
impec

THE BOOK



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actually, it was just a totally simple idea that andy rihs had: to build a high-performance racing bike that is absolutely flawless. a zero-error bike, an “impeccable bike”. in other words, the impec. the fact that it involved nothing less than re-inventing the wheel makes it into a story.

vision vs. status quo



**hitch
your wagon
to a star**

LEONARDO DA VINCI

we'll build the impec

When Andy Rihs gets on his bike, not only is it good for his fitness but most of all for his businesses as well. Sitting in the bike saddle is where he does his thinking. It's where he "gets into the flow", where the contradictions are resolved, horizons open up and things can be thought that previously were unthinkable...

This love story officially begins in early 2001 when Andy Rihs, the boss at hearing systems manufacturer, Phonak, and bike producer, BMC, announced their marriage. At this point in time, BMC was mostly constructing mountain bikes but that was about to change fast. The following year, Andy Rihs' Phonak Racing Team started the Tour de France on BMC racing machines. The riders in their green-and-yellow were pedaling to help people's hearing. "We race for better hearing" was the message they took out across the world.

The strategy bore fruit. Phonak advanced not only to become the biggest and most innovative but also the best known manufacturer of hearing systems in the world – and in the world of road racing BMC became a brand that stood out with its highly independent frame design and its use of innovation.

But Andy Rihs had bigger ideas when he got into the bike business. He doesn't believe in doing anything by halves. Now what was driving him most of all as he bowled along with his bike purring under him is the question of why this ingenious invention – which does so much to propel him forward in his thinking – has still not arrived in the modern age? He was unable to understand why a high-tech material such as carbon was always processed using low-tech methods. And nor did he think that the production of bicycle frames fit for the global market necessarily had to be based in East Asia. And that's when he began to get an idea of where the journey might take him...

Andy Rihs covered another lap on his teammachine and then decided: that's what we will do. We will set a true industrial standard for the construction of carbon frames. We will develop all the technologies we need right through to series production. We will do all of it in Switzerland – with Swiss thoroughness and precision. And when we have finished we will be the first manufacturer in the world able to offer our customers an absolutely faultless carbon frame that satisfies the highest demands. In short, we'll build the impec.



Andy Rihs, owner of BMC

the carbon frame of the future

**the best way
to predict the future
is to invent it.**

ALAN KAY

new, different, better

We wanted to put the frame of the future onto the wheels. We were prepared to question everything. We knew that we had to rethink virtually everything and do some things differently if we were actually to do them better...

Carbon was used as the N°1 material right from the start in the development of the impec. As a result, the traditional laminating process where composite mats are bonded together by hand was basically out of the question. After all, the process comes nowhere near to exploiting the potential of the material. And we absolutely wanted to make use of this potential in the development of the impec.

After almost four years of development, the moment had finally arrived. The Gordian knot was cut clean through the middle. We had finally got to grips with the material and developed two technologies that were of vital importance for the impec. Both totally new, totally different and – we're convinced – totally better.

impec Technology N°1 is the Load Specific Weave process or LSW for short. At this stage of production, each individual tube of the impec frame is made-to-measure seamlessly and with absolute precision. On the impec, the entire frame is optimized to its specific load. Each of its tubes does a different job and therefore has a different design.

impec Technology N°2 is the Shell Node Concept or SNC for short. The frame joints of the impec each consist of two half-shells which are bonded with the frame tubes in the final assembly with absolute precision. These shells are what is actually revolutionary about the impec frame and set new standards when it comes to design. It was only possible to realize the concept by means of a highly rigid composite compound material which can be processed under absolute control using an injection molding process.

As a result of combining LSW and SNC, we have achieved a production quality with the impec that allows us to vouch for the inner perfection of the frame as well. That definitely puts the impec ahead of its time by a length.



Revolutionary: crosslock detail of the impec



**our aim:
zero-error**

**knowledge can be
applied elsewhere to where
it was found.**

BERTHOLD BRECHT

the industrial revolution mk 2

How do you achieve perfection? This question was the overriding priority for the specification we had developed for the impec. Finding the answer took a phenomenal amount of work and we have to admit that at first there was no sign of anything revolutionary...

The recipe is well-known: you take only the best of everything – the best location, the best engineers, the best materials, the best production methods, the best measurement techniques, the best test riders – and put them to work. At least that's the theory.

But the practice mainly consists of sweating, mulling over, failing, falling out, having another go, improving, refining and so on and so forth. The development of the impec was no exception. None of that sounds particularly revolutionary – and yet the result of several years of development work is so demonstrably different to all the rest that you can't even call it evolution.

One of our first exercises incidentally was to bring the good old diamond frame design into the digital age. Using the very latest in production methods and a host of carbon technologies that up until then still hadn't seen the light of day.

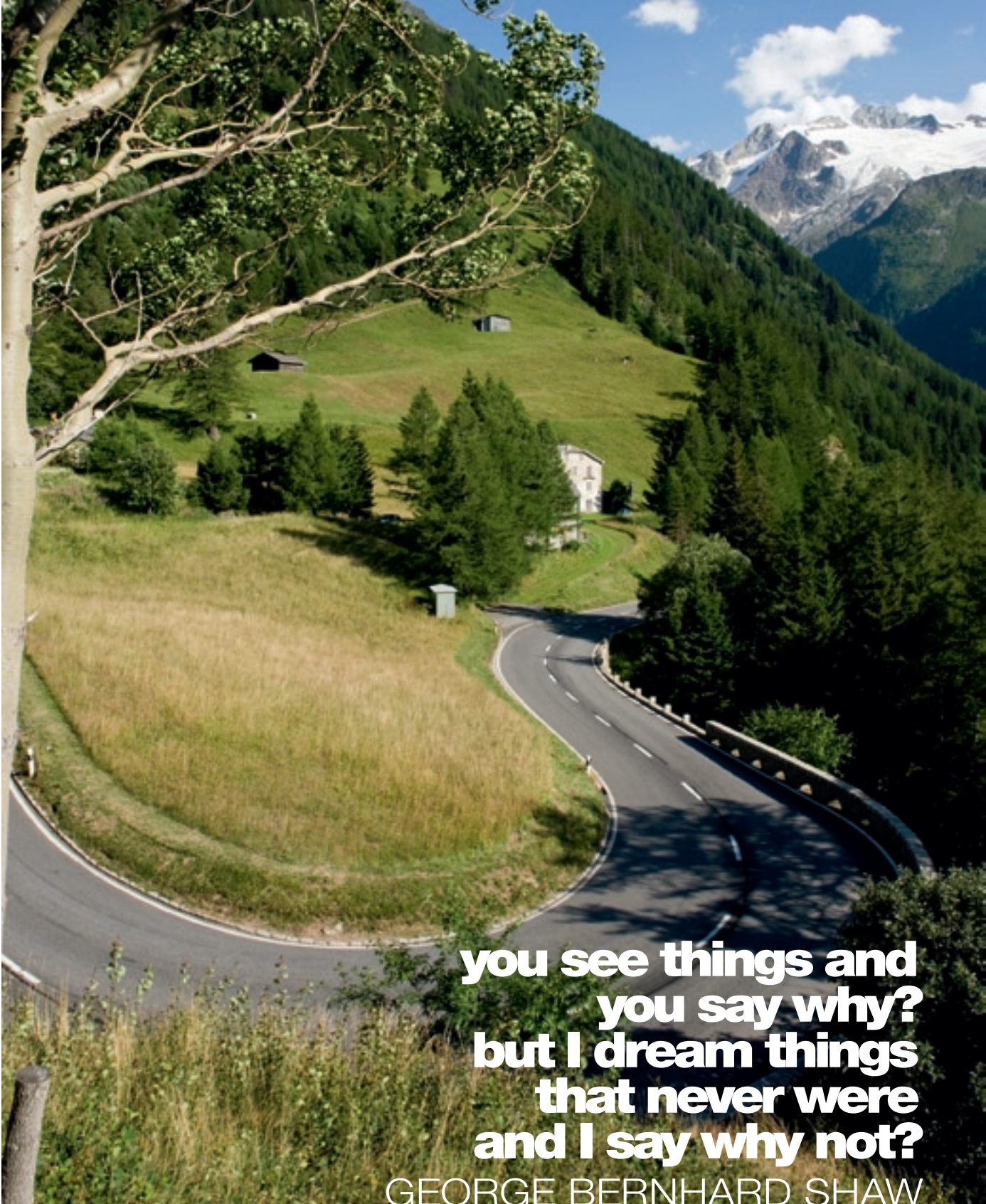
Establishing how we wanted to construct the tubes was relatively quick. Their carbon structures were to be seamlessly woven, from a machine as traditionally used for producing steel cable. So the N°1 basic technology had been found; however, everything else, such as processing the carbon fibers on such a machine, was completely new territory.

