MAAT WHITE PAPER 1.0

PINARELLO
MAAT

CONTENTS

1. INTRODUCTION

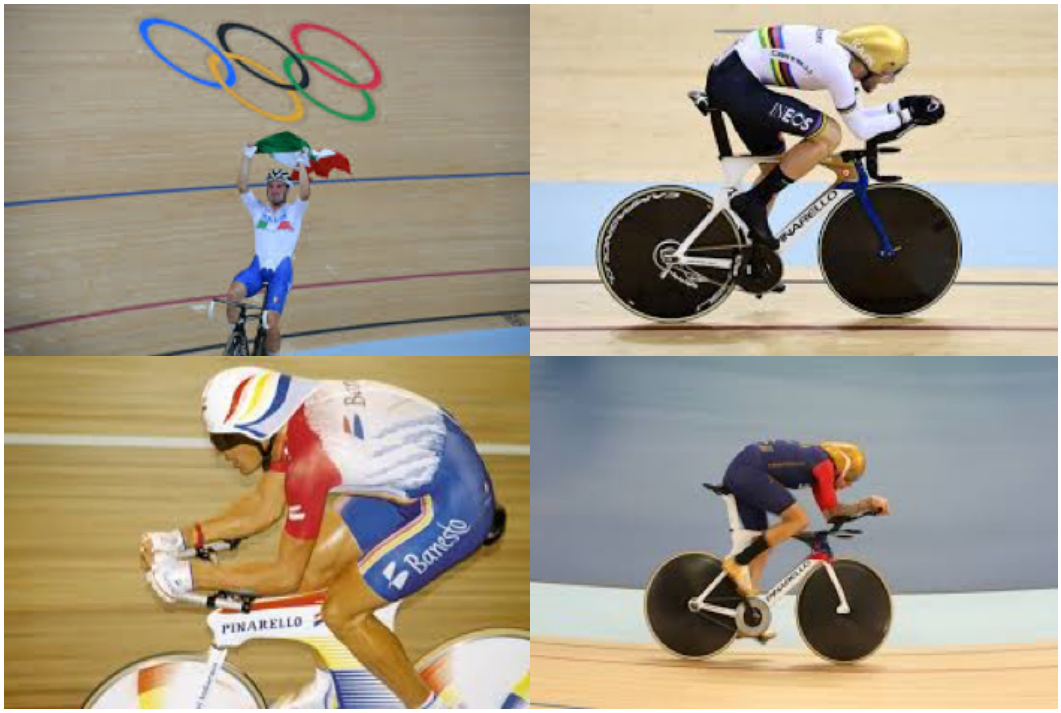
1.1 Pinarello

Cicli Pinarello S.R.L. is one of the most famous and winning bike manufacturers in the world. Founded in Treviso (Italy) in 1952 by Giovanni (Nani) Pinarello, it produces high end racing bikes. This name, Pinarello, recalls legendary victories of the greatest cyclists of all times: since 1975, the first victory in Giro d'Italia with Fausto Bertoglio, Pinarello has won all the most important races in the world, including Olympics, World Championships and Tour de France.

1.2 Track Experience Over the Years

For many years Pinarello has developed track bikes to cover different needs of riders. Starting from the Espada, used by Miguel Indurain in 1996 for hour record, passing through Bolide HR, the weapon developed for Bradley Wiggins's Hour record in 2015, since the recent wins of Elia Viviani with the Maat (Omnium gold medal at the 2016 Olympics) and Francesco Ganna with the Bolide HR again (gold medal in Individual Pursuit and Team Pursuit during Track World Cup).

All of these projects have helped Pinarello to grow over time and improve its products, making them the best performing and desirable bicycles on the market.



