



STEELCORD BELT SPLICE PROCEDURE

INSTRUCTIONS FOR **HOT SPLICING** OF STEELCORD BELTING

Version

10.3

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SCOPE

Because the splice is the weakest spot in a conveyor belt, it is essential to make the splice with greatest possible accuracy. These instructions refer to the materials and techniques involved in splicing Dunlop Steel Cord conveyor belt. In order to maximise performance at the high tensions under which steel cord belting operates, it is very important that the procedures in this guidance manual are strictly adhered to. Fenner Dunlop BV cannot be held responsible for any modification or shortcut in the operation of these recommended procedures. ¹

When in doubt, please contact our Application Engineering Department on +31 (0) 512 585 555.

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1. MATERIALS

Dunlop Conveyor Belting supplies complete splicing materials in custom-made kit form. Each kit is sufficient to make one splice. The following information is required to provide the correct components and quantities:

- ST belt strength rating
- Belt width and thickness
- Cover gauges and grade designation
- Number of cords, pitch and diameter
- Presence of breakers (number, located in top and/or bottom cover) and type
- Available press dimensions and shape

All splice kits contain the following basic components:

- Top and bottom cover panels with adhesion rubber attached and include breaker fabric where applicable.
- Cord filler strips (noodle)
- Edge fill-in strips and end fill-in strips
- Cleaning solvent
- Splicing solution (Dundisol)
- Foil
- Release paper/fabric

The following names are used for the splicing materials:

Dundisol:	Solution to enhance tack	black liquid
Dunlofol:	Unvulcanised adhesion (skim) rubber	sheet
Noodle:	Unvulcanised adhesion (skim) rubber	strips
Duncover:	Unvulcanised cover rubber	sheet
	Edge fill-in / fill-in	strips

Additional instructions and/or materials may be provided separately for specific belt types/constructions.

All splicing materials have a limited shelf life. Splice material past its expiry date should not be used. Each component of the splice kit is marked with an expiry date. These dates should always be checked prior to commencing splicing.

Splice kits stored at ambient temperature of approx. 20°C have a shelf life as indicated by the expiry date. Splice kits should be kept in a cold room below 10°C for an extended shelf life.



2. HEALTH AND SAFETY

The following instructions and procedures shall be observed at all times during the preparation and manufacture of splices in Dunlop Steelcord conveyor belt.

- All equipment used in the splicing of Dunlop Steelcord conveyor belt must comply with site regulations relating to the use of electrical and mechanical equipment.
- Only the materials listed in chapter 1 should be used.
- Always consult the Materials Safety Data Sheets (MSDS) for precautions to be taken when handling solvents, solutions and primers and for first aid treatment. A guide for first aid treatment and the precautions to be taken are as follows:
 - The work area should be adequately ventilated because the process emits vapours during the cleaning and solutioning operations. In the event that a person should experience any respiratory irritation, move them into fresh air. If the symptoms persist, follow the procedures as described on the MSDS and obtain medical attention.
 - Avoid contact with the skin and eyes. Full protective clothing, including overalls, suitable PVC or rubber gloves and eye protection should be worn at all times during the mixing and application of the vulcanising solution and bare cord primer.
 - Clear up any accidental spillages immediately. The application of any absorbent dry powder such as sepiolite sand will help remove stickiness and facilitate removal of the spillage.
 - Empty and/or unused tins should not to be left behind and should be disposed of using an approved and safe method.
 - Most solutions and solvents are flammable and the splice area should be clear of any ignition source. Smoking should specifically be prohibited at or near the splice area.
- Make sure the conveyor belt is properly tagged out, de-energised and secured prior to initiating any work on the system. Ensure that all Dunlop and site safe work procedures are adhered to.



3. VULCANISATION REQUIREMENTS AND TOOLS

The first step in making a good quality splice is preparing the work area so that it is efficient, well lit, clean and adequately protected. Outside installations should be protected by a shelter against adverse weather conditions. Inside installations should be cleaned of excessive dust (especially overhead), have good lighting and protected against dripping water.

The edges of the platen must be parallel to the direction of the belt run travel.

A splicing table extending at least 2m from each end of the bottom platen and 25mm wider than the belt should be constructed. In addition, a separate table of sufficient size should be constructed on which to prepare the rubber splice components. The splicing table must be level or 5mm lower than the platen surface.

The vulcanising press must be large enough to cure the splice in one heat with a minimum 150mm overlap onto the original belt cover at each end of the splice and should be 200mm wider than the belt width.

For multi platen vulcanising presses, use two solid platens to cover the entire area top and bottom with a minimum overlap of 50mm on each end.

The vulcanising press must be capable of a curing pressure on the belt surface of 10 - 14 bar (145 – 200psi).

The curing temperature must be accurately controlled between 150°C and 155°C (300°F and 310°F) except for the Deltahete quality. The curing temperature for Deltahete belting is between 155°C and 160°C (310°F and 320°F). The curing temperature must be accurately controlled over the whole platen area to +/-5°C during heating and curing. For this reason, vulcanising presses with thermostats must be carefully checked for functionality and monitored continuously with thermocouples to ensure they are operating properly. The thermocouples should be strategically placed over the surface of both top and bottom platens. Over cure and/or under cure do not provide sufficiently strong splices. The curing time starts when a temperature of 150°C is reached or 155°C for Deltahete.

