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Rotovelo Revolutionises Travel



You might laugh at first, but it won't be for long.

This sleek-looking vehicle has the potential to seriously transform the way we travel. Combining durability with aerodynamic design principles, Rotovelo is the world's first attempt at taking human powered vehicles to the mainstream using the rotomoulding process.

What is the Rotovelo?

Rotovelo is a type of human powered vehicle (HPV) known most commonly as a 'velomobile' – a recumbent tricycle (differentiated from a conventional bicycle by its reclined seating position) with an aerodynamic shell or 'fairing'. The velomobile format offers riders two main advantages: (1) a significant speed improvement over a conventional bicycle; and (2) weather protection from rain, wind, and sun. In Australia, as in most parts of the world, a velomobile is legally classified as a bicycle, and is therefore able to be safely ridden on the road.

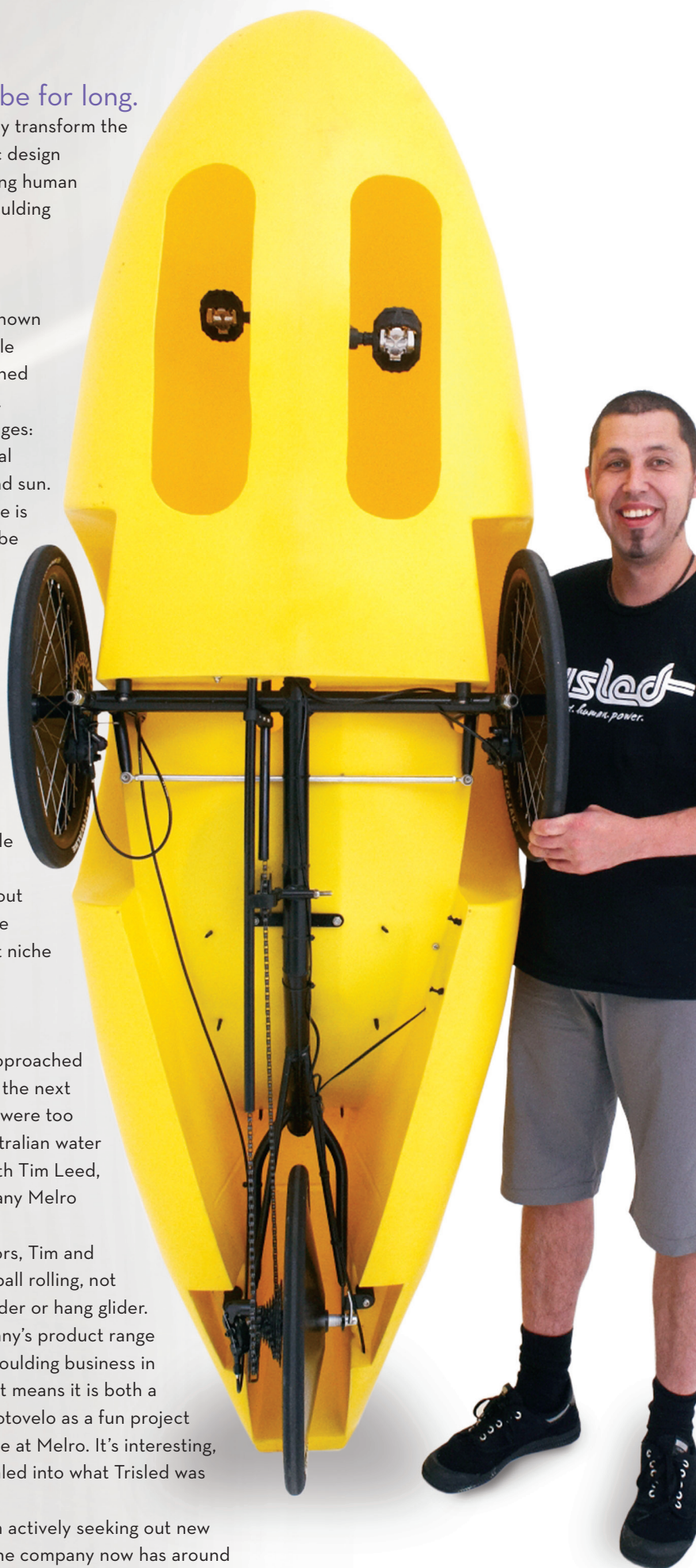
There is a small but brewing worldwide culture of velomobile users serviced by a number of predominantly composite-based velomobile manufacturers. Rotovelo is the world's first rotomoulded velomobile to make it onto the commercial market. According to Ben Goodall, Rotovelo's designer and the Director of Trisled HPVs, this vehicle's rotomoulded fairing makes it more affordable, durable, and practical than most other composite velomobiles. "Rotovelo is a velomobile you can use," says Ben. "You can accidentally bang it into a garage door or touch-park it on the street without having to worry about scratching the paint. It's a subtle shift, but it means that Rotovelo fills a totally different niche to our high-end composite velomobiles."

