CONVEYOR BELT SOLUTIONS
21055 Gorla Minore (VA) - Italy
Via Colombo, 144
Tel. +39 0331 365135
Fax +39 0331 365215
www.sig.it E-mail: sig@sig.it

SIDERFLEX CONVEYOR BELTS

INSTALLATION HANDBOOK

DISTRIBUTED TO	BY	DATE
_____	_____	_____ / _____ / _____

Revision	Date	Prepared by	Approved by
05	01/04/2021	UT	DG

MAIN INDEX

CHAPTER 1

RUBBER CONVEYOR BELT STORAGE

1.1) PACKING

Rubber conveyor belts are generally packed in rolls strapped on the outside. On customer request or for sea freight, the packages used are the following ones:

- Shrink Plastic cover
- Reels or wooden boxes
- Steel reels
- Wooden pallets

1.2) STORAGE

Rubber belts shall be stored, with the reel axis put on horizontal position, preferably in places protected and isolated from the floor by means of wooden axis, pallets or stands (Fig. 1-2-3)

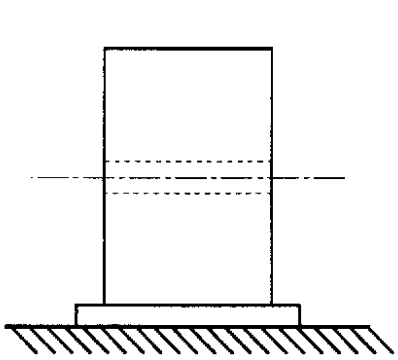


Fig. 1

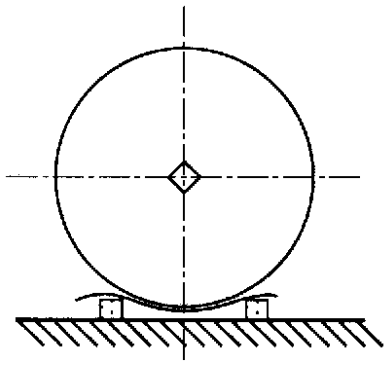


Fig. 2

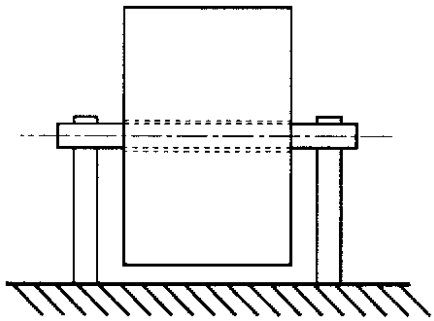


Fig. 3

If the belt is stored outdoors, it shall be laid with the horizontal axis on pallet or wooden pallets and protected with plastic material opportunely punched in order to avoid backwater (Fig. 2).

If the storage lasts more than 90 days, products shall be handled in such a way as the surfaces most exposed to the atmospheric and environmental agents can be alternated.

Rubber belts not correctly protected during the storage could suffer some changes of the physical characteristics and they could become also useless because of hardness, breaks, cracks or other weathering.

These changes can be caused by a particular factor or by combination of factors as: time, oxygen action, ozone, light, atmospheric agents, heat and humidity sources.

The storage temperature must be between –10 °C and + 40 °C, with ideal range between +10 °C and + 25 °C; extreme temperatures or swift and continuous variations can cause a deterioration and can accelerate the ageing process such as to compromise the running and the life of the product.

The storerooms shall not contain equipment able to generate ozone as fluorescent or mercury-vapour lamps and high voltage electrical equipment which can generate sparks or electrical discharges; besides they must not be particularly wet.

The rubber surfaces shall not come into contact with liquid or semisolid products, in particular solvents, acids, volatile components, oils and greases, metals as copper, manganese and their compounds, which are known for their negative effects on the vulcanised rubber.

Even though the low temperature effects (lower than -10 °C) do not cause irreversible damages, they determine a partial stiffening; so, it is very important to take care during the handling and the installation in order to avoid harmful distortions, cracks and cuts. Particularly, before the installation on the plant, the roll temperature should be stabilised on values higher than 10 °C.

1.3) HANDLING

To lift and transport a belt roll, the most suitable system consists in inserting a steel spacing bar (round or square) into the central hole of the reel and slinging it at the ends by means of ropes or chains applied to a balancer mounted on the lifting apparatus (see Fig. 4).

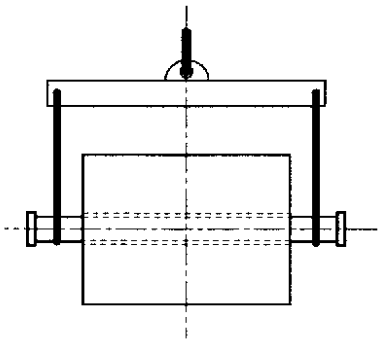


Fig. 4

The balancer and the spacing bar shall have such a length as to prevent the belt edges from being damaged by means of lifting equipment.

If a textile or plastic material sling with a sufficient length and capacity is available, it will be possible to lift the roll inserting it directly into the central reel hole, without using the spacing bar (see Fig. 5).

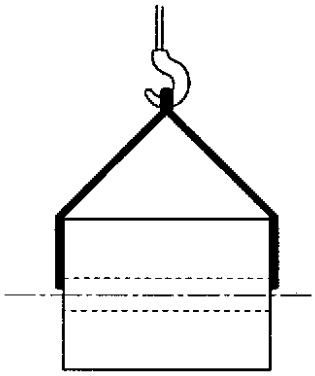


Fig. 5

The lifting shall not be carried out by means of slings which support the roll on the outside without using the central hole, since the non-uniform load distribution can cause the inclination and the fall of the reel (See Fig. 6).

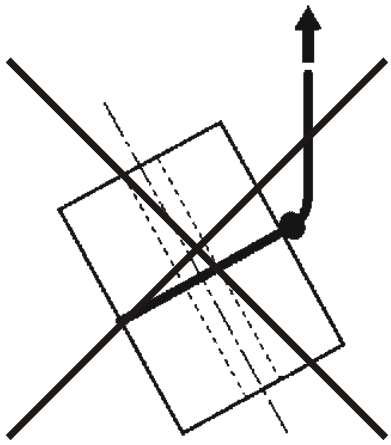


Fig. 6

A traditional fork elevator can be used taking care not to damage the outer side of the belt with forks (see Fig. 7).

Fig. 7

CHAPTER 2

RECOMMENDATIONS FOR THE INSTALLATION

2.1) BELT ASSEMBLY

Normally, belts are winded with the top cover towards the outside.

For a correct and easy belt assembly on the plant, you are advised to proceed as shown in Fig. 8, so that the bottom cover lays on the carrying idlers.

Obviously, in relation to the logistic necessities, it could be necessary to insert the belt beginning from the return section of the conveyor; in this case the top cover shall lay on the return idlers.

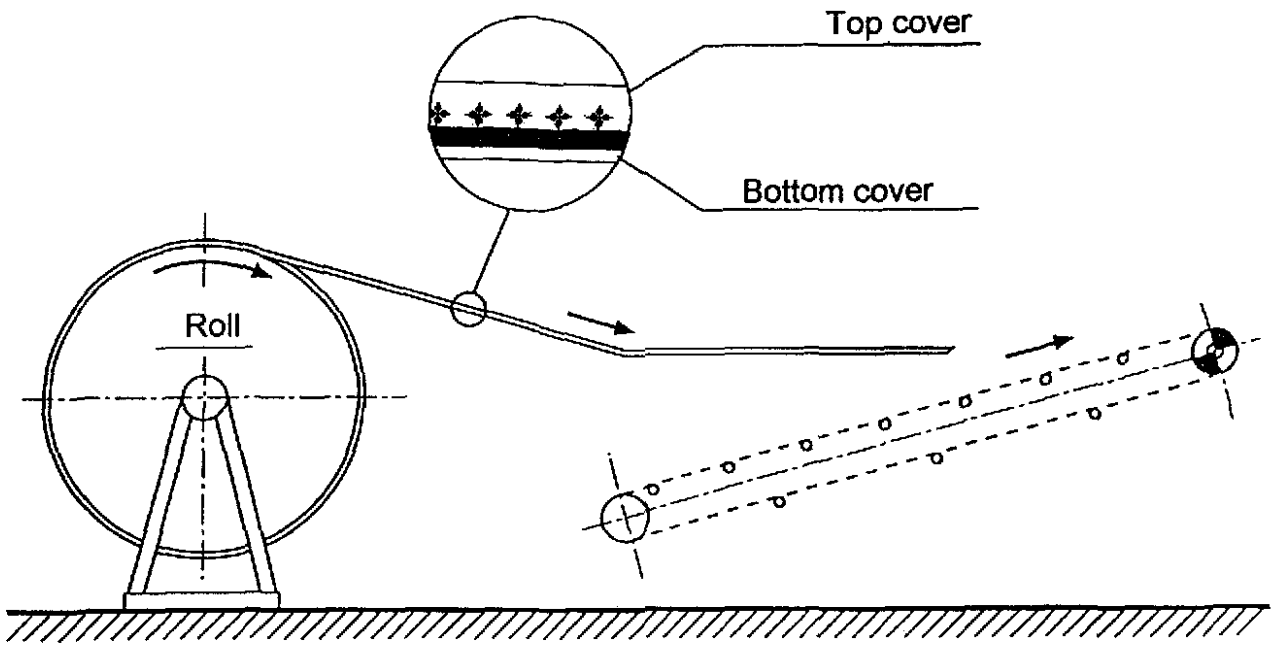


Fig. 8

An easy belt positioning on the plant can be granted by using two metallic clamps fixed at its head so as to avoid sliding which could damage the belt structure.