Refer to table 1 for curing times.

Belt Thickness		Time minutes	Time Deltahete minutes
mm	inches		
0 - 16	0 - 0.63	35-40	45-50
16 - 20	0.63 - 0.79	40-45	50-55
20 - 25	0.79 - 0.98	45-50	55-60
25 - 30	0.98 - 1.18	50-55	60-65
30 - 35	1.18 - 1.38	60-65	70-75
35 - 40	1.38 - 1.57	65-70	75-80
40 - 45	1.57 - 1.77	70-75	80-85

Table 1

SUGGESTED TOOLS:

- press: length: splice length + 300 mm
width: belt width + 200 mm to accommodate belt and edge bars
pressure: 10 - 14 bar
temperature: minimum 150°C (155°C for Deltahete), preferably with forced cooling
- three wooden work boards, of at least 2 m long and width adjusted to belt width
- 4 U-clamps to fix the belt to the boards
- chalk cord for aligning purposes
- 2 edge bars: length: splice length +0.6m, width: 100 mm, thickness: 0.8-1.5 mm below belt thickness
- 2 sash-clamps to tension the edge bars firmly to the belt edges
- oscillating knife (Fein or similar) to remove the cover
- Stanley knives
- flat roller and stitch roller
- grinding tool with variable speed
- pinchers to remove cover
- thickness gauge
- two thermometers with gauges to insert between belt and heating plate
- two thermometers to measure temperature inside heating plates



4. SPLICE METHODS & DIMENSIONS

When the distance between cords in the belt do not permit the interlaying with the minimum thickness of intermediary rubber, the opposing cords must be cut off and butted together in a prescribed pattern to allow for the necessary thickness of rubber. When these cords are cut and butted around the centre of the splice length, it is termed a two-step splice. When the cut-offs are at one third and two thirds of the splice length, it is termed a three-step splice.

Each belt is provided with its own splice dimensions to be followed when laying up.

Because so many different constructions are possible for each ST belt rating, it is impractical to provide details for each one. In all cases, a splice diagram for the specific belt can be obtained from Dunlop on request. An example of a splice diagram can be found in appendix 2.

For the standard types of splices see table 2.

Dunlop Steelcord Belting									
Splice dimensions for belt constructions according to EN ISO15236 part 2 and DIN 22131 part 1									
Belt type	Splice type	Step length (S)		Bend zone (B)		Splice length (L)		Cord gap (G)	
		(mm)	(in)	(mm)	(in)	(mm)	(in)	(mm)	(in)
500	1 - Step	500	20	100	4	750	30	25	1
630	1 - Step	500	20	100	4	750	30	25	1
800	1 - Step	600	24	100	4	850	34	25	1
1000	1 - Step	600	24	100	4	850	34	25	1
1250	1 - Step	650	26	100	4	900	36	25	1
1400	1 - Step	650	26	100	4	900	36	25	1
1600	1 - Step	700	28	100	4	950	38	25	1
1800	2 - Step	700	32	100	4	1675	75	25	1
2000	2 - Step	700	32	100	4	1675	75	25	1
2250	2 - Step	800	32	100	4	1875	75	25	1
2500	2 - Step	800	32	150	6	1985	80	35	1 ½
3150	2 - Step	900	36	150	6	2185	88	35	1 ½
3500	2 - Step	900	36	150	6	2185	88	35	1 ½
4000	3 - Step	950	38	150	6	3270	131	35	1 ½
4500	3 - Step	1000	40	200	8	3540	142	45	1 ¾
5000	3 - Step	1000	40	250	10	3640	146	45	1 ¾
5400	3 - Step	1150	46	250	10	4090	164	45	1 ¾

Table 2

5. DETERMINATION OF THE OVER LENGTH

The necessary over-length is determined by the splice type and the splice angle. A steel cord splice can be made square or on a bias. The most common splice angle is 17 degrees, which is an equivalent bias length of 0.3 x belt width. The normal splice allowance is therefore:

- splice allowance = splice length (L) + 0.3 x W where W = belt width, (refer to figure 1).

However, to match the splice to the vulcanising press bias, this angle may be modified.

