A NON-PROFIT ORGANIZATION

RATS - ROTATING & TURBOMACHINERY SOCIETY

DOW Centennial Centre - Fort Saskatchewan

2022 MRO Technical Conference & Workshops

MAINTENANCE - RELIABILITY - OPERATIONS

Rotating without maintenance

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Flexible couplings

- Rotating equipment requires connections between machines and equipment to transfer the torque and rotation to the intended part and for the intended use.
- Couplings are a common solution to transmit rotation and torque through equipment, along with other solutions such as chain, belts and gears.
- Flexible couplings in particular allow for:
  - Radial, angular and axial misalignment
  - Vibration dampening – to avoid damaging natural frequencies and protect against fatigue life
  - Noise attenuation
  - Shock protection
  - Overload capacity

Applications

Two types of couplings

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Rubber in shear

Rubber in compression

Rubber in compression vs. Rubber in shear

Rubber element is held between parallel plates/flanges through bonding or bolts.

Load is transferred through the couplings by shear to achieve transfer of torque.

Connected to a shaft or flywheel by bolts, taper bore or bore and keyway.

Rubber in shear

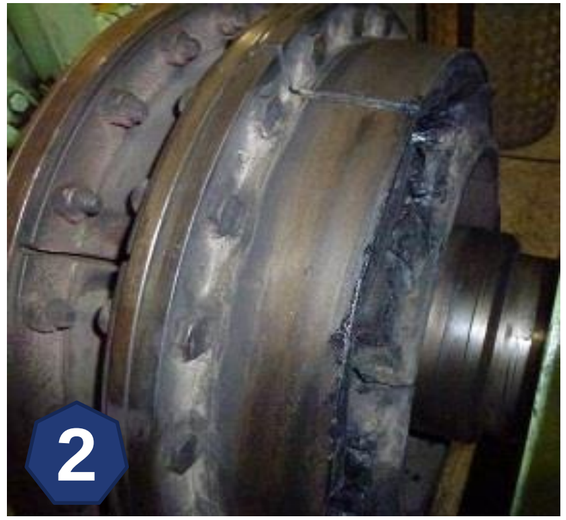
Rubber element between an inner member and an outer member

Load is transferred through the couplings by compression to achieve transfer of torque from one member to the other.

Connected to a shaft or flywheel by bolts, taper bore or bore and keyway.

Rubber in compression

What happened if it goes wrong?



1 – Damaged discflex
2 – Sheared rubber
3 – Cracked hub
4 – Cracked rubber

Causes can include:

- Over loading the coupling
- Excessive misalignment
- Shock events and overload events
- Poor ambient conditions (oil, temperature, humidity)
- Lack of maintenance

Rubber in compression vs. Gear or Grid Coupling

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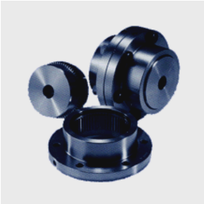
Metal to metal coupling

Load is transferred through metal teeth to achieve transfer of torque.

Connected to a shaft by taper bore or bore and keyway.



Gear or Grid Coupling

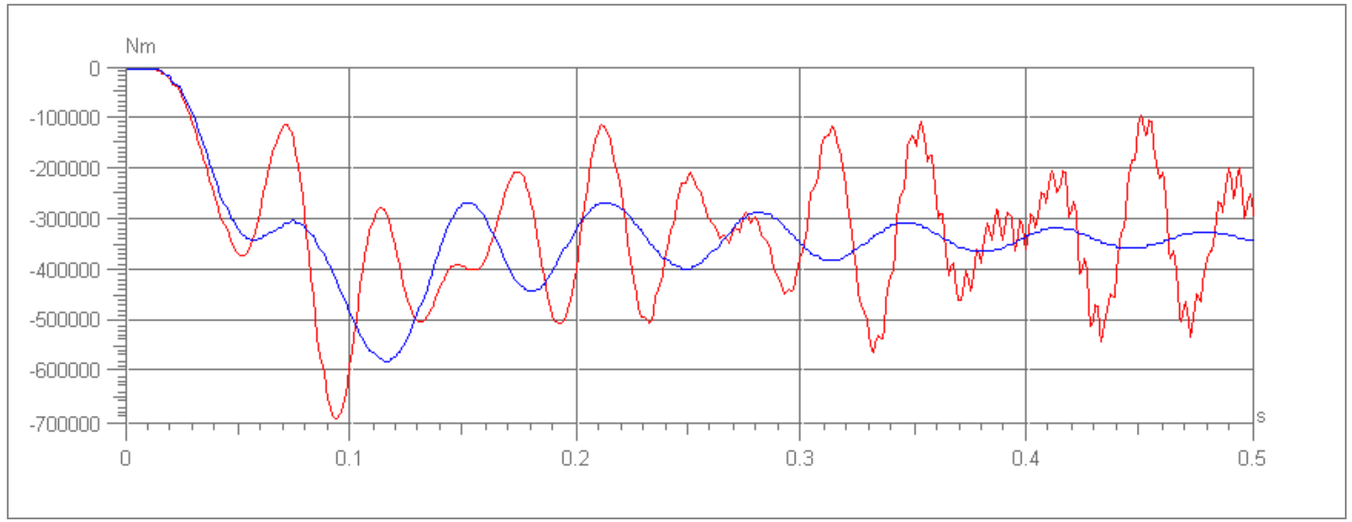
Rubber element between an inner member and an outer member