2. SUMMARY OF THE IMPROVEMENTS

Having created many winning bicycles in recent cycling history, Pinarello was able to draw on a very broad technical know-how to develop this new project.
In fact, the Maat is the outcome of an optimization of the frame coming from the expertise done with
- deep analysis of track aerodynamics done with Bolide HR
- stiffness and power transmission analysis done on all of Pinarello's road bikes
- accurate investigation of rider needs to enhance their riding experience

Summarized, the improvements and results obtained through the development are:

MAAT

AERODYNAMICS:

- Thin and deep optimized tubing sections
- Integrating the frame's headtube (Patent Pending)
- Integrated stem and headset
- Implementation of all the small aero tricks developed for Bolide HR

STRUCTURAL:

- BB and chainstay reinforced
- Asymmetric design

VERSATILITY:

- Multipurpose frame-kit
- Compatible with chainrings up to 66 teeth
- Versatile aero headset spacers
- Compatible with non-integrated stem and handlebar
- Compatible with disc and standard wheels
- Tire clearance up to 23 mm

HANDLEBAR

INNOVATIVE DESIGN OF THE HANDLEBAR:

- Compact reach and stack
- Ergonomic hoods
- Flat areas to accommodate wrist while in aero position
- Thin central section for better handling during hand-sling in Madison races

GEOMETRIES:

- 5 frame sizes
- Longer top tube to accommodate best aero position within UCI rules
- 3 integrated handlebar sizes

3. AERODYNAMICS DESIGN

Aerodynamics is a complex area of study because of the interaction between the airflow with all bike components as well as the rider. The optimization of the parts done one by one could cause worsening of the overall performance because it does not consider the interaction between each of the parts. Because of this, Pinarello for years has used CFD (Computational Fluid Dynamics) technology for aerodynamic studies and development. This allows us to optimize every single frame component and provide proof of the improvement in a full model that includes human dummy.

The aerodynamic analysis completed to develop Bolide HR was used as a reference for the development of the Maat frame, but the Bolide HR was designed to accommodate disc wheels on both front and rear.

Here the frame is created to meet a different set of requests: it must adapt for omnium races, Madison races and as a second choice for sprint races. So the PinaLab took the best of the Bolide HR project and shaped it to the new requests while maintaining the updated UCI rules.

In one of last updates, UCI removed the constraint of having sections with maximum 3:1 ratio, allowing the manufacturer to produce more aero shaped sections. The headtube, fork and rear stays are the parts of the frame-kit that had more benefit from the updated 3:1 UCI rule.

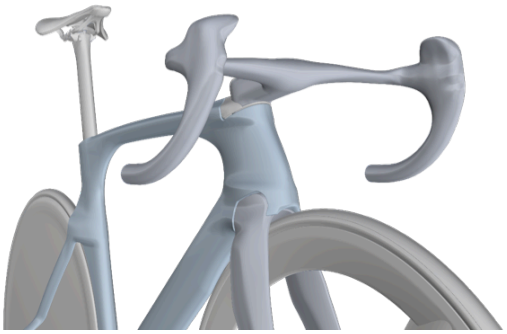
3.1 Headtube

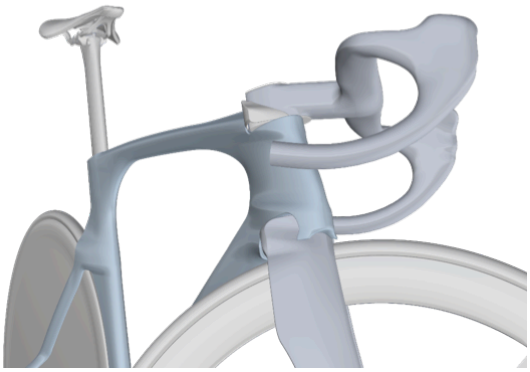
A unique technical solution and design have been developed for the headtube. There was the necessity to blend different requests:

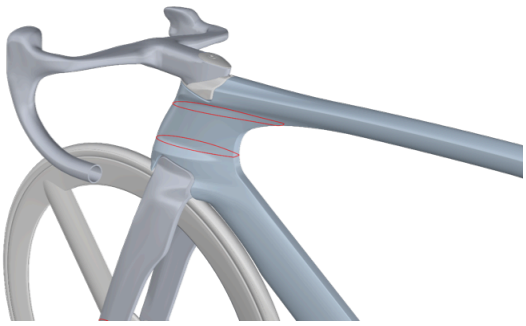
- Best aero performance with long flatback profile
- Respect UCI rules
- Leave the front fork free to rotate same as on a standard road bike for better handling and to preserve the fork and frame integrity during crashes

The fork crown extended in front of the headtube is a common design on time trial bikes or pursuit track bikes. It fulfills the first two requests, but it is not safe during hard turns or crashes.

