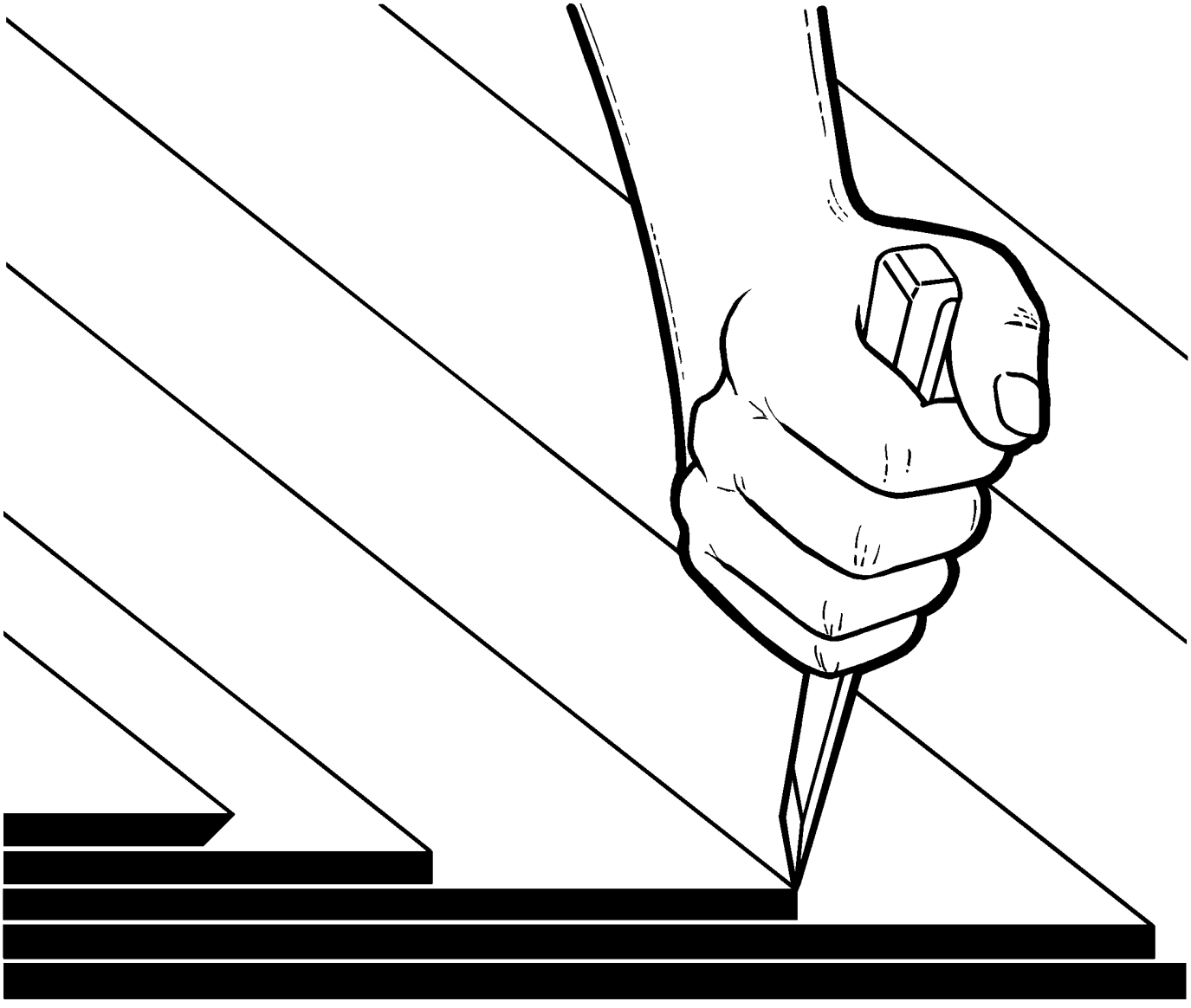
BLAIR
RUBBER COMPANY

INNOVATION TO MAKE IT FIRST, QUALITY TO MAKE IT LAST.

Splicing and Repair Manual

Conveyor, elevator and transmission belts



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BLAIR RUBBER COMPANY

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INTRODUCTION

This material has been designed to cover all aspects of splicing conveyor belting. We have taken a step by step approach using the methods and procedures proven over the years to provide splices with long trouble-free service. However, it should be emphasized that all splices, whether they be mechanical or vulcanized, are dependent upon three key factors that must be present in all splice work and these are:

1. Craftsmanship and procedures
2. Proper materials
3. Proper equipment and tools

Of these, craftsmanship is the most critical to success. The step down process is only as good as the splicer's technique. Care must be taken while cutting along fabric planes that the ply below is not nicked which can seriously reduce the overall splice efficiency.

Avoid taking "short cuts" by reducing carcass step lengths or fill-in fabric used beneath each cover. These procedures are a must to provide satisfactory splice life.

Always make sure the materials and the grade of belting you are splicing are compatible with each other. Use proper quantities as this is vital to a proper flow of materials and bonding during the vulcanizing process.

Check expiration dates and throw away materials that are outdated or contaminated.

Finally, pay careful attention to equipment and tools. Vulcanizers should be checked on a routine basis to assure good working order to provide correct temperature and pressure.

Always use tools designed for the task. As an example, a screwdriver should not be used to separate fabric plies, it can gouge both plies and destroy them. Use a prodder instead.

Never prepare belt ends for splicing in advance. Belting should be prepared only when the splicing process will be completed at that time.

We are confident that by following the procedures found in this manual, you will be able to achieve professional results and long trouble-free service from your belting.

WARNING: Several procedures outlined in this manual involve varying degrees of physical risk. Make sure equipment to be used is adequate for the job and is in good working condition. Wear protective gloves/equipment when working with cutting tools, solvents, etc. When using solvents, be sure to follow safety precautions provided by the manufacturer.

Preparing for the Splice

The Splicing site - Splicing can be done more easily on a horizontal run rather than on an incline. Consider this when you choose the spot at which to pull the belt ends together. If splicing is restricted to an incline, it should be done at the lower end where the belt can be handled easily.

You'll need a flat table to work on at the splicing site. The table should be accessible from both sides. If it isn't, build a temporary catwalk alongside it.

At some installations, a permanent splicing shanty offers protection for splicing and repairs regardless of the weather. However, most customers provide protection under temporary splicing shelters.

If the conveyor is entirely off the ground and several rolls of belting are required, consider making all splices except the last one on the ground in line with the let-off facilities. The first roll can be threaded onto the system and the trailing end spliced to the second. This can be repeated until the belt is completely mounted.

The last splice will have to be made at some point on the conveyor decking.

If the best place for splicing is at some point on the decking and several rolls of belting are required, the belt can be threaded by joining the sections with temporary metal fasteners. Then, when each mechanical splice reaches the splicing station, the metal fasteners can be replaced by a vulcanized splice.

Preparation for splicing - Before attempting either a mechanical or a vulcanized splice, consider these basic requirements:

1. Check the belt ends. Make certain that both ends are "fresh". Never splice with belt ends that have been damaged or contaminated in service. Cut back until you reach fresh material.

2. Draw proper centerlines. Centerlines are basic to straight-running splices. (They should be fundamental to *all* splicing .) Refer to table 9 for details on drawing true centerlines.

When making a mechanical splice, you can take advantage of the pre-cut parallel edges on all factory-slit belting. Square each belt end by scribing a perpendicular line from one belt edge. (A common mechanic's square can be used here.) Before cutting along this line, scribe a second line from the other edge. If the two lines overlap, the belt end is certain to have a square cut and parallel edges. If the lines intersect, the edges are not parallel and a centerline must be drawn.

3. Position the take-up pulley - When splicing, try to position the take-up pulley to accommodate the total movement expected. This belt movement would depend on several factors such as elongation over the life of the belt, take-up pulley travel during the start/stop phase and storage of spare belting.

If you're planning on a vulcanized splice but take-up movement is insufficient, consider vulcanizing all splices but one. Leave one mechanical splice in the belt until the initial stretch is removed. This may take several weeks of normal operation. Afterwards, the mechanical splice can be replaced by a vulcanized splice.

Position of take-up for belt installation

When the final vulcanized splice is made during installation of a conveyor belt, it is very important that the gravity take-up be placed at the proper position. There are many factors affecting proper position of the take-up, and it is difficult to assemble definite data from which a decision can be made. In an attempt to set up such data, it is assumed that:

1 - The proper take-up weight will be in place for tensioning at time of measurement for the last splice.

2 - Belt slack is removed when length determination is made for the last splice.

Position at which take-up should be after the last vulcanized splice is completed is dependent on many factors:

1 - Length of take-up movement provided.

2 - Type of belting being used.

3 - Type of starting control on drive motor.

4 - Whether there is a run-in period with metal fastened splice before last vulcanized splice is made.

5 - Conditions existing during time of splicing. When splicing is necessary for several lengths of belt on a long unit, the belting may be in a relaxed condition for several days or a week. If there is no protective covering over unit, snow or rain may lie on belt. Such a belt will have an increased amount of initial stretch after it is put into operation.

Data have been set up to include consideration of the first four items. Table 1 lists conveyor center lengths and possible take-up movements, along with type of belting. Bold-face sentences in paragraphs following table give suggestions for positioning of take-up when final splice is made.

TABLE 1 - RECOMMENDED TAKE-UP PROVISIONS

Conveyor Centers (Ft.)	Movement		
	"A"	"B"	"C"
50	1-1/2	1-1/2	1
100	3	3	1
200	6	5	1-1/2
300	8	7	2-1/2
500	14	10	4
700	18	13	5
1000	25	18	8
1500	34	25	11
2000	40	30	15
2500	47	35	19
3000	54	39	23
3500	59	42	26
4000	64	45	30
4500	70	48	34
5000	75	50	38

Conveyor Centers (Ft.)	Movement		
	"A"	"B"	"C"
50	1-1/2	1-1/2	1
100	3	2-1/2	1
200	5	4-1/2	1-1/2
300	7	6	2-1/2
500	10	9	4
700	13	11	5
1000	18	15	8
1500	25	21	11
2000	30	25	15
2500	35	29	19
3000	39	32	22
3500	42	35	25
4000	45	37	27
4500	48	39	29
5000	50	40	30

The recommended take-up travel is shown in above tabulation. If screw or fixed type of take-up is used, at least the travel values shown in the C column are recommended and mechanical fasteners would generally be used. With vulcanized splices, the values shown in columns A or B can be recommended.

APPLICATION OF TABLE 1 - Movement A - "Across-line" start. No run-in period. When this amount of take-up movement is provided and "across-the-line" or standard type of reduced-voltage starting is used with a squirrel-cage motor, **belt can be spliced so that approximately 3/4 of take-up movement is left for stretch.** Belt can be spliced in place with no run-in period.

Movement B - Controlled start. No run-in period. With wound-rotor motor and proper controls, or a proper combination of motor and fluid coupling or eddy-current clutch, take-up movements shown under B in Table 1 should be satisfactory. By … proper controls or … combination … is meant a starting in which the breakaway and accelerating torque is held to 130% or 140% of operating torque. **The belt can be spliced so that approximately 3/4 of the take-up movement is left for stretch.** No run-in period is necessary before final vulcanized splice is made.

"Across-line" start. No run-in period. Movement B also can apply when "across-the-line" or reduced-voltage starting is used with a squirrel-cage motor, but the **belt should then be spliced with take-up against the minimum stop in its travel.** This leaves all of take-up movement for belt stretch. Bumpers must be provided to cushion take-up carriage when it strikes its minimum stop during starting period. No run-in period is necessary before final vulcanized splice is made.

"Across-line" start. Run-in period provided. Movement B can also apply when "across-the-line" or reduced-voltage starting with a squirrel-cage motor is used, and it is possible to run belt for 2 or 3 days to a week with metal fasteners before final vulcanized splice is made. When making this splice, **take-up can be positioned to leave approximately 3/4 of its travel for belt stretch.**

Intermediate movement B - C - Slope belt. Controlled start. No run-in period. Take-up near lower end. With some slope belts where take-up is at lower end, less than usual amounts of take-up movement are satisfactory: an amount midway between B and C can be used. Thus, for a fabric belt on 1000 ft. centers, 13 ft. movement can be provided. With a slope belt where drive is at upper end, take-up is sometimes obtained by mounting lower terminal pulley on a carriage or by placing a vertically-or horizontally-operated take-up in return belt strand near lower terminal pulley. The take-up for a slope belt will operate satisfactorily near lower end when belt return slope tension approaches or exceeds slack-side tension necessary to permit drive to function properly. For slope belts of this type, controlled starting usually is employed. **The final vulcanized splice can be made so take-up is positioned to leave approximately 3/4 of its travel for belt stretch.** No run-in period is necessary.

Movement C - "Across-line" start. Run-in period provided. The relatively small amounts of take-up movement shown under movement C are used at the operator's risk. When these minimum amounts of take-up are provided, there is always a chance that the belt will have to be cut and respliced sooner than usually would be expected. When there is no other way out, these small amounts of take-up movement can be used if the starting torque is limited to 130% or 140% of operating torque, and belt is given an ample run-in period with fasteners before making final vulcanized splice. **The take-up must then be against the minimum stop in its travel when final splice is made.** Bumpers should be provided between carriage and its minimum stop. These conditions are applicable for a slope belt.

"Across-line" start. Run-in period provided. Initial tension in belt. If there is "across-the-line" or reduced-voltage starting with a squirrel-cage motor, and these minimum amounts of take-up must be used, a run-in period with a metal-fastened splice should be specified. **The final vulcanized splice should then be made with belt cut 1/4 of 1% short of minimum tape-line measurement (belt length with take-up against its minimum stop).** After the run-in period, this final vulcanized splice measurement places belt on unit with some initial tension applied. For instance, a 400-ft. belt would be cut 1 ft. short of minimum tape-line measurement before making final vulcanized splice.

"Across-line" start. No run-in period. Initial tension in belt. With "across-the-line" or standard type of reduced-voltage starting with a squirrel-cage motor, and assuming that no run-in period may be possible or convenient, **final vulcanized splice can be made with a belt length 1/2 of 1% short of minimum tape-line measurement (belt length with take-up against its minimum stop).** Thus, a 400-ft. belt would be cut 2 ft. short of minimum tape-line measurement.

APPLICATION OF TABLE 1 FOR REDUCED PLY BELTS

Due to the elastic qualities of nylon, belts are considered separately. The required take-up movement when vulcanized splices are used should be that in column A. Take-up position for these belts is recommended as follows:

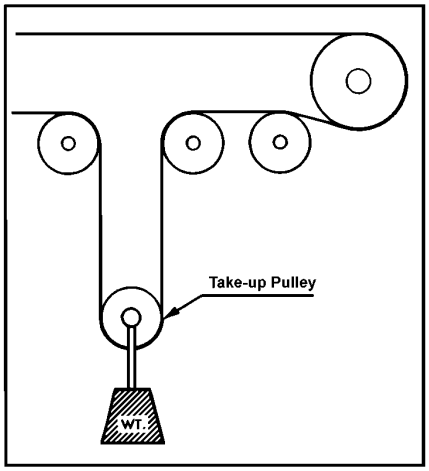
With gravity take-up - Splice with take-up at minimum point of its travel.

With screw take-up and mechanical splice - Splice with take-up at minimum point of its travel.

***With screw take-up and if vulcanized splice is used** - If belt operates at less than 50% of its rated tension, splice with take-up at minimum. If belt operates at 50% or more of its rated tension, splice with a belt length 1/4 of 1% short which provides some initial tension.

Take-up design: This has an important influence on belt stretching for which allowance must be made in splicing. Fig. A shows a standard vertical take-up with 180 degrees wrap-around pulley. When located near the drive pulley, this type provides quickest action in absorbing belt stretch. Two strands of belting support take-up weight. Pull on each strand is found by dividing take-up weight, including pulley and take-up frame, by A. For uniformity of tension, both belt strands must be vertical.

Figure B shows take-up pulley mounted on a carriage, with tension supplied from a weight-supporting cable. This can be used as tail pulley take-up where space limitations demand, or mounted under conveyor structure at some other convenient location. To find pull on each belt strand when carriage moves horizontally: subtract 10% of combined pulley and carriage weight from take-up weight and divide the resulting figure by A. When movement is on incline, slope effect of pulley and carriage weight must be included, and is dependent on angle of incline.



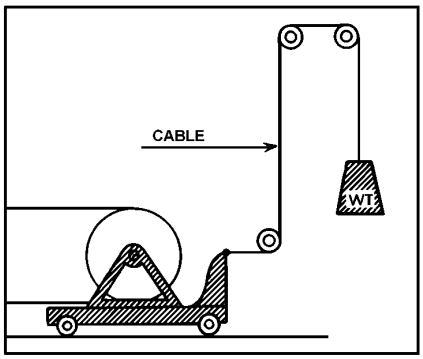


Fig. A - Standard vertical take-up.

Fig.B - Carriage take-up, shown as tail pulley horizontal take-up.

Calculating take-up weight: An estimated take-up weight can be calculated from conveyor motor horsepower. Usually motor is 10 to 50 percent or more above power normally required, so that this calculation could result in an oversize take-up weight. However, an oversize weight often is necessary to lessen belt sag between idlers.

Type of drive	Total angle of wrap on drive pulleys	K-Factor	
		Lagged Bars	
Single-Pulley	180 °	0.50	0.84
Snubbed-pulley	200 °	0.42	0.72
	210 °	0.38	0.67
	220 °	0.35	0.62
	230 °	0.32	0.58
	240 °	0.30	0.54
Dual-pulley	360 °	0.125	0.26
	380 °	0.108	0.23
	400 °	0.095	0.21
	420 °	0.084	0.19
	460 °	0.064	0.15

$Te = \frac{HP \times 33{,}000}{\text{Belt speed, FPM}}$ = Effective tension

$T_2 = K \times Te$ = Theoretical slack-side tension required to drive belt

K_2 = Factor taken from Table 2

$T1 = Te + T_2$ = Tight-side or maximum tension

TABLE 2 - VALUE OF K FOR AUTOMATIC TYPE TAKE-UPS

Take-up weight = $2T_2$, where the effect of pulley and take-up frame weights are included as part of take-up weight.

Belt roll length and diameter - Formula for belt length and roll diameters are as follows:

Roll Diameter = D = 15 LT + 2.0”

Ball Length = $L = \frac{(D-2)^2}{15T}$ or $\frac{D^2-d^2}{15.3T}$

Where D = Roll outside diameter in inches
L = Length of belting in feet
T = Belt thickness in inches
d = Shell diameter in inches

Materials, tools & equipment

Table 3 provides the correct splice material grade to be used on all Reduced Ply conveyor belts. Approved alternate selections are shown where possible. If only one grade is shown - no substitution is allowed.

In addition, a splice kit computation table and example is shown to assist you in estimating the correct amount of material required.

Materials

As stated previously, the proper selection and use of fresh materials is a must to making a good vulcanized splice. The main components of splicing materials are listed below with their proper use shown.

1. Cover stock - Uncured rubber used to rebuild the belt covers in the fill-in area of a splice or making cover repairs.

2. Fill-in fabric - Uncured fabric, frictioned with rubber compound and used to cover the seam created by making a step splice.

3. Tie gum - Uncured rubber used to replace skim coat stock in the splice area.

4. Breaker fabric - Uncured breaker fabric, frictioned or coated with compound for replacement of breaker plies or used as fill-in fabric in the splice area.

5. Cements and solvents - Used to bond component parts together and enhance vulcanization of the splice

TABLE 3 - RECOMMENDED SPLICE MATERIAL USAGE

General Purpose			Oil Service			Elevated Temperature					Fire Resistant		
Cover Grade	Nat. Rbr.	SBR	SBR Nit.	Nitrile	Neop.	Hot SBR	Butyl	EPDM	Coke SBR	Nitrile	SBR Neop.	SBR Nit.	SBR
Grade													
C	1	1	●	●	●	●	●	●	1	●	●	●	●
S	2	2	1	2	1	●	●	●	2	2	1	1	1
H	●	●	●	●	●	1	●	●	●	●	●	●	●
B	●	●	●	●	●	●	1	2	●	●	●	●	●
EP	●	●	●	●	●	●	2	1	●	●	●	●	●
BNI	●	●	2	1	●	●	●	●	●	1	●	●	●
WNI(FDA)	●	●	●	1	●	●	●	●	1	●	●	●	●

1 = Recommended 2 = Substitution ● = Not Recommended

Splice Kit		Cover Stock	Fill-in Fabric	Cement	Tie Gum	Solvent
C	Nat. Rbr.	Grade C	C	B636/637	HI-T	R-587-T
S	Neoprene	Grade S	S	S	S	R-587-T
H	SBR	Grade H	H	H	H	R-587-T
B	Butyl	Grade B	B	B	B	R-587-T
EP	EPDM	Grade EP	B	B	B	R-587-T
FR	SBR-FR	Grade FR	C	B636/637	HI-T	R-587-T
BNI	Nitrile (Black)	Grade BNI	BNI	BNI	BNI	MIBK
WNI	Nitrile (White)	Grade WNI	WNI	WNI	WBI	MIBK

Expiration Dates

WARNING*: Care must be taken to assure the proper grade of materials is used in all splices and that only fresh materials are used within their recommended shelf life. Listed below is a general guide for your use. Refrigeration at 50 degrees F (10 degrees C) will greatly extend the shelf life of these materials.*

Grade "C", "B", "EP" Materials	12 Months
Grade "H", "HI-T", "S", "WNI", "BNI" Materials	6 Months
Grade "BNI", "WNI", Cements	3 Months
All Other Cements	6 Months

area.

Accessory materials

1. Holland cloth - Used between the surface of the new splicing materials and the platens of the vulcanizer to resist sticking of material during cure and provide a smooth surface.

2. Edge seals - Cement type materials used to dress the edge of cut edge belting to give a finished appearance.

Steps required for estimate

1. Consult recommended splice material usage Table 3 to determine grade of material required.

2. See Table 4 to determine correct step length based on belt construction.

3. Use Table 5 to determine the amounts of material needed based upon the step length and number of plies, using the formula for each item.

Estimating material requirements

Listed below is a computation table that gives the quantities of the various items required for various width belts. The tie gum and cover gauges need to be established to match the belt being spliced.

Select belt cover gauges to match those required for the belt to be spliced. For example, for 3/16 X 1/16, order 3/16 and 1/16. If a breaker is being used, subtract the breaker gauge when using multiwarp #12, subtract .032 (1/32) from the cover gauge. For example, 1/8 X 1/16 covers, order 3/32 X 1/32 covers.

WIDTH	PLIES	CEMENTS	TIE GUM	COVER	BREAKER
36"	2	1 Qt.	1 RL.	1 RL./1 RL.	1 RL.
36"	3	2 Qt.	1 RL.	1 RL./1 RL.	1 RL.
36"	4	2 Qt.	1 RL	1 RL./1 RL.	1 RL.
48"	2	2 Qt.	1 RL.	1 RL./1 RL.	1 RL.
48"	3	3 Qt.	2 RL.	1 RL./1 RL.	2 RL.
48"	4	4 Qt.	2 RL.	1 RL./1 RL.	2 RL.
60"	2	3 Qt.	2 RL.	1 RL./1 RL.	2 RL.
60"	3	4 Qt.	2 RL.	1 RL./1 RL.	2 RL.
60"	4	5 Qt.	2 RL.	1 RL./1 RL.	2 RL.
72"	2	3 Qt.	2 RL.	1 RL./1 RL.	2 RL.
72"	3	4 Qt.	3 RL.	1 RL./1RL.	2 RL.
72"	4	6 Qt.	3 RL.	1 RL./1 RL.	2 RL.

Steps Required for Estimates - For Multiple Splices

1. Consult recommended splice material usage Table to determine the grade of material required.
2. See Table 1 to determine correct step length based on belt construction.
3. Use Table 2 to determine the amounts of material needed based upon the step length and number of plies, using the formula for each item.

