BIAS TIRE CONDITIONS ANALYSIS & REPAIR GUIDE

First Edition (2008)

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The following procedures are not intended nor should they be construed as an endorsement of any particular person, organization, or product.

The material in this manual is compiled from TMC Recommended Practices:

- RP 206, Tire Repair Procedures
- RP XXX, *Bias Tire Conditions Analysis Guide*

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PURPOSE AND SCOPE

The following photographs and explanations depict common tire failures and their causes. This guide is designed to be a reference source and a training aid, and to assist users in tire grading. It advises users when it may be necessary to consult with a specialist (original manufacturer or retreader) for final determination of a tire's cause of failure. When using this Guide, it is important to note the over arching issue of the need to insure proper tire inflation. As has been documented in various industry and government studies, a substantial number of tire failure incidences are caused by under inflation. This guide is not designed to be the sole basis on which to base tire or retread warranty claims.

This guide is divided into two sections. The first deals with conditions found in bias tire casings and in original tires. Casing conditions that may be exhibited by retreaded tires can also be found in this section. The second section addresses conditions associated with improper repairs. The third section addresses proper tire repair procedures.

ACKNOWLEDGEMENTS

TMC's *Bias Tire Conditions Analysis Guide* was conducted by Technology & Maintenance Council's Bias Tire Conditions Analysis Task Force under the Council's S.2 Tire & Wheel Study Group. The work was performed under the leadership and guidance of S.2 Study Group Chairman Mitchell Windorff, Schneider National; Task Force Chairman Al Cohn, PSI, Inc.; TMC Executive Director and Vice President of Councils Carl Kirk; and Robert Braswell, TMC Technical Director (who served as editor and product designer on this project).

TMC thanks the following individuals and their companies for their substantial contribution to the development of this work:

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TMC would like to thank the following companies who participated in the development of this Guide by donating their expertise and photographs:

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INTRODUCTION

INTRODUCTION

Determining the causes of tires placed out of service is of vital importance to the fleet operator because of the substantial investment that tires represent. To protect your investment in tires, it is necessary to know what caused each tire's removal from service. This publication will lead to cost savings through providing guidance and help in the following areas:

1. Eliminating causes of failures if possible.
2. Retreading and repairing tires and placing them back into service.
3. Presenting tires for warranty credit when applicable.
4. Improving tire maintenance and tire selection if necessary.
5. Determining reason for failure in order to assign responsibility of emergency road service expenses.

Tire grading should be done prior to the tire being placed in a "scrap pile." After a tire has been demounted from the rim and before it is rolled out the tire shop door, the tire should be inspected with the following questions in mind:

1. Is the tire serviceable?
2. Is it repairable or retreadable?
3. Could it be used in a limited service operation?
4. Should the tire be presented to the original manufacturer or retreader for warranty?
5. If none of the above apply, is it strictly junk?

These questions must be answered before the tire is placed in the scrap pile since the tire may lose its usefulness while waiting in the pile to be graded. Any usable tire should be stored in a dry covered area.

Once it is determined that a tire should be scrapped, the appropriate information should be recorded and entered into a database for further analysis. Accurate and simple records which include causes of failure, numbers of caps, tread depths, etc. are extremely important and helpful when purchasing decisions must be made.

TIRE INSPECTIONS

Remove all foreign objects and water from the tire and examine thoroughly in a well-lighted area. For inspection purposes, the tire can be divided into six areas (see Fig. 1):

1. Tread or Crown Area.
2-3. Upper Sidewall and Shoulder Area on each side.
4-5. Lower Sidewall and Bead Area on each side.
6. Interior bead to bead.

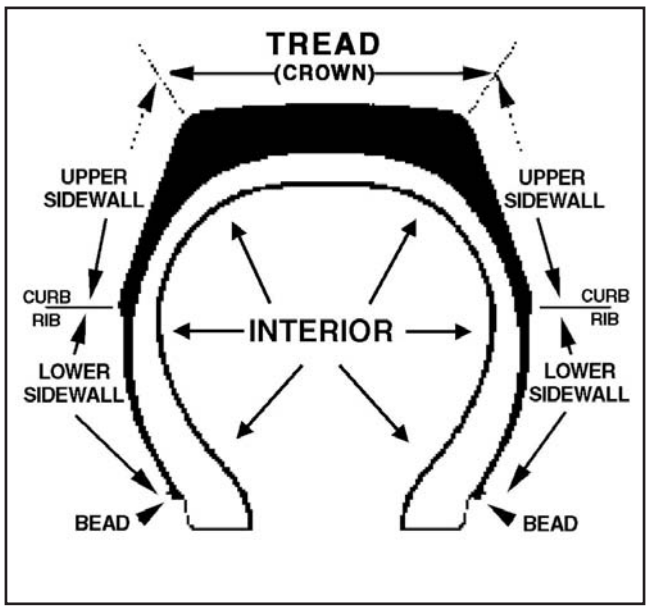


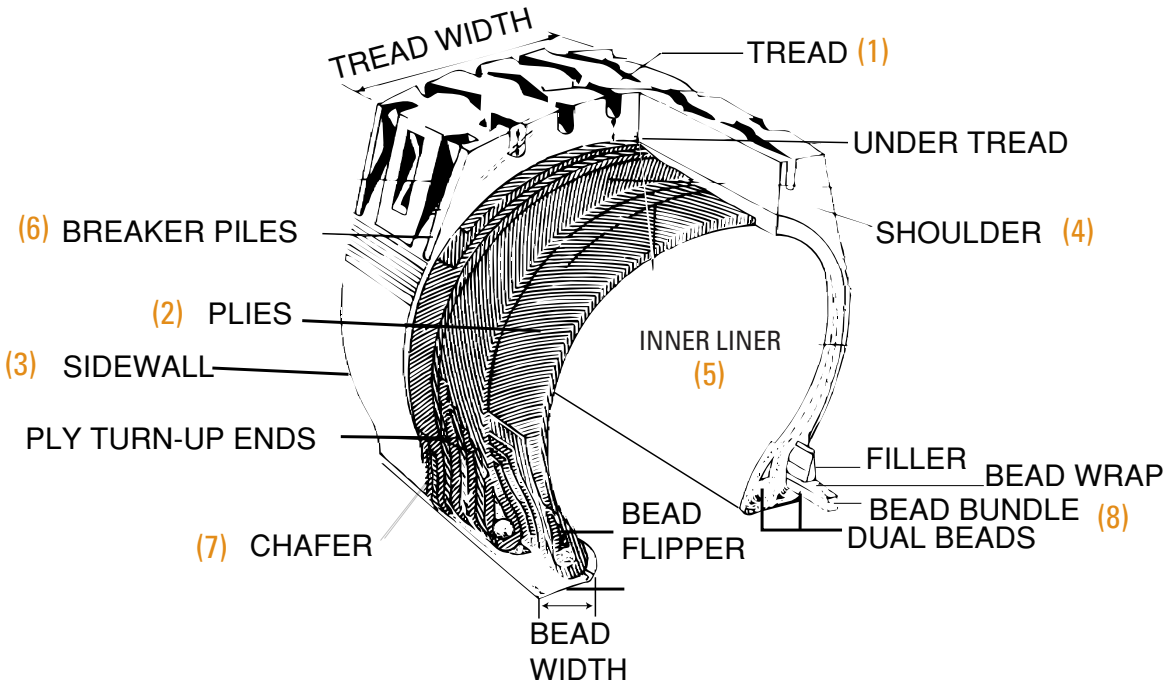
Fig. 1

Begin by inspecting the tread area. Use your hands and eyes to check for punctures, cuts, foreign objects and any distortion in the tread.

Move to the upper and lower sidewalls. Inspect these areas for separation between casing components. This is usually denoted by cracks or bulges, damage to the bead and bead wires, deterioration of rubber caused by oil and grease, weather checking, cuts and penetrations. Then examine the interior from bead to bead looking for wrinkling or corrugations in the inner liner caused by running flat or underinflated, blisters or lumps, cracks and looseness.

Mark all damage, punctures, and separations with a paint stick as you find them. Rotate the tire as necessary for thorough inspections. Use a probe to determine the origin and extent of damage. Inspect the complete tire prior to determining the cause of failure (i.e., often a separation in a tire sidewall may be caused by a nail hole puncture in the tread or a failed repair that would only be noticed by inspecting the interior of the tire). It is possible for a tire to have more than one out-of-service condition. On the exterior of the tire, mark the final disposition based on your inspection; for example, repair, retread, scrap, etc.

Fig. 2 is a bias tire section with definitions of its various components. Understanding the construction of the tire will make failure analysis easier.



(1) Tread—This rubber provides the interface between the tire structure and the road. Primary purpose is to provide traction, directional changes and wear.

(2) Body Plies—Body plies provide strength to the tire, stabilize the tread, and may protect the air chamber from punctures.

(3) Sidewall—The sidewall rubber is specially compounded to withstand flexing and weathering while providing protection for the body ply.

(4) Shoulder—A general area where the sidewall meets the tread.

(5) Inner Liner—A layer of rubber in tubeless tires specially compounded for resistance to air diffusion. The liner in the tubeless tire replaces the innertube of the tube-type tire.

(6) Breaker Plies—Plies which provide strength to the tire and stabilize the tread.

(7) Chafer—A fabric or rubber layer used to protect the flange area of the bead.

(8) Bead Bundle—Made of continuous high-tensile wire wound to form a high-strength unit, the bead bundle is the anchor foundation of the casing which maintains the required tire diameter on the rim.

Fig. 2: Cross Sectional View of Bias Tubeless Tire

GLOSSARY OF TERMS

BIAS TIRE CONSTRUCTION

Bias ply tires are constructed of overlapping crossed layers of cord material and are typically made with nylon or other materials. The crossed plies run on a diagonal from tire bead to tire bead and comprise a generally stiff sidewall area. Sometimes, extra crossed plies or breakers are used under the tread area to further stiffen the crown area and provide better wear resistance or other performance parameters (such as puncture resistance, etc.).

Bias ply tires have been designed over the years to perform in many different types of applications from all-highway to on-off road, to all off-road service conditions. With the advent of the radial tire and some of its inherent advantages, the bias tire is now used much less frequently in long haul over-the-road applications. Radial tires typically are used in applications where heat build-up with bias ply tires is a problem.

TUBELESS AND TUBE-TYPE TIRE CONSTRUCTION

The tubeless tire is similar in construction to a tube-type tire, except that a thin layer of air and moisture-resistant rubber is used on the inside of the tubeless tire from bead to bead to obtain an internal seal of the casing. This eliminates the need for a tube and flap. The two types of tires require different rim configurations: the tubeless tire uses a single-piece wheel; and the tube-type tire requires a multi-piece wheel assembly. Both tires, in equivalent sizes, can carry the same load at the same inflation pressure.

TIRE CONSTRUCTION TERMS

Aspect Ratio—The ratio of tire section height vs. section width.

Bead Bundle—Made of continuous high-tensile wire wound to form a high-strength unit, the bead bundle is the anchor foundation of the casing that maintains the required tire diameter on the rim.

Bead Heel—That part of the bead which faces the rim flange.

Bead Reinforcing Ply—A fabric ply laid over the bias ply turn-up outside of the bead and under the rubber chafer that stabilizes the bead-to-sidewall transition zone.

Bead Seat—Area where the bead fits the rim.

Bead Sole—That part of the bead which seats flatly on the rim.

