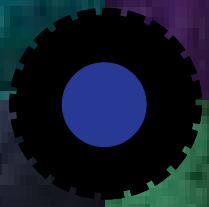
RADIAL TIRE CONDITIONS ANALYSIS GUIDE



A COMPREHENSIVE REVIEW OF TREAD WEAR AND TIRE CONDITIONS

TMC
THE MAINTENANCE COUNCIL

RADIAL TIRE CONDITIONS ANALYSIS GUIDE

A Comprehensive Review of Tread Wear And Tire Conditions

Replaces 1984 *Out of Service Tire Analysis Guide*
and *Radial Tire Wear Conditions and Causes*

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Every carrier who uses the procedures contained herein must first satisfy itself thoroughly that neither the safety of its employees or agents nor the safety or usefulness of any products will be jeopardized by any method selected.

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

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We would like to thank the following companies who participated in the development of this guide by donating their expertise and photographs

American Retreaders Association

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Bridgestone/Firestone, Inc.

Cooper Tire and Rubber Co.

General Tire, Inc.

Goodyear Tire & Rubber Co.

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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 demise. 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.

Tire grading should be done prior to the tire being placed in a “scrap pile.” After a tire has been dismounted 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 to rust 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 scrap pile itself should be organized. Instead of piling tires randomly, arrange them in lines, leaning one against the other. One line should be designated for originals, one for 1st caps, one for 2nd caps, etc. Bias tires should be separated from radials. An organized scrap pile will allow you to make generalized conclusions at a glance in regards to failed tires; i.e.,

1. If a large percentage of tires fail due to a certain operational condition, it may be that the tire is not suitable for the service application.

2. If a large percentage of failed tires are of one brand when several makes of tires are used, it may be that you have a problem with that manufacturer's tires.

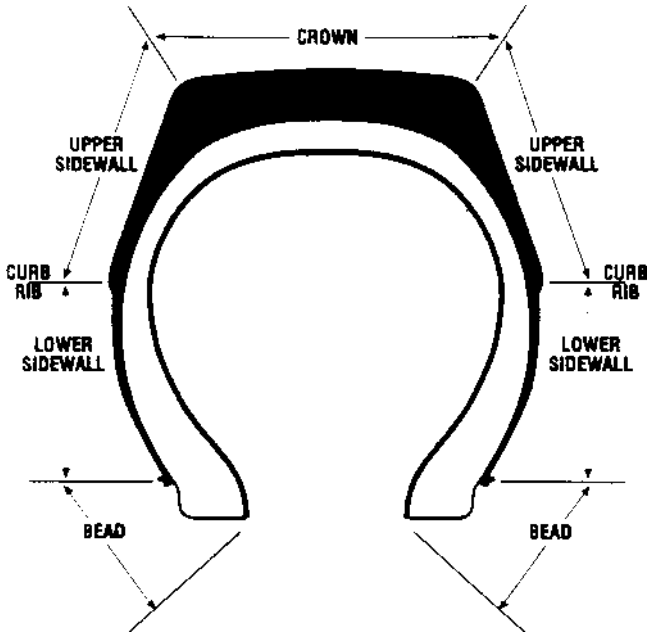
While some deductions can be made simply by looking at an organized scrap pile, more exact conclusions can be derived regarding tire performance when tire records are maintained. Accurate and simple records which include causes of failure, cap numbers, tread depths, etc. are extremely important and helpful when purchasing decisions must be made.

Tire Inspections

Remove all foreign objects and water from the tire and place on a spreader in a well-lighted area. For inspection purposes, the tire can be divided into seven areas:

1. Tread or Crown Area.
2. Upper Sidewall and Shoulder Area on DOT side.
3. Upper Sidewall and Shoulder Area on non-DOT side.
4. Lower Sidewall and Bead Area on DOT side.
5. Lower Sidewall and Bead Area on non-DOT side.
6. Interior on DOT side.
7. Interior on non-DOT side.

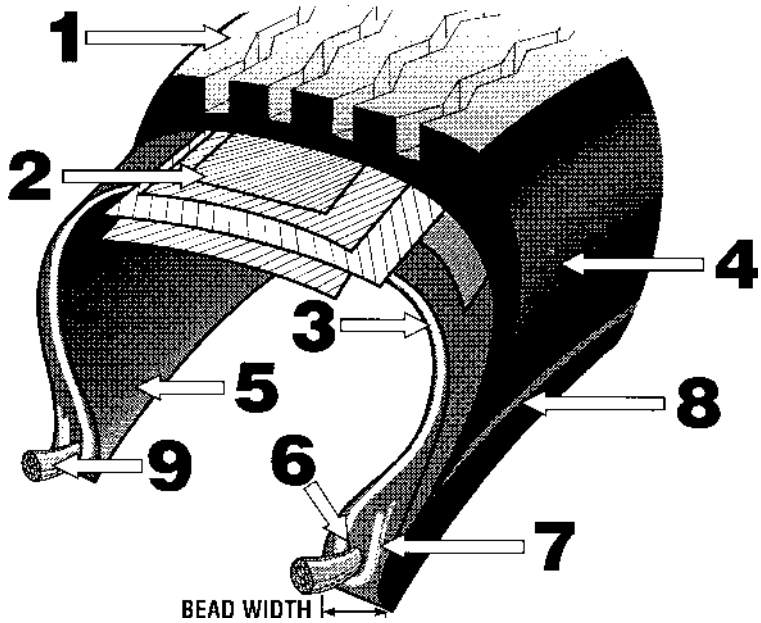
For DOT explanation, see TMC Recommended Practice 210A; also see Glossary, page XIII.



Begin by inspecting the tread area. Look for punctures, cuts, foreign objects and any distortion in the tread. Move to the upper and lower sidewalls of the DOT side and then the non-DOT side of the tire. 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 both sides of the interior 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.

The following is a radial tire section with definitions of its various components. Understanding the construction of the tire will make failure analysis easier.

Typical Radial Tire Cross Section



Cross-Sectional View of Typical Tire

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

(2) Belt - Belt plies, especially steel, provide strength to the tire, stabilize the tread, and protect the air chamber from punctures.

(3) Radial Ply - The radial ply, together with the belt plies, contains the air pressure of the tire. The ply transmits all load, braking, and steering forces between the wheel and the tire tread.

(4) Sidewall - The sidewall rubber is specially compounded to withstand flexing and weathering while providing protection for the radial ply.

(5) 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) Apexes - Rubber pieces with selected characteristics are used to fill in the bead and lower sidewall area and provide a smooth transition from the stiff bead area to the flexible sidewall.

(7) Bead Reinforcement - A ply laid over the radial ply turnup outside of the bead that reinforces and stabilizes the bead-to-sidewall transition zone.

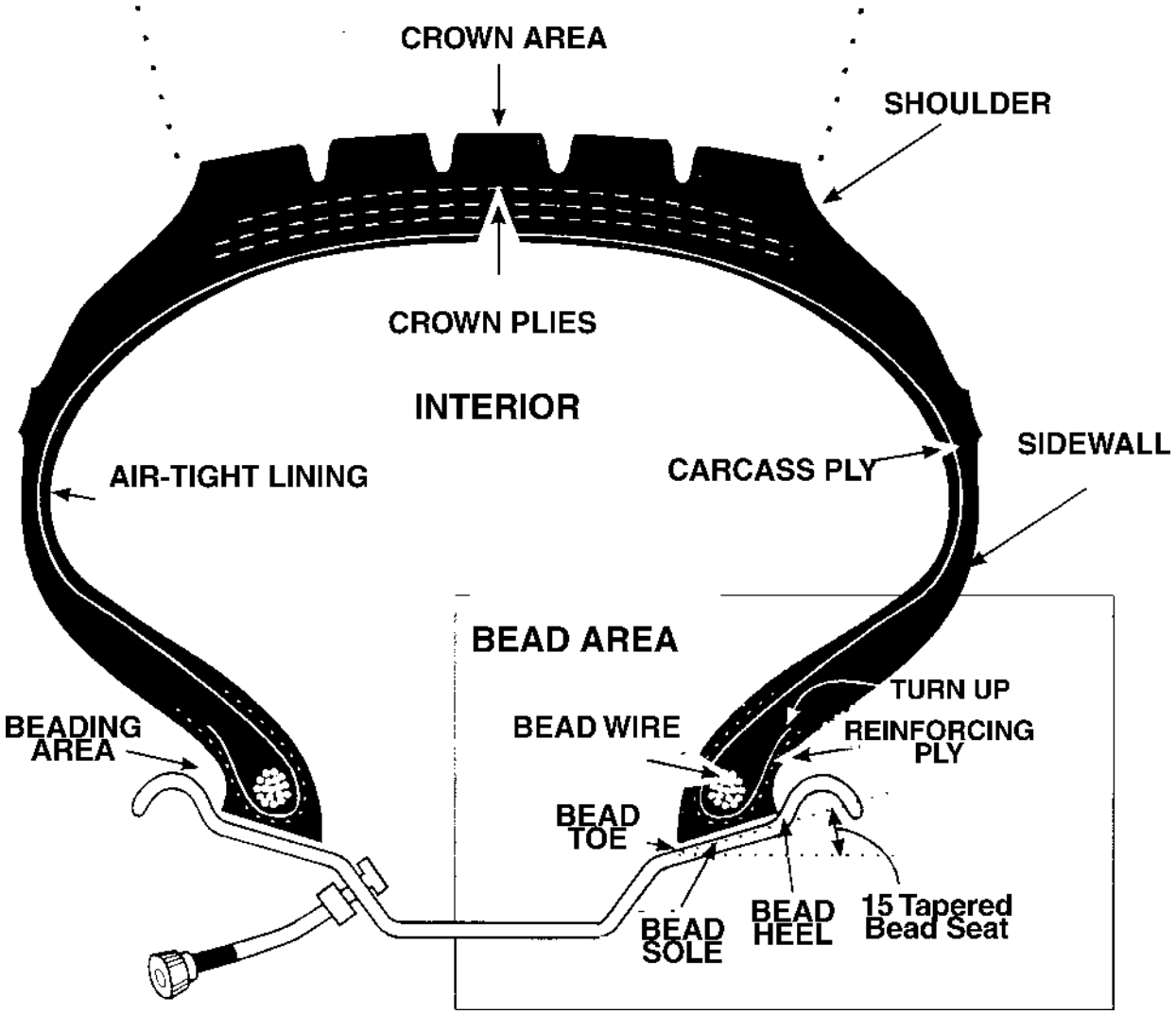
(8) GG Ring - Used as a reference for proper seating of the bead area on the rim.

(9) 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.

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. 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 tubeless radial 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 found in the tread area of retreaded and repaired tires.

Tubeless



Glossary

Bead Chafing - Functional wear of the bead against the rim.

Bead Reinforcement - A fabric or wire ply laid over the radial ply turnup outside of the bead and under the rubber chafer that stabilizes the bead-to-sidewall transition zone.

Bead Seat - Area where bead fits the rim.

Bead Seating - Positioning of the bead on the rim.

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

Belt Package - Belt plies which provide strength to the tire and stabilize the tread.

Bond Line - See Buff Line.

Bonding Materials - Cushion and cement used to bond tread or repair unit to the casing.

Buff Line - The dividing line in the cross section of a tire between the buffed surface of the original tire and the new retread rubber.

Casing - The tire structure excluding tread rubber or design.

Casing Integrity - The quality and soundness of the tire structure.

Casing Preparation - Procedures performed to prepare the casing for retreading which include buffing, skiving, debelting, rebelting, cementing and build up.

Chassis Dynamometer - An instrument used to measure engine power involving rotating the vehicle tires on steel rollers.

Circumferential Direction - 360˚ around the tire.

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

Cure - The process of vulcanization of rubber by applying heat and pressure over a period of time.

Cushion - A tacky natural rubber compound used for adhesion, undertread repair, and build up.

Cushion Migration - The shifting of the tread bonding material during vulcanization which results in a spot of tread uncured.

Delamination - The separation of layers of rubber.

DOT Number - U.S. Department of Transportation identification number.

Dual Position - A wheel position on a vehicle where two tires and wheels are mated to carry the load.

Flow Crack - The separation of rubber compound.

Full Cap - Application of new tread rubber to include not only the tread area but also the shoulder area. The finished retread will look like a new tire.

Inner Liner - The layer or layers of rubber laminated to the inside of a tubeless tire to contain the inflation pressure.

Glossary

Inner Liner Splice - The overlap of inner liner material inside the tire.

Liner - See Inner Liner.

Localized Area - Isolated area; not extending throughout tire.

Lugs (Tread Lugs) - The raised block elements in the tread design.

Mold - Equipment in which a new tire is cured or equipment in which new tread is cured to a worn tire.

Mold Lubricant - Material used as a mold release to facilitate removal of the tire from the mold after curing.

Ply - A layer of rubber coated parallel cords.

Porosity - A rubber condition which exhibits many small pores — usually the result of lack of heat or pressure during the curing process.

Precure Tread - Tread which is vulcanized with the tread configuration molded into it prior to being placed on the buffed casing.

Pressure Differential - The difference in pressure on the outside of the tire and in the inside of the tire as the tread is vulcanized.

Radial Direction - From bead to bead.

Rebelt(ing) - The installation of a new fabric or steel belt in a casing after the original belt has been removed due to excessive damage.

Repair Plug - The rubber material that fills the cavity of an injury in a tire.

Repair Unit - The reinforcing material used to strengthen the area around an injury in a tire.

Retreaded Tire - A casing to which a new tread has been cured to extend the usable life of the tire.

Ribs (Tread Ribs) - Continuous circumferential tread elements.

Shoulder Area - General area where the sidewall meets the tread.

Spread Axles - Tandem axles which are spaced far apart to carry heavy loads.

Top Cap - Only the top or tread area is buffed and a tread rubber with abrupt shoulders is applied.

Tread Grooves - Space between two adjacent tread ribs and/or lugs.

Tread Splice - The junction of tread ends.

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

Weathering - Fine hairline cracks in the sidewall surface of the tire caused by oxidation and other atmospheric effects.

Wicking - A capillary action of air escapement from the tire casing through the use of a piece of cord.

Section I:

New Tire (Original Tread) and Casing Conditions

CASING CONDITIONS

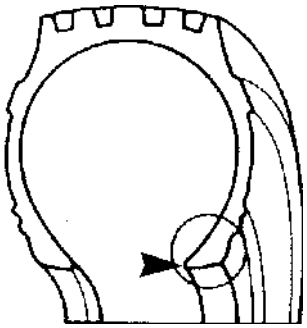
A. Bead Area

BEAD

Torn Beads

APPEARANCE	Bead toe rubber is torn or cut exposing the wire or fabric.
PROBABLE CAUSE(S)	Poor mounting/demounting techniques with tire tools and/or poor lubrication, forklift damage and poor tire handling procedures.

EXAMPLE PHOTO & FIGURE



ACTION

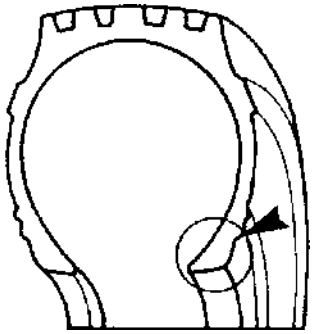
TIRE	If no rust on the wire is evident, repair and return to service. If wire is rusty, gouged, kinked or broken, loose or separated, contact your tire supplier/retreader to determine repairability; otherwise, scrap tire.
VEHICLE	None
OPERATIONS	Review mounting/demounting procedures and tire tools. Ensure the tire beads are well lubricated. Also check new tire handling procedures.

Kinked/Distorted Beads

BEAD

APPEARANCE	Local areas of distortion in the bead seat area.
PROBABLE CAUSE(S)	Improper use of tools, or incorrect techniques used when mounting the tire; shipping/handling damage.

EXAMPLE PHOTO & FIGURE



ACTION

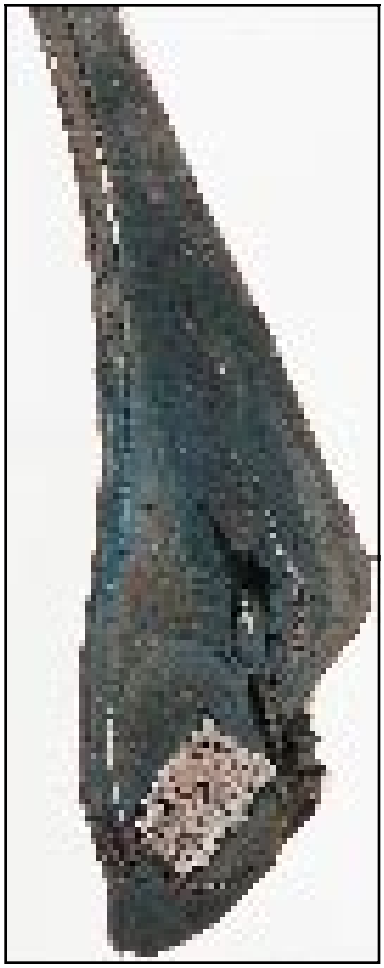
TIRE	Scrap tire.
VEHICLE	None
OPERATIONS	Review mounting/dismounting procedures and tire tools. Ensure the tire beads are lubricated.

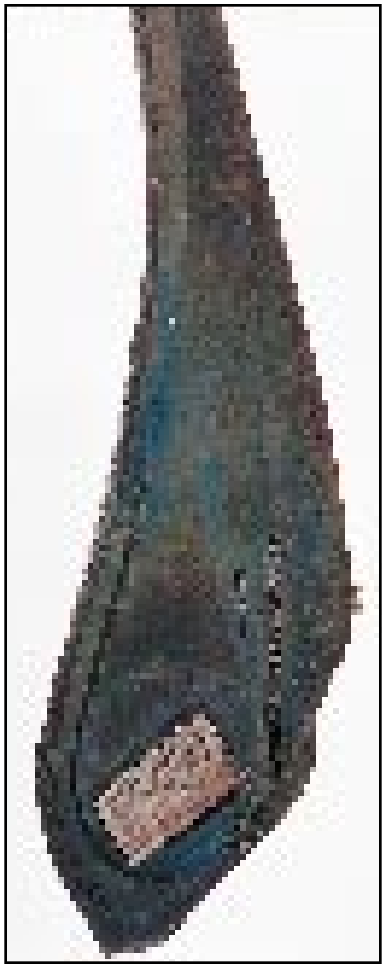
BEAD

Bead Deformation

APPEARANCE	Circumferential indentation of the bead area on the tire
PROBABLE CAUSE(S)	Rusty rims, improper bead/rim lubrication, and bent or damaged rims which result in improper bead seating. Excessive heat in the bead area.

EXAMPLE PHOTO & FIGURE





ACTION

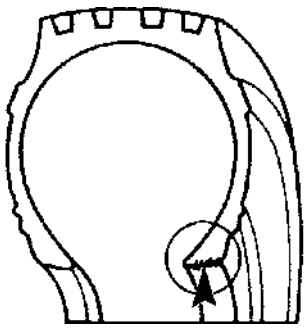
TIRE	If wires are visible, scrap the tire. If only the rubber is distorted, return to service on other than the steer axle.
VEHICLE	None
OPERATIONS	Review mounting/demounting procedures and the use of tire tools. Ensure the tire's beads are well lubricated.

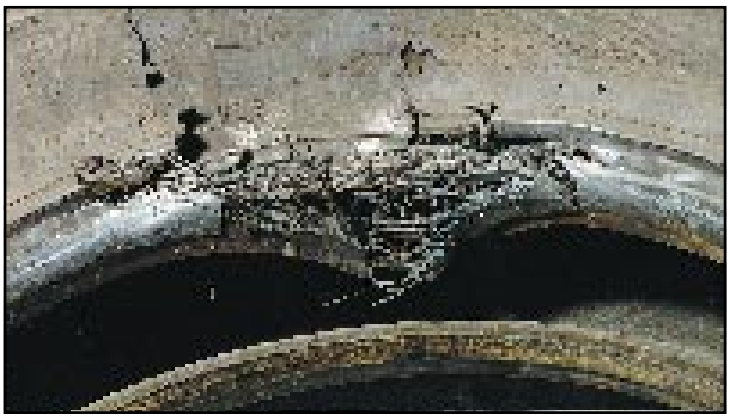
Burned Beads

BEAD

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

EXAMPLE PHOTO & FIGURE





ACTION

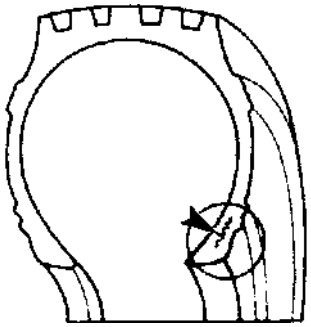
TIRE	Scrap tire.
VEHICLE	None
OPERATIONS	Determine the source of excessive heat and correct the braking condition.

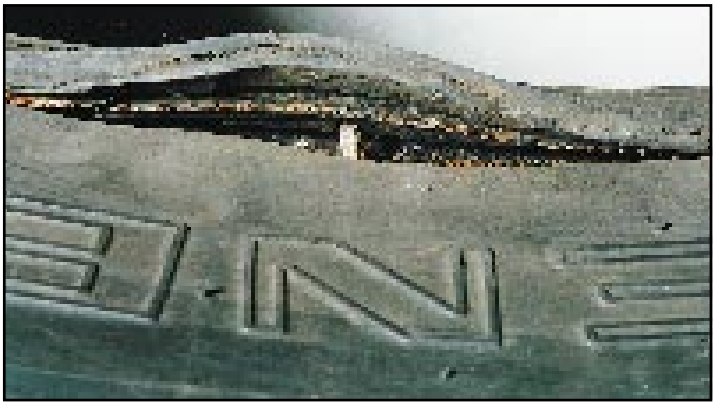
BEAD

Reinforce/Chafer Separation

APPEARANCE	Circumferential cracks above bead flange area with cord material exposed.
PROBABLE CAUSE(S)	Improper bead seating, improper rim size, overload condition, underinflation, impact or possible manufacturing condition.

