ADAC Tyre test

Tyre abrasion – On road tests

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ADAC tyre test - tyre wear

Motivation

The environmental impact of tyre abrasion is increasingly coming into the focus of public perception, often in the context of the general term microplastics. According to recent studies, around 500,000 tonnes of tyre wear are produced annually in the EU.

- **Data basis:** Tyre wear measurements Convoy test
- **Evaluation** summer and winter tyre tests from 2019, 2020, 2021, 2022
  Period: All-season tyre test 2016
- **Methodology:** Evaluation of the weight loss of the tyres in g/1,000 km related to the entire vehicle. Determined by weighing the tyre when new and after 15,000 km

Tyre wear test:

Convoy test: Procedure

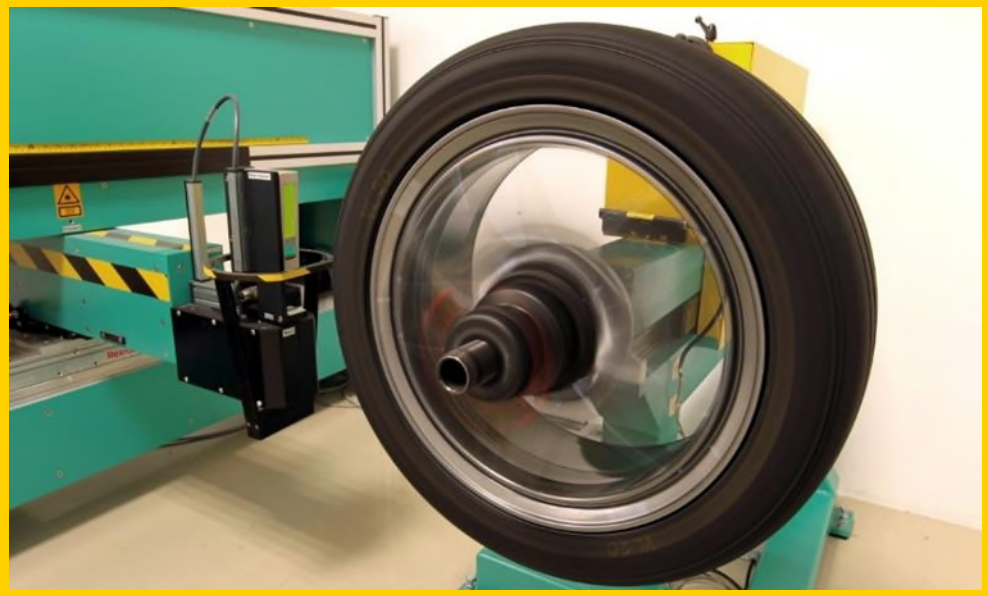
- Driving distance 15,000 km
- 60 % urban and country roads, 40 % motorway
- Daily driving distance: two rounds (clockwise/counterclockwise) with 305 km driving distance each.
- Daily documentation of temperature and driving conditions
- 5 convoys with 4 vehicles each
- Each convoy with 3 test tyres and one reference tyre
- Tyres and drivers rotate anti-cyclical
- Daily check of tyre pressure before driving off
- Test vehicle drives with half payload
- Dummy on passenger and rear seats with 70 kg each

ADAC Technical Centre
Landsberg am Lech, Germany

Tyre wear test

Convoy test: measurement of tyre wear

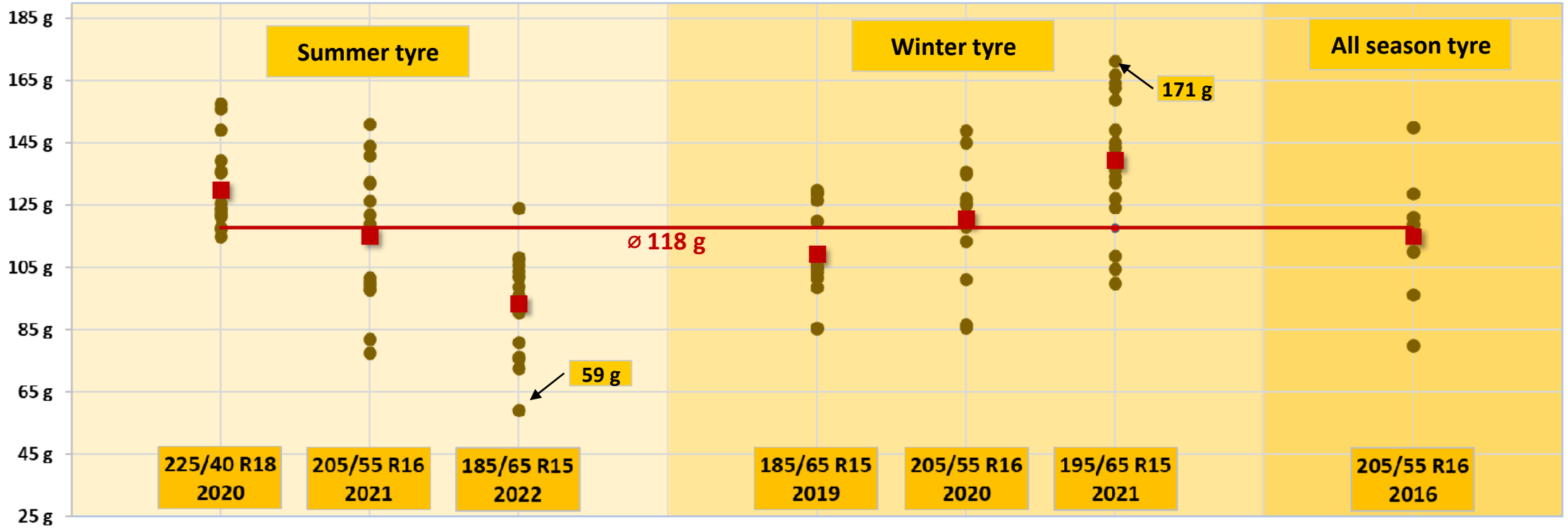
- Tread depth **and tyre weight** is measured every 2,500 km
- The tread depth and tyre weight of the rear tyres is measured every 7,500 km
- Tread depth measurement with special laser-based measuring system
- 8,200 measuring points per revolution, a total of more than one million measuring points per tyre
- Measurement of tyre weight loss



