SWISS SIDE

AERO Tri Suit

Research & Development

White Paper

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INTRODUCTION

This white paper summarises a Swiss Side research and development project spanning 2.5 years, leading to the design of a uniquely performing, aerodynamically optimized triathlon suit. When developed in the right way, the tri-suit can have a significant impact on cycling performance by reducing the aerodynamic drag of the athlete. In particular, for long-distance races with 180km cycling, time savings measurable in multiple minutes are possible for athletes of all levels. The tri-suit also needs to be comfortable and offer enough freedom of movement for the athlete to perform at their maximum capability over multiple hours and across the different disciplines of triathlon (swim – bike – run).

An aerodynamic drag performance benefit can be achieved by using optimal fabrics for the different body parts. On the arms, for example, rough fabrics or special roughness features applied to the fabric, to deliberately induce turbulence to the surface airflow can bring significant gains. While designed to be aerodynamically performant, the suit was also developed with an athlete-centric approach to achieve the desired comfort expected by triathletes. Triathletes' requirements from the suit, particularly for long-distance races, were considered throughout the development process.

The specific targets for this project were therefore defined as follows:

- Develop an objectively quantifiable improvement in aerodynamic performance compared to existing products on the market.
- Deliver an aerodynamic performance benefit for the broadest possible range of athletes, regardless of their size, speed, or the wind conditions.
- Optimise comfort and functionality such as thermal regulation, based on the athlete's needs, specifically for long-distance triathlon events.

The tri-suit development is part of a global Swiss Side textiles R&D project which also encompassed the Aero Calf Sleeves and Aero Socks developments. This report will focus on the specific R&D of the AERO tri-suit but will include Swiss Side's multi-faceted textile aerodynamics R&D process used in the overall textiles project. Therefore, some of the general content is the same as that found in the previously published Aero Calf Sleeves & Aero Socks white paper.

RESEARCH & DEVELOPMENT APPROACH

1. AERODYNAMICS BACKGROUND

Aerodynamic drag is the most significant resistive force a cyclist has to overcome with the exception of when climbing at reasonable gradients. Measures taken to reduce aerodynamic drag will lead to performance improvements.

The aerodynamic drag force F_D acting on a body is defined by

$$F_D = 0.5 * \rho * U^2 * Cd * A$$

ρ = air density
U = air speed
Cd = aerodynamic drag coefficient
A = frontal area

For many geometries, Cd is effectively a constant and does not change with air speed U or density ρ. In these cases, the aerodynamic drag force F_D increases with the square of air speed and linearly with air density.

The rider power P_D to overcome the aerodynamic drag F_D is

$$P_D = F_D * V$$

V = rider ground speed

In no wind conditions, air speed U equals ground speed V and rider power P_D increases with the cube of speed. ($P_D \propto V^3$)

Typically, an athlete can reduce their aerodynamic drag force F_D by reducing their frontal area A or by reducing the Cd.

In cycling, frontal area reductions on the athlete are typically achieved by more aggressive riding positions, whereby the shoulders and head are lowered and similarly, more narrow arm position setups are used, all to create a more compact position with minimal frontal area A. However, such positions can negatively impact physiology, reducing the rider power output, comfort, and increasing fatigue.

Focusing on reductions in Cd, these can be achieved with more aerodynamically optimised equipment, for example with a bike frame with aero tube profiles, helmets, deep section wheels etc. However, at the speeds of cycling, for some geometries and in certain conditions, significant changes in Cd do occur through relatively small changes in the air speed with no change in a geometric shape. These effects are most prevalent on the rider's body, in particular the arms and legs.

The reason for this is the so-called 'boundary layer' transition effect. The boundary layer is the small layer of fluid, in this case air, directly on the surface, increasing from zero velocity on the surface, up to the freestream air velocity. At cycling speeds, the boundary layer can be typically around 1 to 4 mm thick depending on the distance along the object and the speed. The boundary layer can have two states. At lower speeds, it is laminar (the flow in the boundary layer is smooth and parallel to the body surface) and at a certain speed there is a transition, and the boundary layer becomes turbulent (the flow in the boundary layer is mixing and not parallel to the body surface). The distance which the air travels along the surface also plays a role. Typically, the boundary layer begins in a laminar state and after a certain distance (which is also dependent on the speed), it will naturally transition to a turbulent state.

