



A cyclist is riding on a wet road, with water splashing around the tires. The background is a blurred green field and a white post. The title 'RESISTANCE FIGHTERS' is overlaid on the top left. The word 'RESISTANCE' is in white, and 'FIGHTERS' is in blue.

RESISTANCE FIGHTERS

Sixteen tires undergo the big laboratory and practice test, for rolling resistance, adhesion and puncture protection. Which tires have their noses in front? Are tube tires better than folding tires? How can the new tubeless tires perform? Three questions, straight answers and a clearest winner.

TEXT AND PHOTOS: ROBERT KÜHNEN

The horror of metal scraping on asphalt. The typical crash noises make you cringe and the adrenalin rushes to your blood. Thank goodness there's no pain. The motorcycle safety combination and the suit protection absorb the shock of the crash as the driver careens across the wet asphalt and he is back on his feet after two seconds. If he had been dressed only in cycling shorts and T-shirt he wouldn't have gotten away so lightly. This lasts two days long and at the end the motorcycle combination is completely wrecked on the left hand side.

IN SHORT

Tires are inconspicuous items but they certainly have what it takes. There's a world of difference between the best and the worst. There's no better tuning method than fitting a new set of rubber boots. The latest rubber combinations give a real boost to performances. The test-winner, Continental's "GP 4000 S" rolls very well, is very adhesive and is also more puncture proof. A view of the future is Hutchinson's tubeless tire which also rolls very lightly. The tubular tires aren't up to the standard of the top folding tires.

What looks like courageous fun is really hard work, right up to the limit of the driver's prowess and sometimes even beyond that. The target: to test the adhesion of racing tires to their limits and to compare performances. The method is not it hout risk but better practice orientated than any other test. The extra knowledge gained is well worth the sweat. Good adhesion is just one of the challenges for tires and for which they are naturally judged. On top

