

Clutches: Declassified

Engineers Want Reliability, Consistency and Customization

Matthew Jaster, Senior Editor

In the world of PT components, the clutch gets absolutely no recognition whatsoever. There are entire magazines dedicated to gears, bearings and motors, but clutches get very little press outside of the automotive industry. If they do, it's limited to a case study or the occasional product news announcement. Part of the silence may come from the fact that the design and technology of clutches hasn't changed much through the years.

"It's a simple, precise and strong component," said Ron Ashbrook, applications and design director at Mach III. "The overall mechanical design of clutches has remained the same for many, many years. They're as reliable today as they were 40 to 50 years ago."

It's your basic "if it ain't broke, don't fix it" philosophy, according to Andrew Helander, vice president, Tiny-Clutch, Helander Products Inc. "We've been using the same technology on these things for decades. The size and scope may change, but fundamentally they all work the same and they work very well."

Clutches are used to transmit power from one rotating shaft to another. They can protect equipment from any kind of damage that may result from a mechanical overload. Applications vary, including roller coasters, satellites, bottling machines, conveyor systems and printing presses.

PTE recently caught up with Mach III, Tiny-Clutch and Nordex to discuss custom clutches, unique applications and the questions to ask when sizing and selecting these components.

Mach III Focuses on Custom Products

Mach III has shifted to an entirely inbound marketing strategy targeted to direct interaction with design engineers, according to Lesli Riehemann, president and CEO. "Inbound is a current marketing craze, but we started moving in that direction about 15 years ago. Today, a design engineer is more likely to open a web browser if she or he is seeking a clutch, brake or torque limiter solution than to reach out to a rep or distributor, so we know it was the right decision."

This strategy involves Mach III updating their website navigation to make exploring their products easier. "We have also added a new section that highlights our custom products, including access to PDF detail sheets and 3D models for dozens of our custom designs. While we have always publicized our abilities to generate customized products, I am confident that giving engineers the opportunity to see and work with 3D models will lead to more interest." (*Ed's Note: This section can be viewed at: www.machiii.com/Custom-Design-Solutions/.*)

While Mach III offers catalog clutches, the majority of their work is customized to an extent. "There's nothing really 'off the shelf' in the classic

The Mach III CBA4K-002 is a heavy duty, quadruple disc, high torque capacity clutch with female pilot.

sense," said Riehemann. "We build every single item to order even our catalog models are bored to whatever shaft size the customer specifies when the order is placed."

Mach III recently supplied a slip clutch (torque limiter) to Woods Hole Oceanographic Institution, an independent, non-profit organization dedicated to ocean research, exploration and education (www.whoi.edu). "The product we provided, T3C2H-010, is a special ultra-low torque version of our catalog model T3C2H-56L 56C NEMA Frame torque limiter. The two products look identical from the outside, but the T3C2H-010 has a torque rating of 80 pound inches versus the T3C2H-56L with a torque rating of 792 pound inches."

The slip clutch will be mounted between the motor and the gear reducer on an automated winch that lowers instrumentation in and out of salt water autonomously for several months. "The torque limiter would slip in case of a snag to prevent the winch wire from snapping and the instruments being dropped to the bottom of the bay where they are conducting research. The application has a torque requirement of only 8 lb.in. which was too low to be achieved with the catalog model, thus the need for the customized model," Riehemann added.

Ashbrook at Mach III said the company typically works within the 3-8-inch size range. "This is our bread and butter. We're tooled up for these sizes

The Mach III C3A2R-STH is a through shaft pilot mount air clutch.



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and don't need to make any adjustments. Once we look at anything under 3-inches, it becomes a challenge to provide the tooling."

Ashbrook receives plenty of unique application requests from customers. He enjoys the day to day challenges of "putting out fires" for Mach III's customers. He's even had an epiphany in the middle of the night back in 2002 where he jumped up and started sketching out a new clutch design at one o'clock in the morning.

"I've been in a meeting on Friday and turned around and had the clutch on the customer's desk by Monday morning. I'm always looking for new ways to make our products more effective. It usually starts with a problem I have to solve and the solution somehow, somehow always presents itself."



The Mach III T2B2F-012 is a friction torque limiter with integral pulley.



Tiny-Clutch Customizes Eco-Marathon Component

Tiny-Clutch, Helander Products Inc. provides miniature clutches in areas like aerospace, packaging, commercial cookers and HVAC equipment. As mentioned earlier, they've been utilizing the same technology for their roller clutches for decades. The company's magnetic clutches (M-Series) combine the high torque capacity of a spring clutch with the control of a conventional electric clutch.

