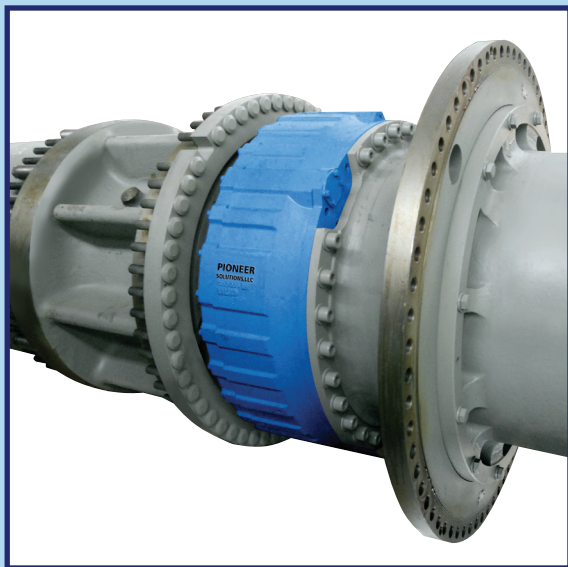


# MANUFACTURED PRODUCTS DIVISION

## WET BRAKE PRODUCTS – OVERVIEW

Pioneer Solutions, LLC utilizes *over 30 years of brake and braking systems experience* to design, manufacture, and supply Oil Cooled Disc Brakes to off-highway dump truck manufacturers. Off-highway dump trucks have extreme braking requirements and are used in some of the harshest environments. Oil Cooled Disc Brakes, also known as wet brakes, *offer a higher degree of performance, productivity, and safety*, and can endure more abusive applications while *maintaining reliable and cost effective performance*. Pioneer provides wet brake solutions for dump trucks with payloads of 25 to 400 tons.



### ADVANTAGES OF WET BRAKE SYSTEMS



*Four corner Wet Brakes are becoming more popular on off-highway dump trucks and are the preference of major quarry and mining companies. Wet brake safety, performance, and service life advantages provide dump truck operators with a **more reliable and productive dump truck solution**.*

- » **Eliminates Axle Fire Risk** – wet brakes are completely enclosed, cooled, and operate at much lower temperatures compared to dry brakes.
- » **Increased Stopping Power** – wet brakes provide more friction area and brake torque compared to dry brakes.
- » **Consistent Brake Torque** – wet brake torque does not fade like dry brakes, because they are cooled; the friction material is constantly immersed with cooling oil. Dry brake torque fades because their friction properties decrease as disc temperature increases.
- » **Exceeds ISO 3450** – wet brake systems easily exceed the rigorous static and dynamic requirements of the ISO 3450 brake certification, which become increasingly more challenging in larger truck sizes.
- » **Front Brake Blending** – trucks that utilize front wet brakes provide blend in capability during the retard operation. This provides **Increased Braking Stability** and can **Enhance Retard Power**– beneficial in a downhill loaded condition.
- » **Longer Service Life** – wet brakes have Longer Service Life which results in **Lower Maintenance Costs** compared to dry brakes.



## WET BRAKE PRODUCT LINE

Pioneer's wet brakes are designed to *operate on both mechanical drive and electric drive dump trucks*. Pioneer offers brakes that can be used on both the front and rear axle of a dump truck. Pioneer's wet brakes are classified by tire and rim size. Within a given series, Pioneer's *flexible design can accommodate different size dump trucks with minor changes to the internal components*.

Brake Series	Tire/Rim Size (inches)	Payload Range (short ton)
3300	33	25-50
3500	35	50-75
4900	49	75-100
5100	51	100-150
5700	57	150-280
6300	63	280-400

## WET BRAKE FEATURES

Pioneer's Wet Brakes are engineered *to provide reliable performance while maintaining a flexible design that can adapt to a variety of OEM axle configurations and hydraulic systems*.

### Multiple Piston Actuation

- » Independent piston design offers better sealing and higher reliability compared to single annular piston design
- » Built-in automatic wear adjustment provides consistent braking response
- » Spring retraction reduces residual brake drag
- » Modular pistons can accommodate a variety of system apply pressures

### High Quality Friction Material

- » Industry tested and proven material is used in the brake friction pack
- » High energy, glaze resistant friction material provides reliable operation, performance, and longer service life

### Expandable Friction Pack

- » Each brake series can be customized to handle different energy and stopping requirements with minor changes to the brake

### Adaptable Mounting

- » Adaptability designed into brake mounting surfaces
- » Brakes can easily accommodate new or existing axle configurations