And yet when it came to the frame joints for the impec the search for the philosophers' stone turned out to be much more difficult. It was not just the issue of the material, but also the design of the nodal points, that were the longest outstanding questions raised by the project. In the end, though, we arrived at a solution with the Shell Node Concept which worked absolutely flawlessly with our specification. Error sources? Negative. The Industrial Revolution Mk 2 had triumphed right down the line – finally, nothing else now stood in the way of building the impec.



impec assembly line in Grenchen

made in switzerland



**you see things and
you say why?
but I dream things
that never were
and I say why not?**

GEORGE BERNHARD SHAW

the home of perfection

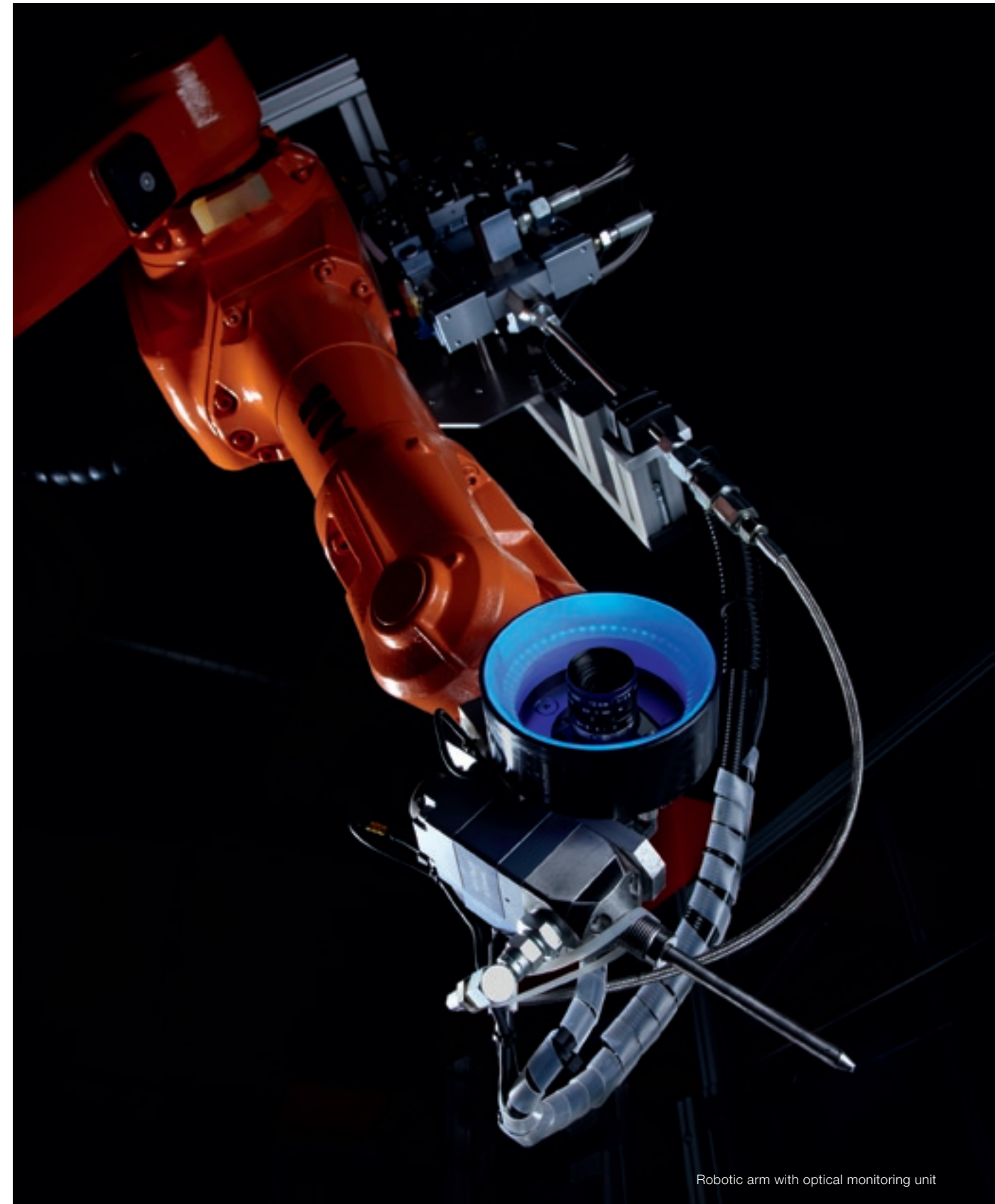
We Swiss are fortunate. We grow up against the backdrop and even in the midst of this fantastically beautiful picturebook scenery of the Alps. Maybe that's why we think that everything in the world should be just as perfect. It certainly helped in the development of the impec...

When you dream – as we at BMC did – of a faultless carbon frame, you very soon arrive at a basic understanding: the first imperative always is to have absolute control over the process. Only when each individual stage of production is capable of being clearly understood, monitored and at the end faultlessly repeated can the perfection in series production we are striving for be realized. From this understanding to Switzerland becoming the home of the impec was then just a relatively short step.

We Swiss have had a particular talent since time immemorial for the ingenious things in life. Not that we claim to have invented everything. But we have taken one issue or problem or another and by applying Swiss precision have got to the bottom of it. Whether it's constructing tunnels and bridges, precision mechanics, measuring systems or plant engineering, we always try to be one of the best.

Today Switzerland is a high-tech business location par excellence. Countless small and medium-sized companies are working on obviously cutting-edge technologies and applications. Ultimately, this specific infrastructure was key to our decision to go against the trend and choose Switzerland as the home of the impec.

And Switzerland has another inestimable advantage. It is a country of immediate access. So accessible that in most cases it's no effort to get hold of the nearest process specialists, CNC programmers and machining engineers. And we have no intention of ever running out of ideas of how we can make the world that little bit more perfect.



Robotic arm with optical monitoring unit

the home of the impec



**the best education
for a clever person
is found in travel**

JOHANN WOLFGANG VON GOETHE

welcome to the peloton

The impec is a textbook example of a standard-bearer of technology. Absolutely innovative, absolutely ingenious, absolutely state-of-the-art. But above all the impec is the absolute road machine for all the roads of the world. And it is truly at home in the peloton...

BMC is one of the few frame manufacturers to put a ProTour circuit-standard team of its own on the starting line. We do it because we are convinced that racing is still the best method for a bicycle manufacturer to continuously improve its products. Nowhere else are the challenges greater and the demands tougher than in the classic competitive cycling events where the world's elite gather.

Regardless of whether during major tours or the Spring Classics, out there in the world of racing it's about pushing the boundaries. It is where the material is tested to its limits. It is where the wheat is separated from the chaff. It is where it is decided whether you have put a good product onto the wheels – or a very good product. And it is where the impec was born.

Regardless of the many innovative technical aspects of the impec project, it was mainly about one thing right from the start: we wanted to build a racing machine fit for the ProTour which conformed to regulations and on which the rider really felt at home. Our underlying aim was the “perfect fit” of rider and machine. A high performance bike where everything just fits. A “work-place” that has everything you could wish for, that radiates safety and reliability and gives its rider a really good feel for the road under the wheels. In a way that's absolutely precise, immediate and unadulterated. On the last 300 meters to the finishing line and on the climb up to Alpe d'Huez – and on the killer cobblestone roads lethal to both men and machines in the legendary Spring Classics.

To achieve this adhesion between rider and machine – to be able to virtually tailor the impec to its rider – we have developed a fitting system. It enables us to combine frame size, rider position, seatpost, stem and handlebar with each other in a huge range of variations. As a consequence, we are now in the fortunate position with the impec of being able to offer not only to our race team, but also to our customers, a bike frame perfectly tailored to their ambitions.



Tour de France 2010, Stage 9:
Cadel Evans and his impec ride wearing yellow.

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the impec is the result of more than three years of rigorous development. it is high-tech plus design plus performance plus pure emotion. and it is the absolute first of its kind.



impec team



impec noble

the design

When building a BMC bicycle, we want its origins to be proudly on display in the frame. And the impec is no exception. The design of the impec identifies it as a true member of the family – even if its frame has evolved in a totally different way...

From the technical point of view, the frame of the impec is a minor revolution. The carbon structure of the frame tubes is woven seamlessly, while the frame joints at the nodal points each consist of two half-shells. No-one has built a bicycle frame like this before. It is absolutely new. Equally new and revolutionary is the entire design of the frame.

