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WHEELBUILDING SYSTEMS

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THE SPOKED BICYCLE WHEEL IS THE PERFECT SOLUTION

Less spokes, more tension

Spoked bicycle wheels: they are indispensable. The properties one needs for a bicycle wheel are: lightness, stiffness and resilience. Furthermore, one wants the narrowest possible tolerances for size and shape, and favorable aerodynamic properties. And all that at a competitive price. A wheelset being the most important factor in the light going of the bicycle makes it in more than one sense a valuable part of the bike. So if the wheel can be subject to maintenance or be repaired when out of true, it's an asset. Only the top racers in road race and mountainbiking can permit themselves to discard each wheel with the tiniest defect.

For millions of cyclists around the world, the spoked bicycle wheel is the perfect solution. Because the spoked bicycle wheel has been perfected over the decades to its recent high standard. For cars and heavy motorcycles, the spoked wheel has been replaced many years ago. But for the bicycle, there is no realistic alternative. Weight, aerodynamics and resilience are too important to skip them by using pressed steel wheels or solid cast wheels. The cast aluminum wheel: too heavy, where weight is so important. The one-piece wheel in mouldable thermoplastic: not stiff enough. The three-spoke carbon composite wheel: no resilience. The one-piece, one material cast wheels made in huge series, like spoked wheels today, might be cheaper in the end. But lighter? And with the same resilience? The built up carbon composite wheels are expensive both in labour and in material cost.

Perfection of the spoked wheel has been a time-consuming evolution. Because a seemingly sensible improvement can only prove its value in daily use, on the hard and ruthless test bed of the sport, the leisure rider, the commuter and the heavyweight tester. Development involves more than one issue. The use of stronger spokes is senseless if the hubs are not strong enough to hold the spoke heads. Strong spokes and hubs make no sense if the rim holes crack under tension.

Of course, wheel makers have realized in historic times that less spokes means better aerodynamics, and lower weight. But to obtain the same stiffness with less spokes, one not only needs stronger rims, spokes and hubs. What's elementary is a more precise wheel build-up, lower tolerances and lower variance in spoke tensions. The threaded connection between nipple and spoke on the high-tension spokes will have to be locked to prevent it to work loose in heavy going. New braking systems like hydraulic disc brakes put hitherto unknown tensions on the spokes on the disc side. New spoke patterns are not only fashion, but also a way to a still lighter, stiffer and more aerodynamic wheel. →

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Glued Nipples

The newest generation of bicycle wheels has less spokes. Wheels with 20, 18 or even only 16 spokes are not uncommon. The spoke tensions have risen to over 1000 N per spoke. On each turn of the wheel , the tension on each spoke varies twice: being in the upper position or the lower position means a tension difference of roughly half the rider's plus bike's weight divided by the square root of half the number of spokes in the wheel. With the used high tension, this is only a low percentage. But even with these very high-tension wheels, low-pressure tyres and full-suspension bicycles, the wheels have to take the punishment of the road or the downhill singletrack, which give deformative impacts within the elasticity of the wheel. With each big hit, the spoke tension will locally and very shortly be down. It is at these moments that spoke nipples will work loose, unless they have been locked to the thread of the spoke. Every race mechanic and every customer services man in the bicycle factory knows the problem of spokes working loose. Some manufacturers of spokes and nipples have invented solutions to lock up the nipple. With a synthetic insert in the nipple (Alpina), with an integrated locking system (SILS by Sapim) or with a semi-fluid compound (Prolock by DT Swiss) the nipple will stay in place.

Holland Mechanics have developed a bonding system which works with a chemical compound comparable with the well-known Loctite products. The system applies a droplet of water-thin glue or bonder to the bottom of the spoke nipple. This bonder finds its way all along the thread through capillary action. The mechanical dispenser which applies the bonder is best installed in the stabilizing unit. This means that the bonder is applied after lacing, but before trueing. When the wheel is ready and the spoke tension is released by deformation of the wheel, the bond constitutes a rest torque needed to unscrew the nipple, which effectively prevents it from unscrewing. Even after manual re-trueing, the nipples will keep an extra 6.5 Nm rest torque.

