
MERLIN®
TITANIUM

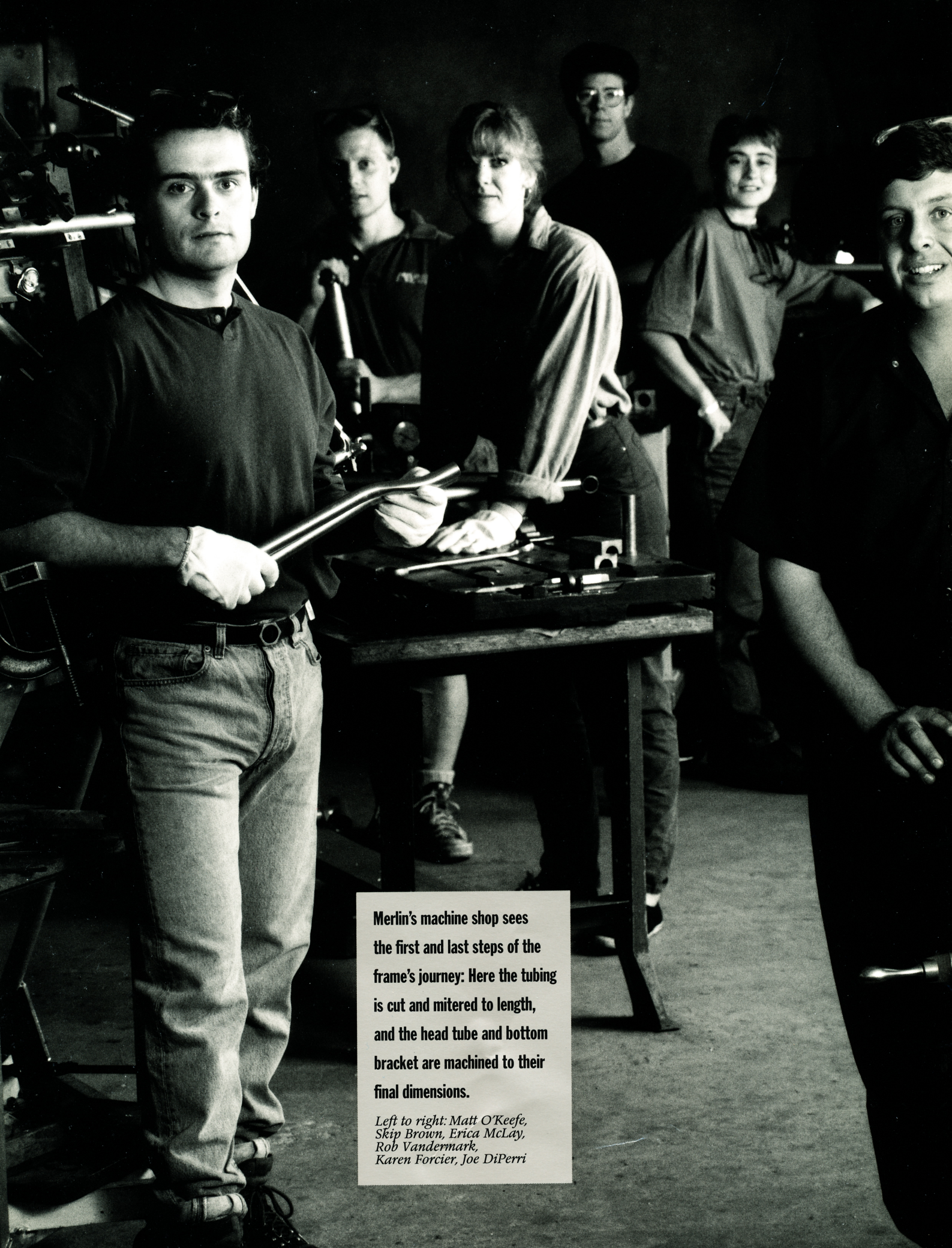
On the cover: Training ride, July 1992. Left to right: Skip Brown, Tim Delaney, Ashley Korenblat, Rob Vandermark, Jennifer Miller, Ross Andrews, Matt O'Keefe

Six years ago, a handful of cycling enthusiasts gathered their wits and resources to begin the adventure that has become Merlin Metalworks. They had few precedents to guide them, and certainly no guarantee of success. Their goal: To create a totally new bicycle, from new alloys and new materials, using techniques that had never been applied to bikes.