Bead Toe—That part of the bead which faces the inside portion of the tire.

Breaker—Plies that provide strength to the tire, stabilize the tread, and protect the air chamber from punctures.

Chafer—A fabric or rubber layer used to protect the flange area of the bead.

Chipper—Single or multiple plies of biased fabric used to reinforce the bead turn-up area.

Cords—The strands of wire or fabric that form the plies and breakers in a tire.

Filler—Rubber pieces with selected characteristics used to fill in the bead and lower sidewall area and provide a smooth transition from the stiff bead area to the flexible sidewall.

Inner Liner—The layer or layers of rubber laminated to the inside of a tubeless tire especially compounded for resistance to air diffusion and contain the inflation pressure. The inner liner in the tubeless tire replaces the inner tube of the tube-type tire.

Ply—A layer of rubber coated cords. The body plies contain the air pressure of the tire. They transmit all load, braking, and steering forces between the wheel and the tire tread.

Ply Turn-up—That area of the plies that wraps around the bead bundle, locking the plies and bead bundle in place.

Sidewall—The sidewall rubber is specifically compounded to withstand flexing and weathering while providing protection for the plies.

Shoulder—A general area where the sidewall meets the tread.

Tread—This rubber provides the interface between the tire structure and the road. Primary purpose is to provide traction and wear.

Undertread—The rubber between the base of the tread groove and the top belt.

PREFACE TO THE BIAS TIRE CONDITIONS ANALYSIS GUIDE

The following photographs and explanations depict common bias tire failures and their causes. This guide is designed to be a reference source and a training aid, and to assist users in tire grading. It advises users when it may be necessary to consult with a specialist (original manufacturer or retreader) for final determination of a tire's cause of failure. This RP is not designed to be the sole basis on which to determine tire or retread warranty claims.

This guide is divided into three sections. The first deals with conditions found in bias tire casings and in original tires. Casing conditions that may be exhibited by retreaded tires can also be found in this section. The second section addresses conditions associated with improper repairs. The third section addresses proper tire repair procedures.

Each condition is designated with alpha as well as numeric condition codes noted on each page. Readers can use these codes—which come from Code Keys 21 and 22 in TMC's Vehicle Maintenance Reporting Standards— for recordkeeping purposes and ease of analysis. Alpha codes are provided for those equipment users that prefer this method of coding. The corresponding numeric code employs a coding system as follows. The first digit "1" denotes tires in general. The second digit denotes a particular section of a tire accordingly:
1—Bead Area
2—Sidewall Area
3—Tread/Crown Area
4—Tire Interior
5—Improper/Failed Repairs
6—Conditions Found in More Than One Area of the Tire
7—Irregular Wear Conditions.

The third and fourth digits designate a particular condition.

Also listed are applicable corresponding codes developed by the American Association of Railroads (AAR) known as "Why Made Codes." These codes, although not as comprehensive as the VMRS codes, are commonly used in intermodal operations.

A list of the AAR codes follows:

WHY MADE CODES
(AAR January 2007)

SECTION I—

TIRE (ORIGINAL TREAD AND RETREAD) CASING CONDITIONS

CASING CONDITIONS

A. BEAD AREA

DELAMINATED BEAD RUBBER

BEAD AREA—CASING CONDITIONS

VMRS SYSTEM CODE: 017

VMRS CONDITION CODE:

ALPHA: BN
NUMERIC 1110

WHY MADE CODE: 03 or 15

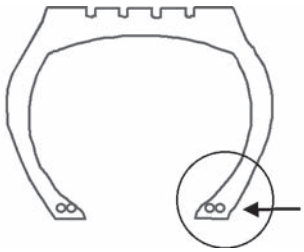
BIAS

APPEARANCE

Top layer of bead rubber peeling away. Can occur on one or both beads. Found on tube-type tires.

PROBABLE CAUSE

Insufficient air pressure to carry load and/or damaged wheel components. Can be exaggerated by overload, improperly matched wheel components.



ACTION

TIRE

Examine tire for severity before returning to service. Submit to servicing dealer.

VEHICLE

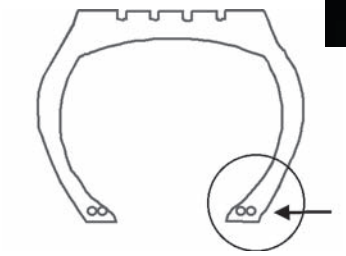
Check vehicle for proper brake operation.

OPERATIONS

None.

BEAD DEFORMATION

APPEARANCE	Circumferential indentation in the bead area of the tire. Found on tubeless tires.
PROBABLE CAUSE	Rusty rims, improper bead/rim lubrication, and bent or damaged rims which result in improper bead seating. Also overload or underinflation.



VMRS SYSTEM CODE: 017

VMRS CONDITION CODE :

ALPHA
BD
NUMERIC
1105

WHY MADE CODE:
02 or 03

BIAS

ACTION

TIRE	If cords are visible, scrap the tire. if only the rubber is distorted, return to service.
VEHICLE	None.
OPERATIONS	Review mounting/demounting procedures and the use of tire tools. Ensure the tire beads are well lubricated. Verify that the tire is the correct load range and properly inflated for the operation.

BURNED BEADS

BEAD AREA—CASING CONDITIONS

VMRS SYSTEM CODE: 017

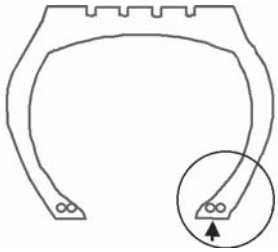
VMRS CONDITION CODE:

ALPHA
BB
NUMERIC
1106

WHY MADE CODE: 24

BIAS

APPEARANCE	Rough, brittle, distorted and/or discolored hard surface in the bead area.
PROBABLE CAUSE	Excessive heat exposure caused by frequent hard braking; improperly adjusted brakes; faulty braking system; insufficient air flow around brakes.



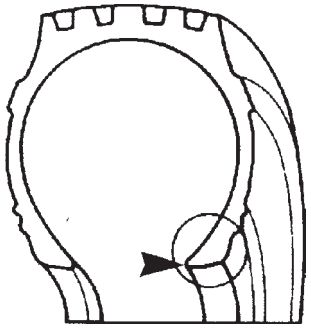
ACTION

TIRE	Scrap tire.
VEHICLE	None.
OPERATIONS	Determine the source of excessive heat and correct the condition.

BEAD DAMAGE BY RIM/SPLIT SIDE RINGS

BEAD AREA—CASING CONDITIONS

APPEARANCE	Cut, tear or detachment in the bead area.
PROBABLE CAUSE	Improper mounting; friction between bead area and rim/side ring.



VMRS SYSTEM CODE: 017

VMRS CONDITION CODE:

ALPHA
BG
NUMERIC
1111

WHY MADE CODE:
14

BIAS

ACTION

TIRE	None.
VEHICLE	Use only correct/servicable wheel components.
OPERATIONS	Review mounting procedures. Verify rim components are properly matched as per OSHA charts.

CASING CONDITIONS

B. SIDEWALL AREA

CIRCUMFERENTIAL UPPER SIDEWALL SPLIT

SIDEWALL AREA—CASING CONDITIONS

VMRS SYSTEM CODE: 017

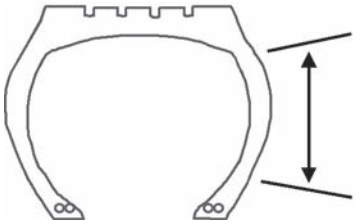
VMRS CONDITION CODE:

ALPHA
OZ
NUMERIC
1215

WHY MADE CODE:
17 or 22

BIAS

APPEARANCE	Circumferential sidewall split.
PROBABLE CAUSE	Weathering/ozone cracking.



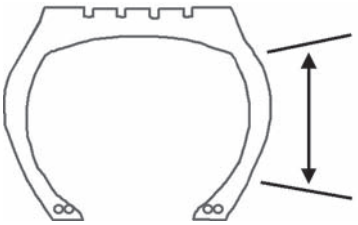
ACTION

TIRE	Scrap tire.
VEHICLE	None.
OPERATIONS	None.

CUT OR TORN SIDEWALL

SIDEWALL AREA—CASING CONDITIONS

APPEARANCE	Sidewall impact break.
PROBABLE CAUSE	Caused by a sudden impact with a road hazard or pot hole. Aggravated by overinflation.



VMRS SYSTEM CODE: 017

VMRS CONDITION CODE:

ALPHA
CU
NUMERIC
1207

WHY MADE CODE:
03 or 14

BIAS

ACTION

TIRE	Scrap.
VEHICLE	None.
OPERATIONS	Review driving and vehicle operational procedures.

WEATHERING/CRACKING/DRY ROT

SIDEWALL AREA—CASING CONDITIONS

VMRS SYSTEM CODE: 017

VMRS CONDITION CODE:

ALPHA
WE
NUMERIC
1210

WHY MADE CODE:
17 or 22

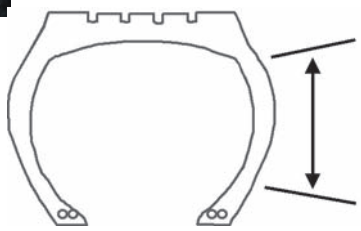
BIAS

APPEARANCE

Numerous tiny cracks in the rubber surface, usually 360˚ around the tire.

PROBABLE CAUSE

Normal aging condition but can be aggravated by extended periods of parking and exposure to high concentrations of ozone. Ozone can be generated from many sources, such as engine exhaust, mercury vapor lamps, welding, electric generators, etc.



ACTION

TIRE

All tires may eventually exhibit this condition in late service-life stage. Tires with ozone cracks deeper than 2/32" should be removed from service.

VEHICLE

None.

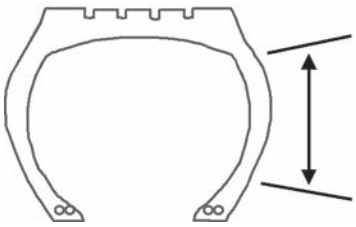
OPERATIONS

Tire storage should not be near any ozone generators. Consult your tire manufacturer if extended periods of parking are expected.

SIDEWALL SEPARATION DUE TO BEAD DAMAGE

SIDEWELL AREA—CASING CONDITIONS

APPEARANCE	Sidewall rubber detached from body ply cord.
PROBABLE CAUSE	Air migration through the casing resulting from bead damage.



VMRS SYSTEM CODE: 017

VMRS CONDITION CODE:

ALPHA
SO
NUMERIC
1205

WHY MADE CODE: 14

BIAS

ACTION

TIRE	Remove from service and scrap tire.
VEHICLE	None.
OPERATIONS	Review mounting procedures.

STACKING DAMAGE—SIDEWALL/SHOULDER

SIDEWALL AREA—CASING CONDITIONS

VMRS SYSTEM CODE: 017

VMRS CONDITION CODE:

ALPHA
VD
NUMERIC
1604

WHY MADE CODE:
14, 19 or 33

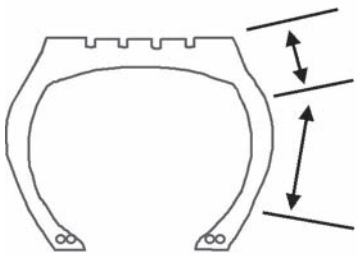
BIAS

APPEARANCE

Scuff marks or snags on sidewall. Cuts in tread. Impact break may be evident in liner. Uniform scuffing or cutting on some major portion of the tire's outer surface, usually extending 360° around the tire.

