Tire Manufacturing Processes

For more information about tire defects, blowouts and tread separations contact the law offices of Kaster & Lynch, P.A. at (352) 622-1600.

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STEEL BELTED RADIAL PASSENGER AND LIGHT TRUCK TIRES

Most steel belted radial passenger and light truck tires are composed of an inner liner, two polyester reinforced body plies, two steel beads, two bead reinforcing strips, two anti-chafing strips, two steel belts, with belt edge wedges or wrap around gum strips, the sidewalls, and the tread. Many tires also include one or two layers of nylon or polyester constricting belts or strips over the steel belts (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 during normal use and is also the area of weakest potential adhesion because of the difficulty of bonding rubber to metal and the mechanical stress at the belt edges. The adhesion can be adversely affected by various manufacturing practices including, but not limited to, under-curing, contamination, and improper storage and handling of tire 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 perspiration, 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 in the “Banbury Mixer” 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 mechanically 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. The slabs of rubber produced are used to calender the body plies, chafers, cap plies or edge strips, steel belts, and all other fabric components used in the tire. Some manufacturers also use a steelastic machine to produce their fabric components. Slab stock is used for extruded components such as the sidewalls, treads, wedges and other solid rubber profiled components.

II. CALENDERING

In the calendering process fabric cords and steel cords are coated with rubber stock. The rubber should be pressed between the individual twisted cord filaments which make up the steel belts. 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 for the steel belts are coated with a very thin layer of brass. These brass coated, rubber encased steel cords (multi-strand cables) become 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 strongest possible 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. This is accomplished by a combination of gauge and halobutyl content. Inner liners are calendered into thin sheets of specified thicknesses and then cut to appropriate widths for use in tire construction. One indication of inner liners that are excessively thin is cord shadowing where the cords of the body plies show through the inner liner. Localized thinning can also be caused by perforations in the body plies which allow inner liner rubber to flow into the body plies of the tire resulting in localized thinning.

V. BEADS

Bead wire configurations fall into four primary categories: .037 weftless, .050 weftless, .050 single strand, and cable beads. Like belt wire, bead wire 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 with brass or bronze 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. Typically, cement is applied to the underside of the tread where it contacts the steel belts or cap plies. This is commonly referred to as tread cement. It is then cut into the appropriate length for tire building. Cement is typically applied to both ends of the tread piece to obtain maximum adhesion.

VII. TIRE BUILDING

It is important to note that most tire companies now operate on 12 hour shifts with tire builders bonuses based on the number of tires they produce over a set minimum requirement. Most steel belted radial tires are assembled by hand. The first stage builder constructs the tire on a cylindrical rotating drum. 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. During second stage tire building, the steel belts and tread are applied as well as wedges or belt edge gum strips. If a cap ply is utilized, it would be placed on during second stage as well. The tire components, known as "green tire" components, are held together mechanically by their tack or stickiness. Prior to assembly 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 "sulfur 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 which is supposed to remove the sulfur, but sometimes merely masks it, and 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 unless the solvent is completely dry when the components are assembled.

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 "green tire" 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 smaller 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 liner 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 can be 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 readily seen. Some manufacturers have 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 during service on the highway is tread belt detachment, commonly referred to as tread 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 usually 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 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 just compare the number of adjustments to the total number of tires produced. 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 serious 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 vast 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 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 components such as skim stock, inner liners, AO package, belt edge treatment and steel cords. They also experience common manufacturing problems since the tires are built on the same machines by the same people. Accordingly, discovery limitations are illogical and merely prevent meaningful analysis of a tire's performance.

ADJUSTMENT DATA ANALYSIS

To understand the pitfalls in adjustment data analysis and the tactics used by tire companies to skew the records to their advantage one must first understand how the data is flawed, then, how it can still be of substantial benefit.

Adjustment data is flawed in several ways. First, not all tires sold by the manufacturer are returned into the adjustment system. While this has been admitted in sworn testimony, it is also basic common sense. Not everyone who purchases a tire returns it to the dealer for an adjustment, either because they are so dissatisfied with the product that they do not want another one, which is the only recourse in adjustment – a replacement with the same product; or, the tire is worn to the extent that there is little or no adjustment value left. Accordingly, most tires that experience tread separations are not returned for adjustments.