"We tend to design miniature clutch systems that simply utilize a one-off piece from one of our standard catalog items. For example, we may take a standard M50 Series Magnetic Spring Clutch and provide the mating pulley and the belt for the customer," Helander said. "We've also built hand-operated tool assemblies that had three clutches in each unit for a hand tool that applies laminate. Some jobs are more common than others."

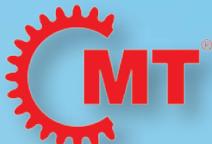
Recently, Tiny-Clutch was asked to provide an M-series clutch for a vehicle participating in the Shell Eco-Marathon. The Eco-Marathon features high school and university teams competing to get the most mileage per gallon in a fuel efficiency competition. This event challenges students around the world to design, build and drive the most energy efficient car. The competition

dates back to 1939 when Shell Oil Company employees made a friendly wager over who could travel the farthest on the same amount of fuel.

Hector Perez, a sophomore at the University of Texas El Paso, is participating in this year's race which takes place in Detroit on April 22-24. "To turn on the motor in our vehicle, we needed a special clutch that could withstand huge amounts of torque but come in a very, very small size," Perez said. "The clutch we were using at first would overheat due to the torque involved, but we discussed the problems we were having with Helander and they customized a solution that fit perfectly."

After a couple of false starts, the vehicle is running well and ready to take on the competition in Detroit. For Perez it was great to work with a company that was so supportive during the entire vehicle design process. "Helander gave us the advice and equipment we needed to make the clutch work. We're excited to see how our vehicle holds up in the Eco-Marathon competition."

"These are time-proven components that are steady and reliable," Helander said. "Once you start getting down to the really small sizes the work gets more complicated because of the precision involved, but we're pleased that the clutch is working well for the University of Texas El Paso team."



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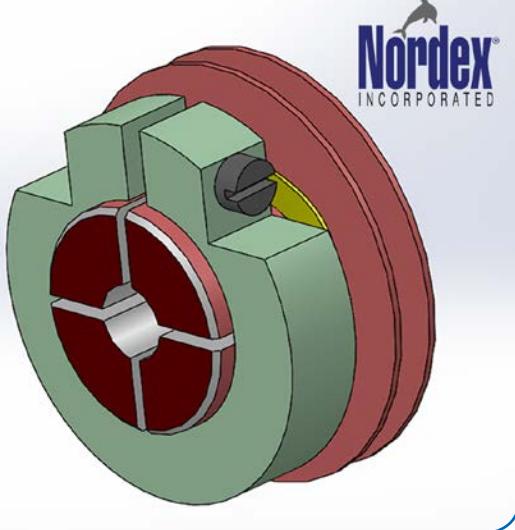
Asking the Right Questions with Nordex

Nordex Inc. offers One Way and Slip Clutches with shaft sizes from $\frac{1}{8}$ to $\frac{3}{8}$. These can be utilized for unidirectional stepping, automatic flywheel decoupling and backstopping. There are many manufacturing challenges involved in manufacturing miniature clutches like these, according to Nicholas Antonelli, mechanical engineer at Nordex, Inc.

"Miniature clutches tend to be low torque capacity and are used in precision applications where the torque range tolerance is very tight," said Antonelli. "Weight as well as the connecting assemblies may need to be factored into the design of the clutch and the component production needs to be consistent over many unit runs."

While the basic concepts are the same in friction clutches for larger models, the main differences in miniature clutches are the complexity and materials. "A miniature friction clutch may have a simple wave washer to apply the force while a large clutch may have several springs to apply forces to specially designed friction plates," Antonelli said. "Miniature clutches have used materials such as cork for a friction surface. Larger clutches may use woven or cast material with good heat transfer potentials to prevent "overheating" during high duty cycle use."

In order to find the right clutch for your application, Antonelli said it's important to ask the right questions. Is the clutch intended for intermittent or continuous duty? Does it need to be adjustable or can it be pre-set at the fac-



Nordex Inc. offers One Way and Slip Clutches with shaft sizes from $\frac{1}{8}$ to $\frac{3}{8}$.

tory? Does it need to prevent overload one time and then be replaced? Is there a certain diameter or length it must fit between? Must it engage remotely?

"All these factors will help determine which clutch is best," Antonelli said. "There are numerous wrap-spring, friction, particle and clutch-brake combinations to suit any requirement, so there is no single clutch that would suit all applications."

Many times a non-engineering entity will let the wrong factor determine which clutch to select, according to Antonelli. "Do not let one factor decide what clutch to purchase, always remember that the clutch is an integral part of the entire drive system."

Today, new materials for friction surfaces that last longer are being developed for clutches that are more environmentally sound. "This is the direction we're headed," Antonelli added.