2.2) PREPARATION OF THE WORKING ZONE

For obvious comfort reasons, if you splice more rolls one with the other, it would be better to carry out all the splicing in a point of the plant only, chosen in the most accessible and functional place to carry out the operations ad to handle the reels.

For the preparation of the working zone on the plant, first of all it is necessary to disassemble an adequate quantity of idler stations in order to create, by means of wooden tables, a steady and comfortable working surface.

Besides, it would be better to choose a point easily accessible by the press, where suitable electrical power is available. Before starting the splicing, place the lower part of the press on the working zone, by fixing it to the metallic frame and put a steel sheet which covers the surface completely.

This zone must be as much clean as possible and must be protected from the atmospheric agents (rain, wind and dust in particular).

2.3) BELT CLAMPING

Lock the counterweight, if present, just close to the upper limit.

During the last splicing, before locking the belt for the preparation of the ends (see Chapter 5), it is suggested to assure a pretensioning in each point so as to avoid too much elongation just after the installation.

As a general rule, the pretension should be such as just to lift the counterweight.

Before starting the preparation of the ends for the splicing, it is necessary to cut the possible belt excess since the available measurement in metres can be more than needed.

CHAPTER 3

EQUIPMENTS AND MATERIALS FOR SPLICING

3.1) DEFINITIONS

The material needed include all that is necessary for making splices and can be split up in two different categories: equipment and raw material.

3.1.1) Equipment

- Electric press equipped with:
  - plane pressure control system (mechanical or hydraulic movement);
  - thermo-regulator with temperature set-up regulation;
  - heat plate dimensions at least 200 mm longer and 200 mm wider than the splice;
- 2 metal sheets - whose dimensions must be slightly higher than heating planes ones;
- 2 lateral edging steel bars - whose thickness must be 1 mm lower than the belt one;
- Clamps to keep fixed the belt ends to the belt structure;
- 2 pulling-bars to keep fixed the lateral edging steel bars - if not welded on the metal sheets;
- Long and short sword knives and/or equivalent electric tool based on high frequency vibrating blade to remove the covers;
- Whetstone to whet knife sword;
- Lever tongs;
- Tirfort equipped with self tightening pincers for rubber;
- Various rollers to press surfaces;
- Punch for eventual bubble perforation;
- Brushes to coat rubber solution on splice surfaces;
- Steel brushes and rotary sanding disks with relative equipment;
- Cutting disk with relative equipment;
- Scissors useful for rubber cutting;
- Drawing rule and square;
- Silicone paper or equivalent;
- Surfaces degreasing solvent;
- Steel cord cutting-nippers;
- Electrical or manual cord shear.

3.1.2) Raw materials

Components for making splices are:

SICOT® 2400: hot splicing solution

SICOP® 2419 0,5 mm: adhesion rubber, 0,5 mm thick;

SICOP® 2502 for abrasion resistant, SICOT® 2802 for heat resistant,
SICOT® 2902 for self-extinguish belts: cover rubber in various thicknesses (from 2 to 4 mm);

IS630: insertion strip (rubberized transversal steel cords). Indispensable for finger or plain stepped splices; not strictly necessary for interlaced stepped splices.

3.2) STORAGE OF THE RAW MATERIALS

The raw materials are packed and sealed in cases if they are liquid or in carton boxes if they are solid.

The standard packages report the expiry date according to the under mentioned conditions and shall be applied for the transport by road only.

In case of transport by sea or by air it will be necessary to produce special protecting packages according to the regulations in force.

All the raw materials for the splicing shall be stored as follows:

- Places shielded from atmospheric agents and which are not subject to extreme conditions.
- Packed and sealed in the original packages.
- Room temperature between 5 and 20°C (70°F).

3.2.1) Recommendations

The expiry date is based on the conditions above mentioned.

After a partial use, the products shall be hermetically sealed and/or packed as at the beginning.

Besides, SIG SpA refuses all responsibility for possible alterations suffered by the products during the transport, for the use of the material already expired or packed without respecting the previous conditions.

3.3) PRESS STORAGE

During the transport and the use, take care not to expose the equipment to collision and to the water in order not to cause damages to the press components as manometers and thermometers. Protect from water and humidity all the electronic components.

During unused period, the equipment shall be stored in a covered area which must be protected from water and humidity. Besides, keep all the locking bolts oiled.

CHAPTER 4

SIDERFLEX CONVEYOR BELTS SPLICES TYPOLOGIES

4.1) AVAILABLE SPLICE METHODS

The splice method to be adopted mainly depends on the warp belt construction; other elements to take into consideration are the number of weft layers and the safety factor.

As described in the standard ISO 15236-4, splice methods can be divided in two main families according to the cord density:

- Splices with higher cord density than the belt are named **Interlaced Stepped Splices**. These splices still follow the rules of ex-DIN 22131, with some deviation in case of particular applications and/or safety factors lower than 8. They are the preferred method every time the belt cord density allows them.
- Splices with same cord density than the belt are of 2 different types named **Finger Splices** and **Plain Stepped Splices**. These splices are necessary when the belt cord density is too high to allow the use of interlaced stepped splices.

4.2) CHOICE OF SPLICE METHOD

SIDERFLEX **IW** and SIDERFLEX **HE** belts, or rather open cords belts (4x7 construction), are joined with **Finger method** according to ISO 15236-4/4.3. For particular applications and/or when belt safety factor is lower than 8, **Plain Stepped method** according to ISO 15236-4/4.2.6 is the preferred method.

In case an eventual transversal increasing of stiffness of the splice does not compromise the belt behavior, it is possible to adopt the **Short Finger method** that guarantees same performances than Finger method with a length 20% shorter. The main difference between standard and short method is the presence, respectively, of one or two layers of transversal steel cords (named Insertion Strip) in the rubber covers. The double steel transversal layer guarantees a bigger strengthen splice, both in terms of traction, resistance against cuts and impact.

In order to see if the Short Finger splice can be applied, please refer to the following table, showing the maximum angle of inclination allowed according to the belt class and width. A particular attention shall be paid on the ΔT value, the vertical distance between the Insertion Strips axis, because an excessive distance of the Insertion Strips would take to a further belt transversal stiffening.

LIMITATIONS FOR SHORT FINGER SPLICES

Class (kN/m)	*INSERTION STRIPS MAXIMUM DISTANCE* ΔT (mm)	*MAXIMUM ANGLE OF IDLERS* BELT WIDTH *(mm)*					
		600	*650*	*800*	*1000*	*1200*	*1400*
350-500-630	5,8	15°	20°	30°	40°	≥ 45°	≥ 45°
800-1000	6,7	10°	15°	25°	35°	≥ 45°	≥ 45°
1250-2250	7,5	10°	10°	15°	30°	40°	≥ 45°

Tab. 1

SIDERFLEX **ID,** SIDERFLEX **HD** and CROSSRIGID **HR** belts, or rather all the standard (see our Siderflex catalogue) regular steel cord belts (7x7, 19+7x7 or 7x19 construction) with warp configuration according to ISO 15236-4 type A1, are joined with **Interlaced Stepped method** according to ISO15246-4/4.2.5.

For not standard SIDERFLEX **ID**, SIDERFLEX **HD**, CROSSRIGID **HR** belts and for other special applications, especially with safety factor lower than 8, please ask for suggestions to our Technical Dept.

As general rule, interlaced stepped splices can be adopted if the space SG between adjacent cords in the splice is as follow:

$$SG \geq 1{,}2 \text{ mm} + (\text{Cord diameter} / 10)$$

To grant the respect of this rule it is suggested to increase the number of steps up to a maximum of 4; over 4, it is preferable to adopt Plain Stepped method.

RESUMPTIVE TABLE FOR SELECTION OF SPLICE METHOD

Type of splice (Ref Chapters)	Standard ID, HD, HR	Standard IW	Standard HE	Not standard ID, HD, HR	Not standard IW, HE	Safety factor < 8
Finger (4.3.1, 5.2)		XX				X
Short finger (4.3.2, 5.3)		X	XX			X
Interlaced step (4.3.3, 5.4)	XX			X		XX
Plain step (4.3.4, 5.2)				XX	XX	XX

XX: preferred method X: possible method

Tab. 2

4.3) SPLICES LAYOUTS AND LENGTHS FOR STANDARD BELT

The following paragraph explains all dimensions to be known to execute a right splice. For each typology, the bold type values represent the splice nominal length.

4.3.1) Finger ~~and step~~ splices for SIDERFLEX IW and HE

The following table shows the fingers length L, equal (in mm.) to the belt ultimate strength, and L_{TOT} that is to say the splice total length.