The Holland Mechanics system has some advantages over the inbuilt locking devices or the pre-applied locking agents. First, it is cheaper in use- the price of the bonder is only in the region of 0.02 euro cents per nipple, depending on the quantity of the wheels made, and it can be applied to any make of nipple or spoke. We at Holland Mechanics are convinced that this technology will trickle down from the high-end use to medium and even low-segment bicycle wheels, because it prolongs wheel life for any spoked wheel.

FROM THE EDITOR

Any questions about issues in this magazine? Please send these to the HM Today editing team: Anecdotes on wheelbuilding in broadest context – historical, incidental, or in any sense instructive – will be rewarded when published in this magazine. Send your contributions to:

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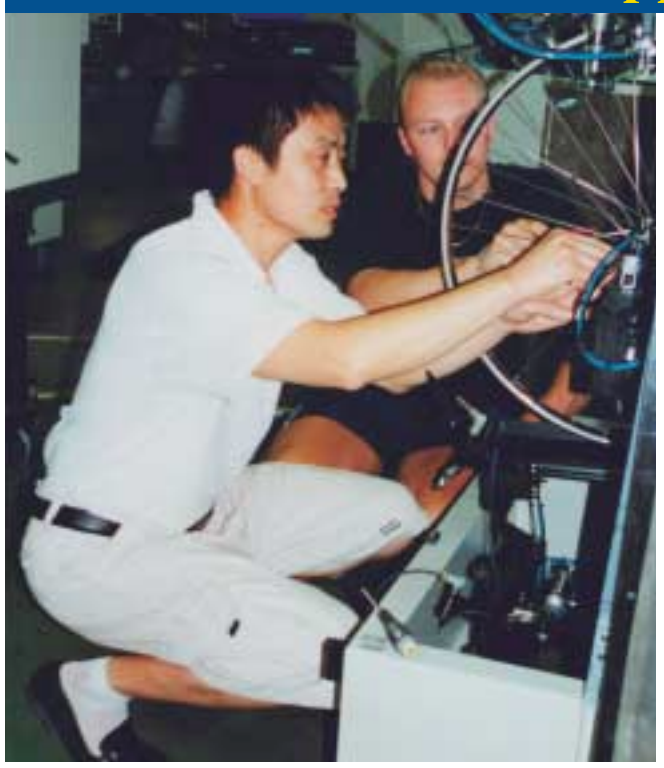
Chinese apprenticeship



Six weeks ago he did not have a passport, and had never been beyond the province of Guangdong. Yan Dingzhu is a Chinese mechanical engineer, who came to Holland Mechanics in Purmerend, Holland to master the HM lacing and trueing machinery. The efficiency of this study will be mutual, because Holland Mechanics is operating a local assembly plant and service center for wheelbuilding equipment in China. The bicycle industry is booming in China, with main production areas in Shenzhen, Shanghai and Tianjin. Although manual labour is still very cheap in China, Holland Mechanics has strong indications that the Chinese and Taiwanese entrepreneurs are aware of the fact that mechanized wheelbuilding is more than saving labour cost: the main issue is the consistency of the product and the possibility of overall monitoring, which is an asset for any company that wants to get an ISO certification and wants to reach European quality. If all goes well, Yan Dingzhu will work in China as a technical representative for HM. In the meantime, he is learning English and a little Dutch, and dreams about home.

Tyre Fitting and Control Station

Tyre fitting is more and more considered an integral part of the wheelbuilding operation. Traditional wheelbuilding considered the fitting of the tyres a separate operation, but in today's factory it does not make sense to carry the wheels after trueing to a store room and another place in the factory to fit the tyres. Holland Mechanics TMC Tyre fitters are not only ergonomically built, the work is also light and easy. The fitting of the tyre is at the same time a kind of final check, and the job invites to job rotation with the other phases in the wheelbuilding process. In our picture, one sees the ends of five parallel Holland Mechanics wheelbuilding lines at the new Merkers Rad factory in Thüringen, Germany.