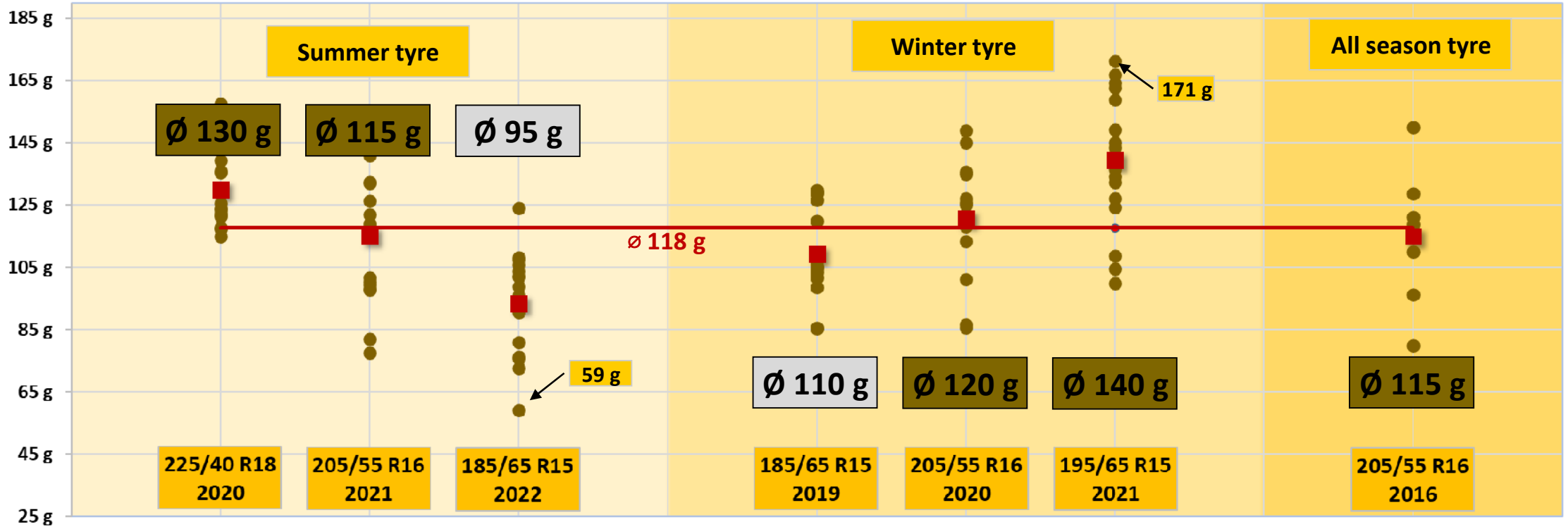
Premises when considering weight loss

- Extrapolation of the tyre weight loss up to a residual tread depth of 1.6 mm is not possible.
- Weight loss is decreasing: higher weight loss at the beginning than at the end
- The abrasion values determined are an average value over 15,000 km.
- The weight of the rear axle tyres is not measured -> the weight loss is extrapolated on the basis of the front axle data, assuming that the tyre wear - and thus the weight loss - is approx. 25% of the front axle tyres
- When considering the absolute weight loss, it should be noted that rubber compounds can have different weights per unit volume of tyre

Tyre wear per vehicle [g/1,000 km]



Tyre wear per vehicle [g/1,000 km]



VW Golf VII VW Polo

The evaluation of the tyre wear provides the following findings

- On average, the tyre wear of a vehicle is just under 120 g per 1,000 km.
- There are no general differences in tyre wear between summer, winter and all-season tyres. There is a tendency for tyre wear to be slightly lower on summer tyres than on the comparable winter tyre size.
- In almost all tyre sizes tested, tyres are found that allow a low tyre wear of < 100 g per 1,000 km.
- One exception is the summer tyre size 225/40 R18. In this size, especially the sporty tyre models were tested, all of which have an above-average tyre wear.
- The summer tyre size 195/65 R15 is also striking. In this dimension, which is suitable for compact vehicles and vans, tyre wear is generally at a very high level. Whether this tyre dimension has design disadvantages or whether the manufacturers are using outdated tyre technology here could not be definitively clarified. But it seems, that this tyre is undersized for the vehicle class.
- The 185/65 R15 tyre size stands out particularly positively. In this tyre size, which is suitable for small cars, there are many models that produce significantly less than 100 g/1,000 km of tyre wear, especially in the summer tyres.

