mm)
PN1200/PN2200/NN1100	250
PN3000/NN1800	400
PN400/PN500/PN6500	500

Table 18

CALCULATING THE SPLICE LENGHT (C.E)

The splice length will be calculated using the following formula:

CE = Bias + (No° of PLIES - 1) x Pitch + Finishes

Where:

Bias = 0.364 x Belt width (for angle of 20°)

FINISHES

Consider ± 100 mm because it includes:

- Top chamfer
- Finishing pitch (25 mm)
- Extra for the final fitting of the last ply, which is removed after closing.

CLEANING THE BELTS

According to the previous procedure, in no case is it recommended to use a "cup" or "tungsten" grinding device due to their extremely aggressive action.

12.8.4. Applying adhesive cement/bonding rubber

Important!
Refer to the procedure of the Dew Point Table before and after applying a coat of adhesive cement (Item 12.4.1).

1. Apply one coat of adhesive cement on both ends: on the fabric and on the rubber of the chamfers, letting it dry for 5 to 10 minutes.
2. Apply a layer of Bonding Rubber on the surface of the pitches excepted for the Finishing Pitch, which will be applied later (see figure 69).
3. Roll the bonding rubber well with the protective paper on the fabric for its complete adherence.
4. Completely remove the protective paper from the Bonding Rubber.
5. Clean and activate the surface of the
bonding layer with an appropriate solvent
6. Use the awl to make small holes in the bonding rubber to eliminate the possibility of bubbles.
7. Join the two ends, ensuring the perfect alignment and fit of the pitches.
8. Apply bonding rubber on the fabric of the Finishing Pitch (see Figure 69).
9. Repeat the procedures of item 3: Roll over the protective paper, remove the paper, clean with solvent, and punch holes with the awl.

10. Apply the cover rubber in the finishing region to fill the space and form the "finishing strip" (see Figure 69).

Note: : Depending on the cover's thickness, many splice technicians opt not to use repair strips, especially in the bottom cover. In this case, we recommend placing between the chamfers, in addition to the cement adhesive, a 1 mm layer of raw COVER rubber over the entire surface of the chamfer.

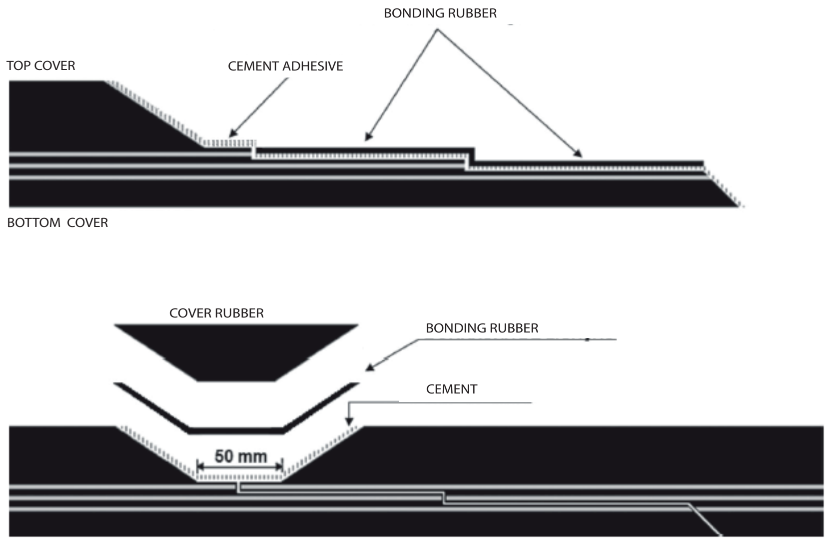


Figura 69: Applying the adhesive cement and bonding rubber

12.8.5 Vulcanization

Center the splice on the press platform so that the ends are inside the platform by at least 50 mm, which means that the platform should be 100 mm larger than the splice both in length and width.

Use the siliconized paper to avoid adhesion between the belt and the platforms.

Put along the belt's edges the steel side guides (or shims) 1 mm to 2 mm thinner than the belt's thickness depending on the total thickness.