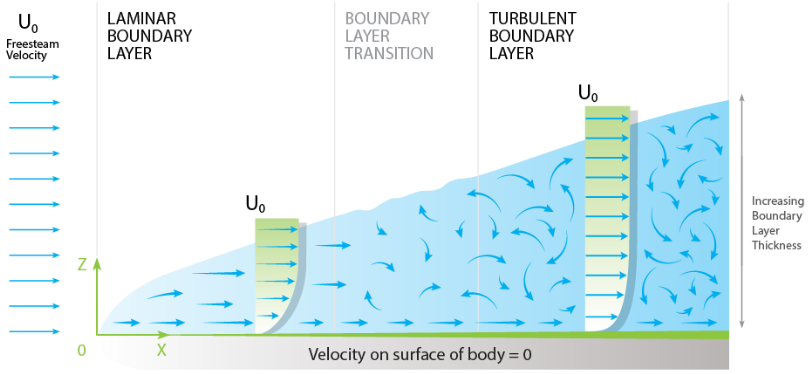

Figure 1: The boundary layer transition effect along a body`s surface.

Factors affecting this transition are described by the Reynold number equation.

$$Re = \rho * U * L / \mu$$

ρ = fluid density
U = fluid speed
L = a characteristic dimension of the body, for example, the diameter of a cylinder
μ = dynamic viscosity of the fluid

In cycling, this effect can be very important for aerodynamic drag performance. Although a turbulent boundary layer has more drag than a laminar one, the mixing effect of the turbulent boundary layer, draws higher energy air to the surface of the body. This helps the air flow remain attached to the body for longer, delaying the flow separation and thereby reducing aerodynamic drag.

As an example, the air flow around circular cylinders and other bodies with curved surfaces, can show significant changes in the large-scale flow structure for a small change in air speeds and/or cylinder diameter. On cylinders, this can result in drastic changes in aerodynamic drag with reductions of more than 50% possible. This has been well documented in literature and are governed by the Re number equation.

It just so happens that the geometry of human body, rider speeds, and typical properties of air are close to a critical Re number where the boundary layer transition can be influenced, in particular by surface roughness and the level of turbulence in the air.

The turbulence level in the air is not controlled by the athlete, however, the surface roughness of the body can be modified by fabric selection. Through fabric selection, these surface flow mechanisms can be manipulated, directly 'tripping' the boundary layer to a turbulent state at the most opportune position on the body to encourage flow attachment, thereby generating Cd improvements at the same air speed. This is the underlying mechanism behind the method developed by Swiss Side to select the optimal fabrics for each body part.

The athletes body position can be approximated as a combination of cylinders. A widely used approach is to test sports apparel on infinite circular cylinder with a diameter close to the body parts typical size. An improvement from the infinite circular cylinders' simplification is to use finite oval cylinders.

The figure below shows the CdA of a 200mm diameter circular cylinder measured with speed steps from 3 to 21m/s (10 to 75 km/h) in the Swiss Side wind tunnel. The cylinder was tested with a smooth surface (dashed black trace; *None*) and 3 different fabrics (blue, orange, and green traces). The smooth surface shows a CdA that decreases slightly with speed. For the 3 different fabrics, the CdA values are similar to the smooth surface at low speeds, however at higher speeds, Fabric 1 and 3 show considerable differences in CdA. The "critical" speed at which the CdA reduction occurs is different between the fabrics. Fabric 2 is a relatively smooth fabric and shows only small differences to the smooth cylinder. Fabrics 1 and 3 have some external structure which create surface turbulence. By creating turbulence, the boundary layer is provoked to transition earlier to a turbulent state, which lowers the speed at which the CdA drop occurs. The goal is to find the fabrics that have the optimal amount of roughness to produce a drag reduction in the speed range of interest.

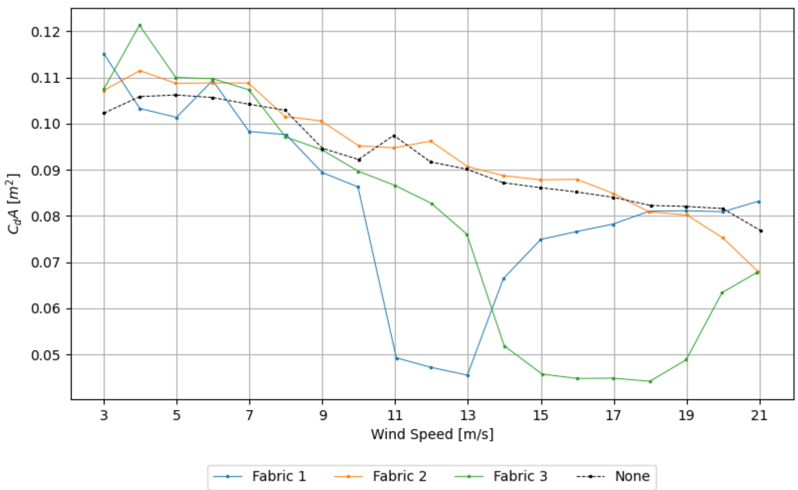

Figure 2: CdA of a 200mm cylinder at speeds ranging from 3 to 21m/s in the Swiss Side wind tunnel.