It could have gone either way, of course. But the results were universally hailed as a breakthrough (some called it a revolution). Completely fabricated from aerospace titanium, the Merlin was astonishingly light, yet extraordinarily tough. Its ride, seemingly both rigid and soft at the same time, defied easy description. It was elegant, even beautiful, yet its naturally durable finish required no special care.

So powerful was the Merlin's debut that in six short years it has become the standard by which bicycles are judged. Not surprisingly, it has been copied again and again, both in the United States and abroad (today there are more than 20 brands of titanium frames on the market). But as you will see, the quality of a Merlin is not so easy to imitate.

And nothing compares to the original.



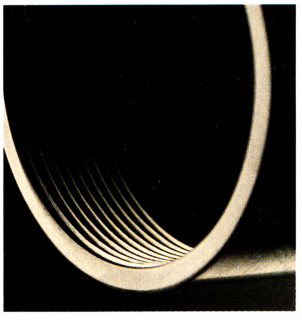
Merlin's machine shop sees the first and last steps of the frame's journey: Here the tubing is cut and mitered to length, and the head tube and bottom bracket are machined to their final dimensions.

Left to right: Matt O'Keefe, Skip Brown, Erica McLay, Rob Vandermark, Karen Forcier, Joe DiPerri

It all starts with the tubing. Titanium is a remarkable material for bicycles. It is very strong, very light, and very durable. It doesn't rust or corrode. It is naturally resilient, and when used properly, it can give a bicycle a welcome liveliness.

Small additions of other elements boost titanium's strength significantly. Merlin 3-2.5 tubing blends 94.5% pure titanium with 3% aluminum and 2.5% vanadium. When the raw tubes reach their finished dimensions, they are heat-treated and cold-worked until they meet Merlin's minimum yield strength of 113,000 psi, an 8% boost above the titanium industry's own specifications. Merlin tubing also has the most stringent tolerances for wall thickness, outside diameter, and ovality. All of it is 100% aerospace certified; no scrap, seconds, or "recreational grade" tubing is used.

Raw materials are only a starting point, of course. The trick is to deploy them wisely, using no more than necessary to get the job done. (Weight and strength, the fundamental concerns of the cyclist, are always at odds.) So besides the 23 standard tube sizes available from the titanium industry, Merlin's engineers have created an additional 14 custom sizes. These unique tubes, exclusive to Merlin, vary incrementally in diameter and wall



Merlin's custom-made tubing exceeds aerospace standards for straightness, ovality and wall thickness, and, at 113,000 psi, bests it for strength, too.

Threading and facing the bottom bracket shell *after* welding eliminates the distortion and alignment problems that plague other designs.

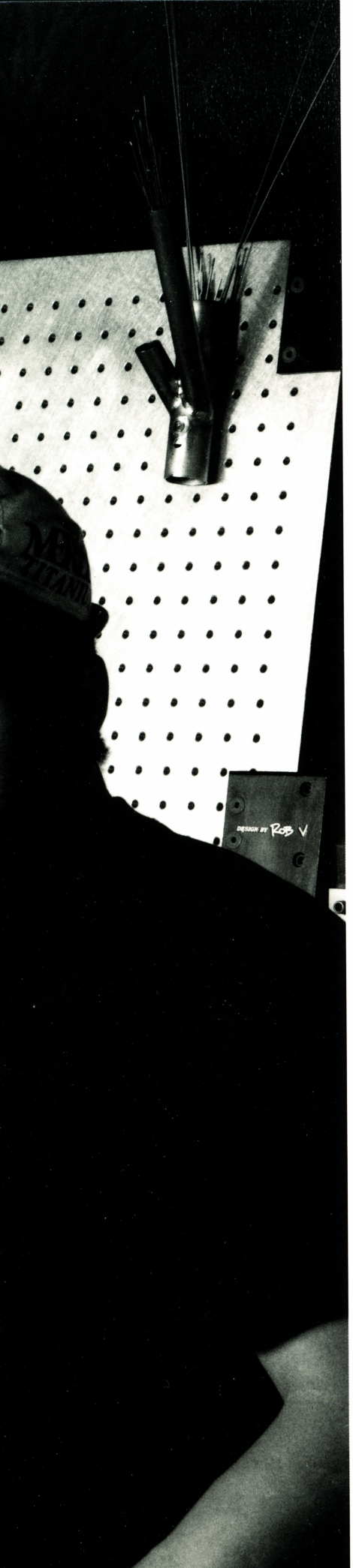
thickness, to optimize the ride, handling, and strength characteristics of the bikes.