Qty. (Total Req'd) = Tables 1 & 2 Value for each item X Width belt in inches / 36 (constant) X No. of splices required X *Multiplication factor for total splices required

*Multiplication factor is 1.25 for 3 or more splice kits. All quantities are rounded to next nearest whole number to assure enough material.

Estimating Textile Belt Material Splice Requirements

Table 4 - Splice Kit Computation

Construction	Step Length	Tie Gum Gauge	Breaker/Fill-in Fabric Type
Cotton: 28 oz.	6"	.010"	Multiwarp #12*
32 oz.	6"	.010"	Multiwarp #12*
Glass: 43	6"	.010"	Multiwarp #12*
PCB: 35	6"	.010"	Multiwarp #12*
43	6"	.010"	Multiwarp #12*
MP: 35, 43	6"	.010"	Multiwarp #12*
50, 60	6"	.010"	Multiwarp #12*
MP: 70	9"	.010"	Multiwarp #12*
PN: 90-120	12"	.010"	Multiwarp #12*
+PN: 110(S)	12"	.020"	Multiwarp #12*
+PN: 110(H)	12"	.020"	Multiwarp #12*
Style ° M	12"	.020"	Multiwarp #12*
H XH XXH	12"	.020"	Multiwarp #12*
+ Style ° 220	12"	.020"	Multiwarp #12*
330,440,550,660	12"	.020"	Multiwarp #12*
300,450,600	12"	.020"	
+PN: 150(S)	15"	.020"	Multiwarp #12*
+PN: 110(H)	15"	.020"	Multiwarp #12*
PN: 155	15"	.020"	Multiwarp #12*
PN: 195, 200	18"	.020"	Multiwarp #12*
240	18"	.020"	Multiwarp #12*
+Grade: 200	18"	.020"	Multiwarp 200

*Belts with 1/32" or less covers require light 011 replacing Multiwarp fill-in fabric.

Table 5- Materials Factor

No. of Plies	2	3	4	5	6	7	8	9
6" Step Length								
Cement	.50	.75	1.25	1.75	2.0	2.50	3.00	3.50
Tie Gum	.31	.41	.50	.59	.69	.78	.87	.97
*Cover STK	0.225 or 0.450 SEE NOTE							
BRK/FILL-IN	1.00 FOR ALL BELTS							
9" Step Length								
Cement	.75	1.13	1.87	2.62	3.00	3.75	4.50	5.25
Tie Gum	.47	.61	.75	.89	1.03	1.17	1.31	1.45
*Cover STK	0.225 or 0.450 SEE NOTE							
BRK/FILL-IN	1.00 FOR ALL BELTS							
12" Step Length								
Cement	1.0	1.50	2.50	3.5	4.00	5.00	6.00	7.00
Tie Gum	.63	.82	1.0	1.19	1.38	1.56	1.75	1.94
*Cover STK	0.225 or 0.450 SEE NOTE							
BRK/FILL-IN	1.00 FOR ALL BELTS							
15" Step Length								
Cement	1.25	1.87	3.13	4.37	5.0	6.25	7.5	8.75
Tie Gum	.78	1.02	1.25	1.48	1.72	1.95	2.19	2.4
*Cover STK	0.225 or 0.450 SEE NOTE							
BRK/FILL-IN	1.00 FOR ALL BELTS							
18" Step Length								
Cement	1.5	2.25	3.75	5.25	6.0	7.5	9.0	10.50
Tie Gum	.94	1.22	1.50	1.78	2.06	2.34	2.63	2.91
*Cover STK	0.225 or 0.450 SEE NOTE							
BRK/FILL-IN	1.00 FOR ALL BELTS							

Note: + Cover Stock value to be 0.450 for these items using reduced ply fabrics.

Example:
Splice kit required for: 3 splices 48" 3 ply 330 RMAII 3/8 x 1/8 belt covers
Step length - from Table 4 = 12"
Materials factor - from Table 5 = A. Cement 1.50, B. Tie Gum 0.82,
C. Cover Stock 0.450, D. /Fill-in 1.00,
E. Solvent (equals 4 x amount of cement)

A. CEMENT - Must be in full quarts for two part cements (C636, C637) it must be an even number of each that added together equals the required total. Consult Table 3.

Qty. = 1.50 x $\frac{48"}{36"}$ (1.33) x 3 x 1.25 = 7.5 or 8 Qts. = 4 Qts. C636, 4 Qts. C637 required

B. TIE GUM - The amount is in cans of tie gum 9" wide x 16' long. The correct gauge is selected from Table 3. Consult 2020-B Hvy.

Qty. = 0.82 x $\frac{48"}{36"}$ (1.33) x 3 x 1.25 = 4.1 or 4 cans = 4 cans .020" gauge, grade HiT.

C. COVER STOCK - The amount is in rolls of cover stock 18" wide x 2-1/2 yards long. The correct top cover and bottom cover gauge and the amount required for both covers must be calculated. Correct grade is obtained from Table 3.

NOTE: The gauge ordered is always 1/32" less than the actual gauge per cover unless the original gauge is 1/32" or less.

If the cover gauge is thicker than those available, a combination of the available gauges is made to add up to the required gauge and the amount of rolls ordered correspondingly.

3/8 Top = 12/32 - 1/32 = 11/32 1/8 Bottom = 4/32 - 1/32 = 3/32

Cover Qty. = 0.450 x $\frac{48"}{36"}$ (1.33) x 3 x 1.25 = 2.25 or 2 cans = 2 rolls Grade C 3/16", 2 rolls Grade C 1/8", 2 rolls Grade C 1/16", 4 rolls Grade C 1/32" required

(1) Required for proper top gauge would be: 2 rolls 3/16", 2 rolls 1/8" and 2 rolls 1/32" to equal 11/32" required.

(2) For bottom gauge would be: 2 rolls 1/16" and 2 rolls 1/32" to equal 3/32" required.

D. BRK/FILL-IN FABRIC - For correct type see Table 3. The amount is the same with or without breakers in the covers and is in rolls: 9" wide x 2-1/2 yards long for top cover gauge 1/16" and over. For longitudinal/nylon with covers of 1/32" or less divide the amount in half and provide light (611) 1-1/4" wide x 2-1/2 yard rolls.

Qty. = 1.00 x $\frac{48"}{36"}$ (1.33) x 3 x 1.25 = 4.9 or 5 rolls = 5 rolls #12 fill-in fabric, 9" x 2-1/2 yds. required

E. SOLVENT - Must be in full quarts. Equal to 0.4 x total amount of cement.

Qty. = 0.4 x 7.5 = 3 Qts. required.

Steel cable materials

Most materials used in steel cable belting are special makeup items and are produced for each individual splice. The basic materials are listed.

1. Sheeted cable gum - Special rubber compounded to maximize adhesion of the rubber to the cable strength members.

2. Steel cable belting splicing fabric - Specially frictioned impact plies for use in the splice area to tie into the existing portions of the belting.

3. Cover stock - Uncured rubber to rebuild the covers in the splice area.

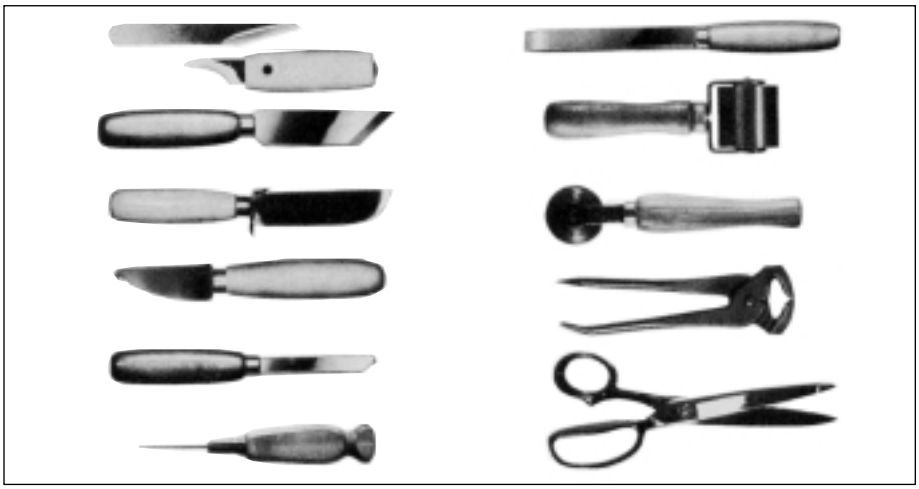
4. Miscellaneous - In addition. Breakers, film, micadust, replacement cable and fill-in fabric is available if required.

STEEL CABLE SPLICE MATERIAL QUANTITY ESTIMATES

BELT PIW NO.	800, 1000 1050	1150, 1400	1700, 1800 2100, 2400	2700, 2800 3500, 3900
B636/B637 Cements, Quarts				
Multiply width of belt X this factor and double amount	.108	.117	.125	.142
R-587-T Solvent, Quarts				
Multiply width of belt X this factor	.117	.117	.133	.150
Grade HI-T Cable Gum				
Belt width + 2"				
Gauge, inches	.105"	.120"	.145"	.170"
Yards per splice	5	5-1/2	6	7
Cover-Grade C				
Belt width + 2"				
Yards/Per Splice				
Top	2-1/2	2-3/4	3	3-1/2
Bottom	2-1/2	2-3/4	3	3-1/2
Noodles 1/8" x 14"				
Belt width X 2 X Length of Splice in Feet				

Holland Cloth - 1 yard per splice or minimum of 10 yards per order
Thixon OSN2 - Steel Cable Primer - 1 gal./Splice

Tools for splicing and repair



*1. Mill knife with two interchangeable blades. Use: cutting belt cover, etc. ***

2. Bevel-point knife 1" wide. Use: Skiving, cutting fabric, trimming rubber sheet.

3. Half-round or round-end knife 1" wide. Use: Trimming rubber and fabric.

**4. One-ply knife, offset type . Use: Cutting heavy fabric in belt. Hook-like tip cuts only one ply thickness in single pass across exposed fabric.*

5. Combination one-ply knife and light prodder. Use: Cutting light fabric in belt, one ply at a time. Prying loose fabric and rubber in belt.

*6. Awl: Use: Puncturing air bubbles trapped under rubber.***

7. Prodder. A tool having a blunt, chisel-like blade. Use: Loosening of plies and rubber. Forcing edges of patches, etc., into place.

8. Two-inch roller. Use: Forcing fabric and sheet rubber into good contact with surfaces to which they are applied.

9. Stitcher having toothed wheel 2" in diameter. Use: Forcing edges of cover stock, etc., into place.

**These one-ply knives are available with hook sizes to fit the high tension fabrics. Available sizes - .065, .080, .100.*

10. Pincers. These are familiar carpenter's claw-type 8" long. Use: Pulling cover, fabric loose from belt. Before using, file jaws to remove sharpness at edges, corners. Wrap handles with tape for better grip.

11. Scissors. Heavy-duty 10" size. Use: Cutting and trimming fabric, cover stock, etc.

Additional tools not shown here that will be useful:

A 50-ft. steel tape marked in feet and inches.

An 8-ft. steel rule.

Thickness calipers.

Counter or dusting brush.

Cable cutters (steel cable belt).

A 2" paint brush for spreading cement.

White or silver pencil for marking belt.

Chalk line and chalk.

Work gloves for safety.

To keep edged tools working efficiently, have sharpening equipment handy. Many belt splicers sharpen knives on No. 00 emery cloth laid on a piece of scrap belting or cemented to a piece fastened to the bench top. For sharpening one-ply knives, use a fine-grit triangular abrasive stone 6" long and about 1/2" on a face. (See Photo)

Sharpening a one-ply knife.

TABLE 6
ONE-PLY KNIFE RECOMMENDATION

Knife Number	Belt Construction
K421 Offset Knife	32 oz., MP35, PCB35 MP43, PCB43 MP50 35 oz., MP60 MP70
K421 - .065	PN90, PN120 Flexseal M PN110 Flexseal H
K421 - .080	PN150 PN155 PN195 PN200 PN240 Flexseal XH, XXH, 200

PCB, MP - Multiple Ply
PN - Polyester-Nylon Fabric

Curing splice in vulcanizer

Vulcanizer: Because most conveyor belt splicing is done on the job, portable, electrically-heated vulcanizers are used.

Caution: As a safety measure, check vulcanizer for electrical grounds. Always make sure that both platens are grounded with heavy copper cable before turning on power. Some connecting cords have a built-in third wire for grounding. Warning - failure to follow instructions could result in bodily injury or death.

Check power supply to make sure it is correct voltage and type for vulcanizer. Serious vulcanizer damage can result from incorrect voltage and type of current.

Heat vulcanizer to 287 degrees F. Position it over top fill-in for first heat.

Tighten clamping nuts on vulcanizer by hand; do not use a wrench at this point. Tighten each nut for a total of one turn only, after resistance is felt.

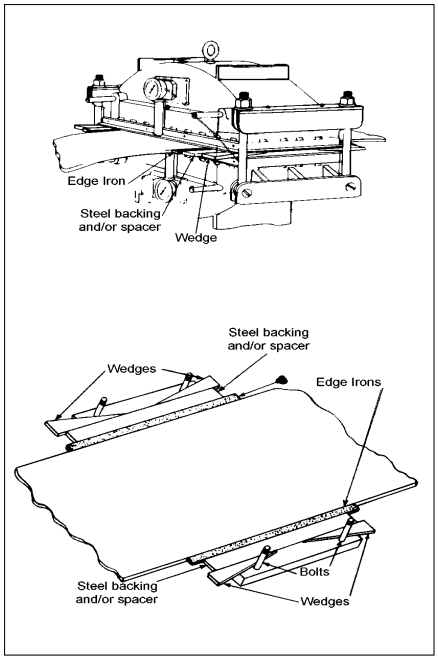


Fig. A - Use of wedges to provide pressure on belt edges during curing.

Place edge irons against belt edges. Wedges or clamps can be used to obtain edge pressure.

Now tighten clamping nuts. Use only the wrench furnished with vulcanizer. With normal pull, wrench has leverage sufficient to produce desired pressure over platen area (around 100 to 125 psi). In tightening, give each nut in succession a half-turn or less.

For curing belt splice, block in with edge irons to a thickness selected to gauge less than belt gauge by following amounts.

Belt Thickness	Iron gauge - less
Up to 1/4”	1/64”
1/4” to 1/2”	1/32”
1/2” & over	1/16”

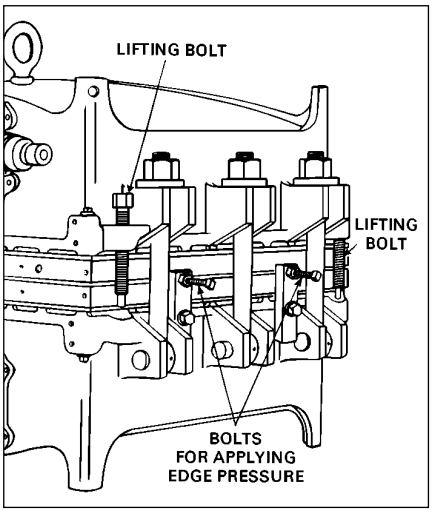


Fig. B - Bolts used instead of wedges for applying pressure to belt edges during vulcanization.

Check wedges or clamps exerting pressure on edge irons, to make sure they are tight and that edge pressure is correct.

Place a protecting cover over vulcanizer to reduce heat loss, especially around platen edges. On a cold, windy day, such loss can be so great that rubber will not be completely cured at edges.

Only vulcanizers having two heated platens are recommended for curing splices.

You can obtain further details of vulcanizer handling from vulcanizer manufacturer’s instruction manual.

Curing schedule: Curing time depends on belt thickness, type of vulcanizer, and type of rubber compound. The following table of curing times can be used for either splicing or repairing. (See Table 7)

Turn vulcanizer on before starting to assemble splice. Let platens heat to 287 degrees F. After vulcanizer is clamped on belt, platen temperature will drop. Let it return to 287 degrees before starting to time period of curing. The curing temperature (287F) must be maintained throughout time of vulcanization. If temperature drops, allow more curing time; if it rises, a shorter time will do. (See Table 8)

Undercuring, overcuring: Undercured rubber is soft and lacks resilience. A simple test: Press end of screwdriver into rubber. If indentation remains, rubber probably is undercured, and additional time in vulcanizer is needed.

Overcuring, up to a degree, is indicated by too much hardness as compared with rest of belt rubber. Extreme overcuring can cause softening (known as reversion) which becomes worse if further curing is attempted.

If edges of vulcanizer platens are not up to temperature, the rubber may be undercured in that region. When you suspect this condition, allow an extra 5 to 10 minutes of curing time over

TABLE 7 - CURING TIME FOR CONVEYOR BELTING

	GRADE I & II (IN MINUTES AT 287 deg. f)		SCOF NITRILE OR NEOPRENE (IN MINUTES AT 287 deg. f)		EPDM (BUTYL) (IN MINUTES AT 305 deg. f)
Thickness of Belt or Repair Depth	1 Heated Platen	2 Heated Platens	1 Heated Platen	2 Heated Platens	2 Heated Platens
3/16” and less	34	23	50	37	45
1/4”	38	24	52	39	46
5/16”	42	25	53	40	47
3/8”		26		42	48
7/16”	Use 2-	27	Use 2-	43	48
1/2”	platen	28	platen	45	49
9/16”	press	29	press	47	50
5/8”	above	30	above	48	51
11/16”	5/16”	31	5/16”	49	52
3/4”		32		50	52

*Over 3/4”: Add 2 minutes for each 1/16” of additional thickness. *This curing schedule is intended for portable vulcanizers under average field conditions. For Belt Repair Shops having permanent repair presses in heated buildings, the time can be reduced 5 minutes from the schedule shown for Natural or SBR.*

that indicated in Table 7. This does no harm to work, yet assures complete curing at edges.

If temperature of vulcanizer platens is above or below 287 degrees F.: For every 5 degrees above 287, deduct one-fifth of time that would be correct for 287 degrees. For every 5 degrees below 287, add one-fifth of time that would be correct for 287 degrees. Example: Curing for belt 5/8" thick is 30 minutes at 287 degrees.

At 282 degrees, correct time would be

$$30 + \frac{30}{5} = 36 \text{ minutes}$$

At 292 degrees, time would be

$$30 - \frac{30}{5} = 24 \text{ minutes}$$

Lowest vulcanizing temperature permissible is 265 degrees F., highest is 310 degrees F.

Overlapping heats: When vulcanizer platens will not cover entire splice, two or more heats are necessary. Each heat should overlap preceding one about 1-1/2". A common practice is to cure top cover fill-in first, then proceed in overlapping steps toward bottom cover fill-in. When two vulcanizers are available, place one over top cover fill-in, one at center of splice, and step both of them in the same direction. When the vulcanizer available will not cover the fill-in in one heat, we recommend that first heat be made in the center of the splice area, then proceed in overlapping steps toward the cover fill-ins.

Cooling splice: At temperatures used in vulcanizing, rubber compounds lose tensile strength. Therefore, allow belt splice to cool to normal air temperature before maximum belt tension is applied. This is important when operating tensions are 75 to 100 percent of maximum permissible tensions recommended by manufacturer. When you can hold your hand on splice without discomfort, belt can be put into use. You can hasten cooling by running water over splice.

Blow-ups, blisters: A blow-up or blister that appears when platens are removed is caused by moisture in belt or by air trapped in new material. Moisture may be water that was in belt carcass, or in solvents used in cleaning off skimcoat rubber.

To prevent blow-ups: Allow vulcanizer platens to cool below steam temperature (212 degrees at sea level) before releasing platen pressure.

If a blow-up or blister does occur, repair work must be done in affected area. Simply reapplying vulcanizing heat and pressure will not remedy the condition, for cement and tie gum already have been vulcanized fully and further curing treatment will not cause them to adhere.

TABLE 8 - CURING TIME FOR PLYLOCK BELT JOINT

Thickness of Belt	NATURAL RUBBER and SBR		OILPROOF Length of Heat - Minutes	
	Vulcanizer with 2 Heated Platens	Vulcanizer with 1 Heated Platen	Vulcanizer with 2 Heated Platens	Vulcanizer with 1 Heated Platen
3/16" and under	18	24	37	50
1/4"	19	26	39	52
5/16"	20	28	40	53
3/8"	21	30	42	56
7/16"	22	31	43	57
1/2"	24	..	45	..
9/16"	26	..	47	..
5/8"	27	..	48	..
11/16"	28	..	49	..
3/4"	29	..	50	..

**We do not recommend use of single platen vulcanizer for Oilproof belts.*

Making a vulcanized step splice

Conveyor or elevator belt

The following instructions are what is required to make a step splice in a conveyor or elevator belt. The important steps are:

1. Cutting the belt to proper length.
2. Laying out the splice by measuring and drawing lines.
3. Stepping down the belt ends.
4. Applying splicing materials.
5. Assembling the splice.
6. Filling gaps lin top and bottom cover.
7. Vulcanizing.

Cutting the belt to proper length

First you must determine the total amount of belting required to pass completely around the conveyor system with the take-up in the proper position. In addition, you will require enough additional belting to produce the overlap at the splice and to allow for trimming ends (and cutting all plies) on a 22 degree bias angle. (See Fig. G)

To figure the additional length of belting needed for a vulcanized splice, use Table 9.

Belt vulcanized splice lengths

The following schedule for belt length required per vulcanized splice is based upon a 22 degree splice angle (measured by a lead equal to 0.4 belt width). The recommended splicing method for Reduced Ply belts is to remove the ply material from the steps starting at the end of the belt. This requires an extra 6.0" at each belt end for clamping which is in addition to the normal 3.0" for trim.

AL = SL(N - 1) + 0.4W + TA
AL = additional length
N = number of plies in belt
W = belt width in inches
SL = step length in inches
TA = allowance for 3" trim and 6" to clamp each end of belt to table or deck when required

TABLE 9 - VULCANIZED SPLICE - REQUIRED BELT LENGTH

Required Splice Length Without Lead - Inches						Reqd. Lead Lgth.	
Plies	Cotton Glass MP35	MP43 MP50 MP60	MP70 PN90	PN110 PN120	PN195 PN240 PN200	Belt Width in Inches	Lead Length in inches
2				27		12	5
3	15	27	33	39	51	18	7
4	21	33	42	51	69	24	10
5	27	39	51	63	87	30	12
6	33	45	60	75	105	36	14
7	39	51	69	87	123	42	17
8	45	57	78	99	141	48	19
9	51	63	87	111	159	54	22
10	57	69	96	123	177	60	24
	Above lengths based on these step lengths & trim allowance.					66	26
	SL-6 TA-3	SL-6 TA-15	SL-9 TA-15	SL-12 TA-15	SL-18 TA-15	72	29
						78	31
						84	34
						90	36
						96	38
Formula: Splice Length = SL (N-1) + 0.4W + TA SL = Step Lgth. In TA = Trim Allow., In. W = Wdth., In. N = No. Plies							

Direction of Splice

Direction a splice travels is not critical for lightly-loaded belts operating over large pulleys. But for installations operating at or near full rated belt tensions, maximum splice life can be obtained only by running splices in the direction shown in the drawings. When loaded, declined belt drives the motor as a generator. Step direction should be opposite that recommended when drive does the pulling.

The diagrams show steps positioned so the proper cover fill-in makes contact with drive pulley before any other part of splice reaches it. In dual or tandem drive, splice is positioned relative to drive pulley it reaches first (primary pulley).

MEDIUM TENSION BELTING
Cotton or polyester-cotton blend (PCB)

(without breaker)

These instructions are for cotton and polyester-cotton blend fabrics, without breaker.