Load is transferred through the couplings by compression to achieve transfer of torque from one member to the other.

Connected to a shaft or flywheel by bolts, taper bore or bore and keyway.

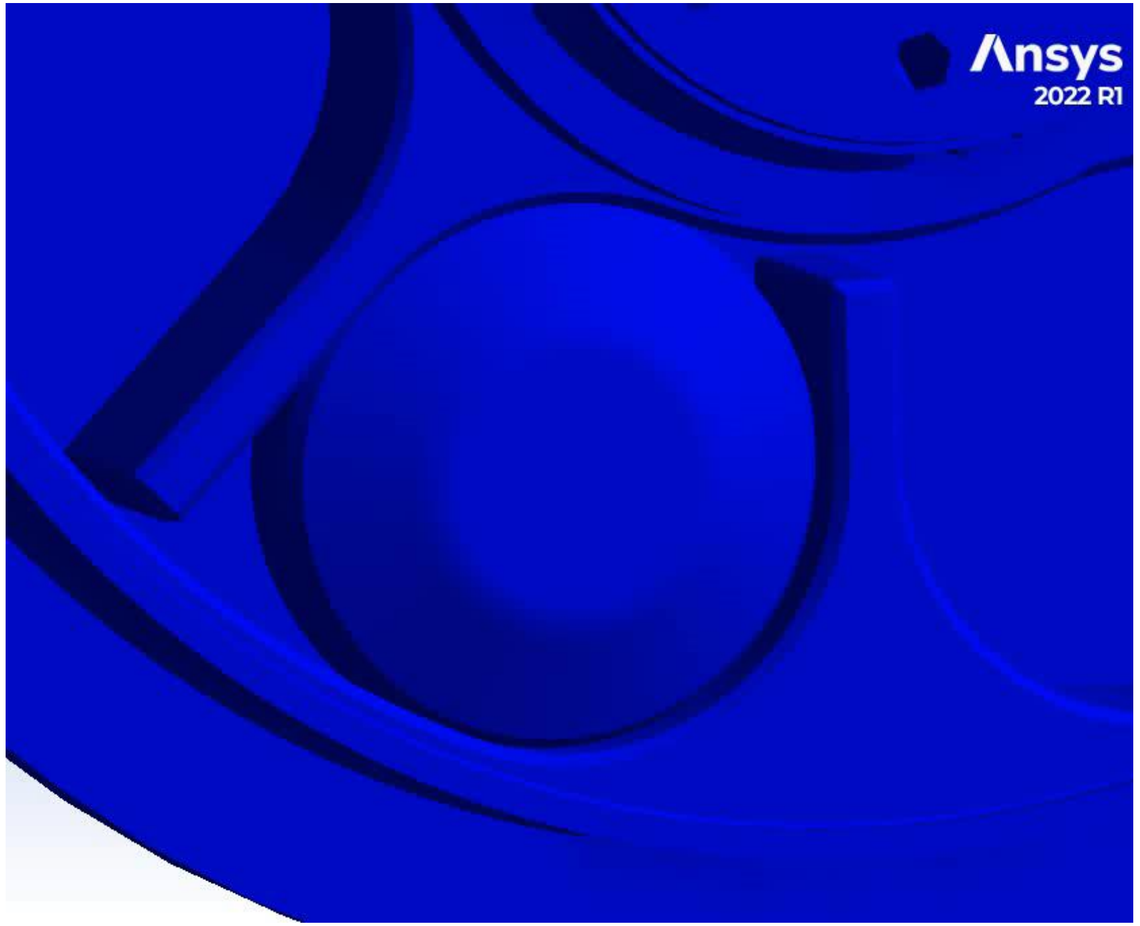
Rubber in compression

Compared to metallic couplings, rubber-in-compression drastically reduces vibration in the drivetrain. This minimised damage to drivetrain components.