In pursuit of further refinement, Merlin recently created the world's first seamless double-butted 3-2.5 titanium tubing. Double-butting puts more material at the ends of the tubes, for strength, and less in the middle, for light weight. In Merlin's Extralight frame, weight is cut by as much as 26%—almost a full pound—compared to a straight-gauge frame. Yet there is no compromise in ride or rigidity.

This quest for precision and accuracy is carried forward throughout the

Before the tubes are tack welded in place, data points are accessed from a CAD computer program and transferred to this unique jig, assuring that each frame meets all alignment specifications.

Left to right: Neil Mansfield, Curtis Jackson



Our seamless double-butted tubing cuts weight without cutting strength. This Extralight head tube shows the butting process clearly.

The Extralight's chainstays are also double-butted. Their large diameter and V-shaped bend, used on all road models, adds lateral stiffness.

process of framebuilding. The tubing is machined to a tolerance of ±0.010". That is, the gap at each mitered joint measures precisely within ten-thousandths of an inch, ensuring full penetration of the 6-4 titanium filler material during welding.

Before the tubes can enter the weld room, however, they must be supercleansed in a recirculating bath that removes all traces of foreign matter. Hereafter, they are handled only with white cotton gloves, to prevent contamination by skin oils.

In the weld room, the tubes are placed in a unique Merlin-designed, computer-driven jig. Special pressure fittings are attached to the head and seat tubes, and all openings at the bottom bracket, water bottle bosses, and brake bridges are sealed. Pure argon gas is then introduced into the frame, to purge oxygen from the area. Oddly enough, for all its vaunted strength, molten titanium becomes hopelessly brittle in the presence of oxygen, so welding must be performed in an inert atmosphere.

Small tack welds—dots of material to connect the tubes—are applied to each joint. The frame is then released from the jig and checked for alignment. Any variance is immediately corrected; the tubes are separated, then realigned, retacked, and rechecked. In this way, the frame is built straight, so that minimal cold-setting (forcible alignment at room temperature) is required later.

Finally, the welding begins. It's a slow process, because the area must be shielded from oxygen at all times. Weld temperature is another complication. Most of the larger joints are welded at approximately 3200° F., and the job proceeds relatively quickly. But some of the tubes are exceedingly thin—that's why Merlins ride like Merlins—and both temperature and technique must be adjusted to create a strong weld without warping or burning the tubes. In all, it takes about four hours just to complete the welds on a frame.

To prevent contamination, the weld areas are shielded with inert gas. Merlin's craftsmen, led by Tim Delaney, use a special 6-4 titanium filler material with an annealed strength of 126,000 psi.

Left to right: Bob Sykes, Jozef Smatana, Steve Haberek, Tim Delaney, Pete Sweeney

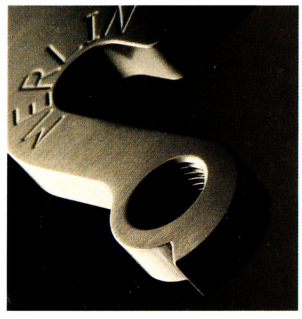
After a thorough quality audit, the frame moves on to machining and facing. First the bottom bracket is faced and align-bored, and its threads cut by a computer-controlled vertical machining center. The sequence here is vital. Although facing and threading a completed frame is much more difficult and costly than doing the work beforehand on a raw bottom bracket shell, it is the only way to guarantee perfect alignment of the bottom bracket axis with the main frame.

It is also the only way to guarantee perfect threading, because the heat of welding invariably warps the shell slightly, a distortion that cannot be removed by a simple chasing operation after the fact. And if the threads are not perfect, it will be impossible to adjust the spindle bearings properly; either they will bind, or they will be so loose that they will rapidly wear out.

The head tube is reamed and faced next—again, doing this slow, difficult operation at the end is the only way to do it right—and the seat tube is also reamed to its final dimension of 27.2 mm. All Merlins use a custom-made, welded seat tube reinforcement that withstands countless adjustments without stretching or bending; no odd seatpost sizes, shims or other inserts are required.