The figure below shows the CdA of small and big diameter cylinders, measured with airspeed steps from 3 to 21m/s (10 to 75 km/h) in the Swiss Side wind tunnel. The cylinder was tested with a smooth surface (dashed black trace; None) and 2 different fabrics. For the tested fabrics, a drop in CdA occurs for both textiles on both cylinders. For a given fabric, the speed at which the CdA drops is however different for each geometry. This shows the importance of the Reynolds Number on the boundary layer transition and aerodynamic drag decrease of the cylinder.

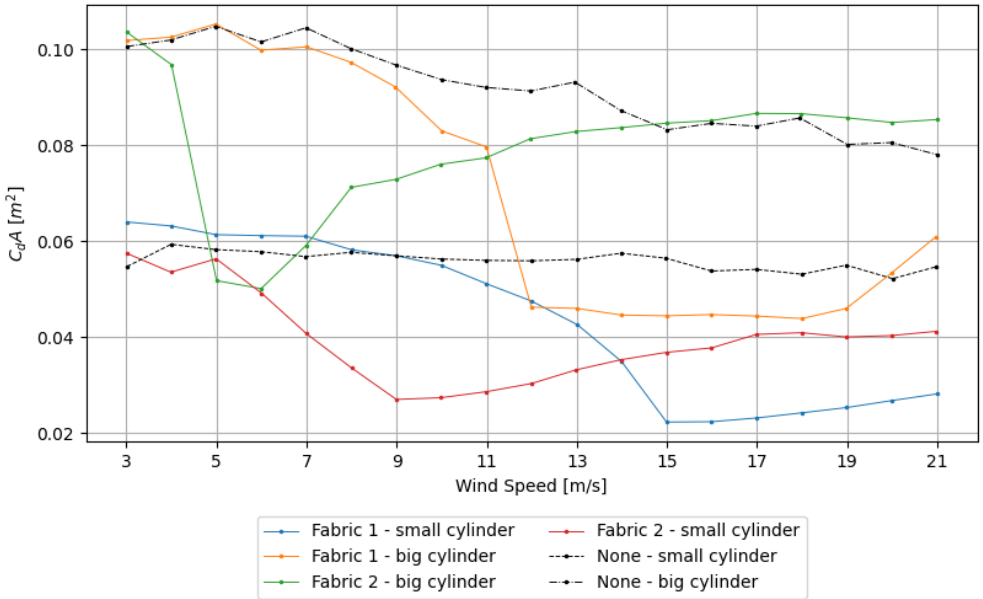

Figure 4: CdA of small and big cylinders at speeds ranging from 3 to 21m/s in the Swiss Side wind tunnel.

From the examples above, we can appreciate the potential for drag reduction based on circular cylinders. The circular cylinder geometries are an idealized representation and the human body parts are more complex with different sizes.

Due to the complexity of the problem, it was considered that no optimum fabric could be defined just through theory and that a range of fabrics would need to be physically tested and characterised, using multiple testing methods.

2. DEVELOPMENT METHODS

The AERO tri-suit development is part of a global textiles R&D project which encompasses the Aero Calf Sleeves and Aero Calf Socks. As part of the textiles R&D, a novel, multi-faceted aerodynamics development and testing process was created. The comfort & functional development of the suit was done in parallel. An athlete-centric approach has been used to develop the suit by including the athletes' expectations and feedback throughout the entire process. The suit has been developed to deliver an aerodynamic improvement without compromising on the comfort and needs of triathletes.

The fabric choices and suit construction have been considered with aerodynamics and comfort together. All the fabrics tested in the wind tunnel were chosen such that they would not be detrimental to the suit fit. For areas where aerodynamics has less importance, the fabric choice was focused on the functional aspects such as cooling on the back of the rider and abrasion/chafing resistance on the inner leg.

Aerodynamics

Swiss Side needed to find methods to be able to assess the aerodynamic benefits of a wide range of fabrics in an accurate and practical manner.

The following is a list of methods employed by Swiss Side, with benefits and limitations noted for each:

a) Wind tunnel fabric testing on circular cylinders

Benefits:

- Fundamental starting point measurement for classifying fabric performances.
- Can be tested in Swiss Side in-house wind tunnel over a wide range of speeds with high measurement accuracy and high efficiency, allowing a large number of tests in a time and cost-effective manner.
- Turbulence can be introduced in a controlled manner in the Swiss Side wind tunnel, to understand the real-world (non-laboratory) airflow turbulence impact on the results.

