3.0.0 TYRES.

Tyres are designed to support the load of the vehicle, to retain air and to be the only contact with the road surface. Overall tyre design is extremely complex as it represents a balanced compromise among different performance factors. If one of these factors is changed, all the others change as well. Performance gained in one area is mostly lost in another one. For example, if rolling resistance and tread wear are decreased, traction will adversely affected as side effect.

Although rubber is the main material used for make a tyre there is a long list of other materials used as well.

An example of out of what composites a passenger car tyre can be made of:

- 14% natural rubber (rubber tree);
- 27% synthetic rubber (crude oil);
- 28% carbon black (crude oil);
- 10% processing oils;
- 4% organic fabric;
- 10% steel wire.

3.1.0 TYRE TYPES.

3.1.1 ALL SEASON PERFORMANCE.

These tyres meet the need of high performance in almost all weather conditions.

3.1.2 PERFORMANCE.

Designed to give a great steering response and to provide more grip they have the disadvantage of wearing down faster and a harsher ride.

3.1.3 ALL SEASON.

These are the most common tyres on the market nowadays. They are designed to handle all weather conditions and they provide a good amount of ride comfort.

3.1.4 WINTER.

Especially designed to stay pliable in the cold and give a better grip on snowy/icy surfaces. They will wear down faster on dry surfaces.

3.2.0 TYRE STRUCTURE.

3.2.1 BIAS (DIAGONAL) TYRE D.

A pneumatic tyre in which the ply cords extend to the beads and are laid at alternate angles, generally at 27 degrees to 45 degrees to each other.

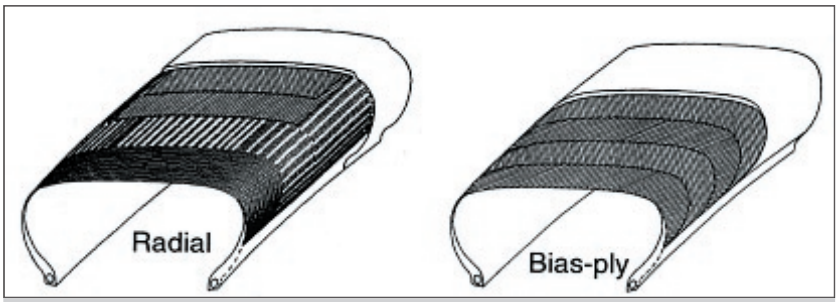
This bead –to-bead lying of opposed angle plies is having the tendency to flex during tire rolling, creating increased rolling resistance, heat and friction. This flex is also responsible for a limited “handling”.

3.2.2 BIAS BELTED TYRE B.

A pneumatic structure of bias ply (diagonal) type in which the carcass is restricted by a belt comprising two or more layers of substantially inextensible cord material laid at alternate angles close to those of the carcass. These belts are placed along the circumference of the tyre’s carcass.

3.2.3 RADIAL PLY TYRE R.

A pneumatic tyre in which the ply cords extend to the beads and are laid substantially at 90° to the centre-line of the tread, the carcass being stabilised by an essentially inextensible circumferential belt. The sidewalls are able to flex more easily as the body plies are oriented at a right angle to the tyre centreline. This type of construction dramatically reduces the friction between body plies resulting in less heat generation.



Pict. 15:

3.3.0 TREAD DESIGN TYPES.

The design of a tread has to take into consideration the following objectives:

- a tread noise factor as low as possible; good comfort level;
- water evacuation performance in wet weather conditions;
- optimum adhesion in dry conditions;
- good steering response;
- good braking performance.

Depending upon the final segment destination, one of these factors will dominate the others.

Pict. 16:

3.3.1 SYMMETRIC (pict. 16).

Consistent across the tyre's face. Both halves of the tread face are the same design.

3.3.2 ASYMMETRIC (pict. 17).

Pict. 17:

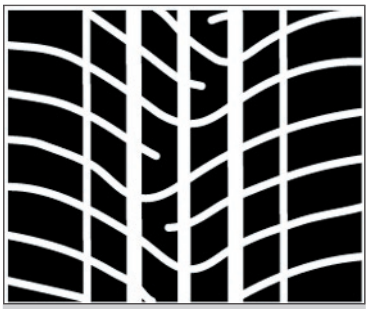
The tread pattern changes across the face of the tire. Usually incorporates larger tread blocks on the outer portion for increased stability cornering. The smaller inner blocks and the grooves aid in dissipating water. Most asymmetric treaded tyres are also unidirectional.

3.3.3 UNIDIRECTIONAL (pict 18).

Pict. 18:

Designed to rotate in only one direction, unidirectional tires enhance straight-line acceleration by reducing rolling resistance. They also provide shorter stopping distance. Unidirectional tires must be dedicated to a specific side of the vehicle. Care must be taken when rotating unidirectional tires to ensure that the repositioned tire rotates in the correct direction.

3.3.4 TREAD ELEMENTS.



Pict. 19:

Grooves: serve to eliminate water from the tread at the contact patch. There are longitudinal or circumferential grooves and lateral grooves. The larger the grooves the more water can be evacuated. Smaller grooves serve to a more precise manipulation of traction, tread noise and water dissipation.

Sipes: are thin grooves on the tread blocks to improve traction in snow and to aid water evacuation. These narrow slits allow the tread blocks to squeeze closed and spread open during road surface contact.

Shoulder: The shoulder is the part of the tread that makes the transition with the sidewall. The shoulder determines the overall handling and grip during cornering.

Blocks: Tread blocks are the raised elements of the tread that contact the road surface. They provide the traction. Their shape and size are determined by a huge number of design factors.

Contact patch: is the area of the tyre coming in contact with the road surface. The bigger the patch, the more grip is provided. Contact patches of tyres with an aspect ratio of 60 and higher are longer than they are wide. They provide a superior traction on

snow-covered surfaces and a smoother ride. On high performance tyres with an aspect ratio of 55 and lower, the patch is wider than it is long. A variety of elements determine further the contact patch as inflation pressure, wheel alignment angles, actual driving speed, presence of water, etc.

Void ratio: is the ratio between the area that is occupied by grooves and the area taken up by the blocks (or the area that comes in contact with the road surface). A rain tyre will have a higher “void ratio” than a dry high performance tyre.

Dimples: Indentations in the tread that are designed to provide cooling relief, in an otherwise uninterrupted tread block or rib.

Ribs: a row of tread blocks that creates a contact band along the circumference of the tread.