PROBABLE CAUSE

Contact with vehicle components, such as loose u-bolts, slipped spring clips, restraining bolts, loose fenders, flap hangers, and trailer wheel house molding, etc.



ACTION

TIRE

Return the tire to service on a dual position unless abrasion extends to the ply cords. If the cords are exposed, consult your tire repair facility for the possibility of repair.

VEHICLE

Analyze cause of the condition and correct. Ensure the tire does not come in contact with vehicle components.

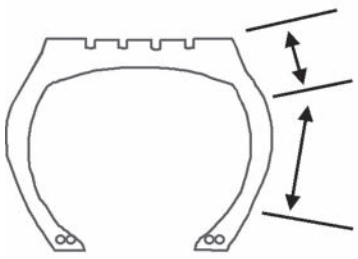
OPERATIONS

Review pretrip inspection programs.

SURFACE CUT FROM STACKING DAMAGE

SIDEWALL AREA—CASING CONDITIONS

APPEARANCE	Scrapes, gouges or cuts in the shoulder or sidewall.
PROBABLE CAUSE	Road hazard, rails, rebar, etc. May occur during chassis stacking.



VMRS SYSTEM CODE: 017

VMRS CONDITION CODE:

ALPHA
CU
NUMERIC
1207

WHY MADE CODE:
14 or 33

BIAS

ACTION

TIRE	Remove tire from service. Send to repair/retread supplier for possible repair or scrap.
VEHICLE	None.
OPERATIONS	Check stacking procedures.

SHOULDER/SIDEWALL SURFACE CUT DOWN TO THE CORD

SIDEWALL AREA—CASING CONDITIONS

VMRS SYSTEM CODE: 017

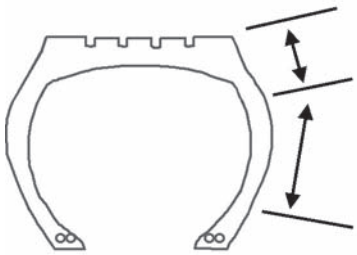
VMRS CONDITION CODE:

ALPHA
CU
NUMERIC
1207

WHY MADE CODE:
14

BIAS

APPEARANCE	Scrapes, gouges or cuts in the shoulder/sidewall, extending down to the cord.
PROBABLE CAUSE	Road hazard, curbing, rails, vandalism, etc.



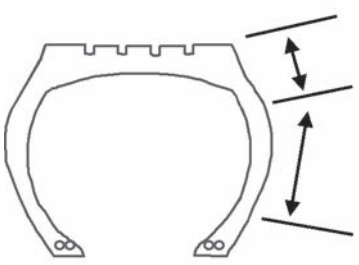
ACTION

TIRE	If cords are visible, repair the tire if damage to cords is within repair limits and return to service; otherwise scrap tire. If cords are not visible, have a spot repair made to prevent damage growth.
VEHICLE	None.
OPERATIONS	If similar damage occurs on several tires, investigate vehicle operations to determine the cause of the damage.

SIDEWALL CUT

SIDEWALL AREA—CASING CONDITIONS

APPEARANCE	Sidewall cut.
PROBABLE CAUSE	Contact with road debris/hazard.



VMRS SYSTEM CODE: 017

VMRS CONDITION CODE:

ALPHA
CU
NUMERIC
1207

WHY MADE CODE:
14

BIAS

ACTION

TIRE	If cords are visible, repair the tire if damage to cords is within repair limits and return to service; otherwise scrap tire. If cords are not visible, have a spot repair made to prevent damage growth.
VEHICLE	None.
OPERATIONS	If similar damage occurs on several tires, investigate vehicle operations to determine the cause of the damage.

RUN FLAT

SIDEWALL AREA—CASING CONDITIONS

VMRS SYSTEM CODE: 017

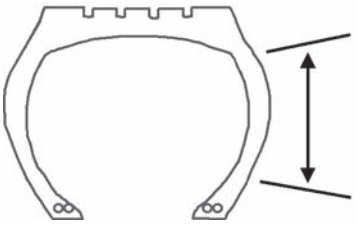
VMRS CONDITION CODE:

ALPHA
RF
NUMERIC
1606

WHY MADE CODE: 16

BIAS

APPEARANCE	Discoloration, blistering, wrinkling, and /or separations of the inner liner.
PROBABLE CAUSE	Continued operation while underinflated and/or overloaded.



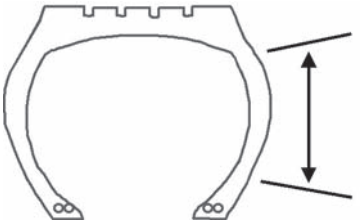
ACTION

TIRE	Scrap the tire.
VEHICLE	None.
OPERATIONS	Review tire inflation maintenance procedures.

RUN FLAT TO DESTRUCTION

SIDEWALL AREA—CASING CONDITIONS

APPEARANCE	Discoloration, blistering, wrinkling, and /or separations of the inner liner.
PROBABLE CAUSE	Continued operation while underinflated and/or overloaded.



VMRS SYSTEM CODE: 017

VMRS CONDITION CODE:

ALPHA
RF
NUMERIC
1606

WHY MADE CODE:
16

BIAS

ACTION

TIRE	Scrap the tire.
VEHICLE	None.
OPERATIONS	Review tire inflation maintenance procedures.

SIDEWALL INNERLINER CRACKS

SIDEWALL AREA—CASING CONDITIONS

VMRS SYSTEM CODE: 017

VMRS CONDITION CODE:

ALPHA
LC
NUMERIC
1407

WHY MADE CODE:
14

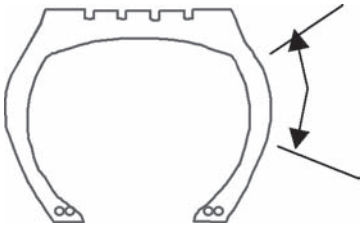
BIAS

APPEARANCE

Cracks in the shoulder/sidewall of the tire exterior. Cracks also visible in the shoulder area of the innerliner.

PROBABLE CAUSE

Continued operation while overloaded and underinflated
.



ACTION

TIRE	Scrap the tire.
VEHICLE	None
OPERATIONS	Review tire inflation maintenance procedures.

CASING CONDITIONS

C. TREAD/ SHOULDER AREA

PLY SEPARATION

SHOULDER AREA—CASING CONDITIONS

VMRS SYSTEM CODE: 017

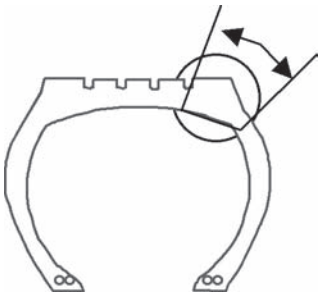
VMRS CONDITION CODE:

ALPHA
BL
NUMERIC
1317

WHY MADE CODE: 01, 04 or 10

BIAS

APPEARANCE	Bulge in shoulder area. May progress to complete separation exposing the ply cord material.
PROBABLE CAUSE	Contaimination, foreign material, overload, improper pressure. Check for punctures, repairs, contamination, breaks or underinflation.

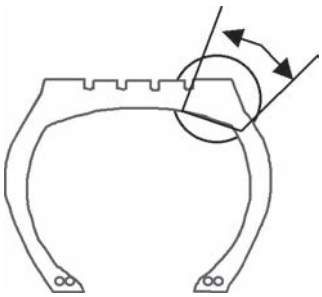


ACTION

TIRE	Remove the tire from service. If no repairs or punctures are found, contact your tire supplier.
VEHICLE	None.
OPERATIONS	None.

SHOULDER RIB TEARING

APPEARANCE	Tear at the base of the shoulder rib (first rib or shoulder).
PROBABLE CAUSE	Caused by running over curbs, rails, sidewalks, severe localized impacts and aggravated by underinflated and overloaded tires.



VMRS SYSTEM CODE: 017

VMRS CONDITION CODE:

ALPHA
RT
NUMERIC
1310

WHY MADE CODE:
14

BIAS

ACTION

TIRE	If fabric is showing, remove from service and scrap. If fabric is not evident, retread or return to service on a dual position.
VEHICLE	None.
OPERATIONS	Review driving and inflation procedures.

CUTS AND SNAGS

SHOULDER AREA—CASING CONDITIONS

VMRS SYSTEM CODE: 017

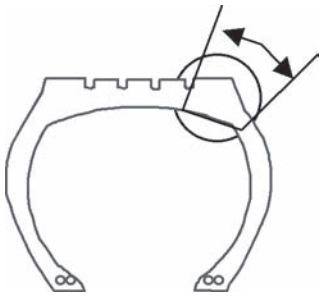
VMRS CONDITION CODE:

ALPHA
CU
NUMERIC
1207

WHY MADE CODE:
14, 26, or 33

BIAS

APPEARANCE	Scrapes, gouges or cuts in the shoulder, extending to the tread and/or sidewall.
PROBABLE CAUSE	Road hazard, curbing, rails, vandalism, etc.



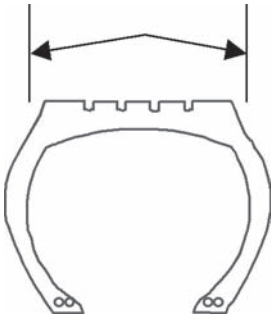
ACTION

TIRE	Remove from service. Send to repair/retread supplier for potential repair or scrap.
VEHICLE	None.
OPERATIONS	If similar damage occurs on several tires, investigate vehicle operations to determine the cause of the damage.

EXCESSIVE WEAR

TREAD AREA—CASING CONDITIONS

APPEARANCE	Tire worn below 2/32" or less of tread circumferentially or localized.
PROBABLE CAUSE	Tire run too long in service or worn brake skid left in service.



VMRS SYSTEM CODE: 017

VMRS CONDITION CODE:

ALPHA
EX
NUMERIC
1309

WHY MADE CODE:
09, 15 or 25

BIAS

ACTION

TIRE	Retread if possible.
VEHICLE	None
OPERATIONS	Review maintenance practices, removal criteria and drive pre/post inspection procedure.

GROOVE CRACKING

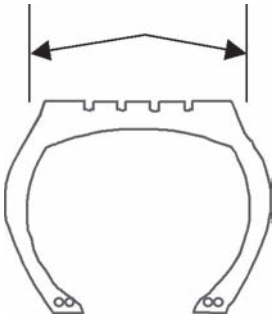
TREAD AREA—CASING CONDITIONS

APPEARANCE

Cracks at the base of the grooves.

PROBABLE CAUSE

Caused by casing growth, prolonged underinflation, weathering or insufficient undertread in new tire. Can be aggravated by excessive speed and rock cuts.



VMRS SYSTEM CODE: 017

VMRS CONDITION CODE:

ALPHA
GC
NUMERIC
1312

WHY MADE CODE: 17

BIAS

ACTION

TIRE

If cracking is superficial, tire may remain in service. If cracks extend to the ply cord, contact your tire supplier.

VEHICLE

None

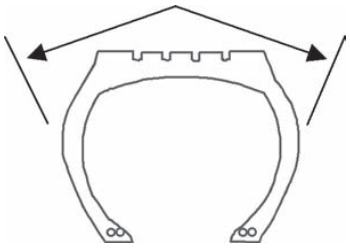
OPERATIONS

Review inflation maintenance, tire selection and driving procedures.