EXAMPLE PHOTO & FIGURE





ACTION

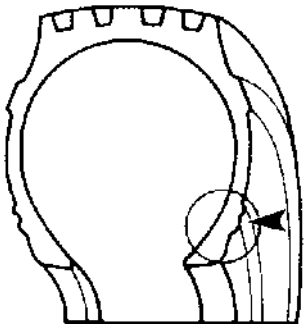
TIRE	Remove from service and consult tire manufacturer.
VEHICLE	None
OPERATIONS	Ensure proper rim sizes, mounting procedures and inflation pressures are utilized.

Petro/Lubricant Damage

BEAD

APPEARANCE	Rubber exhibits blistering, swelling, or spongy condition in the bead area. In later stages the bead may appear dry and brittle. Petroleum odor may be evident.
PROBABLE CAUSE(S)	Use of petroleum-based products such as a lubricant, i.e., oil, diesel fuel and antifreeze.

EXAMPLE PHOTO & FIGURE



ACTION

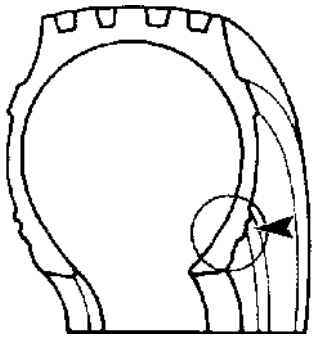
TIRE	Scrap tire.
VEHICLE	None
OPERATIONS	Use of proper non-petroleum-based tire lubricants.

BEAD

Bead Damage from Curbing

APPEARANCE	Localized rippling or waviness in the bead flange area with no exposed cord.
PROBABLE CAUSE(S)	Curbing.

EXAMPLE PHOTO & FIGURE



ACTION

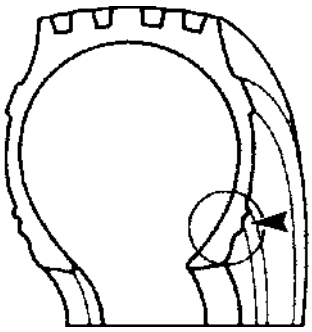
TIRE	Return tire to service.
VEHICLE	None
OPERATIONS	Review driving procedures.

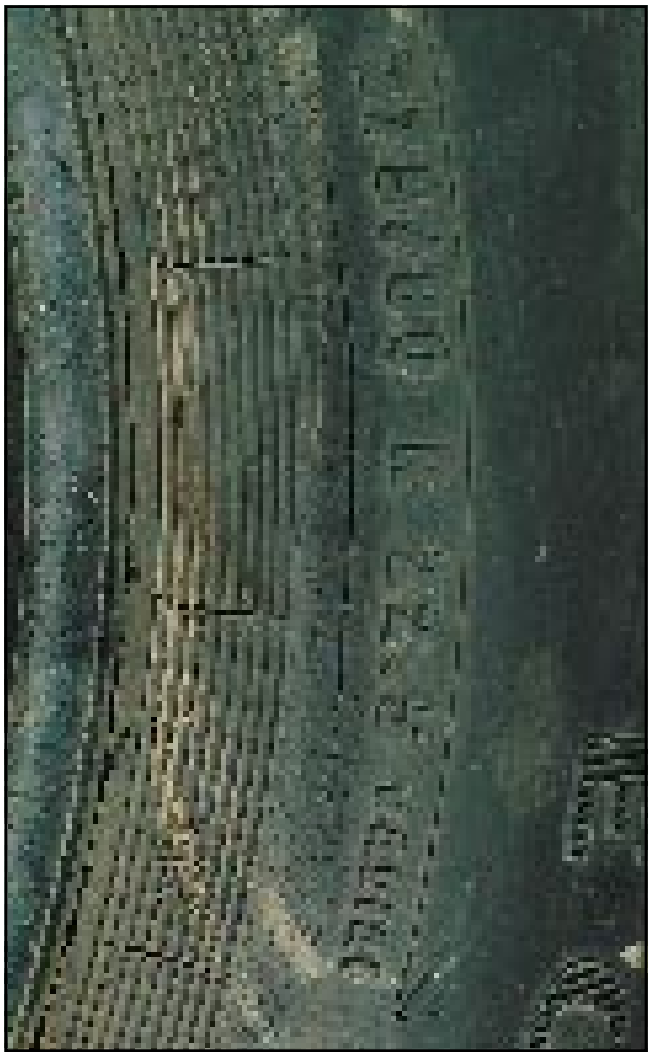
Bead Area Flow Crack

BEAD

APPEARANCE	Circumferential crack above the bead with no wire exposed.
PROBABLE CAUSE(S)	Improper rubber flow during the manufacturing process.

EXAMPLE PHOTO & FIGURE





ACTION

TIRE	Remove from service and contact the tire manufacturer.
VEHICLE	None
OPERATIONS	None

CASING CONDITIONS

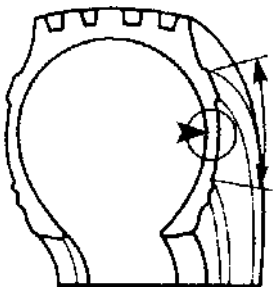
B. Sidewall Area

SIDEWALL

Spread/Damaged Cord

APPEARANCE	Radial, pencil shaped bulge in the sidewall of a radial tire.
PROBABLE CAUSE(S)	Wider than normal wire spacing. A tire with a repair may show this condition soon after being repaired, or the condition may arise somewhere along a body ply that has been damaged — not necessarily in the repair area.

EXAMPLE PHOTO & FIGURE



ACTION

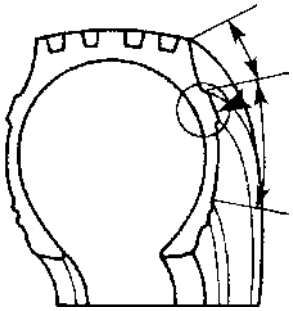
TIRE	Determine the cause of the bulge. Repaired tires can often be returned to service on dual positions unless the bulge height exceeds 3/8" when inflated. If the cause of the bulge is not a repair or damage, contact the tire manufacturer.
VEHICLE	None
OPERATIONS	

Cuts And Snags

SIDEWALL

APPEARANCE	Scrapes, gouges or cuts in the sidewall.
PROBABLE CAUSE(S)	Road hazard, curbing, equipment damage, wash rack rails, pit rails, vandalism, etc.

EXAMPLE PHOTO & FIGURE



ACTION

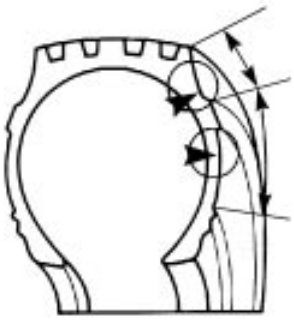
TIRE	If damage has not exposed ply cords, tire may be run out on dual positions. If the cords are visible, repair the tire if damage to the cords is within repair limits and return to service; otherwise scrap tire.
VEHICLE	Ensure the tire does not come in contact with vehicle hardware.
OPERATIONS	If similar damage occurs on several tires, investigate vehicle operations to determine the cause of the damage.

SIDEWALL

Sidewall Separation

APPEARANCE	Irregular shaped bulge in mid/upper sidewall area; may progress to complete separation of sidewall rubber from the casing exposing the ply cords. No repairs, breaks or punctures in the casing are evident.
PROBABLE CAUSE(S)	Loss of adhesion between the sidewall rubber and the body ply.

EXAMPLE PHOTO & FIGURE



ACTION

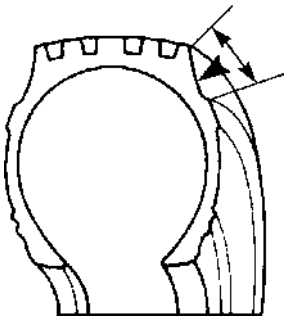
TIRE	Remove the tire from service and contact your tire manufacturer.
VEHICLE	None
OPERATIONS	None

Chain Damage

SIDEWALL

APPEARANCE	Numerous pock marks around the tire on the mid to upper sidewall and crown area.
PROBABLE CAUSE(S)	Chain abrasion often due to loose or improperly sized chains or extended chain use on dry surfaces.

EXAMPLE PHOTO & FIGURE



ACTION

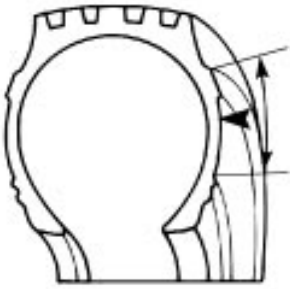
TIRE	Run out the tire on a dual position unless damage extends to the ply cord. If ply cords are visible, consult your tire repair facility for the possibility of repair.
VEHICLE	None
OPERATIONS	Select the proper chain size. Correct the installation procedures and enforce chain removal when conditions warrant.

SIDEWALL

Vehicle/Equipment Damage

APPEARANCE	Uniform scuffing or cutting on some major portion of the tire's outer surface, often extending 360˚.
PROBABLE CAUSE(S)	Contact with vehicle hardware, such as loose U-bolts, slipped spring clips, restraining bolts, loose fenders, flap hangers and trailer wheel house molding, etc. Can also be caused by objects trapped between the duals.

EXAMPLE PHOTO & FIGURE



ACTION

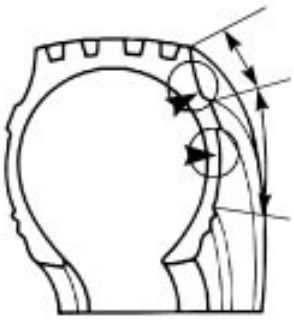
TIRE	Return the tire to service on a dual position unless abrasion extends to the ply cords. If the cords are exposed, consult your tire repair facility for the possibility of repair.
VEHICLE	Analyze cause of the condition and correct.
OPERATIONS	None

Damage Induced Sidewall Separation

SIDEWALL

APPEARANCE	Irregular shaped bulge in the mid/upper sidewall area; may progress to complete separation of the sidewall rubber from the casing, exposing the ply cords. Breaks in the liner, a puncture or damage to the casing is evident.
PROBABLE CAUSE(S)	A puncture, impact, inner liner damage or bead damage.

EXAMPLE PHOTO & FIGURE



ACTION

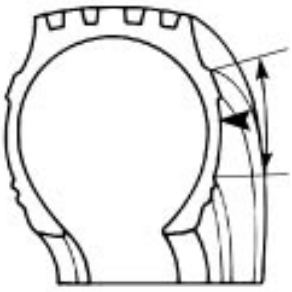
TIRE	Scrap tire.
VEHICLE	None
OPERATIONS	Determine the cause and take appropriate corrective action.

SIDEWALL

Sidewall Abrasion/Scuff Damage

APPEARANCE	Abrasion on large areas of the sidewall, often 360˚ around the tire.
PROBABLE CAUSE(S)	Rubbing against curb or guide rails. Most often seen in city delivery service.

EXAMPLE PHOTO & FIGURE



ACTION

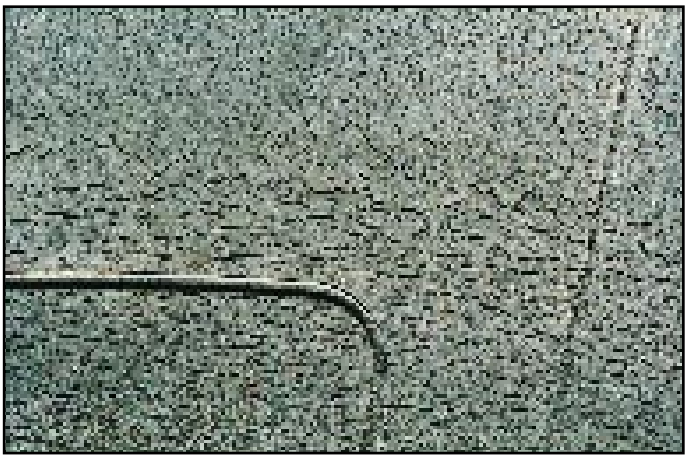
TIRE	If the cords are exposed, scrap tire. Otherwise, the tire can be returned to service. If abrasion appearance is objectionable, mount the scuffed side away from the curb.
VEHICLE	None
OPERATIONS	Review driving procedures.

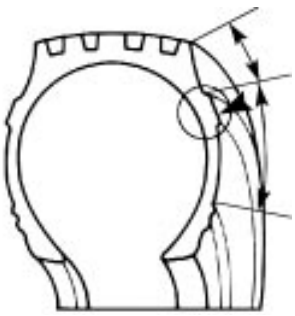
Weathering

SIDEWALL

APPEARANCE	Numerous tiny cracks in the rubber surface, most often 360˚ around the tire.
PROBABLE CAUSE(S)	Rubber surface exposure to environmental elements. Aggravated by long periods of parking and high concentrations of ozone.

EXAMPLE PHOTO & FIGURE





ACTION

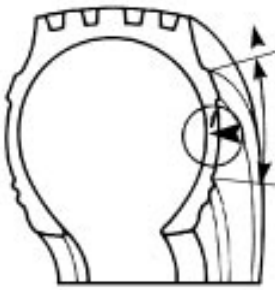
TIRE	All tires may eventually exhibit this condition in late service-life stage. Tires can be run out on the steer axle if weathering is minor; on dual positions if weathering is moderate. Severe weathering may require removal from service.
VEHICLE	None
OPERATIONS	Weather protection materials compounded into the tire are more effective when the tire is exercised. Therefore, minimize parked vehicle time. Consult your tire manufacturer if long periods of parking are expected.

SIDEWALL

Impact Break

APPEARANCE	Break in the sidewall through the casing. This condition will usually deteriorate quickly to a radial runflat appearance.
PROBABLE CAUSE(S)	Caused by a sudden impact with a road hazard or a chuck hole. Aggravated by overinflation.

EXAMPLE PHOTO & FIGURE



ACTION

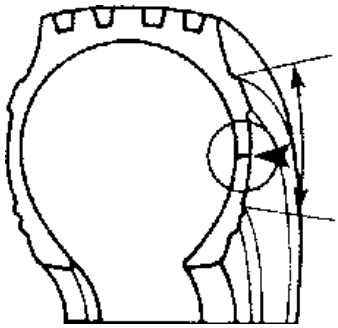
TIRE	Consult your tire repair facility for the possibility of repair or scrap tire.
VEHICLE	None
OPERATIONS	Review driving and maintenance procedures.

Branding Damage

SIDEWALL

APPEARANCE	Stress cracks extending from the characters branded into the tire after manufacture.
PROBABLE CAUSE(S)	Caused by branding too deep, in the wrong location on the tire sidewall, at too high a temperature, or at a sharp angle.

EXAMPLE PHOTO & FIGURE



ACTION

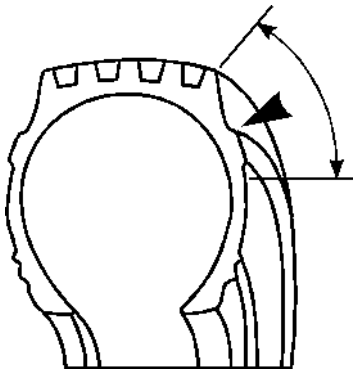
TIRE	Tires with hairline cracks can be returned to service. Depending upon crack severity and location, consult your tire manufacturer; if cords are exposed, scrap tire. Otherwise consult your tire repair facility for the possibility of repair.
VEHICLE	None
OPERATIONS	Review the tire manufacturer's branding recommendations.

SIDEWALL

Diagonal Cracking

APPEARANCE	Diagonal crack or cracks in the upper sidewall area of tires on drive and trailer axles.
PROBABLE CAUSE(S)	Frequently can be a result of torque transfer. Aggravated by underflation. This condition should not be confused with cut(s) from sharp curb edges, road hazards, etc.

EXAMPLE PHOTO & FIGURE



ACTION

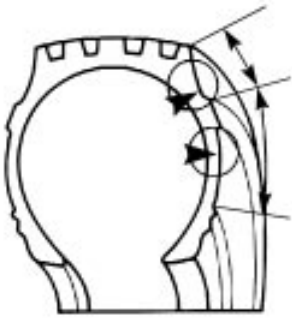
TIRE	Remove from service and consult your tire manufacturer.
VEHICLE	None
OPERATIONS	None

Petroleum Product Damage

SIDEWALL

APPEARANCE	Sidewalls appear swollen, soft and spongy. In extreme cases, sidewalls may be undulated or distorted. Petroleum odor may be evident.
PROBABLE CAUSE(S)	Oil, diesel fuel, antifreeze or chemical contamination.

EXAMPLE PHOTO & FIGURE



ACTION

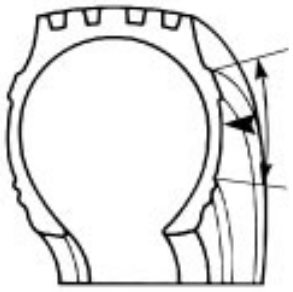
TIRE	If contamination is slight, return tire to service. If there is a difference in stiffness or distortion in one sidewall when compared with the other, scrap tire.
VEHICLE	Check vehicle for fluid leaks.
OPERATIONS	Take special precautions during fueling to avoid spills

SIDEWALL

Forklift Damage

APPEARANCE	Cut similar to impact damage on a brand new tire.
PROBABLE CAUSE(S)	Caused during shipping and handling by lift truck forks.

EXAMPLE PHOTO & FIGURE



ACTION

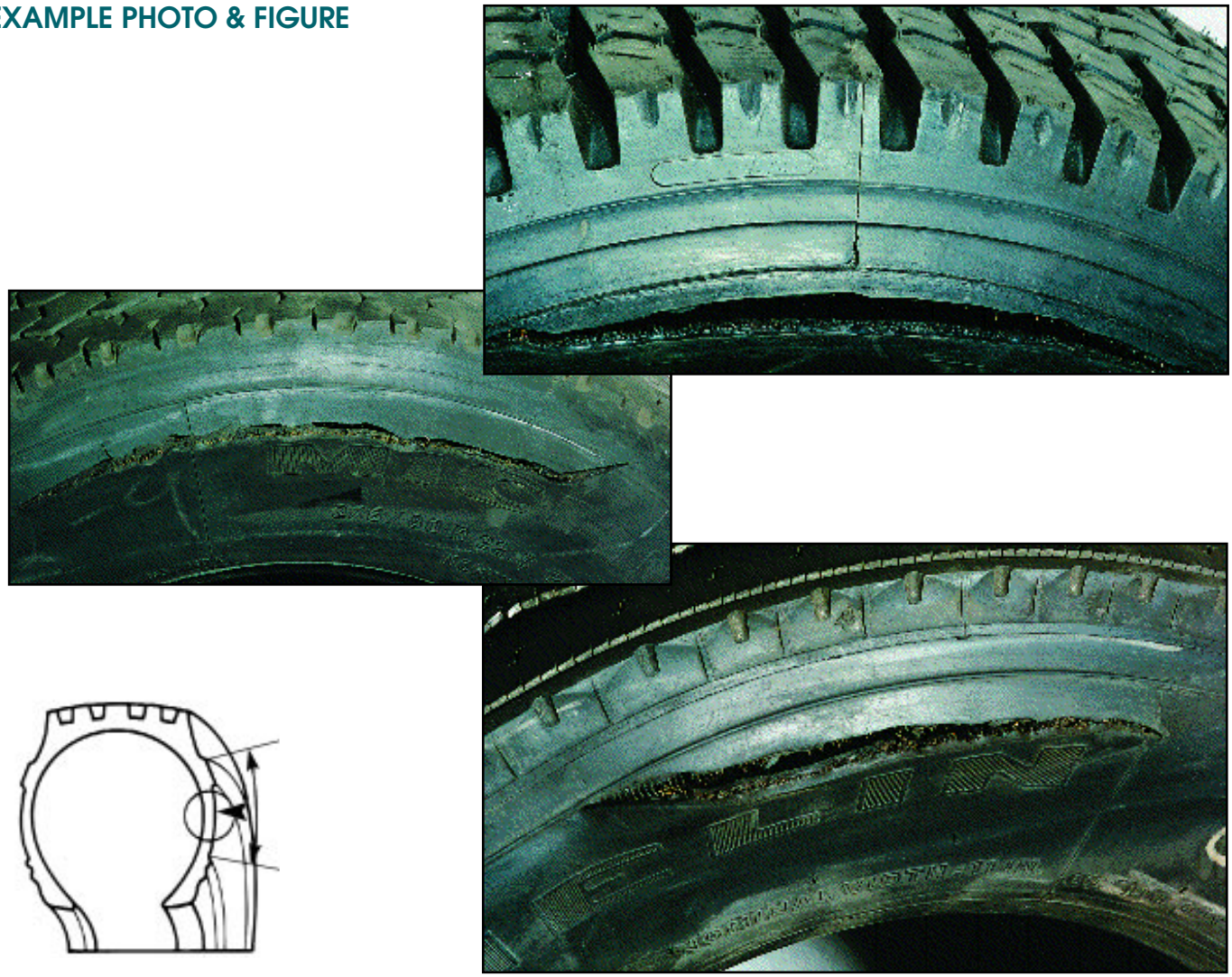
TIRE	Do not place in service. Determine responsibility for the damage.
VEHICLE	None
OPERATIONS	Inspect tire upon receipt.