Class (kN/m)	*350*	*500*	*630*	*800*	*1000*	*1250*	*1400*	*1600*	*1800*	*2000*
L (mm)	**350**	**500**	**630**	**800**	**1000**	**1250**	**1400**	**1600**	**1800**	**2000**
L_{TOT} (mm)	450	600	730	900	1100	1350	1500	1700	1900	2100

Tab. 3

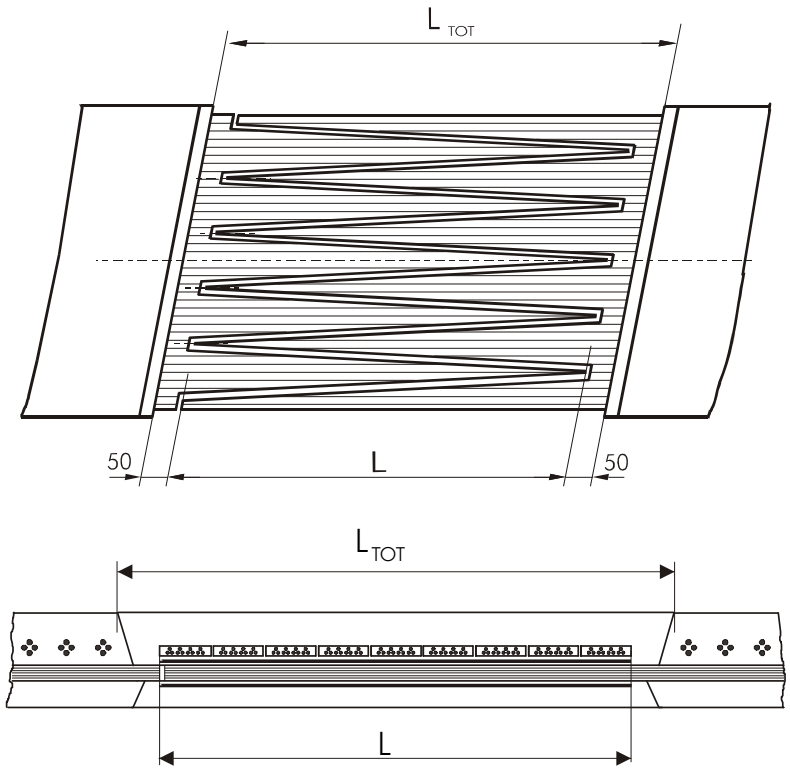


Fig. 9

For safety factor < 8 it is possible to adopt longer fingers L (20 to 30% more, please ask to Technical dept.) and/or a double layer of Insertion Strip; however, in these cases, it is preferable to use the Plain Stepped method.

4.3.2) Short finger splices for SIDERFLEX IW and HE

For this typology, the fingers length L is equal to the 80% of the belt ultimate tensile strength. L_{TOT} also represents the splice total length:

Class (kN/m)	350	500	630	800	1000	1250	1400	1600	1800	2000
L (mm)	**280**	**400**	**500**	**630**	**800**	**1000**	**1120**	**1280**	**1440**	**1600**
L_{TOT} (mm)	380	500	600	730	900	1100	1220	1380	1540	1700

Tab. 4

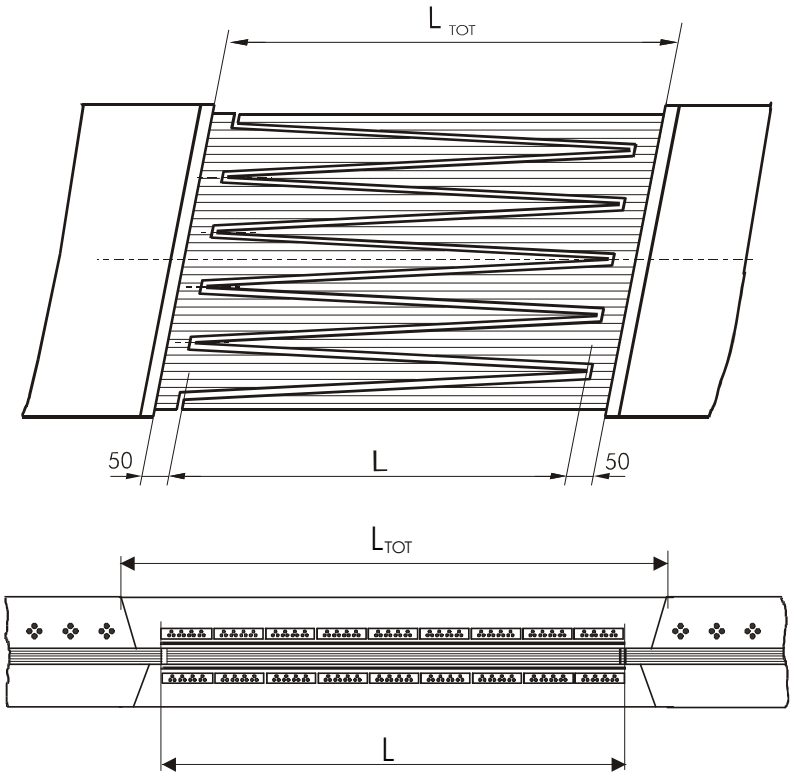


Fig. 10

As clearly visible comparing Fig. 9 and 10, Short Finger method is characterized by the presence of two layers of Insertion Strip instead of only one. This double structural layer allows the splice to be shorter than the standard Finger splice.

For safety factor < 8 it is possible to maintain the length L of Finger method; however, it is preferable to use the Plain Stepped method.

4.3.3) Interlaced stepped splice for standard SIDERFLEX ID, SIDERFLEX HD and CROSSRIGID HR

The following table shows the cords overlap length L, the splice L_{TOT} total length, and the step length S dimensions:

	ONE-STEP SPLICE (Fig. 11)							*TWO-STEP SPLICE (Fig. 12)*			
Class *(kN/m)*	*500*	*630*	*800*	*1000*	*1250*	*1400*	*1600*	*1800*	*2000*	*2500*	*3150*
L *(mm)*	250	250	250	300	350	400	450	750	850	1050	1350
L_{TOT} (mm)	**450**	**500**	**550**	**600**	**650**	**700**	**750**	**1050**	**1150**	**1350**	**1650**
S *(mm)*	250	250	250	300	350	400	450	350	400	500	650

Tab. 5

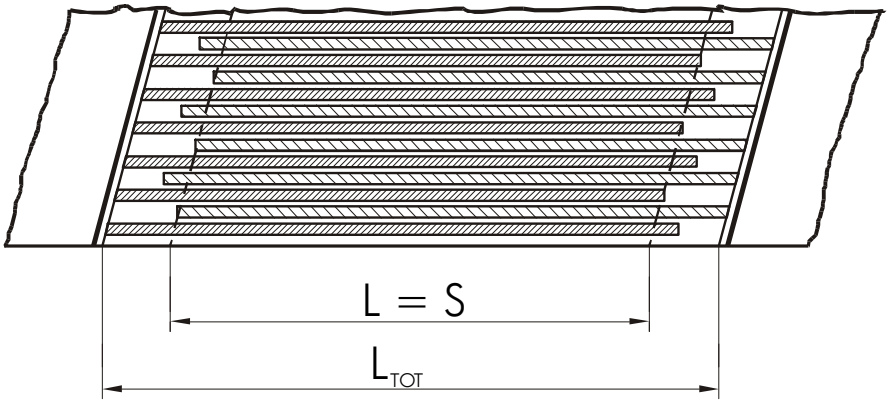


Fig. 11

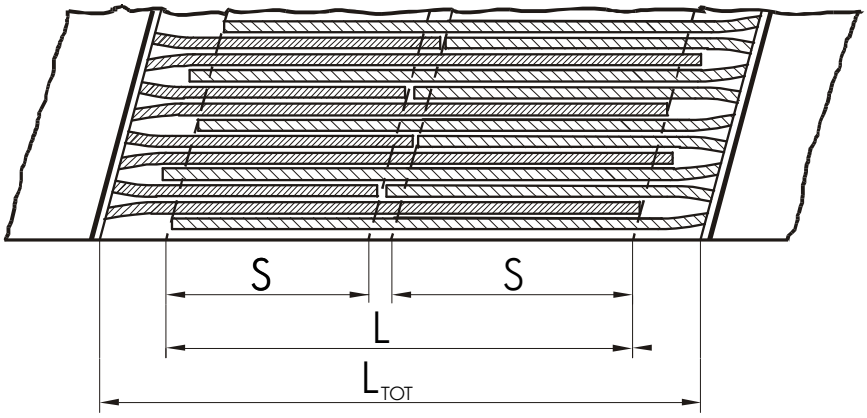


Fig. 12

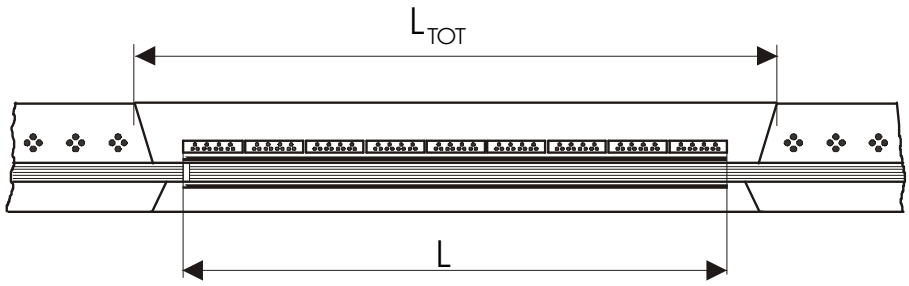


Fig. 13

For this specific splice configuration, the layer of Insertion Strip placed over the cords is not a structural element, so it is not strictly necessary for the splice resistance. It is suggested in case it is desirable the replacement of the original weft to assure good impact, tear and cut resistance to the splice, too.