Tensiomatic

Tensiomatic is our spoke tension measuring equipment. To measure the tension of a spoke, there are hand tools like the instruments made by Hozan or DT Swiss. The tool is perfectly suited to measure spoke tension in a bicycle wheel and as such it is used by race mechanics and wheelbuilding analysts. But the hand tool is time-consuming: one has to measure 32 spokes, take down the values measured and perform the analysis. The Holland Mechanics Tensiomatic enables every bicycle manufacturer to do a more frequent check in a more efficient way. Because of the two sides measuring procedure the Tensiomatic is more reliable than other tension analyzers. The stand-alone measuring equipment is intended for the professional wheelbuilding department to collect such quantities of data that can show systematical errors that may be retraced to a machine failure or to a miss by one of the wheelbuilders' base materials: the hub, the spoke, the nipple or the rim. Of course, Holland Mechanics backs this layout with knowhow and a huge experience with all possible causes of exceptional spoke tension patterns.

Lacing from memory

Deep section rims have deep nipple holes. With deep double wall and triple wall rims, the scanning of the holes is a sophisticated and time-consuming procedure that cannot be effectuated by every lacer. Holland Mechanics has developed special software for their ISL Lacer, which does not scan every single spoke hole during the lacing process as usual, but performs one complete scanning round and then laces the whole wheel from memory.

Light Motorcycles

Spoked wheels with small-diameter rims and big hubs are found on light motorcycles, and for instance e-bikes with a hub motor. These can be laced an trued mechanically with a CN lacer and DTI trueing machine. The CN Lacer is the most versatile lacing machine, which means that its scanning system can cope with the angles the spokes make with the wheel radials. The bigger the hub diameter and hub width are in relation to the rim diameter, the more difficult it is to locate the spoke through the spoke hole in the rim. The CN Lacer is the perfect machine to lace electric motor hubs or brake drums. Ask Holland Mechanics, your business partner, for details.

Double trail

The Holland Mechanics FloorPlan for the wheelbuilding shop can be downloaded free of charge from the Holland Mechanics website. The FloorPlan software calculates the most ergonomical machine layout for a given workshop room, or designs the ideal floorplan for a new workshop. A new module in the FloorPlan is the application of a double trail between the lacers and the stabilizers and trueing machines, which increases the buffer capacity between the units of a wheel assembly line. This double trail can be a useful and simple addition which enhances the mutual logistics between the machines.
Download form: www.hollandmechanics.com/floorplan

Tubeless systems Tubeless tires have better sealing, and less punctures. No wonder they are very popular with mountainbike racers- virtually all the top riders use tubeless tires these days. One of the systems in use, the UST, has a doublewall rim without spoke holes in the outer wall. Threaded nipple holders are screwed into the inner rim wall. The threaded holes in the inner wall are not punched but opened by deformation so that the material is not lost, but stretches inward for increased support of the nipple holders. Holland Mechanics closely co-operates with Mavic, the inventors and patent holders of the UST tubeless system to mechanize the inserting of the nipple holders and the lacing of the UST wheel. Licenses for the manufacture of UST wheels have been given out to bicycle factories in Europe, Asia and America.

Paired Spoke Technology A couple of years ago, a new idea about spoke positioning was worked out by American wheelbuilder Rolf. The idea was to attach one point on the rim circumference with opposing flanges of the hub. The idea was not entirely new, it had been used in the 19th century with wire spokes running from flange to flange through an adjustable eyelet on the rim. The Rolf system uses normal spokes, with the spoke holes in the rim as close together as practically possible to allow the nipple key to be wielded in between. Holland Mechanics developed the special small trueing hands which fitted between the paired spokes, and the software to true the wheel properly.

The Rolf patent was the beginning of a whole series of new spoke patterns and arrangements. Bontrager makes wheels similar to Rolf, Shimano uses the paired spoke technology with the spokes running from the rim (headside) to the hub (nipple side). Other manufacturers like Rigida, Vuelta, Alex rims and Campagnolo all developed their own paired spoke pattern. Campagnolo has a pattern not in pairs, but in triplets: two spokes from the drive side flange and one in between from the opposing side. Many of today's high-end wheels have a tangental spoke pattern on the drive side of the rear wheel and a radial layout on the offside. Holland Mechanics developed a special software programme for single-hand trueing, which is applicable for asymmetric spoke patterns to enable wheel manufacturers to true their special layouts mechanically.