The impec conceals nothing. Quite the opposite, in fact – it wears its insides on the outside. The frame joints are based on the Shell Node Concept and are the frame's striking feature. Purely in terms of design, SNC is an absolutely consistent refinement of our Skeleton Concept which differentiates many BMC developments from all the rest. The skeleton strut between the seat tube and the top tube makes absolute sense in design terms and what is more has now become our trademark.

Another stunning feature of the impec are the precision-woven carbon structures of the frame tubes which reveal the inner perfection of the frame.

As the first bike of its kind, the impec is even now something of a technical icon. Everything about it is pure high-tech. Everything about it is solely for the purpose of turning the vision of the flawless high performance bike into reality. This requirement has also been a key factor in the design of the impec.

The impec transforms technology into design and bare facts into pure emotion. Or in the words of architect Louis Sullivan: Form follows function.



Powerful detail:
BB30 integrated into the Shell Node Concept

the technology

To rethink the bike. To optimize the genetic code. That was the job of our engineers. Resulting in the impec: a standard-bearer for technology that combines the latest developments in the construction of carbon frames with components that are in a class of their own...

The impec is a textbook example of a racing machine. The bike has been strictly tailored to conform to UCI regulations. Total weight: 6.8 kilos. While accommodating the demands of everyday racing, the entire bike is configured for maximum performance and load. It starts with the design of the frame and does not end with the choice of technical components. The basic rule for the impec is that only the finest of everything will do.

The impec's frame is an absolute first. Never before have there been frame tubes whose carbon structure is seamlessly woven onto molded carriers. Never before have there been two-piece frame joints made from a high-density carbon compound material. And never before have there been high-tech frames produced in an industrial zero-error process.

At the heart of the revolution are the Load Specific Weave – LSW process and the Shell Node Concept – SNC. Both technologies are BMC's own developments that we have carried out exclusively for the impec. The bike also has many other high-tech features, such as a tapered fork and low seat stay.

To make the qualities of the flawless high performance frame really tangible, only the finest components are used on the impec. For example, high-end products by Campagnolo, Shimano and Sram are available to choose for the group, while Di2, Shimano's digitally controlled gear system, can be supplied from the factory. The wheelsets are from Easton or Mavic and the preferred saddle is from Selle Italia. But whichever variation you finally decide to go for, it will be perfect.



Cockpit of the impec team version

impec innovations

Load Specific Weave – LSW

Load Specific Weave – LSW is one of the two technologies we have developed specially for the impec. In this process, the tubes for the frame of the impec are woven first of all from carbon fibers and then in a second step are converted to a highly rigid structure using a special resin compound. The load-specific weaving process is fully automated and delivers precision visible to the naked eye. The frame of the impec is a carbon fiber and resin structure which is accurate to one tenth of a millimeter.

What is new about LSW is the processing of carbon fibers from the reel. The tubes are woven seamlessly and with a perfect fit onto positive molds of pinpoint accuracy. What is new is that each of these tubes is designed, programmed and produced to be perfectly optimized for the load it will bear. This results in absolutely flawless frame tubes for the impec.



→ Find out more about LSW in the Technologies section.

Shell Node Concept – SNC

The Shell Node Concept – SNC guarantees maximum stiffness and stability of the frame joints on the impec. These high-density half-shells are made from a newly developed carbon compound material and are bonded under precision control with the frame tubes during assembly of the frame. At the same time, the interior design of the half-shells is optimized to provide for optimum adhesion between all the individual parts of the frame.

The benefit of the SNC half-shell technology lies in its total control over the junctions. A robot is also used when the impec's frame is joined together and in addition an optical system controls each individual joint.

What is new about the SNC above all is that a composite compound material produces an extremely rigid material. What is new is that we process this material in a precision injection molding process. This results in absolutely flawless frame joints on the impec.



→ Find out more about SNC in the Technologies section.

impec quality features

An improved frame has always been the main development aim at BMC. As a result, we have brought a whole host of exciting innovations onto the market in recent years which are of course fitted as standard on the impec...



Force Specific Tubing

Force Specific Tubing defines BMC's philosophy of optimizing frame tubes for their load and their weight. With the impec, we were able to turn this philosophy into reality with even greater rigor with the new Load Specific Weave – LSW and Shell Node Concept – SNC technologies. The structural advantages of these dual technologies have resulted in all stresses being optimally absorbed and distributed within the frame.



Low Seat Stay

On the impec as well a lower slung seatstay and special flex zones in this area provide for the typical BMC mix of ride comfort with lateral stiffness and absolute handling precision. The low seatstay is a feature that you very quickly learn to value – especially on longer tours and the worst kinds of roads.



Tapered Steertube

The impec is fitted with a tapered fork. The shaft of the fork is strengthened from below. This is how the impec compensates for the extreme stresses which are exerted on the lower section of the steertube – an obvious plus in safety.

System Integration

BMC frames are also fundamentally different from the rest in that we have already thought of everything that makes a perfect bicycle out of a frame at the design stage. We want one part to join flawlessly onto another. Add-on parts, such as the seatpost, are developed and produced for the impec by our suppliers at their premises. This development work based on partnership with our suppliers ensures the perfect interplay of frame and components. The aim is to minimize tolerances in order to further optimize the ride qualities.



geared up for the future

shimano Di2

Di2 stands for Digital Integrated Intelligence; it comes from Shimano and represents the arrival of digital components in bicycle construction at the highest level. The digitally controlled electronic gear system is a revolution in itself and sets new standards in the high-end sector with its “fly by wire” concept.

Di2 permits particularly fast and precise gear changes. It is impossible to miss a gear with Di2. With its smart sensor technology, Di2 also controls and corrects the position of the chain during the ride and optimizes power transmission to the rear wheel. In short, Di2 offers greater safety and the very best in user-friendly gear changes. The system also reduces friction loss and wear.

The impec can be supplied with Di2 from the factory, making this version an impressive product through rigorous system integration. The frame was designed so that all components in the system play a specific role and are incorporated to optimum effect into the overall design.



Discreetly and thoughtfully placed:
integrated cable and Di2 battery behind chainring

systematic fitting

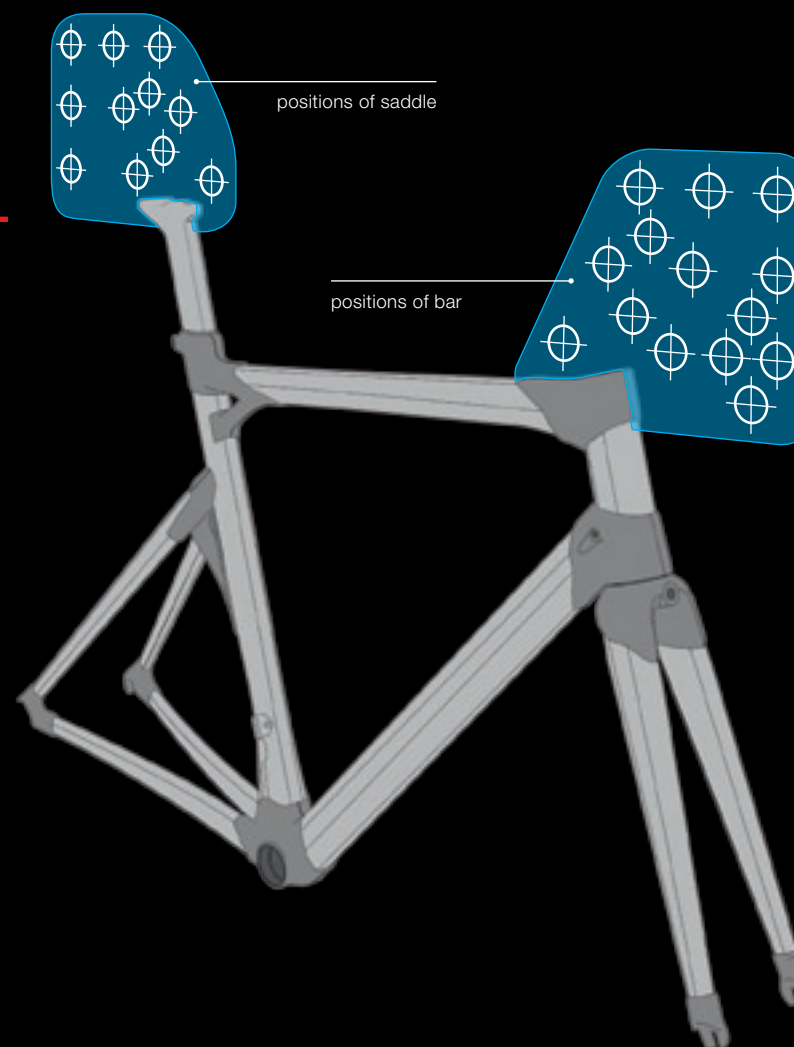
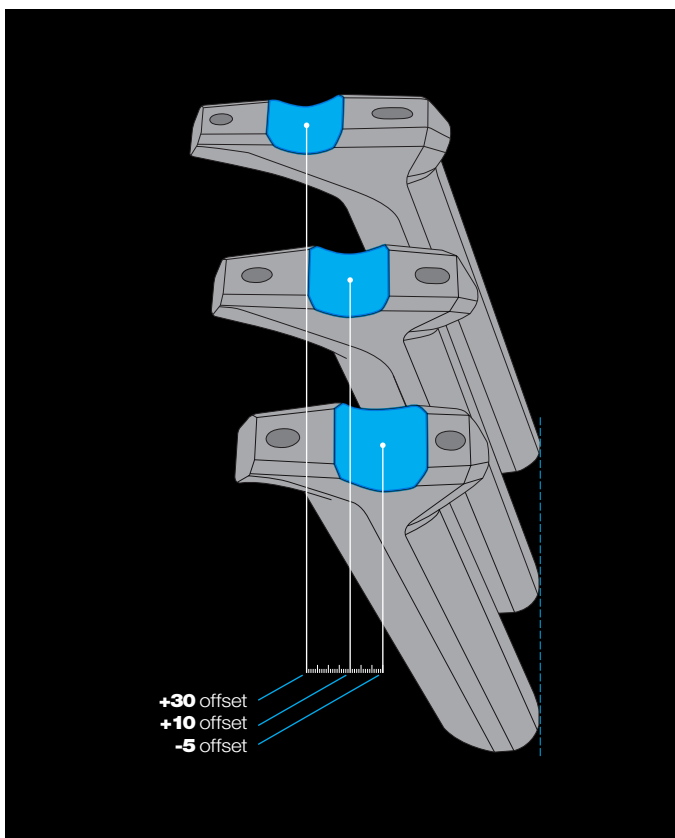
The impec isn't an off-the-peg bike but a tailor-made suit. It is made-to-measure for its rider. Tailored for you and tailored for your ambitions. To do this we have developed a modular system for the impec which permits a whole host of variations...

