SEKA

EXAERA E2

ONE FRAME - EVERY PATH

WHITE PAPER

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OBJECTIVES

The ExAero GR was born to help riders travel faster over more complex terrain and deliver a winning edge in every gravel race.

Here, we present our guide to some of the world's most exciting gravel races for 2025.

Event	Course Descrption	Single-day Distance, Elevation Gain (km, m)	Calories Burned (kcal)	Ideal Fuel & Hydration Volume (Water bottle size 500ml)	Refuel Station Regulations	Rules for Dealing with Mechanicals	Percentage of Unpaved Sections	Recommended Tire Width	Men's 1st Place Avg. Speed (kph)	Men's 1st Place Total Time (h : min : s)
Unbound Gravel 2025 (200)	Single day ultra-enduro Rolling terrain with a gentle average gradient.	Distance≈325.7 Elevation Gain≈3,080	Approximately 8,000–10,000	Bottles of water: 10-16 Energy Gel: 12-25	Two neutral aid stations and two neutral water stations; outside aid results in disqualification.	For major repairs, they must reach a designated aid station. Riders are self-supported and must carry their own spares (tubes, CO2).	Above 90%	45-55mm	37.13	8:37:09
Belgian WaffleRide 2025 (CA) (Long distance)	Single day ultra-enduro Rolling terrain with a gentle average gradient.	Distance≈172 Elevation Gain≈2,286	Approximately 4,000–4,500	Bottles of water: 5-7 Energy Gel: 6-10	Utilize aid stations or be self-supported.	For major repairs, they must reach a designated aid station or official event support vehicle (waiting time required). Riders are self-supported and must carry their own spares (tubes, CO2).	Approximately 40%	38-45mm	34.8	4:57:08
UCI Gravel Worlds 2025 (Men Elite)	Single day ultra-enduro	Distance≈181 Elevation Gain≈1,650	Approximately 4,500–5,000	Bottles of water: 5-8 Energy Gel: 6-11	50km loop course. 3.5 laps with two aid stations per lap. Support is strictly prohibited outside of designated aid stations.	For major repairs, they must reach a designated aid station. Riders are self-supported and must carry their own spares (tubes, CO2).	Approximately 62%	38-45mm	38.75	4:39:12
Migration Gravel Race Leop-ard 2025 (Full distance)	Single day ultra-enduro 4 days The stages consist mostly of rolling terrain, demanding repeated power bursts to maintain momentum.	1: 129 / 2: 144 / 3: 158 / 4: 186 Elevation Gain≈8, 000	Single day Approximately between 3800 and 8000	Single day Bottles of water: 3–8 Energy Gel: 5-12	Two water stations; self-supported fuel.	For major repairs, they must reach a designated aid station. External assistance is permitted, but only with the rider's own spares. Riders are self-supported and must carry their own spares (tubes, CO2).	Above 80%	45-55mm	43.5 (Net riding time, excluding rest periods) Average speed is slightly slower, with lower average power, but power distribution is more fragmented and intense; normalized power and perceived exertion are high.	14:57:12 (Total time for all stages)

	Highly variable and complex terrain, long distances, and significant cumulative elevation	Long stages that demand substantial carry capacity per resupply	A higher incidence of mechanical failures	Significant variation in optimal tire width choices	High average speeds and long finish times, where the cumulative benefit of small gains is substantial
"The Winning Formula" =	Exceptional stiffness and compliance	Ample Storage Modularity & Capacity	Ample Storage Modularity & Capacity	Class-Leading Tire Clearance	Optimized Aero Performance

= ExAero GR

Racing performance has always been at the core of SEKA's products. This time, our goal is to conquer every gravel event.

*Most popular gravel races generally prohibit receiving any mobile support or mechanical assistance on the course, in the interest of safety and fairness.
Take the world-class gravel race Unbound Gravel 200 as an example: riders are required to prepare a "Drop Bag" in advance, containing food, water, energy gels, spare tires, and tools, which is then transported by race officials to designated checkpoints for use and replacement during the race.

PRODUCT OVERVIEW

ExAero Mag Bottle System:
(Compared to standard round bottles)
A single aero bottle saves **5.7w**
Dual aero bottles save **4.6w**

Exceptional Rear Shock Absorption:
The WindEye structure
106N/mm vertical compliance

Glaudius GR Intergrated Handlebar:
15 sizes
16° of flare for gravel riding

Lightweight: **980g**
True monocoque frame construction
980g frame weight
(T1100 reinforced by M46J)

Tire Clearance:
Front : **56mm**
Rear: **52mm**

Geometry:
6sizes. Optimized for agility and confidence inspiring handling.