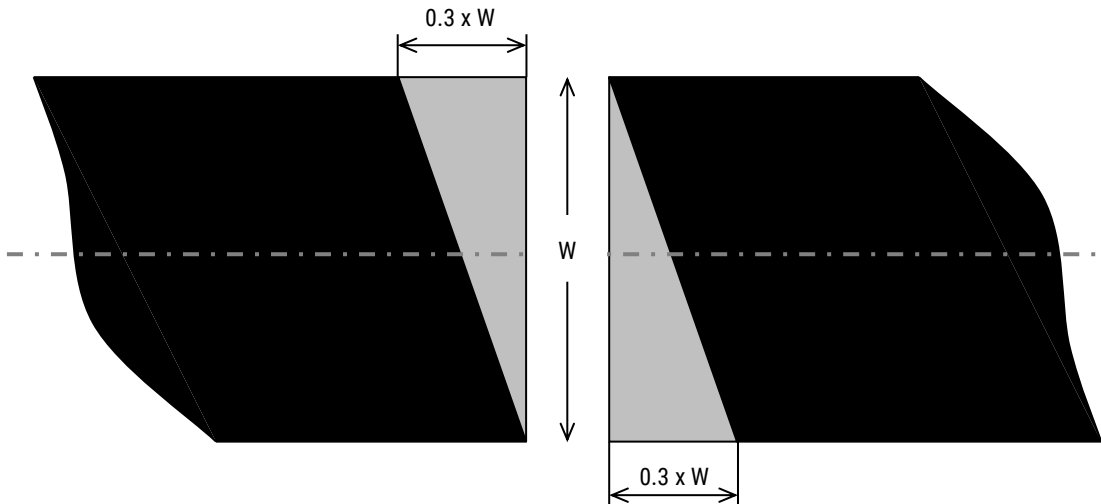


Figure 1

6. BELT PREPARATION

- The belt should be centrally located on the troughing idlers on each side of the splice area. This enables final adjustments to easily be made for splice alignment. The two belt ends are then overlapped on the bottom platen of the vulcanising press and aligned visually.
- Mark centre points on each belt end (three or four times) at 1 to 2m intervals that are then joined using a chalk line. Do not use the belt edge as a reference. The centre lines are used to make final alignment.

Now clamp the belt to the work surface to prevent movement.

Do not nail the belt. Nails can damage the cords and the nail holes may allow moisture to come into contact with the cords causing corrosion and premature failure.

6.3 Marking the splice bias lines:

- 6.3.1 On the belt edges, mark the splice bias lines on both ends. Match the bias angle to the vulcanising press angle and mark a bias line on the top end parallel to the end of the platen and at least 150mm in from the end.

6.3.2 Measure a distance equal to the splice length from the ends of the bias line toward the belt and mark a second bias line parallel to the first line. Make sure this line is at least 150mm in from the other end of the platen.

6.3.3 Fold back the top end; use the edge mark to draw the bias line on the bottom end. Make sure that the belt ends are still in alignment.

6.4 Stripping the covers:

6.4.1 Starting with the upper belt end make a vertical cut across the belt down to the cords approximately 50mm next to the cut off end. (This allows extra room to cut cords to the length at a later stage.)

6.4.2 A second cut at at least a 45° skive angle is then made along the other bias line making sure not to damage the cords.

6.4.3 Next remove the rubber edges along the length of the splice on the outer cords.

6.4.4 Start stripping the top cover at the leading point of the skived cut by pulling with pincers and cutting under the cover just above the cord. Try to leave a thin layer of rubber on the cord.

6.4.5 When a sufficient amount of rubber has been pulled free, attach a clamp and put the cover under tension to facilitate cutting. Control the tension on the cover so that the rubber between the cords is not distorted.

6.4.6 Either “hooking” or “piano wires” can be used to achieve freeing the cords. It is suitable for belts with cord diameter over 5.0mm (3/16”) to use the piano wire. Piano wire may damage smaller cords.

Hook knife method

- Hook wires as per Dunlop hook knife procedure, leaving 25mm (1”) transition from the bottom of the skive.
- After hooking, the rubber at the end of the landing (transition) needs to be cut to facilitate the removal of bottom cover.
- Clean excess rubber off from cords to ensure uniform shape prior to cutting cords to length. Refer to figure 2.
- Cut cords to length using approved cord cutters.
- Fold belt end back.
- Cut bottom skive as per splice diagram.
- Repeat the process for the other end.

Piano wire method

- Approximately 25 mm (1”) from bottom of the skive, cut rubber between cords parallel to skive.
- Fold belt end back, cut skive and remove an approximately 200mm (8”) wide window.
- Cut a 25mm (1”) window between cords from end of skive.
- Insert folded piano wire around every cord.

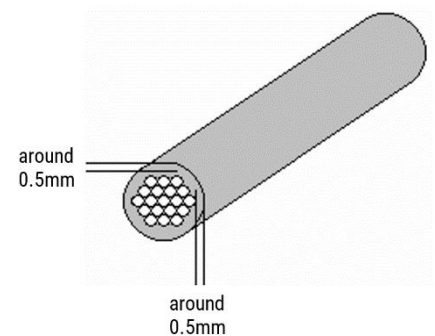


Figure 2

- Fold belt end back to the table and proceed to pull piano wires by using pulling plate.
- Clean excess rubber off from cords to ensure uniform shape prior to cutting cords to length. Refer to figure 2.
- Fold belt end back.
- Repeat the process for the other end

6.4.7 Buff the stripped surfaces with a rotary wire brush taking great care not to expose any cords or burn rubber. Extend buffing onto the surface of the covers over a width of approximately 75 mm (3").

6.5 Preparing the cords:

6.5.1 Brush thoroughly to remove all buffing dust and dirt.

6.5.2 At this point, reconfirm belt end alignment before solutioning and building the splice. Using a chalk line check the alignment of the original centre lines and then with a tape measure confirm to ensure that the cover skives are the correct distance apart for the splice being performed, and at least 150mm in from the ends of the platen. Mark edge of belts and skives on the press plate.

6.5.3 Clamp the belt firmly to the work surface and fold back the belt ends.

6.5.4 **Do not nail** the belt. Nails can damage the cords and the nail holes may allow moisture to come in contact with the cords causing corrosion and premature failure.