Limitations:

- Shape difference of a circular cylinder to generic body part shapes.
- The cylinder is tested as an isolated geometry which neglects the interactions between the body parts.

More than 65 fabric types were evaluated in this way with speeds in the range of 10 to 75 km/h on cylinders of two diameters. The small diameter cylinder has a geometry close to the lower legs and arms. The big cylinder has a geometry close to that of the thigh and torso.

b) Wind tunnel fabric testing on oval cylinders

Benefits:

- Shape is closer to the body part shapes than the circular cylinders.
- Can be pitched to accurately represent the body parts' position.
- Can be tested in Swiss Side in-house wind tunnel over a wide range of speeds with high measurement accuracy and high efficiency, allowing a large number of tests in a time and cost-effective manner.
- Turbulence can be introduced in a controlled manner in the Swiss Side wind tunnel, to understand the real-world (non-laboratory) airflow turbulence impact on the results.

Limitations:

- Shape difference of an oval cylinder to generic body part shapes.
- The cylinder is tested as an isolated geometry which neglect the interactions between the body parts.

20 fabric types were evaluated in this way with speeds in the range of 10 to 75 km/h on oval cylinders of two different size with different pitch and yaw angles.

c) Wind tunnel testing with full sized Time-Trial mannequin

Benefits:

- Testing with the complete bike rider geometry ensures greater flow field accuracy.
- A complete yaw scan can be done which gives more information about the sailing effect (drag reduction with yaw) on the complete rider.
- Turbulence can be introduced in a controlled manner in the full-size wind tunnel used, to understand the real-world (non-laboratory) airflow turbulence impact on the complete bike-rider-system results.

Limitations:

- Testing in the full-size wind tunnel is more costly and with reduced availability compared to Swiss Side inhouse wind tunnel.
- Lower testing efficiency leading to less options tested and a narrower speed band.
- Reduced drag force measurement resolution compared to Swiss Side in-house wind tunnel.
- No dynamic motion of the legs, although the static leg results can apply for coasting or descending scenarios when the rider does not pedal.

More than 15 configurations were tested on the mannequin.

d) Wind tunnel testing with athletes

Benefits:

- Testing with the complete bike rider geometry ensures greater flow field accuracy.
- Testing with different athletes' body sizes
- Inclusion of dynamic moving legs through rider pedaling
- Turbulence can be introduced in a controlled manner in the full-size wind tunnel used, to understand the real-world (non-laboratory) airflow turbulence impact on the complete rider results.

Limitations:

- Reduced drag force measurement resolution due to athlete repeatability.
- Discrete yaw angle measurements compared to dynamic yaw scans made with the mannequin.

e) Road tests with athletes

The on-road measurements of aerodynamic drag coefficient were made using the Swiss Side CdA Meter. This step is an important correlation step to ensure improvements measured in the wind tunnel are also measured on the road.

Benefits:

- The most realistic real-world conditions, including the effect of turbulence in the air, although the turbulence intensity cannot directly be controlled.

Limitations:

- More time-consuming than wind tunnel testing.
- Reduced aerodynamic drag measurement resolution due to indirect measurement, athlete repeatability and real-world effects on the measurement system, compared to the more controlled environment and direct force measurement process of wind tunnel testing.

Additional test methods included:

- In some cases where the fabric was not isotropic, the orientation of the fabric to the geometry was changed.
- Some cases were tested with different levels of turbulence in the airflow.

Figure 3: General image of the Swiss Side wind tunnel while fabric testing.

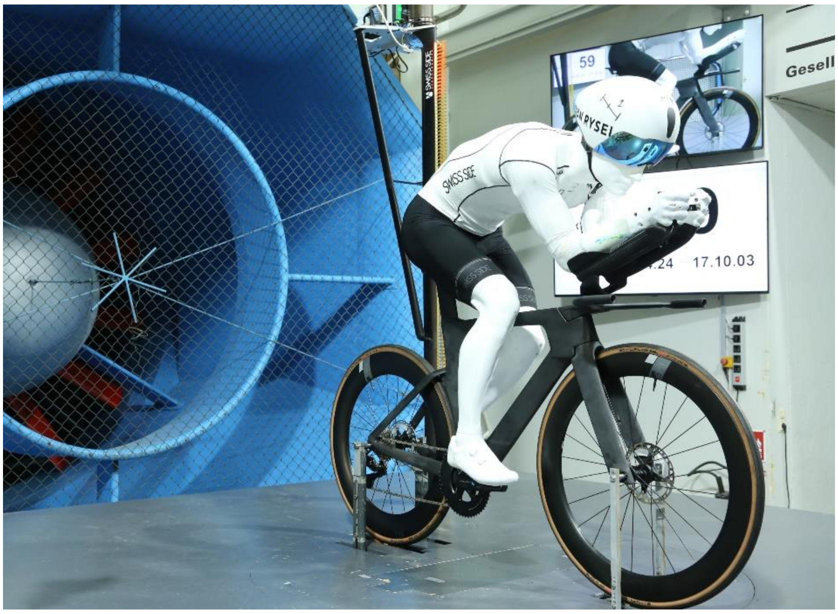

Figure 4: Time Trial mannequin testing with an AERO Tri Suit prototype in the wind tunnel.