- Metallic coupling
- Rubber coupling

Rubber in compression



Application engineering

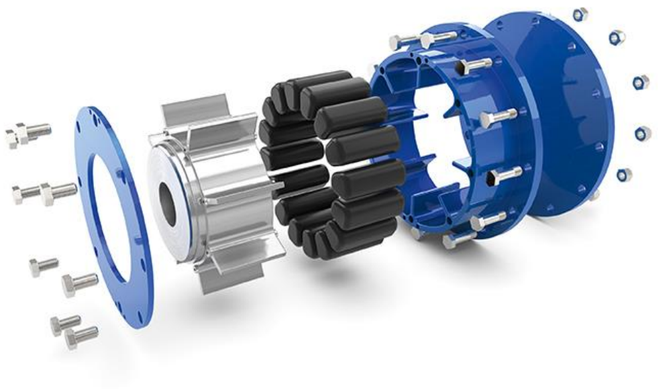
- **Interface** – standard and bespoke interface designs.
- **Torsional Vibration Analysis** – analysis of vibratory performance and ensuring problematic natural frequencies are avoided.
- **Stiffness** - achieving specific stiffness ranges through design and correct rubber block material selection.
- **Non-linear analysis** – understand performance of the coupling in various loading scenarios, including shock loading.
- **Environment** – selection or appropriate materials for applications in aggressive environments including oils, humidity, static electricity and high temperature.
- **Classification** – achieving class society approval for selected applications including ABS, Lloyds, DNV and Atex.

Rubber Selection

The rubber blocks and elements used in Renold Hi-Tec Couplings are key elements in the coupling design. Strict quality control is applied in the manufacture, and frequent testing is part of the production process.

Identification label	Natural Red (F, NM)	Styrene-Butadiene Green (SM)	Neoprene Yellow (CM)	Nitrile White (AM)	Stryene-Butadiene Blue (S)	Silicone Blue (Si)
Resistance to Compression Set	Good	Good	Fair	Good	Fair	Good
Resistance to Flexing	Excellent	Good	Good	Good	Good	Good
Resistance to Cutting	Excellent	Good	Good	Good	Fair	Fair
Resistance to Abrasion	Excellent	Good	Good	Good	Good	Fair
Resistance to Oxidation	Fair	Fair	Very Good	Good	Fair	Excellent
Resistance to Oil & Gasoline	Poor	Poor	Good	Good	Poor	Good
Resistance to Acids	Good	Good	Fair	Fair	Good	Good
Resistance to Water Swelling	Good	Good	Good	Good	Good	Good
Service Temp. Maximum; Continuous	80°C	100°C	100°C	100°C	100°C	200°C
Service Temperature Minimum	-50°C	-40°C	-30°C Flame Proof	-40°C	-40°C High Damping	-50°C
Rubber Block Types						
DCB PM	NM	SM	CM	AM	S	SI
	Renold 45					
		Renold 50	Renold 50		Renold 50	
	Renold 60	Renold 60			Renold 60	
SPECIAL WB	Renold 70	Renold 70	Renold 70	Renold 70	Renold 70	Renold 70
	Renold 80	Renold 80				
				Renold 90		

Rubber-in-Compression



Exploded view showing the construction of a rubber-in-compression coupling.

- Black rubber blocks are trapped between the inner and outer rotating members.
- As the inner and outer members move relative to each other the rubber is compressed against the paddles.
- When rubber is loaded in compression, it behaves as an incompressible fluid which makes it very strong.
- The rubber blocks are pre-compressed in the coupling's steel housing so all the rubber is working to dampen vibration and transmit torque.
- Rubber-in-compression makes the couplings failsafe ensuring they will continue to operate even after torque overloads that would tear a rubber tyre **(Tyreflex)** or strip gear coupling **(Gearflex)** teeth.