Laying out belt ends

Locating center lines: When laying out belt ends for stepping-down operations, make all measurements from a center line extending 15 to 20 ft. from each end of belt. Instead of simply drawing center line with belt edges as a guide, use following method.

At intervals of 3 to 5 ft., mark center points in belt width, using light colored chalk or pencil. Draw an average center line with these points as guides.

Squaring ends: Before determining 22 degree bias angle on portion to be stepped-down first, locate line establishing square end of belt.

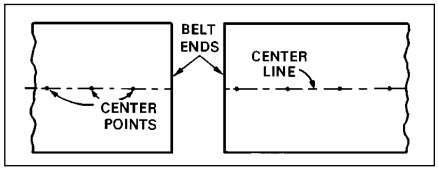


Fig. E - Locating belt center line. This line is an "average" drawn with respect to a number of center points established near belt ends.

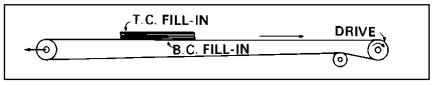


Fig. A - Single drive contacting bottom side of belt. Bottom-cover fill-in makes contact with pulley before stepped region of splice reaches it.

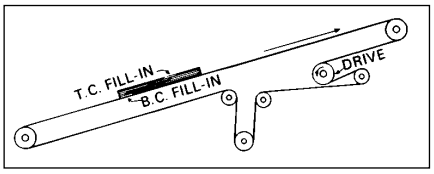


Fig. B - Single-pulley drive contacting top side belt.

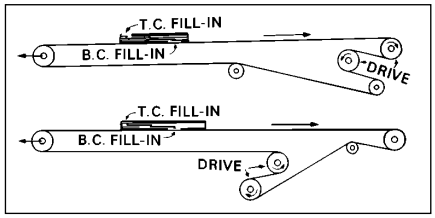


Fig. C - Two dual-drive arrangements contacting bottom side of belt. Step direction is with respect to primary drive pulley.

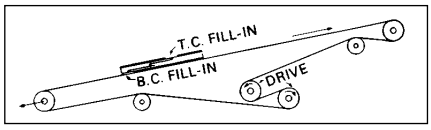


Fig. D - Dual or tandem drive with primary pulley contacting top side of belt.

When belt edges are reasonably true: Place straight-edge along one belt edge. Use carpenter's square to mark line across belt at right angles to straight-edge. Or you can place long part of square directly against belt edge. Next, do same with respect to other belt edge. If the two cross lines do not coincide, use a median line (drawn halfway between them) as guide in marking belt square. Squaring may also be done from an accurate center line.

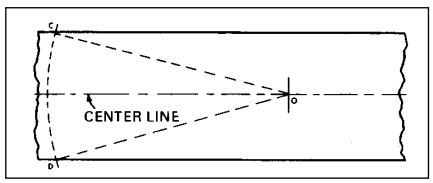


Fig. F - A common method of squaring belt ends. With O as a center, arc CD is drawn to intersect belt edges or (when edges are uneven) lines drawn near edges and parallel to center line.

When steel-square method cannot be used: At a distance from belt end equal to about 1-1/2 times belt width, drive an awl or small nail into belt at center line (point O, Fig. F). Use this as a pivot for holding end of steel tape. At point near present belt end where tape crosses belt edge, mark point C on rubber and note distance OC as indicated by tape. Keeping tape taut, swing it to intersect other belt edge. Mark point D, which must be same distance from pivot O as point C is. Line CD drawn across belt will be square with center line.

Measuring and marking bias angle: When marking a vulcanized splice, a bias angle of 22 degrees is used for cutting belt ends, plies, and covers.

Referring to Fig. G: Along line XC, measure back from C a distance equal to 0.4 x W, and mark point E. Draw a straight line connecting E and D. Angle EDC will be 22 degrees. See photos 1 and 2.

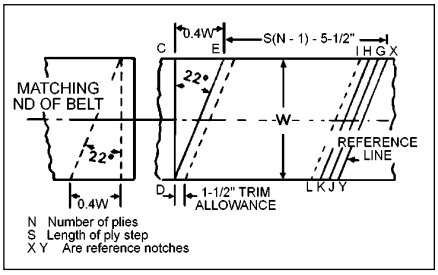
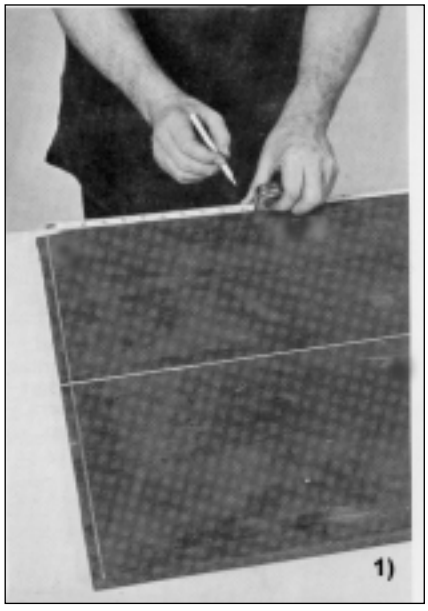
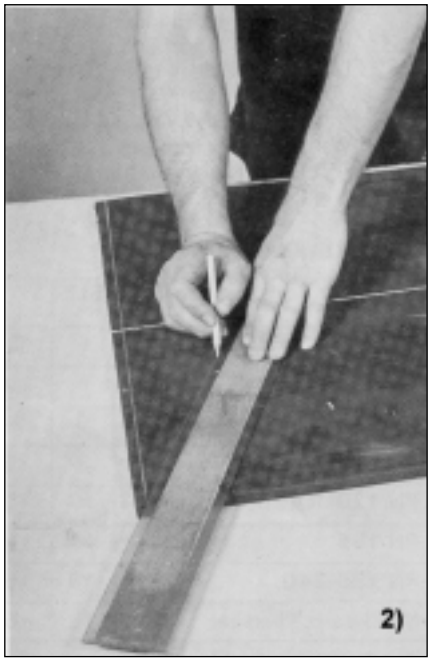
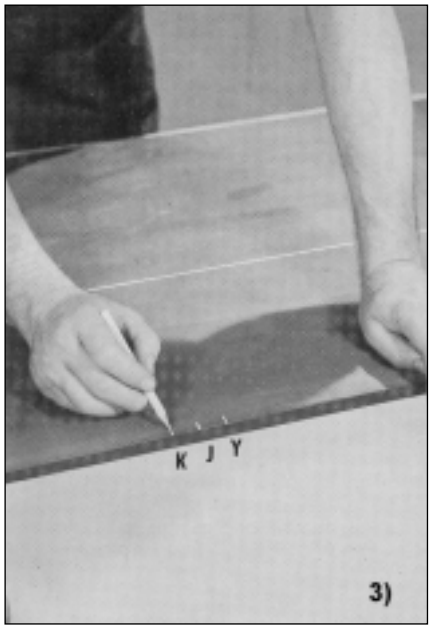


Fig. G - Laying out belt ends to proper bias angle, and establishing guide and cutting lines. Angle may run in either direction depending on type rhombic platen.



Marking reference, cutting lines: Along upper belt edge (Fig. G) measure distance XE. To determine this distance, multiply length of each ply step by one less than the number of plies, and add 5-1/2". Example: Belt is 6-ply and steps are to be 6", XE = 6" (6 - 1) + 5-1/2" = 35-1/2".

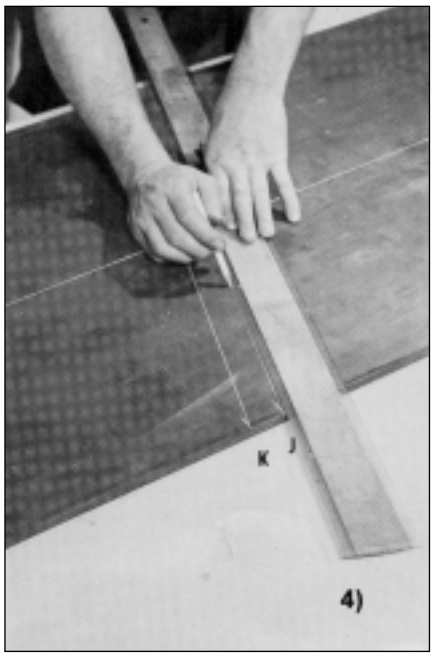




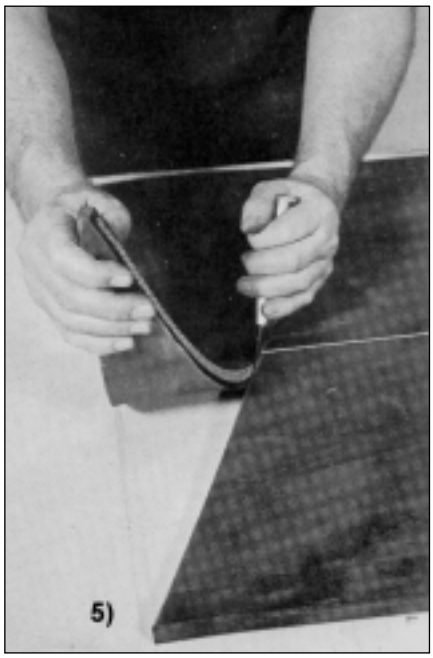
Make YD equal to XE. Draw reference line XY. At X and Y, make small notches in belt edge to serve as reference points if line is rubbed off. Lay off and draw two more lines, GJ and HK, parallel to XY at 2" intervals. See photos 3 and 4. (Disregard line IL at this time.) GJ and HK are called cover fill-in cutting lines.

As a check, lay out all cutting lines for ply steps. Last step should have an extra 1-1/2" for trimming, making it 7-1/2" long.

Trim end of belt to the 22 degree bias angle by cutting along line ED with mill knife held perpendicular to belt. See photo 5.



Marking other belt end: Place marked end over other (second) belt end, and align the two ends carefully with aid of previously-drawn center lines. If layout was made on top cover, place this surface in contact with back cover of other end. Transfer positions of reference notches. Mark along belt end you just cut to a 22 degree bias: this line becomes reference line for second end. Where it intersects edges, make reference notches to serve as guides in laying out cutting lines for back cover fill-in and ply steps. Points opposite reference notches of first end determine bias angle of second end. Draw line connecting these points, and cut second end along this line.



Making cover fill-in cuts

1 - With mill knife held at 45 degree angle, make first cover fill-in cut along line GJ (Fig. 11 and Photo 6). This cut is No. 1 in Fig. 12. Cut-edge of rubber cover should appear as at a, Fig. 13. In some cases where service conditions are severe, and cover is heavy (over 1/4"), leading edge of top cover fill-in is undercut, as at b in Fig. 13. Cut only to first ply of fabric, not into or through it; you can feel knife point touching fabric. Or you can cut almost to fabric, and tear rubber rest of way when removing fill-in strip.

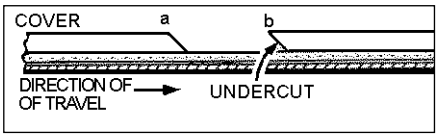
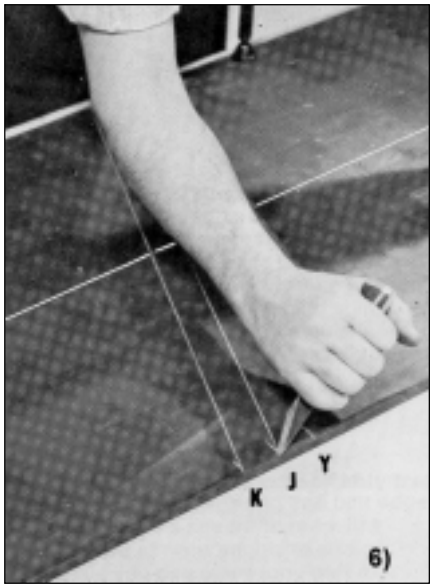


Fig. 13 - Section through fill-in area showing how belt cover may be beveled or undercut.



2 - With mill knife held vertically, cut along line HK through rubber cover to first fabric ply. See Photo 7.

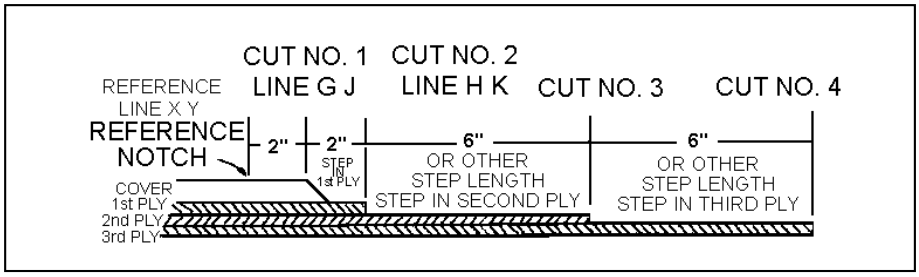
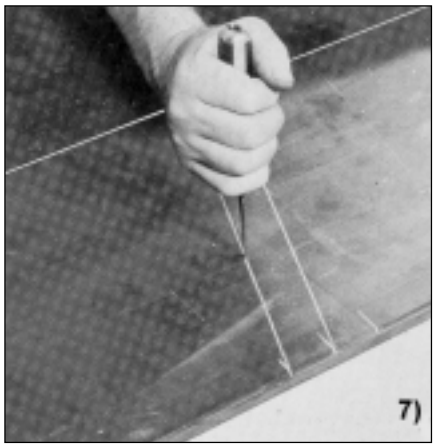
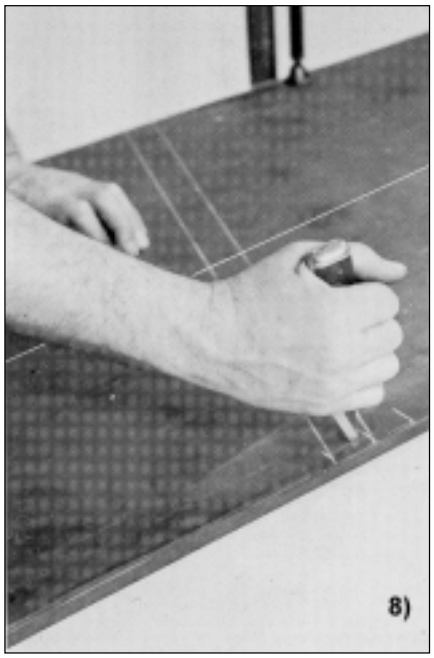


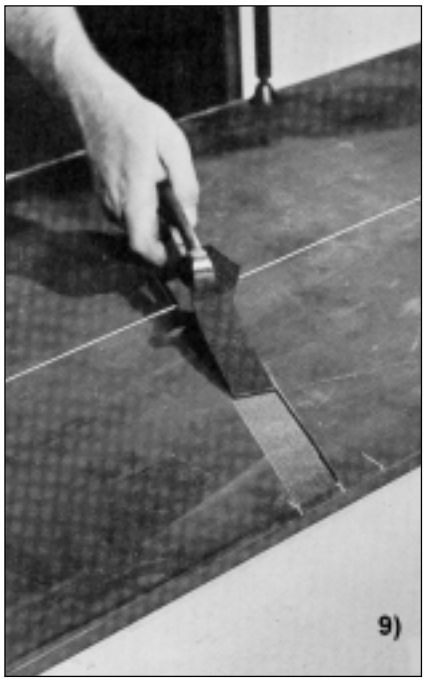
Fig H - Stepping down fabric belt that has no breaker



3 - Between and at right angles to the two cuts just made across belt, cut through top cover to fabric parallel to and 1/4" from each belt edge. Such 1/4" strips are left so edges of belt will not be damaged during subsequent stripping of cover and plies. See Photo 8.



4 - Aided by prodder and pincers, loosen cover and strip it from area inside cuts. This exposes top fabric ply. If you have difficulty pulling fill-in area strip free, cut it along center so you can strip off half at a time. See Photo 9.



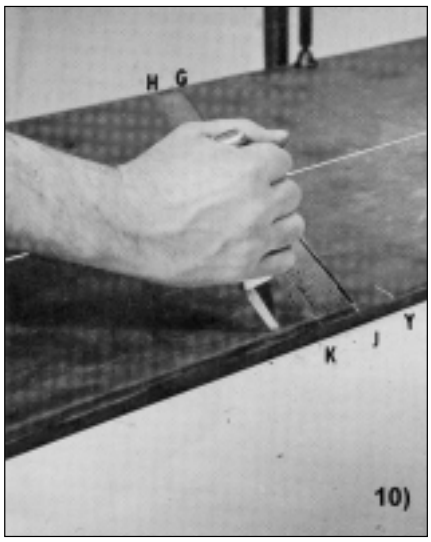
Stepping-down belt ends

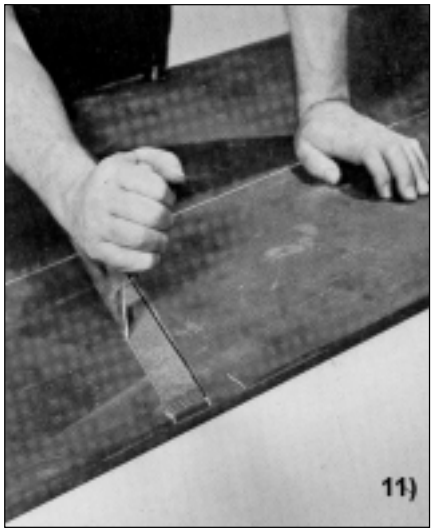
This process consists of cutting and stripping off sections of successive fabric or cord plies in such a way that exposed portions remaining form a series of steps.

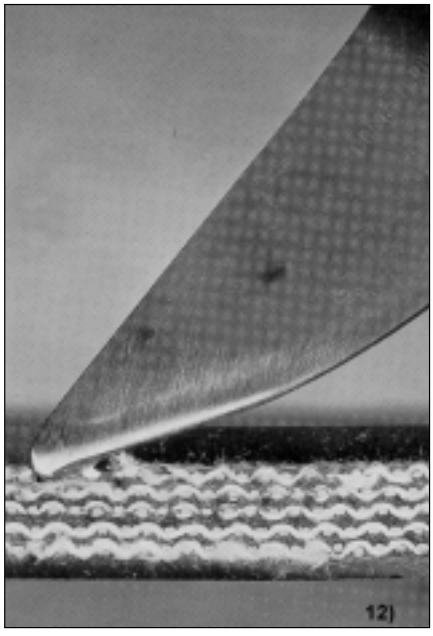
1 - With mill knife, make a vertical cut parallel to and 1/4" from each belt edge, and extending from cover fill-in cut to end of belt. Blade should penetrate cover and first fabric ply. See Photo 10.

2 - With one-ply knife, cut through first fabric ply along line of last transverse cut you made through cover (Cut No. 2 along line HK, Fig. H and Photo 11).

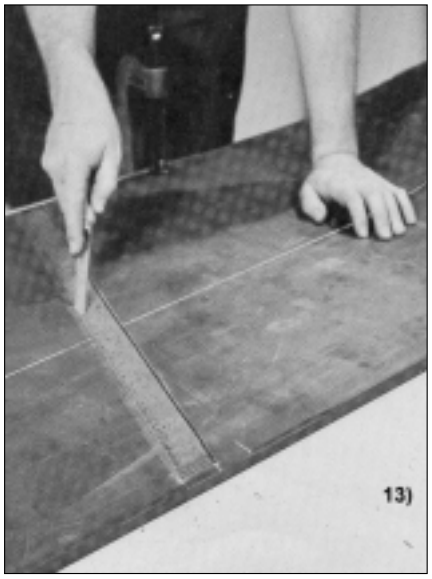
The one-ply knife has a hooked tip which, at a single pass, will cut through one thickness of fabric. Press firmly but not excessively hard. Do not make a repeat cut unless it is necessary, then use extreme care or you may damage next ply. See photo 12.



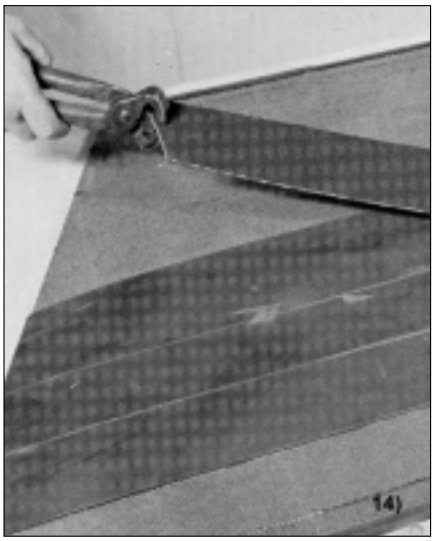




3 - With prodder, break through skim coat beneath the cut fabric ply on side of cut toward belt end. Loosen about 1/2" of ply across width of belt. This enables you to grip ply and attached cover with pincers. When prodding, be careful not to damage fabric or next ply. See Photo 13

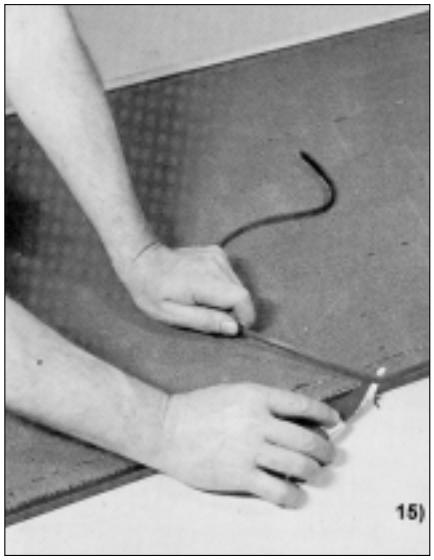


4 - Strip off top cover and first fabric ply from fill-in to end of belt. Standard widths of 4" can be hand pulled and are recommended. So, before pulling, make cuts 4" apart, parallel to belt edges and extending

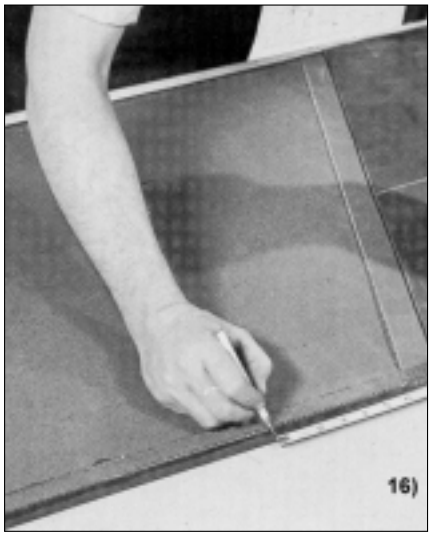


through cover and first ply only. If you cannot judge when knife blade has penetrated first ply, you can cut through cover only, and make additional light passes to score fabric so it will rip. Alternate way: Strip off cover. Use one-ply knife to cut through fabric. With pincers, grip loosened end of each fabric strip and pull it free. Pull off skim-coat rubber along with fabric so ply beneath will be bare. See Photo 14

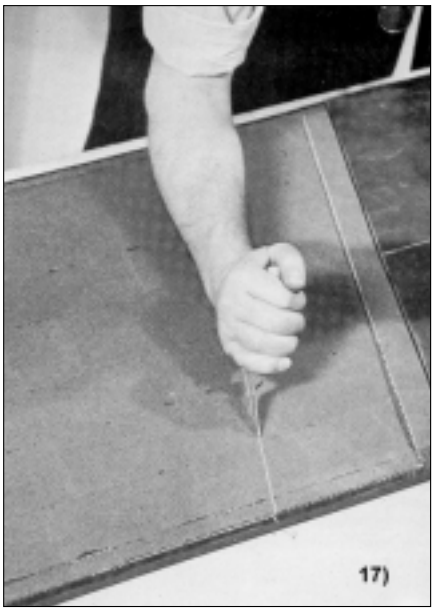
5 - With bevel-point or round-nose knife, trim off strips remaining along belt edges, so belt is smooth and level all the way across. See Photo 15



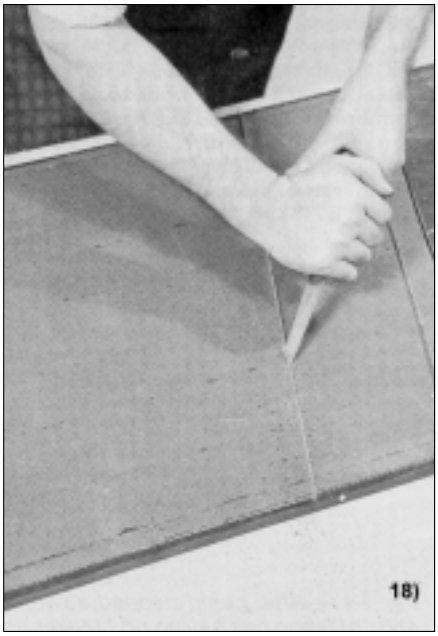
6 - By measuring from reference notches, mark ends of cutting line for forming step in second ply. See Photo 16. This step will be 6" long, and cutting line will be 10" from reference line (Fig. H: line marked "Cut No. 3").