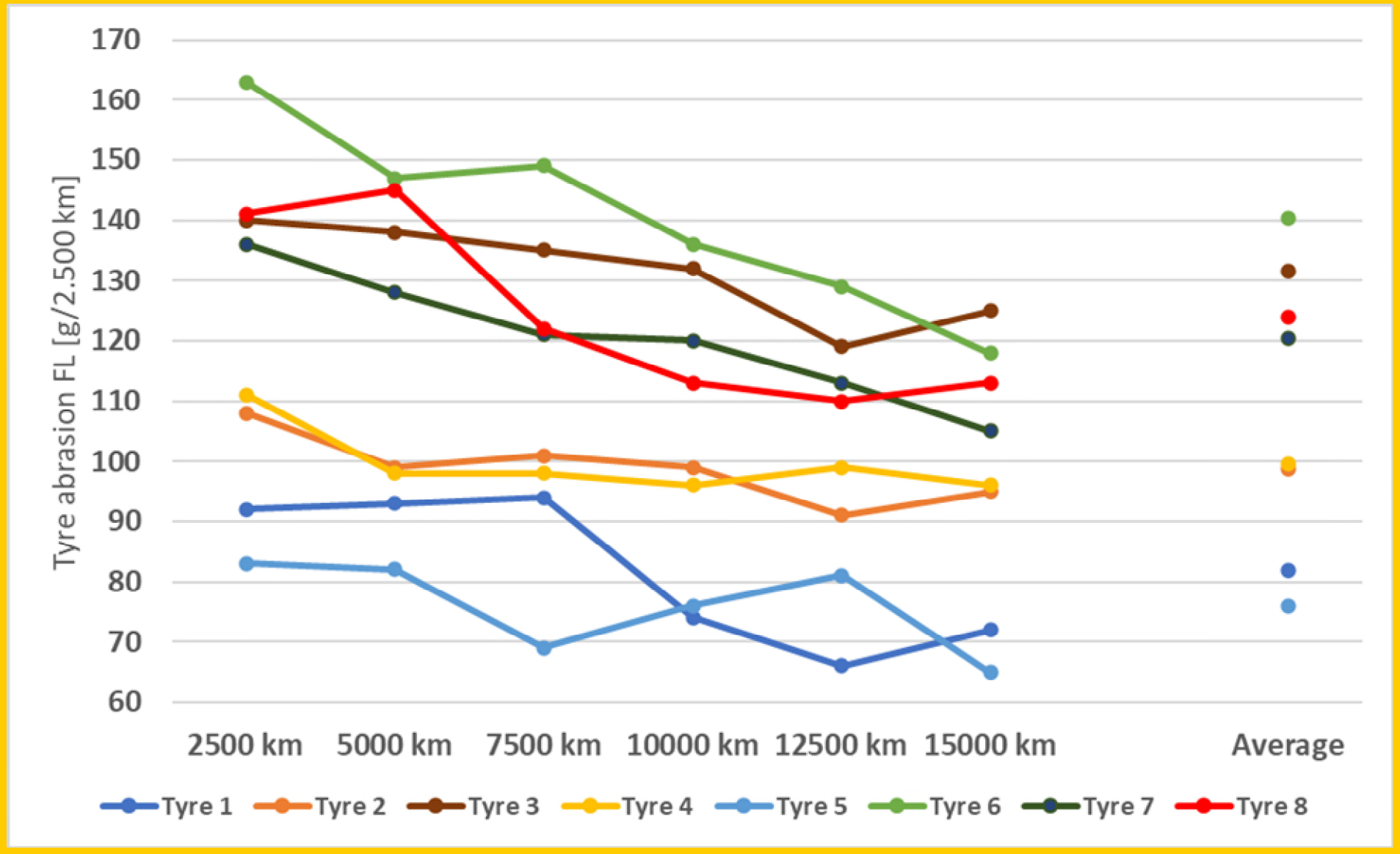
The investigation of the correlations between tyre wear and tyre performance yields the following conclusions

- There are tyre models in all dimensions that have low wear and good driving safety at the same time.
- Tyres with low abrasion do not necessarily lead to increased risk of aquaplaning, as aquaplaning characteristics depend purely on tread design and depth and not on the rubber compound.
- In winter tyres, it is evident that tyres with low abrasion tend to have poorer snow performance. However, there are tyres that resolve this trade-off in the best possible way and still have acceptable snow performance with low wear.
- Especially with sporty tyre dimensions and so-called ultra-high performance tyres (UHP), the focus often seems to be placed only on high driving stability on dry roads. The tyre wear that goes along with this is hardly in the focus of many manufacturers. However, the above-average tyre performance on dry roads hardly brings any additional safety gain in normal road use, as the limit range is enormously high. These tyres are at best good for the race track.