6.5.5 Place foil under the cords to keep them clean.

7. PREPARATION OF THE SPLICE

7.1 Preparing the splice:

7.1.1 If required, wash the cords and the buffed surfaces carefully using approved solvent sparsely and a lint-free cloth. Allow solvent to dry.²

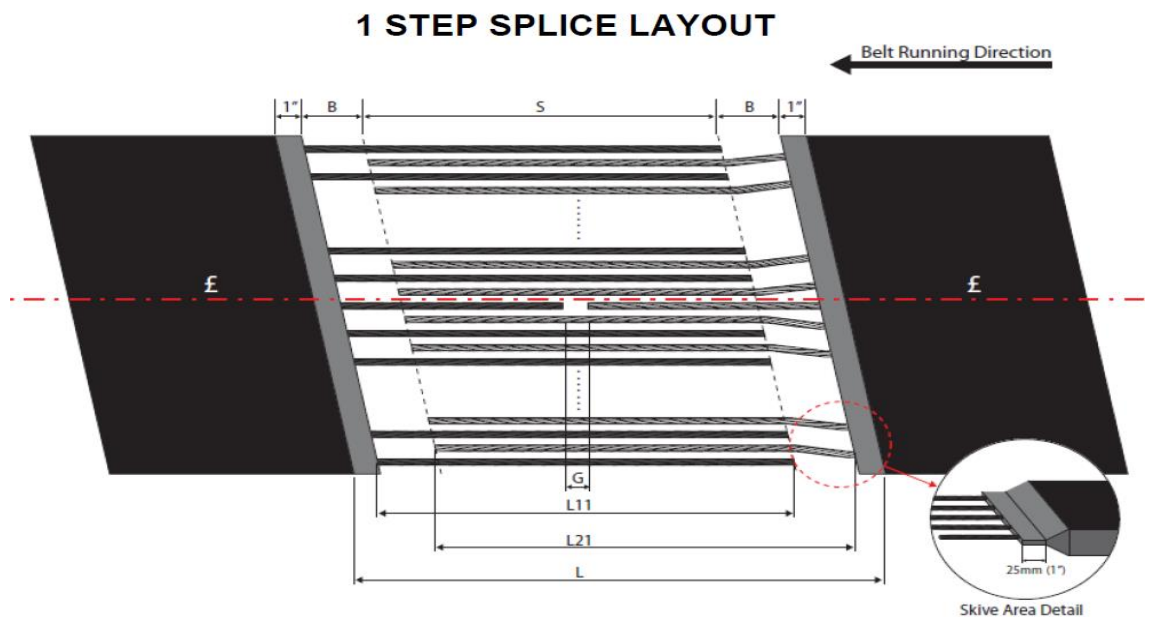
7.1.2 Install thermocouples on the bottom plate/common plate and cover the press area with release paper/fabric and lay extra layers of release paper in strips on the area of the bias cover joints.

7.1.3 Place the bottom cover panel into position, adhesion rubber side up, as marked.

7.1.4 Mark and cut the skives to match the bottom cover skives of the belt.

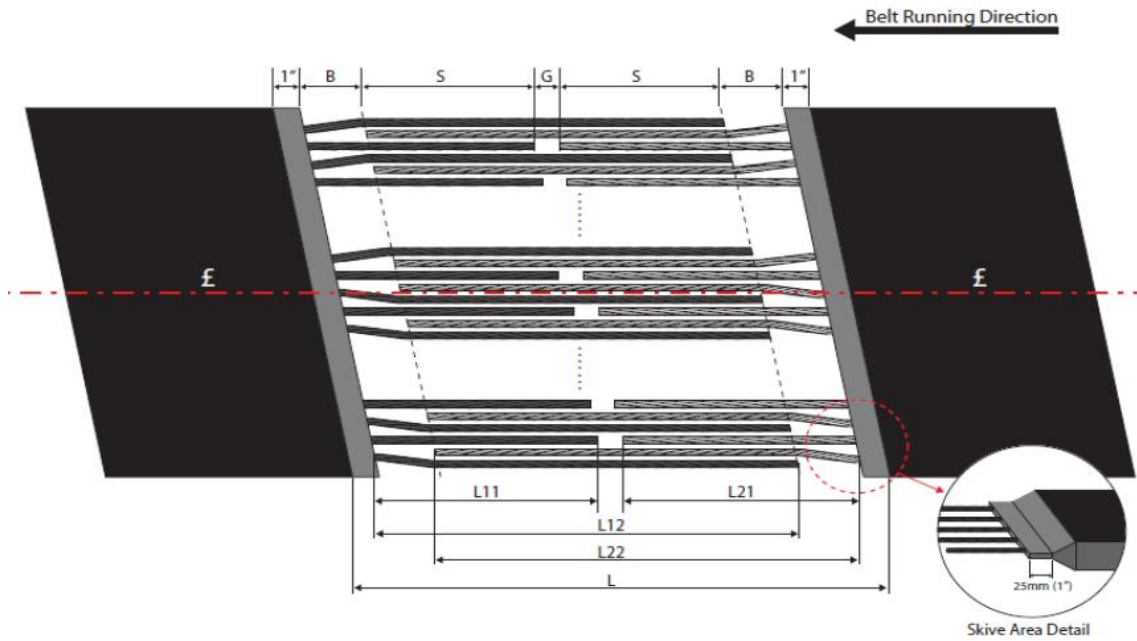
² Take great care not to get solvent into the ends of the cords as blisters may result during curing.

