

SECTION REPAIR OF BIAS AND RADIAL PLY OFF-THE-ROAD TIRES* IN A FULL SERVICE REPAIR FACILITY *SIZES 16.00 AND LARGER

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I. INTRODUCTION

The purpose of this Recommended Practice (RP) is to provide step-by-step procedures for performing section repairs to bias and radial ply off-the-road (OTR) tires, sizes 16.00 and larger, that are to be returned for continued service. These industry approved guidelines have been prepared for use by full service repair facilities.

II. BIAS PLY OTR TIRES

A. Inspection

1. Careful inspection of tires is of utmost importance and should be done under adequate lighting (i.e., 200 footcandles (fc)/2153 lux (lx) minimum, 300 fc/3229 lx recommended) at the work surface, so that the interior and exterior of the tire is adequately exposed for visual and manual examination of all cuts, breaks, and punctures.
2. All tires should be clean and dry both inside and outside, and allowed to reach a minimum room temperature of 65°F. Tires must be secured using a tire stand before starting work.
3. Tires with the following conditions or injuries should be rejected. Note: this is not a complete list.
 - a. Damage due to underinflation or being run flat
 - b. Body ply separations

- c. X-breaks and damage beyond repairable limits
- d. Rubber deterioration

B. Permissible Repairs

1. Tires may be repaired in the crown, shoulder, and sidewall areas.
2. Maximum repair dimension for bias ply OTR tires typically should not exceed 1/3 of the cross section of the tire in any direction. Always refer to repair materials manufacturer for specific repair limits.
3. Each repair must be evaluated using the following guidelines:
 - a. Service requirement of the tire including: load, speed, and front or rear wheel application
 - b. Overall condition of the casing
 - c. Location of the injury
4. Satisfactory section repairs cannot be made in the bead area "A" (see Figure 1). To determine the non-repairable bead area, measure with a flexible rule and follow the contour of the tire.



Figure 1

SECTION REPAIR OF BIAS AND RADIAL PLY OFF-THE-ROAD TIRES IN A FULL SERVICE REPAIR FACILITY

| BIAS TIRE SIZE | NON-REPAIRABLE BEAD AREA "A" | |
|--|------------------------------|-------------|
| | INCHES | MILLIMETERS |
| 16.00, 18.00 | 5" | 125 mm |
| 21.00, 24.00 | 6" | 150 mm |
| 27.00, 30.00, 33.00 | 8" | 200 mm |
| 36.00, 40.00 | 12" | 305 mm |
| 17.5 | 4" | 100 mm |
| 20.5, 23.5 | 5" | 125 mm |
| 26.5, 27-56.5, 29.5, 30-56.5, 30/65, 33.25 | 6" | 150 mm |
| 33.5, 33-59.5, 35/65, 36-59.5, 37.25, 37.5, 39-59.5 | 8" | 200 mm |
| 40/65, 41.25/70, 45/65, 50/65, 53.5, 55.5, 58, 65/65 | 12" | 305 mm |
| The above dimensions are guidelines only. | | |

C. Preparation of Injuries

1. Cut away all loose rubber with a skive knife, and remove rubber around the injury with a rotary gouger on a low-speed (i.e., 5,000 rpm maximum) buffer, before starting the repair (see Figure 2).



Figure 2

2. Taper skive the body plies with a knife at approximately a 45-60 degree angle in the sidewall, and approximately a 30-45 degree angle in the tread area, and buff to achieve a TRMG BT3 buff texture (see Figure 3 and RP 01/02-23 "BTS6 - Standard Buffing Textures for Tire Retreading and Repairing").



Figure 3

3. Cut away fabric plies with a tungsten carbide rasp using a low-speed (i.e., 5,000 rpm maximum) buffer.
4. Cut fabric plug with a knife, and inspect the plug to ensure the complete removal of damage (see Figures 4 and 5).