In consideration of the foregoing, the only real way to use adjustment records is to compare the total number of adjusted tires to the number of tires under separation adjustment codes, both direct tread separation codes and indicia of tread separation codes. What the tire companies typically do in litigation is to compare just one tire size and one category of tread separations to the total number of tires produced, which is a meaningless number since not all tires that fail are returned in the system and not all tires that have tread separations are even recognized. It is blatantly misleading to compare only the number of tread separation adjusted tires to the number of manufactured tires and even more misleading to relate just one or two categories of adjustments for separation to the total number of tires produced. It is meaningful to take all of the indicia of tread belt separation and compare that number to the total number of tires returned for adjustments. One must understand, of course, that even this number is skewed in favor of the manufacturer because of the tires that are not placed into the system as explained above.

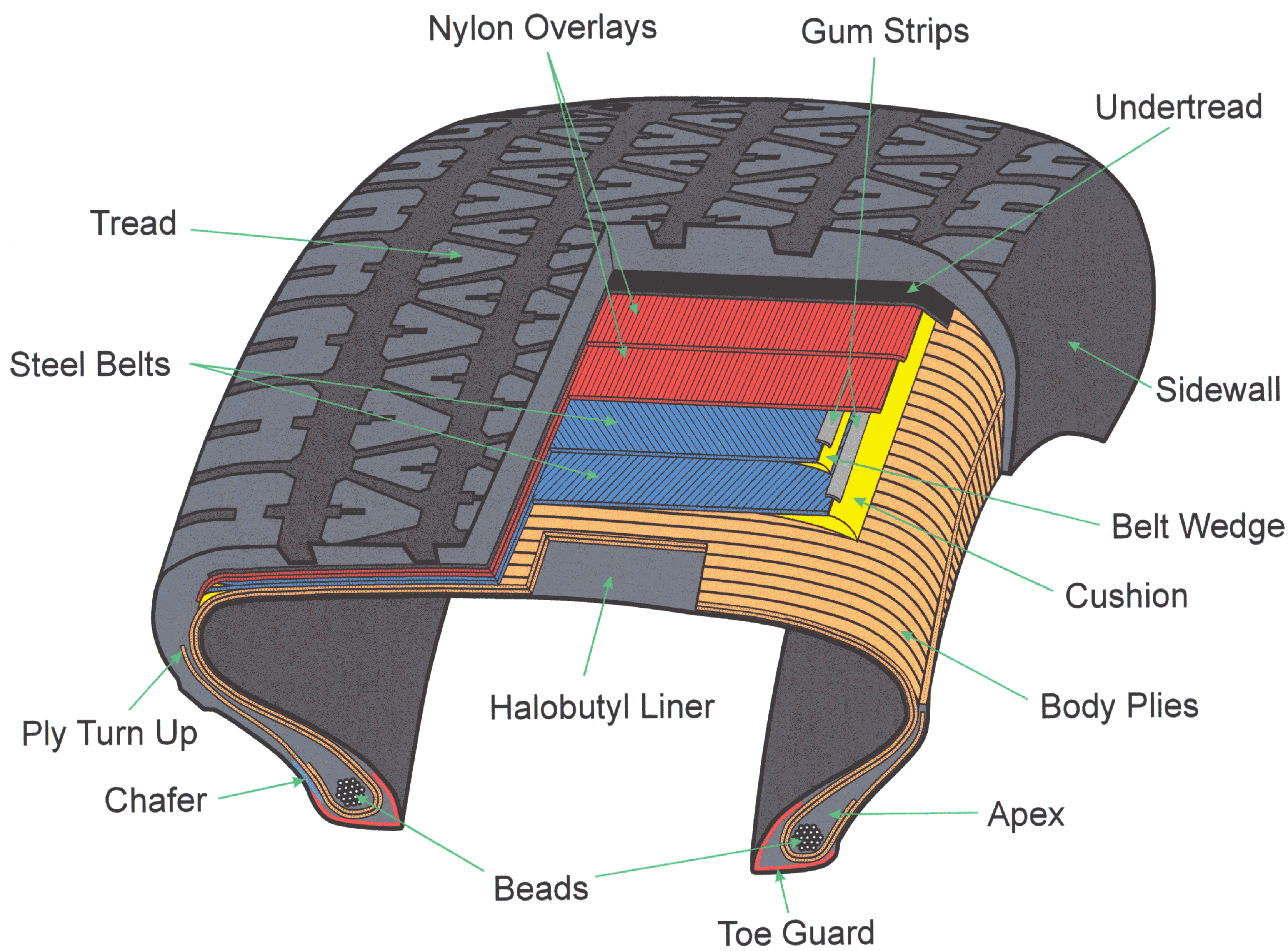
Another important flaw which skews the system is that not all tread separations are reported and the ones that are reported are not always accurately reported. For example, in tire company records we have reviewed, we learned of examples of tread separations that were never placed into the system for a variety of reasons, including lack of appropriate and adequate information from the dealers and desires to credit dealers before the tires were analyzed. Another flaw is that tires that are returned by the dealers under the separation category are often changed to non-adjustable conditions by adjustment center technicians under codes such as “impact damage puncture” so that ,even though there are separations, the inspectors, who are not supposed to be tire failure analysts, are making tire failure analyst decisions and attributing the failures to things other than manufacturing or design defects and taking them out of the system as non-adjustable conditions. This leads us to the question of which condition codes need to be reviewed in order to determine how many tread separations have occurred among the tires that are returned.

