

# **Tire Manufacturing Processes**

*For more information about tire defects, blowouts and  
tread separations contact the law offices of Bruce R.  
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**<http://tirefailures.com>**

## **STEEL BELTED RADIAL PASSENGER AND LIGHT TRUCK TIRES**

Most steel belted radial passenger and light truck tires are composed of one or two inner liners, one or two polyester reinforced body plies, two beads, two bead reinforcing strips, two anti-chafing strips, two steel belts, the sidewalls, and the tread. Some tires include one or two layers of nylon or polyester constricting belts or strips between the steel belts and the tread (safety belts or cap plies). See pictorial, Exhibit 1.

The most common failure mode of steel belted radial passenger and light truck tires is separation between the steel belt components. This area is subject to the highest amount of stress and is also the area of weakest potential adhesion because of the difficulty of bonding rubber to metal. The adhesion can be adversely affected by various manufacturing practices including, but not limited to, under-vulcanization, contamination, and improper storage and handling of components. For example, if any moisture is allowed to accumulate on steel belt wire or between the steel belts, degradation of the steel wire components or pockets of separation may occur. Similarly, small pockets of air between the steel belts may result in a breakdown of adhesion. Less common, but sometimes present, are foreign materials cured within the tire such as small pieces of metal, wood, or other contaminants. Contamination found in cured tires has varied widely, including chicken bones, a live shotgun shell, a wrench, a glove, timecards, screws, etc.

### **MANUFACTURING PROCESS**

There are six basic processes in the manufacture of tires:

1. Mixing of carbon blacks, elastomers and chemicals to form the rubber compounds.
2. Calendering the fabrics and steel cord and coating them with rubber.
3. Extruding the treads and sidewall components.
4. Manual assembly of the green tire components on tire building machines.
5. Vulcanizing or curing the tire with heat and pressure.
6. Final finishing, including inspection, storage and shipping. (A certain portion of finished tires are also repaired in the final finishing process.)

See pictorial, Exhibit 2.

#### **I. MIXING**

Steel belted radial tires incorporate as many as ten different ingredients with the rubber compounds. These compounds include antioxidants, antiozonants, curing agents, elastomers, sulfur reinforcing agents, cobalt, magnesium oxide, rubber polymers, calcium carbonate, zinc oxide, carbon black, and processing materials. The compounds are prepared by mechanically mixing in a Banbury Mixer to break down the rubber in an attempt to obtain a uniformly homogenous mass which is subsequently formed into slabs of rubber that are extruded or calendered for use in tire building.

## II. CALENDERING

In the calendering process fabric cords and steel cords are coated with rubber stock. The body plies and reinforcing strips incorporate polyester cord that is coated in an adhesive liquid. The cord is passed between large heated rolls of a calendering machine. A woven fabric is similarly prepared and calendered for the anti-chafing strips.

Since rubber will not adhere to bare steel, the steel cord wires are coated with a very thin layer of brass. These brass coated steel cords (multi-strand cables) are used in the steel belts.

The brass coated steel wire is usually purchased from outside vendors and shipped to the tire manufacturer in sealed containers to prevent moisture contamination. When received by the manufacturer the wires should be stored in a temperature and humidity controlled environment until they are coated with skim stock rubber in the calender. It is critical that belt wire not be exposed to moisture as it is susceptible to corrosion during the manufacturing process, which leads to a breakdown in adhesion.

When the wires are removed from the shipping container they are placed on roller apparatus in the creel room where temperature and humidity should be controlled and continually monitored. The wire then passes from the creel room through the open plant to the calender. The distance from the creel room to the calender varies among manufacturers ranging from 20 to 60 feet. The area of the plant between the creel room and calender is not humidity and temperature controlled so that there is a potential for moisture to accumulate on the bare wire before it is encapsulated in rubber.

This problem is exacerbated by slowdowns, temporary shutdowns, humidity spikes, and failure to adequately control temperature and humidity within the creel room. Once the belt wire becomes contaminated with moisture, it becomes more difficult to obtain proper adhesion of the rubber to the brass-coated wire. The bond between the rubber and the belt wire is critical in the construction of steel belted radial tires.

The steel wire passes from the creel room on rollers through aligning combs into the calender where the wires are coated with a thin sheet of skim stock rubber. The rubber should also penetrate the steel cords for maximum adhesion. Both the polyester cords and steel cords are cut at specified angles and widths for use in tire building.

## III. EXTRUSION

Some tire components are formed by extrusion of uncured rubber, including tread and sidewall components. Extruders are both hot and cold fed systems. Typically, extruders are barrel shaped. The material is fed into the barrel and the mixed compound is pushed forward by a screw mechanism.

#### IV. INNER LINER

The inner liner is a critical component of modern tires. In steel belted radial tubeless tires, the inner liner is the substitute for the tube used in the older style tube tires. It is formulated to provide the least amount of air permeability possible while obtaining adhesion to the body plies. Inner liners are calendered into thin sheets of specified thicknesses and then cut to appropriate widths for use in tire construction.

#### V. BEADS

Bead wire configurations fall into four primary categories: .037 weftless, .050 weftless, .050 single strand, and cable beads. Like belt wire, bead is generally purchased from outside vendors and shipped in hermetically sealed containers to prevent corrosion from moisture prior to manufacturing. The bead wire is plated like the belt wire to provide high adhesion to the insulating rubber. Insulating rubber is usually pressed into and around the bead when it is drawn through an extruding die. Bead chaffer, which is rubber reinforcement around the bead wire, is also placed in the area of the beads to give strength and resilience during tire mounting.

#### VI. TREAD

Tire tread incorporates several special rubber compounds which are simultaneously extruded to provide the appropriate dimensions for the specific tire. Once the tread assembly has been extruded it is coated with a rubber compound adhesive (cement). It is then cut into the appropriate length for tire building.