Figure 4



Figure 5

5. Remove scorched rubber with a coarse brass wire brush on a low-speed (i.e., 5,000 rpm maximum) buffer to achieve a TRMG BT3 buff texture (see Figure 6).

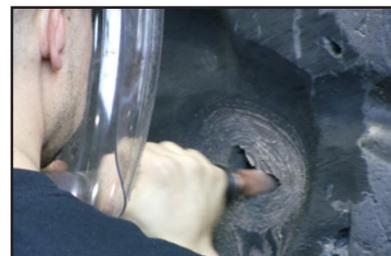


Figure 6

SECTION REPAIR OF BIAS AND RADIAL PLY OFF-THE-ROAD TIRES IN A FULL SERVICE REPAIR FACILITY

Doing so will allow for maximum surface contact with the fill rubber. Inspect the damaged area and look for separations and additional damaged body plies.

6. Clean the buffed area with a brass wire brush and vacuum to remove all loose particles.
7. Measure the injury across the widest point of the ply with the greatest amount of damage. Then measure the depth of the injury and record the measurements on the sidewall of the tire.

D. Repair Unit Selection and Preparation for Installation

1. Follow repair material manufacturer's recommendations for proper repair unit selection.
2. Before marking out an area for the repair unit, clean an area slightly larger than the repair unit to remove contaminating lubricants from the inner liner surface.
3. Using a tire crayon, mark the centerline of the injury drawing toward the bead, then draw another line perpendicular to the first (see Figure 7). These lines should be used to center the repair unit over the skive.



Figure 7

Center the selected repair unit or a template over the injury, and outline the perimeter (see Figure 8). Remove the repair unit or template and draw a line 1" (25 mm) smaller and 1" (25 mm) larger than the repair unit or template

(see Figure 9 - "A" and "B") to ensure that crayon marks are not removed when buffing.



Figure 8

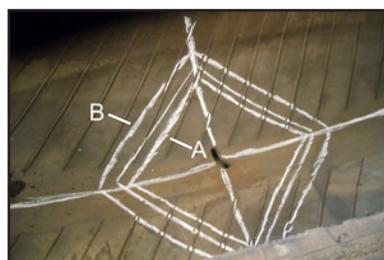


Figure 9

4. Buff the innerliner within the marked area ("A") using a low speed (i.e., 5,000 rpm maximum) buffer, to achieve a TRMG BT1 buff texture (see Figure 10). Take care not to expose or damage any body cords. A change in the color of the rubber can typically be observed as you get close to the body plies. Preparing the tire in this manner will allow for good adhesion of the repair materials.

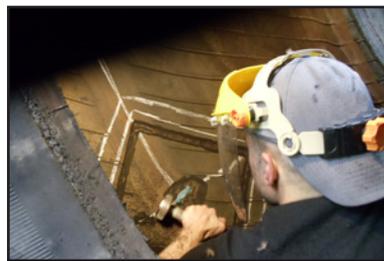


Figure 10

NOTE:

The tires of some manufacturers need to have the two inner plies also removed in order to ensure a good bonding surface. For specific information, contact the Off-The-Highway Tire Development Department of the manufacturer of the tire.

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5. Taper-buff the innerliner between perimeters "A" and "B" to a 60 degree angle to prepare the area for rubber adhesion (see Figure 11).



Figure 11

E. Repair Material Application - Uncured Repair Units

1. Remove any rubber dust and contaminants from the buffed area with a soft brass wire brush, and vacuum to provide a clean, dry surface.
2. Apply one coat of "brush-type" black vulcanizing cement to the texturized surfaces, both in the skive and inside the tire (see Figures 12 and 13).



Figure 12



Figure 13

3. Before filling the skive with rubber, install four vent cords to evacuate trapped air from the injury (see Figures 14 and 15). Vent cords should be a small diameter cotton cord or other suitable

bleeder cord. Place the cords in the skive so that the ends extend through the skived area and 2/3 of the distance to the edge of the patch buff. If the tire is to be retreaded, cords should extend beyond the tread buff area. Venting is recommended in all curing systems including open steam "kettles".

