

REPAIRING DEMOUNTED BIAS AND RADIAL PLY TUBELESS AND TUBE-TYPE AGRICULTURAL TIRES

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I. PURPOSE

This Recommended Practice (RP) provides step-by-step procedures for repairing demounted bias and radial ply tubeless and tube-type agricultural tires that are to be returned for continued service.

Although repair procedures vary slightly among repair material manufacturers, the procedures described in this RP are generally acceptable. Consult repair material and tire manufacturers to ensure proper application of the products used.

WARNING

Serious bodily injury may result from not wearing adequate personal protective equipment (PPE), including eye protection (i.e., goggles or face shields), ear protection, and respiratory protection while repairing tires.

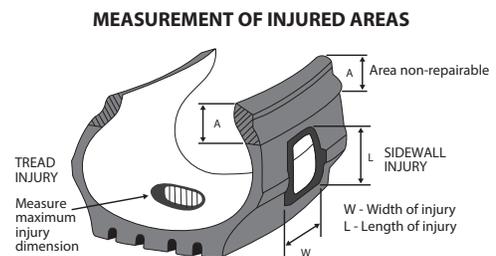
II. INSPECTION

Careful inspection of agricultural tires is of utmost importance.

- A. Tires with evidence of moisture, ballast, dirt, or other contamination in the injured areas, must be thoroughly cleaned and dried, both inside and outside.

- B. Tires must be thoroughly inspected for damage and non-repairable conditions on both the inside and outside of the tire using sufficient lighting (i.e., 300 footcandles (fc) / 3229 lux (lx) minimum). Tires with extensive weather checking (i.e., 3/32" (2 mm) or deeper cracks), damage due to underinflation or being run flat, separation between plies, separated or damaged beads, or ply turn-ups, must be rejected.

- C. Measure the size of the injury to determine if it initially falls within repairable limits (see Figures 1 and 2). Reject tires with injuries exceeding the maximum size limits or where repair units would overlap.



Note: size of injury exaggerated for clarity

Figure 1

Figure 2

| TIRE CROSS SECTION | AREA "A" NON-REPAIRABLE |
|--------------------------------|-------------------------|
| 13.6 - 16.9 (345 - 430) Radial | 4" (100 mm) |
| 18.4 - 20.8 (465 - 530) Radial | 4 1/2" (115 mm) |
| 23.1 (585) and larger Radial | 5 1/2" (140 mm) |
| 13.9 (345) and smaller Bias | 3" (75 mm) |
| 14.9 - 20.8 (380 - 530) Bias | 4" (100 mm) |
| 23.1 (585) and larger Bias | 5" (125 mm) |

- D. No repairs may be made in the bead area (area "A") where casing penetration or wire damage has occurred.

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III. INJURY PREPARATION

Tires must be thoroughly dried before proceeding with the repair. It is recommended that the areas to be repaired be cleaned both inside and outside of the tire in order to remove contaminating materials.

Begin by locating the injury and mark it with a tire crayon. Probe the injury to remove any foreign materials and determine the extent of the injury. Be careful not to damage any of the cords or enlarge the injury.

Apply pre-buff cleaner on the area to be buffed, and scrape the area to remove all contaminants. Be sure to clean an area at least 1" (25 mm) larger than the repair unit being used.

IV. REPAIR UNIT SELECTION

There are two procedures that can be used for making a section repair in a radial ply tire. One procedure involves installing a radial repair unit designed such that its cord ends must fall within the low flex areas of the tread-belt package and the bead area of the tire (see Figures 3, 4 and 4a).

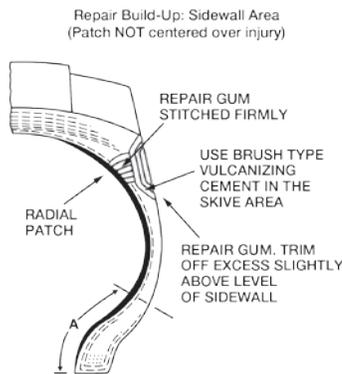


Figure 3



Figure 4

Radial Tire Crown Repair Patch in Tire



Figure 4a

The other procedure involves installing a radial repair unit designed to be centered over the injury without concern for its ending in the low flex areas of the tire (see Figure 5). Repair material manufacturers' and new tire manufacturers' recommendations may differ.