- 7.1.5 Mark the position of the individual cord ends as required by the splice pattern. Mark on the cords or on the bottom cover.
 - 7.1.6 Cut each cord to its proper length.
 - 7.1.7 Fold the cords back out of the way.
 - 7.1.8 Remove the foil, wash the adhesion rubber surface of the back cover panel with solvent and make holes on the "back" panel with awl with 50 to 100mm interval from adhesion rubber surface.
 - 7.1.9 Allow to dry thoroughly.
 - 7.1.10 Apply a coat of Dundisol to the adhesion rubber surface of the bottom cover panel. In case of Deltahete, ROS or BV ROM quality no Dundisol is allowed on the skives! See appendix 3 for more detailed information. Apply a coat of Dundisol to all cord surfaces only if required for an acceptable tack level whilst laying.
 - 7.1.11 Allow to dry thoroughly
 - 7.1.12 Match the skives of the belt and the bottom cover panel.
 - 7.1.13 Stitch and roll the cover joints firmly.
 - 7.1.14 Separate the cords to equal numbers on each side. Mark the centreline of the belt on the "bottom" panel using the backside of a knife to provide a reference for laying the cords.³
- 7.2 Laying in the cords**
- 7.2.1 For the correct splice layout refer to the splice diagram for the specific belt.

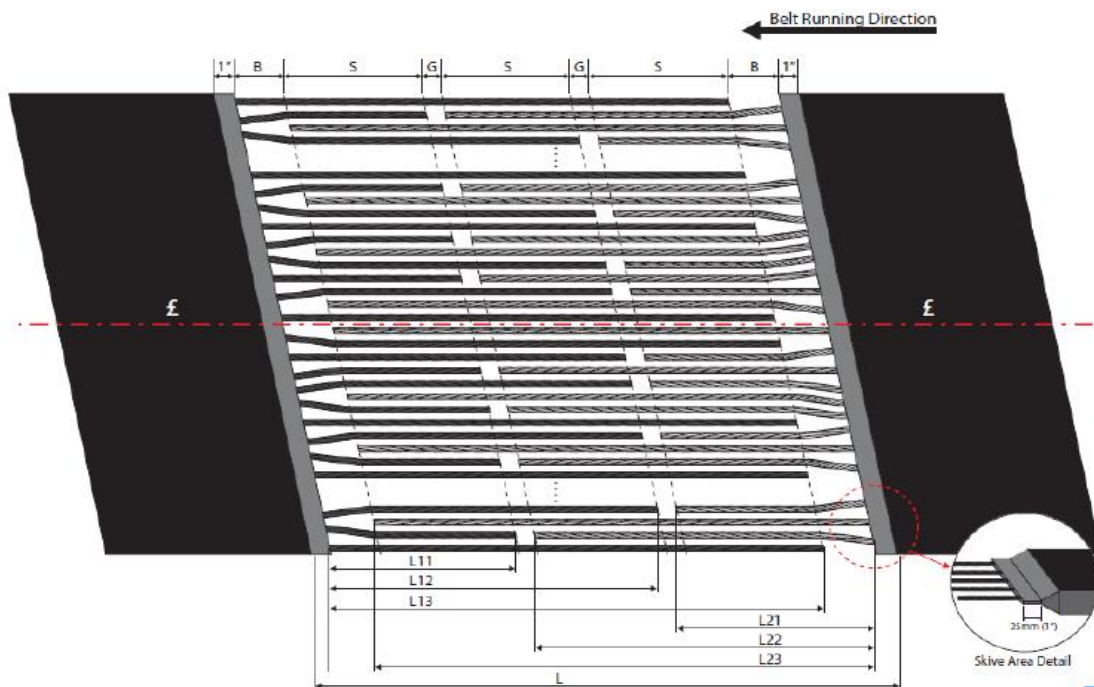


³ Excessive chalk on the back cover could affect adhesion.

2 STEP SPLICE LAYOUT



3 STEP SPLICE LAYOUT



7.2.2 Wash the cord filler strips with solvent to remove all dust and/or chalk if necessary. ⁴

7.2.3 Starting with the centre cord (when there are an uneven number of cords) or the cords either side of centre (for an even number of cords) lay in the cords as straight as possible. When butting cords leave the gap shown in table 2 or in the splice diagram.

⁴ The surfaces must be perfectly clean to obtain a good adhesion.

- 7.2.4 Build out from the centre in both directions.
 - 7.2.5 Roll each subsequent cord from the side to ensure complete contact with the preceding cord filler rubber and to keep the cords as straight as possible. ⁵
 - 7.2.6 Do not cut the cords out to correct bow.
 - 7.2.7 Completely fill the gaps at the ends of the cords with end filler rubber.
 - 7.2.8 When all the cords are in position, build up the edges of the splice to cord height using the edge filler strips provided.
- 7.3 Closing the splice:**
- 7.3.1 Cover the splice surface with foil and lay in the top cover panel (adhesion rubber side down) so that the skives can be marked and cut to match the belt top cover bias skives.
 - 7.3.2 Remove the foil, wash the adhesion rubber surface of the top cover panel with solvent and make holes on "top" panel with awl with 50 to 100mm interval from adhesion rubber surface.
 - 7.3.3 Apply one coat of Dundisol to the cover panel adhesion rubber surface if it is necessary. In case of Deltahete, ROS or BV ROM quality no Dundisol is allowed on the skives!
 - 7.3.4 When dry, the top cover panel is laid into position making sure that the bias skives fit. ⁶
 - 7.3.5 Stitch and roll the cover joints firmly then lightly hammer the entire splice surface.
 - 7.3.6 Mark the belt edges on the splice with a chalk line approximately 5mm (1/4") wider and trim excess rubber using a straight edge.
 - 7.3.7 Install splice identification brand/markings
- 7.4 Curing the splice:**
- 7.4.1 Check the alignment of the splice for last time using a chalk line and the centrelines.
 - 7.4.2 Cover the entire splice with release paper/fabric.
 - 7.4.3 Place 100mm wide edge irons at the sides of the splice 0.8 to 1.5mm (1/32" to 1/16") less in gauge than the belt and at least 0.6m longer than the splice. Hold the irons in place against the belt edges with sash clamps or come-a-longs.
 - 7.4.4 Install thermocouples on top of the top cover side.