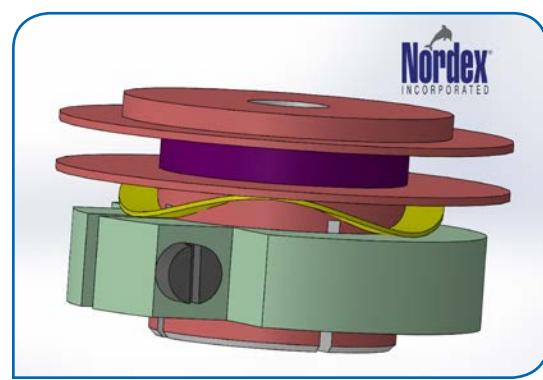
"Smaller sizes, lower costs and improved materials are being examined for the next generation of clutches." **PTE**

For more information:

Mach III Clutch, Inc.
Phone: (866) 291-0849
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Nordex, Inc.
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Tiny-Clutch
Helander Products, Inc.
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www.tinyclutch.com



Today, new materials for friction surfaces that last longer are being developed that are more environmentally sound.

The Other Side of the Spectrum

While this article examined smaller clutches and applications, there's plenty of room for larger components as well. Case in point: Eaton's Airflex 76VC2000 dual clutch system and Wichita Clutches Grinding Mill clutches.

Eaton's Airflex 76VC2000 (www.eaton.com) transmits rotary torque from high-speed electric motors that drive gearboxes or low-speed synchronous motors to high-performing mills up to 14,750 horsepower per pinion. The clutch's 76-inch-diameter friction drum enables it to transmit adequate torque for large grinding mill-drive applications. The clutch offers a motion-control solution for higher horsepower grinding mills, which were driven primarily by clutchless, low-speed motors in the past. This creates a slow startup rate that keeps component wear to a minimum and reduces power consumption.

High-speed motors using gearboxes or low-speed synchronous motors have been available for grinding mills, but mismatched clutches resulted in a startup rate that was

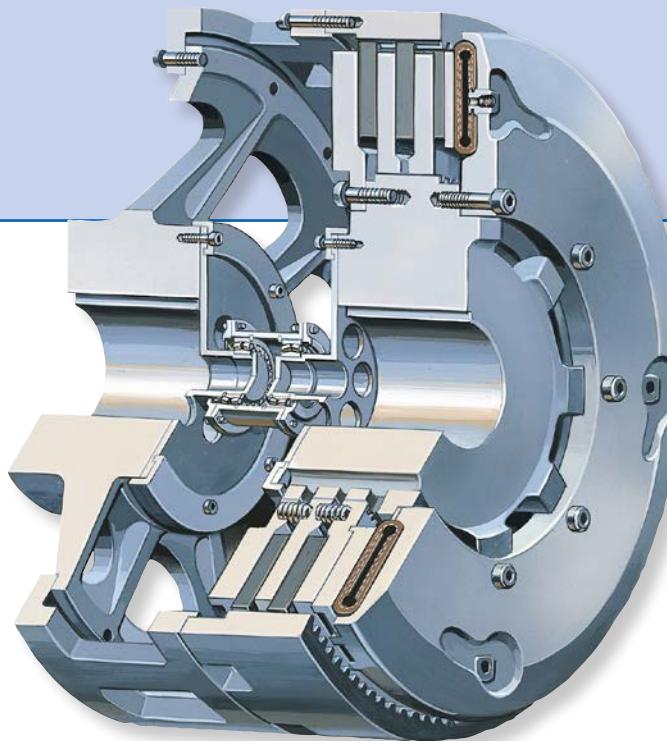
too fast, causing increased stresses on mechanical systems. Eaton's VC clutch enables low-speed synchronous motors or high-speed motors driving through a gearbox to achieve full engagement at a slower rate not achievable with previous clutch solutions, thereby protecting the powertrain by slowing the acceleration of the entire drive system.

Wichita Grinding Mill clutches (www.wichitoclutch.com) are designed to provide smooth starts with limited current surge for heavy-duty grinding mills. The clutch is adaptable to remote control allowing centralized operation through simple air or electric circuits. These clutches do not need to be adjusted or lubricated, offer high heat dissipation and feature high energy absorbing friction material. The 72-in. version offers a maximum speed of 12,930 hp. **PTE**

For more information:

Eaton
Phone: (800) 386-1991
www.eaton.com

Wichita Clutch
Phone: (940) 767-2000
www.wichitoclutch.com



Wichita Grinding Mill clutches do not need to be adjusted or lubricated and offer high heat dissipation.

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