It all starts with a fitting at one of our specialist dealers. The dealer will first of all take precise measurements and then define with you how your very own impec is to be constructed and configured. Five frame sizes, each with two rider positions, three seatposts and a range of stems are available to choose. The fitting is of key importance for the final quality of the impec. Indeed, it is only when all these parameters are fine-tuned to each other that the unity of rider and machine can evolve, as was always intended when we first developed the impec.

The frame of the impec is hardwired for competition from top to bottom. But even if you are simply looking for the perfect riding machine for entirely your own ambitions, the impec is the first choice. Two different rider positions can be supplied. The Race Fit and Performance Fit options. The difference between the two configurations lies above all in the height of the top tube.

In the Race Fit, the impec is absolutely configured for competition. This geometry corresponds closely to the SLR01 teammachine on which Cadel Evans won the Flèche Wallonne in 2010.

In the Performance Fit version, the seatpost and head tube are 19 mm longer and the distance between saddle and handlebar is 6 mm shorter than in the Race Fit thus achieving a somewhat more comfortable seated position.



Saddle positions and bar positions

Positional parameters from evaluation of teamriders and customers

Geometry options

2 geometry options for each frame for different needs of riders



racefit

Race Fit with low stack and increased reach



performancefit

Performance Fit with increased stack and reduced reach

Framesizes

5 frame sizes for each options. Total of 10 frame sizes



Framesizes 50 to 60 in Race Fit



Framesizes 50 to 60 in Performance Fit

models and configurations



impec

🚴	Colour	team	noble
🚴	Frame	impec	impec
🚴	Fitting	race/performance	race/performance
🚴	Sizes	50/53/55/57/60	50/53/55/57/60
🚴	Gear speeds	20	20
🚴	Crankset	Campagnolo Super Record, 53-39/50-34	Campagnolo Super Record, 53-39/50-34
🚴	Rear cogs	Campagnolo Super Record, 12-25/12-27	Campagnolo Super Record, 12-25/12-27
🚴	Front derailleur	Campagnolo Super Record	Campagnolo Super Record
🚴	Rear derailleur	Campagnolo Super Record	Campagnolo Super Record
🚴	Shifters	Campagnolo Super Record	Campagnolo Super Record
🚴	Brakes	Campagnolo Super Record	Campagnolo Super Record
🚴	Handlebar	Easton EC90, 400/420/440 mm	Easton EC90, 400/420/440 mm
🚴	Stem	Easton EA90, 90/100/110/120/130 mm	Easton EA90, 90/100/110/120/130 mm
🚴	Seatpost	impec, +30/+10/-5 mm	impec, +30/+10/-5 mm
🚴	Saddle	Selle Italia Flite	Selle Italia Flite
🚴	Hubs	Easton EC90 SL	Mavic Cosmic Carbone SLR
🚴	Rims	Easton EC90 SL	Mavic Cosmic Carbone SLR
🚴	Tires	Continental Grand Prix 4000s	Mavic Cosmic Carbone SLR

impec

🚴	team	noble
🚴	impec	impec
🚴	race/performance	race/performance
🚴	50/53/55/57/60	50/53/55/57/60
🚴	20	20
🚴	Shimano Dura Ace, 53-39/50-34	Shimano Dura Ace, 53-39/50-34
🚴	Shimano Dura Ace, 12-25/12-27	Shimano Dura Ace, 12-25/12-27
🚴	Shimano Dura Ace DI2	Shimano Dura Ace DI2
🚴	Shimano Dura Ace DI2	Shimano Dura Ace DI2
🚴	Shimano Dura Ace DI2	Shimano Dura Ace DI2
🚴	Shimano Dura Ace	Shimano Dura Ace
🚴	Easton EC90, 400/420/440 mm	Easton EC90, 400/420/440 mm
🚴	Easton EA90, 90/100/110/120/130 mm	Easton EA90, 90/100/110/120/130 mm
🚴	impec, +30/+10/-5 mm	impec, +30/+10/-5 mm
🚴	Selle Italia Flite	Selle Italia Flite
🚴	Easton EC90 SL	Mavic Cosmic Carbone SLR
🚴	Easton EC90 SL	Mavic Cosmic Carbone SLR
🚴	Continental Grand Prix 4000s	Mavic Cosmic Carbone SLR

models and configurations



impec

🚴	Colour	team	noble
🚴	Frame	impec	impec
🚴	Fitting	race/performance	race/performance
🚴	Sizes	50/53/55/57/60	50/53/55/57/60
🚴	Gear speeds	20	20
🚴	Crankset	Sram Red BB30, 53-39/50-34	Sram Red BB30, 53-39/50-34
🚴	Rear cogs	Sram Red, 11-26/11-28	Sram Red, 11-26/11-28
🚴	Front derailleur	Sram Red	Sram Red
🚴	Rear derailleur	Sram Red	Sram Red
🚴	Shifters	Sram Red	Sram Red
🚴	Brakes	Sram Red	Sram Red
🚴	Handlebar	Easton EC90, 400/420/440 mm	Easton EC90, 400/420/440 mm
🚴	Stem	Easton EA90, 90/100/110/120/130 mm	Easton EA90, 90/100/110/120/130 mm
🚴	Seatpost	impec, +30/+10/-5 mm	impec, +30/+10/-5 mm
🚴	Saddle	Selle Italia Flite	Selle Italia Flite
🚴	Hubs	Easton, EA90 Aero/EC90 SL	Mavic, Ksyrium Elite/Cosmic Carbone SLR
🚴	Rims	Easton, EA90 Aero/EC90 SL	Mavic, Ksyrium Elite/Cosmic Carbone SLR
🚴	Tires	Continental Grand Prix 4000s	Continental Grand Prix 4000s

impec

🚴	team	noble
🚴	impec	impec
🚴	race/performance	race/performance
🚴	50/53/55/57/60	50/53/55/57/60
🚴	20	20
🚴	Shimano Dura Ace, 53-39/50-34	Shimano Dura Ace, 53-39/50-34
🚴	Shimano Dura Ace, 11-25/11-27	Shimano Dura Ace, 11-25/11-27
🚴	Shimano Dura Ace	Shimano Dura Ace
🚴	Shimano Dura Ace	Shimano Dura Ace
🚴	Shimano Dura Ace	Shimano Dura Ace
🚴	Shimano Dura Ace	Shimano Dura Ace
🚴	Easton EC90, 400/420/440 mm	Easton EC90, 400/420/440 mm
🚴	Easton EA90, 90/100/110/120/130 mm	Easton EA90, 90/100/110/120/130 mm
🚴	impec, +30/+10/-5 mm	impec, +30/+10/-5 mm
🚴	Selle Italia Flite	Selle Italia Flite
🚴	Easton, EA90 Aero/EC90 SL	Mavic, Ksyrium Elite/Cosmic Carbone SLR
🚴	Easton, EA90 Aero/EC90 SL	Mavic, Ksyrium Elite/Cosmic Carbone SLR
🚴	Continental Grand Prix 4000s	Continental Grand Prix 4000s

accessories

With the impec, we really have thought of everything. Even the things that make the perfect bike that little bit more perfect. Hence, a range of exclusive top quality accessories are available from the factory to complement your impec – from travel bag to drink bottles.



warranty

As we have rigorously geared the entire creative process toward the best in manufacturing and product quality, this has also resulted in the Impec having unparalleled material life expectancy. The frame is supplied without any weight limitation and, on activation, with a lifetime guarantee.

