

Tire Track Identification

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Abstract

Tire Track Identification is based on different software products today. The aim is to find the car type and/or the mounted tires on the car of a suspect based on a tire track from a crime scene.

During the last decades, the "Tire Book", with about 5.000 printed tire patterns, was the only way to find the identity of a tire from a corresponding tire track.

The "Tire Database" is now available on two different standard software platforms - Access and Excel. It was developed in cooperation with ENFSI (European Network of forensic Science Institutes). To find 1 tire out of about 15.000 you have 7 different search criteria, so all in all there are about 3 million possible variations. The result is a short technical description of the specific tire, a Figure of the tread pattern and its classification. The history of each tire will give important information on patent disputes.

The "Car Database" is available in standard Excel-format for worldwide use. The database is based on the original tire equipment of cars at their delivery. Conversion tables will help to find corresponding tire sizes on the legal and illegal replacement market. About 12.000 different passenger cars, SUVs and light truck models of more than 300 different car manufacturers are listed. Wheel base, front and rear track and the tire size of the original equipment are listed for search.

The tire database is used by "TreadMate", a product of our partner Foster&Freeman, too. All products are updated annually.

Introduction

"Each tire on the street is unique ... that is the strategy of our business"

The identification of tire tracks at crime scenes has become very popular during the last 20 years. A positive identification of a specific tire pattern and the car of the suspects are very difficult because of our global tire and car market. With the help of modern IT equipment it will be more efficient for the investigators of forensic tire impression to analyze crime scenes [1-4].

Our product, a worldwide car and tire database, is focused on the Worlds market. That is necessary because approximately 60% of tires in the replacement market of the United States are imported from Europe and Asia. For easy use we decided to use a standard database format: Excel® and/or Access®.

The target of our database is mainly the identification of tire patterns, but they can also be used for copyright violation, mainly by Asian companies, and information on the import and export market of tires.

The foundations of each crime scene examination by our software are photographs or castings [1,5], including measurements from the pattern found (reference scales). The pattern can be taken from almost any surface. Mainly there are tire tracks on solid ground, sand, snow or mud, but we also have Figures of patterns on the skin of a person, imprints on the inside of trousers and objects lying on the street which were driven over by the car.

The first step is to classify specific properties of the pattern. The 7 classification criteria are: Vehicle type, pattern type, structure, center of the tire, circumferential groove near the centerline, characteristic of main blocks and shapes of main fine cuts.

Normally you will get between 1 and 15.000 results. In that case

(normally up to 10 results) you have to manually compare the Figure from the crime scene to the photos in our database.

For further information on the specific footprint you have to know some technical details of cars, tires and a basic knowledge in physics. Knowledge [2,6-9] of the influence on air pressure, irregular wear, load of car, regular wear based on millage and condition of shock absorbers can narrow your result.

For the identification of vehicle tire tracks at the crime scene, you can measure the wheel base and front and rear tracks. The quality of these measurements depends on the soil texture, the axle design of the car and its weight. Based on the tire size of the original equipment of the car at its delivery, other sizes are permitted on the replacement market.

In most criminal cases cars are involved. That is why it can be helpful to know more about the car and its tires quickly. Our databases of cars and tires are a useful resource for crime scene investigators to find specific cars and tires at a crime scene.

Materials and Methods

There are 2 main fields in identification:

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- Identification of tire pattern
- Identification of a car by its track on the ground

Tire identification

The first step in tire identification is to get a high resolution photo or a cast from the crime scene, including a measuring tape [1,5] to show scale (Figure 1).

For the identification our company offers 2 different possibilities – manual or electronic searching [10,11].

Tire book (manual search): The tire book is a list of about 5,000 different tire patterns from all over the world in the following categories:

- * Passenger car tires (new and retread pattern)
- * SUV and light truck tires (new and retread pattern)
- * Agricultural tires
- * Industrial tires

Tire Figures will be given by the industry in different resolutions and qualities. The patterns are sorted by type (see list above) and company. Tires older than 10 years are taken out due to the quantity (limitation: 400 printed pages with about 8000 Figures). A short technical description is included (Figure 2).

