

Armored Face Conveyor Systems



Armored Face Conveyor Systems Features

High Productivity

Horsepower installation of up to 4800 kW (6,434 hp) for carrying capacity in excess of 6000 tonne/hr (6,614 ton/hr).

Long Service Life

Special line pan profile shape provides minimum friction, low power requirements and extended lifetime of flight bars and profiles.

Flexibility

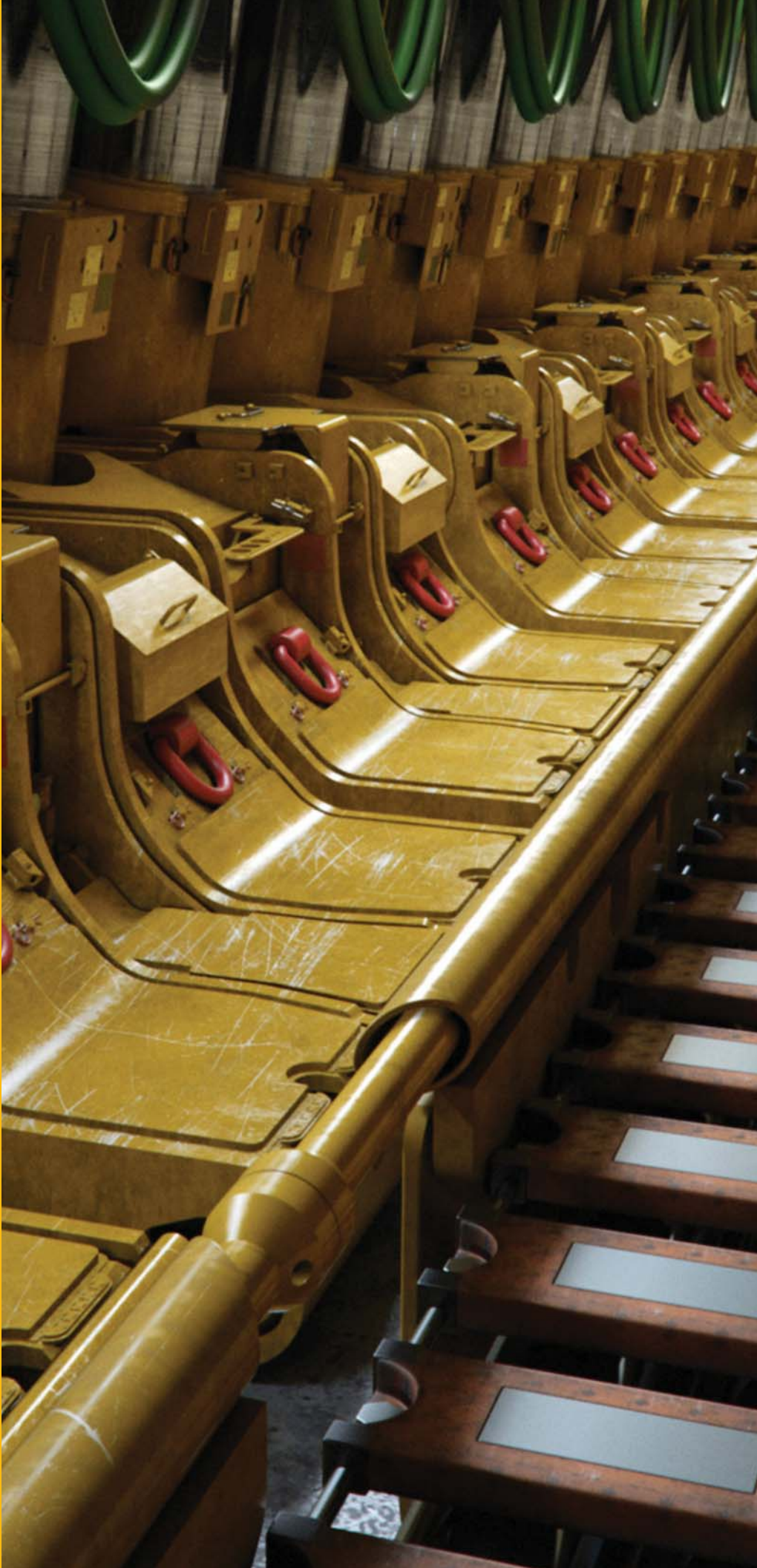
Great adaptability of various shearer haulage systems to best suit the application; different drive frame options for discharge available.

Intelligent Drive Systems

Cat® CST gearboxes with integrated soft-start-heavy-load start-up, load sharing and overload protection function.

High Serviceability

Line pan inspection doors provide easy access to bottom strand of the chain for minimized downtime at maintenance.



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Armored Face Conveyor Systems

Best in the Long Run



PF6 line pan

Moving Mountains

No matter how fast your shearer can cut, you can't keep cutting until you move the coal away from the face. Cat® Armored Face Conveyors (AFCs) are designed to keep things moving and to carry the maximum possible amount of coal smoothly away from the coal face. They are designed for high availability and economy in operation. They are easy to maintain and offer long service life and a great return on investment to mine operators.

Best in the Long Run

Cat AFCs excel through cutting-edge technology, quality, experience and superior product support. Of course, that's what any AFC manufacturer would like to promise. But we can. Our engineers invented the AFC in the early 1940s. Of the ten most productive mines in the world, eight use our face conveyors.

Several systems have successfully operated in 350 to 470 m (1,150 to 1,540 ft) faces producing up to 5000 tonnes (5,512 tons) per hour and 10 million tonnes (11 million tons) per year. Our experience and track record are unmatched in super-long and high-capacity face conveyors.

And of course, Caterpillar – recognized as a world-leading developer and manufacturer of integrated longwall systems – has a long history of engineering solutions that meet the needs of mine operators. That's why our longwall systems have been in service in all major coal-mining regions of the world for decades.



Cat PF6 line pan

Meeting all Needs

From AFC tail drive to entry belt conveyor return end, Cat AFC systems are designed for a variety of performance requirements in low, medium and high seams, for short and long faces. Caterpillar meets the demand of today's high-capacity shearers and, of course, our own automated plow systems.

The PF Range

The line pan is the backbone of the AFC – literally. It not only conveys material from the face, but also acts as the guide rail for the shearer – with traction forces of up to 1000 kN (224,809 lbf).