⁵ Periodically check the straightness with a line held parallel to the belt centreline. Occasionally in order to lay straight, the filler strip may be stretched out slightly to reduce its thickness. If the cords are stripped properly and they are being laid properly, i.e., pushed tightly together and straight, this should not be necessary.

⁶ To prevent air entrapment the practice of holding and rolling must be used, i.e., gradually lowering the cover panel into place while rolling.

- 7.4.5 Place the top solid plate if it is necessary and top platen in position and assemble the vulcanising press.
- 7.4.6 The beams should be positioned so that they are parallel with the bias angle and evenly spaced. A pair should be positioned over each cover joint and at each transverse sectional platen joint.
- 7.4.7 In order to assure uniform temperature the vulcanising press must be protected from drafts during the cure.
- 7.4.8 Switch on the power, and adjust the control box(es) to the temperature specified in the documentation. By monitoring all thermocouple readings, manual adjustment may be required to ensure the temperature increases evenly.
- 7.4.9 Tighten edge bar sash clamps, check that the edge bars are not tilted and then apply platen pressure of 4 bar (60psi).
- 7.4.10 Check the edge bars and sash clamps, and tighten again if necessary.
- 7.4.11 When the temperature reaches 75 °C (165°F), increase the platen pressure to 7 bar (100psi).
- 7.4.12 When one of the thermocouples reaches 110°C, increase the pressure to 8.5 bar (125psi) and shut down the control box(es) (pause heating).
- 7.4.13 After 5 minutes switch the control box(es) back on and increase the platen pressure to 9.5 bar (140psi).
- 7.4.14 When the temperature reaches 120°C, increase the platen pressure to 10-12 bar (145-175psi) and hold until the temperature rises to the curing temperature specified in the documentation.
- 7.4.15 After the temperature reaches the curing temperature of 150 °C or as specified in the documentation, if necessary increase the platen pressure to the curing pressure specified in the documentation and maintain this pressure.
- 7.4.16 Cure the splice for the recommended time using the guidance from table 1 or as specified in the documentation.
- 7.4.17 The temperature and pressure must be monitored continuously and recorded every 5 minutes during the curing process.
- 7.4.18 When the cure is completed, water cool to 60°C (150°F) and hold for 15 min before releasing the pressure. If no water cooling is available, allow to cool to 60°C before releasing pressure.
- 7.4.19 Dismantle the vulcanising press and trim the splice.
- 7.4.20 Buff any over flow rubber from skives only after the surface has cooled.
- 7.4.21 It is recommended to check the dimensions of the splice (thickness, width and length), the straightness and the hardness on the top and bottom cover to ensure a proper cure.

APPENDIX 1

Using foreign splicing materials with Dunlop belts

Where materials other than those of Dunlop are being used there are two important considerations:

NOTWITHSTANDING THE ABOVE REMARKS, DUNLOP CANNOT GUARANTEE THE COMPATIBILITY OF THE MATERIALS BEING USED AND IT IS THE CARE OF THE PROVIDER OR MANUFACTURER OF THE MATERIALS TO PROVIDE ANY GUARANTEE OR ASSURANCE THAT MAY BE REQUIRED BY THE BELT USER.

AND

THE CURE RATE OF MATERIALS MAY DIFFER CONSIDERABLY AND THE DUNLOP CURING PROCEDURE AND TEMPERATURES ARE NOT APPLICABLE.
THE PROVIDER OR MANUFACTURER OF THE MATERIALS BEING USED MUST SUPPLY A CURING PROCEDURE OR SPECIFIC TIME/TEMPERATURE CONDITIONS.

APPENDIX 2

Example of a splice diagram

DUNLOP
CONVEYOR BELTING

Conveyor Ident: K0069
Belt Length(s): 450m

Belt Details:
Belt width: 2500 mm
Designation: **ST** 1400 kN/m
Top cover: 9 mm
Pulley cover: 6 mm
Grade: M

Cord details
No of cords: 161
Cord diameter: 4.8 mm

Belt Dimensions:
Measured belt thickness: 20.7 mm
Calculated belt thickness: 19.8 mm
Approximate belt mass: 66.8 kg/m