#### VII. TIRE BUILDING

Steel belted radial tires are assembled partially by hand. In the first stage of tire building process, the inner liner, body plies, beads, bead reinforcing strips and sidewalls are assembled by the first stage tire builder. The first stage builder constructs the tire on a cylindrical rotating drum. During second stage tire building, the steel belts and tread are applied. The tire components are held together mechanically by the tack or stickiness in the components. The body plies and steel tread components are stored in large rolls. Prior to the components being transferred to the building machines they are often stored in this rolled configuration. Woven fabric liners are placed between the layers of the rolled material to prevent the components from sticking together.

If the rolls of stored material are not promptly utilized, they can lose their tacky quality. This makes it difficult, if not impossible, for the components to properly adhere together before

vulcanization. In the latter stages of degradation, sulfur can be visualized on the surface of the components as a white or grayish layer which is called **blooming**.

Appropriate building practices require that components which have lost their tackiness, especially components with sulfur bloom, be scrapped. Most manufacturers, however, allow their tire builders to utilize petroleum solvents to **freshen** belt material or body plies that have lost their tackiness or which demonstrate sulfur bloom. Use of the petroleum solvent masks the sulfur, can cause pockets of trapped gas between components, and can allow the uncured components to move so that the precise alignment necessary for steel belts is compromised.

## VIII. VULCANIZATION (Cooking or curing)

Subsequent to second stage, the green tire is transferred for vulcanization. The tire is coated with a liquid to ensure that it will not stick to the mold. In the mold the green tire is placed over an inflatable rubber bladder. Typically, the vulcanizing machine is a two piece metal mold. The bladder forces the tire against the mold, forming the sidewall patterns and tread pattern. The molding is accomplished through the use of steam pressure or hot water inside of the bladder.

The rubber components of the tire are vulcanized by steam generated heat in the mold and bladder at pressure as high as 400 psi and temperatures of approximately 200° for approximately ten minutes. This heat results in chemical and physical changes in the rubber compounds. At the molecular level, profound chemical changes occur during vulcanization. The rubber components are transformed from plastic consistency to the consistency found in a finished tire. The vulcanization process chemically and physically links the various components, forming what should be an inseparable bond. The shorter rubber molecules are linked to the long polymer chain linked molecules.

When the molecules in the various components properly bond, all interfacing surfaces are obliterated forming the finished green tire. Thus, any pattern marks from the fabric liner used during storage should be totally obliterated in a properly cured tire. One should never see liner pattern marks on a tire that has been properly cured (vulcanized). Manufacturers use various time periods for the vulcanization process. In an effort to reduce the time required for the manufacture of a tire, manufacturers are continually attempting to reduce the vulcanizing time. One method that is utilized is radiation of components prior to vulcanization. It should be noted that under-vulcanization will result in a lack of adhesion of the components. One indication of this lack of adhesion in a failed tire is pattern liner marks. As a result of vulcanization, the rubber becomes essentially insoluble and cannot be processed by any of the means used to manipulate the green rubber during the assembly process.

## IX. FINAL INSPECTION AND REPAIR

All tires are supposed to be visually inspected and placed on a tire uniformity machine (TUG) before they are sent to the warehouse. Unfortunately, the visual inspection process sometimes lasts as little as fifteen seconds and on occasion is nonexistent. When an abnormality is discovered

the tire is sent to classifiers who can route the tire to repair, scrap the tire, or set the tire aside for further inspection. Repairs include buffing and grinding. If a foreign object is ground out of a tire, green tire rubber is placed in the area where finished rubber has been removed. The tire is then spot vulcanized or repaired by the repairman so that the repair cannot be seen. Some manufacturers experienced air bubbles or blisters that can be visualized on the inner liner of the tire. These blisters have been repaired by poking them with an icepick-like device (awl) either through the tread, both steel belts and both body plies down to the blister and then pushing the air back out the hole produced by the icepick device, or by puncturing the blister from the inside and pressing the inner liner against the body plies with a hand stitcher. Neither of these repairs are appropriate or satisfactory and can lead to failure of the tire in the field. After final inspection/repair, tires are sent to the warehouse where tread labels are placed on the tire. They are then transferred to the retailer.

## POST-MANUFACTURING

### I. ADJUSTMENTS

All tires are subject to warranty adjustment until they are worn out. If a tire fails before it is worn down to 2/32nds inch treadwear, it is usually subject to adjustment by the tire manufacturer. The defective tire is returned to the dealer. If the dealer determines an adjustable condition is present, he will give the consumer partial credit on the purchase of a new tire depending on the extent of wear of the old tire. The tire is then sent to a regional adjustment center where a technician verifies the adjustable condition and enters adjustment data in a computer terminal. If the condition is verified, the retailer is given credit and the tire is destroyed. In some instances, the tire will be sent to the manufacturer's tire engineering department for evaluation.