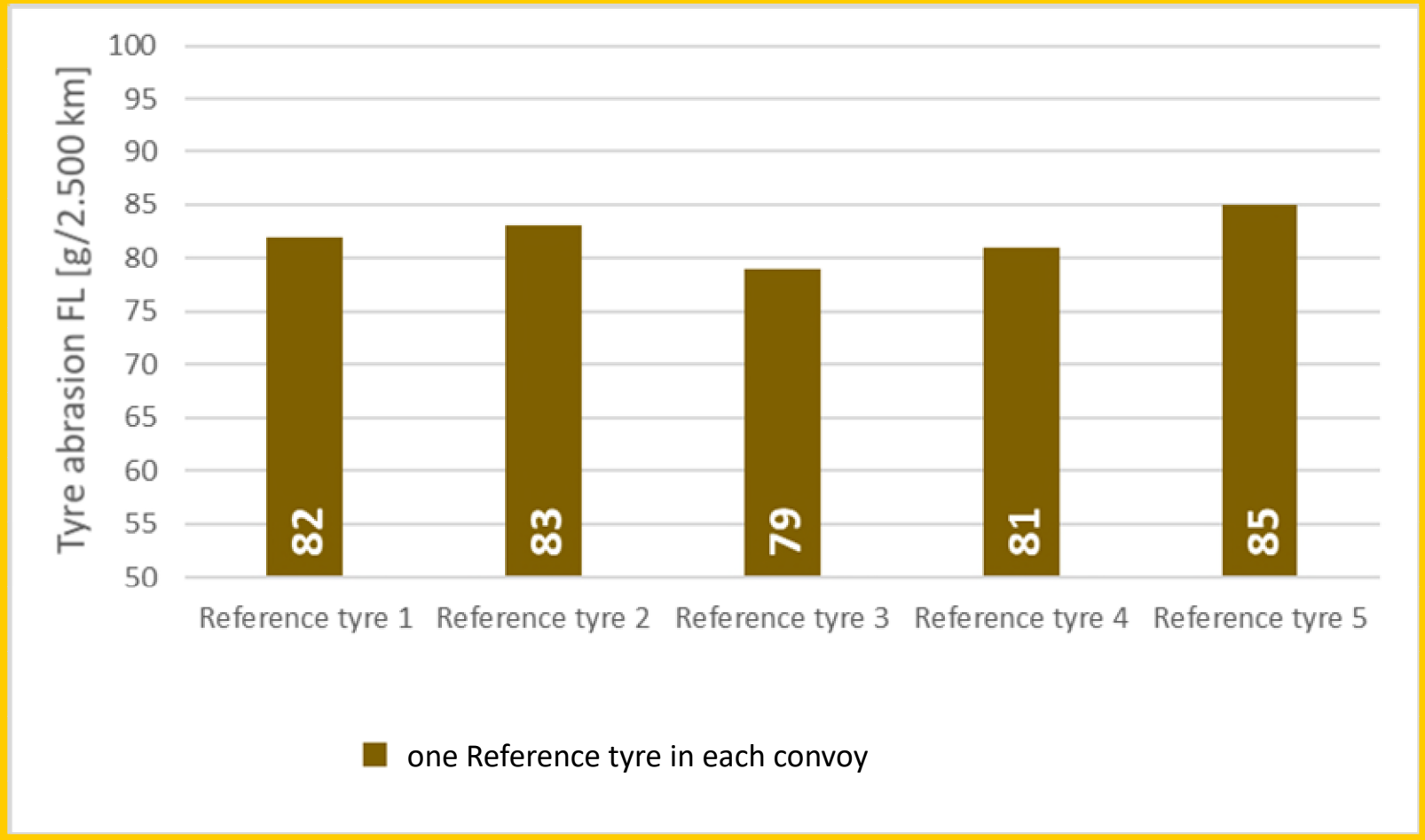
Conclusion

- Modern tyres can be low-wear and safe at the same time. Tyre manufacturers need to make better use of this technological leap in future tyre developments to reduce the environmental impact of tyre abrasion
- Today, a premium tyre is no longer defined only by safety and performance. Above all, the so-called premium manufacturers should be aware of their responsibility and attach significantly greater importance to the issue of tyre abrasion, especially also in public perception and in advertising statements
- Ultra-high performance tyres hardly improve driving safety in normal road traffic any more, but belong on the race track. Tyre manufacturers should therefore focus more on safe and at the same time environmentally friendly tyres in the future
- Environmentally friendly tyres should be offered in all common tyre sizes. If, due to the design, there are tyre sizes that cannot fully resolve the conflict of objectives with regard to driving safety, this should also be clearly communicated to consumers, or a more sensible tyre size should be recommended.

Tyre abrasion over test time [Example: summer tyre 205/55 R16]



Repeatability onroad tests [Example: summer tyre 205/55 R16]



ADAC experience with Onroad wear tests

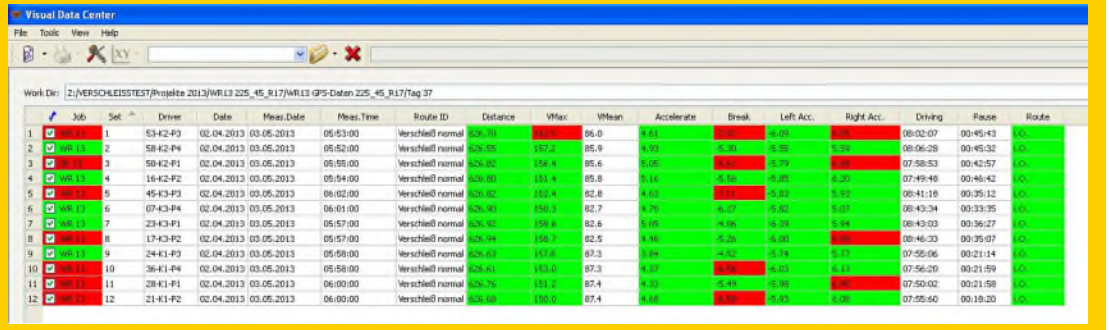
- Tyre abrasion tests in real world operation can only provide a valid and reproducible result if reference tyres (and reference vehicles) are used.
- As tyre abrasion changes over the lifetime of the tyre, a driving distance of at least 10,000 km is strongly recommended.
- Comparable abrasion tests in real traffic are complex and time-/cost-intensive, have a negative impact on the environment and the population, and pose a safety risk for the drivers and other road users
- The aim should therefore be to develop a laboratory test for evaluating tyre abrasion with highest priority. The first step should be to define an appropriate test bench, that reflects the real world abrasion behaviour of a tyre as far as possible.
- In the second step a representative driving profile should be defined in order to determine the absolute tyre abrasion. The use of the existing WLTC cycle supplemented by lateral accelerations could be helpful here.
- The development of a tyre abrasion test should take into account the experience gained from emissions legislation in terms of the test methodology and verification tests (WLTP, RDE, ISC).