Figure 5: One athlete with an AERO Tri Suitt prototype in the full-size wind tunnel.

Figure 6: Real world measurements with CdA meter.

Comfort

Swiss Side used an athlete-centric approach for the development of the AERO Tri Suit. Athletes were included in the design iterations of suits from stage 0 up to testing the final prototypes.

The first step was to define the expectations for a good tri-suit for long distance races together with elite athletes. Understanding the needs of the triathletes helped set the main targets and issues to solve in the suit design. The athletes were consulted on the fit and functionality of the prototypes at each iteration. Prototype evolutions were also used in races at various milestones during the development. Jan van Berkel used an early prototype at the IRONMAN Switzerland 2023, and the final prototypes were used by 9 athletes, men and women, notably at IRONMAN South Africa 2024.

The construction of the suit was developed by choosing the appropriate fabrics for each of the body parts, considering aerodynamics, comfort and thermal management. The sewing seam types and positions were designed for both aerodynamic performance but also for maximum freedom of movement and comfort (without chafing) considering all three triathlon disciplines (swim – bike – run).

3. PERFORMANCE CRITERIA

Throughout the process, the aim was to produce a tri suit that delivered strong aerodynamic drag (CdA) reductions over a wide range of athletes (sizes) and speeds. The ranking of performance for the fabrics tested in the Swiss Side wind tunnel was based on a weighting system which rewards the results based upon how often each speed occurs in typical triathlon races, and the time saving for each speed for a given CdA reduction. The weighting system was based on a broad range of races (flat and hilly) and riders (different age groups & ability). In this way, it is ensured that the performance benefit is delivered at realistic speeds seen by triathletes of all levels.

For the full-size wind tunnel testing, the bike rider configuration is tested at multiple yaw angles to simulate the effect of crosswind. The performance of the suit was calculated using a weighting system which rewards the results based upon how often each effective yaw (crosswind) angle occurs in typical triathlon races under general wind conditions.

The speed and yaw weighted performance are referred to as "merit performance" in this paper.

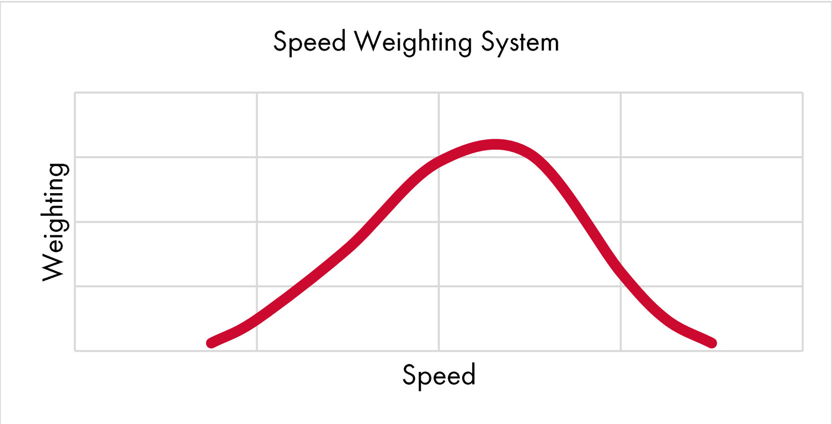

Figure 7: Speed Weighting System schematic of speed frequencies in triathlon races.

RESULTS

4. SWISS SIDE WIND TUNNEL

A fabric can have roughness from the weave (fine-scale roughness) and/or roughness from larger dimension structures in the fabric (large-scale roughness). There are many ways within the structure of the fabric to achieve a desired layer of roughness. Different arrangements of roughness components in the fabric will lead to different types of turbulent boundary layers. Too little turbulation provoked by the roughness features may not be adequate to impact the boundary layer. Too much turbulation can then add too much disturbance and lead to increased drag or even early flow separation. Therefore, finding the right level of turbulation from the roughness features, which can be based on size or orientation but also the position, makes for a very complex challenge.