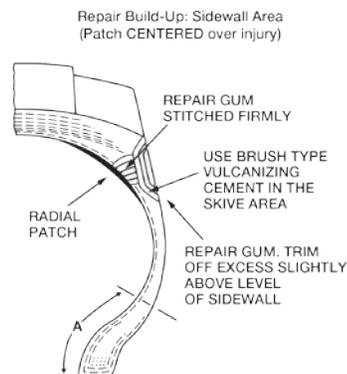


Figure 5

For bias ply tires, the repair unit should be installed so that the platform of the repair unit, where the reinforcement plies intersect, extends 25% past the extent of the injury.

Never install a radial repair unit in a bias tire or a bias ply repair unit in a radial tire.

V. REPAIR METHODS

The extent of repairable areas where satisfactory repairs may be made are shown in Figures 6 and 7 on the following page. Use only bias ply repair materials in bias ply tires and only radial ply repair materials in radial ply tires. Repairs should be processed using appropriate equipment.

A. Puncture Repairs (i.e., nail hole injuries)

Puncture repairs up to and including 3/8" (10 mm) may be handled by using a repair unit and vulcanizing rubber stem (i.e., two-piece) or a repair unit/plug (i.e., one-piece) method. Injuries larger than 3/8" (10 mm) require a full section repair.

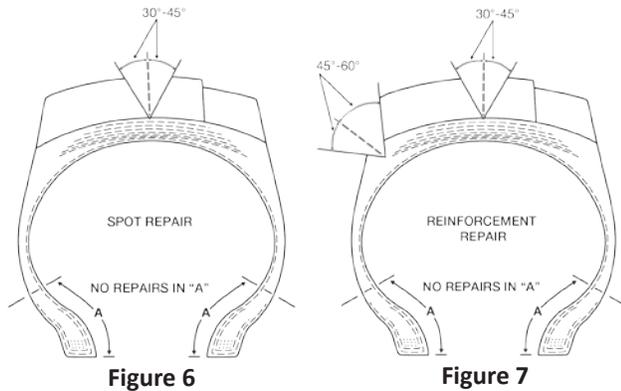


Figure 6

Figure 7

B. Spot Repairs

One of the most neglected areas of agricultural tire repairs, is the failure to identify and repair injuries which do not extend completely through the casing.

Bias Ply Tires

For bias ply tires, any injury with less than 25% of actual plies damaged requires a spot repair with an appropriate injury filling material only.

Radial Ply Tires

For radial ply tires, any injury to the top ply in the tread area, or rubber damage exclusively in the sidewall area, requires a spot repair with an appropriate injury filling material only. Any number of spot repairs can be made to the tire. All other damage should be treated as a section repair.

See "D. Section Repairs" for instructions on preparing and filling the injury.

C. Reinforcement Repairs

Bias Ply Tires

For bias ply tires, any injury from 25% to less than 75% of actual body plies damaged,

requires a reinforcement repair with an appropriate repair unit and injury filling material. This type of injury does not extend completely through the plies. See Figure 7.

See "D. Section Repairs" for correct repair procedures.

D. SECTION REPAIRS

Bias Ply Tires

For bias ply tires, any injury with more than 75% of actual body plies damaged, requires a section repair with an appropriate repair unit and injury filling material.

Radial Ply Tires

For radial ply tires, any injury extending beyond the top ply in the tread area, or damage to the body ply in the sidewall area, requires a section repair with an appropriate repair unit and injury filling material (see Figure 8).