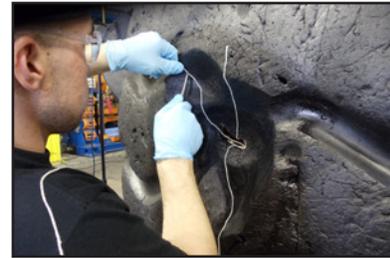


Figure 14



Figure 15

4. Cover the entire area within perimeter "B" with a "floaters" cushion of 1/16" (1.5 mm) gauge or 1/8" (3 mm) gauge all purpose cushion gum. Stitch the cushion gum down with a stitcher working from the center out to avoid trapping air.
5. Slit across the middle of the protective poly film backing on the bottom of the repair unit. Fold the backing at the slit to expose 3" (75 mm) to 4" (100 mm) of cushion. Apply the repair unit by centering it over the skive with the position arrows pointing towards the beads (see Figure 16).

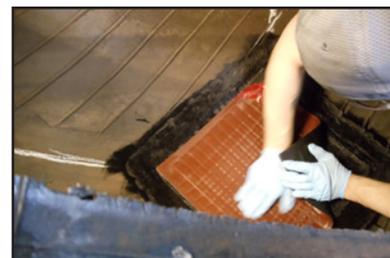


Figure 16

Using a serrated stitcher, firmly stitch down working from the center of the repair unit out. Remove the remaining backing a few inches at a time, and stitch. Continue until all backing has been removed and the repair unit is completely stitched to the tire.

6. Remove the poly film covering from the top of the repair unit.
7. Apply strips of butyl rubber, making sure to overlap the repair unit and the over-buffed area of the repair unit, then stitch to remove air (see Figure 17).



Figure 17

8. Line the skive area with a layer of cushion gum and stitch thoroughly. Fill the skive area with cushion gum or extruded rubber (see Figure 18). Fill and stitch at regular intervals to avoid trapping air.



Figure 18

F. Repair Material Application - Chemical Cure Repair Units

Precured or chemical repair units are to be used when the repair or reinforcement is cured with the retread in a retread mold, or when the repair plug is cured with a C-clamp or spotter.

1. Remove any rubber dust and contaminants from the buffed area with a soft brass wire brush, and vacuum to provide a clean, dry surface.
2. Apply a coat of chemical vulcanizing cement and let dry thoroughly. A second coat may be required. Refer to the manufacturer's recommendations.
3. Remove the protective poly film backing from the repair unit and align the repair unit with the buffed and cemented surface. Apply the repair unit a few inches at a time, working from the center out. Stitch thoroughly to remove any trapped air.
4. Coat the edge of the repair unit with butyl rubber or an inner liner sealant.

G. Heat Curing

The length of curing time is based on the depth of the injury, the type and operating temperature of the equipment used, and the cure rate of the cushion gum. Since correct curing time can vary greatly depending upon the combination of the above factors, and both undercure or overcure can adversely affect performance of the repair, it is important to check with equipment and repair material manufacturers to establish the correct curing time.

III. RADIAL PLY OTR TIRES

A. Inspection

1. Careful inspection of tires is of utmost importance, and should be done under adequate lighting (i.e., 200 fc/2153 lx minimum, 300 fc/3229 lx recommended) at the work surface, so that the interior and exterior of the tire is adequately exposed for visual and manual examination of all cuts, breaks, and punctures.

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2. Tires with the following conditions or injuries should be rejected. Note: this is not a complete list.
 - a. Damage due to underinflation or being run flat
 - b. Severe wire rusting due to cuts and snags
 - c. Belt edge separations
 - d. Broken or deformed bead wires
 - e. Injuries beyond repairable limits
 - f. Rubber deterioration
3. Tires for repair should be stored inside the shop to keep them dry and limit rusting of steel cords due to exposure.