Basic knowledge about racing tires

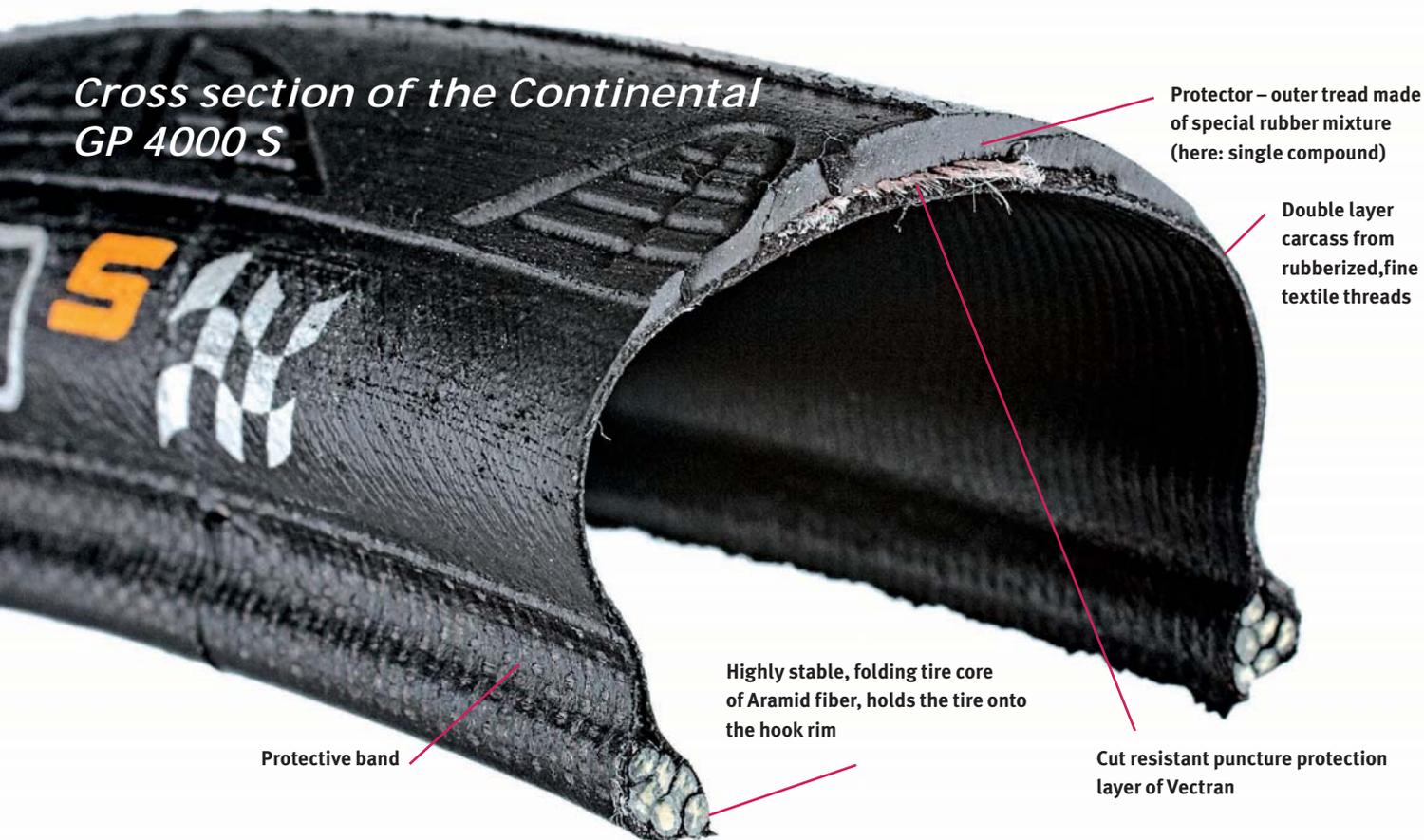
Aramid – very hard, artificial fiber for tire cores and breakdown protection layers
+++ Breaker – breakdown protection layers under the tire wall
+++ Butyl – artificial rubber, material for tubes, extremely airtight
+++ Compound – rubber mixture for the tire wall (single, dual, triple compound for single, double or triple rubber mixtures)
+++ Snakebite – tire defect caused when an object gets trapped between the rim and the tire wall
+++ Folding tire – tire with folding core for hooking rim
+++ Carcass – underbody of the tire made of rubber textile threads
+++ Latex – natural rubber. Material for special light running tubes. Not completely airtight but extremely elastic and difficult to pierce
+++ Protector – outer tread of the tire
+++ Tire width – important for

of that they should also roll lightly, last for ages and be puncture proof, qualities which tend to stand in each other's way. Good adhesion and light rolling oppose each other just as light running and optimal puncture protection. Nevertheless the manufacturers never give up and keep trying with new rubber combinations and construction tricks, such as the tubeless tire, to square the circle.

A VARIETY OF CONSTRUCTIONS

Our test will show if they will succeed. Ten folding tires and six tubular tires take the start. They are mostly the established bestsellers. The recommended prices range from 37 to 99 euros, but the market demands them for 30 % less. The tires distinguish themselves in their construction quite clearly as in carcass construction, puncture protection, rubberizing and profile. The treads are made from up to three

Cross section of the Continental GP 4000 S



Protector – outer tread made of special rubber mixture (here: single compound)

Double layer carcass from rubberized, fine textile threads

Highly stable, folding tire core of Aramid fiber, holds the tire onto the hook rim

Cut resistant puncture protection layer of Vectran

Protective band

the ride performance. Wider tires roll easier under the same pressure as smaller tires. 23 mm is a good compromise for riding comfort and an easy run. At very high speeds smaller tires can be advantageous due to aerodynamic benefits +++ **Tire size** – given in millimeter after the ETRTO norm: 622 -23 stands for 622 millimeter inside diameter and 23 millimeter width +++ **Tire height** - stands for the outer circumference. Higher tires offer better all round protection +++ Tubular tires – tires with a built-in, non-exchangeable tube. Stuck to the rim +++ **Tubeless** – tubeless folding tires with an airtight outer wall, which can be ridden on special wheel rims +++ Vectran – extreme cut safe artificial fiber, from which puncture protective layers are made

rubber mixtures, which are meant to optimize the road handling: softer adhesive mixtures for the tire flanks and a hardwearing mixture for the middle of the tread are a normal strategy. Schwalbe with their model “Ultremo” use different layers molded over each other. On the other hand there are single-compound mixtures who’s tread is made from just one form of rubber, for example at Conti and Zipp. The profiles offer everything you want, from Slick to Diamond to the special molding of the Zipp tires, about which the manufacturer explained that the golfball-shaped surface of the “Tangente” model, similar to the rims, improves the aerodynamics. Unfortunately during this test we couldn’t qualify this.