The vulcanization temperature should be 145°C, 155°C, and/or 165°C, and the pressure as shown below:

Vulcanization Recommendation	
Textile type	**Pressure (kgf/cm^2)**
PN1200/PN2200/NN1100	Pressure of $7kgf/cm^2$
PN3000/NN1800 PN400/PN500/PN6500	Pressure of 8 to $10kgf/cm^2$

Table 19

T = 145ºC		T = 155ºC		T = 165ºC	
Thickness (mm)	Vulcanization time (min)	Thickness (mm)	Vulcanization time (min)	Thickness (mm)	Vulcanization time (min)
up to 6,0	15	up to 6,0	8	up to 6,0	5
6,1 - 9,0	16	6,1 - 9,0	10	6,1 - 9,0	6
9,1 - 12,0	18	9,1 - 12,0	11	9,1 - 12,0	8
12,1 - 15,0	23	12,1 - 15,0	13	12,1 - 15,0	10
15,1 - 18,0	30	15,1 - 18,0	20	15,1 - 18,0	15
18,1 - 21,0	37	18,1 - 21,0	26	18,1 - 21,0	18
21,1 - 24,0	45	21,1 - 24,0	32	21,1 - 24,0	23
24,1 - 27,0	52	24,1 - 27,0	38	24,1 - 27,0	26
27,1 - 30,0	55	27,1 - 30,0	40	27,1 - 30,0	28
30,1 - 33,0	62	30,1 - 33,0	45	30,1 - 33,0	31
33,1 - 36,0	70	33,1 - 36,0	50	33,1 - 36,0	35
36,1 - 39,0	75	36,1 - 39,0	55	36,1 - 39,0	39
39,1 - 42,0	82	39,1 - 42,0	60	39,1 - 42,0	42

Table 20: Vulcanization time for textile belts

Note: Remember that the vulcanization time starts counting from the moment when the ideal temperature is reached.

The press should be opened only after the temperature has lowered to 60°C.

12.9. Splices on high temperatures belts (ATS and ATS Plus)

Below are described the differences and peculiarities when doing a splice on ATS (High Temperature Super) belts.

12.9.1. Tools needed

• Chalk and string
• Metal ruler in millimeters at least as wide as the belt
• Round whetstone (grit size 24, Ø 4”)
• PPEs (safety glasses, metal wire gloves, ear protectors, helmet, etc.)
• Metal square (approximately 15")
• Tape measure (minimum 3 m)
• Paintbrush size 1.1/2" or 2" for applying the adhesive
• Pliers
• Knife for rubber
• Knife for fabric
• Pencil or pen
• Clamp
• Brush
• 7" Angular Sander (6000 rpm, sanding disc of grit 100, Ø 7")
• Grinder with a flexible cable for steel brush (750W, 4800rpm)

- Steel brush (Ø 4")
- Awl
- Screwdriver with rounded corners
- Rollers to roll the splice (1/2" and 2" wide)
- Press
- Solvent
- Siliconized paper
- Side shims (1 mm lower than the belt's thickness)

12.9.2. Materials Needed

- ATS Bonding Rubber
- ATS Cover Rubber
- ATS Adhesive
- M-1227A

Note: : The ATS splice kit is different because the adhesive cement needs to be prepared in the field by mixing it from the compound M-1227A.

12.9.3. Procedimientos

1. Calculate the length of the splice in the same way as the previous procedure
2. Prepare the ends according to the previous procedure, but sanding a strip adjacent to the chamfer 25 mm wide in which to place the cover rubber (see figure 70).

3. Clean the belt in scaling area, taking the necessary precautions to avoid rupturing the fibers by the action of the rotating tools and eliminating any sanding and oily residue on the surface prepared.

Importante!
Before and after applying the M 1227A compound coat, check the procedure on the Dew Point Table.

4. Apply a coat of compound M 1227A on the fabric at both ends, letting it dry for about 30 minutes

Note: The compound M1227A must be applied exclusively on fabric and not on rubber. If the entire pitch area has rubber, there is no need to apply compound M 1227A.

5. Mix the compound M 1227A with the cement adhesive. The amount must be in the proportion of 1:10. Ex. Adhesive cement 5L will have the mixture of 0.5 L. Paint the fabrics and the chamfers at both ends with the mixture of compounds, leaving to dry until tack is reached.

6. Apply a layer of Bonding Rubber on the surface of the pitches excepted for the Finishing Pitch, which will be applied later.

7. Roll the bonding rubber well with the protective paper on the fabric for its complete adherence

8. Completely remove the protective paper from the Bonding Rubber.

9. Clean and activate the surface of the bonding layer with appropriate solvent.

10. Use the awl to make small holes in the bonding rubber to eliminate the possibility of bubbles.

11. Join the two ends, ensuring the perfect alignment and fit of the pitches.

12. If necessary, apply a coat of compound M 1227A on the fabric of the pitches, letting it dry for about 30 minutes

13. Paint the fabric of the finishing pitch and the chamfers (including the 25mm sanded strip) on both ends with the product resulting from mixing the cement adhesive with compound M 1227A, letting it dry until tack is reached (see Figure 70).