TIRE CLEARANCE

Tire Width Range	Aerodynamic Performance	Rolling Resistance (Hard-Packed Gravel)	Rolling Resistance (Loose Gravel, Mud)	Comfort	Grip	Handling & Stability	Events & Corresponding Courses and Surfaces
35-40mm	★★★★★	★★★★★	★★★⯪☆	★★☆☆☆	★★☆☆☆	★★★☆☆	UCI Gravel Worlds, BWR, Strade Bianche, High-speed, Gravel mixed with paved sections
40-45mm	★★★★☆	★★★★☆	★★★☆☆	★★★☆☆	★★★★☆	★★★★☆	Grinduro, BWR CA, Short to Medium distance Mixed gravel and hard packed dirt road
45–50mm	★★★☆☆	★★★☆☆	★★★☆☆	★★★★☆	★★★★★	★★★★★	Unbound Gravel, Migration, Gravel Earth, Traka Long distance, Rough and chunky gravel roads with flint
50–56mm (≈ 2.2 inch)	★★☆☆☆	★★☆☆☆	★★★⯪☆	★★★★★	★★★★★	★★★★★	TransRockies, Migration Mixed gravel, hard packed dirt road, rocky and muddy conditions with technical sections

Tire selection is one of the most critical factors affecting Gravel race performance.

As shown in the table, different tire widths vary significantly in aerodynamic efficiency, rolling resistance, comfort, and stability:

35–40mm Optimized for speed on mixed surfaces with significant pavement;
45–50mm The balanced choice for long-distance compliance and control on rough gravel;
50–56mm Built for extreme conditions, prioritizing traction and puncture protection.

A well-chosen tire width balances aerodynamics, grip, and handling for optimal performance.

The ideal width is not a fixed value but should be tuned to specific course conditions.

The ExAero GR accommodates this need with maximum tire clearances of **56mm (front) and 52mm (rear)**, giving riders the freedom to choose the optimal setup for any race or terrain.

STORAGE AND MODULARITY

Down Tube Integrated Internal Storage Compartment

In long-distance gravel races, riders typically need to carry 0.8–1.5L of nutrition, tools, and emergency gear. While traditional external storage solutions offer sufficient capacity, they often create significant aerodynamic drag.

Wind tunnel and CFD data indicate that a 1L externally mounted saddlebag increases the effective frontal area (ΔCdA) by approximately **0.003m²**.

The resulting power loss can be calculated using the following equation:

$$\Delta P = 1/2 \cdot \rho \cdot \Delta CdA \cdot v\_air^3$$

Where:
ρ (Air density) = $1.2234 kg/m^3$,
ΔCdA (Increase in effective frontal area) = $0.003 m^2$,
v_air (Relative airspeed) = 40km/h = 11.11m/s.

Calculation conditions:
Total mass = 85kg, Rolling resistance coefficient (Crr) = 0.009,
Relative airspeed = 40km/h

Substituting these values gives:
$\Delta P \approx 2.5w$

This 2.5W power loss corresponds to approximately 0.3% reduction in speed under a constant power output, culminating in a time loss of roughly **20 seconds** over an 80 km course.

SEKA

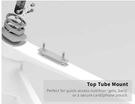
The ExAero GR features a fully integrated down-tube storage compartment, engineered to securely hold essentials like spare tubes, CO_2 cartridges, and tools. Its design achieves an optimal aerodynamic form without compromising storage capacity.

The compartment utilizes a Fidlock magnetic latch, ensuring a seamless, secure, and clean interface that performs reliably in all racing conditions.

For further versatility, the frame includes modular mounting interfaces on the down tube, top tube, and seatpost. This comprehensive system allows riders to tailor their setup based on race distance, nutrition needs, and preference—or run a clean, ultra-lightweight configuration when extra cargo isn't needed.

By seamlessly integrating storage and expansion, the ExAero GR delivers an unprecedented balance of aerodynamics, weight, and versatility, offering a more complete solution than any other racing gravel platform.

Rear Seatpost Mount
Ideal for clothing, rain gear, repair kits, or a number plate holder.