The frame is now only a few hours from completion. In that time it will receive a durable satin-grey finish, along with decals and a coat of wax. Titanium is impervious to the elements, so plain soap and water will keep it looking new forever (Merlin's lifetime warranty is described in the owner's manual).

Merlins differ from ordinary bikes in so many details that a short description can barely do them justice. The road bikes have geometry created by Tom Kellogg, with long top tubes to place the rider in the most aerodynamic and comfortable position. Seat angles are chosen to locate



Our seat insert is machined from custom stock; it withstands countless adjustments without stretching, and takes a standard 27.2-mm seatpost.

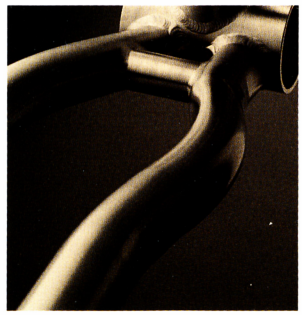
Vertical dropouts machined from solid 6-4 titanium plate have unbeatable strength, assure fast wheel changes, and maintain perfect alignment.

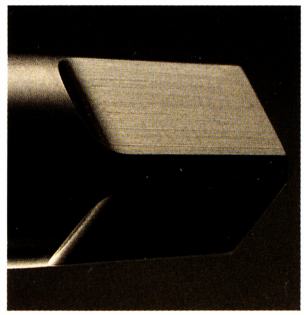
Merlin's six-step finish is protected with a light coat of wax, and can be cleaned with soap and water. Since titanium does not rust or corrode, its satin beauty is easy to maintain.

Left to right: Dave MacDonald, Martine Canfield, Kimon Greenland

the rider's center of gravity within the vertical plane of the bottom bracket, rather than ahead of it.

The mountain frames, designed by Rob Vandermark, have sloping top tubes to cut weight and improve vertical compliance. They also feature S-Bend stays for better tire clearance, and for a smooth ride that keeps the wheels in contact with changing terrain. All Merlins are designed for long





S-Bend mountain chainstays, made from laterally stiff 7/8-inch tubing, clear 2.6-inch tires with ease, and allow the use of low-profile cranks.

The world's strongest crank spindle, made from a rare alloy called Beta-C, is 45% lighter than steel, and accurate to ±0.0001 inches.

distances; you can ride one all day and still feel fresh at the end.

And then there are details like our exclusive Beta-C crank spindle, made from a titanium alloy so rare that there is only one source for it in the world. It has a gun-drilled, stepless through hole, to eliminate damaging stress risers, and it is centerless ground to an accuracy of ±0.0001". With a heat-treated strength of 195,000 psi, it is the strongest spindle made, and yet it is 45% lighter than its closest competitor, steel.

And there are our machined and engraved 6-4 titanium vertical dropouts, which maintain perfect wheel alignment and permit fast wheel changes. And our 7/8-inch V-Bend road chainstays, which enhance lateral stiffness.

But to focus only on these details is to lose sight of the whole. And in the end, it is really the ride that counts.

For that, we urge you to visit your Merlin dealer, to try the Merlin for yourself. There, you'll see how our custom tubing smooths the ride over rough patches of road or singletrack. You'll feel the light weight of the frame as you climb hills, and you'll find our precision alignment at work as you carve corners, or arrow down long, straight stretches.

And then you will discover why, in a marketplace crowded with imitations, the Merlin stands apart as a true original.

Light. Durable. Strong. Made for cyclists who demand the very best.

Merlin Extralight

Frame Size *(cm, center to top)*	**49**	**51**	**53**	**54**	**55**	**56**	**57**	**58**	**59**	**61**
Head angle *(degrees)*	72.5	73.0	73.0	73.0	73.5	73.5	73.5	73.5	74.0	74.0
Seat angle *(degrees)*	74.0	74.0	74.0	73.5	73.5	73.0	73.0	73.0	73.0	72.5
Top tube *(cm)*	52.1	53.3	54.5	55.0	55.5	56.1	56.5	57.1	57.5	58.5
Chainstay *(cm)*	41.6	41.3	40.6	41.0	41.0	41.0	41.0	41.0	41.0	41.6
Wheelbase *(cm)**	97.1	97.4	98.0	98.0	98.0	98.1	98.5	99.0	99.0	100.2
Standover height *(cm)*	73.8	76.0	77.9	78.6	79.7	80.3	81.4	82.3	83.4	85.5
Bottom bracket drop *(cm)*	7.3	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	6.7
Head tube length *(cm)*	6.6	8.6	10.5	11.4	12.0	12.8	13.8	14.8	15.6	17.8
Steerer length *(cm)*	11.2	13.2	15.1	16.0	16.6	17.4	18.4	19.4	20.2	22.4
Fork rake *(cm)**	4.8	4.5	4.5	4.5	4.0	4.0	4.0	4.0	4.0	4.0
Frame weight *(pounds)*	2.42	2.47	2.55	2.60	2.66	2.68	2.69	2.79	2.92	3.09