For safety factor < 8 it is possible to adopt longer steps S (please ask to Technical dept.)

4.3.4) Plain stepped splice for special applications

Plain Stepped splices are used for not standard belt constructions and/or special applications, when the cord density in the belt doesn't allow the adoption of the interlaced stepped splice; please ask to Technical dept. for details.

As general and indicative rule, for standard applications with safety factor ≥ 8, the following table shows the steps length S and L_{TOT} that is to say the splice total length.

Cord Type	*4x7 2,8 mm*	*4x7 3,9 mm*	*4x7 4,5 mm*	*7x7 3,1 mm*	*7x7 3,6 mm*	*7x7 4,4 mm*	*7x7 5,2 mm*
S (mm)	**250**	**350**	**450**	**300**	**350**	**450**	**550**
L (mm)	**1125**	**1575**	**2025**	**1350**	**1575**	**2025**	**2475**
L_{TOT} (mm)	1255	1705	2155	1480	1705	2155	2605

Tab. 6

As visible in Fig. 14, the Plain Stepped splice is characterized by 4 steps of length S, 1 half step of length S/2 and "10-cord" fingers (each 10 cords one is cut and does not participate to the splice).

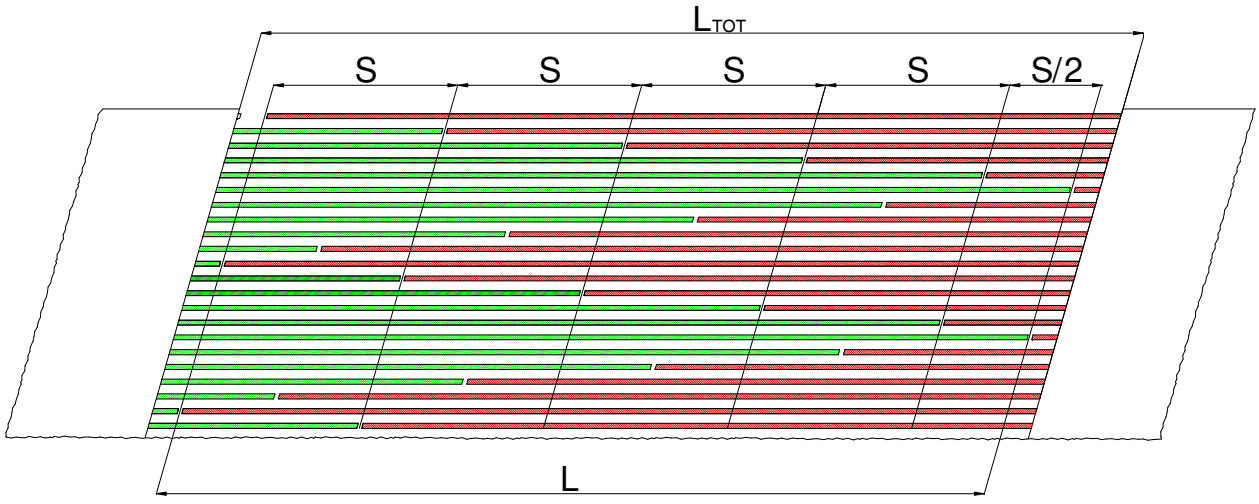


Fig. 14

CHAPTER 5

SPLICE EXECUTION

5.1) GENERAL INDICATIONS

Splice is the union of the rubber conveyor belt ends, to allow the handling of materials and its relative conveyance.

A correct execution of the splice is fundamental for the conveyor running, linearity and efficiency.

The instructions of this manual are as much complete as possible; however, they require a specific knowledge and adequate skill to be understood and put into practice.

The life of a splice carefully executed is correlated to the belt maintenance and to the correct use of the whole system. Since in any case splice is the weakest part of the belt development, any possible failure, defect and problem of the system parts – scrapers, rollers, drums, counterweights, hoppers and motors- is transmitted to the belt and of course to the splice itself.

Even if there are several types of splice adequate to steel cord belts, none of them is purely mechanical: hot vulcanization is the only safe splice system for this type of belts.

Splices are executed by the head-to-head approach of the cords of the two ends to be connected, properly pre-arranged.

In order to distribute the stresses on the splice in a proper way during the winding on the drums and the passage on the inclined rollers, we suggest executing around 16° inclined splices, with respect to the belts transversal line, based on the following formula:

$$L_a \cong 0{,}3 \times B$$

where L_a = inclined section length

B = belt width

A higher inclination allows a better division of the stresses, but also a bigger splice length, therefore higher and heavier presses are required.

Rectangular splices (where $L_a=0$) are also acceptable, even if the inclined splices shall be always preferred; the choice of geometry depends substantially on the shape and dimensions of the available vulcanization presses.

It is particularly fundamental to contemplate a proper splice length, which can guarantee an optimum tension distribution; this length L depends on the splice typology and on the belt class, as it has been already explained on Chapter 4.

The procedures required for the above-mentioned splice typologies will be hereafter explained. The ends preparation, the closure operations and the resulting belt structure will be described for each procedure.

In order to avoid troubles during the operation and risks of cord pull-out, place the external cords opposite to the running direction (Fig. 15). According to the splcie method, see here below the correct cord disposition.

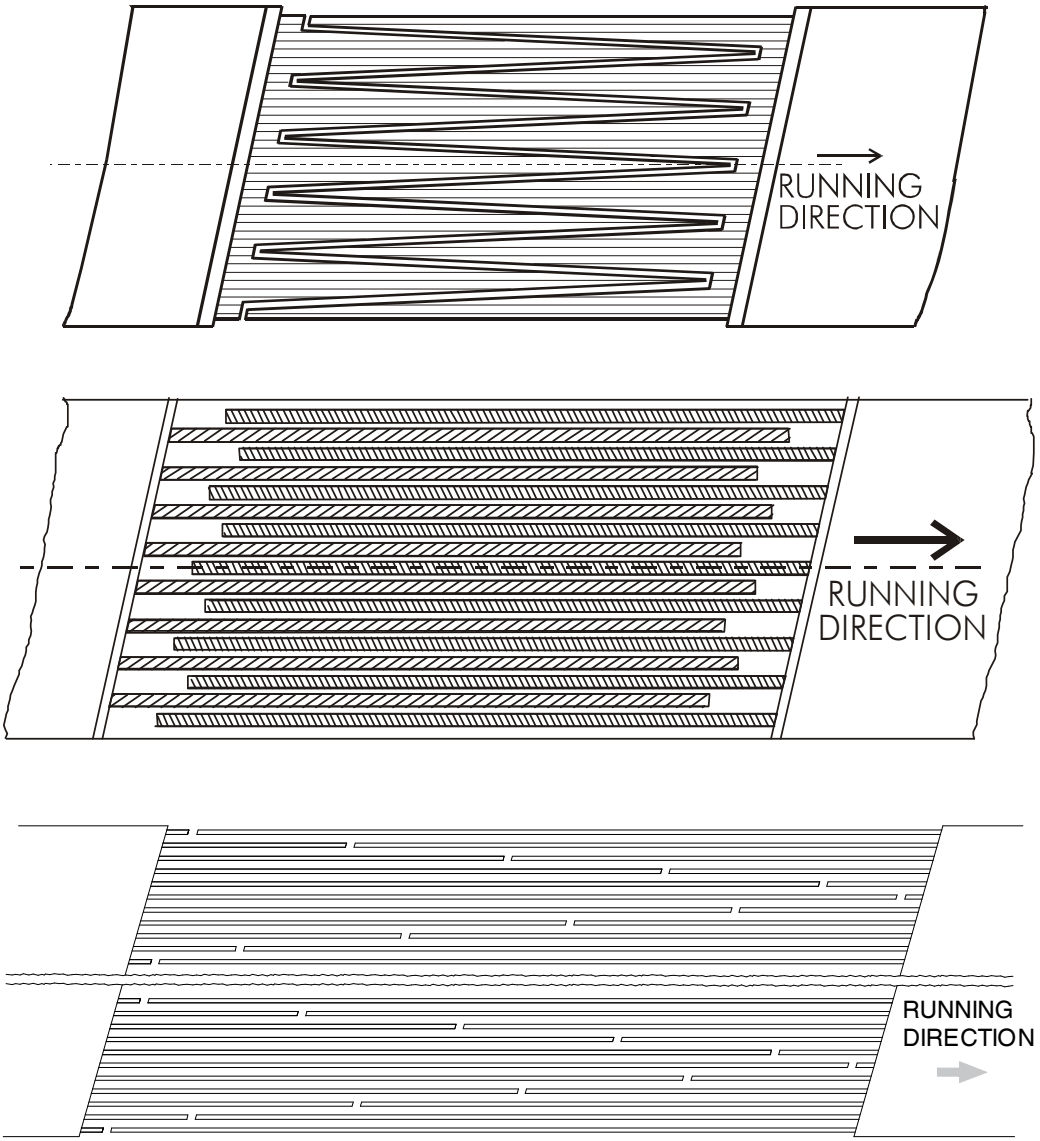


Fig. 15

5.2) FINGER SPLICE and PLAIN STEPPED SPLICE

5.2.1) Tracing of the cutting lines on the covers

Place the belt on the installation or on a worktable.

Cut the ends, following transversal lines (lines AB), about 16° inclined (BH = 0.3 x AH - Fig. 16). To execute this operation, we suggest making a V-shaped incision, about 2 cm wide, along the cutting line and to proceed with the cutting by a cutting disk.