The correspondence to the Figure from the crime scene must be done manually.

Tire database (Electronic Search): The 2013 database contains 15,838 tire patterns from 357 different tire companies worldwide

The data in the database is the same as in the book, but there are the differences in:

- Quantity : no tire will be taken out (present: 15,000 pattern)
- Including motorcycle tires
- Searching criteria on tire name and/or producing company
- Searching criteria on pattern characteristic

Pattern characteristics

- Vehicle type (e.g. passenger tire)
- Pattern characteristic (e.g. directional pattern)
- Structure of tire pattern (e.g. snow tire)
- Center of the tire (e.g. groove)
- Circumferential grooves at the center (e.g. straight groove)
- Shape of blocks (e.g. V-Shape – letter design)
- Shape of fine cuts inside the blocks (e.g. curved)

An electronic manual is added to the database. There you will find detailed instruction for using the filter functions.

As a result you will get 1 or more goals for your search. In Figure 3 (bottom, left) you will see the result in the Access version.

The results of Access and Excel version are equal. It is subject to the user which program they want to use (Figure 4).

Car identification

The 2013 database contains 12,706 different car models from 191 car producers worldwide.

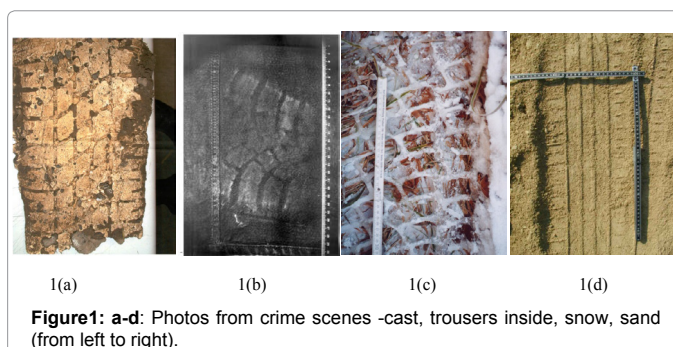
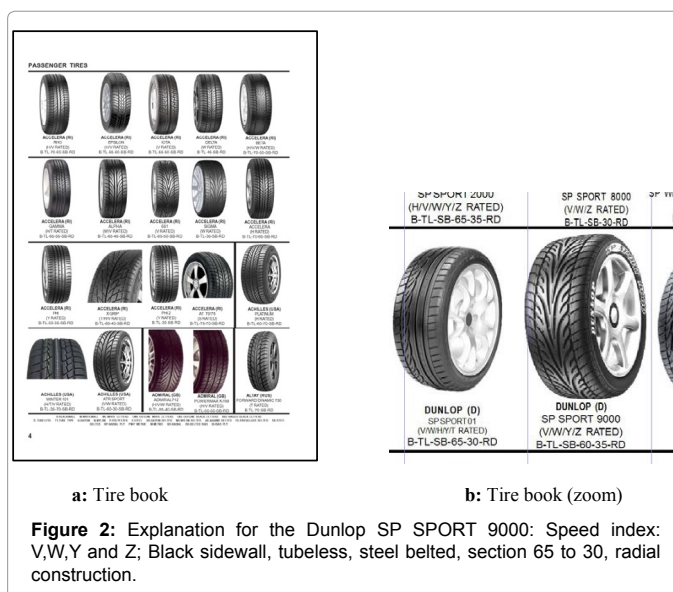


Figure1: a-d: Photos from crime scenes -cast, trousers inside, snow, sand (from left to right).



a: Tire book

b: Tire book (zoom)

Figure 2: Explanation for the Dunlop SP SPORT 9000: Speed index: V,W,Y and Z; Black sidewall, tubeless, steel belted, section 65 to 30, radial construction.