IMPACT BREAK

TREAD AREA—CASING CONDITIONS

APPEARANCE	Localized break through the tread rubber, crown, sidewall and casing.
PROBABLE CAUSE	Severe, concentrated impact with a foreign object or a pothole. Aggravated by overinflation and high speed.



VMRS SYSTEM CODE: 017

VMRS CONDITION CODE:

ALPHA
IM
NUMERIC
1605

WHY MADE CODE: 03 or 08

BIAS

ACTION

TIRE	Scrap tire.
VEHICLE	None
OPERATIONS	Review vehicle operation parameters and driving procedures.

IRREGULAR WEAR

TREAD AREA—CASING CONDITIONS

APPEARANCE	Tire worn on edge of one shoulder sometimes extending to inner ribs.
PROBABLE CAUSE	Excessive camber, misaligned or bent axle, or improper bearing adjustment.

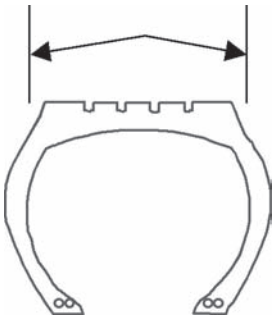
VMRS SYSTEM CODE: 017

VMRS CONDITION CODE:

ALPHA
RO
NUMERIC
1719

WHY MADE CODE:
15

BIAS



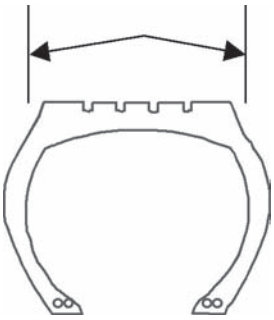
ACTION

TIRE	If shoulder wear is severe, remove and retread.
VEHICLE	Diagnose misalignment and/or mechanical condition and correct.
OPERATIONS	Review maintenance procedures.

STACKING DAMAGE—TREAD

TREAD AREA—CASING CONDITIONS

APPEARANCE	Individual or multiple cuts, usually in the tread grooves in a localized area of the crown.
PROBABLE CAUSE	Caused by tire contact with stacked chassis component.



VMRS SYSTEM CODE: 017

VMRS CONDITION CODE:

ALPHA
VD
NUMERIC
1604

WHY MADE CODE:
14 or 33

BIAS

ACTION

TIRE	Remove from service and perform thorough inspection.
VEHICLE	None.
OPERATIONS	Review stacking procedures.

TREAD OFF WHILE STILL INFLATED

TREAD AREA—CASING CONDITIONS

APPEARANCE	Tread missing with frayed body cords.
PROBABLE CAUSE	Operation after tread separation or body cord exposure.

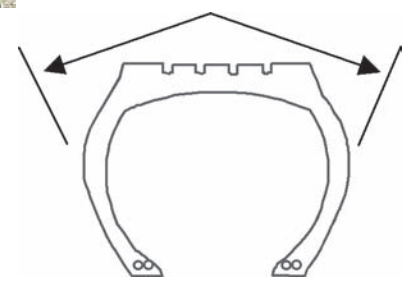
VMRS SYSTEM CODE: 017

VMRS CONDITION CODE:

ALPHA
TS
NUMERIC
1319

WHY MADE CODE:
10

BIAS



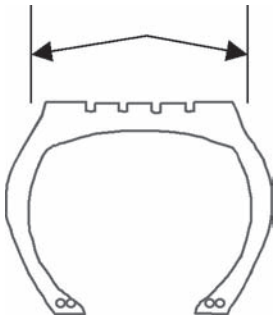
ACTION

TIRE	Scrap.
VEHICLE	None.
OPERATIONS	Review tire maintenance and driver breakdown procedures.

RETREAD SEPARATION

TREAD AREA—CASING CONDITIONS

APPEARANCE	A portion of tread rubber only has lifted and separated from the buffed surface.
PROBABLE CAUSE	Faulty retread and/or repair workmanship and/or material.



VMRS SYSTEM CODE: 017

VMRS CONDITION CODE:

ALPHA
VD
NUMERIC
1604

WHY MADE CODE:
10 or 28

BIAS

ACTION

TIRE	Consult your retreader/repair supplier for possible warranty adjustment. If no casing damage, send back to retreader to retread again.
VEHICLE	None.
OPERATIONS	None.

BRAKE SKID DAMAGE

TREAD AREA—CASING CONDITIONS

VMRS SYSTEM CODE: 017

VMRS CONDITION CODE:

ALPHA
BS
NUMERIC
1716

WHY MADE CODE:
34

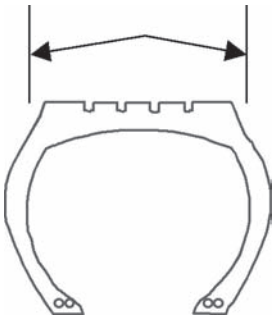
BIAS

APPEARANCE

Localized spot of excessive wear across the tread face showing abrasion marks from the tread sliding on the road surface. Damage may extended into the casing.

PROBABLE CAUSE

Brake skid usually occurs on trailer and drive tires. Aggravated by new brakes (high friction, not worn in), unbalanced brake system, aggressive use of brakes, driver abuse and unloaded vehicles. Frequently associated with gravel surfaces



ACTION

TIRE

If condition does not extend below 2/32" of tread, duals can be rematched to position flat spots 180° from each other. Since flat spotting tends to repeat in the same location, rotation should be performed as soon as possible. If more severe, the tire can be repaired or retreaded if damage is not into the belts. If damage is excessive, scrap tire.

VEHICLE

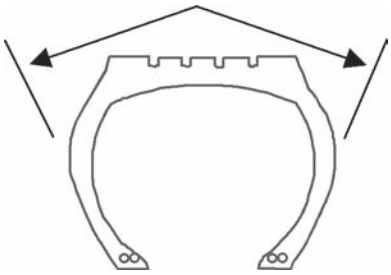
Check brake system components and brake balance.

OPERATIONS

Review driving procedures.

CHIPPING/FLAKING/CHUNKING TREAD

APPEARANCE	Chiping, tearing, chunking, bulging and detachment of tread on the crown.
PROBABLE CAUSE	Caused by tire running over curbs or rails or by severe localized impacts.



VMRS SYSTEM CODE: 017

VMRS CONDITION CODE:

ALPHA
CC
NUMERIC
1305

WHY MADE CODE:
14

BIAS

ACTION

TIRE	Tires with minor chipping and flaking can be returned to service. If cord is visible, consult your retreader for the possibility of repair and retread.
VEHICLE	None.
OPERATIONS	Review tire selection, tire operation and driving procedures.

VEHICLE DAMAGE

TREAD AREA—CASING CONDITIONS

VMRS SYSTEM CODE: 017

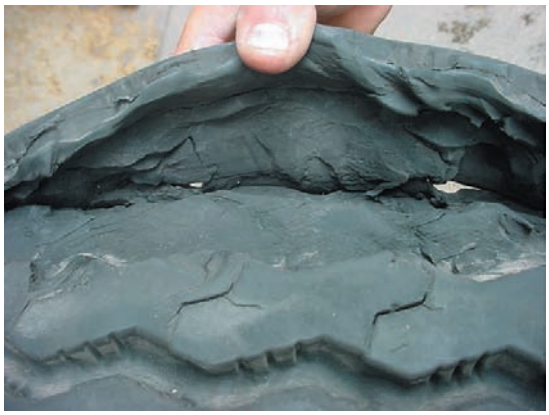
VMRS CONDITION CODE:

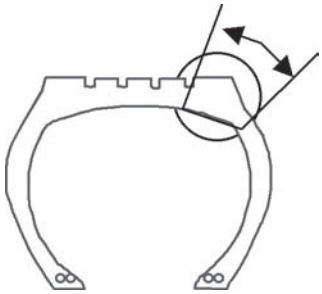
ALPHA
VD
NUMERIC
1604

WHY MADE CODE: 14

BIAS

APPEARANCE	Tear at the base of the shoulder groove (first rib.)
PROBABLE CAUSE	Caused by running over curbs, rails, sidewalks or sharp turning. Sometimes could be caused by a tread leaving casing.





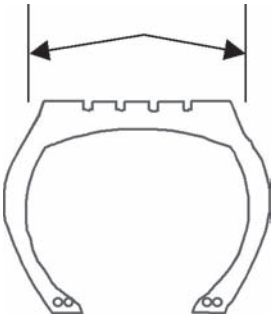
ACTION

TIRE	If the casing is damaged or cord is visible, remove the tire from service and consult your tire manufacturer. If casing is not damaged, return to service in a dual position. If the condition is more severe, scrap tire.
VEHICLE	Analyze the cause of the condition and correct. Ensure the tire does not come into contact with the vehicle.
OPERATIONS	Review driving procedures and pre-trip inspection practices.

OPEN TREAD SPLICE

TREAD AREA—CASING CONDITIONS

APPEARANCE	A space is evident between the tread ends.
PROBABLE CAUSE	Poor workmanship, poor tread end adhesion or the tread was cut too short.



VMRS SYSTEM CODE: 017

VMRS CONDITION CODE:

ALPHA
OT
NUMERIC
1330

WHY MADE CODE: 01

BIAS

ACTION

TIRE	The tire may be returned to service and run out its tread life; or consult your retreader for possible warranty adjustment and retread again.
VEHICLE	None
OPERATIONS	None

TREAD LIFT/SEPARATION

TREAD AREA—CASING CONDITIONS

VMRS SYSTEM CODE: 017

VMRS CONDITION CODE:

ALPHA
TS
NUMERIC
1319

WHY MADE CODE: 10

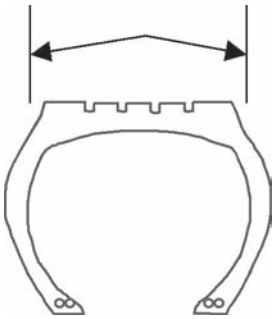
BIAS

APPEARANCE

Bulge on shoulder or tread face area may be accompanied by split through the bottom of the tread groove. Usually localized wear in the tread above the separated area will occur. May result in a loss of a section of tread. Belt package is intact.

PROBABLE CAUSE

Adhesion loss between the tread rubber and the tire belt package. Can be caused by tread penetration and/or cut. Also, missed nail hole in retread.

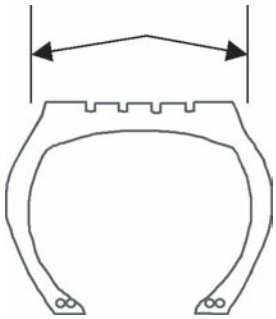


ACTION

TIRE	Remove tire from service. Consult your tire manufacturer or retreader.
VEHICLE	None
OPERATIONS	None

TREAD DELAMINATION

APPEARANCE	Evidence of layers or flakes of rubber in the tread.
PROBABLE CAUSE	Rubber compounding condition, contaimination of tread rubber.