3.3.5 TREAD DEPTH.

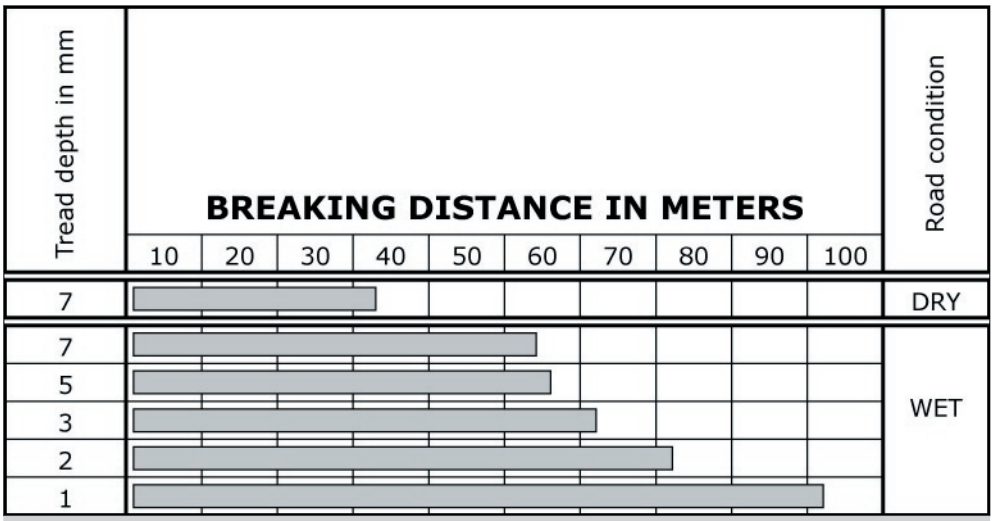
Security is given by sufficient tread depth in wet, mud and snow conditions.

The danger of “aquaplaning” is the result of consumed treads.

It is recommended to change summer tyres at a **“Rest tread depth”** of 2 millimetres, and in the case of large high performance tyres, 3 millimetres.

Winter tyres loose already efficiency at 4 millimetres of tread depth rest.

Also the braking distance is affected by the available tread design.



Pict. 20:

3.4.0 FUNDAMENTALS.

3.4.1 BASIC TERMS AND DEFINITIONS.

Learning about tyres begins with some terms and definitions that are commonly used in all aspects of the tyre industry. Knowing and understanding these terms is fundamental for learning about tyre sizing systems, sidewall nomenclature, and all the factors that affect

tyre performance and handling.

The illustration below features many of the important basic terms that you must become familiar with.

$$\text{Aspect Ratio} = \frac{\text{Section Height} \times 100}{\text{Section Width}}$$

ASPECT RATIO.

A tyre's aspect ratio is the dimensional relationship of the tyre's section height to section width, expressed as a percentage. The lower the aspect ratio, the shorter the sidewall and, in most cases, the quicker the steering response. But also any road imperfections are more readily transmitted from the tread to the steering wheel.

$$\text{Deflection} = \text{Free Radius} - \text{Loaded Radius}$$

DEFLECTION.

FREE RADIUS.

The radius of the tyre/wheel assembly that is not deflected under load.

LOADED RADIUS (STATIC LOADED RADIUS).

Distance from wheel axle centreline to supporting surface at a given load and stated inflation pressure.

LOADED SECTION HEIGHT.

Distance from rim seat to the outer tread surface of a loaded tyre **AND/OR** the loaded radius minus half of the nominal rim diameter.

NOMINAL RIM DIAMETER.

Diameter of rim seat supporting the tyre bead (example: 13", 15" and 16.5").

OVERALL DIAMETER.

The diameter of the inflated tyre without any load.

OVERALL WIDTH.

Maximum width in cross-section of unloaded tyre including protruding side ribs, decorations and RPB's (Rim Protector Bars).

RIM WIDTH.

Linear distance between rim flanges in contact with the tyre.

ROLLING CIRCUMFERENCE.

The linear distance travelled by a tyre in one revolution (its circumference). This can vary with load and inflation.

SECTION HEIGHT.

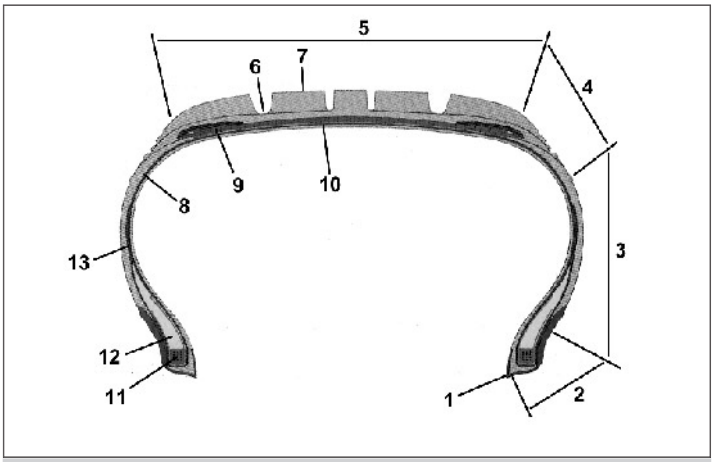
Distance from rim seat to outer tread surface of an unloaded tyre.

SECTION WIDTH.

Linear distance between outside of sidewalls of inflated tyre without any load (exclusive of protruding side ribs, decorations and RPB). Ends with a **"5"** or a **"0".**

TREAD WIDTH.

The portion of the tread design which comes in contact with the road.

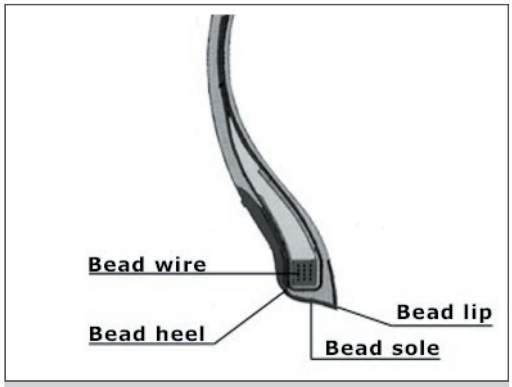


Pict. 21:

1	*Bead lip*	**8**	*Inner liner*
2	*Bead assembly*	**9**	*Cap plies*
3	*Side wall*	**10**	*Belts*
4	*Shoulder*	**11**	*Bead bundle*
5	*Tread*	**12**	*Bead filler*
6	*Groove*	**13**	*Carcass*
7	*Block*		

The bead needs to have a:

- minimum pressure:
  - to keep the air inside;
  - to keep the beads on their seat;
  - to avoid slipping during acceleration and braking.
- Max pressure which should be exceeded to avoid damage during mounting and to secure an uniform seating on the rim.



Pict. 22:

3.4.2 TYRE SIZING SYSTEMS.

3.4.2.a Reading a sidewall.

