

Plastic Final Drive Cover – Reducing Handling Risk

Thiess



Figure 1: Black HDPE Final Drive Covers in use at Thiess' Brisbane CRC

The Problem

Mining truck rear wheel groups contain large reduction gearboxes (final drives) that are rebuilt by Thiess' Component Rebuild Centre (CRC) in Brisbane. When these components are delivered, a cover over the spindle is required to prevent rust forming on sensitive steel surfaces. Covers were previously made from heavy steel plates with no manual handling lifting points. Inherently heavy and awkward, they created a large weight on a worker's spine, increasing back strain risk if they bent or twisted. Covers were also secured with silicon and bolts, and required the help of a second person to remove. The cover seal had to be removed by hand before the drive could be repaired or replaced. This added an additional 30 minutes of labour.

CRC engineers, Rhys Markun and Burkhard Rabe, identified an opportunity to re-engineer the design of the cover to reduce the risk of physical injury to maintenance workers.

The Solution

The initiative re-engineered the cover to include an in-built lift point closer to the maintenance worker's centre of gravity. This significantly reduced the weight on a fitter's spine by enabling a more comfortable lift. The material was also swapped from a heavy steel plate to a lighter, high-density polyethylene (HDPE). Machine spigots were also added to the plate that fit straight onto the final drive spindles. These spigots allow a single worker to easily lift and place the cover. This overcame the previous requirement for a second person or awkward installation by the primary worker while holding the part. The new covers also reduce fitment time, using the component installation o-ring as the seal.

Version 1 – The initial prototype was designed and developed into a 3D model by our CRC engineers, using the 3D CAD program – Inventor. The model was sent to an external plastic manufacturer to produce the cover. The prototype had fixed handles fitted externally to the front face of the cover, which was designed to match the clearances of the existing steel parts. A concern was raised that external fixed handles could potentially break during transport and handling. The team also discovered that high-density polyethylene or (HDPE) the material they were using for this design, required loose fitting tolerances as the cover would expand and contract due to weather conditions.

Version 2 – The team improved the design with a second prototype, increasing the clearance gap and replacing the fixed external handles with a fold-away style. They developed this design using the loose fitting tolerances, to ensure the design accounted for changing weather conditions.



Figure 2: Version 2 - HDPE Final Drive Cover with fold-away handles

Version 3 – A further improvement was made before placing batch orders. The fold-away handles were replaced with an in-built box eliminating the chance of damage during transport and bringing the fitter’s body closer to the device’s centre of gravity, further reducing body strain. This design allows maintenance staff to successfully grip onto the cover during installation and removal, requiring only one person to remove and install the plastic cover.

This worked well and, after positive testing results, this prototype is still in use across all of Thiess’ Australian projects.

Following the success of the covers for Caterpillar 793 and 789 mining trucks, the team has begun adapting this design to fit Caterpillar 785s and Caterpillar 777s. Components for these trucks will be rebuilt at Thiess’ CRC in Balikpapan, Indonesia. Upon completion of further testing, the design will be sent to Thiess’ Balikpapan CRC for use on their components.

All prototypes underwent safety and compliance testing and verification.



Figure 3: Version 3 - HDPE Final Drive Cover with in-built box

The Benefits/Effects

The design has significantly reduced the awkward nature of fitting this part. It has a professional standard of finish and showcases the CRC team's commitment to innovative solutions that benefit our clients – in this case, Australia and Pacific's (APAC's) sites.

Approximately four final drives are rebuilt across CRC Brisbane and Hazelmere weekly, with 20 covers in rotation – in excess of 1,000 uses annually. Measureable benefits of the new cover include:

- **Improving manual handling** and significantly lowering the risk of back strain
- **Eliminating common hand pinches** from the previous steel plate (while there were no recorded injuries from the previous cover, further reducing risk to personnel is valuable)
- **Enabling a previously two-person job to be safely performed by one person with greater ease and in considerably less time**
- **Saving 40 minutes of labour** per final drive rebuild
- **Saving a further 40 minutes** when fitting the component on site
- **Giving fitters far more confidence** that the component is 100% sealed, thanks to the o-ring, and removing concern of any compromise to seals during installation
- **Eliminating a weakness of the previous covers**, which were susceptible to over-torquing the securing bolts – no such incidents have occurred with the new cover design.

The high-quality finish of the plastic covers showcases the CRC team's commitment to creating innovative solutions that align with Thiess' Principles of safety and innovation.

Transferability

The plastic cover's design is transferable to any off-highway truck model and can be upsized for ultra-class mining machinery. Within Thiess, all sites supported by CRC Brisbane are already benefiting from the Caterpillar 793 and 789 sized final drive covers. The designs have also been shared with Thiess' CRC Hazelmere – covers have been successfully sent and returned multiple times to Thiess' Australia operations including to FMG's Solomon Mine.

Additionally, any future transportation of ultra-class machinery with plastic covers would remove the need for a crane lift, which has been identified as a high-risk activity. As a result of the plastic cover's success, the CRC Brisbane team have used the design to develop large seal covers for excavator hydraulic cylinder barrels. They have also designed covers for sand-blasting off-highway truck front wheel hubs, cylinder bearing areas during painting, and for excavator gearbox protection during transport. They are now looking at future opportunities to create new covers that seal and protect other component parts.

Innovation

With extensive industry experience and connections, the CRC team has never come across another supplier that uses a lightweight plastic final drive cover. The in-house designed and delivered innovation lowers the risk of back strain by reducing the cover's weight – improving its ergonomics and eliminating the inherently awkward features. It has also saved fitment and removal time by eliminating the silicone application and cleaning. The seal is now achieved using the component's installation o-ring (made from HDPE) and the machined edge. The HDPE cover weighs 16.9 kilograms and would weigh 145.5 kilograms if it were to be designed using the original metal material. This reflects the flexibility and durability of the HDPE design, while ensuring the solution was lightweight to prevent back strain on maintenance personnel.

The design has been extremely successful and adaptable, with engineers believing the concept can be applied across the industry on any type of machinery where a steel plate is used to cover a component for transportation, storage, sand-blasting and painting. It may be 'small', but this kind of proactive initiative and innovative thinking is what keeps companies at the forefront of excellence.



Figure 4: HDPE Final Drive Cover design adapted for a Cylinder with a fixed handle

Approximate cost

The design and development work of this component was primarily completed in-house, allowing for significant cost savings. While the initial outlay to produce a HDPE cover is approximately \$800 more expensive than a regular metal cover, the lifespan of a cover is significantly increased making it more cost effective over time. Covers cost \$1,165 per unit when eight covers are purchased in a single transaction.