GT frame technology handbook V.03

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GT history

GT has produced bicycles to be faster, stronger and better than any other bicycle on the market. With over 30 years of design, manufacturing and racing heritage it's no wonder that GT Bicycles frame designs are on the forefront of bicycle technology.

The following is a guide to highlight and explain the different technologies that go into a GT bicycle frame. It explains why we do the things we do and how the rider will benefit from them. There are 3 sections:

Section 1 talks about GT specific technology. These are features that were designed, engineered and in some cases, patented by GT Bicycles for our exclusive use.

Section 2 talks about frame technologies that are common to the industry and explains why GT engineers have chosen to use them.

Section 3 talks about different frame materials that GT uses in their products and what benefits come from each of them.

GT Bicycles has a design philosophy called Technological. This means that anything we design is logical from a technical standpoint; everything is there for a reason.

GT technologies

SUSPENSION PHILOSOPHY

i-Drive EXPLAINED

Pedal feedback is one of the biggest reasons suspension bikes have inefficient pedaling characteristics.

Pedal feedback is caused by an additional unwanted reactionary force that causes the pedals rotate backward during rear wheel travel. This is caused by the rear wheel getting further away from the front chain rings. The chain needs more slack to make up for this distance change and pulls back on the front chain wheel. This creates a reverse rotation in the crank set, in turn disrupting the riders pedal cadence and requiring more energy from the rider to overcome (See Fig. A).

With i-Drive technology, we've allowed the bottom bracket to move separately from the front triangle and rear triangle in a way that counteracts pedal feedback. During this movement, the distance from the pedal to the seat does not change. For the most part, pedal feedback is eliminated and the rider doesn't have that extra pedal force to overcome (See Fig. B).

Some suspension designs lock out the suspension until the rider hits a big enough bump or rely on "platform shock technology" to increase pedal efficiency. In both of these cases, active suspension has been compromised to increase pedaling efficiency. With i-Drive technology you get efficient pedaling and an active suspension 100% of the time.

ADDRESSING PEDAL INDUCED BOBBING

Pedal induced bobbing is an event in which the force of your downward pedal stroke causes the rear suspension to compress resulting in energy loss. This is controlled by adding back in a small amount of pedal feedback, also called anti-squat. Too much anti-squat (or pedal feedback) will lock out the suspension; reduce suspension action and ultimately, a loss of pedaling efficiency. Too little anti-squat results in efficiency loss from pedal induced bobbing.

What we have achieved in a GT suspension design is a natural balance between the downward body movement compressing the suspension and a small amount of anti-squat extending the suspension. The result is a neutral-feeling system that remains active over the small bumps yet does not "bob" when pedaling.

ADDRESSING WHEEL TRAJECTORY

Wheel trajectory or wheel path is important because it is crucial that the rear axle move in the same direction as the bump force. If the wheel path does not line up with the direction of the bump force, the rider will lose momentum with each bump they hit. GT suspension bikes are designed with a single, high pivot to give the bikes an arcing wheel path which moves up and back. This allows the suspension to accurately follow the bump force from beginning to end without the rider losing any momentum.

ADDRESSING FRAME DESIGN

Frame designs that rely on multiple links to attach the front and rear triangles are subject to frame flex and long term durability issues. Each additional piece in a linkage design is an additional area that is subject to flex.

Although GT suspension frames with i-Drive technology have a total of 4 pivots, the suspension works as a single pivot (cantilever) design. By using this type of frame design, we've been able to construct a stiff rear end using box construction and an oversize pivot. Single pivot frame designs are simple, cost effective and trouble free mechanisms.

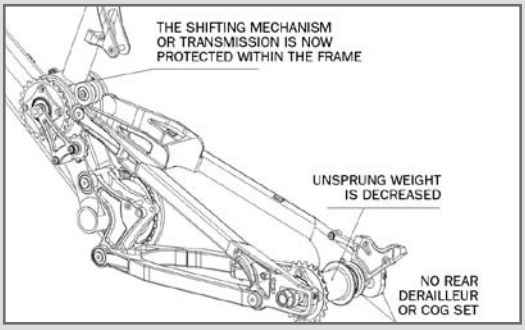
TRIPLE TRIANGLE

By lengthening the seat stays to not only attach to the seat tube but also weld directly to the sides of the top tube, GT engineers have decreased the size of the front and rear triangles and added a third triangle. This reduction in size yields a much stronger and rigid structure.