Under the folding tires the new Hutchinson tubeless model, which is fitted onto special rims (see the box right), stands out. Classic – some might say archaic – are however tubular tires, which are glued directly onto the rims. Many bike racers still swear by these models and they have achieved new merits since carbon rims, made almost singularly for tubular tires, have dominated the cycling sport. One can philosophize about the different construction principles, in the end what counts is the measurable effect. Curtain up for the tests.

Tubeless and happy?

Tubeless tires have been available for mountain bikes for some years and offer clear advantages: they are more resistant against cuts and roll easier. Hutchinson now offers the first tubeless tire for a racing bike. The carcass is rubberized airtight; the tire holds the air via a fat lip onto the outside of the rim. A prerequisite is a specially made rim without spoke drilling where the valve is fixed directly onto the rim. At the present, the only available rim for the tubeless tire on a racing bike is the Shimano Dura-Ace aluminum rim. In tests the Hutchinson “Fusion 2 Tubeless” rolled nearly 18,5 watt lighter than the normal “Fusion 2” – another world. However the tubeless tire has a thinner tread, which favors a lighter run. When it comes to adhesion and puncture protection, the Hutchinson tubeless cannot compete with the best tires.

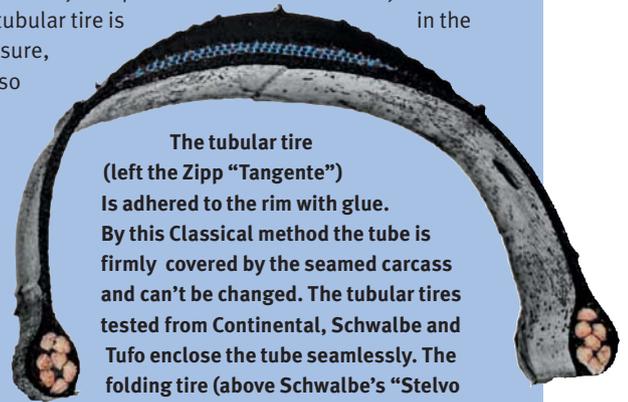
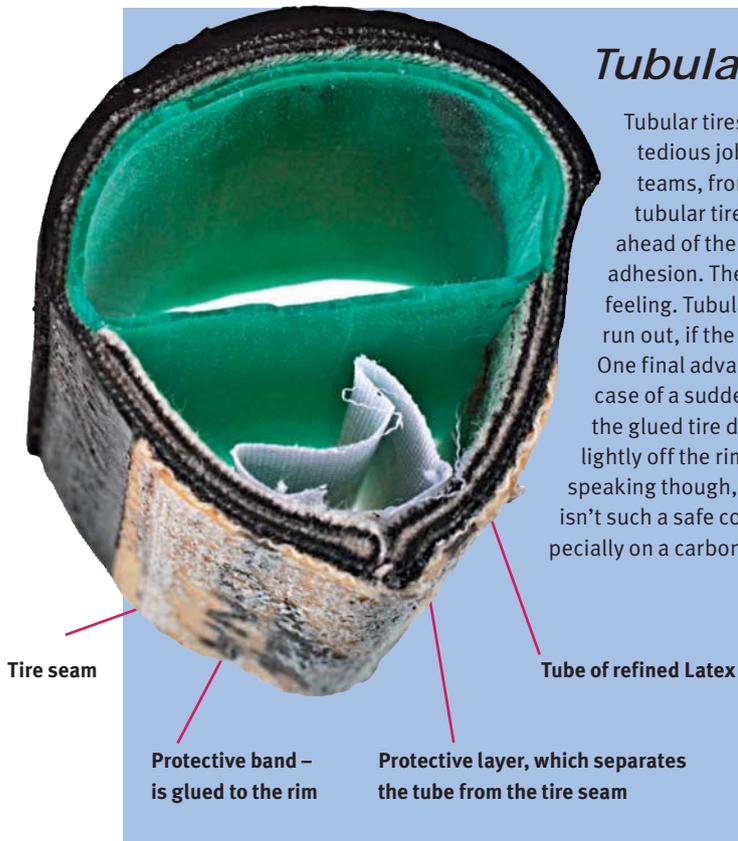
- + resistant to cuts
- + lower roll resistance
- only one rim type available at present
- 0,5 to 1 bar pressure loss per day