Features of rubber-in- compression

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Maintenance free

- Lubrication or adjustment not required
  - No downtime for maintenance
  - Reduced operator/manpower requirements
  - No failures of drivetrain due to lack of coupling maintenance

Shock load protection

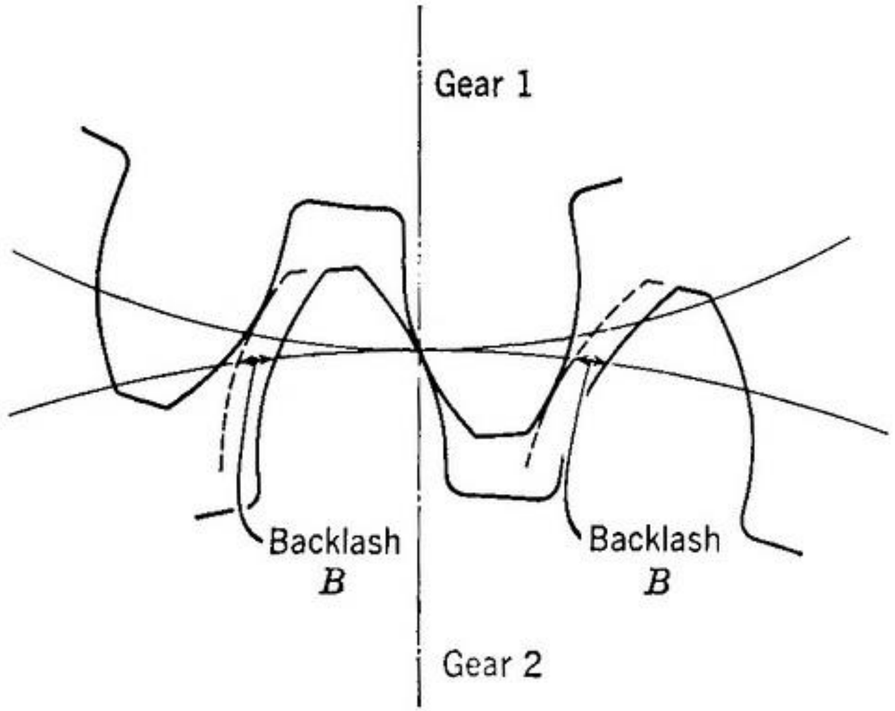
- Absorbs high torque impulse loads
  - Minimises damage to the drivetrain

Misalignment capability

- Allows axial and radial misalignment between the driving and driven machines
  - Reduced loads on driving and driven components
  - Allows for thermal expansion
  - Low radial and axial stiffness, reducing bearing loads

Zero backlash

- Reduces torque amplification factors
  - Avoids damage to the drivetrain



Summary

- High torque density
- Intrinsically fail safe
- Vibration damping
- Maintenance free
- Shock load protection
- Misalignment capability
- Zero backlash

Cost savings
that result in the
lowest lifetime costs

Why Choose Hi-Tec Couplings?

Hi-Tec couplings deliver the durability, reliability and long life that customers demand.

- **Fit and Forget**
  - Once fitted, Hi-Tec couplings require zero maintenance
  - The only serviceable components are the rubber blocks, which in most cases are good for 10 years

- **Lowest Lifetime Costs**
  - Assuming a gear coupling equivalent requires maintenance every 6 months and replacement every 2.5 years, a Hi-Tec coupling saves approximately 3,000$ over 5 years. That's without considering the savings made by eliminating maintenance downtime and coupling failure.

Renold RBI – Construction

RENOLD HiTec Couplings

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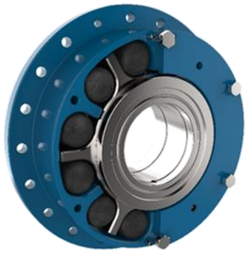
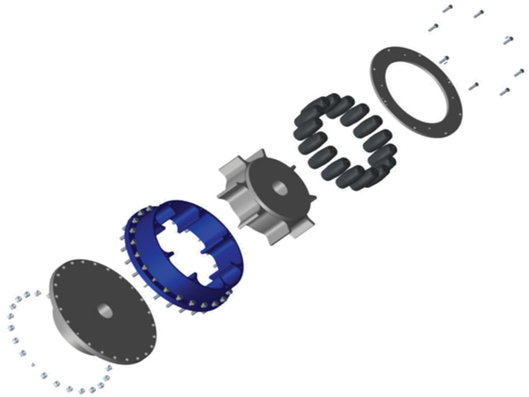
Application:
Paper Machine –
Pulp & Paper Industry





Overview:
Upgrade couplings throughout a paper machine to modern elastomeric coupling using Renold RBI coupling range by replacing existing flexible disc couplings.