Top Tube Mount
Perfect for quick-access nutrition (gels, bars) or a secure card/phone pouch.

Bottom Bracket / Down Tube Mount
Securely carries a tool capsule, storage bottle, or an additonal water bottle.

AERODYNAMICS

A gravel bike must master diverse terrains without compromising on speed and racing performance.

When it comes to a frame's racing performance, no factor is more critical than aerodynamic efficiency.

Our philosophy therefore focuses on the complete system's aerodynamics in a real-world racing configuration. We optimize not just the frame's drag coefficient, but the entire ecosystem: frame geometry, tire clearance, integrated storage, and modular expansion systems.

CFD Analysis and Optimization

CFD **(Computational Fluid Dynamics)** served as the core development tool in the early stages of the ExAero GR project. It enabled the analysis of airflow characteristics and pressure distribution around the frame prior to wind tunnel testing.

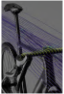
Throughout this process, we conducted multiple rounds of numerical analysis and localized geometric refinements under standardized boundary conditions. The focus was on optimizing tube cross-sections, transitional zones, and rear wake structures to enhance flow continuity and minimize energy loss across the entire frame.

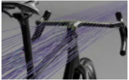
During the Computational Fluid Dynamics (CFD) analysis of the complete ExAero GR prototype, the primary focus areas were:

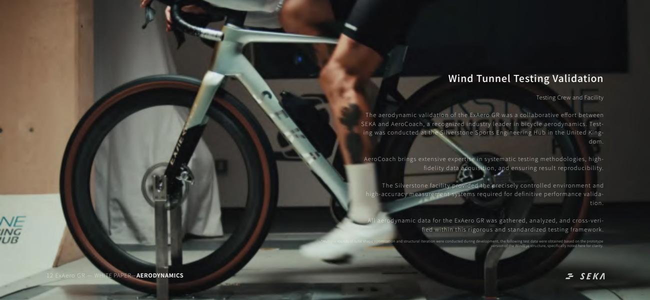
1. Frontal Area Optimization: Analyzing and improving airflow pattern around the integrated handlebar, head tube, and fork;
2. Overall Flow Field Management: Optimizing the complete bike's airflow and pressure distribution;
3. Wake Control: Evaluating and refining the "WindEye" structure's ability to manage wake behavior;
4. Component Analysis: Simulating the aerodynamic drag difference between aero bottles and standard round water bottles.

Through multiple iterative cycles of CFD analysis, we established the core aerodynamic design direction and key structural features of the ExAero GR.

Subsequent wind tunnel testing validated these CFD predictions and provided precise quantification of the final product's real-world aerodynamic performance.







Wind Tunnel Testing Validation

Testing Crew and Facility

The aerodynamic validation of the ExAero GR was a collaborative effort between SEKA and AeroCoach, a recognized industry leader in bicycle aerodynamics. Testing was conducted at the Silverstone Sports Engineering Hub in the United Kingdom.

AeroCoach brings extensive expertise in systematic testing methodologies, high-fidelity data acquisition, and ensuring result reproducibility.

The Silverstone facility provided the precisely controlled environment and high-accuracy measurement systems required for definitive performance validation.

All aerodynamic data for the ExAero GR was gathered, analyzed, and cross-verified within this rigorous and standardized testing framework.

*Multiple rounds of tube shape optimization and structural iteration were conducted during development, the following test data were obtained based on the prototype version of the WindEye structure, specifically noted here for clarity.

SEKA

ExAero GR: Wind Tunnel Aerodynamic Data Validation
(A joint study conducted by SEKA and AeroCoach)

Test Objective:
To validate the aerodynamic performance of the ExAero GR prototype, following CFD optimization, under controlled wind tunnel conditions.

ExAero GR Complete Bike Configuration

Frameset	ExAero GR 54
Wheels	Zipp 303 XPLR SW
Tires	Schwalbe G-One RS Pro, F45mm, R45mm
Integrated Handlebar	Gladius GR 400mm-110mm
Water bottle	ExAero Mag bottle*2

Rider & Setup

Total Mass (Rider + Equipment)	85kg
Saddle height	745mm
Hood Reach	660mm
Hood Stack	700mm
Hand position	Hood position

Test Environment

Crr (Loose Gravel / Clay Surface)	0.009
Relative Wind Speed	40km/h
Air Density	1.2234kg/m³
Gradient	0

Test Method & Calculation Basis:
All tests were conducted at the Silverstone Sports Engineering Hub under controlled laboratory conditions. Data collection and system calibration were managed by the AeroCoach team.
Aerodynamic calculations followed the Barry (2018) protocol, utilizing an equal-angle weighting method across a defined yaw distribution.
Testing covered yaw angles from −20° to +20°, with the model rotated in increments of 0.167°.
Dynamic data were acquired continuously at a sampling rate of 100 Hz, yielding 6,000 discrete data points per minute for robust statistical analysis.