The PinaLab came up with this innovative design where the head tube is extended in front of the fork crown, creating a long integrated aero profile together with fork and downtube. This technical solution is now patent pending.



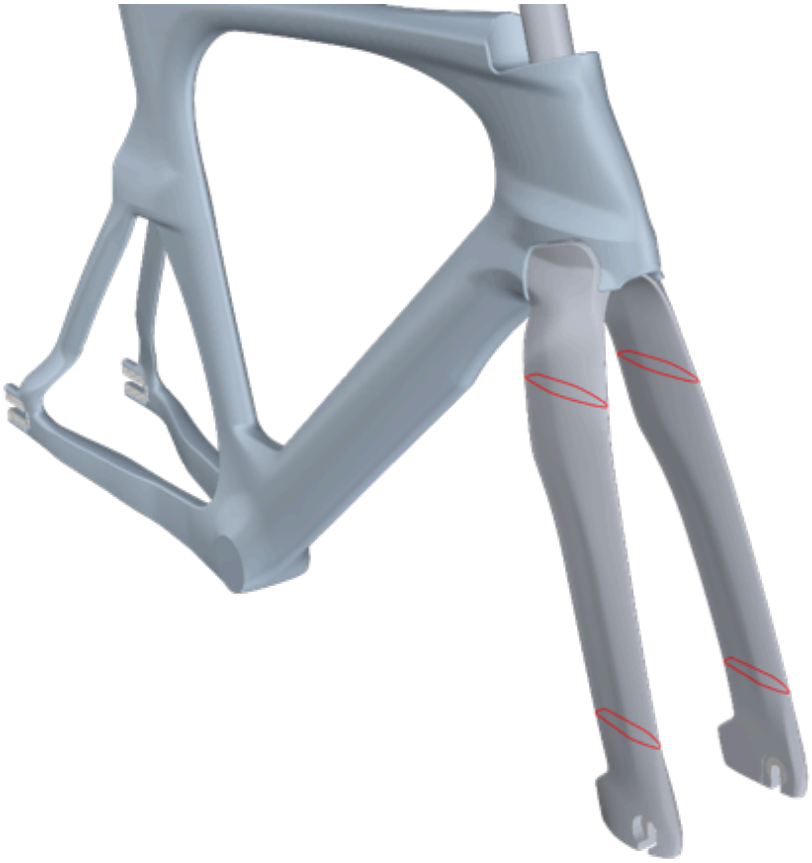




3. AERODYNAMICS DESIGN

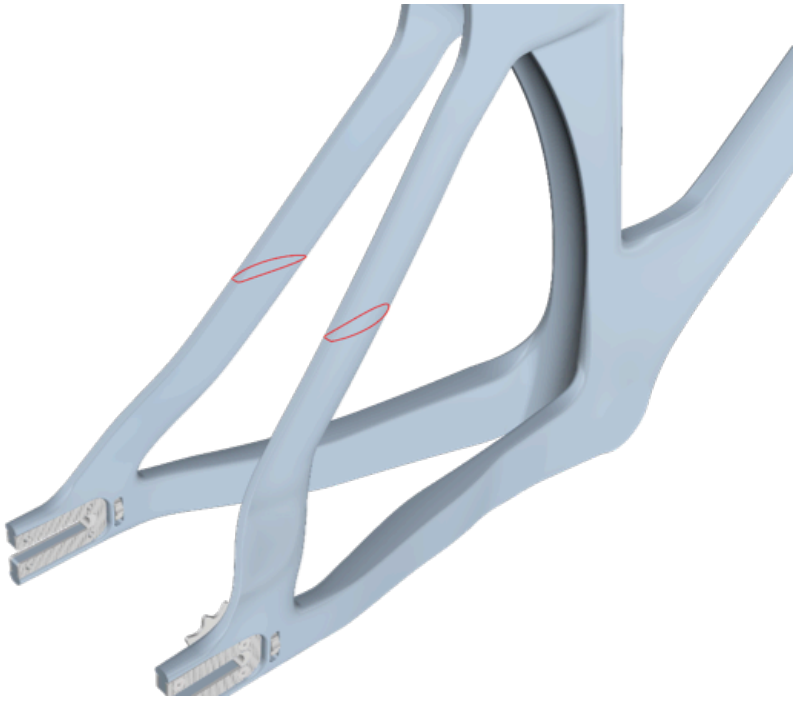
3.2 Fork

The fork is one of the most important parts of the bike in terms of aerodynamics. In fact, it is not only interacting with the airflow, but it is also driving the airflow along the rest of the frame and the rider's legs.
The benefit of 3:1 rule is clearly visible in on the fork legs. Their sections, pointy and flatback, are close to the cord length limit, placed by the rules at 75 mm. Their width is driven by stiffness performance. The fork legs are wide to get better performance with all kinds of front wheels, from standard spokes, through big carbon aero spokes to disc wheels.



3.3 Seat Stays

In the rear the dimension of seat stays is a balance between aero performance, again with over 3:1 sections, weight, and not creating them too deep. This section is asymmetric, with flat inner surfaces, to match widespread used disc wheels, aero outer surfaces and flatback.



3.4 Downtube and Seattube