Not only will the stronger frame last longer through years of bombing down your favorite, rocky fire road but the increased rigidity will improve responsiveness in pedaling and steering. Torsional flex is greatly reduced on a Triple Triangle frame design.

Besides, what other brand can be recognized even if the decals have been removed? GT

INTERNAL TRANSMISSION



An Internal Transmission frame design is one that does not use a conventional, externally mounted derailleur to change gears. There are a number of benefits to this type of frame design.

The first benefit of an internal transmission is that the transmission mass is housed in the center of the frame. This allows the designer to reduce the un-sprung weight of the rear wheel. Un-sprung weight is the mass on the bike that is directly connected to the wheels and swing arm, and not isolated through the suspension. By decreasing this mass, it allows the suspension to respond quicker to changes in the terrain.

The second benefit is, now that the conventional rear derailleur and cog set have been removed from the rear wheel, the hub flanges can be moved outward and centered on the hub. This, as you know, creates a stronger and stiffer wheel.

The third benefit is, by moving the gear changing mechanism to the center of the bike, you eliminate the possibility of damaging the most vulnerable component on the bike, the rear derailleur. The shifting mechanism is now protected within the frame and has less of a chance of being damaged even during a severe crash.

The most important benefit of an Internal Transmission frame design is that it will open the door for future frame and suspension designs. By getting away from a standard shifting mechanism, GT engineers can improve not only in the areas listed above but they can also improve on the bicycles performance including pedaling efficiency and wheel trajectories.

FORCE OPTIMIZED CONSTRUCTION

OUR STORY

A pioneer in carbon fiber bicycle construction, GT Bicycles was the first company in the United States to produce thermoplastic carbon mountain bike frames in significant quantities. In 1996 GT Bicycles globally marketed the USA made Carbon fiber LTS. The Super Bike II (SB-2), produced in collaboration with USA Cycling for the 1996 Atlanta Olympic Games is still the benchmark for carbon construction and aerodynamic design. GT Bicycles, through its extensive research and development of carbon construction techniques, has numerous patents dating back to the early 90's.

OUR REASON

With a metal bicycle frame, the composition of the metal and the mechanical characteristics can not be easily changed over the length of the tube. This can only be done by forming or layering the metal at the cost of additional weight. With carbon, changing the placement, the direction and the make up of each layer of material is possible, in turn creating a lighter and stronger structure. The cross section (the shape) of each tube can also be designed for optimum strength and stiffness.

OUR TECHNOLOGY

Force Optimized Construction is GT Bicycle's proprietary composite manufacturing process in which the construction of each frame is optimized to give the frame exceptional strength and stiffness in the areas that need it most but at the same time removing material in the areas that need it least. There are 4 important factors that make up Force Optimized Construction:

Monocoque (One Piece) Frame Construction - GT frame design begins with choosing a construction method that has the highest-strength-to-weight ratio available. Lug construction adds weight and can be weaker due to the possibility of voids and pockets between joints. The joints can also act as stress risers which weaken and eventually fail. Monocoque frame construction gives you a strong, one piece frame with the lowest possibility of construction imperfections.

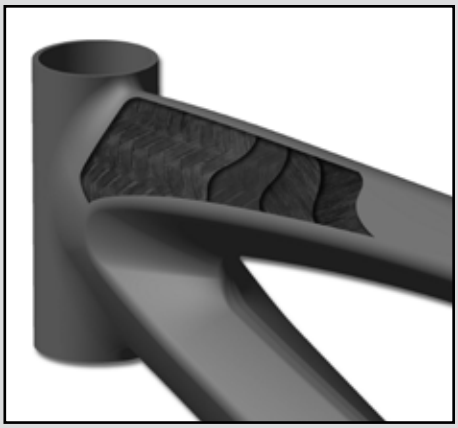
Optimized Tube Construction - Forces enter a bicycle frame from both the rider and the terrain. These forces, push, pull, twist, stretch and compress every tube on the frame in every direction. By using Finite Element Analysis (FEA), each tube on a GT carbon frame is designed with these forces in mind and they are given a cross section (a shape) to counteract those forces.