VMRS SYSTEM CODE: 017

VMRS CONDITION CODE:

ALPHA
DL
NUMERIC
1303

WHY MADE CODE:
10

BIAS

ACTION

TIRE	If the problem is not severe, the tire could be returned to service until run out. Consult your tire or retread manufacturer.
VEHICLE	None
OPERATIONS	None

PENETRATIONS AND ROAD HAZARDS

TREAD AREA—CASING CONDITIONS

VMRS SYSTEM CODE: 017

VMRS CONDITION CODE:

ALPHA
RH
NUMERIC
1607

WHY MADE CODE: 27

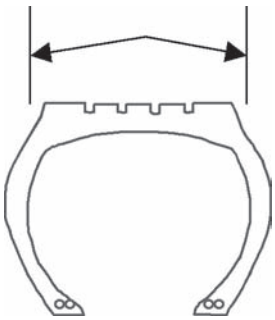
BIAS

APPEARANCE

Evidence of a puncture or damage by a foreign object through the crown area; may result in loss of air and/or separation.

PROBABLE CAUSE

Road hazard or foreign object.



ACTION

TIRE

Consult your repair facility for possibility of repair. If the damage is beyond limits and/or a separation is evident, scrap tire.

VEHICLE

None.

OPERATIONS

Eliminate yard debris and review pre-trip inspection procedures.

SECTION II—

RETREAD/ REPAIR CONDITIONS

IMPROPER/ FAILED RETREAD CONDITIONS

VARIOUS AREAS

IMPROPER RETREAD CURE

RETREAD—IMPROPER/FAILED CONDITIONS

VMRS SYSTEM CODE : 017

VMRS CONDITION CODE :

ALPHA
TR
NUMERIC
1321

WHY MADE CODE: 01

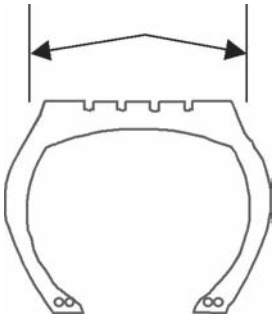
BIAS

APPEARANCE

A portion of tread rubber only has lifted and separated from the buffed surface.

PROBABLE CAUSE

Cure pressure. Faulty retread workmanship and/or material such as a scorched or contaminated buffed surface, old cushion gum, wet cement, or tread rub ber, imrproper cure conditions, missed nail hole, or a faulty repair.



ACTION

TIRE

Consult your retreader for possible warranty adjustment. Retread the tire again if possible.

VEHICLE

None.

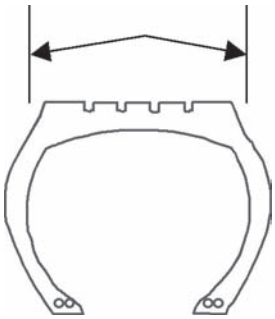
OPERATIONS

None.

IMPROPER RETREAD CURE—FULL NON-SKID

RETREAD—IMPROPER/FAILED CONDITIONS

APPEARANCE	Buffline visible concave wear pattern.
PROBABLE CAUSE	Mold cure retread with insufficent rubber in center of tread.



VMRS SYSTEM CODE : 017

VMRS CONDITION CODE :

ALPHA
RE
NUMERIC
1320

WHY MADE CODE: 01

BIAS

ACTION

TIRE	Consult your retreader.
VEHICLE	None.
OPERATIONS	None.

RETREAD SEPARATION - REPAIR RELATED

RETREAD—IMPROPER/FAILED CONDITIONS

VMRS SYSTEM CODE : 017

VMRS CONDITION CODE :

ALPHA TR
NUMERIC 1321

WHY MADE CODE: 01

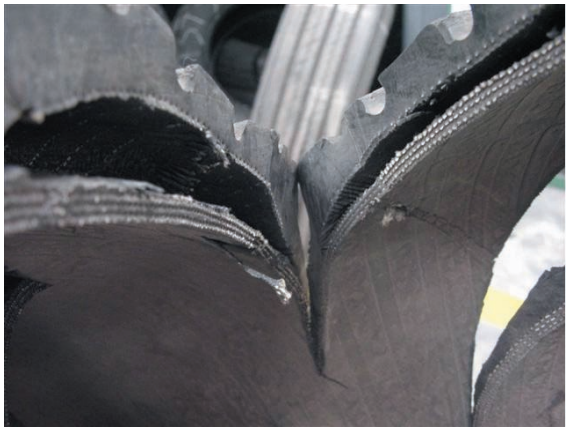
BIAS

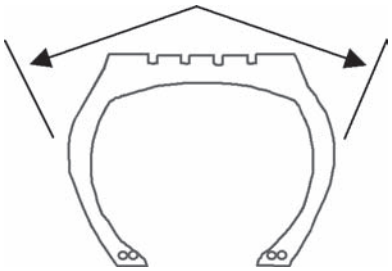
APPEARANCE

The rubber and casing are detached. A repair is evident in the area of the separated tread.

PROBABLE CAUSE

Faulty repair. Air seeped through or was trapped in the injury and under the tread which eventually reduced adhesion between the tread and the tire and resulted in a separation.





ACTION

TIRE

Consult your retreader and/or repair supplier for possible warranty adjustment. Repair and retread the tire again if possible.

VEHICLE

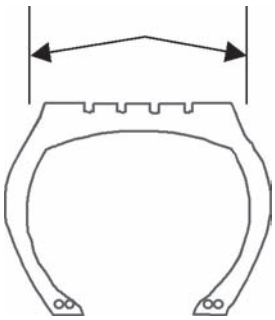
None.

OPERATIONS

Review repair techniques with your repair technician or repair supplier.

EXCESS RUBBER ON SHOULDER POST RETREAD

APPEARANCE	Excessive rubber at bond line on a new retread.
PROBABLE CAUSE	Untrimmed rubber after curing.



VMRS SYSTEM CODE : 017

VMRS CONDITION CODE :

ALPHA
N/A
NUMERIC
N/A

WHY MADE CODE:
N/A

BIAS

ACTION

TIRE	Cosmetic condition. Tire can be left in service.
VEHICLE	None.
OPERATIONS	None.

RETREAD SEPARATION - REPAIR RELATED

TREAD AREA—CASING CONDITIONS

VMRS SYSTEM CODE : 017

VMRS CONDITION CODE :

ALPHA TR
NUMERIC 1321

WHY MADE CODE: 01, 04, 08, 20, or 28

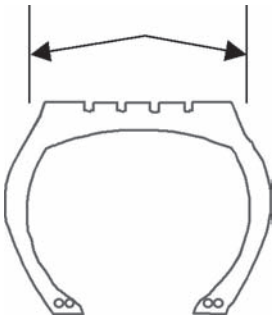
BIAS

APPEARANCE

A portion of the tread is separated from the buffed surface. A repair is evident in the area of the separated tread.

PROBABLE CAUSE

Faulty repair. Air seeped through or was trapped in the injury and under the tread which eventually reduced adhesion between the tread and the tire and resulted in a separation.



ACTION

TIRE	Consult your retreader and/or repair supplier for possible warranty adjustment. Repair and retread the tire again if possible.
VEHICLE	None.
OPERATIONS	Review repair techniques with your repair technician or repair supplier.

RETREAD EDGE LIFTING

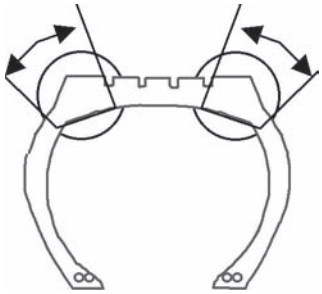
TREAD AREA—CASING CONDITIONS

APPEARANCE

The retread is worn to excess on one shoulder of the tire; the edge of the tread is loose and exhibits more wear in the area of separation.

PROBABLE CAUSE

Caused by: cure related problems, retread processing problems, improper shoulder buff, insufficient bonding gum, or improper tread selection for application.



VMRS SYSTEM CODE : 017

VMRS CONDITION CODE :

ALPHA TE
NUMERIC 1322

WHY MADE CODE: 04, 07, 10 or 28

BIAS

ACTION

TIRE

If severe, consult your retreader for possible warranty adjustment. If the tire casing is sound, retread the tire again. Continue in service if condition is not severe.

VEHICLE

None.

OPERATIONS

None.

BOND LINE POROSITY

TREAD AREA—CASING CONDITIONS

VMRS SYSTEM CODE : 017

VMRS CONDITION CODE :

ALPHA BP
NUMERIC 1323

WHY MADE CODE: 04, 08, 10, 11, 19, 28

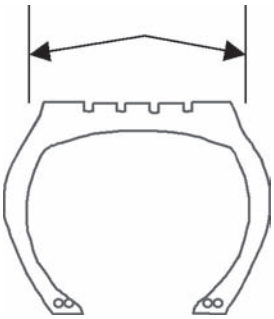
BIAS

APPEARANCE

Large sections, if not all, of tread has separated from the casing; porosity is evident. This appears as a sponge-like surface that is frequently tacky.

PROBABLE CAUSE

Lack of proper cure conditions, i.e., time, temperature and pressure.



ACTION

TIRE

Consult your retreader for possible warranty adjustment. Retread and rerun.

VEHICLE

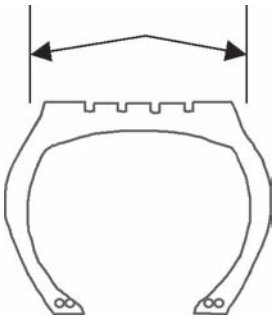
None.

OPERATIONS

None.

MISSED PUNCTURE

APPEARANCE	A portion of the tread is separated from the casing at the buff line in the area of the unrepaired puncture. This occurs soon after retreading.
PROBABLE CAUSE	An undetected and/or unrepaired penetration.



VMRS SYSTEM CODE : 017

VMRS CONDITION CODE :

ALPHA
MP
NUMERIC
1324

WHY MADE CODE:
04, 08, 10, 19, 20, 28

BIAS

ACTION

TIRE	Consult your retreader for possible warranty adjustment. Repair and retread again if possible.
VEHICLE	None.
OPERATIONS	None.

SKIVE FAILURE

TREAD AREA—CASING CONDITIONS

VMRS SYSTEM CODE : 017

VMRS CONDITION CODE :

ALPHA SF NUMERIC 1325

WHY MADE CODE: 04, 08, 14, 20, 28

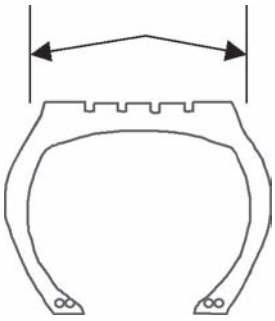
BIAS

APPEARANCE

Excessive wear in the tread area, or missing tread at the location of a skive. The skive may appear rusty, scorched or exhibit loose wire ends.

PROBABLE CAUSE

Improper skive workmanship which causes poor adhesion resulting from scorching, loose cable ends, wet cement, and/or incorrect skive fill that traps air.



ACTION

TIRE

Consult your retreader for possible warranty adjustment. If within limits of repair, repair the tire again and retread.

VEHICLE

None.

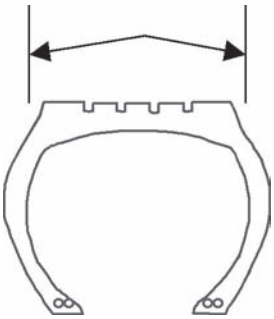
OPERATIONS

Review skive techniques with your retreader.

MISALIGNED TREAD

TREAD AREA—CASING CONDITIONS

APPEARANCE	Tread is not centered on the crown and may appear “snaked” around the tire or offset to one side.
PROBABLE CAUSE	Poor/improper tread application.