Seattube and downtube sections are derived from the original Bolide HR version, with long cord aero profile and small flatback.

3.5 Other Details

The PinaLab also integrated these small aero details:
- Sero shaped fork dropouts
- Integrated headset/toptube/handlebar design with the stem sunk into the toptube, keeping the necessary versatility (the frame is compatible also with other stem/bar assemblies).
- Newly designed aero shaped headset spacers

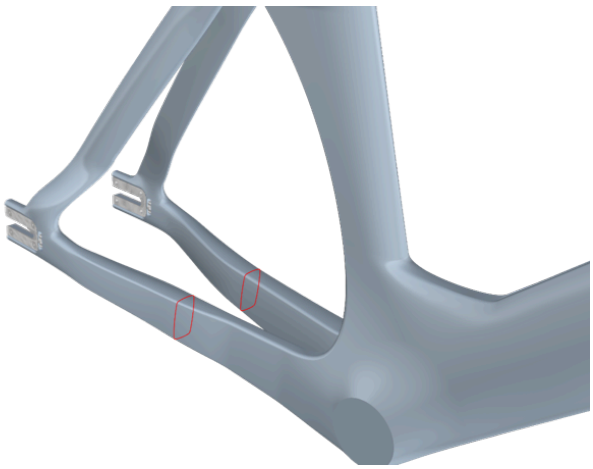
4. STRUCTURAL DESIGN

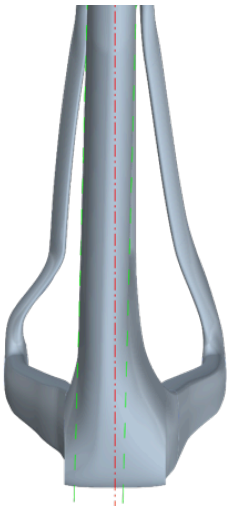
Cross sections and shape of tubes are as important as the material choice to ensure stiffness and lightness. At the same time, as discussed above, it has a meaningful influence on aerodynamics. Therefore, the final structural design is the optimal compromise between an aero and a stiff shape.

Since 2009, Pinarello has studied and developed the asymmetric frame that optimally counteracts the asymmetric forces developed during pedaling. In fact, on the right side of the frame pedal force and chain tension are acting as sum of the two, on the left side those forces are opposed. This means that the frame tubes must be enlarged on the right side to provide a symmetric behavior on the bike.