Circumferential Fatigue Rupture (Zipper)

SIDEWALL

APPEARANCE	A circumferential break in the mid to upper sidewall exposing an even line of broken cords.
PROBABLE CAUSE(S)	Severe underinflation which produces casing cord fatigue, often a result of a puncture.

EXAMPLE PHOTO & FIGURE



ACTION

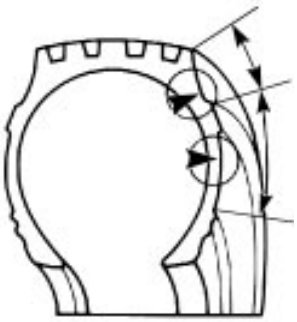
TIRE	Scrap tire.
VEHICLE	None
OPERATIONS	Routinely inspect all tires with inflation pressures 20% lower than your fleet's inflation standard; thoroughly inspect all tires prior to repair and retreading; always use a safety cage during inflation. Consult your tire or retread supplier for proper inspection procedures.

SIDEWALL

Open Sidewall Splice

APPEARANCE	Regular smooth opening of the top layer of sidewall rubber that may appear radially or diagonally. Appearance is similar to a cut, however, the opening extends at a sharp angle into the sidewall rubber. No cords are exposed.
PROBABLE CAUSE(S)	Manufacturing process.

EXAMPLE PHOTO & FIGURE



ACTION

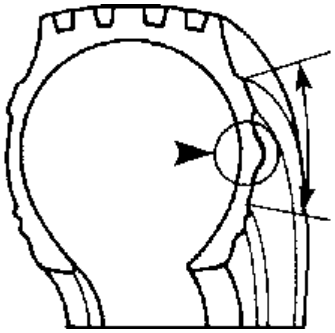
TIRE	Remove the tire from service. Consult your tire manufacturer.
VEHICLE	None
OPERATIONS	None

Sidewall Bumps (Blisters)

SIDEWALL

APPEARANCE	Small, raised, scattered areas in the upper sidewall that can be felt when rubbing the casing. In later stages, the sidewall may appear blistered and can lead to a sidewall rupture.
PROBABLE CAUSE(S)	Deterioration of internal components over time. Fatigue of casing. Accelerated by overload/underinflation.

EXAMPLE PHOTO & FIGURE



ACTION

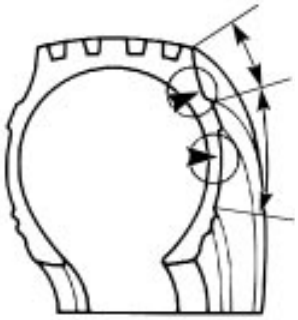
TIRE	Remove the tire from service. If this condition arises during the warranty period, consult your tire manufacturer. Otherwise scrap tire.
VEHICLE	None
OPERATIONS	None

SIDEWALL

Sidewall Penetration

APPEARANCE	Any damage caused by an object that goes through the sidewall of the tire.
PROBABLE CAUSE(S)	Road debris and, occasionally, vandalism with a sharp puncturing instrument.

EXAMPLE PHOTO & FIGURE



ACTION

TIRE	Have the tire inspected by your tire repair supplier to determine repairability.
VEHICLE	None
OPERATIONS	Avoid road hazards.

Radial Split

SIDEWALL

APPEARANCE	A vertical break through the sidewall occuring between two body ply cables, that does not break the cables.
PROBABLE CAUSE(S)	Severe impact. This situation can occur in overinflated and/or overloaded conditions.

EXAMPLE PHOTO & FIGURE

ACTION

TIRE	Have the tire inspected by your tire repair supplier to determine repairability.
VEHICLE	None
OPERATIONS	Review inflation maintenance program and review driver training.

CASING CONDITIONS

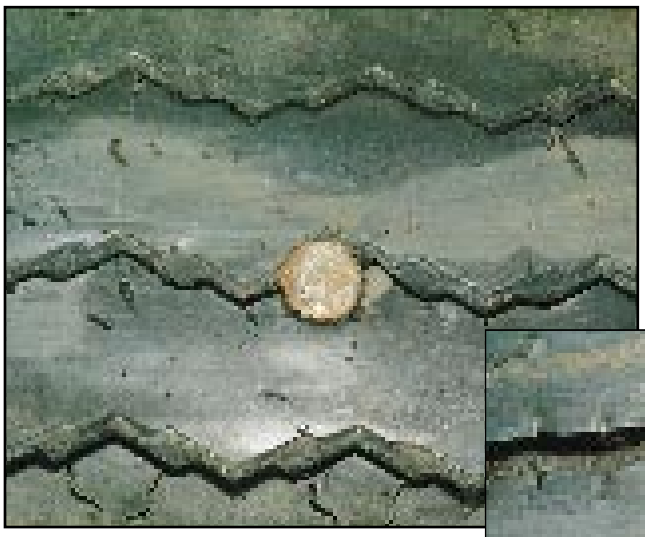
C. Crown Area

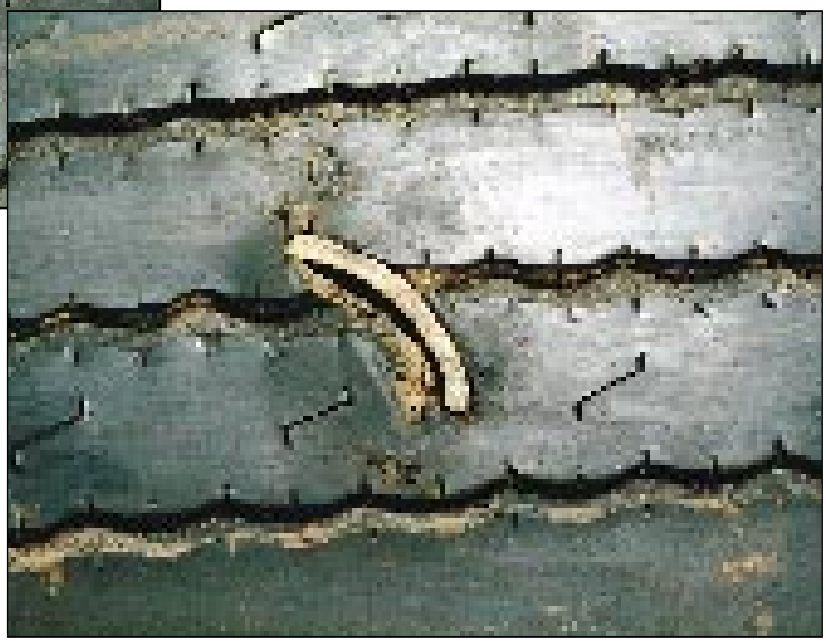
CROWN

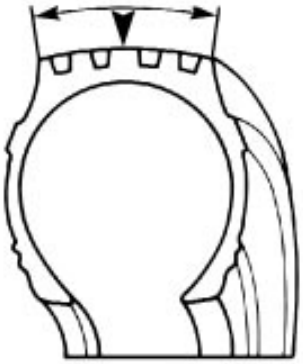
Penetrations And Road Hazards

APPEARANCE	Evidence of a puncture or damage by a foreign object through the crown area; may result in a separation.
PROBABLE CAUSE(S)	Road hazard or foreign object.

EXAMPLE PHOTO & FIGURE







ACTION

TIRE	Determine casing integrity. Consult your repair facility for possibility of repair. If the damage is excessive and/or a separation is evident, scrap tire.
VEHICLE	None
OPERATIONS	None

Vehicle Damage

CROWN

APPEARANCE	Cut in tread or shoulder area, usually 360˚ around tire.
PROBABLE CAUSE(S)	Contact with vehicle hardware, such as mud flap brackets, trailer wheel house molding, bumpers, etc.

EXAMPLE PHOTO & FIGURE

ACTION

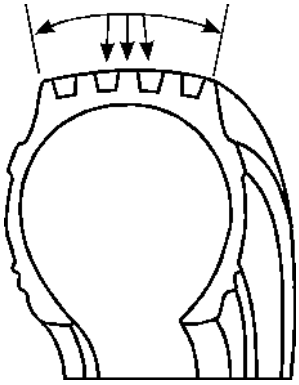
TIRE	If cuts are not deeper than the base or the tread groove, return to a dual position. If the damage is deeper, retread or rebelt if possible. If the condition is more severe, scrap tire.
VEHICLE	Analyze the cause of the condition and correct.
OPERATIONS	Review driving procedures.

CROWN

Forklift Damage/Cuts And Snags

APPEARANCE	Individual or multiple cuts, usually in the tread grooves in a localized area of the crown.
PROBABLE CAUSE(S)	Caused by lift truck forks or similar equipment.

EXAMPLE PHOTO & FIGURE



ACTION

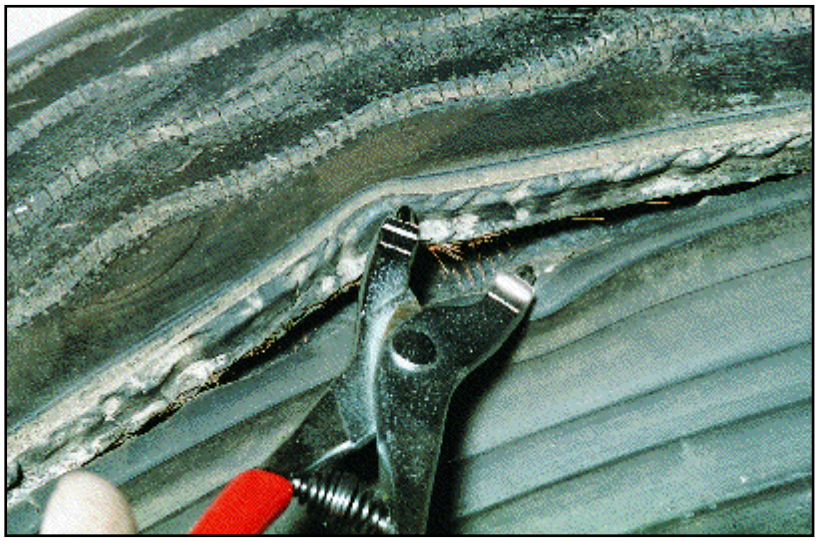
TIRE	If the tire is new, determine the responsibility for damage before placing it into service. If the tire has been in service but no steel is exposed, return to service. If steel is exposed, retread or rebelt.
VEHICLE	None
OPERATIONS	Inspect new tires upon receipt.

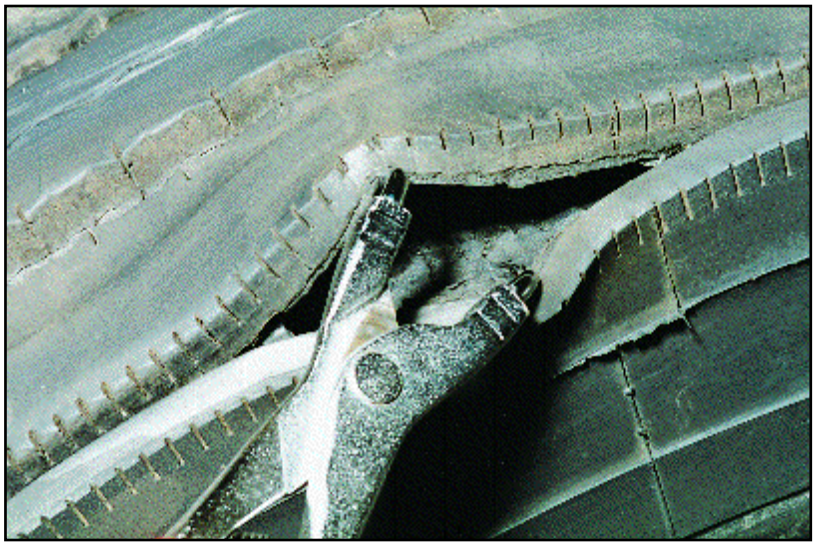
Belt Lift/Separation

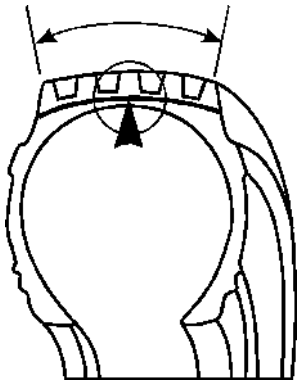
CROWN

APPEARANCE	A bulge or split through the upper sidewall/shoulder area. Probing will reveal the belts sometimes accompanied by a worn spot in the tread.
PROBABLE CAUSE(S)	Adhesion loss within the tire at the edge of the belt package. May be associated with a penetration or other damage. Can be aggravated by spread axle use or dragging tire sideways.

EXAMPLE PHOTO & FIGURE







ACTION

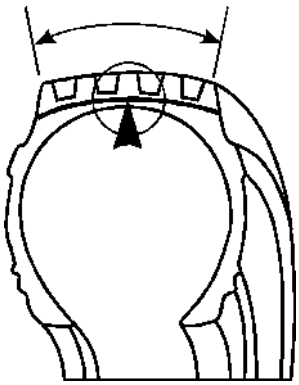
TIRE	Remove from service and consult your tire manufacturer.
VEHICLE	None
OPERATIONS	Use largest radius turns possible to avoid tire scrubbing.

CROWN

Tread Lift/Separation

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(S)	Adhesion loss between the tread rubber and the tire casing. Can be caused by tread penetration.

EXAMPLE PHOTO & FIGURE



ACTION

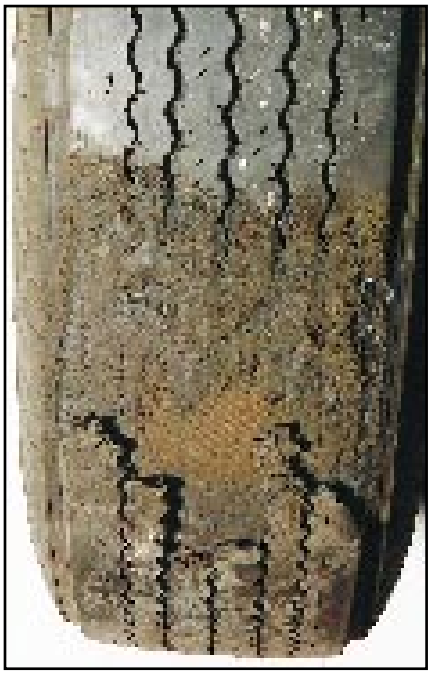
TIRE	Remove tire from service. Consult your tire manufacturer.
VEHICLE	None
OPERATIONS	None

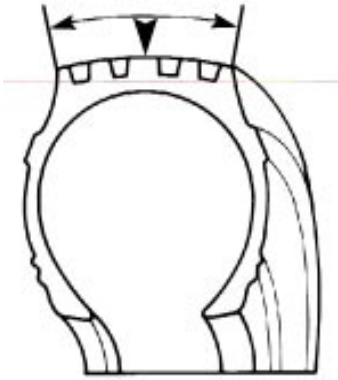
Brake Skid Damage

CROWN

APPEARANCE	Localized spot of excessive wear across the tread face showing abrasion marks from the tread sliding on the road surface; damage may extend into the casing.
PROBABLE CAUSE(S)	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.

EXAMPLE PHOTO & FIGURE





ACTION

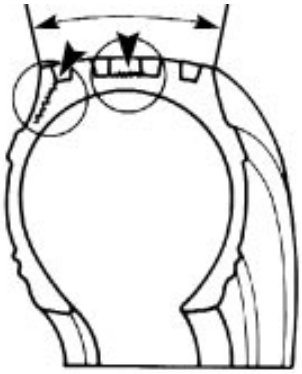
TIRE	If condition does not extend below 2/32" of tread, duals can be rematched to position flat spots 180˚ from each other. If more severe, the tire can be repaired or retreaded if damage is not into the belts. If skid damage is into the tire belts, it may be possible to remove the top belt and/or rebelt the tire; consult your retreader. If damage is too excessive, scrap tire.
VEHICLE	Check brake materials and brake balance.
OPERATIONS	Review driving procedures.

CROWN

Tread Chunking

APPEARANCE	Sections of tread torn from the tire.
PROBABLE CAUSE(S)	Caused by tire running over curbs or rails or by severe localized impacts. Aggravated by hot tires, spread axles, sharp turning and off road utilization.

EXAMPLE PHOTO & FIGURE



ACTION

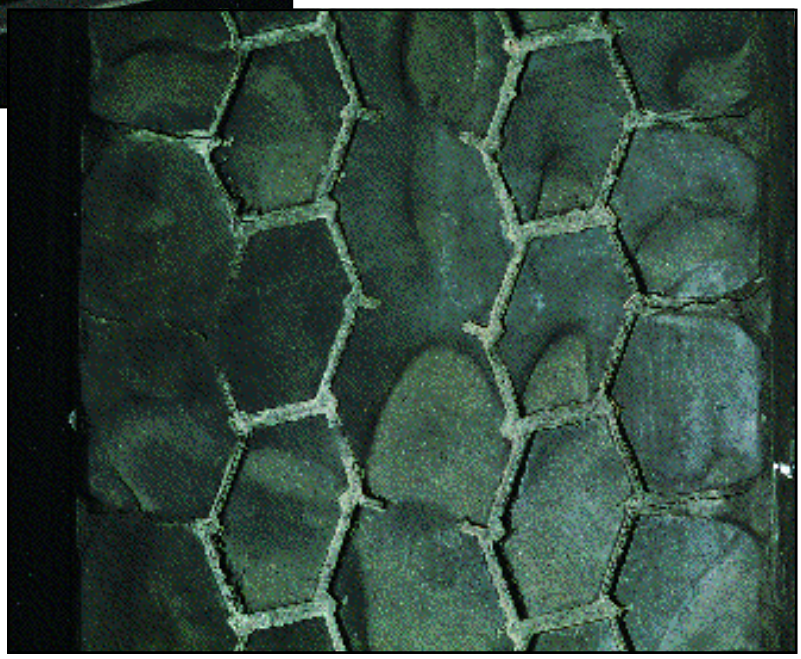
TIRE	Remove the tire from service. Repair or retread.
VEHICLE	None
OPERATIONS	Review tire selection. Review driving procedures.

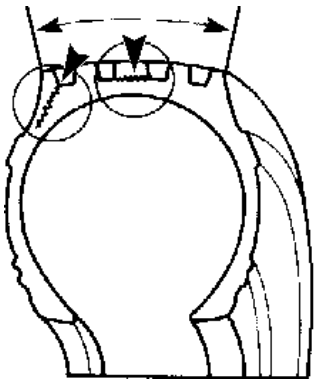
Lug Base Cracking

CROWN

APPEARANCE	One or more cracks in the tread rubber located between and at the base of lugs in the shoulder area.
PROBABLE CAUSE(S)	This condition is caused by a combination of drive axle torque, load and heat. It also can be due to tire construction or started by stone drilling. It is aggravated by underinflation.

EXAMPLE PHOTO & FIGURE





ACTION

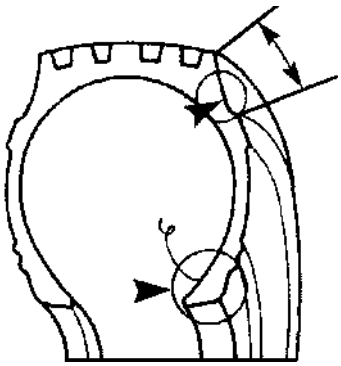
TIRE	If cracks do not extend into the retread buff line, return to dual wheel service. If cracks extend deeper, consult your tire manufacturer.
VEHICLE	None
OPERATIONS	None

CROWN

Wild Wire

APPEARANCE	Wire protruding through the exterior or interior surface of the tire.
PROBABLE CAUSE(S)	Loose or separated bead or body wires.

EXAMPLE PHOTO & FIGURE



ACTION

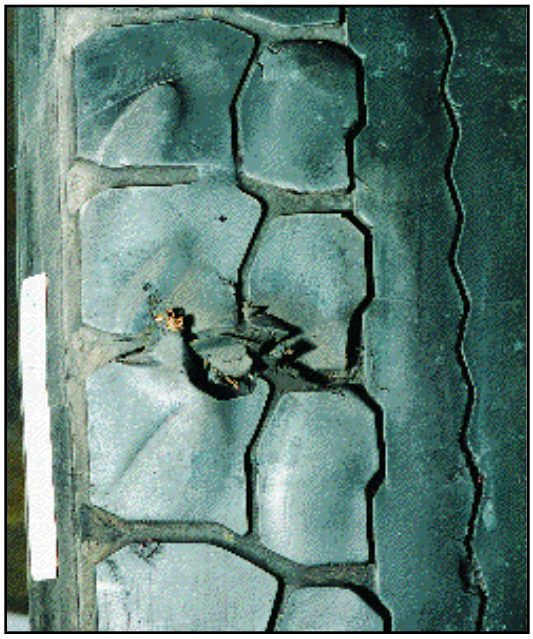
TIRE	Consult your tire manufacturer.
VEHICLE	None
OPERATIONS	None

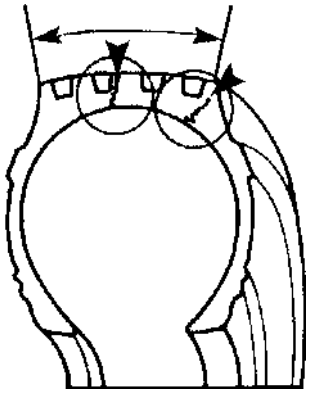
Impact Breaks

CROWN

APPEARANCE	Localized break through the tread rubber and the casing.
PROBABLE CAUSE(S)	Severe, concentrated impact with a foreign object or a chuck hole. Aggravated by overinflation and high speed.