The circular cylinder testing was used as an initial learning process for the fabric options, and as a filter for the subsequent oval cylinder tests in the Swiss Side wind tunnel. For the fabric tests performed in the Swiss Side wind tunnel, the aerodynamic drag was weighted based on speed as described above, to give a single CdA value. The fabric ranking based on the merit performance was generally similar on the oval and circular cylinders.

The plot below shows the merit CdA change for 27 fabrics options on the small and big circular cylinders compared to no fabric. The most interesting fabrics of the small and big cylinders have been assigned a colour in the plots.

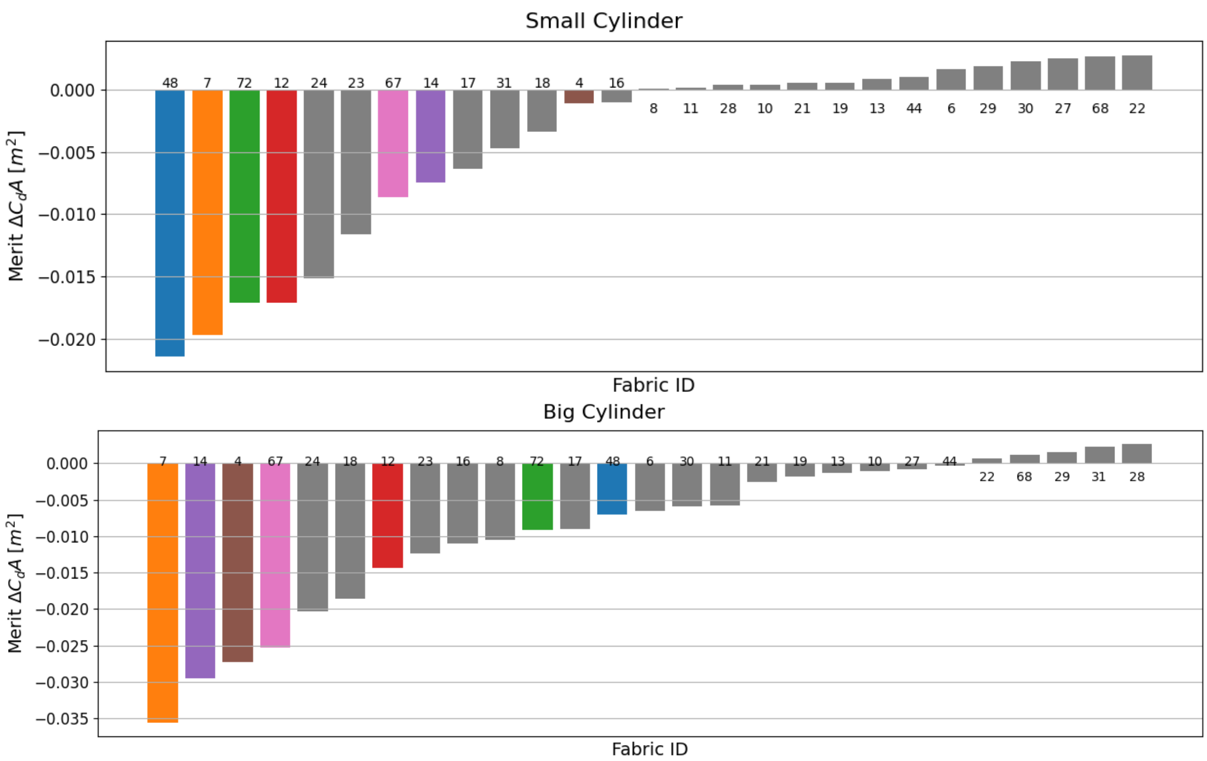

Figure 8: Merit textile performance relative to no textile for the two cylinders.

Of note is that fabric 7 performs well on both the small and big cylinders whereas the performance of the other fabrics is generally size specific. This highlights the importance of testing the fabrics on multiple configurations.

The choice of fabrics for the different body parts was done by analysing the merit performance and the fabric drag response curves with speed for the geometries closest to the dimensions of the body part of interest. The fabric selection was made such that the range of speed at which the drag is reduced, is as wide as possible, thereby delivering a more robust performance over a broader range of speeds and rider morphology.

5. FULL-SIZE MANNEQUIN AND ATHLETE WIND TUNNEL TESTS

Using the results and fabric selection from the Swiss Side wind tunnel, multiple suit prototypes were developed with different fabrics and suit structures. The most promising aerodynamic fabrics were tested on the legs, body sides, shoulders, and arms. A total of more than 15 different prototypes were tested in the wind tunnel on the full-sized mannequin.

Figure 9: AERO Tri Suit prototypes with different fabrics on arms and shoulders.