Providing this promise with the warranty is possible as the entire manufacturing process of the impec frame is subject to continuous monitoring and logging. Based on this data, we are able to assemble an absolutely flawless frame from absolutely faultless components that will resist the toughest stresses in the long term. That's signed, sealed and delivered.

So here are the key warranty features to start off with. For all other aspects, please refer to the detailed warranty conditions for the impec.



1

Lifetime guarantee by online registration

The frame of the impec can be equipped with a lifetime guarantee for the initial owner. To activate this guarantee, you need to register the bike online with BMC when ordering and no later than 30 days after purchase. If you do not register the bike online, the warranty period remains 5 years.

2

No weight limit

The impec is so well constructed that it can effortlessly carry even a well-built rider. So if you are looking for a weight limit with the impec warranty, you'll be searching in vain.

3

No race limit

The impec is a racing machine according to the regulations of the UCI. Accordingly, the warranties we provide with the frame also apply if you ride competitively and take part in road races with the impec.

4

Crash replacement

Should damage be sustained through no fault of your own, even with proper use and without involving third parties, which results in the functional capacity of the impec frame and the rider's safety to be compromised, Impec owners have a one-off claim for replacement of the defective frame at a preferential price. For the exact details on this benefit, please visit our website and click on Crash Replacement.

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forget everything you know about the construction of carbon frames. the impec is fundamentally different. the frame of the impec has been rethought from start to finish and gives absolutely precise answers to a host of questions that until now have remained unanswered.

our development process

Idea, realization, optimization, production. BMC developments all have one thing in common. They pass through a clearly defined four-stage process which ensures that theory and practice ultimately come together seamlessly. The aim is not New but Better. The impec is pretty consistent in following this philosophy...

Before we enter the realm of impec technology, we would first like to pay tribute to those people who made the development of the impec possible in the first place.

On the one hand, these are our designers, engineers and development partners who in the course of recent years have put in so much overtime in order to crack some really tough nuts. Without these colleagues, it would hardly have been possible to reinvent the bike – and the entire production process to produce the frame at the same time.

And then there is the BMC Excitement Research Team – in other words, our professionals – who play a key role both at the optimization stage and in our development philosophy.

The reason being that when you want to test the limitations of the technology, it won't happen without the direct feedback of those who push the product to its absolute limits. And they are primarily our riders. They toil in the spotlight, they ride to the limits, they are our best advertisement and, after the race, they tell us how they felt it went. We owe them a debt of thanks for that.

Perhaps that might not seem particularly customer-oriented, but it was right for the members of the BMC Excitement Research Team that we developed the impec right at the very start. Indeed, one thing was clear: the bike would only have a real chance in the market when Cadel Evans and his team went through hell with it. Only through their efforts in the 2010 Tour de France could we be sure that the impec would live up to its name in tough race conditions as well.

The result of this integrated development work is that today we are in a position to offer our customers a product that was not only designed and produced according to all the rules in the book but has also been tested under true world championship conditions. It's a good feeling, isn't it?

Research and Development
department in Grenchen



in the beginning, there was the tube

Generally, tubes are circular in cross-section. However, in special cases and with the tubes for the frame of the impec in particular, it is really not that simple...

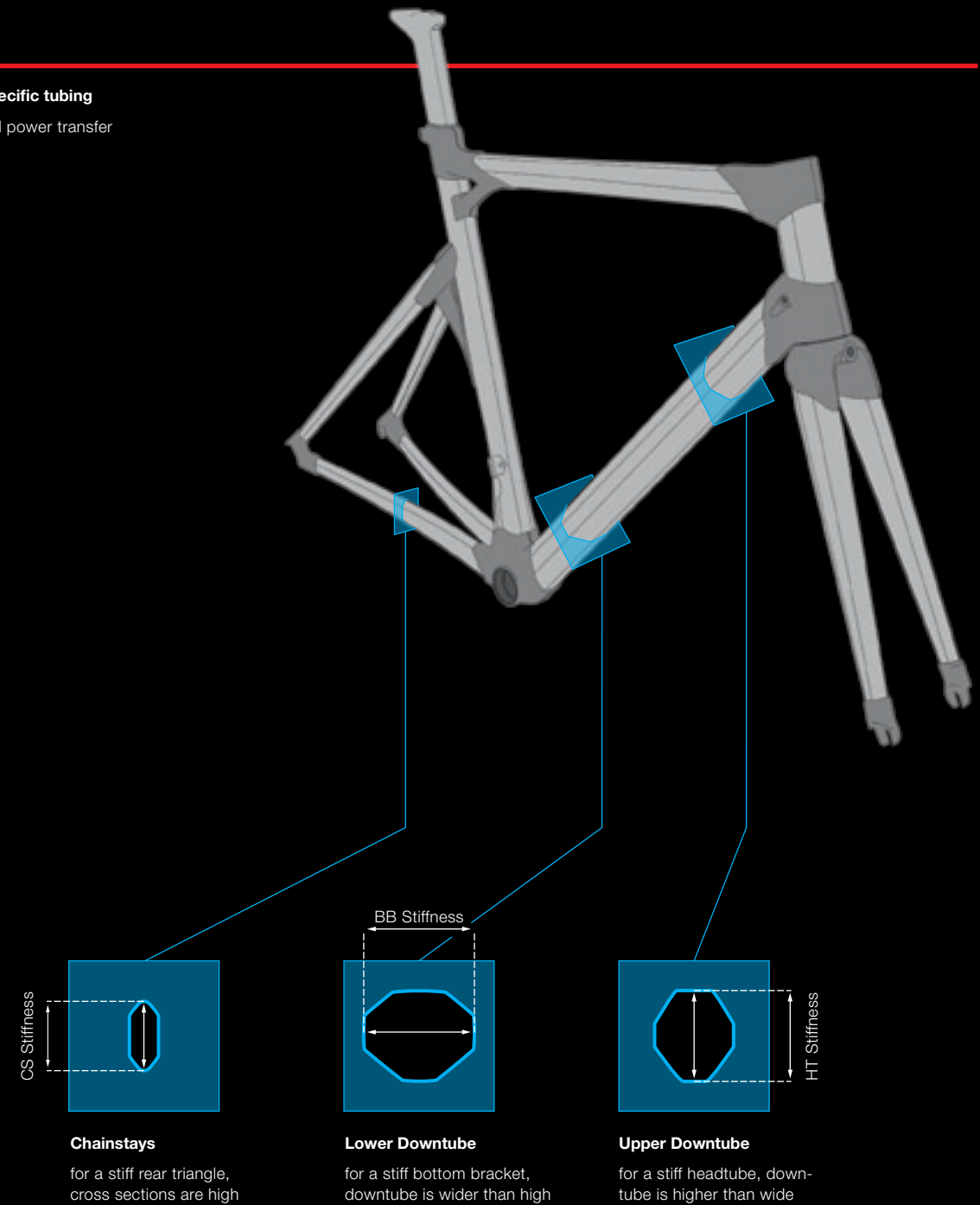
The perfect racing machine – according to ancient wisdom – transforms maximum possible energy invested by its rider into direct propulsion without bringing its own weight to bear. The frame needs to be light and rigid and yet stable and agile at the same time.

In order to bring these attributes together in an optimum ratio in the impec, we first concentrated on the design of the frame tubes. We wanted to design each individual tube in such a way that it will optimally absorb and distribute across its entire length all the stresses that are brought to bear.

This wasn't actually a new idea for our engineers and designers. For a number of years, they had been working on technologies so that we could optimize frame tubes from composite material specific to load. The terms "Tuned Compliance Concept" and "Force Specific Tubing", for example, represent BMC innovations that provide for greater stability, accurate handling and increased rider comfort and were of key importance in the development of the impec.

We knew pretty well where a frame needed to be more rigid in order to optimize the efficiency of its rider. We knew how the perfect frame tube needed to be designed – and incidentally it is very rarely round. And we knew that such perfection would remain Utopian without the perfect manufacturing process. It was time to develop Load Specific Weave.