Through wind tunnel testing and application of the Barry (2018) weighted averaging method, the ExAero GR was validated with a CdA of **0.3938m²**.

This result closely aligns with the aerodynamic targets set during the CFD simulation and optimization phase, confirming the efficacy and accuracy of our virtual design process in real-world conditions.

To contextualize this **CdA value of 0.3938m²**, we conducted a comparative wind tunnel test under identical conditions, using SEKA's **Spear** road model as a benchmark.

Yaw angle	Weighting function (Barry 2018)	Exaero GR Front 45mm Rear 45mm	Spear
-20	0.09	0.037266058	0.035971672
-17.5	0.158	0.064917198	0.061587659
-15	0.237	0.095819393	0.091194206
-12.5	0.377	0.15105237	0.144565042
-10	0.543	0.217058094	0.209996573
-7.5	0.683	0.273960092	0.262224217
-5	0.857	0.337634175	0.327930789
-2.5	0.952	0.372215253	0.364617353
0	1	0.385906857	0.383573578
2.5	0.952	0.372241709	0.364249631
5	0.857	0.33122072	0.319608696
7.5	0.683	0.264674209	0.254361544
10	0.543	0.214516372	0.203797164
12.5	0.377	0.149217639	0.145694013
15	0.237	0.094668436	0.092631718
17.5	0.158	0.063921812	0.061613664
20	0.09	0.037009564	0.035492197
Weighting	**8.749**	**0.39382533**	**0.381977453**

The weighted yaw-angle parameters were defined according to the Barry (2018) standard.

Wind tunnel testing was validated by comparing results from a live rider with those from a static lower-body mannequin.

The SEKA Spear represents a benchmark for aerodynamic efficiency in road racing, while the ExAero GR is engineered as a competitive, aerodynamically-optimized gravel platform.

This comparative test aims to quantify the aerodynamic performance gap between a dedicated gravel bike and an aero road bike, providing a clear and intuitive reference.

Given their distinct purposes, the bikes were tested in their typical real-world configurations. The specific setup differences between the ExAero GR and the Spear are detailed below:

Frame model	Size	Wheelset	Tires	Integrated Handlebar	Groupset	Water Bottle	Rider, Kit, and Bike Total Mass
ExAero GR	54	Zipp 303 XPLR SW	Schwalbe G-One RS Pro, F45mm, R45mm	Gladius GR 400-110	Sram Red XPLR	ExAero Mag bottle *2	85KG
Spear	M	Zipp 404 Firecrest	Pirelli Pzero 28C	Rapier 395-100	Shimano Dura-ace	500ml round bottle* 2 (Held by Spear bottle cages)	81.8KG

Apart from the model-specific configurations for the ExAero GR and Spear, all other test parameters—including environmental conditions and measurement procedures—were held constant.

The wind tunnel test measured the Spear's CdA at **0.3820m².** This results in a CdA difference (ΔCdA) of **0.0118m²** between the two models under their optimal, real world setups.

Based on this ΔCdA, the aerodynamic power difference between the two bikes was calculated as follows:

$$\Delta P = 1/2 \cdot \rho \cdot \Delta CdA \cdot v\_air^3$$

The test results confirm that the ExAero GR requires approximately **9.9W** more aerodynamic power than the Spear, which aligns with expectations given their distinct design purposes.

This difference is primarily attributed to the ExAero GR's wheelset and tire configuration. The combination of wider tires and larger-section rims accounts for roughly **10W** of additional aerodynamic drag.

Furthermore, the comparison underscores a key advantage of the ExAero GR: its integrated storage. To match the capacity of the ExAero GR's down-tube compartment, the Spear would require an external saddle bag, which we previously estimated would induce an aerodynamic penalty of approximately **2.5W**.

Parameter Description：
ρ (Air Density) = 1.2234kg/m³,
ΔCdA (CdA Increment) = 0.003m²,
v_air (Relative Airspeed) = 40km/h = 11.11m/s.