Thank you for your attention

Tyre wear test:

Convoy test: Measuring equipment

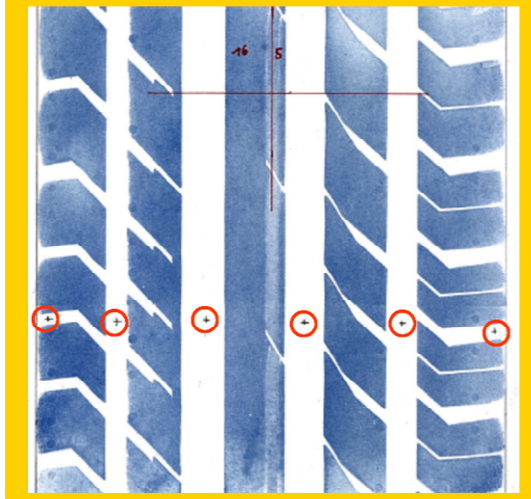
- GPS datalogger with 8 Hz data recorder
- Route
- Speed
- Longitudinal and lateral accelerations
- Driving time and breaks
- Route

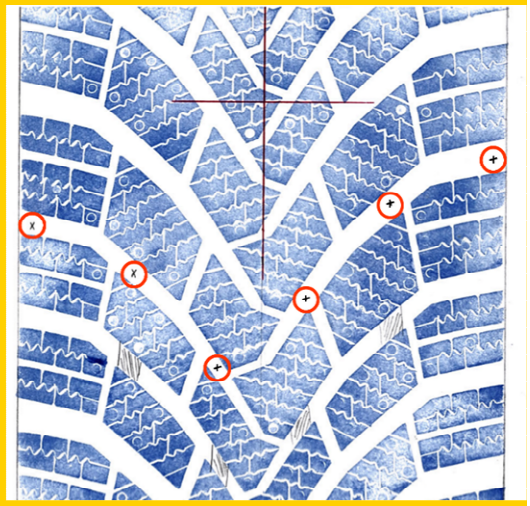


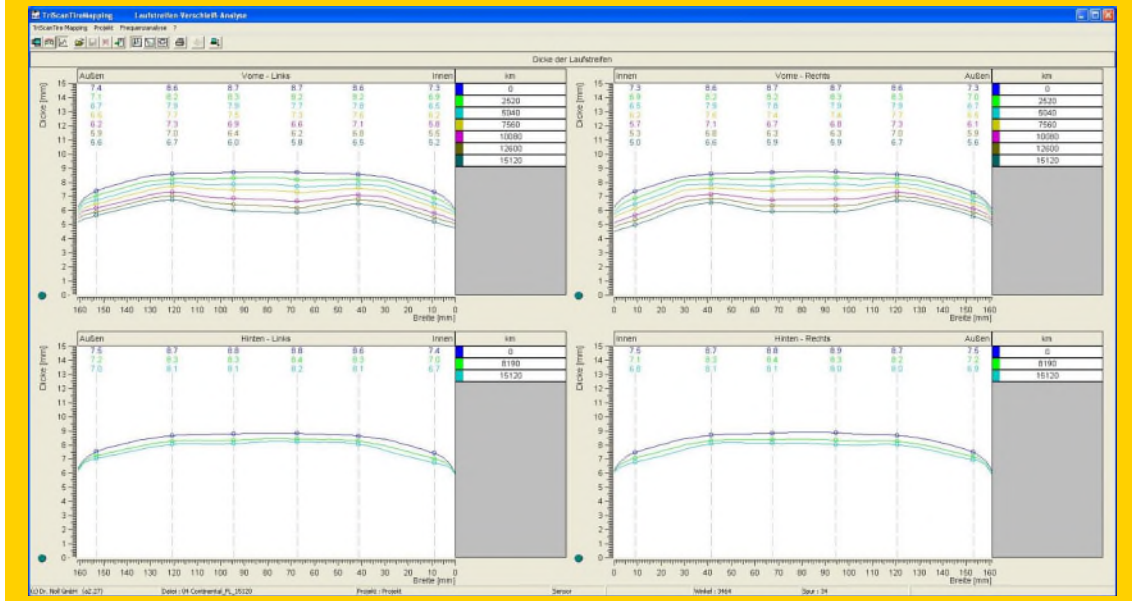
Tyre wear test

Convoy test: measurement of tyre wear

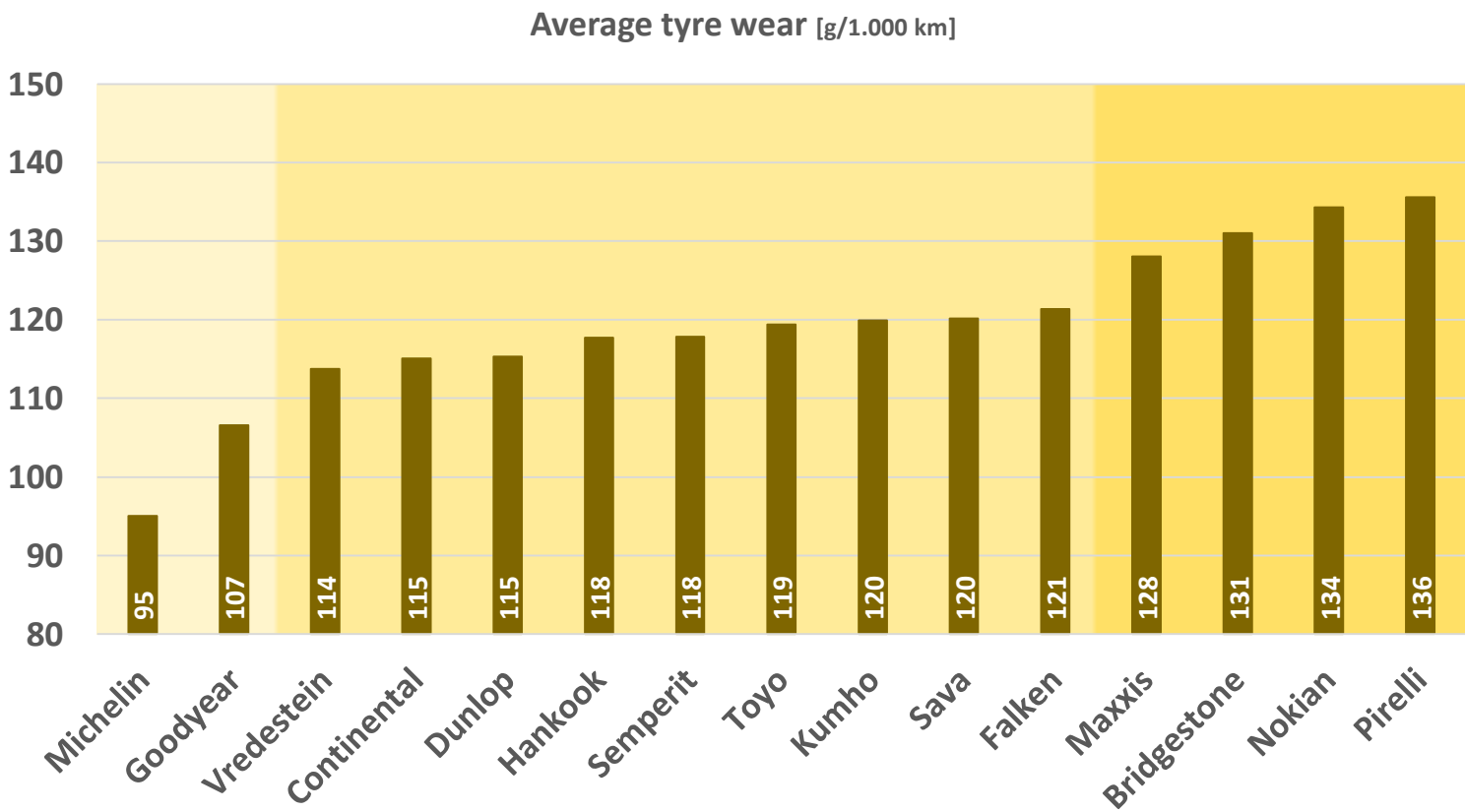
- Running performance is calculated up to a limit of 0.5 mm on shoulders and 1.6 mm on TWI lines
- The total power is calculated from 33% of the average shoulder and 67% of the average TWI lines
- If the estimate of the worst groove differs from the overall estimate by more than a factor of 2, the worst groove is scored.







Low tyre wear and safe driving characteristics



Version: 03/2022

Results in detail

225/40R18 (Sommerreifen 2020)	Reifenabrieb [g/1.000 km] ↑	Note trockene Fahrbahn	Note nasse Fahrbahn
Falken Azenis FK510	115	2,9	2,4
Bridgestone Potenza S001	117	1,7	3,0
Michelin Pilot Sport 4	118	1,9	2,0
Rotalla Setulla S-Pace RU01	118	2,9	3,6
Goodyear Eagle F1 Asymetric 5	121	1,7	2,3