Figure 19

B. Permissible Repairs

1. Tires may be repaired in the crown, shoulder, and sidewall areas.
2. Section repairs should not be so close together that reinforced repair units overlap.
3. Each repair must be evaluated using the following guidelines:
 - a. Service requirement of the tire including: load, speed, and front or rear wheel application
 - b. Overall condition of casing
 - c. Location of the injury
4. Satisfactory section repairs cannot be made in the bead area "A" (see Figure 19). To determine the nonrepairable bead area, measure with a flexible rule and follow the contour of the tire.

| RADIAL TIRE SIZE | NON-REPAIRABLE BEAD AREA "A" | |
|--|------------------------------|--------|
| 16.00R, 18.00R, 21.00R, 24.00R | 5" | 125 mm |
| 27.00R, 30.00R, 33.00R | 6" | 150 mm |
| 36.00R | 8" | 200 mm |
| 37.00R, 40.00R | 10" | 255 mm |
| 17.5 R, 20.5 R | 3-1/4" | 80 mm |
| 23.5R, 25/65R, 26.5R, 29.5R, 30/65R | 5" | 125 mm |
| 33.25R, 33.5R, 35/65R, 37.25R, 37.5R | 6-1/4" | 160 mm |
| 40/65R, 40.5R, 40.5/75R, 45/65R, 48/95R, 50/65R | 6-3/4" | 170 mm |
| 50.5R, 53.5R, 55.5 and larger | 12" | 305 mm |
| The above dimensions are guidelines only. Injuries reaching to the ply turn-up area should not be repaired. | | |

C. Preparation of Injuries

1. Using a knife, rasp, or rotary gouger, remove damaged rubber from the injured area to expose structural damage to the body plies (see Figure 20 on the following page). Take great care not to enlarge the injured ply area unnecessarily.

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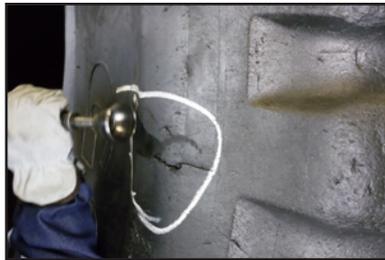


Figure 20

2. Remove loose steel cord with a tungsten carbide stone or carbide burr.
3. Using a high speed (i.e., 30,000 rpm maximum) buffer, and a tungsten carbide stone or carbide burr, follow the injury through each ply, removing all damaged wire cord (see Figure 21).



Figure 21

4. Steel cords must be free of rust, ground clean, and imbedded into solid rubber. Carefully inspect the repair area to ensure that no separation exists between the plies (see Figure 22).



Figure 22

5. Scorched and reverted rubber should be removed using a wire brush.
6. A TRMG BT3 buff texture is required for good repair adhesion.
7. Steel cords should be smooth to

the touch and should not have heat discoloration. Minimize steel exposure.

8. Establish injury size by measuring the length and width of the maximum opening of the radial cord ply after skiving and buffing. Measure the depth of the injury at this time to establish a proper cure time.

D. Repair Unit Selection and Preparation for Installation

1. Follow repair material manufacturer's recommendations for proper repair unit selection and placement.
2. Before marking out an area for the repair unit, clean an area slightly larger than the repair unit to remove contaminating lubricants from the inner liner surface.
3. Using a tire crayon, mark the centerline of the injury drawing toward the bead, then draw another line perpendicular to the first. These lines should be used to center the repair unit over the skive.

With the tire beads in a relaxed position, place the selected repair unit or a template in the correct position over the injury inside tire, and outline the perimeter. Remove the repair unit or template, and draw a line 1" (25 mm) smaller and 1" (25 mm) larger than the repair unit or template (see Figure 23 - "A" and "B") to ensure that crayon marks are not removed when buffing.



Figure 23

4. Buff the innerliner within the marked area "A" using a low speed (i.e., 5,000 rpm maximum) buffer to achieve a TRMG BT1 buff texture (see Figure 24). Take care not to expose any body plies. A change in the color of the rubber can typically be observed as you get close to the body cord. Preparing the tire in this manner will allow for good adhesion of the repair materials. Pull or buff the innerliner from the tire.