VMRS SYSTEM CODE : 017

VMRS CONDITION CODE :

ALPHA MT NUMERIC 1327

WHY MADE CODE: 02, 04 or 28

BIAS

ACTION

TIRE	Consult your retread supplier for warranty consideration, continue in service or retread the tire again.
VEHICLE	None.
OPERATIONS	None.

SECTION III—

TIRE REPAIR PROCEDURES

BIAS TIRE REPAIR PROECEDURES

INTRODUCTION

A properly made repair can provide many additional miles of wear to an otherwise useless tire and greatly reduce the tire's cost/mile.

This section provides step-by-step procedures for repairing bias tires that can be easily followed by the tire technician and which will consistently produce satisfactory repairs. It has been designed to be used as an everyday working tool. The instructions in this section deal with the use of chemical cure repair units.

Since there are several suppliers of fine quality repair materials, this document does not specifically endorse the use of any one brand or type of repair system. Two types of repair units can be used. The first type is selected for the size of the injury it is to cover and is centered over the finished hole when installed, regardless of the injury's location in the repairable area of the tire. The second type is also selected for the size of the injury it is to cover, but is always placed over the injury so that the repair unit's ends do not end in a flex area (sidewall) of the tire and are not necessarily centered over the injury. The use of either type of repair unit is a matter of personal preference; both will provide excellent results in reinforcing a tire repair. A repair unit must be used in all permanent tire repairs.

There are two types of rubber backing used on repair units. These are referred to as chemical and uncured. Chemical repair units need only an "activator" found in chemical cement applied to its base cushion material. This is the only way a chemical-cure type repair unit will vulcanize. Uncured repair units consist of "raw materials" or bonding layers that have not been exposed to heat. Temperature (212-300°F), time, and pressure are necessary to vulcanize repair units to the tire. Proper rubber backing selection is critical and is dependent upon the curing equipment used in the tire repair shop.

It is recommended that the user consult repair material suppliers for detailed information regarding their products. It is advisable not to mix product brands (cements, repair units, etc.) to ensure that the curing characteristics of the products are compatible.

A list of repair material suppliers and their addresses can be found at the end of this section. Many of these suppliers conduct repair seminars and can provide complete kits of materials and equipment for repairing bias and radial tires.

GENERAL CONSIDERATIONS FOR ALL TIRE REPAIRS

Careful inspection is mandatory in the repair of bias tires. Tires should be checked thoroughly on a well-lighted (200 ft. candles minimum, 300 ft. candles recommended) spreader both inside and out, with all foreign material and moisture removed from the tire. All tires to be repaired should be stored inside in a dry environment, and should never be exposed to the weather.

While there are many types of acceptable repair materials on the market today, **the only acceptable method of tire repair calls for removal of the tire from the rim or wheel. Repairs made from the outside while the tire is still mounted are not recommended**.

⚠ DANGER: All OSHA/EPA safety equipment must be used when repairing tires. Adequate ventilation should also be maintained when working with solvents and cements.

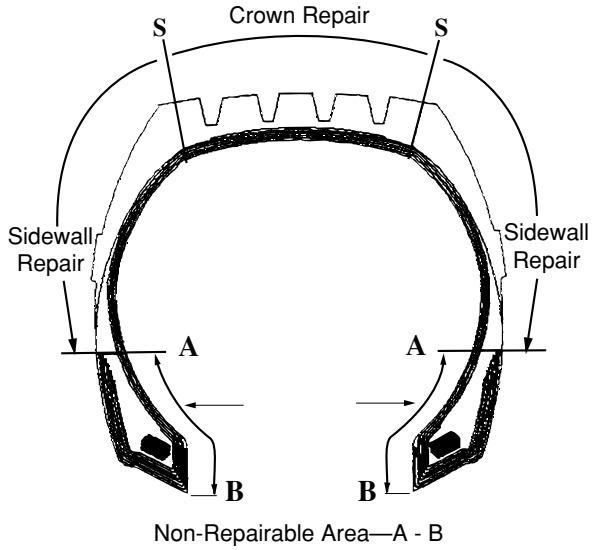
As a general rule, tires should not be repaired if any of the following conditions are found during the tire inspection:

1. External.

a. Exposed cords beyond repairable limits.
b. Separations beyond repairable limits.
c. Broken belts.
d. Excessive oxidation (weather checking) extending to the body plies.
e. Damage which exceeds the size of a repairable injury or requires the repairs to overlap in tires or that are in the same quadrant in bias tires.
f. Broken or kinked beads.
g. Damaged beads exposing bead wire.
h. Injuries beyond repairable limits.
i. Tires with less than 2/32 inches (2mm) nonskid remaining unless retreading is planned.
j. Previously installed repairs found to be defective and unrepairable.

2. Internal

a. Injuries beyond repairable limits.
b. Porous or loose liners.



Non-Repairable Area—A - B

Fig. 3

c. Open inner liner splices beyond repairable limits.
d. Loose cords on the inside ply or evidence of having been run underinflated or overloaded.
e. Injury to the ply cord beyond repairable limits.

3. Acceptable Repair Limits

More than one section repair can be made safely in truck tires. The distance between injuries is limited to the extent that the repair units, when properly installed, do not overlap. The size of the repair will also have a bearing on the number that can be installed. There is no limit to the number of nail hole repairs that can be made in a tire provided they do not overlap.

Bias tire repairs should be limited to only two section repairs in any quadrant of the tire for tires designated for local service; and one section repair per quadrant for tires in highway service. Repairs can be made in all areas of bias tires except in the bead area shown in Fig. 3 as the A-B area. Only repairs involving rubber damage and chafer ply damage can be made here.

When it is necessary to make multiple repairs, consider the value of the tire when determining if multiple repairs are cost-effective.

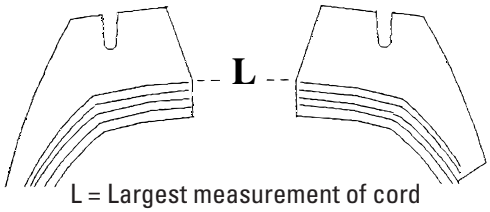
REPAIR LIMITATIONS

Once the injury has been skived out, a measurement must be taken to ensure that the area to be repaired falls within the repair material manufacturer's parameters. In bias ply tires, the longest measurement of cord damage, in any one direction is used (see Fig. 4).

TABLE 1:
NON REPAIRABLE BEAD AREA FOR BODY PLY DAMAGE

TIRE CROSS SECTION	A-B AREA*
All Passenger	1.5" (38 mm)
Truck-Tubetype Up to 7.5 8.25 and above	 3" (76 mm) 3.5" (89 mm)
Truck-Tubeless Up to 8.5 9 and above	 3" (76 mm) 3.5" (89 mm)
* Rubber spot repair only in this area. Repair to body ply and/or bead structure in this area is not permitted.	

*A-B area is the non-repairable area of the tire. Only repairs involving rubber damage and chafer ply damage can be made in this region. The distance is measured from the bead toe on the inside of the tire.



L = Largest measurement of cord damage in any one direction.

Bias Repair Measurement

Fig. 4

TABLE 2A
BIAS TRUCK TIRES—SECTION REPAIR INJURY SIZE LIMITS
(HIGHWAY DRIVE OR TRAILER TIRES)

TIRE SIZE	MAXIMUM INJURY SIZE Crown Area (25% of tire cross section minus 1")	MAXIMUM INJURY SIZE Sidewall Area (1/2 the maximum crown injury size)
7.50-20/8-22.5	7/8 INCH (22 mm)	7/16 INCH (11mm)
8.25-20/9-22.5	1-1/16 INCH (27mm)	17/32 INCH (13mm)
9.00-20/10-22.5	1-1/4 INCH (32mm)	5/8 INCH (16mm)
10.00-20/11-22.5	1-1/4 INCH (32mm)	5/8 INCH (16mm)
10.00-22/11-24.5	1-1/2 INCH (38mm)	3/4 INCH (19mm)
11.00-20/12-22.5	1-1/2 INCH (38mm)	3/4 INCH (19mm)
11.00-22/12-24.5	1-1/2 INCH (38mm)	3/4 INCH (19mm)
11.00-24	1-3/4 INCH (44mm)	7/8 INCH (22mm)
12.00-20/12.00-24	2" INCH (51mm)	1 INCH (25mm)

If the repair person cannot identify the type of service the tire will be placed in, repairs should be made in accordance with the information in Table 2A only.

NOTE: All measurements are made across the widest point of the skive at the top ply.

TABLE 2B
BIAS TRUCK TIRES—SECTION REPAIR INJURY SIZE LIMITS
(LOCAL SERVICE DRIVE OR TRAILER TIRES)

TIRE SIZE	MAXIMUM INJURY SIZE Crown Area (25% of tire cross section minus 1")	MAXIMUM INJURY SIZE Sidewall Area (1/2 the maximum crown injury size)
7.50-20/8-22.5	1-7/8 INCHES (48mm)	15/16 INCHES (24mm)
8.25-20/9-22.5	2-1/16 INCHES (52mm)	1-1/32 INCHES (26mm)
9.00-20/10-22.5	2-1/4 INCHES (57mm)	1-1/8 INCHES (29mm)
10.00-20/11-22.5	2-1/4 INCHES (57mm)	1-1/8 INCHES (29mm)
10.00-22/11-24.5	2-1/2 INCHES (64mm)	1-1/4 INCHES (32mm)
11.00-20/12-22.5	2-1/2 INCHES (64mm)	1-1/4 INCHES (32mm)
11.00-22/12-24.5	2-1/2 INCHES (64mm)	1-1/4 INCHES (32mm)
11.00-24	2-3/4 INCHES (70mm)	1-3/8 INCHES (35mm)
12.00-20/12.00-24	3 INCHES (76mm)	1-1/2 INCHES (38mm)

NOTE: All measurements are made across the widest point of the skive at the top ply.

If the repair person cannot identify the type of service the tire will be placed in, repairs should be made in accordance with the above information only.

TOOLS AND MATERIALS LIST FOR BIAS TIRE NAIL HOLE REPAIR

Materials

- Nail hole repair units
- Combination patch/stem repair systems
- Chemical vulcanizing cement
- Cement dispensers
- Rubber buffer/liner cleaner
- Rubber solvent dispensing can
- Rubber inserts or stems
- Repair sealant

Hand Tools

- Low RPM drill — low RPM (1200 rpm or slower)*
- Low-speed air buffer (2,500-5,000 rpm) with quick change chuck and adapters*
- 1/4", 1/8", 3/8" carbide cutters
- Fine-grit grinding stone or wheel
- 3/8" Stem Brush
- Soft Wire Brush
- - Cup rasp 1x3 inches
- Wet/Dry Vacuum Cleaner**
- 1/8 -1/4-inch corrugated stitcher
- Probing Awl
- Flexible Blade Skiving Knife
- Stem Insertion Tool
- Slip Joint Pliers
- Needle Nose Pliers
- Side Cutters
- Rubber Scraper
- Tire crayon
- Safety glasses

* NOTE: All air tools need to be equipped with a rear exhaust kit.

**NOTE: A vacuum cleaner should always be used to remove buffing dust, dirt and debris from a tire. Never use an air blow gun to remove this matter, since it will blow contaminants onto a freshly buffed surface and introduce moisture and oil from the air lines into the tire.