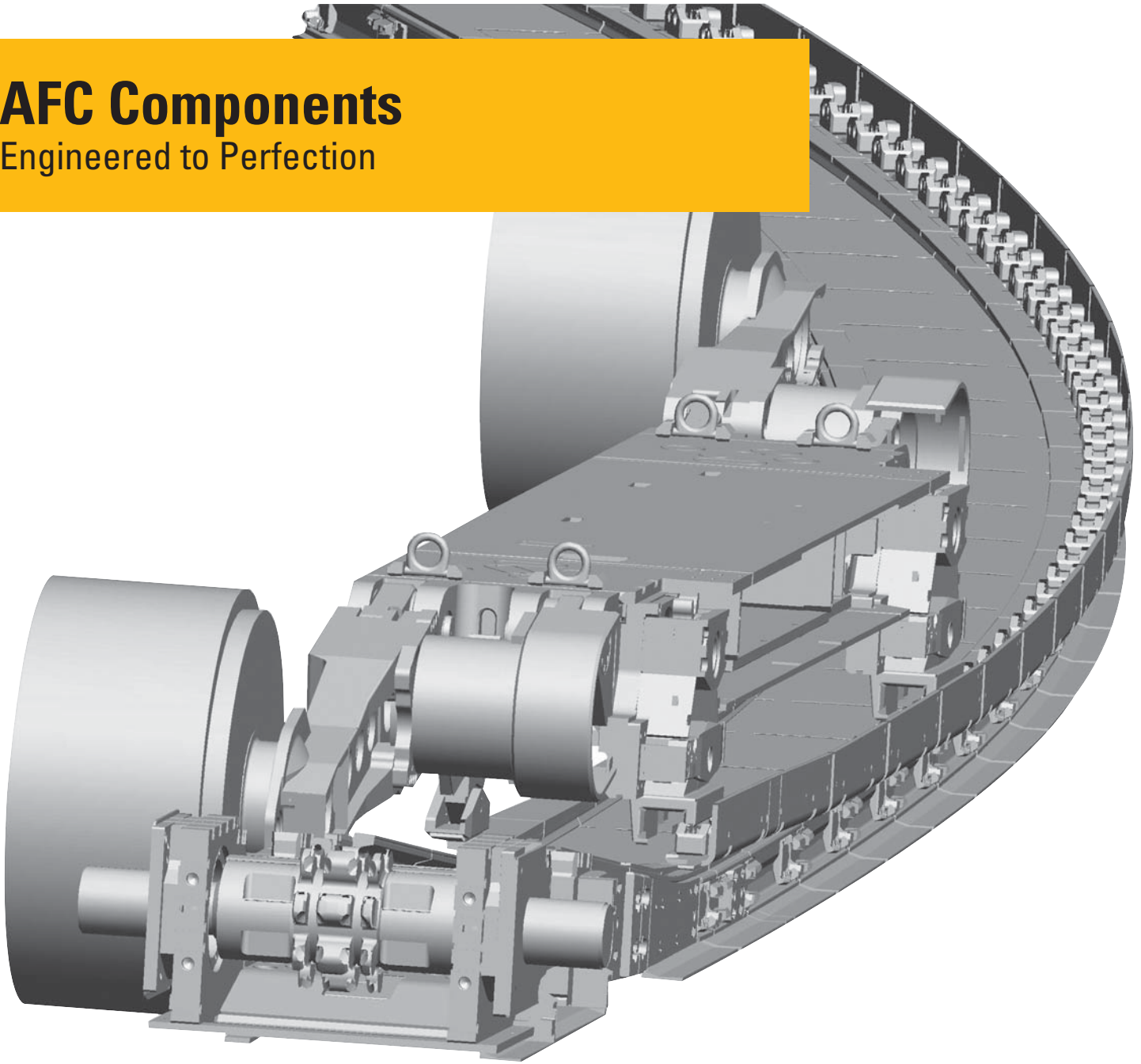
Caterpillar offers a range of line pans to suit different needs. These range from the PF3 for capacities of up to 1300 tonnes (1,433 tons) per hour to the state-of-the-art PF6 with a capacity of 5000 tonnes (5,512 tons) per hour.

Typical Technical Data AFC Line Pan					
Type	Width Outside	Top Plate Thickness	Bottom Plate Thickness	Dogbone Breaking Force	Production Average Per Hour
PF3	822 mm (32.4 in)	30 mm (1.2 in)	20 mm (0.8 in)	2000 kN (449,618 lbf)	1300 tonnes (1,433 tons)
PF4	932 mm (36.7 in) 1032 mm (40.6 in) 1132 mm (44.6 in)	40 mm (1.6 in)	25 mm (1.0 in)	3600 kN (809,312 lbf)	1800 tonnes (1,984 tons) 2500 tonnes (2,756 tons) 3500 tonnes (3,858 tons)
PF5	1042 mm (41.0 in) 1142 mm (45.0 in) 1342 mm (52.8 in)	50 mm (2.0 in)	30 mm (1.2 in)	4500 kN (1,011,640 lbf)	2500 tonnes (2,756 tons) 3500 tonnes (3,858 tons) 5000 tonnes (5,512 tons)
PF6	1042 mm (41.0 in) 1142 mm (45.0 in) 1342 mm (52.8 in)	30 + 25 mm (1.2 + 1.0 in)	30 mm (1.2 in)	4500 kN (1,011,640 lbf)	2500 tonnes (2,756 tons) 3500 tonnes (3,858 tons) 5000 tonnes (5,512 tons)
PF7	1542 mm (60.7 in)	30 + 25 mm (1.2 + 1.0 in)	30 mm (1.2 in)	4500 kN (1,011,640 lbf)	6200 tonnes (6,834 tons)

Typical Technical Data Stageloader Line Pan					
Type	Width Outside	Top Plate Thickness	Bottom Plate Thickness	Dogbone Breaking Force	Production Average Per Hour
PF4	932 mm (36.7 in) 1132 mm (44.6 in) 1332 mm (52.4 in)	40 mm (1.6 in)	25 mm (1.0 in)	3600 kN (809,312 lbf)	2000 tonnes (2,205 tons) 3800 tonnes (4,189 tons) 5500 tonnes (6,063 tons)
PF6	1342 mm (52.8 in) 1542 mm (60.7 in) 1742 mm (68.6 in)	50 mm (2.0 in)	30 mm (1.2 in)	4500 kN (1,011,640 lbf)	5500 tonnes (6,063 tons) 6200 tonnes (6,834 tons) 7000 tonnes (7,716 tons)

AFC Components

Engineered to Perfection



3D-Simulation of a shearer on a Cat PF6 face conveyor at the head end under extreme bending

Engineered to Perfection

There are many parts to an Armored Face Conveyor: shearer haulage system, drives, drive frames and sprockets, gearboxes, line pans, chain conveyors as well as entry conveyors and belt tail pieces. Each of these components has to be engineered to perfection, but also has to work together optimally with the other parts of the system.