Twisting forces put on frame tubes during pedaling.

Proprietary Kiting and Sequence Process - Just as wood and metal have a grain direction, carbon has a fiber direction. Each layer of carbon fiber used in our frames is placed in a certain spot and certain orientation depending on the direction of force on that part of the frame. This gives the rider the most compliant and comfortable ride possible.

Typical FEA model for studying pedaling forces on the frame.

Proprietary Blend of Fiber Types - There are many different types of fibers that can be used to make up carbon fiber frames. GT uses a proprietary blend of TR30 and TR50 fibers in different areas of the frame to increase stiffness or strength in the places where it matters. Again, GT engineers use FEA to study and calculate areas in need of strength or support to give you the stiffest, strongest and lightest weight frame possible.



This 4 part combination of base construction, shape design and material/fiber application is what **Force Optimized Construction** is all about.

OUR RIDE

GT engineers have optimized our carbon frames to give the rider a comfortable ride that is stiff enough for quick accelerations and responsive steering, strong enough for serious use and yet super light for that competitive edge.

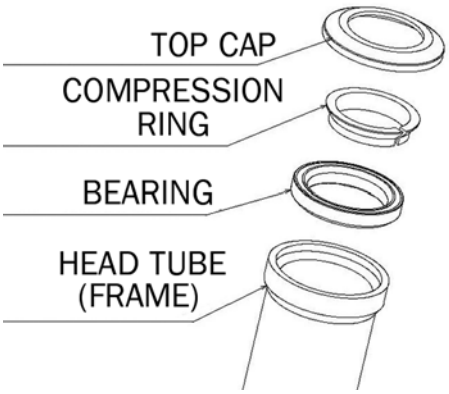
This is Force Optimized Construction...

FRAME technologies

INTEGRATED HEADSET SYSTEM

An integrated headset is one that is built in to the frame. Headset cups are eliminated by machining the bearing cups into the head tube.

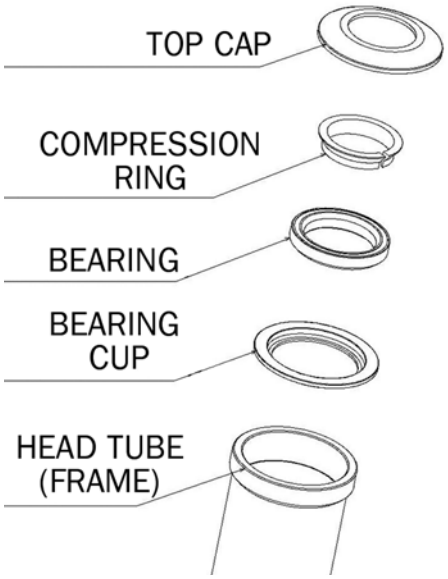
In addition to creating an easier assembly to maintain and a lighter weight system, the stack height is much lower which allows for a longer head tube to increase frame strength.



INTERNAL HEADSET SYSTEM
(SEMI-INTERGRATED)

An internal headset is a headset in which the bearing cups are recessed within the diameter of the head tube.

This headset system allows for a more stylish fork/head tube/ stem junction. The decreased stack height in conjunction with a head tube length increase allows for a stronger frame.



REPLACEABLE DERAILLEUR HANGER

The most vulnerable part on a bicycle is the rear derailleur. This mechanism hangs off of the right side of the bike and can easily be caught on rocks, branches and passing cars if you're not looking. Once you've done this, you've probably damaged the derailleur and quite possibly stripped, broken or bent the hanger that it is attached to.

By including a replaceable derailleur hanger system on most of our models, GT has eliminated the possibility of frame replacements due to broken or stripped out derailleur hangers. Simply remove the rear wheel and derailleur, unbolt the damaged hanger and replace.

REPLACEABLE DROPOUT

By including replaceable drop outs on some GT models, the rider is not only able to easily remove and replace a damaged derailleur hanger easily but can also reconfigure their frame for different types of axle sizes and rear end connections.