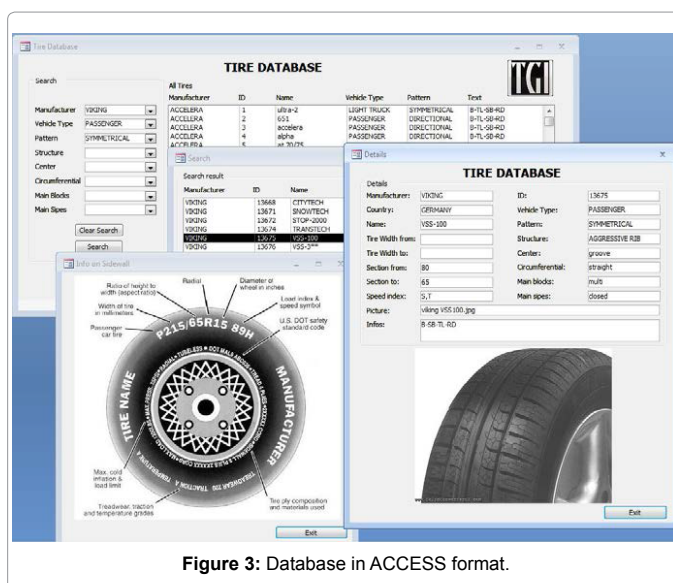


Figure 3: Database in ACCESS format.

The database is written in excel format. Based on car producers and model, front and rear track and wheelbase are listed (Figure 5). The given tire size is the original equipment which is used on the new car. This tire size should be the same for the delivery in every country. It is known that some countries use a replacement tire size.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
1	TIRE GLOBAL INFORMATION												HELP	PATH OF PHOTOS: C:\DATENTIRES 2013						
2	COMPANY INFO			TIRE INFO		SIZE INFO		DATABASE-INFO					LINK TO PHOTO	SEARCH						
3	MANUFACTURER	COUNTRY	D	NAME	Tire Width Form	Tire Width to	Section Form	Section to	Speed index	CAT/AGE	RANGES 2013	TEXT (if available)		VEHICLE TYPE	PATTERN	STRUCTURE	Center	Circumferential grooves (center)	main blocks	main sipes (fine cuts)
4	ACCELERA	INDONESIA	1	651			65	50	V	2010	B-TL-SB-RD	PHOTO	PASSENGER	DIRECTIONAL	undefined	BLOCK/GROO	no	mult	no	
5	ACCELERA	INDONESIA	2	accelera			70	65	H	2010	B-TL-SB-RD	PHOTO	PASSENGER	DIRECTIONAL	undefined	rib	straight	SQUARE DIS	no	
6	ACCELERA	INDONESIA	3	alpha			65	45	V.W	2010	B-TL-SB-RD	PHOTO	PASSENGER	DIRECTIONAL	undefined	rib	straight	mult	no	
7	ACCELERA	INDONESIA	4	al 70/75			75	70	S	2011	B-TL-SB-RD	PHOTO	PASSENGER	DIRECTIONAL	undefined	rib	straight	SQUARE DIS	no	
8	ACCELERA	INDONESIA	5	beta			70	50	H.V.W	2010	B-TL-SB-RD	PHOTO	PASSENGER	DIRECTIONAL	undefined	groove	straight	mult	no	
9	ACCELERA	INDONESIA	6	delta			45	45	W	2010	B-TL-SB-RD	PHOTO	PASSENGER	DIRECTIONAL	undefined	groove	straight	mult	no	
10	ACCELERA	INDONESIA	7	epsilon			65	60	H.V	2010	B-TL-SB-RD	PHOTO	PASSENGER	DIRECTIONAL	undefined	BLOCK/GROO	straight	mult	no	
11	ACCELERA	INDONESIA	8	gamma			65	55	T.H	2010	B-TL-SB-RD	PHOTO	PASSENGER	DIRECTIONAL	undefined	rib	straight	mult	curved	
12	ACCELERA	INDONESIA	9	iota			55	50	V	2010	B-TL-SB-RD	PHOTO	PASSENGER	UN-EVEN	undefined	no	straight	mult	no	
13	ACCELERA	INDONESIA	10	phi			50	35	Y	2010	B-TL-SB-RD	PHOTO	PASSENGER	UN-EVEN	undefined	undefined	straight	no	no	
14	ACCELERA	INDONESIA	11	phi_2			30		Y	2011	B-TL-SB-RD	PHOTO	PASSENGER	UN-EVEN	un-even	undefined	straight	no	holes	
15	ACCELERA	INDONESIA	12	rho			70	60	H.V	2010	B-TL-SB-RD	PHOTO	PASSENGER	SYMMETRICAL	undefined	rib	straight	mult	no	
16	ACCELERA	INDONESIA	13	sigma			35	35	W	2010	B-TL-SB-RD	PHOTO	PASSENGER	DIRECTIONAL	undefined	undefined	straight	undefined	no	
17	ACCELERA	INDONESIA	14	snow						2011	B-TL-SB-RD	PHOTO	PASSENGER	DIRECTIONAL	SNOW TYPE	groove	straight	mult	curved	
18	ACCELERA	INDONESIA	15	ultra-2			82		P	2011	B-TL-SB-RD	PHOTO	LIGHT TRUCK	SYMMETRICAL	LETTER DESIGN	groove	ZIGZAG	V-Shape	straight	
19	ACCELERA	INDONESIA	16	x grip			65	40	T.H.V	2011	B-TL-SB-RD	PHOTO	PASSENGER	DIRECTIONAL	SNOW TYPE	groove	straight	mult	straight	
20	ACHILLES	USA	17	atr sport			60	30	V.W	2012	B-TL-SB-RD	PHOTO	PASSENGER	DIRECTIONAL	DIRECTIONAL	rib	straight	mult	no	
21	ACHILLES	USA	18	platinum			70	60	H	2012	B-TL-SB-RD	PHOTO	PASSENGER	DIRECTIONAL	DIRECTIONAL	no	straight	mult	no	