Force specific tubing
optimized power transfer



the load specific weave process

impec Technology N° 1 is the Load Specific Weave process – LSW. This robot-controlled process creates the frame tubes for the impec. Each of them is manufactured with absolute precision and made-to-measure according to specification with verifiable accuracy...

LSW is the name of a complex three-stage process at the end of which is the perfect frame tube. In brief, the three stages are as follows: weaving, resin injection and cutting – and from these stages comes a humble, flawless carbon tube that only needs to be lacquered, printed and attached to other equally faultless tubes to make the perfect frame.

The strict use of digital technology results in absolute transparency in Load Specific Weave. To provide for this transparency, each workpiece carrier is equipped with a data matrix which contains all the programs for the different process stages that the frame tubes of the impec pass through. The system gives the various robots their commands and at the same time records all the relevant data for each individual workpiece.

Weaving

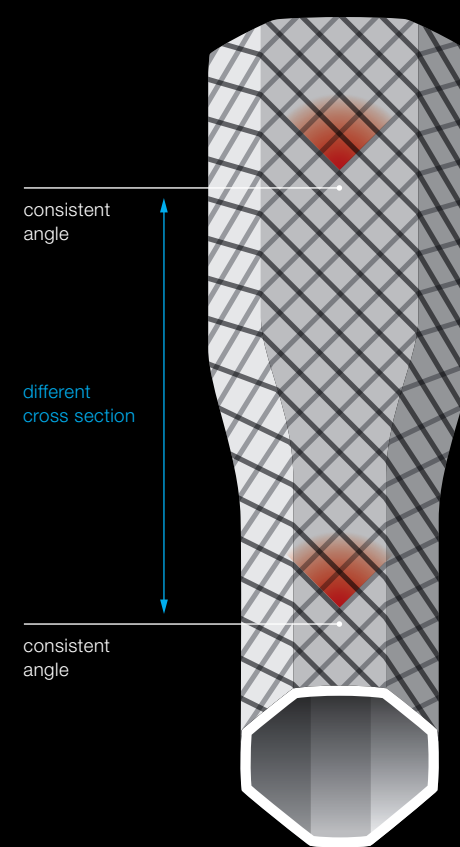
In a more detailed version, the production of the impec commences as follows: an industrial robot picks up a material carrier with the positive mold of the tube that is to be produced. It then feeds this core to a radial braiding machine as up until now has been similarly used mainly in the production of steel cables. The data matrix is read off and the weaving process begins. More than 100 bobbins loaded with wafer-thin threads run through the machine along sinusoidal paths to weave a seamless tube of carbon fibers around the positive core at the center of the machine. The material density and arrangement of the fibers is determined here by the rate of advance and the mold of the positive core. The rate of advance varies according to the specific load for which the tube is configured at this point. When the carbon structure is fully woven, the tube is cut off, the material carrier retracts from the radial braider and another core takes its place on the machine.

LSW

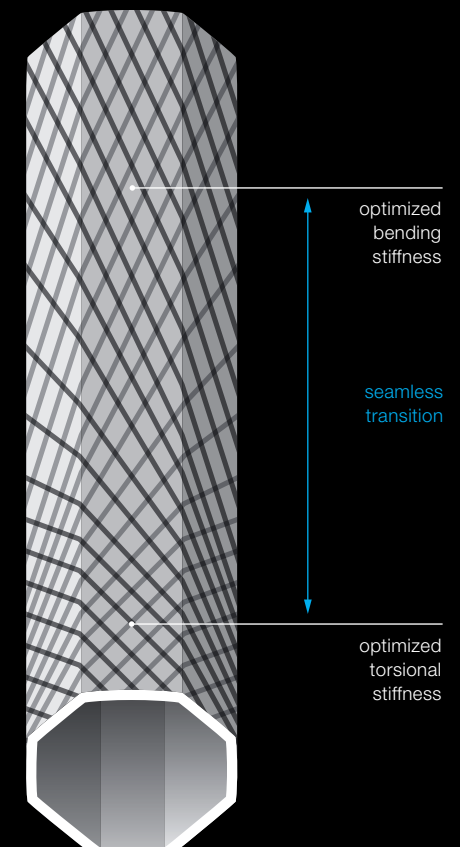
Load Specific Weave means

- defined and controlled fiber orientation
- consistent angles over different cross sections
- different angles in the same cross section

LSW tube with consistent angles over different cross sections



LSW tube with different angles in the same cross section





LSW begins here:
radial braiding machine with robot arm

Resin injection

In the next stage of production, a tube is formed from the made-to-measure carbon sleeve. To achieve the required production quality, we have developed the first fully automated resin injection process in the world for composite materials. Although this is largely a strictly guarded commercial secret, it would be hardly possible to continue the story of the creation of the perfect frame without a few key details.

Central to the second stage of the process are the female molds of all the tubes from which the frame of the impec is created. In these molds, the resin infusion of the carbon structures takes place under absolutely controlled conditions. For this process, the positive core with the previously load-specific woven carbon sleeve is fed into the corresponding mold. A special 2-component resin is then injected through a mixing tube at the lower end of the mold. The workpiece is then left in the mold for as long as it takes to complete the curing process.

Cutting

We now move on to the third and final production stage of the Load Specific Weave process – cutting the tubes to length. This process is also fully automated and prepared and carried out with extreme precision by industrial robots. Step 1: The tube is separated from the mold together with its positive core. Step 2: The material carrier with the positive core is removed from the tube. Step 3: A precision saw with diamond blades cuts the tube to its final size. Step 4: The finished tube goes for final inspection and then to the paintshop.



Resin is added to the frame tubes
of the impec in these molds.

the gordian knot

We knew what we wanted to do. We knew that we wanted to manufacture the perfect frame tubes. But what this perfect joining together of the tubes would ultimately look like was a completely different matter...

When the aim is 100% performance, then to get there you need 100% quality. And when the aim is 100% quality, then to get there you need 100% process control. This was the perfection-driven pressure we were working under when it came to defining the nodal points of the impec frame.

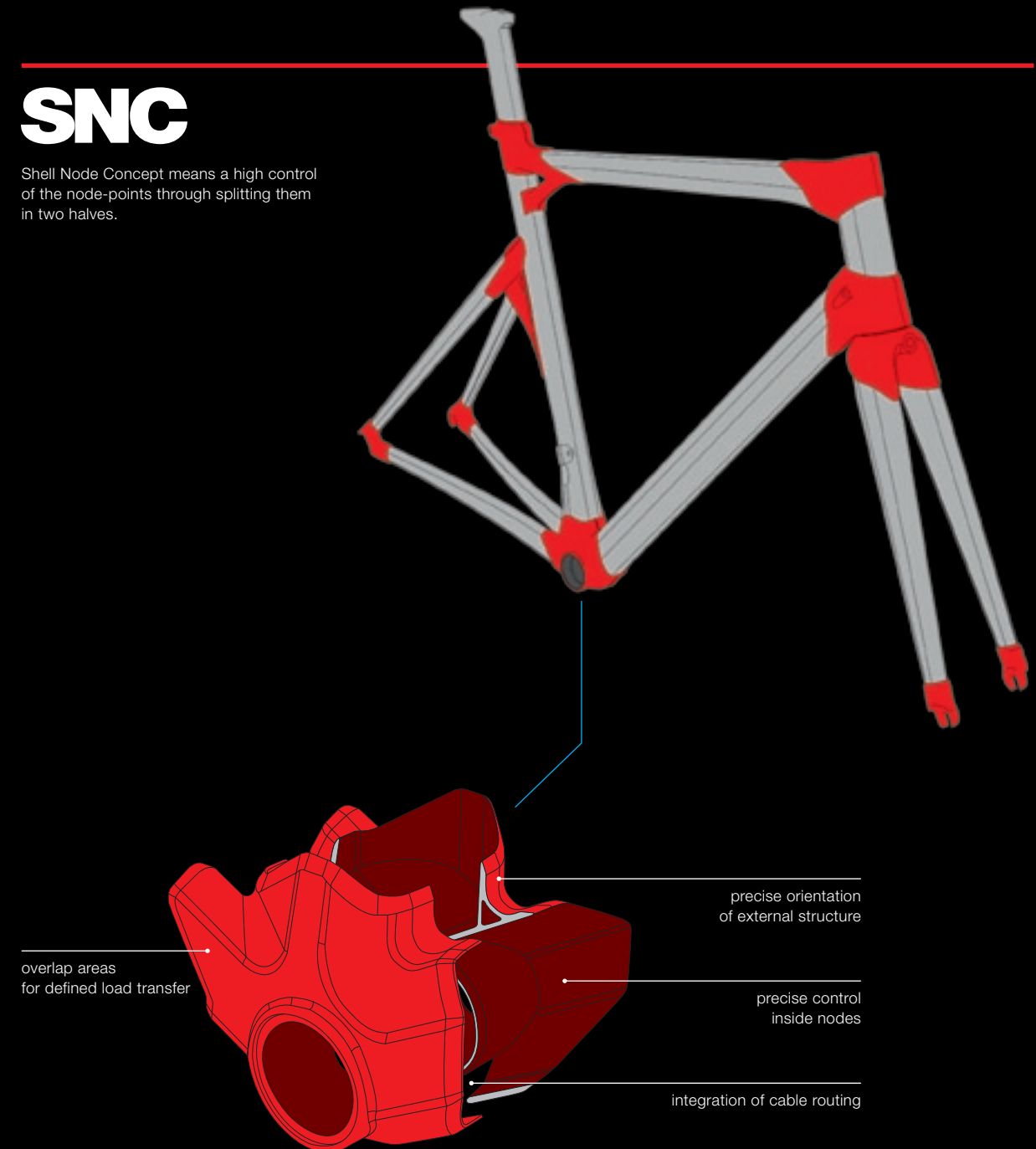
We were looking for a solution that would pass all the requirements for the impec with flying colors in terms of weight, stiffness and quality. The frame joints placed particular demands on our engineers; indeed, the solution that we finally decided on would not have been recognizable as such when we first started on the development.