W H E E L - L O G I C

Big wheels Not a Bicycle, but a Dicycle is what this layout was officially denominated in the 19th century. Only BSA have made dicycles in series, and they are considered rare and valuable collector's items. The dicycle seen here is moved forward by a swing system. The rider sits in a cradle and swings forward on an ingenious system of chainwheels and freewheels which move the dike forward on the back stroke of the swing. The Dike is very versatile. It is seen here at the annual Brussels Salon.

Villum

When Soltof from Denmark stopped with the production of the best-known hand wheeltrueing jig, the Villum, Holland Mechanics has aquired the assets of the Villum and will continue to produce this heavy-duty stand which is appreciated by the bike industry for checks, slight corrections, repairs or small quantities of handbuilt series. For generations, the Villum has been a practical tool and it remains to be so. But in addition to the lines of mechanical wheelbuilding equipment, the Villum serves in many factories as a psychological weapon: it helps the operators and shop managers to keep up their skills. Some proficiency in hand building wheels, and the odd correction here and there makes one feel that one masters the process taking place at high speed in the trueing machine.

HM Philosophy fully adopted by Merkers Rad

Holland Mechanics is proud of the opportunity it got to provide the all-new Merkers Rad factory in Germany with five cells of wheelbuilding equipment, with everything so exactly like the book that it almost seems surrealistic. We gladly give you a couple of views of the five HFS hub fillers, the lacers and the tyre fitting system. Most of the HM machinery are staffed by women, and that's not only at Merkers. More and more lacing and tyre fitting is done by women.

Disc Brakes

The use of disc brakes on a spoked wheel implies special requirements for the spoking. A bicycle front wheel with usual rim brakes can be spoked radially. The slowing down of the rotational movement of the rim is translated in the slowing down of the bicycle. Stopping the rims and the tyres may cause the bike to skid some distance, but if the bicycle rides on anything but on ice, this is the fastest way to slow down and ultimately come to a standstill. The slowing down of the rotational speed of the rim is transferred without any resistance to the hub, which turns on frictionless ball bearings. Theoretically, one can spoil the rear wheel when keeping the force on the pedals and at the same time braking on the rim. But nobody is that strong.

With a brake attached to the hub, the situation is completely different. The specific problems that have been signaled with today's strong hydraulic disc brakes have never been noticed to a similar extent with coaster brakes, drum brakes, i-brakes or roller brakes. But with all these brake types, radial spoked wheels are impossible. The spokes have to transfer the slowing down of the rotational speed of the hub to the rims, and the tyres have to stop the bicycle. Braking hard means that the pulling spokes (between hub and rim) are compressed. With a hydraulic disc brake, these forces can be so big that the spoke nipples come temporarily loose from the rim bed, and tend to unscrew. Therefore it is imperative for disc brake wheels to use the right crossover spoke pattern, and to arrange the spoke heads in the right way.

In the front wheel, the heads of the spokes which are under pulling tension while in braking mode should be located inwards of the spoke flanges. In the rear wheel, the heads of the spokes on the drive side which are under pulling tension while in the drive mode, should be located inwards of the spoke flange. On the brake side of the rear wheel, the heads of the spokes which are under pulling tension while in braking mode should be located inwards of the spoke flange.

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Holland Mechanics, the people who are dedicated to wheelbuilding, continue to develop the machinery to build the most sophisticated bicycle and light motorcycle wheels. Whether you are turning out more than a million wheels a year in a straightforward pattern, or 10.000 super-high end wheels with different patterns, Holland Mechanics can be your partner.