Splice type: SINGLE step

Step length: 700 mm

Overall splice length including bias: 920 mm / 1930 mm

Press bias angle: 22°

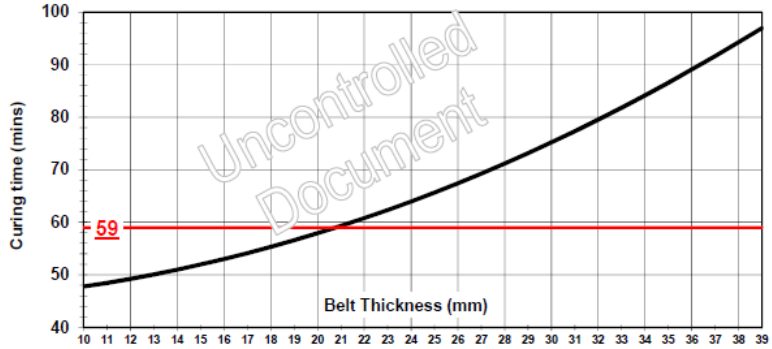
Curing conditions:
Curing temperature: 145 ± 5°C
Curing time: 59 mins
Cure time commences at: 140 °C (on ALL platens)
Cure pressure: 160 - 200 psi (1100-1400kPa)
Minimum platen size: 1270 x 2700 mm wide

Splicing Materials:
Solution: S19
Bonder: 1525
Cover: 3522
Solvent: Toluene

Splicing Instruction

ISSUED: 24-04-2017

Customer: _____
Site: _____



Check actual belt thickness and adjust cure time from graph above.
CURE TIMES ARE VALID FOR FENNER DUNLOP MATERIALS ONLY.
For other materials, refer to the manufacturer

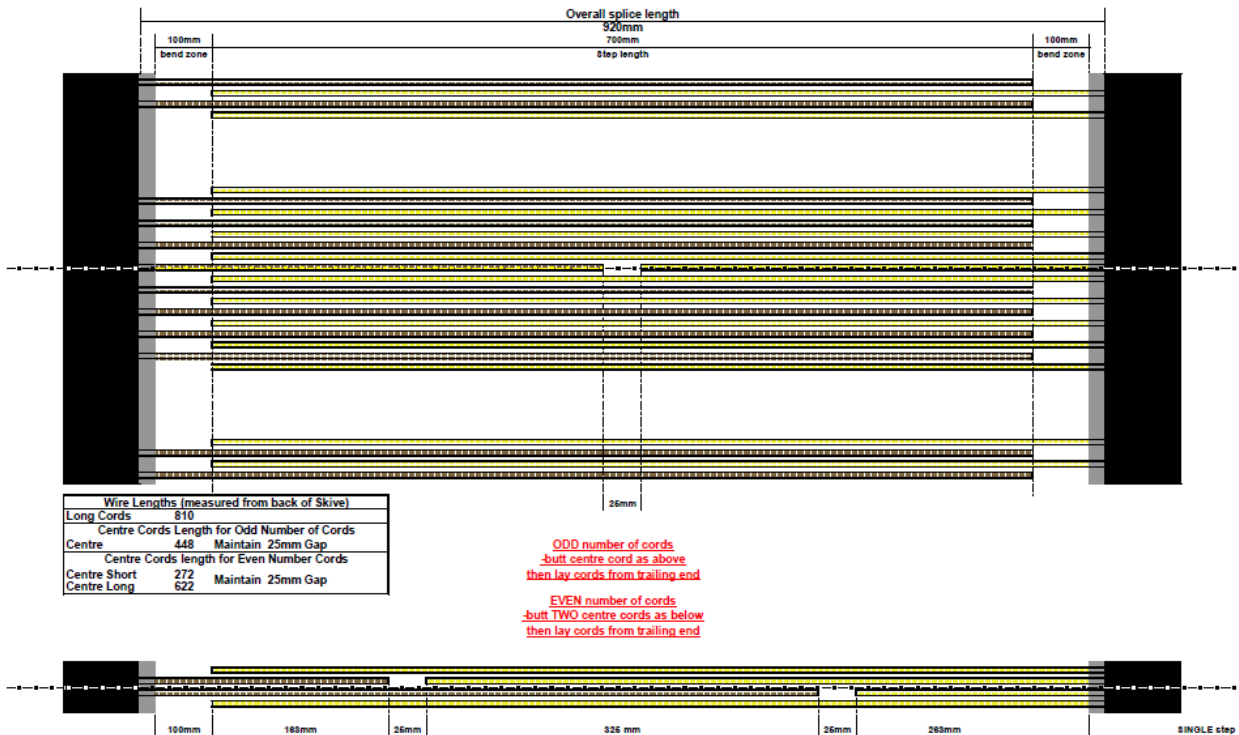
MATERIALS REQUIRED:

Filler gum		End filler		Edge strip	
Length	296 m	Length	39 m	Length	2.4 m
Thickness	4.8 mm	Thickness	4.8 mm	Thickness	4.8 mm
Width	2.8 mm	Width	10.4 mm	Width	50 mm

Cover panels	
For each cover	4 m long x 1500mm wide
Top cover	8 mm 3522 cover 1.5 mm 1525 bonder
Pulley cover	5 mm 3522 cover 1.5 mm 1525 bonder

Solution	
S19	10 litres
Fabric	9 metres x 150 cm wide
Visqueen	8 metres x 160 cm wide
Toluene solvent as required	