7 - With one-ply knife, cut along line established in preceding operation. See Photo 17. Cut through one fabric ply only. Also cut through same ply along lines 1/4" from each belt edge and extending to end of belt.



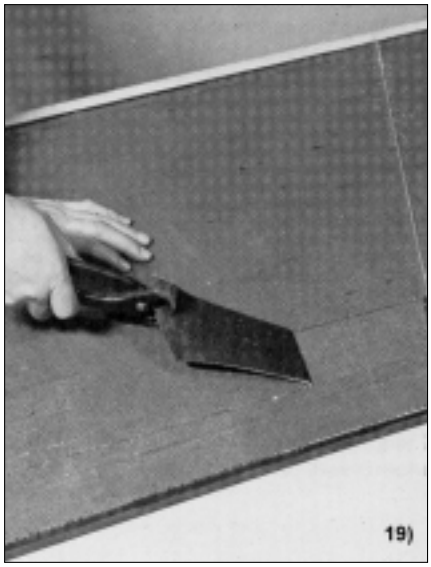
8 - With prodder, break through skim coat under portion of ply to be removed. Loosen it from underlying fabric for a distance of 1/2", or so, from transverse cut. See Photo 18.



9 - For easier ply removal, make several lengthwise cuts with one-ply knife so fabric and attached skim coat can be pulled off in strips.

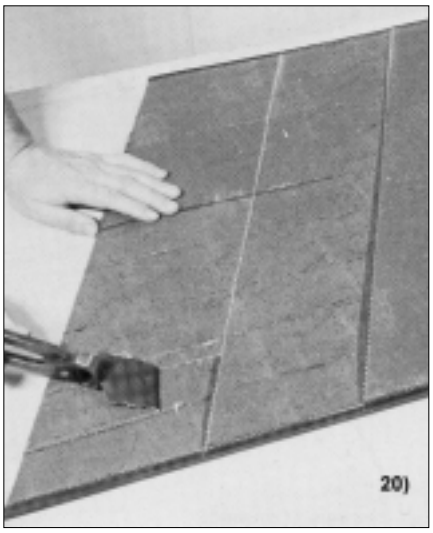
10 - Strip off loosened ply fabric and skim-coat rubber adhering to it. See Photo 19.

11 - Trim edges as before to make belt level all the way across.



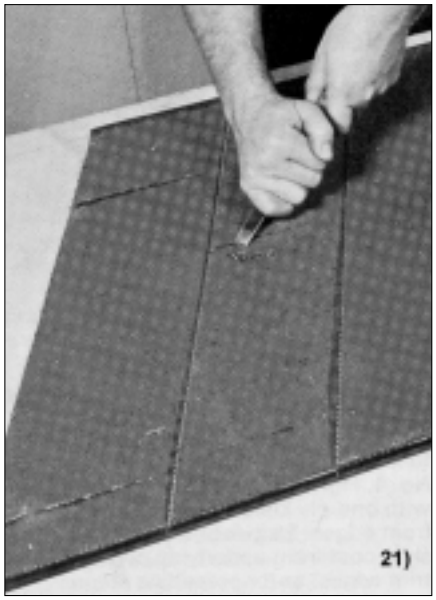
12 - Measure from reference points to locate cutting line for next step. (Cut No. 4, Fig. H) Cut through fabric with one-ply knife, including cuts 1/4" from edges. Strip fabric and its adhering skim coat from underlying ply and trim edges, as for preceding steps.

13 - Use same procedure for each succeeding step, until all plies are exposed. See Photo 20. Steps will look like this: First ply step directly under the cover is 2" long (including portion covered by bevel along cut edge of cover). The next (second ply) step, and all remaining steps are 6" long, except last step which measures 7-1/2" to provide 1-1/2" for trimming when splice is fitted together.

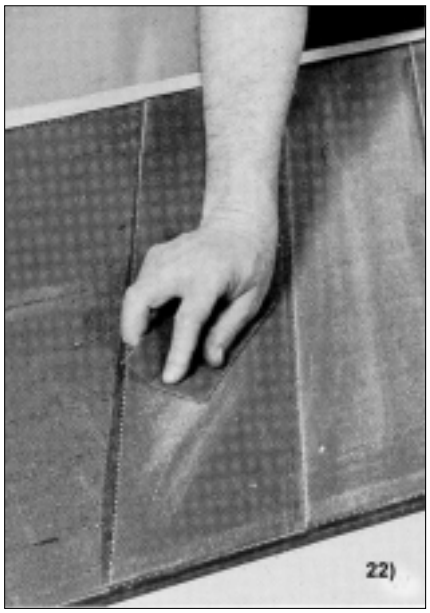


Cleaning and buffing splice steps

Use prodder to remove any skim coat remaining on exposed piles. See Photo 21. This is made easier by letting rubber solvent, applied in limited quantity to the remaining skim coat only, act on the rubber a few minutes. Because of danger of damaging fabric, a sharp-edged scraper, wire brush, or similar tool should not be used for removing skim coat.



Buffing: Use coarse emery cloth such as No. 1 or No. 2 to buff all surfaces of fabric steps and beveled edges of cover. See Photo 22. This cleans off loose particles and raises fabric nap so cement can produce a stronger bond. Excessive buffing may damage fabric enough to cause later failure.



Making cover fill-in - Measure 3-1/2" toward the splice from the belt end, line DE, and draw a cutting line. With mill knife at 45 degrees, cut along this line, through cover only. Make similar vertical cuts parallel to and 1/4" from belt edges. Pull off strip of cover. Trim edges flush with belt. This work can also be done after the belt is fitted together as explained on pages 22 and 23.

Stepping-down second end

Next, step-down second end of belt. The procedure is the same as for first end. There are two cutting lines corresponding to GJ and HK in Fig. G for bottom-cover fill-in. These and reference lines XY are spaced at 2" intervals (Figs. J and L). First-ply step is 2" long, second and successive steps are each 6" - with 1-1/2" additional trim allowance on final step next to top cover.

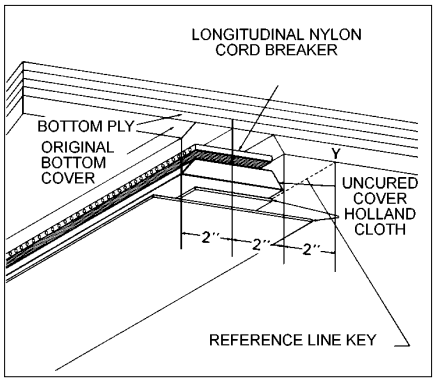


Fig. L - Details of bottom cover fill-in for fabric belt width 1/16" or heavier cover.

Checking fit: After cleaning and buffing second end, place belt ends together to see if they fit properly. Each step should butt neatly against corresponding step in matching half of splice. There should be no overlapping, no gaps. If misfitting does occur, make corrections by proper trimming of plies. A good fit at this stage assures a satisfactory splice.

Cementing: Stir thoroughly each can of splicing cement. If you are working with Grade C cement, mix the No. 636 and No. 637 portions together. Expose both stepped surfaces by turning back the belt end forming uppermost portions of splice. Apply a liberal coat of cement to both ends. See Photo 23. Brush thoroughly to assure good coverage and penetration. Coat all steps and cover fill-in areas up to end of 2" first ply step. Let dry thoroughly. Drying can be hastened by fanning to increase air circulation. Hot air, as from an electric hair dryer, is sometimes used. Heat should not be sufficient to cause partial curing of cement.

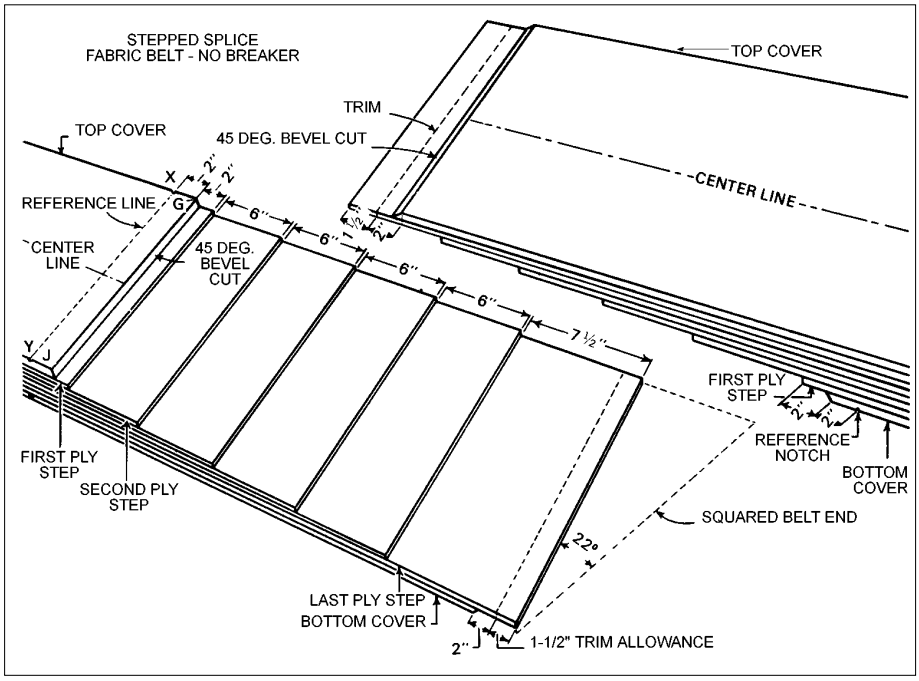


Fig. J - After being stepped-down, ends of fabric belt having no breaker should look like this.

Apply second coat of cement just as you did the first. Let dry until tacky.

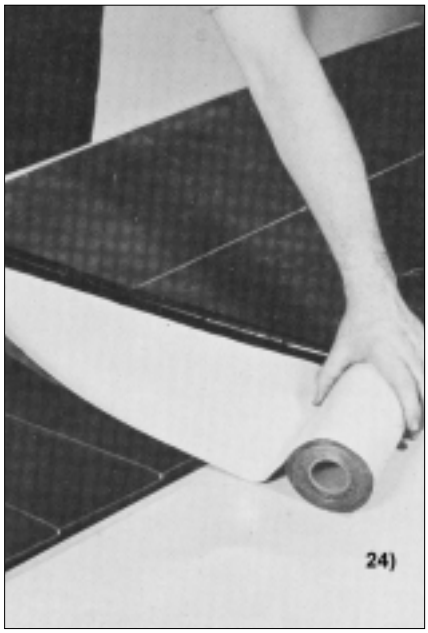
Applying tie gum: Determine proper

thickness of tie gum to use (See Table 3, pg. 11)

Starting at 6" step nearest top cover, apply a 9"-wide strip of tie gum. Keep one edge of gum even with projecting end of ply adjacent to cover; do not cover the 2" step in this ply.

See Photo 24. Leave polyethylene film on upper surface of gum. If necessary, wash tie gum with solvent to remove dirt or bloom or to increase tackiness, before applying it.

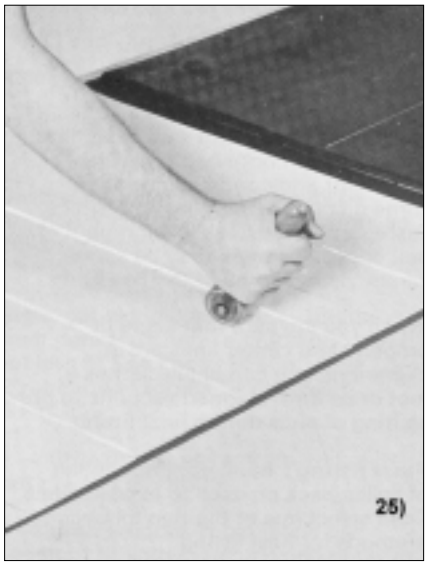
3 - Measure for cut through cover.



With hand roller, force tie gum into good contact with cemented surface. See Photo 25. Use awl to puncture any trapped air bubbles.

Apply successive strips of tie gum to remaining steps until all of splice area is covered.

Apply tie gum to only one belt end.



Fitting splice together

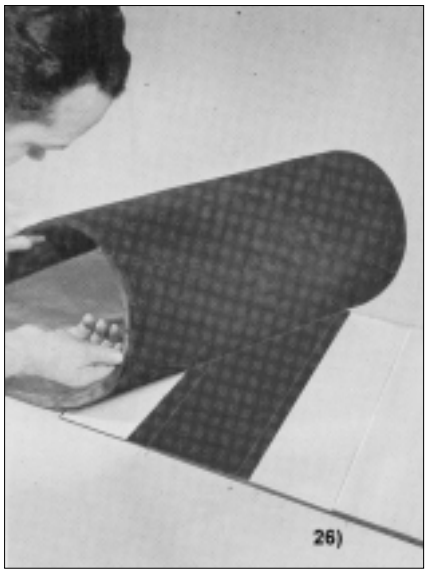
Before removing any polyethylene film from tie gum surface that is to come into contact with other half of splice, make another check to see if steps fit together neatly. Make sure, also, that center lines of both belt ends are in alignment and continue straight for some distance each way from splice. Disregard differences in alignment of belt edges, for there may be some variations in widths of the two ends.

When you are sure that steps fit properly and center lines are in alignment, you can apply clamps a foot or so from stepped sections to prevent shifting of ends during final fitting.

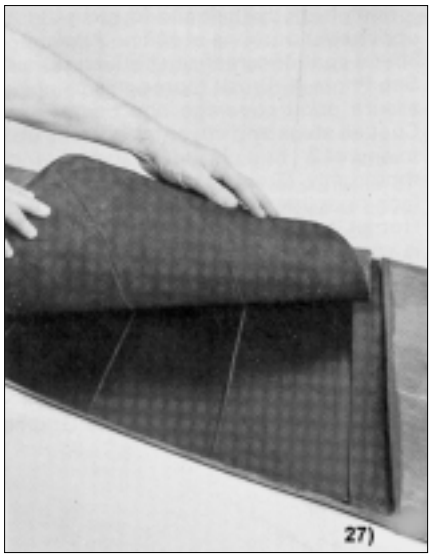
Final fitting: Bend uppermost half of splice back on itself to expose steps. Then select one of the two following methods for final fitting:

1 - Narrow belt with five steps or less: Peel polyethylene film off second step from belt end and for 1" each way from this step. Position upper half of splice over lower half. See Photo 26. They will adhere along area from which polyethylene film was removed. Roll and hammer belt to assure good adhesion.

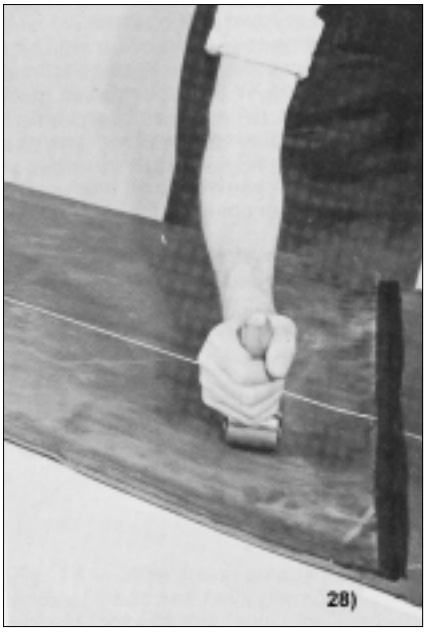
Remove remainder of polyethylene film in direction of top cover fill-in. Bring splice surfaces carefully together, making sure that each step fits properly. See Photo 27.



Roll to assure good contact. See Photo 28.



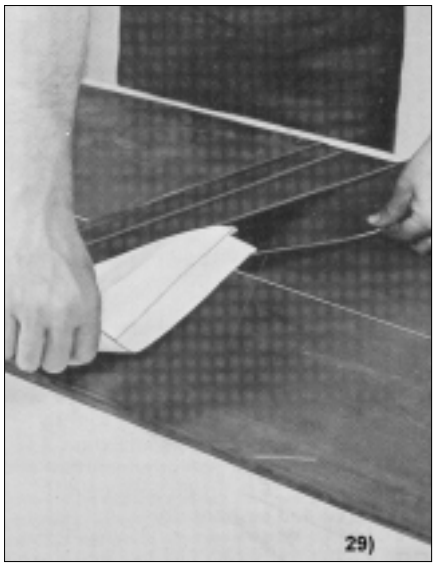
2 - Wide, heavy belt of more than five steps: Remove polyethylene film from middle step or from either step near middle when there is an even number, and for about 3" each way. Bring other half of splice into position. Roll exposed step into contact. Working toward top cover fill-in, remove polyethylene film from next step and 3" beyond. Fit and roll halves of this step together, continue until fill-in is reached. This system permits each step to be fitted individually.



Cover fill-ins- 1/16" thick or thicker cover

After assembly of the ply steps, gaps remaining in top and bottom covers have to be filled in with new rubber. When belt has no breaker, these gaps are identical except that top cover usually is thicker. Marking a top-cover fill-in is described. For the bottom-cover fill-in the procedure is the same, except where noted.

1 - If not already done, remove polyethylene film from tie gum over step adjacent to fill-in area and over extra fabric that was allowed for trim. See Photo 29.



2 - Roll cover to force tie gum into good contact with cemented surface of matching half of splice.

3 - Measure for cut through cover, and draw a straight guide line. This line is positioned so width of fill-in between edges of cover rubber will be 4" (Fig. K). Line will be 6" from reference line XY on top cover (Fig. G, line IL and Fig. J).

The covers at the belt ends may be stripped from the belt now or before as explained on page 21.

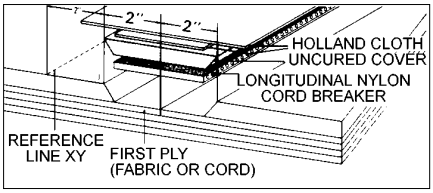
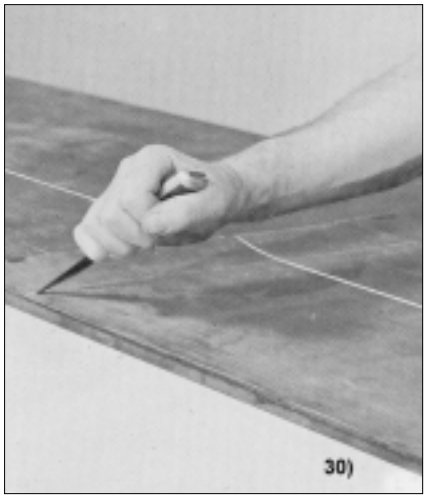


Fig. K - Details of top fill-in for fabric belt that has no breaker.

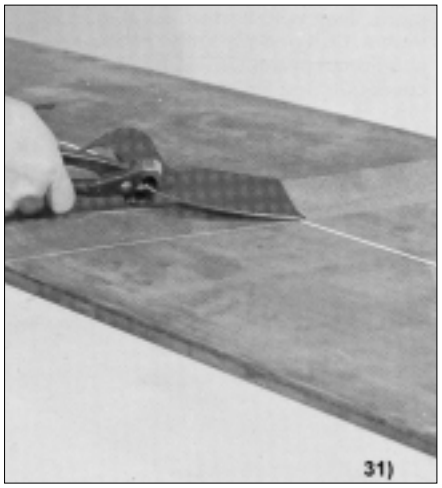
4 - With bevel-point knife at 45 degree angle, cut along guide line IL. Blade must penetrate only to first fabric ply, not into it. See Photo 30. Cut-edge of rubber will appear beveled as in Fig. H.

5 - Strip rubber cover from end of



belt ply. See Photo 31.

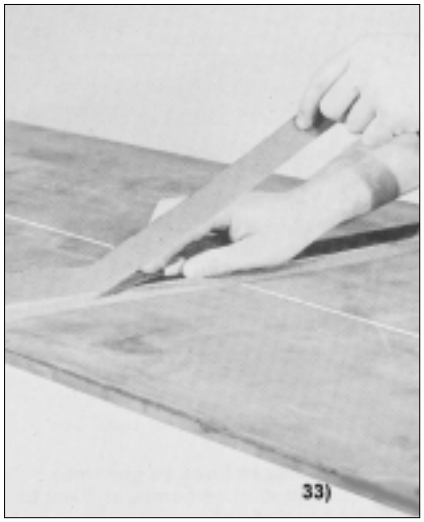
6 - With prodder, force fabric ply into



tight fit with matching end of ply in other splice half, and into good contact with ply below it. See Photo 32. Prodder makes crease in fabric along joint.

7 - Run bevel-point knife along crease to trim off excess fabric. See Photo 33.

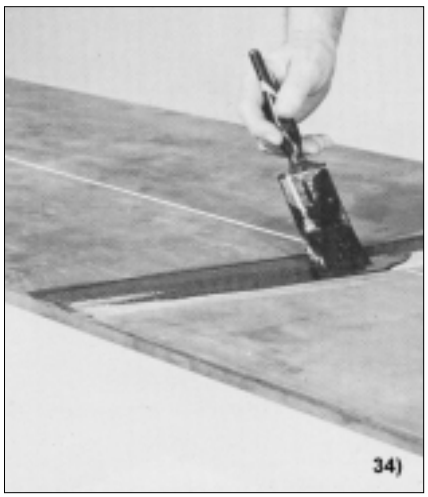
8 - With coarse emery cloth, lightly



buff the fabric. Buff firmly the beveled edge of cover rubber and top surface of cover for about 1/2" back from fill-in area.

9 - Brush coat of cement over buffed area, working it well into fabric, and let dry. See Photo 34. Apply second coat and let dry until tacky.

10 - A longitudinal nylon cord breaker



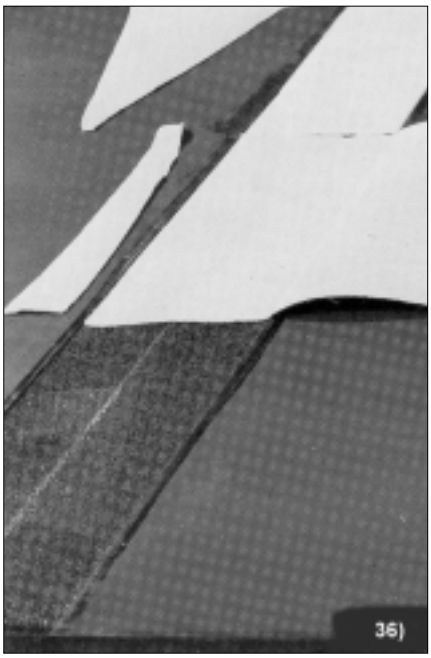
shall be used over butt seams of outside plies where there is no breaker in original covers and covers are 1/16 of an inch thick or thicker. Brush one coat of cement on one surface of this breaker stock and allow to dry. Also cut a strip of uncured cover stock slightly longer than and 1-1/2" wider than the fill-in. Remove polyethylene film and brush coat of cement on surface it protected. Let cement dry.