Improvement Challenge

User needed ability to vary motor speeds throughout the paper machine and utilize couplings with zero backlash while minimizing current electricity within drivetrain.

Solution

Renold RBI couplings provides zero backlash presenting an ideal upgrade solution. The couplings offer two desirable characteristics including good torsional vibration dampening and low maintenance requirements (i.e. no lubrication, ease of inspection as no dismantling required). Importantly, RBI couplings separate metal components with rubber blocks. Dielectric rubber blocks improve insulation properties and reduces risk of current electricity transmission.

Outcome

All flexible couplings were replaced with Renold RBI couplings. User achieved objective of eliminating backlash and minimizing current electricity transmission throughout the paper machine drivetrain while benefiting from reduced coupling maintenance requirements.

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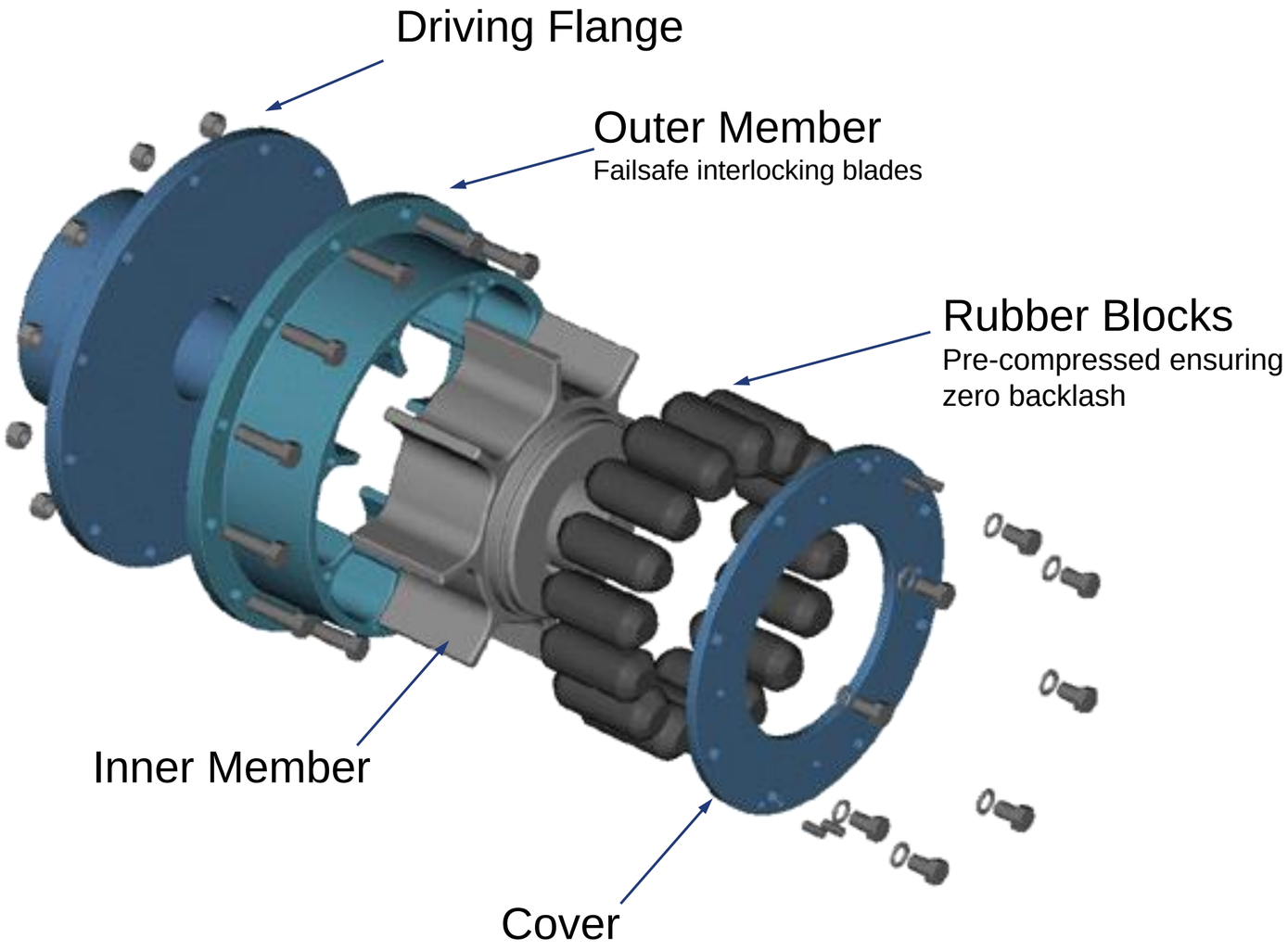
Driving Flange
Outer Member
Failsafe interlocking blades
Rubber Blocks
Pre-compressed ensuring zero backlash
Inner Member
Cover