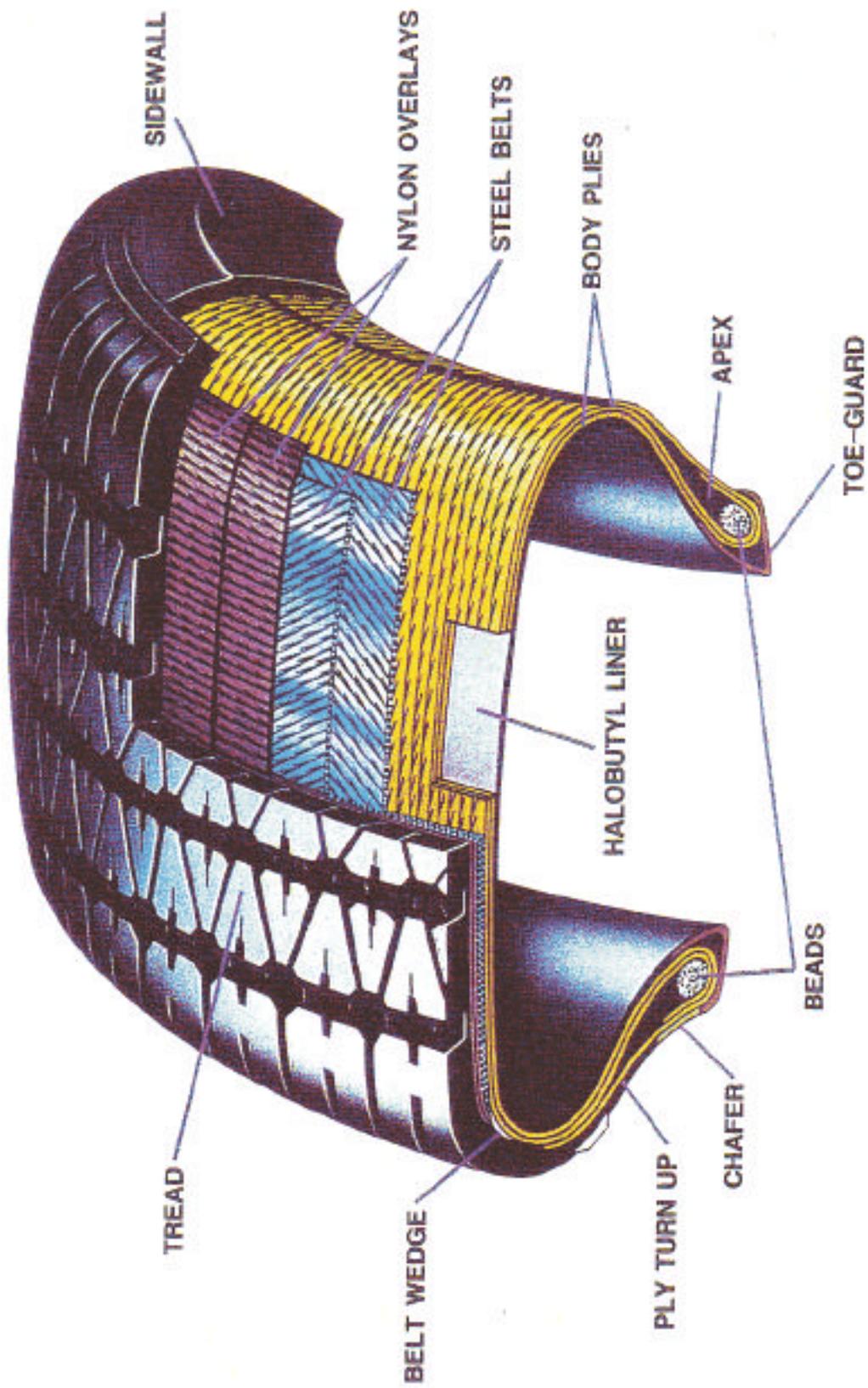
The most common mode of failure of steel belted radial tires is tread belt separation. This can vary from complete delamination of the tread and upper steel belt to small separations between the components which can result in accelerated localized wear or vibrations during operation. There are at least six to eight different categories of adjustment that indicate tread belt separation in various stages. It should be noted that most tires that fail in service are not placed into the adjustment system for a variety of reasons. First, dissatisfied customers will merely discard the tire and change brands. Secondly, if a non-adjustable condition is found, the tire does not go into the system. For example, if the retailer determines that the tire failed as a result of a road hazard, the tire is not adjusted. Furthermore, tires resulting in claims or lawsuits are not adjusted. If a tire is more than approximately half worn or near the end of its useful life and there is not enough credit to justify adjustment, the tire will not be adjusted. It should also be noted that tires sold under private brands may very well be adjusted by the private vendor, such as Pep Boys or Sears, and these tires will not always be part of the adjustment system. See examples of adjustment codes, Exhibit 3.

Despite its limitations, the adjustment system is the best way to evaluate the performance of a tire in the field, as long as the information is not artificially manipulated or improperly handled.

One should not compare the number of adjustments to the total number of tires. Rather, one should consider the percentage of adjustments for any given category or categories to the total number of adjustments. For example, one would compare the total number of tread belt separations from the various categories which indicate tread belt separation to the total number of adjustments. If the number of tread belt separation related tires is very high compared to the other adjustable conditions, a tread belt separation problem exists.

## II. CLAIMS TIRES

In addition to adjusted tires, companies routinely obtain tires as a result of a claim system. If a tire failure, such as tread separation, causes property damage, that tire will not go into the adjustment system. Claims tires are routinely sent back to the manufacturer for analysis. The majority of claims tires are tread belt separations. The claims records can also be beneficial in evaluating the performance of tires in the field, especially when considered with adjustment records. It should be noted that most manufacturers inappropriately assert trade secret or proprietary protection for both adjustment records and claims records and invariably attempt to limit access to meaningful records by narrowing any information produced in litigation to one tire and one week of production. Since most plants have common skim stock and common problems, these are illogical limitations that prevent meaningful analysis of a tire's performance.