4.1 Chainstays and Downtube

The most crucial frame portion to guarantee the greatest power transfer from the rider to the wheel is the area of the bottom bracket and the chainstay. As mentioned previously on the asymmetry concept, the bottom bracket is where all forces are localized from the pedals and chain tension. The torque generated by the rider's leg is transfer to the cassette and consequently to the rear wheel through the chain.
However, if the chainstays were to flex due to the forces involved, the distance between crank and pinion would be reduced and consequently, there would be a drop-in chain tension. This results in a loss of power transferred to the rear wheel. It is therefore fundamental, for a correct performance-oriented design, to develop the chainstay tubing section in a way that they will not deflect under the torque generated by the rider.





On Maat, the PinaLab applied what was learned with Dogma F12 to increase the moment of inertia and therefore the stiffness without adding weight. This is the reason why PinaLab chose a squared profile for chainstays.
The downtube, although its section was deeply aero, is completely asymmetric. It is moved on the right side of the frame in comply with the asymmetric concepts.

4.2 Material Choice

The proper choice of material will deeply influence the performance of the frame. Carbon Fiber Reinforced Polymer (CFRP), in particular, can be optimized for every single area of the frame to achieve the best stiffness and lightness, based on the localization of stress. As done on our high-end road bikes, the main material used is Torayca T1100 1K carbon, which ensures the highest tensile strength in the world. This choice contributes to increased impact strength to prevent breakages. Thanks to the highest grade of carbon fiber used (especially higher strength) we were able to get a lighter frame while maintaining strength. The T1100 fibers have been used in the higher stressed areas, in order to take advantage of its incomparable strength.

5. CUSTOMIZATION AND VERSATILITY

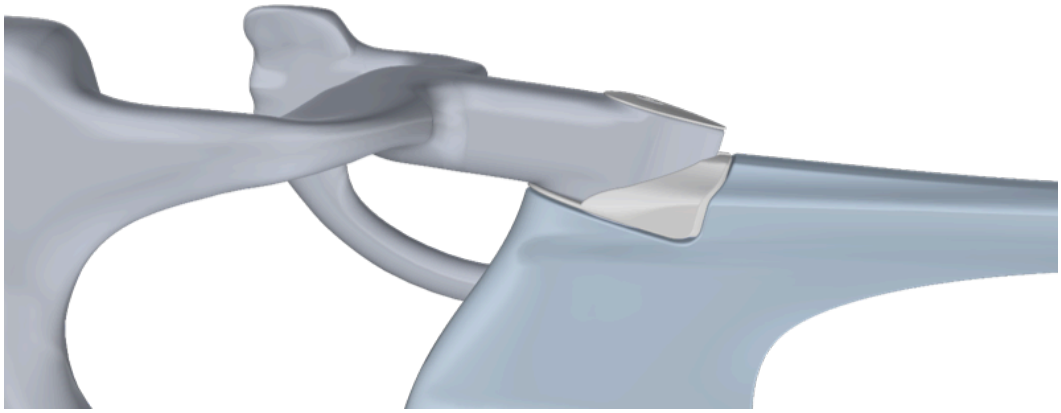
The keywords for the Maat project were: customization and versatility. The PinaLab was constantly thinking about how to make this bike with ease of use and compatibility with different track disciplines and riders' expectations. The innovations and solutions that have been found are summarized below.

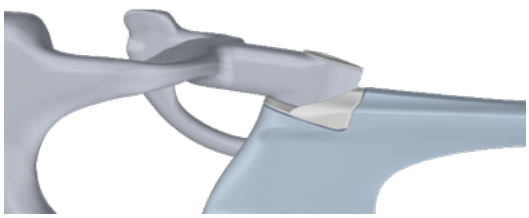
5.1 Multidiscipline

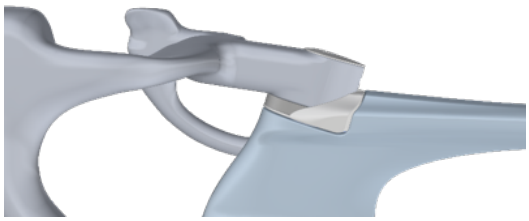
This frame-kit has been created to accommodate different riders' requests. It is studied specifically for Madison and Omnium events, but due to its stiffness and headset versatility it could be used also for sprint events.