Note:
Due to variations in tire width and tread pattern across brands, the power difference between 45mm gravel and 28mm road tires typically falls within a 9–11W range.
The subtle differences in reach and stack resulting from the frame geometry itself are compensated for by adjusting the position of the hoods.

Wind Tunnel Testing: The Aerodynamic Impact of Tire Width

Tire selection is one of the most critical performance factors in gravel racing.

Characteristics like size, pressure, and casing structure collectively influence a bike's aerodynamics, rolling resistance, handling stability, compliance, and puncture resistance.

A clear industry trend has seen gravel tire widths evolve from 35mm to 45mm, 50mm, and beyond, as riders recognize the superior control, comfort, and rolling performance wider tires provide on rough terrain. However, quantitative data on the aerodynamic cost of this increased width has remained limited.

To address this, we conducted controlled wind tunnel tests on key tire-width configurations. Our goal was to obtain definitive data, quantify the aerodynamic trade-offs, and provide riders with actionable insights for selecting the optimal tire.

The results are presented below:

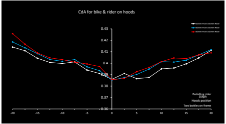
Tire Width Configuration	Front Tire Width	Rear Tire Width	CdA	Δ CdA
A	45mm	45mm	0.3938	0
B	50mm	45mm	0.3962	0.0024
C	50mm	50mm	0.3974	0.0036

Wind Tunnel Test Environment
ρ (Air Density) = 1.2234kg/m³
v_air (Relative Airspeed) = 40km/h = 11.11m/s

All parameters except for the tire width configuration—including rider position, bike fit (reach/stack), wheelset, and bottle/storage configuration—were held constant.

Yaw angle	Weighting function (Barry 2018)	Front 45mm Rear 45mm av	Front 50mm Rear 45mm av	Front 50mm Rear 50mm av
-20	0.09	0.037266058	0.037671	0.0383197
-17.5	0.158	0.064917198	0.0653229	0.0658181
-15	0.237	0.095819393	0.0967811	0.0969276
-12.5	0.377	0.15105237	0.1520138	0.1525635
-10	0.543	0.217058094	0.2180933	0.2189011
-7.5	0.683	0.273960092	0.2753781	0.2738333
-5	0.857	0.337634175	0.3400741	0.3422279
-2.5	0.952	0.372215253	0.3745994	0.3780502
0	1	0.385906857	0.3852375	0.3856293
2.5	0.952	0.372241709	0.3688687	0.3681266
5	0.857	0.33122072	0.334343	0.3364437
7.5	0.683	0.264674209	0.2697035	0.2706935
10	0.543	0.214516372	0.2179431	0.2179685
12.5	0.377	0.149217639	0.1511592	0.1525214
15	0.237	0.094668436	0.095421	0.0957557
17.5	0.158	0.063921812	0.064352	0.0643496
20	0.09	0.037009564	0.0370692	0.0368146
Weighting	**8.749**	**0.39382533**	**0.3961827**	**0.3974237**

The weighted yaw-angle parameters were defined according to the Barry (2018) standard.



Test Results & Analysis
Under identical speed conditions, the test results reveal minimal differences in CdA and aerodynamic power across the three tire widths, with a maximum variation of **less than 2.5W**. This indicates that tire width has a relatively limited impact on overall aerodynamics within this specific performance envelope.

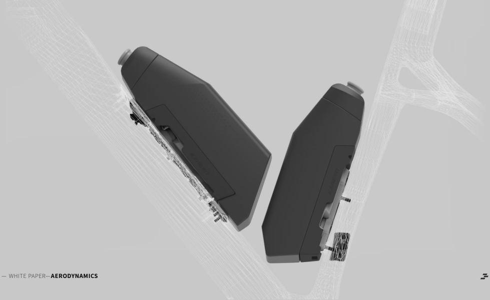
Notably, at a 0° yaw angle, the aerodynamic performance of all three setups was nearly identical.
(Note: More pronounced differences in tire shape or higher test speeds would increase this aerodynamic variance.)

The primary advantages of different tire widths lie in their terrain-specific performance:

Narrower Tires: Excel on hard-packed or paved surfaces, offering superior aerodynamic efficiency and lower rolling resistance.