11 - Place end of longitudinal nylon cord breaker, cemented side down, over fill-in area, starting 1/4" from belt edge. Be sure that its cords run parallel to edge of belt. Roll fabric into fill-in area. Use prodder to force fabric tightly into corner. See Photo 35. Cut off excess fabric flush with bottom edge of fill-in with a .065 one-ply knife. Fabric should not project up on the skived cover cut. See Fig. K.

12 - Making butt seams in the longitu-

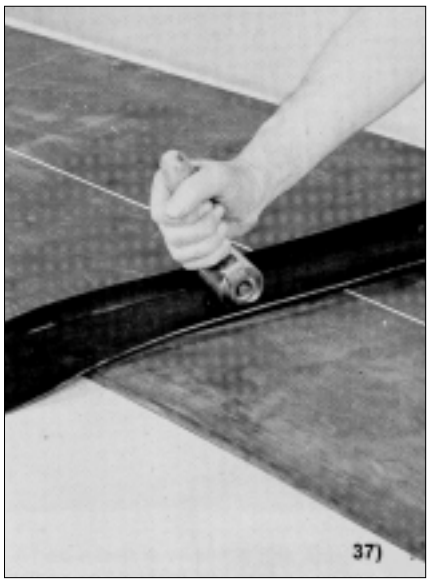
dinal nylon, lay fabric in the fill-in area across the full width of the belt. See Photo 36. Trim the end so it is 1/4" short of the belt edge.

13 - Place cover stock over; fill-in



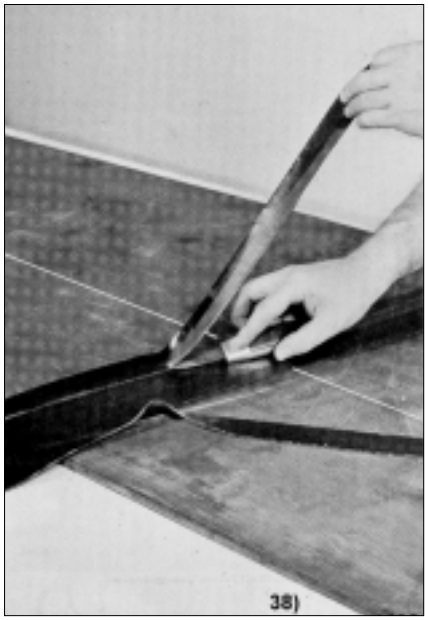
area, cemented side down. Roll into good contact. See Photo 37.

14 - With bevel-point knife, trim off



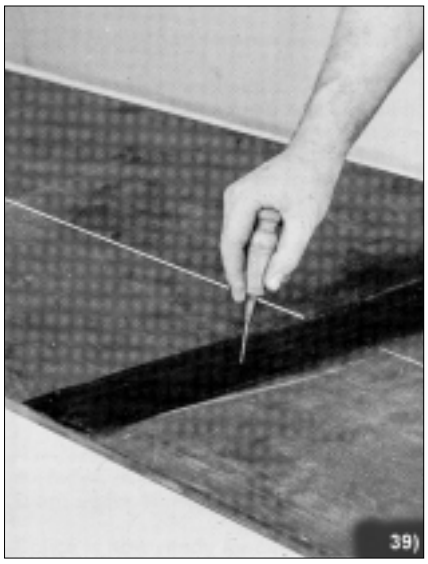
excess cover stock all around. See Photo 38. When two strips of cover stock are necessary to produce desired fill-in thickness: Remove polyethylene film from second strip and apply one coat of cement to uncovered surface at same time you prepared first strip. After first strip is trimmed, wash bloom from its exposed surface with cloth moistened with solvent. Place second strip with its cemented surface down. Roll firmly.

15 - With awl, make numerous holes



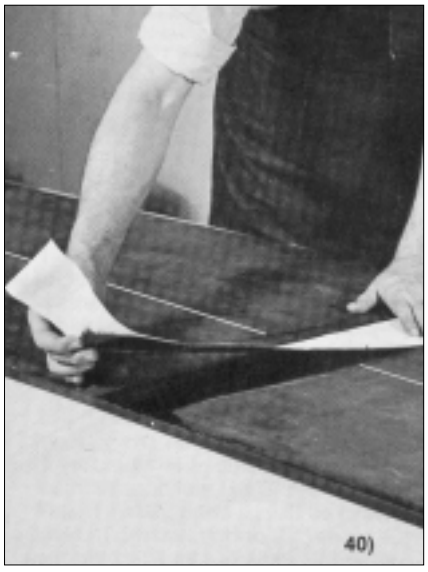
(spaced 1/2" each way) in uncured cover stock, to let trapped air or steam escape during vulcanization. See Photo 39. Extend awl holes only to depth of new material. Roll stock again to force out trapped air.

16 - Brush light coat of cement over



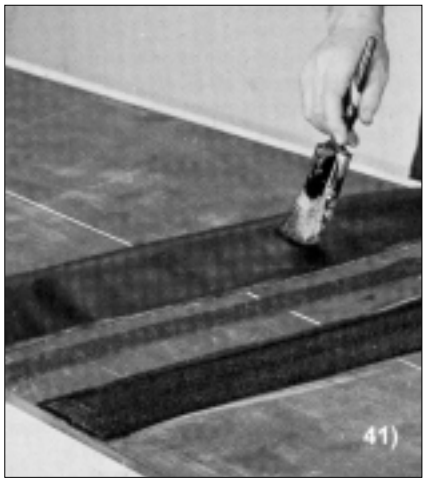
fill-in area and one surface of a strip of holland cloth 1" wider than fill-in.

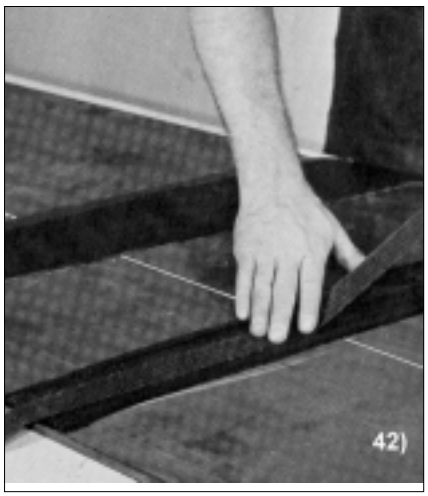
17 - Place holland cloth, cement-side down, over fill-in. See Photo 40. Trim it even with belt edges. Holland layer protects fill-in during handling, produces a smooth surface on rubber, and prevents fill-in from sticking to vulcanizer platen. Turn belt over and complete other cover fill-in in same manner.



Cover fill-in 1/32" thick cover -

1 - Cut 1-1/4" strip of light No. 611 breaker fabric slightly longer than fill-in. Coat surfaces of this strip with cement. See Photo 41. Also cut a strip of uncured cover stock to same length, and 1-1/2" wider than fill-in. Remove polyethylene film and brush coat of cement on surface it protected.





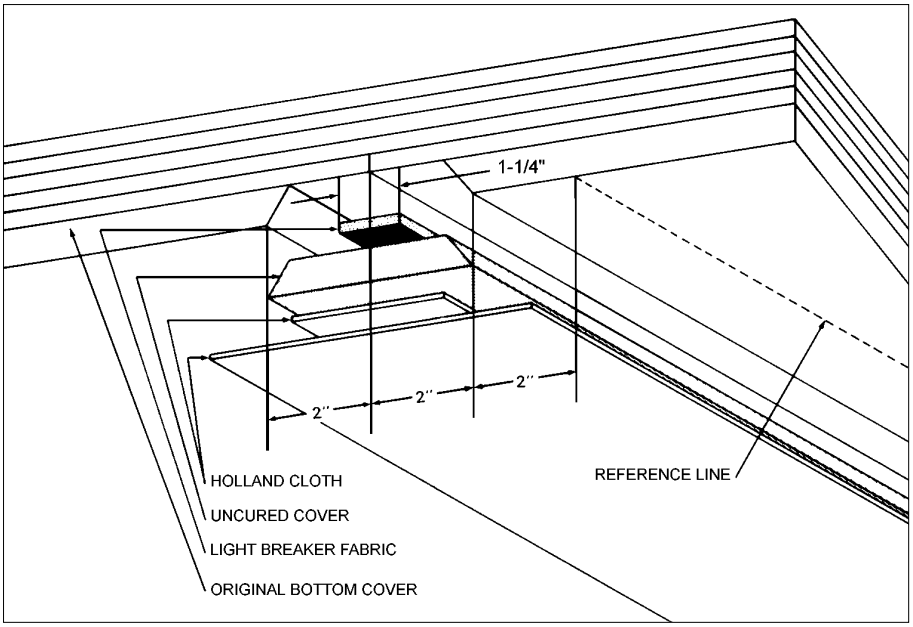


Fig. L - Details of bottom cover fill-in for cotton and polyester-cotton blend fabric belt with 1/32" cover.

Let cement dry (See Fig. L).

2 - Center breaker fabric over butt joint in fabric ply. See Photo 42. Trim ends so they are 1/4" short of belt edges. Roll breaker fabric into firm contact. Finish cover fill-in as described.

Finishing edges

When a belt is wider at one end, edges will not be even when splice is assembled. If edges are not too badly worn or cut, and width difference is not great, try to fit them together so they will require no further building-up or finishing.

1 - If edges must be renewed, trim them so they are even and slightly under with respect to belt width. Amount they are undersize should be equivalent to the 1/16" to 1/8" thickness of cover stock to be applied. Buff edges with coarse emery cloth,

as shown. See Photo 43.

2 - Brush two coats of cement on belt edges at splice, allowing each to dry. Brush one coat on strips of belt cover stock to be applied to edges.

3 - Press cemented surfaces of rubber stock against belt edges. Roll into good contact.

4 - Trim strips flush with belt surfaces, as illustrated in Photo 44. Roll

them again, thoroughly.

Splice is now ready for curing in vulcanizer.

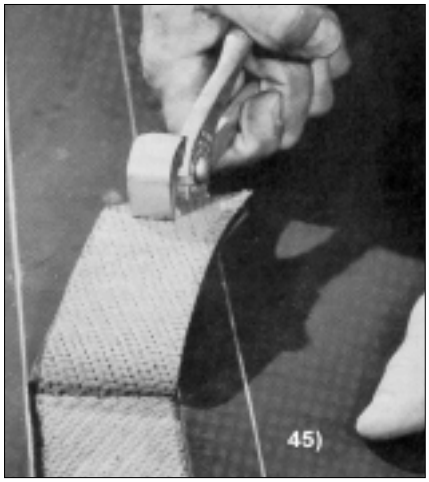
Splicing fabric belt having breaker

1 - Locate center line, square the ends, locate reference line (XY, Figs. G, M) - the same as for a belt without a breaker. Many of the subsequent operations are like those for belts having no breaker, but some are different.

2 - Locating cutting lines. After locating the reference points and lines, draw cover fill-in cutting line GJ 1" from XY, and line HK 2" from GJ (See Figs. G,M). (Line IL will be drawn later.) Trim belt end to 22 degree angle. Lay out ply steps as a check.

3 - Mark matching belt end as described on page 18. Note that reference line XY is same distance from bias-cut belt end whether or not there is a breaker in cover on which XY is drawn.

4 - Making cover fill-in cuts. Make 45 degree cut through cover along line GJ. Make vertical cut through cover along HK. Make cuts through cover parallel to and 1/4" from both belt edges. Strip out 2"-wide section of cover, exposing transcord breaker fab-



ric. See Photo 45.

5 - Stepping-down belt - Breaker step: Make cuts parallel to and 1/4" from each belt edge, through cover and breaker and extending from line HK to end of belt. With one-ply knife, cut through breaker along line HK. Prod loose this edge of breaker and skim coat under it. Strip off top cover and breaker from line HK to belt end. Trim off 1/4" strips of cover and breaker along belt edges.

6 - First-ply step: Measure 4" from reference line XY to locate line IL (Fig. G). With one-ply knife, cut along this line (cut No. 3, Fig. M) through first fabric ply. Also cut through this ply 1/4" from belt edges, from IL to end of belt. Strip off fabric ply and skim coat under it from IL to belt end. Trim 1/4" strips from belt edges to expose all of next ply. Step in first fabric ply is 1" long.

7 - Second-ply step: Measure from reference line XY a distance of 10" to

locate cut for forming step in second fabric ply (Cut No. 4, Fig. M). This is the first 6" step. Strip off unwanted fabric and skim coat, and trim edges as before.

8 - Remaining steps: Use same procedure for each remaining step, until all plies are exposed. Steps will look like this: Breaker projects 2" beyond cover, measured from top surface of cover at beveled edge (Fig.M). First fabric ply step directly under breaker is 1" long. Next (second-ply) step and all remaining steps are 6" long, except last step which is 7-1/2" long to provide 1-1/2" for final trimming.

9 - Back cover fill-in cut: After belt has been stepped down, strip 3-1/2" of back cover from the belt as described for belt having no breaker (pages 22 and 23).

10 - Second end: Next, step-down other half of splice. There is no breaker ply next to bottom cover, so procedure for this end is same as that described for belt having no breaker (page 19).

11 - Top cover fill-in cut with transcord breaker or breaker fabric: Measure 4-1/2" toward splice from belt end, line ED, and draw cutting line. With mill knife at 45 degree, cut along this line, through cover only. Make similar vertical cuts parallel to and 1/4" from belt edges. Pull off strip of cover. Mark a line across breaker 2-1/2" from and parallel to belt end line ED. Cut through breaker but not into fabric ply. Strip off unwanted part of breaker. This leaves adjacent fabric ply, which, with trim allowance of 1-1/2", is exposed approximately 2-1/2".

12 - Cleaning, buffing, assembling steps: When belt has a breaker, this is same as described for belt without breaker (page 21). When applying tie gum, cover splice area as far as short step of ply next to breaker (line IL in Fig.G and Fig.M).

13 - Top cover fill-in with transcord breaker or breaker fabric: When a belt has a transcord breaker or breaker fabric beneath top cover, procedure for making top cover fill-in differs from that for back cover fill-in. First remove polyethylene film from remainder of tie gum adjacent to fill-in area. Roll top cover to force tie gum against cemented surfaces as far as end of first ply step in fill-in area. With prodder force this ply into good conduct with next ply. Cut off projecting portion of fabric. Roll down remainder to form neat butt joint. Fill-in should appear as in Fig.N.

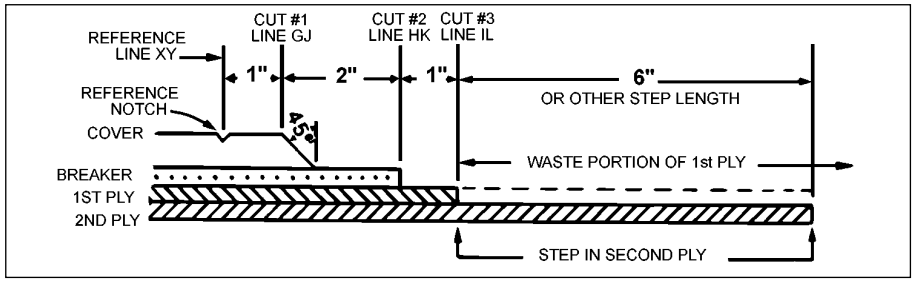


Fig. M - Stepping-down fabric that has a breaker ply next to top cover.

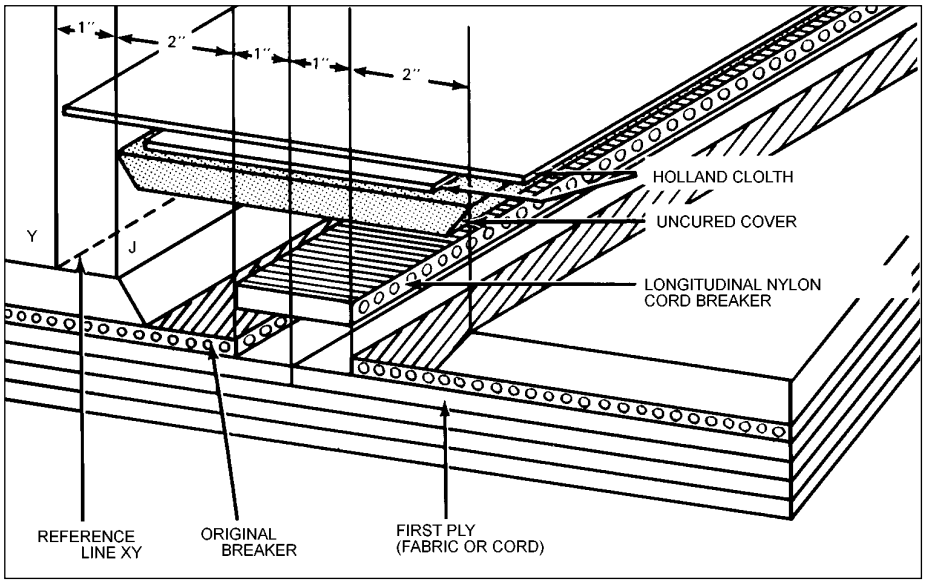
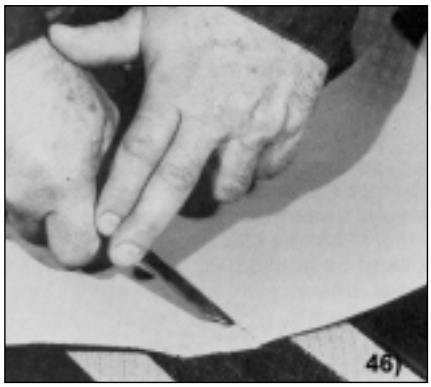


Fig. N - Details of top cover fill-in for cotton and polyester-cotton blend fabric that has a breaker.

14 - Buff fabric and rubber. Apply two coats of cement. Let first coat dry thoroughly, second until tacky.

15 - A longitudinal nylon cord breaker shall be used over butt seams of outside plies when there is a transcord breaker or breaker fabric in the original covers. Brush one coat of cement on one surface of this breaker stock and allow to dry.

16 - Place end piece of 9" wide longitudinal nylon breaker, cemented side down, over fill-in area. Be sure that its cords run parallel to and start 1/4" from the belt edge. With a prodder or stitcher, force new longitudinal nylon breaker into good contact with the original breaker fabric. See Photo 46.



17 - With bevel-point knife, trim longitudinal nylon breaker so remaining piece just fills gap in original breaker as in Photo 47. When 9" strips are used, two or more may be required to cover fill-in area. Trim ends of breaker strip 1/4" from belt edges. Roll breaker fabric into good contact.

18 - Apply cement and uncured cover

stock as already described (pages 23-24).

Splicing Butyl and EPDM belts

Splicing instructions for Butyl and EPDM conveyor differ from a natural rubber or SBR conveyor only in material used and temperature of the vulcanizer.

The butyl compounds used have characteristics that differ from other rubber compounds. These extra precautions should be followed.

Materials - Butyl - Grade B materials.

EPDM - EPDM cover stock. Grade B tie gum and cement.

Solvent may be used for thinning cement, tackifying tie gum or cover stock or for cleaning the stepped down belting carcass.

Butyl compounds have less tackiness than other rubber compounds, especially after aging. Under proper conditions, Grade B splicing materials are usable 6 months after processing. Check condition of splicing compounds before using.

Splice preparation

1. The fitted splice of a butyl belt can be distorted more easily than one with rubber compounds. This is due to the fact that butyl splicing materials are less tacky than other compounds. Place belt and vulcanizer in such position on the supports to allow for minimum amount of bending or distortion as splice is moved into the vulcanizer. C-clamps can be used to hold ends in register until ready for curing.

2. Grade B cement should be permitted to dry thoroughly before applying the Grade B tie gum.

3. After Grade B tie gum is applied and rolled down into place, remove the polyethylene film backing in narrow strips. This prevents pulling the tie gum loose from the cemented steps.

Vulcanizing

1. Use 305 deg. F. vulcanizing temperature. Butyl compounds require a higher vulcanizing temperature for best results. To use 287 deg. F. would require doubling the cure time shown for 305 deg.

2. All heats should be given a cool-down to prevent possibilities of blisters or blow-ups. Allow vulcanizer platens to cool down to 240 deg. or below before releasing platen pressure.

3. Use Holland or mylar film over splice to prevent cover sticking to press platen.

SPLICING HIGH TENSION BELTS

The general splicing procedure is the same shown for cotton and PCB fabrics with these important modifications.

Synthetic fabrics; rayon, nylon and polyester, are given a special treatment during processing to provide increased adhesion to the rubber compounds. This reddish brown colored treatment must not be removed in splicing.

The treated fabrics are harder and more compact than cotton fabrics. This fact, plus the increased adhesion, makes the synthetic constructions more susceptible to damage by the prodder at the step lines. A modified method of stripping down the belt ends is recommended to eliminate damage that could be caused by prodding to lift the lead edge of the plies in stripping.

Laying out: Square the belt end and lay out as shown in Fig. F and G except allow 6” extra on each belt end. This extra length is used for clamping down the belt end for reverse stepping of the splice.

Cover fill-in cuts at belt end: Remove cover fill-ins from the belt ends as described on pages 21 and 27.

Stepping down:

1 - Clamp belt end.

2 - Remove cover with standard procedures.

3 - With one-ply knife of the proper size, cut the first step. Do not prod along this cut.

4 - Make a rough cut at the belt end beyond the step area and, with prodder or chisel, lift the first ply far enough to attach a clamp and cable. Strip ply back to cut made for first step.

5 - Make cut for second step and again strip back, working from the end of belt.

6 - Repeat until all plies stepped back.

7 - Remove the area containing the rough cuts and prodded plies.

Cleaning and buffing: In most cases, the rubber skim coats will split and leave a layer of rubber on the synthetic fabric surfaces. It is only necessary to buff this coating to insure removal of loose rubber particles and dirt. Do not buff any exposed fabric areas. If a heavy skim coat is left on some areas after stripping, reduce its thickness by buffing the rubber only to obtain as even a pressure surface for the new cement and tie gum as possible.

1 - Layout: Belt layout is the same as already described.

2 - Cutting steps: To prevent damage to underlying plies, steps should be cut with the proper one-ply knife. See Page 14 for recommendation.

3 - Cementing: Use Grade C (636/637) cements on all high tension belting. For belts of other qualtities, see Table 3 for recommended materials.

Mix Grade C (636/637) cements in accordance with instructions given on the container. Apply an even coat of cement, brushing thoroughly to assure good coverage and to eliminate areas of heavy cement deposition. Coat all steps and cover fill-ins up to the end of the first ply step. Let dry thoroughly. Apply a second coat and let dry until tacky.

4 - Applying tie gum: Determine proper thickness of Grade Hi-T tie gum to be used.

5 - Cover fill-ins: The longitudinal nylon cord breaker is used over the butt joints of outside ply of the splice in the following areas.

A. Over butt seams of outside plies where there is no breaker in original covers and covers are 1/16” thick or more (Fig. O).

B. As replacement of heavy breaker

fabric or transcord breakers originally in covers and under the fill-in strip (Fig. P).

SPLICING REDUCED PLY

The general splicing procedure is the same as for high tension belting except, with these important modifications. The following instructions apply to Reduced PLY.

Splice length: The determination of the additional length of belt needed for splicing is explained on page 17.

Laying out: The layout for Reduced Ply belts without and with breakers is the same (Fig.Q). Note the 6" allowance left at each end to permit reverse stripping.

Removing cover at fill-in: At belt ends remove cover and existing breaker where the cover fill-in is to be located. Make a vertical cut along the belt end, line ED, through the cover and existing breaker down to the ply.

At a distance of 5-1/2" from the belt end, make a 45 deg. cut parallel to the first cut. Make a vertical cut parallel to and 1/4" from each edge between the two cuts. Cut through only the cover and existing breakers. Strip off all covers and existing breakers.