** SR Prism fork*

Features:

- Geometry by Tom Kellogg
- 27.2-mm seatpost diameter
- Derailleur clamp supplied with frame
- 130-mm rear axle spacing
- Brake cable stops at 7 o'clock
- 7/8-inch V-Bend chainstays
- Optional bottom bracket spindle: Merlin Beta-C
- Optional fork: SR Prism
  Fork color: Iridium blue
- Steerer lengths calculated with a 46-mm stack height; parts should be measured before cutting the steerer tube.
- Frame weight does not include fork or bottom bracket.
  All weights are approximate.

Standover heights are measured midway on the top tube, and will vary with tire profile.

For an approximate calculation of your correct frame size, measure your inseam in centimeters, crotch to floor in bare feet, and multiply by 66 percent.

For custom sizes, paint, clearcoat and other custom options, please contact Tom Kellogg, Spectrum Cycles, 1190 Dorney Road, Breinigsville, PA 18031; 215-398-1986.

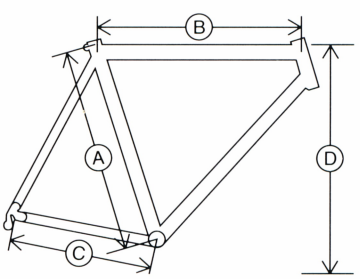
Merlin Road

Frame Size *(cm, center to top)*	**49**	**51**	**53**	**54**	**55**	**56**	**57**	**58**	**59**	**61**
Head angle *(degrees)*	72.5	73.0	73.0	73.0	73.5	73.5	73.5	73.5	74.0	74.0
Seat angle *(degrees)*	74.0	74.0	74.0	73.5	73.5	73.0	73.0	73.0	73.0	72.5
Top tube *(cm)*	52.1	53.3	54.5	55.0	55.5	56.1	56.5	57.1	57.5	58.5
Chainstay *(cm)*	41.6	41.3	40.6	41.0	41.0	41.0	41.0	41.0	41.0	41.6
Wheelbase *(cm)**	97.1	97.4	98.0	98.0	98.0	98.1	98.5	99.0	99.0	100.2
Standover height *(cm)*	73.8	76.0	77.9	78.6	79.7	80.3	81.4	82.3	83.4	85.5
Bottom bracket drop *(cm)*	7.3	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	6.7
Head tube length *(cm)*	6.6	8.6	10.5	11.4	12.0	12.8	13.8	14.8	15.6	17.8
Steerer length *(cm)*	11.2	13.2	15.1	16.0	16.6	17.4	18.4	19.4	20.2	22.4
Fork rake *(cm)**	4.8	4.5	4.5	4.5	4.0	4.0	4.0	4.0	4.0	4.0
Frame weight *(pounds)*	2.74	2.86	2.97	3.02	3.06	3.23	3.39	3.50	3.61	3.90

** SR Prism fork*

Features:

- Geometry by Tom Kellogg
- 27.2-mm seatpost diameter
- 1 1/4-inch derailleur clamp required
- 130-mm rear axle spacing
- Offset brake cable guides
- 7/8-inch V-Bend chainstays
- Optional bottom bracket spindle: Merlin Beta-C
- Optional fork: SR Prism
  Fork color: Iridium blue
- Steerer lengths calculated with a 46-mm stack height; parts should be measured before cutting the steerer tube.
- Frame weight does not include fork or bottom bracket.
  All weights are approximate.



A: Seat tube, center to top
B: Top tube, center to center
C: Chainstay, center to center
D: Standover, top tube to ground

Please see the opposite page for information on custom frames, standover heights, and frame size calculations.