Cooper Zeon CS-Sport	122	2,0	3,3
Maxxis Victra Sport 5	123	2,0	2,2
Vredestein Ultrac Vorti	124	2,5	2,7
Nexen N`Fera Sport	124	2,2	2,6
Continental Premium Contact 6	125	2,4	1,7
Sava Intensa UHP 2	135	1,8	2,7
Hankook Ventus S1 Evo3	136	2,0	3,1
Nokian Powerproof	139	2,4	2,4
Toyo Proxes Sport	149	2,0	2,8
Kumho Ecsta PS71	156	2,4	2,3
Pirelli P Zero	157	1,3	1,8
Durchschnittlicher Reifenabrieb:	130 g/1.000 km		

very good
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Results in detail

205/55R16 (Sommerreifen 2021)	Reifenabrieb [g/1.000 km] ↑	Note trockene Fahrbahn	Note nasse Fahrbahn
Goodyear Efficient Grip Performance 2	82	2,6	2,3
Fulda Ecocontrol HP2	98	2,5	2,8
Petlas Imperium PT515	98	3,3	3,3
Kumho Ecsta HS51	99	2,6	2,2
Apollo Alnac 4G	100	2,6	2,7
BF Goodrich Advantage	102	2,2	2,9
Bridgestone Turanza T005	118	2,0	2,1
King Meiler Sport 1	119	3,2	3,6
Semperit Speed-Life 3	122	2,0	1,9
Continental Premium Contact 6	126	2,0	1,8
Maxxis Premitra 5	132	1,4	2,2
Hankook Ventus Prime 3 K125	132	1,5	2,7
Uniroyal Rainsport 5	141	2,9	2,1
Pirelli Cinturato P7 C2	144	2,0	2,0
Nokian Wetproof	151	2,1	2,3