The tubeless model of the Hutchinson “Fusion 2” (right) is 66 gram heavier than the similarly constructed folding tire (left) It rolls very much lighter. This shows the potential of the new tubeless tire

Tubular- or folding tire?

Tubular tires are still the first choice for professional racers. Apart from the tedious job of gluing, which is taken on by a mechanic in professional teams, from a technical point of view there are no more arguments for the tubular tire. Our test shows clearly that the best folding tires are way ahead of the best tubular tires. The folding tires roll easier and have better adhesion. They are relatively easier to fit and offer a just-as-good riding feeling. Tubular tires on the contrary can often cost nerves with a light radial run out, if the valve isn't absolutely and precisely fitted. One final advantage for the tubular tire is in the case of a sudden loss of pressure, the glued tire doesn't spring so lightly off the rim. Basically speaking though, the gluing isn't such a safe connection, especially on a carbon rim.



The tubular tire (left the Zipp "Tangente") is adhered to the rim with glue. By this Classical method the tube is firmly covered by the seamed carcass and can't be changed. The tubular tires tested from Continental, Schwalbe and Tufo enclose the tube seamlessly. The folding tire (above Schwalbe's "Stelvo Rain") is an open construction where the tube is loosely laid inside.

RIGID TESTS

As shown, we've tested anew the adhesive abilities of the tires with the special TOUR Test-roller – this time on a slippery asphalt surface. Our test driver Fabian Kleiner has courageously taken the curves in pouring rain and risked the adhesive levels to collect the results from the border areas of cycle racing, which should be unique in this form.

The maximal speed in the curves, reveals how much adhesion the tire has. The test divided the competitors into three classes: the best adhesive results were achieved by the special mixtures of Schwalbes "Ultrimo", Continental's "Grand Prix 4000 S" and "Grand Prix 4 Season" and Michelin's "Pro2Grip" plus the "Tangente" from Zipp. Schwalbes

A slippery affair

TOUR has meanwhile gained experience with the test roller on the theme of adhesion in the wet on three different, non-slip surfaces. If the road is raw and sharp edged, good tires show extremely good grip. If the gravel in the asphalt is sleek – as in worn curves or breaking zones before traffic lights, the wet adhesiveness diminishes. Here the differences of grip between the various asphalt surfaces is much greater than that between the best and the worst tires. However the more adhesive tires allow a much higher speed on the curves on non-slip asphalt than tires that are less adhesive. On non-slip asphalt



good tires show by the response from the front wheel where the borderline begins. They start to drift and sputter. This can be controlled by the rider's smooth reactions. On extreme, slippery surfaces the differences between an adhesive mixture and a normal rubber top disappear. The back wheel usually slides out which nearly always leads to a fall. It is difficult to judge a road surface ahead, especially if the

course is unknown. Tip: on a straight road brake the rear wheel until it blocks, here you can get an idea of the adhesive qualities of the asphalt.

The test

The test tires are ridden by TOUR testers for thousands of kilometers in training and racing. After that come the laboratory tests, carried out under standard and controlled conditions.

Roll resistance

The tests were carried out on a roll test stand belonging to Continental, which offers the best test facilities in Germany that we know of. The test stand was reequipped with TOUR testing equipment and the Tests were carried out and analyzed by TOUR engineers. The roll resistance was measured at 35 km/h with a load of 50 kilograms. The measured variable is a force which is converted into a power output in watt, as this can be directly evaluated in relation to the performance of the rider. **In the table the roll resistance is entered as a total weight of 50 grams for the bike and rider.** (The roll resistance rises linearly with speed and

weight load). The roll resistance lay in this test between 34 and 54 watt at 35 km/h. In a halfway dynamic sitting position at this speed, the rider needs a 220 watt performance. The roll resistance of the test track lies by 35 km/h, roughly between 15 to 25 % of the performance.