Cat AFC components achieve this. Each is designed for powerful, reliable and economical operation with low maintenance over a long service life, promoting high productivity and delivering a great return on investment.

Shearer Haulage System

Cat rackbar shearer haulage systems meet the demands of today's high-performance shearers. We use design and material selection aimed at achieving maximum system availability, longest possible shearer, sprocket and trapping shoe life and on-system suitability for seam undulations.

As with all Cat products, these systems are the result of extensive R&D work and comprehensive laboratory and field testing. This ensures the optimum solution for haulage system and sprocket. This led to a unique design concept with optimized first/last tooth geometry rackbars available with pitches of 126 mm (4.96 in) for medium-production and 146/151 mm (5.75/5.94 in) for high-production shearers.



JumboTrack™ shearer haulage system



JumboTrack shearer haulage system



Cross frame

Drive Frames

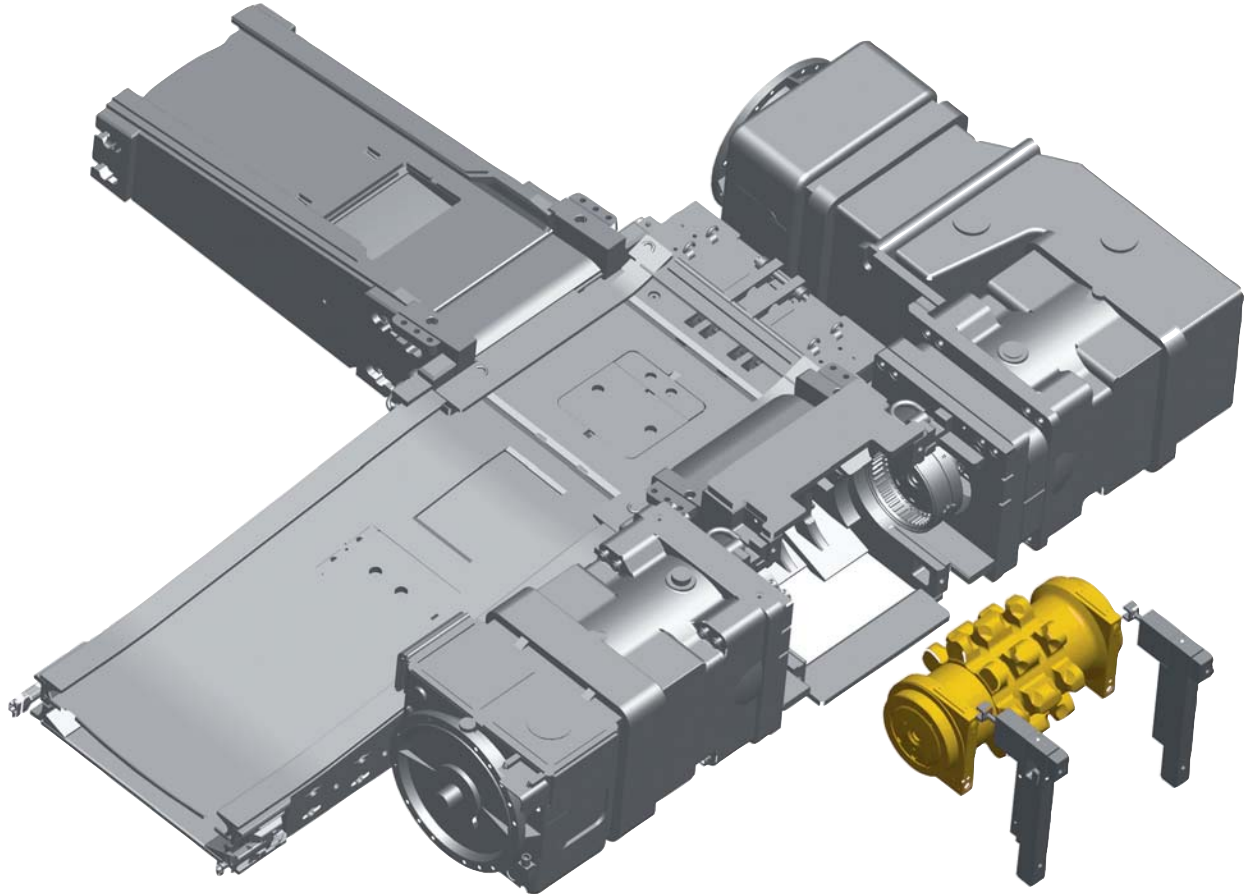
Head-gate drive frames operated today are typical of the cross-frame design. Different capacity ratings are available depending on the total power required. The frame sides are manufactured from thick, solid plates to handle the high torque that may be generated and to ensure an adequate safety margin. Flange plates used to mount the transmission units enable easy handling.

Benefits

- Head drive does not cause a production bottleneck, maximum stability at maximum power, high power drives can be installed, upgrade normally possible, high AFC performance and availability.

AFC Components

Engineered to Perfection



Sprocket Module

Drive Modules

The latest development is a drive frame with replaceable one-piece sprocket/shaft/bearing – a “drive module.” These are available in various sizes to suit individual power requirements, right up to 2×1800 kW (2,412 hp) per drive. The drive module is identical for both main and tail drive. The drive frames are independent of the gearboxes used – flange plates and stub shafts are used for interfacing. Two hydraulic cylinders are integrated in the frames for disassembly of the drive module. These are powered by an external pump. There are similar designs for smaller drive frames.

Benefits

- Drive module can be replaced underground without disassembly of the gearboxes, drive units are available in different sizes and are independent of the gearbox used.

GR Sprocket

In contrast to conventional sprockets, the Cat GR sprocket is specially designed to spread the load across three teeth, ensuring maximum contact surface between the chain links and the sprocket teeth during operation. This results in lower wear and extended life of the sprocket and the chain.