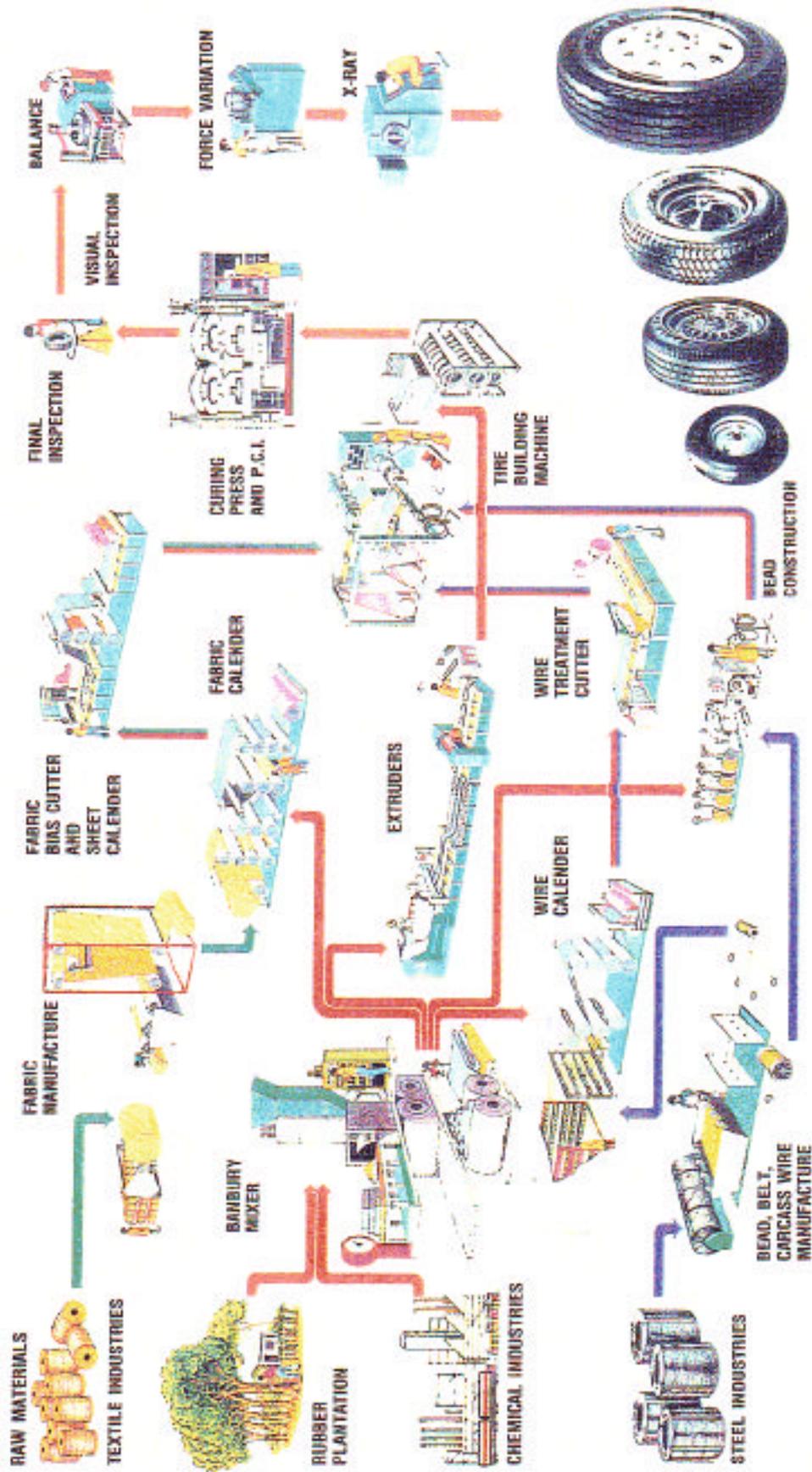


FIGURE 23 The tire manufacturing process.

## Eligible Adjustable Conditions

Tread or Sidewall

- 10 Tread chipped
- 11 Mold tears
- 12 Open tread splice
- 13 Out of round or balance  
(Never hit road)
- 14 Ride disturbance (has hit road)
- 15
- 16 Off register
- 17 Tread cracks in grooves
- 18 Weather checking - tread
- 19 Factory repair
- 20 Stock fold or flow crack - tread
- 21 Thin undertread or sidewall
- 22 Delaminated stock
- 23
- 24 High crown (must cut to determine)
- 25 Spot wear
- 26 Cut growth
- 27 Conicity (Pull)
- 28 Overwrap splice wear
- 29 Irregular wear - RMT

Separation

- 30 Between plies
- 31 Between belts
- 32 Tread separation
- 33 Between liner and plies
- 34 In sidewall
- 35 At wing and tread junction
- 36 Tread stock separation
- 37 Separation at ply turn-up
- 38 Separation between ply and belt
- 39 Separation at rim flange

Bead

- 40 Inside circum break within rim flange  
area (Fabric involved)
- 41 Outside circum break within rim flange
- 42 Split chafer
- 43 Outside circum break above rim flange  
(Fabric involved)
- 44 Cracking/Oxidation - at or below aligning  
rib (rubber only)
- 45 Kinked bead
- 46 Chafed bead
- 47
- 48
- 49 Buffed or thin bead  
(Over)

Carcass

- 60 Inside circum flex break at shoulder
- 61 Inside circum flex break above bead
- 62
- 63 Wide fabric splice
- 64 Loose cords; spread cords; exposed cords
- 65 Buckled in crown or sidewall
- 66 Flex at turn-up
- 67 Loose balance pad
- 68 Liner - cracked, splice, misc.
- 70 Perforation leaker - air loss
- 71
- 72
- 73 Foreign material cured inside
- 74
- 75 Distorted tread - Radial tires
- 76 Pick cord-wicking - (Stl. Belt radial)
- 77
- 78
- 79 Bag leak

Sidewall and Buttress

- 80 Open splice
- 81 Diagonal cracks
- 82 Radial cracks
- 83 Weather checking - sidewall (above  
aligning rib)
- 84
- 85 Stock fold or flow crack - sidewall
- 86
- 87
- 88 Foreign material cured in sidewall
- 89
- 90
- 91
- 92 White sidewall - excessive buffing  
discoloration, etc.
- 93 White sidewall punch through
- 94
- 95
- 96 Circum cracking - shoulder area
- 97 Veneer peeling
- 98 Cracking at stock junction
- 99 Miscellaneous