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Continental EcoContact 6	59	2,5	2,8
FULDA EcoControl HP 2	73	2,7	3,1
Firestone ROADHAWK	76	2,2	2,8
GOODYEAR EfficientGrip Performance 2	76	2,3	2,0
MICHELIN PRIMACY 4	81	1,8	2,0
COOPER CS7	90	3,2	3,2
BFGoodrich ADVANTAGE	91	2,9	3,0
SEMPERIT SPEED-LIFE 3	96	2,4	3,0
PIRELLI CINTURATO P1 VERDE	99	1,6	2,3
Laufenn G Fit EQ+	102	2,4	2,6
Matador MP47 Hectorra 3	102	3,3	2,7
BRIDGESTONE TURANZA T005	104	1,8	1,7
DUNLOP SPORT BLUERESPONSE	106	2,0	2,5
FALKEN SINCERA SN110 ECORUN	107	1,9	2,6
Giti GitiSynergy H2	108	2,4	2,3
VREDESTEIN ULTRAC	124	1,8	2,1
Durchschnittlicher Reifenabrieb:	93 g/1.000 km		

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185/65R15 (Winterreifen 2019)	Reifenabrieb [g/1.000 km] ↑	Note trockene Fahrbahn	Note nasse Fahrbahn	Note auf Schnee
Kleber Krisalp HP3	85	2,1	2,3	2,5
Michelin Alpin A4	86	2,2	2,1	2,8
Vredestein Snowtrac 5	99	3,0	2,8	2,7
Davanti Wintoura	102	3,4	5,5	3,8
Goodyear Ultragrip 9	104	2,5	1,9	3,1
Toyo Snowprox S943	105	3,0	2,6	5,1
Sava Eskimo S3+	105	3,6	2,8	1,9
Dunlop Winter Response 2	105	2,3	1,9	1,9
Falken Eurowinter HS01	107	2,7	2,5	2,9
Continental Winter Contact TS860	108	2,5	1,8	2,2
Hankook Winter i*cept RS2 W452	109	2,5	2,1	2,5
Nokian WR D4	120	3,1	2,9	2,0
Gislaved Euro Frost 6	127	2,8	3,2	2,7
Kumho Wintercraft WP51	129	2,7	2,8	3,2
Pirelli Cinturato Winter	129	2,4	2,0	2,4
Viking Win Tech	130	2,5	3,2	2,5
Durchschnittlicher Reifenabrieb:	109 g/1.000 km			

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Tristar Snowpower HP	86	2,2	5,5	4,3
Michelin Alpin 6	87	2,5	2,0	2,1
King Meiler Winter Tact WT81	101	3,7	5,4	2,9
Falken Eurowinter HS01	113	2,9	2,3	2,7
Dunlop Winter Sport 5	118	2,5	2,3	2,0
Sava Eskimo HP2	120	3,1	3,1	2,5
Hankook Winter i*cept RS2	121	2,5	2,0	2,1
Goodyear Ultra Grip 9+	122	3,0	2,0	1,8
Toyo Observe S944	125	3,2	2,5	2,3
Giti Gitiwinter W1	126	3,4	3,3	2,0
Continental Winter Contact TS860	127	3,0	1,8	2,0
Maxxis Premitra Snow WP6	135	2,0	2,3	2,5
Semperit Speed-Grip 3	136	3,7	2,1	1,9
Bridgestone Blizzak LM005	145	2,1	1,3	2,1
Pirelli Cinturato Winter	149	3,3	2,2	1,8
Durchschnittlicher Reifenabrieb:	121 g/1.000 km			

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BF Goodrich G-Force Winter 2	100	2,2	2,6	1,9
Michelin Alpin 6	105	1,9	2,5	2,2
Vredestein Wintrac	109	2,5	2,3	2,2
General Tire Altimax Winter 3	124	3,4	3,5	1,9
Nokian WR Snowproof	127	2,5	3,3	2,3
Dunlop Winter Response-2	132	2,0	2,1	2,0
Goodyear Ultra Grip 9+	134	2,3	1,8	2,0
Kumho Wintercraft WP51	137	3,6	3,0	2,5
Barum Polaris 5	143	3,0	3,2	2,0
Continental Winter Contact TS860	145	2,7	1,6	1,9
GT Radial Winter Pro 2	149	3,5	3,5	2,4
Laufenn i Fit+ LW31	159	2,6	2,2	1,9
Yokohama Bluearth*Winter V906	163	2,1	3,1	2,2
Falken Eurowinter HS01	164	2,3	2,7	2,4
Maxxis Premitra Snow WP6	167	2,2	2,3	2,6
Bridgestone Blizzak LM005	171	2,5	1,7	2,8
Durchschnittlicher Reifenabrieb:	139 g/1.000 km			

very good
(0,6 - 1,5)

good
(1,6 - 2,5)

satisfactory
(2,6 - 3,5)

acceptable
(3,6 - 4,5)

poor
(4,6 - 5,5)