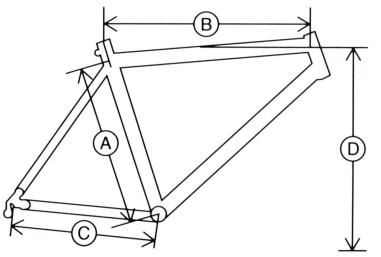
Merlin Mountain

Frame Size *(in., center to center)*	**13.5**	**15.0**	**16.5**	**18.0**	**20.0**	**21.5**
Head angle *(degrees)*	70.5	70.5	71.0	71.0	71.5	72.0
Seat angle *(degrees)*	73.5	73.5	73.0	72.5	72.5	72.0
Nominal top tube *(in.)*	21.0	22.0	23.0	23.63	24.25	25.0
Chainstay *(in.)*	16.75	16.75	16.75	16.75	16.75	16.75
Wheelbase *(in.)**	40.1	41.1	41.9	42.3	42.9	43.2
Standover height *(in.)*	27.5	28.5	29.6	30.6	32.2	33.4
Bottom bracket height *(in.)*	11.6	11.6	11.8	11.8	11.9	11.9
Head tube length *(in.)*	3.38	3.75	4.25	5.0	6.0	7.0
Steerer length *(in.)*	5.0	5.5	6.0	6.75	7.75	8.75
Frame weight *(pounds)*	3.18	3.25	3.35	3.52	3.70	3.92

** Ritchey Logic fork (1.75 in. rake)*

Features:

- 27.2-mm seatpost diameter
- 1 1/4-inch derailleur clamp on 13.5 and 15; 1 3/8-inch clamp on all other sizes
- 135-mm rear axle spacing
- Top tube cable routing is available at extra cost
- Optional spindle: Merlin Beta-C
- Optional fork: Ritchey Logic
- Steerer lengths calculated with a 46-mm stack height; measure parts before cutting tube.
- Frame weight does not include fork or bottom bracket. All weights are approximate.
- All models have sloping top tubes. "Nominal" length is as if the top tube were horizontal.
- Standover heights vary with tire profile. For approximate size, multiply inseam, crotch to floor in bare feet, by 59%.



A: Seat tube, center to center
B: Top tube, center to center, horizontally
C: Chainstay, center to center
D: Standover, midspan of top tube to ground

How To Use These Charts

Strength is one of the most important considerations for a bicycle frame. Ultimate (tensile) strength is the breaking point of a material. Yield is the point at which it permanently deforms. However, all metals lose strength after welding. Thus, the most meaningful basic comparison is with the material in its welded condition, as shown at right.

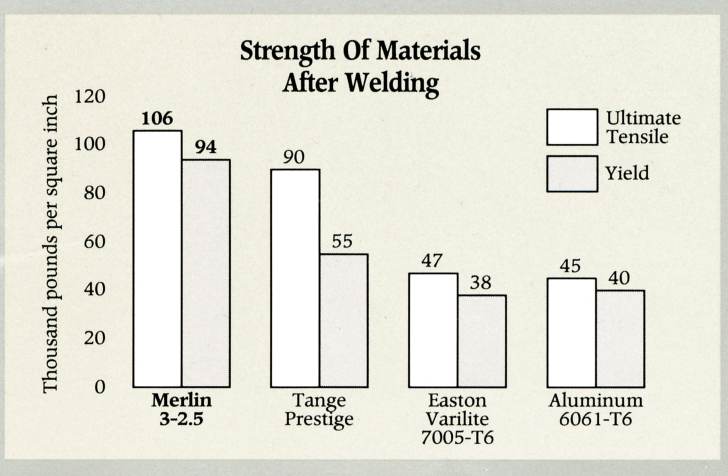
In the real world, though, most frame failures are caused by fatigue—that is, from the regular stresses that occur on each ride. All other things being equal, high fatigue strength means longer frame life.