The best prototypes were also tested with athletes throughout the different iterations. The early athlete tests in 2023 were already conclusive with significant improvements achieved. Following these positive results, a prototype suit was made for Jan van Berkel, which he wore during his race victory at IRONMAN Switzerland 2023.

At the final development stage, the production specification AERO Tri Suit prototype was tested against 3 other suits to validate its aerodynamic performance. From Swiss Side's extensive athlete testing experience, two of the typically best performing suits on the market were identified (Suit 1 and Suit 2), as well as a main brand top tier suit (Suit 3). All suits were tested at speeds of 35, 45, and 55 km/h. The merit performance difference of the 3 suits compared to the AERO Tri Suit is shown in the table below with the aero drag power (Watts) differences at the tested speed.

Speed	35 km/h		45 km/h		55 km/h	
Deltas	CdA	Watt	CdA	Watt	CdA	Watt
Swiss Side tri-suit	0	0	0	0	0	0
Suit 1	0.0052	2.8	0.0016	3.8	0.0011	2.3
Suit 2	0.0058	3.2	0.0034	1.7	-0.0014	-3
Suit 3	0.0055	3	0.0074	8.4	0.0075	15.9

Table 1: Merit Performance Deltas of 3 competitor suits to the AERO Tri Suit on the full-sized mannequin.

The AERO Tri Suit is the best of the tested suits at 35 and 45 km/h and the second best at 55 km/h. It is interesting to note the speed effect on the suit's performance. As explained in the textiles aerodynamic development process, the fabric roughness will create turbulence which will decrease the drag for a certain speed range. This highlights the importance of developing the suit for the correct speeds. The AERO Tri Suit was designed with both age-grouper and professional triathletes in mind and not just pro-athletes in mind. The results show that the development approach was successful, delivering the best performing suit for the most relevant speeds during a long-distance triathlon race.

In addition, the suits have been tested with the full-sized mannequin and athletes in turbulent airflow. The results validated the top performance of the AERO Tri Suit, in the range of real-world turbulence intensities.

The Swiss Side wake measurement system was routinely used to assess the changes in the wake brought about by tri-suit changes. The wake is measured in a plane directly behind the rear wheel. The total pressure loss in the airflow is measured by 128 probes. This is effectively a measurement of the energy lost in the air flow, which is the aerodynamic drag. In this way, the aerodynamic drag losses are visualised, and the specific area which has changed can be identified. The image below shows a measurement with the system, in this case with an athlete in a standard triathlon setup:

Figure 10: Aerodynamic measurements in a full-size wind tunnel on athlete. The red zone indicates no losses (100% total pressure). The darker the blue, the more the losses/aerodynamic drag.

The wake is also displayed in the data analysis system as contours of total pressure coefficient. The smaller the contour number the greater the losses. The bigger the area of the contour the greater the losses. In the image below, the blue traces are with suit 1, the orange with AERO Tri Suit. Here we see the orange contour lines (AERO Tri Suit) are displaced closer to the centre line in the region from 0.8 to 1.3 m above the ground compared to the blue lines (suit 1) indicating reduced losses in the wake in the region of the upper body.

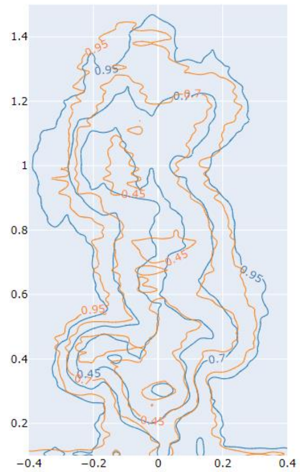

Figure 11: CpT plot of Suit 1 (blue) vs Swiss Side Tri-Suit (orange). Axis Z shows the height above the ground, axis Y shows the lateral position.

6. COMFORT & FUNCTIONALITY

By interviewing elite triathletes, the key issues that needed to be solved and the needs to be fulfilled in the suit design were defined as follows:

- Have a compatible fit for the three disciplines (swim – bike – run) which allows for a full freedom of movement.
- Reduce the irritation on the leg (in particular for running) and on the neck and armpit (in particular for swimming).
- Find an aerodynamically and functionally optimised pocket system, other than on the lower-back of the suit which is aerodynamically detrimental.
- Use non-hydrophobic fabrics for effective cooling.