EXAMPLE PHOTO & FIGURE





ACTION

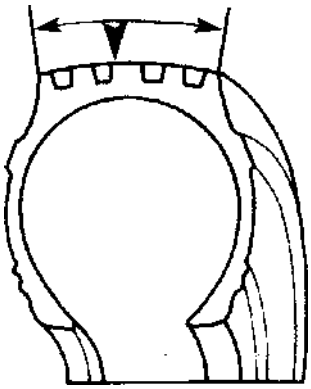
TIRE	Scrap tire.
VEHICLE	None
OPERATIONS	None

CROWN

Chipping/Flaking/Chunking Tread

APPEARANCE	Rough, abraded tread surface with numerous small flakes or chunks of tread removed.
PROBABLE CAUSE(S)	Operation of tires with over-the-road tread rubber compounds on gravel surfaces and haul roads; misapplication of the tire to service conditions. Aggravated by high torque, over inflation and short turns, especially on drive tires.

EXAMPLE PHOTO & FIGURE



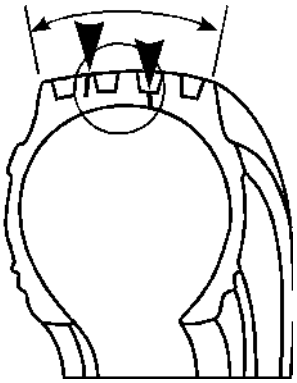
ACTION	
TIRE	Tires with minor chipping and flaking can be returned to service. If damage extends below 2/32" retread the tire. If steel is visible, consult your retreader for the possibility of repair and retread.
VEHICLE	None
OPERATIONS	Review tire selection.

Stone Drilling

CROWN

APPEARANCE	Damage caused by stones trapped in the tread which penetrate the tread base and extend into the belts.
PROBABLE CAUSE(S)	Tread design and/or misapplication of the tire to service conditions (gravel roads/quarry operation).

EXAMPLE PHOTO & FIGURE



ACTION

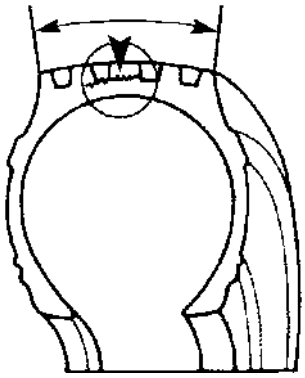
TIRE	Remove remaining stones and return to service. If penetrations are into the belts, consult the retreader or your tire manufacturer. If unable to retread or rebelt, scrap the tire.
VEHICLE	None
OPERATIONS	Review tire selection.

CROWN

Regrooving Damage

APPEARANCE	Exposed belts at the base of the regroove.
PROBABLE CAUSE(S)	Regrooving too deep.

EXAMPLE PHOTO & FIGURE



ACTION

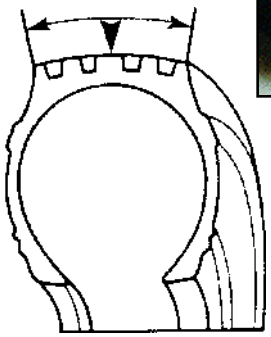
TIRE	Consult your retreader for the possibility of retreading.
VEHICLE	None
OPERATIONS	Review the cost effectiveness of regrooving.

Dynamometer Type Damage

CROWN

APPEARANCE	Swollen, spongy area hidden inside the center rib/lug extending up to 360˚ around the tire. Can cause a flat wear spot or may surface as a localized cavity.
PROBABLE CAUSE(S)	Excessive heat buildup on a dynamometer, also on high speed, lightly loaded overinflated applications using deep lug tires.

EXAMPLE PHOTO & FIGURE



ACTION

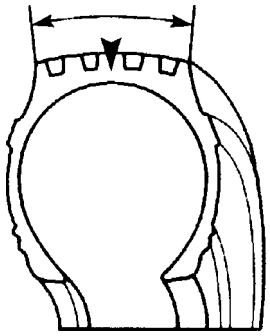
TIRE	Consult your retreader for the possibility of retreading.
VEHICLE	None
OPERATIONS	Review dynamometer procedures. Review load pressure or tire selection.

CROWN

Chemical Damage

APPEARANCE	Localized spot of blistered, spongy or deteriorated rubber in tread area.
PROBABLE CAUSE(S)	Exposure to chemicals, usually solvent in nature, which attack tread rubber.

EXAMPLE PHOTO & FIGURE



ACTION

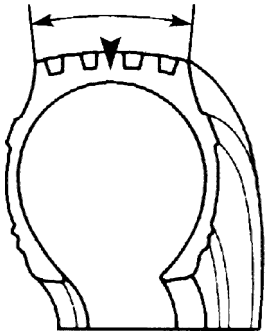
TIRE	Depending upon extent of chemical damage, return to trailer service or retread tire.
VEHICLE	None
OPERATIONS	None

Excessive Wear

CROWN

APPEARANCE	Tire worn to point of exposing casing reinforcement material.
PROBABLE CAUSE(S)	Run too long in service or brake skid.

EXAMPLE PHOTO & FIGURE



ACTION

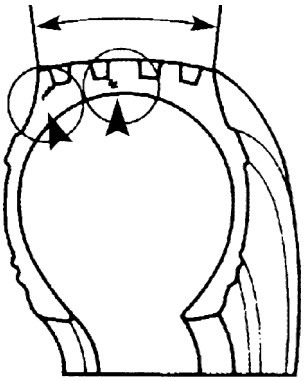
TIRE	Retread and rebelt if possible; otherwise scrap tire.
VEHICLE	None
OPERATIONS	None

CROWN

Rib Tearing

APPEARANCE	Tear at the base of the main tread grooves, generally at the shoulder; no tread missing.
PROBABLE CAUSE(S)	Caused by running over curbs and rails, or by severe localized impacts, aggravated by spread axles, hot tires and sharp turning.

EXAMPLE PHOTO & FIGURE



ACTION

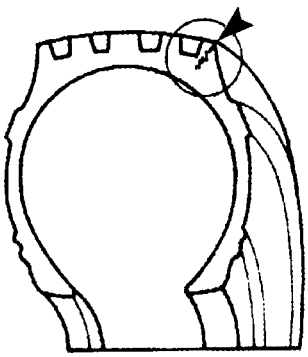
TIRE	If steel is showing, consult your tire manufacturer. If steel is not evident, retread or return to service on a dual position.
VEHICLE	None
OPERATIONS	Review driving procedures.

Defense Groove Tearing

CROWN

APPEARANCE	Tear at the base of the defense groove (decoupling groove, stress relief groove, shoulder groove).
PROBABLE CAUSE(S)	Caused by running over curbs or rails, or by severe localized impacts, aggravated by sharp turning.

EXAMPLE PHOTO & FIGURE



ACTION

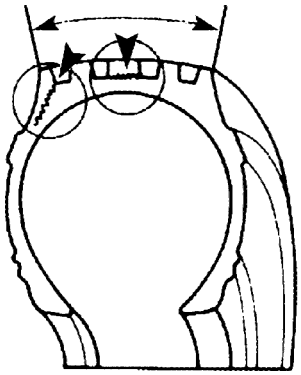
TIRE	If steel is visible, contact your tire manufacturer. If the tear extends near the buff radius, consult your retreader for possible retread. Otherwise return to service.
VEHICLE	None
OPERATIONS	Review driving procedures.

CROWN

Groove Cracking

APPEARANCE	Areas at the base of the grooves with cracks.
PROBABLE CAUSE(S)	This condition is caused by high side forces applied to a rib type tire. It can also be caused by petroleum damage, weathering, or exhaust on drive tires.

EXAMPLE PHOTO & FIGURE



ACTION

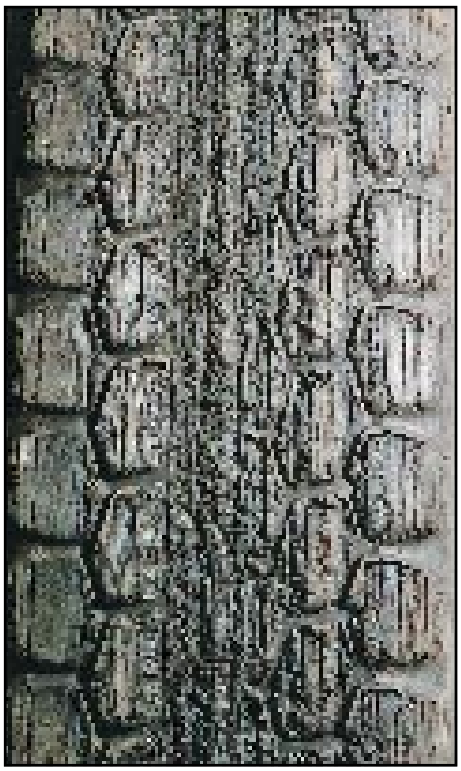
TIRE	If cracking is superficial, continue tire in service. If cracks are greater than 2/32" or more past the bottom of the groove, contact your tire manufacturer.
VEHICLE	Review exhaust routing.
OPERATIONS	Review driving procedures in tight turns.

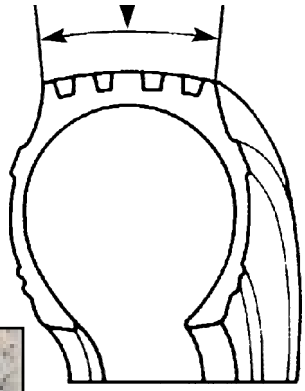
Spin Damage

CROWN

APPEARANCE	Circumferential cuts or lines around tire.
PROBABLE CAUSE(S)	Spinning drive tires on ice, sand, gravel, etc.

EXAMPLE PHOTO & FIGURE





ACTION	
TIRE	Place the tire back into service if the damage does not extend beyond the base of the tread groove. If damage is deeper, retread or rebelt if possible. If the condition is more severe, scrap tire.
VEHICLE	None
OPERATIONS	Review driving procedures and/or drive tire selection.

CASING CONDITIONS

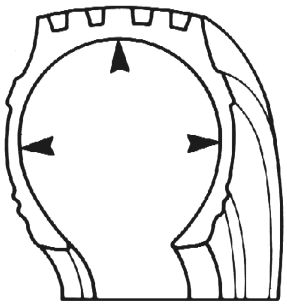
D. Tire Interior

INTERIOR

Penetrating Objects

APPEARANCE	Foreign object protruding through the interior surface of the tire.
PROBABLE CAUSE(S)	Impact with road hazard.

EXAMPLE PHOTO & FIGURE



ACTION

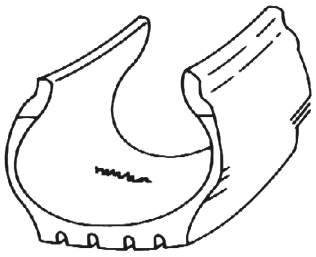
TIRE	Remove foreign object. Inspect degree of damage. Repair if permissible according to repair limit standards, and restore moisture seal and air retention integrity. If damage is excessive, scrap tire.
VEHICLE	None
OPERATIONS	None

Open Inner Liner Splice

INTERIOR

APPEARANCE	Split in the rubber of the tire inner liner at the juncture of the inner liner material.
PROBABLE CAUSE(S)	Loss of adhesion at the splice due to excessive flexing from underinflation; may also be manufacturing related.

EXAMPLE PHOTO & FIGURE



ACTION

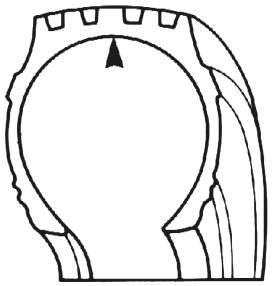
TIRE	Repair inner liner with rubber gum to ensure air retention integrity if ply cords are not exposed. If ply cords are visible, contact your tire manufacturer.
VEHICLE	None
OPERATIONS	None

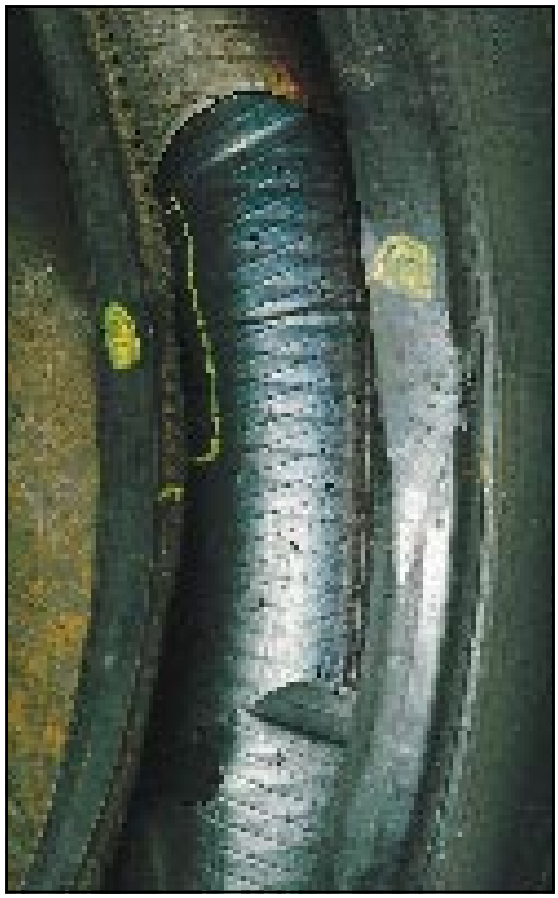
INTERIOR

Inner Liner Bubbles, Blisters And Separations

APPEARANCE	Bubble or blister in the tire interior.
PROBABLE CAUSE(S)	Adhesion loss of inner liner material to the casing.

EXAMPLE PHOTO & FIGURE





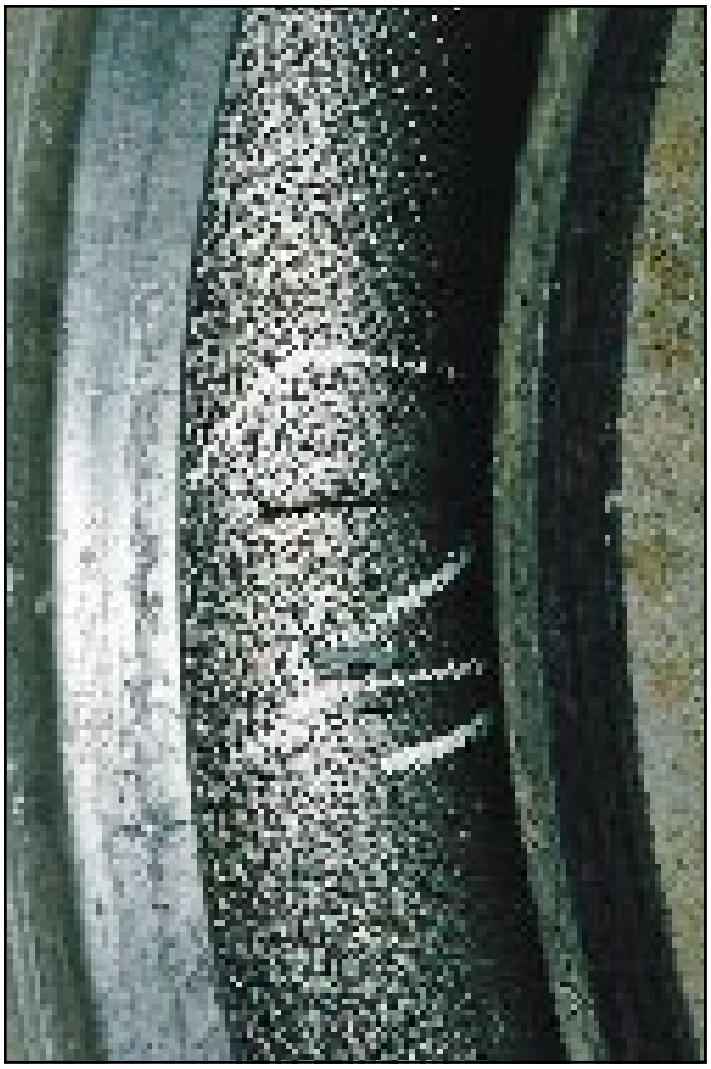
ACTION

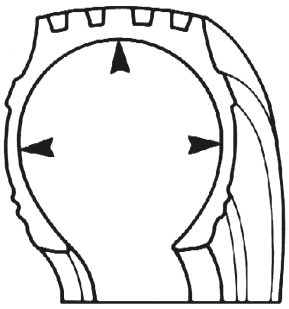
TIRE	Remove from service and contact your tire manufacturer. If blisters are small and few, the inner liner can be repaired and the tire can be placed back into service.
VEHICLE	None
OPERATIONS	None

Inner Liner Cracking

APPEARANCE	One or more cracks in the inner liner at locations other than the inner liner splice.
PROBABLE CAUSE(S)	Under inflation, excessive heat buildup in the tire interior. May also be manufacturing related.

EXAMPLE PHOTO & FIGURE





ACTION

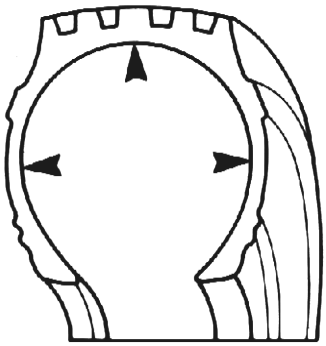
TIRE	Remove the tire from service and contact your tire manufacturer.
VEHICLE	None
OPERATIONS	None

INTERIOR

Pulled/Loose Cords

APPEARANCE	Depression or elevation in the surface of the tire interior along the radial cord path.
PROBABLE CAUSE(S)	Impacts, penetrations, poor repairs and under inflation which damage ply material.

EXAMPLE PHOTO & FIGURE



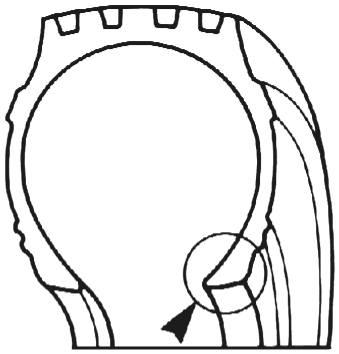
ACTION

TIRE	Scrap tire.
VEHICLE	None
OPERATIONS	None

Tearing, Mount/Dismount Damage

APPEARANCE	Tearing or loss of adhesion of the inner liner material inside the bead toe area.
PROBABLE CAUSE(S)	Poor mounting/demounting techniques or lack of lubricant.

EXAMPLE PHOTO & FIGURE



ACTION

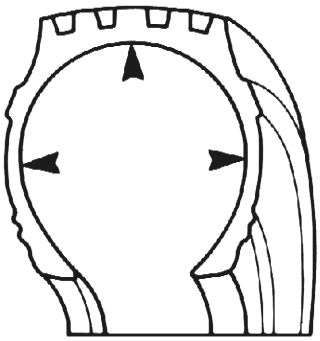
TIRE	Repair the inner liner or scrap the tire if damage is too excessive.
VEHICLE	None
OPERATIONS	Review tire mounting/dismounting procedures and the use of tire tools.

INTERIOR

Foreign Object Inner Liner Damage In Tubeless Tire

APPEARANCE	A series of random cuts or abrasion marks around the circumference of the tire interior, not otherwise explained.
PROBABLE CAUSE(S)	Foreign object in tire.

EXAMPLE PHOTO & FIGURE



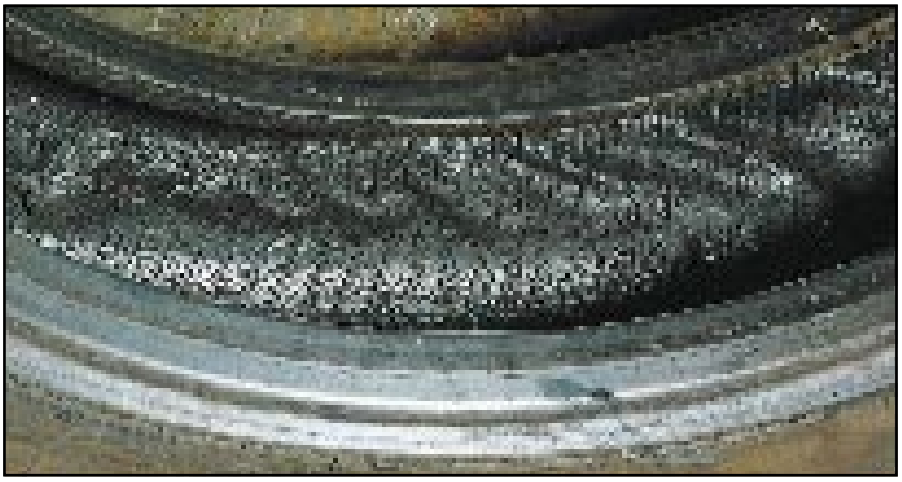
ACTION

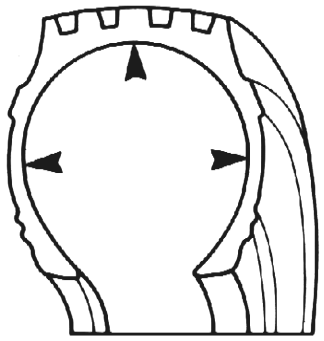
TIRE	Inspect for degree of damage, repair if possible; otherwise scrap the tire.
VEHICLE	None
OPERATIONS	None

Run Flat

APPEARANCE	Discoloration, blistering and/or separations of the inner liner.
PROBABLE CAUSE(S)	Continued operation after loss of inflation pressure.