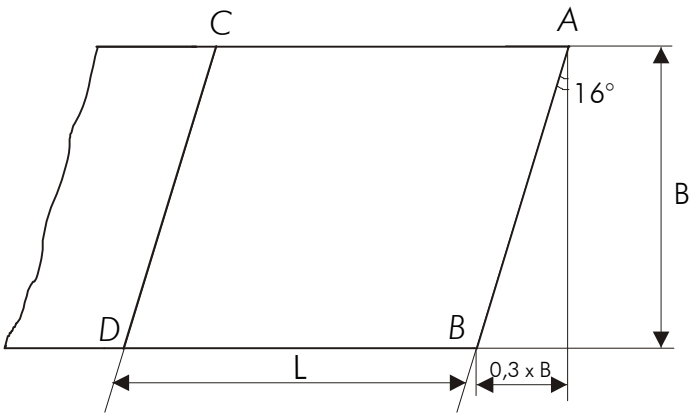


Fig. 16

Then carry out the splice area, variable according to the class of the belt (Tab 3 page 13). This area is delimited by a line (CD – this line also 16° inclined) L far from the free end.

Then trace a line (EF) on the upper surface, parallel to the previous one (CD) at a 50 mm. distance; repeat the same procedure for the lower surface, this time with a 20 mm distance (line GH).

The belt so marked will be as follow:

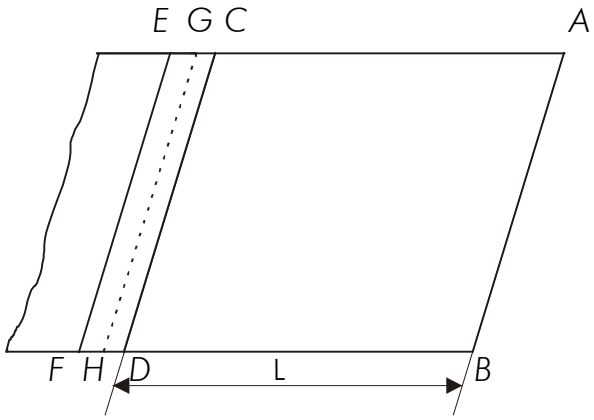


Fig. 17

5.2.2) Covers incision and removal

Cut with a knife, in a slightly slanting position, along the top cover internal (EF) and external (CD) line, so cutting off the strip CDFE; this strip is to be removed by knife and lever tongs to tear away the covers.

Along the uncovered strip find out the weft cords and lift them up with a lever; cut them using cutting nippers. Do not use cutting disk to avoid damaging of the longitudinal cords.

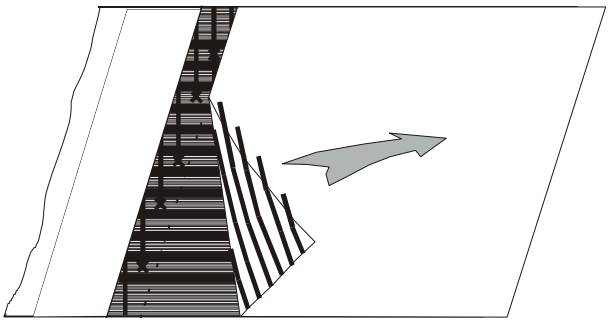


Fig. 18

By mean of a knife blade or equivalent electric tool placed between longitudinal and transversal cords, uncover the working area pulling out the cut transversal cords and relative rubber cover as shown in Fig. 18. During this operation, the detaching cover must be hooked by a proper self-tightening pincer and tensioned by Tirfort or equivalent winch. The applied tension should be enough to keep the pulled part tensioned in order to make more efficient the blade action but not too high causing its ripping. We suggest starting the operation from the point D (Fig. 17). In case of use of an electric toll, typically a high frequency vibrating blade, operate parallel to the longitudinal cords and pay attention not to damage them.

The same operation, subject to belt overturning, should be also executed for the bottom cover; SIDERFLEX HE typology, with two weft, one in each covers, requires the removal of the weft cords buried in the bottom cover together with the cover itself – in the same way as the upper cover cords has been removed. For SIDERFLEX IW the removal operation interests only the rubber of the bottom cover.

The upper and lower uncovered surfaces shall then superficially be grinded with a rotary sanding disk to eliminate all possible irregularities and excess of rubber due to the cover removal in order to obtain a regular and rough surface, taking care to leave a layer of rubber on the cords.

With the same rotary sanding disk grind the belt covers along the lines EF and GH.

Then cut away the rubber from the border zone of the ends to be spliced until the external cords are visible.

5.2.3) Profiles tracing and creation

The next phase foresees the creation of complementary geometric profiles on the two ends.

The following figures show the geometry of the splices to be executed with the two ends, according to the selected method.

a) finger splice

This tracing shall start from the belt axle and end near the edges and shall be reported on both ends in order to guarantee a precise fixed splice of the two ends.

The only caution is to report a correct tracing according to the belt working direction, that is to say to make sure that the most external cords end is on the opposite direction compared to the running direction.

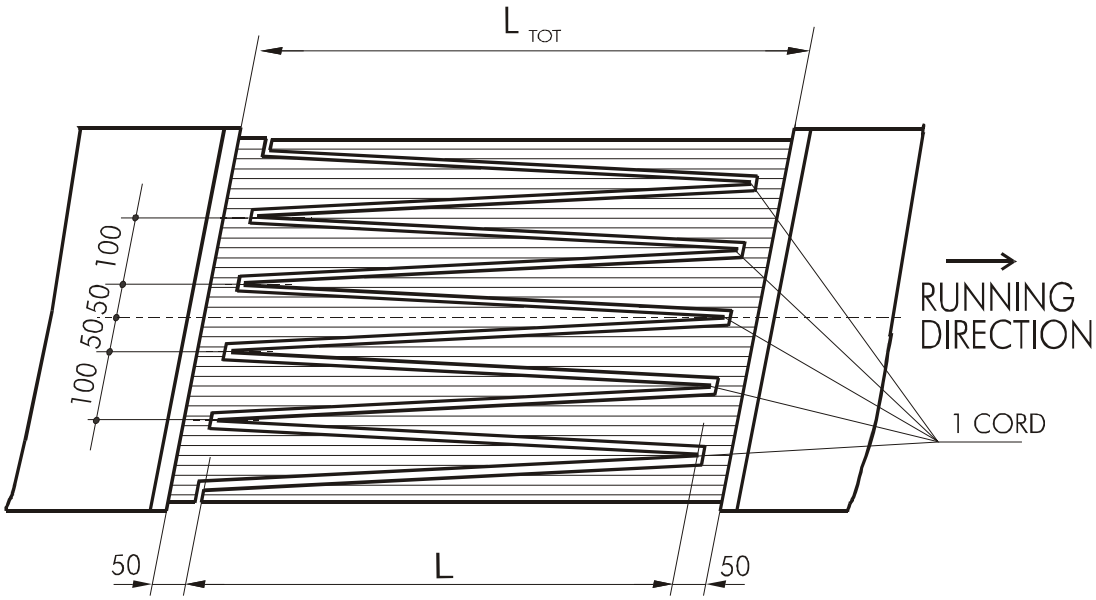


Fig. 19 – Finger configuration

b) plain stepped splice

Based on the sketch of Fig. 20 and on the number of cords of the belt, adapt the cut pattern closed to the two belt edges in order to assure that the external cords are placed in the opposite direction of the belt motion. Considering that each finger is composed by 10 cords, this operation is possible creating two external fingers of a minor number of cords than 10; this pattern alteration must be reproduced specularly on the two prepared belt ends. This operation is particularly critical and cannot be improvised at the moment of the cord cut.

To reduce as much as possible the risk of cord ejection from the belt, the first and the last external cord of the rear part of the splice, with reference to the running direction, should be trimmed as short as possible (indicatively less than 10 mm). See * on Fig. 20.