To provide the best possible fit for the three disciplines, a unique construction was developed which encompasses the best of the butterfly-cut and classic short distance tri-suit constructions. The upper body front panel is partially detached from the shorts and has a ¾ zip. The partially detached front panel guarantees the best fit in cycling and running. Thanks to the suit construction, it does not create folds on the lower part of the belly when in time-trial position. For running, the partially detached panel will allow the suit to stretch more and will ensure that the suit does not add any tension on the chest and shoulder in the upright position, which would decrease the triathletes' performance. While the detached part provides the best fit for the different disciplines, having the suit attached on the back and on the sides, ensures that the suit has the optimum construction for aerodynamic performance and will not move around in transition or during the different disciplines. The ¾ zip allows for an easy and good opening of the suit while ensuring that the suit will not start to flap around and satisfy IRONMAN regulations.

For the panel construction of the suit, the first segmentation was made based on wind tunnel test to define the key zones for implementing different fabric types, whilst not adding unnecessary seams that would disturb the airflow. This was done in part with the use of the 'chicken suit', a suit made with integrated wool-tufts, to help visually identify local flow vectors but also separated regions, or areas which are impacted by dynamic movement of the legs.

Figure 12: Time Trial mannequin with the chicken suit in the wind tunnel

In addition to "aerodynamic" considerations, the seams have been adjusted to guarantee the best comfort, free the shoulder movement, limit the irritation and avoid any tensions as they induce stress on the general body. For example, the seams around the shoulder and on the neck have been adapted based on the feedback of athletes throughout the design process.

To reduce the irritation during swimming and running, two solutions were used. On the neck, a sewn hem was used to reduce the irritation during swimming. On the leg, an elastic was implemented. The typical laser cutting process normally used, burns the material which makes the edge harder and increases the irritation. The elastic provides a more comfortable finish, maintains the shorts in place and ensures that the bottom of the suit remains in position throughout the 3 disciplines. The choice of the suit finishes in the neck and leg areas were validated by the athletes with testing in training and in real race conditions.

To have the maximum aerodynamic performance, it was chosen to remove back pockets and an alternative system was designed. The pockets were instead placed on the inside of the suit at the front. The front pocket also allows for easy access not only during cycling but also whilst running. With the pocket being located close to the hip, it is possible to run with the zip open while still having some gel or bars in the pocket. The feedback on the front pocket system was excellent, also confirming this to be a superior and more ergonomic solution than pockets on the back of the suit.

The fabrics were defined by zones for aero and non-aero performance. For the non-aero performance zones, fabrics were chosen to satisfy the comfort and function requirements. On the upper front of the body for example, the fabric choice was driven by breathability, lightweight and preventing excess water retention. The suit dries therefore quickly and has a good sweat evaporation. On the leg, a very different fabric was chosen, giving the best compromise between, support, weight, but also durability which is needed for accommodating rubbing on the saddle during cycling and eventually rubbing between the legs during running.

7. ON ROAD AND COMPETITION TESTING

An early prototype was tested in competition by Jan van Berkel. The tri-suit showed aerodynamic gain in the wind tunnel and was produced for IRONMAN Switzerland 2023. Jan van Berkel won the race which provided high confidence that it was already a high-performing tri-suit concept. He gave valuable feedback of the suit performance and comfort in race conditions which helped further improve the quality, design and function of the tri-suit for subsequent iterations.

The final prototype was tested on the road where the performance of different suits was also measured using the Swiss Side CdA-meter. The improvements in aerodynamic drag performance of the AERO Tri Suit measured in the wind tunnel were confirmed.

The final production-specification prototype was also used by 9 athletes in training and race conditions. Excellent performances were achieved by the athletes in their races, with a number of personal best times on the bike leg and on entire race distance of the IRONMAN 70.3 South Africa. All athletes participating in the IRONMAN South Africa qualified for the IRONMAN or IRONMAN 70.3 world championships. In addition to achieving good performance, the feedback from the athletes was good and confirmed that the targets were achieved. None of the athletes suffered any chafing during their race and they all appreciated the comfort and freedom of movement of the suit for the three disciplines (swim – bike – run). In addition, the triathletes where pleased with the functionality of the front pockets. The front pockets provide a significant time gain in the second transition with the ability to quickly stuff the nutrition in it. Their easy reach also allows for easier fulling during the bike and run.

ABOUT SWISS SIDE

Established in 2011, the Swiss Side brand was a spin-off from Formula 1 motorsport, based on co-founder Jean-Paul Ballard's 14-year long F1 career, with purpose to transfer the closely guarded know-how to the cycling industry, particularly when it comes to aerodynamics and physics. Today, Swiss Side is a proven industry leader in developing the best performing aerodynamic cycling & sports products, having developed world-wide leading know-how and R&D infrastructure for low-speed aerodynamics. The fruits of this can be found not only in products under the Swiss Side brand but also those developed in collaboration with some of the biggest brands, athletes and pro-cycling teams in these industries.