14. Apply bonding rubber on the fabric of the Finishing Pitch (see Figure 71).

15. Roll over the protective paper, remove the paper, clean with solvent, and punch holes with the awl.

16. 16. Apply the cover rubber in the finishing region to fill the space and form the "finishing strip" (see Figure 71.

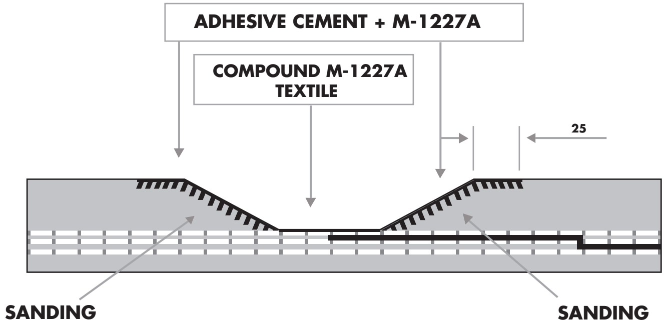
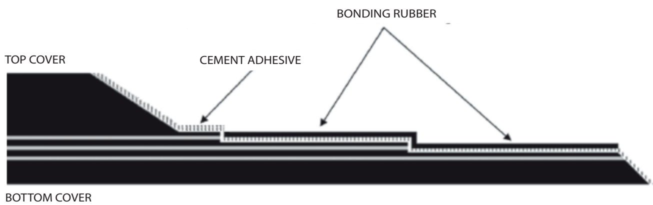


Figure 70



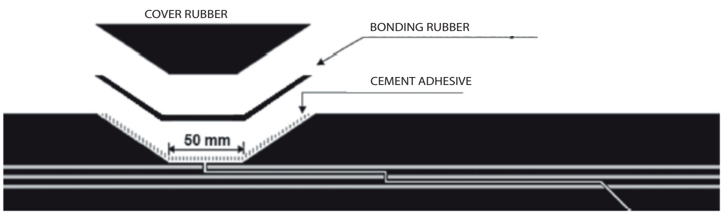


Figure 71: Aplication of the cement adhesive and the bonding rubber

12.9.4. Vulcanization

Center the splice on the press platform so that the ends are inside the platform by at least 50 mm, which means that the platform should be 100 mm larger than the splice both in length and width.

Use the siliconized paper to avoid adhesion between the belt and the platforms.

Place the steel side guides (or shims) along the belt's edges so that they are 1 mm to 2 mm thinner than the belt's thickness depending on the total thickness.

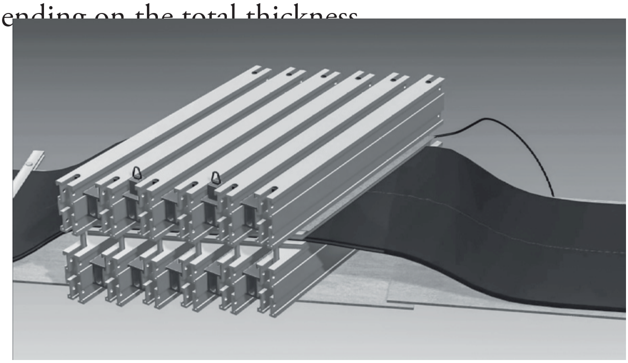


Figura 71

The vulcanization temperature must be 165°C and the pressure 7 kgf/cm2.

Textile type	Pressure (kgf/cm²)
PN1200/PN2200/NN1100	Pressure of 7kgf/cm²
PN3000/NN1800 PN400/PN500/PN6500	Pressure of 8 to 10kgf/cm²

Table 21

The vulcanization time should follow the table below:

T = 165ºC (ATS and ATS Plus)	
Thickness (mm)	**Vulcanization time (min)**
up to 10,0	35
10,1 - 12,0	40
12,1 - 14,0	45
14,1 - 16,0	50
16,1 - 18,0	55
18,1 - 20,0	60

Table 22

Note: Remember that the vulcanization time starts counting from the moment when the ideal temperature is reached.

The press should be opened only after the temperature has lowered to 60°C.

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ORGANIZATION
Correias Mercúrio S/A Industria e Comércio Ingeniería de Aplicación y Asistencia Técnica

COMPANY CONTACT
tecnica@correasmercurio.com.br
www.mercurioconveyorbelt.com