Benefits

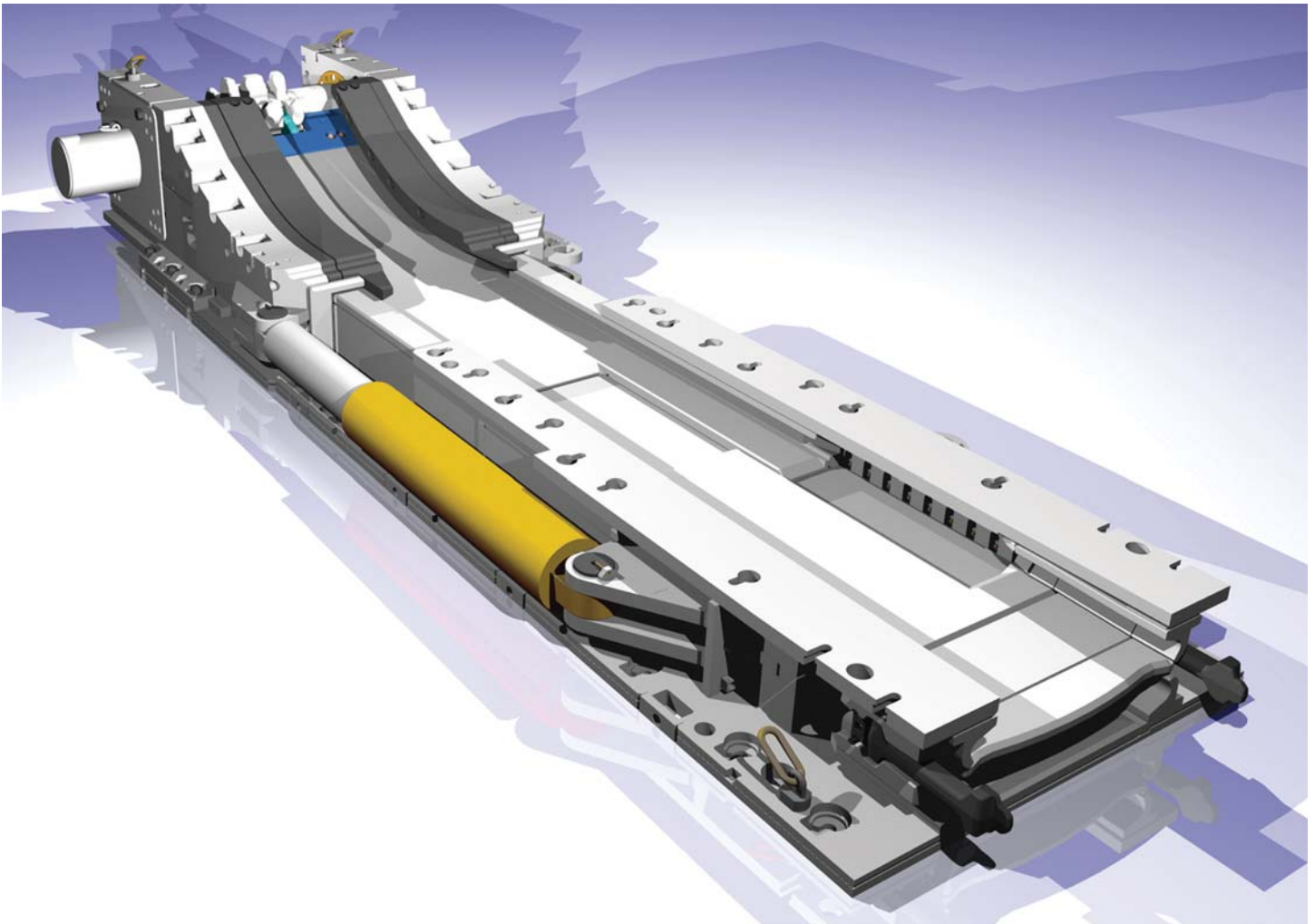
- More efficient power transmission with GR sprocket (97% vs. 93%), resulting in extended sprocket and chain life and less chain stretch.

Tail Drives

Tail drives are normally the tensionable type, especially with long faces and/or high installed power. These have a stroke of 0.50 m (19.7 in) for shorter, less powerful conveyors, and 1 m (39.4 in) for long faces or conveyors with extremely high installed power. These allow control of 1 m (39.4 in) and 2 m (78.7 in) of slack chain respectively. An automated system keeps the AFC chain at optimum tension during operation.

Benefits

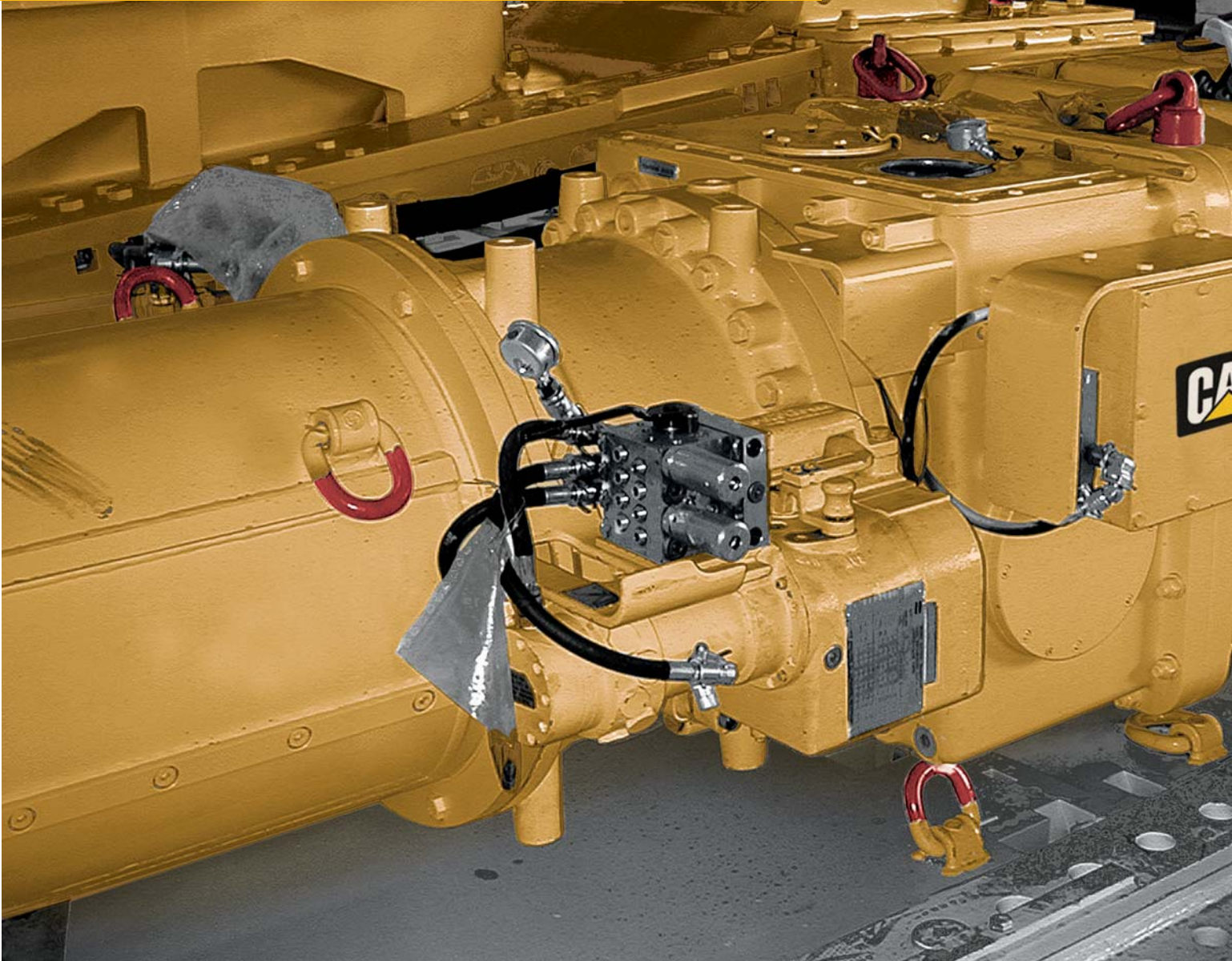
- Maximum chain life and minimum conveyor downtime for double cut.