Wet adhesion

Tested on a wet road. The tester took a special roller and rode down a hill, then took the test curve with a radius of 12,50 meters. The speed was raised each time – until he drifted or crashed. **The max. achieved curve speed, shown in the table, is a measure of the adhesiveness of the tire.** Repeat attempts allowed the rider to make statements about the feel of the riding experience in border areas which otherwise couldn't have been achieved. The test roller has a similar weight distribution and steering geometry as a racing cycle, the riding inclination is a little less than on a cycle as the center of gravity is deeper and nearer to the inner curve.

Compared to the adhesion test made by TOUR 2/07, the test track was more slippery, due to a sleeker road surface. The static friction results, which describe the grip independently from the radius of the curve, lay in this test between 0,52 and 0,69. In the last test on a specially non-slip asphalt (in the rain) the values lay between 0,69 and 1,17.

Puncture protection

Ascertained in the TOUR laboratory. A fine ground screwdriver blade is pressed onto a tire with a force of 35 kilograms. Then a shaker is switched on which gives the blade a swinging movement. **The time it takes for the blade to penetrate the tire is measured and entered in the table.** The experiment is stopped after three minutes and noted with "passed" and is carried out five times in all. The measured data align to a larger result in our practical experience. Tires that resist the blade for three minutes are in practice well puncture protected.

“Stelvio” tubular tire with its conventional rubber mixture is also surprisingly up with the main group.

In the midfield follow Conti’s “400” tubular tire as well as the reputed wet specialist “Stelvio Rain from Schwalbe. The other test tires clearly gripped much worse. Interesting in this test is the feedback from the tires to the riders on the way to the limit. “Ultrimo”, “Grand Prix 4000 S” and “Tangente” convey the feeling of full-bodied rubber and show sensitivity in the border areas through increasing drift. Michelin follows another philosophy. The tires from

the French ride harder, feel less like rubber and start to sputter in the border areas. One of the testers said - “Wooden tires”. Seen positively, such tires are joy riders and less shock absorbing - individual preferences and riding styles play a role here.

A sputtering, but not completely sliding front wheel still shows clearly that it is about to happen. The behavior of the Vittoria tire is a little unfortunate: it suddenly drifts away with too much angle and gives the impression as if the adhesive mixture is not on the shoulder but somewhere in the