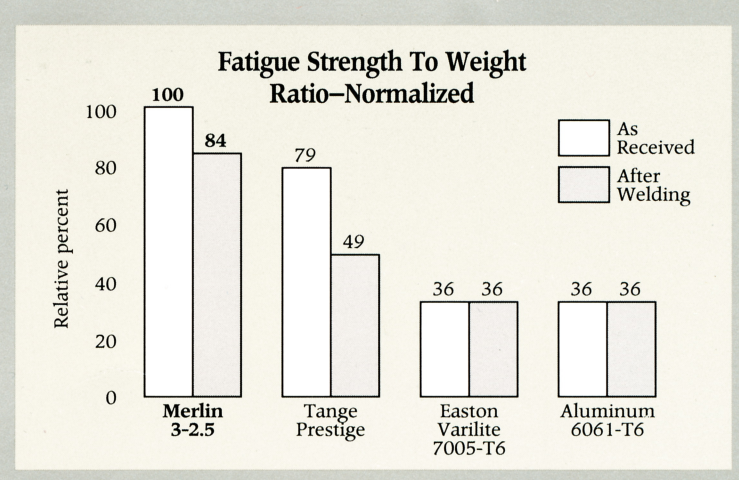
Another important consideration is frame weight, which is a function of the material's strength-to-weight ratio; the higher the number, the lower the potential weight.

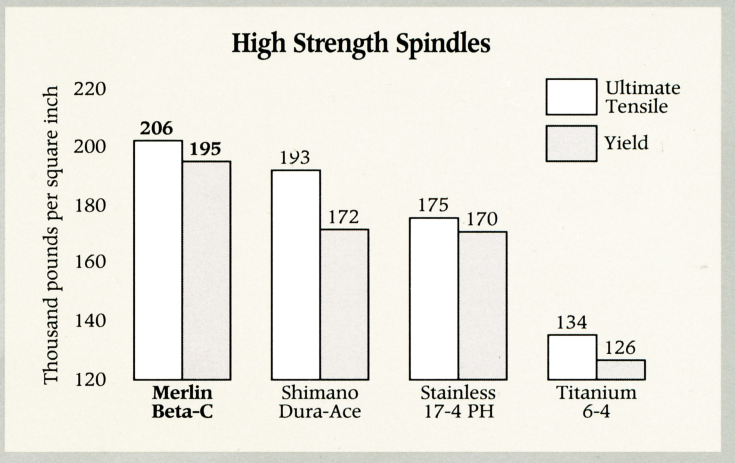
Combine these elements—strength after welding, fatigue strength and weight—and you obtain the fatigue strength-to-weight ratio, the most useful indicator of actual frame performance.

Bottom bracket spindle design considerations are different. In a frame, low strength can be overcome with more material. But a spindle has a fixed diameter, so its minimum strength must be at least 130,000 psi. Above that, higher strength leads to longer life, and lighter material leads to lower weight. Merlin's Beta-C spindle has the same weight as a 6-4 spindle, yet is approximately 45% lighter than a chrome-moly or stainless spindle of like design.

References: *Bicycle Metallurgy for the Cyclist*, Douglas Hayduk; Easton Aluminum, Inc.; Haynes International; *Machinery's Handbook, 24th ed.* (Industrial Press, Inc.); *Metal Fatigue in Engineering*, Fuchs and Stephens; Tange USA; *Welding in 3-2.5 Tubing*, Chan and McMahon, University of Pennsylvania. ©1992 Merlin Metalworks, Inc. All specifications subject to change without notice.







Machining: *Skip Brown, Joe DiPerri, Karen Forcier, Tom Intoni, Curtis Jackson, Erica McLay.* ***Welding:*** *Tim Aldrich, Tim Delaney, Steve Haberek, Tibor Horvath, Neil Mansfield, John Rogers, Jozef Smatana, Scott Spence, Pete Sweeney, Bob Sykes.* ***Finishing:*** *Martine Canfield, Rob Ellison, Scott Erskine, Kimon Greenland, Ann-Rose Leiberman, Dave MacDonald, John Paschkewitz, Keith Rouse, Dan Stewart, Alex Tegelaar.* ***Customs & Prototypes:*** *Matt O'Keefe.* ***Research & Development:*** *John Hickey, Rob Vandermark.* ***Purchasing:*** *Jennifer Miller.* ***Shipping:*** *Calvin Cote.* ***Kids in the Back Room:*** *Ross Andrews, Hunter Bahr, Ted Costantino, Cory Erickson, Gwyn Jones, Ashley Korenblat, Lisa Rodier*

The Merlin falcon
(Falco columbarius)

MERLIN®
TITANIUM

Merlin Metalworks, Inc.
40 Smith Place, Cambridge, MA 02138 • 617-661-6688

Merlin International S.A.R.L.
BP 106, 01630 St. Genis Pouilly, France • 33 50 20 69 53

For additional technical information and the name of your nearest Merlin dealer, please call.

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