## Non-adjustable Conditions

- 100 Cut or snagged
- 101 Failure due to impact
- 102 Rim bruise
- 103 Star bruise (impact)
- 104 Unrepairable puncture
- 105 Failure due to puncture
- 106 Stone puncture
- 107 Properly repaired puncture
- 108 Repairable puncture
- 109 Failure - improper repair - plug only
- 110 Road hazard - Underinflation failure
- 111 Failure - improper repair - patch only
- 112 Stud penetration - field studded
- 113 Run flat (Print-out on invoice will be Underinflation failure)
- 114 Cut by obstruction on vehicle
- 115 Cut up by type of service (spinning, chains, off-road use)
- 116 Scuffed by curbing
- 117 Plug or Patch only (secondary code)
- 118 Failure in repaired area (dealer repair - must be proper)
- 119 Broken bead - mounting
- 120 Damaged bead - mounting or dismounting
- 121 Damaged by faulty rim
- 122 Damaged by lock ring
- 123 Damaged by tube valve
- 124 Damaged by tube fold
- 125 Malwear - Non rotation
- 126 Mechanical malwear (Alignment, camber, castor, bearings, etc.)
- 127 Worn by faulty brake
- 128 Underinflation wear
- 129 Overinflation wear
- 130 Malwear (induced by slow wearing operations, - i.e. river wear, shoulder step wear, chamfer wear, fast wear on both shoulders) RMT tires
- 131 Failure due to overload (includes bead deformation on RMT tires)
- 132 Stone drilling
- 133 Low pressure SW Fatigue
- 134 Worn out
- 135 Foreign material between tire + tube
- 136 Casing failure - beyond warranty
- 137 Not adj. For uniformity
- 138 Failure in cap (recap)
- 139 Item not of our manufacture
- 140 Adjustable condition not found
- 141 Rib/lug tearing
- 148 Road Test Warranty
- 149 Returned for lifetime warranty (even wear)
- 150 Returned for mileage warranty (even wear)
- 151 Returned for Unlimited Mileage/Time Warranty
- 500 Used Recall tire (primary code)

## ABBREVIATIONS

M = Tire is marked  
CFS = Cut for sep.  
N/M = Not marked  
N = Nail still in  
VMS = Vent marks showing  
Held = Held  
SEGM = Segmented Mold

(The print-out that appears on the invoice is underlined.)

UNIROYAL/GOODRICH ADJUSTMENT CONDITION CODES

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PAGE 1.

110	01	UNCODED CONDITION
120	01	POLICY: NO CONDITION SPECIFIED
121	01	WORN OUT
123	01	NON DEF. TRADE IN 6
161	01	SEPARATION IN RECAPPED TIRE
199	01	BROKEN BEAD WIRE
200	01	INELIGIBLE CLAIM
202	02	PENETRATION RUPTURE
203	02	CUT: TREAD
204	02	RUPTURE: UNSPECIFIED
205	02	CUT: BUTTRESS
206	02	CUT: SIDEWALL (INCLUDING BUFFING RIB)
207	02	RIM BRUISE
209	02	PUNCTURE: BUTTRESS
210	05	DISTORTED (IN STORAGE)
211	02	PUNCTURE: SIDEWALL (INCLUDING BUFFING RIB)
212	01	DAMAGED IN HANDLING
213	02	PUNCTURE: RUN UNDERINFLATED
214	02	PUNCTURE: TREAD, REPAIRABLE
215	03	TUBE TROUBLE (CAUSED TIRE ADJUSTMENT)
216	02	PUNCTURE: TREAD, NON-REPAIRABLE
218	03	FLAP TROUBLE (CAUSED TIRE ADJUSTMENT)
224	02	RUPTURE: TREAD
234	02	RUPTURE: BUTTRESS
244	02	RUPTURE: SIDEWALL
253	08	RADIAL CRACKING AT BRANDING
266	02	RUN FLAT
300	00	NEW GOODS
310	06	SIDEWALL INDENTATION, HEAVY FABRIC SPLICE
311	07	SHIFTED SHELL: DEFECTIVE MOLD
312	08	POOR FINISHING
313	05	DISCOLORED SIDEWALL
314	08	LOOSE-WRINKLED BALANCE DOUGH
315	07	FOREIGN SUBSTANCE IN BAND PLY OR LINER
319	07	NO SERIAL
330	07	KINKED BAG (CROWN)
331	07	OFF REGISTER: OPEN MOLD
341	07	BLEMISHED TREAD, DIRTY MOLD
342	07	FOREIGN SUBSTANCE IN TREAD
343	07	FOREIGN SUBSTANCE IN SIDEWALL
348	08	BLEMISHED-BUFFED SIDEWALL
352	07	MOLD TEARING
353	10	FOLDOVER
358	12	HUMP CHECKING OR CRACKING
361	16	TREAD BLOW
362	06	THIN LINER

364 07 DEFECTIVE BAG, GENERAL  
365 07 LEAKY BAG  
366 06 DEPRESSED SKIMCOAT: LINER MISSING  
368 06 LOOSE TUCK  
375 06 LINER CRACKS OR OPENINGS  
376 06 EXPOSED CORDS IN TOE STRIP, BAND PLY, OR LINER

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PAGE 2.