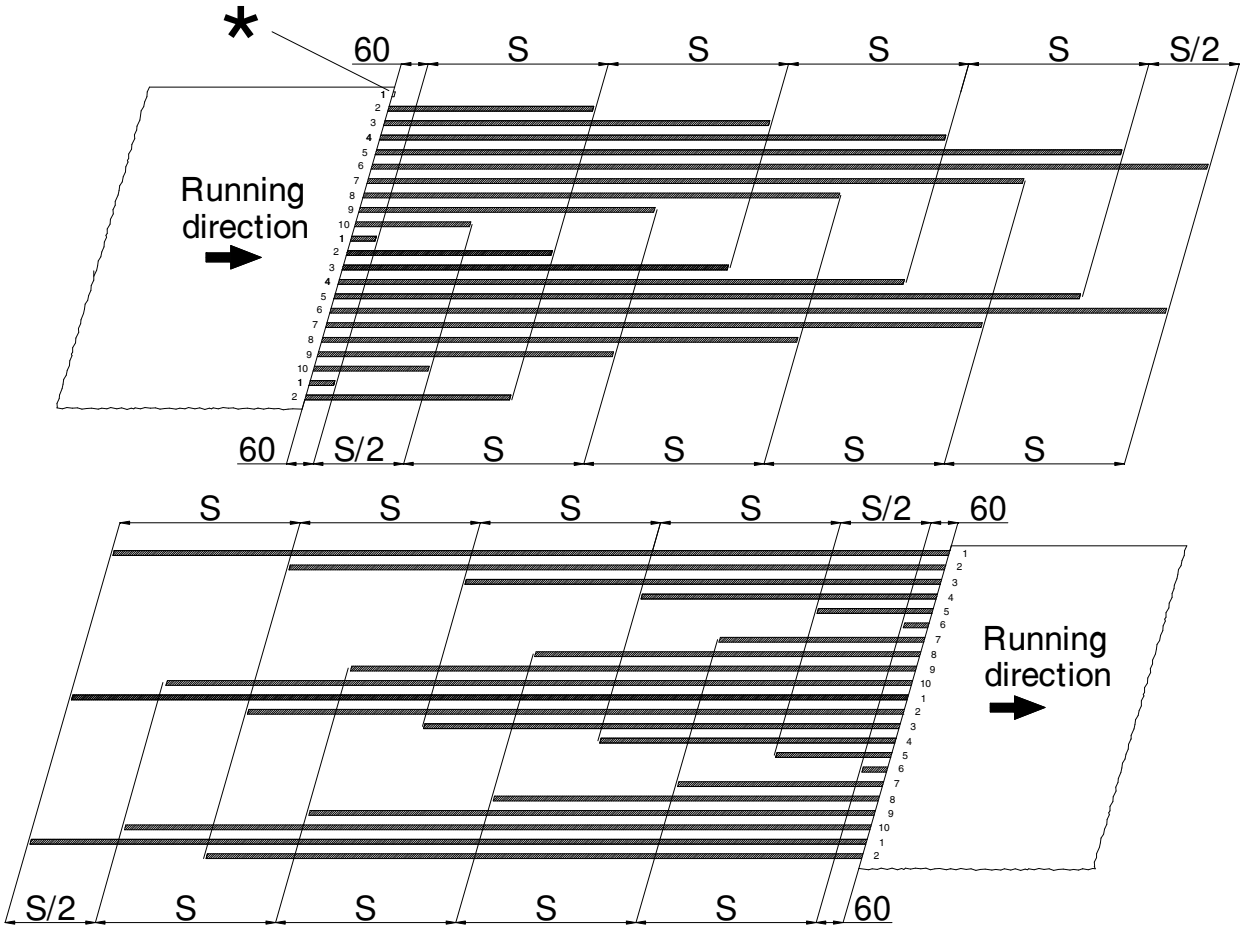


Fig. 20 – Plain stepped configuration

The rubber among adjacent cords should not be eliminated and the obtained fingers should remain solid and not divided in single cords.

In both methods the cutting execution, which can guarantee a perfect fixed splice of the two ends shall be carried out by a properly stout cord shear. We suggest avoiding the use of cutting disks to exclude the damaging of the adjacent cords.

The ***perfect alignment of the two ends shall now be guaranteed***. On this purpose, mark two points on each end of the belt, at least 50 cm far away one from the other along the central axis; in this way we have four reference points, which can be easily aligned by a string.

Once the ends are aligned, fix them by clamps to the cabinet bench.

Match finally both ends following Fig. 19 or Fig. 20 depending on the adopted method, checking that the two complementary parts perfectly match without overlapped parts (to be eventually removed by shears).

5.2.4) Splice closure

Overturn the fingers on each side and place the lower cover on the press table.

Apply the SICOT® 2400 solution, according to the following quantities (as implicit, this passage will not be mentioned again in the procedure):

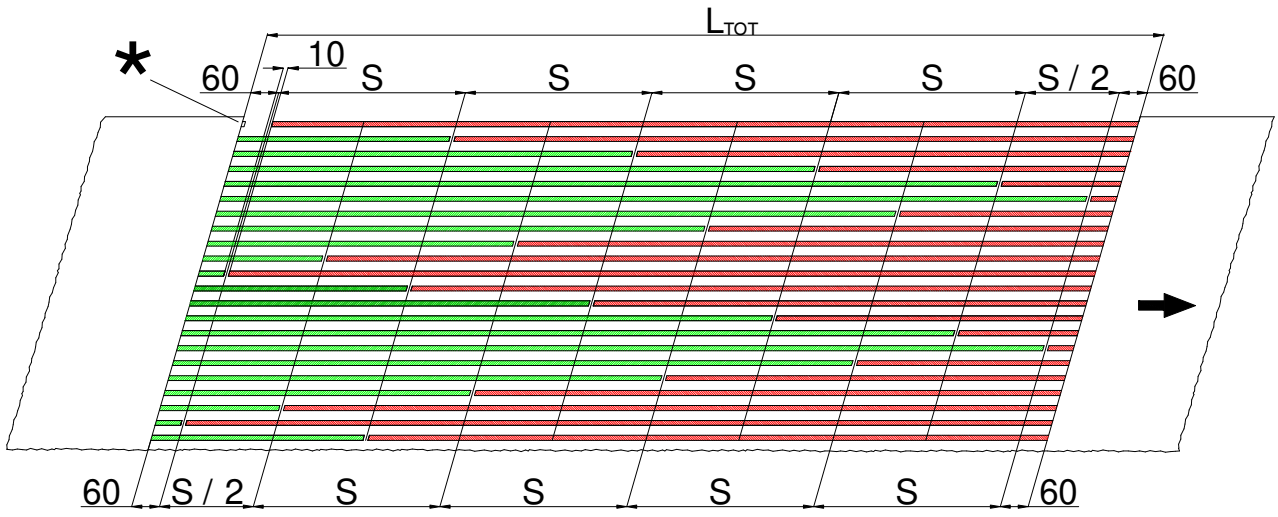
- 1 solution coat on the uncured rubber sheet; in case the rubber surface shows some white or crystalline efflorescence (it is simply wax or sulphur surfacing, not a symptom of poor quality or bad conservation) polish it by mean of a solvent before the application of the solution;
- 2 coats on each cord layer sides; the first coat should dry completely before the application of the second one.

The quantity of rubber solution SICOT® 2400 to be applied on each coat should be just enough to wet the surface, it must not be flooded. It is not required to use rubber solution more than necessary.

The drying of the last coat of rubber solution should not be complete; skill operators well know when the surface is ready for the coupling. The waiting time cannot be estimated as it depends on the ambient conditions.

Over the bottom cover, a layer of SICOP® 2419 uncured rubber, cut in accordance with the fixed splice area dimensions, shall be applied.

Close the splice, moving the fingers alternatively, starting from the belt centre, leaving a gap of 10 mm among fingers. For finger method the result is shown in Fig. 19; for plain stepped method, the final result is shown in Fig. 21.



* Trimmed cord (< 10 mm)

Fig. 21

Due to the cord density, the final structure of the splice is compact and it should not show evident gaps between cords; however, where present, fill the possible fissures, holes, gaps among the cords, especially at the end of each step, with adhesion rubber SICOP® 2419 0,5 mm. Cover the external cords with a layer of same adhesion rubber SICOP® 2419 0,5 mm and complete the rebuilding of the side edges with available SICOP®.

Apply two separate layers of adhesion rubber SICOP® 2419 0,5 mm on the steel cord layer; after the matching of each single layer of adhesion rubber it must be well rolled to assure the adherence to the surrounding cord layer.

Using an electric shear or a plate shear, cut the required Insertion Strip IS630 to cover the exact splice length; to grant the correct covering of the splice area the strips must be cut with an inclination of 16°, the same of the splice; the length of each strip should be such as to cover all the cord area, taking care not to reach the belt edges.

Clean both Insertion Strips sides with a solvent and apply the rubber solution SICOT® 2400.

Place the Insertion Strips close to the belt casing along the required "L" splice section, without gap among them on the direction, parallel to line CD to obtain a homogeneous and continuous layer.

On the splice, apply the top cover rubber coats required, in order to obtain a thickness 1mm higher than the original belt thickness.

Place two steel bars, 1 mm lower than the belt thickness, and lock them steadily to the belt and to the press table (in case they are not already welded).

Protect both surfaces with a silicone cloth as wide as the press plates; place the upper plate of the vulcanizing press, interposing a slightly wider plate compared to the press tables and turn on the heating and pressure devices as indicated on Section 6.

It is' absolutely essential that all layers making up the splice are carefully solutioned and let dry before the application; if this is not executed, air bubbles may result on the surface during the vulcanization, making the product quality and mechanical resistance worse.

The above makes the splice to have the following longitudinal section.