### Integral Maintenance Inspection

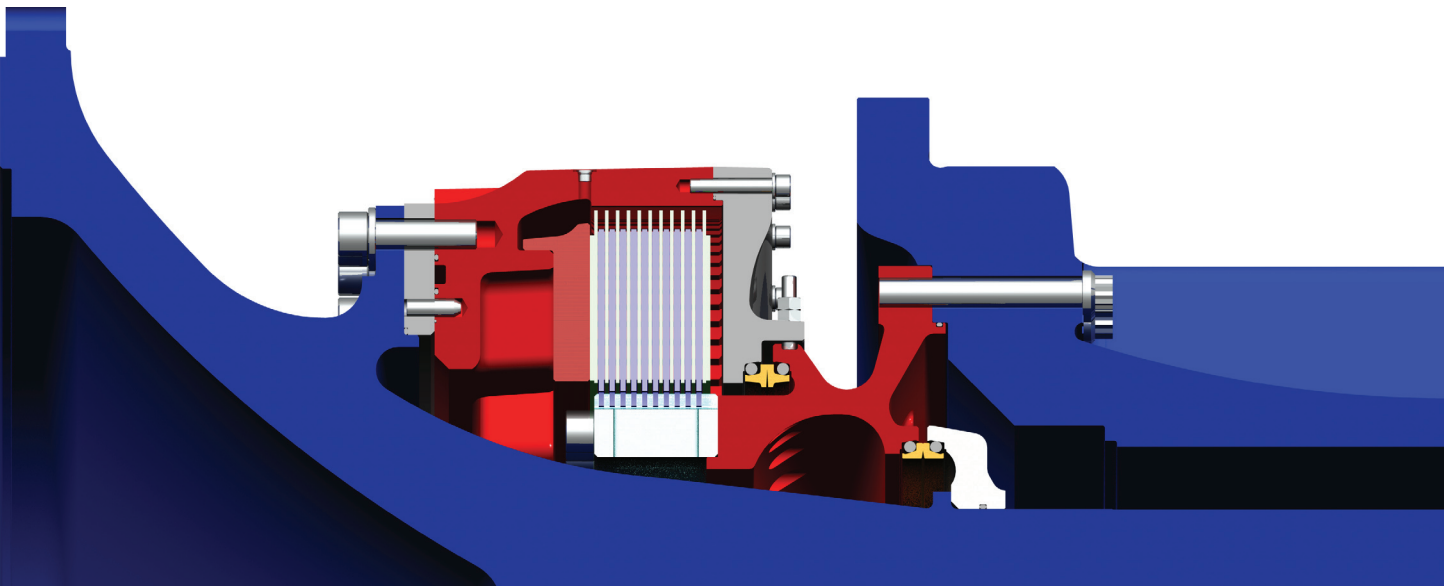
- » Friction pack wear can be measured without disassembly of the brake or axle

### Maximized Parts Commonality

- » Front and rear brake designs are virtually identical
- » Simplifies maintenance training and spare parts inventory

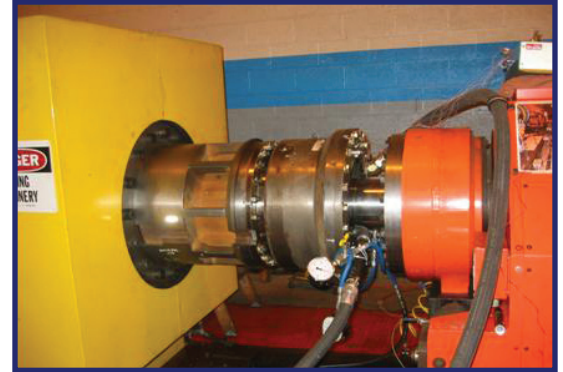
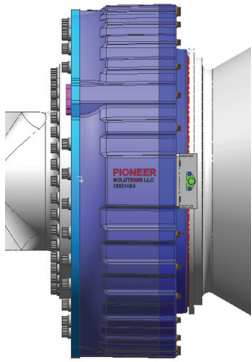
### Sealed Design

- » Unaffected by the harsh mining environment
- » High performance metal face seals protect the brakes from external contamination and internal mixing of cooling oil and gear oil



# THE PIONEER ADVANTAGE

Pioneer's Manufactured Products Division is organized to *deliver customer satisfaction throughout the product life cycle*. In addition to designing and manufacturing the wet brake products, Pioneer provides technical support to OEMs in machine/brake system design integration, axle/brake prototype assembly, and machine/brake system testing.



## ENGINEERING • MANUFACTURING • PRODUCT SUPPORT

### Design Engineering

- » Development of new brake models and products
- » Modifications to brake designs to integrate into customer axles designs
- » Maintenance engineering for product improvement and technology upgrades

### Engineering Support for OEM Integration

- » Design support to customers in mechanical integration (axle design), hydraulic systems, and monitoring/control systems