A New Partnership

After completing the initial design of Rotovelo, Ben approached a number of rotomoulding manufacturers to take it to the next stage. "Most of them didn't take the idea seriously or were too busy with immediate markets associated with the Australian water tank boom," says Ben. But he definitely hit a chord with Tim Leed, director of the Melbourne based rotomoulding company Melro (Melbourne Rotomould Pty Ltd).

Both adventure seekers and small business operators, Tim and Ben, had a number of common interests that got the ball rolling, not the least their mutual love of soaring cliffs in a paraglider or hang glider. Tim was primarily interested in diversifying the company's product range when Ben approached him with Rotovelo. "The rotomoulding business in Australia is very much diversify or die," says Tim. "That means it is both a challenging and exciting time for the industry. I saw Rotovelo as a fun project that would add to the culture we're trying to build here at Melro. It's interesting, it's different, and it pushes boundaries. I definitely dialed into what Trisled was trying to achieve with the product."

Melro has a dedicated sales and development team actively seeking out new opportunities in rotomoulding. Established in 2006, the company now has around



thirty employees and produces an ever-increasing range of unconventional rotomoulded products alongside the conventional (like water tanks). Combined with Tim's personal interest in adventure-seeking and his willingness to trial new ideas, Trisled and Melro were an ideal match.

From Composites to Rotomoulding

The switch to rotomoulding meant that Trisled was able to combine more of the vehicle's design elements (seat, foot holes, wheel covers, etc.) into the fairing, whilst speeding up the production process and keeping costs down. "Composite manufacturing of our velomobile fairings is messy, time-consuming, and costly," says Ben. "Typical wait times for a vehicle are anywhere between about 6 months and 2 years, and that timeline applies pretty much everywhere in the world. While the result may be amazing, you don't end up with the type of vehicle you want to leave on the footpath while you're picking up the milk."

The similarities with the kayak industry haven't escaped

Ben's notice. Indeed they were part of the inspiration behind Rotovelo. "Rotomoulded kayaks were the beginning of the mainstream kayak market," says Ben. "The industry was able to scale-up production quickly and efficiently, as well as offer a product that is both durable and incredibly usable."

For Trisled, the prospect of rotomoulded vehicles also offers advantages for international saleability, such as reduced risk of damage in transport, the option to provide demo vehicles and sample stock to overseas dealers, and the ability to supply a distributor with a container-load of Rotovelos—an option previously unthought of. "We have difficulty meeting deadlines on one composite vehicle, let alone twenty plus, just because of the complexities and unknowns involved in creating high-end vacuum-infused carbon-Kevlar-fibreglass fairings," Ben says.

From Design to Production

Although Ben and Tim thought that a rotomoulded velomobile should work, there were many unknowns, which could only

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be tested with a physical sample, so the next step was the fabrication of a plastic-welded proof-of-concept prototype. It wasn't pretty, but this vehicle proved the estimated wall thicknesses (and therefore the super critical vehicle weight) were accurate. Both Trisled and Melro used Solidworks 3D CAD software, and this proved invaluable in the considerable work required finalising the design, and optimising for rotomoulding and the toolmaking process.

In conjunction with Melro's mould-maker, Justin from Whatever Engineering, the team decided on a fabricated steel mould to meet Trisled's timeframe and budget, and to allow for additional modifications along the way. Attention to detail was a critical factor for Trisled in a market where smooth curves are essential for customer satisfaction and vehicle performance. Unlike water tank manufacturing, the market won't tolerate small imperfections and any bump can create aerodynamic drag. "We used an interesting combination of communication techniques with the toolmaker to ensure Ben's design was faithfully translated into the tool," says Tim.

"Conventional paper drawings were not able to describe many areas of Rotovelo, so we also used rapid prototyped models, various types of patterns (laser cut in a range of materials or printed), extensive reference to the 3D CAD models, and lots of meetings on the tool making floor. The completed tool is a fantastic example of just what can be fabricated out of metal when you have such a high caliber tool maker at your disposal. Rotovelo is almost completely made up from complex multi-plane curves, which all need to blend seamlessly into each other. There are complex part lines, very few flat surfaces, and of course the left and right sides must be perfect mirror images of each other."

The production of each Rotovelo shell involves similar attention to detail. Because of the variation in wall thicknesses required in the part and geometry constraints, extensive use of mould pre-heating is required before the tool can go into the oven. Carefully directed internal cooling air is introduced into multiple ports of the cavity to ensure the part stays true during cool down.