Stepping down:

1 - Clamp belt end to splicing table or conveyor deck.

2 - Making cover fill-in cuts: Make a 45 deg. cut along line G-J. See Fig.Q and vertical cut along line H-K, and remove cover and existing breakers as described.

3 - Cutting RP plies: With a one-ply knife of the proper size, cut the first step. Do not prod along the step line. Stripping is done in reverse.

4 - Reverse stripping: Make a rough, transverse cut in the first ply near the clamped end of the belt. The cut should be outside the splice area, see Fig. Q, line D-E. With a prodder or chisel lift the ply far enough to attach a stripping clamp. Strip ply back to cut made at first step line.

5 - Repeat in case of 3- and 4-ply belts until all plies have been stepped down.

6 - Remove clamp and cut off end of belt along line ED.

7 - Repeat same procedure for second end of belt.

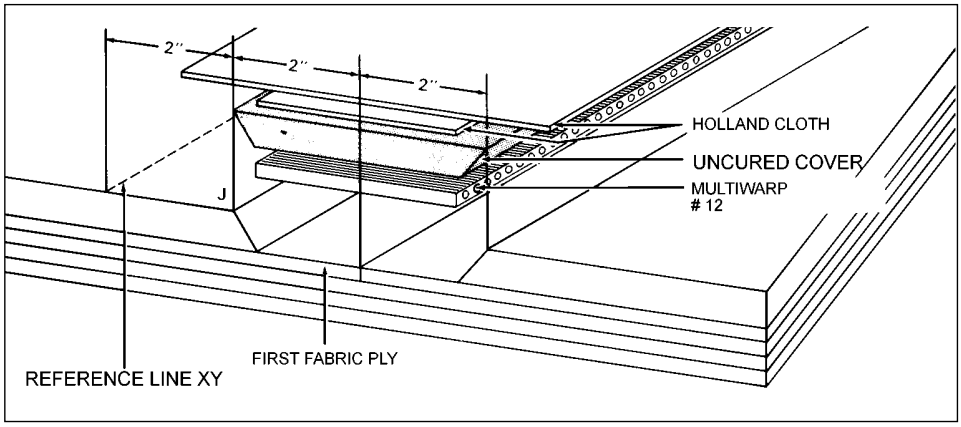


Fig. O - Details of fill-in for high tension belts without breaker.

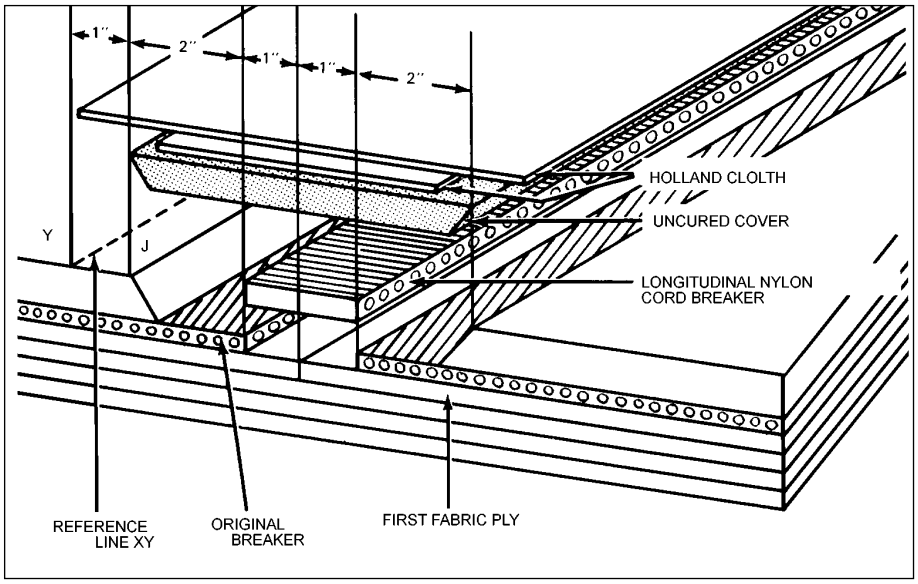


Fig. P - Details of fill-in for high tension belts with breaker.

Cleaning and buffing: In most cases some rubber will be left on the fabric steps. Buff these areas lightly to remove dirt and loose particles of rubber. Do not buff any exposed fabric areas.

Cementing: Use Grade C 636/637 (2 part) cement (mixed according to instructions on container) on all Grade I, II belting. See Table 3 for other grades.

Apply an even coat of cement on each belt end, brushing thoroughly to assure good coverage. Coat entire splice area to the end of the first ply step. Cross-brush across width of belt to spread out any accumulations of cement between fabric ribs. Let dry thor-

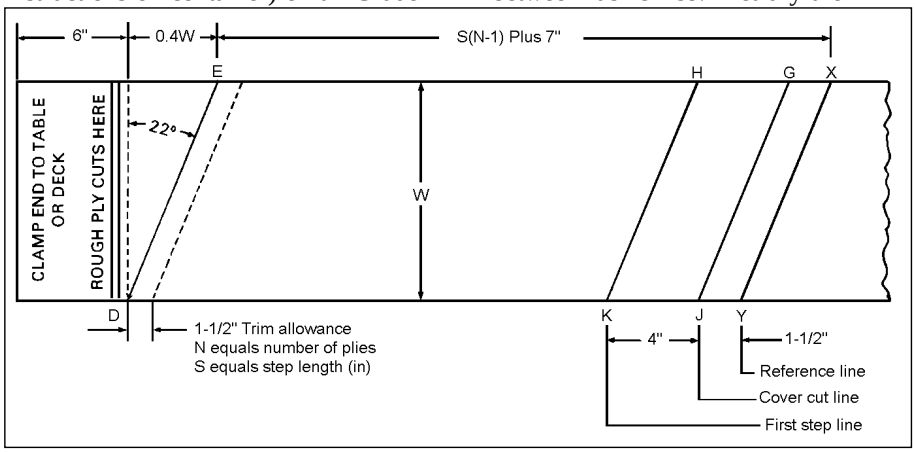


Fig. Q - Splice layout for Flexseal belts.

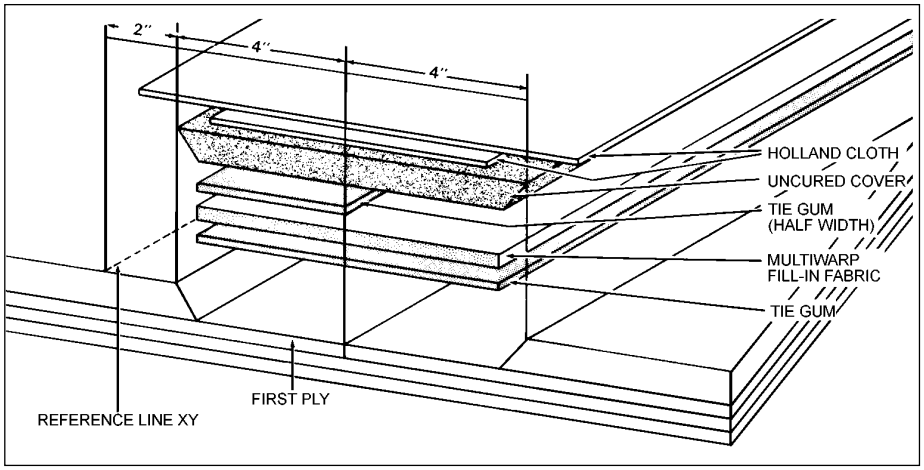


Fig. R - Details of fill-in for Flexseal belts without breaker.

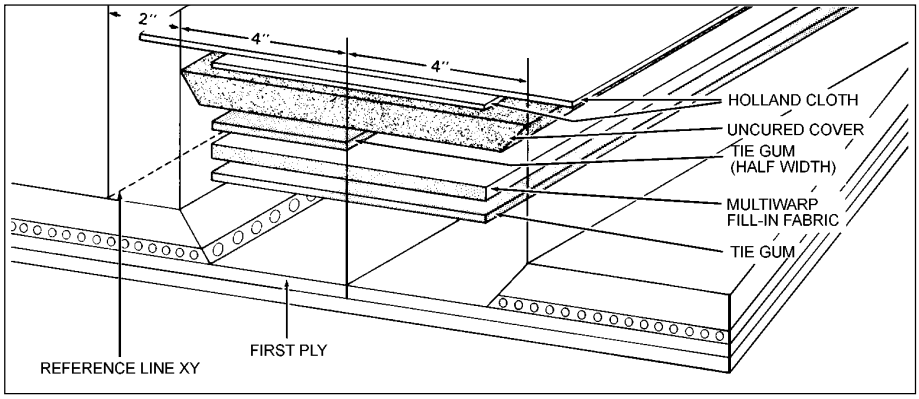


Fig. S - Details of fill-in for Flexseal belts with breaker.

oughly - apply a second coat and let dry until tacky.

Applying tie gum: Starting at the step line of the top ply, apply 9" wide strips of tie gum across entire splice area. Do not cover 4" step in top ply. With hand roller, force tie gum into good contact with cemented surface. Remove plastic film and apply a second (and, if necessary, a third) layer of tie gum. Total tie gum thickness should be about 0.020" (for rubber belts, use two layers of 0.010", or one layer of 0.020" Grade Hi-T tie gum). For neoprene belts, use one layer of 0.020" ga. or two layers of 0.010" ga. Grade S tie gum. Do not remove plastic film from last layer of tie gum applied. Apply tie gum to only one belt end.

Fitting splice together: Follow general instructions given on pages 22 and 23.

Making cover fill-in: Make fill-in in accordance with general instructions with the following exceptions.

1 - See Fig. R for layout and dimensions of fill-in for RP belts without breakers and Fig. S for RP belts with breakers. The fill-in procedure is the same for belts with or without breaker with 1/16" or more thick cover. RP requires minimum covers of 1/16" for vulcanized splices.

2 - After cementing fill-in area and allowing to dry, apply an 8" long strip of tie gum (.020" ga. Grade Hi-T for rubber belts, .020" ga. Grade S for neoprene) to the fill-in area.

3 - Use 9" wide strip of coated Multiwarp fill-in fabric No. 12. Fabric is furnished cut on bias ready for use. To increase tackiness, cement both sides lightly and allow to dry. Roll fabric into fill-in area with warp cords parallel to edge of belt. Use prodder to force fabric tightly into corners. Cut off excess fabric flush with bottom edges of fill-in area. Fabric should not project up onto skived cover cut (see Figures R and S). Fill-in fabric may be seamed.

4 - Cut a strip of .020" tie gum long enough to cover entire length of fill-in and 4" wide or half of the total fill-in width. Cover the area from the outside step line to the cover cut line away from the splice area. For rubber belts use .020" Hi-T tie gum. For Neoprene belts use .020" Grade S tie gum in both top and top and bottom cover fill-in strip. This equalizes thickness throughout entire splice area.

5 - Cut strip of uncured cover stock long enough to cover entire length of fill-in and about 9" wide. Use cover stock 1/32" thinner than original cover thickness - brush one side lightly with correct cement to increase tackiness.

6 - Apply strip of cover stock over the Multiwarp fill-in fabric and .020" tie gum and complete fill-in according to instructions on pages 23-26.

7 - Finish belt as described.

STEEL CABLE BELTING

The splicing of steel cable belting requires different tools and techniques to do it properly.

Butt splice

A. Belt placement on table and establishment of center line
(See Table 10).

1. The vulcanizer bottom platen should be flush with the table top, and located between the two end sections of the table. With this type of setup, the belt can remain in place between the side-boards on the table and thus retain good alignment.

2. Place first belt end into position on table. Entire length of splice area should be over the work table (bottom platen of vulcanizer). When belt is in proper position, approximately 18' to 20' of belt will be laying on table if table is similar to recommended type.

3. Establish center line of belt. (See Table 11).

a) Measure across width of belt at six to seven points in length of belt on the table, and mark the center at each point of measurement.

b) At each of the center markings, measure to each edge of belt to check exactness of centering and adjust markings accordingly.

c) Mark center line. Scribe a line on the cover of the belt from the belt end to the clamp. This line must be durable enough to remain evident

throughout the entire splicing operation.

B. Laying out splice area

(Refer to Tables 11 and 12). Care should be taken to get the splice as close to level as possible.

1. Establish a perpendicular line across belt near belt end. To do this, select a point on the center line about six feet from this point to a point on one edge about 12 inches from the belt end. Repeat to find a corresponding point on the other edge, measuring the same distance from the point on the center line. A line drawn between these two points will be perpendicular to the belt edges.

2. Locate and Mark Splice Reference Lines and Step Lines.

a) Determine splice angle. From one of the edge marks established in 1 above, measure back a distance of 0.4 times the belt width (example: for 60" belt width, 0.4 x 60" = 24") along the edge, and mark this point. Draw a line from this new point to the end of the perpendicular line on the other edge. This will establish the splice angle. This line can also serve as line C or H (Table 12) depending on which end is being worked on first.

b) Cut belt end along either line C or H. To facilitate cutting, it is suggested that the top cover be removed in a 2" wide strip centered along line C or H. The preferred method of cutting cables along the belt has been with circular "carborundum" cutting blades.

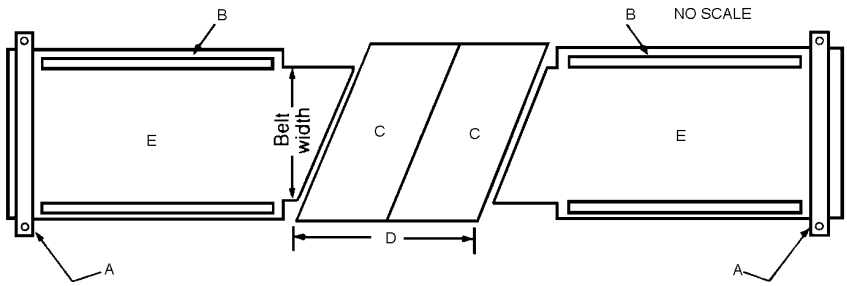
c) Referring to Table 12, locate the splice step lines (not the individual cable cut locations) by measuring back from the points established in "a" above. Draw step lines on belt cover which is up. Mark edges at step lines for bottom side. The bottom step will be drawn in later.

C. Stripping and preparation of belt ends

1. Bevel cut through top cover at the cover fill-in line (Lines A or K in Table 12). Cut through top cover at line C or H. Strip off the cover between cuts (3" wide x width of belt at bias angle).

2. Cut through impact ply at fabric step line (Line C or H, Table 12).

TABLE 10 - WORK TABLE FOR STEEL CABLE BELT SPLICING

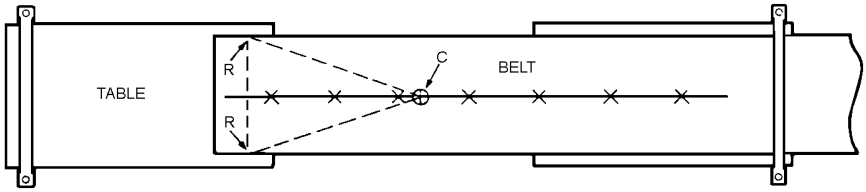


A. Clamps
B. 2" x 4" wood sideboards, both sides of table.
C. Rhombic shaped, 22 deg. bias, bottom platens of vulcanizer. These platen surfaces must be flush with surfaces of table end sections.
D. Determined by length of vulcanizer sections to be used to cure the steel cable belt splice in one heat.
E. Each end table section should be 8' to 10' long x belt width + 12".

End table sections must be very sturdy and must be fastened down securely to avoid shifting. Apply sideboards as indicated in splicing instructions. A 3 ft. wide walkaway should be provided on each side of table.

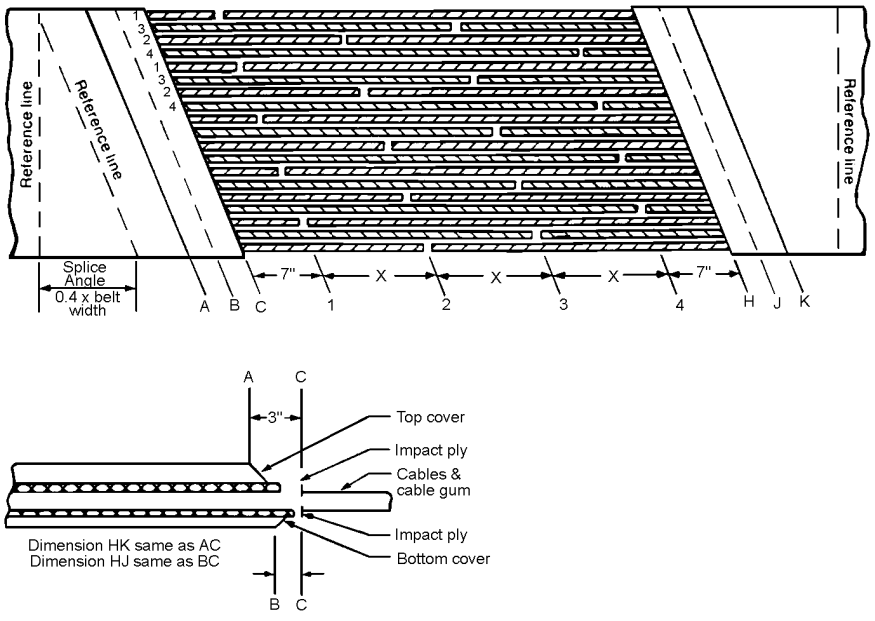
Work table should be 30" above walkway and 18 to 20" above conveyor decking.

TABLE 11



Measure across belt in several areas and mark center in each case, as indicated by x's above. Draw line through x's to establish centerline. Select point "C" on centerline approximately 6' from end of belt. Measure, and mark, a point on each edge, equidistant from "C". Draw a line between these points, shown as "R" above. Use this line for location of splice reference lines and step lines.

TABLE 12



Note: Rhombic shape of platen dictates splice to be used as shown in Table 10 and opposite direction in Table 12

3. Strip off top cover from remainder of splice area. The impact ply should not be removed during this step because, in doing so, it can take much of the rubber between cables with it.

4. Fold back the belt to expose the bottom side of the splice area. Draw the step lines for the bottom steps. The marks for these steps were made on the edges of the belt in Step B-2-C.

5. Cut bottom steps. Bevel cut through bottom cover at bottom cover fill-in (line B or J). Cut through bottom cover at bottom impact ply step line (line C or H). Strip out bottom cover between these cuts (1-1/2" wide x width of belt at bias angle).

6. Cut through bottom impact ply at step line (Line C or H).

7. If bottom cover is greater than 1/8", remove it from the remainder of splice area. Otherwise, proceed directly to Step C-8.

8. Suspend splice area. Attach vise grips or some similar clamping devices on end of belt, and attach these to pulling devices such as come alongs, Lug Alls, or similar. Apply tension with pulling devices and suspend belt end.

9. Cut out material between cables. Cut on each side of each cable vertically through entire remaining belt structure (i.e., cable gum, top and bottom impact plies, and bottom cover, if 1/8" or less. The length of these cuts to extend from the end of each cable to the step lines at either C or H. Cut off the material strips at the approximate step line.

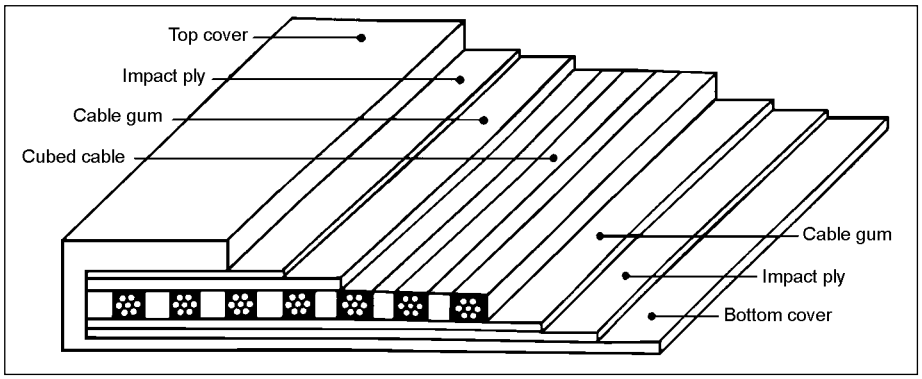
10. Cut off material on top of cables. Trim the cable rubber and impact ply away from the top of each cable. The cut is made in a horizontal plane, using the cable itself as a guide while cutting. The length of each cut will extend from the end of the cable to the step line, either C or H. Remove this material by cutting at the appropriate step line.

11. Cut off material on bottom of cables. Remove the vise grips, and lay the belt end back. Trim off the bottom cable rubber, impact ply, and cover if left intact, in a fashion similar to that outlined in Step C-10.


CUBED CABLE

NOTE: The intent of Steps 9, 10, and 11 is to remove as much material (impact ply and rubber) as possible from each cable without exposing the "bare" metal surface of the cable. This is often referred to as "cubing" operation because of the square profile of rubber which remains on the cable.

TABLE 13 - Arrangement of materials in splice.



This method of cable trimming should expose a minimum bare metal. A small amount of such exposure can be tolerated. The strength of this vulcanized steel cable splice depends on the level of cable adhesion to the original rubber surrounding it. The new cable gum bonds on the original cubed cable gum surrounding each cable. In other words, the splice strength depends on the shear adhesion resulting from a rubber/rubber bond, rather than a rubber/metal bond.

In cases where,

(1) Excessive brass metal is exposed;

(2) Corrosion or other causes have deteriorated the bond between the original rubber and the brass cable;

(3) The cable is exposed and is zinc cable;

Refer to special procedures in Appendix A on page 36.

12. Place belt end back onto work table.

13. Clamp belt to table, and apply side boards. Line up center line of belt so that it is approximately in center of table, and parallel to edges of table. Clamp, with full width clamp to end of table. Nail on side boards snug against belt edges. See Table 10.

14. Mark the four cutting, or step lines, on each cable. These cable-cut lines are referred to as lines 1, 2, 3, and 4 in Table 12. Locate these lines by measuring from the reference lines on belt which now is clamped into position.

15. Apply a strip of masking tape or similar material along top step line C or H, full width along bias.

16. Mark each cable as to its cutting location. On the masking tape, designate the cable as 1, 3, 2, 4 and 1, 3, 2, 4 etc. on across to indicate along which cable step line they should be cut.

17. Cut each cable at the corresponding step location.

18. Clean and buff the bevels of the top and bottom cover fill-in areas. Buff top cover bevels (Line A or K). Pull belt end back. Buff bottom cover bevels (Line B or J). Buff so that contact surface is rough.

Instructions for use of cements and solvents

The splice buildup will involve the use of cements and solvents. The following instructions are very important. Read carefully. Except in special cases, instructions given here will not be repeated in the step by step process of buildup. Also, refer to Table 13 for a pictorial description of the arrangement of the various materials in the splice.

Cements - In all steps in building up the splice, cement is applied to all surfaces to be joined. The cement to be used is Grade C which is a 50:50 mix of #636 and #637 cements. Mix equal parts of each for belts. For neoprene belt, use one part neoprene Grade S cement. Cement is to be applied as follows:

a) All unvulcanized surfaces (impact ply, cover stock, cable gum) - Apply one coat of cement.

b) All vulcanized surfaces (trimmed cables, ends of cured covers, steps in cured belting) - Apply two coats of cement.

Full coverage with a thin layer of

cement is more reliable than a thick layer of cement. Always allow the first coat of cement to dry thoroughly before applying the second coat.

Solvents - R-587-T is the recommended solvent to clean off all uncemented surfaces. It should be used if any dirt appears on the surface of any splicing material, cured or uncured. However, if cement has been applied to the surface, the solvent should not be used as it will soften and may remove the cement. The only exception to this is the case of extreme dirt deposit on the cement coat. In most cases, if a cemented surface has a slight dirt deposit, apply another coat of cement.