### Manufacturing Quality

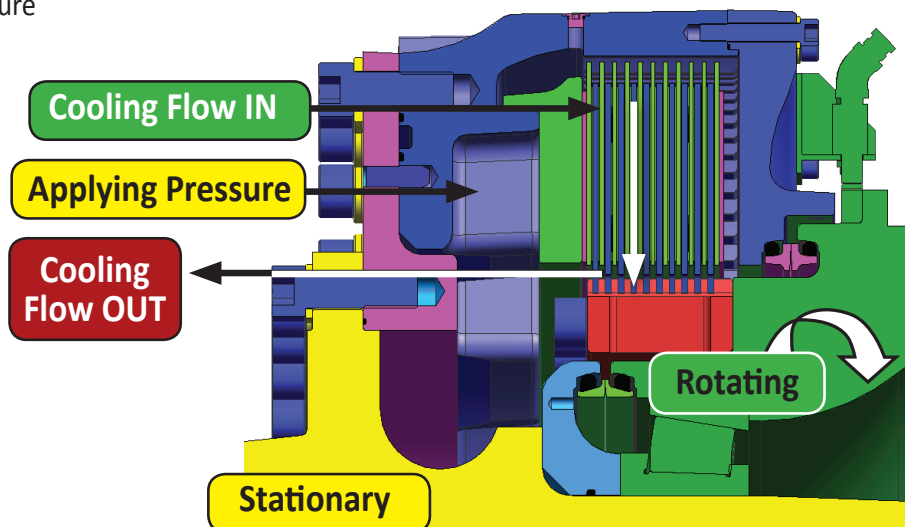
- » Supplier selection and manufacture of components
- » Brake assembly
- » Inspection process and procedures to ensure quality products
- » Factory testing of assemblies prior to shipment
- » Secure packaging and shipment

- » Brake connects to stationary and rotating axle components
- » Pressure is supplied from the brake apply system
- » Brake torque generated by pressing rotating and stationary discs together → friction
- » Heat is dissipated by cooling oil from the brake cooling system

### Product Support

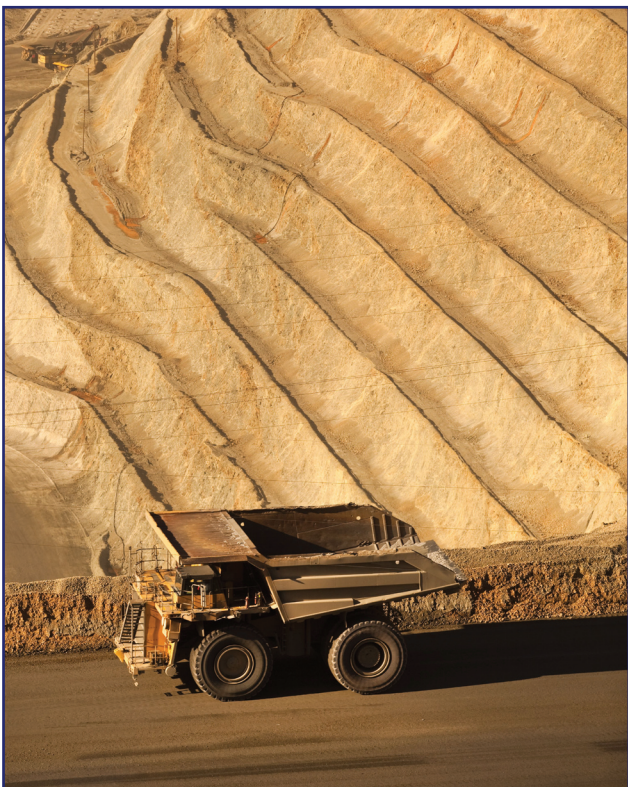
- » Manuals – complete service and parts manuals
- » Training – for brake installation onto axles and basic brake, hydraulic systems, and machine operation
- » Testing – onsite factory testing and mine site ISO 3450 certification testing
- » Service – spare/replacement parts supply, detailed assembly/disassembly instructions, and field service support
- » Warranty – issue investigation, resolution, and warranty claim administration

## Basic Brake Operation



# MANUFACTURED PRODUCTS DIVISION

## WET BRAKE PRODUCTS – OVERVIEW



### PIONEER SOLUTIONS, LLC HISTORY & BACKGROUND

*Pioneer Solutions, LLC was formed in 2004 and is primarily comprised of the former Euclid-Hitachi dump truck engineering department.* The company was able to retain a large group of experienced personnel in a broad range of technical disciplines when Hitachi Construction Machinery discontinued its North American operations. *Pioneer Solutions has over 300 combined years of experience in the off-highway and heavy equipment industries,* and supports customers through two main business divisions – Manufactured Products and Engineering Services.

*The Manufactured Products Division* supplies specialized products to equipment manufacturers in the areas of braking systems and power train components. Pioneer focuses on highly engineered components, such as oil cooled disc brakes, differential gearing, and final drive planetary assemblies. These components require advanced manufacturing processes and a high level of quality to perform in the extreme applications of the mining industry. This business supports customers throughout new product development, prototype, production, and field service..

*The Engineering Services Division* provides design, engineering, and project management services to equipment manufacturers and end users. Pioneer has engineering and design expertise in all of the technical disciplines (structural, hydraulic, power train, and electrical) related to developing off-highway and heavy equipment. This business is organized to support customers throughout the entire product life cycle – from new product development to field failure resolutions, and machine upgrades.