377 06 PLY MISSING  
378 08 BUFFED OR REPAIRED BEAD  
379 06 BAKED LINER STOCK  
380 06 EXPOSED FABRIC (TREAD)  
381 06 EXPOSED CORDS IN SIDEWALL  
384 06 SPREAD CORDS OR GAPPED FABRIC SPLICE  
385 06 DEFECTIVE BAND PLY OR LINER SPLICE  
386 07 BROKEN FABRIC AT BAG VENT  
388 06 WIDE BEAD  
398 06 NARROW BEAD  
399 07 KINKED BEAD  
404 16 BREAKER BREADKS (RADIAL PLY)  
410 07 NOT POST INFLATED  
411 09 OFF BALANCE  
412 09 RADIAL RUNOUT  
413 06 WHITE IN BLACK  
414 07 ROUGH BAND PLY  
415 07 DAMAGED AT SERIAL  
416 09 LATERAL RUNOUT  
420 09 CONICITY/LATERAL PULL  
421 06 INSUFFICIENT UNDERTREAD  
423 06 BLACK IN WHITE SIDEWALL  
430 09 THUMP  
434 09 HEAVY FABRIC OR TREAD SPLICE  
441 08 TREAD REPAIR FAILURE  
443 06 LOOSE COVERSTRIP  
450 11 STORAGE CHECKING  
451 06 OPEN SPLICE: TREAD  
452 10 CIRCUMFERENTIAL OPENING IN SIDEWALL  
454 06 OPEN SPLICE: BLACK  
455 06 OPEN SPLICE: WHITE  
456 06 OPEN SPLICE: COVERSTRIP  
459 15 DETRITUS, COVERSTRIP CHAFING  
460 03 TREAD SPONGING  
463 06 SIDEWALL BLISTER  
467 07 UNDERCURE  
468 10 LOOSE TREAD EDGE: TOE STRIP SEPARATION (HEAVY SERVICE)  
475 06 ADJACENT PLIES SAME DIRECTION

476 08 LINER REPAIR FAILURE  
478 06 LEAKER  
479 06 LEAKER (RUNOUT TUBE FURNISHED)  
485 03 INDIVIDUAL CORD SEPARATION  
486 06 CROSSED CORDS  
488 06 WRINKLED CHAFER  
489 06 MISPLACED CHAFER  
498 06 LOFTED BEAD WIRE  
510 03 SKID-TRACTION (HEAVY SERVICE)  
511 04 STONE RETENTION  
512 04 NOISE  
513 09 LATERAL FORCE VARIATION (EXCESSIVE SIDE THRUST - RAD PL  
514 09 HI SPEED VIBRATION/ROUGHNESS  
515 03 TIRE RADIO STATIC-SHOCK

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PAGE 3.

516 09 UNDER SIZE  
517 09 OVER SIZE  
521 14 RAPID WEAR  
524 06 SRT PUSH-BACK  
525 16 PROTRUCING BRKR WIRE - INWARD OR OUTWARD  
527 04 SCUFFED COVERSTRIP  
530 14 IRREGULAR WEAR: GENERAL  
531 14 ROW WEAR (INNER)  
532 14 SHOULDER WEAR --  
533 14 FLAT SPOT, TREAD  
638 14 TREAD FLAKING  
639 14 RAPID WEAR INDUCED BY TREAD FLAKING  
640 13 TORN SEGMENT: PERFORATION: INSERT SEPARATION  
641 13 CHIPPING OR CHUNKING OUT  
642 13 TORN SHOULDER, BRIDGE, GROOVE; UNDERCUT GROOVE  
CRACKING  
651 13 GROOVE CRACKING  
652 10 BUTTRESS SPLIT  
653 12 TORQUE CRACK IN SIDEWALL (RADIAL PLY)  
654 11 SIDEWALL CHECKING: BLACK  
655 11 SIDEWALL CHECKING: WHITE  
656 12 RADIAL CRACKING: BUTTRESS  
658 12 RADIAL CRACKING: SIDEWALL  
659 12 RADIAL CRACKING: WHITE  
751 16 BELT SEPARATION  
752 16 DISTORTED TREAD  
759 16 CAP/BASE TREAD SEPARATION (HEAVY SERVICE)  
760 13 LAMINATION SEPARATION (FOLD IN TREAD)  
761 16 TREAD SEPARATION  
763 16 SIDECOVER SEPARATION  
764 16 LINER SEPARATION

765	16	PLY SEPARATION
767	17	SEPARATION IN PLYLOCK
768	17	SEPARATION AT BEAD
775	03	SPOT BREAK
776	03	CHAFED BAND PLY
881	11	DITCH CHECKING OR CRACKING
883	06	RADIAL FABRIC SPLIT
885	18	BUCKLED SIDEWALL (TRACTOR AND RADIAL PLY)
886	18	BROKEN FABRIC
887	19	BREAK ABOVE BEAD
986	19	FATIGUED CHAFER (RADIAL PLY)
989	15	CHAFED BEAD
998	06	WIRE CUT
999	06	PROTRUDING BEAD WIRE

## POLICY

110 01 UNCODED CONDITION  
120 01 POLICY: NO CONDITION SPECIFIED  
121 01 WORN OUT  
123 01 NON DEF. TRADE-IN  
161 01 SEPARATION IN RECAPPED TIRE  
199 01 BROKEN BEAD WIRE  
200 01 INELIGIBLE CLAIM  
212 01 DAMAGED IN HANDLING

## HAZARD

202 02 PENETRATION RUPTURE  
203 02 CUT: TREAD  
204 02 RUPTURE: UNSPECIFIED  
205 02 CUT: BUTTRESS  
206 02 CUT: SIDEWALL (INCLUDING BUFFING RIB)  
207 02 RIM BRUISE  
209 02 PUNCTURE: BUTTRESS  
211 02 PUNCTURE: SIDEWALL (INCLUDING BUFFING RIB)  
213 02 PUNCTURE: RUN UNDERINFLATED  
214 02 PUNCTURE: TREAD, REPAIRABLE  
216 02 PUNCTURE: TREAD, NON-REPAIRABLE  
224 02 RUPTURE: TREAD  
234 02 RUPTURE: BUTTRESS  
244 02 RUPTURE: SIDEWALL  
266 02 RUN FLAT