5.2 Headset Spacer Versatility

The need to adjust handlebar stack is common for all riders regardless of their ability. Sometimes even during the season there is the need to raise or lower the stem.
The spacers, specifically aero shaped to fit the long nose of the frame, are available in 5mm and 10mm height.
To fit different riders needs this headset can accommodate both integrated handlebar or standard stem and handlebar assembly. The headset is fully compatible with current Most Tiger stems.







5.3 Tire Clearance

Form several years we are assisting on road discipline the growth of tire size. Also in track events the trend is an increased tire section. Until a few years ago the standard was 19 mm tubulars. Now many riders are moving towards 22 mm section tubular and even 23 mm.
Maat is designed to accommodate up to a 23 mm tire.

6. HANDLEBAR

The new handlebar was developed specifically for the Maat to achieve the best aerodynamic and structural performances with a deep study on ergonomics.
The requests from the riders were very particular. Looking carefully at the rider's habits during races, the PinaLab figured out several improvements to implement in the new handlebar.
Several designs have been developed, with different bar width, flare-out angle, grip design, and a horizontal section to allow the best ergonomics while adopting a "time trial" position or during a hand-sling.

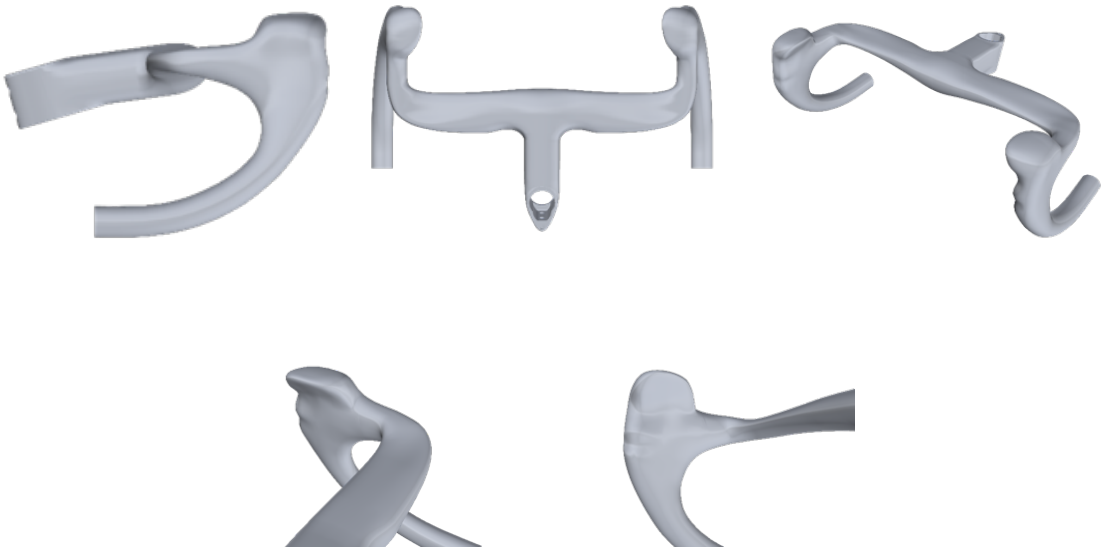
All these designs have been produced by rapid prototyping and then tested with riders on a dummy bike. After several hours of tests, we came out with all specifications for the final design.