EXAMPLE PHOTO & FIGURE





ACTION

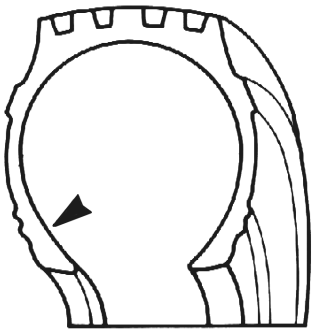
TIRE	Scrap the tire.
VEHICLE	None
OPERATIONS	None

INTERIOR

Pinch Shock

APPEARANCE	A horizontal, crescent shaped crease or break in the inner liner in the sidewall area. A small bulge may also appear in the damaged area.
PROBABLE CAUSE(S)	Severe impact.

EXAMPLE PHOTO & FIGURE



ACTION

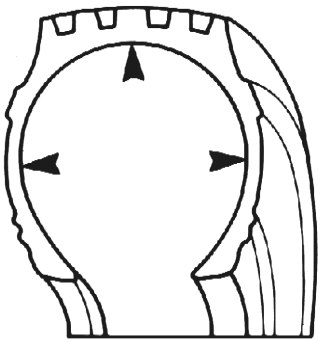
TIRE	Have the tire inspected by your tire repair supplier to determine repairability.
VEHICLE	Severe impacts can cause bent rim flanges. Inspect wheels and recheck alignment.
OPERATIONS	Review driving procedures and driver education.

Impact Break

INTERIOR

APPEARANCE	Crack or break in tire interior surface. May be accompanied by pulled or loose cords.
PROBABLE CAUSE(S)	Sudden and excessive force applied to the tire exterior which exceeds reinforcing material limits. May be caused by road hazard or driver abuse.

EXAMPLE PHOTO & FIGURE



ACTION

TIRE	Scrap tire.
VEHICLE	None
OPERATIONS	Review driving procedures.

CASING CONDITIONS

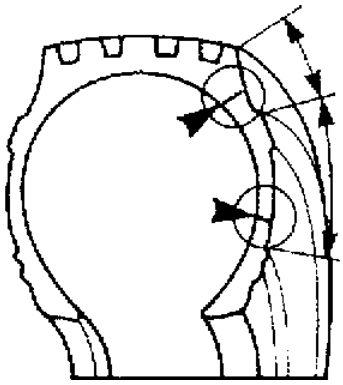
E. Any Area

ANY AREA

Run Flat

APPEARANCE	Advanced deterioration of radial tire affecting 360° of tire sidewall.
PROBABLE CAUSE(S)	Loss of inflation pressure. Diagnosis of cause of inflation loss becomes difficult or impossible as this condition progresses.

EXAMPLE PHOTO & FIGURE



ACTION

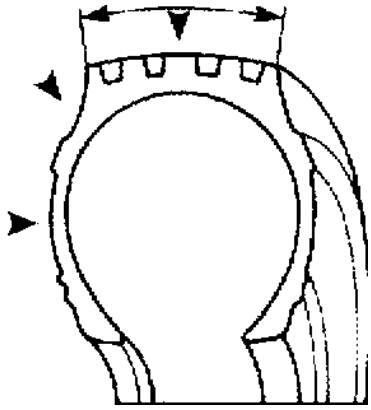
TIRE	Scrap the tire.
VEHICLE	None
OPERATIONS	None

Electrical Discharge

ANY AREA

APPEARANCE	Random oriented cracking on tire, sometimes associated with holes or punctures not otherwise explained.
PROBABLE CAUSE(S)	Vehicle contact with electrical cables or lightning.

EXAMPLE PHOTO & FIGURE



ACTION

TIRE	Scrap the tire.
VEHICLE	None
OPERATIONS	None

Section II:

Retread and Repair Conditions

Introduction to Retread Conditions

The area involved in retread conditions is located in the crown area of the tire, and the tire conditions covered in this section are divided into categories that describe their appearance. These categories are: Holes and Injuries, Missing Tread, Cracks, Bulges, and Miscellaneous.

Holes and Injuries are normally caused by in-service impacts and/or penetrations. Many are repairable. Others, due to the severity of the injury, render the casing unfit for further use.

Many casings which are scrapped could be repaired and returned to service—providing proper repair and/or sectioning procedures are followed. Other casings may be repaired and returned to restrictive service.

Irregular wear can be caused by many factors usually related to vehicular irregularities rather than tire or retread anomalies. The conditions cited in this guide will deal with retread problems rather than misalignment, mismatching, etc.

Separation of the tread from the casing can be caused by any number of factors and each of these must be diagnosed separately. Some cracks require immediate attention while others can run out the life of the tread. There are three major causes of cracks: (1) operational abuse, (2) retreading conditions, and (3) new tire manufacturing conditions.

Bulges can be cause by trapped air between the internal components of the tire or between the tire and the retread. In addition, breaks in the body cords can permit a deformation of the casing. Bulges, in general, are an indication of a weakness in the tire which may lead to a tire failure. Upon discovery of a bulge in a tire, the bulge should be outlined with a tire crayon, removed from service and inspected for disposition.

The Miscellaneous category consists of other retread conditions which look severe yet may not affect the tread life. They are cosmetic in nature and usually are the result of poor retread workmanship. These discrepancies should have been caught during the retreader's final inspection. The retreader should be made aware of your concern and then take corrective action.

RETREAD CONDITIONS

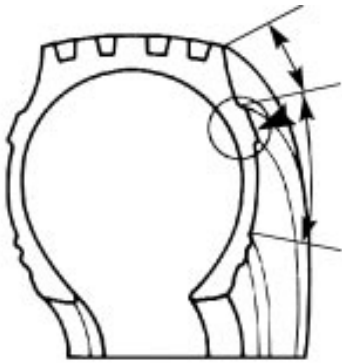
A. Holes and Injuries

HOLES

Bad Spot Repair

APPEARANCE	The repair fill-rubber is missing or loose in the sidewall or tread area and sometimes exhibits cracks.
PROBABLE CAUSE(S)	Poor workmanship. Contaminated buffed area, improper cementing, contaminated fill material, improper cure time or pressure, improper injury removal, etc.

EXAMPLE PHOTO & FIGURE



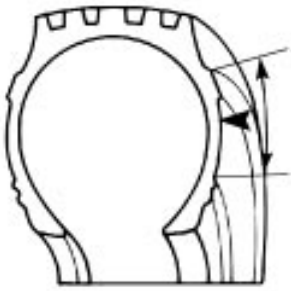
ACTION

TIRE	Consult your retreader/repair person for possible warranty adjustment. Re-repair if possible or scrap the tire if it is unrepairable.
VEHICLE	None
OPERATIONS	None

Spot Repair Should Be A Section Repair

APPEARANCE	The repair fill-rubber is missing or loose from a sidewall spot repair. Ply cords may be exposed. A distortion or separation is evident inside the tire.
PROBABLE CAUSE(S)	Poor workmanship. Not all the injury was removed. A full reinforced section repair should have been made.

EXAMPLE PHOTO & FIGURE



ACTION

TIRE	Consult your retreader/repair person for possible warranty adjustment. Re-repair if possible or scrap the tire if it is unrepairable.
VEHICLE	None
OPERATIONS	None

HOLES

Improper Nail Hole Repair

APPEARANCE	**Interior:** A crack or split extends from the repair unit. The repair unit may be dimpled, cracked or loose. Some signs of heat build up may be evident such as powdery or sticky rubber. **Exterior:** Separation of tire components may be evident in advanced stages.
PROBABLE CAUSE(S)	Nail hole repair procedures were used instead of section repair procedures resulting in inadequate injury removal. An improper size and type of repair unit was used.

EXAMPLE PHOTO & FIGURE

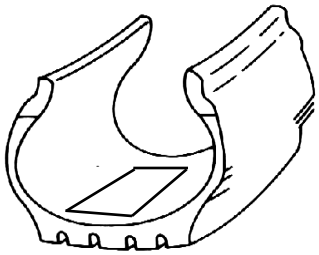
ACTION

TIRE	Consult your retreader/repair person for possible warranty adjustment. Re-repair if possible, otherwise scrap the tire.
VEHICLE	None
OPERATIONS	Review repair techniques with your repair person.

Improperly Aligned Repair

APPEARANCE	**Interior:** The repair unit may be dimpled, lifted or cracked. The repair unit alignment arrows do not point in the proper direction. **Exterior:** Tire components may be separated.
PROBABLE CAUSE(S)	Improperly installed repair unit. (In this case, the bead arrows do not point to the beads.) Improperly trained repair personnel.

EXAMPLE PHOTO & FIGURE



ACTION

TIRE	Consult your retreader/repair person for possible warranty adjustment. Re-repair if possible, otherwise scrap the tire.
VEHICLE	None
OPERATIONS	Review repair techniques with your repair person.

HOLES

Unfilled Nail Hole Repair

APPEARANCE	**Interior:** The repair unit is dimpled or cracked. **Exterior:** Rust is evident in the unfilled hole.
PROBABLE CAUSE(S)	The injury was not filled with a plug or rubber fill material.

EXAMPLE PHOTO & FIGURE

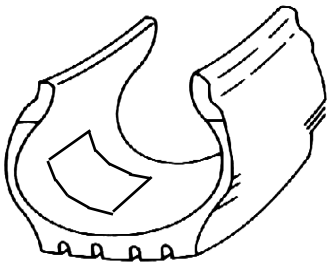
ACTION

TIRE	Consult your retreader/repair person for possible warranty adjustment. Re-repair if possible, otherwise scrap the tire.
VEHICLE	None
OPERATIONS	Review repair requirements with road service vendors and monitor on the road tire service.

Bridged Repair

APPEARANCE	**Interior:** The repair unit is loose, split or torn in the tire's shoulder area. A bulge, polished or gooey area caused by excessive heat may be evident under the repair unit. The fill material may also be cracked. **Exterior:** A sidewall bulge may be evident and the fill material may be cracked. Tire components may be separated.
PROBABLE CAUSE(S)	Improper placement of the repair unit during installation which resulted in trapped air under the repair unit. The tire beads were probably spread during installation of the repair unit.

EXAMPLE PHOTO & FIGURE



ACTION

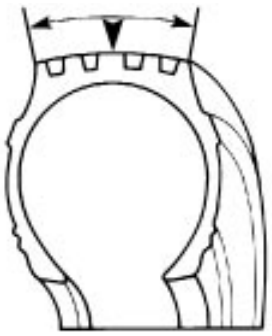
TIRE	Consult your retreader/repair person for possible warranty adjustment. Re-repair if possible, otherwise scrap the tire.
VEHICLE	None
OPERATIONS	Review repair techniques with your repair person.

HOLES

On the Wheel Repair

APPEARANCE	**Interior:** A rubber-coated cord or a cured rubber plug is used to fill the hole with no repair unit covering the injury. Cracks or separation around the hole may be evident. Further damage from penetrating objects may also be evident. **Exterior:** The tread or tire components may be separated.
PROBABLE CAUSE(S)	The tire was not demounted and properly inspected and repaired. **This type of repair is not recommended.**

EXAMPLE PHOTO & FIGURE



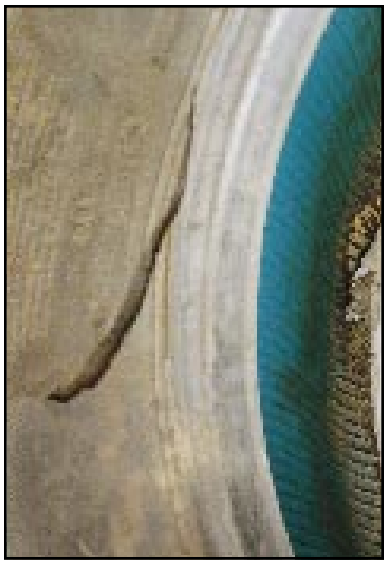
ACTION

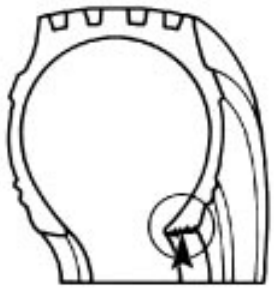
TIRE	Consult your retreader/repair person for possible warranty adjustment. Re-repair if possible, otherwise scrap the tire.
VEHICLE	None
OPERATIONS	Review repair requirements with road service vendors and monitor on the road tire service.

Bad Bead Repair

APPEARANCE	**Interior:** The inner liner may be separated and the bead area may exhibit exposed fabric or steel, cracking, loose rubber and/or improper bead contour. **Exterior:** Separation of the tire components may be evident.
PROBABLE CAUSE(S)	The injury exceeds repair limitation, poor workmanship, improper cure, incorrect fill material, or poor mounting/demounting techniques.

EXAMPLE PHOTO & FIGURE





ACTION

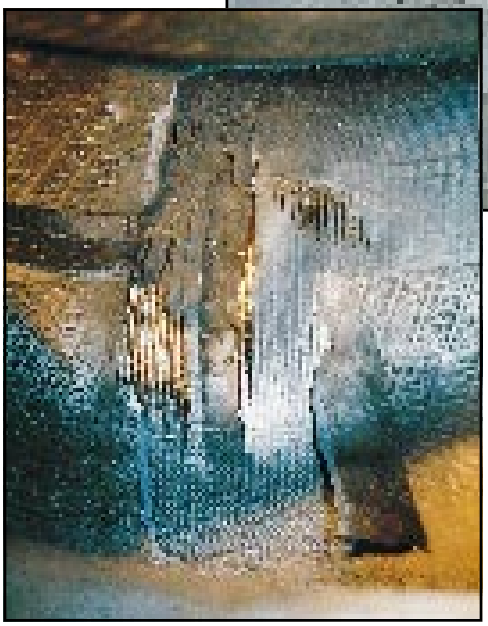
TIRE	Consult your retreader/repair person for possible warranty adjustment. Re-repair if possible, otherwise scrap the tire.
VEHICLE	None
OPERATIONS	Review mounting/demounting procedures to eliminate bead damage.

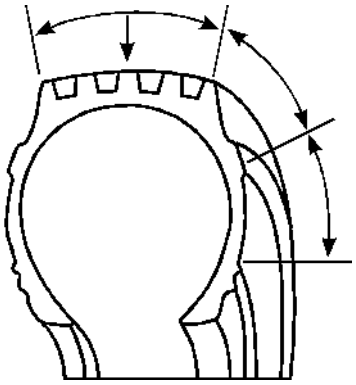
HOLES

Failed Repair - Injury Not Removed

APPEARANCE	**Interior:** A split/crack extends from under the repair unit. The repair unit may also be torn loose or be missing. **Exterior:** Tire components may be separated leaving rusty, loose cords.
PROBABLE CAUSE(S)	All injury or separation was not detected and removed during the repair process, poor workmanship.

EXAMPLE PHOTO & FIGURE





ACTION

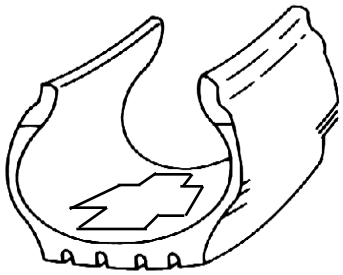
TIRE	Consult your retreader/repair person for possible warranty adjustment. Scrap the tire.
VEHICLE	None
OPERATIONS	Review repair techniques with your repair person.

Bias Repair in Radial Tire

HOLES

APPEARANCE	**Interior:** The repair unit is cracked or distorted. Bias repair units may be round or "X" shaped and are not labeled "Radial" (All radial, reinforced tire repair units are marked "Radial.") **Exterior:** Tire components may be separated.
PROBABLE CAUSE(S)	An incorrect repair unit was installed, improperly trained personnel.

EXAMPLE PHOTO & FIGURE



ACTION

TIRE	Consult your retreader/repair person for possible warranty adjustment. Re-repair if possible, otherwise scrap the tire.
VEHICLE	None
OPERATIONS	Review repair techniques with your repair person.

RETREAD CONDITIONS

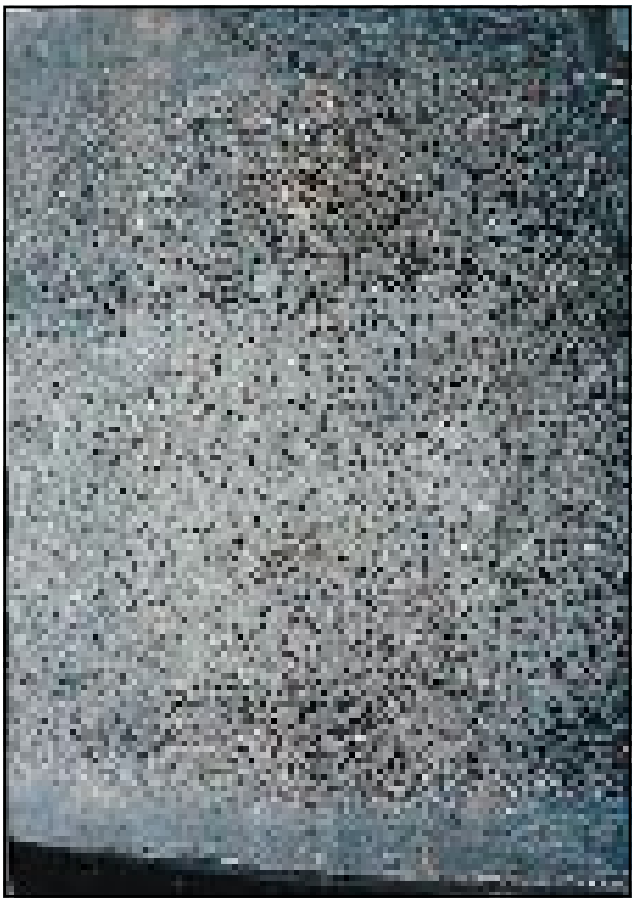
B. Missing/Loose Tread

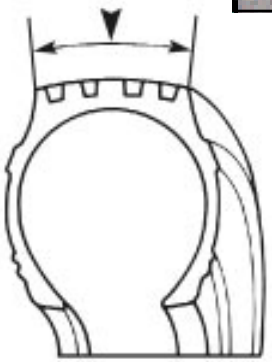
TREAD

Bond Line Porosity

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

EXAMPLE PHOTO & FIGURE





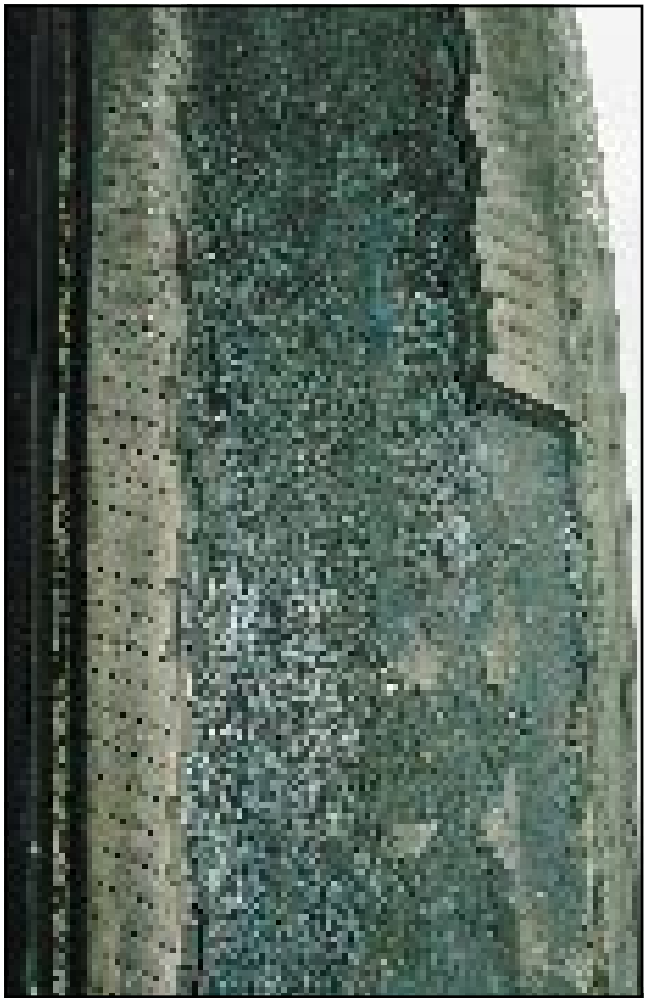
ACTION

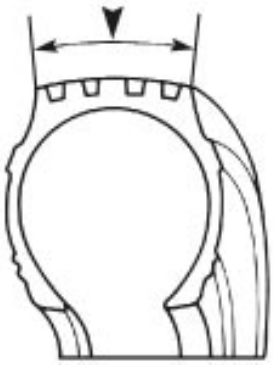
TIRE	Consult your retreader for possible warranty adjustment. Retread and rerun.
VEHICLE	None
OPERATIONS	None

Tread Separation

APPEARANCE	A portion of tread rubber only, located in any area of the tire, lifts and separates from the buffed surface of the tire body.
PROBABLE CAUSE(S)	Faulty retread workmanship and/or material such as a scorched or contaminated buffed surface, old cushion gum or tread rubber, improper cure conditions, missed nail hole, or a faulty repair.