Construction, material and manufacturing process. These three aspects of the frame joints formed the Gordian knot of the impec which could not be untangled using conventional ideas. Everything seemed to be impossibly connected with each other. Until at some point we had the simple idea of creating the frame joints of the impec in two parts.

A clean cut then led to impec Technology N° 2, the Shell Node Concept, where the joints at the nodal points of the frame are not one-piece collars but are each made from two half-shells. These half-shells are manufactured from a revolutionary composite compound material, are extremely rigid and yet light, have outstanding shock absorption qualities and can be connected to the frame tubes in the final assembly with absolute control and precision.

SNC

Shell Node Concept means a high control of the node-points through splitting them in two halves.



the shell node concept process

impec Technology N° 2 is the Shell Node Concept – SNC. With this extremely rigid and high precision half-shell technology, we can also design the frame joints of the impec so that there is nothing to stop us providing a lifetime guarantee...

SNC is the revolution in the construction of the impec. Indeed, SNC allows us to design also the nodal points of the frame so that absolute process control is possible. Three aspects of the Shell Node Concept are of particular importance here. The design, the material and the process.

Design

SNC is more than just a form of technology. SNC is also a design philosophy. The half-shell system allowed us to succeed in consistently transferring the technology of the BMC Skeleton Concept to the entire frame. The impec proudly wears its insides on the outside – it conceals nothing. However, key to the flawless quality of the impec are the inner qualities of the individual half-shells. Their ribbed structure defines the junctions to the frame tubes with absolute precision, while the inner and outer geometries of the shells are configured to optimize the load.

Material

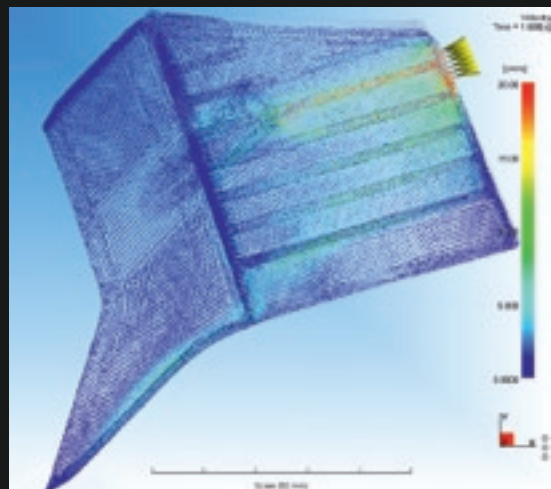
SNC was possible only through a new composite compound material which can be processed by injection molding and fully exploits the qualities of carbon as a material. The granules that are used consist for the most part of carbon fibers and a special 2-component resin.



SNC half shells prior to frame assembly

Mold flow analysis

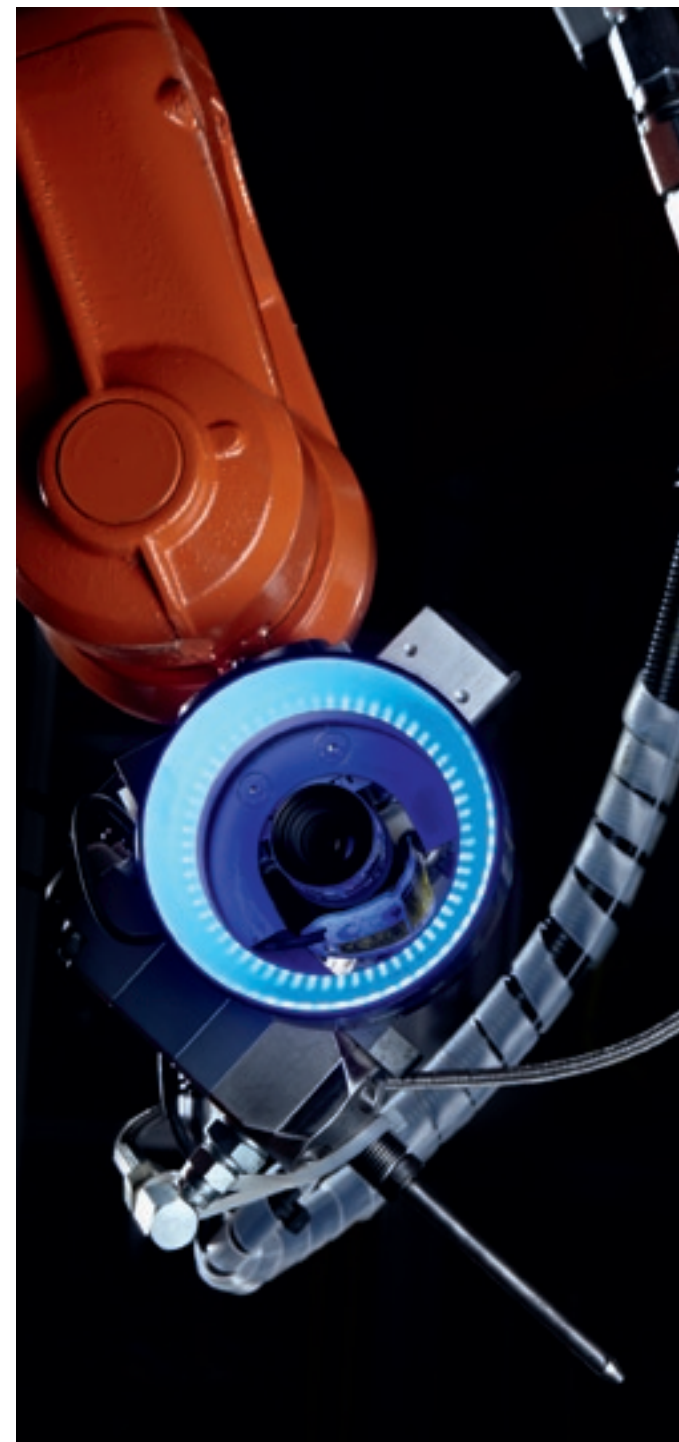
The direction of the carbon fibers inside the various shells can be precisely defined in a simulation process – mold flow analysis – before the final CAD data is fed into the tool construction program. With this mold flow analysis, our engineers were able to make the inside of the shell visible. In this way, we were able to record cleanly and continue to optimize all the key process parameters for injection molding, such as temperature, fill time, flow rate and flow properties.



Mold flow analysis

Tests and CT

To verify the results of the mold flow analysis, the next stage involved construction of the injection molding tools. Small batches of shells were produced which we then subjected to a series of tests. This included scanning the half-shells in a computed tomography scanner. This is because CT allows us to conduct an accurate inspection of the wall thickness and check the overall structure for possible faults. Once these tests had also been successfully completed, nothing stood in the way of series production.



The marriage

In order to connect tubes and shells to the frame of the impec for extreme rigidity, the shells are first placed in a carrier system. This frame carrier is now fed into a robot workstation. The robot we use here is fitted with an optical monitoring system. It recognizes each individual component and defines the exact quantity and position of the composite adhesive to be applied. And in order to meet quality requirements here as well, each contact point is monitored again before the tubes and shells are finally joined together for life. Firmly clamped into the carrier system, the completed frame is then cured in an oven and is then ready for the final quality control which is conducted using a static test process.