The sidewall of a tyre is, in effect, an owner's manual. It contains information needed for your safety and that of the customer. The designations and classifications that appear on it identify everything from common dimensions to standard test identification numbers.

Being able to read sidewall mouldings will help you better understand the performance

standards of tyres. It will also provide you with a guide when mounting and servicing tyres.

A bias (diagonal) tyre is marked as follows: **example... 7.00 - 14**

A bias belted tyre is marked **4.10 B 18**, and radial tyre **10.00 R 20**

3.4.2.b Passenger tyre sizing.

Six sizing systems exist for passenger tyres today:

- P-metric;
- European metric;
- Millimetric;
- Alpha-numeric;
- ISO metric;
- Numeric.

Each of these systems evolved from the first tyre sizing system - the Numeric sizing system -, which is now obsolete. It was developed when all tyres had the same aspect ratio, and it provided only the nominal cross section width of the tyre and the rim diameter in inches.

When converting between inches and millimetres use the following data:

1 inch = 25.4 millimetres

inches x 25.4 = millimetres

millimetres / 25.4 = inches

Here are examples that identify the sizing systems that are seen today:

P-metric.

Today, most U.S. tyre manufacturers build tyres that conform to this system. It evolved in the late 1970's in an attempt to standardise tyre sizing worldwide and is based on the metric system.

P215/65 SR 15, P215/65 R 15, P215/65 R 15 95S	
P	*Passenger Car Tyre*
215	*Section width in millimetres*
65	*Aspect ratio*
R	*Radial construction*
15	*Rim diameter in inches*
95S	*Service description (load index and speed rating)*

European metric.

145SR13, 145R13, 145R13 78S (aspect ratio is 82 and thus not shown)	
155	*Section width in millimetres*
S	*Speed rating*
R	*Radial construction*
13	*Rim diameter in inches*
78S	*Service description (load index and speed rating)*

Pict. 23.

165/65SR14, 165/65R 14, 165/65R14 78T	
185	*Section width in millimetres*
70	*Aspect ratio*
S	*Speed rating*
R	*Radial construction*
14	*Rim diameter in inches*
88S	*Service description (load index and speed rating)*

Pict. 24.

Millimetric.

This is a variation of the European Metric system, which expresses rim diameter in millimetres instead of inches. (**TD - TDX - TRX – CTS- PAX**). Rim diameters and rim width of newly conceived rim types (new concept) will be or are expressed in mm.

155 – 540 R 360 A	
155	*Section width in millimetres*
540	*Overall tyre diameter in millimetres*
R	*Radial construction*
360	*Rim diameter in millimetres*
A	*Asymmetric*

Pict 25.

Alpha-numeric.

In the late sixties, this load-based system evolved. The first letter of the designation identifies the load/size relationship of the tyre. The letter can range from “A” to “N”. The lower the letter (A), the smaller the size and load-carrying capacity at a given inflation pressure. Like millimetric sizing, this system is becoming obsolete, though some commercial light trucks tyres and many race tyres continue to use it.

BR60-13	
B	*Load-carrying capacity*
R	*Radial construction*
60	*Aspect ratio*
13	*Rim diameter in inches*

Sport / competition.

1)

	INDY	FORMULA 1	IMSA
FRONT	*25 – 10/15*	*25,5 - 9,5/13*	*25 x 11,5/17*
REAR	*27 – 14/15*	*26 – 13/13*	*27,5 x 14,5/17*

25	*Wheel diameter in inches*
10	*Section width in inches*
15	*Rim diameter in inches*

2) 235/605–16 f.e.:Yokohama,Bridgestone

235	*Section width in millimetres*
605	*Wheel diameter in millimetres*
16	*Rim diameter in inches*

3) 20/65 – 18 (f.e.: Michelin)

20	*Section width in millimetres*
65	*Wheel diameter in centimetres*
18	*Rim diameter in inches*

Pict. 26.

Numeric.

The Numeric system is the oldest and rather basic. The label refers to the tyre's section width and rim diameter only. At that time, there were two common aspect ratios: 82 and 92.

If the section width number ended in zero, the tyre had an aspect ratio of 92. (f.e.: 7.00-14).

If the section width number ended in a number other than zero, the aspect ratio was 82. (f.e.:8.25-14).

ISO metric.

The ISO metric sizing uses the normal metric system but is adding the tyre's load capacity, (f.e.: 195/65 R15 83H) where 83 is the load index.

3.4.2.c P-metric applications on light trucks.

When a P-metric tyre is fitted to a light truck or sport utility vehicle, the rated load-carrying capacity of the tyre must be reduced as these vehicles often experience more severe service situations. If you examine the vehicle's tyre placard and determine that P-Metric tyres were original equipment on the vehicle, the vehicle manufacturer has already reduced the tyre load to what appears on the placard.

On the other hand, if the vehicle's tyre placard indicates that the vehicle's original equipment fitment was a light truck tyre, and the customer requests a P-metric replacement, you must reduce the rated load shown on the tyre sidewall as follows:

FORMULA:

Rated Load = Reduced Load for Light Trucks / 1.1

EXAMPLE:

If you have a P235/75R15XL with a rated load of 2183 at 41 psi that you want to use on a light truck, you would reduce the rated load by dividing it by 1.1.

2183 / 1.1 = 1985 at 45 psi

Remember to reduce the P-metric tyre's rated load before considering the passenger tyre a replacement for the O.E. tyre. If the vehicle comes equipped with load range "D" or "E" light truck tyres, you will find it impossible or impractical to consider passenger tyres as replacements as they will not carry the load.

SOMETHING MORE ABOUT LIGHT TRUCKS AND SUVS.

The automotive industry is dividing Light Trucks as following:

- Passenger vans
- Cargo vans
- Sport Utility Vehicles (SUV's)
- Small SUV
- Compact SUV
- Full –sized SUV
- Pickups

Most Pickups and SUV's are originally equipped with passenger car tyres to lower rolling resistance and weight which results in lower fuel consumption and lower operation costs. Pickups and SUV's normally have a higher centre of gravity than passenger cars. Ground clearance is important, so taller tyres are installed. These vehicle have a full frame body construction to enhance their strength. This adds weight to be carried by the tyres. Also the

driveline's complexity and the unsprung weight of the wheels, drive axle, drive shaft and transfer case add extra weight to be carried by the tyres.

3.5.0. SPECIAL DESIGNATIONS AND NOMENCLATURE.

3.5.1. SPEED RATING SYSTEMS.

Only DOT approved tyres are speed rated (f.e. race tyres do not have this requirement). Also light truck tyres (LT) do not require a speed rating.