Figure 4: Database in Excel format.

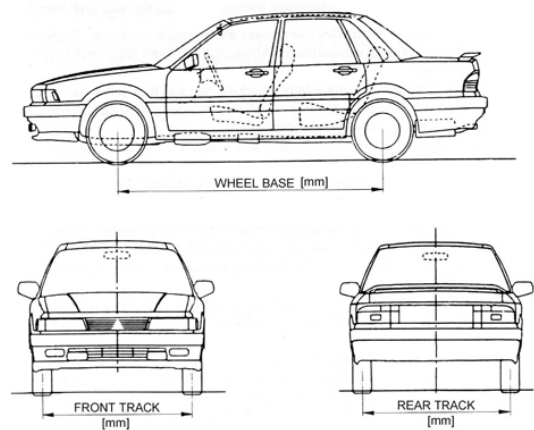


Figure 5: car dimensions (here in [mm]; [inch] available).

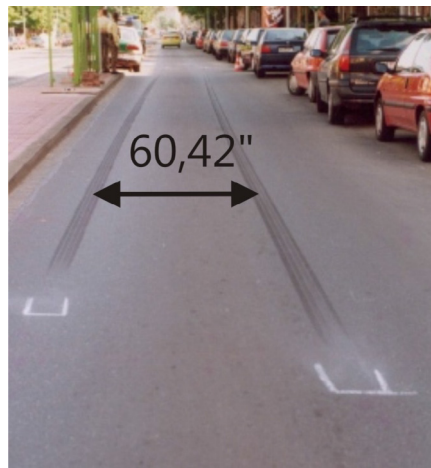


Figure 6: Example of a tire track on the road (60,42" = 1535 mm).

Figure 6 shows a front or rear track on a paved road. On unpaved roads you will normally find front and rear track including the wheel base. Depending on the axle geometry you can sometimes decide if the car was used under full load. In one crime case, some years ago, it was important to know, if the stolen car was still under load.

The Excel database in Figure 7 is listed in [mm] and [inch]. In column K you will find the typical original equipment tire size.