Results in detail

195/65R15 (Winterreifen 2021)	Reifenabrieb [g/1.000 km] ↑	Note trockene Fahrbahn	Note nasse Fahrbahn	Note auf Schnee
BF Goodrich G-Force Winter 2	100	2,2	2,6	1,9
Michelin Alpin 6	105	1,9	2,5	2,2
Vredestein Wintrac	109	2,5	2,3	2,2
General Tire Altimax Winter 3	124	3,4	3,5	1,9
Nokian WR Snowproof	127	2,5	3,3	2,3
Dunlop Winter Response-2	132	2,0	2,1	2,0
Goodyear Ultra Grip 9+	134	2,3	1,8	2,0
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Results in detail

185/65R15 Vergleich 2019 zu 2022			Reifenabrieb [g/1.000 km] ↑	Note trockene Fahrbahn	Note nasse Fahrbahn
Bridgestone	2019	Turanza T005	97	1,5	1,9
	2022	Turanza T005	104	1,8	1,7
Continental	2019	Conti Premium Contact 5	123	2,2	2,4
	2022	Conti EcoContact 6	59	2,5	2,8
Falken	2019	Ziex ZE310 Ecorun	71	1,8	3,0
	2022	Sincera SN110 Ecorun	107	1,9	2,6
Firestone	2019	Roadhawk	79	1,5	2,8
	2022	Roadhawk	76	2,2	2,8
Giti	2019	Gitisynergy E1	82	2,8	3,2
	2022	GitiSynergy H2	108	2,4	2,3
Goodyear	2019	Efficient Grip Performance	91	1,9	2,7
	2022	EfficientGrip Performance 2	76	2,3	2,0
Michelin	2019	Cross Climate +	58	2,6	2,4
	2022	Primacy 4	81	1,8	2,0
Pirelli	2019	Cinturato P1 Verde	93	2,3	3,4
	2022	Cinturato P1 Verde	99	1,6	2,3
Semperit	2019	Comfort-Life 2	99	2,9	3,0
	2022	Speed-Life 3	96	2,4	3,0
Vredestein	2019	Sportrac 5	70	2,3	2,2
	2022	Ultrac	124	1,8	2,1

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satisfactory
(2,6 - 3,5)

acceptable
(3,6 - 4,5)

poor
(4,6 - 5,5)

Example: Typical weight loss of a tyre during 15.000 km (front axle)

205/55R16 (Summer tyres 2021)	Tyre abrasion [g/1.000 km] ↑	Score dry road	Score wet road	Tyre noise [dB(A)]	Label (RR/wet/noise)
Goodyear Efficient Grip Performance 2	82	2,6	2,3	70,5	B/A/69
Fulda Ecocontrol HP2	98	2,5	2,8	70,8	C/B/70
Petlas Imperium PT515	98	3,3	3,3	73,0	C/B/71
Kumho Ecsta HS51	99	2,6	2,2	70,6	C/B/69
Apollo Alnac 4G	100	2,6	2,7	71,3	C/B/70
BF Goodrich Advantage	102	2,2	2,9	71,4	C/A/70
Bridgestone Turanza T005	118	2,0	2,1	73,1	B/A/71
King Meiler Sport 1	119	3,2	3,6	73,2	-
Semperit Speed-Life 3	122	2,0	1,9	70,5	C/B/71
Continental Premium Contact 6	126	2,0	1,8	71,8	C/A/71
Maxxis Premitra 5	132	1,4	2,2	71,8	C/A/70
Hankook Ventus Prime 3 K125	132	1,5	2,7	70,6	C/A/71
Uniroyal Rainsport 5	141	2,9	2,1	70,5	C/A/71
Pirelli Cinturato P7 C2	144	2,0	2,0	71,0	C/A/70
Nokian Wetproof	151	2,1	2,3	70,8	C/A/68

Durchschnittlicher Reifenabrieb: 118 g/1.000 km

Tips for the consumer

- Frequent drivers in particular should buy tyres with low wear - this not only saves money, but also protects the environment
- Summer/winter tyres should be changed seasonally so that they do not fall out of the appropriate temperature window and wear increases unnecessarily as a result.
- Tyre pressure should be checked regularly. Underinflation can increase wear just as much as overinflation.
- The axle settings should be checked at regular intervals in a specialist workshop, at the latest when an uneven wear pattern is noticed on the tyre
- A steady and anticipatory driving style not only ensures low fuel consumption, but also ensures less tyre wear

Factors influencing tyre wear

"Tyre wear in everyday use is strongly influenced by operating and driving style. A fuel-efficient driving style also ensures lower tyre abrasion."

- **Topography:** driving in mountainous regions increases tyre abrasion
- **Driving surface:** concrete surfaces cause higher tyre abrasion than asphalt
- **Weather conditions:** wet road surfaces cause higher tyre abrasion
- **Air temperature:** higher temperatures increase tyre abrasion
- **Vehicle Weight:** the higher the vehicle weight, the higher the tyre abrasion
- **Axle geometry:** sporty chassis setup increases tyre abrasion
- **Engine characteristics:** higher torque increases tyre abrasion
- **Driving speed:** higher speed causes higher tyre abrasion
- **Driving style:** proactive, fuel-efficient driving reduces tyre abrasion

Tyres when new

Production residues on the tyre surface

- Some new tyres have a large rubber overhang on the tread that does not provide any technical benefit to tyre performance.
- The rubber overhang leads to increased tyre wear on the first few kilometres of driving with new tyres. This is an unnecessary environmental impact that could easily be remedied by the tyre manufacturer.