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Tim says that these factors help make Rotovelo one of the most technically demanding products Melro manufactures. "We ended up having to use a Thermal Imaging camera to get the mould pre-heat consistently right," he says. "Air movers are used during the cook cycle to force heat into a deep cavity, and we have to be very careful with cooling. Naturally this required extensive testing and prototyping to get right, and certainly has had all of us pulling our hair out at one time or another as we worked to overcome the many production hurdles." The rotomoulded fairing is not a structural part of Rotovelo – that aspect of the vehicle is still manufactured by Trisled in their Dromana factory from chromoly steel. The shells are shipped to Trisled in batches where they are assembled with a frame, standard bicycle running gear, and accessories such as lights and a mirror. "A major advantage of Rotovelo is its use of standard bicycle componentry," says Ben. "We wanted to keep it as accessible and serviceable as possible for the average Joe Blow off the street."

On the Road

After 12 months of joint development between Trisled and Melro, eight forward-order customers were hungry for their prototype vehicles. As a testimony to his enthusiasm in the product, Tim was one of those first customers. "I've never really been all that excited by on road cycling," he says. "I've much preferred hitting the tracks on the mountain bike, but Rotovelo is just so much fun". So fun in fact, that Tim attempted his first ever Bicycle Victoria Around the Bay in a Day organised ride (210kms) in late 2010. "I lost count of the waves and smiles and car toots as I rode along—not to mention

the many and varied exclamations of surprise as I eased past the roadies on their slower upright bikes," says Tim. "It's not a vehicle for someone who doesn't want to be noticed on the road!"

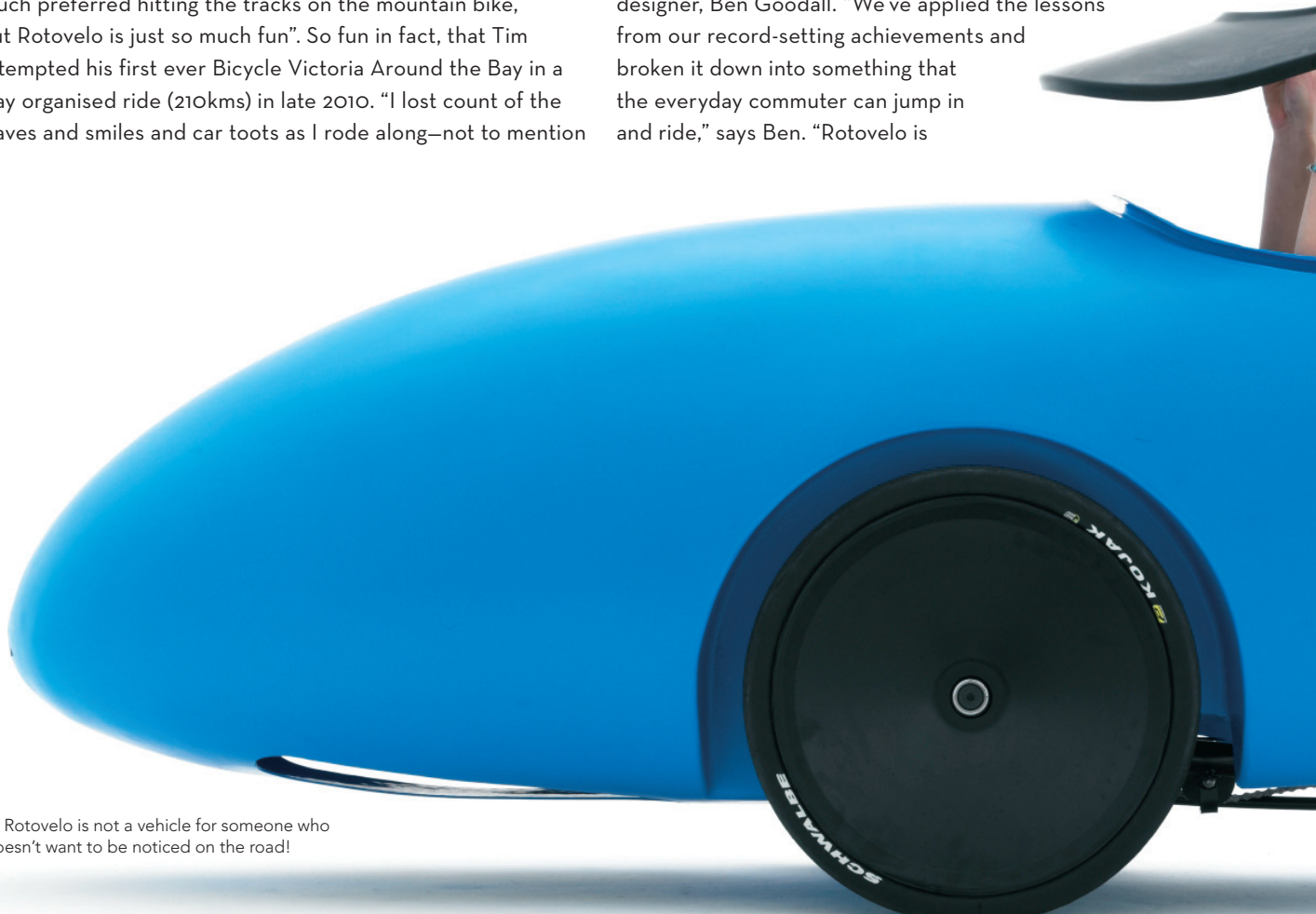
Both Ben and Tim also ride their Rotovelos to and from work most days. "I've been saying for years that I should be riding to work," says Tim. "But when you've got a laptop to worry about, or it's raining and cold, it's a real hassle. With Rotovelo, I'll ride to work a few times a week. My 17" laptop easily fits in the side with a change of clothes, work boots, and so on, and I know it's not going to get wet. I've even eaten take-away whilst riding home it's illegal!"