ADDITIONAL TOOLS AND MATERIALS LIST FOR TIRE SECTION REPAIRS

Materials

- Combination patch/plug repair units
- Section repair units
- Black vulcanizing cement
- Cushion Gum

BIAS TIRE REPAIR PROCEDURES

Hand Tools

3/8- or 1/4-inch Carbide cutters, carbide pencil rasp or drill bits
Core Cutters - 3/8 to 1-1/4" in diameter
High-speed Wire Cord Grinder (20,000+ rpm) with 1/8-inch collet or drill chuck.
Tungsten Carbide Rasps or equivalent in
36 - 60 grit
- Cone rasp 2" x 3/4"
- Radius rasp 3/8" x 2"

Fine Grit grinding Stones
- 1/4-inch diameter pencil-shape grinding stone or 3/16-inch diameter rod-shape grinding stone
- 3/4-inch diameter cone shape
- 1 1/4-inch diameter mushroom shape

1/8" and 1/4" carbide routers and burrs
1/2"-7/8" round burr
Encapsulated Wire Buffing Brush
Electric Spotter (optional if other curing equipment is used)
Shears
Tape Measure
Taper Point Knife
Knife Sharpener
Rotary Gouges

BIAS TRUCK TIRES: SPOT REPAIRS

Spot Repairs are any repairs on the outside of the tire affecting only the exterior rubber in a radial tire and less than 25 percent of the actual plies in a bias tire. Because the injury is shallow, no reinforcing repair unit is required. The size of the spot repair is limited only by the area accommodated by the curing system to be used (i.e., spotter size, section mold size, etc.).

1. Cut away any loose rubber. (If any wire plies are exposed and damaged, a section repair must be made.) See Fig. 5.
2. Buff the injury with a 16- or 36-grit radius rasp or wire brush mounted on a slow speed air buffer (maximum 5,000 rpm) and remove all damaged rubber. (This area need not be any certain size or shape other than it must fit into the parameters of the curing system.) The sides should be beveled to a 45° angle.

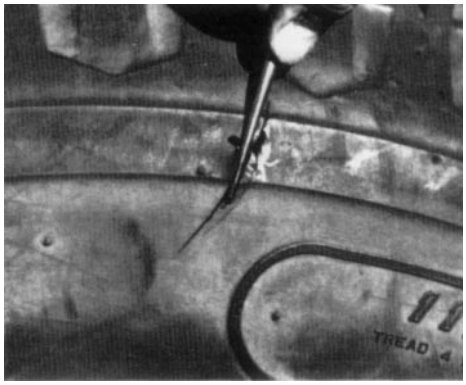


Fig. 5

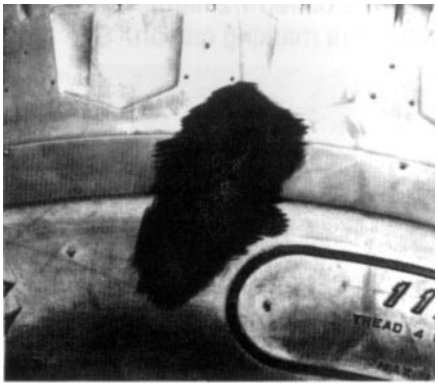


Fig. 6

3. Buff the area 1/2 inch around the skive with a fine grit tungsten carbide radius rasp or wire brush mounted on slow speed air buffer.
4. Remove excess buffing dust from the buffed surface using a soft wire brush followed by a vacuum cleaner. Clean with rubber liner cleaner only if recommended by the repair manufacturer. Allow rubber cleaner to dry thoroughly.
5. Apply a coat of black vulcanizing cement to skive and buffed area. Let dry according to manufacturer recommendations. See Fig. 6.
6. Place cotton vent cords in bias tire skives which expose breaker or body plies. Vent cords should end at the bottom of the cavity. Do not bridge the cavity with the cord. The cord should extend out of the skive past the end of the rubber fill. NOTE: Do not vent spot repairs in radial tires.
7. Use cushion gum or extruder rope to fill the injury. Fill the injury completely by stitching and packing small strips of rubber gum firmly with an awl and a stitcher to prevent trapped air. See Fig. 7.
8. If vulcanizing cushion gum is to be used, build the repair 1/8-1/4-inch higher than the tire sidewall to ensure positive pressure during cure.
9. Follow manufacturers' instructions for curing devices and length of cure.

Fig. 7

10. After the repair has been cured and allowed to cool, finish the repair by buffing the spot even with the tire surface with a fine grit tungsten carbide radius rasp or wire brush mounted on a slow speed air buffer (maximum 5,000 rpm).
11. The tire can be mounted and inflated in a cage immediately and installed on a vehicle.

BIAS TRUCK TIRES: NAIL HOLE REPAIRS

A Nail Hole Repair in the crown (S-S) area of a bias truck tire is 3/8 inch in diameter or less. Any injury larger than this requires a section repair be made. See **Fig. 8**.

1. Place the tire on a spreader and spread the beads slightly to facilitate inspection. Inspect the tire inside and out to determine its repairability.
2. Remove the puncturing object. Carefully probe the hole with an awl to determine its size and direction. Make sure that all traces of the penetrating object have been removed. Mark injury on outside of tire.
3. Apply rubber buffer/liner cleaner to the liner to remove traces around the injury. Use a scraper to obtain a uniform, clear, dull black appearance.
4. Relax the tire beads.
5. Select appropriate rasp or drill bit. With a slow speed air buffer (maximum 5,000 rpm), ream injury in and out until all the damaged area is removed. Ream from inside the tire whenever possible. Take care to avoid burning rubber.
6. Remove excess buffing dust from the buffed surface using a soft wire brush followed by a vacuum cleaner. Clean with rubber buffer/ liner cleaner only if recommended by the repair manufacturer. Allow rubber buffer/cleaner to dry thoroughly.
7. Apply chemical vulcanizing cement into the puncture hole by using a cementing tool or small brush and allow the cement to dry (make sure cement does not puddle, leaving wet cement) or apply the cement only to the tapered portion of the plug. Check with your repair material manufacturer for specifications.
8. Select a nail hole stem or insert to fill the hole. Depending on the supplier, these materials may be inserted several ways. Refer to the individual suppliers' instructions for proper use.

   Note: All stems, inserts, etc. must be larger than the hole to ensure a compression fit results. Manufacturer specifications take this into consideration.

9. Install the stem or insert and cut it off about 1/8 inch above the inner liner.
10. Select the proper bias nail hole repair unit or repair unit template and center it over the injury. Mark an area that is 1/2 inch larger than the repair unit with a tire marking crayon.
11. With a fine grit tungsten carbide cup rasp or a wire buffing brush mounted on a slow speed air buffer (maximum 5,000 rpm), buff the plug stem down until it is flush with the liner. Lightly buff the area for the repair unit to an even, velvet-like (RMA Texture 1-2) texture, removing all traces of the liner design. Do not buff through the inner liner or expose any cord plies. Do not buff into the crayon marks.
12. Remove all buffing dust and debris from inside the tire with a vacuum cleaner. Clean with rubber buffer/liner cleaner only if recommended by the tire or repair material manufacturer. Use it sparingly and ensure that it dries thoroughly.
13. Apply chemical vulcanizing cement with light, even strokes to the buffed area. Then stipple into surface. Turn the repaired area to the 3 or 9 o'clock position to facilitate faster drying and allow cement to dry to a tacky surface. (Cement vapors are heavier than air.)
14. Adjust the spreader so the beads are in a relaxed position (recommended rim width).
15. Carefully remove the backing from the repair unit, taking care not to touch the tacky surface, and install the repair unit over the injury. Make sure that the unit is installed as indicated by the arrows.
16. Use a corrugated stitcher to stitch the repair unit down. Always stitch from the center out both horizontally and vertically. Remove the transparent covering from the top of the repair unit if there is one.
17. When repairing a tubeless tire, apply a repair sealant over the outer edges of the repair unit and the exposed buffed areas around the repair unit.

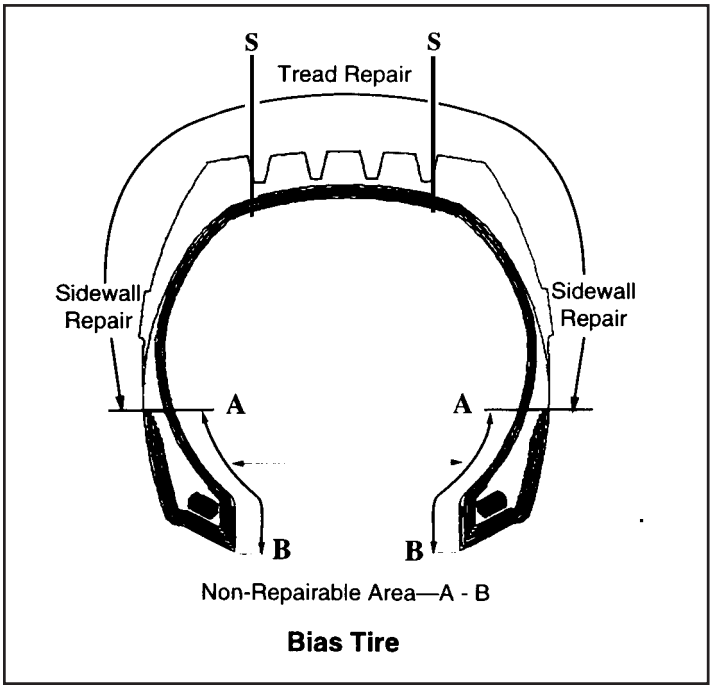


Fig. 8

When repairing a tube-type tire, be sure the sealant is dry before installing the tube. Cover the repair with tire talc.

18. Cut off the stem or plug, if used, on the outside of the tire so it is slightly higher than the tread surface. Do not pull on the stem while cutting.
19. If a stem or plug is used, the tire may be mounted, inflated in a safety cage immediately, and installed on a vehicle.

BIAS TRUCK TIRES: SECTION/REINFORCEMENT REPAIRS

Bias Reinforcement Repairs are made when 25-75 percent of the tire actual body plies are damaged.

Bias Section Repairs are made when the injury is either larger than 3/8 inch in diameter or 75 percent or more of the body plies are damaged. The damage to be repaired must not exceed the specified limits of the repair material manufacturer. See Table 2.

Note: Bias Section Repairs in California apply to injuries that have 50 percent or more of the body plies damaged.

1. Place tire on spreader and spread slightly to facilitate inspection. Inspect the tire inside and outside to determine its repairability.
2. Apply rubber liner cleaner to the liner to remove contaminants around the injury. Use a scraper to obtain a uniform, clean, dull black appearance.
3. For reinforcement repairs. Use a slow speed (maximum 5,000 rpm) air buffer with a 16-grit tungsten carbide rasp. Keep the skive as small as possible while removing all damaged cord. The walls of the skive should be "V"-shaped and tapered to approximately a 45° angle. Finish the skive with a slow speed air buffer (maximum 5,000 rpm) and a 36-46-grit tungsten carbide cone. All cord ends must be buffed back to solid rubber with no "fuzz." The rubber surfaces must be buffed to a RMA #3 or # 4 texture, removing any sharp corners. Carefully inspect the skive to ensure that all of the injury has been removed. Cord ends must be soft and not burned.