EXAMPLE PHOTO & FIGURE





ACTION

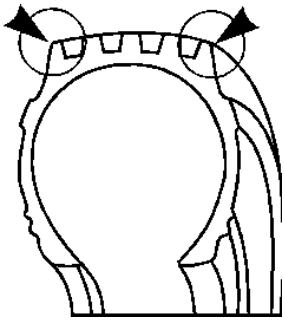
TIRE	Consult your retreader for possible warranty adjustment. Retread the tire again.
VEHICLE	None
OPERATIONS	None

TREAD

Tread Chunking At Splice

APPEARANCE	Portion(s) of tread are missing in the area of the tread splice in a pre-cured retread.
PROBABLE CAUSE(S)	Improper workmanship or contamination at the splice.

EXAMPLE PHOTO & FIGURE



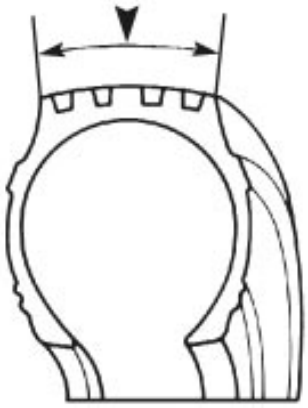
ACTION

TIRE	Run out the tread in the desired position or consult your retreader for a tread spot repair. Retread again if possible.
VEHICLE	None
OPERATIONS	None

Tread Separation - Repair Related

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(S)	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.

EXAMPLE PHOTO & FIGURE



ACTION

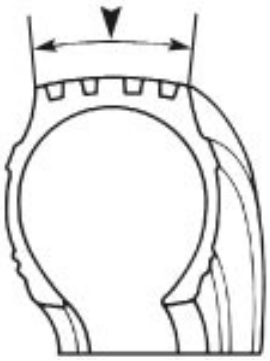
TIRE	Consult your retreader and/or repairman for possible warranty adjustment or repair and retread the tire again.
VEHICLE	None
OPERATIONS	Consult your repairman to correct repair problem.

TREAD

Belt Separation - Repair Related

APPEARANCE	**Exterior:** The tread and one or more belts is loose or missing from a portion or from the whole tire. A repair or skive is evident in the area of the separation. **Interior:** The repair unit may be sunk, dimpled, or cracked.
PROBABLE CAUSE(S)	A faulty repair or skive. Air migrated through the injury causing separation between the belts.

EXAMPLE PHOTO & FIGURE



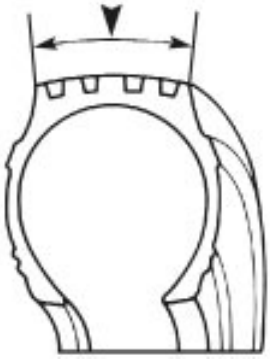
ACTION

TIRE	Consult your repairman and/or retreader for possible warranty adjustment. Scrap the tire.
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 usually occurs soon after retreading.
PROBABLE CAUSE(S)	An undetected and unrepaired penetration.

EXAMPLE PHOTO & FIGURE



ACTION

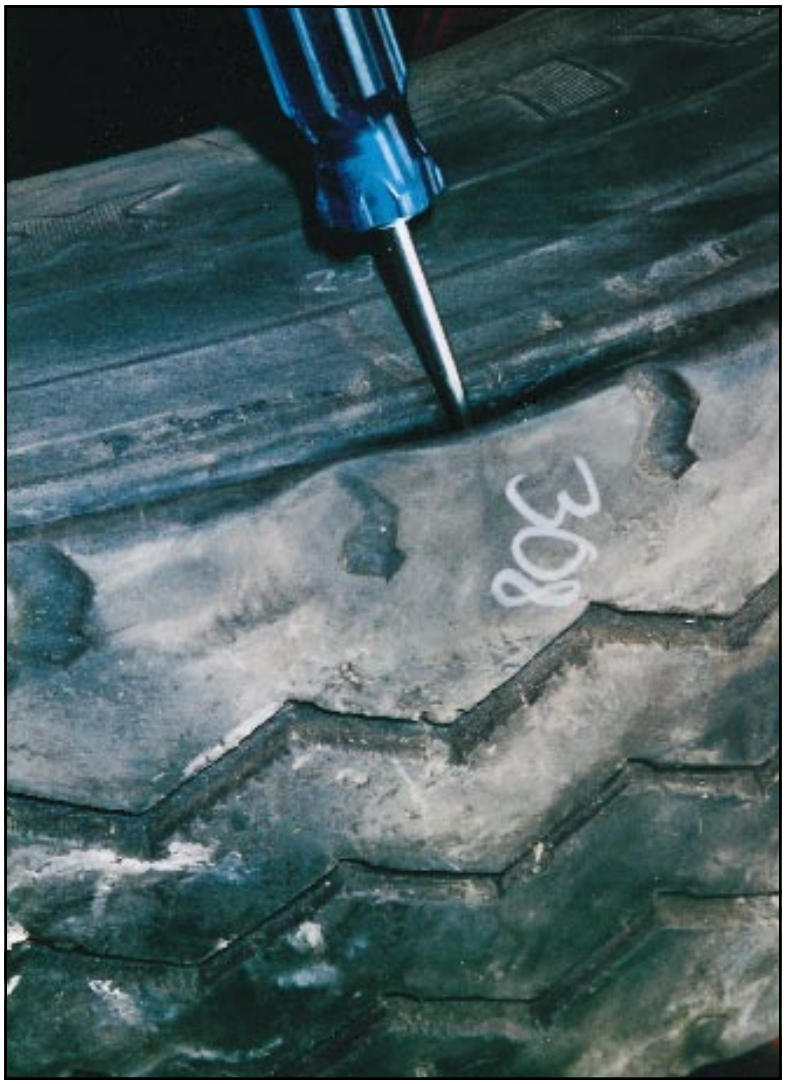
TIRE	Consult your retreader for possible warranty adjustment. Retread again if possible.
VEHICLE	None
OPERATIONS	None

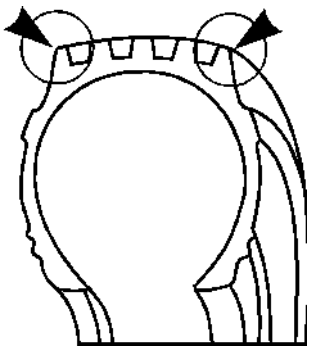
TREAD

Tread Edge Lifting

APPEARANCE	The tread 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(S)	Caused by cure related problems, retread processing problems, the shoulder buffed lower on one side or possible belt edge separation.

EXAMPLE PHOTO & FIGURE





ACTION

TIRE	Consult your retreader for possible warranty adjustment. If the tire casing is sound, retread the tire. If the belt is separating from the casing, consult the original tire manufacturer.
VEHICLE	None
OPERATIONS	None

RETREAD CONDITIONS

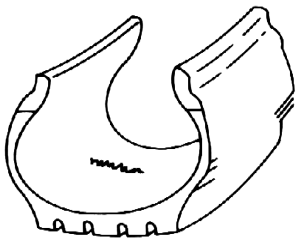
C. Cracks

CRACKS

Failed Inner Liner Repair

APPEARANCE	**Interior:** A crack extends from the repair rubber. Buff marks may be visible around the repair rubber. The repaired area may be coated with liner sealer. **Exterior:** Tire components may be separated.
PROBABLE CAUSE(S)	An attempt to repair liner blisters or an open liner splice failed to seal the air cavity of the tire and air migrated into the tire body causing separation.

EXAMPLE PHOTO & FIGURE



ACTION

TIRE	Consult your retreader for possible warranty adjustment. Scrap the tire.
VEHICLE	None
OPERATIONS	None

Lug Base Cracking

APPEARANCE	Cracking is evident at the base of the tread lugs. Some lugs may be torn from the tread in severe cases.
PROBABLE CAUSE(S)	The wrong tread design was used for the operation (single axle, high torque drive application with deep traction tread design may contribute to this condition), rubber compound, excessive or lack of undertread, over curing.

EXAMPLE PHOTO & FIGURE

ACTION

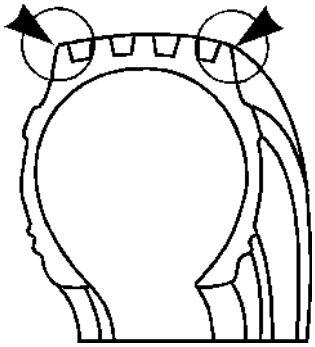
TIRE	Consult your retreader for possible warranty adjustment. Retread if possible.
VEHICLE	None
OPERATIONS	Review tread design selection for application.

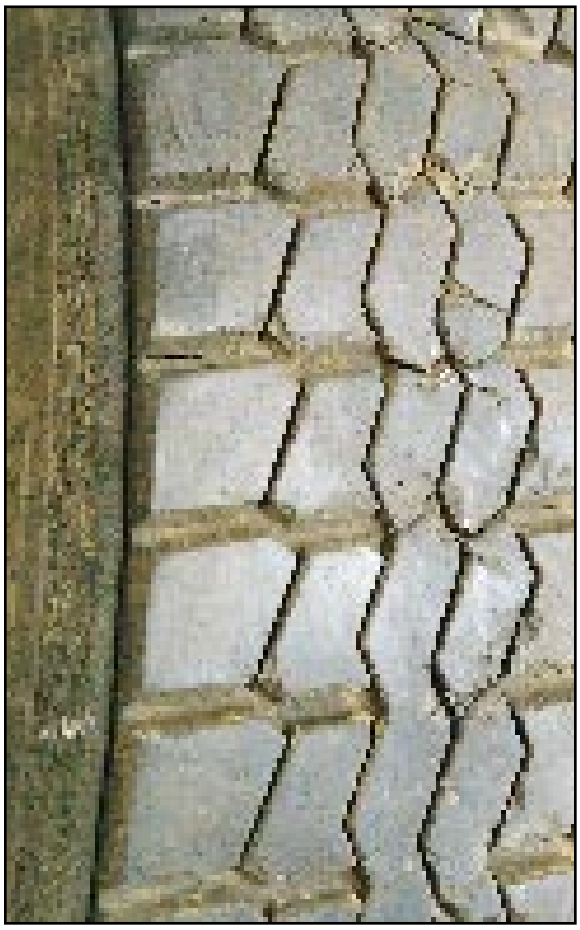
CRACKS

Improper Tread Width

APPEARANCE	A crack appears at the tread edge which can extend into the belt. The tread edge may lift off the casing.
PROBABLE CAUSE(S)	Inadequate support of the belt package during operation which creates a new flex point in the tire. The result is a breakdown of the belts or rubber at the bondline of the retread and the casing.

EXAMPLE PHOTO & FIGURE





ACTION

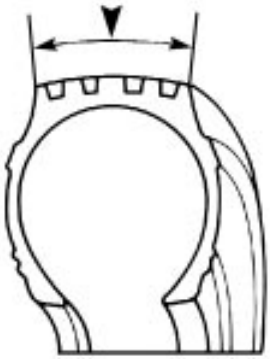
TIRE	Consult your retreader for possible warranty adjustment.
VEHICLE	None
OPERATIONS	None

Open Tread Splice

CRACKS

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

EXAMPLE PHOTO & FIGURE



ACTION

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

RETREAD CONDITIONS

D. Bulges / Depressions

BULGES

Skive Failure

APPEARANCE	A bulge or excessive wear in the tread area, or area where the tread is missing at a skive.
PROBABLE CAUSE(S)	Improper skive or skive fill which traps air or allows air to seep under the tread and results in a localized loss of tread adhesion. Tread or casing separation may occur if not caught early in treadlife.

EXAMPLE PHOTO & FIGURE

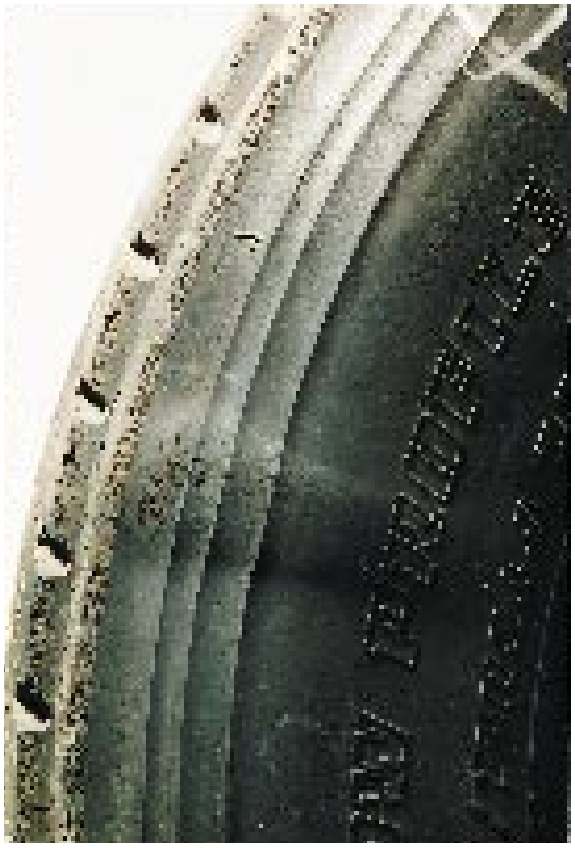
ACTION

TIRE	Consult your retreader for possible warranty adjustment. If within limits of repair, repair the tire again and retread.
VEHICLE	None
OPERATIONS	None

Repair Related Bulge

APPEARANCE	An excessive bulge in the mid/upper sidewall which may progress to a complete separation of the sidewall rubber from the casing. A slight bulge associated with a repair which can be identified with a blue triangular label is normal as the cables reposition themselves after repair. The bulge must not exceed 3/8".
PROBABLE CAUSE(S)	The repair unit is too small or improperly installed.

EXAMPLE PHOTO & FIGURE



ACTION

TIRE	If the bulge exceeds 3/8", scrap the tire.
VEHICLE	None
OPERATIONS	Consult your tire repairman to correct the repair problems.

BULGES

Buckled Tread

APPEARANCE	Undulations are evident in the tread surface and interior of a mold cured retread.
PROBABLE CAUSE(S)	The retread tire was too large for the mold in which it was cured, thus causing distortion in the tire during the curing process.

EXAMPLE PHOTO & FIGURE

ACTION

TIRE	Consult your retreader/repair person for possible warranty adjustment.
VEHICLE	None
OPERATIONS	None

RETREAD CONDITIONS

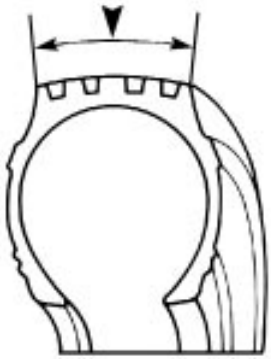
E. Miscellaneous

MISC.

Delamination

APPEARANCE	Evidence of layers of rubber in the tread.
PROBABLE CAUSE(S)	Excessive mold lube or a rubber compounding problem, surface cure of the tread rubber or poor mold fitment.

EXAMPLE PHOTO & FIGURE



ACTION

TIRE	The tread can be run out if the condition is not severe, otherwise consult your retreader for possible warranty adjustment and retread the tire again.
VEHICLE	None
OPERATIONS	None

Tread Surface Porosity

MISC.

APPEARANCE	A spongy appearance in the surface of the tread. Portions of the tread may be missing.
PROBABLE CAUSE(S)	Insufficient tread rubber, improper cure, or poor mold fitment.

EXAMPLE PHOTO & FIGURE

ACTION

TIRE	The tread can be run out if the tread adhesion to the casing is adequate, however, tread wear may be poor. If the adhesion is poor, consult your retreader for possible warranty adjustment, and retread the tire again.
VEHICLE	None
OPERATIONS	None

MISC.

Wing Lift

APPEARANCE	The sidewall shoulder rubber of the retread is loose.
PROBABLE CAUSE(S)	Lack of shoulder buff or poor mold fitment (mold cure), poor tread building, scorched or contaminated buffed surface and/or improper crown radius.

EXAMPLE PHOTO & FIGURE

ACTION

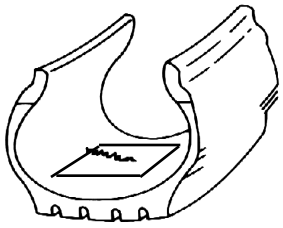
TIRE	Consult your retreader for possible warranty adjustment. Retread again.
VEHICLE	None
OPERATIONS	None

Failed Repair From Underinflation

MISC.

APPEARANCE	Cracks in the repair unit, cracks emanating from the repair unit, loose edges under the repair unit, tacky surface around the repaired area or under the repair unit.
PROBABLE CAUSE(S)	Running the tire underinflated due to a puncture, cut, bad valve stem, lack of proper air pressure, etc.

EXAMPLE PHOTO & FIGURE



ACTION

TIRE	Repair again if permissible according to repair limit standards. If the failure cannot be re-repaired, scrap tire.
VEHICLE	None
OPERATIONS	Review tire inflation maintenance procedures and load conditions.

Section III:

Radial Tire Wear Conditions and Causes

Introduction to Radial Tire Wear Conditions and Causes

To get maximum tread life from radial tires and reduce tire costs/mile, it is essential to minimize uneven tread wear and possible casing damage. Section III of this manual provides a reference source and training aid which will assist the user in identifying radial tire wear patterns and determining causes which can then be corrected to minimize irregular wear.

The advantages of radial tires are that they are slow wearing which prolongs tread life, and they provide a long footprint which reduces scrubbing and results in improved fuel economy. Another advantage is improved casing durability which provides a potential cost-savings through additional retreads. However, these attributes of the radial design can also result in the tire exhibiting more irregular wear patterns when vehicle and tire maintenance or tire construction is inadequate. These wear patterns are not as evident in short haul, high torque operations since the tread wears away much faster and unusual wear patterns are often literally scrubbed off.

Some common causes of the various tire wear patterns which have been identified are as follows:

Maintenance and Operations

- Misalignment on steer, drive, trailer and dolly axles
- Improper inflation maintenance
- Mismatching of tires, especially in dual applications
- Incorrect mounting of the tire on the rim and resulting improper bead seating
- Non-uniformity of the rotating assembly - tire, wheel/rim, brake drum, hub
- Excessive imbalance and/or run-out
- Improper loads for the service application
- Tire misapplication - Use of an improper tire for the axle position or service condition
- Poorly maintained suspensions with looseness in components, or incorrect replacement parts
- Improper use of chains or other traction assists
- Poor driver practices

Tires

- Non-uniformity in balance and/or runout
- Inadequate tire design or construction

Wheels/Rims/Brake Drums/Hubs

- Non-uniformity in balance and/or runout, stud circle concentricity

Inflation maintenance and misalignment on steer, drive, trailer and dolly axles are highlighted under maintenance-related causes of irregular wear patterns. These represent the most common causes for irregular wear patterns and generally have the most severe impact on tire wear when compared with other causes. Inadequate inflation maintenance is a continuous cause that is often overlooked, while misalignment is probably the least understood and often the last to be corrected.

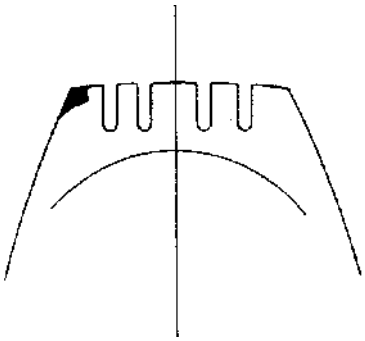
RADIAL TIRE WEAR CONDITIONS AND CAUSES

A. Steer Axle Tires

Shoulder Step/Chamfer Wear

APPEARANCE	Even tread wear in center with steps worn in shoulders. This is confined to the outer portion of the shoulder rib. Can be wider on one shoulder than the other.
PROBABLE CAUSE(S)	Typical of radial tires in slow wearing operations. May vary with tread design and service application.

EXAMPLE PHOTO & FIGURE



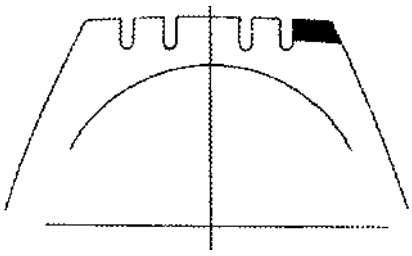
ACTION

TIRE	Little or no loss in overall mileage will result provided tread depth differential is not excessive. Tires can remain on the steer axle.
VEHICLE	None
OPERATIONS	None

Full Shoulder Wear

APPEARANCE	Excessive wear extending across entire shoulder rib to a major tread groove, usually on one side of tire only.
PROBABLE CAUSE(S)	Result of side scrubbing and generally is caused by either improper toe condition or drive axle misalignment. In case of toe in, the outside shoulders of both steer tires will be worn, while in the case of toe out, the inside shoulders of both steers will be worn. Drive axle misalignment wears the inside shoulder of one tire and the outside shoulder of the other steer tire. Poorly maintained suspension components (e.g. torque rods, springs, and spring bushings) can produce the same results.

EXAMPLE PHOTO & FIGURE



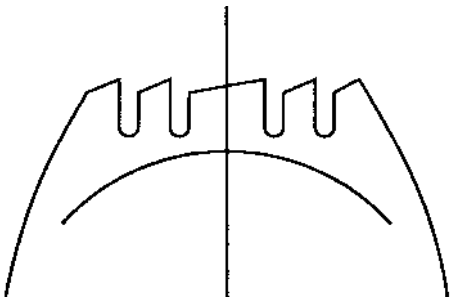
ACTION

TIRE	If wear is severe, tires can be rotated to another position or reversed on the wheel.
VEHICLE	Diagnose misalignment, check suspension components, and correct as required.
OPERATIONS	None

Feather Wear

APPEARANCE	Tread ribs worn so that one side of rib is higher than the other resulting in step-offs across the tread face. Generally, all ribs exhibit this wear.
PROBABLE CAUSE(S)	Excessive side force scrubbing, resulting from severe conditions of misalignment such as excessive toe, severe drive axle misalignment, worn, missing or damaged suspension components, bent tie rod or other chassis misalignment.