The speed rating of a tyre indicates the speed category (or range of speeds) at which the tyre can carry a load under specified service conditions. The speed rating system used today was developed in Europe in response to the need to control the safe performance of tyres at standardised speeds. A letter from A to Z symbolises a tyre's certified speed rating, ranging from 5 km/h (3mph) to above 300 km/h (186 mph). This rating system describes the top speed for which a tyre is certified. It does not indicate the total performance capability of a tyre.

When this speed rating system was originally developed, the Unlimited V category of over 210 km/h (130 mph) was the top speed rating a tyre could achieve. As manufacturers made more tyres that fit into this category, it was necessary to better regulate performance at standardised speeds to ensure safety. The limited V category of 240 km/h (149 mph) was then created, and the Z speed rating was added as the top speed rating that a tyre could achieve. Recently, W and Y limited speed symbols have been added as higher speed categories.

Speed rating is identified as a part of the tyre's sizing or service description. For example, as part of the tyre's sizing it appears as follows:

3.5.1.a Old system.

205/60VR15	
205	*Section width in millimetres*
60	*Aspect ratio*
V	*Speed rating (unlimited V)*
R	*Radial construction*
15	*Rim diameter in inches*

In the latest attempt to standardise tyre designations, all ratings except unlimited VR and ZR incorporate the speed symbol and load index as the tyre's service description.

3.5.1.b New system.

205/60R15 91V	
205	*Section width in millimetres*
60	*Aspect ratio*
R	*Radial construction*
15	*Rim diameter in inches*
91	*Load index*
V	*Speed rating (unlimited V)*

3.5.2. SPECIAL DESIGNATIONS

- temporary use spare types: T105/70 - 14 (= high pressure tyre: 4,2 bar)
- P195/70 R13 passenger car tyre (UTQGL: uniform tyre quality grade labelling; P-series tyres and European metric tyres have different load inflation tables and do not carry equal loads at equal pressures)
- LT235/75R 15/C light truck tyre
- ZR service description if marked (more than 240 mm/h, 149 mph)
- 275/40 ZR 17 consult tyre manufacturer
- 275/40 ZR17 93W to 270 Km/h (168 mph)
- 275/40 ZR17 93Y (93 = load index; Y = speed rating) 300 Km/h (186 mph)
- extra sidewall markings

BSAU	*British Standard institute for speed rating x load index*
DA	*Downgraded tyre (Dèfault d'Aspecte)*
ZP	*Zero Pressure (Michelin)*
EMT	*Extended Mobility Tyre (Good Year)*
AP	*Auto Porteur (Michelin) street use*
DSST	*Dunlop Self Supporting Tyre*
RF-T	*Run Flat – (Tyre Firestone)*
SSS	*Self Supporting Structure (BFGoodrich)*
TPC	*Tire Performance Criteria*

3.5.3 DOWNGRADED TYRES.

It is recommended that downgraded tyres be marked with one of the following three inscriptions:

- DA (before: "sekunda")

- or max 100 km/h
- or max 30 km/h

There are no restrictions on the use of tyres marked "**DA**", but tyres having a maximum speed of 100 Km/h are restricted to vehicles or trailers used at a speed less than or equal to 100 Km/h.

Tyres having a maximum speed of 30 km/h must not be fitted on passenger cars in normal use. They are specifically intended for use on agricultural and construction vehicles having a maximum speed of 30 km/h.

Tyres marked "**DA**" (on at least one sidewall) have been downgraded by tyre manufacturers for various minor reasons of their own which in no way affects their use - for example, superficial blemishes, minor geometrical imperfections etc. The marking "**Max 100 km/h**" - applicable only on tyres beyond speed category "K" - must be branded on both sidewalls and the original speed markings must be removed.

The marking "**Max 30 km/h**" must also be on both sidewalls and the original speed markings must be removed.

The location of the marking "**DA**" is left to the discretion of the tyre manufacturer, but the markings "**Max 100 km/h**" and "**Max 30 km/h**" should be made, wherever possible, across either the brand name or the tyre size designation.

3.5.4 SPEED SYMBOLS.

Speed Symbol	Speed (km/h)	Speed (mph)	Speed Symbol	Speed (km/h)	Speed (mph)	
A1	*5*	*3*	***K***	*110*	*68*	
A2	*10*	*6*	***L***	*120*	*75*	
A3	*15*	*9*	***M***	*130*	*81*	
A4	*20*	*12*	***N***	*140*	*87*	
A5	*25*	*16*	***P***	*150*	*94*	
A6	*30*	*19*	***Q***	*160*	*100*	
A7	*35*	*22*	***R***	*170*	*106*	
A8	*40*	*25*	***S***	*180*	*112*	
B	*50*	*31*	***T***	*190*	*118*	
C	*60*	*37*	***U***	*200*	*128*	
D	*65*	*40*	***H***	*210*	*130*	
E	*70*	*43*	***V****	*Above 210*	*Above 130*	
F	*80*	*50*	***V***	*240*	*149*	
G	*90*	*56*	***W***	*270*	*168*	***ZR***
J	*100*	*62*	***Y***	*300*	*186*	
				Above 300	*Above 186*	

(*) For unlimited V tyres without the service description, the speed category is over 210 km/h (139 mph).

The speed symbol of the tyre is the second part of the service description (see the previous section for speed categories). The service description system is used with all tyres except

Unlimited V and Z. For unlimited V and Z rated tyres, consult the vehicle manufacturer for maximum speed.

3.5.5 LOAD INDEX.

The load index, which is part of a tyre's service description, corresponds with the tyre's load-carrying capacity.

The load index is an assigned number ranging from 0 to 279 that corresponds with the load-carrying capacity of a tyre. Most passenger car tyre load indexes range from 75 to 105, although some passenger tyres carry more.

In the example on page 9, the load index of 91 corresponds to a load-carrying capacity of 615 Kg (1256 lbs.) at maximum inflation pressure.