Wider Tires: Provide enhanced grip, stability, puncture protection, and compliance on loose gravel or clay terrain.

Designed with maximum clearances of up to 56mm, the ExAero GR offers riders broad compatibility and flexible setup options, empowering them to select the optimal tire for any race or terrain.



Aerodynamic Comparison: ExAero Mag Bottles vs. Round Bottles

To further optimize the ExAero GR's aerodynamic performance, we developed **a proprietary magnetic aero water bottle system**. We conducted independent wind tunnel testing to quantify their impact on the bike's overall CdA compared to standard round water bottles.
The results demonstrate a clear aerodynamic advantage for the ExAero Mag aero bottles design.

Bottle Setup	CdA	Δ CdA
Round bottle *2	0.3457	**0**
ExAero Mag bottle*1	0.3383	**-0.0074**
ExAero Mag bottle*2	0.3398	**-0.0059**

Wind Tunnel Test Environment
ρ (Air Density) = 1.2234kg/m³,
v_air (Relative Airspeed) = 40km/h = 11.11m/s.

All parameters except for the water bottle configuration—including riding position, bike fit (reach/stack), wheelset, tires, and storage—were held constant.

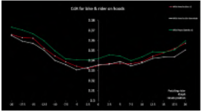
Note on Test Configuration:

The baseline CdA value of 0.3398m² measured in this test is not directly comparable to the 0.3938m² from previous sections, as the overall bike configuration differs.

However, this does not affect the validity of the bottle comparison. The objective here was to isolate the effect of the bottle type. All other variables were held constant, making the measured difference—a −0.0059m² CdA reduction with aero bottles—a reliable result.

Yaw angle	Weighting function (Barry 2018)	ExAero Mag *2	ExAero Mag *1	Round bottles*2 (Held by TACX bottle cages)
-20	0.09	0.03293099	0.032848307	0.033593176
-17.5	0.158	0.057322437	0.056771549	0.058516234
-15	0.237	0.085858201	0.084631496	0.086892368
-12.5	0.377	0.132789585	0.132046198	0.135588758
-10	0.543	0.187115805	0.18468102	0.189805471
-7.5	0.683	0.231233761	0.229411693	0.233345851
-5	0.857	0.286512023	0.283447658	0.292094048
-2.5	0.952	0.315961696	0.31691738	0.323992359
0	1	0.335087303	0.335619514	0.341849281
2.5	0.952	0.320734287	0.32019495	0.329061557
5	0.857	0.289051309	0.290501557	0.295215273
7.5	0.683	0.2300212	0.228607548	0.232071302
10	0.543	0.18396603	0.183355796	0.186498645
12.5	0.377	0.129773267	0.129008485	0.131474423
15	0.237	0.0824283	0.081363827	0.082548125
17.5	0.158	0.055584629	0.054292703	0.055399165
20	0.09	0.032149307	0.031551316	0.032356035
Weighting	**8.749**	**0.339836267**	**0.338327382**	**0.345724593**

The weighted yaw-angle parameters were defined according to the Barry (2018) standard.



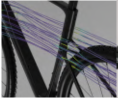
Relative Airspeed	Round bottles *2 (Held by TACX bottle cages)	ExAero Mag *2	ExAero Mag *1
45km/h	0W	-6.9W	-8.7W
39km/h	0W	-4.6W	-5.7W

The test results confirm that the bottle system plays a critical role in the bike's overall aerodynamics. Across all test scenarios, the aero bottles consistently outperformed standard round bottles in aerodynamic efficiency.

This aerodynamic advantage stems from a co-optimized design between the aero bottle and the down tube's cross-sectional profile. The bottle's streamlined shape reduces the turbulent wake area, thereby minimizing localized pressure drag.

*This test was conducted using the second prototype of the ExAero Mag bottle system.

Note on Methodology:
This analysis is based on theoretical modeling.
Under the assumption of an ideal fluid, the CdA is treated as invariant with airspeed and held constant.
The CdA value was measured in the wind tunnel at 45km/h. This same value was applied within the power equation to calculate the theoretical power demand at a riding speed of 39km/h.



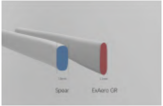
W I N D E Y E

THE WINDEYE STRUCTURE

The WindEye structure creates **a functional zone between the seatstays and seat tube that combines air deflection with vertical compliance.**

This design enables smoother airflow while allowing controlled rear-end flex to absorb road vibrations—delivering both aerodynamic and compliance advantages that have been validated through wind tunnel testing and feedback from thousands of Spear riders.