EXAMPLE PHOTO & FIGURE



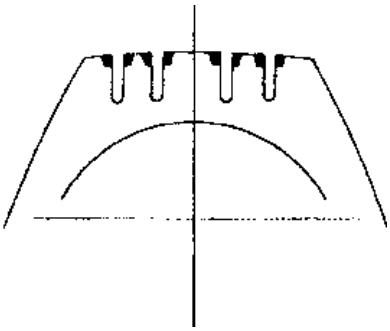
ACTION

TIRE	If feather wear is severe, tires can be rotated to another axle for maximum utilization of remaining tread.
VEHICLE	Diagnose and correct misalignment condition as required. If feather wear on both steer tires is in the same direction, drive axle or other chassis misalignment is indicated. If steer tire feathers are in opposite directions, a toe condition is indicated.
OPERATIONS	None

Erosion/River/Channel Wear

APPEARANCE	Circumferential wear along rib edges next to major tread grooves may be wavy in appearance and vary in width around tire.
PROBABLE CAUSE(S)	Characteristic of slow wear rate of radial tires on free rolling axles. May vary with individual tire tread design and construction. Common in line haul operations in which loads are light and turning is frequent.

EXAMPLE PHOTO & FIGURE



STEER AXLE TIRES

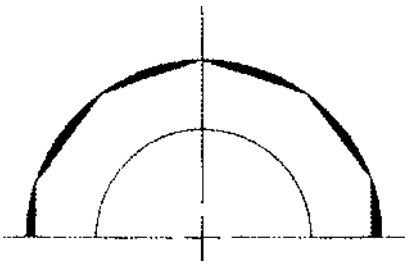
ACTION

TIRE	Erosion wear should not be of concern.
VEHICLE	None
OPERATIONS	None

Cupping/Scallop Wear

APPEARANCE	Localized dished out areas of fast wear creating a scalloped appearance around tire. Appears around the tire on the shoulder ribs. May progress to adjoining ribs.
PROBABLE CAUSE(S)	Usually a result of moderate to severe assembly out of balance condition, improper rim/wheel mounting or other assembly non-uniformity. Can also be due to lack of shock absorber control on some suspension types.

EXAMPLE PHOTO & FIGURE



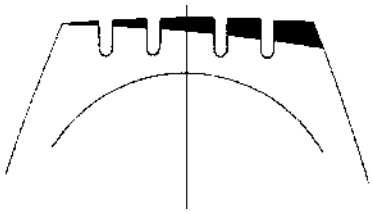
ACTION

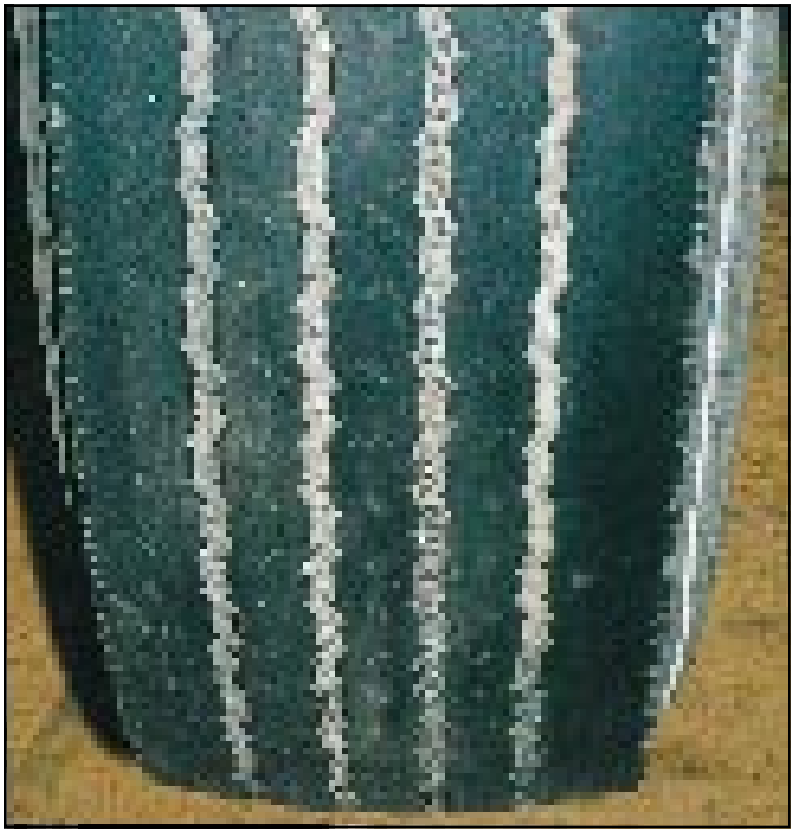
TIRE	If ride complaints arise, tires may be rotated to drive axle.
VEHICLE	Diagnose imbalance condition, i.e., wheel, rim, hub, brake drum. Correct as necessary.
OPERATIONS	None

One-Sided Wear

APPEARANCE	Excessive wear on one side of tire extending from the shoulder towards the center of the tread.
PROBABLE CAUSE(S)	Improper alignment, worn king pins, loose front wheel bearings, excessive axle loads.

EXAMPLE PHOTO & FIGURE





STEER AXLE TIRES

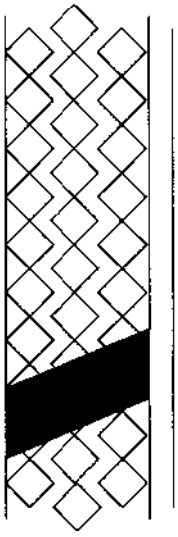
ACTION

TIRE	Depending on severity of wear, tires may be rotated to drive axle or, if worn to minimum tread depths on shoulder, submit for possible retreading.
VEHICLE	Diagnose mechanical problem and correct.
OPERATIONS	None

Diagonal Wear

APPEARANCE	Localized flat spots worn diagonally across the tread, often repeating around tread circumference.
PROBABLE CAUSE(S)	Runout and/or out of balance in conjunction with a slow rate of wear. Can develop from a brake skid, spot wear, shoulder wear, or other advanced wear conditions. Can also be caused by loose wheel bearings and is aggravated by misalignment.

EXAMPLE PHOTO & FIGURE



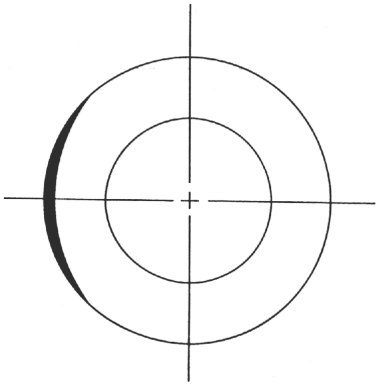
ACTION

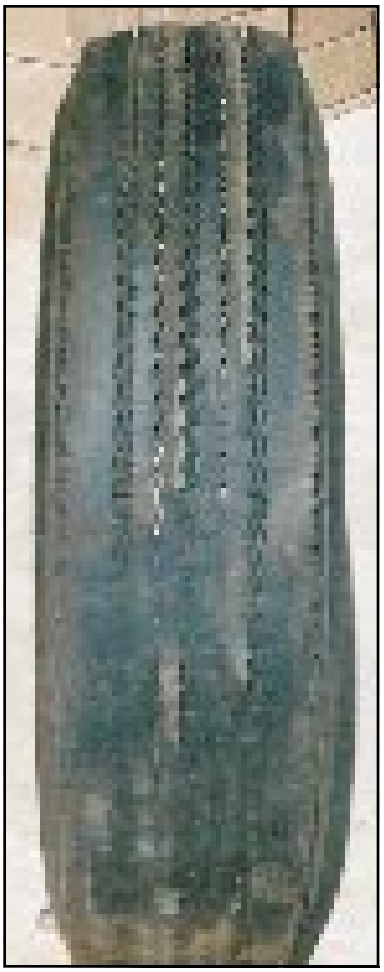
TIRE	The tire may be rotated to the outside drive dual position with change in rotation of the tire. If wear is excessive, submit to retreader for further options.
VEHICLE	Diagnose cause and correct.
OPERATIONS	None

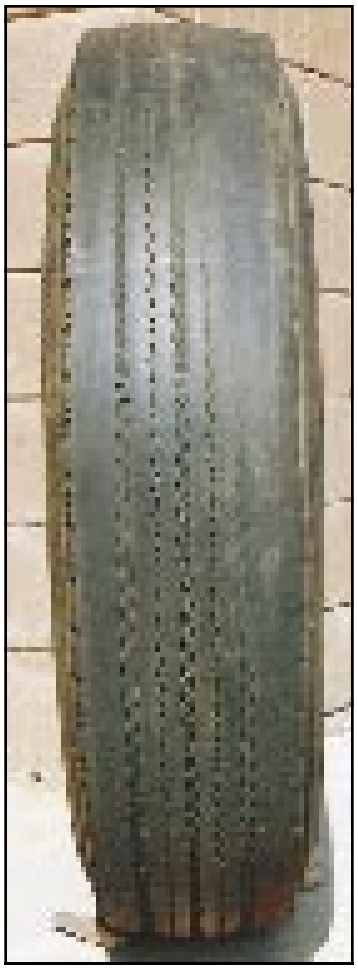
Eccentric/Out-Of-Round Wear

APPEARANCE	Considerable difference in tread depth between 90˚ and 180˚ apart.
PROBABLE CAUSE(S)	Usually a result of excessive radial runout or other non-uniformity in the rotating assembly, e.g. hub, stud circle, wheel/rim, tire and/or improper bead seating of tire on rim. May also be caused by dragging or distorted brake drums and drums with excessive wall thickness variation. May be accompanied by, or develop into, a vibration complaint.

EXAMPLE PHOTO & FIGURE







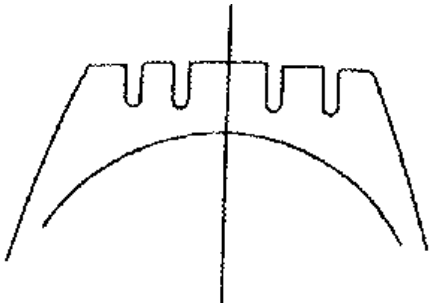
ACTION

TIRE	Tire may be rotated to the trailer dual. If wear is excessive on worn side, submit to retreader for further options.
VEHICLE	Diagnose problem components/parts. Replace or correct as necessary.
OPERATIONS	None

Overall Fast Wear

APPEARANCE	Good wear pattern but fast rate of wear.
PROBABLE CAUSE(S)	Can be caused by service conditions such as mountainous terrain, frequency and severity of turning, abrasive road surfaces in combination with vehicle configurations and their attributes such as power steering, heavy axle loads, high wheel cuts, setback axles, short wheel base tractors, long wheel base straight trucks.

EXAMPLE PHOTO & FIGURE



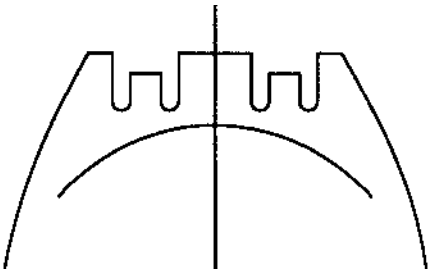
ACTION

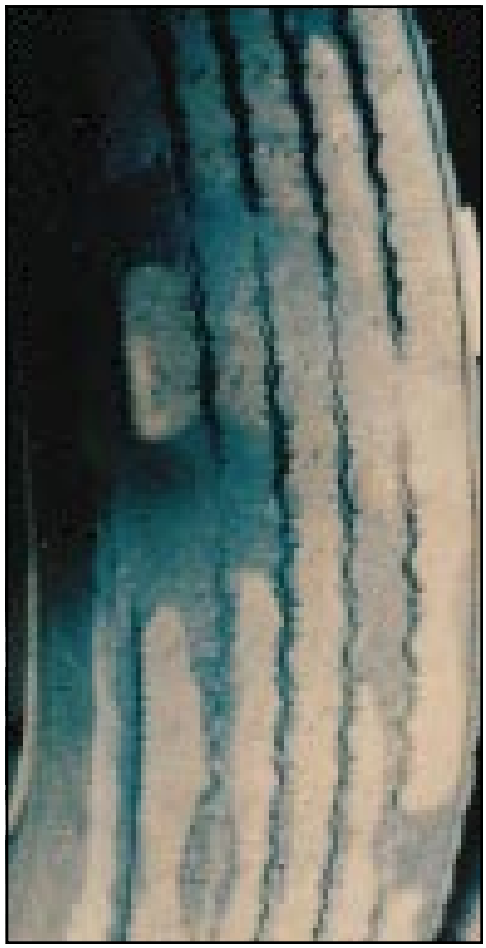
TIRE	None
VEHICLE	Consult vehicle and tire manufacturers when specing equipment or replacing tires.
OPERATIONS	None

Rib Depression/Punch Wear

APPEARANCE	One or more inner ribs worn below the level of the adjacent ribs circumferentially around the tire.
PROBABLE CAUSE(S)	Lack of shock absorber control in some suspension types, improper inflation pressures, loose or worn wheel bearings, assembly non-uniformity such as improper bead seating and out-of-balance condition, aggravated by high speed empty hauls.

EXAMPLE PHOTO & FIGURE





STEER AXLE TIRES

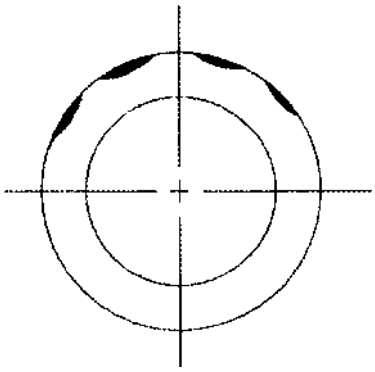
ACTION

TIRE	If not worn excessively, continue to run. If wear is excessive, retread.
VEHICLE	Diagnose mechanical problem and correct.
OPERATIONS	None

Erratic Depression Wear

APPEARANCE	Random, erratic wear around tire circumference.
PROBABLE CAUSE(S)	Lack of shock absorber control in some suspension types. Loose or worn wheel bearings, assembly non-uniformity such as improper bead seating and out-of-balance condition, aggravated by high speed empty hauls.

EXAMPLE PHOTO & FIGURE



ACTION

TIRE	If not worn excessively, continue to run. If wear is excessive, retread.
VEHICLE	Diagnose mechanical problem and correct.
OPERATIONS	None

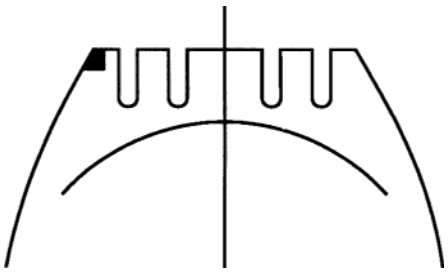
RADIAL TIRE WEAR CONDITIONS AND CAUSES

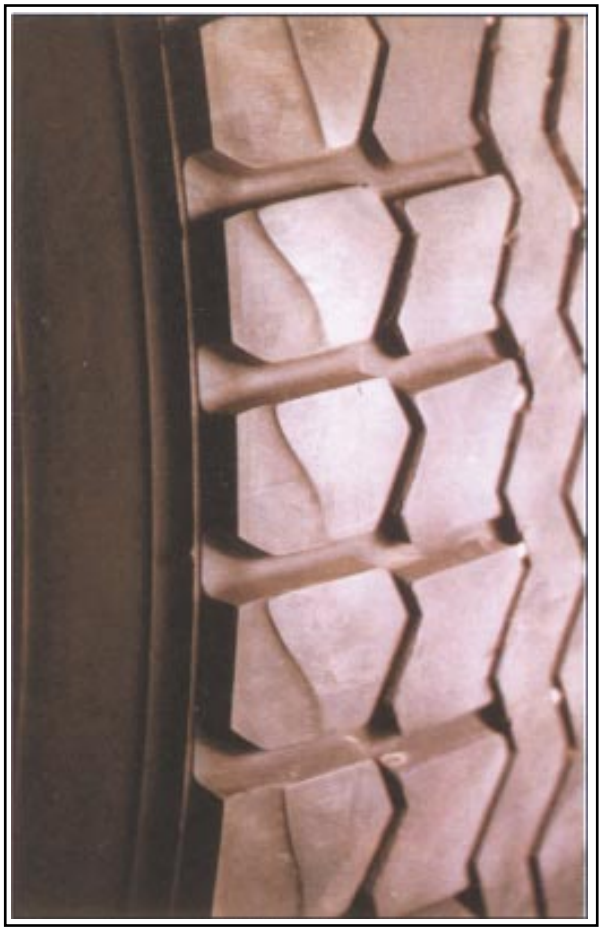
B. Drive Axle Tires

Shoulder Step/Chamfer Wear

APPEARANCE	Tire worn on edge of shoulder. This is confined to the outer portion of the shoulder. Can be wider on one shoulder than the other. This condition usually appears first on the inside shoulder of the inside dual of the front drive axle.
PROBABLE CAUSE(S)	Typical of radial tire construction and slow rates of tread wear. May vary with tread design and service application. Can be aggravated by axle deflection, road conditions, and worn or damaged suspension parts.

EXAMPLE PHOTO & FIGURE





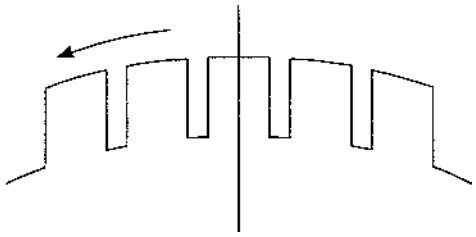
ACTION

TIRE	Consider rotating tire among drive axles. Does not adversely affect overall tread life.
VEHICLE	Inspect for worn or damage suspension parts.
OPERATIONS	None

Heel/Toe Wear

APPEARANCE	Each lug around tire worn high to low from front to back edge.
PROBABLE CAUSE(S)	Most often caused by mismatched inflation pressures or tire diameter in a dual assembly and certain conditions such as P&D operations, mountainous terrains, etc.

EXAMPLE PHOTO & FIGURE



DRIVE AXLE TIRES

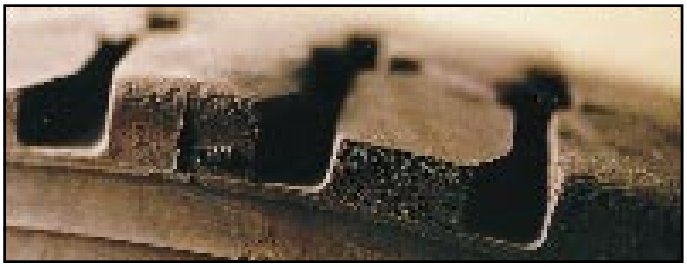
ACTION

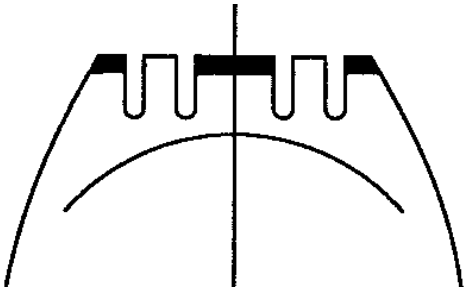
TIRE	Run out on drive axle. If severe, change direction of rotation until tread is worn to point of retread.
VEHICLE	Review tire maintenance practices and tread design selection.
OPERATIONS	None

Alternate Lug Wear

APPEARANCE	Alternate lugs worn to different tread depths around tire circumference. May be every second lug, every third, etc... or a combination thereof.
PROBABLE CAUSE(S)	Mismatched inflation pressures or tire diameters in a dual assembly and certain conditions such as pick up and delivery operations and variations in loads. Is accentuated by slow rate of tire wear and by worn or poorly maintained suspension components or axle misalignment.

EXAMPLE PHOTO & FIGURE





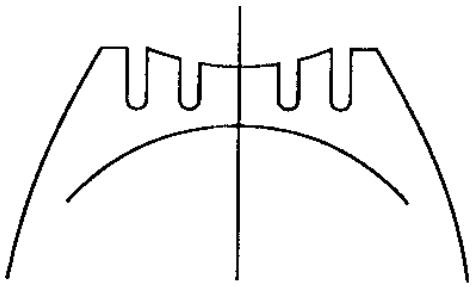
ACTION

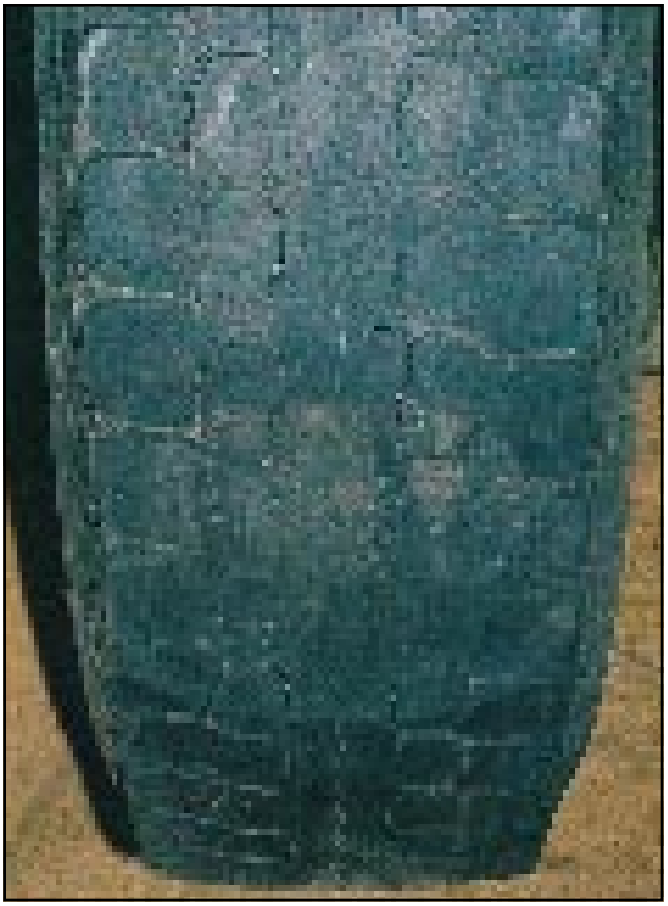
TIRE	Continue to run out unless tread depth variations become severe. Rotate to faster wearing position, i.e., single screw tractor or rear drive axle.
VEHICLE	Check for worn or damaged components and axle misalignment.
OPERATIONS	Review tire maintenance practices and tread design selection.