A bloom or film may appear on the surface of unvulcanized cover stock. This is a natural condition created by the age resistors in the rubber. If it appears, the surface should be cleaned with R-587-T solvent before applying cement. The solvent can be applied with either a rag or a felt pad.

19. Clean cables using solvent.

20. Cement cables. After solvent is dried, apply first coat of cement to each cable and each cover fill-in area. This cement can either be brushed on or also applied with a fabric or sponge pad (as preferred).

21. This completes preparation of the first end of the belt. When the cement is dry and non-tacky, wrap the cables in polyethylene film and lay back off center section of table. Do not remove belt from table. Leave full width of clamp and side boards intact.

22. Lay second end of belt on table, covering center and end section of table.

23. Establish center line as on first end. Line up center lines on the two ends to be spliced. Use a string or equivalent. Center lines should be perfectly aligned. During this same operation, ends of belt must be in proper relative position or distance apart. Refer to Table 12 for required dimensions. Actually, it is not mandatory that the exact overall length be maintained. The required length according to the sketch can be varied several inches by varying the distance between the step lines (C and H) and the first cable step lines (1 and 4). This distance, specified as 7", could be be as little as 5", or could be as much as the cable lengths will allow. However, extra length here increases splice length and could in some cases increase the number of heats required for curing the splice.

24. When the two ends are aligned, nail the side boards against the edges of the second end and apply full width clamp at this end of the table.

25. Lay out the splice area same as for first end, making sure splice angle matches angle on first end. Care must be taken so that all dimensions scribed on this second end match the corresponding dimensions already patterned on the first end.

26. Strip down splice area in same manner as first end. *Do not cut cables to length at this time on second end.* However, the cables are "cubed," cleaned, and cemented as described in previous steps within this section.

This completes stripping and preparation of the belt ends.

D. Assembly of bottom cover pad

1. Remove both ends of belt from work table without disturbing the alignment or the dimensional relationships of either end with respect to the fixed reference marks.

2. Prepare full width bottom cover. This will cover an area between cover fill-in lines B and J (Table 12). The cuts along lines B and J will be along the splice bias angle and should have a bevel cut similar to the matching cover fill-in lines. Place bottom cover onto work table (film side down). Apply one coat of cement to top side. Cut two sufficient width strips of Holland Cloth on the bias to amply cover areas BC and HJ respectively. This will aid subsequent operations in the assembly at the bottom cover pad. (NOTE: Do not remove these inserts until the execution of Step E-3).

3. Prepare full width bottom impact ply. The length should be approximately 2" longer than the distance between Step lines C and H. The cuts along lines B and J will be on the appropriate bias angle. Apply one coat of cement to bottom side of fabric (film remaining on top side). Laminate cemented side of fabric to cemented side of cover stock positioned on work table. Stitch or roll both members of "pad" together. Trim impact ply along fabric step lines C and H. Remove film protecting top side of fabric. Apply one coat of cement to entire top surface of pad.

4. Prepare full width bottom cable gum layer. The bias length cuts should be identical in dimensions to those of the bottom impact ply as outlined in Step D-3. Apply one coat of cement to bottom surface of cable gum, (film remaining on top side). Laminate cemented side of cable gum to cemented side of pad. Stitch or roll all members of pad together.

Trim cable gum along fabric step lines C and H. Do not remove film on top side of pad (covering cable gum surface) at this time.

5. The assembly of the bottom cover pad is now complete. Remove pad from the splice area.

E. Joining of belt ends

1. Prepare work area (bottom vulcanizer platen) with special release agent (mica dust, Mylar, Teflon treated glass fabric, etc.). If mica dust is used, care must be exercised to confine the dust to the vulcanizer surface only.

2. Remove film from the bottom cover pad (film adjacent to bottom cover surface).

3. Place pad onto vulcanizer (with bottom cover side adjacent to vulcanizer surface). Position and match lines B and C of the pad to the corresponding reference lines on one belt end. Remove Holland Cloth covering the area, between lines B and C. Carefully join these surfaces together. In a similar fashion, carefully match and join the area described by lines H and J on the other belt end.

4. Match cables from second belt end. Two men must work together in this operation, and sometimes two pairs of two men are used, one pair on each side of belt. This operation must be started at the center cable (if there is an odd number of cables in the belt) or the two center cables (if there is an even number of cables in the belt). Work must proceed from the center to the edge on both sides. If two men only are working, they start in center and then alternately match a pair of cables on one side of belt, then a pair on the other side. If two pairs of men are working, each pair will work on one side only. The procedure is as follows:

a) Locate center cable(s), in each end.

b) Mark cable from second end of belt just short on matching cable already cut from first end of belt.

c) Cut cable as marked.

d) Cable gum film still remains on top of the bottom cover pad. Remove this film as the cables are cut.

e) Apply one coat of cement to exposed cable gum surface. Apply second coat of cement to cover fill-in areas and all cables. (First coat has already been applied. See Steps C-20 and C-26). The tack of these cemented surfaces (cable and cable gum) will maintain the desired alignment of the cables until vulcanizer pressure is applied during the curing process.

f) Match, cut, and lay all remaining cables of second belt end. Proceed with the cables adjacent to the center cable(s) and alternately advance out toward both edge cables.

F. Completion of the splice buildup

1. Apply additional cable gum strips each side beyond edge cables to cover area out to edges of impact ply, cable gum, and bottom cover. Cement exposed surface of each cable gum insert. Apply to the appropriate locations at the belt edge, bonding to the cemented surface at the bottom cable gum layer. Stitch or roll surfaces. Remove film on top of cable gum inserts. Apply one coat of cement.

2. Prepare top cable gum layer. Cut cable gum to cover splice between Steps (lines C and H). Cement exposed surface of cable gum and apply on top of cables. Trim at Step lines C and H. Stitch or roll surfaces together. Remove film on top cable gum layer. Cement exposed surface.

3. Prepare top impact ply. Cut impact ply to also cover splice between Steps (lines C and H). Cement exposed surface of impact ply and apply on top of cable gum. Carefully trim step lines C and H. Stitch or roll surfaces together. Remove film top of impact ply. Cement exposed surface.

4. Trim edges of splice, making width about 1/4" less than width of original belt. Thus, cut each edge approximately 1/8" in from edges of cured belt outside of splice area. Apply one coat of cement on edges.

5. Prepare top cover (or top cover layers). Cut top cover stock to cover area slightly larger than that between cover fill-in lines A and K. Bevel one bias cut on either line A or K. Cement exposed surface of cover stock. Apply cover on top of impact ply filling precut bevel at one end, and carefully fitting and skiving the other end. Stitch or roll entire composite, including both cover fill-in junctions. Remove film on top side of cover stock. Trim edges of cover stock to trim width determined in Step F-5.

6. Edge buildup. Build up both edges with cover stock material to thickness desired (1/4" minimum). Skive excess flush with top surface of belt. The splice should be about 1/4" wider than the adjoining cured belt.

7. Prick the top cover with a sharp awl. Depth of pricking should extend down into cable structure.

8. Treat top cover and edges with special release agent. The following guides should be considered:

If mica dust is used,

a) lay a 3" wide strip of Holland Cloth (or equal) over both top cover fill-in seams.

b) dust top cover and edges with mica dust.

If Holland Cloth (or equal) is used instead of mica dust, lay Holland Cloth completely over top cover surface of splice.

This completes the buildup of the splice.

TABLE 14 CURE TIMES AND TEMPERATURES FOR STEEL CABLE CONVEYOR BELT

	BELT GRADE					
	RMA GRADE I II				NEOPRENE CABLE BELT	
	285 deg F CURE		300 deg F CURE		300 deg F CURE	
	Set platens at 285 deg F Count time from 280 deg F		Set platens at 300 deg F Count time from 295 deg F		Set platens at 300 deg F Count time from 295 deg F	
	Water Cool Down	Air Cool Down	Water Cool Down	Air Cool Down	Water Cool Down	Air Cool Down
1/2" to 5/8"	28	25	25	25	35	30
5/8" to 3/4"	30	28	28	25	38	33
3/4" to 7/8"	35	30	30	28	40	35
7/8" to 1"	40	35	35	30	45	40
1" to 1-1/8"	45	40	40	35	50	45
1-1/8" to 1-1/4"	50	45	45	40	53	48
1-1/4" to 1-3/8"	55	50	50	45	57	52
1-3/8" to 1-1/2"	60	55	55	50	60	55

Blair Rubber recommends 285 deg F for I and II belt, but recognizes some presses may be set at 300 deg F. At 300 deg F, greater care must be exercised to assure uniform platen temperatures and not to overcure the splice area. Overcuring of Longlife and Super Longlife cable gum is detrimental to the splice rubber strength. Platen uniformity should be within ± 5 deg F of the selected temperature.

The platen temperature should be set at the selected temperature and cure time counted from the time the platens reach 5 deg F below this temperature.

G. Curing (Single heat vulcanizer)

1. Vulcanizer platens must extend beyond the splice area not less than 4" on each end.

2. Position edge irons on bottom platen. Edge irons must be at least as long as the vulcanizer platens. They should also be set up to the same width as cured belt width. The edge irons to be used should be 1/16" to 3/32" thinner than the cured belt thickness. They should be at least 3" wide, and at least 6" longer than the vulcanizer length including cold ends. In use, the edge irons must be solidly backed up as the pressure on them will be much greater than that encountered with textile belts.

NOTE: If Holland Cloth (or equal) were used as the vulcanizer release agent rather than mica dust, place a strip of Holland Cloth over the edge iron surface which will contact the belt edge. Then apply edge irons flush against both edges.

3. Assemble top platens and other vulcanizer parts on top. Attach electrical connections and pressure system. Start heating.

NOTE: It is highly advisable to have thermometers inserted into the edge of platens (e.g. Weston Dial) as a check on platen temperatures. If a question exists in regard to platen temperatures, a thermocouple check should be made. Using a scrap piece of belt between platens and thermocouples on top and bottom belt surface is a reliable method of checking platen surface temperatures before proceeding with the splice cure.

4. Apply pressure as follows:

a) As heating begins, apply 50 psi. Then release pressure. *Such "cold pressing" is recommended operating procedure.*

b) Apply 50 psi until temperature reaches 150 deg F.

c) When temperature reaches 150 deg F, increase pressure to 100 psi.

d) When temperature reaches 200 deg F, increase pressure to 175 psi.

5. Carry the cure the required number of minutes using Table 12. Blair Rubber recommends 285 deg F for I and II belt, but recognizes some presses may be set at 300 deg F, greater care must be exercised to assure uniform platen temperatures and not to overcure the splice area. Overcuring of I and II cable gum is detrimental to the splice rubber strength. Platen uniformity should be within 5 deg. F of the selected temperature. Start timing cure when temperature has reached 5 deg F below the temperature selected from Table 14. This chart shows the curing times and temperatures, based on the grade of the belt and the belt thickness. Use the cured belt thickness when referring to this table.

6. When cure is completed, a water *"cool-down"* is recommended if available. If "air" cool -down is used, use the appropriate time from Table 12. Cool-down should be to *200 deg F or lower* before releasing the pressure.

7. Remove vulcanizer and any release agents that may remain attached to belt (e.g. Holland Cloth).

8. Inspect the splice. Trim edges and/or make any other appearance modifications as may be necessary. If a rubber hardness instrument is available (e.g. Shore A Durometer), check the rubber for uniformity of hardness. The splice is completed. The belt is operational at this point, although it is recommended that splice be allowed to sit at ambient temperature for two or three hours before subjecting it to operating tension.

TABLE 15 - OVERLAP SPLICE

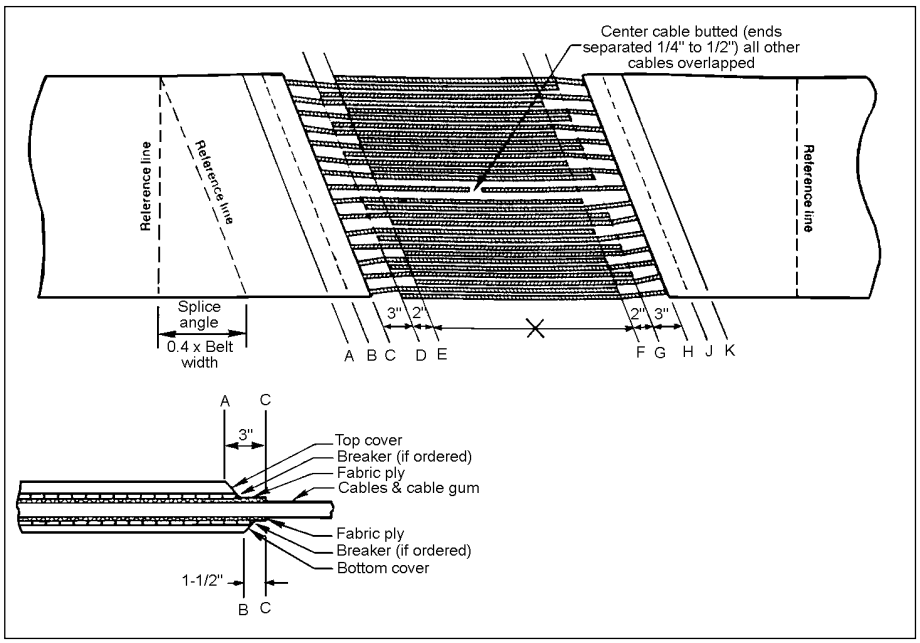
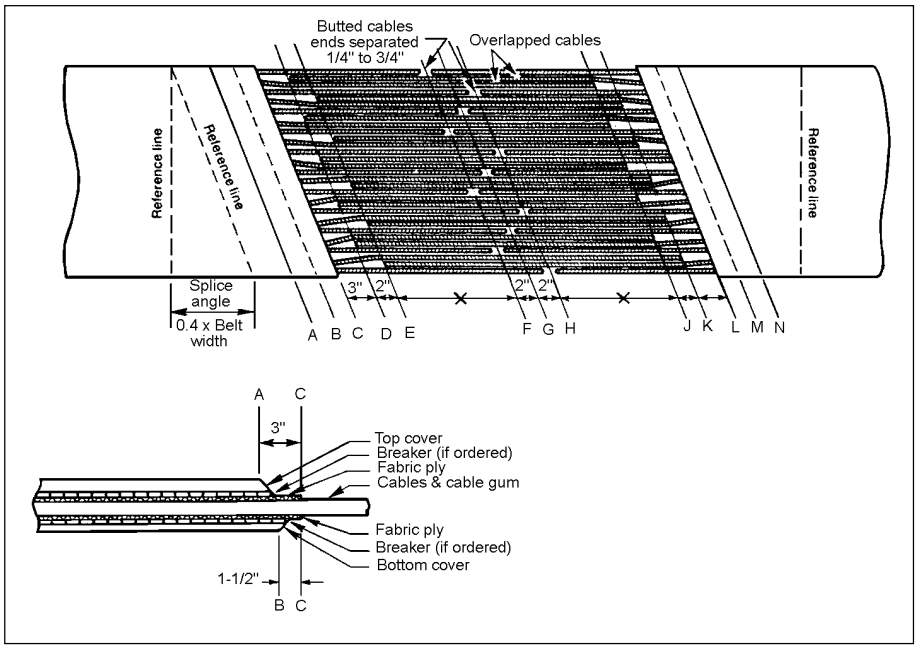


TABLE 16 - COMBINATION OVERLAP/BUTT SPLICE



NOTE: Rhombic shape of platens dictates splice angle.

Overlap splice

For many applications it is possible to make a shorter splice than the butt-step splice with steel cable belting. The overlap splice may be used where the cable spacing is wide enough to allow enough rubber between the lapped cables to provide the required high splice strength.

The overlap splice, where applicable, will produce an equally reliable splice to the butt-step splice.

Overlap splices are not recommended for belts rated higher than No. 2800.

Much of the procedure for the overlap splice is similar to the procedure for this butt-step splice. Therefore the procedure for the overlap splice is abbreviated by reference to the butt-step splice procedure where such duplication exists.

Both procedures are almost identical except for splice buildup. Two additional charts are required. These are tables 15 and 16.

A. Belt replacement on table and establishment of center line. (Table 10 and 11).

The procedure is identical to the butt-step splice (pages 30 - 34).

B. Laying out splice area (Table 11 and 15 or 16).

The procedure is identical to the butt-step splice (page 31) except Table 15 or Table 16 will be used instead of Table 12.

C. Stripping of belt ends.

Follow the same procedure as for the butt-step splice steps 1 though 13. Refer to Table 15 or Table 16 instead of Table 12.

Omit steps 14 through 18.

Build up Splice - The belt ends must be clamped in the proper relative position, and not moved, during splice build-up. Do not tension the splice. Follow same "Instructions for use of Cements and Solvents" detailed on pages 32 - 33 for butt-step splice.

1. Clean entire splice area, including cables, with solvent.

2. With belt ends in position, determine exact dimensions required for bottom cover, bottom breaker (if included), bottom fabric ply, and bottom layer of cable gum.

3. Cut bottom cover, bottom breaker if included, bottom fabric ply, and bottom layer of cable gum to size as determined in step 2 above, with ends of cover leveled.

4. Assemble bottom cover, bottom breaker if included, bottom fabric, and bottom layer of cable gum.

5. Lay belt ends back.

6. Clean bottom cover fill-in areas on belt ends with solvent, and cement, two coats.

7. Lay bottom cover assembly on work table in proper location. Place a 3" strip of Holland under the ends of the bottom cover, with half of Holland extended beyond ends.

8. Fit one belt end to bottom assembly. Start at one side and work across, carefully fitting both the fabric step and the cover.

9. Fit other belt end to bottom assembly, again carefully fitting the fabric and cover steps.

10. Cement cables, two (2) coats.

11. Lay cables. Refer to Table No. 15 or 16, whichever is appropriate for pattern of cable placement. Details are as follows:

a) Number the cables. Apply a strip of masking tape or similar material along the fabric step line, both ends. Number the cables on the masking tape. This will help assure that corresponding cables from the two belt ends are located in the proper relationship in the splice.

b) Cement cable gum surface on bottom assembly two coats.

c) Lay center cable. In both Tables No. 15 and 16, center cables are butted. Always start with the center cable. If the belt has an even number of cables start with one of the two center cables. Butt the center cable at the proper line as indicated in Tables 15 or 16, leaving 1/4" to 1/2" gap between the cable ends. Fill the 1/4" to 1/2" gap with a piece of cable gum strip.

d) Continue laying cables on each side of the center cable. When applying the Table 15 layout, this will involve overlapping all the cables. When applying the Table 16 layout, this will involve alternately overlapped and butted cables. If one man only is doing the work, he should alternate sides, first laying a cable on one side of the center cable, then laying a cable on the other side of the center cable.

e) Check cable alignment regularly, at least once each six cables. Check alignment with a straightedge. If cable buildup is becoming wide, butt an additional cable. Alignment should never be off more than the width of one cable. Additional butted cables are permissible in the Table 15 layout no more frequently than every 12th cable. The cables should be butted approximately midway between lines E and F. In Table 15, additional butted cables are permissible once every ten cables. The cables in this case should be butted not at lines F, G or H, but rather alternately at lines D, E, J or K.

f) Fill in voids at ends of cables. After all the cables have been laid, there will be voids between line C and E (Tables 15 and 16) and between F and H in Table 15 or J and L in Table 15. These are the areas between the ends of the overlapped cables and the fabric step lines. Fill these voids with appropriate quantities of cable gum strips.

12. Complete remainder of splice buildup using same procedure as specified for the standard type splice. Refer to Page 34, steps F1 through F8 (Table 15 or 16).

Curing - Short splices are cured in exactly the same manner as are standard splices with the one exception of tensioning. Refer to section G, but disregard the instructions for tensioning the splices during cure.

Steel Cable Belt Appendix A

Special procedure for preparing cable surface for I, II and FR-SBR cable belts (i.e., general purpose belts, but not neoprene or other special polymer belts).

When splicing or repairing used brass steel cables with minor exposed cable but no rust or corrosion, apply C-636 and C-637 cement to the original rubber that is still bonded to the cables.

When splicing or repairing used brass steel cables with major bare metal or where some corrosion or other cause have exhibited loss of adhesion of the rubber, use the procedure below.

Procedure - bare cables

A. Buff all rust and rubber from cables.

B. Wipe and clean buffed cables with isopropyl alcohol or ethyl alcohol which can be obtained from local sources.

C. Apply heat (mild heat gun) to dry.

D. Degrease by wiping thoroughly with solvent R587T.

E. Allow to dry. Apply heat (mild heat gun) under moist conditions.

F. Apply one coat Thixon OSN-2 cement to bare cables.

G. Allow to dry. Apply heat (mild heat gun).

H. Keep clean.

I. Proceed with standard splicing procedure, which includes a lightly applied coat of Grade C cement over the dry OSN-2 cement.

Note: The key to a successful resplice

is to not have any C-636 and C-637 applied to bare cables. The presence of OSN-2 on rubber surfaces is okay.

SPLICING STEEL CABLE BELTS WITH UNEQUAL NUMBER OF CABLES

It is possible to reliably splice together steel cable belts with unequal numbers of cables (different cable spacing).

It is also possible to reliably splice steel cable belts with modest differences in cable diameters using the sheeted cable gum method of splicing.

Where an unequal number of cables exist, the simple overlap splice shown in Table 15 page 35, should be used.

The only limitation is that we must have approximately a 3/32 inch gap between cables in the assembled splice.

The space between cables in a simple overlap splice after assembly can be calculated as follows:

$$\text{space between cables} = \frac{(BW - 1.5) - (N_1 d_1 + N_2 d_2)}{N_1 + N_2 - 1}$$

where, BW = Belt width (3/4" edge cap is assumed)
N_1 = No. of cables in belt 1
d_1 = Cable diameter of belt 1
N_2 = No. of cables in belt 2
d_2 = Cable diameter of belt 2

For example:

It is desired to splice belt 1 with 80 cables, 1/4 inch in diameter into belt 2 with 91 cables, 7/32 inch in diameter. The belts are 60 inches wide.

The spacing between cables in a simple overlap splice after assembly will be:

$$\text{space between cables} = \frac{(BW - 1.5) - (N_1 d_1 + N_2 d_2)}{N_1 + N_2 - 1}$$

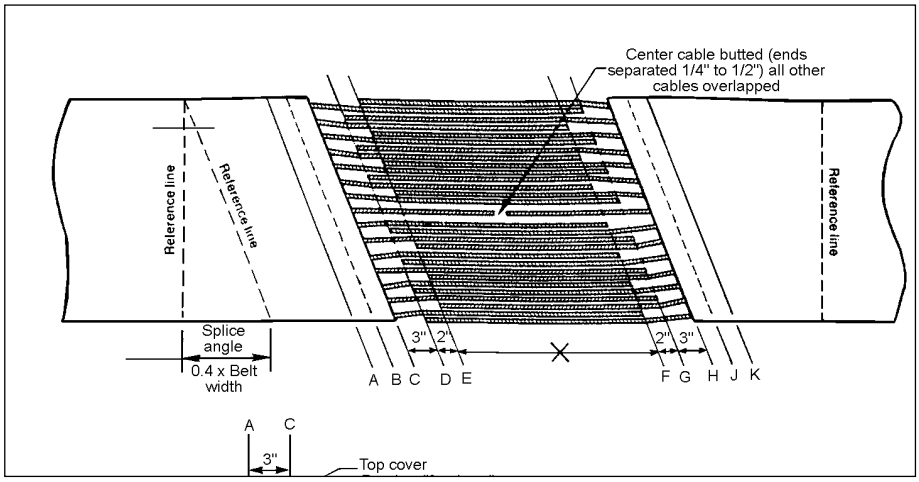
$$= \frac{(60 - 1.5) - (80 \times .25 + 91 \times .219)}{80 + 91 - 1}$$

$$= \frac{58.5 - 39.9}{170}$$

= .109 inches

This is greater than 3/32 inch, so a simple overlap splice can be made with the following exception.