For the ExAero GR, the WindEye structure was redesigned and refined to meet the specific demands of gravel riding.



The rear triangle lateral stiffness test was conducted following ISO 4210-6, Section 5.3 ("Lateral bending test of the frame").

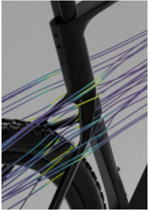
Test Item	Prototype A	Prototype B	ExAero GR
Test Load	30kgf (≈ 294N)	30kgf (≈ 294N)	30kgf (≈ 294N)
Lateral Deformation (mm)	13.47mm	11.9mm	11.47mm
Lateral Stiffness (N/mm)	21.83N/mm	24.71N/mm	25.63N/mm

To accommodate a maximum rear tire clearance of 52mm and maintain compatibility with dual-chainring systems, the ExAero GR introduces tighter spatial constraints on the drive-train side.

This is most apparent in the chainstay profile, which measures just **11mm** at its thinnest point. This geometric necessity inevitably impacts rear-triangle lateral stiffness. To counter this, we performed targeted structural optimizations, refining the WindEye structure to enhance rear triangle **lateral stiffness** without compromising tire clearance or drivetrain compatibility.

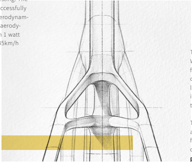
Specifically, the upper and lower connecting plates of the WindEye were thickened through multiple design iterations to provide increased lateral support. This refinement ensures efficient power transfer and meets the rigidity demands of competitive gravel riding.

Validation tests confirm the success of this approach: the final ExAero GR achieves a reartriangle lateral stiffness of **25.63N/mm**, a figure that is **generally consistent with, and even shows a slight improvement over, the benchmark SEKA Spear.**



The weighted yaw-angle parameters were defined according to the Barry (2018) standard.

This design was validated through both CFD analysis and wind tunnel testing. The optimized WindEye structure successfully balances lateral stiffness with aerodynamic efficiency, resulting in a total aerodynamic drag increase of less than 1 watt under a relative wind speed of 45km/h and a ±20° yaw range.



The three-dimensional space formed by the WindEye's upper and lower connecting plates functions as an **"airflow diffuser"**. This design optimizes the turbulent wake and reduces the low-pressure zone behind the seat tube, allowing turbulent airflow generated during riding to pass through this area more efficiently.

To preserve this aerodynamic performance after the structural reinforcement, we performed multiple rounds of CFD optimization on the connecting plates' **cross sectional profiles and angles.**

Following the reinforcement of the WindEye's upper and lower connecting plates, we strategically reduced the wall thickness at the junction of the seat tube and the WindEye structure and incorporated a slimmer profile at the seat tube's lower section. This achieves a more uniform vertical compliance profile.

This targeted approach of **reinforcement and strategic material reduction** achieves a more balanced stress distribution. The result is a significant enhancement in lateral stiffness for efficient power transfer, without compromising the vertical compliance essential for comfort.

Validating this design, **the ExAero GR's rear triangle demonstrates a vertical compliance of 106N/mm.**

For the demanding conditions of long-distance, rough gravel races, the WindEye struture significantly enhances riding comfort, helping riders finish faster.

WEIGHT, STIFFNESS & STRENGTH

Lightweight design remains a paramount concern in SEKA's philosophy, but never at the cost of overall performance.

For a performance gravel frame built to conquer demanding terrain, We prioritize a robust structure with high stiffness and impact resistance—**ensuring exceptional strength and durability without compromise.**

To achieve this optimal balance, we conducted extensive validation of materials, carbon layup, and manufacturing processes. After passing fundamental ISO 4210 and ASTM Condition 2 tests, we further elevated our targets for frame stiffness and impact strength.

Through successive iterations—with frame weight evolving from 900g to 950g, and finally to 980g—we systematically reinforced critical stress zones.

The result is the ExAero GR: a size 54 frame (metal parts and paint excluded) with a final weight of **980g.**

This figure represents the optimal equilibrium between lightweight performance and high impact strength, achieved through rigorous optimization and testing.