The most common category in returned tires is probably “ride disturbance”, which is a strong indication of pending tread separation. Another category high on the list is “spot wear” or “localized accelerated wear” which is often, if not always, an indication of underlying tread separation. Other categories which indicate tread separation are tread crack grooving and, of course, all of the separation codes. There are several other codes that should be examined in order to determine the extent of tread separations as well as the non-adjustable condition codes for tread separation as a result of impact, puncture, etc., which must be included in evaluation of tread separations.

Notwithstanding the inherent flaws in the system, it is an important tool in evaluating the failure of tires in service. This data is routinely analyzed and relied upon by the tire companies and distributed to company managers to evaluate tire performance.

TREAD SEPARATION CODES AND INDICIA OF TREAD SEPARATION INCLUDE:
(Firestone Adjustment Codes)

107 - Tread delamination
117 - Spot wear
129 - Belt distortion (due to penetration)
135 - Tread leaving carcass
136 - Belt leaving belt
138 - Casing leaving casing
139 - Tread leaving belt
145 - Belt distort
153 - Separation not identified
230 - Shoulder separation between rubber and casing
233 - Casing leaving casing (ply separation)
234 - Belt edge separation with evidence of cuts
235 - Belt edge separation no evidence of cuts
330 - Sidewall separation rubber from casing
709 - Harsh ride



Nylon Overlays
Gum Strips
Undertread
Tread
Steel Belts
Sidewall
Belt Wedge
Cushion
Body Plies
Halobutyl Liner
Ply Turn Up
Chafer
Apex
Beads
Toe Guard