LI	kg	LI	kg	LI	kg	LI	kg	LI	Kg	LI	Kg	LI	kg
0	45	40	140	80	450	120	1 400	160	4 500	200	14 000	240	45 000
1	46.2	41	145	81	462	121	1 450	161	4 625	201	14 500	241	46 250
2	47.5	42	150	82	475	122	1 500	162	4 750	202	15 000	242	47 500
3	48.7	43	155	83	487	123	1 550	163	4 875	203	15 500	243	48 750
4	50	44	160	84	500	124	1 600	164	5 000	204	16 000	244	50 000
5	51.5	45	165	85	515	125	1 650	165	5 150	205	16 500	245	51 500
6	53	46	170	86	530	126	1 700	166	5 300	206	17 000	246	53 000
7	54.5	47	175	87	545	127	1 750	167	5 450	207	17 500	247	54 500
8	56	48	180	88	560	128	1 800	168	5 600	208	18 000	248	56 000
9	58	49	185	89	580	129	1 850	169	5 800	209	18 500	249	58 000
10	60	50	190	90	600	130	1 900	170	6 000	210	19 000	250	60 000
11	61.5	51	195	91	615	131	1 950	171	6 150	211	19 500	251	61 500
12	63	52	200	92	630	132	2 000	172	6 300	212	20 000	252	63 000
13	65	53	206	93	650	133	2 060	173	6 500	213	20 600	253	65 000
14	67	54	212	94	670	134	2 120	174	6 700	214	21 200	254	67 000
15	69	55	218	95	690	135	2 180	175	6 900	215	21 800	255	69 000
16	71	56	224	96	710	136	2 240	176	7 100	216	22 400	256	71 000
17	73	57	230	97	730	137	2 300	177	7 300	217	23 000	257	73 000
18	75	58	236	98	750	138	2 360	178	7 500	218	23 600	258	75 000
19	77.5	59	243	99	775	139	2 430	179	7 750	219	24 300	259	77 500
20	80	60	250	100	800	140	2 500	180	8 000	220	25 000	260	80 000
21	82.5	61	257	101	825	141	2 575	181	8 250	221	25 750	261	82 500
22	85	62	265	102	850	142	2 650	182	8 500	222	26 500	262	85 000
23	87.5	63	272	103	875	143	2 725	183	8 750	223	27 250	263	87 500
24	90	64	280	104	900	144	2 800	184	9 000	224	28 000	264	90 000
25	92.5	65	290	105	925	145	2 900	185	9 250	225	29 000	265	92 500
26	95	66	300	106	950	146	3 000	186	9 500	226	30 000	266	95 000
27	97.5	67	307	107	975	147	3 075	187	9 750	227	30 750	267	97 500
28	100	68	315	108	1 000	148	3 150	188	10 000	228	31 500	268	100 000
29	103	69	325	109	1 030	149	3 250	189	10 300	229	32 500	269	103 000
30	106	70	335	110	1 060	150	3 350	190	10 600	230	33 500	270	106 000
31	109	71	345	111	1 090	151	3 450	191	10 900	231	34 500	271	109 000
32	112	72	355	112	1 120	152	3 550	192	11 200	232	35 500	272	112 000
33	115	73	365	113	1 150	153	3 650	193	11 500	233	36 500	273	115 000
34	118	74	375	114	1 180	154	3 750	194	11 800	234	37 500	274	118 000
35	121	75	387	115	1 215	155	3 875	195	12 150	235	38 750	275	121 500
36	125	76	400	116	1 250	156	4 000	196	12 500	236	40 000	276	125 000
37	128	77	412	117	1 285	157	4 125	197	12 850	237	41 250	277	128 500
38	132	78	425	118	1 320	158	4 250	198	13 200	238	42 500	278	132 000
39	136	79	437	119	1 360	159	4 375	199	13 600	239	43 750	279	136 000

3.5.6 MAXIMUM LOAD AND MAXIMUM INFLATION.

Maximum load and maximum inflation moulding indicate the maximum load that can be carried and the maximum pressure needed to support that load.

EXAMPLE:

Max load 990 kg. (2183 lbs.) at

280 kPa (41psi) max. press.

The Alpha-numeric tyre sizing system shows specific load range symbols on the sidewall that indicate how much load the tyre is designed to carry at definite pressure. Most Alphanumeric sized tyres are load ranges B, meaning that they are restricted to the load that can be carried with a maximum inflation pressure of 32 psi. For greater load-carrying capacity, C, D or E tyres can be used.

Note: most load range C, D and E tyres are for light truck applications. These load-carrying capacity designations will appear directly after the size of the tyre as in the LT metric sizing system example below:

EXAMPLE:

LT235/75R15/C

The load-carrying capacity of P-metric tyres is rated either Standard Load or Extra Load. Standard Load tyres are limited by the load that can be carried with a maximum inflation pressure of 35 psi. The load that can be carried with a maximum inflation pressure of 41 psi limits extra load tyres. An extra load tyre (for example P235/75R15XL) will be branded with “extra load”. A standard load tyre does not bear any special designations.

A tyre with a normal inflation pressure of 35 psi may be branded with a maximum inflation of 44 psi, indicating the tyre’s ability to meet special performance requirements. It does NOT increase the tyre’s load capacity.

3.5.7 ADDITIONAL SIDEWALL DESIGNATIONS.

In addition to the previous sidewall labels and moulding, there are a few more designations that deserve explanation. Like the previous designations, the following have been evolving toward the goal of world-wide-standardised tyre labelling:

A) Uniform tyre quality grade labelling.

The Uniform Tyre Quality Grading System (UTQGS) is a tyre information system that provides buyers with information on three categories:

- treadwear
- traction
- temperature

These ratings are based upon test results achieved under special conditions. So it is possible to misinterprete the comparative data as it relates to one’s particular driving habit, conditions, ...

Pict. 27:

Each tyre manufacturer performs its own tests in these areas, following government-prescribed test procedures. Each manufacturer then assigns grades that are branded on the tyre. This is known as the Uniform Tyre Quality Grade Labelling (UTQGL).

EXAMPLE:

Treadwear 300 traction A temperature A

Treadwear.

Treadwear grades typically range from 60 to over 500, in twenty point increments. It's important to remember that the actual life of any tyre is determined by the road surface quality, driving habits, inflation, wheel alignment and the rotation it experiences. To receive a treadwear grade, a tyre is tested under controlled conditions on a government-prescribed test course, which does not necessarily simulate the actual application for which a given tyre is designed to perform. As a result of these test parameters, there is no reliable way to assign miles of wear to treadwear grade points.

Treadwear ratings are determined on a 400-mile government test course covering specified sections of public roads near San Angelo, Texas. A group of not more than four test vehicles travels the course in a convoy so that all tyres experience the same conditions. Tread groove depths of the tyres being tested are measured after each 800 miles. The same procedure is followed for a set of control or "course monitoring tyres". Upon completion of the 7,200-mile test, the rating results of both tests are compared, and the tyres being tested a treadwear rating by the tyre manufacturer.

Never use the treadwear ratings to compare between different tyre brands. These ratings should be used as relative indicators.

Traction.

Traction grades indicate the measurement of a tyre's ability to stop a car in straight-ahead motion on a wet test surface pavement. It does not measure straight-ahead acceleration. It's important to remember that traction rating tests are performed only for straight-ahead sliding on concrete and asphalt surfaces that have a specified degree of wetting which simulates most road surfaces in a rainstorm. The ratings that result from these tests may not apply to cornering traction or peak values of straight-ahead braking force like those experienced in no-skid braking tests. Traction grades range from A to C, with A being the highest attainable grade.