Reinforcement Strategy Based on PAN-Based Carbon Fibers

Unlike the ultra-high-modulus, pitch-based 65T/80T carbon fibers typically used in road bike development, the ExAero GR utilizes **TORAYCA® T1100G** and **TORAYCA® M46J** as its primary reinforcement materials. This is not a simple material substitution, but a deliberate structural optimization strategy focused on achieving superior mechanical balance.

Compared to pitch-based fibers, the PAN-based **T1100G and M46J** offer significantly higher tensile strength and fracture toughness. This enables the frame to maintain a high stiffness-to-weight ratio while **substantially improving impact resistance and energy absorption capacity.**

This material approach allows the ExAero GR to withstand gravel impacts, vibrations, and shock loads while **preserving exceptional structural integrity and fatigue life.**

While the T1100G and M46J solution entails a marginal weight increase compared to pitch-based fibers, the superior balance of stiffness, strength, and toughness it delivers in competitive off-road environments is far more valuable than mere gram shaving.

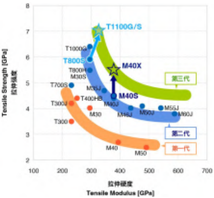


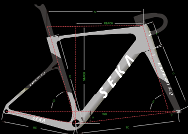
Image source: Toray Industries official websit.

SEKA

True One-Piece Monocoque Structure

Compared to multi-section molding or tube-to-tube bonding, the core advantage of the monocoque process is **its continuous load path**. It allows the carbon fiber to perform at its full potential.

This structural approach delivers superior overall stiffness and power-transfer efficiency while **significantly enhancing impact resistance and fatigue life**. This forms the foundation of the ExAero GR's exceptional strength, durability, and long-term reliability.



Frame Geometry & Height Size Chart

SIZE	STACK	REACH	TRAIL	C1	RC	H	FC	WB	L	N	Q1	Q7	F	G	Standover (mm)	Recommended height (cm & feet)
49	524	369	71	460	423	74	587	999	96.4	509	70.4	75	50	401	747	150-162 4ft 11in-5ft 4in
52	540	375	67	490	423	74	593	1005	111	526	71	74.3	50	401	771	160-172 5ft 3in-5ft 8in
54	559	381	65.5	510	423	72	603	1016	132	541	71.3	74	50	401	792	170-180 5ft 7in-5ft 11in
56	579	389	63.5	535	423	72	615	1027	152	555	71.6	74	50	401	815	178-188 5ft 10in-6ft 2in
58	602	399	61	555	423	70	628	1042	176.5	578	72	73.5	50	401	837	186-196 6ft 1in-6ft 5in
61	620	408	60	580	423	70	641	1055	195	598	72.2	73	50	401	858	194-207 6ft 4in-6ft 9in

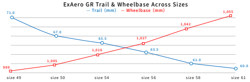
Geometry

The ExAero GR's geometry is engineered to strike an optimal balance between agile handling and confident stability on rough or loose terrain.

Key to this balance is a carefully calibrated **trail figure of 71–60mm** (based on a 350mm wheel radius), which ensures direct steering feedback and predictable control during rapid line changes.

This is complemented by a **74–70mm bottom bracket drop** and **423mm chainstays**. Working in concert with a wheelbase optimized for trail balance, these dimensions deliver both sharp acceleration response and unflappable composure.

To fine-tune the fit, the ExAero GR is available in **6 frame sizes and offers 15 handlebar (integrated) sizes and two seatpost offsets (0mm / 15mm setback)**.



*Values shown are for a 40mm tire width. Note that actual Trail can vary with different tire widths and pressures.

Gladius GR

INTEGRATED HANDLEBAR

The Gladius GR is an integrated handlebar system engineered specifically for the ExAero GR. With **15 combinations** of stem length and handlebar width, it provides a precise fit for riders of all proportions and riding styles.

The drops feature a **16° outward flare** on each side, which optimizes wrist ergonomics for comfort while significantly enhancing control and stability on technical terrain.

A slight **backsweep** design **increases the forward reach space.**

Furthermore, the top section incorporates a **micro-textured, anti-slip surface.** This ensures a secure grip in wet conditions or on rough surfaces, providing confident control and stable front-end handling.

Widths (3 options)：380/440 - 400/460 - 420/480(mm)
Lengths (5 options)：80 - 90 - 100 - 110 - 120(mm)

Any width and length can be freely combined.
Compatible with the Rapier computer mount.

Weight (400/460-90 combo): ≈395g(excluding hardware)
Reach:69mm， Drop:118mm

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