The open design of the shell allowed for the fact that even the last stage of production of the impec frame – the bonding of the shells with the frame tubes – proceeded absolutely transparently in a controlled process.

Robotic arm
with optical monitoring unit

the perfect finish

Even from its appearance, the impec looks different from all the rest. To ensure it remains flawless, its frame is assembled from guaranteed faultless components and requires no finishing. All components are individually finished and inspected and only then released for final assembly.

The digitally controlled paintshop where the shells and frame tubes of the impec receive their high gloss finish is absolutely state-of-the-art, and the lacquering of the impec is immaculate in meeting all environmental requirements and quality provisions. The enclosed system has a very efficient wet separation arrangement, generates little overspray and works with modern lacquers that are low in solvents. Providing the perfect finish is a "hollow wrist", a particularly flexible hollow arm paint robot which lacquers the frame components of the impec in several layers using the wet-on-wet method. This process guarantees optimum adhesion between the individual layers of lacquer and therefore the best quality.

After the paintshop, the ways part once again for the half-shells and frame tubes. While the shells are only lacquered – it is their job to highlight the structural features of the frame – the frame tubes make their way to the printshop. Here they receive the final touch. Here the impec receives its branding.

First choice right from the start for the finishing graphics for the impec was the pad printing system. This print technology is the only process with fully automatic and industrial production capability for the printing of complex surfaces – such as the frame tubes of the impec. From a quality point of view, the result is comparable to lacquering. The pad printing system thus fits perfectly into the production philosophy of the impec. This process stands out from the rest in that the pads transfer the paint 100% to the surface to be printed and the precise color printing is extremely resistant to environmental impact and scratches.



Hollow-Wrist lacquer robot

quality – from a to z

The quality we achieve with the impec is unique worldwide. It is the result of total control from the first to last stage of production. More than 60 different test parameters alone are recorded and analyzed in the manufacture of the frame tubes in the Load Specific Weave process. This results in carbon tubes that need no finishing and do not present voids or defects in the carbon structure.

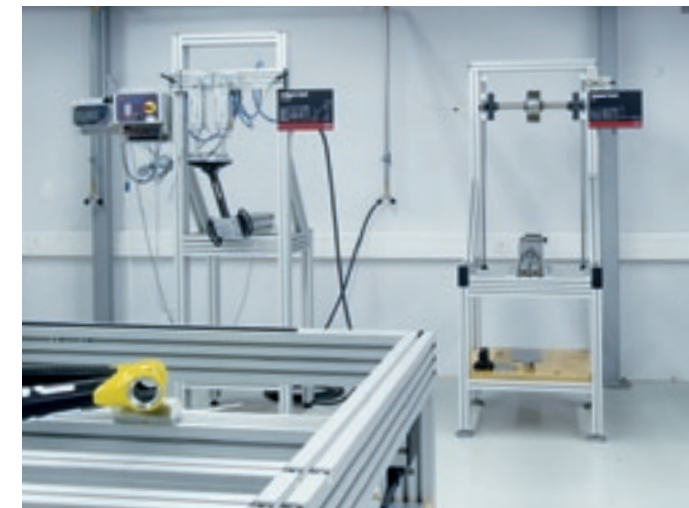
This applies similarly to the production of the frame joints for the impec according to the Shell Node Concept, the lacquering of the tubes and shells, the printing and above all to the final assembly of the frame as well. Defective parts? Negative. Guaranteed.

When the final stage of production is completed, each individual impec frame together with its fork is subjected to a static load test in where it has to hold its ground firm and true. The frame is subsequently measured and the report finally provides the information as to whether the frame meets the extreme quality requirements for the impec.

Random samples are also frequently taken from production which we subject to functionality tests and all have one thing in common: even the strongest are tested to destruction. The aim of this controlled destruction is to obtain data about the maximum resilience of the impec which gives us information at the same time as to whether the entire process continues to achieve a zero-error rating. Absolutely rigorous, absolutely impec.



impec on the teststand



A glance into the test laboratory

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Would you like to experience the impec close up? Would you like to see how it is created? Do you have any questions for us or do you need some answers? Are you interested in our range? We've put together all the key information for you here.

a look behind the scenes

The impec's production process is unique worldwide and sets new standards in the production of carbon frames. As the entire production takes place virtually in one in-tegrated process and at one location, it's the perfect opportunity to take a look behind the scenes...

Welcome to impec World. 47deg.11' N, 07deg.24' E: Grenchen, Solothurn Canton, Switzerland. Here, just a stone's throw away from BMC's HQ, is the factory where the vision of a flawless carbon frame becomes reality and where the impec is constructed virtually from top to bottom. In this fascinating world of highly specialized industrial robots, you'll experience and follow the seven production stages that go into creating the perfect frame to discover for yourself the quality of the impec. And in any case it's an experience we'd love to share with you.

We would be delighted to welcome you on one of our regular factory tours to bring you a little closer to the world of the impec. Interested? Then drop us an email at the following address:

impec@bmc-racing.com



Visitor area of the factory



A glance into the showroom

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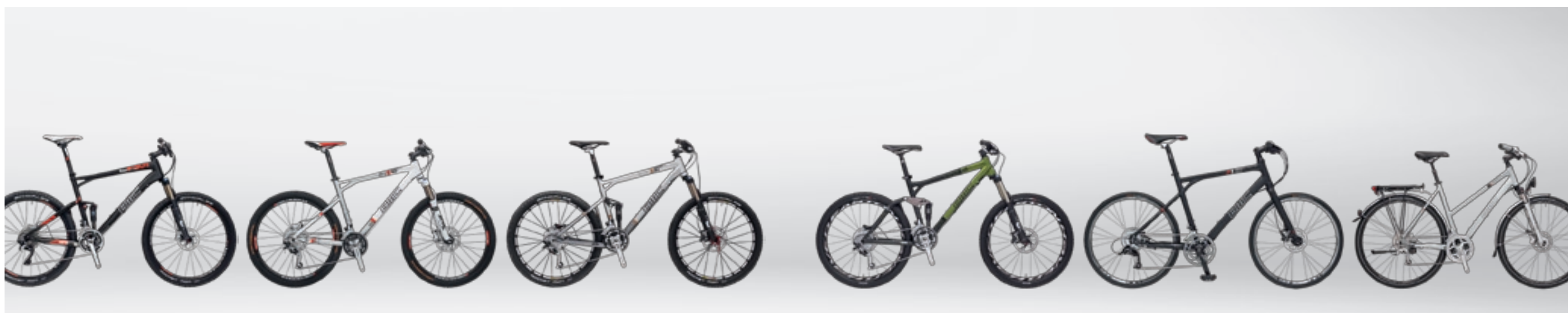
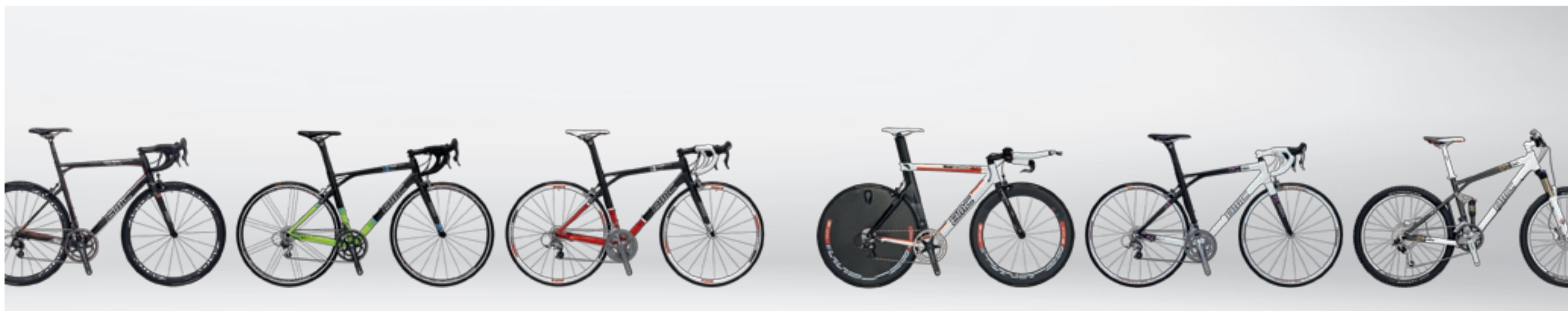
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BMC line up

The impec comes from excellent stock. Excellent design, excellent quality and excellent ride properties are some of the essential features that distinguish all BMC bicycles.

From mountain bikes for beginners through to made-to-measure handcrafted time trial machines for professionals, we offer our customers more than 30 different bicycle models in all virtually all categories and price ranges. Please request our general catalog.



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