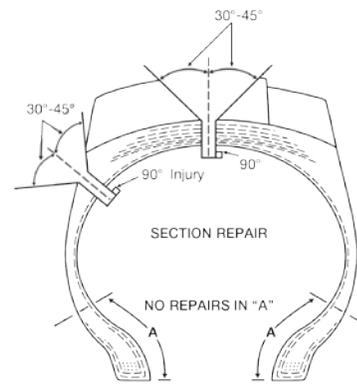


Figure 8

1. Skiving

- Use a small sharp knife or rotary gouger on a low-speed (i.e., 5,000 rpm maximum) buffer to remove all damaged rubber. Keep the skived area as small as possible.

b. Bias Ply Tires

For bias ply tires and fabric cord radial ply tires, use a sharp knife to remove all damaged ply material. Follow the shape of the original injury.

c. Radial Ply Tires

For radial ply tires with steel belts, use a carbide router on a high-speed (i.e., 20,000 rpm minimum) grinder to remove damaged steel ply material.

d. Round out all corners and probe to be sure all of the damage (i.e., separations, cuts, etc.) has been removed. Penetration of the skive through the cord body should be at 90°. Taper the skive to 45° in the crown area and 60° in the sidewall (see Figure 8).

e. Texturize rubber surfaces to a #3 texture, removing all shiny surfaces, knife, and gouge marks. Texturize rubber/cord surfaces to the same #3 texture.

f. Bias Ply Tires

For bias ply tires, trim the cord fabric back to solid rubber leaving no “fuzz”. Use a low-speed (i.e., 5,000 rpm maximum) air tool and medium grit rasp to minimize the possibility of scorching rubber or burning nylon cord.

g. Radial Ply Tires

For radial ply tires, use an aluminum oxide stone on a high-speed (20,000 rpm minimum) grinder to trim steel cables (if applicable) back to solid rubber, then use a wire brush to remove any scorched rubber.

2. Measuring the Injury

a. Bias Ply Tires

To determine the size of the injury for repair unit selection, measure the injury across the maximum injury dimension of removed body ply.

b. Radial Ply Tires

To determine the size of a sidewall injury for repair unit selection, measure the injury across the width and length of the removed cord. Measure tread injuries across the

maximum injury dimension of the removed cord (see Figure 1).

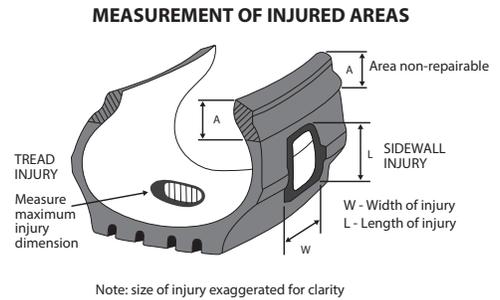


Figure 1

For both bias and radial ply tires, refer to the repair material manufacturer’s repair unit selection chart for appropriate repairable injury size and repair unit selection.

c. In addition, measure the thickness of the tire casing at the repair to calculate cure time, if a heated curing process is to be used. Refer to cushion gum manufacturer for the curing time required for a given thickness.

Note: About 1/8” (3 mm) must be added to the actual depth to account for overbuild and compensate for shrinkage during cure.

3. Using a Spotter Method and a Chemically Cured Repair Unit

a. Lightly buff inside and outside of the tire about 1” (25 mm) around the skive.

b. Use a wire brush to remove all buffing dust from the buffed surface of the inner liner. Use a vacuum to remove all dust inside the tire, being careful not to touch the buffed surface with the vacuum.

Note: Do not use compressed air to clean bonding surfaces because the unfiltered air lines may contain contaminants such as oil, moisture, and lubricants which can reduce adhesion.

- c. Apply cement to properly prepared buffed area according to repair material manufacturer's procedures. Allow the cement to dry thoroughly. For chemical type repairs, be sure to use a compatible cement.
 - d. Apply a 1/8" (3 mm) to 1/4" (6 mm) thick piece of cushion gum to the buffed surface on the inside of the tire. On bias ply tires where rubber is to be cured under heat and pressure into a skived, prepared area, it is recommended that vent cord be used according to the repair material manufacturer's recommendations. This will aid in the escape of any trapped air or gases generated during the curing process.
 - e. On the outside of the tire, fill the skive with cushion gum, starting from the center, and working toward the outside edge of the skive. Use care not to trap air during filling operation, and stitch down thoroughly. Filling may be accomplished using strip stock calendered with poly or rope rubber extruded from a hand-held extruder. Overbuild the skive 1/8" (3 mm) inside and outside of the tire.
4. **Using a Chemical Compound With a Chemically Cured Repair Unit**
 - a. Lightly buff the inside and outside of the tire about 1" (25 mm) around the skive.
 - b. Clean skived area with a wire brush and vacuum to remove all dust and contaminants.
- material manufacturer's procedures. Allow the cement to dry thoroughly.
- d. When using a chemical compound rubber, it is usually better to install the repair unit first, then fill the skive with putty.
 - e. Mix chemical compound rubber according to manufacturer directions. Be sure rubber is thoroughly and completely mixed.
 - f. Stitch rubber into the skived area in small amounts at first, increasing to larger amounts to finish building quickly. Thoroughly stitch each layer as it is applied.
 - g. Curing of self-vulcanizing rubber generally requires several days. However, this time can often be reduced with application of some heat in the form of heat lamps, warm rooms, etc. Check with manufacturer to see if this step is recommended.