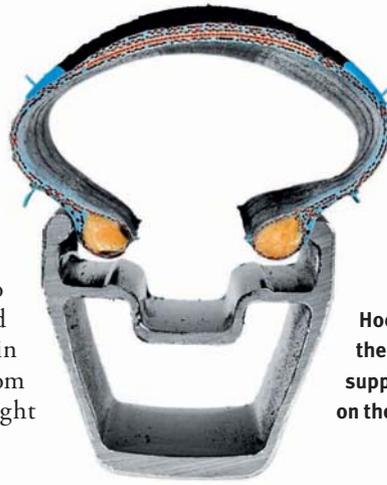
FOLDING TYRES

				
Maker	CONTINENTAL	CONTINENTAL	HUTCHINSON	HUTCHINSON
Model	GP 4 Season	GP 4000 S	Fusion 2	Fusion 2 Tubeless
Price (recommended retail price)	45,00 Euro	42,90 Euro	39,80 Euro	49,80 Euro
Ref. Information	Continental Tel. 0 56 31/58 14 11 www.continental.de	Continental Tel. 0 56 31/58 14 11 www.continental.de	Tri Dynamic Tel. 0 83 87/9 24 42-0 www.hutchinsontires.com	Tri Dynamic Tel. 0 83 87/9 24 42-0 www.hutchinsontires.com
MEASUREMENTS				
Width and height	23,4 x 23 mm	23,4 x 22,8 mm	23 x 22,7 mm	21,9 x 20,5 mm
Weight	224 grams	207 grams	233 grams	299 grams
Roll resistance 35 km/h*) #	53,90 watts	34,30 watts	52,80 watts	34,30 watts
Puncture protection (**)	180 seconds	180 seconds	56 seconds	41 seconds
Wet grip (***)	33,20 km/h	33,00 km/h	30,30 km/h	30,40 km/h
Assembly	without tools	without tools	fairly difficult with tools	fairly difficult with tools
VALUES				
Weight #) (10%)	2,0	1,3	2,3	2,3
Roll resistance (30%)	4,0	1,0	4,0	1,0
Puncture protection (30%)	1,0	1,0	3,3	3,3
Wet grip (30%)	1,0	1,0	3,0	3,0
Performance in border areas	Gives good feedback. Soft transition to grip border. Predictable	Absolute riding impression from lots of rubber. Very safe, predictable. Best ride next to the Ultrimo.	Soft riding impression. Predictable, but with lower adhesion border.	Tubeless tire for special rims. Construction and thinner tread let the tire roll easier than the normal “Fusion”.
Result	Very good puncture protection with double Vectran-breaker and cut-resistant sidewall. For rough courses. Wears angularly, rolls heavily.	Test winner. Optimal roll resistance adhesion and puncture protection. Perfect all-rounder for training and racing. Surface rides off angularly.	Fat riding surface from three rubber mixtures. Sensitive in spite of extra puncture protective layer. Rolls heavily. A tire without special strengths.	Schlauchloser Reifen für spezielle Felgen. Bauprinzip und dünnerer Laufstreifen lassen den Reifen viel leichter rollen als den normalen „Fusion“.
End result (100%)	2,0	1,0	3,3	2,4



*) Roll performance based on 85kg system weight at 7,5 bar. Lower values are better; **) Burin test. Time until the piercing of the tire. Stopped after 180 seconds. #) With the Hutchinson tubeless tire, 65g tire weight taken off because of integrated tube; the note scale accounted for the systematic lower weight of the

tire middle. The “Stevlo Rain” from Schwalbe also slides out surprisingly and without warning. Well-tempered if not very adhesive are the Hutchinson and Tufo tires. The table shows detailed information on all tires. Surprisingly, in the roll resistance test: the very adhesive Continental “Grand Prix 4000 S” also rolls excellently. The rubber mixture called “Black Chili Compound” – stands for the “S” in the name – is on a level with the tubeless tire from Hutchinson and just beats the well-known light



racer “Pro2Race” from Michelin by a nose. Conti’s product manager Wolf vom Walde makes the new tread and rubberized carcass, a development from the auto tire

Hooked rims and folding tires form a system: the tire (here: Michelin’s “Pro2Grip”) supports itself with its core under pressure on the wheel rim flange.



MICHELIN	MICHELIN	SCHWALBE	SCHWALBE
Pro²Grip	Pro²Race	Stelvio Rain	Ultremo
45,95 Euro	40,95 Euro	36,90 Euro	42,90 Euro
Paul Lange	Paul Lange	Bohle	Bohle
Tel. 07 11/25 88-0	Tel. 07 11/25 88-0	Tel. 0 22 65/109-0	Tel. 0 22 65/109-0
www.michelin.de	www.michelin.de	www.schwalbe.de	www.schwalbe.de

Maker
Model
Price (recommended retail price)
Ref. Information

MEASUREMENTS			
23,2 x 22 mm	23,3 x 24,1 mm	23,6 x 23,2 mm	22,5 x 21,2 mm
234 grams	218 grams	215 grams	196 grams
43,70 watts	36,00 watts	51,50 watts	43,30 watts
180 seconds	180 seconds	180 seconds	180 seconds
32,60 km/h	30,30 km/h	31,10 km/h	32,90 km/h
fairly difficult with tools	fairly difficult with tools	without tools	without tools

VALUES	
Weight #)	(10%)
Roll resistance	(30%)
Puncture protection	(30%)
Wet grip	(30%)
Performance in border areas	