Tensionable tail drive

AFC Gearboxes

Smooth and Safe Operation



Gearboxes

Caterpillar offers gearbox solutions – simple planetary or bevel-spur gearboxes for low-power requirements and the installation of a clutch between motor and gearbox for medium-power installations.

The UEL gearbox – a planetary gearbox with an integrated clutch – is designed for higher-power requirements. This friction clutch is closed through face support hydraulic fluid. A hydraulic control system allows the clutch to be set to a certain torque.



Cat intelligent CST drive system for high-capacity face conveyors



Cat CST gearbox

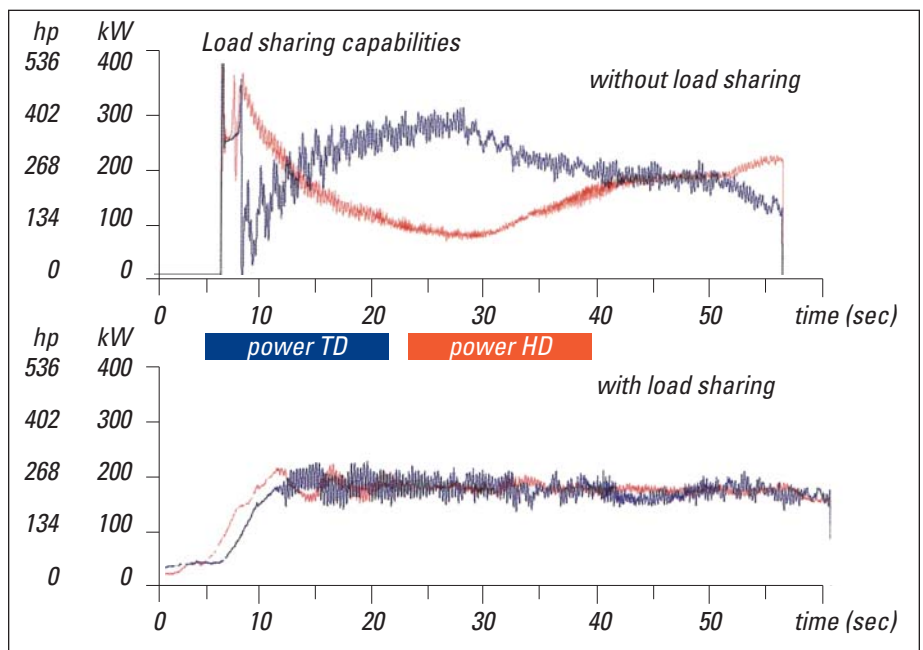
Overload Protection

Overload protection is achieved by measuring the slip of each gearbox. In the event of a chain stall, both motors are switched off. Alternatively, the clutches at both drives can be opened using an optional drive control unit.

The Controlled Start Transmission (CST) drive system is designed for long, high-capacity faces. This drive system allows no-load motor startup, synchronized soft-start and heavy-load startup, as well as accurate load sharing and excellent overload protection.

Benefits

- Caterpillar has the right drive for your application ensuring smooth and safe operation of the conveyor with overload protection and a range of other safety features as required.



Chains

Optimum Performance and Service Life

Chains

For years, we have been matching chain and sprocket design in high-performance face conveyors to achieve optimum performance and service life. This resulted in the 42 × 146 mm (1.70 × 5.70 in) combination chain, the standard chain for applications in the USA and Australia since 1991, and later in the 48 × 144/160 mm (1.90 × 5.70/6.30 in) chain for what was then the world's most powerful conveyor installation with 3 × 1000 kW (3 × 1,341 hp) on a single longwall face conveyor. The latest development is the Cat PowerChain. It is available in sizes 34, 42 and 52. Size 52 is designed to be used with up to 1200 kW (3 × 1,608 hp), with a chain suitable for up to 1800 kW (3 × 2,412 hp) under development.

PowerChain

The wide, arc-shaped cross-section of the vertical links allows a low-profile line pan and the special shape of the horizontal link provides a large running surface where required, drastically reducing surface pressure and chain-joint wear. The method for attaching the flight bar is patented.

The PowerChain 42 × 140 mm (1.7 × 5.5 in) has a breaking force of 2370 kN (532,797 lbf), the PowerChain 52 × 175 mm (2.0 × 6.9 in) of 3610 kN (811,560 lbf).

Benefits

- Faster removal of mined coal by providing high-reliability, high-availability transportation with design features ensuring low wear and long service life, greater permissible elongation of chain compared to round link.