←←←←←←←← BELT DIRECTION ←←←←←←←←

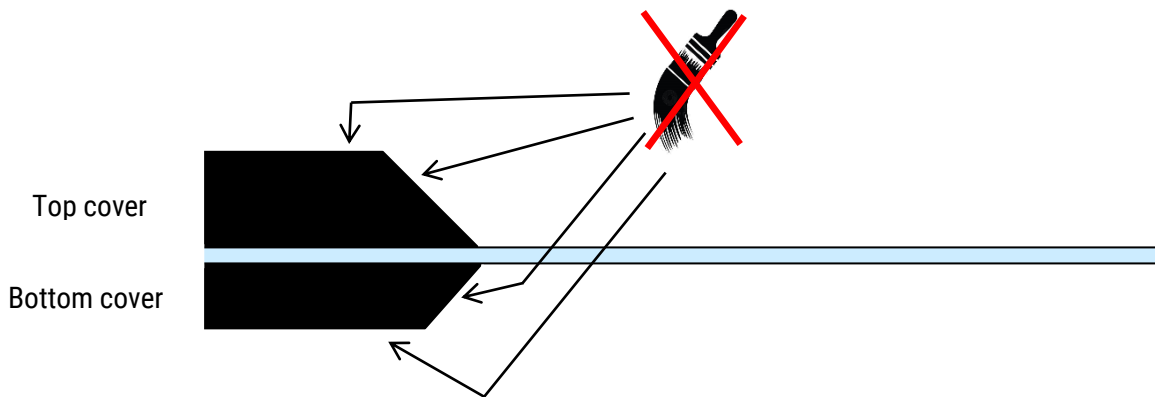


APPENDIX 3

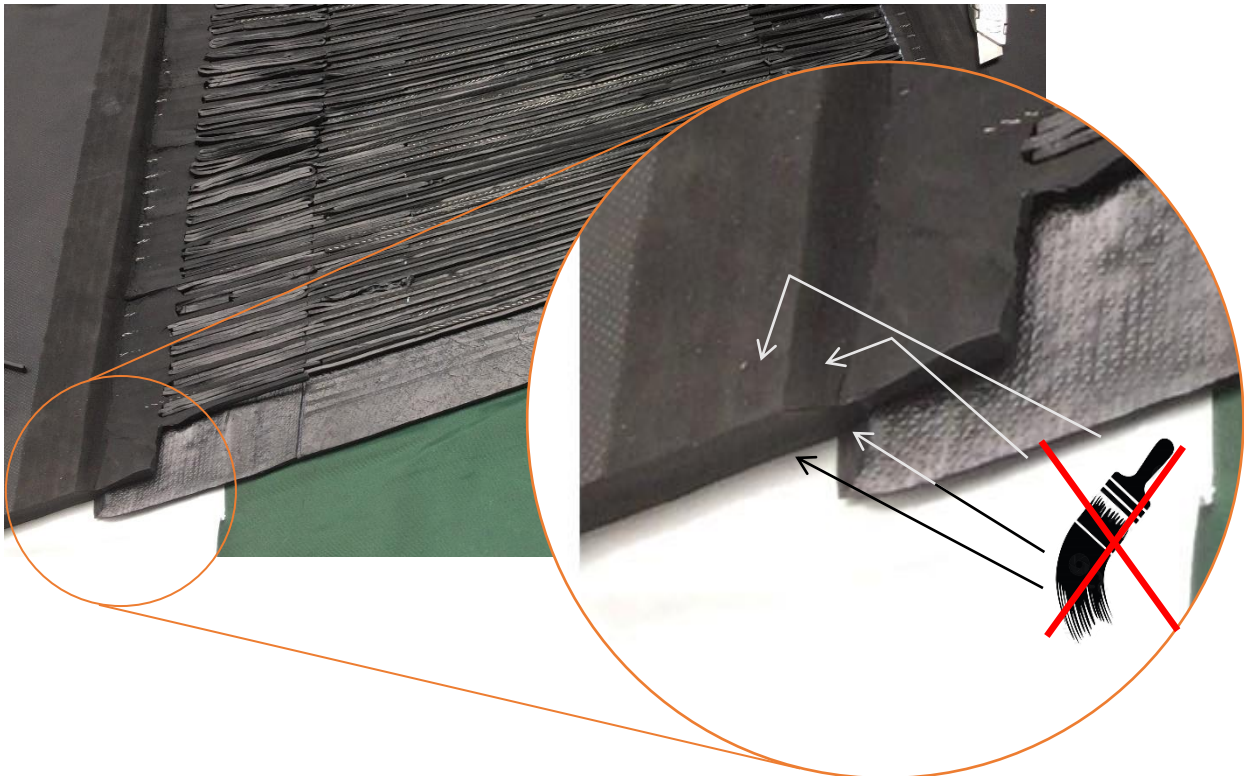
Additional splicing instructions for Steelcord **Deltahete**, **ROS** and **BV ROM**

This document is to be used in addition to the Dunlop CB Steelcord belt splice procedure. The splice system for a Steelcord Deltahete, ROS and BV ROM quality is different from other qualities in the use of the splice solution.

The **solution** should **not be applied** to the **cover chamfer** and the adjacent cover rubber.



Drawing 1. Prepared belt end side view



HOW TO CONTACT US

HOLLAND (HEAD OFFICE)

Telephone: +31(0) 512 585 555

Fax: +31(0) 512 524 599

Dunlop Conveyor Belting – Fenner Dunlop BV
PO Box 14
9200 AA Drachten
The Netherlands

www.dunlopconveyorbelting.com