For the replacement market there is a separate database to find equivalent tire sizes. Regarding to law you should use the same diameter of tires. If somebody does not use the diameter of the original tire size, it is nearly impossible to find the corresponding car.

Database library

Figure 8 shows the main menu (a pdf file with links) of our "Database Library". Each button will open an Excel or Access file or the "tire book" in pdf format. A link to our website <<http://www.tgi.co.at>> and mail address <lux@tgi.co.at> is included.

Content of database library

*Top left: 3 different versions of the car database (book, excel and access)

* Top center: car database

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T		
1	CAR										TIRE		SEARCH				RIM					
2	Vehicle Make	Country	Vehicle Type	Year	wheel base	front track	rear track	OE Tire Size	Replacement Size	Widths [mm]	Section [%]	Rim [inch or mm]	SL	Size	Bolt No	Diameter [mm]	DIS [mm]					
3					[mm]	[in]	[mm]	[in]	[mm]	[in]												
4	Alfa Romeo	Italy	2000 Berlina	73-76	2570	101.18	1324	52.13	1274	50.16	165 R14 H		165	82	14	H	5 1/2Jx14					
5	Alfa Romeo	Italy	2000 GT Veloce	73-76	2360	92.52	1324	52.13	1274	50.16	165 R14 H		165	82	14	H	5 1/2Jx14					
6	Alfa Romeo	Italy	2000 Spider Veloce	73-82	2360	92.52	1324	52.13	1274	50.16	165 R14 H		165	82	14	H	5 1/2Jx14					
7	Alfa Romeo	Italy	Alfa 33 1.3	86-94	2475	97.44	1366	53.78	1365	53.74	165/70 R13 T		165	70	13	T	5 1/2Jx13	4	98	39		
8	Alfa Romeo	Italy	Alfa 33 1.5 Quadrifoglio	86-94	2475	97.44	1366	53.78	1365	53.74	165/70 R13 T	185/60 R14 H	165	70	13	T	5 1/2Jx13	4	98	39		
9	Alfa Romeo	Italy	Alfa 33 1.5	86-94	2475	97.44	1366	53.78	1365	53.74	165/70 R13 T		165	70	13	T	5 1/2Jx13	4	98	39		
10	Alfa Romeo	Italy	Alfa 33 4x4	86-94	2475	97.44	1366	53.78	1365	53.74	175/70 R13 T	175/65 R14	175	70	13	T	5 1/2Jx13	4	98	39		
11	Alfa Romeo	Italy	Alfa 33 1.5 TI	86-94	2475	97.44	1366	53.78	1365	53.74	185/60 R14 H		185	60	14	H	5 1/2Jx14	4	98	39		
12	Alfa Romeo	Italy	Alfa 33 1.7 Qv	86-94	2475	97.44	1366	53.78	1365	53.74	185/60 R14 H		185	60	14	H	5 1/2Jx14	4	98	39		
13	Alfa Romeo	Italy	Alfa 33 1.7 i.e	86-94	2475	97.44	1366	53.78	1365	53.74	185/60 R14 H		185	60	14	H	5 1/2Jx14	4	98	39		
14	Alfa Romeo	Italy	Alfa 75 2.0	82-93	2510	98.82	1368	53.86	1368	53.46	185/70 R13 T	185/65 R14	185	70	13	T	5 1/2Jx13					
15	Alfa Romeo	Italy	Alfa 90 1.8-2.0		2510	98.82	1366	53.78	1368	53.46	185/70 R14 H		185	70	14	H	5 1/2Jx14					
16	Alfa Romeo	Italy	Alfa 90 Turbodiesel		2510	98.82	1366	53.78	1368	53.46	185/70 R14 T		185	70	14	T	5 1/2Jx14					
17	Alfa Romeo	Italy	145 1.9 TD	96-98	2540	100.00	1480	58.27	1441	56.73	175/65 R14 H		175	65	14	H	5 1/2Jx14	4	98	43		
18	Alfa Romeo	Italy	145 1.4	94-00	2540	100.00	1480	58.27	1441	56.73	175/65 R14 T	185/60 R14 H	175	65	14	T	5 1/2Jx14	4	98	43		
19	Alfa Romeo	Italy	145 1.6	94-00	2540	100.00	1472	57.95	1441	56.73	185/60 R14 H		185	60	14	H	5 1/2Jx14	4	98	43		
20	Alfa Romeo	Italy	145 1.7 16V	94-00	2540	100.00	1472	57.95	1441	56.73	185/60 R14 H		185	60	14	H	5 1/2Jx14	4	98	43		
21	Alfa Romeo	Italy	145 2.0	94-00	2540	100.00	1480	58.27	1428	56.22	185/60 R14 H	195/55 R15 V	185	60	14	H	5 1/2Jx14	4	98	43		
22	Alfa Romeo	Italy	145 1.9 JTD	96-00	2540	100.00	1472	57.95	1441	56.73	185/60 R14 H	175/65 R14 T	185	60	14	H	5 1/2Jx14	4	98	43		
23	Alfa Romeo	Italy	145 1.8	94-00	2540	100.00	1472	57.95	1441	56.73	195/55 R15 V		195	55	15	V	6Jx15	4	98	35		
24	Alfa Romeo	Italy	145 Quadrifoglio	98-00	2540	100.00	1472	57.95	1441	56.73	195/55 R15 V		195	55	15	V	6Jx15	4	98	35		
25	Alfa Romeo	Italy	146 1.4	94-99	2540	100.00	1472	57.95	1441	56.73	175/65 R14 H	185/60 R14 H	175	65	14	H	5 1/2Jx14	4	98	43		
26	Alfa Romeo	Italy	146 1.9 TD	98-99	2540	100.00	1480	58.27	1441	56.73	175/65 R14 T		175	65	14	T	5 1/2Jx14	4	98	43		
27	Alfa Romeo	Italy	146 Super V6 24V	94-99	2540	100.00	n.a	n.a	n.a	n.a	195/65 ZR15		195	65	15	Z	6Jx15	4	98	35		
28	Alfa Romeo	Italy	146 2.0	94-99	2540	100.00	1480	58.27	1428	56.22	185/60 R14 H		185	60	14	H	5 1/2Jx14	4	98	43		
29	Alfa Romeo	Italy	146 1.9 JTD	94-99	2540	100.00	1472	57.95	1441	56.73	185/60 R14 H		185	60	14	H	5 1/2Jx14	4	98	43		
30	Alfa Romeo	Italy	146 1.8	94-99	2540	100.00	1472	57.95	1441	56.73	195/55 R15 V		195	55	15	V	6Jx15	4	98	35		
31	Alfa Romeo	Italy	146 Super V6	94-99	2540	100.00	n.a	n.a	n.a	n.a	195/55 R15 V		195	55	15	V	6Jx15	4	98	35		