Traction ratings are established on government maintained skid pads. Twenty measurements are taken with an industry standard control tyre on an asphalt surface and averaged. The same number of measurements is made on a concrete surface. Corresponding measurements are then made on the tyres being tested. Once the results of the tests are compared, traction ratings based on government prescribed coefficient levels are assigned to the tyres that were tested.

Temperature.

Temperature grades also range from A to C, with A being the highest. Temperature grades represent a properly maintained tyre's ability to dissipate heat under controlled indoor test wheel conditions.

Temperature ratings are determined by running tyres on an indoor road-wheel test under specified conditions. Successive 30-minute runs are made in 5-mph increments starting at 75 mph and continuing until the tyre fails. A tyre is graded "C" if it meets the minimum

performance required by **DOT**. Grades of "B" and "A" represent higher levels of performance than the minimum required by **DOT**.

The Temperature grade is established for a tyre that is properly inflated and not overloaded.

B) ECE.

The Economic Commission of Europe (ECE) develops motor vehicle equipment requirements. ECE approved tyres must meet ECE standards for physical dimensions, branding requirements and high-speed endurance regulations. When a tyre bears the ECE symbol on its sidewall, it is certified to the load index and speed symbol that appear in its service description for use in Europe.

The letter and number combination encircled at the beginning of the designation represent the country originally receiving approval, such as E2 for France, or E4 for the Netherlands. The first two digits of the number sequence indicate the Regulation Amendment Series under which the tyre was approved, such as 02 for ECE reg. 30. The last four or five digits represent the tyre size and type.

Not all tyres receive the EEC's approval. In order to be ECE branded, a tyre must receive laboratory approval, meet confirmation-testing requirements and have the facility where it was manufactured pass inspection.

TREADWEAR	TRACTION
	
TEMPERATURE	**ECE**
	

ECE 30 – Country of homologation							
E1	Germany	E11	United Kingdom	E22	Russian Federation	E34	Bulgaria
E2	France	E12	Austria	E23	Greece	E37	Turkey
E3	Italy	E13	Luxembourg	E24	Ireland	E40	Macedonia
E4	Netherlands	E14	Switzerland	E25	Croatia	E42	EC
E5	Sweden	E16	Norway	E26	Slovenia	E43	Japan
E6	Belgium	E17	Finland	E27	Slovakia	E45	Australia
E7	Hungary	E18	Denmark	E28	Belarus	E46	Ukraine
E8	Czech Republic	E19	Romania	E29	Estonia		
E9	Spain	E20	Poland	E31	Bosnia & Herzegovina		
E10	Yugoslavia	E21	Portugal	E32	Latvia		

(in the U.S., speed rating are based on laboratory tests in accordance with SAE J 15961)

C) TPC Spec.

General Motors requires that the tyres it fits on certain vehicles meet defined Tyre Performance Criteria (TPC). These criteria are tested using performance formulas. When a tyre meet the requirements, the TPC specification number is branded on its sidewall.

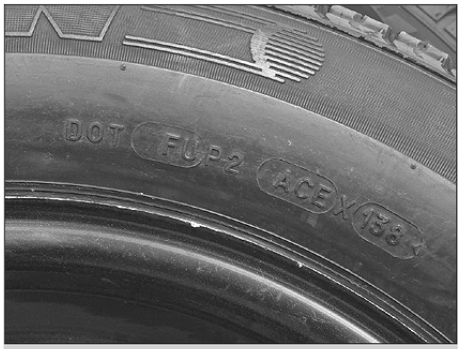
Pict. 32: M+S

D) M + S.

When any of the following markings appear on a tyre, it meets the Rubber Manufacturer's Association (RMA) definition of a mud and snow tyre: M + S, M/S, or M&S.

E) DOT.

DOT signifies that the tyre complies with the United States Department of Transportation tyre safety standards, and is approved for highway use. Tyres without DOT branding are not legal on U.S. highways.



Pict. 33: DOT

EXAMPLE: DOT XB FU XJJX 443

DOT: Department of Transport

XB: The first two letters following DOT designate the tyre's manufacturer and plant code.

FU: The third and fourth characters denote the tyre size.

XJJX: Group of symbols optional with the manufacturer.

443: The ninth and tenth characters denote the week the tyre was produced. The final number signifies the year in which the tyre was manufactured. DOT markings related to the week and year of production will have an additional symbol for the decade of the 1990's. It will be shown as a triangle following

these last three numbers (◄) (Pict. 33)

Starting from the production year 2000 , 4 digits are used to express the manufacturing date (Pict. 34).

Pict. 34:

F) PR (Ply rating).

Ply rating is a historical marking as tyres were made of cotton cord. The actual number of cotton plies in the casing described the tyres' load carrying capacity. Nowadays, polyester, rayon, nylon, steel and aramid are used as casing cord product, where standard or reinforced load designations are used, to express the load carrying capacity.

G) Tube requirement.

A tyre will be labelled to indicate that it is tubeless or that it does require the use of a tube (tube type).

Respect the following combinations to avoid dangerous situations:

RIM	TL	TL*	TT	TT
TYRE	TL	TT*	TL	TT
TUBE	NO	YES	YES	YES

*** Not recommended combination - Only allowed in case of emergency or by the manufacturer.**

H) N-O // K1.

Porsche uses N-0, N-1, N-2 and N-3 to indicate the tyre has been approved for its vehicles or certain axles.

Ferrari uses the K1.

Pict. 35: Rotational direction

I) Outboard sidewall mark.

Whether the tyre is unidirectional or not, the tyre may be designed to use one specific side as the outboard side. If so, the tyre will be marked with "this side out" or "side facing outwards".

J) Rotational direction.

If a tyre is unidirectional, this will be noted on the sidewall by an arrow or by the word "rotation", "driving", and "direction" in conjunction with an arrow to indicate the rolling direction.

Pict. 36: Wear bar indicator

K) Wear Bar indicator.

The position of each wear bar is indicated by a small arrow on the upper sidewall at the base of the shoulder.

L) RSC.

A circle with the letters “RSC” (Run Flat Safety Component) intdicates that the tyre is having reinforced sidewalls (for BMW).

M) PAX System.

Indicates a PAX wheel (Pict. 48, page 41).

3.5.8 STOCKING OF TYRES.

With rim: hanging or horizontal (never standing vertical).

Without rim: not hanging nor piled horizontally (just standing vertical).

3.6.0 RUN FLAT SYSTEMS.

Runflat is a feel-good (long trips in low populated areas) and safety feature (sportive driving without fear for a “flat”) eliminating spare wheels. A requirement of run flat systems in many cases is the need for low inflation warning systems. Runflat systems function so well when they are low on air pressure that under-inflated tyres may be overlooked, resulting in long term permanent damage to the tyre. Different systems of different manufacturers have been brought on the market.