5. Curing

The methods described in this RP are for repair filler cured chemically or with a spotter. Section molds and curing chambers are effective for curing the repair unit to the inner liner at the same time that the filling rubber material is cured. Repair units are usually of the uncured type or the semicured type when used in the section mold or chamber. Procedures will differ in that the inner liner is prepared for the repair unit, the repair unit is laid in the tire and stitched down, and then the hole is filled with repair rubber. Then the repair unit and fill rubber are cured together.

The most commonly used curing equipment for tractor tires is the spotter. Spotters specifically made for tractor tires have sufficient clearance to allow repairs to be cured on any part of the tire. However, when a repair is in or near a lug, the spotter cannot be used without removing all or part of that lug. Such removal may be

Note: Do not use compressed air to clean bonding surfaces because the unfiltered air lines may contain contaminants such as oil, moisture, and lubricants which can reduce adhesion.

- c. Apply an appropriate chemical vulcanizing cement to properly prepared buffed area according to repair

objectionable to the operator. Therefore, the use of self-vulcanizing putty is desirable in this case.

- a. If a cold spotter is used, preheat to operating temperature.
- b. Most spotters come with a set of contour plates. Select the plate that conforms closest to the contour of the tire at the point of cure.
- c. Placement of the heating and pressure element is extremely important to avoid distortion of the tire and to contain the cushion gum within the skived area. For injuries larger than the elements, the repair must be processed in steps requiring separate skiving and curing two or more times on the same injury. Each step must be smaller than the heating/pressure elements.
- d. Calculate cure time using thickness measurement taken in "2.c. Measuring the Injury".
- e. Apply pressure either by hand crank or by air pressure as the equipment requires. If the tire is cured standing up, place repaired area at the three or nine o'clock position to prevent distortion of the repair during the curing process.
- f. Remove the spotter from the tire following cure and allow the tire to cool.

6. Installing the Repair Unit

- a. Take the repair unit and place it according to directions. Be sure to use a radial repair unit in a radial ply tire and bias repair unit in a bias ply tire.
- b. Draw an outline 1" (25 mm) larger than the repair unit on the inner liner.
- c. Using a low-speed (i.e., 5,000 rpm maximum) air tool, buff to a #2

texture, removing all lines and patterns on the inner liner. On tubeless tires, be careful not to remove the inner liner or expose the cords. The inner liner must be restored if the cords are inadvertently exposed. If any cords get damaged on a radial tire during the buffing process, inspect the damage and remeasure the injury to ensure that the injury is still within repairable limits.

- d. After buffing, use a wire brush to remove all buffing dust from the buffed surface of the inner liner. Use a vacuum to remove all dust from inside the tire, being careful not to touch the buffed surface with the vacuum.

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- e. Cement according to repair material manufacturer's procedures. Be sure to use a compatible cement. Allow to dry thoroughly.
- f. Install the repair unit so that its alignment is correct. With the beads relaxed to the normal rim width, place the repair unit, without bridging, over the cemented and buffed area of the tire. Stitch from the center of the repair unit out, being careful not to trap any air. After stitching, remove the protective film from the repair unit and check for proper installation.

7. Using a Plug-Type Repair

- a. Use only bias repair materials in bias ply tires and radial repair materials in radial ply tires.
- b. Properly position the base of the repair unit over the injury and outline it with a tire crayon approximately 1" (25 mm) beyond the repair unit edge.