2,3	1,67	1,7	1,0
2,3	1,33	3,7	2,3
1,0	1,00	1,0	1,0
1,0	3,00	2,0	1,0
Hard riding impression. Sputters a lot. Difficult to gauge.	Hard riding impression. A lot of grip on the shoulder but less in the middle, bounces unpredictably.	Difficult to gauge, gives no feedback. Drifts away. Instead of sputting, tight border area.	Very good riding performance. Full, predictable. Gives the feeling of a lot of rubber on the road.
A tire for training and racing. The light ride suffers from improved adhesion. Wears evenly.	Easy running racer with A robust carcass and good Puncture protection. Adhesion is satisfactory. Wears evenly.	Rain specialist that disappointed on the test asphalt. High roll resistance, very good puncture protection.	Very light racing tire with optimal grip and even better roll resistance. Wears very evenly.
1,5	1,8	2,2	1,4

Result	
End result	(100%)



***) Maximal speed with a curve radius of 12,5m. Higher values are better. tubular tires.

designers, responsible: nano particles of soot together with artificial and natural types of rubber improve their performance. At the other end of the spectrum are the “4 Season” from Conti, Hutchinson’s “Fusion 2” and the “Stelvio Rain” from Schwalbe, that nearly give nearly 20 watt more roll resistance. Classification: the difference between the best and worst tires is bigger than the aerodynamic difference between the best and worst wheels in the latest wheel test (TOUR 6/07). Also remarkable: the best tubular tires in the test run worse than the best folding tires – although there are latex inner tubes in some of them, which would also

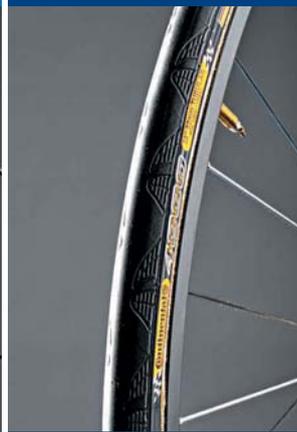
make the folding tires even more quickly. Last test station: the piercing test, which simulates how much resistance the tires have to typical punctures, where stones, thorns or similar objects stick to the tire and with every turn work their way deeper into the rubber.

Here we have nine tires that successfully pass the TOUR test, more than have ever passed the test before. The rest drops back, with Vittoria and Vredestein bringing up the rear. The reason for this are the different puncture protection concepts: where the best in the class insert up to two

FOLDING TIRES



TUBULAR TIRES



	VITTORIA	ZIPP	CONTINENTAL	SCHWALBE
Maker	VITTORIA	ZIPP	CONTINENTAL	SCHWALBE
Model	Evo CX	Tangente	4000 SR	Stelvio
Price (recommended retail price)	43,95 Euro	77,50 Euro	72,90 Euro	64,90 Euro
Ref. Information	T-Punkt Handelsvertretung Tel. 0 41 05/67 09 90 www.vittoria.com	Tri Dynamic Tel. 0 83 87/9 24 42 0 www.zipp.com	Continental Tel. 0 56 31/58 14 11 www.continental.de	Bohle Tel. 0 22 65/109-0 www.schwalbe.de
MEASUREMENTS				
Width and height	23 x 22,7 mm	21,5 x 18,9 mm	22,3 x 19 mm	22,0 x 20,0 mm
Weight	229 grams	204 grams	246 grams	220 grams
Roll resistance 35 km/h*) #	42,00 Watt	36,20 Watt	41,60 Watt	47,00 Watt
Puncture protection **)	9 seconds	47 seconds	180 seconds	180 seconds
Wet grip ***)	30,40 km/h	33,00 km/h	31,80 km/h	32,90 km/h
Assembly	easy with tools	without tools	poss. without tools	poss. without tools
VALUES				
Weight #) (10%)	2,0	1,3	1,3	1,0
Roll resistance (30%)	2,3	1,3	2,0	3,0
Puncture protection (30%)	4,7	3,3	1,0	1,0
Wet grip (30%)	3,0	1,0	2,0	1,0
Performance in border areas	Slips with a lot of angle, sputters with less. Unpredictable	Gives good early feedback without sputtering. Only slightly worse than the GP4000S and the Ultremo.	Predictable and positive. Reaches its limit slightly earlier than the GP 4000 S.	Doesn't give much feedback, grips well.
Result	Rolls well, otherwise problematic: poor puncture protection and sensitive behavior in border areas make it a fine weather tire.	The big surprise. Apart from the puncture protection, a very good tire. Adhesion and roll resistance on a level with the best of the class. Relatively thin tread.	Best tubular tire in the test. Flat and seamlessly made with a Butyl innertube. Doesn't reach the level of the 4000 S folding tire: rolls heavier, grips less.	Lighter, seamless tubular tire with Butyl innertube. In spite of conventional rubber mix, very good grip. Thinner tread. Higher roll resistance.
End result (100%)	3,2	1,8	1,6	1,6