3.6.1 SELF SEALING TYRES.

- **Special tyre**: no
- **Special rim**: no
- **Special 3rd part**: yes, a self sealing rubber compound, with a gelatine aspect, which is equally distributed in the tyre by the centrifugal forces of the rotating wheel. It closes punctures in the tread in 90% of the cases up to 4,7 mm.
- **Examples**:
  - IMS
  - MMS
  - PMS
  - Tirefit
- **Disadvantages**:
  - The system does not guard against sidewall punctures.
  - A tyre, which has punctured, must always be removed from the rim and examined for secondary damage. Liquid sealant may mask secondary damage and preclude internal examination.
  - Can endanger the function of TPMS in the rims.

3.6.2 REINFORCED TYRE STRUCTURE / SIDEWALLS

- **Special tyre**: yes

- **Special rim**: yes, in most cases. Rims with WH and SH
- **Special 3rd part**: yes, in most cases
- **Examples**:
  - **EMT**: Extended Mobility Tyre (Good Year)
  - **AP**: Autoporteur (Michelin)
  - **ZP**: Zero Pressure (Mast)
  - **S-01**: Run Flat (Bridgestone)
  - **SSS**: Self Supporting Structure (BFGoodrich)
  - **DSST**: Dunlop Self-supporting Tyre
  - **RFT**: RunFlatTyre (Bridgestone/Firestone)
  - **EUFORI@ : (Pirelli)**
  - **ZPS:** Zero pressure System (Yokohama).
  - **ECSTA SUPER:** (**KUMHO)**

Pict. 37: EMT

Pict. 38: ZP

Pict. 39: RFT

Pict. 40: Eufori@

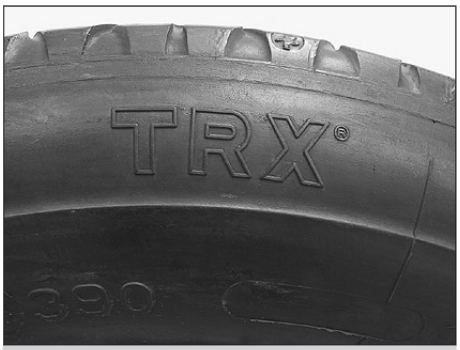
3.6.3 BEAD RETENTION SYSTEMS.

	TD	TDX	DL	BRS	AH	WH	SH	EH	PAX	CSR	CWS
SPECIAL TYRE	yes	yes	yes	yes*	yes	yes*	yes*	no	yes	no	yes
SPECIAL RIM	yes	yes	yes	yes	no	yes	yes	yes	yes	no	yes
SPECIAL 3RD PART	no	no	no	no	yes	no	no	no	yes	yes	yes

(*) Also standard tyres are completely compatible.

- **TD** = Dunlop
- **TDX** = Michelin
- **DL** = Bridgestone
- **AH** = Asymmetric Hump
- **WH** = Wedge Hump
- **SH** = Special Hump
- **EH** = Extended Hump
- **PAX**= Michelin
- **CSR** = Conti Safety Ring
- **CWS** = Conti Wheel System

NOTE: TRX tyres can be mounted on TRX - and TD rims TD tyres only on TD rims.



Pict. 41: TRX

Pict. 42: TDX

METRIC CONTOUR DIMENSIONS.

DL		TD		DD (Divided Rim)	
O	V	O	V	O	V
320	95	315	95-180	310	90
345	110	340	105-195	325	105
370	125	365	120-210	350	120
395	140	390	135-225	375	135
		415	150-240		
		450	165		

CT		TR		PAX	
O	V	O	V	O	V
400	105	315	120-210	360	
425	135	340	135-225	380	
450	150	365	150-240	400	
475	165	390	165	420	
500	180/180A	415	180	440	
		450	195	450	
				460	
				480	
				500	

3.6.4 "TYLOCK" SYSTEM.

- **Special tyre**: no
- **Special rim**: no
- **Special 3rd part**: yes, a ring, which is filling up the drop centre, is avoiding that the beads slide into it.

Pict. 43: Tylock System

3.6.5 "RODGUARD" SYSTEM.

- **Special tyre**: no
- **Special rim**: no
- **Special 3rd part**: yes, two rings mounted in the drop centre on top of the other are supporting the tyre tread from inside in case of air lost.

Pict. 44: Foam filler

3.6.6 FOAM FILLERS.

- **Special tyre**: no
- **Special rim**: no

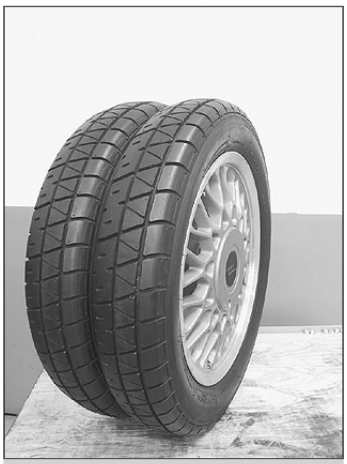
- **Special 3rd part**: yes, a circular ring of butyl rubber in a closed-cell structure is expanding to fill the tyre's internal space in case of an air loss. It keeps the carcass in perfect tension as if inflated.
- **ATS**: Appuye Temporaire Souple (Michelin)
- **EMI**: Espanso Modulare Integrato (Pirelli)

Pict. 45: CTS

3.6.7 CTS (CONTI-TYRE-SYSTEM).

- **Special tyre**: yes
- **Special rim**: yes
- **Special 3rd part**: yes

System whereby the tyres wrap around the rim, instead of pressing against the outer surface



Pict. 46: Twin Tyre System

3.6.8 TWIN TYRE SYSTEM.

- **Special tyre**: yes
- **Special rim**: yes
- **Special 3rd part**: no
- **Advantage**:
  a) In case of a flat, the twin tyre is taking the "run flat" function on that wheel.
  b) No more need for a spare wheel
  c) Central channel for water draining (anti aquaplaning)

3.6.9 LFZ (LIMITEUR EN FLECHE EN Z).

- **Special tyre**: yes
- **Special rim**: yes
- **Special 3rd part**: yes

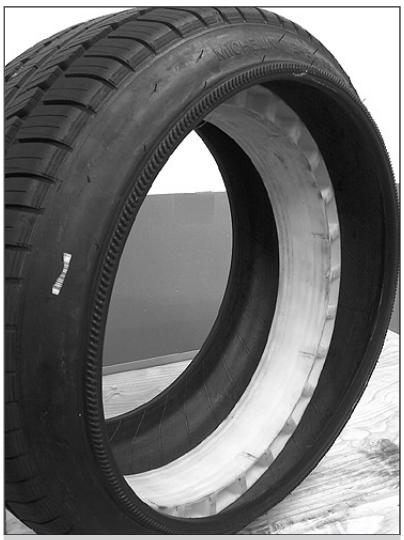
Two piece rims, containing at the inside a support ring for the tyre tread. It is bolted to the rim.