6. HANDLEBAR

6. HANDLEBAR

Only at this point the PinaLab moved forward with proper final design to match all technical features and make it perfectly integrated with the frame's design.
The final features of the handlebar are:

- Compact drop
- Narrow drop width
- 8.5º flare-out
- Ergonomic grips for hands and finger on the top of the drops to create a "new" time trial position
- Flattened top surface on the bar to give a comfortable position for the wrist in time trial position
- Reduced section near the stem for better control during hand-sling
- Streamlined sections for best aerodynamic performances
- Exceptional torsional stiffness for great responsiveness during sprints



7. SIZES

7.1 Frame Sizes

Pinarello is has always offered every single rider the best bike fit. We developed 5 sizes to allow every rider to find the best fit for their body. Every one of these sizes are designed and produced individually: the bigger sizes are reinforced and shaped in order to bear higher stresses, the smaller sizes can be made with less material, saving weight. The frame has steep seat tube and head tube angles, short fork rake, short rear stays and a long toptube.

These characteristics gives the rider:

- Exceptional handling
- Responsiveness under pedaling forces
- Optimal weight distribution
- The possibility to get very aero position on the bike

With the Maat headset top cap being integrated with the frame, reach and stack measurement are calculated on top of the top cap.

CF	CC	L	I	A [º]	B [º]	F	P	T	D	R	G	REACH	STACK
455	425	548	103	76.00º	73.50º	595	378	80	46	38	370	428	471
480	450	563	109	76.00º	74.00º	607	378	95	46	38	370	440	486
500	470	583	122	75.00º	74.00º	620	378	110	46	38	370	448	501
515	485	603	126	75.00º	74.00º	640	378	125	46	38	370	464	515
530	500	623	129	75.00º	74.00º	660	378	140	46	38	370	480	530

7.2 Maat Handlebar Sizes

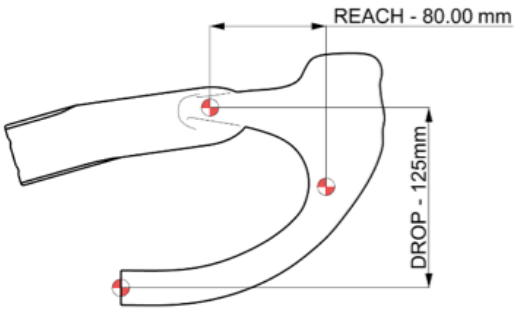
Due to the length of the frame, the handlebar has a very short stem. It is available in three stem sizes 90/100/110 and a unique width 38 cm O-O

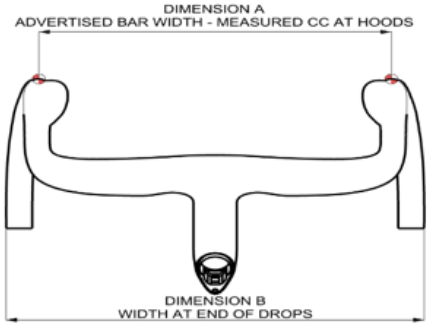
7. SIZES

7.1 Maat Handlebar Sizes

Due to the length of the frame, the handlebar has a very short stem. It is available in three stem sizes 90/100/110 and a unique width 38 cm O-O

DIMENSION A	DIMENSION B	DROP	REACH	OUT BEND
325 mm	380 mm	125 mm	80 mm	8.5º





8. GENERAL SPECIFICATIONS

Carbon Torayca T1100 1K
Track BIKE
Asymmetric Frame
Drop in Bearing System 1” 1/8 - 1”1/4
Italian BB
Axles Bolt-on
Max Tires 700x23
Seat post Aero with Aero Rear Clamp
FlatBack Profile
UCI Approved
Weight: 1350 gr Raw Frame, Not Painted
5 Sizes Available
3 Sizes Integrated Handlebar

9. RACING

The Maat is UCI approved. They are ready to be used in all international competitions.
The Maat will debut in Track World Cup in Hong Kong 29/11-01/12

Cicli Pinarello srl
Viale della Repubblica 12
31020 Villorba (TV) Italy
tel. +39 0422 420877 fax +39 0422 421816
infobike@pinarello.com
www.pinarello.com