BOXED CHAIN STAYS

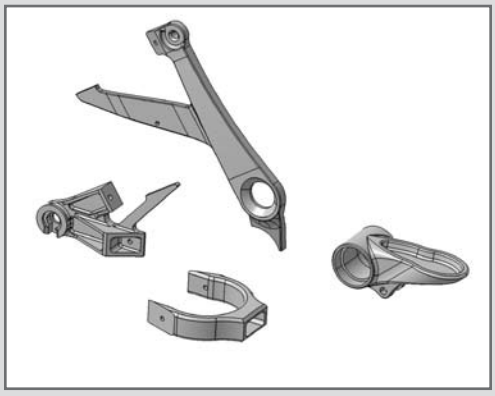
BMX racing is very demanding when it comes to the amount of flex while pedaling and cornering. By increasing the size and cross section on the chain stays, GT engineers are able to increase the strength and stiffness of the rear end of the frame.

Boxed chain stays are a feature in which the stays are made from forming two halves of each stay and welding them together as one. With its size and shape, this monocoque design decreases flex in a way that standard chain stay tubes can not.

FORGED FRAME COMPONENTS

Forging is a manufacturing process where metal is pressed, pounded or squeezed under great pressure into high strength parts known as forgings.

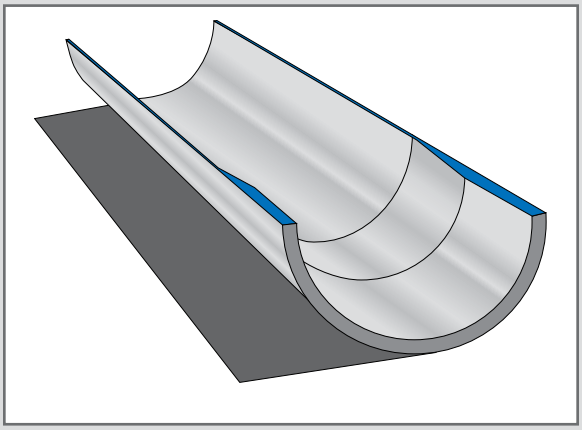
The process is normally (but not always) performed hot by preheating the metal to a desired temperature before it is worked. Forging yields a grain structure oriented to the part shape, resulting in optimum strength, ductility and resistance to impact and fatigue. The forging process can create parts that are stronger than those manufactured by any other metalworking process.



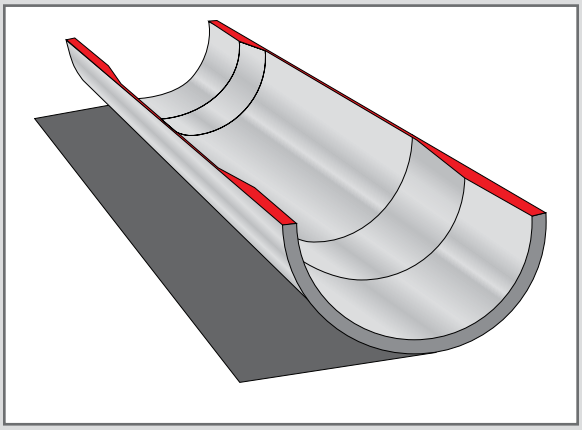
BUTTED TUBING

A butted tube is a tube in which the wall thickness of the tube changes from one end of the tube to the other. The number of wall thickness changes along the length of the tube will determine if it's a Single Butted, Double Butted, Triple Butted, etc., tube. A butted tube will be lighter than a plain gauge tube of the same outer diameter and have similar strength characteristics.

By using butted tubes, GT can have the appropriate wall thickness for welding on each end but have a thinner wall thickness in the middle where it is unnecessary; the benefit being a lighter weight tube.



STANDARD BUTTED TUBE



DOUBLE BUTTED TUBE

HYDRO FORMING

Hydro forming is a tube forming process which uses pressurized liquid to give shape to an otherwise round tube. A given tube is filled with pressurized liquid which expands the tube outward and fills a mold of the desired shape.

This process gives GT engineers the ability to create complex tube shapes. Hydro forming is used to reshape a tube in order to increase strength in the frame design and also to add unique shapes and style to tube profiles.