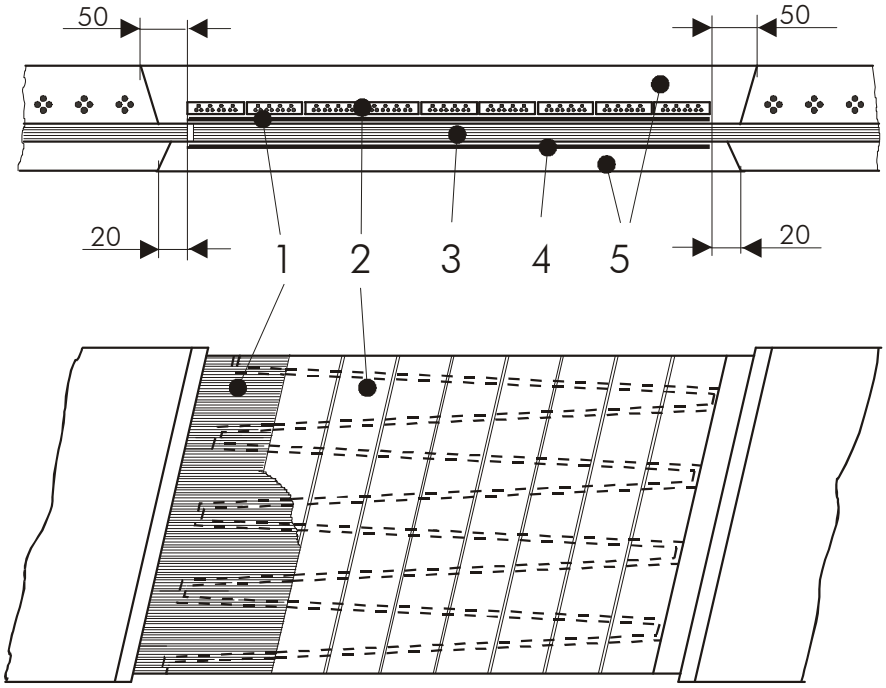


Fig. 22

1) Top adhesion rubber
2) Insertion Strip IS630
3) Steel cord fingers
4) Bottom adhesion rubber
5) Cover rubber

5.3) "SHORT" FINGER SPLICE

As already mentioned, this splice is only a finger splice, whose length is 20% lower (see Table 4, Pag. 14), with respect to the standard splices (Par. 5.2). This can be obtained since Insertion Strips are applied on both covers, carrying out a double binding effect on both belt ends. This method is highly recommended for SIDERFLEX HE, for their characteristic double metallic weft; pay anyway attention to the respect of the requirements of Tab. 1, Pag. 12.

Therefore, please refer to par 5.2.1, 5.2.2 e 5.2.3 for the end's preparation procedures.

5.3.1) Splice closure

The ends closure procedure refers to par. 5.2.4 except for the fact that a first coat of Insertion Strip shall be placed over the bottom cover, before the double layer of adhesion rubber SICOP® 2419 is applied, subject to solution SICOT® 2400 treatment. The next phases follow faithfully par. 5.2.4. indications.

Since the splice includes two different Insertion Strip coats, it is fundamental that their distance is the smallest as possible, in order to avoid an excessive transversal stiffening of the splice itself. Two layers of SICOP® 2419 0,5 mm above and below the fingers are correct to guarantee the requirement of Tab. 1 on page 12 in terms of max distances between IS630 (ΔT).

The above makes the splice to have the following longitudinal section.

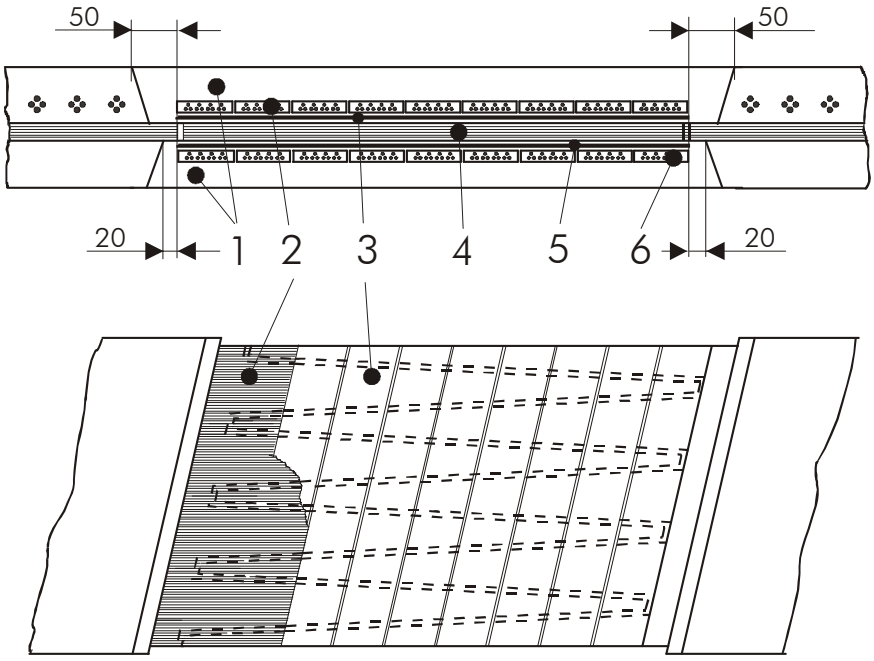


Fig. 23

1) Cover rubber
2) Upper Insertion Strip IS630
3) Top adhesion rubber
4) Steel cord fingers
5) Bottom adhesion rubber
6) Lower Insertion Strip IS630

5.4) INTERLACED STEPPED SPLICE

For this specific type of splice, the Insertion Strip is not strictly necessary, although it is anyway suggested to guarantee the same cut and tear resistance of the original belt.

For the covers tracing and removal phases, the procedure follows faithfully par. 5.2.1 indications.

For splice length L, please refer to Tab. 5, page 15.

5.4.1) Cords cleaning, cutting and alignment

Once the metallic casing surface is cleaned with sanding disk, the cords are separated one from the other by knives. From the cords body, as much rubber as possible shall be removed, leaving a film, functional for the adhesion with the filling rubber.

According to the indications of Tab. 5 Pag. 15, for our standard SIDERLFEX ID, SIDERFLEX HD or CROSSRIGID HR following cord disposition must be set:

- Belt class up to 1600 kN/m: 1 step, that is to say all cords are cut at a length almost equal to the splice length L, so that between the two consecutive cords of one head, one cord coming out from the opposite head can be inserted (Fig. 24).
- Belt class from 1800 to 3150 kN/m: 2 steps, that is to say each head cords are alternatively cut at a length almost equal to L and S, so that two cords of opposed heads can be put side by side and the two next cords can meet “head to head” in the middle of the splice. This particular expedient is due to the insufficient space between the cords, which therefore would not permit to insert another cord, coming from the opposite head, between two of them (Fig. 25).

The following figures clarify the two different cords dispositions. Please take note, in particular, of the several cords lengths and of the transition areas (100 mm), required in order to let the cords have enough space to deviate from their original positions to the ones imposed by the splice configuration. In addition, please take note that the cords are not cut of the same length, but their ends are alternatively about 50 mm staggered; in this way a gradual change of the longitudinal stiffness in the splice area can be ensured.

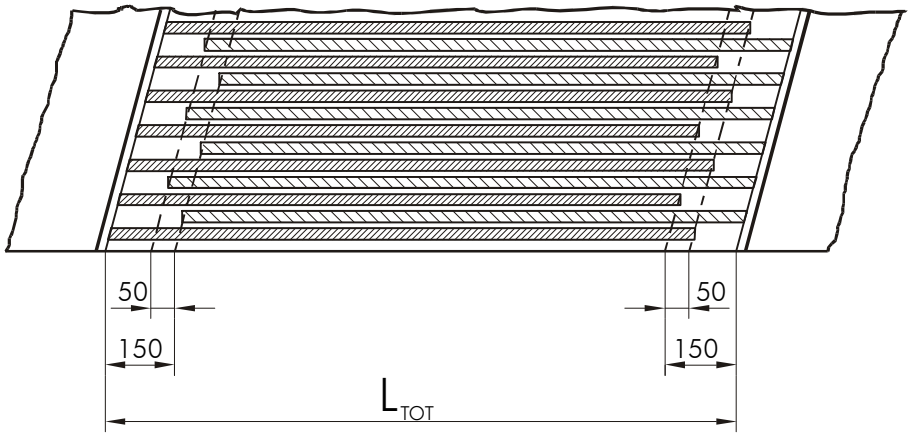


Fig. 24

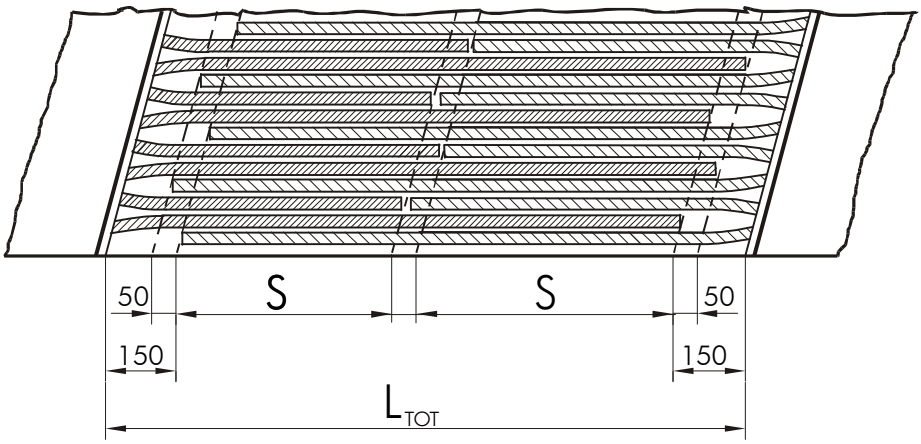


Fig. 25

Now it is necessary to place both ends, guaranteeing their perfect alignment. On this purpose, mark two points on each belt ends, at least 50 cm far one from the other along the longitudinal axis; in this way we have four references points, which can be easily aligned by a string.

Place and fix carefully to the frame or to the bench cabinet under the press lower plane.

Arrange the ends at a distance one from the other equal to L and align them according to the above mentioned four references.

When the correct geometry has been established, mark with a chalk the belts position on the press in order to point out any possible movement. Then fix the ends steadily to the table by clamps.