Brake Skid/Flat Spot Wear

APPEARANCE	Flat spot on tread surface. Surface texture may show abrasion marks from tread sliding on road surface, but surface may have since worn smooth. Often exhibited on more than one tire position on an axle.
PROBABLE CAUSE(S)	Aggravated by new brakes (high friction, not worn in), unbalanced brake system, aggressive use of brakes and driver abuse. Sometimes seen on new vehicle drive-aways.

EXAMPLE PHOTO & FIGURE





DRIVE AXLE TIRES

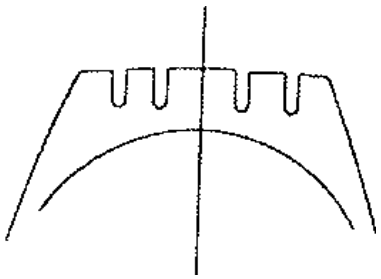
ACTION

TIRE	If condition is not excessive, duals can be rematched to position flat spots 180° from each other. If more severe, the tire can be repaired or retreaded if damage is not into the belts. If skid damage is into the tire belts, it may be possible to remove the top belt and/or rebelt and then retread the tire. Consult your retreader. If damage is excessive, scrap tire.
VEHICLE	Check brake material and brake balance.
OPERATIONS	Review driver training program.

Overall Fast Wear

APPEARANCE	Uniform wear pattern, but fast rate of wear.
PROBABLE CAUSE(S)	Can be caused by service conditions such as mountainous terrain, frequency and severity of turning, abrasive road surfaces and equipment such as single axle drive, long wheel base straight trucks, heavy axle loads, high horsepower engines, or mismatched drive train components.

EXAMPLE PHOTO & FIGURE



ACTION

TIRE	Continue to run and retread. If condition continues, consult tire manufacturer
VEHICLE	Review tire design selection. Carefully match equipment with service requirements. Consult vehicle and tire manufacturer when specing equipment or replacing tires.
OPERATIONS	None

RADIAL TIRE WEAR CONDITIONS AND CAUSES

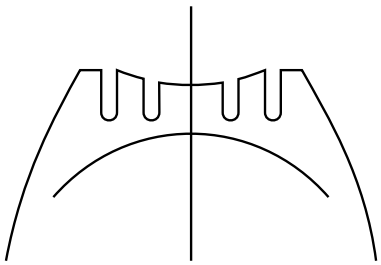
C. Trailer Axle Tires

Brake Skid/Flat Spot Wear

TRAILER AXLE TIRES

APPEARANCE	Localized spot of excessive wear across the tread face. Surface texture may show circumferential abrasion marks from tread sliding on road surface, but surface may have since worn smooth. Usually exhibited on both tires in a dual assembly.
PROBABLE CAUSE(S)	Brake skid occurs most often on dolly, trailer and drive tires. Aggravated by new brakes (high friction, not worn in), unbalanced brake system, aggressive use of brakes, frozen brakes and driver abuse such as the use of only trailer brakes to stop a vehicle. Sometimes seen on new vehicle drive-aways.

EXAMPLE PHOTO & FIGURE



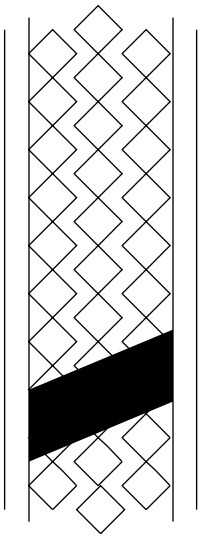
ACTION

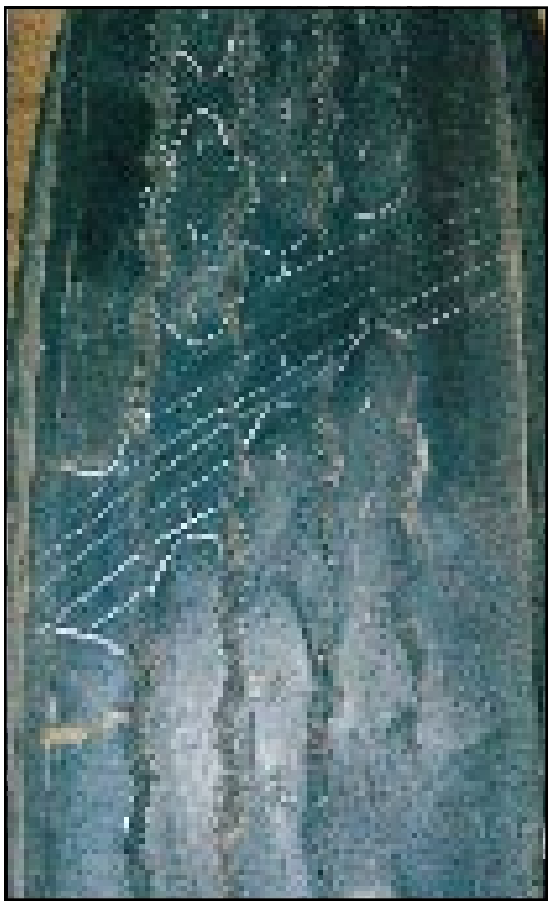
TIRE	If condition is not excessive, duals can be rematched to position flat spots 180˚ from each other. If more severe, the tire can be repaired or retreaded if damage is not into the belts. If skid damage is into the tire belts, it may be possible to remove the top belt and/or rebelt the tire. Consult your retreader. If damage is excessive, scrap tire.
VEHICLE	Check brake material and brake balance.
OPERATIONS	Review driver training program.

Diagonal Wear

APPEARANCE	Localized flat spots worn diagonally across the tread at approximately 25˚-35˚ angles often repeating around tread circumference.
PROBABLE CAUSE(S)	Bad wheel bearings, toe out, mismounting of tire and wheel assembly to trailer, mismatched duals for size and/or inflation pressures; may start as brake skid. Aggravated by high speed empty or light load hauls.

EXAMPLE PHOTO & FIGURE





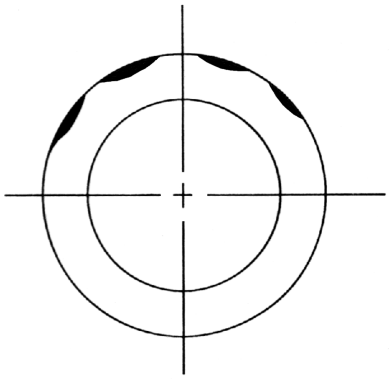
ACTION

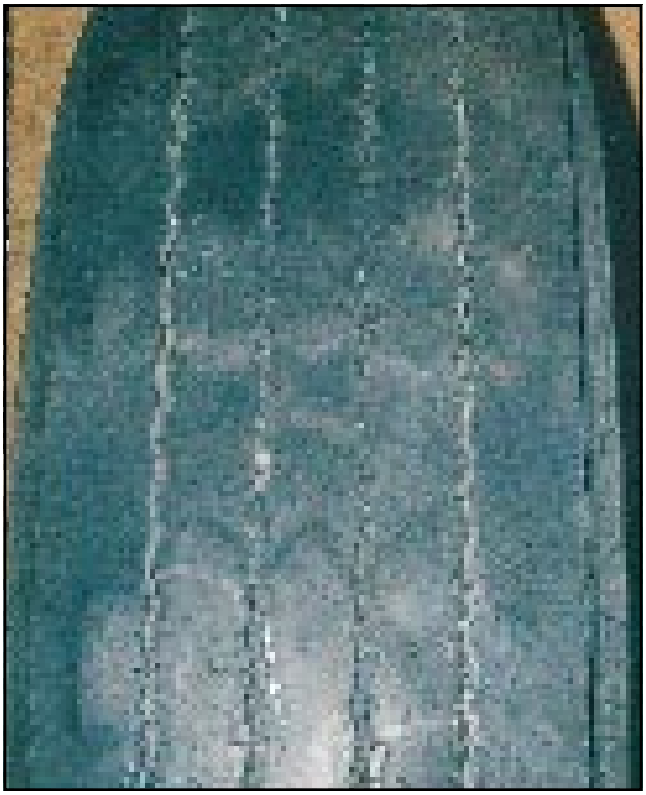
TIRE	Reverse direction of rotation of the tire. If wear is excessive, true or retread
VEHICLE	Diagnose cause and correct.
OPERATIONS	None

Multiple Flat Spotting Wear

APPEARANCE	Numerous areas worn flat around circumference or tread.
PROBABLE CAUSE(S)	Uneven dual loading due to mismatched inflation pressures or tire sizes, worn wheel bearings, imbalance, air suspensions with bad shocks, driver abuse of trailer brakes; aggravated by high speed empty hauls.

EXAMPLE PHOTO & FIGURE





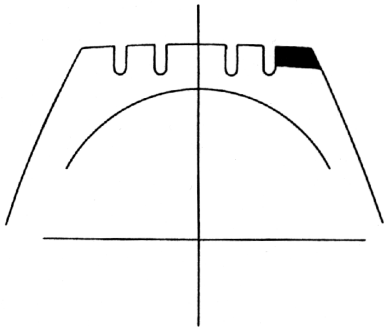
ACTION

TIRE	If not worn excessively, run tires out. If remaining tread at worn spots is 2/32" or less, retread tire.
VEHICLE	Diagnose cause and correct.
OPERATIONS	Consult driver and review maintenance practices.

Rapid Shoulder Wear - One Shoulder

APPEARANCE	Tire worn on edge of one shoulder sometimes extending to inner ribs. Can progress to diagonal wipeout.
PROBABLE CAUSE(S)	Excessive toe, excessive camber. These conditions can be created by a misaligned or bent axle and can also be caused by loose or worn wheel bearings.

EXAMPLE PHOTO & FIGURE



TRAILER AXLE TIRES

ACTION

TIRE	Change direction of rotation of tire. If shoulder wear is severe, remove and retread.
VEHICLE	Diagnose misalignment and/or mechanical condition and correct.
OPERATIONS	None

Shoulder Scrubbing/Scuffing

APPEARANCE	Abrasion on upper tire sidewall near tread edge. Can be accompanied by cracks in tread shoulder area.
PROBABLE CAUSE(S)	Excessive lateral scuffing of tread, especially in tight turns when tire is hot. Most common on heavily loaded, spread axle trailers.

EXAMPLE PHOTO & FIGURE

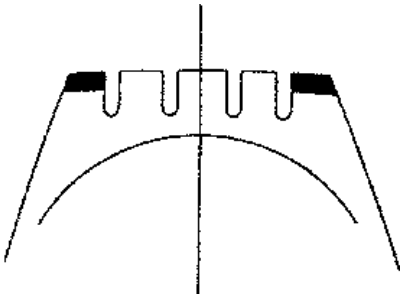
ACTION

TIRE	Move affected shoulders to low scrub positions. If severe, tire removal may be required. Inspect for serviceability on another axle or retread if possible.
VEHICLE	None
OPERATIONS	None

Rapid Shoulder Wear - Both Shoulders

APPEARANCE	Full rib wear on both shoulders.
PROBABLE CAUSE(S)	Frequently found on spread axles as a result of normal service conditions. Also found on dolly axles as a result of the push/pull action of that operation.

EXAMPLE PHOTO & FIGURE



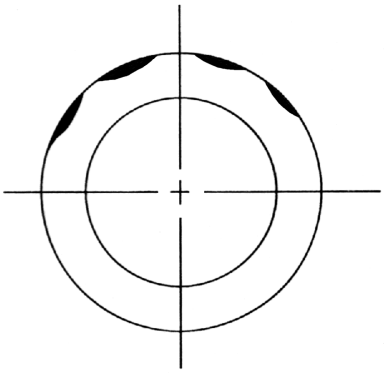
ACTION

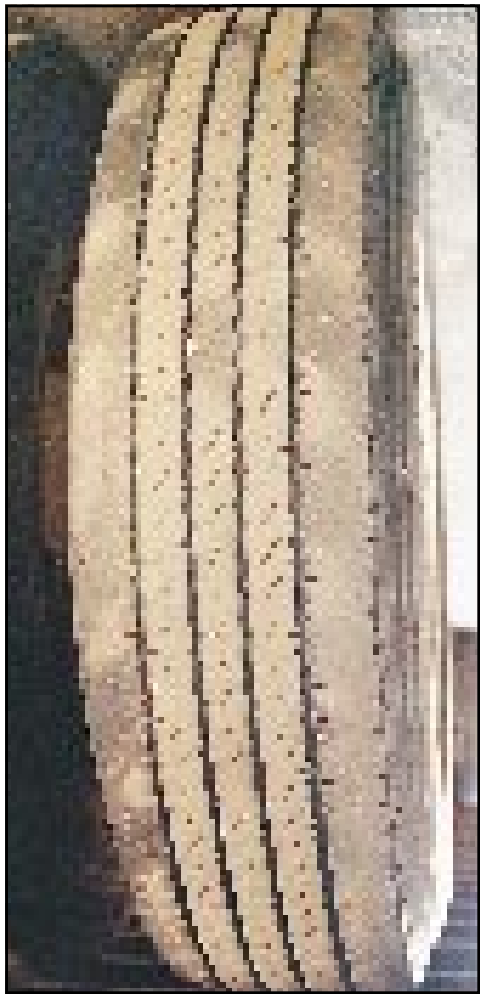
TIRE	If shoulder wear is severe, remove and retread.
VEHICLE	None
OPERATIONS	Review tire application with tire manufacturer.

Erratic Depression Wear

APPEARANCE	Random, erratic wear around tire circumference.
PROBABLE CAUSE(S)	Lack of shock absorber control in some suspension types, mismatched tire sizes and/or inflation pressures between duals, loose or worn wheel bearings, assembly non-uniformity such as improper bead seating and out-of-balance condition, aggravated by high speed empty hauls.

EXAMPLE PHOTO & FIGURE





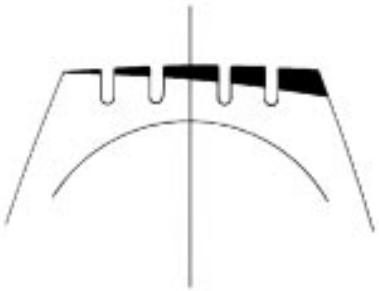
ACTION

TIRE	If not worn excessively, continue to run. If wear is excessive, retread.
VEHICLE	Diagnose mechanical problem and correct.
OPERATIONS	None

One Sided Wear

APPEARANCE	Excessive wear on one side of tire.
PROBABLE CAUSE(S)	Excessive toe, excessive axle camber, non-parallel axles, non-uniform tire and wheel assembly caused by improper bead seating or a bent wheel.

EXAMPLE PHOTO & FIGURE



TRAILER AXLE TIRES

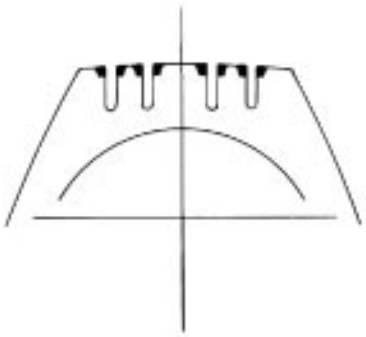
ACTION

TIRE	Change tire position on trailer. If excessive, retread.
VEHICLE	Isolate and correct cause.
OPERATIONS	None

Erosion/River/Channel Wear

APPEARANCE	Localized wear along inside edges of tread ribs which may be wavy in appearance and vary in width around the tire.
PROBABLE CAUSE(S)	Characteristic of slow wear rate of radial tires on free rolling axles. May vary with individual tire tread design and construction.

EXAMPLE PHOTO & FIGURE



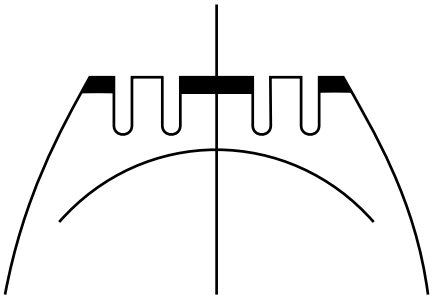
ACTION

TIRE	Erosion wear should not be of concern.
VEHICLE	None
OPERATIONS	None

Rib Depression/PunchWear

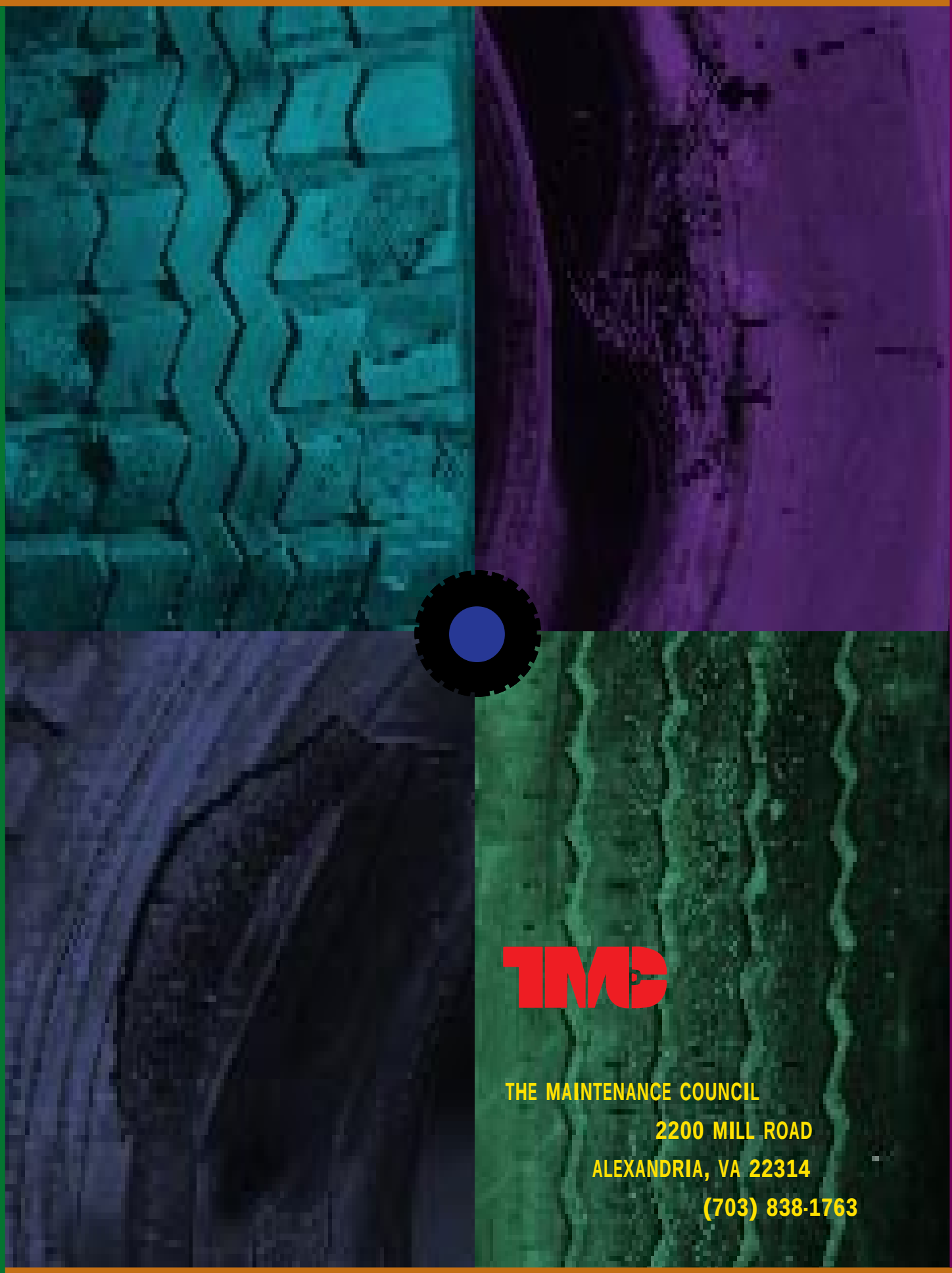
APPEARANCE	One or more inner ribs worn below the level of the adjacent rib around the tire's circumference.
PROBABLE CAUSE(S)	Lack of shock absorber control in some suspension types, mismatched tire sizes and/or inflation pressures between duals, loose or worn wheel bearings, assembly non-uniformity such as improper bead seating and out-of-balance condition, aggravated by high speed empty hauls.

EXAMPLE PHOTO & FIGURE



ACTION

TIRE	If not worn excessively, continue to run. If wear is excessive, retread.
VEHICLE	Diagnose mechanical problem and correct.
OPERATIONS	None



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