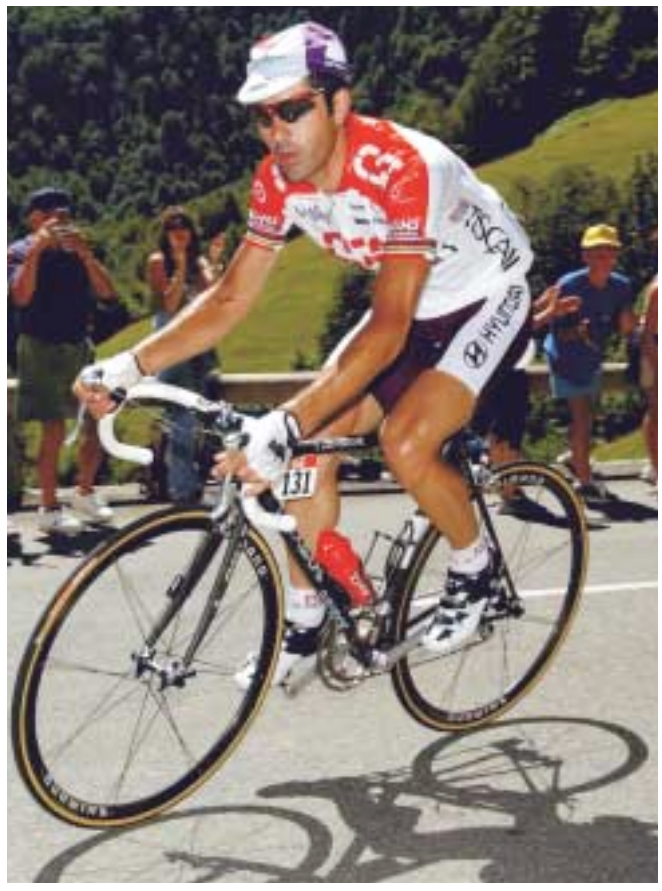

Photo: Shimano/Cor Vos

Professional road racers do not easily accept innovations. Many of the top racers use materials they trust, even if team sponsors have their own specific wheels, saddles or tyres. When the wheels with the odd spoke patterns started to come a couple of years ago, many riders opted to the known and proven. This year saw a breakthrough of the paired spoke wheels by Shimano. French national hero Laurent Jalabert won the stage on the French national holiday, the mountain classification and the prize for the most combative rider, all on Shimano wheels.

57 Wheels per hour!

Deuzimar Sampaio Melo, employee of CBB in Brasil, produces about 57 wheels per hour average! Sometimes she even achieves 60 wheels.
CBB of Brasil is the Latin American leader of bicycle manufacturers, production for this year is planned for 1,2 million.

Jubilee Party

Holland Mechanics' anniversary was celebrated this year on the Dutch island of Terschelling, where one cannot take the car. So everybody sailed – with husband or wife, boy or girlfriend – from the continent, taking his or her bike for local transport to the bungalow park where the HM family was having a good time. At night fires were lit on the beach.

2001 International Show Calendar

* and the shows where Holland Mechanics will be on exhibit.

13-16 September	IFMA Cologne*	Germany
17-21 September	Velo-City conference	Glasgow, Scotland
18-23 September	EICMA Moto & Bici *	Milan, Italy
22-25 September	Bike & Trim	Salzburg, Austria
28 Sep.-7 October	Mondial des Deux Roues	Paris, France
30 Sep.-7 October	Interbike*	Las Vegas, USA
19-21 October	Bicycling Australia Show	Sydney, Australia
19-22 October	Roc d'Azur	Fréjus, France
25-28 October	Bicycl 2001	Poznan, Poland
1-3 November	Japan Int. Cycle Show	Tokyo, Japan
7-11 November	Warsaw Motor Show	Warsaw, Poland
8-18 November	Int. Motorcycle Show	Birmingham, UK
20-25 November	Anhembi Trade Show*	Sao Paulo, Brazil
29-30 November	Bike Vysochina	Zdar nad Sazavou, Cz.
7-16 December	Bologna Motor Show	Bologna, Italy

READER'S LETTERS READER'S LETTERS READER'S LETTERS

Floorview at Raleigh

Towards the end of 2000, Raleigh Industries was re-organizing its production lines. Part of it is the wheel-building operation at Nottingham. It included mechanical hub filling, and the change was considered a massive leap forward. Of course, there were some arguments as to whether the expected output increase of some 30% was reasonable or not.

Operations engineer Neil Barrett wrote:
"We decided to take the Floorview program on as a monitoring tool. At the moment, our ISL Lacers are the only machines connected at the moment. As time moves we will bring the SG's and HFS on line too. The addition of these units will allow the quality recording facility of the system to come into play. What the software enables us to do is to monitor the output of an individual's performance in real time when they are building wheels. At the same time, we can see what type of wheel they are building, their average build time, any idle time and a host of other detail information.
Whilst this smacks a little of 'Big Brother', if used constructively the system is a very powerful tool.