Figure 24

5. Taper-buff the innerliner between perimeters "A" and "B" at a 60 degree angle, to prepare area for rubber adhesion (see Figure 25).



Figure 25

E. Repair Material Application - Uncured Repair Unit

1. Remove any rubber dust and contaminants from the buffed area with a soft brass wire brush, and vacuum to provide a clean, dry surface.
2. Apply one coat of brush-type black vulcanizing cement to the texturized surfaces, both in the skive and inside the tire (see Figures 26 and 27).



Figure 26

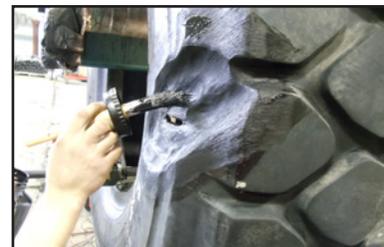


Figure 27

3. Before filling the skive with rubber, install four vent cords (see Figures 28 and 29). Vent cords should be a small diameter cotton cord or other suitable bleeder cord. Place the cords in the skive so that the ends extend through the skived area and 2/3 of the distance to the edge of the repair unit buff. If the tire is to be retreaded, cords should extend beyond the tread buff area. Venting is recommended in all curing systems including open steam "kettles".



Figure 28



Figure 29

SECTION REPAIR OF BIAS AND RADIAL PLY OFF-THE-ROAD TIRES IN A FULL SERVICE REPAIR FACILITY

4. Cover the entire area within perimeter "B" with a "floater" cushion of 1/16" (1.5 mm) gauge or 1/8" (3 mm) gauge all purpose cushion gum. Stitch the cushion gum down with a stitcher working from the center out to avoid trapping air.
5. Slit across the middle of the protective poly film backing on the bottom of the repair unit. Fold the backing at the slit to expose 3" (75 mm) to 4" (100 mm) of cushion. Apply the repair unit by centering it over the skive with the position arrows pointing towards the beads (see Figure 30).



Figure 30

Using a serrated stitcher, firmly stitch down working from the center of the repair unit out (see Figure 31). Remove the remaining backing a few inches at a time, and stitch. Continue until all backing has been removed and the repair unit is completely stitched to the tire.



Figure 31

6. Remove the poly film covering from the top of the repair unit.
7. Apply strips of butyl rubber, making sure to overlap the repair unit and the over-buffed area of the repair unit, and stitch to remove air (see Figure 32).



Figure 32

8. Line the skive area with a layer of cushion gum and stitch thoroughly. Fill the skive area with cushion gum or extruded rubber (see Figures 33 and 34). Fill and stitch at regular intervals to avoid trapping air.



Figure 33



Figure 34

F. Repair Material Application - Chemical Cure Repair Unit

Precured or chemical repair units are to be used when the repair or reinforcement is cured with the retread in a retread mold, or when the repair plug is cured with a C-clamp or spotter.

1. Remove any rubber dust and contaminants from the buffed area with a soft brass wire brush, and vacuum to provide a clean, dry surface.
2. Apply a coat of chemical vulcanizing cement and let dry thoroughly. A

second coat may be required. Refer to the manufacturer's recommendations.

3. Remove the protective poly film backing from the repair unit and align the repair unit with the buffed and cemented surface. Apply the repair unit a few inches at a time, working from the center out. Stitch thoroughly to remove any trapped air.
4. Coat the edge of the repair unit with butyl rubber or an inner liner sealant.

G. Heat Curing

The length of curing time is based on the depth of the injury, the type and operating temperature of the equipment used, and the cure rate of the cushion gum. Since correct curing time can vary greatly depending upon the combination of the above factors, and both undercure or overcure can adversely affect performance of the repair, it is important to check with equipment and repair material manufacturers to establish the correct curing time.

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