3.6.10 DSH-HUTCHINSON-TOTAL FRANCE.

- **Special tyre**: no
- **Special rim**: no
- **Special 3rd part**: yes, two rings mounted in the drop centre on top of the other are supporting the tyre tread from inside in case of air loss.

3.6.11 PAX MICHELIN

- **Special tyre**: yes
- **Special rim**: yes
- **Special 3rd part**: yes, a ring supporting the tyre tread from inside in case of air loss



Pict 47: PAX

Pict 48: PAX

3.6.12 Conti CSR.

- **Special tyre**: no
- **Special rim**: no
- **Special 3rd part**: yes, a ring supporting the tyre tread from inside in case of air loss.

Pict. 49: CSR

3.7.0 PARTICULAR TYRES / FABRICATION SYSTEMS.

ULW	DUNLOP
TRX	MICHELIN
TD	DUNLOP
DL	BRIDGESTONE
TDX	MICHELIN
CTS	CONTINENTAL
PAX	MICHELIN
CWS	CONTINENTAL
CSR	CONTINENTAL

3.7.1 Ultra Light Weight.

Pict. 50: ULW

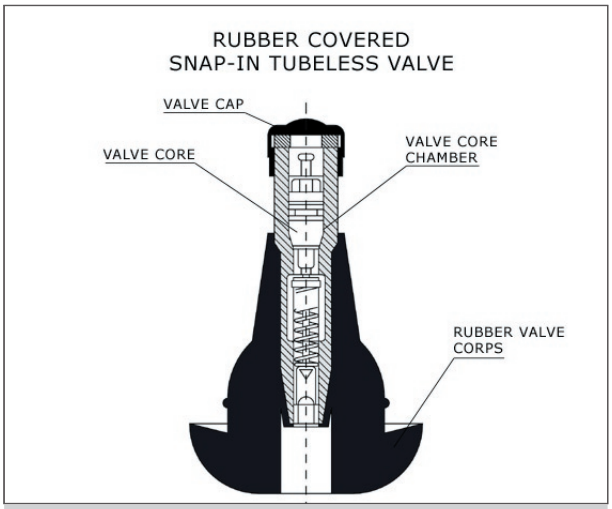
Aramide

- 6 times lighter than steel
- 5-6 times more pull resistance (other names: kevlar/twaron).

ADVANTAGES:

1. Fuel consumption
2. Emissions
3. Lower recycling problems
4. Lower vibrations after longer standstills
5. Better drive comfort, better uniformity
6. Better active drive security:
   a) Lower weight of rotating masses; better function of ABS
   b) Better control during driving (less unsuspended masses)
   c) Light damaged carcass cannot rust

3.8.0 VALVES.



Pict. 51

3.8.1 STYLES.

There are two basic construction styles: the one-piece and the multi-piece.

One-piece: The valve's outer body, in rubber, provides interference fit in the wheel's valve hole. It is installed from the inside of the rim. The diameter of the body's base, which is larger than the whole diameter, features a slight recessed groove that pops into place

within the wheel's hole.

Multi-piece: The multi-piece valve is constructed of a stainless steel main shank that installs into the hole with no interference fit. A separate rubber-sealing base is installed on the stem's base. A stainless steel cup washer and nut are used to fix the stem to the rim. This type of valve eliminates the flexion of the rubber valve at high speeds. Also the appearance of a stainless steel valve is preferred over the black rubber valve. Some wheel manufacturers are offering high performance wheels where the valve is hidden by using several systems depending on the wheel design.

There are several criteria to devise or distinguish valves:

1. The way they are fixed in the rim
   a) threaded valves which are screwed into the valve hole
   b) rubber covered valves which are snapped into the valve hole
2. Type of valve
   a) valves for tubeless tyres which are fixed into the valve hole
   b) valves for tube type tyres:
      i. valves with a rubber foot (vulcanised on the tube)
      ii. valve with a metal foot (fixed to the tube with a nut and a washer)
   c) sensor / valve incorporated
   d) hidden valve
3. Application of the valve
   a) normal valve hole
   b) enlarged valve hole
4. Form of the valve
   a) straight valves
   b) bended valves:
      i. can be fix
      ii. can be revolving

NOTES:

- *It is strongly recommended to mount metal valves (or valve supports for rubber valves) for tubeless tyres on passengers cars, able to exceed 210 km/h (V, W, Y or ZR) and also where the valve is deflected more than 25° by centrifugal force.*
- *CT valves are to be used only on CT rims.*

Snap-in valves for tubeless tyre have to pass the following tests:

- mountability

Pict. 52:

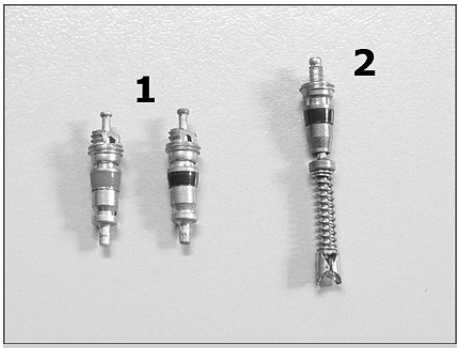
- air tightness
- ozone resistance
- hardness
- surface
- rubber-metal binding

3.8.2. STEMS AND CAPS.

Caps : are often regarded as needless, but the valve cap is critical to valve cleanliness and reliability. It keeps dust, grid and other debris out of the delicate valve stem opening. The cap aids also in pressure containment.

There are two kinds of valve caps:

- The valve cap with incorporated gasket to assure an absolute air tightness of the complete valve assembly
- The normal dust cap (does not have the air tightness function)



Pict. 53:

Stems: there are two types of stems

- The short core of 20mm (**Pict. 53-1**) (can be mounted in the short and the long valve)
- The long core of 33 mm (**Pict. 53-2**) (can only be mounted in the long valve)

The torque with which the core is fixed into the valve is very important (how deep it is screwed into the valve) for inflation and checkikg of the pressure with the chuck of the inflation device.

3.9.0 TYRE REPAIR.

Consult the tyre manufacturer and/or the manufacturer of the repair material for general and more detailed information. Legislations may be different from country to country.

Independently from what tyre manufacturers are saying, the following statements should be respected always:

- tread punctures left unrepaired may cause irreversible damage to the tyre
- repairing of speed rated tyres makes them loose their speed rating
- never use an inner tube to repair a tubeless tyre
- never repair a tyre with run flat damage
- never repair tyres with broken or deformed beads, deterioration of the rubber, ruptures of radial plies.