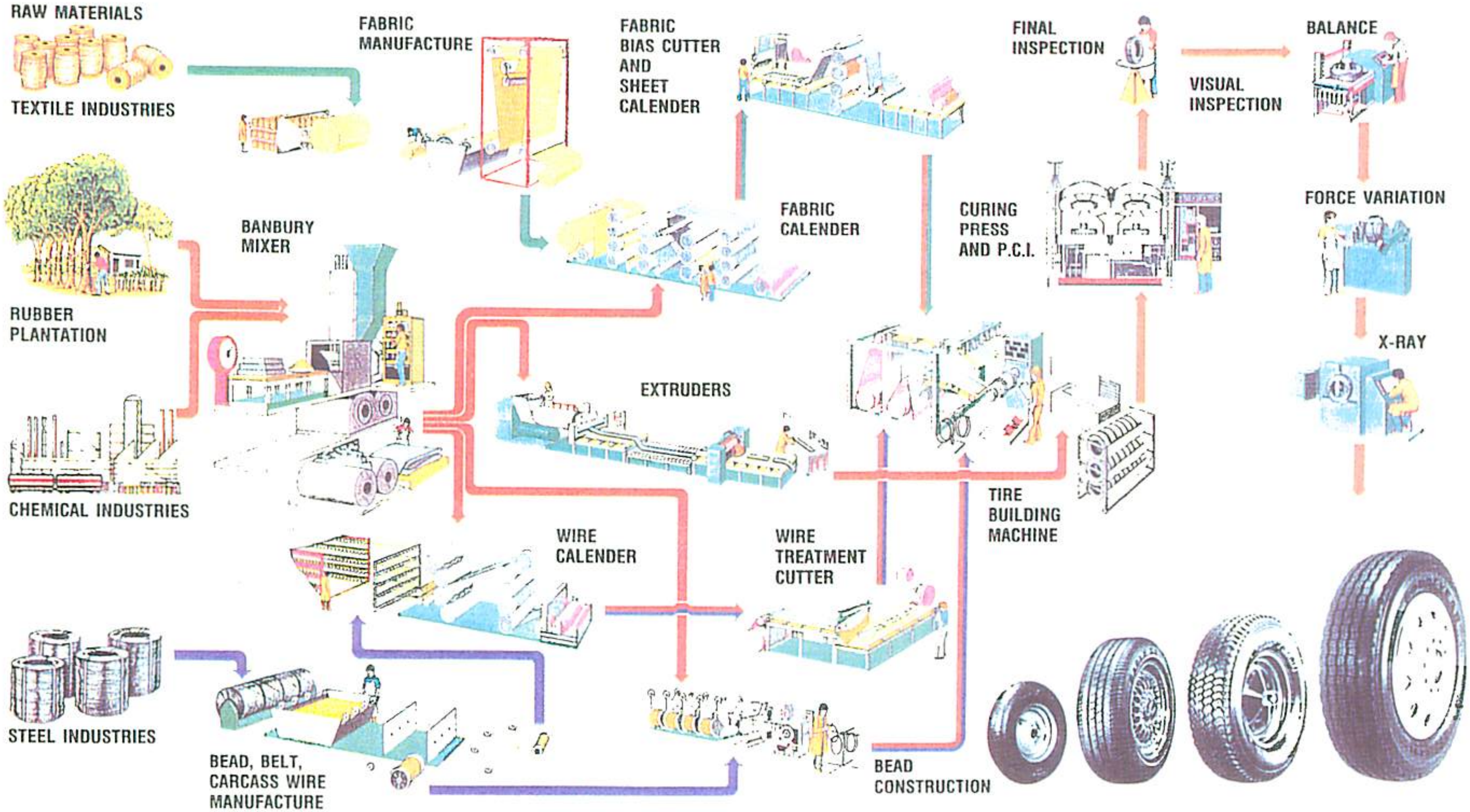


FIGURE 23 The tire manufacturing process.

EXHIBIT 2

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

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

(Over)

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

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
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

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

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 PLIES 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 & 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 & 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

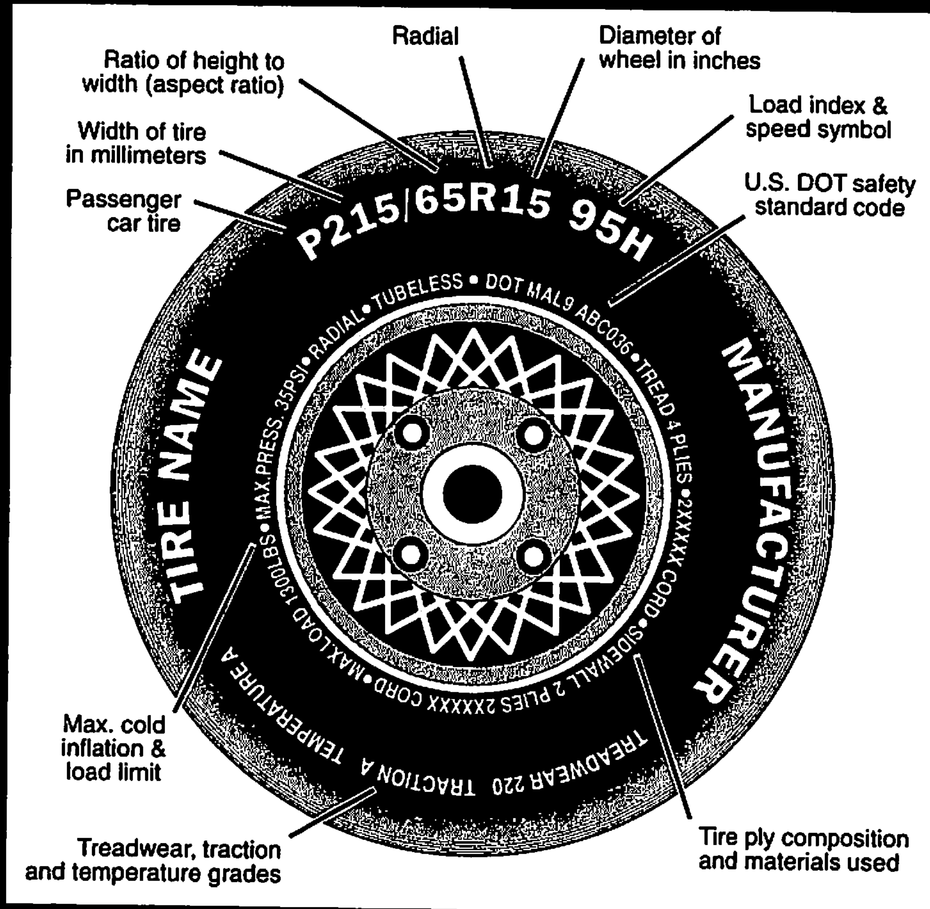
FABRIC FAILURE, UPPER

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 MFR.

DOT MA L9 ABCD 036

MFR. & PLANT CODE NO. — GROUP OF OPT. SYMBOLS WITH THE MFR.

DOT MA L9 ABCD 0301

*NEW CODE AS OF 2000