HTB-GS Construction

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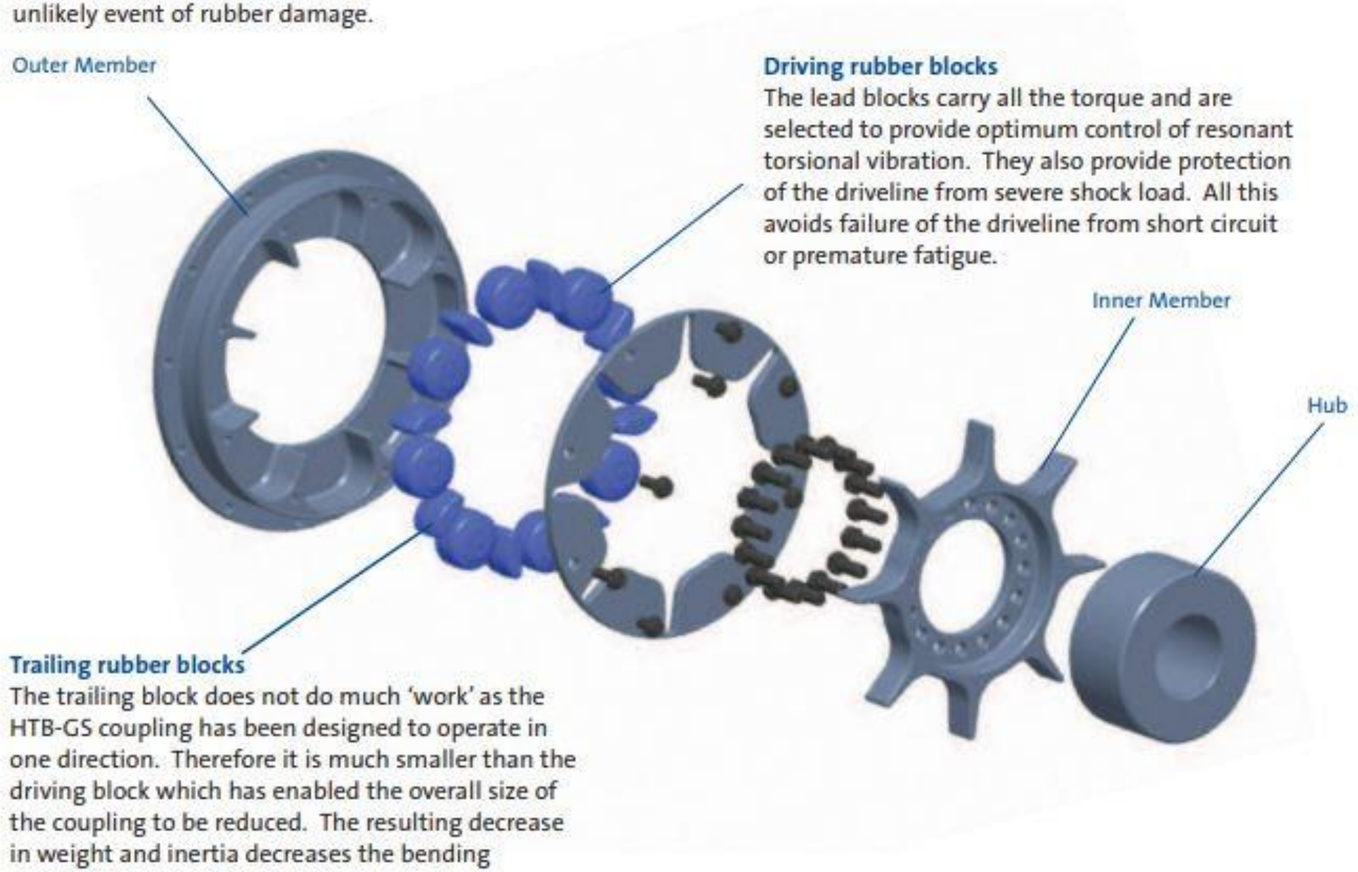
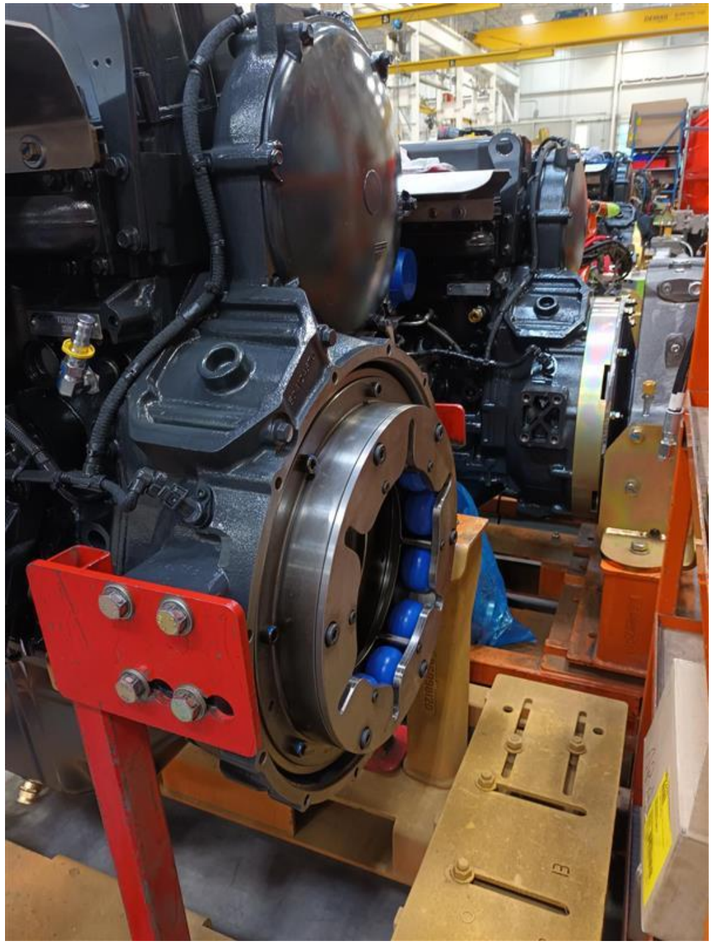
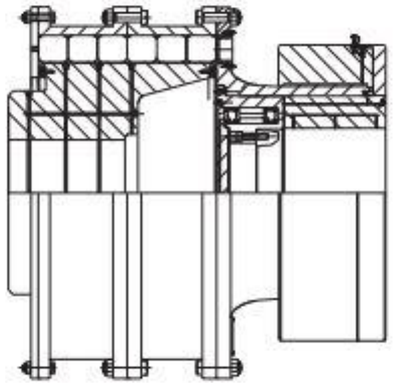
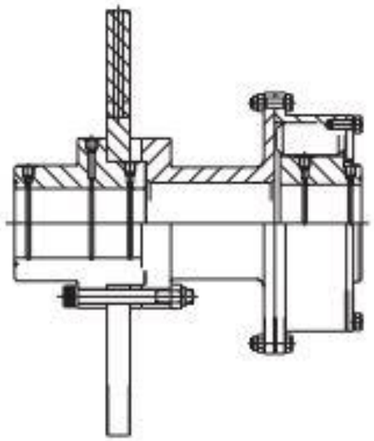
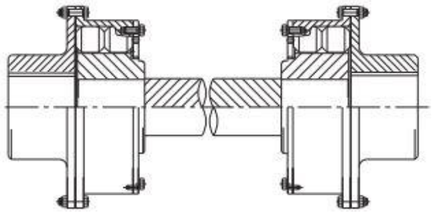
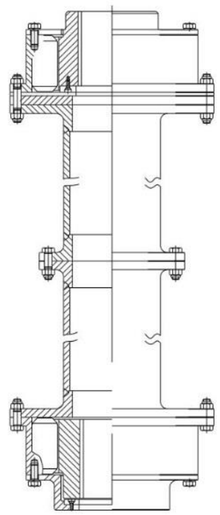
Failsafe Design
The intrinsically failsafe design ensures continuous operation of the driveline in the unlikely event of rubber damage.