Aerodynamics and Speed

While there are other advantages of Rotovelo, such as built-in luggage space and a strong road presence, speed is still the main drawcard. In fact, every land-based HPV record in the world is currently held by faired recumbent bicycles or tricycles, although you would be forgiven for thinking otherwise given that conventional cycling racing is all we normally see in mainstream media. At the extreme end, the world HPV land speed record (on flat road and in controlled winds) is in excess of 130km/h.

Rotovelo doesn't claim to achieve these speeds, but it does come from its own heritage of records achieved by its designer, Ben Goodall. "We've applied the lessons from our record-setting achievements and broken it down into something that the everyday commuter can jump in and ride," says Ben. "Rotovelo is

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all about taking something really fast and making it practical and accessible". The end result, according to Trisled's first Rotovelo customers, is about a 20-30 per cent average speed improvement over a conventional bicycle.

Trisled has worked closely over the years to maximise the potential of the velomobile format, breaking the Australian land speed record (82.66 km/h) in 2008, and the world 24-hour distance record in 2010 (1109 km). That means Trisled's rider, Jeff Nielsen, averaged around 50 km/h for a full 24 hours with jam sandwiches and electrolyte substances as his only fuel—an impressive achievement by any standard, especially since he is the manager of a plant nursery rather than an Olympic athlete. But that's what aerodynamics is all about according to Ben. "Most people have no idea about the potential of aerodynamics," he says. "It's not something we can directly see, feel or touch, so it tends to escape our notice and attention," That's certainly not the case at Trisled, where over a decade of testing, racing and production has taught them a thing or two about aerodynamics principles. This niche business predominantly services Australian HPV racing—a growing organised sport popular with Australian schools.



Major events are now held in three Australian states and typically attract up to 200 vehicles, almost 2000 riders, and over 10,000 supporters and spectators. As well as running their own racing team and producing a range of racing models, Trisled also manufactures a variety of HPVs, such as rickshaws, recreational recumbents, and load-carrying bicycles.

Bridging New Markets

Despite the small Australian market, a Rotovelo user group is already growing in and around Melbourne. "The international velomobile market is much bigger than it is here in Australia," says Ben. "I think people are also more open and accepting of different bicycle formats in countries like Netherlands and Germany. It's a shame because Australia's open roads and suburban sprawl are well-suited to velomobiles". Trisled is currently looking for international dealers and distributors of the product, and has already taken several orders for the USA. In April 2011, Rotovelo will be on show at the international bicycle show 'Spezi' in Germany.

Tim and Ben are also pursuing other opportunities to take the experience gained from this project into different areas of their respective businesses. "I can see great potential for rotomoulding across other aspects of our product range," says Ben. "Now we know it works, I'm already thinking about the next designs".

Similarly, Tim sees opportunities for taking rotomoulding into other industries where aerodynamic principles are key to performance. "Currently we are running Rotovelo in standard material," says Tim. "Obviously this product is a prime candidate for high performance resins, and we are particularly looking forward to experimenting with foam to really get the weight down. We are looking at a number of other projects with similar goals."

Rotovelo is a commercially available vehicle sold by Trisled. It retails for AU\$5900, almost half the price of Trisled's high-end composite velomobile model, Avatar. Rotovelo was recently exhibited at the GoBike Festival in Melbourne and will be on display again in Australia at the Sustainable Living Festival at Federation Square in February. Test rides are also available from the Trisled factory.

For further information on Rotovelo visit the Trisled website: www.trisled.com.au. To find out more about Melro visit: www.melro.com.au and to see more on Whatever Engineering go to www.whateverengineering.com.au. To see Rotovelo in action, type "rotovelo" into YouTube!