Figure 7: Car Database.



TIRE GLOBAL INFORMATION

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DATABASE LIBRARY 2013

Click on DATABASE for SEARCH

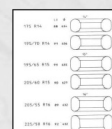


EXCEL-VERSION
ACCESS-VERSION
PDF-VERSION

TIRE DATABASE



CAR DATABASE



TIRE SIZES

SPEED INDEX

LOAD INDEX

DOT CODES

new tires

DOT CODES

retread tires

UTQG CODES

WEB INFO CARS

WEB INFO TIRES

COMPANY ADDRESSES

RETRADING COMPANIES

TUBE MANUFACTURERS

OLD TIMER'S TIRE DEALER

ORGANIZATIONS

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Figure 8: Database Library.

- * Top right: conversion table for replacement tire sizes (Figure 9)
- * Center left: database for speed and load index (Figures 10 and 11)
- * Center, below car database: DOT codes for the production location of each tire and the UTQG code for “traction, wear and temperature” which are important for the use of tires
- * All other databases are addresses of tire companies, old timer’s tire dealers

Summary

To find a car or tire involved in a crime it is easy to use the databases to get preliminary results. No database will replace person evaluating the results. The aim of our databases is to reduce time for the crime scene team in order to get an overview of relevant tire tracks and start the search for the involved vehicles.