MECHANICAL FORMNG

Mechanical forming is a tube forming process in which a tube is pressed, pounded or squeezed into the desired shape. This process is a cost effective way to produce unique tube shapes for designs with relatively simple cross sections.

FRAME materials

CARBON FIBER

One material that is becoming more popular in frame engineering is carbon fiber. This material is produced by layering sheets of carbon fiber cloth into a mold in the shape of the final product. The alignment and weave of the cloth fibers is important for the strength of the resulting material.

By using carbon fiber GT designers can create a lightweight, structurally sound part in virtually any shape. See Force Optimized Contstruction.

6000 & 7000 SERIES ALUMINUM

Probably the most common frame material choice in all of the bicycle industry and a definite favorite with GT engineers.Both 6061-T6 and 7000 series aluminum alloys are the most versatile and widely used aircraft-grade, heat treatable aluminum alloys. Aluminum alloys have a very good strength to weight ratio along with impressive vibration damping characteristics. Aluminum frames can be made light and stiff, making sure the power coming from your legs translates to power in moving the bike.

CHROME-MOLY & HI-TENSILE STEEL

GT utilizes a variety of chrome-moly and hi-tensile steel tube sets, ranging from 100% chrome-moly frames to a mix of chrome-moly and hi-tensile steel tubes for a strong, yet cost-effective frame.

Incredibly light and durable bicycle frames can be made from steel tubing. Many cyclists prefer steel over other materials due to the comfort level and ride feel this frame material can provide. Don't forget...Steel is Real.

FRAME CARE GUIDELINES

It is critical to constantly inspect your complete bike, including frame and components for damage and normal wear before each and every ride. The riding conditions and activities that bikes are used for has increased the wear on bicycles and for this reason, GT Bicycles requires that you inspect your frame frequently.

- Visually inspect your frame before each ride
    - Look for cracks and/or imperfections in the material
- Be aware of any abnormalities in ride quality of your frame
    - Abnormal frame flex or shifting and braking performance
- Always listen for abnormal noises during your ride
    - Sounds like creaking, ticking and popping

If you discover any abnormalities in any of the above categories, or if your bike has been crashed or put thru abnormal stress, please see an authorized dealer for inspection.

Examples of damaging activities:

- Rider crash
- Abrupt stop impacts
- Run into garage while in car rack

If you have crashed or stressed your frame in a way that you're not sure if it is damaged, it is always safest to take your bike to an authorized dealer for a complete inspection.

CARBON FRAMES

Although carbon material has been proven to be extremely strong and can be constructed into bicycle frames that have exceptionally high fatigue life, carbon itself can still be easily damaged when crashed or put thru an abnormally high stress incident. A damaged frame may not show any visible signs or these signs may be difficult to see without meticulous inspection because the damage may be underneath the surface.

Warning: Damaged carbon fiber can fail suddenly with minimal notice and cause serious injury or death.

ALUMINUM AND STEEL FRAMES

Aluminum and steel frames can take direct impacts very well and are not likely to fail catastrophically but it is still very important to inspect your frame before each ride.

OUR POLICY

- Warranty – Pacific Cycle offers a limited warranty on all of its frames against manufacturing defect and materials. Any warranty claims must be placed through a valid Pacific Cycle dealer and must include proof of purchase. Warranty is only valid to the original owner. Please see the bicycles owner manual or your nearest dealer for more details.

- Crash Replacement Program - Because enough people do lay down their carbon bikes in a variety of ways (racing, driving into garages with the bike on the car, others…), that would not be covered under the warranty policy, Pacific Cycle offers a crash replacement program. With a valid proof of purchase and a Pacific Cycle licensed dealer, we can help replace your broken frame with a new frame or complete bike at a reduced cost. Please see your dealer for more details.

technological *adj.* tech′no·log′i·cal

A philosophy of design and engineering that is guided by sensible rational thought rather than the latest marketing fad. Technological design is a system that deals not only with the end product but with all aspects of the product life cycle from conception to eventual obsolescence. Throughout design, development and manufacturing, GT uses its 30 years of experience to build bicycles that illustrate a complete holistic consideration of the product and its eventual owner. With an increasingly crowded marketplace the philosophy of Technological design and engineering marks a clear path towards products that make sense.

GT: technological

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FTH (1/07)