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- c. Apply pre-buff cleaner on the area to be buffed, and scrape the area to remove all contaminants. Be sure to clean an area at least 1" (25 mm) larger than the repair unit.
- d. Mechanically buff the cleaned and marked area using a low-speed (i.e., 5,000 rpm maximum) air tool to a finely textured, #2 surface, using medium grit rasp. Make sure all the inner liner design in the area is removed.
- e. After buffing, use a wire brush to remove all buffing dust from the buffed surface of the inner liner. Use a vacuum to remove all dust from inside the tire, being careful not to touch the buffed surface with the vacuum.
- f. Select the proper cutter and guide to cut out the entire injured area. If the tire has steel belts, a carbide cutter will be necessary.
- g. Insert the stem of the guide into the injury, and center the round disk over the injury making sure that no portion of the injury extends beyond the guide disk. If this occurs, it will be necessary to use a larger size cutter and guide. If the injury extends beyond the largest guide disk, then it will be necessary to do a conventional section repair.
- h. Place the proper cutter into a low-speed (i.e., 1,200 rpm maximum) air or electric drill. Place the cutter over the disk of the cutter guide, and cut perpendicularly through the tire with smooth, even pressure making sure you do not push the cutter through the tire. To remove the cutter from the tire, reverse the drill allowing the cutter to back itself out of the tire.
- i. During this process, support the area to be drilled to prevent a cone-shaped skive and reduce the chance of scorching the rubber.
- j. After cutting out the injury, remove the damaged plug from the cutter and examine the area to be sure there is no injury extending beyond the plug edge.
- k. To remove the damage with a carbide cutter, drill the injury from the inside of the tire 3 - 5 times using a low-speed (i.e., 1,200 rpm maximum) air or electric drill. Repeat the drilling process from the outside of the tire to ensure complete damage removal. Always use the drill in the forward or clockwise direction of rotation when using carbide cutters.
- l. Clean the buffed surface on the inner liner using a wire brush on a low-speed (i.e., 5,000 rpm maximum) buffer. Using light pressure, brush all buffing dust and debris from the buffed surface working from right to left. Once all of the debris is removed from the buffed surface, use a vacuum to remove the debris from the tire, being careful not to touch the buffed surface with the vacuum.
- m. Apply a chemical vulcanizing cement to the hole and to the buffed area. Apply cement according to repair material manufacturer's procedures. Be sure to use a compatible chemical cement with the repair materials. Allow the cement to dry thoroughly.
- n. Remove the protective poly from the repair stem and base. Some manufacturers recommend cementing the stem. This process is strictly for lubrication of the stem when it is pulled through the hole.
- o. Immediately apply the repair unit to the tire, making sure that the bead arrow (if applicable) on the repair

Note: Do not use compressed air to clean bonding surfaces because the unfiltered air lines may contain contaminants such as oil, moisture, and lubricants which can reduce adhesion.

unit points toward either bead of the tire.

- p. Pull the stem through the prepared hole so the base comes in complete contact with the inner liner of the tire. Do not over pull the repair unit.
- q. Stitch the base from the center out to prevent any air from being trapped between the inner liner and the repair unit. It is recommended that the repair be allowed to sit undisturbed for 30 minutes.
- r. On the outside of the tire, while the tire is in a relaxed position, cut the stem off 1/16" (1.5 mm) above the surface of the tread.
- s. If the tire is a tube-type, it is necessary to apply tire talc to the top of the repair unit inside the tire. This will prevent the cushion gum edge

of the repair unit from vulcanizing to the inner tube of the tire. If the tire is tubeless, apply an inner liner sealer to the edge of the repair unit and any exposed buffed surface to restore the integrity of the inner liner.

VI. FINISHING

- A. Using a fine grit stone or sanding drum, buff outside of the injury smooth with the tire surface.
- B. Inspect the repair. The tire should not be distorted, and the repair unit should be solid and cured properly.
- C. Heat-cured repairs can be put into service as soon as they cool. Self-vulcanizing putty repairs must stand unmounted until putty vulcanizes. Refer to repair material manufacturer's recommendations.

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