The database is written in standard Microsoft format “Excel” and “Access” so that it can be used worldwide.

	A	B	C	D	E	F	G
1	METRIC TIRE SIZES						
2	TIRE DIMENSION based on EUROPEAN STANDARD						
3	<i>all measurements are based on DESIGN measurements by recommended rim and</i>						
4							
5	TIRE SIZE	WIDTH		TIRE DIMENSION		CIRCUMFERENCE	
6		[mm]	[inch]	[mm]	[inch]	[m]	[inch]
7	175 R13	178	7.008	608	23.937	1.910	75.200
8	175/80 R13	177	6.969	610	24.016	1.916	75.448
9	195/65 R14	201	7.913	610	24.016	1.916	75.448
10	175/65 R15	177	6.969	609	23.976	1.913	75.324
11	205/55 R15	214	8.425	607	23.898	1.907	75.077
12	225/50 R15	233	9.173	607	23.898	1.907	75.077
13	255/45 R15	255	10.039	611	24.055	1.920	75.571
14	285/40 R15	290	11.417	609	23.976	1.913	75.324
15	185/55 R16	194	7.638	610	24.016	1.916	75.448
16	205/50 R16	214	8.425	612	24.094	1.923	75.695
17	225/45 R16	225	8.858	608	23.937	1.910	75.200
18	255/40 R16	260	10.236	610	24.016	1.916	75.448
19	195/45 R17	195	7.677	608	23.937	1.910	75.200
20	225/40 R17	230	9.055	612	24.094	1.923	75.695
21	215/35 R18	218	8.583	607	23.898	1.907	75.077
22	255/30 R18	260	10.236	611	24.055	1.920	75.571

Figure 9: Example - conversion table for a tire diameter between 607 [mm] to 612 [mm].

Symbol	km/h	mph	Symbol	km/h	mph	Symbol	km/h	mph
A1	5	3	D	65	40	Q	160	99
A2	10	6	E	70	43	R	170	106
A3	15	9	F	80	50	S	180	112
A4	20	12	G	90	56	T	190	118
A5	25	16	J	100	62	U	200	124
A6	30	19	K	110	68	H	210	130
A7	35	22	L	120	75	V	240	149
A8	40	25	M	130	81	W	270	168
B	50	31	N	140	87	Y	300	186
C	60	37	P	150	93	ZR	> 240	> 149

Figure 10: Speed index.

LI	kg	lbs	LI	kg	lbs	LI	kg	lbs	LI	kg	lbs	LI	kg	lbs
50	190	419	65	290	639	80	450	992	95	690	1521	110	1060	2337
51	195	430	66	300	661	81	462	1019	96	710	1565	111	1090	2403
52	200	441	67	307	677	82	475	1047	97	730	1609	112	1120	2469
53	206	454	68	315	694	83	487	1074	98	750	1653	113	1150	2535
54	212	467	69	325	716	84	500	1102	99	775	1709	114	1180	2601
55	218	481	70	335	739	85	515	1135	100	800	1764	115	1215	2679
56	224	494	71	345	761	86	530	1168	101	825	1819	116	1250	2756
57	230	507	72	355	783	87	545	1202	102	850	1874	117	1285	2833
58	236	520	73	365	805	88	560	1235	103	875	1929	118	1320	2910
59	243	536	74	375	827	89	580	1279	104	900	1984	119	1360	2998
60	250	551	75	387	853	90	600	1323	105	925	2039	120	1400	3086
61	257	567	76	400	882	91	615	1356	106	950	2094	121	1450	3197
62	265	584	77	412	908	92	630	1389	107	975	2149	122	1500	3307
63	272	600	78	425	937	93	650	1433	108	1000	2205	123	1550	3417
64	280	617	79	437	963	94	670	1477	109	1030	2271	124	1600	3527

Figure 11: Load index.

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