   For section repairs, the tire is always skived from the outside in. A "Y"-shaped skive is recommended to remove rubber and the injury through the tire. Use a 16-grit radius rasp mounted on a slow speed (maximum 5,000 rpm) air buffer and skive the injury by reaming in and out through the tire at a 90° angle. If all the damaged area cannot be removed by using a cone rasp, use a 16-grit radius rasp. Stay as close to the "Y"-shaped skive as possible. Angles on the sides in the rubber surrounding the injury should be approximately 45.°

4. Use a fine-grit cup rasp mounted on a slow speed buffer and lightly buff 1/2 inch around injury both on the inside and outside. On tube-type tires that have little rubber coating over the cords, it is usually better to use a wire brush instead of a cup rasp. Buff to a smooth and even, velvet-like RMA Texture #1 surface.
5. Remove excess buffing dust from the buffed surface using a soft wire brush followed by a vacuum cleaner. Clean with rubber liner cleaner only if recommended by the repair manufacturer. Allow rubber cleaner to dry thoroughly.
6. Apply a coat of black vulcanizing cement to injury and buffed area inside and out. Let dry approximately 10-to-15 minutes according to manufacturer recommendations.
7. Refer to the repair material manufacturer's repair limitations table to verify that the damage does not exceed repair limits.
8. Relax the spreader so the beads are no wider than the recommended rim width.
9. Use cushion gum or extruder rope to fill injury. Start by placing a piece of gum large enough to cover the entire injury and buffed edges inside the tire. Stitch down firmly with corrugated stitching wheel. From the outside of the tire, fill the injury completely by stitching and packing the rubber gum firmly with an awl and a stitcher to prevent any trapped air. Build repair about 1/8-1/4-inch higher both inside and out to assure positive pressure during cure.
10. Follow manufacturers' instructions for curing devices and length of cure.
11. After the tire has cooled, select the proper repair unit.
12. Use rubber buffer/liner cleaner to remove contaminants from the liner in the area to be buffed. Use a scraper to obtain a uniform, clean dull black appearance. Work from the center out.
13. Place the repair unit or repair unit template over the injury and outline an area to be buffed 1/2 inch larger than the repair unit with a tire marking crayon.
14. With a fine grit tungsten carbide cup rasp or a wire buffing brush mounted on a slow speed air buffer (max. 5,000 rpm), buff the area for the repair unit to an even, velvet-like (RMA Texture 1-2) texture, removing all traces of the liner design and the overflow of the all-purpose gum. Do not buff through the inner liner or expose any cord plies. Do not buff into the crayon marks. See Fig. 9.

Fig. 9

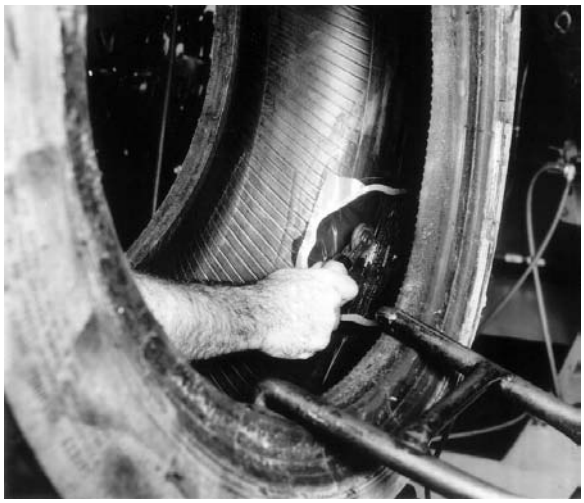


Fig. 10

15. Remove excess buffing dust from the buffed surface using a soft wire brush followed by a vacuum cleaner. Clean with rubber buffer/ liner cleaner only if recommended by the repair manufacturer. Allow rubber buffer/cleaner to dry thoroughly.
16. Apply a thin coat of chemical vulcanizing cement to the buffed area and stipple into the surface. Turn the repaired area to the 3 or 9 o'clock position to facilitate fast drying. (Cement vapors are heavier than air.) Let dry to a tacky surface.
17. Carefully remove the backing from the repair unit, taking care not to touch the tacky surface.
18. With tire beads in a relaxed position, center the repair unit over the injury. Make sure the unit is installed as indicated by the arrows. Press firmly with thumb.
19. When repairing a tubeless tire, apply a repair sealant over the outer edges of the repair unit and the exposed buffed areas around the repair unit. When repairing a tube-type tire, be sure the sealant is dry before installing the tube. Cover the repair with tire talc.
20. Dress injury on tread surface with a fine grit radius rasp mounted on a slow speed air buffer flush with tread. If desired, use a regrooving tool and carefully make grooves in spot continuous with tread grooves. See **Fig. 10**.

BIAS TRUCK TIRES: COMBINATION PATCH/PLUG REPAIRS

Combination Patch/Plug Repairs can be used when the damaged area can be removed by using a core cutter and the maximum size of the area that can be removed is 1-1/4 inch in diameter. If the injury cannot be completely removed or is not perpendicular to the liner surface, the tire must be repaired as described in "Bias Truck Tires - Section Reinforcement Repairs."

1. Place the tire on a spreader and spread the beads slightly to facilitate inspection. Inspect the tire inside and out for repairability.
2. Carefully probe the injury with an awl to determine its size and direction. Make sure all traces of the penetrating object have been removed. Mark outside of tire.
   Note: Proceed with these instructions if the direction of the injury is perpendicular to the liner surface. If it is not, repair using Bias Section/Reinforcement Repair procedures.
3. Select the proper size core cutter or cutter. Do this by placing the core cutter over the injury. Be sure the selected core cutter will completely remove the damaged area.
4. Select the correct combination patch plug repair unit in accordance with the core cutter size.
5. Vacuum inside of tire to remove all dirt and debris.
6. Apply rubber buffer/liner cleaner to the liner to remove contaminants around the injury. Use a scraper to obtain a uniform, clean, dull black appearance.
7. Center repair unit or repair unit template over injury and mark an area around the repair unit that is 1/2 inch larger than the repair unit with a tire marking crayon.
8. With a fine grit cup rasp or a wire buffing brush mounted on a slow speed air buffer (maximum 5,000 rpm), lightly buff the area for the repair unit to an even, velvet-like (RMA Texture 1-2) texture, removing all traces of the liner design. Do not buff through the inner liner or expose any cord plies. Do not buff into the crayon marks.
9. With tire beads in a relaxed position, use a reversible drill (maximum 1,200 rpm) with the proper core cutter to completely cut out injury from inside of tire. Caution must be taken to ensure that the hole is drilled perpendicular to the inside of the tire to ensure correct installation of the repair unit. See **Fig. 11**.
10. Remove excess buffing dust from the buffed surface using a soft wire brush followed by a vacuum cleaner. Clean with rubber buffer/liner cleaner only if recommended by the repair manufacturer. Allow rubber buffer/cleaner to dry thoroughly.
11. Apply a coat of chemical vulcanizing cement over injury and buffed area and stipple into the surface. Turn the repaired area to the 3 or 9 o'clock position to facilitate faster drying. (Cement vapors are heavier than air.) Allow to dry according to manufacturer recommendations.

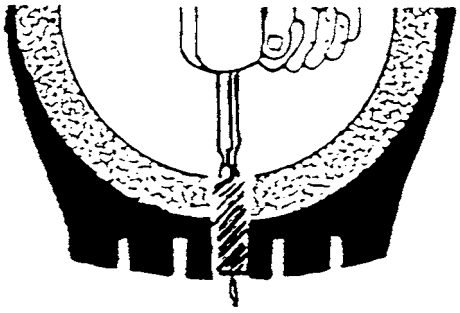


Fig. 11

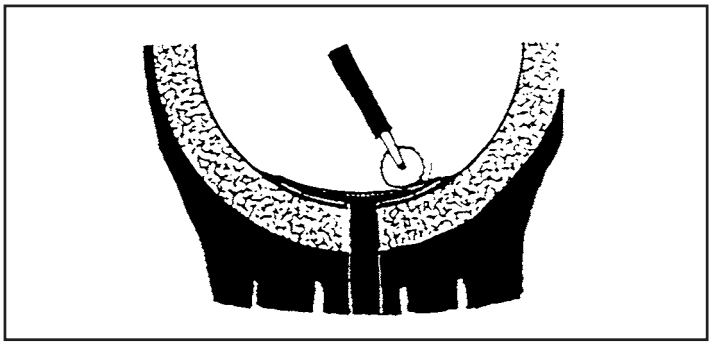


Fig. 12

12. Carefully remove backing or packaging from plug stem and patch, taking care not to touch the tacky surface. Lubricate hole only with vulcanizing cement and insert stem into hole or lubricate only the tapered end of the stem. Check with your repair material manufacturer for its specifications. Make sure the unit is installed as indicated by the arrows. To insert stem, start by pushing it in the center of the repair unit and gripping the protruding stem with pliers and pulling at the same time.
13. After the stem is in position, stitch repair unit down firmly, starting from center of the repair unit outward, using a corrugated stitcher.
14. When repairing a tubeless tire, apply a repair sealant over the outer edges of the repair unit and the exposed buffed areas around the repair unit. When repairing a tube-type tire, be sure the sealant is dry before installing the tube. Use tire talc to cover the repair.
15. Allow cement to dry five minutes before trimming stem.
16. Trim extending portion of stem about 1/16 inch above tread surface. Do not pull on the stem while cutting. See **Fig. 12**.
17. Tire may be mounted and inflated in a safety cage immediately.

ADDITIONAL REPAIR INFORMATION CAN BE OBTAINED FROM THE FOLLOWING:

Bandag, Incorporated
2905 N Hwy. 61
Muscatine, Iowa 52761-5886
(563) 262-1400
Fax: (563) 262-1426
Web site: www.bandag.com

Tire Industry Association
1532 Pointer Ridge Place, Suite G
Bowie, MD 20716-1874
(800) 876-8372
Fax: (301) 430-7283
e-mail: info@tireindustry.org
Web site: www.tireindustry.org

Michelin Tire Corp., USA
P. O. Box 19001
Greenville, SC 29602-9001
(864) 458-5000
(864) 458-4817
Fax: (864) 458-5002
Web site: www.michelin.com

Oliver Rubber Company
701 Lima Ave.
Findlay, OH 45839-0550
(419) 429-7183
Fax: (419) 429-7196
e-mail: info@oliverrubber.com
Web site: www.oliverrubber.com

Patch Rubber Company
P.O. Box H
Roanoke Rapids, NC 27870-8082
(252) 536-2574
Fax: (252) 536-4940
Web site: www.patchrubber.com

Goodyear Tire & Rubber Co.
1144 East Market St., Dept. 703
Akron, OH 44316-0001
(330) 796-2121
Fax: (330 796-4276
website: www.goodyear.com/truck

Rema Tip Top/North America, Inc.
119 Rockland Ave.
Northvale, NJ 07647-2205
201-768-8100
(800) 225-7362
Fax: (201) 768-0946
e-mail: customerservice@rematiptop.com
Web site: www.rematiptop.com

Rubber Manufacturers Association
1400 K Street, NW
Washington, DC 20005-2403
(202) 682-4800
(800) 220-7622
Fax: (202) 682-4854
Web site: www.rma.org

Tech International
P. O. Box 486
Johnstown, OH 43031-0486
(614) 967-9015
(800) 433-8324
Fax: (740) 967-1039
Web site: www.techtirerepairs.com

Truflex/Pang Rubber Co. and
Truflex Rubber Products Co.
P.O. Box 507
Johnson, OH 43031
(800) 862-3000
Fax: (740) 966-8056
e-mail:tbevier@techtirerepairs.com
Web site: www.truflexpang.com