5.4.2) Splice closure

Overturn the splice cords to the back and clean the press face carefully.

Apply the SICOT® 2400 solution, according to the following quantities (as implicit, this passage will not be mentioned again in the procedure):

- 1 solution coat on the uncured rubber sheet; in case the rubber surface shows some white or crystalline efflorescence (it is simply wax or sulphur surfacing, not a symptom of poor quality or bad conservation) polish it by mean of a solvent before the application of the solution;
- 2 coats on all the cord surfaces; the first coat should dry completely before the application of the second one.

The quantity of rubber solution SICOT® 2400 to be applied on each coat should be just enough to wet the surface, it must not be flooded. It is not required to use rubber solution more than necessary.

The drying of the last coat of rubber solution should not be complete; skill operators well know when the surface is ready for the coupling. The waiting time cannot be estimated as it depends on the ambient conditions.

Place the bottom cover rubber - previously cut - on the press plane; then, apply a layer of adhesion rubber SICOP® 2419, 0,5 mm thick, of the same sizes.

Pull a cord along the two ends axis, fixing the splice axle, that is to say the straightness reference for all cords couplings.

Place the cords progressively on the solutioned rubber base, starting from the belt center.

Interpose an adhesion rubber strip SICOP® 2419 on the sides of the cords in contact with the opposite cords as in Fig. 26 or Fig. 27, according to the splice configuration. The thickness of these strips depends on the space between cords to be fulfilled.

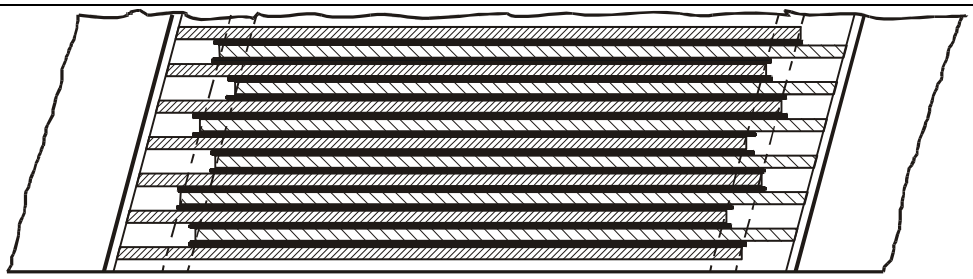


Fig. 26

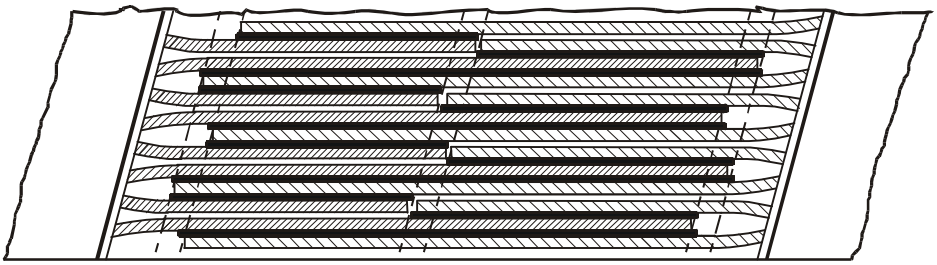


Fig. 27

Check at regular intervals the cords parallelism with the splice axis and bring the changes required to grant the correct alignment.

We recommend checking that a margin is available, adequate to carry out the rubber side profile approx. 20 mm wide.

Apply another rubber solution coat SICOT® 2400 on the cords surface in order to facilitate the upper coats adhesion. Wait for everything to be completely dried, promptly removing by a metallic brush the possible liquid puddles coming to the surface.

Apply a layer of adhesion rubber SICOP® 2419 0,5 mm thick over the cords and fill the side areas with raw rubber, as well as the empty areas, corresponding to each cord end. The result shall be a surface as uniform and plane as possible.

The following "italic" part of the procedure is required only in case of use of Insertion Strip IS630, otherwise proceed further.

Cover with a second layer of adhesion rubber SICOP® 2419.

Cut the Insertion Strips IS630, to be placed parallel to CD, in the correct quantity required to cover the whole splice width and length without any gap among them. Each strip length- parallelogram shaped- shall be a couple of centimetres lower compared to line CD; we suggest using metal shears to cut the IS630 strips.

Place the strips transversally on the splice are, parallel to the line CD.

Cut a cover rubber layer, whose sizes are taken on the splice area, and place it on the below layer; shape this cover in order to have it perfectly match with the area between the lines CD of the two ends.

Check that the splice thickness is 1 mm higher than the belt thickness.

Press and hole the splice surface with a pricker to favour the extraction of gas during vulcanization, avoiding the bubbles creation.

Remove the exceeding rubber on the splice edges.

Place two steel bars, 1 mm lower than the belt thickness, in correspondence with the edges, and lock them steadily to the belt and to the press table (in case they are not already welded).

Protect both surfaces with a silicone cloth as wide as the press plates; place the upper plate of the vulcanizing press, interposing a slightly wider plate compared to the press tables and turn on the heating and pressure devices as indicated on Section 6.

The above makes the splice to have the following longitudinal section (Fig. 28)

It is' absolutely essential that all layers making up the splice are carefully solutioned and let dry before the application; if this is not executed, air bubbles may result on the surface during the vulcanization, making the product quality and mechanical resistance worse.

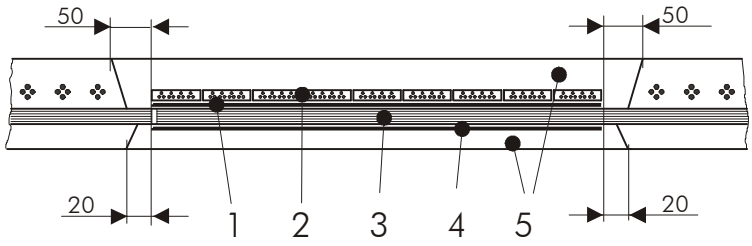


Fig. 28

1) Top adhesion rubber
2) Insertion Strip IS630 (if present)
3) Steel cord layer
4) Bottom adhesion rubber
5) Cover rubber

CHAPTER 6

VULCANIZATION OPERATIONS

6.1) Plates preparation

Before closing the press definitively, check that the containment lateral bars are perfectly positioned. If they are not welded to a plate, make sure that they are well fixed one to the other, in order to be able to effectively buck the rubber pressure during the vulcanization.

Start the plates heating device and apply pressure. For this procedure, the parameters here below should be applied; however, indications and suggestions of the press manufacturer should be considered, too.

6.2) Vulcanization conditions

The following are the process parameters to be observed:

- Pressure on the splice: from 10 to 12 Kg/cm^2;
- Temperature: 150 ± 2 °C;
- Duration: as soon as the indicated temperature is reached, the vulcanization time is 20 minutes for all splices up to 12 mm thick. **For higher thicknesses, add 1 baking minute for each millimetre beyond 12 mm.** The duration of vulcanization starts when all steel plates reach the required temperature.

6.3) Warm up and cool down

As soon the press heating starts, apply on the splice a pressure of around 8 kg/cm^2 until the plate temperature reaches 80 °C, then eliminate the pressure and immediately apply the pressure again reaching the final value of 10-12 kg/cm^2; maintain this pressure for the whole vulcanization duration.

When the vulcanization time is over, switch off the heating keeping the splice under pressure until the temperature will go under 80 °C, to avoid bubbles creation. If the press can be refreshed by water, wait the natural cooling down until 130 °C is reached, then start with the water circulation. Before the pressure reduction, pay attention that the temperature is stabilized under 80 °C.

Remove the press and put the belt again on working conditions, waiting for the splice complete cooling before the energizing.

CHAPTER 7

HOT REPAIRS

Belts repairs can involve covers, bearing casing with its relative coverings and rubber edges.

The materials to be used and the operational process are the same mentioned on the above sections.

In case the belt repair should involve a particularly wide area, we suggest to insert a new piece of belt by two splices at a minimum distance of 5÷6 m.

7.1) REPAIR ON COVERS ONLY

Remove from the involved part, after a rubber incision and without affecting the cords layer, an old cover rectangle, and replace it with a raw rubber sheet SICOP® of the same type and thickness, previously solutioned with SICOT® 2400.

Proceed as per Section 6 as far as the vulcanization, using a field press of proper sizes.

7.2) REPAIR OF STEEL CORD LAYER

It involves the replacement of a belt section; therefore it shall be intended as if it were made up of two consecutive splices, consequently set.

7.3) RUBBER EDGE REPAIR

Remove the damaged section of the edge, clean the surface and apply one coat of SICOT® 2400 solution; then restore the edge rubber with a proper quantity of raw rubber lists obtained from SICOP® previously solutioned in order to remake the edge without exceeding.

Proceed as per Section 6 to vulcanize with a press adequate to edges.

INFORMATION

The information contained in this handbook constitute a general indication of the procedures and do not claim to be the only correct elements for splicing and repair procedures.

It stands to reason that the correct application of the above-mentioned instructions make the final result easier but it does not determinate it, since the responsibility for the actions is not included in the SIG S.p.A. guarantees.

SIG S.p.A. as producer of conveyor belts and other rubber articles is responsible for their products and not for the specific technical choices for which the buyer is the only one in charge.

SIG SpA reserves the right to introduce at any time such modifications at this manual as could be justified by continual developments and improvements.