shown here is designed in a clockwise direction

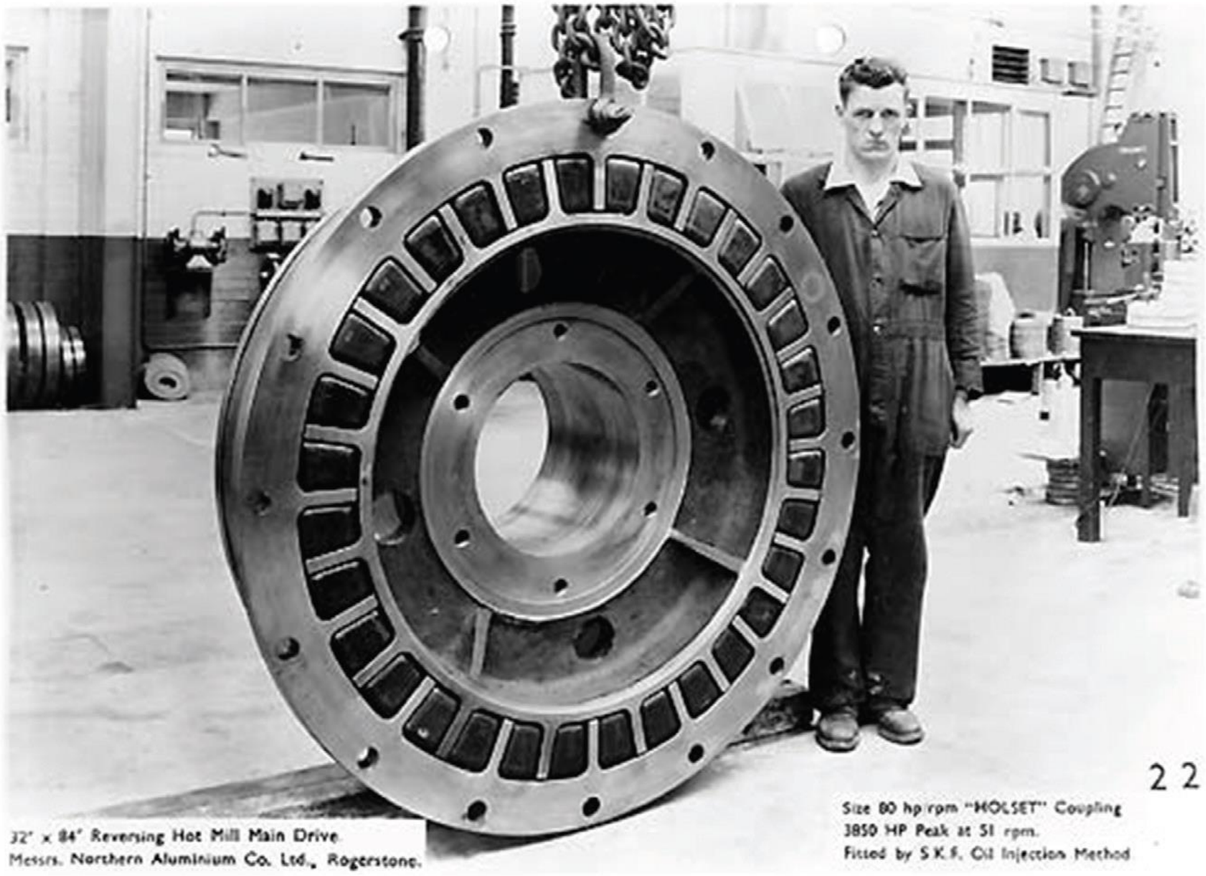




Design Options

Torque Limiting Coupling	Brake Disc Coupling	Cardan Shaft Coupling	Vertical Spacer Coupling
			
• Combination with a torque limiting device to prevent damage to driving and driven machine under shock load	• Combination with a brake disc, for use on cranes, fans and conveyor drives. (Brake drum couplings also available)	• Cardan Shaft Coupling, used to increase the distance between shaft ends and give a higher misalignment capability	• Spacer coupling, used to increase the distance between shaft ends, allowing access to driven and driving machine

Thank you for listening, any questions?



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