It enables the detection of the personnel who are genuinely struggling to maintain outputs we desire and may not want to say anything. It also highlights personnel who are 'abusing' the system and provides real evidence to confront them with. We can monitor the quality of our temporary personnel. Daily production figures are at a keystoke instead of having to count everything manually. Machine performance can be compared. The system still seems in its infancy but it is growing fast and HM have been able to provide software and modifications to suit our needs. The move to a HTML format means that anyone with a browser can view the information provided by the system. The data recorded can be stred in Excel and with a little more development this will provide daily records and printouts of machine performance. Floorview really has brought wheel building into the 21st century. The information it can provide and potentially could provide in the future can only serve to save the user time and make wheelbuilding still more efficient.

NEIL BARRETT
OPERATIONS ENGINEER
RALEIGH INDUSTRIES LTD.
NOTTINGHAM, UK.

Dear Holland Mechanics,

Some time ago when Holland Mechanics no longer had a US based technical support engineer, I had some anxiety concerning the support that HM would be able to offer to its foreign-based users. Often a foreign supplier is very poor at supplying technical support or other information. I have proven to be wrong.
The technical support that I receive when calling Holland Mechanics has been very good, and any fears I had about not being supported were quickly disappeared. It is true that the machines are very well built and require little in the way of very technical repairs. However, when problems have arisen, the support staff at Holland Mechanics has been very understanding and helpful in diagnosing the cause of such technical issues.
Thank you for your continued support.

Sincerely,

RAY TETREAULT
SPECIALIZED BICYCLE COMPONENTS,
SALT LAKE CITY, UTAH, USA

I have been in the wheel building business over 22 years, eleven years with TI Sturmey-Archer of America Inc., six years at Huffy and presently at the Trek Bicycle assembly facility in Whitewater, Wisconsin, USA. Trek made a decision in 1997 to make "Best in Class" wheels, both for After Market and OE. Trek recruited top engineers, developed supplier relationships, and overhauled their manufacturing method. For the equipment needed to efficiently build our range and volume of wheels we looked to Holland Mechanics.

For many years prior to 1997 we built wheels with the CF Lacer and Robot 77 Trueing Machine so we were familiar with HM's reputation and reliability, but we knew we needed to get better to compete. We investigated all other wheel building systems available and determined our best choice was Holland Mechanics. We invited HM sales and engineering staff in to listen to our plans, and see our designs. After listening to our requirements HM made a proposal for us to change to the ISL lacer and the Robot SG trueing machine. Testing showed remarkable improvements in quality just from changing to the ISL and SG but the machines could not handle our complete range of products.

HM engineering and technical staff took our wheel samples back to their lab and re-wrote some of the ISL programming to make it possible to build all our lace patterns and rim designs efficiently. Now our operators just tap a few keys and the ISL will change from a 32 hole, 3 cross 26 inch front wheel to a 24 hole, radial/2 cross, close pair spoke rear 700c wheel with black aero spokes in about 45 seconds. Amazing! We currently have over 250 different wheels programmed into our machines. As for quality, the ISL Lacer has such good control over the spoke tension that it allows us to hand true several of our wheel types directly from the ISL.
Small batch sizes have become very important to Trek, and it is primarily the change from the CF to the ISL technology that has allowed us to accomplish our goals while minimizing down time.

We evaluated the SG Truing Machine but in the end we decided the HM's DC Robot Truer was a better fit for our factory. Our staff was already trained with the Robot 77 and the transition to the DC was easy. The DC is more than fast enough for our lacers and the quality of the finished wheel is, well its freakin' scary. I have seen really good wheel builders spend an hour or more hand trueing a wheel and not get them as beautiful, or as evenly tensioned as the DC does. The machine has settings we manually change for different wheel types and specific levels, spoke tension, trueness etc. This allows us to utilize each piece of equipment most efficiently and can even compensate for inexperienced operators or a batch of touchy parts. We still manually inspect 100% of our wheels to insure our customers are getting the wheel they were promised but without a truing machine as good as the DC, we could not deliver the product our customers want.

Holland Mechanics says they have been making a lot of improvements since we bought new equipment three years ago. I hope so, because wheel building is evolving right now and without HM's help we might have to start saying no to some of the new ideas.
Thanks, HM!

JEFF BOGSTAD
MANUFACTURING ENGINEER
TREK BICYCLE ASSEMBLY FACILITY,
WHITEWATER, WI, USA