## OPERATING

215 03 TUBE TROUBLE (CAUSED TIRE ADJUSTMENT)  
218 03 FLAP TROUBLE (CAUSED TIRE ADJUSTMENT)  
460 03 TREAD SPONGING  
485 03 INDIVIDUAL CORD SEPARATION  
510 03 SKID-TRACTION (HEAVY SERVICE)  
515 03 TIRE RADIO STATIC-SHOCK  
775 03 SPOT BREAK  
776 03 CHAFED BAND PLY

## DESIGN

511 04 STONE RETENTION  
512 04 NOISE  
527 04 SCUFFED COVERSTRIP

## DISCOLORED SIDEWALL

210 05 DISTORTED (IN STORAGE)

313 05 DISCOLORED SIDEWALL

## BUILDING

310	06	SIDEWALL INDENTATION, HEAVY FABRIC SPLICE
362	06	THIN LINER
366	06	DEPRESSED SKIMCOAT: LINER MISSING
368	06	LOOSE TUCK
375	06	LINER CRACKS OR OPENINGS
376	06	EXPOSED CORDS IN TOE STRIP, BAND PLY, OR LINER
377	06	PLY MISSING
379	06	BAKED LINER STOCK
380	06	EXPOSED FABRIC (TREAD)
381	06	EXPOSED CORDS IN SIDEWALL
384	06	SPREAD CORDS OR GAPPED FABRIC SPLICE
385	06	DEFECTIVE BAND PLY OR LINER SPLICE
388	06	WIDE BEAD
398	06	NARROW BEAD
413	06	WHITE IN BLACK
421	06	INSUFFICIENT UNDERTREAD
423	06	BLACK IN WHITE SIDEWALL
443	06	LOOSE COVERSTRIP
451	06	OPEN SPLICE: TREAD
454	06	OPEN SPLICE: BLACK
455	06	OPEN SPLICE: WHITE
456	06	OPEN SPLICE: COVERSTRIP
463	06	SIDEWALL BLISTER 00
475	06	ADJACENT PLYS SAME DIRECTION
478	06	LEAKER
479	06	LEAKER (RUNOUT TUBE FURNISHED)
486	06	CROSSED CORDS
488	06	WRINKLED CHAFER
489	06	MISPLACED CHAFER
498	06	LOFTED BEAD WIRE
524	06	SRT PUSH-BACK
883	06	RADIAL FABRIC SPLIT
998	06	WIRE CUT
999	06	PROTRUDING BEAD WIRE

## CURING

311 07 SHIFTED SHELL: DEFECTIVE MOLD  
315 07 FOREIGN SUBSTANCE IN BAND PLY OR LINER  
319 07 NO SERIAL  
330 07 KINKED BAG (CROWN)  
331 07 OFF REGISTER: OPEN MOLD  
341 07 BLEMISED TREAD, DIRTY MOLD  
342 07 FOREIGN SUBSTANCE IN TREAD  
343 07 FOREIGN SUBSTANCE IN SIDEWALL  
352 07 MOLD TEARING  
364 07 DEFECTIVE BAG, GENERAL  
365 07 LEAKY BAG  
386 07 BROKEN FABRIC AT BAG VENT  
399 07 KINKED BEAD  
410 07 NOT POST INFLATED  
414 07 ROUGH BANK PLY  
415 07 DAMAGED AT SERIAL  
467 07 UNDERCURE

## FINISHING &amp; REPAIR

253 08 RADIAL CRACKING AT BRANDING  
312 08 POOR FINISHING  
314 08 LOOSE-WRINKLED BALANCE DOUGH  
348 08 BLEMISHED-BUFFED SIDEWALL  
378 08 BUFFED OR REPAIRED BEAD  
441 08 TREAD REPAIR FAILURE  
476 08 LINER REPAIR FAILURE

## NON-UNIFORMITY

411 09 OFF BALANCE  
412 09 RADIAL RUNOUT  
416 09 LATERAL RUNOUT  
420 09 CONICITY/LATERAL PULL  
430 09 THUMP  
434 09 HEAVY FABRIC OR TREAD SPLICE  
513 09 LATERAL FORCE VARIATION (EXCESSIVE SIDE THRUST - RAD PL  
514 09 HI SPEED VIBRATION/ROUGHNESS  
516 09 UNDER SIZE  
517 09 OVER SIZE

## CIRC. OPENING

353 10 FOLDOVER  
452 10 CIRCUMFERENTIAL OPENING IN SIDEWALL  
468 10 LOOSE TREAD EDGE: TOE STRIP SEAPRATION (HEAVY SERVICE)

652 10 BUTTRESS SPLIT

SW CHECKING

450 11 STORAGE CHECKING  
654 11 SIDEWALL CHECKING: BLACK  
655 11 SIDEWALL CHECKING: WHITE  
881 11 DITCH CHECKING OR CRACKING

## SW CRACKING

358 12 HUMP CHECKING OR CRACKING  
 653 12 TORQUE CRACK IN SIDEWALL (RADIAL PLY)  
 656 12 RADIAL CRACKING: BUTTRESS  
 658 12 RADIAL CRACKING: SIDEWALL  
 659 12 RADIAL CRACKING: WHITE

## TREAD TEARING &amp; CRACKING

640 13 TORN SEGMENT: PERFORATION: INSERT SEPARATION  
 641 13 CHIPPING OR CHUNKING OUT  
 642 13 TORN SHOULDER, BRIDGE, GROOVE: UNDERCUT GROOVE  
 CRACKING  
 651 13 GROOVE CRACKING  
 760 13 LAMINATION SEPARATION (FOLD IN TREAD)