*) Roll performance based on 85kg system weight at 7,5 bar. Lower values are better; **) Burin test. Time until the piercing of the tire. Stopped after 180 seconds. #) With the Hutchinson tubeless tire, 65g tire weight taken off because of integrated tube; the note scale accounted for the systematic lower weight of the

extra breakers (especially durable Aramid – or Vectran material) between the tread and the carcass, others ignore it, because the protective layers make the tires stiffer and increase the roll resistance. The examples from Conti and Michelin show however, that one can change this disadvantage by using an appropriate rubber mixture.

CLEAR TEST WINNER

In the end, Continental was the tire in front: with the “Grand Prix 4000 S, the Germans have produced a tire that

excels in all categories, as the “1” in the final count shows. With new treads and rubberized carcass the roll resistance has been reduced without weakening the other factors. Schwalbe’s newcomer “Ultremo” and the “Pro2Grip” from Michelin followed close behind.

Somewhat defeated were the tubular tires, which can’t keep up with the best folding tires. ■



TUFO	VITTORIA EVO CX	VREDESTEIN	ZIPP	
Elite Ride 25	Evo CX	Fortezza Pro TriComp	Tangente	Maker
69,95 Euro	59,95 Euro	58,65 Euro	99,00 Euro	Model
Raco	T-Punkt Handelsvertretung	Vredestein	Tri Dynamic	Price (recommended retail price)
Tel. 0362 03/6 14-33	Tel. 041 05/67 09 90	Tel. 00 31/53/4 88 86 88	Tel. 083 87/9 24 42-0	Ref. Information
www.ra-co.de	www.vittoria.com	www.vredestein.com	www.zipp.com	
				MEASUREMENTS
26,0 x 24,4 mm	21,9 x 19 mm	22,7 x 21,6 mm	21,5 x 19,5 mm	Width and height
262 grams	282 grams	278 grams	269 grams	Weight
41,20 Watt	41,10 Watt	36,70 Watt	37,20 Watt	Roll resistance 35 km/h*) #
180 seconds	50 seconds	6 seconds	70 seconds	Puncture protection **)
30,20 km/h	30,60 km/h	30,20 km/h	32,80 km/h	Wet grip ***)
poss. without tools	poss. without tools	poss. without tools	poss. without tools	Assembly
				VALUES
2,0	2,7	2,3	2,0	Weight #) (10%)
2,0	2,0	1,3	1,3	Roll resistance (30%)
1,0	3,3	4,7	3,0	Puncture protection (30%)
3,0	3,0	3,0	1,0	Wet grip (30%)
Gives the impression of lots of rubber. Border area registers. Adhesive border low.	Unpredictable, slides with a lot of angle, sputters with less.	Never gives the impression of a safe grip.	Gives a fine, early feedback and a safe impression of lots of rubber	Performance in border areas
Seamless, especially voluminous tubular tire with Butyl inner tube. Optimal for poor roads.	Classically made seamed tubular tire with a latex innertube and double rubber mix. Disappointing on grip and puncture protection.	Classically made with a latex inner tube, construction similar to the Vittoria but bulkier and faster. Disappointing on grip and puncture protection.	Classically made tubular tire with a latex inner tube. Single Compound with good roll characteristics and golf ball profile. Loses points on puncture protection.	Result
2,0	2,8	2,9	1,8	End result (100%)

***) Maximal speed with a curve radius of 12,5m. Higher values are better. tubular tires.