Since there are 11 more cables in belt 2, two cables from belt 2 must be introduced together in the lapping eleven times.



Determine the point at which doubling up of the cables from belt 2 will occur as follows:

$$\text{interval} = \frac{N_1}{N_2 - N}$$

where, N_1 = No. of cables in belt with least no.

N_2 = No. of cables in belt with greatest no.

therefore,

$$\text{interval} = \frac{80}{91 - 80} = 7.27 \text{ (use 7)}$$

After every seventh cable in the 80 cable belt, two cables will be inserted from the 91 cable belt.

The entire splicing procedure will be the same as for a conventional overlap splice including butting an occasional pair of cables if the center of the splice begins to become wider than the ends during assembly.

SPLICING LIGHT-WEIGHT BELTS

The splicing procedure is the same as shown for fabric belts without breakers with the following exceptions:

1. Laying out: Use a 4" long step. For belts with covers remove 1/2" of cover from each end plus allowance for trim to provide for a one-inch fill-in strip.

2. Cover fill-in: Undercut both edges of cover at fill-in. No lightweight breaker fabric is used over butt joint seams in the outer fabric plies.

3. Curing splice in vulcanizer: Use polished steel or aluminum plate in vulcanizer to obtain surface in splice comparable to top cover of belt.

Repairing conveyor and elevator belts

Minor repairs

Minor vulcanized repairs to covers. A minor repair is one that involves only the belt cover and breaker, and usually is of small area.

Materials needed for minor vulcanized repairs: Cement. Cover stock to match that in belt. Uncured breaker fabric or transcord breaker if this is to be replaced. Solvent. Holland cloth. Repair materials are same as for splicing.

Tools for cover repairs include most of those employed in splicing (page 14).

1 - If repair area is not large, make it any convenient shape except square when cleaning out damaged material. If it is of considerable size, make it approximately diamond-shaped. Trim two edges of repair cavity parallel to belt edges. Position leading and trailing edges at a 20 deg to 22 deg bias. Layout of this diamond is same as for that shown in Fig. Z.

2 - Cut out snagged or loose portion of cover. Hold knife so cut edges make 60 deg angle with belt surface. Safest way is to cut almost through cover - within 1/64" of fabric. When damaged portion of cover is pulled loose, uncut 1/64" will tear through to fab-

ric.

3 - Clean loose particles from repair area. Use prodder to remove adhering patches of rubber. With coarse emery cloth, buff thoroughly the cut edges of rubber and clean the fabric. If carcass is wet, use hot-air blower or heat from vulcanizer to drive out moisture; heat lamps can be used, but with caution to avoid overheating. Buff dried fabric lightly with emery cloth to raise nap.

4 - Apply two coats of cement to exposed fabric and beveled edges of rubber allowing first to dry thoroughly, second until tacky.

5 - Fill cavity with uncured cover stock, making it level with surrounding rubber. If one thickness of cover stock is insufficient, apply successive layers; increase tackiness of layers already placed by applying cement or solvent. Roll each layer into good contact. Deflate blisters.

6 - Place Holland cloth over repair area, letting it extend 1/2" each way. This increases vulcanizer pressure and produces a smooth job.

7 - Vulcanize repair without delay. Have vulcanizer heated to curing temperature beforehand. Length of cure is same as for splicing, as shown in Table 7.

8 - Trim off loose overflow by buffing with coarse emery cloth.

Major repairs

In a major belt repair, material is replaced in belt carcass as well as in cover. The variety of such repairs is so great that definite instructions to cover all cases cannot be given, the following suggestions are to be regarded as general - to be supplemented, when necessary, by good judgement.

Materials needed for major belt repair: Fabric and cord ply materials - Fabric is sold in strips with warp threads running lengthwise. When placing fabric in belt, use weight to match original ply, grade to match rubber. Put skim coat toward belt. Place fabric so warp threads, which are tension members, parallel belt edges. Transcord breaker should be positioned with its tension members (cords) crosswise belt. Tie gum - use proper grade, thickness. Cement - use grade to match rubber.

Tools: Same as for splicing. Splice or repair? First decide on proper procedure: Can belt be repaired successfully? Or should affected portion be cut out and a new splice made, or a new section spliced in?

TABLE 22 - FACTORS DETERMINING WHETHER BELT SHOULD BE CUT AND SPLICE OR REPAIRED.

Conditions					What to do		
Extent of cut or repair							
Percent of belt width affected	Percent of strength loss				Repair	Repair or Splice	Splice
5 10 15 and over	30 45 52				X	X	X
Operating tension - Percent of belt manufacturer's rating up to 45% 45% to 65% 65% to 100%					X	X	
Starting conditions							
Starting is	Belt is		Kind of starting				
	Loaded	Empty	Across-the-line (1)	Controlled (2)			
Infrequent -	X		X		X		
three times		X	X		X		
per day or	X			X	X		
shift		XX		XX	X		
Frequent -	X		X				X
more than four		X	X		X		
times per day	X			X		X	
or shift		X		X	X		

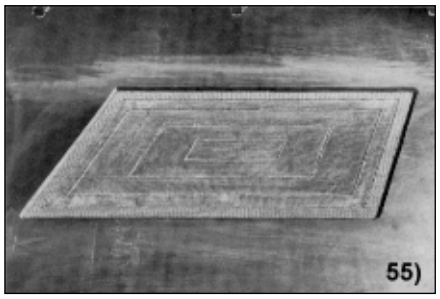
(1) - Across-the-line starting (applying full-load starting characteristics of motor to belt may range up to, sometimes beyond, 200 percent of motor horsepower.
(2) Controlled starting is where torque applied does not exceed 150 percent of operating torque.

These factors help determine whether or not a major repair is advisable: Amount of belt width affected by cut. Operating tensions. Starting characteristics of loaded belt. Frequency of starts or stops. Such factors are the basis for Table 22.

Using table: If all three conditions in Table 22 - extent of cut, operating tension, starting conditions - show "repair," a repair should prove satisfactory. If any one condition shows "splice," do not attempt repair; instead, remove affected belt section and resplice. A "repair or splice" condition requires the use of careful judgement in selecting proper treatment.

Edge repairs: When a repair at or near belt edge is quite long, pressure applied to the new stock during vulcanization causes that side of belt to elongate. Also, replacement fabric will not have same stretch characteristics as original. Consequently, repaired belt may have one edge longer than other, and thus tend to run to one side.

Making repair from one side only: Cut and remove damaged cover and carcass plies. See photo 55. When damage does not extend all the way through belt, this can be done from one side only. Use same tools and



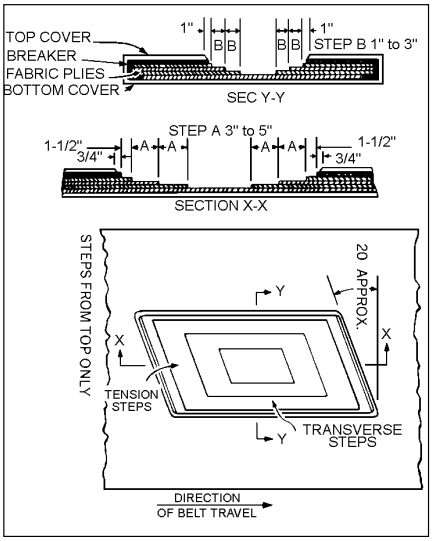


Fig. Z - Major belt repair from one side (belt surface).

methods as when stepping-down a belt for splicing.

Figure Z shows belt preparation for repair from one side only. The "diamond-shaped" cavity is positioned as described for minor vulcanized repairs with leading and trailing edges on a bias angle of about 20 deg. Steps whose longer dimensions parallel direction of belt travel (Y-Y, Fig.Z) are shorter than those on bias angle (X-X, Fig. Z). Steps marked "A" in same figure are called tension steps because they are under tension when belt operates. They are made longer than the transverse steps.

Making repairs from both sides of belt: Figure BB shows a major repair in which carcass is stepped from both

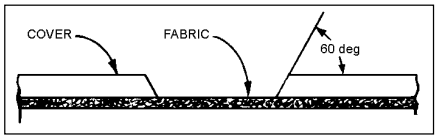


Fig. BB - Section through minor repair cavity showing rubber beveled to 60 deg.

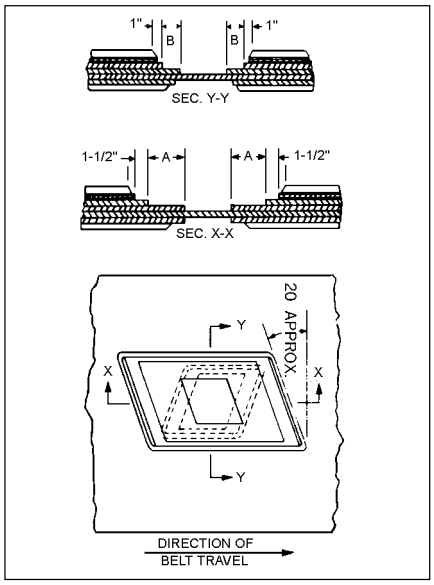


Fig. AA - Major belt repair from both sides (belt surfaces).

belt surfaces. Less area is needed for stepping than when repair is from only one side.

Cut tension steps on opposite bias angles. Their lengths depend on belt operating tension, but usually are 3" to 5". Transverse steps "B" range from 1" to 3", the greater length being desirable when loading conditions are severe. Stagger transverse steps with respect to similar steps on opposite side of belt, so no two are exactly opposite each other.

Repairing slit or break running lengthwise: Make repair from both sides of belt. Stagger the transverse steps. Cut tension steps on an alternate bias, as shown in Fig. CC.

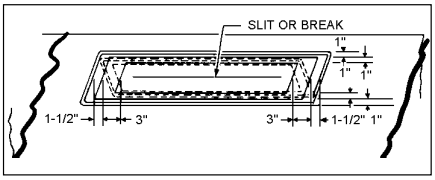


Fig. CC - Repair of long slit or break running lengthwise belt.

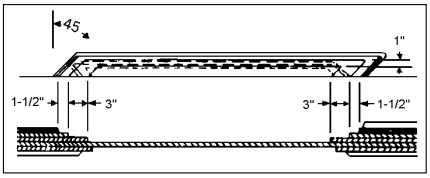


Fig. DD - Repair at belt edge.

Edge repair: When damage is at belt edge, use the same diamond principle as for the previous methods. Make steps from both belt surfaces, staggering them for greater strength. Form the steps by cutting along lines which are about 45 deg. to belt edge (See Fig. DD). To obtain good adhesion of new edge cover stock, extend breaker fabric around repaired carcass edge.

In stepping-down for a repair involving part of carcass, you will remove successively smaller pieces of fabric. When laying out the repair, determine size of last ply that is to be removed, so all damage will be included. Or you can make a small cavity at first, then enlarge it as required.

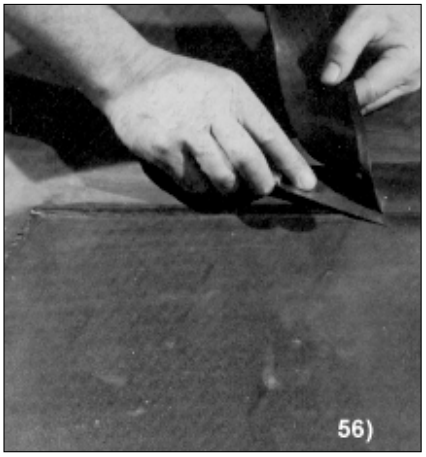
Remove all skim-coat rubber from steps. Buff fabric lightly with emery cloth to raise nap.

Rebuilding repair area:

1 - After stepping-down and cleaning have been completed, dry exposed fabric with heat lamp or hot-air blower if break had admitted water. Brush two cement coats on steps and rubber edges of repair cavity, allowing first to dry thoroughly, second until tacky. Apply one light coat of cement to skim-coat side of piece of fabric that is to be placed first, and let dry until tacky. This piece should be somewhat larger than area it is to occupy.

2 - Position repair fabric in repair cavity. Roll it into good contact. With prodder or stitcher, force new fabric into position along edges of original fabric.

3 - With bevel-point knife, trim off excess material. Edges of new fabric

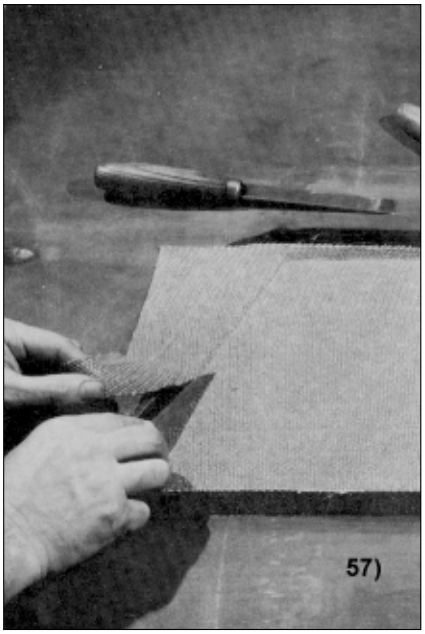


should make neat butt joint with edges of original ply. See Photo 56.

4 - Brush light coat of cement over surface of newly-placed fabric and over skim-coated side of next repair piece. Let dry until tacky.

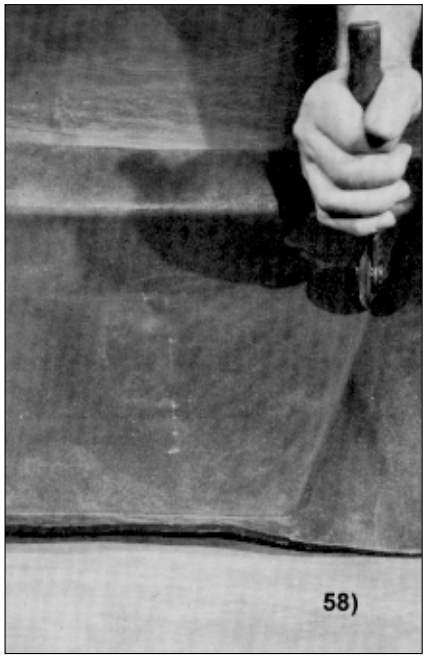
5 - Apply second repair ply as before. Repeat until cavity has been filled to breaker ply.

6 - Install new breaker fabric or transcord breaker in same way as



other fabric plies. Cords must run crosswise belt at right-angles to edges. Trim off excess with bevel-point knife.

7 - Brush coat of cement on breaker and let dry until tacky. Remove polyethylene film from piece of cover stock, and brush light coat of cement on rubber. Apply cemented surface of cover stock to repair area. Roll firmly. Force edges into place with stitchers in photo 58.



8 - Trim off excess rubber with bevel-point knife. See photo 59. Puncture air pockets.

9 - If another thickness of cover is required, cement one already placed, and repeat operation. Build up cover 1/64" to 1/32" higher than surrounding area. Where repair depth extends several plies and from one side only, build-up should be 1/32"

10 - Cover the area of repair with Holland cloth or linerette paper 1/2" larger all around than filled area. Cure in vulcanizer. Remove cloth or paper after curing. With abrasive paper, trim off any rubber overflow not adhering to surrounding cover.

Vulcanizing repair: Small, portable vulcanizers are available for curing repairs, or a splicing vulcanizer can be used. Use a two-platen vulcanizer for any repair whose over-all depth (thickness) is more than 5/16". As in splicing, undercuring in belt repairing results when vulcanizer develops a cold spot. To complete the cure when this occurs, shift vulcanizer and cure area that was under cold spot. Most present-day rubber compounds will stand three to five curing heats before their strength and other properties are affected.

For further information about vulcanizing equipment and operating, see page 15.

Standard Tie Gums Available For Textile Belt Splicing And Repair Materials

GRADE	GAUGE	WIDTH	LENGTH	PRODUCT NO.
HI-T	.010”	9”	5 YDS.	30000
HI-T	.020”	9”	5 YDS.	30001
HI-T	.030”	9”	5 YDS.	30002
HI-T	.045”	9”	5 YDS.	30003
HI-T	.010”	18”	10 YDS.	30100
HI-T	.020”	18”	10 YDS.	30101
HI-T	.030”	18”	10 YDS.	30102
HI-T	.045”	18”	10 YDS.	30103
HI-T	.060”	18”	10 YDS.	30104
S	.010”	9”	5 YDS.	30200
S	.020”	9”	5 YDS.	30201
S	.030”	9”	5 YDS.	30202
S	.045”	9”	5 YDS.	30203
S	.010”	18”	10 YDS.	30300
S	.020”	18”	10 YDS.	30301
S	.030”	18”	10 YDS.	30302
S	.045”	18”	10 YDS.	30303
S	.060”	18”	10 YDS.	30304
H	.020”	9”	5 YDS.	30401
H	.030”	9”	5 YDS.	30402
H	.020”	18”	10 YDS.	30501
H	.030”	18”	10 YDS.	30502
B	.020”	9”	5 YDS.	30601
B	.030”	9”	5 YDS.	30602
B	.020”	18”	10 YDS.	30701
B	.030”	18”	10 YDS.	30702
BNI	.020”	9”	5 YDS.	30801
WNI	.010”	9”	5 YDS.	30900
WNI	.020”	9”	5YDS.	30901

Standard Cover Stocks Available For Textile Belt Splicing And Repair Materials

GRADE	GAUGE	WIDTH	LENGTH	PRODUCT NO.
C	1/32”	18”	2 1/2 YDS.	31000
C	1/32”	18”	10 YDS.	31001
C	1/16”	18”	2 1/2 YDS.	31002
C	1/16”	18”	10 YDS.	31003
C	1/8”	18”	2 1/2 YDS.	31004
C	1/8”	18”	10 YDS.	31005
C	3/16”	18”	2 1/2 YDS.	31006
C	3/16”	18”	10 YDS.	31007
S	1/32”	18”	2 1/2 YDS.	31100
S	1/32”	18”	10 YDS.	31101
S	1/16”	18”	2 1/2 YDS.	31102
S	1/16”	18”	10 YDS.	31103
S	1/8”	18”	2 1/2 YDS.	31104
S	1/8”	18”	10 YDS.	31105
S	3/16”	18”	2 1/2 YDS.	31106
S	3/16”	18”	10 YDS.	31107
H	1/16”	18”	2 1/2 YDS.	31201
H	1/8”	18”	2 1/2 YDS.	31202
H	3/16”	18”	2 1/2 YDS.	31203
EP	1/32”	18”	2 1/2 YDS.	31300
EP	1/16”	18”	2 1/2 YDS.	31301
EP	1/8”	18”	2 1/2 YDS.	31302
EP	3/16”	18”	2 1/2 YDS.	31303
B	1/32”	18”	2 1/2 YDS.	31350
B	1/16”	18”	2 1/2 YDS.	31351
B	1/8”	18”	2 1/2 YDS.	31352
B	3/16”	18”	2 1/2 YDS.	31353
BNI	1/32”	18”	2 1/2 YDS.	31450
BNI	1/16”	18”	2 1/2 YDS.	31451
BNI	1/8”	18”	2 1/2 YDS.	31452
BNI	3/16”	18”	2 1/2 YDS.	31453
WNI	1/32”	18”	2 1/2 YDS.	31500
WNI	1/16”	18”	2 1/2 YDS.	31501
WNI	1/8”	18”	2 1/2 YDS.	31502
WNI	3/16”	18”	2 1/2 YDS.	31503

Standard Breaker Fabrics, Holland Cloth & Cements Available Textile Belt Splicing And Repair Materials

GRADE	TYPE	WIDTH	LENGTH	PRODUCT NO.
C/S	MULTIWARP #12	9”	2 1/2 YDS.	32200
C/S	MULTIWARP #12	9”	10 YDS.	32201
C/S	MULTIWARP #12	50”	50 YDS.	32202
C	LIGHT WT.. (011)	19”	2 1/2 YDS.	32213
C	LIGHT WT.. (011)	19”	10 YDS.	32214
BARE	LIGHT WT.. (011)	19”	2 1/2 YDS.	32218
BARE	LIGHT WT.. (011)	19”	10 YDS.	32217

Scab Fabric - Grade C/S

GRADE	WIDTH	ROLL LENGTH	QUANTITY	PRODUCT NO.
C-MULTIWARP 300	54”	2 1/2 YDS.	1 RL. MIN.	33200

Miscellaneous Products

DESCRIPTION	WIDTH	LENGTH	SIZE	PRODUCT NO.
SOLVENT R-587-T			GAL.	32250
SOLVENT R-587-T			5 GAL.	32251
HOLLAND CLOTH	40”	10 YDS.		32252
HOLLAND CLOTH	40”	50 YDS.		32253

Splicing Cements

GRADE	SIZE	PRODUCT NO.
B636/637 2 PART	QUART	32300
B636/637 2 PART	GALLON	32301
GRADE S	QUART	32308
GRADE S	GALLON	32309
GRADE S	50 GALLON	32310
GRADE H	QUART	32320
GRADE H	GALLON	32321
GRADE B	QUART	32330
GRADE B	GALLON	32331
BNI	QUART	32340
BNI	GALLON	32341
WNI	QUART	32350
WNI	GALLON	32351
OTP	QUART	32380
OTP	GALLON	32381
EP (EPDM)	QUART	32390
EP (EPDM)	GALLON	32391
THIXON OSN2	QUART	32370
THIXON OSN2	GALLON	32371
900R + ACTIVATOR	GALLON	6115

Glossary

Adhesion: strength of bond between cured rubber surfaces.

Bag cure: a method of vulcanization where a flexible air-bag is used to impart positive pressure to splice or repair being vulcanized.

Beveled: cutting of rubber at an angle.

Bias angle: a cut of belt end or fabric made diagonally at an angle of less than 90 degrees to the longitudinal axis.

Blow-up: a blister caused by trapped air between rubber and fabric or between fabric plies.

Breaker fabric: an open-mesh fabric to improve adhesion between cover and carcass.

Buffing: to grind or rub surface of rubber to produce a roughened surface.

Butt seam: a seam made by placing the two pieces to be joined edge to edge.

Carcass: the fabric or cable reinforcing section of belt.

Center line: accurately measured line equal distance from each edge of belt.

Cover: outer rubber covering to give protection to carcass.

Cure: the process of vulcanization.

Cure time: the time required to produce vulcanization at a given temperature.

Edge irons: strips of wood or metal to provide pressure on edges of belt while splice or repair is vulcanized.

Filler thread: the transverse strength member in a woven fabric.

Fire resistant: retards the burning action of fire or flame.

Folded edge: a belt construction with envelope ply so carcass is closed on edges.

Friction: a rubber compound applied to and impregnating a fabric.

High tension: relates to fabrics designed to operate at tensions over 70 pounds per inch per ply.

Holland cloth: a sheeting cloth to which has been applied a glazed finish; used over uncured rubber during vulcanization.

Net endless length: the manufactured length necessary to provide adequate service under operating conditions.

PCB: Polyester and cotton blended fabric.

Platens: heated plates in belt vulcanizer.

Ply: a layer of rubberized fabric.

Ply adhesion: the force required to separate two adjoining strength reinforcing members in a rubber belt.

Reduced ply: High tension fabric to reduce plies necessary.

Skim coat: a layer of rubber laid on a frictioned fabric.

Skive: a cut made on an angle to the surface to produce a tapered or feathered cut.

Tie gum: a thin rubber sheet to replace original friction and skim coat between fabric plies when making splices or repairs.

Transverse cord breaker: a breaker fabric with heavy transverse cord members.

Vulcanization: the process of applying heat and pressure to rubber compounds.

Warp: the yarn that runs lengthwise in a woven fabric.

Weft: the crosswise thread in a fabric - the filling threads.