## WEAR

521 14 RAPID WEAR  
 530 14 IRREGULAR WEAR: GENERAL  
 531 14 ROW WEAR (INNER)  
 532 14 SHOULDER WEAR  
 533 14 FLAT SPOT, TREAD  
 638 14 TREAD FLAKING  
 639 14 RAPID WEAR INDUCED BY TREAD FLAKING

## CHAFING

459 15 DETRITUS, COVERSTRIP CHAFING  
 989 15 CHAFED BEAD

## SEPARATIONS, UPPER

361 16 TREAD BLOW  
 404 16 BREAKER BREAKS (RADIAL PLY)  
 525 16 PROTRUDING BRKR WIRE - INWARD OR OUTWARD  
 751 16 BELT SEPARATION  
 752 16 DISTORTED TREAD  
 759 16 CAP/BASE TREAD SEPARATION (HEAVY SERVICE)  
 761 16 TREAD SEPARATION  
 763 16 SIDECOVER SEPARATION  
 764 16 LINER SEPARATION  
 765 16 PLY SEPARATION

## SEPARATIONS, LOWER

767 17 SEPARATION IN PLYLOCK  
 768 17 SEPARATION AT BEAD

FABRIC FAILURE, UPPER

885 18 BUCKLED SIDEWALL (TRACTOR AND RADIAL PLY)

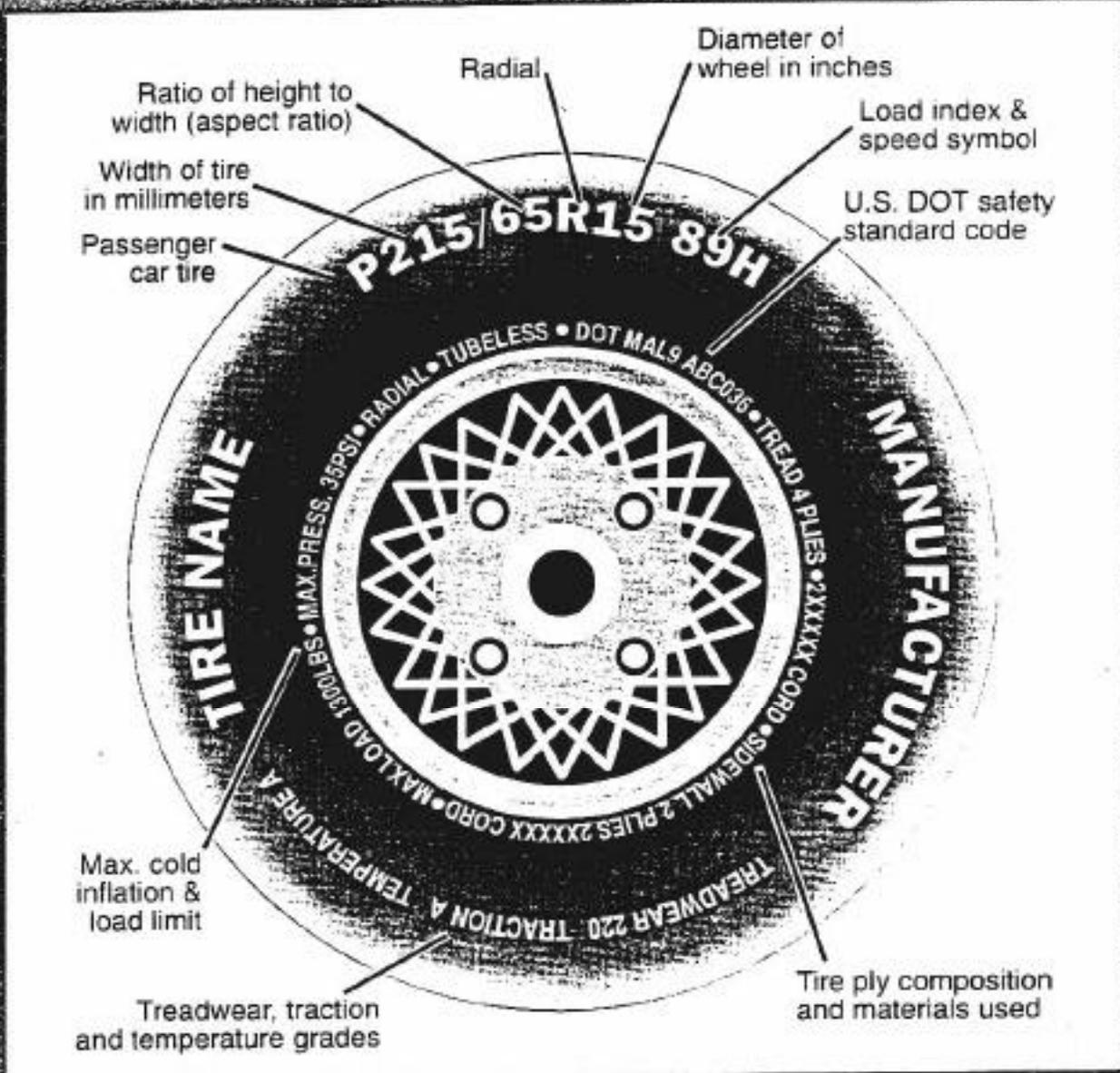
886 18 BROKEN FABRIC

FABRIC FAILURE, LOWER

887 19 BREAK ABOVE BEAD

986 19 FATIGUED CHAFER (RADIAL PLY)

# Know the writing on the wall



## DOT serial number system

DEPT. OF TRANSPORTATION      TIRE SIZE CODE No.      DATE OF MFG.

**DOT MA L9 ABCD 036**

MFR. & PLANT CODE No.

GROUP OF OPT. SYMBOLS WITH THE MFR.

**DOT MA L9 ABCD 0301**