Trial run of a complete system



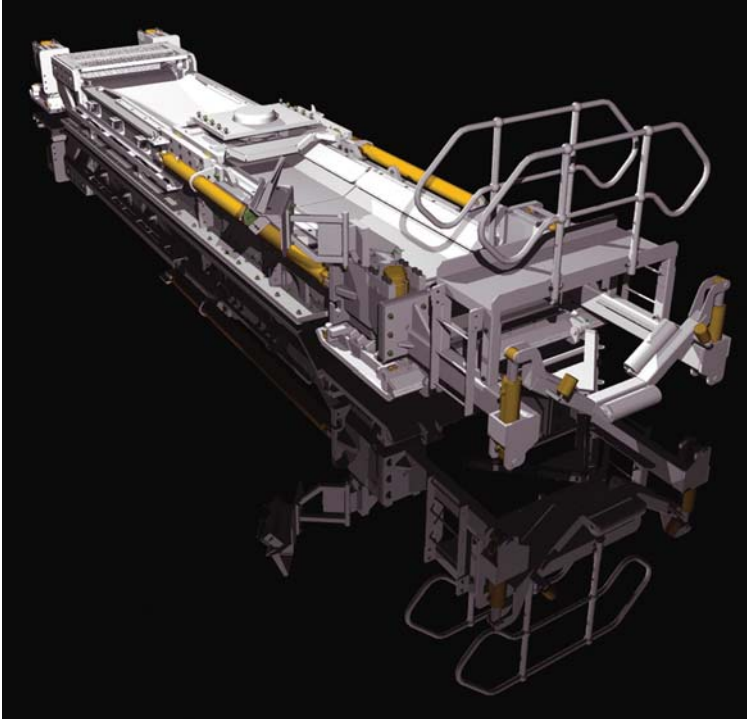
PowerChain and sprocket in use with a Cat beam stageloader



PowerChain inside a Cat BSL in the crusher area

Entry Conveyors and Belt Tail Pieces

Perfectly Matched to the AFC



Bootend assembly

Entry conveyor or stageloader pans are normally of the same type as used in the face. These are normally wider than the AFC. While the return roller is integrated into the cross frame design, the head drive frame of the stageloader is tensionable using hydraulic cylinders.

The crusher, usually an impact roller, is integrated into the stageloader design. The following goose-neck lifts the stageloader discharge over the belt tail piece. Belt tail pieces are available in fixed-, skid- or crawler-mounted versions with an overlap of up to 3.5 m (11.5 ft), all equipped with self-cleaning return drums. The operator can use any specified belt width in this tailor-made equipment.



Complete Cat entry conveyor or beam stageloader (BSL) including crusher and belt tail piece

Benefits

- Stageloader and crusher completely matched to AFC, both with higher capacity to prevent bottlenecks; tailor-made belt tail piece for required capacity and belt dimensions, allowing BTP to handle longitudinal and lateral entry gradients; automated chain tensioning system.



Conveyor Line Pans

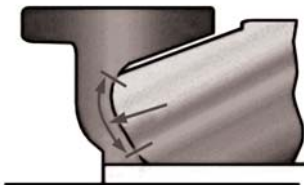
A Line Pan for Every Need



Line Pans for Every Need

Rolled steel is smoother, stronger and harder-wearing than a casting and generates less friction and noise. That's why Caterpillar has focused on rolled steel designs for line pans. All aspects of the line pans have been engineered with reliability, productivity and serviceability in mind.

Compatibility testing



Maximum Contact

The profiles are designed to maximize the contact area between the flight bar and the profile, thus minimizing contact pressure during operation.

- Minimizes friction, reduces power requirements for the face conveyor and results in longer service life of the flights and profiles.

Profile shape of PF conveyors

Rolled Steel

Rolled material has a smoother surface than castings. The material shows maximum wear resistance after initial material conveyance.

- Lower friction and longer service life for wear parts. Up to 10 million tonnes (11 million tons) under normal conditions and up to 20 million tonnes (22 million tons) under favorable conditions.

Safe Dogbone Technology

The forged dogbone pocket and the designed breaking force of up to 4500 kN (1,011,640 lbf) guarantee safe operation of the conveyor at all times. Sophisticated design has been further optimized, ensuring greater tensile strength to reduce stress spikes and ensure perfect protection of the dogbone pocket and the pan itself in the event of an overload.

- Longer service life of dogbone pockets, no damage to conveyor or dogbone housing as the dogbone always breaks first.



Dogbone

Convex/Concave Pan Ends

Cat line pans feature convex/concave pan ends that ensure reduced noise levels. Our line pans are suitable for bi-directional operation.

Welds without Wear

Cat PF line pans have a rolled profile design. Each of the identical profiles are attached with two welds to the top plate of chosen length and width. This results in great flexibility in pan design. Only one of the welds is located in the wear area of the line pan in the top strand.

- High stability of the pan ensured by three welds even when the top plate is totally worn out.

Wear-resistant Top Plate

The top plate is made of wear-resistant material. The thickness varies from 30 mm (1.2 in) (PF3) to 50 mm (2.0 in) (PF5).

- Long service life with matched profile type end.

Flexibility

The line pans are designed to allow deflection between individual line pans of $\pm 6^\circ$ vertically and $0.8\text{--}1.2^\circ$ horizontally.

- Increased flexibility, adaptation to undulating seams, short snake sections possible.

Safe Transfer of Transverse Forces

Transverse forces are transferred through the top plate to the relay bar arrangement.

- High pan stability, even for high-reaction forces; safe operation; low noise; minimum maintenance; full reversibility.

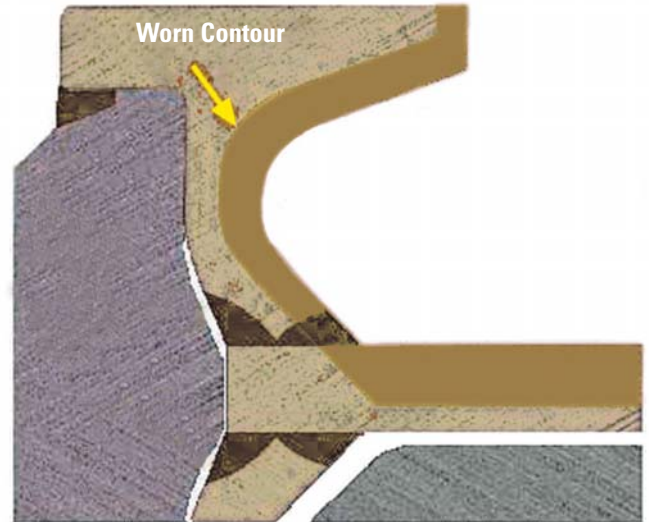
Inspection Doors

A sliding inspection door typically installed in every 6th pan and every special pan allows access to the bottom race of the chain conveyor.

The integrated drawer guide ensures safe seating of the doors.

The inspection door can be removed from gob or face side.

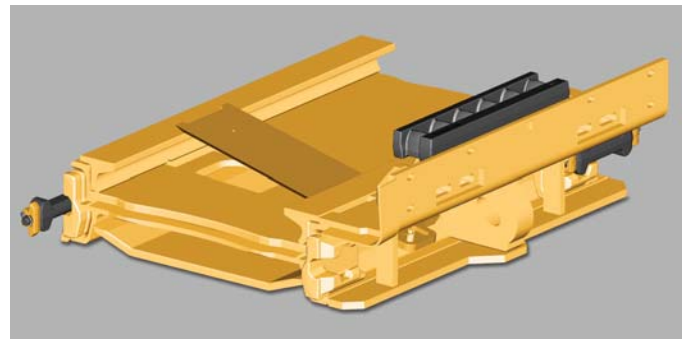
- Easy access to bottom chain, minimum downtime during maintenance or repair.



PF5 profile design with wear pattern



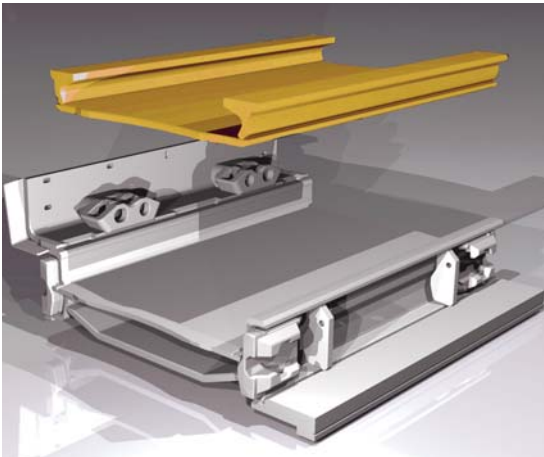
Vertical bending capability of Cat face conveyor systems





The Cat PF6 Line Pan

Lower Wear and Longer Service Life



PF6 pan with replaceable top trough

PF6 – the State-of-the-Art Line Pan

Wear is the weak point in line pan design. Hauling millions of tonnes (tons) of coal away from the longwall is clearly going to result in high levels of wear. Back in 2002, we decided to try something revolutionary. A group of experts from different countries with many years of experience on various conveyor types was brought together to create a new type of pan that would combine the benefits of rolled and cast line pans to provide an optimum solution to mining industry needs.

The First to Really Last and Last

The team developed an innovative pan design meeting all the requirements regarding quality, resistance to wear and conveying capacity in ultra-long panels. The result is the PF6, a hybrid pan that addresses the weakest point in pan design: wear. The simple solution was to make the parts subject to the most wear replaceable.

With its patented trough concept and extremely rugged pan design, the PF6 is particularly suitable for applications in longwalls with extended face length and for panels with coal reserves of 10 million tonnes (11 million tons) and up.

Separation of Wear Parts and Structural Parts

The smart and totally new idea of splitting up the different functional areas in the PF6 allows the separation of wear parts and structural parts. Very hard, wear-resistant materials are used for wear parts, while the structural parts are made of high-strength steel.

- Ability to replace wear parts, substantially longer service life, lower overall pan wear.

Optimized Contact Surfaces

The special shaping of the bottom race – which almost doubles the contact surface – reduces flight bar shoulder wear and substantially reduces friction. The curved transition at the pan ends greatly reduces noise during operation of the chain conveyor.

- Minimal friction and power loss, longer flight bar and profile service life, lower noise.

Maximum Pan Stability

The frame of the pan consists of two C profiles connected by a baseplate. Two tried-and-tested PF5 profiles are welded to the bottom plate of the top trough and then welded or bolted to the pan base. This allows problem-free replacement of worn top troughs.

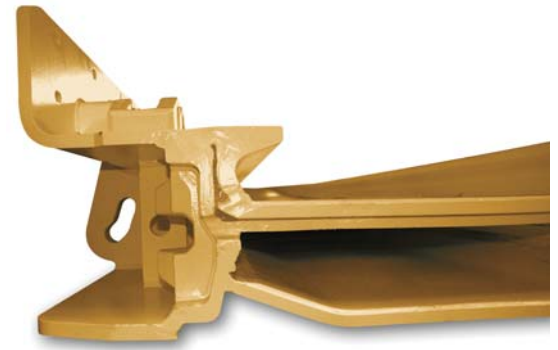
Pan sections are connected by dogbones inserted into pockets in the C profiles. These are designed to engage exactly, providing optimal absorption of vertical and horizontal reaction forces. This ensures reliable transmission of high lateral forces, such as from roof supports. All forces were calculated and the pan was successfully tested with the frame of the PF6 pan only.

- High stability and positive force transmission, easy maintenance, trouble-free operation in both directions.

Customization

Whether the design of the cover plates or the design of spill plates for hoses and cables, all components of the PF6 are individually designed to meet our customers' requirements.

- Optimal adaptation to local conditions, perfect functioning with various shearer haulage systems.



Profile of the PF6 shearer line pan



Simulation of a hump during a compatibility test with a shearer



Rolled Steel Surfaces and Robot Welding

Extremely smooth rolled-steel surfaces ensure minimum friction and power loss. Robot welding ensures standardized welds that can be removed automatically when the top race is worn, allowing replacement of the trough. This innovation is expected to increase the service life of the substructure by a factor of 3.

- Longer service life, simple replacement of wear parts, lower friction and power loss.

Manufacturing Excellence

World Class Welding, Machining and Quality Control



A World-Class Manufacturing Facility

Cat premium face and entry conveyor systems and the respective system components are manufactured at Caterpillar (Langfang) Mining Equipment Co., Ltd in the Hebei province of China.

Since 1998, Caterpillar is constantly making investments in its Langfang manufacturing facility, including equipping the plant with state-of-the-art production machinery and technologies and ongoing training and professional development of the employees.

The Caterpillar manufacturing facility in Langfang serves a large global customer base – producing Cat equipment which is highly efficient and able to meet the most demanding requirements.

Caterpillar Production System

Strictly following the Caterpillar Production System (CPS) and adhering to Caterpillar's corporate culture, Caterpillar Langfang has achieved the highest standards in terms of quality, safety, supply-chain integration and employee engagement. In addition, Caterpillar Langfang obtains numerous key international certifications, including ISO 9001:2008, ISO 3834-2, ISO 14001:2004+Cor.1:2009 and BS OHSAS 18001:2007.

The Caterpillar Production System is at the very heart of the Caterpillar enterprise strategy – and that is for a particular reason. By making CPS part of how Caterpillar does business, it can deliver superior value to mining customers around the world.

CPS is the common order-to-delivery process that optimizes execution and enables achieving safety, quality, velocity, and cost goals.

The CPS process leads Caterpillar Langfang to apply a consistent set of standard processes in manufacturing. Processes which are constantly being improved through the elimination of waste by using 6Sigma and 6Sigma lean tools.



Material Quality Controls

The Purchasing, Supply Chain and Quality Departments of Caterpillar Langfang strictly follow the Caterpillar processes to make sure all raw materials meet the rigorous Caterpillar quality standards. External suppliers adhere to Production Part Approval (PPAP) requirements to ensure parts meet the design requirement. The Quality Department performs dimensional and material inspection for all supplier parts at the relieving dock.

Welding Quality

Caterpillar Langfang has a team of International Certified Welding Engineers, International Certified Welding Technicians and International Certified Welding Inspectors. All the welding work in Caterpillar Langfang is done by highly qualified welders to ensure our Cat equipment lives up to customer expectations. All welding operators complete a rigorous training program that includes certification via visual, destructive and macroscopic inspections to meet Caterpillar's high quality standards.

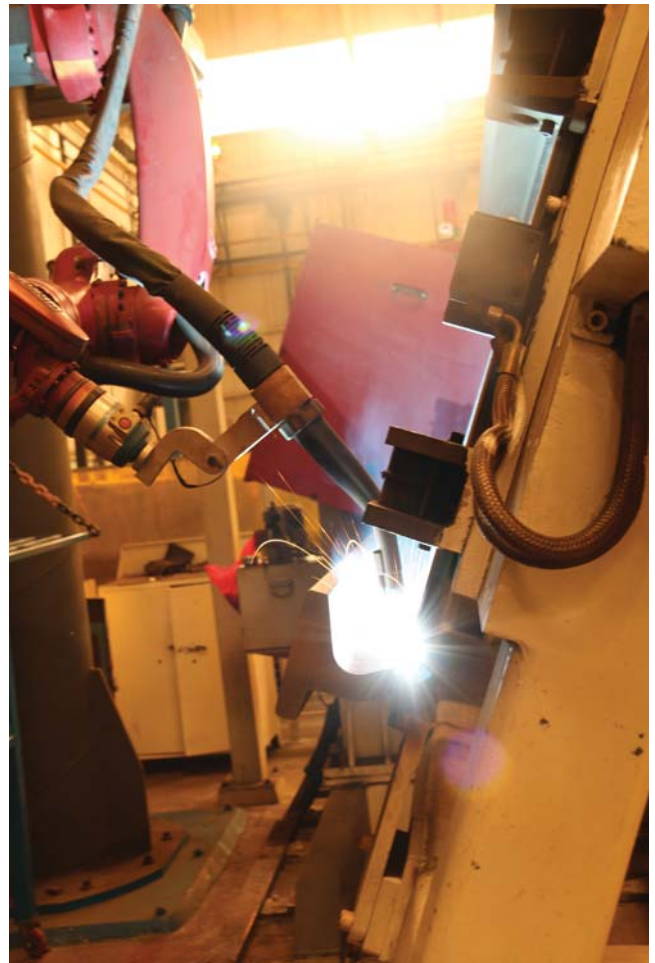
Welds must pass stringent visual inspections by quality control personnel to ensure dimension and quality of components.

Advanced Machining Centers

Computer-controlled machining centers maintain accurate positioning of milling, drilling, and boring operations. Machining precisely controls location, size and surface finish of critical features, which assures perfect assembly of every machine.

World Class Components

Our major components are sourced from Caterpillar component factories and Caterpillar suppliers who are aligned to Supplier Quality Excellence Process (SQEP) certification plans. We conduct constant quality auditing of the incoming components. Advanced Product Quality Planning (APQP) Process along with Production Part Approval Process (PPAP) ensures quality of each part.



Manufacturing Excellence

World Class Welding, Machining and Quality Control



Precision Assembly

Qualified components that pass inspections are taken to Final Assembly Station. The components are strictly classified and located for assembly. This attention to detail creates reliability and durability, which translate into long life.

To ensure the components' quality and conformity comply with technical requirements for final assembly, components are fabricated to the strictest Assembly Work Instructions and Assembly Process Standards.

PDI and PDA

The Pre-Delivery Inspection (PDI) and Pre-Delivery Audit (PDA) processes ensure uniformity in product characteristics and conformity to all specifications. All machines enter the static test booth made with acoustic enclosure to test product performance. All test results are stored and analyzed for trends to monitor quality.

PDA is performed after the machine has been certified through the PDI process. Benefits include:

- Ensure world-class product quality
- Eliminate any failures
- Validate machine performance
- Confirm that controls and procedures are satisfactory

PDI/PDA ensures that the machine received by the customer and dealer is 100 percent defect free and compliant with Caterpillar quality standards and the shipping order.





Quality Process Control

Caterpillar Langfang conducts strict quality process control to ensure the conveyor systems and components manufactured meet customer requirements:

- CAV-E (Customer Acceptance Validation Enabling Process) deployment to manufacturing process
- Quality culture deployment – zero defects
- Rigorous in-process quality gates and inspections
- Product validation before shipment (PDI and PDA)
- Quality stand down
- Stop to fix

A special Inspection Plan is standardized to detect nonconformance and defects. Any nonconformance triggers notice to the responsible personnel for rework. Gauge and inspection equipment calibration and BIQ (Built in Quality) deployment are conducted to achieve manufacturing of 100 percent defect-free products.



For more complete information on Cat products, dealer services, and industry solutions, visit us on the web at www.cat.com

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